SCIENCE WITH XMM: THE FIRST XMM WORKSHOP

Welcome and Introduction

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It's my pleasure to welcome you all to ESTEC, the European Space Research and Technology Centre, and specifically to this First XMM Workshop on 'Science with XMM'.

I'm reminded of a similar meeting held in Amsterdam in June 1981, the 15th ESLAB symposium, with the title 'X-ray Astronomy' which was to set the scene, as we knew it at that time, and to introduce the EXOSAT mission to the scientific community. EXOSAT was to be launched in 1982 (actually delayed to 1983) and we were about to issue the first AO. Though EXOSAT had not yet been launched, this didn't stop us thinking far ahead and we invited Len Culhane to give a paper on X-ray astronomy in the future (1). He described X-80 - an ESA mission under study (not flown, but SAX bears more than a passing resemblance), AXAF (almost the same) and a 'free-flying' version of LAMAR (the Large Area Modular Array of Reflectors). This featured 24, 10 mirror, diamond-turned, Wolter 1 telescopes, with a total collecting area of ~1m^2 at 2keV, an angular resolution of <20" and a field-of-view of >1 sq deg.

In response to a 'call-for-ideas' issued by ESA, a group of scientists (some here today) a blue-covered proposal for an 'X-ray Multi-Mirror' Astronomy Mission in November 1982 (2). This featured 7 high energy telescopes, going out to 10keV with 30" HEW and 0.5m^2, and 20 low energy (LE) telescopes going to 5keV with 10" HEW and 1m^2. The mirror technologies encompassed foils, diamond turning and replication - this latter being used for the EXOSAT mirrors. Every conceivable form of back-end detectors was envisaged: PSCPs, GSCPs, MCPs, CCDs, together with crystal spectrometers, transmission and reflection gratings etc. A low-earth orbit with a Shuttle launch was envisaged.

In September 1983, ESA staff, together with some of the XMM proposers, produced an 'Assessment Study' (3) that scoped XMM to fit within the Ariane 4 envelope. This was accomplished by reducing the number of LE telescopes to 12 though the same area was offered. The mirror fabrication techniques had been narrowed down to foil and replication but the same panoply of back ends remained.

From October 1983 to July 1984 a 'Survey Committee' of European scientists developed the strategy behind the 'Horizon 2000', long term plan for ESA's Scientific Programme (4). The stimulus was to achieve a ~50% increase in the annual Science budget over the following five years or so. Central to this plan was the concept of four 'cornerstones' - large scale missions whose scientific objectives were preordained so as to allow the requisite technological, industrial and programmatic developments prior to their correctly timed implementation - together with a flexible element - so-called medium and small missions - selected in competition. In this plan, the second

cornerstone was to be a 'High Throughput X-ray Spectroscopy' mission - XMM by another name. The Survey Committee said:

> "A High Throughput X-Ray Mission for Spectroscopic Studies between 0.1-20Kev
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> The observatory, comprising multiple telescopes, provides the required sensitivity to perform detailed spectral diagnostics of many classes of objects with low (surface) brightness. This is particularly important for studying the evolution of the large and small-scale structures of the universe. It further allows simultaneous observations of several aspects of astronomical targets which considerably enhance its unambiguous physical interpretation. It is an ideal complement to the AXAF (NASA) mission, which pursues ultimate imaging capabilities with primary emphasis on deep surveys."

While it is known today that the XMM launch date has been moved from August 1999 to January 2000, it might be noted that the example time-line in the Horizon 2000 plan shows the second cornerstone to be launched in early 2000!

A scientific meeting was held in Lynby (5) in 1985 to give the scientific community the opportunity to express its view on the science of XMM and to identify the drivers in the payload development. Serious work on XMM started in 1985 with the establishment of a number of XMM working groups and the conduct of a 'Phase A' industrial study with Dornier Systems.

In February 1987, the XMM Telescope Working group produced its report (6) which concluded that replication technology was the path to follow to provide, with a cluster of 7 telescopes, a collecting area of ~1m^2 at low energies and an angular resolution of <30" HEW.

The overall configuration developed by March 1987, looking very much like XMM as we know it today. Following the experience with EXOSAT which, inter alia, demonstrated the value of a highly eccentric orbit for long, uninterrupted observations of time-variable, X-ray sources, XMM was to be placed in a 48 hr period orbit using the Ariane 4 launcher. The payload now featured only 4 X-ray mirror systems. However a very important feature had been added - the Optical Monitor instrument -to allow simultaneous observation of the (majority of the) field of the X-ray telescopes in the UV and visible bands, again highlighting a lesson learned from the operation and exploitation of EXOSAT.

In November 1987, the XMM Instrument Working group produced its report (7) which, constrained by the 4 mirror systems, concluded that each system should be equipped with a CCD camera and a GSPC, complimented with 2 reflection gratings and 2 Bragg crystal spectrometers.

In March 1988, the XMM Mission Science report was issued (8). Within the constraints given by an Ariane 4 and now a 24hr period orbit, the 'model' payload comprised 3 mirror modules which, using replication technology, was specified to yield a total of 6000cm^2 at 2keV and 3000cm^2 at 7keV with a resolution of <30" HEW. Each mirror module was to be equipped with a CCD camera and two were to be equipped with reflection gratings. The X-ray telescopes were to be complimented by the Optical Monitor. ESA's Scientific Programme Committee (SPC) approved the mission in this form in June 1998 and the AO for the instruments was released the same month.

One year later the SPC approved the selection of the EPIC axial instruments (PI Nanni Bignami, succeeded by Martin Turner in 1997), the RGS instruments (PI Bert Brinkman) and the Optical Monitor (PI Keith Mason). So the long, hard haul of the hardware development programme began.

To complete the XMM picture, the Survey Science Centre (PI Mike Watson) was selected by ESA in 1995. The tasks of the SSC are to develop the pipeline processing for the XMM science data and to marry the serendipitous fields of the X-ray cameras and the Optical Monitor and to initiate ground- based follow up.

We are now in sight of launch, now with the Ariane 5 vehicle into a 48 hr eccentric orbit, with the last elements of the XMM payload due for delivery shortly, after some last minute difficulties with the EPIC and OM instruments. And so we come to this meeting. As you will hear, the mirror development programme has been rather successful, and so some of our community, indeed some of the same persons, just like in the time of EXOSAT were looking ahead to XMM, are looking beyond XMM to the next generation X-ray astronomy mission, e.g. XEUS, however we will not get into XEUS here.

The objective of this First XMM Workshop on 'Science with XMM' is to inform the scientific community about the capabilities of the XMM mission, particularly in the context of the first AO for guest observations which will be released shortly, and to highlight the scientific potential of XMM for a wide range of astrophysical investigations. I wish you an informative and pleasurable three days.

References:

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