Stability of black hole apparent horizons: a complex-magnetic Laplacian spectral problem

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Abstract

We discuss a spectral problem characterising the stability of apparent horizons in General Relativity. Apparent horizons are closed (compact, without boundary) Riemannian surfaces modelling sections of horizons in black hole spacetimes, namely Lorentzian manifolds satisfying Einstein equations and containing light-trapped regions. After presenting the geometric elements relevant for this kind of surfaces, we will formulate the (geometric) spectral problem associated with the so-called stability operator of Marginally Outer Trapped Surfaces (MOTS), an elliptic operator defined on these apparent horizons. Interestingly, such spectral problem is equivalent to the one associated with a magnetic Laplacian with imaginary magnetic field, the magnetic field term corresponding to the black hole rotation (a potential given by the apparent horizon curvature is also present). This connection offers a potentially rich bridge between the original geometric problem in relativity and the spectral analysis study of complexified-magnetic Laplacians.

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