

# Mid-Infrared Imaging of Dust Shells around Young Planetary and Proto-Planetary Nebulae

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The results presented here are from an ongoing mid-infrared imaging study of PPNe and PNe, using MIRAC2 the UA/SAO mid-IR camera. Our 8-21  $\mu\text{m}$  observations have a spatial resolution of about 0.7'' to 1.5'', and a pixel scale of 0.25''/pixel (at UKIRT) or 0.34''/pixel (at IRTF). The high S/N and good spatial sampling in our images of IRAS 22272+5435 and IRAS 07134+1005 allow us to construct temperature and optical depth maps. Using our 11.7 $\mu\text{m}$  and 20.6 $\mu\text{m}$  images we also construct maps which isolate the 11.3 $\mu\text{m}$  (UIR) and 21 $\mu\text{m}$  emission features (Justannont et al. 1995). As a second part of this project, we are modelling the dust emission from PPNe and young PNe, using a axisymmetrical radiative transfer code.

(i) **IRAS 22272+5435:** Our analysis shows the emission is optically thin and the peak temperature of the dust shell is about 190 K, towards the center of the nebula; the isotherms are elliptical along a PA $\approx$ 60°. The ellipticity of the isotherms suggests that the hotter dust grains lie in a disk inclined about 45° to the line of sight. The 11.7  $\mu\text{m}$  feature-to-continuum ratio (Fig 1) peaks about 1.8'' S-E of the center of the nebula. The 11 and 21 $\mu\text{m}$  feature emission appear to be co-spatial with the cooler dust (150K) emission, traced by the 17.8 $\mu\text{m}$  images.

(ii) **IRAS 07134+1005:** The temperature is fairly uniform over the surface of the nebula, at 175 K. The strong 20.6 $\mu\text{m}$  feature emission appears to show a bipolar shape similar to the 20.6 $\mu\text{m}$  continuum. However, the feature-to-continuum ratio is lower towards the center of the nebula.

## REFERENCES

Justannont, K., Barlow, M.J., Skinner, C.J., Roche, P.F., Aitken, D.K. & Smith, C.H. 1996, A&A, 309, 612

Fig. 1: IRAS 22272+5435: Contours show temperature from 150K to 190K; the grayscale shows the 11.7  $\mu\text{m}$  feature-to-continuum ratio map, from 0.3 (white) to 0.6 (black).

