

Mono-monostatic bodies: the story of the Gömböc

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Gömböc and Indian Star Tortoise

The weeble (also called the “Comeback Kid”) is the favorite of many children: whenever knocked over, it always returns to the same (stable) equilibrium position. This toy is, of course, not homogenous, spontaneous self-righting is guaranteed by the weight at the bottom. We may also observe that most weebles have only one unstable balance point, at the top.

When we look at homogeneous objects, the problem becomes less trivial. In two dimensions, it is relatively easy to prove that homogeneous weebles do not exist. In three dimensions the question was open until, in 1995, V.I. Arnold conjectured that convex, homogeneous solids with just one stable and one unstable point of equilibrium (also called mono-monostatic) may exist. These are “special weebles” which share the number and type of equilibria of the toy, however, no weight is added.

Not only did the celebrated mathematician’s conjecture turn out to be true, the newly discovered objects show various interesting features. Mono-monostatic bodies are neither flat, nor thin, they are not similar to typical objects with more equilibria and they are hard to approximate by polyhedra. Moreover, there seems to be strong indication that these forms appear in Nature due to their special mechanical properties. In particular, the shell of some terrestrial turtles looks rather similar and systematic measurements confirmed that the similarity is not a coincidence.

References:

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