

# Programmes in Progress

Status end-December 2007



PROJECT	
SCIENTIFIC PROGRAMME	SPACE TELESCOPE
	ULYSSES
	SOHO
	HUYGENS
	XMM-NEWTON
	CLUSTER
	INTEGRAL
	MARS EXPRESS
	SMART-1
	DOUBLE STAR
	ROSETTA
	VENUS EXPRESS
	HERSCHEL/PLANCK
	LISA PATHFINDER
	GAIA
	JWST
EARTH OBSERVATION PROGRAMME	BEPICOLOMBO
	METEOSAT-5/6/7
	ERS-2
	ENVISAT
	MSG
	METOP
	CRYOSAT
	GOCE
	SMOS
	ADM-AEOLUS
	SWARM
	EARTHCARE
COMMS/NAV. PROGRAMME	ARTEMIS
	ALPHABUS
	SMALL GEO SAT.
	GNSS-1/EGNOS
TECHNOL. PROG.	GALILEO
	PROBA-1
	PROBA-2
HUMAN SPACEFLIGHT, MICROGRAVITY & EXPLORATION PROGRAMME	SLOSHSAT
	COLUMBUS
	ATV
	NODE-2 & -3 & CUPOLA
	ERA
	ISS BARTER & UTIL. PREP.
	EMIR/ELIPS
	MFC
	ASTRONAUT FLT.
	AURORA CORE
EXOMARS	
LAUNCHER PROG.	ARIANE-5
	VEGA
	SOYUZ AT CSG

2001	2002	2003	2004	2005	2006	2007	2008	2009	COMMENTS
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LAUNCHED OCTOBER 1997									
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LAUNCHED SEPTEMBER 2003									
TC-1 LAUNCHED DECEMBER 2003 TC-2 LAUNCHED JULY 2004									
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LAUNCH END-2011									
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LAUNCH JUNE 2013									
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LAUNCH AUGUST 2013									
M5 LAUNCHED 1991, M6 1993, M7 1997									
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MSG-1									
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MSG-2									
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MSG-3 LAUNCH 2011, MSG-4 LAUNCH 2013									
METOP-A LAUNCH OCTOBER 2006, METOP-B 2011, METOP-C 2015									
LAUNCH FAILURE OCTOBER 2005 CRYOSAT-2 LAUNCH MARCH 2009									
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LAUNCH MAY 2008									
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LAUNCH END-2012									
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LAUNCH 2011									
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FIRST LAUNCH MARCH 2008									
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LAUNCHES OCTOBER 2007 & APRIL 2010 CUPOLA WITH NODE-3 OCT 2009 CUPOLA NODE 3 4/10									
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LAUNCH NOT BEFORE END-2009									
MSG									
FOTON M									
APCF-6608XX/6 KASPER/SONIC FAST GERBTO									
MATROSKA									
MAXUS-6									
WASER-1									
FOTON M2									
PFS & EBC									
TEXUS-42									
MAXUS-7									
TEXUS-43									
EMCS/PEMS									
FOTON M3									
PCDF									
EDR/EUTEP/SOLAR									
MELR1									
MELR2									
MASEK-11									
MAXUS-8									
TEXUS-46									
IOARES									
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LAUNCH MID-2013									
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FIRST LAUNCH MAY 2009									



## HST

Hubble has resolved some strange objects nicknamed 'blue blobs' and found them to be brilliant blue clusters of stars born in the swirls and eddies of a galactic collision 200 million years ago. Such 'blue blobs' – weighing tens of thousands of solar masses – have never been seen in detail before in such sparse location.

The 'blue blobs' are found along a wispy bridge of gas strung among three colliding galaxies, M81, M82 and NGC 3077, about 12 million light-years away from Earth. This is not a place astronomers expected to find star clusters, because the gas filaments were considered too thin to accumulate enough material to actually build this many stars. The star clusters in this diffuse structure might have formed from gas collisions and subsequent turbulence, which locally enhanced the density of the gas streams. Galaxy collisions were much more frequent in the early Universe, so 'blue blobs' should have been common. After the stars burned out or exploded, the heavier elements forged in their nuclear furnaces would have been ejected to enrich intergalactic space.

*The so-called 'blue blobs' discovered by Hubble can be seen in the three insets under the visible image on the right (NASA/ESA)*

## Ulysses

Early on 15 January, at the start of a routine test in preparation for the next phase of the Ulysses mission, communication with the spacecraft via the on board X-band transmitter was lost.

As a result, the Spacecraft Operations Team declared a 'Spacecraft Emergency' in order to obtain additional ground station coverage from NASA's Deep Space Network (DSN).

The team was then able to send the commands needed to switch to the S-band transmitter, and establish stable communications, albeit at a low bit rate.

Subsequently, the bit rate was increased to 1024 b/s using a 70 m DSN station and the data recorded on board the spacecraft during the anomaly could be played back.

Since the spacecraft is in a very stable configuration and there are no power or thermal concerns, the Ulysses project ended the emergency status late on 16 January and Ulysses is now in 'Safing Mode'.

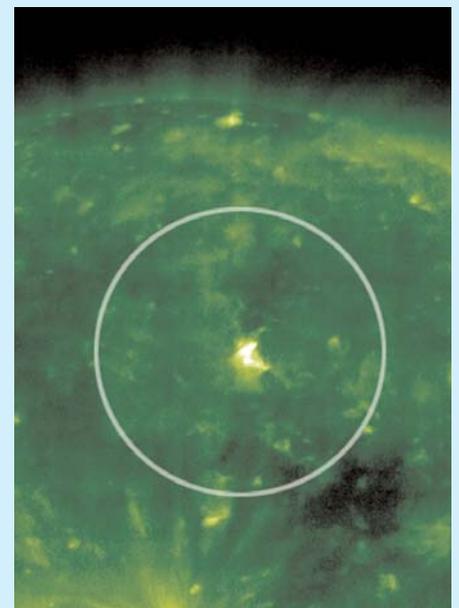
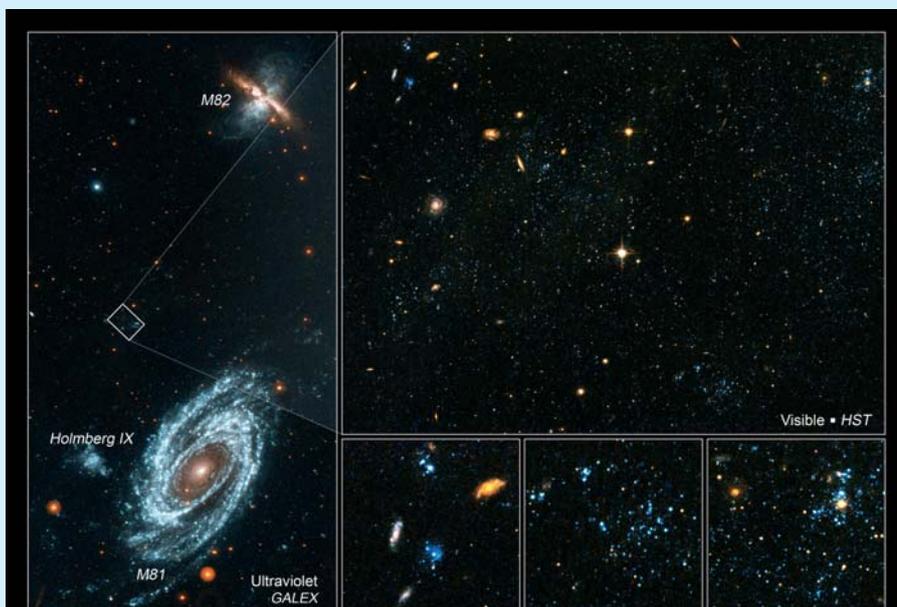
## SOHO

Bright plumes in extreme ultraviolet and soft X-ray emerging from polar coronal holes have been of interest for nearly two decades. It was proposed that they might contribute to high-speed solar wind streams. On the other hand, could they be cooler material with no connection to the plasma sampled at high latitude by Ulysses? The SUMER team carried out a new series of polar plume observations during two campaigns in cooperation with the Japanese spacecraft Hinode and NASA's STEREO mission.

From these observations the 3D-plume geometry could be derived and plasma diagnostics confirmed that plumes have higher electron densities than their environment. The observations furthermore suggest that the plume contribution to the fast solar wind is relatively small. This work is being continued and extended by an International Space Science Institute (ISSI) study team.

On 4 January 2008, SOHO observed the first sunspot of the new solar cycle; see [www.esa.int/esaCP/SEMT1J3MDF\\_index\\_0.html](http://www.esa.int/esaCP/SEMT1J3MDF_index_0.html).

*SOHO captures the first sunspot of the new solar cycle (ESA/NASA)*



## Cassini-Huygens

The first special volume of *Planetary and Space Sciences* on Huygens' results was published in November 2007 (Vol. 55 Iss. 13). Thirteen further papers, accepted for the second volume planned for mid-2008, are available at:

[www.sciencedirect.com/science/journal/00320633](http://www.sciencedirect.com/science/journal/00320633).

The first radar observation at Titan's southern latitude was obtained on 20 December 2007. The synthetic aperture radar image covers the south pole of Titan. A few dark features seen in the image are interpreted as lakes and may correspond to dark features first identified by the Imaging Science Subsystem (camera) in June 2005. Their very dark appearance in the radar image suggests that they are probably filled with liquid methane. Other apparently empty lake basins are seen elsewhere in the radar image. Based on this very first observation at southern latitudes, there appear to be fewer filled lakes near the south pole than seen in a typical region near the north pole. This may support the theory put forward that lakes are filling in and evaporating with a seasonal cycle: methane fills the lakes during the winter (it is currently late winter in the northern hemisphere) and evaporates during the summer (it is currently late summer in the southern hemisphere). Further radar images of the southern latitudes are planned in the next few Titan flybys.

## XMM-Newton

A study was done by Guedel et al. on the detection of hot plasma pervading the extended Orion Nebula, and a related article has been published by *Science Express*, which provides electronic publication of selected science papers in advance of print (29 November 2007 issue). The nearby giant molecular cloud in Orion hosts several thousand stars of ages less than a few million years, many of which are located in

or around the famous Orion Nebula, a prominent gas structure illuminated and ionised by a small group of massive stars (the Trapezium). Guedel et al. present X-ray observations obtained by XMM-Newton revealing that a hot plasma with a temperature of 1.7–2.1 million K pervades the south-west extension of the nebula. The plasma flows into the adjacent interstellar medium. The authors believe that this X-ray outflow phenomenon must be widespread throughout our galaxy.

The XMM-Newton Gallery is a collection of astronomical images and spectra obtained with XMM-Newton ([http://xmm.esac.esa.int/external/xmm\\_science/gallery/public/](http://xmm.esac.esa.int/external/xmm_science/gallery/public/)). The images can be displayed in the latest version of Google Earth in association with the celestial target objects. At the time of writing, the corresponding Google format (KML) file had been downloaded about 2400 times from the XMM-Newton SOC home page ([http://xmm.esac.esa.int/external/xmm\\_science/gallery/images/xmm\\_gallery.kmz](http://xmm.esac.esa.int/external/xmm_science/gallery/images/xmm_gallery.kmz)). The XMM Newton Gallery is also listed on the 'Google Earth' web page as one of the 'featured files in the Google Earth Gallery' in category 'Google Earth KML: Sky', see [http://earth.google.com/gallery/kml\\_listing.html#csky#s1#e10](http://earth.google.com/gallery/kml_listing.html#csky#s1#e10).

## Cluster

New evidence that Coronal Mass Ejections (CMEs) can impact the acceleration of matter near the border of the magnetosphere to speeds higher than 1000 km/s was recently published in *Geophys. Res. Lett.* On 25 November 2001, during the passage of a CME at Earth, the four Cluster satellites were skimming the border of the magnetosphere (magnetopause) in a region called the 'magnetosheath', when they detected accelerated plasma up to speeds of 1040 km/s, while the ambient solar wind speed was only 650 km/s. This study compared observations from the four Cluster satellites with global simulations of the magnetosphere. The acceleration process

that was found, which interestingly is not related to magnetic reconnection but based on magnetic forces, predicted an altered coupling of these high-speed flows with the magnetosphere.

## Double Star

Contact with TC-2, which was lost in early August 2007, was successfully re-established in November. The satellite is in good shape and the European instruments have been successfully switched on. Good data were obtained in December and early January.

## Integral

Integral has discovered an asymmetric distribution of positron annihilation emission in the galactic disc (Weidenspointner et al. in *Nature*). The observed imbalance matches the distribution of a population of bright, hard, low-mass X-ray binary systems and suggests strongly that these binaries are churning out at least half of the antimatter, and perhaps all of it. The reported Integral detection of an 'annihilation-asymmetry' represents a significant step towards a solution for one of the major outstanding problems in high-energy astrophysics. For more details, see [www.esa.int/esaSC/SEMKT2MDF\\_index\\_0.html](http://www.esa.int/esaSC/SEMKT2MDF_index_0.html).

Following a recommendation from the Science Working Team, the pattern of pointing positions on the sky that Integral performs has been slightly modified in order to further reduce systematic effects visible in deep sky mosaic ISGRI images.

## Mars Express

'The European Mars Science and Exploration Conference – Mars Express & ExoMars' took



*Rosetta's view of Earth on 13 November 2007 (ESA/OSIRIS Team)*

place on 12–16 November 2007 at ESTEC and was a great success. A total of 271 abstracts were received, which translated into 125 oral presentations and 146 posters. Overall attendance was over 300. The conference programme (including abstracts, posters and presentations) is available at: <http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=41364>

## Rosetta

On 18 October a trajectory correction manoeuvre was performed to 'fine tune' the approach trajectory to Earth on 13 November. The manoeuvre was extremely accurate and Rosetta passed by Earth at 20:57 UT at a distance of 5300 km over the South Pacific and at a speed of 45 000 km/h. A number of scientific observations were performed. The first pictures from OSIRIS as

well as the Navigation Camera were published as ESA Press Releases.

The scientific case for the Rosetta flyby of asteroid 2867 Steins in September 2008 has been prepared and the requirements for the operation of the scientific instruments discussed. Very few conflicts have been identified, all of which can be resolved. At its 23rd meeting, the Rosetta Science Working Team agreed on the science priorities for the measurements during the Steins flyby.

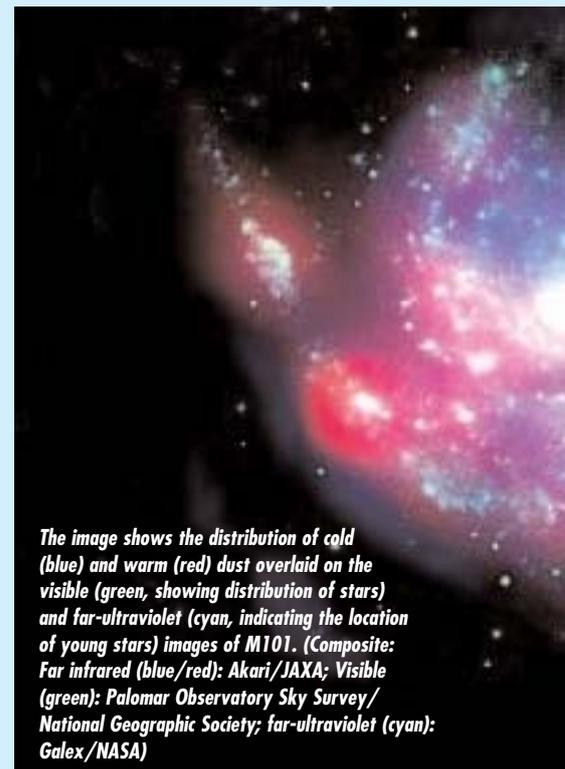
## Venus Express

The 29 November issue of *Nature* contained a special section with nine papers on the results of Venus Express and two additional related articles. In addition, a well-attended press conference was held in Paris the day preceding the issue. These two events led to

a large number of reports in the press, on radio/TV and on the internet. In particular, findings relating to the similarities and differences between the climate evolution of Venus and that of Earth attracted much attention. The escape of water from Venus and the existence of lightning were also referred to frequently.

## Akari

Following the exhaustion of its cryogen at the expected time in August 2007, warm phase performance verification has started based on observations of standard stars. An orbit-change manoeuvre was successfully performed at the end of November to re-establish a Sun-synchronous orbit. Once the detector temperatures have stabilised, a focus adjustment will be performed and the performance evaluation completed. A Call for Observing proposals is expected to be issued this Spring.



*The image shows the distribution of cold (blue) and warm (red) dust overlaid on the visible (green, showing distribution of stars) and far-ultraviolet (cyan, indicating the location of young stars) images of M101. (Composite: Far infrared (blue/red): Akari/JAXA; Visible (green): Palomar Observatory Sky Survey/National Geographic Society; far-ultraviolet (cyan): Gallex/NASA)*

The first results from Akari have been published as a special issue of the *PASJ* journal.

Akari observed M101, a beautiful spiral galaxy located about 23 million light-years away in the constellation Ursa Major (the Big Dipper or Great Bear). Akari revealed giant star-forming regions, located along the outer edge of the galaxy. This is unusual because star formation is generally more active in the central parts of spiral galaxies. The evidence points to M101 having experienced a close encounter with a companion galaxy in the past. The active star formation would have been triggered by the gas dragged out from the companion, falling onto the outer edge of M101 at approximately 150 km/s.

## Hinode

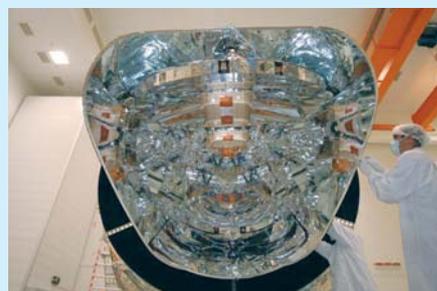
The 7 December issue of *Science* contained nine papers on Hinode, including a cover

image. One of the papers presented evidence for the presence of Alfvén waves in the chromosphere strong enough to power the solar wind, another one for the existence of Alfvén waves in solar X-ray jets. Two of the nine papers have a lead author from Europe. Another special issue, comprising 43 papers with initial results from Hinode, was the 30 November issue of *PASJ*.

A German-Norwegian team of scientists studied the boundary layers of magnetic elements in the solar photo-sphere using the spectro-polarimeter of the Solar Optical Telescope. The extremely high resolution of their data (the best ever achieved in polarimetric data) allowed them observationally to confirm a long-standing theoretical prediction and demonstrate that electric current sheets induced by magnetic boundary layers are common in the photosphere.



*Herschel arrives at ESTEC*



*Planck during integration*

## COROT

A press event arranged by the Paris Observatory on 20 December was very well reported across France. Featured prominently in this press release was a very interesting object discovered during the first long pointing in the galactic centre direction. In this light curve, displaying uninterrupted data over 146 days, one sees a newly-discovered planet orbiting very close to an active star. The light curve also reveals that there are two groups of star spots on the surface of the star at different latitudes, which rotate differentially. Even the 'beats' of the two rotational periods are easily seen in the light curve.

## Herschel/Planck

The integration sequence of both Herschel and Planck is nearly complete and the acceptance test phase has started. All instrument flight model units have been delivered to the two spacecraft and have already been integrated.

Following the mechanical integration of the Herschel instrument focal plane units to the optical bench in the cryostat and an electrical verification of their functionality, the cryostat has been finally closed. The Flight Model spacecraft was transported to ESTEC in early January, and the spacecraft will stay there for the rest of the acceptance test campaign. A bake out will be directly followed by the cooldown and filling with helium. In parallel with the conditioning of the cryostat for the following test phases, the satellite functional test programme has already started.

For Planck, integration of all flight hardware has now been completed. The mechanical test campaign with sine vibration testing and acoustic noise testing was successfully completed in the last days of the year. Next are the integrated system tests in early January.

The ground segment development on the mission operation side in ESOC and the science ground segment in ESAC and the instrument centres is well underway, in preparation for the upcoming system validation tests.



With these final test campaign activities, the programme is moving towards launch, currently planned for end October 2008.

## Lisa Pathfinder

The LISA Pathfinder development is proceeding with some delay to the schedule. The main engineering activities are related to the consolidation of the spacecraft design in preparation for the spacecraft CDR. In parallel most of the subsystems have also had their own subsystem CDRs, and many equipment suppliers have delivered their Flight Models (FMs). Unfortunately the science module FM structure was damaged by a fault during the static test. A new FM structure has been ordered, while the damaged structure will be repaired in order to allow parallel testing at system level and alleviate a further schedule delay. The on-board software development is proceeding: version 2.0 is being tested on the On-Board Computer Development Model.

The two European micropropulsion technologies (needle indium thrusters and slit caesium thrusters) continue their challenging development to prove the readiness of the technologies. Despite numerous problems, many have been solved and progress made in both technologies. It is now expected that the technology most suitable to the needs of LISA Pathfinder will be selected in the second half of 2008.

Regarding the LISA Technology Package (LTP), most of the subsystem CDRs and the LTP system CDR have been held successfully. In parallel all the LTP Electrical Models (ELM) have been built and delivered to Astrium GmbH for testing on the Real Time Test Bench. Progress has been made on all critical subsystems, e.g. the Inertial Sensor vacuum enclosure, the electrostatic suspension front-end electronics and the caging mechanism. For the latter, two different concepts have been breadboarded in order to choose the best design of the delicate interface between the Au-Pt Test Mass and the mechanism 'fingers'.

The launch is expected to take place in mid-2010.

## Microscope

Progress has been made in the two critical domains: payload and micropropulsion. The payload went through successful PDR of the T-SAGE accelerometer allowing start of the development phase. The satellite control requirements were relaxed to allow consideration of cold gas as an alternative micropropulsion system to FEEPs.

A decision between the two candidate micropropulsion techniques is postponed to mid-2008, pending test results.

## Gaia

The PDF concluded in mid-July 2007 left the project with major actions which were finally closed by the end of the year, confirming that the critical science performance requirements of the mission are met by the proposed design.

The competitive selection of about 80 subcontractors, which started in mid-2006, progressed very well and by late summer 2007 all subcontractors contributing to the production of the spacecraft had been selected.

The Multilateral Agreement concerning the Gaia Data Processing has been approved. The formal interfaces with the Data Processing and Analysis Consortium have been agreed and the DPAC Project Office is being implemented.

Preparations were under way for a further and very comprehensive test campaign into the radiation sensitivity of the CCDs. A dedicated test facility reached the final steps of commissioning. The test plan was established in consultation with the scientific community, and the test campaign will start in January 2008.

The first meeting of the Gaia Science Team in its new composition was held in December.

Ways to preserve the accumulated experience of the former members were discussed and a way forward agreed.

## BepiColombo

Contract negotiations with the prime contractor Astrium GmbH were completed and the contract was signed mid-January 2008. The equipment procurement phase has continued and competitive Invitations to Tender have been issued for 40% of the equipment. Approximately a quarter of the subcontractors were selected. The project is undergoing a critical review of the mass growth and mass drivers and is investigating options to reduce the mass. The system design is being consolidated and a design freeze in preparation for the spacecraft PDR is now imminent.

The work on key technologies is continuing in anticipation of the selection of contractors.

The Science Requirements Review for nine instruments of the Mercury Planetary Orbiter have been successfully completed. The scientific performances were confirmed and the design definition is generally adequate. For the remaining two instruments this review is being completed.

The PDR of the Mercury Magnetospheric Orbiter is being held under JAXA responsibility. The board meeting has been postponed until mid-March to allow more time to address thermal, structural and separation dynamics subjects.

## Solar Orbiter

The two parallel study contracts to advance the satellite concept and breadboard the Heat Shield technology, placed with Alcatel Alenia Space and EADS Astrium, have been completed. Both Sun Heat Shield breadboards were manufactured and tested successfully. This study also took the spacecraft system

design trade-offs and the accommodation of scientific instruments a step further, to prepare for the definition phase which will be performed in 2008 and 2009, as confirmed by the Science Programme Committee in November 2007. The spacecraft baseline design relies heavily on the re-use of technology and equipment from BepiColombo.

On the payload side, intensive work on the spacecraft technical interface definition with potential instrument providers has paved the way for progress on the payload accommodation, resources and interfaces. In October 2007 the Solar Orbiter Payload AO was released to the scientific community, with offers to be submitted by mid-January 2008.

ESA and NASA have analysed the possibility of implementing the Solar Orbiter mission together with NASA's Inner Heliospheric Sentinels as a joint programme of cooperative science. A joint Solar Orbiter/Sentinels Science and Technology Definition Team has defined this combined mission. Solar Orbiter will be launched by NASA and will carry significant US payload contributions.

In parallel, technology development activities have been initiated to advance the readiness level of the key elements such as a Sun-filter window, detectors and sun sensors.

## LISA

The Mission Formulation activity performed by Astrium GmbH has produced very good results during the course of the year. The baseline design that includes steering of the whole optical bench plus telescope assembly has been confirmed.

The technology required by LISA has been further matured in the course of 2007, both in liaison with Member States in Europe and in the USA.

Data analysis was progressed in the framework of the Mock LISA Data Challenge that involved the worldwide LISA community.

The SPC confirmed LISA as one of the candidate missions for the Cosmic Vision L1 selection. The need to start the LISA implementation phase right after LISA Pathfinder has been recognised by the two partners, ESA and NASA. The respective roles and responsibilities of the partners are being revisited within the new financial boundaries of the L1 mission envelope for ESA and medium-sized mission envelope for NASA.

## JWST

The JWST Optical Telescope has successfully passed its PDR. The Sun Shield PDR (planned for February 2008) is now the only outstanding review, allowing the mission-level PDR to take place in April 2008 as planned. The design and procurement of the spacecraft has also been initiated by NASA, with a focus on the mission-level PDR.

The NIRSpec CDR for the Micro-Shutter Array assembly has passed successfully. Fifteen flight standard Micro-Shutter Arrays have been produced so far (only eight arrays are needed for the flight model and flight spares programmes). The CDR for the five critical units still remains to be held before the instrument-level CDR in April 2008.

The instrument ceramic optical bench has successfully passed the first part of the proof load testing. It has now been delivered to the prime contractor for completion of the proof load testing.

The Verification Model (VM) of MIRI is presently undergoing the cryo-performance and thermal balance tests. First light using simplified optical stimuli has been seen by the imager and spectrograph channels and initial results are as expected. This test is supported by the actual flight SW developed by JPL. The bottom-up qualification review campaign is ongoing, with seven units still to be reviewed.

Flight detector chips have been down-selected for the MIRI imager and

spectrograph. Integration of the flight detector modules is ongoing. The screening method of the detectors was improved and confirmed the selection of flight detector chips.

The Ariane-5 Launcher RAMP (Revue d'Analyse de Mission Préliminaire) was successfully passed in December 2007.

## GOCE

The environmental test campaign of the Satellite Proto-Flight Model (PFM) has been successfully completed at ESTEC. In October, the Satellite PFM was instrumented and installed in the Large Space Simulator Facility for the Thermal Vacuum/Thermal Balance (TV/TB) test that started on the 27 October. The Satellite PFM was operated continuously 24 hours a day, seven days a week for a period of 15 days in an environment simulating the extreme hot and cold conditions the satellite will experience when in orbit.

Following the TV/TB test, the preservation of the satellite sensor and actuator alignments was verified before the preparation of the next major activity: the mechanical acoustic test performed at the beginning of December. After this, the environmental test campaign was successfully completed at the end of December with the execution of the fit and separation checks with the launcher adaptor, umbilical connection and clamp-band system. In addition, the above-mentioned environmental tests were interleaved with functional tests needed to verify the various satellite operating modes. This completion of the environmental test campaign marks the achievement of a key milestone for the GOCE programme.

In October the Satellite Engineering Model Test Bench was transported to ESTEC in order to support the preparation of the final closed-loop functional tests of the Drag Free Attitude Control System (DFACS). Concerning the gradiometer, the manufacturing of a new set of the harness that connects the six

Accelerometer Sensor Heads to their respective electronics has been completed. This improved new harness has been mounted on the Gradiometer Core PFM, which is now ready to be integrated on the Satellite PFM in place of the Gradiometer STM.

The second part of the GOCE Ground Segment Overall Validation (GSOV) test was executed in December. Nearly all issues identified in the first part of this test campaign were resolved, proving that the ground segment elements are correctly working together in closed loop. Only a few minor issues remain to be checked before launch. The final Acceptance Test of the Calibration and Monitoring Facility was done in October. Furthermore, the Level 1 to Level 2 High-level Processing Facility of the European GOCE Gravity Consortium has successfully confirmed its launch-ready status by successfully completing the final full acceptance review of the overall system.

Finally, a System Validation Test dedicated mainly to the higher satellite functional modes has been successfully performed with exchange of commands/telemetry between ESOC and the Satellite PFM in ESTEC.

## Cryosat-2

Integration of the satellite is well under way, with several units already installed on the nadir panel. The SIRAL antenna has already been delivered and the SIRAL itself will be shipped at the end of January. All the remaining equipment, with two exceptions, will be delivered in February. Currently activities are focused on integration testing, in which each piece of equipment is fully tested in the satellite environment. As the system is built up the team will move on to system testing.

The Final Integration Review was successfully held in January. All of the plans and procedures which will be needed during the coming test phases were scrutinised. The next review will be the Flight Acceptance Review, planned for December 2008, ready for a launch in March 2009.

The Ground Segment CDR was successfully held in December 2007. This review confirmed the interfaces and planning, which will call for extensive ground segment testing during 2008, leading up to the Ground Segment Readiness Review at the end of 2008.

## SMOS

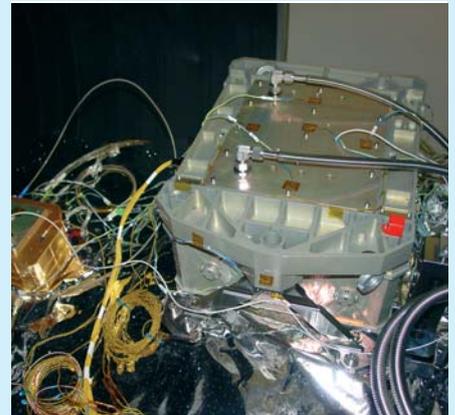
Vibration and acoustic tests at satellite level were passed without any problems, as well as the solar array deployment. Whilst the subsequent launcher adapter fit check and release test went very well as well, an interface problem was discovered, in that the spring pushers (on the launcher side) and the pusher plates (on the satellite side) were offset by 45°. Recovery actions are being investigated. Post-vibration functional tests have been completed without problem, to be followed by TV test commencing early February.

Ground segment development and integration/verification testing is proceeding, with a major milestone being imminent with the Data Processing Ground Segment Version 1 Factory Acceptance Test end of January.

## ADM-Aeolus

The final preparations for the thermal vacuum test sequence of the transmitter laser were completed. This included a set of comprehensive characterisation tests to confirm stable laser operation in air over the expected operational temperature range and in two different mechanical orientations. Since the high-power output laser beam showed some focusing it was decided to re-align the power laser stage in order to avoid potential optical damage in the ALADIN instrument.

The first flight model of the transmitter laser assembly was installed in a thermal vacuum chamber at Galileo Avionica Firenze's premises. First operational tests of the laser in vacuum showed some unexpected



ALADIN laser assembly in vacuum test configuration



Transmitter laser assembly integrated in the thermal vacuum chamber

performance variations of the laser output energy and beam characteristics. These effects are currently under investigation.

Integration of the ALADIN optical bench assembly is complete and final alignment and optical characterisation tests are in progress.

The mechanical and electrical integration of the satellite platform at Astrium Stevenage is complete. An interim version of the Aeolus flight software was delivered to Astrium Stevenage, which allowed preparations for the formal system level tests at platform level to start.

The AO for the ADM-Aeolus Calibration/Validation activities was released

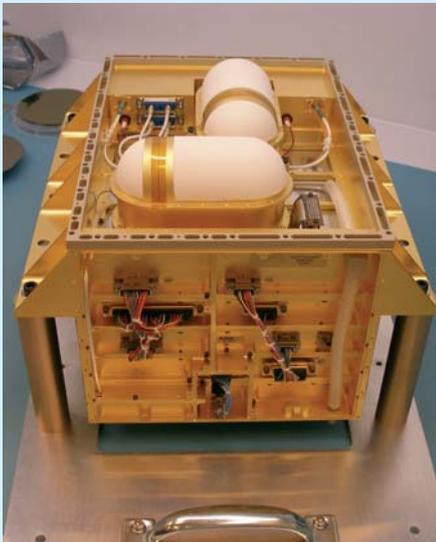
in October 2007. The AO was highly successful: fifteen proposals were received from institutions worldwide, including proposals from Canada, the USA, Japan and China. The proposal evaluation and coordination phase is due to finish with a final proposal selection on 15 March 2008.

The first flight campaign of the ALADIN Airborne Demonstrator (A2D) was completed in November 2007. Good quality flight data could be acquired for the first time. The second flight campaign is currently planned for April 2008.

## Swarm

The major elements of the mission are in progress. The engineering model of the Electrical Field Instrument (EFI) has been manufactured and assembled. The performance and qualification tests are ongoing. A delivery to the satellite prime contractor Astrium GmbH is expected mid March for a test of compatibility on the real testbed of the satellite. The structural model of the optical bench, made in SiC material in order to support the three star trackers and the vector magnetometer with a very stable alignment stability, has been delivered by Boostec.

*Engineering model of the EFI instrument with, on the top of the box in white, the two orthogonal sensor heads (COMDEV)*



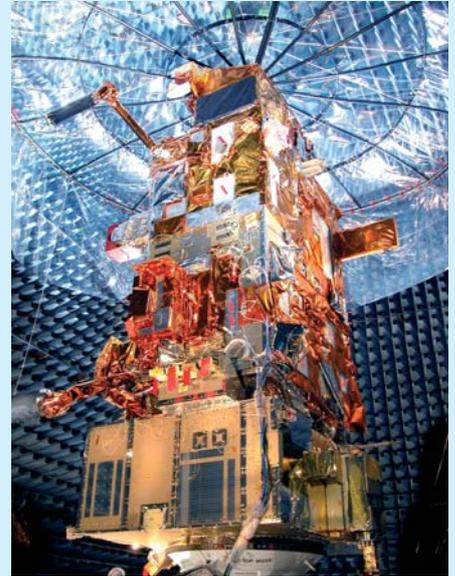
The contracts for the structural elements of the satellite, solar cells, and cold gas propulsion system have been initiated. The other major subsystems of the satellite like the On-Board Computer, GPS, the power conditioners and the S-band transponder are well advanced in design and engineering development. A preliminary coupled load analysis has been conducted with two back-up launchers. Results are still under evaluation by ESTEC and the satellite prime contractor. The qualification of the laser fibre assembly, laser diode and piezo-electric motor for the scalar magnetometer remains critical.

The Level 2 processor architecture, ionospheric current, mantle conductivity and air density algorithm studies are ongoing, paving the way for definition of the Level 2 processing.

## MetOp

### MetOp-A

The HRPT anomaly experienced by the MetOp-A spacecraft is still under investigation. The redundant HRPT-B on-board MetOp will not be switched on until the root cause of the anomaly is found, so



*MetOp-A satellite at EADS Astrium's facilities in Toulouse (EADS Astrium)*

the HRPT service to users continues to be provided by NOAA-17. The MetOp-A instrument performance is excellent.

### MetOp-B and MetOp-C

The MetOp-B and MetOp-C Service and Payload Modules are still in long-term storage, until 2009 and 2010, respectively.

*As fire fighters struggled to contain the blazes on the ground in Southern California, Eumetsat's MetOp-A polar-orbiting satellite was taking images from above with its Advanced Very High Resolution Radiometer. The infrared image clearly shows the hotspots of the fires, the smoke from which can be seen blowing over the Pacific and Baja California in the visible image (Eumetsat)*



## MSG

### *Meteosat-8/MSG-1*

It has been confirmed that the spacecraft performance did not suffer from the object impact in May. After going through a complete seasonal cycle, the thermal situation is non-critical. The main effect now is a regular jump/slow recovery in spin axis tilt. The suspected cause is fluid migration triggered by the thermal event, and analysis is ongoing. Meteosat-8 is operating a 'rapid scan service' with the redundant thruster branch.

What this means: The MSG satellites normally scan the full Earth disc every 15 minutes. By scanning a smaller area, it is possible to scan more frequently. The rapid scan service covers approximately one-third of Earth's disc, covering from 15°– 70° N (including Europe), so the area is scanned every five minutes instead of every 15 minutes (see figure below).

Satellite and instrument performance remain of excellent quality.

### *Meteosat-9/MSG-2*

Meteosat-9 has just completed its second year in orbit. Meteosat-9 is now Eumetsat's nominal operational satellite at 0° longitude, with Meteosat-8 as its back-up. Satellite and instrument performance are excellent.

### *MSG-3*

MSG-3 is still in intermediate storage in the Thales Alenia Space cleanroom, awaiting the restart of the AIT campaign in spring 2010, to prepare MSG-3 for its launch in early 2011.

### *MSG-4*

MSG-4 has been moved to another building at Thales Alenia Space Cannes (V01), also in intermediate storage, awaiting completion of the MSG-4 Pre-Storage Review. The MSG-4 launch is planned for no earlier than 2013.

## Vega

On 3 October, the Launch Vehicle System CDR was formally closed; four major actions are to be completed before the start of the qualification loop and are currently under way.

On 4 December, the P80 Demonstration Model firing test was successfully performed on the BEAP test bench, in Kourou; initial analysis confirms that the measurements are fully in line with predictions. On 20 December, the Modal Characterisation Test (MOCO) for Vega, to obtain the launch vehicle's modal parameters, was successfully completed.

On the Ground Segment, assembly of the Mobile Gantry main structure in Kourou was completed.



Successful P80 demonstration model firing test at Kourou

From the programmatic point of view, an additional slice of the Vega Development declaration has been subscribed by Italy and industrial activities have already been kicked off, dealing with the new Zefiro motor nozzle definition and implementation of the recommendations from the System CDR.

A Vega qualification flight mission carrying the Lares payload has been defined, and relevant discussions with ASI started.

In the next months, the Z23 Qualification Model firing test will take place.

*Meteosat-8 rapid scan area (Eumetsat)*



## Soyuz at CSG

Infrastructure activities (covering the Launch Control Centre, Launch Pad and buildings) are very close to completion, ready to receive Russian equipment by the end of spring 2008.

A meeting of all industries that will work on-site at Sinnamary has been organised, so that all parties are well informed of what is expected and can begin their own planning and responsibilities.

The Mobile Gantry working group has finalised the baseline configuration. Its CDR took place in December 2007 and has become an element of the programme critical path as the delivery is postponed to mid-2008.

The Safeguard Europe kit has been delivered to Russia in December. Russian qualification tests on the launcher will take place at the end of February.



*The Expander Demonstrator rocket engine on its test stand at DLR's test facilities in Lampholdshausen, Germany*

forum for Industry and Delegations from the FLPP Participating States to share technical and programmatic achievements and future perspectives of the programme.



*Advancement of International Cooperation Award from the American Astronautical Society*

international cooperation. The award was given at the 2007 National Conference of the American Astronautical Society (AAS), held 13/14 November in Houston, Texas.

## FLPP

The Concept Selection Meeting of the Building Blocks concept and NGL was held in mid-November.

The Expander Demonstrator test campaign is on-going. Engineering activities and component testing are going on in parallel; the status of technical activities will be assessed by a group of experts appointed and managed by ESA.

The IXV System Requirement Review was delivered in December. FLPP-1 Thrust frame activities are completed. The second set of Expander Demonstrator activities have started after signature of the corresponding rider in December.

A workshop for industry (the FLPP Industrial Workshop) was held at the beginning of February, with the objective of providing a

## Human Spaceflight, Microgravity and Exploration

### Highlights

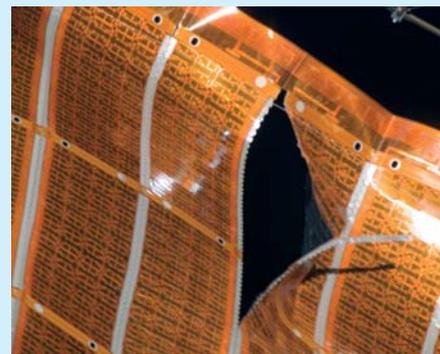
The last few months of 2007 witnessed the beginning of the culmination of many years work for ESA and its industrial partners as 'Harmony' (Node 2) took its place on orbit with the International Space Station in preparation for the Columbus laboratory. Node-2 is the first of three major European elements going to the ISS, Columbus and ATV-1 (*Jules Verne*) being the other two, both planned for launch in early 2008.

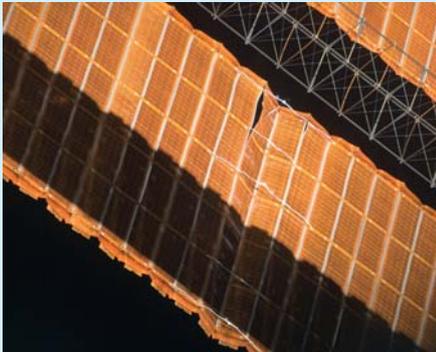
ESA and its ISS partners were presented with the Advancement of International Cooperation Award in recognition of the significant contribution made by the ISS partnership in the advancement of

### International Space Station

As reported in last quarters' *Bulletin*, after a successful launch from the Kennedy Space Center (KSC) on 23 October 2007, Space Shuttle Discovery (flight STS-120/10A) transported the Italian-built Node-2 along with ESA Astronaut P. Nespoli (I) to the ISS on an ASI flight opportunity mission 'Esperia'. Harmony represented the first expansion of the living and working space on the station since 2001.

*This image shows the tear in the jammed solar array on P6 (NASA)*





*This image shows the tear in the jammed solar array on P6 (NASA)*

There were, eventually, four EVAs executed during the mission: to install Harmony in a temporary position connected to Node-1; to detach the solar array set known as P6 and attach it to the extreme port end of the truss structure; and finally an unplanned EVA to repair a jammed solar array wing of P6 by means of 'cufflinks' constructed by the crew. If the damage had not been repaired it could have meant serious delays in the launch of the Columbus laboratory. The ability to problem solve 'on the spot' highlighted the advantage of human spaceflight.

After departure of the Shuttle, the ISS Expedition 16 crewmembers, using Canadarm-2, moved the Pressurized Mating Adapter-2 (PMA-2) from the front of the US laboratory, Destiny, to the Harmony node. In a second operation, Harmony, with PMA-2 on its outboard end, was moved from its temporary position on the Unity node to the front of the Destiny module. Harmony was then in its rightful position enabling future Space Shuttles to dock with the ISS and offer docking ports for ESA's Columbus laboratory and later for Japan's Kibo experiment module. The Increment 16 crew were congratulated on their hard work which allowed the schedule to stay unchanged.

Shuttle managers postponed planned launches of Shuttle *Atlantis* on 6 and 9 December because of false readings from the sensor system that monitors the liquid hydrogen section of the external tank. Two of four LH2 Engine Cut-off (ECO) sensors failed to respond appropriately during tanking of the external fuel tank. The system is one of several that protect the Shuttle's main

engines from catastrophic failure by triggering their shut down if fuel runs unexpectedly low. NASA formed a troubleshooting team to develop a plan of action to address the problem. After a meeting on 11 December, NASA technicians and engineers went ahead on 18 December with a test of the engine cut-off sensor system by pumping super-cold liquid hydrogen into the external fuel tank. The test, conducted on launch pad 39A at KSC, used additional instruments to pinpoint the problem that led to false readings during the two previous countdown attempts for *Atlantis*. The test concluded that the sensors were not the problem but that the fault was

in an open circuit in the 'feed-through' connector of the harness at the external tank wall. NASA engineers worked tirelessly and precisely to solder pins, only fractions of inches apart, to the sockets of the connector assembly, to prevent the open circuit. (The work was completed on STS-122/1E *Atlantis* and ESA's Columbus laboratory was launched in February 2008.)

Flight STS-123/1J/A is set to deliver the Japanese Kibo Logistics Module and the Canadian Dextre (Special Purpose Dexterous manipulator) and is scheduled for launch aboard Shuttle *Endeavour* in March 2008.



*With umbilical lines still attached, the payload canister containing the European Columbus laboratory and Integrated Cargo Carrier-Lite (ICC-Lite) carrying the EuTEF and SOLAR payload suites, are seen lifted up toward the payload changeout room on Launch Pad 39A in early January 2008 (NASA)*

## Space Infrastructure Development and Exploitation

Following its delivery to the launch site in Kourou ATV-1 *Jules Verne* has progressed steadily through the planned ground processing tasks. The Qualification Review Board #2 (QRB2) was successfully completed and preparation is underway for the Flight Acceptance Review (FAR), completion of which will signal the start of the filling and fuelling activities.

At the end of November, *Jules Verne* was given its wings when the integration of the Solar Generation System (SGS) was completed. ATV's tanks were filled with drinking water for the ISS astronauts. This is the municipal water of Turin (Italy) that has been treated according to Russian standards. Dry cargo was also installed in the pressurised compartment of *Jules Verne* and the compartment closed up ready for launch.

The pressurised payload unit and the avionics/propulsion unit, the two major pieces of the *Jules Verne*, were carefully 'mated' for the last time in the final launch configuration on 15 December in the Spaceport's giant integration hall. In January the assembly of Ariane-5 ES and ATV will begin in readiness for its early March launch date.

On 7 October 2007, a successful on-orbit re-ignition of the Ariane-5 upper stage engine was performed which has consolidated Ariane-5's readiness for the launch of *Jules Verne*.

Node 3 has been advanced in the Assembly Sequence and is currently scheduled to launch October 2009 (with the Cupola attached) following delivery of Node-3 to NASA in February 2009.

*Columbus Control Centre, Oberpfaffenhofen, Germany*



*Ariane-5 V178 lifts off for the upper stage engine re-ignition experiment in preparation for the launch of ATV-1 Jules Verne*

Inaugurated in 2004 and situated in the German Aerospace Center (DLR)'s Oberpfaffenhofen location, the Columbus Control Centre (Col-CC) will control and conduct the flight operations of Columbus once it is attached to the ISS. The centre will also house the first permanent European astronaut communicator, or 'EUROcom'. The centre is operated by DLR under contract from ESA and Astrium. Manning 24 hours per day, European controllers on the ground will be responsible for managing the crew-occupied Columbus Laboratory. Col-CC is also connected to ESA's Crew Medical Support Office (CMSO), a full-time medical operations centre staffed by doctors and medical specialists located at ESA's European Astronaut Centre in Cologne, Germany. The CMSO will provide European astronauts with medical advice and monitoring while on board the ISS. All communications go via leased fibre-optic lines; commands are transmitted to the ISS via mission control in Houston, then to the NASA ground station in New Mexico and up to the ISS. All communications are, of course, encrypted to ensure security.

All qualification and simulation testing has been completed, and Col-CC is ready for its role.

ATV-CC operations qualification has continued on track for a launch in early February. Two more Joint Integrated Simulations (JIS) were successfully carried out and a major simulation exercise was conducted throughout the week of 26 November. This exercise, called 'Rendezvous Week', was a full simulation at ATV-CC of the demonstration part of the mission. It also exercised the ISS Programme Mission Management Team in Houston and Moscow in making decisions on whether or not the demonstration objectives had been achieved and on that basis giving the go-ahead for the next mission phase. This was an extremely important exercise and its successful completion has significantly increased the confidence of the ATV-CC operations teams as well as the ISS Programme management.

### Utilisation

The Foton-M3 post flight activities are continuing nominally with the completion of

the outstanding technical verifications and contractual actions. All remaining flight hardware has been de-integrated and returned to ESTEC and further dispatched to the industrial contractors and/or scientists. A full mission report was received from TSSKB-Progress. Preliminary technical and scientific results were presented to the 3rd International Symposium on Physical Sciences held in Nara, Japan, 22/26 October and to the HME-SBD and PB-HME meetings at ESTEC. The 4th POLIZON science meeting was held on 10 December and initial evaluation of flight samples gives positive indications. The final presentation will be performed with all mission participants at ESTEC in March.

ESA's A300 Parabolic Flight programme was resumed with the 46th campaign after implementation of a safety process consolidation during 13/15 November with 11 technology development experiments and investigations in the fields of physical and life sciences. The 47th campaign was held just one month later 18/20 December in which 13 experiments were executed in micro-gravity conditions. The next ESA Parabolic Flight Campaign is scheduled to take place in March 2008.

Three drop tower campaigns were performed in the October time frame at ZARM/Bremen/D. In November a drop campaign on 'Interactions in Cosmic and Atmospheric Particle Systems (ICAPS)' took place but due to technical problems only six drops were executed; the remainder will be concluded in January 2008. Also in November the contract was submitted to ZARM for the 2008 and 2009 campaigns.

Soyuz 15S: The Malaysian spaceflight participant, M. Shukor (MY), and the Russian Increment 16 cosmonaut, Y. Malenchenko (RU) successfully performed a programme of two medical experiments and three biological experiments in a joint Malaysian National Space Agency/ESA experimental programme. During the ISS Increment 15 the Russian crew successfully completed ESA's research package of four experiments. In addition, a set of new dosimeters was installed in the human radiation phantom Matroshka for long-term measurements.



*Columbus with the integrated ICC-Lite carrying the SOLAR and EuTEF payloads inside the cargo bay of Shuttle Atlantis (ESA)*

The MULTIGEN-1 – Batch 1-A (Multi-generation Plant Growth in Space) experiment was completed aboard ISS in the European Modular Cultivation System (EMCS) during week 46. The dried-out plants will be returned to ground with STS-122/1E mission in February 2008. ANITA continues to operate flawlessly in Destiny and provides invaluable ISS atmosphere composition data.

The ISS Increment 16 experimental programme is ongoing since October with four long-term experiments in human physiology (ETD and Immuno) and radiation research (Matroshka and Altcriss). The Russian Expedition 16 crew will also undergo four post-flight experiments at Star City upon their return to Earth with Soyuz in April.

The Columbus payload hardware: the multi-user payload racks Fluid Science Lab (FSL), Biolab, European Physiology Modules (EPM) and the European Drawer Rack (EDR) as well as the passive European Transport Carrier (ETC) were integrated in their launch positions inside Columbus. Also the flight experiment for WAICO, GeoFlow and

FlyWheel has been stowed in Columbus. The external payload carrier (the so-called ICC-Lite) with EuTEF and SOLAR were also installed in the canister. Ground preparations are being prepared for the first Columbus related experiments. The impact of the STS-122/1E delay was coordinated with ESA Payload Ops, Mission Science Office (OPS-H and COL-CC teams). The 1E launch delay will imply a shorter 1E stage with some impacts on the on-orbit sequence of the WAICO and GEOFLOW experiments.

The peer reviews were completed with 15 proposals accepted for Mars-500 and eight for Concordia. The first analysis of 5610 candidates for Mars-500 has reduced the number to 216 who will now undergo further written medical examinations as the next stage in the filter process.

#### **Astronauts**

Following the approval by the September HME Programme Board, the extension of the arrangements between ESA, DLR and CNES until end 2010 concerning cooperation in the framework of the European Astronaut Centre Team were finalised. This permits the use of the expertise of DLR and CNES in the EAC Team, as well as the use of the DLR infrastructure at Cologne.

The next astronaut selection has been approved by the Programme Board in their November meeting and, since then, the preparation has been ongoing for a planned start in 2008.

After his return to Earth, P. Nespoli (I) enjoyed, along with the rest of the crew, the realisation of the extraordinary task they had performed and the immense interest and appreciation that their work had evoked. When he read the newspaper headline 'NASA at its best', Nespoli was proud and felt privileged to have been part of the mission that had carried such an essential component to the ISS making 'Esperia' an important milestone for Europe in space.

H. Schlegel (D) and L. Eyharts (F) continued training with the rest of the crew at KSC and awaited launch of STS-122/1E in early February 2008. For parts of the training



*Nespoli back on terra firma*

performed at JSC, ESA instructors were also involved as they were for the training of US astronauts G. Reisman and T. Kopra, as implemented by ESA instructors at JSC in November 2007.

At the EAC, training for ISS crew members was running full speed with ATV Part 1

*Hans Schlegel and Léopold Eyharts during emergency evacuation training at Kennedy Space Center, Florida (ESA/S. Corvaja)*



## Exploration

### *ExoMars – The Enhanced Mission*

The Enhanced ExoMars Mission will accommodate a much larger scientific payload than originally foreseen in 2005 and as a consequence requires a larger Descent Module to accommodate the Humboldt instruments in the Lander and the Pasteur instruments in the Rover. The Enhanced ExoMars Mission was endorsed by the PB-HME in November with an agreement to proceed to Phase-B2 and Advanced C/D activities to secure the 2013 launch date.

On 31 October, a committing proposal was received in response to the Request for Quotation (RfQ) released to Thales Alenia Space, Italy, (TAS-I), on 17 July. The evaluation process was completed positively on 20 December and a recommendation to proceed to the Phase-B2 and Advanced C/D activities as endorsed by the Programme Board allows the project to proceed.

Significant progress has been made in the detailed design of the mission and the Phase- B2 will start early in 2008 with the Prime and its industrial team. Technology developments, crucial to the Enhanced ExoMars mission, have progressed well and breadboards of the critical items, such as Vented Airbags, the Drill and Sample Preparation and Distribution System have demonstrated the feasibility of the mission in these critical areas.

The Enhanced ExoMars mission will require significant international cooperation with NASA, Roscosmos and the Lead Funding Agencies of the payloads. All the agreements for the cooperation with these various entities are now nearing completion and progress on the approvals is good. The Instrument Multilateral Agreements for the payloads will be signed by the Lead Funding Agencies and ESA in early 2008.

Generally, the project is accelerating activities towards a system Preliminary Design Review (PDR) at the end of 2008. In parallel, preparations for the Council of Ministers 2008 will continue in order to achieve a full approval of the Enhanced ExoMars Mission.



Technology developments crucial to Enhanced ExoMars have been made, such as tests of Vented Airbags

**Core Element**

The Invitations to Tender for the Next Exploration, Science and Technology mission studies, funded by the General Studies Programme, were issued on 16 November.

Science Definition Teams have been nominated for both missions, with participation from the scientists who submitted proposals in response to the 'Call for Ideas', and work was kicked-off at the

**Drill breadboard for Enhanced ExoMars**



joint Mars Express and ExoMars conference in ESTEC in the week of 12 November. A final version of the Core Work Plan was approved by the HME Programme Board at their November meeting.

In the frame of the International Mars Exploration Working Group, a sub-group, IMARS, has been established dedicated to the definition and preliminary design of an International Mars Sample Return mission definition. A commonly agreed mission concept is expected by mid-2008.

**CSTS**

European and Russian industry started joint work, in early September, focused on the definition of the CSTS requirements for Low Lunar Orbit and Low Earth Orbit missions. Roscosmos and ESA have jointly selected for the purpose of further work the vehicle concept to be a modular vehicle consisting of a 'headlight' Soyuz-type capsule; a habitation module; and a service/propulsion module. RSC-Energia and European industry are now working on the preliminary design of the vehicle at system and subsystem level.

**Strategy for Human Spaceflight, Microgravity and Exploration Programmes**

The status of Lunar Exploration Architecture Development was presented at the International Conference for Exploration and Utilisation of the Moon, held in Sorrento 22-26 October.

The International Space Exploration Coordination Group had a successful meeting in Berlin on 6-7 November. Presentations were given covering the status of ESA space exploration plans and the concept of the International Space Exploration Coordination Tool.

The International Space Exploration Conference took place on 8/9 November in Berlin with 350 participants from industry, research organisations, academia, agencies, public organisations, political institutions and media. During the two days of the conference the outline of a European long-term strategy for space exploration was discussed. 