Annual Report

Research Report and Economic Development

2014/2015

DLR

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Executive Board

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The male and female terms used in the texts should be considered to refer to all genders.

Research Report and Economic Development 2014/2015

German Aerospace Center (DLR)

About the cover:
The cover image of this year's issue has been printed in a special process using black thermochromic ink, which becomes transparent when heated to over 28 degrees Celsius. Try it for yourself and reveal our Earth.

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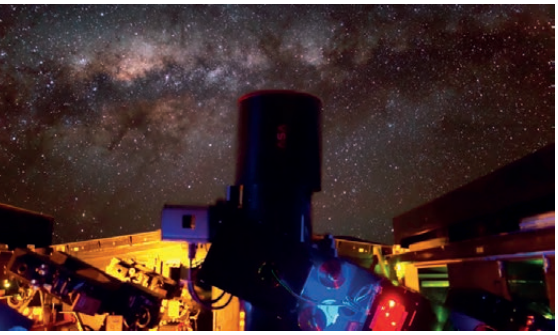
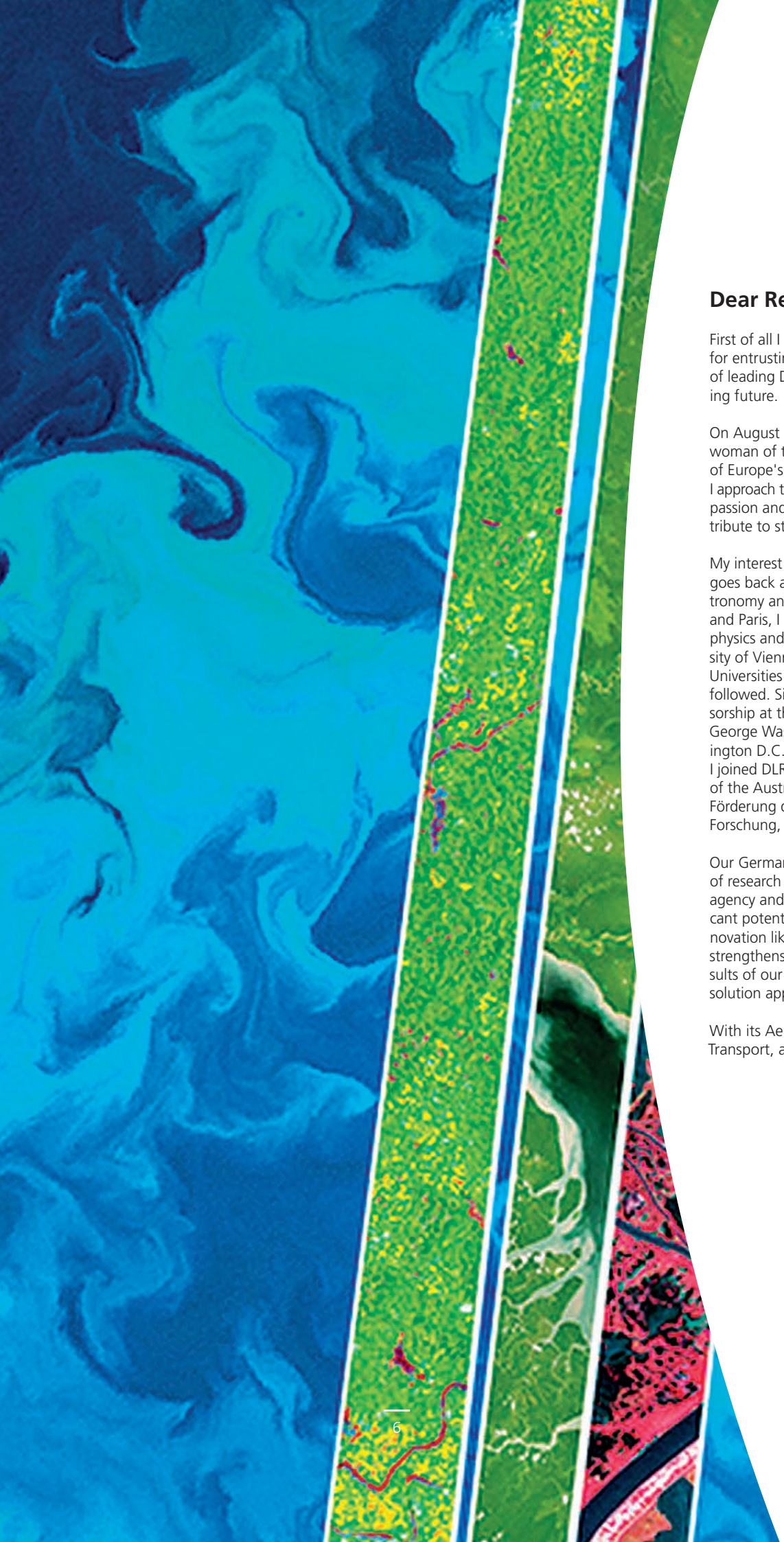


Research Report

Economic Development – Center Development

Facts & Figures



Dear Readers,

First of all I would like to thank everyone for entrusting me with the responsibility of leading DLR into a new and challenging future.

On August 17, 2015, I became chairwoman of the Executive Board of one of Europe's largest research institutions. I approach this new role with great pleasure, passion and enthusiasm in order to contribute to strengthening DLR's profile.

My interest in research and research policy goes back a long way. After studying astronomy and biology in Vienna, Salzburg and Paris, I gained my doctorate in astrophysics and a professorship at the University of Vienna; professorships at the Universities of Leiden and Amsterdam followed. Since 2008 I have held a professorship at the Space Policy Institute of George Washington University in Washington D.C., in the United States. Until I joined DLR, I also served as president of the Austrian Science Fund (Fonds zur Förderung der wissenschaftlichen Forschung, FWF).

Our German Aerospace Center, consisting of research center, project management agency and space agency, holds significant potential synergies that can drive innovation like no other organisation. DLR strengthens German industry, and the results of our outstanding research deliver solution approaches to global challenges.

With its Aeronautics, Space, Energy, Transport, and Defence and Security

programmes DLR not only covers a broad range of topics but moreover directly combines basic and applied research; in cooperation with industry we can even go as far as product development. Aeronautics for example is working towards more resource-efficient and quieter air travel. The Space programme seeks on the one hand to increase our understanding of our home planet, on the other hand to investigate the origins of our solar system and contribute to future (human) space exploration missions. Our Energy programme covers sustainable and more efficient energy supply systems and the very important field of security of supply, while the Transport programme examines new navigation methods and mobility concepts. Finally, the cross-departmental Defence and Security programme is focused on developing modern digital communication and Earth observation systems that can save lives in emergencies, such as during natural disasters.

DLR also shines through its outstanding success in acquiring third-party funding and through its many international cooperations. The Project Management Agency's comprehensive portfolio completes the picture of DLR as an innovation driver.

Excellent research enabled by government funding is the oil greasing the gears of our innovation machine.

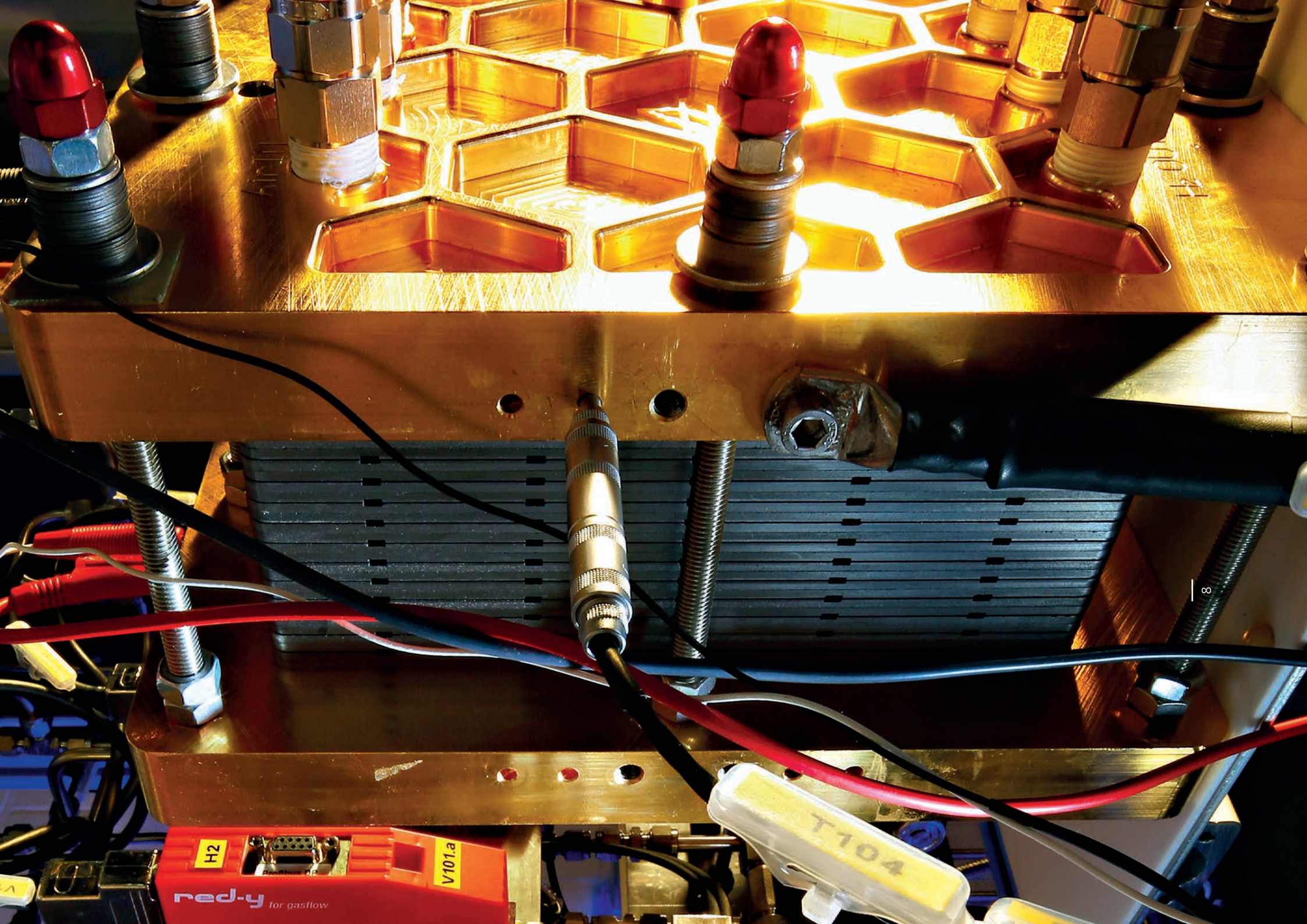
Our annual report provides a wonderful overview of the fascinating world of DLR. Read about exciting projects and scientific findings gained over the previous year in the *Research Results* section, and learn how we have transformed ourselves internally and externally in the *Economic Development – Center Development* section. The *Facts & Figures* section completes our summary with some interesting data.

Let's find out together how our home planet can flourish with your help – touch and symbolically warm up the Earth on our cover image.

I hope I have made you a little curious and you enjoy reading this report.

Sincerely,

Professor Dr Pascale Ehrenfreund
Chairwoman of the Executive Board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RESEARCH REPORT

Aeronautics

In European aeronautics research, major strategic decisions for the Horizon2020 framework programme, and the Joint Technology Initiative Clean Sky 2 and the SESAR 2020 programme in particular, remained the dominant theme during the months of the reporting period.

DLR was again heavily involved at every level. In Clean Sky 2 we submitted applications as a core partner and were successful with five of our seven applications, some of them in collaboration with our French partner Onera. In SESAR 2020 DLR was successful in cooperation with the Dutch NLR.

DLR also continues to contribute significantly to the Federal Government's Aeronautics Research Programme (LuFo). The second call for proposals in LuFo V fell into the reporting period. As in the European framework programme, DLR works closely with industry at the project level in this area, and the resulting network has become firmly established at a high level over the past few years. For DLR this collaboration is important particularly for the short- and medium-term elements of its research as it allows us to constantly align our work to the technological challenges faced by industry in implementing innovations.

National and international cooperations with industry, research institutions and higher education institutions have become commonplace in DLR's Aeronautics programme, and many of the projects presented in brief on the following pages reflect this.

Engine noise

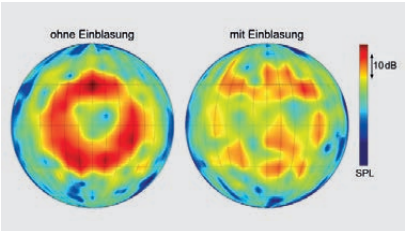
Significant advances with compressed air injection

The DLR Institute of Propulsion Technology has refined and successfully experimentally tested an active technique for reducing jet engine noise. Injecting compressed air allowed the especially unpleasant sound of a turbo fan to be reduced by up to 10 decibels, which is perceived by the human ear as a volume reduction of 50 percent.

The active noise control technology specifically suppresses the irritating sounds of engine components by overlaying an inverse sound field. The examined concept is based on injecting compressed air into the engine via nozzles integrated at regular intervals around the engine wall between the rotor and the stator. The resulting disruption to the flow field activates variable forces on the rotor blades which generate the required counter-noise. Extending the first study, carried out in 2012, the compressed air was now injected through two nozzle rings placed one directly behind the other. This arrangement makes it possible to simultaneously affect two degrees of freedom of the sound field structure instead of, as previously, only one.

Compressed air reduces engine noise in the absorption chamber

The tests were performed at the UHBR (Ultra High Bypass Ratio) fan test rig in Cologne. To assess the noise reduction in detail, the sound field was measured in the intake duct and under free-field-like conditions in the absorption chamber (see image above). The experiments showed a reduction of up to 10 dB in the dominant components of the rotor-stator interaction sounds emitted by the jet air intake. The effect can be clearly seen by comparing the sound pressure gradients shown in the image. The current work was performed in cooperation with industrial partners Airbus Group Innovations and Rolls-Royce Deutschland as part of the LeiLa project from the Federal Government's Aeronautics Research Programme IV.



Sound pressure gradient

Shaking off ice

New methods for de-icing aircraft

Ice on an aircraft's skin represents a significant risk, as wings icing over can affect the plane's ability to fly. Researchers at DLR and TU Braunschweig are jointly working on new methods to remove ice from fuselage, wings and steering gear in an especially energy-saving way. Funded by TU Braunschweig, aviation researchers from the two institutions have jointly set up a de-icing test rig at the university. Currently, aircraft mainly deal with in-flight wing icing by heating the leading wing edges. Hot, compressed air is tapped from the jet engines and piped into the wings, or the wings are warmed with heating mats, consuming significant amounts of electricity. However, these methods use a lot of energy, which limits the aircraft's range. Instead of melting the ice, the new method involves shaking it off without heat, saving energy. At the Braunschweig de-icing test rig, the researchers are exploring ways of specifically causing the unstiffened areas of the wings to vibrate; these vibrations are intended to crack and dislodge the ice. Other experiments are being conducted with a deformable external skin on the wings which can be strongly distended in order to mechanically break the adhered ice.

Icing test rig with wing test sample

In addition, the engineers are developing a highly detailed ice detection system in order to apply these new methods with greater precision, but also traditional ice melting techniques can be deployed more efficiently by allowing ice to be specifically melted or dislodged from the affected parts of an aircraft without wasting energy at ice-free points. The project is moreover testing alternative surface coatings that would prevent ice from adhering to the aircraft in the first place.

The de-icing test rig of the DLR researchers in Braunschweig consists of a wind tunnel installed in a living-room-sized walk-in freezer. A nozzle system injects water droplets, which are accelerated by airflow. This supercools the droplets, which are up to a third of a millimetre in size, to under zero degrees Celsius without freezing them. In the measuring section, the droplets hit a test sample and freeze, generating characteristic ice types such as rime, glaze or mixed ice. The test rig is operated in collaboration with the Institute of Adaptronics and Function Integration at TU Braunschweig as part of the Helmholtz Alliance DLR@Uni-Braunschweig. The SuLaDi (Supercooled Large Droplets Icing) project, which covers the majority of the research, is the lead project of the DLR@Uni initiative for the Braunschweig site.

Milling and pressing

Innovative repair process for fibre-reinforced plastics

Aircraft and vehicle construction increasingly rely on structures made of fibre-reinforced plastics (FRP). DLR researchers in Stuttgart have now developed an innovative repair process to make fibre-reinforced plastics more competitive, more economic and more resource-efficient. The researchers hope this process will help avoid premature scrapping of FRP components and minimise waste in the production process.

Current repair methods for elaborately produced and thus cost-intensive FRP components are mostly time-consuming, inflexible and expensive. Large structures such as those in aircraft fuselage are designed for a lifespan of up to 30 years. If they are damaged, they usually have to be dismantled for repair or replaced entirely. In metal structures, the damaged section can be cut out and new sheet metal riveted in. For components made of fibre-reinforced plastics, the repair process is far more complex: as the fibres are load-bearing, meaning that they ensure the structure's integrity and resilience, they cannot simply be drilled and riveted; this would damage the fibres further. Instead, the DLR researchers strip off the damaged layers of material over a wide area and replace them with a patch, similar to a plaster. The patch consists of the same material, has the same fibre orientation, and bonds with the surrounding structure when heat and pressure are applied.

Mobile repair station for FRP

The repair process used by DLR has two especially interesting features: firstly, the damaged material is removed using a laser. In contrast to other approaches, where the material is removed for example with a milling machine, this process requires no cooling, no clamping or compressive forces are applied to the structure, and tool wear is very low. Secondly, only the patch area and the damaged part of the structure are heated – similar to an induction cooker: a metal sheet the same size as the patch is heated via induction and pressed onto the patch using vacuum equipment. Pressure and heat then cause the patch to bind to the surrounding structure.

The adhesive process is not yet approved for repairs to high-performance plastic structural components in aeronautical applications. Further work is required here. The DLR repair concept has however already won the JEC Award in the MRO (Maintenance, Repair and Overhaul) category at the international composites trade fair JEC Americas in Houston (USA); this award recognises the best innovations in the field of fibre-composite materials.

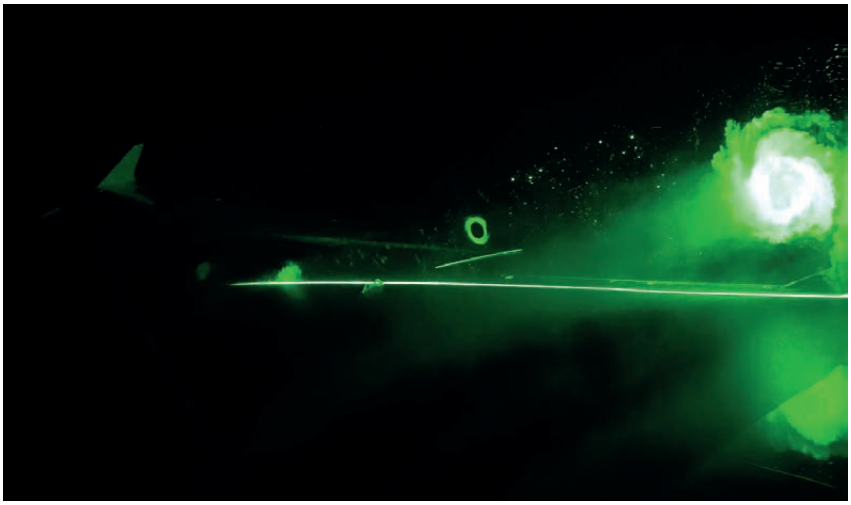
HINVA

Airflow around aircraft wing made visible in flight

The HINVA (High Lift Inflight Validation) project, conducted by researchers at DLR's Institute of Aerodynamics and Flow Technology in cooperation with Airbus, has achieved a world première: for the first time ever, airflow over the wing of a passenger jet in flight has been made visible over a large area using a laser.

The researchers used a contactless imaging procedure to capture the cloud droplets flowing over the wing, thereby revealing air movements and vortex structures. Four highly sensitive special-purpose cameras were installed behind cabin windows to the left and right of what is known as the light section and pointed at a measuring field over the wing, which was illuminated by a laser.

Demonstration of the experiment on the ground



Flow pattern image over the wing of the DLR ATRA

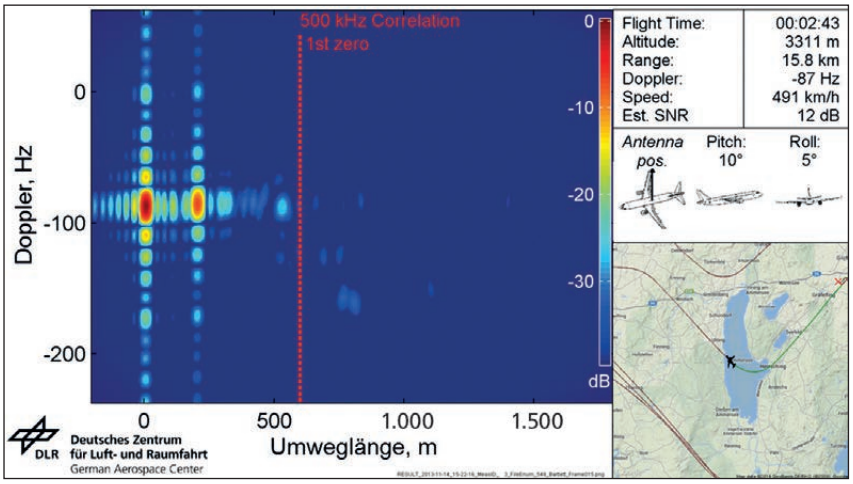
The cameras then recorded thousands of images of the droplets' movements within the illuminated measuring area during different flight attitudes. These images were compiled on the computer to create 3-D visualisations of airflow over the wings in low-speed flight, which will provide information on the effects of wing flaps and engine nacelles on those movements. Combined with previous wind tunnel measurements and computer-assisted flow simulations from the HINVA project, the data from this flight experiment will serve as a comprehensive data basis for developing a better understanding of aerodynamics in extremely low-speed flight; in the long term, this will allow wings and flap systems to be significantly better adapted to low-speed flight in order to optimise future approach procedures at airports. The data are to be used in particular to validate the numerical design procedures this will require.

HINVA is a project from the Federal Government's Aeronautics Research Programme IV. DLR partner Airbus is supporting the project as part of its research, as the intended precise prognosis of flow processes during take-off and landing will contribute significantly to improving future aircraft development.

APNT

Update for satellite navigation systems for aviation

Civil aviation navigation is increasingly based on the use of GNSS (Global Navigation Satellite Systems). To ensure that a safety net is available in the event of GNSS outages, suggestions for ground-based APNT (Alternative Positioning, Navigation and Timing) systems are currently being developed. DLR has shown that the future aeronautical communications system LDACS1 (L-band Digital Aeronautical Communications System, Type 1) is a promising APNT candidate, thus combining communication and navigation uses.



Radio channel characterisation: Doppler shift

Information on the underlying radio channel between ground station and aircraft is of great importance in developing and evaluating ground-based APNT systems. In extensive flight experiments, the radio channel properties were successfully measured for all relevant flight phases. It became apparent that the direct propagation path and the detour paths resulting from reflection show approximately the same Doppler shift in flight, which indicates that the reflections come from the direction of the transmitting antenna. The results have received widespread international recognition, especially from the FAA and Stanford University. A DLR employee has been invited to spend six months at the renowned Stanford University in summer 2015 to develop a channel model for evaluating APNT systems.

To use LDACS1 as an APNT system, methods were developed to generate position estimates from the LDACS1 distance measurements on board the aircraft. These methods are basically familiar from traditional satellite navigation, but had to be adapted to the particular geometrical layout of ground-based APNT systems. In addition, a number of established procedures were combined and barometric altitude measurements integrated. This approach has yielded promising new methods that are currently being evaluated in simulations.

Initial results were presented in September 2014 at the international and highly respected navigation conference ION GNSS+ in the USA. An international expert panel was held in late March 2015 at the DLR Institute of Communications and Navigation in Oberpfaffenhofen.

Parachute for light sport aircraft

PARAPLANE flight tests completed

The aim of the PARAPLANE EU project (2012–2015) was to develop, manufacture and validate a demonstrator for a controllable emergency ballistic reserve parachute for light sport aircraft up to approx. 600 kg (LSA). The advantages of a controllable parachute consist in the ability to choose a suitable landing point, minimise impact energy by landing into the wind and perform flare manoeuvres, and in potential weight savings compared to conventional round canopies. The parachute system is also intended to be usable for space capsules.

Two flight test campaigns took place in Arizona (USA) in March and May 2015, in the course of which gliding parachute systems weighing approx. 500 kg were dropped from an altitude of 3,000 metres a total of twelve times. During the first campaign in March, what is known

PARAPLANE system with S2 gliding parachute

as open-loop tests were performed to characterise the properties of the R2 gliding parachute (87 m²) and the newly developed S2 parachute (60 m²). In the second flight test campaign, a closed-loop test demonstrated the R2 parachute's expanded autonomous control, which allows the system to divert to an alternative landing point if the original target can no longer be reached.

Harness pressure sensor developed and patented by DLR

The work packages of the DLR Institute of Flight Systems consisted mainly of developing and operating the flight measuring systems and analysing the flight tests. The flight experiments also used the harness pressure sensor newly developed by DLR, which provided data on approach velocity. The flight test data from the various different sources are currently being merged, evaluated with system identification methods, and the results documented in reports. This completes the PARAPLANE EU project.

The flight metering systems and methods will be reused in the PARAVAL project in cooperation with the German Armed Forces to instrument drop tests, and the results used to validate DLR's load drop simulation.

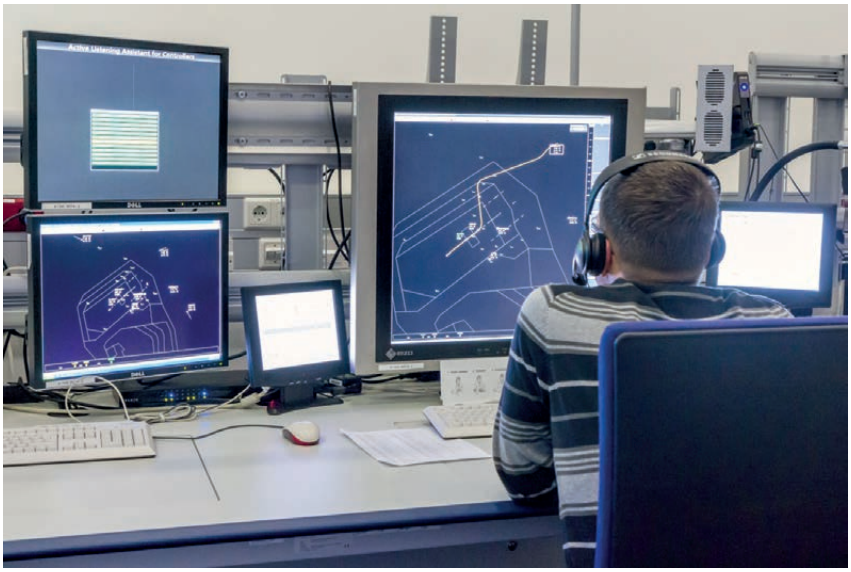
AcListant®

A second pair of eyes for the arrival manager

To manage flights safely, air traffic controllers have to keep track of highly complex situations on their radar screens. Assistance systems help them do this. The DLR Institute of Flight Guidance has collaborated with Saarland University to add a speech recognition system to an air traffic control assistance system (an arrival manager, or AMAN for short).

Under extraordinary circumstances, such as during runway closures or for priority flights, it may be necessary for the air traffic controller to give instructions that deviate from the recommendations of the assistance system. After such an instruction, today's assistance systems require 30 seconds and more to securely register the intentions of the air traffic controller. During this period, in which an aircraft covers several kilometres, the air traffic controller is without reliable assistance.

The Active Listening Assistant (AcListant®) project funded by the Helmholtz Validation Fund and DLR Technology Marketing has developed a solution in the form of automated speech recognition. By listening in on radio communications, the assistance system instantly detects the air traffic controller's intentions and can adjust its planning basis immediately, even in unusual situations. AcListant® uses context information to achieve highly accurate speech recognition. The assistance system knows the airspace and the possible intentions of the air traffic controller, and can thus provide the speech recognition system with the possible instructions for the given traffic situation. What makes AcListant® special is that the assistance system and the speech recognition system support each other. Patent applications for this idea have been submitted worldwide.



Workstation for validating the AcListant® system

Validation experiments were carried out with eleven German, Czech and Austrian air traffic controllers between February and May 2015 and evaluated at the DLR Institute of Flight Guidance. In all, approximately 14,000 instructions were listed, achieving average command error rates of under three percent and a recognition rate of over 91.5 percent. Without the use of context information, the speech recognition rate was only 78 percent.

In cooperation with DFS and Austro Control, the follow-up project AcListant-Strips® is integrating the context-based speech recognition system into radar label management. Air traffic controllers will then no longer have to time-consumingly enter their commands via keyboard and mouse; instead, the speech recognition system will be able to extract this information directly from the voice channel without further effort from the air traffic controller.

ML-CIRRUS mission

Contrail cirrus clouds detected

At present, unanswered questions regarding the properties of contrail cirrus clouds severely limit the value of global prognoses on the climate effects of air traffic. According to the latest findings, contrail cirrus clouds are causing even greater temperature increases than the carbon dioxide emissions from aircraft. To examine the nucleation, lifecycle and climate impact of aviation-induced contrail cirrus clouds, the ML-CIRRUS (Mid-Latitude CIRRUS) mission led by the Institute of Atmospheric Physics undertook a total of 16 measuring flights with the HALO research aircraft at altitudes of eight to fourteen kilometres over central Europe and the Atlantic, using one of the world's most modern cloud instrument sets. The significant volume of measured data has now been evaluated, and has already been presented at international conferences.

HALO measuring contrails and cirrus clouds

It had previously been unclear to what extent the properties of contrail cirrus clouds differ from those of naturally occurring cirrus clouds. To answer this question, an aged contrail cirrus field (without demonstrable influence of natural cirrus clouds) was sampled directly and via remote sensing in a unique meteorological situation. The anthropogenic clouds lead to an increase in natural cloud cover. The contrail cirrus clouds betray their man-made origins even hours later – an increased number of small ice particles remains detectable as a signature of aviation. The effect of these differences in particle count and form on the radiation budget of the atmosphere is currently being examined. Comparing them to the ML-CIRRUS measurements has also significantly improved the parameterisation of contrail cirrus clouds in models, which will allow regions with increased potential for contrail formation to be more easily predicted and avoided depending on the weather. The ML-CIRRUS measurements and models will also make it possible to more precisely quantify the effects of alternative fuels or new technologies on the formation and climate impact of contrails.

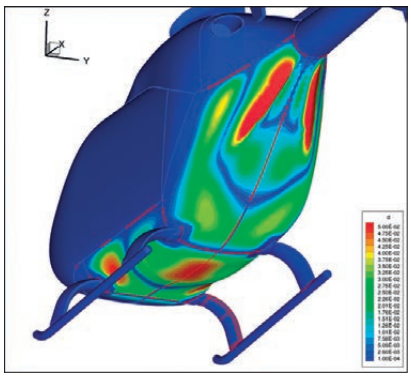
Bluecopter

Ecologically efficient helicopter with innovative aerodynamics

On July 7, 2015, Airbus Helicopters Deutschland (AHD) presented its new demonstrator helicopter, called *Bluecopter*. This innovative helicopter features new ideas and concepts designed to make the helicopter quieter, more fuel-efficient and comfortable. Increased efficiency and lower noise emissions are due mainly to aerodynamic innovations, the basis for many of which was developed in collaboration with DLR research institutions.

Noise reduction by up to 10 dB under the ICAO limit in this helicopter is achieved through, among other things, the Blue Edge rotor blades developed by Airbus Helicopters. The Blue Edge technology uses ideas from the ERATO rotor

The *Bluecopter* by Airbus Helicopters Deutschland (AHD)



Result of DLR optimisation

blade, which was developed by DLR and ONERA and successfully tested in a wind tunnel. DLR and the University of Stuttgart collaborated to develop new low-resistance rotor profiles for the *Bluecopter*'s rotor blades, which were optimised with regard to "dynamic stall" behaviour and tested in the wind tunnel.

DLR researchers were also involved in reducing the aerodynamic resistance of the fuselage.

Using a numeric optimisation procedure, the shape of the fuselage was redesigned around the rear door and fuselage floor. The noticeable "strakes" (baffles) on the rear door are one result of these optimisation calculations. Airbus Helicopters continued this work and developed the aircraft's final form. In addition to wind tunnel experiments, an aerodynamic simulation and optimisation process developed at DLR and based on the DLR TAU code was applied.

Guiding concepts

DLR aims to achieve a high degree of system capability in its proprietary research. The broad range of disciplines represented by its institutes predestines DLR to consider the air transport system as a whole, to assess the major technological challenges in their overall context and derive solutions from the results. This however requires that the various disciplines can be brought together in a suitable manner to jointly work on cross-disciplinary tasks.

In an institution where priorities are not driven by product development, research is able – but also required – to determine the direction and aims of its practical work, and in particular of its interdisciplinary collaborations, itself.

A limited number of selected guiding concepts for this purpose has now been defined. As tools of programmatic work they describe integration platforms that focus DLR's aeronautics research across

disciplines on a set of long-term (virtual) target products. In the coming years, the majority of internally agreed interdisciplinary projects will be assigned to these guiding concepts.

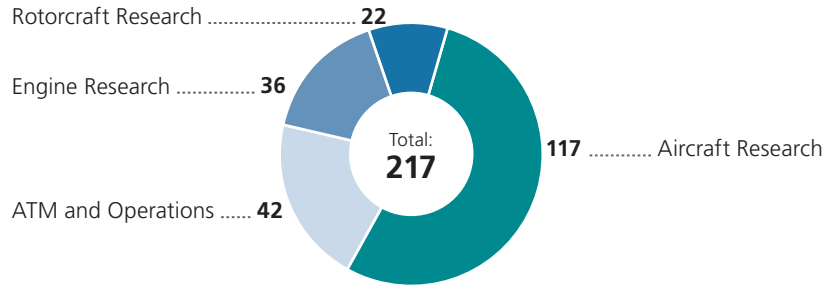
Six such guiding concepts are currently being explored: short-range aircraft, long-range aircraft, uncrewed transport aircraft, the rescue helicopter 2030, efficient air transport and the virtual product. None of these concepts reflects a real industrial project. They were consciously designed to be independent of such projects, but are intended to provide suitable platforms for research in the main fields of technology.

These fields of technology and the challenges faced by research are based not least on the European and national aeronautics strategies and the derived research agendas and roadmaps, the latter of which had previously already provided the framework for programmatic research in aviation.

Aeronautics: Revenues in millions of euros	2014 Actual	2015 Planned	2016 Planned
Basic funding	140	156	162
Third-party funding	78	61	58
Total revenues	**218**	**217**	**220**

Expected Revenue for the year 2015

All figures in million euros



Space

Space Administration, Space Research and Technology

The German Aerospace Center (DLR) is where Germany's national and international space flight activities converge. Research is carried out by the DLR space research institutes, whereas policy issues are the remit of the DLR Space Administration, which is responsible for carrying out national and international space-related activities on behalf of the Federal Government. Scientific, technological and operational contributions are made by DLR's own research institutes. The integrated German space exploration programme combines Germany's participation in the programmes of the European Space Agency (ESA), its involvement in EUMETSAT, the National Space Programme, the DLR research and technology programme *Space* and other space-related activities in science and industry. DLR demonstrates its competence and capability by participating in national and international space missions and research projects in cooperation with partners. The following examples provide a brief overview of the highlights and events of the past year.

German delegation in Luxembourg

ESA Council of Ministers

Ariane 6 programme and continuing operation of the ISS

The ministers of the at the time 20 member states of the European Space Agency ESA and from Canada met on December 2, 2014, in Luxembourg. Negotiations on the European carrier rocket Ariane and Europe's participation in the ISS in particular were very intense. The Council was faced with the challenge of translating the controversial decisions made regarding Ariane at the previous conference in 2012 into a sustainable long-term future in agreement with France. Germany's positions on the future of Ariane and on operating the ISS were successfully brought to bear. The version of Ariane 6 that has now been selected is a fundamentally revised further development of Ariane 5 and meets Germany's wishes in particular regarding the upper stage, which will reside in Germany. In all, resolutions allocating funding of approximately 5.9bn euros were adopted.
The Federal Government has agreed to contribute a total of 1.4bn euros over the coming years, making Germany the joint highest-contributing ESA partner together with France. Secretary of State Brigitte Zypries of the Federal Ministry of Science led the negotiations for the German government, supported by the German delegation to the ESA Council headed by Prof. Wörner, DLR Chairman of the Executive Board, Dr Gruppe, Head of the Space Administration at DLR, and Dr Densing, Director responsible for the ESA programmes in the Space Administration.

ATV-5 viewed from above

ATV-5

Last German space transport vehicle to serve the space station

On August 12. 2014, ATV-5 *George Lemaître* was the last European space transport vehicle to dock at the ISS. Astronaut Alexander Gerst merely had to monitor the automatic docking manoeuvre. The 20-ton vehicle contained experiments such as the EML (Electromagnetic Levitator) furnace, the DLR magnetic field experiment MagVector/MFX, food and clothing for the astronauts, fuel, breathing air, drinking water and spare parts. The journey of the ATV-5 (Automated Transfer Vehicle) took two weeks from its launch on July 30, 2014. ESA had previously tested the new LIRIS (Laser InfraRed Imaging Sensors) system, which was used in addition to the existing navigation system. This new technology allows spacecraft to approach so-called uncooperative targets, such as space debris. Since 2008, the ATV programme has launched a total of five transport vehicles into space to bring supplies to the ISS and dispose of the space station's refuse on their return into Earth's atmosphere. The ATV was also very important for manoeuvres to avoid space debris and for raising the orbit of the ISS, which loses between 50 and 100 metres in altitude every day and has been raised several times using the space transport vehicles. *Georges Lemaître* was docked at the ISS for approximately six months before its controlled descent into Earth's atmosphere, where it burnt up on February 15, 2015.

Germany was a leading participant in ESA's ATV programme and provided around 48 percent of the approximately 3 billion euros required to fund the programme. All ATVs were assembled and tested by main contractor Airbus Defence and Space in Bremen on behalf of ESA. In all, over 30 companies from ten European countries were involved. The Space Administration in DLR manages the programme area and represents Germany's interests at ESA.

The experience gained from the ATV programme will be brought to the development of a European service module for the American Orion capsule, ensuring that Europe remains involved in future human space flight missions. The first "European Service Module" (ESM) on an Orion capsule is expected to be deployed in an uncrewed test flight around the moon in late 2017.

Conference

Satellite communications in Germany in Bonn

The DLR Space Administration organised the fourth conference on *Satellite Communications in Germany – Key to the Modern Information Society* in Bonn on March 25 and 26, 2015. With around 300 attendees, 20 exhibitors and – for the first time – 18 poster talks by junior researchers, the response was extremely positive.

Peter Schlote, Dr Wolfgang Scheremet, Dr Gerd Gruppe and Holger H. Meinel (left to right) opened the conference

Dr Gerd Gruppe and
Major General Benedikt Zimmer

The Laser Communication Terminal (LCT)

GESTRA initiators (left to right): Prof. Alexander Verl, Prof. Dr Joachim Ender, Dr Gerd Gruppe and Lieutenant General Joachim Wundrak

HEINRICH HERTZ

A milestone for the satellite project

On December 19, 2014, the DLR Space Administration and the Federal Ministry of Defence (Bundesministerium der Verteidigung, BMVg) signed an implementation agreement defining and detailing the cooperation between DLR and BMVg on the joint satellite mission Heinrich Hertz. The German mission is scheduled to begin in 2019, but important preliminary activities for the large-scale project are already underway. The Space Administration is organising the joint satellite mission for the Federal Ministry for Economic Affairs and Energy and the Federal Ministry of Defence based on the Delegation of Space Activities Act (Raumfahrtaufgabenübertragungsgesetz, RAÜG). The two ministries participating in Heinrich Hertz are cooperating on utilising the available payload: alongside the scientific and technical components of the mission for the Federal Ministry for Economic Affairs and Energy, the Federal Ministry of Defence will be using free payload capacities for operative satellite communications.

"Superlaser"

Successfully tested on Alphasat and Sentinel-1A

On November 28, 2014, a laser beam for the first time travelled a distance of 36,000 kilometres through space, transmitting satellite images of Earth back to Earth via a relay satellite within just a few seconds. EDRS (European Data Relay System) is a programme of the European Space Agency ESA that uses laser communication technology. A prototype of the laser communication terminal (LCT) has been installed on Alphasat I-XL, while the ESA Earth observation satellite Sentinel-1 acts as a partner station. The LCT on Alphasat and Sentinel-1A can transmit data volumes of up to 1.8 Gigabit per second over a distance of up to 45,000 kilometres. The technology for this pioneering data link comes from Germany: the LCT was financed by the DLR Space Administration with funds from the Federal Ministry of Economics and Energy; Tesat Spacecom GmbH led the development project. The bridgehead to the geostationary relay satellite is its receiving station at DLR's German Remote Sensing Data Center in Oberpfaffenhofen.

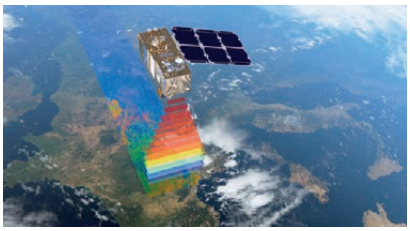
GESTRA project

A space radar for locating debris

GESTRA (German Experimental Space Surveillance and Tracking Radar) is designed to make space a safer place. Scheduled to go live in late 2017, the experimental space surveillance radar GESTRA will observe orbit data for satellites and debris in near-Earth orbits at altitudes of between 500 and 1,200 kilometres that might endanger satellites. The DLR Space Administration has commissioned the Fraunhofer Institute for High Frequency Physics and Radar Techniques (FHR) in Wachtberg to develop and build a powerful radar system to monitor and track near-Earth objects. The project began on April 1, 2015. The radar system will be operated from DLR and the German Air Force's joint Space Situational Awareness Center in Uedern, as the data are considered to be security-relevant. GESTRA will also co-operate with other large-scale facilities such as the TIRA space observation radar or the Effelsberg radio telescope in order to expand the available expertise in bi- and multistatic radar operations.

INNOspace conference in Darmstadt

markets. In addition to cross-industry conferences in various federal states, the initiative's activities include ideas competitions, user workshops and the travelling exhibition "ALL.täglich!", which is designed to inform the wider public of the innovative capacity and the contribution of space exploration to business, society and the environment.


Schematic of Sentinel-2A

"INNOspace"

Collaboration between space exploration and IT

How can space exploration and information technology (IT) benefit each other? And what can they do for business and society? These were the core questions at the third cross-industry INNOspace conference organised by the DLR Space Administration on behalf of the Federal Ministry for Economic Affairs and Energy (BMWi) and the State of Hesse on October 29, 2014, at the European Space Operations Centre (ESOC) in Darmstadt. The conference was opened by Ms Zypries, Secretary of State at the BMWi and Federal Government Coordinator of German Aerospace Policy, Mr Al-Wazir, Minister of Economics, Energy, Transport and Regional Development for the State of Hesse, and Dr Gruppe, Head of the Space Administration in DLR. Like many other areas of business and technology, space exploration is increasingly closely linked with IT. This is particularly true of new developments such as Industry 4.0, the combination of production processes with Internet-based information and communication technologies. This digitally networked form of production generates huge amounts of data, known as "big data", which have to be transmitted and processed in real time. INNOspace is an initiative launched by the Space Administration in early 2013 to promote innovation, technology transfer and new

New ZERO-G aircraft

Take-off to scientific maiden flight

In May 2015, the three space agencies DLR, CNES and ESA jointly held their first parabolic flight campaign with the new ZERO-G aircraft Airbus A310 ZERO-G. Twelve experiments – eight of them from Germany – were successfully conducted. The French company Novespace had bought the former "Chancellor's Airbus" A310 VIP from Germany in summer 2014 and commissioned Lufthansa Technik in Hamburg to extensively service it and convert it into a ZERO-G aircraft. Numerous test flights and this first campaign have shown that the qualified French cockpit crew is able to fly excellent parabolic arcs with this aircraft. Going forward, the three space agencies will be continuing to hold between five and seven scientific campaigns annually.

The Zero-G crew on the ground

Sentinel-2 mission

New processors

As part of the Sentinel-2 mission, the Earth Observation Center has been involved for several years in developing quality control and data validation methods on a number of ESA projects. Currently, the EOC is participating in the Mission Performance Center (MPC) for validating Level 2A products (atmospheric correction). As part of an ESA contract, the Sen2Cor processor integrated into the Sentinel-2 toolbox was developed from DLR's proprietary software package ATCOR. The general focus of the research performed at the EOC is on atmospheric correction, on generating higher-value products (e.g. mosaicing, compositing, classification procedures, time-series processing, data fusion) and on application development.

However, there is currently no operational processor for atmospheric correction in the ground segment of Sentinel-2. The DLR Institute of Remote Sensing Technology has therefore been working closely with the appropriate institutes at

CNES for over a year to design an optimised processor. At the same time, intensive joint negotiations are taking place with ESA-ESRIN to implement the development and operationalisation of this optimised processor. Together with their industrial partners, DLR's German Remote Sensing Data Centre and CNES have significant interest in using this processor to perform Sentinel-2's operational global processing for atmospheric correction.

Sentinel-2, consisting of Sentinel-2A and Sentinel-2B, is a pair of optical Earth observation satellites. They are part of ESA's Copernicus programme. The DLR Space Administration is overseeing the corresponding ESA programmes on behalf of the Federal Ministry of Transport and Digital Infrastructure.

SOFIA

Flying Observatory

After five and a half months in Hamburg, the flying observatory SOFIA set off for its home airbase, the Armstrong Flight Research Center in Palmdale, California, on December 14, 2014. As part of a routine general overhaul, the modified Boeing 747SP, which is used jointly by DLR and NASA as a stratospheric observatory for infrared astronomy, had undergone thorough testing since its arrival at Lufthansa Technik on June 28. DLR thus met part of its commitment to NASA to contribute 20 percent of the cost of operating the observatory. On June 19, 2015, SOFIA took off for its first observation flight in this year's New Zealand campaign and completed 14 research flights with the American FORCAST (Faint Object InfraRed-CAmera for the SOFIA Telescope) instrument and the far-infrared spectrometer GREAT (German REceiver for Astronomy at Terahertz Frequencies), which was built in Germany. The upGREAT far-infrared spectrometer – an advanced version of GREAT – has now successfully completed its first deployment on four commissioning flights in Palmdale, California, analysing the origins of carbon radiation from interstellar gas and dust clouds with previously unseen efficiency. The telescope's instruments and rangefinder camera will also be used to observe a stellar occultation by the dwarf planet Pluto.

SOFIA interior with upGREAT

Space Administration: Funding budget in million euros	2014 Actual	2015 Planned	2016 Planned
National programme (incl. share of management of BMWi contract)	272	273	282
ESA (BMWi/BMBVBS/BMVI)	807	793	771

Joint highlights/projects from the Space Administration and DLR's Space Research and Technology division

ISS mission "Blue Dot"

Successfully completed

On May 28, 2014, German ESA astronaut Alexander Gerst took off for the ISS, making him the third German to have lived and worked in space. During his mission, scheduled to last 166 days, he was involved in 100 different experiments for all ISS partners, including experiments on radiation and astrobiology, space medicine and material sciences for DLR. Alexander Gerst also installed the MFX/MagVector magnetic field experiment and took it into operation. It measures the strength and quality of Earth's protective magnetic field within the ISS and examines the interactions between Earth's magnetic field and an electric conductor. For another material physics experiment, Alexander Gerst installed the EML (Electromagnetic Levitator, see p. 31) and took it into operation. In this cooperation project between DLR and ESA, metal alloy samples are melted and solidified without containers in order to test new alloys.

Among other things, Alexander Gerst removed the FASES unit from its holder in the European Columbus laboratory on the ISS; he also reinstalled the Geoflow experiment, which has been running since 2008 and examines the flow processes inside the Earth without being subject to gravity. The 38-year-old astronaut also continued the skin experiment SKIN-B from Germany as well as his research into headaches and eye health in space. The purpose of all these experiments is to improve life on Earth, explain the origins of life in the Solar system and prepare further exploration projects.

Alongside scientific experiments, a major aim of the mission was to convey science to young people in particular. For a school project, Alexander Gerst manipulated soap bubbles using sound waves. This experiment won the Aktion 42 school competition held by DLR in cooperation with ESA and the Jugend Forscht foundation.

Alexander Gerst also supported this aspect of the mission during the past year with video messages from the ISS and by raising children's awareness of the fragility of our home planet. 90 projects focusing on environmental protection and climate change were submitted to a competition titled *The Blue Planet – Your Mission* and evaluated by an expert jury. Approximately 2,000 school pupils took part in the ideas competition held by DLR's Space Administration. Submissions were evaluated in four categories: oceans, land, rivers/lakes and forests. Secretary of State Brigitte Zypries of the Federal Ministry for Economic Affairs and Energy, Federal Government Coordinator of German Aerospace Policy, also congratulated the girls and boys. The competition was organised with funds provided by the Federal Ministry for Economic Affairs and Energy. More information on the competition and all the winners is available here:

@ **www.beschuetzer-der-erde.de**

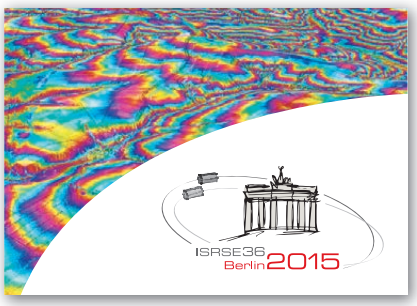
On September 1, 2014, a group of pupils from Siegburg grammar school had the opportunity to contact the astronaut via radio as part of the Amateur Radio on the International Space Station (ARISS) project and ask him questions. In cooperation with the German amateur radio society Deutscher Amateur-Radio-Club e. V. (DARC) and the Department of Geography at Bonn University, the DLR Space Administration assisted the school in this project in order to interest pupils in space exploration, science and technology.

After a three-and-a-half hour flight on board a Russian Soyuz spacecraft, Alexander Gerst and his two fellow crew members Maxim Suraev and Reid Wiseman landed in the Kazakh steppe on November10, 2014, at 4:58 a.m. CET. Gerst is the first German astronaut to return to Germany immediately following his flight and be examined at DLR's :envihab, one of the world's most modern aerospace medical research institutions.

ISRSE 36

DLR Earth observation conference gets to grip with Merlin and Copernicus

From May 11 to 15, 2015, DLR held the 36th International Symposium on Remote Sensing of Environment (ISRSE) in Berlin. Earth observation satellites document changes on our home planet and provide elementary information on weather and climate, biodiversity and ecosystems, sustainable agriculture and forestry, mineral resources and resource utilisation, the quality of water or air. Satellite data can also be helpful in crisis situations or natural disasters; the German radar satellites TerraSAR-X and TanDEM-X and the Sentinel data from the European Copernicus programme are extremely valuable in this respect. Copernicus aids environmental and transport management, disaster preparedness and relief, and helps answer questions on renewable energies. DLR presented current projects on Lidar systems and hyper-spectral technology: the hyperspectral EnMAP satellite, which will be used to answer a range of questions, and the Franco-German climate mission Merlin, which will measure methane levels in the atmosphere using a laser.



Researchers, engineers and businesses presented their latest ideas and systems at the conference; big data is seen as one of several areas holding future opportunities and challenges.

The 36th ISRSE was organised by the DLR Space Administration in cooperation with the International Center for Remote Sensing of Environment in Tucson, Arizona, and the International Society for Photogrammetry and Remote Sensing. Alongside DLR, the main sponsors were the European space agency ESA, the European Commission, the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) and the US space agency NASA.

WADIS-2

Atmospheric research uses rockets to examines gravity waves

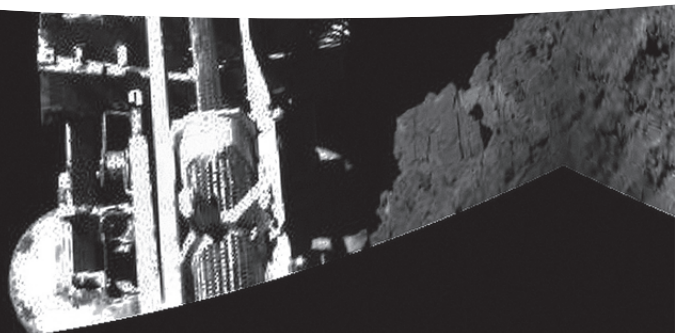
On March 5, 2015, the sounding rocket WADIS-2 took off from Andøya Space Center into the Norwegian night sky with nine experiments on board. In addition, 13 small, simple "weather rockets" were launched to measure pressure and temperature in the days before and after the WADIS launch in order to define a larger weather environment. At an altitude of approx. 126 km, the experiment sensors detected air pressure, temperature, electrical charges and changes in atmospheric density during the flight. These changes in atmospheric density, known as gravity waves, can be measured in the form of temperature, pressure and wind fluctuations. After an approximately ten-minute flight, the payload unit touched down in the North Atlantic.

The WADIS project is scientifically led by the Leibniz Institute of Atmospheric Physics in cooperation with universities and companies from Germany. DLR's mobile rocket base MORABA in Oberpfaffenhofen was responsible for managing the launch campaign. The project was supported by the DLR Space Administration with funds from the Federal Ministry of Economic Affairs and Energy.

Galileo

Four satellites positioned and additional test centres opened

To expand the European satellite navigation system Galileo, two satellites were transported into space on a Russian Soyuz rocket in August 2014 and a further two in March 2015. Due to a frozen hydrazine line in the upper stage, the satellites Milena and Doresa, launched in 2014, could however not be placed into their intended orbit and were released into a lower orbit. Engineers at DLR-GfR later succeeded in raising both satellites. Milena and Doresa now travel almost circular paths on precisely opposite sides of the Earth and reach the same points every 20 days, which allows them to be synchronised with the standard ten-day cycle of the other Galileo satellites.
The Galileo project office at DLR coordinates and DLR-GfR monitors operation of the Galileo satellite constellation from Oberpfaffenhofen in cooperation with the control centre in Fucino, Italy. DLR-GfR holds a 50 percent share in Spaceopal GmbH, a joint venture founded with Italian company Telespazio S.p.A. for the purpose of operating Galileo. In cooperation with the DLR Institute



automotiveGATE near Aachen

of Communications and Navigation, the company works on developing the navigation systems of the future, research to which DLR-GfR brings experience gained at the DLR German Space Operations Center (GSOC).

Of the 30 satellites that will make up the complete Galileo satellite navigation system, eight are now in space. Four satellites have been in space for in-orbit validation of the system since the beginning in 2011. With the launches described above, the first two satellites of the deployment phase are now in place. The next Galileo satellite launch is planned for September 2015.

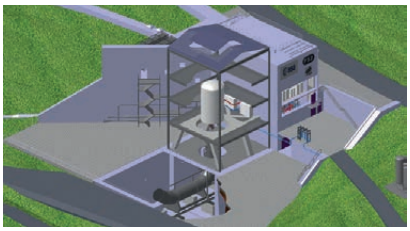
Germany is responsible for approximately 20 percent of the programme. The European Commission has ordered 22 satellites in total from OHB in Bremen for the deployment phase. The European satellite navigation system Galileo is expected to be fully operational by 2020.
To ensure that full use is made of all the technical opportunities the system offers, the DLR Space Administration is already enabling research institutes and industry to test modern navigation technologies and instruments with original Galileo navigation signals today, to ensure that they will be ready for use as soon as the Galileo age begins. After GATE in Berchtesgaden, SEA GATE in Rostock and aviationGATE in Braunschweig, the final two Galileo test and development environments – automotiveGATE and railGATE – were opened on May 22, 2015, near Aachen.

Third Industrial Day

Discussion on the future of European space transport

How will the Ariane 6 rocket resolved on by the Council of Ministers be developed? Which are the challenges facing European space transport if it is to succeed in global competition? And how can innovation potential be identified and advanced? These questions were the focus of the 3rd Industrial Day held by DLR on April 21, 2015, for which over 80 space exploration experts from the European partner countries came together at DLR's Lampoldshausen site.

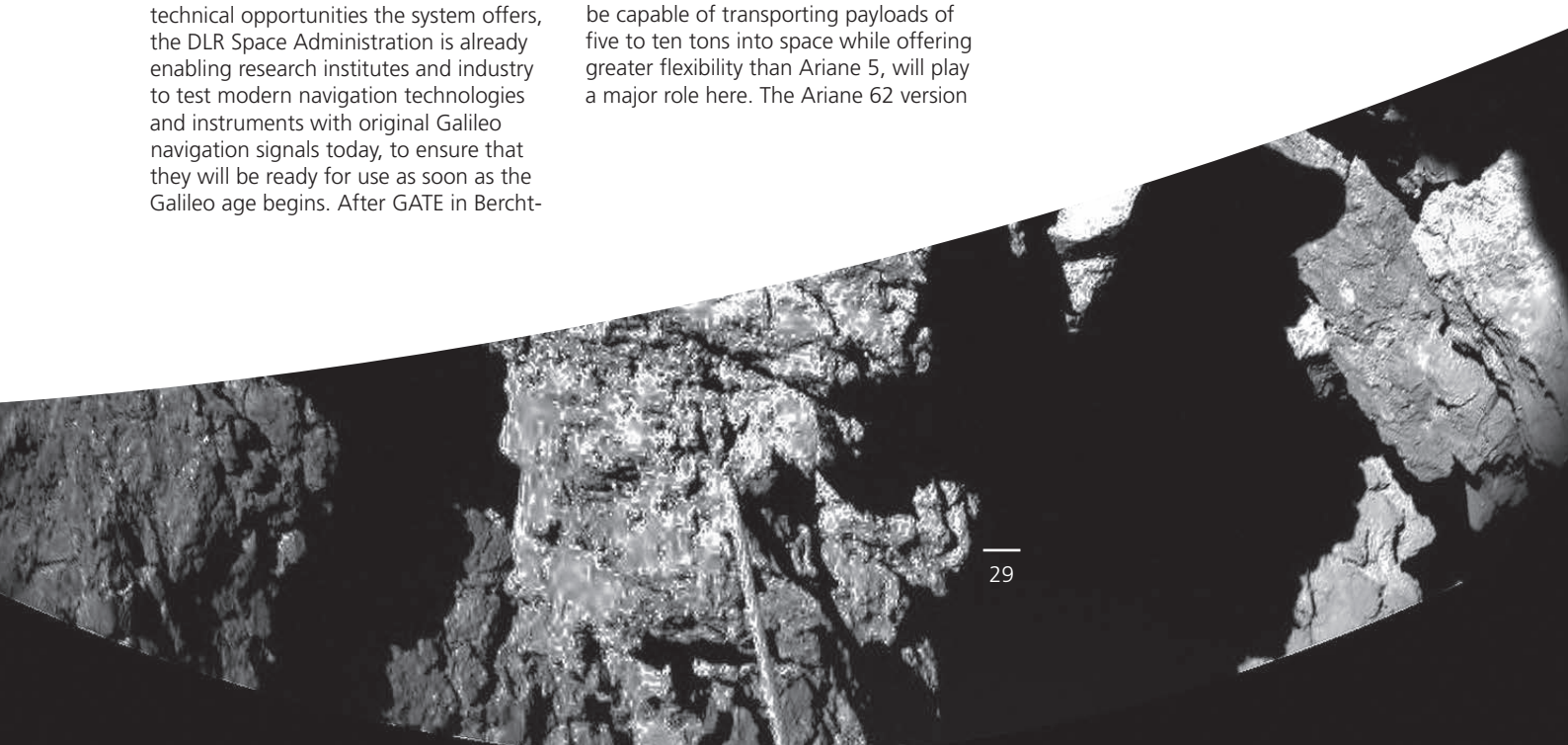
The common goal of all European stakeholders in the field of carrier rockets is to continue the success of the Ariane programme: constructing a new, powerful Ariane carrier rocket is intended to ensure independent, permanently available access to space for Europe and render such access commercially competitive. The development of Ariane 6, which will be capable of transporting payloads of five to ten tons into space while offering greater flexibility than Ariane 5, will play a major role here. The Ariane 62 version

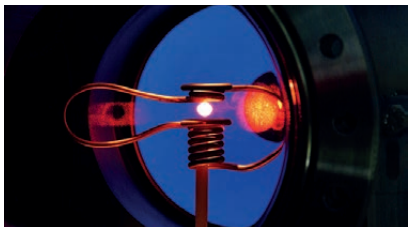


Visualisation of the P5.2 test bed

will be designed for institutional missions with somewhat lighter payloads, while Ariane 64 will carry especially heavy loads such as geostationary telecommunication satellites. The first Ariane 6 flight is planned for 2020.

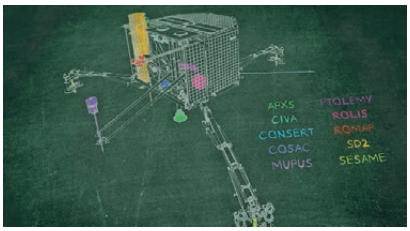
With its unique test bed infrastructure, DLR is in significant demand as a partner in the research and development of propulsion technologies. Technological competence in the field of rocket upper stages will be focused entirely on Ariane 6 and its further developments. A major component will be the new upper stage test facility P5.2 designed and built by DLR engineers on behalf of ESA. The facility will make it possible to test not only engines and individual components, but also entire upper stages – a first in Europe. DLR will thus be making a major contribution to the advancement of the Ariane programme and contributing to maintaining Europe's independent access to space.





Melting alloys without containers

CHARM-F system on HALO



Philae lander – instruments

EML

Electromagnetic levitation from the ISS

In July 2014, the Electromagnetic Levitator (EML) – a multi-user facility – was brought to the ISS and installed in the Columbus module. The EML is an international user platform that enables containerless melting and solidification of electrically conductive samples under ultra-high vacuum and/or high-purity gasses in zero gravity.
It is used to conduct force-free measurements under purely diffusive conditions of certain thermophysical properties of chemically aggressive metals in fluid states with a precision that cannot be achieved on Earth. In addition, early formation phases of material structures (nucleation) and the transition from liquid to solid state are examined and analysed. Research into metastable phases and thermophysical properties is of interest both for basic research and for industrial processes. The results promise major application potential for optimising Earth-bound production processes by means of improved computer models that require highly precise values for thermophysical parameters. The DLR Institute of Material Physics in Space is leading in this field. The flight experiments are prepared and jointly carried out in cooperation between DLR working groups and project partners from Germany, EU member states, the USA, Canada and Japan.

Global warming

New Lidar system used successfully on HALO for the first time

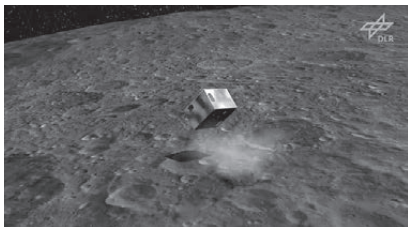
Combating global warming is a major societal challenge. The main causes of accelerated global warming are the significant increases of carbon dioxide and methane caused by human activity. Methane concentration has seen one of the highest increases, rising by a factor of 2.5 since pre-industrial times; reliable prognoses on climate development are however not currently possible. The aircraft-based Lidar (Light Detection and Ranging) system CHARM-F on the DLR research aircraft HALO (High Altitude and Long-range Observatory) is the first instrument capable of successfully measuring these gases. CHARM-F is a newly developed, highly complex integrated path differential absorption (IPDA) Lidar system. Concentration gradients and surface-atmosphere fluxes of CO_2 and CH_4 can be permanently quantified over anthropogenic point sources or larger natural sources. Regional measurements in particular provide highly accurate data products on greenhouse gas sources and sinks. There was previously an egregious lack of such data. HALO validation campaigns with CHARM-F contribute significantly to the success of the Franco-German climate mission MERLIN. They will improve the available data on methane emissions to previously unachieved levels of accuracy and thus contribute significantly to better climate prognoses.

Philae

On 67P/Churyumov-Gerasimenko

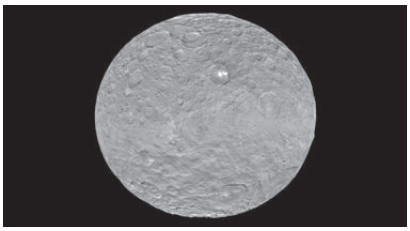
On November 12, 2014, at 4:32 p.m. the lander Philae, which was contributed to the ESA mission Rosetta with significant German support, touched down on the surface of comet 67P/Churyumov-Gerasimenko. 500 million kilometres from Earth, the lander hit its carefully chosen target point almost precisely, but touched the ground only briefly and then bounced. Only approximately two hours later and after a second contact with the ground did it finally land – and has since stood in the shadow of a cliff near a crater edge at the head of the comet. It was the first time that a man-made device successfully landed on a comet and was able to measure data on site. Before the primary battery ran out on November 15, 2014, at 1:36 a.m., almost all its ten instruments were put to use, capturing images, performing atmospheric analyses, probing and conducting spectral analyses of the ground. Philae then fell into a seven-month hibernation from which it reported back again for the first time on June 13, 2015, sending multiple valuable data packages to DLR's MUSC. An initial analysis by the DLR team at the lander control centre in Cologne proved that the lander was operational. The transmissions also included data from the lander's data storage, collected in early May when Philae had already awoken but was not yet capable of transmitting. The new contacts show that Philae has so far withstood the tough conditions on comet 67P very well.

Highlights/projects from DLR's Space Research and Technology division



Mascot – measurements on the asteroid's surface

Joystick from the Kontur-2 project



View of Ceres with its bright spots

Mascot

On its way to 1999 JU3

The Japanese Hayabusa-2 probe with DLR's asteroid lander Mascot took off on December 3, 2014. It will reach its target, asteroid 1999 JU3, in the summer of 2018. On arrival, the Hayabusa-2 probe will first map the asteroid before approaching its surface in early 2019 to take material samples, examine the mineralogical and geological composition of the asteroid's surface and determine its surface temperature and magnetic field. The Mascot lander will free-fall from an altitude of 100 metres to the asteroid's surface and for the first time in the history of space exploration take measurements at multiple locations. As no one knows the asteroid's precise gravitational pull, the greatest challenge will be the lander's separation from the mother probe and its subsequent landing. After approximately 16 hours of data transmission the lander's battery will be empty, bringing the mission to an end. The DLR engineers have installed a total of four instruments on the 10 kg lander. The DLR Institute of Space Systems developed the lander and tested it under space conditions, the DLR Institute of Composite Structures and Adaptive Systems was responsible for the lander's stable structure, and the DLR Robotics and Mechatronics Center developed the swing arm that allows Mascot to jump on the asteroid. The DLR Institute of Planetary Research contributed the MASCAM camera and the MARA radiometer. The asteroid lander Mascot is monitored and operated from the DLR control centre at the Microgravity User Support Center (MUSC) in Cologne.

Kontur-2

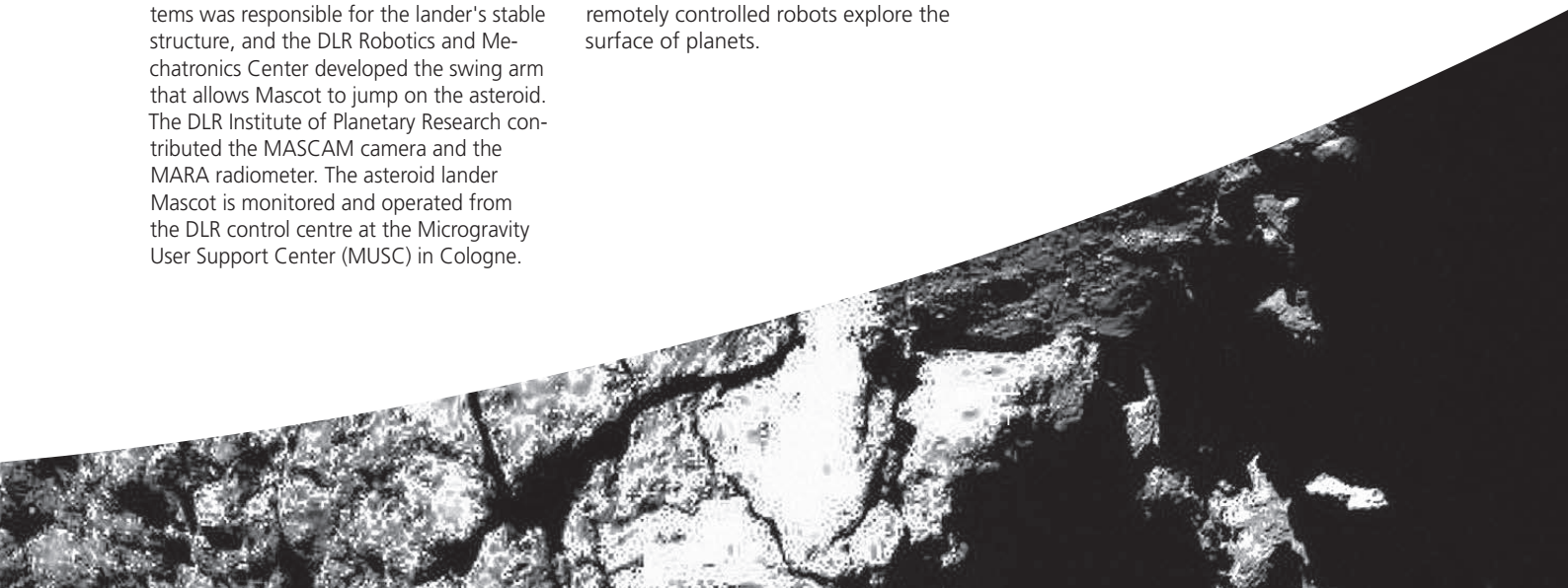
A super-joystick in space

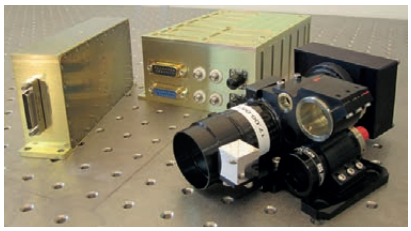
In the Kontur-2 project, the DLR Institute of Robotics and Mechatronics is developing a space-capable joystick with force feedback and two degrees of freedom. Astronauts on the ISS will use this joystick to remotely control robots at the DLR institute in Oberpfaffenhofen and at the project partner RTC (Russian State Scientific Center for Robotics and Technical Cybernetics). The astronauts will control the robot's position and be able to feel the forces resulting from the robot's interaction with its environment, allowing them to perform complex assembly tasks with great delicacy. The joystick was delivered to the ISS in the summer of 2014. Training had previously been provided at the DLR institute in December 2014. The communications infrastructure developed by the predecessor project ROKVISS (Robotics Component Verification on ISS) will be used for data transmission. Major aims are to advance the DLR institute's telepresence technologies and to perform ergonomic studies in zero gravity. The Kontur-2 project is an intermediate step to advanced space missions in which remotely controlled robots explore the surface of planets.

Ceres

A dwarf planet full of surprises

During the Dawn probe's approach to Ceres, which it reached on March 6, 2015, scientists at the DLR Institute of Planetary Research discovered mysterious bright spots. A definitive explanation is yet to be found; they could be caused by ice or salt. On June 5, 2015, Dawn reached its survey orbit and delivered images that show at least eight further bright spots in a crater approximately 90 kilometres in diameter. Spectral measurements are to be used to determine the material forming the bright spots. The images also clearly show a steep, pyramid-shaped mountain rising up approximately 5 kilometres from relatively flat terrain. Numerous craters also have mountains at their centre. The planetary researchers moreover discovered multiple indications of surface activity, such as flows, collapsed structures and landslides. In August 2015, Dawn approached the surface of Ceres to a distance of 1,450 kilometres and was able to capture higher-resolution images that will be used to enhance the existing three-dimensional elevation model of the dwarf planet.





Flight model of the OSIRIS4BIROS system

Gigabit/s

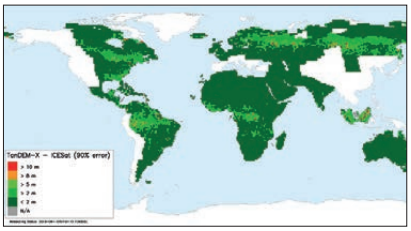
Data links for microsatellites

Earth observation satellites are becoming even smaller and more powerful. The resolution of the installed sensors is constantly growing; so, therefore, is the generated data volume, which increases quadratically to linear resolution, making data transmission more and more difficult. Free-space optical communications however allow data transmission rates that are orders of magnitude higher than traditional radio systems.

At the same time, optical systems are more compact, lighter and use less power. A frequency band with a bandwidth of over 10 terahertz is available for this form of communication; it can be reused as required, is not regulated and almost impossible to tap.

The OSIRIS (Optical Space Infrared Downlink System) project has developed an optical communications terminal and integrated it into the BIROS (Bispectral Infrared Optical System) satellite. BIROS was developed by the DLR Institute of Optical Sensor Systems and will take off in 2016. A laser sends the data from the satellite to the optical ground station at a data transfer rate of 1 gigabit/s. Previous radio links on comparable satellites achieve approx. 2 megabit/s. This means that optical raw data can be transmitted to Earth at high resolution for the first time.

OSIRIS consists of a laser source that transforms the electrical data signal on board the satellite into an optical signal, and a sensor that receives the beacon laser signals from the optical ground station. The resulting findings will be integrated directly into a global standard that is currently being drafted by the Consultative Committee for Space Data Systems (CCSDS) under the coordination of the DLR Institute of Communications and Navigation.



Status of TanDEM-X processing as of June 10, 2015

Radar eyes

TerraSAR-X and TanDEM-X working reliably

The flagships of the national space programme have been delivering high-quality radar remote sensing data for an ever expanding scientific and commercial user base since 2007 and 2010, respectively. Over 160,000 individual image requests with up to 100 km wide coverage strips and ground resolutions of up to one metre have so far been served. The flexible design of the radar instruments allowed the use of innovative experimental imaging modes. The implemented operational expansion of the basic products to include up to 250 km wide ScanSAR acquisitions and Spotlight products with 25 cm azimuth resolution is a valuable addition for maritime and safety-related applications. The geometric accuracy of the TerraSAR-X data has also been dramatically increased. TerraSAR-X images are generally geolocalised to within 1–3 cm.

Since the launch of TanDEM-X, the twin satellites have operated as a bi-static radar interferometer and captured data for a high-precision homogeneous digital elevation model (DEM) of Earth. Their close-formation flight at a distance of 120 metres has meanwhile become routine. Formation changes are implemented with precision and in a fuel-efficient

→ Quickfacts on the DLR Earth Observation Center

Satellites received:	Longest data time series archive:	European satellites received at the EOC today:	European satellites received at the EOC in 2020:	Currently stored data volume:	Annual data increase:	Data volume created by TerraSAR-X and TanDEM-X alone:
19	34 years	8	21	4.3 petabytes	600 terabytes	3,500 terabytes

manner. Imaging for the DEM was completed in early March; the over 2,500 terabytes of data are now being processed. Over 65 percent of the final DEM are already available. High-precision algorithms and the excellent calibration of the radar interferometer allow strictest quality requirements to be met. The achieved accuracy is clearly within the specifications, the cumulative absolute elevation error is better than the target value. Both satellites remain fully operational and have fuel reserves that will last until at least 2020.

BOSS

Biofilms on the ISS

In the space experiment Biofilm Organisms Surfing Space (BOSS) conducted in the ESA experimental unit Expose-R2, an international team of researchers coordinated by the DLR Institute of Aerospace Medicine is examining the resilience of biofilms to space and simulated Mars conditions compared to single living cells on the ISS and in DLR's planetary and space simulation facilities.

Biofilms are among the oldest traceable signs of life on Earth and might be the first life forms to be discovered on other planets in our solar system. They consist of a film in which microorganisms are embedded. The film protects these tiny creatures from external factors, making

The ESA experimental unit Expose-R2 in space on the outside of the ISS

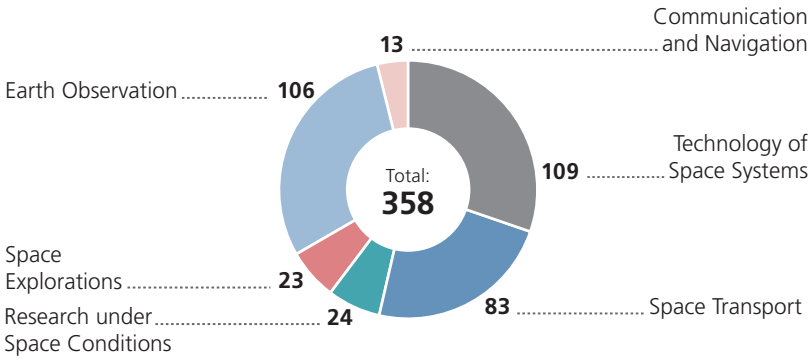
them highly resistant to chemical and physical influences. Researchers assume that dust particles in the biofilm form a protective shield against extraterrestrial ultraviolet (UV) radiation and shield the organisms.

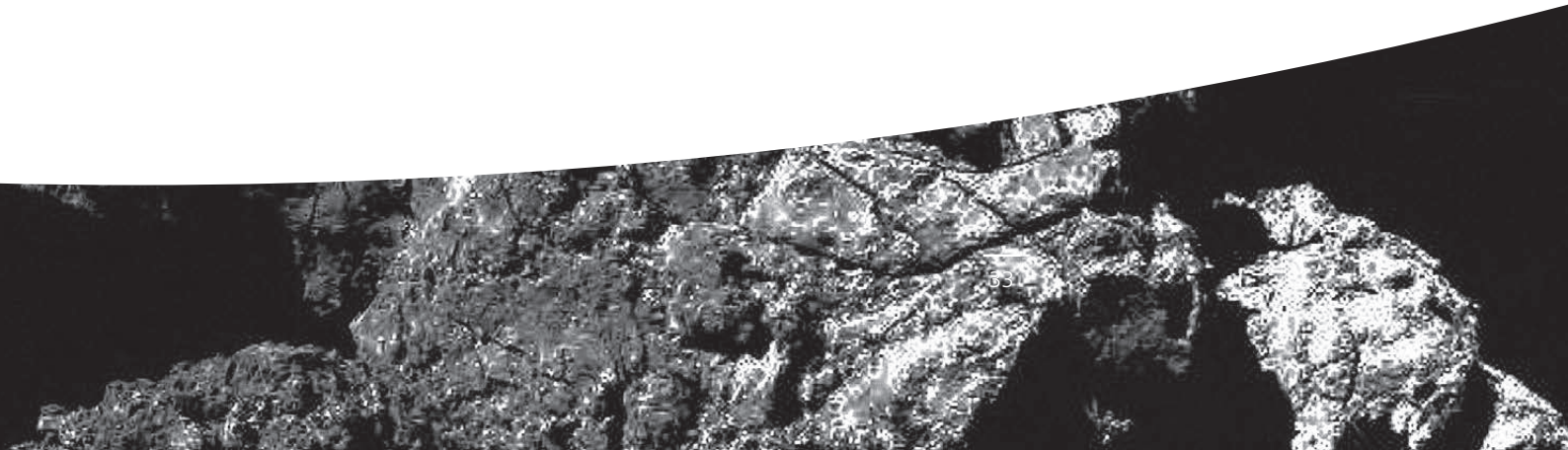
The BOSS experiment examines desiccation, extraterrestrial UV radiation, simulated Mars atmosphere and a Mars-like UV climate. These parameters were tested individually and in combination in experiment verification tests (EVT) and the science verification test (SVT) at the ground simulation facilities. In June 2014 the various biological samples were installed on the URM-D platform on the outside of the Russian ISS module. In one year they will be returned for analysis. The results of the EVT and SVT experiments indicate that these analyses will show better chances of survival and greater vitality in the biofilm organisms. The findings will help answer questions on the origin, evolution and propagation of life in the universe.

Space R&T: Revenues in millions of euros	2014 Actual	2015 Planned	2016 Planned
Basic funding	185	184	190
Third-party funding	166	174	171
Total revenues	**351**	**358**	**361**

Expected revenues for the year 2015

All figures in million euros





Transport

All life is movement, and without movement, there is no life. This insight from Leonardo da Vinci may well be more timely than ever. Mobility has become an essential aspect of our lives; but the price of almost unlimited transportation is high, as it negatively impacts humans and the environment through noise, pollutants and resource consumption. We have nonetheless become accustomed to this form of freedom and harbour corresponding expectations of the future, adequately meeting which will require significant effort. Crucial to this endeavour is a new way of thinking that focuses on individuals' need for mobility and companies' transport requirements while bearing their interactions with the technological possibilities and the overall economic, ecological and societal conditions in mind. Increased emphasis must thus be placed on a systemic view of mobility and transport.

The Transport programme at DLR identified this development early on and placed it at the centre of its research. The joint efforts of 25 DLR institutes from the Transport, Energy, Aeronautics and Space programmes are concentrated on three programmatic research areas: terrestrial vehicles, traffic management and the transportation system. Our research focuses on cars, utility vehicles, and next-generation and generation-after-next trains with lower energy consumption, lightweight structures, optimised aerodynamics, increased safety, greater comfort and less noise. We increase the effectiveness and efficiency of infrastructure utilisation with innovative approaches to managing road and rail traffic, shipping and intermodal transport, and airports. Our contributions to traffic management for large-scale events and disasters assist police and emergency services.

By holistically observing multi-modal transport development and its effects on the environment, the economy and society, the Transport programme is breaking new ground in examining the transportation system. Our systemic research approach allows extensive analyses and assessments and opens up unusual perspectives. The same is true of our research into electromobility and urban mobility. Alongside the details, it is the wider context and interactions, for example between land use, urban planning and transport in urban mobility, that create real added value. Some examples from the wide range of results of DLR's transport research in the 2014-2015 period are presented on the following pages.

Tomorrow's railways

Lighter and without overhead current collectors

Fast, safe, energy-efficient and comfortable – these are the expectations regarding tomorrow's railways. Against this background, researchers at DLR have constructed a lightweight carriage as part of the Next Generation Train (NGT) project. Consistent and comprehensive use of lightweight construction techniques can reduce carriage body mass by up to 30 percent compared to traditional models. Today's carriage bodies are made mainly of aluminium and steel, and impact significantly on a train's total mass. Mass and design of the carriage body also affect many other components, such as running gear or interior design. A lighter carriage body allows for entirely new train concepts: specifically, longer carriages with fewer axles and running gears. But carriage building is not the only area where new ideas are being explored. A study by researchers at DLR and the University of Stuttgart has shown that as an alternative to current collectors, trains could also be supplied with power contactlessly through induction loops in the track bed. The results of the study indicate that this method of energy transfer could supply even high-speed trains with the necessary electrical power.

Alongside better aerodynamics and less noise, a major advantage of inductive energy supply is that it is impervious to weather conditions.

During storms, falling trees regularly cause significant damage to overhead lines, severely obstructing rail traffic. That trees fall on tracks is impossible to prevent, but routes without overhead lines would have the advantage that they could be quickly cleared after a storm and made passable again at short notice, often without requiring repairs.

Concepts for the Next Generation Train family

AIM

A city becomes a laboratory

AIM research intersection in Braunschweig

When it opened its large-scale research facility Anwendungsplattform Intelligente Mobilität (applications platform for intelligent mobility, AIM) in Braunschweig on July 17, 2014, DLR turned an entire city into a laboratory. Transport researchers from DLR, other research organisations and businesses can use AIM to develop, examine and test new technologies for driver assistance systems and transport management. Alongside vehicle traffic, the behaviour of cyclists and pedestrians can also be analysed with the help of video cameras and radar systems. These analyses focus in particular on critical traffic situations, for example when drivers turning right cross paths with pedestrians and cyclists. The movements of road users are systematically recorded, anonymised and evaluated in terms of their risk potential, among other things.

A major advantage of AIM is that data from different sources and facilities can be combined. For example, data from a research intersection, which reflect general traffic flow, can be compared to those from individual vehicles. AIM thus provides an opportunity to first safely trial traffic situations and new technologies through laboratory simulations and then implement them in real urban traffic. In this way the research platform supports a phased transfer of scientific findings into reality.

Presentation of the "Best Originality Award" in Taiwan

Transport Research

Internationally successful

DLR transport researchers have won several international awards for their work. For a joint project with Nanjang Technology University (NTU) in Singapore they received the Best Originality Award from the TECO Technology Foundation. The award recognised their development of a climate compressor for electric vehicles, for which a patent application has been submitted. The climate compressor is integrated directly into the electric motor, cutting down on components, weight and costs. At the same time, the kinetic energy that cannot be completely fed back when braking is routed directly to the climate compressor, further increasing its effectiveness. The award was presented in late August 2014 at the Teco Green Tech International Contest in Taiwan.

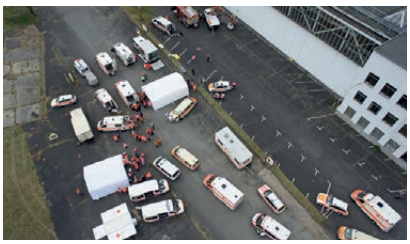
Also in Asia, DLR received the JEC Asia Innovation Award 2014 in the Storage category. DLR's award-winning cellular tank is an innovative, adaptable natural gas tank made from fibre-reinforced plastics. Its modular structure consists of several cylinders, or cells; these cylinders do not have be round but can be produced in a range of shapes, allowing optimal utilisation of the available space within the vehicle and increasing tank volume and vehicle range by approx. 30 percent. DLR is breaking new ground with the production process: in order to make it as lightweight as possible while maintaining the required safety level, the cellular tank is manufactured from fibre-reinforced plastics with a metal liner to prevent leaks. The award was presented in mid-November 2014 at the JEC Asia trade fair and conference in Singapore.

VABENE++

Realtime monitoring tested in practice

The VABENE++ project develops powerful support tools for emergency services and transport authorities. The aim is to be able to efficiently manage both emergency logistics and traffic flows in disasters or at large-scale events, even under extreme conditions, and thereby for example ensure that rescue services arrive quickly where they are needed.

In VABENE++, DLR researchers have for the first time successfully tested a new realtime-capable camera system for traffic monitoring from a helicopter. The high-resolution images and videos are processed on board the helicopter and transmitted directly to ground in seconds; the provided data allow traffic control centres to regulate traffic as required by the situation and guide emergency personnel optimally to the site of an incident.



The Medical Task Forces of the Federal Government conduct an exercise with VABENE++ in Lehnin

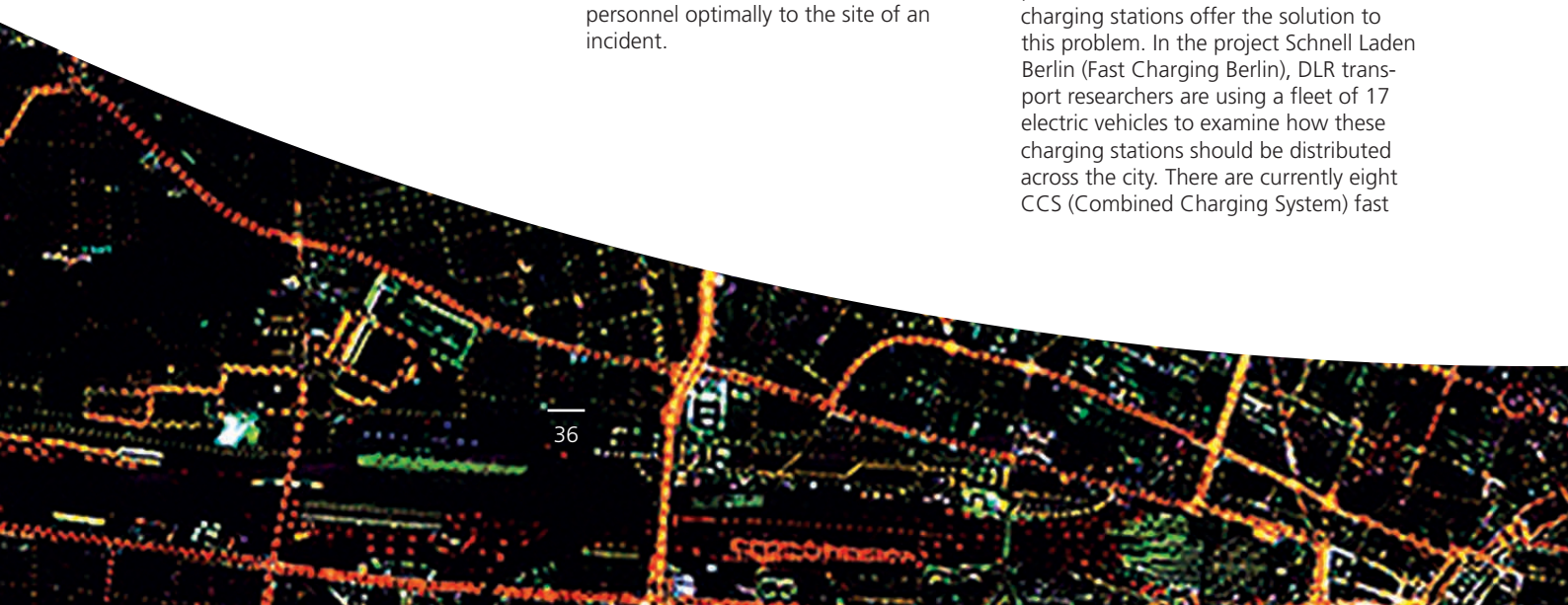
The new system has already been used in several major exercises. On October 25, 2014, for example, the Medical Task Forces of the Federal Government conducted a training exercise in Lehnin to establish how to provide the best possible care for injured persons in large-scale disasters; on April 25, 2015, DLR took part in an exercise of the Bavarian Red Cross.

But VABENE++ has also already proved itself during a real incident: rescue teams were on high alert during the G7 summit in Elmau, Bavaria, and had to be able to quickly travel to the sites of incidents in Munich and environs. DLR provided information on emergency vehicles, the current traffic situation in the Munich area and the fastest routes to incident locations.

CCS

Fast charging in Berlin

Being able to charge electric cars more quickly and at any time is a major requirement for users contemplating the purchase of an electric vehicle. Fast charging stations offer the solution to this problem. In the project Schnell Laden Berlin (Fast Charging Berlin), DLR transport researchers are using a fleet of 17 electric vehicles to examine how these charging stations should be distributed across the city. There are currently eight CCS (Combined Charging System) fast



Fast charging station in Berlin

charging stations in Berlin. These CCS charging stations are all in publicly accessible locations, for example at petrol stations or traffic intersections, and are powered by 100% renewable energy. In addition to the previous publicly accessible charging stations with alternating current, the new CCS stations add a direct current option. With two different plugs, the CCS system offers fast charging both with direct current (50 kilowatts) in less than 30 minutes and with alternating current (22 kilowatts) in approx. one hour. The project Schnell Laden Berlin is one of around 30 core projects in the Berlin-Brandenburg International Showcase for Electromobility. It is funded by the Federal Ministry for Economic Affairs and Energy. DLR is cooperating with RWE Effizienz GmbH, Daimler AG, TU Berlin and Volkswagen AG and others on this project.

InMoBS

Smartphone app helps visually impaired people navigate road traffic

How do blind people navigate traffic? How can we make it easier for them to get their bearings? On the project *Innerstädtische Mobilitätsunterstützung für Blinde und Sehbehinderte* (Intra-urban mobility support for the blind and visually impaired, InMoBS), DLR researchers worked with partners to develop an app that helps visually impaired people travel the streets more safely. Installed on a standard smartphone, the app informs users of their location or of nearby traffic lights, using voice and vibration to convey the information. Because the app communicates with traffic lights via WLAN, the smartphone can tell its user where the next intersection is and whether it has, for example, audible signals to aid the visually impaired, or a centre traffic island. The smartphone beeps when the traffic light turns green, which is helpful especially at crossings without audible signals. The app also uses vibration as a tactile signal, for example to keep users on the right path.

The app is not intended to replace traditional aids such as long canes or guide

Smartphone app with acoustic communication for visually impaired persons

dogs, but to complement them. Feedback and requests from visually impaired people were taken into account when developing the prototype.
There are however some issues regarding positioning reliability and the safety of the overall system that will have to be resolved before the app can be made available for everyday use. The project, which was funded by the Federal Ministry for Economic Affairs and Energy, was a collaboration between DLR and TU Braunschweig, Siemens AG, OECON Products & Services GmbH and TRANSVER GmbH; the German association of blind and visually impaired people, Deutscher Blinden- und Sehbehindertenverband (DBSV), and ITS Niedersachsen GmbH were subcontractors.

→ Quickfact on mobility 4.0

"Digitalisation is changing our lives and thus also our mobility. Big data – vast, ever-growing data volumes – and networking of smart products on the Internet of Things raise new potentials for increasing security, efficiency and comfort in transportation. Increasingly individualised mobility, networking of transport service providers into intermodal transport chains, automation of vehicles and transportation systems and the transition from vehicle- to service-oriented business models are trends of mobility 4.0."

Prof. Dr-Ing. Karsten Lemmer
Director of the Institute of Transportation Systems, Braunschweig and Berlin

Survey

Electric vehicles and their first-time users

In 2014, DLR questioned over 3,000 users of private and commercial electric vehicles for the largest survey of first-time users of electric vehicles in Germany to date. The detailed analysis of their responses provides new, comprehensive answers to the relevant questions: Who are the first-time users of electric vehicles? How are these vehicles used in everyday transportation? What limitations apply to their use, and how do users deal with these?

Most comprehensive survey of first-time users of electric vehicles

Electric vehicles for personal use are largely driven by well-educated male persons with higher incomes. At 51, their average age is higher than that of buyers of conventional new cars. Interest in the innovative vehicle technology and in reducing environmental impact are the main reasons given for buying an electric vehicle – by both private and commercial users. With a share of 87 percent, purely battery-powered vehicles represent the majority of electric vehicles in Germany. In terms of everyday personal use, the study found almost no differences between electric and standard vehicles.

Most private users charge their electric vehicles daily at their home. A surprising result of the survey: neither private nor commercial first-time users were particularly concerned about charging options on public roads. Overall they expressed high levels of satisfaction with their electrically powered new cars: 84 percent of private owners would recommend the purchase of an electric vehicle.

Level crossings

Greater safety through flashing lights

Accidents at level crossings are often severe: approximately one in four such incidents is fatal. Particularly at unguarded level crossings the risk of accidents is very high. DLR has therefore developed a system designed to increase drivers' attentiveness at these technically unsecured crossings and minimise the risk of accidents. Approximately 95 percent of accidents at level crossings are the result of errors on the part of road users; survey results gleaned by DLR have shown that the majority of road users fail to check for approaching trains at level crossings. The researchers have therefore developed a technical addition to the existing security features at unguarded level crossings: a gaze guidance system called PeriLight.

PeriLight is an LED flashlight source located alongside the tracks approximately 40 to 60 metres to the left and right of the level crossing. The system is automatically activated when a driver passes a sensor placed approx. 60 to 80 metres ahead of the crossing. The light flashes ten times, alternately white and pink – first on the left, a second later on the right –, thus drawing the road user's attention. PeriLight makes use of automated processes in human visual information processing: the flashing light in the road user's peripheral vision automatically draws his or her visual attention towards the light source, instinctively causing the correct behaviour at the level crossing.

Flashing light at level crossing to guide drivers' gaze

Tomorrow's Train Design Today

Aeroliner3000 wins competition

The global competition Tomorrow's Train Design Today invited engineers, designers and architects to develop innovative solutions to make Great Britain's railway system fit for the future. The focus was on high-speed travel and a timeline of 30 years. 48 submissions were received in all. In a multi-phase procedure, the Aeroliner3000 train concept developed by DLR and the architecture firm Andreas Vogel Studio won out against high-calibre competitors. As finalists, they will receive funding of approximately one million euros to refine their concept.

Aeroliner3000

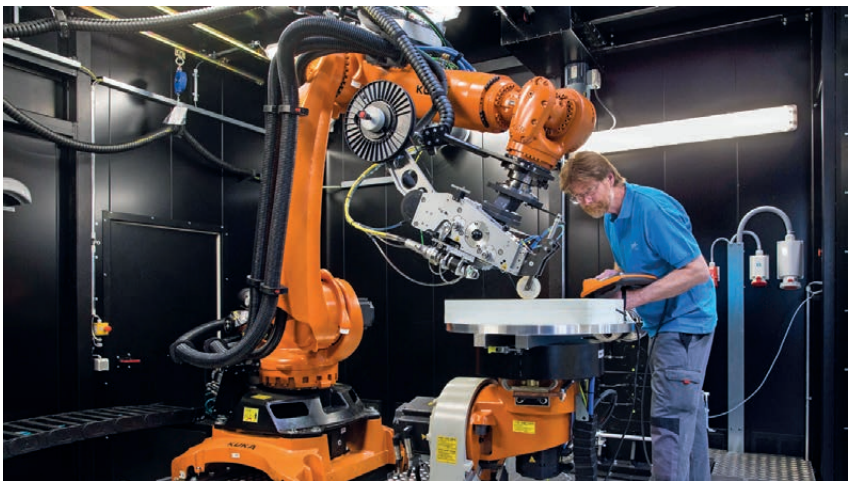
The Aeroliner3000 technology is based largely on the DLR train concept Next Generation Train (NGT), a project in which researchers from eleven DLR institutes conduct interdisciplinary research into central issues exploring how next-generation high-speed trains can be made even faster, safer, more comfortable and environmentally friendly. The partners will use their prize money to develop further details of the Aeroliner3000 concept and build a demonstration model of a middle carriage by the time the competition ends in 2016. The model will be used primarily to continue examining passenger comfort, and will also be exhibited at the international rail transport fair InnoTrans 2016 in Berlin in order to interest manufacturers in the concept.

High-performance plastics

New tape laying machine for component manufacturing

In the automotive sector, extremely lightweight but highly damage-tolerant components made of carbon fibre reinforced plastics are becoming increasingly important. With the help of a new, state-of-the-art facility DLR is now exploring procedures to automate and thus make production of such structures more efficient.

The system consists of a robot on a linear axis, a rotating axis and a rotary/tilt table. At the end of the robot arm is a special head that deposits a strip of fibre-reinforced plastic into a form, creating the desired component layer by layer. This strip of material, known as tape, consists of carbon-fibre reinforced thermoplastic, a special type of plastic that contains carbon fibres for greater rigidity and robustness. Thermoplastics can be moulded under heat and are also weldable, allowing the production of components that could not previously be manufactured with metallic materials alone.



Preparing the DLR tape layer for use

Tape laying is an additive process, meaning material is only laid down where it is actually needed. The component can thus be adapted to specific load profiles. This process produces less waste, making it particularly resource-efficient.

Many fibre-reinforced plastic structures are currently still produced largely by hand. With its new tape layer DLR is on the one hand unlocking the potential of thermoplastics, which represent a particular challenge in manufacturing due to the required high process temperatures; on the other hand, the device facilitates research into ways of automating the production of thermoplastic components.

Emissions

Towards a global calculation standard

How heavily goods transport affects climate is increasingly of interest to companies and consumers. In the search for a standard to calculate emissions along transportation chains, researchers at DLR and European partners conducted the EU project Carbon Footprint of Freight Transport (COFRET) to analyse existing approaches and tools.

Internationally, there are already over 100 different tools for calculating emissions along transportation chains. Negotiating this plethora of options is a major challenge for companies in the transport sector, in industry or retail as there is currently no binding, internationally applicable and accepted standard that takes all elements of the transportation chain into account.

Carbon Footprint of Freight Transport

The COFRET project, which DLR was responsible for coordinating, compiled, analysed and evaluated the various calculation approaches for transportation chains with regard to their compatibility with the existing rules. A particular challenge arose from the fact that transportation chains frequently span multiple countries or even continents. Gaps and ambiguities in the rules were highlighted and concrete solution approaches developed to increase the comparability of the different calculation methods. A concept for a working format in which these solution approaches could be refined and translated into a standard was additionally drawn up. Regular exchanges with the transport industry, logisticians and other stakeholders ensured the practicality of the results.

Outlook

A number of megatrends will define the living environment of people in Germany and Europe in the medium term: The population is slowly shrinking and ageing. People and economic power are increasingly concentrated in urban regions. Economic interdependency and international distribution of labour are expanding. The digitisation of vast areas of life is accompanied by increasing automation in production, services and transportation. Quality of life is becoming more important to individuals, demand for consumer goods is rising. Climate change is advancing, sources of traffic noise are multiplying. Transportation is becoming increasingly intertwined with energy and raw materials supplies. Pressure on public transport infrastructures is growing while funding has become precarious.

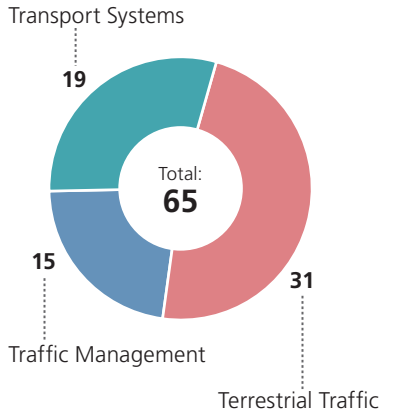
On the technical side, the opportunities created by increasing digitalisation are a major driver. Digitalisation enables better coordination of traffic activities and the integration of means and modes of transport, blurring the boundaries between vehicles, infrastructure and transportation systems as each becomes more and more dependent on the other. Highly and fully automated driving are examples of this trend. Seamless intermodal transportation chains, individualised public

transport or environmentally optimised transport management are not possible without comprehensive digital networking. At the same time, digital technology is creating easier access to mobility options such as car or bike sharing, and to comprehensive data sources that offer significant potential when opened up to innovative applications.

In view of the negative effects of transport on humans and the environment, it is mainly the challenges that act as drivers on the systemic side. Here it will be essential to minimise the conflict between facilitating high levels of mobility and keeping the impact of transportation as low as possible. This means: less resource consumption, better air quality, less traffic noise, limited climate change. Moreover, the number of extreme weather events is increasing due to climate change, significantly affecting the reliability of transportation systems. Reducing pollutant emissions and noise will therefore remain an important task in the long term, which alongside avoiding and shifting transport will require the development and use of new technologies. The DLR Transport programme is taking on these massive challenges in order to ensure that mobility remains sustainable in the best sense of the word – locally, nationally and globally.

Transport: Revenues in millions of euros	2014 Actual	2015 Planned	2016 Planned
Basic funding	46	48	52
Third-party funding	16	17	19
Total revenues	**62**	**65**	**71**

Expected revenues for the year 2015



All figures in million euros

Energy

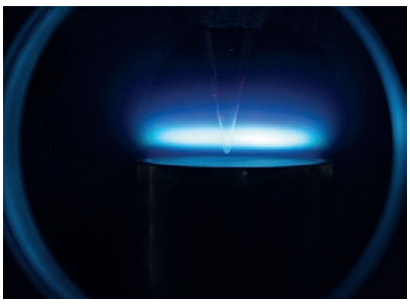
The German Aerospace Center has been successfully undertaking energy research for several decades and is valued as a competent stakeholder by its partners in research and industry. DLR is in some areas Europe's leading research organisation in the fields of environmentally friendly gas turbines, alternative fuels, electrolysis and fuel cells, solar thermal power plants and storage, while DLR's system analysis studies have contributed significantly to Germany's energy policies. Work on battery storage and wind energy was taken up in close coordination within the Helmholtz Association and with the Fraunhofer Gesellschaft. The subjects of DLR's energy research are widely interlinked with its work in aeronautics and space exploration as well as transport research. This applies in particular to gas turbine research in connection with jet engines, and to wind power, here in connection with helicopters and aircraft. Earth observation data enable systems analysis potential studies and the Lidar measuring technologies developed in the space programme, while contributions from the field of regenerative energies can be used for wind power prognoses.

PEPICO

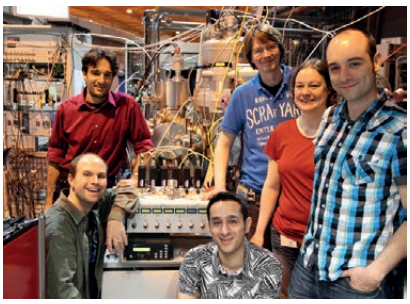
Innovative flame diagnostics

The growing importance of new storage and bio fuels requires state-of-the-art tools that are suited to the increased complexity of the specific combustion processes. A pioneering experiment to examine chemical reaction networks in flames was successfully carried out at Swiss Light Source (SLS), a synchrotron light source located at the Paul Scherrer Institute. Together with their cooperation partners in Switzerland and at the University of Duisburg-Essen, the DLR researchers succeeded in developing a new analytical tool to examine combustion processes and used it to explore questions in the fields of chemical storage and general pollutant generation.

In detail, the highly sensitive photoelectron photoion coincidence spectroscopy process, PEPICO for short, combines two specialised and highly sensitive diagnostic procedures. It requires high-energy vacuum ultraviolet (VUV) radiation which can virtually only be generated at particle accelerators. For use in combustion diagnostics, a specifically designed combustion chamber was taken into operation at the PEPICO spectrometer in order to directly observe the reaction processes in the flames. By means of a nozzle, a sample is taken directly from the flame and converted into a molecular beam via expansion, freezing the chemical reactions. Highly reactive species are thus preserved and are detectable. The species in the molecular beam are ionised with VUV radiation and analysed with the PEPICO method. The PEPICO team was the first to successfully apply this technique to flames.



Laminar flame



The PEPICO team

The new tool enables a comprehensive chemical analysis of the wide range of intermediate products in combustion processes, which is not possible with other methods. Future research will focus on fuel radicals for the first steps in kinetic decay processes in new (bio) fuels and on achieving a generally better understanding of pollutant generation. This work on the DLR Institute of Combustion Technology's core subjects of fuels and pollutants combines scientific basic research procedures with societally relevant issues.

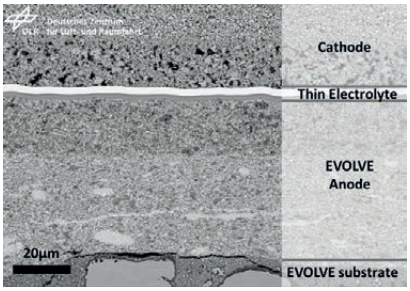
The Swiss Light Source hall with the PEPICO end station

High-temperature fuel cells

A new, innovatively structured generation of cells

Solid oxide fuel cells (SOFCs) are energy transformers with the unique property of combining outstanding electric efficiency of up to 60 percent with vast fuel flexibility ranging from renewable to conventional fuels. SOFCs require no precious metals in their electrodes and are capable of processing not only pure hydrogen but also a vast range of other fuels such as carbohydrates, carbon monoxide and bio fuels. Moreover, these largely noiseless transformers have significant application potential for stationary use as network-independent units, as cogeneration plants, in domestic energy supply and for on-board energy supply in utility vehicles.

The EU project EVOLVE is developing a new cell architecture that combines the advantages of the previous cell generation, known as anode supported cells (ASC) and metal substrate cells (MSC), with innovative electric catalysts on the anode side. The aim is to create a cell with greater flexibility regarding on/off cycles and greater tolerance towards fuel impurities. As a major milestone at the project's half-way point, the DLR researchers were able to present a prototype that offered a power density of 350 mW/cm² at a temperature of 750 degrees Celsius and was capable of withstanding at least ten redox cycles that corresponded to the on/off conditions on the anode side without significant loss of performance (see above image). The technical challenge was solved with an electrolyte that is only 3 µm thick and absolutely impermeable to gas. This prototype thus represents significant progress compared to the ASCs and MSCs that are state-of-the-art today. The researchers are now focusing on analysing the long-term behaviour of the EVOLVE cell and on scaling up its size. Installing the cell in energy supply devices for practical demonstration purposes is a further step towards evaluating this new generation of SOFCs. The results are expected by late 2016.



REM horizontal section of an EVOLVE fuel cell

Cavity receiver

Examining wind effects on heat loss

In DLR's cryogenic wind tunnel, researchers from the DLR Institute of Solar Research are subjecting a model of a cavity receiver to extreme wind flows to measure their effect on the amount of heat lost by the receiver. In order to make the results applicable to a significantly larger, real receiver, the researchers first used liquid nitrogen to reduce the ambient temperature in the cryogenic wind tunnel to -173 degrees Celsius.

Model of a cavity receiver at the cryogenic wind tunnel in Cologne. The lines identify the wind flow calculated with the help of a computer.

The receiver at the tip of the solar tower absorbs the solar radiation reflected by thousands of solar mirrors and transforms it into high-temperature heat that can be used to generate electricity or as process heat. In a cavity receiver, the solar radiation enters a cavity through an opening and heats a heat carrier medium there. This also heats up the air in the cavity, which escapes through the opening and is replaced by cold air from the surrounding area. The more heat is lost in this manner, the higher the cost of the electricity generated or heat produced, as less electricity or heat is produced at the same level of investment.

Previous studies had already shown that inclining the receiver (see image at left) reduces heat loss. DLR's current experiments are for the first time also taking the effects of wind into account. Experiments in the cryogenic wind tunnel showed that the potential for improvement compared to a non-inclined receiver diminishes with increasing wind speeds. However, wind does not always negatively affect power plant effectiveness. In some cases, losses are lower at low wind speeds than without wind. The researchers were able to explain this effect with a natural air curtain: if the wind was deflected in a certain way at the opening of the cavity receiver, it prevented warm air from escaping. The project is currently examining the extent to which such an air curtain could be artificially generated at the receiver opening to increase efficiency.

QFly

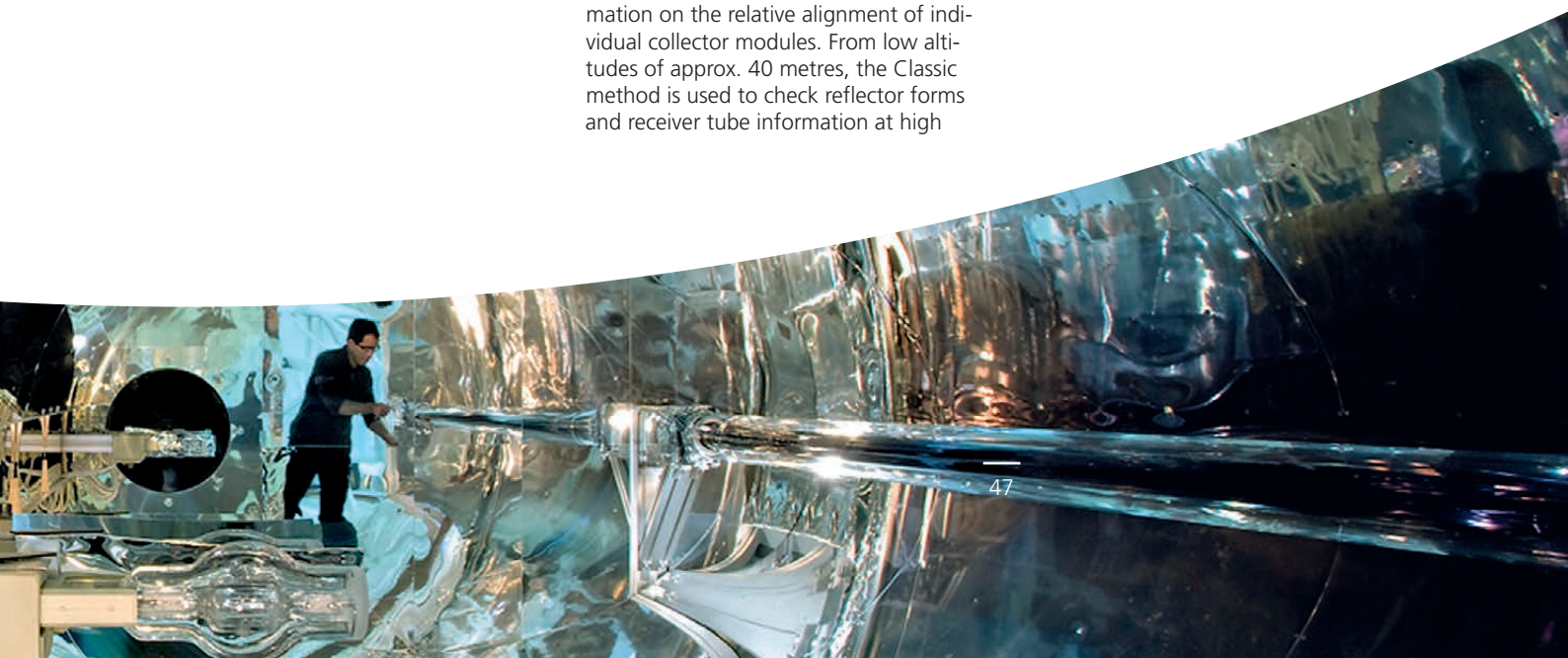
Measuring technique uses quadrocopter and special software to evaluate the efficiency of solar power plants

The collectors of a parabolic trough solar power plant transform solar radiation into high-temperature heat that is used to produce electricity. Assuming an appropriate location, the efficiency of the power plant is determined mainly by the functionality and condition of its components and their solar tracking capabilities. At the DLR Institute of Solar Research, DLR researchers are developing methods to measure components and systems of solar power plants.

A quadrocopter flies past a parabolic trough collector during a test flight at the Plataforma Solar de Almeria

Quadrocopter aerial image of a parabolic trough power plant

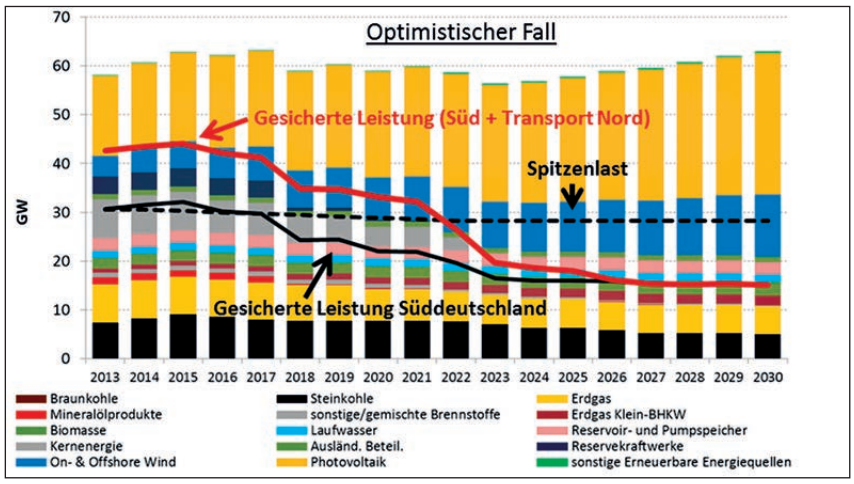
The QFly measuring technique allows the solar researchers to check the geometrical, optical and thermal properties of the solar field's collectors from above. A quadrocopter equipped with a camera flies over the solar field and records aerial images that are evaluated using software developed specifically for the purpose. Images from various altitudes in combination with appropriately adapted measuring methods deliver a range of information: From an altitude of up to 100 metres, the Survey method gathers low-resolution overview results and information on the relative alignment of individual collector modules. From low altitudes of approx. 40 metres, the Classic method is used to check reflector forms and receiver tube information at high spatial resolutions. The Thermo method employs a special thermal imaging camera and is used to detect heat losses that can identify receivers with damaged vacuum insulation. The QFly measuring method was developed and tested at the Plataforma Solar de Almeria (PSA) in southern Spain and has already been used successfully at commercial power plants. The DLR Institute of Solar Research offers QFly to power plant operators and component manufacturers as a service from its QUARZ® Center. At the QUARZ® Test and Qualification Center for CSP Technologies, the DLR Institute of Solar Research transforms research and development results into tailor-made services for industrial partners.



Security of supply in Germany until 2025

Study on behalf of the Baden-Württemberg Ministry of the Environment

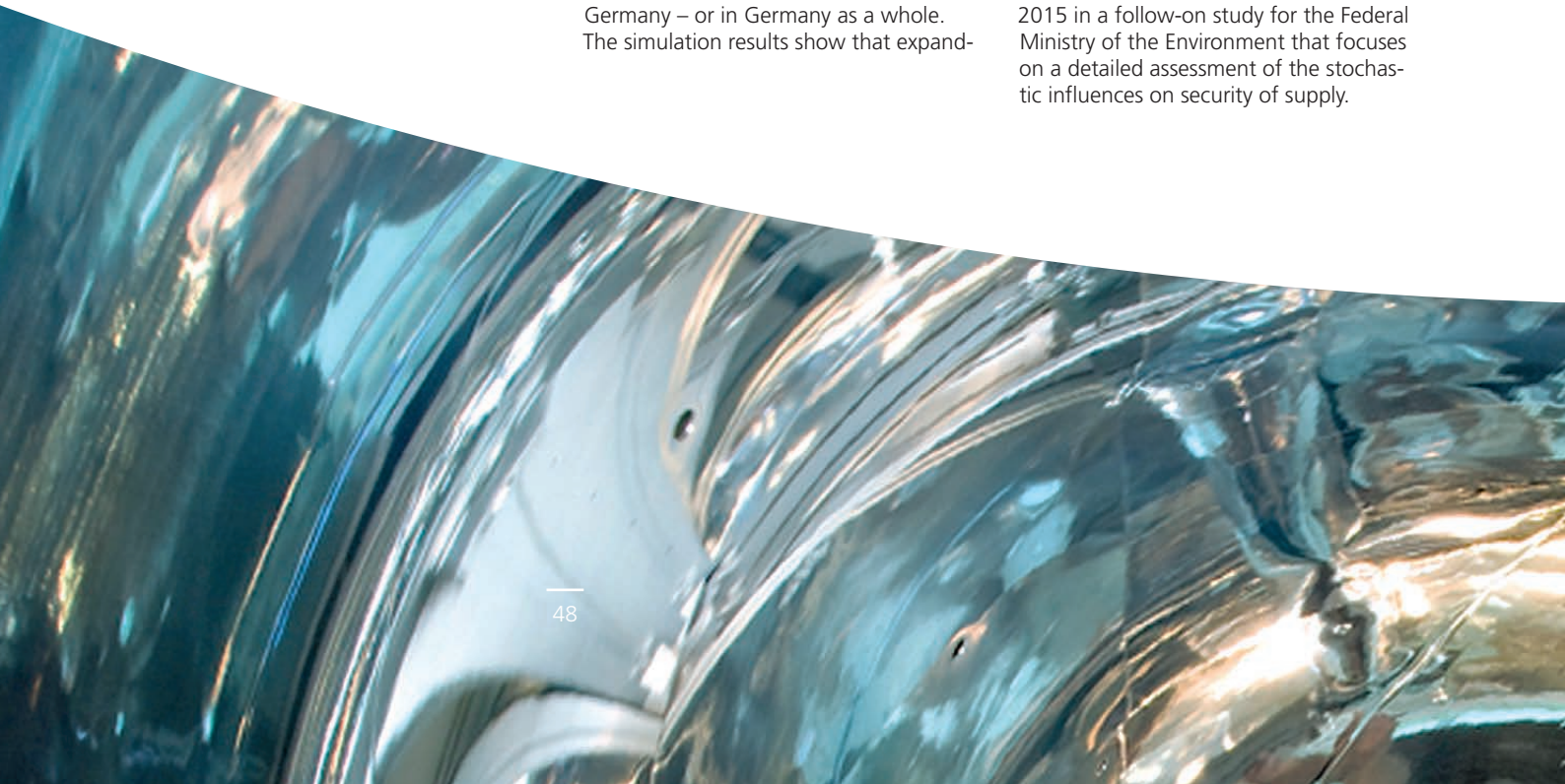
In the summer of 2014, the Systems Analysis and Technology Assessment department at DLR collaborated with the University of Stuttgart to create a study analysing the future development of secure power plant capacity and security of supply in southern Germany on behalf of the Baden-Württemberg Ministry of the Environment. The study examined when and where power outages may occur at times of high demand and low wind and solar power feed-in if no new power plants are built. The results of the study were based largely on the application of DLR's energy system model REMix, which simulates and optimises hourly energy demand, the use of power plants, storage and electricity networks for a chosen area – in this case Germany and its neighbouring countries. The model was applied to two scenarios, of which one assumed favourable and the other unfavourable development of power plant availability. Future security of supply in the period from 2015 to 2025 was analysed for both scenarios.



Comparison of expected peak load in southern Germany and the development of installed and securely available power (with and without imports from northern Germany)

The study results show that without additional power plants, the worst case scenario would already see bottlenecks occurring during periods of high demand in the winter months of 2018. In the more favourable scenario of longer power plant lifetimes and faster expansion of renewable energies, the expected power plant output in Germany will be high enough to ensure security of supply at all times until the end of 2021. Without building new power plants or extending the lifetime of existing power plants, the secured level of supply will from a certain point in time no longer suffice to autonomously cover peak demand in southern Germany – or in Germany as a whole. The simulation results show that expanding networks in Germany and Europe can significantly reduce potential output deficits and delay the need for new capacities for a few years, but without further measures, it will not be able to fully prevent output deficits. Germany will therefore require additional secure energy supplies by 2022 at the latest, be it through new power plant capacities or by modernising existing plants. Increasing flexibility of demand through demand management or investments in storage are also possible solutions for providing secure power.

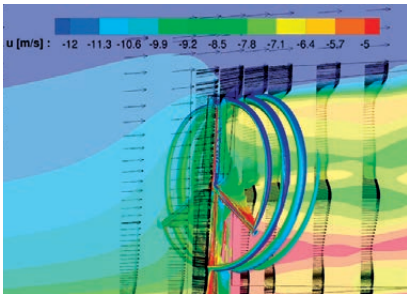
Research into this issue is continuing in 2015 in a follow-on study for the Federal Ministry of the Environment that focuses on a detailed assessment of the stochastic influences on security of supply.



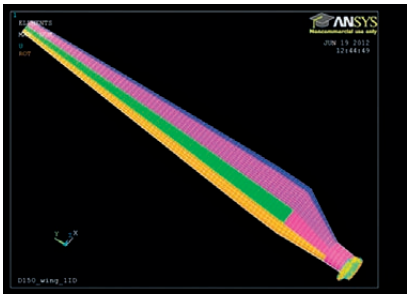
MERWind

Multidisciplinary design principles for rotors for wind power plants

Modern wind power plants represent a complex product for transforming mechanical into electrical energy. Developing these systems therefore requires design and analytical methods capable of already precisely predicting a system's behaviour across a broad range of operating conditions during the development process. Collaboration between different disciplines is paramount here. The MERWind project is therefore developing an interdisciplinary simulation environment for wind energy power plants that will use automated parametric studies to support the derivation of potential improvements during the interdisciplinary rotor design process. The methods applied go beyond the industry-established standard and thus permit precise performance and load predictions, the examination of innovative designs e.g. for long narrow blades and the analysis of plant dynamics and stability. For aerodynamics, a CFD process based on RANS equations is used to simulate the effects of the atmospheric boundary layer. The structure is designed with the help of a Finite Element (FE) model. To calculate blade deformation and the system's aeroelastic behaviour, aerodynamic forces are exchanged using a multi-body simulation program and the system's movements and deformation returned to the flow solver. A computational aeroacoustic (CAA) process is used to determine the system's acoustic properties, while manufacturing and cost aspects are considered in a cost module developed based on measurements.



Aerodynamic system simulation with atmospheric boundary layer profile



Finite element model for sizing the structural model

➔ Thinking energy forward

DLR Energy Research at Hanover Trade Fair 2015

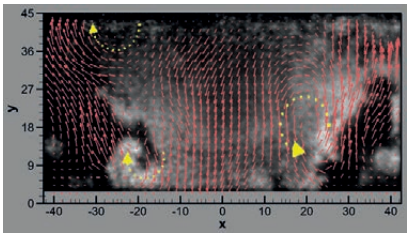
Batteries and fuel cells for the vehicles of tomorrow, solar thermal power plants, heat stores or intelligent blades for wind power plants – there are many approaches to making the energy supply of the future cleaner and more sustainable. At this year's Hanover Trade Fair, the Energy research programme of the German Aerospace Center for the first time presented some of its current projects as part of a broader DLR exhibition (together with DLR Technology Marketing). The projects showed that the spectrum of ***energy research at DLR*** *ranges from basic research to concrete industrial applications. There was significant interest from attendees, and our researchers had many interesting and ground-breaking discussions.*

BIGH2

Climate-friendly gas turbine combustion chamber with hydrogen

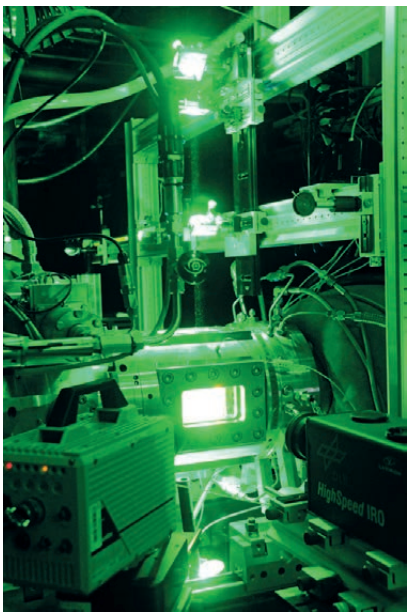
Hydrogen (H_2) can be considered a climate-friendly fuel, as it produces nothing but steam during combustion. It can be generated from excess energy from wind and solar power plants and is produced by the separation of CO_2 when gasifying fossil fuels. These promising concepts have caused the gas turbine industry to examine how their combustion chambers respond to the admixture of H_2.

As hydrogen is far more reactive than natural gas, the development of new gas turbine burners that can safely burn fuel with a high proportion of H_2 is necessary. To this end, the BIGH2 project was initiated in 2007 by the Norwegian research organisation SINTEF in collaboration with the DLR Institute of Combustion Technology and Alstom. The project is funded by the Norwegian government organisation Gassnova and the Federal Ministry for Economic Affairs and Energy.



Simultaneous measurement of instantaneous flow field (arrows) and OH radical concentration (dark = cold unburnt gas, light = flame, grey = hot exhaust gas). Measurements show the interaction of vortices (yellow arrows) with the flame.

The aim of the project is to develop new burner concepts for efficient use of hydrogen in gas turbines based on a fundamental understanding of the involved processes and the use of state-of-the-art numerical simulation tools. Based on fundamental experiments on fuel mixtures and simulation models optimised specifically for hydrogen combustion, new burner concepts were developed in the second project phase. The DLR Institute of Combustion Technology focused on the detailed examination of a range of burner concepts both atmospherically and at the institute's own high-pressure test benches. To complete the second phase, a burner concept was selected and tested at HBK2 at DLR Cologne.



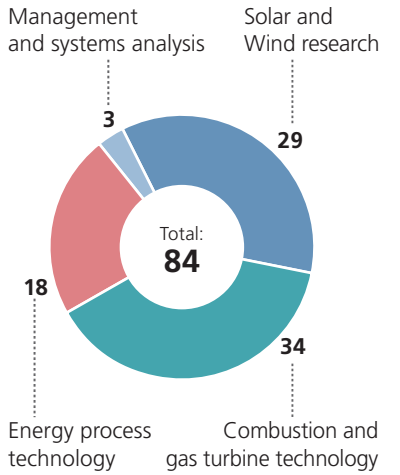
Measuring the flow field of a burner concept optimised for hydrogen using Particle Image Velocimetry (PIV) at the HIPOT (High Pressure Optical Test rig)

Outlook

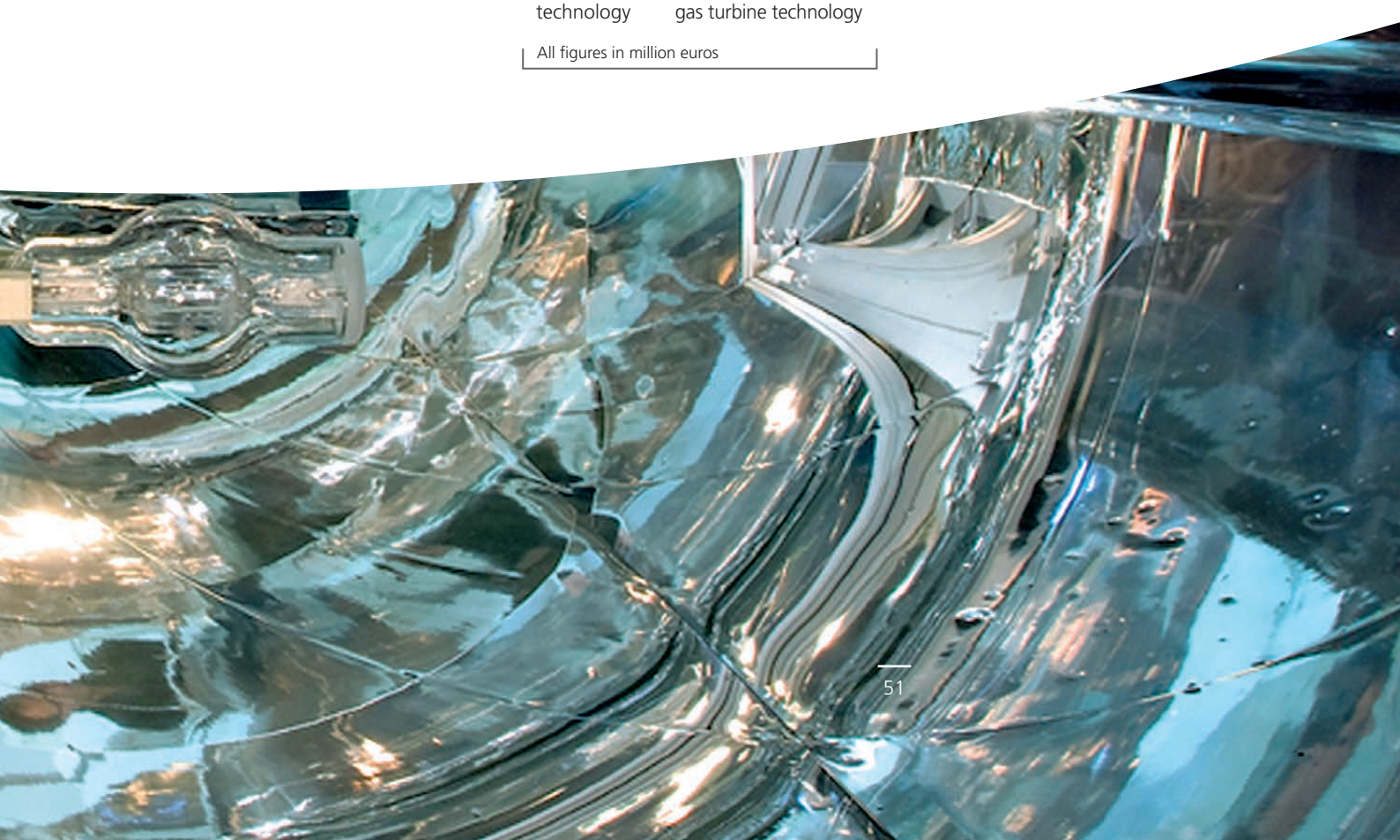
The energy transition is entering a new phase. The introduction of renewable energies has so far been characterised by feed-in tariffs and economies of scale without considering steering aspects. The focus is now no longer on the amount of energy uncontrolledly fed in, but on intelligently implementing further expansion to ensure that a secure and affordable energy supply is maintained. For research this means concentrating more strongly on system-related aspects. At the technological level, the most significant factor is the interaction between the wide range of intelligently controlled devices supplying and consuming electricity; but to further shape the energy transition decision-makers will also require tools enabling them to make the right decisions with regard to the specific properties of the various technologies.

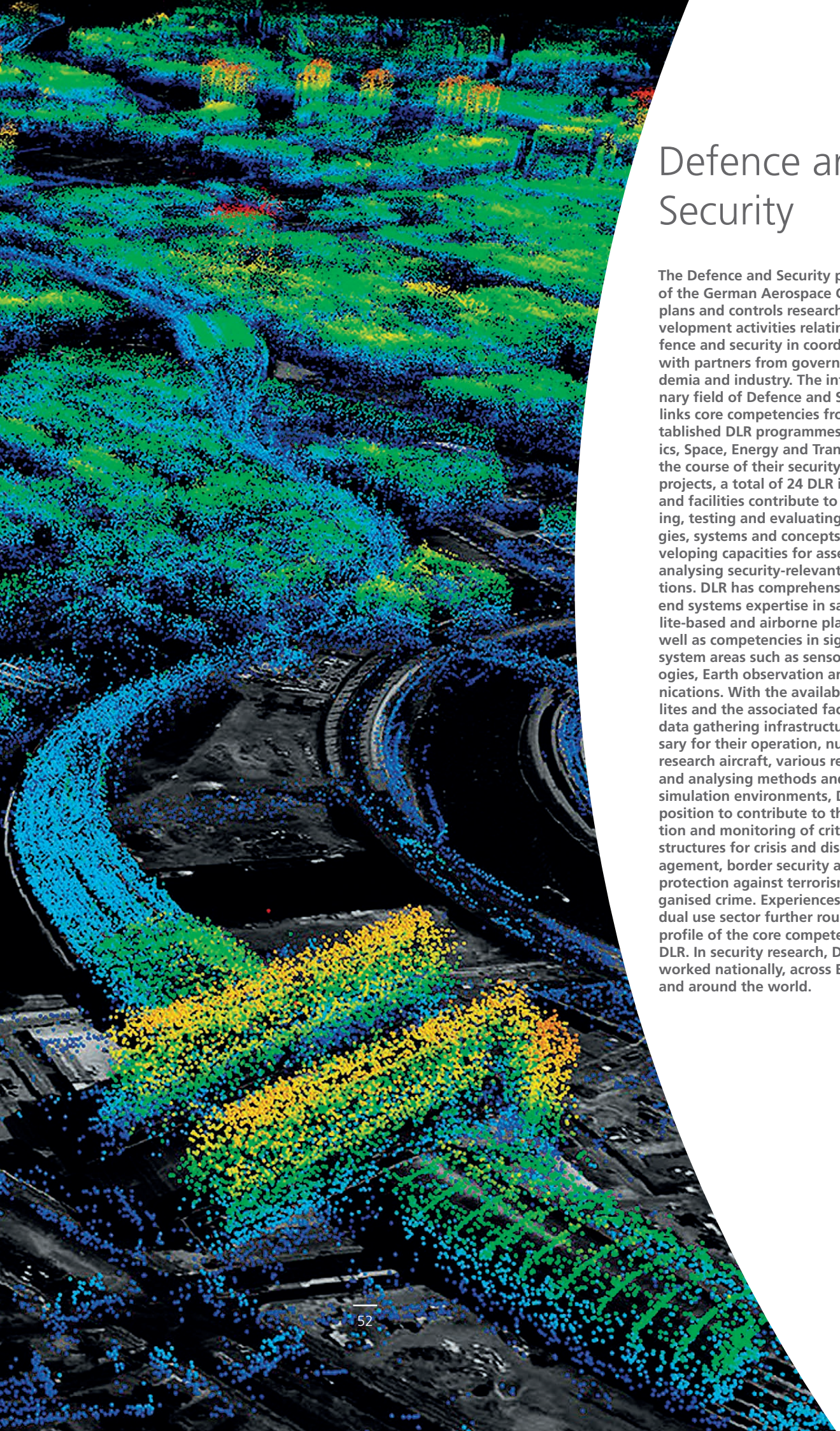
Energy: Revenues in millions of euros	**2014 Actual**	**2015 Planned**	**2016 Planned**
Basic funding	31	32	33
Third-party funding	44	52	54
Total revenues	**75**	**84**	**87**

Expected revenues for the year 2015



All figures in million euros





Defence and Security

The Defence and Security programme of the German Aerospace Center plans and controls research and development activities relating to defence and security in coordination with partners from government, academia and industry. The interdisciplinary field of Defence and Security links core competencies from the established DLR programmes Aeronautics, Space, Energy and Transport. In the course of their security-relevant projects, a total of 24 DLR institutes and facilities contribute to developing, testing and evaluating technologies, systems and concepts and to developing capacities for assessing and analysing security-relevant applications. DLR has comprehensive end-to-end systems expertise in satellite-based and airborne platforms as well as competencies in significant system areas such as sensor technologies, Earth observation and communications. With the available satellites and the associated facilities and data gathering infrastructures necessary for their operation, numerous research aircraft, various recording and analysing methods and special simulation environments, DLR is in a position to contribute to the protection and monitoring of critical infrastructures for crisis and disaster management, border security and protection against terrorism and organised crime. Experiences from the dual use sector further round off the profile of the core competencies of DLR. In security research, DLR is networked nationally, across Europe and around the world.

Its research activities support Germany's position in European and international competition. The strategic alignment of DLR's cross-departmental Defence and Security programme is determined against the backdrop of national and a future European security and defence policy, while also taking into consideration capability profiles defined at an international level and aimed at protecting the population and ensuring peace.

The objective of DLR's security research is to develop strategies to protect basic national values and those of the European area against threats such as organised crime, terrorism, natural disasters and industrial accidents. Its main research fields also include developing and enhancing security systems, analysing existing infrastructures, in particular border crossing points, and developing emergency strategies. This work is conducted against the background of a free, equitable and safe Europe and with a view to protecting the privacy and civil rights of individuals. The following European key research areas are derived from this long-term objective:

- Civil defence
- Security of infrastructures and supply
- Intelligent surveillance and border security
- Ability to restore security in the event of a crisis

Of these, DLR mainly works on the security of infrastructures and supply and on the ability to restore security in the event of a crisis, with the aim of contributing to the above-mentioned key areas through its research. In addition, DLR provides procedures and facilities for demonstrating, testing and evaluating relevant technologies; these are designed to serve advisory purposes and maintain and expand analysis and evaluation capacities for political decision-makers and state users (Federal Criminal Police Office, Federal Office of Civil Protection and Disaster Assistance, Federal Office for Information Security etc.).

Maritime security animation

In addition, DLR manages the activities and coordinates the research of the DLR research association Maritime Security with the aims of bundling and expanding existing competencies to aid maritime security and identifying new and innovative approaches to effectively and efficiently handling maritime security tasks. The overarching goal of these activities is to conduct interdisciplinary, application-oriented basic research in order to support end users mainly in public authorities in meeting their broad and challenging range of responsibilities.

In the field of defence, departmental research forms a bridge between science, society and politics. Its main tasks are advisory and research-based work for the Federal Ministry of Defence (Bundesministerium der Verteidigung, BMVg) as a basis for the ministry's administrative and political decisions. DLR's defence research contributes significantly to these in order to meet the needs of the Federal Armed Forces for military capabilities and close gaps in those capabilities over the medium and long term. This requires DLR to provide both quickly accessible scientific competencies and the ability to work continuously on longer-term issues. Defence technology research is always based on existing research results (add-on principle) and employs dual-use technologies.

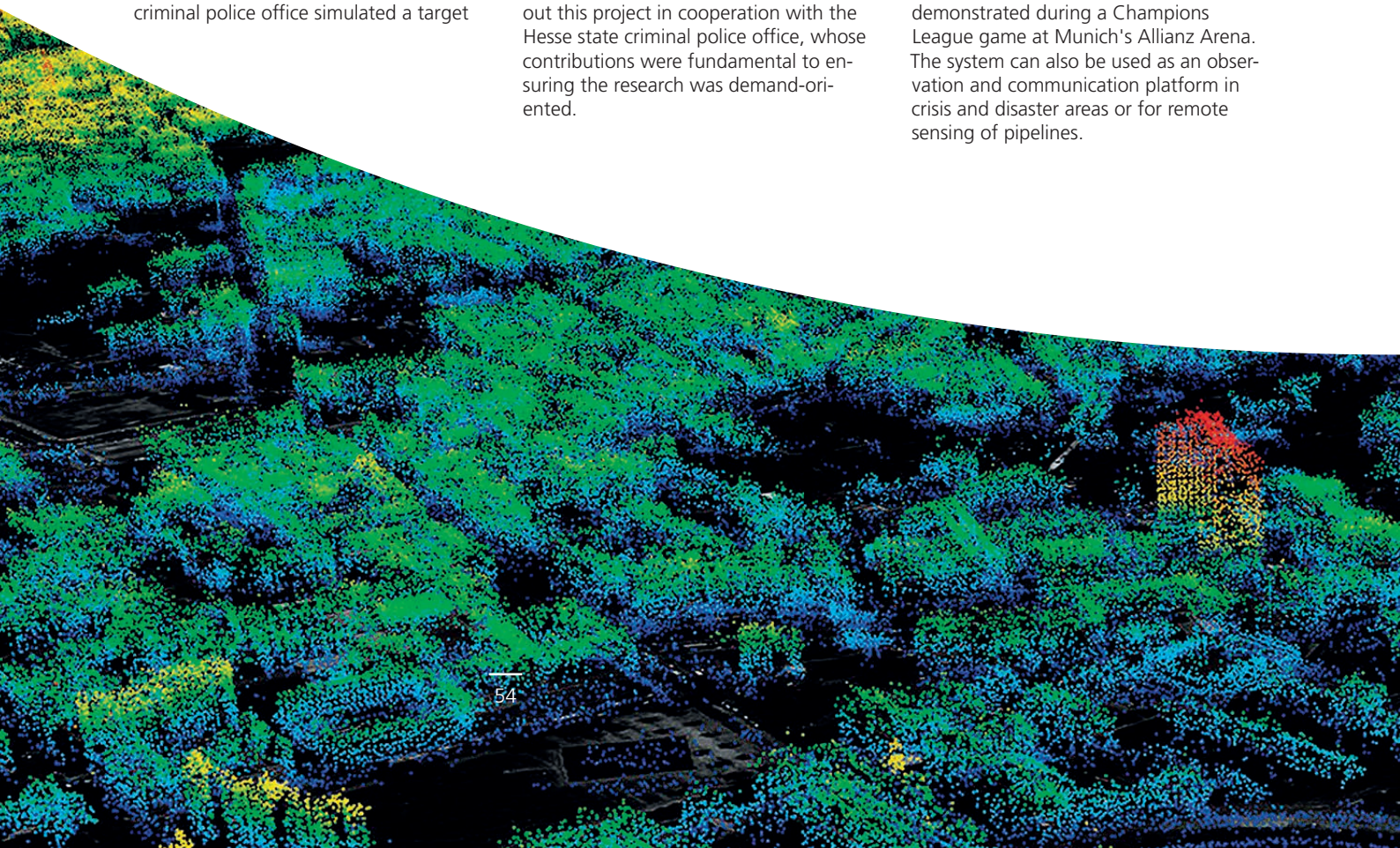
Civil defence research

DLR examines observation system with motorised glider

In law enforcement, in cases of abduction, drug trafficking or surveillance of preparations for terrorist activities, high-resolution real-time aerial images transmitted live to task forces on the ground are required. The helicopters mainly used by the police are very loud and conspicuous when pursuing suspects, and moreover very expensive to procure and operate. The CHICAGO (Echtzeitfähige verdeckte Fahrzeugverfolgung zur polizeilichen Observation – Real-time capable covert vehicle tracking for police observation) project therefore used the DLR motorised glider Antares as an alternative platform for test flights. Antares was equipped with special camera technology and image processing software developed specifically by the DLR Institute of Remote Sensing Technology for this purpose; the live aerial images were transmitted via microwave data link. During the demonstration flight with Antares a test vehicle of the Hesse state criminal police office simulated a target vehicle, travelling along a motorway at up to 210 km/h and making unplanned stops at rest areas. The motorised glider was always able to follow the vehicle and proved so agile that it was even capable of keeping up with changes of direction across motorway junctions. DLR carried out this project in cooperation with the Hesse state criminal police office, whose contributions were fundamental to ensuring the research was demand-oriented.

Camera system under the wing of the DLR motorised glider Antares

Possible uses for the system developed by the project go beyond tracking vehicles. It can for example also be used in the management of large-scale events to record large crowds of people or as a relay station for radio transmission, increasing security there. This application was demonstrated during a Champions League game at Munich's Allianz Arena. The system can also be used as an observation and communication platform in crisis and disaster areas or for remote sensing of pipelines.

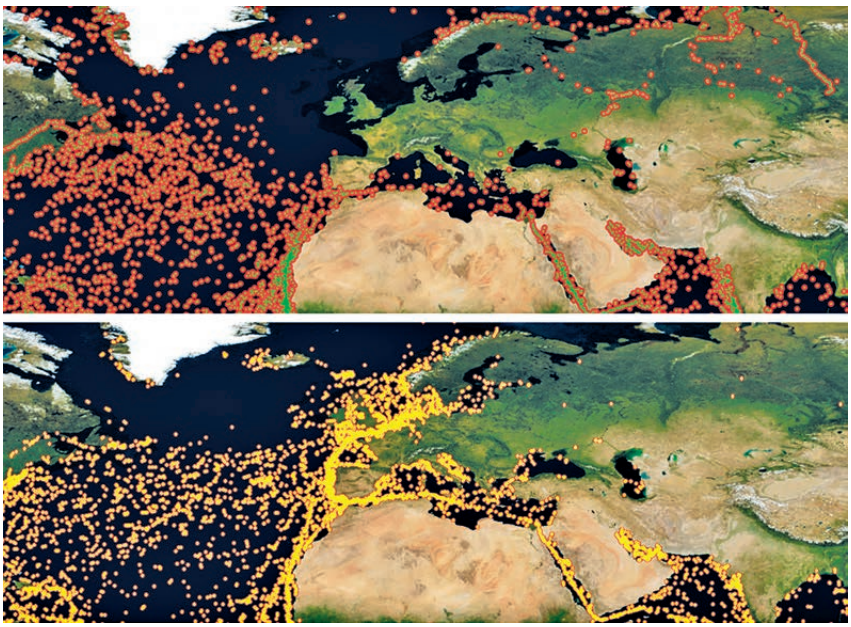


Maritime Security

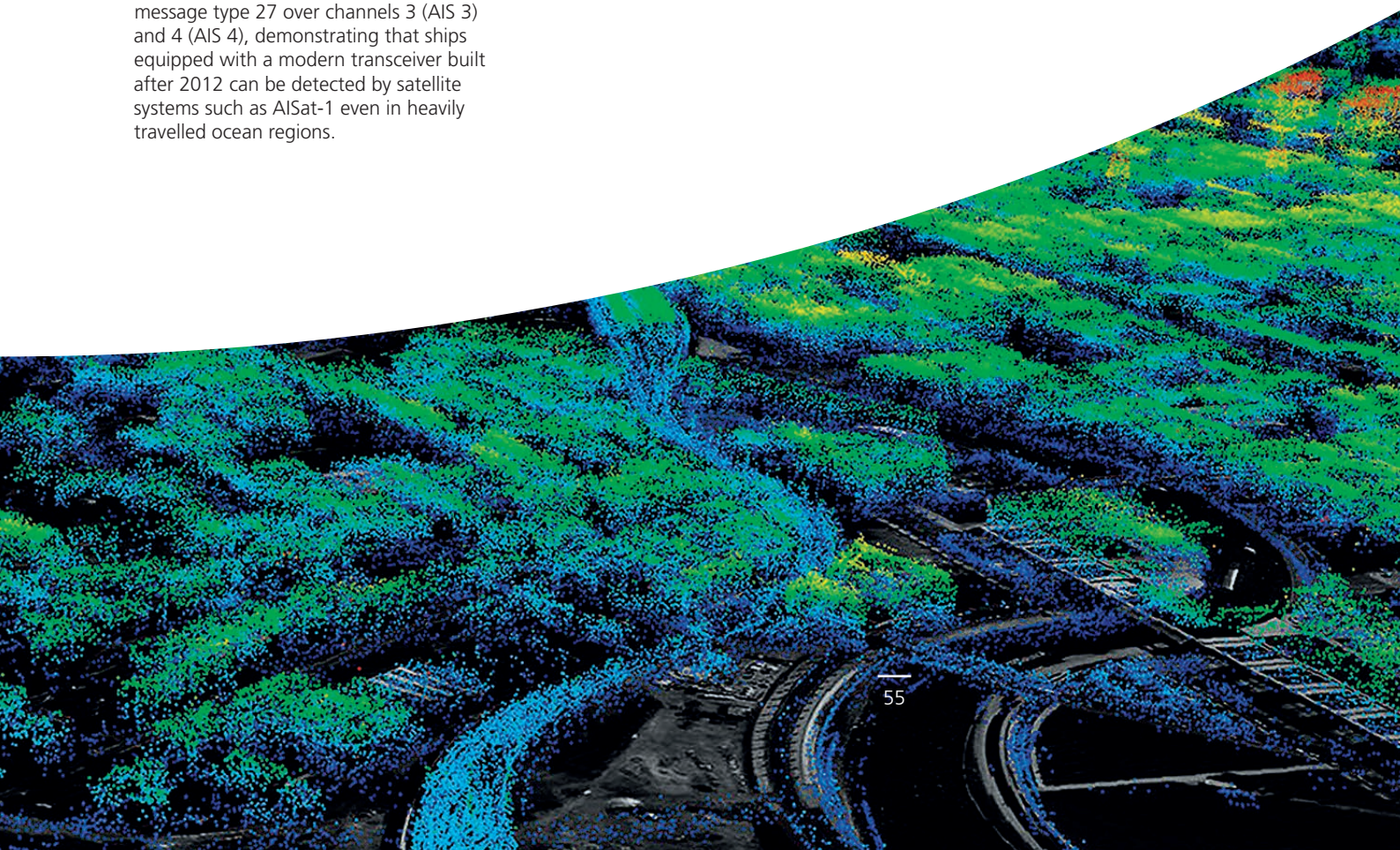
Possibilities and limitations of space-based observation

Maritime observation can ensure safe shipping, help protect oceans and coastal waters, and aid the authorities in combating illegal activities such as hazardous waste disposal at sea, illegal fishing or piracy. DLR is developing satellite platforms and thematic processors that are integrated into operational ground segments.

DLR's AISat-1 satellite, launched on June 30, 2014, is a technology demonstrator for monitoring global shipping movements. By default, the satellite receives and precisely locates AIS (Automatic Identification System) signals sent from AIS transceivers on board ships over channels 1 (AIS 1) and 2 (AIS 2). Multiple commercial satellites that receive AIS signals are already in use, but in heavily trafficked waters such as the German Bight or ports like Singapore the number of ships exceeds the listening capacity of these satellites. A complicated soft- and hardware update performed by the DLR Institute of Space Systems enabled AISat-1 to additionally receive AIS signals of message type 27 over channels 3 (AIS 3) and 4 (AIS 4), demonstrating that ships equipped with a modern transceiver built after 2012 can be detected by satellite systems such as AISat-1 even in heavily travelled ocean regions.



Ship positions on the northern hemisphere detected by the DLR AIS satellite AISat-1 over a period of more than four weeks. The top image shows little or no data reception (channels AIS 1 and AIS 2) in the European area. The image below shows the main shipping routes between Spain and Germany and in the Mediterranean (channels AIS 3 and AIS 4).



DLR at UN workshop

Space technology for the benefit of Earth

Ahead of this year's International Astronautical Congress (IAC), the 24th Workshop on Space Technology for Socio-Economic Benefits took place in Toronto, Canada, from September 26 to 28, 2014. The workshop is a joint event by the United Nations (UN) and the International Astronautical Federation (IAF), and last year explored the question of how space technologies can contribute to solving urgent human challenges for example in healthcare or environmental protection. Key areas were the developing countries and the oceans with their global shipping traffic. DLR researchers debated with representatives of academia, business and society and presented their own solution approaches. Together with partners, DLR conducts research in the Maritime Security research association, contributing its expertise from the fields of aeronautics, space exploration and transport research. The DLR research association Maritime Security consists of four maritime safety and security labs at the DLR sites in Braunschweig, Bremen, Neustrelitz and Oberpfaffenhofen.

Container ship on the high seas; approx. 95 percent of long-distance goods traffic in global trade is transported by sea.

Major goals and developments in this research association relate to the use of marine resources, monitoring greenhouse gas and air pollutant emissions from maritime traffic or e.g. deriving meteo-maritime parameters such as swell, currents or wind conditions from radar satellite data (SAR). These data can then be used not only in shipping, but also for coastal protection or to determine and optimise sites for offshore wind power plants.

MA-RIKA

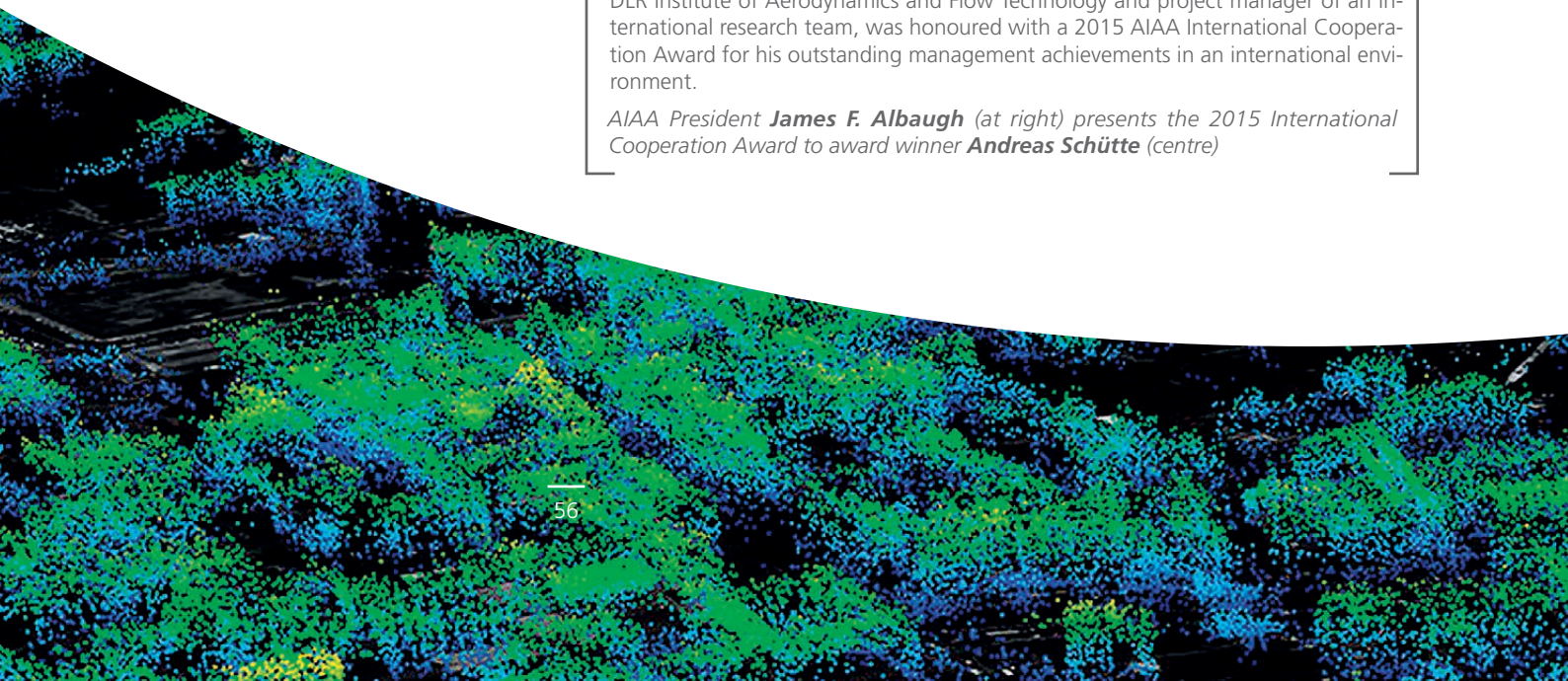
Rapid rescue in acute emergencies

Patients suffering strokes, heart attacks or other major injuries require fast assistance. To ensure optimal care, medical specialists and patients must be able to communicate and coordinate quickly. In cooperation with the University of Münster and the companies opwoco GmbH and metacrew consulting GmbH DLR is developing a communication system for emergency services and citizens. The main objectives of the MA-RIKA project are fast and easy communication pathways for medical specialists amongst each other and faster orientation of patients when searching for the nearest suitable hospital or specialised ward. An initial test phase in the Münster area was carried out successfully in March 2014; the researchers and developers are currently testing the communication system in cooperation with the emergency control centre in the Steinfurt area.

→ Security research – globally recognised!

What do we want to be? A globally recognised, well-known and leading centre! In the spirit of this guideline from DLR's overall strategy, the programme coordination office for security research has succeeded in winning the highest international cooperation award of the American Institute of Aeronautics and Astronautics (AIAA) for a DLR employee by strategically integrating DLR employees into international projects on security-related matters. Andreas Schütte, project manager at the DLR Institute of Aerodynamics and Flow Technology and project manager of an international research team, was honoured with a 2015 AIAA International Cooperation Award for his outstanding management achievements in an international environment.

*AIAA President **James F. Albaugh** (at right) presents the 2015 International Cooperation Award to award winner **Andreas Schütte** (centre)*



New communication options for emergency rescue and response

The application for specialists allows direct and fast contact between emergency medical responders on site and the responsible specialists who will continue treatment at the hospital and carry out any required surgery. Patients are stabilised under direct instructions of a specialist and admitted to a hospital that has capacities to continue their treatment. In addition, the hospital can have a surgery theatre prepared by the time a patient arrives. The project envisages that the emergency control centres assign patients directly to specialist departments. Every department (neurology – cardiology – trauma centre – paediatrics) is to have a special hotline where a specialist is immediately reachable. This ensures that patients are taken directly to the appropriate department with the involvement of the emergency control centre, reducing the amount of time lost due to unclear communication paths.

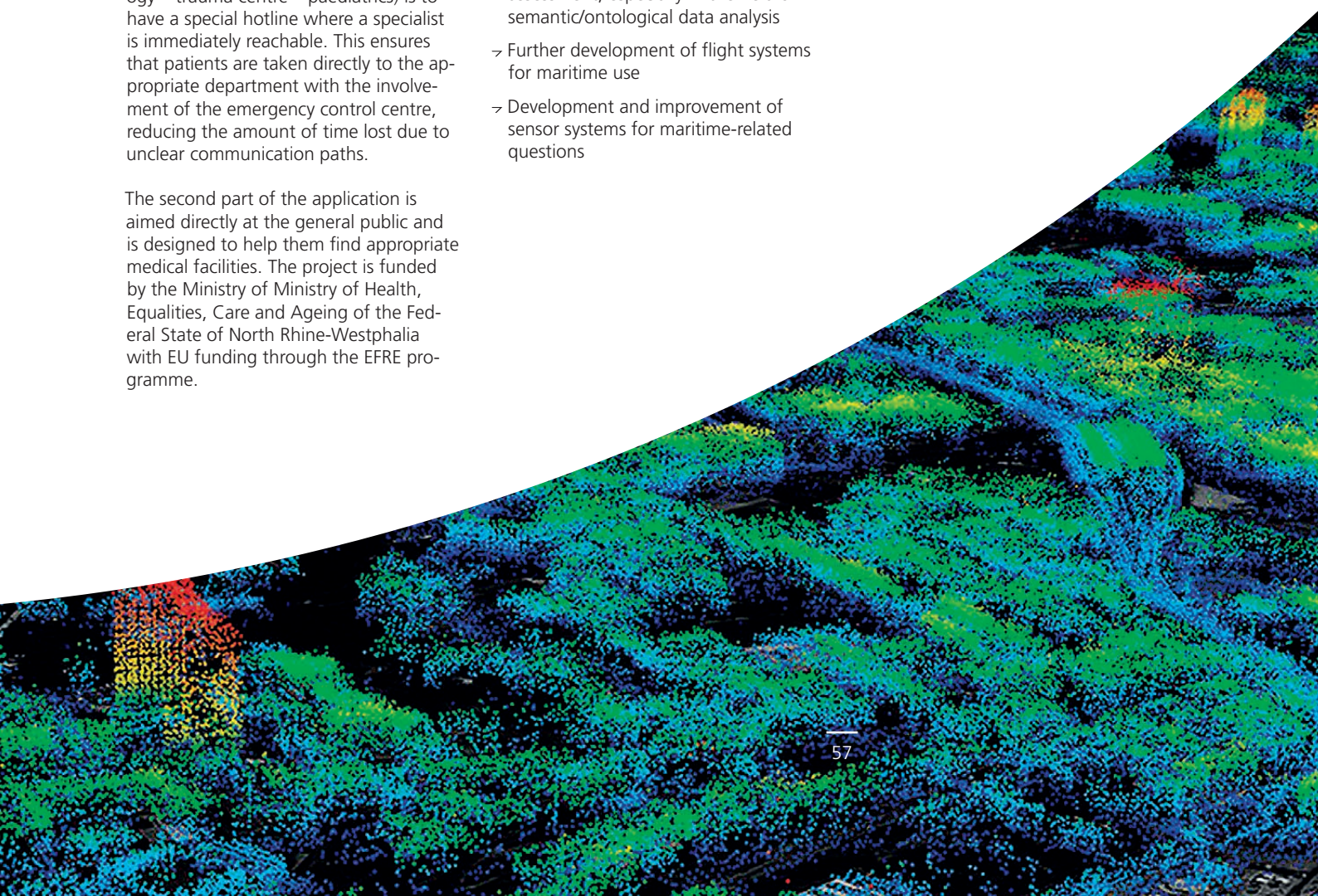
The second part of the application is aimed directly at the general public and is designed to help them find appropriate medical facilities. The project is funded by the Ministry of Ministry of Health, Equalities, Care and Ageing of the Federal State of North Rhine-Westphalia with EU funding through the EFRE programme.

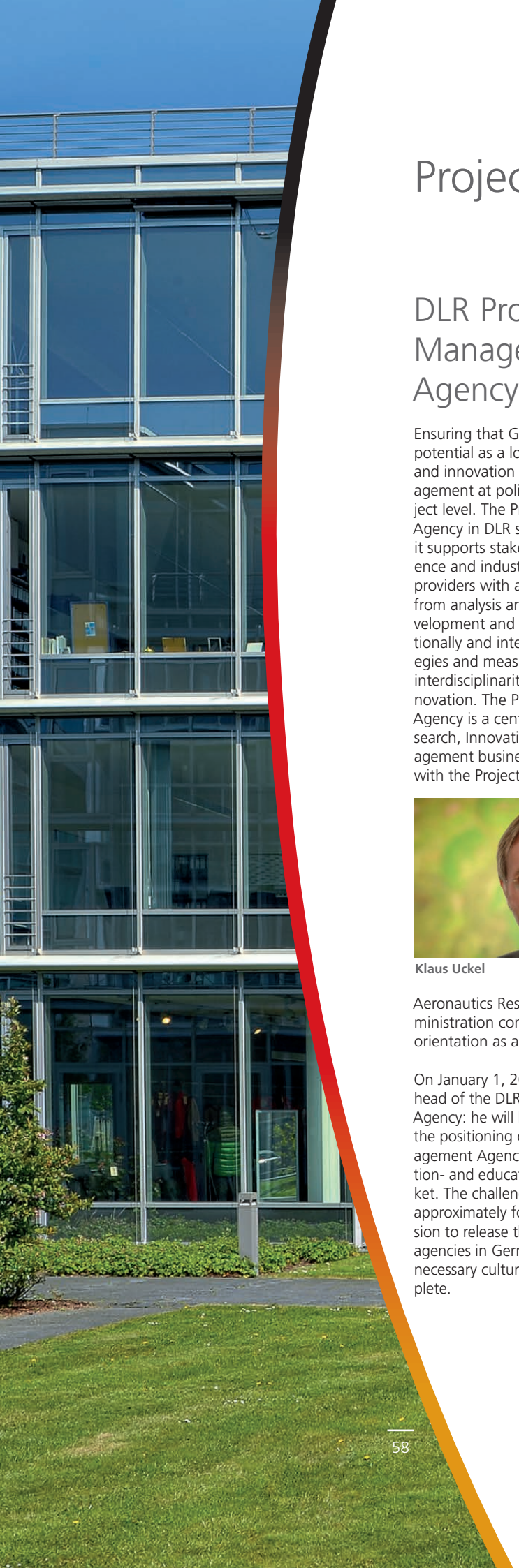
Outlook

In maritime security, DLR will be initiating the second project phase of the overall Maritime Security project for the years 2016 to 2018. From the point of view of DLR's Security and Defence programme coordination, the predominant aim of the research work will be to develop solutions to resolve the conflict arising between the increasing use and importance of maritime infrastructures and the resultant risks, dangers and threats. To achieve this aim, the research association Maritime Security will be focusing predominantly on innovative solutions in the fields of

- Terrestrial and space-based communication and navigation
- Air- and space-based remote sensing of maritime areas
- Data-based development of algorithms to expand maritime situation assessment, especially in the field of semantic/ontological data analysis
- Further development of flight systems for maritime use
- Development and improvement of sensor systems for maritime-related questions

To this end, the four Maritime Safety and Security Labs will be agreeing appropriate projects with the involved DLR institutes. In civil defence research, DLR will continue to expand its security research programme together with other centres in the Helmholtz Association in 2016. The activities of the Helmholtz Association have already set the scientific agenda in some areas of civil defence research and sparked major initiatives. Led by DLR, the HGF intends to strengthen not only its internal networking in the interdisciplinary subject area of civil defence research, but also its networking with external partners, in particular from academia, in 2016.





Project Management Agencies

DLR Project Management Agency

Ensuring that Germany achieves its full potential as a location for knowledge and innovation requires competent management at policy, programme and project level. The Project Management Agency in DLR specialises in exactly that: it supports stakeholders from politics, science and industry as well as education providers with a wide range of services, from analysis and consultancy to the development and implementation of nationally and internationally oriented strategies and measures, focusing mainly on interdisciplinarity, internationality and innovation. The Project Management Agency is a central pillar of the DLR Research, Innovation and Education Management business division and together with the Project Management Agency for

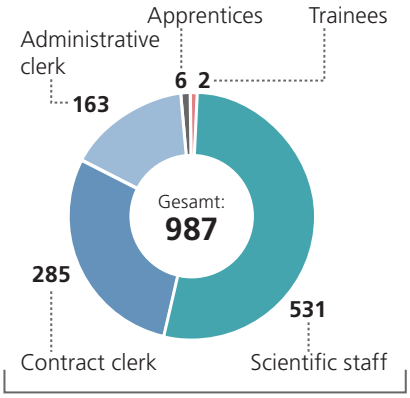
Klaus Uckel

Aeronautics Research and the Space Administration complements DLR's scientific orientation as a research centre.

On January 1, 2015, Klaus Uckel became head of the DLR Project Management Agency: he will be focusing primarily on the positioning of the DLR Project Management Agency on the research-, innovation- and education-related services market. The challenges are clear, and approximately four years after the decision to release the project management agencies in Germany into competition the necessary cultural change is far from complete.

Mr Uckel additionally intends to expand collaboration with the research divisions at DLR and create synergies in shared areas of activity such as innovation or European and international cooperation. Its identity as an integral part of DLR is reflected in the project management agency's name: since 2015, it has been known as the DLR Project Management Agency (DLR-PT). Together with the programme directors and research institutes, the potential for closer collaboration within DLR is being explored while taking the specific conditions applying to DLR-PT

Project Management Agency: Employees 2014



and the interests of its clients into account. Initial steps were taken in May 2015 with the Energy programme.

In 2014, the DLR Project Management Agency supervised 8,426 research projects and managed a total funding volume of one billion euros. With 987 employees, it is one of the largest project management agencies in Germany. The agency is headquartered in Bonn with further sites in Cologne and Berlin; it also has an office in Brussels. Its current clients include mainly federal and state ministries, the European Commission, foundations and associations.

The DLR Project Management Agency continued to expand its range of services in 2014/2015 and won numerous new contracts: The Federal Ministry of Education and Research (BMBF) awarded DLR-PT the contract for the Office for the

Federal Report on Research and Innovation; the report is drawn up in a strategic collaboration with the economics research and consultancy company Prognos. With its Education division the Project Management Agency is additionally implementing the joint teacher training quality campaign of the Federal Government and the federal states on behalf of the BMBF. The Project Management Agency was also commissioned by the BMBF to accompany the cross-disciplinary process to create a roadmap for research infrastructures; this work is led by the Environment division and predominantly entails the economic assessment of large-scale projects. Together with nova-Institut GmbH, the Project Management Agency was responsible as a subcontractor for organising the conference *Ressourcen schonen – biologische Vielfalt erhalten* (Save Resources – Maintain Biodiversity) on behalf of the Federal Ministry for the Environment and the Federal Environment Agency.

The Baden-Württemberg Foundation awarded a new project management contract on Industry 4.0, in which the Project Management Agency with its experts from the Key Technologies division is responsible for the organisational management of the programme and serves as the central point of contact for applicants. The Federal Ministry for Economic Affairs and Energy (BMWi) extended its project management contracts for developing convergent information and communications technology (ICT) and IT applications in business. The Federal Ministry for Economic Affairs and Energy was also impressed with the Project Management Agency's Innovation division and is supporting the go-innovativ programme module through the go-Inno funding programme, which provides innovation vouchers.

Its focus on European and international cooperation enabled the Project Management Agency to successfully acquire contracts from several clients:
For the Federal Ministry of Education and Research it set up the German coordination office for international researcher mobility. The National Contact Point for Health within the National Contact Point for Life Sciences is also managed by the DLR Project Management Agency; this contract was re-awarded in October 2014. The Project Management Agency also provides the ESFRI/large-scale facilities for basic research in natural science support office, which assists the ministry in setting up European research infrastructures. The DLR Project Management Agency was also successful in its ongoing contracts: the BMBF extended the current contract for the BMBF's International Bureau, the BMBF EU Bureau and the BMBF EUREKA/COST Bureau. In the European Framework Programme Horizon2020 the Project Management Agency was involved in ten successfully submitted new projects.

The Project Management Agency has further gained the Federal Joint Committee (Gemeinsamer Bundesausschuss, G-BA), the highest decision-making body of Germany's joint self-government of physicians, dentists, hospitals and health insurance funds, as a new client and will be supporting it with its health research expertise in the future.

From initial ideas through implementation to conclusion and follow-up: the DLR Project Management Agency is a reliable partner for research, innovation and education for its clients – as it has been for over 40 years now. Nationally, across Europe and internationally.

More information and a complete overview can be found in the 2014 annual report or at:

@ **DLR-pt.de**

Projects and funds managed in 2014	Number of projects	in millions of euros
Health research	1,622	197.3
Education research, integration, gender research*	1,603	308.7
Environment, culture, sustainability	1,507	207.8
Information technology	1,107	116.4
European and international cooperation	1,067	26.3
Technical innovation in business	768	91.6
Innovative capacity and research transfer	714	50.7
Scientific communication	38	6.4
Total	**8,426**	**1,005.2**

→ Advancing research, innovation and education

A selection of expertise

Analyses	Strategic Consulting	Funding Management	Research/Innovation Management	Communication, Dialogue	Further Training
Evaluations, studies, monitoring, FTI potential analyses	Policy-shaping, committee work, programme development, internationalisation Utilisation, structural consulting	Application advice, evaluations, approvals, finance management, monitoring funding success	Office, network management, project management, results exploitation	Events, online/print, science communication, dialogue formats/ networking	EU programmes, funding regulations

Project Management Agency for Aeronautics Research

Long-term funding for aeronautics research

The Project Management Agency for Aeronautics Research (PT-LF) supports the Federal Ministry for Economic Affairs and Energy (BMWi) in implementing the German Aeronautics Research Programme (LuFo), and the states of Bavaria, Hamburg, Lower Saxony and Brandenburg, which complement the federal programme with their own development programmes and projects.

In the Federal Government's Aeronautics Strategy, which combines the activities to create a powerful and environmentally friendly air traffic system, an important further implementation step has been taken with the second call for proposals in LuFo V. The overarching goal is to maintain internationally competitive conditions for the aeronautics industry and its research partners to aid them in strengthening and expanding their positions in light of intensifying global competition.

In civil research funding, the second call for proposals for LuFo V has further established the high funding level of approx. 150m euros annually, giving all participating research partners in the now four funding lines SMEs, Ecologically Efficient Aviation, Demonstration and the traditional, cooperative research projects of the Technology funding line sufficient planning security to implement their ideas along the entire innovation chain from basic research to demonstrating technologies that are ready for use. The new SME funding line further lowers the entry threshold to the LuFo programme for small and medium-sized enterprises. The aim in offering these targeted incentives is to integrate these companies in particular even more intensively into innovation and value creation chains, creating a framework in which their innovative potential can better unfold.

The Federal Government is thus providing companies, large-scale research institutions and universities conducting aeronautics research with the framework to develop urgently required technologies to application readiness. Alongside supporting ongoing funding projects, PT-LF's work in the reporting period focused on readying projects in all three funding lines of the call for proposals in LuFo V-1 for approval, and on conducting preparatory work for the next call for proposals, LuFo V-2.

Like the Federal Government, the federal states also maintained their efforts in the field of aeronautics research at a high level. The funding announced for the coming years will allow the participating federal states to effectively flank the activities of the Federal Government. PT-LF manages the vast majority of regional aeronautics research activities in the federal states of Bavaria, Brandenburg, Hamburg and Lower Saxony, which focus on key funding areas that complement the federal programme in order to strengthen regional aviation clusters and supplier landscapes.

The aeronautics research activities of the Federal Government and the federal states are embedded in the European Framework Programme. In order to ensure coordinated activities at regional, national and European levels, PT-LF has, on behalf of BMWi, assumed the role of National Contact Point for the field of aeronautics research in the 7th EU Framework Programme for Research and its successor programme Horizon2020.

In the current, third funding phase, the activities of the EU project AirTN – Air Transport Net – are being continued by the AirTN-NextGen project. After more than eight years as coordinator of AirTN,

GARTEUR
GROUP FOR AERONAUTICAL RESEARCH AND TECHNOLOGY IN EUROPE
FRANCE · GERMANY · ITALY · THE NETHERLANDS · SPAIN · SWEDEN · UNITED KINGDOM

Project Management Agency for Aeronautics Research: Revenues and funding budget in millions of euros	2014 Actual	2015 Planned	2016 Planned
Revenue			
Third-party funding	4.67	5.50	5.80
Funding budget			
Federal Ministry of Economics and Energy	118.76	143.60	154
Ministry of Economics Free State of Bavaria	10.20	17.80	3.73
Ministry of Economics Brandenburg	1.06	0.30	0.90
Hamburg Department of Economics	3.00	8.51	0
Ministry of Economics Lower Saxony	2.84	0	0

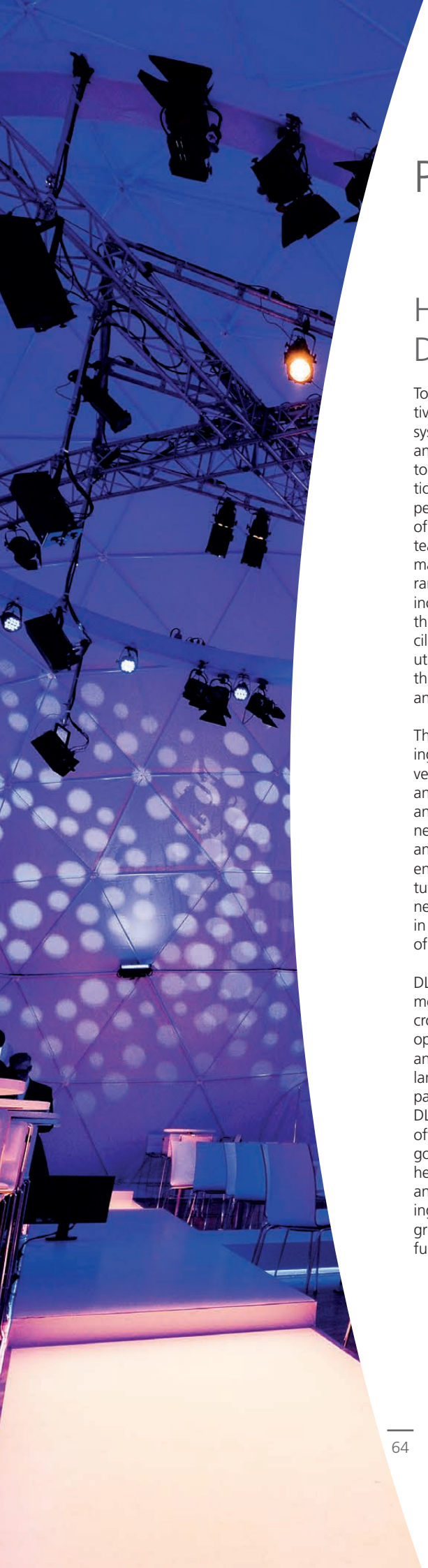
PT-LF handed its management role over to Italian partner CIRA. The AirTN-NextGen network now consists of ten core partners from nine countries, among them PT-LF and currently 16 associated partners who aim to jointly continue making significant contributions to international aeronautics research.

All partners in AirTN-NextGen accept the necessity of coordinating national programmes and funding mechanisms. In view of the ongoing difficulties research programmes face in acquiring adequate funding, effective coordination of national research efforts remains very important in some AirTN partner countries. The necessary funding instruments and mechanisms largely exist within AirTN and have meanwhile been repeatedly tested. Beyond the acknowledged excellent cooperation with the Austrian research programme TAKE OFF, it is intended to further expand cross-programme cooperations in LuFo with our core partners in the future.

In addition, PT-LF is again supporting the BMWi within GARTEUR (Group for Aeronautical Research and Technology in Europe), the oldest research network of the leading European aviation nations and core of AirTN.

As a project management agency for the BMWi, PT-LF has succeeded in maintaining its central position as a service provider and knowledge bearer in the field of aeronautics research at EU, national and regional levels and therefore sees itself in a position to support the BMWi in its efforts to provide coordinated and efficient support for aeronautics research in Germany and prevent duplicate funding. This special role is unique among comparable institutions in the European partner countries.

ECONOMIC DEVELOPMENT – CENTER DEVELOPMENT



People

Human Resources Development

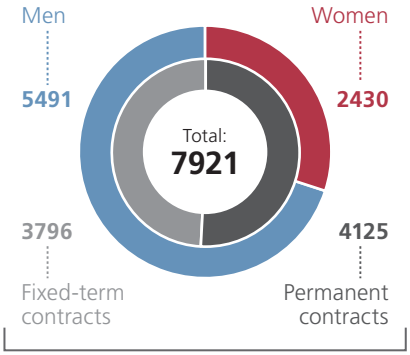
To help DLR fulfil its mission, Administrative Infrastructure (AI) provides holistic, systematic and modern human resources and organisational development services to the whole of DLR. HR and Organisational Development at DLR fosters the performance and development potential of managers, staff, specific target groups, teams and organisational units in a demand-oriented manner, offering a broad range of HR development programmes to increase employees' expertise, enhance their methodical and social skills and facilitate their personal development and utilising a range of tools to maintain these skills while increasing motivation and job satisfaction among our staff.

Through timely and comprehensive training measures, HR and Organisational Development at DLR prepares staff, junior and established managers individually and in their teams/institutes/facilities for new challenges during their time at DLR and beyond, interweaving the overall orientation of DLR and the aims of the institutes/facilities with the development needs of the organisation's employees in order to fulfil the common mission of DLR.

DLR's HR and Organisational Development department provides local and cross-site education and personal development programmes focusing on social and management-related skills, as well as language courses and IT training. The department also cooperates closely with DLR Occupational Health for example by offering training and courses to promote good health. A total of 675 events were held at DLR in 2014. Each employee used an average of 2.0 days for further training in the in-house HR development programme, amounting to a total of 15,840 further training days across the entire staff. Just over 61 percent of DLR employees took part in at least one human resources development programme, HR development programme for managers, or one of our 101 team and organisational development workshops.

Alongside advice on further training, employee management and development, the products and tools of HR and Organisational Development focus in particular on developing leadership skills by providing differentiated HR development for managers and junior managers. There is also a management feedback tool to optimise leadership and collaboration. Coaching for managers and employees and supported team workshops for organisational development further underline this focus. Examples of team workshops include change management, strategy development, leadership and collaboration and customised training for teams.

DLR Personnel in 2014



DLR HR and Organisational Development offers the following tailor-made programs for specific target groups: Mentoring Programme, DLR Talent Management Programme and DLR_Graduate_Program – our programme for doctoral candidates, which is described in more detail in the Education and Outreach section (see p. 67).

The mentoring class of 2015 with mentees, their managers and mentors at the opening event

Mentoring

Supporting junior managers in the acute situation in which they take on management responsibility is the declared aim of the Mentoring Programme. A new class began in June 2014 with 13 young talents who are taking on new challenges by assuming their first management role or comparable responsibilities. The participants in the current mentoring class were picked in early 2015; the class began in late June with 11 selected young talents. Mentors and mentees enter into a one-year supportive relationship in which the mentees – important high-potential employees in situations where they are taking on new challenges and increased responsibilities – can avail themselves of the experience and advice of higher-level managers. The mentoring programme as a development tool for specific managers has such a positive image that higher-level managers are extremely willing to serve as mentors. This year, HR and Organisational development for the first time offered a mentors' workshop for new and experienced mentors as a complementary element.

In late June, the dialogue between the Executive Board and 81 high potentials and junior managers at DLR had its tenth anniversary. This internal communication instrument gives junior staff the opportunity to exchange views with the highest management level, understand the thinking behind significant strategic developments and decisions and discuss them.

This dialogue transcends hierarchy barriers, fosters identification with and loyalty to DLR, and actively promotes networking between the participants. This year's dialogue was held under the Motto "Understanding DLR" and focused on processes and mechanisms of strategic orientation, influence and decision-making, taking environmental and other circumstances at DLR into account. Societal, political, scientific and economic aspects were discussed.

Management Development Programme

Based on the requirements profile for managers developed in 2014 to describe the main social, methodical and personal requirements for successfully performing a management role at DLR, HR and Organisational Development has revised its seminar programme for managers and adapted its training programme for junior managers. In April 2015 the Executive Board decided to make participation in the junior managers programme mandatory for all new disciplinary managers in DLR, effective immediately.

In addition, the Management Feedback instrument was fundamentally revised based on the requirements profile for managers and transferred to a new, modern medium in the form of an online instrument.

Talent Management

Since June 2013, all interested DLR employees can apply for one of the 25 places in the DLR Talent Management Programme. In all, 75 employees from all DLR sites applied. The candidates who met the formal requirements were invited to take part in potential analyses lasting several hours. In the end, the steering committee awarded 22 places on the DLR Talent Management Programme.

A comprehensive potential analysis that included tests, interviews and development centres was conducted in December 2013 to determine the individual development needs of the participants in the Talent Management Programme. The derived measures in the key areas cross-disciplinary skills, management skills

→ Quickfacts on People:

15,840	101	58.5%	31.0%	997	237
Further training days correspond to an average of 2.0 days of further training per employee in 2014	team and organisational development workshops	in scientific areas	female employees	doctoral candidates	trainees

HR Development and Mobility	2012	2013	2014
Training days per employee	1.9	1.9	2.0
Mentoring pairs	11	11	13
Postings abroad (months)	449	499	403

and personal development were discussed with the candidates' line managers in person in order to include their experience of the respective employees and their circumstances.

After the opening event, which took place in February 2014 with the involvement of the Executive Board and managers, the group met in Oberpfaffenhofen in May for its first workshop. In addition to the individual development measures such as seminars, coachings or sponsorships, which the participants will attend in accordance with their development plans, two further joint workshops will be held this year.

The participants in the Talent Management Programme were offered a range of opportunities to exchange views with DLR's top management. Three members of the programme were invited to discuss DLR's overall orientation with the Executive Board at the Board's closed-door meeting in May. Other members of the group took part in this year's New Year's Meeting in Berlin, were invited to the junior managers' dialogue with the Executive Board or the strategy workshop held by the deputy chairman of the Executive Board, Klaus Hamacher. In the course of their dialogue with the Executive Board, in the summer the entire group presented initial outcomes from strategically relevant project topics, which they explore outside the general programme workshops. In autumn 2014, the programme underwent an intermediate evaluation in the form of a written survey of the participants. Together with individual development meetings between the programme management and the participants, the results were used to optimise the programme. They were also discussed with the steering committee in February 2015. In this meeting it was furthermore decided to extend the programme's schedule to 2.5 years and reduce the group size to 16 participants. Applications for the programme will be taken again in the winter of 2015.

Human Resources Marketing

From our own experience on the market and regularly published rankings on the popularity of employers, competition for the best specialists shows no signs of abating. DLR Human Resources Marketing therefore continues to face the challenge of building further on its previous achievements and strengthening the profile and recognition of DLR in its target group. The existing attractiveness of DLR due purely to its research content is bolstered by the credible presentation of factors that show us as a desirable, modern, authentic employer. To this end, DLR is pursuing the following lines of action:

Raising the profile of DLR as an attractive employer:

Based on a target group specific survey of user behaviour, a new DLR job portal was developed in a responsive design, i.e. optimised for use on mobile end devices, and successfully implemented in late April 2015. The series of corporate videos presenting individual DLR institutes with their attractive fields of work was successfully continued; filming for a further video has already begun. During the reporting period, HR Marketing successfully attended 14 higher education fairs, the Hanover Trade Fair and the Open Day

at Oberpfaffenhofen, and for the first time took part in a virtual job fair. The DLR_Student_Insight event in Cologne was DLR's fourth careers day; held in the autumn of 2014, its purpose was to directly connect junior researchers with DLR and DLR researchers. Higher education marketing at defined target universities consistently raises DLR's profile, while editorial content in target group relevant print and online media serves to increase brand recognition and leads directly to DLR's job postings.

Supporting the institutes in recruiting staff:

Over the past twelve months, approximately 691 DLR vacancies were posted to the DLR job portal. New cooperations with specific online job exchanges were implemented and are in constant demand from the institutes. The presence of DLR job postings on relevant online portals was expanded further.

Internal communications and implementation of employer brand positioning:

In order to remain competitive with attractive job postings, a new seminar format for managers was developed that concisely conveys knowledge on the importance, benefits and how-to of formulating precisely targeted job postings. In addition, regular internal training courses educate DLR (junior) managers on their role as brand ambassadors and carry the relevance and function of the DLR employer brand into the wider organisation. Since January 2015, employees leaving DLR are invited by HR Development to participate in an anonymous online exit survey. This new instrument conveys an appreciative employer attitude towards those leaving DLR. The insights gained from these surveys are to be used for internal change and improvement and ultimately to promote DLR's image as an attractive employer.

→ Quickfacts on HR Marketing:

94,200	45,000	691	45	14	1
Visitors to the home page of the DLR job portal	trade fair attendees reached	job advertisements posted	articles and profiles published in print and online	trade and higher education fairs attended	mobile-optimised DLR jobs portal launched

Education and Outreach

Record numbers for DLR_School_Labs, ambitious offerings for students and doctoral candidates – and in Blue Dot and Rosetta two space exploration highlights that were used in a wide range of ways to interest young people in particular: the DLR education and outreach activities – grouped into a comprehensive concept titled DLR_Campus – were extremely popular during the reporting period.

Demand from schools wanting to visit one of DLR's twelve DLR_School_Labs remains high in the first half of 2015. As a result, waiting times are sometimes over a year. The massive interest shows that the concept is effective: DLR_School_Labs give pupils the opportunity to perform experiments relating to current research themselves, allowing them to directly experience how exciting science and technology can be. A further DLR_School_Lab is set to open at TU Darmstadt in 2016. The DLR_School_Labs additionally offer a wide range of other activities such as teacher workshops – which also saw record attendance in 2014 with 996 participating teachers.

DLR_Summer_School Rocket Drives in Lampoldshausen

Around 500 pupils from Wuhlheide attended the SoFi information event in Berlin on March 20, 2015

In the second half of 2014, German ESA astronaut Alexander Gerst's ISS mission and the landing of the Philae probe on a comet presented attractive opportunities to interest young people in research. In cooperation with ESA, DLR therefore provided an extensive education package to accompany the ISS mission Blue Dot; it included school competitions, teaching materials, live radio contact to the ISS and many other activities. The Rosetta mission was the subject of several special events, including one in Berlin with approx. 1,000 young attendees. The Institutes of Materials Physics in Space and of Planetary Research supported all these activities in exemplary fashion.

Alongside all these activities aimed at the wider public, DLR is also dedicated to promoting young high potentials, for example in the form of the DLR_Talent_School, which took place again in 2014 in Braunschweig and in 2015 in Oberpfaffenhofen in cooperation with Jugend Forscht and introduced especially gifted school pupils to DLR's research. Speaking of which, plenty of talent was also evidenced by the members of the space-club_berlin, who won the first German CanSat competition and came second in the European finals. For this competition, the youngsters build their own *mini satellites*, which must be no larger than a drinks can and are then transported to an altitude of approx. 1,000 metres using a small rocket. "Those are smart young people", said departing DLR Chairman of the Executive Board Prof. Wörner of the achievements of the Jugend Forscht winners, who received one of three DLR special awards. The DLR director was pleased to present these awards in person at the closing ceremony for Jugend Forscht, an organisation with which DLR has been cooperating for many years.

For the DLR_School_Labs, schoolchildren come to DLR; DLR_School_Info takes the opposite route and brings DLR's topics to schools. While the first two issues in this series of DLR teaching materials – on energy and on research in zero gravity – were aimed at secondary schools, in 2014 two special issues on planetary research were released for primary schools, created by DLR in cooperation with the renowned Klett publishing house. In addition, a new brochure on job profiles at DLR and the corresponding training paths was published in early 2015 and distributed at schools across Germany in a large run of 200,000 copies in cooperation with a youth magazine.

The DLR institutes and facilities are supervising numerous students completing internships or theses. DLR also has other attractive offerings for students, allowing them for example to carry out their own experiments in the REXUS/BEXUS programme. The REXUS/BEXUS (Rocket and Balloon Experiments for University Students) competition is a joint campaign of DLR and the Swedish space agency SNSB with support from ESA and other institutions. Also aimed at students is the Space Weather Summer Camp, which took place from July 16 to August 6, 2014. The three-week programme was organised by DLR and the University

→ Quickfacts on DLR_Campus:

36,310
School pupils at 12 DLR_School_Labs

approx. **1,000**
teachers in DLR workshops

over **4,000**
schools received DLR teaching materials

approx. **4,000**
visitors per day to the youth portal DLR_next

approx. **700**
participants in the DLR_Graduate_Program

of Alabama. It expanded the knowledge of students from Germany and the USA on space weather and included many practical exercises. Lampoldshausen also hosts a regular summer school, the DLR_Summer_School on space drives, in July/August. At a workshop in January 2015 the institute additionally offered students participating in the STERN programme the opportunity to gain practical experience.

Almost 700 doctoral candidates have registered for the DLR_Graduate_Program since its launch in 2009. This training programme, which is open to all doctoral candidates at DLR without exception, serves to teach cross-disciplinary skills; the expertise and abilities gained from the programme are designed to aid the students during their work at the DLR institutes and in their later careers in research or industry. The DLR_Graduate_Program is also part of the joint graduate programmes DLR operates as part of DLR@Uni with cooperating higher education institutions in Munich, Braunschweig and Stuttgart: doctoral candidates working on the corresponding research projects at DLR or at the higher education institutions participate both in the DLR_Graduate_Program events and in workshops and seminars from the university programmes. Together with joint doctoral candidate seminars and other events, the programme is designed to expand students' views of their own institutions and their own doctoral thesis topics and enable them to gain a highly enriched skills profile.

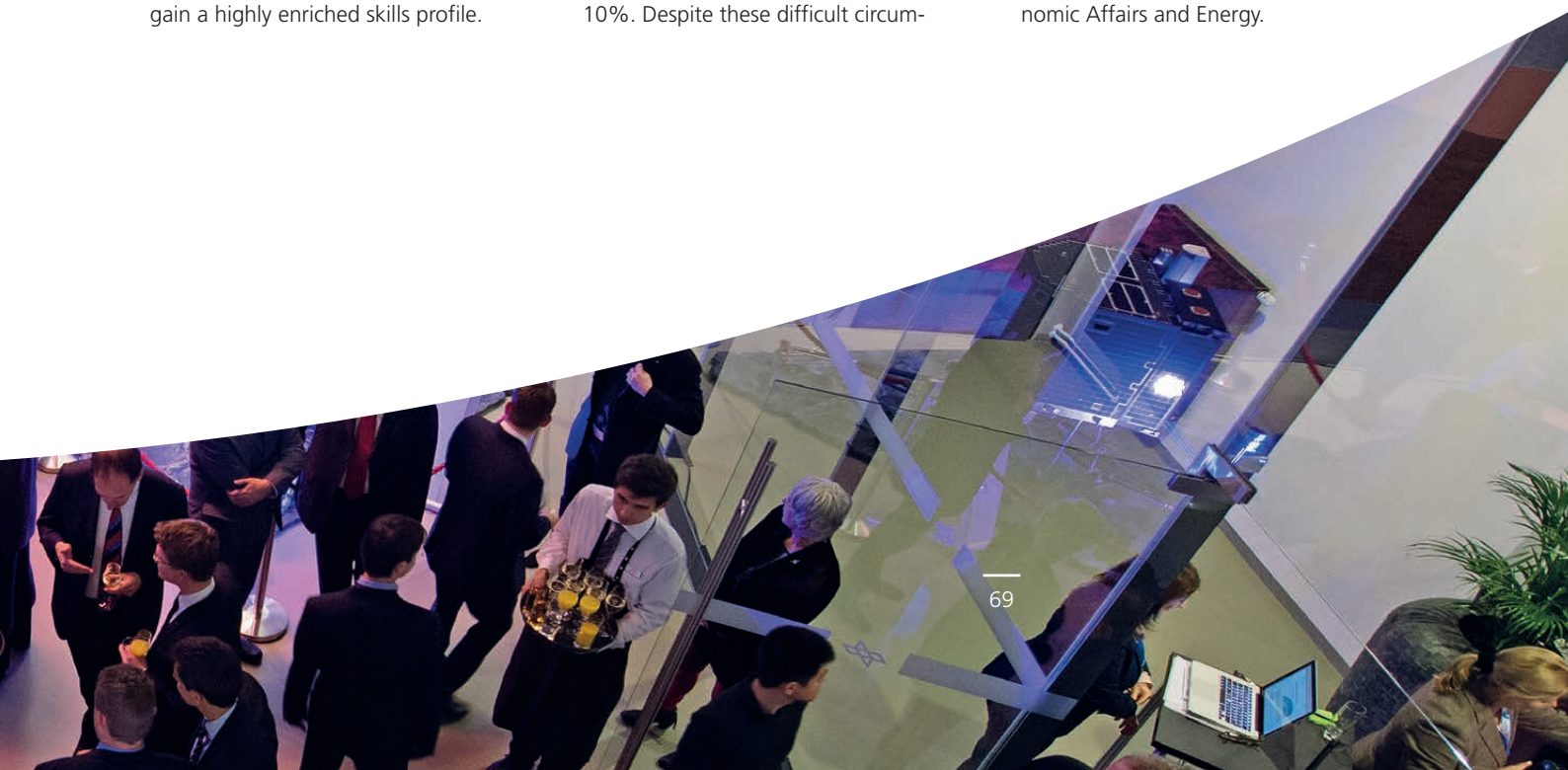
German Staff at ESA

German staff at ESA – a comparison

Member states	Number of employees	Employees [%]	Financial contribution [%]
Germany	383	19.0	24.9
France	427	21.2	20.2
Italy	400	19.9	12.6
UK	215	10.7	10.9
Spain	192	9.5	5.1

Only 25 percent of the contributions to the launcher programme were taken into account in calculating the respective funding contributions.

At the end of 2014, ESA retained a total of 2,233 employees, 2,015 of them in the salary groups commensurate with high-level employment. The proportion of German employees in high-level employment was 19% at that time (as opposed to 18.7 percent in 2013), and thus remained well below Germany's funding contribution of approximately 25%. By contrast, France and Italy, in terms of their respective funding contributions, are markedly over-represented. The main reason that German staff are underrepresented at ESA are the comparatively high salaries in the German aerospace industry. Over the years this has led to a consistently low rate of applications of under 10%. Despite these difficult circumstances, DLR has succeeded in achieving an average rate of 20% for new appointments through various tools such as an advisory service for applicants or a secondment programme agreed with ESA. In the long term, we expect the German Trainee Programme (GTP), which was established in 2010 and has since seen approximately 20 university graduates annually trained at ESA sites, to contribute significantly to increasing the proportion of German personnel. Of the so far 48 graduates of the trainee programme, approximately one third have found employment at ESA. The GTP fellowships are funded from the national space budget of the Federal Ministry of Economic Affairs and Energy.



Diversity and Equal Opportunities

With strategic commitments to enabling a good work-life balance, employers provide important answers to the constantly changing employment market and demographic change. DLR too has been supporting its employees with numerous family-friendly measures for many years. The most effective of these are flexible working time models and support offerings relating to childcare and care for elderly or disabled family members. As a special service, DLR maintains its own family advisory centre and has acquired approximately 60 places for employee children under three years of age at day-care centres near the DLR sites. These and other established family-friendly offerings are the reason that DLR has regularly been awarded the audit berufundfamilie certificate since 2002. In June 2015, DLR received the certificate awarded by berufundfamilie gGmbH (a subsidiary of the Hertie-Stiftung non-profit organisation) for the fifth consecutive time.

Zertifikat seit 2002
audit berufundfamilie

DLR's family-friendly HR policies, in particular the wide range of options for working time and workplace flexibility, are seen as highly positive by a large number of employees. This was confirmed by an employee survey conducted in June 2015. We had previously surveyed opinions on the work-life balance issue five years ago, and are pleased to announce that we were even able to improve on the positive results we achieved then.

→ Quickfacts from the employee survey "Work/life balance at DLR":

2,540
Survey respondents

85%
consider the work/life balance at DLR to be good

70%
recognise the high value of family-friendly HR policies

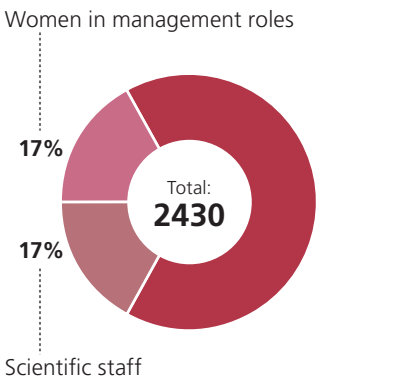
79%
would like to be able to work from home or on the road from time to time

10%
of respondents care for elderly or disabled relatives

Status: June 2015

left to right: Caren Marks, Karin Eichentopf and Dr Frank-Jürgen Weise

Proportion of Women in DLR in 2014



In its guidelines DLR makes a commitment to appreciative and respectful interaction. Harassment and discrimination are not tolerated at DLR in any form. Regarding this aspect, the procedure to prevent sexual harassment in the workplace was developed further: we expanded our network of liaison officers for corresponding advisory meetings. As part of DLR's diversity strategy, a man was for the first time among those appointed to this role. The responsibilities, competences and capacities of these liaison officers were transparently mapped in order to support newly appointed colleagues in the network in particular. A supervision event for this group of employees is held annually.

DLR Gesundheitsmanagement

With a wide range of activities and projects, DLR Health Management continued to develop the topics of health and healthy working at DLR over the past months. The department has added two new fields of activity: sport and health courses and the MUT pilot project.

DLR Health Management designed and developed the sport and health courses for HR Development's education programme for the first time in 2014. After evaluating the previous courses and surveying demand, new courses were introduced and existing courses updated. The long-term goal of this reorganisation is to better coordinate DLR Health Management's course content and programme and to adapt these offerings to the existing specifications for preventative health courses.

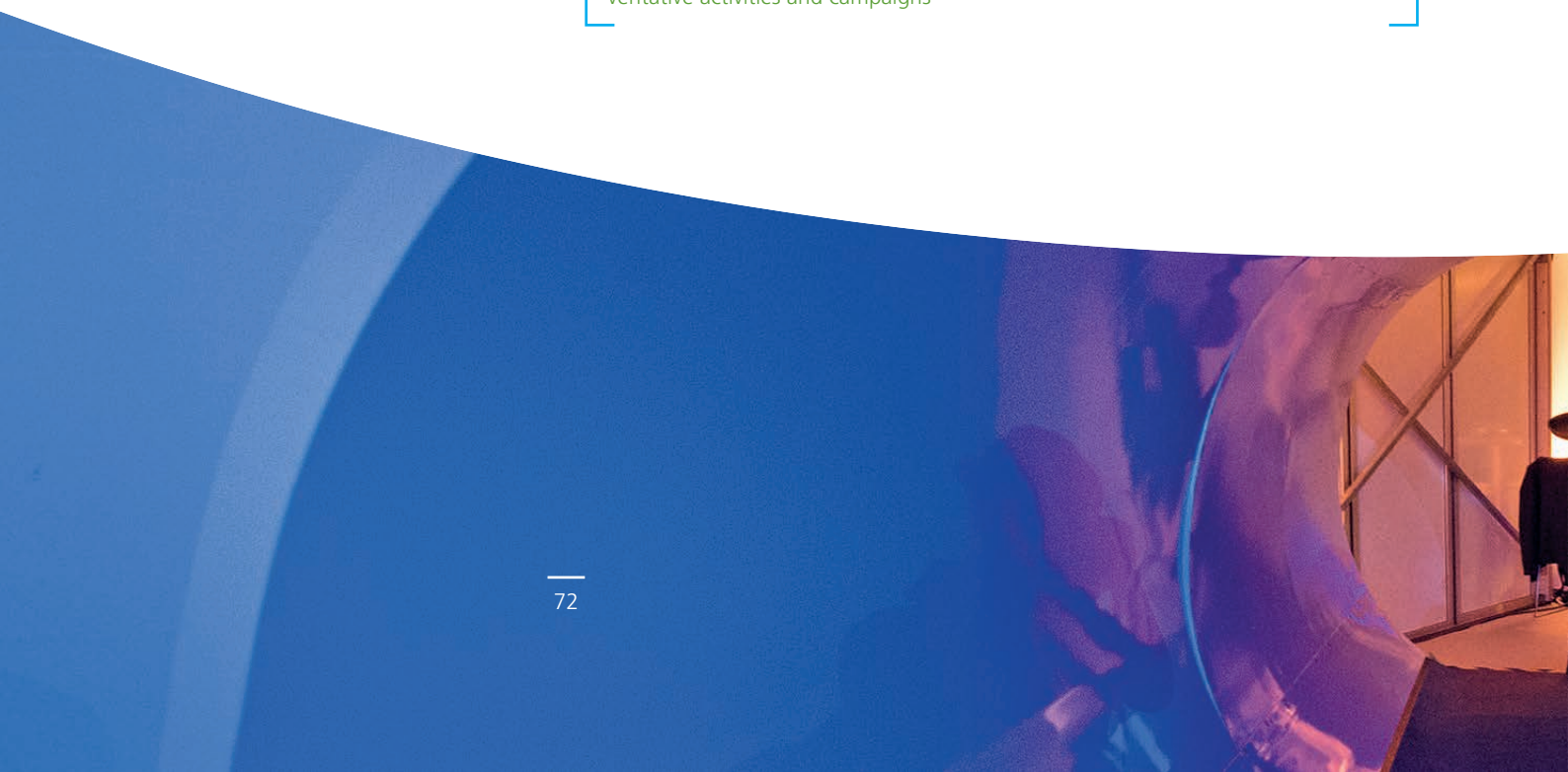
The MUT – Mein UnterstützungsTelefon (My Support Hotline) – pilot project ran for a total of twelve months until June 1, 2015, at the DLR site in Braunschweig. MUT is an advisory service offering employees and managers support from professional counsellors in dealing with psychosocial problems. As this service was very well received in the pilot project and rated very highly in an evaluation, DLR Health Management is currently preparing to expand the programme to all DLR sites from September 1, 2015. Alongside these new priorities, workshops for specific target groups – such as addiction counsellors, trainees or managers – were again held in 2014/2015.

A further highlight of our programme in the past year was the second round of the DLR Cup under the motto DLR Cup 2015 – Fit for Tomorrow, again jointly organised by DLR Health Management and Internal Communications. Over 500 DLR employees attended the large health event and internal football tournament at Höhenberger Sportpark in Cologne. Nine health stations offered employees information about sport and health, including everything from check-ups and personal advice to participating in the right warm-up programme for the football players. Following a nerve-racking penalty shoot-out, the team from Oberpfaffenhofen won the finale to take the cup from previous winner Ein-DLR-tracht Braunschweig. The team's captain proudly accepted the trophy designed and manufactured by trainees at Systemhaus Technik in Cologne from the hands of Prof. Wörner. A total of 24 teams competed for the title.

→ One Health Management for OneDLR:

Objective: Improve the physical, mental and social well-being of DLR employees

Topics and measures: Dealing with and support for psychological stress, (junior) management development, smoke-free workplaces, addiction prevention and dealing with addiction at work, nutrition, work-life-balance, conflict management, preventative activities and campaigns



Results

Third-party Funding

In 2014, our income from third-party funded projects once again increased by 5.3m euros, reaching a record level of 454.1m euros. This is due mainly to an increase in third-party funding from national public investors of the Federal Government. Our income from direct project funding from the Federal Government rose to 60.5m euros, with a significant increase in projects from the Federal Ministry for Economic Affairs and Energy in particular. Direct project funding from the Federal Ministry of Education and Research fell again by 1.3m to now 10.1m euros, as many projects from this investor have come to a close. Due to the increase in institutional funding, the percentage of DLR's total income provided by third-party funding remained at approximately the same level as in the previous year with 52 percent.

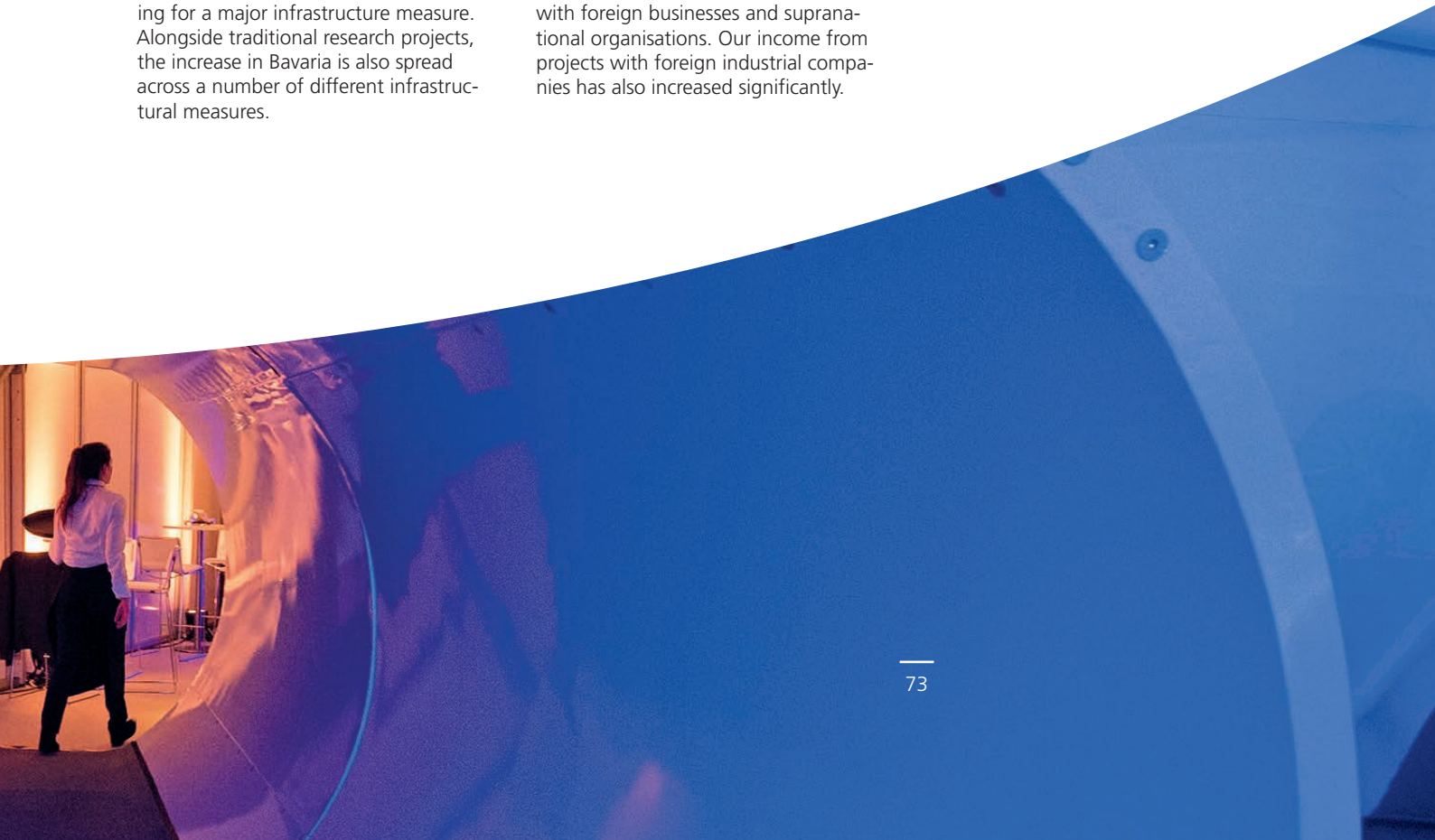
Income from project funding from the federal states was lower during the past business year, falling by 4.3m euros although we saw significant increases in funding from the Federal State of Baden-Württemberg and – again – from the Free State of Bavaria. In Baden-Württemberg this is due mainly to state funding for a major infrastructure measure. Alongside traditional research projects, the increase in Bavaria is also spread across a number of different infrastructural measures.

Third-party funding	2012	2013	2014
Total revenue from third-party funding	419m euros	449m euros	454m euros
Proportion of overall revenue from third-party sources	53%	53%	52%
Earnings trend in revenue from R&T activities in Germany	-2%	6%	-2%
Percentage of earnings from foreign clients (profit volume)	21%	21%	24%
Revenue from EU funding	26.8m euros	30.1m euros	31m euros
Success rate of EU applications (accepted/submitted)	30%	36%	29%
Coordinator quota on approved EU projects	16%	28%	28%

Our income from project management activities has also increased. Otherwise, our income from public contracts in general has dropped slightly.

The share of income from foreign clients (revenue volume) has increased for the first time in years and reached the same level as in 2010 at 24 percent. This is due in particular to an increase in projects with foreign businesses and supranational organisations. Our income from projects with foreign industrial companies has also increased significantly.

Moreover, our income from ESA projects in particular has contributed to our excellent overall results, rising by 9.3m euros from 25.5m euros in the previous year to 34.8m euros. Our income from projects in cooperation with and on behalf of



German businesses fell; compared to the previous year, we saw a reduction of two percent here. Our largest industrial client remains the Airbus Group (formerly EADS Group).

Our income from projects within the EU Framework Programme again increased to now 31m euros. At 28 percent, our share of coordinator projects measured by the total number of EU projects remained at the very high level of the previous year. Our success rate for EU applications (seen over the past three years) has however fallen from 36 percent in 2013 to 29 percent. This is very likely again due to the transition phase between the 7th Framework Programme, which is ending, and Horizon2020. With a total of 280 applications in 2014 we almost doubled the number of submitted projects compared to 2013, however not many projects have yet been approved in Horizon2020.

Research

Scientific quality is one of the most important criteria at the German Aerospace Center. Alongside the levels of third-party funding acquired, significant indicators of this quality are the scientific findings made public in journals, presentations and lectures. Their number varies from year to year, attributable mainly to the nature of project work, to staffing fluctuations and to time spent preparing proposals.

In the reporting period, the number of publications in peer-reviewed journals again reached a new high. Please note that from 2013 onwards the figures in the displayed table also include peer-reviewed abstracts.

Research-related results	2012	2013	2014
Publications in peer-reviewed journals	662	782	940
Appointments to universities	15	29	16
Lectureships	289	306	321
Diplom theses	438	385	443
PhD theses	109	135	136

Technology Marketing

Demand from politics, society and industry to validate and effectively transfer new technologies from research to the development of innovative products, services and procedures remains high. DLR therefore continues to pursue the validation and development of inventions into innovations in accordance with its motto of 4*I – Invention, Innovation, Interaction and Internationality.

The process and tools of Technology Marketing are implemented and developed as needed to support technology transfer effectively, efficiently and transparently. The Technology Marketing process was successfully recertified during the reporting period.

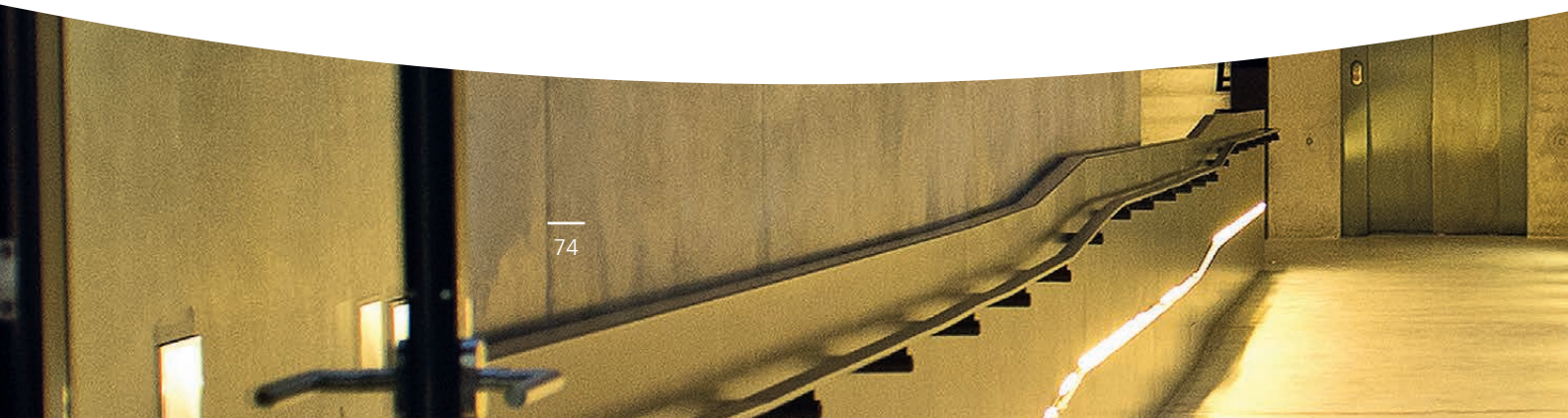
It includes:

- Ideas management with a DLR-wide ideas portal and regular ideas competitions
- Innovation projects to validate, advance and transfer technologies
- Strategic Innovation Partnerships between DLR and business under the brand name "Science2Business/Sc2B"
- Management of intellectual property rights and licences
- Advice and support for start-up companies spun off from DLR
- Direct points of contact in the regional offices of DLR's Technology Marketing for DLR institutes and facilities and the regional business community
- Business-oriented PR to strengthen DLR's profile as a competent technology partner

Examples of successful technology marketing

Science2Business® (Sc2B®) stands for strategic innovation partnerships between businesses and DLR. The number of contractually regulated strategic partnerships was increased by five new partners. A further four cooperation projects were initiated and carried out within these partnerships, and preparations for four more projects are underway.

The ideas competition IDEA AWARD 2015 Leben 4.0 (Life 4.0) was launched in January 2015 to initiate ideas for innovation projects that will lead to new products and services enabling and technically assisting users to remain active in the fourth phase of life.



Funding for three projects was acquired from the Helmholtz Validation Fund during the reporting period; an application for a further project has been submitted and is still being assessed.

Three technologies that were developed and advanced through innovation projects won innovation awards during the reporting period:

Innovative aircraft components from lightweight carbon-fibre reinforced plastics (CFRP) have to be hardened in an autoclave. The problem: during the hardening process, the scientists receive no information on possible errors or defects in the components and cannot interrupt the hardening process. The project developed a sensor that provides information on the quality of the component in the autoclave so that production can be cancelled early on in the event of defects, saving time and protecting the environment. This development won the JEC Innovation Award in the Aeronautics category.

The Innovation Prize awarded by the Society of Friends of the German Aerospace Center goes to a research team at the DLR Institute of Atmospheric Physics for developing an electrical storm nowcasting system for aviation. This innovative electrical storm information is made operationally available to its users – in aviation, these include air traffic control, weather services, airport operations, airlines and pilots. The technology is being implemented into the market through a spin-off company.

→ Quickfacts on Technology Marketing:

3,550
Proprietary rights in Germany and abroad

182
patent applications put DLR on the German Patent and Trade Mark Office's list of the 50 most active patent applicants

39
innovation projects carried out with institutes and facilities

23
ideas at the Idea Award 2015 Leben 4.0

23 companies in **10** years
founded which today employ **404** people

The DLR Special Prize in the ideas competition European Satellite Navigation Competition was awarded for an application idea designed to increase safety in aviation at minimal expense. Small and remote airports generally do not have the infrastructure for specific navigation procedures that additionally assist pilots in low visibility conditions. The project aims to change this with the help of an extension system for satellite-based approach and landing processes (SBAS): SBAS Retranslation Pseudolite System.

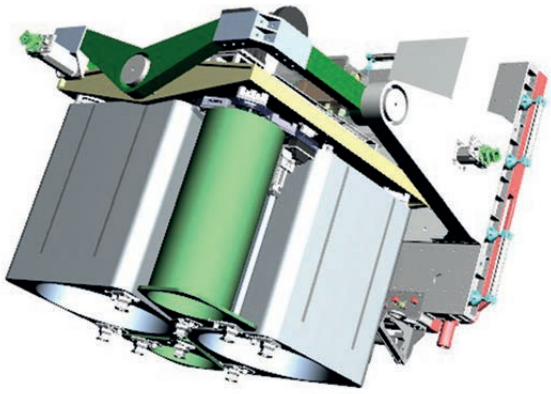
Copernicus Masters annually recognises the best application ideas in the field of Earth observation. It also presents the individual DLR Energy & Environmental Challenge award, which in 2014 went to a research team that intends to use multi-spectral remote sensing data from the Copernicus Sentinel satellites and satellites such as SPOT and RapidEye to quickly and continuously record seaweed populations.

Examples of innovation projects and technology transfer:

Producing fibre composite components in autoclaves requires the provision of vacuum equipment around the component, which is very time-consuming and technically demanding. A frequently occurring problem are leakages, which often result in defects or even total loss of the component during the hardening process. There is therefore a significant need for simple and reliable solutions for process-secure assembly of these vacuum facilities.

The project Automatisierte Leckagedetektion an Vakuumaufbauten mittels Thermografie (Automated Leakage Detection on Vacuum Equipment using Thermographics) at the Center for Lightweight Production Technology (Zentrum für Leichtbauproduktionstechnologie, ZLP) in Stade has developed a thermographic application that can quickly, definitively and automatically locate such defects and derive corrective measures if required.
The functionality and industrial applicability of the system were successfully verified and validated, and final licensing negotiations are being conducted with a mid-sized German industrial company that is already accompanying the project and has founded a dedicated subsidiary to market the technology.

DLR and a large, globally operating US company in the space exploration industry have signed an agreement on developing the Multi-User System for Earth Sensing (MUSES) platform, which will be assembled on the International Space Station ISS. The Institute of Optical Sensor Systems will develop and supply the near-infrared spectrometer DLR Earth Sensing Imaging Spectrometer, which will be integrated into the MUSES platform. This spectrometer will deliver important information about the atmosphere of the oceans and their bio-geophysical composition. The instrument works in the wavelength range from visible to near infrared, permitting precise data capture from the Earth's surface for applications in fields such as fire detection, maritime security and atmospheric research. In connection with this innovation project, the company has already commissioned DLR to develop the instrument further.



Near infrared spectrometer DLR Earth Sensing Imaging Spectrometer

Company Start-ups

Company start-ups remain an important tool for technology transfer. Our activities in this area focus on preparing company founders for their entrepreneurial activities, including supporting them in developing coherent business concepts and validating the underlying technologies for transfer to their new companies. The company start-ups are supported with assistance from the Helmholtz Enterprise Fund, which also provides management support from experienced entrepreneurs. Funding is also available for start-up projects based on DLR technologies and with founding teams consisting of DLR employees and external founders.

Two start-up projects are currently being funded: The planned start-up *tacterion* from the DLR Institute of Robotics and Mechatronics, which intends to market a polymer-based tactile sensor array (artificial skin), and the planned start-up *24/7 Solar* from the DLR Institute of Solar Research, which intends to use a high-temperature particle receiver as part of a solar tower power plant to generate process heat around the clock. The tacterion team won first prize in the Entrepreneurship Award at the European Robotics Forum 2015 in March, and was accepted into the three-month accelerator programme techfounders at unternehmerTUM, the Center for Innovation and Business Creation at TU Munich, in April.

The 24/7 Solar team took first place in the finals of this year's NUK (Neues Unternehmertum Rheinland e. V.) business plan competition, valued at 10,000 euros; its business plan won against a total of 127 submissions. Alongside preparing the company start-up, the team is developing and testing a reference solar system as part of an innovation project with funding from the Helmholtz Validation Fund.

The most effective start-up concepts have shown themselves to be those where business operations are developed while the associated innovation projects work towards technological maturity. A good example is the development of Intelligence on Wheels GmbH in Wessling, which offers a system for avoiding train collisions that was developed at the DLR Institute of Communications and Navigation. As part of an innovation project, the company developed and tested a small series of four vehicle units consisting of hardware and software, which are designed for use in everyday train operations. The company has meanwhile been commissioned by Harzer Schmalspurbahnen (HSB) to equip all its 31 powered vehicles and provide a range of portable and stationary units, 41 transmitting units in all.

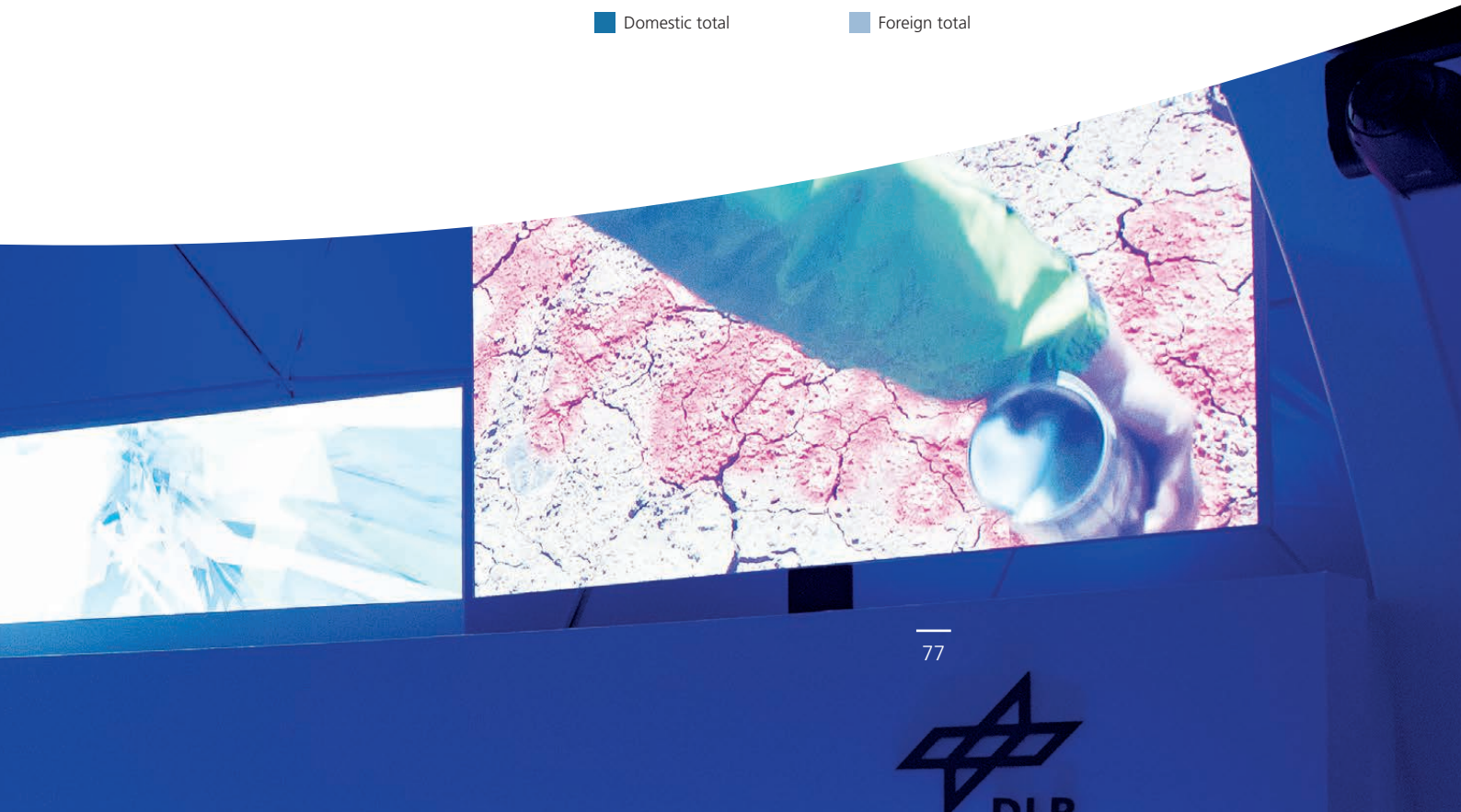
Intellectual Property Rights and Licenses

The field of *intellectual property rights and licenses* involves building and maintaining the DLR intellectual property rights portfolio and managing all commercial marketing agreements, including licensing. At the end of 2014, DLR's intellectual property rights portfolio encompassed approximately 3,550 property rights (patent applications and patents in Germany and abroad, including EP and PCT applications) and was thus at the same level as in the previous year. With 232 registrations, around 18 per cent fewer invention disclosures were submitted in 2014 than in the previous year.

Every year, the German Patent and Trade Mark Office publishes a list of the fifty most active patent applicants in Germany. DLR was again the only Helmholtz institution on this list in 2014, ranked 31st with 182 applications (2013: 23rd with 253 applications). The only other research institution on the list is the Fraunhofer Gesellschaft in Munich, ranked 15th. DLR's excellent place in the ranking issued by the German Patent and Trade Mark Office clearly proves that DLR has significantly furthered the state of the art in its research areas in 2014.

In 2014, licensing generated a turnover of approximately 4.2m euros; following the extraordinarily high revenue in 2013, income from licensing thus returned to the average level of the previous years. The significant income from licensing shows that technologies developed by DLR are in demand and have a high marketing potential.

Proprietary rights in Germany and abroad



Affiliates and Joint Ventures

DLR holds shares in notable companies and company start-ups that offer added value for DLR's work in the context of its research and its strategic alignment, thereby achieving the best possible utilisation of a wide range of synergy effects for scientific contributions to meeting societal challenges.

Management and controlling of these shares is handled by a staff department which additionally oversees DLR's memberships, institutional cooperations and networks particularly with regard to administrative and legal matters. This staff department operates as a central point of contact in all matters relating to DLR's participations and memberships, from initiation through administration to processing.

@ **http://s.DLR.de/19nb**

DLR Joint Ventures Gesellschaft mit beschränkter Haftung (DLR Joint Ventures Limited Liability Company), Bonn

100 percent

DLR Gesellschaft für Raumfahrtanwendungen (GfR) mbH (DLR Institute of Space Applications), Weßling

100 percent

@ **DLR.de/gfr**

German-Dutch Wind Tunnels (DNW) Foundation, Noordoostpolder/Netherlands

50 percent

@ **www.dnw.aero**

European Transonic Windtunnel GmbH (ETW) (European Transonic Wind Tunnels), Cologne

31 percent

@ **www.etw.de**

TeleOp Gesellschaft mit beschränkter Haftung (TeleOp Limited Liability Company), Weßling

25 percent

@ **www.teleop.de**

Anwendungszentrum GmbH (Application Center) Oberpfaffenhofen, Gilching

25 percent

@ **www.anwendungszentrum.de**

Europäische Akademie zur Erforschung von Folgen wissenschaftlich-technischer Entwicklungen Bad Neuenahr-Ahrweiler GmbH (European Academy of Technology Assessment in Germany), Bad Neuenahr-Ahrweiler

25 percent

@ **www.ea-aw.de**

WPX Faserkeramik GmbH (WPX Fibre Ceramics), Cologne

10 percent

@ **www.whipox.com**

Zentrum für Angewandte Luftfahrtforschung GmbH (ZAL Center of Applied Aeronautical Research), Hamburg

10 percent

@ **www.zal.aero**

Innovationszentrum für Mobilität und gesellschaftlichen Wandel (InnoZ) GmbH (Innovation Centre for Mobility and Societal Change), Berlin

6.5 percent

@ **www.innoz.de**

DUALIS MedTech GmbH, Weßling

4.9 percent

@ **www.dualis-medtech.de**

Commendations and Awards

To promote and motivate its employees and service providers DLR awards various prizes and honours, among them the Science Prize, the Senior Scientist award and also research stays. The assistance of DLR's funding institutions and other external organisations allows DLR to offer a broad and interesting range of awards and prizes. Below is an excerpt from 2014.

Internal Awards

DLR Science Prize

- Dr Thomas Jagdhuber,
  DLR Microwaves and Radar Institute

DLR Senior Scientists

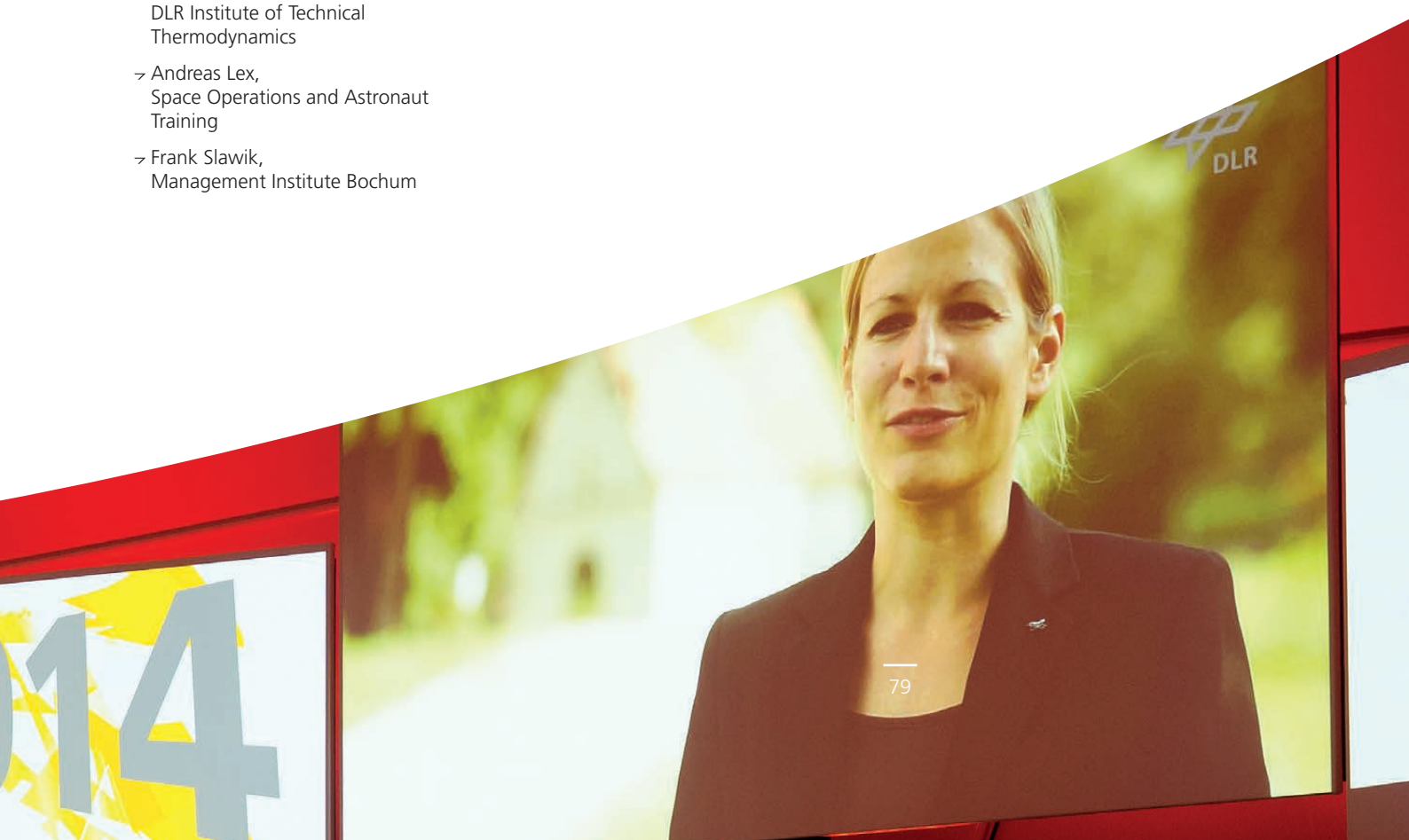
- Dr Ralf Hartmann,
  DLR Institute of Aerodynamics and Flow Technology
- Dr Frank Holzäpfel,
  DLR Institute of Atmospheric Physics
- Dr Hermann Bischl,
  DLR Institute of Communications and Navigation
- Dr Stephan Ulamec,
  Space Operations and Astronaut Training

DLR Quality Prize 2014

- Silvia Hanser,
  DLR Institute of Technical Thermodynamics
- Andreas Lex,
  Space Operations and Astronaut Training
- Frank Slawik,
  Management Institute Bochum

DLR Science Prize for Dr Thomas Jagdhuber

DLR Quality Prize for Frank Slawik



Awards presented by the Society of Friends of DLR (SoF)

The award was presented on November 6, 2014, as part of a scientific colloquium held at DLR Oberpfaffenhofen and managed by Mr Rauck. Invitees included members and funding members of the SoF, award winners and their institute directors. The event offered current and previous award winners and senior scientists the opportunity to present their work and the results of their research stays abroad.

Otto Lilienthal Research Semester

- Dr Franz Andert,
  DLR Institute of Flight Systems,
  Braunschweig
- Prof. Dr Martin Dameris,
  DLR Institute of Atmospheric Physics,
  Oberpfaffenhofen

  Research stays are planned at CSIRO, Autonomous Systems Laboratory, Pullenvale/Brisbane, Australia and at the Institute of Atmospheric Science and Climate (ISAC) in Rome, Italy.

Fritz Rudorf Prize

- Bernhard Stauf,
  Contract Administration, Cologne

  in recognition of his achievements in administration, planning or project management for coordinating examinations on selected special and problem topics/founding the Network of European Research Organisations on ESA Issues NERO.

1st place in the DLR_School_Lab prize, from left: Kenan Helms, Gedeon Schulz, Robert Leineweber, Henrik Bartsch, Phillipp Engelke

Innovation Prize

The project team

- Dr Caroline Forster, Dr Arnold Tafferner,
  DLR Institute of Atmospheric Physics,
  Oberpfaffenhofen,

  was awarded the 2014 Innovation Prize for the project Sicherer und effizienter Fliegen durch innovative Gewitterinformationen im Cockpit (Safer and more efficient flying through innovative thunderstorm information in the cockpit).

Hugo Denkmeier Prize

- Dr Alankrita Isha Mrigakshi
  (as youngest doctoral candidate)

  for her outstanding doctoral thesis on Galactic Cosmic Ray Exposure of Humans in Space – Influence of galactic cosmic ray modules and shielding on dose calculations for low-Earth orbit and near-Earth interplanetary space.

Chairman's Prize

- Tudor Ninacs
  (youngest person to register a patent in his year), Institute of Communications and Navigation, Oberpfaffenhofen,

  for his procedure to restore lost and/or damaged data.

DLR_School_Lab Prize

In 2014, the prize was offered and judged by DLR Bremen on the topic of "Zero Gravity: Amazing Effects". The prize was shared between

- Team 1:
  Kenan Helms, Gedeon Schulz,
  Robert Leineweber, Henrik Bartsch,
  Phillipp Engelke,
  Hölty Gymnasium, Celle
- Team 2:
  Christopher Kessel,
  Gymnasium Horn, Bremen
- Team 3:
  Nina Gabriel, Elin Leupolt,
  Oberschule am Wallerring, Bremen

4th Franz-Xaver Erlacher Promotion Prize

- Gerald Baier,

  doctoral candidate at the DLR Institute of Remote Sensing Technology in Oberpfaffenhofen.

Asto Aerospace Promotion Prize – Industry promotes Research

- Anton Heistser,
  Microwaves and Radar Institute,
  Oberpfaffenhofen.

Susanna Domogalla

External Awards

DLR Special Prize in the Germany-wide "Jugend Forscht" competition

Aviation and Space

- Susanna Domogalla, Koblenz

  For her project: Optimising the aerodynamic properties of aircraft wings through ionic wind turbulators

Information Technology

- Jonas Schulze, Klötze

  For his project: Implementing an optical 3-D scanner using structured light.

Robotics

- Christopher Kolling, Weiskirchen, Karsten Jakobs, Losheim am See Sandro Schmitz, Lebac

  For their project: Protection from optic radiation in robot laser heads.

Christopher Kolling, Karsten Jakobs, Sandro Schmitz

Selection of External Awards in 2014

Award	Prize winner
Maximilian Order for Science and Art	Prof. Gerd Hirzinger
Appointed full member of the Berlin-Brandenburg Academy of Sciences and Humanities	Prof. Markus Rapp
Albrecht Ludwig Berblinger Prize of the German Society for Aviation Medicine	Dr Sonja Brungs
2014 Helmholtz Doctoral Award in the Aeronautics, Space and Transport research field	Dr Pengfei Yang
Junge Akademie membership	Prof Bernadett Weinzierl
STAB Research Award for Fluid Mechanics 2014	Prof. Klaus Hannemann, Dr Jan Martinez Schramm, Dr Alexander Wagner, Markus Kuhn
2014 IEEE Distinguished Achievement Award	Prof. Alberto Moreira
2014 IEEE Fellow	Prof. Irena Hajnsek, Dr Konstantinos Papathanassiou
Bertha Benz Prize for Female Engineers 2014	Michaela Herr
1st Prize, Aviation Award 2014 (Stuttgart Airport)	Dr Volker Grewe
2nd Prize, Aviation Award 2014 (Stuttgart Airport)	Dr Thomas Dautermann, Dr Robert Geister, Michael Felux
NASA Group Achievement Award	Prof. Ulrich Schumann, Prof. Bernd Kärcher, Dr Ulrike Burkhardt, Kaspar Graf
German High Tech Champions Award	Diego Schierle

Relationships and Cooperations

Corporate Communications

DLR's public outreach activities are the responsibility of DLR Corporate Communications. Alongside press and media relations, the department's work spans multiple media (DLR magazine, website, videos, social media such as Facebook or Twitter) and events. DLR Corporate Communications includes professional internal communications and a distinctive corporate design, addressing the wider public as well as media representatives, decision-makers in politics, business and academia, DLR's own employees and other multipliers.

Following our communication of Alexander Gerst's astronaut mission in 2014/15, which met with an unprecedented response, our reporting on the Rosetta space exploration mission, particularly its Philae lander, again saw a record-breaking level of interest from the public. DLR received the International German PR

PR Award for the Blue Dot and Rosetta missions

Award for its multi-layered communication of Alexander Gerst's Blue Dot mission, and the Online Communications Award 2015 for its PR work for the Philae lander. In April 2015, DLR also won the PR Report Award in two categories: its outstanding reporting on the Gerst mission was recognised in the Integrated PR & Content Marketing category, while the DLR campaign Comet Landing Live: the Philae Lander Tweets won the Social Media & Content Strategy category.

Other activities from DLR Corporate Communications covered topics such as aircraft noise and ecologically efficient flying. In addition, research results and surveys on solar energy use, on new energy storage concepts, on the future of electromobility and on driver assistance systems were communicated via trade fairs, press releases, images, video, blogs and social media platforms.

In 2014, DLR's media presence increased by approx. 80 percent compared to the previous year (2013: 3,993 articles; 2014: 7,180 articles) and reached its highest level in the past five years. The blog post *Warum ist Pluto kein Planet mehr?* (Why is Pluto not a planet any more?) spread virally through social media, drawing a readership that was 120 times higher than that of an average blog post; the response was entirely positive.

The broad public interest in the various forms of PR for the Rosetta mission and its Philae lander as well as in Alexander Gerst's ISS mission raised the profile of space exploration and space research significantly: over 57 percent of all DLR articles covered by the media response analysis related to this field of activity. But all DLR's areas of activity contribute to its positive image. During the reporting year, large-scale research facilities and DLR Flight Operations/Flight Experiments in particular benefited from positive media interest.

Lander Philae on the social networks – here on Twitter

Political and Economic Relations

Successful collaboration is based on mutual trust, credibility and reliability – policy advisory as a competent and trustworthy mediator.

These factors determine the relationship between DLR and policy-makers, from the Federal Government through the federal states down to regions and municipalities.

This requires professional political communication that is commensurate with DLR's responsibilities, in its research programmes, to society and to Germany and Europe as locations for research and business.

DLR is committed to maintaining a national, European and international profile. As a reliable partner to policy-makers, on whose behalf it operates, DLR performs its tasks day after day with curiosity, consideration and strategic sensibility.

The means of the Political and Economic Relations department that shapes DLR's political communications at the direct request of the Chair of the Executive Board are varied and, in accordance with the complexity of DLR's remit, primarily personal, professional, reliable and designed to build and secure lasting trust.

Well-established formats at the parliamentary level of the Federal Government, such as the Parliamentary Evening (last year focusing on the ESA Council of Ministers, early this year with Alexander Gerst on the occasion of the New Year's Reception of the Aerospace parliamentary group in the German Bundestag on January 13, 2015, in Berlin), DLR Meets,

Standpunkte format: DLR colleagues working on the interview with Minister of State Ilse Aigner

ESA astronaut Alexander Gerst attends the Parliamentary Evening

and site information visits by members of the Bundestag, members of the state parliaments and members of the European parliament were successfully complemented by Parliamentary Evenings at the federal state level in the reporting year. The first such evening took place in May 2015 in Hanover in cooperation with the German Aerospace Industries Association (BDLI) and met with great interest from members of the state parliament.

Good communication is based on good information. Political and Economic Relations uses a wide range of media to deliver its information. In the reporting period, we created exciting films like *Our World Needs Space* or a 3-D film on robotics. Our work focused more heavily on DLR's activities in the federal states, which is apparent from the design and first edition of brochures aimed at members of state parliaments, members of the German Bundestag and members of the European parliament from the states where DLR has facilities. In addition, the established Berlin Bulletin is joined by a further newsletter "Aus den Ländern" (From the Federal States), which is published in a standardised layout and structure.

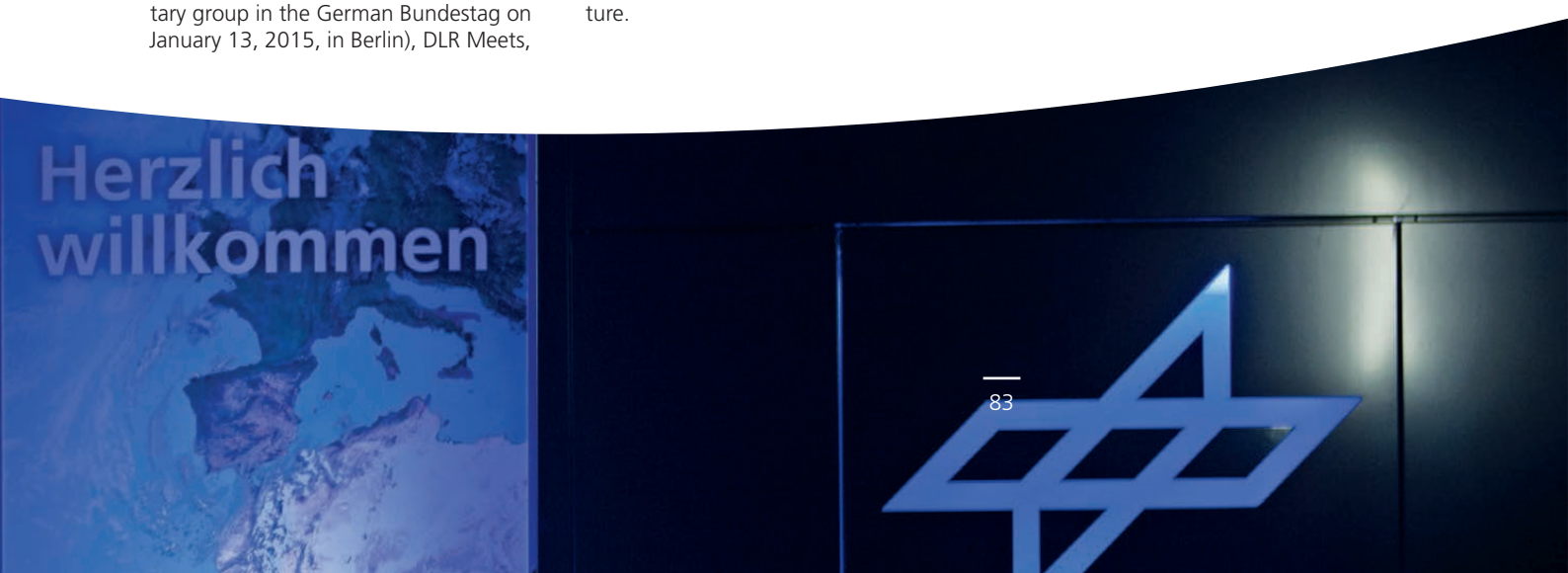
Communication is not a one-way street. Policy-makers have therefore for some time been offered the possibility of contacting DLR directly. The "Standpunkte" (Standpoints) format and other interviews with political decision-makers allow DLR to gather information directly and in person. To this end, the website for the Political and Economic Relations department was revised and adapted to deliver targeted and professional information. New features include a comprehensive media library.

To sum up: DLR's political communications were successfully developed further in the reporting year, as feedback and a performance analysis have confirmed.

And yet, what we always knew still holds true: personal, and where necessary confidential, talks are and will remain the central element of competent and trustworthy policy advisory services.

For more information, please see:

@ DLR.de/pw



Helmholtz Association of German Research Centres

Programme-oriented funding

The third cycle of programme-oriented funding has begun for all DLR's activities and projects. Following the Aeronautics, Space and Transport research field, in which work began in early 2014, research activities that will ultimately achieve the goals in the programme applications evaluated in early 2014 are only now beginning in the Energy research field.

Programme-oriented funding is used to plan the institutional research of the 18 large-scale research institutions in the Helmholtz Association. Based on research policy requirements from the ministries, the head office of the HGF organises the evaluation of the programmes developed by the centres, which then cover research planning for the next five years. DLR's activities contribute in particular to the Federal Government's high-tech strategy and the specific programmes of a range of other ministries relating to space exploration, aeronautics, transport, energy and security, and are integrated into European strategies such as Vision 2020, the European space programme at ESA or the Transport Technology Plan of the European Union.

Initiative and Networking Fund

Alongside evaluating research through programme-oriented funding for the centres, the President of the Helmholtz Association is tasked with managing a fund to spark new initiatives. Funding is available for five elements: new topics for the future; networking with the academic system, here mainly with universities; funding junior researchers; and creating the conditions for top-flight research and to ensure excellence. During the reporting period, DLR was able to acquire projects in particular in the fields of technology transfer and HR measures. In the latter, the key focus was on promoting young researchers, mainly by funding post-doctoral researchers in planetary research, atmospheric research, solar energy and materials research. In technology transfer, highlights include the validation projects RACE-LAB, which explores the use of robot technologies in industry; Centrec, which is developing a centrifugal receiver for solar tower power plants to generate electricity; and Copro2, which is researching the efficient manufacturing of carbon-fibre reinforced profile components for lightweight construction.

National Networks

Collaborations with universities

DLR's university collaborations not only ensure that programmatic research optimally utilises available resources, but also promote joint training of young, highly qualified employees for industry and academia. This cooperation benefits both DLR and the universities: for universities, the cross-disciplinary competence and technical infrastructure available in DLR form an important component of numerous research projects, while DLR is ensured access to the next generation of researchers. Close personnel-based connections formed by appointing DLR institute directors jointly with universities have proved particularly beneficial; selected management positions at DLR institutes are also increasingly being filled through joint appointment procedures.

Within the scope of the Excellence Initiative, collaboration between universities and DLR is becoming increasingly important. Funded by the Helmholtz Association, DLR maintains institutionalised cooperations with selected universities under the name DLR@Uni which are designed to promote more intensive networking and go beyond expert research cooperation in joint scientific projects.

Each year, the DLR institutes supervise approximately 1,000 postgraduate students working on their PhD theses, while over 400 students complete their Diplom theses at DLR facilities. The number of DLR researchers holding lectureships has increased significantly in recent years; 2014 set a new record with now approximately 320 lectures, tutorials, seminars etc. at universities and universities of applied science.

Collaboration with the Fraunhofer Gesellschaft (FhG)

DLR and the Fraunhofer Gesellschaft are cooperating on a wide range of research and development projects. In addition, the two organisations have agreed a regular exchange of information at the strategic level in order to identify any new societally relevant topics early on and develop innovative solutions in a complementary fashion. In technology marketing, DLR is currently collaborating with the FhG on an EU application for the

National and European networks	2010	2011	2012	2013	2014
DFG participations	38	32	35	33	36
Sponsorship agreements	32	33	38	41	50

Bodensee region in the ERDF (European Regional Development Fund) programme. If this funding is successfully acquired in 2016, DLR and the FhG will support and utilise the *BodenseeInnovativ* agency to initiate local innovation projects.

Cooperation with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

DLR and GIZ have taken important steps towards creating a deeper cooperation in recent months, beginning with a joint two-day workshop in November 2014 at the DLR site in Oberpfaffenhofen that aimed to further expand collaboration between the two organisations at an international level and develop a strategic partnership. To this end, experts at GIZ and representatives of the DLR Space Administration, the research institutes and the Project Management Agency outlined their own strengths and weaknesses and discussed subject areas with especially high potential for cooperation. Disaster preparedness and management/ humanitarian technology, climate protection and resource management, megacities, renewable energies and transport were identified as promising topics, and focused working groups set up to explore them over the course of the year.

The parties also agreed to create the required contractual framework, and signed a corresponding Memorandum of Understanding on June 29, 2015. In this MoU, DLR and GIZ express their overarching political will to utilise the potential arising from their complementary competencies. The AVB supplemental agreements are designed to simplify DLR's collaboration as a subcontractor to GIZ and accelerate the implementation of joint projects.

Cooperation with the Karlsruhe Institute of Technology (KIT)

DLR and the KIT, which is also a member of the Helmholtz Association, intend to cooperate more closely in the field of nano- and microtechnologies. The aim is to identify technologies that might offer solutions or improvements to problems in space development. On September 3, 2014, DLR held an expert workshop on the subject, led by Dr Reile, DLR programme director for Space Research and Technology. The KIT delegation was lead by Prof. Dr Saile, head of KIT's Physics and Mathematics division. A number of areas offering potential for closer collaboration were identified, among them sensor technologies, multi-functional materials and supercondensers. Specific options for cooperation are now to be determined in a topic-focused workshop.

Cooperation with the University of Cologne

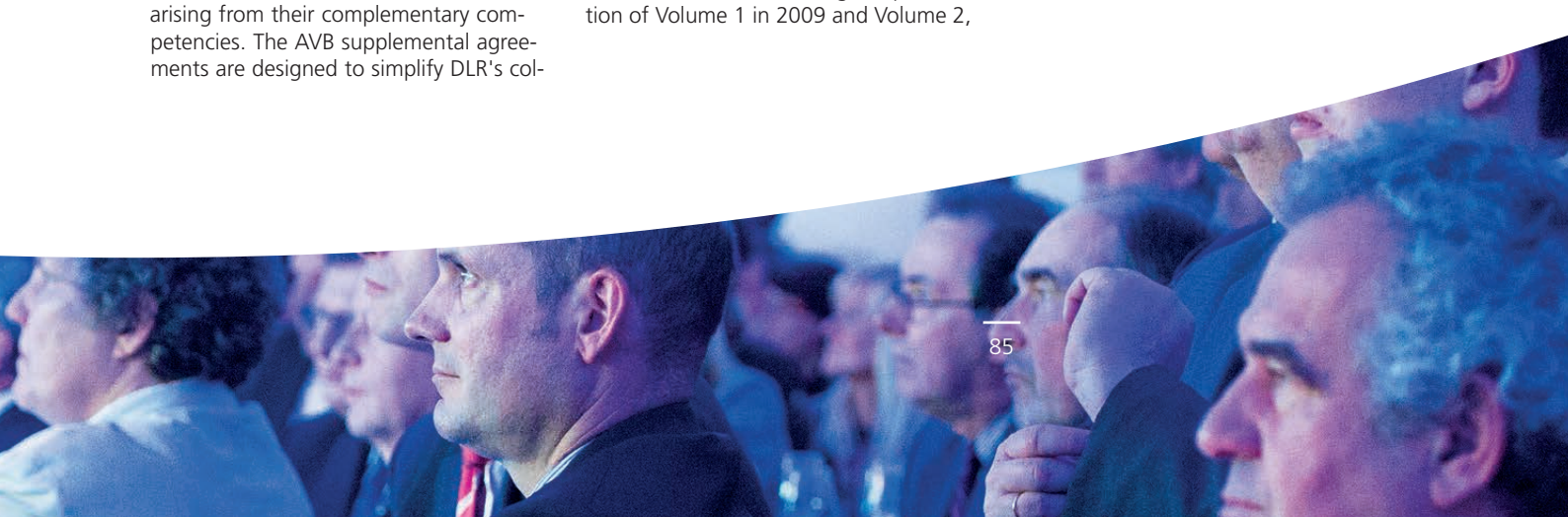
In May 2015, the Institute of Air and Space Law at the University of Cologne held an international symposium to celebrate its 90th anniversary; it is the world's oldest university institute in its field. The institute's internationally recognised Cologne Commentary on Space Law, a three-volume work covering the entire body of space law, is published in cooperation with DLR. Following the publication of Volume 1 in 2009 and Volume 2, on the five UN space treaties, in 2013, Volume 3 on the relevant UN resolutions was issued in April 2015 and presented in a UN context (see p. 97) as well as elsewhere. The next challenge will be to translate the work into Russian and Chinese in cooperation with international partners of the institute.

Participation in DFG programmes

Integration into the programs of the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG) is an important measure of the quality of DLR's research work. DFG's Coordinated Programmes support extensive interdisciplinary networks of researchers dedicated to a wider subject area: Collaborative Research Centres focus on excellence in research, while Priority Programmes are designed to develop expertise and Research Training Groups train high-calibre young scientists. During the reporting period, DLR institutes participated in Collaborative Research Centres 20 times, in Priority Programmes twelve times, and in Research Training Groups four times.

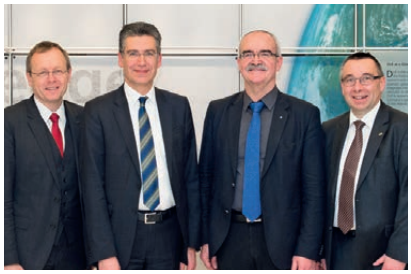
Sponsorships

Sponsorships are a useful tool to facilitate rapid technology transfer through individuals. Industrial companies contribute half the cost of training young researchers who work in fields that are of equal interest to DLR and these companies. In 2014, DLR supervised a total of 50 sponsorships, continuing the upward trend from the previous years.



European Networks

DLR in Brussels



The DLR Chairman of the Executive Board and the head of DLR's Brussels office with representatives of the state of Mecklenburg-Vorpommern

With its New Year's Reception held under the motto Maritime Safety and Security, DLR continued the discussions on the EU's maritime security strategy that have been ongoing since 2014. The former diplomatic representation of the GDR in Brussels, which DLR today shares with the federal state of Mecklenburg-Vorpommern, offered the ideal backdrop for DLR's New Year's Reception in Brussels, held at the invitation of Prof. Wörner and Mr Schröder, secretary of state at the Ministry of Education, Science and Culture of the State of Mecklenburg-Vorpommern. The event, which took place on the evening of January 27, 2015, brought together over 190 high-ranking representatives of the European institutions, from industry, business, research and from DLR to discuss maritime security.

Horizon2020

DLR has submitted multiple applications to the first calls for proposals in Horizon2020: Aeronautics: 63, Space: 73, Energy: 9, Transport: 15 and Security: 1. In Aeronautics, Transport and Energy, approximately half the submitted applications in which DLR is participating have gone through to the second stage of the two-stage procedure. The full applications submitted in late August were evaluated in autumn; DLR's applications again met with significant success.

DLR has also submitted numerous applications to the second calls for proposals in Horizon2020: Aeronautics: 52, including 27 as part of SESAR Exploratory Research, Space: 75, Energy: 18, Transport: 18 and Security: 1. Assessment of these applications was not yet completed at the time of reporting.

In addition to its applications in Horizon2020, DLR was actively involved in preparing the next programme of work for 2016-2017 via its membership in European technology platforms (ACARE, ERTRAC, ERRAC, …) and associations (EERA, ECTRI, EREA, …). Alongside scientific considerations, initial lessons learned from the first Horizon2020 calls for proposals were applied.

System analysis Energy and EU

As a result of the visit from Mr Verhoef, Head of Unit Renewable Energy at the Directorate-General for Research & Innovation, to DLR last year a bilateral seminar at the DLR office in Brussels was organised in order to present DLR's various systems analysis methods and tools to the colleagues from the EU Commission (Directorate-General for Energy, Directorate-General for Research & Innovation). The EU Commission showed significant interest, so that further subject-specific activities are planned and may also be reflected in the 2016-2017 work programme for Horizon2020.

Maritime security strategy

Following the adoption of the EU maritime safety and security strategy by the Council of Europe and the European Parliament last year, the EU Commission recommended an associated plan of action in mid-December 2014. After the topic had already been the main focus of DLR's New Year's Reception in Brussels, Bremen senator Mr Günther and Prof. Wörner invited the relevant stakeholders (industry, users, policy-makers, EU Commission) to a business lunch at the Bremen state representation on February 23, 2015. Ms Gminder of the EU Commission presented the plan of action in detail; then the further implementation phases and the participation and roles of the stakeholders were discussed. In order to sufficiently involve all stakeholders in the implementation, DLR has suggested an approach similar to ACARE in aviation for the Maritime safety and security strategy. A corresponding concept is currently being developed within DLR and is to be discussed with the EU Commission at a working level in the spring of 2015.

European Space Policy from the EU

The 7th annual European Space Policy Conference, which was attended by high-ranking officials and opened this year by the Vice President of the Commission, Mr Sefcovic, and closed by EU Commissioner Ms Bienkowska, took place on January 27 and 28 in Brussels.

Prof. Wörner took part in the panel discussing the central topic of industrial policy, where he used his role mainly to apprise the conference attendees of the challenges to the European space sector currently arising from new American

space exploration companies, often founded out of Silicon Valley, and their innovative management and production methods.

In addition to overarching political topics such as ESA-EU relations, talks between Prof. Wörner and Mr Calleja, Director-General for Internal Market, Industry, Entrepreneurship and SMEs of the EU Commission, on February 28, 2015 in Brussels also dealt with specific industrial policy and programmatic issues. In this context DLR agreed to provide the EU Commission with supporting advice on the upcoming development of the Copernicus services and on the feasibility of future reusable space transportation systems.

Cooperation with ONERA

At the EREA Annual Event on December 9, 2014, the new ONERA president, Mr Sainjon, and Prof. Henke, DLR member of the Executive Board for Aeronautics, held an initial bilateral meeting where the two parties agreed to resume the previous Joint Executive Board Meetings and to continue and expand bilateral programmatic collaboration, particularly within Clean Sky. It became apparent that DLR and ONERA have also developed similar views regarding the further development of EREA, and EREA Future Sky in particular, which they intend to coordinate.at regular intervals bilaterally and possibly also trilaterally with NLR ahead of future EREA Board Meetings.

The 15th ONERA DLR Aerospace Symposium (ODAS 2015) took place from May 27-29, 2015, in Toulouse. Dedicated to the subject of aerial robotics, the conference saw a large number of talks and interesting discussions.

Cooperation with NLR

Mr Peters, CEO of NLR, and Prof. Henke, DLR member of the Executive Board for Aeronautics, held their traditional bilateral meeting on December 9, 2014. Alongside coordinating collaboration within SESAR, on wind tunnels and in EREA, they agreed to hold a joint management seminar between DLR and NLR to expand programmatic bilateral collaboration. This seminar took place on February 11, 2015, in Braunschweig, where DLR heads of institutes and NLR division managers met to find joint topics and derive new cooperation options which it is hoped will lead to specific projects either at the regular meeting between the DLR and NLR programme directors or at the latest when the seminar is repeated in early 2016.

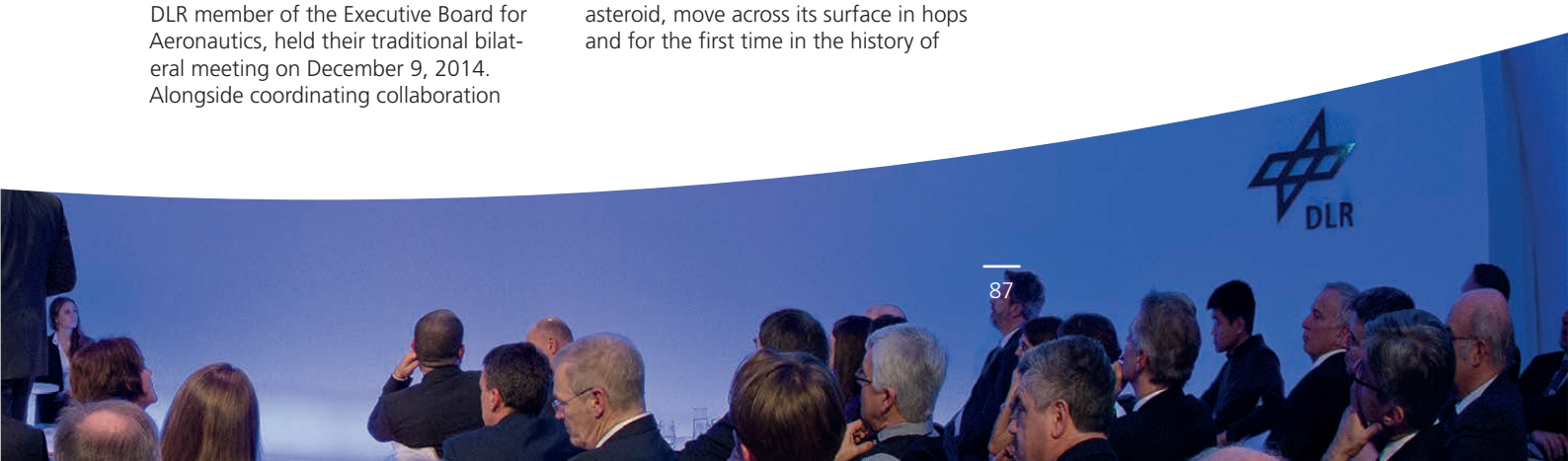
Cooperation with CNES

DLR is providing the LIDAR payload for the bilateral climate mission MERLIN (Methane Remote Sensing LIDAR Mission) while CNES contributes the MYRIADE Evolutions satellite bus including satellite operations. The data will be utilised via a joint payload ground segment. Phase B is currently being implemented, on the German side by Airbus Defence and Space GmbH in Ottobrunn. On the French side, Airbus DS, Toulouse was selected as the industrial supplier for the MERLIN satellite platform in late 2014. The (French) preliminary design review (PDR) for the satellite was carried out successfully in June; the (German) payload PDR will follow in October/November 2015. The final joint French-German decision on mission implementation is scheduled for the end of mission Phase B towards the end of the year. The satellite launch is planned for 2019/2020.

DLR's asteroid lander MASCOT took off for the (C-type) asteroid 1999 JU3 on December 3, 2014, from Tanegashima Space Center in Japan, on board the rocket carrying the Japanese Hayabusa2 probe (see p. 31). During a touch and go manoeuvre on the asteroid, the probe will retrieve material from the asteroid's surface and bring it back to Earth. MASCOT on the other hand will land on the asteroid, move across its surface in hops and for the first time in the history of space exploration conduct measurements at various locations on an asteroid. The lander, which was developed and built at DLR, and its four instruments will be monitored and controlled from DLR's Mascot Control Center in Cologne. CNES's contributions to MASCOT include the power subsystem, part of the telecommunication system including antenna development, analysis of the descent and landing mission, and the MicrOmega (optical microscope and NIR hyperspectral camera) tool, which was developed at the Institut d'Astrophysique Spatiale in Orsay. Hayabusa2 will reach the asteroid in summer 2018.

Cooperation with FFG

The bilateral framework agreement on increased collaboration in space exploration between DLR and FFG stipulates regular meetings of the steering committee. One such meeting was held in November 2014 in accordance with arrangements made at a meeting to discuss the research cooperation earlier that year. Harald Posch (Head of the Austrian Aeronautics and Space Agency ALR) and Dr Thomas Geist (Earth observation expert at ALR) attended the meeting for Austria. DLR was mainly represented by members of the Executive Board Prof. Wörner and Dr Gruppe. Topics on the agenda included discussions on political and strategic matters such as the 2014 Council of Ministers or Horizon2020. In a second block of talks on research cooperations, the attendees also discussed the joint use of the European Earth observation system Copernicus by DLR-DFD and Austria's Earth Observation Data Center (EODC). With DLR's participation in the EODC kick-off meeting in late January in Vienna and joint projects for ESA this cooperation is now taking concrete shape.



European Groups

Institutionalised European space exploration in Horizon2020

Left to right: Massimo Cavaliere (CIRA), Jan Wörner (DLR), Ignacio Azqueta Ortiz (INTA), Michel Peters (NLR) and Bruno Sainjon (ONERA)

The European space industry has submitted a position paper for the upcoming work programme 2016–2017 in order to draw attention to its topics for the next call for proposals. In contrast to aeronautics, transport and energy there is currently no independent body representing the national space research institutions to the EU Commission. In order to be able to position itself in a similar manner to the space industry, DLR has begun negotiations led by Prof. Wörner with other national space research institutions with the aim of developing a joint strategic position. At a working level, a joint position paper was drafted that was discussed with the executive boards of CIRA, INTA, ONERA and NLR on March 12, 2015. At a further executive meeting on June 19, CIRA, DLR, INTA, ONERA and NLR determined to formally create an association in Belgian law by the end of the year in order to be able to represent institutional space research with a strong joint voice based on common programmatic activities.

Joint Technology Initiatives (JTI)/ Public Private Partnerships (PPP)

DLR has successfully submitted applications to the calls for proposals in JTIs and PPPs.

In Clean Sky 2, five of seven applications in which DLR is involved were successfully evaluated. In the recently ended call for proposals for partners, further applications were being prepared with European partners, especially NLR, in areas in which DLR was not involved in preparations. An application for the second wave of calls for proposals for Core Partners in the spring of the coming year will also be possible.

Following the positive assessment of DLR and NLR's joint application for membership in the SESAR 2020 Joint Undertaking, DLR and NLR's options for participation were further substantiated as part of the Competitive Dialogue. A final decision is expected by the end of 2015. Independently of this decision, DLR is participating in 27 applications in the SESAR 2020 call for proposals for exploratory research.

DLR has similarly applied to become an associate member of Shift2rail, the JTI for rail transport, where three of four applications in which DLR was involved were evaluated positively.

DLR participated in two of the 57 submitted project proposals for the 2014 call for the hydrogen fuel cell JTI (FCH-2), neither of which were however accepted for funding.

ACARE/Flightpath 2050

At the DLR New Year's Reception, Prof. Wörner invited the ACARE chairs Mr Hartman (KLM) and Mr Wachenheim (Airbus) to the DLR office in Brussels to discuss the further development of ACARE. In addition to the imminent replacement of the general assembly and thus also the chair team, they discussed the organisation's approach to and communication with the new EU Commission and the European Parliament, and put together initial thoughts on the upcoming review/update process for the ACARE Strategic Research and Innovation Agenda next year, which is to be launched during the next General Assembly Meeting in October 2015.

A dedicated session to celebrate the 15th anniversary of ACARE is being prepared for the 2015 Aerodays, which will take place in October in London.

AET – Association for European Transport

AET is one of the leading European organisations in the transport sector and with more than 300 members from 35 countries has a broad network in research, business and administration. In October 2014, Dr Kuhnimhof, head of the Passenger Transport department at the DLR Institute of Transport Research,

was appointed DLR's representative at AET and was immediately elected to the AET Council. For the next three years he will represent members' interests on this board, which serves the function of a supervisory board, and participate in strategic discussions on the future orientation of AET and the European Transport Conference (ETC) held annually by AET.

EERA – European Energy Research Alliance

Early this year, DLR joined EERA AISBL (AISBL stands for non-profit organisation) as a full member, reaffirming its strong commitment to European energy research. The first general assembly following the restructuring took place on April 29, 2015; over 100 members attended. The day after the general assembly, the topic of Research for the Energy Market 2035 was discussed with the member states, the EU Commission and others.

ECTRI – European Conference of Transport Research Institutes

ECTRI's activities are currently focused on shaping the content of the next Horizon2020 work programme 2016-2017. Led by Dr Piehler, Director of DLR's Transport programme, DLR submitted working papers and statements on research and administrative topics. In November 2014, Dr Piehler was elected Vice President of ECTRI. Alongside its strategic work on the board, DLR is also a major contributor to ECTRI's Thematic Groups and Task Forces. DLR's involvement is motivated mainly by its desire to expand the range of content-related discussions, initiate bilateral cooperations and prepare consortia for EU project applications. This ensures that DLR's positions are integrated into ECTRI's work at all levels.

EGVIA – European Green Vehicles Initiative Association

DLR has been a member of EGVIA, headquartered in Brussels, since 2013. The aim of EGVIA is to promote and facilitate pre-competitive research in the fields of energy efficiency and alternative engines for road vehicles. On behalf of the EU Commission, EGVIA is shaping the European road transport agenda in research, development and demonstration. Following some initial minor difficulties, multiple DLR institutes are now actively participating in the working groups and have submitted EU project applications together with other EGVIA partners.

EREA – Association of European Research Establishments in Aeronautics

On December 9, 2014, EREA chairman Mr Kaspar of the VZLU (Aerospace Research and Test Establishment, Czech Republic) welcomed approx. 150 guests from the European Parliament, the EU Commission, industry, research and member states to the EREA annual reception. In his speech he looked back on the past year, in which EREA took a first important step towards implementing the EREA Future Sky Joint Research Initiative with a successful EU application on safety. In his keynote address, Mr Round, director at the European Defence Agency (EDA) reported on the integration of military aspects into European cooperation.

The EREA board meeting on the following day agreed the further procedure for implementing the EREA Future Sky Joint Initiative, closer cooperation between

Collin Hicks (left) and ESA Director-General Jean-Jacques Dordain at the leaving ceremony for Mr Hicks

EREA and the Council of European Aerospace Societies (CEAS) and the further positioning of EREA in Horizon2020. In addition, further approaches regarding aeronautics research infrastructures in ACARE Working Group 5 and Air Transport Net (AirTN) were determined.

Based on these decisions, the EREA Future Sky Joint Research Initiative developed the "noise" and "system" aspects at the working level and prepared for the upcoming work programme 2016-2017 in Horizon2020.

EURISY

The aim of EURISY is to open up the use of space applications to potential users in particular from the public sector and SMEs. Based on ten selected case studies, EURISY has analysed the advantages of satellite-based information and services for public users. The results of this research indicate that these services effectively support the work of public administrations in terms of cost savings and improve services in these cases. To provide more reliable information,

a large-scale study is now underway based on an online questionnaire; it is available in nine languages and addresses national, regional and local public authorities across Europe. The study is supervised by an advisory board, of which DLR is also a member. In June 2015, Dr Karlheinz Kreuzberg, previously ESA Head of Cabinet, took over the EURISY presidency from Collin Hicks, who had led EURISY for nine years.

DLR is a member of EURISY and represented in both the organisation's general assembly and its council.

YRS – Young Researchers Seminar 2017

DLR has won the call for proposals to host the renowned Young Researchers Seminar 2017. The YRS aims to bring together around 50 young transport researchers from across Europe for a three-day workshop. Instructed by experienced tutors, the young researchers will have the opportunity on the one hand to expand their specialist expertise and on the other to gain experience in communicating and presenting their research in an international but nonetheless protected context. The YRS is jointly funded by the three major European transport associations European Conference of Transport Research Institutes (ECTRI), Forum of European National Highway Research Laboratories (FEHRL) and Forum of European Road Safety Research Institutes (FERSI).

International Cooperation

Algeria

A further pillar has been added to DLR's cooperation with Algeria. In November 2014, DLR and the DG-RSDT (Direction Générale de la Recherche Scientifique et du Développement Technologique) signed a corresponding framework contract. The contract was occasioned by the AlSol project (AlSol = construction of a solar thermal tower power plant in Algeria), which is to be funded through the International Climate Initiative (IKI) of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety. The aims of this project are to install a solar tower and expand it into a demonstration and test centre in Algeria.

Brazil

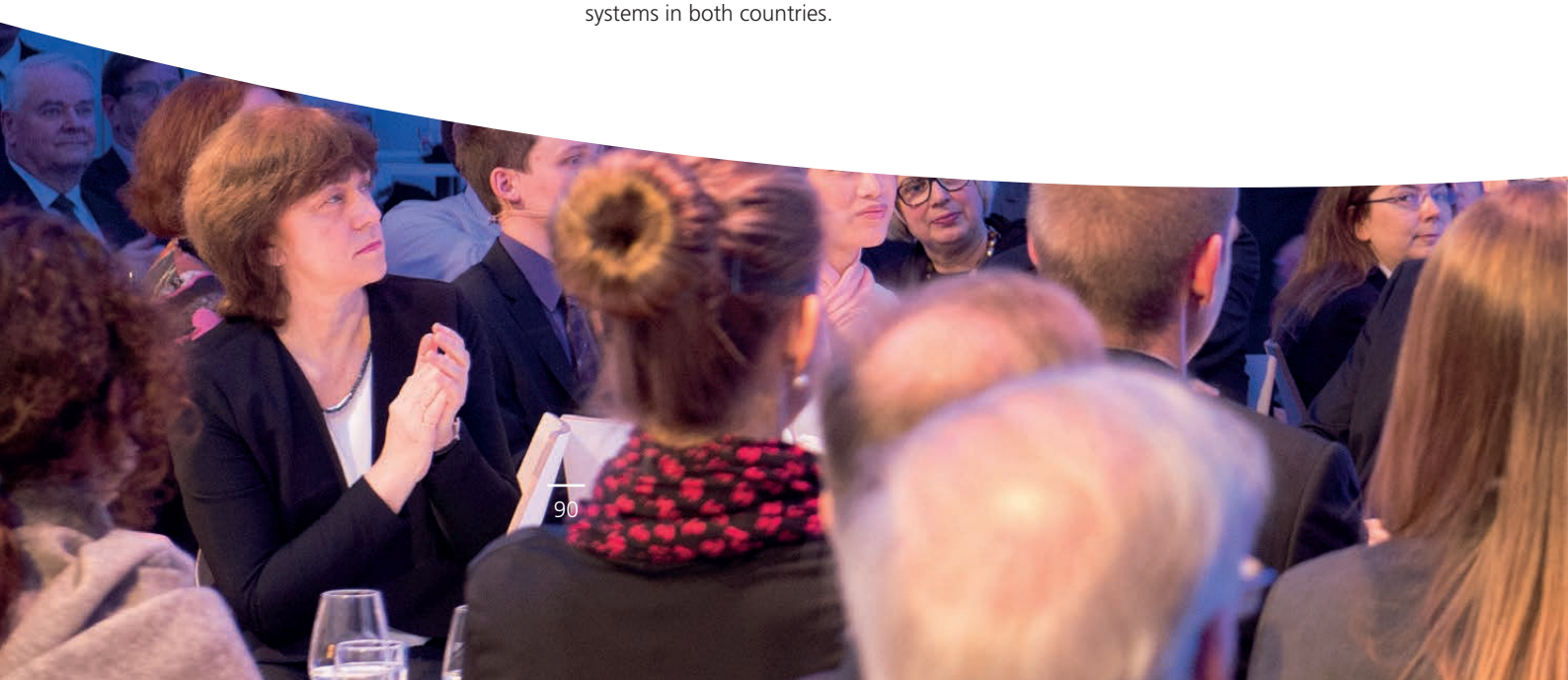
Brazil remains one of DLR's most important international partners in the development of sounding rockets. During mutual visits, most recently by the president of the Brazilian space agency AEB (Agência Espacial Brasileira) to DLR in late April 2015, further steps to expand cooperation between DLR and Brazilian institutions were agreed. The future topics of cooperation are relevant to the whole of DLR and also include the German space exploration industry. By utilising complementary experiences and infrastructures, cooperation with Brazil provides a valuable contribution to technological development in the field of space propulsion systems in both countries.

Collaboration with the space research institute INPE (Instituto Nacional de Pesquisas Espaciais) and other partners to evaluate infrared data from the German TET satellite was further defined during a joint workshop in Berlin in late 2014. Involving the Gesellschaft für internationale Zusammenarbeit (GIZ) and other state partners in Brazil creates a link to the Fire Prevention, Control and Monitoring of Bush Fires in the Cerrado project. The intended reception of TET data in Brazil will serve as a welcome practical contribution to the FireBIRD mission. Signing of a trilateral agreement (DLR, INPE, AEB) on this project is imminent.

The Brazilian fellowship programme Science without Borders (Ciência sem Fronteiras), on which a memorandum of understanding was also signed with AEB in 2013, is allowing first DLR researchers to conduct research stays in Brazil.

China

On October 10, 2014, the new MoU on Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes between the Chinese space agency China National Space Administration (CNSA) and DLR was signed in the presence of Federal Chancellor Merkel and Chinese prime minister Li Keqiang. On the German side, both Prof. Wörner and Dr Gruppe attended the ceremony at the Federal Chancellery. More detailed negotiations took place immediately thereafter at DLR's Berlin Mitte offices. The new treaty replaces corresponding agreements signed by DARA and DFVLR dating from before 1997.



As part of the GRAIN 2 workshop in Xian, the 28th CAE-DLR Joint Committee Meeting, lead by Mr Hüners and Dr Hua Jun, took place on June 5, 2015. The Joint Committee coordinates the research cooperations between the China Aeronautical Establishment (CAE) and DLR.

Israel

On the initiative of Dr Gruppe, DLR and the Israeli space agency ISA initiated the first German-Israeli space days. Key points were discussed with ISA and with the Israeli Ministry of Science, Technology and Space at a meeting attended by DLR members of the Executive Board Prof. Wörner, Dr Gruppe and Prof. Dittus during IAC 2014 in Toronto. The event is to be held in Israel in November 2015 with attendees from research and industry.

Japan

DLR continued to steadily expand its collaboration with Japan in 2014/2015, focusing mainly on the Japanese aerospace agency JAXA, with which DLR agreed a strategic partnership in April 2015. It is JAXA's first such extensive agreement with an international partner. Other cooperation partners included research institutes such as NICT (National Institute for Communication and Information Technologies) and NIRS (National Institute for Radiologic Science), universities (in particular the University of Tokyo and Tohoku University in Sendai), the Japanese specialist administrative department and the country's aerospace industry.

DLR–JAXA strategy meeting in February 2015 in Cologne

A particular highlight of the collaboration with JAXA was the launch of the Japanese asteroid mission Hayabusa-2 on December 3, 2014. The DLR lander MASCOT, which will explore the asteroid 1999 JU3 on location in 2019 (see p. 31), took off with Hayabusa-2. Prof. Dittus and the MASCOT team observed the launch from the Tanegashima Space Center and took advantage of the trip to Japan to hold numerous cooperation negotiations.

The close, long-established cooperation between DLR and JAXA also continued in aeronautics in the form of the trilateral meeting led by Prof. Henke that took place in January 2015 at DLR in Oberpfaffenhofen. A central decision of this year's meeting was to align cooperation in aeronautics research even more strongly to long-term strategic goals.

In February 2015, this notion was also implemented in space exploration. In order to generally align cooperation between DLR and JAXA to longer-term goals, members of the Executive Board Prof. Wörner, Dr Gruppe and Prof. Dittus for DLR agreed a strategic partnership with JAXA Vice President of Strategy Mr Yamaura. In space research, DLR and JAXA intend to coordinate more closely

particularly in the fields of Earth observation, ISS, carrier systems, exploration and generally with regard to space systems and technologies. The specific combination of the respective partners' core competencies will enable the Strategic Partnership to both utilise the research capacities of both partners more effectively and guarantee the targeted use of their taxpayer-funded budgets, allowing DLR and JAXA to generate greater added value and expand their globally recognised strengths in space exploration.

DLR also promoted closer collaboration between the two countries' space industries in 2014/2015. Following a first delegation visit by the German space industry led by Dr Gruppe in June 2014, in September 2014 a delegation of the Japanese space industry led by the Japanese Ministry of Economics (METI) visited the Federal Ministry of Science and DLR. As part of this visit, DLR's Space Administration held a symposium on collaboration between German and Japanese space exploration companies. A reciprocal visit from a German industrial delegation, again led by Dr Gruppe, to Japan in June 2015 met with a positive response from both sides. This continuity in personal negotiations remains especially important in order to develop a trustful, long-term partnership on equal terms.

Japan continues to show great interest in working more closely with Germany in energy research. In order to further sound out cooperation opportunities for DLR in this field, the programme director for Energy Research at DLR, Mr Milow, visited Japan in November 2014 to speak with potential partners and government bodies. The responses were very positive and negotiations will continue in autumn 2015 in Japan. Over the course of the past year, numerous Japanese research institutions, among them the Railway Technical Research Institute (RTRI), the National Institute of Information and Communications Technology (NICT), the Japan Association of Marine Safety (JAMS) and Nagoya University, visited DLR to discuss ongoing cooperations and develop new cooperation projects.

Canada

Canada is a long-standing major partner for DLR, especially in Earth observation. Radar remote sensing is a joint focus of these Earth observation activities. The Canadian Space Agency CSA and the DLR Space Administration support the combined use of C-/X-band data and bilateral cooperation on developing applications with involvement from industry. Of particular interest are near-realtime services for maritime security or the polar region. Combining C- and X-band creates synergy effects with high added value from an operational point of view. A jointly initiated implementation agreement on carrying out coordinated funding measures in this area was published in October 2014.

German-Canadian cooperation in aviation research is also developing positively. The aerospace division of the Canadian National Research Council (NRC Aerospace) undertook several delegation visits to DLR, including a meeting between NRC Aerospace General Manager Jerzy Komorowski and Prof. Henke in December 2014. Beyond the existing cooperations, a long-term partnership with NRC Aerospace would be of interest in a number of areas such as UAV, cabin research and ATM in aeronautics, or remote sensing applications in space exploration.

Kazakhstan

The annual meeting of the KazCosmos–DLR steering committee took place in Astana from October 13 to 19, 2014. The 2nd German Space-Borne SAR Seminar

in Kazakhstan was held to coincide with this meeting. The purpose of the seminar was to enhance both space organisations' understanding of future requirements regarding SAR Earth observation. Major contributors to the meeting further included interested companies in the space industry, particularly Airbus Defence and Space and IABG, and on the Kazakh side the Kazakh state space corporation Kazakhstan Garysh Sapary.

Mexico

As part of a German-Mexican scientific and technical cooperation meeting in July 2014, DLR held a bilateral workshop on capacity building in the space sector in cooperation with the Mexican space agency AEM (Agencia Espacial Mexicana). Cooperation between the two countries was advanced in the field of Earth observation using thermal infrared remote sensing, including fire monitoring. Radar remote sensing and the creation of a ground segment in Mexico were also discussed. As infrastructure for joint future use, the ground station in Chetumal, which was handed over to AEM in early 2014, forms an important element of the bilateral space cooperation.

Russia

Prof. Dittus attended the 2014 COSPAR conference in Moscow with a DLR delegation. Various informal visits and bilateral meetings took place during the conference, for example with the president of SkolTech university, Prof. Edward Crawley; the rector of the Moscow State University of Geodesy and Cartography – MIIGAiK, Prof. Mayorov; and the deputy director general of the leading Russian space exploration company RKK Energia, Alexander Derechin. A further trip to Saint Petersburg and Moscow was planned based on the results of these meetings, and took place in late June 2015. The aim of the discussions was to advance collaboration with Russian institutions and find new areas of cooperation. The most important topics here were the cooperation projects between the DLR Institute of Robotics and Mechatronics and the Institute of Robotics and Technical Cybernetics in Saint Petersburg on the ISS, the cooperation between the DLR Institute of Space Systems and the Keldysh Institute in the field of electrical propulsion systems for spacecraft, and closer collaboration between DLR and the Russian Academy of Sciences in the fields of complex plasmas, material physics in space, Earth observation and solar system research. Multiple institutes of the Russian Academy of Sciences are involved in these activities. The outcome of the discussions was a decision to set up German-Russian working groups to coordinate activities in robotics and in Earth observation and ensure that they are functional by the International Aviation and Space Salon MAKS 2015 in Moscow. At the invitation of Dr Gruppe, Mr Komarov, then director general of the new space exploration company United Rocket and Space Corporation (URSC), visited DLR in Oberpfaffenhofen with several of his deputies on October 8, 2014. Dr Komarov has meanwhile been appointed director general of the ROSCOSMOS state corporation, which was formed in July 2015 through a legally mandated merger between the Roscosmos space agency and URSC. The initiated dialogue was continued by Prof. Wörner at the Paris Air Show in Le Bourget on June 14, 2015.

An inter-agency agreement between DLR and ROSCOSMOS regarding the ICARUS project was signed in September 2014. The purpose of this project is to observe animal migrations from the ISS.

Saudi Arabia

Talks on cooperating to capture direct solar radiation data in order to identify suitable locations for planned solar thermal power plants in Saudi Arabia are currently underway between the DLR Institute of Solar Research and King Abdallah University/Center for Atomic and Renewable Energy (K.A. CARE). This project will be carried out in cooperation with GIZ and for the first time make use of an existing AVB supplemental agreement. The DLR institute would be tasked with the technical validation aspect and would operate as a subcontractor for GIZ, which would be responsible for managing the contract.

South Africa

Cooperation between DLR and the South African Council for Scientific and Industrial Research (CSIR) was expanded particularly in the transport sector. A Memorandum of Understanding (MoU) designed to facilitate joint research on transport systems, material design and production came into force in July 2014. Representatives of the DLR Institute of Vehicle Concepts and CSIR met for a multi-day workshop in Stuttgart in April 2015 to advance thematic approaches in the field of transport systems and vehicle concepts.

South Korea

Alongside the long-established space cooperation with the Korea Aerospace Research Institute (KARI), South Korea is increasingly also becoming an interesting and important cooperation partner in security research. Cooperation in the fields of materials and structural research was further strengthened by a visit from the

First meeting of the DLR-SSAU steering committee in Kiev

Prof. Henke and Dr Shin sign the DLR-NASA cooperation agreement in aeronautics

new president of the Agency for Defense Development (ADD) in November 2014 and visits at the working level. The launch of the Korean Kompsat-3a satellite in March 2015 was a highlight in the space sector. Major parts of the optical instrument were developed by German industry in collaboration with the focal plane electronics section of the DLR Institute of Optical Sensor Systems. The instrument is working extremely well and delivering image data of the highest quality.

Ukraine

In bilateral talks at IAC 2014 in Toronto, the directors of the State Space Agency of Ukraine (SSAU) and the Executive Board of DLR made the decision to establish a DLR-SSAU steering committee. This steering committee met for the first time in June 2015 in Kiev. The committee's main task is to coordinate the mutual cooperation activities. The corresponding agreement was signed during a meeting between Prof. Wörner and Mr Urusski, the head of SSAU, at the Paris Air Show 2015 in Le Bourget.

USA

DLR's already excellent relations with the USA were intensified and expanded in numerous work meetings. In September 2014, Prof. Henke and the NASA Associate Administrator for Aeronautics Research, Dr Shin, met at the International Council of the Aeronautical Sciences (ICAS) to discuss German/European and American aeronautics research and advance bilateral cooperation projects. The DLR Aeronautics guiding concepts and the American NextGen programme formed the background for these talks. Follow-up meetings between Prof. Henke and Dr Shin took place during an ICAS meeting in Washington in May and in June 2015 at the Paris Air Show in Le Bourget, where two cooperation agreements on aircraft noise simulation and improving helicopter aerodynamics were signed and other future cooperation topics were discussed.

Important new aspects of space cooperation and strategy with the USA are the new space economy and commercial space exploration. In addition to Space X, Orbital ATK, Bigelow Aerospace, Teledyne Brown Engineering, Sierra Nevada Corporation SNC and Virgin Galactic, to name just a few, an increasing number of companies such as Urthecast, Google – Skybox, Planetlabs, Nanoracks or Made in Space are offering commercial aerospace applications. In Europe, Great Britain, France and Germany are taking particular note of this trend; the developments are being integrated into strategy development, DLR technology marketing and industrial space policy through the US-German Aerospace Round Table UGART with the American Space Foundation and through the Aerospace parliamentary group.

Presentation of the HALL OF FAME award

To further expand connections to American and German SMEs and academia, a SpaceWorld trade fair on the topic of commercial space flight was held successfully in cooperation with UGART in Frankfurt in October 2014 as part of AIRTEC 2014. To follow up, member of the Executive Board Dr Gruppe travelled to commercial partners on the West and East Coast of the USA in March 2015 to support German partners in lining up commercial projects. The topic was highlighted for the first time at the international Space Symposium in April 2015 in Colorado Springs during a German panel as part of the fifth UGART and at a DLR trade fair booth under the motto Make it with Germany. Also at the Space Symposium, the Technical Understanding Agreement on Dream Chaser between SNC and DLR was extended until 2017. DLR and commercial company Chronos Vision were awarded the Space Foundation's Hall of Fame award for the *Eye Tracking Device*, an innovation from space medicine. The award recognises the successful transfer of space technologies to routine medical practice in ophthalmological cataract surgery. Following Hall of Fame awards for technologies such as Fly-by-Wire for Airbus and Firewatch for DLR–IQ Wireless, this is the third highly respected innovation award from the USA for European/German companies in the last seven years.

Overall, the main focus of DLR's cooperation with the USA remains on bilateral projects such as Eu:CROPIS and mission contributions such as InSight with NASA and selected US universities. Existing and new cooperation projects were discussed in bilateral working meetings at IAC in Toronto in October 2014, during a visit by Prof. Dittus to NASA Langley and JSC Houston in autumn 2014, at the DLR Christmas party in Washington in December 2014 and at the Paris Air Show in June 2015. Visits from US specialists from NASA Glenn to DLR Bremen and from NASA AMES to DLR Cologne served to advance existing cooperations and initiate new projects. These close relations with the globally largest space exploration partner USA are essential to enabling DLR to realise its goals and positions in the long term and set standards for the future.

IFAR – International Forum for Aviation Research

The world's only platform of aeronautics research institutes was founded in 2010 at DLR's initiative and now brings together 26 leading aviation research organisations – one organisation per country – from Europe, Asia, Australia, Africa and America. The IFAR members represent approximately 90 percent of global research in aviation. The organisation's overarching goal is to jointly meet the challenge of enabling environmentally and climate friendly aviation across countries and continents. IFAR utilises exchanges of knowledge and experience to develop strategies for future scientific research and joint projects, and paves the way for new partnerships and cooperations both within aeronautics research and outwardly with business and politics.

IFAR focuses on a range of cross-disciplinary topics: technologies relating to climate impact, noise and local emissions, alternative fuels, efficient flight management, weather and natural phenomena, flight operations and flight safety.

Cooperation in a range of working groups is voluntary, allowing each IFAR member to participate according to its abilities and capacities and open up new cooperations. Communication and networking within IFAR are supported through a dedicated communication platform called IFARLink, which is open to all employees of the 26 IFAR organisations and a range of universities. Supporting young researchers also plays a major role, with annual conferences for junior researchers, virtual conferences that are open worldwide, and IFARLink. New ways of networking young researchers and engineers are being explored through the joint young researchers' award presented by IFAR and ICAS, the International Council of the Aeronautical Sciences, launched in 2014.

The highest IFAR board is the annual summit attended by the top management levels of the member organisations. Prof. Henke as member of the DLR Executive Board responsible for aeronautics is the leading representative for DLR. In 2014, the IFAR summit took place in Zhuhai, China, at the invitation of the Chinese Aeronautical Establishment (CAE). For 2015, NASA has invited the members to California, where the regular bi-annual leadership handover will also take place: NASA's IFAR chair, held by Dr Jaiwon Shin, will pass to JAXA, represented by Dr Kazuhiro Nakahashi. NLR, represented by Michel Peters, will be the new deputy chair.

DLR has played a major role in IFAR from the outset: in addition to its leading subject-based scientific and technical work, Prof. Joachim Szodruch of DLR served as chair for many years, and is now a member of the IFAR management team. DLR also provides the IFAR Executive Secretary, the IFARLink communications platform, the IFAR website and, jointly with NASA, the IFAR Secretariat. DLR and NASA have reached an agreement on their mutual funding of IFAR, ensuring that two of the world's most important aviation research institutions actively further the interests of IFAR.

@ **www.ifar.aero**

UNESCO

From October 15 to 16, 2014, the German UNESCO Commission and DLR held an expert discussion on aerospace history and the possible nomination of German sites and facilities as UNESCO world heritage sites. The two-day talks with approx. 20 experts particularly explored the question of whether sites in Germany could meet the criteria of the UNESCO World Heritage Convention. The possibility of nominating sites from aerospace history is a relatively new idea around the world: these sites are frequently still in current use or re-use; some are also historically charged.

Approaches to meeting the criteria were found in the form of serial nominations, i.e. the joint naming of similar sites or sites that are related to each other. The discussion is to be continued among the previous group of experts at a second workshop in 2015.

In late June 2015, Germany hosted the 39th World Heritage Committee Meeting, held by the the German UNESCO Commission. During this meeting, the results of the DLR expert discussions from October 2014 were presented by DLR and GUC representatives at a side event and

discussed with international experts. Possible steps for future international processes were also outlined.

UN COPUOS

The second UN expert panel took place in November 2014 at DLR in Cologne. 24 experts from DLR, the University of Cologne, ESA, the Federal Foreign Office and the Federal Ministry of Economic Affairs and Energy (BMWi) met with the German ambassador to the United Nations in Vienna to discuss current topics and trends for the UN Committee on the Peaceful Use Of Space (UN COPUOS Vienna) and its two subcommittees. The attendees discussed topics both from the Legal Subcommittee and the Scientific and Technical Subcommittee. Subjects these two committees deal with include:

- The international Space Mission Planning Advisory Group (SMPAG) and the International Asteroid Warning Network (IAWN). Both bodies are affiliated with the UNCOPUOS Scientific and Technical Subcommittee and develop approaches to creating internationally coordinated responses to the dangers of Near Earth Objects. DLR is a member of both bodies.
- Two new groups were founded by the Scientific and Technical Subcommitee in 2015: the Expert Group Space Weather and the Expert Focus Group on Space and Global Health. DLR and the University of Landau are members of these groups.
- UN SPIDER, specifically the Bonn office, has further improved its knowledge portal. Information on satellite data, analysis and interpretation is now also available in Spanish and French.
- The 2015 Legal Subcommittee recognised the issue of *Space Traffic Management*, raised by Germany, as highly significant to regulating the use of space going forward, and created a new working group on the subject. This move aligns with the working group on legal issues relating to small satellites, which was also newly set up.
- The third volume of the English-language standard work on space law, the Cologne Commentary on Space Law (CoCoSL), which is issued in collaboration between DLR and the University of Cologne, was presented at a reception.
- Initial preparations for the planned UNISPACE+50 conference to be held in 2018 were initiated in both subcommittees in order to present UNISPACE+50 as an appreciation of UNISPACE I 1968.
- DLR additionally informed the Scientific and Technical Subcommittee of the latest developments regarding the Rosetta/Philae mission and presented results and experiences from the Blue Dot mission with Alexander Gerst.

International Space University (ISU)

The International Space University (ISU), founded in 1987 and sited in Strasbourg, specialises in teaching space knowledge. The one-year degree course Master of Space Studies and the two-month Space Studies Program cover almost the entire range of space-related topics such as space technology, space policy, space law and economics and management. In its teaching, the ISU focuses heavily on its three 'I's: interdisciplinarity, internationality and interculturality.

The German delegation at the German booth in Bonn

Alexander Gerst: special talk "the blue dot perspective" at the UN SPIDER/UNOOSA/DLR/ BMWi conference in late May in Bonn

DLR is on the Board of Advisors (BoA), the Board of Trustees (BoT) and the Academic Advisory Committee (AAC) of ISU. It also regularly provides lecturers and accepts ISU students who want to complete the mandatory internship for their degree course at DLR. Two DLR employees took part in the Space Studies Program held at Ohio University in the USA in 2015.

UN SPIDER

Together with DLR and UNOOSA, UN SPIDER (UN Platform for Space-based Information for Disaster Management and Emergency Response) highlighted the added value of space-based information for disaster management in several side events at the 3rd Global Conference on Disaster Risk Reduction in Sendai, Japan, in March 2015. In Sendai, OOSA announced the global partnership focusing on Earth observation and space-based technologies formed by 18 partners from around the world, among them DLR, to illustrate the benefit of space-based technologies in disaster management and increase their use. As a member of the German delegation, DLR also staffed the booth initiated by the German Committee for Disaster Reduction (Deutsches Kommitee für Katastrophenvorsorge, DKKV) together with other German organisations working in disaster management.

In May 2015, DLR, UN SPIDER, the Federal Ministry of Economic Affairs and Energy (BMWi) and UNOOSA held the UN/ Germany Conference on Earth Observation – Global Solutions for the Challenges of Sustainable Development in Societies at Risk – at the "Langer Eugen" building in Bonn as a dedicated follow-up event to the conference in Sendai. With approx. 120 participants from over 30 countries, the event was very well attended and addressed aspects of the

Sendai framework that demand Earth observation and space-based information for disaster management. Potential uses of and possible improvements resulting from space-based technologies were discussed in depth in terms of their administrative, scientific, application-oriented, political and horizontal aspects.

UN University (UNU)

UNU is the academic arm of the UN tasked with developing sustainable solutions to urgent global problems. DLR has been cooperating very well with UNU in Bonn for many years, especially in Earth observation. Specific topics include hydrology, risk assessment and vulnerability of our Earth. On February 23, 2015, the two organisations signed an agreement to enhance their cooperation. DLR and UNU hope that this agreement will lead to even closer networking in science and research, and further joint projects on Earth observation, in particular on climate change and sustainable resource protection, but also on satellite communications and navigation, with the aim of building and transferring knowledge. This may also include an exchange of experts and supervision for doctoral and Diplom candidates.

A first joint workshop at management level on the implementation of the agreement focused on migration, urbanisation, environmental and ecosystem services and health. The two organisations also intend to examine the interoperability of various data sectors, from satellite data to data from social media or crowdsourcing, in order to gain better information.

Signing the agreement in Bonn, left to right:
Prof. Dr Wörner, DLR; Prof. Rhyner, Vice Rector of UNU; Prof. Dittus, DLR

OECD Space Forum

In October 2014, the OECD (Organisation for Economic Co-operation and Development), of which DLR is a member, held a high-calibre conference under the heading "The Economic Impacts of Space Technologies" in Paris with presentations from industry and space organisations. DLR contributed on the subject of innovation processes in research and development. The latest issue of the OECD brochure Space Economy at a Glance was published to coincide with the event. In addition to updating data, this publication focuses on the global value creation chain and the particular dynamics of the space sector.

In early 2015, the OECD Space Forum held consultations and workshops with industry, institutions, agencies, associations and statistics offices to discuss data and procedures. DLR participated in these consultations.

Structure and Organisation

Technical Infrastructure

Technical Infrastructure (TI) contributed significantly to shaping the new DLR management system over the past year. To this end TI is represented in the DLR Management System steering committee, the Integrated Management System working group and the Environmental Protection and Occupational Health and Safety working group. A further key area of TI's work was to continue developing processes in Facility Management. Following the Executive Board's decision to gradually integrate and continuously advance energy management in DLR, TI is continuing to develop and shape this policy and advising a subsystem on qualifying for certification as a pilot project.

The Masterplan working group, which was part of Object Management, was successfully concluded. DLR now has a facility management tool at its disposal which in future will allow it to efficiently and reliably plan the use of sites for infrastructure and buildings as required. A further component of future area management is the Rental Management working group, which describes future processes for renting, renting out and purchasing real estate. This working group, run by Object Management, handles matters such as defining DLR's minimum requirements regarding rental properties in close coordination with Construction Management, DLR Security and the Legal and Contracts department. Object Management has successfully implemented sustainable transport within a site. An electric vehicle charging station was set up at DLR's Oberpfaffenhofen site, and electric vehicles were procured for site security at the Cologne and Oberpfaffenhofen sites. These attracted significant visitor interest at the open day in Oberpfaffenhofen on October 12, 2014. A nextbike station with 10 rental bicycles was also installed there.

A positive result for Construction Management: the new :envihab building at the Cologne site was the first DLR building to win the Preis des Deutschen Stahlbaues (German Steel Industry Award) presented by the steel industry association BauforumStahl. The award went to the team of architects, the structural engineer, the steel construction company and also the building's owner, i.e. DLR. By winning one of Germany's oldest architectural prizes DLR has shown that public-sector building owners are capable of maintaining a balance between architectural quality and functionality for research. The :envihab building also won the design award Gestaltungspreis Baukultur in Deutschland. On February 23, 2015, an independent, interdisciplinary jury in Stuttgart selected the building, one of 615 submissions from all over Germany, for recognition in the third prize category.

:envihab Köln

The draft design for the new office complex Building 5 (intended to replace the Central Administration and Executive Board building) at the DLR site in Cologne, which was chosen in a competition, describes a central, free-standing building that projects out in a star shape. The new building covers a usable area of 9,300 m², which includes offices, a printing shop and photographic services.

Electric vehicle charging station in Oberpfaffenhofen

Quality Management and Product Assurance	2012	2013	2014
Number of accreditations	10	9	11
Audits performed	72%	82%	80%
Projects on behalf of Space Administration	33	38	38
INS success rate	1.64	0.00	1.30
TNS success rate	1.39	0.89	0.00

After working through the design and adapting it to current requirements regarding efficient and sustainable construction and systems engineering, the planning application was submitted in February 2015.

With a thermal output of 125 megawatts and similar technical complexity to a large-scale power station, the newly built high-pressure combustion chamber test rig HBK5 (see p. 109) at the Cologne site is the only one of its kind in the world. It will be used for research and development aiming to drastically reduce emissions from gas turbines in aircraft engines and power plants in order to help protect the environment.

The Technology Systems House (Systemhaus Technik, SHT) is a popular service partner within DLR. A project of particular note is interturb – a materials science examination of laser-sintered titanium aluminide. To achieve economic viability, the project focuses mainly on linking complex and wide-ranging skills. In 2015, competencies were developed in the use of product data management (PDM) and product lifecycle management (PLM) platforms, in calculating finite element methods (FEM), calculating and designing fibre composite structures, in five-axis simulation and implementation and in mechatronics/adaptronics. Joint implementation facilitates a common language within the SHT, efficient knowledge transfer and cost savings due to shared infrastructures within projects. With the introduction of FEM 3-D printing, a further technology for a wide range of applications has become available at the Oberpfaffenhofen site. The SHT also relaunched its website to raise its profile. Despite significant demand for the high-quality technical services provided by the SHT, the main focus remains on economic consolidation.

@ **DLR.de/sht/**

Quality Management, Product Assurance, Standards

Quality management

DLR is one of Europe's best research institutions. With this status come highest standards for the quality of our scientific results and technological developments. Assuring that quality is an important corporate policy objective.

It plays a major role in DLR's overall strategic and operative alignment and is an indispensable success factor for reliable research.

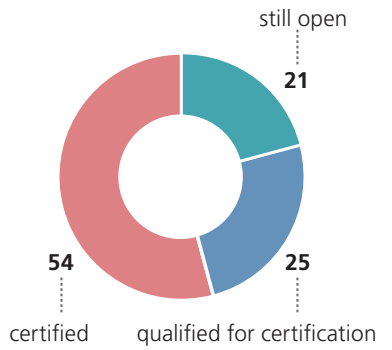
DLR's intentions in implementing its quality management system are to continuously enhance our competitiveness and customer retention, to further improve our legal position, and to increase our efficiency by standardising our operating and management processes across institutes and facilities.

The international quality standard for management systems, DIN EN ISO 9001, was specified as the minimum standard for our institutes and facilities. We intend all our institutes and facilities to qualify for certification in the near future, and actually achieve certification in the medium term.

By the end of the reporting period, 41 facilities had established quality management systems, while a further 11 are currently in the process of setting them up.

Certificates for management systems are the result of an audit by an independent third party, generally the accredited certifying board. The Deutsche Akkreditierungsstelle (DAKKS) is the appointed national organisation responsible for accreditations; accreditation is a formal recognition of technical competence. Certification and accreditation are the basis of and frequently a prerequisite for approval by public authorities, which can be issued by the respective authorities. DLR holds all three forms of approval.

Certifications across DLR



All figures in percent July 2015

Over and above the minimum standard, several subsystems have integrated and achieved certification in sector-specific standards (VDA 6.2, ISO 13485, OSHAS 18001, ISO 14001, DIN ISO 27001).

DLR furthermore has accredited laboratories at the Institutes of Space Systems, Vehicle Concepts and Transportation Systems (RailsiTe®) and holds approvals from the Federal Aviation Office and EASA at the Institute for Flight Experiments and from the German Federal Office of Civil Aviation as an air navigation service provider at DLR GfR.

Certification and accreditation are increasingly considered a competitive advantage in successfully acquiring third-party funding.
DLR currently employs 21 internal auditors; a further 42 are now in training in order to expand the basis for performing internal audits by increasing the number of qualified DLR personnel.

All institutes and facilities have a quality representative or named contact in the Quality Working Group (AKQ). The existing DLR management systems are currently being further modernised and expanded. This integrated approach and the inclusion of a wide range of management topics such as environmental and energy management, occupational health and safety, IT, risk management, compliance and human resources development are designed to identify and utilise synergies.

Product Assurance

Product Assurance is currently undergoing a realignment process in particular in the Research and Technology division of

→ Quickfact:

28

Institutes and facilities independently certified according to international standard **DIN EN ISO 9001**.

DLR with the aim of systematically recording product assurance activities in DLR's research projects and providing the projects with advice and support. In March 2015 a DLR workshop was held to determine demand for this supporting activity from the DLR institutes and facilities.

The result was that the research institutes would like more help in developing and applying norms and standards. The aim is to reduce costs by specifically selecting (tailoring) the necessary requirements and systematising requirements for the various research areas of DLR.

In a pilot project, the product assurance requirements as per the ECSS (European Cooperation for Space Standardization) were tailored to the Spacehand project; the highly anticipated results are expected by the end of the year.

At the same time, a competence and expert network for product and quality assurance is being set up at DLR to achieve horizontal synergies.

Standardisation

In order to effectively spread new technologies and potential growth areas on the global markets, the rapid innovation cycle of technical development demands not only market-based research but also strategic instruments. Alongside patents, norms and standards are also such instruments. Norms and standards are therefore increasingly being integrated into research and innovation processes in Germany and Europe.

Spacehand from the RMC in Oberpfaffenhofen

DLR institutes in the fields of space exploration, aeronautics, energy and transport have been participating in the funding initiatives "Innovation with Norms and Standards" (INS) and "Transfer of Research and Development Results through Standardisation" (TNS) of the Federal Ministry of Economic Affairs and Energy since 2007 and 2010, respectively (see table on p. 101). The aim is to achieve better commercial utilisation of DLR research and development results for the benefit of society, actively support cutting-edge technologies, and increase technology transfer between industry and research.

Since the beginning of its participation DLR has submitted a total of 56 standards-relevant projects. Due to our careful selection of project topics in terms of their relevance and societal importance, an above-average number of projects were awarded to DLR compared to other applicants. The average success rate for both funding programmes is 1.15 for the entire period.

DLR experts are additionally involved in over 60 different national, European and international standards committees, where they hold seats in the research areas of space exploration, aeronautics, energy and transport. Their many activities there include serving as chairpersons for the DIN standards committees NA 131-06 (Space) and NA 131-10 (Interoperability of Information, Communication and Navigation Systems) and leading the German delegation for the international standards committee ISO TC20 SC14 (Space).

Qualifying EEE components for space flight

EEE components account for up to 30 percent of the hardware costs of a space flight system and comprise active and passive electronic, electrical and electromechanical components. Their use and operating environment present particular challenges in terms of reliability, lifecycle and resistance to vibrations, radiation and temperature. EEE components therefore have to be appropriately qualified.

DLR has an annual total budget of approximately 2.4m euros to conduct evaluation and qualification projects for EEE components, which allowed eleven component projects to be funded in 2014. In all, 29 ESCC certificates have been awarded to seven certified German manufacturers since the programme began.

50 percent of the strategic components that are crucial to the performance and reliability of space flight equipment or systems are manufactured in the USA and subject to US export restrictions, also known as ITAR (International Traffic in Arms Regulations). As a result, the availability of EEE components for national space exploration projects is severely limited. The ITAR restrictions mean that systems with strategic US components may not be supplied to certain countries, which makes cooperations between DLR and other space nations difficult or even impossible.

In order to increase the availability of these components from European sources, DLR defines and implements the national Technological Development and Qualification Programme for EEE Components and works with national component manufacturers to develop and qualify these components based on the standards and specifications developed in cooperation with the European partners in the European Space Components Coordination (ESCC). These measures have succeeded in reducing dependency on US exports from 70 percent to 50 percent in recent years.

Sustainability, Environmental Protection, Security

Sustainability

As reported in the previous issue, sustainability is a central issue for DLR. DLR takes the economic, ecological and social aspects of sustainability into consideration both in its strategies and its operations, with the sustainability aspects Research for Sustainability and Sustainable Research as fundamental pillars. In future, DLR will explore this issue more intensively and report on its activities based on the results of the current LENA project led by the Fraunhofer-Gesellschaft.

The first sustainability report 2014/2015 has meanwhile been published and is available as an e-paper to read online or download. The report follows the German Sustainability Code and reflects the information required by the Global Reporting Initiative (GRI). It reports on activities relating to the two aspects listed above; these are therefore not comprehensively covered here.
You can access the report here:

@ **http://s.DLR.de/133v**

The key visual for sustainability in DLR

Environmental Protection

Numerous activities took place in environmental management. For example, the existing internal overview of relevant environmental aspects was further expanded and the environmental performance indicator system advanced and prioritised in line with ISO 14031 (Environmental Management - Environmental Performance Evaluation – Guidelines).

Integrated environmental audits were successfully carried out within TI and at the DLR site in Lampoldshausen. The project management agency in Bonn has expanded its efforts in environmental management and installed a corresponding officer to extend the existing system to include the environmental aspect as per ISO 14001. The DLR Institute for Solar Research is also expanding its management system to conform to ISO 14001.

At the initiative of TI, the Executive Board determined in its 495th Executive Board Meeting in February 2015 that TI should oversee the addition of an energy management pillar to the DLR basic system. The Energy Management working group was created in this context in order to on the one hand meet political and legal requirements regarding energy efficiency and on the other hand reduce energy costs at DLR. In addition, a decision was made to conduct a pilot project to develop and introduce an energy management system at a DLR institute.

The DLR Institute of Composite Structures and Adaptive Systems in Braunschweig has volunteered for this project and will be aiming to qualify for certification as per ISO 50001 (Energy Management System) after the pilot project.

Security

In accordance with the Executive Board's decision at its 495th meeting, the Security and Environmental Officer developed a recommendation for implementing a standardised process across DLR for transferring duties and skills in occupational health and safety (delegation of duties), which the Executive Board approved at its meeting on March 16, 2015. The core element of this recommendation is that responsibility for DLR employee security and environmental protection is considered an inherent component of management work and should thus be intrinsically tied to a disciplinary management function. This delegation of duties along the management chain will be implemented with the support of DLR Security.
DLR Security continues to work on the overall concept for risk assessment in DLR. In this context a prototype developed in-house to document findings from risk assessments was successfully tested. The findings from this application are currently being gathered in a specification document and will then be presented to the staff councils in DLR in order to integrate staff representatives' views regarding the overall risk assessment concept into the specifications. DLR's Emergency and Crisis Management Handbook was coordinated within the responsible working group, which consisted of the managers of the relevant sections of Technical and Administrative Infrastructure, site management teams and the central staff council.

A total of 67 notifiable accidents took place at DLR in 2014, of which 31 were directly connected to work. The remaining 36 accidents occurred during business trips or while travelling between home and the workplace. There were again no fatal incidents at DLR.

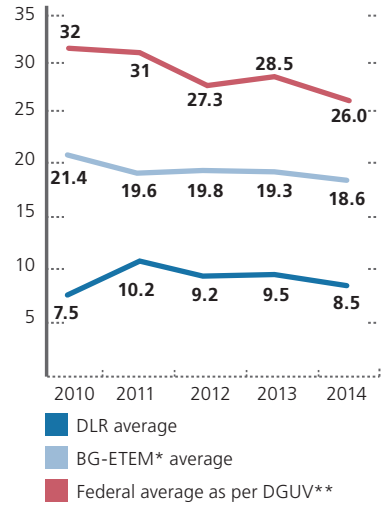
The average working time lost per accident again fell in 2014, to 11.5 days. The entirely work-based accidents were mainly falls and tripping accidents with effects on the entire musculoskeletal system, and cuts. However, accidents involving fractures also occurred during the reporting period and led to longer periods of lost working time.

The accident ratio per 1,000 persons is an indicator designed to facilitate comparisons between accident figures at different companies. In 2014, this indicator was 8.5 at DLR and thus significantly lower than in the previous year.

For comparison, the "accident ratio per 1,000 persons" recorded by the trade association "Energie Textil Elektro Medienerzeugnisse" (Energy, Textiles, Electricity and Media Products, BG-ETEM) among its members was 18.6 in 2014 (19.3 in the previous year).

Accident trends at DLR

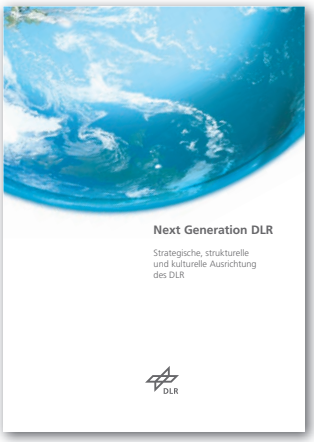
1000 person accident rate
(working and commuting accidents
per 1000 members of staff)

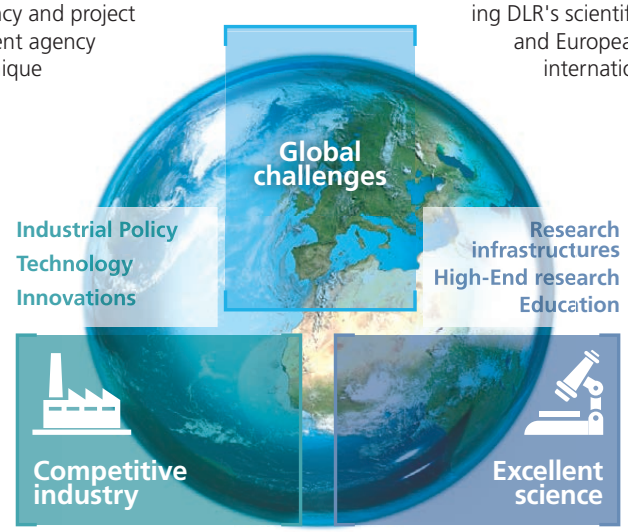


* German professional association representing the Energy, Textiles, Electric Industries and Media Productions
** DGUV: Umbrella organisation, German Social Accident Insurance

Future Development of DLR

Following the publication of the documents Next Generation DLR and the Guidelines in 2014, which describe the central, long-term principles for managing DLR, the addition of medium-term objectives and measures for the individual DLR programmes went public in early 2015. With Prof. Wörner's departure to take up the position of Director General of ESA, the focus under the new Chairwoman of the Executive Board, Prof. Ehrenfreund, is now on quickly transforming this dynamic into concrete, new and additional activities. As a research centre, space agency and project management agency DLR is a unique institution with high potential for synergy. For example, a task force will be working until early 2016 to identify potential synergies between the aeronautics and space exploration, transport, energy and security business areas, the inherently multidisciplinary character of which holds the key to new innovative products and services. The illustration shows the associated challenges and strategic drivers relevant to DLR. The revised overall strategy for DLR planned for the summer of 2016 is also designed with this aim in mind. Alongside the guideline *OneDLR*, strengthening DLR's scientific profile and European and international networking will be further areas of focus. These and other measures will serve to underline and reinforce DLR's claim to be a leading national and European centre in its fields. DLR's research results not only strengthen the core areas of German industry, but also provide important potential solutions to the global challenges of our time.





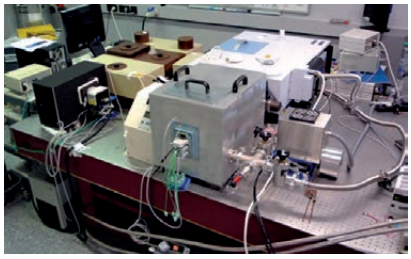
CHALLENGES AND STRATEGIC DRIVERS

The documents can be found here:

@ **http://s.DLR.de/7633**

DLR Infrastructures – A Selection

Berlin



Planetary Emissivity Laboratory

The Planetary Emissivity Laboratory (PEL) is designed for spectroscopic measurements of planetary materials. It consists of three different spectrometers working in a vacuum or purged atmosphere, which can be coupled with a planetary simulation chamber to conduct unique emission capacity measurements in a vacuum at temperatures ranging from 30 to 1000 degrees Celsius. It can also deliver measured reflection and transmission data from solid to fine-grain samples from the visible to the far infrared spectral range. In addition, the laboratory has a large collection of minerals, rocks and extraterrestrial samples, as well as a sample preparation and characterisation department with cabinets for storing samples under controlled atmospheric conditions.

Braunschweig

Modular mock-up

This mock up is used to research, develop and evaluate vehicle interior designs and concepts for driver assistance and automation systems, focusing on technical or human-centred research perspectives depending on the issues to be examined. Affordable and fast, as vehicle structure, seating arrangements, displays and operating controls are flexibly designed. This modularity allows a range of transformations from single-seater to five-seater. The mock-up is integrated into DLR's highly dynamic and scalable simulation environments such as the Virtual Reality Laboratory or the dynamic driving simulator in order to address specific questions in a very targeted manner. This allows vehicle systems and driving strategies to be tested quickly and efficiently.

Braunschweig

RailSET® – humans in the railway laboratory

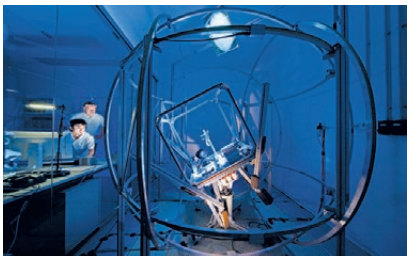
In the railway system, humans interact with a range of technical interfaces as train drivers, traffic controllers or schedulers. Efficiency and effectiveness of these interactions affect the safety and performance of the railway system. The RailSET® laboratory can help design workplaces, new information and assistance systems in a human-centred way. The working context is replicated realistically in a simulation environment to allow researchers to vary influencing factors as required and examine their effects. Train drivers guide simulated trains along simulated routes in a cabin with an original control panel. A simulated workstation for traffic controllers completes RailSET®.

Braunschweig

Do 228 D-CODE upgrade

The Maritime Security research association also examines air-based services: unmanned aerial vehicles for special monitoring purposes. Testing and validating the procedures and technologies developed by the project requires comprehensive demonstration and trial facilities, ranging all the way to a real experimental aircraft. Expanding the existing Do 228 D-CODE system by integrating a digital autopilot (with an interface to the experimental systems) will allow testing of operational and technical contexts.

Bremen



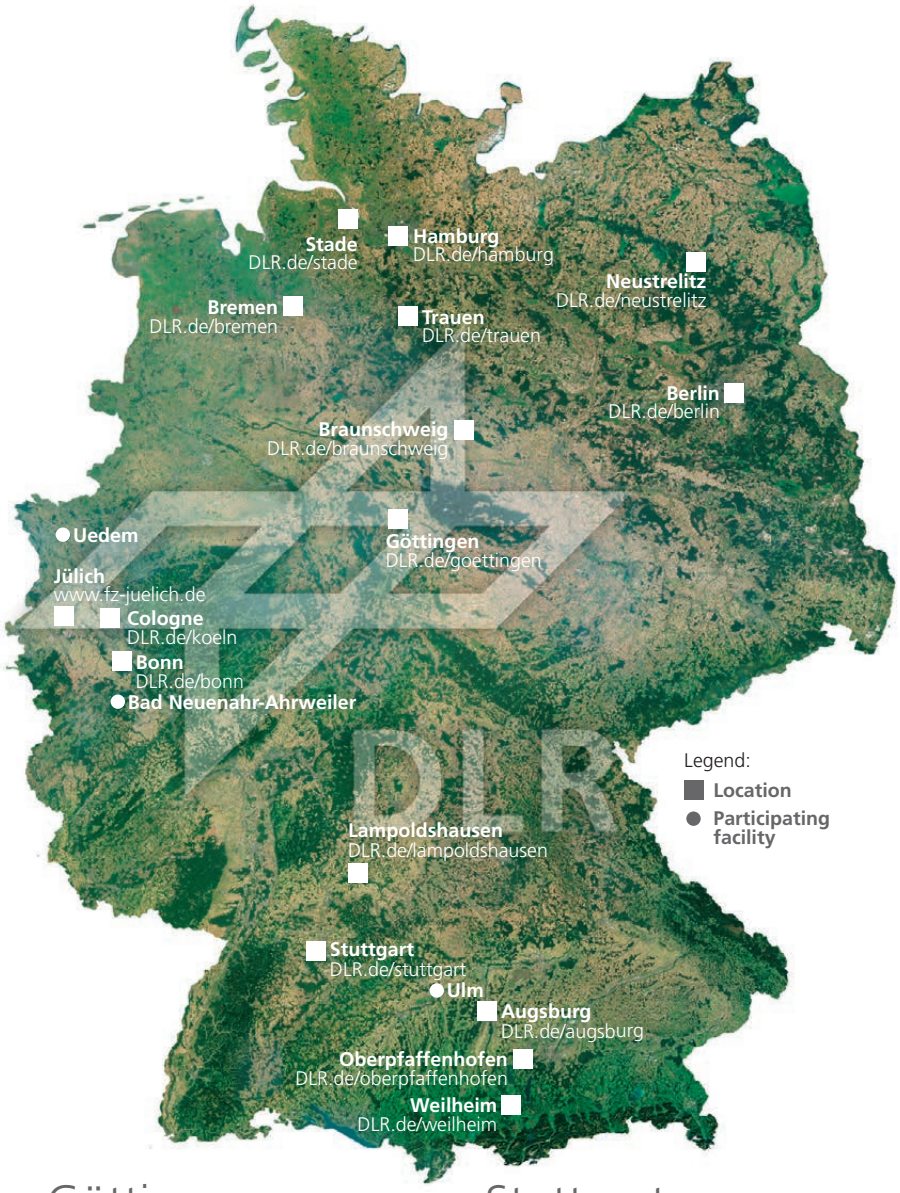
Cryo laboratory

Enables the exploration of scientific and technical questions in space technology relating in particular to the development of restartable cryogenic carrier system upper stages in order to achieve technical solutions. Testing is possible at temperatures of up to -263 degrees Celsius. Among the tests performed here are basic and materials research, qualification and function tests. These include pressure loss measurements on sieves, testing composite fibre tanks and systems for handling cryogenic fuels. Slosh experiments with different tank geometries and research into subcooled fluids are also conducted. The laboratory will contribute actively to the Upper Stage research association and the ESA study FLPP.

Cologne

QUARZ® laboratory

The test rigs in the QUARZ® laboratory are used to test and certify components of solar thermal power plants. This mainly includes reflectors and absorber tubes, which manufacturers or power plant developers can test for performance and longevity. The possibilities range from material tests through assistance in component development to quality control in serial production. In addition, the solar researchers at the QUARZ® laboratory are constantly developing the methods and measuring tools used for specific quality reviews of the components and systems, such as the new QFly measuring method. These results help define product specifications and quality standards for technologies used in concentrating solar thermal power plants.

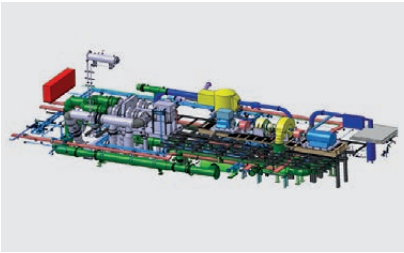


Cologne

HBK 5 Engine Test Rig

In cooperation with industry partners Alstom Power and Rolls-Royce Germany, DLR has expanded its infrastructure for developing environmentally friendly gas turbines. After a construction period of one year and an investment of approx. 50 million euros, the new HBK5 was inaugurated in late November 2014. With its thermal output of 125 megawatts, which corresponds to the power of approx. 1,000 medium-class cars, it offers new testing and development options in the field of combustion chamber test rigs. The facility will make it possible for the first time to test a combustion chamber ring outside a jet engine under highly demanding conditions: inlet pressure, inlet and outlet temperature and the volume of incoming air can be adapted to replicate conditions during aircraft take-off.

Göttingen



Turbine test rig NG-Turb

In the Next Generation Turbine Test Facility (NG-Turb) we have created a new turbine test rig that on the one hand is capable of simulating the main flow parameters of future high-performance turbines (such as higher pressure ratios, expansion to low-pressure turbines, two shafts, multiple stages etc.) and on the other hand is large enough to allow detailed measurements in the flow field or on the model turbine. The facility is designed for pressure ratios up to 14 and a volumetric flow of up to 230,000 m³/h. NG-Turb can be operated at variable pressures and temperatures, allowing important performance indicators such as Mach and Reynolds number to be set independently.

Stuttgart

All-wheel roller test bench

This test bench is designed for front-wheel. rear-wheel and all-wheel drives and features exhaust gas analysis, fluid and gaseous fuel consumption measuring and supply and air conditioning, allowing different driving situations to be simulated both for conventionally powered vehicles and for hybrid vehicles. Thanks to its explosion protection, the test bench is also certified for vehicles with gaseous fuels. An air conditioning system makes it possible to operate the test bench at a constant temperature in the range from -40 to + 60 degrees Celsius. The maximum possible speed at which vehicles can be tested is 200 km/h. The test bench is additionally equipped with a speed-controlled air flow. All these technical parameters make DLR's roller test bench unique in terms of its wide range of testing options.

Stuttgart

DLR battery laboratory

Mobile energy stores form the basis of cutting-edge propulsion systems for vehicles with hybrid engines, for fully electrical vehicles, but also for hydrogen and fuel cell technologies. The key technology for implementing broad electromobility is an efficient, affordable and customer-friendly battery. In the battery laboratory of the DLR Institute of Technical Thermodynamics, researchers are developing lithium-sulphur and lithium-air batteries using new nano- and microstructured electrodes that potentially offer excellent capacity (energy density), and testing the behaviour of these batteries at extreme temperatures.


To SM

FACTS & FIGURES


esa
Alexander Gerst

Members and Committees

As of June 30, 2015, DLR had 40 sponsoring members in addition to honorary members, scientific members and ex officio members.

Ex Officio Members

- Prof. Dr Christine Ahrend, Berlin
- Prof. Dr Richard Bamler, Oberpfaffenhofen
- Prof. Dr Marion Bartsch, Cologne
- Prof. Dr Christa Baumstark-Khan, Cologne
- Uwe Baust, Düsseldorf
- Bernhard Conrad, Hamburg
- Prof. Dr Hansjörg Dittus, Cologne
- Dr Gerd Gruppe, Bonn
- Klaus Hamacher, Cologne
- Prof. Rolf Henke, Cologne
- Karin Holota, Neuhaus
- Prof. Dr Gerd Jäger, Essen
- Prof. Dr Uwe Klingauf, Darmstadt
- Axel Krein, France
- Dr Rainer Martens, Munich
- Prof. Dr Liqiu Meng, Munich
- Dr Fritz Merkle, Bremen
- Prof. Dr Reimund Neugebauer, Munich
- Dr Sigrid E. Nikutta, Berlin
- Peter Schlote, Backnang
- Prof. Dr Christiane Schmullius, Jena
- Prof. Dr Rudolf F. Schwarz, Ottobrunn
- Prof. Dr Stephan Staudacher, Stuttgart
- Prof. Dr Martin Stratmann, Munich
- Prof. Dr Peter Strohschneider, Bonn
- Dr Gerardo Walle, Überlingen
- Prof. Dr Johann-Dietrich Wörner, Cologne

Sponsoring Members

(Public entities that regularly give at least 50,000 euros annually)

- Federal Republic of Germany, represented by the Federal Minister of Economic Affairs and Energy, Berlin
- State of Baden-Württemberg, represented by the Baden-Württemberg Minister of Finance and Economics, Stuttgart
- Free State of Bavaria, represented by the Bavarian State Minister of Economic Affairs, Media, Energy and Technology, Munich
- State of Berlin, represented by the Senator for Education, Science and Research for the State of Berlin, Berlin
- State of Bremen, represented by the Senator for Education and Science, Bremen
- State of Lower Saxony, represented by the Lower Saxony Minister for Science and Culture, Hanover
- State of North Rhine-Westphalia, represented by the Minister for Innovation, Science and Research for the State of North Rhine-Westphalia, Düsseldorf

(Natural persons, legal persons, societies and associations with no legal capacity)

- Aerodata AG, Braunschweig
- AIR LIQUIDE Deutschland GmbH, Düsseldorf
- Airbus Group, Munich
- ALSTOM Power GmbH, Mannheim
- AOPA-Germany, Verband der Allgemeinen Luftfahrt e. V. (Aircraft Owners and Pilots Association), Egelsbach
- Arbeitsgemeinschaft Deutscher Verkehrsflughäfen (German Airports Association), Berlin
- Robert Bosch GmbH, Berlin
- BP Europa SE, Hamburg
- Bundesverband der Deutschen Luft- und Raumfahrtindustrie e. V. (BDLI, German Aerospace Industries Association), Berlin
- CAM Space GmbH, Munich
- Carl-Cranz-Gesellschaft e. V., Weßling/Obb.
- Commerzbank AG, Großkundencenter Region West, Düsseldorf
- Deutsche Gesellschaft für Luft- und Raumfahrt – Lilienthal Oberth e. V. (DGLR, German Society for Aeronautics and Astronautics), Bonn
- Deutsche Gesellschaft für Ortung und Navigation e. V. (DGON, German Institute of Navigation), Bonn
- DFS Deutsche Flugsicherung GmbH, Langen
- Diehl Aerospace GmbH, Überlingen
- ESG Elektroniksystem- und Logistik GmbH, Fürstenfeldbruck
- Fraport AG, Frankfurt/Main
- GAF AG, Munich
- Gemeinde Weßling (local authority), Weßling/Obb.
- HDI-Gerling Industrie Versicherungs AG, Düsseldorf
- Industrieanlagen-Betriebsgesellschaft mbH (IABG), Ottobrunn
- KUKA Roboter GmbH, Augsburg
- LIEBHERR-AEROSPACE LINDENBERG GmbH, Lindenberg
- Lufthansa Technik AG, Hamburg
- MT Aerospace AG, Augsburg
- MTU Aero Engines AG, Munich
- Nord-Micro Elektronik AG & Co. OHG, Frankfurt/Main
- OHB System AG Raumfahrt- und Umwelt-Technik, Bremen
- OHB System AG, Munich
- RheinEnergie AG, Cologne
- Rheinmetall Defence Electronics GmbH, Bremen
- Rolls-Royce Deutschland GmbH, Blankenfelde-Mahlow
- RUAG Aerospace Deutschland GmbH, Weßling
- Siemens AG, Munich
- Snecma Groupe SAFRAN, France
- City of Braunschweig, Braunschweig (local authority)
- Tesat-Spacecom GmbH & Co. KG, Backnang
- Volkswagen AG, Wolfsburg
- ZF Luftfahrttechnik GmbH, Calden

Honorary Members

- The Honorable Daniel Saul Goldin, Washington
- Prof. Dr Walter Kröll, Marburg
- Prof. Dr Reimar Lüst, Hamburg
- Jean Sollier, Rueil-Malmaison, France
- Prof. Gerhard Zeidler, Stuttgart

Scientific Members

- Prof. Dr Hans Hornung, Pasadena, California, USA
- Prof. Dr Joachim E. Trümper, Garching

Members of the Executive Board

As of June 30, 2014

- Prof. Dr Hansjörg Dittus
- Dr Gerd Gruppe
- Klaus Hamacher (Vice Chairman)
- Prof. Rolf Henke
- Prof. Dr Ulrich Wagner
- Prof. Dr Johann-Dietrich Wörner (Chairman)

Senate

As of June 30, 2015, the following persons were members of the Senate:

From the scientific sector

- Prof. Dr Christine Ahrend
- Prof. Dr Richard Bamler
- Prof. Dr Marion Bartsch
- Prof. Dr Christa Baumstark-Khan
- Prof. Dr Uwe Klingauf (Vice Chairman)
- Prof. Dr Liqiu Meng
- Prof. Dr Reimund Neugebauer (ex officio)
- Prof. Dr Christiane Schmullius
- Prof. Dr Stephan Staudacher
- Prof. Dr Martin Stratmann (ex officio)
- Prof. Dr Peter Strohschneider (ex officio)

From the business and industrial sector

- Uwe Baust
- Bernhard Conrad
- Karin Holota
- Prof. Dr Gerd Jäger (Vice Chairman)
- Axel Krein
- Dr Rainer Martens
- Dr Fritz Merkle
- Dr Sigrid E. Nikutta
- Peter Schlote
- Prof. Dr Rudolf F. Schwarz
- Dr Gerardo Walle

From the state sector

- State Secretary Mr Guido Beermann
- Under Secretary Rüdiger Eichel
- Under Secretary Dr Thomas Gerhardt
- Counsellor of State Gerd-Rüdiger Kück
- Under Secretary Günther Leßnerkraus
- State Secretary Matthias Machnig (Chairman)
- Dr Tobias Miethaner
- VLR I Stephan Röken
- Ulrich Schüller
- Under Secretary Dr Beate Wieland

(not entitled to vote in 2015)

- Under Secretary Dr Ronald Mertz

Senate Committee

As of June 30, 2015, the senate committee comprised six members from the scientific sector, six members from the business and industrial sector and six members from the state sector.

From the scientific sector

- Dr Joachim Götz
- Prof. Dr Angelika Heinzel
- Prof. Dr Rolf Radespiel
- Prof. Dr Christiane Schmullius (Chairwoman)
- Prof. Dr Heinz Voggenreiter
- Prof. Dr Gebhard Wulfhorst

From the business and industrial sector

- Eva-Maria Aicher
- Christian Below
- Prof. Dr Jürgen Leohold
- Dr Artur Redeker
- Dr Helmut Richter
- Berry Smutny (Vice Chairman)

From the state sector (entitled to vote in 2015)

- Dr Marcus Beiner
- Under Secretary Holger Schlienkamp
- Under Secretary Dr Dietrich Nelle
- Under Secretary Dietmar Schneyer
- Under Secretary Karl Trauernicht
- Under Secretary Norbert Michael Weber

(not entitled to vote in 2015)

- Dr Walter Dörhage
- Under Secretary Bernd Hoepner
- Senate Counsellor Bernd Lietzau
- Chief Under Secretary Dr Peter Mendler
- VLR Dr Dirk Rotenberg
- Under Secretary Dr Ulrich Steger

Permanent guest members

- Dr Dietrich Heimann
- Prof. Dr Felix Huber

Space Committee

As of June 2015

- USec Dr Werner Kloos, Federal Ministry of Food, Agriculture and Consumer Protection
- USec Beate Lohmann, Federal Ministry of the Interior
- Dr Tobias Miethaner, Federal Ministry of Transport and Digital Infrastructure
- USec Dr Dietrich Nelle, Federal Ministry of Education and Research
- VLR I Stephan Röken, Federal Foreign Office
- USec Rita Schutt, Federal Ministry of Finance
- USec Dr Ewold Seeba, Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
- USec Norbert Weber, Federal Ministry of Defence
- Assistant Director Frank Wetzel, Industrial Policy, Federal Chancellery

Scientific Council

Members of the STC as of 30 June 2015

- Prof Dr Manfred Aigner, Institute of Combustion Technology
- Prof. Dr Alin Albu-Schäffer, Institute of Robotics and Mechatronics
- Niko Bier, Institute of Aerodynamics and Flow Technology
- Dr Martin Bruse, German-Dutch Wind Tunnels
- Dr Birgit Gobereit, Institute of Solar Research
- Prof. Dr Dirk Kügler, Institute of Flight Guidance
- Prof. Dr Barbara Lenz, Institute of Transport Research
- Dr Simon Plass, Institute of Communications and Navigation
- Dr Thomas Popp, German Remote Sensing Data Center
- Prof Dr. Cord-Christian Rossow, Institute of Aerodynamics and Flow Technology
- Prof. Dr Stefan Schlechtriem Institute of Space Propulsion
- Dr Jan Hendrik Starcke, Institute of Combustion Technology

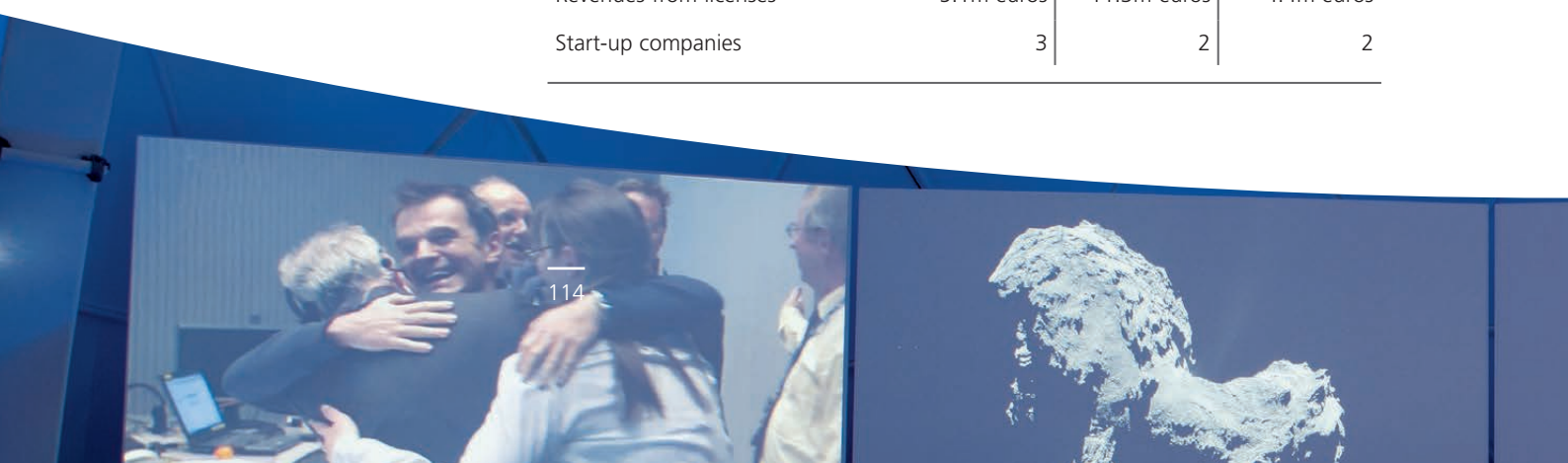
Compilation of Operating Figures

Third-party funding	2012	2013	2014
Total revenue from third-party funding	419m euros	449m euros	454m euros
Proportion of overall revenue from third-party sources	53%	53%	52%
Earnings trend in revenue from R&T activities in Germany	-2%	6%	-2%
Percentage of earnings from foreign clients (profit volume)	21%	21%	24%
Revenue from EU funding	26.8m euros	30.1m euros	31.0m euros
Success rate of EU applications (accepted/submitted)	30%	36%	29%
Coordinator quota on approved EU projects	16%	28%	28%

Research-related results	2012	2013	2014
Publications in peer-reviewed journals	656	781	940
Peer-reviewed publications in proceedings, books, etc.	647	1,012	1,272
Talks given at scientific conferences, workshops, lectures*	0.56	0.51	0.57
Appointments to universities	15	29	16
Lectureships	289	304	321
Diplom theses	438	385	443
PhD theses	109	135	136
Habilitations	3	1	1

* per member of scientific staff employed by the institutes and facilities

Technology Marketing	2012	2013	2014
Investments in technology transfer projects	4.5m euros	4.5m euros	4.5m euros
New in-house technology transfer projects	10	18	16
Revenues from licenses	5.1m euros	11.3m euros	4.4m euros
Start-up companies	3	2	2



Management instruments	2012	2013	2014
Total project work	77.0%	77.2%	77.2%

Quality and Product Assurance	2012	2013	2014
Existing certifications	29	29	31
Number of DLR auditors	14	23	23
Audits performed	72%	82%	80%
Projects on behalf of Space Administration	33	38	38

National and European networks	2012	2013	2014
DFG participations	35	32	36
Sponsorship agreements	38	41	50

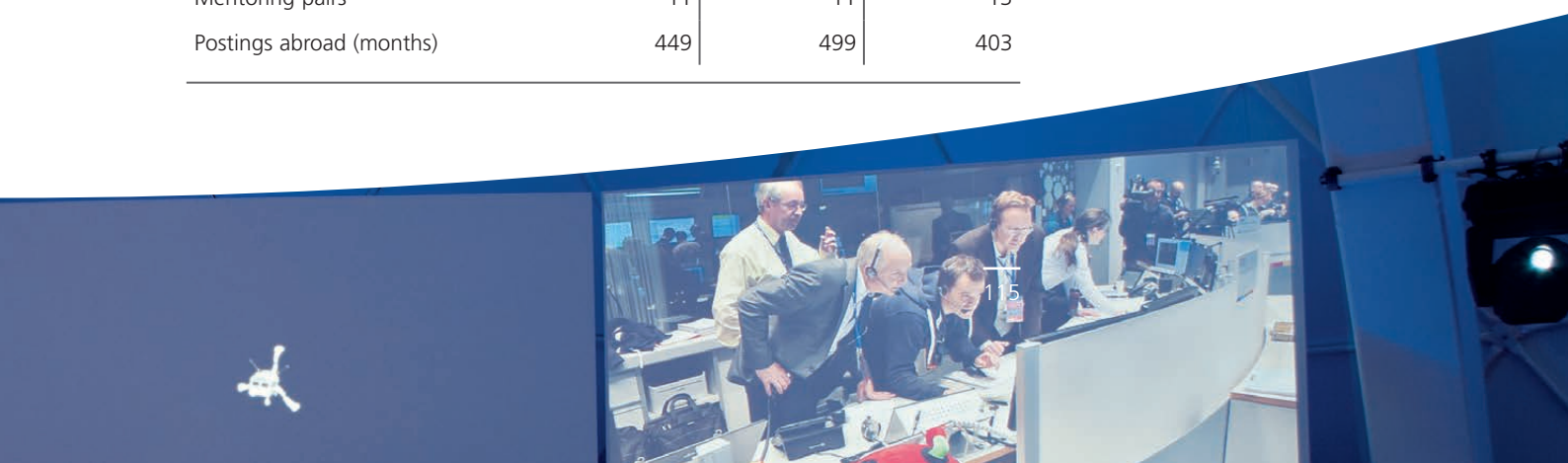
International cooperation	2012	2013	2014
International visiting scientists*	2.9%	2.5%	3.2%

*percentage of scientific staff in institutes and facilities (stays > one month)

Staff	2012	2013	2014
Employees	7,385	7,730	7,921
Scientific staff (total)	4,273	4,473	4,652
Scientific staff employed by institutes and facilities	3,744	3,913	4,028
Permanent/fixed-term contracts	3,707/3,678	3,932/3,798	4,125/3,796
Proportion of women			
– in total	30%	30%	31%
– in management positions	16%	17%	17%
– scientific staff	17%	17%	17%

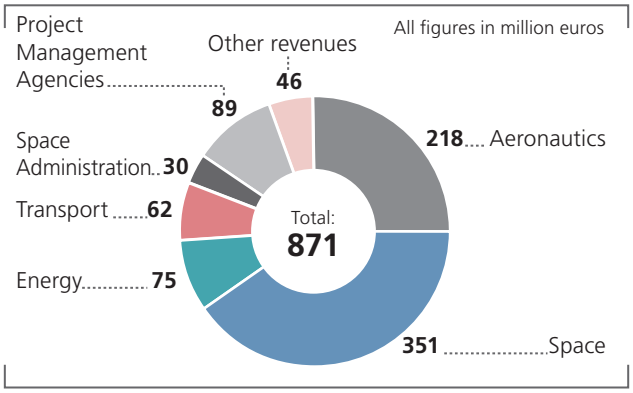
Education and Outreach	2012	2013	2014
Junior researchers	47	45	50
Doctoral candidates (internal/external)	947	1,005	1,018
Trainees	253	268	261

HR development and mobility	2012	2013	2014
Training days per employee	1.9	1.9	2
Mentoring pairs	11	11	13
Postings abroad (months)	449	499	403

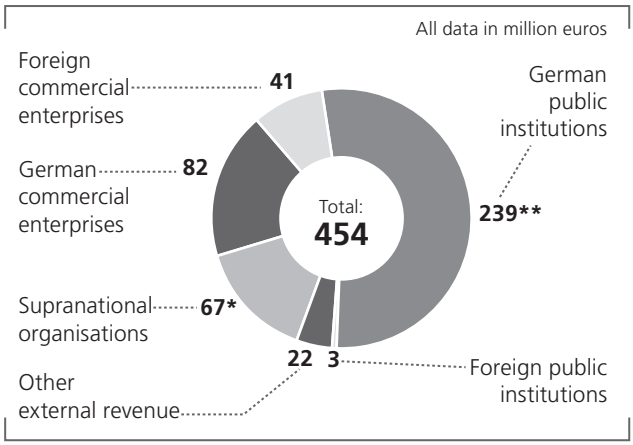


Use of funds at DLR

Overall Revenue 2014

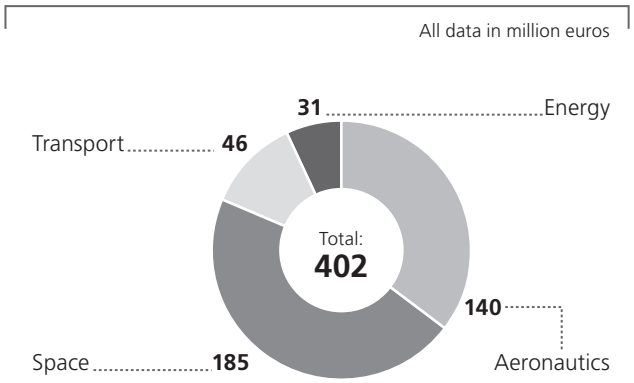


Third-party Funding Related to Origin 2014



* including: ESA **35**, EU **31**, other **1**
** including: national public institutions **113**, project sponsorship **98**, other r&B third-party funding **25**

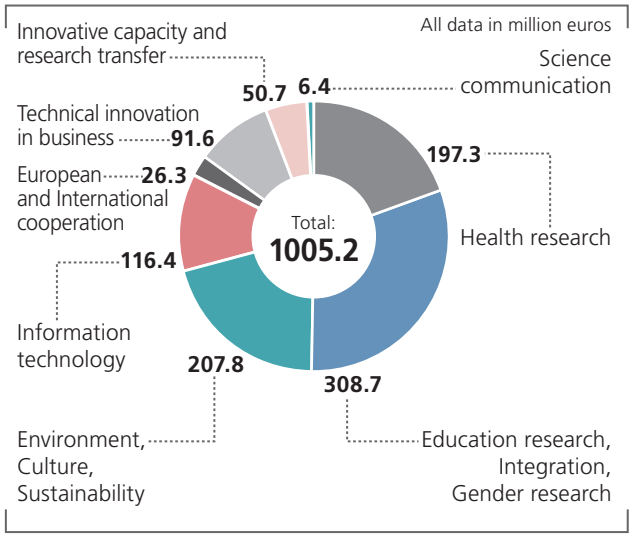
Institutional Funding 2014[1)]



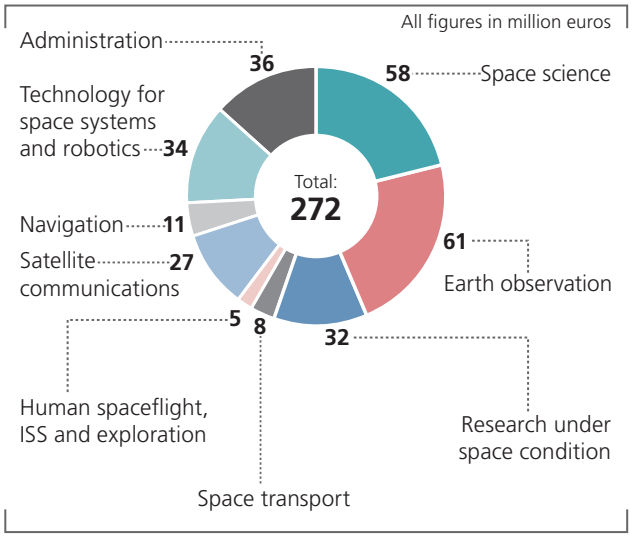
[1)] incl. assigned investments, without HGF fonds and ETW

Funding from the Federal Government

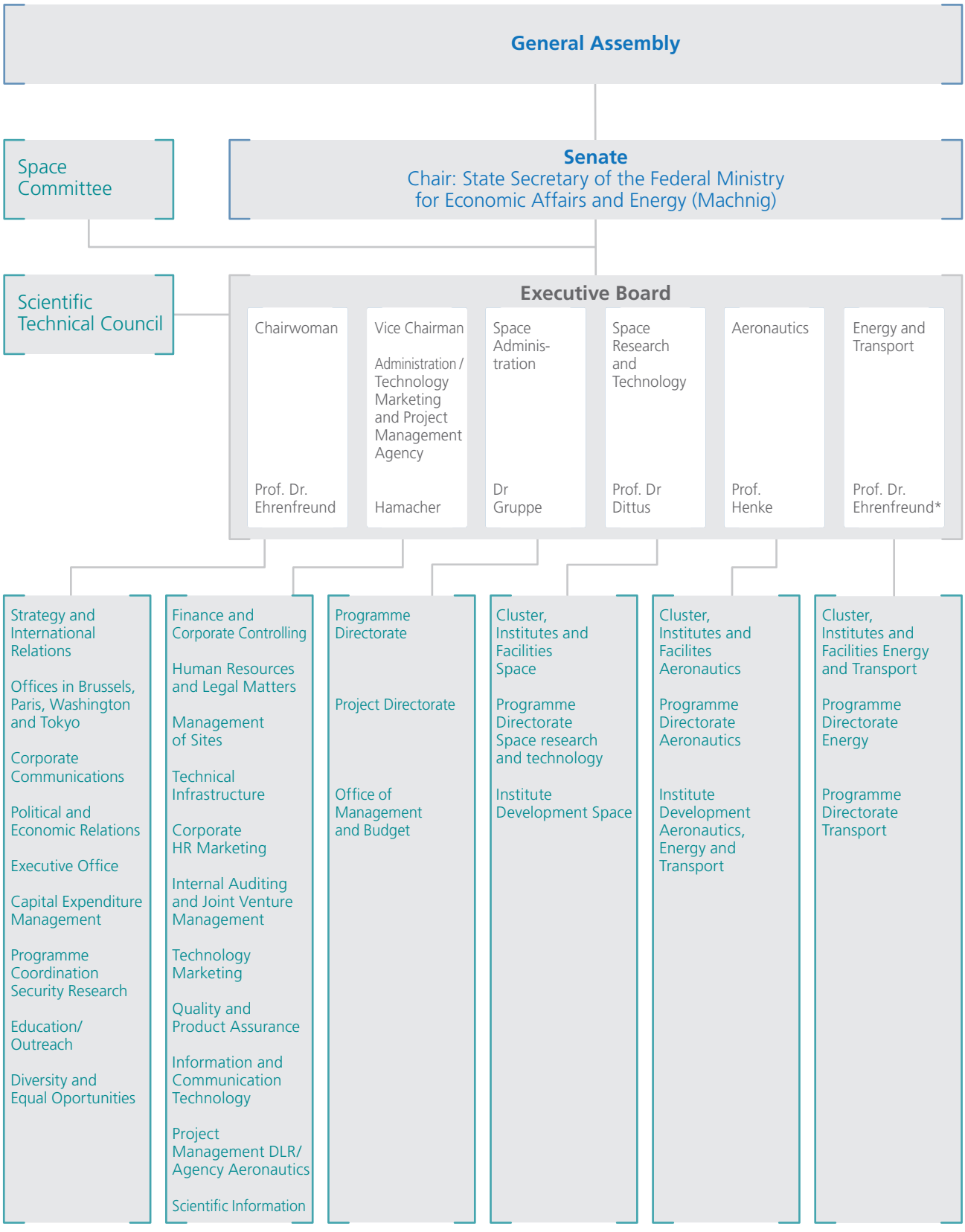
Managed funds of DLR Project Management Agency 2014



National Programme in 2014



DLR Bodies



October 2015

*Acting Executive Board Member for Energy and Transport

DLR at a glance

DLR is the national aeronautics and space research centre of the Federal Republic of Germany. Its extensive research and development work in aeronautics, space, energy, transport and security is integrated into national and international cooperative ventures. In addition to its own research, as Germany's space agency, DLR has been given responsibility by the federal government for the planning and implementation of the German space programme. DLR is also the umbrella organisation for the nation's largest project management agency.

DLR has approximately 8000 employees at 16 locations in Germany: Cologne (headquarters), Augsburg, Berlin, Bonn, Braunschweig, Bremen, Goettingen, Hamburg, Juelich, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stade, Stuttgart, Trauen, and Weilheim. DLR also has offices in Brussels, Paris, Tokyo and Washington D.C.

DLR's mission comprises the exploration of Earth and the Solar System and research for protecting the environment. This includes the development of environment-friendly technologies for energy supply and future mobility, as well as for communications and security. DLR's research portfolio ranges from fundamental research to the development of products for tomorrow. In this way, DLR contributes the scientific and technical expertise that it has acquired to the enhancement of Germany as a location for industry and technology. DLR operates major research facilities for its own projects and as a service for clients and partners. It also fosters the development of the next generation of researchers, provides expert advisory services to government and is a driving force in the regions where its facilities are located.

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DLR

Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

Strategy and International Relations

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DLR.de/en/