The Impact of Large-Scale Surveys on Pulsating Star Research
ASP Conference Series, Vol. 203, 2000
L. Szabados & D. W. Kurtz, eds.

Link between Mass-Loss and Variability Type for AGB Stars?

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Abstract. We discuss difficulties in explaining the distribution of AGB stars in the 25−12 vs. 12−K color–color diagram by steady-state radiatively driven models, and propose that the discrepancy may be due to changes of mass-loss rate with the time scales of $\sim$ 100 yr.

We analyze the distribution of AGB stars in the 25−12 vs. 12−K color–color diagram with respect to their chemistry (O, C, S) and variability type (Miras vs. SRb/Lb). Positions of sources in this diagram depend mainly on dust grain chemical composition and amount of hot dust (500–1000 K). We find that stars are not distributed randomly in this diagram, but they occupy well defined regions according to their chemistry and variability type. While discrimination according to the chemical composition is not surprising, since the optical properties of silicate and carbon grains are significantly different at relevant wavelengths, the separation of Miras from SRb/Lb variables is unexpected.

We show that "standard" steady-state radiatively driven models provide excellent fits to the distributions of Miras of all chemical types (see astro-ph/9812421). However, these models are incapable of explaining the dust emission from O- and S-rich SRb/Lb stars. The models can be altered to fit the data by postulating different optical properties for silicate grains, or by assuming that the dust temperature at the inner envelope radius is significantly lower (300–400 K) than typical condensation temperatures (800–1000 K). While such lower temperatures are required only for O- and S-rich SRb/Lb stars, they are also consistent with the distribution of C-rich SRb/Lb stars. In addition to 25−12 vs. 12−K color–color diagram, differences in distribution of the peak position of the silicate 10-μm emission feature, and F_{18}/F_{10} flux ratio, determined from LRS data also indicate that dust temperature at the inner envelope radius might be lower for O-rich SRb/Lb stars than for O-rich Miras.

The absence of hot dust for SRb/Lb stars can be interpreted as a recent (order of 100 yr) decrease in the mass-loss rate. The distribution of O-rich SRb/Lb stars in the 25−12 vs. 12−K color–color diagram shows that the mass-loss rate probably resumes again, on similar time scales. It cannot be ruled out that the mass-loss rate is changing periodically on such time scales, implying that the stars might oscillate between the Mira and SRb/Lb phases during their AGB evolution.