Contribution ID: **50** Type: **Oral (onsite)**

Dimming blinding floodlights with JWST/NIRSpec IFU: Spatially resolved gas kinematics in the most distant luminous quasar at z=7.6

Thursday 21 November 2024 14:00 (20 minutes)

With the advent of the James Webb Space Telescope (JWST), the study of supermassive black hole (SMBH) and host galaxy co-evolution has entered an unprecedented era, pushing the quasar redshift frontier to z~7.6. In this talk, I will present the first detailed kinematic analysis of the extended rest-frame optical emission in J0313-1806, the most distant luminous quasar currently known, using data from JWST/NIRSpec Integral Field Unit (IFU). Previous observations revealed that J0313-1806 harbors a 1.6-billion solar-mass SMBH within a massive, dusty, and intensely star-forming galaxy (Wang et al. 2021). Its rest-frame UV spectrum shows broad absorption lines and significantly blueshifted CIV broad emission, pointing to the presence of powerful quasar-driven outflows.

JWST/NIRSpec IFU data provide a remarkable view into the detailed kinematics of this quasar-host system, allowing us to map the spatial distribution of nuclear emission, extended gas, and underlying stellar components. We employ advanced cube-analysis techniques to overcome the extreme contrast between the bright quasar core and its surrounding nebula. The resulting flux, velocity, and velocity dispersion maps across the 3"x 3"region around the quasar reveal complex gas dynamics, including the presence of a large, outflowing shell-like structure extending several kpc from the central SMBH.

One of the most intriguing findings is the non-detection of strong [O III] emission combined with significant Balmer line emission (Hβ and Hγ) in the extended gas. This unusual combination could suggest that shock ionization dominates the ionization mechanisms in the extended nebula. Shocks, likely driven by powerful quasar winds, are accelerating and heating the gas, generating Balmer line emission while failing to fully ionize oxygen to produce [O III]. This ionization structure provides crucial insights into the role of mechanical feedback from the quasar, as it redistributes energy across the galaxy.

The velocity and dispersion maps further support this scenario, showing high-velocity (up to 2500 km/s) shocks expanding outward from the central quasar. The presence of such shocks implies that AGN feedback is not only shaping the gas dynamics but is also potentially regulating star formation within the host galaxy. The observed ionization and kinematics point to a complex interplay between the quasar-driven outflows and the host galaxy's interstellar medium, where feedback mechanisms are both heating the gas and potentially suppressing future star formation.

These findings provide a crucial step toward understanding SMBH-host galaxy co-evolution at extreme mass and luminosity scales during the early universe. The detailed analysis of J0313-1806 offers a rare opportunity to study quasar-driven feedback in the most distant quasar known, providing direct evidence of how AGN outflows influence the galaxy's gas and star formation. This work represents a key contribution to our understanding of how the first massive galaxies and black holes evolved during cosmic dawn.

Presenter: WOLF, Julien (Max Planck Institute for Astronomy)