

The Petersen Diagram for RR Lyrae Stars in the Magellanic Clouds

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Abstract. We show that the spread of the Magellanic Cloud RRd stars in the Petersen diagram may be explained in terms of spread in metallicity by one order of magnitude.

Discovery of the large number of double mode RR Lyrae (RRd) stars in both Magellanic Clouds is one of the valuable by-products of the MACHO and the OGLE microlensing projects. In the P_1/P_0 vs. 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 dependences 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 Lyrae stars span the fundamental mode period range of 0.46 – 0.58 d, which, according to our models, corresponds to the metallicity range $Z = 0.0001 - 0.001$. However, the numbers are not reliable because of the uncertainties in the calculated values of the P_1/P_0 vs. P_0 dependence.
- 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 are objects with higher metallicity.

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Reference

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