A SPACE-BASED, NEAR-SUN SURVEY TO DISCOVER ATIRA AND ATEN ORBITAL CLASS NEAR-EARTH OBJECTS.

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Introduction: Maximizing the discovery rate of near-Earth objects/asteroids (NEO's/NEA's) is observationally more challenging than addressing the same goal for the Main Belt asteroids (MBA's); the latter are most efficiently imaged near opposition, but NEA's may achieve their greatest brightnesses in almost any direction from the Earth from the interplay of their illuminated phase geometry and distance from the Earth. The diurnal illumination pattern of the Earth restricts the extent of the sky that may be searched by ground-based instruments (and possible search intervals). Space-based instruments potentially can search more of the sky and are less restricted in time having been freed from the day-night cycle, although their deployed orbit can still restrict the observable sky on different time scales (e.g. instruments in Earth orbit are restricted to looking away from the Earth at any given time). The primary factor in determing the sky available to a space-based instrument is the angular limit on its capability to look near the Sun.

Near Earth Object Surveillance Satellite (NEOSSat): The Canadian Space Agency (CSA) and Defence Research and Development Canada (DRDC) are jointly building NEOSSat, a three-axis stabilized microsatellite derived from the MOST asteroseismology mission now approaching its ninth anniversary of operation [1]. NEOSSat is a dual use mission and will be used half time by DRDC to update high altitude artificial satellite positions, and half time to search for NEO's via the Near Earth Space Surveillance (NESS) project funded by the CSA. The observing instrument is a modified version of the f5.88 Maksutov telescope deployed on MOST with an added inline, oblique-cut baffle to allow observations to 45° solar elongation. The focal plane is shared by two 1k X 1k CCD's, one used for science imaging, and one used by the ACS to achieve 0.5 arcsecond pointing stability in a ~100 second exposure. The square pixels have a width of 3 arcseconds resulting in a 0.86° wide field of view. Instrumental backgrounds are very low leaving the zodiacal light brightness as the primary factor limiting search magnitude sensitivity simulated as V mag of ~20 in 100 second exposures (coupled with the proper motion rates/dwell times of imaged asteroids). The spacecraft is scheduled for launch into an ~800 km-high Sun-synchronous orbit in mid 2012.

Initial Observing Strategy: An arc of sky near 45° solar elongation will be searched across the ecliptic plane both east and west of the Sun effectively creating a curved optical fence of 60 to 80° length (subject to galactic plane avoidance). A succession of four images will be taken for each search region over two orbits constrained by NEOSSat's ~100 minute orbital period and modeled NEA proper motion rates (yielding an initial imaged arcs ~125 minutes long). As the sky and the MBA population become better known, it may be possible to reduce the number of search region revisits.

Current operations are based on sending complete images to the ground where two independently developed asteroid search codes (modified for the parallax introduced by the spacecraft's orbital motion) will search all imagery: TRAPAS (developed by R. Cardinal) and SALTAD (developed by P. Gural [2]). A third search code is being developed by P. Gural to find the fraction of asteroids particularly near the Earth exploiting the large, parallax-induced, apparent motion.

Discovery simulations of a detailed inner solar system NEA model [3] indicate that NEOSSat will discover ~10 Atira class NEA's per year and an order of magnitude more of the other NEA orbital classes.

References: [1] Walker, G., et al. (2003) *PASP, 115*, 1023-1035. [2] Gural, P.S, et al. (2005) *A.J., 130*, 1951-1960. [3] Greenstreet, S. et al. (2012) *Icarus, 217*, 355-366.