Evolution of grain size distribution of galaxies

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Dust in galaxies affects the various evolutionary properties of galaxies, like star formation and spectral energy distribution (SED) of galaxies, etc. Further, these effects depend strongly on the grain size distribution in galaxies as well as the amount of dust. We construct a dust evolution model taking into account the grain size distribution and investigate the evolution of the distribution in galaxies.
We consider three processes as follows: (1) dust destruction by supernova (SN) shocks, (2) metal accretion onto the grain surface in the interstellar medium (ISM) (hereafter grain growth) (3) grain collision in turbulence (shattering and coagulation).

First, we only consider the dust produced by AGB stars and SNe II, dust destruction, and the grain growth. We can reproduce the evolution of dust mass in galaxies only by taking into account the two processes. We found that, however, these effects cannot produce small grains ($< 0.01\mu$m) efficiently. This is because the increase of the number of smaller grains is suppressed by the processes of dust destruction and the grain growth. Thus, small grain production is crucial to explain the observed dust grain size distribution.

We found that if we consider the effect of shattering, smaller grains are produced effectively. Further, the grain growth becomes more effective in earlier phase than the case without shattering, due to the increase of the number of small grains.
As for coagulation, while coagulation does not change the grain size distribution in galaxies significantly with evolution, the grain size distribution was found to be deformed to have a peak in $\sim 0.1\mu$m.