



MAPHYSTO NEWS

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INTRODUCTION

Welcome to the sixth issue of MAPHYSTO NEWS.

In this newsletter we, and some of our guests too, report from recent activities that have taken place under the auspices of MaPhySto. We also look toward the future, reproducing (excerpts of) announcements of forthcoming events.

New readers who may not yet be acquainted with the Centre, may find some general information about MaPhySto at the end of the newsletter.

*Ole E. Barndorff-Nielsen,
Oddbjørg Wethelund, eds.*

NEW FUNDING

Following an evaluation by a panel of international experts, the Danish National Research Foundation has decided to fund MaPhySto for a second period. The expert panel consisted of Professor Chris C. Heyde, Columbia University and Australian National University, Professor Norbert Mauser, Universität Wien, Professor Jean Belissard, Université Paul Sabatier, Toulouse, and Professor Sergio Albeverio, Universität Bonn. The new funding is initially for the period 1 April 2003 - 30 June 2006 but is likely to be extended to a full 5-year period, after which funding from the Foundation will stop in accordance with the Foundation's general rules. It is, however, expected that many of MaPhySto's activities will continue beyond 2008, in some form or other, by embeddings in the various Science Faculties participating in MaPhySto. Ole E. Barndorff-Nielsen reaches retirement age in early 2005 and is consequently stepping down as Scientific Director of MaPhySto by 31 March 2003. However, he will continue participating in MaPhySto activities as Senior Advisor. The new Scientific Director, who takes over from 1 April 2003, is Professor Arne Jensen, Department of Mathematical Sciences, Aalborg University. Arne Jensen's fields of expertise are mathematical physics and inverse problems. The infrastructure of MaPhySto continues to be placed at the Department of Mathematical Sciences, University of Aarhus, with Oddbjørg Wethelund as Project Manager and Annemette Hammer as Secretary.



Arne Jensen, Annemette Hammer, Oddbjørg Wethelund

RECENT EVENTS

Workshop on Stochastic Partial Differential Equations, Statistical Issues and Applications. 4 - 6 January 2001 at the Department of Statistics and Operations Research, University of Copenhagen.

The workshop was organized by Marianne Huebner (Michigan State University) and Michael Sørensen (University of Copenhagen).



The Organizers, Marianne Huebner and Michael Sørensen

The aim of the workshop was to identify promising research directions concerning statistical issues, including ill-posed problems, and to discuss where stochastic partial differential equations can fruitfully be applied. The focus was on applications in finance and

hydrology. Researchers with different approaches to the subject participated and contributed fruitfully to the success of the workshop.

The lecturers were: Jaya P.N. Bishwal (Princeton), Rama Cont (Palaiseau), Marianne Huebner (Michigan), I.A. Ibragimov (St. Petersburg), Nikolai Leonenko (Cardiff), Sergey Lototsky (Los Angeles), Bo Markussen (Copenhagen), Jaroslav Mohapl (Waterloo), Bernt Øksendal (Oslo), Leonid I. Piterbarg (Southern California), Boris Rozovskii (Los Angeles), Tony Shardlow (Durham), and T.S. Zhang (Manchester).

A collection of extended abstracts is available as No. 20 in MaPhySto's Miscellanea Series.

The meeting was a part of MaPhySto's activities in the area of stochastic partial differential equations. The first event was a course with the title "An Introduction to Stochastic Partial Differential Equations" given by Helge Holden (Trondheim) 21 - 25 September 1998 in Copenhagen.

Concentrated Advanced Course on Statistical Mechanics of Disordered Systems. Lectures by Professor Anton Bovier, Weierstrass Institute, Berlin.

Anton Bovier's CAC on *Statistical Mechanics of Disordered Systems* was held in Copenhagen from 23 to 27 April 2001. There were about 25 participants in the course listening to Bovier's lucid and enthusiastic presentation of his topic: spin systems and Gibbs measures, random Gibbs measures, phase transitions, mean-field models such as the Hopfield model etc. This was a state of the art presentation, treating the most recent developments as well as discussing ongoing research, open problems and likely future directions.

The lectures were based on notes prepared for the occasion, which later appeared in the MaPhySto Lecture Notes series (No. 10, June 2001).

Concentrated Advanced Course on Monte Carlo Methods in Financial Engineering. Lectures by Professor Paul Glasserman, Columbia University. Graduate course on Monte Carlo Methods in Financial Engineering jointly arranged by MaPhySto and the Danish Doctoral Educational Network in Finance. On May 28 - June 1, 2001 Professor Paul Glasserman, Columbia University, gave, for approximately 50 participants, a sequence of lectures on Monte Carlo methods applied to finance. The main topics were: Sampling Methods, Generating Sample Paths, Variance Reduction Techniques, Importance Sampling, Stratification, Quasi-Monte Carlo, Discretization Methods, Hedging, American Options, and Market and Credit Risk.

TMR and MaPhySto Summer School on Spatial Statistics and Computational Methods. The *TMR and MaPhySto Summer School on Spatial Statistics and Computational Methods* was held at Aalborg University, Denmark, August 19-22, 2001. It was partly supported by the European Union's TMR network *Statistical and Computational Methods for the Analysis of Spatial Data* and partly by MaPhySto. Lectures on central topics and newly developed methods were offered by the scientists mentioned below, and the course material has developed into the volume *Spatial Statistics and Computational Methods* edited by Jesper Møller and to appear at the beginning of 2003 as a Springer Lecture Notes in Statistics.

Petros Dellaportas and Gareth Roberts gave a tutorial on Markov chain Monte Carlo methods, the computational methodology which is essential for virtually all the complex spatial models considered by the other speakers/authors. Peter Diggle, Paulo Ribeiro Jr., and Ole Christensen gave an introduction to the model-based approach of geostatistics. Merrilee Hurn, Oddvar Husby, and Håvard Rue considered different aspects of Bayesian image analysis. Finally, Jesper Møller and

Rasmus Waagepetersen presented recent advances in simulation-based inference for spatial point processes.

About 40 European PhD-students and post-docs participated in the summer school. Unfortunately there was not room for accepting about 60 other qualified applicants.

2nd Danish Symposium on Applied Analysis "Numerical methods in areas of fluid dynamics, electromagnetics and finance". Organized by the Danish SNF-PDE-group. 23-25 August, 2001, University of Copenhagen.

Instructional and Research Workshop on Multiplicative Processes and Fluid Flows. 23-28 August, 2001, University of Aarhus. State of the art accounts of the connections between multiplicative processes and fluid flows were given, with particular reference to the applications to rainfall, river networks, and turbulence. Much of the material presented was based on recent research results obtained by the focused research group on Navier-Stokes equations at Oregon State University/Indiana University on the one hand and the turbulence research group around the Max-Planck Institute for Physics of Complex Systems, Dresden, on the other.



The participants of the Workshop on Multiplicative Processes and Fluid Flows

Lecture series were given by Edward C. Waymire (Oregon) and Martin Greiner (Dresden/Munich), and further related talks were

presented by Rabi Bhattacharya, Vijay K. Gupta, John C. Orum, Mina Ossiander, Enrique Thomann, Brent M. Troutman, and Dee Winn.

The lecture notes for this workshop are collected in MaPhySto Lecture Notes No. 11, August 2002.

The list of contents is:

E. Waymire: Multiscale and Multiplicative Processes in Fluid Flows

- (1) Introduction and Preliminaries
- (2) Diffusion Models
- (3) Tree Graphs: As Network Models
- (4) Multiplicative Cascades: Statistical Rainfall and Turbulence Models
- (5) Navier-Stokes Equations and Multiplicative Cascades
- (6) Branching Brownian Motion, Fisher/KPP Equation, Burgers Equation: Real Space Cascades

R. Bhattacharya: Multiscale Diffusion Equations

M. Greiner: Turbulent Random Multiplicative Branching Processes

V.K. Gupta: Multiscale Flood Analysis on Self-similar River Networks

2nd MaPhySto Conference on Lévy Processes - Theory and Applications. Between 21 and 25 January 2002 a large group of 115 researchers from all over the world gathered at the University of Aarhus in order to participate in the *2nd Maphysto Conference on Lévy Processes: Theory and Applications*. The first conference in January 1999 was a great success; many of the distinguished speakers had also contributed to the 2001 Birkhäuser volume *Lévy Processes: Theory and Applications* (Eds. O.E. Barndorff-Nielsen, T. Mikosch

J.C. Orum: Stochastic Cascades and 2D Fourier Navier-Stokes Equations

M. Ossiander: On Estimation Theory for Multiplicative Cascades

- (1) Introduction
- (2) An Overview of the Theoretical Foundations
- (3) Dimension Estimates: Some recent Results
- (4) Lognormal Versus log Poisson Generators; A Statistical Problem in Turbulence
- (5) Cascade Models and Temporal Rainfall

E. Thomann: Partial Differential Equations and Multiplicative Processes

- (1) Introduction
- (2) Linear Equations: Feynmann-Kac Formula
- (3) Nonlinear Equations: Navier-Stokes
- (4) NS-Majorizing Kernels
- (5) Successive Iterations of a Contraction Map
- (6) Conclusions and Remarks

B.M. Troutman: River Flow Mass Exponents with Fractal Channel Networks and Rainfall

D. Winn: Gradient-Directed Diffusions and River Network Models

and S.I. Resnick) which has made a major contribution to the current renaissance of activity in this classical area of stochastic processes.

Compared to the first Conference this second meeting was noticeable in several respects.

First of all, there were more speakers – all together 46 – and in addition there were a number of poster presentations. Expositors included the leading people in this field; their contributions covered the whole area of theory and applications, providing a state-of-the-art overview. Therefore the extended abstracts of the conference (available



The participants of the 2nd MaPhySto Conference on Lévy Processes - Theory and Applications

on www.maphysto.dk) are a unique source of information about Lévy processes.

Second, the fraction of young researchers (PhD students, postdoctoral fellows) was significant: close to 40% of the participants.

Third, the spectrum of the talks was very wide, including the theory of Lévy processes on abstract structures (e.g. on groups or random trees), path and distributional properties, new particular classes of Lévy processes and their properties, relations with martingale theory and stochastic calculus, statistical issues and data analysis. Despite the large variety of topics, the participants felt during many talks that there was plenty of coherence throughout this conference and that different talks shed light on seemingly distinct aspects, by unifying and simplifying them.

The most impressive new aspect of the conference was the high contribution of applied work. Not surprisingly, finance was the major application. The interest of practitioners in the more realistic modeling of financial data (mimicking jumps, heavy tails and dependence structure of real-life data) has certainly been one of the triggering forces for the recent new developments in Lévy process theory. Since the last conference, Lévy process theory has become one of the established new approaches

to mathematical finance, and the interested person could meet many of the leading experts at the conference. A second major area of application is physics which was discussed in several talks as well.

The conference was organized by Ole E. Barndorff-Nielsen (Aarhus), Thomas Mikosch (Copenhagen), Elisa Nicolato (Aarhus), Goran Peskir (Aarhus) and Ken-iti Sato (Nagoya). As many of the participants were already familiar from the last Lévy process conference, the practical side of the organization went smoothly and pleasantly. In particular, thanks are due to Oddbjerg Wethelund and Annemette Hammer whose hard work and dedication to the success of the meeting was gratefully acknowledged by all of the participants. The participants had plenty of opportunity to discuss their work, but the social aspects of the stay in Aarhus, including the conference dinner, the reception by the mayor, and the excursion to Ebeltoft, were very well appreciated and will keep the hospitality of the city of Aarhus and its University in good memory.

No doubt: this conference was another great success. Various participants met during the conference in order to discuss the possibility

of creating a European network on Lévy processes and related fields, in order to make the exchange of information more efficient and to plan further meetings of this kind.

Jean Bertoin, David Applebaum and Jan Rosiński

Concentrated Advanced Course on Long Range Dependence, Heavy Tails and Rare Events with Applications to Finance and Telecommunications. The course was given at the University of Copenhagen May 6-10, 2002. Main lecturer was Gennady Samorodnitsky (School of Operations Research and Industrial Engineering, Cornell University). He gave 15 inspiring lectures about the relationship between heavy tailed distributions and large deviations, and the applications of these results in finance and telecommunications. His lectures were enthusiastically received by the 45 participants from Denmark, Sweden, Finland, Norway, Great Britain, Lithuania, Germany, Poland, Spain, Italy, Senegal, Estonia, Switzerland, France, USA, The Netherlands. Supplementary lectures were given by Ilkka Norros (Helsinki), Stan Zachary (Edinburgh), Dima Korshunov (Edinburgh), Bert Zwart (Paris, Eindhoven), Søren Asmussen (Lund), Patrik Albin (Gothenburg) and Murad Taqqu (Boston). The Lecture Notes of Gennady Samorodnitsky are available as item No 12 in Maphysto's Lecture Notes Series.

Book. We would like to draw your attention to the book *Empirical Process Techniques for Dependent Data*. Editors H.G. Dehling (Bochum), T. Mikosch (Copenhagen) and M. Sørensen (Copenhagen), Birkhäuser Boston, September 2002, 380 pages, 70 \$. Many of the contributors to this text participated in the Maphysto Instructional Workshop on Empirical Process Techniques for Dependent Data at the University of Copenhagen in November 2000; the idea for composing this book was born at this workshop.

From the Preface

This volume aims at bringing together empirical process theory with different concepts of dependence in probability theory and statistics. The need for this convergence is a demand of statistical practice where increasingly complicated stochastic models are used to capture the dependence structure of real-life data. Data with complex dependencies are found in fields as diverse as geology, genomics, environmental sciences, finance, insurance, meteorology, physiology, and telecommunications, to name a few. The high speed and large memory of present day computers make it possible to use models for dependence in statistical applications. These advances have brought the inference for stochastic processes into the mainstream of statistics.

As a matter of fact, the investigation of the properties of estimators and test statistics for stochastic processes is much more difficult than for models that assume observations to be independent. Here the other important development in statistical science comes in. Over the last few decades, it has become evident that empirical process techniques are extremely useful when it comes to studying the asymptotic properties of parametric as well as non-parametric statistical procedures. The number of statistical problems that utilize concepts and methods from empirical process theory is steeply increasing. Therefore a theory of empirical processes for dependent data has been developed in recent years.

The main goal of this volume is to give an introduction to empirical process techniques for dependent data and to survey recent developments which are widely scattered over the statistics and probability literature. It is worthwhile stressing that we do not follow standard patterns by sticking to the standard empirical process for stationary sequences. In our own research we have often experienced that researchers with quite different interests and expertise have borrowed techniques from classical empirical process theory without being aware of parallel developments in other areas.

These include the *spectral analysis of time series*, the *bootstrap for dependent sequences*, *extreme value theory for dependent data*, and *empirical processes for mixing dependent observations*, including *processes with long range dependence*. This volume is a unique collection of material from the diverse areas mentioned. The interested reader will easily find the common spirit of the parts of this volume and, hopefully, he/she will be able to discover analogies with techniques used in other fields which are not covered by this book.

Earlier monographs on empirical processes such as *Empirical Processes with Applications to Statistics* by Shorack and Wellner, *Weak Convergence and Empirical Processes* by van der Vaart and Wellner, and *Convergence of Stochastic Processes* by Pollard cover the case of independent observations. We believe that this volume is a timely and indispensable supplement to these books. It can also be seen as a follow-up to the 1986 Birkhäuser volume *Dependence in Probability and Statistics* edited by Eberlein and Taqqu which served as a standard reference for a generation of researchers.

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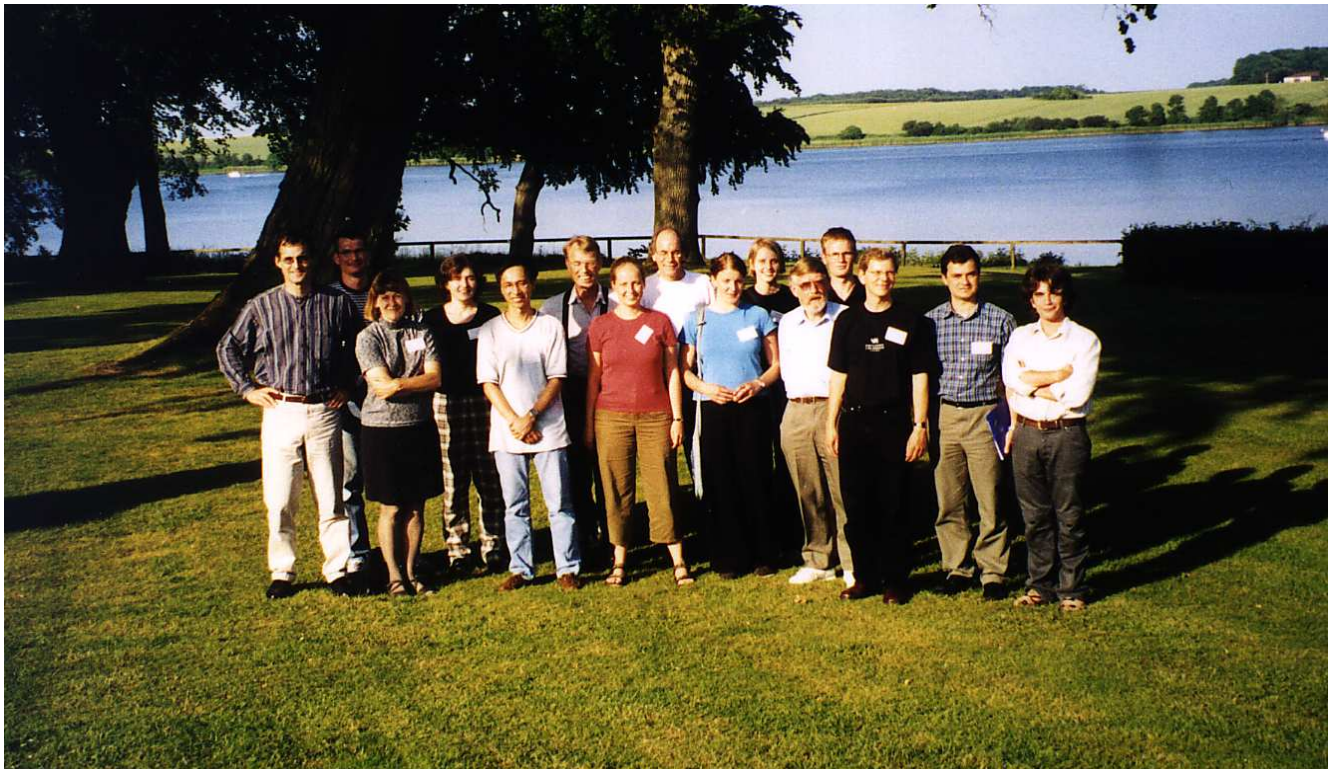


Eva Vedel Jensen and Adrian Baddeley

Second MaPhySto and StocLab Summer School on Stereology and Geometric Tomography. The Second Summer School on Stereology and Geometric Tomography was held at Sandbjerg Estate, June 17-21 2002. About 20 PhD-students and postdocs participated in the summer school. The teaching team consisted of Adrian Baddeley (Perth), Richard Gardner (Washington), Hans Jørgen G. Gundersen (Aarhus), Eva B. Vedel Jensen (Aarhus), Markus Kiderlen (Karlsruhe) and Kiên Kiêu (Versailles). Tutorial lectures on geometric tomography, stochastic geometry

and stereology were given, as well as theoretical and practical(!) exercises. In addition, the programme contained special invited lectures

by Dorte Juhl Jensen from the newly started research centre *Metal Structures in 4D*, funded by the Danish National Research Foundation.



The participants of the 2nd MaPhySto and StocLab Summer School on Stereology and Geometric Tomography

The Third International Conference on High Dimensional Probability. 24-28 June, 2002, Sandbjerg Estate. The conference is the third conference with the title *High Dimensional Probability*. The main subjects of the conference were (i): Empirical processes; (ii): Limit theorems, strong approximations and large deviations; (iii): Gaussian processes; (iv): Stable and infinitely divisible processes; (v): Applications to statistics; (vi): Applications to physics.

The scientific committee consisted of: Michael Marcus (CUNY), Jon A. Wellner (University of Washington) and J. Hoffmann-Jørgensen (University of Aarhus), and the main speakers of the conference were: M. Marcus (USA); J.A. Wellner (USA); R.L. Hudson (England); U. Franz (Germany); R. Dudley (USA); X. Fernique (France); E. Giné (USA);

P. Gänszler (Germany); S. Mendelson (Australia); J. Kuelbs (USA). In addition to the lectures of the main speakers, there was a series of talks delivered by the participants.

The conference revealed the fact that the subject is rapidly developing and that *high dimensional probability* has found new and significant applications in many areas such as statistics, physics and computer science. The conference was very fruitful scientifically, and the perfect conditions at the Sandbjerg Estate gave a lot of opportunities for stimulating discussions. On Wednesday afternoon we had a bus excursion to Højer at the southwest coast of Jutland where the mayor guided us on a tour to and along the dikes.

The participants were urged to submit papers to the proceedings of the conference. The

papers are subjected to a standard refereeing procedure, and Birkhäuser Verlag, Basel,

Switzerland, has agreed to publish the proceedings in their series *Progress in Probability*. The proceedings are expected to be available June-July, 2003.



The participants of the Third International Conference on High Dimensional Probability



From the excursion to the marshland

Summer School: From Lévy Processes to Semimartingales - Recent Theoretical Developments and Applications to Finance. As part of a series of events related to Lévy processes, MaPhySto organised this summer school jointly with CAF and DYNSTOCH. Participants from twenty countries gathered at the University of Aarhus from the 20th to the 27th of August 2002.

The three main speakers A. N. Shiryaev, A. S. Cherny and N. Shephard were supported

by supplementary lectures by O. E. Barndorff-Nielsen, H.-J. Engelbert, F. Hubalek, M. Jacobsen, E. Nicolato, J. Pedersen, M. Sørensen, P. Tankov, and J.H.C. Woerner. In his first lecture A.N. Shiryaev mentioned and illustrated the following often-cited sentence that the theory of stochastic integration for semimartingales seems to have been tailor-made for applications in mathematical finance. The two main themes of this school were the theory of and financial modelling with semimartingales. They were presented by leading experts in the two fields.

A. S. Cherny gave an introduction to the theory of stochastic integration with a particular emphasis on general versions of Itô's formula in the context of semimartingales. Furthermore, he discussed different types of time changes and the fundamental theorems of asset pricing in Lévy-based financial models. His enthusiastic and extremely well-structured lectures were a pleasure to attend. After an introduction to semi-, local

and sigma-martingales, A. N. Shiryaev presented accounts on change of measure, stochastic exponentials and logarithms and representations of semimartingales. His strong expertise was reflected both in the details and the broadness of contents. Both speakers were touching upon the frontiers of current research.

N. Shephard's lectures were based on draft material for the book "Financial Volatility and Lévy Based Models" coauthored with O. E. Barndorff-Nielsen. He presented the application of time changes of Lévy processes to stochastic volatility modelling. Moreover, he addressed the practical issue of simulation of Lévy processes and the newly developed asymptotic theory of realised power variation

for semimartingales. The clarity of his presentation was ensured by numerous colourful graphs and use of modern technology. Additional lectures related to that book were given by O. E. Barndorff-Nielsen on theoretical aspects and E. Nicolato and F. Hubalek on derivative pricing and simulation issues.

Draft versions of that book were made available to all participants and a number of research papers and lecture notes related to A. N. Shiryaev's and A. S. Cherny's lectures were distributed. The participants enjoyed a nice excursion to Ebeltoft and Kalø Slotruin as well as a lovely dinner. Finally, many thanks to O. E. Barndorff-Nielsen, O. Wethelund and A. Hammer for their high quality organisation of this event.

by Manos Venardos and Matthias Winkel



The participants of the Summer School "From Lévy Processes to Semimartingales - Recent Theoretical Developments and Applications to Finance"

SUMMER STIPENDS

A number of Summer Stipends were granted to younger European researchers/advanced graduate students. Below the recipients have written some information on their background and their experience during their stay in Denmark:

Michele Baldini. My name is Michele Baldini and I am a graduate student at New

York University. Born in the "Big Apple", raised in Italy, I received my undergraduate degree in Physics at the University of Bologna, Italy with a thesis on a Schroedinger evolution equation in Quantum Mechanics. Currently I am working on stochastic models for turbulence under the supervision of Prof. Henry McKean at the Courant Institute of Mathematical Science in New York. In particular I

am studying a randomly driven Burgers equation with a special interest on asymptotical behaviour and invariant measures.

During the summer of 2002, I received a grant from Maphysto to visit the centers in Aarhus and in Copenhagen as a researcher fellow. There I had the opportunity to mingle with the local scientific community and work on two very interesting projects: the first, on brownian particles in a gas with non constant temperature and the second, on a stochastic model of wind blown sand. In addition to the scientific aspects of this experience, I was introduced for the first time to the danish culture and its impressive efficiency and surprising warmth. I will not forget the rose bushes at the Sandbjerg Estate...

Special thanks go to Goran Peskir, Bo Markussen and Michael Sørensen for the productive and enjoyable discussions. Also thanks to Annemette Hammer and Oddbjørg Wethelund for helping me with the practicalities. I wish you all the best and hope for future collaborations.

Pavel Gapeev. For the first time I visited Centre for Mathematical Physics and Stochastics (MaPhySto) in January 2002 during the Second Conference on Lévy Processes held in the University of Aarhus. For me it was the best occasion to meet leading specialists in different fields, to attend their talks and to discuss mathematical questions with them. This conference was very well organized and it was felt that MaPhySto has a very good experience to arrange such great meetings. During the Conference Ole E. Barndorff-Nielsen kindly suggested me to apply for a MaPhySto Summer Stipend 2002 for the month of August.

In the first half of August I visited the University of Copenhagen and cooperated with Martin Jacobsen. We discussed some topics related to the stochastic models with jump-diffusion processes. Actually, we started to discuss this subject during my short visit of the University of Copenhagen with a talk in

May 2002. In the second half of August I visited the University of Aarhus and cooperated with Goran Peskir. We worked on several optimal stopping problems for Lévy processes appearing in sequential analysis. It was very nice to meet many colleagues and guests of MaPhySto and discuss new mathematical results with them.

During my visit of the University of Aarhus I attended the courses of the Summer School "From Lévy Processes to Semimartingales - Recent Theoretical Developments and Applications to Finance", where one of the main lecturers was my teacher, Albert N. Shiryaev, whom I am grateful for the support in course of many years. I would like to note that all the courses of the Summer School were supported by well-prepared lecture notes.

If You visit MaPhySto any time of the Year, then You can see a lot of guests and feel the extremely friendly atmosphere created by all the colleagues. Informal meetings such as conference dinner, sight-seeing excursion or weekly coffee-tee make the visit very pleasant. Not least, You can use the library during all the day and every time You are welcome to order a book, to send post or to get some assistant material. In a word, in MaPhySto You find all You need for fruitful research.

It is a great pleasure for me to thank Ole E. Barndorff-Nielsen, Martin Jacobsen and Goran Peskir for the financial support of my visit, for the hospitality and for many useful discussions. The last but not the least thanks I address to Oddbjørg Wethelund, Annemette Hammer and Vivi Arp for the arrangement of a comfortable accomodation and their kind help during all my visits of the University of Aarhus and the University of Copenhagen.

Pierpaolo Montana. I am an assistant professor at the University of Rome I "La Sapienza". My research field is mathematical finance, in particular no-arbitrage pricing theory.

This summer I have been granted a summer stipend from Maphysto to spend two weeks in Aarhus and four in Copenhagen.

The first part of my stay in Denmark has been devoted to the study of Lévy processes, a topic that I've only recently started to study, attending the summer school on this subject. It has been very fruitful for my understanding of this field to have the opportunity to be introduced by the lectures of Professor Shiryaev.

At the same time, during these two weeks I've had the pleasure to have some talks with the researchers at the Maphysto unit in Aarhus. Last but not least, it has been a bibliophile pleasure to spend some time in the Library.

The second half of my visit, in Copenhagen, has been devoted to the study of the pricing of options whose strike is a random variable, also known as Margrabe options. On that topic I'm currently writing a paper.

Also the Copenhagen time has been a great opportunity, both as professional and human experience.

I've particularly appreciated the continuous exchange of ideas that I had with the people of the Maphysto unit in Copenhagen, when I had the chance to talk about actuarial methods with some of the masters of the subject.

Finally, my deep gratitude goes to Professors Barndorff-Nielsen and Mikosch for inviting me, and to staff for the patience and kindness they showed at every my inquiry.

I tried to resume the main aspects of this experience, but the best for every researcher in mathematics is to go in Denmark and to live personally this opportunity.

Peter Tankov. I am very glad to have spent this month in Denmark with Maphysto Summer Stipend. First of all, the summer school "From Levy processes to semimartingales" was very useful for me. Its topic corresponds very closely to the subject of my Ph.D. research. The lectures were quite dense, but since I was already familiar with most of the material, I

could follow everything and this school has brought a good system into my knowledge of this field.

During the summer school I also had some interesting discussions with other participants, especially after I had made my presentation many people approached me during the breaks and asked questions.

After the school I spent one week working with Elisa Nicolato on some extensions of stochastic volatility models of Ornstein-Uhlenbeck type. I think, this work has allowed us both to learn many new things and at the end we came up with new generalizations that were not at all expected at the beginning; I am sure that we are going to continue our collaboration in the future.

For the last week of my stay in Denmark I went to Copenhagen, where I also gave a talk and had some interesting discussions with various people at the Laboratory for Actuarial Mathematics.

I went to Denmark in search for some new ideas for my Ph. D. research and now I have at least five different directions which seem all rather promising. Even when I did not talk to other people, I could advance much faster on my own work than in France because in Denmark the science was the only thing I was thinking about, there were no everyday bureaucratic problems that I often have here.

Finally, I want to thank all the people at Maphysto and the University of Copenhagen who have invited me to Denmark and helped me have such a wonderful visit, especially Ole Barndorff-Nielsen, Elisa Nicolato, Thomas Mikosch, Oddbjørg Wethelund and Annemette Hammer. Thank you very much and I hope that you will continue to organize this program in the years to come, so that other people can also have such wonderful time in Denmark as I have had.

Enrique ter Horst. My name is Enrique ter Horst. I am a Ph.D candidate at Duke University under the supervision of Professor

Robert L Wolpert. My main research area is mathematical finance and my focus is the implementation of Bayesian estimation methods. Assessing the uncertainty when estimating models from mathematical finance is quite important.

Before coming to Duke, I spent four years studying Economics at Strasbourg. The Maphysto Summer Stipend allowed me to travel to Denmark and stay there for a month.

During my stay, I had very helpful and educational discussions with Elisa Nicolato, Goran Peskir and three other summer stipend recipients. I would like to point out how kind Elisa was in making room for me in her office as well as my infinite questions I made to her.

I view now a lot of concepts from a different point of view and this Summer School was extremely beneficial for my research and ideas. Two other things I would also like to point out is that the Library is incredibly well equipped and organised, and interaction among the Maphysto people is great in terms of research. Furthermore, I was struck by the kindness and generosity of the Danish people. In this sense, they have been wonderful hosts and extremely kind!

My personal thanks to Professor Ole E. Barndorff-Nielsen, Oddbjørg Wethelund and Annemette Hammer.



The summer stipendiates. From left to right: Enrique ter Horst, Pavel Gapeev, Peter Tankov, Pierpaolo Montana. Michele Baldini was not present

FUTURE EVENTS

On the following pages you find excerpts of announcements of some forthcoming Maphysto activities. In most cases more information can be found from our web-site.

For a full (and up-to-date) listing we refer you to our web-page

www.maphysto.dk/events/

8-10 January, 2003, University of Copenhagen: Workshop on Dynamical Stochastic Modeling in Biology. www.math.ku.dk/michael/dynbio/

13-17 January, 2003, Sandbjerg Estate: Workshop on Random Matrices and Related Topics. More information can be found from: www.maphysto.dk/events/RandMat2003/

20-21 February, 2003, University of Copenhagen: Workshop organized jointly by Maphysto, CAF and FML on Financial Methods in Insurance. More information can be found from:

www.math.ku.dk/~tmoller/maphysto/

20-22 February, 2003, University of Aarhus: Workshop on Statistical Aspects of Microarray Data. More information can be found from:

www.maphysto.dk/events/MicroArr03/

More information can be found from:

www.maphysto.dk/events/LPS2002/

PERSONALIA

DeGroot Award. Steffen L. Lauritzen has been awarded the DeGroot Award. This prize was established in 2000 in memory of Morris H. DeGroot and was awarded for the first time this year (2002). The award is given as a recognition of a book in the area "Statistical Science". It was emphasized

that the book should be an important, up-to-date, thorough and original contribution to the statistical literature. All categories of books can be considered for the price. Further information on the award is available at <http://www.bayesian.org/awards/DeGrootPrize.html>.

By the first issue of the award the committee was choosing among books published in the period 1996-2000. The choice fell on: Cowell, R. G., Dawid, A. P., Lauritzen, S. L. og Spiegelhalter, D. J. (1999). *Probabilistic Networks and Expert Systems*. Springer-Verlag, New York.

Thiele: Pioneer in Statistics. In October 2002 the book *Thiele: Pioneer in Statistics* was published by Oxford University Press. The book is edited, translated and written by Steffen L. Lauritzen. The book provides an annotated translation into English of T.N. Thiele's (1838-1910) statistical major works, published in Danish in 1880, 1889, and 1899. The book also contains reprints of articles by A. Hald and Steffen L. Lauritzen on Thiele's statistical works and their importance, as well as other biographical information (288 pages.) Further information is available at www.oup.co.uk/isbn/0-19-850972-3.

Humboldt Award. The Alexander von Humboldt Foundation (Germany) has awarded Ole E. Barndorff-Nielsen the Humboldt-Forschungspreis.

Symposium in Honour of Ole E. Barndorff-Nielsen. 16-18 November 2000, University of Aarhus.

On 18 March 2000 Professor Ole E. Barndorff-Nielsen celebrated his 65th birthday, and to honour him on this occasion friends and colleagues from all over the world met in Aarhus in the days 16 - 18 November 2000 for a symposium on themes that are at the centre of his research interests. A second occasion for celebration was that the same year Ole E. Barndorff-Nielsen had been employed at the University of Aarhus for 40 years.

During his scientific career Ole E. Barndorff-Nielsen has played a crucial role in leading Danish statistics in general and the Department of Theoretical Statistics at University of Aarhus in particular to its present high scientific level, not least by his generous support to younger statisticians. In recent years, a main achievement has been the establishment of the Centre for Mathematical Physics and Stochastics, which has strengthened and stimulated Danish applied mathematics in the broad sense. The centre has thrived and attracted much international attention under his dynamic directorship. Ole E. Barndorff-Nielsen has also been a leading figure on the international statistical scene and has had a strong influence on the development of the Bernoulli Society for Mathematical Statistics and Probability; not least in the years 1993 - 1995 when he was the President of the Society, and in the periods when he was the Editor of the journals *International Statistical Review* and *Bernoulli*.

Internationally only few statisticians have over the last 25 years been as productive and as broadly influential as Ole Barndorff-Nielsen. The list of areas to which he has contributed is long and will not be given here. It suffices to mention his work on exponential families, sufficiency and conditional inference, his leading role in the investigation of differential geometric aspects of statistical models, and the three main themes of the symposium: Small sample asymptotics, stochastic modelling in finance and turbulence, and quantum stochastics. In the first of these areas, a central contribution is his formula that approximates the conditional distribution of the maximum likelihood estimator given an ancillary. In the second field, the hyperbolic distributions and their generalizations as well as models based on Lévy processes are at the centre of his work. In recent years Ole Barndorff-Nielsen has turned his interest towards quantum stochastics, where he has for instance been concerned with laser cooling and quantum statistical inference. The

broad scope of his research is perhaps best illustrated by the fact that his name is well-known to researchers in mathematical finance as well as in the physics of wind-blown sand, and his impact on statistical research by the vitality of the Fisherian tradition to which he has contributed in no small measure.

The symposium was a great success and had a pleasant and dynamic general atmosphere. There were many very stimulating scientific talks and lively discussions to which not least Ole Barndorff-Nielsen contributed with his insightful comments and questions. The scientific programme consisted of the following lectures:

S. Asmussen (Lund): Rare events simulation, exponential change of measure and boundaries.

F.E. Benth (Oslo): Optimal portfolio problems in Lévy markets.

B.J. Christensen (Aarhus): Financial risk modelling and inference.

E. Eberlein (Freiburg): Lévy processes in finance.

P. Embrechts (Zürich): Day-to-day risk management: what has mathematics to offer.

R.D. Gill (Utrecht): Quantum information.

P. Jagers (Gothenburg): Growth and extinction.

P.E. Jupp (St. Andrews): Aspects of differential geometry in parametric inference.

B. Jørgensen (Odense): Parameter orthogonality and bias adjustment for estimating functions.

W.S. Kendall (Warwick): Coalescence on the high-dimensional sphere: a caricature for perfect simulation.

C. Klüppelberg (Munich): Limit laws for multivariate exponential families and tail exactness of saddlepoint approximations.

G. Letac (Toulouse): The normal quasi-Wishard distribution.

P. McCullagh (Chicago): What is a statistical model?

T. Mikosch (Groningen, now Copenhagen): Modelling dependence and tails in financial time series.

K. Mølmer (Aarhus): Weak measurements and negative probabilities.

V. Pérez-Abreu (Guanajuato): On the multivariate normal inverse Gaussian distribution.

A. Salvan (Padua) and L. Pace (Udine): On modifications of the profile likelihood.

N. Shephard (Oxford): Econometric analysis of realised volatility and its use in estimating Lévy based non-Gaussian OU type stochastic volatility models.

I. Skovgaard (Copenhagen): Modified residuals in non-linear regression.

W.R. van Zwet (Leiden): Statistics for the contact process.

A.T.A. Wood (Nottingham): Laplace/saddlepoint approximations.

The symposium was organized by Jens Ledet Jensen (University of Aarhus), Eva B. Vedel Jensen (University of Aarhus), and Michael Sørensen (University of Copenhagen) with unfailing secretarial assistance from Oddbjørg Wethelund. The financial support came from three sources: the Danish Science Research Council, the Centre for Analytical Finance, and the Department of Mathematical Sciences at the University of Aarhus. A collection of extended abstracts of the lectures has been published by the Department of Theoretical Statistics, University of Aarhus as volume 16 in the Department's Memoirs Series.

Michael Sørensen



The participants of the Symposium in Honour of Ole E. Barndorff-Nielsen

VISITORS

Below follows the list of visits currently arranged. From the “People” page of www.maphysto.dk you can always find up-to-date information about recent, current and coming visitors at MaPhySto.

Elena R. Loubenets (Technical Univ., Moscow):
Visiting the Aarhus node from
2002/08/05 until 2003/09/01.

Juergen Schmiegel (MPIPKS, Dresden):
Visiting the Aarhus node from
2002/11/03 until 2003/04/31.

Yuri Makeenko (ITEP, Moscow): Visiting
the Copenhagen node from
2002/12/07 until 2003/01/07.

Laszlo Erdos (Georgia Inst. of Techn., Atlanta):
Visiting the Copenhagen node from
2003/01/01 until 2003/03/31.

Neil Shephard (Oxford University):
Visiting the Aarhus node from
2003/01/07 until 2003/01/09.

Victor Perez-Abreu (CIMAT, Mexico):
Visiting the Aarhus node from
2003/01/07 until 2003/01/15.

Jerzy Jurkiewicz (Jagiellonian Univ., Krakov):
Visiting the Copenhagen node from
2003/01/28 until 2003/02/28.

Friedrich Hubalek (TU Wien): Visiting the
Aarhus node from 2003/01/31 until
2003/07/02.

Christoph Boehm (Christian-Albrechts Univ., Kiel):
Visiting the Aarhus node from
2003/02/24 until 2003/02/27.

Carlo Sgarra (Politecnico di Milano):
Visiting the Aarhus node from
2003/03/25 until 2003/05/31.

Alex Novikov (Univ. of Technology, Sydney):
Visiting the Aarhus node from
2003/05/01 until 2003/06/15.

Ken-iti Sato (Nagoya, Japan): Visiting
the Aarhus node from 2003/06/12
until 2003/06/22.

Richard Gill (University of Utrecht):
Visiting the Aarhus node from
2003/07/28 until 2003/08/15.

Peter Jupp (University of St. Andrews):
Visiting the Aarhus node from
2003/07/28 until 2003/08/15.

Albert Shiryaev (Steklov Math. Insit., Moscow):
Visiting the Aarhus node from
2003/08/01 until 2003/08/31.

PUBLICATIONS

Below you will find a list of recent publications from MaPhySto. You may order the publications from MaPhySto or go to the MaPhySto web-page www.maphysto.dk from where you may down-load (most of) the publications mentioned.

Research Reports (ISSN 1398-2699).

2002-44 (December 2002): *Pricing of the American Put Under Lévy Processes* by Sergei Levendorskii.

2002-43 (December 2002):
Pseudo-diffusions and Quadratic Term Structure Models by Sergei Levendorskii.

2002-42 (December 2002): *A discrete time model of investment under non-Gaussian shocks* by Svetlana Boyarchenko, Sergei Levendorskii.

2002-41 (December 2002): *Corrections to Fluid Dynamics* by R.F. Streater.

2002-40 (December 2002): *Local time-decay of solutions to Schrödinger equations with time-periodic potentials* by A. Galtbayar, A. Jensen, K. Yajima.

2002-39 (December 2002): *The Nelson Model with Less Than Two Photons* by A. Galtbayar, A. Jensen and K. Yajima.

2002-38 (November 2002): *A new coherent states approach to semiclassics which gives Scott's correction* by Jan Philip Solovej, Wolfgang L. Spitzer.

2002-37 (November 2002): *Transient properties of many-server queues and related QBD's* by Søren Asmussen, Mats Pihlsgård.

2002-36 (November 2002): *Spiraling attractors and quantum dynamics for a class of long-range magnetic fields* by Horia D. Cornean, Ira Herbst, Erik Skibsted.

2002-35 (October 2002): *A Change-of-Variable Formula with Local Time on Curves* by Goran Peskir.

2002-34 (October 2002): *Directional Analysis of Digitized Planar Sets by Configuration Counts* by Eva B. Vedel Jensen, M. Kiderlen.

2002-33 (October 2002): *Comparative Study of First Touch Digitals: Normal Inverse Gaussian vs. Gaussian Modelling* by Oleg Kudryavtsev, Sergei Levendorskii.

2002-32 (September 2002): *Asymptotic Faithfulness of the Quantum $SU(n)$ Representations of the Mapping*

- Class Groups* by Jørgen Ellegaard Andersen.
- 2002-31 (September 2002): *Automorphism Fixed Points in the Moduli Space of Semistable Bundles* by Jørgen Ellegaard Andersen, Jakob Grove.
- 2002-30 (September 2002): *Bayesian Analysis of Deformed Tessellation Models* by Jesper Møller, Paul G. Blackwell.
- 2002-29 (August 2002): *Van Hove Hamiltonians* (exactly solvable models of the infrared and ultraviolet problem) by Jan Dereziński.
- 2002-28 (August 2002): *Multi-self-similar Markov processes on \mathbb{R}_+^n and their Lamperti representations* by Martin Jacobsen, Marc Yor.
- 2002-27 (July 2002): *On Nonlinear Integral Equations Arising in Problems of Optimal Stopping* by Goran Peskir, J. L. Pedersen.
- 2002-26 (July 2002): *Spectral Theory of Time-Periodic Many-Body Systems* by Erik Skibsted, Jacob Schach Møller.
- 2002-25 (July 2002): *On time-reversibility and estimating functions for Markov processes* by Michael Sørensen, Mathieu Kessler.
- 2002-24 (June 2002): *DT-Operators and Decomposability of Voiculescu's Circular Operator* by Uffe Haagerup, Ken Dykema.
- 2002-23 (June 2002): *Russian and American put options under exponential phase-type Lévy models* by Søren Asmussen, Florin Avram, Martijn R. Pistorius.
- 2002-22 (June 2002): *Martingales and the Distribution of the Time to Ruin* by Martin Jacobsen.
- 2002-21 (June 2002): *Markov Property and Operads* by Rémi Léandre.
- 2002-20 (June 2002): *Positivity Theorem for a Stochastic Delay Equation on a Manifold* by Rémi Léandre.
- 2002-19 (June 2002): *Positivity Theorem without Compactness Assumption* by Rémi Léandre.
- 2002-18 (May 2002): *Shot noise Cox processes* by Jesper Møller.
- 2002-17 (April 2002): *Estimation of the Directional Measure of Planar Random Sets by Digitization* by Eva B. Vedel Jensen, Markus Kiderlen.
- 2002-16 (April 2002): *Geometric Tomography and Local Stereology* by Eva B. Vedel Jensen, R. J. Gardner, A. Volcic.
- 2002-15 (April 2002): *Periodic Ornstein-Uhlenbeck Processes* by Jan Pedersen.
- 2002-14 (April 2002): *Econometric analysis of realised covariation: high frequency covariance, regression and correlation in financial economics* by Ole E. Barndorff-Nielsen, Neil Shephard.
- 2002-13 (April 2002): *The Moment Problem* by Jørgen Hoffmann-Jørgensen.

- 2002-12 (April 2002): *Perfect Independence and Stochastic Inequalities* by Jørgen Hoffmann-Jørgensen.
- 2002-11 (April 2002): *Inhomogeneous Spatial Point Processes by Location Dependent Scaling* by Eva B. Vedel Jensen, Ute Hahn, Marie-Colette Van Lieshout, Linda Stougaard Nielsen.
- 2002-10 (April 2002): *A Clarification about Hitting Times Densities for Ornstein-Uhlenbeck Processes* by Anja Göing-Jaeschke, Marc Yor.
- 2002-9 (March 2002): *An Extension of Seshadri's Identities for Brownian Motion* by Svend Erik Graversen, Raouf Ghomrasni.
- 2002-8 (March 2002): *A Survey and Some Generalizations of Bessel Processes* by Anja Göing-Jaeschke, Marc Yor.
- 2002-7 (March 2002): *Quantum Scattering for Potentials Independent of $|x|$: Asymptotic Completeness for High and Low Energies* by Erik Skibsted, Ira Herbst.
- 2002-6 (March 2002): *Realised power variation and stochastic volatility models* by Ole E. Barndorff-Nielsen, Neil Shephard.
- 2002-5 (March 2002): *Small diffusion asymptotics for discretely sampled stochastic differential equations* by Michael Sørensen, Masayuki Uchida.
- 2002-4 (March 2002): *Inference for observations of integrated diffusion processes* by Michael Sørensen, Susanne Ditlevsen.
- 2002-3 (February 2002): *Bayesian analysis of log Gaussian Cox processes for disease mapping* by Jesper Møller, Viktor Benes, Karel Bodlák, Rasmus Waagepetersen.
- 2002-2 (February 2002): *Perfect simulation and inference for spatial point processes* by Jesper Møller, Kasper K. Berthelsen.
- 2002-1 (February 2002): *Geometric ergodicity of Metropolis-Hastings algorithms for conditional simulation in generalised linear mixed models* by Jesper Møller, O.F. Christensen, R.P. Waagepetersen.
- 2001-46 (December 2001): *Maximum Process Problems in Optimal Control Theory* by Goran Peskir.
- 2001-45 (December 2001): *Perturbation theory of W^* -dynamics, Liouvilleans and KMS-States* by J. Dereziński, V. Jaksic, C.-A. Pillet.
- 2001-44 (December 2001): *On the Oriental Analysis of Boolean Fibres from Digital Images* by Eva B. Vedel Jensen, Salme Kärkkäinen, Dominique Jeulin.
- 2001-43 (December 2001): *Lévy processes and convolution semigroups with parameter in a cone and their subordination* by Jan Pedersen, Ken-Iti Sato.
- 2001-42 (December 2001): *Curvature and Einstein Equation for the Jacobi Group Manifold* by Erik Balslev, Alexei Venkov.
- 2001-41 (November 2001): *Electronic foreign exchange markets and level*

- passage events of multivariate subordinators* by Matthias Winkel.
- 2001-40 (November 2001): *A primer on perfect simulation for spatial point processes* by Jesper Møller, Kasper K. Berthelsen.
- 2001-39 (November 2001): *Lévy Laws and Processes in Free Probability* by Ole E. Barndorff-Nielsen, Steen Thorbjørnsen.
- 2001-38 (November 2001): *Statistical inference for Cox processes* by Jesper Møller, Rasmus P. Waagepetersen.
- 2001-37 (October 2001): *The recovery problem for time-changed Lévy processes* by Matthias Winkel.
- 2001-36 (October 2001): *On Integral Equations Arising in the First-Passage Problem for Brownian Motion* by Goran Peskir.
- 2001-35 (October 2001): *Simulation-based Inference for Spatial Point Processes* by Jesper Møller, Rasmus P. Waagepetersen.
- 2001-34 (October 2001): *Spatial Jump Processes and Perfect Simulation* by Jesper Møller, Kasper K. Berthelsen.
- 2001-33 (October 2001): *No-arbitrage and Completeness for the Linear and Exponential Models based on Lévy Processes* by A. S. Cherny.
- 2001-32 (October 2001): *The Existence and Stability of Noncommutative Scalar Solitons* by Bergfinnur Durhuus, Thordur Jonsson, Ryszard Nest.
- 2001-31 (October 2001): *A note on design-based versus model-based variance estimation in stereology* by Eva B. Vedel Jensen, Asger Hobolth.
- 2001-30 (September 2001): *On a Semilinear Black and Scholes Partial Differential Equation for Valuing American Options. (Part II: Approximate Solutions and Convergence)* by Fred E. Benth, Kenneth H. Karlsen, and Kristin Reikvam.
- 2001-29 (September 2001): *On a Semilinear Black and Scholes Partial Differential Equation for Valuing American Options. (Part I: Viscosity Solutions and Well-Posedness)* by Fred E. Benth, Kenneth H. Karlsen, and Kristin Reikvam.
- 2001-28 (August 2001): *When is a moving average a semimartingale?* by Alexander Cherny.
- 2001-27 (August 2001): *Limit at Zero of the Brownian First-Passage Density* by Goran Peskir.
- 2001-26 (August 2001): *Examples of multivariate diffusions: time-reversibility; a Cox-Ingersoll-Ross type process* by Martin Jacobsen.
- 2001-25 (August 2001): *Statistical inference for transformation inhomogeneous point processes* by Eva B. Vedel Jensen, Linda Stougaard Nielsen.
- 2001-24 (August 2001): *A String Bit Hamiltonian Approach to Two-Dimensional Quantum*

Gravity by Bergfinnur Durhuus,
C.-W. H. Lee.

2001-23 (August 2001): *General Framework for the Behaviour of Continuously Observed Open Quantum Systems* by Ole E. Barndorff-Nielsen, Elena R. Loubenets.

2001-22 (July 2001): *Bayesian inversion of geoelectrical resistivity data* by Martin Bøgsted Hansen, Kim E. Andersen, Stephen P. Brooks.

2001-21 (July 2001): *Hyperbolic Processes in Finance* by Michael Sørensen, Bo Martin Bibby.

2001-20 (July 2001): *Higher order variation and stochastic volatility models* by Ole E. Barndorff-Nielsen, Neil Shephard.

2001-19 (July 2001): *On Quantum Statistical Inference* by Ole E. Barndorff-Nielsen, Richard D. Gill, Peter E. Jupp.

Lecture Notes (ISSN 1398-2702).

No. 13 (September 2002): *Change of Time and Measure for Lévy Processes* by A.S. Cherny, A.N. Shiryaev.

No. 12 (August 2002): *Long Range Dependence, Heavy Tails and Rare Events* by G. Samorodnitsky.

No. 11 (August 2002): *Lectures on Multiscale and Multiplicative Processes in Fluid Flows* by E. Waymire *et al.*

Miscellanea (ISSN 1398-5957).

No. 22 (August 2002): *2nd MaPhySto Conference on Lévy Processes:*

Theory and Applications by Ole E. Barndorff-Nielsen (ed.)

GENERAL INFORMATION ABOUT MAPHYSTO

The Centre for Mathematical Physics and Stochastics — MaPhySto — is a mathematical research centre funded by the Danish National Research Foundation. The Centre came into existence on 1 April 1998 and it is located administratively at the Department of Mathematical Sciences, University of Aarhus. The Scientific Director is *Ole E. Barndorff-Nielsen* and a group of about twenty mathematicians, from the universities of Copenhagen, Odense, Aalborg and Aarhus, are associated with the Centre as “Principal Investigators”. In addition, the Centre comprises a number of “Associated Investigators”.

The main fields of activity of MaPhySto are *Mathematical Physics* (e. g. quantum mechanics, statistical mechanics, quantum field theory) and *Stochastics* (e. g. stochastic analysis, interacting particle systems, stochastic matrices, free probability), with some particular emphasis on the interplay between these two fields. Aspects of *Stochastic Computation*, *Inverse Problems* and *Analytic Number Theory* are also part of the ambit of the Centre.

The personal research of the participating investigators form the backbone of the Centre activities. Based on this, MaPhySto aims to build up knowledge and research in parts of the above-mentioned areas that seem of key importance for future developments in mathematics, whether theoretical or applied. It is sought, in particular, to expand and make more coherent the spectrum of competence represented in mathematics in Denmark.

Concretely, MaPhySto seeks to achieve this through a broad range of activities: short and long term visits by leading international researchers; workshops; conferences; concentrated advanced courses; and summer-schools. Longer lecture series by international or Danish mathematicians are also given.

As an important element in securing a lasting effect of these endeavours the Centre has a number of postdoc positions, that are generally announced internationally via electronic job-advertisement bulletin boards (and of course also via our own web-site).

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