## P247a Numerical study of spin-orbit misalignment and realignment II

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Among 70 transiting planetary systems with measured spin-orbit angles $\lambda$, 29 systems exhibit significant misalignment ($\lambda > \pi/8$), including 8 polar- and 7 retrograde-orbits. These unexpected, counter-intuitive discoveries imply that close-in planets should have experienced inward migration, possibly via planet-planet scattering followed by the subsequent tidal dissipation.

While the tidal dissipation could circularize the orbit and realign the stellar spin and planetary orbit, it has been shown that an equilibrium-tide model results in the orbital decay of a comparable timescale. Thus a planet in the realigned system should quickly infall onto the host star. Thus this simple model does not explain the majority of the realigned systems with finite semi-major axes.

Recently, Lai(2012) proposed a new model in which the damping timescale of the stellar obliquity may be much smaller than that of the planetary orbit. Rogers & Lin(2013) integrated a set of simplified equations derived by Lai(2012), and claimed that planetary systems with initially arbitrary spin-orbit angles have three stable configurations: aligned, anti-aligned and polar orbits.

We have integrated the planetary orbits, and the stellar spin angular momentum in real space without resorting to the above simplified equations, and found that the anti-aligned and polar orbits are not stable but approaching the aligned orbit in the end. We explain why Rogers & Lin(2013) reached an incorrect conclusion, and consider the extent to which our results can explain the observed distribution of the spin-orbit angle $\lambda$.