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MODELS FOR THE IRAS LOW RESOLUTION SPECTRA OF OH/IR STARS

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ABSTRACT

We investigate models for the IRAS LRS (Low Resolution Spectra) of OH/IR stars. OH/IR stars often show the silicate features at 9.7 μm and 18 μm in the spectra obtained by the IRAS LRS as well as remarkably red values in the IRAS photometric colors such as [60]-[25] and [25]-[12]. We compare the radiative transfer model results with observed spectral energy distributions (SEDs) of the stars including IRAS PSC (Point Source Catalog), IRAS LRS and ground based observational data.

1. INTRODUCTION

OH/IR stars with oxygen rich circumstellar dust shells are long period variables with periods between 500 to 2000 days. OH/IR stars which thick dust shells have low effective temperature and these show 9.7 μm and 18 μm silicate feature (Herman & Habing 1985). In this paper, we have compared the radiative transfer model results with observed SEDs of the OH/IR stars including IRAS PSC and IRAS LRS data.

2. MODEL CALCULATIONS

For this paper, we have used the radiative transfer code developed by Egan, Leung, & Spagna (1988) for a spherically symmetric dust shell. For the central stellar, we assume that the luminosity is $1 \times 10^4 L_\odot$ and the black body temperature is 2000 K for all the OH/IR stars. We have used the optical constants derived by Suh & Jones (1997) for silicate dust grains. From the optical constants (n, k) at given wavelength and the size of the grain, the optical efficiency factors are calculated by using the Mie theory. The dust condensation temperature (T_c) is assumed to be 1000 K and the dust condensation radius (R_c) is obtained after a few trials. The outer radius of the dust shell is always taken to be 1000 R_c. The radii of spherical dust grains have been assumed to be 0.1 μm uniformly. The total optical depth (τ) is given at 9.7 μm. And the dust density distribution is assumed to be inversely proportional to the square of the distance ($\rho(r) \propto r^{-2}$).

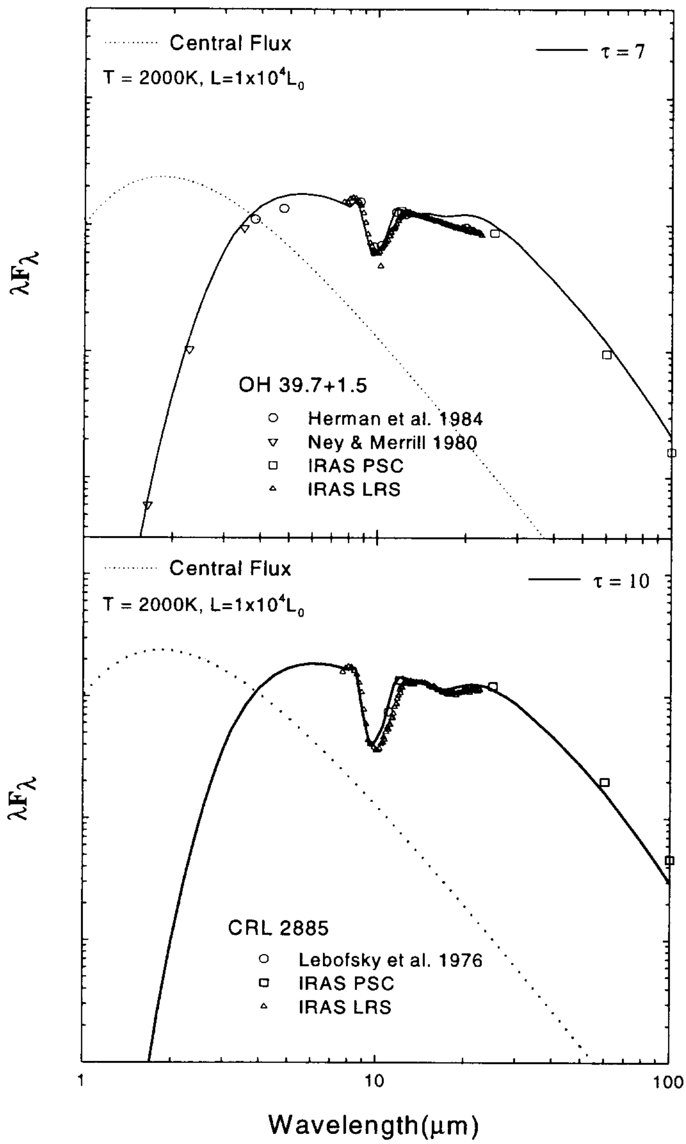

Figure 1. Model results compared with the observation of OH39.7+1.5 and CRL 2885.

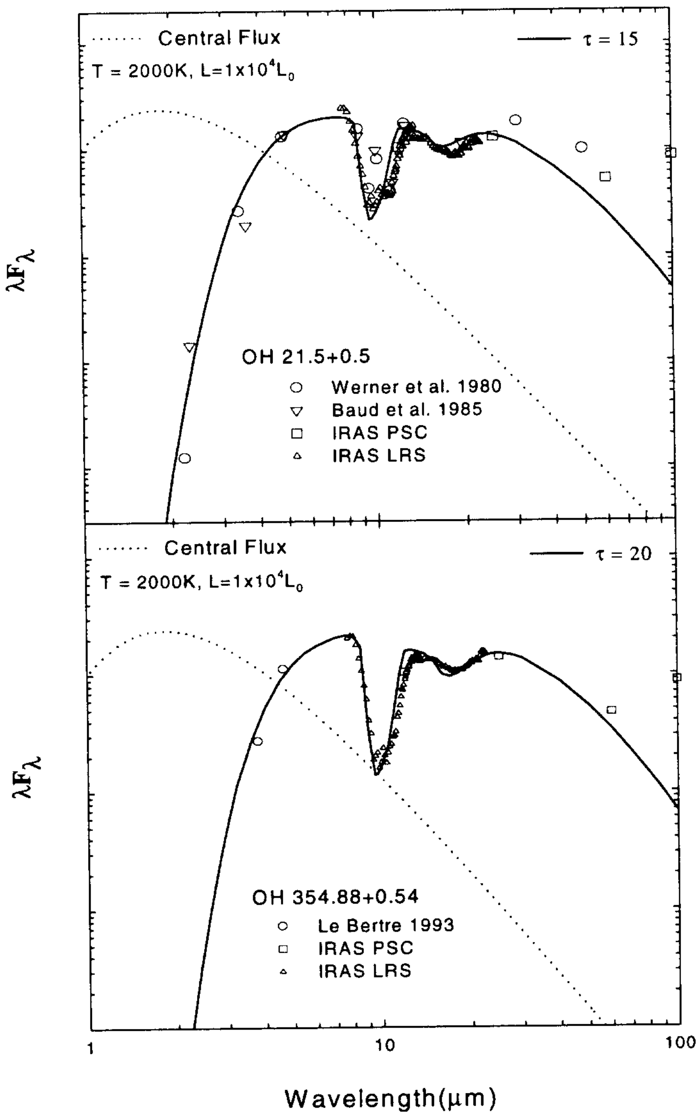

Figure 2. Model results compared with the observation of OH21.5+0.5 and OH354.88+0.54.

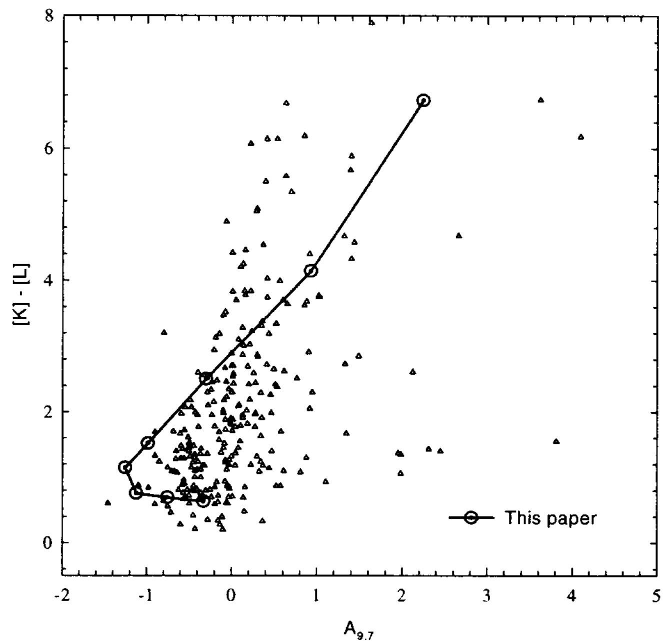

Figure 3. Infrared color index [K-L] compared with $A_{9.7}$.

3. SPECTRAL ENERGY DISTRIBUTION COMPARISON

IRAS LRS provided low resolution spectra from about 8 to 23 μm using a slitless spectrometer. The spectra were observed in two section: a blue section from 8 to 13 μm with resolution $\lambda/\Delta\lambda \sim$ 40 and a red section from 11 to 22 μm with resolution $\sim$ 20. The better quality spectra were collected into the IRAS LRS, which contains the average spectra of 5425 objects However, these spectra are only a small part of the full set of observations. IRAS LRS have 100 observed data at wavelength from 8 to 13 μm and from 11 to 22 μm, respectively. For modeling, we have selected 4 OH/IR stars. We have obtained the results of model calculations as described in last section. We have compared the results with the observed SEDs of the following OH/IR stars, OH39.7+1.5, CRL2885, OH21.5+0.5 and OH345.88+0.54. Results of the model calculations (lines) superimposed on observational data (symbols) for OH39.7+1.5, CRL2885, OH21.5+0.5 and OH354.88+0.54 are shown in Figure 1 and Figure 2.

4. TWO-COLOR DIAGRAM

We have obtained the infrared color index [K-L] versus the depth of 9.7 μm feature. The $A_{9.7}$ is defined by equation 1. We have obtained the $A_{9.7}$ from IRAS LRS data for 258 OH/IR stars. Figure 3 shows the model results compared with observations. The small triangles are the observational data for the 258 OH/IR stars and the lines with large symbols are the results of the model calculations for this paper.

$$A_{9.7} = 2.5 \log \frac{\lambda F_{\lambda(8\mu m)} + \lambda F_{\lambda(12\mu m)}}{2\lambda F_{\lambda(9.7\mu m)}} \quad (1)$$

5. CONCLUSIONS

In this paper, we have used IRAS LRS data to make more complete SEDs for OH/IR stars. We have compared the radiative transfer model results with detailed observed SEDs of the stars including IRAS PSC, IRAS LRS and ground based observational data. If our assumption that $\rho(r) \propto r^{-2}$ and T_c=1000 K is right, the model parameters used for this paper could be useful for investigating AGB stars

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