Poster Abstracts

Active galactic nuclei properties among different selection methods.

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Active galactic nuclei (AGN) galaxies show ubiquitous spectral properties that contrast the ones from non AGN galaxies. Selection methods to find AGNs can in general introduce bias to the study. We analyze the characteristics of low redshift AGNs that were chosen according to different selection methods. We use spatially resolved spectra observed with integral field units (IFU) from the Data Release 15 (DR15) from the SDSS-IV MaNGA Survey. With BPT diagrams, we perform an optical classification and compare our AGN candidates with AGNs selected using radio, infrared and X-ray observations (Comerford et al. 2020) from the MPL-8 release, which crossmatches with our sample. Our preliminary results show that non-optical selected AGN do not seem to follow any trend or position in any BPT diagram. Furthermore, while our AGN selected sample lays offset to the galaxy main sequence, the non-optically selected AGNs are located mostly inside it. We perform a multi-component fitting procedure to the emission lines of the OIII5008,4959 doublet and aim to explore the dynamical properties of the differently selected AGNs.

A∼1000 km s−1 offset between the [CII] 158µm and Lyα line emission in a star-forming galaxy at z=7.2

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I will present new NOEMA observations of one of the most distant sources known in the Northern Hemisphere, the star-forming galaxy GN-108036 at redshift 7.2, when the Universe was only ~700 million years old. We tentatively detect (3σ) the system in the [CII] 158 µm transition, which traces both the neutral and ionized gas. Similar to other galaxies at z > 6, the gas traced by the [CII] line is spatially offset by ~4 kpc with respect to the star-formation activity as traced by the rest-frame UV emission. More interestingly, the [CII] line is blueshifted with respect to the Lyα line by ~1000 km s-1, one of the largest velocity offsets reported to date. Due to the resonant nature of the Lyα line, one likely scenario for the velocity offset is the presence of a stellar-driven outflow with a velocity of the order of ~500 km s-1. GN-108036 also follows the relation

observed between the [CII] luminosity and the star formation rate observed in other high-z star-forming galaxies. In addition, we tentatively detect a neighbour system located at ~30 kpc, at a similar redshift than the host, but with a much wider velocity profile.

Digging deeper into NGC6868: stellar population and ionized gas

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Using the Gemini Multi-Object Spectrograph in the integral field unit mode, the inner (~500pc) region of the galaxy NGC 6868 was observed. This is the most massive galaxy from the Telescopium Group and a rich ISM with a complex dust and molecular gas distribution as well as an intricate ionized gas and stellar kinematics. In order to understand the history and present of this object, we performed stellar population synthesis using STARLIGHT with the MILES simple stellar population models, modeling also the stellar kinematics and the extinction due to cold dust. We find contributions from old metallic populations (12.6 Gyr; 1.6 $Z\odot$) and a dust lane with a peak extinction at 0.65 mag. Moreover, we fitted the emission lines form the ionized gas using IFSCube package throughout the whole FoV. We were able to detect a rotating disc of ionized gas cospatial with the previously mentioned dust lane. Another finding is a region ~150 pc from the center perpendicular to the disc where no ionized gas is observed. The complete scenario behind this object is still uncertain, but further analysis is still being carried out.

Probing the z~6 quasars in a universe with Illustris-TNG physics: Impact of black hole seeding and accretion models

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We explore the implications of a range of black hole seeding and accretion prescriptions on the formation of the brightest z~6 quasars in a universe with Illustris-TNG physics. Using the method of constrained Gaussian realizations, we study the growth of BHs in extremely rare overdense regions within a relatively small [9 Mpc/h]^3 simulated volume. The underlying galaxy formation model is the same as in Illustris-TNG simulations. BH growth is maximum within halos that are compact and have a low tidal field. Even in such regions, the default TNG accretion model fails to assemble the z~6 quasars, unless there is a substantial contribution from BH mergers. Therefore, models

which are very restrictive fail to produce the z~6 quasars due to the paucity of seeds that could form and merge. When mergers are absent, we need super-Eddington accretion or lower radiative efficiencies (assisted by a boost in Bondi accretion rates inferred from simulations) to assemble z~6 quasars. Finally, our results show that z~9-10 progenitor AGNs of z~6 quasars may contain signatures of seed models that may be detectable by JWST and Lynx. This is in addition to strong signatures of seeding expected from LISA measurements up to z~20.

The GLEAMing of the first supermassive black holes: towards a sample of powerful radio galaxies at z > 6

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Optical surveys have discovered luminous Type-I active galactic nuclei (AGN) at redshifts as high as z=7.6. The existence of massive galaxies and their central supermassive black holes at such an early epoch (0.7 Gyr after the Big Bang) raises important questions about how they can form so quickly. To better understand black hole formation and growth in the early Universe, we have developed a new selection technique for finding distant radio-loud Type-II obscured AGN, the high-redshift radio galaxies (HzRGs). In particular, we make use of low-frequency radio data from the 70-230 MHz Murchison Widefield Array (MWA) GLEAM survey, deep NIR imaging from the VLT, and ALMA 100-GHz continuum imaging/spectroscopy. I will present highlights from our project, including the discovery of the second-most distant radio galaxy currently known, at z=5.55, as well as another source that could potentially be at z=8.2 as suggested from both HST grism spectroscopy and optical/NIR SED modelling. I will conclude by describing ongoing efforts to analyse a sample of 52 new GLEAM-selected HzRG candidates; our goal is to identify a sample of powerful radio-loud AGN within the Epoch of Reionisation.

New constraints on the Reionization process from Quasar absorption spectra

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From CMB measurements, cosmic reionization is expected to happen at redshift around 7-8. However, the details of the process are still very uncertain. Quasar absorption spectra are one of the main probes of the reionization epoch, and in particular of its

final phases. The main observables are the evolution of the neutral hydrogen optical depth with redshifts, the properties of the completely absorbed regions and also the ionization status of the metal absorption lines. The XQR-30 survey collects intermediate resolution and high signal-to-noise Xshooter spectra of 30 quasars at 5.8 < z < 6.6. In this poster ,we will present new upper limits on the neutral hydrogen fraction obtained with the model independent method of the ''dark pixel fraction" applied to a sample of more than 40 quasar spectra at high signal-to-noise ratio comprising XQR-30 and other objects from the literature.

COSMOS-Web: Mapping Large Scale Structure Across Cosmic Time

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COSMOS-Web is an approved 218-hour JWST Cycle 1 treasury program that will map a contiguous 0.6 deg2 area with NIRCam and a total 0.2 deg2 area with MIRI in parallel mode observations. The primary science goals of the COSMOS-Web survey are to: 1) revolutionize our understanding of reionization's spatial distribution, environments, and drivers at early stages by pioneering the detection of thousands of galaxies in the epoch of reionization (6<z<11), 2) identify hundreds of the rarest quiescent galaxies in the first 2 Gyr (z>4) to place stringent constraints on the formation of the Universe's most massive (M*>10^10 Msun) galaxies, and 3) directly measure the evolution of the stellar mass to halo mass relation out to z~2.5 and its relationship to galaxies' star formation histories and morphologies. With such a large field-of-view, COSMOS-Web will uniquely facilitate the mapping of large scale structure in the cosmic web over a total 50 million Mpc^3. We will present detailed predictions and measurables and their relationship to large scale structure, summarizing the major anticipated contributions of COSMOS-Web to galaxy formation and evolution.

New AGN Discovered by the Kepler Space Telescope

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We searched the local sky using the Kepler space telescope to find active galactic nuclei (AGN). We looked through 105 nearby galaxies found in the HYPERLEDA database and discovered 66 galaxies observed by Kepler. Using a customized pipeline, we found two

possible objects which demonstrate aperiodic variability typical of AGNs. One object, KIC 8093535, is a well known X-ray source, giving us confidence that this is in fact an AGN.

Probing the Environments of the First Quasars Using Proximity Zone Spectra

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The matter density field at z~6 is very challenging to probe. One of the traditional methods that work successfully at lower redshift is the Lyman-alpha forest in quasar spectra. However, at z~6, the residual neutral hydrogen usually creates saturated absorption, thus much of the information about gas density is lost. The only places where we can detect unsaturated absorption are within a quasar proximity zone, thanks to the enhanced ionizing radiation from the quasar itself. Therefore, the quasar proximity zones play a crucial, irreplaceable role in probing cosmic reionization. In our study, we use simulations to show that the density field around z~6 quasars can be accurately recovered from Lyman alpha absorption spectra. We apply this method to a sample of observed high-quality quasar spectra from the XQR-30 survey to study the large-scale environments where the first quasars reside. In this talk, I will present the method to recover the density and our progress in understanding the large-scale structure during the epoch of reionization and the environments of the first quasars.

Constraining the physical properties of iron low-ionization broad absorption-line quasar outflows with the spectral synthesis code SimBAL

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Broad absorption-line quasars (BALQs) reveal the presence of powerful quasar-driven outflows in their spectra. Iron low-ionization BALQs (FeLoBALQs) are a subtype of BALQ that are expected to have massive outflows with high column densities that can significantly impact their host galaxies. We used SimBAL, our novel spectral synthesis code, to perform the first systematic study of a large sample using the spectra of 50 low redshift ($0.66 < z < 1.63$) FeLoBALQs observed by SDSS/BOSS. We found a large range of ionization parameters and densities of the outflow gas as well as a wide range of distances from the central supermassive black holes ranging from torus scales (~pc) to host galaxy scales (~kpc). We analyzed rest-optical emission line properties of a

subsample of z < 1 objects and discovered a robust evidence for two populations of FeLoBAL quasars differentiated by Eddington normalized accretion rates. We speculate that the two populations may represent BALQs at different quasar evolutionary stages. These results may be used to calibrate the prescriptions of outflow properties in theoretical models of quasar feedback and cosmological simulations of galaxy evolution.

The Extragalactic Serendipitous Swift Survey (ExSeSS) Constraints of the sky density of growing supermassive black holes

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We present a new extra-galactic serendipitous swift survey (ExSeSS) constructed from the 2SXPS survey performed by the Swift/XRT. The ExSeSS sample consists of 3 bands; soft (0.5-2 keV), hard (2-10 keV) and total (0.3-10 keV), covering 2074 deg^2 of sky. Using the new ExSeSS sample we present measurements of the differential number counts of X-ray sources as a function of flux that trace the population of active galactic nuclei AGN in a previously unexplored regime. We explore the difference between using a photon index to describe the shape of the X-ray spectra and using a varying column density with a fixed photon index. We find that taking the column density into account has a large effect on the way our results look, and the agreement we get with previous results and models. Our results in the hard band show good agreement between ExSeSS measurements and previous, higher energy data from NuSTAR and Swift/BAT, when taking into to account the varying column density and show discrepancies between these high energy results and the AGN population synthesis models. These results indicate a change in the properties of the AGN population that is not described by current models.

Einstein ring GAL-CLUS-022058s, a SMG spiral galaxy with a SMBH at z=1.48

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The ‘Molten Ring’ is a bright lensed SMG, reaching in the submillimeter regime a peak flux density of ∼1 Jy at 350 μm, with redshift z = 1.4796 and lies on the so-called main sequence of star-forming galaxies at this redshift. A precise lensing model has been obtained with an amplification factor of 18. The radio emission close to the galaxy could

be related to the lensed galaxy because we found a similar spectral break as for other non-lensed SMGs. The intrinsic k-corrected rest-frame luminosity at 1.4 GHz is 2.9 ×10^26 W/Hz. We obtain an infrared-to-radio luminosity ratio of 0.30, which indicates the presence of a radio-loud AGN. For the radio observations, only a catalog has a high angular resolution of 1.8 arcsec to resolve two sources in the region where submillimeter flux is detected. We have used our precise lensing model, the positions and shapes of the two radio sources and two X-ray emission clumps close to hem in the image plane, to calculate the position of them in the source plane. The source of the AGN signal does not seem to be the Brightest Cluster Galaxy but rather the strongly lensed galaxy hosting two radio jets. The whole data indicate that a radio jet AGN is within this spiral galaxy, giving a non-merger supermassive black hole growth secenario for this galaxy.

Understanding the Role of Red Quasars in Galaxy Evolution

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An important fraction of quasars are red at optical wavelengths, indicating (in the vast majority of cases) that the accretion disc is obscured by a column of dust which extinguishes the shorter-wavelength blue emission. In recent work by our group, we have shown fundamental differences in the radio properties of SDSS optically selected red quasars, which cannot be explained with a simple viewing angle hypothesis (Klindt et al. 2019, Fawcett et al. 2020, Rosario et al. 2020, Rosario et al. 2021, Fawcett et al. 2021). In our latest work, we use VLT/X-shooter spectroscopy of a sample of red and typical quasars to gain insight into these differences. We confirm that dust reddening is the main cause of the red colours and explore the emission line properties of our sample. We confront our spectra against accretion disc models and confirm that red quasars are powered by standard thin-disc accretion once corrected for dust extinction. These results suggest that dusty winds could be driving the fundamental differences in red quasars, and so they may represent an important phase in galaxy evolution.

At the End of Cosmic Noon: a Census of Molecular Gas in Intermediate-Redshift Lensed Quasar Hosts.

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Efforts to understand the link between the starburst (SB) and (un)obscured quasar (QSO) phases of a galaxy have led us to a scenario in which a gas-rich, highly star-forming galaxy depletes its gas reservoir via star formation and AGN feedback, eventually turning into an unobscured, gas-poor QSO. These depleted systems will quench in as little as a few Myr, with quenching expected to peak at z~1. Recent studies challenge this picture, finding no significant difference in the star formation efficiency between obscured and unobscured QSOs, and uncovering many unobscured QSOs with large amounts of dust-obscured star formation. To shed light on the high incidence of star formation in supposedly gas-depleted QSOs, it is crucial to robustly measure their molecular gas content. Currently, there are only three QSOs detected in CO in this epoch. We present a survey of 10 unobscured QSOs at z ~ 1-1.5 undertaken with NOEMA, which targeted the gas reservoirs via the CO(2-1) emission line. We detect CO(2-1) in seven of our targets. Contrary to the canonical model, these unobscured QSOs can be gas-rich with depletion times in the range 50~250 Myr.

Quasar Feedback Survey – the impact of jets and multi-phase outflows on their host galaxies

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Establishing how the most powerful AGN, i.e., quasars, feedback on their host galaxies is still controversial. There has been a lack of consensus on the origin of radio emission seen in typical `radio-quiet' quasars. Towards resolving these issues, we underpin our new Quasar Feedback Survey (QFeedS); a spatially-resolved, multi-wavelength study of 42 powerful z<0.2 quasars. In this talk I will present our high quality 1.5–6 GHz VLA observations for which by combining the radio-to-infrared excess parameter, spectral index, radio morphology and brightness temperature, we find that radio emission in at least 57% of the sample is associated with AGN-related processes. By combining these data with spatially-resolved spectroscopy I will show that we find a high prevalence of jets interacting with the ISM of host galaxies. These observations add to the evidence of a connection between radio emission and ionised gas in quasar host galaxies and at the importance of jets as a feedback mechanism. Finally, I will discuss the implications of these results for understanding galaxy evolution, through a comparison between our observational results and predictions of detailed jet-ISM simulations.

Discovery of z>5 quasars using low-frequency radio observations

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Optical studies of high-redshift quasars have provided important probes of supermassive black hole formation and evolution and the phase transition of neutral to ionised in the early Universe. However, a new generation of radio observatories such as the Low Frequency Array (LOFAR) and the future Square Kilometre Array (SKA) opens up the possibility to study the radio properties of these high-redshift quasars and potentially use the most radio-loud quasars to perform 21 cm absorption spectroscopy. The forthcoming second data release of the LOFAR Two Meter Sky survey (LoTSS-DR2) is now the deepest wide area low-frequency radio survey. We use this data to make the first statistical study of the low-frequency properties of known z > 5 quasars and combine it with the newest optical and infrared surveys to find new z > 5 quasars, since the detection of radio emission drastically decreases the contamination from stellar dwarfs in optical searches. We detect ~35% of the known high-redshift quasars in LoTSS-DR2 and have spectroscopically confirmed a new sample of z>5 quasars. This work shows the potential of the new generation of radio telescopes in studying high-redshift quasars.

Large scale gas reservoirs around high-z submillimeter-bright galaxies revealed by VLT/MUSE

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The circumgalactic medium (CGM) is the gas supply around a galaxy beyond its interstellar medium. It contains valuable information on the formation and evolution of galaxies. The CGM is now often observed around high-z quasars (QSOs), traced by extended Ly-a emission. This emission maps cool gas (T~10^4 K) in massive M~10^12.5 Msun dark matter (DM) halos on ~100 kpc scales and it is thought to be mainly powered by the QSO UV photons. However, other powering channels are viable: galactic/AGN shocks, gravitational cooling and resonant scattering of Ly-a photons. To assess the relative roles of these mechanisms, we extend the study of CGM gas to different types of massive galaxies. Bright sub-mm galaxies (SMGs) are ideal for this study, since they are expected to live in similar DM halos as QSOs, but do not have a hard UV source. We use VLT/MUSE observations aiming at the Ly-a emission of 5 z~3-5 systems with distinct UV outputs: 2 SMGs, 2 submm-bright QSOs, 1 QSO/SMG pair. We will describe our analysis and results on the CGM of the targets, describing their properties, kinematics and powering mechanisms.

Spectroscopic observations of optically-faint radio galaxies at z~3 in the Subaru-HSC Wide field

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Radio galaxies are unique population to probe the interaction between AGN radio jet and host galaxies. Thanks to the wide and deep imagings of Subaru HSC survey, a new radio galaxy catalog with optically-faint counterparts is constructed (WERGS project; Yamashita et al., 2018). The wide optical magnitude range of new catalog unveils a new group in radio galaxies with extremely optical-faint but radio-loud feature. The pilot spectroscopic observation with Keck/LRIS confirms three among them to be high-z radio galaxy (HzRG) with i~23.5 at z~3. We estimate their CIV/HeII and CIII]/CIV line ratios, and find they show higher values in both ratios than known optically-bright HzRGs at z~3. By comparing with Cloudy models, the identified HzRGs are likely to hold a dust-free narrow line region photoionized by AGN, which has low gas metallicity of Z_gas/Z_solar~0.1-0.2 and dense gas clouds of 10^5 cm^-3. In addition, according to the 2d spectrum of one confirmed HzRG at z=3.3, we clearly see two spatial components in the Lya emission: one compact component with large velocity dispersion of ~1000 km/s, and another extended component with lower velocity of ~500 km/s. A deep absorption trough is also detected in its Lya emission. All these features indicate an especially gas-rich environment around optically-faint HzRGs that we might target at the young radio galaxy population in the early universe.

AGN signatures in Red Geyser galaxies from Gemini GMOS-IFU observations

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Red Geysers are quiescent galaxies with galactic scale ionised outflows, likely due to low-luminosity Active Galactic Nuclei (AGN). This class of galaxies was detected using data cubes from the MaNGA survey of SDSS-IV. However, the source of gas ionisation in Red Geysers remains uncertain, due to the lack of high spatial resolution observations. We used Gemini GMOS-IFU observations of the inner ∼1–3 kpc of nine Red Geysers selected from the MaNGA survey to study the gas excitation mechanism. Within an aperture 2.5 arcsec of diameter for MaNGA and 1.0 arcsec for GMOS, BPT diagrams showAGN-like ionisation in the Red Geysers. However, WHAN diagrams show AGN (Hα equivalent width > 3 Å and [NII]/Hα > 0.4) in the central region only in two targets with MaNGA data, while with GMOS we found four AGN host galaxies. For six objects, the Hα

equivalent width is lower than 3Å but larger than 1.5 Å, and we show that this is most probably due to a faint AGN. Thus, our results indicate that the gas in Red Geysers is ionised by an AGN, at least in their central region.

Challenge of Subaru and ALMA: early co-evolution of supermassive black holes and host galaxies

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Since its operation, the Hyper Suprime-Cam (HSC) mounted on the Subaru telescope has been discovering a number of distant (z > 6) quasars, owing to its powerful survey ability. As quasars are the “beacon” of supermassive black holes (SMBHs), they are the ideal laboratory to investigate the cosmic evolution of the SMBH mass vs host galaxy mass relation (so called “co-evolution” relation). Here I will summarize our series of ALMA observations toward such HSC quasars. We have revealed: massive (>10^10 Msun) host galaxies at that early universe, wide variety of star formation activity (from starburst to almost quiescent), mergers of galaxies that may be related to quasar activities, quasar-driven powerful outflow that terminates star formation, and the early shape of the SMBH-host mass relation. I will gauge these from the perspective of “co-evolution”, and may discuss our future plans including JWST and ALMA observations.

COSMOS-Web: A Community Legacy Survey from z=10 to z=0

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We present the COSMOS-Web survey, the largest contiguous area survey to be mapped by the James Webb Space Telescope (JWST) in Cycle 1. In 218 hours, COSMOS-Web will map a contiguous 0.6 deg^2 area with deep NIRCam imaging in four filters (F115W, F150W, F277W, and F444W) and a total 0.2 deg^2 MIRI area (in F770W) in parallel. COSMOS-Web is designed to leave no stone unturned for deep, wide extragalactic surveys – eliminating cosmic variance and resulting in an order of magnitude increase in both early universe galaxies (z>6) and low-mass galaxies at all epochs (e.g., down to M*~10^8 Msun at z~1), thus significantly constraining the shape of the bright end of the UV luminosity function and mapping the evolution of the cosmic web. It will be the primary legacy dataset from JWST for the extragalactic community by providing quick public releases of multi-band, high-resolution near-IR imaging of one million galaxies (and an unprecedented 32,000 in the mid-IR) thus enabling innumerable legacy science

projects. Here we present an overview of the COSMOS-Web survey, our observing strategy, and plans for data products leading to a large range of community science.

The first measurement of the quasar lifetime distribution

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The growth of the supermassive black holes, their impact on the surrounding IGM and host galaxies depend sensitively on the timescale of the quasar accretion episodes, i.e., the quasar lifetime. Unfortunately, a variety of methods produced estimates of the quasar lifetime that are uncertain by orders of magnitude. However, HST/COS spectra of quasars probing the z~3 HeII Ly alpha forest provide a unique opportunity to precisely measure quasar on-times, i.e. lower limits on individual quasar lifetimes. Our recent analysis of 22 HeII spectra reveals a broad range of emission timescales. Building on these results, we present the first direct measurement of the underlying quasar lifetime distribution (QLD).We combine hydrodynamical simulations, custom radiative transfer, and a novel statistical framework to infer the parameters of the QLD. Assuming a log-normal QLD, we infer the mean <log(t/Myr)>=0.22+0.22/-0.25 and standard deviation σ=0.80+0.37/-0.27. We estimate the probability of detecting very young quasars from their proximity zone sizes yielding p(< 0.1Myr) = 0.19±0.10,consistent with recent determinations at z~6. We discuss the impact of our findings on models of SMBH evolution.

Kanobili Monitoring of Blazars with Dedicated Telescopes

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Kanobili monitoring program of blazars was started in the February of 1997 using SBIG ST-6 and Apogee Ap6E CCD cameras attached to dedicated 70-sm meniscus and 125-cm telescopes. Over 4000 nights of observation were conducted for 70 blazars.and more than half million frames were obtained. These data was used to generate homogeneous lights curves of blazars with very dense coverage. Besides we participated in international MW campaigns with VERITAS, HESS, FERMI/Lat and other radio and optical telescopes. Main results of Kanobili program will be presented.

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pectral Synthesis Analysis of Broad Absorption Line Quasars

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Broad absorption line quasars present unassailable evidence of outflows in their rest-UV spectra. Despite more than thirty years of study, the physical properties of BAL outflows remain largely unmeasured. I will describe SimBAL, our forward-modeling spectral synthesis method for analyzing broad absorption line quasar spectra. The principal advantage of SimBAL over traditional analysis methods is that it can be used on spectra with very broad absorptions lines and significant blending. An example is the most powerful BAL outflow yet discovered in the z=2.26 quasar SDSS 1352+4293 (Choi et al. 2020). Since the outflow energy depends mainly on the outflow velocity, such objects promise to be significant contributors to quasar / galaxy feedback. I will show additional examples of its use and discuss future plans and prospects.

Automated methods to find the most distant quasars

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We develop an automated method to identify high-redshift (z > 6) quasars in photometric surveys in the presence of large numbers of contaminants and false positives. Our approach combines i) Bayesian model comparison to compare quasar SEDs to those of contaminating populations such as brown dwarfs, ii) model checking at the pixel level to select only stationary point-sources, and iii) machine learning classifiers to optimise the final classification. We test our algorithms on a cross-matched set of ~4000 visually classified candidates from SDSS and UKIDSS. Our aim is to use these methods on upcoming data-sets from, eg., Euclid and LSST that will enable us to find the first quasars at redshifts of z > 8.

Constraining the Radio-Loud Fraction of Quasars at Redshift 6

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We carry out a series of deep Karl G. Jansky Very Large Array (VLA) S-band observations of a sample of 21 quasars at z∼6. The new observations expand the searches of radio continuum emission to the optically faint quasar population at the highest redshift with rest-frame 4400 Å luminosities down to 3x10^11 Lsun. In this talk, we will report the detections of two new radio-loud quasars: CFHQS J2242+0334 at z = 5.88 and CFHQS

J0227−0605 at z = 6.20. The final derived RLF is 9.4±5.7% for the optically selected quasars at z∼6. Our results show no evidence of significant quasar RLF evolution with redshift. There is also no clear trend of RLF evolution with quasar UV/optical luminosity due to the limited sample size of optically faint objects with deep radio observations. Meanwhile, we carry out new VLBA observations of the most powerful source CFHQS J2242+0334. A weak jet is marginally detected in the tapered image. The new results would be also introduced.

X-Ray Detection in Low Mass AGN Candidates

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We present an analysis of a sample of fifteen nearby (z<0.044) active galactic nucleus (AGN) candidates in low mass (M_*≲10^10 M_⊙) galaxies selected from the NASA Sloan Atlas for their optical variability. We use new and archival observations from the Chandra X-ray Observatory in the broad band (0.5-7 keV), which yielded seven detections and eight non-detections with nuclear luminosities ranging from L_(0.5-7)≈5×10^38 to 8×10^42 erg·s^(-1). These luminosities are then compared to the expected X-Ray luminosity, which is calculated using dust corrected Hα and far UV fluxes. Of the seven galaxies with a detected signal, five have X-Ray luminosities greater than expected from X-Ray binaries (XRBs), three of which have values entirely above the confidence intervals for XRB luminosity. Ten of the fifteen objects also had sufficient emission lines for emission line diagnostics (BPT diagram), which categorized two of the signals as AGN, six as being dominated by star formation, and two as composite galaxies. We discuss the discrepancies in the results of these different methods for AGN selection, in particular regarding low-mass and low-metallicity systems.

The Role of Molecular Gas in Quasar Feedback

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Galactic feedback processes are thought to regulate the co-evolution of accreting black holes and their host galaxy that is observed across cosmic time, but our understanding is still in its infancy. Molecular gas in these galaxies seems to play a significant role in this picture and so characterising this gas and analysing its relation to jets and outflows is an important avenue of research. I will present analysis of the molecular gas properties of an unbiased sample of 17 Type 2 quasars at z<0.2, which are part of the Quasar Feedback Survey. To carry out this research we have observed the three lowest CO

transitions using the ALMA Compact Array and APEX. We analysed the impact of quasar feedback on the molecular gas properties such as total gas content, excitation and temperature in these quasar host galaxies. We also investigated the difference in line profiles and velocity shifts between transitions, which could also relate to the observed radio jets and ionised outflows. I will present these findings along with evidence of molecular gas outflows and extended diffuse gas in these sources as well as potential interactions between the molecular gas and observed radio emission.

What can we learn about reionization from resolved Lyman-alpha profiles? an observational approach

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Reionization is though to be driven by star-bursting systems between 6<z<10. The profile of Lyman-alpha lines contains information about the medium surrounding the emitting source. In particular, local Universe studies have shown that the escape fraction of radiation can be estimated from the separation of doubly peaked profiles. Extrapolating this to higher redshifts, one can then asses the radiation leakage of sources within reionization. Narrow band surveys have proven capable of detecting such systems up to z~7 . In particular, the LAGER survey has selected hundreds of Lyman-Alpha emitters (LAEs) at z~6.9. Ground based medium-resolution NIR spectroscopic follow up is able to both resolved the Lya line and search for UV nebular emission simultaneously, thus shedding light on the nature of early ionizing agents and how they impact their environment. On this talk, we will discuss our methodology and results from it's application to new Magellan/FIRE data of LAGER-CDFS1, the brightest LAE (Log(L_{Lya})~43) within the LAGER-CDFS field. Radiative transfer model fitting suggest a large (>80%) Lyman-alpha escape fraction, consistent with estimates from its equivalent width (~100A).

ACTIVE GALACTIC NUCLEI in the Zwicky Transient Facility (ZTF)

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We analyze a sample of optical light curves for AGNs in the r-band (6339.61 Å) and the g-band (4722.74 Å). We take advantage of a homogeneous analysis of SDSS DR14 quasars spectra by Rakshit et al., 2020 to define a sample with well-measured Black Hole mass (MBH) and Eddington ratio/accretion rate (Ṁ) in different redshift bin. The

emission from quasars is highly variable, and the variability is a potential key to understand the accretion process. Here we calculate the amplitude of variability, or the variance at different time scales in the resulting power spectrum using the 'Mexican-Hat' filter (Arévalo, P. et al., 2012) for a large population of AGN. By separating the variance on different timescales, we find a significant anti-correlation between rest-frame wavelengths and variance by using the redshift as the tool to study different rest-frame wavelengths. Moreover, there is a positive correlation between the variance ratio or the power spectrum slope and rest-frame wavelength. Furthermore, our approach is not affected by biases introduced from redshift effects such as time dilation since the light curves have been corrected for the redshift.

PUMA survey: a MUSE view of extreme (and regular) gas kinematics in local ULIRGs

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ULIRGs are characterised by extreme starburst (SB) and AGN activity, and are therefore ideal laboratories for studying the outflow phenomena and their feedback effects. In this talk, I will present some results obtained from the analysis of MUSE data of a sample of 20 nearby ULIRGs, as part of the 'Physics of ULIRGs with MUSE and ALMA' (PUMA) project (Perna+20,+21;+22sub; Pereira-Santaella+21). Using a kinematic decomposition technique, we analysed ionised gas emission to separate outflows from unperturbed motions. We inferred the incidence and properties of gaseous disks (i.e. Vrot, sigma, Mdyn), and the prevalence of nuclear (and kpc-scale) outflows. These outflows are capable of removing large amounts of gas from the systems ('negative feedback'), potentially affecting the galaxy mass assembly already from the early phases of a merger; moreover, ejected material is also capable of triggering star formation ('positive feedback'). In particular, we reported evidence of enhanced star formation at the edge of - and within - the outflow of Arp 220, the nearest ULIRG in our sample, with SFR of a few Msun/yr and velocity offsets of a few 100 km/s.

Assembly of a rotationally supported star-forming galaxy at z~7

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Studies of the ultraviolet distribution of high-redshift galaxies indicate that the early stages of galaxy formation involve disturbed and clumpy systems. In recent years, the

study of these galaxies has been revolutionized by the advent of ALMA, by accessing the complex process of mass assembly through the observations of the cold gas morphologies and kinematics, yielding increasing evidence of the existence of rotationally supported disks at z~7. In this presentation, I will show the results of a detailed study of a massive star-forming galaxy COS2987 at z=6.8. In previous studies, the galaxy showed tentative signs of being a system supported by rotation, which is a rare case for galaxies in the middle of the reionization period. Our new high-resolution [CII] line imaging with ALMA allows us to spatially resolve the galaxy and dissect the three-dimensional [CII] line emission (space + velocity) and thus understand their morphology and dynamical state. Through modeling of the velocity distribution (using 3DBarolo) we confirm a rotationally-supported nature for this galaxy and observe a co-spatial distribution of the UV and [CII] emission within the main disk

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Investigating the Mpc Environment around the z=7.54 Quasar ULAS J1342+0928

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Theoretical models predict that quasars at z ~6 should be found in the most massive halos of the underlying dark matter distribution. However, observational efforts have not provided a clear picture so far. We investigate the ~1 proper Mpc environment of J1342+0928, a luminous quasar at redshift z = 7.54. We use deep data from the Hubble Space Telescope (HST) to look for galaxy candidates in the vicinity of the quasar J1342+0928 and assess if it is immersed in a protocluster of galaxies as predicted by theory. For this purpose, we rely on imaging of a 1.1 X 1.1 pMpc area surrounding the quasar in the HST filters ACS/F814W, and WFC3/F105W, and F125W. We will use a combination of the Lyman-break technique redshift probability and color-color criteria to select the galaxy candidates. Available Spitzer/IRAC observations at 3.6 mu and 4.5 mu will complement the spectral energy distribution of the candidates in mid-infrared wavelengths to help differentiate the high-redshift galaxy candidates from lower-redshift contaminants. We will compare the number density of the galaxy candidates found to what is expected in a field without a quasar, both from deep field observations and the predictions from the galaxy rest-frame ultraviolet luminosity function at z~ 7.5. The galaxy candidates resulting from this research will be excellent targets for follow-up observations with JWST or ALMA, to confirm the redshift of these galaxies and study their physical properties.

Monsterw with empty bellies: low dense gas fractions in high-z star-forming galaxies

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Dusty, intensely star-forming galaxies (SFR=100-1000 Msol/yr) play a crucial role in the early cosmic history: accounting for up to 50% of the stellar mass and 25% of the star production at z~2. Although their gas content has been extensively studied in low-J CO and [CII] lines, they trace gas at densities well below the star formation threshold (10^5 cm-3). Such high-density gas is better traced by fainter emission lines such as HCN(1-0), which is linearly correlated with the star-formation rate over ~8 dex. Unfortunately, the faintness of the HCN line makes it challenging to study at high-z. Indeed, only two dusty galaxies have been detected in the HCN(1-0) emission to date, indicating elevated dense gas fractions and low star-forming efficiency. I will present the results of a comprehensive VLA survey of HCN/HCO+(1-0) emission in strongly lensed, dusty galaxies at z~3. Surprisingly, most targets are undetected in both lines, implying that most dusty galaxies have low dense gas fractions and increased star-forming efficiency. The high HCN/CO reported in the literature are likely boosted by AGNs rather than indicative of high dense gas content.

Unveiling the AGN intrinsic power and its effect on the host-galaxy ISM

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Local Seyfert galaxies are the perfect laboratories to understand the interplay between SF and AGN activity, given the unparalleled wealth of multi-wavelength data. The accurate determination of the AGN accretion power in the X-rays and mid-IR, associated with the study of the molecular component of the ISM in the mm-band, are key ingredients to investigate the effect of AGN on the ISM. In this work, we focus on a sample of 33 local Seyfert 2 galaxies, which have NuSTAR observations in the X-rays, Spitzer mid-IR spectra, and CO single-dish observations. By performing a detailed X-ray spectral analysis, we found: i) the first accurate determination of the intrinsic power (LX) and column density (NH) of the obscuring material; ii) the comparison of the obscuration in the X-rays with that derived in the mid-IR (9.7µm absorption feature). Then, by comparing the molecular gas content (derived with new and archival single-dish CO spectroscopy) and the PAH emission between the Seyfert 2 and a control sample of normal SF galaxies (SFGs), we found that: i) local AGN and SFGs show similar

molecular gas masses and depletion times; ii) PAH emission is suppressed in AGN with respect to SFGs.

REBELS LP: Insights into the Physical Properties of Massive Galaxies during the Epoch of Reionization

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Achieving a physical characterization of galaxy build-up in the reionization epoch has been a long-standing goal in extragalactic astronomy. By using ALMA to spectrally scan 46 massive UV-bright z>6.5 galaxies for [CII] in our REBELS Large Program and pilot studies, we have constructed a large sample of massive galaxies with [CII] and continuum detections. Here we present the survey design and preliminary results, looking at the relation between [CII] and SFR, [CII]/Lir, dust, and kinematic properties and their possible evolution compared to local relations. This gives us some valuable initial insight into both the evolution of the physical properties and the formation of dust in these massive galaxies in the EoR. Finally we discuss the exciting future prospects for this survey ALMA, JWST and ground-based spectroscopy.

Multi-frequency Imaging of kpc-scale Jets in Obscured Radio Powerful Quasars

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The relationship between Active Galactic Nuclei (AGN) and their host galaxies is central to the evolution of galaxies over cosmic time. AGNs interact with their host galaxies through two main feedback mechanisms; jet-driven or wind-driven mode. It is well known that relativistic jets interact with the intra-cluster medium (ICM) on large scales, thereby regulating the cooling flows in the cores of galaxy clusters. However, the role and impact of jets on small (< a few kpc) sub-galactic scales are not well understood. I present multi-frequency imaging and spectral analysis of a few targets that belong to a unique sample of 167 heavily obscured quasars (0.5 < z < 2.8) with sub-galactic, young jets. The sample is selected to have extremely red mid-infrared colors in WISE, compact and bright radio source in NVSS/FIRST, and faint or no detection in SDSS. The galaxies in this sample are believed to have undergone a recent merger leading to heavy obscuration and substantial starburst activity and host a recently (re)triggered AGN. High-resolution VLA snapshot imaging at 10 GHz revealed that 80% of the sources are

compact (< a few kpc), and 57% showed peaked or curved spectra consistent with being young radio AGN. We present a subset of sources here that have radio jet/lobe structures on a few arcsecond scales making them Compact Steep Spectrum (CSS) sources. Using the deeper multi-band VLA imaging, we performed a detailed analysis to investigate source morphologies, energetics, and broadband radio spectral properties of these sources. We also discuss the implications of our study in understanding the impact of young radio sources and their jets on their surroundings and host galaxy evolution.

Uncovering the physics of star formation in the Epoch of Reionization with [CII] 158 µm and [OIII] 88 µm

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Recent ALMA detections of the [CII] 158 µm and [OIII] 88 µm emission lines allow some of the first explorations of the interstellar medium in the early Universe. In this talk, I will present new [OIII] observations of four bright z ~ 7 Lyman-break galaxies spectroscopically confirmed by ALMA through the [CII] line, unlike recent [OIII] detections where Lyα was used. I will present a multi-wavelength comparison with new deep HST images of the rest-frame UV, whose compact morphology aligns well with [OIII] tracing diffuse ionized gas as opposed to the more spatially extended [CII] emission mainly produced in neutral gas. This suggests we are witnessing intense star formation which locally shows extreme [OIII]/[CII] ratios indicative of 'leaking' ionizing radiation. Other regions might be more metal-enriched and obscured by dust, as indicated by the dust continuum. Probing the continuum at two wavelengths furthermore allows us to constrain key dust properties such as its temperature and yield, both largely unknown for high-redshift galaxies. One source appears to require surprisingly cold dust which, if confirmed, would have important implications for the formation mechanisms of dust.

The Contribution of AGN Accretion Disks to Hydrogen Reionization

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The reionization of the universe is the most recent major cosmic phase-transition of the intergalactic medium, widely thought to be driven by young stars and accretion disks around supermassive black holes (SMBHs). In this talk I will present a framework that

consistently traces the growth and the ionizing output of the first generation of SMBHs at z=6, accounting for the evolution of their spectral energy distributions and various accretion histories (including super-Eddington growth), as dictated by the evolving BH mass, accretion rate, and spin. These novel calculations show that the contribution of SMBHs to reionization could be higher than what can be expected by considering simplistic (and unphysical) assumptions, but that this contribution is likely limited to late stages.

Hot Dust Obscured Galaxy Environment

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Studying the environments of high-redshift galaxies is crucial for understanding the physics of the early Universe and providing insights into how galaxies evolve across cosmic time. The Lyman break selection approach is one of the most powerful techniques for studying the environment of high-redshift galaxies. A population of hyper-luminous obscured quasars known as Hot Dust-Obscured Galaxies (Hot DOGs) were identified by the Wide-field Infrared Survey Explorer satellite telescope (WISE). We are studying the environment of the most luminous obscured AGN (Hot DOG, W2246-0526), and probably the most luminous galaxy known in the universe. In this talk, I will give a brief summary of our search for Lyman break galaxies (LBGs) using data from Gemini GMOS-S deep imaging in the r, i and z bands, which identified 50 LBG candidates in the vicinity of this Hot DOG. I will discuss some of the most interesting findings, we came across.
