THERMODYNAMICS OF BLACK HOLES: HAWKING-PAGE TEMPERATURES AND SECOND ORDER PHASE TRANSITIONS

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ABSTRACT

In general relativity, volume is a coordinate-dependent quantity, and as a result, it is typically not included as a thermodynamic variable in the description of **black hole thermodynamics**. My presentation explores how different volume definitions can be consistently incorporated into these descriptions from a thermodynamic perspective. Various approaches in the literature are reviewed, their implications analyzed, and the conclusions discussed. The primary focus is on the phase structure of **Anti-de Sitter–Kerr black holes** and the **Hawking-Page phase transitions**. The goal is to examine the feasibility of integrating volume as a meaningful variable in the thermodynamic framework of different types of black holes.

KEYWORDS Black hole thermodynamics, Hawking-Page phase transition

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