ISO

A major milestone was reached on 7 August when the last of the ISO data entered the public domain. All ISO data are now available to the worldwide astronomical community via the ISO Data Archive, located at <www.iso.vilspa.esa.es>. This archive contains nearly 30 000 scientific observations of all classes of astronomical objects, ranging from the Solar System to very distant extragalactic sources, plus another 70 000 data sets including calibration and engineering observations, and data from instruments operated in parallel and serendipity modes.

The scientific community is using this archive very intensively; in July, for example, more than 8000 observations (a third of the scientific observations in the archive) were downloaded. An incremental development of the archive and its facilities is being followed, with a major release for calibration users having successfully been made in July. Results from ISO data continue to feature prominently in the scientific literature. Examples of ISO results can also be found on the Web via the above URL.

Cluster-II

The functional and environmental test programmes have now been completed on the first two flight-model spacecraft (FM6 and FM7). The acceptance review for the first spacecraft has been successfully held and all open work, which is required to be completed before shipment to the launch site, has been identified. The third spacecraft (FM8) is fully integrated and undergoing functional testing before being shipped in late October to IABG, Munich for its environment testing. The last spacecraft (FM5), which was originally 'Phoenix', has started its payload integration.

The ground segment has successfully passed the Ground Segment Implementation Review (GSIR). No major show-stoppers were identified and it was agreed that the present progress would lead to ground-segment readiness in early 2000. The activities associated with moving the 15 m antenna dish from the Odenwald in Germany to Villafranca in Spain have almost been concluded.

The ground qualification for the new Fregat upper stage for the Soyuz launch vehicle has now been successfully completed. The modifications to the launch tower for Fregat are also now ready and the production of all parts of the launch vehicle for the first vehicles is in hand, consistent with the launch of the first demonstration flight of Soyuz/Fregat in January 2000.

In conclusion, all elements of the Cluster-II mission are on schedule for the launching of the four spacecraft by two launches in June and July 2000.

XMM

Ahead of schedule, the spacecraft left Rotterdam harbour on 12 September for its sea trip aboard the 'Toucan' to Kourou. A first team travelled at the same time by plane to prepare the premises so that work could start immediately upon the ship's arrival. The unloading and installation work was done during the night, and less than 48 h after the ship had moored in Kourou harbour, all necessary material was operational and the first test on the reaction control system was underway.

The spacecraft is now installed in the Final Assembly Building. Mechanical assembly has been completed and functional checks on the onboard systems and scientific payload have been performed successfully. The spacecraft is currently undergoing system validation testing, during which it is operated from ESOC in Darmstadt (D). After completion of this test, further functional checks will be conducted and the alignment of the satellite will be verified. Early November will see commencement of the propellant loading activities, after which the combined operations involving both launch vehicle and satellite will commence.

The satellite flight-acceptance review is progressing well. No major problems have been discovered and the review team is now compiling its report for a final meeting of the Board at the end of October in Kourou.

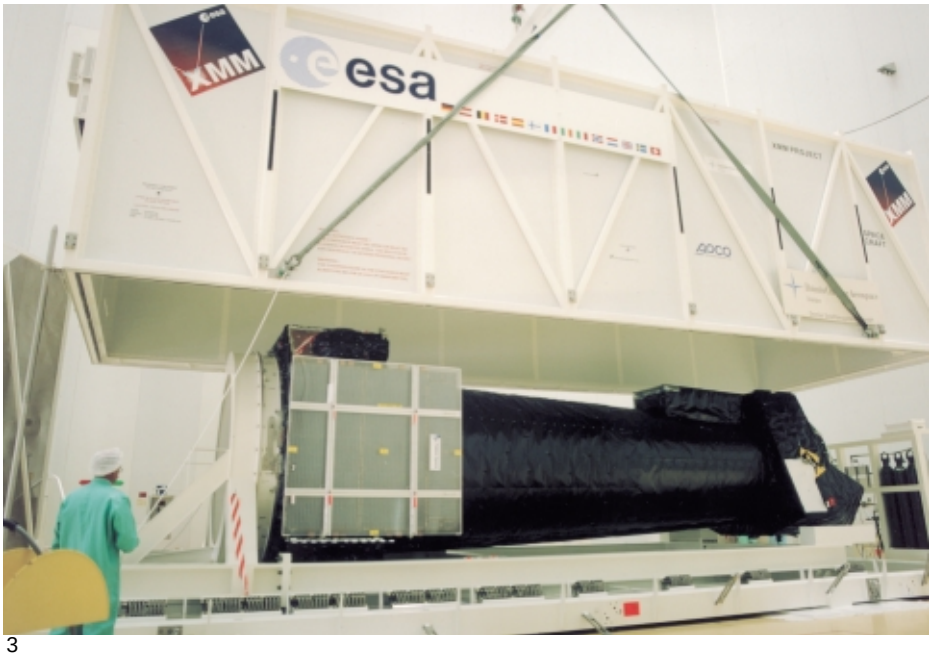
All ground control software has been delivered and software/hardware integration has been completed. The ground segment is currently involved in the system validation test, after which the Science Operations Centre will be shipped to and installed in Vilspa (E). The ground station hand-over is now rescheduled for early October, in time for the ground-segment readiness review.

The tests conducted in the first phase of the launch campaign have confirmed that all experiments installed on the spacecraft are healthy. Experiment teams are supporting the system validation testing in Kourou and in Darmstadt.

Artist's impression of two of the Cluster-II spacecraft on the Fregat upper stage

1

2



3

XMM will be launched on flight Ariane-504. The launch-vehicle technical acceptance review is currently taking place at Arianespace/Evry, the last formal step before entering into the final phase of launch preparation. The current schedule leads to a launch on 10 December.

Rosetta

Integration of the spacecraft Structural and Thermal Model (STM) has made significant progress since the delivery of the main spacecraft structure in early August. Integration of the harness and propulsion subsystems, including the internal thermal blankets, has been completed. A proof pressure test has been successfully performed. All of the instrument STM models have been integrated. Following the vibration and thermal-vacuum test at IABG in Munich (D), the Lander STM was delivered as planned in mid-August. After its integration on the spacecraft, a separation test has been successfully completed. The programme is on schedule for the delivery of the STM spacecraft to ESTEC in December 1999, ready for the start of the environmental test campaign.

At equipment level, the Preliminary Design Reviews (PDRs) have been completed. Software reviews are now being carried out, addressing all of the avionics software. Overall within the Programme, both on the spacecraft and payload sides, attention is now focussed on the Engineering Qualification Model (EQM) programme, which is due to start in the near future.

As regards the Ground Segment, the industrial contractors for the Mission Control System software and the Rosetta ground simulator have been selected and activities in these areas have started.

Transport of the XMM spacecraft to Kourou, French Guiana

1. Shipment by the “Toukan” from Rotterdam (NL) to Kourou

2. Arrival by truck at the Launch Base

3. Unloading XMM from its transport container

Mars Express

The payload, spacecraft and mission-level requirements review activities were successfully completed just before the summer period. The Board met on 28 June and it concluded that the review had been successful, provided that certain actions are closed out in due time.

The Principal Investigators met in late June to initiate the detailed planning of their instruments. That planning is complicated by the fact that that several instruments could generate more data than the spacecraft can transmit to Earth. Compromises will therefore have to be worked out to ensure that all instrument teams get a sufficient share of the data volume over the mission's lifetime.

The preparations for the Preliminary Design Review (PDR) have started with instrument-level reviews in September. Several Principal Investigators have already submitted their data packages in preparation for these reviews.

After signature of the contract with Starsem for the provision of the launch services, normal work on the detailed definition of all requirements and interfaces has started. The Prime Contractor will be responsible for all technical interfaces, while ESA retains responsibility for all contractual matters.

Artemis

Following the virtual completion of testing of the Artemis satellite, the Pre-Shipment Review has been held. This major Agency review has concluded that, while some documentation still needs to be finalised, when the few remaining tests are completed the satellite will be ready for shipment to the launch site. However, NASDA has experienced some technical problems with the launch campaign (H2F8) preceding the Artemis launch, and has consequently announced some delay. A new launch date will be fixed as soon as the situation on H2F8 is clarified. In the meantime, it is planned to place the Artemis satellite in storage.

With the exception of some baseband equipment at the Telemetry, Tracking and Command (TTC) station, the ground facilities needed to operate Artemis are ready and activities are now concentrating upon preparation of the flight-operation procedures and on simulations to exercise these procedures and to train the operations personnel.

Work is also proceeding at Redu (B) on the facilities to be used by NASDA to receive data from their spacecraft via Artemis. The radio-frequency equipment to be provided by ESA has been delivered to Redu and is being installed and tested, while NASDA is implementing its baseband equipment.

EOEP

Strategy and future programmes
Following agreements in May to initiate the first slice of the Earth Observation Envelope Programme (EOEP), in June the Earth Observation Programme Board (PB-EO) selected the first Earth-Explorer Core Missions. The first mission to be funded is 'Cryosat', which is designed to measure and monitor the volume of ice over the polar regions. The second mission, SMOS, is designed to determine ocean salinity and soil moisture. A third mission, ACE, is to be maintained in 'hot-standby' in case of unforeseen problems with either of the first two.

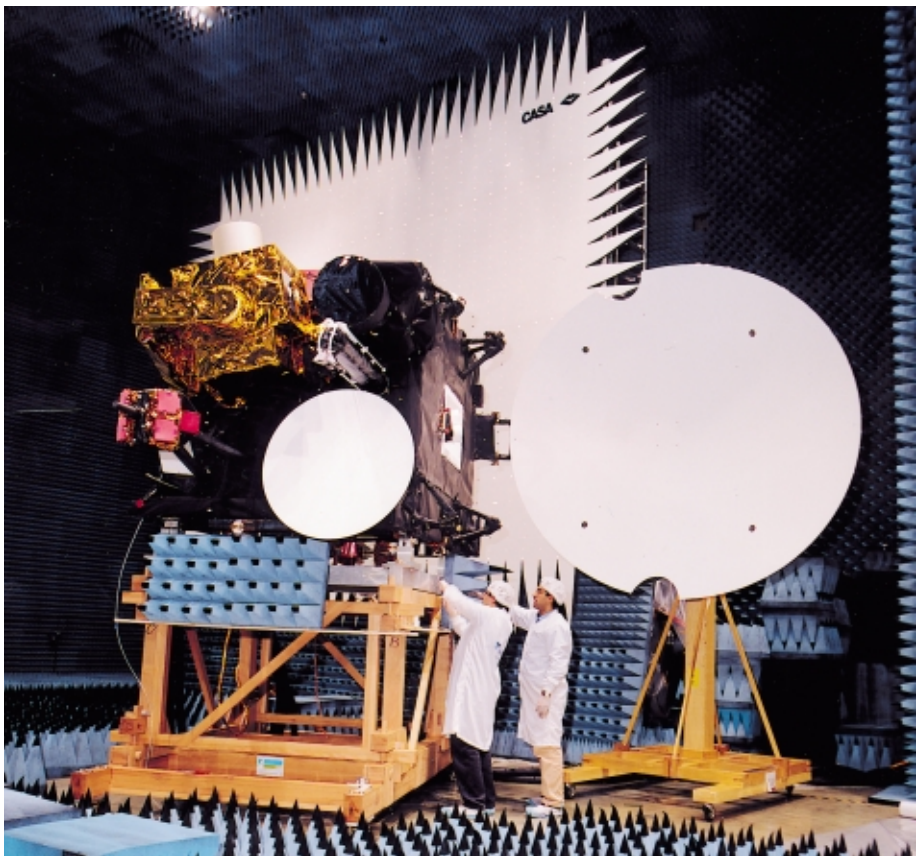
Future missions
The Phase-A studies of the first four candidate Earth-Explorer Core Missions have been completed and subjected to extensive, independent technical and programmatic evaluation prior to the final selection procedure, which will take place in October/November 1999.

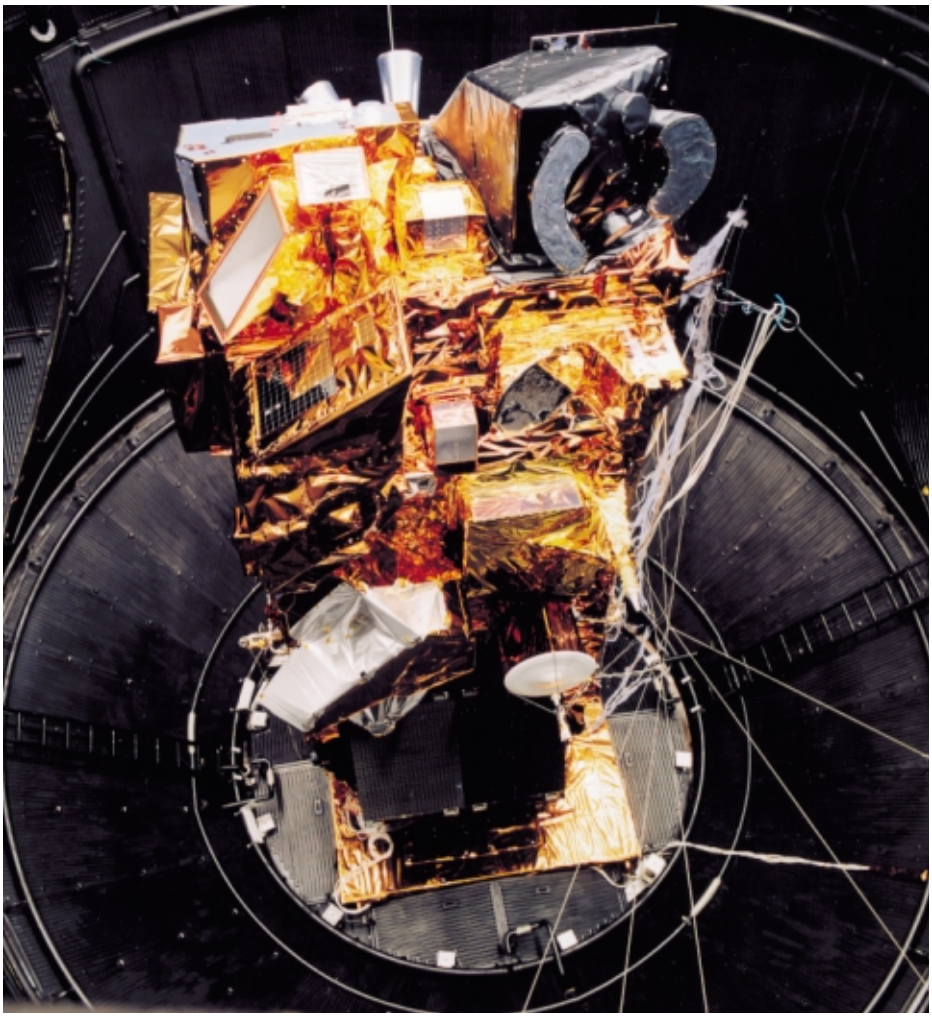
Envisat/Polar Platform

Envisat system
The system activities have been focused on two areas: ensuring completeness of the system verifications before launch, including Ground Segment Overall Verification (GSOV), and preparation of the calibration/validation activities for the in-orbit commissioning of the satellite.

Satellite activities
All the flight-model instruments or instrument assemblies delivered in recent

Artemis during acoustic testing at ESTEC in Noordwijk (NL)





Envisat in the Large Space Simulator (LSS) at ESTEC in Noordwijk (NL)

months have been integrated successfully, and the complete flight-model Payload Module, accompanied by an impressive amount of Electrical and Mechanical Ground-Support Equipment (EGSE and MGSE) was shipped to ESTEC (NL) at the beginning of June. A large part of the Matra Marconi Space team has moved from Bristol (UK) to ESTEC to continue the Assembly, Integration and Test (AIT) activities.

In August, the flight-model Payload Module was transferred, after final preparation, into the ESTEC Large Space Simulator (LSS) for thermal testing. The thermal-balance and thermal-vacuum tests were executed and completed with just a few minor problems, which are currently being addressed. In parallel, the Service Module flight model has been prepared for a qualification shock test with Ariane-5-provided test equipment.

As one of the outcomes of the Envisat Satellite Qualification Review (ESQR), completed in July 1999, the installation of a second Solid-State Recorder has been decided upon and initiated.

Envisat payload

The verification activities on the MIPAS Instrument Optical (MIO) flight-model assembly have been completed successfully and consent to ship it to ESTEC for integration on the satellite was given at the end of September.

The MERIS flight model has been re-integrated, final testing of the instrument is in progress, and delivery is expected before the end of November.

The ASAR antenna has been accepted, following successful completion of the beam-forming tests, and the complete instrument is currently undergoing final integration testing. These tests are expected to be completed at the end of the year.

The repair programme for the ultraviolet-straylight problem on the SCIAMACHY Optical Assembly has been validated and implemented. Final acceptance activities have resumed and delivery of the instrument is expected in early 2000.

Envisat ground segment

The development and integration of the main elements of the Flight Operations Segment (FOS) is progressing according to plan. The operating strategy for the two onboard Solid-State Recorders has been finalised and the associated modifications are being implemented in both FOS and PDS in parallel. The deployment of the Payload Data Segment (PDS) version V2 has been completed and the corresponding acceptance tests are planned for November. A PDS V3 version is currently being defined to cope primarily with updates in the satellite-to-ground interfaces and corresponding evolution/refinement of the instrument-processing algorithms.

Meetings have been held with the potential National and Foreign Station Operators following release of the corresponding applicable specifications. The Processing and Archiving Centre (PAC) implementation activities are in progress with most of the assigned PACs. The Invitation to Tender (ITT) for the commercial distributors is planned to be released in the near future; a briefing for potential tenderers was organised in early September.

Meteosat Second Generation

The engineering-model satellite has been fully integrated and is now undergoing radiated Electro-Magnetic Compatibility (EMC) tests.

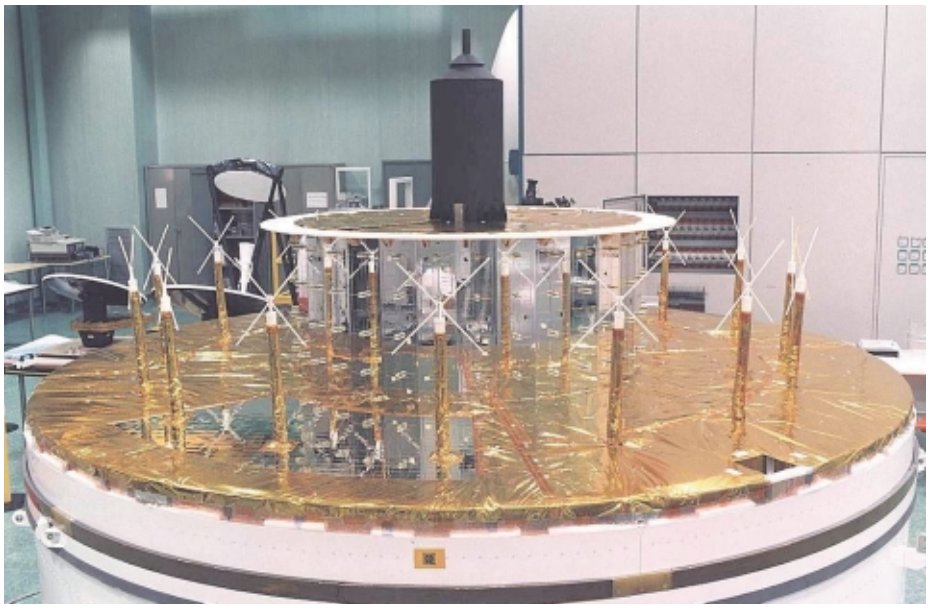
The MSG-1 flight-model satellite received its mission communications subsystems in July. The accompanying photograph shows the antenna farm prior to its shipment from Alenia Aerospazio in Rome (I) to Alcatel Space Industries in Cannes (F).

The flight-model SEVIRI Optical Instrument has also been delivered and is presently undergoing acceptance testing. Its measured performance confirms the good

quality data already obtained with the SEVIRI engineering model.

The predicted launch date for the MSG-1 spacecraft remains October 2000. MSG-2 and MSG-3 also remain on schedule, with a predicted launch date of 2002 for MSG-2, and an anticipated storage date in 2003 for MSG-3.

Investigations into how to overcome the Ariane-5 shock problem are in progress. Representative flight data from two other satellites on a SYLDA-5 frame are expected in early 2000.



The Meteosat Second Generation antenna subsystem

ERS

Mission operations
During the previous quarter, the ERS system has been operated continuously, with a high level of performance from both the satellite and the ground segment. ERS-2 has ensured the nominal mission, with the ERS-1 payload in hibernation as the mission backup.

The real-time mission was interrupted during four orbits to test the readiness of the overall ERS system for the year-2000 transition. The results demonstrated that the system has indeed been correctly upgraded for that purpose and it is Y2K-compliant.

ERS-1 status
As noted above, the ERS-1 payload continues in hibernation and its performance remains unchanged with respect to the previous report. The SAR is activated twice per day, without data transmission, to maintain the battery capabilities.

ERS-2 status
The platform, the Instrument Data Handling and Transmission (IDHT) system and the payload operated nominally throughout the reporting period. The satellite pointing remains within specification. The close monitoring of gyroscope performance showed an improvement in the noise levels on gyros nos. 5 and 6, but a small degradation in gyro no. 1. Gyro no. 1 has therefore been replaced in the 'piloting triplet' by gyro no. 4, to avoid further degradation and to keep it in operational condition for future use. This piloting triplet will remain in operation until next December when a new Attitude, Orbit and Control System (AOCS) software package will be up-linked to the spacecraft. This newly developed software, which pilots the satellite using just one gyro instead of three, is currently under test.

Metop

With the objective of achieving contract signature before the end of the year, both the Metop industrial partners and the customers, ESA and Eumetsat, have focussed their attention on closing out all of the remaining open points in the contractual and technical baseline. One major element of this has been the firm incorporation of the GRAS instrument within the overall contract, given that at the start of Phase-C/D this instrument, introduced late into the programme, was still an allocation within the industrial proposal.

In parallel with this activity, ESA and Eumetsat have been finalising the details of the documents defining their relationships in this joint programme.

In terms of the industrial development effort, the Preliminary Design Review (PDR) cycle has been completed and many items of equipment are in the final testing stages before delivery of the engineering models for integration. Customer-Furnished Instruments (CFIs) from the United States have been delivered and are in pre-integration with the NOAA (instrument) Interface Unit (NIU) at the Payload Module integrator Dornier (D).

Definition of all elements that will interface with the ground segment has been a priority, so that Eumetsat could issue its Invitation to Tender (ITT) for the core ground segment. This was achieved at the end of August.

PROBA

The spacecraft electrical-model test campaign has been concluded. Integration of the Proto-Flight Model (PFM) spacecraft is ready to start at the end of October with the delivery of the primary structure. The engineering models of the spacecraft computer and power subsystem will support the spacecraft integration before the delivery of the flight units, planned for the end of the year. The other platform flight units have already been delivered, with the exception of the receivers and transmitters, which will also be delivered at the end of the year. The payload-instrument deliveries are planned in November and December after completion of the calibration campaign for the CHRIS spectrometer and after the environmental testing for the DEBIE debris sensor. They will be integrated on the spacecraft with the engineering model of the payload processor unit.

The software development continues in parallel, and the Software Validation Facility has been delivered. The electrical-model test campaign has allowed the reduced version of the software needed to support the spacecraft integration effort to be finalised and validated. The automatic generation of the attitude-control software is now starting following the first delivery of the control models.

As part of the validation of PROBA's attitude-control performance, particularly during the manoeuvres required for the spectrometer measurements, functionality tests have been performed on the wheels and the dual-head star sensor.

The current planning will allow environmental testing of the spacecraft in March and a Qualification and Design Review in December 2000, after the delivery of the last PFM unit.

The first release of the Operations Control Centre software has been delivered and the procurement of the portable ground station initiated. The operations activities at Redu (B) have been initiated.

A second meeting has taken place with the Principal Investigators of the CHRIS instrument, and it has been decided to release an Announcement of Opportunity (AO) to enlarge the exploitation of the CHRIS observations. The observations will be coordinated by ESA's Earth Sciences Division.

The CHRIS spectrometer for PROBA during acceptance testing

International Space Station

European Participation in the ISS Exploitation Programme

The Executive has continued to pursue co-ordination and assessment activities with industry and the User Community. Meetings with industry on the cost and technical references have taken place and a commercial utilisation workshop will be held on 28 October 1999. A first meeting of the multilateral ISS working group on commercialisation will take place in Washington DC on 2 November with the aim of establishing common ground-rules among the Partners for the commercialisation of their respective segments.

ISS Overall Assembly Sequence

Investigations are still continuing to bring the Columbus launch date forward from February 2004 to September 2003, and a Space Station Control Board (SSCB) will be held in end-November/early-December to baseline Assembly Sequence flights for the year 2000.

The launch-preparation testing of the Service Module systems, which include the ESA-furnished DMS-R, is continuing at Baikonur. It was agreed to delay the launch from November to a launch window between 26 December and 16 January, and a more precise launch date will be established at a General Designers' Review (GDR) meeting in Moscow end-October/early-November.

Columbus laboratory

The system-level Electrical Test Model (ETM) testing is proceeding according to plan and Critical Design Reviews (CDRs) at equipment level are about 65% complete, with no major showstoppers evident. Flight-model manufacture is underway with the primary structure pressure shell welding completed.

Columbus Launch Barter

Nodes-2 and -3

Node-2 design has progressed well and flight-unit assembly will start in the first half of next year. The accommodation requirements for Node-3 have continued to change throughout the period, but a Reference Configuration Review in July re-established a baseline for this node and design work has now recommenced.

Software Deliveries/DMS-R items/ Associated Sustaining Engineering for NASA

The last period of sustaining engineering is nearing completion; all other obligations for this element of the Barter have been completed.

Crew Refrigerator/Freezer Racks

The technology study is proceeding as planned, but changes to the agreed Barter requirements, which were expected to be available by end-September, have not yet been received.

Cryogenic Freezer Racks

Following a meeting held by NASA with scientific utilisation representatives and experts of different disciplines, a new release of the Cryosystem Specification was issued and is being reviewed by ESA.

Cupola
Industrial work has progressed well and on schedule, and a full-scale mock-up has been completed and used to conduct a crew review with the participation of ESA and NASA astronauts. Following the announcement of the cancellation of the requirement for the second Cupola and potential changes to the design characteristics of the remaining flight unit, an estimate of the programmatic effects on the scope of the Barter is being prepared.

Automated Transfer Vehicle (ATV)
Preliminary Design Reviews (PDRs) for the Propulsion and Re-boost Subsystems, the Spacecraft Structure Subsystem and the Integrated Cargo Carrier Subsystem have been completed successfully. The overall Phase-C/D planning is under revision and will likely result in a five- to six-month shift in the launch of the first ATV, to end-2003.

Investigations have taken place on the possibility of launching the ATV on the Ariane-5 versatile version with re-startable EPS (Etage Propergols Stockables); a decision on this approach is expected in October 1999.

X-38/CRV and Applied Re-entry Technology (ART)
At the end-July closing date for subscription to the European participation in the ISS Crew Return Vehicle programme, six Member States had confirmed their subscriptions. Two other Member States intend subscribing as soon as a number of arrangements have been formalised. The level of subscription achieved, approximately 190 MEuro, will allow Europe to play a major role in this programme.

The second B52 drop test with X-38 Vehicle V132 was successfully performed in July. For this test, the ESA-provided GNC software for the parafoil descent phase was active. The CDRs for all European hardware for the X-38 orbital test vehicle (V201) have been successfully completed and the manufacture of flight hardware is on schedule.

Atmospheric Re-entry Demonstrator (ARD)
The contract for ARD data exploitation was kicked-off in Bordeaux (F) on 21 July, and its completion is expected within less than a year.

Ground-segment development and operations preparation
More than 20 responses have been received from industry following the Announcement of Opportunity for declaring interest in the Columbus Control Centre subsystem procurements. Invitations to Tender (ITTs) are planned to be released in January 2000.

Utilisation
Promotion
External peers have evaluated the proposals received in response to the 1998/99 Announcements of Opportunity (AO) and made recommendations. Due to their identified application potential, thirty-one of the proposals that were recommended qualify for funding from the Microgravity Application Promotion (MAP) budget. Most of the qualifying projects have been proposed by teams with a strong European dimension and with identified industrial partners. Further new proposals are expected in response to the recently issued Life Sciences AO.

The Programme Committee charged with the preparation of the Global ISS Utilisation Conference 'ISS Forum 2000 - Berlin 13-15 June 2000' will meet in early-November. All ISS Partner Countries and key personalities in Research and Development (R&D) as well as from education and the media, are expected to be present.

Preparation
Although at the end of July the future of DLR's participation in FOCUS was in doubt, a solution has been found allowing activities to continue. At the same time, confirmation from a German industrial consortium regarding their contribution to Phase-C/D of FOCUS has been received. A statement of work is now being prepared to cover a bridging phase, which will be co-financed by ESA, DLR and German industry.

Hardware development
Phase-C/D for the four Express Pallet Adapters (ACES, EUTEF, EXPORT and SOLAR) is now expected to start early next year. The NASA-provided Express Pallet System is experiencing significant delays and, consequently, the Express Pallet Programme is experiencing a delay of more than one year.

Astronaut activities
The CNES Perseus mission with ESA Astronaut J.P. Haigneré on board was successfully completed on 28 August, with the landing in Kasakstan. J.P. Haigneré spent 189 days onboard Mir, which is the longest stay in space by a non-Russian astronaut.

A first group of seven candidates from industry and DLR have started the ISS Instructor Training Course.

Early deliveries
Data Management System for the Russian Service Module (DMS-R)
Modifications to overcome the problems identified in the ESA ground system during the 'four-box test' in Houston in May have been provided to RSC-Energia in accordance with the agreed schedule, and have been verified during the latest 'four-box test' completed in Moscow in October. A software patch to eliminate another DMS-R related problem (boot problem) has also been provided.

MPLM Environmental Control and Life Support Subsystem (ECLSS)
All deliveries have now been completed and the first part of formal 'Transfer of Ownership' protocols between ESA and ASI has been signed by both parties.

The equipment sets for the first two MPLM flight units have been integrated into 'Leonardo' and 'Raffaello' and have been delivered to NASA/KSC for pre-launch ground processing. To date, no problems with the ECLSS hardware have been reported.

European Robotic Arm (ERA)
The ERA CDR was closed-out in October. Initial 'flat-floor' testing with the ERA Engineering/Qualification Model (EQM) has been conducted and the EQM has been delivered to ESTEC for thermal heat-balance tests. Following these tests, it is planned to carry out further flat-floor testing. Assembly of the subsystem flight models is well underway and final assembly of the flight arm is now expected to be complete in May 2000, with delivery to Moscow targeted for end-2000.

Laboratory Support Equipment (LSE)
The CDR for the MELFI -80°C Freezer was formally closed in July. The cooling-performance issue was resolved, with no impact on the specification or design. The Laboratory Ground Model was tested for thermal mathematical model correlation

and will be delivered to NASA in December.

The Ground Unit of the Material Science Glovebox (MSG) was delivered to NASA at the end of August. NASA provided a Crew Test Report in September, which includes some crew-requested modifications that are currently being assessed.

NASA accepted the High Fidelity Avionics and Mechanical Simulators for Hexapod. The Mechanical Simulator is currently undergoing system-level configuration checks.

Microgravity

EMIR-1 and EMIR-2
Eleven ESA microgravity experiments were flown and processed onboard the retrievable Russian capsule Foton-12 from 9 to 24 September. These included three fluid-physics experiments in the FluidPac/Telesupport assembly; four exobiology/radiation experiments in the Biopan; one material-science experiment in the AGAT furnace; two biological experiments in their dedicated and investigator-provided instruments; and one meteorite simulation experiment embedded with three samples in the heat shield of the re-entry capsule.

The PDRs for the European Modular Cultivation System (EMCS) and the Percutaneous Electrical Muscle Stimulator (PEMS) have been completed and authorisation for the development (Phase-C/D) of these facilities has been given.

Phase-C/D for the exobiology facility EXPOSE has been kicked-off.

Following hardware acceptance in October, the facility for studies of the Morphological Transitions in a Model Substance (MOMO) will be delivered to Kennedy Space Centre in November for integration into Spacehab. The flight on Shuttle mission STS-101 is now scheduled to take place in February 2000.

Preparations are continuing for the flight of the Advanced Protein Crystallisation Facility (APCF), Biobox and Biopack, the Facility for Adsorption and Surface Tension (FAST) studies, and the Advanced Respiratory Monitoring System (ARMS) on the STS-107/Spacehab flight in early-2001.

Microgravity Facilities for Columbus (MFC)
For Biolab, nearly all of the subsystem CDRs have been initiated, and the engineering-model manufacturing is almost complete.

Proposals for Phases-B/C/D for the Experiment Preparation Unit (EPU) have been received; their evaluation is in progress and the contract is expected to be awarded by end-October 1999.

The engineering-model manufacturing for the Fluid Science Laboratory (FSL) is 50% complete.

The discussion concerning the introduction of the Microgravity Vibration Isolation System (MVIS) developed by the Canadian Space Agency (CSA) has been shifted to November, due to a delay incurred in the completion of the MVIS PDR.

The Letter of Agreement (LoA) with NASA for the Materials Science Laboratory (MSL) in the US Lab has been signed in September. The absence of a signed LoA had led to a hiatus in the technical exchange between ESA and NASA (due to export-control issues) of about six months. This has introduced a delay into the MSL development, the extent of which is presently being assessed.

The European Physiology Modules (EPM) Phase-B is progressing, with the mid-term review planned in October 1999. Phase-B is foreseen to end by early-2000.

The LoA between NASA and ESA concerning the co-location of the EPM and the NASA Human Research Facility (HRF), as well as the exchange of other physiological experiments, is not yet finalised.

The 2.2 m-diameter Foton-12 reentry capsule carrying Biopan, soon after landing