

# ANNUAL REPORT 2006

**Dutch Research School of Theoretical Physics (DRSTP)**  
**Landelijke Onderzoekschool voor Theoretische Natuurkunde (LOTN)**

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# Preface

This is the Annual Report 2006 of the Dutch Research School of Theoretical Physics (DRSTP). It provides an overview of the educational and research activities during 2006, intended for a broad spectrum of interested parties. The report also presents two research highlights written by staff members of the Research School. In addition, it offers a wealth of factual information, such as a list of the participating staff, of the PhD students, a comprehensive list of publications, as well as other relevant statistics.

The annual report is not the only information that we make available throughout the year. We also publish a monthly newsletter and a yearly guide of our educational activities. Up-to-date information on the DRSTP is also readily available on internet at: <http://www1.phys.uu.nl/drstp/>.

Finally, we should like to thank all of those who contributed to the Research School during this past year.

prof. dr. B. de Wit  
Scientific director

prof. dr. K. Schoutens  
Chair governing board

August 2007



# Contents

<b>1</b>	<b>The DRSTP in 2006</b>	<b>7</b>
<b>2</b>	<b>Scientific highlights</b>	<b>11</b>
<b>3</b>	<b>PhD programme</b>	<b>19</b>
3.1	Educational programme . . . . .	19
3.1.1	DRSTP postgraduate courses (AIO/OIO schools) . . . . .	19
3.1.2	Guest lecturers . . . . .	20
3.2	PhD degrees and subsequent employment . . . . .	21
3.3	PhD degrees granted in the DRSTP in 2006 . . . . .	21
3.4	Other PhDs advised by DRSTP staff . . . . .	36
3.5	DRSTP PhD students (31 December 2006) . . . . .	36
3.6	Scientific and educational activities of PhD students in Quantum Field Theory and Elementary Particle Physics (theme 1) . . . . .	42
3.7	Scientific and educational activities of PhD students in Statistical Physics, Condensed-Matter Theory and Quantum Optics (theme 2) . . . . .	47
<b>4</b>	<b>Scientific staff (31-12-2006)</b>	<b>55</b>
4.1	Permanent staff . . . . .	55
4.2	Temporary staff (31-12-2006) . . . . .	57
4.3	Associate members . . . . .	58
<b>5</b>	<b>Academic publications</b>	<b>59</b>
5.1	Theme 1: Quantum field theory and elementary particle physics . . . . .	59
5.2	Theme 2: Statistical physics, condensed-matter theory and quantum optics . . . . .	66
<b>6</b>	<b>Scientific activities</b>	<b>77</b>
6.1	Theme 1: Quantum field theory and elementary particle physics . . . . .	77
6.2	Theme 2: Statistical physics, condensed-matter theory and quantum optics . . . . .	88
<b>7</b>	<b>Science-related activities</b>	<b>99</b>
7.1	Professional publications . . . . .	99
7.2	Other publications . . . . .	100

7.3	Public lectures . . . . .	101
7.4	Other contributions . . . . .	102
<b>8</b>	<b>Research funding</b>	<b>107</b>
8.1	Personal grants . . . . .	107
8.2	FOM funding . . . . .	108
8.3	EU-networks . . . . .	112
8.4	ESF . . . . .	114
8.5	Other . . . . .	114
<b>9</b>	<b>Organisation DRSTP 2006</b>	<b>117</b>
<b>10</b>	<b>Addresses</b>	<b>119</b>
<b>Appendix A</b>		
	Mission Statement	123
<b>Appendix B</b>		
	Selection and supervision procedure of PhD students	126
<b>Appendix C</b>		
	Postgraduate AIO/OIO schools	128
<b>Appendix D</b>		
	National seminars	133
<b>Appendix E</b>		
	Symposia	136
<b>Appendix F</b>		
	Statistics	139

# 1 | The DRSTP in 2006

The Netherlands has a long tradition in theoretical physics which involves research performed at university institutes, industrial laboratories, and government institutions. The strength of this research area is, for a large part, based on the unity of methods employed in a wide range of applications. This reveals itself both in scientific research as well as in academic education.

In order to structure and coordinate the graduate education in theoretical physics, the Dutch Research School of Theoretical Physics (DRSTP) was accredited in 1994 by the Royal Netherlands Academy of Arts and Sciences (KNAW) and reaccredited in 1999 and 2004. The school is, at this moment, a cooperation between the theoretical physics groups of six Dutch universities: Universiteit van Amsterdam (UvA), Vrije Universiteit Amsterdam (VUA), University of Groningen (RUG), Leiden University (UL), Radboud University Nijmegen (RU) and Utrecht University (UU, commissioner). In addition, there are several associated groups and individual researchers.

The main objectives of the Dutch Research School of Theoretical Physics are to implement a joint programme of graduate education in theoretical physics and to maintain and strengthen research in theoretical physics from a broad unifying perspective that exploits the interrelationships between different fields of theory. The DRSTP is based on the conviction that a joint venture of all the moderately sized local theory groups, each with its own profile, offers added value for the achievement of these objectives. The current version of the mission statement and a short description of the DRSTP organization can be found in appendix A.

## *The DRSTP graduate programme in 2006*

As part of the research training, under supervision of a member-scientist of a participating university, the Research School guarantees a wide range of educational opportunities for its PhD students. These consist of postgraduate schools, advanced courses, seminars and topical courses in the Netherlands, and international experience in the form of workshops, summer schools or extended research visits abroad. As in previous years the educational board published the educational guide with an overview of the regular advanced courses taught at the universities.

In 2006 nineteen students obtained their PhD. The average time between the start of the research and the date of the PhD exam is 48,0 months. In reaction to comments in the reaccreditation report of the ECOS (KNAW) the rules for the admission of students to the DRSTP have become more strict. In this admission procedure, the so-called “agreement of education and guidance” (plan for training and supervision) plays a crucial role. The selection and admission procedure is described in appendix B.

*The DRSTP research programme*

Theoretical physics is based on universal principles. New concepts often have a much wider validity than for the field where they were initially discovered, and methods of description developed in one field are often fruitful in another. Hence, theoretical physics is characterized by unity in diversity. The research programme of the DRSTP is organized according to two themes:

- Theme 1: Quantum field theory and elementary particle physics.
- Theme 2: Statistical physics, condensed-matter theory and quantum optics.

To give an impression of the variety of research topics, two highlights are presented in chapter 2. The specific content of the research programme depends on the responsible project leaders, on their creativity as well as their success in acquiring research funding from their home university, the Dutch research councils of NWO, or from international sources such as European Union programmes.

The 2006 research output of DRSTP members presented in this annual report is presented according to the two research themes.

*Staff mutations in 2006*

Dr. G.T. Barkema was appointed as an adjunct professor of Computational Statistical Physics of (Bio)polymers at Leiden University on behalf of the “Stichting Physica” in March 2006.

Dr. R. Duine was appointed as assistant professor at the Institute for Theoretical Physics (UU) in September 2006.

Prof. dr. L.F. Feiner (Philips) resigned as adjunct professor at the Institute for Theoretical Physics (UU) on January 1, 2006. This ended his affiliation with the DRSTP. Prof. dr. D. Lenstra became Dean of the Faculty of Electrical Engineering, Mathematics & Computer Science at the Technical University Delft in November 2006. This ended his affiliation with the DRSTP.

*New member DRSTP Advisory Board*

In 2006 prof. dr. David Nelson (Harvard University) became a new member of the advisory board of the DRSTP. David Nelson’s research focuses on collective effects in the physics and chemistry of condensed matter. His current interests also include vortex physics, the statistical mechanics of polymers, topological defects on frozen topographies and biophysics.

*Guest chairs*

Also in 2006 staff members and PhD students profited from the presence of world renowned physicists appointed on the guests chairs.

Prof. dr. A.V. Ashtekar (Penn State Univ.) occupied the Kramers Chair at Utrecht University. He taught a lecture course on *Black holes in fundamental physics*.

Prof. dr. D.R. Nelson (Harvard University) occupied the Lorentz Chair at Leiden University. He taught a lecture course on *Topics in statistical biophysics and quantitative biology*.



Prof. dr. M. Roček (SUNY, Stony Brook) occupied the Van der Waals Chair at the Universiteit van Amsterdam. He taught a lecture course on *Supersymmetry and supergravity*.

#### *Awards and distinctions*

C.W.J. Beenakker (UL) was awarded the Akzo-Nobel Science Award 2006 in Haarlem, the Netherlands on 30 November 2006.

W.J.P. Beenakker (RU) was awarded the ‘Onderwijsprijs Natuurkunde en Sterrenkunde 2006’ at the Radboud University Nijmegen, the Netherlands on 6 September 2006.

L. Huijse (UvA) was awarded the Pieter Zeeman Scriptieprijs 2005-2006 for the best Master Thesis in Physics at the University of Amsterdam, the Netherlands, in 2005 and 2006 by the Pieter Zeeman Foundation, entitled: *The information loss paradox*, supervisor: Prof. dr. J. de Boer, August 2005.

J.H. Koch was awarded the title ‘Docent of the year 2005 - 2006’ of the OWI Exact Sciences (FNWI), University of Amsterdam, the Netherlands.

P. Machado (UU) received the Yuval Neeman Diploma at the 44th International School of Subnuclear Physics, Ettore Majorana Centre, Erice, Italy which was held from 29 August to 7 September 2006.

H.T.C. Stoof (UU) was elected Fellow of the American Physical Society ‘for pioneering contributions to the many-body theory of ultracold atomic gases, and especially for the development of the theory of Feshbach resonances in strongly interacting Bose and Fermi gases’ on 14 November 2006.

G. ’t Hooft (UU) received an Honorary Doctor Degree at the ‘Instituto Universitario de Fisica Fundamental y Matematicas’ of the University of Salamanca in Spain on 26 May 2006.

J. Zaanen (UL) was awarded the NWO/Spinoza Prize 2006 in Den Haag, the Netherlands on 29 November 2006.

#### *“DRSTP-Young” symposium*

On 26 and 27 October 2006 the DRSTP-Young symposium “The Future of Theoretical Physics in the Netherlands” was held in Conference center *De Bergse Bossen* in Driebergen. The participants made a number of recommendations concerning the future of the DRSTP to the governing board. For the program of the meeting, see appendix E.

#### *Visiting scientists (long term)*

S. Alexandrov (Montpellier) was a guest at the Institute for Theoretical Physics (UU) from 20 January to 16 July.

R. Brito Lopez (Univ. Madrid) was a guest at the Institute for Theoretical Physics (UU) from 5 July to 8 August.

R. Capozza (University of Modena, Italy) was a guest at the Radboud University (RU) for collaboration within the HCP-Europe framework for a period of two months.

A. Drzewinski (Polish Academy of Sciences, Warsaw, Poland) was a guest at Instituut-Lorentz for Theoretical Physics (UL) from 1 May until 31 May.

M. Hübscher (Un. Autonoma de Madrid, Spain) was a guest at the Centre for Theoretical Physics (RUG) from September until December.

V. Irkhin (Moscow State University, Russia) was a guest at the Radboud University Nijmegen (RU) in the context of the NWO framework (Russian-Dutch collaboration) in October and November.

P. Machado was a guest at the Institute for Theoretical Physics (UU) from 1 January 2006 to 1 January 2007.

A. Mukherjee (Indian Institute of Technology, Bombay, India) was a guest at the Instituut-Lorentz for Theoretical Physics (UL) from 1 May until 31 July.

S.I. Mukhin (Moscow Institute for Steel and Alloys, Moscow, Russia) was a guest at the Instituut-Lorentz for Theoretical Physics (UL) from 25 January to 25 February.

This annual report is organized as follows. Chapter 2 contains two scientific highlights. Chapter 3 gives a description of the educational programme, short summaries of the PhD theses published in 2006, an overview of the scientific and educational activities of the PhD students affiliated to the DRSTP. An overview of the DRSTP scientific staff and associate members is given in chapter 4. The chapters 5, 6, 7 contain, respectively, the 2006 publications, talks and other presentations and science-related activities (public lectures, professional publications). Data on research funding are listed in chapter 8.

## 2 | Scientific highlights

*This chapter presents two highlights of theoretical research carried out by members of the Research School. One concerns work on graphene, a recently discovered allotrope of carbon. This work belongs to condensed matter physics, one of the topics in theme 2 of the school. The contribution has been written by Mikhail Katsnelson. Also the second highlight belongs to theme 2 and deals with non-equilibrium behaviour in active gels and living cells. This contribution has been written by Fred MacKintosh.*

### **Chiral tunneling and the Klein paradox in graphene**

(Mikhail Katsnelson, RU)

The physics understanding of our world is based on two rather strange theories, the relativity theory and the quantum mechanics. Many concepts that underpin these theories are very subtle and, sometimes, completely contradict to a “common sense”. Examples of such paradoxes are the “twin paradox” in the relativity theory and the famous “Schrödinger cat” in quantum mechanics, which are widely discussed now not only in scientific and philosophical literature but also have found their way to science fiction and movies.

Even deeper paradoxes appear if these two great theories are combined into the relativistic quantum mechanics or quantum electrodynamics (QED). It was proposed by British physicist Paul Dirac eighty years ago. In quantum mechanics, electron is neither wave nor particle but, at least, it is a well-defined individual entity. In QED, an electron is an excitation of some mysterious field (or vacuum) unifying electrons with their antipodes, positrons. In normal quantum mechanics, we can measure accurately either position of the electron or its velocity but not both of them simultaneously. In relativistic quantum mechanics, we cannot measure even the electron position with arbitrary accuracy since, when we try to do this, we create electron-positron pairs from the vacuum and we cannot distinguish our original electron from these newly created electrons. In quantum mechanics, electrons can propagate through classically impenetrable barriers (so-called tunneling effect that is widely used in modern electronics). In this case, the higher the barrier the smaller its quantum transparency. In QED, the quantum tunneling phenomenon takes an even more unexpected and seemingly absurd turn: even very high and very broad barriers can become completely transparent for electrons. This conclusion from the Dirac theory was reached by Swedish physicist Oscar Klein in the late 1920's and is now known as the “Klein paradox”. However, in practical terms, this paradox can be relevant - either fortunately or unfortunately - only for such exotic situations as the collisions of super-heavy nuclei or evaporation of black holes, and it was never observed or even attempted to observe experimentally.

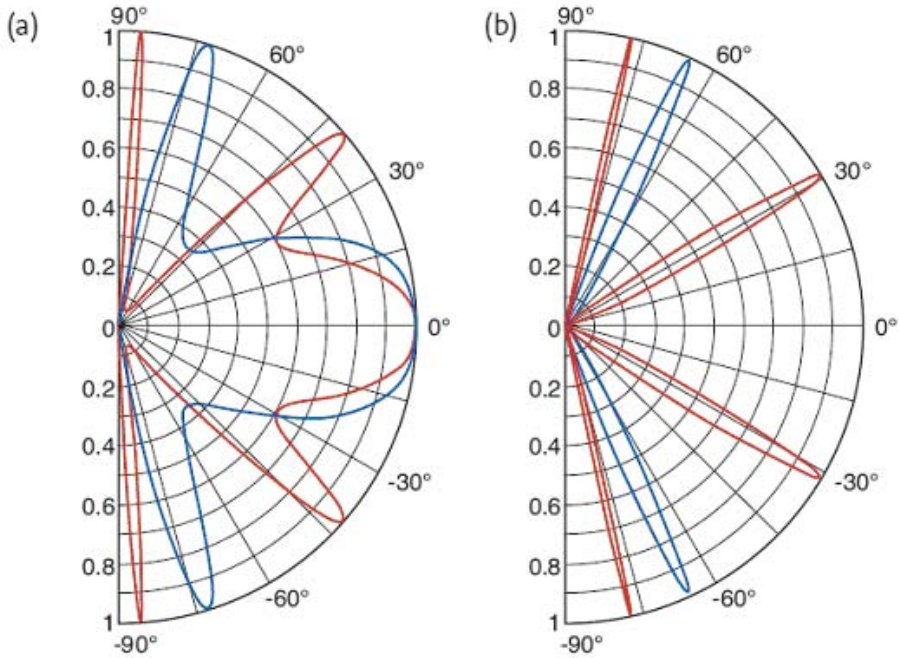


Figure 2.1: Transmission probability through a 100-nm-wide barrier as a function of the incident angle for single- (a) and bi-layer graphene. Blue and red curves correspond to different charge carrier concentrations.

It was predicted that this amazing phenomenon can in fact be observed and investigated experimentally in a relatively simple bench-top experiment using a recently discovered new allotrope of carbon, graphene [1]. In this one-atom-thick layer of carbon, electrons behave as ultrarelativistic particles and are accurately described by the Dirac theory, and the conditions required for the Klein paradox are readily achievable. This work further develops a new paradigm, where fundamental physical processes that happen in the universe and unreachable even for the largest modern elementary particle accelerators, can now be simulated in graphene. In graphene, charge carriers have the energy spectrum typical for ultrarelativistic Dirac quantum particles. The Klein paradox should therefore be very important for the propagation of charge carriers through potential barriers. In particular, a standard scheme used for transistors made from conventional semiconductors will therefore not work properly for graphene. At the same time, the charge carriers in bilayer graphene demonstrate a new type of tunneling which is different from both standard nonrelativistic tunnel effect and the

Klein tunneling. The predicted behavior may be important for electronics. In particular, it opens a way to use the bilayer graphene to build carbon-based transistors.

[1] M.I. Katsnelson, K.S. Novoselov and A.K. Geim, *Nature Physics* 2, 620 (2006).

## Non-equilibrium mechanics and fluctuations in active gels and living cells (Fred MacKintosh, VUA)

The cytoplasm/interior of living cells is a highly dynamic environment, in which motion is governed by the competing effects of active processes and ever-present thermal fluctuations that are important at the cellular scale of micrometers. Active processes within cells are often governed by motion and force generation due to *molecular motors*, small proteins that generate forces using biochemical energy. Such active processes usually lead to directed movement. While many details of molecular motor activity are well understood at the single-molecule level, much less is known about how such motors act cooperatively within the cell. In an experimental and theoretical collaboration, Daisuke Mizuno, Catherine Tardin, and Fred MacKintosh at the VU, together with Christoph Schmidt, at Georg-August-Universität (Göttingen), have designed and constructed an *in vitro* model system that demonstrates important characteristics of cytoplasmic dynamics. This work was published in *Science* [1].

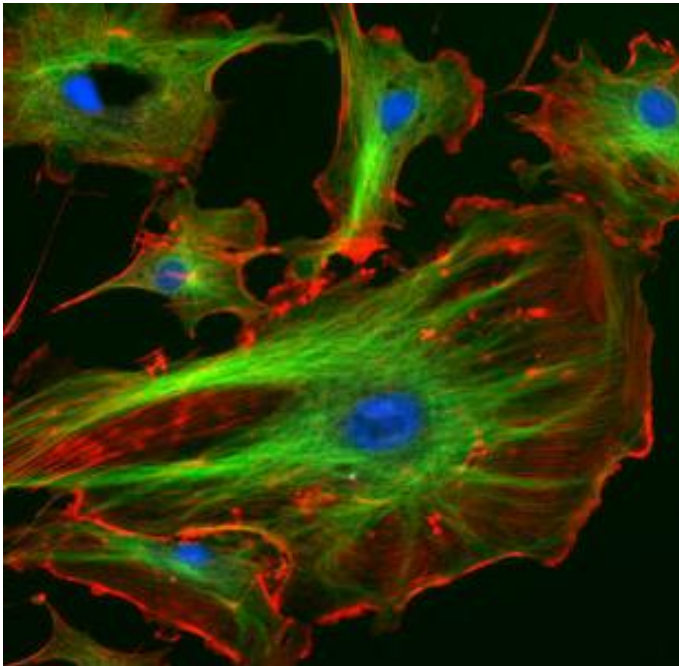


Figure 2.2: Eukaryotic cytoskeleton, in which actin filaments are labelled red and microtubules are green. Nuclei are shown in blue. (From Wikipedia.)

The mechanics of living cells are largely governed by their mechanical framework, the *cytoskeleton*, which is a nonequilibrium composite material including filamentous protein polymers and motor proteins. As materials, *in vitro* networks of cytoskeletal filaments have been shown to have interesting and unusual mechanical properties,

including a highly non-linear elastic response. While there has been much progress in recent years separately on the equilibrium mechanics of biopolymer networks and the single-molecule properties of molecular motors, little is known about the collective properties of networks that include active force generation. This work shows how motor activity can radically alter the material properties of biopolymer networks stiffening them by up to a factor of 100, in accord with theory.

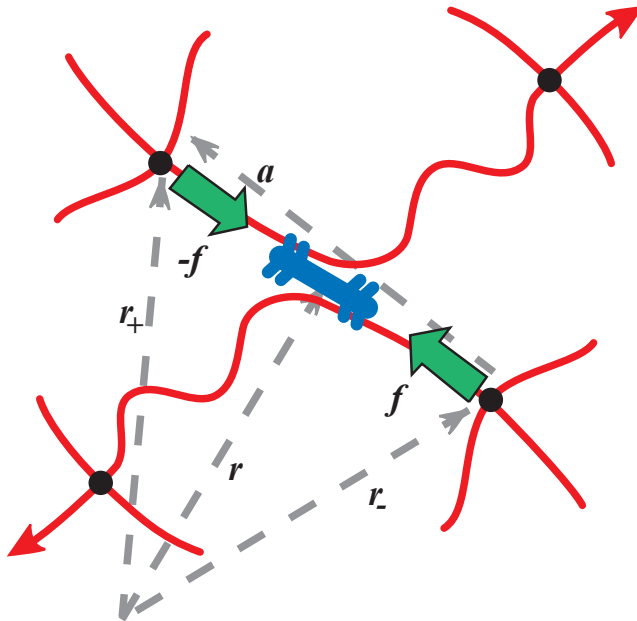


Figure 2.3: Molecular motors (middle) generate a force pair (arrows), which strains the network of filaments [1,2].

### *Active gels*

Cellular cytoskeletal networks are far from equilibrium materials, due in large part to molecular motors that exert internal forces within the networks, which presents a challenge for quantitative statistical/thermodynamic modeling. This work also demonstrates pronounced low-frequency, non-equilibrium fluctuations. Such systems are examples of *active gels*, which are the focus of a growing sub-field within soft matter physics. The theoretical model developed here is based on known non-linear elastic properties of biopolymer networks, together with fluctuating forces due to motor activity. It is shown that the unbinding of motor proteins naturally results in a characteristic spectrum of colored noise that can be distinguished from thermal fluctuations by its spectrum.

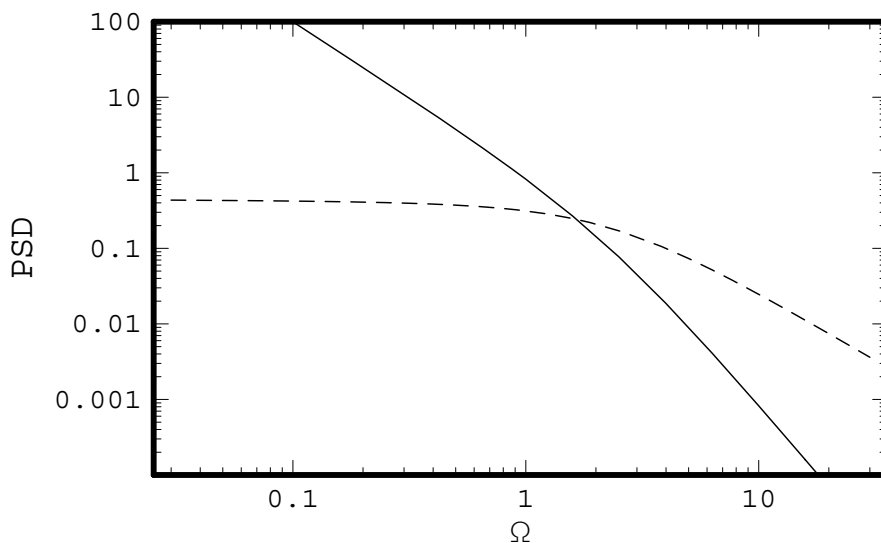


Figure 2.4: The predicted power spectral density as a function of frequency, due to both molecular motors (solid line) and thermal fluctuations (dashed) in an active gel, showing that the non-equilibrium fluctuations are only expected to be apparent at low frequency [2], consistent with experiment.

#### *The fluctuation-dissipation theorem and non-equilibrium fluctuations*

A quantitative description of the function of cells and their complex machineries requires a combination of a biochemical molecular approach with a statistical and thermodynamic one. However, since it is a defining property of living systems to be out of thermodynamic equilibrium, classical methods have to be extended to account for this. This work shows how non-equilibrium motor activity controls the mechanical properties of a simple three-component *in vitro* model of the cytoskeleton. The non-equilibrium origin of this active mechanical control is demonstrated by a violation of a fundamental theorem of statistical physics, the fluctuation-dissipation (FD) theorem, which links thermal fluctuations of arbitrary systems to their response to external perturbations. This FD theorem is a generalization of Einstein's famous description of Brownian motion. While it is only valid in equilibrium, its possible generalizations to out-of-equilibrium systems, ranging from granular materials to living cells has been hotly debated. Prior studies in cells have suggested violations of the FDT, although no direct test has so far been possible. These experiments show that the non-equilibrium fluctuations only appear at low frequency, consistent with the theoretical prediction of colored noise, varying inversely with the square of the frequency, due to molecular motors.



*Implications for living cells and synthetic materials*

Together with experimental colleagues at Harvard (the Weitz group) and AMOLF (Gijsje Koenderink), the implications of these principles, and especially the predicted spectrum of motor fluctuations, are being extended from *in vitro* systems to living cells. This work has already identified a dominant non-directed, stochastic motion of micron-size contents of the cytoplasm, which is demonstrably non-Brownian in origin and due to cooperative motor activity. This motion is many times faster than diffusion, although its time-dependence, surprisingly, resembles ordinary thermal diffusion.

This work also suggests that cells might be able to rapidly adjust their mechanical properties by contractile motor activity*i.e.*, by flexing their *muscles*. This model can also form the basis for quantitative design principles for creating synthetic polymeric materials with tunable elastic properties and muscle-like activation.

- [1] D. Mizuno, C. Tardin, C.F. Schmidt, F.C. MacKintosh, Nonequilibrium mechanics of active cytoskeletal networks, *Science*, 315:370 (2007).
- [2] F.C. MacKintosh and A.J. Levine, Non-equilibrium mechanics and dynamics of motor-activated gels, [arxiv.org/0704.3794](https://arxiv.org/abs/0704.3794).



## 3 | PhD programme

*This chapter provides an overview of the educational programme and of the PhD degrees granted in 2006. Research projects of current PhD students and data on their scientific and educational activities in 2006 are given.*

The DRSTP offers a joint programme of graduate education leading to a PhD. The educational programme is based in part on the regular advanced courses, seminars and topical courses offered at the participating universities. The DRSTP organizes at least two postgraduate schools every year. Furthermore, students can gain international experience by attending (international) workshops or summer schools and, in certain cases, by making extended research visits abroad. The governing board is advised on educational matters by the educational board. Regular advanced courses at the universities are published in a nationwide survey at the beginning of each academic year.

Seventy (70) PhD students were affiliated with the DRSTP on December 31, 2006. Nineteen (19) PhD students obtained their PhD in 2006. The governing board of the DRSTP decides on admission of individual PhD students and monitors their progress. The affiliation of students is based on the ‘agreement of education and guidance’ (plan for training and supervision), drawn between each individual student and his/her advisor(s). This document is submitted to the governing board before a decision is taken about the formal affiliation. An extended description of the selection and supervision procedure is presented in appendix B of this annual report.

### 3.1 Educational programme

#### 3.1.1 DRSTP postgraduate courses (AIO/OIO schools)

The following courses were held in 2006:

##### **Theoretical High Energy Physics (THEP)**

The DRSTP Postgraduate Course (AIO/OIO school) Theoretical High Energy Physics was held from 23 January to 3 February 2006 in Hotel & conference center De Bergse Bossen, Driebergen. The programme was organized by M. de Roo (RUG) and R. Timmermans (KVI) and included the following lectures (8 hours each):

G. Arutyunov (UU): *Introduction to AdS/CFT*

D. Boer (VUA): *QCD*

B. Schellekens (NIKHEF/RU): *Beyond the standard model*

J.W. van Holten (NIKHEF/VUA): *Black holes, compact stars and gravitational waves*

In addition to these lecture courses, daily discussion/problem sessions were held in the afternoon (4,5 hours each week).

Evening seminars (25 January and 1 February) were given by B. de Wit (UU) entitled: *Black hole entropy* and K. Jungmann (KVI) entitled: *Precision tests of the standard model*. The other evening presentations (15 minutes) were given by the students.

Twenty-one (21) people participated. Seventeen (17) of them were from the Netherlands, three (3) participants came from Belgium (2 KU Leuven, 1 UL Brussels) and one (1) participant came from Copenhagen. Further information is given in appendix C.

### Statistical Physics and Theory of Condensed Matter (SPTCM)

The DRSTP Postgraduate Course (AIO/OIO school) Statistical Physics and Theory of Condensed Matter was held from 15-19 May 2006 in Hotel & conference center De Bergse Bossen, Driebergen. The programme was organized by J. van den Brink (UL) and R. van Roij (UU) and included the following lectures (4 hours each):

M. Katsnelson (RU): *Path integrals*

C. Morais Smith (UU): *Dissipation in quantum systems*

P. van der Schoot (TUE): *Self organisation in soft matter*

M. van Hecke (UL): *Jamming and force networks in granular matter*

In addition to these lecture courses, daily discussion/problem sessions were held in the afternoon (2 hours for each lecture course). The course of M. Katsnelson consisted of 6 hours lectures and no discussion/problem sessions. An evening seminar (18 May) was given by D. van Delft (NRC Handelsblad) entitled: *Worth publishing! How do editors of the 'NRC Handelsblad' select, describe and make scientific research interesting for their readers*. The other evening presentations (10 minutes) were given by the students.

Twenty-one (21) students participated. All participants were from the Netherlands. Further information is given in appendix C.

### 3.1.2 Guest lecturers

Prof. dr. A.V. Ashtekar (Penn State Univ.) occupied the Kramers Chair at Utrecht University from 1 April to 1 June 2006. He taught a lecture course on *Black holes in fundamental physics*.

Prof. dr. D.R. Nelson (Harvard University) occupied the Lorentz Chair at Leiden University from 1 May to 1 June 2006. He taught a lecture course on *Topics in statistical biophysics and quantitative biology*.

Prof. dr. M. Roček (SUNY, Stony Brook) occupied the Van der Waals Chair at the Universiteit van Amsterdam from 1 January to 31 July 2006. He taught a lecture course on *Supersymmetry and supergravity*.

## 3.2 PhD degrees and subsequent employment

In 2006 nineteen (19) PhD students received their PhD degree. Ten (10) of them received postdoctoral positions (in the Netherlands, Belgium, Canada, France, Germany, Italy, Japan, Norway, UK and USA), seven (7) a position at a commercial company, one (1) a position as scientist at a non-physics research institute and one (1) received a PhD position in mathematics. More information on career moves of former PhD students during the last six years can be found in appendix F.

## 3.3 PhD degrees granted in the DRSTP in 2006

*In this section a short summary of the PhD theses published in 2006 is given. The summaries are written by the students themselves.*

### **Brendel, K. (UU)**

thesis title: *Nucleation in the two-dimensional Ising model*

advisor: prof. dr. H. van Beijeren

co-advisor: prof. dr. G.T. Barkema

date: 9 January 2006

present position: programmer, Cubic Eyes, Nieuwegein, the Netherlands

The aim of this thesis is to study nucleation both numerically and analytically. The approach followed is to start with very simple models. In chapter 2 we study the Ising model without an external magnetic field. This system does not feature nucleation, but at low temperatures it jumps back and forth between a state in which most spins are up, to one in which most spins are down. The dominant pathway at low temperatures consists of the formation of a single pair of closed interfaces in the shorter periodic direction, which perform a relative diffusive motion around the longer periodic direction and annihilate after meeting each other through the periodic boundary.

In chapter 3 we study the Ising model with an external field on a square lattice. Initially the system is in a metastable state, with most of the spins anti-aligned with the external field. It will stay in this metastable state for an extended period of time, but eventually one of the small clusters of aligned spins that arise due to fluctuations, will grow beyond the critical cluster size, and take over the whole system. After this, most of the spins are aligned with the external field, and the system is in its stable state.

In chapter 4 the same model is studied. The effective rates of growth and shrinkage of clusters are now studied in detail. The mass of the nucleating cluster is followed in time, and mapped to a random walker undergoing drift and diffusion. The latter is described by the Fokker-Planck equation, in which in our case the drift and diffusion coefficients depend on cluster size.

The method developed in chapter 4 is then applied to a completely different phenomenon: the fluctuations of the geomagnetic dipole. Instead of to the time-evolution

of the size of the nucleus, we apply our method of analysis, based on the Fokker-Planck equation, to the time-evolution of the strength of the geomagnetic dipole, which has been measured accurately over the last 800,000 years from fossile records. This is described in chapter 5.

**Cvetkovic, V. (UL)**

thesis title: *Quantum liquid crystals*

advisor: prof. dr. J. Zaanen

date: 29 March 2006

present position: postdoctoral fellow, Johns Hopkins University, Baltimore, Maryland, USA

The research described in this thesis is devoted to a mathematical description of quantum versions of the liquid crystalline state that is in classical form well known from flat television screens. The underlying ambitions of this research extent well beyond this theme: smectic- and nematic quantum liquids are more of convenience to address the very general question regarding the nature of bose fluids (superfluids and superconductors) that emerge from microscopic matter that is in a literal sense maximally interacting. The core result of this research is the discovery that a completely tractable field theoretical description exists for bose fluids in 2+1 dimensions, in the limit that the length associated with crystalline correlations in the fluid becomes infinite as compared to the length scales associated with the microscopic constituents. This field theory rest on a Kramers-Wannier duality where the quantum elastic medium corresponding with the crystalline state is described in terms of stress gauge fields, having as sources the topological defects of the crystal (dislocations and disclinations). The quantum smectics- and nematics then correspond with distinct Bose condensates formed from quantum-proliferated dislocations. Since dislocation matter is gauged, these actually correspond with effectively relativistic dual stress superconductors/Higgs phases. Starting out with electromagnetically charged matter it turns out that these dual stress superconductors are at the same time behaving like conventional electromagnetic superconductors, modulo some interesting special effects associated with the partial spatial orders. The central result is the prediction that in such 'orderly superconductors' the long wavelength electro-dynamical response acquires a new universal feature: we predict a new massive, propagating mode appearing at small frequencies and momenta, that can be understood as the (shear) stress gauge equivalent of the vector boson in the Higgs phase, acquiring some small bit finite electrical charge. This prediction is of direct empirical relevance for high  $T_c$  superconductivity and it has inspired several experimental groups to gear up their machinery in order to hunt for this new particle.

**Dams, C.J.F. (RU)**

thesis title: *Topics in quantum field theory*

advisor: prof. dr. R.H.P. Kleiss

date: 13 June 2006

present position: postdoctoral fellow, Università degli studi, Milan, Italy

In this PhD-thesis some topics in quantum field theory are considered. The first chapter gives a background to these topics.

The second chapter discusses renormalization. In particular it is shown how loop calculations can be performed when using the axial gauge fixing. Fermion creation and annihilation configurations for the one loop level are obtained and an example calculation was done to check that these lead to gauge invariant amplitudes.

The next topic in the second chapter is renormalization prescriptions. The scheme dependence that these prescriptions lead to is discussed and we come up with a re-expanded perturbative series that turns the scheme-dependent series into a scheme-independent one. We check that numerical results are similar to the ones obtained from some often-used renormalization prescriptions.

The third chapter considers the electro weak standard model in the axial gauge. The Feynman rules are derived and particle creation and annihilation configurations are defined. Using these two ingredients it is, in principle, possible to do tree-level calculations.

The fourth chapter is concerned with unstable particles. The problem that cross sections diverge when the colliding particles are unstable is discussed. We derive that an effective cross section that is proportional to the size of the incoming wave packets can be defined. This is the linear beam size effect. This derivation is done in a manifestly Lorentz invariant manner. Furthermore, a Monte Carlo prescription is given that incorporates this effect into the usual integration procedure. This chapter also goes into the case of incoming wave packets that are very large. A very strange prescription, involving complex momentum components, was proposed in the literature. We replace this prescription by a more reasonable one. We also consider the case where the incoming unstable particle is in a pancake-shaped wave packet.

**Davidse, M. (UU)**

thesis title: *Nonperturbative effects in supergravity*

advisor: prof. dr. B. de Wit

co-advisor: dr. S. Vandoren

date: 30 January 2006

present position: quantitative analyst, Asset Management Department, AEGON, the Netherlands

Compactifying (the low energy approximation of) type-IIA(B) string theory on a Calabi-Yau three-fold yields a  $N = 2$  supergravity theory in four spacetime dimensions, coupled to vector multiplets and hypermultiplets. This theory describes the massless Kaluza-Klein modes associated with the compactification. An important question is what effect the D-branes in the ten-dimensional theory have on the four-dimensional theory. We have investigated this for the NS five-brane and the membrane, in the supergravity approximation. In the four-dimensional supergravity theory these objects are described by certain solutions to the equations of motion that can be found by means of Bogomol'nyi equations. These are nonperturbative objects, as reflected by their (finite) actions which depend inversely on the string coupling constant.

To investigate the effect of these objects on the four-dimensional supergravity physics,

we have constructed the effective actions that incorporate the one-loop effects in the presence of an NS five-brane and membrane respectively. We have restricted ourselves to the study of these nonperturbative effects in the case of the universal hypermultiplet. In the case of the NS five-brane we have performed an instanton calculation by constructing the one-loop measure in the presence of the NS five-brane. This measure can then be used to compute correlation functions and thereby construct the effective action. The effects of the membrane have been computed by making use of knowledge of the isometries that are preserved and/or broken by this object. Gauging the unbroken isometry of the universal hypermultiplet produces a potential. We have shown that the nonperturbative membrane effects to the effective action make it possible for this potential to have a (meta-)stable de Sitter vacuum.

**Dickerscheid, D.B.M. (UU)**

thesis title: *Quantum phases in optical lattices*

advisors: prof. dr. ir. H.T.C. Stoof

co-advisor: dr. P.J.H. Denteneer

date: 6 February 2006

present position: postdoctoral fellow, Tokyo Institute of Technology, Japan

An important new development in the field of ultracold atomic gases is the study of the properties of these gases in a so-called optical lattice. An optical lattice is a periodic trapping potential for the atoms that is formed by the interference pattern of a few laser beams. A reason for the interest in these systems is that the effects of the interatomic interactions can be strongly enhanced. More specifically, it has been shown in a beautiful experiment by Greiner et al. in 2002 that by loading a Bose-Einstein condensate into an optical lattice it is possible for the system to undergo a quantum phase transition to a new quantum phase of matter, the so-called Mott insulator phase. Within this Mott insulator phase each lattice site is occupied by exactly one atom. This makes the Mott insulator phase especially well suited for applications in the field of quantum computation and quantum information processing. We have theoretically investigated the above mentioned quantum phase transition and our formalism allows for a description of the Mott insulator phase at nonzero temperatures. Another important experimental development in the field of ultracold atomic gases is the use of Feshbach resonances to control the interatomic interactions. Such a resonance occurs whenever two colliding atoms form a long-lived molecule for some time. The crucial point of a Feshbach resonance is that the above mentioned molecule has a magnetic moment that is not equal to twice the magnetic moment of the atom. As a consequence the energy difference between the two atoms and the molecule and hence the interactions between the atoms can be controlled by using an external magnetic field. By combining these two techniques, i.e. by trapping ultracold atomic gases in an optical lattice and by tuning a magnetic field near a Feshbach resonance there can be a new quantum phase transition between two superfluid phases.

We have derived the theory for the description of these Feshbach Resonances in optical lattices and applied it to various systems. To be a bit more precise, if we tune the external magnetic field such that the energy difference between a molecule and two atoms is sufficiently negative, then the gas consists of a Bose-Einstein condensate



of molecules. In contrast, if the energy difference is large enough and positive we have a gas that consists primarily of a Bose-Einstein condensate of atoms. It turns out that these two limits are separated by an Ising-like quantum phase transition. By using atomic Bose gases near a Feshbach resonance detailed experimental studies which test the theoretical predictions of the statistical and dynamical properties of these quantum phase transitions can be made.

**Erzgräber, H. (VUA)**

thesis title: *Dynamics of delay-coupled semiconductor laser systems*

advisors: prof. dr. D. Lenstra (TU Delft) and prof. dr. B. Krauskopf (VUA/Univ. Bristol)

date: 4 December 2006

present position: postdoctoral fellow, Vrije Universiteit Amsterdam, the Netherlands

Nonlinear laser dynamics has received considerable attention because of possible applications, but also fundamental physical and mathematical aspects are of great interest. This thesis is concerned with the dynamical behavior of semiconductor lasers subject to external delayed perturbations. In particular the time delay in the coupling to external elements is of importance, because it substantially complicates the dynamical behavior. This time delay arises from finite signal propagation times and, hence, is large compared to the laser internal time scales so that it cannot be neglected. Specifically, the thesis investigates two different delay-coupled semiconductor laser systems: (I) a semiconductor laser subject to delayed filtered optical feedback, where a part of the laser emission is filtered by a Fabry-Perot filter and then feed back into the laser, and (II) two semiconductor lasers that are mutually delay-coupled via their optical fields. With concepts and tools from dynamical systems theory a comprehensive study of the underlying bifurcation structure of two systems is presented. Knowledge of this underlying structure is the key to understanding complicated laser dynamics. The results from the bifurcation analysis are interpreted in terms of the dynamics of the real laser system and compared with experiments.

**Juricic, V. (UU)**

thesis title: *Field-theoretical studies of a doped Mott insulator*

advisor: prof. dr. C. Morais Smith

date: 22 June 2006

present position: postdoctoral fellow, Simon Fraser University, British Columbia, Canada

In this thesis, the magnetic and the transport properties of  $La_{2-x}Sr_xCuO_4$  in the undoped and lightly doped regime are investigated. In Chapter 2, we consider the role of the Dzyaloshinskii-Moriya (DM) and the pseudodipolar (XY) interactions in determining the magnetic properties of the undoped material,  $La_2CuO_4$ , motivated by recent experiments. The effect of the anisotropies is to introduce gaps for the spin excitations, which are responsible for the ground-state properties of the material. When a magnetic field is applied, the DM anisotropy leads to an unexpected linear coupling of the staggered magnetization to the magnetic field, which is responsible

for a completely anisotropic magnetic susceptibility, in agreement with experiments. In Chapter 3, we investigate the effect of the DM and the XY anisotropies on the magnetism when Sr doping is introduced in  $La_2CuO_4$ . Our starting point is the nonlinear sigma model, which includes these anisotropies, and the dopant holes, represented via an effective dipole field which couples to the background magnetization current. In the antiferromagnetic phase,  $x < 2\%$ , this coupling leads to a decrease of the spin gaps, in good agreement with recent experiments. The DM gap gives rise to the stability of the antiferromagnetic state up to the doping level  $x_{AF} \simeq 2\%$ . Beyond this doping concentration, the spins rearrange to form an incommensurate helicoidal state, which gives rise to two incommensurate peaks in the spin-glass phase of  $La_{2-x}Sr_xCuO_4$ , as observed by neutron scattering experiments. Finally, we propose a measurement of the doping dependence of the incommensurability in the magnetic field as a 'smoking-gun' experiment that would discriminate between the helicoidal and the stripe scenarios in the spin-glass phase of  $La_{2-x}Sr_xCuO_4$ .

In Chapter 4, we study vortex dynamics in a frustrated spin system displaying helicoidal order. We start with the  $SO(3)$  nonlinear sigma model to describe long-wavelength fluctuations around the noncollinear spin state. This model allows for single vortices and vortex-antivortex pairs, which, as we show, exhibit dissipative dynamics due to the coupling to magnons. Finally, motivated by recent experiments, we consider an application of the model for describing the transport in lightly doped  $La_{2-x}Sr_xCuO_4$ .

**Kager, W. (UvA)**

thesis title: *Conformally invariant paths in 2D statistical physics. With a guide to Schramm-Löwner evolution*

advisor: prof. dr. B. Nienhuis

date: 21 March 2006

present position: researcher EURANDOM, Eindhoven, the Netherlands

This thesis is concerned with geometric aspects of conformally invariant random planar paths. In particular we study paths obtained in the scaling limit of two-dimensional models of statistical physics at a second-order phase transition. Examples of such paths are the boundaries of clusters of positive or negative spins in the Ising model, the boundaries of Fortuin-Kasteleyn clusters in the random cluster model, self-avoiding walks and so on. One can show that the only possible candidate for the scaling limit of one of these random paths (assuming conformal invariance and a kind of Markovian property hold in the limit) is a member of the family of Schramm-Löwner Evolutions (SLE) introduced by Oded Schramm a few years ago.

The first part of the thesis can be considered as a guide to SLE. Chapters 1 and 2 introduce SLE as the only possible candidate for the scaling limit of the cluster boundaries in the critical Ising model or in critical percolation. Chapter 3 discusses other models that are believed or are known to be described by SLE, and chapter 4 considers in detail some computations that one can do with SLE to derive properties and critical exponents of these models. The text is intended to provide a thorough introduction to SLE for both physicists and mathematicians. Background on conformal mapping theory and the mathematical theory of stochastic processes, needed for

a rigorous understanding of SLE, is provided in the appendix of the thesis. Chapters 5 and 6 specialize to random planar paths that have the locality property. Loosely speaking, these are random paths that do not feel the boundary of the domain they live in, until they hit it. A special family of paths with this property is the family of Reflected Brownian Motions (RBM). These processes are ordinary Brownian motions in the interior of a domain, but are reflected at a fixed angle when they hit the boundary. We show that in every given triangle there is an RBM which, started from a given corner, will hit the opposite side with the uniform distribution. It is known that for local processes in general, this hitting distribution determines also the distribution of the hull (the collection of points that are either on the path or enclosed by the path) generated by the process up to the hitting time. We use this to study numerically the hull generated by a self-avoiding trail in the Brauer model. Our results are consistent with the hypothesis that, in the scaling limit, this hull has the same distribution as that of an RBM with perpendicular reflection on the boundary.

**Mboyo Esole, J. (UL)**

thesis title: *Fayet-Iliopoulos terms and BPS cosmic strings in  $N = 2$  supergravity*

advisor: prof. dr. A. Achúcarro

date: 29 November 2006

present position: postdoctoral fellow, KU Leuven, Belgium

Supersymmetric field theories may have states with the property that they are invariant under a fraction of the existing supersymmetries. These are known as BPS states (after Bogomol'nyi-Prasad-Sommerfield). Furthermore, BPS cosmic strings (Abrikosov-Nielsen-Olesen vortex defects) have the property that their mass per unit length equals their magnetic flux, in suitable units. This thesis gave the first known example and a general method to find such BPS cosmic strings in  $N=2$  gauged Supergravity -whose existence had been questioned previously-.

**Michaelis, B.D. (UL)**

thesis title: *On dephasing and spin decay in open quantum dots*

advisor: prof. dr. C.W.J. Beenakker

date: 16 November 2006

present position: researcher, RWE Energy AG, Dortmund, Germany

The electron spin was discovered in 1925 by the Leiden physicists George Uhlenbeck and Samuel Goudsmit. Today, there is an entire field within electronics, called spintronics, that makes use of the electron spin to switch a current and control a logical device. For such applications it is important that the spin maintains its direction and that an initial polarization does not decay, for example due to a nuclear magnetic field. In this thesis we describe a method that we have developed to account for the decay of the spin polarization. Since a few years a second class of applications of the electron spin is being developed, in which the spin is the carrier of quantum information. To transfer quantum information not only the direction of the electron spin should be preserved (up or down), but also superpositions of the two directions should be maintained. The degradation of a quantum mechanical superposition is

called dephasing (or decoherence). The same mechanisms that cause decay of the polarization also cause dephasing, but there exist also mechanisms that cause only dephasing — without spin decay. The model for spin decay that we have developed can account for dephasing as well — because it is a fully quantum mechanical model. Earlier models for spin decay and dephasing were mostly aimed at electrons in a small confined region in thermal equilibrium (a so-called quantum dot). Our model applies to an open system out of equilibrium, through which an electrical current can flow. The focus on nonequilibrium systems is a central theme of this thesis.

**Nobbenhuis, S.J.B. (UU)**

thesis title: *The cosmological constant problem; an inspiration for new physics*

advisor: prof. dr. G. 't Hooft

date: 15 June 2006

present position: merchant banking associate programme, Corporate & Investment Banking, Fortis, Utrecht, the Netherlands

We have critically compared different approaches to the cosmological constant problem, which is at the overlap of elementary particle physics and cosmology. This problem is deeply connected with the difficulties formulating a theory of quantum gravity. After the 1998 discovery that our universe's expansion is accelerating, the cosmological constant problem has obtained a new dimension. We are mainly interested in the question why the cosmological constant is so small.

We have identified four different classes of solutions: a symmetry, a back-reaction mechanism, a violation of (some of) the building blocks of general relativity, and statistical approaches. We conclude that so far none of the approaches gives a satisfactory solution. A symmetry would be the most elegant solution and we study a new symmetry under transformation to imaginary spacetime.

**Ostojic, S. (UvA)**

thesis title: *Statistical mechanics of static granular matter*

advisor: prof. dr. B. Nienhuis

date: 28 September 2006

present position: postdoctoral fellow, Department of Biology, École Normale Supérieure, Paris, France

Grains of sugar in a jar form a peculiar physical system which seems solid as long as the jar is at rest, but which flows as soon as the jar is sufficiently tilted. Each of the grains is in itself a classical solid body, the physics of which is extremely well understood, yet the conglomeration of many of them leads to novel collective behavior. Such assemblies of large numbers of macroscopic particles are called *granular materials*. The most ubiquitous example is sand, but the definition encompasses a variety of other systems ranging from stacks of books to pills in a conveyor belt, and from piles of pears on a market stall to rocks in the rings of Saturn.

These assemblies of grains are most commonly found in a static state in many aspects reminiscent of a solid. Their solid-like behavior is mainly due to the intricate network formed by repulsive forces between particles in contact. The discrete nature and

high spatial inhomogeneity of this *force network* are the source of many remarkable phenomenological properties. For example the distribution of weight under a pile of sand depends on the manner in which the pile was formed. If the sand was poured homogeneously from a large sieve, the weight is maximal under the center of the pile as might be intuitively expected. In contrast, if sand was poured from a localized source, the weight is maximal on a ring around the center. This phenomenon is due to the orientation of particle contacts caused by avalanches.

The importance of the underlying discrete force network have raised doubts about the relevance of a continuum, elastic mechanical description of static granular matter. In consequence, alternative descriptions have been proposed, and in particular a statistical approach called the *force network ensemble*. The main aim of this thesis is to critically assess the use of this theoretical framework, by comparing its predictions with experimental findings and results of other models.

The starting point of the force network ensemble is to ignore the details of the contact mechanics, and take into account only the fundamental constraint that the forces must balance on each grain. For a given geometrical arrangement, this requirement does not specify a unique force network but many of them, as the number of unknown forces is typically larger than the number of equations for mechanical balance. The central idea of the force network ensemble is that statistical features of forces might be described accurately by considering equally likely any network formed by repulsive forces in balance on each grain. While such a prescription might at first seem somewhat arbitrary and simplistic, the results presented in this thesis show that it provides a surprisingly complete picture of the physics of force networks.

The first part of this dissertation develops several levels of motivation for the force ensemble approach. Chapter 1 is a brief introduction to different aspects of granular matter, focusing on the limits of classical theories and the need for new ones. Chapter 2 describes in more detail the phenomenology of static granular assemblies, defines the basic concepts used in the rest of the thesis, and introduces the force network ensemble.

The second part investigates the possibility of describing the propagation of forces between grains in the framework of the force ensemble. The propagation of forces is usually studied via the mechanical response function, i.e. the effect of adding a small overload on one of the grains. Experimental studies have found that the shape of this function is sensitive to the geometrical arrangement of grains, as it distinguishes ordered packings from disordered ones. We study two different experimentally relevant geometries: two-dimensional arrays of hexagonally packed, frictionless grains, and the effects of friction between grains in a rectangular packing. Altogether, we find that the force network ensemble describes the transmission of forces at an unexpected level of detail, as it produces predictions in agreement with experimental observations and realistic numerical simulations.

The third part of this thesis studies properties of spatial patterns of large forces between grains, an aspect that has remained insufficiently treated in the literature. We introduce a method to characterize the stochastic patterns of large forces. This method uncovers a scale invariance, which can be characterized by scaling exponents and a scaling function. The study of force networks obtained by large scale numerical simulations reveals that the scaling exponents and the scaling function are universal

in a large class of granular packings. We show that the force network ensemble generates networks belonging to the same universality class, while other simple models do not. Finally, the effects of external shear stresses on the geometry of forces are investigated within the framework of the force ensemble. While the shear stresses do not modify the scaling exponents, they induce an anisotropy, which remarkably appears to be universal.

**Pijlman, F. (VUA)**

thesis title: *Single spin asymmetries and gauge invariance in hard scattering processes*

advisor: prof. dr. P.J.G. Mulders

date: 12 January 2006

present position: research scientist, Philips, Eindhoven, the Netherlands

In the thesis effects are studied that appear in hard scattering processes when one accounts for transverse momentum of partons. The hard scattering processes that are treated are semi-inclusive lepton-lepton, lepton-hadron, and hadron-hadron scattering. The processes are called hard because the momenta of the initial particles and the measured particles (or jets) in the final state are well separated by large momentum differences. The partons that are studied are quarks and gluons which form the constituents of hadrons. This research has investigated effects that arise from transverse momentum of partons. Since these partons only appear in hadrons, the transverse momentum of partons is defined with respect to the parent hadron momentum.

The thesis studies the scattering process from a theoretical viewpoint. The main assumption is that in certain kinematical regions the cross sections can be determined from cross sections of the elementary partons folded with parton distribution and fragmentation functions (these connect the partons with hadrons). In other words, the distribution of partons or their fragmentation into hadrons is at some stage supposed to be independent of the scattering process; this is also known as factorization. The investigation has its focus on (color) gauge invariance of the theory. The relation of transverse momentum dependent effects and gauge invariance is of increasing interest after the publications of Brodsky, Hwang, Schmidt; Collins; and Belitsky, Ji, Yuan, who show the possibilities of nonvanishing single spin asymmetries in particular model calculations. The interesting point here is that such single spin asymmetries would be absent if quarks and gluons would not be part of a gauge theory. In that sense these QCD-effects are like the Aharonov-Bohm effect in QED.

In the investigation mathematical tools are developed, enabling one to express the cross sections in experiment independent quantities. These tools have successfully been confronted with fundamental issues like unitarity to the first few non-trivial orders. The results we found is that the way in which distribution and fragmentation functions are encountered in an experiment depends in a subtle way on the process, but without violating factorization, at least at tree level. However, the results do raise questions on the issue of factorization that still need to be addressed. In order to clarify these questions, we made several predictions for cross sections that can be tested in the next years. Those measurements will contribute to our understanding

of the nucleon's substructure and very likely guide physicists in answering the remaining questions.

**Qian, X. (UL)**

thesis title: *Scaling, clusters and geometry*

advisor: prof. dr. H.W.J. Blöte

date: 14 September 2006

present position: ICT trainee, Collis, Leiden

This thesis is focused on the study of phase transitions and universal critical phenomena of spin lattice models. New Monte Carlo algorithms were developed that enable the investigation of such models. A new level of accuracy is achieved in the determination of the universal parameters of the most common type of critical transition in nature, the Ising transition in three dimensions. The work took place at the Lorentz Institute for theoretical physics, under the guidance of Prof. dr. H.W.J. Blöte. The main results of this thesis are in the field of theoretical and computational physics.

**Snoek, M. (UU)**

thesis title: *Vortex matter and ultracold superstrings in optical lattices*

advisor: prof. dr. ir. H.T.C. Stoof

date: 23 June 2006

present position: postdoctoral fellow, Johann Wolfgang Goethe University, Frankfurt am Main, Germany

Since a Bose-Einstein condensate is a superfluid, it responds to rotation by forming quantized vortices. In principle the vortices are quantum mechanical objects. However, the size of the quantum fluctuations is inversely proportional to the density, which is usually far too large to give any observable effect on the vortex fluctuations. The quantum fluctuations can be greatly enhanced by using a one-dimensional optical lattice. A one-dimensional lattice is formed by two counterpropagating laser beams, making up a standing wave which results in a periodic potential. When applied to a cigar-shaped Bose-Einstein condensate, the Bose-Einstein condensate is cut into two-dimensional pancake-condensates, which are weakly coupled by tunneling. Since the number of particles in each pancake-condensate is small, the quantum fluctuations are much larger in this setup.

For slow rotation, a single vortex line will penetrate the system. The quantum fluctuations of the vortex-line form bosonic excitations, which are called kelvons and have the same dispersion as a particle in a periodic potential. Since at the position of the vortex the particle density vanishes, there is a bound state for fermionic atoms when the interspecies repulsion is strong enough. This allows for the creation of an ultracold superstring of which the bosonic modes are formed by kelvons and the fermionic modes are formed by the fermionic atoms in the vortex core. In order to have supersymmetry, the laserparameters need to be tuned such that the dispersions the kelvons and the fermionic atoms are exactly the same. As a result of the supersymmetry, the stability of the superstring is enhanced. Experimentally, the supersymmetry can be probed by performing measurements on the spreading of the vortex positions and the

density of the fermionic atoms.

When the Bose-Einstein condensate is rotated very rapidly, vortex lattices appear. Ultimately, the vortex lattices melt because of quantum fluctuations and are replaced by vortex liquids. A one-dimensional optical enhances the quantum fluctuations and brings the vortex-lattice melting within experimental reach. Another consequence is that the pancake condensates are small and effects from the finite size and inhomogeneous density are important. This leads to the possibility that the vortex lattice is melted at the outside whereas it is still solid in the center of the condensate, giving rise to phase coexistence between a vortex lattice and a vortex liquid. By looking into the correlation between the vortices the precise nature of the solid and the liquid can be investigated and various phases can be distinguished. By changing the depth of the optical potential, the hopping between the sites can be controlled, which influences the stiffness of the vortex-lines. This allows for the investigation of the crossover from decoupled two-dimensional condensates to the strong-coupling limit, where the system behaves like a three-dimensional system. We also investigated the effect of a nonzero temperature. Only for very low temperatures a vortex-lattice can be observed. Finally it is also possible to change the trap geometry. In particular it is possible to apply a quartic potential on top of the harmonic potential. In this situation it is possible that a vortex liquid in the center is surrounded by a vortex lattice.

**van Zon, J.S. (VUA)**

thesis title: *Stochastic dynamics in sand and cells*

advisor: prof. dr. F.C. MacKintosh

date: 24 March 2006

present position: postdoctoral fellow, Centre for Integrative Systems Biology, Imperial College London, United Kingdom

In this thesis, I have applied methods from statistical physics to problems from the field of granular materials and biochemical networks.

Granular materials, like sand or powders, exhibit behavior that is reminiscent of the behaviour of the different phases of molecular matters. When undisturbed, granular materials are often in a solid-like phase. However, when energy is supplied, for instance in the form of vibrations, granular materials can show complicated, fluid-like behavior. Because energy is dissipated in collisions between the grains, these systems are far from thermodynamical equilibrium. Dilute, vibrated granular materials, also called 'granular gases', are often studied as a simple model system to understand the behaviour of granular fluids as well as non-equilibrium systems in general.

We have studied the shape of the velocity distribution in such granular gases. Many experiments found that the distribution of velocities of grains in a granular gas is different from the Gaussian distribution expected in a molecular gas. However, different experiments find almost as many different velocity distributions and the deviation from a Gaussian distribution remains unexplained. By simulation, we identified a single parameter, describing the way energy flows into the gas, that strongly determines the form of the velocity distribution. We showed that the seemingly conflicting results of previous experiments could all be explained by underlying variations in this parameter, which are directly related to differences in experimental setup. In addition,



identification of this parameter could now open the way for a theoretical description of granular gases.

The behaviour of living cells is governed by biochemical networks that are formed of many interacting regulatory molecules. Many of these molecules exist in small copy numbers, between 10-1000 per cell. In this case, the probabilistic nature of chemical reactions and the random diffusive motion of these molecules can lead to stochastic variation in behaviour and responses of entire cells. Simulation can be an excellent tool for studying such variations. However, most existing simulation techniques either have to assume that all molecules are distributed uniformly throughout the cell, so that their diffusive motion can be ignored, or take into account diffusion but are generally very slow. We have developed a technique that uses Green's functions of the diffusion equation to quickly jump from one reaction to another without explicitly simulating the diffusive motion of the molecules in between. In contrast to existing techniques, our technique makes it possible to follow the stochastic behaviour of cells over the course of hours and days, while still taking the effects of diffusion properly into account.

We have applied the simulation technique to a realistic model of gene expression under control of a repressor. With our simulation technique we find that a dissociated repressor molecule will on average rapidly rebind many times, before eventually diffusing away. This leads to increased fluctuations in mRNA and protein levels. In existing simulation techniques that ignore diffusion, such as the Gillespie algorithm, these rapid rebindings are not observed and consequently the magnitude of the fluctuations is underestimated. In addition, we show how the reaction rates of repressor dynamics can be modified so that the effects of rapid rebinding are properly taken into account even for simulations that ignore diffusion.

**Warringa, H.J. (VUA)**

thesis title: *Thermodynamics of QCD-inspired theories*

advisor: prof. dr. P.J.G. Mulders

co-advisor: dr. D. Boer

date: 28 February 2006

present position: postdoctoral fellow, Norges teknisk-naturvitenskapelige universitet, Institutt for Fysikk, Trondheim, Norway

In this thesis I investigate the thermodynamics of the  $O(N)$  nonlinear sigma model and the  $CP^{(N-1)}$  model in  $1 + 1$  dimensions, which are toy models for QCD. In particular I put emphasis on the calculation of the effective potential and the pressure to next-to-leading order in  $1/N$ . One interesting result is that the effective potential contains temperature-dependent ultraviolet divergences that vanish in the minimum. Furthermore I discuss two low-energy effective theories, the  $O(N)$  linear sigma model in  $3 + 1$  dimensions and the NJL model. In the  $O(N)$  model I calculate the effective potential and the pressure up to next-to-leading order in  $1/N$ . I also discuss a rather low bound on the mass of the sigma meson in that model. The NJL model is used to calculate phase diagrams with pseudoscalar condensation and color superconductivity

as a function of different quark chemical potentials. I find that phases with pseudoscalar condensation are separated from the color superconducting phases by a first order transition.

**Westra, D.B. (RUG)**

thesis title: *Symmetries in  $N = 4$  supergravities*

advisor: prof. dr. M. de Roo

date: 29 September 2006

present position: PhD student, Department of Mathematics, University of Vienna, Austria

One of the driving forces of theoretical physics is the idea that many aspects of nature can be explained by little rules. In this sense the grand unification theories can be seen as the holy grail of theoretical physics. Unifying gravity with the other three known forces is a difficult task, which has not been completed yet and probably will take several more years. In trying to find a unifying framework the analysis of symmetries turns out to be fruitful.

One of the problems in contemporary physics is resolving the mismatch between astronomical data and the theoretical description of the universe. There seems to be just a small amount of ‘ordinary’ matter present in the universe, the rest is unknown and takes on the form of dark matter or of dark energy. Another problem is that opposed to what was expected, the universe seems to go through a phase of accelerated expansion. Since the only forces that we know of that works on large distances is gravity, the incapability of theoretical physics to provide an answer to these problems might be related to the impossibility (till yet) to give a unifying framework for gravity and the other three forces. The thesis analyses different vacua of  $\mathcal{N} = 4$  supergravity theories to see whether they can provide an explanation for the astronomical data. Supergravity theories are field theories having a special kind of symmetry, called supersymmetry, and they describe gravity. Due to these properties supergravity theories are interesting candidates for supplying a theoretical framework in which gravity can be combined with other forces. Supergravity theories also arise as low-energy limits of another candidate unification theory, super string theory. Within this class of supergravity theories the  $\mathcal{N} = 4$  supergravity theories are those theories with a prescribed amount of supersymmetry.

Gauging  $\mathcal{N} = 4$  supergravity theories gives rise to a scalar potential. The vacua of these potentials determine the behavior of gravity at long-distance scales; a positive value for the vacuum scalar potential can give rise to an accelerated expanding universe. The behavior of the scalar potential depends on the gauge groups used. In a first analysis we restricted to semisimple gauge groups and no stable vacuum with a positive scalar potential value was found. Therefore the analysis was extended to so-called contracted orthogonal groups that are nonsemisimple. Trying to fit the contracted orthogonal groups into the gauge groups required some knowledge of invariant metrics on these groups and it was shown which of these groups admit an invariant metric and how to analyse their gauging.

**Zoetekouw, B. (UU)**

thesis title: *Phase behavior of charged colloids: many-body effects, charge renormalization and charge regulation*

advisor: prof. dr. H. van Beijeren

co-advisor: dr. R.H.H.G. van Roij

date: 8 September 2006

present position: research scientist, Philips, Eindhoven, the Netherlands

The main topic of this thesis is Poisson-Boltzmann theory for suspensions of charged colloids in two of its approximations: cell-type approximations that explicitly take into account non-linear effects near the colloidal surfaces, such as charge renormalization, at the expense of neglecting any explicit multi-body interactions; and (ii) linear approximations that do take into account explicit multi-body interactions but neglect any non-linear effects. These approximations give contradictory results with regards to the existence of spinodal instabilities at low salinity.

Firstly, we review Poisson-Boltzmann theory and its cell approximation, and derive a complete description of the linear approximation in a semi-grand canonical framework; we show that this theory gives rise to so-called volume terms, which drive spinodal instabilities at low salinity, and which also give important contributions to the osmotic pressure of such colloidal suspensions. We then construct a novel theory by combining the cell-type and the linear approximations. Taking the strong points of each, the newly constructed theory takes into account both the non-linear behavior near the colloidal surfaces and the explicit multi-body interactions between the colloids. Using this theory, we calculate phase-diagrams as a function of the salt concentration and the colloidal density for many values of the charge  $Z$  and the radius over Bjerrum-length ratio  $\lambda B / a$ . We find that spinodal instabilities occur for systems with  $Z \lambda B / a \geq 25$ , and that these instabilities for large charges  $Z$  are connected to the gas-liquid instability of the primitive model with small ( $Z=1-10$ ) valencies, suggesting that both instabilities have the same physical origin.

Furthermore, we study charge regulation, which describes the chemical equilibrium between ions bound to the colloidal surfaces and free ions. We first study this effect in the Poisson-Boltzmann cell model, and calculate the net charge of the colloids as a function of the particle size, the dissociation constant, the colloid density and the salt concentration. We scanned a large part of parameter space for spinodal instabilities, but find no such instabilities within this model.

Finally, we include the charge regulation effects into the newly developed multi-centered non-linear Poisson-Boltzmann theory. For silica particles, we calculate the charge  $Z$  as a function of the colloid density and the salt concentration, and we find that, for almost all systems examined, the coupling parameter  $Z \lambda B / a \leq 10$ . We thus conclude that, in this model with charge regulation, the coupling parameter is too small for spinodal instabilities to occur. We explicitly calculated phase-diagrams for a large number of colloidal charges and radii, and indeed find no instabilities. Therefore, we conclude that the spinodal instabilities that were found in the model with fixed colloidal charge are probably hard to reach in experimental setups with silica particles.

### 3.4 Other PhDs advised by DRSTP staff

**Burmistrov, I.S. (UvA)**

thesis title:  $\Theta$  renormalization, superuniversality, and electron-electron interactions in the theory of the quantum Hall effect

advisor: prof. dr. A.M.M. Pruisken

date: 24 May 2006

present position: scientific researcher, L.D. Landau Institute for Theoretical Physics, Moscow, Russia

### 3.5 DRSTP PhD students (31 December 2006)

*This section gives an overview of the PhD students affiliated to the DRSTP on 31 December 2006. The projects are chronologically ordered according to starting date. The research themes mentioned refer to quantum field theory and elementary particle physics (theme 1) and statistical physics, condensed-matter theory and quantum optics (theme 2).*

**Universiteit van Amsterdam (UvA)**

- Hagemans, R.L. (aio) as of 1 April 2003 with K. Schoutens and J.-S. Caux.  
project: correlations in strongly coupled spin systems (theme 2).
- Cheng, M.C.-N. (oio) as of 1 September 2003 with J. de Boer and K. Skenderis.  
project: various aspects of quantum gravity, holography and the physics of black holes (theme 1).
- van der Meulen, M.P. (oio) as of 1 October 2003 with J. Smit.  
project: applications of field-theoretic methods to the physics of the early universe (theme 1).
- Kampmeijer, L. (oio) as of 1 November 2003 with F.A. Bais.  
project: monopoles with non-Abelian charges, hidden symmetry and confinement (theme 1).
- Galistu, G. (oio) as of 1 December 2003 with A.M.M. Pruisken.  
project: experimental determination of electronic structure of low-dimensional electron systems, with emphasis on quantum critical phenomena of a two-dimensional electron gas in the quantum Hall regime (theme 2).
- Manschot, J. (oio) as of 1 March 2004 with E.P. Verlinde.  
project: the study of the connection between gravity and gauge theory using string theory, in particular with applications to cosmology (theme 1).
- Koers, H.B.J. (aio) as of 1 April 2004 with K.J.F. Gaemers and J.-W. van Holten.  
project: modelling sources and properties of neutrinos in the universe, in particular high-energy neutrinos detectable by neutrino telescopes as presently being developed world-wide (theme 1).

- Arsiwalla, X.D. (oio) as of 1 November 2004 with E.P. Verlinde.  
project: development of non-perturbative methods in string-theory, in particular topological strings and black holes (theme 1).
- Hollands, L. (aio) as of 1 November 2004 with R.H. Dijkgraaf.  
project: the study of mathematical aspects of string theory, in particular topological strings (theme 1).
- Messamah, I. (oio) as of 1 November 2004 with J. de Boer.  
project: issues in quantum gravity using non-perturbative string theory, in particular the quantum physics of black holes, their formation and Hawking radiation, cosmological models and the nature of quantum space-time geometry (theme 1).
- Hoogeveen, J. (oio) as of 1 September 2005 with R.H. Dijkgraaf and K. Skenderis.  
project: string theory, in particular the Berkovits formulation of superstrings (theme 1).
- Kanitscheider, I.R.G. (oio) as of 1 September 2005 with J. de Boer and M. Taylor.  
project: quantum gravity, in particular holography (theme 1).
- El-Showk, S.N. (oio) as of 10 September 2005 with J. de Boer.  
project: quantum gravity wing perturbative and non-perturbative string theory (theme 1).
- Zozulya, O.S. (oio) as of 1 October 2005 with K. Schoutens.  
project: collective behavior vs. entanglement in atomic matter (theme 2).
- Mehmani, B. (aio) as of 1 December 2005 with B. Nienhuis and Th.M. Nieuwenhuizen.  
project: fundamental aspects of quantum physics (theme 2).
- Huijse, L. (aio) as of 1 June 2006 with K. Schoutens.  
project: study of supersymmetric lattice models (theme 2).
- van Rees, B.C. (oio) as of 1 September 2006 with K. Skenderis.  
project: understanding black holes and wormholes in 2+1 dimensions as well as global issues in AdS/CFT (theme 1).
- Atmaja, A. (oio) as of 1 November 2006 with J. de Boer.  
project: studies of string theory/gauge theory duality aiming to make contact with QCD (theme 1).

### Vrije Universiteit Amsterdam (VUA)

- Bomhof, C. (oio) as of 1 September 2003 with P.J.G. Mulders.  
project: quark-gluon structure of hadrons in high-energy scattering processes (theme 1).

- Conti, E. (aio) as of 1 October 2004 with F.C. MacKintosh.  
project: theory of dilute granular gases (theme 2).
- Wessels, E. (oio) as of 1 December 2004 with P.J.G. Mulders and D. Boer.  
project: investigating observable consequences of the colour glass condensate (theme 1).
- Boomsma, J.K. (aio) as of 1 September 2006 with P.J.G. Mulders and D. Boer.  
project: phase transitions in QCD (theme 1).

### University of Groningen (RUG)

- van Riet, T. (oio) as of 1 September 2003 with E.A. Bergshoeff.  
project: braneworlds (theme 1).
- Hartong, J. (aio) as of 1 September 2004 with E.A. Bergshoeff.  
project: the quest for quantum gravity (theme 1).
- Ploegh, A.R. (oio) as of 1 September 2004 with E.A. Bergshoeff.  
project: towards a formulation of coinciding M5-branes (theme 1).
- Chemissany, W. (bursaal) as of 1 October 2004 with M. de Roo.  
project: light from string theory (theme 1).
- Deuzeman, A. (bursaal) as of 1 January 2006 with E.A. Bergshoeff.  
project: understanding non-perturbative aspects of strong and weak interactions (theme 1).
- Ruszel, W.M. (bursaal) as of 1 March 2006 with A.C.D. van Enter.  
project: non-Gibbsian aspects in lattice statistical mechanics (theme 2).
- Nutma, T.A. (oio) as of 1 October 2006 with M. de Roo.  
project: string theory and quantum gravity (theme 1).
- Kadosh, P. (bursaal) as of 1 September 2006 with M. de Roo.  
project: understanding and constraining extra-dimensional theories (brane worlds) derived as effective low-energy realizations of M-theory (theme 1).

### Leiden University (UL)

- Leurs, B.W.A. (oio) as of 1 November 2002 with J. Zaanen.  
project: the theoretical investigation of quantum liquid crystalline phases as of relevance to various strongly interacting electron systems (theme 2).  
PhD exam: 12 September 2007.
- van Wezel, J. (aio) as of 1 March 2003 with J. Zaanen.  
project: decoherence due to spontaneous symmetry breaking (theme 2).
- Ellenbroek, W.G. (oio) as of 1 November 2003 with W. van Saarloos.  
project: theory of granular matter (theme 2).

- Becherer, P. (aio) as of 1 January 2004 with W. van Saarloos.  
project: dynamics of friction and polymer flow (theme 2).
- de Kok, M.O. (oio) as of 1 January 2004 with P. van Baal.  
project: non-perturbative aspects of gauge theories (theme 1).
- Zacheddu, M. (oio) as of 1 January 2004 with C. Filippi (W. van Saarloos).  
project: Why is green fluorescent protein green? A quantum Monte Carlo study (theme 2).
- Salmi, P. (oio) as of 1 July 2004 with A. Achúcarro.  
project: semilocal string networks in the early universe (theme 1).
- Bardarson, J. (oio) as of 1 September 2004 with C.J.W. Beenakker.  
project: theory of phase-coherent dynamics of entangled electronic states in nanostructures (theme 2).
- Sousa, K.S. (aio) as of 1 September 2004 with A. Achúcarro.  
project: extended objects in cosmological models with supersymmetry (theme 1).
- Snyman, I. (oio) as of 15 January 2005 with C.J.W. Beenakker.  
project: developing theory for nanostructures that are strongly coupled to radiation, with the goal of studying ways to produce entangled microwave photons out of entangled electron-hole pairs (theme 2).
- Giovanetti, G. (oio) as of 1 August 2005 with J. van den Brink.  
project: electronic structure and electron correlations in organic molecular crystals (theme 2).
- Idema, T. (oio) as of 1 September 2005 with H. Schiessel and C. Storm.  
project: theoretical biophysics of membranes and proteins (theme 2).
- Emanuel, M.O. (aio) as of 1 December 2005 with H. Schiessel.  
project: theoretical biophysics of DNA and its complexation with proteins (theme 2).
- Beekman, A.J. (oio) as of 1 January 2006 with J. Zaanen.  
project: topological phases in quantum liquid crystals (theme 2).
- Habraken, S.J.M. (aio) as of 1 February 2006 with G. Nienhuis.  
project: quantum optics with complex light (theme 2).
- Ament, L. (aio) as of 1 September 2006 with J. van den Brink.  
project: theory of decoherence and defect formation in many-body quantum systems (theme 2).
- Mesaroš, A. (aio) as of 1 September 2006 with J. Zaanen.  
project: quantum liquid crystals and emerging Einsteinian gravity (theme 2).

- Sepkhanov, R.A. (aio) as of 1 September 2006 with C.W.J. Beenakker.  
project: investigation of transport properties in graphene, with a particular emphasis on the role of superconductivity (theme 2).
- Žeravčić, Z. (oio) as of 1 September 2006 with W. van Saarloos.  
project: the behavior of the granular media in the vicinity of the so-called ‘jamming point’ (theme 2).

### **Radboud University Nijmegen (RU)**

- Lazopoulos, A. (aio) as of 15 April 2002 with R.H.P. Kleiss.  
project: numerical investigation of multi-patron processes (theme 1).  
PhD exam: 26 March 2007.
- van Kessel, M.T.M. (oio) as of 1 April 2004 with R.H.P. Kleiss.  
project: path integral aspects of spontaneous symmetry breaking (theme 1).
- Wagenaar, J.W. (aio) as of 1 December 2004 with R.H.P. Kleiss.  
project: Kaon-nucleon interactions (theme 1).

### **Utrecht University (UU)**

- Romans, M.W.J. (aio) as of 1 February 2003 with H.T.C. Stoof.  
project: effects of phase fluctuations in the Bose-Einstein condensate (theme 2).
- Benedetti, D. (oio) as of 1 April 2003 with R. Loll.  
project: to construct and investigate a gravitational path for black-hole geometries, using nonperturbative methods (theme 1).
- de Vroome, M. (oio) as of 1 June 2003 with S. Vandoren and B. de Wit (advisor).  
project: to investigate non-perturbative aspects of superstring compactifications, using instanton techniques and supergravity tools (theme 1).
- Westra, W. (aio) as of 15 September 2003 with R. Loll.  
project: constructing models of quantum gravity by means of non-perturbative Lorentzian methods (theme 1).
- Vocks, H. (aio) as of 1 June 2004 with G.T. Barkema (H. van Beijeren, formal advisor).  
project: polymers and polymeric systems by means of computer simulation (theme 2).
- Torres Valderrama, A. (oio) as of 1 September 2004 with R.H.H.G. van Roij (H. van Beijeren, formal advisor).  
project: gaining theoretical understanding of suspensions of charged colloids, in particular in external fields (theme 2).
- Stavenga, G.C. (aio) as of 1 May 2005 with E. Laenen and B. de Wit.  
project: perturbative and non-perturbative QCD in high-energy scattering (theme 1).



- Koetsier, A.O. (aio) as of 1 August 2005 with H.T.C. Stoof.  
project: thermodynamical and dynamical properties of degenerate gases (theme 2).
- Janssen, T.M. (aio) as of 1 September 2005 with T. Prokopec (G. 't Hooft, formal advisor).  
project: novel observational consequences from cosmic inflation and observational consequences of interacting quantum fields during inflation (theme 1).
- Kuipers, J. (aio) as of 1 September 2005 with H. van Beijeren and G.T. Barkema.  
project: comparison between classical nucleation theory (CNT) and computer simulation results of nucleation in lattice gases (theme 2).
- Zwanikken, J.W. (aio) as of 1 September 2005 with R.H.H.G. van Roij (H. van Beijeren, formal advisor).  
project: theoretical study of suspensions of colloidal molecules, such as dumbbells and (semi-) flexible chains, both in bulk and in external fields (electric, shear, gravity) (theme 2).
- Lim, L.-K. (aio) as of 15 January 2006 with C. Morais Smith.  
project: the application of theoretical methods to describe rotating Bose-Einstein Condensates in the quantum Hall limit (theme 2).
- Gubbels, K. (aio) as of 1 February 2006 with H.T.C. Stoof.  
project: ultra cold atomic gases (theme 2).
- Eggen, E.J. (aio) as of 1 March 2006 with R.H.H.G. van Roij and H. van Beijeren.  
project: theoretical study of suspensions of colloidal molecules such as dumbbells and (semi-) flexible chains, both in bulk and in external fields (electric, shear, substrates) (theme 2).
- Reska, P. (aio) as of 1 Augustus 2006 with R. Loll.  
project: the focus is on various aspects of non-perturbative quantum gravity and quantum cosmology, and in particular the question of the role of the conformal factor and big-bang scenarios (theme 1).
- Makogon, D. (aio) as of 15 August 2006 with C. Morais Smith.  
project: transport properties in one dimensional systems (theme 2).
- de Leeuw, M. (aio) as of 1 October 2006 with G. Arutyunov (B. de Wit, formal advisor).  
project: the development and application of new methods aimed to further understand the relationship between gauge and string theories (the AdS/CFT correspondence) (theme 1).
- Looyestijn, H.T. (aio) as of 1 October 2006 with S. Vandoren (B. de Wit, formal advisor).  
project: to study the perturbative and non-perturbative structure of type II superstrings compactified to four space-time dimensions, and its relation to heterotic string theory (theme 1).

### 3.6 Scientific and educational activities of PhD students in Quantum Field Theory and Elementary Particle Physics (theme 1)

#### Arsiwalla, X.D. (UvA)

- *Black holes in topological string theory*, DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (talk)
- Spring School on Superstring Theory and Related Topics at ICTP, Trieste, Italy, 27 March-4 April 2006 (attended)
- Amsterdam Strings 2006 Workshop, ITF, Universiteit van Amsterdam, the Netherlands, 3-13 July 2006 (attended)
- PhD school for String Theory and Mathematical Physics, Amsterdam Session, 13-24 November 2006 (attended)
- International Workshop on String Theory, Puri, India, 12-19 December 2006 (attended)

#### Benedetti, D. (UU)

- *Ising model on causal dynamical triangulations*, Enrage Network's First Conference, Edinburgh, UK, 3-7 April 2006 (talk)
- Ecole Normale Supérieure, Paris, France, 28 June-6 July 2006 (work visit)
- *The quantum Hamiltonian of (2+1)-dimensional gravity from combinatorics?*, Institute for Theoretical Physics, Utrecht, the Netherlands, 6 October 2006 (talk)
- SPhT Saclay, Paris, France, 9-13 October 2006 (work visit)
- *A simplicial path to the quantum Hamiltonian of gravity*, Young Researchers Conference, Perimeter Institute, Waterloo, Canada, 4-8 December 2006 (talk)

#### Bomhof, C. (VUA)

- *Universality of single spin asymmetries in hard processes*, The 2nd Workshop on the QCD Structure of the Nucleon, Villa Mondragone Monte Porzio Catone, Rome, Italy, 12-16 June 2006 (talk)
- *Sivers effect asymmetries in hadron-hadron collisions*, International Workshop on RHIC Spin Physics, Nishina Hall, RIKEN, Hirosawa 2-1, Wako, Saitama, Japan, 29-30 September 2006 (talk)
- *Sivers effect asymmetries in hadron-hadron collisions*, International Spin Physics Symposium (SPIN 2006), Kyoto, Japan, 2-7 October 2006 (talk)

#### Boomsma, J.K. (VUA)

- The NIJMEGEN06 International Summer School on Astroparticle Physics, Nijmegen, the Netherlands, 29 August-8 September 2006 (attended)
- The IMAPP-Symposium 2006, Radboud University Nijmegen, the Netherlands, 13 October 2006 (attended)
- National Seminar Theoretical High Energy Physics, NIKHEF, Amsterdam, the Netherlands, 20 October 2006 (attended)

#### Chemissany, W. (RUG)

- *Born-Infeld theory and 'derivative corrections'*, DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (talk)

- ICTP Spring School on Superstring Theory and Related Topics, Trieste, Italy, 27 March-4 April 2006 (attended)
- *Constituents, fundamental forces and symmetries of the Universe*, RTN Meeting, 2nd Workshop and Midterm Meeting, Aula Magna Partenope Ateneo Federico II, Napoli, Italy, 9-13 October 2006 (talk)

**Cheng, M.C.-N. (UvA)**

- *A Farey tail for  $N=2$  black holes*, National Taiwan University, Taipei, Taiwan, 26 June 2006 (talk)
- *A Farey tail for attractor black holes*, Arnold Sommerfeld Institute of Theoretical Physics, Munich, Germany, 9 November 2006 (talk)
- *More bubbling solutions*, Harvard University, Cambridge, USA, 29 November 2006 (talk)
- *More bubbling solutions*, Rencontres Théoriciennes, Laboratoire de Physique Théorique de l'ENS, Paris, France, 14 December 2006 (talk)

**Davidse, M. (UU)**

- *Nonperturbative effects in supergravity*, Institute for Theoretical Physics, Utrecht, the Netherlands, 23 January 2006 (talk)

**de Kok, M.O. (UL)**

- *Supersymmetry on the lattice*, Heriot-Watt University and Edinburgh University, Edinburgh, UK, 19 April 2006 (talk)
- *Supersymmetry on the lattice*, Syracuse University, Syracuse, New York, USA, 3 August 2006 (talk)

**de Vroome, M. (UU)**

- RTN Winter School on Strings, Supergravity and Gauge Theories, CERN, Geneva, Switzerland, 16-20 January 2006 (attended)

**El-Showk, S. (UvA)**

- *Motivation for topological strings*, DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (talk)
- *From Field Theories to Elliptic Objects*, Winter School, University of Dusseldorf, Germany, 28 February-4 March 2006 (attended)
- Spring School on Superstring Theory and Related Topics at ICTP, Trieste, Italy, 27 March-4 April 2006 (attended)
- DAMTP in Cambridge, UK, 25-29 September 2006 (invited visit to collaborate)
- *M-theory in the City*, Workshop, University of London, Queenmary, London, UK, 9-11 November 2006 (attended)

**Hartong, J. (RUG)**

- *A democratic formulation for 7-branes*, DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (talk)
- ICTP Spring School on Superstring Theory and Related Topics, Trieste, Italy, 27 March-4 April 2006 (attended)
- *Seven-branes in type IIB string theory*, The 11th Marcel Grossmann Meeting on General Relativity, Berlin, Germany, 23-29 July 2006 (talk)
- Summer School on Strings, Gravity and Cosmology, University of British Columbia, Vancouver, Canada, 7-18 August 2006 (attended)

- *Seven-branes in type IIB string theory*, 2nd RTN Workshop on Constituents, Fundamental Forces and Symmetries of the Universe, Naples, Italy, 9-13 October 2006 (talk)

**Hollands, L. (UvA)**

- *Introduction to topological strings, part II*, DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (talk)
- *Topological strings on compact Calabi-Yau's*, ESF School in HEP and Astrophysics Strings and Brains, 22 May-3 June 2006, Cargèse, Corsica, France, 25 May 2005 (talk)
- Simons Workshop in Mathematics and Physics in Stony Brook, New York, USA, two weeks in July 2006 (attended)

**Hoogeveen, J. (UvA)**

- DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (attended)
- Spring School on Superstring Theory and Related Topics at ICTP, Trieste, Italy, 27 March-4 April 2006 (attended)

**Janssen, T. (UU)**

- DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (attended)
- *Problems and hopes in nonsymmetric gravity*, 2nd International Conference on Quantum Theories and Renormalization Group in Gravity and Cosmology, IRGAC 2006 Barcelona, Spain, 11-15 July 2006 (talk)
- School on Particle Physics, Gravity and Cosmology, Dubrovnik, Croatia, 21 August-2 September 2006 (attended)
- *Chiral freedom*, Institute for Theoretical Physics, Utrecht, the Netherlands, 10 November 2006 (talk)
- *Review of the direct empirical proof of the existence of dark matter*, Institute for Theoretical Physics, Utrecht, the Netherlands, 1 December 2006 (talk)

**Kampmeijer, L. (UvA)**

- Workshop Topological Phases and Quantum Computation, Santa Barbara, USA, 24 April-12 May 2006 (attended)

**Kanitscheider, I. (UvA)**

- DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (attended)
- Spring School on Superstring Theory and Related Topics at ICTP, Trieste, Italy, 27 March-4 April 2006 (attended)
- International Conference STRINGS 2006, Beijing, China, 19-24 June 2006 (attended)

**Manschot, J. (UvA)**

- *Black hole degeneracies and topological strings*, DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (talk)
- Spring School on Superstring Theory and Related Topics at ICTP, Trieste, Italy, 27 March-4 April 2006 (attended)

- International Conference STRINGS 2006, Beijing, China, 19-24 June 2006 (attended)
- Amsterdam Strings 2006 Workshop, ITF, Universiteit van Amsterdam, the Netherlands, 3-13 July 2006 (attended)
- PhD school for String Theory and Mathematical Physics, Amsterdam Session, the Netherlands, 13-24 November 2006 (attended)

**Mboyo Esole, J. (UL)**

- Stanford Institute for Theoretical Physics (Prof. Renata Kallosh) Stanford, California, USA, January-March 2006 (work visit)
- *Cosmic strings in  $N=2$  supergravity*, SITP, Stanford, California, USA, March 2006 (talk)
- *Cosmic strings in  $N=2$  supergravity*, UCSB, USA, March 2006 (talk)
- Summer school ‘Prospects in Theoretical Physics: Applications of String Theory’, Princeton, New Jersey, USA, 17-28 July 2006 (attended)
- *Cosmic strings in  $N=2$  supergravity*, Princeton, USA, July 2006 (talk)
- Simons Workshop, Stony Brook, New York, USA, August 2006 (attended)

**Messamah, I. (UvA)**

- *What’s the dual of a dipole?*, DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (talk)
- International Summerschool, Cargèse, Corsica, France, 22 May-3 June 2006 (attended)

**Nobbenhuis, S.J.B. (UU)**

- *The cosmological constant problem; an inspiration for new physics*, Institute for Theoretical Physics, Utrecht, the Netherlands, 8 June 2006 (talk)

**Ploegh, A.R. (RUG)**

- *Attractors in generalized assisted inflation*, DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (talk)
- ICTP Spring School on Superstring Theory and Related Topics, Trieste, Italy, 27 March-4 April 2006 (attended)
- *Dynamics of generalized assisted inflation*, University of Groningen, Groningen, the Netherlands, 28 February 2006 (talk)
- RTN meeting on Constituents, Fundamental Forces and Symmetries of the Universe, Napoli, Italy, 9-13 October 2006 (attended)

**Reska, P. (UU)**

- *Causal dynamical triangulations in quantum gravity*, International School of Sub-nuclear Physics, Erice, Sicily, Italy, 29 August-7 September 2006 (poster)

**Salmi, P. (UL)**

- *Oscillons: numerical studies in two dimensions* - UK Classical Lattice Field Theory Network Meeting, University of Kent, Canterbury, UK, 5-6 January 2006 (talk)
- *Oscillons: numerical studies in 2D* - Dutch Astrophysics Days, Sterrewacht, Leiden, the Netherlands, 4-5 April 2006 (talk)
- COSLAB Workshop ‘Condensates in Physics’, University of Nottigham, UK, 19-21 April 2006 (attended)
- *Classical field theory and solitons*, University of Cambridge, UK, 3-6 July 2006 (poster)

- *Numerical investigation of oscillons in 2 dimensions* - Laboratory Cosmology, University of Leiden, the Netherlands, 4-9 September 2006 (talk)
- *Non-perturbative dynamics in the early universe*, Madrid Autonoma University, Madrid, Spain, 13-15 September 2006 (talk)
- *Numerical investigations of oscillons* - DESY-Theory Workshop, DESY, Hamburg, Germany 26-29 September 2006 (talk)
- Cosmology Seminar, University of Sussex, UK, 24 October 2006 (attended)

**Sousa, K.S. (UL)**

- *Cosmic strings in brane-antibrane inflation*, DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (talk)
- Master Course ‘Supersymmetry and P-Branes’, Granada, Spain, 13-17 March 2006 (attended)
- Winter School in Attractor Mechanism, Frascati, Italy, 20-24 March 2006 (attended)
- COSLAB Meeting, Nottingham, UK, 19-21 April 2006 (attended)
- COSLAB Meeting, Leiden, the Netherlands, 4-9 September 2006 (attended)

**Stavenga, G. (UU)**

- *Operator product expansion*, DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (talk)
- CTEQ Summer School on QCD Analysis and Phenomenology, Rhodos, Greece, 1-9 July 2006 (attended)
- Under the Spell of Physics, Conference in honour of Gerard 't Hooft, Vlieland, the Netherlands, 14-16 July 2006 (attended)

**van der Meulen, M.P. (UvA)**

- *Quantum corrections to correlation functions in de Sitter space*, DESY Theory Workshop, 26-29 September 2006, Hamburg, Germany, 27 September 2006 (talk)
- 10th Paris Cosmology Colloquium Physics of the Early Universe Confronts Observations: WMAP 2006, Paris, France, 26-28 October 2006 (attended)

**van Kessel, M.T.M. (RU)**

- *The path integral approach to SSB*, DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (talk)

**van Riet, T. (RUG)**

- RTN Winterschool on Strings, Supergravity and Gauge Theories, Geneva, Switzerland, 16-20 January 2006 (attended)
- *Scaling cosmologies in gauged supergravity*, Theoretical High Energy Seminar of Dip. di Fisica Teorica, Università di Torino, Italy, 3 October 2006 (talk)
- RTN Workshop, Constituents, Fundamental Forces and Symmetries of the Universe, Naples, Italy, 9-13 October 2006 (attended)
- *Scaling cosmologies in gauged supergravity*, the joint V.U.B.-U.L.B.-K.U.L. Seminars, Leuven, Belgium, 21 November 2006 (talk)
- *Cosmology and higher-dimensional (super-)gravity*, Departamento de Fisica Teorica y del Cosmos Universidad de Granada, Spain, 30 November 2006 (talk)

**Wagenaar, J.W. (RU)**

- *Strong meson-baryon interaction*, DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (talk)

- *Soft core model for Meson-Baryon interactions*, Conference HYP2006, Mainz, Germany, 9-14 October 2006 (poster)

**Wessels, E. (VUA)**

- *The colour glass condensate*, DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006 (talk)
- *The colour glass condensate*, NNV Fall Meeting, Lunteren, the Netherlands, 27 October 2006 (talk)

**Westra, W. (UU)**

- *Emergence of AdS2 from quantum fluctuations*, 11th Marcel Grossmann Meeting, Berlin, Germany, 25 July 2006 (talk)
- *Emergence of AdS2 from quantum fluctuations*, Institute for Theoretical Physics, Utrecht, the Netherlands, 23 November 2006 (talk)
- *Backgrounds from background independent quantum gravity*, Young Researchers Conference, Perimeter Institute, Waterloo, Canada, 4-8 December 2006 (talk)

### 3.7 Scientific and educational activities of PhD students in Statistical Physics, Condensed-Matter Theory and Quantum Optics (theme 2)

**Ament, L. (UL)**

- *New light on magnetic excitations: indirect resonant inelastic X-ray scattering on magnons*, Synchrotron and Neutron Users Workshop, Den Haag, the Netherlands, 12 October 2006 (poster)
- *Theory of resonant inelastic X-ray scattering*, Synchrotron and Neutron Users Workshop, Den Haag, the Netherlands, 12 October 2006 (poster)

**Bardarson, J. (UL)**

- *How spin-orbit interaction can cause electronic shot noise in chaotic billiards*, International School on Fundamentals of Nanoelectronics, Keszthely, Lake Balaton, Hungary, 27 August-1 September 2006 (talk)

**Becherer, P. (UL)**

- First Dynamics of Patterns Day, Amsterdam, the Netherlands, 8 February 2006 (attended)
- *Amplitude expansions for subcritical instabilities*, PHYNECS European Network Meeting and 8th Minerva Winter School, Rehovot, Israel, 12-18 February 2006 (talk)
- *Instabilities in flows of viscoelastic fluids*, DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Nijmegen, the Netherlands, 15-19 May 2006 (talk)
- Second Dynamics of Patterns Day, Amsterdam, the Netherlands, 23 May 2006 (attended)
- Advanced School on Pattern Formation at Interfaces with Applications to Materials Science, Biomedical and Physico-Chemical Processes, International Centre for Mechanical Sciences, Udine, Italy, 16-20 October 2006 (attended)

- Soft Matter Meeting, Amsterdam, the Netherlands, 18 December 2006 (attended)

**Beekman, A.J. (UL)**

- Spring School, Casimir Research School, Heeg, the Netherlands, 1-4 May 2006 (attended)
- *Non-abelian defects and braid statistics*, DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, 15-19 May 2006 (talk)
- Conference Quantum Criticality, Lorentz Center, Leiden University, the Netherlands, 7-18 August 2006 (attended)
- PhD Course Advanced Theory of Condensed Matter by prof. dr. Jan Zaanen, Leiden University, the Netherlands, Fall 2006 (attended)
- Course, ‘Doelgericht Werken & Plannen’, Stichting voor Fundamenteel Onderzoek der Materie (FOM), Utrecht, the Netherlands, 5 October and 2 November 2006 (attended)

**Conti, E. (VUA)**

- *Nonlinear behaviour of filament networks*, DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, 15-19 May 2006 (talk)
- *Feshbach resonances in an optical lattice*, Scientific meeting FOM Condensed Matter, Veldhoven, the Netherlands, December 14-15, 2004 (poster)

**Cvetkovic, V. (UL)**

- *Ordered limit of superconductivity*, Seminar, Department of Physics, Johns Hopkins University, Baltimore, USA, April 2006 (talk)

**Dickerscheid, D.B.M. (UU)**

- *Quantum phases in optical lattices*, PhD Thesis Talk, Institute for Theoretical Physics, Utrecht, the Netherlands, 31 January 2006 (talk)

**Eggen, E. (UU)**

- DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, 15-19 May 2006 (attended)
- *Charged colloidal rods*, SFB TR6 Summer School on Soft Matter ‘Colloids in External Fields: Physics and Applications’, Cargèse (Corsica), France, 2-13 October 2006 (poster)
- Jülich Soft Matter Days, Bonn, Germany, 14-17 November 2006 (attended)
- Soft Matter Meeting, Amsterdam, the Netherlands, 18 December 2006 (attended)

**Ellenbroek, W.G. (UL)**

- J.M. Burgers Day, Delft, the Netherlands, 12 January 2006 (attended)
- National Seminar Statistical Physics, Delft, the Netherlands, 27 January 2006 (attended)
- National Seminar Statistical Physics, Leiden, the Netherlands, 31 March 2006 (attended)
- *A critical length scale in jammed granular media*, DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, 15-19 May 2006 (talk)
- Boulder School 2006, Physics of Soft Matter: Complex Fluids and Biological Materials, Boulder, Colorado, USA, 26 June-21 July 2006 (attended)



- Dynamics of Patterns Day, Amsterdam, the Netherlands, 19 October 2006 (attended)
- Soft Matter Meeting, Amsterdam, the Netherlands, 18 December 2006 (attended)
- W.G. Ellenbroek is a member of the ‘Centrale Ondernemings Raad’ of FOM

#### **Erzgräber, H. (VUA)**

- *Continuation study of a semiconductor laser with filtered optical feedback*, Workshop Applied Dynamical Systems ‘Advanced Numerical Methods for Mathematical Modeling’, Gent, Belgium, 22-23 June 2006 (talk)
- *Interacting frequency and relaxation oscillations in a semiconductor laser with filtered optical feedback*, CLEO/Europe-EQEC Focus Meeting on Nonlinear, Quantum and Chaotic Optics: New Directions in Photonic and Optical Communications 2006, Cannes, France, 26 September 2006 (talk)
- *Filtered feedback induced dynamics and bifurcations of a semiconductor laser*, Laser-centre Day, LCVU, Amsterdam, 13 December 2006 (talk)

#### **Gubbels, K. (UU)**

- *Feshbach resonances in an optical lattice*, DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, 15-19 May 2006 (talk)
- *Stark deceleration: molecules riding waves*, Department of Molecular and Laser Physics, Radboud University Nijmegen, the Netherlands, 17 March 2006 (talk)
- International School of Physics ‘Enrico Fermi’, course on ‘Ultra-Cold Fermi Gases’, Varenna, Italy, 20-30 June 2006 (attended)
- Workshop on Bose-Einstein Condensation, Free University Berlin, Germany, 27-29 October 2006 (attended)
- *Ultracold Fermi gases with a population imbalance*, Molecular Physics Department, Fritz Haber Institute, Berlin, Germany, 27 October 2006 (talk)

#### **Hagemans, R.L. (UvA)**

- *Dynamics of integrable spin chains*, International Conference Statistical Physics and Low Dimensional Systems, Nancy, France, 17-19 May; 18 May 2006 (talk)
- International Summerschool: PITP-Les Houches Summer School Quantum Magnetism, Les Houches, France, 6-23 June 2006 (attended)

#### **Huijse, L. (UvA)**

- DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, 15-19 May 2006 (attended)
- INSTANS Summer Conference, Como, Italy, 12-16 June 2006 (attended)
- Quantum Criticality Workshop, Leiden, 7-19 August 2006 (attended)

#### **Idema, T. (UL)**

- Dynamics of Patterns Meeting, Amsterdam, the Netherlands, 8 February 2006 (attended)
- *Barbapapas at the cellular level*, Casimir Spring School, Heeg, the Netherlands, May 2006 (talk)
- *Barbapapas at the cellular level*, Jagiellonian University, Cracow, Poland, May 2006 (talk)
- Workshop Soft Condensed Matter Physics in Molecular and Cell Biology, Lorentz Center, Leiden, the Netherlands, 8-12 May 2006 (attended)
- *Barbapapas at the cellular level - towards understanding the shape of multi-compo-*

- ment bilayer vesicles*, DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, 15-19 May 2006 (talk)
- Boulder School in Condensed Matter and Material Physics, Boulder, Colorado, USA, 26 June-21 July 2006 (attended)
- Dynamics of Patterns Meeting, Amsterdam, the Netherlands, 19 October 2006 (attended)
- Annual Dutch Meeting on Molecular and Cellular Biophysics, Lunteren, the Netherlands, 9-10 October 2006 (attended)
- Soft Matter Meeting, Amsterdam, the Netherlands, 18 December 2006 (attended)

**Juricic, V. (UU)**

- *Magnetic and transport properties in lightly doped  $La_{2-x}Sr_xCuO_4$* , Brookhaven National Laboratory, USA, 9 March 2006 (talk)
- *Magnetic and transport properties in lightly doped  $La_{2-x}Sr_xCuO_4$* , March Meeting American Physical Society, Baltimore, USA, 13 March 2006 (talk)
- *Magnetic and transport properties in lightly doped  $La_{2-x}Sr_xCuO_4$* , Physics Department, Boston University, USA, 20 March 2006 (talk)
- *Magnetic and transport properties in lightly doped  $La_{2-x}Sr_xCuO_4$* , Physics Department, Harvard University, USA, 21 March 2006 (talk)
- *Field-theoretical studies of a doped Mott insulator*, Institute for Theoretical Physics, Utrecht, the Netherlands, 13 June 2006 (talk)

**Koetsier, A. (UU)**

- *BEC-BCS crossover in an optical lattice*, Institute for Theoretical Physics, Utrecht, the Netherlands, 28 April 2006 (talk)
- *BEC-BCS crossover in optical lattice*, DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, 15-19 May 2006 (talk)

**Kuipers, J. (UU)**

- DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, 15-19 May 2006 (attended)

**Leurs, B.W.A. (UL)**

- *Charge order and nodal fermions in high-temperature superconductivity*, 8th International Conference on Materials and Mechanisms of Superconductivity and High-Temperature Superconductors, Dresden, Germany, 9-14 July 2006 (poster)

**Lim, L.-K. (UU)**

- DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, 15-19 May 2006 (attended)
- Conference ‘Strongly Correlated Systems in Low Dimension’, Ascona, Switzerland, 2-8 July 2006 (attended)

**Mehmani, B. (UvA)**

- *Simultaneous measurement of non-commutative variables*, DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, 15-19 May 2006 (talk)
- *Simultaneous measurement of non-commuting observables*, ITF, Universiteit van Amsterdam, the Netherlands, 22 November 2006 (talk)

**Ostojic, S. (UvA)**

- *Scale-invariance and universality of force networks in static granular*, Workshop on Relaxation Dynamics of Macroscopic Systems, Cambridge, UK, 19-13 January 2006 (poster)
- *Scale-invariance and universality of force networks in static granular*, Journées de Physique Statistique, Paris, France, 20 January 2006 (talk)
- *Scale-invariance and universality of force networks in static granular*, National Seminar Statistical Mechanics, Leiden, the Netherlands, 31 March 2006 (talk)
- *Scale-invariance and universality of force networks in static granular*, Seminar École Normale Supérieure, Paris, France, 10 May 2006 (talk)

**Romans, M.W.J. (UU)**

- *Dressed Feshbach molecules in the BEC-BCS crossover*, APS March Meeting, Baltimore, USA, 13-17 March 2006 (talk)

**Ruszel, W.M. (RUG)**

- Workshop ‘Yep Large Deviations, Random Media, and Random Matrices’, Eurandom, Eindhoven, the Netherlands, 20-24 March 2006 (attended)
- 14th Meeting of AIO’s Stochastics, Hilversum, the Netherlands, 8-10 May 2006 (attended)
- *On the way towards the ito calculus*, Dynamical Systems Seminar, University of Groningen, the Netherlands, 15 May 2006 (talk)
- Conference ‘Stochastic Processes in Mathematical Physics’, La Pietra, Florence, Italy, 19-23 June 2006 (attended)
- Stochastische Prozesse, Doktorandentreffen, Münster, Germany, 31 August - 1 September 2006 (attended)
- *Chaotic temperature dependence at zero temperature: a bounded spin example*, Summerschool Statistical Mechanics, Prague, Czech Republic, 19 September 2006 (talk)
- *Chaotic temperature dependence at zero temperature: a bounded spin example*, Workshop ‘Applications of Stochastic Processes’, Potsdam, Germany, 28 September 2006 (talk)
- Mark Kac Seminars 2006 (attended)

**Snoek, M. (UU)**

- *Vortex-lattice melting in a one-dimensional optical lattice*, Institut für Theoretische Physik, Aachen, Germany, 21 February 2006 (talk)
- *Vortex lattice melting in a stack of Bose Einstein condensates*, APS March Meeting, 13-17 March, Baltimore, USA, 13 March 2006 (talk)
- *Vortex matter and ultracold superstrings in optical lattices*, Institute for Theoretical Physics, Utrecht, the Netherlands, 20 June 2006 (talk)
- University of British Columbia, Vancouver, Canada, 3-8 July 2006 (work visit)

**Torres Valderrama, A. (UU)**

- Winter School of Physical Chemistry, Han-sur-lesse, Belgium, 6-10 February 2006 (attended)
- *Density functional theory and colloidal suspensions*, DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, 15-19 May 2006 (talk)
- SFB TR6 Summer School on Soft Matter, ‘Colloids in External Fields: Physics

and Applications', Cargèse (Corsica), France, 2-13 October 2006 (attended)

**van Wezel, J. (UL)**

- *Spontaneous symmetry breaking in superconductors*, XI Training Course in the Physics of Strongly Correlated Systems, University of Salerno, Italy, October 2006 (talk)
- *Spontaneous symmetry breaking and decoherence*, Theory Seminar, Cambridge University, UK, November 2006 (talk)
- *An experimental test of gravitationally induced quantum state reduction*, Theory Seminar, Theory of Condensed Matter, Cambridge University, UK, November 2006 (talk)

**Vocks, H. (UU)**

- *POP-ART: thermodynamically correct activated event sampling in complex materials*, DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, 15-19 May 2006 (talk)
- *POP-ART: thermodynamically correct activated event sampling in complex materials*, SimBioMa workshop on Path Sampling in Molecular Simulation, Université d'Orsay Paris-Sud, Laboratoire de Chimie Physique, Orsay, France, 28 November-1 December 2006 (talk)
- Department of Physics, University of Montreal, Canada, 3-18 December 2006 (work visit)

**Žeravčić, Z. (UL)**

- Dynamics of Patterns Day, Amsterdam, the Netherlands, 19 October 2006 (attended)
- Soft Matter Meeting, Amsterdam, the Netherlands, 18 December 2006 (attended)

**Zoetekouw, B. (UU)**

- *Phase behavior of charged colloids*, Institute for Theoretical Physics, Utrecht, the Netherlands, 6 September 2006 (talk)

**Zozulya, O.S. (UvA)**

- *Towards entanglement in quantum Hall effect*, DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, 15-19 May 2006 (talk)
- International School of Physics Enrico Fermi, Ultra-Cold Fermi Gases, Varenna, Italy, 20-30 June 2006 (attended)
- International School Laser Cooling and Bose-Einstein Condensation, Les-Houches, France, 10-22 September 2006 (attended)

**Zwanikken, J.W. (UU)**

- Winter School of Physical Chemistry, Han-sur-Lesse, Belgium, 6-10 February 2006 (attended)
- SFB-TR6 Workshop, Bonn, Germany, 20-22 March 2006 (attended)
- *Mode selection and stretching of capillary waves by shear flow*, DRSTP Postgraduate Course Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, 15-19 May 2006 (talk)
- *Mode selection and stretching of capillary waves by shear flow*, SFB TR6 Summer School on Soft Matter, 'Colloids in External Fields: Physics and Applications', Cargèse (Corsica), France, 2-13 October 2006 (talk)

- Jülich Soft Matter Days, Bonn, Germany, 14-17 November 2006 (attended)
- *Colloids on interfaces: narcissistic interactions*, Soft Matter Meeting, Amsterdam, the Netherlands, 18 December 2006 (talk)



## 4 | Scientific staff (31-12-2006)

*Below an overview is given of the permanent and temporary staff of the DRSTP on 31 December 2006. Also the associate groups and members are listed. PhD students are given in chapter 3 (sect. 5).*

*Theme 1 refers to the research area quantum field theory and elementary particle physics and theme 2 to statistical physics, condensed-matter theory and quantum optics. The fte commitment of the permanent staff is given in the last column.*

### 4.1 Permanent staff

<u>Universiteit van Amsterdam (UvA)</u>	theme	fte
prof. dr. ir. F.A. Bais	1	0.50
dr. J.-S. Caux	2	0.50
prof. dr. J. de Boer	1	0.50
prof. dr. R.H. Dijkgraaf	1	0.50
prof. dr. J.H. Koch	1	0.10
prof. dr. B. Nienhuis	2	0.50
dr. Th.M. Nieuwenhuizen	2	0.50
prof. dr. A.M.M. Pruisken	2	0.50
prof. dr. K. Schoutens	2	0.50
dr. K. Skenderis	1	0.50
prof. dr. J. Smit	1	0.50
dr. L.J. van den Horn	1	0.25
dr. W.A. van Leeuwen	2	0.50
prof. dr. E.P. Verlinde	1	0.50

<u>Vrije Universiteit Amsterdam (VUA)</u>	theme	fte
dr. K. Allaart	2	0.10
dr. B.L.G. Bakker	1	0.20
dr. D. Boer	1	0.25
prof. dr. B. Krauskopf	1	0.00
prof. dr. F.C. Mackintosh	2	0.50
prof. dr. P.J.G. Mulders	1	0.25
prof. dr. J.W. van Holten	1	0.00
prof. dr. W.L.G.A.M. van Neerven	1	0.00
dr. T.D. Visser	2	0.25

<b>University of Groningen (RUG)</b>	<b>theme</b>	<b>fte</b>
prof. dr. E.A. Bergshoeff	1	0.50
prof. dr. M. de Roo	1	0.50
dr. E. Pallante	1	0.50
prof. dr. A.C.D. van Enter	2	0.50
<b>Leiden University (UL)</b>	<b>theme</b>	<b>fte</b>
prof. dr. A. Achúcarro	1	0.80
prof. dr. G.T. Barkema	2	0.00
prof. dr. C.W.J. Beenakker	2	0.40
prof. dr. H.W.J. Blöte	2	0.10
dr. P.J.H. Denteneer	2	0.80
prof. dr. Y. Levin	1	0.20
prof. dr. G. Nienhuis	2	0.40
prof. dr. H. Schiessel	2	0.40
prof. dr. P.J. van Baal	1	0.80
prof. dr. J. van den Brink	2	0.40
prof. dr. W.L.G.A.M. van Neerven	1	0.80
prof. dr. ir. W. van Saarloos	2	0.40
prof. dr. J. Zaanen	2	0.80
<b>Radboud University Nijmegen (RU)</b>	<b>theme</b>	<b>fte</b>
dr. W.J.P. Beenakker	1	0.30
prof. dr. A. Fasolino	2	0.20
prof. dr. M.I. Katsnelson	2	0.40
prof. dr. R.H.P. Kleiss	1	0.30
dr. T.A. Rijken	1	0.50
prof. dr. A.N.J.J. Schellekens	1	0.10
prof. dr. J. van den Brink	2	0.00
<b>Utrecht University (UU)</b>	<b>theme</b>	<b>fte</b>
prof. dr. J. Ambjørn	1	0.18
dr. G. Arutyunov	1	0.60
prof. dr. G.T. Barkema	2	0.60
prof. dr. B. de Wit	1	0.60
dr. R.A. Duine	2	0.60
prof. dr. E. Laenen	1	0.00
prof. dr. R. Loll	1	0.60
prof. dr. C. Morais Smith	2	0.60
dr. T. Prokopec	1	0.60
prof. dr. J. Smit	1	0.00
prof. dr. ir. H.T.C. Stoof	2	0.60
prof. dr. G. 't Hooft	1	0.60
prof. dr. H. van Beijeren	2	0.60



prof. dr. J.E.J.M. van Himbergen	2	0.00
dr. R.H.H.G. van Roij	2	0.60
dr. S. Vandoren	1	0.60

## 4.2 Temporary staff (31-12-2006)

<b>Universiteit van Amsterdam (UvA)</b>	<b>theme</b>	
dr. J.M.O. Baptista	1	
dr. R.A.P. Britto	1	
dr. P. Calabrese	2	
dr. D.P.A. Faribault	2	
dr. A.J. Kashani-Poor	1	
dr. P.L. McFadden	1	
dr. K. Papadodimas	1	
dr. S. Reffert	1	
dr. K.E. Schalm	1	
dr. M. Taylor	1	
dr. J.P. van der Schaar	1	
<b>Vrije Universiteit Amsterdam (VUA)</b>	<b>theme</b>	
dr. D. Danova	2	
dr. K. Green	2	
dr. A. Utermann	1	
<b>Leiden University (UL)</b>	<b>theme</b>	
dr. Y. Bazaily	2	
dr. F. Bruckmann	1	
dr. S.C. Davis	1	
dr. C. Filippi	2	
dr. R. Jeannerot	1	
dr. F. Krüger	2	
dr. T. Ludwig	2	
dr. A. Morozov	2	
dr. A. Ossipov	2	
dr. P. Recher	2	
dr. V.G. Rousseau	2	
dr. D. Sadri	2	
dr. D.I. Santiago	2	
dr. A. Rycerz	2	
dr. K. Shundyak	2	
dr. C. Storm	2	
dr. T. Tighe	2	

<b>Radboud University Nijmegen (RU)</b>	<b>theme</b>
dr. A. Grechnev	2

<b>Utrecht University (UU)</b>	<b>theme</b>
dr. L.F. Alday	1
dr. R.L. Doretto	2
dr. B. Eden	1
dr. J. Engquist	1
dr. J. Henson	1
dr. O. Hohm	1
dr. S.R. Jain	2
dr. G.S. Krishnaswami	1
dr. P. Massignan	2
dr. D. Oriti	1
dr. K. Peeters	1
dr. I. Pushkina	1
dr. G. Rigopoulos	1
dr. D. Robles Llana	1
dr. H. Sahlmann	1
dr. F.S. Saueressig	1
dr. A. Starodubtsev	1

<b>4.3 Associate members</b>	<b>theme</b>
prof. dr. H.A. de Raedt (RUG)	2
prof. dr. ir. H. Dekker (TNO/UvA/TU/e)	2
dr. B.J. Hoenders (RUG)	2
dr. ir. L.P.J. Kamp (TU/e)	2
prof. dr. J. Knoester (RUG)	2
prof. dr. D. Lohse (UT)	2
NIKHEF theory group (Amsterdam)	1
Theoretical and Polymer Physics Group (TU/e)	2
prof. dr. R.G.E. Timmermans (KVI)	1

## 5 | Academic publications

*This chapter presents an overview of publications in refereed journals published in 2006. The publications belonging to theme 1 and theme 2 are given separately. Within each theme the publications are ordered according to university. Note that publications by associate members are not included. Professional publications are listed in chapter 7.*

### 5.1 Theme 1: Quantum field theory and elementary particle physics

#### Universiteit van Amsterdam

- Aganagic, M., Dijkgraaf, R.H., Klemm, A., Mariño, M. and Vafa, C., *Topological strings and integrable hierarchies*, Commun. Math. Phys. 261 (2006) 451-516.
- Aguiar de Moura, F.A.P. and Schiappa, R., *Higher-derivative corrected black holes: Perturbative stability and absorption cross-section in heterotic string theory*, Class. Quant. Grav. 24 (2006) 361.
- Alday, L.F., de Boer, J. and Messamah, I., *The gravitational description of coarse grained microstates*, JHEP 0612 (2006) 063.
- Alday, L.F., de Boer, J. and Messamah, I., *What is the dual of a dipole?*, Nucl. Phys. B 746 (2006) 29-57.
- Bais, F.A. and Mathy, C.J.M., *Defect-mediated melting and the breaking of quantum double symmetries*, Phys. Rev. B 73 (2006) 224120.
- Banks, T., Fiol Nunez, B.S. and Morisse, A., *Towards a quantum theory of de Sitter space*, JHEP 0612 (2006) 004.
- Britto, R.A.P., Feng, B. and Mastrolia, P., *The cut-constructible part of QCD amplitudes*, Phys. Rev. D 73 (2006) 105004.
- Craps, B.E.L., Evnin, O. and Nakamura, Shin., *D0-brane recoil revisited*, JHEP 0612 (2006) 0081.
- Craps, B.E.L., Rajaraman, A. and Sethi, S., *Effective dynamics of the matrix big bang*, Phys. Rev. D 73 (2006) 106005.
- Craps, B.E.L., Evnin, O. and Nakamura, Shin., *Local recoil of extended solitons: a string theory example*, JHEP 0701 (2006) 050.
- de Boer, J., Cheng, C.N., Dijkgraaf, R.H., Manschot, J. and Verlinde, E.P., *A Farey tail for attractor black holes*, JHEP 0611 (2006) 024.
- Diaconescu, D.-E., Dijkgraaf, R.H., Donagi, R., Hofman, C. and Pantev, T., *Geometric transitions and integrable systems*, Nucl. Phys. B 752 (2006) 329-390.
- Dijkgraaf, R.H., Gopakumar, R., Ooguri, H. and Vafa, C., *Baby universes and*

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  - Proukakis, N.P., *Interplay of density and phase fluctuations in ultracold one-dimensional Bose gases*, Phys. Rev. A73 (2006) 023605 [cond-mat/0505039].
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  - Silva Neto, M.B., *Magneto-elastic coupling between copper spin configurations and*

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  - Zoetekouw, B. and van Roij, R., *Volume terms for charged colloids revisited: a grand-canonical treatment*, Phys. Rev. E73 (2006) 021403 [cond-mat/0510226].
  - Zoetekouw, B. and van Roij, R., *Nonlinear screening and gas-liquid separation in suspensions of charged colloids*, Phys. Rev. Lett. 97 (2006) 258302 [cond-mat 0611290].

## 6 | Scientific activities

*This chapter contains an overview of conference talks, seminars, lecture courses and poster presentations of staff members and postdoctoral fellows. An overview of the presentations of PhD students is given in chapter 3 (sects. 6 and 7). A list of public lectures can be found in chapter 7 (sect. 3)*

### 6.1 Theme 1: Quantum field theory and elementary particle physics

#### Universiteit van Amsterdam

- Aguiar de Moura, F.A.P., *Perturbative stability and absorption cross-section in higher-derivative heterotic string black holes*, Paris VI - Jussieu, France, 30 May 2006.
- Aguiar de Moura, F.A.P., *Perturbative stability and absorption cross-section in higher-derivative heterotic string black holes*, Paris XI - Orsay, France, 8 June 2006.
- Bais, F.A., *Topological interactions and quantum computation*, Faculteit der Natuurwetenschappen, RUG, Groningen, the Netherlands, 9 February 2006.
- Bais, F.A., *From anyons to algebras*, Kavli Institute for Theoretical Physics, Santa Barbara, California, USA, 7 March 2006.
- Bais, F.A., *Alice electrodynamics*, Kavli Institute for Theoretical Physics, Santa Barbara, California, USA, 26 April 2006.
- Bais, F.A., *The physics of quantum doubles and their breaking*, Conference 'Knots and Physics', Institut de Recherche Mathématique Avancée, Strassbourg, France, 9 June 2006.
- Bais, F.A., *Anyons and quantum computation*, Conference on Quantum Technologies, Cambridge University, UK, 1 September 2006.
- Bais, F.A., *The physics of quantum groups and their breaking*, National Seminar High Energy Physics, NIKHEF, Amsterdam, the Netherlands, 20 October 2006.
- Bais, F.A., *Topological phases and quantum computation*, Ehrenfest Colloquium, Lorentz Institute, Leiden, the Netherlands, 15 November 2006.
- Britto, R.A.P., *Beyond diagrams*, Conference Frontiers in Theoretical Physics, Niels Bohr Summer Institute, Copenhagen, Denmark, 14 August 2006.
- Britto, R.A.P., *Unitarity cuts and QCD loop amplitudes*, 'High Precision for Hard Processes' LHC Seminar, Zürich, Switzerland, 6 September 2006.
- de Boer, J., *On the origin of gravitational thermodynamics*, International Work-

- shop on Black Holes, Black Rings and Topological Strings, 31 March-4 April 2006, Arnold Sommerfeld Center for Theoretical Physics, Munich, Germany, 3 April 2006.
- de Boer, J., *On the origin of gravitational thermodynamics*, International Conference Cosmology, Strings, and Black Holes, Copenhagen, Denmark, 18-21 April 2006, 18 April 2006.
  - de Boer, J., *Topological G2 strings*, 9-11 November 2006, International Conference M-Theory in the City, London, UK, 9 November 2006.
  - Dijkgraaf, R.H.D., *A universal wave function for topological string theory*, Workshop ‘Topological Strings and Black Holes, Harvard University, Massachusetts, USA, 31 January 2006.
  - Dijkgraaf, R.H.D., *String theory and the end of space and time*, 10th Anniversary Lecture CAMS, American University in Beirut, Lebanon, 20 February 2006.
  - Dijkgraaf, R.H.D., *Topological string theory and Auguste theory*, Opening Symposium ‘Center for the Topology and Quantization of Moduli Spaces, Aarhus University, Germany, 9 March 2006.
  - Dijkgraaf, R.H.D., *Black holes and topological strings*, Niels Bohr Institute, Copenhagen, Denmark, 29 March 2006.
  - Dijkgraaf, R.H.D., *The unreasonable effectiveness of physics in modern mathematics*, Niels Bohr Lecture, Niels Bohr Institute, Copenhagen, Denmark, 29 March 2006.
  - Dijkgraaf, R.H.D., *Black holes and topological strings, Eurostrings*, Cambridge, UK, 3 April 2006.
  - Dijkgraaf, R.H.D., *The quantum geometry of string theory*, Distinguished Lecture Series, Dept. Mathematics and Physics, UC Berkeley and MSRI, USA, 25-28 April 2006.
  - Dijkgraaf, R.H.D., *String theory and black holes*, Universität Hannover, Germany, 10 May 2006.
  - Dijkgraaf, R.H.D., *String theory and quantum gravity*, Technische Universiteit Eindhoven, the Netherlands, 9 November 2006.
  - Dijkgraaf, R.H.D., *Low energy effective actions and special geometry*, ‘PHD school 2006, Amsterdam-Brussels-Paris’, Amsterdam, the Netherlands, 16 November 2006, lecture series
  - Fiol Nunez, B.S., *On the critical points of the entropic principle*, International Conference Eurostrings, Cambridge University, UK, 5 April 2006.
  - Fiol Nunez, B.S., *deWitt metrics in M-theory*, International Workshop IV Simons Workshop in Mathematics and Physics, University of Stony Brook, USA, 23 August 2006.
  - Kashani-Poor, A.K., *A stringy test of flux-induced isometry gauging*, Saclay, Paris, France, 26 January 2006.
  - Kashani-Poor, A.K., *The wave-function behavior of the open topological string partition function on the conifold*, CERN, Geneva, Switzerland, 20 June 2006.
  - Kashani-Poor, A.K., *The wave-function behavior of the open topological string partition function on the conifold*, Institut Henri Poincaré, Paris, France, 12 October 2006.
  - Kashani-Poor, A.K., *The wave-function behavior of the open topological string par-*

- tition function on the conifold*, Max Planck Institut, Potsdam, Germany, 30 October 2006.
- Papadodimas, K., *Large N phase transitions in weakly coupled gauge theories and AdS/CFT*, École Polytechnique, Paris, France, 19 December 2006.
  - Reffert, S., *Geometric aspects of moduli stabilization*, University of Rome II ‘Tor Vergata’ Rome, Italy, 4 December 2006.
  - Roček, M., *A gravitational effective action on a finite triangulation*, ITF, Universiteit van Amsterdam, the Netherlands, 23 March 2006.
  - Schalm, K.E., *Cosmology, quantum gravity and string theory*, ITF, Universiteit van Amsterdam, the Netherlands, 23 February 2006.
  - Schalm, K.E., *On the IR structure of gravity and holography*, Workshop Cosmology, Strings and Black Holes, Niels Bohr Institute, Copenhagen, Denmark, 19 April 2006.
  - Schalm, K.E., *Transplanckian physics and the CMB: A status report*, STRINGS 2006, International Conference, Beijing, China, 19-24 June 2006; 21 June 2006.
  - Schalm, K.E., *Non-extremal black holes are BPS*, Simons Workshop on Mathematical Physics, Stony Brook, USA, 22 August 2006.
  - Schalm, K.E., *Effective actions for gravity*, Natural UV Cut-Offs in Cosmology Workshop, Perimeter Institute Waterloo, Canada, 7 September 2006.
  - Skenderis, K., *Kaluza-Klein holography*, Barcelona, Spain, 16 February 2006.
  - Skenderis, K., *Kaluza-Klein holography*, Queen Mary, London, UK, 23 March 2006.
  - Skenderis, K., *Kaluza-Klein holography*, Potsdam, Germany, 25 April 2006.
  - Skenderis, K., *Holographic anatomy*, 4th Simons Workshop in Mathematics and Physics, Stony Brook, USA, 24 July-25 August 2006; 15 August 2006.
  - Skenderis, K., *Cosmology/Domain-wall correspondence*, Heraklion, Greece, 28 September 2006.
  - Skenderis, K., *Quantum gravity, strings, branes and holography*, Heraklion, Greece, 5 October 2006.
  - Skenderis, K., *Cosmology/Domain-wall correspondence*, KU Leuven, Belgium, 9 November 2006.
  - Smit, J., *Quasiparticle description of sterile neutrino production*, International Workshop on Sterile Neutrinos in Astrophysics and Cosmology, Crans Montana, Switzerland, 25-29 March 2006; 27 March 2006.
  - Smit, J., *Classical approximation in field theory*, International Workshop on Classical Field Theory and Solitons, Centre for Mathematical Sciences, Cambridge University, Cambridge, UK, 4 July 2006.
  - Smit, J., *A low-scale universe?*, International Workshop on Non-Perturbative Dynamics in the Early Universe, Autonoma University, Madrid, Spain, 13-15 September 2006; 14 September 2006.
  - Smit, J., *Baryogenesis and the standard model*, Institute for Theoretical Physics, University Groningen, the Netherlands, 13 November 2006.
  - Taylor, M., *Kaluza-Klein holography*, Imperial College, London, UK, 17 March 2006.
  - Taylor, M., *Holographic anatomy of fuzzballs*, University of Crete, Greece, 28 September 2006.
  - Taylor, M., *Black holes in string theory*, University of Crete, Greece, 5 October

- 2006.
- van der Schaar, J.P., *Radiation deformed closed inflation*, Spinoza Institute, Utrecht, the Netherlands, 10 November 2006.
  - van der Schaar, J.P., *Cosmology as a testing ground for string theory*, Astronomical Institute ‘Anton Pannekoek’, Universiteit van Amsterdam, the Netherlands, 1 December 2006.
  - Verlinde, E.P., *The topological string partition function and BPS counting*, Harvard University, Harvard, USA, 31 January 2006.
  - Verlinde, E.P., *M-theory, topological strings and the counting of BPS states*, Banff Physics Center, Alberta, Canada, 8 February 2006.
  - Verlinde, E.P., *Topological strings and the black hole Farey tail*, International Workshop on Black Holes, Black Rings and Topological Strings, Arnold Sommerfeld Center for Theoretical Physics, Munich, Germany, 31 March-4 April 2006; 3 March 2006.
  - Verlinde, E.P., *M-theory, topological strings and the black hole Farey tail*, Eurostrings 2006. Conference, Cambridge, UK, 4 April 2006.
  - Verlinde, E.P., *A Farey tail for attractor black holes*, Strings 2006. Conference, Beijing, China, 24 June 2006.
  - Verlinde, E.P., *Emergent space-time and induced gravity*, Mitchel-Texas Conference on Time-Dependence and the Cosmological Singularity in String and M-Theory, Cambridge, UK, 25 August 2006.
  - Verlinde, E.P., *Emergent space-time and induced gravity*, Conference on Strings Versus Cosmology, Madrid, Spain, 17 November 2006.

### Vrije Universiteit Amsterdam

- Badalian, A.M., Simonov, Yu.A. and Bakker, B.L.G., *Masses and decay constants of  $B_q$  mesons in QCD string approach*, ICHEP06, Moscow, Russia, 26 July-2 August 2006.
- Bakker, B.L.G., Boomsma, J.K. and Ji, C.R., *Singularities in the light-front Yukawa model*, International Few-Body Conference, Santos, Brazil, 23 August 2006.
- Bakker, B.L.G. and Boomsma, J.K., *The Box diagram in Yukawa theory*, Light-Cone 2006, Minneapolis, USA, 18 May 2006.
- Bakker, B.L.G., *Light-front dynamics: opportunities and challenges*, University of Bratislava, Slovakia, 1 February 2006.
- Bakker, B.L.G., *The Box diagram in Yukawa theory*, TNT Seminar, NC State University, Raleigh, USA, 23 May 2006.
- Boer, D., *QCD spin physics - a theoretical overview*, Workshop & Symposium on ‘RHIC Physics in the Context of the Standard Model’, Brookhaven National Laboratory, USA, 18-23 June 2006, 23 June 2006.
- Boer, D., *Gluon saturation effects on single spin asymmetries*, International workshop on ‘RHIC Spin Physics’, RIKEN, Japan, 29-30 September 2006, 30 September 2006.
- Boer, D., *Gluon saturation effects on single spin asymmetries*, 17th International Spin Physics Symposium ‘SPIN2006’, Kyoto, Japan, 2-7 October 2006, 6 October 2006.
- Mulders, P.J., *Universality of single spin asymmetries in hard processes*, DIS2006,



Tsukuba, Japan, 22 April 2006.

- Mulders, P.J., *Single spin asymmetries in  $p\bar{p}$  scattering*, Workshop on Observables in  $p\bar{p}$  Interactions and their Relevance to QCD, Trento, Italy, 2-6 July 2006, 4 July 2006.
- Mulders, P.J., *The Nobel prize in Physics 2006*, Colloquium Vrije Universiteit, Amsterdam, the Netherlands, 4 October 2006.
- Mulders, P.J., *Time reversal odd phenomena in Quantum Chromodynamics*, Universiteit Oldenburg, Germany, 9 November 2006.
- Mulders, P.J., *General remarks on Angular Momentum*, INFN, Trieste, Italy, 23 November 2006.
- Mulders, P.J., *Theoretical and experimental challenges of semi-inclusive deep inelastic scattering*, Workshop on Inclusive and Semi-Inclusive Spin Physics with High Luminosity and Large Acceptance at 11 GeV, 13-14 December 2006, Jefferson Lab, USA, 14 December 2006.

### University of Groningen

- Bergshoeff, E., *Supergravity and branes*, Granada, Spain, March 2006, lecture course.
- Bergshoeff, E., *Supergravity and branes*, Valencia, Spain, March 2006, lecture course.
- Bergshoeff, E., *Seven-branes revisited*, Istanbul, Turkey, April 2006.
- Bergshoeff, E., *The challenges of string theory*, Oldenburg, Germany, May 2006.
- Bergshoeff, E., *IIB seven-branes revisited*, XXIX Spanish Relativity Meeting E.R.E. 2006, Mallorca, Spain, September 2006.
- Bergshoeff, E., *The symmetries of M-theory*, XV International Workshop on Geometry and Physics, Puerto de la Cruz, Tenerife, Spain, September 2006.
- Bergshoeff, E., *Seven-branes in IIB supergravity*, Workshop M-Theory in the City, London, England, November 2006.
- Bergshoeff, E., *TBA*, Topical Conference on Elementary Particle Physics and Cosmology, Coral Gables and Key Biscayne, USA, December 2006.
- Kerstan, S., *Supersymmetry in 10D*, Leuven (KUL), Belgium, 26 April 2006. (talk).
- Kerstan, S., *On supersymmetry in 10 dimensions*, Annecy (LAPTH), France, 22 June 2006.
- Pallante, E., *QCD on a BlueGene*, BlueGene User Meeting, Rekencentrum, Groningen University, the Netherlands, 8 March 2006.
- Pallante, E., *Quenched penguins*, International Symposium on Lattice Field Theory, Tucson, Arizona, USA, July 2006.
- Pallante, E., First Meeting of FLAVIANet (EU Network on Flavour Physics): Summary talk as chairperson of the WG on ‘Analytic Approaches to Non-Perturbative QCD’, Barcelona, Spain, 2-4 November 2006.

### Leiden University

- Achúcarro, A., *Non-topological string networks*, Madrid IFT Workshop on Non-perturbative Dynamics in the Early Universe, Universidad Autonoma de Madrid, Spain, 13-15 September 2006.
- Achúcarro, A., *Advanced cosmology*, International Summer School, Nijmegen, the

Netherlands, 29 August-8 September 2006.

- Bruckmann, F., *Instantons and monopoles on and off the Lattice*, ‘Fruhjahrstagung DPG’, (Spring Meeting of the German Physical Society), Dortmund, Germany, 28 March 2006.
- Jeannerot, R., *Inflation, strings, CMB anisotropies and leptogenesis*, 41st Rencontres de Moriond: Workshop on Cosmology: Contents and Structures of the Universe, La Thuile, Italy, 18-25 March 2006.
- Mukherjee, A., *Hadron optics: patterns in DVCS*, Workshop on Light-Cone QCD and Non-Perturbative Hadron Physics, Minneapolis, USA, 15-19 May 2006.
- Mukherjee, A., *Hadron optics: patterns in DVCS*, Second Workshop on the QCD Structure of the Nucleon, Rome, Italy, 12-16 June 2006.
- van Baal, P., *A review of instanton quarks and confinement*, Quark Confinement and the Hadron Spectrum 7, Ponta Delgada, Azores, Portugal, 2 September 2006.

### **Radboud University Nijmegen**

- Beenakker, W.J.P., *SUSY-QCD corrections for the LHC*, Tata Institute of Fundamental Research (TIFR), Mumbai, India, 20 October 2006.
- Rijken, T.A., *Recent soft-core baryon-baryon interactions*, Workshop SNP-2006, Zhang-jia-jie, China, September 2006.
- Rijken, T.A., *Recent soft-core baryon-baryon interactions*, Int. Conf. on Hypernuclear and Strange Particle Physics, HYP2006, Mainz, Germany, October 2006.
- Schellekens, A.N., *Beyond the standard model*, DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, 23 January-3 February 2006, lecture series.
- Schellekens, A.N., *Sightseeing in the landscape*, Workshop ‘Beyond the Standard Model’, Bad Honnef, Germany, 13 March 2006.
- Schellekens, A.N., *Sightseeing in the landscape*, École Polytechnique, Paris, France, 26 April 2006.
- Schellekens, A.N., *Sightseeing in the landscape*, National Seminar Theoretical High Energy Physics, Amsterdam, the Netherlands, 19 May 2006.
- Schellekens, A.N., *Sightseeing in the landscape*, Workshop on String Vacua and the Landscape, Trieste, Italy, 31 May 2006.
- Schellekens, A.N., *Sightseeing in the landscape*, Strings 2006, Shanghai Workshop, Shanghai, China, 14 June 2006.
- Schellekens, A.N., *RCFT orientifolds and standard model realizations*, String Phenomenology 2006, Santa Barbara, USA, 29 August 2006.
- Schellekens, A.N., *Sightseeing in the landscape*, Chalmers University, Göteborg, Sweden, 3 October 2006.
- Schellekens, A.N., *Sightseeing in the landscape*, Max Planck Institute for Gravitational Physics, Golm, Germany, 26 October 2006.
- Schellekens, A.N., *Beyond the standard model*, NIKHEF, Amsterdam, the Netherlands, 16 November 2006, lecture series.
- Schellekens, A.N., *Sightseeing in the landscape*, London Triangle Seminar, London, UK, 13 December 2006.

### Utrecht University

- Alday, F., *Green-Schwarz strings in TsT transformed backgrounds*, Humbolt University, Berlin, Germany, 10 February 2006.
- Alday, F., *Green-Schwarz strings in TsT transformed backgrounds*, AEI, Golm, Germany, 11 February 2006.
- Alday, F., *What is the dual of a dipole?*, Institute for Theoretical Physics, Utrecht, the Netherlands, 24 February 2006.
- Alday, F., *Towards a string bit formulation of  $N=4$  super Yang-Mills*, Santiago de Compostela, Spain, 10 March 2006.
- Ambjørn, J., *The relation between Lorentzian and Euclidean 2d quantum gravity*, Jagellonian University, Krakow, Poland, 6 January 2006.
- Ambjørn, J., *The emergence of  $AdS(2)$  from quantum fluctuations*, 11th Marcel Grossmann Meeting on Recent Developments in Theoretical and Experimental General Relativity, Gravitation, and Relativistic Field Theories, Berlin, Germany, 23-29 July 2006.
- Ambjørn, J., *The emergence of non-commutative space-time*, Jagellonian University, Krakow, Poland, 6 September 2006.
- Ambjørn, J., *ZZ-branes in 2d Euclidean and Lorentzian 2d quantum gravity*, Yerevan University, Yerevan, Armenia, 6 October 2006.
- Ambjørn, J., *4d quantum gravity: computer simulations*, Berlin, Zeuthen, Germany, 6 November 2006.
- Arutyunov, G., *Uniform light-cone gauge for strings on  $AdS_5 \times S^5$ : solving  $su(1|1)$  sector*, Niels Bohr Institute, Copenhagen, Denmark, 10 January 2006.
- Arutyunov, G., *Solving strings on  $AdS_5 \times S^5$  in truncated sectors*, Triangle seminar, King's College, London, UK, 25 January 2006.
- Arutyunov, G., *Uniform light-cone gauge for strings on  $AdS_5 \times S^5$ : solving  $su(1|1)$  sector*, Institute for Theoretical Physics, Utrecht, the Netherlands, 20 February 2006.
- Arutyunov, G., *The classical inverse scattering method*, Institute for Theoretical Physics, Utrecht, the Netherlands, 8, 15, 22 February and 8 March 2006.
- Arutyunov, G., *The S-matrix for strings on  $AdS_5 \times S^5$* , Conference 'Strings and QCD', DESY, Hamburg, Germany, 17-20 May 2006.
- Arutyunov, G., *On  $AdS_5 \times S^5$  string S-matrix*, Niels Bohr Summer Institute 'Frontiers in Theoretical Particle Physics', 3 July-18 August 2006, Copenhagen, Denmark, 6 July 2006.
- Arutyunov, G., *On  $AdS_5 \times S^5$  string S-matrix*, conference 'Integrability in Gauge and String Theory', 24-28 July 2006, Max-Planck-Institute for Gravitational Physics, Albert-Einstein-Institute, Potsdam, Germany, 28 July 2006.
- Arutyunov, G., *Off-shell symmetry algebra of  $AdS_5 \times S^5$  superstring*, The School of Mathematics, Trinity College, Dublin, Ireland, 27 November 2006.
- Arutyunov, G., *Pohlmeyer v.s. Zakharov: Bäcklund and monodromy charges*, The School of Mathematics, Trinity College, Dublin, Ireland, 29 November 2006.
- de Wit, B., *Black hole entropy*, DRSTP Postgraduate Course Theoretical High Energy Physics, Driebergen, the Netherlands, evening lecture, 25 January 2006.
- de Wit, B., *Black hole partition functions and duality*, Institute for Theoretical Physics, Utrecht, the Netherlands, 27 January 2006.

- de Wit, B., *BPS black holes: partition functions, duality and higher-order derivative interactions*, Workshop on Black Holes, Black Rings and Topological Strings Sommerfeld Center for Theoretical Physics, München, Germany, 1 April 2006.
- de Wit, B., *Microscopic and macroscopic BPS black holes*, Simons Workshop, Stony Brook, USA, 9 August 2006.
- de Wit, B., *Entropy of BPS black holes*, ENS Summer Institute, Paris, France, 24 August 2006.
- de Wit, B., *New results in  $N=2$  supergravity*, Ahrenshoop, Berlin, Germany, 30 August 2006.
- de Wit, B., *Much ado about  $N=2$* , Thirty years of Supergravity, Paris, France, 17 October 2006.
- Eden, B., *Integrability and transcendentalities*, Institute for Theoretical Physics, Utrecht, the Netherlands, 30 October 2006.
- Eden, B., *Integrability, transcendentalities and crossing*, ENS Paris, France, 7 November 2006.
- Eden, B., *Integrability, transcendentalities and crossing*, Institute for Theoretical Physics, Utrecht, the Netherlands, 15 December 2006.
- Engquist, J., *4D singleton composites in a gauged WZW model*, Niels Bohr Institute, University of Copenhagen, Denmark, 6 June 2006.
- Engquist, J., *4D singleton composites in a gauged WZW model*, Institute of Fundamental Physics, Chalmers University of Technology, Sweden, 13 June 2006.
- Henson, J., *Comparing causality principles*, Institute for the History and Foundations of Science, Utrecht University, the Netherlands, 30 March 2006.
- Krishnaswami, G., *Mathematical structures and approximations for large- $N$  multi-matrix loop equations*, Abdus Salam ICTP, Trieste, Italy, 13 June 2006.
- Krishnaswami, G., *Classical abelian gauge theory inspired by ideal  $2 + 1$  hydrodynamics*, Feza Gursev Institute, Istanbul, Turkey, 25 July 2006.
- Krishnaswami, G., *Loop equations of large- $N$  multi-matrix models*, Feza Gursev Institute, Istanbul, Turkey, 1 August 2006.
- Krishnaswami, G., *Scale invariant 4d  $O(N)$  scalar field model in the large- $N$  limit*, Feza Gursev Institute, Istanbul, Turkey, 3 August 2006.
- Laenen, E., *Particles in the sky and underground*, Icelandic Physical Society, Reykjavik, Iceland, 6 January 2006.
- Laenen, E., *Resummation and high energy scattering*, IMSc, Chennai, India, 21 February 2006.
- Laenen, E., *Theory of heavy flavor production*, Ringberg Castle Workshop, Germany, 3 October 2006.
- Laenen, E., *Resummation in QCD?*, Ringberg Castle Workshop, Germany, 4 October 2006.
- Laenen, E., *QCD resummation and hadron colliders*, University of Austin, Texas, USA, 30 October 2006.
- Laenen, E., *QCD resummation and hadron colliders*, University of Rochester, New York, USA, 7 November 2006.
- Loll, R., *Taking a close look at (quantum) spacetime*, Department of Physics and Astronomy, Utrecht University, the Netherlands, 24 February 2006.
- Loll, R., *Triangulations & causal quantum gravity*, Workshop ‘The World a Jigsaw

- Tesselations in the Sciences', Lorentz Center, Leiden, the Netherlands, 8 March 2006.
- Loll, R., *Recent developments in causal dynamical triangulations*, ENRAGE Network Conference-cum-Workshop, International Centre for Mathematical Sciences, Edinburgh, UK, 4 April 2006.
- Loll, R., *Taking a close look at (quantum) spacetime*, Ehrenfest Colloquium, Leiden University, the Netherlands, 3 May 2006.
- Loll, R., *Quantum gravity, or the art of building spacetime*, XXIX Spanish Relativity Meeting, Palma de Mallorca, Spain, 5 September 2006.
- Loll, R., *The quantum structure of spacetime*, Zuse Symposium, Berlin, Germany, 6 November 2006.
- Machado, P., *Can one hear the shape of a fractal spacetime?*, 44th International School of Subnuclear Physics, 29 August-7 September 2006, Ettore Majorana Centre, Erice, Italy.
- Peeters, K., *String methods for strongly coupled particle physics*, Institute for Theoretical Physics, Utrecht, the Netherlands, 11 October 2006.
- Peeters, K., *Finite-temperature QCD from string theory: a status report*, National Seminar HEP, NIKHEF Amsterdam, the Netherlands, 13 October 2006.
- Peeters, K., *Loop quantum gravity: inside out*, Rencontres Theoriciennes, Paris, France, 26 October 2006.
- Peeters, K., *Screening lengths in a quark-gluon plasma from string theory*, Saclay, Paris, France, 27 October 2006.
- Prokopec, T., *A solution to the cosmological constant problem?*, Institute for Theoretical Physics, Utrecht, the Netherlands, 13 April 2006.
- Prokopec, T., *Foundations of stochastic inflation*, 'Nongaussianity from Inflation', CTC Informal Workshop, 19-22 April 2006, Centre for Mathematical Sciences, University of Cambridge, UK, 21 April 2006.
- Prokopec, T., *A new dark matter candidate*, Heidelberg University, Germany, 6 July 2006.
- Prokopec, T., *Nonsymmetric metric field as dark matter*, IRGAC 2006. Barcelona, 2nd International Conference on Quantum Theories and Renormalization Group in Gravity and Cosmology, 11-15 July 2006, Barcelona, Spain, 13 July 2006.
- Prokopec, T., *Nonsymmetric metric field as dark matter*, Workshop on 'Modern Cosmology, Inflation, CMB and LSS', 30 July-6 August 2006, Benasque, Spain, 3 August 2006.
- Prokopec, T., *Stochastic theory of inflation*, Workshop 'On Perturbative Dynamics in the Early Universe', Madrid, Spain, 13 September 2006.
- Prokopec, T., *The future of (theoretical) cosmology*, DRSTP-Young Symposium: The Future of Theoretical Physics in the Netherlands, 26-27 October 2006, Driebergen, the Netherlands, 26 October 2006.
- Prokopec, T., *Nobel Colloquium 2006*, with John Heise, Utrecht University, the Netherlands, 8 December 2006.
- Rigopoulos, G., *Evolution of non-linearities in multi-field inflation*, Workshop on non-Gaussianity from Inflation, DAMTP, Cambridge, UK, 20 April 2006.
- Rigopoulos, G., *Non-linear evolution of inhomogeneities during multi-field inflation*, 22nd IAP Colloquium: Inflation +25. The first 25 Years of Inflationary

- Cosmology, Institut d' Astrophysique de Paris, France, 29 June 2006.
- Rigopoulos, G., *Non-linear evolution of inhomogeneities during multi-field inflation*, NEB XII, The biannual meeting of the Hellenic Society for Gravitation, 29 June-2 July 2006, Nafplio, Greece, 2 July 2006.
  - Rigopoulos, G., *Non-linear evolution of inhomogeneities during multi-field inflation*, Workshop on non-Gaussianity in Cosmology, International Centre for Theoretical Physics, 24-28 July 2006, Trieste, Italy, 25 July 2006.
  - Rigopoulos, G., *Non-Gaussianity and its evolution in multi-field inflation*, Mini-conference on Cosmological Perturbations, Galileo Galilei Institute for Theoretical Physics, Florence, Italy, 24 October 2006.
  - Rigopoulos, G., *Non-Gaussianity as a new observable for inflation*, High Energy and Particle Physics Group, University of Crete, Greece, 27 October 2006.
  - Rigopoulos, G., *Non-Gaussianity as a new observable for inflation*, McGill University, Montreal, Canada, 5 December 2006.
  - Rigopoulos, G., *The evolution of non-linear perturbations in inflation*, Fermilab, Batavia, IL, USA, 7 December 2006.
  - Rigopoulos, G., *Non-Gaussianity in multi-field inflation*, Perimeter Institute, Canada, 12 December 2006.
  - Robles Llana, D., *String corrections to  $N=2$  effective actions*, RTN Young Researchers Presentation, RTN Midterm Meeting, Naples, Italy, 12 October 2006.
  - Sahlmann, H., *Exploring the diffeomorphism invariant Hilbert space*, 11th Marcel Grossmann meeting, Berlin, Germany, 25 July 2006.
  - Sahlmann, H., *Diffeomorphism invariant scalar fields*, Penn State University, State College, PA, USA, 1 December 2006.
  - Sahlmann, H., *Diffeomorphism invariant scalar fields*, Max Planck Institute for Gravitational Physics, Potsdam, Germany, 19 December 2006.
  - Saueressig, F., *Renormalization group improved cosmologies*, XVIII Workshop 'Beyond the Standard Model', 13-16 March 2006, Bad Honnef, Germany, 14 March 2006.
  - Saueressig, F., *Tensors, hypers and string loop corrected hypermultiplet moduli spaces*, Institute for Theoretical Physics, Utrecht, the Netherlands, 27 April 2006.
  - Saueressig, F., *Tensors, hypers and string loop corrected hypermultiplet moduli spaces*, Queen Mary College, London, UK, 4 May 2006.
  - Saueressig, F., *Tensors, hypers and string loop corrected hypermultiplet moduli spaces*, University of Liverpool, Liverpool, UK, 2 May 2006.
  - Saueressig, F., *Superconformal gravity*, Summer school 'Strings and Branes - the Present Paradigm in Gauge Theory and Cosmology', 22 May - 3 June 2006, Cargese, France, 26 May 2006.
  - Saueressig, F., *Introduction to quantum Einstein gravity*, NIKHEF, Amsterdam, the Netherlands, 12 June 2006.
  - Saueressig, F., *Renormalization group improved cosmologies*, ITP, Utrecht University, the Netherlands, 27 June 2006.
  - Saueressig, F., *Asymptotically safe quantum gravity and fractal space-times*, 'Quantum Gravity in the Americas III', 24-26 August 2006, Penn State University, USA, 24 August 2006.
  - Saueressig, F., *String loop corrected hypermultiplet moduli spaces*, RTN Network

- Conference (Forces Universe), 9-13 October 2006, Naples, Italy, 11 October 2006.
- 't Hooft, G., *Controversies in physics at the Planck scale*, Wroclaw University of Technology, Institute of Physics, Poland, III LEPMI Symposium on Quantum Information and Engineering, 27 January 2006.
  - 't Hooft, G., *Dynamics of the black hole horizon*, Wroclaw University of Technology, Institute of Physics, Wroclaw, Poland, 30 January 2006.
  - 't Hooft, G., *Complex transformations and the cosmological constant problem*, CERCA: Confronting Gravity Workshop, 16-21 March, St. Thomas, USVI, USA, 20 March 2006.
  - 't Hooft, G., *Complex transformations and the cosmological constant problem*, National Center for Physics, 12th Regional Conference on Mathematical Physics, Islamabad, Pakistan, 28 March 2006.
  - 't Hooft, G., *Prospects and problems in contemporary physics*, CERN Council Strategy Group Workshop, Zeuthen, Berlin, Germany, 2 May 2006.
  - 't Hooft, G., *Determinism in quantum mechanics*, Lorentz Institute, 'Beyond the Quantum', Leiden, the Netherlands, 30 May 2006.
  - 't Hooft, G., *Should we improve quantum mechanics?*, Symposium N.G. van Kampen 85, 'Past, Present and Future', Utrecht, the Netherlands, 29 June 2006.
  - 't Hooft, G., *About quantum mechanics*, International School of Subnuclear Physics on The Logic of Nature, Erice, Sicilia, Italy, 6 September 2006.
  - 't Hooft, G., *A mathematical theory for deterministic quantum mechanics*, Third International Workshop Dice 2006, 11-15 September, Castello di Piombino, Tuscany, Italy, 14 September 2006.
  - 't Hooft, G., *Deterministic quantum mechanics*, University of Pisa, Italy, 15 September 2006.
  - 't Hooft, G., *Black holes in particle physics*, Technische Universität, Institut für Kern- und Teilchenphysik, Dresden, Germany, 10 October 2006.
  - 't Hooft, G., *The origin of quantum mechanics*, Nijmegen, the Netherlands, 13 October 2006.
  - 't Hooft, G., *The string in an excited baryon*, Workshop 'Origin of Mass and Strong Coupling Gauge Theories (SCGT 06)', 21-24 November 2006, Nagoya University, Japan, 21 November 2006.
  - 't Hooft, G., *Conclusion talk*, workshop 'Origin of Mass and Strong Coupling Gauge Theories (SCGT 06)', 21-24 November 2006, Nagoya University, Japan, 24 November 2006.
  - 't Hooft, G., *Models for confinement*, International Symposium pnLambda50, The Jubilee of Sakata Model, 25-26 November 2006, Nagoya University, Japan, 25 November 2006.
  - 't Hooft, G., *Complex transformations and the cosmological constant problem*, Tokyo University, Japan, 27 November 2006.
  - 't Hooft, G., *Complex transformations and the cosmological constant problem*, Nagoya University, Japan, 4 December 2006.
  - 't Hooft, G., *Black holes and elementary particles*, Nagoya University, Japan, 5 December 2006.
  - 't Hooft, G., *Determinism in quantum mechanics*, Nagoya University, Japan, 7 December 2006.

- 't Hooft, G., *Renormalization and gauge invariance*, Yukawa-Tomonaga Centennial Symposium 'Progress in Modern Physics', 11-13 December 2006, Kyoto, Japan, 11 December 2006.
- Vandoren, S., *Quaternionic manifolds from special Kähler geometry*, Phys-Math Seminar, Utrecht, the Netherlands, 3 February 2006.
- Vandoren, S., *Quantum corrections to hypermultiplet moduli spaces*, Weizmann Institute, Rehovot, Israel, 6 February 2006.
- Vandoren, S., *Nonperturbative effects in supergravity and string theory*, XVIII Workshop 'Beyond the Standard Model', 13-16 March 2006, Bad Honnef, Germany, 16 March 2006.
- Vandoren, S., *De Sitter vacua from string theories*, 'Cosmology, Strings, and Black Holes', 18-21 April 2006, Copenhagen, Denmark, 19 April 2006.
- Vandoren, S., *Non-extremal D-instantons and the AdS/CFT correspondence*, Hebrew University, Jerusalem, Israel, 30 May 2006.
- Vandoren, S., *Hypermultiplet moduli spaces and topological strings*, ICTP Trieste, Italy, 6 June 2006.
- Vandoren, S., *Quaternionic-Kähler geometry and instantons*, Oxford, UK, 12 June 2006.
- Vandoren, S., *Instantons and black hole solutions in supergravity*, Freiburg University, Germany, 29 June 2006.
- Vandoren, S., *Aspects of hypermultiplet moduli spaces*, Simons Workshop in Stony Brook, New York, USA, 18 August 2006.
- Vandoren, S., *Ultracold superstrings*, Cosmolab Meeting, Leiden, the Netherlands, 7 September 2006.
- Vandoren, S., *Exact results in non-perturbative four-dimensional superstrings*, European RTN meeting, Napoli, Italy, 13 October 2006.
- Vandoren, S., *Summing instanton corrections to four-dimensional superstrings*, Amsterdam (UvA), the Netherlands, 7 November 2006.
- Vandoren, S., *Some exact results in four-dimensional non-perturbative string theory*, Institute for Theoretical Physics, Utrecht, the Netherlands, 11 December 2006.
- Westra, W., *Emergence of AdS<sub>2</sub> from quantum fluctuations*, 11th Marcel Grossmann Meeting, Berlin, Germany, 25 July 2006.

## 6.2 Theme 2: Statistical physics, condensed-matter theory and quantum optics

### Universiteit van Amsterdam

- Aquino, G., *Kovacs effect in a fragile glass model*, Les Houches Meeting 2006, Statistical Physics of Glasses, Spin Glasses, Information Processing and Combinatorial Optimization, Les Houches, France, 20-24 February 2006; 21 February 2006.
- Bouttier, J., *Planar maps and embedded trees*, Mark Kac Seminar, Utrecht University, the Netherlands, 2 June 2006.
- Bouttier, J., *From matrix models to map-tree bijections*, Int. Conference 'Journées MAS de la SMAI', Lille, France, 6 September 2006.



- Calabrese, P., *Time-dependence of correlation functions following a quantum quench*, ITF, Universiteit van Amsterdam, the Netherlands, 8 March 2006.
- Calabrese, P., *Time-dependence of correlation functions following a quantum quench*, University of Florence, Italy, 22 March 2006.
- Calabrese, P., *Entanglement entropy and quantum field theory*, ITP, Utrecht University, the Netherlands, 21 April 2006.
- Calabrese, P., *Entanglement entropy and quantum field theory*, STATPHYS Conference, Nancy, France, 17-19 May 2006; 17 May 2006.
- Calabrese, P., *Correlation functions in 1D Bose gases*, INSTANS Summer School, Villa Olmo, Como, Italy, 12-16 June 2006; 2 June 2006.
- Calabrese, P., *Entanglement entropy and quantum field theory*, University of Naples, Italy, 10 October 2006.
- Calabrese, P., *Aging in critical systems*, ITF, University of Amsterdam, the Netherlands, 24 October 2006.
- Calabrese, P., *Correlation functions in 1D Bose gases*, STATPHYS Meeting, Trieste, Italy, 14-15 December 2006; 14 December 2006.
- Caux, J.S., *Dynamical density correlations in the 1D Bose gas*, Seminar WZI, Universiteit van Amsterdam, the Netherlands, 10 May 2006.
- Caux, J.S., *Dynamical density correlations in the 1D Bose gas*, ENS, Lyon, France, 23 May 2006.
- Caux, J.S., *Computing the dynamics of spin chains*, Como University, Italy, 15 June 2006.
- Caux, J.S., *Computing the dynamics of quantum spin chains and 1D Bose gases*, ENS, Lyon, France, 13 September 2006.
- Caux, J.S., *Computing the dynamics of quantum spin chains and 1D Bose gases*, ENS, Paris, France, 15 November 2006.
- Caux, J.S., *Calculating the dynamics of quantum spin chains and 1D Bose gases using integrability*, ITF, Utrecht University, the Netherlands, 8 December 2006.
- Caux, J.S., *The dynamics of quantum spin chains and 1D Bose gases*, University of Montreal, Montreal, Canada, 17 December 2006.
- Nienhuis, B., *The tricritical transition of the 2D  $O(n)$  model*, National Seminar Statistical Physics, Delft, the Netherlands, 27 January 2006.
- Nienhuis, B., *Tricritical transition of the  $O(n)$  model in two dimensions*, Seminaire Physique Statistique, Service de Physique Théorique du CEA, Saclay, France, 6 March 2006.
- Nienhuis, B., *Fractal force chains in static sand piles*, Seminaire de la Federation de Physique Statistique Paris-Sud, France, 9 March 2006.
- Nienhuis, B., *Universal behavior of granular force chains*, Seminaire de Physique Mathématique, Service de Physique Théorique du CEA, Saclay, France, 14 March 2006.
- Nieuwenhuizen, T.M., *The electron as a soliton in classical electrodynamics*, Institut für Theoretische Physik, Humboldt Universität, Berlin, Germany, 10 January 2006.
- Nieuwenhuizen, T.M., *The electron as a soliton in classical electrodynamics*, Seminar ENS, Lyon, France, 16 January 2006.
- Nieuwenhuizen, T.M., *The electron as a soliton in classical electrodynamics*, Lorentz

- Workshop ‘Beyond the Quantum’, Leiden University, the Netherlands, 1 June 2006.
- Nieuwenhuizen, T.M., *What is spin?*, Conference ‘Foundations of Probability and Physics, Växjö, Sweden, 4-9 June 2006; 5 June 2006.
  - Nieuwenhuizen, T.M., *Explanation of the Gibbs paradox within the framework of quantum thermodynamics*, Symposium ‘The Second Law of Thermodynamics’, San Diego, California, USA, 19-20 June 2006; 20 June 2006.
  - Nieuwenhuizen, T.M., *The relativistic theory of gravitation as an alternative to Einstein’s general theory of relativity*, 11th Marcel Grossman Conference, Berlin, Germany, 24-29 July 2006; 27 July 2006.
  - Nieuwenhuizen, T.M., *The relativistic theory of gravitation: an alternative to general relativity?*, Lorentz Workshop COSLAB, 4-8 September 2006, Leiden, the Netherlands; 6 September 2006.
  - Nieuwenhuizen, T.M., *Not-so-general relativity, the cosmological constant and all that*, ITF, Universiteit van Amsterdam, the Netherlands, 27 September 2006.
  - Nieuwenhuizen, T.M., *Quantum thermodynamics view on the Gibbs paradox and work fluctuations*, Institut für Theoretische Physik, Oldenburg, Germany, 26 October 2006.
  - Nieuwenhuizen, T.M., *Einstein versus Maxwell: Is gravitation a curvature of space, a field in flat space, or both?*, Meudon, France, L’ Observatoire de Paris, France, 11 December 2006.
  - Nieuwenhuizen, T.M., *Einstein versus Maxwell: Is gravitation a curvature of space, a field in flat space, or both?*, Seminaire Service de Physique Théorique, Saclay, France, 18 December 2006.
  - Pruisken, A.M.M., *The vartheta angle, electron-electron interactions, and super universality of the quantum Hall effect*, Institute of Mathematical Sciences (IMSc), Chennai, India, 2 August 2006.
  - Pruisken, A.M.M., *The vartheta angle, electron-electron interactions, and super universality of the quantum Hall effect*, Workshop on Quantum Criticality, Lorentz Center, Leiden, the Netherlands, 7-19 August 2006; 9 August 2006.
  - Pruisken, A.M.M., *Exact Haldane mapping for all  $S$  and super universality of quantum spin liquids and quantum Hall liquids*, Brown University, Providence RI, USA, 19 October 2006.
  - Pruisken, A.M.M., *Exact Haldane mapping for all  $S$  and super universality of quantum spin liquids and quantum Hall liquids*, Weizmann Institute, Rehovot, Israel, 28 December 2006.
  - Schoutens, K., *Quantumcriticaliteit en superfrustratie – een workshop en een idee*, Lorentz Center Leiden, the Netherlands, 23 March 2006.
  - Schoutens, K., *Topological quantum computation with non-abelian quantum Hall states*, ITF, Universiteit van Amsterdam, the Netherlands, 29 March 2006.
  - Schoutens, K., *Wavefunctions for topological quantum registers*, KITP Santa Barbara Program on Topological Phases and Quantum Computation, KITP Santa Barbara, USA, 26 April 2006.
  - Schoutens, K., *Wavefunctions for topological quantum registers*, INSTANS Summer Conference Como, Italy, 12-16 June, 2006; 12 April 2006.
  - Schoutens, K., *Wavefunctions for topological quantum registers*, Conference on Strongly Correlated Systems in Low Dimension, Monte Verita, Ascona, Switzer-

land, 2-8 July 2006; 2 July 2006.

### Vrije Universiteit Amsterdam

- Green, K., Krauskopf, B. and Lenstra, D., *Mode structure of a vertical-cavity surface-emitting laser subject to optical feedback*, IEEE/LEOS 2006, poster.
- MacKintosh, F.C., *Cytoskeletal networks: elasticity, dynamics, and active gels*, Technion, Haifa, Israël, 20 March 2006.
- MacKintosh, F.C., *Cytoskeletal networks: elasticity, dynamics, and active gels*, University of Pennsylvania, USA, 4 April 2006.
- MacKintosh, F.C., *Cytoskeletal networks: polymer physics meets cell biology*, Condensed Matter and Materials Physics (CMMP06), Exeter, UK, 20 April 2006.
- MacKintosh, F.C., *Active and passive cytoskeletal networks: prestress, active stiffening, and non-equilibrium dynamics*, Workshop on Driven States in Soft and Biological Matter, Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy, 26 April 2006.
- MacKintosh, F.C., *Viscoelasticity of cytoskeletal biopolymer solutions and networks: polymer physics and the cell*, 3rd Annual European Rheology Meeting (AERC-2006), Hersonisos, Crete, Greece, 28 April 2006.
- MacKintosh, F.C., *Cytoskeletal networks: polymer physics and the cell*, TU Delft, the Netherlands, 1 May 2006.
- MacKintosh, F.C., *Cytoskeletal networks: elasticity, dynamics, and active gels*, Gordon Research Conference on Theoretical Biology and Biomathematics, 5 June 2006.
- MacKintosh, F.C., *Cytoskeletal networks and solutions: polymer physics and cell mechanics*, 80th ACS Colloid and Surface Science Symposium, Boulder, Colorado, 20 June 2006.
- MacKintosh, F.C., *Active cytoskeletal networks*, Workshop on New Physical Approaches to Molecular and Cellular Machines, Kavli Institute for Theoretical Physics, UCSB, Santa Barbara, USA, 22 June 2006.
- MacKintosh, F.C., *Cytoskeletal networks: elasticity, dynamics, and active gels*, International Workshop on Mesoscale and Multiscale Description of Complex Fluids, Prato, Italy, 6 July 2006.
- MacKintosh, F.C., *Models of cytoskeletal biopolymer networks: modes of deformation and force transmission*, Munich, Germany, 31 July 2006.
- MacKintosh, F.C., *Elastic and dynamic properties of cytoskeletal biopolymer networks: probing microstructure and mechanical response*, Munich, Germany, 3 August 2006.
- MacKintosh, F.C., *Active gels*, Aspen, Colorado, USA, August 2006.
- MacKintosh, F.C., *Active cytoskeletal networks*, DPG Physics Workshop, Active Biomimetic Materials, Bad Honnef, Germany, 24-29 September 2006.
- MacKintosh, F.C., *Active gels: cytoskeletal networks with contractile forces*, Dynamics of Complex Fluids Conference, Isaac Newton Institute for Mathematical Sciences, Cambridge, UK, 2-5 October 2006.
- MacKintosh, F.C., *Future of soft matter and biological physics*, DRSTP-Young Symposium on the Future of Theoretical Physics in the Netherlands, Driebergen, 27 October 2006.

- MacKintosh, F.C., *Viscoelasticity of cytoskeletal biopolymer solutions and networks: polymer physics and the cell*, Annual Polymer Day, DTU Denmark, 2 November 2006.
- MacKintosh, F.C., *Non-linear elasticity and contractile fluctuations in active biopolymer gels*, Amsterdam - New Amsterdam Workshop on Soft Condensed Matter Physics, NYU, New York, USA, 10 November 2006.
- MacKintosh, F.C., *Active and passive cytoskeletal networks: prestress, active stiffening, and non-equilibrium dynamics*, ESF Workshop on Physics of the Cell: From Single Molecules to Collective Behavior, Barcelona, Spain, 30 November 2006.

### University of Groningen

- van Enter, A.C.D., *First-order transitions in the presence of continuous symmetries*, Leuven, Belgium, February 2006.
- van Enter, A.C.D., *First-order transitions in the presence of continuous symmetries*, Florence, Italy, May 2006.
- van Enter, A.C.D., *First-order transitions in two- and higher-dimensional  $n$ -vector models*, Melbourne, Australia, 20 July 2006.
- van Enter, A.C.D., *First-order transitions in the presence of continuous symmetries*, Conference ‘Topics in Mathematical Physics’, Sao Paulo, Brasil, 1-4 August 2006.

### Leiden University

- Beenakker, C.W.J., *Mesoscopic physics in graphene*, Program on ‘Topological Phases and Quantum Computation’, Santa Barbara, USA, 15 March 2006.
- Beenakker, C.W.J., *Quantum computation*, Marie Curie Advanced Study Institute on ‘Quantum Optics and Quantum Computation’, Riomaggiore, Italy, 2-7 April 2006.
- Beenakker, C.W.J., *Mesoscopic superconductivity in graphene*, International Workshop on ‘Dynamics of Relaxation in Complex Quantum and Classical Systems and Nanostructures’, Dresden, Germany, 7-11 August 2006.
- Beenakker, C.W.J., *Relativity meets superconductivity in carbon monolayers*, International School on ‘Fundamentals of Nanoelectronics’, Keszthely, Lake Balaton, Hungary, 27 August-1 September 2006.
- Beenakker, C.W.J., *Quantum technology*, Symposium on ‘The Best of NanoScience’, Delft, 20 October 2006.
- Betouras, J., *Charge degrees of freedom on frustrated lattices*, Spinoza Institute, Utrecht, the Netherlands, February 2006.
- Betouras, J., *Charge degrees of freedom on frustrated lattices*, Conference on Quantum Criticality, Lorentz Center, Leiden, the Netherlands, August 2006.
- Filippi, C., *Quantum Monte Carlo methods for electronic structure problems*, Spring School 2006: Computational Methods in Condensed Matter Physics, Forschungszentrum Jülich, Germany, 6-17 March 2006.
- Filippi, C., *Excitations in biomolecules from correlated calculations*, Workshop on Ab Initio Modeling of Biomolecules: Methods and Applications, Lorentz Center, Leiden, the Netherlands, 3-7 July 2006.
- Filippi, C., *Excitations in biomolecules from quantum Monte Carlo*, 11th Nano-

- quanta Workshop on Electronic Excitations, Houffalize, Belgium, 19-22 September 2006.
- Filippi, C., *Quantum Monte Carlo methods in electronic structure theory*, Forward Look Workshop on European Computational Physics, Forschungszentrum Jülich, Germany, 13-14 November 2006.
  - Krüger, F., *Frustrated antiferromagnetism: Deconfined quantum criticality versus fluctuation induced first order*, National Seminar Statistical Physics, Leiden, the Netherlands, March 2006.
  - Krüger, F., *Frustrated antiferromagnetism: Deconfined quantum criticality versus fluctuation induced first order*, 8th International Conference on Materials and Mechanisms of Superconductivity and High-Temperature Superconductors, Dresden, Germany, July 2006, poster.
  - Krüger, F., *Frustrated antiferromagnetism*, Workshop Quantum Criticality, Leiden, the Netherlands, August 2006.
  - Krüger, F., *Killing RPA in electron-doped cuprates*, Conference Stripes 2006, Rome, Italy, December 2006.
  - Mukhin, S.I., *Self-organized electronic extended van Hove singularity as electron-lattice dynamic confinement effect*, International Conference Stripes 2006: Quantum Phenomena in Complex Matter, Rome, Italy, December 2006.
  - Nienhuis, G., *Angular momentum and astigmatism of bichromatic beams*, SPIE meeting Photonics West, San Jose, California, USA, 24 January 2006.
  - Nienhuis, G., *State reduction by measurements with a null result*, Lorentz Workshop Beyond the Quantum, Leiden, the Netherlands, 1 June 2006.
  - Schiessel, H., *The 30 nm fiber: as dense as it gets*, Multiscale Materials Modeling, Freiburg, Germany, September 2006.
  - Schiessel, H., *The 30 nm chromatin fiber: as dense as it gets*, Jülich Soft Matter Days, Bonn, Germany, November 2006.
  - Storm, C., European Solid Mechanics Conference 2006, Budapest, Hungary, 2006.
  - van den Brink, J., *Orbital order and orbital excitations in oxides: recent developments*, École Nouveaux Etats Electroniques de la Matière, Aussois, France, May 2006.
  - van den Brink, K., *Limit to manipulation of qubits due to spontaneous symmetry breaking*, International Conference on Magnetism, Kyoto, Japan, August 2006.
  - van den Brink, J., *Decisive role of orbital fluctuations for two cooperative Jahn-Teller orderings*, International Symposium on the Jahn-Teller Effect, Trieste, Italy, August 2006.
  - van den Brink, J., *A new route towards multiferroics*, Orbital 2006, Berlin, Germany, October 2006.
  - van Saarloos, W., *Subcritical shear-induced instabilities and turbulence of viscoelastic fluids*, Minerva Winter School, Rehovot, Israel, 17 February 2006.
  - van Saarloos, W., *Subcritical shear-induced instabilities and turbulence of viscoelastic fluids*, APS March Meeting, Baltimore, USA, 13-17 March 2006.
  - van Saarloos, W., *Front propagation into unstable states: a general perspective*, AIMS 6th Conference, Poitiers, France, 25-28 June 2006.
  - van Saarloos, W., *Soft hard matter - the response of granular media near jamming*, Amsterdam - New Amsterdam meeting, New York, USA, 10 November 2006.

- van Saarloos, W., *What can nonlinear analysis teach us about the transition to turbulent visco-elastic flows*, International Conference on Differential Equations and Dynamical Systems, Edinburg, Texas, USA, 16-18 December 2006.
- van Saarloos, W., *A different look at front propagation into unstable states*, International Conference on Differential Equations and Dynamical Systems, Edinburg, Texas, USA, 16-18 December 2006.
- Trauzettel, B., *Quantum-limited shot noise in graphene*, 6th Rencontres du Vietnam on ‘Nanophysics: From Fundamentals to Applications’, Hanoi, Vietnam, 6-12 August 2006.
- Trauzettel, B., *Quantum-limited shot noise in graphene*, Journées de la Matière Condensée, Toulouse, France, 28-31 August 2006.
- Zaanen, J., *Observing the orderly limit of superconductivity*, CREST International Workshop ‘Highlights and Perspectives in Strongly Correlated Electronic Systems’, Tokyo, Japan, January 2006.
- Zaanen, J., *Where are the spin superfluids?*, COE Workshop ‘Advances in Strongly Correlated Electronics’, Kashiwa, Japan, January 2006.
- Zaanen, J., *Duality and elastic matter*, KITP Program on Topological Phases and Quantum Computation, Santa Barbara, USA, February 2006.
- Zaanen, J., *20 years of high  $T_c$  superconductivity*, National Seminar Condensed Matter Physics, Utrecht, the Netherlands, April 2006.
- Zaanen, J., *Proving the fluctuating stripes in the high  $T_c$  superconductors*, International Conference M2S-HTSC VIII, Dresden, Germany, July 2006.
- Zaanen, J., *Fermionic quantum criticality and the fractal nodal surface*, Theoretical and Experimental Magnetism Meeting, Abingdon, UK, August 2006.
- Zaanen, J., *Fermionic quantum criticality and the fractal nodal surface*, Lorentz Center Workshop ‘Quantum Criticality’, Leiden, the Netherlands, August 2006.
- Zaanen, J., *Fermionic quantum criticality and the fractal nodal surface*, International Workshop ‘Orbital 2006’, Berlin, Germany, October 2006.
- Zaanen, J., *Proving the fluctuating stripes in the high  $T_c$  superconductors*, International Conference ‘Stripes 2006’, Rome, Italy, December 2006.

### **Radboud University Nijmegen**

- Fasolino A., *From defect formation in graphene to liquid carbon in the earth: an accurate interatomic potential for carbon*, International Conf. Carbon 2006, Aberdeen, UK, 16-21 July 2006.
- Katsnelson M.I., *Two-dimensional ultrarelativistic Fermi-gas in graphene*, University of Augsburg, Augsburg, Germany, June 2006.
- Katsnelson M.I., *Spin-polarized STM of half-metallic ferromagnets: Correlation effects*, Workshop ‘Surface Spin Correlations’, Hamburg, Germany, September 2006.
- Katsnelson M.I., *Two-dimensional ultrarelativistic Fermi-gas in graphene*, University of Groningen and Workshop ‘Simulations of Novel Carbon Materials’, Lyon, France, October 2006.
- Katsnelson M.I., *Two-dimensional ultrarelativistic Fermi-gas in graphene*, Lebedev Physical Institute, Moscow, Russia, November 2006.
- Katsnelson M.I., *Background to correlation phenomena, lectures at the winter school in modern electronic structure theory*, Uppsala, Sweden, December 2006.

**Utrecht University**

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- Barkema, G., *Restoring thermodynamics and dynamics in activation-relaxation techniques*, ACS fall meeting, San Francisco, USA, 10 September 2006.
- Barkema, G., *Physical chemistry of affymetrix microarrays*, Ehrenfest colloquium, Leiden, the Netherlands, 18 October 2006.
- Barkema, G., *The future of computational physics*, DRSTP-Young Symposium: The Future of Theoretical Physics in the Netherlands, 26-27 October, Driebergen, the Netherlands, 26 October 2006.
- Dickerscheid, D., *Quantum phases in optical lattices*, ITF, Utrecht, the Netherlands, 31 January 2006.
- Doretto, R., *Lowest Landau level bosonization*, Institute for Theoretical Physics, Utrecht, the Netherlands, 16 January 2006.
- Doretto, R., *Bosonization approach for quantum Hall ferromagnets*, National Seminar on Condensed Matter Physics, Utrecht, the Netherlands, 7 April 2006.
- Doretto, R., *Bosonization approach for quantum Hall ferromagnets*, Conference ‘Strongly correlated systems in low dimension’, Ascona, Switzerland, 2-8 July 2006.
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- Duine, R., *Spin transfer: from spin valves to current-driven domain walls*, Institute for Theoretical Physics, University of Amsterdam, Amsterdam, the Netherlands, 12 October 2006.
- Duine, R., *Theory of current-driven domain wall motion*, Köln University, Köln,

- Germany, 3 November 2006.
- Duine, R., *Giant magnetoresistance and current-induced torques in antiferromagnetic metals*, Zernike Institute, Universiteit Groningen, the Netherlands, 19 December 2006.
  - Feiner, L.-F., *III-V nanowires for vertical devices on silicon*, Trends in NanoTechnology 2006, Grenoble, France, 5 September 2006.
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  - Jain, S.R., *Random matrix theories and exactly solvable models*, International Workshops on ‘Pseudo-Hermitian Hamiltonians in Quantum Physics’, and, ‘Conformal Field Theory and Integrable Models’, University of Bologna, Bologna, Italy, 3-8 July 2006.
  - Jain, S.R., *Random matrix theories and exactly solvable models*, Università degli studi dell’Insubria, Como, Italy, 7 July 2006.
  - Jain, S.R., *Some exact results in quantum mechanics*, Service de Physique Théorique, CEN, Saclay, France, 9 October 2006.
  - Jain, S.R., *A small collection of exact results for integrable and non-integrable systems*, Doppler Institute, Prague, Czech Republic, 14 November 2006.
  - Jain, S.R., *Resonances*, Nuclear Physics Institute, Rez, Czech Republic, 16 November 2006.
  - Jain, S.R., *Plane polygonal billiards*, Institute for Theoretical Physics, Utrecht, the Netherlands, 20 December 2006.
  - Morais Smith, C., *Spiral phases in high- $T_c$  superconductors*, Laboratoire de Physique des Solides, Univ. Paris-Sud Orsay, France, 26 April 2006.
  - Morais Smith, C., *Zooming in on the quantum Hall effect*, Instituto de Física Gleb Wataghin, University of Campinas, Brazil, 2 May 2006.
  - Morais Smith, C., *Magnetic and transport properties of lightly doped LSCO*, International Conference ‘From Solid State to Biophysics III’, 24 June-27 June 2006, Cavtat, Croatia, 25 June 2006.
  - Morais Smith, C., *Quantum Hall: novel perspectives*, Meeting of the ‘Quantum Matter and Emergent Materials’ Initiative, FOM, Utrecht, the Netherlands, 30 June 2006.
  - Morais Smith, C., *BEC of excitons in bilayer quantum Hall systems: a bosonization approach*, Lorentz Center Conference: ‘Quantum Criticality’, 9-18 August 2006, Leiden, the Netherlands, 18 August 2006.
  - Morais Smith, C., *The future of condensed matter theory*, DRSTP-Young Symposium: The Future of Theoretical Physics in the Netherlands, Driebergen, the Netherlands, 26-27 October 2006.
  - Morais Smith, C., *Stripes versus spiral phases in lightly doped high- $T_c$  superconduc-*



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- Stoof, H., *Dressed molecules in the BEC-BCS crossover*, Workshop on Strong Correlations in Ultra-Cold Fermi Systems, Aspen, Colorado, USA, 17 January 2006.
  - Stoof, H., *Ultracold superstrings*, University of Groningen, Groningen, the Netherlands, 30 January 2006.
  - Stoof, H., *Superfluidity in atomic Fermi gases*, Free University, Berlin, Germany, 10 February 2006.
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  - Stoof, H., *Ultracold superstrings*, COSLAB, Nottingham, UK, 20 April 2006.
  - Stoof, H., *Unbalanced Fermi gases qubits and macroscopic quantum coherence*, Bad Honnef, Germany, 9 May 2006.
  - Stoof, H., *Ultracold superstrings*, COSLAB, Leiden, the Netherlands, 7 September 2006.
  - Stoof, H., *Unbalanced Fermi gases*, Solitons and Nonlinear Phenomena in Degenerate Quantum Gases, 27-30 September, Cuenca, Spain, 28 September 2006.
  - Stoof, H., *Imbalanced Fermi gases*, Workshop ‘Quo Vadis BEC?’, Free University, Berlin, Germany, 29 October 2006.
  - Stoof, H., *Imbalanced Fermi gases*, Mainz University, Mainz, Germany, 12 December 2006.
  - Tanase, C., *Nucleation of tactoids in hard rods systems: a microscopic approach*, Conference Solid/Fluid Interfaces, Complex Fluid Interfaces and Nanofluidics, 9-14 September, Obergurgl, Austria, 11 September 2006.
  - Tanase, C., *Self-organization in mixtures of filaments and motor proteins*, Cell Biology and Biophysics (EMBL), Heidelberg, Germany, 10 August 2006.
  - van Beijeren, H., *Equilibrium shapes of CsCl type crystals*, Symposium on Surface Science 2006, St. Christoph am Arlberg, Austria, 8 March 2006.
  - van Beijeren, H., *Fluctuation theorem with realistic thermostats*, Work, dissipation and fluctuations in nonequilibrium physics, Brussels, Belgium, 25 March 2006.
  - van Beijeren, H., *Chaos and the physics of non-equilibrium systems*, Newton Institute, Cambridge, UK, 18 April 2006.
  - van Beijeren, H., *Chaos and the physics of non-equilibrium systems*, Dynamical systems and statistical mechanics, Durham, UK, 4 July 2006.
  - van Beijeren, H., *The Kolmogorov-Sinai entropy of hard ball systems and the dynamics of eigenvalues of the curvature tensor*, Randomness and hyperbolicity in dynamical systems, Budapest, Hungary, 24 August 2006.
  - van Beijeren, H., *Applications of the Boltzmann equation in dynamical systems theory*, Boltzmann symposium, München, Germany, 13 October 2006.
  - van Roij, R., *Hard colloidal rods near soft walls: wetting, drying, and symmetry breaking*, Annual Meeting DFG-network ‘Colloidal Dispersions in External Fields’, Bonn, Germany, 20 March 2006.
  - van Roij, R., *Charged colloids and mixtures thereof in suspension*, ITF-UVA seminarium, Amsterdam, the Netherlands, 20 April 2006.
  - van Roij, R., *The fate of the gas-liquid spinodal of charged colloids at low salinity*, Annual meeting EU network SoftComp, Venice, Italy, 3 May 2006.
  - van Roij, R., *Nonlinear screening for highly charged colloids: how to avoid nu-*

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- van Roij, R., *Suspensions of charged colloids: nonlinear screening, gas-liquid instability, and charge regulation*, AMOLF colloquium, Amsterdam, the Netherlands, 4 September 2006.
  - van Roij, R., *Charged colloids at low salinity: in bulk and near oil-water interfaces*, Theoretical Physics colloquium, Heinrich Heine Universität, Düsseldorf, Germany, 8 November 2006.

# 7 | Science-related activities

*This chapter presents an overview of the science-related activities of DRSTP staff members and postdoctoral fellows. Besides publications in professional journals (sect. 7.1) and publications about or related to physics in daily newspapers (sect. 7.2) also public lectures (sect. 7.3) are given. All other outreach activities like forum discussions, television interviews, personal columns in newspapers etc. are listed in the paragraph ‘other contributions’ (sect. 7.4). Science-related activities of PhD students can be found in chapter 3 (sects. 3.6 and 3.7).*

## 7.1 Professional publications

- Dijkgraaf, R.H.D., *Het landschap van de fysica*, NTvN (2006) 72-11.
- Dijkgraaf, R.H.D., *Zoeken naar de ultieme materie*, in ‘Verwondering, wetenschap in Nederland’, Boom, 2006.
- Feiner, L.F., *Iconen van de fysica*, NTvN 72 (2006) 38.
- Feiner, L.F., *NiNa, wat is er nieuw en waar is de natuurkunde gebleven?*, NTvN 72 (2006) 54.
- van Lankvelt, F.J.M., Reijnders, J.W. and Schoutens, K., *Quantumloeistoffen voor roterende bosonen*, NTvN (2006).
- Loll, R., *Het bubbelbad van de kosmos*, Scientific American (Dutch Edition), (March 2006) 62-65.
- Loll, R., *Zoeken naar de ultieme materie*, in ‘Verwondering, Wetenschap in Nederland’, Boom, Amsterdam (2006) 180-184.
- Ruijgrok, T., *Heuristic proof of the theorem of Borsuk and Ulam*, Special Spring issue 2006 of Foton, Journal for physics teachers and their students.
- Sahlmann, H., *Quantum dynamics in loop quantum gravity*, Contribution for the Encyclopedia of Mathematical Physics, J.P. Francoise, G. Naber, S.T. Tsou (eds.), Elsevier (2006).
- ’t Hooft, G., *Kleiner dan kleinst - In het binnenste van de materie*, Bres, Tijdschrift voor wetenschap en verwondering 235, 2006, 12-17.
- ’t Hooft, G., *Het einde van de informatierevolutie - De wet van Moore is less*, Bres, Tijdschrift voor wetenschap en verwondering 236, 73-78.
- ’t Hooft, G., *Foreword*, in the Encyclopedia of Mathematical Physics (5 Volumes), (eds.) J.-P. Francoise, G.L. Naber and T.S. Tsun, Elsevier, 2006.
- van Enter, A.C.D., *College van Censuur*, NTvN 72 (2006) 273.
- van Enter, A.C.D., *Vlotgeschreven overzicht*, NTvN (2006) 331.
- Zaanen, J., *De duistere kant van de snaar theorie*, NTvN 72 (2006) 314.

## 7.2 Other publications

- Beenakker, W.J.P., *Theoretische hoge-energiefysica*, Impuls, nr. 82, August 2006.
- Dijkgraaf, R.H.D., *Voor het klikken de klas uit*, NRC Handelsblad, 21 January 2006, column.
- Dijkgraaf, R.H.D., *Lieve Marchia*, Folia 21 (59), 3 February 2006, column.
- Dijkgraaf, R.H.D., *Fanmail*, Folia 24 (59), 24 February 2006, column.
- Dijkgraaf, R.H.D., *Snelle speeltjes voor miljardairs*, NRC Handelsblad, 25 February 2006, column.
- Dijkgraaf, R.H.D., *Ga alsjeblijft weg!*, Folia 27 (59), 17 March 2006, column.
- Dijkgraaf, R.H.D., *Islam uit de vergelijking*, NRC Handelsblad, 18 March 2006, column.
- Dijkgraaf, R.H.D., *Wetenschap: mooie verhalen over het onbekende*, Opinie & Debat, NRC Handelsblad, 1 April 2006, column.
- Dijkgraaf, R.H.D., *Contactgestoord*, Folia 30 (59), 7 April 2006, column.
- Dijkgraaf, R.H.D., *De Chinezen komen!*, NRC Handelsblad, 15 April 2006, column.
- Dijkgraaf, R.H.D., *Lillipotwissen en reuzentorren*, NRC Handelsblad, 13 May 2006, column.
- Dijkgraaf, R.H.D., *Hebt u geen andere globe?*, Folia 35 (59), 19 May 2006, column.
- Dijkgraaf, R.H.D., Eindexamen vwo natuurkunde 1,2 op verzoek van de Volkskrant, de Volkskrant, 1 June 2006.
- Dijkgraaf, R.H.D., *Een goedkope oplossing*, NRC Handelsblad, 10 June 2006, column.
- Dijkgraaf, R.H.D., *Oudere jongeren*, NRC Handelsblad, 8 July 2006, column.
- Dijkgraaf, R.H.D., *The Universe of the DoDecemberahedron, the art of Gerard Caris* (also in German).
- Dijkgraaf, R.H.D., Voorwoord kinderuniversiteit, in M. van der Heijden, L. van de Oudewetering, *Waar komt de regenboog vandaan?*, Winkler Prins Kinderuniversiteit, 2006.
- Dijkgraaf, R.H.D., *Weg met de dijkgraaf!*, NRC Handelsblad, 16 September 2006, column.
- Dijkgraaf, R.H.D., Peiling Ministers hebben goed op de winkel gepast, meer niet, de Volkskrant, 19 September 2006.
- Dijkgraaf, R.H.D., *Hipoconders*, Folia 07, 13 October 2006, column.
- Dijkgraaf, R.H.D., *Honderdduizend miljard gedichten*, NRC Handelsblad, 14 October 2006, column.
- Dijkgraaf, R.H.D., *Waar is Christiaan Huygens gebleven; Canon blijkt getrouwe afspiegeling van onze nationale angst voor bètavakken*, NRC Handelsblad, 18 October 2006, column.
- Dijkgraaf, R.H.D., *Belang van Huygens groter dan Ot en Sien; Canon negeert ten onrechte bètawereld*, NRC Next, 20 October 2006.
- Dijkgraaf, R.H.D., *Plakjes tijd*, Dagkrant van het Holland Animation Film Festival in t Hoogte te Utrecht, 1-5 November 2006.
- Dijkgraaf, R.H.D., *Sociale snaren*, in De toppen van het kunnen, Dirk van Delft, Bert Bakker, 2006.
- Dijkgraaf, R.H.D., *De eerste verjaardag*, voorwoord in Techniek Toernooi 2006.

- Dijkgraaf, R.H.D., *Wachten op meneer Lisa*, Folia nummer 10, 10 November 2006, column.
- Dijkgraaf, R.H.D., Bijdrage verhaal in boek *Ik geloof dat .. maar heb geen bewijs*, samengesteld door John Brockman, Spectrum, eerste druk 2006.
- Dijkgraaf, R.H.D., *De bekende Nederlander in getallen, volgens Bartjens*, Tijdschrift voor reken-wiskunde-onderwijs, Jaargang 26, nr. 2, November 2006.
- Dijkgraaf, R.H.D., *Najaar-verslag*, Folia nummer 13, 1 December 2006, column.
- Mulders, P.J., *Hoe leeg is het heelal?*, Vakidoot, Jrg 05-06, no. 6, pp. 3-6 (2006).
- Pallante, E., *Working with Stella*, Article in ASTRON Newsletter, December 2006, pp. 26-27.
- Zaanen, J., Feature article in popular science magazine ‘Quest’, September 2006 and HP-de Tijd, December 2006.

### 7.3 Public lectures

- Bais, F.A., *Speciale relativiteit*, Vereniging voor Weer en Sterrenkunde, Zwolle, the Netherlands, 19 January 2006.
- Bais, F.A., *Natuurwetten, een ontmoeting tussen wis-en natuurkunde*, Freudenthal Instituut, Utrecht, the Netherlands, 23 November 2006.
- Beenakker, W.J.P., *Quantummechanica: God dobbelt wél*, Science Cafe, Nijmegen, the Netherlands, 14 June 2006.
- Beenakker, W.J.P., *Van klassiek tot kwantum*, Ouderdag, Radboud University Nijmegen, the Netherlands, 25 March 2006.
- Bergshoeff, E., *Open vragen in de hedendaagse natuurkunde*, voordracht gegeven ter gelegenheid van deelname Dagblad van het Noorden aan de Nationale Wetenschapsquiz 2006, the Netherlands, November 2006.
- Dijkgraaf, R.H.D., *NVORWO-lezing: de relatie tussen science, rekenen en techniek*, Panama Conferentie, Noordwijkerhout, the Netherlands, 18 January 2006.
- Dijkgraaf, R.H.D., *Rekenen, wetenschap en techniek*, Nationale Rekendagen, Noordwijkerhout, the Netherlands, 15 March 2006.
- Dijkgraaf, R.H.D., *The birth of the universe*, FMF-symposium, Universal Origins, Marchtini Plaza, Groningen, the Netherlands, 4 October 2006.
- Dijkgraaf, R.H.D., *Space, time and physics*, Van Abbemuseum and Technical University Eindhoven, the Netherlands, 9 November 2006.
- Loll, R., *Het reizende universum*, Jury presentation on behalf of ‘Team Loll’ in the National Academische Jaarprijs Competitie 2005/06, Utrecht, the Netherlands, 19 May 2006.
- Morais Smith, C., *The magic world of electrons in two-dimensions*, Natuurkundig Gezelschap, University of Utrecht, the Netherlands, 4 April 2006.
- Prokopec, T., *The vacuum and geometry in cosmology*, Department Day, Utrecht University, the Netherlands, 21 June 2006.
- ’t Hooft, G., *The smallest building blocks of matter*, 40th Foundation Day lecture, Goa, India, 2 January 2006.
- ’t Hooft, G., *The smallest building blocks of matter*, Wroclaw, Poland, 20 January 2006.

- 't Hooft, G., *Controversies in physics*, at the Planck Scale University of Pisa, Galilei Colloquium, Pisa, Italy, 3 March 2006.
- 't Hooft, G., *Black holes and elementary particles*, 1st Meeting of Nobel Laureates with Pakistani Students/Young Scholars, Islamabad/Lahore, Pakistan, 27 March 2006.
- 't Hooft, G.,  $E = MC^2$ , Lowlands University at the Music Festival Lowlands, the Netherlands, 20 August 2006.
- 't Hooft, G., *Black holes and elementary particles*, Sonderforschungsbereich, Humboldt University, inaugural lecture, Berlin, 6 October 2006.
- 't Hooft, G., *What is quantum mechanics?*, 8th Symposium on Frontiers of Fundamental Physics, (16-19/10/06), Madrid, Special lecture sponsored by the president of 'Agencia de Desarrollo Economico Madrid Emprende', D. Miguel Angel Villanueva, Consejero Delegado de Gobierno de Economia y Partipacion Ciudadana, Madrid, Spain, 17 October 2006.
- 't Hooft, G., *Highlights in subnuclear physics*, Forum on Creativity, National University Singapore, 17 November 2006.
- 't Hooft, G., *The smallest building blocks of matter*, Higashiyama Campus, Nagoya University, Japan, 23 November 2006.
- 't Hooft, G., *Black holes and elementary particles*, National University of Singapore (NUS), 15 November 2006.
- 't Hooft, G., *Theoretical physics and science fiction*, Nanyang Technological University of Singapore (NUS), 16 November 2006.

## 7.4 Other contributions

- Bais, F.A., *Kennis maken*, Nunspeet, Leergang Kennis Management AOG, De Sparrenhorst, the Netherlands, 19 January 2006.
- Bais, F.A., *Eerst zien, dan geloven: over wetenschap, waarden en wartaal*, Maagdenhuis op maandag, Universiteit van Amsterdam, the Netherlands, 10 April 2006.
- Bais, F.A., *Turningpoints in science*, European Comenius Course, St. John's College, Cambridge, UK, 12-13 April 2006.
- Bais, F.A., *Turningpoints in science*, Pacific Science Center, Seattle, Washington, USA, 16 May 2006.
- Bais, F.A., *The equations: Icons of knowledge*, Microsoft Research, Redmond, Washington, USA, 16 May 2006.
- Bais, F.A., *The equations; Icons of knowledge*, GIREP Conference, Amsterdam, the Netherlands, 22 August 2006.
- Bais, F.A., *Turningpoints in science*, European Comenius Course, St. John's College, Cambridge, UK, 23-24 August 2006.
- Bais, F.A., *De naakte waarheid*, in: series of double lectures 'Weten en/of geloven', organised by KNAW and K.L. Poll Foundation, Beurs van Berlage, Amsterdam, the Netherlands, 14 November 2006.
- Bais, F.A., *Slot debat*, in: series of double lectures 'Weten en/of geloven', organised by KNAW and K.L. Poll Foundation, Beurs van Berlage, Amsterdam, the Netherlands, 14 November 2006.

- Bais, F.A., *Powers of ten*, NEMO, Beta Festival FNWI, Amsterdam, the Netherlands, 11 December 2006, presentation of film with commentary.
- Beenakker, C.W.J., *Star Trek*, Jongerenwerkgroep voor Sterrenkunde, Leiden, 10 February 2006.
- Beenakker, C.W.J., *Quantum technologie*, Science and Technology Summit ‘Vliegende Hollanders’, Amsterdam, 15 November 2006.
- Beenakker, C.W.J., *Quantum technologie*, Natuurkundig Genootschap ‘Wessel Knoops’, Arnhem, 12 December 2006.
- Dijkgraaf, R.H.D., *God of Darwin*, Buitenhof televisie, the Netherlands, 1 January 2006.
- Dijkgraaf, R.H.D., *Over het werk van Veltman, ’t Hooft en Van der Meer, Nobele Hoofden*, Ministerie OCW, 18 January 2006.
- Dijkgraaf, R.H.D., *Wiskunde en de snaartheorie*, Nederlandse Wiskunde Dagen, Noordwijkerhout, the Netherlands, 4 February 2006.
- Dijkgraaf, R.H.D., *Is er een bèta-crisis in Nederland?*, Debat Science Cafe, Radboud University Nijmegen, the Netherlands, 8 February 2006.
- Dijkgraaf, R.H.D., *Niet alleen voor kleine Einsteins*, Interview, de Volkskrant, 11 March 2006.
- Dijkgraaf, R.H.D., *Een diepfluweelpaarse echtgenoot*, Symposium ‘De ontdekking van Kleur’, Nederlandse Vereniging voor Kleurenstudie, Nederlands Natuur- en Geneeskundig Congres, Vereniging van Vrienden van het Allard Pierson Museum, Amsterdam, the Netherlands, 11 March 2006.
- Dijkgraaf, R.H.D., *Kan de wereld gevangen worden in een formule?*, Comenius Leergang, Zeist, the Netherlands, 17 March 2006.
- Dijkgraaf, R.H.D., *Tot hoever kun je tellen?*, Children’s lecture and book presentation ‘Waar komt de regenboog vandaan?’, Nemo Science Center, Amsterdam, 19 March 2006.
- Dijkgraaf, R.H.D., *Wetenschap voor jonge kinderen*, Hoe?Zo! Radio, 21 March 2006.
- Dijkgraaf, R.H.D., *Momenten van conflict tussen geloof en wetenschap*, Dijksterhuislezing, Koning Willem II College, Tilburg, the Netherlands, 22 March 2006.
- Dijkgraaf, R.H.D., *Alfa/Bèta, Dolce Vita*, KRO Radio, 27 March 2006.
- Dijkgraaf, R.H.D., Presentation *Waar komt de regenboog vandaan?*, to Staatssecretaris Mark Rutte, Universiteit van Amsterdam, the Netherlands, 27 March 2006.
- Dijkgraaf, R.H.D., *Realistisch wiskunde onderwijs versus abstract denken*, Forumdiscussie, Nederlands Wiskundig Congres, Delft, the Netherlands, 28 March 2006.
- Dijkgraaf, R.H.D., *Homo universalis: Dijkgraaf en Sleichim*, Vlaams-Nederlands Huis de Buren, Brussel, Belgium, 20 April 2006.
- Dijkgraaf, R.H.D., *Begaafde kleuters*, Sarah Blom, NRC Handelsblad, 29 April 2006.
- Dijkgraaf, R.H.D., *Can the world be captured in an equation?*, Workshop ‘The Generosity of Artificial Languages in an Asian Perspective,’ De Balie, Amsterdam, the Netherlands, 20 May 2006.
- Dijkgraaf, R.H.D., Presentation, NWO Eurekaprijzen, Nemo Science Center, Amsterdam, the Netherlands, 23 May 2006.
- Dijkgraaf, R.H.D., *NWO Strategienota*, Hoe?Zo! Radio, 24 May 2006.

- Dijkgraaf, R.H.D., Interview, Tolle Belege, 2006.
- Dijkgraaf, R.H.D., Project Filmacademie, Tjandreizen, 2006.
- Dijkgraaf, R.H.D., On-line interview, Natuurkunde.nl, 2006.
- Dijkgraaf, R.H.D., Interview, FOM Express, 2006.
- Dijkgraaf, R.H.D., *Veel van mijn inzichten komen als ik college geef*, Interview, Elsevier Thema, October 2006.
- Dijkgraaf, R.H.D., Interview (snaartheorie, betacanon), Amsterdam, FM, radio program Amsterdam, Wordt Wakker.
- Dijkgraaf, R.H.D., Volkskrant Kenniscafe Debate, with the theme ‘De Exacte Canon’, Volkskrantcafe, Utrecht, the Netherlands, 16 October 2006.
- Dijkgraaf, R.H.D., Boek presentation to Jeroen Brouwers, *In het midden van de reis door mijn leven*, Letterkundig Museum, Den Haag, the Netherlands, 19 October 2006.
- Dijkgraaf, R.H.D., Interview for film award Pieter Zeemansprijs (24 November 2006) in Gemeente Schouwen-Duiveland, 1 November 2006.
- Dijkgraaf, R.H.D., *Eenheid van de bètavakken*, Tweede Universum lecture, Vliegende Hollanders, Science & Technology Summit, Amsterdam, the Netherlands, 15 November 2006.
- Dijkgraaf, R.H.D., *Creativity*, Studium Generale, Rietveld Academie, Amsterdam, the Netherlands, 15 November 2006.
- Dijkgraaf, R.H.D., Interview Herfstgasten, Vliegende Hollanders, Science & Technology Summit 2006, Amsterdam, 15 November 2006.
- Dijkgraaf, R.H.D., Interview *Prometheus-geheim van de uitblinker*, Amsterdam, 17 November 2006.
- Dijkgraaf, R.H.D., Interview *Zoeken naar de ultieme materie*, in ‘Verwondering Wetenschap in Nederland’, Boom, 2006.
- Dijkgraaf, R.H.D., Interview *Wetenschap en kunst*, Periodiek, Fysisch- Mathematische Faculteitsvereniging, Groningen, 2006.
- Dijkgraaf, R.H.D., Interview *Geleerden en geloof*, HP De Tijd, December 2006.
- Dijkgraaf, R.H.D., Contribution and interview in the book *Opgelost; toepassingen van wiskunde en informatica*, B. Mols, Veen Magazines, 2006.
- Loll, R., *The urgent need to look to the future*, Pandora, published by Utrecht University’s Women’s Network, pp. 10-13, (interview).
- Mulders, P.J., *Hoe vinden elementaire deeltjes hun weg*, voordracht in kader van het scholierenprogramma ‘Op de Hoogte’, Den Haag, 5 April 2006.
- Mulders, P.J., *Hoe vinden elementaire deeltjes hun weg*, voordracht in kader van het scholierenprogramma ‘Op de Hoogte’, Den Haag, 12 October 2006.
- Pallante, E., Collaboration with Theater Adhoc for the production of the theater play ‘Het Mysterie van Majorana’.
- Pallante, E., chairperson of the WG on ‘analytic approaches to non-perturbative QCD’.
- Schoutens, K., *Fibonacci-nyonquantumHallquantumcomputers*, Oriëntatie 2e jaars studenten, Universiteit van Amsterdam, 6 November 2006.
- Storm, C., *Chaostheorie*, Wolfert Dalton College Rotterdam, 23 January 2006; Walburgcollege Zwijndrecht, 9 February 2006; Calvin College Goes, 28 March 2006; Gymnasium Haganum Den Haag, the Netherlands, 19 April 2006.



- 't Hooft, G., *Symbool van onze nieuwsgierigheid*, Elsevier, nummer 50/51, p. 42.
- 't Hooft, G., *There may be extra-terrestrial life, says Nobel Laureate*, Interview in 'The Navhind Times', Goa, India, Goa, India, 3 January 2006.
- 't Hooft, G., Interview in 'Slowo Polskie' (paper) and with 'Polskie Radio Wroclaw', Poland, 10 January 2006.
- 't Hooft, G., Interview with 'ATV Live News Night Programm', Islamabad, Pakistan, 27 March 2006.
- 't Hooft, G., Interview with 'Live PTV Programm (news morning)', Islamabad, Pakistan, 28 March 2006.
- 't Hooft, G., Talk *De Wereld van het allerkleinste*, Gezelschap E'64 (Eindhoven 1974), Best, the Netherlands, 11 April 2006.
- 't Hooft, G., Interview with 'Humanistische Omroep Radio 747' on Planetenbiljart, Theodoor Holman (live), Desmet, Amsterdam, 25 April 2006.
- 't Hooft, G., Interview on Planetenbiljart, with 'Met het Oog op Morgen', radio programm, Media Park, Hilversum, 30 April 2006.
- 't Hooft, G., *De ultieme regel kennen we nog niet*, interview with J. de Ceulaer of 'Knack', issue nr. 21, pp. 76-82.
- 't Hooft, G., Interview with Ger Jochem of 'Noorderlicht', VPRO Radio programm, Hilversum, 9 May 2006.
- 't Hooft, G., Short speech on the occasion of the retirement of Nicole Ribet Point de vue du Vieux continent, Ecole Normale Supérieure, Paris, France, 12 May 2006.
- 't Hooft, G., Interview with Gudrum De Geyter, of 'Alinea', VRT Klara live radio programm, Brussels, Belgium, 18 May 2006.
- 't Hooft, G., Press conference on the occasion of the Doctor Honoris Causa granted by the Universidad de Salamanca, Spain, 25 May 2006.
- 't Hooft, G., *Op weg naar het ene*, interview with D. van Delft of 'NRC Handelsblad', scientific supplement, 16 June 2006.
- 't Hooft, G., Speech on the occasion of the renovated memorial gravestones in honour of H. Kamerling Onnes and his brother Menso, Stichting Altvoorde, Dorpskerk, Voorschoten, together with Mrs. G.A. Kamerlingh Onnes - van Dedem, 17 June 2006.
- 't Hooft, G., *De cosmologische constante*, Faculty Club, Utrecht, the Netherlands, 12 June 2006.
- 't Hooft, G., *The last word*, Symposium 'Under the Spell of Physics', Vlieland, the Netherlands, 16 July 2006.
- 't Hooft, G., Comments on cover, book written by Lee Smolin *The trouble with physics*, (Hought Mifflin Comp.).
- 't Hooft, G., *De allerkleinste brokjes materie*, for high school students, Hogeschool Rotterdam ('Brains and work'), the Netherlands, 20 October 2006.
- 't Hooft, G., *Nano physics in the Netherlands*, the International Seminar on Nano Technology, Kuwait Inst. Scientf. Research (KISR), 5 November 2006.
- 't Hooft, G., Round table discussion nano-technology, Kuwait Inst. Scientf. Research KISR, 6 November 2006.
- 't Hooft, G., Dialogue session for children 14-17 years, Hwa Chong Institution, Singapore, 15 November 2006.
- van den Brink, J., Radio interview, Radio 1, Noorderlicht, 31 January; Radio 747,

De Avonden, 20 February 2006.

- Zaanen, J., *Hoe maak je een kernbom*, open day for high school students organized by the Leidsche Flesch, Leiden, the Netherlands, April 2006.
- Zaanen, J., Closing presentation at the ‘NWO-talent day’, Utrecht, October 2006.

# 8 | Research funding

*Below an overview is presented of funding organizations that financially supported the research of the DRSTP in 2006. Regular university funding is not listed.*

## 8.1 Personal grants

### *University grants*

- University USF Grant VUA, P.J. Mulders (VUA) (1999-2005)
- University USF Grant VUA, F.C. MacKintosh (VUA) (2001-2007)
- High Potentials Grant UU, R. van Roij (UU) (2005-2010)

### *KNAW*

- Fellowship, D. Boer (VUA)(2001-2006)
- Academy professorship, G. 't Hooft (UU) (2005-2010)

### *NWO*

- Spinoza grant (1999), C.W.J. Beenakker (UL) (2000-2009)
- Spinoza grant (2003), R.H. Dijkgraaf (UvA)(2004-2008)
- Spinoza grant (2006), J. Zaanen (UL) (2006-2011)
- VICI grant (2002), H.T.C. Stoof (UU) (2003-2008)
- VICI grant (2003), A. Achúcarro (UL) (2004-2009)
- VICI grant (2004), R. Loll (UU) (2005-2010)
- VIDI grant (2004), K.E. Schalm (UvA) (2005-2009)
- VIDI grant (2004), M.M. Taylor (UvA) (2005-2009)
- VIDI grant (2005), K. Peeters (UU) (2006-2011)
- VENI grant (2006), L.F. Alday (UU) (2006-2008)

### *EU Marie Curie fellowships*

- F.S. Saueressig (UU), *A new string duality for gauged supergravity and its physical and mathematical applications*, (1 November 2005 - 1 November 2007).
- G.S. Krishnaswami (UU), *Large-N Yang-Mills Theory*, (1 October 2005 - 1 October 2007).
- H. Sahlmann (UU), *Non-perturbative path integrals for quantum gravity*, (18 October 2006 - 18 October 2008)

*Other*

- F. Aquiar de Moura (UvA), Portugal Science and Technology Foundation, *Accoes efectivas em Teorias de Supercordas*.
- R. Doretto (UU), fellowship of the Brazilian agency Conselho Nacional de Desenvolvimento Científico e Tecnológico, (1 June 2005 - 1 June 2006).
- D. Rodriguez-Gómez (UvA), Spanish Ministry of Science (M.A.R. Osario), *Matter at very high energy, density and finite temperature*, (2006).
- B.P. Williams (UvA), International Research Fellowship of the National Science Foundation USA (2005-2006).

**8.2 FOM funding**

- **FOM-A-01** (group leader F.A. Bais)  
*Fundamental interactions (FOM programme 31)*  
 99FI01: Fundamental interactions (F.A. Bais, J. Smit)  
 02FI02: Holographic aspects of string theory structure of QCD (J. de Boer)  
 02FI11: Fundamental interactions (J. Smit)  
*Projectruimte*  
 00PR1889: Strings, black holes and holography (J. de Boer, R.H. Dijkgraaf)
- **FOM-A-05** (group leader B. Nienhuis)  
*Mathematical physics (FOM/GBE programme 11)*  
 01MF11: Application of stochastic Lowner evolution to critical phenomena (B. Nienhuis)  
*Collective and cooperative statistical physical phenomena (FOM programme 46)*  
 00CCSPP01: Static and dynamic phenomena in stackings (B. Nienhuis)  
 04CCSPP26: Correlations in groundstates without finite size corrections (B. Nienhuis)  
*Overgangsprogramma BUW*  
 00SF05: Universal scaling functions (B. Nienhuis)
- **FOM-A-13** (group leader A.M.M. Pruiskén)  
*Strongly interacting condensed matter (FOM programme 34)*  
 02SIC15: Studying duality and topological excitations in disordered materials (A.M.M. Pruiskén)
- **FOM-A-15** (group leader Th.M. Nieuwenhuizen)  
*Strongly interacting condensed matter (FOM programme 34)*  
 02SIC16: Thermodynamics and measurement in the quantum world: challenging the validity of standard knowledge (Th.M. Nieuwenhuizen)
- **FOM-A-20** (group leader R.H. Dijkgraaf)  
*Mathematical physics (FOM/GBE programme 11)*  
 01MF08: Holography and topological invariants (J. de Boer)  
*String theory and quantum gravity (FOM programme 57)*

- 01STQG01: Thermodynamics of strings, fluxes and branes (J. de Boer, R.H. Dijkgraaf)
- 02STQG07: Matrix models and supersymmetric gauge theory (R.H. Dijkgraaf)
- 02STQG08: String theory beyond supergravity (R.H. Dijkgraaf)
- Projectruimte*
- 02PR2149: String theory and cosmology (J. de Boer)
- 03PR2266: Supersymmetric gauge theories and matrix models (R.H. Dijkgraaf and J. de Boer)
- 04PR2387: Connecting gauge interactions with gravity through string theory (E.P. Verlinde)
- 06PR2510: Cosmological vacua in string theory (E.P. Verlinde)
- **FOM-A-25** (group leader K. Schoutens)  
*Collective and cooperative statistical physical phenomena (FOM programme 46)*
  - 04CCSPP23: The challenges of the chiral metal (J.-S. Caux)
  - 04CCSPP24: Collective behavior vs entanglement in atomic matter (K. Schoutens)  
*FOM-Springplankplaatsen*
  - 02SP002: FOM-Springplankplaats (J.-S. Caux)
  - **FOM-G-01** (group leader E.A. Bergshoeff)  
*Fundamental interactions (FOM programme 31)*
  - 02FI12: Braneworlds (E.A. Bergshoeff/M. de Roo)  
*String theory and quantum gravity (FOM programme 57)*
  - 01STQG03: String theory and quantum gravity (E.A. Bergshoeff/M. de Roo)
  - 02STQG06: Towards a formulation of coinciding M5-branes (E.A. Bergshoeff/M. de Roo)
  - **FOM-G-18** (group leader A.C.D. van Enter)  
*Mathematical physics (FOM/GBE programme 11)*
  - 99MF02: States and metastates in disordered lattice systems (M. Winnink/A.C.D. van Enter)
  - **FOM-L-01** (group leader P. van Baal)  
*Fundamental interactions (FOM Programme 31)*
  - 02FI13: Fundamental interactions (P. van Baal)
  - 02FI14: Fundamental interactions (W.L.G.A.M. van Neerven)
  - **FOM-L-03** (group leader G. Nienhuis)  
*Quantum optics of small systems (FOM Programme 15)*
  - 97QOSS3 Microlasers (G. Nienhuis)
  - **FOM-L-05** (group leader C.W.J. Beenakker)  
*Physics of electronic and magnetic structures and devices (FOM Programme 38)*
  - 02PSD17: Current fluctuations in mesoscopic systems (C.W.J. Beenakker)  
*Waves in complex media (FOM Programme 45)*
  - 02WCM02: Chaotic wave dynamics (C.W.J. Beenakker)

*Projectruimte*

04PR2285: Controlled quantum entanglement in the Fermi sea (C.W.J. Beenakker)

05PR2407: Antibunched and entangled microwaves in nanostructures  
(C.W.J. Beenakker)

06PR: Mesoscopic physics in graphene (C.W.J. Beenakker)

- **FOM-L-07** (group leader W. van Saarloos)

*Collective and cooperative statistical physical phenomena (FOM programme 46)*

04CCSPP15: Efficient statistical physical models for simulating macroscopic visco-elastic flow instabilities and turbulence (W. van Saarloos)

*Physics of granular matter (FOM Programme 63)*

03PGM03: Fundamental aspects of statics and dynamics of granular media  
(W. van Saarloos)

*Dynamics of patterns (FOM/GBE programme 79)*

633.000.403: Visco-elastic instabilities and the nature of weak visco-elastic turbulence  
(W. van Saarloos)

*Projectruimte*

03PR2182-2: Instabilities in polymer processing (W. van Saarloos)

03PR2263: Why is green fluorescent protein green? A quantum Monte Carlo study  
(C. Filippi)

05PR2438: When soft condensed matter gets hard: the “jamming transition” in granular media (W. van Saarloos)

- **FOM-L-15** (group leader J. Zaanen)

*Strongly interacting condensed matter (FOM programme 34)*

02SIC20-2: Complexity in quantum-mechanical electron systems: Dynamical stripes and Z<sub>2</sub> gauge invariance (J. Zaanen)

*Collective and cooperative statistical physical phenomena (FOM programme 46)*

04CCSPP13: Quantum phase transitions and fermion signs (J. Zaanen)

04CSSPP31: Orbital physics in oxides: novel types of quantum order  
(J. van den Brink)

*Projectruimte*

04PR2295: Stripe fractionalization: the quest for emergent gauge principle  
(J. Zaanen)

04PR2358: Does spontaneous symmetry breaking limit quantum coherence?  
(J. van den Brink)

*FOM-Springplankplaatsen*

02SP001: FOM-Springplankplaats (J. van den Brink)

- **FOM-L-26** (group leader H. Schiessel)

*Material properties of biological assemblies (FOM programme 90)*

05MPBA09: Theory of the role and behavior of membranes in composite systems  
(H. Schiessel)

06PR2465: Statistical mechanics of semiflexible biopolymers under tension and compression (H. Schiessel)

- **FOM-N-01** (group leader R.H.P. Kleiss)  
*Fundamental interactions (FOM programme 31)*  
 02FI15: Fundamental interactions (R. Kleiss)  
*FOM-Springplankplaatsen*  
 00SP: FOM-Springplankplaats 2000-2007 (W.J.P. Beenakker)
  
- **FOM-N-09** (group leader M.I. Katsnelson)  
*Fundamental properties of surfaces and interfaces (FOM programme 39)*  
 99PSI11: Theoretical studies of friction at contacting surfaces (A. Fasolino)  
 02PSI18: Dynamical mechanisms of energy transfer at surfaces and solid-solid interfaces (A. Fasolino)  
*Projectruimte*  
 05PR2427: Magnetic adatom clusters on metal surfaces as tunable many-body systems (M.I. Katsnelson)  
 06PR2481: Graphene: the two dimensional crystal that should not exist (A. Fasolino)
  
- **FOM-U-01** (group leader G. 't Hooft)  
*Fundamental interactions (FOM programme 31)*  
 02FI17: Fundamental interactions (G. 't Hooft)
  
- **FOM-U-05** (group leader H.T.C. Stoof)  
*Strongly interacting condensed matter (FOM programme 34)*  
 02SIC25: Quantum spin nematic states in spinor Bose-Einstein condensates (F. Zhou)  
*Collective and cooperative statistical physical phenomena (FOM programme 46)*  
 00CCSPP11: Quantum phases of matter (H.T.C. Stoof/P. Denteneer (UL))
  
- **FOM-U-07** (group leader H. van Beijeren)  
*Collective and cooperative statistical physical phenomena (FOM programme 46)*  
 00CCSPP09: Nonequilibrium systems and SRB measures (H. van Beijeren)
  
- **FOM-U-29** (group leader B. de Wit)  
*String theory and quantum gravity (FOM programme 57)*  
 01STQG02: New approaches to hypermultiplets/local field theory couplings of BPS states (B. de Wit)  
 02STQG09: Non-perturbative quantum black holes (R. Loll)  
 02STQG10: Instantons in string theory (S. Vandoren/G. 't Hooft)
  
- **FOM-U-31** (group leader R. van Roij)  
*Structure, function and flow of soft materials (FOM programme 27)*  
 01SFFSM30: Phase behaviour, structure and dynamics of colloidal suspensions (R. van Roij)  
*FOM-Springplankplaatsen*  
 99SP22: FOM-Springplankplaats (R. van Roij)  
*Projectruimte*  
 03PR2241: Inhomogenous suspensions of charged colloids: voids, sedimentation, wetting and nucleation (R. van Roij)

*FOM/DFG Physics of colloidal dispersions in external fields (FOM programme 61)*  
in collaboration with DFG (transregio SFB 6018)

Duration: 2002-2008

Scientist in charge: A. van Blaaderen (UU)

Coordinator DFG: H. Löwen (Düsseldorf, Germany)

Participating theorist: R. van Roij (UU)

- **FOM-V-01** (group leader P.J. Mulders)  
*Fundamental interactions (FOM programme 31)*  
02FI18: Fundamental interactions (P.J. Mulders)  
*Projectruimte*  
98PR1714: Gluon dynamics in the proton (P.J. Mulders)  
04PR2302: Exposing the color glass condensate (D. Boer)  
05PR2422: Time reversal odd phenomena in quantum chromodynamics
- **FOM-V-13** (group leader F.C. MacKintosh)  
*Physical biology II (FOM programme 56)*  
01FB28-3: Mechanosensing and chemical signalling in single oesocytes-3  
(F.C. MacKintosh)  
*Biomolecular physics (FOM programme 60)*  
03BMP23: Micromechanics and active response of biopolymer networks  
(F.C. MacKintosh)  
*Material properties of biological assemblies (FOM programme 90)*  
05MPBA04: Cytoskeletal/filamentous protein networks and assemblies  
(F.C. MacKintosh)  
05MPBA05: Active cytoskeletal protein assemblies (G. Koenderink/  
F.C. MacKintosh)  
05MPBA06: Microrheology and non-equilibrium fluctuations of active cytoskeletal  
networks (F.C. MacKintosh/G. Koenderink)  
05MPBA10: Guest budget (F.C. MacKintosh)  
05MPBA11: Personal budget, program leader (F.C. MacKintosh)

### 8.3 EU-networks

- Dynamics and statics of glasses and spin glasses: from aging to memory and equilibrium structures (G. Aquino) Human Potential Programme - (RTN)  
Duration: until 1 September 2006  
Scientist in charge for UvA: Th.M. Nieuwenhuizen



- Non-equilibrium physics of complex fluids and biological systems (EU RTN 2-2001-00339)  
Duration: 2002-2006  
Network coordinator: University of Bayreuth, Germany  
Scientist in charge for UL: W. van Saarloos
- Hadron physics (integrated infrastructure initiative RII3-CT-2004-506078)  
Duration: 2004-2007  
Network coordinator: C. Guaraldo (Frascati, Italy)  
Scientist in charge for VUA: P.J. Mulders
- Fundamentals of nanoelectronics (MRTN-CT-2003-504574)  
Duration: 2004-2008  
Network coordinator: University of Lancaster, UK  
Scientist in charge for UL: C.W.J. Beenakker
- Soft matter composites-an approach to nanoscale functional materials (6th framework programme, network of excellence 502235-2)  
Duration: from 01-06-2004 until 01-06-2009  
Network coordinator: D. Richter (Jülich, Germany)  
Scientists in charge: A. van Blaaderen/H. Lekkerkerker  
Participating theorist: R. van Roij (UU)
- Constituents, fundamental forces and symmetries of the universe (MRTN-CT-2004-005104)  
Duration: from 01-11-2004 until 31-10-2008  
Network coordinator: D. Lüst (München, Germany)  
Scientist in charge for RUG: E.A. Bergshoeff  
Scientist in charge for UU: B. de Wit
- Superstring theory (MRTN-CT-2004-512194)  
Duration: from 01-01-2005 until 31-12-2009  
Network coordinator: L. Brink (Göteborg, Sweden)  
Scientist in charge for UvA: R.H. Dijkgraaf  
Scientist in charge for UU (associated with UvA): G. 't Hooft
- European network on random geometry (MRTN-CT-2004-005616)  
Duration: from 01-09-2005 until 31-08-2009  
Network coordinator: R. Loll (UU)
- PSI-K F-electron (HPRN-CT-2002-00295)  
Duration: from 01-09-2005 until 31-08-2006  
Network coordinator: A. Svane (Arhus University, Denmark)  
Scientist in charge for RU: M.I. Katsnelson

- HEPTOOLS (MRTN-CT-2006-035505)  
Duration: from 01-12-2006 until 30-11-2010  
Network coordinator: Dr. C.G. Papadopoulos (NRCS Dimokritos, Greece)  
Scientist in charge for RU: R.H.P. Kleiss
  
- Flavour Physics Training network FLAVIANet  
Duration: 2006 -  
Network coordinator: A. Pich (Valencia U., Spain)  
Scientist in charge for RUG (associated with Valencia) : E. Pallante

## 8.4 ESF

- Network COSLAB - Laboratory Cosmology (ESF)  
Duration: from 2001 until 2006  
Network coordinator: G. Volovik, T.W.B. Kibble  
Scientist in charge for UL: A. Achúcarro
  
- Programme towards atomistic materials design (Psi-k) (ESF)  
Duration: 2003-2008  
Network coordinator: V. Heine (Cambridge)  
Scientist in charge for UL: C. Filippi
  
- Interdisciplinary statistical and field theory approaches to nanophysics and low dimensional systems (INSTANS)  
Duration: 2005-2010  
Network coordinator: G. Mussardo (SISSA, Trieste).  
Scientist in charge for UvA: K. Schoutens

## 8.5 Other

### NWO

- Mathematical Physics project (D. Lenstra, B. Krauskopf) (VUA)  
Dynamics of Patterns; Delay dynamics of laser patterns (K. Green)
  
- Geometric aspects of quantum theory and integrable systems (NWO-047017015)  
Duration: from 30-10-2005 until 30-10-2008  
Network coordinator: G. Helminck (University of Twente)  
Scientist in charge: G. Arutyunov (UU)

- NWO Van Gogh travel grant: Physical models of DNA biochips  
G. Barkema (UU) (2004-2006)  
Participant: E. Carlon (Lille, France)

### **STW**

- VTF 5386 (T. Visser) (VUA): Towards quantitative near-field optics (H. Schouten)
- ETC 5963 (D. Lenstra) (VUA): Towards ultrafast communication (Freeband Communication Programme) (W. Wang)
- Freeband Communication BSIK programme (D. Lenstra) (VUA): Broad band photonics (M. van Iersel)

### **INTAS**

- Strings, branes and higher-spin gauge fields (INTAS-03-51-6346)  
Duration: from 01-11-2004 until 31-10-2007  
Network coordinator: A. Sagnotti (Rome)  
Scientist in charge: B. de Wit (UU)
- Extended supersymmetry, strings and non-commutativity in field theory (INTAS-05-1000008-7928)  
Duration: 2006-2008  
Scientist in charge: E. Bergshoeff (RUG)

### **UU grant**

- Prestige masters grant (UU) (2004-2008)



## 9 | Organisation DRSTP 2006

### Governing board:

prof. dr. M. de Roo (RUG)	050-3634956	m.de.roo@rug.nl
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prof. dr. D. Nelson, Harvard University, Cambridge, USA  
prof. dr. S. Sachdev, Harvard University, Cambridge, USA  
prof. dr. G. Sawatzky, University of British Columbia, Vancouver, Canada  
prof. dr. G. 't Hooft, Utrecht University, Utrecht, the Netherlands  
prof. dr. F. Wilczek, Massachusetts Institute of Technology, Cambridge, USA

### Educational board:

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drs. G.C. Stavenga (UU), repres. PhD students council		

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# 10 | Addresses

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# Appendix A

## Mission statement

### Objectives

The Dutch Research School of Theoretical Physics (DRSTP) is a cooperation between the theoretical physics groups of six Dutch universities with the following purpose:

- to implement a joint programme of graduate education in theoretical physics that draws upon a dynamic research environment
- to maintain and strengthen research in theoretical physics from a broad unifying perspective that exploits the interrelationships between different fields of theory
- to strengthen, both in research and graduate education, connections with experimental physics, and of multidisciplinary ties, for instance with mathematics, computational science, astrophysics, earth science, physical chemistry and the life sciences.

The DRSTP is based on the conviction that a joint venture of all the moderately sized local theory groups, each with its own profile, offers added value for the achievement of these objectives. The DRSTP represents a sizable part of the national activity in theoretical physics, a field that has a strong tradition in the Netherlands. At present there exists no other organization that represents this field of research at the national level. The DRSTP welcomes further growth, for instance, by cooperation with institutions in neighbouring countries that share these goals. Often its educational activities already attract students from neighbouring countries and occasionally some of these activities are based on a close collaboration with partners abroad.

### Mandate

The governing board of the DRSTP, which consists of representatives of the partners, is responsible for undertaking any suitable initiative to further its goals. The scientific director of the DRSTP is responsible for implementing the overall policy on behalf of the board and for coordinating the DRSTP activities. The mandate to carry out these tasks is based on an official agreement between the boards of the participating universities, as a result of which the DRSTP has been accredited by the Royal Netherlands Academy of Arts and Sciences (KNAW) in June of 1994 and re-accredited in 1999 and 2004. The agreement guarantees means for a six year period in terms of explicit staff commitments as well as graduate student positions. The DRSTP is assisted in

its endeavor by an international advisory committee of distinguished scientists.

## Research

Theoretical physics is based on universal principles. New concepts often have a much wider validity than the field in which they are discovered, and methods of description developed in one field are sometimes very fruitful in another. Hence theoretical physics is characterized by unity in diversity.

The research programme of the DRSTP comprises two themes:

- Theme 1: Quantum field theory and elementary particle physics.
- Theme 2: Statistical physics, condensed matter theory and quantum optics.

The specific content of the research programme depends on the responsible project leaders, on their creativity as well as their initiative to obtain research funding from their home universities, the Dutch research councils of NWO, or from international sources such as European Union programmes.

The research programme is carried out under the responsibility of the governing board and the scientific director in accordance with the agreement. The governing board of the DRSTP safeguards the objectives of the research school. It monitors the overall coherence and quality of the research programme. The board discusses periodically whether the programme remains on the forefront of international developments. The scientific advisory committee plays an essential part in these matters.

The DRSTP is also accountable to the faculties of the participating universities. Therefore it reports regularly on past and planned activities, both in research and graduate education, on the basis of information presented in its yearly reports.

## Graduate programme

The six universities in the DRSTP offer a joint programme of graduate education leading to a PhD. As part of the research training, under the supervision of a member scientist in a participating university, the Research School guarantees a wide range of educational opportunities for its PhD students. They consist of advanced courses, seminars and topical courses in the Netherlands, and international experience in the form of workshops, summer schools or extended research visits abroad.

The governing board of the DRSTP decides on admission and monitors the evaluation of progress with a prognosis of ultimate success after the first year. This takes place on the basis of an “agreement of education and guidance” between each individual PhD student and its supervisor(s), to be submitted to and approved by the board upon admittance.

A board of education advises the governing board. It also assembles the content of the yearly programme of regular activities. Standard advanced courses are published in a nationwide survey. Special PhD courses are offered within the DRSTP, in quantum field theory, statistical physics and in theoretical condensed matter physics, or result from joint efforts with other research schools.

The input of graduate students in the school takes place in the form of a graduate student council that meets regularly with the director and the chairman of the governing board and board of education (which also has one student member).

Individual members of the DRSTP play a pivotal role in helping to organize many summer schools and workshops, in the Netherlands as well as abroad, and in serving

as teachers in all the activities that the DRSTP undertakes by itself or in cooperation with others.

### **Other responsibilities**

The responsibilities of the DRSTP includes:

- the promotion of a stimulating research environment in theoretical physics
- setting uniform standards of quality
- making educational supplements available tailored to individual research needs.

The board also develops a wide range of activities in order to support an exciting research climate from fund-raising, e.g. for postdoctoral fellows, guest teachers or international mobility of DRSTP students, to the selection of visiting professors, for example on the Kramers (UU), Lorentz (UL) or Van der Waals (UvA) Chairs.



## Appendix B

# Selection and supervision procedure of PhD students

### **Selection and supervision of PhD students**

When a PhD research position opens up at one of the participating universities, there is usually an open round of applications. Important criteria in the selection procedure are the potential of the student for doing independent scientific research and the level and skills demonstrated in the master programme.

Admission to the DRSTP requires to submit a ‘plan for training and supervision’ [opleidings- en begeleidingsplan], containing a global description of educational activities with details provided for the first year. The plan also specifies how individual guidance will be provided under responsibility of the thesis advisor. The Research School safeguards a consistent implementation of the agreement, with uniform standards. The plan has to be submitted to the DRSTP bureau. Formal admission is subject to approval by the governing board.

After one year the progress is evaluated, based on an interview with the thesis advisor and an independent second referee. The school safeguards this procedure without interfering with the responsibilities of the employer. Participation in the educational programme is an explicit element of the evaluation. The outcome of the evaluation will reflect on whether the student will be able to complete the research programme within the amount of time allotted. If the prognosis is negative, the student will be asked to leave the DRSTP. Such outcomes should be, and are, extremely rare provided proper care is given to the initial selection.

A student can appeal a negative evaluation with the governing board of the school; a decision will be reached within one month. If the student does leave the school before completing the PhD, a diploma, specifying the student’s accomplishments in the educational programme, will be provided.

After the first year, throughout the duration of the PhD project, the progress will be closely monitored, for example by additional yearly evaluation interviews.





# Appendix C

## Postgraduate AIO/OIO schools

### Theoretical High Energy Physics

**Date:**

23 January - 3 February 2006

**Location:**

Hotel & conference center De Bergse Bossen, Driebergen, the Netherlands

**Scientific organisers:**

M. de Roo (RUG); R. Timmermans (KVI)

**Lecturers:**

G. Arutyunov (UU): *Introduction to AdS/CFT*

D. Boer (VUA): *QCD*

B. Schellekens (NIKHEF/RU): *Beyond the standard model*

J.W. van Holten (NIKHEF/VUA): *Black holes, compact stars and gravitational waves*

**Guest lecturers:**

B. de Wit (UU): *Black hole entropy*

K. Jungmann (KVI): *Precision tests of the standard model*

**Participants (21):**

Arsiwalla, Xerxes (UvA)

Chemissany, Wissam (RUG)

Compère, Geoffrey (UL Brussels)

El-Showk, Sheer (UvA)

Gesser, Jens Anders (NBI, Copenhagen)

Hartong, Jelle (RUG)

Hollands, Lotte (UvA)

Hoogeveen, Joost (UvA)

Janssen, Tomas (UU)

Kanitscheider, Ingmar (UvA)

Koekoek, Gideon (NIKHEF)

Manschot, Jan (UvA)

Messamah, Ilies (UvA)

Ploegh, Andre (RUG)

Sousa, Képa (UL)

Stavenga, Gerben (UU)

van den Bleeken, Dieter (KU Leuven)

van Kessel, Marcel (RU)

Wagenaar, Jan Willem (RU)

Wessels, Erik (VUA)

Wyder, Thomas (KU Leuven)

**Student presentations:**

- Xerxes Arsiwalla (UvA): *Black holes in topological string theory*
- Wissam Chemissany (RUG): *Born-Infeld theory and ‘derivative corrections’*
- Geoffrey Compère (UL Brussels): *Gödel spacetime, particles and black holes*
- Sheer El-Showk (UvA): *Motivation for topological strings*
- Jelle Hartong (RUG): *A democratic formulation for 7-branes*
- Lotte Hollands (UvA): *Introduction to topological strings, part II*
- Gideon Koekoek (NIKHEF): *The warm inflation model*
- Jan Manschot (UvA): *Black hole degeneracies and topological strings*
- Ilies Messamah (UvA): *What’s the dual of a dipole?*
- Andre Ploegh (RUG): *Attractors in generalized assisted inflation*
- Kepa Sousa (UL): *Cosmic strings in brane-antibrane inflation*
- Gerben Stavenga (UU): *Operator product expansie*
- Dieter van den Bleeken (KU Leuven): *Fermions on D-branes*
- Marcel van Kessel (RU): *The path integral approach to SSB*
- Jan Willem Wagenaar (RU): *Strong meson-baryon interaction*
- Erik Wessels (VUA): *The colour glass condensate*

# Statistical Physics and Theory of Condensed Matter

**Date:**

15 - 19 May 2006

**Location:**

Hotel & conference center De Bergse Bossen, Driebergen, the Netherlands

**Scientific organisers:**

J. van den Brink (UL); R. van Roij (UU)

**Lecturers:**

M. Katsnelson (RU): *Path integrals*

C. Morais Smith (UU): *Dissipation in quantum systems*

P. van der Schoot (TUE): *Self organisation in soft matter*

M. van Hecke (UL): *Jamming and force networks in granular matter*

**Guest lecturer:**

D. van Delft (NRC Handelsblad): *Worth publishing! How do editors of the 'NRC Handelsblad' select, describe and make scientific research interesting for their readers*

**Participants (23):**

Becherer, Paul (UL)

Beekman, Aron (UL)

Conti, Enrico (VUA)

di Marco, Igor (RU)

Eggen, Eelco (UU)

Ellenbroek, Wouter (UL)

Grechnev, Alexei (RU)

Gubbels, Koos (UU)

Huijse, Liza (UvA)

Idema, Timon (UL)

Koetsier, Arnaud (UU)

Kuipers, Jan (UU)

Lim, Lih-King (UU)

Luna, Katherine (UL)

Mehmani, Bahar (UvA)

Scaramucci, Andrea (RUG)

Torres Valderrama, Aldemar (UU)

van Dijk, Leon (TUE)

Vlaming, Bas (RUG)

Vocks, Henk (UU)

Yimer, Yeneneh (TUE)

Zozulya, Oleksandr (UvA)

Zwanikken, Jos (UU)

**Student presentations:**

Paul Becherer (UL): *Instabilities in flows of viscoelastic fluids*

Aron Beekman (UL): *Non-Abelian defects and braid statistics*

Enrico Conti (VUA): *Nonlinear behaviour of filament networks*

Wouter Ellenbroek (UL): *A critical length scale in jammed granular media*

Koos Gubbels (UU): *Feshbach resonances in an optical lattice*

Timon Idema (UL): *Barbapapas at the cellular level - towards understanding the shape of multi-component bilayer vesicles*

Arnaud Koetsier (UU): *BEC-BCS crossover in optical lattice*

Bahar Mehmani (UvA): *Simultaneous measurement of non-commutative variables*

Andrea Scaramucci (RUG): *Magnetic pattern formation in magnetic thin films*

Aldemar Torres Valderrama (UU): *Density functional theory and colloidal suspensions*

Bas Vlaming (RUG): *Exciton dynamics in biased one-dimensional systems*

Henk Vocks (UU): *POP-ART: thermodynamically correct activated event sampling in complex materials*

Oleksandr Zozulya (UvA): *Towards entanglement in quantum Hall effect*

Jos Zwanikken (UU): *Mode selection and stretching of capillary waves by shear flow*

# Appendix D

## National seminars

### Condensed Matter Physics

- **Date:**

7 April 2006

- **Location:**

Buys Ballot Laboratory/Institute for Theoretical Physics, Utrecht University, the Netherlands

- **Scientific organiser:**

C. Morais Smith (UU)

- **Program:**

R. Doretto (UU): *Bosonization approach for quantum Hall ferromagnets*

J. Mooij (TU Delft): *Superconducting flux qubits*

B. van Wees (RUG): *Spintronics: a new kind of electronics using the electron spin as a carrier of power and information*

J. Zaanen (UL): *Twenty years of high  $T_c$  superconductivity*

- **Date:**

6 October 2006

- **Location:**

Gorleaus Laboratories, Leiden, the Netherlands

- **Scientific organisers:**

J. van den Brink (UL); J. Zaanen (UL)

- **Program:**

P. Abbamonte (Urbana-Champaign):

*Charge character of the static stripe phase in  $La_{2-x}Ba_xCuO_4$*

S. Girvin (Yale): *Quantum noise and amplification*

H. Hilgenkamp (UT): *Experiments with fractional magnetic flux quanta*

M. Mostovoy (RUG): *Magnetic frustration and ferroelectricity*

## Statistical Physics

- **Date:**

27 January 2006

- **Location:**

Laboratorium for Technical Physics, Delft, the Netherlands

- **Scientific organiser:**

H. Blöte (UL)

- **Program:**

C. Filippi (UL): *Photoactive molecules: do first-principle calculations have predictive power?*

D. Panja (UU): *Passage times for unbiased polymer translocation through a narrow pore*

B. Nienhuis (UvA): *The tricritical transition of the 2D  $O(n)$  model*

S. de Leeuw (TU Delft): *Droplet coalescence in a fluid environment*

- **Date:**

31 March 2006

- **Location:**

Huygens Laboratory, Leiden University, the Netherlands

- **Scientific organisers:**

P. Denteneer (UL); H. Schiessel (UL); H. van Leeuwen (UL); W. van Saarloos (UL)

- **Program:**

E. Demler (Harvard): *Interference between independent fluctuating condensates*

F. Krüger (UL): *Frustrated antiferromagnetism: fluctuation induced first order vs. deconfined*

S. Ostojic (UvA): *Scale invariance and universality of force networks in static granular matter*

E. Sultan (UL): *Statistics of crumpled paper*

## Theoretical High Energy Physics

- **Date:**

19 May 2006

- **Location:**

NIKHEF, Amsterdam, the Netherlands

- **Scientific organiser:**

J. de Boer (UvA); J. Smit (UvA)

- **Program:**

J. Ellis (CERN): *Ways to look for supersymmetry at the LHC*

B. Schellekens (NIKHEF): *Sightseeing in the landscape*

G. Shiu (Wisconsin-Madison): *The promise of string phenomenology*

J.-P. van de Schaar (UvA): *The universe according to WMAP III*

- **Date:**

20 October 2006

**Location:**

NIKHEF, Amsterdam, the Netherlands

**Scientific organisers:**

J. de Boer (UvA); J. Smit (UvA)

**Program:**

S. Bais (UvA): *The physics of quantum groups and their breaking*

R. Boels (Oxford): *Hidden gauge symmetry in perturbative Yang-Mills theory*

K. Peeters (UU): *Finite-temperature QCD from string theory: a status report*

M. Shaposhnikov (Lausanne): *Neutrino oscillations, dark matter and baryon asymmetry of the universe as physics at the electroweak scale*





# Appendix E

## Symposia

### **The Future of Theoretical Physics in the Netherlands**

On 26 and 27 October 2006 the DRSTP-Young Symposium 2006 ‘The Future of Theoretical Physics in the Netherlands’ was held in the Conference center ‘De Bergse Bossen’ in Driebergen. The symposium was attended by 21 participants from the Netherlands. The organizing committee was: D. Boer (VUA), J.S. Caux (UvA), E. Pallante (RUG), J. van den Brink (UL) and R. van Roij (UU).

#### *Program*

*Thursday, October 26*

T. Prokopec: *The future of theoretical cosmology*

G. Barkema: *The future of computational physics*

Discussion session: *The funding of theoretical physics*

Discussion session: *Educational issues relevant to theoretical physics*

C. de Morais Smith: *The future of condensed matter theory*

*Friday, October 27*

F. MacKintosh: *The future of complex systems and soft matter*

R. Timmermans: *The future of subatomic and astroparticle physics*

Discussion session: *Recruitment and employment*

Drafting of report (for organizers and interested participants)

#### *List of participants:*

1. Gleb Arutyunov (UU), String theory
2. Gerard Barkema (UU), Computational condensed matter physics
3. Miriam Blaauboer (TUD), Quantum dynamics in nanoconductors
4. Daniël Boer (VUA), Particle physics phenomenology
5. Jeroen van den Brink (UL), Condensed matter theory
6. Jean-Sébastien Caux (UvA), Condensed matter theory
7. Rembert Duine (UU), Spintronics
8. Ute Ebert (CWI & TU/e), Nonlinear dynamics and complex systems
9. Fred Mackintosh (VUA), Soft matter, complex systems
10. Cristiane Morais Smith (UU), Condensed matter theory
11. Maxim Mostovoy (RUG), Condensed matter theory

12. Elisabetta Pallante (RUG), Particle physics
13. Tomislav Prokopec (UU), Theoretical cosmology
14. René van Roij (UU), Soft condensed matter
15. Jan Pieter van der Schaar (UvA), String theory
16. Koenraad Schalm (UvA), String theory
17. Cornelis Storm (UL), Theoretical biophysics
18. Rob Timmermans (RUG), Subatomic and astroparticle physics
19. Stefan Vandoren (UU), String theory

# Appendix F

## Statistics

### Statistics 2006

On 31 December 2006 seventy (70) PhD students were affiliated to the DRSTP. In 2006 twenty-one (21) PhD students joined the DRSTP.

Nineteen (19) PhD degrees were granted in 2006 (5% to women). The average duration of their PhD research (from start of contract to PhD exam date) was 48,0 months (52,1 in 2005).

### Statistics 2001-2006

**PhDs (AIO/OIO) granted  
1 January 2001 - 31 December 2006  
(per theme)**

	2001	2002	2003	2004	2005	2006	Total AIO + OIO
Theme 1	5	7	6	7	9	7	41
Theme 2	5	5	7	6	10	12	45
AIO/OIO	5/5	6/6	4/9	4/9	9,5/9,5	10/9	38,5/47,5
Total	10	12	13	13	19	19	86

## PhD efficiency

In the period 1 January 2001 - 31 December 2006, 86 PhD degrees were granted. Of these students 71% finished their PhD research within four years and six months. The full distribution is as follows:

within 4 years:	21	(24%)
within 4 years and 6 months:	40	(47%)
within 5 years:	12	(14%)
more than 5 years:	13	(15%)

The fraction of PhD degrees granted to women in the period 1 January 2001 - 31 December 2006 is 8%.

To monitor the PhD efficiency at a slightly longer time scale, we also present some data for the period 1 January 1999 - 31 December 2006. In this period 131 PhD students have started their research work. At the end of this period (31 December 2006) 57 of them have graduated and 5 of them have prematurely discontinued their contract. Of the remaining 69, 2 will graduate in 2007. For 67 students the PhD exam date is not yet known; they all started their PhD research after 1 January 2003.

<b>Employment following the PhD</b>		
<b>2001-2006</b>		
	number	%
<i>Postdoctoral positions in theoretical physics:</i>		
the Netherlands	6	
EU	33	
USA	7	
Abroad elsewhere	3	
subtotal	49	57%
<i>Positions in academia and in public (research) institutions not related to theoretical physics:</i>		
Postdoc philosophy RU	1	
Research scientist abroad	1	
PhD position mathematics (abroad)	1	
EURANDOM, Eindhoven	1	
Dutch Cancer Inst.	1	
Leiden Univ. Medical Center	1	
Utrecht Univ. Medical Center	1	
Computing center RU	1	
subtotal	8	9%
<i>Positions in the government and in government related organizations:</i>		
Ministry of Justice	1	
CBS The Hague	1	
Ministry of Public works	1	
Coordinator funding agency FOM	1	
subtotal	4	5%
<i>Positions in commercial companies:</i>		
Philips research	3	
NXP semiconductors	1	
Utility company	1	
Banking	3	
Actuary assistant	1	
(Pension) insurance	2	
Various software companies	7	
Consultancy (Ernst&Young/McKinsey)	3	
subtotal	21	24%
<i>Teaching positions:</i>		
High school teacher	2	
subtotal	2	2%
<i>Other:</i>		
Military service	1	
Unknown	1	
subtotal	2	2%
<b>Total</b>	<b>86</b>	