Scientific Report 2007

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Cover:
Anonymous 17th-century watercolor of the Semper Augustus, the most famous bulb and the symbol of the Dutch tulip mania in the early 17th century. The background of the Semper August shows a fractal plot of the basins of attraction of two different long-run equilibria in a simple nonlinear model with heterogeneous expectations describing bubbles and crashes in financial markets.

Contents

Mission Statement

The Lorentz Center is an international center that coordinates and hosts workshops in the sciences, based on the philosophy that science thrives on interaction between creative researchers. Lorentz Center workshops focus on new collaborations and interactions between scientists from different countries and fields, and with varying seniority.

The Lorentz Center concept
In order to allow both junior and senior researchers to catch up with the rapid international developments and to establish new contacts and collaboration, Lorentz Center workshops bring together groups of 20 to 50 junior and senior researchers in a stimulating environment with working space for all participants: offices with a desk, personal computer, white boards, meeting rooms. Through a combination of informal talks, working sessions and discussions, participants are able to assess the status of a field and its future, and to collaborate, establish new international contacts, and spot upcoming talent.
Workshops can be proposed and organised by any researcher from any country. Workshops organised by researchers from different scientific backgrounds and nationalities are encouraged. Proposals for workshops are reviewed by the Program Advisory Boards. Currently there are Advisory Boards for astronomy, computer science, lifesciences, mathematics, and physics. The Center is also open to proposals outside these fields. Submission procedures are aimed at rapid evaluation.
In collaboration with the social sciences and humanities institute NIAS, the Lorentz Center welcomes proposals for interdisciplinary workshops that bring together one or more disciplines of the Lorentz Center with those of the NIAS. Proposals for these workshops are reviewed by the Interdisciplinary Advisory Board.

Surrounded by excellence
The Lorentz Center is located in Leiden University's J.H. Oort Building which also hosts the Instituut-Lorentz for theoretical physics, the Kamerlingh Onnes Laboratory and the Leiden Observatory. The Mathematics and Chemistry Departments and the Leiden Institute of Advanced Computer Science are located in adjacent buildings. All Dutch universities and research institutes can easily be reached by public transport; the universities in Amsterdam, Utrecht, Delft and Rotterdam can be reached by train within an hour. Schiphol International Airport is only 15 minutes by train.

Collaboration with NIAS
In collaboration with the social sciences and humanities institute NIAS located nearby, the Lorentz Center welcomes proposals for interdisciplinary workshops that bring together one or more disciplines of the Lorentz Center with those of the NIAS. Lorentz Fellowships are awarded by NIAS to scholars who are engaged in research across the boundaries of the humanities, the social sciences and the natural sciences. As part of the fellowship, the Lorentz Fellow is offered the opportunity to organize an interdisciplinary workshop at the Lorentz Center. Applications for Lorentz Fellowships should be sent to NIAS.

Support
The Lorentz Center is supported by Leiden University, Ministerie van OCW (the Dutch Ministry of Education, Culture and Science), FOM (the Dutch Physics Funding Foundation "Fundamenteel Onderzoek der Materie"), NWO, Research Council EW.
The Lorentz Fonds regularly supports workshops in Physics.

Foreword by the director

The year 2007 marked the tenth anniversary of the Lorentz Center. We celebrated this event by offering our workshop participants and colleagues in Leiden commemorative notepads with a collage of some of our recent posters on the front. If I look back at the development of the center since it opened its door for the first workshop in 1997, I realize how much has happened since those times. Over the years, the Lorentz Center has naturally found its own place internationally as an attractive center for workshops of one to two weeks in the sciences – this is reflected by the fact that we are getting more and more workshop proposals from outside the Netherlands, especially in physics. We are proud that in this way we play an important role in the internationalization of Dutch science. In terms of the organization, to organizers and workshop participants the most striking difference with how we operated in the early days is that we now have a fully professional staff, and that the development of new workshops is stimulated and supported by a science advisor before the proposals are sent to the independent program advisory boards that decide on the workshop program. This buildup and professionalization would have been impossible without the increasing support from both the Dutch scientific community and, at the national level, from our national funding agencies NWO and FOM and our ministry of science and education OCW. At the occasion of our tenth anniversary, I wish to thank all of the individuals and institutions who helped build the Lorentz Center.

An important new development of the last year was that the NIAS *(Netherlands Institute for Advanced Study* in the Humanities and Social Sciences) and the Lorentz Center started organizing interdisciplinary activities under the auspices of a new interdisciplinary board. As part of this program, NIAS and the Lorentz Center together offer the opportunity to organize interdisciplinary workshops at the Lorentz Center, or to spend (part of) a sabbatical at the NIAS as "Lorentz Fellow". A Lorentz Fellow is also expected to be (co)organizer of an interdisciplinary workshop. Some examples of workshops that have been hosted at the Lorentz Center in 2007 through this program are *Brain Mechanisms and Cognitive Processes in the Comprehension of Discourse* in March, *Complexity in Economics and Finance* in October, and *Literature and Evolutionary Theory* in December.

In collaboration with NIAS, we use the word interdisciplinary to denote workshops that bring together researchers from the natural scientists with colleagues from the humanities or social sciences. But actually, quite a few of our natural science workshops are quite interdisciplinary as well: at the *Computational Complexity of Quantum Hamiltonian Systems* workshop in July, computer scientists and physicists working on quantum computing came together to explore the potential of statistical physics methods to calculate the low energy spectrum of quantum Hamiltonians, ideas that were discussed at the *Condensed matter meets gravity* in August led to new collaborations as well as a nice article in the science section of one of the leading Dutch newspapers, while at the *Algorithmic Bioprocesses* workshop in December we saw computer scientists and biologists exchange ideas. While the expansion of our mission into the life sciences is not going as fast as I would like, the workshop *Proteins killing tumor cells* that was held in late October, brought a completely new science community to our center. We had many positive reactions from the participants on our workshop format, and we hope and expect to see this community back in the not too distant future. Meanwhile, our program board for life sciences is actively stimulating the development of new life science workshops.

Quite a few meetings have also an educational component; in this regard it is worth drawing attention to the *Show Physics* workshop which promoted exchange of ideas and experiences

among groups from all over Europe who visit schools, science museums and other scientific venues to do performances and give scientific demonstrations. It was a great success.

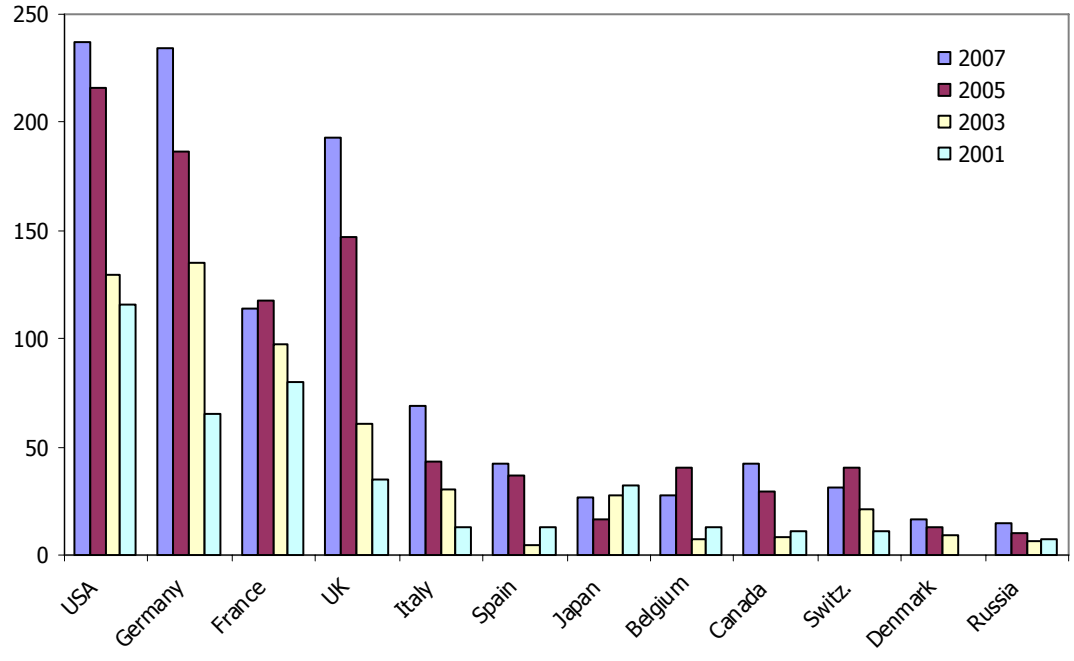
Another first this year, was that the Lorentz Center received funding from the EU 6th Framework programe: The Marie Curie Action "Conferences and Training Courses" co-sponsored a "Series of Events" which consisted of four workshops in the fields of mathematics and computer science: *"Gossip-based Computer Networking"* (the last workshop of 2006), *"Mathematics: Algorithms and Proofs"*, *"Nonlinear Collective Behaviour: Networks, Swarming and Reaction Diffusion Dynamics "*, and the above mentioned "*Computational Complexity of Quantum Hamiltonian Systems*".

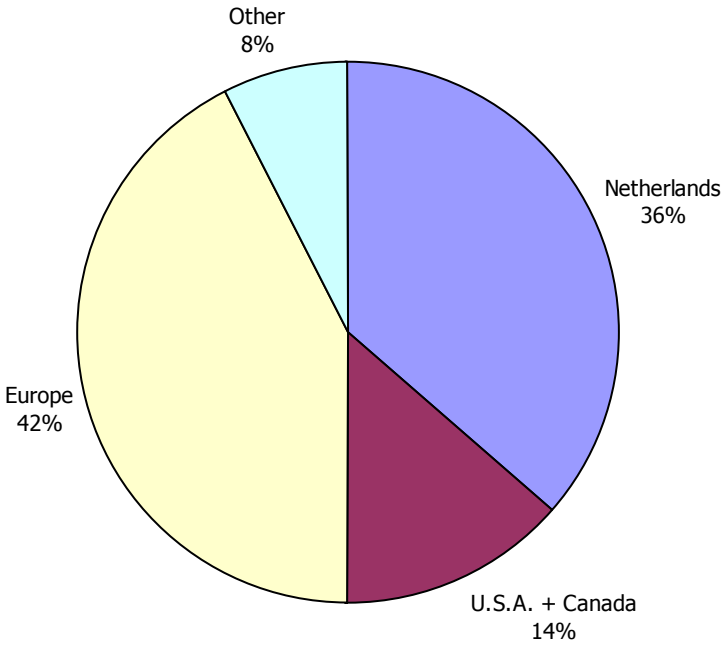
While at the national level there is an increased awareness of the importance of having industry and academia work together – the successful Industrial Partnership Programs that FOM has initiated are a testimony to this – we do not see this reflected yet in our workshop program. I actually do think that the Lorentz Center is an ideal place to bring industrial and academic scientists together, so one of my goals for the future is to increase the industry's awareness of the Lorentz Center and the opportunities it offers.

The Lorentz Center is nowadays almost operating year round, so we start to see a leveling off in the number of workshops and meetings, as the table below shows.

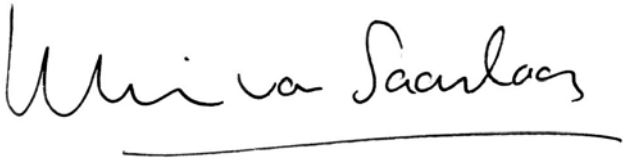
YEAR	2000	2001	2002	2003	2004	2005	2006	2007
Number of Meetings	23	31	34	31	38	41	45	45
Number of Workshops	**15**	**21**	**23**	**22**	**31**	**35**	**41**	**42**
Number of Visitors	880	1002	1421	1436	1640	1693	2009	2136
Regular workshop participants	**640**	**735**	**1005**	**1007**	**1133**	**1562**	**1729**	**2008**

The charts below illustrate that although there are significant fluctuations from year to year, we continue to draw increasing numbers of participants from Europe and North-America. The number of participants from the Netherlands has been pretty stable at about 35-40% over the years. It is also worth mentioning that about 38% of our workshop participants are junior scientists, i.e., graduate students and postdocs.





Finally let me mention that in 2007 we redesigned our website **http://lorentzcenter.nl** and that we for the first time offered the possibility on our website to sign up for email announcements of workshops. These announcements are sent out once the program of a workshop has been published on the web, usually a couple of weeks before a workshop begins. More and more colleagues in the Netherlands are using this facility, as it is a good way to stay informed about what is happening and to check whether it might be of interest to register for a workshop or to just come over for a day or so. If you want to sign up too, go to **http://lorentzcenter.nl/email.php**.



Wim van Saarloos
Director Lorentz Center

March 2008

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Interdisciplinary Program Board

The interdisciplinary program board oversees the collaboration of NIAS (Netherlands Institute for Advanced Study in the Humanities and Social Sciences) and Lorentz Center, including the selection of interdisciplinary workshops, and the selection of the Lorentz Fellows at NIAS.

Chair

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Scientific Report

Mathematics: Algorithms and Proofs

January 8 – 12, 2007

Aim

The goal of the workshop was to bring together people from the communities of formal proofs, constructive mathematics and computer algebra (in a wide sense). It is a continuation of previous meetings in Schloss Dagstuhl (2003 and 2005), Luminy (2004) and Castro Urdiales (2006). The previous meetings have been quite successful in bringing these communities closer together. One objective of the workshop is to bridge the gap between conceptual (abstract) and computational (constructive) mathematics, by providing a computational understanding of abstract mathematics. It is becoming clear that many parts of abstract mathematics can be made constructive and even computational and that abstract mathematical techniques contain an underlying constructive content. We are not only interested in algorithms however, but also in formal proofs of the correctness of these algorithms.

Computer algebra provides a variety of interesting basic algorithms, from exact linear algebra to various aspects of elimination and real root counting, which are the foundations for much more sophisticated results like nullstellensatz, quantifier elimination etc... It is remarkable that in constructive and computer algebra, progress in sophisticated algorithms often implies progress on these basic algorithms.

Moreover the scope of computer algebra is now widened by the consideration of seminumerical algorithms. When such algorithms are correctly controlled, they actually deal with real and complex numbers in the constructive meaning of these objects. So computer algebra fills many objectives of computational analysis.

Providing formal proofs of correctness to the computer algebra community is very useful, specially for algorithms which are basic and used everywhere. On the other hand, a collection of mathematically non trivial examples is very useful for the formal proof community, which also needs powerful automatic methods from computer algebra.

For more information about the MAP-community we refer to http://www.disi.unige.it/map where one can also find the MAP manifesto. MAP is an acronym for 'Mathematics: Algorithms and Proofs'.

Participants

There were 59 participants from many different countries.

Program

Tutorials

- Arjeh Cohen (Eindhoven University) - *Three aspects of exact computation*
- Thierry Coquand (Chalmers, Sweden) - *A logical approach to abstract algebra*
- Per Martin-Löf (Stockholm, Sweden) - *Topos theory and type theory*

Invited talks

- Michael Beeson (San José State, USA) - *Algorithms and Proofs in Geometry*
- Dirk van Dalen (Utrecht University) - *The lonely revolutionary. Brouwer's first program.*
- Hendrik Lenstra (Universiteit Leiden) - *Ordering fields*

Contributed talks

Thorsten Altenkirch (Nottingham, UK) - *Quotient Types in Observational Type Theory*
Jesus Aransay (La Rioja, Spain) - *A mechanised proof of the Basic Perturbation Lemma*
Eyvind Briseid (Darmstadt, Germany) - *Using proof mining to find computable rates of convergence for the Picard iteration sequence for non-nonexpansive functions.*

Jan Draisma (Technische Universiteit Eindhoven) - *A scenic tour in tropical geometry*
Gilles Dowek (l'École polytechnique, France) - *The linear-algebraic lambda-calculus* (joint work with Pablo Arrighi)
Harold Edwards (New York, USA) - *Addition on Elliptic Curves*
Peter Hancock (Edinburgh, UK) - *Stream Processing, a la Brouwer* (Joint work with Neil Ghani and Dirk Pattinson)
Assia Mahboubi (INRIA/MSR, France) - *A formal correctness proof for the subresultant algorithm*
Sean McLaughlin (CMU, USA) - A Methodology for Implementing Reusable Decision Procedures
Henri Lombardi (France Comté, France) - *Constructive real algebra*
Russell O'Connor (Radboud University) - *Implementing Analysis*
Paulo Oliva (Queen Mary, University of London, UK) - *Modified realizability of classical linear logic*
Peter Paule (Research Institute for Symbolic Computation (RISC), J. Kepler University Linz, Austria) - *A Computer Proof of a Conjecture of Moll*
Ana Romero Ibañez (Rioja, Spain) - *Constructive Spectral Sequences*
Peter Schuster (Munich, Germany) - *Labelled Trees of Finite Depth* (joint work with Hervé Perdry)
Helmut Schwichtenberg (Munich, Germany) - *Goedels Dialectica Interpretation*
Bas Spitters (Radboud University) - *Located and overt locales* (jww Thierry Coquand)
Roland Zumkeller (l'École polytechnique, France) - *Towards a formal proof of the Kepler conjecture*

Outcome
The workshop was highly successful. The presentations were of excellent quality as can be judged from the slides which may be found on the workshop website. The friendly atmosphere in Lorentz center stimulated interaction between the participants. The coffee room and offices were used for discussions from early to very late in the day. We received many very positive reactions, both on the scientific quality and on the stimulating well-organized center.

Acknowledgement
We would like to thank the Lorentz center for providing excellent facilities and support. The workshop was supported by DIAMANT, KNAW, Marie Curie Action 'Conferences and Training networks', and NWO.

Scientific Committee
Thierry Coquand (Chalmers, Sweden)
Henri Lombardi (France Comté, France)
Peter Paule (University of Linz, Austria)
Bas Spitters (Radboud Univerisity Nijmegen, the Netherlands)

Organizing Committee
Herman Geuvers (Radboud Univerisity Nijmegen)
Bas Spitters (chair, Radboud Univerisity Nijmegen)
Freek Wiedijk (Radboud Univerisity Nijmegen)

This workshop is part of a "Series of Events" in the Marie Curie SCF (Conferences and Training Courses) Action.

Scientific Report

Computational Cosmology

January 15 – 19, 2007

From January 15 through January 19, 2007, nearly 70 people from 7 countries participated in what turned out to be a very successful meeting at the Lorentz Center.

Computational cosmology is already a central part of modern, astronomical research, but continues to increase in importance. A small number of simple physical laws can give rise to an amazingly rich phenomenology, as numerous observations demonstrate so beautifully. The continuing increase in the speed and memory of computers allows us to perform ever more detailed simulations of complex astronomical phenomena, which can then be used to create "virtual observations". Such simulations are invaluable for testing theoretical models, for constraining the physical parameters of such models, and for gaining insight into the relative importance of different physical processes. Numerical simulations are also widely used for the design of observational campaigns, for testing data analysis software, and for revealing observational biases.

The workshop "Computational Cosmology" brought together researchers active in various ongoing collaborative simulation projects, as well as researchers who would like to get involved. The focus was on simulations of the formation of structure in the universe, ranging from the first stars to the present-day large-scale distribution of galaxies. There was a nice mix of technical (simulation techniques) and physics applications talks.

The first three days were filled with plenary talks and discussion sessions in which the latest developments were presented and debated. The last two days the participants split up in smaller groups. These group meetings included hands-on sessions in which participants were taught to use various software packages developed by the collaborations, discussions of specific problems, and brainstorms about future projects.

The workshop was successful in all respects. People were brought up to date, problems were solved, existing collaborations were expanded and new ones were formed.

The diverse and excellent facilities of the Lorentz Center, as well as the efficient and friendly help from Wies Groeneboer and Martje Kruk, greatly contributed to the success of this workshop. We are also very grateful for the financial support from the Lorentz Center and NOVA.

Joop Schaye (Leiden University, Netherlands)
Carlos Frenk (Durham University, United Kingdom)
Simon White (Max Planck Institut fur Astrophysik, Germany)

Scientific Report

Stieltjes/NDNS+ Onderwijsweek
Probability and Statistics in Population Genetics

January 22 – 26, 2007

Population dynamics is concerned with modeling and understanding the relationships between members of a population, in particular their genetic similarity. Kingman's coalescent is a probability model for describing the ancillary relationships between genes sampled from a current population, under the assumption that evolution is neutral relative to this gene. Random processes of mutation can be imposed on the branches of the coalescent, leading to distributions of genetic diversity.

This week was an intensive course attended by 25 students at the master and PhD level, mostly from mathematics, centered around the coalescent, introducing the students to the mathematical concepts necessary to understand its construction, and studying several extensions. As Kingman's coalescent is a Markov process in continuous time, the week started with an introduction to such processes (by Ronald Meester), together with a number of other genetic applications of Markov processes. Next Kingman's coalescent was introduced (by Aad van der Vaart) followed by an introduction to mutation processes (by Frank den Hollander). The short course was concluded by a discussion of statistical inference on coalescent and mutation processes (by Aad van der Vaart). Additional illustrative talks were given on hidden Markov models (by Mathisca de Gunst) and on variations of the coalescent (by Matthias Birkner).

Motivation for the course was taken from Simon Tavare's St. Flour lecture notes and many recent articles on the subject. The students were successfully brought to the level of recent research in stochastics, in which population dynamics is an important topic.

The Lorentz Centre, in which all students had an office and which provided for ample opportunities for social exchanges, proved to be a very productive environment both for learning recent research ideas and for getting to know other young scientists in the Netherlands with similar interests.

The week was sponsored by the Thomas Stieltjes Institute for Mathematics and the cluster Nonlinear Dynamics of Natural Systems (NDNS+).

Aad van der Vaart (Vrije Universiteit Amsterdam, Netherlands)
Sjoerd Verduyn Lunel (Leiden University, Netherlands)

Scientific Report

Mathematical Modeling and Analysis of Biological Networks

January 29 – February 2, 2007

This workshop was organized by the mathematics cluster Nonlinear Dynamics of Nonlinear Systems + (NDNS+), and focused on applications of mathematics in the life sciences. Some lectures were delivered by key members of the NDNS+ cluster. The main part of the program was divided over four themes:

(i) Molecular recognition (Monday/Tuesday);
(ii) Brain sciences: time series analysis and network analysis (Tuesday/Wednesday);
(iii) Reaction networks (Wednesday/Thursday);
(iv) Stochastic models in genetics (Thursday/Friday).

These themes cover a wide range of applications in the life sciences, and also involve the full spectrum of mathematics represented in the NDNS+ cluster (analysis and stochastics). The lectures were delivered both by life scientists and mathematicians. The extended lunch breaks and evenings offered ample opportunity for exchanging ideas. The broad perspective and views across the borders was appreciated, and will lead to further interaction between mathematicians and life scientists, as well as mathematicians of different backgrounds.

The topics of the workshop covered biological processes at all levels of organisation. Molecular processes were exemplified by protein-protein recognition, the modulation of receptor activity, or biochemical systems viewed as mathematical control systems. Other talks considered interactions of cells with their environment or interactions between cells, leading for instance to bacterial microfilms, cellular transport mechanisms, or neuronal networks. Besides by talks on the structure, plasticity and growth of neuronal networks, the brain sciences were represented by attention for the use of time series of MEG or EEG data to characterize functional networks, and mathematical modelling of cognition as an input-output system at a higher level of organization. At the highest of biological organisation topics considered were as diverse as social interaction among ants, and evolution. Probabilistic models for evolutionary genetics were considered by several speakers, and addressed the ancestral relations between DNA sequences, the development of mutations and the resulting genetic types in time, and the effects of mutations on reproductive modes.

The need for more and appropriate mathematical models was mentioned by several of the life scientists. The importance of accurate methods to fit such models to data was also made clear, as was the necessity of studying the (in)sensitivity of models to changes in parameter values.

Sjoerd Verduyn Lunel (Leiden University, Netherlands)
Aad van der Vaart (Vrije Universiteit Amsterdam, Netherlands)

Scientific Report

Graphene

February 5 – 9, 2007

The workshop on "graphene" has taken place from Feb. 5 to Feb. 9. The total number of registered participants was around 70, coming from all over the world. In addition a large number of participants from The Netherlands joined the workshop for individual days –the maximum number of participants reached 120 on the first day of the workshop. Both senior and junior participants took active part in the workshop and contributed to the lively atmosphere and discussions that have been taking place during the entire week. These were stimulated by the particular format of the workshop. The number of talks scheduled per day was typically three or four. These were all extended talks during which the initial part of the discussion took place, contributing to an easy interaction between the participants even after the talks. One poster session was scheduled. We followed a similar format in a previous workshop, and as in that case this format was particularly appreciated by the participants.

The purpose of this workshop was to bring together researchers in the booming field of graphene electronics and to give an overview of the present state of the art in this field, both experimentally and theoretically. Since the field is evolving rapidly in this period many new and unpublished results were discussed at the workshop. This has contributed to maintain a constant level of excitement among the participants. At present Dutch researchers form a considerable fraction of the leading scientist in the field of graphene electronics. The workshop has contributed to spread the interest in graphene to a larger number of Dutch senior and junior scientists that were not previously active in this field. In all these respects the workshop fully reached its goals, even beyond expectations. It is clear that the field will continue to flourish in the future with many new experimental and theoretical findings.

The participants clearly expressed their enthusiasm for the workshop, they appreciated the scientific contents as well as the logistic organization. Particularly efficient was the role of the Lorentz Center management.

A. Morpurgo (Delft, Netherlands)
M.I. Katsnelson (Radboud University, Netherlands)
A.K. Geim (Manchester University, U.K.)
J. van den Brink (Leiden University, Netherlands)

Scientific Report

Nanoscale Magnetic Resonance Imaging and Localized Spectroscopy

February 12 – 16, 2007

Scientific content and motivation

The objective of this workshop was to get scientists in the world together to Magnetic resonance imaging and localized spectroscopy are well-known tools in medicine and molecular biology. Forging the tools for NMR imaging at the level of the cell and down to the level of molecules, including spectroscopic investigations of cellular constituents, requires a merger between MRI methods and AFM methods and can be the next step in NMR imaging research: Magnetic Resonance Force Microscopy (MRFM). Successful implementation of this technology can lead to fundamental breakthroughs in instrumentation in life science (systems biology) and nanoscience investigations. In the workshop experts have been brought together to draft a road map, identifying the hurdles and knowledge gaps that need to be resolved.

As all nuclear magnetic resonance methods, MRFM has intrinsically low selectivity and sensitivity. In principle single-spin sensitivity is possible, however, by optimizing gradient and cantilever designs. For (selective) imaging of small ensembles of spins at ambient temperatures, RF induced, microwave induced and light-induced dynamic nuclear polarization methods, based on polarization transfer from electrons to nuclei, will be necessary to overcome existing detection limits.

The workshop was linked into the Dutch science community through the involvement of the Cyttron molecular imaging program and the national genomics center of excellence Center for Medical Systems Biology (CMSB) and the Advanced Spectroscopy facility of the Institute for Molecules and Materials (IMM) at Radboud University.

Topics addressed in the workshop

Among the issues that were addressed are:

- Range and limitations of microcoils vs. AFM tips
- Spatial resolution in 2-D and 3-D
- How to deal with strong gradients
- Cantilever design
- Modalities for imaging, e.g. multislice inversion recovery, making movies
- From the current stage of chemical contrast to spectra with resolution: many ideas are around and need to be discussed
- Potential for 2-D spectroscopy methods
- The sensitivity limit is now 10^3 nuclear spins and what can be done to improve this further (DNP, photo-CIDNP)
- How to implement molecular imaging at subcellular levels: relaxation agents and tagging with polarizers
- Sample preparation, including isotope labeling (e.g. D_2O for contrast)
- Applications in systems biology
- Applications in nanoscience

Scientific Report

Outcome of the Workshop

The program has included review presentations from pioneers in the field, as well as presentations reviewing the urgency arising from the applications. The main purpose of the workshop was to deliver a road map for development and implementation of the technology, identifying the dynamics in the current scientific progress, identifying knowledge gaps and possible routes to fill up these gaps. To achieve this, the participants were divided over panels addressing the state of the art, knowledge gaps and further directions for research in establishing

1. Molecular Structure Microscope;
2. Sub-micron Imaging and Localized Spectroscopy by MRFM;
3. Hyperpolarisation for NMR microsamples;
4. Microcoil Magnetic Resonance Imaging and Localized Spectroscopy; and
5. Imaging Applications of Cells and Tissue.

An extensive report on the outcome of the panel discussions is available through the organizers. The main fundamental research needs identified during the workshop are:

- Methods to overcome problems related to the relaxation of the nuclear spins need to be developed. The current predominant detection scheme involving adiabatic reversals demands rotating frame spin-lattice relaxation of tens of microseconds. True versatility demands the possibility to work with samples of much shorter $T_{1\rho}$;
- To achieve single nuclear spin sensitivity, gradients of at least 200 G/nm with force detection in the sub-attonewton regime will be necessary.
- Generation of high hyperpolarisation in biological functional units that aims to provide high levels of hyperpolarisation and direct them into regions of specific interest in small volumes will be important.
- Resolving chemical shifts and monitoring of dipolar interactions needs to be worked out.
- Methods for fast acquisition and parallelization will have to be developed.
- Image processing requires deconvolution of point spread functions and advanced filtering will be essential for an operational device and do not exist yet.
- F-MRFM probes and their application needs to be explored

The workshop was the first of its kind, at a very early moment in the development stage. One invited speaker at the workshop, Tjerk Oosterkamp, a young scientist early in his career, has, as a direct result from the workshop, been able to acquire an ERC Startup Grant for research into the MRFM field.

Acknowledgments

The facilities of the Lorentz Centre (offices with computers, common room) were excellent for the purpose of the meeting, which was the conception of a new instrumental method, rather than just having a progress report on an ongoing process.
This workshop would not have been possible without the financial support of the Lorentz Center, The CMSB, Cyttron and the IMM. The organizers are particularly grateful to Martje Kruk, Henriette Jensenius and Wies Groeneboer for their help and assistance.

Huub de Groot (LIC, Leiden University, The Netherlands)
Jorg Matysik (LIC, Leiden University, The Netherlands)
Hartmut Oschkinat (FMP, Berlin, Germany)
Beat Meier (ETH, Zürich, Switzerland)
Arno Kentgens (RU, Nijmegen, The Netherlands)

Scientific Report

MUSE Busy Week

February 19 – 23, 2007

From 19-23 February 2007 the MUSE instrument team gathered in the Lorentz Center to discuss the progress and critical items of the MUSE instrument. MUSE—the Multi Unit Spectroscopic Explorer—is a 2nd generation instrument for the VLT which uses a combination of wide-field integral field spectroscopy and adaptive optics to allow for both large area blind surveys of the high-redshift universe as well as resolved spectroscopy of extended nearby objects, like galaxies or globular clusters, resolved stellar spectroscopy of galactic sources, and high-spatial resolution monitoring of solar-system bodies. The MUSE instrument is being designed and built by an international consortium of 6 international institutes in partnership with ESO.

MUSE is currently in its preliminary design phase, which involves close collaboration between the different partners to remove discrepancies between the elements designed at the various institutes. This MUSE Busy Week was planned to provide input for the MUSE Preliminary Design Review, to take place in July 2007. As the title of the meeting already suggests, the Busy Week meeting required intense exchanges of information, both across the whole consortium, and between small working groups. The team meeting took place in the form of a number of plenary sessions, but mostly in smaller groups to discuss certain aspects of the MUSE instrument, science and interfaces. The days were divided in roughly four sessions, each containing either a plenary or group session.

With the optical design of MUSE nearly frozen and an initial mechanical design of MUSE available, more detailed items of MUSE needed to be discussed. After the initial day, which was mainly dedicated to the (project) management of MUSE, the independent subsystems of MUSE were addressed.

- The MUSE instrument will have a metrology system which keeps the instrument and its AO system (GALACSI—developed by ESO) aligned. This system should work in the various modes of MUSE and finally a good compromise between complexity and accuracy was found.
- The different elements of MUSE will have to interface together and fit within the total allowable mass- and volume budget. During the busy week both meetings on the overall mechanics of MUSE as well as meetings on the various substructures were held, like the Calibration Unit, Integral Field Units and support structure.
- Since MUSE will be operating with more than 24 ccd-cameras, cooling, vacuum systems and electronics are important elements of MUSE, even in the overall mass budget. A relatively advanced design of the cryogenic- and vacuum system was presented, base on LN_2 cooling. Furthermore, a balanced division was made between the MUSE instrument and the MUSE AO system GALACSI on the use of the available resources, like power and cooling.
- To be able to maintain the performance of MUSE detailed error budgets have been made and a full simulation of MUSE is under way, to verify that the expected performance is achieved.
- MUSE is a relatively complex instrument without movable elements for alignment. This means that special care is needed for the assembly, integration and testing (AIT) of the instrument. A significant effort was devoted to determining the optimal way to do the AIT of MUSE both in Europe as well as in Chile. With 24 spectrographs, full (re-) alignment

would cost too much time and an intelligent alignment scheme and stable structure is required to be able to deliver the instrument on time.

The week concluded with the bi-monthly MUSE Progress Meeting, where the consortium provided the client (ESO) with a summary of progress since the previous meeting. This meeting was a significant mile-stone in the project's development and the overall conclusion was that MUSE is well under way and that a lot of progress was made. The consensus was that the MUSE Busy Week was very successful, both from the perspective of progress in the instrument as well as in interaction of the MUSE team members.

Remko Stuik (Leiden Observatory, Netherlands)
Richard McDermid (Leiden Observatory, Netherlands)
Tim de Zeeuw (Leiden Observatory, Netherlands)

Scientific Report

Computational and Mathematical Approaches to Societal Transitions

February 26 – March 2, 2007

The field of societal transitions is relatively young, especially with regard to computational and mathematical methods. The field however is expanding rapidly and this workshop is a sign of this. The aim was to broaden the scope of the research on societal transitions with exact methods. From various exact scientific fields and disciplines researchers were selected with a fascination for societal phenomena. Some 40 participants were present, ranging from economics to physics and sociology to complexity coming from New Zealand to Brazil, Italy to the United Kingdom and all over the world. The variety of disciplines, however and the fact that the topic of societal transitions was relatively new to the participants as well asked for a different approach to this workshop.
The organisation chose to organise this workshop in a really interactive way, rather than to have lectures, discussions, lectures, etc. the aim was set in the beginning of the week to produce some results by the end of the week. This was to be interpreted as prototypes of transition models, actual computational and mathematical approaches. To facilitate this, the organisation called in Harry te Riele as a facilitator/showmaster. Together with Jessica de Boer and her team of artists they succeeded in creating an intensely creative atmosphere, which proved to be a good way to cross the boundaries of the different backgrounds and disciplines. Jessica and her team also organised the "meet the scientist" evening on the Wednesday where we presented the workshop and the preliminary results to a general audience in "de Veenfabriek". Roughly the week featured a transition from a general "what are transitions" to "how can we use our computational and mathematical tools with them". The objective to have concrete results was met completely with five presentations of teams of participants presenting their proto-models.
The outcomes of this workshop exceeded everyone's expectations, both in tangible and intangible results. To start with the latter – not even mentioning the tremendous fun and great evenings – the intense week led to the coming in to being of a new scientific community. This international community, latter dubbed ExTraScience (www.drift.eur.nl/extrascience), which stands for Exact Transition Science, consists of people that in the vein of this workshop apply exact methods to study societal transitions. The workshop has produced several fruitful ideas and collaborations that are leading to a special issue in the journal Computational and Mathematical Organisation Theory (CMOT) which is to see the light halfway 2008. The ExTraScience community comes together in real life as well for instance at the ENS in Paris in June and October 2007, for general collaboration and for the special issue (courtesy of CERES-*ERTI*, www.environnement.ens.fr). For 2008 the organisation has been invited to organise a "Modelling of Societal Transitions" session for the fifth conference of the European Social Simulation Association (**www.essa.eu.org**).

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J. Timmermans (DRIFT, Erasmus Universiteit Rotterdam FSW)
M. Schilperoord (DRIFT, Erasmus Universiteit Rotterdam FSW)

Scientific Report

Extragalactic surveys with LOFAR

March 6 – 8, 2007

LOFAR, the Low Frequency Array, is a next-generation radio telescope that is being built in the Netherlands and expected to be fully operational at the end of this decade. It will operate at frequencies from 15 to 240 MHz (corresponding to wavelengths of 20 to 1.2 m). Its superb sensitivity, high angular resolution, large field of view and flexible spectroscopic capabilities will represent a dramatic improvement over previous facilities at these wavelengths. As such, LOFAR will carry out a broad range of fundamental astrophysical studies and will be an important vehicle for astronomical research in the Netherlands.

An important goal that has driven the development of LOFAR since its inception is to explore the low-frequency radio sky by means of a series of unique surveys. We are planning to exploit the unprecedented sensitivity and wide instantaneous field of LOFAR to conduct large-sky surveys at 15, 30, 60, 120 and 200 MHz. Such surveys should start in 2009, when the 100 km LOFAR should become operational.

Four topics are driving the definition of the proposed surveys. These are:

- Formation of massive galaxies, clusters and black holes using z>6 radio galaxies as probes,
- Intercluster magnetic fields using diffuse radio emission in galaxy clusters as probes,
- Star formation processes in the early Universe using starburst galaxies as probes, and
- Exploration of new parameter space for serendipitous discovery.

The aim of the meeting was to (i) provide input for planning the surveys and subsequent production, (ii) plan preparatory/follow-up observations, (iii) discuss theoretical simulations related to the survey science.

During the meeting about 60 % of the time was devoted to scientific presentations related to the main scientific topics that will be addressed by the surveys. The remainder of the time was devoted to lively discussions. These discussions were first held in subgroups with subsequent plenary sessions to summarize the conclusion reached in the subgroups. These discussions focused on:

- Does the current set of surveys cater for our needs?
- What scientific topics do need more input?
- How do we get organised?
- Can we plan/prioritize the various surveys/fields/frequencies?
- What needs to be done as preparatory and follow-up observations?

The list of people that attended the meeting included members of the survey team plus selected members from the LOFAR project. The list contains staff members at astronomical institutes (75 %) and PhD students/postdocs working on the project (25%).

The meeting was a great success. It not only gave a good overview of the science related to the survey, but it represented an important step towards the definition of the surveys and the constitution of the science working groups. A key element of this success was that the

Lorentz Centre not only provided the conference facilities, but also office space and smaller meeting rooms where the science working groups could meet.

Huub Röttgering (Sterrewacht Leiden, Universiteit Leiden)
Peter Barthel (Kapteyn Instituut, Groningen)
George Miley (Sterrewacht Leiden, Universiteit Leiden)
Raffaella Morganti (Astron, Dwingeloo)
Ignas Snellen (Sterrewacht Leiden, Universiteit Leiden)

Scientific Report

Brain Mechanisms and Cognitive Processes in the Comprehension of Discourse

March 12 – 16, 2007

The aim of this workshop was to investigate neurological bases of higher-order cognitive processes, particularly those involved in the comprehension of language in discourse. In research on discourse comprehension, linguists and cognitive psychologists have combined forces (such as via the Society for Text and Discourse meetings) for some time. However, the understanding of the neural basis of discourse comprehension, and its implications for cognitive and linguistic theory, has remained relatively undeveloped. One reason is that, for experimenters, the combination of discourse-level language materials and neuro-imaging methodology presents a number of challenging practical problems. A deeper reason is that the expertise needed to design a good discourse-relevant neuro-imaging study, or to develop a theory of discourse comprehension that takes into account what we know about language, about cognition, and about the brain, is distributed over different, relatively non-interacting scientific communities: whereas discourse experts meet in forums such as the Society for Text and Discourse meetings, much of the psycholinguistic neuro-imaging expertise has until recently been concentrated in laboratories focusing on sentence-level issues, with the experts meeting at such forums as the CUNY sentence processing conference, the Cognitive Neuroscience Society meeting or the Human Brain Mapping conference. Although historically and sociologically understandable, this separation of fields is unfortunate and bound to block progress.

The aim of our 5-day workshop was to advance our understanding of how readers and listeners comprehend discourse by bringing together representatives from linguistics, cognitive psychology, and (cognitive) neuroscience, and by providing an atmosphere conducive to the exchange of ideas, mutual learning, and development of ideas for future research. Over 40 participants from around the world attended. Those with a focus in neuroscience were able to familiarize themselves with linguistic and cognitive theories of discourse comprehension, whereas those with a focus on linguistics and cognition were able to become acquainted with relevant findings and methodologies in cognitive neuroscience.

The morning sessions were organized in terms of the various fields involved in discourse comprehension research: (1) constraints from linguistics and from neuroscience, (2) processing models, (3) high-speed neuro-imaging studies (EEG, ERP), (4) neural substrate identification (fMRI, PET, hemifield techniques), and (5) individual variations in discourse comprehension, including patient research. For each discipline, two senior speakers presented an 1-hr plenary overview of their own and related research approaches and specifically identified issues relevant to interdisciplinary collaboration (e.g., what they need from other fields as well as what they can bring to those other fields). Afternoon activities consisted of small-scale discussion groups around specific themes, followed ba a 1-hr plenary lecture on a topic relevant to discourse comprehension (e.g., conversation, figurative language). In addition, afternoons hosted a demonstration/tutorial of neuro-imaging techniques, a poster session (with ~ 30 posters), and a social event.

The presentations and posters were of very high quality and, more importantly, evoked considerable cross-disciplinary discussion and interaction. As a result, participants from each of the various areas expressed the usefulness of the workshop. The final discussions considered the possibility of a recurring workshop as well as the possibility of publication of

research presented here. Posters and presentation slides of all participants will be placed on the workshop website for easy access.

We want to express our deep gratitude to Martje Kruk, Henriette Jensenius, and Gerda Filippo, and the other staff of the Lorentz Center for their assistance in making this workshop a success. We thank the Lorentz Center, the Netherlands Institute for Advanced Studies, and the Psychology Department of the University of Amsterdam (Psychonomics group) for their financial support.

Paul van den Broek (Univ. of Minnesota, Unites States)
Jos van Berkum (Max Planck Institute & University of Amsterdam, Netherlands)
Evelyn Ferstl (Univ. of Sussex, United Kingdom)

Scientific Report

Two-dimensional Turbulence

March 19 – 23, 2007

The aim of the workshop was to bring together researchers working on various aspects of two-dimensional turbulence. Originally motivated by its relevance to large-scale geophysical flows, this branch of fluid dynamics has inspired (and continues to do so) many scientists during the last two decades, ranging from mathematicians, theoretical physicists, plasma physicists and fluid dynamicists to astrophysicists, meteorologists and physical oceanographers.
Approximately 60 participants from around the world [USA (10), Canada (7), Israel (5), Japan (1), United Kingdom (8), France (7), Italy (5), Denmark (2), Sweden (2), The Netherlands (14)] took part in the meeting, the majority of them staying for the full week. The participants ranged from PhD students to well-established researchers in the field. The programme included eight invited review lectures and approximately 30 shorter presentations by regular participants.
The review lectures covered a wide variety of aspects:

Robert Ecke (USA) – Experiments on quasi-two-dimensional turbulence
Guido Boffetta (It) – Conformal invariance in two-dimensional turbulence
Gregory Eyink (USA) – Circulation cascades in two-dimensional turbulence
Marie Farge (Fr) – Intermittency and coherent vortices in 2D turbulence: a wavelet point of view
Antonello Provenzale (It) – Cascades, instabilities, and transport in 2D turbulence
Erik Lindborg (S) – Can the atmospheric energy spectrum be explained by 2D turbulence?
Geoffrey Spedding (USA) – Experiments on turbulence in stratified fluids
David Dritschel (UK) – The inviscid limit of two-dimensional turbulence.

The contributions of the regular participants included theoretical modeling issues (cascades, spectra, conformal invariance, intermittency, transport properties, coherent structures), laboratory experiments (in shallow-layer geometries, in rotating and/or stratified fluids), numerical simulations and atmospheric / oceanographic aspects (spectra, coherent structures, Rossby waves).
In general, both the invited and contributed lectures stimulated lively discussions. It was generally felt that the workshop was a great success, also due to the setting provided by the Lorentz Center.

The organizers are most grateful to the Lorentz Center for its generous support. Also, the organizational support provided by LC staff is greatly acknowledged. We also gladly acknowledge financial support from the JM Burgers Centre Research School for Fluid Mechanics to support the participation of PhD students, the FOM 2D Turbulence programme, TU/e, and the SMARTER NWO-Computational Science programme for support of invited senior scientists.

Herman Clercx (TU/e, Netherlands)
GertJan van Heijst (TU/e, Netherlands)

Scientific Report

Show Physics

March 26 – 30, 2007

Show Physics is an outreach activity which consists of performing science shows at schools and other science venues. In this way, contacts between the scientific community and society are built and the image of science is positively influenced.

Show Physics is often an ad-hoc activity, initiated by one or more enthusiastic persons. The background of these persons varies greatly from physics show group to group; there are activities which are initiated by students, university professors, actors, museum staff, etcetera. For this reason, there is great potential in bringing the show physics groups together and exchanging best practices, which is what was done at the Lorentz Center workshop *Show Physics 2007*.

The workshop consisted of two components. The first was a series of lectures with talks both by experienced science communicators and by representatives from the science shows present. The function of the former is to give the groups a solid overview of what kind of activities have been successful in the past, while the latter serves to introduce the groups to each other, from which possibilities for cooperation and synergy can be found.

The second component of the workshop consisted of a series of experimental sessions, for which participants were encouraged to bring their demonstration experiments with them to Leiden. In these sessions, the participants showed each other their experiments. This component culminated in a demonstration of all of the experiments on the streets of Leiden on the second-to-last day of the workshop.

Besides these two main components, there was also a social part of the program, including a boat tour in Leiden, a conference dinner, and a visit to Teylers museum on the last day of the workshop. Such a social program is essential for a workshop which derives a great deal of its added value from the contacts which are created.

The Show Physics 2007 workshop has generated positive responses from all of the participants, and one participant has taken it upon him to organize Show Physics 2008. This clearly demonstrates the success of the workshop, and the need for more of such activities.

Furthermore, many show physics groups which were represented at the workshop have learned new experiments from this workshop, which they have incorporated into their demonstrations. In this way, *Show Physics 2007* has strengthened physics shows across Europe.

K. Herbschleb (RINO, Netherlands)
J. Renema (RINO, Netherlands)
C. Voetmann (Aarhus University, Denmark)

Scientific Report

The Many Faces of Quantum Fields

April 10 – 13, 2007

Quantum Field Theory (QFT) is the main framework of all fundamental physical theories up to the Planck scale. It not only generates the Feynman diagrams that match scattering experiments in particle physics to a high precision. In the past decades QFT has found many applications from condensed matter physics and quantum optics to cosmology covering an enormous range of scales. The connection between different regimes requires concepts like symmetry breaking and renormalization.

In a parallel development, perturbative calculation schemes have been supplemented by approaches to the nonperturbative regime. On the analytic side these are for instance mean field theory, large-N approximations and instanton methods. The latter are closely related to other solitonic excitations like monopoles, vortices and strings which allow the study of non-vacuum sectors of the theory. Chiral fermions, present for topological reasons, and supersymmetry have brought in new phenomena including the concept of duality.

The discretisation on space-time lattices is the best suited regulator of QFT with respect to numerical computations. In particular lattice gauge theory has developed many techniques to explore the world of strong interactions. Moreover, field theories at finite temperature and density and in gravitational backgrounds have become prominent tools for the investigation of physical systems. These include phase transitions in the early universe with effects like cosmic strings and baryogenesis which under some circumstances call for QFT methods out of equilibrium.

The workshop brought together experts in various aspects of QFT. The 31 participants were from 10 different countries, with a considerable fraction of PhD students and postdocs to truly leading figures like G. 't Hooft, R. Jackiw (who gave a very interesting Colloquium Ehrenfestii) and M . Luescher. Most of the talks had a review character which helped interactions between the different branches, mainly in smaller groups. We actually keep the talks available at the webpage, such that the lines of argument (as well as certain details) can be looked up at any time.

Several participants paid their compliments about the informal and fruitful atmosphere at the Lorentz center. We would like to thank Yolande van der Deijl for helping us with the organization of this workshop.

J.W. van Holten (VU, Netherlands)
J. Smit (UvA, Netherlands)
F. Bruckmann (Regensburg University, Germany)
A. Achucarro (Leiden University, Netherlands)

Scientific Report

Theory, Modeling, and Evaluation of Single-Molecule Measurements

April 16 – 20 2007

Single-molecule measurements provide qualitatively different data than conventional experiments on ensembles. Noise, fluctuations, irreproducible events can distort, or limit measurements, but at the same time provide novel information. Understanding and exploiting single-molecule data requires fresh theoretical and statistical approaches, which in turn are spawning a broad variety of new theoretical questions and experimental methods. During the last decennium, theoretical literature on single molecules has vigorously grown, with Lévy statistics and weak ergodicity breaking in the blinking of molecules and semiconductor nanocrystals, maximum entropy methods to analyze data, Markov chains in the complex reaction pathways of biomolecules, and the generating function formalism connecting density matrix approaches with multi-event probabilities.
The workshop brought together prominent theorists and experimentalists to develop a community of language and approaches in this exciting new field. Several of the workshop speakers are authors of a book scheduled to appear in early 2008. By laying the foundations of an emerging field, the workshop has been of service to a broad community spanning chemical physics, material science, nanoscience, and life sciences.

The program included sessions on general mathematical tools, ergodicity breaking, theory and statistics of force measurements, molecular motors, conformational dynamics and interactions of biomolecules, evaluation and analysis of fluorescence data.

There were 46 registered participants from the USA (12), the Netherlands (10), Europe (15), Israel (4), Asia (2), the Americas (2), and Australia (1), and 25 speakers. The general impression was of a very lively workshop, with passionate discussion and debate during and after the sessions. The participants were particularly delighted by the working ambience and the location of the workshop – Holland in tulip time-, as well as the facilities and helpful staff of the Lorentz Center.

E. Barkai (University of Bar-Ilan, Israel)
F. L. H. Brown (University of California at Santa Barbara, USA)
H. Yang (University of California at Berkeley, USA)
M. Orrit (Leiden University, Netherlands)

Scientific Report

Quantum effects in arrays of nanocrystals

April 23 – 27, 2007

Recent years have seen explosive growth of interest in the physics of *arrays of nanocrystals*: a new class of artificially manufactured materials with programmable properties which can be modified by altering the nanocrystal composition and size. Arrays of nanocrystals include various granular systems containing metallic, ferromagnetic or superconducting granules, artificially prepared arrays of quantum dots or superconducting tunnel junctions. The modern technologies allow for preparing the arrays with the size of a basic unit varying from *1* up to *100 nm*. Due to a drastic decrease of a nanocrystal size the thermodynamic and transport properties of arrays are governed by specific interplay between quantum-mechanical effects and mesoscopic phenomena. The recent discoveries boosted this field of research. E.g. it is a metal-insulator transition and cotunneling in granular systems, quantum phase transition in chains of small Josephson junctions, observation of a giant enhancement of macroscopic quantum tunneling (MQT) in layered high-T_C superconductors. These quantum effects are due to a peculiar interplay of quantum-mechanical tunneling between nanocrystals, Coulomb interactions, and disorder and/or superconducting fluctuations. From the theoretical point of view the arrays of nanocrystals is a particular example of strongly interacting many-body systems, and, therefore, the development of the adequate methods and models allowing analysis and description of such structures is of a great fundamental interest.

The main purpose of the Workshop was to bring together the leading experts in study of thermodynamic and transport properties of diverse nanostructured systems. There were 26 participants who presented talks and took part in discussions focused on recent experiments and theoretical approaches.

The main topics of the workshop were as follows: theoretical approaches to description of arrays of nanocrystals, arrays of metallic/magnetic granules, arrays of semiconductor quantum dots, mesoscopic superconducting tunneling junction arrays, layered high-T_C superconductors, arrays of Josephson pi-junctions, nonlinear excitations in the arrays of nanocrystals, dissipation, decoherence and noise effects.

Following the tradition of the Lorentz Center, the workshop has provided ample time for informal discussions. Each participant has been given a desk and access to a computer. Two to three talks were given each morning, while afternoons were mostly used for informal round-table discussions and collaborations. There was very fruitful interaction between experts working in different areas. The discussions between participants have initiated novel projects, e.g. nonlinear transport in disordered superconducting films, the macroscopic quantum tunneling (MQT) in diverse inhomogeneous superconducting systems, transport in graphene based systems, etc.

The workshop organizers and participants would like to extend their most sincere gratitude to Martje Kruk-de Bruin and Gerda Filippo for their hospitality and the efficient and qualified running the workshop.

V.M. Vinokur (Argonne National Laboratory, Argonne, Ill. USA)
M.V. Fistul (Ruhr University, Bochum Germany)
A. Golubov (University of Twente, Enschede, Netherlands)

Scientific Report

Stieltjes/Diamant Instructional conference & workshop
Solvability of Diophantine equations

May 7 – 16, 2007

From May 7-11 we organized an instructional conference on methods to solve Diophantine equations for Ph.D-students and young post-docs (under the auspices of the Thomas Stieltjes Research Institute and the Diamant cluster) and from May 14-16 an advanced workshop on the same topic for experienced researchers.

Already in the 1960's and before, mathematical methods were developed which made it possible in principle to resolve certain classes of Diophantine equations, e.g., A. Baker's lower bounds for linear forms in logarithms of algebraic numbers, and the hypergeometric method going back to Thue and Siegel. With the advancement of computer technology, in the 1980's it became possible with these methods to resolve such Diophantine equations in practice. During the past 12 years there were new breakthroughs in mathematics which made it possible to resolve several other classes of Diophantine equations which could hitherto not be attacked. Wiles and Taylor gave a proof of Fermat's last theorem that the sum of two positive n-th powers, where n is a integer greater or equal than 3, cannot be an n-th power.
In their proof they introduced new techniques based on modular functions and Galois representations, which turned out to be very fruitful to handle generalizations of Fermat's equation. Mihailescu managed to prove Catalan's conjecture that 8 and 9 are the only consecutive powers by new ideas from algebraic number theory. Flynn, Poonen, Schaefer, Bruin and others developed a method of Chabauty from the 1940's based on p-adic analysis and used this to determine the rational points on certain algebraic curves. A current trend is to prove general theorems on Diophantine equations by combining the above mentioned techniques with extensive computations.

During April and May 2007 Prof. Michael Bennett (University of British Columbia, Vancouver) was visiting the University of Leiden as a Kloosterman professor. Prof. Bennett is one of the leading experts on effectively resolving Diophantine equations with a broad knowledge of the above mentioned methods, and the instructional conference and workshop were organized on occasion of his visit.

The lectures at the instructional conference from May 7-11 were given by Prof. Bennett, Prof. Bugeaud (Strassbourg), Prof. Siksek (Warwick) and Dr. Bruin (SFU, Vancouver). These lecturers took care of the program of the instructional conference, with Prof. Bennett as the leading coordinator. The lectures were given in the mornings. In the afternoons there were exercise sessions, in which the participants could practice with the material taught in the mornings. On Friday May 11 there were four lectures for a general audience. The lecturers had taken great care to make the material accessible to non-experts. The instructional conference had 45 participants, mainly consisting of Ph.D-students from Europe, America and Asia, and also several Ph.D-students from the Netherlands.

For the workshop from May 14-16 we had invited 15 leading experts, among whom the four lecturers of the instructional conference and 11 other invitees from Europe, America and Asia, namely I. Chen (SFU, Vancouver), P. Corvaja (Udine, Italy), J. Cremona (Nottingham), W. Ivorra (Paris XII), S. Laishram (Tata Institute Mumbay), F. Luca (Morelia, Mexico), A.

Pinter (Debrecen, Hungary), C. Skinner (Princeton), M. Stoll (Bremen), S. Tengely (Debrecen) and G. Walsh (Ottawa). Apart from the invitees, there were 30 non-invited participants from all over the world.
There were 15 advanced lectures covering the whole area discussed above. Some of these were survey lectures and others discussions of recent work. Between the lectures there was ample time for informal discussions.

Both the instructional conference and the workshop were very successful, both for the quality of the lectures and for the number of attendees.

The material that was distributed among the participants has been posted on the web, namely the hand-outs and exercises for the instructional conference and the abstracts of the lectures given at the workshop. During the instructional conference and the workshop, the speakers posed several open research problems. These have been posted on the web as well, see for this material **http://www.math.leidenuniv.nl/~evertse**

The instructional conference and the workshop were sponsored, apart from the Lorentz Center, by the Thomas Stieltjes Research Institute, the Mathematical Research Institute, The Diamant cluster, and the Number Theory Fund. The KNAW offered financial support to the workshop.

Frits Beukers (Utrecht University, Netherlands)
Jan-Hendrik Evertse (Leiden University, Netherlands)
Rob Tijdeman (Leiden University, Netherlands)

Scientific Report

Silicon Nanoelectronics

21 – 25 May, 2007

Aim: In the past two years tremendous progress has been achieved in silicon nanoelectronics, based in large part on materials breakthroughs. These developments have been spread over several sub-fields that historically have been only loosely connected, yet the ultimate goals are similar: control over the degrees of freedom in silicon either (i) to make beneficial use of quantum phenomena in the context of quantum information, or (ii) to contain and control quantum effects in the context of classical electronics. The aim of the workshop was to gather experts on materials synthesis, quantum device fabrication, industrial silicon processing, and quantum materials theory for the exchange of ideas.

Participants and activities: The workshop attracted 52 participants from Australia, Austria, Belgium, Brazil, France, Germany, Israel, Italy, Japan, Spain, The Netherlands, United Kingdom, and the United States. There were 28 invited talks over 5 days. In addition, there was a lively panel discussion, and there were numerous informal discussions in front of posters and over coffee. The informal meeting space provided by the Lorentz Center was extremely valuable in this regard and was essential for helping to establish the friendly and open tone of the workshop.

Program: The workshop focused on six key areas in silicon nanoelectronics: electron spin resonance (ESR) in Si, prototype MOSFET devices and single-donor physics in such devices, engineering of single donor systems by both top-down and bottom-up methods, gated quantum dots in Si/SiGe heterostructures, materials issues and opportunities for silicon nanoelectronics, and theoretical developments, including decoherence phenomena and architectures for quantum computing.

Outcomes: The workshop was very successful in achieving its goals. This was the first international workshop to bring together the diverse group of researchers focused on silicon nanoelectronics with a special emphasis on quantum processes and properties. The invited talks were quite dynamic with a great deal of interaction between the speakers and the workshop participants, which is exactly what we had hoped for. The workshop was organized with a focus on a specific topic each day, and this contributed to the lively interactions. The panel discussion worked extremely well and provided an opportunity to discuss the future as opposed to the past, which is one of the most important roles for a workshop such as this. Another measure of success are a number of new interactions that have persisted after the end of the workshop. The presentations at the workshop were disseminated in electronic format to all the participants and to the organizations providing outside support.

Acknowledgements: The organizers would like to thank the staff of the Lorentz Center, especially Wies Groeneboer and Martje Kruk, for helping to organize a very successful and enjoyable workshop. We also would like to acknowledge generous funding support from the Lorentz Center, The Kavli Institute for NanoScience in Delft, The ARO and NSA, and Omicron Nanotechnology.

Sven Rogge (University of Technology Delft, Netherlands))
Mark Eriksson (University of Wisconsin, USA)

Scientific Report

N-body dynamics in near-Keplerian potentials

May 29 – June 1, 2007

Dynamics in near-Keplerian potentials play central role in planetary science and in the physics of galactic nuclei. The development of both disciplines has been somewhat disjoint. However, astronomical observations over the past decade strongly suggest that theoretical techniques developed in both fields could be mutually beneficial. Firstly, extra-solar planets have been discovered, and many of them have been found to move on highly eccentric, inclined orbits, much like stars move around supermassive black holes. Secondly, it has been discovered that young stellar discs, which look like scaled up planetary discs, are orbiting supermassive black holes in the centers of the Milky Way and Andromeda Galaxies. It was thus the purpose of the workshop to bring together researchers working on planetary and galactic dynamics, and address the topics of common interest.

In that, the workshop was highly successful. It overlapped with the Oort professorship of Scott Tremaine, one of the world's most prominent dynamics experts at Leiden Observatory. The workshop was attended by 42 scientists from Europe, United States, and Canada, working on a variety of aspects of the near-Keplerian dynamics. About half of the scientists were PhD students or postdoctoral fellows, and 7 of the scientists are working in the Netherlands.

The seminar time was split approximately equally between the talks on planetary dynamics and on galactic nuclei. About 1/3 of the seminar time was allocated for discussions, which were lively and fruitful. Parts of the afternoon were also left free for discussion and collaboration.

A wide range of topics was discussed, and of particular interest were physical ideas discovered in one field and applied to another. As an example, Hills' idea for tidal disruption of binary stars by a supermassive black hole has been recently extended into the context of Solar-system dynamics and used to explain formation of irregular moons of Neptune.

The response to the workshop was universally enthusiastic, in no small part because of the excellent LC facilities and staff support. The workshop was financed by the Lorentz Center, NOVA, and Oort lectureship fund.

K.H. Kuijken (Leiden Observatory, Netherlands)
Y. Levin (Leiden Observatory, Netherlands)
S. Portegies Zwart (UvA, Netherlands)
S. Tremaine (Princeton, USA)

Scientific Report

Designing the Bodyplan: Developmental Mechanisms

June 4 – 8, 2007

General Strategy
This was a meeting about concepts. We were concerned with "Developmental Principles" or "Developmental Mechanisms" which implement the embryo's body plan. We focussed on four aspects (below) which are important for the making the embryo's main body axis
These topics were presented and discussed in a workshop at the Lorentz Center in the University of Leiden, attended by 43 participants, ranging from the leading workers in the field to Ph.D. students and master students.
The topics were highlighted by presentations and then discussed, using highly interactive panel discussions which were initiated by the speakers answering some main questions and then continued with questions from the floor. We were lucky enough to have some very extrovert, challenging and active participants and animated discussions continued during the walks through the June countryside to and from our hotel; during the evenings; during a barbecue on the beach at Katwijk and a boat trip through the Kaag (a famous lake chain near Leiden) and in short at every possible opportunity. Because the meeting was about concepts, it included a session about theoretical models and theoreticians (who are excellent discussants). Due to the connectedness of the topics, it was inevitable that most were spread over different sessions. Where a talk connected two topics, a choice was made.
The topics, speakers and some of the main questions were as follows.

1/ Making the axial pattern.
Two principles are important for making different zones along the main body axis.
a/ Concentration gradients. A key mechanism is that cells respond to quantitatively different concentration ranges in a concentration gradient of an extracellular signal molecule (morphogen) and this causes them to express qualitatively different genes. Graded quantitative information is thereby converted into qualitative information, This provides a mechanism that can generate sequential zones of different cell types, for example, along the embryo's main axis. Gradients and their likely importance were ably introduced by Lewis Wolpert who pioneered this idea in the '60s. The topic was then explored for three well established axial gradients. Wnts (Rik Korswagen); Cdx (Steve Gaunt); retinoids (Malcolm Maden) A notable feature of this session was the demonstration, by Malcolm Maden, that retinoids pattern the neck region of the axis in all three germ layers in parallel.
b*/ Timing mechanisms*. A biological clock can also generate a spatial pattern. A key example here is the somitogenesis clock, a mechanism in which an oscillating system of gene expression is measured off in time to deliver repeating spatial units (somites) along the main body axis. This idea first featured in theoretical models in the '70s. It has now been clearly demonstrated by diect experimental evidence by Pourquie and his collaborators. There were five presentations on timing. Claudio Stern, with the role of timing in specifying and regionalising the brain. Tony Durston with his Hox timing model. Olivier Pourquie, Stan Mare and Tatiana Resende on somitogenesis. Highlights here were the spectacular advances in somitogenesis, Pourquie presented his real time visualisation of the somitogenesis oscillator and his microarray analysis of its oscillating gene expression.
2*/ The Hox module*:
One way of generating qualitatively different zones along an axis is where a chromosomal complex acts as a functional unit such that the physical order of the genes in the complex provides information for timing and/or or for spatial location of gene expression. The classical examples here are the Hox gene complexes. The hox genes were discovered in the

'70s by Walter Gehring among others and Hox colinearity was first documented in vertebrates by Denis Duboule among others. We examine how Hox complexes are regulated and how these function in delivering patterning information along the main body axis.
This topic was covered by 7 speakers; Walter Gehring; Denis Duboule; Alain Prochiantz; Joost Woltering; Jacqueline Deschamps; Olivier Pourquie; Tony Durston. This topic was, of necessity rather scattered over different sessions. Highlights from this topic were: the conclusions from Walter Gehring and Joost Woltering that posterior prevalence can depend on protein-protein interactions or on translational control via microRNA's respectively. This collinear property seems to be collinear of necessity (and is anyway anterior prevalence for 3' Drosophila hox genes). Its mechanism is presumably secondary. Prochiantz gave his usual brilliant exposition of homeoprotein transfer. Denis Duboule argued for evolution of different forms of hox colinearity from an amphioxus like hox cluster and pointed out that the highly compacted and collinear hox clusters found in vertebrates so far occur only in vertebrates. Olivier Pouquie's discovery of temporally collinear hox regulated gastrulation movements clearly links to the Durston group's discoveries concerning temporally collinear establishment of the hox pattern during gastrulation.
3/ *Coordinated cell movements*.
One of the least well investigated aspects of embryonic development is how embryos develop their shape (morphogenesis) via coordinated cell movements. We focussed on fundamental principles underlying this aspect during main body axis development. Kees Weijer presented his exciting discovery that directional cell movement to a signal source (chemotaxis) mediates morphogenesis of the embryo during axis formation and Pourquie presented his discovery of hox regulated ingression during gastrulation. Ray Keller amazed us all with his exposition of how hitherto undiscovered movements like convergence thickening subtly shape the embryo. Val Wilson reminded us that stem cells and growth are also important and Elena Tzouacanou followed cell lineage retrospectively.
4/ *Theoretical Models*
This meeting was about concepts and it was appropriate we had a session on theoretical models. This was ably chaired by Hans Meinhardt whose model for the evolution of bilaterality and incorporation of the trunk module never fails to amaze and inspire. Paulien Hogeweg presented a chemoptactic model of gastrulation based on Weijer's findings and Stan Maree a mathematical development of the (Cooke-Zeeman/Pourquie) clock-wavefront model for somitogenesis Frietson Galis's human defects in segmentation and Hans Metrz's evodevo completed a satisfying session
Besides the main topics, there were other exciting aspects. Lewis Wolpert's presentation of left right asymmetry. Markus Affolter's brilliant presentation of chemotaxis and other aspects during tracheal morphogenesis, Herman Spaink on Toll; Gabby Krens on ERK's.
Conclusion and perspectives
In conclusion, this field is definitely at a stage where the essence of the A-P patterning mechanism which has eluded investigators for more than 80 years is now finally within reach. It is extremely worthwhile to build on the foundations laid by this meeting. Measures underway/under discussion are: collecting and distributing the presentations from the meeting and a list of key references; and writing a joint review. The meeting was such a great success that we plan a series of related workshops in the future.
We thank Yolande van der Deijl and Martje Kruk and the Lorentz Center staff fore their really excellent organisation of the meeting. This created an extremely positive atmosphere which contributed greatly to its brilliant success.

T. Durston (IBL, Leiden University, Netherlands)
M.M. Jespers (IBL, Leiden University, Netherlands)

Scientific Report

Nonlinear Collective Behaviour: Networks, Swarming and Reaction-Diffusion Dynamics

June 11 – 15, 2007

The focus of this workshop was on the confluence of interdisciplinary research involving nonlinear cooperative behavior in complex systems. This is a broad research area with applications in many fields since cooperative behavior underlies much of the observed phenomena in nature.

Instead of surveying all aspects of the field of nonlinear cooperative behavior, the workshop emphasized some of the most exciting and least well developed aspects of this topic: reaction-diffusion dynamics in heterogeneous media, the dynamics of networks and cooperative behavior and swarming in systems with self-propelled elements.

In physical, chemical and biological systems cooperative behavior often stems from diffusive coupling of nonlinear elements and reaction-diffusion equations provide the prototypical description of such systems. Cooperative phenomena leading to pattern formation in homogeneous reaction-diffusion media have been intensively studied for several decades. This coupling between local nonlinear reaction dynamics and diffusion forms the basis for the description of many aspects of networks and the cooperative behavior of self-propelled elements. The new key feature of the application of reaction-diffusion ideas to these systems is the heterogeneity of the medium (for example, the network elements may be domains in space where specific sequences of reactions take place). The inclusion of spatial heterogeneity builds the connection between the relatively new research topics as the dynamics on networks and cooperative behavior and swarming, with the established field of reaction-diffusion systems.

This workshop brought together leading experts on these topics and quite a number of young researchers (PhD, postdoc and beginning tenure track). This double mixture of established and beginning scientists with a wide variation of backgrounds (biology, chemistry, mathematics, physics) worked extremely well. It was inspiring to all participants to find out that although the various approaches and types of 'scientific languages' were quite heterogeneous, there was a striking agreement on the central themes and questions in the field. For example, the mechanisms underlying the experiments on and observations of swarming by groups of animals (ants, birds, fishes) by Couzin could be (partly) understood by (extensions of) the models of Vicsek and Chate. The chemical experiments by Showalter and his group and the realistic models for dynamics and mechanics of cardiac tissue presented by Panfilov considered exactly the same type of phenomena as the more mathematical studies of Nishiura and others.

The Lorentz Center provided this multi-disciplinary group of participants with a stimulating atmosphere in which the different points of view -- experimental, computational, mathematical -- could be brought together and interact. The unique infrastructure of the Lorentz Center, for instance the combination of having offices (with extensive computer facilities) for all participants with a very pleasant common room, was crucial for the success of the workshop.

And the workshop was indeed successful. As was intended and hoped for from the beginning, the workshop succeeded in identifying the common tools and phenomena in the broad field of `collective phenomena', and in setting the perspective for future work in this field. The organization of this workshop was inspired by the success of another Lorentz Center workshop, that had a similar character and focus, `Patterns and Waves -- Mathematics and Nonlinear Chemistry', organized by Doelman and Nishiura in September 2001. Together, these two workshops may form the foundation of highly influential series of workshops in this intrinsically multi-disciplinary research field.

The workshop was supported by NDNS+, The Marie Curie Actions, NWO, FOM, and OCW.

R. Kapral (Toronto, Ontario, Canada),
K. Showalter (Morgantown, WV, United States),
A. Doelman (Amsterdam, Netherlands)

This workshop was co-sponsored by the EUs 6th Framework Program as part of a Marie Curie "Series of Events" (Conferences and Training Courses).

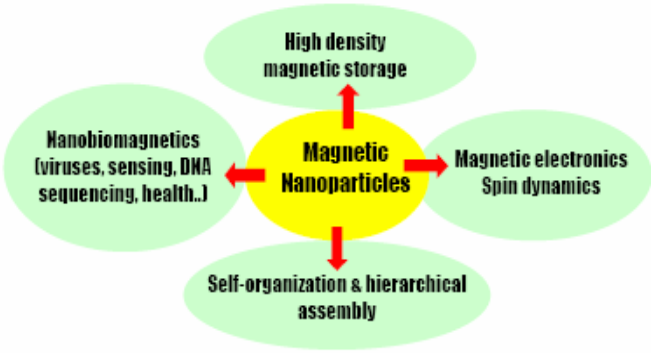
Scientific Report

Magnetic Nanoparticles: Challenges & future prospects

June 18 – 23, 2007

This was a workshop devoted to magnetic nanoparticles, considering both fundamental aspects and applications. Although magnetism is one of the oldest scientific disciplines, it remains at the forefront of the emerging nanotechnology era in limited atom systems such as nanoparticles, which bridge the gap between atomic and solid-state physics. As a subfield of nanoscience, nanomagnetism shares many of the same basic organizing principles, such as geometric confinement, physical proximity, and chemical self-organization. The control of their monodispersity and surface properties leads to a variety of nanotechnological applications. Their use as non-volatile data storage media offers some insuperable advantages over other forms of storage, which is based on a rare combination of extremely fast switching time with long term stability. The drive towards ever smaller and faster electronic devices has forced scientists to consider quantum dynamics, which governs the interaction of particles at atomic scale. Strong emphasis was paid on the impact of magnetic nanoparticles on biosystems/biomedical applications. Two of the principal challenges in biomedical nanoscience were illustrated such as: a) the detection of disease at the earliest possible time prior to its ability to cause damage (diagnostics and imaging) and b) delivering treatment at the right place, at the right time whilst minimizing unnecessary exposure (targeted therapy with a triggered release).

The efforts to understand magnetism, structure and their correlation in nanoparticle systems are hindered by the dispersion of their size and properties and by variations in surface structure (use of surfactants etc.). Furthermore, the resulting structures and properties depend very much on the kinetics of the preparation process, and therefore particles prepared with different techniques (cluster beam, evaporation, organometallic synthesis etc.) differ in their properties. Along with the advance in the preparation processes, new characterization techniques (scanning probe based, spin polarized electrons, element specific hysteresis, ultrafast magnetization dynamics) have become indispensable to studying nanomagnetism. Research also stimulates the understanding of new phenomena at nanoscales, and generates new device principles in high density storage media, nanobiomagnetics, self-organization, hierarchical assembly, and magnetic electronics.



Major research areas related to magnetic nanoparticles

Hence, a synergistic approach was applied within a consortium of scientists who are involved in different aspects of magnetic nanoparticle science and technology. One of the workshop aims was to bridge the gap between scientific and practical aspects, and establish a common language between physicists, chemists, engineers and biologists interested in this field. The participants had diverse expertise related to different aspects of magnetic nanoparticle characterization, synthesis, study of fundamental properties, and optimization for current and emerging applications. The main workshop focus was on:

- Fundamentals of magnetic vs. geometric and electronic structure of nanoparticles
- Potential and feasibility of emerging applications with magnetic nanoparticles

Scientific Report

Magnetic electronics & Spin dynamics
Nanobiomagnetics (viruses, sensing, DNA sequencing, health..)
Self-organization & hierarchical assembly
High density mangetic storage

A multitude of specific questions was adressed by speakers & participants. These included:

- Nanoparticle structure (geometric, electronic, magnetic) as a function of its size.
- How the spin systems of clusters evolve as a function of particle size.
- How can we beat the superparamagnetic limit
- Can nanoparticles of nonmagnetic materials be ferromagnetic?
- Surface vs. bulk magnetism in nanoparticles
- Can different crystal facets of a nanoparticle be ferromagnetic or paramagnetic
- Exchange bias effects in oxide shell/metal core systems of magnetic nanoparticles
- How growth aspects (chemical, gas phase approaches) can influence magnetic properties
- In which way the nanoparticle-substrate interaction alter magnetic properties
- Correlated spin-glass states in strongly interacting nanoparticle assemblies
- Spin injection and accumulation in magnetic nanoparticles
- Magnetic storage, and hybrid top-down/bottom-up concepts
- How can the bits be organized along the radial tracks of a magnetic recording disk
- Self-organization and hierarchical assembly process of magnetic nanoparticles
- Magnetic electronics
- Organic soft matter templating, magnetic viruses & biomineralization of magnetic nanoparticles.
- Cell manipulation, DNA sequencing, organ imaging by magnetic resonance imaging (MRI)
- Biomedical applications: magnetophoretic mobility, toxicity, heath issues
- Nanobiomagnetic sensing

This was an open workshop, where we invited our colleagues to participate, in particular those in the Netherlands. We specifically encouraged participation by junior scientists (graduate students/postdocs).

We plan in the near future to publish proceedings in 2008 in the *Journal of Nanoscience and Nanotechnology* (American Scientific Publishers, invited by Dr. H. Nalwa).

Our participants found the workshop very successful and the Lorentz Center a great place to perform a workshop where a warm and positive atmosphere inspired further discussions and future collaborations. The help from the LC staff was excellent and we are very grateful for their support!

D. Gournis (Ioannina, Greece)
B. J. Kooi (Groningen, Netherlands)
G. Hadjipanayis (Newark, United States)
I. Panagiotopoulos (Ioannina, Greece)
G. Palasantzas (Groningen, Netherlands)

Scientific Report

VIEW: Visual Interactive Effective Worlds

June 25 – 27, 2007

The goal of this workshop was to bring together the participants (PhD students, postdocs, senior researchers) active in the recently started NWO-program VIEW (Visual Interactive Effective Worlds), along with a small number of experts in the field. Also a number of other Dutch researchers and PhD students active in the area attended.

The PhD students and postdocs presented their first results on the VIEW-projects, which ranged from quantitative design of spatial interaction techniques for desktop mixed-reality environments, morphological and wavelet-based volume processing and visualization, multi-field data visualization techniques for medical applications, a multi-modal visualization environment for interactive analysis of medical data, a visual exploration environment for analyzing gene regulation in developmental processes, and a visualization system where users can articulate an "expression of interest".

The invited speakers gave talks which were tutorial in nature, addressing such diverse topics as Virtual Reality & presence, optimal sampling, interactive visualization of diffusion image data, 3D visualization of vasculature, flow visualization, experimental research in visualization, and questions to ask in Information Visualization projects. A special panel was organized on questions related to publication strategies in the field of visualization.

The workshop greatly stimulated interaction between all participants. The discussions were extremely lively, and the participants were unanimously positive about the location and facilities provided by the Lorentz Center.

F.H. Post (Technical University of Delft, Netherlands)
J.B.T.M. Roerdink (University of Groningen, Netherlands)
J.J. van Wijk (Technical University of Eindhoven, Netherlands)

Scientific Report

Physics of Nanoscale Superconducting Heterostructures

July 2 – 6, 2007

Rapidly progressing miniaturization of nanodevices brings about exciting novel physical phenomena and creates new challenges for their adequate interpretation within the quantum theory. One of the most fundamental concepts of quantum mechanics --quantum coherence -- plays a crucial role in our understanding of numerous intriguing properties of nanostructures discovered over recent years. Quantum coherence of electrons is of particular importance in hybrid structures composed of a superconductor (S) and a normal metal (N) or a ferromagnet (F). In such structures Cooper pairs can penetrate into the latter, thereby significantly changing the properties of the system. As a result of this proximity effect the N- or F-metal also acquires superconducting properties, such as being able to carry supercurrent and, hence, exhibiting Josephson and Meissner effects as well as other superconducting properties.

Although the physics of this superconducting proximity effect is rather well understood in a variety of more conventional NS systems, recently a number of novel nanoscale superconducting structures was fabricated and new interesting experimental results were reported. Examples are recent observations of dc Josephson effect in single wall carbon nanotubes and in graphene monolayers placed in-between superconducting electrodes; experimental studies of crossed Andreev reflection in NS an FS structures; investigations of quantum phase slips in superconducting nanowires; and recently obtained experimental indications on unconventional pairing and long range proximity effect in FS structures. These recent experimental advances require adequate interpretation and motivate theoreticians to analyze yet unexplored regimes and situations.

The main objective of this Workshop was to bring together leading scientists actively working in different sub-fields of mesoscopic superconductivity in order to discuss the state of the field in both theory and experiment and to promote new collaborations. There were 47 participants who presented talks and took part in discussions focused on recent experiments and theoretical approaches.

The main topics of the workshop were the following:
-- proximity and Josephson effects in carbon nanotubes
-- superconducting quantum dots
-- quantum phase slips in superconducting nanowires
-- crossed Andreev reflection in NS and FS structures
-- superconducting proximity effect in graphene
-- parity effect and persistent currents in superconducting nanorings
-- superconductor-ferromagnet proximity structures.

The program included longer invited talks, short oral contributions and posters for use in discussion time. There was very fruitful interaction between experts working in different areas, theorists and experimentalists. Following the tradition of the Lorentz Center, the workshop provided sufficient time for informal discussions and work on (prospective) collaborations. This continues to be a much appreciated feature of LC workshops as opposed to the more traditional ones, as was emphasized by a number of participants.

The workshop organizers and participants would like to extend their most sincere gratitude to Martje Kruk-de Bruin and Wies Groeneboer for perfect organization of the workshop, hospitality and help.

Jan Aarts (Kamerlingh Onnes Laboratory, Leiden, Netherlands)
Alexander Golubov (University of Twente, Netherlands)
Andrei Zaikin (Forschungszentrum Karlsruhe, Germany)

Scientific Report

Model systems for Infectious disease and cancer in zebrafish

July 16-18, 2007

After the Amsterdam European zebrafish meeting in July a group of 72 scientists met at the Lorentz Center to focus on the exciting new possibilities to use zebrafish for the study of molecular mechanism of disease processes. The optical transparency of the zebrafish in the early life stages enables the use of optical imaging techniques for monitoring cellular processes at the molecular level in an entire vertebrate organism that already have been exploited for intricate studies of embryonic development. Given the strong relatedness of the zebrafish immune system to that of humans (Trede et al 2004) it is possible in many cases to link new molecular and cellular insights to medical applications. In this work shop two promising research areas in which the immune system plays a major role: infectious disease and cancer. The great advances in microscopic and biophysical analyses can be used to monitor the early stages of disease at resolution and time scales that are more relevant than is possible using alternative models, such as MRI or luminescence analysis in rodents. This offers novel opportunities to understand the signal transduction pathways underlying disease phenomena such as cancer or infectious diseases. Considering the small size of the test organism the measurements at the molecular and cellular levels can be integrated with data obtained at the whole organism level, especially since fluorescence multicolor labeling techniques enable the causative agent of the disease (e.g. cancer cells or microbes) to be easily detectable at all dimensions of measurement. Last but not least, due to its amenability to large scale forward and reverse genetic screens the zebrafish is powerful for discovery of novel gene functions in disease processes. In this work shop the advances in the technical possibilities were high-lighted in two practical topics: the emergence of power-full screen models for infectious disease and cancer. These diverse topics were linked by a full day of attention to the mechanisms of the immune system of the zebrafish with particular attention to cellular defense mechanism and the innate immune system. Since the emergence of new cancer test systems is one of the fields that develops most rapidly this topic was put first in the meeting. As mentioned in the welcome address of the meeting, the comparisons between defense mechanisms against microbes and cancer cells in can be predicted to reveal interesting parallel or differences that could give new insights in specificity determinants of innate immune responses that are still poorly understood in any eukaryotic test system.

Day 1. Cancer studies

The topic of the first day of meeting was cancer. The presentations particularly focussed on tumor progression in transgenic solid tumor models and transgenic xenografts. In recent years, the zebrafish has vaulted to the top as a laboratory model organism for cancer research because of the strikingly similar molecular and histopathological features of fish and human tumors.

Day 2, The immune system
The topic of the second day of the meeting was normal and abnormal development of zebrafish adaptive and innate immune cells. Most of mammalian hematopoietic lineages have been identified in zebrafish and new molecular insights on molecular signaling in the innate immune system was presented. The conserved nature of human and the zebrafish innate immune system was highlighted and discussed in detail.

Day 3. Host-microbe interactions
In the talks of this last half day session, new data addressing the interactions between bacteria and zebrafish were presented. A major topic was the interaction between mycobacteria and macrophages. A hallmark of mycobacterial diseases, such as tuberculosis and lepra, is that infected macrophages and other immune cells aggregate into tight structures, called granulomas. Using a zebrafish - *Mycobacterium marinum* infection model, the cellular and molecular bases of the intricate interactions leading to granulomas has been successfully studied.

Concluding remarks
From the above it is clear that zebrafish has many advantages to offer as a model for the studies of immune related diseases. The growing number of scientists that now use zebrafish in their research in this area promises many new exciting discoveries in the near future. A detailed report about all the scientific presentations will be published in the journal Zebrafish in early 2008.

B.E. Snaar-Jagalska (Leiden University, Netherlands)
Nikolaus Trede (Salt Lake City, United States)
Annemarie, H. Meijer (Leiden University, Netherlands)
Herman P. Spaink (Leiden University, Netherlands)

Scientific Report

Computational Complexity of Quantum Hamiltonian Systems

23 – 27 July, 2007

The workshop brought together a diverse set of researchers who were interested in the rigorous mathematical analysis of techniques for simulating the properties of quantum systems described by many-body Hamiltonians.Many of the participants coming from different communities in (mathematical) physics and computer science were meeting for the first time. Participants expressed the opinion that they learned new tools and results during the workshop that could be useful in their own research. There was a lot of interaction between the participants, many questions were asked during talks and work-breaks were used by participants to further interact and collaborate.

Important results were extensively discussed at this workshop for the first time. An example is the result that determining the ground-state energy of a quantum Hamiltonian of a one-dimensional chain is a hard problem to solve for quantum computers (in technical terms, the problem is QMA-complete). The QMA-classification, and the various other quantum classes that now exist in computer science beyond the class NP, were thoroughly reviewed and discussed. The idea of BQP-completeness, and its occurrence in apparently non-quantum settings such as the Potts model and some string transposition problems, were presented. New techniques for the efficient representability of many-body quantum states arising from the theory of quantum entanglement, such as matrix product states, were frequently discussed. New uses of many-body perturbation theory in formal computer science were presented. The perturbation technique was used in proving the hardness of certain types of Hamiltonian problems as well as the construction of a new efficient classical simulation algorithm for weakly-interacting quantum systems. A central tool in various results was the 30-year theorem of Lieb and Robinson. Variants, extensions and new applications of this theorem were given and discussed.

Many participants praised the freshness and the quality of the workshop talks, and felt that the workshop had truly identified an emerging field of interdisciplinary theoretical science.

Co-sponsoring is acknowledged from IBM and the EU 6th framework program.

D. DiVincenzo (IBM Research, United States)
B. Terhal (IBM Research, United States)

This workshop is part of a "Series of Events" in the Marie Curie Action SCF (Conferences and Training Courses).

Scientific Report

From Massive Stars to Supernova Remnants

August 6 – 17, 2007

This workshop brought 52 astrophysicists together for 2 weeks. The interest in the workshop is already apparent from the fact that most of them were present for the full two weeks. The workshop's topic concerned the overlap between two subdisciplines; on the one hand the evolution of massive stars, and in particular their late phases; on the other hand scientist working on supernovae and their remnants. Although there is a natural connection between the two, there are few workshops/conferences that cover both topics.

The program was well thought out, but loosely defined, in the sense that much time could be devoted to discussion or talks that came during the meeting. Each morning there were two long, invited talks, discussing the state of the art in research on particular topics. In the afternoon several short talks were scheduled, sometimes as a late addition, for example the talks on magnetars by Bryans Gaensler, Jacco Vink and Huib Henrichs. Although the programmed list of speakers initially looked sparse, in practice the program turned out to work very well. Moreover, the time allotted to free discussions, work or collaborations was extensively used by most participants. The workshop had also a good balance between well known, seasoned scientist and young and upcoming scientist.

Much attention during the meeting went out to two objects. The first one is the brightest supernova ever observed, SN1006gy. One of the participants, who was involved in the observations of this supernova, Nathan Smith, was also an invited speaker. Much discussion was devoted to the origin of this supernova, an energetic, pair-creation instability supernova, or a normal supernova which was preceded by extensive mass loss. In the latter case the prediction is that the brightness will rapidly decline, as most of the energy is being radiated away, instead of converted in kinetic energy. The other famous object is SN1987A. Two of the experts on this supernova, R. McCray, and R. Kishner both gave invited talks on this remnant. In addition some of the other participants discussed some of their latest data on this supernova. The workshop also paid much attention to Type Ib/c supernovae, explosions of massive stars that somehow lost their outer envelopes. There is a connection between gamma-ray bursts (GRBs) and these supernovae. Several aspects of Type Ibc supernovae and GRBs was discussed by a.o. N. Langer (stellar evolution, rotational mixing), T. Thompson (on the connection between magnetars/supernovae), R. Wijers (GRB afterglows, theory), S. Kulkarni (GRB observations), A. Soderberg (radio emissio from hypernovae), and M. Modjaz (observations of Type Ibc supernovae). Radio emission form supernovae were also discussed by K. Weiler. The evolution of supernovae and their remnants was further elucidated by R. Chevalier and C. Fransson, co-organizers of the workshop. On the supernova remnant side, R. Fesen and J. Vink gave an overviews of optical, resp. X-ray emission from supernova remnants, whereas B. Gaensler gave a talk on pulsar wind nebulae.

Most speakers have made their presentation slides available, which can be found at http://www.phys.uu.nl/~vinkj/lorentzcenter2007.

R.A. Chevalier (Carlottesville, Verginia, United States)
C. Fransson (Stockholm, Sweden)
N. Langer (Utrecht, Netherlands)
J. Vink (Utrecht, Netherlands)

Scientific Report

Condensed matter meets gravity

August 27 – 31, 2007

The goal of this exploratory workshop was to bring together a rather diverse group of physicists that for various reasons in recent years have started to search for opportunities for cross-fertilization between quantum condensed matter physics on the one hand, and quantum gravitational physics on the other hand. There is an established school of thought in the form of Kibble's 'COSLAB' but this is in first instance driven by questions coming up in cosmology, looking for analogies in condensed matter physics. Through very recent developments an interest emerged in various branches of condensed matter community into gravitational issues which seem to go beyond the Kibble approach and more in the direction of quantum aspects of gravity. Last but not least, in a late stage of the organization the news broke that direct connections exist between quantum criticality and string theory and we did put in some extra effort to involve string theorists as well in the organization. Altogether, this workshop was very timely and exciting to the extent that a number of US participants announced at the end of the meeting that they intend to organize a follow up meeting likely in Santa Fe in 2008 or 2009. This might well be the beginning of a meeting series in the future. We also notice that a meeting with a very similar title and aim is organized in London in 2008, while also a meeting is planned at the Perimeter Institute with X.G. Wen as co-organizer.

To start out with the highlight of the meeting: the first day was dedicated to the newly discovered connection between the string theoretical AdS-CFT (or Maldacena) correspondence and the hydrodynamical behavior of the quantum critical fluid as of relevance to high Tc superconductivity. The key player Sachdev and the dutch string theorist Schalm gave presentations: this excitement was picked up by the NRC-Handelsblad giving exposure to this story on their science pages. A next big theme at the meeting was the emergence of space-time from 'condensed matter like' microscopic degrees of freedom, with a special attention to the role of emergent diffeomorphism: Volovik's 'fermion universe', Kleinert's 'world crystal', Markopoulou's's extensions of spin-nets, Chapline's spin-orbit theory, and especially Sung-Sik Lee's explicit construction of a diffeomorphic theory starting from bosons on a lattice. Causality is a hairy issue in all these constructions and Loll's causal triangulations as well as Tony Zee's penetrating questions shed a fascinating light on the role of real (instead of imaginary) time. A related but yet distinct development is the discovery of intriguing connections between S.C Zhang's quantum Hall effect in 4 dimensions and various mathematical structures (including twistors) as of relevance to quantum gravity as highlighted by Nair.

The third set of presentations had a more phenomenological outlook, focussing on condensed matter inspired extensions of GR (Nieuwenhuizen, Mottola, Mazur, Klinkhamer, Burinskii) as well as the 'analog model' school of thought (Pulllin, Duncan, Schutzhold, Garay). Finally, the last day took a quite open outlook, where condensed matter physicists like Nussinov and Ortiz as well as the string theorist Taylor presented their fascinating ideas that somehow did have dealings with the overall theme of the workshop.

This was undoubtedly a very stimulating meeting that will have a lasting impact on this very young but fertile new field. Finally, all the participants were quite impressed and very positive about by way matters have been organized by the Lorentz Center.

Scientific Report

MIRI

September 5 – 7, 2007

The next decade will see the launch of the James Webb Space Telescope (JWST), one of the most exciting new astronomical observatories expected to see first light in the coming years. The telescope's only instrument covering the mid-infrared part of the spectrum, MIRI, is the product of a largely European consortium, and thus of immense interest and importance to the European scientific community. MIRI will provide imaging and spectroscopy at wavelengths of 5 to 27 microns. Its broad wavelength response in the thermal infrared combined with the outstanding sensitivity of a passively cooled, 6m class aperture telescope opens a large new discovery space – from the study of the very first light sources after the Big Bang to observations of planet formation in process and birth of life in the Universe. The instrument is being developed by NASA and a consortium of European partners sponsored by the European Space Agency (ESA). The science team overseeing the construction of MIRI is led by Dr. George Rieke, University of Arizona. Dr. Gillian Wright, UK Advanced Technology Centre, is the European PI. NOVA, the Netherlands Research School for Astronomy, is responsible for the design and building of the Spectrometer Main Optics Module.

Operating such a complex instrument requires a thorough understanding of all aspects of its design, from the optical and mechanical components to the moving mechanisms and detectors. Testing and calibration are therefore of crucial importance to the success of MIRI and of the JWST mission as a whole. The team performing the scientific testing is composed of scientists from European Consortium institutes, and is responsible for all aspects of functional testing, verifying the performance against requirements and determining the on-ground calibration. A verification module for MIRI is currently being tested at the Rutherford Appleton Laboratory (UK).

The workshop held at the Lorentz Center marked the final opportunity for the test team to meet before the start of the test campaign in November 2007. The aim of the meeting was to discuss progress in assembly of the instrument at RAL and readiness for the test campaign. Because of Leiden's convenient location, many scientists and engineers with an interest in MIRI, including from the US partner institutions, gathered at the Lorentz Center.

The meeting was very successful in that it provided an excellent platform for exchanging information and plans within the team and with partners from the US. For several new members the meeting was the first chance to be introduced to the rest of the team and the Lorentz Center, including the social dinner, was an ideal setting for this. The feedback from the participants was invariably good.

The organisers are therefore very grateful to the Lorentz Center, and to Martje Kruk and Yolande van der Deijl in particular, for helping organise this very informative workshop at short notice. The meeting was funded by the MIRI consortium.

Sarah Kendrew (Leiden University, Netherlands)
Tim Grundy (Rutherford Appleton Laboratory, United Kingdom)
Tanya Lim (Rutherford Appleton Laboratory, United Kingdom)
Bart Vandenbussche (Katholieke Universiteit Leuven, Belgium)
Joris Blommaert (Katholieke Universiteit Leuven, Belgium)
Alistair Glasse (UK Astronomy Technology Centre, United Kingdom)

Scientific Report

Galois Theory and Explicit Methods

September 17 – 21, 2007

This workshop was the first annual meeting of the FP6 Marie Curie Research Training Network called Galois Theory and Explicit Methods (contract number MRTN-CT-2006-035495). The network unites 12 centers of expertise of international stature in a broad range of computational techniques in number theory and arithmetic geometry. The network is coordinated by B. de Smit of the team in Leiden.

The main purpose of the network is to facilitate a joint research program carried out mainly by 12 EU funded PhD students ("early stage researchers"). These 12 young scientists got together for the first time at this workshop.

The scientific program consisted of a number of distinct parts. A tutorial part aimed mainly at the PhD students presented two short courses on the specific subjects of function fields (Riemann Roch, Riemann hypothesis, analogy with number fields) and differential Galois theory.

Several key experts, also from outside the network, were invited to explain some very recent developments in a number of key note lectures. For instance, Gunter Malle (Kaiserslautern) presented convincing numerical evidence contradicting the famous Cohen Lenstra heuristic in a particular case. Since then an alternative heuristic has been formulated, but a satisfying heuristic explanation is still lacking. Alan Lauder (Oxford) presented his recent computational work on ranks of elliptic curves over function fields -- he recently was awarded an ERC Starting Grant for this work.

We had short talks by all of the network's PhD students, so that the entire network is now familiar with its PhD students. And there were lectures of the senior staff of the network about the network's research program. For the full collection of abstracts see: http://websites.math.leidenuniv.nl/gtem/index.php?mn=conf2007&pg=0

The non-scientific part consisted of some meetings (steering committee annual meeting, an informal meeting with the PhD students on practical issues, smaller work package meetings), and the social program, with the ever successful dinner on the boat as its climax.

The flexible set up of the Lorentz Center was of great benefit to this meeting: we had lectures for the whole group, several meetings in the Gratama zaal, lots of socializing in the common room and discussions with small groups in the offices. The size of the meeting was rather large (59 persons), but the organisation went very smoothly.

The meeting was an excellent starting point for the next three years of the network, and it sets the bar high for the next annual meetings in Bordeaux (2008), Warwick (2009) and Barcelona (2010).

Teresa Crespo (Barcelona, Spain)
Jan Denef (Leuven, Belgium)
Bart de Smit (Leiden, Netherlands)
Heinrich Matzat (Heidelberg, Germany)

Scientific Report

Disorder in Condensed Matter and Cold Atoms

September 24 – 28, 2007

During the past decade ultracold atoms have rapidly developed into a new laboratory for quantum many-body physics. Artificial "solids" can be created in optical lattices, simulating and exploring many issues that are of key importance in condensed matter as well. During the last few years, effects of disorder are now taking center stage in cold quantum gases as well, where they can be realized with an unprecedented degree of control and flexibility. On the other hand, disorder and interactions have long been of relevance in solids, where they cause such diverse phenomena as frustrated magnetism and glasses, which in spite of large experimental and theoretical efforts are only partially understood up to now.

The main goal of the meeting was to enable the transfer of concepts and ideas between leading researchers of the two fields. Each morning we had a 1-hour overview lecture which set the stage for a series of focused talks, supplemented by an additional poster session on one of the afternoons. Part of the afternoon was free for discussions and collaboration.

The feedback from the participants was extremely positive. On the experimental level, this has been possibly the first meeting where "pure" condensed matter meets cold atoms, as became clear for example during the overview lecture of S. Kravchenko on metal-insulator transitions in two dimensions. Yet another, different and exciting experimental realization of Anderson localization in photonic lattices was presented by T. Schwartz. As pointed out by A. Aspect and Th. Giamarchi, the specific type and length scale of disorder in optical lattices affects the physics in an essential way, leading to very different localization phenomena e.g. for bichromatic lattices and speckle fields.

On the theory side, it became clear soon that in one spatial dimension powerful numerical and analytic techniques have by now led to a consistent theoretical picture. Moreover, there is recent progress in seemingly elementary but actually rather tricky issues such as generalizing random matrix theory to disordered bosons, as demonstrated in a talk by V. Gurarie. However, we are just at the beginning of a more quantitative understanding of disordered interacting systems in higher dimensions, where even longstanding issues like the nature and extent of the Bose-glass phase remain largely open. It is here that we expect the most spectacular progress due to experiments in cold quantum gases during the coming years.

The workshop was funded by the Lorentz Center, the European Science Foundation (ESF) and the Deutsche Forschungsgemeinschaft (DFG).

I. Bloch (University of Mainz, Germany)
W. Hofstetter (University of Frankfurt/Main, Germany)
R. Mössner (University of Oxford, United Kingdom)
K. Schoutens (Universiteit van Amsterdam, Netherlands)

Scientific Report

Streamers, sprites, leaders, lightning: from micro-to macroscales

October 8 – 12, 2007

The workshop brought scientists and some engineers together who work on very similar physical processes in vastly different disciplines and areas of application: from lightning research up to automotive industry, and from applied math, theoretical physics and computational science through plasma diagnostics and pulsed power electrical engineering up to satellite missions and radio observatories exploring phenomena of atmospheric electricity. The common theme was the space charge dominated discharge (the so-called streamer) that forms the early stages of electric breakdown in large systems, and occurs in sizes from milli- or centimeters (at atmospheric pressure) up to many kilometers (at low pressures in high layers of the atmosphere). Co-organizer Davis Sentman therefore coined the term "the elementary particle of transient discharges" for them.

There were 54 participants from 10 countries, almost all stayed during the whole week. We had a total of 36 talks that lasted 20, 30 or 40 minutes, clustered into morning sessions of 3.5 hours and sessions in the late afternoon of 1.5 to 2 hours. This scheme left enough time for discussions, a long poster session on Monday afternoon and a lab visit at TU Eindhoven on Friday afternoon. This program structure gave participants a chance to present their results in a condensed manner and to elaborate details in private discussions. These discussions evolved very well, and many participants expressed the view that the workshop indeed has created many unexpected and fruitful contacts across disciplinary borders. Here a few examples are given:

1. A core subject were streamers in lab and applications and sprites above thunderclouds. New observations and simulations of streamers and sprites were presented and compared. Questions concerned location and conditions of streamer or sprite generation, the wide distribution of diameters and velocities, branching and interaction, and the later steps of evolution characterized by conductivity and chemical products. On the simulational side, also microscopic physical mechanisms were discussed and models and numerical techniques were compared. In general, phenomena in streamers and sprites are quite similar, and theory succeeds to reproduce the simplest single streamer processes and starts to address multi-streamer processes. The computational complexity lies in the multiscale nature of the streamer phenomenon as well as in the uncertainty about microscopic mechanisms. Various cooperations on the theoretical site emerged across disciplinary borders.
2. These multiscale mechanisms are in particular in place if indeed the high field region within a streamer acts as an electron accelerator and generates X-rays. X-rays from discharges are observed above thunderclouds and by electrical engineers in the lab, where energy distribution of emitted photons and precise timing and location within the discharge are under investigation. The workshop might actually lead to an exchange of equipment between the department of electrical engineering at TUE and the ASIM project of ESA-ESTEC. Theoretical collaboration is planned between the Danish National Space Center and CWI Amsterdam.
3. Another joint theme are the chemical products of streamers and sprites. They are the reason to use streamers in various industrial applications; sprites might substantially contribute to atmospheric chemistry at high altitudes. This was probably the first meeting where researchers from both disciplines discussed this issue. The topic will also be

adressed in a workshop during the ESCAMPIG conference next summer in Grenada in an interdisciplinary setting.

4. Another common theme was afterglow: an optical emission delayed from the plasma region by seconds. It was observed and explained in lab experiments by Vasco Guerra in Portugal, but might have a big impact on the interpretation of sprite photographs. Guerra said: "As soon as I am home on Monday, I will start studying a new subject: sprites."
5. How does lightning start in the thundercloud? How does the streamer start in a natural spark or a discharge lamp or a spark plug? The role of cosmic airshowers or radioactivity was compared to that of graupel or dust.
6. The LOFAR network in the East of the Netherlands was presented that wil go into serious operation in the summer of 2008. Its primary purpose is astronomical, but it was known to measure lightning as well. As a result of the workshop, lightning researchers from New Mexico might start analyzing LOFAR data.

Goal and setup of the workshop were much appreciated. The enthousiasm of participants together with the facilities and staff support of the Lorentz Center made it into a success.

We are presently looking for means to continue the exchange between disciplines. A webpage for uploading titles and links of publications is under consideration. Furthermore, the organizers were invited to edit a cluster issue in J. Phys. D where major workshop contributions will be published.

U. Ebert (Amsterdam, Netherlands)
D.D. Sentman (Fairbanks, United States)

Scientific Report

Hamiltonian lattice dynamical systems

October 15 – 19, 2007

Hamiltonian lattice dynamical systems form a special but important class of models in the physical sciences. They arise naturally in the study of crystals in solid state physics, as many-particle models for statistical mechanics, as spatial discretisations of partial differential equations, modeling coupled oscillators in engineering and as idealizations of DNA molecules in the biological sciences.
An important example of such a Hamiltonian lattice dynamical system is the Fermi-Pasta-Ulam chain, which was introduced 50 years ago. Its - at the time - surprising non-ergodicity properties strongly influenced the development of KAM theory, chaos and solitons. Our understanding of integrability and stochasticity in the Fermi-Pasta-Ulam chain is far from satisfactory, but recent progress on the role of symmetry, periodic and quasi-periodic behavior and integrable approximations is bound to lead to a better understanding of the process of energy equipartition and transport among vibrational excitations in lattice dynamical systems. In particular, the recent interest in nanoparticles and nanodevices, optical lattices and transport through molecules makes such an understanding highly desirable.

This workshop brought together two groups of researchers:
1. Mathematicians that work on lattice dynamical systems, in particular the Fermi-Pasta-Ulam problem, and related topics such as KAM theory, bifurcation theory and variational methods.
2. Physicists and numerical experimentalists with an interest in lattice dynamical systems and their applications.

The main topics that were addressed during this workshop are:
1. Integrability, near-integrability and KAM theory for Hamiltonian lattices.
2. Special solutions (solitary waves, rotating waves, breathers, etc.) and their bifurcations in a Hamiltonian framework.
3. Energy transport and ergodicity of Hamiltonian lattices.
4. Formal asymptotic methods and numerics.

Our workshop distinguished itself from other related meetings by a focus on mathematical methods for and phenomenology of Hamiltonian lattices. Moreover, it aimed to explicitly bridge between the physics and mathematics communities, among others by gathering scientists that do not usually meet.

This workshop lasted five days, with four 45 minutes plenary talks per day, usually three in the morning and one in the late afternoon. Apart from the talks there was a poster session on Wednesday afternoon in which six younger participants presented their work. It is important to note that the program contained a lot of free time, and we are under the impression that most participants used this time well for discussions and cooperation. The following participants gave a plenary talk: Serge Aubry (Gif-sur-Yvette), Dario Bambusi (Milan), Henk Broer (Groningen), Alan Champneys (Bristol), Sergej Flach (Max Planck Dresden), Luigi Galgani (Milan), Marc Georgi (Berlin), Andreas Henrici (Zurich), Guillaume James (Toulouse), Ted Janssen (Nijmegen), Magnus Johansson (Linkoping), Vadim Kaloshin (College Park Maryland), Panos Kevrekidis (Massachusetts), Thomas Melvin (Bristol), Dmitry Pelinovsky (McMaster), Michel Peyrard (Lyon), Hartmut Schwetlick (Bath), JonathanWattis (Nottingham), Johannes Zimmer (Bath), MaciejWojtkowski (Olsztyn).

The following participants presented a poster: Luca Delfini (Florence), Andreas Henrici (Zurich), Vassilis Koukouloyannis (Thessaloniki), Ioannis Kourakis (Belfast), Lars Kroon (Linkoping), Thomas Melvin (Bristol), Alexei Yulin (Bristol).
The following people also participated: Konstantinos Efstathiou (Groningen), Heinz Hanssmann (Utrecht), Hermen Jan Hupkes (Leiden), Thomas Kappeler (Zurich), Greg Pavliotis (Imperial College London), Jens Rademacher (CWI Amsterdam), Michelangelo Vargas Rivera (VU Amsterdam), Ferdinand Verhulst (Utrecht).

The workshop program left ample time for discussion, and it is our impression that participants made optimal use of this possibility. We have had many positive reactions from participants about the facilities of the Lorentz Center, the selection, quality and topics of the talks and the active atmosphere during the workshop.
A few examples: Wattis mentioned that staying in the same hotel, having offices to work in, a schedule with lots of free time and a coffee room all helped stimulate the discussions. Galgani wrote that the organisation was "simply perfect". Zimmer remarked that he had an "unusual" number of follow-up contacts since the workshop. Kourakis writes that he was happy to meet many people he did not know before, but with whom it turns out he shares many interests. Broer writes that his overall impression is "very positive".
We are very pleased with the interaction between physicists and mathematicians, which was one of the main aims of this workshop. In particular we know of the following concrete outcomes of the workshop:
1. The talk by Peyrard on energy speading in DNA molecules sparked a discussion with Theoretical Physicists from Milan that has gone on all week. The people involved discovered many connections and similarities between the classical FPU problem and present day DNA research. Peyrard mentioned that this is likely to lead to several further developments and cooperations between the two groups.
2. The following invitations that we know of are a direct consequence of this workshop: Wattis was invited to Milan by Bambusi to work on 2-dimensional FPU systems. Georgi was invited to London by Lamb to lecture on Lin's method. Rink was invited to Maryland by Kaloshin for cooperation.
3. Wojtkowski mentioned that his discussions with Galgani have led him to better determine his future research on ergodicity and reversibility.
4. Zimmer wrote us that he is likely to have several follow-up contacts after the workshop and in a discussion with Peyrard learned of a research question he will probably work on with a student.

Apart from the facilities, secretarial support and financial contribution of the Lorentz Center, we obtained funding from the cluster Nonlinear Dynamics of Natural Systems (2500 Euro) and the KNAW (2000 Euro).

Bob W. Rink (Free University Amsterdam, Netherlands)
Jeroen S.W. Lamb (Imperial College London, United Kingdom)

Scientific Report

Complexity in Economics and Finance

October 22 – 26, 2007

The workshop focused on theoretical, experimental and empirical work on modeling dynamic phenomena in different areas of economics ranging from macroeconomics to financial markets. Mathematical methods and their applications to economics and finance played a central role in the workshop. In addition, recent results from laboratory experiments, analysis of data and simulation of agents-based models were also discussed. Central workshop themes included:

- evolutionary market dynamics in interacting systems of heterogeneous agents;
- expectations and learning: theory and laboratory experiments with human subjects;
- the relation between interacting particle systems in physics and interacting agent-based modeling in economics and finance;
- application of nonlinear dynamics in macro-economics and finance;
- validation and estimation of agent-based models.

Each day there were three one-hour lectures, two in the morning and one in the late afternoon. These lectures (a total number of 15) were all given by leading experts in the field. Between the lectures there was plenty of time for discussions in the common room or in smaller groups in one of the offices. Sometimes these discussions led to an informal presentation at the small seminar room at the Lorentz center. In addition, there were poster presentations, mainly by participants who could not give a talk, since the total number of talks had been kept small to stimulate discussions. The lectures were well attended by PhD students from Universities in the Netherlands and abroad (there were 18 PhD students among 50 participants). One social dinner and a boat trip with dinner were organized for all participants.

The format of workshops at the Lorentz center is unique in the Netherlands. In particular, the fact that all participants have offices with computer facilities, as well as a common room and an additional small seminar room, provides a unique opportunity for scientific discussions and international cooperation. Such facilities are available only in the world's very best universities or research centers. The format stimulates international cooperation very much and the workshop provided important feedback on the research of our CeNDEF group in Amsterdam. The results of the workshop will be published in a special issue of the Journal of Economic Dynamics and Control.

This workshop would not have been possible without the financial support by

- the Lorentz center (financed by NWO);
- the research project "Complex Markets" (financed by the EU within the 6th framework program STREP);
- the Center for Nonlinear Dynamics in Economics and Finance (CeNDEF), University of Amsterdam.

We would like to thank the staff of the Lorentz Center, Prof. Dr. Wim van Saarloos, Dr. Henriette Jensenius and especially Dr. Martje Kruk-de Bruin and Yolande van der Deijl for their essential and efficient support before and during the workshop. Everything was

organized extremely well, so that the organizers of this workshop could just concentrate on participating in its scientific part.

Mikhail Anufriev (University of Amsterdam, Netherlands)
Cars Hommes (University of Amsterdam, Netherlands)
Alan Kirman (Marseille, France)
Matteo Marsili (Trieste, Italy)

Scientific Report

Proteins killing tumour cells

October 29 – November 2, 2007

Current anticancer therapies are limited by toxicity to normal tissue and the occurrence of therapy-resistant tumour cells. Over the past few years, several cellular and viral proteins such as apoptin, E4orf4, HAMLET, MDA7, NS1 and TRAIL have been discovered that can induce tumour cells to commit suicide (apoptosis), but which leave healthy cells unaffected. These tumour-specific apoptosis inducing proteins appear to sense tumour-related molecular changes in cancer.

Besides an obvious therapeutic application, this protein family also raises important research questions:

1. Which pathways in the tumour cell leading to apoptosis are switched on by these proteins and by which mechanisms?
2. Are there alternative means of switching on these (apparently dormant) apoptosis pathways in tumour cells?
3. Are there common mechanisms that the anti-tumour proteins share?
4. How do these proteins function in normal cells?

These and other related questions are at the forefront of scientific research and answering them requires a wide range of expertise: virologists, cancer specialists, cell biologists, biochemists, structural biologists, bio-informaticians, biophysicists.
So far, there has not been any substantial opportunity to bring together such diverse experts whose major interest includes the proteins that kill tumour cells and the underlying mechanisms of tumour formation.

The present workshop explored for the first time these interesting proteins and the common and specific pathways by which they function. A better understanding of proteins that kill tumour cells, their mode of action and their exploitation as therapeutic agents will provide a substantial contribution to both fundamental and applied cancer research.
About 50 registered scientists from The Netherlands, USA, Canada, Australia, China, Sweden, Germany, Austria, Denmark and United Kingdom attended the workshop and various students and scientists visited one or more lecture sessions. Among the official participants were about 20 PhD students and junior scientists. In total, 35 lectures were presented by senior as well as junior scientists covering the theme of the workshop. Besides the oral presentations also 12 posters were presented. These presentations led to stimulating discussions in the excellently equipped offices and central meeting room of the Lorentz Centre. Besides the lectures and poster session a workshop on living cell imaging has been hold, which was attended by many of the participants.

The participants were very enthusiastic about the open and stimulating atmosphere during the whole meeting. The scientific need for meeting other scientists working in the field of proteins inducing tumour-specific apoptosis was clearly abundant. One participant stated: "*We thought that we were orphans, but we are family".* During the meeting a scientific board was established consisting of 7 senior scientists (Tavassoli, Svanborg, Borst, Noteborn, Teodoro, Ramesh and Pipas) and 1 junior scientist (Rothe-Brinkman). Their first activity will be to organize the next workshop on "Proteins killing tumour cells (PKTC)", to be held next year in Lund, Sweden. The PKTC meetings will be organized at least every second year. As

important, several research collaborations have been initiated and/or intensified during or after the workshop.
Under the guidance of Dr. Backendorf and Prof. Farzaneh, 10 junior scientists are writing a "Meeting Report" on the various topics discussed during the workshop and which will be published in Cell Death & Differentiation (Nature Publishing Group). Most of the invited speakers agreed to contribute a chapter to the book "Proteins killing tumour cells" within the series of Apoptosis and Disease of Research-SignPost. The scientific coordinators of the workshop will act as editors.
There are plans to establish a "PKTC consortium" with its own Website where participants will have the possibility to exchange ideas, post interesting literature, etc. Financial support for this consortium will be sought by various group from national and international instances.
In conclusion, the first workshop on "Proteins killing tumour cells" has fulfilled the expectations of the organizers and the participants and contributes to the success of this novel research field.

This workshop would not have been possible without the financial support of the Lorentz Center, Leiden Institute of Chemistry, King's College London, Cyttron, LUF, Douwe Breimer Foundation, TI Pharma and Bayer Health Care – Bayer Schering Pharma. The organizers are particularly grateful to Martje Kruk, Wies Groeneboer and Gerda Filippo for their help and assistance and to Jaap Brouwer, Michael Green, Farzin Farzaneh and Lex van der Eb for their advices as members of the advisory board.

Claude Backendorf (Leiden University, Netherlands)
Jannie Borst (Netherlands Cancer Institute, Netherlands)
Mathieu Noteborn (Leiden University, Netherlands)
Mahvash Tavassoli (King's College London, United Kingdom)

Scientific Report

Applied Quantum Measurement (AQM07)

November 5 – 9, 2007

In recent years, the role of measurement in quantum mechanics has evolved from a puzzling break-up of deterministic evolution to a powerful tool in the emerging science of quantum information. The AQM07 workshop, held November 5-9, 2007, gathered together experimentalists and theoreticians working on fundamental and applied problems in quantum measurement. The topics discussed included: quantum state and process estimation, quantum computation via measurement, quantum-limited metrology, pre- and post-selected quantum systems and "weak measurements", and fundamental bounds on the distinguishability of quantum states.

Forty-two scientists from around Europe and the world attended the workshop, including a number of Dutch scientists. We invited five keynote talks on recent high-profile results, given by recognized experts on a range of topics: quantum key distribution (R. Werner), uncertainty relations for POVMs (S. Massar), weak measurement (A. Steinberg), optimal partial estimation of quantum states (J. Fiurášek), and quantum memories with light-atom interface (E. Polzik).

Three lecturers provided tutorials on particularly relevant concepts: convex optimization and the construction of optimal measurements (A. Doherty), quantum measurement and time reversal (G. Leuchs), and one-way quantum computation (D. Browne). In addition to these extended seminars, we solicited shorter contributed talks, and were able to accommodate all the participants who wished to present their work. In the (admittedly biased) opinion of the organizers, the talks were generally excellent and interesting.

We intentionally left large breaks between talks, to promote discussion and collaboration between participants. Most of the participants attended all the sessions and (thanks to the Lorentz Center's dedicated coffee machines!) contributed to a spirited discussion - which continued into the evenings in most cases. Informal canvassing of the participants afterward indicated that the amount of time devoted to informal discussion and collaboration was appreciated, and that the keynote/tutorial talks were widely appreciated by a heterogeneous (by design) audience of experimentalists, theorists, and mathematicians.

The true test of any workshop is in its repercussions - in the amount of collaboration and idea-sharing that trails in its wake. Within a few months after the workshop, we feel confident that the AQM07 workshop was in this sense a resounding success. We, the organizers, have established several collaborations as a direct result, and informal discussions with other participants confirms that our experience was not unique. Most satisfyingly, vigorous post-workshop discussions between two of us (Drs. Blume-Kohout and Gilchrist) and one of the keynote speakers led to the organization of a followup workshop on quantum state and process estimation, to be held in Toronto in 2008.

The facilities and the kindness of the personnel (in particular Ms. Gerda Filippo) of the Lorentz Center have certainly been an essential ingredient in the success of the workshop, appreciated by all the participants. We are well aware that we, as excellent exemplars of the "absent-minded scientist" stereotype, would have been utterly lost without them! We observed great appreciation (from the participants) for two logistical features in particular:

first, the excellent offices; second, the convenient hotel in which most of us were housed, and where we could gather for drinks and dinner in the evening.

Richard Gill (Leiden University, Netherlands)
Marco Barbieri (University of Queensland, Australia)
Alexei Gilchrist (Macquarie University, Australia)
Robin Blume-Kohout (Caltech, United States)

Scientific Report

Two Decades of Probabilistic Verification – Reflections and Perspectives

November 12 – 16, 2007

Model checking is emerging as a practical tool for automated debugging of complex reactive systems such as embedded controllers and network protocols. Such systems are subject to various phenomena of stochastic nature, such as message loss or garbling, unpredictable environments, faults, and delays. Accordingly, stochastic model checking aims to establish, for instance, whether "the chance of shutdown occurring is at most 0.01%". The goal of the workshop was to survey stateof-the-art techniques for the modeling and verification of random aspects of computer systems, and to identify the main research challenges for the next decade. The workshop was organized by VOSS2, a research collaboration between the Netherlands and Germany within the NWO-DFG bilateral cooperation program. The workshop brought together 50 researchers, including 28 from the VOSS2 project.

There were 6 invited presentations in which experts gave an overview of what has been accomplished but also outlined future research directions. The remaining activities concentrated on four (related) themes, selected with the explicit purpose to stimulate/encourage active collaboration between the participants:
The first day was devoted to the presentation of tools, tool-chaining, and tool-related design issues. Altogether 13 probabilistic verification tools were presented by their designers/ specialists: PRISM, MRMC, MOTOR, MOEBIUS, SMART, CADP, PReMo, APEX, PIPE, CASPA, CORAL, PASS, Liquor/PROBMELA. The presentations were followed by lively discussions about ways to further improve the tools. Participants were asked to tackle a challenging case study on gossiping protocols that was defined by the organizers.
During the second day, following a tutorial by Maarten van Steen, participants presented their solutions. As was to be expected, analysis of gossip algorithms is beyond the capabilities of current probabilistic model checkers, which can only handle networks with about 5 nodes, whereas practical networks contain more than 10.000 nodes. Several ideas for solutions were discussed, with as bottom line that we need to get away from enumerating things, moving to fluid-flow like models. Participants were asked to propose one or more specific technical problems. The seven most interesting problems were selected, and about one day was devoted to discuss them.
During one session, all participating PhD students/postdocs got 10-15 minutes to present their ongoing research, followed by in depth discussions in subgroups.

The workshop saw the birth of many new collaborations on probabilistic verification. We plan to prepare a special issue of ACM SIGMETRICS Performance Evaluation Review, to appear by the end of 2008, devoted to the results of the case study verification. We also aim at a few theory related publications, possibly in a special issue of the Information & Computation journal. A start was made with a follow-up of the VOSS2 project, possibly also involving other European countries.
The workshop organizers would like to thank the team of the Lorentz center involved in this workshop, Yolande van der Deijl, Dr Henriette Jensenius and Dr Martje Kruk-de Bruin, for their hospitality and excellent support. The generous financial support through the Lorentz Center, the support received from NWO/DFG through the VOSS2 project, as well as the additional funds received from DFG, are gratefully acknowledged.

Frits Vaandrager (Radboud University Nijmegen, Netherlands)
Christel Baier (Technical University of Dresden, Germany)
Boudewijn Haverkort (University of Twente, Netherlands)
Holger Hermanns (Saarland University, Germany)
Joost-Pieter Katoen (RWTH Aachen, Germany)
Markus Siegle (Universität der Bundeswehr, Munich, Germany)

Scientific Report

ELSA school on the Science of Gaia

November 19 – 28, 2007

Gaia is the European Space Agency mission which will provide a stereoscopic census of our Galaxy through the measurement of high accuracy astrometry, radial velocities and multi-colour photometry. Gaia is scheduled for launch in late 2011 and over the course of its five year mission will measure parallaxes and proper motions for every object in the sky brighter than magnitude 20 --- amounting to about 1 billion stars, galaxies, quasars and solar system objects. It will achieve an astrometric accuracy of 12-25 microarcse-conds, depending on colour, at 15th magnitude and 100-300 micro-arcseconds at 20^{th} magnitude. Multi-colour photometry will be obtained for all objects by means of low-resolution spectrophotometry between 330 and 1000 nm. In addition radial velocities with a precision of 1-15 km/s will be measured for all objects to 17th magnitude.

ELSA (European Leadership in Space Astrometry) is a Marie-Curie research training network which brings together world-leading expertise in space astrometry, the use of space platforms for mapping the three-dimensional structure of our Galaxy, with specialists on numerical algorithms and software engineering for the double purpose of (1) preparing for the scientific exploitation of data from the Gaia mission and (2) training the next generation of researchers in this uniquely European specialty to maintain and extend European leadership in space astrometry.

The primary goal of ELSA is to develop a new theoretical understanding of the concep-tual, physical, and numerical aspects of space astrometry and turn this understanding into practical analysis tools which will form an essential contribution towards the Gaia data processing system. However, as organizers of the school we felt that it is important that from the outset the young researchers in this network have a solid understanding of the science goals of the Gaia mission in order to provide them with the proper back-ground and motivation for the specific research they will undertake. At the same time bringing the potential `end-users' of the Gaia data together with the community involved in preparing for and running the mission would foster very valuable contacts and mutual understanding.

Because the lecture program would be of general interest to anyone interested in the Gaia mission the school was also open to participants from outside the ELSA network. In total 25 students participated in the school which was also attended by the scientists in charge of the network nodes. Including the lecturers there were 54 participants in total.

The programme in the first week consisted of two 90 minute lectures in the morning followed in the afternoon by exercises that the students had to carry out in groups. The lectures covered the following topics: Stellar evolution, stellar atmospheres, structure and dynamics of the Galaxy and the Local Group, formation and evolution of the Galaxy in a cosmological context, chemical enrichment history of the Galaxy as encoded in its stars, binaries, exoplanets, fundamental physics, and dynamics and physical properties of small solar system bodies. The lecturers has the difficult task of covering these very broad topics in just 90 minutes while taking into account the non-astronomical background of some of the participants.

The afternoon exercises were intended to let the students actually work actively on some of the topics discussed during the lectures and so create a more workshop-like atmosphere.

Scientific Report

The exercises were designed by the lecturers together with the ELSA scientists in charge. The students were divided into 8 groups of 2-4 people and the worked on exercises covering: population synthesis and stellar content of galaxies, calculating orbits of astrometric binaries, estimating the photocentre-barycentre discre-pancy for observations of solar system objects, analyzing the calibration of the Cepheid period luminosity relation, computing a relativistic astrometric model, working with SDSS data to detect the Sagittarius stream, detecting tidal debris in the halo in a simulated Gaia catalogue, and analyzing stellar spectra as observed with Gaia's RVS instrument. The results of the exercises were presented by the students and discussed on the last afternoon of the first week. In addition all the students brought posters on their work which they presented during a mid-week afternoon session.

The lectures in the second week were devoted to more ELSA-specific issues. An intro-duction to GRID computing was given by a representative from Dutch Space BV through a very interesting role-playing game in which the participants had to take on the roles of the various components in a GRID architecture. The game was very successful in demonstrating the complexities of setting up a GRID environment. There were three lectures on how space projects are realized by ESA and its industrial partners and the final two lectures concentrated on the interpretation of astrometric data and the Gaia mission in the context of other large surveys.

The ELSA school was on the whole very successful in providing the students with a broad introduction to the science of Gaia. The lecture program combined with the exercises was very full with little time to read the posters or for more relaxed interactions during the day. Shorter lectures of an hour or so with longer coffee breaks would probably have been better. However the hard work by the participants in the first week did foster a real sense of being together in a large and exciting project. A Google-groups web page was even established by the students as a means to stay in touch with each other after the workshop.

The Lorentz Center facilities were very much appreciated by all those who attended the school and we would like to thank the staff (especially Wies Groeneboer) for helping to make this school a real success.

All the lectures have been made available on-line through the ELSA web-site:
http://www.astro.lu.se/ELSA/

Anthony Brown (Leiden University, Netherlands)
Lennart Lindegren (Lund University, Sweden)
Mary Kontizas (National and Kapodistrian University of Athens, Greece)
Catherine Turon (Observatoire de Paris, France)
Karri Muinonen (University of Helsinki, Finland)

Scientific Report

Algorithmic Bioprocesses

December 3 – 7, 2007

One of the Grand Challenges of informatics is to understand the world around us in terms of information processing. An important example of interdisciplinary research towards such an understanding is the interplay between biosciences and informatics. As an illustration of this research, this workshop focused on algorithmic bioprocesses, especially including algorithmic self-assembly and RNA folding, algorithmic foundations for biochemical reactions, and algorithmic nature of developmental processes.

Four focus topics had special attention during the workshop:

- Algorithmic self-assembly.
- RNA folding.
- Algorithmic foundations for biochemical reactions.
- Algorithmic nature of developmental processes.

The workshop was very succesful. Excellent researchers presented their work and there was a very lively atmosphere with many discussions. There were more than 40 participants coming from all over the world.

During the workshop participants decided to make a book (with the same title as the workshop) as a spin-off from the workshop. Springer-Verlag has accepted the book proposal and draft chapters are due in March 2008.

A. Condon (Vancouver, Canada)
D. Harel (Rehovot, Israel)
J.N. Kok (Leiden University, Netherlands)
A. Salomaa (Turku, Finland)
E. Winfree (Pasadena, United States)

Scientific Report

The prospects of LOFAR surveys

December 10 – 12, 2007

LOFAR, the Low Frequency Array, is a next-generation radio telescope that is being built in the Netherlands and neighbouring countries and will be fully operational at the end of this decade. It will operate at frequencies from 15 to 240 MHz (corresponding to wavelengths of 20 to 1.2 m). Its superb sensitivity, high angular resolution, large field of view and flexible spectroscopic capabilities will represent a dramatic improvement over previous facilities at these wavelengths. As such, LOFAR will carry out a broad range of fundamental astrophysical studies and will be an important vehicle for astronomical research.

An important goal that has driven the development of LOFAR since its inception is to explore the low-frequency radio sky by means of a series of unique surveys. We are planning to exploit the unprecedented sensitivity and wide instantaneous field of LOFAR to conduct large-sky surveys at 15, 30, 60, 120 and 200 MHz. Such surveys should start in 2009, when the 100 km LOFAR should become operational.

Four topics are driving the definition of the proposed surveys. These are:

- Formation of massive galaxies, clusters and black holes using z>6 radio galaxies as probes,
- Intercluster magnetic fields using diffuse radio emission in galaxy clusters as probes,
- Star formation processes in the early Universe using starburst galaxies as probes, and
- Exploration of new parameter space for serendipitous discovery.

The tasks of the survey science team are to (i) provide input for planning the surveys and subsequent production, (ii) plan preparatory/follow-up observations, (iii) carry out theoretical simulations, (iv) to be involved / take the lead in one of the science areas. Initially the science team was mainly comprised of Dutch astronomers. Recently Germany and the UK have joined LOFAR, and the size of the science team has doubled. In addition, there are a number of members of the team that have been invited to joined since they have either relevant scientific or technical expertise or access to important observing facilities.

The meeting at the Lorentz center on Dec 10-12, 2007 was the first meeting of the international science team. Items on the agenda included:

- Survey plans
- LOFAR project
- Formation of massive galaxies and clusters
- Star Formation in the early Universe
- Intercluster magnetic fields
- Serendipity
- Physics of radio sources and active galaxy nuclei
- Magnetic fields and ISM in nearby galaxies
- Large scale structure of Universe and its evolution
- Galaxy and its constituents

On the first day an overview was given on the status of LOFAR and the main scientific topics that will be addressed by the LOFAR surveys. The presentations took about 50 % of the time

so that there was ample time left for discussions. These discussions will focused on:

- Refinement of the survey definitions to optimise the scientific outcome
- Field selection
- Preparatory and follow-up observations

In addition, 25 % of the time was set aside so that the newly formed subgroups on the various science topics could meet and plan their work. The list of people that attended the meeting included members of the international survey team plus selected members from the LOFAR project.

The meeting was a great success. The discussions related to the scientific priorities of the surveys took place in a very open atmosphere. It is clear that this meeting was the start of a very fruitful collaboration with especially Germany and the UK to maximise the scientific success of the LOFAR survey project.

Huub Röttgering (Sterrewacht Leiden, Universiteit Leiden, Netherlands)
Peter Barthel (Kapteyn Instituut, Groningen, Netherlands)
Philip Best (The Royal Observatory Edinburgh, Edinburgh, United Kingdom)
Rainer Beck (Max-Planck-Institut für Radioastronomie Bonn, Germany)
George Miley (Sterrewacht Leiden, Universiteit Leiden, Netherlands)
Raffaella Morganti (Astron, Dwingeloo, Netherlands)
Ignas Snellen (Sterrewacht Leiden, Universiteit Leiden, Netherlands)

Scientific Report

Literature and Evolutionary Theory

December 13 – 15, 2007

Theme of the workshop was the emerging field of research on literature and evolution, bringing together scientists, and scholars from the humanities and social sciences. It was the *goal* of the workshop to distinguish clearly between different approaches now hiding under the same general label of 'literature and evolution', to determine their academic viability, and to develop new research questions. To this end, this workshop brought together biologists, life scientists, psychologists, anthropologists, and scholars in the humanities (literature, philosophy, cultural history). There were about 45 participants, including a number of graduate students from various academic backgrounds. The workshop consisted of contributions by key-note speakers, followed by several-hour discussion sessions. The evening program featured a showing of the film 'Babel' (with introduction by Murray Smith), and the first English-language performance of 'Under the Leiden beech tree; dialogues on the value of science' (by Frans Saris; performed by Jan Keyne and Frans Saris, with musical accompaniment by Merlijn Runia, Aleksei Nazarov, and Anke van der Kooij, three students of the Leiden Faculty of Creative Arts), followed by discussion. Details of the program and presentations may be found on the website of the Lorentz Center: http://www.lc.leidenuniv.nl/lc/web/2007/279/info.php3?wsid=279

Subthemes: After a general introduction to the field by Ineke Sluiter (Leiden University), the workshop was structured around the following subthemes:

1. The question of whether literature (and the arts more in general) are themselves an adaptive product of human evolution or whether they are just a by-product of our expanded brains. Brian Boyd (Auckland, NZ) argued for an evolutionary origin of fiction based on the universal features of 'play', especially pretend-play, and attention sharing.

2. Literature as laboratory or archive. Some researchers consider literature a testing-ground for the insights of evolutionary psychology. Literature (and film) represent essential human behaviors. Jonathan Gottschall ((Pittsburgh) presented his work on Homer's Iliad, and on the universal (and quantifiable) characteristics of folk stories. Murray Smith (Canterbury) explained evolutionary features of cinematographic technique in terms of their effect, given natural constraints on human perception.

3. Some researchers look at the 'evolution' of literature and other cultural phenomena themselves ('memes' versus 'genes'). How does the 'co-evolution' of biology and culture work? Do stories somehow take care of their own survival? How do the phenomena of random change, selective retention, and reproduction function in a cultural (non-genetic) context? In his keynote, David Sloan Wilson (Binghamton) made a convincing case for the relevance of group selection, not only in a cultural context, but also in a genetic one. This was an important 'missing link' between the two evolutionary domains.

Final discussion and outcome: The final discussion session was preceded by short statements by four participants exploring avenues of future research. Anthropologist Raymond Corbey (with Angus Mol) (Leiden University) proposed an evolutionary approach to the Beowulf story by interpreting the contemporary material remains in terms of conspicuous consumption. Philosopher Herman Philipse (University of Utrecht) expressed scepticism about the added value of the 'data set' of literature as an archive for an evolutionary approach. Katja Mellmann (Munich) offered the perspective of a literary scholar. Dutch literature specialist Marita Mathijsen (Univ. of Amsterdam) proposed to apply an evolutionary approach to the historiography of literature (similarly, André Lardinois had proposed a

macroevolutionary explanation for the survival of just 33 out of 1200 known Greek tragedies).

An important result is that our present knowledge of cultural evolution resembles Darwin's position vis-à-vis genetic evolution: we recognize the dynamics without knowing the carrier. The open-minded interaction between scholars from very different background was very effective. Several avenues for future research were proposed and will no doubt be put into effect.

The organizers are most thankful to the Lorentz Center, in particular to Academic Director Wim van Saarloos, executive director Martje Kruk and program assistant Wies Groeneboer, as well as to the Netherlands Institute for Advanced Study (NIAS) and its director Wim Blockmans, for generous hospitality on both evenings.

Jaap Goedegebuure (Leiden University [Dutch Literature])
Bas Haring (Leiden University [Public Understanding of Science])
Frans Saris (Leiden University [Physics])
Ineke Sluiter (Leiden University [Classics])
Arie Verhagen (Leiden University [Cognitive Linguistics])

Scientific Report

Karyotyping: from microscope to array

December 17 – 19, 2007

In order to speed up and boost the introduction of high resolution molecular karyotyping in the diagnostic setting, laboratory specialists and clinicians have met at Leiden in December 2007.

Since 1960 we know chromosomal aberrations to be an important cause of congenital malformations and mental retardation. Chromosomes are studied using the light microscope to analyse spreads of nuclei arrested in metaphase. This technique has distinct advantages: all chromosomes can be inspected and compared in one view, and single cells are analysed, enabling clonal analysis. There are also disadvantages: a rearrangement has to involve at least 5-10 million basepairs to be visible by microscopy. The technique is laborious and requires long training of skilled personnel, and is therefore costly. By Fluorescent In Situ Hybridization (FISH) smaller rearrangements can be detected, but this technique also requires considerable hands on time of highly trained technicians. Furthermore FISH is not suitable for whole genome analysis, and due to its focal nature, requires recognition of specific clinical signs characteristic for a particular rearrangement.
Recently, hybridization of DNA on arrays carrying either clones or oligonucleotides enables molecular karyotyping at unprecedented resolution. Since arrays are now offered by several companies at decreasing prices, routine molecular karyotyping of all patients with mental retardation and/or congenital malformations becomes a realistic option.
However, polymorphic variation of chromosomes without phenotypic effects, a problem that already occurred with microscopic karyotyping, hits us head on when the resolution of our techniques increases. We now know that up to 12% of the genome can vary in copy number without having an effect on the human phenotype.
Therefore, for each small rearrangement detected using the new array techniques we will have to collect evidence indicating whether or not the variant is causal to the problem of the patient.
It is very clear that microscopic karyotyping will be replaced by molecular analysis by array. This big change has many practical implications, both for clinicians and for the laboratory. There is already a plethora of different types of arrays to choose from. Software packages to analyse the data are popping up at increasing speed. Databases containing results from large groups of analysed patients as well as 'normals' are available for those who are able to find them on the web. Several databases combining clinical and molecular data of patients are being filled by the more active groups.
The clinical cytogeneticist, the clinical molecular biologist, and the clinical geneticist will have to collaborate closely to make a first distinction between clearly pathogenic rearrangements, possibly pathogenic rearrangements, possibly 'normal' variants, and clear cut 'normal' variants. Subsequently, strategies to better define the questionable rearrangements will have to be designed.

During the Leiden Array Workshop ("the LAW" ☺) laboratory specialists, bioinformaticians and clinicians from the clinical genetic centres in The Netherlands and Flanders have exchanged approaches, tools and guidelines for molecular analysis. Several practical sessions have been held to train the use of databases on the web, the software packages to analyse array data, and the use of clinical databases.

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On Monday December 17, Dr Peter Taschner from the Department of Human Genetics of Leiden University introduced exercises to teach the participants to find information on copy number variations using web resources. If you are interested, you can visit: http://www.humgen.nl/CNVexercise.html.
In the afternoon Dr Nigel Carter and Shola Richards from the Sanger Centre at Cambridge, UK, presented the DECIPHER database of chromosomal variants (http://www.sanger.ac.uk/PostGenomics/decipher/). Nigel Carter reported impressive results of the research on copy number variation in the Sanger Centre.

On Tuesday December 18, the participants were stimulated by Drs Conny van Ravenswaay, Nicole de Leeuw, and Bregje van Bon to enter chromosomal aberrations detected in their own laboratory into the ECARUCA database (www.ecaruca.net).

In the afternoon, and on Wednesday morning the participants could choose between three practical training sessions on various array platforms:
Affymetrix, guided by Drs Joris Veltman, Rolph Pfundt, and Jayne Hehir-Kwa from Nijmegen;
Agilent, guided by Drs Klaas Kok (Groningen) and Jacqueline Schoumans (Karolinska Institutet, Stockholm)
Illumina, guided by Drs Claudia Ruivenkamp, Antoinette Gijsbers from Leiden, and Martin Poot from Utrecht.

In the meantime and during the closing session many issues were hotly debated. During the year 2008 all clinical genetic centers in The Netherlands will implement molecular karyotyping in the routine diagnostic workup of patients with mental retardation and/or congenital malformations. Five centers will implement the Agilent oligonucleotide platform, whereas three centers will use Affymetrix SNP arrays.
We have agreed to come together again in January 2009 to compare results.

I take this opportunity to thank all the organisers and speakers who have made this Workshop a very lively and stimulating experience for all participants. I also thank the staff of the Lorentz Center for their excellent support, in particular Yolande van der Deijl for flawless administration, and Erik Deul for extensive computer support.

M. Breuning (Leiden University, Netherlands)