Dusty star formation in the early Universe: lessons from ALMA

While the very first galaxies were metal and dust free, we can expect that after about a gigayear some galaxies produced significant dust contents through supernovae and AGB stars. Before ALMA, observing dusty galaxies at z>4 was a huge challenge and only a couple extreme objects (quasars, extreme submillimeter galaxies) were observed. In the recent years, large ALMA programs (ALPINE, REBELS) built statistical samples of normal star-forming galaxies at z>4 in dust continuum. In this presentation, I will review the main results on dust by these surveys.

ALMA revealed that the galaxies most massive at these early times are already significantly dust obscured (IRX > 0), while the lower mass ones are mostly transparent to UV. The most extreme massive systems have no optical counterparts, and it opens the question of a missed contribution to the star formation history at early times. While the IRX-beta relation follows in average the SMC, the attenuation curves exhibit large variations from one object to the other. It demonstrates that in absence of long-wavelength data star formation rates can be poorly estimated. After considering these effects, we can estimate that at z~5, about half of the UV from star formation is already absorbed by dust and re-emitted in the far infrared. Finally, I will discuss the evolution of the dust temperature and its impact on the interpretation of the high-z ALMA data.