

ALMA2019: Science Results and Cross-Facility Synergies



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Sounding diffuse molecular gas with ALMA as a mean to prove that the CO-dark gas is molecular

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Contributed talk

Abstract:

Studies of the dust continuum emission and extinction, and of the gamma ray emission show that a fraction of the interstellar gas is not traced by the combination of HI 21 cm and CO J=1-0 emission lines. The nature and physical conditions of this so called CO-dark gas are debated. We have used ALMA to search for molecular absorption towards distant quasars in the field of view of molecular clouds (Chamaelon, Taurus-Auriga, Galactic Bulge). We show that HCO⁺ absorption, tracing the presence of diffuse molecular hydrogen, is detected down to reddening values approaching the threshold for H₂ formation ($E(B-V) \sim 0.1$ mag), and that the detected amount of molecular gas explains the presence of CO-dark gas. CO is detected toward a subset of sources with column densities at the same level as those derived from FUV spectra, that are too low to produce a detectable J=1-0 emission. The CO-dark gas is dynamically active with complex HCO⁺, HCN, CCH and CO line profiles. The CO line profiles are narrower than those from HCO⁺, providing further support for a tight coupling of the gas dynamics and chemistry. This work also confirms that HCO⁺ is the most sensitive tracer of diffuse molecular gas at millimeter wavelengths, with a mean abundance relative to H₂ of 3×10^{-9} , firmly established by several comparisons with other, independent column density determinations.

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