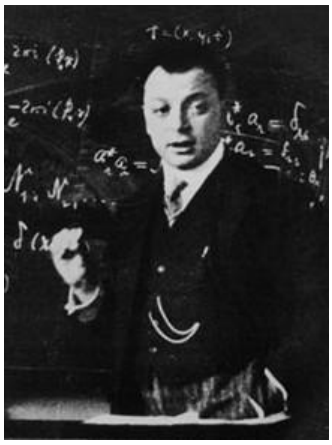
PAULI SYMPOSIUM

ON

MATHEMATICAL MODELING : NEW DIRECTIONS AND APPLICATIONS



MONDAY, 26. NOVEMBER 2012, 15 h – 18 h

INSTITUT FRANÇAIS - PALAIS GLAM-CALLAS, SALON ROUGE
Währinger Str. 30, 1090 Wien

At the occasion of the prolongation of the „Unité Mixte Internationale: Institut CNRS Pauli", UMI 2842 du CNRS, at the Wolfgang Pauli Institute, Wien.

15h00 – 15h10 *"Welcome"*
Guillaume ROUSSON (Directeur de l'Institut Francais)
Norbert J. MAUSER (Director, WPI & Institut CNRS Pauli)

Walter SCHACHERMAYER (WPI c/o U. Wien), *chairman*

15h10 – 15h45
Pierre-Louis LIONS (Collège de France):
"On Mean Field Games"

15h45 – 16h20
Sylvie MELEARD (Ecole Polytechnique):
"Stochastic modeling of Darwinian evolution"

16h20 – 16h55
Ivar EKELAND (Univ. Paris-Dauphine):
"Modeling limited liability"

17h00 – 18h00 *"Cocktail"*

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Pauli Symposium on "Mathematical Modeling: new directions and applications"

Abstracts:

Pierre-Louis Lions (Collège de France) :

"On Mean Field Games"

This talk will be a general presentation of Mean Field Games (MFG in short), a new class of mathematical models and problems introduced and studied in collaboration with Jean-Michel Lasry. Roughly speaking, MFG are mathematical models that aim to describe the behavior of a very large number of "agents" who optimize their decisions while taking into account and interacting with the other agents. The derivation of MFG, which can be justified rigorously from Nash equilibria for N players games, letting N go to infinity, leads to new nonlinear systems involving ordinary differential equations or partial differential equations. Many classical systems are particular cases of MFG like, for example, compressible Euler equations, Hartree equations, porous media equations, semilinear elliptic equations, Hamilton-Jacobi-Bellman equations, Vlasov-Boltzmann models... In this talk we shall explain in a very simple example how MFG models are derived and present some overview of the theory, its connections with many other fields and its applications.

Sylvie Méléard (Ecole Polytechnique):

"Stochastic modeling of Darwinian evolution"

We consider stochastic models describing the Darwinian evolution of a polymorphic population with mutation and selection. The interactions between individuals occur by way of competition for resources whose concentrations depend on the current state of the population.
Our aim is to model the successive fixations of successful mutants in the population and further its diversification on an evolutionary time scale.
We prove, starting from a birth and death model, that, when advantageous mutations are rare and the population size large enough, the population process behaves on the mutation time scale as a jump process moving between successive equilibria. The main idea is a time scale separation: the time scale for the selection process to eliminate disadvantaged types has to be much smaller than the mutation time scale.
Essential technical ingredients are the study of a generalized system of ODE's modeling a finite number of biological populations in a competitive interaction due to multi-resources and a fine description of the invasion and fixation of mutants using branching processes.

Ivar Ekeland (Univ. Paris-Dauphine):

"Modelling limited liability"

Limited liability is ubiquitous in our society: managers do not carry the losses, investors and shareholders do. So how are we to expect that the managers will act in the best interests of investors and/or shareholders ? This is known in economics as the moral hazard problem. It was considered intractable until a few years ago, when Sannikov found a way to frame it as a stochastic optimal control problem. I will describe Sannikov's method and the rich field of work that has developed since.

Short Biography: **Pierre-Louis Lions** studied at ENS rue d'Ulm with PhD at Paris 6 in 1979, directed by H. Brezis. His large field of research interests around the theory of nonlinear partial differential equations ranges from (quantum) physics, fluid mechanics to mathematics of economy and finance. Lions, together with R.DiPerna, was the first to prove global (renormalized) solutions to the Boltzmann equation. In 1994 he received the Fields Medal. Other awards Lions received include the IBM Prize in 1987 and the Philip Morris Prize in 1991. He is a doctor honoris causa of Heriot-Watt University (Edinburgh) and of the City University of Hong-Kong. He is member of the Académie de sciences and Officier de la Légion d'Honneur. He holds the chair of *Partial differential equations and their applications* at Collège de France in Paris as well as a position at the CEREMADE at Univ. Paris 9 "Dauphine" and at Ecole Polytechnique. Together withM. Crandall he introduced the notion of viscosity solutions. Another key technique developed by Lions is "concentration compactness"; he introduced certain measures to handle the concentrations, including the Wigner measure. Currently he is interested in "mean field games" e.g. in mathematical finance. He is on the editorial board of around 25 international journals. His enormous impact on mathematics is enhanced by the school of his PhD students, starting from M. Esteban and B. Perthame, his participation in European projects (like the HYKE network) and his activity in boards both in industry and academic research (including the board of the WPI).

Short Biography: Sylvie Méléard studied at ENS Fontenay-aux-roses, received her PhD in 1984 from the Université Pierre et Marie Curie in Paris, directed by El Karoui. She obtained an assistant professor position firstly at the Université du Mans, and then at Paris 6. She obtained her "Habilitation à diriger des recherches" in 1991 and a full Professor position in 1992 at the Université Paris Ouest-Nanterre. Since 2006, she is full professor at Ecole Polytechnique and currently she is the directrice of the Applied Mathematics Department. Her scientific interests focus on probability and stochastic processes, interacting particle systems and measure-valued processes. In the last decade, she developed mathematical (and especially stochastic) modeling for ecology and evolution. She is the leader of a French ANR research group on this topic. She is also the leader of a big research program with the Muséum National d'Histoire Naturelle and the Company Veolia-Environment concerning mathematical modeling of the biodiversity. She is on the editorial board of several journals (Annals of Probability, Stochastic Processes and their Applications, Maths in Action). Her current research mainly concerns the stochastic modeling of Darwinian evolution. The focus is given on the interplay between the ecological properties of the population and the evolution of genetic parameters.

Short Biography: Ivar Ekeland went to school at the lycée Francais in Vienna, studied at ENS rue d'Ulm in Paris and obtained his doctorate in 1970. He is a Senior Research Fellow at the French National Centre for Scientific Research (CNRS). Among other leading positions he was the president of the université Paris-Dauphin from 1989 to 1994 and held the Canada Research Chair in Mathematical Economics at the University of British Columbia until his retirement in 2011. He has received prizes from the French Academy of Sciences, the French Mathematical Society, and the Belgian Academy of Sciences. He is a Fellow of the Royal Society of Canada, a foreign member of the Norwegian Academy of Science and the Austrian academy of sciences where he serves also in the "international scientific board". He holds honorary doctorates from UBC, from the University of Saint-Petersburg for Economics and Finance and from the Universität Wien. Ivar Ekeland is the founding editor of the "Annales de l'Institut Henri Poincaré-Analyse non linéaire" and he currently Editor in Chief of "Mathematics and Financial Economics". His broad scientific interests include in particular nonlinear functional analysis, the calculus of variations ("Ekeland's variational principle"), chaos theory, mathematical economics... He has also written numerous books and papers in mathematics, economics and finance, also for the larger audience (e.g. "The best of all possible worlds") and for children (e.g. "The cat in numberland"). He is also a regular contributor to the journal Nature as well as to the magazine Pour la Science.