The 10th Galaxy Evolution Workshop

August 6(Tue)-9(Fri), 2024
ASIAA, Taipei, Taiwan

BOOK OF ABSTRACTS

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CODE OF CONDUCT

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gew-soc-2024@googlegroups.com

Day1 Tuesday, 6 Aug 2024

START	END	NAME	TITLE
8:50	9:20		Registration
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			Day1-AM1 Chair: Hidenobu Yajima
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10:00	10:15	Novan Saputra Haryana	Study of Star Formation Quenching across Redshift Range of 2 < z < 7 using JWST dan HST Data
10:15	10:30	Takumi Kakimoto	The role of the galaxy group environment in quenching at high redshifts
10:30	10:45		Poster flash talks 1, No.4-10 [1min x7 + Q&A]
10:45	11:15		Break
			Day1-AM2 Chair: Kei Ito
11:15	11:30	Riku Sato	Intermediate-mass quiescent galaxies at z~3-4 observed with JWST/NIRSpec
11:30	11:45	Masayuki Tanaka	A proto-cluster of massive quiescent galaxies at z=4
11:45	12:00	Tsung-Chi Chen	Are BCGs born special?
12:00	12:15		Poster flash talks 2, No.11 (remote), 12 (remote), 14-19 [1min x8 + Q&A]
12:15	13:45		Lunch + Poster viewing
			Day1-PM1 Chair: Jubee Sohn
13:45	14:15	Jeong Hwan Lee（invited）	The Evolution of Galaxy Morphology in the High-Redshift Universe Viewed by JWST Observations and HR5 Simulations
14:15	14:30	Juan Pablo Alfonzo	Katachi (形): Decoding the Imprints of Past Star Formation on Present-Day Morphology in Galaxies with Interpretable CNNs
14:30	14:45	Zhaoran Liu	Characterizing Dust Extinction and Spatially Resolved Paα Emission within 97 Galaxies at 1<z<1.6 with JWST NIRCam Slitless Spectroscopy
14:45	15:15		Break
			Day1-PM2 Chair: Jubee Sohn
15:15	15:30	Kota Adachi	Enhanced gas-phase metallicities and suppressed outflows indicated for galaxies in a core region of the cosmic noon cluster
15:30	15:45	Chenze Dong	Birth of Earliest Warm-Hot Intergalactic Medium in a Protocluster at z=2.3
15:45	16:00	Yuta Suzuki	Quasar Environment and Large-Scale Feedback at z~2.2 Probed with Lyα Emitters and Continuum Selected Galaxies
16:00	16:30		Break
			Day1-PM3 Chair: Haruka Kusakabe
16:30	16:45	Ronaldo Laishram	Mapping the Large Scale Structure and Environmental Dependence of Star Forming and Morphology
16:45	17:00	Ko Ishida	Mapping galaxies with various populations in proto-supercluster at z=2.23 with QSO clustering
17:00	17:15	Yongming Liang	Cosmic Himalayas: The Most Concentrated Quasars at Cosmic Noon
17:15	17:30	Yu-Jan Wang	Clash of Titans: the impact of dense environment on massive dusty star-forming galaxies

Day2 Wednesday, 7 Aug 2024

START	END	NAME	TITLE
			Day2-AM1 Chair: Hsi-Yu Schive
9:30	10:00	Minjung Park (invited)	Rapid quenching of massive quiescent galaxies at cosmic noon. (online)
10:00	10:15	Chian-Chou Chen (TC)	Unveiling the Enigmatic Universe of Hyper Luminous Infrared Galaxies: Insights from AS2COSPEC
10:15	10:30	Ryusei Kano	Expansion of the dust radiation evolutionary framework to encompass the influence of dust number density within distant galactic environments
10:30	11:00		Break
			Day2-AM2 Chair: Daichi Kashino
11:00	11:15	Kosuke Takahashi	Ruby-Rush; Investigating accelerated growth of massive galaxies at z~5 (online)
11:15	11:30	Hiddo Algera	The Resolved Dust and Interstellar Medium of a z=7.31 Rotating Disk
11:30	11:45	Kuria Watanabe	Puzzlingly High N/O and N/C Galaxies at z ~ 6-10: Any Mechanisms for Insufficient C and O Enrichments
11:45	12:00	Hajime Fukushima	Formation of massive star cluster under radiative and stellar wind feedback: origins of extremely high N/O ratios and multiple stellar populations
12:00	12:15	Meng-Yuan Ho	Primordial Turbulence: Accretion of Clouds in the Early Universe
12:15	13:45		Lunch + Poster viewing
			Day2-PM1 Chair: Kyuseok Oh
13:45	14:15	Su Kung-Yi (invited)	Self-regulation of black hole accretion via jets in atomic cooling halo
14:15	14:30	Pei-Cheng Tung	Growth of Galaxy in the Cold Mode Accretion
14:30	14:45	Maxime Rey	Beyond the galaxy: the power of the CGM in constraining feedback mechanisms.
14:45	15:15		Break
			Day2-PM2 Chair: Satoshi Kikuta
15:15	15:30	Yu-Ling Chang	Properties of the CGM of DESI luminous red galaxies
15:30	15:45	Hiroyuki Hirashita	Evolution of grain size distribution in the circum-galactic medium
15:45	16:00	Kosei Matsumoto	Exploring SED evolution considering the dust Size Evolution of a zoom-in galaxy simulation with Gadget4-Osaka
16:00	16:15	Yu-Han Ling	Unravelling the Characteristics and Evolution of Dusty Star-Forming Galaxies in the COSMOS Field
16:15	16:45		Break
			Day3-PM3 Chair: Takuma Izumi
16:45	17:00	Boris Sindhu Kalita	The role of clumps in galaxy evolution unveiled by JWST and ALMA
17:00	17:15	Yoshihisa Asada	Bursty star formation and galaxy-galaxy interactions in low-mass high-z galaxies in the era of JWST
17:15	17:30	Takashi Yamamoto	Suppression of star formation at the center of barred spiral galaxies

Day3 Thursday, Aug 8 2024

START	END	NAME	TITLE
			Day3-AM1 Chair: Wu Po-Feng
9:30	10:00	Yao-Yuan Mao (invited)	SAGA Survey: A Census of 101 Satellite Systems around Milky Way-like Galaxies
10:00	10:15	Qianhui Chen	Exploring the Evolution of SFR and Gas-Phase Metallicity in Spiral Galaxies Over the Past 3Gyr
10:15	10:30	Huai-Hsuan Chiu	Simulating multiwavelength spectra and images of cosmic ray driven winds
10:30	11:00		Break
			Day3-AM2 Chair: Hidenobu Yajima
11:00	11:15	Michal Bilek	What is the origin of the different kinematic morphologies of early-type galaxies? (online)
11:15	11:30	Carlos Lopez-Coba	The diversity of noncircular rotation motions in the MUSE-PHANGS galaxies: from ten pc scales to kpc scales.
11:30	11:45	Ting-Xuan Li	Why is there star rebirth inside galaxies? An investigation into the Rejuvenated Galaxies (RGs) from MaNGA.
11:45	12:00	Rogerio Monteiro-Oliveira	Can the dichotomy scenario explain the observed variety of elliptical galaxies?
12:00	12:15	Priya Goyal	Probing the Redshift Evolution of the Fundamental Plane: Insights from Horizon Run 5 Simulations
12:15	12:25		Conference photo shooting
12:25			Free afternoon
18:30			Banquet

Banquet venue: 曉鹿鳴樓 (Taida Table)

Location: NTU Campus, 2nd Student Activity Center of National Taiwan University 1F

4 mins walk from MRT Gongguan Station, Exit 2

URL: https://meals.ntu.edu.tw/en/restaurant/info/id/218

Google maps: https://maps.app.goo.gl/7VGwn7iVT1JjE1Yw6

Day4 Friday, 9 Aug 2024

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			Day4-AM1 Chair: Yi-Kuan Chiang
9:30	9:45	Seiya Imai	Search for extreme emission line galaxies at 1
9:45	10:00	Moka Nishigaki	Chemical Evolution of Galaxies from z=0—5 with UniverseMachine
10:00	10:15	Yu Voon Ng	The Metallicity of DESI Dwarf Galaxies
10:15	10:30	Kun-Bao Yang	A systematic investigation of environmental dependencies of galactic properties across the Hubble sequence
10:30	11:00		Break
			Day4-AM2 Chair: Hsi-Yu Schive
11:00	11:15	Yi-Kuan Chiang	CSFD: An Accurate, All-Purpose, Full-Sky Dust Map
11:15	11:30	Chih-Teng Ling	Exploring the faintest end of mid-infrared luminosity functions up to z ≃ 5 with the JWST CEERS survey
11:30	11:45	Kim Seong Jin	Cosmic SF history inferred from the JWST source counts.
11:45	12:00	Yuxin Huang	Constraints on the cosmic baryon distribution with the FLIMFLAM survey
12:00	12:15	Ting-An Wu	Probing Missing Baryons: Stacking Compton y-map in All-sky Filamentary Structures.
12:15	13:45		Lunch + Poster viewing
			Day4-PM1 Chair: Ena Choi
13:45	14:00	Hsiang-Yi Karen Yang	Cosmic-ray Feedback in Galaxies: Fermi Bubbles and Odd Radio Circles
14:00	14:15	Satoki Matsushita	Birth of Radio Activity in a Quasar
14:15	14:30	Liu Qiang	Time-variable Line-locking Absorption Systems in HE0151−4326
14:30	14:45	Shoichiro Mizukoshi	Updated AGN Picture with Dusty/Dust-free Gas Structures and Effects of the Radiation Pressure
14:45	15:15		Break
			Day4-PM2 Chair: Yoshiki Toba
15:15	15:30	Naoki Matsumoto	Unveiling heavily obscured SMBH growth in the early universe
15:30	15:45	Satoshi Yamada	X-ray Winds In Nearby-to-distant Galaxies (X-WING) - I: Legacy Surveys of Galaxies with Ultrafast Outflows and Warm Absorbers in z ~ 0-4
15:45	16:00	Yumi Watanabe	Study of dense gas around AGN in the nearby Seyfert galaxy NGC 1068
16:00	16:15	Ji-Jia Tang	The Variability Structure Function of the Highest-Luminosity Quasars on Short Timescales
16:15	16:45		Break
			Day4-PM3 Chair: Yoshiki Toba
16:45	17:00	Akino Yasuda	Relation between molecular gas and star-forming activity on the merger sequence in local U/LIRGs
17:00	17:15	Bovornpratch Vijarnwannaluk	The Host Morphologies of X-ray-selected Active Galactic Nuclei Observed with JWST.
17:15	17:30	Kianhong Lee	Ongoing and fossil large scale outflows detected in a high-redshift radio galaxy: ALMA [CII] observation of TN J0924-2201 at z=5.17
17:30			Closing Remarks

POSTER LIST

Day1,10:30-10:45, Poster flash talks 1, No.4-10 [1min x7 + Q&A]
Day1,12:00-12:15, Poster flash talks 2, No.11(remote), 12 (remote), 14-19 [1min x8 + Q&A]

No.	NAME	TITLE
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2	Mariko Kubo	Resolving massive quiescent galaxies at the core of the SSA22 protocluster at z = 3.09
3	Shunya Uchida	Topological data analysis of galaxy spatial distributions
4	Hidenobu Yajima	Bright galaxies and giant HII bubbles in protoclusters at the epoch of reionization
5	Po-Feng Wu	Detection of cool gas around a quiescent galaxy at z=4 by JWST
6	Yoshiki Toba	Emergence of AGN in galaxy clusters: the relationship among AGN, environment, and cluster-cluster mergers
7	Toru Misawa	AGN Feedback Efficiency with NAL Outflow Winds
8	Yuri Yanagiya	Statistical analysis of BAL quasars using SED fitting
9	Makoto Sato	Transverse Proximity Effect around a Type 2 Quasar
10	Misaki Mizumoto	X-ray spectroscopy of AGN in the XRISM era
11	Seira Kobayashi	A new wide exploration of high-z radio galaxies with the gzK selection
12	María Emilia De Rossi	Exploring the Nature of First Galaxies with JWST and ALMA
13	Suchetha Cooray	A population-level inference of dust attenuation in local galaxies
14	Mau Otsuki	Dust enrichment in the circum-galactic medium
15	Haruka Kusakabe	First detections of SiII* halos at z=2-4 with MUSE
16	Satoshi Kikuta	UV and Lyα Halos of Lyα Emitters across Environments at z=2.84
17	Beomchan Koh	The impact of bursty star formation and stellar feedback processes on Lyman alpha emission
18	Ryo Albert Sutanto	Study of properties and demography of clumpy galaxies beyond z > 3 with HST & JWST public data
19	Sy-Yun Pu	Dark on dark: constraining cosmological parameters with high-redshift galaxies
20	Toshiki Saito	Starbursting molecular clouds in gas-rich merging galaxies
21	Hyunwoo Song	Finding the relation between O32 and Lyman continuum escape fraction using RAMSES-RTZ

Oral Presentations

Day1 Tuesday, 6 Aug 2024

No.1

Death of massive galaxies: characterization of quiescent galaxies in the early Universe

Kei Ito, The University of Tokyo

Abstract

Thanks to the recent deep observations, some massive galaxies are known to stop their star formation even just 1-2 Gyrs from the Big Bang. These early massive quiescent galaxies are likely to have obtained their stellar mass by bursty star formation within a short period and suddenly quenched. However, their statistical properties and quenching mechanisms are still unclear. In this talk, I will review the current status of surveys of quiescent galaxies at high redshift and introduce our studies to characterize massive quiescent galaxies using data from ground-based and space telescopes. Specifically, I will introduce our study on the morphological properties of quiescent galaxies using JWST/NIRCam imaging and an ongoing project to analyze JWST/NIRSpec spectra.

No.2

Study of Star Formation Quenching across Redshift Range of $2 < z < 7$ using JWST dan HST Data

Novan Saputra Haryana, Bandung Institute of Technology

Co-author(s): Novan Saputra Haryana (Bandung Institute of Technology), Abdurro'uf (The Johns Hopkins University), Hesti Retno Tri Wulandari (Bandung Institute of Technology)

Abstract

Galaxies formed approximately 300 million years after the Big Bang, during the cosmic dawn epoch. Subsequently, they underwent evolution in parallel with the universe's development. This evolutionary process encompasses various aspects, notably the rate of star formation within galaxies. In their early stages, galaxies exhibited a much higher rate of star formation compared to the present epoch. The processes and mechanisms responsible for the subsequent slowdown in star formation rate remain a prominent topic of study in astrophysics. In this research, imaging data from the James Webb Space Telescope (JWST) and the Hubble Space Telescope (HST) spanning the redshift range of $2 < z < 7$ will be utilized to examine the demographics of quiescent galaxies across a wide range of redshifts. Additionally, we aim to investigate how the morphological parameters of these galaxies evolve over time. Our goal is to gain insights into the mechanisms and processes responsible for the deceleration of star formation rates within galaxies. In the analysis, galaxies within the redshift range of $2 < z < 4.5$ exhibited the highest number density around log M ~ 10.5, with their number density decreasing with increasing redshift. However, within the redshift range of $2 < z < 2.5$, another number density peak was observed at log M ~ 8.75, indicating the presence of numerous quiescent dwarf galaxies at this redshift range. Furthermore, for the redshift range of $4.5 < z < 7$, the number density remained relatively constant at ~ 10^-6 Mpc^-3 dex^-1. Unlike the previous redshift range, the number density in this range decreased around log M ~ 10.5. In addition to the findings mentioned, our analysis reveals intriguing variations in the time between galaxy formation and the quenching phase across different redshift ranges. Notably, galaxies within the redshift range of $5.5 < z < 7$ exhibit a remarkably short quenching period, sometimes less than 0.9 Gyr. Furthermore, we observed a correlation between quenching duration and galaxy mass within this redshift range, with lower mass galaxies experiencing a quicker quenching phase compared to

their higher mass counterparts. These insights suggest that there are different quenching mechanisms involved between low and high mass galaxies.

No.3

The role of the galaxy group environment in quenching at high redshifts

Takumi Kakimoto, The Graduate University for Advanced Studies

Co-author(s): Takumi Kakimoto (The Graduate University for Advanced Studies, SOKENDAI), Masayuki Tanaka, Masato Onodera (NAOJ), Rhythm Shimakawa (Waseda University), Makoto Ando (NAOJ), Kei Ito (The University of Tokyo)

Abstract

Recently, we reported on the spectroscopic confirmation of a massive quiescent galaxy (QG) at z=4.53 in the COSMOS field (Kakimoto et al. 2024). This galaxy is among the youngest QGs confirmed so far with a formation redshift of 5.2 (200 Myr old) and is likely a galaxy in the process of being quenched. A unique aspect of the galaxy is that it is in an extremely dense region, suggesting that effects from surrounding environment are important to quench the galaxy. A follow-up spectroscopic observation with FOCAS is scheduled in March 2024 and we will report on results from the observation. To extend this work, we make an attempt to unveil the typical environment of massive QGs at high redshifts. By selecting QGs at z>3 using high-accuracy photometric redshifts, we find that many of them are located in group-like environment. We summarize differences between isolated QGs and those in group environment and discuss their implications for the quenching physics.

No.4

Intermediate-mass quiescent galaxies at z~3-4 observed with JWST/NIRSpec

Riku Sato, Waseda University

Co-author(s): Riku Sato, Akio Inoue (Waseda University), Yuichi Harikane (UTokyo) and others.

Abstract

We present the analysis of three intermediate-mass quiescent galaxies (QGs) with stellar masses of ~10^10 Msolar at redshifts z~3–4 with JWST/NIRSpec. We confirm these target galaxies are consistent with quiescent population. Additionally, we identify these QGs to be less massive than those discovered in previous works, particularly prior to the JWST era. Two of our target galaxies exhibit the potentially-blended Halpha+[NII] emission line. We discuss whether this feature comes from an Active Galactic Nucleus (AGN) or star formation. One of the target galaxies is covered by JWST/NIRCam imaging. We reveal its disc-like profile with a Sersic index of n~1. We examine the galaxy on the size-mass relation from the literature. We discuss the importance of these intermediate quiescent galaxies in the field of galaxy evolution.

No.5

A proto-cluster of massive quiescent galaxies at z=4

Masayuki Tanaka, NAOJ

Abstract

We discuss an over-density region of several massive quiescent galaxies at z=4 in UDS. The over-density region is first identified using high-accuracy photometric redshifts based on deep multi-band photometry. Follow-up spectroscopic observations with MOSFIRE on Keck confirmed a massive quiescent galaxy at z=4. Using the spectrophotometric redshift technique (i.e., photometry + spectra), we confirm 4 additional quiescent galaxies at the same redshift. These quiescent galaxies are concentrated within 1 Mpc scale, and they form an early red sequence, suggesting that the red sequence appears during the initial phase of cluster formation. The over-density region exhibits a higher fraction of quiescent galaxies compared to the field. This is the first evidence for the Butcher-Oemler effect at such a high redshift. There are other recent studies that suggest that some of the massive quiescent galaxies at high redshifts are in locally dense environments, and we discuss implications of this trend in the context of quenching physics.

No.6

Are BCGs born special?

Tsung-Chi Chen, ASIAA/NTU

Co-author(s): Tsung-Chi Chen (ASIAA/NTU), Chen-Yu Chuang (ASIAA/NTHU), Yen-Ting Lin (ASIAA), Dylan Nelson (Heidelberg University), Annalisa Pillepich (MPIA)

Abstract

The most luminous galaxies in galaxy clusters, typically known as Brightest Cluster Galaxies (BCGs), are the most massive galaxies in the Universe. They possess unusual properties such as extended profile, photometric homogeneity, and central location in galaxy clusters, suggesting they may follow different evolution routes from other cluster member galaxies. In literature, two complementary statistical tests have been adopted to examine the uniqueness of BCGs, i.e., whether BCGs are simply the statistical extremes of the luminosity function of cluster galaxies or a distinct population. Using these two tests, previous studies have shown that BCGs are special up to redshift of z~1. Here we extend the analysis of BCG uniqueness by performing these tests on BCGs in the state-of-the-art cosmological hydrodynamical simulation TNG300 and the new simulation suite, TNG-Cluster, which provides better sampling at the high-mass end. Results from both tests suggest that simulated BCGs are special up to redshift z~4. In addition, we also perform similar analyses on HST and Spitzer data, showing that observed BCGs are already special at redshift z~2. In this contribution, we present our results and further discuss their implications on the "nature" vs. "nurture" issue for BCGs.

No.7

The Evolution of Galaxy Morphology in the High-Redshift Universe Viewed by JWST Observations and HR5 Simulations

Jeong Hwan Lee, Seoul National University

Co-author(s): Jeong Hwan Lee (Seoul National University), Changbom Park (Korea Institute for Advanced Study), Ho Seong Hwang (Seoul National University), and Minseong Kwon (Seoul National University)

Abstract

The morphologies of galaxies are crucial for understanding galaxy evolution and formation over cosmic time. Prior to the advent of the James Webb Space Telescope (JWST), the morphologies of high-redshift galaxies were considered to be highly uncertain due to observational limitations. Instead, cosmological simulations such as Horizon Run 5 (HR5) have played an important role in elucidating the morphology of high-redshift galaxies. In a recent HR5 study, Park et al. (2022) suggested that the morphologies of galaxies in the cosmic morning ($z>4$) are dominated by disks formed in protogalactic clouds with initial angular momentum. The advent of JWST allows us to observe the morphology of high-redshift galaxies. To compare the results from observations and HR5 simulation, we study the morphologies of about 19,000 galaxies with log $M^*/M_\odot>9$ at $z=0.6$-8.0, using data from six JWST deep fields such as NEP-TDF, NGDEEP, CEERS, COSMOS, UDS, and SMACS J0723-7327. We classified their morphology based on their Sersic indices (n) and asymmetry (A), following the classifier used in Park et al. (2022). As presented in the HR5 study, disk morphologies are dominant for galaxies at $z>4$ in the low-mass regime (log $M^*/M_\odot<11$), accounting for ~70% of the total galaxy population. In contrast, in the high-mass regime (log $M^*/M_\odot>11$), the spheroid fraction tends to increase with decreasing redshift, reaching ~60% at $z<1.5$. This suggests that the initial disk-type morphologies in the cosmic morning have transformed into spheroid-type morphologies with mass growth over time. In conclusion, the findings from JWST data are consistent with the HR5 results, indicating the effectiveness and usefulness of cosmological simulations for predicting galaxy formation and evolution.

No.8

Katachi (形): Decoding the Imprints of Past Star Formation on Present-Day Morphology in Galaxies with Interpretable CNNs

Juan Pablo Alfonzo, Tohoku University

Co-author(s): Juan Pablo Alfonzo (Tohoku University), Kartheik Iyer (Columbia University), Masayuki Akiyama (Tohoku University), et al.

Abstract

The physical processes responsible for shaping how galaxies form and quench over time leave imprints on both the spatial (galaxy morphology) and temporal (star formation history; SFH) tracers that we use to study galaxies. While the morphology-SFR connection is well studied, the correlation with past star formation activity is not as well understood. To quantify this we present Katachi (形), an interpretable convolutional neural network (CNN) framework that learns the connection between the factors regulating star formation in galaxies on different spatial and temporal scales. We recover the expected trends of M_* governed by the growth of galaxy bulges, and SFR correlating with spiral arms and other star-forming regions. We also find the SHAP maps of D4000 are more complex than those of M_* and SFR, and that morphology is correlated with t50 even at fixed mass and SFR.

No.9

Characterizing Dust Extinction and Spatially Resolved Paα Emission within 97 Galaxies at 1<z<1.6 with JWST NIRCam Slitless Spectroscopy

Zhaoran Liu, Tohoku University

Abstract

We present results on Paα emitting galaxies from the JWST FRESCO survey in the GOODS fields. Using JWST NIRCam WFSS, we analyzed emission line fluxes, star formation rates, and flux distributions of 97 Paα emitters at $1 < z < 1.6$. We combined Paα fluxes with archival Hα data from HST WFC3 to assess dust extinction. Our findings show a correlation between dust extinction and stellar mass, with more massive galaxies having greater extinction. Lower mass galaxies are nearly dust-free and smaller in star formation and stellar continuum, while massive galaxies show varied dust and star formation patterns, suggesting different evolutionary phases. This study highlights JWST WFSS's capabilities in studying emission line galaxies and Paα's importance in understanding dust and obscured star formation in the early universe.

No.10

Enhanced gas-phase metallicities and suppressed outflows indicated for galaxies in a core region of the cosmic noon cluster

Kota Adachi, Tohoku University

Co-author(s): Kota Adachi (Tohoku University), Tadayuki Kodama (Tohoku University), Jose Manuel Pérez-Martínez (Instituto de Astrofisica de Canarias), Tomoko Suzuki (Kavli Institute for the Physics and Mathematics of the Universe), and MAHALO team membsers

Abstract

Chemical evolution of galaxies is determined by not only past star formation activities but also gas inflow from surrounding large-scale structures and outflow from galaxies back to the halos driven by AGN or SNe. Such gaseous processes may well depend on the surrounding environments, especially in clusters, because of inefficient gas accretion and enhanced gas stripping. Past simulations predict that the vigorous mass assembly and transition of gas accretion phase occurs at cosmic noon. However, the details of how the gas flows actually work are still under debate, and it is also hard to observationally quantify them. In this presentation, we report on our near-infrared spectroscopy of member galaxies in cluster XCS2215 (z=1.46) with Keck/MOSFIRE to measure gas-phase metallicities of 27 Hα emitters. Our results show that the cluster galaxies have 0.13-0.17 dex higher metallicities for the same stellar mass compared to field galaxies in COSMOS at similar redshift. We also see an environmental offset in the fundamental metallicity relation which indicates that the metallicity offset is not due to the difference in evolutionary stages of gas mass and SFR, but is due to environmental effects. Compared with other clusters at higher redshifts (z>2), the z=1.5 cluster galaxies are more metal-rich due to chemical evolution. Moreover, low-mass galaxies show larger evolution than massive galaxies, which is consistent with the downsizing scenario. We also indirectly estimate the outflow rates by combining the gas mass derived by ALMA observations and gaseous metallicity of this work, and compare them with chemical evolution models including outflows. As a result, we find that galaxies in XCS2215 core are consistent with weaker outflow than that of field counterparts. All these results put together, we conclude that the metallicity enhancement in this X-ray cluster is caused by the lack of metallicity dilution due to inefficient gas accretion in shock- heated hot ICM. Moreover, the outflow is also suppressed due to confinement of metal- enriched gas by dense IGM in the cluster core, leading to further chemical evolution by recycling the gas.

No.11

Birth of Earliest Warm-Hot Intergalactic Medium in a Protocluster at z=2.3

Chenze Dong, Kavli IPMU

Abstract

The observation of the local universe reveals a 30~40% deficit of baryon matter compared with the prediction of the standard model, commonly known as the "Missing Baryon Problem." The hard-to-detect nature of the warm-hot intergalactic medium (WHIM) may contribute to the missing baryon budget. According to the cosmological simulations, the WHIM with a temperature higher than 100,000 Kelvin and low density may spam throughout the universe but is almost invisible in the observation. Due to a lack of efficient tracers, there is little evidence of the production and evolution of WHIM, especially at high redshift. In this talk, we first present our discovery on a protocluster at z=2.3 named COSTCO-I. The protocluster, firstly identified via the galaxy surveys, was later found corresponding to a region with high transmission in CLAMATO Lyman-alpha tomography map, contrary to the theoretical relation where protoclusters would have low Lyman-alpha transmission (Flatuation Gunner-Peterson Approximation, FGPA). We attributed this to a hotter intergalactic medium (IGM) across a few physical megaparsecs around the protocluster, implying the formation of WHIM associated with the protocluster. After that, we introduce our recent progress on constraining the mechanism of large-scale heating with The Three Hundred simulation suites. We found that the simulation prescription with AGN kinetic feedback matched the COSTCO-I well on the overdensity-transmission parameter space, contrary to the rest prescriptions with weaker AGN feedback or stellar-only feedback exhibited a lower Lyman-alpha transmission. We thus argue jet feedback is a plausible candidate for the large-scale gas heating around COSTCO-I, rather than stellar feedback or gravitational shock heating. In the future, the prime focus spectroscopy (PFS) on the Subaru Telescope will profoundly extend the mapping volume of tomography survey to about 100 times more than CLAMATO. We expect to discover more protoclusters like COSTCO-I around z~2, which will shed light on the origin of WHIM associated with structures at cosmic noon.

No.12

Quasar Environment and Large-Scale Feedback at z~2.2 Probed with Lyα Emitters and Continuum Selected Galaxies

Yuta Suzuki, Ehime University

Co-author(s): Yuta Suzuki, Yoshiki Matsuoka (Ehime University), Satoshi Kikuta, Hisakazu Uchiyama, Haruka Kusakabe (NAOJ)

Abstract

The photoevaporation effect refers to an ionization/heating process of surrounding material by intense ultraviolet (UV) radiation, which suppresses galaxy formation by preventing cooling and gravitational collapse of gas in the surrounding dark matter halos. This could be most effective for low-mass galaxies around luminous quasars. Here, we report on a statistical analysis of quasar photoevaporation at z ~ 2.2, which compares the density of Ly Alpha Emitters (LAEs) and photo-z galaxies. We select 18 quasars, which are covered by Hyper Suprime-Cam Subaru Strategic Program and CFHT Large Area U-band Deep Survey. We spatially normalize the surrounding LAE/photo-z galaxy distribution to the median quasar proximity zone, stack them, and then compare their shapes of density profiles. As a result, we find that the density of LAEs is significantly lower than that of photo-z galaxies within the quasar proximity zone. We further find that the LAEs with higher EWs are less dense than those with lower EWs, and that the fainter photo-z galaxies are significantly reduced in density. Finally, we create a control sample of photo-z galaxies with similar host halo mass to the quasars, and find that the number densities of both LAEs and (other) photo-z galaxies increase toward the control galaxies while the rate of increase is smaller toward the quasars. In this talk, we will present these results and discuss the presence and possible effects of the photoevaporation effect on galaxy formation.

No.13

Mapping the Large Scale Structure and Environmental Dependence of Star Forming and Morphology

Ronaldo Laishram, Tohoku University

Co-author(s): Ronaldo Laishram, Tadayuki Kodama, Takahiro Morishita, Jose Manuel Perez-Martinez, Yusei Koyama, Andreas Faisst, Tomoko Suzuki, Naoaki Yamamoto

Abstract

The distribution of galaxies in the universe is inhomogeneous and represents large-scale structures (LSS) that consist of galaxy clusters, groups, and filaments connecting them. Understanding how galaxy characteristics are influenced by their environments and how they evolve over cosmic time within LSS is crucial. Utilizing dual narrow-band filters for precise redshift estimation, we investigate the environmental effects on star formation in galaxies within large-scale structures at z~0.4 and 1.5. We explore star-forming activity and the spatial distribution of Hα and continuum emission at z=0.4, probing the 3-D cosmic web. We found that star formation in cluster core galaxies is more centrally concentrated and less compared to the field sample, which may imply the influence of ram-pressure stripping. We also explore the morphological features and star formation activities of [OII] emitters in the COSMOS UltraDeep field at z ∼ 1.5 using JWST NIRCam data from the COSMOS-Web survey and Subaru Hyper Suprime-Cam. We also report the discovery of large filamentary structures traced by [OII] emitters, surrounding an extremely overdense core of ∼ 11× higher galaxy number density compared to the field average. Heightened star-forming activity was found in dense regions contrary to redshift 0.4, suggesting an environmental impact on early galaxy evolution. Future studies will further explore the chemical abundance, gas content, and kinematics of these galaxies to understand the underlying processes in this overdense structure.

No.14

Mapping galaxies with various populations in proto-supercluster at z=2.23 with QSO clustering

Ko Ishida, Tohoku University

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Abstract

Galaxy clusters form and develop at intersections of filamentary large scale structures (LSSs) over cosmic times. It is strongly suggested that the formation and evolution of galaxies and their super massive black holes are tightly related to the surrounding environment, likely due to the enhanced galaxy mergers and vigorous gas accretion along filaments. Since the star formation activities in the progenitors of present-day clusters are thought to be peaked at z~2, it is the critical epoch for us to witness the structure growth and galaxy evolution in action. In this study, we focus on a unique structure at z=2.23 hosting proto-clusters and their surrunding LSSs, called 2QZ cluster field. This is first identified by a strong clustering of 4 QSOs at similar redshifts within a 30x30 cMpc region, which provides us a unique laboratory to investigate the effect of QSOs to the surrounding environments. Previous multi-wavelength observations have revealed the existence of LSSs traced by Hα emitters (HAEs), dusty starburst galaxies, and X-ray point sources (likely AGNs). In order to better cover the entire structure with suppressed bias, we performed a new analysis utilizing the archival imaging data taken with HSC on Subaru and WFCAM on UKIRT. To sample galaxies with various stellar populations, in addition to the improved HAE selection, we newly apply the gzK color selection, which is sensitive to both quiescent and star forming galaxies. We can also estimate stellar mass, star formation rate, and clustering properties. As a result, we have discovered new overdensities traced by gzK galaxies which are likely connecting between the previously known structures, which allow us to make a more detailed comparison of galaxy properties as a function of local/global environments as well as QSO proximity. We note that this redshift is also unique as there is a narrow-band filter on

HSC/Subaru which captures redshifted Lyα emitters across the entire structures, which will tell us HI gas distribution if combined with the existing Hα map, and thus gas accumulation and QSO feedback processes.

No.15

Cosmic Himalayas: The Most Concentrated Quasars at Cosmic Noon

Yongming Liang, ICRR, U. Tokyo

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Abstract

Discovered by the MAMMOTH-Subaru survey in BOSSJ0210, the Cosmic Himalayas is an extraordinary structure hosting 11 SDSS/eBOSS luminous (L_bol≳10^46 erg s^-1) Type-1 quasars at z=2.2, within a compact (40 cMpc)^3 region. This structure represents the most significant quasar density peak at z>2, being 30 times the average with a remarkable 17σ significance. Mapped by Subaru/HSC NB387 for z=2.2 Lyman-alpha emitters (LAEs), the quasar overdensity intriguingly does not match LAE overdensities but lies perpendicular to a ~100 cMpc large-scale filament. This filament's nodes showcase distinct galaxy properties, such as varied star-formation rates, AGN hosting probabilities, and extended Lyman-alpha emission detection, with quasars positioned at intermediate points. Initial insights from 3D intergalactic medium (IGM) tomography, created using SDSS/eBOSS background quasars, indicate a significant ionizing stage difference between the filament's nodes, suggesting quasars play a central role in shaping the ionizing topology. These findings highlight the Cosmic Himalayas as a unique structure for advancing our understanding of the interplay between quasars, galaxies, and the IGM.

No.16

Clash of Titans: the impact of dense environment on massive dusty star-forming galaxies

Yu-Jan Wang, ASIAA

Co-author(s): Yu-Jan Wang (NTU, ASIAA) Chian-Chou Chen (ASIAA) Po-Feng Wu (NTU) Fabrizio Arrigoni Battaia (MPA)

Abstract

In recent years, understanding the impact of environment on galaxies within the local universe has been a focal point of research. However, during the 'cosmic noon' epoch (z = 2-4), it remains unclear how environmental factors influence galaxies and their characteristics. To address this, we investigate proto-clusters, the predecessors of local massive galaxy clusters. Building upon previous research efforts, we have identified environments hosting strong Lyman-alpha nebulae (referred to as enormous Lyman-alpha nebulae, ELANe) associated with quasars (QSOs) as potential proto-clusters. We conducted a number density analysis of dusty star-forming galaxies (DSFGs) around ELANe using JCMT/SCUBA-2 observations at 850 microns. We found the number of DSFGs around ELANe to be 2-3 times higher than those in blank fields. Further observations with ALMA detected 15 reliable CO emission lines in DSFGs around ELANe, and spectral energy distribution (SED) fitting using multi-wavelength data provided CO and infrared luminosity measurements. Comparing molecular and dust properties between ELANe and field samples, we found that gas fractions in DSFGs around ELANe on megaparsec scales were comparable to those in blank fields. Interestingly, gas fractions in DSFGs around QSOs at halo-scale distances showed a decrease similar to those observed in QSOs themselves. Overall, our findings suggest that only on the halo scales environmental factors significantly influence the interstellar medium properties of massive dusty star-forming galaxies.

Day2 Wednesday, 7 Aug 2024

No.17

Rapid quenching of massive quiescent galaxies at cosmic noon.

Minjung Park, Harvard University

Abstract

The existence of massive quiescent galaxies at high redshifts (z>3) requires intense star formation and rapid quenching. In contrast, quiescent galaxies at low redshifts (z<1) seem to have a broad range of quenching timescales, suggesting multiple quenching mechanisms. The link between these two epochs is not yet well understood. At cosmic noon (z~2), many questions about the quiescent galaxy population remain unanswered: what are the quenching histories and mechanisms, and what are the descendants of the quiescent galaxies at early epochs. We study 16 massive quiescent galaxies at z~2 selected from a mass-selected representative sample of the Blue Jay survey. We reconstruct their star formation histories by fitting spectral energy distribution models to the JWST/NIRSpec R~1000 spectra. We find that massive quiescent galaxies at z~2 can be split into three categories with roughly equal numbers of galaxies according to their SFHs: 1) Relatively old galaxies quenched at early epochs; 2) Galaxies that are rapidly and recently quenched after a flat or bursty formation history (depending on the assumed prior); 3) Galaxies that are rapidly and recently quenched after a major starburst. Most recently quenched galaxies show neutral gas outflows, probed by blueshifted Na D absorption, and ionized gas emission, with line ratios consistent with active galactic nucleus (AGN) diagnostics. This suggests that AGN activity drives multi-phase gas outflows, leading to rapid quenching. The two oldest massive quiescent galaxies in our sample appear to have extremely early formation and quenching (z>6), possibly descendants of early post-starbursts at z>3. These galaxies still show neutral gas reservoirs and low-level star formation, consistent with weak Hα emission, perhaps because the ejective AGN feedback that caused rapid quenching has weakened over time.

No.18

Unveiling the Enigmatic Universe of Hyper Luminous Infrared Galaxies: Insights from AS2COSPEC

Chian-Chou Chen (TC), ASIAA

Abstract

The highly intense star-forming galaxies, particularly the most massive ones, offer a unique platform to scrutinize theories concerning the baryon cycle. Understanding the driving physics behind their vigorous star formation activities is pivotal. Moreover, it's crucial to ascertain whether their interstellar medium (ISM) properties resemble those of less massive and less active systems, and if their physical characteristics such as mass and number density can be explained within existing theoretical frameworks. To tackle these inquiries, we've launched AS2COSPEC, a comprehensive spectroscopic survey targeting a complete and flux-limited sample of 54 dusty star-forming galaxies (DSFGs) selected at 850 microns in the COSMOS field. We've achieved a remarkable success rate in detecting emission lines in over 90% of cases, establishing spectroscopic redshifts at z=2-5. Utilizing meticulous spectral energy distribution (SED) fittings with high-quality multi-wavelength photometry from X-ray to radio data available in COSMOS, we've inferred their physical properties. Our findings reveal that these galaxies are largely unlensed and exhibit intrinsic infrared luminosities comparable to Hyper Luminous Infrared Galaxies (HyLIRGs). During this presentation, I'll delve into their ISM characteristics, encompassing aspects such as star formation, dust content, and molecular gas based on subsequent CO and [CI] observations. Furthermore, I'll unveil preliminary insights gleaned from our analysis of their dynamics and morphology, facilitated by newly obtained imaging data from the James Webb Space Telescope (JWST).

No.19

Expansion of the dust radiation evolutionary framework to encompass the influence of dust number density within distant galactic environments

Ryusei Kano, Nagoya University

Abstract

In the study of galaxy evolution, the presence of dust within galaxies plays a crucial role in various physical aspects, such as the spectral energy distribution (SED) and the star formation history. To investigate the dust evolution of galaxies over time, our research incorporates a comprehensive model that considers both dust and chemical evolution. By adopting this framework, we have successfully constructed a galaxy SED model, enabling us to precisely compute the SED of nearby galaxies. However, when we apply our SED model to galaxies at high redshifts ($z \sim 8$), some modifications is necessary to reproduce their observational SED due to difference of galaxy properties. In this work, we try to change partial theory of the current SED model and reproduce the observed SEDs of very high-redshift galaxies. The molecular cloud around a young star is called a clump, which is considered to be a sphere. Since distant galaxies are considered to be compact, the density in the clumps should be higher than that of nearby galaxies. Therefore, we made the clump radius have a different dependence from the entire galaxy, and by increasing the number density of dust in a clump, we were able to obtain high dust emission, the same as the observed value. This approach allows for more highly reproducible simulations. The results suggest that distant galaxies have a higher dust number density than nearby galaxies and therefore emit more dust radiation.

No.20

Ruby-Rush; Investigating accelerated growth of massive galaxies at z~5

Kosuke Takahashi, Tohoku University

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Abstract

Identifying when/where massive galaxies first appeared in the Universe and knowing how the star-forming activities of those galaxies were quenched is critical for understanding galaxy formation and early evolution. It can also put strong constraints on the efficiency of galaxy formation in the early Universe and, eventually, on the current standard theory of hierarchical structure formation. Recent observations have confirmed the existence of the massive galaxies (~10^11Msun) at z~4.6. In this study, we aim to go further back in time and search for protoclusters at z~5 to discover mature, massive galaxies of comparable mass that have already quenched star-forming activities. We will report our discoveries of strong candidates of massive galaxies at z~5 and discuss the accelerated massive galaxy formation in the high-density regions only a billion years after the Big Bang.

No.21

The Resolved Dust and Interstellar Medium of a z=7.31 Rotating Disk

Hiddo Algera, Hiroshima University / NAOJ

Abstract

Over the last decade, ALMA has revolutionized our understanding of the interstellar medium (ISM) conditions of distant galaxies. For one, ALMA has now detected (sub-)millimeter continuum emission from dozens of galaxies at z > 6.5, establishing the importance of dust-obscured star formation already within the first 800 Myr after the Big Bang. Moreover, through various bright emission line diagnostics such as [CII]158 and [OIII]88, ALMA can be used to directly study the physical conditions and kinematics of the ISM within the earliest galaxies. In this talk, I will use observations from half a dozen different ALMA campaigns to study the dust and interstellar medium properties of REBELS-25: a spectacular, but otherwise normal, massive dusty galaxy at z=7.31. First, I will use six-band ALMA continuum observations to accurately constrain its dust SED, and demonstrate REBELS-25 to host a massive dust reservoir. Following this, I will move onto resolved scales: using new, high-resolution (~0.2") [CII] observations, I will show REBELS-25 to be a rotating disk galaxy -- the most distant cold disk known to date. I will then discuss matched-resolution Band 8 dust continuum and [OIII] observations, which provide a resolved dust temperature and [OIII]/[CII] map of this spectacular galaxy. Finally, I will compare this wealth of ALMA data with new JWST/NIRSpec IFU observations of REBELS-25, and shed light on how dust obscuration can bias our interpretation of early massive galaxies.

No.22

Puzzlingly High N/O and N/C Galaxies at z ~ 6-10: Any Mechanisms for Insufficient C and O Enrichments

Kuria Watanabe, National Astronomical Observatory of Japan

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Abstract

The observations conducted with JWST have disclosed galaxies at high redshifts characterized by extremely high N/O and low C/N ratios, exemplified by GN-z11. The high N/O and low C/N ratios of these galaxies are largely biased toward the equilibrium of the CNO cycle, suggesting that these three galaxies are enriched by metals processed by the CNO cycle. The low C/N and high N/O ratios of these three galaxies cannot be explained by typical chemical evolution models including asymptotic giant branch stars in their early chemical enrichment stages. We thus investigate three scenarios associated with dominant CNO-cycle materials, i.e., Wolf-Rayet stars, supermassive stars (with 10^3 - 10^5 solar masses), and tidal disruption events. We develop the chemical evolution models of these scenarios, assuming star formation based on various initial mass functions with core-collapse supernovae (CCSN) based on the theoretical yields. We find that the C/O and N/O ratios of these three galaxies are explained by any of these three scenarios. However, the N/O values of the three models decrease quickly after the CCSNe take place due to a large amount of oxygen ejected from CCSNe. Because CCSNe appear in a very short time scale (<1 Myr) for massive star progenitors, the massive stars need to directly collapse into black holes without CCSNe to prevent oxygen enrichment. This mechanism may be related to the seed black hole formation of the supermassive black holes found at high redshift.

No.23

Formation of massive star cluster under radiative and stellar wind feedback: origins of extremely high N/O ratios and multiple stellar populations

Hajime Fukushima, University of Tsukuba
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Abstract

By performing 3D radiation hydrodynamics simulations with radiative and stellar wind feedback, we study the formation of young massive star clusters (YMCs). We include the metal yield by stellar wind and supernovae. We find that the young massive star clusters are only born in the high-surface density clouds where radiative feedback becomes ineffective due to strong gravitational force from the star clusters. In such a case, metal-enriched and high-density gas is formed around the star clusters. Before the supernovae occur, the high N/O ratios of gas are achieved due to stellar wind from Wolf-Rayet stars. The N/O ratios are comparable to that of discovered high-z galaxies (e.g., GN-z11). On the other hand, the oxygen-enriched gas appears after a supernova occurs inside the star cluster. Also, the N/O ratios of enriched stars are similar to those of second-population stars in globular clusters (GCs). Combining the condition of the YMC formation and the timescales of stellar evolution, we show that metal-enriched stars are only born in star clusters more massive than 1.e6 Msun. This condition of stellar multiple populations in YMCs allows us to constrain the formation site of GCs.

No.24

Primordial Turbulence: Accretion of Clouds in the Early Universe

Meng-Yuan Ho, ASIAA
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Abstract

Turbulence is a pivotal factor in the star formation process, influencing the characteristics of early stars. Existing simulations have predicted the formation of stars with significantly greater mass than observed in metal-poor stars, potentially attributed to the absence of turbulence. Recent studies indicate that turbulence can raise the temperature of primordial clouds, thereby reducing the star-forming rate (SFR) and impacting the mass of the earliest stars in the universe. Additionally, research has identified accretion-driven turbulence as a universal phenomenon in the cosmos. While implementing driven turbulence in simulations can provide valuable insights, the underlying relationship between primordial turbulence and cloud dynamics remains unclear. This study presents N-body hydrodynamics (HD) cosmological simulations utilizing the GIZMO code, which incorporates critical physics such as radiative cooling for primordial gas and turbulence diffusion. The initial conditions are derived from halo data within the TNG project at $z \sim 20$, where the halo with total mass ranges from 1e6 to 1e8 solar mass. Employing particle-splitting techniques, we achieve the finest resolution of 0.1 to 1 solar mass per gas particle, enabling us to unveil the intricate structure within dense clouds. Our analysis encompasses various physical properties, including density distributions, accretion rates, and the Mach number of the turbulence spanning the entirety of our simulations. Our primary objective is to unveil the intricate relationship between halo mass and these fundamental properties, furthering our understanding of the role of turbulence in the star formation process.

No.25

Self-regulation of black hole accretion via jets in atomic cooling halo

Su Kung-Yi, BHI, Harvard University
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Abstract

The early growth of black holes (BHs) in atomic cooling halos is likely influenced by feedback on the surrounding gas. While the effects of radiative feedback are well-documented, mechanical feedback, particularly from AGN jets, has been comparatively less explored. Building on our previous work that examined the growth of a 100-solar-mass black hole in a constant density environment regulated by AGN jets, we have expanded the black hole mass range from 1 to 10,000 solar masses and adopted a more realistic density profile for atomic cooling halos. We provide an analytic models for jet cocoon propagation and feedback regulation. We also identify several critical radii—namely, the terminal radius of jet cocoon propagation, the isotropization radius of the jet cocoon, and the core radius of the atomic cooling halo—that are crucial in determining black hole growth, given specific gas properties and jet feedback models. In a significant portion of the parameter space, our findings show that jet feedback substantially disrupts the halo-core gas density during the initial feedback episode, halting black hole growth beyond 10,000 solar masses. Conversely, conditions characterized by low jet velocities and high gas densities enable sustained black hole growth over extended periods. We have identified the parameter space that allows a stellar-mass black hole to grow into a supermassive black hole at high redshift by accreting gas from an atomic cooling halo.

No.26

Growth of Galaxy in the Cold Mode Accretion

Pei-Cheng Tung, ASIAA, NTU
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Abstract

Throughout the history of a galaxy, the interplay between the galaxy, CGM, and IGM is crucial to its evolution and growth. Gas accreted from the CGM and IGM (or cosmic web) cools down and flows into the galaxy, while feedback from stars and the supermassive black hole (SMBH) returns to the CGM, forming an active ecosystem in the star-forming galaxies. Models have suggested that cold accretion should be an effective way to fuel a galaxy and maintain its star formation. With the halo mass smaller than 3e11 solar mass, the heating n contributed by the gravitational potential is weak enough so that cold gas from filaments can flow directly into the galaxy thus enhancing the accretion, which might be a decisive factor in supporting the star formation and the building-up of mass in dwarf galaxy. In this research, we focus on the accretion of gas from the surrounding environment to the galactic center. We present N-body and hydrodynamical simulations with GIZMO code including physical models such as radiative cooling, star formation, and feedback from star and SMBH. To address the question realistically, we take advantage of the state-of-the-art cosmology simulation, IllustrisTNG, to set the initial conditions. Then, we raise the resolution and implement a set of more sophisticated physical models in our simulation. We examine the physical properties of the accreting CGM gas and study how it affects the evolution of host galaxies. The result shows gas from CGM can make significant impact on the baryon content of the galaxy, including the growth in total mass and the star formation.

No.27

Beyond the galaxy: the power of the CGM in constraining feedback mechanisms.

Maxime Rey, Yonsei University
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Abstract

The study of galaxy formation and evolution has progressed significantly in recent decades, with numerical simulations producing galaxies matching observed properties. However, the inner workings of the feedback processes that regulate the growth of galaxies are not fully understood. To address this, a new generation of high-resolution simulations has been developed, using subgrid models to describe unresolved phenomena at the resolution scale. While these simulations can produce galaxies comparable to observations, there is a degeneracy between subgrid models which can only be lifted by an observable beyond galactic properties. We thus turn a medium both challenging to model and sensitive to feedback, the circum-galactic medium (CGM). In this talk, I present the results of a series of zoom-in cosmological simulations of the same galaxy using different subgrid models. I will first demonstrate how different subgrid models can produce galaxies with similar stellar masses, but distinct CGM. Then, I will show that even though an underlying degeneracy can be sustained between models, they can be fully differentiated by relying on column densities. Finally, I will show how such simulations compare to observations, and present keys to reach a better agreement between simulations and observations.

No.28

Properties of the CGM of DESI luminous red galaxies

Yu-Ling Chang, National Taiwan University
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Abstract

The circumgalactic medium (CGM), the interface of gas flows between galaxies and intergalactic medium, holds crucial information about the key mechanisms driving galaxy evolution. To investigate the connections between the properties of the CGM and galaxies, we assemble a sample of about 1 million luminous red galaxies (LRGs) with background QSOs compiled from the largest spectroscopic dataset provided by the Dark Energy Spectroscopic Instrument (DESI) survey. With this massive dataset, we statistically characterize the properties of the CGM of DESI LRGs, including absorption line strengths, gas spatial distribution, and gas kinematics, and combine recent radio datasets to identify galaxies with radio-mode feedback in operation. In this talk, I will present the latest results of the CGM properties of LRGs and address two key questions: (1) how massive galaxies and their CGM co-evolve through cosmic time and (2) how radio-mode feedback affects the CGM of massive galaxies. These measurements place stringent constraints on the models of gas flows and provide novel insight into the mechanisms governing the cosmic baryon cycle.

No.29

Evolution of grain size distribution in the circum-galactic medium

Hiroyuki Hirashita, ASIAA

Abstract

Some observations showed that dust is distributed in a wide region out of galaxies, especially, in the circum-galactic medium (CGM). In order to theoretically understand the origin and evolution of circum-galactic dust, we construct a dust evolution model that incorporates the evolution of grain size distribution. We treat each of the galaxy and the CGM as a one-zone object, and consider the mass exchange between them. We take into account dust production and interstellar dust processing for the galaxy based on our previous models, and newly incorporate sputtering in the hot phase and shattering in the cool phase for the CGM. We find that shattering increases the dust destruction (sputtering) efficiency in the CGM. The functional shape of the grain size distribution in the CGM evolves following that in the galaxy, but it is sensitive to the balance between sputtering and shattering in the CGM. For an observational test, we discuss the wavelength dependence of the reddening in the CGM traced by background quasar colors, arguing that, in order to explain the observed reddening level, a rapid inflow from the CGM to the galaxy is favored because of quick dust/metal enrichment. Small grain production by shattering in the CGM also helps to explain the rise of dust extinction toward short wavelengths.

No.30

Exploring SED evolution considering the dust Size Evolution of a zoom-in galaxy simulation with Gadget4-Osaka

Kosei Matsumoto, Ghent University

Co-author(s): Kosei Matsumoto, Kentaro Nagamine, Hiroyuki Hirashita, Maarten Baes

Abstract

Dust within the interstellar medium (ISM) holds significant importance in revealing the observed characteristics of galaxies, yet the evolution of dust itself within galaxies and its manifestation as observable properties remain elusive. To address these problems, we employ a hydro-simulation code, Gadget4-Osaka, to model the evolution of grain size distribution within the framework of galaxy evolution. Subsequently, we conduct post-processing dust radiative transfer simulations using SKIRT based on the developed model. Gadget4-Osaka encompasses AGN and star-formation feedback models, as well as dynamic dust evolution: the production of dust from Supernova and AGB stars and interstellar dust processing such as accretion, shattering, coagulation, and sputtering. In a previous study (Matsumoto et al., 2024), we applied this framework to simulate an isolated galaxy reperesenting the Milky Way galaxy, observing the progressive production of small grains, including polycyclic aromatic hydrocarbons (PAHs), through the shattering of larger grains over time. Consequently, distinct PAH features emerged within the spectral energy distribution (SED) of the galaxy at the later galaxy evolutionary stage. However, the influences of gas accretion flows from the Intergalactic medium, galaxy mergers, and starburst on dust evolution have not been considered in the simulation. Thus, we also conduct a zoom-in simulation of a Milky Way-like galaxy throughout cosmic time and examine these effects. Furthermore, we discuss the spectral characteristics present in the SED of the galaxy across various galaxy evolutionary stages.

No.31

Unravelling the Characteristics and Evolution of Dusty Star-Forming Galaxies in the COSMOS Field

Yu-Han Ling, NTU, ASIAA
Co-author(s): Yu-Han Ling (NTU, ASIAA), Chian-Chou Chen (ASIAA)

Abstract

We explore the characteristics and development of dusty star-forming galaxies within the COSMOS field. Utilizing flux measurements from the super-deblended catalog, we identified 41 main-sequence galaxies and analyzed their gas-phase metallicity using spectroscopic observations from Keck/MOSFIRE and VLT/KMOS. Employing Modified Black Body (MBB) spectral energy distribution (SED) fitting, we estimated dust mass and dust temperature. Our study categorized the sample into three redshift bins (z=0.9, 1.4, and 2.2) to distinguish evolutionary patterns. Additionally, we utilized stacked images with the non-detection sources spanning 100um to 1200um to investigate lower dust mass. Our findings indicate a correlation between higher stellar mass and increased dust mass, as well as a positive relationship between gas-phase metallicity and dust mass. The dust-to-stellar mass ratio, when considering gas-phase metallicity, displays no discernible trend across redshift bins. Surprisingly, no significant evolutionary trends are evident in the examined physical properties. Nonetheless, the observed dust mass at a given stellar mass and gas-phase metallicity does not significantly exceed values found in the local universe, highlighting the intricate interplay of factors influencing the characteristics of dusty star-forming galaxies across cosmic epochs.

No.32

The role of clumps in galaxy evolution unveiled by JWST and ALMA

Boris Sindhu Kalita, Kavli-IPMU

Abstract

In the study of galaxy evolution, we are yet to understand the significance of the 'clumpiness' observed in high-redshift (z>1) galaxies, primarily investigated in rest-frame UV. I will be presenting our work on galaxy clumps, that exploits JWST/NIRCam, HST/ACS, and high-resolution ALMA continuum imaging. By utilising the CEERS and FMOS JWST+HST databases to access rest-frame UV, optical, and near-IR data from galaxies within the z = 1-2 range, we achieve precise and resolved estimations of their stellar mass distributions. We find that the previously identified UV clumps in galaxies from this epoch constitute components of underlying, more abundant 'stellar clumps', detectable up to rest-frame near-IR wavelengths. We find these structures to have sufficient mass to drive gas to galaxy cores via gravitational torques, also supported by radial property gradients. Additionally, star formation in the galaxy bulge exhibits correlations with the total mass of clumps, further substantiating this scenario. High-resolution ALMA sub-mm continuum observations in the FMOS sample enable these measurements, allowing the spatial separation of core and disk star formation. Moreover, the net stellar mass of bulges show strong correlations with clump masses. This further links bulge formation and stellar clumps. Lastly, I will also show evidence of the bulge stabilising the gas in the disk, inhibiting further clump formation and driving morphological quenching across the galaxy.

No.33

Bursty star formation and galaxy-galaxy interactions in low-mass high-z galaxies in the era of JWST

Yoshihisa Asada, Kyoto Univ.
Co-author(s): Yoshihisa Asada (Kyoto Univ.), Marcin Sawicki (St. Mary's Univ.), and CANUCS collaboration

Abstract

Revealing the assembly process of low-mass high-z galaxies has been a longstanding goal of modern extragalactic astronomy. In the hierarchical picture of structure formation, galaxy interactions and mergers are thought to be frequent in the early universe and essential for the evolution of these galaxies. Early results from JWST observations suggested the evolution sequence of high-z galaxies is highly bursty – fluctuating star formation with very short timescales – and galaxy local environments such as interactions can be a cause of the bursty star formation. We will present our results investigating the star formation burstiness and the local environments of low-mass galaxies at z~5-6. We used JWST observations of gravitational lensing cluster fields by the CAnadian NIRISS Unbiased Cluster Survey (CANUCS), to explore low-mass galaxies at high-z in various environments. We found the galaxy-galaxy interaction seems to be a quite common phenomenon among high-z low-mass galaxies, and the clustered environments or galaxy-galaxy interactions indeed enhance the star formation burstiness in low-mass high-z galaxies, by enabling rapid bursts of star formation and subsequent fast quenching. Our results suggest the galaxy local environment is quite pivotal in early-phase galaxy assembly. In the talk we will also show results from NIRSpec follow-up observations to further discuss the physical origins triggering bursty star formations in low-mass interacting galaxies at high-z.

No.34

Suppression of star formation at the center of barred spiral galaxies

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Abstract

A CAS analysis (Conselice 2003) of CO(2-1) data images of 73 galaxies from PHANGS-ALMA yielded significant results. One result is that barred spiral galaxies have relatively higher central concentrations of molecular gas than non-barred spiral galaxies. We also performed the same analysis on Hα data images of 19 galaxies in PHANGS-MUSE. We found four barred spiral galaxies with a high Concentration index in CO(2-1) and a low Concentration index in Hα. This analysis suggests that star formation is suppressed in the center of these barred spiral galaxies. It may be an important insight into the evolution of nearby galaxies. This issue will be discussed in detail.

Day3 Thursday, 8 Aug 2024

No.35

SAGA Survey: A Census of 101 Satellite Systems around Milky Way-like Galaxies

Yao-Yuan Mao, University of Utah

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Abstract

We present the main findings of the third Data Release (DR3) of the Satellites Around Galactic Analogs (SAGA) Survey, a spectroscopic survey characterizing satellite galaxies around Milky Way (MW)-mass galaxies. SAGA DR3 includes 378 satellites identified across 101 MW-mass systems in the distance range 25-40.75 Mpc, and an accompanying redshift catalog of background galaxies (including 46,000 taken by SAGA) in the SAGA footprint of 84.7 sq. deg. The number of confirmed satellites per system ranges from zero to 13, in the stellar mass range 10^6-10^10 solar masses. Based on a detailed completeness model, this sample accounts for 94% of the true satellite population down to a stellar mass of 10^7.5 solar masses. Below 10^7.5 solar masses, we identified 135 satellites with confirmed redshifts, of which 98 are star forming. We find that the mass of the most massive satellite in SAGA systems is the strongest predictor of satellite abundance; one-third of the SAGA systems contain LMC-mass satellites, and they tend to have more satellites than the MW. The SAGA satellite radial distribution is less concentrated than the MW, and the SAGA quenched fraction below 10^8.5 solar masses is lower than the MW, but in both cases, the MW is within 1-sigma of SAGA system-to-system scatter. We do not find a signal for corotation of SAGA satellites. Although the MW differs in many respects from the typical SAGA system, these differences can be reconciled if the MW is an older, slightly less massive host with a recently accreted LMC/SMC system. The very low-mass star-forming satellites in the SAGA system will put new constraints on the quenching mechanism in the early universe.

No.36

Exploring the Evolution of SFR and Gas-Phase Metallicity in Spiral Galaxies Over the Past 3Gyr

Qianhui Chen, The Australian National University

Abstract

Spiral structures are important drivers of the secular evolution of disc galaxies, however, the effects of spiral arms on the development of galaxies remain mysterious. In this talk, we present two spiral galaxies at z~0.3 from the Middle Age Galaxy Properties with Integral Field Spectroscopy (MAGPI) survey and nine nearby spiral galaxies from the TYPHOON survey. We investigate the two-dimensional distributions of star formation rate (Halpha) and gas-phase metallicity. We notice significant offsets in Halpha (~0.2 dex) among the spiral arms, downstream and upstream of SG1202 at z~0.3. No azimuthal variation in Halpha or gas-phase metallicities is observed in SG1204, another spiral galaxy at z~0.3, which can be attributed to the tighter spiral arms in SG1204 than SG1202, coming associated with stronger mixing effects in the disc. Expanding the study to nine nearby spiral galaxies with the TYPHOON survey, we observe that the azimuthal variation in SFR and metallicity in 3 of our galaxies. These findings suggest changing relationships between SFR and metallicity over the past 3 billion years. It also highlights the complex influence of spiral arms on metal mixing in galactic discs.

No.37

Simulating multiwavelength spectra and images of cosmic ray driven winds

Huai-Hsuan Chiu, University of Michigan

Co-author(s): Huai-Hsuan Chiu (University of Michigan) Mateusz Ruszkowski (University of Michigan) Timon Thomas (AIP) Maria Werhahn (AIP, MPA) Christoph Pfrommer (AIP)

Abstract

Formation of galaxies is significantly influenced by galactic winds, possibly driven by cosmic rays due to their long cooling time and better coupling to plasma compared to radiation. In this study, we compare the radio observations of the edge-on galaxy NGC 4217 from the CHANG-ES collaboration catalog with a mock observation of an isolated galaxy based on the AREPO simulation that adopts the state-of-the-art two-moment cosmic ray transport treatment and multiphase ISM model. We find significant qualitative and quantitative agreement between the simulated and observed images and spactroscopic data. Specifically, we find that (i) the simulated emission maps match observations much better than previous studies and the shapes of intensity profiles are only very weakly dependent on the normalization of the magnetic field; (ii) the simulated radio polarization images exhibit X-shaped morphology, often seen in edge-on galaxies, which is consistent with the presence of a galactic-scale outflow; and (iii) the multiwavelength spectrum above 0.1 GHz is in agreement with the observations. This qualitative match is possible provided that the simulated magnetic field is moderately boosted, which could be attributed to the galactic disk interaction with the CGM. Our results highlight the importance of incorporating advanced cosmic ray transport models in simulations, and provide a deeper understanding of galactic wind dynamics and its impact on galaxy evolution.

No.38

What is the origin of the different kinematic morphologies of early-type galaxies?

Michal Bilek, Paris Observatory, LERMA

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Abstract

Early-type galaxies (i.e. elliptical and lenticular) are divided into slow and fast rotators according to the appearance of their maps of line-of-sight velocity. Fast rotators show clear ordered rotation, while slow are supported mostly by velocity dispersion. I will speak about our work on investigation of the origin of this diversity. Inspired by cosmological simulations, we assumed that galaxies first form as fast rotators and then mergers transform some of them to slow rotators. We investigated the correlations of a measure of rotational support with various properties of galaxies that are sensitive to mergers. These include stellar ages, the presence of tidal features, and kinematically distinct cores. Each of these parameters is sensitive to a different type of merger and has a different lifetime. The found correlations, or their lack, together with observations of high-redshift universe, are explained the easiest, if the rotation support of early-type galaxies was decreased by multiple minor wet mergers more than 10 Gyr ago.

No.39

The diversity of noncircular rotation motions in the MUSE-PHANGS galaxies: from ten pc scales to kpc scales.

Carlos Lopez-Coba, ASIAA

Abstract

In this work, we address the origin of noncircular rotation in 19 galaxies from the MUSE/VLT-PHANGS survey. It is often assumed that gas and stars follow circular rotation around the nucleus, while this is true at global scales, nonaxisymmetric sources like spiral arms, and stellar bars, induce deviation from circular rotation on the gas and stars. In addition, local processes related to the ISM like star formation, nuclear activity, shocks and diffuse gas contribute to noncircular rotation in the observed line of sight velocities. We carried out a systematic study of the noncircular rotation at an unprecedented spatial resolution. We find that by only considering kinematics we are able to characterize the ionization conditions of the ionized gas. These results highlight the importance of kinematics when trying to understand the local and global conditions of the ISM.

No.40

Why is there star rebirth inside galaxies? An investigation into the Rejuvenated Galaxies (RGs) from MaNGA.

Ting-Xuan Li, National Taiwan University

Abstract

Galaxies generally evolve from active to passive, which analog to high star-formation rate (SFR) to low SFR. However, some galaxies were observed to evolve from low SFR to high SFR. Our main motivation is to investigate the origin of the rejuvenated gas through gas-phase metallicity. A lower gas-phase metallicity value is anticipated if the rejuvenated gas originates from the intergalactic space. We totally identify 27 and 11 RGs from spatially-resolved and integrated selection methods, respectively, from approximately 10,000 MaNGA galaxies. We found that the gas-phase metallicity of rejuvenated spaxels is not significantly lower than normal star-forming spaxels; therefore, there is not strong evidence to suggest that the gas comes from intergalactic space. Additional analyses are ongoing and will be presented upon completion.

No.41

Can the dichotomy scenario explain the observed variety of elliptical galaxies?

Rogerio Monteiro-Oliveira, ASIAA

Co-author(s): Rogerio Monteiro-Oliveira (ASIAA), Yen-Ting Lin (ASIAA), Wei-Huai Chen (NTU/ASIAA), Chen-Yu Chuang (NTHU/ASIAA), Abdurro'uf (Johns Hopkins University), Po-Feng Wu (NTU), Eric Emsellem ESO) and Martin Bureau (University of Oxford)

Abstract

The identification of patterns in large samples of elliptical galaxies is crucial for understanding their formation, as common features point toward similar assembly histories. Supported by observed correlations (albeit based on small galaxy sample sizes), some researchers have proposed that elliptical galaxies can be split into two distinct groups. On one side lie the most luminous ellipticals, characterized by boxy-shaped isophotes, a high value of alpha-to-iron abundance ratio, and stellar dynamics showing a slow rotator (SR) pattern. On the other hand, the antipode group contains lower luminosity galaxies with disky isophotes, a low alpha-to-iron ratio, and dynamics supported by rotation (fast rotators, FR). This is known as the dichotomy of elliptical galaxies. However, this idea has not yet found full agreement in the literature, as many other researchers have not found the same correlations. To help shed light on this topic, we used a sample of ~2,000 galaxies identified as ellipticals via deep learning by the MaNGA survey. We extracted from them a diverse set of parameters, including their isophote shapes (boxy or disky), stellar kinematics (SR or FR), chemical composition (alpha-to-iron abundance in terms of [Mg/Fe]), and stellar velocity dispersion. We also added their absolute magnitude and stellar mass from the NASA-Sloan Atlas, totaling seven parameters per galaxy. Then, we conducted an intensive search for correlations among all these parameters. We found that the ellipticals are majority disky-shaped (65%) and FRs (67%), but the abundance of [Mg/Fe] does not show any differences between the different classes. The result of the principal component analysis revealed that our sample of elliptical galaxies shows a single pattern, discarding, therefore, the dichotomy scenario. The different classes (boxy/disky and SR/FR) occupy slightly different loci in the extended parameter space, which may explain the observed trend that led to the misled dichotomy using small sample sizes.

No.42

Probing the Redshift Evolution of the Fundamental Plane: Insights from Horizon Run 5 Simulations

Priya Goyal, Korea institute for Advanced Study (KIAS), Seoul, Republic of Korea
Co-author(s): Priya Goyal(KIAS), Prof Changbom Park (KIAS)

Abstract

We investigate the Fundamental Plane (FP) evolution of Early-Type Galaxies (ETGs) in the Horizon Run 5 (HR5) simulations from redshift ~ 2.1 to 0.625. We find that a tight plane relation between galaxy size, surface brightness, and velocity dispersion already exists as early as $z = 2.1$ with scatter as low as ~0.04 dex across this redshift range. We find that $4c + b + 2 = \delta$, where $\delta \sim 0.9$ for FPs in HR5, rather than zero as is typically inferred from observations. This implies that a tight power-law relation between the dynamical mass-to-light ratio Mdyn/L and the dynamical mass Mdyn is not present in the HR5 simulations. This can be due to inefficient star formation rates in the simulation producing high star forming ETGs even at the massive end of the stellar mass function. We then study the redshift evolution of FP and M/L ratio by tracing the structural and passive evolution of these sample of ETGs. This study is useful in the era of ongoing observational efforts with the James Webb Space Telescope (JWST) and the next generation ground based telescopes, which will provide more detailed insights into ETGs at high redshifts, offering invaluable understanding of the underlying processes driving galaxy formation and evolution.

Day4 Friday, 9 Aug 2024

No.43

Search for extreme emission line galaxies at 1

Seiya Imai, SOKENDAI/NAOJ

Co-author(s): Seiya Imai, Masayuki Tanaka, Yusei Koyama, Kiyoto Yabe, Masato Onodera, Makoto Ando(NAOJ), Kei Ito(Univ. of Tokyo)

Abstract

Revealing the nature of low-mass galaxies with strong emission lines is of importance to understand the early stage of galaxy formation and evolution. These galaxies often exhibit a strong [OIII]λ5007Å emission line and referred to as extreme emission line galaxies (EELGs). Recent JWST observations reveal that EELGs are common at $z > 6$, but Lower redshift EELGs at $0 < z < 3$ are useful objects to study their properties in greater detail. EELGs in the local universe are first identified as green peas, and they have been examined extensively to date. However, our understanding of intermediate redshift EELGs at $1 < z < 3$ is very limited. Galaxies with strong [OIII] 5007 equivalent widths are extremely rare, and understanding their evolution requires a large sample size. We here investigate statistical properties of EELGs(EW([OIII]5007)>1000Å) at 11000Å) from a small patch of the data matching spec-z catalog. We first identify candidates using color-color diagrams. We then carry out detailed SED fitting using the u2K catalog to infer their redshifts, stellar-mass, and star formation rates. In this talk, we will report these physical properties of EELGs and discuss their evolution around cosmic noon.

No.44

Chemical Evolution of Galaxies from z=0—5 with UniverseMachine

Moka Nishigaki, SOKENDAI/NAOJ

Co-author(s): Moka Nishigaki (SOKENDAI/NAOJ), Peter Behroozi (NAOJ/University of Arizona), Masami Ouchi (NAOJ/The University of Tokyo)

Abstract

The main goal of this study is to understand the fraction of metals produced in galaxies that promptly re-enrich the interstellar medium (ISM) compared to metals that are ejected into the circumgalactic medium (CGM). We refer to this fraction as the ISM return fraction. Constraining the ISM return fraction helps us understand the baryon cycle, especially the feedback mechanisms involving outflows. We develop a novel empirical model that infers the average metallicity evolution of galaxies from redshift z~5 to z~0, which is enabled by recent JWST metallicity measurement and constraints on galaxy ISM masses. The key concept of this model is that the average ISM return fraction over time can be approximated by the fraction of metal mass in the ISM divided by the total metal mass produced and ejected into the ISM by stars. Anchored in the UniverseMachine framework (Behroozi+19), which links galaxy and halo properties, our model converts observational data on gas-phase ISM and CGM metallicities and galaxy ISM masses across z=0—5 into constraints on the ISM return fraction. Utilizing observational constraints on ISM metallicities from star-forming regions and damped Lyman-alpha systems, we develop the model with a realistic metal mixing approach that treats atomic and molecular gases individually, departing from the conventional assumption of well-mixed ISM. Our best-fitting model indicates that deeper potential well depths lead to more metals returning to the ISM, with no significant redshift evolution. We also find that the return fraction to the atomic phase is low, which indicates that the returning gas predominantly enriches the molecular phase, and that metals are not well-mixed within the molecular and atomic phases in the ISM.

No.45

The Metallicity of DESI Dwarf Galaxies

Yu Voon Ng, National Taiwan University
Co-author(s): Yu Voon Ng (NTU); Ting-Wen Lan (NTU)

Abstract

The mass-metallicity relation indicates that galaxies with higher stellar masses tend to have higher metallicities. However, the low-mass end of this relationship remains poorly understood due to the difficulties of identifying dwarf galaxies and measuring their metallicities. In this talk, I will present the latest results of exploring the low-mass end of the relation using the new dataset from the Dark Energy Spectroscopic Instrument (DESI) survey at redshifts within 0.1. We employ a convolutional neural network (CNN) method to identify the dwarf candidates from the images and then estimate the gas metallicity of galaxies with multiple lines detected in the DESI spectra. For systems with limited line information, we explore a new parameter space and stack the spectra to obtain their metallicities. Utilizing the DESI dataset, we largely increase the sample size and obtain stringent constraints on the mass-metallicity relation at the low-mass end.

No.46

A systematic investigation of environmental dependencies of galactic properties across the Hubble sequence

Kun-Bao Yang, NTU
Co-author(s): Kun-Bao, Yang (Department of Physics, NTU, Taiwan) Yen-Ting, Lin (ASIAA, Taiwan) Po-Feng, Wu (Graduate Institute of Astrophysics, NTU, Taiwan) Dylan Nelson (Universität Heidelberg, Zentrum für Astronomie, ITA ,Heidelberg, Germany)

Abstract

We have conducted a systematic study of the dependencies on environments of several key galactic properties (such as size, color, 4000 Angstrom break strength, star formation rate) for elliptical, lenticular, early and late-type disk galaxies separately, using a low redshift volume-limited galaxy sample from Sloan Digital Sky Survey (SDSS), finding that the dependencies, albeit varying systematically with the Hubble sequence, are typically rather weak. We have further examined such dependencies using galaxies produced by IllustrisTNG, finding generally good agreement, especially for central galaxies. Our results suggest that, whatever mechanisms that are responsible for transformation of morphologies of galaxies must have taken place at high-z such that by z~0, environmental dependencies are nearly washed out.

No.47

CSFD: An Accurate, All-Purpose, Full-Sky Dust Map

Yi-Kuan Chiang, ASIAA

Abstract

The widely used Galactic dust reddening map, the Schlegel, Finkbeiner, & Davis (1998, SFD) map, was found to be contaminated by the cosmic infrared background (CIB). Such a systematic can impact precision cosmology using galaxy clustering, lensing, and supernovae Ia (Chiang & Ménard 2019). In this talk, I will provide a solution by introducing a new, full-sky Galactic dust map dubbed CSFD, the corrected SFD. CSFD carries all Galactic features in the original SFD but with the CIB contamination removed via a data-intensive, clustering-based method. The new map enables more

accurate extinction correction for the galaxy survey community. Meanwhile, it provides a better foreground template for the next generation of CMB and intensity mapping experiments.

No.48

Exploring the faintest end of mid-infrared luminosity functions up to z ≃ 5 with the JWST CEERS survey

Chih-Teng Ling, National Tsing Hua University

Co-author(s): Chih-Teng Ling (NTHU) Tomotsugu Goto (NTHU) Seong Jin Kim (NTHU) Cossas K -W Wu (NTHU) Tetsuya Hashimoto (NCHU) Tom C -C Chien (NTHU) Yu-Wei Lin (NTHU) Simon C -C Ho (ANU) Ece Kilerci (Sabancı University)

Abstract

Mid-infrared (MIR) light from galaxies is sensitive to dust-obscured star formation activities because it traces the characteristic emission of dust heated by young, massive stars. By constructing the MIR luminosity functions (LFs), we are able to quantify the overall dusty star formation history and the evolution of galaxies over cosmic time. In this work, we report the first rest-frame MIR LFs at 7.7, 10, 12.8, 15, 18, and 21 μm as well as the total IR LF from the JWST Cosmic Evolution Early Release Science (CEERS) survey. We identify 506 galaxies at z = 0–5.1 in the CEERS survey that also have optical photometry from the Hubble Space Telescope. With the unprecedented sensitivity of the JWST, we probe the faintest end of the LFs at z = 0–1 down to L* ∼ 107L⊙, ∼2 orders of magnitude fainter than those from the previous generation of IR space telescopes. Our findings connect well with and continue the faint end of the MIR LFs from the deepest observations in past works. As a proxy of star formation history, we present the MIR-based luminosity density up to z ≃ 4.0, marking the first probe of the early Universe by JWST Mid-Infrared Instrument.

No.49

Cosmic SF history inferred from the JWST source counts.

Kim Seong Jin, National Tsing Hua Univerisity

Co-author(s): Seong Jin KIM (NTHU), Tomotsugu GOTO (NTHU), Chih-Teng LING (NTHU), Cossas K.-W. WU (NTHU), Tetsuya HASHIMOTO (NCHU), Ece KILERCI (Sabanci Univ), Simon C.-C. HO (ANU), Yuri UNO (NCHU), Po-Ya WANG (NTHU), Yu-Wei LIN (NTHU)

Abstract

With the advent of the JWST, extragalactic source count studies were conducted down to sub- μJy in the mid-infrared (MIR), which is several tens of times fainter than what the previous-generation infrared (IR) telescopes achieved in the MIR. In this work, we aim to interpret the JWST source counts and constrain cosmic star-formation history (CSFH) and black hole accretion history (BHAH). We employed the backward evolution of local luminosity functions (LLFs) of galaxies to reproduce the observed source counts from sub- μJy to a few tens of mJy in the MIR bands of the JWST. The shapes of the LLFs at the MIR bands were determined using the model templates of the spectral energy distributions (SEDs) for five representative galaxy types (star-forming galaxies, starbursts, composite, AGN type 2 and 1). By simultaneously fitting our model to all the source counts in the six MIR bands, along with the previous results, we determined the best-fitting evolutions of MIR LFs for each of the five galaxy types, and subsequently estimated the CSFH and BHAH. Thanks to the JWST, our estimates are based on several tens of times fainter MIR sources, the existence of which was merely an extrapolation in previous studies.

No.50

Constraints on the cosmic baryon distribution with the FLIMFLAM survey

Yuxin Huang, The University of Tokyo
Co-author(s): Yuxin Huang (the University of Tokyo), Khee-Gan Lee (Kavli IPMU) et al.

Abstract

Fast radio bursts (FRBs) are a promising new technique to probe the cosmic baryon distribution through their dispersion measures (DM), which can be further enhanced by combining with spectroscopic data of the foreground fields. I will introduce the FLIMFLAM survey, a wide field multi-object spectroscopic survey that targets the foreground galaxies of localized Fast Radio Bursts (FRBs). The goal of the survey is to independently constrain the total amount of cosmic baryons residing the IGM and CGM, as well as measure the mean host DM contribution. On behalf of our collaboration, I will introduce new results that place the first-ever constraints on the relative fractions of cosmic baryons residing in the IGM and CGM, using the first data release (DR1) of the FLIMFLAM data which targets 9 FRBs. This is done by running MCMC analysis on models based on the observed foreground galaxy distribution, for which we have (i) reconstructed the matter density field using the Bayesian reconstruction code ARGO to calculate the IGM contribution and (ii) calculated the intervening CGM contribution of DM using a modified NFW model. Our results are the first time that the CGM gas fraction of M_halo~ 10^11-10^12 solar mass galaxy halos has ever been measured. We will also publicly release our data the allow reproducibility of our results. Similar analysis of future data sets will allow us to detect the imprint of galaxy and AGN feedback on the cosmic baryon distribution.

No.51

Probing Missing Baryons: Stacking Compton y-map in All-sky Filamentary Structures.

Ting-An Wu, National Taiwan University

Abstract

In addressing the 'missing baryon problem', simulations indicate that these baryons may reside in the warm-hot intergalactic medium (WHIM) within the filamentary structures between galaxy halos. Leveraging the Planck thermal Sunyaev-Zeldovich effect (tSZ) maps (Compton y-map), we perform an all-sky stacking analysis of about 1.5 million galaxy pairs from over 0.38 million selected galaxies in the Gaia DR3 galaxy candidate catalog. The redshift of samples from Gaia exhibits high completeness and homogeneity but lower purity. To enhance accuracy, we employ machine learning to construct a new, high-purity redshift catalog trained by redshift and photometry from Gaia, WISE x SuperCOSMOS, and SDSS. The selected galaxy pairs are in the redshift range $0.09 < z < 0.18$, with a median redshift $z = 0.13$. The median length of galaxy pairs is 25.3 Mpc. Upon stacking these refined samples, we observe significant detections of the tSZ signal within the filament regions between galaxy pairs. These excess tSZ signals are potentially originated from WHIM in the filaments and carry the information of the baryon fraction. During the presentation, I will elucidate how we characterize the baryon distribution within the filamentary structures based on the all-sky stacking results.

No.52

Cosmic-ray Feedback in Galaxies: Fermi Bubbles and Odd Radio Circles

Hsiang-Yi Karen Yang, National Tsing Hua University
Co-author(s): Hsiang-Yi Karen Yang (NTHU), Po-Hsun Tseng (NTU), Hsi-Yu Schive (NTU), Tzihong Chiueh (NTU), Ellis Owen (Osaka), Yen-Hsing Lin (NTHU)

Abstract

Relativistic jets from active galactic nuclei (AGNs) are vital drivers of massive galaxy properties, and cosmic rays (CRs) have shown to have significant impacts on the properties of galaxies and the circumgalactic medium. To achieve self-consistent numerical simulations, it's crucial to model CR propagation, spectral evolution, and emission mechanisms. Our 3D CR-magnetohydrodynamic simulations reveal that past activity of Sgr A* can explain the Fermi and eRosita bubbles in the Milky Way. We investigate the formation of symmetric bubbles through AGN jet interactions with the dense Galactic disk. Additionally, we explore the possibility of detecting Fermi bubble analogs in nearby galaxies using both hadronic and leptonic scenarios. When observed head-on, AGN jet-inflated bubbles offer a promising explanation for recently discovered odd radio circles (ORCs). These works advance our understanding of the roles of CRs in AGN feedback and their influence on various astrophysical phenomena within our cosmic neighborhood.

No.53

Birth of Radio Activity in a Quasar

Satoki Matsushita, ASIAA
Co-author(s): Satoki Matsushita (ASIAA), Kaiki Taro Inoue (Kindai Univ.), Kouichiro Nakanishi (NAOJ), Takeo Minezaki (Univ. Tokyo)

Abstract

Many AGNs show radio activities, but not clear how the activities start. So far, the Gigahertz Peaked-Spectrum (GPS) sources and/or the Compact Steep-Spectrum (CSS) sources are consider to be in the early phase of the radio activities. However, most of these sources are compact, but located at high-z universe, so that the best way to study is to observe the gavitationally lensed system of such sources. We observed MG J0414+0534, which is a quadruply lensed GPS QSO located at z = 2.639, with the ALMA Band 9 long baseline configuration. Both continuum and CO(11-10) have been detected, and the de-lensed image reached to 50 pc resolution. It shows the jet-ISM interaction within the scale of 1 kpc. In this presentation, we will discuss the evolution of radio activity in this QSO system.

No.54

Time-variable Line-locking Absorption Systems in HE0151−4326

Liu Qiang, Shinshu University
Co-author(s): Qiang Liu Toru Misawa Akatoki Noboriguchi

Abstract

A super massive black hole (SMBH) and its host galaxy are believed to have evolved together (i.e., co-evolution) since they have the scaling relations. Outflow winds from activate galaxy nuclei (AGN) likely play a crucial role in the co-evolution between them. In this study, we monitored absorption profiles arising at outflow winds from quasars in their spectra. We chose a quasar HE0151-4326 as our target since it keeps line-locked absorption profiles in the spectrum, taken in several different observing epochs. We discovered the absorption lines had been variable especially in their Covering factor. We discuss the variability trend based on i) gas motion scenario and ii) change in the ionization scenario.

No.55

Updated AGN Picture with Dusty/Dust-free Gas Structures and Effects of the Radiation Pressure

Shoichiro Mizukoshi, the University of Tokyo

Co-author(s): Shoichiro Mizukoshi, Takeo Minezaki, Hiroaki Sameshima (univ. Tokyo), Mitsuru Kokubo (NAOJ), Hirofumi Noda (Osaka univ.), Taiki Kawamuro, Satoshi Yamada (RIKEN), Takashi Horiuchi (univ. Tokyo)

Abstract

We investigate the properties of two gas structures of active galactic nuclei (AGNs), i.e., dusty and dust-free gas components, by separating them with the line-of-sight dust extinction (Av) and the neutral gas column density (NH). We find that the typical column density of the dusty and dust-free gas is different depending on the Seyfert type, indicating that both structures have anisotropic column density distributions. The number of targets with the dusty gas column density (NH,d) of log(NH,d) [cm−2] > 23 is much smaller than that with the same column density of the dust-free gas. This result indicates that the optically-thick part of the dusty gas structure is very thin. There are very few targets with a larger Eddington ratio (f_Edd) than the effective Eddington limit of the dusty gas and the covering factor of the dusty gas with 22 ≤ log(NH,d) [cm−2] < 24 shows a clear drop at the effective Eddington limit. These results support the scenario in which the covering factor of the dusty torus decreases in a high Eddington ratio due to the radiation-driven dusty gas outflow. The covering factor of the dust-free gas with the column density (NH,df) of 22 ≤ log(NH,df) [cm−2] < 24 similarly shows the decrease in high Eddington ratio, while it might be due to the dust-free gas outflow driven by some other mechanisms than the radiation pressure. Finally, we propose an updated picture of the AGN gas structure based on our results and Ricci et al. (2017).

No.56

Unveiling heavily obscured SMBH growth in the early universe

Naoki Matsumoto, Tohoku University

Abstract

Heavily obscured AGN in the early universe is an important population that represents an early violent growth phase of the SMBHs and host spheroidal components. Recent deep/wide surveys show the possibility that many luminous AGN are so obscured that they could be undetectable even in the hard X-ray band (i.e., heavily obscured AGN) at z>3 and they have large contribution to overall SMBHs growth rate. We performed a search for z>3 heavily obscured AGN in the XMM-LSS and COSMOS field focusing on their strong rest-frame NIR emission originated from AGN hot dust. As a result of the selection, ~70% of selected sources are not detected by the deep X-ray survey in these fields. SED fitting analysis on all selected candidates revealed that the AGN bolometric luminosities reach log(Lbol)~46-48, indicating that they can be heavily obscured and host a SMBH under vigorous growth phase. In order to evaluate their contribution to the cosmic SMBH growth rate, we estimated the black hole accretion rate density (BHAD) utilizing the estimated Lbol. The estimated BHAD of including heavily obscured AGN significantly exceeds the previous X-ray studies and reaches the theoretical simulations that reproduce the observed massive SMBHs in the present day.

No.57

X-ray Winds In Nearby-to-distant Galaxies (X-WING) - I: Legacy Surveys of Galaxies with Ultrafast Outflows and Warm Absorbers in z ~ 0-4

Satoshi Yamada, RIKEN

Co-author(s): Satoshi Yamada, Taiki Kawamuro (RIKEN), Misaki Mizumoto (U. of Teacher Education Fukuoka), Claudio Ricci (UDP), Shoji Ogawa (ISAS/JAXA), Hirofumi Noda (Tohoku U.), Yoshihiro Ueda, Teruaki Enoto (Kyoto U.), et al.

Abstract

As an inaugural investigation under the X-ray Winds In Nearby-to-distant Galaxies (X-WING) program, we assembled a dataset comprising 133 active galactic nuclei (AGNs) spanning redshifts z ~ 0-4 characterized by blueshifted absorption lines indicative of X-ray winds. Through an exhaustive review of previous research, we compiled the outflow parameters for 575 X-ray winds, encompassing key attributes such as outflow velocities (Vout; km/s), ionization parameters (Xi), and mass outflow rates. By leveraging these parameters, we systematically categorized the winds into three distinct groups: (1) ultrafast outflows (UFOs; logVout\gt4, logXi\gt2), (2) low-ionization parameter (low-IP) UFOs (logVout\gt4, logXi\lt2), and (3) warm absorbers (logVout\lt4). A notable finding was the identification of a velocity gap around Vout ~ 10,000 km/s. This gap was particularly evident in the winds detected via absorption lines within the \lt2 keV band, indicating different origins for low-IP UFOs and warm absorbers. In cases involving Fe XXV/Fe XXVI (6.7/7.0 keV) lines, where the gap might be attributed to potential confusion between emission/absorption lines, the possibility of UFOs and galactic-scale warm absorbers being disconnected is considered. An examination of the outflow and dust sublimation radii revealed a distinction: UFOs appear to consist of dust-free material, whereas warm absorbers likely comprise dusty gas. From 2024, the XRISM is poised to alleviate observational biases, providing insights into the authenticity of the identified Vout gap, a pivotal question in comprehending AGN feedback from UFOs (Yamada+24b, ApJS, submitted). Finally, we will report the latest results of the UV-to-radio SED fittings and studies on their multiphase outflows.

No.58

Study of dense gas around AGN in the nearby Seyfert galaxy NGC 1068

Yumi Watanabe, Fukushima University/NAOJ

Abstract

We focus on the effect of active galactic nuclei (AGN) on interstellar matter to understand galaxy evolution. The dense gas tracer HCN(J=1-0) and molecular gas tracer CO(J=1-0) have been commonly used to study the physics of molecular gas around AGN. We observed the nearby Seyfert galaxy NGC 1068 to study dense gas around the AGN. NGC 1068 has a circumnuclear disk (CND) (radius ~0.2 kpc) surrounding the AGN. The HCN/CO intensity ratio map of NGC 1068 with the highest resolution (60 pc) and highest sensitivity compared to previous studies was created. The HCN/CO intensity ratio was higher than the typical value of 0.1 (e.g., Casasola et al. 2011) not only for the CND but also for 0.3 kpc outside of the CND. Anomalous excitation or anomalous abundances are one of the likely causes. The excitation anomaly could be a maser, but no sign of it was obtained from the spectra.

No.59

The Variability Structure Function of the Highest-Luminosity Quasars on Short Timescales

Ji-Jia Tang, NTU

Abstract

The stochastic photometric variability of quasars is known to follow a random-walk phenomenology on emission timescales of months to years. Some high-cadence restframe optical monitoring of the past has hinted at a suppression of variability amplitudes on shorter timescales of a few days or weeks, opening the question of what drives the suppression and how it might scale with quasar properties. Here, we study a few thousand of the highest-luminosity quasars in the sky, mostly in the luminosity range of L_bol=[46.4, 47.3] and redshift range of z=[0.7, 2.4]. We use a dataset from the NASA/ATLAS facility with nightly cadence, weather permitting, which has been used before to quantify strong regularity in longer-term restframe-UV variability. As we focus on a careful treatment of short timescales across the sample, we find no evidence of any systematic breaks or suppression in the UV variability structure function at short timescales; instead, the data is consistent with a single-slope random walk across restframe timescales of dt=[10, 250] days.

No.60

Relation between molecular gas and star-forming activity on the merger sequence in local U/LIRGs

Akino Yasuda, The University of Tokyo

Co-author(s): Akino Yasuda (The University of Tokyo), Kentaro Motohara (NAOJ), Shuhei Koyama (The University of Tokyo)

Abstract

Previous studies have shown that there is a strong correlation between the stellar mass and star formation rate (SFR) in galaxies, called the star formation main sequence (SFMS). Galaxies located above the SFMS in the SFR – stellar mass plane are particularly active in star formation and are called luminous infrared galaxies (LIRGs) or ultra-luminous infrared galaxies (ULIRGs) based on their infrared emission. One of the causes of active star formation in U/LIRGs is thought to be the interaction between galaxies, and many U/LIRGs are known to interact with each other. Studying these active star-forming activities is important for understanding galaxy formation and evolution. To understand the physics behind the active star formation of U/LIRGs, we estimated the molecular gas masses of 45 local U/LIRGs using 12CO (1-0) line data observed by the Nobeyama 45 m radio telescope. These sources (PARADISES galaxies) were selected from the sample of the PARADISES project, a near-infrared narrow-band imaging survey of the Pa α emission lines of local U/LIRGs. Molecular gas masses of PARADISES galaxies and samples from two previous studies were examined in relation to molecular gas mass, molecular gas fraction, star formation efficiency, and galaxy properties. In order to investigate the relationship between interactions and star formation activity in local U/LIRGs, the objects in our sample were classified into merger stages based on their morphology. The results show no trend in molecular gas fraction or star formation efficiency with merger stage in PARADISES galaxies.

No.61

The Host Morphologies of X-ray-selected Active Galactic Nuclei Observed with JWST.

Bovornpratch Vijarnwannaluk, ASIAA
Co-author(s): Bovornpratch Vijarnwannaluk, Zhen-Kai Gao, Ranjan Adarsh, Wei-Hao Wang, Chen Chian-Chou

Abstract

Observations of supermassive black holes (SMBH) in the local universe show a strong correlation between their mass and host galaxy properties. This may be a result of fueling and feedback between the SMBH and the host galaxy during its active phase as active galactic nuclei (AGN) which can be reflected in the host galaxy morphology. Local luminous AGN tend to reside in massive bulge-dominant galaxies while less luminous AGN (eg. Seyferts) reside in disk-dominated galaxies. However, the evolution of the AGN host galaxy through cosmic time is still unclear, especially at high redshift during the bulk of SMBH and stellar mass formation. Thanks to the high-angular resolution in the near-infrared of JWST NIRCAM, it is now possible to resolve the host galaxy of redshift 2-4 AGN with 2-10 keV luminosity of logLx=43-45. Here, we present our preliminary results on the morphology of 1250 X-ray-selected AGN detected from the C-COSMOS survey within the footprint of the COSMOS-Webb program. Using the NIRCAM images, we first fit sersics profiles to the AGN type-2 host galaxy and perform AGN host galaxy decomposition for type-1 AGN.

No.62

Ongoing and fossil large scale outflows detected in a high-redshift radio galaxy: ALMA [CII] observation of TN J0924-2201 at z=5.17

Kianhong Lee, Tohoku University/NAOJ
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Abstract

High-redshift radio galaxies are massive star-forming galaxies with powerful radio jets, often located on or below the star-forming main sequence of galaxies. This suggests that they are in the process of being quenched. TN J0924-2201 is one of the most distant known radio galaxies, associated with three CO(1-0)-detected companions at z~5.2. We present ALMA observations of [CII] line and the corresponding 1 mm continuum emission of TN J0924-2201. While obtaining the [CII] line and 1mm continuum emission at the host galaxy, our observations revealed no detection at the positions of the three CO(1-0) companions. The derived systematic redshift z_[CII] of the host galaxy from the [CII] line is 5.17, indicating a blueshift than the Lya-derived redshift by a velocity offset of ~1000 km/s, marking the largest velocity offset between [CII] line and Lya line recorded at z>5 to date. Within the host galaxy, we identified an extended [CII] structure with a velocity of ~500 km/s, suggestive of an outflow. This finding aligns with the shell outflow model, providing consistency with the observed large velocity offset of Lya. Applying the PDR model, our analysis indicates that the three massive CO(1-0) companions exhibit high density and a weak radiation field. Assuming they are also outflow, their velocities of ~1500 km/s surpass the escape velocity of a 10^13 Msun halo, implying the removal of molecular gas from the host galaxy. These results collectively point towards a distinctive phase in galaxy evolution occurring in a radio galaxy.

Poster Presentations

Day1,10:30-10:45, Poster flash talks 1

No.2

Resolving massive quiescent galaxies at the core of the SSA22 protocluster at z = 3.09

Mariko Kubo, Tohoku University
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Abstract

The SSA22 protocluster at z = 3.09 is one of the most significant structures in the Universe. Based on the multi-wavelength deep and wide imaging observations, galaxies ranging from SMGs to massive quiescent galaxies have been discovered. It suggests that this structure is in the transition epoch of modern giant ellipticals in clusters of galaxies today. A NIRCam/JWST imaging observation for this protocluster was performed in Cy 2. It resolved the morphologies of galaxies and the distribution of low-mass galaxies along the structure. It shows that several giant ellipticals have already been in such a distant protocluster at z>3.

No.3

Topological data analysis of galaxy spatial distributions

Shunya Uchida, Nagoya University
Co-author(s): Shunya Uchida, Tsutomu T. Takeuchi (Nagoya Univ.), Suchetha Cooray (Stanford Univ.), Ryusei R. Kano (Nagoya Univ.), Yoh-ichi Mototake (Hitotsubashi Univ.), Daiki D. Iwasaki (Nagoya Univ.)

Abstract

Galaxies do not evolve as isolated objects, but rather is dependent on their environment within the large-scale structures of the Universe. Therefore, it is important to understand the connection between the galaxies and their spatial distribution. Traditionally, conditional two-point correlation functions have been used to characterize the effect on galaxy properties by their spatial distribution. However, traditional statistics cannot identify individual structures. In this study, we applied Topological Data Analysis (TDA), a technique that can identify prominent structures from point cloud data, for studying the galaxy distributions and their property dependence. We applied TDA to a dataset binned by stellar mass and star formation rate and explored the distribution patterns. This poster presents the findings from the TDA approach and examines their validity.

No.4

Bright galaxies and giant HII bubbles in protoclusters at the epoch of reionization

Hidenobu Yajima, University of Tsukuba
Co-author(s): Hidenobu Yajima (University of Tsukuba), Makito Abe (Kosen, Kure College), Kenta Soga (University of Tsukuba), Hajime Fukushima (University of Tsukuba)

Abstract

We lead a simulation project called FOREVER22, focusing on the formation of massive bright galaxies in the large-scale structure and their radiative properties (Yajima et al. 2022, MNRAS, 509, 4037). We find that galaxies with star formation rates exceeding 100 solar masses per year form in protoclusters even at z > 8, and their brightnesses and stellar masses are similar to those of candidates observed by JWST (Yajima et al. 2023, MNRAS, 525, 4832). In addition, we calculate the ionization structures around protoclusters and find that giant HII bubbles with the size of ~ 1 cMpc can be associated with protoclusters at z~10. In my presentation, I will show the recent simulation results on galaxy formation, reionization, and the observabilities of member galaxies in protoclusters.

No.5

Detection of cool gas around a quiescent galaxy at z=4 by JWST

Po-Feng Wu, National Taiwan University
Co-author(s): Po-Feng Wu, National Taiwan University

Abstract

The unprecedented sensitivity of JWST in the IR allows us to discover and characterize galaxies at high redshift. Obtaining restframe UV and optical continuum spectra of z>3 galaxies would take dozens of hours on large ground-based telescopes but only a few hours on JWST. Absorption-line spectroscopy and characterization of high-redshift quiescent galaxies become possible. I will present the first detection of cool gas around a massive quiescent galaxy at z=4 with JWST NIRSpec. This galaxy has no measurable H_beta or [OII] emission, indicating that the star formation rate is less than 1/10 of the star formation main sequence at z=4. Modeling the restframe optical absorption lines shows that the last major star formation event was at ~500 Myrs before observation. Clear [Mg II] and [Fe II] absorptions present in the restframe UV spectrum cannot be fully attributed to stellar absorption, indicating absorption by cool gas surrounding the quiescent galaxy. Combining the absorption strengths from cool gas and the metallicity measured from stellar absorption, we could estimate the hydrogen column density. This case demonstrates a viable way to probe the gas content surrounding high-z quiescent galaxies.

No.6

Emergence of AGN in galaxy clusters: the relationship among AGN, environment, and cluster-cluster mergers

Yoshiki Toba, NAOJ
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Abstract

We present the statistical properties of active galactic nuclei (AGNs) in approximately one million member galaxies of galaxy groups and clusters, selected using the Subaru Hyper Suprime-Cam (HSC), so-called CAMIRA clusters. The focus of our investigation is on the AGN power fraction (fAGN), which is the proportion of the contribution of AGNs to the total infrared (IR) luminosity, LIR(AGN)/LIR, and how the fAGN depends on (i) the cluster redshift (zcl) and (ii) the distance from the cluster center (R/R200). We gathered data in the ultraviolet--mid-IR range and performed spectral energy distribution (SED) fitting using the CIGALE code to investigate fAGN of CAMIRA member galaxies. We find that (i) the value of fAGN in CAMIRA clusters increases with zcl, with a steeper slope than that of field galaxies and (ii) fAGN is higher in cluster outskirts, especially in the massive merging clusters. These results suggest that the emergence of the AGN population depends on the redshift and environment and that galaxy groups and clusters at high redshifts play a crucial role in AGN evolution (Toba et al. 2024, ApJ, in press.).

No.7

AGN Feedback Efficiency with NAL Outflow Winds

Toru Misawa, Shinshu Univ.
Co-author(s): Toru Misawa (Shinshu Univ.), Jane C. Charlton (PSU), Michael Eracleous (PSU)

Abstract

AGN outflow winds contribute to the evolution of host galaxies, if the total kinetic energy is large enough to regulate star formation activity (i.e., AGN feedback), as seen in some quasars with broad absorption lines (BALs). Narrow absorption lines (NALs) with line widths less than 500 km/s may also contribute to AGN feedback due to their large outflow velocity and detection rate. In this study, we use the column density ratio of the excited and the ground states of CII and SiII to constrain the typical electron density and radial distance of NAL absorbers, and finally evaluate mass outflow rate, kinetic luminosity, and the feedback efficiency.

No.8

Statistical analysis of BAL quasars using SED fitting

Yuri Yanagiya, Shinshu university
Co-author(s): Yuri Yanagiya, Akatoki Noboriguchi, Toru Misawa

Abstract

Broad absorption lines (BALs) with a line width of > 2000 km/s are often detected in spectra of quasars with a fraction of those quasars (BAL quasars) is in the range of about 10 – 40%. There are two possible scenarios of BAL quasars; i) they are viewed at large inclination angle (but not so large as Type 2 quasars) and ii) they are at the early stage of quasar evolution. If the former is the case, a detection rate of BAL quasars depends on an inclination angle and an opening angle of dust torus. However, these parameters have not been evaluated in detail using large samples. In this study, we exploit photometric archive data in multi-bands from UV (SDSS), NIR (2MASS), to MIR (WISE) to estimate three key parameters (an inclination angle, an opening angle of dust torus, and dust extinction) by SED fitting with CIGALE. We perform the analysis for both BAL and non-BAL quasars to see if the result is consistent to the inclination scenario (or the evolution scenario is more promising).

No.9

Transverse Proximity Effect around a Type 2 Quasar

Makoto Sato, Shinshu University
Co-author(s): Makoto Sato (Shinshu University), Toru Misawa (Shinshu University), Yusuke Maeda (Shinshu University), Akatoki Noboriguchi (Shinshu University), Rikako Ishimoto (The University of Tokyo)

Abstract

An intense ultraviolet (UV) radiation from quasars ionizes neutral hydrogen in the inter-galactic medium (IGM) within several Mpc from the quasars, causing a proximity effect. However, this effect may be anisotropic, since there exists more neutral hydrogen in the transverse direction than in the line-of-sight direction around typical Type 1 (i.e., face-on) quasars (Prochaska et al. 2013). The most plausible explanation for this trend is that the UV radiation from quasars is shielded by the dust torus, making the UV radiation anisotropic. Indeed, the opposite trend (i.e., HI gas is deficit in the transverse direction) is seen around BAL quasars whose inclination angle is large (i.e., observing from edge-on), which supports this scenario (Misawa et al. 2022). In this study, we performed the same analysis around a Type 2 quasar whose large inclination angle is guaranteed more than BAL quasars. We compare our results to those of the past studies around Type 1 and BAL quasars to verify the anisotropic scenario with the dust torus.

No.10

X-ray spectroscopy of AGN in the XRISM era

Misaki Mizumoto, University of Teacher Education Fukuoka
Co-author(s): Misaki Mizumoto (University of Teacher Education Fukuoka)

Abstract

The X-ray satellite, XRISM, was successfully launched on September 7, 2023. It was reported that the Resolve micro-calorimeter onboard XRISM has an impressive energy resolution of ~5 eV with the onboard calibration source. In this presentation, I will provide an overview of the instrument's characteristics on XRISM and the expected scientific results for the AGN study. The main scientific topic is as follows: 1. Where is the surrounding material, e.g., broad line region, torus? 2. What is the physical parameter of the X-ray wind, including UltraFast Outflows (UFOs)? 3. How do AGN affect their host galaxies? If any data has been published before the presentation, I will also share these results.

Poster Presentations

Day1,12:00-12:15, Poster flash talks 2

No.11

A new wide exploration of high-z radio galaxies with the gzK selection

Seira Kobayashi, Ehime university
Co-author(s): Seira Kobayashi, Tohru Nagao, Yuta Yamamoto, Ryota Ide, Kohei Shibata (Ehime Univ.), Mariko Kubo (Tohoku Univ.), Hisakazu Uchiyama, Yoshiki Toba, Takuji Yamashita (NAOJ)

Abstract

Understanding the role of radio jets at high-z is essential to study the AGN feedback, which is considered one of the keys of galaxy formation and evolution. However, statistically-large samples of high-z radio galaxies (HzRGs) have not been constructed so far, due to their rarity and technical limitations. In this work, we employed the gzK selection method that identifies both star-forming and passive galaxies in the cosmic noon. This approach enables us to carry out a comprehensive study of HzRGs at z~2. We identified a total of 88 star-forming RGs (sgzK-RGs) and 18 passive RGs (pgzK-RGs) by cross-matching optical data from Subaru/HSC, near-infrared data from VISTA VIKING, and radio data from VLA FIRST, utilizing the gzK selection criteria. From the SED fitting, we found that the sgzK-RGs are on the main sequence (MS) of star-forming galaxies, and are in good agreement with investigation in the previous literature. On the other hand, our pgzK-RGs exhibit a deviation of ~1 dex below the MS. This suggests that the gzK selection method can uncover a new population of RGs in the high-z Universe, which were previously unexplored.

No.12

Exploring the Nature of First Galaxies with JWST and ALMA

María Emilia De Rossi, Institute for Astronomy and Space Physics
Co-author(s): María Emilia, De Rossi (Institute for Astronomy and Space Physics, Argentina) & Volker, Bromm (University of Texas at Austin, USA)

Abstract

By applying a model of primeval dust, we predict the FIR-continuum luminosities of massive galaxies such as those detected by the JWST at z>7. According to our results, upper FIR flux limits inferred from ALMA observations can constrain dust fractions and ISM metallicities in primeval galaxy sources. Encouragingly, when adopting model parameters (e.g. star formation efficiency, gas metallicity, dust-to-metal mass ratio) expected for typical first galaxies, our predicted FIR spectra are in agreement with upper flux limits derived from ALMA. In particular, higher values for the gas metallicity (> 5x10**-2 Zsun) and dust-to-metal ratio (> 0.06) are ruled out by current observations, unless a higher star formation efficiency is assumed. Our results suggest that ALMA multi-band observations could help to address the chemical composition of dust and its grain size distribution in the early universe. In the future, a crucial challenge would involve not only an improvement of the FIR sensitivities, but also extending the wavelength coverage along different ALMA bands.

No.13

A population-level inference of dust attenuation in local galaxies

Suchetha Cooray, Stanford University
Co-author(s): Suchetha Cooray (Stanford), Peter Behroozi (Arizona, NAOJ)

Abstract

Dust is critical in inferring the physical parameters of observed galaxy populations from their spectral energy distributions (SEDs). However, our understanding of dust attenuation is limited due to known degeneracies between galaxy properties and dust in SED fitting of single galaxies (dust–metallicity–age degeneracy). However, some degeneracy could be broken

by incorporating population-level number density evolution from cosmological structure formation. Thus, we introduce a novel approach to infer population-level dust attenuation properties by statistically matching observed galaxies (SDSS Main Galaxy Sample) with simulated ones from cosmological simulations. We use the star formation histories from UniverseMachine (Behroozi et al. 2019) and star formation-stellar mass-metallicity relations to derive unattenuated SEDs with stellar population synthesis (e.g., Conroy & Gunn 2010). With the matching between attenuated observed SEDs and unattenuated simulated SEDs, we can then use flexible parameterizations to derive the connection between dust and galaxy physical properties. The outcome will be essential for an unbiased understanding of galaxy formation and is part of our efforts towards population-level inference of galaxy SEDs.

No.14

Dust enrichment in the circum-galactic medium

Mau Otsuki, Hiroshima University
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Abstract

Dust in the circum-galactic medium (CGM) could cause systematic reddening of background sources and play an important role in gas heating and cooling. To understand the origin and evolution of dust in the CGM, we develop a dust enrichment model. We describe each of the central galaxy and its CGM as a single zone, and consider the mass exchange between them through galactic inflows and outflows. We calculate the evolution of the gas, metal, and dust masses in the galaxy and the CGM. In the galaxy, we include stellar dust production and interstellar dust processing. The dust in the galaxy is transported to the CGM via galactic outflows, and is further processed by dust destruction (sputtering) in the CGM. We parameterize the time-scale or efficiency of each process and investigate the effect on the dust abundance in the CGM. We find that the resulting dust mass is sensitive to the dust destruction in the CGM, and the dust supply from galactic outflows, both of which directly regulate the dust abundance in the CGM. The inflow time-scale also affects the dust abundance in the CGM because it determines the gas mass evolution (thus, the star formation history) in the galaxy. The dust abundance in the CGM, however, is insensitive to stellar dust formation in the galaxy at later epochs because the dust production is dominated by dust growth in the interstellar medium. We also find that the resulting dust mass in the CGM is consistent with the value derived from a large sample of SDSS galaxies. (This project started as a summer student project at ASIAA in 2021.)

No.15

First detections of SiII* halos at z=2-4 with MUSE

Haruka Kusakabe, NAOJ
Co-author(s): Haruka Kusakabe (NAOJ/UniGE), V. Mauerhofer (RUG), A. Verhamme (UniGE), T. Garel (UniGE), J. Balizot (CRAL), J. Richard (CRAL), Y. Guo (CRAL), F. Leclercq (UT Austin)

Abstract

The hydrogen of the circumgalactic medium (CGM) is found to be common among star-forming galaxies through extended Lya emission (Lya halos, e.g., Steidel+11; Leclercq+17; Kusakabe+22). The CGM is supposed to be metal enriched even at z > 2 from absorption line studies (e.g., Lehner+16; Muzahid+21; Davies+22). However, this method does not provide the spatial distribution of the CGM around individual galaxies. Recently the metal-enriched CGM has been mapped with [OII], MgII, and FeII* emission at z = 0-1.5 (e.g., Yuma+13; Finley+17; Leclercq+22) as well as with [CII] at z > 4 for massive galaxies (e.g., Fujimoto+19). At z =2-4, there is no bright emission tracer of the CGM, and the most promising but extremely faint tracer would be SiII*. In this project, we search for SiII* extended emission around 39 individual galaxies at z=2-4 using deep MUSE data (Bacon+23) and find 5 detections of SiII* halos. We also stack a subsample of UV-bright galaxies and confirm the presence of SiII* haloes. We investigate the surface brightness profiles of SiII* and discuss the origin of SiII* emission. We also compare observed surface brightness profiles and those in simulations in Mauerhofer+21.

No.16

UV and Lyα Halos of Lyα Emitters across Environments at z=2.84

Satoshi Kikuta, Univerisity of Tokyo
Co-author(s): Satoshi Kikuta (University of Tokyo)

Abstract

We present UV and Lyα radial surface brightness (SB) profiles of Lyα emitters (LAEs) at z = 2.84 detected with the Hyper Suprime-Cam on the Subaru Telescope. The depth of our data, together with the wide-field coverage including a protocluster, enable us to study the dependence of Lyα halos (LAHs) on various galaxy properties, including Mpc scale environments. UV and Lyα images of 3490 LAEs are extracted, and stacking the images yields SB sensitivity of ~1e-20 erg/s/cm^2/arcsec^2 in Lyα, reaching the expected level of optically thick gas illuminated by the UV background at z~3. Fitting of the two-component exponential function gives the scale-lengths of 1.56 and 10.4 pkpc. Dividing the sample according to their photometric properties, we find that, while the dependence of halo scale-length on environment outside of the protocluster core is not clear, LAEs in the central regions of protoclusters appear to have very large LAHs, which could be caused by combined effects of source overlapping and diffuse Lyα emission from cool intergalactic gas permeating the forming protocluster core irradiated by active members. For the first time, we identify UV halos around bright LAEs that are probably due to a few lower-mass satellite galaxies. Through comparison with recent numerical simulations, we conclude that, while scattered Lyα photons from the host galaxies are dominant, star formation in satellites evidently contributes to LAHs, and that fluorescent Lyα emission may be boosted within protocluster cores at cosmic noon and/or near bright QSOs.

No.17

The impact of bursty star formation and stellar feedback processes on Lyman alpha emission

Beomchan Koh, Yonsei University
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Abstract

Lyman alpha (LyA) emission is a useful probe of gas kinematics in galaxies. It is also proposed as a potential metric for finding potential Lyman continuum (LyC) leakers that may have reionized the Universe, making it a valuable tool for studying galaxy formation and reionization. In this study, we use two different sets (idealized and cosmological) of radiation-hydrodynamic simulations performed with RAMSES-RT and investigate the impact of baryonic processes on LyA profiles. Specifically, we investigate how bursty star formation alters the neutral gas distribution in and around galaxies, and the relative role of different stellar feedback processes in the formation of LyA. Finally, we compare the simulated LyA profiles with the LyC escape to see if there is a correlation between them.

No.18

Study of properties and demography of clumpy galaxies beyond z > 3 with HST & JWST public data

Ryo Albert Sutanto, Bandung Institute of Technology
Co-author(s): Ryo Albert Sutanto, Itsna Khoirul Fitriana, Lucky Puspitarini

Abstract

Over the past two decades, large telescopes like the Hubble Space Telescope (HST) have been able to provide clear images of galaxies through resolved imaging, allowing astronomers to study the structure and morphology of galaxies with redshifts $z<3$. The success of capturing those images was followed by the James Webb Space Telescope (JWST), an outer space telescope with sensitivity far surpassing that of the HST. This makes it possible to conduct studies on galaxy structures at higher redshifts ($z>3$). One interesting feature in studying galaxy structure is the presence of clumps actively forming stars on a kiloparsec (kpc) scale. These clumps features are suspected to be more commonly found in galaxies with high redshifts, as in galaxies with low redshifts, star formation activity more often occurs in the

spiral arms of the galaxy. Furthermore, studies on clumps in galaxies at high redshifts are currently very limited. By understanding the properties of galaxies with clumps, both at high and low redshifts, a more comprehensive understanding of galaxy evolution in the universe can be obtained.

No.19

Dark on dark: constraining cosmological parameters with high-redshift galaxies

Sy-Yun Pu, NTHU, ASIAA
Co-author(s): Sy-Yun Pu (NTHU, ASIAA), Chian-Chou Chen (ASIAA), Teppei Okumura (ASIAA)

Abstract

The Hubble tension has been a significant focus of discussion within the field of galaxy evolution and cosmology. Our approach aims to address this issue from a perspective encompassing higher redshifts, seeking to enhance our statistical understanding through surveys of the distant universe. In this study, we leverage cosmological simulation data from redshifts 2 and 3 to investigate the feasibility of conducting galaxy surveys with upcoming generation instruments. Our analyses enable us to tightly constrain parameters such as Omega_m and H_0, reaching precision levels of approximately 2% and 3%, respectively. These findings underscore the potential and significance of conducting galaxy surveys at high redshifts.

No.20

Starbursting molecular clouds in gas-rich merging galaxies

Toshiki Saito, Shizuoka University
Co-author(s): Toshiki Saito (Shizuoka University) and the PHANGS-ALMA team

Abstract

(U)LIRGs form stars 10-100 times more efficiently than main sequence galaxies, which is explained by nearby (U)LIRGs being gas-rich merging galaxies. Numerical simulations and sub-kpc observations clearly show that tidal interaction between gas-rich progenitors is condensing gas and triggering subsequent starburst activity in the nuclear region and throughout the extended disk. However, it remains unclear if the properties of their molecular clouds, as the sites for star formation, themselves differ as well from those in normally star-forming galaxies. Obvious differences would potentially imply important changes to current theories. Before ALMA it was impossible to study clouds in (U)LIRGs. We present <150 pc resolution CO(2-1) data for 33 nearby (U)LIRGs and compare basic statistical cloud properties between nearby (U)LIRGs and nearby main sequence galaxies from the PHANGS-ALMA large program.

No.21

Finding the relation between O32 and Lyman continuum escape fraction using RAMSES-RTZ

Hyunwoo Song, Yonsei University
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Abstract

Lyman Continuum radiation (LyC) ionizes hydrogen in the early Universe, suppressing star formation and thus directly affecting the evolution of galaxies. However, finding galaxies that emit LyC is difficult because it is easily absorbed by neutral hydrogen gas. As an alternative, indirect methods have been proposed to study the LyC escape using the ratio of [OIII] to [OII] luminosities (O32 ratio), but their physical connection is not clearly understood. In this study, we perform numerical simulations using RAMSES-RTZ to understand the relationship between the O32 ratio and the LyC escape fraction. Using numerical simulations with different maximum resolutions, we show that resolving the OII ionization front is important for predicting the OII luminosity in homogeneous media. We also perform turbulent GMC simulations and discuss the correlation between the LyC escape fraction and the O32 ratio.

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