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On the nature of the 30-μm feature in carbon-rich Planetary Nebulae

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We report on the analysis of the 30-μm feature seen in the spectra of ten C_{60}-containing carbon-rich Galactic planetary nebulae, and establish that the feature and the continuum emission could be due to the same carrier.

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We have searched the Spitzer Space Telescope archive for Galactic Planetary Nebulae observed with the Infrared Spectrograph (IRS), showing the characteristic resonances due to C_{60} at 17.4 and 18.9 μm [1]. We identified 11 such sources, including five that were previously known to contain fullerenes. The spectra all show a prominent 30-μm feature, commonly attributed to MgS [2]. However, doubt was cast over this identification by Zhang et al. [3], using energetic and abundance arguments.

We have explored the possibility that the 30-μm feature is an intrinsic resonance to the carrier of the cold dust continuum, by constructing an astronomical carbon-dust opacity table (Fig. 1), and fitting it to ten of the sources in our sample for which sufficient spectral data are available. We are able to achieve a good fit in all ten cases (Fig. 2), implying that the carrier of the dust continuum and the 30-μm feature can be one and the same material. Indeed, the graphite opacities presented by Draine & Lee [4] show a strong resonance around 40 μm, which may shift to shorter wavelengths when the conductivity of the graphite changes [5].

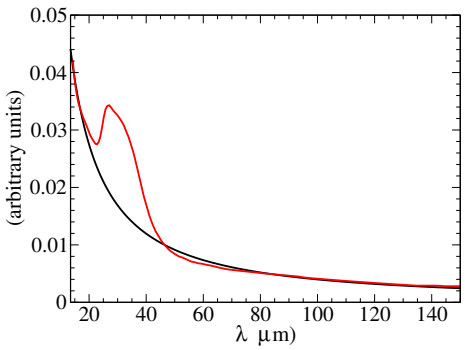

Figure 1: The derived opacity table for the carrier of the 30 μm feature and the dust continuum (red), compared to a power-law opacity $\propto \lambda^{-1.2}$ (black). Figure taken from [1].

These results recently appeared in press, and the reader is referred to Section 4.8 in the work by Otsuka et al. [1], where a detailed description of the analysis is given.

References

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[3] K. Zhang, B. W. Jiang, & A. Li, *On Magnesium Sulfide as the Carrier of the 30 μm Emission Feature in Evolved Stars*, ApJ **702**, 680–685 (2009), [0907.1037]

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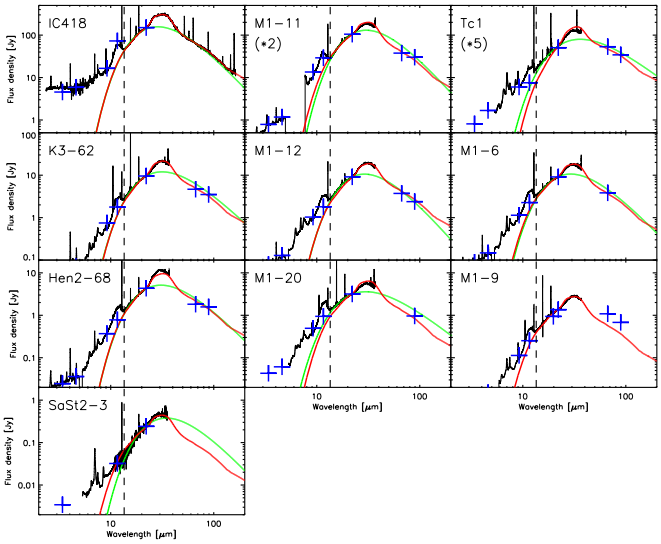

Figure 2: The best fit results for each of the objects to the continuum emission beyond 13.5 μm, and the 30 μm feature. The spectra are shown in black, and the photometry points with blue crosses. The red line shows the best fit result, which was fit to the data to the right of the dashed line. The best fit modified blackbody, e.g. a single temperature blackbody multiplied by a λ^{-p} emissivity law, to the same data is shown for comparison in each of the panels with a green line. For clarity, the spectra of M1-11 and Tc 1 are shifted by the indicated factor. Figure taken from [1].