AXSIO: The Advanced X-ray Spectroscopic Imaging Observatory

Jay Bookbinder (SA), Robert Petre (GSFC), Andrew Ptak (GSFC), Randall Smith (SAO) and the AXSIO team

The Advanced X-ray Spectroscopic Imaging Observatory (AXSIO) will address fundamental and timely questions in astrophysics: *What happens close to a black hole? How did supermassive black holes grow? How does large scale structure form? What is the connection between these processes?*

To address these science questions, AXSIO will trace orbits close to the event horizon of black holes, measure black hole spin for several hundred active galactic nuclei (AGN), characterize outflows and the environment of AGN during their peak activity, observe supermassive black holes out to redshift z=6, map bulk motions and turbulence in galaxy clusters, find the missing baryons in the cosmic web using background quasars, and observe the cosmic feedback where black holes and supernovae inject energy on galactic and intergalactic scales.

AXSIO represents a simplified version of the International X-ray Observatory (IXO), developed in direct response to the Astro2010 recommendations. IXO's key scientific objectives are preserved at an overall mission cost < $2B. Key technical changes include a focal plane incorporating only the two instruments considered critical by Astro2010, and angular resolution at the recommended 10 arcsec (while preserving a goal of 5 arcsec).

Despite the simplifications from IXO, AXSIO will nonetheless provide six times more collecting area at 1 keV than any previous X-ray observatory, combined with spectrometers that will deliver a 30-fold increase in effective area for high-resolution spectroscopy, microsecond spectroscopic timing, and high count rate capability. The improvement of AXSIO relative to current X-ray missions is equivalent to a transition from the 200 inch Palomar telescope to a 12 m telescope while at the same time shifting from spectral band imaging to an integral field spectrograph.

The mission will employ a 1.7 m diameter, 10 m focal length segmented glass mirror with a microcalorimeter array for high-resolution spectroscopic imaging with near-constant energy resolution across the 0.3-10 keV band. The calorimeter will incorporate different sized pixels: an inner array of small pixels for high count rates and the highest possible energy resolution for point sources, and an outer array of larger pixels that extends the field of view for diffuse sources. High-resolution spectroscopy of point sources in the 0.2-1.0 keV band will be achieved with a high-efficiency grating spectrometer.

AXSIO will be available to the entire astronomical community. Previous experience assures us that unexpected discoveries will abound, and AXSIO will contribute to the understanding of new phenomena, as they are uncovered. The high technical readiness of the key components means that AXSIO could be started later this decade for launch in the early 2020s. We will also discuss enhancements of the technology being developed for AXSIO that could lead to an even more powerful mission subsequent to AXSIO in the late 2020s.

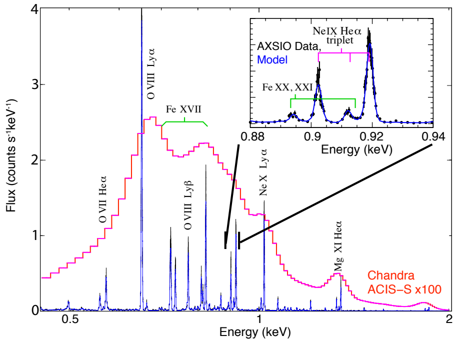

Figure 1: *The AXSIO effective area will be almost an order of magnitude greater than current imaging X-ray missions. Coupling this with an increase in spectral resolving power up to two orders of magnitude higher relative to previous capabilities will open a vast discovery space for high-energy phenomena. AXSIO high-resolution X-ray spectra (blue) show the metal-enriched hot gas outflowing from a starburst galaxy, a part of the feedback process unresolvable with current X-ray CCD data (magenta).*