# SPACE ENVIRONMENT -A TOOL FOR INDUSTRIAL RESEARCH

SCIENTISTS AND INDUSTRY EXPLOIT THE UNIQUE CONDITION THAT EXISTS IN SPACE FOR CONDUCTING RESEARCH WHICH WOULD NOT BE POSSIBLE TO PERFORM ON GROUND, AND TO IMPROVE AND OPTIMISE PROCESSES ON EARTH. THE WEIGHTLESS ENVIRONMENT OF THE INTERNATIONAL SPACE STATION (ISS) REPRESENTS A STRATEGIC TOOL FOR APPLICATION-ORIENTED AND INDUSTRIAL RESEARCH FOR THE BENEFIT OF SOCIETY AND INDUSTRY.

#### THE INTERNATIONAL SPACE STATION: A UNIQUE RESEARCH INFRASTRUCTURE



Orbiting the Earth at 400 kilometres altitude and free from the effects of gravity in its free-fall orbit, the Space Station represents a unique infrastructure for performing research under weightlessness conditions.

Since the first crew entered the International Space Station in October 2000, the ISS has been continuously manned. Regular flights bring supplies and experiments and ferry astronauts to and from the Station, and a permanent crew lives and works on board the Station, conducting experiments on behalf of the scientific and industrial community on Earth.

The facilities and resources available on board not only allow scientists to carry out groundbreaking research, but also offer companies the opportunity to increase their competitive advantage by using the space environment as a platform for developing and testing new products and innovative technologies.

### BENEFITS OF RESEARCH IN SPACE

## FUNDAMENTAL PHYSICS

The exploitation of the space environment has allowed the development of entirely new research domains, such as the physics of complex plasmas, which has been growing from being virtually nonexistent ten years ago to a booming science with hundreds of publications per year. Among the potential applications of space research in complex plasma and dust particle physics are the development of novel plasma coating techniques, the growth of novel substances for solar cells and plasma screens, and improved modelling of Earth climate and its environment. Space also represents a unique environment for atomic quantum research,

## FLUIDS AND COMBUSTION

Experiments in weightlessness allow one to understand the mechanisms governing flow dynamics and heat transfer in heat/fluid exchanging systems, which are still not well-understood, largely due to the masking influence of gravity on experiments performed on Earth.

which generates new knowledge and contributes to critical technological development in areas ranging from fundamental physics, to space navigation, environment monitoring and Earth sciences.



Potential applications of research in fluids and combustion ranges from enhanced oil recovery and energy production techniques to improved efficiency of power plants and reduced emissions of engines.

#### MATERIAL SCIENCES

Research under conditions of weightlessness can optimise computer models of major industrial processes, leading to the development of new production methods or materials. Potential applications include increased reliability of numerical simulation and control of casting facilities in metallurgical industry, and improved efficiency of production of industrial crystals.

#### BIOTECHNOLOGY

is a non-invasive tool

in which to investigate cellular

Weightlessness react on them. This is essential for the better understanding of biological and physiological processes with potential applications from drug development to tissue engineering.

#### NANOTECHNOLOGY

Space experiments also help in understanding the fundamentals of nanoparticle formation and subsequent self-assembly without aravity-driven effects such as sedimentation. This area is gaining increasing interest from the scientific community in Europe, due to the large range of nanotechnology applications like sensors, catalysis, electronics, medical devices, etc.

functions. It provides insight into how cells perceive signals and

#### HEALTH

The space environment has detrimental effects on the human body: astronauts who stay in space for a longer period of time lose bone and muscle mass, their cardiovascular, vestibular and immune systems are compromised. Most of these effects are reversible upon reintroduction of normal gravity. The observed physiological changes often have commonalities with ageing, and to widespread diseases such as osteoporosis and cardiovascular

#### FOOD AND NUTRITION

Research in the food area specifically focuses on nutraceuticals and functional food, as well as on new methods of processing, packaging and conservation. The

> challenge in designing nutrition, which is fit for space and for



human body adapts to the lack of gravity can contribute to a better understanding of these processes, thus supporting the developments of effective countermeasures, from pharmaceuticals to fitness equipment.

the demanding needs of the crews is to create food that withstands the special conditions of the space environment, is highly balanced and efficient as for nutritional value, and at the same time can be maintained fresh, tasty and uncontaminated for a prolonged period: a unique opportunity for the food and nutrition industry.

Additional information can be found at: WWW.SPACEFLIGHT.ESA.INT/SURE OR CAN BE REQUESTED AT: SUREAD2006@esa.int