Fifteen years of science in a parabolic flight aircraft – Airbus A300 ZERO-G goes into retirement

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The Airbus A300 ZERO-G has completed 5200 flights, 4200 flying hours and 13,180 parabolas in the service of science and microgravity research. Now, the parabolic flight aircraft, operated by French company Novespace, is bowing out into well-earned retirement following the 25th research campaign for the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR). Since 1999, teams of scientists from across Germany have conducted over 400 experiments in 15 hours of weightlessness on board the aircraft, answering important biological, medical and physical questions in doing so. Numerous technological tests have also been part of the programme. Experimental equipment has been tested for use in space – on the International Space Station (ISS), for example.

Flights for doctoral theses

How do plants know which way is up or down in microgravity? What role does gravity play for healthy, functional cells? How does our brain activity change and how does our immune system respond without the effects of gravity? What can we learn from research in microgravity that will benefit people on Earth? What is the best way to collect space debris? How can the properties of metal alloys be improved? How are planets formed? "All these and many other scientific questions have been investigated in the 25 German parabolic flight campaigns and have provided indispensable data to young scientists for their research," said Ulrike Friedrich, Project Manager for parabolic flights at the DLR Space Administration.

Over 150 scientific dissertations from undergraduates and doctoral candidates have been based on the results achieved during parabolic flights. Here, there are numerous examples from basic research leading to improved diagnoses or treatment of disorders for people on Earth. For example, researchers used parabolic flight experiments to come up with the idea of using whole body vibration not only for improved astronaut training, but also in clinical rehabilitation. There are indications that children with spastic paralysis can improve their motor function, coordination and fitness using this technique.

Floating for minutes as if on the Moon or Mars

Different accelerations are required for some scientific investigations, so there are also flights that simulate the gravitational conditions on the Moon (0.16 g) and Mars (0.38 g). A ‘lunar parabola’ provides the required acceleration for 25 seconds and a ‘Martian parabola’ for 35 seconds. Such campaigns were carried out in 2011 and 2012, in tandem with the French Space Agency (CNES) and the European Space Agency (ESA).

Parabolic flights – a bridge to the Space Station

Numerous scientific questions require more than the 22 seconds of weightlessness during a 'zero-g' parabola to be answered. In fact, the aircraft climbs and descends 31 times, thus guaranteeing 11 minutes of weightlessness per flying day – so with three to five flying days there are 33 to 55 minutes of weightlessness per campaign. Many scientists also want to carry out research in the permanent microgravity of the ISS. "Parabolic flights are their bridge to the Space Station. If the experiments here provide interesting results, the scientists can hope to continue their research 400 kilometres above Earth," explains Friedrich. For example, extensive preliminary research for 18 German experiments on the ISS was first carried out on DLR parabolic flights.

The 'flying classroom' – students and teachers conduct research in weightlessness

Parabolic flights are also ideal for bringing young future scientists directly into contact with subjects involving microgravity research. Dozens of students have participated in the preparation and analysis of parabolic flight experiments in six medical and biological projects. Some were even able to go on the flights. On another occasion, 12 teachers tried out demonstration experiments that German astronaut Alexander Gerst later conducted on the Space Station.

The Airbus A300 ZERO-G's home airport is Bordeaux-Mérignac in France. This is where Novespace, which operates the campaigns for DLR, provides the necessary infrastructure required for preparing and running the campaigns. Its final scientific flight campaign – which is also the 25th DLR campaign – took off from there. In connection with this, its very last journey on 3 November 2014, took it to its final destination – Cologne/Bonn Airport, where it will be on public display in future.

But this does not spell the end of the era of scientific parabolic flights. A successor aircraft is already being prepared – an Airbus A310 that has been in service as a German government aircraft since 1989 and has been used for, among other things, delivering the current Federal Chancellor Angela Merkel safely to her destinations. After being converted, this Airbus will be used as the new 'ZERO-G' for future parabolic flight campaigns.

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Experiments in weightlessness

Dust phenomena that are found on other planets are being investigated in an experiment run by the University of Duisburg.

TEMPUS research facility

The TEMPUS facility is used on DLR parabolic flights to melt and resolidify samples in weightlessness. The data is aimed at enabling casting processes on Earth to be carried out more effectively in future.

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Airbus A300 ZERO-G at sunrise

A perfect sunrise on the first flying day of the 25th DLR parabolic flight campaign – on the morning of 27 October 2014 at 07:45 CET, the first rays of the Sun bathe the Airbus A300 ZERO-G parabolic flight aircraft in a pleasant orange light at Bordeaux-Mérignac Airport. At this time, scientists and technicians had already been at work for two hours preparing the aircraft.

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