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Geometrically thick tori around compact objects with a quadrupole moment

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We study geometrically thick perfect-fluid tori with constant specific angular momentum, so-called “Polish doughnuts”, orbiting deformed compact objects with a quadrupole moment. More specifically, we consider two different asymptotically flat, static and axisymmetric vacuum solutions to Einstein’s field equation with a non-zero quadrupole moment, the q -metric and the Erez-Rosen spacetime. It is our main goal to find features of Polish doughnuts in these two spacetimes which qualitatively distinguish them from Polish doughnuts in the Schwarzschild spacetime. As a main result we find that, for both metrics, there is a range of positive (Geroch-Hansen) quadrupole moments which allows for the existence of double tori. If these double tori fill their Roche lobes completely, their meridional cross-section has the shape of a fish, with the body of the fish corresponding to the outer torus and the fish-tail corresponding to the inner torus. Such double tori do not exist in the Schwarzschild spacetime.

Primary author: MEMMEN, Jan-Menno

Co-author: PERLICK, Volker

Presenter: MEMMEN, Jan-Menno

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