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NSOS-α: THE FIRST KOREAN ASTEROID SURVEY TELESCOPE

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Extended Abstract—

The Near Space Optical Survey-alpha (NSOS-α) telescope is the first asteroid surveyor telescope in Korea. This telescope is designed for discovering and cataloging Near-Earth Asteroids (NEAs), specifically Potentially Hazardous Asteroids (PHAs), which may pose a threat to our planet. To achieve these goals, the 1.5-m wide-field optical telescope with a five-square-degree field of view will be installed and operated at the Cerro Tololo Inter-American Observatory (CTIO), in Chile. The conceptual design of the telescope was concluded in 2022, and operations are planned from mid-2026 onward. The NSOS-α telescope will be the first dedicated observation facility for surveying NEAs in the Southern Hemisphere with a 1.5-m class telescope. We expect the possibility of synergy with the LSST telescope, which is scheduled for first light in 2023. This paper outlines the mission and scientific goals for the NSOS-α telescope, and the configuration for the follow-up network of newly discovered objects is discussed herein.

1. Introduction

A total of 31,191 NEAs were discovered in 2022, including 87 PHAs. Recently, asteroids have been discovered prior to Earth impact, such as 2022 EB5, 2022 WJ1, and 2023 CX1. As observed in the case of the Chelyabinsk meteor falls, a small-sized asteroid can cause huge damage to human civilization. Currently, most asteroid-surveying telescopes are located in the Northern Hemisphere. As a counterpart to the Catalina Sky Survey (CSS) in the Southern Hemisphere, a 0.5-m telescope was operated at Siding Spring Observatory in Australia from 2004 to 2013. Recently, ATLAS telescopes were installed in South Africa and Chile. However, the NSOS-α project will be the first dedicated telescope in the Southern Hemisphere for surveying NEAs using a 1.5-m class telescope.

2. Telescope design and site

The conceptual design of the telescope was completed in 2022 through a collaboration between KASI and the NSF's National Optical-Infrared Astronomy Research Laboratory (NOIRLab) (Cho et al. 2022). A 3D model of the telescope is illustrated in Figure 1. The optical system is designed using a 1.5-m class primary mirror; the telescope will be equipped with CCD arrays of 9k × 9k sensors featuring a five-square-degree field of view.

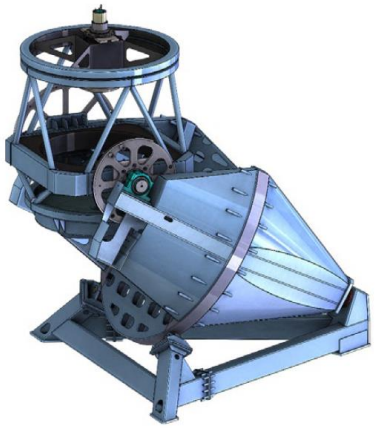

Fig 1. NSOS-α telescope 3D model

The NSOS-α telescope will be installed at the CTIO. The CTIO is an optimal location in the Southern Hemisphere given the number of clear days and observation conditions. In addition, the telescope must be located in a similar longitudinal zone for cooperation with the CSS telescopes. The first observation is scheduled for mid-2026.

3. Survey strategy

As the NSOS-α telescope is located in the Southern Hemisphere, it can cover areas that the surveyor

telescopes in the Northern Hemisphere are unable to observe. For example, Figure 2 presents the sky coverage of the CSS and the NSOS-α projects. The CSS data presented herein is from 2020, and the NSOS-α data represents the observable area of the telescope.

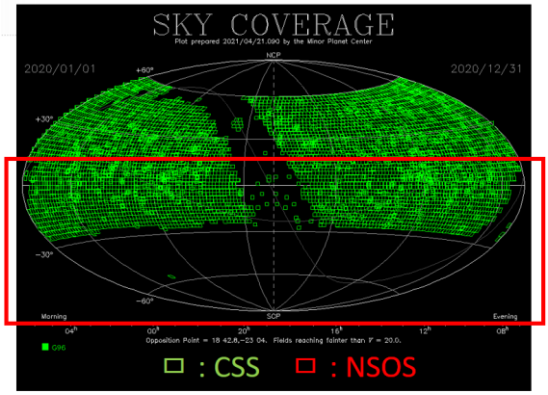

Fig 2. Sky coverage of the CSS (green box) and NSOS-α (red box)

In practice, upon investigating the location information (RA, Dec) of PHAs discovered in 2022, we reveal that it is vulnerable in the Southern Hemisphere. Figure 3 plots the distribution of the location (latitude) at the time of discovery of 87 PHAs discovered in 2022. The blue, green, and red lines represent the ecliptic latitude, declination, and galactic latitude, respectively. In addition, the black dashed line implies data wherein uniform distribution is considered. The PHAs distribution clearly suggests that a greater number of asteroids are found on the ecliptic plane. For efficient asteroid discovery, we shall begin determining the optimal observation strategies through survey simulations.

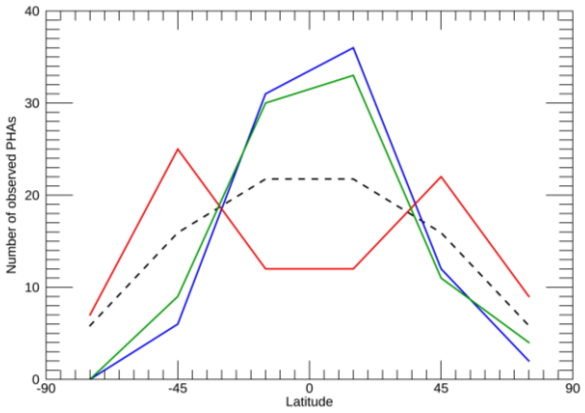

Fig 3. Latitudinal variation of PHAs discovered in 2022

4. Follow-up observation network

A follow-up observation network is essential for discovering and validating NEAs. To allow for the synergistic discovery of NEAs, KASI is considering cooperation with the CSS on telescope operation and the development of detection software. Additionally, considering the geographical situation in the Southern Hemisphere, this collaboration is urgently required to participate in surveys with telescopes based in Chile and Australia. We are also trying to realize a collaboration with the Vera C. Rubin Observatory, previously referred to as the Large Synoptic Survey Telescope (LSST).

5. References

Cho, M., Yim, H.-S., Kyeong, J. et al. (2022). “Development of a wide field telescope for the NSOS-α.” *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series* **1218813**