

Localization of the 5D supergravity action and Euclidean saddles for the black hole index

We investigate equivariant localization of the gravitational on-shell action in odd dimensions, focusing on five-dimensional ungauged supergravity. We analyze the conditions for cancellation of boundary terms, so that the full action integral is given in terms of the odd-dimensional analog of the nuts and bolts of Gibbons-Hawking. We construct asymptotically flat Euclidean supersymmetric non-extremal solutions with an additional $U(1)$ symmetry preserving the supercharge, two independent rotations and an arbitrary number of electric charges, providing black hole saddles of the gravitational path integral that computes a supersymmetric index, and evaluate their action equivariantly. We find that these Euclidean saddles smoothly interpolate between the supersymmetric extremal black holes and two-center horizonless microstate geometries. The interpolating parameter is the formal temperature, which does not appear in the action; hence the two limiting solutions give the same contribution to the index.

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