The far-IR dust SEDs of z > 5 galaxies: Hot or Cold?

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Abstract

In the past, we have accumulated large samples of galaxies at z > 5 through extensive spectroscopic surveys. Recently, the ALMA Large Program to Investigate [CII] at Early Times (ALPINE) has gathered rest-frame 158um continuum and [CII] measurements for 118 normal main-sequence galaxies at 4 < z < 6. These data build an important first step to learn about the dust and metal content in the early Universe. However, one data point is not enough to constrain the shape of their far-IR SED, which is crucial to understand the dust properties of early galaxies in more detail. I will present a recent study in which we acquired 30h of additional ALMA observations for 4 ALPINE galaxies at z = 5.5 to constrain their far-IR SED by multiple data points for the first time. We find that their far-IR SEDs are cooler than expected (but still warmer compared to present day galaxies at similar IIR luminosities). Furthermore a comparison to IR-luminous dusty sub-millimeter galaxies at the same redshift shows that our galaxies are too hot for their far-IR luminosity. This could be a result of their lower metal content, lower dust mass density, or more diffuse spatial dust distribution. This idea is confirmed by our simple analytical model of dust emission through a spherical dust cloud including secondary heating: Hotter dust emission is expected in low-density dust environments, however, a threshold in hot dust emission is reached below a certain dust density (similarly to what is found in observations). JWST spectroscopy of these two populations of galaxies will tell us the differences in their evolutionary history and help us piece together a picture of how galaxies in the early universe formed and evolved.

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