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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) ~ 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 that 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 3x10-9, firmly established by several comparisons with other, independent column density determinations.

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