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Holographic Thermodynamics of AdS Black Holes: Central Charge Criticality

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We reconsider the thermodynamics of AdS black holes in the context of gauge–gravity duality. In this new setting – where both the cosmological constant Λ and the gravitational Newton constant G are varied in the bulk – we rewrite the first law in a new form containing both Λ (associated with thermodynamic pressure) and the central charge C of the dual CFT theory and their conjugate variables. We obtain a novel thermodynamic volume, in turn leading to a new understanding of the Van der Waals behavior of the charged AdS black holes, in which phase changes are governed by the degrees of freedom in the CFT. Compared to the 'old' P – V criticality, this new criticality is 'universal'(independent of the bulk pressure) and directly relates to the thermodynamics of the dual field theory and its central charge.

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