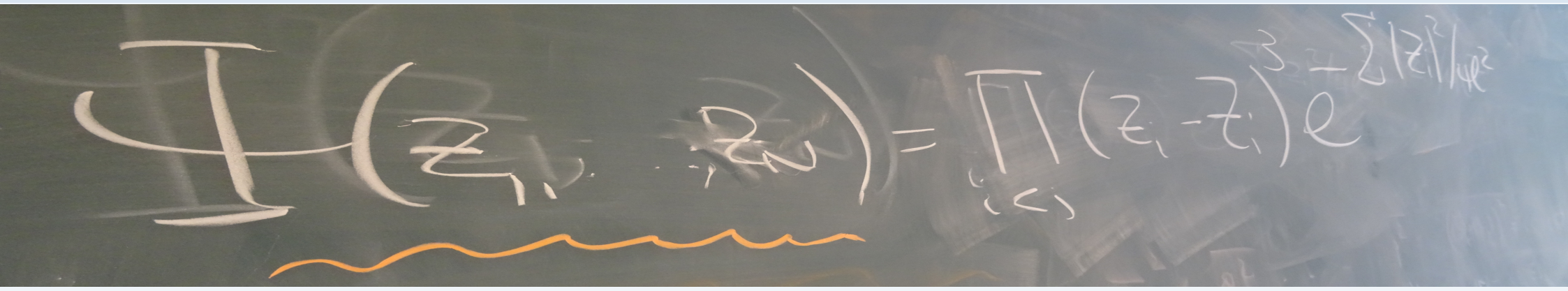
Institut de Physique Théorique

Cours de Physique Théorique



Topological Phases of Matter

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On Fridays 8, 15, 22, 29 November 2019 and 6, 13 December 2019, from 10:00 to 12:15.

Topological materials have recently become one of the most studied subjects in solid state physics, in particular with the discovery of topological insulators and the search for Majorana fermions. Such states have been described as possible building blocks for quantum computers, hence the importance to study their properties and identify systems that can support them. Experimentally, many signatures are consistent with the formation of Majorana states, but there is still no definite proof of their existence.

In this series of lectures we will give a broad view of topological systems, including topological insulators, quantum Hall effect, and topological superconductors. We will discuss the properties of Majorana states and other topological edge states in both one-dimensional and two-dimensional systems, as well as the techniques to study the formation of these states and their properties. We will then introduce Integer and fractional quantum Hall effects using the composite fermion contruction of wavefunctions. We will describe fractional charge and statistics of the quantum Hall states and their effective field theoretic description. Finally, the pfaffian wavefunction proposed to describe the elusive state at filling 5/2 will be also decribed together with its excitations.

The program of the lectures will include:

1. Topology in solid state systems; Examples of topological materials and topological edge states (e.g. Majorana)
2. Analytical and numerical techniques to derive the formation of edge states
3. 2D electronic systems, Landau levels, integer and fractional quantum Hall effect
4. The Laughlin wavefunction, more fractions composite fermions
5. Multicomponent systems: spins and interlayer phase coherence, quantum Hall ferromagnetism
6. The pfaffian state and its excitations

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