R42b Dust Emission Model for Lyman-Break Galaxies

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Lyman-break galaxies (LBGs) contain non-negligible amount of dust. Takeuchi et al. (2003)(T03) constructed a model of the infrared spectral energy distribution (SED) for very young galaxies by taking into account the dust size distribution in the early stage of galaxy evolution, which can be different from that of present-day evolved galaxies. We applied T03 model to LBGs and constructed their expected SED. We also examined the detectability of LBGs at submillimeter wavelengths in an eight-hour deep survey by ALMA. In order to examine the grain size distribution of dust, we calculated the SEDs based on two distince type of the distribution models: single-sized distribution and power-law one ($dn/da \propto a^{-3.5}$).

We found that the power-law dust makes it easier to detect LBGs than the single-sized one, although the difference is not very large. It is interesting to note that, in a very early phase of the evolution (age $t \lesssim 10^8$ yr), galaxies with single-sized dust are brighter than those with power-law dust, but the situation is inverted when the galaxy becomes older $t \gtrsim 10^8$ yr: the latter get more luminous than the former in the (rest-frame) far-infrared (FIR) and the submillimeter. We also found that the difference of the grain size distribution affects the SED drastically at mid-infrared (MIR) wavelengths. Galaxies with power-law dust distribution have much less flux at MIR than the other. Generally, strong outflow is observed in LBGs, and consequently their geometry of dust configuration might be relatively simple. It reduces the uncertainty accompanied with radiative transfer, and we can safely explore the dust grain size distribution high-redshift galaxies by (observer-frame) FIR observations.