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Extremal Rotating Black Holes in Einsteinian Cubic Gravity

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New solutions of Einsteinian cubic gravity coupled to a Maxwell field that describe the near-horizon geometry of charged and rotating black holes are presented. We show that the $AdS_2 \times \mathbb{S}^2$ near-horizon geometry of Reissner-Nordstr\"om black holes receives no corrections, but deviations with respect to the extremal Kerr-Newman solution appear as we turn on the angular momentum. We provide analytic slowly-spinning approximations, as well as numeric solutions for these corrected geometries, but we also find additional solutions that do not reduce to $AdS_2 \times \mathbb{S}^2$ geometries in any limit and that do not have a counterpart in Einstein gravity. Remarkably, we are able to obtain closed-form exact expressions for the area and Wald's entropy of all of these black holes. To the best of our knowledge, this is the first time the entropy of a rotating black hole in higher-order gravity has been exactly computed. Using this result, we analyze the phase space of extremal back holes, which turns out to be considerably more involved than the situation in Einstein gravity.

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