Science Review: AXSIO Reviewed by CST and Support Team

Overview/General Notes:

AXSIO has two instruments: an imaging calorimeter array and a retractable grating (with CCDs). X-rays are focused by slumped glass optics. The imager has angular resolution of 10″ (compared to 5″ for IXO), reduced collecting area (0.9 m^2 at 1.25 keV; 0.2m^2 at 6 keV), and a small field of view (4′ x 4′ outer array; 0.6′ x 0.6′ inner array). The imager samples 0.5-10 keV, and the spectral resolution is < 2 eV. The grating spectrometer maintains resolving power ~ 3000 over 0.3-1.0 keV, with 1000 cm^2 effective area.

Compared to IXO, there is no wide-field survey instrument, no capability in hard X-rays, and no polarimetry. A modification to the calorimeter provides timing capability (0.1 ms time resolution; 15,000 c/s with deadtime < 10%). This mission has already gone through an MDL study and the cost is estimated at $1.9B.

1) What happens close to a Black Hole?

Concept	Measurement
Strong gravity predicts effects on X-ray spectra	Time resolved high resolution spectroscopy of the relativistically-broadened Fe K features

With the calorimeter + large area combination that is roughly similar to IXO, AXSIO can track hot spots in accretion disks with the Fe line, as planned for IXO.

2) When and how did super massive Black Holes grow?

Concept	Measurement
Distribution of spins determines whether black holes grow primarily via accretion or mergers.	SMBH spin survey, high S/N spectroscopic measurements of Fe K line in multiple AGN

Figure 3 shows that different BH evolution models predict different distributions of spins. The claim is that AXSIO can follow up 60 bright AGN in the Swift BAT catalog with spin measurements accurate to <10%. Longer observations will make up for the lack of 30 keV response that is important to constraining the shape of the continuum and thus the shape of the Fe K line.   It is unclear how much exposure time is needed to measure spins to <10% in these 60 bright AGN, or to measure the spins in the 100 stellar mass black holes (or how are these targets identified).

Since AXSIO lacks a wide-field instrument, there will be no survey of distant SMBH as has been planned for IXO. However, it will be able to do targeted follow-up of higher-z sources found by other missions, which will enable study of very luminous objects.

3) How does large-scale structure evolve?

Concept	*Measurement*
Find and characterize the missing baryons in the IGM	*High resolution absorption line spectroscopy of the WHIM over many lines of sight using AGN as illumination sources.*

Concept	*Measurement*
Detect the growth of cosmic structure and the evolution of the elements	*Measure the mass and composition of a survey of clusters of galaxies at redshift < 2*

The gratings and calorimeter are again largely similar to that proposed for IXO and here the two main topics are measuring IGM absorption lines and studies of galaxy clusters.

4) What is the connection between supermassive black hole formation and evolution of large-scale structure (i.e., cosmic feedback)?

Concept	*Measurement*
Resolve cluster bubbles and cavities and AGN jets where energy from AGN is deposited	*Measure the metallicity and velocity structure of hot gas in galaxies and clusters*

There will be studies of AGN bubbles and jets in clusters to measure the impact of AGN on the intracluster medium.

5) How does matter behave at very high density?

Concept	*Measurement*
Neutron star Equation of State can be mapped by measuring M,R for a range of NS	*Measure redshift, pressure broadening in Fe absorption lines during X-ray bursts to determine M and/or R*

Concept	Measurement
Neutron star Equation of State can be mapped by measuring R, M for a range of NS	*timing studies, not explained in detail*

There are four types of NS measurements, basically similar to the IXO science case. It is unclear how AXSIO's reduced timing capability affects the four techniques for NS EOS determinations.