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Self-gravitating tori around black holes: Bifurcation, ergoregions, and geometrical properties

Thursday 24 September 2020 18:15 (15 minutes)

This talk is based on the paper "Self-gravitating perfect-fluid tori around black holes: Bifurcations, ergoregions, and geometrical properties"by W. Dyba, W. Kulczycki, P. Mach, Phys. Rev. D (2020).
We investigate numerical solutions of Einstein field equations corresponding to a stationary, axial symmetric spacetime containing a self-gravitating perfect-fluid torus rotating around a black hole. We assume that the gas is polytropic and moves according to the Keplerian rotation law. We have found a new type of bifurcation in the parameter space of solutions—for a given maximal density within the torus and fixed inner and outer radii, there can exist two solutions differing in the mass of the torus. This effect can be explained in geometrical terms—the inner volume of the massive torus can be much larger than the volume corresponding to the light one. In both cases we investigate the influence of the torus on the location of the innermost stable circular orbit (ISCO). The result, especially for the less massive branch of solutions, may have astrophysical applications for the estimates of the accretion rate, for example during binary neutron star mergers. We have also investigated strong field effects appearing for the massive branch of solutions, in particular the occurrence of ergoregions with spherical and toroidal topologies. If time permits, I will also discuss preliminary results on the stability of the obtained solutions.

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