Petersen Diagrams for RR Lyræ Stars in the Magellanic Clouds

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Abstract

Discovery of the large number of double mode RR Lyræ(RRd) stars in both Magellanic Clouds is one of valuable by-products of the MACHO and the OGLE microlensing projects. In the P_1/P_0–P_0 (Petersen) diagram the objects occupy an extended band encompassing all previously known RRd stars. Our goal has been to explain the shape and the extent of this band.

We calculated pulsation periods for extended sets of unfitted envelope models adopting various *luminosity-metallicity* and *mass-metallicity* relations. The inferred P_1/P_0–P_0 dependencies were confronted with the observed band.The confrontation led us to the following conclusions:

- The shape of the RRd band in the *Petersen diagram* is determined primarily by the *luminosity-metallicity* relation. With the empirical relation of Buonanno et al. (1990) the models reproduce the observed shape.
- The width of the band reflects the range of the metallicity parameter Z. In the Magellanic Clouds the double-mode RR Lyræ stars span the fundamental mode period range of $0.46 \div 0.58\ d$, which according to our models corresponds to the metallicity range $Z = 0.0001 \div 0.001$. However, the numbers are not reliable because of the uncertainties in the calculated values of the P_1/P_0–P_0 ratios.
- There is a difference in the population of RRd stars between two Magellanic Clouds. In the LMC we see many more objects at the short period end of the band that is objects with higher metallicity.

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References

Buonanno, R., Cacciari, C., Corsi, C.E., and Fusi Pecci, F. 1990, A&A, 230, 315