various wavelength and size of filters. 50 nm medium bandwidth filters from 600 - 1050 nm, seven SDSS (Sloan Digital Sky Survey) filters and Johnson-Cousin BVRI filters are installed for now. We also have a plan to use narrow band interference filters to classify high redshift quasars or to obtain SEDs of interesting astronomical sources in details more efficiently. We also developed KAP82 (Kyung Hee University Auto guiding Package for 82 inch telescope) for auto guiding software. CQUEAN and SQUEAN have been developed by CEOU (Center for the Exploration of the Origin of the Universe).

[구 AT-02] Transformation of Filter Systems for SQUEAN (SED camera for QUasars in EArly uNiverse)

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We have recently installed SQUEAN on the 82 inch telescope at the McDonald Observatory, USA. This instrument consists of an ANDOR CCD camera, a focal reducer, an electronic box, an auto guiding system and a new filter wheel which holds up to 20 filters. Currently the filter wheel is equipped with Johnson-Cousins BVRI filters, SDSS rizY and isiz filters, and 50nm medium band pass filters (M625(625nm), M675(675nm), M725(725nm), M775(775nm), M825(825nm), M875(875nm), M925s(925nm), M975(975nm), and M1025(1025nm)). Our medium band pass filter system is suitable with SED fitting. Filter transformation methods are essential for time-domain observations including transient objects, e.g., supernovae, variable stars, and solar system bodies. In this work, we develop a series of equations to convert the open clusters photometry data within these filter systems.

[구 AT-03] Performance of KHU Auto-guiding Package for McDonald 82 inch Telecope (KAP82)

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In astronomical observations, stable auto-guiding and accurate target centering capabilities are critical to increase observation efficiency and sensitivity. Recently, Center for the Exploration of the Origin of the Universe (CEOU) has developed SQUEAN (SED camera for QUasars in EArly uNiverse). SQUEAN is installed and had successful observations at the 82 inch Otto Struve Telescope of McDonald Observatory in 2015 February. We have upgraded the existing auto-guiding softwares to KAP82 (KHU Auto-guiding Package for the McDonald 82 inch Telescope). Keeping the original hardware systems and the software algorithms of CAP (CQUEAN Auto-guiding Package), KAP 82 is completely re-written in Visual C++. We developed several center finding algorithms, e.g., 2D-gaussian fitting and weighted mean methods. In this presentation, we compare the auto-guiding performances with these algorithms.

[구 AT-04] Participation in G-CLEF Preliminary Design Study by KASI

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The GMT-Consortium Large Earth Finder (G-CLEF) is a fiber-fed, optical band high dispersion echelle spectrograph that selected as the first light instrument for the Giant Magellan Telescope (GMT). This G-CLEF has been designed to be a general- purpose echelle spectrograph with the precisional radial velocity (PRV) capability of 10 cm/sec as a goal. The preliminary design review (PDR) was held on April 8 to 10, 2015 and the scientific observations will be started in 2022 with four mirrors installed on GMT. We have been participating in this preliminary design study in flexure control camera (slit monitoring system), calibration lamp sources, dichroic assembly and the fabrication of the proto-Mangin Mirror. We present the design concept on the parts KASI undertaken, introducing the specifications and capabilities of G-CLEF.

[구 AT-05] Preliminary Design of the G-CLEF Flexure Control Camera

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The GMT-Consortium Large Earth Finder(G-CLEF) is one of the first light instruments at the Giant Magellan Telescope. The international consortium consists of five astronomical institutes including the Center for Astrophysics, the Observatories of Carnegie Institute, the University of Catolica in Chile, the University of Chicago, and Korea Astronomy and Space Science Institute, led by CfA. The extremely precise radial velocity capability is one of the principal instrumental feature of G-CLEF. The RV goal is 10 cm/s capable of detecting an Earth-like planet around a Sun-like host star. This high precision wavelength calibration stability requires a set of significantly tight optomechanical tolerances in the mechanical design of the Flexure Control Camera system. KASI is in charge of the Flexure Control Camera and the Calibration Light System for the G-CLEF spectrograph. In this presentation, we introduce the preliminary design and analysis results of the G-CLEF Flexure Control Camera.

[구 AT-06] Multi-Core Fiber Based Fiber Bragg Gratings for Ground Based Instruments

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Fiber Bragg gratings (FBGs) are the most compact and reliable method of suppressing atmospheric emission lines in the infrared for ground-based telescopes. It has been proved that real FBGs based filters were able to eliminate 63 bright sky lines with minimal interline losses in 2011 (GNOSIS). Inscribing FBGs on multi-core fibers offers advantages. Compared to arrays of individual SMFs, the multi-core fiber Bragg grating (MCFBG) is greatly reduced in size, resistant to damage, simple to fabricate, and easy to taper into a photonics lantern (PRAXIS). Multi-mode fibers should be used and the number of modes has to be large enough to capture a sufficient amount of light from the telescope. However, the fiber Bragg gratings can only be inscribed in the single-mode fiber. A photonic lantern bi-directionally converts multi-mode to single-mode. The number of cores in MCFBGs corresponds to the mode.

For a writing system consisting of a single ultra-violet (UV) laser and phase mask, the standard writing method is insufficient to produce uniform MCFBGs due to the spatial variations of the field at each core within the fiber. Most significant technical challenges are consequences of the side-on illumination of the fiber. Firstly, the fiber cladding acts as a cylindrical lens, narrowing the incident beam as it passes through the air-cladding interface. Consequently, cores receive reduced or zero illumination, while the focusing induces variations in the power at those that are exposed. The second effect is the shadowing of the furthest cores by the cores nearest to the light source. Due to a higher refractive index of cores than the cladding, diffraction occurs at each core-cladding interface as well as cores absorb the light. As a result, any core that is located directly behind another in the beam path is underexposed or exposed to a distorted interference pattern from what phase mask originally generates. Technologies are discussed to overcome the problems and recent experimental results are presented as well as simulation results.

[초 AT-07] Development of state-of-the-art detectors for X-ray astronomy

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We are developing large arrays of X-ray microcalorimeters for applications in X-ray astronomy. X-ray microcalorimeters can detect the energy of X-rays with extremely high resolution. High-resolution Imaging spectroscopy enabled by these arrays will allow us to study the hot and energetic nature of the Universe through the detection of X-rays from astronomical objects such