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Cosmological simulation with dust evolution

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Dust enrichment is one of the most important aspects in galaxy evolution. The evolution of dust is tightly coupled with the nonlinear evolution of the ISM including star formation and stellar feedback, which drive the chemical enrichment in a galaxy. Hydrodynamical simulation provides a powerful approach to studies of such nonlinear processes.

In this work, we perform a smoothed particle hydrodynamic simulation with a dust enrichment model in a cosmological volume. We adopt the dust evolution model that represents the grain size distribution by two sizes and takes into account stellar dust production and interstellar dust processing. We show that our cosmological simulation allows us to examine the dust mass function and to analyze the dust abundance and dust properties in galaxies statistically. The simulation broadly reproduces the observed dust mass functions at redshifts $z \sim 0$ and 2.5 and the relation between dust-to-gas ratio and metallicity shows a good agreement with the observed one at $z = 0$, which indicate a successful implementation of dust evolution in our cosmological simulation. Besides, we also examine the redshift evolution up to $z \sim 5$, and find that the galaxies have the highest dust abundance at $z = 1-2$. For the grain size distribution, we find that galaxies with metallicity $\sim 0.3 Z_{\odot}$ have the highest small-to-large grain abundance ratio at $z < 5$; consequently, the extinction curves in those galaxies have the steepest ultra-violet slopes.

Consider for a poster?

Yes

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