Evolution of Dust-to-Metal Ratio in Galaxies

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abstract This paper investigates the evolution of the dust-to-metal ratio in galaxies based on a simple
evolution model for the amount of metal and dust with infall. We take into account grain formation in stellar
mass-loss gas, grain growth by the accretion of metallic atoms in a cold dense cloud, and grain destruction by
SNe shocks. Especially, we propose that the accretion efficiency is independent of the star-formation history.
This predicts various evolutionary tracks in the metallicity ($Z$)-dust-to-gas ratio ($D$) plane depending on
the star-formation history. In this framework, the observed linear $Z$-$D$ relation of nearby spiral galaxies can
be interpreted as a sequence of a constant galactic age. We emphasize that an observational study of the
$Z$-$D$ relation of galaxies at $z \sim 1$ is very useful to constrain the efficiencies of dust growth and destruction.
We also suggest that the Lyman break galaxies at $z \sim 3$ have a very low dust-to-metal ratio, typically $0.1$.
Although the effect of infall on the evolutionary tracks in the $Z$-$D$ plane is quite small, the dispersion of the
infall rate can disturb the $Z$-$D$ relation with a constant galactic age.