Star-dust interplay in late type galaxies at $z < 0.5$

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The huge growth of data available for the scientific community in the last decade allowed, for the first time in astronomy, a truly panchromatic approach. These data shed light on fundamental correlations, linking the dust component of a galaxy with its star formation rate (SFR). However, the relation between the SFR and dust emission is complex, and still it is not clear what mechanism drives it, motivating a further investigation. In this talk I will re-examine these correlations considering the intrinsic properties of the galaxies dust, and relating them to the SFR. We selected a sample of ∼800 normal star forming galaxies with photometric data between $0.15 < \lambda < 500$ μm, and analyzed them with different spectral energy distribution fitting methods.

The dust luminosities and the SFR show a strong correlation, but for low values of both parameters, the scatter in the correlation increases. We show that introducing a selection based on the fraction of ultraviolet emission absorbed by dust, we can reduce drastically the data scatter. Galaxies with similar absorption coefficients, despite a different SFR, have a similar balance between the fraction of dust heated by the star formation and the interstellar radiation field (IRF). Dust masses and SFR also show a correlation, but weaker with respect to the dust luminosities. Our results indicate that this scatter is due to a different intensity of the IRF produced by stars during late evolutionary stages, and this shifts the galaxies position in the dust mass-SFR plane. The differences in the intensity of the IRF is the origin of the observed scatter, and the correlation becomes stronger once selected galaxies following an IRF based selection criteria.

The link between dust and star formation is quite complex, with still many aspects to be investigated. We show that if we include in the analysis the internal properties of the dust, the scatter between SFR and dust mass and/or luminosities can be removed. In this context the MIR and FIR emissions play a crucial role, because they can trace both stellar and dust components, and reduce the uncertainties in the estimation of the balance between the two processes. This is even more clear investigating the feasibility of such analysis (focused on the nearby Universe traced by SDSS) at higher redshift, where this wavelength range will be observed through the MIRI and NIRCAM filters on board of the JWST. The typical SED of a normal star forming galaxy at $z \sim 0.2$ with JWST will be detected up to $z = 2$, however we observe that the non detections are related not only to the stellar mass of the galaxy, as expectable, but also to the amount of dust in thermal equilibrium within the ISM.

In the SFR versus stellar mass (M_*) plane these galaxies occupy a region included between local spirals and higher redshift star forming galaxies. These galaxies represent the population that at $z < 0.5$ quenches their star formation activity and reduces their contribution to the cosmic Star formation rate density. The galaxies subsample with the higher masses ($M_* > 3\times10^{10}$ $M_\odot$) does not lie on the main sequence, but shows a small offset, as a consequence of the decreased star formation. Low mass galaxies ($M_* < 1\times10^{10}$ $M_\odot$) settle in the main sequence with SFR and M_* consistent with local spirals. The multi-wavelength approach allows the identification of a mixed galaxy population, with galaxies still in an assembly phase, or galaxies at the beginning of their passive evolution. We show that if we include in the analysis the internal properties of the dust, the scatter between SFR and dust mass and/or luminosities can be removed.