Probing inner structures of molecular torus with CO ro-vibrational absorption lines

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Abstract

What maintains geometrically thick structure of dusty molecular torus around Active Galactic Nuclei (AGN) have not been understood yet. A theoretical study suggests internal turbulent motions by the radiation pressure from AGN cause the formation of a geometrically thick torus (Wada et al.2016) . This model is called Radiation-driven fountain model. Therefore, velocity of the gas is a key parameter to understand the thickness of the torus.
Recent observational studies revealed CO ro-vibrational absorption lines have 3 velocity components: outflow, inflow and systemic component (Shirahata et al.2013) and they are considered as some parts of the inner sides of the torus because the gas temperature is high (273 K). However, the distribution of those components in the torus is uncertain.

To investigate the distribution of those components in the torus, we examine CO absorption lines with Radiation-driven fountain model. Using a snapshot of the model, we perform post-processed CO non-local thermodynamic equilibrium radiative transfer simulations and observe spectrum at an observational angle of 75 degrees. In this simulation, We corporate not only rotational excitation and also ro-vibrational excitation and dust radiative transfer to determine CO level population under the environments of infrared radiation from dust in the torus.
As a result, the simulation produces CO absorption lines with three velocity components corresponding to Observation naturally. The components of outflow and inflow are derived from hot outflow gas driven by radiation pressure of AGN and accretion gas in the inner side (< 2 pc) of the torus. This results support observational expectations and we suggest CO ro-vibrational absorption lines can give insights into 2 pc of the structure of the molecular torus.

*Speaker

Morpho-kinematic diversity in the Early Universe revealed by the ALPINE survey

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Abstract

The ALPINE survey has exploited the potential of the ALMA telescope to analyze the gas and dust properties of a sample of 118 normal main-sequence galaxies right after the epoch of Reionization, at redshift between 4 and 6, by observing the [CII] line at 158 um rest-frame and the adjacent far-infrared continuum. The [CII] emission can provide useful information about the star formation mechanisms that shape the interstellar medium of these sources. Together with its kinematics, it can be used as a tool to distinguish the morphology of these primordial galaxies and to describe the environment in which they reside, revealing evidence for ongoing merging, ordered rotation and turbulence. By taking advantage of the wealth of ancillary data available for the whole ALPINE sample and of the 3D information coming from each data cube, we have now improved the previous qualitative morpho-kinematic classification of the ALPINE galaxies and we have then investigated the connection between the morphology and the physical parameters describing these sources, such as their star-formation rate (SFR), stellar mass and dust content. Finally, with an in-depth study of each morphological class, we aim to shed light on the evolution of these primordial galaxies through the cosmic time by estimating, for instance, the fraction of minor and major mergers at redshift greater than 4 or by characterizing the processes that led to the formation of ordered rotating discs in the early Universe.

*Speaker

Automatic approach to studies of galaxy properties in large astronomical catalogues

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Abstract

I review the results of machine learning methods applied by our team to classify data and effectively extract information on different types of galaxies from large astronomical photometric and spectroscopic surveys, including VIPERS, AKARI and WISE. Present-day astronomical catalogues already very often fall in the Big Data category, listing millions or even billions of sources. New facilities like Vera Rubin Observatory will raise these numbers by orders of magnitude. I will show how we apply different methods for efficient classification of different types of data, and how this allows to refine galaxy evolution studies from such catalogues.

*Speaker

Dust and stellar emission in edge-on galaxies

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Abstract

Edge-on galaxies are the best targets to explore the 3D structure of dust, gas and stellar constituents of galaxies. In this study, we exploit Herschel PACS100um-SPIRE500um and Spitzer 3.6um data to investigate both the vertical and radial extent of the dust and stellar emission in 10 well-resolved nearby edge-on galaxies. We use 2D and 3D models to fit the observed profiles and search for optimal functions to describe the individual dust components in these galaxies. We find that most galaxies from our little sample demonstrate an excess of dust emission in the vertical direction as compared to a single dust disc model. For them, the dust emission is best described by a sum of a thin and thick dust disc. The geometrical sizes (scale length and scale height) of these dust components show a gradient with wavelength. We also compare the derived parameters of the dust components, based on the emission in the FIR-submm, with those derived from a radiative transfer modelling and based on the observed dust attenuation in this galaxies in the optical and NIR. Finally, we compare the properties of the stellar and dust distributions, including breaks and truncations in the corresponding radial profiles. We conclude that the dust and stellar emission profiles show, in most cases, similar structural features and should have the same origin.

*Speaker

Star Formation Rate estimations at $0.5 < z < 1.0$ with the VIMOS Public Extragalactic Redshift Survey (VIPERS)

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Abstract

Having an accurate estimation of the Star Formation Rate (SFR) is crucial to understand the formation and evolution of galaxies over cosmic time. Thanks to the Sloan Digital Sky Survey (SDSS), numerous studies have been performed which highlighted our comprehension about the local Universe (z< 0.3). To go one step further and expand our knowledge about the distant Universe, similar studies have to be undertaken at z> 0.5. In this work, we make use of VIPERS, the biggest available spectroscopic survey at z_˜0.7 with a sample of _˜90 000 galaxies. Contrary to the local Universe, Halpha cannot be used as a SFR tracer as it is shifted-out from the optical window. Therefore, different tracers and techniques have to be used in order to recover the SFR of galaxies with a good accuracy. We used the CIGALE code to reconstruct the Spectral Energy Distribution (SED) of star-forming galaxies from UV to FIR in order to obtain an estimation of the SFR. We exploited several SFR tracers, calibrated for the local Universe, to estimate the SFR of VIPERS galaxies. A comparison between the SFR obtained with CIGALE and the SFR estimated using different tracers is made in order to discuss the validity of SFR laws at z< 0.3 extrapolated at z_˜0.7. We investigated, between all these tracers, which one is the most accurate and practical to use at z_˜0.7. Using SDSS data through the GALEX-SDSS-WISE Legacy Survey, the SFR values between z< 0.3 and z_˜0.7 are also discussed. One of the interesting features of VIPERS is the observation of the [OII] line which is known to be a good SFR tracer. Since the SFR based on [OII] depends on the metallicity of galaxies, we examined how this dependence affects the SFR estimations at z_˜0.7.

*Speaker

Highly accreting quasars: leaders in metal enrichment on galactic and super galactic scales?

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Abstract

We present a method of estimating the metallicity of the broad line emitting gas applied to a pilot sample of extremely accreting quasars from the Sloan Digital Sky Survey. We define and measure diagnostic ratios on two line components, one associated with a virtualized, low-ionization subsystem and one associated with a high ionization outflow, possibly in the form of a wind. Our results indicate very high metal content with metallicity values higher than 10 times solar, and most likely the highest value along the quasar main sequence. Considering the amplitude of the blueshifts in the high ionization component, we suggest that the outflowing gas does not remain gravitationally bound to the central black holes, but may instead diffuse into the interstellar and possibly, into the intergalactic medium. However, an analysis aimed to assess the extent of the enrichment would require spectra for a large sample and high S/N ratio.

*Speaker

The 2175 A dust feature in star-forming galaxies at 1.3

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Abstract

We present direct measurements of the 2175 A absorption feature in 505 star-forming "main-sequence" galaxies at 1.3

*Speaker