

The motion of photons around black holes

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The motion of photons around black holes determines the shape of shadow and match the ringdown properties of a perturbed black hole. Observations of shadows and ringdown waveforms will reveal the nature of black holes. In this paper, we study the motion of photons in a general parametrized metric beyond the Kerr hypothesis. We investigated the radius and frequency of the photon circular orbits on the equatorial plane and obtained fitted formula with varied parameters. The Lyapunov exponent which connects to the decay rate of the ringdown amplitude is also calculated. We also analyzed the shape of shadow with full parameters of the generally axisymmetric metric. Our results imply the potential constraint on black hole parameters by combining the Event Horizon Telescope and gravitational wave observations in the future.

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