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J. Delgado: Epicyclic frequencies for a generic ultracompact object

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Recently, it has been shown that the radial stability of a light-ring (LR) in a spacetime generated by a stationary, axisymmetric, asymptotically flat object with a Z2 symmetry determines the possibility and radial stability of timelike circular orbits (TCOs) around the LR. In this paper, we generalise this result by also considering the vertical (angular) stability of the orbits through the study of the radial and vertical epicyclic frequencies. We show that the vertical stability of the LR only determines the vertical stability of the TCOs around it. A relation between the sum of the squared epicyclic frequencies and the Ricci tensor is also provided. With such relation, we show that objects with radially and vertically unstable LRs (TCOs) violate the null (strong) energy condition.

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