NSOS-α: The First Korean Asteroid Survey Telescope

Myung-Jin Kim[1], Hong-Suh Yim[1], Jaemann Kyeong[1], Jung Hyun Jo[1], Dong-Goo Roh[1], Youngmin JeongAhn[1], Hong-Kyu Moon[1], Hee-Jae Lee[1], and Sungki Cho[1]

[1]Center for Space Situational Awareness, Korea Astronomy and Space Science Institute, Korea,

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 wil l 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.

NSOS-α Telescope Design

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, SPIE proceeding 1218813). 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 of 9k × 9k sensors featuring a five-square-degree field of view.

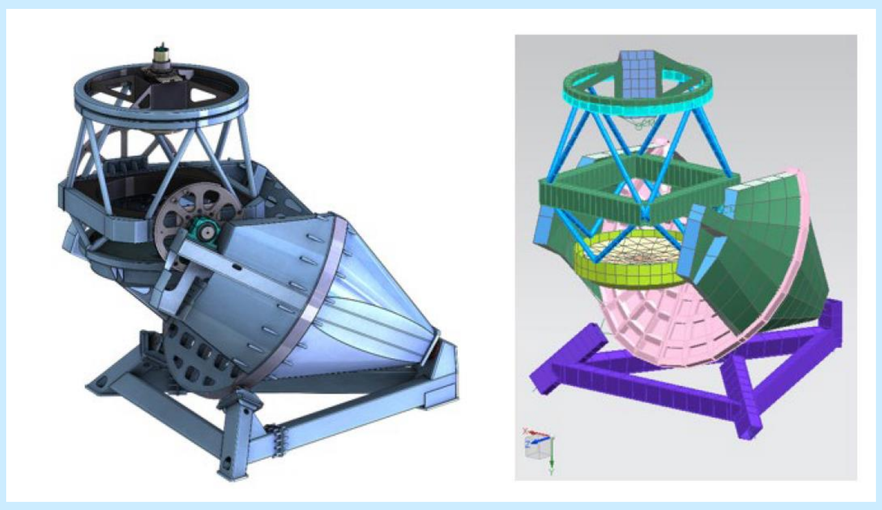

Figure 1. NSOS-α telescope 3-D solid model (left) and FE model (right)

Survey Strategy

As the NSOS-α telescope is located in the Southern Hemisphere, it can cover areas that the survey telescopes in the Northern Hemisphere are unable to observe. For example, Figure 3 presents the sky coverage of the CSS (green box) and the NSOS-α (red box) projects. The CSS data presented herein is from 2020, and the NSOS-α data represents the observable area of the telescope. In practice, upon investigating the location information (RA, Dec) of PHAs discovered in 2022, we reveal that it is vulnerable in the Southern Hemisphere (see Fig 4).

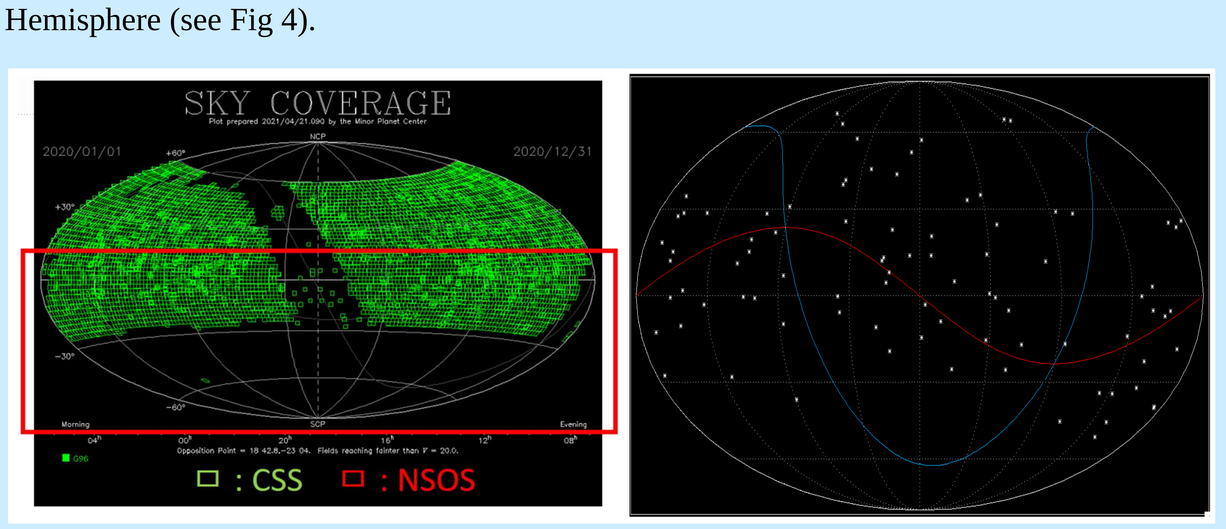

Figure 3. Sky coverage of the CSS (green box) and NSOS-α (red box)

Figure 4. Sky plot of 87 PHA discovered in 2022

Site: CTIO

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. Figure 2 shows the weather data in 2021 of the KMTNet (Korea Microlensing Telescope Network) telescope operated by KASI. We can clearly see that CTIO has the best number of clear night and seeing condition compared to Siding Spring Observatory (SSO) and South African Astronomical Observatory (SAAO).

In addition, it is necessary to be located in a similar longitudinal zone for cooperation with the Catalina Sky Survey (CSS) telescopes. To allow for the synergistic discovery of NEAs, KASI is discussing cooperation with the CSS on telescope operation and the development of detection software.

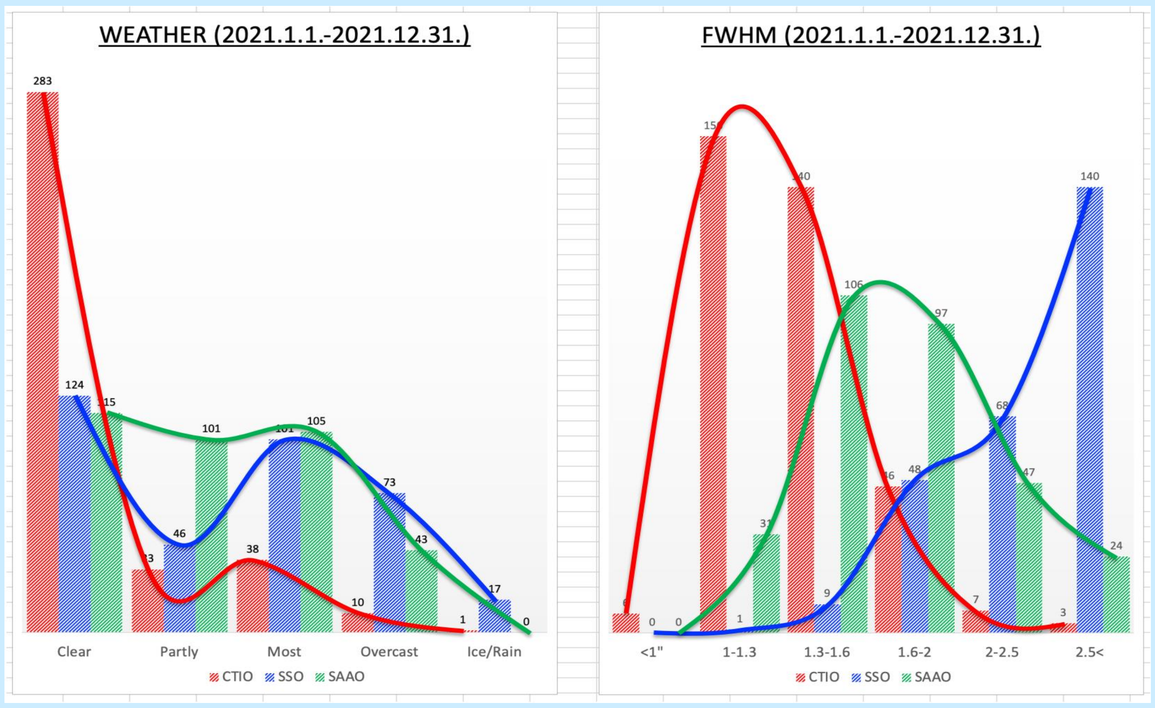

Figure 2. Comparison of the weather in three observatories from KMTNet data (https://kmtnet.kasi.re.kr/kmtnet/)

Figure 5 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.

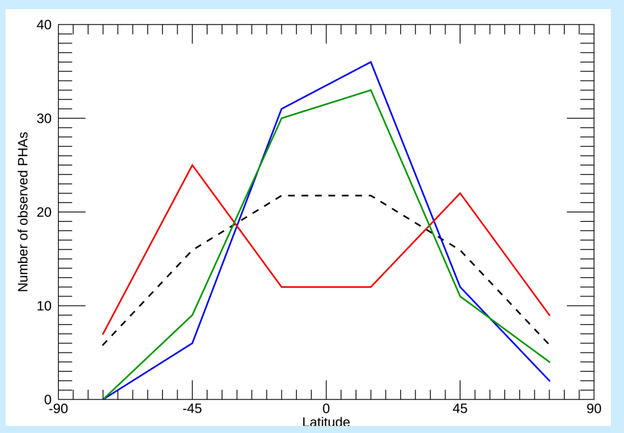

Figure 5. Latitudinal distribution of PHAs discovered in 2022

Follow-up Observation Network

A follow-up observation network is essential for discovering and validating NEAs. We are planning to make the NSOS-α follow-up telescope network. Considering the geographical situation in the Southern Hemisphere, this collaboration is urgently required to participate in surveys with telescopes located 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).

If you are interested in participating in the NSOS-α follow-up observations network, please contact Myung-Jin Kim by email below.

Myung-Jin Kim (skarma@kasi.re.kr)