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A PHOTOMETRIC STUDY OF SHORT PERIOD VARIABLE STARS IN OPEN CLUSTERS

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RESUMEN. Se llevó a cabo fotometría fotoeléctrica de estrellas variables del tipo Delta Scuti ya conocidas en los cúmulos de Coma, Praesepe, Pleyades, α Per y NGC 2264, con el objeto de determinar sus períodos de pulsación. Asimismo, también se llevó a cabo fotometría multicolor uvby-β en las estrellas del cúmulo, y búsqueda de nuevas variables en los siguientes cúmulos abiertos: NGC 2539, NGC 6494, NGC 6882-5, NGC 7062, NGC 7063 y NGC 7686.

ABSTRACT. The photoelectric photometry of known Delta Scuti variable stars in selected open clusters (Coma, Praesepe, Pleiades, α Per, and NGC 2264) was carried out in order to determine the periods of pulsation. Multicolor uvby-β photometry and a search for new variables in other open clusters (NGC 2539, NGC 6494, NGC 6882-5, NGC 7062, NGC 7063 and NGC 7686) were also performed.

Key words: PHOTOMETRY — STARS-δ SCUTI

I. INTRODUCTION

There are many advantages to studying variable stars in open clusters. For example: the parameters that determine the evolution of stars, such as chemical composition and age can be considered to be the same for all the stars in the cluster. In general these parameters are very poorly determined or only known for the nearest clusters. These data, along with the mass and effective temperature allow us to better determine the physics which explains the pulsation mechanisms. This is the principal reason we study variable stars which are members of open clusters since the differences between one star and another within the same cluster is due to the original mass from which the stars were formed and the differences from cluster to cluster are due to the distinct chemical composition of each one.

As a result of the diversity of pulsation modes which are found in short period variables, the accurate determination of their periods is fundamental. In reality, it is possible to find correlation between pulsation modes and physical properties which will permit us, as a natural step, to test the validity of the theoretical models built for this type of variables and provide more precise data for future models. Our photometric observations have permitted us to determine the periods and the pulsation modes.

Previous studies carried out on open clusters (Breger 1972, 1973; Slovak 1979; Horan 1979) indicate that the number of variable stars that lie within the instability strip limits is about 30% of the total; a result that has also been found by Breger(1979), for field stars.

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II. OBSERVATIONS

Photoelectric photometry in the uvby-β colours has been obtained at the 1.5 m telescope of San Pedro Martir National Observatory for several open clusters. Simultaneously a search of short period variability in only one filter in stars between the spectral type B to F has been carried out utilizing the 0.84 m at the same observatory. At the 0.84 m telescope, the limit of magnitude for the detection of variability was 12.5 mag and at the 1.5 m telescope, the limit was 16.0 mag.

Observations of already- identified Delta Scuti stars in nearby clusters (Pleiades, Praesepe, Coma, α Per and NGC 2264) were presented. This part of the paper had as a main objective the determination of the periods of variation of these stars. Only one filter was used for the stars in Coma, but multicolor photometry (uvby-β) was carried out in Praesepe and the Pleiades. Both multicolor photometry of all the stars in the cluster, as well as photometry to determine the periods of the variables was performed. All known Delta Scuti type variables were studied in Coma, α Per and NGC 2264, while in Praesepe and the Pleiades only the variables with the greatest amplitude were observed (Table 1).

Table 1. Open Clusters with Known Delta Scuti Stars

Cluster	Distance (pc)	Age (yrsx10^6)	Variables Observed/known	References
Coma	85.4	700	3/3	Bahner 1957 Breger&Sanwal 1969 Jackisch 1972
Pleiades	139.6	100	3/4	Breger 1972
α Per	166	400	3/3	Slovak 1978
Praesepe	171	700	5/9	Breger 1970
NGC 2264	850	2	2/2	Breger 1972

The clusters with undetermined new Delta Scuti stars were chosen from the Hoag et al. (1961) and Mermilliod (1976) catalogues. The primary criteria for selection was that the clusters should have stars within the instability strip and for this purpose we used the B-V index and the color-color diagram given by Hoag et al.

The search for variable stars was exhaustive in some clusters up to 12.5 mag and the multicolor photometry was carried out over more than a hundred stars in each cluster. The clusters observed and the observational characteristics are listed in Table 2. Even though this study is still in the reduction stage, it has already been possible for us to detect new variables.

Table 2. Observed Open Clusters

Cluster	Tested stars for variability	No. of stars with uvby-β phot.
NGC 2539	18	60
NGC 6494	17	100
NGC 6882-5	16	100
NGC 7062	8	100
NGC 7063	15	100
NGC 7686	4	100

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