

DOUBLE-MODE RR LYRAE STARS IN IC 4499

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ABSTRACT: Thirteen double-mode RR Lyrae (RRd) stars, with mean magnitudes $\langle B \rangle_c = 18.30 \pm 0.10$ and $\langle V \rangle_c = 17.80 \pm 0.15$, have been identified in the variable-rich Oosterhoff type I globular cluster IC 4499. The stars have surprisingly uniform properties, and are considerably different from RRd stars found in Oo II systems. The mean first-overtone period (Fig.1) is $\langle P_1 \rangle = 0.357^d \pm 0.005^d$ (cf. $\langle P_1 \rangle = 0.40^d$ for Oo II RRd stars), and the mean ratio of the first-overtone period to the fundamental period is $\langle P_1/P_0 \rangle = 0.7443 \pm 0.0002$. The mean double-mode pulsation mass for the 13 stars, using the King Ia ($Y=0.279$, $Z=0.001$) mass calibration, is $0.535 \pm 0.003 M_\odot$. Such an average mass is $0.11 M_\odot$ smaller (i.e. $\sim 17\%$ smaller) than that for RRd stars found in Oo II systems, and possibly $\sim 0.01 M_\odot$ smaller than the mean mass for the two RRd stars in M3 (it is important to note that the zero point of these mass determinations is uncertain by at least 15%). The metal abundances for the RRd stars, and for the system of RR Lyrae stars as a whole, are found to be consistent with $\langle [\text{Fe}/\text{H}] \rangle = -1.38 \pm 0.20$, determined from ΔS spectroscopy. In the Peterson diagram (Fig.2), all known RRd stars now divide (apparently by mass) into two groups (split according to Oosterhoff type). With a reddening of $E_{B-V} = 0.26 \pm 0.03$, the cluster distance modulus is $(m-M)_0 = 16.23^m \pm 0.23^m$.

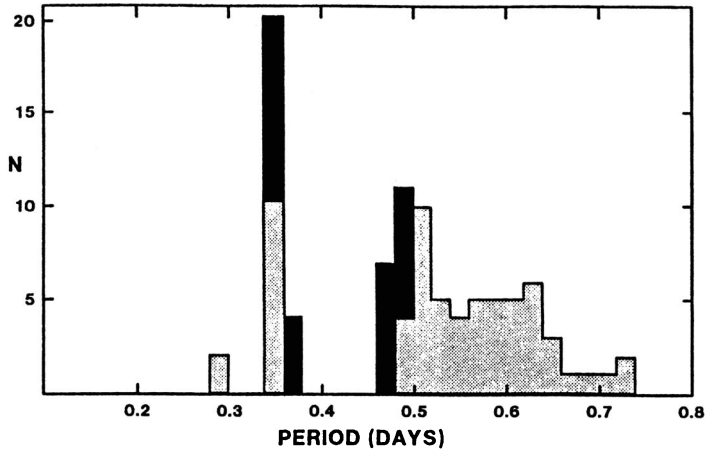


Fig.1 - Period histogram of the RR Lyrae stars in IC 4499. The black areas represent both period components of the double-mode RR Lyrae stars, and the shaded areas represent all other RR Lyrae stars.

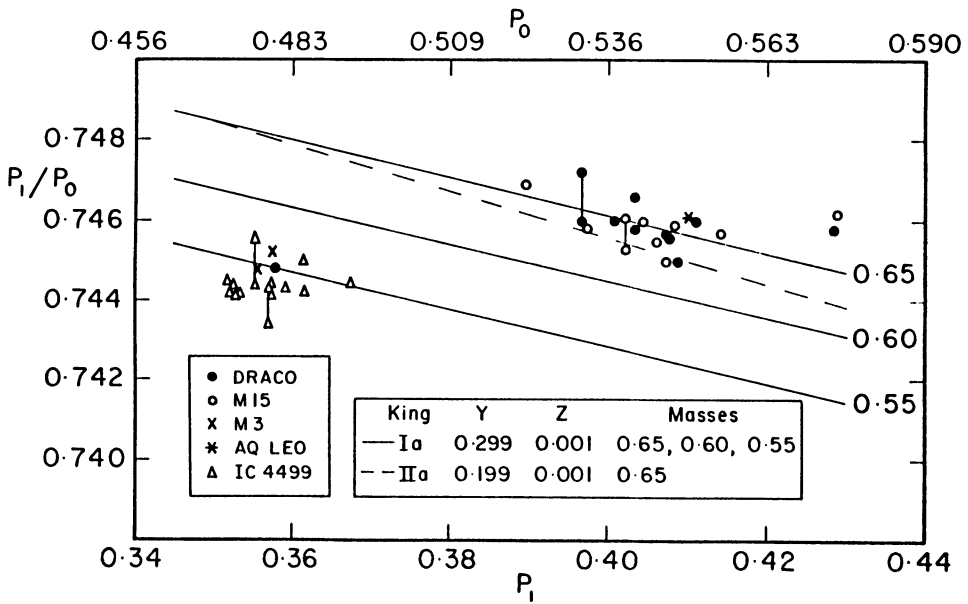


Fig.2 - Petersen diagram showing the positions of all known double-mode RR Lyrae stars. Note that the mean mass of the IC 4499 RRd stars is $\sim 0.535 M_{\odot}$, and that the stars are virtually indistinguishable from the two RRd stars in M3 and the low mass RRd star in Draco.