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Photon region and shadow in a spacetime with a quadrupole moment

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A black hole's shadow is expected to deform under the influence of an external gravitational field caused by matter present in its vicinity. This talk aims to characterise the distortion of a Schwarzschild black hole shadow due to a non-zero quadrupole moment c_2 by qualitatively investigating the behaviour of light rays close to the black hole horizon. In particular, the numerical investigation in the meridional plane for $1 \gg c_2 > 0$ finds four non-circular closed geodesics and their neighbouring geodesics exhibit chaotic behaviour that is not present in the undistorted Schwarzschild spacetime. The black hole shadow is therefore approximated by restricting the observational setup accordingly. In that case, the black hole shadow's eccentricity indicates a prolate deformation for static observers. The photon sphere in the Schwarzschild spacetime deforms into a photon region with a crescent-shaped projection on the meridional plane. Furthermore, the resulting boundary curve of the black hole shadow is visualised.

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