

7th China-Chile Bilateral Conference for Astronomy



Contribution ID: 46 Contribution code: CC05

Type: **Talk**

Multiphase gas in regulating galaxy and black hole growth

Tuesday, January 6, 2026 11:50 AM (25 minutes)

The growth of galaxies and their central supermassive black holes (SMBHs) is regulated by multiphase gas in the circumnuclear and star-forming regions, as well as in the circumgalactic environment. These gas phases range from cold molecular clouds to warm ionized gas and hot diffuse halos, transporting metals, dust, and angular momentum that influence both star formation and black hole accretion.

In this talk, I will present recent results on how multiphase gas regulates this growth cycle with multiwavelength observations, focusing on three parts:

1. Metal enrichment and dust content in the circumgalactic medium (CGM) revealed by JWST and ALMA.
I will discuss how the distribution of metals and dust traces feedback, inflow, and outflow processes, and how these shape the long-term chemical evolution of galaxies.
2. Statistical results between CGM properties and host galaxy conditions.
Using large quasar samples from DESI and high-quality spectroscopy from VLT and the galaxy detected by JWST, I will show how the ionization state and metallicity of the CGM connect with star formation history in the host galaxy from the reionization era to the present.
3. Dense and ionized nuclear gas in regulating black hole growth.
I will present our recent results on how the density, ionization state, and geometry of circumnuclear gas influence accretion and the co-evolution of the SMBH and its host galaxy.

Together, these results highlight the central role of multiphase gas in linking baryon cycling, star formation, and black hole growth across cosmic time.

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Session Classification: Invited talk(s)

Track Classification: CC05: Galaxies, AGNs, Black Holes and Cosmology