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The Thermal Casimir Effect in Scalar Lattice Field Theory

Motivated by the recent small system collisions at the LHC, we present exact first principles results for the finite-system-size corrections to the thermodynamics of both massless and massive non-interacting scalar field theories. We find corrections of 50-75% to the speed of sound at scales relevant to the quark-gluon plasma produced in heavy-ion collisions. The methods used to derive these results rely on a rigorous formulation of the lattice path integral partition function, with particular focus on ensuring absolute analytical control over every step of the derivation. Finally, we discuss the extension of this rigorous framework toward interacting theories, outlining the path toward computing next-to-leading order (NLO) finite system size corrections in a massive ϕ^4 theory.

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