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# Sentinel Mission for Planetary Defense

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## ABSTRACT

The Sentinel Mission is an infrared space mission that is being built by the B612 Foundation. It will fly a 50-cm IR telescope in a heliocentric orbit interior to the Earth's orbit. From this vantage point, it will survey over half of the sky and provide detection and accurate orbits for Near Earth Objects (NEOs) as well as numerous other moving objects such as comets and main-belt asteroids. During its nominal 6.5-year mission lifetime, it will essentially complete the NEO inventory down to 140 m diameter while also providing substantial constraints on the NEO population down to a Tunguska-sized object. An important element for planetary defense is the early detection of potential impactors that will permit careful investigation of mitigation alternatives. We have recently developed a suite of tools to provide survey modeling for this class of survey telescope. The purpose of the tool is to uncover hidden complexities that govern mission design and operation while also working to quantitatively understand the orbit quality provided on its catalog of objects without additional follow-up assets.

This survey model is a statistically based tool for establishing completeness as a function of object size and survey duration. Effects modeled include the ability to adjust the field-of-regard (includes all pointing restrictions), field-of-view, focal plane array fill factor, and the observatory orbit. Consequences tracked include time-tagged detection times from which orbit quality can be derived and efficiency by dynamical class. The dominant noise term in the simulations comes from the noise in the background flux caused by thermal emission from zodiacal dust. The model used is sufficient for the study of reasonably low-inclination spacecraft orbits such as

are being considered. Results to date are based on the 2002 Bottke et. al. NEA orbit distribution model and a recent size distribution by A.W.Harris. The system can work with any orbit distribution model and with any size-frequency distribution. This tool also serves to quantify the amount of data that will also be collected on main-belt objects by simply testing against the known catalog of bodies. In addition to studying the detection characteristics of the survey, we analyzed synthetic astrometry for NEOs to assess the quality of the orbit that can be expected

Results of our modeling show that the heliocentric orbit is ideal for finding the subset of NEOs that have the highest probability of impacting Earth: those with long synodic periods that pass Earth slowly and are thus most likely to be deflected during their close pass. Additionally, the distant location of the Sentinel observatory decouples Sentinel discoveries from those of on-going ground-based surveys that are able to efficiently discover those NEOs that are closest to Earth.