THE 3.4 MICRONS ABSORPTION FEATURE IN CRL 618

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1. Introduction

CRL 618 is a bipolar proto-planetary nebula which is rapidly evolving from an AGB star into a planetary nebula (Westbrook *et al.* 1975). The central star is optically invisible; a bright infrared source is present at its position. Lequeux and Jourdain de Muizon (1990) obtained a 3.1-3.8 μm spectrum of the object in a 5" aperture, detecting lines of atomic and molecular hydrogen and an absorption band at 3.4 μm. Their spectrum is the first evidence that the carrier of the 3.4 μm feature, which has been detected along several lines of sight in our galaxy (e.g., Pendleton *et al.* 1994) and in at least two other galaxies, is found in the envelopes of some highly evolved stars.

In 1995 December we obtained improved 3 μm observations of the infrared object at the center of CRL 618, using CGS4 at UKIRT. The resultant spectrum, shown in Fig. 1 covers an area of 3.6"x 1.2" (RA x Dec) and has a resolution of about 0.0030 μm. It shows a rising "dust" continuum, fifteen emission lines of H I and H_2, broad 2.99-3.08 μm and 3.35-3.55 μm absorption features, and a weak 3.3 μm UIR emission feature.

2. Discussion

The detection of the 3.3 μm UIR band confirms the tentative detection by Lequeux and Jourdain de Muizon (1990). The absorption near 3.0 μm is similar, although not identical to those seen in many carbon stars, and has been identified as due to HCN and C_2H_2 in IRC+10216 (Hall & Ridgway 1978).

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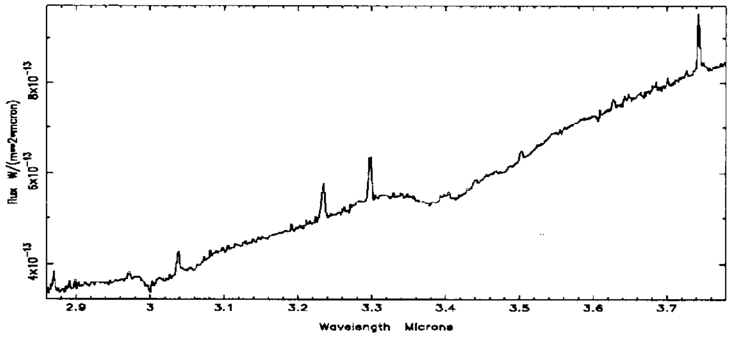

Figure 1. 3 μm spectrum of CRL 618

The profile of the 3.4 μm absorption (without the superposed H_2 lines at 3.44 and 3.50 μm) is almost identical to those seen in the galactic center and elsewhere. Noteworthy are the sub-peaks at about 3.38 μm and 3.42 μm, which are only marginally present in spectra of other sources. Their wavelengths and the general structure near 3.48 μm match laboratory spectra of methyl and methylene groups in saturated aliphatic hydrocarbons.

It has been widely considered that in the 3.4 μm feature arises in organic residues produced by UV photolysis of dirty ices which originally formed in dark clouds (e.g., Sandford *et al.* 1991). As there is no ice in CRL 618, this supposition is at least partially incorrect. In the carbon-rich environment of CRL 618, the carrier(s) may be produced by the interaction of hydrogen atoms with graphitic materials in the presence of UV radiation, or by proton bombardment of carbon-rich dust in shocks. Models along these lines have been proposed recently by several groups (e.g., Tielens *et al.* 1994).

Indeed it must now be questioned whether the carrier of the 3.4 μm feature ever is manufactured in the interstellar medium. Two small groups of objects, an unusual subset of post-AGB objects and certain novae show emission features near 3.4 μm which are nearly the mirror image of the 3.4um absorption feature (see Geballe 1997). Material from these types of objects also may contribute to the interstellar 3.4 μm absorption feature.

References

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