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On the distinction between δ Scuti and SX Phoenicis variable stars

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RESUMEN: Revisando investigaciones previas, llevadas a cabo por diversos autores, acerca de los períodos y las amplitudes de las estrellas variables tipo δ Scuti y SX Phoenicis, pero con una muestra más amplia, detectamos algunas características interesantes que comprometen la real distinción entre estos grupos de variables.

ABSTRACT: Reviewing previous investigations by some authors on periods and amplitudes of δ Scuti and SX Phoenicis type variable stars, but with a widest sample, we detect some interesting features that compromise the real distinction between these groups of variables.

Key words: STARS-DELTA SCUTI — STARS-VARIABLE

I. AMPLITUDE HISTOGRAM

Using information available in the *Catalogue of Variable Stars in the Lowest Part of the Instability Strip* (García et al., 1988), we constructed an amplitude histogram (Fig. 1) in wich we can observe two clearly separated groups: one with amplitude ≤ 0.3 mag. and the other one between 0.3 and 0.8 mag.

The former shows the characteristic tendency of δ Scuti stars to concentrate in the low amplitude zone. Previous investigations (Breger, 1979) show a nearly exponential distribution with a modal value of 0.02 mag. We could not confirm this behaviour; on the other hand our results show that the mode is shifted towards 0.05 mag. depicting a nearly Gaussian distribution around it.

δ Scuti are very low amplitude stars. The mechanism which limits the amplitude is a crucial problem for the understanding of the pulsational behaviour of dwarf cepheids. The physical explanation of the phenomenon is unknown, nevertheless, the sharing of pulsational energy among several modes is probably a very important factor limiting the amplitude observed (Dziembowski, 1980). Dziembowski (1982) also has shown that this distribution of energy may be due to nonlinear mode coupling. In particular, he discriminates between a direct resonance mechanism and a parametric one. In the former case, one or two unstable modes feed a resonant mode with a higher frequency. In the parametric resonance case, a high frequency unstable mode partially decays into one or two damped lower frequency modes.

The other group of the histogram recalls the attention on the homogenity of the variability features in the part of the instability strip near the ZAMS: we clearly have a modal value of 0.5 mag. McNamara (1985) concluded that the rotational velocity of the stars belonging to this group is lower than the stars of the first one. Conventionally, stars with V amplitude ≤ 0.3 have been classified as δ Scuti variables, and otherwise as dwarf cepheids. A

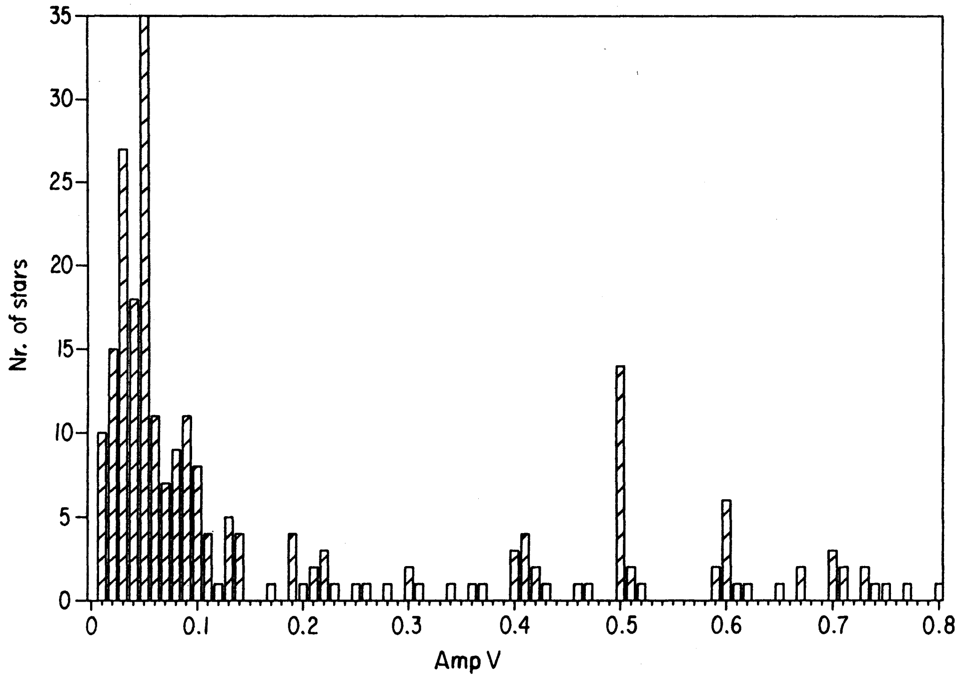

Fig. 1 : Amplitude-frequency distribution for 246 stars.

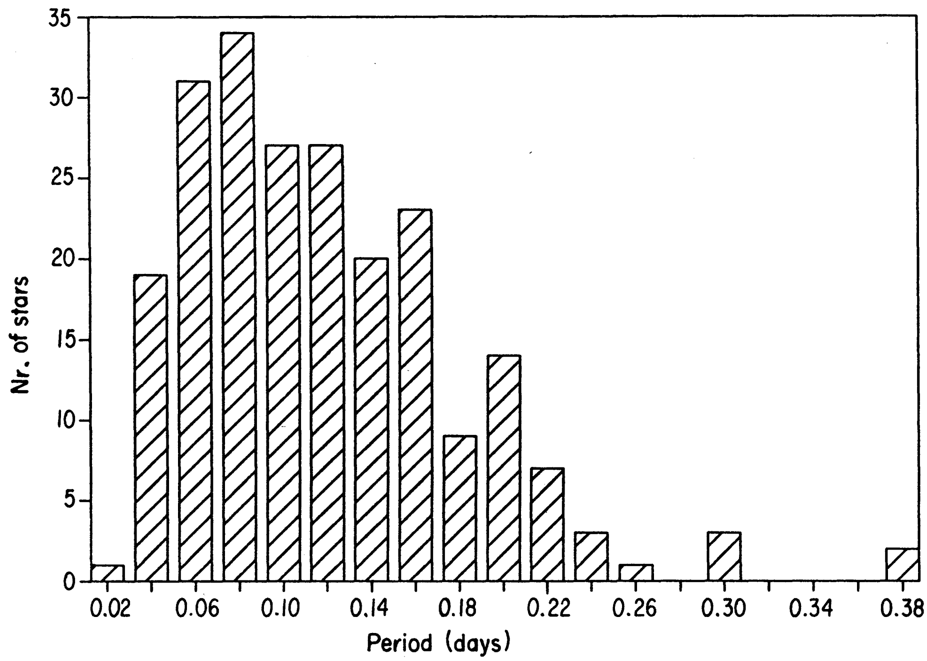

Fig. 2 : Period-frequency distribution for 246 stars.

couple of works, Breger (1979) and McNamara & Feltz (1978), have pointed out that the classification according to light amplitude is very arbitrary.

The majority of the stars in the instability strip near the ZAMS have space motions and metal abundances characteristics of Population I δ Scuti stars. There is however a small subgroup, led by SX Phoenicis, which sistematically shows low metallicities, high space motions, low luminosities, the shortest periods and the greater amplitudes.

McNamara's results and the shape of our histogram certainly show that a new revision of the above concepts is required.

II. PERIOD HISTOGRAM

The period histogram (Fig. 2) shows that the vast majority of δ Scuti variables have periods oscillating between 0.04 and 1.16 days, with a modal value of 0.08 days.

It is interesting to attend previous results (Frolov 1972, Baglin et. al 1973, Tsvetkov 1977, 1985) which show, although with much less data, a minimum at P=0.11-0.12 days. Tsvetkov suggests that this minimum may be due to the existence of oscillations in several modes, but in our period-frequency distribution, such minimun is not present.

Many of the these stars are multiperiodic and show a period ratio of the two main oscillations in the range $0.768 < P1/P0 < 0.778$. This value of P1/P0 has enabled identification of the two periodicities with the fundamental and first overtone modes of radial oscillation. Initial theoretical investigations (Petersen & Jorgensen, 1972; Dziembowski & Kozlowski, 1975) showed that the observed period ratios could be explained only by models of low mass and low heavy element content. More recently, works done by Stellingwerf (1979) have shown that the observed period ratios can be achieved by models of Population I stars of normal mass and chemical composition. The apparent difference between δ Sct and SX Phe stars seem to be in the presence of modes of pulsation of radial and non radial nature (Breger, 1983).

We think that the real distinction between SX Phe and δ Sct stars must be accurately defined.

REFERENCES

Baglin, A.; Breger, M.; Chevalier, C.; Hauck, B.; Le Contel, J.M.; Sareyan, J.P. and Valtier, J.C. 1973, *Astron. Astrophys.* **23**, 221
Breger, M. 1979, *Publ. Astron. Soc. Pac.* **91**, 5
Breger, M. 1983, *Harvard Obs. Bull.* 7, 283
Dziembowski, W. 1980, *Nonradial and Nonlinear Stellar Pulsation*, eds. H.A. Hill and W.A. Dziembowski (Springer Verlag, New York) p. 22
Dziembowski, W. 1982, *Acta Astron.* **32**, 147
Dziembowski, W.; Koslowski, M 1975, *Acta Astron.* **24**, 245
Frolov, M.S. 1972, *Astron. Tsirk.*, nr.671, 3
Garcia, J.R.; Cebral, R.; DiGiorgio, F.; Romano P.; Scoccimarro, E.R., Wahnon, P.; Zimmermann, M. 1988, *Bull. Inform. CDS* nr. 34, 67
McNamara, D.H. & Feltz, K.A. Jr. 1978, *Publ. Astron. Soc. Pac.* **88**, 510
McNamara, D.H. 1985, *Publ. Astron. Soc. Pac.* **97**, 715
Petersen, J.O.; Jorgensen, H.C. 1972, *Astr. Astrophys.* **17**, 367
Stellingwerf, R.F. 1972, *Astrophys. J.* **227**, 935
Tsvetkov, Ts.G. 1977, *Dissertation*, Moscow
Tsvetkov, Ts.G. 1985, *Astrophys. Space Sci.* **89**, 435

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