KINEMATIC ANALYSIS OF CEPHEUS OB3

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ABSTRACT

24 early type stars were selected in the Cepheus OB3 region and the surrounding area on the basis of their relationship to the Cepheus OB3 association or their photometric compatiblility with this group. A kinematic study using Hipparcos data did not show significant differences between the well known members and the remaining stars. Because some stars overlap Cepheus OB2 region, a connexion between both groups cannot be ruled out. Kinematic ages for the young and old subgroups are computed.

Key words: space astrometry; open clusters and assotiations: individual: Cepheus OB3; stars: early type; ages.

1. INTRODUCTION

The stellar association Cepheus OB3 is about 725 pc from the Sun, and shows two clear subgroups with different evolutionary stages (Blaauw 1964). The surrounding region is rich in interstellar dust and gas and some studies indicate the existence of low-mass young stars (Moreno-Corral et al. 1993, Testi et al. 1995) and current star formation in the region (Sargent 1977, 1979).

The first systematic photometric study was carried out by Blaauw et al. (1959; hereinafter referred to as BHJ). They determined photometric membership from UBV photometry. The members they found are of spectral types earlier than B5. Jordi et al. (1992), from Strömgren photometry, suggested 5 new members of the group. The inclusion of these stars would enlarge the previously assumed area of Cepheus OB3 association.

From UBVRI-CCD photometry of stars in 18 randomly selected fields, Jordi et al. (1996) searched for faint members of the association. They listed 42 candidate members with apparent visual magnitudes $11.1 < V < 17.2$. The 19 brightest candidates were also observed in the $uvby-\beta$ system and 8 of them were confirmed as members.

In this paper, we analyze the kinematic behaviour of the confirmed members of Cepheus OB3 and some other early-type stars in the area, using the Hipparcos data. Kinematic ages are computed.

2. THE SAMPLE

Our sample contains 24 stars in Cepheus OB3 region and the surrounding area (internal proposal INCA 053). 16 of them are well known members (referred to as BHJ members) and the remaining 8 (called non-BHJ) were selected attending to the compatibility of their photometric data with the group (Jordi et al. 1992, Särg & Wrandemark 1970). Their spatial distribution is shown in Figure 1.

Individual photometric compatibility with the group was stablished according to the position on the intrinsic colour–magnitude diagram (Figure 2). The solid line is the ZAMS by Mermilliod (1981) corrected by the distance modulus of the association (9.32 mag).

Table 1 contains Hipparcos proper motions and cross-identifications of HIP numbers with BHJ and Särg & Wrandemark (SW).

3. KINEMATIC ANALYSIS

The Hipparcos proper motions present small dispersions and in comparison with former proper motion determinations (PPM catalogue) we found a very low correlation (Table 2). For the 23 stars in common, the Pearson's correlation coefficients are 0.048 and -0.005 for $\mu_\alpha \cos\delta$ and μ_δ, respectively.

The kinematic identity of associations is difficult to establish when observational errors do not allow the resolution of internal velocity dispersions. In our sample, the standard deviation of the Hipparcos data in proper motion (Table 3) is greater than the mean observational errors (0.95 and 0.94 mas/yr).

For the 16 BHJ stars, the previous kinematic analysis by Garmany (1973) gives a dispersion in μ_x and μ_y of 9.9 and 6.1 mas/yr. The author claimed that the internal errors were about 3 mas/yr, but HIP proper

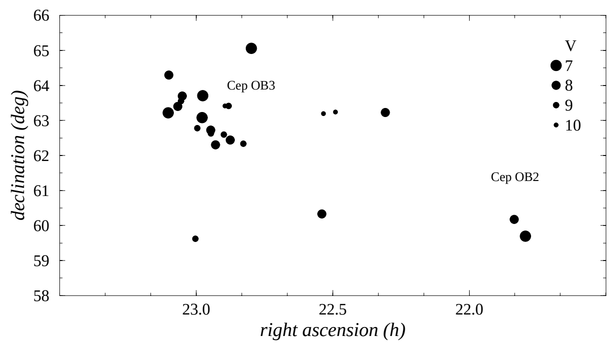

Figure 1. The concentration of stars corresponds to the 16 well known members of Cepheus OB3 association. The remaining 8 are spread over a larger area; the two westernmost stars overlap the region of the association Cepheus OB2. Since proper motions of the two subsamples are not statistically different (see Figure 3), a possible connection of Cepheus OB3 and Cepheus OB2 (Simonson 1968) cannot be ruled out.

Table 1. Hipparcos proper motions (mas/yr) and cross-identifications.

HIP	ident.	$\mu_\alpha \cos\delta$	μ_δ
107598	SW 6	-2.68	-2.51
107789	SW 8	-1.54	-4.62
110125	SW 26/27	-1.99	-3.74
111010	SW 51	-3.84	-0.91
111221	SW 58	-2.27	-3.82
111253	SW 57	-3.35	-2.63
112562	BD+64°1717	-2.23	-0.59
112718	BHJ 2	-5.46	-4.50
112947	BHJ 10	-1.63	-2.72
112983	BHJ 14	-2.92	-3.94
113051	BHJ 18	-2.41	-2.15
113065	BHJ 20	-3.85	-2.33
113218	BHJ 31	-2.31	-3.84
113301	BHJ 40	-1.20	-3.70
113306	BHJ 41	0.53	-3.72
113443	BHJ 47	-1.50	-2.04
113461	BHJ 46	-2.59	-4.14
113538	BHJ 54	0.33	-4.15
113565	SW 115	-4.33	-2.51
113825	BHJ 66	-0.81	-1.58
113849	BHJ 68	-0.39	-1.18
113907	BHJ 69	-2.02	-0.77
114060	BHJ 75	-1.25	-0.97
114070	BHJ 76	-1.66	-1.81

Table 2. Mean proper motions from Hipparcos and PPM catalogues for the 23 stars in common.

	HIP	PPM
$\mu_\alpha \cos\delta$(mas/yr)	-2.13±1.43	-0.98±11.55
μ_δ(mas/yr)	-2.73±1.31	-4.74±4.78

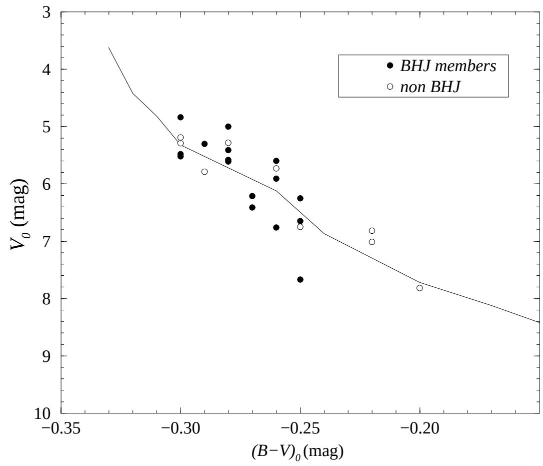

Figure 2. Intrinsic colour–magnitude diagram from stars in our sample.

Table 3. Mean proper motions and radial velocities (Barbier-Brossat et al. 1994) for the stars in our sample.

	BHJ	non-BHJ
No. of stars	16	8
$\mu_\alpha \cos\delta$(mas/yr)	-1.82±1.50	-2.78±0.97
μ_δ(mas/yr)	-2.72±1.27	-2.67±1.40
V_r (km/s)	-18.32±9.96	-23.97±15.67

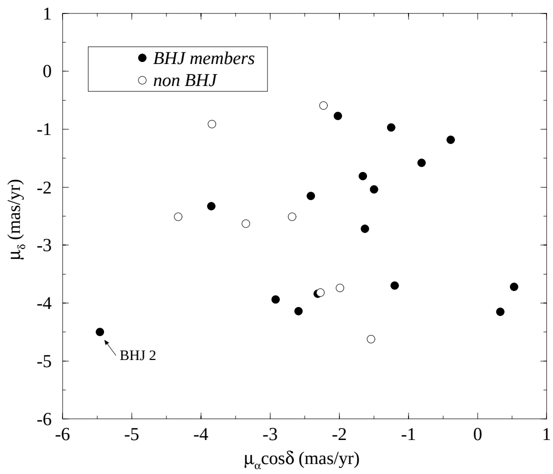

Figure 3. Proper motions of the stars in our sample. The difference between the mean proper motions of the two subsamples ($|\Delta\mu_\alpha \cos\delta| =$ 0.96 mas/yr and $|\Delta\mu_\delta| =$ 0.06 mas/yr) does no appear to be statistically significant. The membership of the star BHJ 2 (HIP 112718) is doubtful on the basis of its HIP astrometric data.

Table 4. Ages.

Kinematic ages from this study:	N	Age (Myr)	
BHJ members	16	0.9	
Old subgroup	10	0.8	
Young subgroup	6	0.4	
Kinematic and nuclear ages from other sources:		Age (Myr)	
Old subgroup:			
Blaauw (1964)		8	nuclear
Blaauw (1991)		10	nuclear
Garmany (1973)		0.5	expansion
de Zeeuw & Brand (1985)		8-12	nuclear
Jordi et al. (1996)		7.5	nuclear
Young subgroup:			
Blaauw (1964)		4	nuclear
Blaauw (1991)		7	nuclear
Jordi et al. (1996)		5.5	nuclear

motions show that these internal errors were underestimated and that the actual intrinsic dispersion of the proper motions within the association is smaller than the dispersion she quoted.

The membership of the star BHJ 2 (HIP 112718) is doubtful on the basis of its Hipparcos astrometric data.

The dispersion of tangential velocities is evaluated from the dispersion in proper motions assuming a distance of 725 pc. The value of about 5 km/s obtained is smaller than the standard deviation of the available radial velocities. The presence of binaries (Garrison 1970, Garmany 1972) may be the cause of this large σ (Table 3).

The two subsamples (see Figure 3) do not show any significant difference in proper motions. If several of non-BHJ stars belong to Cepheus OB2, this could mean that a relation between these two associations cannot be ruled out. Simonson (1996) reported that a concentration of neutral hydrogen surrounds both associations.

4. KINEMATIC AGE

Kinematic age is obtained by reversing proper motions of the members and tracing them back in time. The smallest configuration is assumed to correspond to the kinematic age. For several reasons, as shown by Brown et al. (1997), the kinematic age is always an underestimation of the real age.

The kinematic ages obtained for each subgroup are indicative of their concentration. Since the young group is more concentrated than the old one, its kinematic age is lower.

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