[구 AI-02] Status of KASI's Contribution to SPHEREx

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The KASI team are participating in the NASA MIDEX mission (PI Institute: Caltech), the all-sky infrared spectro-photometric surveyor SPHEREx (Spectro-Photometer for the History of the Universe, Epoch of Reionization, and Ices Explorer). The SPHEREx will provide us the first all-sky infrared spectro-photometric data set to probe the origin of our Universe, to explore the origin and evolution of galaxies, and to explore whether planets around other stars could harbor life. After the project PDR (Preliminary Design Review) was successfully passed on the last September, the fabrication of flight hardware is in progress. As an international partner, KASI deeply involved in all fields of projects, i.e., the development of calibration facility, the construction of data reduction modules and the science studies for the SPHEREx. After finishing the fabrication and test of calibration facility for the SPHEREx in this year, it will be delivered to Caltech. Here, we report the status of the SPHEREx project and the progress in the Korean participation.

[구 AI-03] Optical Clock Comparison using High-frequency VLBI Observations (고주파수 VLBI 관측을 이용한 광시계 비교)

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2030년경에는 현재 '초(second)'를 정의하는 세슘 원자의 마이크로파 주파수를 이용한 원자시계 보다 훨씬 더 정밀한 광주파수시계(이하 광시계)를 이용한 초의 재정의를 앞두고 있다. 전 세계 각국에서 개발된 광주파수 시계의 동등성 확보를 위해서는 10^{-17} 이상의 정밀도로 시각/주파수를 대륙 간에 비교할 수 있는 기술 개발이 필수적이다. 현재의 대륙 간 시각 비교에 사용되는 위성을 이용한 시각/주파수 비교 방식은 10^{-16} 수준의 정밀도가 한계이나, 한국천문연구원과 국토지리정보원이 보유한 전파망원경을 이용하여, 10^{-17} 수준 또는 이보다 나은 광시계 비교가 가능할 것으로 기대되고 있다. 본 연구에서는 천문연과 세종의 전파망원경을 이용하여 세계 최초로 22 GHz 대역에서 광섬유로 전송된 원자시계 신호를 이용한 VLBI 관측에 성공하였다. 이를 통해 고정밀 원자시계 비교 능력을 검증함으로써, 향후 초의 재정의에 가장 큰 당면 과제인 대륙간 고정밀 광시계 비교 연구의 실질적인 기반을 마련하였다. 이후 한-이태리 VLBI 관측을 통하여 표준과학연구원과 이탈리아 INRIM에서 개발한 두 광시계의 동등성 비교를 진행할 계획이다.

[구 AI-04] Python Package Prototype for Adaptive Optics Modeling and Simulation

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Adaptive Optics (AO) was first studied in the field of astronomy, and its applications have been extended to the field of laser, microscopy, bio, medical, and free space laser communication. AO modelling and simulation are required throughout the system development process. It is necessary not only for proper design but also for performance verification after the final system is built. In KASI, we are trying to develop the AO Python Package for AO modelling and simulation. It includes modelling classes of atmosphere, telescope, Shack-Hartmann wavefront sensor, deformable mirror, which are the components for an AO system. It also includes the ability to simulate the entire AO system over time. It is being developed in the Super Eye Bridge project to develop a segmented mirror, an adaptive optics, and an emersion grating spectrograph, which are future telescope technologies. And it is planned to be used as a performance analysis system for several telescope projects in Korea.

[구 AI-05] IMSNG: Automatic Data Reduction Pipeline gppy for heterogeneous telescopes

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