Dust production in asymptotic giant branch stars

Sundar Srinivasan (ASIAA)

Low- and intermediate-mass stars (0.8 – 10 M_{sun}) ascend the asymptotic giant branch (AGB) towards the end of their lives. Their extended convective layers mix the products of shell hydrogen and helium burning – in particular, ^{12}C – into the photospheric regions. Pulsations then levitate this material to cooler layers, resulting in the formation of gas molecules and, further out, solid dust particles. The chemistry of the gas and dust depends on the small overabundance of either oxygen or carbon. Efficient outflows of material result from the interaction of dust with stellar radiation, and a significant fraction of the star's original mass can be returned to the interstellar medium, where it can be incorporated into the next generation of stars. Consequently, AGB mass loss has a very direct influence on the life cycle of dust in galaxies.

Recent theoretical developments have enabled a better treatment of AGB dust production in galactic chemical evolution and stellar population synthesis models. Together, such models predict the quantity and composition of AGB dust as well as the mass, color, and luminosity distributions of the underlying AGB population. Concurrently, improved observations allow us to compute their dust production rates via multi-band photometry, or investigate the dust properties using high-resolution spectra. In this review, I will compare the current theoretical predictions to constraints on AGB dust production from observational data.