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Black Hole Solutions in Extended Metric-Palatini Gravity

Extended metric-Palatini gravity, quadratic in the antisymmetric part of the affine curvature, is known to lead to the general relativity plus a geometric Proca field. The geometric Proca, equivalent of the non-metricity vector in the torsion-free affine connection, qualifies to be a distinctive signature of the affine curvature. In this talk, we explore how shadow and photon motion near black holes can be used to probe the geometric Proca field. To this end, we derive static spherically symmetric field equations of this Einstein-geometric Proca theory, and show that it admits black hole solutions in asymptotically AdS background. We perform a detailed study of the optical properties and shadow of this black hole and contrast them with the observational data by considering black hole environments with and without plasma. As a useful astrophysical application, we discuss constraints on the Proca field parameters using the observed angular size of the shadow of supermassive black holes M87* and Sgr A* in both vacuum and plasma cases. Overall, we find that the geometric Proca can be probed via the black hole observations.

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