PLANETARY NEBULAE: THEIR EVOLUTION AND ROLE IN THE UNIVERSE
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IR Spectroscopy and Imaging of IRAS 16342-3814

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1. Introduction.

The late stages of stellar evolution of stars with low or intermediate mass (1 $M_\odot$ to 8 $M_\odot$) are characterized by extensive mass loss, which can be traced in their circumstellar environment. Here we consider the case of IRAS 16342-3814, a bipolar proto planetary nebula which shows very high velocity (~ 50 km s^{-1}) OH maser emission (Sahai et al. 1999). We present the complete Infrared Space Observatory (ISO) spectrum and an infrared TIMMI2 Q-band image of this source. Based on these data we discuss the composition and geometry of the circumstellar dust in IRAS 16342-3814.

2. Overview of the observations and preliminary discussion.

The ISO spectrum of IRAS 16342-3814 (see figure 1, left panel) is characteristic of that of an extremely reddened OH/IR type Asymptotic Giant Branch (AGB) star, perhaps the reddest observed until now. Saturated amorphous silicate absorption features are seen at 10 and 20 μm, together with *crystalline silicate absorption* features up to 45 μm. No other OH/IR star is known to have crystalline silicate features in absorption at these wavelengths. A 45 μm feature of crystalline water ice is also found in absorption.

The behaviour of the amorphous and crystalline silicate and crystalline water ice features suggests that IRAS 16342-3814 must have an extremely large mass-loss rate. Indeed, a preliminary radiative transfer calculation of the circumstellar envelope suggests that the mass loss rate may be as large as 10^{-3} $M_\odot yr^{-1}$. Such mass loss rates are only expected during the final stages of the AGB phase (the super wind phase) after which the star turns into a protoplanetary nebula or post-AGB star.

Optical images, taken at 0.55 and 0.80 μm with the Hubble Space Telescope (HST), reveal a bipolar reflection nebula, with a dark equatorial waist separating the two lobes of the nebula and obscuring the central star. These images suggest that IRAS 16342-3814 is a protoplanetary nebula (Sahai et al. 1999). Combined with our observation of IRAS 16342-3814 still having an extremely reddened OH/IR type spectrum, we therefore suggest that the star must be a very young

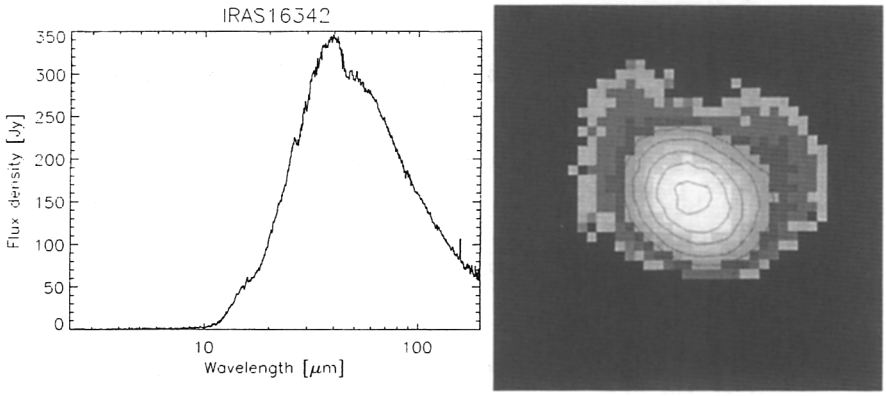

Figure 1. The ISO spectrum (left panel) and the deconvolved TIMMI2 Q-band image (right panel) of IRAS 16342-3814. The total field of view of the TIMMI2 image measures 8" × 8" and is centered on the source. North is down, east is right. The spectrum of IRAS 16342-3814 is that of an extremely reddened OH/IR star. The source is elongated in the Q-band (see contours) and shows extended emission.

post-AGB star, perhaps the youngest one observed at present. This makes IRAS 16342-3814 a very interesting object for the study of the transition between (OH/IR-type) AGB stars and post-AGB stars.

We observed IRAS 16342-3814 using TIMMI2 at the ESO 3.6m telescope at La Silla (Chile). In figure 1 (right panel) we present the Q-band (20 μm) image. The image reveals an elongated structure approximately aligned with the bipolar nebula seen in the HST images and is about 3" along its major axis. The relatively close alignment suggests a high optical depth of dust towards the central star, again indicating a high mass-loss rate. The image also shows a halo around IRAS 16342-3814, most likely a remnant from a period of enhanced, but more spherically symmetric, mass loss during the previous AGB phase.

References

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