P68a Numerical Study of Spin-orbit Misalignment and Realignment

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Significant spin-orbit misalignments have been identified in many transiting planetary systems, some of which are interpreted as retrograde or nearly polar orbits. These unexpected discoveries imply that such misaligned close-in planets have possibly 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 because of the uncertainties of the initial conditions and also the complicated evolution up to several Gyrs.

In paticular, we focus on the tidal interaction between the stellar spin and the planetary orbital angular momentum. We follow Correia et al. (2011), and perform numerical integration of the secular evolution of exoplanet systems in very eccentric and inclined orbit up to 10^{10} year.

We find that the tidal interaction tends to realign the spin-orbit angle fairly efficiently under certain conditions. Indeed it is consistent with the observational indication that older systems have a higher fraction of spin-orbit alignment. This realignment process is important in confronting the initial conditions of the multi-planetary systems against the observed fraction of misaligned systems, and thus in interpretating the origin of exoplanetary systems.