Confirming and characterizing new mean motion resonances in the Kepler and TESS catalogues

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The study of orbital resonances allows for the constraint of planetary properties of compact systems. Mean motion resonance occurs when two or more planets repeatedly exchange angular momentum and energy as they orbit their host star, since the planets will always conjunct at the same point in their orbits. We can predict a system's resonances by observing the orbital periods of the planets, as planets in or near mean motion resonance have period ratios that reduce to a ratio of small numbers. However, a period ratio near commensurability does not guarantee a resonance; we must study the system's dynamics and resonant angles to confirm resonance. Because resonances require in-depth study to confirm, and because two-body resonances require a measurement of the eccentricity vector which is quite challenging, very few resonant pairs or chains have been confirmed. We thus remain in the era of small number statistics, not yet able to perform large population synthesis or informatics studies. To address this problem, we build a python package to find, confirm, and analyze mean motion resonances, primarily through N-body simulations. We then analyze all near-resonant planets in the Kepler/K2 and TESS catalogues, confirming over 60 new resonant pairs and various new resonant chains. We additionally demonstrate the package’s functionality and potential by characterizing the mass-eccentricity degeneracy of Kepler-80g, exploring the likelihood of an exterior giant planet in Kepler-80 and Kepler-223, and studying the formation history of K2-138.