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The area-angular momentum-charge inequality for black holes in cosmological spacetimes

We establish the conjectured inequality between area, angular momentum, and charge for stable apparent horizons in spacetimes with positive cosmological constant, and show that it is saturated precisely for extreme Kerr-Newman-de Sitter data. As with previous inequalities of this type, the proof reduces to minimizing a functional that is related to a renormalized harmonic energy. In this case the maps are from $\mathbb{S}^2 \to \mathbb{H}^2_{\mathbb{C}}$, and the functional is significantly distorted by the presence of a cosmological constant. Nevertheless we observe that the functional is convex along geodesic deformations, guaranteeing a unique minimizer. This observation also simplifies previous proofs of less embellished inequalities. This is joint work with E. Bryden.