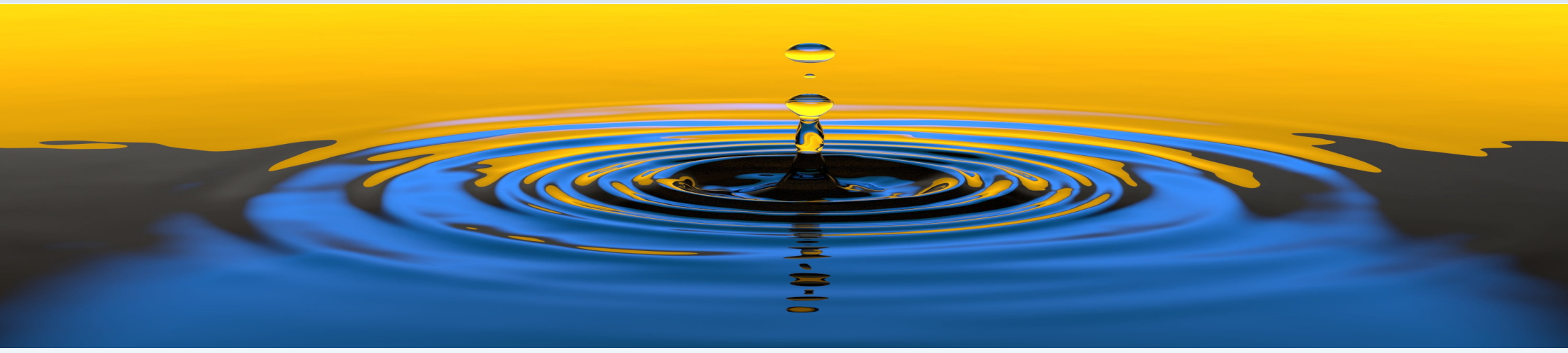
Institut de Physique Théorique

Theoretical physics courses



Resurgence Methods and Applications

Ricardo Schiappa (IST, ULisboa)

On Fridays 13, 20, 27, March 2020 and 3 April 2020, from 10:00 to 12:15.

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.

The program of the lectures will include:

1. Introduction
2. Resurgent Analysis of a Quartic-Potential Integral
3. Lefschetz Thimbles for Linear Problems
4. Borel Transforms for Nonlinear Problems
5. Physical Resurgence: From Lattices to Virasoro Algebras
6. Resurgent Analysis of an Elliptic-Potential Integral

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