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SMALL BODIES

Cloud of chaos

Astron. J. (in the press); preprint at https://arxiv.org/abs/1705.02845

More and more spacecraft are sent towards small objects in the Solar System. Thus, knowing how a massless particle orbits around small irregularly shaped bodies is not just an exercise in celestial dynamics, but also a practical issue for mission planning. Dumbbell-shaped bodies are a particularly interesting case. They are quite common among small bodies in the Solar System as they are a natural outcome of binary contact. Co-rotating binary systems generate a chaotic orbital field, but what about almost-binary dumbbells? José Lages and co-authors approach this problem using a model whose main parameter is the ratio between the actual rotation of the body and the theoretical rotation rate of an equivalent two-body system, computed using Kepler's third law.

Surprisingly, the simulations find that, as the rotation rate gets lower than the Keplerian one, the chaotic zone around the object swells significantly. The authors use two real small bodies to illustrate the consequences of this result. The asteroid 243 Ida, for example, has a rotation rate comparable to its theoretical value. Thus, Ida possesses a relatively small chaotic zone, which can explain how it can sustain the presence of a small satellite (called Dactyl), located within a marginally chaotic region. In contrast, the asteroid 25143 Itokawa has a big extended chaotic area around it. This property could be the reason why Itokawa does not have natural satellites and also why the Japanese spacecraft Hayabusa could not be put in a direct orbit around it. Future small-bodies missions may benefit from this study when it comes to selecting targets.

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