Abstract Submitted
for the APR21 Meeting of
The American Physical Society

**Extreme Kerr black holes are non-unique** LIOR BURKO, Theiss Research, GAURAV KHANNA, University of Massachusetts Dartmouth and University of Rhode Island, SUBIR SABHARWAL, University of Massachusetts Dartmouth — The uniqueness of classical black holes – the celebrated "no hair theorems" – guarantee that no parameters other than the mass, charge, and spin angular momentum of stationary black holes can me measured. For a family of scalar or gravitational perturbations of an extreme Kerr black hole, whose members vary only in the radial location of the center of the initial packet, we demonstrate a linear relation of a generalized Ori pre-factor - a certain expression obtained from the late-time expansion or the perturbation field at finite distances - and the Aretakis conserved charge . It can be established that there is an Aretakis conserved charge for scalar or gravitational perturbations of extreme Kerr black holes. This conclusion, in addition to the calculation of the Aretakis charge, can be made from measurements at a finite distance: Extreme Kerr black holes have gravitational hair that can be measured at finite distances, and violates the uniqueness theorems. This gravitational hair can in principle be detected by gravitational-wave detectors. We identify the failure of the uniqueness theorems to apply with the time dependence of extreme black holes along their event horizons (Aretakis behavior of certain transverse derivatives), although external perturbations decay.

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Date submitted: 05 Jan 2021 Electronic form version 1.4