On the Athena ground segment

Michael Watson[1], Natalie Webb[2]
1) University of Leicester (United Kingdom); 2) IRAP (France)

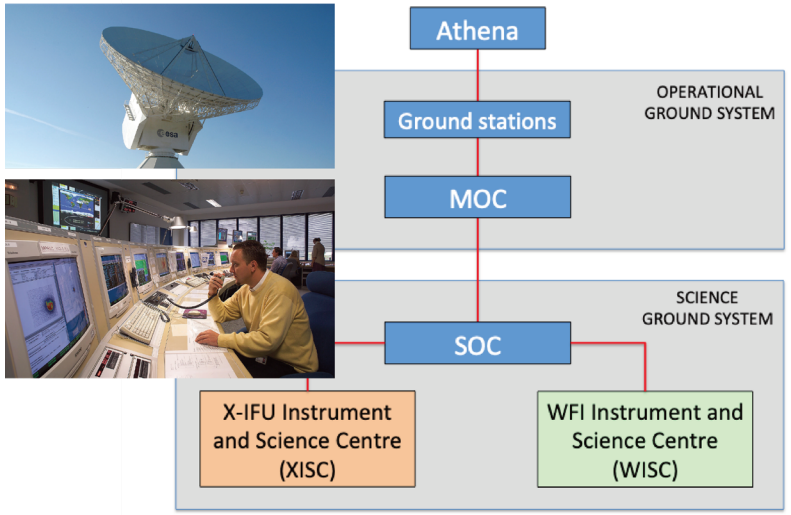
The term "ground segment" is used in space missions like *Athena* to describe all the elements needed to operate and monitor the spacecraft and instruments, downlink the data to the ground, to plan the observations and carry out data processing of the observational data. An effective ground segment is an essential part of any project's success. In the case of *Athena*, its operations present no unusual requirements and can be met with a standard ESA ground segment approach, but the software needed for the science data processing and analysis needs to match the sophistication of the advanced technology on which *Athena*'s instruments are based.

The *Athena* Ground Segment illustrated schematically in the figure, follows the successful models adopted for XMM-*Newton* and *Herschel*. It consists of the ESA ground station network, a Mission Operation Centre (MOC), a Science Operations Centre (SOC), and two Instrument Science Centres (ISCs), one each for *Athena*'s two instruments, the Wide Field Imager (WFI) and the X-ray Integral Field Unit (X-IFU). The MOC and the SOC will be provided by ESA, whilst the two ISCs will be funded by the ESA member states. The MOC is responsible for all aspects of the command, control and maintenance of the spacecraft, whilst the SOC will be the interface with the scientific user community (e.g., mission planning, calls for observing proposals, science archive, user support) and will be responsible for the overall coordination of the *Athena* Science Ground Segment (ASGS).

The two ISCs will be responsible for calibration and performance monitoring of their respective instruments and more generally for ensuring their successful operation. But equally importantly they will be responsible for the science analysis software required to maximize the potential of *Athena*, as well as the processing of all *Athena* observations to produce a standard set of data products. Parts of the ASGS common to both instruments (e.g., data access libraries) will be developed jointly by the SOC and the ISCs.

The ISCs have already been established. The overall concept for both is that their activities will be undertaken by a distributed collaboration of European institutes, together with NASA-funded contributions. For the WFI, its wide field of view coupled with *Athena*'s high sensitivity means that some of the challenges for the WFI science software include optimizing the source detection software and developing sophisticated techniques for accurately determining the image background. For the X-IFU, its very high imaging spectral resolution will provide a wealth of diagnostics on gas bulk motions, chemical abundances, and spatial distribution, along with a physical characterisation of the different targets. To achieve this, our understanding of the many atomic processes behind the spectral features will need to be improved and innovative software to exploit the abundance of new information will need to be developed.

In addition to this SGS our international partners (JAXA, NASA) may host a local facility to support their national community.



Schematic of the Athena Ground Segment (Credit: M. Watson & N. Webb). Top photo: ESA Cebreros antenna (Credit: ESA). Bottom photo: XMM-Newton Science Operation Centre (SOC) located at the European Space Astronomy Centre (ESAC) (Credit: ESA).

Athena X-ray Observatory @AthenaXobs ACO@ifca.unican.es www.the-athena-x-ray-observatory.eu