The evolution of the dust and gas content in galaxies

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Abstract

By means of Herschel observations, we have studied the scaling relations in place between gas, dust, stellar mass (M_{star}) and SFR and their evolution from z∼2.5 to the local Universe. The gas mass is estimated from dust mass measurements by adopting assumptions on the dust-to-gas ratio. The inferred relation between SFR and gas mass (integrated Schmidt-Kennicutt relation) for the bulk of the population is in good agreement with previous results based on CO measurements, despite the completely different approaches. This confirms the reliability of this method, applicable to much larger samples of galaxies. In order to resolve the degeneracies associated with the Main Sequence (MS) relation, dust and gas evolution have been investigated by disentangling the effects of M_{star} and SFR. We observe no evolution in the gas fraction (f_{gas}) with redshift once M_{star} and SFR are fixed. We explain these trends by introducing a universal relation between fgas, M_{star} and SFR that does not evolve with redshift, at least out to z∼2.5. Galaxies move across such relation as their gas content evolves across the cosmic epochs. The projection of this 3D fundamental relation onto the M_{star}-SFR plane yields the MS and its evolution with redshift. We observe that the gas fraction of MS galaxies evolves differently depending on their stellar mass, in agreement with a downsizing scenario.