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Tidal forces in CoRoT planetary systems

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Abstract

CoRoT is a french space mission searching for extra-solar planets since December 2006.

The stability of close-in planetary orbits (¡ 0.1 AU) under the influence of tidal forces depends on the ratio of the tidal dissipation factor Q_* and the stellar love number $k_{2,*}$. Both parameters are not very well constrained. Many various models yield values for $Q_*/k_{2,*}$ which span several orders of magnitude: $10^{5.5} < Q_*/k_{2,*} < 10^{10}$. The tidal migration rate for different dissipation factors was computed for each CoRoT-system.

It is shown that the CoRoT-planets would migrate to the stellar Roche limit within an extreme short time if $Q_*/k_{2,*} < 10^6$. Compared with the age of the host star, it would be highly unlikely to observe three of the seven CoRoT planets: CoRoT-1b, CoRoT-2b and CoRoT-7b.

Significant orbital migration assuming reasonable $Q_*/k_{2,*}$-values ($Q_*/k_{2,*} \approx 10^8$) is only expected for the massive close-in CoRoT planets: the hot Jupiters CoRoT-1b, CoRoT-2b and the Brown Dwarf CoRoT-3b. A considerable angular momentum transfer from the decaying orbital motion of these massive objects to their host stars would be expected, resulting in extreme increase of the stellar rotation. This is only observed for the host star CoRoT-3 which may eventually achieve a double synchronous rotation state with its companion. Another CoRoT planetary system, CoRoT-4, is not in a tidally locked state. The agreement between stellar rotation and orbital revolution rate seems to be a coincidence.