Envelope Pulsations of a $1\,M_\odot$ AGB Star During Thermal Pulses

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Usually, the lower boundary conditions for non-linear hydrodynamic studies of the pulsations of Mira envelopes are taken from a core mass – luminosity relation and kept fixed. However, during thermal pulses (TPs) the luminosity L_* may vary by up to a factor of five on a timescale which is not much longer than the thermal timescale of the whole envelope. Ya'ari & Tuchman (1996, *ApJ*, 456, 350) have shown that Miras do not pulsate linearly around an equilibrium configuration but develop into an essentially non-linear regime.

Here, $L_*(t)$ as given by a stellar evolution calculation was used instead. In the "rapid dip" following the TP regular pulsations cease and the behavior is reminiscent of a semi-regular variable. In the following peak very violent oscillations may take place, even leading to some mass loss, if L_* is high enough. In one calculated example L_* (averaged over the pulsation cycles) drops from initially 3000 to $700\,L_\odot$ in the dip about 500 years after the TP and rises up to 3800 in the peak another 500 years later. In the quiescent hydrogen burning phase prior to the TP the period P is about 450 days, hence the star would most probably be observed as a Mira. As a response to the rapid luminosity variations P drops to about 100 days in the dip, showing small amplitudes and irregularities in the light curve, and rises to more than 500 days during the peak. This value is maintained for longer than 1000 years. The maxima of $L_*(t)$ in each pulsation cycle even reach up to $7000\,L_\odot$.

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