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Local first law of black hole

The first law of black hole mechanics is not physically well-defined because some quantities, such as mass and angular momentum, are defined at infinity, while others, like surface gravity and angular velocity, are defined at the event horizon. Establishing the full law requires traveling back and forth between the horizon and infinity, as well as the knowledge of the entire spacetime, which poses challenges for real measurements. We are currently working on establishing a local form of the first law, and intriguingly, we have found that it is independent of charge and angular momentum in a meaningful way. This result holds particular significance and applicability for astrophysical black holes.
Reference: e-Print: 2307.10986 [gr-qc].

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