Programmes in Progress

Status end-March 2004
### In Orbit

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### Under Development

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ISO

The Infrared Space Observatory Data Archive has been enhanced in content with six new sets of Highly Processed Data Products, the result of dedicated projects focused on cleaning the products of selected instrument modes of residual instrumental artifacts. ISO data were used extensively in the first scientific demonstration of the Astrophysical Virtual Observatory, on 27 January at ESO in Garching (D).

ISO continues to have a significant presence in the refereed literature, with more than 1100 papers drawing upon ISO data and covering all areas of astronomy having appeared since late 1996. Recent highlights include: tentative identifications of urea and formamide in SWS spectra of interstellar ices; detailed observations with the LWS instrument in the direction of the centre of our galaxy, towards the Sgr B2 region, where more than 70 lines from 15 molecular and atomic species have been detected at high signal-to-noise ratios; the first detection of cold dust in the extended disk of neutral hydrogen in a spiral galaxy, and in the northern shell of Centaurus A, both obtained with the ISOPHOT instrument; and the detection of dust-enshrouded star-forming activity in the infrared luminous interacting galaxies system Arp 299, obtained with the ISO camera.

Ulysses

An important milestone in the mission was reached in February, when ESA’s Science Programme Committee unanimously approved the funding to continue operating Ulysses until 31 March 2008. This latest extension, the third in the mission’s history, will enable Ulysses to acquire observations during a third set of polar passes. A key goal is to observe as fully as possible the influence of the recent polarity change in the Sun’s magnetic field on the high-latitude heliosphere. The Jupiter Distant Encounter (JDE) campaign that commenced on 25 January was completed successfully on 8 March. The onboard tape recorder has been switched on again, marking the end of more than 40 days of 24-hour per day real-time coverage by the Deep Space Network. With the exception of the gamma-ray burst (GRB) instrument, the scientific payload was operated continuously during the JDE campaign without the need for power sharing. The spacecraft and the scientific instruments are in good health. On 30 June, Ulysses will be at its maximum distance from the Sun (5.41 AU) heading south, having crossed the heliographic equator on 20 February.

Analysis of the data acquired during the Jupiter campaign is still in progress. Nevertheless, a number of interesting results have already emerged. The DUST instrument detected streams of dust particles flowing from Jupiter. First observed by the same instrument in 1992, the dust streams comprise grains no larger than smoke particles, and are believed to originate in the volcanoes of Jupiter’s moon Io. The dust particles, which carry an electric charge, are strongly influenced by Jupiter’s magnetic field. Electromagnetic forces propel the dust out of the Jovian system and into interplanetary space. The recent observations include the most distant dust stream ever recorded, at 3.3 AU from Jupiter. Another unusual feature is that the streams occurred with a period of about 28 days. This suggests that solar-wind streams that co-rotate with the Sun play an important role. The most intense peaks showed fine structure not seen in 1992.

During its second encounter, Ulysses approached Jupiter from high northern latitudes, opening a window on previously unexplored parts of the Jovian magnetosphere. This was of particular interest to scientists studying Jupiter’s natural radio emission, since a distinctive type of radio signal is believed to originate in the high-latitude auroral zones of Jupiter. These signals, which have a repetitive, burst-like character, have indeed been detected throughout the campaign period. The radio and plasma-wave experiment onboard Ulysses first detected bursts of radio waves occurring approximately every 40 minutes during the Jupiter fly-by in 1992. These so-called ‘quasi-periodic’, or QP-40 bursts were present for several hours, then faded away and reappeared a number of hours later. More recently, NASA’s Chandra X-ray observatory detected similar QP-40 pulsations in X-rays emitted in hot spots in Jupiter’s northern polar regions. Although not fully understood, these phenomena also seem to be triggered by streams of high-speed solar wind hitting Jupiter’s magnetosphere.

On 22 March, SOHO discovered its 750th comet since its launch in December 1995. SOHO comet 750 was discovered in LASCO instrument images by the German amateur astronomer Sebastian Höning, one of the most successful SOHO comet-hunters. It is part of the Kreutz family of ‘Sun-grazing’ comets, which usually evaporate in the hot solar atmosphere.
The LASCO coronagraph on SOHO, designed for seeing outbursts from the Sun, uses a mask to block the bright rays from the visible surface. It monitors a large volume of surrounding space and as a result has become the most prolific discoverer of comets in the history of astronomy. More than 75% of the discoveries have come from amateur comet hunters around the World watching the readily available SOHO images on the web. So, anyone with Internet access can take part in the hunt for new comets and become a ‘comet discoverer’!

XMM-Newton operations continue to run smoothly. The spring 2004 eclipse season passed without any problems. A dedicated model of the satellite’s radiation environment is being used to optimise the science observation windows in order to maximise the percentage of successful observations.

An update to the onboard software of the EPIC-MOS cameras has been tested on the flight-spare camera by the Principal Investigator team. The next step will be to verify the software, developed at VILSPA (E), by uploading it to the flight camera. This new version will allow the discarding of blemished pixels due to the expected radiation damage over the years to come.

The work on upgrading the overall ground segment to SCOS-2000 is proceeding on schedule. By October 2004, the full ground segment will run on SCOS-1b and SCOS-2000 in parallel to validate the new systems. The final switchover to SCOS-2000 will be made after a successful three-month trial period.

The data processing and data shipment is going according to plan, with over 3300 observation sequences having been executed and the data for 3100 of these having already been shipped.

The programme-completion status is as follows (13 April 2004):

- Guaranteed time: 99.0 %
- AO-1 programme: 98.0 %
- AO-2 programme: 99.6 %
- AO-3 programme: 30.1 %.

XMM-Newton observed the field of the Gamma-Ray Burst GRB 031203 on 12 December 2003. The observations started only 6 hours after the alert had been received from the Integral team. The images obtained are among the most impressive taken so far with the EPIC cameras. Around the X-ray afterglow, a halo appeared as concentric ring-like structures. Their radii increased with time and can be explained by small-angle X-ray scattering. This represents the first detection of a time-dependent dust-scattered X-ray halo around a GRB.

By early-April, more than 500 papers based on XMM-Newton data had been published in, or submitted to, the refereed literature.

Cluster, now in its fourth year of operation, is performing nominally with all instruments returning data as laid down in the Master Science Plan. Since June 2002, Cluster has collected data for 24 h per day, except during satellite constellation and attitude manoeuvres when some instruments are switched off. The fifth constellation manoeuvre will take place in May-June, when the spacecraft separation will be changed from 250 to 1000 km. Perfect tetrahedra (same distance between all spacecraft) are formed at two places along the orbit, after perigee in the Northern Hemisphere and at apogee, to be able to cover a large part of the orbit with a good three-dimensional configuration.

X-ray halo around the afterglow of GRB 031203 at different times after the burst had occurred. The images were taken with XMM-Newton’s EPIC-pn camera (Copyright ESA/S. Vaughan, Univ. of Leicester)
One of the fundamental physical processes in the Universe is magnetic reconnection. For scientists, somewhat fortunately, it occurs frequently in the Earth’s magnetosphere. It is an explosive process, giving rise to a huge amount of energy that is drawn into the Earth’s atmosphere by magnetic field lines. There are many unsolved issues involved in reconnection, such as the triggering of the process and the formation of a thin current sheet that is known to occur before reconnection takes place. It was one of the subjects of the 7th Cluster Workshop held in the first week of March. The scientific presentations and discussion focused particularly on the tail of the Earth’s magnetosphere.

Between July and October 2003, the four Cluster spacecraft were in a tetrahedral formation separated by about 200 km. This was an ideal separation for resolving the structure of the thin current sheet obtained from the curlometer technique using magnetic-field data from the FGM instruments on the four spacecraft. Dr. Rumi Nakamura and her colleagues at the Space Research Institute in Graz (A) have investigated the current-sheet crossings observed on 17 August 2003. During the Workshop, a detailed comparison took place between the current density obtained by the curlometer and the average current obtained by the PEACE electron instrument on the four spacecraft. The resulting good agreement confirmed the existence of a thin current sheet in the magnetotail carried mainly by the electrons (see accompanying figure).

The top figure shows the four spacecraft measurements of the X-component of the magnetic field and the ion flow from Cluster (C1 – black, C2 – red, C3 – green, C4 – blue). The bottom left figure shows the three components of the magnetic field and the current density obtained using the curlometer technique during a selected interval including a current-sheet crossing. The bottom right figure shows a schematic of the dynamics of the Earth’s magnetotail. As a result of magnetic reconnection, a huge amount of energy is released towards the Earth’s atmosphere and a plasmoid - a magnetic bubble - escapes from the magnetosphere back into the solar wind.

The central part of our Galaxy, as seen by Integral in gamma-rays. The brightest 91 objects in the image were classified by Integral as individual sources, while the others appear too faint to be properly characterised at this stage (Courtesy of F. Lebrun, CEA-Saclay)
Integral has solved one of the long-standing puzzles in gamma-ray astronomy – the nature of the diffuse glow of soft gamma-rays seen from our Galaxy. F. Lebrun and co-workers, reporting in the journal Nature, demonstrate that, with its superior ability to see faint details, Integral has shown that individual sources produce the soft gamma-ray background seen only as a `diffuse glow’ by previous observatories. Many of these sources are likely to be black holes or neutron stars.

**SMART-1**

During the first quarter, SMART-1 has continued to fly on the transfer trajectory that is gradually taking the spacecraft towards the Moon. The orbital operations entailed first a rapid expansion of the orbit in order to escape the dangerous Van Allen radiation belts around the Earth, followed by an optimised sequence of thrust and coasting arcs designed to achieve the desired transfer orbit. In March, a series of about 20 long eclipses took place, which interrupted thrusting but did not otherwise affect the spacecraft or its instruments. In the meantime, all of the scientific instruments have been commissioned. The results are still being analysed, but generally seem satisfactory. Recently, a new thrusting strategy has been resumed, entailing regular perigee thrust arcs of 10 to 15 hours. The electric-propulsion system will have accumulated some 2000 hours of operation by the end of April, producing a velocity increment of more than 1300 m/s. All subsystems are also functioning very well.

The ground-control team is now conducting ‘routine spacecraft operations’. Contact is established with the spacecraft on the basis of station availability, the baseline being twice a week for 8 hours. A detailed trajectory optimisation based on actual electric-propulsion performance was recently performed and SMART-1’s arrival at and capture by the Moon is now planned for mid-November. The lunar orbit will then be adjusted and optimised to meet the scientific observational needs, with the main lunar-science phase beginning in January 2005.

**PROBA**

PROBA operations from ESA’s Redu (B) station have continued to be shared between technological activities (mainly related to the testing of new flight software) and normal user operations related to the SREM, DEBIE, HRC and CHRIS instruments.

ESA has drafted and started implementing the 2004 acquisition plan for CHRIS/PROBA operations. In addition to supporting the continuation of past projects, the new plan makes provision for specific experiments related to ESA programmatic objectives. These include acquisitions in support of Earth Explorer candidate SPECTRA Phase-A activities, joint acquisitions between the CHRIS and German BIRD satellites in support of FuegoSat fire-monitoring activities, and acquisitions to support ESA Globewetland service development activities. A CHRIS/PROBA Workshop at ESRIN on 28-30 April will provide the opportunity to review preliminary results and fine-tune the acquisition plan.
Mars Express

Following the successful injection of Mars Express into its final orbit, the sequential switch-on of all instruments began in early January. Enough scientific data had been accumulated by 23 January to hold a very successful Press Conference, at which the first results were presented. In particular, the journalists called the first direct detection of water ice by the OMEGA instrument ‘sensational’.

In March, the PFS instrument scientists reported traces of methane in the Martian atmosphere. As the mean lifetime of methane molecules in the planetary atmosphere is relatively short (a few hundred years only), there must be an as yet unidentified mechanism maintaining their presence.

The only remaining commissioning activity is the release of the radar booms, originally planned for May. Recent boom-deployment simulations by the radar team have raised concerns about the dynamics of the release. Further investigations are therefore needed before authorising the deployment, and so some delay is envisaged.

A further major manoeuvre has been successfully performed to establish the so-called ‘e100’ orbit, which reduced the apocentre from some 14 000 km to about 11 000 km. The scientific community requested this manoeuvre to provide a better data-taking balance between the scientific instruments during the mission’s operational phase. The instrument operations and data production activities are already at near-operational levels, with 90 Gbit of data having already been accumulated by the scientific payload.

Double Star

The commissioning of the TC-1 equatorial satellite was completed in February, all payload and satellites are operating nominally, and the first scientific results are very promising. An attempt to deploy the STAFF boom was unfortunately not successful; the experimenter team are therefore revising their operational modes to gather the best possible scientific data with this adverse configuration. The magnetic noise was improved by an attitude adjustment, which removes boom shadowing of the solar arrays. The remaining magnetic emissions from the solar panel are being tackled by FGM with an adapted calibration method.
Following the Commissioning Review for TC-1 held in Villafranca (E), all space and ground-segment systems are operational. An official handover ceremony has taken place in Beijing, with both Chinese and European scientists presenting their first results to the public. TC-1 is now in full routine-operation mode in consultation with the DSP/Cluster scientific community to define coordinated observations and to provide routine data analysis.

On the second Double Star satellite (TC-2, polar), a detailed Chinese-European study revealed a design problem with the solar generator. Thanks to the rapid reaction by Chinese industry, the necessary modifications have already been implemented, resulting in a significant reduction in magnetic emissions. With the satellite’s assembly and basic functional tests completed, TC-2 is now undergoing its environmental test campaign, involving mechanical vibration testing in April and thermal testing in May, followed by EMC and magnetic verification in June.

The launch campaign in Tai Yuan is expected to commence by end of June for the planned 20 July launch.

Rosetta

After two short launch postponements due to the weather and a small technical problem, Rosetta was flawlessly injected on 2 March into its Earth-escape orbit, which will take it in ten years’ time to comet Churyumov-Gerasimenko. The orbital injection accuracy provided by Ariane was almost perfect, with little need for any correction manoeuvres.

After the launch, the solar arrays and high-gain antenna were deployed, the launch locks on the lander were released, and spacecraft checkout began. The launch and early-orbit phase was completed within three days and all spacecraft subsystems were reported to be working nominally.

Payload commissioning then began and ten of the twelve experiments, including the lander, have since been switched on and no major anomalies have been reported. All experiment booms have also been successfully deployed. Due to ground-station availability, payload commissioning will take place in two sessions, in May and in September/October.

The ground segment is performing well, including ESA’s latest New Norcia ground station in W. Australia.

The very high accuracy of the Ariane launch means that the spacecraft has sufficient extra fuel to give scientists the freedom to choose to fly by two very interesting asteroids, between the orbits of Mars and Jupiter, during the cruise out into deep space before the comet rendezvous. The first fly-by in September 2008 will be of Steins, a fairly small asteroid with a diameter of just a few kilometres. In July 2010, Rosetta will then visit Lutetia, a much larger body with a diameter of about 100 km.

The Rosetta mission has therefore had a near-perfect start, but there is still a long journey to be made before the spacecraft eventually catches up with the comet Churyumov-Gerasimenko in 2014, which it will study at close quarters for the next two years.

Venus Express

The project is progressing according to plan, with the Critical Design Review process starting in March at the prime contractor Astrium’s site in Toulouse (F). Flight-model deliveries have also commenced and, most importantly, the flight structure integrated with the entire propulsion system was shipped in early April from Stevenage (UK) to Turin (I) for the integration of the flight-model subsystems. Although the schedule is tight, the project is still on track for the 26 October 2005 launch from Baikonur.

The Herschel telescope primary mirror has entered the next production stage, with the grinding of the front surface prior to the final polishing of the mirror. The Planck telescope’s secondary-reflector qualification model is close to completing its cryogenic optical testing. The primary reflector of the qualification model has successfully passed the mechanical test phase and is also being prepared for cryogenic optical testing.

The parallel Eddington system-definition studies have been completed, with mature designs established at both industrial consortia. The contract for the development of the CCDs for the Eddington cameras is also nearing completion.

Herschel/Planck/ Eddington

Manufacture of the structural and qualification models of the Herschel cryostat hardware and the manufacture and assembly of the engineering models for all electronic units has progressed and several units have already been delivered.

For Planck, the structural qualification testing for the two main subassemblies of the Payload Module, the telescope and the payload-module structures, has already been completed. Manufacture of the main hardware elements of the Herschel cryostat, such as the helium tanks and the cryostat vacuum vessel, have experienced some delay, but most are now close to assembly. Some final detailed-design activities are currently being completed in preparation for the Payload Module and satellite Critical Design Reviews in April/May.

The qualification models of the Planck and Herschel scientific instruments have made good progress, with most now under test prior to their delivery to industry during the summer. The instrument teams are already concentrating their efforts on timely production of their flight models.

The Herschel telescope primary mirror has entered the next production stage, with the grinding of the front surface prior to the final polishing of the mirror. The Planck telescope’s secondary-reflector qualification model is close to completing its cryogenic optical testing. The primary reflector of the qualification model has successfully passed the mechanical test phase and is also being prepared for cryogenic optical testing.

The parallel Eddington system-definition studies have been completed, with mature designs established at both industrial consortia. The contract for the development of the CCDs for the Eddington cameras is also nearing completion.

SMART-2/LISA Pathfinder

SMART-2, the second of the Small Missions for
Advanced Research and Technology, is dedicated to demonstrating key technological aspects of the Laser Interferometer Space Antenna (LISA), a space-borne gravitational-wave detector to be flown as a cooperative ESA-NASA mission. LISA consists of three spacecraft separated by 5 million km, designed to detect the 'ripples' in space-time produced by massive objects such as black holes.

The basic idea behind SMART-2 is to shrink one LISA ‘arm’ from 5 million km to a few centimetres and accommodate it within a single spacecraft, also known as LISA Pathfinder. The technologies to be demonstrated are the inertial sensors, consisting of two free-floating test masses contained within two vacuum cavities and an associated metrology package (the LISA Technology Package, or LTP), the proportional micro-thrusters (both field-effect-emission and cold-gas), and the so-called drag-free attitude-control system. The spacecraft also hosts an equivalent NASA/JPL-provided Drag Reduction System (DRS).

The SMART-2/LISA Pathfinder implementation contract with Astrium Ltd. (UK) was kicked-off in February, and work is already in progress on the definition of such critical subsystems as the drag-free attitude control, the micro-propulsion technologies and the avionics architecture.

The SMART-2 launch is foreseen in the first half of 2008.

James Webb Space Telescope (JWST)

The JWST has received full NASA support to ensure its timely launch in 2011, which will minimise the impact of the cancellation of the next Space Shuttle service mission to the Hubble Space Telescope, and the full teams at ESA and NASA are now in place to face this challenge. All the JWST System Requirement Reviews (SRRs) have been successfully completed and the subsystem SRRs are also partially complete.

ESA’s participation in JWST consists of the Telescope’s launch on an Ariane-5, the Near-Infrared Spectrograph (NIRSpec), and the Mid Infra-Red Instrument (MIRI), consisting of an imager and a spectrograph, developed by a consortium of European Institutes.

Gaia

The final presentation of the Gaia technology ground-verification contract took place at ESTEC on 3 February. This successfully brought to an end a one-year industrial study by EADS Astrium of the objectives and requirements for the ground-verification activities that need to be undertaken before launch, including measurement of the optical behaviour at the operational temperature. This was an essential exercise in concluding whether the stringent payload goals can be guaranteed in orbit, and identifying the associated costs and facilities needed. Central to the plans are the use of the ‘Focal’ thermal-vacuum facility in Liege, Belgium.

The final presentation of results from the Gaia technology High-Stability Optical Bench contract also took place in ESTEC on 3 February. This concluded a two-year study of the basic angle-monitoring device. The work has proved the principles and processes using a laboratory prototype of a device that should ultimately have a 1 microarcsec monitoring accuracy.
The model of the novel European 500 N spacecraft apogee motor developed for AlphaBus by EADS-ST (D)

**CryoSat**

Significant progress has been made in the development of the satellite and a major milestone was reached with the completion of the Satellite Test Bed activities in late-March. EADS Astrium GmbH (D) is now integrating the electronic boxes on the mechanical structure where the cold gas subsystem and the electrical harness were previously accommodated. The next step will be the integration of the solar array that has been successfully accepted at Emcore's premises (USA).

On the payload side, manufacture of the flight model of the SIRAL altimeter has been completed. Alcatel (F) will proceed immediately with its final integration and tuning, once the extensive testing of the engineering model is completed. Excellent results have been obtained so far.

Unfortunately, a few repair activities, due to quality problems lately reported with some electronic parts, are hampering the progress of the on-going integration activities both at satellite and payload level. This is generating some uncertainties in the schedule for the satellite environmental testing foreseen at IABG (D).

Activities related to the CryoSat ground segment are progressing according to plan. The first Satellite Validation Test (SVT0) was successfully performed by ESOC in early February, confirming the efficiency of the new development approach being followed by ESOC and EADS Astrium GmbH. The Payload Data Segment facility (which includes the Instrument Processing Facility for Level-1b and Level-2 products) has been successfully installed in Kiruna by ACS (I). The long ground-segment validation campaign has been initiated and will last until September.

On the launcher side, the launch-campaign planning has been reviewed and the detailed plan for the joint operations with Eurockot/Khrunichev at Plesetsk is now consolidated. The launch should take place in late 2004.

**AlphaBus**

As part of the ESA-funded Phase-B activities, the prime contractors Alcatel Space (F) and EADS Astrium (F) have started the selection of equipment providers for the buildup of the industrial consortium for the AlphaBus main development phase (Phase-C/D). The Agency participates in the industrial evaluations and ensures that they are conducted fairly and equitably. The overall tendering and selection process will last six months. The Phase-B definition work for AlphaBus funded by CNES continues at prime contractor level and will be finalised with a Preliminary Design Review in the second half of this year. In parallel, preparations are in hand for the release of a Request for Quotation for Phase-C/D in the same period.

The AlphaBus pre-development activities are progressing well with eighteen contracts awarded by the Agency as part of the preparatory phase to secure the enabling technology needed for the AlphaBus line of products.
months, it will be subjected to a series of mechanical and thermal tests in order to demonstrate qualification of the overall instrument design.

Electrical testing of the Accelerometer Sensor Head (ASH) demonstration model at ONERA (F) has progressed according to plan, demonstrating successful levitation of the proof-mass under 1-g conditions for the first time. The first integration tests with the ASH front-end electronics are planned to start at the end of April.

In the spacecraft platform area, preparatory activities are underway for the integration of the Engineering Model Test Bench that will be used to verify the platform’s functional and electrical performance, including real-time closed-loop tests with the pre-validated flight software.

The payload main development effort (Phase-C/D) is in full swing, operating under an ‘Authorisation to Proceed’ (ATP). Manufacturing Release Reviews are being held with all subcontractors, to review and agree the baseline for engineering-model production. Parts procurement for the flight models has been initiated.

The Implementation Agreement with CNES, defining the principles of the cooperation between the two agencies within the SMOS project, has been presented to ESA’s Earth-
Observation Programme Board. The Request for Quotation for Alcatel, for Phases-B/C/D of the satellite-engineering tasks, based upon use of a recurrent Proteus spacecraft bus, is in preparation by CNES and ESA. The baseline AIT flow at satellite level has been agreed between the two agencies and is now with industry for detailed assessment.

A launch site survey at Plesetsk, the site for Rockot launches, is being prepared, mainly to guarantee compatibility of the SMOS mechanical ground-support equipment with the local transportation and processing facilities. Industrial activities for the ground segment are awaiting the release of national Spanish funding.

ADM-Aeolus

The contractor teams for the spacecraft and its instrument are all now fully operational, and the last few, more difficult, subcontracts for the onboard computer, the flight software and the solar array have all been kicked-off. Many of the subsystems have successfully undergone their Preliminary Design Reviews. A number of subsystem Critical Design Reviews have also been held.

Work is progressing well towards structural-model testing and a working-model-based development and verification environment (functionally replacing an engineering-model satellite). The satellite Critical Design Review will address the results of these activities in May 2005. A full set of pump diode stacks has been delivered for the engineering-model laser. The first few flight-model stacks have been manufactured with some delay, but delivery of the flight-model lasers is not affected.

A Request for Quotation has been issued to DLR (D), which will conduct ground and airborne campaigns using a special version of the ALADIN instrument. DLR will also provide independent expertise for the algorithms to be used for engineering calibration of the data. Principle agreement has been reached with the European Centre for Medium-Range Weather Forecasts (ECMWF) on their involvement with Aeolus meteorological products. The ECMWF will (with support from MeteoFrance, KNMI, IPSL and DLR) conduct the necessary studies to define the production algorithms, produce the operational software and test it in dry runs including data validation, and use it to produce the operational products until the end of the mission. They will also report on the Aeolus data’s contribution to NWP skills. ECMWF will also provide the necessary software to Meteorological Offices that wish to produce their own Level-2 products using their own temperature and pressure fields.

In parallel, the MetOp-2 Service Module (SVM-2) has successfully completed its thermal-vacuum testing at Intespace (F), with only two minor anomalies recorded. In particular, modifications to the thermal design of the module and test fixtures were demonstrated successfully, thus finalising the last elements of SVM qualification.

Launch of the first MetOp satellite is still expected in the fourth quarter of 2005, the period agreed between Eumetsat and the launch-service provider Starsem.

MetOp

The MetOp integration programme continues to progress very well, with the MetOp-1 satellite’s assembly, integration and testing nearing completion and the MetOp-2 payload and service modules having completed their environmental test campaigns. The MetOp-1 satellite mechanical test results confirmed that the protoflight model exhibits higher damping compared with the structural-model tests in 2001, resulting in lower mechanical levels at identified critical locations. Based on these results, the concerns about the mechanical compatibility of the US instruments can be considered closed. The MetOp-1 satellite test campaign will conclude with onboard-software testing, AOCS sign tests and the second System Verification Test with the Eumetsat Mission Control Centre. The MetOp-1 Flight Acceptance Review, scheduled to be completed by end-June, is in preparation.

On MetOp-2, the Payload Module (PLM-2) successfully completed its thermal-vacuum testing in February in the ESTEC test facilities. The major new element for this test was the presence of a fully flight-representative IASI instrument, which required the implementation of a very complex test jig, with cryogenic panel and gas-cell/blackbody targets. All elements involved in the test performed excellently. After the test, PLM-2 was transported back to Friedrichshafen (D) for final testing prior to delivery for integration into the satellite in July.

Meteosat Second Generation (MSG)

MSG-1

The first Meteosat Second Generation satellite (MSG-1) commenced routine operations on 29 January. For the operational phase, Eumetsat has designated the satellite ‘Meteosat-8’, providing continuity with the existing satellites operating in geostationary orbit.

MSG-2

The MSG-2 launch window has been further reduced to the three months of February-April 2005. Preparations have started for taking the satellite out of storage, where it has remained since June last year. It will then be given a ‘health check’, followed by a System Validation Test (SVT) and fine balancing, in preparation for the launch campaign, which is planned to start early in November.

MSG-3

The MSG-3 performance tests have been finalised. The prime contractor, Alcatel Space, is preparing the satellite for short-term storage, after which activities will focus on preparations for the MSG-2 launch. Thereafter, MSG-3 will be de-stored again and some additional work performed before the satellite is put into long-term storage (planned to last at least two and a half years).

MSG-4

All activities are going according to plan.
A Meteosat-8 composite image of visible information acquired on 18 February 2004 at 13:00 UTC: red for the 1.6 µm near infrared channel, green for the 0.8 µm visible channel, and blue for the 0.6 µm visible channel. Turquoise cloud signals the presence of ice particles, whereas white cloud is liquid moisture. Snow on the ground is turquoise. The large white patch over northeastern Europe is fog or stratocumuli, sharply contrasting with the snow-covered areas further south. Vegetation cover shows as green, due to its absorption properties in the visible range. Sandy or granitic areas are pink.

(Courtesy of Eumetsat)

ARTEMIS

This has been a period of routine operations with a high quality of service to the major data relay, land mobile and navigation users SPOT-4, Envisat, Telespazio and EGNOS. After one year of Artemis service operations the optical data relay link has logged over 100 hours total of operation with some 450 links, and the RF link has performed for over 560 hours with some 1800 links. The land mobile and navigation services have been continuous. Initial problems with data relay services due to spacecraft spurious upsets have now been overcome with new software and procedures, and the availability of the data-relay services is now around 99%. Increased data-relay utilisation can be expected in the near future. All spacecraft subsystems are performing well and the satellite status is nominal. The propellant lifetime is still predicted to be 10 years.

A number of enquiries have been received from new users wishing to use Artemis data relay and land mobile services. Interface tests with the Automated Transfer Vehicle are in preparation.
Vega

All launch-vehicle activities have been kicked-off by ELV (I), the prime contractor, and a number of subcontracts have been signed, including that with EADS-ST (F) for the guidance, navigation and control system. The launcher System Design Review will begin on 6 April after an intensive recovery phase during the first quarter of the year, which resulted in a comprehensive package of review documents and a number of new programmatic objectives.

The first Zefiro-9 motor case (DM00) was manufactured in February and is ready for its first pressure test.

The recent P80 first-stage activities have included preparations in March for the casting tests in Kourou on the Inert Loading Model. The large P80 filament-winding machine from Avio (I) has been installed and tested in the new Vega building in Colleferro (I), ready for manufacture of the first motor case.

Key choices regarding nozzle technologies have been agreed with SNECMA Propulsion Solide (F) after a number of trade-offs and development tests.

Evaluation of the industrial offers for the ground segment was completed in February. A number of technical updates to match developments in the interfaces between ground segment and launcher have been investigated.

Following a review of the status of all elements of the programme, the first Vega qualification flight has been rescheduled for the end of 2006.
**Highlights**

On 31 January, Progress flight 13P docked safely with the International Space Station (ISS). It carried among other things experiment hardware for the upcoming ‘DELTA’ Soyuz Mission and elements of the Automated Transfer Vehicle’s (ATV) rendezvous and docking system. Progress 13P also carried ‘Matroschka’, a human upper-body phantom, which has become the first European external payload to be mounted on the ISS. Everything is ready for the next Soyuz flight, 8S planned for 19 April 2004, on which ESA astronaut André Kuipers will conduct his 11-day Dutch Soyuz Mission ‘DELTA’.

In February, the Space Shuttle programme’s management indicated that the Shuttle’s Return to Flight date will be no earlier than 6 March 2005.

No critical issues regarding the status of ISS hardware and consumables have been identified. Limited science activities are ongoing with the two-man crew and the Station is in excellent order technically speaking.

**Space infrastructure development**

All Columbus payload facilities have completed their qualification in the Rack Level Test Facility. For Columbus itself, testing has shown that the audible noise level is well below the requirement level, making it the quietest module for the ISS.

The ATV-1 schedule currently supports launch in mid-May 2005. All integration activities will be completed at the Prime Contractor’s site in Bremen (D) prior to shipment of the flight model to ESTEC. Consequently, the environmental testing at ESTEC, initially planned for mid-April, has been delayed to July. This should have no impact on the launch date. The spacecraft structure mechanical qualification tests are in progress, while functional testing has also started.

Manufacture of the Russian Equipment Control System flight module has been completed and acceptance tests are about to start. The fully validated Flight Application Software V2.1 has now been delivered to the users (Functional Simulation Facility and the ATV Ground Control Simulator).

The ground operations for Node 2 have taken place at Kennedy Space Center (KSC). Node 3 machining, manufacturing and assembly work is ongoing and final preparations for the proof test, to be conducted in April 2004, are also in progress.

The Phase-0/1 Safety Review for the Cryogenic Freezer (CRYOS) took place in January and the Preliminary Design Review (PDR) Board Meeting was held successfully in March. A bridging phase, covering activities from July to October, will be introduced, and the Phase-C/D will start in October 2004.

Window integration and leak testing on the Cupola have been successfully completed and the Element Leak Test started. The Qualification/ Acceptance Review is planned for May 2004.

The European Robotic Arm (ERA) system acceptance has been accomplished, including the flight spares and the mission-preparation and training equipment. No confirmed launch date for ERA is yet available.

**Operations and related ground segments**

The Columbus Control Centre’s development is going well with successful completion of the Site Acceptance Review for the Ground Segment Data Services System. The System Design Review 2 is ongoing and the Board is planned for April 2004.

The ATV Control Centre’s development and integration is continuing on schedule with the monitoring and control system passing its Factory Acceptance Review and the first ATV System Validation Testing between ground and flight segments being successfully concluded.

The Data Management System for the User Support and Operations Centres (USOCs) has successfully completed its PDR. Installation of the Erasmus USOC at ESTEC has started. The System Requirements Review closeout for the Operations Preparation and Planning System Version 1 is ongoing. The PDR has been rescheduled to take into account the effects of the Columbus delay.

Columbus operations preparation is progressing and a second table-top simulation was successfully performed at the Columbus Control Centre.

**Utilisation planning, payload development and preparatory missions**

In the penultimate round for new Microgravity Application Promotion (MAP) project continuation proposals, 12 new proposals were evaluated in February. Five were recommended for direct continuation (three physical sciences, two life sciences), five were recommended for resubmission, and two for termination. By the deadline of 29 March, nine proposals had been received, of which seven were for life sciences and two for physical sciences; these will be evaluated during April.

The European Drawer Rack (EDR) flight-model interface testing with Columbus was successfully completed in February. The EDR Training Model Integration Review is planned for early April 2004.

The European Transport Carrier (ETC) Flight Acceptance Review was kicked-off in March and should be completed during April 2004. The complete set of Cargo Transfer Bags (CTBs) for the Columbus-1E launch has been delivered and the Engineering Change Request for CTB outfitting and payload stowage facility has been approved.

The flight modules of Biolab, the European Physiology Modules (EPM) and the Fluid Science Laboratory (FSL) have been delivered prior to Columbus integration, planned for April 2004. The EPM Phase-3 Flight Safety Data Package has been delivered. The FSL Training Model Acceptance Review was successfully completed at the European Astronaut Centre (EAC) and the Cardiolab Training Model was delivered to EAC.

The Pulmonary Function System flight-model 1 and 2 upgrades have been completed and tested in preparation for shipment to Johnson Space Center.
NASA has confirmed that first MELFI flight unit 1 (FU-1) will fly on flight ULF1.1, no earlier than May 2005. The system test campaign for FU-2 is almost complete, while the compatibility tests with the Japanese Experiment Module have been completed. The MELFI FU-3 rack has been integrated, with the exception of the Brayton subsystem. NASA has requested ESA to perform acceptance in Europe for and to store the Hexapod pointing system for a period still to be defined.

In February, an integrated software test with the three SOLAR (Solar Monitoring Observatory Facility) instrument software simulators, was successfully executed.

Qualification tests for EXPOSE (Exobiology Exposure Facility) have been completed and Part 1 of the Flight Acceptance Review is in progress. The EXPOSE flight model (with dummy trays) is ready for delivery to EuTEF (European Technology Exposure Facility) for system integration.

The payload PDR of the Atomic Clock Ensemble in Space (ACES) has been successfully closed, while the mission PDR is planned for mid-2004. In January a three-month delay was announced in the delivery of the Space Hydrogen Maser due to technical and design problems.

The Columbus External Payload Adaptor (CEPA) Post-Shipment Incoming Inspection in Europe was successfully completed in February, and the fit-check testing between CEPA and Columbus is ongoing.

Preparations for the Dutch Soyuz mission ‘DELTA’ were successfully completed. In order to be able to complete the scientific programme within the available crew time, the mission will last 11 days. Joint Integrated Simulations took place in February and March with the participation of all operations sites. The 36th Parabolic Flight Campaign, with 13 experiments, was successfully conducted in March.

A full Foton-M2 capsule payload complement has been established and development is in progress.

For the sounding-rocket campaigns, a Request for Quotation for Texas flight 42 was issued and the experiments for MiniTexus EML-1 (Electro-Magnetic Levitator) have been selected. In addition, Maxus-6 development is progressing according to schedule, a contract for advanced procurements for Maxus-7 is being prepared, and Maser-10 contract negotiations for the Phase-C/D have been completed and work has started.

The European Modular Cultivation System/Express Rack interfaces have been successfully tested at the Payload Software Interface Verification Facility at NASA’s Marshall Spaceflight Center.

The Protein Crystallisation Diagnostics Facility (PCDF) engineering-model testing and flight-model assembly are in progress, and the training model was delivered to EAC in February 2004.

**ISS education**

The final activity and experiment preparations for the DELTA Soyuz mission education programme ‘Zeg het ISS’ were performed.

The European Commission Directorate General for Education and Culture has approved two ESA pre-proposals i.e. the Socrates/Minerva Action, ‘Innovation in Information Communication Technology, Space for Learning’ and the Socrates/Erasmus Action ‘Life in Space’. The final proposals for both actions were submitted in March.

The ISS Education Kit has been published in German and an agreement has been reached for the distribution in Germany of 50% of the kits (10 000 copies). The Dutch Ministry of Education has agreed to the distribution of the Kit in Dutch to all secondary schools in The Netherlands.

**Commercial activities**

An Invitation to Tender for a commercial agent in the Biotechnology market segment has been issued.

In the framework of the MEDIET (Mediterranean DIET) project, food and trays have been delivered; the food certification process is ongoing in Russia.