EREXS Science Evaluation

Reviewed by CST and Support Team

Overview

EREXS is a medium mission (cost ~ $500M) that would be launched into a 15 deg. Low earth orbit. It has two instruments, a coded-mask CZT 1.8 m^2 large-area detector (HXI) with both wide (80 deg. X 50 deg.) and "narrow" (7 deg. X 7 deg.) arrays and an 0.8 m IR telescope (IRT; 0.3-2.2 μm) with imaging and modest spectroscopic (R=30-1000) capabilities. The HXI energy range would be 5-300 keV. High-z GRB would be detected as tracers of early BH formation and used as background light sources to study the primordial ISM with the IRT. Nearby transients would include shock break-out SNe and tidal disruption events, the latter of which would trace the local SMBH poplution. The HXI would be performing a hard X-ray survey ala Swift and INTEGRAL but at higher sensitivity, which would give an obscured AGN census. The estimated cost would be in the range $400-900M.

What happens close to a Black Hole?

Not discussed. X-ray reflection may be doable but not discussed and NuSTAR will likely observe the best canidates for this science with better signal/noise.

When and how did super massive Black Holes grow?

Concept	*Measurement*
Wide-field survey of AGN	*Detect obscured AGN and blazars*

Concept	*Measurement*
Primordial BH creation and dormant SMBH census	*Detect primoridial black hole (z>10) creation as GRBs, tidal disruptions survey quiescent nearby SMBH*

EREXS would measure the creation of earliest black holes (those resulting in high-z GRBs) and survey obscured AGN and blazars via hard X-ray (E>5 keV) detections (and 20" localization for identifying counterparts). EREXS will also detect tidal disruptions in quiescent nearby supermassive black holes in galactic nuclei which would be a constraint on SMBH evolution.

With only CZT detectors (and hence ~ 1 keV spectral resolution) AGN Fe-K studies and spin measurements are not feasible.

How does large scale structure evolve?

Concept	*Measurement*
Study primoridal star formation and ISM	*Use GRBs as tracers of star formation at high-z and as bgd. light sources to study high-z ISM in absorption with IR telescope*

EREXS would measure primordial ISM through absorption line studies of high-z GRBs and high-z star-formation with GRBs as a tracer. It has no high-resolution X-ray spectral capability so WHIM measurements are not possible. The detection of clusters or measurements of cluster physics is not possible.

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

Concept	*Measurement*
Study growth of BHs over cosmic time scales which coupled with bulge masses checks feedback models	*Detect SMBH at z=10 -> 0, get masses of SMBH and bulge masses from hard X-ray and IR observations(?)*

This is claimed to be answered in that surveying for obscured AGN and quiescent SMBHs (via tidal disruption) independently measures the SMBH M-sigma relation but it is not clear how well masses are determined. The RFI response also refers to SXI data which is not an instrument on EREXS. The RFI response focuses on SMBH feedback on Galactic rather than cosmic (cluster) scales. However, this can be considered in the light of the feedback science of IXO, measuring the end result of feeback rather than directly probing outflow velocities in AGN and starburst-driven outflows. The direct detection of AGN feedback in clusters is not possible here.

How does matter behave at very high density?

Concept	*Measurement*
Detect merging of NS-NS and NS-BH binaries	*Wide-area hard X-ray transient survey detecting short GRBs*

EREXS would detect short GRBs which may be neutron star – neutron star or neutron star – black hole mergers and hence their study involves the physics of very high density matter. It does not have a high-speed timing capability to study the neutron star equation of state.