Science Review: SuperMon & Black Hole Tracker

Reviewed by CST and Support Team

Overview:

The SuperMon and Black Hole Tracker mission concept consists of 4 spacecraft in LEO at a total cost of ~ $500M. The SuperMon would be 3 identical micro-satellites to provide nearly all-sky coverage to search for X-ray transient events and to provide uninterrupted coverage of a source exhibiting interesting behavior. The Black Hole Tracker would be a medium-sized satellite (although a weight of 2000+ kg might be in the "large" class) that would employ the same detector technology as SuperMon essentially scaled up to provide more collecting area. The RFI states that "Low Energy Proportional Counters" would be used as the sky monitors in the 2-10 keV range with an area of ~1000 cm^2, and a localization accuracy of 0.5 degrees. The main detector would be the so-called "semiwich" instrument that would consist of a stack of a He-filled proportional counter, a Si detector, and a CdZnTe detector. The semiwich instrument would have a claimed area of ~400 cm^2, response over the 2-60 keV bandpass, and a polarization sensitivity of 1% MDP for a 100 mCrab source in 10^5 s. The mission would detect and localize new GRBs and XRFs, and could study any bright X-ray transient or variable source. The satellites would be designed to repoint quickly to a new transient of interest.

The RFI response states that this mission would address IXO science objectives #1, #2, and #5 but not #3 and #4. However, little detail is provided on the measurements that such a mission could make. The RFI response states that the mission will detect 300 GRBs and 150 XRFs and localize 150 GRBs and 75 XRFs. The RFI response states that the mission will provide spectra and variability data on ~100 X-ray sources on a continuous basis.

What happens close to a Black Hole?

Concept	Measurement
Strong gravity predicts effects on X-ray spectra	Joint spectral, timing & polarization measurement of stellar mass and supermassive black holes.

BHT has the ability to acquire spectra of bright X-ray sources with high time resolution in the 2-60 keV band; however, it lacks high spectral resolution. The RFI response states the mission can track Galactic BHs, collect spectra and timing information from ~100 X-ray sources, and track dozens of AGNs to identify QPOs, but it does not state how bright these sources have to be if BHT is to acquire data of a given quality, nor does it provide any simulations or estimates of the spectral and timing data.

When and how did super massive Black Holes grow?

Concept	Measurement
Distribution of spins determines whether black holes grow primarily via accretion or mergers.	Measure the spin and accretion rate of bright AGNs although feasibility is unclear

The RFI response states that the mission can measure the spin and accretion rate of bright AGNs but it does not specify how bright the AGNs need to be to achieve a result with a given precision nor does it state for how many AGNs such measurements would be possible.

How does large scale structure evolve?

SuperMon and BHT have essentially no capability to address this science objective.

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

SuperMon and BHT have no capability to address this science objective.

How does matter behave at very high density?

Measure the equation of state of neutron stars through (i.) spectroscopy and (ii.) timing	Spectroscopy, timing, & polarization of neutron stars.

The mission has capability for this science objective but little detail is provided in the RFI on the exact measurements that the mission could make.