Mathematical models of Quantum Field Theory

Centre de Mathématique Appliquées, Polytechnique, Palaiseau.

The talks will take place in the conference room of the "Centre de Mathématiques Appliquées", second floor, wing 00 of the laboratories building.

	SCHEDULE	
	Tuesday, December 7	Wednesday, December 8
9h30	*Reception - Coffee/Tea*	*Coffee/Tea*
10h00 - 11h00	Jérémy **FAUPIN**	Annalisa **PANATI**
11h15 - 12h15	Marcel **GRIESEMER**	Volker **BACH**
12h15 - 14h00	*Cold Buffet*	*Lunch*
14h00 - 15h00	Vladimir **GEORGESCU**	Zied **AMMARI**
15h15 - 16h15	Laurent **BRUNEAU**	Paul **INDELICATO**
16h15 - 16h45	*Break - Coffee Tea*	*Break - Coffee Tea*
16h45 - 17h45	Mathieu **LEWIN**	Thierry **DAUDÉ**

Z. AMMARI, Université de Rennes 1
Title: Mean field limit of quantum dynamics for general bosonic states.
Abstract: In this talk I will present some results obtained in collaboration with Francis Nier on propagation of Wigner measures in infinite dimension for a mean field problem. In particular, I will discuss the derivation of the Hartree equation from bosonic quantum dynamics for general states using Wigner measures.

V. BACH, Johannes Gutenberg Universität Mainz
Title: The Brockett-Wegner Diagonalizing Flow
Abstract: The idea of diagonalizing self-adjoint operators by strongly continuous, non-autonomous unitary flows dates back to works of Brockett and Wegner from the early 1990ies. I will review these ideas and report on its mathematically rigorous implementation, as well as, its application to concrete models. My review is based on joint work with Jean-Bernard Bru.

L. BRUNEAU, Université Cergy-Pontoise
Title: Thermalization of a QED cavity
Abstract: We study repeated interactions of the quantized electromagnetic field in a cavity with a beam of two-level atoms, so-called "One-atom masers" experiments. We study the large time behaviour of the system. We show that whenever the atoms are initially in thermal equilibrium at temperature $T > 0$, and provided some non-resonance condition is satisfied, the beam of atoms drive the electromagnetic field towards thermal equilibrium at some renormalized temperature T^*. Our result is non-perturbative in the strength of the atom-field coupling.

T. DAUDÉ, Université Cergy-Pontoise
Title: Inverse scattering at fixed energy in de-Sitter-Reissner-Nordström black holes
Abstract: In this talk, we shall consider massless Dirac fields propagating in the outer region of de Sitter-Reissner-Nordstrom black holes, a class of spherically symmetric charged spacetimes with positive cosmological constant. We shall first define the corresponding partial wave scattering matrices $S(\lambda, n)$, objects that encode the scattering properties of an incoming Dirac wave having energy λ and angular momentum n. We shall show that the metric of such black holes is uniquely determined by the knowledge of the partial scattering matrices at a fixed non-zero energy and for almost all angular momenta. The main tool used to prove this result consists in complexifying the angular momentum and in using the particular analytic properties of the "unphysical" scattering matrix $S(\lambda, z)$ when z belongs to the complex plane. This result was obtained in collaboration with François Nicoleau.

J. FAUPIN, Université Bordeaux 1
Title: On perturbation theory for embedded eigenvalues
Abstract: In this talk we review some results on second order perturbation theory for embedded eigenvalues of an abstract class of self-adjoint operators. The framework of the study is singular Mourre's theory, under assumptions on the regularity of bound states with respect to a conjugate operator. Our main concerns are upper semicontinuity of the point spectrum and the Fermi Golden Rule criterion. These results apply to the massless Nelson model for arbitrary coupling. Joint work with J.S. Møller and E. Skibsted

V. GEORGESCU, Université Cergy-Pontoise
Title: Techniques algébriques dans l'analyse spectrale des hamiltoniens des champs quantiques
Abstract: Une description suffisamment explicite de la C*-algèbre engendrée par certaines classes d'hamiltoniens permet d'obtenir des résultats intéressants dans l'analyse spectrale de ces opérateurs: le but de cet exposé est de montrer comment fonctionne cette stratégie, tout d'abord pour des systèmes à un nombre fini mais variable de particules et ensuite pour des modèles de théorie quantique des champs.

M. GRIESEMER, Universität Stuttgart
Title: Unique Solutions to Hartree-Fock Equations for Closed-Shell Atoms
Abstract: In this talk we shall discuss the problem of uniqueness of the Hartree-and Hartree-Fock ground states of atoms. We show, for example, that the Hartree-Fock ground state of a closed shell atom is unique provided the atomic number Z is sufficiently large compared to the number N of electrons. More specifically, a two-electron atom with atomic number $Z \geq 35$ has a unique Hartree-Fock ground state given by two orbitals with opposite spins and identical spatial wave functions. This statement is wrong for some $Z > 1$, which exhibits a symmetry breaking.
- Joint work with Fabian Hantsch.

P. INDELICATO, Laboratoire Kastler Brossel, CNRS, Université Pierre et Marie Curie
Title: Recent progress in bound-state QED: from light elements to super-heavy ones.
Abstract: QED has been tested in the last decade in a number of ways. Ill report on recent experiment in exotic atoms and highly charged ions. The new measurement of the Lamb shift in muonic hydrogen leads to a value of the proton radius that contradicts what can be extracted from normal hydrogen. Recent experiments at medium and high-Z on few electron ions provide new stringent tests of strong field QED. New proposed experiments should lead to study in more detail the super-heavy elements ($Z > 137$). These new results raises question about the use of perturbation theory in BSQED, its pertinence and convergence, and on the details of the interaction between QED and QCD or nuclear structure details.

M. LEWIN, Université Cergy-Pontoise
Title: Renormalization of Dirac's Polarized Vacuum
Abstract: In this talk I will review several results on a model describing relativistic atoms while taking into account some QED effects like the polarization of the vacuum. I will first present the model and recall previous results, mainly dealing with the existence of ground states and their properties (joint works with Gravejat, Hainzl, Séré and Solovej). Then, I will explain how to remove the ultraviolet cut-off by means of a renormalization procedure, following a recent work with Gravejat and Séré.

A. PANATI, Centre de Physique Théorique, Luminy et Université du Sud Toulon-Var
Title: Infrared aspects of a model of QFT on a static space time
Abstract: We consider the Nelson model with variable coefficients, which can be seen as a model describing a particle interacting with a scalar field on a static space time. We consider the problem of the existence of the ground state, showing that it depends on the decay rate of the coefficients at infinity. We also show that it is possible to remove the ultraviolet cutoff. (joint work with C. Gérard, F. Hiroshima, A. Suzuki)