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Properties of Free-floating Planets Ejected through Planet–Planet Scattering

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Multiple studies show that planet–planet scattering plays a key role in the dynamical evolution of planetary systems. It can also contribute to the census of free-floating planets. In this work, we run an ensemble of N-body simulations and record the properties of ejected planets. Our simulations sample a wide range of orbital and physical parameters. We find that 40%–80% of planets are ejected, depending on the initial number in the system. Most ejections occur over $\sim 10^8$–10^9 yr. The mean excess velocity of ejected planets lies in the range 2–6 km s^{-1} relative to the host star, and strongly depends on the semimajor axis of the innermost planet. Regardless of initial location, all planets are equally likely to be ejected. Bound and ejected planets show distinct mass distributions, with bound planets being more massive. Increasing planetary radii reduces the ejection fraction due to higher collision rates. The properties of ejected planets do not strongly depend on initial spacing, though ejection timescales increase with separation. The ejection fraction is also largely insensitive to the distance from the host star used to define unbound status. Comparing our results with observed free-floating planet populations, we conclude that fewer than five Jovian-mass planets need to form per star to match observations—consistent with current constraints from both observations and planet formation models.

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