KIAA/DoA Post-Doc Science day 2017

Book of Abstracts

November 30 – December 1, 2017

KIAA-PKU Auditorium

November 30, 2017

Session 1: Active Galactic Nuclei

AGN nuclear regions from high-z universe to local galaxies

Ming-yi Lin (10:10–10:30)

X-ray emission is a powerful diagnostic tool to identify active galactic nuclei (AGN). However the higher X-ray obscuration fraction is hard to be explained by the dusty torus of the AGN unified model. Such additional X-ray obscuration has been observed among the infrared bright galaxies in the high-z universe, and has been used to interpret as the result of nuclear star formation in the host galaxy. Due to the limited spatially resolution, the current facilities cannot resolve the small scales in the high redshift AGN. Nearby AGN offers a good laboratory that enables us to study the nuclear star formation in detail on < 100 pc scales. In this talk, I will present the studies of the nuclear regions in high redshift AGN as well as nearby AGN.

Measuring Star Formation Rate in active and inactive galaxies - Perspective from PAH

Yanxia Xie (10:30–10:50)

Quantifying star formation in galaxies is essential to understanding their evolution. To this end, different observables have been used to calibrate the star formation rate (SFR) in galaxies (Kennicutt & Evans 2012). The emission features from polycyclic aromatic hydrocarbons (PAHs) have long been proposed as a useful tracer of star formation on galactic scales. I will introduce a new method to decompose the emission features of PAHs from mid-infrared spectra using theoretical PAH templates in conjunction with modified blackbody components for the dust continuum and an extinction term. The primary goal is to obtain robust measurements of the PAH features, which are sensitive to the star formation rate, in a variety of extragalactic environments. Compared to previous commonly used techniques, our template fitting method is more physically motivated and greatly reduces the number of free parameters. The calibration of SFR based on the improved measurements is also presented and briefly discussed at the end.

The Galaxy-Absorber Connection

Ravi Joshi (10:50–11:10)

Studies of the circum-galactic medium (CGM) are crucial for understanding both the inflow of gas accreting into the galaxies and the outflow carrying away the energy and the metals generated inside the galaxies. One of the powerful tool to study the CGM is offered by absorption lines observed in background quasar spectra which trace the neutral gas reservoir for star formation. In principle, they encode clues regarding the early stages of galaxy formation. I will discuss our recent efforts to understand the galaxy-absorber connection and prospects for identifying the host galaxies of metal absorbers.

VLBI observation of dual/binary supermassive black hole candidates

Xiaolong Yang (11:10–11:30)

According to hierarchical structure formation theory, galaxy merger are very common, due to supermassive black hole (SMBH) existence at all large galaxies, hence, the merger of galaxy will eventually form dual/binary SMBH. If the two black holes are both active, no doubt we can detect them. However, there are just few of dual/binary AGNs have been identified, especially for pc-scale binary SMBH, simulation results show there is a peak or even the final destination for binary black hole evolution, this is so-called "final pc problem". Galaxy merger will accelerate the feeding of central SMBH and trigger AGN, searching for dual/binary SMBH can also help for investigating this subject. All this depend on searching for more dual/binary SMBH. Currently there are no straightforward observational

methods neither to select nor to confirm a large number of dual active galactic nuclei (AGN) candidates. Very long baseline interferometry array as the most powerful facility which can reach milli-arcsec resolution, this will confirm us in directly resolving pc-scale binary black hole, furthermore, with its high resolution, we can distinguishing the core and diffused jet or interstellar radio emission, this will effectively identify kpc-scale dual AGN to consolidate the merger driven AGN prediction.

Session 2: Co-evolution of Black Holes and Host galaxies

Structure and Stellar Mass of the Host Galaxies of Type-2 Quasars

Dongyao Zhao (13:00–13:20)

AGNs have played a fundamental role in the galaxy evolution and it is essential to study their host galaxies. In this work, by employing a large sample of local type 2 quasars (QSO2s), we carry out much improved galaxy decomposition and stellar mass estimation to detail study the morphology, structure, stellar mass, stellar population, and scaling relations of host galaxies and bulges to better understand the coevolution between supermassive black holes and galaxies as well as the evolution of AGNs. Taking advantages of the high-quality IR images of HST WFC3, we find that only 5/30 of the QSO2 host galaxies show merging/disturbed morphologies, and 13/30 are bar/spiral galaxies having regular disk structures. We then fit the galaxies 2D light profile not only with Sersic model, but taking into account bar and disk component to extract more accurate photometric properties of galaxy bulges. A few of our QSO2s have extremely small bulges implying the supper Eddington accretion of their central BHs. We obtain color of bulges and host galaxies of QSO2s by fitting the UVIS images of HST WFC3 as well. Interestingly, the bulge of QSO2 host shows younger stellar population than the whole galaxy. Moreover, with discussing the effects of emission line, Balmer coat and scattered light on the stellar mass measurement, we obtain more accurate stellar masses of QSO2 host galaxies and their bulges, and find a tight relationship between the mass of BH-bulge. Our results provide more observational constraints on the AGN evolution.

Exploring the physics in accretion and jet in nearby narrow-line Seyfert 1 galaxies

Yao Su (13:20–13:40)

In this paper, we explore the physics of the accretion and jet in the ten nearby narrow-line Seyfert 1 galaxies (NLS1s) with higher Eddington ratios, i.e., ¿0.1. Specifically, we investigate the mutual correlation between the radio luminosity, X-ray luminosity, bolometric luminosity and black hole mass. By adopting partial correlation analysis, we find that there is: (1) a positive correlation between L_{rmX} and M_{rmBH} (2) a positive correlation between L_{rmR} and L_{rmbol}, (3) no significant correlation between L_{rmR} and L_{rmX}. The correlation between L_{rmX} and M_{rmBH} indicates that the X-ray emission is saturated with increasing $\dot{M}$ for $L_{rmbol}/L_{rmEdd} \gtrsim 0.1$, which may be understood in the framework of slim disc scenario. Finally, we suggest that a larger NLS1 sample with high quality radio and X-ray data is needed to further confirm our conclusions in the future.

Black Hole Growth in Disk Galaxies Mediated by the Secular Evolution of Short Bars

Min Du (13:40–14:00)

How gas is transported to the galactic central regions is a critical question for understanding the growth of black holes (BHs). The bars-within-bars (S2B) system has been hypothesized as an important mechanism for driving gas inflows to small scale, feeding central BHs. In order to quantify the maximum BH mass allowed by this mechanism, we examine the robustness of short inner bars to the dynamical influence of BHs. Large-scale bars are expected to be robust, long-lived structures; extremely massive BHs, which are rare, are needed to completely destroy such bars. However, we find that inner bars in S2Bs can be destroyed quickly when BHs of mass M_{bh} ∼0.05 0.2% of the total stellar mass ($M_{\odot}$) are present. Thus, inner-bar-driven gas inflows may be terminated when BHs grow to 0.1perhaps even frequent, in the universe, which facilitates the growth of bulges.

Can we see a naked singularity, the most extreme object in the universe?

Chandrachur Chakraborty (14:20–14:40)

The spin precession frequency of a test gyro diverges on the event horizon of a Kerr black hole (BH), but is finite and regular for a Kerr naked singularity (NS) everywhere except at the singularity itself. Therefore a genuine detection of the event horizon becomes possible in this case. We then investigate the Lense- Thirring (LT) precession or nodal plane precession frequency of the accretion disk around a BH and a NS to show that clear distinctions exist for these configurations in terms of radial variation features. The LT precession in equatorial circular orbits increases on approaching a BH, whereas for NS it increases, attains a peak, and then decreases. Interestingly, for a=1.089, it decreases until it vanishes at a certain radius, and it acquires negative values for a >1.089 for a certain range of ṙ For 1.

Non-circular flows in barred galaxies

Toky Randriamampandry (14:40–15:00)

The observed velocities of gas in barred spiral galaxies are a combination of the azimuthally averaged circular velocities and non-circular streaming motions. It is important to account for these non-circular motions when using the gas rotation curve to construct mass models of galaxies. Using numerical simulations, we show that the commonly used method of determining the rotation curve of a galaxy (the so-called tilted-ring method) can significantly under/over estimate the rotation curves depending on the bar orientation. I will also discuss the limitation of the publicly available code DiskFit, which is specifically designed for barred galaxies.

December 1, 2017

Session 3: Satellite/ Dwarf galaxies

Far-IR radio correlation in dwarf galaxies

Li Shao (10:00–10:20)

Using radio 20cm continuum data from the Local Volume HI Survey (LVHIS) and far-IR data from IRAS, we study the far-IR radio correlation in a sample of 82 the Local Volume galaxies, including 70 dwarf galaxies. We find that the FIR-radio correlation (FRC) holds well for dwarf galaxies. The FIR-to-radio flux ratio of dwarf galaxies is consistent with constant over three orders of magnitude. It is confirmed that both FIR and radio emission are mainly connected with star formation but with significant non-linearity. Dwarf galaxies are radiation deficient in both bands, when normalized by star formation rate. With correlation analysis, we identify the key galaxy properties associated with the FIR and radio deficiency. Some major deficiency factors, such as stellar mass surface density, will cancel out when taking the ratio between FIR and radio fluxes. The remaining factors, such as HI fraction and galaxy size, are moderately correlated with the FIR-to-radio flux ratio. But they are expected to cancel each other due to the distribution of galaxies in the parameter space. This cancellation is probably responsible for the "conspiracy" to keep the FRC alive in dwarf galaxies.

Bimodal Age distribution of Infalling Halos

Jingjing Shi (10:20–10:40)

Using a high-resolution N-body simulation, we study the mass accretion history of infalling dark matter halos before being accreted by larger halos. We find a clear bimodality in the distribution of the formation time for these

infalling halos. Interestingly, the normalized formation time distribution for the young population almost does not change with the accretion time, while the peak and width of the distribution for the old population increase with the decrease of the accretion time. The infalling halos are dominated by the young population at high redshift and the old population at low redshift. Our analysis suggests that the bimodal feature arises from the two-phase accretion history of halos: at the accretion time, the young population are still at fast accretion phase, while the old population are already at slow accretion phase. We also find that normal halos do not show a significant signal for such bimodality, and the EPS merger trees also fail to reproduce it. Finally, we discuss its implications on galaxy formation.

The dynamical origin of multiple populations in Magellanic Cloud clusters

Jongsuk Hong (10:40–11:00)

Formation of compact stellar systems by fast transformation of infalling dwarfs within clusters

Min Du (11:00–11:20)

Ultra-comact dwarfs and compact ellipticals, i.e., compact stellar systems (CSSs), are distinct outliers from the size and luminosity relation observed in normal early-type galaxies. Here I will report my latest result about the formation of CSSs. With the N-body+gas simulation, we model a dwarf galaxy infalling into a M31-like system with a cosmological corona. The gas at the outer parts of the dwarf galaxy is stripped, as expected, while the remaining gas at the central region forms a compact core after several pericentric passages. Thus a diffuse, gas-rich dwarf galaxy is transformed into a compact elliptical quickly. The central starbursts are probably triggered by the combined effect of the high ram- pressure inside the corona and the close-by tidal encounters. Under the ram- pressure of the corona, the metallicity and *alpha* elements produced in supernova can enrich the inter-stellar medium of the dwarf efficiently. Thus stars forming from the remaining gas are able to confine more metallicity and *alpha* elements than the dwarf evolved in an isolated environment, which is consistent with observations. This result suggests that CSSs may form from normal dwarf via central concentrated starbursts triggered in the cluster environment.

Session 4: Globular Clusters, Variable Stars, and Star formation

Globular cluster systems of Coma ultra-diffuse galaxies: evidence of multiple formation channels

Sungsoon Lim (13:00–13:20)

How did M85 form?: Globular cluster system of M85

Youkyung Ko (13:20–13:40)

M85 is a peculiar S0 galaxy in the Virgo cluster, known as a merger remnant. We survey globular clusters (GCs) in M85 using Gemini-N/GMOS. We identify 20 genuine GCs that belong to M85 based on their radial velocities. We find two interesting features of the M85 GCs: 1) the presence of 4 Gyr-old GCs with solar metallicities, and 2) the strong rotation of the M85 GC system with the rotation amplitude of 179 km/s. These results suggest that M85 experienced a wet merging event about 4 Gyr ago and an off-center major merging event as well.

The Interstellar Extinction in Local Galaxies and Distances to the Galactic Classical Cepheids

Shu Wang (13:40–14:00)

Star formation towards the Sh 2-53 region influenced by accreting molecular filaments

Tapas Baug (14:00–14:20)

In spite of the fact that the massive stars are the most important to determine the fate of their host galaxies, formation and evolution mechanism of these stars are highly illusive. Processes like "core accretion", "competitive accretion", and "proto-stellar collisions" are ambiguously believed to be responsible for the formation of massive star. With the advent of the Herschel observations filamentary structures are frequently identified, and massive stars are occasionally found to form at the junction ("hub") of these filaments. However, none of these models are yet well established. We performed a multi- wavelength data analysis of a 30'x30' area around the Sh 2-53 region, which is associated with three H II regions, two mid-infrared bubbles (N21 and N22), and infrared dark clouds (hereafter S53 complex). The ionized emissions are predominantly detected within the bubble and the Sh 2-53 region. The S53 complex harbors clusters of young stellar objects (YSOs). It also hosts several massive condensations (3000-30000 Msun) that are traced in the Herschel column density map. However, the dynamical ages of the H II regions do not support the hypothesis that dust clumps and clusters of YSOs are influenced by the expansion of the H II regions. The 13CO line data trace the S53 complex in a velocity range of 36-60 km/sec, and show the presence of at least three molecular components (viz., 36-45, 46-55, and 56-60 km/sec). The S53 complex is found to be located at the junction of at least five molecular filaments. The flow of gas toward the junction is evident in the velocity space of the 13CO data. Altogether, the S53 complex is embedded in a very similar "hub-filament" system to those reported in Myers (2009), and the active star formation is evident towards the central "hub" inferred by the presence of the clustering of YSOs.

Session 5: Transients

Studies on Dispersion Measure of Fast Radio Bursts

Yuanpei Yang (14:40–15:00)

Fast radio bursts (FRBs) are a new mysterious class of radio transients with short intrinsic durations, large dispersion measures (DMs), and all-sky distribution. Their physical origin is not identified, but the recent observational properties have finally settled FRBs to the cosmological range. Our recent works about FRB includes: 1. Extracting host galaxy DM and constraining cosmological parameters using FRBs data; 2. Large host-galaxy DM of FRBs; 3. The DM variation of FRBs; 4. Synchrotron heating by a FRB in a self-absorbed synchrotron nebula and the persistent emission of FRB 121102. The studies on FRB DM and the nebula emission can reveal some important properties of FRBs.

Observations of the closest hydrogen poor superluminous supernova in a "normal" galaxy

Subhash Bose (15:00–15:20)

Hydrogen-poor superluminous supernovae (SLSNe-I) are a rare class of events whose explosion mechanism is not well understood. Existing studies suggest a strong bias in production efficiency of these events towards low-metallicity and dwarf galaxies. Here we present detailed multi-band observations for a SLSN-I Gaia17biu, which we identify in a "normal" spiral galaxy (NGC 3191) in terms of stellar mass (several times $10^10\ M_\odot$) and metallicity (roughly solar). At a redshift z=0.031, the SN is the closest SLSN-I discovered till date. Due to the proximity of the SN, implying highest apparent brightness for a SLSN-I, we are able to study Gaia7biu in an unprecedented detail. Its

pre-peak near-ultraviolet to optical color is similar to that of Gaia16apd and among the bluest observed for a SLSN-I, while its peak luminosity (M_g = -21 mag) is towards the low end of the SLSN-I luminosity function. From our high signal-to-noise ratio spectra, we could identify several new spectroscopic features that may help to probe the properties of these energetic explosions. Our spectropolarimetric observations reveals a polarization of $\sim 0.5\%$ with no strong wavelength dependence, suggesting a modest, global departure from spherical symmetry for the source. In addition, we put the tightest upper limit yet on the radio luminosity of a SLSN-I at $<5.4\times 10^{26}$ erg/s/Hz (at 10 GHz), which is almost a factor of 40 better than previous upper limits and one of the few measured at an early stage in the evolution of an SLSN-I. This limit largely rules out an association of this SLSNe-I with known populations of gamma-ray bursts (GRBs). The upper limits of Radio and X-ray nondetections likely suggest the absence of any strong CSM interaction.

A Comparative Study of Long and Short GRBs

Ye Li (15:20–15:40)

Gamma-ray bursts (GRBs) are the most luminous explosions in the universe. They are generally classified into two types according to the durations of their *gamma*-ray emission. Progenitors of short-duration GRBs (SGRBs) are believed to be compact stars binaries (e.g., neutron stars and black holes; also known as Type I GRBs by their physical origin). For long-duration GRBs (LGRBs) they are thought to be originated from core-collapse of massive stars (Type II). However, the duration criterion is not always reliable. In this dissertation, I propose a multi-parameter method based on multi-wavelength data of GRBs to classify them by their physical nature, i.e., Type I or Type II.

The LGRB Event Rate and Host Metallicity Distribution

John Graham (15:40–16:00)

There is now strong evidence that Long-duration Gamma-Ray Bursts (LGRBs) have an intrinsic preference for low-metallicity environments despite the existence of some exceptions to this trend. We find that per unit star-formation an LGRB occurs about 30 times more often at metallicities below 8.3 on the KK04 scale than above. Then, we relate the LGRB rate to the cosmic star- formation rate, and show that in low-metallicity environments one LGRB occurs for approximately every 40 broad-lined Type Ic SNe. Recent improvements in the population of LGRB host galaxies with measured metallicities and host masses allows us to investigate how the distributions of both these properties change with redshift. After addressing possible biases in the populations caused by the efficiency of obtaining metallicity measurements at different redshifts, we find the metallicity distribution of LGRB host galaxies shows a curious lack of evolution with redshift seen in both host galaxies with measured metallicities and the expected metallicities of LGRB host given their mass and redshift. This is at odds with the general evolution in the mass metallicity relation, which becomes progressively more metal poor with increasing redshift. We further find that the LGRB host galaxy mass distribution increase with redshift is consistent with that needed to preserve the LGRB metallicity distribution as the mass metallicity relation decreases with redshift. We also find that the metallicities estimated from mass and redshift are about twice as metal rich as the population with actually measured values which resolves much of the difference between the LGRB formation metallicity cutoff of about a third solar in Graham & Fruchter 2015 with the cutoff value of solar claimed in Perley et al. 2016 in favor of the former. As LGRB hosts do not follow the general mass metallicity relation, there is no substitute for actually measuring their metallicities!