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Dirac fermions under imaginary rotation

The growing interest in the thermodynamic properties of strongly-interacting systems under rotation, particularly using lattice gauge techniques on the Euclidean manifold and with an imaginary angular velocity $\Omega = i\Omega_I$, has motivated the current study of Dirac fields under imaginary rotation. For $\nu = \beta\Omega_I/2\pi$ a rational number, the thermodynamics of free scalar fields "fractalizes" in the large volume limit, that is, it depends only on the denominator q of the irreducible fraction $\nu = p/q$. We consider the same problem for free, massless, fermions at finite temperature $T = \beta^{-1}$ and chemical potential μ and confirm that the thermodynamics fractalizes in the case $\mu = 0$. Curiously, fractalization has no effect on the chemical potential μ, which dominates the thermodynamics at large values of q. The fractal behavior is shown analytically for the fermionic condensate, the charge currents and the energy-momentum tensor. For these observables, the values on the rotation axis and the large temperature behaviour are validated by analytic continuation and comparison with the results obtained in the case of real rotation. Enclosing the system in a fictitious cylinder of radius R and length L_z allows constructing averaged thermodynamic quantities that satisfy the Euler relation and also fractalize.

Category

Theory

Collaboration (if applicable)

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