P230a Numerical study of orbit-crossing timescales of multi-planet systems

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Significant spin-orbit misalignments have been identified in many transiting planetary systems, some of which indeed are interpreted as retrograde or nearly polar orbits. These unexpected results imply that the misaligned close-in planets have experienced inward migration via planet-planet scattering and the subsequent tidal friction.

The basic processes have been studied in detail by pioneering work by Nagasawa et al. (2008), but the quantitative prediction of the resulting fraction of the misaligned systems is difficult due to the lack of the knowledge of the relevant initial conditions. In order to constrain/reconstruct the initial condition of those systems in a statistically reliable fashion, we started a series of systematic numerical investigations of the evolution of multi-planet systems over a wide range of the initial parameter space.

Following Yoshinaga et al. (1999), Marzari and Weidenschilling (2002) and Chatterjee et al. (2008), we study the stability of multi-Jupiter mass planet systems orbiting around a sun-like star by changing their mass, planet-planet separations scaled in terms of their mutual Hill radii, eccentricity and inclination. We extend the earlier work, and focus on how the orbit-crossing timescales depend on the initial planetary eccentricity and inclination. In the talk, we present our results of the orbit-crossing time scales and discuss their implications for the formation of planetary systems with significant spin-orbit misalignments.