Automatic detection of asteroids and meteoroids — a wide-field survey

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The small Near-Earth Asteroids (NEAs) represent a potential risk but also an easily accessible space resource for future robotic or human in-situ space exploration or commercial activities. However, the population of 1–300 m NEAs is not well understood in terms of size- frequency and orbital distribution. NEAs with diameters below 200 m tend to have much faster spin rates than large objects and they are believed to be monolithic and not rubble-pile like their large counterparts. Moreover, the current surveys do not systematically search for the small NEAs that are mostly overlooked. We propose a low- cost robotic optical survey (ADAM-WFS) aimed at small NEAs based on four state-of-the-art telescopes having extremely wide fields of view. The four Houghton-Terebizh 30-cm astrographs (Fig. left) with 4096×4096 -pixel CCD cameras will acquire 96 square degrees in one exposure with the plate scale of 4.4 arcsec/pixel. In 30 seconds, the system will be able to reach +17.5 mag in unfiltered mode. The survey will be operated on semi-automatic basis, covering the entire night sky three times per night and optimized toward fast moving targets recognition. The advantage of the proposed system is the usage of existing of-the-shelf components and software for the image processing and object identification and linking (Denneau et al., 2013). The one-year simulation of the survey (Fig. right) at the testing location at AGO Modra observatory in Slovakia revealed that we will detect 60–240 NEAs between 1–300 m that get closer than 10 lunar distances from the Earth. The number of detections will rise by a factor of 1.5–2 in case the survey is placed at a superb observing location such as Canary Islands. The survey will also serve as an impact warning system for imminent impactors. Our simulation showed that we have a 20 % chance of finding a 50-m NEA on a direct impact orbit. The survey will provide multiple byproducts from the all-sky scans, such as comet discoveries, sparse light curves of bright main-belt asteroids, space-debris detection, and stationary transient events like novae, supernovae, variable stars, and microlensing. The budget for the prototype development and testing is estimated to be 1,000,000 EUR. The planned development time is one year.

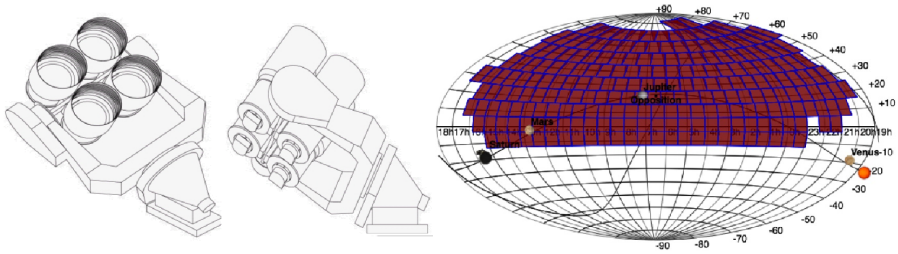

Figure: Left — Mechanical design of 4 telescopes attached to a mount with a total FOV of 96 square degrees with a limiting magnitude of 17.5. Right — sky coverage per night.

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References: Denneau, L. et al. 2013, PASP, 125, 357.