→ INFORMATION KIT

ATV *Edoardo Amaldi*

European Space Agency

→ INFORMATION KIT

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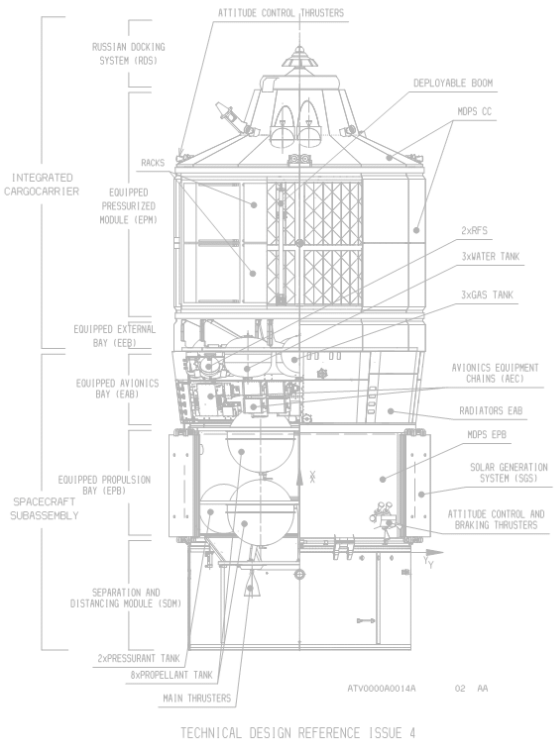
ATV technical design ›



Cover: ATV-2 docking under the watchful eye of the Moon

MISSION OVERVIEW

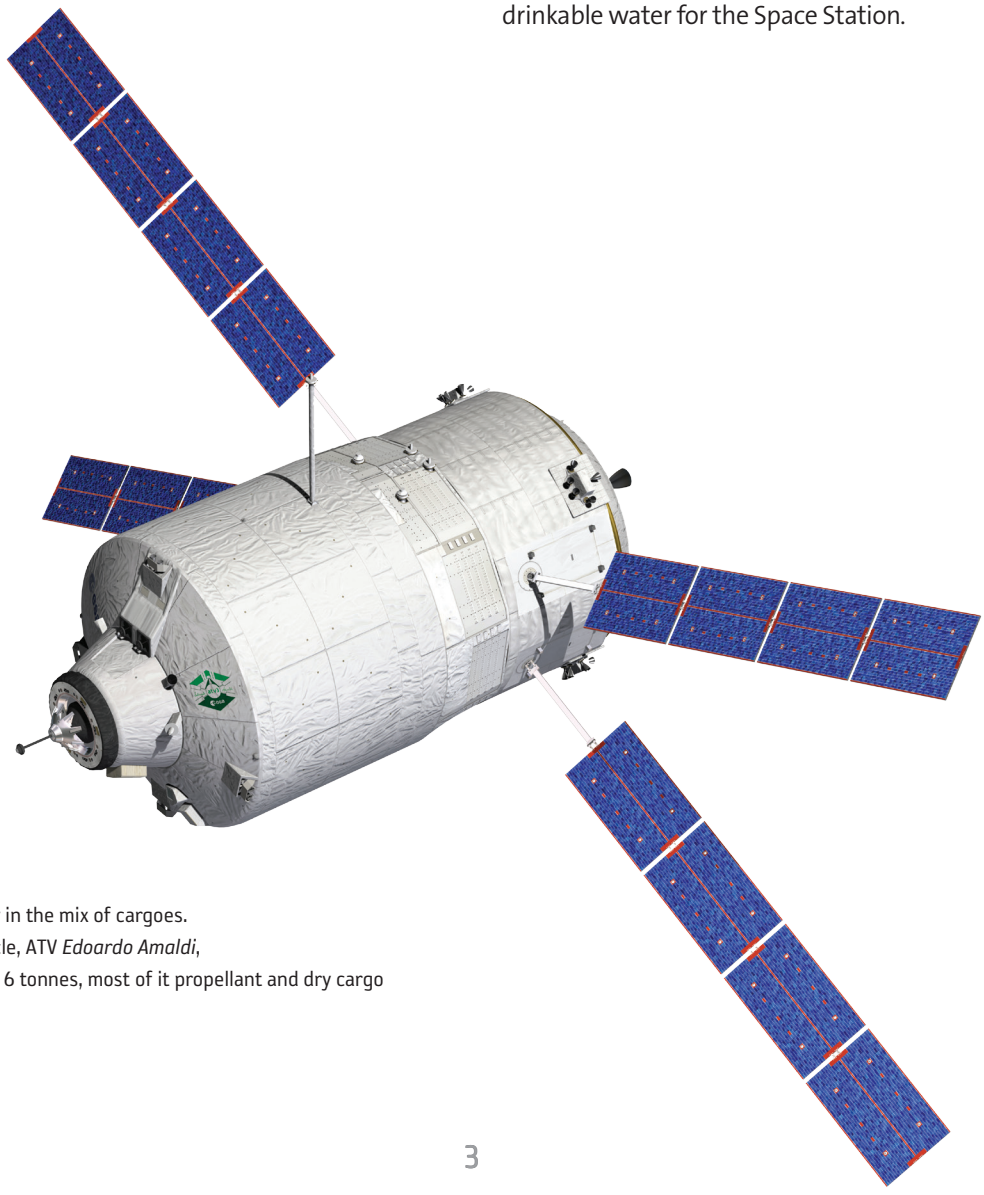
Europe's most challenging spacecraft is about to start its third voyage to the International Space Station (ISS) loaded with 6.6 tonnes of cargo. Named *Edoardo Amaldi* after the Italian physicist and spaceflight pioneer, ATV-3 is scheduled to lift-off in March from ESA's Spaceport in Kourou, French Guiana, on top of the Ariane 5 heavy-lift launcher.

The latest in the family of Automated Transfer Vehicles (ATVs) comes in time to play a vital role in Station logistics: ATV-3 will serve as a cargo carrier, storage facility and 'tug' vehicle for nearly half a year. The European space freighter faces this mission with proven propulsion efficiency and loaded with more dry cargo in its hold than ever before.

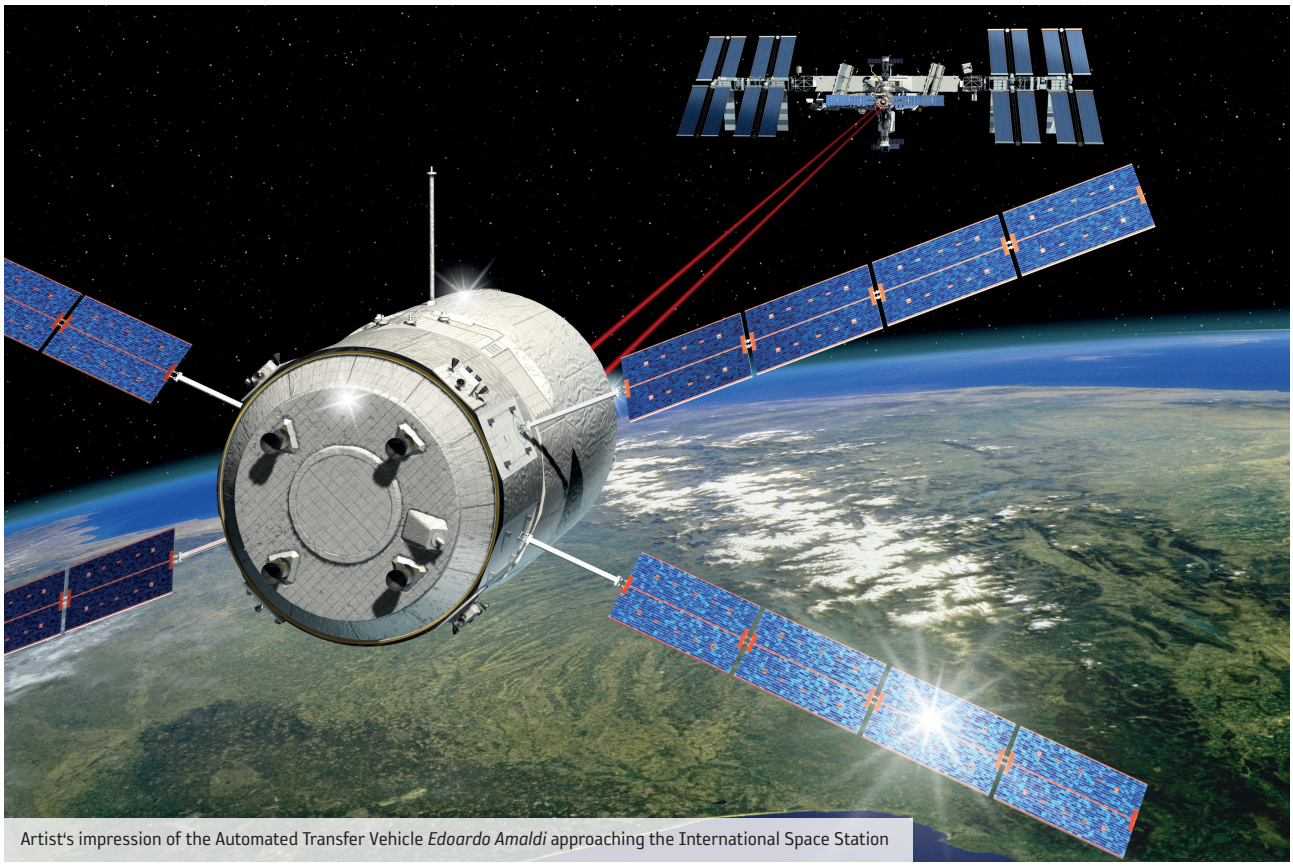
Of all vehicles visiting the ISS, *Edoardo Amaldi* has the largest upload capability. ATV-3 is the only one, besides the Russian Progress spacecraft, that can provide refuelling, attitude control and regular orbital reboosts. It can also enable occasional manoeuvres to avoid collisions with space debris.

The 20-tonne vehicle is able to navigate on its own and dock automatically with the Station with a precision of better than six centimetres. ESA astronaut André Kuipers, on board during his PromISSe mission, will welcome *Edoardo Amaldi* to the orbital outpost. André will be the ISS primer crew member overseeing rendezvous and docking operations.

Following the path of its predecessor, ATV-2 *Johannes Kepler*, ATV-3 will fulfil its duty of resupplying the crew with food, water, oxygen and research or maintenance equipment. Within this 'package', the vehicle is delivering a critical piece of the system that recycles urine into drinkable water for the Space Station.



ATV allows flexibility in the mix of cargoes.
This particular vehicle, ATV *Edoardo Amaldi*,
will carry more than 6 tonnes, most of it propellant and dry cargo



Artist's impression of the Automated Transfer Vehicle *Edoardo Amaldi* approaching the International Space Station

With this mission, Europe contributes in kind towards its share of the operational costs of the ISS and takes another step forward in space transportation. ATV is Europe's ticket to space.

Time pressure

The much shorter turnaround time and a larger late cargo loading capability make the ATV-3 mission a great hat-trick for Europe. *Edoardo Amaldi* is the first of the ATV series to be processed and launched within the target cadence of one per year.

European teams and industry got to the starting line on time even if some of the post-flight technical recommendations from ATV-2 *Johannes Kepler* were only available at a very advanced stage of this prelaunch campaign. The production and integration chain worked at full capacity.

The rush is not gratuitous. Following the retirement of the Space Shuttle in July 2011, the end of an era for the US space programme led to a new scenario. From that moment, the Station supplies are uploaded on unmanned expendable cargo vehicles provided by the international partners. During the ATV-3 attached phase, the third Japanese Transfer Vehicle Kounotori (HTV-3) will also resupply the orbital outpost.

Before the new US commercial resupply service vehicles goes operational, ensuring the annual launch rate is vital for the Space Station logistics.

ESA astronaut Paolo Nespoli took this photograph of the ATV *Johannes Kepler* launch from on board the ISS

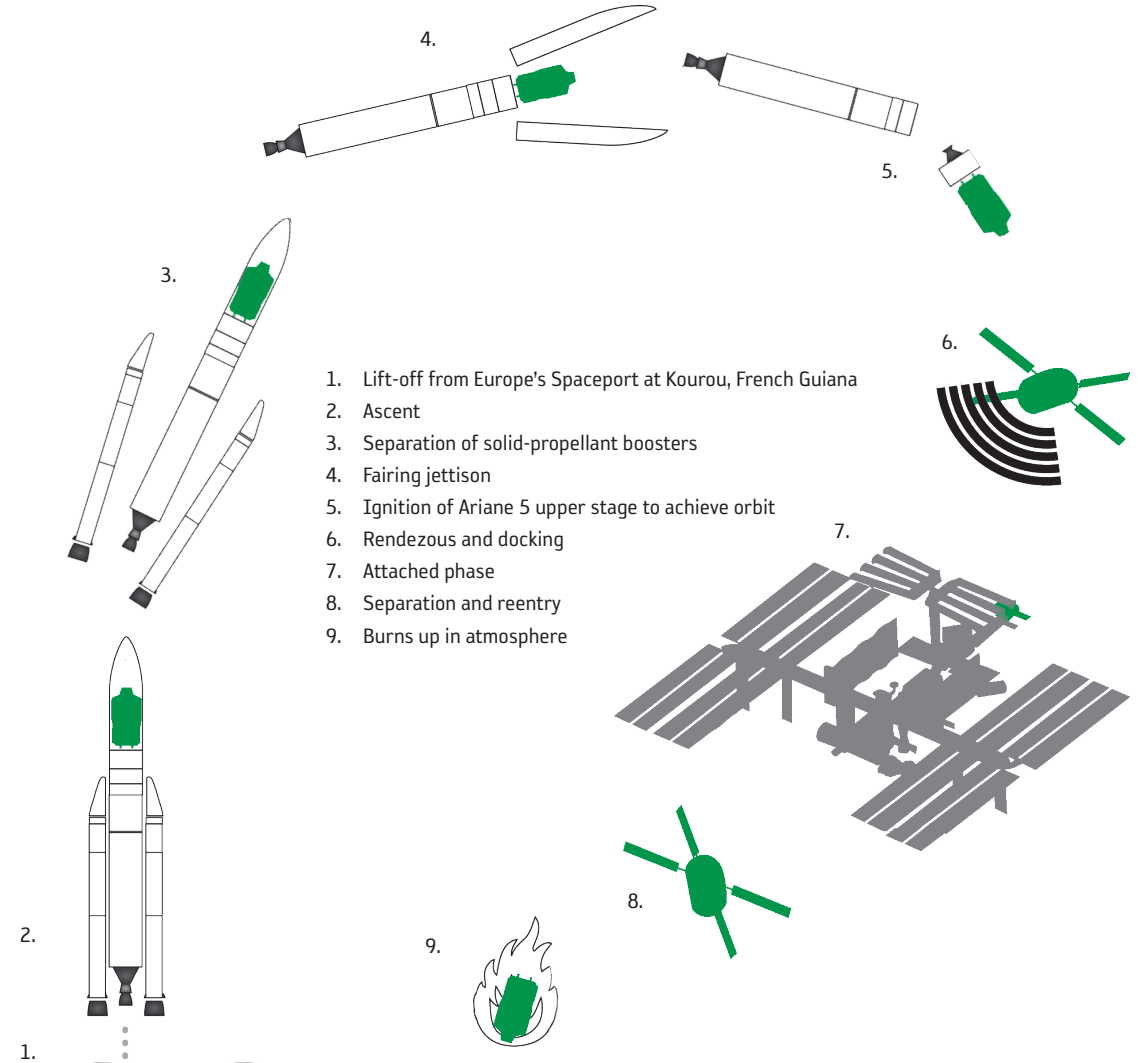
KEY DATA

Launching site	Kourou, French Guiana
Launch date	9 March 2012, 10:00 GMT (11:00 CET) *(Central European time*)*
Launcher	Ariane 5 ATV
Docking	19 March
Undocking	27 August 2012
Mission duration	171 days

** As of January 2012*

ATV-3	
Largest diameter	4.5 m
Length (probe retracted)	9.8 m
Vehicle mass	13.455 kg
Deployed solar arrays	22.3 m

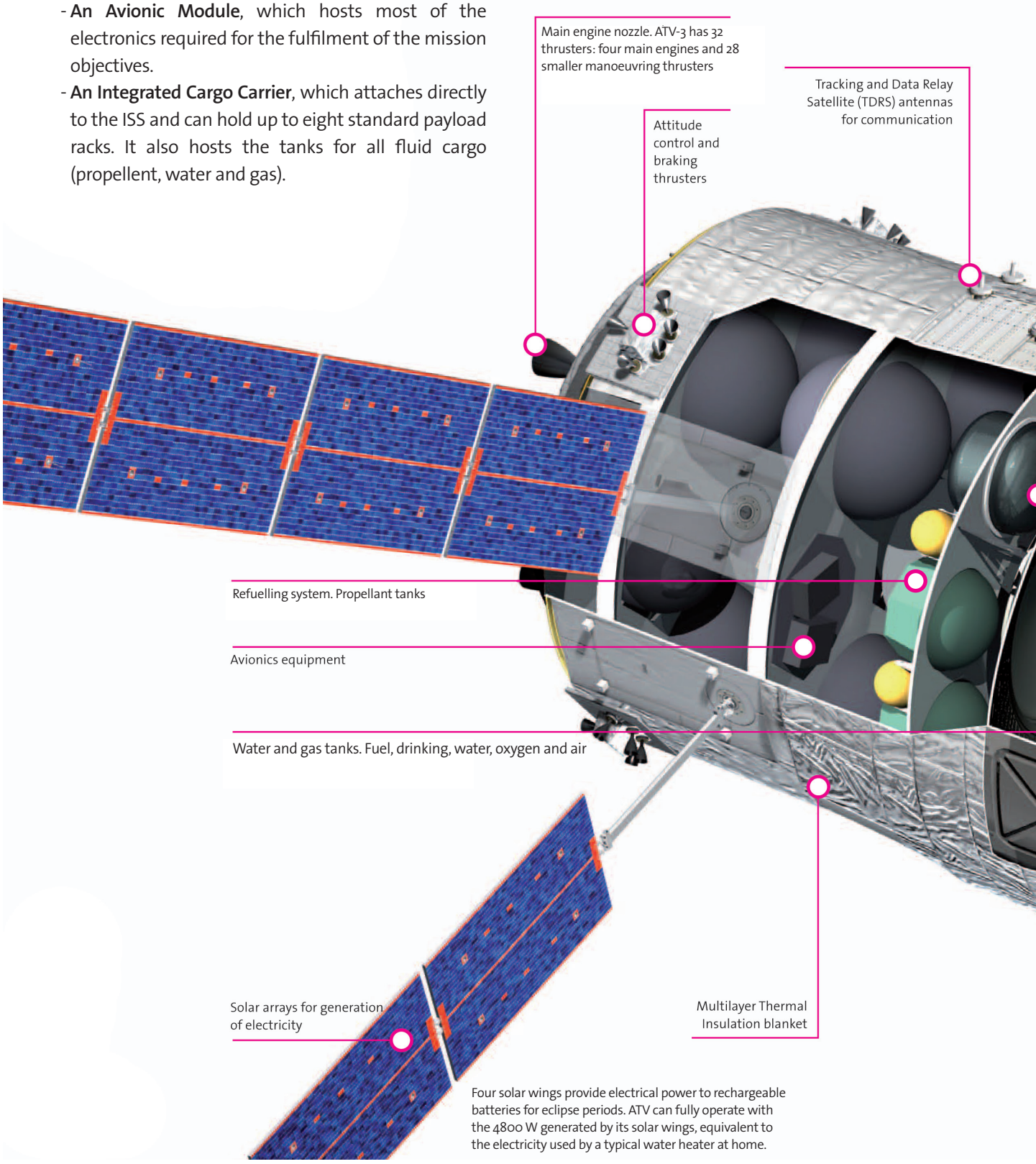
Ariane 5	
Height	Up to 53 m
Diameter	Up to 5.4 m
Liftoff mass	760 tonnes
Payload mass after launch	Up to 20.1 tonnes



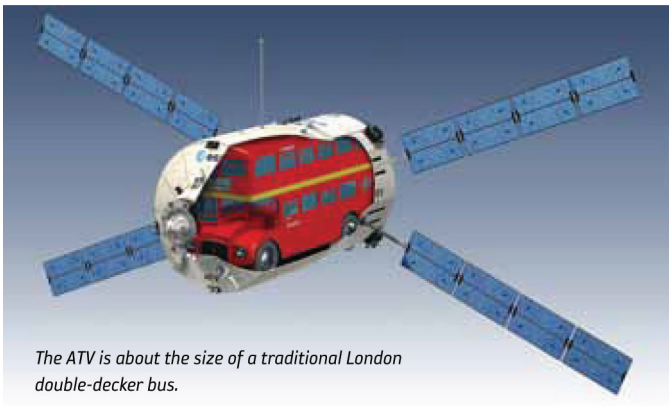
1. Lift-off from Europe's Spaceport at Kourou, French Guiana
2. Ascent
3. Separation of solid-propellant boosters
4. Fairing jettison
5. Ignition of Ariane 5 upper stage to achieve orbit
6. Rendezous and docking
7. Attached phase
8. Separation and reentry
9. Burns up in atmosphere

A LOOK AT THE SPACECRAFT

- The Automated Transfer Vehicle consists of three main sections:
  - **A Propulsion Module**, which has 4 main engines and 20 smaller thrusters for attitude control.
  - **An Avionic Module**, which hosts most of the electronics required for the fulfilment of the mission objectives.
  - **An Integrated Cargo Carrier**, which attaches directly to the ISS and can hold up to eight standard payload racks. It also hosts the tanks for all fluid cargo (propellent, water and gas).



Four solar wings provide electrical power to rechargeable batteries for eclipse periods. ATV can fully operate with the 4800 W generated by its solar wings, equivalent to the electricity used by a typical water heater at home.



The ATV is about the size of a traditional London double-decker bus.

GPS antennas for positioning

Equipped Pressurised Module aft bulkhead

8 attitude control thrusters to complement the propulsion system

8 standard payload racks to store equipment

Startracker

Part of the ATV rendezvous and docking system, telegoniometer

Docking system

The 'nose' contains the rendezvous sensors and Russian docking equipment.

Micrometeoroid and orbital debris protection system

4 optical rendezvous sensors. Two videometers and two telegoniometers fire laser pulses at reflectors on the Russian Zvezda service module for range and range rate detection

WHY EDOARDO AMALDI?

The official name of the third ATV spacecraft name pays tribute to the Italian physicist and spaceflight pioneer Edoardo Amaldi. He was a leading figure of Italian science in the 20th century, particularly in fundamental experimental physics. In the 1930s, Amaldi was member of a group of young Italian scientists, known as the 'Via Panisperna boys', who made the famous discovery of slow neutrons. That achievement would later make possible the nuclear reactor.

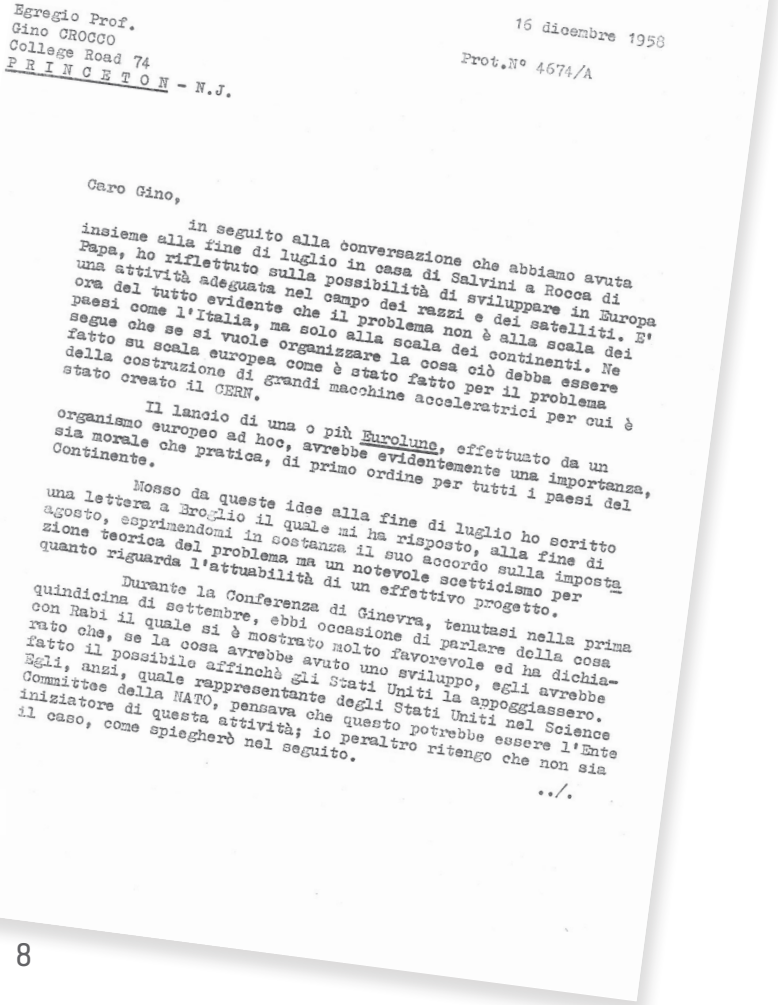
From his initial studies in nuclear physics, he did pioneering work in the field of cosmic rays and then devoted himself to the new field of particle physics. In the last part of his career, he turned again to emerging scientific areas working on the experimental search for gravitational waves.

The Italian physicist contributed directly to the realisation of national and international projects, such as the Electron Synchrotron for the Instituto Nazionale di Fisica Nucleare (INFN) and the European Organization for Nuclear Research (CERN). He was one of the few who in the post-war years prompted action towards a space organization with European character, ultimately leading to the founding of the European Space Research Organization (ESRO) and later ESA.

Amaldi was a strong believer in the open nature of science and the need for international cooperation. The ATV-3 mission recognises his contribution as one of the founding fathers of European space research not only with his name on it. A blueprint of a letter written by Edoardo Amaldi in 1958 will fly on board the spacecraft to the International Space Station.

The unique historical document reflects his ambitious vision of a peaceful, non-military European space organization. Once the dream has come true, his words are flying to space to attract, as he stated in the letter, "the liveliest part of the new generation."

Edoardo Amaldi (1908-89). His message will get to space on board ATV-3



Egregio Prof.
Gino CROCCO
College Road 74
P R I N C E T O N - N.J.

16 dicembre 1958

Prot.N° 4674/A

Caro Gino,

in seguito alla conversazione che abbiamo avuta insieme alla fine di luglio in casa di Salvini a Rocca di Papa, ho riflettuto sulla possibilità di sviluppare in Europa una attività adeguata nel campo dei razzi e dei satelliti. E' ora del tutto evidente che il problema non è alla scala dei paesi come l'Italia, ma solo alla scala dei continenti. Ne segue che se si vuole organizzare la cosa ciò debba essere fatto su scala europea come è stato fatto per il problema della costruzione di grandi macchine acceleratrici per cui è stato creato il CERN.

Il lancio di una o più Eurolune, effettuato da un organismo europeo ad hoc, avrebbe evidentemente una importanza, sia morale che pratica, di primo ordine per tutti i paesi del Continente.

Mosso da queste idee alla fine di luglio ho scritto una lettera a Broglio il quale mi ha risposto, alla fine di agosto, esprimendomi in sostanza il suo accordo sulla imposta zione teorica del problema ma un notevole scetticismo per quanto riguarda l'attuabilità di un effettivo progetto.

Durante la Conferenza di Ginevra, tenutasi nella prima quindicina di settembre, ebbi occasione di parlare della cosa con Rabi il quale si è mostrato molto favorevole ed ha dichiarato che, se la cosa avrebbe avuto uno sviluppo, egli avrebbe fatto il possibile affinchè gli Stati Uniti la appoggiassero. Egli, anzi, quale rappresentante degli Stati Uniti nel Science Committee della NATO, pensava che questo potrebbe essere l'Ente iniziatore di questa attività; io peraltro ritengo che non sia il caso, come spiegherò nel seguito.

../.

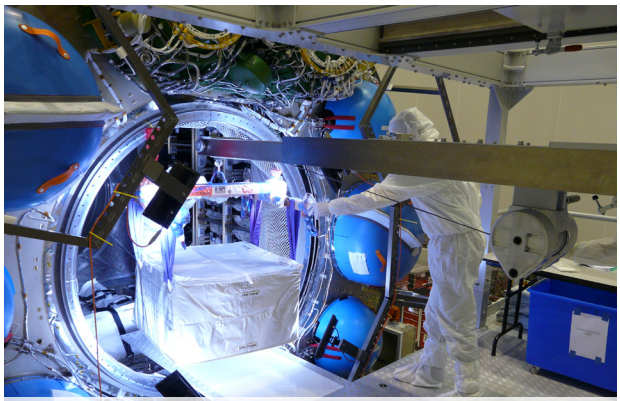
ATV-3 will dock to the International Space Station using laser guidance

ATV RECORDS

- It is the heaviest spacecraft ever launched by ESA and on an Ariane rocket.
- It can carry in total about three times the payload of a Russian Progress-M and somewhat more than a Japanese HTV.
- It has a high level of autonomy, allowing it to navigate on its own. It can dock automatically with the Station with a precision of better than six centimetres.
- It has the largest reboost capability of any vessel visiting the Station thanks to Europe's most complex, powerful and versatile propulsion system.
- It can provide water, various gases, propellant and dry cargo, as well as ISS attitude control and reboost services.
- It is a multifunctional spaceship, combining the fully automatic capabilities of an unmanned vehicle with human spacecraft safety requirements.
- It has the largest and most sophisticated flight software ever developed by ESA.

EXPRESS DELIVERY SERVICE

Permanently inhabited since 2000, the ISS relies on logistic vehicles like ATV to upload all kinds of cargo, as well as propellants to maintain its orbit. However, the various needs of the Station change with every mission.



Heavy bags being loaded on board ATV-3.
In total, the vehicle will carry about 60 bags

ATV-3 is not just a carbon copy of the ATV-2 flown last year. *Edoardo Amaldi* carries almost 600 kg more of dry cargo and the volume available has also increased from six cargo racks on the first two flights to eight racks on ATV-3. Every cubic centimetre of the carrier is at full capability.

Most of the cargo is in place since last November, but the very last packages are loaded only three weeks before launch. The amount of late cargo has been doubled compared to ATV-2, and about 60 bags for about 530 kg will be stored, including the precious 'crew care packages' traditionally prepared by the families with personal gifts for the astronauts.

The late loading is a delicate operation. With ATV on top of its Ariane 5 launcher, ESA uses a special access device to load last-minute cargo items via the hatch that will connect the vehicle to the Station once in space.

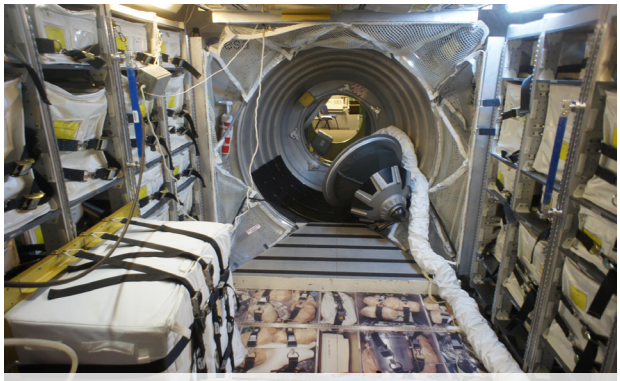
This expanded late access – a first for ATV-3– shows ESA's great flexibility in adapting the cargo to the Station needs. Perhaps the most valuable cargo on ATV-3 is the Fluids Control Pump Assembly (FCPA), a critical piece of the system that recycles urine into drinkable water that could affect the ISS life support systems. Right now, there is only one FCPA available in orbit. If it breaks down, the astronauts will still have enough water for some time, but the Station wouldn't work at full efficiency.

WHAT'S INSIDE?

Fluid cargo	**4,395 kg**
ISS propulsive support	3,150 kg
Refuelling propellant	860 kg
Water	285 kg
Gas (oxygen and air)	100 kg
Dry cargo	**2,200 kg**
Main dry cargo	1,665 kg
Late load dry cargo	535 kg
TOTAL:	**6,595 kg**

The puzzle inside ATV has been carefully laid out in the past months taking into account the centre of mass. The cargo team have calculated where to optimally store each bag in order to avoid disturbances to the sophisticated guidance and control systems.

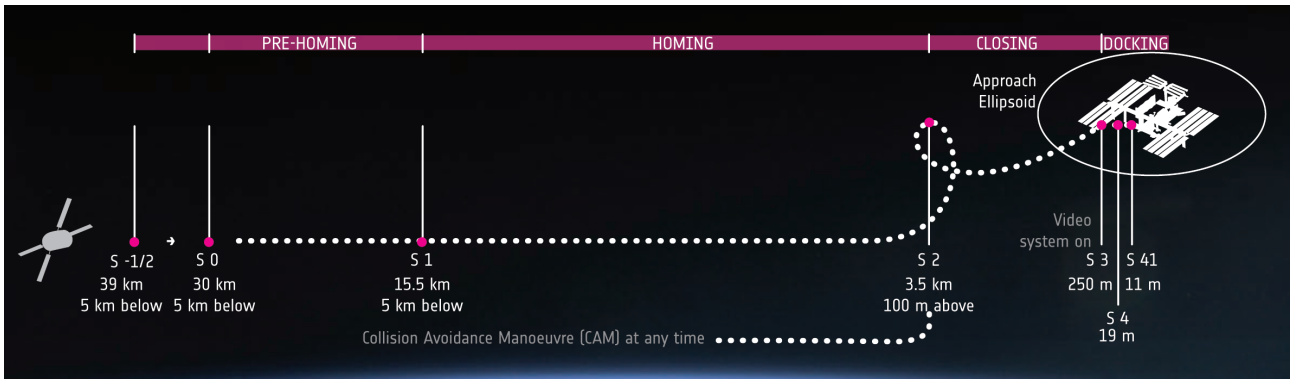
All the cargo, including food, experiments, spare parts, tools or clothing, is packed into special bags with barcodes. The labelling makes it easy for crew to unload and also facilitates the planners on the ground to keep track of the various items on board the ISS.



Interior of the ATV simulator showing the vessel in 'in-flight' configuration

THE PATH TO THE SPACE STATION

The outskirts of the Amazonian jungle will be once again the exuberant setting for the ATV launch. The Ariane 5 launcher will take off from Kourou breaking for the second time its own record. With a mass of more than 20 tonnes at launch, *Edoardo Amaldi* will be the heaviest spacecraft ever to be lifted by any vehicle of the Ariane rocket family.



Before the rocket moves to the launch pad, teams on site will make sure that *Edoardo Amaldi* and Ariane 5 can perfectly recognize each other's commands, and that the optical sensors for docking are working flawlessly.

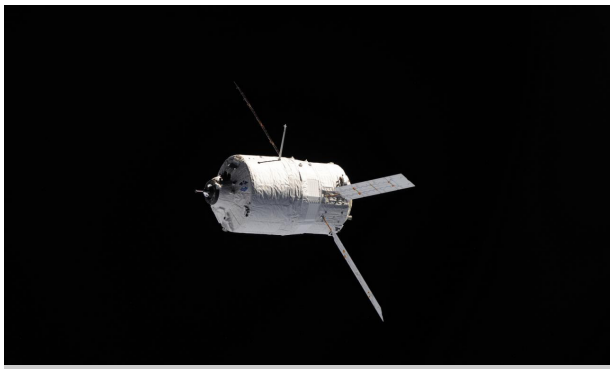
The ATV countdown will start ten hours prior to launch, and there is no margin for even a one-minute delay. The launch window stretches for ten days to meet the busy ISS schedule.

About an hour after lift-off, *Edoardo Amaldi* separates from the rocket and its high-precision navigation system guides the spacecraft on a rendezvous trajectory towards the Space Station. While a star tracker identifies different constellations in the sky to calculate the vessel's orientation in space, a GPS receiver gives positional information. Together, they are the modern equivalent of centuries-old navigation techniques.

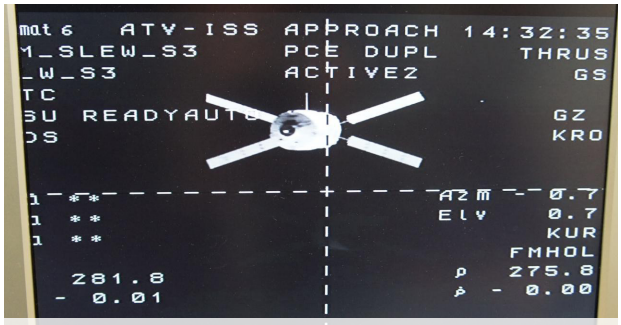
The hazards of a high solar activity during the ATV missions have already been foreseen by the ESA engineers. During the 'free flying' phase of the ATV, the solar flares don't affect the space vessel. However, during the rendezvous phase the GPS systems, both on the ATV and on the ISS, need to work with maximum accuracy. After the maiden flight of *Jules Verne*, new software was installed in the Russian GPS system to exclude ionospheric perturbations, so to match the level of precision required during the earlier stages of the rendezvous.

ATV'S CRITICAL PHASES

- Launch and separation from the launcher
- Rendezvous and docking
- Undocking and reentry



ATV *Johannes Kepler* approaches the ISS



ATV as seen from the camera located in the Zvezda module

André Kuipers and Oleg Kononenko during ATV training

Space debris could also jeopardize the mission, but the flight dynamic team in ATV-CC is constantly checking space surveillance networks to track possible hazards. If any object passes nearby, a new trajectory and manoeuvres for the ATV-3 will be calculated automatically.

ATV-3 will need a few days to get to a hold point some 30 km behind the ISS. From this distance *Edoardo Amaldi* will start performing relative guidance, navigation and control, piloting itself to the ISS throughout a series of predefined manoeuvres, gradually closing towards the Station while both vehicles orbit Earth at around 28 000 km/h.

During the last 250 metres, the ATV's state-of-the-art automatic rendezvous system employs a videometer's eye-like sensors which analyse the behaviour of its own laser beam returned from an ISS target pattern purposely installed more than a decade ago.

After calculating the distance and direction to the docking port on the Russian Zvezda module, the 20-tonne ferry can manoeuvre itself and dock with the International Space Station with a precision of less than 6 cm. In total, the rendezvous lasts roughly three and a half hours.

ESA astronaut André Kuipers and his crewmate Oleg Kononenko, Expedition 31 commander, will monitor the ATV as it approaches the Station. The Space Station has no window facing the ATV approach path, but André can observe it via a camera mounted on the aft end of the Zvezda module. The astronauts are well trained to intervene in case any off-nominal situation prevents the ATV from docking.

The Automated Transfer Vehicles are very safe by design, but also from an operational point of view. There are at least three barriers of safety to protect the ISS and the crew inside. If there are any last-minute problems, either ATV's computer, the ground controllers in Toulouse or André Kuipers can stop the approach and send the vehicle away in a safe manner. In the worst-case scenario, it is possible to trigger a programmed sequence of anti-collision manoeuvres, fully independent of the main navigation system.

With the hooks closed and the docking probe retracted, it is the turn of the data and electrical connections. And as soon as all interfaces are established, the crew can open the hatch and enter the pressurised part of the ATV. Since that moment, André will be in charge of logistics operations on the vehicle.

Training inside the mock-up at ESA's European Astronaut Centre

EXTRA LIVING QUARTERS FOR THE CREW

The European spacecraft is not only a supply ferry. Each ATV is a vital means for ISS housekeeping, scientific research and astronaut well-being. It will be relative quiet inside *Edoardo Amaldi* compared to the rest of the Station.

Once ATV-3 is securely attached to the orbital complex, astronauts dressed in their normal clothing can enter the cargo section and begin removing the cargo items. Among them, the crew will find maintenance supplies, science hardware, parcels of food and family mail.

Behind the cargo section, ATV is configured to carry storage tanks with refuelling propellant for the Station's own propulsion system, as well as oxygen and air for the ISS. The gas delivery system is very simple. Manual valves on the gas control panel allow astronauts to release the desired quantity of oxygen directly into the Station's atmosphere.

Edoardo Amaldi is also equipped with three water tanks. One of them will be filled with 285 litres, whereas the other two could be used to store 'technical water' (supplementary feed, circulation or cooling water) during the attached phase. It is also possible to load the tanks with liquid waste before departure.

NASA astronauts Cady Coleman and Scott Kelly with some goodies from ATV-2

ATV-3 brings kits for an ESA experiment that measures how much energy André spends in space

Extra space, extra science

ATV-3 also brings very useful items for the sake of science. Some of the ESA experiments that will receive valuable pieces are:

Altea-Shield

Special tiles will be uploaded to the Station for this experiment that aims at obtaining a better understanding of the light flash phenomenon, and more generally the interaction between cosmic rays and brain function. The tiles will help to test different shielding materials for their effectiveness against radiation.

Energy

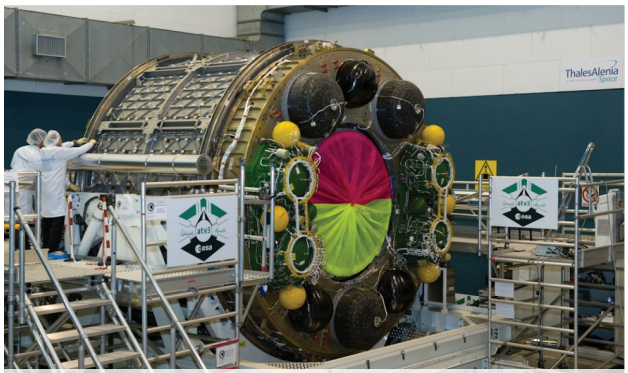
Food and urine collection kits will be delivered. The experiment studies how a negative energy balance observed during spaceflight may affect many physiological functions. Changes in André's energy balance and expenditure will be measured, which will help in deriving an equation for energy requirements in weightlessness. This will contribute to planning adequate, but not excessive cargo supplies for food.

Biolab Life Support Module 3

Biolab is a multi-user facility designed to support biological experiments on micro-organisms, cells, tissue cultures, small plants and small invertebrates. A module and power boards of the ESEM experiments (Evaluation of Space environment and Effects on Materials) are being sent in order to recover the Biolab functionalities.

A MATTER OF PROPULSION

ATV is the most complex propulsion system ever designed and flown in Europe. The European vessel can perform ISS attitude control and orbital reboosts, as well as enable manoeuvres to avoid potential collisions with space debris. Its thrusters have not only to guide the spacecraft to the Space Station, but also away from it at the end of the mission.



ATV-3's cargo carrier getting ready for its flight

The engines of its predecessor, *Johannes Kepler*, achieved the biggest boost for spaceflight since the Apollo missions to the Moon – the ISS orbit was raised by more than 40 km. Maintaining the Station's orbit will be vital especially during the forthcoming period of high solar activity. The atmospheric density in the ISS altitude range will increase, provoking a larger drag that would need to be actively compensated.

The ATV propulsion system, already in a mature state, has been tuned up for *Edoardo Amaldi*. During the ATV-2 deorbiting, the ESA team was surprised to see that the propulsion system was still working on re-entering the atmosphere, trying to keep the vehicle under control. A real proof of how robust the propulsion system is.

Why is the ATV propulsion system unique?

- It is compatible with human spaceflight requirements.
- It operates nearly automatically, with some engines being used during the whole mission.
- Its dimensions. Only the dry mass of the propulsion system is 1.5 tonnes. It comprises 32 thrusters, 68 electric valves, 84 pressure sensors and nearly 200 temperature sensors and heaters.

Of all the vessels that deliver cargo to the Station, ATV can send the largest quantity of fuel. *Edoardo Amaldi* is indeed focused on delivering propellant: its main payload is nearly 4 tonnes of fuel in different forms to restock the Station's reserves.

Propellants onboard

- The ATV propulsion system will use about 3 tonnes to fulfil three functions:
- **Attitude control**. This capability saves critical propellant for the ISS.
- **Maintaining the Station's orbit** in order to counteract the remaining atmospheric drag the ISS is exposed to. The Station's orbit suffers a natural decay of 50– 100 m each day.
- **ISS debris avoidance manoeuvres**.

- Russian refuelling propellants. 860 kg will be transferred after docking into the tanks of the Zarya module. This allows the Station to perform its own attitude control and reboost when there is no visiting vehicle. The ATV is connected to the Space Station's own propellant system to replenish the Russian tanks.


Top centre, ATV-2 as seen from space shuttle *Discovery*

GROUND SUPPORT

ATV will navigate, fly and dock to the Station automatically, but it will be monitored and commanded from the ATV Control Centre (ATV-CC), located in the premises of the French space agency, CNES in Toulouse, France.

Celebrating success when *Johannes Kepler* was set for final deorbit burn

Only two months after the end of *Johannes Kepler* mission, staff at ATV-CC have been busy preparing and simulating the operational scenarios. Such a short turnaround, a first for an ESA mission, would have been impossible without the team spirit that emanates from all the parts involved in the ATV project.

Without major modifications from the last mission, ATV operations have become more robust. New procedures and specific training for contingency situations emerged during the preparations for *Edoardo Amaldi*. The entire ATV-CC team underwent joint integrated simulations in which the three control centres involved – Moscow, Toulouse and Houston- have trained together.

During the highly active phases of an ATV flight – from launch to docking, and from departure to reentry – a dedicated 60-person team works together to control all procedures. For the attached phase, fewer operators are needed, but the control centre is manned 24 hours a day.

The ATV project involves about 2000 people from ESA and the European industry. *Edoardo Amaldi* was developed and is built under ESA contract by a European industrial consortium led by EADS Astrium.

ATV Control Centre in Toulouse, France

Team spirit

Massimo Cislaghi
Mission Manager
"Since ATV-2 *Johannes Kepler* started its voyage to the Station one year ago, and even months before that, we have been working under high time pressure. Even if operating the ATV for its third mission may look like a routine activity, relaxation is not an option. It could seem that this is a carbon copy of the ATV-2, but in reality ATV-3 is bringing much more to the space transportation scenario."

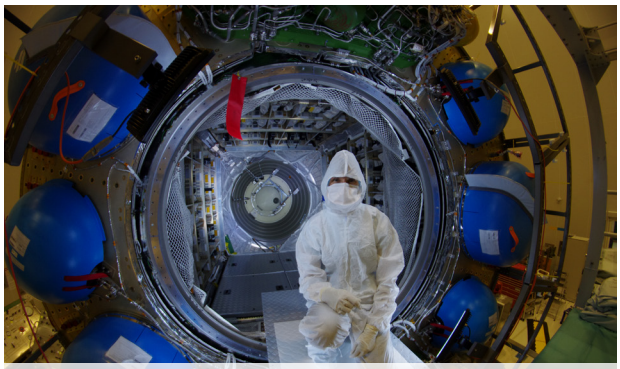

Massimo Cislaghi at work

Jean-Michel Bois
Operations Division Head at ATV Control Centre
"During the rendezvous of ATV-1, I saw from the control room the huge mass of the vehicle approaching the Station with the sunlight reflecting on the solar panels. It was exhilarating to see that it was real, that it was truly happening. With ATV-3, we also feel that we have to do our job and contribute to the success of the mission. This is really a team, and when you are in communication with Houston or Moscow, you realize that you're being part of a very exciting space adventure."

Jean-Michel Bois checking data

Dominique Siruguet
Campaign Manager in Kourou
"Even after witnessing around 50 launches here, and even knowing exactly what is going on during the countdown, the launch of *Edoardo Amaldi* will be a very spectacular and emotional one. If there is a problem with the vehicle, I'm the guy who presses the red button in the last minutes. I'm confident that it won't happen, but we are well prepared to set the ATV in a safe configuration if necessary. Managing people, reacting quickly, taking decisions on the spot... I love this job."

Kirsten MacDonell
Cargo Integration Engineer
"I have been working in the ATV series for eight years. I started as team lead of the instructors at the European Astronaut Centre. We trained a lot together with the astronauts inside the ATV mock-up. Then I moved within the project to take care of the cargo. I learned a lot of things during the ATV-2 mission, so I thought that the third one will be easier, just more daily work. However, new things are always coming up!"


Kirsten MacDonell next to the ATV-3 hatch during loading operations

Fabio Caramelli
the 'propulsion guy'
"During the approaching and the docking phase, the cameras on the ISS point on the vehicle, so you can see on your computer the codes and, at the same time, the vehicle in the big screen. For me it's quite unique! ATV is more than a teenager, to me it is already an adult. I'm very confident about the success of the mission. The three years I've spent at ESA with the ATV project have been the best so far from any point of view. The team spirit is really positive."


Integrated Cargo Carrier
• Thales Alenia Space Italy facilities, Turin
Equipped Propulsion and Avionics Bay
• EADS Astrium facilities at Bremen, Germany
Russian Mission Control Centre
• Korolev, Russia
NASA Mission Control Center
• Houston, United States
Launch site
• Kourou, French Guiana
ATV Control Centre
• Toulouse, France

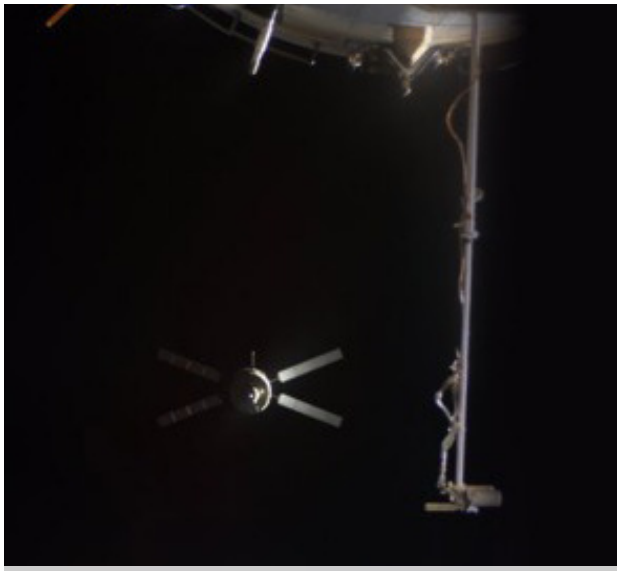
ENCOUNTER WITH THE ATMOSPHERE

Edoardo Amaldi remains as a pressurised part of the orbital complex for more than five months. The ATV can have an orbital life of up to six months and the actual stay depends on the needs of the International Space Station and its schedule of visiting spacecrafts.

During the attached phase, the crew gradually removes all the cargo and replaces it with unwanted material – liquid and dry waste – to clear the limited space in the Station. More than six tonnes of ISS waste can be destroyed during the reentry.

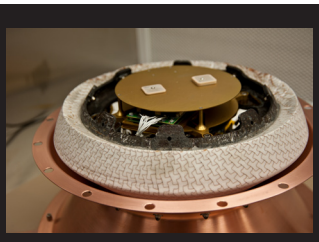
With the resupply mission completed, the crew seals the hatch and the spacecraft undocks from the ISS by ground command. By end of August, ATV-3 will start its return flight, thereby freeing the docking port for another vehicle.

ATV-3's last journey will be a controlled and destructive reentry into Earth's atmosphere. Its engines deorbit the spacecraft on a steep flight path that causes it to break up and burn high harmlessly over an uninhabited area of the southern Pacific Ocean.



One of the last pictures of ATV *Johannes Kepler* taken just after it undocked from the ISS

ANOTHER CHANCE FOR THE FUTURE 'SPACE BLACK BOX'



A small device will share ATV-3's final trip: the Reentry Breakup Recorder (REBR) will gather data to help engineers understand reentry breakup and make reentering space junk less hazardous. It might also be a prototype for a black box system for future space transportation systems.

The REBR already flew on board ATV-2 as a 'piggyback' device, but unfortunately no data were received. Operating in this harsh and extremely dynamic environment, the failure could have been generated by a variety of causes. For this flight, REBR has been relocated farther from the propulsion tanks to avoid possible damage before the breakup.

As ATV-3 enters the atmosphere, the system will turn on its suite of sensors to record data on the vehicle's breakup for about five minutes. Built by The Aerospace Corporation and funded by the US Air Force, this device contains miniature sensors that will collect extensive information about temperature, pressure and other data.

The ATV-3 breakup due to aerodynamic heating and forces will cause REBR to be jettisoned from *Edoardo Amaldi*, activating its own transmitter and uplinking the recorded data to an Iridium satellite. A last 'phone home' before its disintegration in the atmosphere.

LEGACY AND FUTURE

After the successful flights of the two first ATVs in 2008 and 2011, ESA has been able to guarantee the delivery of these precious cargo vehicles to keep the Station and its permanent six-astronaut crew working at full capacity.

Now the third one in ESA's family of Automated Transfer Vehicles takes the baton from the gained expertise. For ATV-3 *Edoardo Amaldi*, a network of control centres around the world are seamlessly integrated with each other to serve global operations activities for the International Space Station. The trilogy is complete, but the saga continues.

With at least another decade of continuous support to the ISS in mind, the ATV series take another step ahead for European space transportation. Production for more vehicles is underway in full swing, and ATV-4 and ATV-5 launches are set for 2013 and 2014 respectively.

As the cargo will vary from flight to flight depending on the Station's needs, ATV is being upgraded in every mission to increase its flexibility. For ATV-4, for example, a new type of internal lift will allow a greater amount of late load cargo. With bigger individual bags and heavier masses, there is more room and potential for last-minute items.

This flexibility makes ATV an excellent basis for developing a versatile service module to tackle different exploration mission designs.

Surfing with the ATV

Since first launched in 2008, ESA's ATV Blog has become a major communication success. It is an extremely popular source of information and is now permanently linked and regular cited from numerous top-level media and space enthusiast sites, as well as social media.

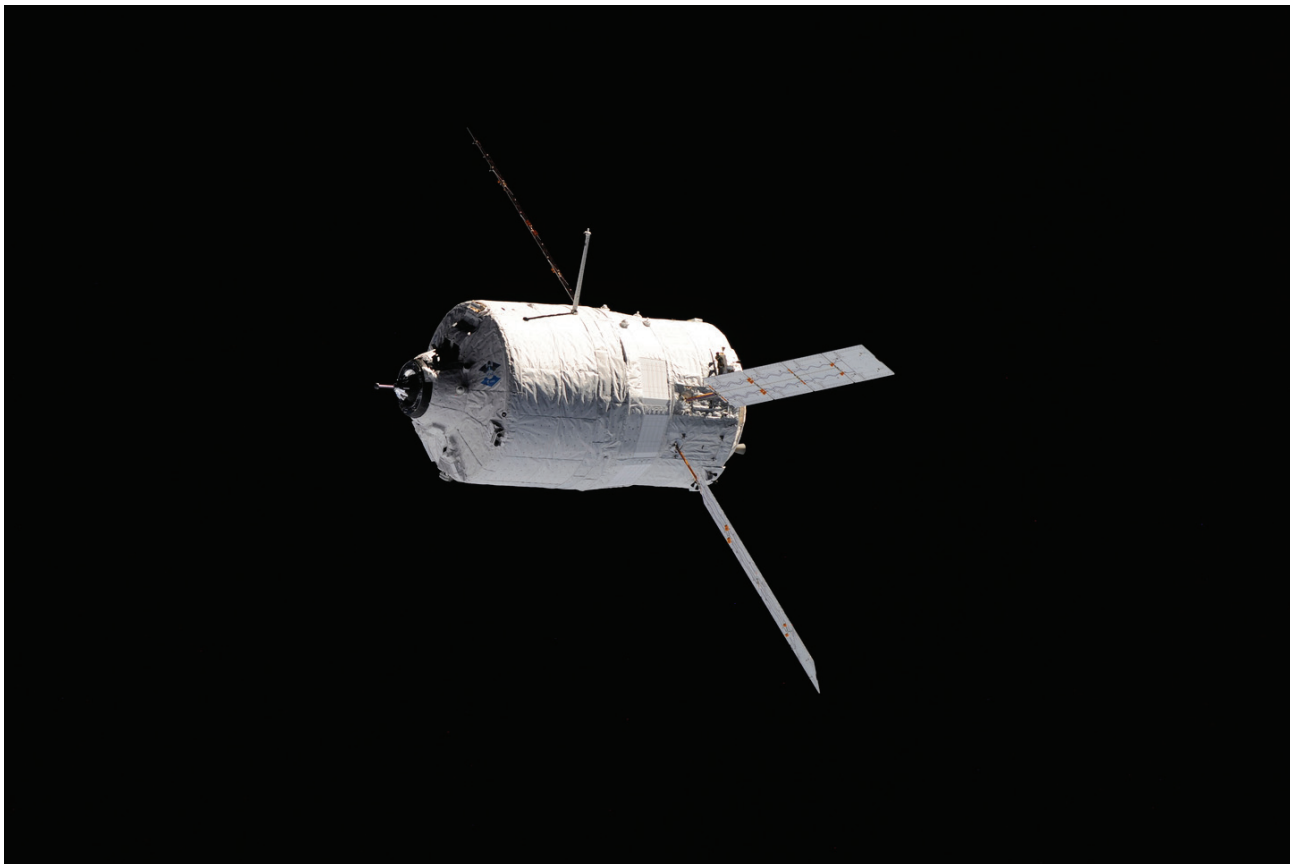
Almost 250,000 page views in 2011 plus millions of content impressions via Facebook and Twitter confirm the success of its formula: an editorial 'human touch' with quotes, interviews, video and comments published in a friendly and informal style.

The blog has also won a reputation for being the authoritative source for mission updates as they happen. Even the ATV mission director answers directly to website visitors!

Any and all aspects of ATV are covered, from the launch campaign, astronaut training, lift-off and docking through the attached and reentry phases. The blog provides quick, real-time updates during critical mission phases. It is especially trafficked during peak times, ant last year was visited by over 23,000 readers during the ATV-2 docking in just six hours.

Come and follow the ATV-3 mission at:
http://blogs.esa.int/atv/

→ USEFUL CONTACTS/LINKS



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CNES' ATV blog:
http://www.cnes.fr/web/CNES-fr/8698-atv-2.php

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