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Finite System Size Correction in ϕ^4 Theory NLO scattering

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We compute for the first time the finite size corrections to NLO $2 \to 2$ scattering in ϕ^4 theory on a $\mathbb{R}^{1,(3-n)} \times \mathrm{T}^n$ spacetime. In order to do so we developed multiple novel techniques, including denominator regularization, a generalization of a formula by Ramanujan using the sum of squares function, and an analytic continuation of the generalized Epstein Zeta function. We show that our calculations pass all consistency checks, and numerically as well as analytically examine the behavior of the scattering amplitude as well as the effective coupling. We discuss the implications for critical exponents in condensed matter systems as well as how denominator regularization might be further employed to simplify calculations involving fermions and curved spacetimes.

Most important, our results form a first step in quantifying analytically the finite size system effect on the trace anomaly in QCD, which may lead to significant corrections to the extracted viscosity to entropy density ratio in small systems.

This talk is based on arXiv:2203.01259 and *W.A. Horowitz and JFDP in preparation.*

In-person participation

Yes

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