

Institut de Physique Théorique

Theoretical physics courses



Resurgence Methods and Applications

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Friday, May 13th, 10:00 to 12:15, in person at IPhT and online; Monday, May 16th, 14:00 to 16:15, in person at IPhT and online;

Friday, May 20th, 10:00 to 12:15, online-only; Monday, May 30th, 14:30 to 16:45, online-only.

Open, non-interactive livestream at youtube.com/ipht-tv. Interactive videoconference: compulsory registration on the website courses.ipht.fr, to receive videoconference link. Please, stay updated (change of schedule, sanitary constraints...) by checking the course website.

In general interacting theories — quantum mechanical, field, gauge, or string theories — perturbation theory is divergent: perturbative expansions have zero radius of convergence and seemingly cannot be summed. Nonperturbatively well-defined results can still be constructed out of perturbation theory by the uses of resurgence and transseries.

Asymptotic series require the use of resurgence and transseries in order for their associated observables to become nonperturbatively well-defined. Resurgent transseries encode the complete large-order asymptotic behaviour of the coefficients from a perturbative expansion, generically in terms of (multi) instanton sectors and for each problem in terms of its Stokes coefficients. By means of two very explicit examples, we plan to introduce the aforementioned resurgent, large-order asymptotics of general perturbative expansions, including discussions of transseries, Stokes phenomena, generalized steepest-descent methods, Borel transforms, nonlinear resonance, and alien calculus.

Time permitting, we will discuss advanced examples in matrix models, minimal and topological strings, and Jackiw-Teitelboim gravity. The discussion will focus both on the construction of the resurgent transseries, their resonance, and the computation of associated Stokes data.

The program of the lectures will include:

1. Introduction
2. Toy Models for Resurgent Analysis
3. Lefschetz Thimbles, Borel Transforms, Resummations
4. Multidimensional Resurgence and Resonance
5. Alien Calculus Revisited
6. Advanced Applications and String Theory

