Snowmass2021 - Letter of Interest

Opportunities for the Snowmass Community in High Energy Astrophysics

Thematic Areas:

■ (CF6) Dark Energy and Cosmic Acceleration: Complementarity of Probes and New Facilities
■ (IF1) Quantum Sensors
■ (IF7) Electronics/ASICs

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Outstanding opportunities exist for the application of detector and readout technologies being developed within the Snowmass community to the field of high energy astrophysics. For example, the flagship Lynx X-ray Observatory concept, currently under consideration by the Astro 2020 National Academies Decadal Survey on Astronomy and Astrophysics, is baselined to carry a large ($\sim 10^5$ pixel) TES microcalorimeter array providing non-dispersive, high-spectral resolution X-ray imaging; here the detector and readout technologies hold strong synergies with those being developed for CMB-S4. The Lynx Observatory will also carry fast, low-noise, next generation CCD-like detectors, serving both a wide field High Definition X-ray Imager and powerful grating spectrometers; here the synergies extend to technologies being developed for X-ray science with instruments such the upgraded Linac Coherent Light Source. The science of Lynx is compelling and highly complementary to DOE projects such as LSST, CMB-S4 and future, planned spectroscopic instruments. For example, Lynx will provide unparalleled measurements of: black hole growth reaching back to the epoch of cosmic dawn (providing powerful synergies with new spectroscopic surveys); the physics of neutron stars (extending a new bridge to nuclear physics); the evolution of the largest cosmic structures (providing powerful synergies with LSST and CMB-S4); and, perhaps most importantly, precise, quantitative measurements of the baryonic astrophysics that will otherwise systematically limit all future studies of dark energy with galaxy surveys. Beyond Lynx, a broad range of smaller high energy astrophysics satellite missions are planned, extending into the arenas of, e.g., fast timing science, gravitational wave transient follow-up, X-ray polarization measurements, and hard X-ray and gamma-ray astronomy. These missions will present further synergistic opportunities, for example the use of DOE nuclear detector technology for AMEGO (All-sky Medium Energy Gamma-ray Observatory), or recent developments of fast time resolving X-ray detectors for LCLS, APS and NSLS-II for the STROBE-X mission (X-ray Timing and Spectroscopy on Dynamical Timescales from Microseconds to Years), as well as potential applications of direct dark matter detection technologies, including liquid noble gas detectors, to gamma ray science.

The purpose of this LOI is to encourage the Snowmass community to consider broadly the opportunities for collaborative engagement with NASA and other agencies in future satellite missions, especially where our community brings unique technological strengths and where the scientific scope of the missions is of clear interest to us. The Fermi satellite serves as an example of how successful such collaborations can be.

References: (hyperlinks welcome)

Lynx Observatory science and technology overview: https://www.lynxobservatory.com/
Lynx technology roadmaps: https://www.lynxobservatory.com/blog/roadmaps
Astro2020 Activities, Projects, and State of the Profession white papers: https://aasjournals.github.io/aas-obits-mirror/astro2020-apc-index.html
AMEGO mission: https://asd.gsfc.nasa.gov/amego/files/AMEGO_Decadal_RFI.pdf
STROBE-X mission concept: https://113qx216in8z1kdeyi404hgf-wpengine.netdna-ssl.com/wp-content/uploads/2019/09/231_ray.pdf

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