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Kepler and Exoplanet System Architecture

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Abstract

About one-third of the ~1200 transiting planet candidates detected in the first four months of Kepler data are members of multiple candidate systems. There are 115 target stars with two candidate transiting planets, 45 with three, 8 with four, and one each with five and six. The distribution of observed period ratios shows that the vast majority of candidate pairs are neither in nor near low-order mean motion resonances. Nonetheless, there are small but statistically significant excesses of candidate pairs both in resonance and spaced slightly too far apart to be in resonance, particularly near the 2:1 resonance. Virtually all candidate systems are stable, as tested by numerical integrations (assuming a nominal mass-radius relationship). Several considerations strongly suggest that the vast majority of these multi-candidate systems are true planetary systems. Using the observed multiplicity frequencies, we find that a single population of planetary systems that matches the higher multiplicities generally underpredicts the number of singly-transiting systems. We provide constraints on the true multiplicity and mutual inclination distribution of the multi-candidate systems, revealing a population of systems with multiple small planets with low ($1-5^\circ$) mutual inclinations.