PHYSICS AND ASTRONOMY
SEMINAR

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"Resurgence in Quantum Field Theory: Handling the Devil's Invention"

Abstract

Renormalized perturbation theory for QFTs typically produces divergent series, even if the coupling constant is small, because the series coefficients grow factorially at high order. The most important type of such divergences in asymptotically-free theories like QCD are known as renormalons, and were conjectured by 't Hooft to be related to confinement and the mass gap. A natural, but historically difficult, question has been how to make sense of the asymptotic nature of perturbative series. In what sense do such series capture the physics of a QFT, even for weak coupling? I will discuss a recent conjecture that the semiclassical expansion of path integrals for asymptotically free QFTs - that is, perturbation theory - yields well-defined answers once the implications of resurgence theory are taken into account.

Resurgence theory relates expansions around different saddle points of a path integral to each other, and has the striking practical implication that the high-order divergences of perturbative series encode precise information about the non-perturbative physics of a theory. These ideas will be discussed in the context of a QCD-like toy model theory, the two-dimensional principal chiral model, where we used resurgence theory to deal with the renormalons. Fitting 't Hooft's conjecture, understanding the origin of renormalon divergences allows us to see the microscopic origin of the mass gap of the theory in the semiclassical domain.

Friday, November 08, 2013
2:30 p.m.
Elliott Building
Room 060