MaPhySto News

This Issue

Introduction

Welcome to the second issue of MaPhySto News. This newsletter reports on recent and forthcoming events at MaPhySto. As may be seen from these reports, the events are to a large extent based on the very active participation of international colleagues. It is a pleasure here to acknowledge this support, which is essential for the life of the Centre. In particular, I wish to thank the lecturers of the various Concentrated Advanced Courses, that form an important element in the overall endeavours of MaPhySto. These courses have all been at the forefront of research, in a variety of fields, and have been excellently presented and well attended by – mostly younger – researchers, from abroad as well as from inside Denmark. Anyone who has given such a course will know that it requires a major investment of time and effort, both in the preparation and in the carrying through.

General information about the Centre is available at the end of the newsletter.

Ole E. Barndorff-Nielsen.

Recent Events

Workshop on Statistical Inference for Stochastic Processes: Theoretical and Computational Aspects.
In the days August 25-29, 1998 a group of 30 researchers from 10 countries met at the Department of Theoretical Statistics, University of Copenhagen for a workshop on the theoretical and computational aspects of statistical inference for stochastic processes organized by Martin Jacobsen and Michael Sørensen. The workshop was sponsored by MaPhySto, the Centre for Analytical Finance and the University of Copenhagen.

FIGURE 1. Albert Shiryaev and Reinhard Höpfner.

The participants, most of whom had never met before, included well known senior researchers like Albert N. Shiryaev (Moscow) and Yacine Ait-Sahalia (Princeton) as well as post docs, Ph.D. students and other young researchers. This blend resulted in a very lively and stimulating week with several high-quality talks and interesting discussions, formal as well as informal. The general atmosphere during the workshop was enthusiastic and relaxed. Main themes were discretely observed continuous

time processes and models from finance. The latter theme was not originally intended, but it is an important area of application for the methods discussed at the workshop to which many researchers now devote a lot of attention.

FIGURE 2. Dean Karl Pedersen's welcome at the centre's inauguration. Sitting from right to left: Peder Olesen Larsen (director of the Danish National Research Foundation), Henrik Tvarnø, Henning Lehmann, Jan Trøjborg and Ole E. Barndorff-Nielsen.

Official inauguration of MaPhySto.
On 16 September 1998 the Centre was officially inaugurated (together with another centre – Center for Metal Catalyzed Reactions, funded by the Danish National Research Foundation).

After a short introduction by Karl Pedersen (Dean of the Faculty of Science) the word was given to Mads Øvlisen (President and CEO, Novo Nordisk). In his speech, Mads Øvlisen stressed the importance of keeping basic research as a national, public duty. Furthermore he seconded the decision of The Danish National Research Foundation to build centres around already strong groups of researchers.

More formal welcomes were then issued by Henning Lehmann (Rector, University of Aarhus), Jan Trøjborg (Minister for Research and Information Technology), Henrik Tvarnø (chairman of the board of the Danish National Research Foundation and Rector, Odense University), and by the directors of the two existing centres at the faculty Glynn Winskel (BRICS) and Jens Ulrik Andersen (ACAP).

After a short coffee-break the centres gave general audience presentations of (some of) the

research taking place at the centres. In Ma-PhySto's case, this consisted of a short general description of the Centre and its participants (given by professor Ole E. Barndorff-Nielsen, Scientific director of MaPhySto) followed by a talk by Professor Eva B. Vedel Jensen with the title "Mathematics, cancer diagnostics and brain research".

The inauguration was rounded off with a small reception.

Concentrated Advanced Course on Stochastic Partial Differential Equations.
In the period September 21-25, 1998 a concentrated advanced course on stochastic partial differential equations was held at the Department of Theoretical Statistics, University of Copenhagen. The lectures were given by Professor Helge Holden from the Norwegian University of Science and Technology, Trondheim, Norway, who is coauthor of a recent book on the subject of the course. One of the other coauthors is Bernt Øksendal (Oslo), who recently gave another concentrated advanced course at MaPhySto.
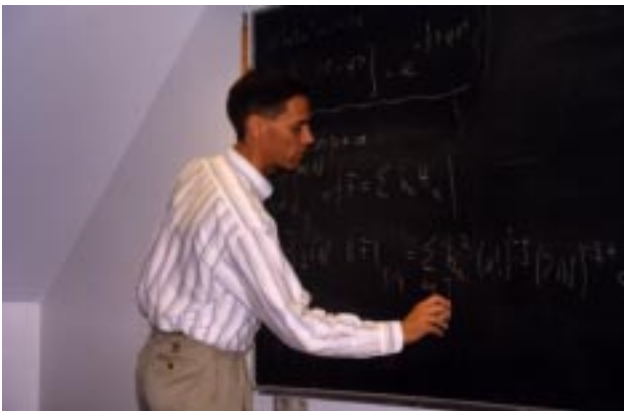

FIGURE 3. Lecturer Helge Holden.

Tutorial classes were held by Fred Esben Benth, who is a post doc at the University of Aarhus. Fred has written a booklet with solutions to the problems, which can be downloaded from the MaPhySto web site. The course was organized by Michael Sørensen and sponsored by MaPhySto. There were 21 participants from 7 countries.

It can safely be said that the course was very successful. The participants learnt a lot and asked many interesting questions that provoked quite a bit of discussion, in particular during the tutorial classes.

FIGURE 4. Yacine Ait-Sahalia (while participating in the Workhop on Statistical Inference).

Workshop on Geometric Scattering.
As part of the activities in Mathematical Physics a narrowly focused workshop on Geometric Scattering was held in Aarhus November 5–7. Geometric Scattering is an approach to (quantum) scattering theory, which combines methods from geometry with methods from (usual) many-body scattering theory, in an attempt to analyze the scattering process in detail. Richard Melrose (MIT) gave a series of three one-hour lectures, introducing the basic concepts, analyzing propagation of singularities, and giving an overview of the metrics to which the methods have been (or can be) applied. András Vasy (Berkeley) gave a series of three lectures, dealing with geometric scattering and the many-body problem, finishing with an analysis of the structure of the scattering matrix for the three-body problem. Maciej

Zworski (Berkeley) also gave a series of three lectures, dealing with a variety of problems, including resonances and pair correlations for phase shifts.

There were two one-hour lectures, on closely related problems, one by P. Perry (Lexington, Kentucky), dealing with examples of isoscattering manifolds, and one by G. Salomonsen (MaPhySto, Aarhus), dealing with η-invariants for manifolds with corners.

The workshop was concluded with a long session on open problems.

There were 20 mostly younger participants in the workshop, from seven different countries.

Extended abstracts have been issued in the publication Miscellanea No. 7 which can be fetched from the MaPhySto web-site.

Graduate Course on Modular forms and Dirichlet Series. In the fall term Professor Alexei Venkov taught this course at the Department of Mathematical Sciences, University of Aarhus.

Graduate Course on Marked Point Processes and Piecewise Deterministic Processes. In the last two months of the fall term Professor Martin Jacobsen visited MaPhySto at the Department of Mathematical Sciences, University of Aarhus and gave this course during his visit.

Study group on Inverse Problems. At Aalborg University the study group on Inverse Problems has continued to have regular meetings once a week. Aalborg has also occasionally invited guest speakers with support from MaPhySto.

FIGURE 5. Most of the participants of the Course on Stochastic Partial Differential Equations.

Concentrated Advanced Course on Queueing Network Theory.
From Tuesday, November 10 to Friday, November 13, Professor Jim Dai (Georgia Institute of Technology) gave a concentrated advanced course on Queueing Network Theory. The course focused in particular on the fluid model approach to studying stability of multiclass networks.

FIGURE 6. Lecturer Jim Dai

Jim Dai, being one of the leading experts in the field, succeeded in bringing the participants (about 20, mostly from Sweden and Denmark) to the forefront of current research in the subject. The lectures were based on parts of a preliminary version of a book on the subject *Brownian models of stochastic processing networks*, being written by Jim Dai, J. Michael Harrison and Ruth J. Williams.

Workshop on Quantum Geometry, Random Matrices, Statistical Models of Strings and Quantum Gravity.
A Workshop on Quantum Geometry, Random Matrices, Statistical Models of Strings and Quantum Gravity was organized at the Niels Bohr Institute, University of Copenhagen, November 26-28th, 1998. The workshop was co-sponsored by the Department of Mathematics, University of Copenhagen, via the SNF-grant *Geometry and Global Analysis*, and by the Niels Bohr Institute.

The workshop dealt with the above-mentioned topics in a broad sense, also emphasizing the newest developments in theoretical physics, i.e. M-theory and M(atrix) theory, although these were not explicitly mentioned in the title of the workshop.

The program and abstracts from the Workshop can be found in the note Miscellanea No. 8.

A short Workshop on Geometric and Microlocal Analysis. On January 21-23, 1999 this workshop took place at the Department of Mathematics, University of Copenhagen. The workshop was organized by G. Grubb and J. P. Solovej and co-sponsored by MaPhySto and by the The Danish Natural Science Research Council.

Thematic Period on Lévy Processes, Product Integrals and Pathwise Integration.
Report by Thomas Mikosch and Ken-iti Sato

The MaPhySto Centre started the 1999 year with various exciting events. The first two of them were devoted to product and pathwise integration. Professors R. Dudley (MIT) and R. Norvaiša (Academy Vilnius) gave a Concentrated Advanced Course (CAC) on this topic. They also provided extensive notes which contain supplementary new material to their book on the same topic. The latter is to appear as a volume of Springer Lecture Notes. Both references will definitely become standard in the nearest future.

The Workshop following the CAC was closely related to various non-standard integration techniques in probability and statistics. About 40 participants discussed results of their recent research, including applications of the product integral in statistics (Kaplan-Meier estimator), various new types of (non-Itô type) stochastic integrals (allowing for the integration of non-predictable processes or with respect to non-semimartingales), numerical solutions to stochastic differential equations,

and applications in finance. The CAC and the Workshop showed us the advantages, but also the limitations of the pathwise approach to stochastic integration. There was general agreement on the fact that all the different approaches to stochastic integration have their merits and that one has to decide in dependence on the problem to be solved which method is most appropriate.

The main event in January was certainly the Conference on Lévy Processes (18-22 January) with about 50 participants. The list of registered researchers on the MaPhySto webpage reads like the "Who-Is-Who in Stochastic Processes".

Lévy processes have attracted the attention of mathematicians for many years. There is no doubt that Brownian motion has been the most important and most familiar member of the Lévy family. But the main emphasis of the Conference was on non-continuous Lévy processes. Our knowledge about the theoretical properties of special processes (such as stable or hyperbolic Lévy motion) is very good.

However, these processes were mostly treated because of their "mathematical beauty".

FIGURE 7. Coffee break during the workshop. From left to right: Richard M. Dudley, Richard Gill, Rudolf Grübel and Thomas Mikosch.

About half of the contributions to the Conference was still devoted to purely theoretical problems, but the other half treated applications in various fields, in particular physics and finance.

FIGURE 8. About half of the participants dared to join the excursion into the woods south of Århus

FIGURE 9. After a short, although a bit slippery, walk to the beach and back, the "hikers" had their well-earned coffee and cake ("boller" and "kringle") at *Restaurant Skovmøllen*.

Recently Lévy processes more general than stable processes have found an enormous theoretical interest and also a multitude of practical applications. The development of computers has had a great impact on this new interest: one can make paths of such processes visible and study their path and distributional properties by Monte-Carlo techniques. The jump character of the paths of Lévy processes makes them very attractive for modelling turbulence or extreme changes in the stock market. This view has been propagated by Prof. Ole Barndorff-Nielsen for many years, and the Conference was certainly the first major scientific event where experts from Lévy processes, self-similar, self-decomposable and infinitely divisible processes could present a picture of the state of the art.

As usual for any event at the MaPhySto Centre, the scientific highlights were accompanied by sight-seeing, excursions and dinners which made the participants feel to be very much welcome in Aarhus. The organisation was perfect, although an improvement on the weather seems possible.

Many thanks to Ole E. Barndorff-Nielsen, Oddbjørg Wethelund and Søren Have Hansen for organising these events. January was a great success for MaPhySto.

Aarhus, 22 January, 1999

Thomas Mikosch   Ken-iti Sato
University of Groningen   University of Nagoya.

Editorial remark: It should also be said that from both the workshop and from the conference there will appear mini-proceedings volumes in the Miscellanea series.

Furthermore MaPhySto will try to maintain an updated bibliography of works on or related to Lévy processes. This can be found from
www.maphysto.dk/events/LevyProc/

FUTURE EVENTS

The list below is taken from our web-page `www.maphysto.dk/events/` listing events where (at least) the dates and main content have been fixed. From the above-mentioned web-page you may find more information on each of the events.

22-26 February 22-26, 1999: **University of Aarhus:** *Concentrated Advanced Course on Stochastic Simulation.* **Lectures by S. Asmussen.**

22-24 April, 1999: **University of Aarhus: First MaPhySto Workshop on Inverse Problems:** *Inverse Problems in Stratified Media* **Confirmed speakers include: V. Enss, A. Nachman, J. Ralston, D. Sinoquet and E. Clévédé.**

5-7 May, 1999: **University of Aarhus:** *Workshop on Turbulence and Finance.*

17-22 May, 1999: **University of Odense:** *Concentrated Advanced Course on Free Probability.* **Lectures by U. Haagerup and K. Dykema.**

9-20 August, 1999: **University of Aarhus:** *Summerschool on Empirical Processes.* **Lectures by R. M. Dudley, A.W. Van der Vaart, J.A. Wellner, P. Gänssler, J. Hoffmann-Jørgensen plus invited guest speakers.**

21-26 October, 1999: **University of Aarhus:** *Workshop on Stochastics and Quantum Physics.* **Confirmed speakers include: A. Barchielli, F. Bardou, V.P. Belavkin, H. Carmichael, R.D. Gill, P. Høyer, A.S. Holevo, U. Haagerup, G. Lindblad,**

H. Maassen, G. Mahler, S. Massar, S. Popescu and B. Øksendal.

PERSONNEL NEWS

Kostantinous Anagnostopoulos.
For the period January 1, 1999 and half a year onwards, Kostantinous Anagnostopoulos has been appointed research assistant professor (postdoc) at the Niels Bohr Institute with funding from MaPhySto. Together with Jan Ambjørn at NBI he is currently working on determining both the Hausdorff and the spectral dimension in four-dimensional quantum gravity models.

Current and Future Guests.

Wolfgang Spitzer (EU postdoc, Copenhagen): **In Copenhagen until 1999/08/31.**

Søren Asmussen (Lund): **Visiting from 1999/01/01 until 1998/02/28.**

Karsten Prause (Freiburg): **Visiting from 1999/01/04 until 1999/02/26**

Jan Dereziński (Warsaw University): **Visiting from 1999/01/19 until 1999/02/20.**

Victor Perez-Abreu (CIMAT, Mexico): **Visiting from 1999/02/15 until 1999/02/26.**

Mykola Leonenko (Kiev University): **Visiting from 1999/04/26 until 1999/05/24.**

Peter E. Jupp (St Andrews, Scotland): **Visiting from 1999/09/25 until 1999/12/31.**

<center>PUBLICATIONS</center>

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).

1999-7 (February 1999): *Asymptotic normality of the maximum likelihood estimator in state space models* by Jens Ledet Jensen, Niels Væver Petersen.

1999-6 (January 1999): *Parameter identification for stochastic Burgers flows via parabolic rescaling* by Nikolai N. Leonenko, Wojbor A. Woyczynski.

1999-5 (January 1999): *On the ruin problem for some adapted premium rules* by Søren Asmussen.

1999-4 (January 1999): *Stability of Character Resonances* by Erik Balslev, Alexei Venkov.

1999-3 (January 1999): *Spectral theory of Pauli-Fierz Hamiltonians I.* by Jan Derezinski, Vojkan Jaksic.

1999-2 (January 1999): *Superposition of Ornstein-Uhlenbeck Type Processes* by Ole E. Barndorff-Nielsen.

1999-1 (January 1999): *Phillips-Sarnak's conjecture for $\Gamma_0(8)$ with primitive character* by Erik Balslev, Alexei Venkov.

1998-34 (December 1998): *Higher Skein Modules* by Jørgen Ellegaard Andersen, Vladimir Turaev.

1998-33 (December 1998): *Connected Correlators in Quantum Gravity* by Jan Ambjørn, P. Bialas, J. Jurkiewicz.

1998-32 (December 1998): *Spectral and scattering theory of spatially cut-off $P(\varphi)_2$ Hamiltonians* by J. Derezinski, C. Gérard.

1998-31 (December 1998): *Non- and semi-parametric estimation of interaction in inhomogeneous point patterns* by Jesper Møller, Adrian Baddeley, Rasmus Waagepetersen.

1998-30 (November 1998): *White noise generalizations of the Clark-Ocone theorem with application to mathematical finance* by Knut Aase, Bernt Øksendal, Jan Ubøe.

1998-29 (November 1998): *Solution of the Bayesian Sequential Testing Problem for a Poisson Process* by Goran Peskir, Albert N. Shiryaev.

1998-28 (November 1998): *On a connection between singular stochastic control and optimal stopping* by Fred Espen Benth, Kristin Reikvam.

1998-27 (November 1998): *Discretely observed diffusions: classes of estimating functions and small $Delta$-optimality* by Martin Jacobsen.

1998-26 (October 1998): *Four-dimensional gonihedric gauge spin system* by Jan Ambjørn, G. Koutsoumbas, G. K. Savvidy.

1998-25 (October 1998): *Thermodynamics of D0-branes in matrix theory* by Jan Ambjørn, Y. M. Makeenko, G. W. Semenoff.

1998-24 (October 1998): *On the asymptotic exactness of Thomas-Fermi theory in the thermodynamic limit* by Jan Philip Solovej, Pedro Balodis Matesanz.

1998-23 (September 1998): *Simplified Estimating Functions for Diffusion Models with a High-dimensional Parameter* by Michael Sørensen, Bo Martin Bibby.

1998-22 (September 1998): *An extension of P. Lévy's distributional properties to the case of a Brownian motion with drift* by Svend Erik Graversen, Albert N. Shiryaev.

1998-21 (September 1998): *On the scattering operator for the Schrödinger equation with a time-dependent potential* by Arne Jensen.

1998-20 (September 1998): *On arbitrage and replication for fractal models* by Albert N. Shiryaev.

1998-19 (September 1998): *Exact Distributional Results for Random Resistance Trees* by Ole E. Barndorff-Nielsen, Tina Hviid Rydberg.

1998-18 (September 1998): *Incorporation of a Leverage Effect in a Stochastic Volatility Model* by Ole E. Barndorff-Nielsen, Neil Shephard.

1998-17 (September 1998): *On weighted $L^2(\Omega)$-Spaces, their Duals and Ito Integration* by Fred Espen Benth.

1998-16 (August 1998): *Nonparametric Bayes inference for concave distribution functions* by Martin Bøgsted Hansen, Steffen L. Lauritzen.

1998-15 (August 1998): *Space-time multi type log Gaussian Cox processes with a view to modeling weed data* by Jesper Møller, Anders Brix.

1998-14 (August 1998): *Random Matrices and K-theory for Exact C*-algebras* by Uffe Haagerup, S. Thorbjørnsen.

1998-13 (August 1998): *An Example of Non-Attainability of Expected Quantum Information* by Ole E. Barndorff-Nielsen, R. D. Gill.

1998-12 (August 1998): *Euclidean and Lorentzian Quantum Gravity – Lessons from Two Dimensions* by Jan Ambjørn, R. Loll, J.L. Nielsen, J. Rolf.

1998-11 (July 1998): *The Malliavin Derivative of Generalized Random Variables* by Fred Espen Benth.

1998-10 (August 1998): *Quantum Geometry and Diffusion* by Jan Ambjørn, K. N. Anagnostopoulos, T. Ichihara, L. Jensen, Y. Watabiki.

1998-9 (June 1998): *Inhomogeneous Markov point processes by transformation* by Eva B. Vedel Jensen, Linda Stougaard Nielsen.

1998-8 (June 1998): *NBI Matrix Model of IIB Superstrings* by Jan Ambjørn, L. Chekhov.

1998-7 (May 1998): *Perfect simulation of conditionally specified models* by Jesper Møller.

1998-6 (May 1998): *Maximal Inequalities for the Ornstein-Uhlenbeck Process* by Svend Erik Graversen, Goran Peskir.

1998-5 (May 1998): *Non-perturbative Lorentzian Quantum Gravity, Causality and Topology Change* by Jan Ambjørn, R. Loll.

1998-4 (May 1998): *Random Matrices with Complex Gaussian Entries* by Uffe Haagerup, Steen Thorbjørnsen.

1998-3 (May 1998): *Extensions of Fill's algorithm for perfect simulation* by Jesper Møller, Katja Schladitz.

Lecture Notes Series (ISSN 1398-2702).

No. 1 (December 1998): *An introduction to p-variation and Young integrals* by R. M. Dudley, R. Norvaiša.

Miscellanea (ISSN 1398-5957).

No. 10 (January 1999): *Mini-proceedings from the Workshop on Product Integrals and Pathwise Integration* (January 11-13, 1999) by Ole E. Barndorff-Nielsen and Thomas Mikosch (eds.).

No. 9 (January 1999): *Stability of Fluid and Stochastic Processing Networks* by J. G. "Jim" Dai.

No. 8 (December 1998): *Report on Workshop on quantum geometry, random matrices, statistical models of strings and quantum gravity* by J. Ambjørn, B. Durhuus and J.P. Solovej (eds.).

No. 7 (December 1998): *Report on Workshop on Geometric Scattering* by Arne Jensen and Erik Skibsted (eds.).

No. 6 (October 1998): *Concentrated Advanced Course on Stochastic Partial Differential Equations* (Exercises and Solutions) by Fred Espen Benth.

No. 5 (September 1998): *Abstracts from the Workshop on statistical inference for stochastic processes: theoretical and computational aspects* by M. Jacobsen and M. Sørensen (editors).

No. 4 (August 1998): *Number Theory and Spectral Theory* by Erik Balslev.

No. 3 (August 1998): *Abstracts from the Mini-workshop on Stochastics* (August 4-6, 1998, University of Aarhus) by Ole E. Barndorff-Nielsen (ed.).

No. 2 (July 1998): *On asymptotics of estimating functions* by Michael Sørensen.

Books. We would also like to draw your attention to the fact that the proceedings volume *Geometry in Present Day Science* (Proceedings of the Conference, University of Aarhus, Denmark 16–18 January 1998), edited by Ole E Barndorff-Nielsen and Eva B Vedel Jensen is now available from World Scientific Publishers. The proceedings volume focusses on the applications of geometry in present day science. It contains contributions from a variety of fields, including biology, computer science, mathematics, medicine, physics and stochastics.

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, interactive 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-advertisment bulletin boards (and of course also via our own web-site).

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