Preface

The Fifth European Congress of Mathematics (5ECM) took place from July 14–18, 2008 in the RAI Convention Center Amsterdam. It was organized by the Centrum Wiskunde en Informatica Amsterdam, the University of Amsterdam, and the VU University Amsterdam, under auspices of the European Mathematical Society. Included in this congress was the 44th Nederlands Mathematisch Congres, the yearly congress of the Royal Dutch Mathematical Society (KWG). 5ECM stood under the special patronage of the KWG. Previous European Congresses of Mathematics were held in Paris (1992), Budapest (1996), Barcelona (2000), and in Stockholm (2004).

About 1000 mathematicians from 68 different countries attended the congress.

The first of ten plenary lectures, to get the congress started, was delivered by Richard Taylor. As all the other plenary lecturers, he did a wonderful job of explaining his work to a general mathematical audience. Another major item on the programme were three science lectures. These lectures outlined applications of mathematics in other sciences. Mathematical modeling plays a crucial role in predicting climate change, as was stressed by Tim Palmer (European Centre for Medium Range Weather Forecasts). He also outlined what would be necessary to improve on the current state of affairs in the mathematical modeling to obtain predictions on a finer scale than is possible at the moment. Ignacio Cirac (Max Planck Institute für Quantenoptik) discussed quantum information theory, and the challenges in this area. The third science lecture was given by Jonathan Sherratt (Heriot-Watt University) who talked about the latest developments in mathematical modeling for population dynamics. Thirty-three invited lectures were presented in sessions of four or five parallel talks.

As in the four preceding EMS congresses, ten EMS prizes were given to young researchers, not older than 35 years, who had been selected by a Prize Committee appointed by the EMS. In addition, the Felix Klein Prize was awarded for the second time, jointly by the EMS and the Institute for Industrial Mathematics in Kaiserslautern, for an application of mathematics to a concrete and difficult industrial problem.

There were twenty-two minisymposia, spread over the whole mathematical area. These minisymposia played a role in attracting people to the ECM meeting that would otherwise perhaps not have come to such a broad mathematics congress. The organizers are grateful to the organizers of the minisymposia for their valuable help.

Two Round Table meetings were organized: one on Industrial Mathematics and one on Mathematics and Developing Countries.

As part of the 44th Nederlands Mathematisch Congres, the so-called Brouwer lecture was given, by Phillip Griffiths of IAS Princeton. The Brouwer lecture is or-

ganized every three years by the KWG. The Brouwer lecturer receives a gold medal commemorating the Dutch mathematician L. J. Brouwer. The Brouwer lecture with the Brouwer medal is The Netherlands' most prestigious award in mathematics. Information about Brouwer was given by Dirk van Dalen in an invited historical lecture during the congress. Other parts of NMC44 were the 9th Beeger lecture by Dan Bernstein of the University of Illinois at Chicago (organized once every two years to commemorate the Dutch number theorist N. G. W. H. Beeger and sponsored by CWI Amsterdam) and the third Philips PhD prize lectures for Dutch PhD students (sponsored by Philips Eindhoven and this time won by Erik Jan van Leeuwen of CWI Amsterdam).

These proceedings present extended versions of nineteen of the invited talks which were delivered during 5ECM. We are grateful to the authors for their contributions and to the following referees: Keith Ball, Henk Broer, Arjeh Cohen, Gerard van der Geer, Robbert Dijkgraaf, Klaas Landsman, Eduard Looijenga, Terry Lyons, Yvan Martel, Andrzej Pelczar, Nicolai Reshetikhin, David Riley, Benjamin Rossman, Marta Sanz-Solé, Floris Takens, Constantin Teleman, Rob Tijdeman, Bruno Vallette, and Don Zagier.

A congress of this size is impossible to organize without generous financial support from the government, businesses and industry, and the local mathematical community. The full list of subsidy-providers and sponsors is given in the section Sponsors of these Proceedings. Although all subsidy-providers and sponsors are equally appreciated, we like to single out the most important ones here. The largest single subsidy was provided by NWO, the Netherlands Organization for Scientific Research. Biggest sponsors were Foundation Compositio Mathematica and ING Corporation.

The editors

André Ran
Herman te Riele
Jan Wiegerinck

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Opening Ceremony

The 5ECM attendants were first welcomed by André Ran, chairman of the 5ECM Organizing Committee. Following this, a spectacular *tableau vivante* of Rembrandt's most famous painting "The Nightwatch" from 1642 was built up on the stage, accompanied by rolls of drum from the drummers in the painting. Next, Robbert Dijkgraaf, president of the Royal Netherlands Academy of Arts and Sciences, Amsterdam, stepped out of this *tableau*, dressed in mediaeval costume, to give the official opening address to the congress. Finally, Ari Laptev, president of the European Mathematical Society, welcomed the attendants on behalf of the EMS.

Welcome Address by André Ran, Chairman of the Organizing Committee of 5ECM

Ladies and gentlemen, it is my great pleasure to welcome you all to Amsterdam to enjoy this special mathematical event. For The Netherlands it was an honour to be selected for the fifth European Congress of Mathematics, and many people within the Dutch mathematical community have worked hard to prepare for you a special congress. As a matter of fact, preparations for this congress started as early as 2001, so we have been at it for almost seven years. We hope the week will be a successful event for all of you, and that all of you will come away from this congress with the feeling that you have learned something new. Above all, we hope you will have an enjoyable week in Amsterdam.

We know that the mathematical events here at the RAI will have to compete with a wonderful city and its surrounding countryside. However, since you are all mathematicians we hope that the math will win from interesting sites like the museums like a boat tour on the canals, or a walk in the city streets.

I would like to take this opportunity to thank all those who supported us financially, via subsidies, via sponsoring, or via gifts. There are too many to name them all. However, I want to name just a few and then show the complete list, which you can also find in your programme on page 2.

The first organization I want to single out is the most important one for us. The Netherlands Organization for Scientific Research provided us with a very substantial subsidy. As a matter of fact, about 1/5 of the total budget was covered from this subsidy. Without their support the congress would not have been possible in Amsterdam.

NWO is investing in mathematics in terms of money, but also in terms of ensuring that the knowledge generated through its initiatives is disseminated and utilised. Since science knows no borders, NWO also is looking across the national border, mainly aiming to increase cooperation in Europe. The development of the European Research

Area is seen as a key element in this. Apart from this NWO cooperates and maintains contacts with Russia, Asia, Africa and America. Representatives of NWO will be around during the congress, and are more then willing to discuss with you. I would like to ask you all to show your appreciation to them in a round of applause.

Other subsidies were donated by many organizations, a full list can be found in your programme book.

There were also many companies who sponsored us with substantial amounts. For most of those you will find an item in your congress bag, or an advertisement in the program, or just read the label on the water bottles that will be distributed during the conference. Their logos can also be found on our website, and just clicking on those will get you to the website of the company.

Other companies, like ING Bank, even have a stand, and have representatives here at the congress. Again, may I ask you to show your appreciation by a round of applause?

Finally, we received gifts from several companies, organizations and private individuals, and important guarantee subsidies from several organizations. These too are of course highly appreciated.

Important support in terms of money, manpower, moral support, and help in the organization was received from the Dutch mathematical community and the Koninklijk Wiskundig Genootschap. Mathematicians from all over the country helped us by being chairs of committees, organizing mini-symposia or helping out with many trivial matters. People from almost all universities in the Netherlands were involved in the organization in one way or another. Without them it would have been impossible to organize this event.

Before I give the floor to the President of the Royal Netherlands Academy of Arts and Sciences, Professor Robbert Dijkgraaf, for the official opening of this congress, I would like to draw your attention to the screen: to save you a trip to the Rijksmuseum, we have already given you a taste of what is undoubtedly the most famous 17th century Dutch painting: the "Nightwatch" by Rembrandt.

Opening Address by Robbert Dijkgraaf, President of the Royal Netherlands Academy of Arts and Sciences, Amsterdam

Distinguished Guests, Fellow Mathematicians, Ladies and Gentlemen,

It is a great privilege and a real pleasure to welcome you to Amsterdam and the fifth European Congress of Mathematics on behalf of the Dutch scientific community in general and the Royal Netherlands Academy of Arts and Sciences in particular.

Given this embarrassing grand entrance, I feel it is appropriate to say a few words on the relation between mathematics and the arts from a historical perspective.

This year the Academy celebrates its bicentenary. It is among the oldest royal institutions of the Netherlands, even antedating the Kingdom of the Netherlands by

The Nightwatch, 1642
Rembrandt van Rijn (1606–1669)
Rijksmuseum Amsterdam

seven years. This mathematical paradox is resolved by the fact that the Academy was founded during the French occupation by a different King of Holland, Louis Napoléon Bonaparte, brother of the French emperor. Louis Napoléon was a somewhat tragic figure, rather unhappy in gloomy and cold Amsterdam, mostly vacationing in the sunny south of France. Yet he bravely tried to master the Dutch language, making himself rather infamous by pronouncing his title of King of Holland consistently as something that translates into English as 'rabbit of Olland'.

The Academy was founded along the French model as the Royal Institute of Science, Letters and Fine Arts. Painters, writers and composers were elected among its first members. Ludwig van Beethoven was a foreign member, as was the French painter Jacques-Louis David. The magnificent 17th century lodgings of the Academy, the Trippenhuis in the historic centre of Amsterdam also known as the small Royal Palace, was for a long time home to the Rijksmuseum. Rembrandt's masterpiece 'de Nachtwacht', that has just materialized before your eyes, was for many years exhibited in our Great Hall. But both the artists and the paintings left the Academy in 1851 when our government in the spirit of that time judged them of little practical use for science.

The Rembrandt Nightwatch tableau with Robbert Dijkgraaf addressing the audience

In the early nineteenth century the bond between science and art was thought to be much more self-evident, although one can wonder for the right reasons. In these days it was argued that scientists should be foremost eloquent and artists should be learned and academic. That attitude was demonstrated by one of the founding fathers of the Royal Academy, the mathematician Jan Hendrik van Swinden, professor at the University of Amsterdam and chair of the international committee defining the metric units, in which capacity he addressed the National Congress in Paris on the 4th of July 1799. He was eloquent in both old and new languages, always speaking with the required 'genteel appearance and civilized posture' and 'without a single letter in writing before him.'

That not all mathematicians could rise to the standard of Van Swinden, now and two hundred years ago, becomes clear from a contemporary description of a mathematician as in general 'stiff, dull, pale and drawn, also in domestic circles, where even the gentle words of a loving spouse or the flattering of precious children could not bring life into his frigid countenance.' 'The mathematician views a lovely landscape with the cold eyes of a land surveyor.'

Ladies and Gentlemen, the last time that the Netherlands saw such a distinguished gathering of mathematicians was the year 1954 when Amsterdam hosted the International Congress of Mathematicians. I am happy to see quite a few distinguished guests present today who attended that Congress as students or young and upcoming professors. This reminds us of the strong historical bonds in mathematics, where

only a few degrees of separation connect us all to the grand historical figures. For example, Sir Michael Atiyah recently told me how the ICM in Amsterdam was his first visit abroad as a graduate student and how at that time he was looking forward with great expectations to hear the lectures of Hermann Weyl and John von Neumann. His fellow student at that time, Sir Roger Penrose attended, as many other participants, a reception in the Stedelijk Museum where a small exhibition was organized around an unknown Dutch graphic artist by the name of M. C. Escher. As one says: the rest is history. Penrose subsequently wrote a paper with his father, the distinguished geneticist Lionel Penrose, introducing Escher's impossible figures to the world. One of the remarkable side-effects of the ICM has been the interactions between Escher and mathematicians from all over the world leading to many new pieces of art and many new mathematical ideas.

Ladies and Gentlemen, the ECM is a wonderful initiative of the European Mathematical Society that brings the best of mathematics together. Viewed from a historical perspective this Congress is a remarkable illustration of the rapid growth of mathematics, the diverse spectrum of interactions touching more and more fields in science and applications in society. At the same time it is a testament to the unity of mathematics. The Dutch mathematical community has to be praised for their efforts to host this prestigious congress and for carrying a large share of the financial burden. The unity of mathematics is further enhanced by the incorporation of the Dutch Mathematical Congress within the ECM, this despite the earlier Dutch rejection of the European constitution. Indeed, this congress reminds us of the special role of the Netherlands and Amsterdam through the centuries as a place of scientific diplomacy and cooperation, both within Europe and the world.

With these thoughts I am happy to give the word to the President of the European Mathematical Society, Professor Ari Laptev.

Thank you and enjoy these days in Amsterdam.

Welcome Address by Ari Laptev, President of the European Mathematical Society

Ladies and gentlemen,

It is a great pleasure for me to welcome you all to the Fifth European Congress of Mathematics here in this culturally rich city of Amsterdam and I am delighted to see so many participants.

The Programme Committee has worked hard to provide us with an exciting week of distinguished lectures that I am sure we will find stimulating, challenging and enjoyable.

The 5th European Congress of Mathematics is, without doubt, the main mathematical event of the year 2008. It enables mathematicians from all over the world to meet their fellow colleagues, some of whom they might otherwise never have the

chance to meet. Such Congresses also provide opportunities for interaction between different areas of mathematics which often leads to new exciting development of sometimes completely new areas of mathematics.

Mathematics is a very dynamic subject that has a growing number of applications in both traditional and new areas such as environmental science, biology, medicine, finances and telecommunication. The present impressive technological development is unthinkable without the new discoveries in Mathematics made during the last decades.

The European Mathematical Society, founded in 1990, together with the National European Mathematical Societies play an increasingly important role in promoting Mathematical Science in Europe.

In a few moments the names of the ten EMS Prize Winners will be announced. These brilliant young European mathematicians have already made substantial contributions in different areas of our beautiful subject and we thank the Prize Committee for their excellent choices.

Finally on behalf of all the Congress participants I would like to congratulate the 5ECM organizers on their committed work and for making this event possible.

And lastly I would like to express our gratitude to all the sponsors without whom this Congress would not be possible. We are very grateful to all funding agencies supporting the Congress, in particular, the Royal Dutch Mathematical Society for their involvement in organizing this event.

Prize Ceremony

Ten *EMS prizes* were awarded during 5ECM by the European Mathematical Society in recognition of distinguished contributions in Mathematics by young researchers not older than 35 years. The EMS prizes are presented every four years at the European Congress of Mathematics.

The Prize Committee was appointed by the EMS and consisted of fifteen recognized mathematicians from a wide variety of fields (listed in the section Committees). The prizes were first awarded in Paris in 1992, followed by Budapest in 1996, Barcelona in 2000, and Stockholm in 2004. During 5ECM in Amsterdam, the prizes were awarded after the Opening Ceremony on July 14, 2008. Each prize winner received 5,000 Euro.

The prize money for the EMS Prizes was generously made available by the Dutch Foundation Compositio Mathematica.

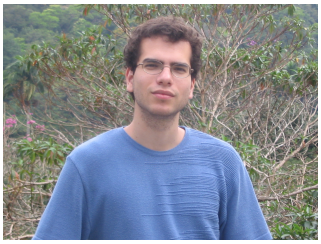
The *Felix Klein Prize* has been established by the European Mathematical Society and the endowing organization: the Institute for Industrial Mathematics in Kaiserslautern. It is awarded to a young scientist or a small group of young scientists (normally under the age of 38) for using sophisticated methods to give an outstanding solution to a concrete and difficult industrial problem, which meets with the complete satisfaction of industry. The Prize is presented every four years at the European Congress of Mathematics. The prize committee consisted of six members appointed by agreement of the EMS and the Institute for Industrial Mathematics in Kaiserslautern (listed in the section Committees). The first prize was presented at 3ECM in Barcelona to David C. Dobson. During 4ECM in Stockholm, no Felix Klein Prize was awarded.

The eleven Prize Winners are listed below. Two of the EMS Prize winners, Artur Avila and Laure Saint-Raymond, were invited by the 5ECM Scientific Committee to present an Invited Lecture, before they were selected as Prize Winner by the Prize Committee.

The Prize Ceremony during 5ECM was chaired by the Chair of the EMS prize Committee Rob Tijdeman.

The Prize Winners

Artur Avila



Full name: Artur Avila Cordeiro de Melo, born: June 29, 1979; citizenship: Brazilian; Ph.D.: IMPA Rio de Janeiro, Brazil; presently: Clay Mathematics Institute, Paris 6, France and IMPA, Rio de Janeiro, Brazil.

Artur Avila has obtained many important results in dynamical systems, especially in the theory of iterated rational maps and the Teichmüller geodesic flow. Several of them provide the final solution to longstanding and major problems, for example: his proof with Lyubich that there are infinitely renormalizable Julia sets in the quadratic family $f(z) = z^2 + c$ with Hausdorff dimension strictly less than 2, his proof with Jitomirskaya of the "ten Martini Conjecture" of B. Simon, his proof with Viana of the Kontsevich–Zorich conjecture on simplicity of the Lyapunov spectrum for the Teichmüller geodesic flow, his proof with Forni that almost every interval exchange which does not have the combinatorics of a rotation is weakly mixing and his proof with Gouëzel and Yoccoz of exponential mixing for the Teichmüller flow. He is internationally recognized as a leader of research in these areas.

Alexei Borodin

Born: June 25, 1975; citizenship Russian; Ph.D.: University of Pennsylvania, U.S.A. 2001; presently: CalTech, Pasadena, U.S.A.

Alexei Borodin has made substantial contributions to the representation theory of "big" groups, to combinatorics, interacting particle systems and random matrix theory. A key observation of Borodin and Olshanski in the representation theory of big groups is that the irreducible characters for the group are associated with stochastic point processes. Borodin found a determinantal formula for the correlation functions of the so-called generalized regular representation of the infinite symmetric group and, with Olshanski, also of the unitary group. A stunning consequence of his work is one of the first proofs of a conjecture of Baik, Deift and Johansson in Combinatorics. In later work Borodin analyzed the irreducible character associated with the

generalized regular representation. Borodin and his collaborators also developed a radical new approach for analyzing totally antisymmetric simple exclusion processes. Equally remarkable is his work on isomonodromy transformations of linear systems of difference equations and his solution of a problem of Widom on the spectrum of some matrix. Borodin is a brilliant mathematician.

Ben Green

Full name: Ben Joseph Green, born: February 27, 1977; citizenship: British; Ph.D.: University of Cambridge, 2002; presently University of Cambridge, England.

Ben Green is best known for his celebrated result with Terence Tao that there exist arbitrarily long arithmetic progressions of primes. Some basic ideas for the proof can already be found in the earlier work of Green. Therein he proved that every relative dense subset of the primes contains an arithmetic progression of length 3. In another paper he improved a result of Bourgain on the sumset of two dense subsets of an interval. Where Bourgain obtained a lower bound 1/3 in the exponent and Ruzsa an upper bound 2/3, Green got a lower bound 1/2. One of the essential steps in the proof of the famous result with Tao is the discovery by Green that the work of Goldston and Yildirim on short intervals between primes provided precisely the "random-like" superset of the primes that they needed. After their proof Green and Tao have continued their investigations. This has allowed them to give an asymptotic for how many progressions of length 4 there are in the primes up to N. By now Green has a string of highly impressive results.

Olga Holtz

Name: Olga V. Holtz; born: August 19, 1973; citizenship: Russian; Ph.D.: University of Wisconsin-Madison, 2000; presently: Technische Universität Berlin, Germany, and University of California-Berkeley, U.S.A.

Olga Holtz has made substantial contributions to several mathematical areas including algebra, numerical linear algebra, approximation theory, theoretical computer science and numerical analysis. Some of these are spectacular results such as the proof of the

Newton inequalities for M-matrices, the fundamental work on accurately evaluating polynomials in finite arithmetic and the proof that all group theory based fast matrix multiplication methods are numerically stable. These are not only very strong results in theoretical computer science that may have a fundamental impact on computational methods of the coming years, but they also required very deep mathematical theory in the context of finite group theory. Her new work on zonotopal algebra is a substantial contribution to combinatorial commutative algebra. Olga Holtz is a mathematician who truly transcends the traditional boundaries of applied versus pure mathematics.

Bo'az Klartag

Born: April 25, 1978; citizenship: Israeli; Ph.D.: Tel-Aviv University, 2004; presently: Clay Mathematics Institute, Princeton University, U.S.A.

Bo'az Klartag's main achievements are in Asymptotic Geometric Analysis. He has solved a number of long standing problems in this field. He broke the record on the minimum number of symmetrization steps of convex bodies required to transform them into near balls, thereby solving problems posed by Hadwiger and Bourgain–Lindenstrauss–Milman. He solved the isomorphic version of a slicing problem posed by Bourgain 20 years ago, exhibiting novel ideological and technical ideas. This work has a strong impact on Functional Analysis. He proved a central limit theorem for convex bodies, a beautiful result bringing, in a novel way ideas of Convex Geometry into Probability Theory. With Feffermann he solved a fundamental problem on optimal extrapolation of smooth functions. Bo'az Klartag is a surprisingly productive young mathematician who has succeeded, in a very short time, to make breakthroughs in a number of different directions of major significance in modern analysis.

Alexander Kuznetsov

Born: November 1, 1973; citizenship: Russian; Ph.D.: Moscow State University, 1998; presently: Steklov Mathematical Institute, Moscow, Russia.

Kuznetsov has made fundamental contributions to birational projective geometry, representation theory, mathematical physics, homological algebra, and non-commutative geometry. A trademark of his work is the blend of his ground-breaking ideas and technical sophistication. His work on birational projective geometry includes theories of homological Lefschetz decompositions, homological projective duality and categorical resolutions of singularities. Kuznetsov boldly and innovatively combines several ideas ranging from very classical algebraic geometry such as Mori's Minimal Model Program to such hot topics as Kontsevich's Homological Mirror Symmetry Program. His techniques can be used in situations where the conventional constructions do not apply and thus extend the range of birational projective geometry considerably. Kuznetsov's work is a great source of inspiration.

Assaf Naor

Born: May 7, 1975; citizenship: Czech/Israeli; Ph.D.: Hebrew University, Jerusalem, Israel; presently Courant Institute, New York, U.S.A.

Assaf Naor has made ground-breaking contributions to three mathematical fields: functional analysis, the theory of algorithms and combinatorics. Naor is the leading architect of the modern theory of non-linear functional analysis: a theory that has taken off in recent years and has become an essential tool in mathematical computer science. Among other things, Naor and a variety of collaborators discovered an

unpredicted threshold phenomenon in the non-linear Dvoretzky Theorem, found a non-linear analogue of the cotype invariant and proved a sophisticated non-linear analogue of the celebrated Maurey–Pisier Theorem. Naor's work has led to essentially optimal embeddings of finite subsets of L_1 into Hilbert space and thence, the best available polynomial time approximation algorithm to compute the sparsest cut in a network with several commodities. Assaf Naor's versatility, originality and technical power are overwhelming and his work has a profound influence on functional analysis and mathematical computer science.

Laure Saint-Raymond

Born: August 4, 1975, citizenship: French; Ph.D.: Paris VII, France, 2000; presently: ENS Paris, France.

Laure Saint-Raymond is well known for her outstanding results on nonlinear partial differential equations in the dynamics of gases and plasmas and also in fluid dynamics. Her most striking work concerns the study of the hydrodynamic limits of the equation of Boltzmann in the kinetic theory of gases, where she answered a question posed by Riemann within the framework of his 6th problem. Recently, in collaboration with I. Gallagher, she aims at understanding the equations of rotating fluids within the limit where the number of Rossby tends to 0. They have already obtained surprising results in this direction. At 32 years, Laure Saint-Raymond is at the origin of several outstanding and difficult results in the field of nonlinear partial differential equations of mathematical physics. She is one of the most brilliant young mathematicians in her generation.

Agata Smoktunowicz

Born: October 12, 1973; citizenship: Polish; Ph.D.: PAN, Warsaw, Poland; presently: University of Edinburgh, Scotland and Institute of Mathematics of the Polish Academy of Sciences.

Agata Smoktunowicz has solved a number of outstanding problems in noncommutative algebra. She has made the first significant progress for decades on some fundamental problems concerning nil rings. The most spectacular of these results is the construction, over any countable field, of a simple nil algebra. This solves a famous problem of Levitsky, Jacobson and later Kaplansky from around 1970. This work is a technical tour-de-force. Other outstanding problems she has solved include an answer to a problem about polynomial rings over nil rings first asked by Amitsur in 1971, the proof of the Artin–Stafford Gap Theorem for graded domains, and the first examples of finitely generated nil, but not nilpotent algebras with polynomially bounded growth. In all her work, Smoktunowicz has introduced novel techniques and constructions and she displays a great ability to deal with long, difficult and technically demanding calculations.

Cédric Villani

Born: October 5, 1973; citizenship: French; Ph.D.: ENS, Paris, France, 1998; presently: ENS Lyon, France.

Cédric Villani has contributed to the theory of non-equilibrium statistical mechanics, in particular in connection with the Boltzmann equation and the Landau equation in plasma physics. He proved the Cercignani conjecture and obtained with Desvillettes the first convergence result to a global gaussian equilibrium for the Boltzmann equation without any smallness assumption. A second component of Villani's work is at a crosspoint between probability, functional analysis, partial differential equations, differential and Riemannian geometries. With Otto he studied the link between diffusion equations, Talagrand inequalities and logarithmic Sobolev inequalities. More recently, Lott and Villani obtained a new characterization of Riemannian manifolds with bounded Ricci curvature from below, in terms of convexity of the Boltzmann entropy with respect to optimal transportation (Monge–Kantorovich–Wasserstein) metrics. By his way of looking at problems Villani has inspired many.

Josselin Garnier, the Felix Klein Prize Winner

Born: June 18, 1971; citizenship: French; Ph.D.: École Polytechnique, 1996; presently: Université Paris 7.

Josselin Garnier was appointed associate Professor in Mathematics in Toulouse at the (remarkably young) age of 30, and he joined the Université Paris Diderot (Paris 7) in 2005, where he became a full professor in 2007. He is affiliated to the Laboratoire de Probabilités et Modèles Aléatoires and the Laboratoire Jacques Louis Lions. He is also a scientific consultant at the Nuclear Energy Agency (CEA), he has a number of research contracts with many teams of CEA, with the French Electric Company (EDF), and with the European Aeronautic Defence and Space company (EADS). In 2006, he has been one of the organizers (with Guillaume Bal and Didier Lucor) of the CERMRACS summer activity of SMAI that aims at promoting the collaboration between academic and industrial mathematicians on dedicated problems.

His research is at the interface of stochastics and applied analysis, and the fields of applications are mainly in optics, wave propagation and plasma physics. He is a leading scientist dealing with probabilistic aspects in the framework of partial differential equations and he has shown his ability to apply powerful theoretical tools to deal with real industrial problems.

Josselin Garnier has both an impressive academic curriculum (wave propagation in random medium where a recent breakthrough is the analysis of time reversal of the wave when the medium is randomly layered, first proof of the existence of solitons in random media with qualitative and quantitative information, analysis of Bose–Einstein condensates...) where he has published numerous high level publications in international scientific journals both in the mathematical area and in applied physics area but he is also deeply involved in real applications (new techniques in imaging for the detection of buried objects, telecommunication for comparison of signal-to-noise ratio and signal-to-interference ratio for various protocols in wireless communication, design of the target in the Laser Mega Joule experimental device in the framework of Inertial Confinement Fusion, problems in aeronautics where for acoustic problems, electromagnetic compatibility analysis, design of antennas.... the industrial conception has to incorporate now Random modeling and uncertainty management). Finally he knows very well the state-of-the-art about most of the numerical methods in Computational Fluid Dynamics and he can provide very useful orientations for robust simulations of these problems.

Congress Programme

Plenary Lectures

Luigi Ambrosio	Optimal transportation and evolution problems in spaces of probability measures
Christine Bernardi	From a posteriori analysis to automatic modelling
Jean Bourgain	New developments in arithmetic combinatorics
Jean-François Le Gall	The continuous limit of large random planar maps
François Loeser	The geometry behind non-archimedean integrals
László Lovász	Very large graphs
Matilde Marcolli	Renormalization, Galois symmetries and motives
Felix Otto	Pattern formation and partial differential equations
Nicolai Reshetikhin	Topological quantum field theory: 20 years later
Richard Taylor	The Sato–Tate conjecture

Science Lectures

J. Ignacio Cirac	Quantum information theory: applications and challenges
Tim Palmer	Climate change and the trillion-dollar millenium mathematics
Jonathan Sherratt	Periodic travelling waves in field vole populations

Invited Lectures

Nalini Anantharaman	Entropy and localization of eigenfunctions
Christoph Böhm	Ricci flow in higher dimensions
Annalisa Buffa	On the discretization of differential forms
José Antonio Carrillo	The Patlak–Keller–Segel model: free energies, geometric inequalities
Nils Dencker	The solvability of differential equations
Bas Edixhoven	On the computation of the coefficients of modular forms
Manfred Einsiedler	Spectral gap and effective equidistribution

László Erdös	Derivation of the Gross–Pitaevskii equation for the dynamics of the Bose–Einstein condensate
Nicola Fusco	The sharp Sobolev inequality in quantitative form
Søren Galatius	Homotopy theory and automorphism groups
Dmitry Kaledin	Motivic structures in non-commutative geometry
Nikita Karpenko	Essential dimension of finite p-groups
Arno Kuijlaars	Critical phenomena in random matrix theory
Miklós Laczkovich	Whitney constants, twisted sums, and the difference property
Michel Ledoux	Markov operators, classical orthogonal polynomial, ensembles and random matrices
Wolfgang Lück	Topological rigidity of aspherical manifolds
Yvan Martel	Inelastic collision of two solitons for nonintegrable gKdV equations
Sergei Merkulov	Wheeled pro(p)file of Batalin–Vilkovisky formalism and BF theory of unimodular Poisson structures
Ralf Meyer	Equivariant non-commutative topology
Oleg Musin	Positive definite functions in distance geometry
Nikolai Nadirashvili	Singular solutions to fully nonlinear elliptic equations
Jaroslav Nešetřil	From sparse to nowhere dense structures: dualities and first order properties
Yuval Peres	Internal aggregation with multiple sources
Christoph Schweigert	Bundle gerbes and surface holonomy
H. Mete Soner	Nonlinear parabolic PDEs and pricing intervals
Balázs Szegedy	Non-standard methods, regularity and the completion of hyper-graphs
Constantin Teleman	Topological field theories in 2 dimensions
Ana Vargas	Bilinear restriction theorems and applications to dispersive equations
Frank Wagner	Geometric model theory
Reinhard Werner	Locality and unitarity in the structure of quantum cellular automata
Andreas Winter	High dimensional geometry in quantum information
Ragnar Winther	Finite element exterior calculus – a link between algebraic topology and numerical analysis
Stanislaw Woronowicz	The trace formula for Haar weight on locally compact quantum groups

Prize Winner Lectures

Artur Avila	Dynamics of quasiperiodic cocycles and the spectrum of the almost Mathieu operator
Alexei Borodin	Random surfaces in dimensions two, three, and four
Ben Green	Patterns of primes
Olga Holtz	Complexity and stability of linear problems
Bo'az Klartag	High-dimensional distributions with convexity properties
Alexander Kuznetsov	Derived categories and rationality of cubic fourfolds
Assaf Naor	The story of the sparsest cut problem
Laure Saint-Raymond	Some results about the sixth problem of Hilbert
Agata Smoktunowicz	On some open questions in noncommutative ring theory
Cédric Villani	Optimal transport and Riemannian geometry: Monge meets Riemann
Josselin Garnier	Passive sensor imaging using cross correlations of noisy signals

Round Table on Industrial Mathematics

Wim Mulder	The seismic inverse problem
Valtteri Niemi	Mathematics in mobile communications
Wil Schilders	Mathematics in the electronics industry, and in industry as a whole
Gerrit T. Timmer	Applied mathematics at work: lessons learned in 25 years at ORTEC

Round Table on Mathematics and Developing Countries

(moderators: Andreas Griewank, Tsou Sheung Tsun)

This round table discussion was organised as a follow up to one on "Developing Mathematics in the Developing World" held at ICIAM07. While the previous event had a global scope, this one has focused on developing mathematics in Africa. Apart from the moderators the panel included Wandera Ogana (Kenya), Laura Pauline Fotso (Cameroon), Gareth Whitten (South Africa), Leif Abrahamsson (Uppsala University), Paulus Gerdes (Mocambique), Mohamed Jaoua (Nice) and Bernard Philippe

(Rennes). They are all actively involved in several development activities and organizations.

Each of the panelists spoke for about 10 minutes, followed by a discussion among and between themselves and the audience on the following topics: Status quo of mathematics in statistical terms; Challenges with the development of advanced Centres of Excellence; Barriers: political, economical, and cultural; Remedies: "Twinning" of departments from developing countries with departments from the developed countries; Strategies to persuade African governments to support the development of mathematics in their countries.

Special Lectures

Dan Bernstein	Edwards curves (Beeger Lecture)
Dirk van Dalen	Brouwer's revolution – a century later
Phillip Griffiths	Complex algebraic geometry (Brouwer Lecture)

Philips PhD Prize Lectures

Stefanie Donauer	Infinitely many unobservable data – asymptotics in deconvolution problems
Willemien Ekkelkamp	Predicting the sieving effort for the number field sieve factorization method
Robbert de Haan	More efficient cryptography from error correcting codes
Erik Jan van Leeuwen	Geometric optimization for wireless networks and computational biology
Arjen Stolk	An algebraic approach to discrete tomography
Yana Volkovich	Probabilistic analysis of web ranking

Minisymposia

Advances in Variational Evolution (org.: Alexander Mielke, Ulisse Stefanelli)

Yann Brenier	A non-convex gradient flow structure for mass transport, convection and magnetic relaxation
Nassif Ghoussoub	Navier–Stokes evolutions as self-dual variational problems
Giuseppe Savaré	Gradient flows and diffusion in metric spaces under lower curvature bounds

Ulisse Stefanelli The weighted-energy-dissipation functional

Algebra and Optimization (org.: Jan Draisma, Monique Laurant)

Harm Derksen	G-invariant tensors
Marie-Françoise Roy	Certificates of positivity in the Bernstein's basis
Markus Schweighofer	Which sets can be described by linear matrix inequalities?
Frank Vallentin	Semidefinite programming bounds

Applications of Noncommutative Geometry
(org.: Gunther Cornelissen, Klaas Landsman)

Caterina Consani	Noncommutative geometry and motives
Yuri Manin	An update on real multiplication
Pedro Resende	Noncommutative geometry and Bohr's doctrine of classical concepts
Walter van Suijlekom	On the geometry of noncommutative gauge fields

Applied Algebraic Topology (org.: Michael Farber)

Yuliy Baryshnikov	Enumeration in sensor networks and integrals with respect to Euler characteristics
Gunnar Carlsson	Persistent topology and data
Konstantin Mischaikow	Databases for global nonlinear dynamics
Marian Mrozek	Reduction homology algorithms
Shmuel Weinberger	A topological view of unsupervised learning from noisy data

Combinatorics of Hard Problems (org.: Josep Diaz, Oriol Serra, Jaroslav Nešetřil)

Jiří Matoušek	Low-distortion embeddings in $\mathbb{R}^d$
Colin McDiarmid	Random graphs from a minor-closed class
Marc Noy	Enumeration of planar graphs and related families of graphs
Vera T. Sós	Convergence of dense graph sequences

Coupled Cell Networks (org.: Peter Ashwin, Ana Dias, Jeroen Lamb)

Konstantinos Efstathiou	Unstable attractors and heteroclinic cycles in pulse coupled networks with delay

Michael Field	Global dynamics and heteroclinic cycles in coupled cell systems
Hiroshi Kori	Synchronization engineering via global delayed nonlinear feedback
Oleksandr V. Popovych	Decoupling of oscillatory ensembles by mixed nonlinear delayed feedback
Eric Shea-Brown	Reliable and unreliable dynamics in driven oscillator networks

Discrete Structures in Geometry and Topology (org.: Dmitry Feichtner-Kozlov)

Corrado De Concini	Hyperplane arrangements, polytopes and box-splines
Peter Littelmann	Equations defining symmetric varieties and affine grassmannians
Frank Sottile	Bounds for real solutions to equations from geometry
Sergey Yuzvinsky	Completely reducible fibers of a pencil of curves and combinatorics

Galois Theory and Explicit Methods (org.: Bart de Smit)

Anna Morra	Counting cubic extensions with given quadratic resolvent
Samir Siksek	A multi-Frey approach to Diophantine equations
William Stein	Computing with abelian varieties of GL_2-type using Sage
Jan Tuitman	A generalized sparse effective nullstellensatz

Global Attractors in Hyperbolic Hamiltonian Systems
(org.: Andrew Comech, Alexander Komech)

Vladimir Buslaev	Generic scenario of the scattering for nonlinear wave equations
Andrew Comech	Global attraction to solitary waves in models based on the Klein–Gordon equation
Scipio Cuccagna	On asymptotic stability of standing waves of nonlinear Schrödinger equations
Elena Kopylova	Scattering of solitons for the Schrödinger equation coupled to a particle
Markus Kunze	Radiation in classical particle systems
A. E. Merzon	On scattering states in the nonlinear Lamb system
David Stuart	Vortices in a Chern–Simons–Schrödinger system

Graphs and Matroids (org.: Bert Gerards, Hein van der Holst, Rudi Pendavingh)

Jim Geelen	Matroid minors
Paul Seymour	Perfect matchings in planar cubic graphs
Robin Thomas	K_t minors in large t-connected graphs
Carsten Thomassen	Graph decomposition

Hypoellipticity, Analysis on Groups and Functional Inequalities
(org.: Waldemar Hebisch, Boguslaw Zegarlinski)

Jean-Philippe Anker	Evolution equations on homogeneous spaces
Dominique Bakry	Gradient bounds for hypoelliptic heat equations
Martin Hairer	Slow energy dissipation in anharmonic chains
Krzysztof Oleszkiewicz	Noise stability of functions with low influences

Mathematical Challenges in Cellular Systems
(org.: Frank Bruggeman, Mark Peletier)

Pauline Hogeweg	Spatial pattern formation and multilevel evolutionary dynamics
Johan Paulsson	Fundamental limits on the suppression of noise
David Rand	Global sensitivity and summation laws for cellular network dynamics
Jens Timmer	Data-based identifiability analysis of non-linear dynamical models

Mathematical Finance (org.: Hans Schumacher, Peter Spreij)

Hans Föllmer	Probabilistic quantification of financial uncertainty
Philip Protter	Modelling financial bubbles
Walter Schachermayer	The fundamental theorem of asset pricing for continuous processes under small transaction costs
Thaleia Zariphopoulou	SPDE and portfolio choice

Mathematical Logic (org.: Peter Koepke, Benedikt Löwe, Jaap van Oosten)

Mirna Džamonja	Combinatorics of trees
Sy-David Friedman	Consistency completeness
Mai Gehrke	Duality theory as a Rosetta Stone for relational semantics

Erik Palmgren	Point-free topology versus topology according to Brouwer and Bishop
Giovanni Sambin	Minimalist foundation and pluralism in mathematics: computation and structure in topology
Katrin Tent	Simplicity of certain automorphism groups
Boban Velickovic	PCF structures of height less than ω_3

Mathematics of Cryptology (org.: Ronald Cramer)

Steven Galbraith	Elliptic curves, pairings and public key cryptography
Oded Goldreich	The bright side of hardness – relating computational complexity and cryptography
Eyal Kushilevitz	The private information retrieval problem
Renato Renner	Induction and quantum cryptography

Random and Quasi-periodic Operators
(org.: Frédéric Klopp, François Germinet)

Alexander Fedotov	On the behavior at infinity of solutions of an almost periodic equation
Abel Klein	Recent results concerning localization in continuum random Schrödinger operators
Wolfgang König	A two-cities theorem for the parabolic Anderson model
Raphael Krikorian	KAM-Liouville theory and an extension of a theorem by Dinaburg and Sinai
Armen Shirikyan	Control and mixing for nonlinear PDE's
Simone Warzel	On the joint distribution of energy levels of random Schrödinger operators

Representation Theoretical Methods and Quantization
(org.: Stefaan Caenepeel, Jürgen Fuchs, Alexander Stolin, Christoph Schweigert, Freddy van Oystaeyen)

Giovanni Felder	Riemann–Roch–Hirzebruch formulae for traces of differential operators
Gilles Halbout	Universal deformations and propic methods in quantum groups
Bernhard Keller	Mutations of quivers with potentials and derived equivalences
Wendy Lowen	Stacks and dg categories in deformation theory
Ingo Runkel	Conformal field theory, vertex operators, and Frobenius algebras

Rough Path Theory (org.: Peter K. Friz)

Sandy M. Davie	Discrete approximation to solutions of rough path equations
Peter Friz	On some properties of SDEs and first order SPDEs with Gaussian noise
Massimiliano Gubinelli	Some infinite dimensional rough-paths
Christian Litterer	Numerical analysis on Wiener space: cubature methods

Singular Structures in Variational PDE's (org.: Matthias Roeger, Mark Peletier)

Piotr Gwiazda	Flat metric and structural stability of a nonlinear population model
Matthias Kurzke	Vortices in Chern–Simons Higgs theories away from self-duality
Xiaofeng Ren	On the resonance condition of a singular limit problem from the Ohta–Kawasaki and the Gierer–Meinhardt theories
Marc Oliver Rieger	Two applications of transport theory: gradient flows of Young measures and portfolio optimization
Didier Smets	Stability of the kink for the NLS flow

Spectral Problems and Hilbert Spaces of Entire Functions
(org.: Joaquim Bruna, Hakan Hedenmalm, Kristian Seip, Mikhail Sodin)

Aharon Atzmon	Weighted Hardy spaces and the uncertainty principle for Fourier transforms
Alexander Borichev	Approximation on the line: weight's perturbations
Jean-François Burnol	The Fourier transform as a spectral problem
Nikolai Makarov	Linear complex analysis and de Branges spaces
Alexander Ulanovskii	Universal sampling and interpolation of band-limited signals

Spectral Theory
(org.: E. Brian Davies, Timo Weidl, Frédéric Klopp, Thomas Hoffmann-Ostenhof)

Maria Esteban	Self-adjoint extensions via Hardy-like inequalities
Rupert L. Frank	Lieb–Thirring and Hardy–Sobolev inequalities
Gian Michele Graf	Quantization of charge transport: equivalence of scattering and Chern number approaches
Yoram Last	On the structure of Hofstadter's butterfly

Alexander V. Sobolev	Some aspects of perturbation theory for the periodic Schrödinger operators

Weak Approximations of Stochastic Differential Equations (org.: Dan Crisan)

Mireille Bossy	Discretization of non-linear Langevin SDEs
Emmanuel Gobet	Closed pricing formula via weak approximation of financial models
Peter Kloeden	Convergence in stochastic numerics: some new developments
Terry Lyons	Resampling and cubature on Wiener space