COURS THEMATIQUES

Au cours de l'automne 2018, une série de leçons sera organisée sur le thème

Stochastic quantisation of QFTs & applications to quantum gravity and early cosmology

Laurent Baulieu – LPTHE UPMC

Stochastic Quantisation is a universal method with a wide field of applications. These series of lectures aim at motivating its use for quantum gravity and early cosmology, and giving a thorough portrait of its present status. Their content is organised as follows:

- **Challenges and proposals in early cosmology and quantum gravity.**
- **Langevin equation for the Brownian motion.**
- **Langevin equation for QFT Euclidean correlators (Parisi – Wu approach).**
- **Emergence of Minkowski time in stochastic quantisation.**
- **Link with Fokker–Planck formulation, properties of convergence of correlation functions at infinite stochastic time.**
- **More recent formulation using stochastic time, supersymmetry and path integral representation.**
- **Connection with topological quantum field theory.**
- **Treatment of gauge theories within the stochastic quantisation approach – examples with various local symmetries.**
- **Compatibility between space–time supersymmetry and stochastic supersymmetry.**
- **Properties of the correlation functions at finite values of the stochastic time, depending on the rank of the Langevin equation.**

CPHT – ECOLE POLYTECHNIQUE

First lecture Thursday October 4
Motivations in early cosmology and quantum gravity
11:00 – salle Louis Michel – CPHT

Abstract: Euclidean quantum gravity might be defined by a stochastic quantisation that is governed by a higher-order Langevin equation rather than by a first-order stochastic equation, giving a transitory phase where Minkowski time cannot be defined, so the parameter that orders the evolution of quantum gravity phenomena is the stochastic time. This may enlarge the definition of causality in the period of primordial cosmology. For stochastically quantised gravity, one predicts a transition from an oscillating quantum phase to a classical one, where the Minkowski time has emerged. In the beginning, the universe is diluted, filled with scattered classical primordial black holes. The smallest ones decay then quickly in matter with a standard quantum-field-theory evolution, whereas the heaviest ones are stable and remain therefore in the Universe till our era. In order to give substance to this idea we examine the meaning of a second-order Langevin equation in zero dimensions for defining precisely what is second-order stochastic quantisation in a solvable case.