

PERIOD VARIATIONS IN SX PHE STARS: CY AQR, DY PEG AND  
HD 94033

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RESUMEN. Se ha llevado a cabo un análisis de los tiempos de máxima de tres estrellas del tipo SX Phe. Los resultados indican un decremento del período, consistente con los modelos teóricos de pre-enanas-blancas de  $0.02 M_{\odot}$ .

ABSTRACT. An analysis of the times of maximum light of three SX Phe star was carried out. The results support a monotonous decrement of the period which is consistent with the theoretical models of pre-white-dwarfs of  $0.2 M_{\odot}$ .

Key words: STARS- $\delta$  SCUTI — STARS-PULSATING — STARS-SX PHE

The period variations in pulsating stars can be compared directly with those calculated from evolutionary sequences and the evolutionary stage of the stars can be determined.

In the case of SX Phe stars, it is believed that they belong to an older population than the normal Delta Scuti type and, therefore, an exact determination of the period variation is specially interesting since this fact can be related with evolutionary stages and these stars can be described by either of the following two models: "Young" Pop II stars leaving the main sequence or they could be found in a more advanced evolutionary stage which would correspond to pre-white-dwarfs that still generate their energy through the burning of hydrogen in the shell.

Up to now we have found detectable variation in the period of some stars which have been most extensively observed in the last forty years: CY Aqr and DY Peg and an indication of the period variation of HD 94033.

A comprehensive study of the times of maxima for CY Aqr with a time span of fifty three years has been carried out. The results support a monotonous decrement of the period and the ephemeris found is given by  $2440892.637 + 0.061038318 E - 4.58 \times 10^{-13} E^2$ . Models of low mass ( $\approx 0.2$  solar masses) explain the parameters of this star.

An analysis of a complete list of the times of maximum light of DY Peg that exists in the literature has been carried out. With 681 times of maximum light covering a time span of 46 years, the following ephemeris was deduced:  $T_{\max} = 2437178.3729 + 0.07292633 E - 2.20 \times 10^{-15} E^2$  which implies a period variation of  $d \ln P / dt = -3.020 \times 10^{-8} \text{ yr}^{-1}$ . A direct comparison with the models suggests that this star is in the stage of a pre-white dwarf of  $0.2 M_{\odot}$  as suggested by the theoretical models of Dziembowski and Kozłowski (1974). New observations of the maximum light of HD 94033 allow a determination of an ephemeris  $T_{\max} = 2442516.1585 + 0.05951012 E$  and the O- residuals suggest a period variation. Hence, the three stars which were considered here share the typical SX Phe characteristics (low metal content, high space velocity or high galactic latitude) and also show a detectable period variation.

TABLE 1. COMPARISONS OF OBSERVATIONAL PARAMETERS WITH MODELS OF POSSIBLE EVOLUTIONARY STAGES

Parameters	CY Aqr			HD 94033			DY Peg		
	Predicted		Observed	Predicted		Observed	Predicted		Observed
	Model I	Model II		Model I	Model II		Model I	Model II	
log g	3.960	3.694	3.947	4.12	3.878	4.14	3.59	3.60	...
log Te	3.845	3.837	3.893	3.887	3.877	3.884	3.87	3.917	3.93
M bol	1.959	...	1.85	1.959	...	...	2.551	2.623	...
M/M <sub>o</sub>	2.0	0.23	...	2.0	0.225	...	0.4	0.23	...
P(d)	0.069	0.0671	0.061038318	0.0535	0.0496	0.05951012	0.0705	0.0836	0.07292633
dlnP/dt (y <sup>-1</sup> )	...	-5 × 10 <sup>-8</sup>	-8.3 × 10 <sup>-8</sup>	...	-1.33 × 10 <sup>-8</sup>	...	...	-3 × 10 <sup>-8</sup>	-3.02 × 10 <sup>-8</sup>

Model I. Stellingwert, R. 1979, Ap. J., 227, 935. Model II. Dziembowski, W. and Kozlowski, M. 1974, Acta Astr. 24, 245.

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