"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Invited talk
11/19/2019, 9:00 - 9:25

**Ivo Labbe**
(Swinburne University of Technology)

Title: **The first billion years of galaxy formation**

Abstract: The formation of the first galaxies is one of the most exciting frontiers in studies of galaxy evolution. We can now observe galaxies when the universe was only a few percent of its current age, and trace their rapid growth with time. Yet significant questions and challenges remain. When did the first galaxies form? What are the properties of the galaxy stellar populations, their capability to produce ionizing photons, and their role in reionizing the intergalactic medium? I will review results from deep observations with ground- and space-based telescopes, highlighting recent advances from the final mission of the Spitzer Space Telescope and the Atacama Large Millimeter Array. Informed by these, I will look ahead as we prepare for the launch of the forthcoming James Webb Space Telescope.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 9:25 - 9:40

**Daichi Kashino**
(ETH Zurich)

Title: **Exploring the end tail of cosmic reionization with Subaru/HSC**

Abstract: Measurements of the effective optical depth (tau_eff) of the Lyman-alpha forest have established the increase in the average HI opacity of the IGM back to z~6, the end epoch of reionization. Interestingly, the observed dispersion in tau_eff increases dramatically at z>5.5 and very large opaque regions have been discovered even though the Universe was largely reionized by then. Two major scenarios have been proposed to reproduce the observed tau_eff distribution, which invoke large fluctuations either in the ionizing background or IGM temperature, and predict contradictory correlation between tau_eff and large-scale matter density. In order to distinguish these scenarios, we have been carrying out galaxy surveys in the redshift range 5.5<~z<~6.0 using Subaru/HSC in the fields where tau_eff measurements are available from z>6 quasar spectra. The wide-field imaging enables us to construct the galaxy density maps and correlate the galaxy surface density with the opacity measurement in each redshift slice and line of sight. In this presentation, we present our first results and discuss which scenario is preferred.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 9:40 - 9:55

**Satoshi Yamanaka**
(Waseda University )

Title: **CHORUS: Candidates of Lyman continuum galaxies at z=3.3 and 4.9 selected from CHORUS narrow-band data**

Abstract: We report the candidates of Lyman continuum galaxies (LCGs) at z=3.3 and 4.9 selected from the narrow-band images which are observed as a part of Cosmic HydrOgen Reionization Unveiled with Subaru (CHORUS; PI: A.K. Inoue) project. In order to understand the dominant sources of cosmic reionization, the fraction of ionizing photons (Lyman continuum; LyC) which escape from galaxies into the surrounding intergalactic medium is one of the most important physical quantities of star-forming galaxies. The wide area and deep narrow-band imaging survey with Subaru/Hyper Suprime-Cam is a powerful and efficient way to search for the high-z LCGs and to constrain the escape fraction of LyC. We investigate the LyC from the Lyman alpha emitter candidates at z=3.3 and 4.9 by using the unique narrow-band filters of Subaru/NB0387, NB0527, and NB0718. As a result, we find some possible candidates of LCGs at z=3.3 and 4.9. When the LyC from the LCGs at z=4.9 is confirmed, it is the highest-z LCGs so far. We show the details of our LCG candidates, and discuss the escape fraction and the possibility of the foreground contamination.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 9:55 - 10:10

**Shotaro Kikuchihara**
(University of Tokyo)

Title: **Early Low-Mass Galaxies and Star-Cluster Candidates at z~6-9**

Abstract: We present very faint dropout galaxies at z~6-9 with a stellar mass M* down to M*~10^6Mo that are found in the Hubble Frontier Fields (HFF) program in conjunction with the deep Spitzer images and lensing effects. We investigate stellar populations of the galaxies with the optical/NIR photometry and BEAGLE (stellar population synthesis + photoionization) models, identifying 357 galaxies with M*~10^6-10^9Mo. We derive the galaxy stellar mass functions (GSMFs) at z~6-9 that extend a stellar mass limit to M*~10^6Mo. Comparing M* of the galaxies with the effective radii R_e on the source plane, we have pinpointed two objects with low stellar masses (M*<=10^7Mo) and very compact morphologies (R_e<=40pc) that are comparable with those of globular clusters (GCs) in the Milky Way today. These objects are candidates of star clusters that should be a part or a dominant component of high-redshift low-mass galaxy, some of which may be related to GCs today. We discuss future spectroscopic observations for the high-redshift GC candidates with the Subaru Telescope.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"

Invited talk

11/19/2019, 10:25 - 10:50

**Catlin Casey**

(UT Austin)

Title: **Rare galaxies in the early Universe**

Abstract: I will present some of the difficulties and challenges in identifying some of the most rare galaxy populations -- like submillimeter luminous galaxies and luminous AGN -- beyond z>4. These galaxies represent the Universe's first massive galaxies, and likely sit at the nodes of the cosmic web, linking together dense filaments tracing out protocluster environments. Our techniques used to identify these galaxies has tremendous impact on how we interpret their importance.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 10:50 - 11:05

**Ken-ichi Tadaki**
(NAOJ)

Title: **A sub-kiloparsec-view of the most massive star-forming galaxies at z>4**

Abstract: Submillimeter galaxies at z>4 are the most likely progenitors of compact quiescent galaxies at z=1-3. They are building up their central cores through compact starbursts with an effective radius of 1-2 kpc. ALMA 0.08-arcsec resolution observations reveal off-center gas clumps in a submillimeter galaxy at z=4.3 as well as a rotation-dominated disk. Exploiting the kinematic properties and the spatial distribution of molecular gas mass surface density, we find that the starburst disk is gravitationally unstable, implying that the self-gravity of gas overcomes the internal pressure by stellar feedback. This result is consistent with a scenario that in-situ clumps are formed through disk instability. On the other hand, we find an evidence for an ex-situ clump that does not corotate with the starburst disk. The accretion of such a non-corotating clump could stimulate violent disk instability, driving gas inflows into the central regions of the galaxy. Our results suggest that compact cores are formed through an extreme starburst due to a gravitational instability, triggered by non-corotating clumps. New laser tomography AO experiments on Subaru (ULTIMATE-START) will provide high-resolution K-band images, which are essential for characterizing the stellar component of in-situ/ex-situ gas clumps at z=4.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 11:05 - 11:20

**Seiji Fujimoto**
(U. Waseda)

Title: **First Identification of 10-kpc Scale [CII] 158um Halos around Star-Forming Galaxies at z=5-7**

Abstract: We report the discovery of 10-kpc scale [CII] 158um halos surrounding star-forming galaxies in the early Universe. We choose deep ALMA data of 18 galaxies each with a star-formation rate of ~ 10-70 Msun with no signature of AGN whose [CII] lines are individually detected at z=5.153-7.142, and conduct stacking of the [CII] lines and dust-continuum in the uv-visibility plane. The radial profiles of the surface brightnesses show a 10-kpc scale [CII] halo at the 9.2sigma level significantly extended more than the HST stellar continuum data by a factor of ~5 on the exponential-profile scale length basis, as well as the dust continuum. We also compare the radial profiles of [CII] and Lya halos universally found in star-forming galaxies at this epoch, and find that the scale lengths agree within the 1sigma level. The existence of the extended [CII] halo is the evidence of outflow remnants in the early galaxies and suggest that the outflows may be dominated by cold-mode outflows, which challenges current galaxy evolution models.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 11:20 - 11:35

**Ryota Kakuma**
(The University of Tokyo, ICRR)

Title: **Cross-Correlation Ly$\alpha$ Intensity Mapping with Star-Forming Galaxies at z = 5.7 and 6.6**

Abstract: We present results of the cross-correlation Lya intensity mapping with Subaru/HSC ultra-deep narrowband images and LAEs at z=5.7 and 6.6 in a total area of 4 square degrees. Although overwhelming amount of data quality controls have been performed for the narrowband images and the LAE samples, we further conduct extensive analysis evaluating systematics. Removing the systematics, we carefully calculate cross-correlations between Lya intensity of the narrowband images and the LAEs.

We identify very diffuse Lya emission with the $3\sigma$ ($2\sigma$) significance at $>$ 150 ckpc far from the LAEs at z=5.7 (6.6), beyond a virial radius of star-forming galaxies with M_h ~ 10^11 M$\odot$. The diffuse Lya emission possibly extends up to 1,000 ckpc with the surface brightness of 10^−20−10^−19 erg s^−1 cm^−2 arcsec^−2. We confirm that the small-scale ($<$ 150 ckpc) Lya radial profiles of LAEs in our Lya intensity maps are consistent with those obtained by recent MUSE observations. Comparisons with numerical simulations suggest that the large-scale (~ 150−1,000 ckpc) Lya emission are not explained by unresolved faint sources of neighboring galaxies including satellites, but by a combination of Lya photons emitted from the central LAE and other unknown sources, such as a cold-gas stream and galactic outflow.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Invited talk
11/19/2019, 13:30 - 13:55

**Taddy Kodama**
(Astronomical Institute, Tohoku University)

Title: **Past 20 years of panoramic studies of distant clusters with Subaru and the Future**

Abstract: Since the first open-use science operation of Subaru in 2000, we have been targeting distant clusters of galaxies, taking the unique advantages of wide-field observation capabilities of Subaru both in optical and near-infrared.
Our original PISCES project mapped out large-scale structures in and around clusters at $0.4<z<1.3$ on 30Mpc co-moving scale. The next Mahalo-Subaru project has extended the survey back to $z=2.5$. Using narrow-band filters, we have been mapping star-forming line emitters in and around clusters and porto-clusters, and revealing the inside-out quenching of star formation activities from cluster cores to the surrounding regions as time progresses.
In the dense cores of a cluster at the cosmic noon ($z=2.5$), we see an enhancement of star forming activities, which are likely driven by ample gas that is supplied by massive gas inflow through the filamentary structures. It is consistent with strong Lya line attenuations with respect to the Ha emission lines as indicated by dual narrow-band imaging (Lya and Ha), and also with higher molecular gas mass fraction as observed with ALMA (Gracias-ALMA project). Together with other results in the literature, we argue that the gas accretion mode may be changed from the cold accretion mode accompanied by high star formation activity, to the hot mode where gas cooling and thus accretion to galaxies become inefficient, resulting in the quenching of the cluster cores.
We are now extending the Subaru cluster survey to even much larger areas with HSC by the project named HSC^2. By combining the red-sequence technique and the narrow-band imaging technique, we can construct more representative samples of galaxy clusters by mitigating the selection bias. We plan to follow-up those unique cluster samples with PFS, in order to characterize galaxy properties, and to investigate environmental effects and quenching histories over the cosmic times.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 13:55 - 14:10

**Satoshi Kikuta**
(Sokendai / NAOJ)

Title: **Lyman-alpha view around a z = 2.84 hyperluminous QSO at a node of the cosmic web**

Abstract: We report on the results of deep and wide-field (1.1 deg^2) narrow-band observations with HSC of a field around a hyperluminous QSO (HLQSO), HS1549+1919, residing in a protocluster at z = 2.84, to map the large-scale structure of Ly$\alpha$ emitters (LAEs). One HSC pointing enables us to detect 3490 LAEs and 76 extended Ly$\alpha$ blobs (LABs), probing diverse environments from voids to protoclusters. The HLQSO is found to be near the center of the protocluster, which corresponds to the intersection of ~100 comoving Mpc-scale structures of LAEs. LABs are basically distributed along the large-scale structure, with larger ones particularly clustering around the HLQSO, confirming a previously noted tendency of LABs to prefer denser environments. Moreover, the shapes of LABs near the HLQSO appear to be aligned with the large-scale structure. Finally, a deep Ly$\alpha$ image reveals a diffuse Ly$\alpha$ nebula along a filamentary structure with no luminous UV/sub-mm counterpart, which may be due to a cold filament with high clumping factor illuminated by the QSO, with the required high clumpiness provided by unresolved residing halos of mass $\leq 10^{9-10} M_\odot$. Dependence of Ly$\alpha$ halos of LAEs on photometric properties are also probed through stacking analysis.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 14:10 - 14:25

**Michael Rich**
(UCLA)

Title: **Extended Lyman Alpha Nebulae associated with Radio Overdensities at z~3**

Abstract: We have imaged the fields of radio source overdensities at z~3 and find 7 cases of extended Lyman alpha nebulae (LAN). We find that the LAN are extended on scales of >100 kpc. In one case, there appears to be three sites of emission adjacent to what appears to be emission associated with the galaxy cluster, which is consistent with models of cosmological cold flows. In contrast with LAN at z>4, we do not find clear sources of photoionization, such as a nearby QSO.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 14:25 - 14:40

**Hideki Umehata**
(RIKEN)

Title: **Gas filaments connecting galaxies and supermassive black holes in a proto-cluster**

Abstract: A generic prediction in a cold dark matter universe is the presence of a network of filaments within which galaxies form and evolve. However, the faintness of the emission from the intergalactic gas in these filaments had prevented us from testing this picture. We report the detection of Ly$\alpha$ radiation from multiple filaments connecting galaxies within a z=3.1 proto-cluster using VLT/MUSE and Subaru/Suprime-Cam. Together with spectroscopy using ALMA and Keck/MOSFIRE, intense star formation and supermassive black-hole activity is also found to occur within the galaxies embedded in this structure, which are the likely sources of the elevated ionizing radiation powering the observed Ly$\alpha$ emission. The network of filaments is believed to be responsible for powering star formation and black hole growth in one of the most active galaxy populations at z~3, in line with predictions of modern cosmological simulations.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 14:40 - 14:55

**Andrew Newman**
(Carnegie Observatories)

Title: **LATIS: Mapping the IGM and Galaxy Environments at z~2.5 with Magellan**

Abstract: I will introduce LATIS, the Lyman-alpha Tomography IMACS Survey, a 56-night project using the IMACS spectrograph at Magellan to produce the largest high-resolution three-dimensional maps of the intergalactic medium at z=2.2-2.8 to date. We are mapping the large-scale structure at ~1 pMpc resolution by observing the Lyman-alpha forest in deep spectra of ~3000 luminous Lyman-break galaxies. LATIS will ultimately cover a 1.7 deg^2 area, of which we have completed 0.6 deg^2 in the COSMOS and CFHT Legacy Survey fields. I will motivate the technique of Lyman-alpha tomography, introduce the design of the survey, and present our initial maps along with mock surveys performed in simulations. LATIS will provide environmental information for all galaxies within a 10^7 cMpc^3 volume using a technique that is independent of galaxy tracers and closely connected to the underlying matter density field. The LATIS data set will therefore be a powerful resource for studying environment-dependent galaxy evolution at cosmic noon, as well as a preview of larger tomography surveys that can be undertaken with PFS or the ELTs.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 15:30 - 15:45

**Tomoko Suzuki**
(Tohoku Univ./NAOJ)

Title: **Dissecting star-forming region within galaxies in a proto-cluster at z=2.53 with Subaru/IRCS+AO188**

Abstract: It still remains unclear if the structural growth of star-forming galaxies can differ depending on their surrounding environments. To trace how galaxies are building-up their structures, direct observations of on-going star formation within the galaxies are necessary. We conducted the Adaptive Optics (AO)-assisted imaging observations for star-forming galaxies in a dense proto-cluster core at z = 2.53 with Subaru/IRCS+AO188. We obtained the images of Halpha-emitting region as well as stellar continuum with an angular resolution of 0.2 arcsec by using the narrow-band filter. Based on the stacking analyses, we investigated the spatial extent of the star-forming region traced by Halpha and compared it to that of the stellar component. We found that the star-forming region is more extended than the stellar distribution for the massive star-forming galaxies (logM*>10), suggesting the inside-out growth of the structure. Our group has found a similar trend for star-forming galaxies at z~2-2.5 in general fields with the same observational technique. Our results suggest that the structural growth of star-forming galaxies at z~2-2.5 is dominated by the internal secular processes rather than the external processes irrespective to the surrounding environments.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 15:45 - 16:00

**Tao Wang**
(University of Tokyo)

Title: **Environmental effects on massive galaxy formation from the most distant X-ray clusters**

Abstract: The role of local environment in massive galaxy formation remains debated. While it has been known that massive ellipticals are preferentially located in dense environments, the early assembly of these galaxies makes it difficult to explore what is the role of environment during their formation/quenching. Here we combine multiwavelength observations with Subaru, VLT, VLA, and ALMA towards the most distant known X-ray cluster at z=2.51, to reveal a key formation phase of massive clusters, in which clear evidence of environmental dependence on galaxy star formation and gas properties has been observed. This provides direct evidence on the environmental dependence of massive galaxy formation at their peak formation epoch.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 16:00 - 16:15

**Shigeru Namiki**
(SOKENDAI)

Title: **The environmental impacts on the mass-metallicity relation at z=1.52.**

Abstract: We present the results of our near-infrared (NIR) spectroscopic observations of a rich cluster candidate around a radio galaxy at z = 1.52 (4C65.22) with Subaru/MOIRCS and LBT/LUCI. We observed 71 galaxies mostly on the star-forming main sequence selected by our previous broadband (photo-z) and narrow-band H$\alpha$ imaging observation with Subaru in this cluster environment. We successfully confirmed the redshifts of 39 galaxies, and conclude that this is a gravitationally bound, real cluster at z = 1.517. Our spectroscopic data also suggest a hint of large-scale filaments or sheet-like three-dimensional structures crossing at the highest-density cluster core. By stacking the spectra to derive their average interstellar medium (ISM) gas-phase metallicity based on the [N II]/H$\alpha$ emission line flux ratio, we find that the mass-metallicity relation (MZR) in the 4C65.22 cluster environment is consistent with that of H$\alpha$- selected field galaxies at similar redshifts. Our results suggest that the environmental impact on the MZR is small at high redshifts, but chemical evolution in the high-z cluster is still under debate and there is only less than ten cluster sample. We believe that PFS and ULTIMATE Subaru would enable us to perform the discussion with a large number of deep spectroscopic data.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 16:15 - 16:30

**Masao Hayashi**
(NAOJ)

Title: **Probing large-scale structures at z<1.6 by HSC wide-field survey**

Abstract: Subaru HSC is a powerful instrument to reveal the large-scale structures over several tens Mpc scale and its redshift evolution, which is essential to better understand the structure formation and evolution in Universe. We demonstrated that the already-known supercluster CL1604 at z~0.9 is a part of the more extended structures and thus the tip of the iceberg. A set of narrow-band (NB) filters also makes HSC unique. Using the HSC-SSP DR1 data, we revealed the large-scale structures of star-forming galaxies on about 50 comoving Mpc scale including galaxy clusters, filaments, and voids. Now, the NB data available from the HSC-SSP DR2 and CHORUS surveys allow us to expand our previous study in terms of denser redshift slices and wider/deeper survey than the DR1. We proceed to conduct follow-up spectroscopy of more than one thousand NB emitters using 2dF+AAOmega at AAT, and then confirm them at a high success rate. The combination of wide-field imaging and multi-fiber spectroscopy is a pilot study for the synergy of HSC and PFS. We will present a unique ability of HSC in revealing the large-scale structures at z<1.6 and then discuss how the galaxies have evolved along the structures by combining with the spectroscopic data.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 16:30 - 16:45

**Mike Hudson**
(University of Waterloo)

Title: **First weak lensing results from the UNION Survey**

Abstract: Gravitational lensing is a powerful method of mapping the distribution of matter around galaxies, clusters, voids and filaments in the cosmic web. I will review recent results from weak lensing surveys, including the first map of dark matter dominated filaments between galaxies in the cosmic web, and the link between galaxies and their host halos: dependence on redshift, stellar mass, colour, and galaxy size. Finally I will present the first weak lensing results from the Ultraviolet Near-Infrared Optical Northern Survey (UNIONS): a survey whose goal is 5000 square degrees of pan-chromatic data from CFHT, Pan-STARRS and Subaru.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/19/2019, 16:45 - 17:00

**Takashi Kojima**
(University of Tokyo)

Title: **Extremely Metal-poor Galaxies Probed with Subaru/HSC Deep Imaging and Optical Spectroscopy**

Abstract: Early-epoch galaxies are expected to have primordial characteristics such as very low metallicity (<10% Zsun), low stellar mass (10^6 Msun), and young stellar age (<30 Myr). Galaxies with such characteristics have been discovered in the local universe, which are called extremely metal-poor emission-line galaxies (EMPGs). EMPGs provide us a nearby laboratory helpful to understand the very early-phase of star formation.
In this study, we search for EMPGs in the local universe (z<0.02) from deep imaging data of Subaru/HSC-SSP as well as wide-field imaging data of SDSS. We have successfully selected ~70 EMPG candidates over a wide range of i=17–24 mag thanks to the combination of the HSC and SDSS data. Recently, we have identified 10 real EMPGs in our pilot optical spectroscopy with Keck/DEIMOS, Subaru/FOCAS, and Magellan/LDSS3+MagE. In this talk, we report results of the pilot spectroscopy and discovery of one of the most metal-deficit galaxies discovered ever (~2% Zsun). We discuss the existence of very hot star population in EMPGs suggested by high-ionization lines and elemental abundances.

“KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity”
Contribution poster
11/19/2019, 17:00 - 17:15

**Tetsuya Hashimoto**
(National Tsing Hua University)

Title: **A young galaxy cluster in the old Universe**

Abstract: "Galaxies evolve from a blue star-forming phase into red quiescent one by quenching their star-forming activity. In high density environments, this galaxy evolution proceeds earlier and more efficiently. Therefore, local galaxy clusters are dominated by well-evolved red, elliptical galaxies. Here we report a discovery of a "blue cluster", that is a local galaxy cluster with an unprecedentedly high fraction of blue star-forming galaxies yet hosted by a massive dark matter halo. The blue fraction is 0.57 that is 4.0 sigma higher than those of the other comparison clusters under the same selection and identification criteria. The velocity dispersion of the member galaxies is 510 km/s, which corresponds to a dark matter halo mass of $2.0^{+1.9}_{-1.0} \times 10^{14}$ Msun. The blue fraction of the cluster is more than 4.7 sigma beyond the standard theoretical predictions including semi-analytic models of galaxy formation. The probability to find such a high blue fraction is only 0.003%, which challenges the current standard frameworks of the galaxy formation and evolution in the Lambda CDM Universe. The galaxy distribution suggests the existence of filamentary cold gas streams in the massive halo even in the local Universe, which has already disappeared in the theoretically simulated local Universes. "

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Invited talk
11/21/2019, 9:00 - 9:25

**Gwen Rudie**
(Carnegie Observatories)

Title: **The Circumgalactic Medium of Star-Forming Galaxies at 2<z<3**

Abstract: The exchange of baryons between galaxies and their surrounding intergalactic medium (IGM) is a crucial but poorly-constrained aspect of galaxy formation and evolution. I will present results from the Keck Baryonic Structure Survey (KBSS), a unique spectroscopic survey designed to explore both the physical properties of high-redshift galaxies and the connection between these galaxies and their surrounding intergalactic baryons. The KBSS is optimized to trace the cosmic peak of star formation (z~2-3), combining high-resolution spectra of hyperluminous QSOs with densely-sampled galaxy redshift surveys surrounding each QSO sightline. I will present new detailed studies of metal-enriched absorbing gas in the high-z CGM, highlighting the gas kinematics and thermal properties and the diversity of physical conditions found close to galaxies. I will also present new measurements of the evolution of hydrogen and carbon-bearing gas within the CGM from z~2.3 to z~0.2 which exhibit surprising trends. Collectively, these data constrain the nature and sphere of influence of galaxy-scale outflows, intergalactic accretion, and their evolution as a function of time.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/21/2019, 9:25 - 9:40

**Yuma Sugahara**
(ICRR, UTokyo)

Title: **Fast Outflows Identified in Early Star-Forming Galaxies at z = 5–6**

Abstract: We present velocities of galactic-scale outflows in seven star-forming galaxies at z=5-6 with a stellar mass of M*~10^{10.1} Mo. We make use of the ALMA [CII]158 um emission lines and the deep Keck/DEIMOS spectra of the galaxies at z=5-6 available to date, to obtain the precise systemic velocities and metal absorption lines, respectively. We fit outflow-line profiles to the SiII1260, CII1335, and SiIV1394,1403 absorption lines in a composite Keck spectrum. The measured maximum outflow velocity at z~5-6 is vmax=810^{+140}_{-160} km/s on average, which is higher than those at z=0 by a factor of 3.5 and comparable to z=2, at M*~10^{10.1} Mo. Interestingly, vmax shows a clear positive correlation with vcir, the halo circular velocity estimated from the stellar masses, for galaxies with M*=10^{10.0-10.8} Mo over z=0-6 with ~0.1 dex scatters. This positive correlation suggests that the outflow velocity is physically related to the halo circular velocity. The redshift evolution of vmax at M*~10^{10.1} Mo is explained by the increase of vcir toward high redshift.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Invited talk
11/21/2019, 9:40 - 10:05

**Annalisa Pillepich**
(MPIA)

Title: **Universe(s) in a box: insights from the TNG simulations and needed steps forward**

Abstract: Contemporary cosmological hydrodynamical simulations are reaching unprecedented levels of sophistication and complexity. Numerical programs like IllustrisTNG are allowing us to model reasonably realistic populations of galaxies across an ever wider range of masses, environments, evolutionary stages and cosmic epochs. There we resolve and model the structural details of thousands of galaxies together with the large-scale cosmic web by solving the equations of gravity and magnetohydrodynamics and by including prescriptions for star formation, stellar evolution, metal enrichment, cooling and heating of the gas, galactic outflows and feedback from the supermassive black holes, all within the LCDM paradigm. In the talk, I will give examples of the insights and quantitative characterizations that the IllustrisTNG simulations, and particularly the new TNG50 run, are suggesting us about the evolution and interplay of all matter components within and around galaxies. I will also discuss some of the future steps that are required to further improve the theoretical modeling, to enhance the discovery potential of astronomy data, and to augment the sophistication and veracity of the comparison between observed and simulated data.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Invited talk
11/21/2019, 10:20 - 10:45

**Camilla Pacifici**
(STScI)

Title: **Synergy between galaxy models and observations to unveil the high-redshift Universe**

Abstract: In the past years, ground-based and space telescopes have given us inestimable information about the Universe we leave in. We can now study the physical properties of galaxies from the present day, up to 13 billion years ago. However, the interpretation of high-resolution data, both in terms of spatial and spectral resolution, is becoming very challenging or even impossible without proper tools and comprehensive models. With the help of existing data, we need to develop and test new approaches that will allow us to deal with the amount of information we will receive in the future.
I will present how we can generate libraries of galaxy spectra where all components are computed in a consistent manner, using detailed star formation and chemical enrichment histories from cosmological simulations, state-of-the-art spectral models including nebular emission, and different treatments for dust attenuation. With such model spectra, we can simultaneously interpret spectral features and broadband photometry, from large scales to small regions inside a galaxy.
I will show how this approach is being applied to current observations from photometric and spectroscopic surveys and how it will be used for future observations to derive constraints on the stellar, dust, and metal content of high-redshift galaxies.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/21/2019, 10:45 - 11:00

**Ken Mawatari**
(Institute for Cosmic Ray Research, University of Tokyo)

Title: **Balmer Break Galaxy candidates in the Reionization Epoch: Hint on Star-Formation Activity at z > 10**

Abstract: We report a new sample of high-z passive galaxy candidates in the COSMOS field. We photometrically identify three candidate galaxies with the strong Balmer breaks (Balmer Break Galaxies; BBGs) at $5 < z < 8$ down to [3.6] ~ 24mag in the 0.41 deg^2 effective area. Follow-up observations with the Atacama Large Millimeter/submillimeter Array (ALMA) reveal that they are not detected in their dust emission. Comprehensive template fitting analysis of the observed spectral energy distributions (SEDs) reveals that galaxies as massive as ~ 5 x 10^10 Msun in stellar mass dominated by old stars already exist at z ~ 6, although contamination from exotic AGNs or ultra-luminous LBGs at z ~ 20 cannot be completely ruled out. While these BBGs make a small contribution to the cosmic stellar mass density in the z ~ 6 Universe, their stars should be formed at much higher redshift, $z > 10$. We estimate star-formation rate density (SFRD) owed by the BBG progenitors. Our estimate supporting smooth SFRD evolution beyond z ~ 8 will serve as a guide for future surveys aiming at direct identification of first galaxies.

“KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity”
Contribution talk
11/21/2019, 11:00 - 11:15

**Tomo Goto**
(National Tsing Hua University)

Title: **Revealing cosmic star formation history and black hole accretion history with AKARI and the HSC**

Abstract: Understanding infrared (IR) luminosity is fundamental to understanding the cosmic star formation history and AGN evolution. In the AKARI NEP wide field, AKARI has obtained deep images in the mid-infrared (IR), covering 5.4 sq.deg. However, our previous work was limited to the central area of 0.25 sq.deg due to the lack of deep optical coverage. To rectify the situation, we used the newly advent Subaru telescope's Hyper Suprime-Cam to obtain deep optical images over the entire 5.4 sq.deg of the AKARI NEP wide field. With this deep and wide optical data, we, for the first time, can use the entire AKARI NEP wide data to construct restframe 8um, 12um, and total infrared (TIR) luminosity functions (LFs) at $0.15<z<2.2$. A continuous 9-band filter coverage in the mid-IR wavelength (2.4, 3.2, 4.1, 7, 9, 11, 15, 18, and 24um) by the AKARI satellite allowed us to estimate restframe 8um and 12um luminosities without using a large extrapolation based on a SED fit, which was the largest uncertainty in previous work. By combining the AKARI and HSC data, we report dust-hidden cosmic star formation history and AGN evolution from $z=0$ to $z=2.2$.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/21/2019, 11:15 - 11:30

**Andrea Silva**
(NAOJ)

Title: **The star formation properties of merging galaxies at 0.3<z<2.5**

Abstract: We present a study of the influence of galaxy mergers on star formation at 0.3 < z < 2.5. Major mergers are selected from the CANDELS/3D-HST catalog using a peak-finding algorithm. Mergers have projected galaxy nucleus separation of their members between 3 and 15 kpc. We compare the star formation activity in merging and nonmerging galaxies and find no significant differences. We find that only 12% of the galaxies in major mergers are starbursting. The low fraction of starbursting merging galaxies in this sample suggests that at galaxy nucleus separations of 3-15 kpc merging galaxies are still in an early stage and are yet to reach the maximum level of star formation activity. Furthermore, the level of star formation enhancement and its duration could be arguably reduced compared to local mergers, as shown by simulations of high-z mergers, and might also depend on the physical properties (such as stellar mass and gas fraction) of the merging galaxies.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution talk
11/21/2019, 11:30 - 11:45

**Erin Kado-Fong**
(Princeton University)

Title: **Integrated Light Tidal Features Across the Mass Spectrum: Results from HSC-SSP**

Abstract: Observations of tidal features around external galaxies provide a window into the infall orbit, mass, and stellar populations of the satellite progenitors that form these extended features. Given its exquisite sensitivity, area, and seeing, HSC offers an unprecedented view of the low surface brightness universe that is complementary to deep, targeted observations of nearby galaxies. Building on previous work in which we developed a method to automatically detect tidal features around galaxies and generated one of the largest such samples to date (Kado-Fong et al. 2018), I will examine the formation mechanism of such tidal debris around massive galaxies as a function of the present-day morphology of the tidal feature system, and consider the correlation between the tidal feature morphology and the properties of its host galaxy. I will then present a sample of dwarf-dwarf mergers in the field, and examine the progression of star formation throughout the dwarf-dwarf merger sequence.

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Invited talk
11/21/2019, 13:30 - 13:55

**Sirio Belli**
(MPE / CfA)

Title: **The Star Formation Histories of Massive Quiescent Galaxies at z~2**

Abstract: Why do massive galaxies stop forming stars at high redshift? The nature of this quenching process is one of the most important missing pieces in the puzzle of galaxy formation.
Using deep Keck spectroscopy of massive quiescent galaxies at z~2, we were able to infer the star formation histories and measure the stellar ages for these systems. We found that, in order to reproduce simultaneously the observed age distribution and the number density evolution of quiescent galaxies, both a fast (~100 Myr) and a slow (~1 Gyr) quenching channels are needed. These measurements offer new, powerful constraints on the physical mechanisms responsible for galaxy quenching.

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Contribution talk
11/21/2019, 13:55 - 14:10

**Danilo Marchesini**
(Tufts University)

Title: **A Complete and Unbiased Photometric View of Ultra-massive Galaxies in the First 2 Gyr of Cosmic History**

Abstract: One of the most controversial questions regarding the formation and evolution of galaxies is when and how today's most massive galaxies form. At z=0, elliptical galaxies with Mstar>1012Msun are known to exist. These galaxies host the largest SMBHs and often live in clusters as BCGs. But what are their progenitors at z>3? What are their properties? At what epoch do they assemble? Are they always found in over-dense environments or do they also form in isolation? How often do they host AGNs? Do they all become BCGs by the present day? One surprising initial finding is that the number density of ultra-massive galaxies (UMGs; Mstar>3x10^11 Msun) evolves very little between z=4 to z=1.5. The formation of these massive galaxies so early in the Universe's history puts very tight constraints on models of galaxy formation and evolution. I will present the characterization of the stellar population properties, number density, AGN incidence, and environments of the largest sample, to-date, of UMGs at z>3 constructed from state-of-the-art photometric catalogs over ~8 deg^2 in XMM and CDFS. This sample (~60 UMGs; K<23.5 AB) is the first representative stellar-mass complete sample of UMGs in the first 2 Gyr of cosmic history, including both quiescent and dusty star-forming galaxies.

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Contribution talk
11/21/2019, 14:10 - 14:25

**Masayuki Tanaka**
(NAOJ)

Title: **Stellar velocity dispersion of a massive galaxy with suppressed star formation at z=4.01**

Abstract: We present a measurement of stellar velocity dispersion of the most distant, massive quiescent galaxy spectroscopically confirmed to date. Using deep multiwavelength data in UDS, we have constructed a photometric sample of massive (~10^11 Msun) galaxies with suppressed star formation rates at z~4. We carried out a spectroscopic follow-up observation of the brightest galaxy in the sample with Keck/MOSFIRE. The 7 hour MOSFIRE spectrum reveals 4 prominent Balmer lines and we confirmed the galaxy at z=4.01. This is the most distant galaxy with suppressed star formation rate confirmed to date. Thanks to the high S/N of the spectrum, we successfully measured its stellar velocity dispersion, sigma_* = 288 +- 61 km/s. This is consistent with the velocity dispersion of nearby massive galaxies, which indicates that the stellar velocity dispersion does not evolve significantly since z=4. Using the physical size of this galaxy measured from the deep HSC data, which is consistent with the typical size of massive quiescent galaxies at z~4 in the rest-frame optical from Kubo et al. (2018), we find that the stellar mass inferred from photometry is consistent with the dynamical mass, which excludes exotic IMF models. We discuss future prospects for JWST.

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Contribution talk
11/21/2019, 14:25 - 14:40

**Francesco Valentino**
(Cosmic Dawn Center - Niels Bohr Institute)

Title: **Quiescent galaxies at z~4: formation and evolution**

Abstract: We present our spectroscopic study of quenching/quiescent galaxies at z~4, resulted in the detection of 3 systems with Keck/MOSFIRE and VLT/X-Shooter. The absence of nebular emission lines and far-infrared detections confirms a suppressed star formation. From the joint modeling of the spectrum and the SED, we derive stellar masses of log(M⋆/Msun)~11, placing these galaxies >1-2 dex below the main sequence. Such modeling suggests that these sources experienced a strong (SFR~1200-1600 Msun/yr) and short (~50-150 Myr) burst of star formation in their past, properties reminiscent of the population of sub-mm galaxies (SMGs) generally indicated as candidate progenitors. We thus compare the comoving number densities and the expected properties of the progenitors with observations of z>4 SMGs, finding a fair agreement with the deepest surveys detecting not only the most extreme starbursts, but also more normal galaxies. Exploring the Illustris-TNG simulation, we do retrieve populations of quiescent galaxies at z~3-4 and SMGs at z~4-5, with number densities and properties in rough agreement with the observations at z~3, but in increasing tension at higher redshift. We find that not all the progenitors of z~4 quiescent galaxies shine as bright SMGs in their past and, conversely, not all bright SMGs quench by z~3.

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Contribution talk
11/21/2019, 14:40 - 14:55

**Kate Whitaker**
(UConn)

Title: **The REQUIEM Survey: REsolving QUIEscent Magnified Galaxies**

Abstract: Understanding the formation and quenching of massive quiescent galaxies at cosmic noon (z~2) remains a major problem in galaxy formation theory. While clues to their formation will be imprinted on the stellar populations in their inner cores, such analyses are beyond the capabilities of current technology. Here, we present some preliminary results from a unique upcoming survey leveraging the Hubble Space Telescope WFC3/G141 grism spectroscopy and ALMA dust continuum imaging of a unique sample of gravitationally lensed massive quiescent galaxies from z=1.5 to 3. The boost in spatial resolution and signal that strong gravitational lensing affords gives us the rare opportunity to perform spatially resolved age measurements at 0.5 kpc resolution and improved sensitivity to measure their gas content.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Invited talk
11/21/2019, 15:30 - 15:55

**Takahiro Morishita**
(STScI)

Title: **Probing evolution and quenching histories of massive galaxies at high redshift**

Abstract: Formation histories of early-type galaxies have been a long-standing question. The main conclusion from previous studies of local fossil records is that many of them have completed their star formation activity by z ~ 2. Recent findings of quenched galaxies at high redshift independently support this. Their formation histories at earlier times, and the primary driver for quenching, are still unclear.
In this talk, I will first present our latest work on massive, quenched galaxies at z ~ 2. Our new SED modeling, in combination with legacy HST spectroscopic + photometric data, reveals evolution histories of these galaxies with no functional assumption on the form of their star formation histories. Based on the results, I will discuss possible problems in SED modeling concerned with assumptions in star formation histories.
I will then present future plans with JWST/NIRSPEC and NIRISS. High-sensitivity/spectral resolution data at 1–5 $\mu$ m wavelength will push the current limit to higher redshifts, and possibly provide clues to the formation and death of the first generation of massive galaxies. I will highlight aspects that will be, and will not be, revealed by JWST, the latter of which has to wait for the advent of 30 m-class telescopes.

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Invited talk
11/21/2019, 15:55 - 16:20

**David Sanders**
(University of Hawaii, Institute for Astronomy)

Title: **The Hawaii Two-0 Survey: The Evolution of Massive Galaxies at $3 < z < 7$**

Abstract: The Hawaii 20 sq.deg. Deep Survey (H20) of the North Ecliptic Pole (NEP) and Chandra Deep Field South (CDFS) - the 2 major calibration fields for Euclid and WFIRST - is combining nearly 6000 Hrs. of "warm-Spitzer" imaging and 40 nights of Subaru-HSC imaging and Keck-DEIMOS spectroscopy to provide the first definitive constraints on the evolution of the massive galaxies, $\log(M^*/M_{sun}) > 10.5$, at $3 < z < 7$, estimates of their dark matter halos via clustering measurements, and identification of rare "Rosetta stone" objects that may be re-ionizing the universe at $z > 7$. I will review current state-of-the-art measurements of the galaxy mass function at $z > 3$, and show the improvements that will result from the Hawaii Two-0 Survey.

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Contribution talk
11/21/2019, 16:20 - 16:35

**Po-Feng Wu**
(Max Planck Institute for Astronomy)

Title: **Multiple paths from star-forming to quiescence: tracing galaxy formation with deep spectroscopic survey**

Abstract: The stellar populations record the trajectories of formation of galaxies. The LEGA-C spectroscopic survey dedicates 100 nights with VLT/VIMOS in obtaining high S/N continuum spectra of high-redshift galaxies. For the first time, we can access information on the stellar populations of $z>0.5$ galaxies for a representative sample. I will show the variety of formation histories as inferred from the spectra of over 1,000 galaxies at $z\sim1$. Together with the high-resolution images taken by the Hubble Space Telescope, I will demonstrate that galaxies follow multiple pathways evolving from star-forming to quiescent. On one hand, we see evidence for a process that slowly shuts off star formation and transforms star-forming galaxies to quiescent galaxies without necessarily changing their structures. On the other hand, there is likely another mechanism that rapidly quenches galaxies, an event that coincides with dramatic structural evolution. This complex behavior can only be revealed by a large sample of galaxies with high-quality spectra. Future multi-object spectrographs with high multiplicity on large telescopes will open up new opportunities in extra-galactic archeology.

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Contribution talk
11/21/2019, 16:35 - 16:50

**Pieter Van Dokkum**
(Yale University)

Title: **The sizes of massive galaxies in COSMOS-DASH**

Abstract: Wide area surveys of the distant Universe have been hampered by the lack of high resolution imaging in the near-infrared. To address this, we have executed COSMOS-DASH, a 0.6 square degree survey in the COSMOS field with the WFC3/IR camera on HST. This was possible thanks to an innovative technique that increased the near-IR mapping speed of Hubble by a factor of 8. We measured the size-mass relation of massive galaxies with these data, finding that the relation is not a powerlaw but shows an upturn at high masses. Furthermore, we find that the size-mass relation has the same form as the stellar mass-halo mass relation, for a simple conversion between the virial radius and r_80, the radius containing 80% of the light. The talk will also discuss prospects for improving size and total luminosity measurements of galaxies using low surface brightness-optimized telescopes, and the synergy between wide field optical and near-IR surveys from space and the ground.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution poster
Poster ID: P35

**Shiro Mukae**
(Univ. Tokyo)

Title: **HETDEX-HSC: Wide-Field Imaging Survey for Hobby-Eberly Telescope Dark Energy Experiment**

Abstract: We present our wide-field HSC survey for an emission line survey of Hobby-Eberly Telescope Dark Energy Experiment (HETDEX). We carry out the deep r-band imaging (10 $\sigma$ depth of r = 25.1) over the ~ 300 deg2 field where HETDEX now conducts a blind survey to identify one million LAEs at z = 1.9-3.5 with the ~35,000 fiber-fed IFU instrument, VIRUS on the 10m Hobby-Eberly Telescope. Our imaging data is essential to the HETDEX survey for distinguishing high-z LAEs and low-z [OII] emitters by the equivalent width discrimination and machine learning techniques. In the conference, we will discuss the synergy between HSC and HETDEX along with the progress of the HETDEX survey.

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Contribution poster
Poster ID: P36

**Akio Inoue**
(Waseda University)

Title: **CHORUS: Cosmic HydrOgen Reionization Unveiled with Subaru**

Abstract: I will present an overview of the CHORUS project, a Subaru intensive program. This is a deep multiple narrowband imaging survey in the COSMOS field. The observations are already completed last year and I will present the latest status of the data analyses as well as some initial science results including LyA luminosity functions at z=2--7 and Lyman continuum galaxy candidates at z=3--5.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution poster
Poster ID: P37

**Kazuyuki Ogura**
(Bunkyo University)

Title: **Semi-analytic examination for the cosmic variance on the H-alpha emitter distribution**

Abstract: The New Numerical Galaxy Catalog (nu^2GC) is a semi-analytic model for the galaxy formation, which is successful to reproduce various statistical properties of galaxies at 0<z<6 by combining the state-of-the-art N-body simulation and phenomenological model. A remarkable aspect of the nu^2GC is a large comoving volume up to ~1 Gpc^3 with sufficient mass resolution, which enables us to examine various properties of galaxies obtained by wide field surveys such as the Subaru Strategic Program survey with Hyper Suprime-Cam (HSC-SSP).

As a pilot study, we construct a model of H-alpha emitters (HAEs) with nu^2GC, resulting that it well reproduces H-alpha luminosity function (LF) at z=0.4 obtained by HSC-SSP observations. Based on the model, we have found that (1) HAEs are good tracer for the structure such as cosmic filaments, (2) the H-alpha luminosity function within ~2 deg^2 area show significant field variance up to ~1dex, and (3) >15 deg^2 surveys are required to converge the luminosity function.

We present the current status of our HAE model and future prospects of the model for comparing it with the PFS wide field survey.

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Contribution poster
Poster ID: P38

**Yongming Liang**
(SOKENDAI / NAOJ)

Title: **Correlation between galaxy and IGM at z~2.2 based on Subaru/HSC MAMMOTH overdensities and SDSS/(e)BOSS quasar spectra**

Abstract: The correlation on distribution between HI in the intergalactic medium (IGM) and galaxies now attracts great interests. In the MAMMOTH project, Cai+2016 found that Coherently Strong Lyman-alpha Absorption Systems (CoSLAs) can be ideal tracers for massive overdensities. We performed deep narrowband imaging using the Hyper Suprime-Cam (HSC) on the 8.2-m Subaru Telescope to probe Lyman Alpha Emitters (LAEs) at z~2.2 in the fields traced by such extreme groups of HI absorbers. The CoSLAs are selected from quasar spectra of the complete SDSS/(e)BOSS database covering over 10,000 deg^2, equivalent to a survey volume of ~1 cGpc^3, which is one order of magnitude larger than current z>2 galaxy surveys. Here we show our results that massive large scale structures are found in the four observed HSC fields. We also find a hint of the direct positive correlation between our LAE overdensity sample and the optical depth of Lyman-alpha absorption in (e)BOSS background quasar spectra, which is also supported by a cross-correlation analysis for the distribution of LAEs and LoSs with low/high optical depth subsamples. Such results help us to constrain the different mass assembly history for galaxies and neutral intergalactic gas during the epoch of Cosmic Noon.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution poster
Poster ID: P39

**Masanori Iye**
(NAOJ)

Title: **Subaru Study on the Spin Parity Distribution of Galaxies and Structure Formation**

Abstract: Observational studies on the inhomogeneity of the scalar density field in the Universe by means of microwave background radiation and 3D mapping of galaxy distribution were successful in constraining structure formation scenarios of the Universe. Next step could be studies on the vector fields of the Universe. Recent study of 146 nearby spiral galaxies by the authors provides a corroborative evidence that all the spiral galaxies are trailing. This finding enables us to decide the sign of the line-of-sight component of the spin vector of each spiral, just from their images, whether the spiral is S-wise or Z-wise. We are using the deep learning algorithm to judge S/Z winding of 50,000 spiral galaxies up to a redshift 0.8 in the HSC Wide image data covering up to a scale of 1Gpc. Tidal spin-up, pancake collapse, and primordial whirl scenarios predict different distribution of galaxy spins. We are looking for any anisotropy and early result of the study will be reported. We could even use another bit of information on the spin vector orientation by making a second round PSF spectroscopy for each galaxy at a point offset along the major axis from their center.

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Contribution poster
Poster ID: P40

**Hisanori Furusawa**
(NAOJ)

Title: **A study of bright star-forming galaxies at redshift 7 using Subaru Telescope**

Abstract: We present a campaign of searching for bright star-forming galaxies at redshift 7 using Subaru Telescope. Our previous intensive program perform z-band deep integration (z>~26.5) with Suprime-Cam on two fields (COSMOS and SXDS) , and find 18 candidates of UV-bright Lyman-break galaxies (MUV<-21.75), combined with the public NIR data (UltraVISTA and UKIDSS/UDS).
Followup spectroscopy with FOCAS reveals a LyA emitter (LAE) at z=7.168 with small rest-frame EW (3.7A). We estimate a fraction of bright LAEs with large EW is less than 0.23 at z~7. This implies that a growth of the LAE fraction possibly levels off and even falls between z=6 and 7. LAEs with strong LyA may be more common in bright galaxies than in fainter ones.
The Hyper Suprime-Cam (HSC) survey allows to extend the survey volume. We perform a bright LAE search at z~7 using HSC-SSP data. From S16A NB0921 detection, we select 48 bright LAE candidates (NB921<~24), and 10 LAEs are spectroscopically confirmed. We further conduct MOIRCS NIR spectroscopy on two LAEs that show very large EW (>200A). No significant evidence of a large AGN contribution or Pop III components has been detected in the NIR spectra.
We will report the sample and project status.

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Contribution poster
Poster ID: P41

**Nozomu Tamada**
(Ehime University)

Title: **Hunting optical counterparts of high-z DLAs with Subaru/HSC**

Abstract: It is important to understand the total picture of the galaxy evolution, but galaxies in the early phase of their evolution is not well understood because their gas fraction is so high that their stellar emission is very faint generally. In this study, we focus on the Damped Lyman-alpha Absorption (DLA) system (quasar absorption-line system with log N_HI >= 20.3 cm-2). Though high-z DLAs are interesting objects to assess the early phase of the galaxy evolution, only a small number of optical DLA counterparts at z>2 have been identified so far (<20). Thus statistical properties of optical counterparts of high-z DLAs are not fully understood.
In this study, we used optical data taken through the Subaru HSC-SSP survey for identifying optical counterparts of high-z DLAs (z>2). Specifically, we selected photometric candidates of galaxies at $2 < z < 3$ using our dedicated color-selection criteria, and investigated the average number count of those galaxies around high-z DLAs. As a result, we found that the number density of z=2-3 galaxies at 2-3 arcsec from DLAs shows a significant number excess (~27%) with respect to that in comparison fields.

"KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity"
Contribution poster
Poster ID: P42

**Yasunori Terao**
(University of Tokyo)

Title: **H alpha emitters at z~2.1－2.5: selection from broad-band photometry**

Abstract: Investigating properties of star forming galaxies (SFGs) over cosmic time is essential to understand galaxy evolution. Therefore various narrow-band (NB) surveys have been conducted targeting the H alpha emission line from high-z SFGs. However, NB surveys need large survey areas to construct large samples due to narrow redshift windows. In this presentation, we introduce our method to derive the H alpha fluxes of galaxies at z~2.1－2.5 from broad-band data using ZFOURGE multi-band catalog. We have performed SED fitting with emission lines to accurately estimate stellar continuum fluxes and identified ~2000 H alpha emitters by excesses from the continuum in the Ks-band. Their luminosity function shows an excess in the bright-end compared to the result of a NB survey (HiZELS; Sobral et al. 2013), which can be mostly explained by the fact that more massive galaxies have larger H alpha sizes. Regardless of the excess, an increase in derived cosmic star formation rate density is small and still consistent with previous results. We will also discuss the application of our method to different lines such as [OIII] and how our analysis is improved by wide-field surveys with medium-band filters, like SWIMS-18.

“KAIA•HÖ•KÜ: Towards Understanding the origin of the Complexity and Diversity”
Contribution poster
Poster ID: P43

**Naoaki Yamamoto**
(Tohoku University)

Title: **Various evolutionary stages of galaxy clusters at high redshifts**

Abstract: It is important to study the properties of the galaxies and their environmental dependence at high redshift. However there are not so many statical studies of high-z clusters because high-z galaxy clusters are rare and member galaxies are very faint. Then we used HSC-SSP data which have larger field of view and deeper than previous surveys and we tried to construct a large sample of galaxy clusters at z = 0.5~1.2. We carried out two surveys. At first, we conducted “Blue cloud survey”, in which we found over-density regions of star-formation galaxies by using narrow band filter to capture [O II] or [OIII] emission. Secondary, we conducted ""Red sequence survey”, in which we found over-density regions of red sequence galaxies by using broad band filter. We named these two survey as ""HSC-HSC , which stands for Hybrid Search for Clusters with HSC. We found a lot of galaxy cluster candidates. Especially in "Blue cloud survey", the candidates dominated by emission line galaxies were found. We studied properties of these cluster candidates by using color-magnitude diagram, luminosity function and so on. We confirmed "down sizing". Our results suggest that they may be corresponding to a younger stage of galaxy cluster formation.

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Contribution poster
Poster ID: P44

**Makoto Ando**
(The University of Tokyo)

Title: **Exploring Galaxy Proto-Cluster Cores at z~2**

Abstract: Many properties of galaxies depend on the environment they are located in. Galaxy clusters are the densest regions in the universe, and their member galaxies are known to have different properties from field galaxies at least at z<1: a more top-heavy stellar mass function (SMF), a higher passive fraction, etc. To reveal when and how such differences arise, their progenitors called proto-clusters should be researched. A proto-cluster is split into a number of dark matter halos (DMHs) and an unbound region. In this study, among those structures, we focus on the most massive DMH, or a proto-cluster "core", where environmental dependence is likely to be strongest. We search for such cores at cosmic noon with expected halo masses of >~ 10^13 Msun. Using the COSMOS2015 galaxy catalog by Laigle+16, we identify more than 100 core candidates at z~2. Clustering analysis shows that these candidates are indeed hosted by DMHs with the targeted mass range. We find that core member galaxies have a more top-heavy SMF and a higher passive fraction than field galaxies, indicating that differences in these properties seen in local clusters have already appeared in cores at z~2.

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Contribution poster
Poster ID: P45

**Umi Kobayash**
(NAOJ/SOKENDAI)

Title: **Influence of galaxy mergers on AGN activities**

Abstract: In the cold dark matter model, galaxy interactions and mergers are one of the primary mode of galaxy growth. We occasionally observe active galactic nuclei (AGNs) at the center of galaxies, and one may expect that galaxy interactions drive the gas inflow to the center and trigger the AGN activity. However,previous work does not seem to show a clear connection between galaxy interactions and AGNs. We tackle this issue using high quality data from the HSC survey. Our sample is constructed from SDSS DR14 within a redshift range of $0.01 \leqq z \leqq 0.2$. A test sample consists of several thousand galaxies. We visually classified the galaxies using the HSC images, which have a much higher quality than, e.g., SDSS, and identified galaxies with irregular/disturbed morphologies. After that, we adopted Convolution Neural Network (CNN) using above galaxies as the training sample to improve our statistics. In our poster, we discuss the differences in AGN fraction, color distribution, and environment between merger and non-merger galaxies with respect to each of the two methods, visual classification and CNN

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Contribution poster
Poster ID: P56

**Sadman Ali**
(Subaru Telescope)

Title: **Characteristics and evolution of the UV upturn phenomenon in cluster early-type galaxies**

Abstract: The UV upturn is a rise in the spectra of early-type galaxies (ETGs) below 2500Å. Both theoretical considerations and observational evidence point towards hot horizontal branch (HB) stars being the main source of the UV output in old ETGs, while the optical part of their spectra is dominated by MS and RGB stars.
By combining GALEX and UVOT data below 3000Å, we generated for the first time comparatively detailed UV SEDs for Coma cluster ETGs. Fitting these SEDs with a two-component SSP+blackbody models show a range of temperatures between 10000 – 21000K for the UV upturn population, and the strength of the upturn is found to be roughly correlated with galaxy mass. We also find the UV-optical colours of Coma red sequence galaxies to be identical to those of Fornax, Perseus and 20 other low redshift clusters ($z<0.1$) from the 2dF survey, which strongly indicates that the upturn is a ubiquitous feature in all cluster early-type galaxies at low redshift. Furthermore, the upturn strength is found to be completely independent of the cluster environment in which the galaxies reside. We then extended the study of the upturn in cluster red sequence galaxies at $z = 0.2, 0.3, 0.55$ & $0.7$ using their UV-optical colours – in each case probing beyond the L* point. From this analysis, the incidence and strength of the upturn is found to remain constant from $z = 0$ to $0.55$, but this strength is significantly diminished in the $z = 0.7$ cluster, implying that the stellar population responsible for the upturn in a typical red sequence galaxy is only just developing at this redshift and is essentially fully-developed by ~1-2 Gyrs later. This evolutionary behaviour is most consistent with Helium-enhancement being the key driver of the hot HB stars. By comparing our results with the predictions made by the YEPS Helium-enhanced spectrophotometic models, we find that a solar metallicity hot HB sub-population that displays a consistent upturn between $0 < z < 0.55$ but then fades by $z = 0.7$ would require a Helium abundance of $Y \geq 0.45$, if formed at $zf = 4$. This also plausibly sets a lower limit of 1010Msun to the in situ stellar mass of L* galaxies at this redshift.