IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Microgravity Sciences on board ISS and beyond (6)

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ESA'S SCISPACE PROGRAMME IN PHYSICAL SCIENCES - RESEARCH AND APPLICATIONS

Abstract

The European Columbus module is for the European Space Agency (ESA) the key research laboratory in space to exploit the unique potential of the International Space Station (ISS) in a broad range of utilisation areas. For ESA, life and physical sciences are the focal areas comprising human research, biology/astrobiology, radiation and materials science, fluids and fundamental physics. In addition, an increasing number of technology demonstrations are providing further knowledge necessary for Earth-related services and future human exploration in space. ESA has performed more than 220 experiments on the ISS since the launch of Columbus, within the scientific context of its SciSpacE programme. Selected highlights performed by ESA will be presented to show the latest accomplishments and future plans of the international scientific cooperation.

The physical sciences research plan covers a broad range of topics such as fundamental physics, dynamics of complex fluids, thermal-diffusion, fluids dynamics and phase changes as well as melting and solidifications processes with ab interdisciplinary dimension to most topics. In addition, the applied research focuses on the behaviour of complex fluids, two-phase heat transfer and the properties of materials for improving knowledge about physical behaviour and product processes on Earth and Space. Currently in operation on the ISS, the experiment PK-4 studies the liquid phase and flow phenomena of cold dusty plasmas. In the Atmospheric sciences, the ASIM payload monitors since 2018 the upper atmosphere of the Earth for gigantic electric discharges and Gamma-ray flashes powered by thunderstorms. Soon to come is a unique payload, ACES, equipped with high stability and accuracy atomic clocks. The clock signal generated on-board the ISS will be used to perform space-to-ground comparisons with the best atomic clocks available on Earth. Moreover, it will provide stable and accurate time for different applications, including differential geopotential measurements, time and frequency metrology, time transfer and synchronization experiments, atmosphere studies.

International science collaboration with other ISS partners and national agencies is continuously expanding and provides various significant mutual benefits. The increasing yield of unique scientific knowledge and simultaneous operational experience demonstrate the extraordinary exploitation value of the ISS as a permanent human outpost in Low Earth Orbit (LEO) for fundamental science, applications and technology demonstration, as well as for future human exploration.