The 38th International Symposium on Lattice Field Theory

LATTICE 21

JULY 26-30 2021, ZOOM/GATHER@MIT

Contribution ID: **568** Type: **Oral presentation**

Taylor expansions and Padé approximations for Lefschetz thimbles and beyond

Tuesday, 27 July 2021 06:15 (15 minutes)

Deforming the domain of integration after complexification of the field variables is an intriguing idea to tackle the sign problem. In thimble regularization the domain of integration is deformed into an union of manifolds called Lefschetz thimbles. On each thimble the imaginary part of the action stays constant and the sign problem disappears. A long standing issue of this approach is how to determine the relative weight to assign to each thimble contribution in the (multi)-thimble decomposition. Yet this is an issue one has to face, as previous work has shown that different theories exist for which the contributions coming from thimbles other than the dominant one cannot be neglected. Historically, one of the first examples of such theories is the one-dimensional Thirring model.

Here we discuss how Taylor expansions can be used to by-pass the need for multi-thimble simulations. If multiple, disjoint regions can be found in the parameters space of the theory where only one thimble gives a relevant contribution, multiple Taylor expansions can be carried out in those regions to reach other regions by single thimble simulations. Better yet, these Taylor expansions can be bridged by Padé interpolants. Not only does this improve the convergence properties of the series, but it also gives access to information about the analytical structure of the observables. The true singularities of the observables can be recovered. We show that this program can be applied to the one-dimensional Thirring model and to a (simple) version of HDQCD. But the general idea behind our strategy can be helpful beyond thimble regularization itself, i.e. it could be valuable in studying the singularities of QCD in the complex $\hat{\mu}_B$ plane. Indeed this is a program that is currently being carried out by the Bielefeld-Parma collaboration.

Primary authors: ZAMBELLO, Kevin (University of Parma and INFN, Gruppo Collegato di Parma); DI RENZO, Francesco (INFN - National Institute for Nuclear Physics); SINGH, Simran (University of Parma, Italy)

Presenter: ZAMBELLO, Kevin (University of Parma and INFN, Gruppo Collegato di Parma)

Session Classification: QCD at nonzero Temperature and Density

Track Classification: QCD at nonzero Temperature and Density