PhD project in ASTROPHYSICS

Title of the Project: ***Quasars at cosmic dawn in the ALMA and JWST era***

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Scientific Case: Quasars at cosmic dawn (redshift z>6, age of the Universe <1 Gyr) are among the most active and massive sources in the early Universe. Their luminosity comes from rapid (>10 M_{sun} yr^{-1}) gas accretion onto already formed supermassive (10^9 M_{sun}) black holes – the mere presence of such gargantuous mass concentrations in the early Universe challenges our understanding of their formation. Their host galaxies harbor immense (~10^{11} M_{sun}) gas reservoirs that feed intense episodes of star formation (100-1000 M_{sun} yr^{-1}). In this PhD project, the perspective candidate will work on proprietary and archival ALMA and JWST observations of z>6 quasars (see an example in Fig.1) with the goal to study the early growth of the black holes, the rapid assembly of their host galaxies, and the build-up of their small (~10 kpc) and large (> Mpc) scale environment. The synergy between JWST, ALMA and other facilities enables for the first time to shed light on the black hole mass growth, their accretion rates, the gas kinematics, the physics of the interstellar medium (excitation conditions, metallicity, dust reddening, etc), and the properties of the environment where these early quasars reside.

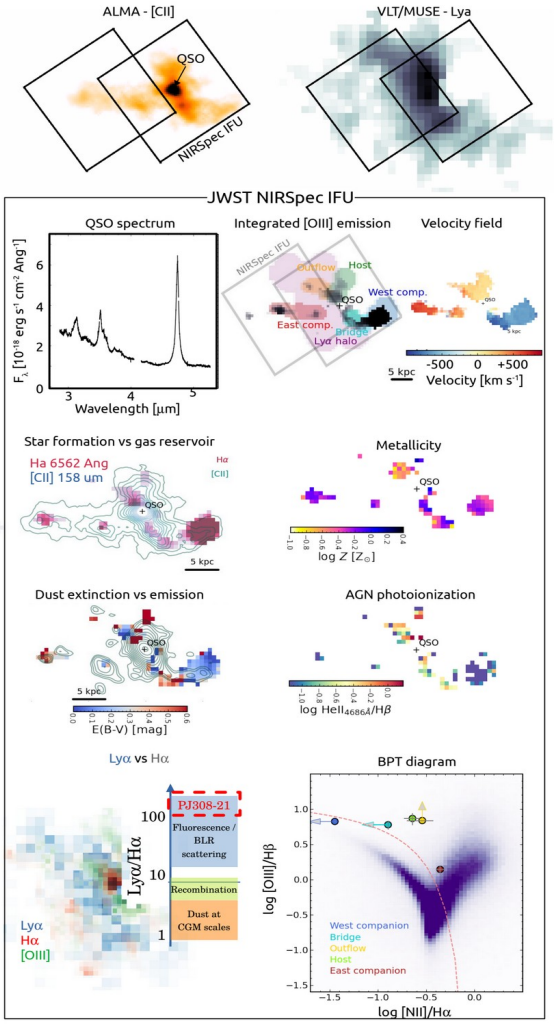

Figure 1: The quasar PJ308-21 at z=6.2342, observed with ALMA, VLT/MUSE, and JWST/NIRSpec. The combination of these datasets allows us to study the quasar phenomenology (black hole mass, accretion rate), the gas kinematics, the physics of the interstellar medium in the host galaxy and its companions (metallicity, dust extinction, photoionization) and the origin of the Lya halo. Figure adapted from Loiacono, Decarli et al. (2024) and Decarli et al. (2024).

The perspective student will join an active team of researchers with strong international collaborations, and work with state-of-the-art data from some of the best astronomical facilities. While data have already been gathered, the perspective student is expected to secure more telescope time via competitive calls, and potentially lead observing runs in telescopes around the world. Generous research funding for traveling will be available throughout the PhD program.

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