The promise for AGB stars: The physics/chemistry of the inner circumstellar envelope, and the mass loss history

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Physics/chemistry of the inner envelope
The PACS imaging line spectrometer will provide important information on the physical/chemical conditions in the inner circumstellar envelopes of AGB-stars, e.g. on the rotational transitions of the important coolants CO, HCN, and H_2O, and on various molecular species that participate in the initial chemistry of the escaping gas. ISO was limited to high mass loss rate and/or very nearby objects. In addition studies of the dynamics in the acceleration zone will be possible with HIFI.

Dust composition
Most of the solid state features are found in the NIR and MIR ranges, although a crystalline water ice feature at 62 μm has been seen towards early post-AGB objects, planetary nebulae, Herbig Ae/Be stars, and Herbig-Haro objects. Most ISO observations in these ranges were suffering from too low S/N-ratios. The sensitivity of FIRST is superior, but the short wavelength end of PACS may limit what can be achieved in this area.

Long-term evolution of the AGB mass loss
The temporal variation of the mass loss rate is to a large extent unknown. This applies to all time scales from the pulsation period to the full time scale of the AGB-phase. On the intermediate time scales (10^2–10^4 yr) there is now growing evidence for substantial variations in the mass loss rate, e.g. detached CO and dust shells and multiple-shell structures seen in scattered light. Extended dust emission observed with PACS, perhaps in combination with SPIRE, will provide important results on the long-term mass loss history.