The crucial role of molecular gas to constrain galaxy evolution: the case of 4 Dusty Star-Forming Galaxies at the Cosmic Noon

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One of the most discussed issues in modern astrophysics concernes the formation and evolution of massive and dusty star-forming galaxies (DSFGs) observed at the peak of Cosmic Star formation History (z~2-3; [1], [2]). Indeed, we currently lack of a self-consistent explanation of both the mechanisms triggering and fuelling their intense burst of dust-obscured star formation (SFR > 100 M_{Sun}/yr) and the astrophysical processes driving their subsequent evolution (e.g. AGN and stellar feedback). In this respect, the detection of molecular spectral lines at great spatial and spectral resolution plays an essential role. I will highlights its relevance through the analysis of 5 CO emission lines (J>1) detected for 4 DSFGs at z_{spec}~2 in the Great Observatories Origins Survey South (GOODS-S) field by ALMA [3]. The study exploits data cubes from the ALMA Science Archive products at the highest spatial and spectral resolution currently available ($\Delta\theta$ < 1'' and Δv < 65 km/s) for these sources, while galaxy multiwavelength broad-band emission (from radio to X-ray) was already studied in great details by [4]. The analysis of the CO lines reveals a massive ($M_{H2}>10^{10}$ M_{Sun}) rotating disc of molecular gas, that extends over a larger area than the one covered by dust FIR emission (median r_{CO}/r_{FIR}=2.2), and fuels the dusty burst of star formation. However, the presence of interactions and/or molecular outflows cannot be excluded. Some features in the CO momenta maps of 3 galaxies are suggestive of forthcoming/ongoing AGN feedback, which is thought to trigger the morphological transition from star-forming discs to early-type galaxies. Finally, I will exploit the theoretical scenario for galaxy evolution by [5] & [6] to give a possible self-consistent interpretation of the observational outcomes by comparing the optical, FIR and CO sizes and morphologies of the 4 DSFGs.

References

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