Abstract

Fruitful information about the galaxy properties can be derived from the spectral energy distribution (SED) of the dust thermal continuum, including the star formation rate (SFR) and dust and gas mass of galaxies, which are critical for understanding galaxy evolution. In practice, however, this can be challenging at high redshifts because most high-z objects have merely a few photometric data points in the dust SED owing to the high confusion noise of the infrared instruments and limited number of bandpasses available. To infer $L_{\rm IR}$ (and hence SFR) and gas mass of high-z galaxies thus requires understanding how far-infrared dust SED is shaped, which is the main topic of this thesis. For the study presented in this thesis, I adopt the galaxy SED catalogue produced using a sample of $z = 2 - 6$ galaxies generated by the the cosmological zoom simulation suite MassiveFIRE with the aid of the 3D dust radiative transfer code SKIRT. I explore in detail the physical mechanisms for shaping the far-infrared SED of galaxies, with a particular emphasis on the role of dust opacity and dust temperatures. I show that the bulk of the dust remains at low temperature at high redshift due to the dust obscuration near the young star-forming regions, and using a constant *mass-weighted* dust temperature (~ 25 K) provides a reasonably good estimate of the gas mass of high-z galaxies through the Rayleigh-Jeans (RJ) technique. In addition, I conduct a comprehensive analysis on the origin of the IRX-$\beta_{\rm UV}$ relation, a technique commonly adopted for deriving $L_{\rm IR}$ of galaxies based the UV data alone, and assess the different sources of both the intrinsic scatter as well as the observational biases of this relation. The results presented in this thesis link the theoretical study of galaxies at high redshift to observational constraints, thus providing new insights into the growth of galaxies and the physical processes driving the cosmic star formation history.