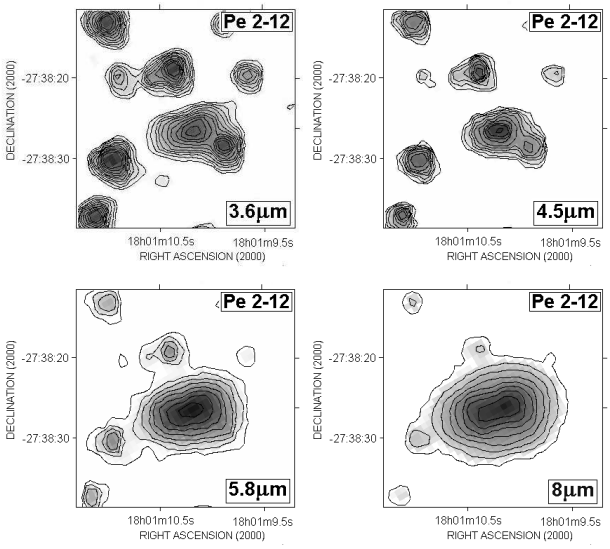

Fig. 2. Contour maps of Pe 2-12, where contour levels [A, B, C] are given by [9, 3.65, 0.1780] at 3.6 μm, [10, 2.58, 0.1111] at 4.5 μm, [10, 4.44, 0.1780] at 5.8 μm, and [17.5, 10.33, 0.1780] at 8.0 μm. It will be noted that the dimensions of the source appear to increase with increasing MIR wavelength, and that the internal contours are highly elliptical, perhaps indicative of a barely resolved bipolar structure.

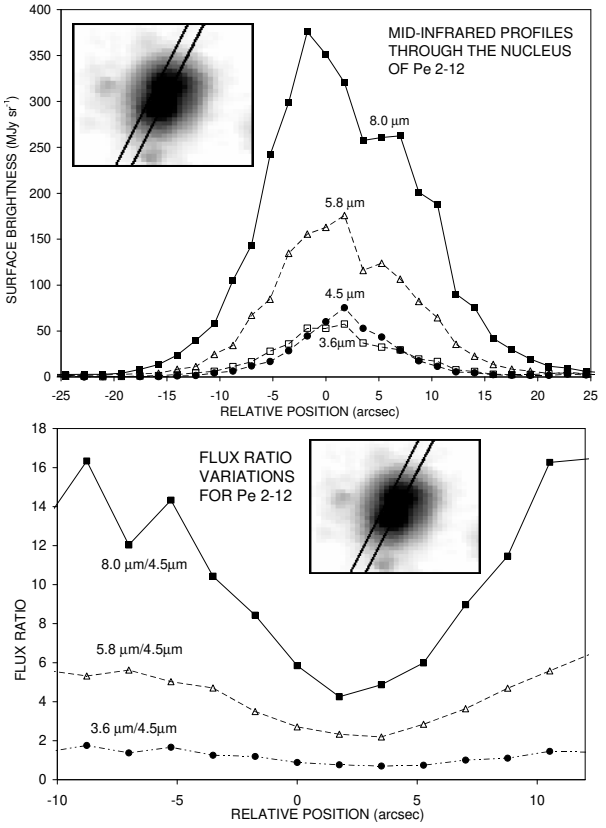

Fig. 3. Profiles along the major axis of Pe 2-12, where we show the variation in surface brightness with nebular position (upper panel), and of the flux ratios 3.6 μm/4.5 μm, 5.8 μm/4.5 μm, and 8.0 μm/4.5 μm (lower panel). The inserted images show the directions and widths of the traverses used for these trends. It will be noted that the longer wave profiles have a somewhat double-humped appearance, as might be expected where we are observing the two lobes of a bipolar structure – and there is indeed some further indication of this structure in the inserts, and in the contour maps in Figure 2. Note the evidence for an increase in flux ratios with distance from the nucleus.

find $1/10^{\rm th}$ peak emission widths of 10.0 arcsec at 4.5 μm, 13.0 arcsec at 5.8 μm, and 14.7 arcsec at 8.0 μm. Such a trend is closely comparable to what has been seen in other PNe (e.g., Phillips & Ramos-Larios 2008a; Ramos-Larios & Phillips 2008), and may be attributable to PAH band emission within the nebular PDR; the ν=0-0 S(4)-S(7) transitions of H_2; and warm dust continua arising from stochastic heating of small grains (Phillips & Ramos-Larios 2008a).

It is also conceivable, although perhaps less likely, that lower excitation ionic lines contribute to these trends, including the λ8.99 μm transition of [ArIII]. The absence of spectra for the exterior regions of this source precludes us from constraining these mechanisms, or defining which is the most dominant – and a similar situation applies for other nebulae as well. However, the presence of PAH band emission in PNe such as NGC 40 (Ramos-Larios et al. 2010), and in the PDRs about compact HII regions (Phillips & Ramos-Larios 2008c), suggests that the increase in MIR fluxes to longer wavelengths, and the extended emission in the 5.8 and 8.0 μm channels may arise from small PAH molecules within the nebular PDRs. This is perhaps the primary mechanism where C/O > 1.

The evolutionary status of this source is quite uncertain, although one might envisage that where the PN is relatively young (and the dimensions of the ionised regime are small), then we may be observing an envelope which is largely neutral and emerging from the proto-planetary phase of evolution. Having said this, we note that Zhang (1995) quotes a statistical distance of 15.4 kpc, which would place Pe 2-12 well on the other side of the Galactic centre. The corresponding physical size (for an optical diameter of $\Theta = 5$ arcsec) would then be of the order of $\sim$0.37 pc, making the source reasonably evolved.