

Low resolution spectroscopy of IRAS sources with PN like IR colours

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Abstract. We present here the results of an ongoing optical spectroscopic survey at low resolutions (2\AA at best) of IRAS sources which have far infrared colours similar to those of planetary nebulae. From this survey we have so far discovered two new low excitation PN (IRAS 07171 + 1823 and IRAS 17395-0841), several post-Asymptotic Giant Branch (post AGB) stars, and other peculiar stars. Among the peculiar stars are Hen 3-1336 and IRAS 18489-3703. They have similar far-infrared colors. We find that these two stars have spectral types that correspond to late G-dwarfs or early K-dwarfs. All the Balmer lines in our blue region spectra are in emission. The Ca II H and K lines are also in emission. These two stars are most likely post-T Tauri stars.

1. Introduction

The IRAS survey has detected many stars with circumstellar dust, among which are planetary nebulae and stars in the post-AGB stage of evolution. Many such objects have been identified based on their far-infrared colours (eg. Parthasarathy and Pottasch, 1986, 1989). These IRAS sources fall within the colour box $12\mu/25\mu$ flux ratios ≤ 0.3 , and $25\mu/60\mu$ flux ratios ≥ 0.3 . Post-AGB stars have B to K supergiant spectral types (Parthasarathy 1994). We are carrying out a program of spectroscopy and imaging of IRAS sources with far-infrared colours similar to those of planetary nebulae. From our survey, we have detected several new post-AGB stars, two new PN and some peculiar objects. In this paper we present a brief description of the spectra of some of these stars.

2. Observations

The candidate stars were observed with the spectrograph and 2-D Frutti photon counting detector at the 1m telescope at Cerro Tololo Inter-American Observatory (CTIO), Chile in April 1994. The CTIO spectra cover the wavelength range from 3800\AA to 5020\AA at a resolution of 2\AA . Two of the objects discussed here were also observed using the 2.3m telescope and the Boller and Chivens spectrograph at Vainu Bappu Observatory (VBO) at Kavalur. The spectra obtained at Kavalur cover the wavelength range from 4340\AA to 6900\AA at a resolution of 5\AA .

3. Discussion

The IRAS fluxes of the eight stars considered in this paper are given in table 1. The flag (L) by the side of some of the fluxes indicates the upper limit of the flux density. The flag (:) indicates that the flux is of moderate quality. The spectra are shown in Figs 1 to 8.

Table 1. Data on IRAS sources described in the text.

Object	l	b	V	MK	IRAS flux density (Jy)			
					12 μ m	25 μ m	60 μ m	100 μ m
IRAS 07171+1823	199.47	+14.37		-	0.41(L)	1.38	0.70	1.00(L)
IRAS 17041-2709	356.7	+8.0		?	0.25(L)	0.66	1.00	3.64(L)
IRAS 17395-0841	300	+11.0	13.2	-	0.31	4.18	8.43	6.38
IRAS 18023-3409	357.61	-6.31	11.3	B9Iae+	0.26	2.94	1.82	25.64
IRAS 18237-0715	23.65	+2.23	11.0	Be	1.84	4.01	38.24	35.13
IRAS 18313-1738	15.32	-4.27	12.4	Be	9.41	7.28	1.00(:)	68.70(L)
IRAS 18489-3703	359.15	-16.09		-	0.45(L)	0.45(:)	1.56	1.22(L)
IRAS 19336-0400	34.58	-11.75			.38(L)	8.18	5.56	2.32

IRAS 17041-2709 (= Hen 3-1336) (=AS 218) and IRAS 18489-3703 :

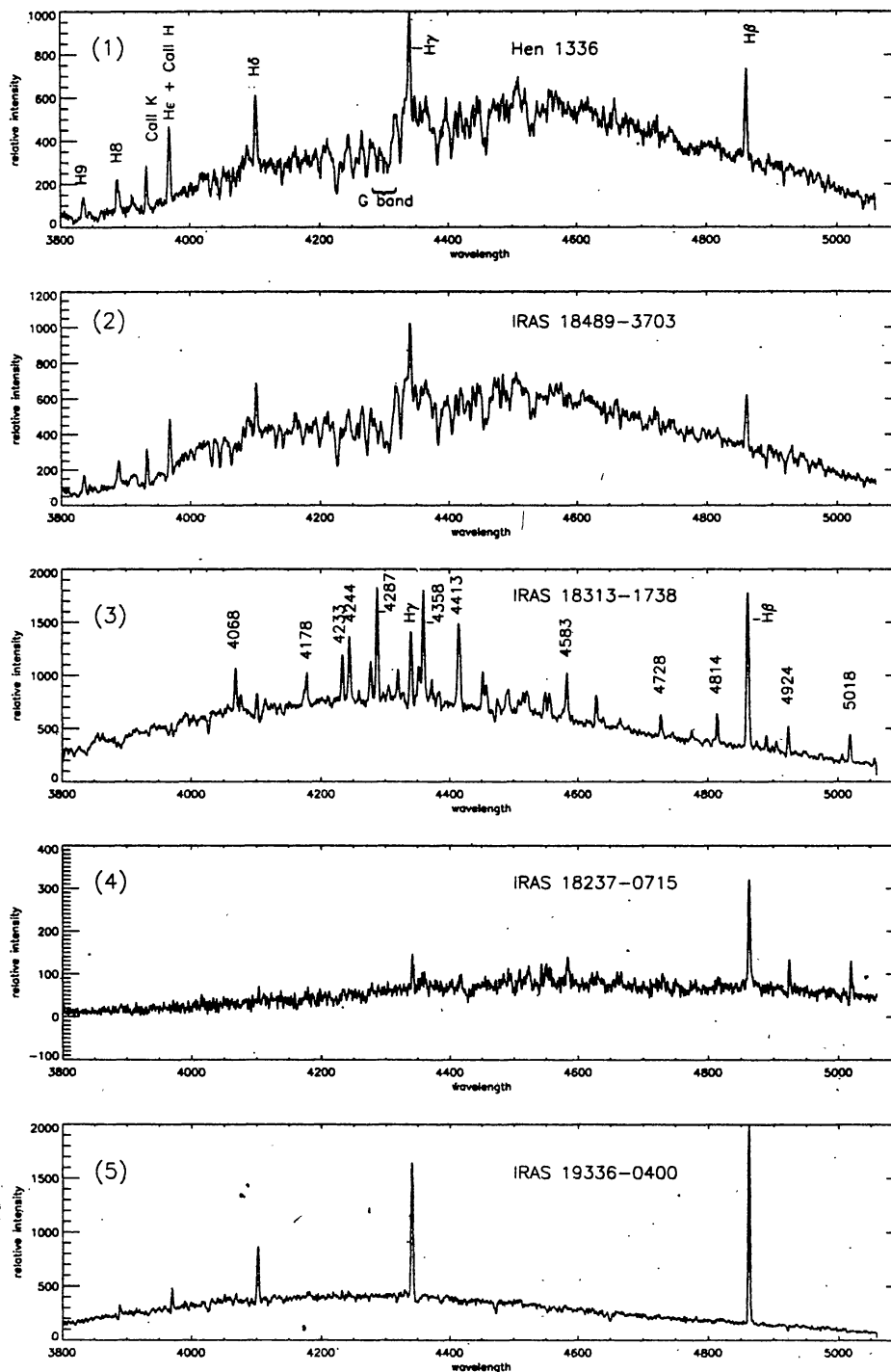
These stars show identical spectra showing the Balmer lines in emission and the G band of CH in absorption. Quast et al (1987) list IRAS 17041-2709 as an isolated post-T Tauri star showing photometric light variations. Wackerling (1970) lists it as a B type star but gives no reference to the source of the classification. Johnson (1986) lists it as a K dwarf with H α emission. The blue region spectra of these two stars indicate that they are late G dwarfs or early K dwarfs. The presence of thin dust shells and Balmer lines and H and K lines in emission and the late type dwarf spectral types suggest that these belong to the post-T Tauri type stars.

IRAS 18313-1738 :

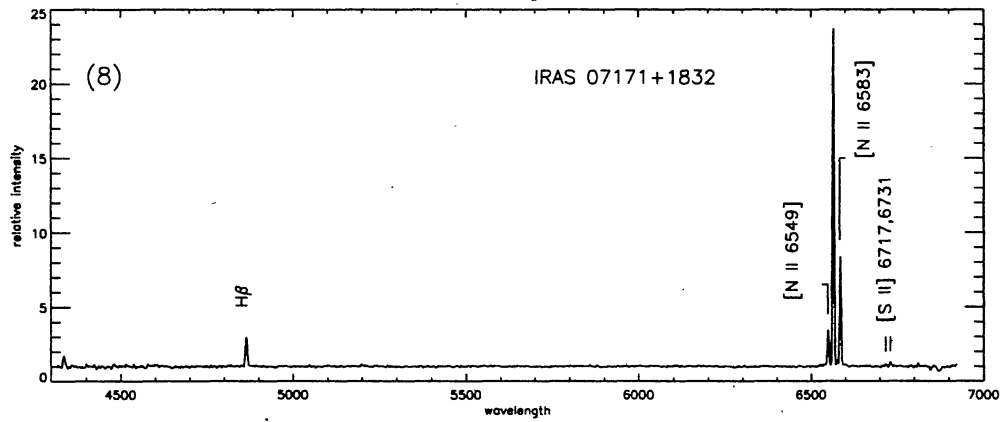
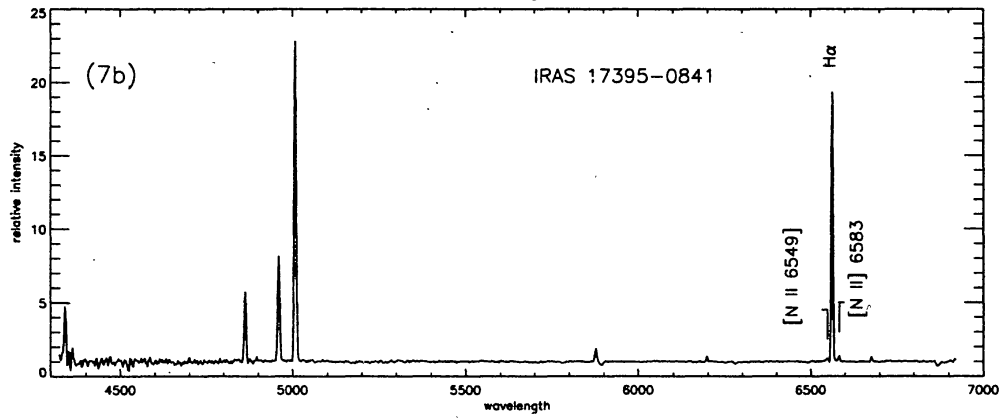
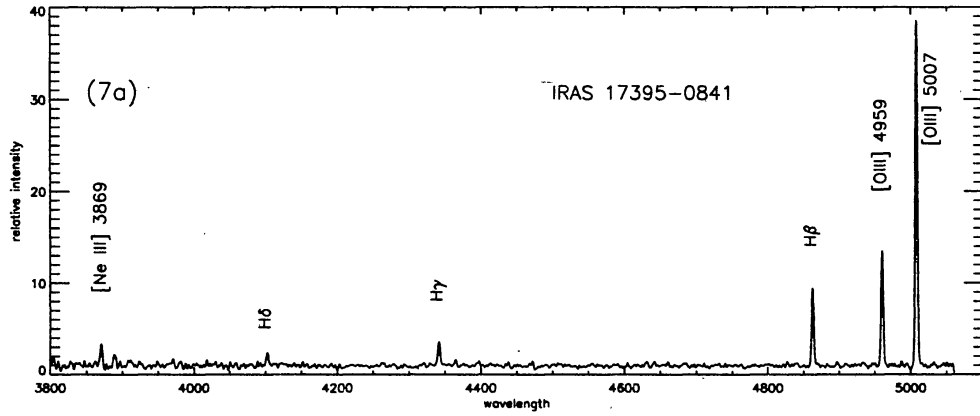
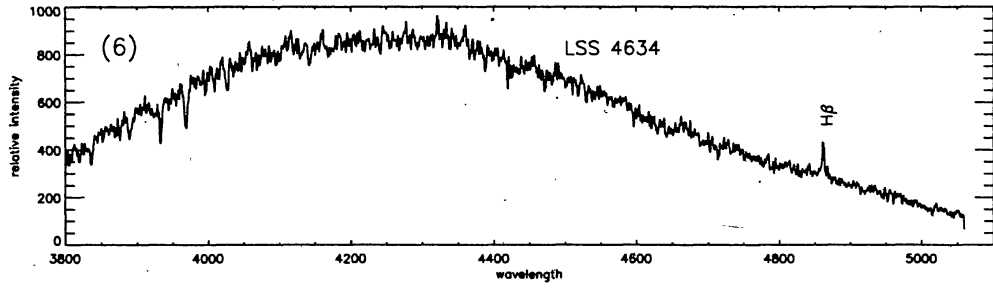
Allen and Swings (1976) classify it as a peculiar Be star showing strong Fe II and [Fe II] emission. It has H - K = 1.55 (The et al. 1994) indicating near IR excess. It may be similar to HD 51585 which is a BQ[] and B[e] star and listed as a post-AGB star by Parthasarathy and Pottasch (1986). Its evolutionary stage is uncertain. Is it a post-AGB star or massive B star? We find several FeII and [FeII] lines emission. Further study of this star is in progress.

IRAS 18237-0715 :

Its flux at 60 μ is quite large, and points to a large amount of cool dust. Needs to be studied further in order to understand its evolutionary status.



Figures 1- 8. The spectra of the IRAS sources discussed in the text. Figure 1 and 2 are nearly identical. Most of the emission lines in Fig. 3 are due to Fe II and [Fe II]; some of these features are also seen in Fig.4. The Balmer lines are seen in emission in Fig. 5.



IRAS 19336-0400 :

The spectrum shows strong emission in Balmer lines and very few weak absorption features; it is an early type star at high Galactic latitude with colours like PN. The high galactic latitude and cold detached circumstellar dust shell with flux maximum at 25 microns similar to that found in many PN and the Balmer lines in emission indicates that it is a hot post-AGB star.

IRAS 18023-3409 (= LSS 4634) :

This is a B9 supergiant star, showing emission in Balmer lines in its spectrum taken in 1978 (Vijapurkar and Drilling 1993). Its IRAS colours are like those of a PN. It may be a post-AGB star and not a massive B9 supergiant.

IRAS 17395-0841 :

We have obtained its spectrum from 3800Å to 6900Å. From the IRAS fluxes the circumstellar dust temperature is found to be 90° K. It shows strong [O III] emission. [N II] and Balmer emission lines are also seen. In the raw spectrum, the region of the nebular lines is slightly more extended than that of the continuum, indicating the presence of a nebula of about 2 seconds of arc diameter (Vijapurkar et al. 1997). We conclude that it is a new low excitation PN. This is also a high galactic latitude star.

IRAS 07171 + 1823 :

Its spectrum obtained at VBO shows Balmer lines in emission and also the nebular lines of [SII] and [NII]. The circumstellar dust temperature is found to be 180° K by fitting a blackbody to the infra-red fluxes. It is a high galactic latitude star. The presence of a cold dust shell with far-IR colours similar to PN and the presence of nebular lines of [SII] and [NII] suggests that IRAS 07171+1823 is a hot post-AGB star or a low excitation PN.

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