constantly revised and modularized according to the upgrades of the TCS and the hardware changes. Recently we have implemented the stable network communication and the semi-automatic focusing modules to enhance observational convenience. In this presentation we describe the current status of the SQUEAN control software and introduce a software architecture which is optimized on efficient astronomical observations.

[구 AT-05] Seoul National University Camera II (SNUCAM-II) : The New SED Camera for Lee Sang Gak Telescope (LSGT)

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We present the characteristics and the performance of the new CCD camera system, SNUCAM-II (Seoul National University CAMera system II) that was installed on the Lee Sang Gak Telescope (LSGT) at the Siding Spring Observatory Australia in 2016. SNUCAM-II consists of a deep depletion chip covering a wide wavelength from 0.3 μm to 1.1 μm with high sensitivity (QE at 90%). It is equipped with SDSS ugriz filters and 13 medium band width (50nm) filters. On LSGT, SNUCAM-II covers 15.7 x 15.7 arcmin FOV at pixel scale of 0.92 arcsec and a limiting magnitude of g = 19.91 AB mag at 5σ with 180s exposure time. SNUCAM-II will enable us to study Spectral Energy Distributions (SEDs) of diverse objects from extragalactic sources to solar objects in the southern hemisphere for research and education activities.

[구 AT-06] Results of Observation Performance Test for NYSC 1m Telescope

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National Youth Space Center

국립고흥청소년우주체험센터는 덕흥천문대 1M망원경으로 관측한 자료를 축적하고 있다. 1M망원경이 설치 된 후 발생했던 문제점인 광축, 극축, 지향정밀도, 추적정밀도를 개선하기 위해 시도했던 방법의 결과를 개선 전후 관측 자료를 비교하여 소개하고자 한다. 현재는 오토가이드 없이 별 추적이 3600초 정도 가능하다. 또한, 스크립트 활용으로 소프트웨어를 개선하여 관측의 용이성을 증대시켰다. 은하측광, 분광, 시계열관측 등 차별화된 연구를 수행하기 위한 기기 및 소프트웨어의 확충·보완을 수행하고 있다.

중성미자 천문학과 한국형 중성미자망원경

[초 NK-01] Korean Neutrino Telescope and Neutrino Science

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Neutrinos play an important role in astronomy and therefore they need to be observed as well as other astronomical messengers. The first observation of astronomical neutrinos is from the SN1987a by the Kamiokande neutrino telescope in Japan. Unlike other astronomical messengers neutrinos can cover all energy range of astronomical phenomena due to their weak interactions and neutrality.

Multi messenger astronomy including optical, neutrino, and cosmic ray observations, provides more information on astronomical phenomena and thus such collaborational works are ongoing worldwide. A future Korean neutrino telescope consisting of huge (260 kiloton) water Cherenkov detector under a mountain was proposed in 2016 and the sensitivity studies on various topics are in progress with international collaborators.

In this talk I will introduce the future Korean neutrino telescope and its science as well as the potential candidate sites in Korea. We invite all of you to work together for the future Korean neutrino telescope that will operate more than 30 years.

[초 NK-02] Astronomy Potentials with Korean Neutrino Detector and Telescope

Soo-Bong Kim
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A 250 kton water Cherenkov detector is proposed to be built in Korea to determine the CP violation phase and the neutrino mass ordering using a neutrino beam produced in J-PARC of Japan. It will be also a world-leading neutrino telescope to reveal the mystery of supernova explosion by observing a neutrino burst. The telescope is expected to detect more than 100,000

neutrinos in ten seconds from a supernova explosion in our Galaxy. The pointing accuracy will be better than 1 degree and be able to guide early optical telescope observations. The expected rate of supernova explosion in our galaxy is once per every 30 years in the most optimistic case or once per every 100 years in the worst case. If it is indeed observed, it will be a historical chance to study the supernova explosion mechanism in great details. In this talk, various astronomy potentials will be discussed if the Korean neutrino observatory is built.

[구 NK-03] Supernova Rates of the Milky Way and the Local Group

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A major goal of the proposed Korean Neutrino Detector and Telescope is to detect neutrino burst from core-collapse supernova (SN) explosions in the Milky Way, which will provide an unprecedented opportunity to look into the core of an exploding massive star. Detection with high statistics would give important information for the explosion physics. It can also detect neutrino signals from SN events in the Local Group and trigger alert of the event for the astronomical community. In this talk, I will review the SN rates of the Milky Way and the Local Group, and will discuss the implications for the proposed neutrino telescope.

[구 NK-04] Supernovae Follow-up Observations and the Korean Neutrino Telescope

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Massive stars ($\geq$8 $M_{\odot}$) are believed to experience core-collapse and finish their lives as supernova (SN) explosions. Astronomers operating the current SN survey facilities try to catch the first moments of SN explosions. Since neutrinos are emitted first from the SNe before the electromagnetic lights, any neutrino detections from more than two sites within around 10 seconds could be useful alert for early follow-up observations, especially for optical SN follow-up telescopes. In this talk, I will brief the current SN follow-up observation projects, what they want to find out and contribute to SN sciences. Focus will be on the early detection and early sciences on SNe, which is what the Korean Neutrino Telescope can contribute most importantly.

고에너지 천체물리학

[구 HA-01] Ultra-high-energy cosmic rays and filaments of galaxies in the northern sky

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The Telescope Array (TA) experiment reported the arrival direction distribution of ultra-high-energy cosmic rays (UHECRs) with energies above 5.7×10^{19} eV in the northern sky. A clustering of TA events, the so-called hotspot, was found; however, its nature has not yet been understood. To understand the origin of the TA hotspot, we examine the sky distributions of the TA UHECR arrival direction and filamentary structures of galaxies in the local universe. By statistical tests for anisotropy, we find a close correlation of the TA events with the filaments of galaxies connected to the Virgo cluster. We discuss our finding and its implications.

[구 HA-02] Shock Acceleration Model for Giant Radio Relics

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Although most of observed properties of giant radio relics detected in the outskirts of galaxy clusters could be explained by relativistic electrons accelerated at merger-driven shocks, a few significant puzzles remain. In some relics the shock Mach number inferred from X-ray observations is smaller than that estimated from radio spectral index. Such a discrepancy could be understood, if either the shock Mach number is