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Towards a Worldline Monte Carlo approach in curved space

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Numerical Worldline MonteCarlo techniques in flat spacetime have been deeply developed in order to extract physical information from QFT systems. We study a possible way to extend such procedures to the case of (Euclidean) curved spaces, where the proper-time discretization of a bosonic worldline point-particle is treated similarly to a time-slicing regularization for the associated quantum path integral. In particular, it induces a well-known counterterm in the theory which, together with curvature effects arising directly from the curved metric tensor, plays the role of a potential. To test the setup, we focus on the calculation of the free heat kernel of a bosonic point-particle on a D-sphere, for which the expressions of the effective potential and of the metric tensor were provided in closed form. Here, the curved space problem was turned into a flat space one, making the verification of our numerical method quite straightforward.

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