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Chemical tracers of dense gas in extragalactic environments

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Abstract. Within the context of ALMA (and future missions such as SPICA) we present some recent observational and theoretical work on molecular line emissions from extragalactic environments.

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Extragalactic molecular line emission is an ensemble of PDRs and dense (star forming?) gas where the spatial and temporal effects are 'diluted' in the beam. Several molecular species (CO, HCN, HNC, CS, HCO^+...) are observable, especially in nearby galaxies. The question that we address is: can we use molecules as probes of the physical and chemical conditions of galaxies?

We have performed extensive theoretical (Bayet *et al.* 2008a, Bayet *et al.* 2009a) and observational (Bayet *et al.* 2008b, Bayet *et al.* 2009b) studies of the chemistry of star forming as well as photodominated regions representing different types of galaxies. Our theoretical studies provide us with trends in the chemistry in response to changes in the physical conditions of galaxies. A list of molecular tracers of star forming as well as PDR gas in different categories of galaxies can be found in our papers (see above references), but a particularly useful result to report here is the comparison of the molecular tracers predicted by dense star-forming core models with those derived from PDR models. For example while SO_2 and H_2S should both be delectable in star forming gas in starburst galaxies, they are inappropriate tracers of PDRs. By contrast HCO^+ is predicted to be undetectable in dense star forming cores while enhanced in PDR-dominated galaxies. For high redshift sources, H_2CS and H_2CO are both predicted to be inadequate molecular tracers of PDRs, while both are good signatures of dense star-forming cores.

Observationally we have carried out an extensive survey of CS (predicted to be a high density tracer) in order to better determine the properties of the very dense star forming gas over a large range of physical conditions (Bayet *et al.* 2009b) and an highlight of our work is that high J CS lines, in particular the 7-6, seem to be tracing a gas with a minimum density of 10^7 cm^{-3}, typical of 'hot cores' and hence of high mass star formation.

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