

You Can't Over-Charge or Over-Spin a Black Hole

ROBERT WALD

*Enrico Fermi Institute and Department of Physics, The University of Chicago,
5640 South Ellis Avenue, Chicago, Illinois 60637, USA
rmwa@uchicago.edu*

ABSTRACT

The Kerr-Newman solutions are the only stationary black hole solutions of the Einstein-Maxwell equations in 4-dimensions. However, these solutions 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 an apparent 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.