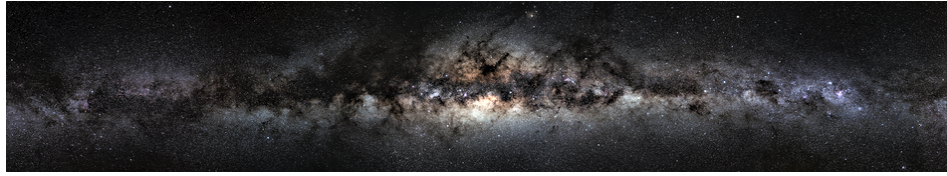


Dark Sectors of Astroparticle Physics (AstroDark-2021): Axions, Neutrinos, Black Holes and Gravitational Waves



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Asteroid Tracking Array and Space Quantum Technology for Fundamental Physics

Tuesday, 7 December 2021 11:38 (18 minutes)

We study for the first time the possibility of probing long-range fifth forces utilizing asteroid astrometric data, via the fifth force-induced orbital precession. We examine nine Near-Earth Object (NEO) asteroids whose orbital trajectories are accurately determined via optical and radar astrometry. Focusing on a Yukawa-type potential mediated by a new gauge field (dark photon) or a baryon-coupled scalar, we estimate the sensitivity reach for the fifth-force coupling strength and mediator mass in the mass range $m \simeq 10^{-21} - 10^{-15}$ eV. Our estimated sensitivity is comparable to leading limits from torsion balance experiments, potentially exceeding these in a specific mass range. The fifth force-induced precession increases with the orbital semi-major axis in the small m limit, motivating the study of objects further away from the Sun. We discuss future exciting prospects for extending our study to more than a million asteroids (including NEOs, main-belt asteroids, Hildas, and Jupiter Trojans), as well as trans-Neptunian objects and exoplanets. Our work can also be applied to the studies of dark matter and gravitational waves. The new development of NASA/NIST proposals of Quantum technologies in Space could bring drastic improvements to our studies, which I will discuss briefly near the end of the talk. This talk is mainly based on <https://arxiv.org/abs/2107.04038>.

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