Morning			**Sub-parsec scales and jets**	**Reverberation mapping**	**Hundred parsec scale structure**	**Instrumentation and observing programmes**
Afternoon		**the Broad Line Region**	**Parsec scale structure, composition, and kinematics**		**AGN in cosmology**	

Start	**(PDF repo -->)**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
09:00			**Invited**	**Flash Talks**	Leftley James	**Invited**
09:15					Moszczynski Niklas	
09:30			Gupta Kriti Kamal	**Invited**	Gonzalez-Martin Omiara	Matsumoto Kosei
09:45			Shablovinskaya Elena*		Mckaig Jeffrey	Kovacevic Andjelka
10:00			Ricci Claudio*	Newsome Megan*	Goold Kameron	Shimizu Taro
10:15			Davies Richard	Bentz Misty	Vermot Pierre	Petrov Romain
10:30			**Coffee**	**Coffee**	**Coffee**	**Coffee**
10:45						
11:00			Swain Subhashree*	Pandey Shivangi*		**Discussion**
11:15			Nandi Payel*	Malygin Eugene*	Sykes Calvin	
11:30			Chand Krishan*	Fries Logan	**Discussion**	**General Discussion**
11:45			Kallová Kristína	**Discussion**		
12:00			**Discussion**			
12:15						
12:30		**Coffee and Snacks (Early Arrivals)**	**Lunch**	**Lunch**	**Lunch**	**Lunch**
12:45						
13:00						
13:15					**Invited**	
13:30		**Welcome Information**				
13:45					Marziani Paola	
14:00		**Invited**	**Invited**		Chakraborty Avinanda	
14:15					Martínez-Aldama Mary Loli	
14:30		Kovacevic-Dojcinovic Jelena*	Drewes Nora		**Coffee**	
14:45		Du Pu	Diaz Yaherlyn			
15:00		Songsheng Yu-Yang	Ursini Francesco		Allyson Brodzeller	
15:15		Sturm Eckhard	Yin Charles		Mirabel Felix*	
15:30		Temple Matthew	Izumi Takuma		Das Mousumi	
15:45		**Coffee**	**Coffee**		**Discussion**	
16:00						
16:15		Li Yan-Rong*	Zhang Tianfang			
16:30		Hutsemekers Damien	Stalevski Marko		**Conference Dinner and Tour (Late Finish)**	
16:45		Wada Keiichi	Vander Meulen Bert			
17:00		Popovic Luka C.*	Dimopoulos Georgios*			
17:15		Negi Vibhore*	Kawamuro Taiki			
17:30		Mohana A Krishna*	**Discussion**			
17:45		**Discussion**				
18:00						

the Broad Line Region	*** Online talks**
Sub-parsec scales and jets	**Unconfirmed**
Parsec scale structure, composition, and kinematics	**PDF Repository**
Reverberation mapping	
Hundred parsec scale structure	
AGN in cosmology	
Instrumentation and observing programmes	

X-ray spectral and timing characteristics of compact symmetric objects

Subhashree Swain*[1], C. S. Stalin[1], and Vaidehi S. Paliya[2]

[1]Indian Institute of Astrophysics – India
[2]Inter-University Centre for Astronomy and Astrophysics [Pune] – India

Abstract

Compact Symmetric Objects (CSOs) are a distinct category of jetted active galactic nuclei. We examined the X-ray charac- teristics of 16 bona fide CSOs using observations from Chandra and XMM-Newton. Among the sources with XMM-Netwon observations, we found two sources, J0713+4349 and J1326+3154 to show clear evidence of variations in the soft (0.3–3 keV), the hard (3–10 keV) and the total energy (0.3–10 keV) band with the normalised excess variance (Fvar) as large as 1.17 ± 0.27%. Also, the Fvar is found to be larger in the hard band relative to the soft band. From analysis of the hardness ratio (HR) with flux, we found both the sources to show a harder when brighter (HWB) trend. Similarly, in the Chandra observations, we found seven sources to show flux variations, with similar variations in both the soft and hard bands. Of those, only one source namely J1347+1217 showed variation of HR with flux with a HWB trend. From spectral analysis, carried out in a homogeneous manner, we found the existence of obscured as well as unobscured CSOs. We report the identification of two sources, J0111+39076 and J2327+0846 that are highly obscured with the intrinsic hydrogen column density NH $> 10^{23}$ cm^{-2}. For majority of the CSOs, the observed X-ray emission is dominated by their relativistic jet emission, except for the sources, JJ0713+4349, J1407+2827 and J2022+6136, for which the detection of Fe Kα emission points to the dominance of X-ray emission from disk/corona rather than the relativistic jet. Our results point to diverse X-ray characteristics of CSOs.

*Speaker

X-ray polarimetry of the torus in the Circinus Galaxy

Francesco Ursini*[1]

[1]Università degli Studi Roma Tre – Italy

Abstract

We present the first Imaging X-ray Polarimetry Explorer (IXPE) observation of the Circinus Galaxy, the closest and X-ray brightest Compton-thick AGN. We find the source to be significantly polarized in the 2–6 keV band. The X-ray spectrum is known to be dominated by reflection components, both neutral (torus) and ionized (outflow cone). From the spectropolarimetric analysis of IXPE and Chandra data, we find a polarization degree of 20-30% for the neutral reflector, and a polarization angle roughly perpendicular to the radio jet. A comparison with Monte Carlo simulations shows that the neutral reflector is consistent with being an equatorial torus with a half-opening angle of 45-55 deg. This has been the first X-ray polarization detection in a Seyfert galaxy, confirming the basic predictions of the Unification Model.

*Speaker

Velocity-Resolved Reverberation Mapping of NGC 3227

Misty Bentz*[1]

[1]Georgia State University – United States

Abstract

We describe the results of a new reverberation mapping program focused on the nearby Seyfert galaxy NGC 3227. Photometric and spectroscopic monitoring was carried out from December 2022 to June 2023 with the LCO network of telescopes. We detected time delays in several optical broad emission lines: Hbeta, Hgamma, Hdelta, and He II. We also detect velocity-resolved behavior of the Hbeta emission line, with different line-of-sight velocities corresponding to different observed time delays. Modeling of the full velocity-resolved response of the Hbeta emission line was carried out with the phenomenological code CARAMEL, finding a black hole mass of M_BH=1.23 (+1.52/-0.67) x 10^7 Msun, and suggesting that the Hbeta-emitting BLR may be represented by the inner surface of a biconical or flared disk structure that is inclined to our line of sight at an angle of _~33 degrees and with gas motions that are dominated by rotation. We compare these results with a simple analysis using a new photoionization-based reverberation modeling code, BELMAC, and place the results of this new reverberation program in context with previous studies of NGC 3227 and other nearby AGNs.

*Speaker

Varstrometry for Dual AGN using Radio Interferometry (VaDAR)

Emma Schwartzman*[1], Tracy Clarke[2], Kristina Nyland[2], Nathan Secrest[3], Ryan Pfeifle[4], Henrique Schmitt[2], Shobita Satyapal[1], and Barry Rothberg[3]

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[2]United States Naval Research Laboratory – United States
[3]U.S. Naval Observatory – United States
[4]NASA Goddard Space Flight Center – United States

Abstract

Binary and dual active galactic nuclei (AGN) are an important observational tool for studying the dynamical evolution of galaxies and supermassive black holes (SMBH). However, they are notoriously difficult to unambiguously detect due to current observational limits and biases, and are often identified serendipitously. An entirely new method for identifying possible AGN pairs makes use of the exquisite positional accuracy of *Gaia* to detect astrometrically-variable quasars, in tandem with the high radio spatial resolution of the Very Large Array (VLA) and the Very Long Baseline Array (VLBA). Colloquially called *varstrometry*, this process can be used to measure emission flux, and place limits on source angular size and separation. We present new radio observations with the VLA 2-4 GHz (S-band) and 8-12 GHz (X-band) of 18 quasars ($0.7 < z < 2.9$) exhibiting significant positional variability, selected from the SDSS DRQ16 and matched with the *Gaia* EDR3. In combination with several radio surveys (VLASS, FIRST, etc.), these observations have provided constraints on the origin of the astrometric variability and probe source morphology on hundred-parsec scales. We also present preliminary observations of a sub-sample of seven quasars observed with the VLBA at S- and X-bands, providing milliarcsecond scale constraints on the origin of the jitter, and probing source morphology on parsec scales.

*Speaker

Unveiling Supermassive Black Hole Environments with TDEs

Megan Newsome*[1,2]

[1]Las Cumbres Observatory – United States
[2]UC Santa Barbara – United States

Abstract

When stars approach the tidal radius of a supermassive black hole (SMBH) and find themselves unraveled, the resulting debris stream spirals toward the SMBH and creates a flare whose light can outshine the host galaxy. TDEs have recently offered us glimpses into the sub-parsec local environments near SMBHs. AT 2020mot is a typical UV/optical TDE, but is uniquely bright in the near-infrared and even shows a later enhancement in brightness along the tail of the light curve. This could be the first TDE to show two "dust echoes," indicative of concentric rings of thin dust within 0.1 parsecs of a SMBH, among the smallest scales at which dust has been inferred near SMBHs. Similarly, the event AT 2022upj is an extreme coronal line emitter (ECLE) that shares emission line diagnostics in common with the small subset of ECLEs believed to be "light echoes" of TDEs in gas-rich environments. Events like AT 2020mot and AT 2022upj are novel opportunities to peer into the closest material of otherwise invisible black holes in quiet galaxies. Studying these events will explore the fundamental connections between supermassive black holes, galaxy evolution, and accretion mechanics.

*Speaker

Unveiling Compton-thick AGN with NuSTAR and mid-IR observations

Francesco Salvestrini*[1,2]

[1]INAF - OAS Bologna – Italy
[2]DiFA - Università di Bologna – Italy

Abstract

A multi-wavelength strategy is necessary to achieve an accurate characterisation of AGN, especially in the case of heavy obscuration or weak emission. Coupling the nearly unbiased mid-IR selection with the observations in the X-rays, which are able to penetrate and measure large columns of obscuring material, is crucial to obtain a complete picture of the AGN emission and the surrounding material. Here, we present the results from a complete and systematic study of the hard X-ray properties for 36 mid-IR selected local Seyferts 2 by using NuSTAR observations.
The focusing power of NuSTAR at energies above 10 keV is crucial to unveil the intrinsic AGN emission in the case of heavy obscuration, as well as to reveal the key features associated to the presence of a high-column density material surrounding the accreting supermassive black hole, i.e. the torus.
By modelling the spectral shape of emission reprocessed by the torus (accounting for the absorbed component along the line-of-sight, the reflected one, and fluorescent emission lines), we put constrains on the shape and the properties (e.g., clumpiness) of the torus.
We present i) the first accurate determination of the intrinsic power and column density (NH) of the obscuring material for an almost complete Type 2 AGN sample, with new and archival NuSTAR observations; ii) constrains on the properties obscuring torus with physically motivated models (e.g., MyTorus) in the X-rays. The comparison of the level of obscuration in the X-rays with that derived in the mid-IR with different proxies (e.g., the silicate absorption feature, PAH EW), as well at mm wavelength with ALMA.
Our results allows us to investigate the population of nearby heavily-obscured AGN, as well as the multi-wavelength properties of the obscuring torus, crucial to design future campaign with larger samples.

*Speaker

The spatial extent of the coronal line region in active galactic nuclei

Jeffrey Mckaig*[1], Shobita Satyapal[1], Ari Laor[2], Nicholas Abel[3], Claudio Ricci[1,4,5], Sara Doan[1], and Jenna Cann[6]

[1]George Mason University [Fairfax] – United States
[2]Technion - Israel Institute of Technology [Haifa] – Israel
[3]University of Cincinnati – United States
[4]Universidad Diego Portale – Chile
[5]Kavli Institute for Astronomy and Astrophysics [Beijing] – China
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Abstract

Forbidden, collisionally excited, optical atomic transitions from high ionization potential (IP> 54.8 eV) ions are known as optical Coronal Lines (CLs). These lines, which are characterized by high critical densities (_˜10ˆ7-10ˆ9 cmˆ-3) and a typical FWHM of _˜1000-2000 km sˆ-1, have traditionally been thought to originate between the broad and narrow line regions or perhaps on the ionized skin of the ubiquitous torus. However, high resolution maps have shown optical CL emission extended from parsec to kilo-parsec scales, questioning the true location of the so called "coronal line region". Here, we study the formation of optical CLs as a function of distance from the AGN source using the spectral synthesis code Cloudy. We test multiple slabs of radiation pressure confined gas with various dust contents and metallicities to calculate the expected CL luminosity and equivalent width in each slab. The ionizing slope of the continnuum source is also allowed to vary. We find a large stratification of CL emission out to hundreds of parsecs determined by a transitions critical density, with higher critical density transitions peaking closer to the accretion disk. This implies that direct AGN photoionization can drive optical CL production well into the traditional NLR of AGN without the need for other excitation mechanisms such as shocks. Finally, we show dust has a dramatic effect on CL production; these models show that most CLs are unobservable when dust is present, with (Ne V) 3425.88A being the exception. While many optical CLs originate from elemental species which are depleted onto grains, lines from neon will be uneffected by such depletion due to its noble nature.

*Speaker

The relation between ionised outflows and molecular gas content in nearby X-ray AGN

Alejandra Rojas*[1]

[1]Universidad Diego Portales [Santiago] – Chile

Abstract

An open question in extragalactic astronomy is what is the extent to which the Active Galactic Nuclei (AGN) affect the evolution of their host galaxies. Proper characterization of the AGN influence becomes necessary for cosmological hydrodynamical simulations that invoke feedback from these AGN to realistically simulate galaxy growth and evolution. AGN-driven outflows are frequently detected in low-redshift and high-redshift galaxies across a wide range in luminosity and multiple gas phases. However, most of the samples considered by these studies are incomplete as often only bright AGN are considered and the samples are biased against absorption in the optical/soft X-ray band. In this study, we present recent MUSE and ALMA CO (2-1) observations of nearby hard X-ray selected AGN. The AGN sample covers a large range in bolometric luminosity, black hole mass, Eddington ratio and obscuration and therefore, allows us to perform an unbiased statistical study of outflows and their impact on host galaxies. We find kpc-scale ionized outflow signals in all galaxies and substantial amounts of molecular gas in their central regions ($<$ 300 pc) distributed in a compact disk or ring-like structure. We will show if the presence of AGN results in a negative or positive feedback. We will conclude by presenting relations between the AGN luminosity, outflow power with molecular gas content and star formation rate of the host galaxy determined using ancillary multi-wavelength data and advanced SED models.

*Speaker

The power of relativistic jets

Luigi Foschini*[1]

[1]INAF - Osservatorio Astronomico di Brera – Italy

Abstract

One of the key problem in the physics of relativistic jets is to estimate their power. There are several methods, but the results can differ even by orders of magnitudes. We started a program aimed at understanding the reasons for these differences (whether wrong hypotheses or intrinsic source variability), and – if possible – to converge to a reliable measurement of this physical quantity. We present the results of the comparison between different methods based on multiwavelength observations of a sample of jetted AGN.

*Speaker

The Origin of X-Ray Polarization in the Circinus Galaxy

Atsushi Tanimoto*[1], Keiichi Wada[1], Yuki Kudoh[2], Hirokazu Odaka[3], Ryosuke Uematsu[4], and Shoji Ogawa[5]

[1]Kagoshima University – Japan
[2]Tohoku University – Japan
[3]Osaka University – Japan
[4]Kyoto University – Japan
[5]JAXA – Japan

Abstract

An Imaging X-ray Polarimetry Explorer (IXPE) has recently detected polarization for the first time in the nearest Seyfert 2 galaxy, the Circinus galaxy. To reproduce the IXPE results, we computed the degree of polarization based on two types of radiative hydrodynamic simulations: a parsec-scale three-dimensional model and a sub-parsec-scale axisymmetric model with a higher spatial resolution. We confirmed that these models naturally explain the multi-wavelength observations of the Circinus galaxy from the radio to the X-rays. We used a Monte Carlo Simulation for Astrophysics and Cosmology code to compute the linear polarization of continuum emission. We found that the degree of polarization based on the parsec-scale radiation-driven fountain model was smaller than that observed with IXPE. The degree of polarization based on the sub-parsec-scale model depends on the hydrogen number density of the disk (d), and the degree of polarization obtained from our simulation is consistent with that observed with IXPE in the case of $14 \leq \log d/\{cm\}\{-3\}$.$We also found that the degree of polarization changed over a timescale of approximately$

*Speaker

The millimeter-continuum emission of radio-quiet AGN

Claudio Ricci*[1]

[1]Universidad Diego Portales [Santiago] – Chile

Abstract

Recent studies have proposed that the nuclear millimeter continuum emission observed in nearby active galactic nuclei (AGN) could be created by the same population of electrons that gives rise to the X-ray emission that is ubiquitously observed in accreting black holes. In my talk I will present the results of a dedicated high spatial resolution (_˜60-100 milliarcsecond) 100 GHz ALMA campaign on a volume-limited, hard X-ray (> 10 keV) selected, sample of radio-quiet AGN. We find an extremely high detection rate (25/26 or _˜95

*Speaker

The Lx-Luv plane: investigating accretion state and energy transfer in quasars

Susanna Bisogni*[1]

[1]INAF, IASF-Milano – Italy

Abstract

The relation between X-ray and UV luminosities in quasars, holding for several decades in both bands and over a wide redshift range, suggests the universality of the physical mechanism governing the energy transfer from the accretion disc to the hot corona. By analysing X-ray spectroscopic data from the Chandra Source Catalog 2.0 for a robust sample of over 2000 SDSS DR14 quasars, we found a smaller intrinsic dispersion in the Lx-Luv relation (delta $<$ 0.2 dex at z$>$ 3) compared to photometric-based studies and confirmed its non-evolution up to

*Speaker

The iron lines in spectra of Active Galactic Nuclei: a two-component model

Jelena Kovačević-Dojčinović*[1], Ivan Dojčinović[2], Maša Lakićević[1], and Luka Popović*[1]

[1]Astronomical Observatory Belgrade – Serbia
[2]University of Belgrade, Faculty of Physics – Serbia

Abstract

The numerous iron lines are among the most intriguing spectral features in the spectra of Active Galactic Nuclei (AGN). Their mechanisms of excitation, the place of their emission in AGN structure, and their correlations with other spectral parameters represent interesting topics for research in the broad line region (BLR). Here we represent two-component modelling of the iron lines, where we assume that Fe II lines arise from two emission regions: from the very broad line region (VBLR), the part of the BLR closer to the supermassive black hole, and from the intermediate line region (ILR), which is part of the BLR farther away from the black hole. We point out that Fe II VBLR components could form the Fe II pseudocontinuum in some special cases, and consequently affect measured spectral parameters in the optical spectra. Also, we discuss possible underlying physics in the so-called Quasar Main Sequence, as implied by the results of the Fe II two-component modelling.

*Speaker

The innermost hot dust in AGN as seen by GRAVITY

Ric Davies*[1]

[1]Max Planck Institute for Extraterrestrial Physics – Germany

Abstract

The hot dust around AGN traced by the near-IR continuum provides insights to some of the key questions regarding the size and composition of the dust structure and its connections to the central engine. I will present our latest measurements of the hot dust sizes of 17 type 1 AGNs from VLTI/GRAVITY interferometric observations. I will discuss (i) possible mechanisms for the shallower slope of the size-luminosity relation, which we find to be 0.4 rather than the 0.5 expected if dust sublimation sets the inner boundary of the structure; (ii) constraints on the dust geometry and composition implied by the systematic offset between the size-luminosity relations from interferometry and reverberation mapping; (iii) black hole masses inferred from the dust size, based on its strong correlation with the BLR size. I will finish by considering the prospects for connecting GRAVITY observations on sub-parsec scales to JWST observations at _˜10-100 parsec scales, for a more comprehensive understanding of the nuclear dust structure of AGNs.

*Speaker

The impact of AGN activity in nearby Seyfert galaxies: high resolution study of the multiphase ISM

Maria Vittoria Zanchettin*[1,2]

[1]Scuola Internazionale Superiore di Studi Avanzati / International School for Advanced Studies – Italy
[2]INAF - Osservatorio Astronomico di Trieste – Italy

Abstract

I will discuss the physics of the multiphase gas in local active galaxies and the impact of the Active Galactic Nucleus (AGN) on the host galaxy evolution. AGNs can generate winds and jets that interact with the host galaxy interstellar medium (ISM). In this talk I will focus on the warm ionized, cold molecular phases and radio properties, using VLT/MUSE, ALMA and VLA data. I will present a detailed dynamical modeling of the gas component through which we can reconstruct the distribution and kinematics of the disks, winds, jets and their interaction.By exploiting spatially resolved MUSE multi-line diagnostics, we are able to derive the best estimate of the velocity field, spatial distribution, and electron density, therefore properly quantify the ionized mass and outflow energetics. By comparing high resolution radio and sub-mm data of the central region we are able to infer the presence of compact radio-jets, star formation activity and dust emission on sub-kpc scales.I will present the application of our approach to a sample of local hard-X-ray selected Seyfert galaxies, including NGC2992. In this changing look AGN we detect a multiphase almost edge-on disc and a dust reservoir co-spatial with the molecular disk. On a few kpc-scales the wind is multiphase, with a fast ionized component and a slower molecular one. VLA data shows the presence of star formation activity in the disk and of expanding radio bubbles interacting with the surrounding ISM.

*Speaker

The first joint ALMA/X-ray monitoring of a radio-quiet AGN: understanding the origin of the compact mm emission

Elena Shablovinskaya*[1], Claudio Ricci[1,2], Chin-Shin Chang[3], and Taiki Kawamuro[4]

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[2]Kavli Institute for Astronomy and Astrophysics [Beijing] – China
[3]Joint ALMA Observatory – Chile
[4]RIKEN Cluster for Pioneering Research – Japan

Abstract

The origin of compact radio/mm emission observed in nearly all radio-quiet Active Galactic Nuclei (AGN) is still debated. Recent studies have proposed that it is produced by self-absorbed synchrotron emission from the accretion disk corona, which is also responsible for the X-ray emission ubiquitously observed in AGN. The detection of correlated variability between the mm and X-ray bands would be the smoking gun supporting this idea. We carried out the first joint mm (ALMA; ∼100 GHz)/X-ray (NICER/NuSTAR/XMM-Newton/Swift; 0.3-80 keV) observations of the brightest unobscured radio quiet-AGN, IC 4329A (z = 0.016). In my talk, I will present the first results of this large campaign, particularly focusing on the evidence of mm emissions preceding the X-ray signal by _˜11 days, as well as the detection of quasi-periodic oscillations in the 2-10 keV flux. The correlated behaviour between X-ray and mm fluxes suggests an association between the mm-wave source and the X-ray corona, opening discussions about the mechanisms triggering mm variability.

*Speaker

The Detection of a Large Sample of Dual AGN and what they reveal about Galaxy Evolution

Mousumi Das*[1], Anwesh Bhattacharya , Snehanshu Saha , Françoise Combes , Abhishek Paswan , and C.p. Nehal

[1]Indian Institute of Astrophysics – India

Abstract

As galaxies merge their nuclei come closer and eventually become bound in a common envelope. During this process the nuclei may start accreting mass and become active galactic nuclei (AGN). So there can be pairs of AGN (also called dual AGN), starburst-AGN pairs and starforming nuclei pairs in merger remnants. Although galaxy mergers are common, dual AGN appear to be rare. But their detection is important because they help us understand the formation of supermassive black hole (SMBH) binaries, SMBH growth and AGN feedback in multiple nuclei systems. In this presentation we discuss a novel algorithm called GOTHIC that makes a systematic survey of existing imaging data for the discovery of dual nuclei in closely merging galaxies. GOTHIC uses imaging processing techniques to find dual peaks in the images. We have applied GOTHIC to a spectroscopic sample of a million galaxies in SDSS DR16, lying in the redshift range of z=0 to 0.75 approximately. We have detected 159 dual AGN in this sample, of which 2 are triple AGN systems. Our results show that dual AGN are not common, and triple AGN even rarer. The color (u-r) magnitude plots of the closely merging galaxies shows that star formation is quenched as the nuclei come closer and as the AGN fraction increases. The quenching is especially prominent for dual AGN galaxies that lie in the extreme end of the red sequence.

*Speaker

The broad emission line widths of quasars as a redshift-independent luminosity indicator for cosmology

Paola Marziani*[1], Mary Loli Martínez-Aldama*[2], Tania Mayte Buendia Rios[3], Alice Deconto Machado[4], Swayamtrupta Panda[5], Castalia Alenka Negrete[3], Deborah Dultzin[3], Ascension Del Olmo[4], Natasa Bon[6], and Edi Bon[6]

[1]INAF - Osservatorio Astronomico di Padova – Italy
[2]Universidad de Valparaiso Chile – Chile
[3]Instituto de Astronomia, UNAM – Mexico
[4]Instituto de Astrofísica de Andalucía – Spain
[5]LNA – Brazil
[6]Astronomical Observatory of Belgrade – Serbia

Abstract

An effective systematization of quasar spectral properties has been made possible by the set of correlations known as the Eigenvector 1 of quasars (also known as the quasar main sequence). The correlations involve multifrequency properties from the radio to the hard X-ray domain, and are believed to be ultimately governed by the accretion mode of the supermassive black hole powering quasars. In this interpretation extreme optical singly-ionized iron emitters are associated with extreme Eddington ratios. These quasars are easily identifiable in large spectroscopic surveys over a broad redshift range. The very high accretion rate makes it possible that their supermassive black holes radiate at a stable, extreme Eddington ratio according to accretion disk theory. After reviewing basic observational properties of extreme quasars, we present a method to derive the main cosmological parameters based on redshift-independent "virial luminosity" computations from measurements of emission line widths. The method relies on the small dispersion in Eddington ratio for extreme quasars as well as on the profiles of low- ionization broad emission lines that are consistent with a virial velocity field, and is roughly equivalent to the luminosity estimates based from line width in early and late type galaxies (Tully-Fisher and Faber-Jackson laws). A major issue for the cosmological application of the method is therefore the identification of emission lines whose broadening is predominantly virial over a wide range of redshift and luminosity. We report on developments using the AlIII 1860 intermediate ionization line and the Hydrogen Balmer line H-beta, and on caveats of the method.

*Speaker

Super-Eddington accretion in the nearby Universe

Kristína Kallová*[1] and Claudio Ricci[1,2]

[1]Universidad Diego Portales [Santiago] – Chile
[2]Peking University [Beijing] – China

Abstract

Active Galactic Nuclei (AGN) are among the most powerful sources of radiation in the Universe, emitting across many wavebands of the electromagnetic spectrum. While the inner regions of the accretion disc heat up to temperatures high enough to be bright in optical/UV, X-rays are produced by inverse Compton scattering of the optical/UV photons on the hot and relativistic electrons in the corona, located near the supermassive black hole (SMBH). The properties of the accretion disc, and the interplay between disc and corona are still poorly understood, particularly for the phase in which the SMBH is accreting extremely rapidly. Studies of the spectral energy distribution (SED) of the AGN can help us better understand the accretion process. SEDs can be obtained by the decomposition of the photometric data between the host galaxy and the AGN using GALFIT. In my presentation I will apply this approach to focus on the least-studied phase of SMBH accretion, in which AGN accrete above the Eddington limit. Theoretical models predict that during this stage the disc emissivity changes dramatically, shaping the appearance of the SED. My work uses various disc models to fit the optical-to-X-ray SED of a sample of local super-Eddington AGN, to provide better constraints on the accretion process and disc structure in the most rapid phase of the SMBH growth.

*Speaker

Sub-pc supermassive binary black holes in the active galactic nuclei: Broad line shapes and variability

Luka C. Popovic*[1], Sasa Simic[2], Andjelka Kovacevic[3], and Dragana Ilic*[3]

[1]Astronomical Observatory, Volgina 7, 11150 Belgrade – Serbia
[2]Faculty of science, University of Kragujevac, Radoja Domanovića 12, 34000 Kragujevac – Serbia
[3]Department of Astronomy, University of Belgrade—Faculty of Mathematics, Studentski trg 16, 11000 Belgrade, – Serbia

Abstract

Here we discuss the expected variability in the broad line flux and profiles and in the continuum of Active galactic nuclei (AGNs) due to the presence of sub-pc supermassive binary black holes (sub-pc SBBHs). We modelled the UV and optical AGN spectra using different dynamical parameters of SBBHs and found the expected variability in different spectral ranges in the broad lines and continuum. We demonstrate that the broad line shapes, in combination with the variability, may be very important in the discovery of sub-pc SBBH systems in AGNs.

*Speaker

Spiral Arms in Broad-line Regions of Active Galactic Nuclei

Pu Du*[1]

[1]Institute of High Energy Physics, Chinese Academy of Sciences – China

Abstract

In recent years, increasing evidence has indicated the presence of inhomogeneity and substructures in the broad-line region (BLR) of active galactic nuclei (AGNs). However, there has been a lack of physical models that can describe the substructures within the BLR while incorporating realistic gas dynamics. In this study, we propose a density wave model for the BLR and systematically investigate the observational characteristics of its spiral arm structure, including broad emission line profiles, velocity-resolved time lags/velocity-delay maps in reverberation mapping, and differential phase curves in interferometric observations, some of which are found to be consistent with observations at high fidelity. The proposed model offers an explanation for some long-standing puzzling phenomena. This presentation will report the progress made in this relevant research.

*Speaker

Spectroastrometric Reverberation Mapping of Broad-line Region

Yan-Rong Li*[1] and Jian-Min Wang

[1]Institute of High Energy Physics, Chinese Academy of Sciences – China

Abstract

Reverberations of spectroastrometric signals naturally arise in broad-line regions (BLRs) of active galactic nuclei (AGNs) as a result of the continuum variations that drive responses of the broad emission lines with time delays. Such signals provide a new diagnostic for mapping BLR kinematics and geometry, complementary to the traditional intensity reverberation mapping (RM) technique. We present a generic mathematical formalism for spectroastrometric RM and show that under realistic parameters of a phenomenological BLR model, the spectroastrometric reverberation signals vary on a level of several to tens of microarcseconds, depending on the BLR size, continuum variability, and angular-size distance. We develop a Bayesian framework with a sophisticated Monte Carlo sampling technique to analyze spectroastrometric data and infer the BLR properties, including the central black hole mass and angular-size distance. We demonstrate the potential of spectroastrometric RM in spatially resolving BLR kinematics and geometry through a suite of simulation tests. The application to realistic observation data of 3C 273 obtains tentative, but enlightening results, reinforcing the practical feasibility of conducting spectroastrometric RM experiments on bright AGNs with the operating Very Large Telescope Interferometer as well as possibly with the planned next-generation 30 m class telescopes. We make the code for spectroastrometric reverberation mapping analysis publicly available at https://github.com/LiyrAstroph/BRAINS.

*Speaker

Revealing Low-Luminosity AGN with JWST

Kameron Goold*[1]

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Abstract

The ReveaLLAGN survey investigates seven nearby low-luminosity active galactic nuclei accreting at $< 1\%$ of their Eddington limit. Utilizing JWST NIRSpec and MIRI integral field spectroscopy, we explore targets spanning 4 orders of magnitude in black hole mass and accretion rate. While the vast majority of nearby galaxies host such AGN, their accretion structures and impact on host galaxies remain poorly understood. JWST's powerful resolution and sensitivity allow us to cleanly separate the AGN continuum and emission lines from the surrounding galaxy, providing insight on their accretion structures, including jets and outflows. I will focus on the nuclear emission lines, including the coronal line emission observed in our low-luminosity AGN. In Goold et al. 2023, we showed that Sombrero hosts the lowest luminosity coronal lines ever detected, with broad and blue-shifted lines that suggest the presence of strong outflows. I will expand these results to include the full sample of ReveaLLAGN targets.

*Speaker

Resolving the BLR with VLTI/GRAVITY

Eckhard Sturm*[1], Daryl Joe D. Santos[1], Yixian Cao[1], Ric Davies[1], Lucas Kuhn[2], Dieter Lutz[1], Jinyi Shangguan[1], and Taro Shimizu[1]

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Abstract

With VLTI/GRAVITY and near-infrared interferometry, we can directly spatially resolve the broad-line region (BLR) to probe its structure and kinematics and to derive supermassive black hole (SMBH) masses via dynamical modelling. I will summarize the current status of our Large Programme on AGN with GRAVITY. All of our studied BLRs (7 type 1 AGNs) can be well described by a thick, rotating disk of clouds. For each individual AGN, though, we can trace substructure and non-circular motions (outflows). I will present an updated BLR radius - AGN luminosity (R-L) relation independent of that derived with reverberation mapping (RM) measurements. Our GRAVITY R-L relation implies that at higher luminosities, the BLR size is smaller than that predicted by the standard R-L relation, similar to what studies have shown for highly accreting sources. Model-independent photocentre fitting also revealed spatial offsets between the hot dust continuum and the BLR, likely caused by asymmetric K-band emission of the hot dust. Furthermore, based on our results, we have developed a method to model multiple broad lines of the BLR from a single-epoch spectrum, enabling measurements of some important physical parameters, such as the inclination angle and virial factor of the BLR. I will discuss all these results and will finish with a short outline of the potential of the ongoing instrument upgrades (GRAVITY+).

*Speaker

Resolving supermassive black hole feeding and feedback down to sub-parsec scales

Takuma Izumi*[1], Keiichi Wada[2], Masatoshi Imanishi[1], Kouichiro Nakanishi[1], Kotaro Kohno[3], Yuki Kudoh[2], Taiki Kawamuro[4], Shunsuke Baba[2], Naoki Matsumoto[5], Yutaka Fujita[6], and Konrad R. W. Tristram[7]

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Abstract

Mass accretion is a fundamental process for the growth of supermassive black holes and activating the central engines. However, detailed accretion properties have not been observationally identified particularly at the central ¯10 parsec of active galaxies due to the compactness. Here we report high resolution ALMA observation results toward the active nucleus of the Circinus galaxy (D= 4 Mpc). We observed CO(3-2), HCN(4-3), (CI)(1-0), and submm recombination line H36a, to probe multiphase gas distributions and dynamics. We, for the first time, robustly identified a sub/parsec-scale dense molecular inflow toward the AGN. Only a tiny portion ($<$ 3%) of this inflow is consumed for the actual black hole growth but a bulk portion is blown-out by multiphase outflows. The observed dense gas disk around the AGN is gravitationally unstable and is able to drive accretion down to the central ¯1 parsec. However, the disk seems to be gravitationally stable at the innermost sub-parsec scale. Hence another physical process, or further denser gas disk that is currently missed, will be required for the final sub-parsec scale accretion.

*Speaker

Resolving close binaries of supermassive black holes in the era of optical interferometry

Yu-Yang Songsheng*[1] and Jian-Min Wang

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Abstract

Pairs of supermassive black holes (SMBHs) at different stages are natural results of galaxy mergers in the hierarchical framework of galaxy formation and evolution. However, identifications of close binaries of SMBHs (CB-SMBHs) with sub-parsec separations in observations are still elusive. Recently, unprecedented spatial resolutions achieved by GRAVITY/GRAVITY+ onboard The Very Large Telescope Interferometer through spectroastrometry (SA) provide new opportunities to resolve CB-SMBHs. Differential phase curves of CB-SMBHs with two independent broad-line regions (BLRs) are found to have distinguished characteristic structures from a single BLR {songsheng2019}. Once the CB-SMBH evolves to the stage where BLRs merge to form a circumbinary BLR, it will hopefully be resolved by the pulsar timing array (PTA) in the near future as sources of nano-hertz gravitational waves. In this work, we use a parameterized model for circumbinary BLRs to calculate line profiles and differential phase curves for SA observations. We show that both profiles and phase curves exhibit asymmetries caused by the Doppler boosting effect of accretion disks around individual black holes, depending on the orbital parameters of the binary and geometries of the BLR. We also generate mock SA data using the model and then recover orbital parameters by fitting the mock data. Degeneracies between parameters contribute greatly to uncertainties of parameters but can be eased through joint analysis of multiple-epoch SA observations and reverberation mappings.

*Speaker

Relativistic Jet of TeV-Detected Blazar Mrk 501: Features of Extreme Particle Acceleration Processes

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Abstract

The TeV-detected nearby (z = 0.034) blazar Mrk 501 is prominent by the extreme X-ray and TeV-band variability on diverse timescales ranging from years down to a few minutes. The intense 0.3-10 keV monitoring with X-Ray Telescope onboard Swift revealed a long-term increase in the baseline X-ray level in some epochs, explained by enhanced collimation rate of high-energy plasma through the relativistic jet. In the flaring epochs, X-ray spectra are frequently very hard with the photon indices of 1.4–1.8, the synchrotron SED peak E_p situated beyond 2 keV and sometimes at the energies higher than 10 keV. In turn, this requires extreme electron energy distribution (EED) with the high-energy cut-off extending to Lorentz factors of 10^6. The source frequently showed a transition from logparabolic to hard power-law EED and conversely within 1 ks time intervals, hinting at the presence of turbulence-driven magnetic reconnection in the relativistically magnetized jet area with very small spatial extents of _~10^12 cm. Our analysis revealed the relationship between the synchrotron SED peak height and position, which is expected by transition from the Kraichnan-type into the 'hard-sphere' turbulence; harder-when-brighter spectral evolution, explained by the injection of high-energy electron population with a hard energy distribution and by the dominance of synchrotron cooling of the highest-energy electrons over the IC-cooling; possible presence of hadronic cascades and random fluctuations in the particle acceleration rate; subhour 0.3–10 keV flux variability, explained by the interaction between the relativistic shock front and jet inhomogeneities with strong magnetic fields. Mrk 501 also exhibited the features of first-order Fermi acceleration with very low initial particle energy distribution and/or shock propagation in the magnetized jet area with different confinement efficiency.

*Speaker

Quasar Classification and Diversity in DESI

Allyson Brodzeller*[1] and Kyle Dawson[1]

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Abstract

Quasars are invaluable for studying dark energy and structure growth, as their intrinsically high luminosity facilitates detection at redshifts where galaxy classification with Silicon-based detectors becomes challenging. For example, the spatial clustering of quasars and the Lya-forest observed in their spectra can be used to constrain the growth rate of structure at redshifts in the matter-dominated regime that is intermediate to weak lensing and the cosmic microwave background, directly addressing the "lensing is low" problem. The Dark Energy Spectroscopic Instrument (DESI) will collect approximately 3 million unique quasar spectra for large-scale clustering measurements, increasing the number of spectroscopically confirmed quasars by a factor of 4. The quasar spectral templates used for automated classification must have sufficient flexibility to capture the broad range of emission line profiles, line offsets, and continuum shapes to provide high-accuracy redshifts for precision cosmology measurements. I will present the process of building physically-motivated quasar templates for DESI, the diversity observed in the spectroscopic sample, and the performance in redshift estimation.

*Speaker

Probing the size and kinematics of the quasar broad line region with gravitational microlensing

Damien Hutsemekers*[1], Lorraine Braibant[1], Dominique Sluse[1], and Djordje Savic[1]

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Abstract

Until now, the size and kinematics of the quasar / AGN broad emission line region (BLR) have been mainly investigated using reverberation mapping. Thanks to this technique, the extremely useful BLR radius - AGN luminosity (R-L) relation has been parametrized for several emission lines. Although very successful, reverberation mapping becomes difficult to implement for high redshift high luminosity quasars that require years or decades of monitoring. Gravitational microlensing can provide independent measurements of the BLR size and kinematics since the magnification of a source in the quasar core depends primarily on its size. By comparing good-quality spectra of different images of a lensed quasar, the differential magnification of subregions in the BLR induces line profile distortions that can be used to probe the BLR properties. As this technique only requires good-quality spectra of the different images, it can be particularly useful to explore the BLR in high redshift objects. In order to probe the geometry and kinematics of the BLR, we computed the effect of microlensing on the broad emission line profiles considering representative BLR models and magnification maps specific to each lensed quasar. A Bayesian scheme was developed to identify the best models. We will present the technique and the results obtained so far for five quasars. In all cases, flattened geometries predominate, such as a Keplerian disk or an equatorial wind. The size of the BLR has been estimated and found in good agreement or smaller than the values expected from the reverberation mapping R-L relations.

*Speaker

Probing the Distribution and Properties of Coronal Line Emission with VLT/MUSE: Follow-Up Observations of the CLASS Sample

William Matzko*[1], Shobita Satyapal[1], Emma Schwartzman[1,2], Michael Reefe[3], Nathan Secrest[4], and Remington Sexton[1,4]

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[3]Massachusetts Institute of Technology – United States
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Abstract

Coronal lines (CLs) are elusive forbidden high ionization emission lines that can provide a myriad of insights into galaxies. Their high ionization potential (IP) indicates energetic processes associated with Active Galactic Nuclei (AGN) that generally cannot be replicated by stellar processes. Hence, CLs may be able to reveal AGN missed by common optical and mid-infrared detection methods, and can further trace AGN-driven outflows near their launching point. In this work, we examine a subset of known CL galaxies from the CLASS sample, a robust sample of CL detections in all of the Sloan Digital Sky Survey Data Release 8 (SDSS DR8), that have archival integral field unit (IFU) observations from VLT/MUSE as well as archival radio data from the Very Large Array (VLA). The four galaxies in our sample are local, have a wide span in star formation rate, and exhibit extremely red WISE colors. We analyze the morphology and spatial extent of the CL emission, and compare it with radio and lower IP line emission. We find the CL emission is typically more compact than emission from lower IP lines and concentrated in nuclear regions, but can be off-nuclear and exhibit projected spatial extents between $\sim$ $1 - 7 kpc from the host galaxy's photocenter. The extended CL emission is accompanied by co - spatial radio emission; the surrounding gas is generally consistent with radiative shock models from the MAPPINGS III lib nuclear CL emission. Lastly, nine new CLs are identified in the VLT/MUSE data that were missed in the CLASS sample due t

*Speaker

Probing Long-term Variations of Blazars Using Multi-wavelength Observations

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Abstract

Blazars are a class of active galaxies whose multi-band emission is dominated by non-thermal radiation originating from their relativistic jet pointing towards Earth. They exhibit extreme variations ranging from all the time-scale from minutes to years across the electromagnetic band. Considering the time-scale of the observed flux variation, the variability can be classified as short-term (time-scale of minutes to hours to days to weeks) and long-term variability (variations with months to years time-scale). These variations occur as flares or the quiescent/low-activity states. Studies on long-term variations were limited in the past due to a lack of acquisition of longer good-quality multi-band observations. The origin and cause of short-term variability might not represent the underlying mechanism for observed long-term variations. The cause for such long-term variations could have a more fundamental global origin. Also, the contribution of external photon fields from components outside to the jet, such as accretion disc, broad-line region, dusty torus, etc., could play an important part in observed variability. Therefore, studies related to long-term variability are essential. "Fermi γ-ray space telescope", with its enhanced sensitivity and rapid scanning capability over the earlier γ-ray space telescopes, along with other space and ground-based observatories (Fermi-LAT, Swift, AstroSat, etc.) & associated theoretical modelling, is used to study blazar physics in this work for a list of sources. Some key findings of this work are (a) blazars could remain in a decade-long low γ-ray activity state, (b) there might be an active region in the relativistic jet at _˜1 pc distance from central black hole, from which emission blobs originate and propagate down the jet (c) presence of bents in the jets or deceleration of emitting region down the jet could give rise to long-term variations. The details on results of these four published work will be presented here.

*Speaker

Probing dynamics and thermal properties inside AGN molecular tori with CO rovibrational absorption lines

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Abstract

Exploring dynamics and thermal properties is a key to understanding Active galactic nucleus (AGN) torus. Torus is considered a geometrically thick structure around a supermassive black hole, and it is physically challenging for the torus to maintain its thickness. A hydrodynamic simulation (Wada et al. 2016) suggests that a part of gas falling into the black hole is blown away by the radiation from the accretion disk at the center of the AGN, and hence, the gas circulation around the AGN dynamically forms a torus. However, AGN tori are typically too small (the size _˜ 10 pc) to spatially resolve the gas motion inside the torus with existing telescopes. Thus, it is still unknown whether the circulation really works inside Tori. Therefore, it is essential to investigate the clues of gas motion by spectroscopy.

In this study, we investigate whether the gas motion inside tori can be studied through the spectroscopy of CO rovibrational absorption lines (λ_˜4.7 um, v=0-1, ΔJ=$\pm$1) by performing dust and non-LTE line radiative transfer based on the hydrodynamic simulation. First, we find that most dust emission at λ_˜4.7 um is derived from the inner a-few-pc regions of the torus, and hence, CO absorption lines are observed against the dust emission. At an inclination angle of 77 ◦, the observed absorption lines contain multiple velocity components, which capture the gas circulation around the AGN, such as gas inflowing toward the black hole and outflow gas ejected by the radiation of the accretion disk. Furthermore, the level populations at lower-J of those components are collisionally determined, and the excitation temperatures indicate their high kinetic temperature (T> 100 K). Therefore, these results suggest that observations of CO rovibrational absorption lines can provide us with the dynamics and thermal properties of the gas in AGN tori.

*Speaker

Polychromatic modelling the central parsecs of NGC1068

James Leftley*[1]

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Abstract

GRAVITY and MATISSE have produced a wealth of observations of NGC1068 which allowed for single-waveband image reconstructions to be produced from 2-12 microns. From these images, morphological information was inferred from the brightness distributions and, by aligning the images, temperature profiles were extracted to produce information about the dust composition. However, it is difficult to infer the true multi-wavelength geometry from the individual band images because the absolute position of each image is unknown and therefore the image alignment (and resulting SEDs) are based on assumptions. Indeed, there have been multiple published interpretations of the central morphology. In this talk, I will present our attempt to simultaneously model the observations of NGC1068 provided GRAVITY and MATISSE over the entire wavelength range. We use a polychromatic model with a geometry based on the disk+wind interpretation of the unified model of AGN to test if this morphology can simultaneously explain every band. Furthermore, our images in each wavelength are not independent so a model based alignment between images can be made from which temperature distributions and dust composition can be inferred.

*Speaker

Polarized view of gamma-ray emitting narrow-line Seyfert 1 galaxies: The case of 1H0323+342

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Abstract

The gamma-ray emitting narrow-line Seyfert 1 galaxies are unique objects that launch powerful jets. However, due to the projection effect, the black hole masses estimated by total flux spectra have high uncertainty. Polarized spectra provide a unique view of the central engine through scattered light. We performed spectro-polarimetric observations of 1H0323+342, one of the closest jetted NLSy1, using SPOL/MMT. The source shows a low degree of polarisation of the line profile with a value of 0.12%, and the polarisation angle obtained is 175.27 deg. We performed a detailed spectroscopic analysis, investigating the spectral lines' line widths, shifts, and profiles. The polarized spectrum is found to have a similar width as the flux spectra for the H$\alpha$$emissionline.Weusedtherelationbetweenvelocitiesandpolarizationanglesacrossthe

*Speaker

Origin of the Changing-state AGNs

Keiichi Wada*[1]

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Abstract

The changing-look AGNs are one of the fundamental phenomena to understand the origin of BLRs. However, it is still unclear what causes the time variability in spectra from X-ray to UV/optical. AGNs are variable over a broad time scale, but here we focus on the variability in Balmer lines, typically one year to tens of years. We investigated the spectral properties of ionized gas exposed to radiation from an active galactic nucleus (AGN) with a 10ˆ7 Msun supermassive black hole. Employing two-dimensional radiation-hydrodynamical simulations, we focus on the gas within the dust-sublimation radius, followed by post-process pseudo-three-dimensional calculations utilizing the spectral synthesis code CLOUDY. Our simulations successfully reproduce broad (_˜ several 1000 km/s) emission lines, such as Halpha and Hbeta, but their profiles are time-dependent. Over _˜30 years, the Balmer lines change their strength and width. We found that these variabilities originate in the dynamical change of the rotating disk with strong radiation-driven outflows in r _˜ 10ˆ-3 pc.

*Speaker

Optical Variability of FSRQs in the Tomo-e Gozen Northern Sky Transient Survey

Tianfang Zhang*[1], Mamoru Doi[1], Mitsuru Kokubo[2], Shigeyuki Sako[1], Tominaga Nozomu[2], Tanaka Masaomi[3], Ohsawa Ryou[2], and Yasushi Fukazawa[4]

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[3]Tohoku University [Sendai] – Japan
[4]Hiroshima University – Japan

Abstract

We studied the optical variability of 83 flat-spectrum radio quasars (FSRQs) listed in the 4FGL catalog. The data was collected from the Tomo-e Gozen Northern Sky Transient Survey, with each FSRQ having an average of _˜50 epochs. We excluded FSRQs where host galaxy influence could lead to underestimated optical variability based on their average optical luminosity. FSRQs with γ-ray photon indices () greater than 2.6 displayed very low optical variability, showing a distinct standard deviation distribution compared to other FSRQs (KS test P value = 5E-6). These FSRQs tended to be situated in regions of low γ-ray luminosity during each cosmic epoch. Furthermore, FSRQs with over 2.6 exhibited significantly lower structure function amplitude than those with below 2.6 with a variability timescale of more than 10 days, possibly indicating the variability timescale of the accretion disk. Thus, we deduce that the optical component of FSRQs with over 2.6 is likely dominated by the accretion disk. On the other hand, FSRQs with below 2.6 exhibited high optical variability and a short variability timescale (less than one day), indicating that they are more influenced by the jet compared to FSRQs with over 2.6.

*Speaker

Optical Exploration of AGN Geometry: A Unified Approach of Reverberation and (Spectro)Polarimetry

Eugene Malygin*[1], Elena Shablovinskaya[1,2], Roman Uklein[1], and Luka Č. Popović[3,4]

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[4]University of Belgrade-Faculty of Mathematics – Serbia

Abstract

Due to the spatial unresolvability of AGN, the distribution and geometry of matter in the central parsec - from fully ionized plasma to cold dust - is the subject of discussion and detailed study. The most common method for estimating the size of structures, reverberation mapping, makes it possible, in combination with polarimetric observations, to measure a wide range of physical parameters of the SMBH and its surrounding matter. We present the results of observations of several type 1 AGNs using a variety of observational methods, from photometric reverberation to spectropolarimetry. Comparison of independent approaches to estimating SMBH masses by photometric reverberation mapping and broad line spectropolarimetry allows us to estimate the inclination angle of the nucleus, and the polarimetric reverberation mapping method developed by us indicates the position of the equatorial scattering region, which differs from the predicted dust sublimation radius.

*Speaker

Nuclei of the Milky Way morphological twins (MWMT) of the DIVING 3D survey

Patricia Da Silva*[1], Françoise Combes[1], Roberto Menezes[2], and Beatriz Barbuy[3]

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[2]Instituto Mauá de Tecnologia – Brazil
[3]Instituto de Astronomia, Geofísica e Ciências Atmosféricas [São Paulo] – Brazil

Abstract

How the nuclei of galaxies that are similar to ours look like? Does the Milky Way nucleus, that has an inactive supermassive black hole, follow the trend of its twins? I will present the sample nuclei of galaxies that have the same morphological type as the Milky Way (SABbc and SBbc). This sample is from the Deep IFS View of Nuclei of Galaxies (DIVING 3D) survey, which has the goal of observing nuclei of galaxies of the southern hemisphere with the B band magnitude less than 12 and galactic latitude greater than 15 degrees. The survey comprises 170 galaxies, resulting optical data cubes with high spatial resolution. The sample of the MWMT comprises 15 galaxies, whose distances varies from 26.4 Mpc to 8.5 Mpc. In this project we study the emission of the nuclear region, the gas kinematics, the stellar kinematics and stellar archaeology. We also complement the study with other data in order to draw general scenarios of the phenomena we observe, as much as possible. I will present the main results and the future plans of this project, which comprise the quantification of possible AGN fueling, using images on the red band and ALMA data.

*Speaker

NEW AGN TORUS MODEL INCLUDING THE ROLE OF GRAIN SIZE

Omiara Gonzalez-Martin*[1]

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Abstract

Spectral fits to the infrared spectra from the nuclear regions of AGN can place constraints on the dust properties and distributions by comparison with models. However, none of the currently available models fully describe the current observations of AGNs available today. Among the aspects least explored, we focus on the role of dust grain size. We recently offer the community a new SED library which is based on the two-phase torus model developed before, with a parameter space optimization and including the maximum grain size as a model parameter in the range Psize= 0.01-10.0um. We also fit this new and several existing libraries to a sample of 68 AGNs with Spitzer/IRS spectra. We find that our model can adequately reproduce up to _˜85-90% of the spectra. The dust grain size parameter significantly improves the final fit in up to 90% of them and _˜1/3 of our sample requires dust grains as large as Psize_˜10um, suggesting dust grain growth at the proximity of the AGN. Nonetheless, we also remark that the disk+wind or the clumpy torus models are still required to reproduce the spectra of a non-negligible fraction of objects, suggesting the need for several dust geometries to explain the AGN infrared continuum.

*Speaker

Multi-wavelength band fitting from GRAVITY and MATISSE data of the active galactic nucleus in NGC1068

Niklas Moszczynski*[1], Yann Clenet[1], Romain Petrov[2], James Leftley[2], and Pierre Vermot[1]

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[2]Université Côte d'Azur – Observatoire de la Cote d'Azur – France

Abstract

The Unification Scheme for Active Galactic Nuclei (AGN) was introduced by Miller & Antonucci (1985) to explain the various types of AGNs, which postulates that the observation of the types depend on the inclination angle of the observer. AGN of type 1 are seen face on, allowing to directly observe the super massive black hole (smbh) and the accretion disk, while AGN of type 2 are seen edge-on obscuring the center of the AGN by dust in the equatorial plane. Image reconstruction techniques and RT simulations based on ground based interferometric IR data of nearby AGNs suggest an extension, where IR polar emission has been detected, and proposed as dusty wind extending at scales much larger than the dust in the equatorial plane (Hönig et al. 2012, 2013; Tristram et al. 2014; López-Gonzaga et al. 2016; Asmus et al. 2016, Leftley et al. 2018). **NGC1068** is a nearby AGN and has sparked big interest due to its entangled structure of its dusty medium, while being relatively easily spatially resolved from ground based interferometric IR observations in several wavebands. Analysis of the AGN in the K-band (GRAVITY collab. 2020), has suggested the existence of a **hot ring** along with a warm foreground, which challenges the Unification model for AGN. Analysis of the same target by MATISSE in the L, M and N band, points towards the **confirmation of the Unification model** for AGN including a polar emission (Gamez Rosas et al. 2022). Analyzed independently, these results seem to point to opposite interpretations, which furthermore has given NGC1068 support to carry out a multi-wavelength fit of both the GRAVITY and MATISSE data. I will primarily carry out 3D modelling with the **RT tool SKIRT** (Camps and Baes 2020, ascl:1109.003), aiming to **disentangle** the appearing contradiction.

*Speaker

Modelling stochastic accretion onto the AGN torus with radiation hydrodynamics

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Abstract

Hydrodynamical simulations incorporating the effects of radiative processes have become a useful tool for studying the AGN torus region, enabling detailed predictions of its structure and kinematics to be made. Existing modelling typically involves initialising the simulation with a pre-existing gas disk in Keplerian rotation, and following the subsequent evolution of the disk in response to the AGN radiation field.

I will present results from new simulations, which seek to address this limitation by modelling the ongoing "stochastic" accretion of material into the torus, in the form of discrete gas clouds of mass 10^4-10^5 Msun. These simulations feature a large dynamic range, allowing features on scales of 1-100pc to be resolved over several Myr of simulated time. Through control of the accretion rate and assumed AGN luminosity, they allow the state of the system to be investigated in both quiescent and active phases.

They reveal that the destruction of individual clouds gives rise to a complex, multi-layered outflow structure at small scales, and that while a disk structure does form, it is periodically disrupted by infalling material. Furthermore, the disk exhibits sub-Keplerian rotation, with significant support from radiation pressure.

Meanwhile, at greater distance from the central source the outflows are found to reorganise into the familiar biconical form. However, this large-scale structure retains an imprint of the accretion process, in the form of an up to 25-degree offset between the outflow axis and the assumed accretion disk axis (with respect to which the anistropic AGN radiation field is specified).

Finally, I will show that the effect of the accretion process is also clearly visible in the torus region's emission, where rapidly-changing obscuration due to the accreting clouds results in strong "flickering" in infrared- and submillimetre-line emission (see attachment), despite the assumed AGN luminosity remaining constant.

*Speaker

miniJPAS: 2d Star Formation Properties of X-ray AGN Host Galaxies

Nischal Acharya*[1]

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Abstract

Active Galactic Nuclei (AGN) are known to play a crucial role in shaping the properties of their host galaxies. In this study, we investigate the impact of AGN on both global and central star formation rate (SFR) in the host galaxies. Our sample comprises 32 X-ray AGN located in the EGS field, observed with XMM and Chandra instruments. We use a control sample of 107 normal galaxies to establish a comparison. First, we evaluate the global properties of the AGN and normal galaxy samples using spectra constructed with 56 narrow-band and 4 broad-band filters from the miniJPAS survey. We fit the SEDs to obtain their physical properties. Our results reveal no significant difference in the global star-forming properties between the AGN and normal galaxy samples.

Next, we employ the miniJPAS survey as a low-resolution IFU, to dissect the AGN and normal galaxies radially along their position angle into several bins. We extract spectra from each radial bin and fit SEDs to obtain detailed SF properties within each bin. Our analysis reveals compelling evidence of suppression of the SFR in the central regions of AGN host galaxies, contrasting with the absence of such suppression in normal galaxies. These findings suggest that the presence of AGN may directly impact the central regions of galaxies, leading to significant modulation of star formation activity.
Despite the absence of discernible differences on a global scale, we observe clear indications of quenched SFR in the center of AGN hosts. These findings shed light on the intricate interplay between AGN activity and the evolution of their host galaxies, highlighting the need for further investigations to unravel the underlying mechanisms responsible for these quenched star-forming properties in the center of X-ray AGN host galaxies.

*Speaker

Measuring the size of CIV broad line region of the quadruply lensed system Q2237+0305. Microlensing time series

Savić ore*[1], Damien Hutsemekers[1], and Dominique Sluse[1]

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Abstract

Current and future generations of wide-field surveys are expected to identify thousands of bright and robustly modellable lensed quasars. For each successful detection of a caustic crossing event, an immediate ground-based spectroscopy follow up may play a key role in understanding the evolution of quasars at high cosmological redshifts.
Microlensing methods up to date have demonstrated the potential of measuring the effective size of the quasar central engine for a few dozens of systems. Recently, Braibant et al. (2017) have proposed a method to constrain the BLR (broad line region) structure based on the study of the microlensing induced line deformation through four measurable indices/features: μcont the magnification of the continuum underlining the emission line; μBLR the total magnification of the broad emission line; WCI and RBI indices sensitive to wings/core and red/blue line profile distortions. Hutsemékers et al. (2019) have developed a probabilistic/bayesian framework enabling to constrain the geometry, inclination and effective size of the BLR by comparing the observed indices similar to ones derived from simulated microlensed line profiles.

Here, we extend this approach by comparing the indices time series with the simulated ones. We use 35 epochs of archival near-infrared spectrophotometric data of Q2237+0305 obtained with ESO/VLT between 2004 and 2007. We measure the indices time series for CIV line and a continuum emission at 1450 Å.

We find that the most likely geometry for this system is Keplerian disk. Effective CIV emitting BLR size and the SMBH mass we inferred are in good agreement with the previous measurements (Hutsemékers & Sluse 2021). Future prospects will include the application of the same method to other broad emission lines observed for quadruply lensed systems such as SDSS J1004+4112, RX J1131-1231, HE0435-1223 and others.

*Speaker

Mapping the Gas Kinematics Around Luminous Quasars with SDSS-V BHM-RM

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Abstract

Reverberation mapping (RM) has been successful in measuring the masses of quasars under the assumption that the gas in the broad-line region (BLR) is moving in orbits dominated by gravity. The multi-object SDSS-RM campaign expanded this effort to the first set of luminous and high-redshift quasars, and revealed cracks in the foundation of black hole masses by showing that many luminous quasars have more complicated BLR structures than simple photoionization-bounded gas. Within the last two decades, velocity-resolved RM has unveiled a diversity of non-virial kinematics in the BLR of AGN, putting additional pressure on the enterprise of black hole mass estimation. This is especially apparent in the case of the hyper-variable quasar RM160, where the dramatic radial-velocity shifts have been interpreted as inflow onto the BLR. I will show velocity-resolved RM of RM160 confirming the presence of inflow onto the BLR. This analysis represents the first of its kind for the SDSS-RM/BHM-RM dataset. Previous work has been limited to a set of nearby, low-luminosity AGN, while BHM-RM allows to expand to a broader sample of luminous quasars across cosmic time for which this analysis is possible. These results demonstrate how the high-cadence, long-duration, and multi-epoch time domain spectroscopy of SDSS-RM/BHM-RM is shedding new light on the detailed physics of the gas near luminous quasars.

*Speaker

Long Timescale Reverberations in the Tidal Disruption Event AT2019qiz and in the AGN MRK110

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Abstract

While there have been multiple reverberation mapping studies measuring the size of the Broad Line region, to date this has not been done with Coronal Lines. These lines originate from an Intermediate Line Region between the Broad and Narrow Line Regions, with expected delays on the order of years. In this talk, I will present two sets of results. The first is three years of spectra from the Tidal Disruption Event AT2019qiz. These show coronal lines appearing 4-500 days after the observed outburst. The (Fe VII)6087 line has peaked, while the (Fe X)6375 line, the (Fe XI)7892 line and the (Fe XIV)5304 line generally continue to rise. The second is the evolution of the (Fe VII)6087 line in MRK110 using archive data from between 1984 and 2019. MRK110 underwent a dimming between 2001 and 2003, and this is reflected in the evolution of the (Fe VII)6087 line with a lag of approximately 1500 days. I will also present discuss an absorption feature found in MRK110 blueward of the (Fe VII)6087 line. These results can help inform modeling of parsec-scale structures, constraining the size, density, and kinematics of the coronal line region, as well as the SED of AGNs in the EUV.

*Speaker

Intranight optical variability of low-mass active galactic nuclei: a pointer to blazar-like activity

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Abstract

This study aims to characterize, for the first time, intranight optical variability (INOV) of low-mass active galactic nuclei
(LMAGNs) which host a black hole (BH) of mass MBH $\sim$ 10ˆ6 M, i.e. even less massive than the Galactic centre BH Sgr A$\star$
and 2–3 orders of magnitude below the supermassive black holes (SMBHs, MBH $\sim$ 10ˆ8 –10ˆ9 M), which are believed to power
quasars. Thus, LMAGNs are a crucial subclass of AGNs filling the wide gap between SMBH and stellar-mass BHs of Galactic
X-ray binaries. We have carried out a 36-session campaign of intranight optical monitoring of a well-defined, representative
sample of 12 LMAGNs already detected in X-ray and radio bands. This set of LMAGNs is found to exhibit INOV at a level
statistically comparable to that observed for blazars (MBH $>\sim$ 10ˆ(8–9) M) and for the γ -ray-detected Narrow-line Seyfert1 galaxies (MBH $\sim$ 10ˆ7 M) which, too, are believed to have relativistic jets. This indicates that the blazar-level activity can even be
sustained by central engines with BHs near the upper limit for intermediate-mass BHs (MBH $\sim$ 10ˆ3 –10ˆ6 M).

*Speaker

Intra-night monitoring of the blazar OT 355

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Abstract

The high-redshift blazar (z=0.975) OT 355 (3FGL J1734.3+3858) was observed in four colors (BVRI) on more than 35 nights between years 2017 and 2023 with the telescopes of Belogradchik AO and Rozhen NAO, Bulgaria. The object was monitored on intra-night time scales for about 100 hours in total. Significant intra-night and night-to-night variations of up to 0.5 mag were detected. Variability characteristics, color changes and a possible "rms-flux" relation were studied and discussed. Studying blazar variability on the shortest possible time-scales is of huge importance for setting constraints on the physical processes in the relativistic jets and the linear sizes of the emitting regions, and thus – to better understand jets' nature.

*Speaker

I Zw 1 and H0557-385: The Dusty Tori of Two High Eddington AGNs Imaged in the MATISSE LM-Bands

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Abstract

Over the past decade, mid-infrared interferometry has given us insight into the structure of the dusty 'torus' within the central ten parsecs in AGNs. Particularly, it has shown that an equatorial dust disc and a hollow outflow cone explain the observations very well. The cone is orientated along the AGN system axis and launched with infrared radiation pressure near the sublimation region. However, studies so far mainly focused on Seyfert nuclei accreting around $L/LEdd$ ˜ 0.05. Here, we investigate how this dust structure is impacted by high Eddington accretion, particularly the wind launching region. We studied two Type 1s, I Zw 1 ($L/LEdd$ ˜ 2.14 – 2.5) and H0557-385 ($L/LEdd$ ˜ 0.5), using the MATISSE interferometer in the LM-bands (3.4 and 4.6 um). Using a novel data reduction technique to accurately characterise faint interferometric data, we obtained Gaussian HWHM sizes in the L and M band respectively of 1.09 mas and $<$ 0.51 mas (H0557-385) and 0.65 mas and 0.94 mas (I Zw 1). We also obtained GRAVITY K-band (2.2 um) data for I Zw 1, where we obtain a Gaussian HWHM of 0.41 mas. Looking at the relative size as a function of wavelength, we see that both objects follow the dependency for a homogenous disc in the KLM-bands but then remain more compact at longer wavelengths. This implies that the inner disc is inflated – 'puffed up' – due to the AGN and IR radiation pressure, throwing a shadow over the disc. In addition, previously published MIDI N-band data suggests the launching of a wind in H0557-385. Hence, the accretion rate is an important factor in how much the inner disc is puffed up, compared to other AGNs, and the structure of the mid-infrared disc.

*Speaker

How do outflows from the AGN affect the star formation activity inside the host galaxy?

Ankush Mandal*[1]

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Abstract

Outflows from AGN are believed to have a profound effect on the evolution of the host galaxy. The local input of the energy by the outflow into the ISM of the host galaxy can alter the physical state of the gas and regulate the star formation activity. We apply a turbulence-regulated model of star formation (published in Mandal et al. 2021) to explore how different processes, such as turbulence, gravity, and cooling affect the evolution of the dense star-forming gas being impacted by AGN-driven outflows. We apply this model to both galactic scale simulations of AGN jet-disk interaction as well as resolved simulations of collision between the outflows and individual star-forming clouds. The latter studies employ a newly developed Poisson solver in the PLUTO code to probe the impact of the self-gravity of dense clouds. We find that the shock from the outflow can induce turbulence inside the gas leading to reduced star formation. Also, the radiative shocks can compress the gas to a very high density making the cloud more prone to become gravitationally unstable to form stars. We also find that such systems can go through different evolutionary phases depending on the degree and strength of the interaction.

*Speaker

High-z Observations of Quasars with GRAVITY+

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Abstract

Near infrared interferometric observations of AGN can spatially resolve the BLR and provide important constraints on the size, geometry, and kinematics of the BLR as well as dynamically measuring the supermassive black hole mass. Before GRAVITY+, this was limited to AGN in the local universe due to technical constraints. In this talk, I will present the first high-redshift observations of quasars with GRAVITY+ and highlight the first BLR detection and SMBH measurement. At z=2.33, we measure a BLR size of 0.31 pc which is a factor of 2 smaller than expected based on the radius-luminosity (R-L) relation. Through dynamical modeling, we measure a black hole mass of 3x10ˆ8 Msun which combined with the bolometric luminosity indicates a highly super-Eddington accreting quasar (L/L_Edd = 7-20) and increases evidence that Eddington ratio plays a role in driving deviations from the R-L relation. We further place this quasar within the context of galaxy evolution by measuring the host galaxy mass which shows the SMBH is significantly undermassive when compared to similar luminosity high-z quasars as well as the local M_BH - M_stellar relation for early type galaxies. This suggests the host galaxy built up before the SMBH but the SMBH is currently going through a rapid growth phase. I will end my talk with an outlook towards a GRAVITY+ high-z programme aimed at probing galaxy-SMBH coevolution with the highest precision.

*Speaker

Feeding and Feedback in Nuclei of Galaxies (NUGA)

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Abstract

Our primary objective is to investigate the close environment of AGN and its connection to the host galaxy through the morphology and dynamics of the gas inside the central kpc in nearby AGN. Probing the dynamical structures leading to the fuel of the supermassive black hole from hundreds to parsec scales, the duty cycle of gas and the impact of molecular outflows on the star formation are crucial to understand how AGN are fueled, and how the energy generated by the active nucleus can in turn regulate its gas accretion. We present ALMA observations of the molecular gas tracers of 7 Seyfert/LINER galaxies part of the NUGA (NUclei of GAlaxies) survey, conducted at an unprecedented spatial resolution of 0.06-0.09" (equivalent to 3-10 pc). Our project unveils the existence of molecular tori in approximately all sample, characterized by diverse orientations relative to the line of sight, often misaligned with the host galaxy's orientation. Furthermore, our findings shed light on the interplay between AGN fueling and feedback cycles, manifested as trailing spirals detected within 100 pc scales and molecular outflows.

*Speaker

Fantastic FANTASY fits of AGN spectra in the era of large spectroscopic surveys

Dragana Ilic*[1,2], Andjelka Kovacevic[1], Nemanja Rakic[3], and Luka Popovic[1,4]

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[2]Hamburger Sternwarte/Hamburg Observatory – Germany
[3]Physics Department, Faculty of Natural Sciences and Mathematics, University of Banjaluka – Bosnia and Herzegovina
[4]Astronomical Observatory Belgrade – Serbia

Abstract

We have developed a tool for multicomponent fitting of active galactic nuclei (AGN) spectra in the optical and near infrared wavelength band named FANTASY (Fully Automated pythoN Tool for Agn Spectral analYsis). Spectra are modelled by simultaneously fitting the wide range of wavelength (from 3700 to 11000A) with the underlying broken power-law continuum, predefined emission line (narrow, broad, coronal, etc.) lists, and an extensive Fe II model. The FANTASY code has been tested on a sample of type 1 AGN spectra from the SDSS database with S/N> 20 covering the range from H$\gamma$$to$H$\alpha$$line, andhasproventoworkinan$automated$way.Oneinteresting$finding$oftheFANTASY$modelling$ofAGNt

$FANTASY$currently$treats$the$uncertainties$inthespectra, and$consequently$in$measured$spectral$quantities, using$a$Mont

Weshow$that$the$FANTASY$codeiswell$optimised$for$bulk$fittingofAGN$type$1$spectra$from$SDSS, as$itisflexibleandeasy$t

*Speaker

Exploring the circumnuclear material of SMBH using realistic X-ray spectral models

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[1]Universidad Diego Portales [Santiago] – Chile
[2]Université de Genève = University of Geneva – Switzerland

Abstract

It is well established that the supermassive black holes (SMBH) in the very center of active galactic nuclei are surrounded by a mixture of gas and dust, which reprocesses the radiation that originates in the center of it. High energy radiation in the X-ray band can be a good probe of the properties of the circumnuclear material, since its interaction with the nuclear gas can generate spectral features that are strongly dependent on the geometry and physical state of the medium. Many X-ray spectral models perform well in fitting data from the currently available observatories. However, they lack flexibility either in the physical processes implemented or in the geometrical configuration.
Using RefleX, a ray-tracing platform for generating X-ray spectra and images (Paltani & Ricci, 2017) we have developed the most-realistic X-ray models currently available. These new models consider much more complex geometries compared to those currently available, while implementing all the most important physical interactions. The first model, RXToPo, considers a toroidal dusty component and a polar medium oriented perpendicular to the rotational plane of the SMBH. The second model, RXagn1, includes, besides the torus and polar medium, also the accretion disk and the broad-line region. During my presentation, I will introduce these newly developed models, provide a comprehensive explanation of their configuration and present examples of their use on real and simulated spectra. The utilization of advanced, complex models will be crucial with the advent of new high-resolution facilities such as XRISM.

*Speaker

Exploring the central 100 parsecs of NGC 1068 with Near-Infrared spectroscopy and Machine-Learning deconvolution

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Abstract

I will present an in-depth investigation into the central 100 parsecs of the nearby active galaxy NGC 1068, with a specific focus on Near-Infrared (NIR) observations. My conclusions are based on a combined analysis of adaptive optics (AO) assisted spectroscopic data from Y to K, extracted from SPHERE/LSS and SINFONI observations, and AO-assisted deconvolved images from the H to M, obtained with NaCo and SPHERE.
One interesting aspect of this work is the utilization of a newly developped machine-learning based deconvolution algorithm. This state-of-the-art technique provides enhanced clarity and resolution, enabling to detect and analyze various structures within the central region of NGC 1068.

On top of the bright central source, this investigation has revealed numerous structures within the heart of this galaxy. These include a cuspy star forming Nuclear Star Cluster, and giant clouds whose ionization appears to be the result of shock-induced processes. Interstingly, a number of these structures show signs of streaming toward the nucleus.
This in-depth investigation gives us a better understanding of the core of NGC 1068. It reveals new structures and shows how machine-learning can improve deconvolution in the field of astronomy.

*Speaker

Evidence of Jet induced ionized outflow at pc scale using multiwavelength studies

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[2]Indian Institute of Astrophysics – India

Abstract

AGN can have an impact on their host galaxy via radiation, outflows and relativistic jets from them by their capability to heat, compress and/or remove gas, at different scales. On an observational perspective, the impact of AGN on their host galaxies is a matter of debate. To understand the complex connection between AGN and the ISM of their hosts at smaller scales (of the order of parsecs), we present the multiwavelength study of one nearby AGN host galaxy, NGC4395. NGC4395 hosts a intermediate mass black hole, having mass of around 10ˆ4 - 10ˆ5 M_sun and situated at a distance of _˜4.5 Mpc. Using optical integral field unit (IFU) data from GMOS mounted on the 8m Gemini-North telescope, we found the presence of ionized outflowing gas, co-spatial with resolved radio jet-like structure at 15 GHz at 10 pc scale. The asymmetry in the ionized (OIII) line and the high velocity dispersion indicates that the medium is kinematically disturbed. Using CLOUDY and MAPPING III model, we found the ionization is to be due to shocks. The power of the jet is _˜10ˆ39 erg/s which is higher than the power of the ionized outflowing gas (_˜4 x 1036 erg/s). From Gemini-NIFS and ALMA data, we found a spatial offset of the cold molecular gas (CO 2-1) relative to the nuclear hot outflwing molecular gas (H2 2.408 um), favouring a scenario of the AGN inhibiting star formation on a 10 pc scale.

*Speaker

Effect of Energetic Outflows of Quasars in the Galaxy

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Abstract

Since the last few decades, it has been established that supermassive black holes (SMBH) residing at the centers of galaxies play a significant role in cosmic evolution of structures in the Universe. Effects of SMBH feedback or AGN feedback have been directly observed in galaxies and clusters using multi-wavelength datasets. To probe the energetic outflows from quasars that are responsible for heating the intergalactic medium we model the thermal Sunyaev-Zeldovich (SZ) effect from quasar outflows. We use the GIZMO meshless finite mass hydrodynamic cosmological simulation SIMBA (Dave et al. 2019), which includes different prescriptions for quasar feedback. From these theoretical simulations, we perform mock observations of the Atacama Large Millimeter Array (ALMA). In this presentation, I will show for all the systems we get an enhancement of the SZ signal, when there is radiative feedback, while the signal gets suppressed when the jet mode of feedback is introduced in the simulations. Our mock ALMA maps reveal that, with the current prescription of jet feedback, the signal goes below the detection threshold of ALMA. We also find that the signal is higher for high redshift systems, making it possible for ALMA and cross SZ-X-ray studies to disentangle the varying modes of quasar feedback and their relative importance in the cosmological context. We further investigate the host galaxy properties of radio loud and radio quiet quasars by modeling their spectral energy distribution using multi-wavelenghth data sets with the updated version of X-CIGALE code. Our preliminary studies show that there is not much significant difference in the host galaxy properties between radio loud and radio quiet quasars.

*Speaker

Dissecting the obscuration and outflow of AGN in Circinus galaxy from optical to infrared

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Abstract

Circinus galaxy harbors an archetypal obscured active galactic nucleus (AGN). At a distance of _˜4 Mpc, it is one of the closest Seyfert 2 galaxies, allowing high angular resolution studies across a range of wavelengths. Recent MIR interferometry and single dish imaging have cast this galaxy in a major role as a prototype of the newly recognized population of 'polar dust AGN'. In this picture, a major fraction of the MIR emission is associated with dusty winds blown away from the sublimation zone by radiation pressure. I will present our efforts to understand the obscuring and outflowing structures in Circinus using MIR imaging, optical polarimetry and IFS data, tied together by state-of-the-art radiative transfer simulations. All the evidence paints a consistent picture of a compact dusty disk responsible for the obscuration and feeding of the black hole, and a dusty outflow in the polar direction, which extends into the ionization cone and produces some peculiar features in interaction with the immediate surroundings in the host galaxy.

*Speaker

Dissecting the circumnuclear medium of Circinus AGN in X-rays

Bert Vander Meulen*[1], Marko Stalevski[1], and Maarten Baes[1]

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Abstract

The full-3D radiative transfer code SKIRT has recently been extended into the X-ray range, to study the circumnuclear gas and dust of AGN based on their reprocessed X-ray emission (Vander Meulen et al. 2023). The simulation domain of SKIRT now covers the X-ray to mm wavelength range self-consistently, with all features of the established SKIRT framework available.

We used the SKIRT code to model the parsec-scale medium of Circinus AGN in X-rays, adopting a distribution of gas and dust consistent with previous VLT and VLTI observations. This X-ray model incorporates the clumpy structure of the polar wind component, X-ray interactions with dust grains, and self-consistent kinematics, improving upon previous X-ray modelling efforts. We compare our model spectra to observational Chandra and NuSTAR data, and discuss the best-fit model parameters. In addition, we demonstrate how SKIRT simulations can be used to constrain the kinematic structure of the circumnuclear medium with upcoming XRISM observations. Circinus AGN forms a prototype for the AGN population with polar extended gas and dust, whose structure can be studied in larger samples using our new SKIRT spectral models.

*Speaker

Did BIack hole-jets rapidly enhance star and galaxy formation in the very early Universe?

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[2]Instituto de Astronomia y Fisica del Espacio (IAFE) – Ciudad Universitaria. Buenos Aires, Argentina

Abstract

In the local and distant universe are observed relativistic jets from black holes (BHs) enhancing star formation. This BH-jet "positive feedback" takes place by the impact of BH-jets and associated massive outflows on high-density cold molecular clouds, which lead to rapid compression of the gas and subsequent enhancement of star formation. Since the global gas density in the universe evolves with redshift z as (1+z)ˆ3, this BH-jet triggering mechanism of star formation must be very important in the Epoch of Reionization (EoR) and cosmic dawn. In this context, I will propose that several of the surprising JWST observations, such as the unexpected large numbers of compact, extremely bright and massive starburst galaxies at very high redshifts, as well as the very massive galaxies with very early quenched star formation, can be explained by AGN-jet positive and negative feedback. Furthermore, I would like to discuss whether the rapidly growing BH seeds of the supermassive BHs (SMBHs) of _˜10ˆ9 solar masses in quasars up to z = 7 may have triggered the formation of the first massive stars and galaxies of Pop III.

*Speaker

Deciphering the Mass Measurement Odyssey of Intermediate mass black hole NGC 4395 : The Enigma Unveiled?

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[2]Center for Theoretical Physics of the Polish Academy of Sciences, Warsaw – Poland

Abstract

Studying Intermediate mass black holes (IMBHs) and estimating the black hole mass could unravel the quest for the origin of Supermassive black hole (SMBH) seeds present at high redshift and how they co-evolve with their host galaxy. The difficulty in detecting these IMBHs and the requirement of high spatial resolution to measure BHs mass makes this task very challenging. We performed a spectroscopic reverberation study of an extremely low luminous Seyfert 1 galaxy NGC 4395 to study its central engine. High-cadence photometric and spectroscopic data were collected over consecutive days in March 2022 using the 1.04-m Sampuranand Telescope, 1.3-m Devasthal fast optical telescope, and 3.6-m Devasthal optical telescope at ARIES, Nainital. The analysis revealed strong emission lines in the spectra and obtained light curves of 5100Å continuum flux (f_{5100}) and Hα, $with fractional variabilities of 7$

*Speaker

Constraining the X-ray reflection in low accretion rate AGN using XMM-Newton, NuSTAR and Swift

Yaherlyn Diaz*[1], Lorena Hernández-García , Patricia Arévalo , Elena López-Navas , Claudio Ricci , Mike Koss , Omaira González-Martín , Mislav Balokovic , Natalia Osorio-Clavijo , Javier Garcia , and Angela Malizia

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Abstract

An interesting feature in AGN accreting at low rate is the weakness of the reflection features in their X-ray spectra, which can result from the gradual disappearance of the torus with decreasing accretion rates. It has been suggested that low luminosity AGN (LLAGN) would have a different reflector configuration compared with high luminosity AGN. Our purpose is to constrain the geometry and column density of the reflector in a sample of LLAGN covering a broad X-ray range of energy combining data from XMM-Newton+ NuSTAR+Swift. We use XMM-Newton+ NuSTAR + Swift observations of a hard X-ray-flux limited sample of 17 LLAGN from BASS/DR2 with accretion rates $\lambda_{Edd}< $10^{-3}. We fit all spectra using a reflection model for torus and accretion disk reflectors. We found atenta

*Speaker

Confronting AGN outflow and accretion models with SDSS quasar demographics

Matthew Temple*[1]

[1]Universidad Diego Portales – Chile

Abstract

One commonly-invoked launching mechanism for AGN outflows is radiation line driving. This mechanism depends closely on the SED of the ionizing continuum, and so is inherently linked to the structure of the accretion flow. Theories of radiation line-driven winds therefore provide testable predictions as a function of black hole (BH) mass and accretion rate. In the first part of my talk I will confront these predictions using the ultraviolet emission line properties of 190,000 quasars from SDSS DR17. We quantify how the shape of CIV 1549A and the equivalent width (EW) of HeII 1640A depend on the BH mass and Eddington ratio inferred from MgII 2800A. The blueshift of the CIV emission line is commonly interpreted as a tracer of quasar outflows, while the HeII EW traces the strength of the 10-100eV continuum which photo-ionizes the ultraviolet emission line regions. Above L/LEdd$>$ 0.2, there is a strong mass dependence in both CIV blueshift and HeII EW. Large CIV blueshifts are observed only in regions with both high BH mass and high accretion rate, consistent with predictions for radiation line driven winds. The observed trends in HeII and 2 keV X-ray strength are broadly consistent with theoretical models of AGN SEDs, where the ionizing SED depends on the accretion disc temperature and the strength of the soft excess. At L/LEdd $<$ 0.2, we find a dramatic switch in behaviour: the ultraviolet emission properties show much weaker trends, and no longer agree with SED models, hinting at changes in the structure of the broad line region. Overall the observed emission line properties are generally consistent with the radiation line driving scenario, where quasar winds are governed by the SED, which itself results from the accretion flow and hence depends on both the SMBH mass and accretion rate.

*Speaker

Combining Differential Interferometry and Reverberation Mapping in the J band

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Abstract

Spectro Astrometry (SA) from phase differential interferometry has proven to provide a measure of the mass of the Super Massive Black Hole at the heart of an AGN from a super resolution of its BLR. SARM that combines the SA angular measures with the Reverberation Mapping (RM) linear information yields additional constraints on the SMBH mass and direct distance measurements with a possible contribution to the Hubble tension problem. However, the model fits of SA and RM, alone as well as combined in SARM are sensitive to parameter degeneracies due to the unknown geometry of the BLR, resulting in a loss of accuracy of the mass and distance measurements. We show that this accuracy can be improved by adding additional geometrical information, indirectly from the observation of the inner dust structure and directly from amplitude differential interferometry of the BLR that measures the variations of visibility or coherent flux trough the emission line. With the current optical interferometers, amplitude differential interferometry of the BLR would be accessible (only) at the VLTI in the J band. The J band has the additional major advantage that it allows a much larger sample of BLR combining high accuracy SA and Reverberation Mapping with reasonable time spans. We discuss the feasibility of such a J band instrument with its specific fringe tracker, the impact on the number of accessible targets and the gain in precision and accuracy that would be offered by the J band on the VLTI.

*Speaker

Bolometric Corrections from a Large Multi-Wavelength Study of Nearby Unobscured AGN

Kriti Kamal Gupta*[1]

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Abstract

AGN are powered by mass accretion and emit electromagnetic radiation mainly at optical, ultraviolet, and X-ray wavelengths. Hence, a detailed analysis of the multi-wavelength spectral energy distributions (SEDs) of AGN can provide fundamental insights into their accretion properties. A complete and consistent study of broadband AGN SEDs can be used to estimate what fraction of the total accretion luminosity of AGN is emitted at different wavelengths (bolometric corrections), additionally shedding light on how the X-ray coronal emission and the optical/UV disk emission are linked. In my work, I used an almost unbiased sample of hard-X-ray-selected AGN in the local universe. All these sources have multi-wavelength coverage thanks to the BAT AGN Spectroscopic Survey (BASS). I compiled and processed high-quality, simultaneous, optical, UV, and X-ray data for my sample of 250 unobscured AGN to construct and fit their optical to X-ray SEDs. In this talk, I will present the main results from my Ph.D. research, including optical to X-ray spectral indices and optical, UV, and X-ray bolometric corrections over a wide range of black hole masses, luminosities, and Eddington ratios. I will discuss the key parameters regulating these bolometric corrections and also mention the implications of my results on our current understanding of accretion flow and emission arising in the innermost regions of AGN.

*Speaker

Blazars' variability on intranight to year-long timescales using the ZTF survey

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Abstract

Variability from minutes to year-long timescales in blazars' is proven to be a powerful tool to probe their central parsec region around the supermassive black hole. Despite several efforts in the last four decades, the nature of this variability is still not well understood, like, a complex color behavior has been seen in a handful of blazars pointing to an interplay between the jet-dominated and disc-dominated state. Furthermore, an elusive periodic signature with periods spanning from months to years has also been seen in a few blazars, however, the exact physical mechanisms arising within the jet and/or accretion disk, giving rise to this periodicity, is still unclear. I will discuss our recent results on investigating for the first time, the blazar population using the extensively large ZTF data, to (1) test the universality of color variability of the blazar population in general and their origin (2) flux variability on diverse timescales, and (3) detection of elusive QPO signatures with periods ranging from _˜140-200 days in 5 blazars (out of _˜2100 blazars) and the possible mechanisms giving rise to these signatures.

*Speaker

Bayesian Unification of Time Domain Observations for Close Binary Supermassive Black Hole Detection and Construction of Robust Target Catalogues

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Abstract

Here, we present the Bayesian framework for the unification of time domain observations in the detection of Close Binary Supermassive Black Holes (CB-SMBHs). Bayesian inference provides a powerful approach to analysing multiple sources of data, increasing the robustness of findings. We focus on the extraction and interpretation of CB-SMBH orbital and flux parameters, highlighting the benefits of Bayesian techniques in maximising information from the data. Next, using quasar light curves from the Vera C. Rubin Legacy Survey of Space and Time AGN Data Challenge database (Richards & Yu, 2021–2022), we demonstrate a time-domain technique for periodic variability mining, providing insights for the construction of the catalogues of CBSMBH candidates as targets for forthcoming facilities such as GRAVITY+ and the next generation Event Horizon Telescope.

*Speaker

Application of the Radius-Luminosity Relation in Cosmology

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Abstract

The disagreement between the Hubble constant in the early and local Universe has motivated the appearance of alternative probes to constrain the energy content of the Universe. Active Galactic Nuclei (AGN) are one of the most energetic phenomena observed in the nearby Universe up to redshift z $\sim$ 7.6. Therefore, they are suitable to estimate cosmological properties. In this talk, we will summarize the efforts to determine the content of matter in the Universe using the Radius-Luminosity relation. Based on six cosmological models and MgII/CIV samples with eight orders of magnitude in luminosity at 0_z_3.36, we found that the parameters of the RL relation are independent of the cosmological model, which indicates that RL is standardizable. We obtained weak cosmological constraints but consistent with LamdaCDM. We also used the low-redshift Hb sample, however, there is a 2sigma tension between the constraints given by Hb and those from the LambdaCDM probes. This tension will need to be addressed when more reverberation-mapped from LSST, SDSS-V or ozDES surveys are available.

*Speaker

An ALMA Study of Mm-wave Continuum Emission from Hard X-ray Selected Nearby AGNs

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Abstract

AGNs emit radiation across a wide range of wavelengths. However, until the advent of ALMA, the AGN mm-wave continuum emission has been poorly understood. While thermal and synchrotron components, extending from the infrared and cm-wave bands, respectively, have been expected, ALMA has found an excess explainable by synchrotron self-absorption (SSA) emission from the AGN X-ray corona. Thus, the mm-wave emission could provide crucial insight into the central engines of AGNs. To study the emission in more detail, we analyzed subarcsec Band-6 ALMA data of 98 nearby AGNs (z< 0.05) from the Swift/BAT catalog. This sample provides the largest number of AGNs with high spatial resolution sampling (_˜1-200 pc), and is almost unbiased for obscured systems. We found a tight relation of 1 mm and X-ray luminosities with a scatter of _˜0.36 dex. While the mm-wave emission thus may be the SSA from the X-ray corona, we also discuss other possible origins, including dust emission, outflow-driven shock, and small-scale (< 200 pc) jets. We rule out dust emission as a dominant source, as the mm-wave slope is generally flatter than expected. Also, the lack of an increase in the mm-wave luminosity with the Eddington ratio would suggest that a radiation-driven outflow is possibly not a common mechanism. We furthermore show that the mm-wave luminosity is independent of inclination-angle indicators, inconsistent with a simple jet model. Overall, our results put important constraints on the origin of the mm-wave continuum emission.

*Speaker

AGN activity in closely interacting galaxie.

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Abstract

Galaxy interactions and mergers are important for both galaxy formation and evolution (Springel et al., 2005). The merging of the two galaxies, each harbouring a supermassive mass black hole at its centre, brings the two nuclei to the centre of the merger remnant through dynamical friction. In gas-rich mergers, this phenomenon is usually accompanied by gas infall towards the nuclei, increased cloud collisions, and shocks, all leading to enhanced star formation and stellar outflows. We study the morphology of star formation and the associated nuclear activity in a sample of 8 closely interacting southern galaxies, which are in different stages of interaction, starting with nearly merged nuclei that have one prominent bulge to more widely spaced interacting galaxies. We take advantage of the unprecedented capabilities of MUSE and UVIT to carry out a highly detailed spatially and spectrally resolved study of star formation rate, star formation histories, metallicity and AGN activity in the sample of eight interacting galaxies. Most of our sample galaxies are gas-rich and show evidence of recent, massive star formation in tidal tails, rings and spiral arms. We find that around 50% of the sample galaxies show AGN activity. We detected a triple AGN in one of the interacting system. Furthermore, we also detected ionized outflows and extended narrow line regions associated with the nuclear region in some galaxies.

*Speaker