a general purpose high dispersion instrument that is fiber-fed and capable of extremely precise radial velocity measurements. G-CLEF has undergone a preliminary design review in April 2015 and is now entering final design phase and construction. G-CLEF has been designed to measure the mass of Earth-analogue exoplanets and to make critical observations in near-field and high-Z cosmology. We describe the G-CLEF instrument and several key science missions that shaped the development of G-CLEF. First light on the GMT is scheduled for late 2020.

[초 IT-05] Young Open Clusters: Their Uses in Star Formation Studies

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Open clusters are one of stellar systems consisting of a few hundreds to thousands of stars. The cluster members are, in general, believed to be a coeval stellar population at the same distance, and therefore they have almost the same properties in chemical composition and kinematics. Owing to these advantages, the clusters are utilized in many astronomy studies, such as the calibrations of distance and stellar age scales, assessments of stellar evolution theories, and the chemical evolution of the Galactic disk. Young open clusters are, inter alia, superb objects to study star formation process as most of stars are known to be formed in clusters. In this talk, I will review the uses of these young open clusters in star formation studies based on the ongoing work of our research group on the stellar initial mass function, an age spread problem, mass accretion rate of pre-main sequence stars, and a feedback of high-mass stars on surroundings.

외부은하 / 은하단

[박 GC-01] Selection of High Redshift Quasars with Multi-wavelength Data

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High redshift quasars (z > 5) hold keys to understanding the evolution of the universe in its early stage. Yet, the number of high redshift quasars uncovered from previous studies is relatively small (70 or so), and are concentrated mostly in a limited redshift range (z ~ 6). To understand the early mass growth of supermassive black holes and the final stage of the cosmic reionization, it is important to find a statistically meaningful sample of quasars with various physical properties. Here we present a survey for high redshift quasars at 5 < z < 7. Through color selection techniques using multi-wavelength data, we found quasar candidates and carried out imaging follow-up observations to reduce contaminants. After optical spectroscopy, we discovered eight new quasars. We obtained near-infrared spectra for 3 of these 8 quasars, measured their physical properties such as black hole masses and Eddington ratios, and found that the high redshift quasars we discovered are growing via accretion more vigorous than those of their lower redshift counterparts. We estimated the quasar number densities from our discoveries and compared them to those expected from the quasar luminosity functions in literature. In contrast to the observed number density of quasars at z ~ 5, which agrees with literature, the observed number density at z ~ 7 shows values lower than what is expected, even after considering an extrapolated number density evolution. We conclude that the quasar number density at z ~ 7 declines toward higher redshift, more steeply than the empirically expected evolution.

[구 GC-02] Mapping the Polarization of the Radio-Loud Lyman Alpha Nebula B3 J2330+3927

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Lyα nebulae, or "Lyα blobs", are extended (~100 kpc), bright (L[Lyα] ~ 1044 erg/s) clouds of Lyα -emitting gas. The origin of the Lyα emission remains unknown, but recent theoretical work suggests that measuring the polarization could discriminate among powering mechanisms. we will discuss current status of Lyα polarization observations at high-redshift and our on-going survey program. We will present the first narrow-band, imaging polarimetry of a Lyα blob, B3 J2330+3927 at z=3.09, with an embedded, radio-loud AGN (C. You et al. in prep.). The AGN lies near the blob's Lyα emission peak and its

radio lobes align roughly with the blob's semi-major axis. With the SPOL polarimeter on the MMT telescope, we map the polarization in a grid of circular apertures of radius 0.6" (4.4 kpc), detecting a significant (>2σ) polarization fraction P% in 10 apertures and achieving strong upper-limits (as low as 2%) elsewhere. The degree of the polarization map increases from P% ~ 5% at ~5 kpc from the blob center to ~20% at the outer part (~30 kpc). The detections are distributed asymmetrically, roughly along the blob's major axis. The polarization angles (θ) are mostly perpendicular to this axis. These results are consistent with the picture that Lyα photons produced at the AGN (or the host galaxy) are resonantly scattered away from the center. Higher polarization fraction on the radio jet suggests that the gas is more optically thin along the jet than the off-axis region.

[구 GC-03] The Environmental Dependence of the Mass-Size Relation for the Most Massive Galaxies

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We study the environmental dependence of the mass-size relation for the most massive early type galaxies ($M>10^{10.7}M_{\odot}$) in the redshift range 0.10~0.15. As a measure of the environment, galaxy number densities are measured by the 10^{th} nearest galaxies within 6500km/s from galaxies with spectroscopic redshifts. The sizes of galaxies are measured by non-parametric method. We find that galaxies more massive than $10^{11.1}M_{\odot}$ show the environmental dependence in the mass-size relation. The galaxies with $M> 10^{11.1}M_{\odot}$ located in the densest, cluster like environment have larger sizes and extended surface brightness profiles than their counterparts located in a low dense environment. We also find that the environmental dependence of the mass-size relation is more significant for the brightest cluster galaxies (BCGs) than non-BCGs. Our result can be explained with a hierarchical growth of the most massive galaxies through dissipation-less merger in dense environment.

[구 GC-04] Alignments of interacting haloes in the Horizon run 4 simulation

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Interactions such as mergers and flybys play a fundamental role in shaping galaxy morphology. We used the Horizon Run 4 cosmological N-body simulations to study the aligments of spins and shapes of interacting haloes as a function of the halo mass and large-scale density.

Interactions preferentially occur in the plane of rotation, and in the direction of the major axis of prolate haloes, and the trajectories are preferentially radial and prograde.

We found a very strong alignment of the shapes already at redshift as high as 4.

The spins are initially unaligned or even anti-aligned, and become more and more aligned as the redshift decreases.

The alignment signals are stronger and evolve more at lower densities, and mass plays a secondary role.

[구 GC-05] Mock Galaxy Catalogs from the Horizon Run 4 Simulation with the Most Bound Halo Particle - Galaxy orrespondence Method

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We introduce an advanced one-to-one galaxy correspondence method that populates dark matter halos with galaxies by tracing merging histories of most bound member particles (MBPs) identified in simulated virialized halos. To estimate the survival time of a satellite galaxy, we adopt several models of tidal-destruction time derived from an analytic calculation, isolated galaxy simulations, and cosmological simulations. We build mock galaxy samples for each model by using a merging tree information of MBPs from our new Horizon Run 4 N-body simulation from $z = 12$ to 0. For models of galaxy survival time derived from cosmological and isolated galaxy simulations, about 40% of satellites galaxies merged into a certain halo are survived until $z = 0$. We compare mock galaxy samples from our MBP-galaxy correspondence scheme and the subhalo-galaxy scheme with SDSS volume-limited galaxy samples around $z = 0$ with $M_r - 5\log h < -21$ and -20. Compared to the subhalo-galaxy