Xenia Science Evaluation

Reviewed by CST and Support Team

Overview

Xenia a large ($1000M) mission that plans on three independent telescope/instruments. CRIS is a calorimeter with 1-3 eV resolution over 0.1-3 keV, a 1x1 deg. FOV, ~ 3' PSF and ~ 1000 cm^2 effective area. HARI is a wide-field X-ray telescope with 10-15" resolution over a 1.5 deg CCD or CMOS FOV. The effective area will be up to 1000 cm^2 at 1 keV and 100 cm^2 at 6 keV. TED is a pair of coded-mask 5-200 keV CZT detectors with a ~ 800 cm^2 effective area (20-50 keV). Count rates up to 10s of kcounts/s can be handled albeit with low timing resolution (on order of 0.1-1 s). Xenia would be launched into a low-inclination LEO orbit. The emphasis of the RFI is on using GRBs as background sources for studying primordial ISM and WHIM, and cluster science with the calorimeter and wide-field X-ray detectors. The WHIM and cluster science is a good match to IXO science goals 3 and 4. Calorimeter + CCD science for AGN and X-ray binaries was not discussed. With foreign contributions Xenia would be under $1B but it was classified as large mission by science support team since the total mission cost would be > $1B.

What happens close to a Black Hole?

Concept	*Measurement*
Strong gravity predicts effects on X-ray spectra	*in principle yes with CRIS in pointed observations, but not discussed*

Not discussed but could have been since calorimeter plus CCDs would do well with bright AGN and black hole candidates. However CRIS only goes to 2 keV and the effective area for HARI is relatively low at 6 keV, so Astro-H may do better.

When and how did super massive Black Holes grow?

Concept	*Measurement*
Distribution of spins determines whether black holes grow primarily via accretion or mergers.	*in principle yes with CCD and calorimeter in pointed observations, but not discussed*

Concept	*Measurement*
Wide field survey of obscured AGN	*Also not discussed but in principle will be done with wide-field imager but not as well as eRosita*

This topic is also not discussed directly. HARI will be surveying AGN in addition to clusters but with less effective area and a significantly worse PSF than eRosita.

Spin measurements are not discussed but some of this science might be done with CRIS and HARI, although given the soft response of CRIS and low effective area of HARI at 6 keV Astro-H will do better.

How does large-scale structure evolve?

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

Concept	*Measurement*
Detect the growth of cosmic structure and the evolution of the elements	*Measure the mass and composition of 500 clusters at redshift < 2, will help find clusters with wide-field imager*

This science is emphasized and implemented via observing the WHIM in both emission and absorption with CRIS. Also surveying clusters with HARI and measuring the X-ray properties of clusters and groups out to their virial radius with HARI will contribute here. However low surface brightness studies of the outskirts of clusters will be difficult since AGN contamination may be significant. It will be hard to eliminate the cluster core for temperature measurements with low spatial resolution. Cluster studies beyond z of 1 will be difficult given the angular resolution of HARI.

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.*

Concept	*Measurement*
Turbulence and metal abundances trace interaction of agn/wind with cluster, even with 4 arcmin PSF	*Imaging spec. of clusters and groups out to virial radius*

Large bubbles/cavities could be observed with calorimeter observations of velocities in clusters as with IXO but with worse PSF (requirement: 4'/ goal 2.5' HPD) and lower effective area (requirement/goal at 0.6 keV 1000/600 cm^2). The low spatial resolution may be particularly problematic for this science since cavities will not be resolved and hence be diluted in the calorimeter spectra.

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	*In principle yes (mainly with broad-band spectroscopy) but not discussed*

Not discussed but could have been for all three detectors, albeit not with high time resolution measurements that IXO would have done.