Contribution ID: **36** Type: **not specified**

Bridging the microhertz gap with asteroids: opportunities and challenges for gravitational wave detection

Friday, 27 August 2021 23:15 (20 minutes)

The science case for a broad program of gravitational wave (GW) detection across all frequency bands is exceptionally strong. At present, there is a dearth of coverage by existing and proposed searches in the GW frequency band lying between the peak sensitivities of PTAs and LISA, roughly 0.1-100 microhertz. In this talk, I will outline a conceptual mission proposal to access this band. I will demonstrate that a few carefully chosen asteroids which orbit in the inner Solar System can act as excellent naturally occurring gravitational test masses despite the environmental noise sources. As such, a GW detector can be constructed by ranging between these asteroids using optical or radio links. At low frequencies, I will discuss how gravity gradient noise arising from the combined motion of the other $\sim 10^6$ asteroids in the inner Solar System sharply cuts off the sensitivity of this proposal. Sensitivity in the middle of this band is mostly limited by various solar perturbations to the asteroid test masses, while the high-frequency sensitivity is limited by noise in the ranging link. The projected strain-sensitivity curve that I will present indicates significant potential reach in this frequency band for a mission of this type.

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Session Classification: Gravitational Waves as Probes for New Physics

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