

Second law protection theorem for Lorentz-violating black holes

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Abstract

Black holes in Lorentz-violating theories of gravity have been argued to violate the second law of thermodynamics by perpetual motion energy extraction. We analyse the possibility of such energy extraction in classical Penrose splitting processes in which the energy budget of incoming and escaping particles is defined with respect to time translations at an asymptotically flat infinity. We show, in a spherically symmetric setting with two species of particles in geodesic motion, that such energy extraction cannot happen in any Lorentz-violating theory in which gravity remains attractive, in the sense of a geometric inequality that we describe. This inequality is satisfied by all known black hole solutions to Einstein- \mathfrak{a} ether and Hořava theories of gravity.

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