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Three-body resonances role in shaping planetary architecture

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Recent works on three-planet mean motion resonances (MMRs) have highlighted their importance for understanding the details of the dynamics of planet formation and evolution. While the dynamics of two-planet MMRs are well understood and approximately described by a one-degree-of-freedom Hamiltonian, little is known of the exact dynamics of three-body resonances besides the cases of zeroth-order MMRs or when one of the bodies is a test particle. I propose the first general integrable model for first-order three-planet mean motion resonances. I show that one can generalize the strategy proposed in the two-planet case to obtain a one-degree-of-freedom Hamiltonian. The model is valid for any mass ratio between the planets and for every first-order resonance. I show the agreement of the analytical model with numerical simulations. As example of application, I show how capture in three-body first-order MMR can affect tidal dissipation, which give us constraints on the dynamical history of systems where a strong dissipation is thought to have took place such as Kepler-221.

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