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Bardeen Black Hole from a Self-Dual Radius in Spacetime

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From a phenomenological point of view, the singularities of ordinary black hole solutions hint at a breakdown of general relativity. The Bardeen black hole is a prototype of regular black hole solutions, i.e. those which are geodesically complete and avoid a curvature singularity.

The Bardeen solution is generally interpreted as a magnetically or electrically charged solution to gravity coupled to non-linear electrodynamics. In this talk, we derive that in a spacetime inheriting a self-dual radius from string theory, black holes naturally take on the Bardeen form.

The threshold mass for Bardeen black holes achieves a particular interpretation. During the evaporation process, a black hole undergoes a transition from an instable classical Schwarzschild phase to a stable quantum phase. In the end, there is a cold, thermodynamically stable remnant. The minimal black hole size of the order of the self-dual radius.

The self-dual radius can be tested by its impact on quantum mechanical systems. We find that it modifies the form of the atomic electrostatic potentials. We derive experimental bounds from high-precision spectroscopy of the hydrogen atom. The investigation of the $1S_{1/2}$–$2S_{1/2}$ transition frequency allows to constrain the self-dual radius down to below 3.9×10^{-19} m.

Primary author: WONDRAK, Michael Florian (Goethe-Universität Frankfurt and Helmholtz Research Academy Hesse for FAIR)

Presenter: WONDRAK, Michael Florian (Goethe-Universität Frankfurt and Helmholtz Research Academy Hesse for FAIR)

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