Simulations of Extinction Laws toward Steady Sources Surrounded by Circumstellar Dust

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Multiple scattering processes are important in considering the nature of extinction by circumstellar (CS) dust. For example, it has been shown that multiple scattering may explain the unusual extinction law toward Type Ia supernovae (SNe Ia) (Wang 2005; Goobar 2008). In this study (Nagao, Maeda, Nozawa, 2016, ApJ, accepted), we systematically study effects of multiple scattering on extinction laws for bright point sources surrounded by dusty CS medium using Monte Carlo simulations, adopting various dust models. We find that behaviors of the resulting extinction laws are dependent on the properties of CS grains, and therefore the extinction laws toward such dusty objects could be used to constrain the properties of dust they have produced. If applied to SNe Ia, we find that either silicate grains of small size or PAH (Polycyclic Aromatic Hydrocarbon) are important to realize the low values of R_V observed for SNe Ia.