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"Barrel Instability" for Elongated Secondaries in Binary Asteroids

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Most close-in planetary satellites are in synchronous rotation, which is usully the stable end-point of tidal despinning. Saturn's moon Hyperion is a notable exception by having a chaotic rotation. Hyperion's dynamical state is a consequence of its high eccentricity and its highly prolate shape (Wisdom et al. 1984). As many binary asteroids also have elongated secondaries, chaotic rotation is expected for moons in eccentric binaries (Cuk & Nesvorny 2010), and a minority of asteroidal secondaries may be in that state (Pravec et al. 2016). The question of the secondary's rotation is importrant for the action of the BYORP effect, which can quickly evolve orbits of synchrnous (but not non-synchronous) secondaries (Cuk & Burns 2005). Here we report preliminary numerical simulations which indicate that in binary systems with a large secondary and significant spin-orbit coupling a different kind of non-synchronous rotation may arise. In this "barrel instability" the secondary slowly rolls along its long axis, while the longest diameter is staying largelly aligned with the primary-secondary line. This behavior may be more difficult to detect through lightcurves than a fully chaotic rotation, but would likewise shut down BYORP. Unlike fully chaotic rotation, barrel instability can happen even at low eccentricties. In our presentation we will discuss our theoretical results and their implications for the evolution of binary asteroids, such as the Didymos-Dimorphos pair.