Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

Resurgence and the Large N Expansion

By

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In this dissertation we focus on recent developments in the study of resurgence and the large N expansion. It is a well known fact that perturbative expansions, such as the large N expansion, are divergent asymptotic series. This is a signal that there are non-perturbative effects of the form e^{-N} that also need to be considered, and our original perturbative series should be upgraded to one including powers of both $1/N$ and e^{-N}, which is called a *transseries*. The machinery needed to tackle transseries was developed in the 1980s under the formalism of so-called *resurgence*. Using its tools we can derive a web of large-order relations showing how coefficients of the transseries, perturbative and non-perturbative, are connected to each other, and this is the origin of the term *resurgence*. This tells us that the perturbative part already "knows" all about the non-perturbative effects.

Matrix models appear in multiple contexts in theoretical physics, and this was the arena chosen to test and understand the ideas of resurgence, particularly the matrix model with a quartic potential. We consider different phases of the quartic matrix model, with special focus on the two-cut phase, in order to test the predictions of resurgence and study their implications.

In the second part of the dissertation we used our knowledge of resurgent transseries and the quartic matrix model to address a different type of question. Namely, can we make use of an expansion at large N to generate results at finite N? We did this by comparing an analytical solution of the quartic matrix model at finite N to a resummation of the transseries. Moving around in parameter space we saw how the non-perturbative sectors could go from irrelevant to absolutely crucial in order to generate the correct answer at finite N.

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