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Resonant Mode Coupling in Red Giants[1]

NEVIN WEINBERG, University of Texas at Arlington, PHIL ARRAS, University of Virginia, DEBADITYA PRAMANIK, Massachusetts Institute of Technology

Asteroseismic studies of red giants generally assume that the oscillation modes can be treated as linear perturbations to the background star. However, Kepler observations show that the oscillation amplitudes increase dramatically as stars ascend the red giant branch. Thus, the linear approximation may not always be valid. In previous work, we showed that mixed modes in red giants are unstable to nonlinear three-wave interactions over a broad range of stellar mass and evolutionary state. Here we solve the amplitude equations that describe the nonlinear mode dynamics for large networks of resonantly coupled modes. We find that nonlinear interactions can lower the energy of gravity-dominated mixed modes by $> 80\%$ compared to linear theory predictions. However, they have only a mild influence on the energy of pressure-dominated mixed modes. We conclude that resonant mode coupling can have a potentially detectable effect on the oscillations of highly evolved red giants, though it cannot account for the population of moderately evolved red giants that exhibit dipole modes with unusually small amplitudes.

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