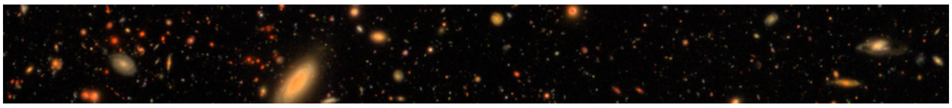

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Asteroid Tracking Array and Space Quantum Technology for Fundamental Physics

Wednesday, 29 September 2021 12:10 (15 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 $m \simeq 10^{-21} - 10^{-15}\,\mathrm{eV}$. Our estimated sensitivity is comparable to leading limits from torsion balance experiments, potentially exceeding these in a specific mass range. The fifth forced-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.

Presenter: TSAI, Yu-Dai

Session Classification: Wednesday AM