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Deformations of extremal black holes in GR and from stringy interactions BAOYI CHEN, LEO STEIN, Caltech — Linear perturbation theory is a powerful toolkit for studying black hole spacetimes. However, the perturbation equations are hard to solve unless we can use separation of variables. In the Kerr spacetime, metric perturbations do not separate, but curvature perturbations do. The cost of curvature perturbations is a very complicated metric-reconstruction procedure. This procedure can be avoided using a symmetry-adapted choice of basis functions in highly symmetric spacetimes, such as near-horizon extremal Kerr. We focus on this spacetime, and (i) construct the symmetry-adapted basis functions; (ii) show their orthogonality; (iii) show that they lead to separation of variables of the scalar, Maxwell, and metric perturbation equations; and (iv) solve for the deformations to the near-horizon extremal Kerr metric due to two example string-inspired beyond-GR theories: Einstein-dilaton-Gauss-Bonnet, and dynamical Chern-Simons theory, in the weak-coupling limit. We find that the EdGB metric deformation has a curvature singularity, while the dCS metric is regular. From these solutions we compute orbital frequencies, horizon areas, and entropies. This sets the stage for analytically understanding the microscopic origin of black hole entropy in beyond-GR theories.

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