LUMINOSITY AND VELOCITIES OF OBN STARS FROM HIPPARCOS

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ABSTRACT

A hundred N enhanced or N rich O-B stars (OBN) have been observed by the European Hipparcos satellite, including five objects investigated for PSR companions (Philp et al. 1996, Sawyer et al. 1996). By implementing with radial velocity the astrometric data kindly supplied by the Hipparcos project (ESA 1997) we have inferred absolute visual magnitudes, galactocentric positions and velocities of ninety OBN stars.

By ignoring nine outliers the OBN stars show average galactocentric distances \( R_g = 8.58 \pm 0.04 \) kpc, \( |Z| = 60 \pm 5 \) pc and space velocities \( X_g = 0 \pm 2, Y_g = 219 \pm 1, Z_g = 0 \pm 1 \); velocity with respect to the LSR \( V_{lsr} = 17 \pm 1 \) km s\(^{-1}\). The absolute visual magnitudes, after correcting for IS absorption are, on the average, larger (fainter) by 0.9±0.2, from those inferable from spectral type and luminosity class (Lang 1992) for 42 single stars.

The bulk of OBN stars behave like common O-B stars and evolves in the same space with akin kinematics. Only 3 bona fide runaway stars are recognized among ninety OBN's: HIP 18614, 70574 and 92198. The first object does not possess a PSR companion. HIP 70574, with galactocentric space velocity of 390 km s\(^{-1}\), might have been ejected from a disrupted binary by an SNII event.

Subluminous, by 3 to 4 ± 1 mag, OBN stars, are recognized among OBN objects with NIII emission lines. Five subluminous ON stars are suggested to be evolving from O to the recently identified sdO stage (Dreizler 1993).

Key words: OBN stars.

1. INTRODUCTION

O-B stars with N strong absorption lines were first noted by Walborn (Margoni et al. 1997). Most of them are N rich stars (Leushin 1988). Their statistical properties were studied by Leushin (1988) and by Margoni et al. (1997). Both found that tides in binary system seem the most efficient cause for bringing nitrogen at the surface of OBN stars, even on MS objects.

Most OBN stars were observed by the Hipparcos astrometric satellite. We have computed with astrometric data (ESA 1997) and ground based observations, as baricentric or averaged radial velocities, spectral types, luminosity classes and projected rotational velocities, the following parameters: absolute visual magnitudes \( M_v \), with their s.e. \( (eM_v) \), galactocentric distance \( R_g \), height \( Z \) on the galactic plane, galactocentric oriented space velocity components \( X_g, Y_g, Z_g \) and the velocity with respect to the local standard of rest \( V_{lsr} \). They are listed in Table 1 together with multiplicity \( M \) (1 or 2).

On the average the difference between \( M_v \) and the absolute visual magnitude inferred from spectral types \( M_{vsp} \) (Lang 1992) is 0.9±0.2 mag for single stars and 0.5±0.2 mag for binaries OBN, as reported in Table 2 together with averaged values of other parameters from Table 1.

Table 2. Average abundances, abs. mag., gal. distances and velocities of single and binary normal OBN stars.
The average value of the absolute height on the plane is 60 pc and only 3 runaway OBN stars could have been ascertained. OBN's evolve in the same space and with akin kinematics of OB stars (Stone 1979). Some OBN's with emission lines and seen against PN or within nebulae may be precursors either of PN or of SNI I besides the two known supergiant precursors of SN 1987a and SN 1993j. The velocity with respect to the LSR is labelled V_{lsr} in Table 1, with its error eV. The last column M labels single stars with 1
and binaries with 2. A few data show uncomfortably large errors. We performed multivariate analyses in the parameter space, some omitted from Table 1 (see Oliva 1998). After some trials the following parameters appear significant: $M_V$, $Sp$ (spectral type), $Cl$ (luminosity class), $[Z]$, $X_g$, $Y_g$, $Z_g$, $M$ (multiplicity). The principal components $pc_1$ and $pc_2$ of a linear combination of these variables for all objects in Table 1 were obtained. By rotating the axes in order to get the maximum variance with the SPSS 1993 VARIMAX algorithm, we projected the multi-space distribution on the fact1/fact2 plane as represented in Figure 1.

![Factor variables of the multivariate analysis for the labelled parameters. Numerical labels refer to the ordinal positions of objects in Table 1.](image)

We will now discuss whether subluminous OBN stars in Table 3 may be related to intrinsically faint O-B stars. Subluminous O-B stars are found among the subdwarf O stars (Drügler 1993). These are further distinguished between faint and luminous sdO. The absolute magnitude of the latter ranges from $-0.5$ to $-1 \pm 1$. Their N enrichment is due to stripping of the external layers. However sdO stars are hotter and less luminous than the five subluminous OBN stars in Table 3, having on the average $M_v = -2.4 \pm 0.3$ (s.e.). A few WO objects show absolute visual magnitude comparable to that of the five subluminous OBN stars in Table 3 with $M_v = -2.4$ (Lang 1992).

A new class of stars is the Of/WN class noted by Wolf et al. 1987 and by Walborn et al. 1996, that possess NIII emission lines. Since at least 2/5 of subluminous OBN stars in Table 3 possess the f-feature common to the Of/WN class (NIII emission lines) it would be tempting to suggest that: subluminous OBN stars in Table 3 are evolving towards the Of/WN stage. However, the absolute visual magnitude of Of/WN stars ranges from $-4$ to $-7$ (e.g. Crouther & Smith 1997). Then, the subluminous OBN stars in Table 3 may be the precursors of sdO stars in their way towards the WD stage. A few PN precursor candidates among OBN stars within nebulae are suggested in Table 3 according to a list of Lozinskaya & Lomovskii 1982.
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