Planetary Nebulae in our Galaxy and Beyond
Proceedings IAU Symposium No. 234, 2006
M. J. Barlow & R. H. Méndez, eds.

doi:10.1017/S1743921306003814

Sub-arcsec mid-IR imaging of OH 231.8+4.2

C. Muthumariappan[1], Sun Kwok[2] and Kevin Volk[3]

[1]Institute of Astronomy & Astrophysics, Academia Sinica, Taiwan
email: muthu@asiaa.sinica.edu.tw

[2] Department of Physics, University of Hong Kong, Hong Kong, China
email: sunkwok@hku.hk

[3] Gemini Observatory, Hilo, Hawai'i, U.S.A
email:kvolk@gemini.edu

Abstract. We present 0.18″ resolution mid-infrared images of OH231.8+4.2 using the *Gemini* South telescope. The images show a bright central core of ∼1″ in size, with extended emissions in the lobes. We find evidence for different chemical composition of the dust in the core and the lobes from the narrow-band images.

1. Introduction

OH231.8+4.2 is an oxygen-rich bipolar reflection nebula which shows OH emission (Bujarrabal & Bachiller 1991, Alcolea *et al.* 2001). Although it is often referred to as a proto-planetary nebula, the fact that it has a Mira variable in the center suggests that it could be a symbiotic star.

OH231.8+4.2, like several other bipolar reflection nebulae, is a strong infrared source where most of the energy is emitted from the dust component. The central stars of these nebulae are often obscured by a dust torus believed to play an important role in the shaping of the nebulae. A good determination of the shape and size of the torus and its relation to the bipolar lobes is needed to understand the shaping process. The 8-m *Gemini* telescopes, with their almost diffraction-limited imaging capability in the mid-IR, are ideally suited for this purpose. In this paper, we present mid-IR images of OH231.8+4.2 obtained with the *Gemini* South telescope.

2. Observations

Observations were made with the Thermal Region Camera and Spectrograph (TReCS) at the *Gemini* South telescope with a pixel size of 0.09″ and a FOV of 28.8″ × 21.6″ . The FWHM of the image at 10 μm is 0.4″. The data were reduced using *Gemini* IRAF tasks and were calibrated for photometry. Pixel-limited spatial resolution was obtained with deconvolution which was then smoothed with 2″×2″ matrix.

3. Results

Mid-IR emission in this nebula is concentrated in a core of size 1″ diameter. Extended emissions are also seen along the polar regions (Fig. 1). At longer wavelengths, the emission is more extended along the equatorial regions and is enhanced in the polar lobes. From fluxes measured through filters with central wavelengths 7.73, 8.74, 9.69, 10.38, 18.3, 20.68 μm, the spectra of core and lobes can be plotted separately (Fig. 1). We can see that the spectra of the core and the lobe are very different. The core shows a strong featureless 10 μm absorption band consistent with amorphous silicates, whereas

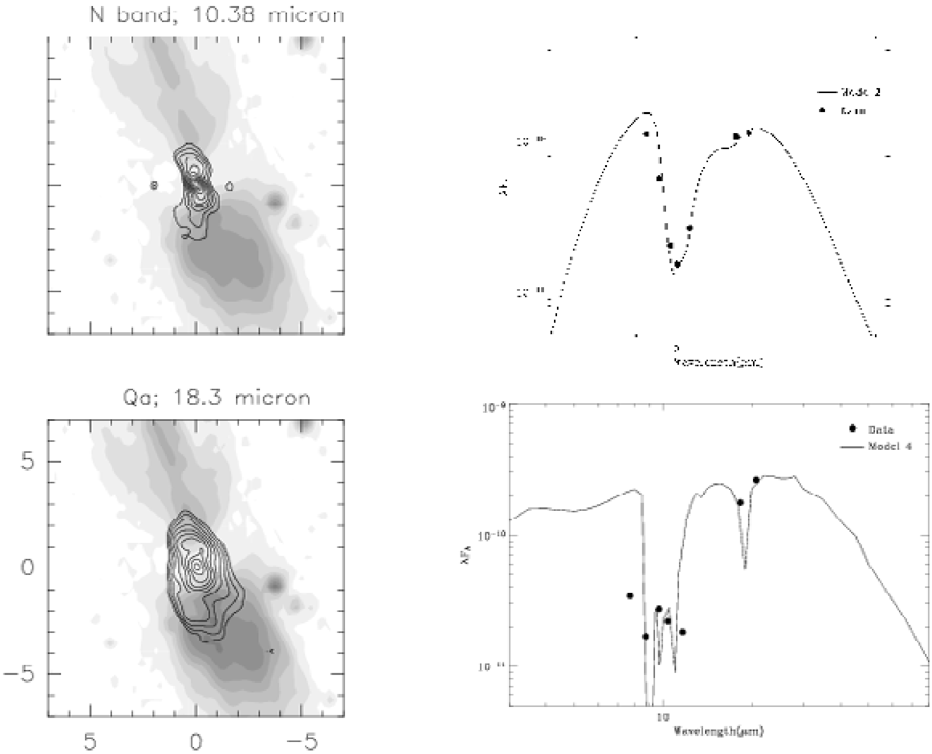

Figure 1. Left: TReCS images (line contours) of OH 231.8+4.2 superposed on the 675W image (grayscale) of *HST*. Right: the spectrum of the core (top right panel) and the lobes (right bottom panel). The dots are *Gemini* photometry and the curves are model fits to the phometry. The chemical composition of the dust is assumed to be amorphous silicates and alumina in the core, and amorphous silicates and alumina plus crystelline enstatite in the lobes.

the spectrum of the lobes shows discrete narrow features. If we assume that the core is the result of recent mass loss, then this difference suggests a different chemical composition of the dust between the two different phases of ejection. The spectra of the core and the lobes are fitted with the 1-D radiation transfer code DUSTY, with an assumed radial density distribution of $r^{-1.5}$.

The dust mass derived from the 20.68 μm flux of our observation is 2.2× 10^{-4} $M_\odot$ assuming optically thin conditions. The total dust mass derived from the 60 μm IRAS flux is 4.8× 10^{-3} $M_\odot$, implying that a large amount of cool dust is present at larger radial distance which is not seen in mid-infrared.

Our results shows that ground based mid-infrared imaging obtained with large, thermally optimized telescopes like *Gemini* are capable of resolving the circumstellar dust shells. Such observations will give us important clues on the chemical composition of the dust in different parts of the nebulae.

References

Alcolea, J. *et al.* 2001, A&A, 373, 932
Bujarrabal, V., and Bachiller, R. 1991, A&A, 242, 247