

Master 2 Research internship offer **Academic year 2024 – 2025**

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Address/Workplace: Franco-Chilean Laboratory of Astronomy, Camino el Observatorio 1515, Las Condes, Santiago, Chile

Hosting research team:

Internship title: Molecular hydrogen in numerical simulations over cosmic time

Summary of proposed work:

The molecular gas of the cold neutral medium plays a crucial role in galaxy evolution as it's the key ingredient for the formation of stars. Molecular hydrogen is very difficult to observe directly and we therefore often must rely on indirect tracers of the molecular gas, such as CO line emission. Nonetheless, direct constraints on H₂ are possible to obtain through absorption line spectroscopy thanks to the rotational and vibrational levels of the Lyman and Werner bands of the H₂ molecule. These lines are observable in the rest-frame far-UV. In ground-based spectroscopy these lines become available at redshifts greater than ~ 2.5 , which has enabled the first direct studies of H₂ in distant galaxies.

The frequency of detecting these lines is very low; only about 1 in about 1000 quasars show intervening molecular absorption systems. We therefore need large representative samples in order to get robust constraints on the evolution of H₂ from an absorption line perspective. We furthermore need to understand how these absorption systems relate to the underlying galaxy population to link the gas properties to galaxy properties (such as stellar mass). Upcoming data with the 4MOST instrument will provide new revolutionary constraints on the frequency distribution of H₂ absorption line systems. Yet, in the meantime we can use numerical simulations to test our understanding of where these absorption systems arise in galaxies over cosmic time.

This proposed project will analyse snapshots from the Sphinx and NewHorizon simulations to study the distribution of molecular gas in high-redshift galaxies and compare these to our preliminary observational constraints.

Please note: The internship will take place in Santiago de Chile! A good level of English is therefore required.

#MolecularGas #GalaxyEvolution #NumericalSimulations

Nature of the financial support for the internship: FCLA and team funding

Potential for a follow-up as a PhD thesis: Yes