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IRAS12316−6401: A NEW SYMBIOTIC MIRA?

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Abstract.
Current observations indicate that IRAS12316-6401 is a new addition to the rare class of resolved symbiotic Miras, however future observations will be needed to confirm this.

Key words: Stars: winds, outflows — binaries: symbiotic — planetary nebulae: general — Stars: individual (IRAS12316−6401)

1. Introduction

In our search for new obscured planetary nebulae (PNe) we selected candidates from the IRAS Point Source Catalogue based on infrared colors typical of PNe. When we observed these candidates in the radio continuum at 6 cm, on average 20 % of the objects were detected (Van de Steene & Pottasch 1993, 1995). Subsequent optical spectroscopy showed that most of the PN candidates detected in the radio have emission line spectra typical of PNe (Van de Steene et al. 1996a, 1996b). However, two objects showed spectra that are special. One of these objects, IRAS12316−6401, will be discussed in more detail in this paper.

2. Discussion

An Hα+[N II] image of the object obtained with EMMI on the NTT at ESO is shown in Fig. 1. The morphology is typical of bipolar PNe at low resolution: an elongated inner nebula surrounded by a spherical circumstellar shell. The Hα+[N II] image yielded a FWHM size of 1.2×1.0 arcsec at 30° PA (0.96 arcsec FWHM seeing). The surrounding shell is much larger: 4.6 arcsec diameter in RA and 4.5 arcsec in DEC at 20% of the peak flux. The position of the source is RA = $12^{\rm h}\ 34^{\rm m}\ 36\overset{\rm s}{.}063$, DEC = $-64°\ 18'\ 17\overset{''}{.}20$ (J2000).

The infrared spectral energy distribution (SED) of IRAS12316-6401 is shown in Fig. 2. From the IRAS and MSX photometry it is clear that it has an extended circumstellar envelope containing cool dust, which is typical for young PNe. The dereddened (I-J) and (J-K) colors are 0.56 mag and 1.70 mag, resp. (based on A_V=3.8 mag from the Balmer decrement). It places this object inconclusively

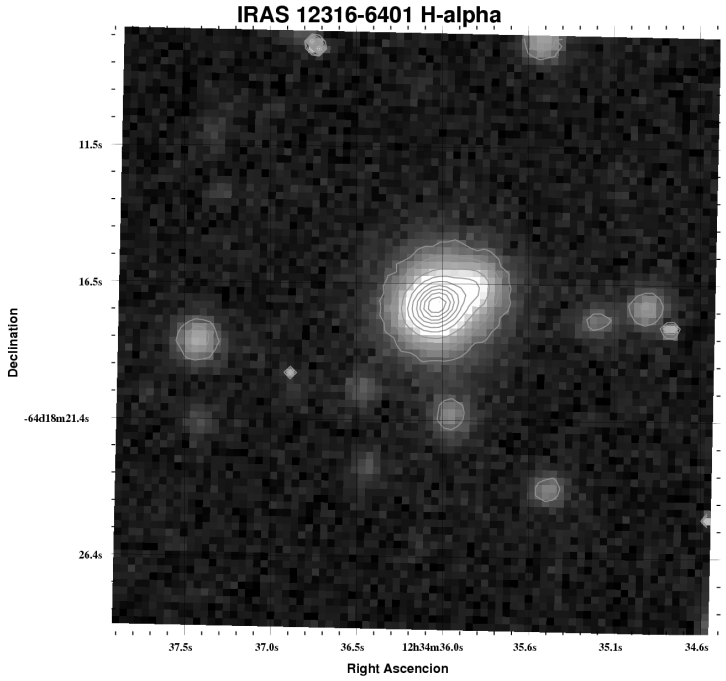

Fig. 1. The EMMI Hα+[N II] image of IRAS12316−6401 (shown on a square-root stretch).

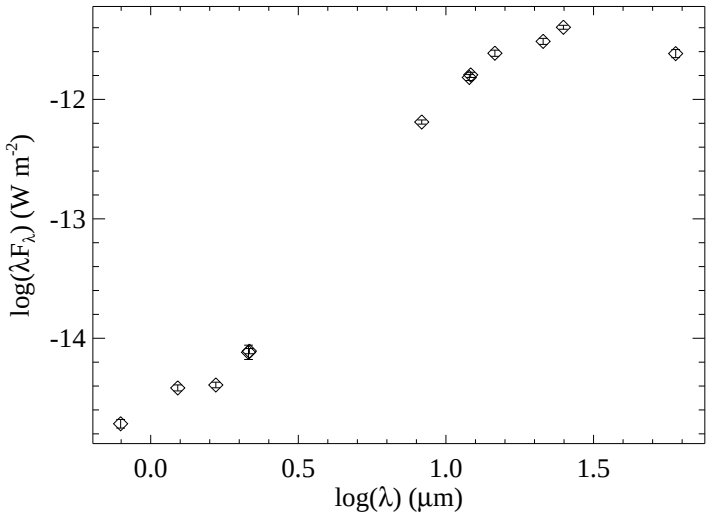

Fig. 2. The spectral energy distribution of IRAS12316−6401 (not corrected for reddening).

between regular PNe and symbiotic Miras in the color-color diagram proposed by Schmeja & Kimeswenger (2001). From inspection of the SED in Fig. 2 one could argue that the K-band emission is dominated by hot dust emission, which would argue in favor of the presence of a symbiotic binary system.

In the optical high resolution echelle spectrum obtained with EMMI on the NTT, the Hα line shows evidence of a stellar wind which is clearly not spherically symmetric. It suggests that the system is driving a powerful jet approximately aligned with the line of sight. The spectrum shows broad emission lines with velocities up to 600 km s^{-1}. Such velocities are seen in [WC]-type PNe. However, such an identification is ruled out since we haven't detected any C III or C IV emission lines. This spectrum shows analogies with symbiotic stars and strongly bipolar PNe: H I profiles with extended wings, rich Fe II and [Fe II] emission, and strong [N II]. In normal PNe iron lines are usually not observed, because this element is strongly depleted in dust. Hence these broad emission lines are likely formed in dust-free gas and not in the dusty circumstellar envelope, which expands more slowly as indicated by the CO expansion velocity of 25 km s^{-1}. The object shows the [Fe VII] 608.7 nm line with a sharp red edge, which is typical of symbiotic nebulae. There is no direct evidence of a binary system, since no red or yellow giant has been observed yet. This could be caused by strong dust obscuration in the optical. The He II 468.6 nm line was detected as well. If the line is photoionized, the temperature of the white dwarf must be at least 60,000 K. We can see these optical emission lines either because they are reflected by dust or because we are looking down the dust-free jet. The list of detected lines fairly closely follows that of the prototypical symbiotic star Z And and the observed velocities agree fairly well with those reported by Skopal et al. (2006). However the spectrum doesn't show the Raman scattered O VI 682.5 nm line typical in symbiotics. This could imply that the white dwarf has low stellar temperature ($<$ 100,000 K), and thus is still in an early post-AGB phase.

3. Conclusions

The evidence is pointing towards the fact that this object belongs to the rare class of resolved, symbiotic Miras. However, so far, the evidence is not conclusive. Only eight spatially resolved symbiotic Miras are currently known, so this object could be a valuable addition to this rare class.

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