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Detectability of coorbital planets from radial velocity data

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Abstract

The possible existence of exoplanets in coorbital motion has fascinated planetary scientists for several years. Since the diversity of exoplanetary configurations continue to surprise us, even after 15 years of the discovery of Peg51b, it seems almost natural to expect Trojan planets to exist somewhere and their announcement to be only a matter of time. For systems with more than one planet, we know that the existence of resonant motion may be possible evidence of a past large-scale planetary migration due to interactions with the gaseous disk. Although their importance it is unquestionable is still intriguing why some commensurabilities are very populated (e.g. 2/1 MMR) and others that are currently empty (particularly the 1/1 MMR).

The previous literature works related with coorbital detections proposed to distinguish between coorbital and single planet fits from radial velocity observations (RV), examining residuals for long-term observations. As in other low order resonances, the coorbital configurations have large mutual interactions due to resonant motion.

We go further and analyzed the detectability possibilities of hypothetical exoplanets in coorbital motion from synthetic RV signals, considering different types of stable planar configurations, orbital eccentricities and mass ratios. For each nominal solution corresponding to small-amplitude oscillations around the periodic solution, we generate a series of synthetic RV curves mimicking the stellar motion around the barycenter of the system. We then fit the resulting data sets and we compare the resulting residuals with different models. Finally we estimated orbital parameters and also analyzed the dynamics of fitted system. Later we identified formation scenarios for such type of orbits with the 2D public hydro-code FARGO.