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Pulsating B-Type Stars in Young Open Clusters

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Abstract. During the last several years about a dozen young northern clusters and associations have been observed in our program of searching for B-type variables. As far as B-type pulsators are concerned, we found that (i) young northern open clusters are a few times less abundant in β Cephei stars than the southern ones, (ii) all newly discovered SPB stars seem to be monoperiodic.

1. Introduction

Since 1994 we have been conducting an observational program of searching young open clusters in the northern hemisphere for B-type variables. The observing facility consists of a 60-cm reflecting telescope operated in the Białków station of the Wrocław University Observatory. The telescope is equipped with a $6' \times 4'$ field-of-view CCD camera and an autoguider.

So far, about a dozen young clusters and one OB association have been observed. Those with already published results are listed in Table 1.

2. The incidence of β Cephei stars

As found by Balona and co-workers (Balona, 1994; Balona & Koen, 1994; Balona & Laney, 1995), the three young southern clusters of the Sagittarius-Carina arm of the galaxy (NGC 3293, NGC 4755, and NGC 6231) contain a large number of β Cephei stars. In these clusters, β Cephei-type pulsations have been discovered in about half of the stars falling into the theoretical instability strip. When compared with the number of stars in the $-1.5 < M_V < -4.5$ mag range, these β Cephei stars constitute about 35 ± 7 %.

On the other hand, in seven northern open clusters and one OB association observed by us (Table 1), all lying in the Perseus or Local arms of the Galaxy, we found only 10 β Cephei stars among the 190 stars falling within the above-mentioned range of M_V. The fraction is now 5.3 ± 1.7 %, several times smaller than in the southern clusters. This difference is most likely due to the metallicity difference between the clusters. Since southern and northern clusters we consider differ, on the average, by about 3 kpc in the galactocentric distance, the striking difference in the β Cephei star incidence we report can be explained in terms of the metallicity gradient in the Galaxy.

Table 1. Variables detected in the Wrocław search.

Cluster name	Pulsators				Other	Total
	β Cep	SPB	δ Sct	Other		
NGC 6823	0	1	2	0	12	15
Cygnus OB2 [1]	2	2	0	0	25	29
NGC 7128	0	1	0	0	7	8
NGC 7235	1	1	0	2	5	9
NGC 7419	1	0	0	0	28	29
NGC 663	2	1	0	0	26	29
NGC 869 (h Per) [1,2]	2	1	0	0	7	10
NGC 884 (χ Per) [1,2,3]	2	0	0	1	7	10
TOTAL	10	7	2	3	117	139

[1] we observed only the central part of the cluster/association,
[2] in cooperation with Dr. J. Krzesiński, Mt. Suhora Obs., Pedagogical Academy, Cracow,
[3] all observations were carried out at the Mt. Suhora Observatory.

3. SPB stars

As far as slowly pulsating B-type (SPB) stars are concerned, we found only seven candidates. Several such stars are present in the southern clusters as well. Surprisingly, all SPB stars we discovered appear to be monoperiodic. It seems, therefore, that multiperiodicity is not a common feature in these stars as was initially thought. The small number of SPB stars known in clusters does not allow any meaningful comparisons as to the differences in the incidence of SPB variability among the southern and northern clusters. We can only conclude that a very small fraction (less than 1 %) of stars falling in the SPB instability strip shows detectable pulsations.

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References

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