A New Generation of Model Atmospheres for AGB Stars Inspired by ISO

S. Höfner[1], R. Loidl[2], B. Aringer[2], U.G. Jørgensen[3], J. Hron[2]

[1] *Uppsala Astronomical Observatory, Box 515, SE-75120 Uppsala, Sweden*
[2] *Institute for Astronomy, Univ. of Vienna, Türkenschanzstr. 17, A-1180 Vienna, Austria*
[3] *Astronomical Observatory, NBIfAFG, Juliane Maries Vej 30, DK-2100 Copenhagen, Denmark*

The atmospheres of AGB stars are strongly influenced by the effects of stellar pulsation. The shock waves developing in the outer layers of the star due to the pulsation affect the atmospheric structure in two ways: local temporal variations caused by passing shock waves and a levitation of the outer atmosphere where the formation of molecules and dust takes place. Therefore a reliable interpretation of high-quality observational data like ISO-SWS spectra requires a consistent time-dependent modelling of the stellar atmosphere and circumstellar envelope.

Early attempts to calculate synthetic spectra in the ISO-SWS range showed that the state-of-the-art dynamical models – mainly constructed to investigate dust formation, mass loss and the observational properties of dust-enshrouded AGB stars – were not sophisticated enough to study molecular spectra in the IR. Therefore we started a project to improve the dynamical models, especially with regard to the treatment of molecular opacities and radiative transfer.

Recently, we have succeeded to construct a new generation of models which combine time-dependent dynamics and frequency-dependent radiative transfer (Höfner 1999, A&A 346, L9). The resulting synthetic spectra show a dramatic improvement compared to the existing dynamical models which are based on grey radiative transfer. The models cover a region which starts below the stellar photosphere and reaches out into the circumstellar envelope, giving a consistent description of the transition zone between the atmosphere and the stellar wind. This region of the outer atmosphere and inner circumstellar envelope can be probed by analysing molecular features in the ISO-SWS spectra that we have obtained.

We are currently working on a small grid of such non-grey time-dependent model atmospheres to study the influence of stellar parameters and pulsation properties on the IR molecular spectra. Preliminary results indicate that some features which cannot be explained by classical hydrostatic model atmospheres may be a natural consequence of the dynamical processes (see also contributions by Loidl et al. and Aringer et al.).