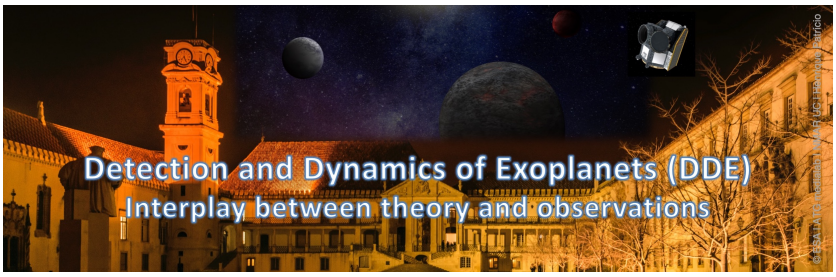

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Breaking cold Jupiter resonance chains with stellar flybys

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Planetary migration models predict multiple planets captured into a chain of mean-motion resonances during the disk phase. Over a dozen systems have been observed in these configurations, nearly all close-in planets, with a lack of resonant chains for planets with orbital periods larger than ~300 days. Dynamical studies often overlook the fact that stars do not evolve in isolation. In this work, we explore the possibility that the absence of giant planets in wide-period resonant chains may be due to post-formation disruption caused by stellar flybys. For planets in the 2:1-2:1 and 3:2-3:2 resonant chains, we evaluate the long-term stability after varying parameters such as the planet masses, as well as the inclination, pericentric distance, and mass of the flyby star. The encounter occurs within the secular regime, mainly perturbing eccentricities and inclinations. Our integrations show that the 2:1-2:1 resonant chain is significantly more resilient to a stellar flyby than for the 3:2-3:2 configuration. The nature of the instability is different in both scenarios, the 2:1-2:1 becomes unstable quickly, soon after a penetrative close encounter. Instead, planets in the 3:2-3:2 chain become unstable in long timescales due to more distant flybys that only provide small perturbations for the system to chaotically dissolve. If an encounter occurs between a star hosting planets and a passing star, Jupiter-mass systems with 3 planets in a 3:2-3:2 resonant chain or more compact initial configurations are likely to be disrupted.

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