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Black Holes Cannot be Over-Charged or Over-Spun¹

ROBERT WALD, University of Chicago

The Kerr-Newman solutions are the only stationary black hole solutions of the Einstein-Maxwell equations in 4-dimensions, but they describe black holes only when the inequality $M^2 \geq (J/M)^2 + Q^2$ is satisfied, where M , J , and Q are the mass, angular momentum, and charge of the black hole. Therefore, if an extremal or nearly extremal black hole can be made to absorb matter with sufficiently large angular momentum or charge as compared with its energy, one would obtain a contradiction with cosmic censorship. Hubeny and others have made proposals as to how this might be done, but a proper analysis of this proposal requires a calculation of all second order effects on energy, including, in particular, effects arising from self-force. We show in this work that when all of the second order effects are taken into account, no over-charging or over-spinning of a black hole can occur, provided only that the non-electromagnetic matter satisfies the null energy condition. The proof is based upon general properties of canonical energy and does not require an explicit calculation of self-force effects.

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