Surveying Gas in Post-AGB Disks

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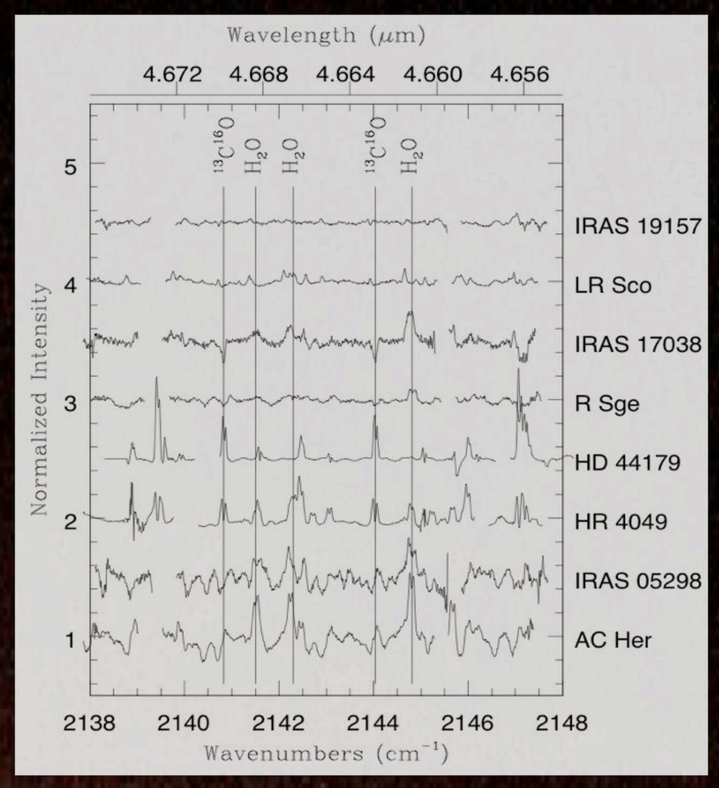
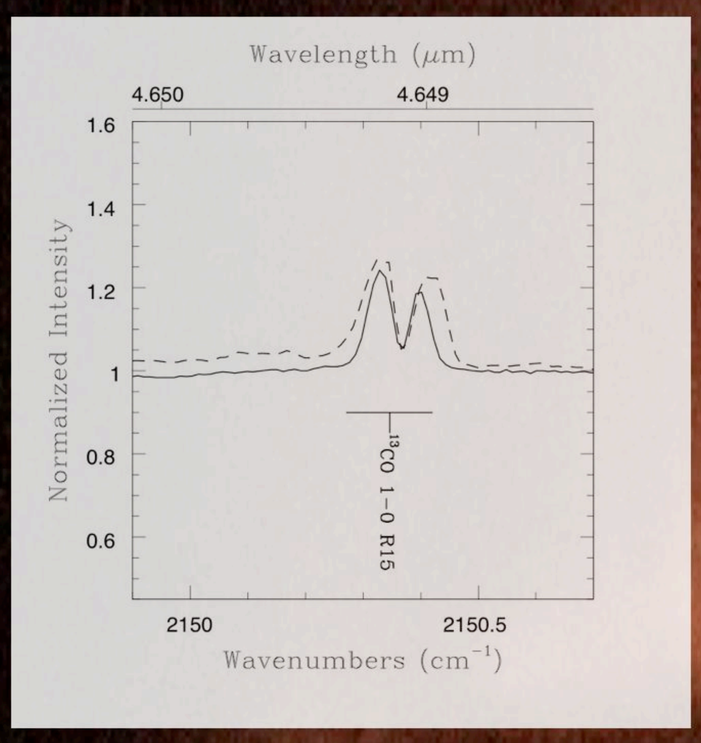
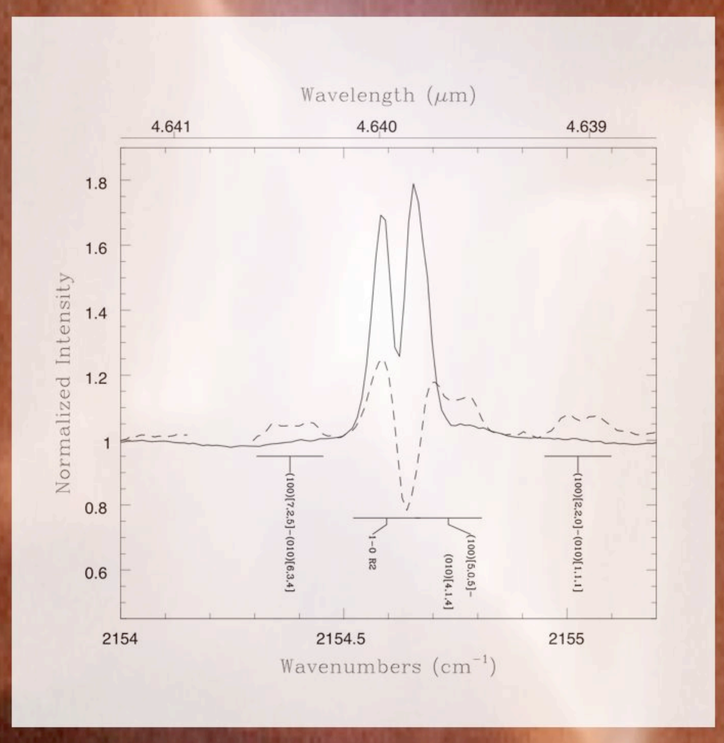
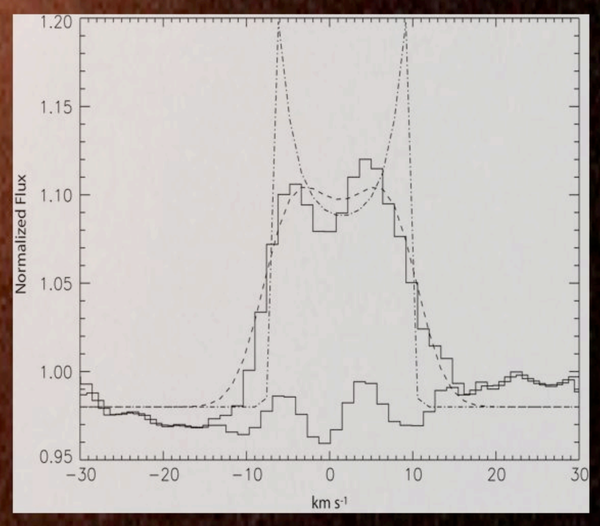
The 4.6 μm spectra of A-K post-AGB supergiants were observed with Phoenix/Gemini at high resolution (R~50000). The stars were selected because their mid-Infrared colors suggest the presence of thick disks. Optical spectroscopy suggests that all these objects are single lined spectroscopic binaries. Our infrared spectra reveal for most stars the presence of CO and sometimes H_2O lines from a disk. A sample of spectra are shown to the right. The disks appear to be circumbinary and likely result from mass ejection in the common envelope phase.



Line profiles give the projected rotational velocity of the disk and information on gas outflow from the central cavity. Two profiles from HR4049 (dashed) and HD 44179 (solid) are compared at left and center. A HR 4049 line profile (below right) is shown modeled by a gas layer interior to thick dust disk with an inclination of 60°.

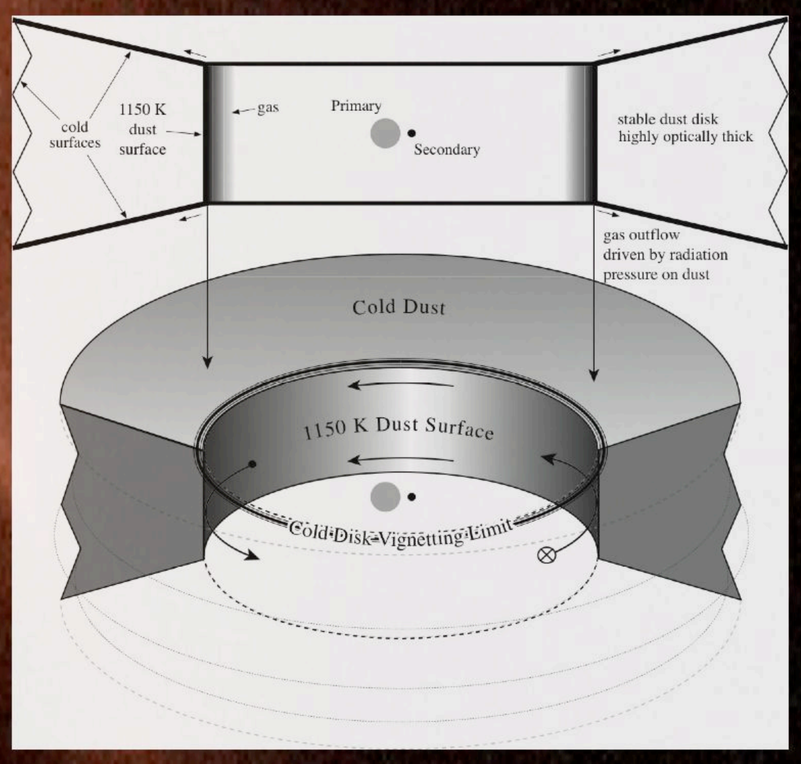






HR 4049

In the prototype HR 4049 the 4.6 μm spectrum shows a rich emission line forest of circumbinary origin. The presence of H_2O lines confirm the oxygen-rich nature of the circumbinary gas which is in contrast to previously detected carbon-rich dust. Modeling of the line profiles shows that the circumbinary gas is located in a thin, rotating layer near the dust disk. For HR4049 the inclination and inner diameter of the disk have been modeled from the SED. The model resulting from the combined spectroscopy and photometry is shown at right. This model allows the masses of the individual stars in the binary, $M_{A\,I}$~0.6 $M_\odot$ and $M_{M\,V}$~0.3 $M_\odot$, to be derived. The typical white dwarf mass for the supergiant confirms the post-AGB nature of this star. Results are detailed in 2007 ApJ 664 501.



Model disk (Dominik et al. 2003 AA 397 595). The central binary consists of a post-AGB star typically with a dwarf companion.

Red Rectangle = HD 44179

The HD 44179 disk is seen more edge on than HR 4049. As for HR 4049 we see lines formed in the inner cavity implying an inclination of ~80°. The disk lines do not undergo radial velocity shifts with orbital phase so the disk, as show in the cartoon above, is circumbinary. This is contrary to conclusions of Witt et al. 2009 ApJ 693 1946. The HD 44179 disk has much less H_2O than HR 4049 perhaps as a result of more extensive grain processing. Background: NASA-HST Red Rectangle nebula image--van Winckel & Cohen.