Astronomy in Focus - XXX
Proceedings IAU Symposium No. XXX, 2018
M. T. Lago, ed.

doi:10.1017/S1743921319003259

YORP equilibria: ways out of YORP cycles

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Abstract. Here, we discuss the YORP equilibria, to which asteroids can come as the result of their evolution due to the YORP effect.

The evolution of small asteroids is governed by the YORP effect, which can include several different varieties: normal YORP (NYORP), tangential YORP (TYORP), and binary YORP (BYORP) (Vokrouhlický *et al.*, 2015). The conventional wisdom says that asteroids evolve according to YORP cycles: an asteroid is accelerated by the YORP effect to the disruption limit, forms a binary, then the binary decays, and the asteroid starts a new YORP cycle, with a decreased mass, an altered shape and a small angular momentum.

Still, there are several mechanisms, by which YORP cycles can be interrupted and YORP evolution of asteroids stopped:

(a) Equilibrium between TYORP and NYORP, which can cancel each other at a certain rotation rate (Golubov & Krugly, 2012; Golubov *et al.*, 2016).

(b) For a singly-synchronous binary, equilibrium between TYORP, NYORP and tides acting on the primary, and between BYORP and tides acting on the secondary (Golubov *et al.*, 2018).

(c) For a doubly-synchronous binary, equilibrium between NYORP and BYORP, which are equal at a certain distance between the primary and the secondary (Golubov & Scheeres, 2016).

For each of the three kinds of equilibria, their probabilities are of the order of 10 percent, implying that each asteroid should be caught into an equilibrium after several YORP cycles. Stable asteroids survive, while unstable ones are disrupted and recreated in YORP cycles, until they perhaps become stable, in a process similar to natural selection. Thus the YORP effect can check itself and minimize its own importance for asteroids evolution.

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