German Aerospace Center

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REXUS campaign underway: Sounding rockets carrying student experiments ready for launch

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Assembling the payload module

After more than a year of preparations, students are eagerly awaiting the launch of their experiments

The two-week REXUS 5/REXUS 6 research campaign started on Monday 2 March 2009. In collaboration with the Swedish National Space Board (SNSB) and the European Space Agency (ESA), the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) enables students to carry out their own experiments on board sounding rockets for the first time. During the ten-day campaign, German and Swedish experts will help the up-and-coming researchers to prepare the two small rockets. The experts and students are gathered at Esrange, the European launch site for sounding rockets and balloons near the city of Kiruna in northern Sweden, in order to take part in the campaign. While outside temperatures reached 20 degrees Celsius below zero, the countdown started.

Carefully preparing their first space mission

For the students, this is the culmination of the project for which they have been preparing for a year. Everything began when they submitted their applications in response to a call for proposals by DLR and ESA in the winter of 2007-2008. In March 2008, five experiments from Germany, Finland, Norway and Spain were selected for inclusion in the campaign. During the training week in April 2008, the students had to submit their experiment designs to a critical review by DLR, SSC and ESA experts known as the PDR (Preliminary Design Review). During this training week, the students also learned how to build their experiment in such a way that it would be able to withstand the forces exerted on it during a rocket launch.

Three months later, during the CDR (Critical Design Review), the students had to show that they had understood and implemented the experts' requirements and suggestions. Once their designs were approved, they could start building the flight hardware. Three weeks before the start of the campaign, this hardware was put to the test at DLR's Mobile Rocket Base (Mobile Raketenbasis; MORABA) in Oberpfaffenhofen, where electrical tests and the mechanical integration of the hardware with the rest of the rocket payload were carried out. The students cleared this hurdle as well.

The up-and-coming researchers left their experiments in the care of engineers and technicians of DLR and SSC until their arrival in Sweden. During a stopover on the way to the Arctic Circle, the rocket payloads of REXUS 5 and REXUS 6 were balanced in Stockholm, and their physical properties such as mass, centre of gravity and moment of inertia were measured.

REXUS rocket launch

Two weeks inside the Arctic Circle

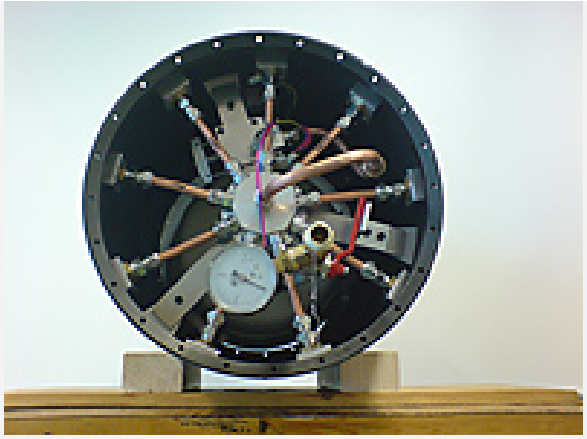
Exciting days lay ahead for the students upon their arrival in Kiruna. During the first week of the campaign, further testing was carried out on the combination of the experiments and the overall REXUS launch system. Checks were also carried out to see if Esrange's telemetry systems were able to receive data from the sounding rockets and if all other ground systems were functioning as planned. At the same time, the rocket engines and flight hardware were prepared and installed.

On Monday 9 March 2009, the REXUS 6 rocket will be 'rolled out' – it will be brought out to the launch pad and prepared for launch. The test countdown is scheduled for the same day. During this test countdown, all the procedures of a regular launch will be executed and the countdown clock will tick down to zero, but the actual launch will not take place. If everything goes according to plan, the launch will take place on Tuesday 10 March. The rocket will then soar to an altitude of about 95 kilometres, just touching outer space before turning around and falling back to Earth. Air friction will slow the payload down and, when it reaches an altitude of about four kilometres, the recovery system will be activated. A parachute will then allow the payload to land safely. The launch of the second rocket, REXUS 5, is scheduled for Thursday 12 March.

The scientific and technological questions addressed by the REXUS campaign

The student experiments carried out during this campaign are concerned with geophysics and atmospheric physics, as well as with testing new technologies. The AGADE experiment (Applied Geomagnetics for Attitude Determination Experiment), designed by students of the Technical Universities of Dresden and Freiberg, will fly on REXUS 6. Very small satellites require compact and lightweight sensor systems. AGADE will test small, commercially available magnetometers to see if they are fit for this purpose.

The aim of the experiment is to establish whether they are suitable for measuring the attitude of such small satellites. The measurement data obtained during the REXUS flight will be evaluated against the rocket's attitude and trajectory, a standard model of the Earth's magnetic field, and data obtained on board and on the ground by high-precision reference magnetometers.



The NISSE experiment

The same payload also includes the Norwegian NISSE experiment (Nordic Ionospheric Sounding rocket Seeding Experiment) of the University of Bergen. The aim of this experiment is to create an artificial cloud of ice crystals at an altitude of 90 to 100 kilometres by releasing water from the rocket. This cloud will then be monitored by three radar systems in Sweden, Finland and Norway. This will allow the students to investigate its behaviour in the ionosphere and under special electromagnetic conditions.

The CharPa experiment, designed by a group of doctoral students of the Institute of Atmospheric Physics in Kühlungsborn, is installed under REXUS 5's nose cone, which will be jettisoned at an altitude of about 70 kilometres. Using a special electrode, measurements will be carried out to establish whether the electrical charge of particles found at altitudes above 60 kilometres occur naturally, or whether they are caused by frictional processes.

These particles are known as mesospheric smoke particles, as they are formed from meteorite ablation products. They have a diameter of between one and five nanometre and occur in concentrations of several thousands per cubic centimetre. Scientists suspect that they play an important role in atmospheric processes such as the formation of noctilucent clouds of ice crystals.

The next experiment module contains ITIKKA, an experiment of the Tampere University of Technology in Finland. For their own amateur rocket project, the student team has developed and built an inertial platform, which they now want to fly under 'real conditions' for the first time on REXUS. The Vib-Bip team of the Castelldefels School of Technology in Spain will use the conditions of reduced gravity obtaining on REXUS 5 to experiment with gas bubbles that are injected into a vibrating cylinder filled with water.

REXUS rocket on the launch pad

REXUS and BEXUS - a programme for young scientific talent

The German-Swedish REXUS/BEXUS programme enables students to gain hands-on experience in preparing and carrying out space exploration projects. Every autumn, students can submit proposals for experiments to be flown in the gondola of a balloon, or on board sounding rockets (REXUS - Rocket EXperiments for University Students). Half of the payload capacity of the rockets and balloons is always reserved for students of German universities and colleges of higher education. The Swedish space agency SNSB has made the Swedish share available to students from other ESA member states as well.

The BEXUS balloons are especially suited for atmospheric research and technological experiments. The helium balloons have a volume of 10 000 to 12 000 cubic metres, and they can reach an altitude of 20 to 35 kilometres during a three- to six-hour flight. The balloon system can have a maximum length of up to 100 metres; the maximum payload capacity is 100 kilogrammes. Similar scientific questions are addressed by REXUS research rocket missions. The rockets reach an altitude of about 100 kilometres and they offer several minutes of experiment time.

The DLR Space Agency (DLR Raumfahrt-Agentur) in Bonn manages the programme and allocates the DLR experiments. The DLR Institute of Space Systems (DLR-Institut für Raumfahrtsysteme) in Bremen is in charge of the organisation, supervision and integration of the German experiments. It is also responsible for internal project management at DLR. The flight campaigns are carried out by EuroLaunch, a joint venture of DLR's Mobile Rocket Base (Mobile Raketenbasis; MORABA) and the Esrange Space Center of the Swedish Space Corporation (SSC).

In autumn 2009, students will be able to submit new experiment proposals for the September 2010 balloon campaign and the March 2011 rocket campaign.

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