THE ACTIVITIES

Scientific Projects
Scientific Research & Earth Sciences
Earth Observation
Telecommunications
Space Transportation
Manned Spaceflight & Microgravity
Technical & Operational Support
Technology
International Cooperation
Public Relations
Publications
**Scientific Projects**

**XMM**

**Launch: January 2000**

Significant milestones were achieved in 1998 with the delivery of the spacecraft flight equipment and successful completion and review of the spacecraft-level test campaigns for the structural and thermal model at ESTEC and the electrical model at Dornier (D).

The assembly and integration activities on the flight spacecraft commenced at Dornier in January, by which time the majority of the flight equipment was available. Late delivery dates were accommodated by re-scheduling the integration activities and streamlining test plans wherever possible.

In late summer, however, it became clear that some payload elements would only be available towards the end of the year. To keep the original launch date, major cuts would need to be made in the verification plan for the flight spacecraft, increasing the overall technical risk beyond an acceptable level. A new plan for integration, test and launch was therefore established which mitigated the technical risk to an acceptable level whilst limiting the schedule and cost impacts for the overall project. In September, the proposal, with a new launch date in January 2000, was reviewed and approved by the Director of Science.

Test activities on the Service Module of the spacecraft, unaffected by the late payload delivery, had started at ESTEC during October according to the original plan.

The project team closely followed the SOHO recovery activities and carefully analysed the lessons learnt with the objective of increasing, where necessary, the robustness of the design of the XMM spacecraft against catastrophic loss of attitude. As a result, a set of possible improvements was identified and the related modifications were implemented without delay.

In December, three months ahead of schedule, ESA formally handed over the flight mirror modules to Dornier. The three mirror modules form the core of the XMM payload, projecting the X-ray picture of the sky onto the instrument detectors. As the major technological challenge of the project, the mirror modules were developed and built under direct ESA responsibility by Media Lario (I). All mirror modules significantly exceed the specified performance.

The ground-segment development proceeded successfully and the first combined testing of the ground control software together with the flight spacecraft was conducted in October. The next combined system-level test will be run in early 1999.

Preparations are now underway for the release to the scientific community of the remote proposal submission system, which will be available via the World Wide Web (WWW) in early 1999. This will provide the tool for scientists from all over the World to propose observations to be made by XMM in orbit.

After the successful qualification of the Ariane-5 launcher, interface verification using the data obtained from the qualification flights confirmed the current XMM spacecraft design. Preparations for the detailed definition of the launch campaign are well underway.

*The XMM spacecraft structural and thermal model under test at ESTEC (NL)*
Cluster-II

Launches (two): Mid-2000, about one month apart

During the year, industry throughout Europe manufactured the various spacecraft units and the majority of the equipment for the first two new flight spacecraft has been delivered. The units that have been changed since the original Cluster mission, the solid-state recorder and high-power amplifier, have successfully completed their qualification programme. The integration of the first new spacecraft (FM6) has proceeded according to plan. The complete payload is installed and the spacecraft will undergo system functional testing early in 1999, before being shipped to IABG in Munich in March 1999 for the environmental test programme. Integration on the second flight model (FM7) has also started and will follow FM6 by approximately three months.

All payload deliveries are going according to schedule and calibrations have been performed with only minor problems.

During the year, the launch-services contract was signed with the Franco-Russian Starsem consortium. This covers the provision of two Soyuz launch vehicles with Fregat upper stages to be launched from Baikonur in Kazakhstan in the middle of 2000. This contract includes an insurance clause, which provides for a back-up launch on an Ariane-4 if long delays should arise in the Soyuz-Fregat development schedule. Fregat is a new upper stage and the contract
stipulates that two successful Soyuz-Fregat launches must be completed before the Cluster-II launch.

The decision was taken to move the main antenna to be used for the Cluster-II operations phase from Odenwald in Germany to Villafranca in Spain. This move has started and will be completed in time for the launch preparations for Cluster-II. All other maintenance/upgrade activities for the ground-segment hardware and software are progressing satisfactorily.

The Cluster Science Data System and Joint Science Operations Centre have been in a partial hibernation mode, with only software updates for the processing of the scientific data being performed. Towards the end of the year, plans for re-commissioning and testing have been discussed and agreed with all parties.

Integral

Launch: September 2001

1998 marked a turning point for the Integral project. After many years of design, planning and development, the integration and testing of most of the mission elements have started.

The main emphasis in the early part of the year was on the preparation of the Structural Thermal Model (STM) programme. The STM of the whole satellite, including representative instrument STMs, was integrated at Alenia’s premises in Italy and shipped to ESTEC for environmental testing in early May. This programme was successfully completed in October.

A Hardware Design Review was held in early September, prior to the Engineering Model (EM) system-level activities. Successful completion of this review allowed the work on the EM to begin. Despite delays in the deliveries of instrument EMs and continuous troubleshooting for the core electrical ground-support equipment, significant progress has been made.

Recent reviews of the delivery schedule for the instrument flight models led to the conclusion that the launch date of April 2001 could not be maintained. Extensive work-around activities are being implemented, and a launch at the beginning of the autumn 2001 window is currently estimated as the best possible target.
In response to science concerns, an alternative 72 hour orbit has been baselined to maximise the time that the spacecraft spends above 60 000 km during each orbit.

ESA’s contribution to the Proton launcher-interface studies and the Integral-specific adaptations have been clarified in meetings with the Russian side. Good progress was made and agreement on the major technical and programmatic aspects has been achieved. Nevertheless, full implementation of these agreements is still pending the entry into force of the ESA/RSA Integral Arrangement.

Work on Ariane-5 as the backup launcher has continued throughout the year. A draft Interface Control Document (ICD) has been produced and will be refined during 1999.

Progress has been made in detailing both the managerial and technical interfaces between all parties involved with the ground segment. Procurement of the hardware and software components for each of the elements has started. A review of the status of the complete ground segment is in progress.

Rosetta

Launch: January 2003

The ESA Industrial Policy Committee (IPC), meeting in Paris on 26 November, gave the final approval for the Rosetta main development (Phase-C/D) contract. This concludes a rather complex selection process for the industrial contractors, which has at times seen very heavy competition within European industry, but which has ultimately enabled the given geographical-return targets to be closely met.

The spacecraft design has made considerable progress. A stable instrument-accommodation configuration has been achieved and the first round of mechanical and thermal analysis is complete. After a number of iterations, the spacecraft thermal design has been confirmed to be feasible with the limits imposed by the solar-array power available up to distances of 5.5 AU from the Sun. Considerable effort has also been devoted to the design of the spacecraft onboard software, which is extremely schedule critical. This issue has been assessed in detail by a joint ESA/Industry working group. The software design is expected to be fully consolidated at the Software Requirements Review in February 1999.

As a conclusion to the project Phase-B, an extensive series of reviews has closely scrutinised the design and the development status of all Rosetta mission elements, including the spacecraft, instrument payload, ground segment and launcher. The Rosetta Lander has also been the subject of a specific design review by an independent team, which has confirmed the validity of the proposed design and praised the excellent engineering solutions in many critical areas.

Without ignoring the very critical overall schedule situation, the Mission System Design Review Board concluded in early December that there is good confidence of mission success for all elements.

FIRST/Planck

Launch: 2007

The Science Programme’s effort to put both FIRST and Planck on a firm and affordable basis made progress during the year.

In early March, instrument proposals were received from five scientific consortia, three for FIRST and two for Planck. These payload proposals were endorsed by peer review and approved by the Science Programme Committee (SPC) at its May meeting.

The mission baseline studies had been carried out both in industry and by the Agency, covering three options: FIRST and Planck spacecraft with independent launches; FIRST and Planck spacecraft using a single launch vehicle; and a simple spacecraft combining the FIRST and Planck missions.

The procurement of a new 35 m Deep-Space Antenna has also been finalised and the contract signed with SED (Canada), leading a consortium of European industries. Currently the proposed site for the antenna, in Perth, Western Australia, is being negotiated with the relevant authorities.
At the May SPC meeting, the option of two spacecraft on one launch vehicle was adopted as the mission baseline, with a launch date in 2007, and a cost target of 654 M€, which is well below the previous cost estimates.

The scientific consortia activities commenced in early summer with a detailed definition of the technical and programmatic aspects of their instruments and their scientific data centres.

Joint discussions with national funding agencies, principal investigators and the Agency were held to investigate possibilities for reducing the constraints on funding of the scientific payloads expressed by Delegations.

One of the key recommendations of the selection process had been to bring forward the system design of the Planck payload with its complex cryogenic technology. A Planck payload architect (Alcatel, F) has been selected, via an open tender, to conduct a one-year study. A Straylight Working Group composed of independent scientists has been set up to deal with this specific aspect.

In addition, FIRST and Planck scientists have also identified in detail those elements of their payloads and interfaces which might benefit from common development.

Co-operation with NASA has been pursued on the FIRST telescope. JPL is developing a scaled-down CFRP demonstration model, representative of the final 3.5 m main reflector for the telescope.

The Canadian Space Agency has shown interest in participating in the FIRST/Planck mission and

![Artist's impression of the Mars Express orbiter](image-url)
contacts are planned in early 1999 to define possible contributions.

ESA-funded technological developments (cryo-coolers, detectors, data-processing software) for key payload elements have progressed during the year. In particular a 1.35 m silicon-carbide demonstration reflector was manufactured by a consortium led by Matra Marconi Space (F). This new technology is showing very good potential and is being developed as a back-up to the NASA-JPL CFRP telescope, should this technology fail to deliver the necessary performance.

**Future Science Projects**

1998 was a busy year for future science projects. In addition to starting the industrial studies for the Cornerstone missions GAIA, LISA, IRSI and Mercury Mission, a significant effort was devoted to the preparation of the SMART-1 mission and to the definition of a science technology programme. The highlight of the year, however, was the successful implementation of a new approach to project study and mission selection, as demonstrated by the unanimous approval by the Science Programme Committee of the Mars Express mission in November. The approach taken was to combine several hitherto separate phases of the procurement process into a single phase of activity, thereby saving about three years compared with the old assessment and selection cycle. Future cooperation with NASA on the Next-Generation Space Telescope (NGST) was also studied extensively during the year.

The aim with all of these activities is to define a programme of science missions that are World-class, but within a budget that is affordable. All of the missions are demanding and, if implemented, would put European industry and scientists in a leading position vis-a-vis the rest of the World.

**Prodex**

Prodex is an optional scientific programme established to provide funding for the industrial development of scientific instruments or experiments proposed by Institutes or Universities, and selected by ESA for one of its programmes (science, microgravity, Earth observation, etc.). The Agency provides both administrative and financial management knowhow and technical support.

The Member States currently participating in Prodex are: Switzerland, Belgium, Ireland, Austria, Norway, Denmark and Hungary. Negotiations regarding the Czech Republic’s participation have been continued, and Portugal, Poland and Rumania have reiterated their interest in joining in the near future.

The projects being developed range from small ERS data-analysis programmes to fully-fledged instruments for scientific payloads. The following experiments or experiment subsystems were finalised during the year:

**STS-95**
- Advanced Protein Crystallisation Facility
- Hitchhiker Experiment
- Biobox Experiment
- Facility for Adsorption and Surface Tension
- Sleep and Respiration Disturbance Analysis
- Advanced Gradient Heating Facility.

**XMM**
- Telescope Module Power Supply Unit for the Optical Monitor
- Detection Box for the Reflection Grating Spectrometer Experiment.

**ERS**
- Oil-Spill Monitoring.

**OERSTED**
- Ground-Segment Preparation.

**IMAGE**
- Ultraviolet Spectral Imager.

In addition, several design efforts are still in progress, such as the work on the engineering model of the Radiation Environment Monitor for the Integral Mission.