
Photon rings as tests for alternative spherically symmetric geometries with thin accretion disks

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Abstract

The imaging by the Event Horizon Telescope (EHT) of the supermassive central objects at the heart of the M87 and Milky Way (Sgr A) galaxies, has marked the first step into peering at the photon rings and central brightness depression that characterize the optical appearance of black holes surrounded by an accretion disk. Recently, Vagnozzi et. al. (S. Vagnozzi, et al. arXiv:2205.07787 (gr-qc)) used the claim by the EHT that the size of the shadow of Sgr A can be inferred by calibrated measurements of the bright ring enclosing it, to constrain a large number of spherically symmetric space-time geometries. In this work we use this result to study some features of the first and second photon rings of a restricted pool of such geometries in thin accretion disk settings. The emission profile of the latter is described by calling upon three analytic samples belonging to the family introduced by Gralla, Lupsasca and Marrone, in order to characterize such photon rings using the Lyapunov exponent of nearly bound orbits and discuss its correlation with the luminosity extinction rate between the first and second photon rings. We finally elaborate on the chances of using such photon rings as observational discriminators of alternative black hole geometries using very long baseline interferometry.

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