THE ATHENA WIDE FIELD IMAGER

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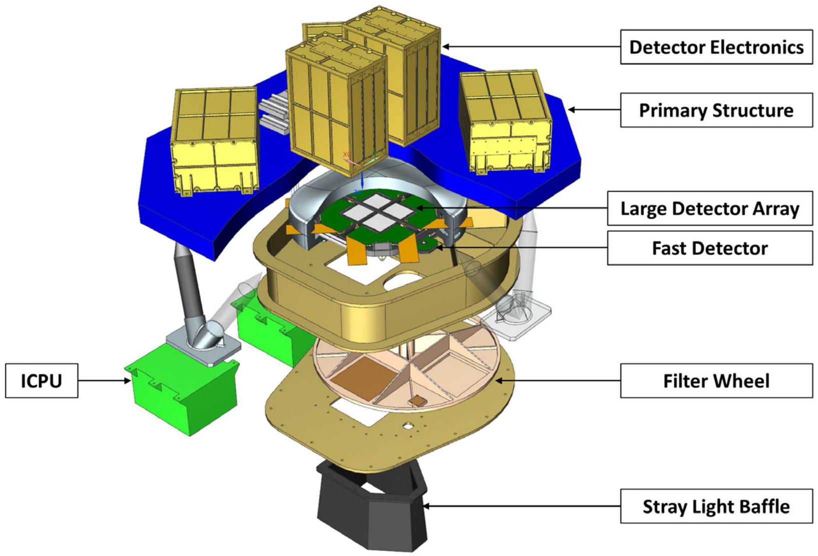
The Wide Field Imager (WFI) will provide two defining capabilities to Athena – sensitive wide-field imaging spectroscopy and excellent high-count rate performance. It will do so with the use of two separate detectors, the Large Detector Array (LDA) optimized for its field of view (40′×40′) with a 100 fold survey speed increase compared to existing X-ray missions, and the Fast Detector (FD) designed for high throughput and low pile-up for point sources as bright as the Crab nebula (a nearby supernova remnant commonly used as a bright flux reference in X-ray Astronomy).

Both detectors will utilize the same sensor technology of Depleted P-channel Field-Effect Transistors (DEPFET), novel in X-ray Astronomy. They will be sensitive at 0.2-15keV with a state of the art spectral resolution of <170eV HEW at 7keV, even at the end of the mission. The physical area onto which the field of view of the LDA will be projected is approx. 14cm×14cm, which significantly exceeds the currently available semiconductor wafer size. Thus, the LDA will be composed of a 2×2 mosaic of identical 512×512 pixel matrices, encompassing a total of 1 Megapixels. Each of the 450μm thick and 130μm × 130μm wide pixels will cover ~2.2′′ on the sky, adequately sampling the 5′′ HEW mirror point spread function. This will enable a positional accuracy for point sources of <1′′, which is required, e.g., for identifying the faint optical/NIR counterparts to high-redshift Active Galactic Nuclei.



Drawing of the WFI with its main subsystems (ICPU is Instrument Control and Power Unit). Credit: WFI team

The FD will have 64×64 pixels and will be operated with a time resolution of 80μs, corresponding to a frame rate of 12.5kHz. It will achieve the demanding high-count rate performance by being placed ~35mm out of focus, thus spreading the X-ray photons as homogeneously as possible over the entire sensitive area. While this 'trick' will discard most of the imaging information, it will optimize pile-up (two photons striking the same pixel at practically the same time, tricking the detector into counting them as a single photon at higher energy) and throughput and thus will enable the accurate spectral reconstruction required to measure, e.g., the spins of black holes and the accretion geometries in Galactic X-ray binaries.

To mitigate radiation damage, caused by proton hits, an Aluminum proton shield surrounds the detectors. A second layer of protection will be composed of multiple layers of materials with decreasing atomic number. This so-called graded-Z shield will absorb X-ray fluorescence photons generated in the camera that would otherwise contribute to the instrument background. Together with ultra-thin coating of the sensor and particle identification by the detector itself, the particle-induced background shall be minimized to study e.g., the low-surface brightness regions in the outskirts of galaxy clusters.

The two detector systems, with their control and readout electronics, form the heart of the WFI. However, their operation would not be possible without additional critical components: the electronics for signal processing and filtering, and for control and power distribution, a filter wheel and baffle, a passive thermal system that ensures that the detectors operate at a stable temperature of approx. -80°C, and of course, a mechanical structure that holds everything together.

These capabilities, when placed on the focal plane of Athena's superb mirror together with the X-IFU (watch this space), will revolutionize our understanding of the Hot and Energetic Universe.