

MICROGRAVITY SCIENCES AND PROCESSES (A2)  
Microgravity Processes onboard the International Space Station and Beyond (7)

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EXPERIMENTING AT MOON AND MARS GRAVITY LEVELS DURING PARABOLIC FLIGHTS TO  
PREPARE FOR PLANETARY EXPLORATION

**Abstract**

Aircraft parabolic flights provide repetitively up to 20 seconds of reduced gravity during ballistic flight manoeuvres. Parabolic flights are used to conduct short microgravity investigations in Physical and Life Sciences and in Technology, to test instrumentation prior to space flights and to train astronauts before a space mission. The European Space Agency (ESA) has organized since 1984 more than fifty parabolic flight campaigns for microgravity research experiments utilizing six different airplanes. More than 600 experiments were conducted spanning several fields in Physical Sciences and Life Sciences, namely Fluid Physics, Combustion Physics, Material Sciences, fundamental Physics and Technology tests, Human Physiology, cell and animal Biology, and technical tests of Life Sciences instrumentation. Since 1997, ESA uses the Airbus A300 'Zero G', the largest airplane in the world used for this type of experimental research flight and managed by the French company Novespace, a subsidiary of the French space agency CNES. From 2010 onwards, ESA and Novespace will offer the possibility of flying Martian and Moon parabolas during which reduced gravity levels equivalent to those on the Moon and Mars will be achieved repetitively for periods of more than 20 seconds. Scientists will be invited to submit experiment proposals to be conducted at these partial gravity levels. This paper presents the technical capabilities of the Airbus A300 Zero-G aircraft used by ESA to support and conduct investigations at Moon-, Mars- and microgravity levels to prepare research and exploration during space flights and future planetary exploration missions. Some Physiology and Technology experiments performed during past ESA campaigns at 0, 1/6 and 1/3 g are also presented to show the interest of this unique research tool for microgravity and partial gravity investigations.