Spectroscopic analysis of two peculiar emission line stars: RJHA 49 & SS73 21*

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ABSTRACT

Aims. To investigate the spectra and the evolutionary stages of two peculiar emission-line stars: RJHA 49 and SS73 21.

Methods. We used low and high resolution optical data. Line identifications and measurements were performed for several features in their spectra.

Results. For each object, we have derived the extinction and the excitation temperature from a set of [Fe ii] lines, and the electron density from [N ii] lines. For RJHA 49, no detailed spectroscopic study was done so far. Regarding SS73 21, our low resolution spectrum confirms the main characteristics found in previous works. On the other side, from our high resolution data, we have found that the Hα line presents a double-peak, in contrast with the suggestion in the literature that it should reveal a P-Cygni profile. Surprisingly, we found a few He i transitions resembling P-Cygni profiles (e.g. He i λ5876), directly suggesting that mass loss is active in SS73 21. We also discussed the nature of these two objects based on the data obtained. Although the evolutionary status of SS73 21 seems well established from previous studies (a proto-planetary nebula), the situation for RJHA 49 is not so clear mainly due to its unknown distance. However, from the strength of [N ii] λ5754 relative to [O i] λ6300, the possibility of RJHA 49 being a LBV object is reduced, and a B[e]-supergiant or a proto-planetary nebula status is more plausible.

Key words. Stars: emission-line - Stars: AGB and post-AGB - Stars: individual: RJHA 49, SS73 21

1. Introduction

The spectral characteristics of a group of stars known as “B[e]-stars” (B-type stars with forbidden emission lines, mainly from iron, in the optical spectrum) have been received wide attention in the recent years. Interestingly, different groups of objects in distinct and well defined evolutionary stages may present a very similar spectrum, with Balmer lines, several permitted and forbidden iron emissions, as well as an infrared excess. Due to this fact, it was proposed in the literature that all these objects should be categorized as stars with the “B[e]-phenomenon” (Lamers et al. 1998). Yet, there is a group that still resists to be properly identified, namely, the “unclassified B[e] stars” (or unclB[e] stars). Although some stars within this group are better studied than others (e.g. HD 45677 and HD 50138; Lamers et al. 1998), the nature and the evolutionary status of most of them has not yet been revealed. An interesting review regarding the observational properties of different subgroups of B[e]-stars and a comparison to other peculiar emission line objects, including the unclB[e] class, was recently presented by Miroshnichenko (2006).

Following our program to investigate emission-line objects in the southern hemisphere at the European Southern Observatory (ESO) whose nature is not well established, we present in this paper spectroscopic data of two peculiar emission-line stars: RJHA 49 (=MWC 819) and SS73 21 (=Th 35-27). Both objects were selected from the works of Sanduleak & Stephenson (1973) and Allen & Swings (1976). Previous efforts of our program led to a classification of 33 emission-line stars (Pereira et al. 2003a) and an analysis of three stars with η-Car spectrum: SS73 11 (Landaberry et al. 2001), SS73 56, and Hen 2-79 (Pereira et al. 2003b).

There are not many objects that have an η-Car type spectrum. In the early 70’s, Swings and Allen (1973) realized that the spectral characteristics in the visual of MWC 645 and MWC 819 (=RJHA 49) looked very similar to η-Car. MWC 645 would be later investigated by Jaschek et al. (1996). RJHA 49 has already been classified as a possible planetary nebula (Kohoutek 1971), a Be star with infrared excess (Allen & Swings 1976) and more recently, as a B[e] star by The et al. (1994) and an unclB[e] by Lamers et al. (1998). According to Miroshnichenko (2006), RJHA 49 is one of the objects that “received almost no attention since the introduction of B[e] stars”. On the other side, the nature of SS73 21 seems to be better established. On the basis of infrared IRAS colors, Parthasarathy & Pottasch (1989) first suggested that this object could be a proto-planetary nebula. Indeed, different recent studies based on images and low resolution spectroscopy have supported this view (García-Lario et al. 1999; Sahai et al. 1999; Parthasarathy et al. 2001). In the present paper, the high resolution optical spectrum of SS73 21 is investigated for the first time.

The rest of the paper is divided in the following manner: in Sect. 2 we present the details of our observational
data, including the reduction procedure, and the extinction derived for each object. In Sect. 3 we present some physical conditions derived for both objects, namely, the excitation temperature from forbidden iron lines and the electron density from forbidden nitrogen lines. In Sect. 4 we discuss their nature and finally in the last section we summarize the main points of our work.

2. The Data

2.1. Observations & Reduction

The low resolution spectroscopic observations were performed using a Boller & Chivens spectrograph at the Cassegrain focus of the ESO 1.52m telescope in La Silla (Chile) on February 4th, 1999 (RJHA 49) and March 2nd, 1999 (SS73 21). A UV-flooded thinned Loral Lesser CCD #39 (2048 x 2048, 15 μm/pixel) was used as the detector; it gives a high quantum efficiency in the blue and in the UV. We used the grating #23 with 600 l/mm, providing a resolution of about 4.6 Å in the range ~4000 - 8000 Å. The slit orientation was East-West and the slit width was 2". The sky conditions in these observations were mostly clear, but not photometric with a mean seeing of 1.5", therefore the flux calibration should be seen with caution.

The spectra were reduced using standard IRAF tasks, from bias subtraction and flat-field correction, through spectral extraction and wavelength and flux calibration. Spectrophotometric standards from Oke (1974) and Hamuy et al. (1994) were observed.

In the linearized spectra, the fluxes of emission lines have been measured by the conventional method adjusting a gaussian function to the line profile thereby obtaining the intensity, the central wavelength and the line width at half power level. Uncertainties in the line intensities come mainly from the position of the underlying continuum. We estimate the errors in the fluxes to be about 20% for weaker lines (line fluxes about 10 on the scale of Hβ=100) and about 10% for stronger lines.

RJHA 49 and SS73 21 were also observed in high resolution mode with FEROS in the 1.52m ESO telescope in La Silla (Chile) on February 9th and February 3rd of 2001, respectively. The FEROS spectral resolving power is R = 48 000, corresponding to 2.2 pixels of 15 μm. The total wavelength coverage is ~4000 - 9200 Å, and the nominal S/N ratio measured by RMS flux fluctuation is approximately 100 after 3600 secs of exposure time. The spectra were reduced with the MIDAS pipeline reduction (Kaufer et al. 1999) package consisting of the following standard steps: CCD bias correction, flat-fielding, spectrum extraction, wavelength calibration, correction of barycentric velocity, and spectrum rectification.

2.2. The spectra of RJHA 49 and SS73 21

2.2.1. Low resolution

Our optical spectra of RJHA 49 and SS73 21 is displayed in Figure 1. For comparison, we also show in this Figure spectra of other objects previously analyzed by us, namely, Hen 2-79, SS73 11, and SS73 56, as well as the spectrum of η Car, obtained at the same resolution.

The spectrum of RJHA 49 presents several strong emission lines mostly due to single ionized forbidden and permitted iron over a flat continuum. The majority of the iron features are also present in the spectrum of the objects above mentioned. The nitrogen forbidden line at 5754 Å is present but weaker than the oxygen forbidden line at 6300 Å. The intensities of these two transitions are particularly important, since they can be used as a criteria to distinguish for example, a B[e]sg from a LBV star (Zickgraf 1989). As in the other stars, Hα and Hβ are among the strongest lines in the spectrum.

García-Lario et al. (1999) studied the low resolution spectrum of SS73 21 from 3500 ~ 11200 Å. According to these authors, a rich emission line spectrum can be seen, which is characterized by strong and broad emission of Hβ Balmer lines. Permitted emission lines of HeI, FeII, OI and CaII as well as forbidden transitions from ions such as [FeII], [NII], [OI], [SII] and [CaII] are also present. These characteristics are confirmed by our more recent data. Furthermore, we found no significant line variations compared to their study. Nevertheless, as will be seen later in the paper, the analysis of the high resolution spectrum of SS73 21 provided valuable additional informations compared to the low resolution data.

Overall, we can see from Figure 1 that the spectrum of RJHA 49 and SS73 21 are similar to the spectrum of the objects Hen 2-79, SS73 11, SS73 56, and η Car. The main characteristics in common are clearly the presence of several FeII and FeII emissions, and the Hβ Balmer lines. Interestingly, with the exception of η Car, the nature of all these peculiar stars is not yet firm established. For SS73 11 for example, although Landaberry et al. (2001) could conclude that this object is not a B[e]sg, a Herbig AeB[e] or a symbiotic star, these same authors argue that a LBV or a proto-planetary nebula classification is possible. For Hen 2-79 and SS73 56, a detailed analysis of their spectrum favors a proto-planetary nebula status, but an evolved massive star classification cannot be discarded (Pereira et al. 2003b). Undoubtedly, one of the main difficulties to determine the nature of these and other similar objects is their unknown distance. This point and the status of RJHA 49 and SS73 21 will be discussed in Section 4.

In Table 1 we provide the line identifications as well as the line fluxes of transitions other than from FeII, for RJHA 49 and SS73 21. As it can be seen, some features in the spectrum of SS73 21 are not present in RJHA 49, such as the HeI and the [SII] lines. For RJHA 49, there are no previous line measurements in the literature. In addition to Table 1, columns 4th and 7th of Table 2 lists the line flux, in units of Hβ=100, of some multiplets of single ionized forbidden iron used for reddening and excitation temperature determination (see Sections 2.3 and 3.1). For line identifications we used the same procedure described in Landaberry et al.(2001).

2.2.2. High Resolution

The high-resolution spectra were used to better identify some features which are blended or were not resolved in the low resolution spectra. This procedure allowed us to estimate the different contributions of each transition and discover important line profiles (e.g. Hα; see below).

In Figure 2 we show three spectral regions to better illustrate the differences in strength of some emission lines among the objects studied here (RJHA 49 and SS73 21).
to those already studied in Landaberry et al. (2001) and Pereira et al. (2003b). It can be seen that the strength of the forbidden line \([\text{O} i]\lambda 6300\) is stronger than \([\text{N} ii]\lambda 5754\) in RJHA 49, SS73 21, SS73 56 and Hen 2-79 while in SS73 11 the opposite occurs.

Our optical high resolution spectrum of SS73 21 reveals interesting additional informations regarding previous studies. The most important one is that the \(H\alpha\) line clearly presents a double-peak rather than the P-Cygni profile proposed by Parthasarathy et al. (2001) on the basis of low resolution data. As can be seen in Figure 2, the \(H\alpha\) double-peak profile is also present in the other stars. SS73 21 has the broadest profile. In RJHA 49, \(H\alpha\) has the strongest intensity and the blue peak is more intense than the red one.

Table 3 shows the intensities relative to the continuum and equivalent widths of some identified lines in the spectrum of these stars. The 'blue' and 'red' component mentioned in Table 3 refers to the two peaks seen in the profile of the Balmer lines.

2.3. Extinction

We determined the extinction parameter for RJHA 49 and SS73 21 in the same way as Pagel (1969). Our previous works regarding SS73 11, SS73 56 and Hen 2-79 (Landaberry et al 2001; Pereira et al 2003b) followed the same procedure. We first measured line fluxes of some \(\text{Fe} ii\) forbidden lines (between 4100\(\AA\) and 7000\(\AA\)) with excitation potential between 2.5 and 3.2 eV. We then plot \(\log I\) (defined below) against the reciprocal wavelength \((1/\lambda(\mu m))\) in the abscissa. The ordinate \(\log I\) is related to the difference between the logarithm of the observed flux and the logarithm of the emitted flux by the source in the same wavelength range according to:

\[
\log I = \log (F_{\text{obs}}(\lambda)) - (\log (5000/\lambda) + \log (g A) - 0.56 \chi + 2.0). (1)
\]
The table below lists the observed emission line fluxes $F_\lambda$ for the two stars RHA 49 and SS73 21, along with their corresponding excitation potentials $\chi$. The data is taken from the spectrum of RHA 49 and SS73 21 in units of $\text{H}_\beta=100$. The parameter $\chi$ is defined in the text and is the ratio of the parameter $\beta$ (also defined in the text) of some selected Fe II emission lines used for determining excitation temperatures.
Table 2

| M  | Identification | \( \chi \) (eV) | \( F(\lambda) \) | \( \log I \) | \( \beta \) | \( F(\lambda) \) | \( \log I \) | \( \beta \) |
|----|----------------|----------------|----------------|------------|--------|----------------|------------|--------|
| 21F | 4243.98        | 3.14           | 22.0           | 0.00       | 4.17   | 3.3            | -0.83      | 3.26   |
| 551 | 4244.81        | 3.21           | 4.0            | 0.03       | 4.16   | 0.9            | -0.62      | 3.43   |
| 21F | 4276.83        | 3.19           | 6.0            | -0.32      | 3.83   | 2.2            | -0.75      | 3.16   |
| 551 | 4319.62        | 3.21           | 4.0            | -0.29      | 3.84   | 1.4            | -0.74      | 3.30   |
| 551 | 4346.85        | 3.14           | 6.0            | 0.08       | 4.25   | 0.8            | -0.80      | 3.29   |
| 35F | 4352.78        | 3.19           | 11.0           | 0.29       | 4.42   | 1.7            | -0.47      | 3.52   |
| 715 | 4358.37        | 3.22           | 11.0           | 0.14       | 4.27   | 1.9            | -0.26      | 3.42   |
| 715 | 4372.43        | 3.21           | 3.0            | -0.13      | 4.00   | 1.2            | -0.53      | 3.52   |
| 715 | 3147.99        | 2.84           | 2.0            | 1.26       | 4.67   |                |            |        |
| 31F | 5477.25        | 3.32           | 2.0            | 0.18       | 3.83   |                |            |        |
| 31F | 5476.96        | 3.18           | 6.0            | 0.45       | 4.10   | 1.0            | -0.33      | 3.92   |
| 31F | 5163.94        | 3.37           | 8.0            | 0.40       | 4.07   | 1.0            | -0.51      | 3.22   |
| 31F | 5283.10        | 3.37           | 3.0            | 0.29       | 4.01   |                |            |        |
| 31F | 5551.53        | 3.89           | 3.0            | 0.68       | 3.94   |                |            |        |
| 31F | 6944.91        | 3.80           | 3.0            | 0.90       | 3.80   |                |            |        |
| 724 | 6188.55        | 3.95           | 1.0            | 0.94       | 3.87   |                |            |        |
| 724 | 5870.01        | 4.10           | 2.0            | 0.37       | 3.39   |                |            |        |
| 724 | 6044.10        | 4.08           | 3.0            | 0.73       | 3.75   |                |            |        |
| 724 | 4898.61        | 4.50           | 4.0            | 0.42       | 3.60   |                |            |        |
| 724 | 5060.08        | 4.74           | 3.0            | 0.60       | 3.78   |                |            |        |
| 724 | 5673.22        | 4.10           | 6.0            | 0.65       | 3.67   |                |            |        |
| 724 | 5835.44        | 4.70           | 5.0            | 0.65       | 3.66   |                |            |        |
| 724 | 5048.18        | 4.70           | 3.0            | 0.72       | 3.72   |                |            |        |

The identification determination of RJHA 49 and SS73 21.

Table 3. Equivalent widths and intensities relative to the continuum of some lines in the spectra of RJHA 49 and SS73 21.

| Wavelength | Identification | RJHA 49 | SS73 21 |
|------------|----------------|---------|---------|
| Line       | \( \lambda_{\text{lab}} \) | I/Lc | W\( \lambda \) (Å) | I/Lc | W\( \lambda \) (Å) |
| H\( \gamma \)-blue | 4340 | 11 | 3 | 3 | 4 |
| H\( \gamma \)-red | 4340 | 11 | 6 | 8 | 9 |
| H\( \beta \)-blue | 4861 | 18 | 11 | 9 | 8 |
| H\( \beta \)-red | 5169 | 23 | 15 | 4 | 2 |
| Fe\( \text{ii} \) | 5316 | 45 | 33 | 9 | 5 |
| N\( \text{ii} \) | 5754 | 12 | 8 | 2 | 1 |
| He\( \text{i} \) | 5876 | — | — | 4 | 5 |
| O\( \text{i} \) | 6300 | 75 | 38 | 12 | 7 |
| He\( \text{ii} \) | 6563 | 595 | 77 | 66 | 52 |
| H\( \alpha \)-blue | 7155 | 31 | 24 | 5 | 3 |
| H\( \alpha \)-red | 8446 | 126 | 150 | 28 | 42 |
| Ca\( \text{ii} \) | 8498 | 9 | 7 | 11 | 15 |
| Ca\( \text{ii} \) | 8662 | 3 | 2 | 11 | 13 |

3. Physical Conditions

3.1. Excitation temperature

Since we observe several emission lines of forbidden single ionized iron in the spectra of RJHA 49 and SS73 21, it is possible to derive the excitation temperature in the emitting region by following the description of Viotti (1969) (see also Thackeray 1967). This procedure was previously used by us for SS73 11, SS73 56 and Hen 2-79.

In Table 2 we show the parameter \( \beta \) (6th and 9th columns) defined as \( \beta = \log (F(\lambda) \lambda(\text{Å})/gA) \) and the excitation potential of the forbidden lines used in the calculation (3rd column). In the above expression \( F(\lambda) \lambda(\text{Å}) \) is the line intensity in units of H\( \beta =100 \) corrected for reddening and \( \lambda \) is given in Angstroms. The obtained temperature based on this method is \( T_{\text{exc}} = (8300 \pm 850) K \) for SS73 21 and \( T_{\text{exc}} = (12000 \pm 1100) K \) for RJHA 49.

3.2. Electron Density

The electron density was obtained using the dereddened [N\( \text{ii} \) \( \lambda 6584/5754 \) ratio. For RJHA 49 and SS73 21 the ratios are 3.0 and 8.3, respectively. Adopting an electron temperature of 10000 K, the electron density is \( 8.2 \times 10^3 \text{ cm}^{-3} \) for RJHA 49 and \( 2.6 \times 10^5 \text{ cm}^{-3} \) for SS73 21. García-Lario et al. (1999) found a value for SS73 21 compatible to ours \(( \sim 2 \times 10^5 \text{ cm}^{-3} \)).
Fig. 2. High resolution spectra obtained with FEROS spectrograph in the region around the forbidden nitrogen line at 5754Å(a), 6300Å(b) and Hα(c). From top to bottom we show the spectra of SS73 21, RJHA 49, SS73 11, SS73 56 and Hen 2-79. Notice the strength of Hα in RJHA 49. The intensities are in continuum units.

4. The Nature of RJHA 49 and SS73 21

Although we have investigated in some detail the spectrum of RJHA 49 and have estimated some physical conditions of its envelope, it is still difficult to determine its evolutionary status since its distance is not well constrained and thus, its luminosity cannot be accurately derived. The lack of wide and narrow band images such as the ones made in the case of SS73 21 (Sahai et al. 1999) also complicates this kind of discussion. However, according to Zickgraf (1989), it is possible to use [N II] and [O I] to distinguish a Be star from a LBV. By following this criteria, since the [O I] λ6300 line is more intense than the [N II] λ5754 (see Figure...
we conclude that RJHA 49 is either a B[e]-supergiant or a proto-planetary nebula.

Although the emission-line spectra of RJHA 49 and SS73 21 and the other stars look similar to η Car (Figure 1) this does not mean that they are in the same evolutionary stage. Hillier et al. (2001) reported that the spectrum of η Car taken at high spatial resolution (0.′′1 × 0.′′13) with the Hubble Space Telescope (HST) is considerably different than the ones obtained from ground telescopes. Low resolution spectroscopic observation of η Car, as the one presented in our Figure 1, results in a combination of nebular (mainly from the Weigelt blobs) and central source spectra, i.e., in narrow permitted and forbidden lines (e.g. [Fe II], Fe II and H i) superimposed on a broad emission line spectrum.

As we already mentioned, SS73 21 was first suggested to be a proto planetary-nebula by Parthasarathy & Pottasch (1989), according to its far-infrared IRAS colors. Recently, HST images have revealed long cylindrical-shaped bipolar lobes, surrounded by a faint elliptical halo, which is possibly a remnant of the AGB phase (Sahai et al. 1999). These characteristics were almost simultaneously observed by García-Lario et al. (1999) through images and optical and near-infrared spectroscopy. The presence of a circumstellar disk is also inferred from these studies and from polarization data (Scarrot & Scarrot 1995).

The amount of reddening in the direction of SS73 21 can help to constrain its luminosity and thus its nature. However, different values exist for this quantity. If we consider a visual extinction of about 7 magnitudes, as in the work of Sahai et al. (1999), we would have a luminosity of approximately 28000$L_\odot$, at a distance of 3kpc (Bujarrabal & Bachiller 1991). This places this star in the HR diagram among Be supergiants (Figure 8 of Miroshnichenko et al. 2001), for a probable temperature of ~ 22000K (Sahai et al. 1999). On the other hand, by considering a visual extinction of 2.4 magnitudes (from the present work), we arrive at a much lower value for the luminosity, of 2000$L_\odot$. This estimate shows a better agreement with a proto-planetary nebula status for SS73 21, which is claimed in the literature.

Our analysis of the high resolution data of SS73 21 shows important spectral characteristics not seen in previous studies. An important matter which is highlighted in the literature is that the broad, non-gaussian profile of the Hα line seen in low resolution spectra of SS73 21 and of some other proto-planetary nebula (e.g. M 2-9) is due to mass outflows. Indeed, Parthasarathy et al. (2001) suggested that the asymmetry in Hα seen in SS73 21 is probably due to a P-Cygni profile. However, as we have presented in Section 2.2.2, our high-resolution spectrum of SS73 21 reveals a Hα with a double-peak profile. This fact is compatible with the presence of a circumstellar disk, which was deduced from the studies aforementioned.

Another very interesting characteristic revealed by the high-resolution spectrum of SS73 21 is that some He I lines resemble a P-Cygni profile. This can be seen in Figure 3 for the transitions He I λ5015, λ5876 and λ6678. If these lines are indeed in P-Cygni, it is a direct evidence that mass-loss is active in SS73 21. We found no other lines of other ions
with such profiles. At present, it would be very difficult to determine the formation region of these emissions. A stellar wind of the central star could be a possibility, but P-Cygni lines can be also formed in a strong bipolar outflow. Clearly, it would be valuable to obtain a mass-loss rate estimate. However, this is beyond the scope of the present paper, since it would require the use of radiative transfer models.

An estimate for the expansion velocity involved can be made from the He\textsc{i} $\lambda 5015$ line. We chose not to consider the He\textsc{i} $\lambda 5876$ and He\textsc{i} $\lambda 6678$ lines shown in Figure 3 in this calculation. For the former, the wavelength coverage of the absorption part of the profile is very uncertain. In the latter transition, the absorption is barely visible. Before computing the expansion velocity, we have derived a radial velocity ($V_{\text{rad}}$) for SS73 21 of approximately $+63\text{ km s}^{-1}$ from a comparison between laboratory and observed wavelengths of several emission lines. After correcting for $V_{\text{rad}}$, and considering the wavelength where the absorption part of the He\textsc{i} $\lambda 5015$ profile returns to the continuum, we finally derived a value of $\sim 90 \text{ km s}^{-1}$. This value is lower than the terminal velocities usually found in central stars of planetary nebulae, which reach hundreds or even thousands of km s$^{-1}$ (e.g. Hultzsch et al. 2007), and it is considerably higher than the expansion velocity related to molecular transitions of CO in SS73 21, which is $\sim 15 \text{ km s}^{-1}$ (Bujarrabal & Bachiller 1991).

5. Summary and Conclusions

We have analyzed low and high resolution optical spectra of two peculiar emission-line stars: RJHA 49 and SS73 21. We have performed line measurements and identifications for several features in their spectra. The spectrum of RJHA 49 was analyzed in detail for the first time. For both objects, a set of iron and nitrogen forbidden lines were used to derive the interstellar reddening, the excitation temperature, and the electron density. We showed that the H$\alpha$ line in SS73 21 presents a double-peak profile, in contrast with the suggestion in the literature that it should reveal a P-Cygni with high resolution data. The presence of the double-peak implies that the determination of E(B-V) from the H$\alpha$/H$\beta$ ratio is not reliable, since we cannot securely assume case B recombination. We found that some He\textsc{i} lines in SS73 21 resemble a P-Cygni profile, directly suggesting that mass-loss is active in this star. Finally, we discussed the nature of both objects, where the status of SS73 21 is more clear (a proto-planetary nebula) than for RJHA 49. Solely from the [O\textsc{i}] and [N\textsc{ii}] line strengths, RJHA 49 is either a B[e]-supergiant or a proto-planetary nebula. In order to gain more insight on the evolutionary stages of these and other similar peculiar emission line stars, distance estimates, high angular resolution spectroscopy, as well as wide and narrow band images would be very desirable.

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References

Allen, D.A. & Swings, J.P., 1976, A&A, 47, 293.
Bujarrabal, V. & Bachiller, R., 1991, A&A, 242, 247.
García-Lario, P., Riera, A. & Manchado, A., 1999, ApJ, 526,854.
Hamuy, M., Suntzeff, N.B., Heathcote, S.R., Walker, A.R., Gigoux, P. & Phillips, M.M., 1994, PASP, 106, 566.