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Eikonal quasinormal modes and photon orbits of deformed Schwarzschild black holes

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The geometric optics approximation provides an interpretation for eikonal correspondence that, in black-hole-containing spacetimes, connects high-frequency black hole quasinormal modes with closed photon orbits around said black hole. This correspondence has been identified explicitly for several GR black holes, violation of which can be a potential hint toward physics beyond GR. However, the identification of the correspondence seems largely relies on specific symmetries of the spacetimes that correspond to the separability of equations. One naturally asks how the eikonal correspondence would appear if the spacetime is less symmetric. In this talk, we consider a deformed Schwarzschild spacetime retaining only axisymmetry and stationarity. We show that up to the first order of spacetime deformations, the eikonal correspondence manifests through the definition of the averaged radius of trapped photon orbits along their one period. This averaged radius overlaps the potential peak in the master wave equation, which can be defined up to the first order of spacetime deformations, allowing the explicit identification of the eikonal correspondence. The talk is based on arXiv:2205.02433.

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