The Interstellar and Circumgalactic Media at low and high redshift as traced by the Atomic Carbon and Carbon Monoxide

Paola Andreani

[1] *European Southern Observatory, Karl Schwarzschild strasse 2, 85748 Garching, Germany*

We present single dish and interferometric observations towards low and high redshift galaxies targeting the CI[1-0], CI[2-1] and CO (various J levels) lines and discuss the physical properties of the gas which can be derived from these tracers.

We show how CI-rich / CO-poor molecular gas can be concomitant with very cold dust emission while the CO SLEDs remain highly excited out to higher-J levels (see e.g. Fogarty et al, 2019).

The ratio between the warm gas to the total gas using the available low-J/high-J CO SLED of the J=1-0, 3-2, 4-3, 5-4, 7-6 transitions are used to gauge whether Photon-Dominated-Regions (PDRs) or non-FUV sources power the (CO-rich) gas thermal states (e.g. Papadopoulos et al. 2014, Andreani et al., 2018). The comparison between the T_{kin} and T_{dust} constrained by the line measurements and the dust sets an additional powerful test for the power source of the gas/dust thermal states.

Furthermore, examining possible extreme gas-dust thermal decoupling over large H_2 and dust mass reservoirs is important beyond ISM studies since it impacts the initial conditions of star formation, and the type of the resulting stellar IMF (Papadopoulos et al, 2011). Should such conditions prevail, a top-heavy IMF becomes strongly preferred, with direct cosmological consequences for the more distant and more vigorously star-forming galaxy clusters (e.g. Oteo et al. 2018, Zhang et al., 2018).

References

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