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Tidal dissipation within hot Jupiters: a new appraisal

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Eccentricity or obliquity tides have been proposed as the missing energy source that may explain the anomalously large radius of some transiting "hot Jupiters". To maintain a non-zero and large obliquity, it was argued that the planets can be locked in a Cassini state, i.e. a resonance between spin and orbital precessions (Winn & Holman, 2005). We compute the tidal heating within "inflated" close-in giant planets with a non-zero eccentricity or obliquity. We further inspect whether the spin of a "hot Jupiter" could have been trapped and maintained in a Cassini state during its early despinning and migration. We estimate the capture probability in a spin-orbit resonance between $\sim$ 0.5 AU (a distance where tidal effects become significant) and 0.05 AU for a wide range of secular orbital frequencies and amplitudes of gravitational perturbations. Numerical simulations of the spin evolution are performed to explore the influence of tidal despinning and migration processes on the resonance stability. We find that tidal heating within a non-synchronous giant planet is about twice larger than previous estimates based on the hypothesis of synchronization. Chances of capture in a spin-orbit resonance are very good around 0.5 AU but they decrease dramatically with the semi-major axis. Furthermore, even if captured, both tidal despinning and migration processes cause the tidal torque to become large enough that the obliquity ultimately leaves the resonance and switches to near 0°. Our conclusions are that locking a "hot Jupiter" in an isolated spin-orbit resonance is unlikely at 0.05 AU but could be possible at larger distances. Another mechanism is then required to maintain a large obliquity and create internal heating through obliquity tides (See Levrard et al., in press for A&A, 2006, astro-ph/0612044 for more details).