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Finite System Size Correction in ϕ^4 Theory NLO scattering

Using a novel regularization technique, we compute for the first time the NLO finite system size corrections to $2 \to 2$ scattering in massive ϕ^4 theory. This is a useful first step to get insight into the effect of finite system sizes present in heavy-ion collisions at the LHC. Previously an equation of state for the relativistic hydrodynamics encountered in heavy-ion collisions at the LHC has been calculated using lattice QCD methods. This leads to a prediction of very low viscosity, due to the nature of the trace anomaly calculated. Finite system corrections to this trace anomaly could challenge this calculation, since the lattice QCD calculation was extrapolated to an effectively infinite system. To verify the robustness of this trace anomaly it is beneficial to add the finite system corrections that will be encountered. We construct a massive ϕ^4 theory while imposing periodic boundary conditions on n of the 3 spatial dimensions. In order to compute the corrections to NLO $2 \to 2$ scattering we employed a novel regularization technique, derived a generalization to a formula originally proposed by Ramanujan and derive a new analytic continuation to the generalized Epstein Zeta function. We find that the results we obtain pass non-trivial analytic consistency checks. Finally the finite size corrections to the total cross section, running coupling and effective coupling is explored analytically as well as numerically, in order to estimate the size of such finite system corrections in massive field theories.

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Yes

Level for award;(Hons, MSc, PhD, N/A)?

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