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OPERA: Novel Opportunistic Missions for NEO Exploration

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ABSTRACT

Current asteroid exploration mission campaigns take years to plan and similar periods of flight time to execute project objectives. The energy requirements are great and gravity assist is used to make up for C3 deficits. Asteroid sample return missions take even longer. All of these mission objectives and operations involved add to the complexity of payloads on such spacecraft. Dedicated heavy lift launchers like the SLS and the Starship may offer pathways in the near future for quick high energy trajectories, but mission resource tradeoffs could make them prohibitive.

Many cometary fragments, asteroids and bolides and ranging in size from the large to the very small make frequent close by approaches to Earth. Our observation systems are getting better at tracking objects as they appear close to Earth.

NEO surveys and models are continuing to refine bolide trajectories all the way to surface impact. And recent observatories, including those by amateur astronomers, continue to refine the ability to detect and track NEOs. Short notice detection of bolides on terminal trajectory are becoming possible and even the accurate prediction impact locations are being refined and conclusively verified post-impact.

Are there innovative options opening up now that allow for quicker asteroid reconnaissance missions?

OPERA is a novel preliminary concept proposal to use existing space assets, augmented with adequate power, propulsion and communications modules that are becoming available today, to do opportunistic flyby observation of such NEOs as they appear at close range to Earth. The OPERA concept proposes to image and capture as much data by conducting swift flybys as target bodies flyby in close range of Earth, drastically cutting short the time to intercept them.

Several satellites in various Earth orbits, both decommissioned and operational, have payloads that can be tailored for such swift flyby missions. If implemented creatively, OPERA strategy can provide NEO data at a fraction of current asteroid mission budgets.

Preliminary concept of the OPERA opportunistic asteroid exploration strategy and system architecture elements are presented for further discussion