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J. Novo: Circular orbits from 2D effective metrics

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The motion of particles on general (1+3)-dimensional spacetimes satisfying a set of assumptions can be described by the geodesics of a 2-dimensional manifold. In this work we resort to these 2-dimensional metrics to study circular geodesics of generic static, spherically symmetric, and asymptotically flat (1 + 3)-dimensional spacetimes containing either non-extremal black holes or horizonless compact objects. This is done by studying the Gaussian curvature of the 2-dimensional manifold as well as the geodesic curvature of circular curves on these. This study considers both null and timelike circular geodesics. The study of null geodesics in this formulation retrieves the known result of the number of light rings (LRs) on the spacetime outside a black hole and on spacetimes with horizonless compact objects. With an equivalent procedure we formulate a similar theorem on the number and location of marginally stable circular orbits of a given spacetime satisfying the previously mentioned assumptions. Some ongoing work concerning the generalization of this technique to rotation spacetimes will also be presented.

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