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What hazards lurk in the SOHO/STEREO datasets?

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ABSTRACT

More than 3600 comets have been detected in SOlar and Heliospheric Observatory (SOHO) and Solar TErrestrial RElations Observatory (STEREO) images since 1996. However, orbits have only been published for the first ~2000 of these objects, with routine calculation of orbits for new detections having essentially ceased since late 2010. As part of the NASA-funded Sungrazer project (https://sungrazer.nrl.navy.mil/), one of us (KB) has continued to record new detections and perform astrometric reductions. Although we do not attempt orbital calculations, we continue to categorize new detections based on apparent trajectories. While approximate orbits can be assumed for comets in known dynamical groups, the orbits of unrelated "non-group" comets are completely unknown. We will report on the current detection statistics of near-Sun comets, paying particular attention to the populations with the possibility of harboring as yet unidentified potentially hazardous objects (PHOs). The first such potential reservoir of PHOs is the "Marsden group," whose members are dynamically related to comet 96P/Machholz 1. The brightest of these, P/1999 J6 SOHO, apparently passed 0.012 AU from Earth in June 1999. More than 50 Marsden comets have now been detected, although some are likely return apparitions of the same objects (orbital periods are 5-6 years). Given that fragmentation is rampant and ongoing in this group, there may now or eventually be

more members on potentially hazardous orbits. Thus, it is critical from a planetary defense standpoint that the orbits of all of these objects be determined.

The second candidate PHO-seeding population is comprised of more than 150 “non-group” objects that are as yet not known to be linked to any other solar system objects. While it is assumed that they are all cometary in origin, little is known about most of these objects and some may originate from asteroidal populations and lose mass due to thermal processes during their extremely close approaches to the Sun. The published orbits suggest that many have high inclinations and presumed long orbital periods; few have sufficiently well characterized orbits to determine if they are PHOs. Nonetheless, new dynamical linkages have been found as data have accumulated.

Although the orbits determined for SOHO discovered objects have large uncertainties, they have been successfully used to recover both short (322P by Knight et al. 2016) and long period (C/2015 D1 by Hui et al. 2015) comets from the ground, with resulting vast improvements in the orbits. A regularized process of orbit determination would facilitate the incorporation of these near-Sun objects into existing follow-up surveys. Non-gravitational forces from outgassing may be a significant factor in perturbing objects into PHO orbits, and can be better quantified by such follow-up observations. The current backlog of orbit calculations may harbor as yet unrecognized PHOs, and the processing of this backlog, in addition to identifying such PHOs, would likely provide a wealth of context to future observations of near-Sun objects, leading to a considerable advancement in our understanding to their role as PHO reservoirs.