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ω Centauri – a Laboratory for Critical Tests of Stellar Structure and Evolution*

L. M. Freyhammer[1], J. O. Petersen[2], M. I. Andersen[3]

[1] *University of Brussels (VUB), Pleinlaan 2, 1050 Brussels, Belgium / Nordic Optical Telescope, Apartado 474, 38700 S/C de La Palma, Spain*

[2] *Astronomical Observatory, NBIfAFG, Juliane Maries Vej 30, DK-2100 Copenhagen Ø, Denmark*

[3] *Department of Physical Sciences, Division of Astronomy, P.O. Box 3000, FIN-90401 Oulu, Finland*

Abstract. Preliminary results are reported for a monitoring program on ω Cen. We search for multi-mode SX Phe stars and changes in pulsation parameters of the cluster variables in order to test models of stellar evolution. With a periodogram for 10,000 light curves, we estimate that ω Cen hosts several hundred SX Phe stars.

1. Observations and Data Reduction

With data obtained over 5 yr for the largest globular cluster ω Cen, we use SX Phœnicis and RR Lyrae stars to test models of stellar evolution and structure. In 1997 we presented discovery of a double-mode SX Phe star and reported other candidates (Freyhammer, Andersen, & Petersen 1998). Fourier analysis of these candidates is presented with 6 new SX Phe candidates.

The Danish 1.5-m telescope, La Silla, was used in 1995 to obtain 2000 *BVI* observations of ω Cen in 5 fields. In order to search for short-period variables, one field (FOV=$8\farcm7\times8\farcm7$) was centered on the cluster center and observed in the *B* band for two nights. Results from these 180 images are described here. Reductions were made with DAOphot/IRAF. To get consistent photometry for the same star in each image, we first subtracted 60 000 faint stars ($B<18\fm5$) by using photometry from a composite of images (seeing $<1\farcs2$). This reduced the final photometry to 20 000 stars. Power spectra were calculated for all stars, and the time series with the most pronounced periods were analyzed with *S*-spectra least-squares Fourier analysis (Andreasen 1987; Garrido & Rodríguez 1996).

2. Results and Discussion

Properties for 14 variables are listed in Table 1 with proposed mode identifications. OGLE stars are variables from Kaluzny et al. (1996). Half of the stars are positioned within $3'$ from the cluster center and crowding dominates

*Based on observations obtained at the European Southern Observatory at La Silla, Chile

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Table 1. Semi-amplitudes H (mmag) and frequencies ν (d^{-1}) of significant peaks. *Italic* indicates BSS within the instability strip.

		Radial modes						Unid. modes	
ID	$\langle B\rangle$	ν_0	H_0	ν_1	H_1	ν_2	H_2	ν	H
CUO 411	17.50	18.34	15±4	23.69	88±4	28.93	13±4		
CUO 1071	18.22			23.21	45±6	28.40	19±6		
CUO 3592	17.86							17.66	84±7
CUO 7029	17.48	16.67	25±6	20.76	112±6				
CUO 7523	18.72	24.26	36±6	30.74	23±6				
CUO 7944	18.05							18.07	53±10
CUO 9939	17.25							18.17	55±7
CUO 11436	17.08			20.09	17±4	24.09	56±4		
CUO 11577	17.76	18.81	36±8	23.76	47±8				
CUO 14483	17.16	18.67	79±4	24.04	12±4				
CUO 16743	17.90			19.75	51±6	24.28	21±6	33.04	24±6
OGLE 2	17.95	20.76	71±5	26.71	17±5			33.01	21±5
OGLE 3	17.23	16.05	378±10			23.40	20±4		
OGLE 4	17.42	20.19	195±4	25.82	10±4				

their photometry. The Fourier solutions are affected by 0.3 d^{-1} aliases due to two intervening nights and 30-60 mmag rms noise in the light curves. Mode identification is made with theoretical period ratios for radial modes in Petersen-diagrams. CUO 411, 1071, 14483, 16743, and OGLE 2 and 4 agree well with standard evolutionary models (the best being $Z = 0.001$ and $M = 1.1M_{\odot}$). No modes could be identified for the remaining variables. Since we have not got V photometry for all stars yet, it is not possible to check if all are blue stragglers (BSS) inside the Cepheid instability strip. The distribution of periods from 10 000 light curves with S >10% is not random as expected for constant stars: there are significant peaks for 18 and 24 d^{-1}, comprising ~300 stars. This can be explained by a large population of SX Phe stars within this central field, pulsating in the ν_0 and ν_1 modes, but may contradict findings of fewer BSS in the whole cluster (Kaluzny et al. 1997). With new observations from 1998 and 1999 we expect to improve the Fourier solutions and clarify the number of SX Phe stars in ω Cen.

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