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The Near-Earth Object Camera: A Planetary Defense Mission

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The Near-Earth Object Camera (NEOCam) is a proposed NASA mission that is designed to make significant, rapid progress in the discovery of near-Earth objects (NEOs), asteroids and comets that come close to the Earth's orbit. NEOCam's objectives are to find, track, and characterize NEOs in an effort to achieve the goal given to NASA by the U.S. Congress to find more than 90% of NEOs larger than 140 m in effective spherical diameter by 2020 [1]. While the NEOWISE mission has returned physical properties for >1000 NEOs to date, its wavelengths, field of view, and orbit prohibit it from achieving this objective. Moreover, without significant new capability, the existing suite of ground-based observatories and the planned Large Synoptic Survey Telescope will not achieve 90% completeness objective for NEOs >140 m for several decades [2][3][4].

NEOCam is a wide-field 50-cm space telescope employing two channels simultaneously imaging at 4-5.2 and 6-10 microns (Figure 1). These wavelengths were chosen to maximize sensitivity to NEOs, because these objects emit most of their radiation at thermal infrared (IR) wavelengths. Effective spherical diameters can be computed for minor planets out to approximately the orbit of Saturn using thermal IR data once an orbit is known. Moreover, signal from background stars and galaxies is reduced in thermal IR wavelengths at the sensitivities probed by NEOCam relative to their appearance at visible wavelengths, helping to minimize confusion when extracting NEO detections from each image.

By operating from a halo orbit around the Sun-Earth L1 Lagrange point (Figure 2), NEOCam can cover a region bounded by 45-120 degrees in solar elongation and +/-40 degrees in ecliptic latitude (though coverage of the ecliptic poles is possible and planned for calibration purposes). This instantaneous field of regard encompasses a wide swath of the volume surrounding the Earth's orbit, since this region is where the NEOs in the most circular, Earth-like orbits that are most likely to have close encounters with the Earth spend the majority of their time. Moreover, this field of regard enables discovery of objects that spend much of their time interior to Earth's orbit.

NEOCam will execute a survey cadence that is optimized to detect NEOs and obtain orbits that are as good or better than the distribution of orbits currently in the Minor Planet Center's holdings. To ensure high linking efficiency, the observatory will collect at least four observations of a single patch of sky over a period spanning ~6-8 hours; this field will be revisited ~11 days later. This survey pattern is repeated continuously throughout the five-year baseline mission.

NEOCam is currently in Extended Phase A (an extended study phase) following three Step 1 rounds in NASA's 2005, 2010, and 2015 Discovery competitions and one Step 2 round in 2016. The project has been moved from the Discovery program to NASA's Planetary Defense Coordination Office.

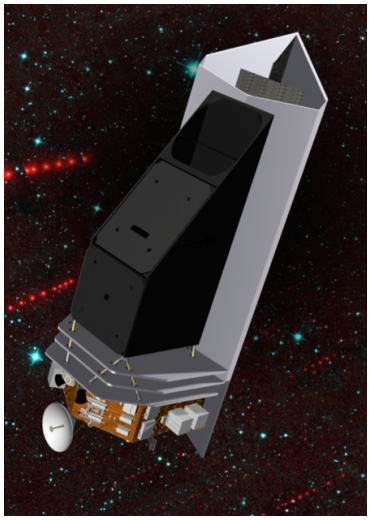

Figure 1: The NEOCam design incorporates passive radiators and thermal shielding to achieve the required operating temperatures for its optics and IR detectors.

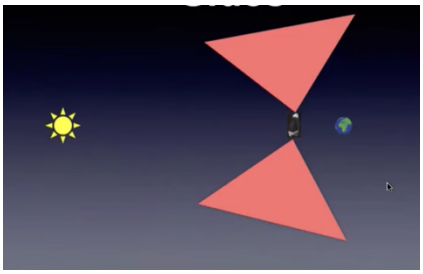

Figure 2: NEOCam will survey from 45-120 degrees solar elongation and +/- 40 degrees from the ecliptic.

Acknowledgements

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References

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[3] Mainzer et al. (2015) AJ 149, 172

[4] Grav et al. (2016) AJ 151, 172