

Kilometer-sized trans-Neptunian objects revealed by OASES

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Organized Autotelescopes for Serendipitous Event Survey (OASES) is an optical observation project that aims to detect and investigate stellar occultation events by kilometer-sized trans-Neptunian objects (TNOs). The abundance and the size distribution of the kilometer-sized TNOs is thought to provide fundamental knowledge of the accretion processes from the early stages of the outer solar system. However, they are extremely faint and are impossible to detect directly even with 8-m~10-m aperture telescopes. Instead of the direct detection, a monitoring observation of stellar occultation events is one of the possible ways to estimate the abundance and the size distributions of the kilometer-sized TNOs. Since stellar occultations by the TNOs are very rare (lower event rate than 10^{-2} events per year per star) and short duration (shorter than one second) events, a lot of stars must be monitored simultaneously with a sampling cadence much higher than general optical observation instruments. We thus developed multiple low-cost observation systems for wide-field and high-speed photometry. The observation system consists of commercial off-the-shelf 0.28 m aperture f/1.58 optics providing a 2.3×1.8 square-degree field of view and a commercial CMOS camera obtaining full-frame imaging with a frame rate greater than 10 Hz. This project currently exploits two observation systems, which are installed in Miyako island, Okinawa, Japan. Owing to the recent improving CMOS technology of high-speed imaging and low readout noise, the observation system is capable of monitoring ~2000 stars at the Galactic plane simultaneously with V-band magnitudes down to ~13.0, providing ~20% photometric precisions in light curves with a sampling cadence of 15.4 Hz. The OASES two observation systems are therefore executing coordinated monitoring observations of a dense stellar field in order to detect the occultations by the kilometer-sized TNOs for the first time.

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