

matter-only cosmological simulation, N-Cluster Run, we explore the evolution of galaxies on the phase space driven by large-scale filaments. We find that galaxies around the filaments form a common trajectory on the phase space as well as cluster galaxies do. We also examine how these trajectories change depending on various physical parameters such as galaxy mass, initial distance of galaxies from large-scale filaments, and cluster mass.

[포 GC-16] Deep polarization observations of a ram pressure stripped galaxy, NGC 4522

Woorak Choi¹, Aeree Chung¹, Chang-goo Kim², Bumhyun Lee³

¹*Department of Astronomy, Yonsei University, Seoul, South Korea*

²*Department of Astrophysical Sciences, Princeton University, Princeton, USA*

³*Kavli Institute for Astronomy and Astrophysics, Peking University, China*

We present high-resolution, high-sensitivity continuum data of NGC 4522 observed at 3 cm (X-band) and 10 cm (S-band) in full polarization mode using the JVLA. This observation has 2 - 4 times better spatial resolution and 2 - 5 times better sensitivity compared to previous continuum observations. NGC 4522 is a Virgo spiral galaxy undergoing active ram pressure stripping. This galaxy is particularly well known for the CO emission detected outside its stellar disk, some of which coincides with the extraplanar HI gas and H α patches. The major goal of our JVLA observation is to leverage our understanding of the influence of the ram pressure on the general ISM field and multi-phase medium. By combining our new deep radio continuum data and previous observations, we will investigate how the B-field properties can be affected by the ram pressure, and what roles the B-field plays in the stripping process of the multi-phased ISM and in the star formation activity when the ram pressure is present.

[포 GC-17] Physical Connection between Ionized Outflows and Radio jets in Young Radio Quasars.

Seong Hyeon Hwang, Minjin Kim
Department of Astronomy and Atmospheric Sciences, Kyungpook National University

We present NIR spectroscopic data of young radio quasars obtained from Flamings-2 (F2) at Gemini-South. The targets are originally selected

from Wide-Field Infrared Survey Explorer survey in combination with radio survey data, such as FIRST and NVSS. Our goal is to find observational evidence of jet-driven outflows, which is expected to be present in young luminous quasars from the theoretical studies. While 16 targets were observed with F2, narrow emission lines ([O III] or H α) were detected in 7 targets. FWHM of the emission lines (up to 2500 km/s) were remarkably broad compared to ordinary quasars, revealing the presence of strong outflows. The black hole mass estimated from Eddington limit ranges from ~ 108 to 109 solar mass, indicating that the target quasars are likely to be progenitors of massive galaxies. Finally, we present the comparisons between the outflow velocity and the physical properties of radio jets derived from the VLA radio imaging data, in order to investigate the physical connection between the ionized outflows and radio jets.

[포 GC-18] Evolution of Star Formation Rate - Density Relation over Cosmic Time in a Simulated Universe: the Observed Reversal Reproduced

Ho Seong Hwang¹, Jihye Shin¹, Hyunmi Song^{1,2}
¹*Korea Astronomy and Space Science Institute,*
²*Yonsei University*

We use the IllustrisTNG cosmological hydrodynamical simulation to study the evolution of star formation rate (SFR)-density relation over cosmic time. We construct several samples of galaxies at different redshifts from $z=2.0$ to $z=0.0$, which have the same comoving number density. The SFR of galaxies decreases with local density at $z=0.0$, but its dependence on local density becomes weaker with redshift. At $z \geq 1.0$, the SFR of galaxies increases with local density (reversal of the SFR-density relation), and its dependence becomes stronger with redshift. This change of SFR-density relation with redshift still remains even when fixing the stellar masses of galaxies. The dependence of SFR on the distance to a galaxy cluster also shows a change with redshift in a way similar to the case based on local density, but the reversal happens at a higher redshift, $z \sim 1.5$, in clusters. On the other hand, the molecular gas fraction always decreases with local density regardless of redshift at $z=0.0-2.0$ even though the dependence becomes weaker when we fix the stellar mass. Our study demonstrates that the observed reversal of the SFR-density relation at $z \geq 1.0$ can be successfully reproduced in cosmological simulations. Our results are consistent with the idea that massive, star-forming galaxies are strongly clustered at high redshifts, forming larger structures. These

galaxies then consume their gas faster than those in low-density regions through frequent interactions with other galaxies, ending up being quiescent in the local universe.

천문우주관측기술

[포 AT-01] Development of public release system of science mission data from KPLO and future space explorations

Joo Hyeon Kim
Korea Aerospace Research Institute

우리나라는 최초의 우주탐사선이자 달탐사선인 KPLO를 2022년 8월에 발사할 예정이다. KPLO에는 6기의 임무 탑재체가 실리게 되며, 이중 4개의 탑재체는 국내의 대학과 정부출연연구소에서 개발하여 달 표면과 주변 우주환경에 대한 과학임무를 수행하게 된다.

이들 국내에서 개발된 과학탑재체가 달 궤도에서 획득한 Data, 즉 과학자료는 지상국에서 수신하여 이를 처리하여 과학연구 혹은 교육 목적으로 활용될 것으로 예상된다. 이러한 태양계 탐사 과학임무로부터 획득된 과학자료는 과학의 공익성과 연구교류 활성화를 위해서 국제적으로 대중에게 공개하고 있다. 이에 KPDS도 일반 사용자들이 인터넷으로 이들 과학자료를 쉽게 검색하고 다운로드 받을 수 있도록 한국항공우주연구원에서는 KARI Planetary Data System(KPDS)를 구축하고 있으며, 일반에게 공개할 예정이다.

KPDS는 단순히 과학자료를 제공하는 것에서 그치지 않고, 이들 과학자료가 NASA에서 개발한 PDS4 표준을 준수하고 있는지 검증함으로써 세계 각국의 타 우주관련 기관과 상호활용이 용이하도록 하여 활용성을 높은 과학자료로 관리하게 된다. 또한 이러한 PDS4 표준 준수여부를 검증함으로써 KPLO 이후 우리나라에서 수행하게 될 미래의 우주탐사 과학임무로부터 획득될 과학자료도 저장, 공개할 수 있도록 KPDS는 범용성을 고려하여 개발하고 있다.

[포 AT-02] Deep Learning Study of the 21cm Differential Brightness Temperature During the Epoch of Reionization

Yungi Kwon¹, Sungwook E. Hong²
¹Department of Physics, University of Seoul,
²Natural Science Research Institute, University of Seoul

We propose a deep learning analysis technique with a convolutional neural network (CNN) to predict the evolutionary track of the Epoch of Reionization (EoR) from the 21-cm differential brightness temperature tomography images. We use 21cmFAST, a fast semi-numerical cosmological

21-cm signal simulator, to produce mock 21-cm maps between $z = 6 \sim 13$. We then apply two observational effects, such as instrumental noise and limit of (spatial and depth) resolution somewhat suitable for realistic choices of the Square Kilometre Array (SKA), into the 21-cm maps. We design our deep learning model with CNN to predict the sliced-averaged neutral hydrogen fraction from the given 21-cm map. The estimated neutral fraction from our CNN model has great agreement with the true value even after coarsely smoothing with broad beam size and frequency bandwidth and heavily covered by noise with narrow beam size and frequency bandwidth. Our results show that the deep learning analyzing method has the potential to reconstruct the EoR history efficiently from the 21-cm tomography surveys in future.

[포 AT-03] Optical Design for UVOMPIS and Design Concept of the Mirror Holder

Woojin Park¹, Seunghyuk Chang², Soojong Pak¹, Jimin Han¹, Hojae Ahn¹, Sunwoo Lee¹, Geon Hee Kim³, Dae-Hee Lee⁴

¹Kyung Hee University, ²Center for Integrated Smart Sensors, Korea Advanced Institute of Science and Technology (KAIST), ³Korea Basic Science Institute, ⁴Korea Astronomy and Space Science Institute

We present the optical design of Linear Astigmatism Free - Three Mirror System (LAF-TMS) D200 for UVO-Multiband Polarizing Imager System (UVOMPIS). LAF-TMS D200 is the off-axis wide-field telescope with EPD = 200 mm, F/2, and Field of View (FoV) = $2^\circ \times 4^\circ$. Its optical mirrors are optimized to freeform surfaces for high-quality optical performance over a wide FoV. The proposed mirror holder consists of four aluminum optomechanical modules that have applied for LAF-TMS D150 which is a prototype of the LAF-TMS system. It can accurately mount mirrors and also can sustain from vibration environments. As a feasibility study, quasi-static, modal, harmonic, and random vibration analyses have been performed to LAF-TMS D150 optomechanical structure under the qualification level of the Soyuz-2/Fregat launch system. We evaluate the vibration analysis results in terms of von Mises stress and Margin of Safety.

[포 AT-04] Johnson BV standardization of 60cm telescope at Gyeonggi Science High School for the Gifted

Hojae Ahn¹, Seungjun Oh², Hyundong Lee², Woojin