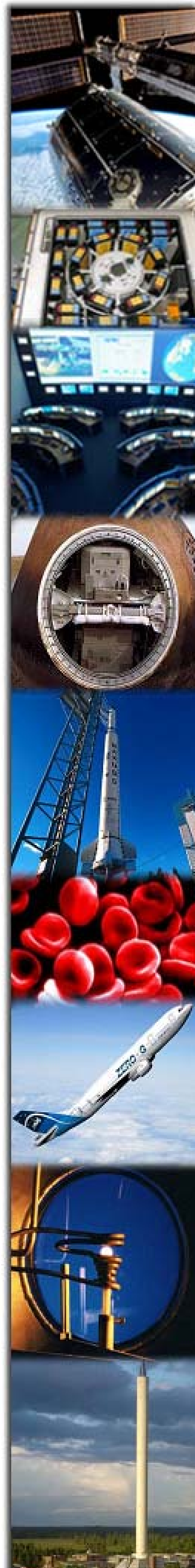
HUMAN SPACEFLIGHT, MICROGRAVITY AND EXPLORATION

FEBRUARY 2008

COMPILED BY HME SCIENCE AND APPLICATIONS DIVISION
THE RESEARCH AND OPERATIONS DEPARTMENT OF THE DIRECTORATE OF HUMAN SPACEFLIGHT, MICROGRAVITY AND EXPLORATION RELEASES A NEWSLETTER ON HIGHLIGHTS OF THE MONTH.

CLICK ON ONE OF THE HEADLINES BELOW TO GO TO THE RELEVANT TOPIC

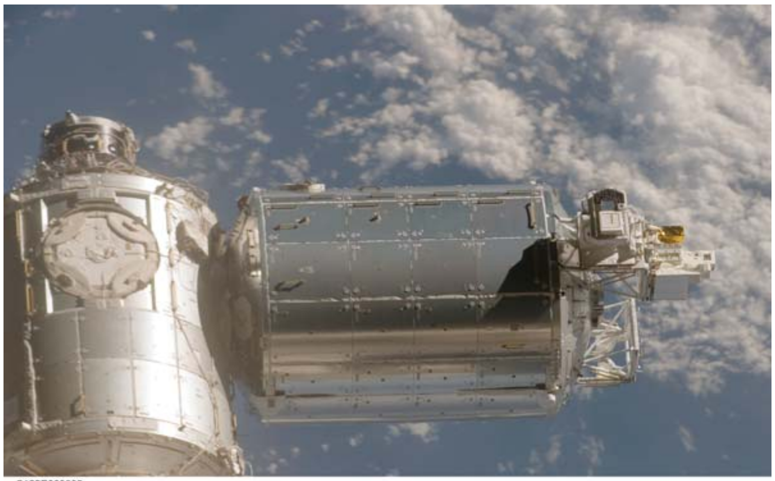


ACCESS EARLIER NEWSLETTERS HERE
YOU CAN UNSUBSCRIBE OR EXPRESS AN OPINION HERE

EDITOR: B. ELMANN-LARSEN, ESA/ESTEC-HME

COLUMBUS'S EXTERNAL PAYLOADS
- EUTEF AND SOLAR - IN PLACE DURING EVA-3 ON 15 FEBRUARY – FIRST SCIENCE DATA SOON TO COME

THE EUROPEAN TECHNOLOGY EXPOSURE FACILITY – EUTEF – AND THE SUN MONITORING OBSERVATORY – SOLAR – NOW ARE ACTIVE FACILITIES ON THE EXTERNAL PLATFORMS ATTACHED TO COLUMBUS. THUS EXPOSED TO UNPROTECTED SPACE CONDITIONS THEY ARE ALREADY PROVIDING UNIQUE DATA BY USE OF THE MOST SOPHISTICATED TECHNOLOGY IN MONITORING SPACE IN A MULTITUDE OF APSPECTS. EUTEF IS A PLATFORM THAT ACCOMMODATES 9 DIFFERENT SINGLE INSTRUMENTS. IT PROVIDES THESE SINGLE INSTRUMENTS WITH DATA COMMUNICATION, POWER AND TEMPERATURE CONTROLLING FEATURES. SOLAR SITS ON ITS OWN PLATFORM, FOLLOWING THE SUN FOR APPROXIMATELY 15 MINUTES OF EACH ORBIT THE ISS PERFORMS



S122E009992

Columbus Module attached: SOLAR (top-right) and EuTEF (sticking out to the right) mounted on their structures (courtesy NASA)

From a first view the EuTEF instruments appear to have very little to do with each other, and it is also true that they are constructed and built as separate entities, with highly focused, specific goals. But as we shall see, when their objectives are laid out, data from different, independent devices form a very attractive suite of accurate, time tacked complementary data that together will represent qualitatively much more value than when seen as individual, independent instruments.

From the beginning two main issues have been driving the design of the facility as a whole, namely;

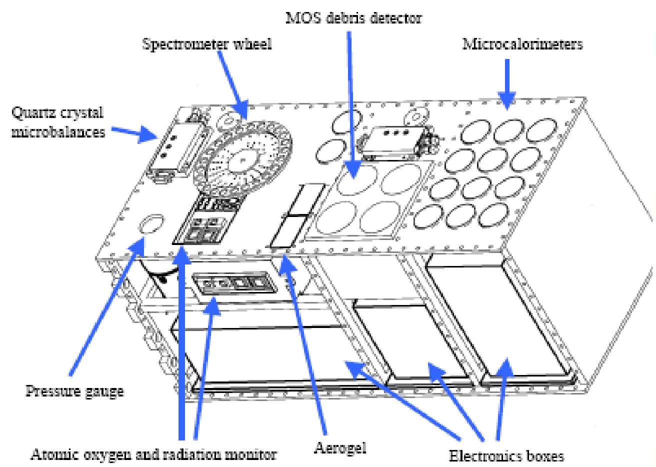
- the type of exposure that each of the nine single instruments need, as each one of them utilize the Space environment in different ways, depending on the specific purpose, and
- the temperature control in terms of how to get rid of the heat load, coming both from the instruments themselves (electrical boards), but also from the exposure to very high temperatures (up to 120 degrees C) when the ISS is passing through the day-part of each orbit, 16 times per day.

BACK TO TOP...

The type of exposure each instrument needs has been solved by careful positioning of them relative to each other. Thus, FIPEX and DEBIE-2 both need RAM and Zenith, EXPOSE needs Zenith, and the heat radiator needs to be on the wake side together with the DHPU. The Avionics Radiator System, (ARS), forming the rear end on the picture above, is a large aluminium plate covered with silver foil to increase the heat radiation, and seen from the other side one can observe a cut-out in the upper edge of that plate, so that one side is lower than the other. This has been necessary for allowing PLEGPAY, FIPEX and DEBIE-2 to radiate their intrinsic heat optimally under the given conditions. That other structures of the ISS are located in the direction of the heat dissipation, away from the radiator plate, makes a dramatic difference regarding how much heat can be dissipated. The radiation balance has therefore continuously been a key aspect to keep in mind when the architecture of the accommodation of the different elements had to be decided.

The objective and characteristic of each of EuTEF facilities are described in the following:

MEDET, MATERIAL EXPOSURE AND DEGRADATION EXPERIMENT (Needs RAM and Zenith views)



Past experiments, with degradation measurements only, have not always exhibited real in-space degradation effects as samples are often cured by oxygen in the air after their return. Moreover, the degradation dynamics, combined effects and saturation processes are not fully understood. Ground based simulation experiments have been performed, which are often very complex arrangements. It is however known, that the simultaneous existence of atomic oxygen, thermal cycles and micro-meteorites are much more serious than each environment alone (citation from J. Dauphin in "THE DEGRADATION OF METAL SURFACES BY ATOMIC OXYGEN" p. 109, A de Rooy, see reference.

The MEDET experiment has three objectives:

1) Evaluation of the effects of the complex Space environment on the optical and thermo-optical properties of materials to be considered for utilisation on LEO spacecraft. Optical materials generally have highly polished and accurately formed surfaces so that even low levels of degradation may have a significant effect on the long-term performance of the component. This includes the active measurement of thermo-optical properties (and more accurately, their variation as a function of Space exposure) for a number of proposed materials. Among these are anodizations and other materials externally used on board LEO spacecraft (such as SSM and new thermal paints). Calorimetric devices will be employed for this purpose.

BACK TO TOP...

2) Assessment of the effects of the ISS environment on optical windows. A special emphasis will be placed on the degradation process that is due to molecular contamination. Contamination results from various sources, such as out-gassing and degradation of materials, manoeuvres of the service vehicles, re-boost operations, firings of the attitude control systems, dumps and EVA. A spectrometer system will periodically measure the spectral optical transmission of transparent samples

3) Investigation of micro-particles and debris fluxes (especially their variation as a function of time) and, after retrieval, the origin of the debris and the detectors' behaviour. Active capacitor type detectors (MOS) will be used to monitor the size distribution and the spatial-temporal variation of small dust particles.

Science team: S. Duzckier – ONERA, France, A. Tighe – ESA
Industrial partners: CNES, ONERA, University of Southampton, ESA)
Illustration: From M. Dinguirard and J.C. Mandeville, ONERA, Toulouse, France: Materials Exposure and Degradation Experiment (MEDET), AIAA 2001- 5070
Read more about technical details of the MEDET facility here

DOSTEL, (DOSIMETRY TELESCOPES RADIATION MEASUREMENTS – DLR – SMALL RADIATION TELESCOPE FOR MEASURING RADIATION ENVIRONMENT

DOSTEL (Dosimetric Telescope) is a charged-particle telescope that will monitor the particle flux, dose rate and linear energy transfer (LET), spectra of radiation from the Van Allen belts, deep Space and the Sun. See a definition of LET here)
The latest in a long row of experiments that try to map the cosmic radiation pattern, intensity and variations, DOSTEL now finds its place as one of the nine EuTEF instruments. The involved dosimeters technique has been applied on numerous earlier Space missions.
DOSTEL was recently a part of the Matroshka facility in the external location on the station, where DOSTEL was placed on top of the Matroshka mannequin, that was attached to the exterior surface of the Russian Zvezda module for 539 days during 2004-05.
DOSTEL consists of a telescope of two 300m Canberra PIPS (Passivated Implanted Planar Silicon) detectors and two additional Hamamatsu 300 m PIN diodes. The circular PIPS detectors have an active area of 6.93 cm and the rectangular PIN detectors active area is 2.31 cm (2.1 x 1.1 cm). The PIN diodes are arranged perpendicular to each other and the telescope axis
Reference: Abstract, 11th WRMISS, Baumeister, S.

Technical Team: Soenke Burmeister at burmeister@physik.uni-kiel.de
Science Team: Guenther.Reitz@dlr.de
Industrial partner: DLR Institute of Space Medicine

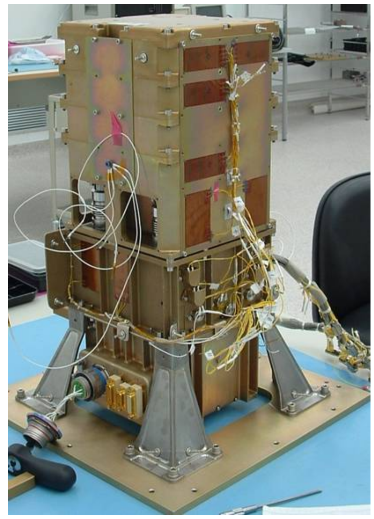
BACK TO TOP...

TRIBOLAB, Tribology properties of materials:

(Tribology: The science of the mechanisms of friction, lubrication, and wear of interacting surfaces that are in relative motion, from Greek 'tribos', a rubbing)

The TRIBOLAB instrument aims to test solid and lubricant systems in Space, which have proven to be ideal candidates on ground, in particular the effects of microgravity, vacuum and launch as well as ISS environment and collateral radiation effects. The instrument hosts three different experiments:

- Fluid lubricant experiment on test and verification of labyrinth seal and vent design;
- Tribological evaluation of coatings and surface treatment
- Evaluation of thermal sprayed solid lubricant coatings
- The experiment will be realized in the area of Pin-on-Disk (POD) investigating coatings, Ball Bearing (BB), and Labyrinth Sealing in Effusion Cells.



The particular focus is on the effect of Space conditions, i.e. vacuum, temperature microgravity and radiation impact on lubrication in diverse contexts.

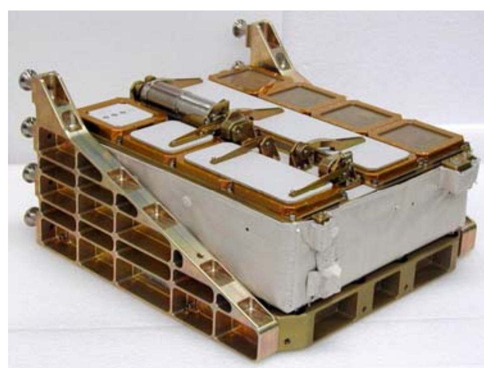
(Ref. EuTEF Integrated payload system safety methodology, proceedings Joint ESA-NASA Space-Flight Safety Conference, ESTEC, Noordwijk (NL) 11-14 June 2002 (ESA-SP-486, August 2002)

Contact Industry: Instituto Nacional de Técnica Aeroespacial (INTA) and AICIA
Industrial partner: INTA, INASMET

EXPOSE, Photo- and Exobiology

With success exposure of a multitude of samples to the hostile Space conditions have brought highly important knowledge of survival of diverse living organisms for longer periods of time. The latest such experiment package was flown in September 2007 in BIOPAN, see 'Biopan's robust passengers', September 2007 Newsletter and also experiment STONE.
Some of the same 'passengers' are onboard EXPOSE-E as the EuTEF version of EXPOSE is called, together with additional new ones, under the following experiment names:

- LIFE
- ADAPT
- PROCESS
- PROTECT
- SEEDS



As EXPOSE-E is supposed to stay in orbit for around 18 months, and that not all samples are to be exposed in the same manner time-wise, the facility has a number of controllable mechanisms that allow manipulating the machinery when necessary, via diverse microprocessors, the Expose Control Unit, or ECU, that controls motors, valves, and data acquisition. Not the least temperature control is important,

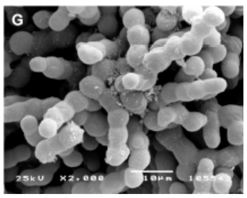
BACK TO TOP...

handled via the Thermal Control System, the TCS. In addition three stepper motors and three valve systems are actuated via the ECU. Finally, in the case that over-heating threatens, the lids over the sample trays can be closed.

The EXPOSE-E Experiments;

LIFE: (Coordinator S. Onofri, Italy)

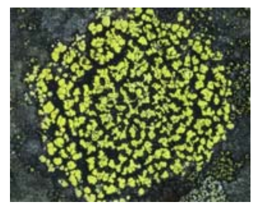
As on BIOPAN, organisms particularly resistant to extreme environment, also spelled out in more detail in the 2007 September Newsletter, EXPOSE-E accommodates Lichens, fungi and symbionts (organisms that live in close, prolonged association). The species flown are:



Left: Antarctic fungi, *Cryomyces antarcticus and C. minteri,* here shown as Electron Microscope image. Read the key paper by the principal investigator here

Bottom left: the fungal element of the of the Lichen *Xanthoria elegans* (here shown as the fully grown lichen sheath.

Right: the lichens Rhizocarpon geographicum and Xanthoria elegans



ADAPT (Coordinator P. Rettberg, Germany)

Exobiologists are among other things concerned with the ability of microorganisms to travel in Space, embedded in micrometeorites for example, and to continue life on another planet than the one they originated on. The ADAPT experiment is in particular looking at, if these microorganisms respond to the long-lasting harsh UV radiation, that is lethal for most living matter, by increasing their resistance in one or the other way. The tray-like structure will accommodate 2 chemical and 6 biological experiments or experiment systems. Experiments are accommodated in 3 trays, 12 sample carriers, and hundreds of sealed and vented cells. Microbes in artificial meteorites as well as microbial communities from special ecological niches, such as endolithic and evaporitic ecosystems will be studied over a period of 18 months. The sample trays will either be vented or sealed and will be covered by an optical filter system to control intensity and spectral range of solar UV irradiation. Control of sun exposure will be achieved by the use of individual shutters. The following are the objectives of this experiment:

BACK TO TOP...

- To improve the understanding of the organic chemistry processes in Space, the biological adaptation strategies to extreme conditions, e.g. on early Earth and Mars, and the distribution of life beyond its planet of origin.

- Molecular adaptation strategies of microorganisms to different Space and planetary UV climate conditions.

- The Adapt experiment will investigate the capability of microorganisms to adapt to qualitatively and quantitatively different UV levels as found on Earth and on Mars.

Reference: G. Horneck, Summer School Alpbach 2007 Astrobiology, July 17-26, 2007

PROCESS (Coordinator H. Cottin, France)

(Prebiotic Organic Chemistry on Space Station)

The central question here is how the gap between basic chemical compounds and the formation of primitive life could have been transgressed.

The abstract from a recent lecture (look for ESA Lecture no. 3 Basic Prebiotic Chemistry' here) of the principal investigator best describes the central questions under the PROCESS heading:

"Before reaching a sufficient complexity to fill the giant gap between chemistry and biology, molecular structures have evolved from single molecules such as CH4, HCN, H2CO, towards key prebiotic compounds: amino acids, puric and pyrimidic bases, sugars. Nowadays three kinds of environments are considered to be the place in which the very first steps of prebiotic chemistry took place:

1. Earth prebiotic atmosphere);
2. The bottom of oceans, near hydrothermal vents;
3. Space, in the solar nebula and even the interstellar medium, before meteorites and comets would seed Earth oceans with complex organic material."

The lecture is discussing the relevance of these three hypotheses. From simple considerations of organic chemistry some ways are identified to understand the first chemical steps leading to the formation of amino acids, puric and pyrimidic bases and sugars in prebiotic environments.

Further experiment focal areas are:

PROTECT:

Aim is to investigate the resistance to the Space environment of spores, also in terms of the degree of damage they experience and how and if they are able to repair these damages.
Coordinator: G. Horneck, Germany.

BACK TO TOP...

SEEDS:

Again *Arabidopsis thaliana* seeds are used, seeds from the plant that is so well described from the level of the entire genome. There will be a number of steps on the ground, in the experiment process, one being the effect of UV light, the next being an investigation of improving the resistance. The flight experiment will be performed in EXPOSE, and seeds thus exposed to Space will be examined and genetically examined post-flight, for examination of essential functional qualities, and an assessment of damages to the genetic material.
Coordinator: D. Tepfer, France.

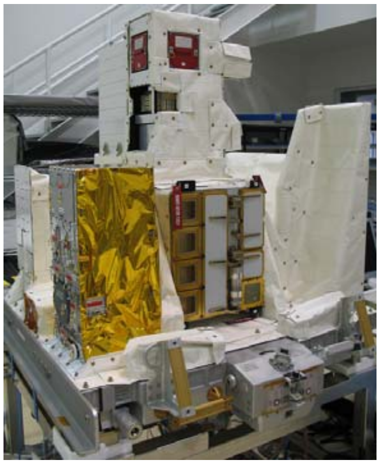
DEBIE-2, DEBRIS IN ORBIT EVALUATOR-2, MICROMETEORITE AND ORBITAL DEBRIS DETECTOR.

DEBIE-2 space debris impact detector (courtesy Carlo Gavazzi Space)

DEBIE-2's three detectors need the following orientations: RAM,
Zenith and the starboard (right) directions. All encountered debris, e.g. micrometeorites and particles or dust of man made origin will be registered. Each sensor maintains three plasma detectors and two piezoelctric detectors. Impact on a thin aluminium foil covering the detectors. The impact on the foil generates signals that the detector can process. The piezoelectric detectors are impact and pressure sensitive and they are coupled to the foil to measure the energy released upon impact. A wire grid (25 microns) supports the very thin (6 microns thick) foil and the registered signals are stored electronically.

Industrial partner: Patria Finavitec, under ESA contract
Contact Science Coordinator: G. Drolshagen, ESA

FIPEX, (Flux (Phi)-Probe-Experiment) Atomic Oxygen Detector



FIPEX (dark lamellar areas) under DEBIE-2 (re
square cut-outs) highest in middle

The Space environment, in this context in particular the aggressive atomic oxygen and the temperature variations are in focus in for the FIPEX facility, see similar aspects above under MEDET. The high-energy ionizing UV radiation is splitting O_2 into two oxygen atoms, this formation mainly taking place between 80 and 160 km altitude in the atmosphere. Due to atmospheric temperature profiles and the gravitational effect that lighter particles move to higher altitudes, atomic oxygen can be found at far larger altitudes than the ones where they are formed. In this manner atomic oxygen becomes the dominant variant up to 500 km. The effect of UV

BACK TO TOP...

radiation in splitting of oxygen and formation of ozone is also addressed in Newsletter November 2007, Drop Tower Experiments

FIPEX type sensors have been flown on several earlier missions for measurement of low concentration oxygen. With these first commercial ceramic oxygen sensors the distinction between O_2 and the atomic version O was not possible. Mainly the atomic oxygen and in particular the ionized O^+ is of special interest due to its highly aggressive corrosive character, where e.g. spacecraft surface materials such as Mylar and Capton react very vividly with O^+, whereas metals apart from silver and osmium do no react significantly. The corrosive effect on spacecraft surfaces but also on optical surfaces is not the least based on the energy with which the gas collides with it, due to the high velocity of the orbiting spacecraft. The energy developed by impact is mostly over the activation energy level necessary for related chemical reactions, e.g. formation of an oxide with the material it encounters.

The FIPEX system consists of new developed electro-chemical sensors made from a ceramic electrolyte with catalytically active platinum electrodes. These are able to distinguish the different oxygen ions.
Source: Fausolas et al. and Roger Förstner TU Dresden

PLEGPAY, *Plasma Electronic Gun Payload for Plasma Discharge*

The PLEGPAY facility has a few basic components in order to generate the data expected from it. The main question is focused around electrostatic charging and discharging of gases in low earth orbit on large Space structures, identifying a potentially fatal problem for spacecraft electronics. The most effective technology for avoiding unwanted and uncontrolled events is based on hollow cathode technology which consists of a cavity closed at one end. This is essentially the system that PLEGPAY provides for controlled experiments with variations in gas flows. In order to perform controlled experiments PLEGPAY provides as well a pressurised gas tank with dose controller and timer, such that the inert gas Xenon can be released into the chamber where it becomes ionized by electrons emitted by an insert for ignition.

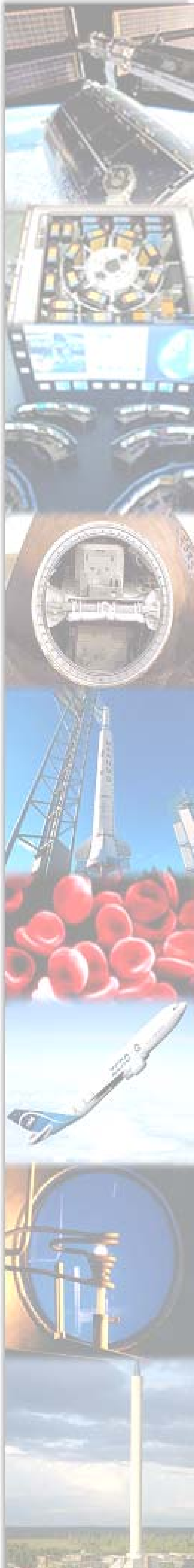
PLEGPAY Flight Model with hollow cathode

Contact Scientist: G. Noci - TAS, Italy
Industrial partner: Thales Alenia Space, Florence

EuTEMP

For temperature monitoring in the payload particularly between the time EuTEF is removed from the Shuttle Atlantis' payload bay and until is it firmly installed on EuTEF.

BACK TO TOP...



EuTEMP is a measurement unit that acquires temperatures, with small dimension, autonomous feed by batteries, build to resist to extreme temperatures of Space environment, at least for several days after launch. EuTEMP will transmit its data to Earth through Columbus on the International Space Station.

The role of EuTEMP is specifically important during the installation of EuTEF on the Columbus. At that stage a critical transfer phase will occur, where heaters are switched off and the thermal control can only be achieved by passive means. During this phase, duration of which depends how smoothly the EuTEF installation will go, the temperature can drop to very low values. EuTEMP will register and provide temperature measurement from a number of measurement points on EuTEF.

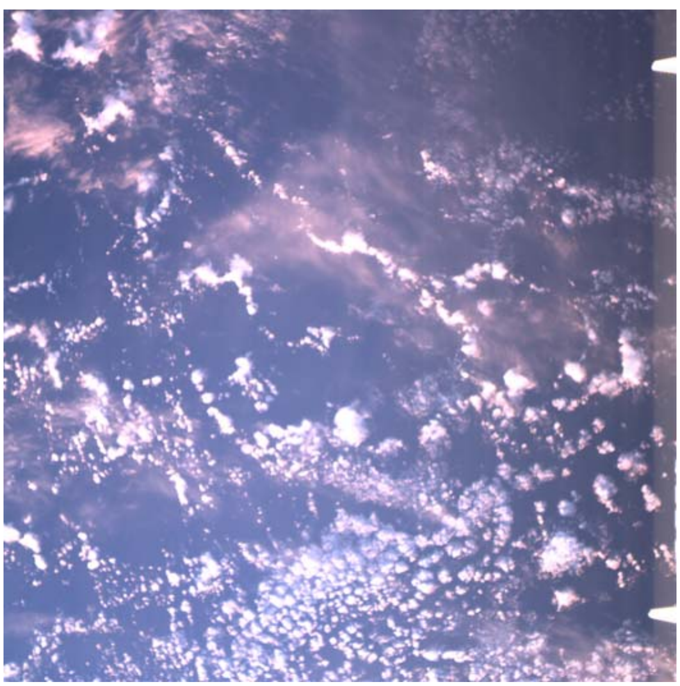
EuTEMP was developed with the capacity to be autonomous, equipped with batteries for at least 10 days. It is able to record temperatures for a month and later transmit the recorded values to the Earth, through the communications link according to the MIL-STD-1553 bus of EuTEF.

Source and Industrial partner: EFACEC, under ESA contract

Earth Viewing Camera (EVC)

The Earth Viewing Camera, the EVC is located in the EuTEF with a fixed Earth direction of view. The Camera is supposed to produce images every 20 seconds around the clock for promotional, awareness and other potentially useful purposes. It is a so-called Commercial-of-the Shelf or COTS item

Undoubtedly the EVC will become a popular produce of photo series that till this point in time did not exist. The quality is supposed to be medium range resolution, but good enough to provide material for an array of analytical purposes.



EVC has been activated onboard the external platform of Columbus and has transmitted the first images to the ground.

Contact ESA: Massimo.Sabbatini@esa.int
Industrial partner: ESA/Carlo Gavazzi Space for outreach activities

Left: One of the first photos taken by the EVC (Courtesy ESA)

BACK TO TOP…

SOLAR – Now a complete, high accuracy solar spectrum monitoring facility onboard ISS


SOLAR being manipulated for installation on its platform by NASA astronaut Stan Love (Courtesy NASA)

The Sun is the primary energy source of the Earth and has via the effect of different parts of its spectrum profound influence on the composition of the atmosphere and thereby directly on the climate of the Earth. The SOLAR payload is an ESA developed Sun observatory designed to operate from one of Columbus' external platfoms, the CEPF. SOLAR is composed of three separate instruments that together cover almost the entire energy and irradiation spectrum of the Sun, namely the SolACES instrument (for absolute spectral irradiance), the SOLSPEC instrument (for Solar spectral irradiance measuremetns) and the SOVIM instrument (for Solar Variability and Irradiance Monitor).

Accurate measurements of the entire solar spectrum will allow an improved interpretation of events in the atmosphere and on Earth during the period of measurement. Further, as the solar cycle of 11 years never gives constant values it is essential to be able to relate other observations to accurate, time-tacked measurements.

SOLAR pointed to the Sun has been designed for a mission of up to 3 years. The three science instruments developed by different European research institutes are mounted on and pointed to the Sun by means of a Coarse Pointing Device, that ensures pointing at and tracking of the Sun during the orbit around the Earth.

The CPD includes a Control Unit (CU) to provide SOLAR with electrical power conditioning and distribution, data handling, pointing control, and telemetry distribution functions, and a CPD Mechanical Assembly (CMA), that drives the pointing platform hosting the science instruments on two orthogonal axes (+/-40deg and +/-25deg).
A Sun Sensor is installed on the pointing platform to complement the ISS attitude data with real time acquisition of the sun position, and to lock the sun target at the beginning of the sun tracking manoeuvre.

The CMA and the CU are installed on a Columbus External Payload Adapter (CEPA), carrying the ISS standard unpressurised interface (the FRAM) to mate with the launch/retrieval carrier and with the Columbus Laboratory.

The CPD development has been demanding. It has required resolving a number of critical technical challenges, to find the best compromise between structural, mechanical, thermal, and tight geometrical requirements. In order to best achieving the requested

BACK TO TOP...

structural performance, an extensive use of carbon fibre composite material has been realised for construction of the CPD.

The development of the SOLAR payload facility has in terms of complexity been equivalent to the development of a scientific mini satellite. In fact, with the exception only of electrical power generation, propulsion, and communication antennas, basically all other spacecraft subsystems are represented in this facility.

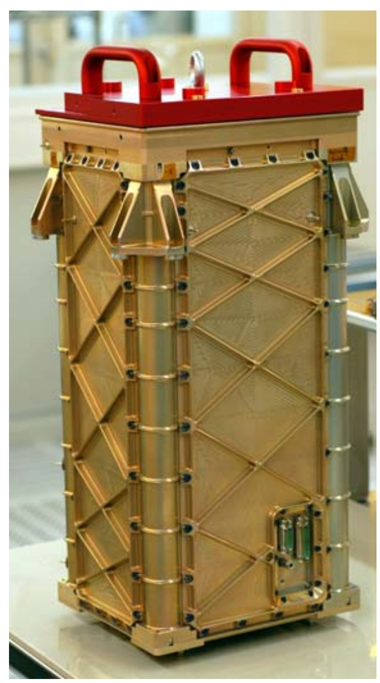
Similarly to EuTEF, the SOLAR development project has been faced with technical and programmatic requirements including high demands for Shuttle payloads on many fronts, but in addition has put severe demands on cleanliness until the moment the payload doors have been sealed.

The SOLAR installation on-board the Columbus Laboratory was performed on 15 February 2008, by an EVA manoeuvre that extracted SOLAR from Shuttle Atlantis cargo bay, and transferred it to the Columbus External Platforms Facility, the CEPF.

As identified as a critical issue also for other external payloads whose functionality is depending critically on optical surfaces, also SOLAR has been carefully controlled for avoidance of unwanted contamination. This is best done by implementing a positive nitrogen pressure in and around the facility, optimally until it is either securely placed in the launch envelope, or delivered in space. On ground the risk is that unwanted organic material gets a chance to grow and sediment on the optical surfaces. Later, in orbit, such surface, are threatened by chemical processes involving atomic oxygen. Particular attention had also to be devoted to cleanliness, to prevent that contamination degrades the science instruments performance.

The three SOLAR science instruments together can offer complementary data to better measure the Sun energy emission. Overall, their measurements will be able to cover over 99% of the entire energy and irradiation spectrum of the sun. In detail, the SOLAR science instruments are the following:

SolACES (SOLar Auto-Calibrating EUV/UV Spectrophotometers)



The instrument SolACES is a new development. It has the task to measure the absolute spectral irradiance of the full disk of the sun in the Extreme UV to UV region (15 nm - 220 nm) and its variation over time. It is expected to provide a basis for more accurate mathematical models of the Earth's thermosphere and ionosphere. The spectral resolution of these measurements is below 2 nm depending on the wavelength in the spectrum.
Experience shows that it is desirable to be able to perform regular calibrations of the instrument, due to both potential 'drift' in the electronics and also in order to ensure that changes in the optical surfaces do not have adverse effects on accuracy of the measurements.
A novel feature of SolACES is therefore its capability to auto-calibrate the instrument repeatedly during the

BACK TO TOP...

whole mission. The auto-calibration capability will be achieved by using two tri-current ionisation chambers, filled with the gases Ne, Xe and NO, as primary detector standards, and silicon diodes as secondary detector standards. The ion currents measured at the chambers are directly related to the incoming solar photon fluxes. This technique will account for the inevitable efficiency improvement of the instrument, and allow EUV flux measurements with an up to now unprecedented absolute radiometric accuracy of explicit better than 10%.

Contact Science Coordinator: Schmidtke@ipm.fhg.de
Instrument Developer: Fraunhofer Institute IPM, with Industrial support from EADS-ST, Friedrichshaven (D)

SOLSPEC (SOLar SPECtral irradiance measurements)

SOLSPEC has been flown on several space missions earlier in different versions. It measures the absolute solar spectral irradiance from 180 nm to 3000 nm, and studies the solar variability over both short and long time scales.

Contact Science Coordinator: Gerard.Thuiller@aerov.jussieu.fr
Instrument Developer: CNRS/Aeronomie – Partners: IASB/BIRA (B), LSW (D)

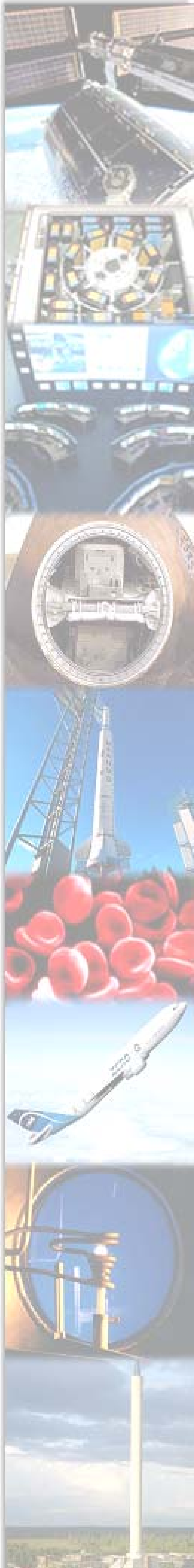
SOVIM (SOlar Variability & Irradiance Monitor)

SOVIM is derived from instruments already flown on other missions. It is designed to measure the solar spectral irradiance with filter-radiometers in the near UV (402 nm), visible (500 nm), and near IR (862 nm), and the total solar irradiance in the range from 200nm to 100µm

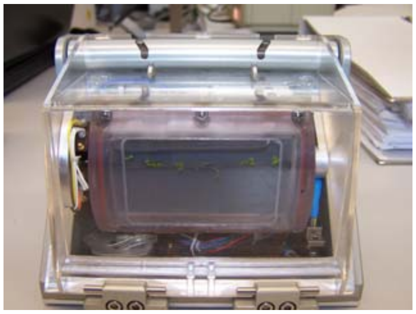
Contact Science Coordinator: cfrohlich@pmodwrc.ch
Instrument Developer: PMOD/WRC – Partner: IRMB Bruxelles (B).

Contact ESA Programme Manager for SOLAR development:
Piero.Galeone@esa.int

BACK TO TOP...



BIOLAB – COMMISIONED AND READY FOR THE WAICO EXPERIMENT



BIOLAB incubator with growing *A. thaliana* seeds (Courtesy OHB)

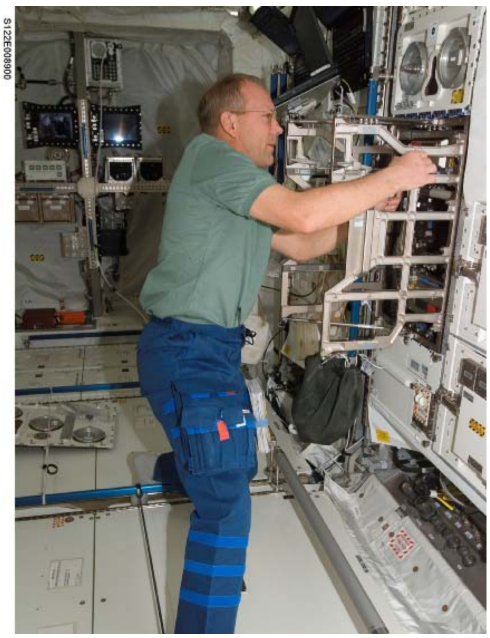
With BIOLAB in place and active in ESA's Columbus module, a new era of biological research can start. Not that experiments necessarily will be of a different category than hitherto but the facilities that are offered by BIOLAB are changing the scene for what can be done. The first experiment is the WAICO experiment, Waving and Coiling of Arabidopsis Roots at Different g-levels, which will be on when this is being read, an experiment that very much builds on the same database on *Arabidopsis thaliana*, the plant that enjoys centre stage in so many space experiments. See also earlier stories on *A.thaliana* in Newsletters 2007.

BIOLAB provides a much more sophisticated environment than hitherto available, via its state-of-the-art instrumentation, a well controlled life support system, in addition to the ability to support long-term experiments. In this new environment, the WAICO experiment will be only one example of versatility that BIOLAB will be able to support.

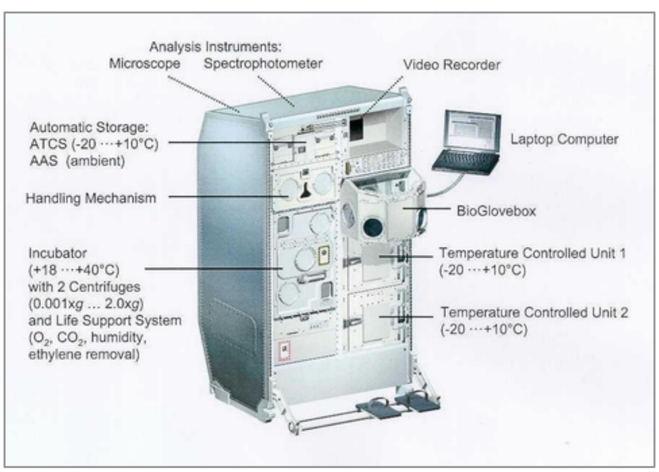
WAICO is engaged in investigating in particular the behaviour of the root under influence of different levels of gravity. Thus 0-g will be the main experimental condition whilst an onboard 1-g control centrifuge will provide an onboard control experiment.

Both a Wild Type and a genetically modified set of seeds will be set off in the BIOLAB incubators, the genetically modified to be deprived of some of the essential factors for its ability to respond to gravitational stress.

WAICO will be running planned as of 26 February.



ESA astronaut Hans Schlegel setting up the incubator rotor compartment of Biolab. (NASA)

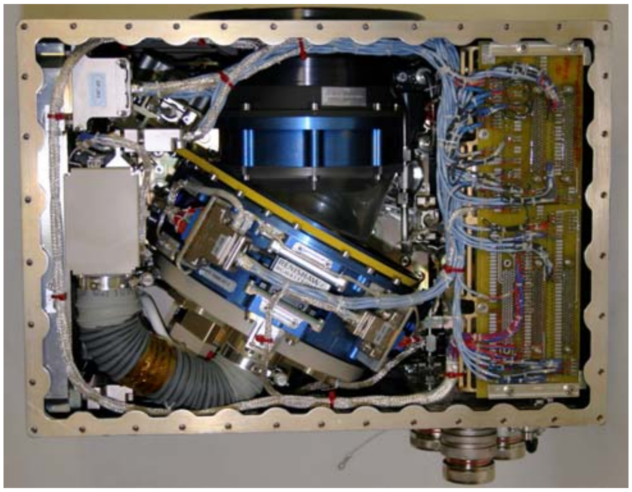


BIOLAB will provide a multitude of facilities, as indicated on the figure *(left)*.

Tour the BIOLAB facility here . Click on 'Components' to read more about BIOLABs many features.

BACK TO TOP...

FLUID SCIENCE LAB (FSL) UP AND RUNNING – GEOFLOW TO BE THE FIRST EXPERIMENT



Geoflow experiment container

The objective of GeoFlow is to study thermally-driven rotating fluids, in order to investigate the stability, pattern formation, and transition to turbulence of viscous incompressible fluids contained between concentric, co-axially rotating spheres.

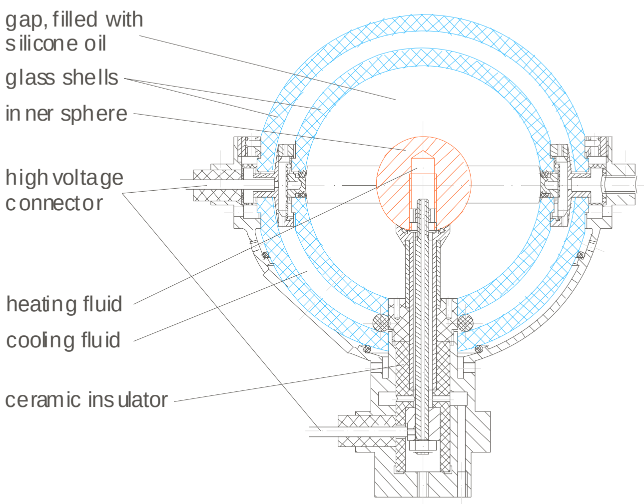
These physical mechanisms are important for a large number of astrophysical and geophysical problems showing flows in spherical geometry driven by rotation and convection: For example, to explain the mantle convection of the Earth, the differential rotation effect on the sun, the zonal atmospheric jets on the giant planets, or the flow in a planet's interior (like the Earth).

If phenomena are studied experimentally in an Earth lab, gravity acts axial to a spherical model, and not central, like in the Earth's core. Necessary microgravity conditions are available at the International Space Station (ISS).

Understanding and controlling fluid flow in a spherical geometry under the influence of rotation will also be useful for improving spherical gyroscopes and bearings, centrifugal pumps, etc.
Furthermore, study of effects related to the electro-hydrodynamic force, which serves to simulate the central gravity field, will find applications in high-performance heat exchangers, and in the study of electro-viscous phenomena. It will also help to understand the motion of liquids in several ground-based industrial applications where injected ions are a source of charge, e.g. in electrostatic precipitators and ion-drag pumps.

ESA's Fluid Science Lab (FSL) is one of the racks being commissioned in the Columbus module. The first experiment to run is Geoflow and planned to be started early March 2008.

BACK TO TOP...



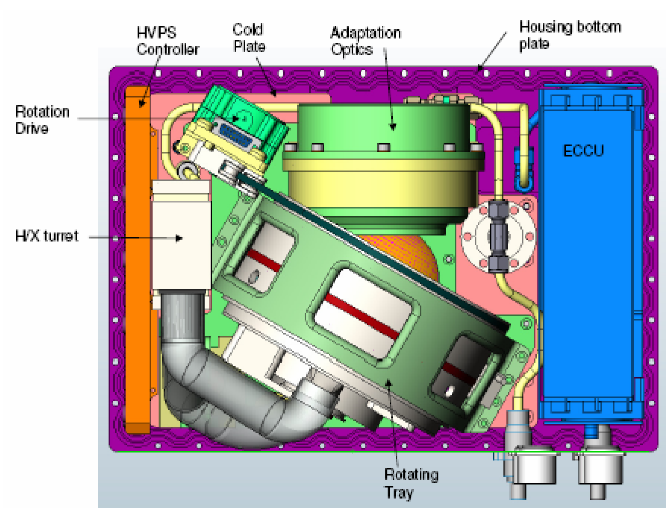
Left: Schematics of principle experiment setup

Scientists involved:

Coordinator:
Ch. Egbers, TU Cottbus, Germany: Preparatory experiments in laboratory, design and tests of Space experiment, numerical simulations of thermal convection

P. Laure, Ph. Beltrame, INLU (Univ. de Nice), France: Development of code for bifurcation analysis, bifurcation analysis with and without rotation, special regimes: mode interactions
Proposed new partners (to be formalised):

ESA Coordinating Scientist: Stefano.Mazzoni@esa.int



BACK TO TOP...