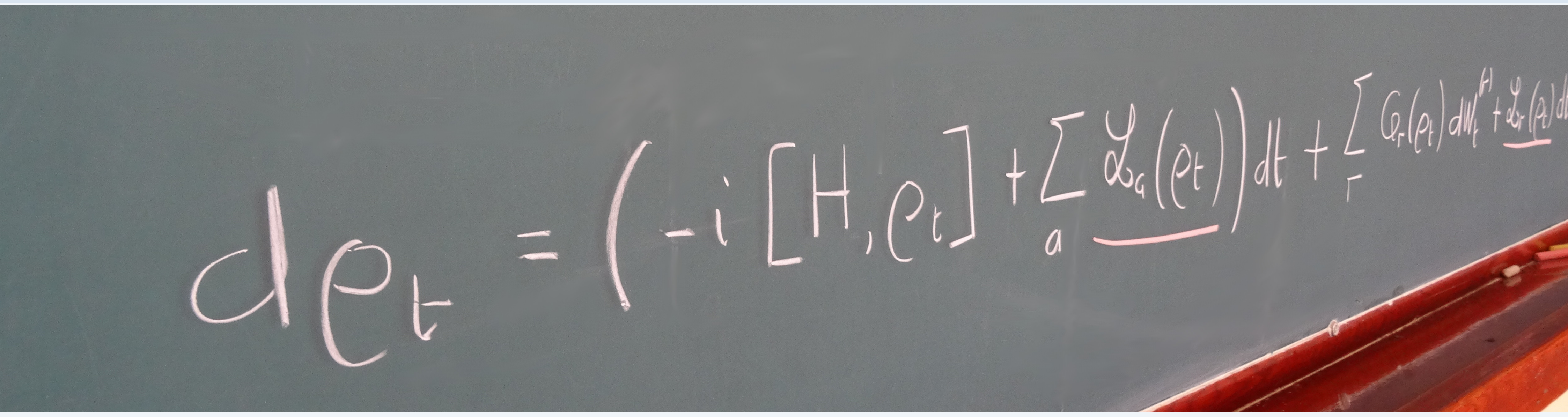
Cours de l'Institut de Physique Théorique



An introduction to Markovian open quantum systems

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The Fridays 2, 9, 16, 23, 30 June 2017, from 10:00 to 12:15.

Closed systems (classical or quantum) are always an idealization of reality. A number of techniques of various accuracy and complexity are in use to take into account interactions of the system with its environment. In the crudest non trivial approximation, the effect of the environment is assumed to depend only on the immediate past of the state of the system (i.e. the density matrix in the quantum case), leading to the notion of Markovian open systems.

In these lectures we motivate the relevance and consistence of the Markovian approximation for open quantum systems. We also show a very deep connection between effects of an environment and effects of repeated indirect measurements.

We introduce non-demolition measurements and draw some broad conclusions on measurement in quantum mechanics. More generally we use indirect measurements as a tool to scrutinize the evolution of open quantum systems and analyze some properties of quantum trajectories.

We also introduce the basics of quantum noises.

Our focus is on properties that are related, or analogous to classical probability theory. We use the discrete time case to introduce the basic concepts, but also make the connection with continuous time systems.

Lecture 1: Quick overview of open quantum systems; Brief review of quantum mechanics; Indirect measurements

Lecture 2: Discrete quantum Markovian evolution; Non demolition measurements and progressive wave function collapse

Lecture 3: From discrete to continuous time: Lindbladian evolution and its stochastic counterpart

Lecture 4: Quantum trajectories, quantum jumps

Lecture 5: A brief introduction to quantum noises

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