The department of Physics presents:

The Annual Symposium

organized by the LabEx ENS-ICFP
(International Centre for Fundamental Physics)

Tuesday, October 1, 2013
2:00 – 6:00 PM - Salle Dussane

Chair: Serge Haroche, 2012 Nobel Prize in Physics

The objective of the symposium is to offer a forum for discussion to new members of the department and to introduce them to everyone.

Program

2:00 pm **Marc Mézard, Werner Krauth** Welcome
2:10 pm **Serge Haroche** Inaugural address

2:30 pm **Tatsuo Azeyanagi** "Sewing up with gauge/gravity dualities"
JRC laureate 2013, ENS – ICFP, Department of Physics
String theory and Quantum field theories

Abstract: Gauge/gravity duality has revealed deep connections between gauge theory and gravity. In this presentation, I would like to explain the power and usefulness of the duality through some examples. I will then discuss what we can learn about gauge theory, gravity and non-perturbative aspects of string theory from the gauge/gravity duality.

2:50 pm **Nicolas Cherroret** "Do atomic interactions question the Anderson transition?"
Chargé de recherche CNRS – Kastler-Brossel Laboratory
Quantum physics

Abstract: When a quantum particle, for instance an atom, propagates in a 3D disordered environment, a spatial localization of its wave function occurs when the particle's energy is decreased below a critical value: this is the Anderson transition. Macroscopically, this peculiar effect manifests itself as a phase transition separating a regime where transport is diffusive and the system a "conductor" (above the critical point) from a regime where transport is completely suppressed and the system an "insulator" (below the critical point). This phase transition was recently thoroughly investigated both theoretically and experimentally in a collaboration between the PhLAM lab in Lille and the Complex Quantum System group at LKB.

In cold atomic disordered gases, a new actor is very often present and strongly complicates the physics of disorder: interactions. Ongoing research on 1D gases of disordered bosons already indicates that Anderson localization tends to be strongly altered by interactions. Their effect on the Anderson transition that occurs in 3D is, on the other hand, presently unknown. In this presentation I will discuss recent theoretical predictions partially elucidating this question as well as numerical results obtained with the kicked-rotor model, a peculiar system where Anderson localization occurs

due to quasi-periodic modulations of a laser rather than due to a spatial disorder. Open questions and perspectives will conclude the talk.

3:10 pm **Michael Koepf** "Growth and Development in Biological Systems: From Bacteria to Olive Trees"
JRC laureate 2013, ENS – ICFP, Department of Physics
Soft Matter and Biosciences

Abstract: This brief recount of my personal research experience starts with a discussion of the spontaneous formation of nanoscopic stripe patterns in mono-molecular coatings and different ways to tune the obtained structures. I will then turn to the ultimate form of self-organization: Life. Recently developed continuum models including either polar or nematic order parameters, elasticity, and chemical or compositional inhomogeneities, allow to describe various biological and bio-mimetic materials. I will present applications ranging from tissue dynamics during wound healing to instabilities in nematic elastomers, fascinating materials that combine the properties of liquid crystals and rubbers. Finally, I will introduce my JRC project "Growth and Development in Biological Systems: From Bacteria to Olive Trees" on growth and development on the various different scales of life.

3:30 pm **Domenico Orlando** "N=2 Gauge Theories, Dualities and Integrability from String Theory"
IPM laureate 2012 ENS – Laboratory of Theoretical Physics
Theoretical physics

Abstract: In the last few years, major progress has been obtained in the evaluation of partition functions for N=2 supersymmetric gauge theories. I will show how such advances can be understood from the point of view of string theory, which provides a geometrical interpretation for the relationship between supersymmetric field theories and integrable models.

3:50 pm ***Coffee Break***

4:20 pm **Quentin Glorieux** "Propagation of an entangled state through a fast light medium"
Maître de conférences UPMC – Kastler-Brossel Laboratory
Quantum optics

Abstract: Entanglement has long been thought to play a vital role in quantum information and communication protocols. Thus, much theoretical and experimental work has been done to investigate the fundamental properties of entanglement.
Recently, we have conducted experimental work to investigate the use of entanglement for quantum imaging as well as the behavior of continuous-variable entanglement and quantum mutual information upon propagation through dispersive media.
A four-wave mixing process in warm atomic vapor is used to both generate an entangled state of light, as well as produce a medium exhibiting slow- and fast-light properties. Differences in the behavior of the entanglement and quantum information after propagating through such dispersive media have been highlighted. Our study can help us to better understand the role of quantum noise as a limiting factor for ultra fast quantum communication.

4:40 pm **Anastasia Fialkov** "Understanding the Primordial Universe"
JRC laureate 2013, ENS – ICFP, Department of Physics
Theoretical Cosmology and Astrophysics

Abstract: A significant part of the history of our Universe, which includes the dark ages, formation of the first bright objects, and the epoch of reionization, remains unexplored at present due to observational challenges. Fortunately, the distribution neutral hydrogen, which amounts for 74% of baryonic matter in the Universe, can be mapped by detecting its redshifted 21-cm line. By measuring this signal today we can learn about the first bright sources in the history of the Universe, probe clustering properties of dark matter, verify presence of early dark energy, etc. In my talk I will show how we can predict some of the properties of the early Universe using the 21-cm signal. In addition, I will mention other ways to learn about primordial Universe using cosmology.

5:00 pm **Antonio Amariti** "Aspects of N=2 duality in three dimensional SUSY gauge theories"
IPM laureate 2013, ENS – Laboratory of Theoretical Physics
String theory

Abstract: Many four dimensional supersymemtric gauge theories flow in the deep IR to strong coupling, where a perturbative expansion is not possible. Nevertheless in many cases a dual description in terms of "magnetic" weakly coupled degrees of freedom exists and it gives access to many properties for these theories (e.g. dynamical SUSY breaking).
A similar story exists in three dimensions, even if the four dimensional analogy has to be taken with some grain of salt. I will review focus on these dualities in the case of four supercharges (N=2 SUSY in three dimensions) and discuss some of my recent progresses in the field.

5:20 pm **Benjamin Basso** "The beauties of gluon scattering amplitudes in Super-Yang-Mills Theory"
Chargé de recherche CNRS – Laboratory of Theoretical Physics
Theoretical Physics

Abstract: My research is focused on the study of gauge and string theories. I am especially interested in understanding the duality that has been conjectured to hold between these theories and in developing non-perturbative methods for unravelling the dynamics of both theories.

5:40 pm **Kris Van Houcke** "Summing Feynman diagrams for strongly correlated fermions"
Maître de conférences ENS – Laboratory of Statistical Physics
Statistical Physics

Abstract : Expansion in Feynman diagrams is a standard tool of quantum many-body theory. However, one is usually restricted to a few low-order diagrams. Bold diagrammatic Monte Carlo (BDMC) is a new technique to perform the summation of skeleton Feynman diagrams up to high order. We present a cross-validation between BDMC and precision experiments on ultra-cold atoms. Specifically, we focus on the normal-state equation of state of the unitary gas, a prototypical example of a strongly correlated fermionic system. The BDMC method works directly in the thermodynamic limit and with zero-range interactions. The diagrammatic series is found to be strongly oscillating but resummable thanks to sign-alternation of the diagrammatic contributions. The obtained equation of state is in excellent agreement with recent high-precision measurements. The contact, which is a key observable for resonant fermions, can be calculated accurately. The cross-validation demonstrates that a series of Feynman diagrams can be controllably resummed in a non-perturbative regime using BDMC. I will also discuss results for the Fermi polaron, a single impurity atom that is strongly coupled to a Fermi sea, and for the homogeneous electron gas.

6:00 pm ***Cocktail dînatoire - Bibliothèque des Sciences Expérimentales- 29 rue d'Ulm- First floor***