THE DETECTION LIMITS FOR TRANS-NEPTUNIAN DWARF PLANETS OF THE SIDING SPRING SURVEY.

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Introduction: The population of icy objects beyond Neptune provide dynamical and compositional insight into the early history and subsequent evolution of the Solar System. The past several years have seen the completion of major surveys of this population across the Northern Hemisphere sky and the introduction of surveys in the South. We present the results of our archival search of more than ten thousand square degrees of sky south of the ecliptic observed over five years, with an approximate limiting flux of m(clear) ~ 19.5. We detail our innovative survey technique, its null detection, and our modelling of the survey's sensitivity via a synthetic population of trans-Neptunian objects (TNOs).

Survey: The Siding Spring Survey is an ongoing survey for near-Earth asteroids that has been operating at the 0.5 m Uppsala telescope at Siding Spring Observatory since 2004. In the five years to late 2009, it observed each of ~2300 4.55 square degree fields on between 30 and 90 nights. These fields span approx. -15 to -70 declination and the full range in right ascension, avoiding the galactic plane by 10 degrees either side. Although this Uppsala observing cadence is much more widely spaced than that of a purpose-designed TNO survey, its dense temporal coverage was sufficient to allow any bright dwarf planets to be detected many tim on each field in the course of each year. This would provide high-quality orbits with multiple oppositions to any discoveries.

Algorithm: We extracted the transient sources from these images and permute all sets of three sources (triplets) generated from observations of the same field made within a 180-day period centred on opposition. We overcome the computational demands of fitting orbits to these abundant triplets through a prefilter for bound, plausible outer Solar System orbits, then fully fit the selection through the *orbfit* package [1]. Arcs are created by linking all permutations of two triplets and refitting for valid orbits, then visually inspecting for false positives. This proved highly parsimonious and left no dwarf planet detections.

Efficiency limits: We simulate the observation of [2]'s synthetic Centaur, Kuiper belt and scattered disk populations according to their sky positions throughout the five years of Uppsala surveying. We apply a range of absolute magnitudes to each observable object, evaluate each against the visible magnitude limit of its corresponding observation, and orbit-fit triplets and arcs of the successful detections. From this we compute our detection efficiencies as a function of TNO orbital parameter space.

Results: We detect no new dwarf planets. We note that all known dwarf planets, including Pluto, fall outside our survey coverage in its temporal span. (Recently discovered 2012 DR30 moved onto northerly fields with too few nights to be considered in this survey only after our survey period had concluded). This result places constraints on the bright end of the trans-Neptunian population, and models of TNO size distribution.

References: [1] Bernstein G. and Khushalani B. 2000. *Astronomical Journal* 120:3323. [2] Grav T. et al. 2011. *Publications of the Astronomical Society of the Pacific* 123 (902):423-447.