First discoveries from OSSOS — the Outer Solar System Origins Survey

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Great progress has been made in the last decade in understanding the origins of the population of small icy objects in the outer Solar System. The sculpting of their orbits under the architectural rearrangement of the giant planets has left its signature in these small-body populations. The discoveries have shown an essential need for the surveys that collect samples of the population to have a complete tabulation of their intrinsic observational biases: this alone permits correct retrieval of the underlying population. The existing known sample of well-characterised trans-Neptunian objects are too few to continue making progress in distinguishing between models of the history of the Solar System.

We have designed a survey using 560 hours of CFHT time over four years to provide many hundreds of new TNOs with exquisitely characterised, high-precision orbits. This new wide-field survey began observations with CFHT MegaPrime in February 2013, and by its conclusion in 2016 aims to have doubled the number of trans-Neptunian objects suitable for testing models.

OSSOS will image eight 21-square-degree areas of sky placed to sample the dynamically cold and the dynamically hot populations, imaging with MegaCam's one-square-degree field of view to an ideal target survey depth of $m_r \sim 24.5$. This allows us to sample the Kuiper belt across a large range of sizes produced by accretion and collisional processing in the original planetesimal belt. Our survey sensitivity to trans-Neptunian objects is individually quantified for every chip of the 756 in the mosaic formed by these 21 MegaCam pointings: we plant PSF-matched sources in the discovery images at rates of motion appropriate to objects from near Saturn out to 300 au. We combine these detection efficiencies and the survey pointings to provide along with all survey discoveries a Survey Simulator. This provides the full characterisation of the survey in a way that allows easy testing of models of the migration of the giant planets: provide a model small-body population, and the Simulator shows how that population would appear if it had been observed by our survey, which can then be compared to the actual discoveries of the survey.

Our first quarter of the survey, observed for discoveries during the 2013A semester at CFHT, have now had their discoveries recovered in early 2014 at CFHT. Each 21 square degrees, these two survey areas were placed to sample the dynamically cold and the dynamically hot populations. The on-ecliptic area reached a survey depth of $m_r = 24.01$ at the 40% threshold of TNO detection efficiency; the off-ecliptic area reached $m_r \sim 24.5$ at the 40% threshold. We confirm our inner boundary of sensitivity to Centaur- like objects by re-detecting Saturn's irregular moon Ijiraq at 9.8 au, and expect our distance sensitivity to be some 300 au. We report a hundred discoveries from 2013A. Our tracking efficiency as of Jan 2014 is 94% recovery for objects above our survey depth limits; this is anticipated to improve, as more recovery observations are scheduled in 14A on these fields.

We will discuss the orbital properties of our discoveries and their implications for the evolution of the populations of the trans-Neptunian region. The astrometric grid built as part of the OSSOS survey has allowed very high-quality astrometry on each discovery: uncertainties in their orbital elements are already far below 1%.