## COMMISSION 44: ASTRONOMY FROM SPACE (L'ASTRONOMIE A PARTIR DE L'ESPACE)

### Report of Meeting

PRESIDENT: M. Oda

VICE PRESIDENT: Y. Kondo

I. BUSINESS MEETING

The following officers and members of the Organizing Committee were elected: President: Y. Kondo; Vice President: K. Pounds; Organizing Committee: A. A. Boyarchuk, G. W. Clark, G. Courtes, M. Grewing, E. B. Jenkins, F. Macchetto, M. Oda, J. Rahe, G. B. Sholomitzcy, Y. Tanaka, J. Truemper, K. A. van der Hucht, A. J. Willis.

The formation of an international "Working Group on Far and Extreme UV Spectroscopy" was proposed, with J. Linskey as chairman.

II. SCIENCE MEETINGS

Commission 44 sponsored eight science sessions which were devoted to "Future Space Programmes"; they were chaired by R. Bonnet, B. Burke, Y. Kondo, M. Oda, J. Rahe, and A. Willis. Brief summaries of the meetings, some of which are received from the speakers, are given in the following. Commission 44 co-sponsored several Joint Sessions which are not included in this report.

1. Topics Related to Space Station (SS)

B. Burke reviewed discussions at the US Space Science Board meetings "Major Directions 1995-2015" which focussed on future strategies of space science in general and of each discipline, including astronomy and astrophysics. Naturally the US plan for the SS has deep impacts on the strategy. Discussions of a possible lunar base and specifically of large scale space interferometers were reviewed.

It was reported that the TFSUSS (so-called Banks Committee) consisting of US scientists with international observers as an advisory group to OSSA of NASA discusses various possible modes of scientific uses of the SS. In the committee's sub-meeting held in October at Napa Valley, California the necessity of establishing an international group of scientists (i.e., a forum, arena, or even an institution) to reflect demands of the scientific community to the SS was emphasized and a report will be issued shortly.

R. D. Chapman commented on SS and discussed four points. First, he described the organization of the SS programme: a level A programme at NASA Headquarters with broad overview of the activity, a level B programme at the Johnson Space Center with responsibility for integrating the entire programme, and level C projects at other NASA centers with responsibilities for parts of the programme. Then he outlined the objectives of the programme, and pointed out that the ability to construct, deploy, service, and maintain scientific payloads will change the way space science will be done in the future. He then described the SS infrastructure which includes the core station, co-orbiting and polar platforms. In effect, free-fliers and other platforms (SPARTAN, Leasecraft) will become part of the infrastructure through servicing and maintenance. Finally, he



https://doi.org/10.1017/S0251107X00026377 Published online by Cambridge University Press

discussed several issues such as instrument component compatibility, data system transparency and telescience.

R. M. Bonnet reviewed the European views on the SS. Being invited by NASA in 1983 to participate in the SS project, ESA signed in June 1985 a MOU which covers activities during Phase B. In January, the Council of ESA approved all the components of ESA's Long Term Plan. Among this Plan, the Columbus project represents what Europe intends to develop as their participation to the SS. Columbus consists of the Pressurized Module, Service Module, a co-orbiting and a polar Platform, and a Service Vehicle.

The Europeans foresee that the SS will be mostly used for assembling larger structures in space, servicing and repairing of larger facilities. The station could be used also as a transportation mode for planetary or interplanetary missions.

ESA's Space Science Directorate, in its long term plan "Space Science, Horizon 2000" which was reviewed in a separate session, has identified two missions which would be suited to and would take advantage of the SS. These are a high-throughput Heterodyne Spectroscopy Mission (FIRST) to be placed on the co-orbiting platform, and a Cometary Mission which uses the station as a transportation mode and as quarantine facility.

At this stage, there are no concrete plans, but studies are proceeding to better define the SS capabilities.

A more economic approach may be to base the design of these elements on the re-utilization of modules or of devices which have been developed by ESA for the Spacelab programme, such as the EUREKA platform, a shuttle launched and retrievable platform. As soon as the SS is operational, could EUREKA serve as one of the co-orbiting platforms and be used as an element to assemble larger platforms. The first flight of EUREKA is scheduled for 1988; 80% will be devoted to microgravity and 20% to astronomy.

2. Agencies/Report (1)

NASA: C. Pellerin discussed NASA's space plans. The present status of facility-type space observations with advanced technology was reviewed including Hubble ST (launch scheduled in '86), GRO ('88), AXAF ('92?), and SIRTF ('94?). As examples of moderate missions EUVE, COBE, STE, Cosmic Ray Explorer, Gravity Probe with the precision gyro-scope which has been developed in the past 20 years were discussed.

SMM will be taken back around 1988 and repeatedly be used as a spacecraft bus for moderate missions: EUVE may be the first of these and XTE may follow.

As a research base, a concept of SPARTAN has emerged from the rocket program and the Get-Away-Specials aboard the shuttle. Future SPARTAN and SPARTAN from SS are discussed.

FUSE (LYMAN), QUASAT, ST follow-on instruments, life science, how to proceed in infrared astronomy were reviewed as well as shuttle, SS, advanced SS, LDR etc.

USSR: The original plan for this session included an updated progress report of the USSR programmes for the 1980s, similar to the one presented at the Patras General Assembly. While the overall report was not presented, for the France-Soviet gamma ray experiment, SIGMA, a written report was contributed, and the radio interferometer was introduced as RADIOASTRON.

H. M. Tovmassian reported the progress of the GLASAR experiment to search for galaxies and quasars with excess UV-emission. This new survey in the far UV has been planned in Byurakan where the concept of the activity of the nuclei of galaxies was originally developed and where a survey to find galaxies with excess UV-emission had been undertaken in the mid-sixties.

The telescope has been manufactured and will be launched in the next year. With two star trackers the expected area to be photographed is about 9000 square degrees. The Geneva observatory is taking part in the programme.

NASA/EUVE: S. Bowyer presented the progress report on the Extreme UV Explorer which is to provide the first all-sky map of extreme ultraviolet sources in the 80 to 800 A band and to provide spectra of some of the sources.

3. Agencies Report (2)

The Near Term Activities at the ESA: R. M. Bonnet reported on ESA's activities for the period extending from the present time to 1992, including projects already approved and in the construction phase.

EXOSAT, an X-ray observatory operating in the medium and low energy range, which was launched in May 1983 carries Imaging Telescopes operating at low energies and a set of medium energy Gas Scintillation Proportional Counters. A long period of uninterrupted observations allowed by the high eccentric orbit of EXOSAT has made it possible to obtain the best light curves ever obtained on binaries. During its 2.5 years of observation many new objects have been observed. The end of the mission is foreseen for October 1986.

ESA's mission to Comet Halley, GIOTTO, was launched on the second of July 1985 with the Ariane-1 launcher. Its interplanetary trajectory will be corrected a few days prior to encounter in order to achieve a flyby of Halley at a distance of 500 km. GIOTTO carries experiments in particular to study the environment of the nucleus of the comet and to take pictures of it with a resolution of 30 meters. The camera proved already its capability by taking pictures of Vega, Jupiter and of the earth.

ULYSSES, the new name for the International Solar Polar Mission (ISPM), prepared jointly by ESA and NASA, will observe the sun from above the poles and make measurements of the solar wind and of the interplanetary medium at high ecliptic latitude ($>70^{o}$). The satellite is scheduled for launch in May 1986. It has been agreed that ULYSSES will fly over the South Pole first in mid 1989.

ESA is also participating in the Hubble Space Telescope (HST) by providing the solar arrays of the satellite, building one of the focal plane device, the Faint Object Camera (FOC), and participating in the operation at the ST Science Institute in Baltimore.

HIPPARCOS which is to be launched after HST by an Ariane launcher in 1988 is an astrometric mission whose primary objectives are to measure the positions, parallaxes of more than 100,000 stars with an accuracy of 0.002 arcseconds, and the proper motion of these stars with anaccuracy of 0.002 arcseconds per year. In addition astrometric and photometric measurements with a lower accuracy but for a much larger number of stars will be performed. The payload is now being tested.

ESA is now preparing ISO, the Infrared Space Observatory, to be launched at the end of 1992 (which will be presented in more detail in another session).

The SOHO, CLUSTER and other Cornerstones of ESA's Long Term Programme were

included in the presentation by J. Bleeker on "ESA's Report Horizon 2000" (ESA-SP-1070, 1984). (see page 299)

Japan's Space Programme/ISAS: M. Oda reviewed Japan's presently ongoing and future programmes which have been approved or are under planning. First, the organizational structure of space development in Japan was reviewed; it was emphasized that science and application are promoted under separate organizations sponsored by different governmental agencies and that scientific programmes are conducted within the academic circle including rocketry and spacecraft engineering. With this policy technical capability and scientific demands are well matched and academic autonomy and flexibility are assured but the scale of the programme is limited. The ISAS as one of the Inter-University Research Institutes plays the role of executing space science programmes, coordinating the activities of the universities and producing the long-term strategies for space science. The strategy recommended to the government in 1975 was that the backbone are small and moderate missions at a constant pace fitting to the scientific demands, with big projects and international programmes scattered at intervals of several years.

Currently operating astronomical missions are TENMA, the X-ray astronomy satellite specialized by the $cm^2$ Gas Scintillation Proportional Counters, and two Halley's Comet missions, SAKIGAKE and SUISEI. SUISEI had started to take Lyman alpha pictures of Halley's hydrogen coma. The X-ray astronomy satellite ASTRO-C to be launched in February 1987 will carry 5000 $cm^2$ proportional counters, an all sky monitor and a gamma ray burst monitor. The mission is under collaboration with UK and US scientists.

Apart from missions for space plasmas, a programme for the next solar maximum, HESP (SOLAR-A), is proposed for 1991 launch. An X-ray astronomy satellite, ASTRO-D, with a large throughput X-ray telescope with medium spatial and spectral resolution is considered for proposal for 1992-3.

A space VLBI with highly eccentric orbit with an apogee of 50,000 km is under study for mid 1990's hopefully with coherent relationships to QUASAT.

Japan's approach to the SS was discussed. An MOU was signed for Japan's participation in the Phase B study: Japan is to contribute a pressurized experimental module with an attached platform. Whether the module is an autonomous body for operation and utilization and whether the use of Japanese scientists are limited to this module is uncertain to ISAS and also to NASA: i.e. are international contribution recognized as those to the whole SS system or parts with clean interfaces? Concensus among scientists is that, if the use is limited to the module, few modes of the use are expected for scientific observation except for microgravity experiments: scientists find free-fliers much more useful. The small free-flying platform system somewhat similar to EUREKA appeals to Japan scientists for basic technological studies.

## 4. Hubble Space Telescope and Related Topics

A status report on the preparations for Hubble Space Telescope operations were presented by E. J. Schreier, as a guide for potential proposers. The status of the science instruments was discussed, and possible changes in their nominal characteristics indicated, based on current testing. Potential limitations during early operations were pointed out, such as observing minor planets with small aperture instruments.

In the area of HST proposals, scientists are reminded that proposal material (forms, guidelines, policies, descriptive material and instructions) were sent out to the community at the end of October; the deadline for proposals for the

https://doi.org/10.1017/S0251107X00026377 Published online by Cambridge University Press

first cycle is 28 February 1986. If changes in the launch schedule become known in time, attempts will be made to extend the deadline. The recommendations of the working groups in the various disciplines were reviewed. Three possible key projects were recommended: Ho and the distance scale; QSO absorption lines; and a medium-deep survey. Also discussed was the likelihood of adding a remote entry capability for proposers. The STScI is developing a system which may allow users to submit proposals electronically from their home or institutional computers, via a commercial packet-switched network; this would also give proposers an opportunity to validate their proposals (for snytax and internal consistency), using STScI developed software.

Finally, the status of scientific data processing for HST users was reviewed. In particular, one has to deal with the three key elements of a distributed data analysis system: portable software; a state-of-the-art archive; and a communications network linking users and resources. In the first area are mentioned the status and anticipated capabilities of the Science Data Analysis System (SDAS -- the basic applications software designed for HST), the Image Reduction and Analysis Facility (IRAF -- a system being developed by the National Optical Astronomy Observatories with STScI collaboration, which will be used as a command language and environment for SDAS, and which in addition will have its own set of applications software), and the Calibration Data Base System (CDBS -- a set of applications and systems software and a relational data base to handle HST instrument calibration and engineering data.) IRAF has been demonstrated to be portable on a variety of systems (VAX/VMS, VAX/UNIX, SUN/UNIX, MICROVAX, MV10000/AOS-VS). SDAS has been integrated with IRAF but, as the current time, is limited to VMS systems. In the second area, the status of a joint effort by the STScI and the European Coordinating Facility is discussed to develop a prototype optical disk archive; it is currently anticipated that this facility is available by launch. Lastly, it was pointed out that NASA is sponsoring a pilot project which will link several astronomical institutions and will also provide external user access. The network is presently being set up and may be set up early enough to allow remote user access to HST data.

J. M. Mead reported on the data coverage across the spectrum. Approximately 500 machine-readable catalogs of non-solar system objects are now available at both the Astronomical Data Center of the NASA/Goddard Space Flight Center and at the Centre de Donnees Stellaires (CDS) of the Strasbourg Observatory. Using this data base, we have developed several tools which are currently providing identification and analysis support for archival data from the Infrared Astronomy Satellite (IRAS) and the International Ultraviolet Explorer (IUE) satellite:

1) the Catalog of Infrared Observations (CIO) (Gezari, Schmitz and Mead, 1982), which contains data on all objects observed in the infrared since 1965 as obtained from journal articles;
2) the Combined List of Astronomical Sources (CLAS) (Mead and Hill, 1983), which merges 25 catalogs containing potential candidates for optical identifications by IRAS;
3) the Bibliographical Index of Objects Observed by IUE (Mead, Kondo and Boggess, 1983), which lists the objects observed by IUE and reported in the astronomical literature;
4) the Data Inventory of Space-based Celestial Observations (Version 1.0) (DISCO) (Brotzman, Hill and Mead, 1985), which provides a directory of non-solar system objects observed by 16 space experiments.

All of these data tools should be useful not only for planning future space observations, but also for correlative analyses across the spectrum.

## 5. Missions Under Preparation

ROSAT (German X-ray Observatory): B. Aschenbach described the ROSAT

https://doi.org/10.1017/S0251107X00026377 Published online by Cambridge University Press

mission. ROSAT (Röntgensatellit) is the next X-ray astronomy mission to be launched. The scientific payload consists of two independent instruments: a large X-ray telescope (6 - 100 Å) and a smaller XUV telescope - the Wide Field Camera - (60 - 300 Å) which are looking parallel. The primary scientific objective is to perform the first all-sky X-ray and XUV surveys with imaging telescopes leading to an improvement in sensitivity by several orders of magnitude compared with previous surveys. A large number of new sources is expected to be discovered ($\geq 10^3$ sources in the X-ray band) and located with an accuracy of $\leq 1$ arcmin in the X-ray band and $\leq 2$ arcmin in the XUV band, respectively.

After completion of the sky survey which will take half a year, the instruments will be used in a pointing mode for detailed investigations of selected sources with respect to spatial structures, spectra and time variability. In this mode ROSAT will be available for guest observers. For the X-ray telescope three different detectors can be commanded into the focal plane: either one of two redundant position sensitive proportional counters (PSPC) providing coarse spatial (30") as well as simultaneous spectral resolution (E/ E 2) or a channel plate detector (HRI) with very good spatial resolution (7") but no spectral information at all. The XUV Wide Field Camera is equipped with two redundant channel plate detectors and thin film absorption filters are used for spectral discrimination. More details about the instrumentation and the scientific objectives can be found in the papers by Trumper, Phys. Scr. T7, 209 (1984) and Pye et al. in 'X-Ray Emission from Active Galactic Nuclei", eds. W. Brinkmann and J. Trumper, p. 261 (1984).

The project as a whole is now well in the hardware phase with the engineering models of the spacecraft, the telescope, the X-ray focal plane instrumentation and the Wide Field Camera being completed. The nominal environmental tests, i.e. vibration of the telescope, static load tests of the spacecraft structure, model survey tests of the complete spacecraft and the first integrated system tests have successfully been run. Quite a success was also obtained in the development areas: the PSPC could be built with an energy resolution of 40% at 1 keV maintaining the required spatial resolution and the X-ray mirror prototype system shows an angular resolution of 4 arcsec half energy width. Flight hardware is now being built and the project is on schedule which encourages us to see ROSAT being launched by the Space Shuttle at the end of 1987.

ASTRO-C: K. Koyama presented a progress report of ASTRO-C which will be launched in February 1987. Main objective is the study of time variability of galactic and extragalactic X-ray sources. The prime instrument is a set of large area proportional counters of total effective area about 5000 $cm^2$ which are being produced in collaboration with Leicester University and Rutherford-Appleton Laboratory. The spacecraft also carries an all sky monitor and a gamma ray burst monitor which is under collaboration with Los Alamos National Laboratory.

The ASTRO Observatory: The progress of this new shuttle-borne observatory for ultraviolet astronomy was reviewed by A. Davidsen. The ASTRO Observatory consists of three distinct instruments. The Hopkins Ultraviolet Telescope (HUT) is for probing the far and extreme ultraviolet designed and built by members of the Johns Hopkins University. HUT consists of a 90 cm f/2.0 mirror. The Ultraviolet Imaging Telescope developed at NASA's GSFC is for the deep, wide-field ultraviolet photography. UIT has a 38 cm diameter mirror of f/9 and a 40 arcmin field of view which covers the spectrum from 1200 to 3200 A. The Wisconsin Ultraviolet Photopolarimetry Experiment (WUPPE) is designed to measure the polarization of ultraviolet light from celestial objects. The instrument is capable of detecting both linear and circular polorization simultaneously, and thus well suited for the examination of intense magnetic fields in compact objects. The Wide Field Camera developed by NASA's MSFC is designed to photo-

https://doi.org/10.1017/S0251107X00026377 Published online by Cambridge University Press

graph comet Halley.

6. Planned Missions (1)

The SAX Mission (Italian X-ray Astronomy Satellite): The SAX Mission proposed to the Italian National Space Plan was described by G. Spada. The original proposal was submitted by a consortium of Italian institutes, with participation of Holland ESA. SAX has the objective of carrying out systematic and comprehensive observations of X-ray sources in the 0.1-200 keV energy region. The mission is for spectral and timing measurements on a variety of selected sources and for monitoring the sky in the 2-30 keV range for the investigation of long term variability and the study of the transients. Coaligned narrow field of view instruments are 4 Concentrator/Spectrometer, a High Pressure Gas Scintillation Proportional Counter and a Crystal Scintillator (Phoswich). The wide field of view instrument consists of three Wide Field Cameras. The nominal launch date is the end of 1989.

The Infrared Space Observatory (ISO): R. Bonnet described the ISO mission. It is an approved mission of the ESA Science Programme. It is a cryogenically cooled 60 cm Ritchey Cheretien Telescope equipped with a set of four focal plane instruments; a camera, a photometer, and a short and a long wavelength spectrometer. ISO will have a sensitivity $10^3$ to $10^4$ times larger than IRAS and will therefore be able to detect very weak sources. The main scientific aims of the mission are to study extragalactic astronomy, cosmology and star formation processes. The overall length of ISO is 5.2 m and it weighs 1800 kg; it will be on a 12 hour ecliptical orbit with an apogee of 39400 km.

The Solar Optical Telescope (SOT): This shuttle borne solar telescope was discussed by S. Jordan; it will be built under the management of the GSFC. It was reported that the telescope will have a 1.3 m diameter primary mirror with an on-axis Gregorian optical system which provides diffraction-limited viewing in the visible of 0.1 arcsecond or a resolution of 73 km on the sun. The coordinated instrument package consists of the photographic filtergraph, the tunable filtergraph and the spectrograph system. SOT will become operative in early 1990's.

SIGMA :
A written comment was contributed by Cezarsky on this French gamma ray imaging experiment on the board Soviet satellite GRANAT. The instrument consists of the NaI detector with the coded mask covering the energy range of 30 keV - 2 Mev. The instrument with a diameter of 1.2 m and a length of 3.5 m weighs 1000 kg. In the field of view of $7.3^o$ x $7.3^o$ the source positional accuracy is 1.5 arcmin. Expected launch date is December 1987.

7. and 8. Planned Missions (2)

XMM (European X-ray Telescope Mission)*: J. Bleeker. HESP: Japan's next solar maximum mission was presented by Y. Uchida. The mission is planned to be performed in collaboration of solar physicists in US and Japan. It will follow the collaborative efforts between SMM and HINOTORI during the last Solar maximum. The scientific instruments consist of a hard X-ray imager, soft X-ray mirror telescope, X-ray spectrometer, Bragg spectrometer, gamma-ray spectrometer, and a solar irradiance-meter. The hard X-ray imager covering 10-80 keV as a Fourier-synthesis type modulation collimator provides a spatial resolution of 8". The soft X-ray mirror telescope for 0.1-1 keV provides a 2.5" resolution. The launch date is expected to be mid 1991.

QUASAT (NASA-ESA Space VLBI): R. T. Schilizzi described that the idea of very-long-baseline radio interferometers with separations of elements larger than

https://doi.org/10.1017/S0251107X00026377 Published online by Cambridge University Press

the size of the Earth has led to the QUASAT concept of space VLBI. The early concepts for this joint ESA/NASA mission were discussed at a Workshop on QUASAT held in Vienna in June 1984 (ESA Document SP-213) and reviewed again at a Workshop held in Charlottesville in May 1985. The mission concept involves a free-flying satellite carrying a radio telescope in an elliptical orbit around the Earth in conjunction with the major ground-based VLBI networks in Europe, USA, USSR, and Australia. The perigee is 5700 km, the apogee 12500 km, and the inclination $63^{o}$. The angular resolution expected for QUASAT at its wavelengths of 1.35, 6 and 18 cm will be 90, 400 and 1200 micro arcsec respectively. The main goal of the QUASAT mission is to probe the nuclei of radiogalaxies and quasars more deeply and with greater detail than is possible with ground-based networks alone.

As study has shown that the overall mission, which is based on current VLBI and spacecraft engineering practices, is technically feasible. As far as the spacecraft is concerned the major new aspect is the deployable antenna. Antenna configurations have been studied in ESA and in NASA.

Discussion of the requirements for a potential multi-nation space VLBI mission involving QUASAT, the RADIOASTRON satellite of the USSR and a Japanese satellite is going on.

Indian X-ray and Gamma Ray Satellite Experiments: T. M. K. Marar reported on two scientific payloads which are planned and are under preparation to be flown on the Stretched Rohini Series of Satellites (SROSS). The first of these, SROSS-1, will carry a gamma ray burst payload to monitor gamma ray bursts in the energy range of 20-3000 keV. It will measure temporal variations with high time resolution. It will also measure temporal evolution of burst energy spectra searching for cyclotron lines and other features. The instrument consists of a main and a redundant scintillation detector.

An Indian X-ray astronomy satellite on the fourth SROSS mission during 1989-1990 is proposed for the study of temporal variability and spectral characteristics of X-ray sources jointly by scientists from TIFR and ISRO. The instrument consists of X-ray telescopes for pointed mode and scan mode observations. A secondary payload on the observatory is for the study of transient X-ray novae.

Chinese Space Programmes were presented in a poster by Ma Yugian.

LYMAN/FUSE (Far UV Spectroscopic Explorer), report by A. Boggess and M. G rewing.

The scientific importance of the 900-1200 Angstrom region follows from the concentration of atomic and ionic resonance lines in this region. These as well as the lines from molecular hydrogen are powerful diagnostic tools for studying the temperatures, densities, and abundances in hot, thin plasmas that exist in interstellar and intergalactic space, in the photospheres, chromospheres, and coronae of stars, in galactic nuclei, and within our own solar system.

A telescope with large collecting area, an efficient spectrograph (either of Rowland or of échelle type), and high quantum-yield detectors have to be combined : a grazing incidence telescope similar to ones used in x-ray astronomy is probably the best choice to achieve a large effective collecting area over the 900-1200 Angstrom range, and to maintain good efficiency throughout the entire EUV band, down to 100 Angstrom.

Studies of this project, which have so far implied scientists from ESA, NASA and Australia, are being presently actively pursued.

HORIZON 2000 : J.A.M. Bleeker.

The Horizon 2000 long term plan for European space science is based on four major elements, identified as cornerstones, with a time line to about 2007. These cornerstones represent the top priority in the domains of solar-system sciences, astronomy and astrophysics in Europe. The cornerstones include :

- A Solar Terrestrial Physics (STP) programme comprising a solar and heliospheric observatory and a four-probe space plasma mission.
- A mission to Primordial Bodies, this will most probably entail a comet-nucleus sample return.
- A High Throughput X- ray spectroscopy mission between 0.2-10 keV.
- A High Throughput heterodyne spectroscopy mission between 0.1-1 mm.

Apart from these major elements a number of smaller scale missions are realized in the same time frame like ULYSSES, the ESA part in HST, HIPPARCOS, ISO and about four more projects in this class. In addition space science payloads based on the EURECA-platform are envisaged.
Reference document ESA SP-1070.

*A EUROPEAN MISSION ON HIGH THROUGHPUT X-RAY SPECTROSCOPY : J.A.M. Bleeker

This mission is a cornerstone programme in the Horizon 2000 long term plan. The scientific objectives require a powerful imaging instrument with the highest possible collecting area to arrive at the photon statistics required for high quality spectral measurements and a large dynamic range in energy (wide band spectroscopy). The prime design drivers for this mission can be stated as :

- Energy band : 0.2-10 keV (bulk of the X-ray photons).
- Throughput : Optimized for the 2-8 keV band : $A_{eff} \geq 10^4$ cm$^2$ (2 keV), $5.10^3$ cm$^2$ (8 keV).
  Angular resolution : $\leq$ 30 arcsec half power width at 7 keV.
- Spectral resolution : a wide range of spectral resolving power $\lambda/\Delta\lambda$ = 10 → few $10^3$ is called for.
  Considering the emphasis of the mission objectives low resolution spectroscopy ($\lambda/\Delta\lambda$ = 100) should be ensured at full throughput.
- Time resolution : one millisecond for spectral variability studies.
- Time scale : technological development 1986-1992, hardware development 1992-1997, launch 1997/1998, operations 10 years minimum.

https://doi.org/10.1017/S0251107X00026377 Published online by Cambridge University Press