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System of Observation of Daytime Asteroids (SODA)

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ABSTRACT

The Chelyabinsk event of Feb 15, 2013 clearly demonstrated that decameter-sized Near Earth Objects (NEOs) should be considered as hazardous ones when they impact populated areas. Another important lesson is that bodies approaching the Earth from the day sky could not be discovered by any ground-based or near Earth Space telescopes because of unfavorable phase angle and scattering light. A comprehensive cataloguing of decameter size NEOs is a task for the very distant future. So far, it has been impossible to make a complete catalogue to predict collision of 10 m bodies with the Earth in advance. The only way of mass detection of such NEOs is to find them the in the near Earth Space and to warn about possible collision.

We proposed the project of space system SODA (System of Observation of Day-time Asteroids) for exhaustive detection of decameter (>10 m) bodies coming from the Sun direction into the near Earth space (i.e. at distances less than ~1 million km from the Earth). The main idea of the mission is to put one or two spacecraft equipped with medium-size (30 cm) wide field telescopes with pre-aperture active

mirrors into the vicinity of the L1 (in Earth-Sun system) point. This position is very good for detecting bodies of interest due to relatively short distance between the telescope and the asteroid, and optimal phase angle. Another paper describes trajectory design for SODA [1]. Observation will be performed in a barrier mode. Typical NEOs approaching from the Sun will cross the barrier approximately one day before closest approach to the Earth. Upon the first detection the NEO's orbit can be refined by using additional observation. The computer controlled fast slewing (pre-aperture) mirror can provide very flexible and quickly changed observational modes. In the case of a collision orbit, the accuracy of orbit determination should be sufficient to calculate the entry point into the Earth's atmosphere to an accuracy of 10 km. According to our simulation in 5 years the SODA project will discover about 3000 NEOs with size of >10 m coming into near Earth space. In 5-10 years of operation at least one 10 m class impactor will be discovered and several smaller one. It means that during the spacecraft lifetime (up to 10 years) it will generate several useful alerts.

We describe the preliminary design and status of the SODA mission. We mention additional science potential of the mission, including such options as Earth climate monitoring and Sun observation (similar to DSCOVR’s goals). The necessity of collaboration with night-time observational systems that are focused on detection of NEOs in the near Earth space (ATLAS, INF, GWAC) is emphasized.

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(Alternative session, Time slot, Oral or Poster, Etc…)

[1] Kovalenko, Irina D., B. M. Shustov, D. Dunham, A. Shugarov, and N. A. Eismont. "System of Observation of Daytime Asteroids: Trajectory and Orbit Design." Planetary Defence Conference 2019, College Park, Maryland, USA (2019).