Non-radial oscillations in M-giant semi-regular variables: Kepler observations and stellar models

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Abstract

The success of asteroseismology relies heavily on our ability to identify the frequency patterns of stellar oscillation modes. For stars like the Sun this is relatively easy because the mode frequencies follow a regular pattern described by a well-founded asymptotic relation. When a solar like star evolves off the main sequence and onto the red giant branch its structure changes dramatically resulting in changes in the frequency pattern of the modes. From the analysis of almost four years of Kepler data of the most luminous stars in the field (M giant) we find that their frequency spectra are dominated by triplets. We also find that the pattern is dominated by dipole modes even for the most luminous stars in our sample. To support this investigation we follow the evolution of the adiabatic frequency pattern from the main sequence to near the tip of the red giant branch for a series of models. We find a significant departure from the asymptotic relation for the non-radial
modes near the red giant branch tip, resulting in the observed triplet frequency pattern. Our identification explains previous results from ground-based observations reporting sub ridges in the period-luminosity diagram and fine structure in the Petersen diagram.

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