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MAPPING AND SPECTROSCOPY OF PLANETARY NEBULAE IN THE MID-INFRARED

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We present mapping, profiles and photometry for 24 planetary nebulae (PNe) detected in the GLIMPSE 3D mid-infrared (MIR) survey of the Galactic plane. This has involved mapping the shells in the 3.6, 4.5, 5.8 and 8.0 bands, as well as obtaining profiles through the nuclei, and maps of flux ratio parameters. The PNe show many of the properties observed in previous studies of these sources, including evidence for longer wave emission from outside of the ionised zones, a likely consequence of emission from polycyclic aromatic hydrocarbons (PAHs) within the nebular photo-dissociation regimes (PDRs). We also note variations in 5.8 μm/4.5 μm and 8.0 μm/4.5 μm flux ratios with distance from the nuclei, and present evidence for enhanced MIR emission in the halos of the sources – 5.8 and 8.0 μm halo surface brightnesses, when compared to maximal values within the nuclei, appear to be >10 times greater than are observed in the visible.

It is apparent that the haul of extended, higher surface-brightness PNe is rather slim - particularly when compared to what has been observed in previous surveys (e.g. Phillips & Ramos-Larios 2008; Ramos-Larios & Phillips 2008). This was, in general, broadly to be expected, given that the 3D survey covers regions which are further away from the Galactic plane, and at larger positive and negative latitudes. The spatial density of PNe is very much reduced compared to those observed at lower Galactic latitudes

It is finally worth noting that a good fraction of the PNe detected in this survey were either extremely compact and unresolved, or had a size which was too modest to permit a useful analysis. Four examples of the latter sources are: M 1-27, M 1-35, Pe 1-6 and Pe 1-15. The most extended of these sources are M 1-27 and Pe 1-6, both of which have circular/elliptical morphologies. It is clear however that it would be difficult to reliably assess their properties, and/or assess spatial trends in their emission.

We have also presented the first phase of photometry for GLIMPSE 3D sources, limited (in this case) to PNe having evidence for spatial extension. The colour-colour mapping of these results appears similar to what has been observed for other PNe, although we also note evidence for a possible secular evolution in the [5.8]-[8.0] indices. The more evolved GLIMPSE I sources appear to have lower mean colours, whilst the (mostly) less evolved Acker et al. (1992) nebulae have larger values of this parameter. This may reflect corresponding variations in nebular emission mechanisms.

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