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

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Preface

This DRSTP Annual Report 2014 provides an overview of the educational and research activities during 2014. The Annual Report also presents two research highlights written by staff members of the Research School. In addition, it offers 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 is provided by the DRSTP. A monthly Newsletter is published as well as a yearly Educational Guide containing all DRSTP activities. Up-to-date information is readily available on our website at: http://web.science.uu.nl/drstp/

We would like to thank all of those who contributed to the Research School during this past year.

Prof. G.E. Arutyunov  
Scientific Director

Prof. E.P. Verlinde  
Chair Governing Board

August 2015
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1 | General information

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 manifests itself both in scientific research and in academic education.

To structure and coordinate the graduate education in theoretical physics, the Dutch Research School of Theoretical Physics (DRSTP) was formed. The school is a cooperation between the theoretical physics groups of six Dutch universities: University of Amsterdam (UvA), Vrije Universiteit Amsterdam (VUA), University of Groningen (RUG), Leiden University (UL), Radboud University Nijmegen (RU), Utrecht University (UU) (commissioner) and of the National Institute for Subatomic Physics (Nikhef). In addition, there are several associate members. The DRSTP was accredited in 1994 by the Royal Netherlands Academy of Arts and Sciences (KNAW) and reaccredited in 1999, 2004 and 2010.

The main objectives of the DRSTP are to implement a joint program 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.

Theoretical physics is based on universal principles. New concepts often have a much wider validity than in the field in which they are discovered, and methods developed in one field are sometimes very useful in another. Hence, theoretical physics is characterized by unity in diversity. The research program of the DRSTP is organized according to two themes:

- Theme 1: Particle physics, cosmology, quantum gravity and string theory.
- Theme 2: Quantum matter, quantum information, soft condensed matter and biophysics.
The specific content of the research program depends on the responsible project leaders, on their creativity as well as their success in acquiring research funding from their home university, from the Dutch research councils of NWO, or from international sources such as European Union programs.

The research output of DRSTP members presented in this Annual Report is presented according to the two mentioned research themes. The mission statement of the DRSTP can be found in Appendix A.
The DRSTP in 2014

On 31 December 2014, there were 70 tenured, 60 non-tenured staff members (postdocs) and 119 PhD students affiliated to the DRSTP. The research output led to 19 PhD dissertations and 353 academic publications.

Mutations in the organization of the DRSTP
* Scientific Advisory Committee members Prof. M. Henneaux (Brussels) and Prof. R. Kallosh (Stanford), extended their memberships for another three years.
* Dr. F.S. Saueressig (RU) succeeded Dr. W.J.P. Beenakker (RU) as member of the Educational Board.
* K.K. Vos MSc (RUG) succeeded J.P. Noordmans MSc (RUG) as member of the PhD Student Council.

In Chapter 10 an overview is provided of the DRSTP committee members per 31 December 2014.

Mutations of members of partner institutes (new appointments, resignations, termination of DRSTP membership, retirement, inaugural lectures)

New appointments:
* Prof. W.J.P. Beenakker (RU) was appointed Professor by special appointment of Experimental High-Energy Physics at the University of Amsterdam's (UvA) Faculty of Science (FNWI) per April 2014.
* Dr. V. Cheianov (UL) was appointed Associate Professor per 1 October 2014.
* Dr. C.N. Cheng (UvA) was appointed Assistant Professor per 1 January 2014.
* Dr. P. Corboz (UvA) was appointed Assistant Professor per 1 May 2014.
* Dr. L. Giomi (UL) was appointed Assistant Professor per 1 September 2014.
* Dr. E. Lerner (UvA) was appointed Assistant Professor per 15 July 2014.
* Dr. E. Pajer (UU) was appointed Assistant Professor per 1 September 2014.
* Prof. D. Roest (RUG) was appointed Associate Professor.
* Prof. K.E. Schalm (UL) was appointed Professor.

Resignations:
* Prof. G.E. Arutyunov (UU) 1 October 2014.
* Dr. A. Parnachev (UL) 10 September 2014.
Honorary doctorates, (poster) prizes/awards, NWO grants, fellowships, distinctions of members of the DRSTP

* Dr. F. Benini (UvA) Fellow of the Delta Institute, Amsterdam, the Netherlands.
* Dr. A. Castro (UvA) Emmy Noether Visiting Fellowship, Perimeter Institute, Waterloo, Ontario, Canada.
* Dr. A. Castro (UvA) VIDI Grant, NWO, the Netherlands.
* Dr. M.C.N. Cheng (UvA) ERC Starting Grant for project *Moonshine and string theory*, 2014.
* Prof. J. de Boer (UvA) Grant: Delta ITP PhD position, together with J. van Wezel and J. Zaanen (Leiden).
* Prof. B. de Wit (Nikhef/UU) Knight in the Order of the Netherlands Lion.
* Dr. S. Gryb (RU) and Dr. M. Martin-Benito (RU) NWO Veni Fellowship.
* Dr. D.M. Hofman (UvA) *Holography in the de Sitter static patch*, FOM projectruimte, 2014.
* Dr. D.M. Hofman (UvA) and Dr. U. Gürsoy (UU), Delta ITP postdoc funding grant; hired: Nabil Iqbal.
* M.A. Janssen MSc (UU) Poster award, Physics Department Day, Second prize.
* Dr. J.I. Jottar (UvA) Congressi Stefano Franscini Award for the best scientific contribution by a young scientist at the conference, for his talk *Recent developments in string theory*, Ascona, Switzerland, July 2014.
* Prof. M.I. Katsnelson elected member of KNAW (Netherlands Academy of Science).
* V. Koning MSc (UL) (FOM) winner Young Speakers Contest at FYSICA 2014, Nederlandse Natuurkundige Vereniging; winner Young Speakers Contest at General Scientific Meeting of the Belgian Physical Society 2014, NNV.
* Prof. E. Laenen (Nikhef), PI: FOM Programme, Higgs as Probe and Portal
* Dr. E. Lerner (UvA) John F. Kennedy Prize for outstanding achievements, Weizmann Institute of Science, Israel, 2014.
* Dr. E. Lerner (UvA) Otto Schwarz Graduate Scholarship Fund Award, Weizmann Institute of Science, Israel, 2014.
* Dr. E. Lerner (UvA) Levzion Excellence Fellowship, Weizmann Institute of Science, Israel, 2014.
* Dr. M. Postma (Nikhef), co-applicant: FOM Programme, Observing the Big Bang: the quantum universe and its imprint on the sky
* Drs. M. Scalisi received a grant awarded by the COST Action MP1210 for the research project “Cosmological Inflation and Quantum Gravity” to be held at SITP, Stanford University, working with Prof. Andrei Linde and Prof. Renata Kallosh.
* Drs. M. Scalisi received “Marco Polo Fund” awarded by University of Groningen for the research project “Cosmological Inflation and Quantum Gravity” to be held at SITP, Stanford University, working with Prof. Andrei Linde and Prof. Renata Kallosh.
* Prof. A. Starobinsky (Moscow) 2014 Kavli Prize in Astrophysics from the Norwegian Academy of Science and Letters, the Norwegian Ministry of Education and Research and the Kavli Foundation.
* Prof. A. Starobinsky (Moscow) Member of the Norwegian Academy of Science and Letters, elected 29 May 2014.
* Prof. A. Starobinsky (Moscow) Doctor Honoris Causa from the Kazan Federal University, Kazan, Russia.
* R. van den Berg MSc (UvA) QM&QI Young Speaker’s prize 2014.
* Prof. S.J.G. Vandoren (UU) NWO Graduate Programme 2014.
* G. van Miert MSc (UU) Nominated for EMMEPH thesis prize.
* M. van Wijk MSc and Prof. A. Fasolino (RU) poster prize: *Sliding friction of layered materials*, The First European Workshop on Nanoscale and Mesoscale Friction, Can Picafort, Spain.
* M. van Wijk MSc, A. Schuring MSc, Prof. M.I. Katsnelson and Prof. A. Fasolino (RU) poster prize: *Moiré patterns in graphene*, SIMMposium 2014.
* Dr. B.S.E. Vercnocke (UvA) Academische Stichting Leuven-prijs voor Wetenschap en Technologie (9 September 2014).
* Dr. C. Weniger (UvA) VIDI Grant, NWO, the Netherlands.
* Dr. F. Zandanel (UvA) VENI Grant, NWO, the Netherlands.

**Guest chairs**

* Each year eminent theoretical physicists hold guest chairs at our affiliated institutes.
* Prof. D.J. Gross (Department of Physics, University of California) occupied the Lorentz Chair at Leiden University from 1 May to 30 June 2014. Unfortunately, Professor Gross had to leave after one week, due to personal circumstances.

**Visiting professorships held by DRSTP staff**
* Prof. F.A. Bais (UvA) appointed as External Professor, Santa Fe Institute, New Mexico, USA.
* Prof. F.A. Bais (UvA) appointed Scientific Director, Santa Fe Complex Systems Summer School 2014, St Johns College, Santa Fe, USA, 31 May-6 July 2014.
* Dr. P. Corboz (UvA) Visiting Fellowship at Perimeter Institute, Waterloo, Ontario, Canada.
* Dr. D.M. Hofman (UvA) Visiting Professor, Departamento de Fisica, Universidad de Buenos Aires, Argentina, 2014.
* Prof. R. Loll (RU) Distinguished Visiting Research Chair, Perimeter Institute, Waterloo, Ontario, Canada.
* Prof. B. Nienhuis, visiting Professor at Melbourne University, 13 November-20 December 2014.
* Dr. T.M. Nieuwenhuizen (UvA), Distinguished Visiting Full Professorship at the Insiternational Institute of Physics, Natal, Brazil, 1 September-19 October 2014.
* Prof. K. Schoutens (UvA) Visiting Scientist Rudolf Peierls Centre for Theoretical Physics of the University of Oxford, December 2014.
* Dr. G.J. Stephens (VUA) Adjunct Assistant Professor, Okinawa Institute of Science and Technology, Japan

Visiting scientists (long term)
* D. Baumann (Cambridge University) was a guest of Prof. J. de Boer (UvA) from 19 March 2014 to 19 March 2015.
* D. Engelhardt (USA) a visiting PhD student and guest of Dr. B. Freivogel (UvA), awarded a US National Science Foundation (NSF) Graduate Research Opportunities Worldwide (GROW) grant in conjunction with NWO to conduct research at the University of Amsterdam, 1 September 2014-27 March 2015.
* Prof. J. Gomis (University of Barcelona, Spain) visited the Van Swinderen Institute, University of Groningen, from 1 February – 31 March 2014.
* Dr. A. Goya (Argentina) visited the Van Swinderen Institute, University of Groningen.
* Professor P. Hoyer (Helsinki University) visited Nikhef, Amsterdam, from 1 April-30 May 2014.
* Prof. S. Mukhin (University Moscow, Institute for Steel and Alloys), was a guest of Prof. C.W.J. Beenakker (UL) from 6 January-16 February 2014 and from 6 July-3 August 2014.
* G. Sarosi (Hungary) was a visiting PhD student and guest of Dr. A. Castro (UvA) as part of the Delta ITP visitor program from 1 September 2014-28 February 2015.
* Prof. A.A. Starobinsky (Landau Institute, Moscow) was a guest at the ITP during the periods November 2014, February 2015 and mid-June to mid-July 2015. This guest professorship was made possible by a Delta ITP grant for a proposal submitted by Dr. T. Prokopec. Professor Starobinsky taught a module of the Delta ITP course Advanced Topics in Theoretical Physics:
  - Cosmological perturbation theory and quantum effects in inflation.
  - Present status of the search of gravitational waves from inflation, Theoretical Cosmology Meeting, Leiden University, the Netherlands, 7 November 2014.
  - Advanced course in Modern Cosmology, Utrecht University, 12 academic hours (10, 17 and 24 November 2014).
Delta Institute for Theoretical Physics (D-ITP)

After the start-up year in 2013, the Delta ITP initiative has considerably expanded its scope and impact in 2014. We are particularly proud of the excellent new staff members and fellows that joined the Delta ITP in 2014.

In the annual joint project competition some exciting and high-quality research proposals were awarded in 2014 for two postdoctoral and three PhD positions. These projects all contribute to the general research objectives of the Delta ITP initiative and will further strengthen the cohesion between the different institutes.

To enhance synergy and encourage a joint interest in our main research themes a new series of triangle meetings on Holography was initiated in 2014, next to the already existing Theoretical Cosmology triangle meetings. The participating institutes each take turns in hosting these meetings and Delta ITP funding is used to invite leading international speakers. We eagerly anticipate another series of triangle meetings on the third Delta ITP theme, Quantum and Topological Matter, in 2015.

On the Delta ITP education front in 2014 preparations began to start a Theory in Practice workshop series, in close collaboration with the Industry Advisory Council in which ABN-AMRO, McKinsey, NFI and Shell are represented. A first edition of this workshop series is currently underway and received an overwhelming amount of interest from advanced master and PhD students.

In closing I would like to note that 2014 was a tremendously successful year in terms of national funding for theoretical physics. The NWO Incentive Scheme, the FOM Projectruimte and the FOM Vrije Programma granted a record amount of research proposals in theoretical physics. The Delta ITP initiative will certainly benefit from this amazing success in the years to come. Congratulations to everybody!

Erik Verlinde, chair of Delta ITP

The 2014 Delta ITP annual report and further information is available at: http://www.d-itp.nl/about
3 | Scientific highlights

This chapter describes two highlights of research in theoretical physics, presented from the personal point of view of members of the Research School who have been actively involved in them. One describes entanglement that plays a key role in research into the quantum structure of spacetime. This work belongs to theme 1 of the School and the contribution was written by Professor Wim Beenakker (RU). The second highlight belongs to theme 2 and deals with new surprises in the equilibration dynamics of many-body quantum systems. This contribution was written by Professor Jean-Sébastien Caux (UvA).

Supersymmetry and noncommutative geometry
(Professor Wim Beenakker, Radboud University & University of Amsterdam)

Our present understanding of the fundamental interactions in Nature is summarized in two very different theories. On the one hand the Standard Model (SM) of particle physics has been extremely successful in describing all currently known elementary particles and their mutual non-gravitational interactions. It is a relativistic quantum field theory that describes the short-distance physics that takes place at collider experiments: Matter is described by fermionic quantum fields, with each field carrying internal quantum numbers that specify its susceptibility to certain interactions (e.g. electrostatic charge for the electromagnetic interactions and colour for the strong nuclear forces). The non-gravitational interactions are being transmitted by bosonic force carriers, which are described by bosonic quantum fields. On the other hand the gravitational force is represented very elegantly and equally successfully in the geometric description of General Relativity (GR). It is a classical field theory that encodes the large-distance properties of gravity in the metric of curved spacetime. The common denominator shared by these two theories is the use of an action principle, which says that the equations of motion are obtained by minimizing the action pertaining to the theory. The action itself follows from demanding invariance under local reparametrizations of internal (SM) or spacetime (GR) coordinates.

Noncommutative geometry: where both worlds meet

In an attempt to merge both approaches, noncommutative geometry tries to geometrize all forces and as such tries to treat all forces on equal footing (see [1]). This is achieved by giving the curved spacetime a layering that reflects the internal degrees of freedom of the SM, resulting in a kind of fine structure of spacetime. All interactions are then encoded in the metric of this noncommutative spacetime, with the SM bosons featuring in the layering
part of the metric. These SM bosons take care of the communication between the various layers and thereby mediate the interactions. The corresponding action of the noncommutative theory consists of two pieces: a fermionic matter part and a bosonic geometric part (called spectral action) that takes the form of a vacuum energy in empty noncommutative space (Figure 3.1).

![Figure 3.1: Artist's impression of noncommutative spacetime. It describes the electroweak interaction through the two sheets between which the Higgs boson (H) propagates, and the strong interaction through the perpendicular coloured sheet.](image)

Going beyond the Standard Model
Apart from combining the SM and GR, and providing a geometrical understanding of the SM, the crucial difference between the SM and its noncommutative counterpart is twofold. In the SM the Higgs boson and its interactions are added by hand, and the Higgs boson is effectively treated as a matter particle. In the noncommutative version, the Higgs boson is effectively treated as one of the force carrying bosons and the interactions are subject to additional constraints from the spectral action. This gives rise to falsifiable consequences for the parameters of the model, such as unification-style relations between the coupling constants and a prediction for the Higgs-boson mass. Given the particle content of the SM, the measured coupling constants are not compatible with unification at a high energy scale and the measured Higgs-boson mass of 125 GeV is well outside the predicted window between 158 and 173 GeV. However, we already have
strong experimental and theoretical indications that the SM will not be the end of the story. For instance, the SM cannot account for the dark-matter phenomena observed at various cosmological length scales.

Supersymmetry and noncommutative geometry
To this end a research group at the Radboud University in Nijmegen investigated the possibility to construct noncommutative geometries that have a supersymmetric action. Supersymmetric theories constitute a popular class of beyond the SM theories that can provide a dark matter candidate and at the same time can be compatible with gauge coupling unification at a high energy scale. Previous attempts to reconcile supersymmetry and noncommutative geometry had failed to reach a conclusive answer. The tricky part is that supersymmetry links fermions to bosons, which live in completely different realms in noncommutative theories, with the fermions representing matter and the bosons describing the geometric structure. As a consequence, constraints from the spectral action feed back into the matter part of the action, leading to a highly constrained system. In a series of three papers [2] a theoretical framework was developed for identifying the basic building blocks of a potentially supersymmetric theory and the demands that supersymmetry imposes. The study resulted in several no-go scenarios and provided a step-by-step procedure for building a full-fledged noncommutative supersymmetric theory. It was shown that such full-fledged theories are sparse, being severely constrained by the spectral action. On the upside, simple models proved to be possible: for the first time a noncommutative super Yang-Mills theory was constructed. In addition, it was shown that mechanisms of soft supersymmetry breaking, which are crucial for supersymmetric model building, can arise from the spectral action in a very natural way.


Equilibration in many-body quantum systems: even more subtle than expected
(Professor Jean-Sébastien Caux, University of Amsterdam)

One of the deep realizations of the last few years in quantum physics has been that many-body systems which are carefully isolated from the environment can in some circumstances fail to reach thermal equilibrium, even after long time scales. This fact, famously demonstrated in the quantum Newton’s cradle experiment [1], has underlined our general lack of understanding of how relaxation actually occurs in real systems.

Textbooks on equilibrium statistical mechanics teach us that one can understand the properties of many-body systems in terms of reduced variables like temperature and chemical potential. The crucial point is that these reduced parameters are related to conserved charges of the system, respectively the energy and the particle number. In a typical system, these are assumed to be the only conserved charges of physical relevance. When prepared in an out-of-equilibrium initial state, normal systems are expected to equilibrate to the thermal equilibrium state predicted using Gibbs’ textbook formalism.

A special situation however occurs in one dimension: many systems then exhibit the property of integrability, which boils down to the existence of a larger number of conserved quantities beyond the energy and particle number. Many realizations of integrable systems have recently been displayed in fields including cold atoms, quantum dots and quantum magnetism. Since each conservation law constrains the possible equilibration processes, such integrable systems are not expected to relax to Gibbs thermal equilibrium, but rather to a more complicated steady state described by a so-called Generalized Gibbs Ensemble (GGE) [2], taking other available conserved charges into account. A currently widespread belief states that only simple local conservation laws are physically relevant.

A new approach
Recently, the group of J.-S. Caux in Amsterdam has developed a set of powerful methods for describing the equilibration processes and the ensuing steady-state of integrable systems initialized in an out-of-equilibrium state. This set of methods comes under the name of the Quench Action (QA) approach [3], and is able to provide exact results directly in the thermodynamic limit, even in the presence of strong interactions. Exact solutions were obtained for interaction quenches in atomic gases [4] and in quantum spin chains [5]. This last publication concerns the equilibration of a purely antiferromagnetic state (Néel) let free to evolve under the famous spin-exchange Heisenberg Hamiltonian. Besides giving an exact solution, the authors also managed to implement a GGE for this in principle experimentally-realizable situation.
An unexpected discrepancy, and its surprising resolution

The completely unexpected outcome of this study is that the exact solution and the predictions from the GGE using local charges do not agree as far as steady-state expectation values are concerned. This underlines that the existence of more complicated conservation laws beyond the usual local ones can have measurable consequences on simple observables, and that relaxation processes can be affected by their presence. That this is indeed the case was established in a more recent paper [6].

The lesson to be learned from these studies is that theorists’ textbook notions of locality and universality do not apply in out-of-equilibrium dynamics in one dimension (Figure 3.2).

Figure 3.2: The generic protocol studied in the papers mentioned consists in initializing the system in a highly nonequilibrium quantum state, and to let unitary time evolution take its normal course thereafter. The basic principles of (quantum) statistical mechanics predict thermalization. Surprisingly, this does not occur in isolated many-body systems in one dimension. The Amsterdam group has developed methods to tackle such situations. In this illustration, an antiferromagnetically ordered (Néel) state is released into a quantum spin chain.


4 | PhD program

This chapter provides an overview of the educational program and of the PhD degrees granted in 2014. Research projects of current PhD students and data on their scientific and educational activities in 2014 are given.

The DRSTP offers a joint program of graduate education leading to a PhD. The educational program 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.

The Governing Board of the DRSTP decides on admission of individual PhD students and monitors their progress.

An extended description of the selection and supervision procedure is presented in Appendix B.

4.1 Educational program

4.1.1. Postgraduate courses (AIO/OIO schools)

The following courses were given in 2014:

**Theoretical High Energy Physics (THEP)**
The DRSTP Postgraduate Course (AIO/OIO school) Theoretical High Energy Physics was held from 27 January-7 February 2014 at Hotel and Conference Center Landgoed Zonheuvel in Doorn, the Netherlands. Further information is available 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 10-21 March 2014 at Hotel and Conference Center Landgoed Zonheuvel in Doorn, the Netherlands. Further information is available in Appendix C.
4.1.2. PhD Day
On 3 October 2014 the DRSTP PhD Student Council organized their seventh PhD Day in Utrecht. Further information is available in Appendix D.

4.2 PhD degrees and subsequent employment
On 31 December 2014 one hundred and nineteen (119) PhD students were affiliated with the DRSTP. Twenty-seven (27) PhD students joined the DRSTP in 2014 and nineteen (19) students were awarded their degrees. Information about career moves of former PhD students can be found in Appendix G.

4.3 PhD degrees granted in the DRSTP in 2014
In this section a short summary of the PhD theses published in 2014 is given.

Caldeira Costa, R.N. (UvA)
thesis title: Aspects of the AdS/CFT correspondence
advisors: Prof. K. Skenderis and Prof. M. Taylor
date: 11 September 2014
present position: equity research analyst, Credit Suisse, Lisbon, Portugal

The AdS/CFT correspondence is an exact realization of the holographic principle in string theory where all the gravitational physics is conjectured to be encoded at the boundary of the space where the closed strings propagate. In this thesis we begin by reviewing this duality from first principles: we discuss the large $N$ limit of gauge theories and their relation with string theories and discuss in detail the derivation of the correspondence from D-brane physics and supergravity. We then start with the main research topics of this thesis. Within the framework of AdS/CFT, different sectors of string theory have the potential to model holographically strongly coupled systems in condensed matter physics that enjoy some degree of conformal symmetry. In this thesis we focus on specific systems with non-relativistic scale invariance and construct their geometric duals. The latter are typically AdS plane wave solutions of massive vector theories coupled to Einstein gravity and include the Schrodinger geometries. We discuss how the symmetries of such systems are realised in the gravity models and show how observables such as correlation functions are computed holographically.

We then focus on a different aspect of the AdS/CFT correspondence. Currently, a central problem in holography is to understand how to formulate string theory in asymptotically flat spacetimes in terms of field theories in less dimensions. In this thesis we develop two possible approaches to flat space holography, one based on the flat space limit of AdS/CFT and the other on hyperboloidal foliations of asymptotically Minkowski spaces.
Haan, S. de (RUG)  
thesis title: *Models of massive gravity in three dimensions.*  
advisor: Prof. dr. E.A. Bergshoeff  
date: 13 October 2014  
present position: web developer, Emakina NL, Amsterdam, the Netherlands

The accepted theory of gravity is general relativity. It was invented by Einstein in 1917. Although Einstein had no precise measurements available to guide him in the development of his theory, general relativity describes gravity in our solar system amazingly well. Was he lucky? The answer is no. As soon as one starts to modify general relativity, severe problems arise. One of these problems is that unitarity is lost. Unitarity is the requirement that the sum of probabilities of possible outcomes in a system adds up to one. In this thesis, we look for alternatives to Einstein’s theory in 2 + 1 dimensions that overcome unitarity problems. In particular, we develop models in which the graviton has a mass.

Goykhman, M. (UL)  
thesis title: *Strings and AdS/CFT at finite density*  
advisor: Prof. J. Zaanen  
co-advisor: Dr. A. Parnachev  
date: 24 June 2014  
present position: Oehme Fellow, Theoretical Physics, University of Chicago, Illinois, USA

The AdS/CFT correspondence is a powerful approach to problems of strongly coupled low-energy phases of matter. It has been proving to be efficient at giving a qualitative description of the phenomena such as confinement and chiral symmetry breaking in QCD-like models, and superconductivity and Fermi surfaces in strongly-coupled condensed matter systems. In this thesis we apply the methods of holography to find out properties of low-energy physics.

Haaker, S.M. (UvA)  
thesis title: *Topological phases in condensed matter systems: a study of symmetries, quasiparticle and phase transitions*  
advisor: Prof. C.J.M. Schoutens and Prof. F.A. Bais  
date: 3 October 2014  
present position: Concept Developer and Manager, Science Promotional Projects, Amsterdam

The research described in this thesis focuses on topological phases in condensed matter systems. It can be roughly divided into two parts. In the first part noninteracting systems are studied. The symmetry algebra of a charged spin-1/2 particle coupled to a non-Abelian magnetic field is determined, which explains the finite and infinite degeneracy of the energy. This system is a candidate for a continuum model of a three-dimensional...
topological insulator. Next, a two-dimensional version is considered on a sphere, where its spectrum is solved. The planar version of the Sam model is probed by the insertion of a non-Abelian flux. Starting from a spin-polarized state, the adiabatic insertion of the flux results in a state with nontrivial spin-texture which is recognized as a quantum Hall skyrmion. The second part covers topological phases which stem from an underlying interacting model and that carry quasiparticles with fractional statistics. By applying a technique called topological symmetry breaking transitions between different phases can be induced. A careful treatment shows that different domains may appear in the broken phase separated by domain walls and it leads to a clear interpretation of confined particles. Moreover, phase transitions induced by multilayered condensates are considered. Non-Abelian phases as well as an entire hierarchy of Abelian fractional quantum Hall states are treated. A special focus is given to the study of the one-dimensional boundary between the two phases.

Holsheimer, K. (UvA)
thesis title: Holographic renormalization for Lifshitz spacetimes
advisor: Prof. J. de Boer
date: 4 July 2014
present position: data scientist, Mobile Professionals, Amsterdam, the Netherlands

A variational formulation is given for a theory of gravity coupled to a massive vector in four dimensions, with Asymptotically Lifshitz boundary conditions on the fields. For theories with critical exponent $z=2$ we obtain a well-defined variational principle by explicitly constructing two actions with local boundary counterterms. As part of our analysis we obtain solutions of these theories on a neighborhood of spatial infinity, study the asymptotic symmetries, and consider different definitions of the boundary stress tensor and associated charges. A constraint on the boundary data for the fields figures prominently in one of our formulations, and in that case the only suitable definition of the boundary stress tensor is due to Hollands, Ishibashi, and Marolf. Their definition naturally emerges from our requirement of finiteness of the action under Hamilton-Jacobi variations of the fields. A second, more general variational principle also allows the Brown-York definition of a boundary stress tensor.

Hörig, C. (UU)
thesis title: Nonequilibrium transport through Kondo quantum dots: a real-time renormalization group analysis
advisor: Prof. C. Morias Smith
co-advisor: Dr. D. Schuricht
date: 10 December 2014
present position: consultant, d-fine GmbH, Frankfurt am Main, Germany
Kondo physics first surfaced into the scientific world in 1934 via an unexpected observations made by a group of experimentalists, who measured the temperature-dependent resistance of gold wires in their laboratory at the University of Leiden. When decreasing the temperature below 4 Kelvin, they observed an unexpected increase of the resistance, which resulted in a resistance minimum that was not accounted for by the theoretical understanding at that time. Only 30 years later, Jun Kondo, a Japanese physicist from Tokyo, was the first to explain this curiosity, known as the Kondo effect, under the assistance of the Kondo model. Although his findings explained the increased resistance, a more fundamental problem was raised: the Kondo problem, an unphysical divergence of the resistance at very low temperatures. To solve this problem required the development of more advanced methods beyond the scope of pure perturbative methods, namely the use of renormalization group (RG) methods. More than twenty years after Kondo’s first steps towards the solution of the resistance minimum, the Kondo effect experienced a scientific revival due to the emergence of quantum dot systems in solid state physics. A quantum dot is a very localized and spatially restricted area within a metal, where only a few electrons fit in the area. The limited spatial spread constrains the possible positions for the electrons on the dot, and forces them into strong interactions with each other—they are strongly correlated. In quantum dot systems, not only the Kondo effect in equilibrium situations between the dot and its surrounding reservoirs can be studied, but also the effects of nonequilibrium situations, where a finite bias voltage drives a current through the quantum dot. However, the nonequilibrium Kondo effect is far less explored compared to its equilibrium counterpart and it requires the development of new methods beyond established equilibrium methods. To fill this gap, we use the recently developed real-time renormalization group (RTRG) method in the weak-coupling regime and its extension to the crossover regime, from weak coupling to strong coupling. Furthermore, different combinations between the number of electrons on the dot and the number of reservoirs of electrons in the surrounding metal allow for distinct physical situations, which can be studied within the framework of the RTRG method. We subsequently characterize the properties of the the overscreened, the underscreened, and the fully screened Kondo model by analyzing their physical observables and, in parts, their time evolution. The perturbative foundation of the RTRG method gives us the opportunity to gather new analytic insights for higher spin Kondo systems, on the one hand, and provides for a qualitative comparison of obtained results to various other methods and analytic results, on the other hand.
Knegjens, R.J. (Nikhef)
title thesis: *Strategieën voor de jacht op nieuwe fysica met strange beauty mesonen*
advisor: Prof. R. Fleischer
date: 11 March 2014
present position: postdoctoral fellow, Technical University of Munich; per December 2015 Geophysicist (seismology), Shell, Rijswijk, the Netherlands

The outline of this thesis is as follows. In Chapter 2 we introduce some of the existing theoretical tools and frameworks common to our analysis strategies. In Chapter 3 we present the Bs meson system, and focus in particular on the observables and subtle effects that originate from the sizable decay width difference of the mass-eigenstates of this system. In Chapter 4 various strategies for extracting the angle $\gamma$ of the unitarity triangle using the decay modes $\text{Bs} \to \text{K}^+\text{K}^-$ and $\text{Bs} \to \text{D} (\ast) \text{s} \text{K}$ are discussed. The former decay mode is dominated by QCD penguin topologies whereas the latter is governed purely by tree topologies and is theoretically clean. In Chapter 5 we turn our attention to determining the Bs mixing parameters, particularly the mixing phase $\phi_s$. To this end we analyse decay modes of the form $\text{Bs} \to \text{J}/\psi \text{s} \text{s}^\ast$, with the $\text{ss}^\ast$ state taken to be the $f_0(980)$ or the $\eta$ (0) mesons. We also present an analysis strategy for pinpointing the mixing parameters based only on a pair of effective lifetime measurements. In Chapter 6 we discuss how an untagged time-dependent analysis of the rare decay $\text{Bs} \to \mu^+\mu^-$ offers complementary information to the branching ratio, which can help to discriminate between various models of New Physics. In addition we point out how this branching ratio must be corrected due to the Bs decay width difference. In Chapter 7 we summarise the findings of this thesis and provide an outlook.

Koning, V. (UL)
title thesis: *On the geometry of fracture and frustration*
advisor: Prof. M.L. van Hecke
co-advisor: Dr. V. Vitelli
date: 26 November 2014
present position: unknown

This thesis addresses geometric frustration. This appears when the local order cannot be maintained throughout the whole of space. Defects are a common source of geometric frustration. We have examined the energetics of frustration and connected it to fractures in materials.
Korovins, J. (UvA)
thesis title: Holography with broken Poincaré symmetry
advisor: Prof. K. Skenderis
date: 10 October 2014
present position: postdoctoral fellow, Max Planck Institute for Gravitational Physics (Albert Einstein Institute), Hannover, Germany

The thesis deals with the extensions of the holographic dualities to the situations where part of the Poincaré group has been broken. Such theories are particularly relevant for applications of gauge/gravity dualities to condensed matter systems, which usually exhibit non-relativistic symmetry.

Lodato, I. (UU)
thesis title: Supersymmetric higher derivative couplings and their application
advisor: Prof. B. de Wit
date: 29 September 2014
present position: unknown

After an elementary introduction on black hole physics, supersymmetry and effective theories, which motivates the importance of higher derivative couplings in supergravity, we give an exhaustive treatment of the covariant phase space formalism with many examples explicitly worked out. This sets the stage for the two distinct analyses that follow. The first analysis relies on the superconformal formalism of supergravity and its multiplet structure. We explicitly construct a new class of N=2 higher derivative invariants in four dimensional supergravity, based on logarithms of conformal primary chiral superfields. This class of locally supersymmetric invariants can be combined with the supersymmetrization of the square of the Weyl tensor to obtain the supersymmetric extension of the full Gauss-Bonnet term. The construction is carried out in the context of both conformal superspace and the superconformal multiplet calculus. This allows for the resolution of two open problems. First, we confirm that this new class of higher derivative invariants coincides with a particular 4D supersymmetric invariant arising from dimensional reduction of the 5D mixed gauge-gravitational Chern-Simons term. Secondly, it becomes clear why, in certain models, the pure Gauss-Bonnet term without its supersymmetric completion has reproduced the correct result in calculations of the BPS black hole entropy. We subsequently derive the conditions for fully supersymmetric backgrounds of general N=2 D=4 superconformal theories of gravity, and a non-renormalization theorem for this new class of higher derivative couplings is presented. Since the theorem implies that the invariant and its first order variation must vanish in a fully supersymmetric background, the macroscopic entropy of supersymmetric black hole solutions of N=2 D=4 supergravity is not modified by this class of higher derivative quantum corrections. This confirms the results, obtained more than a decade ago, of de Wit et al. which
numerically coincides with the microscopic results worked out by Witten, Strominger and Maldacena. The second analysis aims at studying the fate in higher derivative gravity of flat directions, i.e. scalar fields which are not fixed at the horizon by the attractor mechanism. We present two explicit examples of higher derivative supergravity theories in five and ten dimensions. In 5D, we consider as a background the 1/2 BPS supersymmetric spinning black hole solution in asymptotically AdS spacetime found by Gutowski and Reall. We find in this case that the two-derivative flat directions are not lifted after the addition of supersymmetric higher derivative terms, although the results can be extended to non-supersymmetric deformations of the two-derivative theory. This suggests that, as long as the two-derivative background solution preserves some supersymmetries, then flat directions remain flat even when quantum corrections are considered. We then analyzed type IIB theory in ten dimensions and consider the rotating D3-brane solution as background. Since this solution is not supersymmetric we find, as expected, that the dilaton gets fixed upon including the cubic α’corrections to type IIB action.

**Merbis, W. (RUG) (CUM LAUDE)**
thesis title: *Chern-Simons-like theories of gravity*
advisor: Prof. E.A. Bergshoeff
date: 26 September 2014
present position: postdoctoral fellow, Vienna, Austria

Gravity is perhaps the most well-known force of nature to the majority of the people, but to a theoretical physicist it remains the most enigmatic one. In modern day physics the gravitational force is related to a number of deep mysteries of the universe in which we live. For instance: what is the correct quantum theory of gravity? How did the universe evolve? What are dark matter and dark energy? One way to look at gravity is as a theory for interacting spin 2 particles called gravitons. These gravitons are thought to be massless particles. In this thesis we explore the possibility and feasibility of theories describing gravitons with a small mass in a simplified setting: in two spatial dimensions. Most notably we consider massive gravitons interacting with massless ones and develop a theoretical framework which is classically self-consistent. The way these models are constructed is novel and it may lead to new cosmological applications if it can be successfully generalized to three spatial dimensions.
Noordmans, J.P. (RUG) (CUM LAUDE)
title thesis: Lorentz violation in weak decays
advisors: Prof. R.G.E. Timmermans and Prof. H.W. Wildschut
co-promotor: Dr. C.J.G. Onderwater
date: 21 November 2014
present position: postdoctoral fellow, University of Groningen, the Netherlands; per July 2015 postdoctoral fellow, University of the Algarve, Faro, Portugal

The research focuses on theoretical aspects of testing one of the fundamental parts of contemporary (theoretical) physics: Lorentz symmetry. The significance of this symmetry has its roots in Einstein’s theory of special relativity, of which it forms the basis.

There are at least two reasons for testing Lorentz symmetry. Firstly, it remains important to experimentally confirm Lorentz symmetry with growing precision because of its deep embedding in all our theories of nature. Secondly, research on new fundamental theories has brought to light the possibility of deviations from Lorentz symmetry. The latter has led to many investigations of Lorentz symmetry over the last two decades. In particular in particle physics the issue has gained much attention.

Previous to the work described in this thesis, this attention was mainly limited to a specific part of particle physics: quantum electrodynamics. In the thesis the testing grounds for Lorentz symmetry are extended to a different important part of particle physics: the weak interaction. This interaction is relevant in nuclear reactions and for the existence of the Sun. We took mathematical steps that enable the testing of Lorentz symmetry also in the weak interaction.

Subsequently we made recommendations for new experiments. In addition we confirmed, using existing experimental data, that our work gives new and unique limits on deviations from Lorentz symmetry. We also found one result that seems to suggest that Lorentz symmetry is not exact, however, this needs to be investigated further.

Ortiz, P. (UL)
title thesis: Effects of heavy fields on inflationary cosmology
advisors: Prof. A. Achúcarro; Prof. J.-W. van Holten
date: 30 September 2014
present position: postdoctoral fellow, Leiden University, the Netherlands

Over the last decades, many different extensions of the simplest inflationary models have been proposed, in particular the possibility of having more degrees of freedom present during inflation, which would interact with the inflaton producing a rich phenomenology. This is motivated not only from the observational point of view, but also from the theoretical point of view, since the high energies at which inflation occurs suggest a theoretical framework based on high energy theories such as
supergravity or string theory, where the presence of additional fields is ubiquitous. The research described in this thesis has helped in analysing the possibility that additional fields are present during inflation, where we have studied many different aspects of it: from the theoretical consistency to the detectability.

Romanets, O. (RUG)
thesis title: Dynamically-generated baryon resonances with heavy flavor
advisor: Prof. R.G.E. Timmermans
date: 10 January 2014
present position: ASML, Veldhoven, the Netherlands

The study of heavy hadrons is a central topic in particle physics. In contrast to the particles built of light quarks, states that contain heavy quarks (charm or bottom) are difficult to treat, because there is no rigorous model to describe these states.
On the other hand, the development of new techniques in experimental physics makes possible the observation of new states with heavy flavor. It is nowadays a challenge to interpret the nature of these new detected particles. Hadron resonances (particles that can decay in other ones) can be interpreted as states made of quarks or/and states built of hadrons, called molecular states.
In this thesis we study baryon resonances with heavy flavor, molecular states generated dynamically from the scattering of mesons with baryons. For this purpose we use a model which respects two important symmetries Quantum Chromodynamics, chiral symmetry and heavy-quark spin symmetry.
We find charm and strange baryon resonances that can be compared to experimental states, and also make predictions for other states, with total number of charm 1, 2, and 3. Moreover, two bottom-flavored states with masses 5912 and 5920 MeV have been obtained in our model. These states were found by the LHCb collaboration last year. We have also analyzed hidden-charm baryon resonances, and predict states with masses around 4 GeV, most of them as bound states. All these results will be tested in the near future by the PANDA experiment at the FAIR facility in Germany.
Sfondrini, A. (UU)
thesis title: *Towards integrability for AdS3/CFT2*
advisor: Prof. G.E. Arutyunov
date: 28 April 2014
present position: postdoctoral fellow, Humboldt University, Berlin, Germany

In this thesis we consider certain supersymmetric string theories on curved backgrounds containing the three-dimensional anti-de Sitter space, AdS3. On the one hand, these are gravity theories in three dimensions, which makes them simpler than real-world gravity but still rich in interesting phenomena. On the other hand, according to the holographic duality, each of these gravitational theories should be equivalent to a suitable quantum field theory with conformal symmetry in two dimensions, a CFT2. In that low dimension, such conformal field theories enjoy an infinite-dimensional Virasoro symmetry which strongly constrains them, but remain non-trivial. Our study is confined to a particular regime, the 't Hooft limit, in which the strings propagate freely. Free string theory can be described as a non-linear sigma model from the string worldsheet (geometrically, a two-dimensional cylinder) into a target space of the form AdS3xM, where M is a manifold without boundary. For us, M is a product of circles and three-dimensional spheres, namely M=S3xT4 or M=S3xS3xS1, both of which enjoy 16 supersymmetries. For the sake of brevity, our presentation is mostly focused on the massive sector of the former geometry, while more general cases are discussed in the concluding chapter. Our main result is to describe how these theories are integrable at the quantum level, i.e. how their worldsheet scattering matrix factorises and their spectrum can be efficiently computed by Bethe ansatz techniques. This is done both from the point of view of the worldsheet theory and of a dual spin chain picture. We also discuss how this procedure is supported by overwhelming evidence from independent (perturbative or semiclassical) calculations, up to two loops in the worldsheet theory expansion.

Toldo, C. (UU)
thesis title: *Anti-de Sitter black holes in gauged supergravity*
advisor: Prof. S.J.G. Vandoren
date: 11 June 2014
present position: postdoctoral fellow, Columbia University, New York, USA

This thesis is devoted to the analysis of asymptotically Anti-de Sitter (AdS) black holes arising as solutions of theories of gauged Supergravity in four spacetime dimensions. After a brief recap of the main features of gauged supergravity, the first part of the thesis deals with the explicit construction of solutions and the analysis of the Supergravity flow equations in Fayet-Iliopoulos N=2 gauged supergravity. First of all we analyze the known examples of static supersymmetric extremal Anti-de Sitter black hole solutions in this theory. Then we provide techniques to generalize these solutions to extremal non-supersymmetric ones, found by solving a set of first
order equations. Subsequently we find nonextremal solutions, namely black holes with nonvanishing temperature. These configurations are found by solving the full system of the Maxwell-Einstein-scalar equations of motion. We finally make new steps towards a systematic approach to find the most general black hole solution in Fayet-Iliopoulos gauged supergravity. Configurations found by this procedure have nonvanishing angular momentum, electric and magnetic charge, mass and NUT charge. In the second part of the thesis we focus on the nonextremal AdS static solutions and we study the thermodynamics of these configurations. We compute the conserved charges of the solutions and we show that the first law of thermodynamics holds. In the canonical ensemble we discover a first order phase transition between small, hairy black holes and large, less-hairy ones, when the charge is below a critical value. We analyze this phase transition in the dual field theory via the AdS/CFT correspondence, and we find that the process can be interpreted as a liquid-gas phase transition in the dual field theory, that falls in the class of ABJM models. Furthermore we provide some details about the thermodynamics of the rotating configurations. We then compare the various definition of mass for asymptotically Anti-de Sitter configurations. We compute the mass with the Ashtekar-Magnon-Das procedure and by means of holographic renormalization techniques. We provide a set of first order equations for nonextrema static configurations by a suitable squaring of the one-dimensional reduced action. Finally we also provide the correct BPS bound for stationary configurations. We conclude the thesis with further remarks and possible directions of future research.

van den Broek, T.C.H. (RU)
thesis title: Supersymmetry and the spectral action: on a geometrical interpretation of the MSSM
advisor: Prof. R.H.P. Kleiss
date: 5 September 2014
present position: Advisor, Andersson Elffers Felix, Utrecht, the Netherlands

This PhD thesis aims at combining the framework of noncommutative geometry and supersymmetry. A particular class of non-commutative geometries called almost-commutative geometries can be used to describe particle theories. This thesis contains a systematic search for such almost-commutative geometries whose corresponding spectral action exhibits supersymmetry. Chapter 2 discusses extensions of the Standard Model in the context of noncommutative geometry in general. In Chapter three a framework is developed to build and analyze potential supersymmetric theories. Chapter 4 covers supersymmetry breaking mechanisms in this context. Finally, the approach of Chapter three is applied to what is to yield the non-commutative version of the MSSM in Chapter 5.
van der Bijl, E. (UU)
thesis title: *Spin currents and magnetization dynamics in multilayer systems*
advisor: Prof. H.T.C. Stoof
co-advisor: Dr. R.A. Duine
date: 28 January 2014
present position: postdoctoral fellow, Netherlands Cancer Institute, NCI, the Netherlands

In this thesis the interplay between spin currents and magnetization dynamics is investigated theoretically. With the help of a simple model the relevant physical phenomena are introduced. From this model it can be deduced that in systems with small spin-orbit coupling, current-induced torques on the magnetization require inhomogeneous magnetization textures. For systems exhibiting large spin-orbit coupling, expected to be present in multilayer structures, such torques exist even without gradients in the magnetization direction. We consider current-induced torques in ferromagnetic metals with both Rashba spin-orbit coupling and inhomogeneous magnetization. We first construct all torques that are allowed by the symmetries of the system, to first order in magnetization-direction gradients and electric field. Subsequently, we use a Boltzmann approach to calculate the spin torques that arise to second order in the spin-orbit coupling. We apply our results to current-driven domain-wall motion and find that the domain-wall mobility is strongly affected by torques that result from the interplay between spin-orbit coupling and inhomogeneity of the magnetization texture. In Chapter 4 we consider the spin torques induced by a temperature gradient for systems with strong spin-orbit coupling. Using a fictitious gravitational field the thermal linear response coefficients can be calculated using a Kubo formula. However, without properly accounting for equilibrium components unphysical divergences are encountered. We show how to remove these difficulties and predict how the electrically and thermally induced spin-orbit torques change the resonance amplitudes and frequencies in a ferromagnetic resonance experiment. In Chapter 5 we propose an effect whereby an electric current along the interface between a ferromagnetic and normal metal leads to injection of pure spin current into the normal metal, if the magnetization-direction in the ferromagnet varies along the direction of current. For the specific example of a spiral spin structure, we compute the voltage induced via the inverse spin-Hall effect. Furthermore, we show that this pure spin current leads to modification of the parameters that govern the spin-transfer torques and current-driven domain-wall motion, which can be used to optimize the latter in layered magnetic systems. This effect in principle enables control over the location of spin-current injection in devices. In the last scientific Chapter of the Thesis we study the motion of a magnetic domain wall through a disordered potential. This is done by simulations of the two dimensional random-bond Ising model. The domain walls are driven by an applied field. For low fields the velocity is expected to be described by the creep law. Our
results indicate roughness and creep motion exponents that are in agreement with values reported in the literature.

van der Schee, W. (UU)
thesis title: *Gravitational collisions and the quark-gluon plasma* 
advisors: Prof. T. Peitzmann and Prof. G.E. Arutyunov
date: 2 July 2014
present position: postdoctoral fellow, MIT, Boston, USA

This thesis addresses the thermalisation of heavy-ion collisions within the context of the AdS/CFT duality. The first part clarifies the numerical set-up and studies the relaxation of far-from-equilibrium modes in homogeneous systems. Less trivially we then study colliding shock waves and uncover a transparent regime where the strongly coupled shocks initially pass right through each other. Furthermore, in this regime the later plasma relaxation is insensitive to the longitudinal profile of the shock, implying in particular a universal rapidity shape at strong coupling and high collision energies. Lastly, we study radial expansion in a boost-invariant set-up, allowing us to find good agreement with head-on collisions performed at the LHC accelerator. As a secondary goal of this thesis, a special effort is made to clearly expose numerical computations by providing commented Mathematica notebooks for most calculations presented. Furthermore, we provide interpolating functions of the geometries computed, which can be of use in other projects.
4.4 Other PhD's advised by DRSTP staff

Zargar, R. (UvA)
thesis title: *Thermodynamics and vibrational modes of hard sphere colloidal systems*
advisors: Prof. D. Bonn and Prof. B. Nienhuis

4.5 PhD students (per 31-12-2014)

*This section gives an overview of the PhD students affiliated to the DRSTP on 31 December 2014. The projects are chronologically ordered according to starting date. The research themes mentioned refer to particle physics, cosmology, quantum gravity and string theory (theme 1) and quantum matter, quantum information, soft condensed matter and biophysics (theme 2).*

**University of Amsterdam (UvA)**

- Wouters, B.M. as of 1 October 2010 with E.P. Verlinde.
  project: string theory and the emergence of gravity (theme 1).

- Eliëns, I.S. as of 1 September 2011 with J.-S. Caux (K. Schoutens, formal advisor).
  project: to provide the theory support in the search for and recognition of Luttinger liquid behaviour in the planned experiments by other teams (theme 2).

- Mayerson, D.R. as of 1 September 2011 with J. de Boer.
  project: research in the topic of the AdS/CFT correspondence, a conjecture in string theory that makes it possible to study strongly coupled field theories holographically using gravity models. An especially active topic at the moment is applications of AdS/CFT to condensed matter theory, which includes the study of holographic models for superconductors and (non-)fermi liquids (theme 1).

- Mosk, B. as of 1 September 2011 with J.P. van der Schaar (J. de Boer, formal advisor).
  project: to investigate how the vacuum evolves if compact dimensions grow in size and to what kind of excitations such an evolution might lead (theme 1).

- Fokkema, T.B. as of 12 September 2011 with J.-S. Caux (K. Schoutens, formal advisor).
  project: focus on the theory for the in- and out-of-equilibrium dynamics of interacting Bose gases, using the exact integrability of the underlying systas a base (theme 2).
- de Lange, P. as of 13 September 2011 with E.P. Verlinde.
  project: most prominently the fundamental role of space-time will be
  investigated by considering both black-hole solutions in string theory and
  both sides of the AdS/CFT conjecture (theme 1).

- de Nardis, J. as of 1 October 2011 with J.-S. Caux (K. Schoutens, formal
  advisor).
  project: the main focus will be on the calculation of observable dynamical
  response functions such as spin-spin correlations (theme 2).

- Pinzani Fokeeva, D. as of 19 October 2011 with M.M. Taylor
  (K. Skenderis, formal advisor).
  project: development of holographic models for condensed matter systems
  (theme 1).

- Feher, G. as of 1 February 2012 with B. Nienhuis.
  project: exact correlation functions from qKZ equations (theme 2).

- van den Berg, R. as of 1 September 2012 with J.-S. Caux.
  project: study of Gaudin models and spin chains with possible
  applications to experiments (theme 2).

- Vlijm, R.P. as of 1 September 2012 with J.-S. Caux.
  project: low dimensional magnetism in and out of equilibrium; correlation
  functions of spin chains using Algebraic Bethe Ansatz approach (theme
  2).

- Rietkerk, R.J. as of 15 September 2012 with E.L.M.P. Laenen.
  project: computing (quantum corrections) to top and Higgs collider
  processes. Develop (automated) tools thereto (theme 1).

- Silverwood, H.G.M. as of 1 October 2012 with G.F. Bertone (J. de Boer,
  formal advisor).
  project: astroparticle phenomenology specifically direct and indirect dark
  matter detection, and determination of local properties of the dark matter
  hole (theme 1).

- Ilgin, I. as of 1 November 2012 with A. Turner (E.P. Verlinde, formal
  advisor)
  project: to study and develop the principles behind the emergence of space
  time in physical contexts with event horizons, such as black holes, as well
  as horizon-free settings (theme 1).

- Cohen Maldomado, D.B. as of 15 September 2013 with A. Castro (J. de
  Boer, formal advisor).
  project: research is related with the Kerr/CFT duality. It is known that in
  the extremal Kerr black hole, the near horizon quantum states can be
identified with two dimensional conformal field theory. In the non extremal case, though we can’t do the same approach that the extremal case to show this duality, the scalar wave equation show a conformal group symmetry which show insights that somehow this property is present even if the black hole is not extremal. Understanding this is still an open question and it’s relevance is related with the fact that the Kerr black hole is potentially related with physical objects in our Universe. (theme 1).

- Dimitrakopoulos, F. as of 1 September 2013 with B. Freivogel (J. de Boer, formal advisor).
  project: topics in classical and quantum gravity, cosmology and string theory: stability of anti de Sitter and asymptotically anti de Sitter spacetimes, the quantum initial state and topics in conformal field theories (theme 1).

- Feyereisen, M.R. as of 1 September 2013 with S. Ando (J. de Boer, formal advisor).
  project: to study the γ-ray flux probability distribution from dark matter annihilation in extragalactic holes. The γ-ray luminosity of blazars (a known background for the annihilation signal) is also studied (theme 1).

- Kabir, L. as of 1 September 2013 with B. Freivogel and J.P. van der Schaar (J. de Boer, formal advisor).
  project: quantum gravity and cosmology (theme 1).

- Arvidsson Liem, S. as of 2 September 2013 with G.F. Bertone (J. de Boer, formal advisor).
  project: searching for dark matter at the LHC and with astroparticle experiments (theme 1).

- Jefferson, R.A. as of 15 September 2013 with B. Freivogel (E.P. Verlinde, formal advisor).
  project: connecting quantum gravity to cosmology (theme 1).

- Diamanti, R.D. as of 1 October 2013 with S. Ando and G.F. Bertone (J. de Boer, formal advisor).
  project: implication of particle physics models for indirect dark matter searches (theme 1).

- Niesen, I.A. as of 15 July 2014 with P.H. Corboz (J.-S. Caux, formal advisor)
  project: investigation of 2D spin systems on triangular lattices using tensor network algorithms (theme 2).
- van Leuven, S.P.G. as of 15 July 2014 with M. Cheng (E.P. Verlinde, formal advisor)
  project: gauge dynamics and emergent geometry. Understanding the gd (2,0) theory through AGT type correspondence. Studying generalizations of the AGT correspondence (theme 1).

- Bartels, R.T. as of 1 September 2014 with C. Weniger (J. de Boer, formal advisor)
  project: phenomenology of particle dark matter, in particular in the context of indirect detection (theme 1).

- Visser, M.R. as of 1 September 2014 with E.P. Verlinde
  project: the emergence of space and gravity from entanglement (theme 1).

- Llabrés Llambias, E.M. as of 15 September 2014 with A. Castro (J. de Boer, formal advisor)
  project: emergence of space-time through entanglement entropy, in the context of AdS/CFT duality (theme 1).

- Oling, G.W.J. as of 15 September 2014 with D. Hofman (J. de Boer, formal advisor)
  project: string theory, holography and plan to investigate de Sitter holography (theme 1).

- van Caspel, M.T. as of 15 September 2014 with V. Gritsev (J.-S. Caux, formal advisor)
  project: to investigate the properties of open quantum systems with multiple steady states (theme 2).

- Ferrari, F.F. as of 1 October 2014 with M. Cheng (E.P. Verlinde, formal advisor).
  project: understanding the ‘Umbral Moonshine’ phenomenon in terms of CFT and string theory. We will research the symmetric aspects of conformal field theories related to K3 manifolds and the related compactifications in string theory (theme 1).

- Klop, L.B. as of 15 October 2014 with S. Ando (J. de Boer, formal advisor).
  project: theoretically address astrophysical uncertainties in order to understand underlying dark matter component better (theme 1).

**Vrije Universiteit Amsterdam (VUA)**
- Buffing, M.G.A. as of 1 September 2011 with P.J.G. Mulders.
  project: transverse momentum dependent gluon distributions and color gauge invariance (theme 1). PhD exam: 16 September 2015.
  project: development of computational models for fiber networks (theme 2).

- Signori, A. as of 1 November 2012 with P.J.G. Mulders.
  project: theoretical aspects of transverse momentum dependent parton
distribution functions as part of the FOM project "QCD at work in the
Higgs sector" (theme 1).

- Cotogno, S. as of 1 October 2014 with P.J.G. Mulders.
  project: transverse momentum dependent distribution and fragmentation
functions - theory and phenomenology (theme 1).

- van Daal, T. as of 20 October 2014 with P.J.G. Mulders and D. Boer
  (RUG).
  project: transverse momentum of partons in nucleons, fundamental and
phenomenological aspects (theme 1).

University of Groningen (RUG)
- Andringa, R. as of 1 September 2008 with E.A. Bergshoeff.
  project: properties of gravitational theories in three-dimensional
space-time, in particular with regard to contributions of higher
order in the curvature, and to black holes (theme 1).

- Nunes da Silva, T.J. as of 1 October 2010 with E. Pallante.
  project: understanding how conformality is restored in non-abelian gauge
theories and its consequences, with particular focus on LHC physics
(theme 1).

- Dekens, W.G. as of 1 September 2011 with D. Boer and R.G.E.
  Timmermans.
  project: parity violation and weak charges of quarks (theme 1).

- Kovačević, M. as of 1 October 2011 with E.A. Bergshoeff.
  project: gravity in three dimensions as a road to quantum gravity (theme
1).

- Vos, K.K. as of 1 December 2011 with R.G.E. Timmermans and H.W.
  Wilschut.
  project: theory beyond the standard model of particle physics in β-decay
(theme 1).

- Zojer, T. as of 1 January 2012 with E.A. Bergshoeff.
  project: higher-spin and higher-derivative gravity (theme 1).

- Scalisi, M. as of 1 April 2012 with D. Roest (E.A. Bergshoeff, formal
advisor).
project: signatures of string inflation (theme 1).

- Parra Rodriguez, L. as of 1 April 2013 with E.A. Bergshoeff.
  project: extensions of gravity both to include higher-derivative terms in the Riemann curvature as well as to higher spins; new massive gravity (theme 1).

- Basanisi, L. as of 1 September 2013 with E.A. Bergshoeff.
  project: first aim: investigate models of three-dimensional gravity; second aim: investigate the role of branes in string theory in particular their classification and their relation to different proposals for the geometry underlying string theory (theme 1).

- Galante, M. as of 1 September 2013 with D. Roest (E.A. Bergshoeff, formal advisor).
  project: study of the new one parameter family of SO(8) gauged supergravities. In particular, inflation scenarios and cosmological implications of that theory (theme 1).

- Alkac, G. as of 15 October 2013 with E.A. Bergshoeff.
  project: models of gravity in three spacetime dimensions, especially their supersymmetric and higher spin extensions (theme 1).

- Coone, A.A. as of 16 January 2014 with D. Roest (E.A. Bergshoeff, formal advisor).
  project: to investigate whether the initial conditions of the very early Universe can be understood from inflation; particular focus will be placed on the role of (conformal) symmetry and/or genericity (theme 1).

- Brijan, J.-W. as of 16 March 2014 with K. Papadodimas (E.A. Bergshoeff, formal advisor).
  project: black holes and the AdS/CFT correspondence (theme 1).

- Penas, V.A. as of 1 June 2014 with E.A. Bergshoeff.
  project: extensions of gravity both to include higher-derivative terms in the Riemann curvature as well as to higher spins; new massive gravity (theme 1).

- Barragán Amado, J.J. as of 1 August 2014 with E. Pallante.
  project: conformal symmetry in strongly coupled theories (theme 1).

- Klein, R. as of 1 September 2014 with D. Roest (E.A. Bergshoeff, formal advisor).
  project: improve our understanding of the initial conditions for the very early Universe. Particular emphasis will be placed on the conditions that result from inflation (theme 1).
Leiden University (UL)
- van Ostaay, J. as of 1 September 2009 with C.W.J. Beenakker.

- van Heck, B. as of 1 June 2011 with C.W.J. Beenakker.
  project: quantum transport in topological insulators and graphene (theme 2).

- Bagrov, A. as of 1 September 2011 with K.E. Schalm (J. Zaanen, formal advisor).
  project: application of AdS/DFT to condensed matter physics and quantum criticality in particular (theme 2).

- Mi, S. as of 1 September 2011 with C.W.J. Beenakker.
  project: transport properties of topological insulators and graphene (theme 2).

- Atal, V. as of 1 October 2011 with A. Achúcarro.
  project: observational tests for inflationary cosmology (theme 1).

- Ivashko, A. as of 1 October 2011 with A. Boyarsky (A. Achúcarro, formal advisor).
  project: particle physics beyond the standard model, the early universe (theme 1).

- Schram, R. as of 1 October 2011 with H. Schiessel and G.T. Barkema.
  project: polymer simulation models for large scale chromatin organisation, identification of possible segregation mechanisms of the sister chromosomes after duplication (theme 2).

- Beuman, T.H. as of 1 December 2011 with V. Vitelli (M. van Hecke, formal advisor).
  project: the stochastic geometry of non-Gaussian fields (theme 2).

- Slager, R.-J. as of 1 January 2012 with J. Zaanen.
  project: research in the role of translational symmetry breaking in electronic topological order (theme 2).

- Diez, M. as of 1 February 2012 with C.W.J. Beenakker.
  project: study of topological phase transitions and superconductors in order to identify signatures in transport and thermodynamic properties of those transitions (theme 2).

- Liu, K. as of 1 September 2012 with J. Zaanen.
  project: gravity at a Kelvin: the collective modes of the superconducting quantum nematics (theme 2).
- Meszéna, B. as of 1 September 2012 with K. Schalm (J. Zaanen, formal advisor).
  project: applying the AdS/CFT correspondence to condensed matter systems (theme 1).

- Baireuther, P.S. as of 7 January 2013 with C.W.J. Beenakker and Y. Nazarov (TU Delft).
  project: transport properties of topological insulators and superconductors (theme 2).

- Tarasinski, B.M. as of 7 January 2013 with C.W.J. Beenakker.
  project: quantum transport properties of topological states of matter (theme 2).

- Almog, A. as of 14 January 2013 with D. Garlaschelli (J.M. van Ruitenbeek, formal advisor).
  project: statistical physics of time series and financial networks (theme 2).

  project: theory and computer simulation of the motion of domain walls in small-scale magnetic materials, driven by either a current or by an external field (theme 2).

- Saravanan, S.K. as of 1 July 2013 with J.-W. van Holten.
  project: extreme mass ratio binaries (theme 1).

- Säterskog, P. as of 1 September 2013 with K. Schalm (A. Achúcarro, formal advisor).
  project: strongly coupled systems using holography and AdS/CFT (theme 1).

- Sulangi, M. as of 1 September 2013 with J. Zaanen.
  project: to explore nano experiments on quantum matter (theme 2).

- Tompitak, M. as of 1 September 2013 with G.T. Barkema and H. Schiessel.
  project: sequence dependent plectoneme dynamics (theme 2).

- Babeanu, A.-I. as of 15 September 2013 with D. Garlaschelli (J. van Ruitenbeek, formal advisor).
  project: statistical physics and social dynamics (theme 2).

- van Zuiden, B.C. as of 15 September 2013 with V. Vitelli (M. van Hecke, formal advisor).
  project: theoretical investigations of melting on a curved space (theme 2).
  project: signatures of topological superconductivity in oxide interfaces (theme 2).

- Zhou, Y. as of 17 September 2013 with V. Vitelli (M. van Hecke, formal advisor).
  project: topological soft matter and active matter (theme 2).

- Poovuttikul, N. as of 1 October 2013 with J. Zaanen.
  project: quantum matter versus the AdS/CFT correspondence (theme 2).

- Torrado Cacho, J. as of 1 October 2013 with A. Achúcarro.
  project: signatures of heavy physics in the primordial perturbations (theme 1). PhD exam: 31 March 2015.

- Gemmetto, V. as of 1 November 2013 with D. Garlaschelli (J. van Ruitenbeek, formal advisor).
  project: multilevel complex networks (theme 2).

- Green, R. as of 1 March 2014 with V. Vitelli (M. van Heck, formal advisor).
  project: to investigate order in toroidal nematic liquid crystal; study topological soft matter classical systems and associated phase transitions; investigate overlap between soft (theme 2).

- Ostroukh, V. as of 1 August 2014 with C.W.J. Beenakker.
  project: transport theory of topological insulators and superconductors (theme 2).

- Benenkowski, B. as of 1 September 2014 with K. Schalm.
  project: AdS/CFT: the application of holographic methods for strongly coupled theories to puzzles in strongly correlated condensed matter systems (theme 1).

- Bondarenko, K. as of 1 September 2014 with A. Boyarsky (A. Achúcarro, formal advisor).
  project: physics beyond the standard model at accelerators and in the universe (theme 1).

- Grubinskas, S. as of 1 September 2014 with L. Frits (UU) and V. Cheianov (UL) (C.W.J. Beenakker, formal advisor).
  project: impurities in Dirac and Weyl semimetals (theme 2).
- Bovenzi, N. as of 1 October 2014 with C.W.J. Beenakker.
  project: transport properties of topological insulators oxide interfaces
  (theme 2).

- Welling, Y.M. as of 1 October 2014 with A. Achúcarro.
  project: to study how primordial non-Gaussianities are effecting the
distribution of dark matter at late times; this is in the framework of EFT
of LSI (theme 1).

Radboud University Nijmegen (RU)
- Pires, L.P. as of 1 February 2012 with R. Loll.
  project: low energy/classical limits of Horava-Lifshitz gravity in its
different versions. Connections between Horava-Lifshitz gravity (HLG)
and causal dynamical triangulations (CDT) (theme 1).

- Ado, I. as of 1 December 2013 with M. Titov (M.I. Katsnelson, formal
advisor).
  project: condensed matter theory with the emphasis on topological effects
in nanostructures involving magnetic materials (theme 2).

- Alkofer, N. as of 1 April 2014 with F.S. Saueressig (R. Loll, formal
advisor).
  project: black hole dynamics in asymptotically safe quantum gravity
(theme 1).

- Donker, H.C. as of 1 August 2014 with M. Titov (M. Katsnelson, formal
advisor).
  project: condensed matter theory with the emphasis on topological effects
in nanostructures involving magnetic materials (theme 2).

Utrecht University (UU)
- Franzen, A.T. as of 1 June 2009 with G. ‘t Hooft.
  project: algebraical description of quantum effects of the horizon of black
holes and related aspects of quantum field theories (theme 1).

- Troppenz, T. as of 7 September 2010 with R.H.H.G. van Roij (M. Dijkstra
(UU), formal advisor).
  project: to study the thermodynamic and structural properties of
(nano)rods in emulsion droplets exposed to external electric fields (theme
2).

- Glavan, D. as of 1 May 2011 with T. Prokopec (R. Loll, formal advisor).
  project: to develop methods for evaluating the backreaction of quantum
fluctuations of scalar and tensor fields in general expanding space times
on the evolution of the Universe. He will investigate to what extend can
the backreaction change the evolution of the Universe during an
inflationary phase as well as in a late universe, thereby studying its relevance for dark energy (theme 1).

project: to study interactions between proteins in aqueous solution at such high concentrations that there is a lack of hydration water and the proteins partially denature (theme 2).

- Di Liberto, M. as of 15 July 2011 with C. Morais Smith.
project: to study strongly interacting cold atoms out of equilibrium in optical lattices. In particular, the Floquet theory will be used to derive effective models out of the time-dependent ones. Quantum novel phases will be investigated, always keeping in mind their possible experimental realization (theme 2).

- Armaitis, J. as of 1 September 2011 with R.A. Duine (H.T.C. Stoof, formal advisor).
project: many-body effects in cold-atom systems, especially spin transport in mixtures of bosonic atoms (theme 2).

- Borsato, R. as of 1 September 2011 with G.E. Arutyunov.
project: research is concentrated on study strings propagating in integrable backgrounds, the latter include beta-deformations of the AdS$_5$ x S$^5$ space-time. The main goal is to construct a rigorous quantization scheme by using methods from the theory of exactly solvable models (theme 1). PhD exam: 7 September 2015.

- Jacobs, V. as of 1 September 2011 with S.J.G. Vandoren (H.T.C. Stoof, formal advisor).
project: applications of the AdS/CFT correspondence to condensed matter systems at strong coupling. In particular, the study of black hole solutions with anisotropic Lifshitz scaling, and its connection to cold Fermi gasses at unitarity (theme 2). PhD exam: 24 August 2015.

- de Leeuw, A.-W. as of 1 September 2012 with R.A. Duine (H.T.C. Stoof, formal advisor).
project: collective phenomena in quantum-many body systems, in particular the out-of-equilibrium dynamics of photon Bose-Einstein condensates (theme 2).

- Everts, J. as of 1 September 2012 with R.H.H.G. van Roij.
project: electrostatics in oil (theme 2).

- Lamers, J. as of 1 September 2012 with G.E. Arutyunov.
project: to study a newly discovered relationship between vacua of N=2 supersymmetric gauge theories and integrable models (theme 1).
- Gaddam, N. as of 1 January 2013 with S.J.G. Vandoren.
  project: a microscopic understanding of black holes in gauged $N = 2$ supergravity theories, including bulk realizations of related (0,4) SCFTs. A study of single center black hole entropies in $N = 2$ ungauged supergravity, topological invariants of related quiver gauge theories and corresponding counting problems in algebraic geometry. A preliminary interest in holographic realizations of fractional quantum Hall effect and confining geometries (theme 1).

- Buhrandt, S. as of 1 February 2013 with L. Fritz (H.T.C. Stoof, formal advisor).
  project: to study the properties of (frustrated) magnets and their unconventional excitations, including for instance analogues of magnetic monopoles (theme 2).

- Soligno, G. as of 1 February 2013 with R.H.H.G. van Roij.
  project: effective electrostatic and capillary interactions at particle-laden aqueous interfaces (theme 2).

- Flebus, B. as of 1 April 2013 with R.A. Duine (H.T.C. Stoof, formal advisor).
  project: definition of a two-fluid theory for spin superfluidity in magnetic insulators (theme 2).

- Janssen, M.A. as of 1 May 2013 with R.H.H.G. van Roij.
  project: modeling the electrical double layer near the surface of nanoporous super capacitors, aiming at the optimization of capacitivemixing and water desalination processes (theme 2).

- Jain, S.K. as of 13 August 2013 with G.T. Barkema.
  project: to develop an empirical potential and atomistic models of a solar cell and graphene (theme 2).

- Betzios, P. as of 1 September 2013 with U. Gürsoy (S.J.G. Vandoren, formal advisor).
  project: applications of gauge/gravity duality in strongly coupled systems (theme 1).

- Papadoulaki, O. as of 1 September 2013 with U. Gürsoy (S.J.G. Vandoren, formal advisor).
  project: exploration of QCD and condensed matter systems using gauge/gravity duality (theme 1).

- Quelle, A. as of 1 September 2013 with C. Morais Smith.
  project: various aspects of topological materials out of equilibrium, thermodynamics, non-trivial geometry, etc. (theme 2).
- Sybesma, Z.W. as of 1 September 2013 with S.J.G. Vandoren.  
project: on the elucidation of the applications of AdS/CFT holography (theme 1).

- Bet, B. as of 1 October 2013 with R.H.H.G. van Roij.  
project: to study the individual and collective properties of active matter: particles on micrometer scale that transform energy into movement. In particular, we use numerical methods to describe the hydrodynamics of colloidal 'swimmers' (theme 2).

- Gergs, N.M. as of 1 October 2013 with D. Schuricht (C. Morais Smith, formal advisor).  
project: transport properties and out of equilibrium dynamics of low-dimensional strongly correlated quantum systems (theme 2).

- Jansen, A.P. as of 1 February 2014 with U. Gursoy (S.J.G. Vandoren, formal advisor).  
project: to study the dynamics of strongly coupled plamas in non-equilibrium and extreme conditions such as high temperature and magnetic fields, by means of gauge-gravity duality (theme 1).

- Küppersbusch, C.S. as of 1 February 2014 with L. Frits (C. Morais Smith, formal advisor).  
project: interaction effects in electronic systems of two dimensions with linear and quadratic dispersion (theme 2).

- Drwenski, T. as of 1 September 2014 with R.H.H.G. van Roij.  
project: theoretical and/or numerical studies of soft-matter systems in and/or out of equilibrium, initially focussing on liquid crystals of changed/flexible/chiral particles (theme 2).

- Menezes, N. as of 1 September 2014 with C. Morais Smith.  
project: pseudo-QED, which is a formalism that projects the 3D dynamics of photons into a 2D plane to appropriately describe the interactions among electrons in 2D systems, such as graphene, silicene, and topological insulators (theme 2).

- van der Woude, D. as of 1 September 2014 with E. Pajer (S.J.G. Vandoren, formal advisor).  
project: effective field theory of large scale structure (theme 1).

- van Miert, G. as of 11 September 2014 with C. Morais Smith.  
project: describe topological properties of artificial graphene nanocrystals superlattices; to investigate the effect of disorder in this system as well as the response to external (theme 2).
- Liao, L.L. as of 1 October 2014 with H.T.C. Stoof.
  project: Bose-Einstein condensation of photons (theme 2).

- Liu, L.L.H. as of 1 October 2014 with T. Prokopec (S.J.G. Vandoren, formal advisor).
  project: to study the Higgs sector of the standard model, enriched by additional CP violating scalar fields during infusion. The goal is to investigate whether the model can be used to create cosmological perturbations and matter - anti-matter density consistent with observation (theme 1).

- Puskarov, T. as of 1 October 2014 with D. Schuricht (H.T.C. Stoof, formal advisor).
  project: time-evolution and relaxation of low-dimensional quantum systems after local and global quenches in the interaction parameters (theme 2).

- Plantz, N.W.M. as of 1 November 2014 with H. Stoof and S.J.G. Vandoren.
  project: holography for an ultracold boson gas at unitarity (theme 1).

  project: to investigate the Berry phase's signatures in ultra-cold atomic systems, where interactions and external magnetic fields (inhomogenous) are induced (theme 2).

**Nikhef Theory Group (Nikhef)**

- De Bruyn, K.A.M. as of 1 June 2011 with R. Fleischer and D. Koppenburg (M.M. Merk, formal advisor).
  project: CP-violating phenomena in B-meson decays (theme 1).

- d'Ambrosi, G. as of 15 September 2011 with J.-W. van Holten and J.F.J. van den Brand (VUA).
  project: research on the emission of gravitational waves by binary systems consisting of a massive black hole and a second compact object (theme 1).

- Bonocore, D. as of 1 December 2011 with E. Laenen.
  project: QCD processes at the LHC; precision predictions via resummation and/or Monte Carlo. Development of new methods thereto (theme 1).

- Reys, V. as of 1 March 2012 with B. de Wit.
  project: study of BPS black hole entropy using localization, and possibly other applications (theme 1).
- Ciceri, F. as of 15 November 2012 with B. de Wit.
  project: study of higher-derivative couplings in supergravity with
  applications to black hole entropy and the question of finiteness (theme
  1).

- Wiechers, M. as of 1 April 2013 with M. Postma (formal advisor, E.L.M.P.
  Laenen).
  project: to study models of dark matter and their phenomenological
  implications. The focus is on models that relate ordinary and dark matter
  and thus explain why their respective abundances are so similar (theme
  1).

- Ruijl, B.J.G. as of 1 September 2013 with J. Vermaseren (formal advisor,
  S. Bentvelsen)
  project: using methods from artificial intelligence, we solve problems in
  high energy physics, particularly the computation of four-loop Feynman
  diagrams (theme 1).

- Fumagalli, J. as 1 November 2014 with M. Postma (formal advisor, E.L.M.P. Laenen).
  project: to study extensions of the Standard Model, and their particle and
  cosmological phenomenology, focusing on models that can describe
  inflation, the period of accelerated expansion in the early universe (theme
  1)
4.6 Scientific and educational activities of PhD students (theme 1)

Alkofer, N. (RU)
- Spectral dimensions from the spectral action, Oberwölz Symposium, Oberwölz, Austria, 11 September 2014 (talk).
- Spectral dimensions from the spectral action, PhD Day Dutch Research School of Theoretical Physics, Utrecht, The Netherlands, 3 October 2014 (talk).
- Spectral dimensions from the spectral action, Workshop on Non-Perturbative Methods in Quantum Field Theory, Balatonfüred, Hungary, 8-10 October 2014 (talk).
- Dimensional reduction in asymptotically safe gravity, ERG2014, Int. Conf. on the Exact Renormalisation Group 2014, 22-26 September 2014 (talk).

Atal, V. (UL)
- Decoupling in the early Universe and the presence of high energy physics in the CMB, Leiden University, Leiden, the Netherlands, 8 October 2014 (seminar).
- Decoupling in the early Universe and the presence of high energy physics in the CMB, IPMU, Tokyo, Japan, 18 November 2014.

Arvidsson Liem, S.L.S. (UvA)
- Physics@FOM Veldhoven 2014, Conference, Veldhoven, the Netherlands, 21-22 January 2014 (attended).
- Astroparticle Physics 2014, Conference, Amsterdam, the Netherlands, 23-28 June 2014 (attended).
- What can an MET excess at LHC tell us about dark matter?, SLAC Summer Institute: Shining Light on Dark Matter, Summer School, Menlo Park, USA, 4-15 August 2014 (talk).
- Global scans of combined EFT operators, Amsterdam-Paris-Stockholm 4th meeting, Workshop, Amsterdam, the Netherlands, 29 September-1 October 2014 (talk).

Bartels, R.T. (UvA)
- Winter School, Odense, Denmark, 1-4 December 2014 (attended).

Basanisi, L. (RUG)
- Rigid supersymmetric theories in curved superspace, DRSTP THEP school, 27 January-7 February 2014 (talk).

Benenowski, B. (UL)
Betzios, P. (UU)
- Emergent gauge symmetry in condensed matter: the Kitaev model
  Quantum phase transitions and the Kitaev model, Conformal Gravity and
  Black Holes (talk).
- Summer School on String Theory and Holography - Portugal Amsterdam
  String Workshop 2014.
- Quantum Field Theory, String Theory and Condensed Matter Physics,
  Kolymbari, Greece (attended).

Bonocore, D. (Nikhef)
- The Drell-Yan process beyond threshold, UCLA RadCor Loopfest 2015, 15-
  19 June 2015.

Borsato, R. (UU)
- Eta-deformed AdS5xS5, Imperial College of London, London, UK, February
  2014 (seminar).
- Kramers-Wannier duality in three dimensions, ITF Utrecht, Utrecht, the
  Netherlands, March 2014 (talk).
- Eta-deformed AdS5xS5, Humboldt University, Berlin, Germany, June
  2014 (seminar).
- Strongly coupled gauge theories, King’s College, London, UK, February
  2014 (attended)
- Integrability in gauge and string theory, Hamburg, Germany, July 2014
  (attended).
- Nordita School on Integrability, Stockholm, Sweden, August 2014
  (attended).
- Visit collaborator in Hamburg, Germany, October 2014.

Buffing, M.G.A. (VUA)
- How to observe color in hadronic interactions if you are color-blind,
  Physics@FOM 2014, Veldhoven, the Netherlands, 21-22 January 2014
  (talk).
- National Seminar Theoretical High Energy Physics, Amsterdam, the
  Netherlands, 21 March 2014 (attended).
- Color entanglement in hadronic processes for TMD PDFs, QCD Evolution
  Workshop, Santa Fe, USA, 12-16 May 2014 (talk).
- How to observe color in a color-blind world, C.N. Yang institute for
  Theoretical Physics, Stony Brook, USA, 19-23 May 2014 (talk).
- Color effect for transverse momentum dependent parton distribution
  functions in hadronic processes?, Light Cone 2014 Meeting, Raleigh, USA,
  26-31 May 2014 (talk).
- Universality of TMD correlators, Transversity 2014, Chia, Italy, 9-13
  June 2014 (talk).
- DRSTP PhD Day 2014, Utrecht, the Netherlands, 3 October 2014
  (attended).
- PLaneT talk, Utrecht, the Netherlands, 28 October 2014 (talk).
- National Seminar Theoretical High Energy Physics, Amsterdam, the Netherlands, 21 November 2014 (attended).
- *Gauge links and color structures in transverse momentum dependent correlators*, International Workshop on Frontiers of QCD, Mumbai, India, 2-5 December 2014 (invited talk).
- Visiting the IIT Bombay in Mumbai, India, during the week after the ‘International Workshop on Frontiers of QCD’ workshop for collaboration with local people, 8-12 December 2014 (visit).

**Cohen Maldonado, D.B. (UvA)**
- Solvay School, Theoretical Physics School, Brussels-Paris-Amsterdam, Belgium-France-the Netherlands, September-December 2013 (attended).
- FOM Veldhoven, Conference, Veldhoven, the Netherlands, January 2014 (attended).

**Coone, A.A. (RUG)**
- PhD Day, Groningen, the Netherlands, 20 September 2014 (attended).
- DRSTP school (talk).
- Modave Summer School in Mathematical Physics (attended).
- Advanced Course in Modern Cosmology by Alexei Starobinsky at the ITP Utrecht, the Netherlands (attended).
- Desy theory workshop (attended).
- University of Portsmouth, Portsmouth, UK (work visit).

**Cotogno, S. (VUA)**
- *Light front wave functions from AdS/QCD correspondence*, NNV meeting, Lunteren, the Netherlands, 7 November 2014 (talk).

**de Bruyn, K. (Nikhef)**
- European School of High Energy Physics (ESHEP), Garderen, the Netherlands, 18 June-1 July 2014 (attended).

**de Lange, P. (UvA)**
- *Global porperties of microstate geometries in six dimensions*, University of California, San Diego, USA, 19 April 2014 (talk).

**Diamanti, R. (UvA)**
- 19th Symposium on Astroparticle Physics, Hotel Spelderholt, Beekbergen, the Netherlands, 27-28 March 2014 (attended).
- Journal Club at GRAPPA Institute, University of Amsterdam, the Netherlands, 31 March 2014 (talk).
- Amsterdam-Paris-Stockholm 4th meeting, GRAPPA, University of Amsterdam, the Netherlands, 29 September-1 October 2014 (talk).

**Dimitrakopoulos, F. (UvA)**
- DRSTP Postgraduate Course, Theoretical High Energy Physics (THEP), Doorn, the Netherlands, 27 January-7 February 2014
- String Theory Workshop, Amsterdam, the Netherlands, June 2014 (attended).

**Feyereisen, M.R. (UvA)**
- CP3O Winter School, Odense, Denmark, December 2014 (attended).
- Jerusalem Winter School in Theoretical Physics, The Hebrew University, Jerusalem, Israel, December 2014-January 2015 (attended).

**Gaddam, N. (UU)**
- 32nd Jerusalem Winter School, The Hebrew University, Jerusalem, Israel, 29 December 2014-8 January 2015 (attended).
- AIO/OIO School, The DRSTP School for Statistical Physics and Theoretical Condensed Matter Physics, Doorn, the Netherlands, 10-21 March 2014 (attended).
- Cargese Summer School, Corsica, France, 2-13 June 2014 (attended).
- International Conference on "Recent Developments on String Theory", Ascona, Switzerland, 21-25 July 2014 (attended).
- *Black Hole physics as an inter-disciplinary science*, ITF, Utrecht, the Netherlands, 16 December 2014 (talk).

**Glavan, D. (UU)**
- *Late-time quantum backreaction in cosmology*, Workshop Modern Cosmology: Early Universe, LSS and CMB, Benasque, Spain, 3-16 August 2014 (talk).
- *Late-time quantum backreaction of a non-minimally coupled massless scalar*, Institute for Theoretical Physics, Autónoma University of Madrid, Madrid, Spain, 4 December 2014 (talk).
- *Late-time quantum backreaction of a non-minimally coupled massless scalar*, NORDITA, Stockholm, Sweden, 8 December 2014 (talk).
- *Late-time quantum backreaction of a non-minimally coupled massless scalar*, Helsinki Institute of Physics, University of Helsinki, Helsinki, Finland, 10 December 2014 (talk).
- *Late-time quantum backreaction of a non-minimally coupled massless scalar*, Department of Physics, University of Jyvaskyla, Jyvaskyla, Finland, 11 December 2014 (talk).
- *Late-time quantum backreaction of a non-minimally coupled massless scalar*, Rudjer Boskovic Institute, Zagreb, Croatia, 22 December 2014 (talk).

**Ilgin, I.I. (UvA)**
- Jerusalem Winter School in Theoretical Physics, Jerusalem, Israel, 30 December 2013-9 January 2014 (attended).
- Black Holes and Quantum Information Workshop, Rehovot, Israel, 12-17 January 2014 (attended).
- Cargese Summer Institute, Corsica, France, 2-14 June 2014 (attended).

Ivaskho, A. (UL)
- Cosmological magnetic fields generated by quantum effects, Physics@FOM Veldhoven, Veldhoven, the Netherlands, 21-22 January 2014 (talk).
- Electroweak interactions and unified theories, Moriond, La Thuile, Italy, 15-22 March 2014 (talk).
- Heavy neutral leptons in the space and at accelerators, 19th APP symposium, Beekbergen, the Netherlands, 27-28 March 2014 (talk).

Jefferson, R.A. (UvA)
- 32nd Winter School in Theoretical Physics: “100 Years of General Relativity: From Theory to Experiment and Back”, Israel Institute for Advanced Studies, Jerusalem, Israel, 29 December 2014-8 January 2015 (attended).

Kabir, L.R. (UvA)
- DRSTP Postgraduate Course, Theoretical High Energy Physics (THEP), Doorn, the Netherlands, 27 January-7 February 2014 (attended).
- Cargese School on Strings and Holography, Cargese, Corsica, 2-14 June 2014 (attended).
- Modave School in Mathematical Physics, Modave, Belgium, 1-5 September 2014 (attended).

Klein, R. (RUG)
- Workshop, Module on Scientific Integrity, 7 October 2014 (attended).

Korovins, J. (UvA)
- Spring School on Superstring Theory and Related Topics, Trieste, Italy, 31 March-8 April 2014 (attended).

Lamers, J. (UU)
- GQT Graduate School and Colloquium Zandvoort, the Netherlands, 3-7 November 2014 (attended).
- Introduction to quantum integrability, Modave Summer School in Mathematical Physics, Modave, Belgium, 1-5 September 2014 (lecture)
- Functional equations from the reflection algebra, Summer School on Quantum Groups and Integrability: Algebraic, Analytic and Geometric Aspects, Hamburg, Germany, 21-25 August 2014 (poster).
- Functional equations from the reflection algebra, Integrability in Gauge and String Theory (workshop), Hamburg, Germany, 14-18 August 2014 (poster).
- Integrability and Isomonodromy in Mathematical Physics (workshop), Lorentz Center, Leiden, the Netherlands, 7-11 July 2014 (attended).
- GQT Graduate School and Colloquium, Zeist, the Netherlands, 30 June-4 July 2014 (attended).
- *From supersymmetric gauge theories to quantum integrability*, DRSTP Postgraduate AIO/OIO School 2013 Theoretical High Energy Physics, Doorn, the Netherlands, 27 January-7 February 2014 (talk).
- GQT Graduate School and Colloquium, Zeist, the Netherlands, 14-18 January 2014 (attended).

**Mayerson, D.R. (UvA)**
- Workshop on Exotic Structures in Spacetime, Kyoto, Japan, 10-21 March 2014 (talk).
- *Exotic branes & 3D supergravity*, seminar, Groningen, the Netherlands, 8 May (talk).
- Amsterdam String Summer Workshop, Amsterdam, the Netherlands, 30 June-11 July 2014 (attended).
- *Exotic branes & 3D supergravity*, seminar, Copenhagen, Denmark, 22 October 2014 (talk).
- *Exotic branes & 3D supergravity*, seminar, Stony Brook, USA, 29 October 2014 (talk).
- *Exotic branes & 3D supergravity*, seminar, Chicago, USA, 12 November 2014 (talk).

**Merbis, W. (RUG)**
- *Massive gravity and holography in three dimensions*, Physics@FOM, Veldhoven, the Netherlands, 21 January 2014 (talk).
- Conference, Physics@FOM, Veldhoven, the Netherlands, January 2014 (attended).
- Conference, Cargèse Summer School in String Theory and Holography, Cargèse, France, June 2014 (attended).

**Meszena, B. (UL)**
- Holographic BCS theory, Bagrov, A., Meszéna, B., Physics@FOM Veldhoven, the Netherlands, 21-22 January 2014 (poster).
- FOM@ Veldhoven (workshop), the Netherlands, 21-22 January 2014 (attended).
- Amsterdam String Workshop, Amsterdam, the Netherlands, 30 June-11 July 2014 (attended).
- Physics with Industry (workshop), Lorentz Center, Leiden, the Netherlands, 24-28 November 2014 (attended).

**Mosk, B. (UvA)**
- Summer Workshop 2014 Theoretical Physics, Cargese, Corsica, 2014 (attended).
- **Vacua and correlators in hyperbolic de Sitter space**, Theoretical Cosmology Meeting, Amsterdam, the Netherlands, 5 December 2014 (talk).

**Nunes da Silva, T. (RUG)**
- **From the quark gluon plasma to strongly coupled conformal theories**, Quark Matter Conference, Darmstadt, Germany, 18-24 May 2014 (poster).
- Student Day, 18 May 2014 (attended).

**Parra Rodriguez, L. (RUG)**
- Introductory physics presentation, Groningen, the Netherlands, 29 August 2014 (presentation for bachelor students).
- PhD Day, Groningen, the Netherlands, 20 September 2014 (attended).
- **Supersymmetry, an introduction part I**, CTN high-energy postgraduate meeting, Groningen, the Netherlands, 10 March 2014 (talk).
- **Supersymmetry, an introduction part II**, CTN high-energy postgraduate meeting, Groningen, the Netherlands, 17 March 2014 (talk).

**Pinzani Fokeeva, N. (UvA)**
- **Towards a general fluid/gravity correspondence and the membrane paradigm**, Pisa, Italy, 7 May 2014 (talk).
- Holographic Inhomogeneities Workshop, Amsterdam, the Netherlands, April 2014 (attended).
- Cargése Summer School on String Theory, Ph.D.School, Cargése, France, June 2014 (attended).
- Amsterdam String Workshop, Amsterdam, the Netherlands, 30 June-11 July 2014 (attended).
- **Testing the membrane paradigm with holography**, 20th European Workshop on String Theory Workshop, Mainz, Germany, 22-26 September 2014 (poster).
- DRSTP Ph.D. Day, Utrecht, the Netherlands, 3 October 2014 (organizer).
- **Effective actions for fluids from holography and the membrane paradigm**, Bruxelles, Belgium, 4 November 2014 (talk).
- **Effective actions for fluids from holography and the membrane paradigm**, Trieste, Italy, 14 November 2014 (talk).
- **Effective actions for fluids from holography and the membrane paradigm**, Imperial College of London, UK, 27 November 2014 (talk).
- **Effective actions for fluids from holography and the membrane paradigm**, Chicago, USA, 1 December 2014 (talk).

**Pires, L. (RU)**
- **GR from HLG, can we recover it?,** DRSTP Postgraduate AIO/OIO School 2014, 27 January-7 February 2014 (talk).
- **Renormalization group approaches to quantum gravity,** Perimeter Institute Waterloo, Canada, 22-25 April 2014 (poster).
- **On the role of the extra kinetic term coupling \( \lambda \) in classical Hořava-Lifshitz gravity,** Perimeter Institute Waterloo, Canada, 8 May 2014 (talk).
- **More on "Little Lambda" in Horava Lifshitz gravity,** Institute for Theoretical Physics, Cologne, Germany, 25 November 2014 (talk).

**Reys, V. (Nikhef)**
- **Black hole degeneracies in string theory and supergravity,** DRSTP School 2014, Doorn, the Netherlands, 30 January 2014 (talk).
- **An Introduction to Supergravity,** NIKHEF Student Seminar, Amsterdam, the Netherlands, 28 March 2014 (talk).
- **Steps towards a non-renormalization theorem for black hole entropy,** Strings 2014, Princeton, USA, 24 June 2014 (poster).
- **Black Objects Beyond Supersymmetry Workshop,** Utrecht, the Netherlands, 1-3 September 2014 (attended).

**Rietkerk, R.J. (UvA)**
- **Unitarity cuts of Wilson lines,** Physics@FOM 2014, Veldhoven, the Netherlands, 21-22 January 2014 (poster).
- **1/Nc expansion at LHC,** DRSTP Postgraduate Course, Theoretical High Energy Physics (THEP), Doorn, the Netherlands, 27 January-7 February 2014 (talk).
- **UvA IOP PhD symposium,** Amsterdam, the Netherlands, 4 May 2014 (attended).
- **Imaginary parts of Wilson lines,** Cargese International School for Theoretical Physics, Cargese, France, 14-26 July 2014 (talk).
- **Imaginary parts and discontinuities of Wilson line correlators,** IPhT CEA Saclay, Saclay, France, 1 October 2014 (talk).
- **Najaarsvergadering NNV,** Lunteren, the Netherlands, 7 November 2014 (attended).

**Scalisi, M. (RUG)**
- **Particle Cosmology after Planck,** DESY theory workshop at DESY, Hamburg, Germany, September 2014 (attended).
- **QU4 - Fourth Quantum Universe Symposium at University of Groningen,** Groningen, the Netherlands, April 2014 (attended).
- **Postgraduate AIO/OIO THEP School 2014,** DRSTP, Doorn, the Netherlands, January – February 2014 (attended).
- The Lyth bound with a spectral tilt, DESY theory workshop “Particle Cosmology after Planck” at DESY, Hamburg, Germany, September 2014 (talk).
- The large-N limit of inflation, Postgraduate AIO/OIO THEP school 2014, organized by DRSTP, Doorn, the Netherlands, January 2014 (talk).
- Visiting scholar at SITP (Stanford Institute for Theoretical Physics), Stanford University, US, working with Prof. Andrei Linde and Prof. Renata Kallosh, October – December 2014 (work visit).

Signori, A. (Nikhef/VUA)
- Resummation-evolution-factorization (REF) workshop 2014, TMDlib, Antwerp, Belgium, 8 December 2014 (attended).
- Workshop on TMDs and quarkonia, TMDs vs uPDFs, IPN Orsay, France, 3 November 2014 (attended).
- 4th international workshop on transverse polarization phenomena in hard processes (Transversity 2014), Multiplicities and phenomenology, Chia, Cagliari, Italy, 10 November 2014 (attended).
- Phenomenology of unpolarized TMDs from SIDIS data, Conference: 22nd International Workshop on Deep-Inelastic Scattering and Related Subjects (DIS 2014), University of Warsaw, Poland, 30 April 2014 (attended).
- TMDs in a nutshell, Dutch Research School in Theoretical Physics, Doorn, the Netherlands, 30 January 2014 (talk).
- Does the transverse motion of quarks depend on their flavor?, Physics at FOM 2014, Veldhoven, the Netherlands, 21 January 2014, (poster presentation).
- Nikhef Topical Lectures, Nuclear Physics, Amsterdam, the Netherlands, 17-19 December 2014 (attended).
- Nikhef Topical Lectures, CP violations, Amsterdam, the Netherlands, 5-7 March 2014 (attended).
- DRSTP - PhD Day 2014, Utrecht, the Netherlands, 3 October 2014 (attended).
- Vrije Universiteit - PhD Day 2014, Amsterdam, the Netherlands, 25 June 2014 (attended).
- Bound states in QED and QCD, Paul Hoyer, Nikhef, Amsterdam, the Netherlands, March-April 2014 (attended).
- DRSTP - Theoretical High-Energy Physics School 2014, Dutch Research School in Theoretical Physics (THEP), Doorn, the Netherlands, 27 January-7 February 2014 (attended).

Silverwood, H.G.M. (UvA)
- Physics@FOM Veldhoven 2014, Veldhoven, the Netherlands, 21-22 January 2014 (attended).
- 19th Symposium on Astroparticle Physics in Netherlands, Hotel Spelderholt, Beekbergen, the Netherlands, 27-28 March 2014 (attended).
- Projected dark matter limits from CTA with systematics and diffuse emission, Astroparticle Physics 2014, Amsterdam, the Netherlands, 23-28 June 2014 (talk).
- Constraining the DM density profile of the Milky Way's central kpc, SLAC Summer Institute: Shining Light on Dark Matter, Summer School, Menlo Park, USA, 4-15 August 2014 (talk).
- A realistic assessment of the CTA sensitivity to Dark Matter annihilations, Amsterdam-Paris-Stockholm meeting (workshop), Amsterdam, the Netherlands, 29 September-1 October 2014 (talk).
- Indirect Dark Matter detection with gamma rays, DRSTP PhD Day, Utrecht, the Netherlands, 3 October 2014 (talk).

Torrado Cacho, J., (UL)
- Search for localized features in Planck CMB due to a transient in the speed of sound, UK Cosmo meeting at King’s College London, London, UK, 20 January 2014 (talk).
- Imprints of heavy fields during Inflation as correlated features in the primordial perturbations, Physics@FOM, Veldhoven, the Netherlands, 21-22 January 2014 (talk).
- Search for localized features in Planck’s CMB due to a transient in the speed of sound, Theoretical Cosmology Meeting of the Netherlands, Rijksuniversiteit Groningen, the Netherlands, 7 March 2014 (talk).

van Daal, T. (Nikhef)
- Renormalization group invariants in the minimal supersymmetric standard model, NNV Subatomic Physics Meeting, Lunteren, the Netherlands, 11 November 2014 (talk).
- National Seminar Theoretical High Energy Physics, Nikhef, Amsterdam, the Netherlands, 21 November 2014 (attended).
- Introduction to C++, Course by Nikhef, Amsterdam, the Netherlands, 1-12 December 2014.

Wouters, B. (UvA)
- Physics@FOM Veldhoven, the Netherlands, 20-21 January 2014 (attended).
- Emergent Phenomena in the Dynamics of Quantum Matter: Disorder, Quenches, Simulations and Experiment, CUNY, Conference, New York, USA, 14-18 April 2014 (attended).
- Interaction quench in the Lieb-Liniger model, field theory methods in low-dimensional strongly correlated quantum systems, ICTP, Conference, Trieste, Italy, 24-29 August 2014 (poster).

Zojer, T. (RUG)
- Cargèse Summer School "String Theory and Holography", Cargèse, France, 2-14 June 2014 (attended).
- Modave Summer School, Modave, Belgium, 1-6 September 2014 (attended).
- The non relativistic superparticle, Vienna, Austria, 15 April 2014 (talk).
- Non-relativistic supergravity, Berlin, Germany, 24 November 2014 (talk).
- Non-relativistic supergravity, Brussels, Belgium, 1 December 2014 (talk).
4.7  Scientific and educational activities of PhD students (theme 2)

Ado, I. (RU)

Almog, A. (UL)
- GDP driven models for the international trade network, DRSTP Postgraduate Course, Statistical Physics and Theory of Condensed Matter (SPTCM), Doorn, the Netherlands, 10-21 March 2014 (talk).
- Binary versus non-binary information in real time series: empirical results and maximum-entropy matrix models, Sigma Phi International Conference on Statistical Physics, Rhodes, Greece, 7-11 July 2014.
- Binary versus non-binary information in real time series: Empirical results and maximum-entropy matrix models, Conference, ECCS, Lucca Italy, 22-26 September 2014.
- GDP-driven model for the binary and weighted structure of the international trade network, European Conference on Complex Systems (ECCS), Lucca, Italy, 22-26 September 2014.

Armaitis, J. (UU)
- A Bose-Einstein condensate of dipolar molecules as a quantum rotor, Physics@FOM Veldhoven 2014, the Netherlands, 21-22 January 2014 (attended).
- A Bose-Einstein condensate of dipolar molecules as a quantum rotor, DRSTP Postgraduate Course, Statistical Physics and Theory of Condensed Matter (SPTCM), Doorn, the Netherlands, 10-21 March 2014 (talk).
- Collective modes of binary Bose mixtures, Theoretical Physics Seminar, Vilnius University, Vilnius, Lithuania, 3 November 2014 (talk).

Babeau, A.I. (UL)
- DRSTP AIO/OIO School 2014 Statistical Physics and Theory of Condensed Matter, Doorn, the Netherlands, 10-21 March 2014 (talk).

Bagrov, A. (UL)
- Pairing induced superconductivity in holography, Holographic methods and applications, Reykjavik, Iceland, August 2014 (talk).
- *The string theory universe*, Mainz, Germany, 22-26 September 2014.

**Baireuther, P. (UL)**
- *Quantum phase transitions of a disordered antiferromagnetic topological insulator*, TopOsLo Workshop, University of Oslo, Norway, 8-12 December 2014.

**Bet, B. (UU)**
- DRSTP AIO/OIO School 2014 Statistical Physics and Theory of Condensed Matter, Doorn, the Netherlands, 10-21 March 2014 (talk).

**Betzios, P. (UU)**
- DRSTP AIO/OIO School 2014 Statistical Physics and Theory of Condensed Matter, Doorn, the Netherlands, 10-21 March 2014 (talk).

**Buhrandt, S. (UU)**
- *Frustration in classical spin systems*, PhD day talk, Utrecht, the Netherlands, 3 October 2014 (talk).
- *Spin-liquid phase and order-by-disorder on the swedenborgite lattice*, talk at the DPG meeting in Dresden, Germany, 3 April 2014 (talk).
- *Spin-liquid phase and order-by-disorder on the swedenborgite lattice*, poster at the DPG meeting in Dresden, Germany, 4 April 2014 (poster).

**de Leeuw, A.-W. (UU)**
- *Schwinger-Keldysh theory for Bose-Einstein condensation of photons in a dye-filled optical microcavity*, FOM Veldhoven, the Netherlands, 21-22 January 2014 (poster).

**de Nardis, J. (UvA)**
- Summer College on Non-linear Dynamics, Dynamical Transitions and Instabilities in Classical and Quantum Systems, ICTP, Trieste, Italy, 14 July-1 August 2014 (attended).

**Diez, M. (UL)**
di Liberto, M. (UU)
- Controlling coherence via tuning of the population imbalance in a bipartite optical lattice, Sondernseminar of the Institute of Theoretical Physics, Hannover, Germany, 27 November 2014.
- Quantum simulation with driven Floquet systems, Workshop Quantum correlations out of equilibrium, ETH Zürich, Switzerland, 6 November 2014.
- Quantum correlations out of equilibrium, Zurich, Switzerland, 5-7 November 2014.
- DRSTP Postgraduate AIO/OIO School Statistical Physics and Theory of Condensed Matter (SPTCM), Doorn, the Netherlands, 10-21 March 2014 (attended).
- Steps and plateaus in the visibility of bosons in an optical lattice, Physics@FOM, Veldhoven, the Netherlands, 21 - 22 January 2014 (poster).
- Institute of Theoretical Physics, Host L. Santos, Hannover, Germany, 3 days in November 2014 (visit).
- Institute of Physics, Host G.I. Japaridze, Tbilisi, Georgia, 10 days in May 2014 (visit).

Eliens, I.S. (UvA)
- Quantum integrability, conformal field theory and topological quantum computation, Natal, Brazil, 23 March-6 April 2014 (poster).
- School on non-linear dynamics, dynamical transitions and instabilities in classica land quantum systems, Trieste, Italy, 14 July-1 Augustus 2014 (attended).
- Conference on field theory methods in low-dimensional strongly correlated quantum systems, Trieste, Italy, 25-29 Augustus 2014 (attended).

Everts, J. (UU)
- Colloidal charge regulation in oily solvents, FOM Veldhoven 2014, the Netherlands, 21-22 January 2014 (poster with N. Boon and R. van Roij).

Féher, G. (UvA)
- Two dimensional statistical lattice models and qKZ equations, DRSTP AIO/OIO School 2014 Statistical Physics and Theory of Condensed Matter, Doorn, the Netherlands, 10-21 March 2014 (talk).
- Mathematical Physics Seminar, Université Pierre et Marie Curie, Paris, France, 5 May 2014 (talk).
- Mathematics PhD seminar, Amsterdam, the Netherlands, 15 May 2014 (talk).
- IoP PhD/PostDoc Symposium, 4 June 2014 (talk).
- Finite-size technology in low dimensional quantum systems, Budapest, Hungary, 16-21 June 2014 (talk).
- Condensed Matter Theory Seminar, Amsterdam, the Netherlands, 24 September 2014 (talk).

**Fokkema, T.B. (UvA)**
- FOM Veldhoven, the Netherlands, 21-22 January 2014 (attended).
- FOM Masterclass Andreas Heinrich, Veldhoven, the Netherlands, 20 January 2014 (attended).
- School SFT 2014 - Lectures on Statistical Field Theories, Florence, Italy, 3-14 February 2014 (attended).
- D-ITP Advanced Topics in Theoretical Physics, module 2: "CFT and WZW models", 2014 (attended).
- Phd symposium Amsterdam, the Netherlands, 4 June 2014 (attended).
- Mathematica Course, University of Amsterdam, the Netherlands, June 17 and September 9 (attended).
- FOM, FOM/f Symposium, Utrecht, the Netherlands, 19 September 2014 (attended).
- Workshop Physics with Industry, Lorentz Center Leiden, 24-29 November 2014 (attended).

**Gaddam, N. (UU)**
- DRSTP AIO/OIO School 2014 Statistical Physics and Theory of Condensed Matter, Doorn, the Netherlands, 10-21 March 2014 (talk).

**Gemmetto, V. (UL)**
- DRSTP AIO/OIO School 2014 Statistical Physics and Theory of Condensed Matter, Doorn, the Netherlands, 10-21 March 2014 (talk).
- Multiplexity and multireciprocity in interdependent network, European Conference on Complex Systems (ECCS), Lucca, Italy, 22-26 September 2014 (talk).
- Multiplexity versus correlation: The role of local constraints in real multiplexes, European Conference on Complex Systems (ECCS), COINETS Satellite (Infrastructures Complexity of Interacting Networks and Systems), Lucca, Italy, 25 September 2014 (talk).
- Multi-level complex networks, Sinergia - ScienceWISE Kick-off meeting, EPFL, Lausanne, Switzerland, 10 January 2014 (talk).
Gergs, N. (UU)
- Energy current cotunnelling features for the Anderson quantum dot, DPG Spring Meeting of the Condensed Matter Section, Dresden, Germany, 1-4 April 2014 (talk).
- Topological ordered states and disorder, Correlations, Criticality and Coherence in Quantum Systems, Évora, Portugal, 6-10 October 2014 (poster).

Goykman, M. (UL)
- AdS/CFT and Landau Fermi liquids, Crete Center for Theoretical Physics, Heraklion, Crete, Greece, 6 March 2014 (talk).
- CERN Winter School on Supergravity, Strings and Gauge Theory, CERN, Switzerland, February 2014 (workshop).
- Amsterdam String Workshop, Amsterdam, the Netherlands, July 2014.

Haaker, S.M. (UvA)
- FOM, FOM@Veldhoven, Veldhoven, the Netherlands, 21-22 January (attended).

Hörig, C.B.M. (UU)

Jacobs, V. (UU)
- Quantum field theory, string theory and condensed matter physics, Greece, 31 August-8 September 2014 (poster).
- FOM Veldhoven, the Netherlands, January 2014 (poster)

Jain, S.K. (UU)
- DRSTP AIO/OIO School 2014 Statistical Physics and Theory of Condensed Matter, Doorn, the Netherlands, 10-21 March 2014 (talk).
- Shell Technology Center, Bangalore, India, 3-4 April 2014 (visit).
- Mathematica workshop at ITF, Utrecht, the Netherlands, 24 and 29 April 2014.
- FOM Introduction Meeting, Utrecht, the Netherlands, 4 March 2014 (attended).
- FLASH (Fundamental and Application of Silicon Heterojunction solar cells) meeting, Eindhoven, the Netherlands, 20 May 2014.
- An empirical potential for graphene and study of energetics of single Stone-Wales defect: A step prior to a-Si, Meeting and presentations with Shell Coach and Colleagues (Solar energy experts), Shell Office, Amsterdam, the Netherlands, 25 September 2014 (talk).
- PlaneT Talk, ITP, Utrecht, the Netherlands, 30 September 2014 (talk).

Janssen, M. (UU)
- "Blue energy" from mixing water of unequal salinity and temperature, Postgraduate AIO/OIO School 2014, Statistical Physics and Theory of Condensed Matter (SPTCM), Doorn, the Netherlands, 10-21 March 2014 (talk).
- Interfaces in water and environmental science, International Conference on Interfaces against Pollution (IAP), Wetsus, Leewarden, the Netherlands, 2014 (talk).
- Exploiting temperature effects in blue energy harvesting and desalination of water, Liquids 2014, the 9th Liquid Matter Conference, University of Lisbon (ULisboa) and School of Engineering of the Lisbon Polytechnic Institute (ISEL), On behalf of the European Physical Society, Lisbon, Portugal, 2014 (poster).
- Exploiting temperature effects in blue energy harvesting and desalination of water, International Conference on Interfaces against Pollution (IAP), Interfaces in Water and Environmental Science, Wetsus, Leewarden, the Netherlands, 2014 (poster).
- School Han-sur-Lesse, 2014 (attended).

Keesman, R. (UL)
- DRSTP AIO/OIO School 2014 Statistical Physics and Theory of Condensed Matter, Doorn, the Netherlands, 10-21 March 2014 (talk).

Koning, V. (UL)
- Doughnut-shaped droplets of liquid crystal, FYSICA 2014, Leiden, the Netherlands, 1 April 2014.

Kuppersbusch, C. (UU)
- Research period at the Raymond and Beverly Sackler School of Physics and Astronomy, Tel Aviv University, Israel 2 January-31 March 2014.
- Quasiparticle interference on the surface of topological insulators, 2014 (talk).

Licup, A.J. (VUA)
- Physics@FOM 2014, Veldhoven, the Netherlands, 21-22 January 2014 (attended).
- KNAW Biophysics meeting, Trippenhuis Amsterdam, Amsterdam, the Netherlands, 13 May 2014 (attended).
- 16th Dutch Soft Matter Meeting, VU University Amsterdam, Amsterdam, the Netherlands, 15 May 2014 (attended).
- Netherlands Society for Biochemistry and Molecular Biology Lecture: prof. Carlos Bustamante, KNAW Amsterdam, Amsterdam, the Netherlands, 16 September 2014 (attended).
- Dutch Biophysics 2014, Veldhoven, the Netherlands, 29-30 September 2014 (attended).
- *Origins of nonlinear elasticity in fibrous networks*, DRSTP PhD Day, Utrecht University, Utrecht, the Netherlands, 3 October 2014 (talk).
- DRSTP PhD Day 2014, Utrecht University, Utrecht, the Netherlands, 3 October 2014 (attended).
- COST WG2 meeting: Nanomechanical Properties of Intermediate Filaments, AMOLF, Amsterdam, the Netherlands, 23 October 2014 (attended).
- KNAPW Biophysics Meeting, Trippenhuis Amsterdam, Amsterdam, the Netherlands, 11 November 2014 (attended).
- Physics with Industry 2014 workshop, Lorentz Center Leiden, Leiden, the Netherlands, 24-28 November 2014 (attended).

**Liu, K. (UL)**
- Karpacz 50th winter school of theoretical physics, Wroclaw, Poland, 2-9 March 2014 (attended).
- National Seminar Condensed Matter, Twente, the Netherlands, 9 April 2014 (attended).

**Niesen, I.A. (UvA)**
- PhD Day, Utrecht, the Netherlands, 3 October 2014 (attended).

**Papadoulaki, O. (UU)**
- DRSTP AIO/OIO School 2014 Statistical Physics and Theory of Condensed Matter, Doorn, the Netherlands, 10-21 March 2014 (talk).

**Poovuttikul, N. (UL)**
- Summer School on String Theory and Holography, Lisbon and Porto, Portugal, 14-26 July 2014 (attended).
- Amsterdam String Workshop, University of Amsterdam, the Netherlands, 30 June-11 July 2014 (attended).

**Quelle, A. (UU)**
- *Floquet topological insulators*, Quantum Correlations out of Equilibrium, workshop, Zürich, Switzerland, November 2014 (talk).
- Thermodynamica van Kleine Systemen, workshop, Leiden, the Netherlands, December 2014 (attended).
- Topological insulators on a graphene Mobius band, DRSTP condensed matter PhD school, Doorn, the Netherlands, 2014 (talk).
- Floquet topological insulators, DITP, Amsterdam, the Netherlands, June 2014 (talk).
- Floquet topological insulators, DITP, Leiden, the Netherlands, September 2014 (talk).

Säterskog, P. (UL)
- DRSTP AIO/OIO School 2014 Statistical Physics and Theory of Condensed Matter, Doorn, the Netherlands, 10-21 March 2014 (talk).

Slager, R.-J. (UL)
- Exact enumeration of Hamiltonian walks, Casimir Spring School, Arnemuiden, the Netherlands, 6-8 May 2014 (talk).
- Space group classification of topological band insulators, ERMS meeting topological materials II, Warsaw, Poland, 18 September 2014 (talk).
- The conspiracy of electronic topology and crystal symmetry: Dislocation line mode in topological band insulators, Gordon Conference, Boston, USA, 22-27 June 2014 (talk)
- The conspiracy of electronic topology and crystal symmetry: Dislocation line mode in topological band insulators, FOM@Physics Veldhoven, the Netherlands, January 2014 (talk)
- EMRS Fall meeting, Topological materials II, Warsaw, Poland, 15-18 September 2014 (workshop).
- Fom@Physics Veldhoven, Veldhoven, the Netherlands, January 2014 (workshop).
- Gordon Conference, Correlated Electron systems, Boston and South Medley, USA, 22-27 June 2014 (workshop).

Soligno, G. (UU)
- DRSTP AIO/OIO School 2014 Statistical Physics and Theory of Condensed Matter, Doorn, the Netherlands, 10-21 March 2014 (talk).
- Particle wall interactions and near wall dynamics, SOMATAI workshop T4, Forschungszentrum, Jülich, Germany, 17-21 March 2014.
- SOMATAI summer school, Berlin, Germany, 15-25 August 2014.
- SOMATAI workshop T6, Dresden, Germany, 1-5 December 2014.
- Equilibrium shapes of Fluid-Fluid Interfaces by a new numerical method, Physics@FOM 2014, Veldhoven, the Netherlands, 2014 (poster).

Sulangi, M. (UL)
- Physics@FOM Veldhoven, Veldhoven, the Netherlands, January 2014 (attended).
- 50th Karpacz Winter School for Theoretical Physics, Karpacz, Poland, March 2014 (attended).
- Casimir Spring School, Arnemuiden, the Netherlands, May 2014 (attended).
- Frontiers of Condensed Matter Summer School, San Sebastian, Spain August-September 2014 (attended).

**Sybesma, W. (UU)**
- *Speciale Relativiteit*, International Physics Olympiad, 4 June 2014 (talk).
- Solvay school of physics, October-December 2013/2014 (9 weeks).
- DRSTP SPTCM School, March 2013/2014 (2 weeks).
- DRSTP THEP School, January 2014/2015 (2 weeks).
- Mathematica Summer School, July 2013/2014 (1 week).
- Templeton meeting, Leiden, the Netherlands, November 2014 (attended).

**Tarasinski, B. (UL)**

**van den Berg, R. (UvA)**
- DRSTP Postgraduate Course, Statistical Physics and Theory of Condensed Matter (SPTCM), Doorn, the Netherlands, 10-20 March 2014 (attended).
- The Abdus Salam international Centre for Theoretical Physics, Conference on Field Theory Methods in Low-Dimensional Strongly Correlated Quantum Systems, Trieste, Italy, 25-29 August 2014 (attended).

**van Heck, B. (UL)**
- *Superconducting circuits with Majorana modes*, Condensed matter seminar, Yale University, USA, 1 December 2014 (talk).

**van Miert, G. (UU)**
- Workshop on Correlations, Criticality and Coherence in Quantum Systems, Evora, Portugal, 5-10 October 2014 (attended).

**Vlijm, R.P. (UvA)**
- Physics at FOM Veldhoven, Veldhoven, the Netherlands, 21-22 January 2014 (attended).
- DRSTP AIO/OIO School 2014 Statistical Physics and Theory of Condensed Matter, Doorn, the Netherlands, 10-21 March 2014 (talk).
- Applications of algebraic Bethe ansatz matrix elements to spin chains, Integrable systems and quantum symmetries, Prague, Czech Republic, 24-27 June 2014 (talk).
- Applications of algebraic Bethe ansatz matrix elements to spin chains, RAQIS ’14: Recent advances in quantum integrable systems, Dijon, France, 1-5 September 2014 (poster).

Zhou, Y. (UL)
- Lorentz Center Workshop, Topological mechanics: from metamaterials to robots, Leiden, the Netherlands, 6-11 October 2014.
# 5 | Scientific staff (per 31-12-2014)

Below an overview is given of the permanent and temporary staff members of the DRSTP on 31 December 2014. The associate members are also listed. PhD students are listed in Chapter 4 (Section 4.4). Theme 1 refers to particle physics, cosmology, quantum gravity and string theory and theme 2 to quantum matter, quantum information, soft condensed matter and biophysics.

## 5.1 Permanent staff

<table>
<thead>
<tr>
<th>University of Amsterdam (UvA)</th>
<th>theme</th>
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<tbody>
<tr>
<td>Dr. S. Ando</td>
<td>1</td>
</tr>
<tr>
<td>Prof. F.A. Bais (emer. 2010)</td>
<td>1</td>
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<tr>
<td>Dr. G.F. Bertone</td>
<td>1</td>
</tr>
<tr>
<td>Prof. H.W. Capel (emer. prior to 2007)</td>
<td>2</td>
</tr>
<tr>
<td>Dr. A. Castro Anich</td>
<td>1</td>
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<tr>
<td>Prof. J.-S. Caux</td>
<td>2</td>
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<tr>
<td>Dr. C.N. Cheng</td>
<td>1</td>
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<tr>
<td>Dr. P.R. Corboz</td>
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<tr>
<td>Prof. J. de Boer</td>
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<td>Dr. B.W. Freivogel</td>
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<tr>
<td>Dr. V. Gritsev</td>
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<tr>
<td>Dr. D.M. Hofman</td>
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<td>Prof. J.H. Koch (emer. 2009)</td>
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<td>Prof. E.L.M.P. Laenen</td>
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<td>Dr. Th.M. Nieuwenhuizen</td>
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<td>Prof. A.M.M. Pruisken</td>
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<td>Prof. K. Skenderis</td>
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<td>Prof. J. Smit (emer. 2008)</td>
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<td>Dr. L.G. Suttorp (emer. prior to 2007)</td>
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<td>Prof. M.M. Taylor</td>
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<td>Dr. L.J. van den Horn (emer. 2008)</td>
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<td>Dr. J.P. van der Schaar</td>
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<td>Dr. W.A. van Leeuwen (emer. 2008)</td>
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<td>Dr. J. van Wezel</td>
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<td>Prof. E.P. Verlinde</td>
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**Vrije Universiteit Amsterdam (VUA)**  
- Dr. K. Allaart (emer. 2008)  
- Dr. B.L.G. Bakker (emer. 2009)  
- Prof. R. Fleischer  
- Prof. F.C. MacKintosh  
- Prof. P.J.G. Mulders  
- Dr. G.J. Stephens  
- Prof. T.D. Visser  
- Prof. P.R. ten Wolde  

**University of Groningen (RUG)**  
- Prof. E.A. Bergshoeff  
- Prof. D. Boer  
- Prof. M. de Roo (emer. 2011)  
- Prof. E. Pallante  
- Dr. K. Papadodimas  
- Prof. D. Roest  
- Prof. R.G.E. Timmermans  
- Prof. A.C.D. van Enter  

**Leiden University (UL)**  
- Prof. A. Achúcarro  
- Prof. G.T. Barkema  
- Prof. C.W.J. Beenakker  
- Prof. H.W.J. Blöte (emer. 2008)  
- Dr. A. Boyarsky  
- Dr. V. Cheianov  
- Dr. P.J.H. Denteneer  
- Dr. D. Garlaschelli  
- Dr. L. Giomi  
- Prof. G. Nienhuis (emer. 2010)  
- Prof. K.E. Schalm  
- Prof. H. Schiessel  
- Prof. J.W. van Holten  
- Prof. J.M.J. van Leeuwen (emer. prior to 2007)  
- Dr. V. Vitelli  
- Prof. J. Zaanen
### Radboud University Nijmegen (RU) theme

| Prof. W.J.P. Beenakker | 1 |
| Prof. A. Fasolino | 2 |
| Prof. M.I. Katsnelson | 2 |
| Prof. R.H.P. Kleiss | 1 |
| Prof. H.J.F. Knops (emer. 2005) | 2 |
| Prof. R. Loll | 1 |
| Dr. F.S. Saueressig | 1 |
| Prof. A.N.J.J. Schellekens | 1 |
| Dr. M.J.M. Titov | 2 |
| Dr. S. Yuan | 2 |

### Utrecht University (UU) theme

| Prof. G.T. Barkema | 2 |
| Dr. R.A. Duine | 2 |
| Prof. M.H. Ernst (emer. prior to 2007) | 2 |
| Dr. L. Fritz | 2 |
| Dr. U. Gürsoy | 1 |
| Prof. E.L.M.P. Laenen | 1 |
| Prof. C. Morais Smith | 2 |
| Dr. E. Pajer | 1 |
| Dr. D. Panja | 2 |
| Dr. T. Prokopec | 1 |
| Prof. Th.W. Ruijgrok (emer. prior to 2007) | 1 / 2 |
| Dr. D. Schuricht | 2 |
| Prof. J. Smit (emer. 2008) | 1 |
| Prof. H.T.C. Stoof | 2 |
| Prof. G. ’t Hooft (emer. 2011) | 1 |
| Prof. H. van Beijeren (emer. 2008) | 2 |
| Prof. P.P.A.M. van der Schoot | 2 |
| Prof. R.H.H.G. van Roij | 2 |
| Prof. S.J.G. Vandoren | 1 |

### Nikhef Theory Group (Nikhef) theme

| Prof. B. de Wit (emer. 2010) | 1 |
| Prof. R. Fleischer | 1 |
| Prof. J.H. Koch (emer. 2009) | 1 |
| Prof. E.L.M.P. Laenen | 1 |
| Dr. M. Postma | 1 |
| Prof. A.N.J.J. Schellekens | 1 |
| Prof. J.-W. van Holten | 1 |
| Dr. J.A.M. Vermaseren | 1 |
### 5.2 Temporary staff

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<th>University of Amsterdam (UvA)</th>
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<td>Dr. M. Garcia Echevarria</td>
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<td>Dr. H.R. Afshar</td>
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<td>Dr. E.I. Zavala Carrasco</td>
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<td>Dr. B. Baxevanis</td>
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<td>Dr. B. Chen</td>
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Radboud University Nijmegen (RU)  
Dr. J. Cooperman 1
Dr. G. D’Odorico 1
Dr. S. Gryb 1
Dr. J. Hynbida 1
Dr. M. Martin Benito 1

Utrecht University (UU)  
Dr. P. Chudzinski 2
Dr. E. Cobanera 2
Dr. M. Crichigno 1
Dr. R. Gobbetti 1
Dr. A. Härtel 2
Dr. V. Juricic 2
Dr. J. Martinez Magan 1
Dr. A. Marunovic 1
Dr. A. Mitchell 2
Dr. F. Porri 1
Dr. S. Samin 2
Dr. P. Szepietowski 1
Dr. H.-Q. Zhang 1

Nikhef Theory Group (Nikhef)  
Dr. D. Butter 1
Dr. A. Guarino 1
Dr. F. Herzog 1
Dr. G. Inverso 1
Dr. T. Ueda 1
Dr. L. Zeune 1

5.3 Associate members

Prof. H. Dekker (UvA) (emer. prior to 2007) 2
Prof. H.A. de Raedt (RUG) 2
Prof. L.-F. Feiner (Philips) 2
Prof. B.J. Hoenders (RUG) (emer. 2010) 2
Dr. L.P.J. Kamp (TU/e) 2
Prof. J. Knoester (RUG) 2
Prof. D. Lohse (UT) 2
Prof. M.V. Mostovoy (RUG) 2
Theoretical and Polymer Physics Group (TU/e) 2
6 | Academic publications

This chapter presents an overview of publications in refereed journals published in 2014. The publications belonging to theme 1 and theme 2 are given separately. Within each theme the publications are ordered according to affiliation. Data concerning staff members: G.T. Barkema (UU/UL), B. de Wit (Nikhef/UU), R. Fleischer (Nikhef/VU), E.L.M.P. Laenen (Nikhef/UU/UvA), A.N.J.J. Schellekens (Nikhef/RU) and J.-W. van Holten (Nikhef/UL) is listed under their primary affiliation. Publications by associate members are not included. Professional publications are listed in Chapter 8.

6.1 Theme 1

University of Amsterdam


**Vrije Universiteit Amsterdam**


**University of Groningen**


**Leiden University**

- Rampf, C., Rigopoulos, G., & Valkenburg, W., A relativistic view on large scale N-body simulations, Class. Quant. Grav. 31, 234004 (2014).

**Radboud University Nijmegen**

**Utrecht University**
- Beenakker, W., Borschensky, C., Krämer, M., Kulesza, A., Laenen, E., Theeuwes, V., Thewes, S., *NNLL resummation for squark and gluino production at the LHC*.
- Daniel Butter, Bernard de Wit, Ivano Lodato, *Non-renormalization theorems and N=2 supersymmetric backgrounds*, JHEP 03 (2014) 131
- P.M. Crichigno, T. Matsumoto and K. Yoshida, *Deformations of T{1,1} as Yang-Baxter sigma models*, KUNS-2502, ITP-UU-14-20, SPIN-14-18.
- G. ’t Hooft, *The Cellular Automaton interpretation of quantum mechanics, a view on the quantum nature of our universe, compulsory or impossible?*, Springer ISBN 978-3-319-41285-6

Nikhef Theory Group

- Fleischer, R., Probing New Physics with $B_0\rightarrow\mu+\mu$: Status and perspectives, Int. J. Mod. Phys. A 29 (2014) 1444004.
- Cardoso, G.L. and Mahapatra, S., Deformations of special geometry: searching for the topological string, JHEP 1409 (2014) 096.

6.2 Theme 2

University of Amsterdam


**Vrije Universiteit Amsterdam**


**University of Groningen**

**Leiden University**


Utrecht University
7 | Scientific activities

This chapter contains an overview of talks given by staff members at (international) conferences, seminars, symposia, colloquia, meetings, workshops, lecture courses given at schools and universities and poster presentations of staff members and postdoctoral fellows. Data concerning staff members G.T. Barkema (UU/UL), B. de Wit (Nikhef/UU), R. Fleischer (Nikhef/VUA), E.L.M.P. Laenen (Nikhef/UU/UvA), A.N.J.J. Schellekens (Nikhef/RU) and J.-W. van Holten (Nikhef/UL) is listed under their primary affiliation. A list of public lectures is available in Chapter 8 (Section 8.2). An overview of scientific activities held by PhD students is presented in Chapter 4 (Sections 4.6 and 4.7).

7.1 Theme 1

University of Amsterdam
- Bertone, G., Dark Matter searches, Rencontres de Blois, France, 18-23 May 2014.
- Bertone, G., The quest for Dark Matter, Colloquium “Academic Highlights”, University of Amsterdam Faculty Colloquium, Amsterdam, the Netherlands, 3 March 2014.
- Calore, F., DarkSUSY: Load it! Run it! Plot it!, CASPAR 2014: Codes in AStroPArticle Research, University of Hamburg, Hamburg, Germany, 17-19 September 2014.
- Calore, F., Shining through the Galaxy: A Robust identification of the Fermi GeV excess, IPMU Seminar, Tokyo, Japan, IPMU, 17 October 2014.
- Calore, F., Gamma rays from Galactic pulsars, NOW: Neutrino Oscillations Workshop, Conca Specchiulla, Italy, 7-14 September 2014.


- Cheng, M.C.N., Durham Mathematical Physics Seminar, Durham, UK, seminar, 9 May 2014.

- Cheng, M.C.N., Strings 2014 Conference, Princeton, USA, 3-6 June 2014.


- Cheng, M.C.N., UvA Geometry and Mathematical Physics Seminar, Amsterdam, 16 September 2014.

- Cheng, M.C.N., Mathematics/Physics Colloquium, Hamburg, Germany, 23 October 2014.

- Cheng, M.C.N., Theoretical Physics Christmas Workshop, Madrid, Spain, 10-12 December 2014.
- de Boer, J., *Entropy in higher spin theories*, Conference Aspects of Supergravity, Stony Brook, USA, 6-10 January 2014.
- Lippert, M.S., *Holographic anyonic superfluidity*, Gauge/Gravity Duality group seminar, Max-Planck Institute, Munich, Germany, 1 October 2014.
- Lippert, M.S., *Holographic anyonic superfluidity*, Department of Physics/Helsinki Institute of Physics joint seminar, University of Helsinki, Finland, 16 October 2014.
- Lippert, M.S., *What is string theory good for?*, Phd/Postdoc Symposium, University of Amsterdam, the Netherlands, 4 June 2014.
- Lovell, M.R., *Sterile neutrino dark matter: the 3.5keV line and galaxy formation*, APS meeting, Amsterdam, the Netherlands, 20 November 2014.
- Lovell, M.R., *Sterile neutrino dark matter: the 3.5keV line and galaxy formation*, CCAPP seminar, Ohio State University, Columbus, USA, 14 November 2014.
- Lovell, M.R., *Sterile neutrino dark matter: the 3.5keV line and galaxy formation*, Astronomy seminar at Rutgers University, Piscataway Township, USA, 18 November 2014.

- Lovell, M.R., *Sterile neutrino dark matter: The 3.5keV line and galaxy formation*, High energy phenomenology, experiment, and cosmology seminar, Texas, USA, University, 20 November 2014.


- van der Schaar, J.P., *Universal behaviour of non-minimal models of inflation*, CP3-Origins seminar at Centre for Cosmology and Particle Physics Phenomenology, University of Southern Denmark, Odense, Denmark, 27 October 2014.

- Tan, H.-S., *Closed string partition functions from doubled geometries*, 20th European String Theory Workshop, Mainz, Germany, September 2014.


- Vercnocke, B.S.E., *Natural inflation and de Sitter vacua in supergravity*, high-energy theory lunch seminar, Groningen, the Netherlands, 6 November 2014.

- Vercnocke, B.S.E., *De Sitter vacua in supergravity*, high energy theory lunch seminar, Leuven, Belgium, 15 October 2014.

- Vercnocke, B.S.E., *Natural inflation and de Sitter landscapes in supergravity*, THC@NL Dutch Theoretical Cosmology Meetings, Utrecht, the Netherlands, 4 October 2014.

- Vercnocke, B.S.E., *Microstate geometries for radiating black holes*, High-energy Theory Seminar, Groningen, the Netherlands, 7 January 2014.


- Waalewijn, W.J., *Dissecting soft radiation with factorization*, MPI@LHC 2014, Krakow, Poland, 3-7 November 2014.


- Weniger, C., *Dark Matter searches in the lab and in the sky*, Physics Colloquium, Monash, Australia, 3 April 2014.
- Yang, I.S., *Causal patch complementarity and the firewall paradox*, University of California, Santa Cruz, USA, April 2014.
- Yang, I.S., *Causal patch complementarity and the firewall paradox*, University of California, Berkeley, USA, April 2014.
- Zeune L., *Constraining SUSY scenarios using simplified models*, Amsterdam-Paris-Stockholm Meeting, Amsterdam, the Netherlands, 30 September 2014.

**Vrije Universiteit Amsterdam**
- Kasemets, T., *Doble Parton scattering*, Nikhef Jamboree, Amsterdam, the Netherlands, 16 December 2014.
- Kasemets, T., *Exploring the hadron structure: TMDs and DPDs*, Nikhef Jamboree, Nijmegen, the Netherlands, December 2014.
- Kasemets, T., *Interference DPDs and polarization in double ccbar*, MPI@LHC 2014, Krakow, Poland, November 2014.
- Mulders, P.J., *Transverse momentum dependent distribution functions of definite rank*, the QCD Evolution 2014 Workshop, Santa Fe, USA, 13 May 2014.
- Mulders, P.J., *Transverse momentum dependent distribution and fragmentation functions in high energy scattering processes*, 17th Taiwan Nuclear Physics Summer School, Taipei, Taiwan, 26 August 2014.
- Mulders, P.J., *TMDs, offering opportunities at small kT and small x!*, Annual meeting of the Groupement de Recherche on QCD and Hadron Physics, Palaiseau, France, 16 December 2014.
- Pisano, C., *TMD gluon distributions and quarkonium production in unpolarized pp collisions*, Workshop, AFTER@LHC: Probing the strong
interactions at A Fixed Target ExpeRiment with the LHC beams, Les Houches, France, 12 January 2014.

- Pisano, C., *Probing the transverse dynamics and the polarization of gluons inside the proton at the LHC*, 49th Rencontres de Moriond on QCD and High-Energy Hadronic Interactions, La Thuile, Italy, 27 March 2014.

- Pisano, C., *Transverse momentum dependent gluon distributions at the LHC*, QCD Evolution Workshop, Santa Fe, USA, 12 May 2014.

- Pisano, C., *Azimuthal asymmetries in pp→jet nX*, 4th Int. Workshop on Transverse Polarization Phenomena in Hard Scattering (Transversity 2014), Chia, Italy, 09 June 2014.


**University of Groningen**


- Bergshoeff, E.A., *Branes and string geometry*, Research Programme, Quantum Gravity, Black Holes and Strings, KITPC, Beijing, China, May 2014.


- Roest, D., *Inflatie: de eerste seconde na de Oerknal*, VU, Amsterdam, the Netherlands, 18 September 2014.
- Zavala, I., 20th European Workshop on String Theory, Mainz, Germany, September 2014.
- Zavala, I., String Phenomenology, ICTP, Trieste, Italy, July 2014.
- Zavala, I., Mextrings, Colima, Mexico, June 2014.
- Zavala, I., Fourth Quantum Universe Symposium, CTN, University of Groningen, the Netherlands, 16-17 April, 2014.
- Zavala, I., Meeting on Extra Dimensions, Mesoamerican Centre for Theoretical Physics, Tuxtla, Mexico, November 2013.
- Zavala, I., Hannover University, Germany, May 2014.
- Zavala, I., ICG, University of Portsmouth, UK, 12 March 2014.
- Zavala, I., CINVESTAV, Mexico, 9 January 2014.

**Leiden University**
- Achúcarro, A., *Transient reductions of the inflaton speed of sound in the Cosmic Microwave Background*, Seminar, Arizona State University, USA, 20 October 2014.
- Achúcarro, A., *Strings and the Cosmic Microwave Background*, A String Theory Universe, Mainz, Germany, 22-26 September 2014.
- Achúcarro, A., *Intercommutation puzzles (of Abelian Higgs strings)*, ASU-Tufts Cosmic Strings meeting, Phoenix, USA, 2-5 February 2014.
- Achúcarro, A., *Transient reductions in the inflaton speed of sound in the Cosmic Microwave Background*, Seminar, McGill University, Montreal, Canada, 30 January 2014.
- Davison, R., *Linear resistivity from hydrodynamics*, Holographic in homogeneities Workshop, Amsterdam, the Netherlands, April 2014.
- Davison, R., *Momentum dissipation and charge transport in holography*, Groningen University Seminar, Groningen, the Netherlands, April 2014.
- Davison, R., *Holographic momentum dissipation and effective theories of transport*, DITP Holography Meeting, Utrecht, the Netherlands, November 2014.
- Garzilli, A., *The signature of sterile neutrinos in the Lyman α forest*, Lorentz Institute, Leiden, the Netherlands, 13 February 2014.
- Garzilli, A., 'Tracing the Cosmic Web' (Workshop), Lorentz Center, Leiden, the Netherlands, 17-21 February 2014, attended.
- Hu, B., Reconstruction of primordial spectra from CMB, Working month, Shanghai JiaoTong University, China, Shanghai, 19 May-7 June 2014.
- Ortiz, P., Search for a transient reduction in the inflaton speed of sound in the CMB, UK Cosmology meeting, King’s College London, UK, 20 January 2014.
- Ortiz, P., Transient reduction of the inflaton speed of sound in the Planck data, Physics@FOM, Veldhoven, the Netherlands, 21-22 January 2014, poster.
- Ortiz, P., Transient reductions in the speed of sound in the Planck CMB data, Theoretical Cosmology meeting, Groningen, the Netherlands, 7 March 2014.
- Ortiz, P., Transient reductions of the inflaton speed of sound in the Planck CMB data, VI CPAN days, Sevilla, Spain, 21-23 October 2014.
- Palchyhov, V., Simulating the social processes of science, Lorentz Center Workshop, 7-11 April 2014.
- Parnachev, A., Entanglement negativity, Dublin Institute for Advanced Studies, Dublin, Ireland, November 2014.
- Parnachev, A., Holography and Femi liquid, KITP, Santa Barbara, USA, January 2014.
- Parnachev, A., Holography and Femi liquid, Utrecht University, the Netherlands, February 2014.
- Parnachev, A., Entanglement negativity, Crete Center for Theoretical Physics, Heraklion, Greece, April 2014.
- Parnachev, A., Entanglement negativity, Budker Institute, Novosibirsk, Russia, May 2014.
- Schalm, K.E., *Far from equilibrium energy flow in quantum critical systems*, Seminar, Harvard University, USA, April 2014.
- Schalm, K.E., *Far from equilibrium energy flow in quantum critical systems*, Seminar, Columbia University, USA, April 2014.
- Schalm, K.E., *Far from equilibrium energy flow in quantum critical systems*, Seminar, Perimeter Institute, Waterloo, Canada, March 2014.
- Silvestri, A., *Testing general relativity on cosmological scales*, Utrecht University, the Netherlands, 8 December 2014.
- Valkenburg, W., *Cosmic variance on the local expansion rate*, Progress on Old and New Themes in Cosmology (PONT), Avignon, France, 14-18 April 2014.
- Valkenburg, W., *Symmetries of the universe and a proposal to constrain them*, Seminar, Queen Mary University of London, London, United Kingdom, July 2014.

- Valkenburg, W., *Some nonlinear structure from a scalar field*, Non-Linear Structure in the Modified Universe, Lorentz Center workshop, Leiden, the Netherlands, July 2014.


- van Holten, J.W., *HiSPARC*, Physics seminar, University of Utah, Salt Lake City, USA, 10 January 2014.


**Radboud University Nijmegen**


- Cooperman, J., *A perspective on causal dynamical triangulations in 3+1 vignettes*, Quantum Gravity Seminar, Perimeter Institute, Waterloo, Canada, 4 December 2014.


- Gryb, S., *Cosmological perturbation theory of shapes*, Int. Workshop on Shape Dynamics, University of New Brunswick, Fredericton, Canada, 8-9 May 2014.
- Gryb, S., *Cosmological perturbation theory of shapes*, Ludwig Maximilians University, Munich, Germany, 23 June 2014.
- Loll, R., *What you always wanted to know about CDT, but did not have time to read about in our papers*, Workshop, Renormalization Group Approaches to Quantum Gravity, Perimeter Institute, Waterloo, Canada, 22-25 April 2014.
- Loll, R., *What you always wanted to know about quantum gravity ....*, Nikhef Jamboree, Nijmegen, the Netherlands, 16 December 2014.

- Martin-Benito, M., *The Quantum echo of the early Universe*, Sixth jerte Advanced Relativity meeting, Navaconcejo, Extremadura, Spain, 7-10 April 2014.


- Vidotto, F., *Planck stars physics*, Department of Physics, University of Trento, Trento, Italy, April 2014.
- Vidotto, F., *What can we learn from loop quantum cosmology? The case of Planck Stars*, WE-Heraeus-Seminar Quantum Cosmology, Bad Honnef, Germany, 28 July-1 August 2014.
- Vidotto, F., Vievques Island, Puerto Rico, 5-10 January 2014.

**Utrecht University**

- Crichigno, M., Participation in the "Simons Center summer Workshop, Black Holes, Cosmology and Strings", Stony Brook University, USA, 2014.
- Crichigno, M., Scientific visit to Prof. Nikolay Bovev, KU Leuven, Belgium.
- Gürsoy, U., Seminar in the University of Crete, Heraklion, 18 December 2014.
- Szepietowski, P., *C-a in holography and the superconformal index*, Delta ITP triangle meeting on holography, University of Amsterdam, the Netherlands, 31 October 2014.

**Nikhef Theory Group**

- Butter, D.P., *Complex geometry and conformal supergravity in projective-harmonic superspace*, ITF Utrecht, Utrecht, the Netherlands, 12 September 2014.
- de Wit, B., *Off-shell dimensional reduction*, Workshop Aspects of Supergravity, Simons Center, Stony Brook, USA, 7 January 2014.
- de Wit, B., *Deformations of special geometry: Searching for the topological string*, Harvard University, Boston, USA, 27 March 2014.
- de Wit, B., *Deformations of special geometry: Searching for the topological string*, University Milano-Bicocca, Milano, Italy, 15 April 2014.
- de Wit, B., *Locally USp(8) invariant IIB Supergravity and E6(6) covariance*, Université de Mons, Mons, Belgium, 21 May 2014.
- de Wit, B., *IIB Supergravity and the E6(6) covariant vector-tensor hierarchy*, Workshop, Exceptional Symmetries and Emerging Spacetime, Nanyang Technological University, Singapore, 10 November 2014.
- Echevarría, M.G., *Scale Evolution of Gluon TMDs*, Transversity 2014, Chia, Italy, 10 June 2014.
- Fleischer, R., *Probing new physics with Bs 0 →μ+μ−: Status and perspectives*, Int. Conf. on Flavour Physics and Mass Generation, Singapore, 11 February 2014.
- Laenen, E., *Four lectures on QCD*, European School of High-Energy Physics, Garderen, the Netherlands, 22 June 2014.


- Mulders, P.J., *Transverse momentum dependent distribution functions of definite rank*, the QCD Evolution 2014 Workshop, Santa Fe, USA, 13 May 2014.

- Mulders, P.J., *Transverse momentum dependent distribution and fragmentation functions in high energy scattering processes*, 17th Taiwan Nuclear Physics Summer School, Institute of Physics, Academia Sinica, Taipei, Taiwan, 26 August 2014.


- Mulders, P.J., *Spin dependent TMDs of definite rank*, 21st Int. Symp. on Spin Physics (SPIN2014), Peking University, Beijing, China, 22 October 2014.

- Mulders, P.J., *TMDs, offering opportunities at small kT and small x!*, Annual meeting of the Groupement de Recherche on QCD and Hadron Physics, Ecole Polytechnique, Palaiseau, France, 16 December 2014.


- Petraki, K., *Atomic dark matter*, Workshop, Odense, Denmark, 1 April 2014.


- Pisano, C., *TMD gluon distributions and quarkonium production in unpolarized pp collisions*, Workshop, AFTER@LHC: Probing the strong interactions at A Fixed Target ExpeRiment with the LHC beams, Les Houches, France, 12 January 2014.

- Pisano, C., *Probing the transverse dynamics and the polarization of gluons inside the proton at the LHC*, 49th Rencontres de Moriond on QCD and High-Energy Hadronic Interactions, La Thuile, Italy, 27 March 2014.

- Pisano, C., *Transverse momentum dependent gluon distributions at the LHC*, QCD Evolution Workshop, Santa Fe, USA, 12 May 2014.


- Schellekens, A.N., *Now what?*, Physics@FOM, Veldhoven, the Netherlands, 22 January 2014.
- Schellekens, A.N., *Particle physics in the multiverse*, VU LaserLab Colloquium, Amsterdam, the Netherlands, 26 February 2014.
- Schellekens, A.N., *Particle physics in the multiverse*, Niels Bohr Colloquium, København, Denmark, 10 September 2014.
- van Holten, J.W., HiSPARC, Physics seminar, Salt Lake City, USA, 10 January 2014.
- Waalewijn, W.J., *Dissecting soft ISR*, Underlying Event, and Hadronization with Factorization, SCET 2014, Munich, Germany, 26 March 2014.
- Waalewijn, W.J., *Dissecting soft radiation with factorization*, MPI@LHC 2014, Krakow, Poland, 4 November 2014.
- Waalewijn, W.J., *QCD at the LHC*, National Seminar, Amsterdam, the Netherlands, 21 November 2014.
7.2 Theme 2

University of Amsterdam
- Brockmann, M., *Gaudin-like determinants for overlaps in integrable systems and their application to quench problems*, Integrable Lattice Models and QFTs, Bad Honnef, Germany, June 2014.
- Brockmann, M., *Quench action approach for the Néel-to-XXZ quench*, Recent Advances in Quantum Integrable Systems, Dijon, France, September 2014
- Caux, J.S., *Dynamics in Heisenberg chains: From fractional excitations to new out-of-equilibrium states of matter*, Integrable Lattice Models and Quantum Field Theories Workshop, Bad Honnef, Germany, 29 June 2014.
- Caux, J.S., *Dynamics in one dimension: From fractional excitations to exact solutions of out-of-equilibrium situations*, Templeton Meeting, Leiden, the Netherlands, 24 November 2014.
- Caux, J.S., *Dynamics in one dimension: From fractional excitations to new out-of-equilibrium Dynamics states of matter*, UvA Strings Group Journal Club, Amsterdam, the Netherlands, 12 September 2014.
- Caux, J.S., *Dynamics in one dimension: From fractional excitations to new out-of-equilibrium states of Matter*, Integrable Systems and Quantum Symmetries, Prague, Czech Republic, 26 June 2014.
- Caux, J.S., *Dynamics in one dimension: From fractional excitations to new out-of-equilibrium states of matter*, Mathematical Physics Workshop, Leiden, the Netherlands, 8 July 2014.


- Corboz, P.R., *Competing states in the t-J model: uniform d-wave state versus stripe state*, SCES2014, Grenoble, France, 7-11 July 2014.

- Corboz, P.R., *Projected entangled-pair states*, Quantum Matter Templeton meeting, Leiden, the Netherlands, 24-25 November 2014.

- Corboz, P.R., *Recent progress in simulating strongly correlated systems with 2D tensor network methods*, Condensed Matter Seminar, University of Tokyo, Tokyo, Japan, 23 October 2014.

- Corboz, P.R., *Recent progress in simulating strongly correlated systems with iPEPS*, Condensed Matter Seminar at the University of Tokyo, Kobe, Japan, 20-22 October 2014.

- Corboz, P.R., *Recent progress in simulating strongly correlated systems with tensor network methods*, XXVI IUPAP Conference on Computational Physics (CCP2014), Boston, USA, 11-14 August 2014.


- Lahtinen, V.T., *Condensate-induced transitions and critical spin chains / Hierarchy of exactly solvable spin-1/2 chains with so(N)_1 critical points*, Seminar, University College London, UK, May 2014.
- Lahtinen, V.T., *Condensate-induced transitions and critical spin chains / Hierarchy of exactly solvable spin-1/2 chains with so(N)_1 critical points*, Seminar, University of Utrecht, the Netherlands, February 2014.
- Lahtinen, V.T., *Condensate-induced transitions and critical spin chains / Hierarchy of exactly solvable spin-1/2 chains with so(N)_1 critical points*, Seminar, University of Austin, USA, January 2014.
- Lahtinen, V.T., *Condensate-induced transitions and critical spin chains / Hierarchy of exactly solvable spin-1/2 chains with so(N)_1 critical points*, Seminar, MPI Garching, Munich, Germany, February 2014.
- Lerner, E., *Self organization and rheology of dense non-Brownian flows - a geometric approach*, Seminar, Institute of Physics, Universiteit of Amsterdam, Amstedam, the Netherlands, 2014.
- Nienhuis, B., *Has E8 been seen in nature?*, Australian New Zealand Mathematical Congress, Melbourne, Australia, 8-12 December 2014.
- Nieuwenhuizen, T.M., *Bell inequalities*, Seminar, Institute of Physics, University of Amsterdam, Amsterdam, the Netherlands, 8 May 2014.
• Nieuwenhuizen, T.M., *Bell versus Einstein: Who won the last round?* Joint physics colloquium with the IIP, Universidade Federal do Rio Grande do Norte, Natal, Brazil, 16 October 2014.


• Nieuwenhuizen, T.M., *Gravitational hydrodynamics as an application of turbulence in the early Universe*, Turbulence in the sky as on Earth Workshop, Natal, Brazil, 13 October 2014.


• Schoutens, C.J.M., *Quantum Hall quantum registers and conformal field theory*, Seminar, University of Utah, Salt Lake City, USA, 6 May 2014.


**Vrije Universiteit Amsterdam**


- MacKintosh, F.C., *Fluctuations in equilibrium and non-equilibrium systems*, 2014 Summer School on Active Matter, Gwangju, South Korea, June 2014.

**University of Groningen**
- van Enter, A.C.D., Probability seminar of the Technion, Haifa, Israel, 19 October 2014.
- van Enter, A.C.D., CECAM workshop Percolation and the Glass Transition, Tel Aviv University, Israel, 2014.
van Enter, A.C.D., Workshop, Mathematical Facets of Crystallization, Lorentz Center, Leiden, the Netherlands, 9 September 2014.

van Enter, A.C.D., Seminar, UFRJ, Rio de Janeiro, Brazil, 11 August 2014.


van Enter, A.C.D., The 13th Probability Day Erlangen-München, Germany, 13 May 2014.

van Enter, A.C.D., The Statistical Seminar of Chalmers University, Göteborg, Sweden, 8 April 2014.

**Leiden University**

- Beenakker, C.W.J., Colliding Majorana fermions have a memory, Weizmann Institute, Rehovot, Israel, 27 October 2014.
- Blöte, H.W.J., First-order transition of the 3-state Potts model in 2D, Seminar, Department of Physics, Beijing Normal University, Beijing, China, 28 October 2014.
- Blöte, H.W.J., Efficient simulation of LR models: principle and applications, Seminar, Institute of Theoretical Physics, Chinese Academy of Science, Beijing, China, 24 November 2014.
- Chen, B., Kinks in topological soft matter, American Physical Society March Meeting, Denver, USA, 3-7 March 2014.
- Chen, B., Topological soft matter: From linkages to kinks, van der Waals Colloquium, Leiden University, Leiden, the Netherlands, 9 May 2014.
- Chen, B., Kinks in topological mechanics, 16th Dutch Soft Matter Meeting, VU Amsterdam, Amsterdam, the Netherlands, 15 May 2014.
- Chen, B., Topological soft matter: From linkages to kinks, Seminar, University of Michigan, Ann Arbor, USA, 11 June 2014.
- Chen, B., Topological soft matter: From linkages to kinks, Seminar, Brandeis University, Waltham, USA, 26 June 2014.
- Chen, B., Topological soft matter: From linkages to kinks, Lorentz Center Workshop: Topological Mechanics, Leiden University, Leiden, the Netherlands, 6-10 October 2014.
- Chen, B., Topological soft matter: From linkages to kinks, Seminar, University of Warwick, Coventry, UK, 4 December 2014.
- Chevallier, D., Majorana Fermions and Andreev bound states in topological nanowires, 10th Capri spring school, Italy, 28 April-3 May 2014.
- Chevallier, D., Spin accumulation in out-of-equilibrium superconductors, Seminar, CPT Marseille, France, November 2014.
- Eslami Mossallam, B., Multiplexing nucleosome positioning signals and genetic information, Multiscale Modelling of Biomolecular Systems meeting, VU University, Amsterdam, the Netherlands, November 2014.


- Giomi, L., *Cell mimicry in active liquid crystals*, This week discovery, Leiden University, Leiden, the Netherlands, 1 December 2014.
- Schiessel, H., *Breaking the second genetic code*, Joan van der Waals colloquium, Leiden, the Netherlands, April 2014.
- Vitelli, V., Amolf Colloquium, Amsterdam, the Netherlands, 30 June 2014.
- Vitelli, V., School of Engineering and Applied Sciences, Harvard University, Boston, USA, 3 April 2014.
- Vitelli, V., Theoretical Physics Initiative, Graduate School, CUNY, New York, USA, 31 March 2014.
- Vitelli, V., Physics Department, Umea University, Sweden, 17 January 2014.
- Vitelli, V., Gran Sasso Science Institute, L’Aquila, 13 January 2014.
- Vitelli, V., Mathematics Department, Universita’ La Sapienza, Rome, Italy, 11 January 2014.
- Wu, K., Gravity at a Kelvin: The generalized rigidity of superconducting quantum nematic, FOM@Physics, January 2014.
- Wu, K., Gravity at a Kelvin: The generalized rigidity of superconducting quantum nematic, March meeting, Denver, USA, 3-7 March 2014.
- Wu, K., Gravity at a Kelvin: The generalized rigidity of superconducting quantum nematic, Talk, Quantum Phenomena in Strongly Correlated Electrons, Cracow, Poland, 15-18 June 2014.
- Wu, K., How bilayer excitons can greatly enhance thermoelectric efficiency, UC Santa Barbara, California, USA, 12 March 2014.
- Wu, K., How bilayer excitons can greatly enhance thermoelectric efficiency, Glam Special Seminar, Stanford, USA, 17 March 2014.
- Wu, K., How bilayer excitons can greatly enhance thermoelectric efficiency, UC Berkeley, California, USA, 15 March 2014.
- Zaanen, J., Quantum matter emerging under the spell of the fermion signs, Talk, Kick-off conference for the Templeton Foundation’s Physics of Emergence project, University of Pittsburg, USA, 31 January-3 February 2014.
- Zaanen, J., Holographic duality and the quantum critical strange metals, Three lectures, 50th Karpacz Winter School of Theoretical Physics, Karpacz, Poland, 2-9 March 2014.
- Zaanen, J., The black hole in a grain of copper rust (and other surprises in the quantum matter universe), “kindergarten” lecture, 50th Karpacz Winters Shool of Theoretical Physics, Karpacz, Poland, 3 March 2014.
- Zaanen, J., AdS/CMT: From black holes to quantum matter, Talk, KNAW Genootschap, Sectie Natuur- en Sterrekunde, Amsterdam, the Netherlands, 26 May 2014.
- Zaanen, J., Pairing instability in quantum critical metals, Talk, (Towards) Room Temperature Superconductivity workshop, Lorentz Center, University of Leiden, the Netherlands, 30 June-4 July 2014.


**Radboud University Nijmegen**


Utrecht University


- Duine, R.A., *Interactions near interfaces: From skyrmion stabilization to magnon condensation*, Seminar, Groningen University, the Netherlands, 29 September 2014.


- Fritz, L., *Spin-liquid phase and order-by-disorder on the swedenborgite lattice*, Seminar, Tel Aviv University, Tel Aviv, Isreal, February 2014.

- Fritz, L., *Interaction limited minimal conductivity in mono- and bilayer graphene*, Seminar, Utrecht University, Utrecht, the Netherlands, May 2014.

- Fritz, L., *Spin-liquid phase and order-by-disorder on the swedenborgite lattice*, Seminar, Radboud University Nijmegen, Nijmegen, the Netherlands, May 2014.


- Morais Smith, C., Colloquium, 50 years of the Physics Institute, Rio de Janeiro, Brazil, 27 February 2014.
- Morais Smith, C., *Topological states in higher orbitals*, Talk, Leiden, the Netherlands, 1 April 2014.
- Prokopec, T., *Gauge invariant cosmological perturbations*, Unitarity and frame independence in Higgs inflation, Workshop, Modern Cosmology: CMB and LSS, Benasque, Spain, 12 August 2014.
- Prokopec, T., *Late time quantum backreaction from inflationary fluctuations of non-minimally coupled scalars*, Inflationary Cosmology as a Window to Quantum Gravity, Tainan, Taiwan, 20 December 2014.
- Prokopec, T., *Global monopoles in cosmology: The universe’s spatial curvature and CMB anomalies*, Inflationary Cosmology as a Window to Quantum Gravity, Tainan, Taiwan, 20 December 2014.


- Schuricht, D., *Local spectral properties of one-dimensional electron systems*, Colloquium, Physics of Interfaces and Nanomaterials, University of Twente, Enschede, the Netherlands, 15 May 2014.


- Schuricht, D., *Relaxation dynamics of one-dimensional systems after a quantum quench*, Seminar zur Statistischen Physik, University of Wuppertal, Germany, 30 January 2014.


- A. A. Starobinsky, *Present status of the search of gravitational waves from inflation*, Lecture, Theoretical Cosmology Meeting, Leiden University, the Netherlands, 7 November 2014.

- A. A. Starobinsky, Advanced course in Modern Cosmology, Utrecht University, the Netherlands, 12 academic hours 10, 17 and 24 November 2014.


- van Roij, R., *Harvesting blue energy from mixing river- and sea water in porous electrodes: towards optimal-power calculations*, Minisymposium Sustainability @ science and geosciences, Utrecht, the Netherlands.

- van Roij, R., *Colloidal self-assembly in liquids*, Utrecht Summer School Theoretical Physics, Utrecht, the Netherlands, 28 August 2014.


- van Beijeren, H., *KPZ-behavior of hydrodynamics in one dimension*, University of Konstanz, Germany, 27 January 2014.

- van Beijeren, H., *KPZ-behavior of hydrodynamics in one dimension*, Institut für theoretische Physik, University of Innsbruck, Austria, 29 January 2014.


- van Beijeren, H., *KPZ- and related behavior of hydrodynamics in one dimension*, School on Non-linear Dynamics, Dynamical Transitions and Instabilities in Classical and Quantum, The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy, 1 August 2014.


- van der Schoot, P., *Nucleation kinetics of nanoparticle encapsulation by virus coat proteins*, Lorentz workshop on Form and Function of Protein Nanoshells: Assembly, Mechanics and Dynamics, Leiden, the Netherlands, 23 February 2012.

- van der Schoot, P., *Virus-based nanoparticles*, International conference on nanostructures, Kish Island, Iran, 7 February 2014.


- van der Schoot, P., *Role of solvent in supramolecular polymerisation*, Department of Physics, Freie Universität Berlin, Germany, 16 October 2014.

van der Schoot, P., *Encapsulation of nanoparticles by virus coat proteins: predictions from simple models*, Topical Seminar on Virus Particles, Research Center for Function Molecular Systems, Nijmegen, the Netherlands, 29 October 2014.

van der Schoot, P., *Role of solvent in supramolecular polymerisation*, Discussion Meeting on Aggregation and Clustering of Molecules, Royal Danish Academy of Sciences and Letters, Copenhagen, Denmark, 30 October 2014.

van der Schoot, P., *Tactoids large and small*, Department of Physics, Universidad de Sevilla, Seville, Spain, 20 November 2014.

van der Schoot, P., *Role of solvent in supramolecular polymerisation*, Instituut Lorentz, Universy of Leiden, Leiden, the Netherlands, 27 November 2014.


8 | Scientific-related activities

This chapter presents an overview of the science-related activities of DRSTP staff members and postdoctoral fellows. Here we list publications about (or related to) physics in a variety of printed media in Section 8.1. In Section 8.2 public lectures are listed. All other outreach activities such as forum discussions, television/radio interviews, personal columns in newspapers etc. are listed in the paragraph `other contributions' (Section 8.3). Science-related activities of PhD students can be found in Chapter 4 (Sections 4.6 and 4.7).

8.1 Physics-related publications

- Bergshoeff, E.A., *De wondere wereld van de speciale relativiteit*, 'Top of the Prof's' lezing gegeven in het Infoversum ter gelegenheid van het 400- jarig bestaan van de RUG, Groningen, June 2014.
- Ganor, O.J., Hong, Y.P., Moore, NSun, H.Y., Tan, H.S., Torres-Chicon, N.R., \textit{Q-balls of Quasi-particles in a (2,0) theory model of the fractional quantum Hall effect.}

8.2 Public lectures

- Bais, F.A., \textit{Complexity and innovation}, SFI/Comenius course, Santa Fe Institute, Santa Fe, USA, 31 October -10 November 2014.
- Bertone G., *The dark universe*, University of Western Cape, Cape Town, South Africa, 20 November 2014.
- Castro, A., *Lectures on black hole thermodynamics*. Lecturer, Institute of Theoretical Physics, KU Leuven, Belgium, 2-6 June 2014.
- de Boer, J., *Wat is vacuum*, talk at Viva Fysica, Amsterdam, 31 January 2014.
- Fritz, L., Student seminar on quantum phase transitions, fall 2014.

Juricic, V., *“Quantum superconducting criticality in graphene and topological insulators”*, Physics@FOM Veldhoven, the Netherlands, January 2014.


Morais Smith, C., *How f-male a woman should be to succeed?*, Future of Women in Business, Club of Amsterdam, the Netherlands, 24 April 2014.


Mulders, P.J., *Ontdekkingsreis naar het allerkleinste en het allergrootste in het heelal*, VU Publiekslezing, de Balie, Amsterdam, the Netherlands, 10 March 2014.

Prokopec, T., *Parity violation in the sky, What does it tell us about our Universe?*, Department Day, Utrecht, the Netherlands, 24 May 2014.

Schoutens, C.J.M. *Quantumwereld*, Nationale Comeniusleergangen, 22 May 2014 and 18 September 2014.


Schuricht, D., Inaugural lectures, *Collective phenomena in the quantum world*, Department Day of the Department of Physics and Astronomy Utrecht University, 8 May 2014.


Vonk, M. *Van Heisenberg naar entropische zwaartekracht (From Heisenberg to entropic gravity)*, lecture for the masterclass "The Quantum Universe", Amsterdam, 12 November 2014.

Vonk, M. *Zwarte gaten - bestaan ze wel? (Black holes - do they exist?)*. talk at a youth summer camp for astronomy, Asten, the Netherlands, 1 August 2014.


- van Roij, R., *Blauwe energie opwekken uit menging van zoet en zout water*, 17 June 2014, Sonnenborgh Utrecht, Kijk Live!.
- van Roij, R., *Green energy out of the blue*, Utrecht, Opening of the academic year of the Faculty of Science, 4 September 2014.
- van Roij, R., four lectures on “Electrostatics in liquids” at the Dutch PhD winter school Physical-Chemistry, Han sur Lesse, Belgium, 29-31 January 2014.
- Zaanen, J., *De stralen van het zwarte gat en het wezen van materie* (public lecture), Nacht van kunst en Kennis, Boerhaave Museum, Leiden, the Netherlands, 20 September 2014.

### 8.3 Other contributions

- Bais, F.A., Interview NTR m.b.t. Stephen Hawking, Kennis van Nu, radio 5, 22 May 2014.
- Bais, F.A., *Complexity now*, Panel discussion, Santa Fe Institute, Santa Fe, USA, 20 June 2014.
- Bais, F.A., Interview NTR i.v.m. T. Tjin, Kennis van Nu, radio 5, 2 December 2014.
- Katsnelson, M.I., Interview, Robert Dulmers, De groene Amsterdammer, the Netherlands, 31 July 2014.
- Katsnelson, M.I., Interview, Elma Drayer, Trouw, the Netherlands, 21 June 2014.
- Kleiss, R., Moderation at the Nijmegen Science Café (three times), Radboud PUC “Excellentieprogramma”, 2014.
- ’t Hooft, G., "Plancks 2014", Speaker, Stephen Hawking, Beatrix Theater, Utrecht, the Netherlands, 23 May 2014.
- van der Schaar J.P., Grote Klapper, interview tbv artikel Volkskrant wetenschapsbijlage, Amsterdam, 22 March 2014.
- van der Schaar J.P., ABC van de Oerknal, bijdrage tbv boek Govert Schilling, Amsterdam, 26 March 2014.
- van der Schaar J.P., interview Metro, Amsterdam, 18 March 2014.
9 | Research funding

Below an overview is presented of funding organizations that financially supported the research of the DRSTP in 2014. Regular university funding is not listed.

9.1 Personal grants

NWO
- VENI grant (2009) N. Banerjee (UU) (2010-2013)
- VIDI grant (2011) A. Parnachev (UL) (2011-2016)
- Spinoza grant (2011) E.P. Verlinde (UvA)
- VICI grant H. Hilgenkamp (UT)-L. Rademaker (UL)

ERC
- ERC Starting grant, G. Bertone (UvA) The moment of truth for WIMP dark matter (2011-2016)
- ERC Advanced investigator grant, B. de Wit (UU/Nikhef) Supersymmetry: a window to non-perturbative physics (2010-2015)
- ERC Starting grant, R.A. Duine (UU), New frontiers in spintronics (2008-2013)
- ERC Advanced investigator grant, P.J.G. Mulders (VUA) Quantum chromodynamics at work (2012-2017)
- ERC Advanced investigator grant, E.P. Verlinde (UvA) *Emergent gravity, string theory and the holographic principle* (2011-2016)

**EU Marie Curie Intra-European Fellowships**
- P. Artoisenet (Nikhef) (2012-2014)
- B. Vercnocke (UvA) QM-Sing (2013-2015)

**Other personal fellowships**
- D. Cohen (UvA), National Commission for Scientific and Technological Research Chile, PhD (2013-2017)
- L. Pena Pires (UU/RU) Portuguese Foundation for Science and Technology, PhD Fellowship (2012-2016)
- N. Poovuttikul (UL) Institute for the Promotion of Teaching Science and Technology (IPST), DRSTP Scholarship 2008-2017

### 9.2 FOM funding

**FOM-A-20** (group leader J. de Boer) (UvA)
FOM programme 121: A string theoretic approach to cosmology and quantum matter (2010-2014)
- 09CQ01: Dynamical aspects of black holes (J. de Boer, M. Taylor, E.P. Verlinde, UvA)
- 09CQ02: Holography and cosmology (K. Skenderis, J.P. van der Schaar, UvA)
- 09CQ09: Programme management, workshops and guests (E.P. Verlinde, UvA)
Projectruimte 10PR2818: An entropic view on gravity and the cosmos (E.P. Verlinde, J. de Boer, UvA)
Projectruimte 14PR3153: Holography in the Sitter static patch (D. Hofman, UvA)
Projectruimte 14PR3156: Quantifying violations of causality in quantum gravity (B. Freivogel, UvA)

**FOM-A-25** (group leader J.-S. Caux) (UvA)
FOM programme 128: The singular physics of 1D electrons:
- 10ODE02: New linear Luttinger liquid response functions (J.-S. Caux, UvA)
FOM programme 134: Topological insulators:
- 11T106: Topological Insulators Developing a Quantum Field (C.J.M. Schoutens, UvA)
FOM-A-32 (group leader G. Bertone) (UvA)
FOM programme 139: The missing universe: what is the subatomic constituent of dark matter:
- 12DM02: Dark Matter Theory (G. Bertone, UvA)

FOM-G-01 (group leader E. Bergshoeff) (RUG)
- 09CQ05: *Effective actions for string cosmology* (FOM Programma: A string theoretic approach to cosmology and quantum matter) (E. Bergshoeff)
- 12PR3026: *A new road to massive gravity?* (Projectruimte 2012) (E.A. Bergshoeff)
- 09CQ06: *A string theoretic approach to cosmology* (D. Roest)
- 14ANBI01: *Inflationary attractors in the very early universe* (2014-…) (D. Roest)

FOM-L-15 (group leader J. Zaanen) (UL)
FOM program: A string theoretic approach to cosmology and quantum matter
- 09CQ08: Fermions and AdS/CFT (A. Bagrov)

Projectruimte
- 10PR2759: Fermionic quantum criticality and anti-de-sitter theory: black-hole answers for condensed matter questions (Y. Liu, Y.-W. Sun)
- 12PR2960: Gravity at a Kelvin: the generalized rigidity of the superconducting quantum nematicm (K. Wu, J. Nissinen)

FOM program: Topological insulators
- 11TI05: Theory of topological defects in 2D and 3D TI's (R.-J. Slager)

FOM-U-01 (group leader G. 't Hooft) (UU)
Theoretical particle physics in the era of the LHC (FOM program 104)
- 09PR2744: The 4D/5D connection for black holes and black rings (G. 't Hooft)

FOM-U-05 (group leader H. Stoof) (UU)
Projectruimte
- 10PR2783-2: Spin drag in Bose gases (H. Stoof/R. Duine/P. van der Straten)

FOM-U-29 (group leader S. Vandoren) (UU)
A string theoretic approach to cosmology and quantum matter (FOM program 121)
- 09CQ03: Fixed point CFT's for condensed matter systems (S. Vandoren)
- 09CQ04: Moduli stabilization and cosmological vacua (S. Vandoren)
Projectruimte
- 09PR2731: Statistical versus thermodynamic black hole entropy (B. de Wit)
- 14OBB04: Observing the Big Bang (T. Prokopec)
- 14HPP04: Higgs as a Porobe and Portal (T. Prokopec)

**FOM-U-31** (group leader R. van Roij) (UU)

Innovative physics for oil and gas (FOM/SHELL program 116)
- 08iPOG08: Electrokinetics and electroacoustics near oil-water interfaces in porous media (R. van Roij)

Projectruimte
- 07PR2592: Do smectic nuclei exist? (R. van Roij and M. Dijkstra)

**FOM-U-34** (group leader R. Duine) (UU)

Controlling spin dynamics in magnetic nanostructures: combining fast time and short length scales for tomorrow's technology (FOM program 109)
- 80SPIN03: Theory domain walls (R. Duine)

**FOM program** Magnon Spintronics (R. Duine)

Projectruimte
- SKYRMIONICS - towards skyrmions for nanoelectronics, (R.A. Duine, H.J.M. Swagten.)

**FOM-V-01** (group leader P. Mulders) (VUA)
- 12PR2986: Quantum chromodynamics at work in the Higgs sector (P.J. Mulders)

**FOM-V-13** (group leader F. MacKintosh) (VUA)

*Mechanosensing and mechanotransduction by cells (FOM program 117)*
- 09MMC08: Force transmission in the extracellular matrix (F. MacKintosh)

*Marginal soft matter: leveraging the mechanics of responsive networks (FOM program 143)*
- 12CMA04: Theory of tunable marginal networks and thermal paradox materials (F. MacKintosh)

**FOM-R-01** (group leader R. Loll (RU):

Projectruimte
- Dynamical dimensions in quantum gravity: why less may be more (R. Loll)
- Reality check for quantum cosmology (R. Loll)
- Ironing out the quantum wrinkles of spacetime (R. Loll)
- Spectral geometries and observables (R. Loll)
- Black hole dynamics in asymptotically safe quantum gravity (F. Saueressig)

- Non-equilibrium magnetism on the time scale of exchange and spin-orbit interactions, (M.I. Katsnelson)

### 9.3 FOM-Nikhef

**FOM program** (group leader E. Laenen)
Theoretical Particle physics in the era of the LHC (FOM programme 104)
- 07TPP06: Tools, methods and applications for new physics predictions for the LHC (J.W. van Holten, E. Laenen, J. Vermaseren)

**FOM program** (group leader E. Laenen)
Higgs as Probe and Portal

**FOM program** (group leader E. Verlinde)
String theory and quantum gravity (FOM programme 57)
- 01STGQG04: Conformal field theory (A. Schellekens)

**FOM program** (group leader J. van den Brand)
String theory and quantum gravity (FOM program 57)
- 01STGQG04: Conformal field theory (J.-W. van Holten)

**FOM-Nikhef** (group leader J. Vermaseren)
Projectruimte
- 07PR2556: Precision phenomenology at the LHC (J. Vermaseren)

**FOM-Nikhef** (group leader A. Schellekens)
Projectruimte
- 05PR2435: Standard model interactions from open string theory (A. Schellekens)

**FOM-Nikhef** (group leader R. Fleischer)
Projectruimte
- 05PR2435:

Personal grants:
Running:
ERC Advanced Grant: Bernard de Wit
ERC Advanced Grant: Jos Vermaseren
*ERC Advanced Grant: Piet Mulders

Marie Curie Fellowship: Daniel Butter
Marie Curie Fellowship: Wouter Waalewijn
9.4 EU-networks

Study of Strongly Interacting Matter (HadronPhysics3)
Duration: 2012-2014
Netwerk coordinator: C. Guaraldo (Frascati)
Scientist in charge for VUA: P.J.G. Mulders

LHCPhenoNet (Contract nr. PITN-GA-2010-264564)
Duration: from 01-01-2011 until 31-12-2014
Network coordinator: Dr. G. Rodrigo (Valencia)
Scientist in charge for Nikhef: E. Laenen

EU IRSES (International Research Staff Exchange Scheme)
Quantum Integrability, Conformal Field Theory and Topological Quantum Computation (J.-S. Caux) (2012-2016)

9.5 Other

University grants
- UvA Research Priority Area: GRavitation and AstroParticle Physics
  Amsterdam (GRAPPA) UvA
- *The phases of gauge theories with many flavours*, NCF-grant for computing time (E. Pallante) (RUG)
- De Sitter-leerstoel, E.A. Bergshoeff (RUG) (2009)

KNAW
- Academy professorship, E.A. Bergshoeff (RUG) (2010-2015)

NWO
- NWO Gravitation: Delta Institute for Theoretical Physics: Matter at all Scales (2012), 2013-2022 (E.P. Verlinde) (UvA)
- NWO Graduate Programme: GRAPPA (2012), 2013-2017 (J. Vink, UvA)
  NWO Graduate Programme for Theoretical Physics: ITP Utrecht (2014), 2015-2019 (S. Vandoren, UU)

European commission

Templeton project
10 | Organization (per 31-12-2014)

Scientific Advisory Committee:
Prof. P.M. Chaikin (NYU), New York University, USA
Prof. M. Henneaux (ULB), University of Brussels, Belgium
Prof. R. Kallosh (SU), Stanford University, California, USA
Prof. G. ’t Hooft (UU), Utrecht University, the Netherlands
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11 | Partners and associate members

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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 and of the National Institute for Subatomic Physics (Nikhef) 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 other disciplines such as 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 neighboring countries that share these goals. Often its educational activities already attract students from neighboring 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 partners, 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 reaccredited in 1999, 2004 and 2010. 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 Scientific Advisory Committee of distinguished scientists.

**Research**

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

The research fields of the DRSTP are highly diverse, ranging from the physics at the very smallest length scales to the large scale structure of space and time, and from the study of building blocks of matter to the intricacies of the many-body physics of condensed matter, be it quantum matter, soft matter or bio-matter.

The methods employed in these various fields make up the universal language of theoretical physics: formalisms such as the renormalization group and quantum field theory, and various concepts of statistical, computational and mathematical physics are universally applied and establish cross-talk among the research fields.

The research areas covered by the DRSTP can be grouped into the following broad and overlapping themes:

- Theme 1: Particle physics, cosmology, quantum gravity and string theory
- Theme 2: Quantum matter, quantum information, soft condensed matter and biophysics

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 program 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 partners. 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 partners in the DRSTP offer a joint program of graduate education leading to a PhD. As part of the research training, under the supervision of a member scientist of the corresponding node, 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 ‘Education and Supervision Form’ [opleiding- en begeleidingsplan (OBP)] between each individual PhD student and its supervisor(s), to be submitted to and approved by the Board upon admittance.

The Educational Board 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 PhD Student Council that meets regularly with the scientific director and the chairman of the Governing Board and Educational Board (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 include:

- the promotion of a stimulating research environment in
- 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’s

When a PhD research position opens up with one of the participating partners, 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’s program.

Admission to the DRSTP requires the submission of an 'Education and Supervision Form' [opleiding-en begeleidingsplan (OBP)], 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 program is an explicit element of the evaluation: students are expected to attend at least two DRSTP postgraduate schools and the DRSTP symposium ‘Trends in Theory’. The outcome of the evaluation will reflect on whether the student will be able to complete the research program 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 a student does leave the school before completing the PhD program, a diploma, specifying the student’s accomplishments in the educational program, 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 courses (AIO/OIO schools)

Theoretical High Energy Physics (THEP)

Date:
27 January – 7 February 2014

Location:
Hotel and conference center Landgoed Zonheuvel, Doorn, the Netherlands

Scientific organizers:
S. Ando (UvA); J.-W. van Holten (Nikhef/UL); A. Signori (VUA)

Lecturers:
A. Boyarsky (UL): Plan B: BSM physics without net particles at the LHC
B. de Wit (UU): Gauge theories
R. Fleischer (Nikhef/VUA): Flavor physics: CP violation and rare B decays
S. Vandoren (UU): Black holes

Evening lecturer:
P. Decowski (Nikhef/UvA)

Twenty-two (22) PhD students participated. All students were from the Netherlands. A guided walk was organized for the students as a social event.

PhD students (22) and their presentations (22) (10 min. + discussion):
Alkaç, Gokhan (RUG): Covariant symplectic structure of gravity theories
Basanisi, Luca (RUG): Supersymmetry in curved space
Bonocco, Domenico (Nikhef): An effective field theory for soft gluons
Bryan, Jan-Willem (RUG): The black hole firewall paradox
Ciceri, Franz (Nikhef): A few words on dimensional reduction
Cohen, Diego (UvA): Kerr/CFT duality
Coone, Dries (RUG): Phases of gauge theories
Dimitrakopoulos, Fotios (UvA): Cosmological implications of the Higgs discovery
Feyereisen, Michael (UvA): Hamilton-Jacobi dynamics of quantum weak values
Galante, Mariano (RUG): Perspectives in Higgs inflation
Jefferson, Robert (UvA): Landscaping with monodromies: D-brane superpotentials from lines on hypersurfaces
Kabir, Laurens (UvA): Black holes and quantum information
Lamers, Jules (UU): From supersymmetric gauge theories to quantum integrability

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Parra, Lorena (RUG): *3D non-relativistic supergravity*
Pires, Luis (RU): *GR from HLG, can we recover it?*
Reys, Valentin (Nikhef): *Black hole degeneracies in string theory and supergravity*
Rietkerk, Robbert (UvA): *1/Nc expansion at LHC*
Scalisi, Marco (RUG): *The large-N limit of inflation*
Signori, Andrea (VUA): *TMDs in a nutshell*
Torrado Cacho, Jesus (UL): *Search for localized features in Planck's CMB due to a transient in the speed of sound*
Volponi, Marco (Nikhef): *Nice to meet you, Higgs inflation*
Wiechers, Michael (UvA): *Asymmetric dark matter*
Statistical Physics and Theory of Condensed Matter (SPTCM)

Date:
10 – 21 March 2014

Location:
Hotel and conference center Landgoed Zonheuvel, Doorn, the Netherlands

Scientific organizers:
R. Duine (UU); R. van den Berg (UvA); V. Vitelli (UL)

Lecturers:
Wouter Ellenbroek (Tu/e) and Rembert Duine (UU): Quantum linear-response theory and the fluctuation-dissipation theorem
Lars Fritz (UU): Path-integral methods
Henk Stoof (UU): Renormalization-group theory
Paul van der Schoot (TU/e, UU): Non-equilibrium thermodynamics

Evening lecturer:
Karla de Bruin (Netherlands Forensic Institute): Bloody physics in forensics

Twenty-seven (27) PhD students participated. All students were from the Netherlands. A cooking workshop was organized for the students as a social event.

PhD students (27) and their presentations (20) (10 min. + discussion):
Ado, Ivan (RU): Transport in topological insulator in proximity to a ferromagnet
Almog, Assaf (UL): --
Armaitis, Jogundas (UU): A Bose-Einstein condensate of dipolar molecules as a quantum rotor
Babeanu, Alexandru (UL): Structure and properties of cultural space
Bet, Bram (UU): --
Betzios, Panagiotis (UU): --
Buhrandt, Stefan (UU): --
de Leeuw, Arie-Willem (UU): Bose-Einstein condensation of photons
Di Liberto, Marco Fedele (UU): Quantum simulation of correlated-hopping models with fermions in optical lattices
Everts, Jeffrey (UU): A Landau theory for lyotropics
Feher, Gyorgy (UvA): Two dimensional statistical lattice models and qKZ equations
Flebus, Benedetta (UU): Spin-transfer excitation of topologically-protected spin-wave edge modes
Gaddam, Navaneeth Krishna (UU): Towards less unreal black holes
Gemmetto, Valerio (UL): Multi-level complex networks
Gergs, Niklas Miroslav (UU): *Energy current cotunnelling features for the Anderson quantum dot*
Jain, Sandeep Kumar (UU): --
Janssen, Mathijs (UU): "Blue energy" from mixing water of unequal salinity and temperature
Keesman, Rick (UU): *Domain wall structure in 2D Ising model*
Licup, Albert (VUA): *Strain-induced critical behavior in disordered random networks*
Liu, Ke (UL): *Quantum nematic ordered phase in 2 + 1 dimensions*
Papadoulaki, Olga (UU): --
Quelle, Anton (UU): --
Säterskog, Petter (UL): *Mirror symmetry in 3 dimensional N = 4 supersymmetric theory*
Soligno, Giuseppe (UU): *Equilibrium shapes of fluid-fluid interfaces*
Sybesma, Watse (UU): *Singing black holes that matter*
vander Berg, Rianne (UvA): *Time-evolution methods for systems close to integrability*
Vlijm, Rogier (UvA): *Scattering of bound magnons in spin chains*
Appendix D | PhD Day

Date:
Friday, 3 October 2014

Location:
Booth Hall, Library Utrecht University, Heidelberglaan 3, the Netherlands

Organizers:
Members of the DRSTP PhD Student Council; Bureau DRSTP

Lecturers (35 minutes each):
Natalia Alkofer (Nijmegen): Spectral dimensions from the spectral action
Stefan Buhrandt (UU): Magnetic frustration in classical spin systems
Albert J. Licup (VU): Origins of nonlinear elasticity in fibrous networks
Hamish Silverwood (UvA): Indirect dark matter detection with gamma rays
Keri Vos (RUG): Was Einstein wrong? Searching for Lorentz violation in weak decays

External speaker (former PhD student Nikhef):
Reinier de Adelhaart Toorop (consultant, Roland Berger): From theoretical physics to strategy consulting

Summary
The PhD Day was held for the seventh time.
Eighty students (80) attended the PhD Day of which forty-nine (49) were PhD students, thirty-one (31) Master’s students and one (1) participant was a former PhD student of Nikhef, Amsterdam who is now employed at Roland Berger.
In the afternoon a pub quiz was held.
### List of participants (49 PhD students; 31 Master’s students)

1. Alkofer, Natalia (RU Nijmegen)  
   PhD/speaker
2. Almog, Assaf (UL)  
   PhD
3. Anagiannis, Vasileios (UvA)  
   Ms
4. Armaïtis, Jogundas (UU)  
   PhD
5. Bart, Henk (UU)  
   Ms
6. Benenowski, Bartosz (UL)  
   PhD
7. Bet, Bram (UU)  
   PhD
8. Bonocore, Domenico (Nikhef)  
   PhD
9. Borsato, Riccardo (UU)  
   PhD
10. Buffing, Maarten (VUA/Nikhef)  
    PhD
11. Buhrandt, Stefan (UU)  
    PhD/speaker
12. Cohen Maldonado, Diego Benjamin (UvA)  
    PhD
13. Coone, Dries (RUG)  
    PhD
14. de Adelhart, Reinier (Roland Berger)  
    external speaker
15. d'Ambrosi, Giuseppe (Nikhef)  
    PhD/organizer
16. Dekens, Wouter (RUG)  
    PhD
17. de Leeuw, Arie-Willem (UU)  
    PhD
18. Di Liberto, Marco (UU)  
    PhD
19. Dispenza, Davide (UvA)  
    Ms
20. Drwenski, Tara (UU)  
    PhD
21. Dutta Mazumdar, Namrata (UvA)  
    Ms
22. Ferreira, Francesca (UvA)  
    PhD
23. Flebus, Benedetta (UU)  
    PhD
24. Flicker, Felix (UvA)  
    PhD
25. Gaddam, Nava (UU)  
    PhD
26. Gergs, Niklas (UU)  
    PhD
27. Hetharia, Danny (UL)  
    Ms
28. Ion, Irina (RUG)  
    Ms
29. Jaibi, Olfa (UL)  
    Ms
30. Jain, Sandeep Kumar (UU)  
    PhD
31. Janssen, Mathijs (UU)  
    PhD/organizer
32. Kabir, Laurens (UvA)  
    PhD
33. Kattemölle, Joris (UvA)  
    Ms
34. Klabbers, Rob (UU)  
    Ms
35. Kouyzer, Pieter (UU)  
    Ms
36. Kruthoff, Jorrit (UvA)  
    Ms
37. Küppersbusch, Carolin (UU)  
    PhD
38. Lepoeter, Susanne (RU Nijmegen)  
    Ms
39. Llabres Llambies, Eva (UvA)  
40. Licup, Albert (VUA)  
41. Liu, Ke (UL)  
42. Menezes, Natalia (UU)  
43. Meszena, Balazs (UL)  
44. Min, Vincent (UvA)  
45. Mohebbi, Mehran (UvA)  
46. Nascimento, Leandro (UU)  
47. Nadson, Kaitlin (UvA)  
48. Niesen, Ido (UvA)  
49. Nieuwenhuizen, Ludo (UvA)  
50. Oling, Gerben (UvA)  
51. Papadomanolakis, Jorgos (UU)  
52. Petaĉ, Mihael (UL)  
53. Pinzani Fokeeva, Natalia (UvA)  
54. Pires, Luis (RU)  
55. Pozzi, Alessio (RUG)  
56. Punter, Melle (UU)  
57. Puškarov, Tatjana (UU)  
58. Ricciardulli, Vittorio (UvA)  
59. Rodenburg, Jeroen (UU)  
60. Saravanan, Satish Kumar (UL)  
61. Saterskog, Petter (UL)  
62. Schlottke, Mikola (UvA)  
63. Schut, Mijke (Nikhef)  
64. Sikkenk, Tycho (UU)  
65. Signori, Andrea (VUA)  
66. Silverwood, Hamish (UvA)  
67. Stuij, Simon (UU)  
68. Sybesma, Watse (UU)  
69. van der Wild, Matthijs (UL)  
70. van der Woude, Drian (UU)  
71. van Dijk, Bram (UU)  
72. van Gorsel, Jeroen (UL)  
73. van Leuven, Sam (UvA)  
74. van Miert, Guido (UU)  
75. Visser, Dennis (RUG)
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Institution</th>
<th>Title/Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>76</td>
<td>Visser, Manus (UvA)</td>
<td></td>
<td>PhD</td>
</tr>
<tr>
<td>77</td>
<td>Vogel, Sjoerd (UvA)</td>
<td></td>
<td>Ms</td>
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<tr>
<td>78</td>
<td>Vos, Keri (RUG)</td>
<td></td>
<td>PhD/organizer/speaker</td>
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<td>79</td>
<td>Werkhoven, Ben (UU)</td>
<td></td>
<td>Ms</td>
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<td>80</td>
<td>Zan, Bernardo (UvA)</td>
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Dutch Research School of Theoretical Physics

PHD DAY

Utrecht, 3 October 2014

K. Vos
Was Einstein wrong? Searching for Lorentz violation in weak decays

S. Buchmann
Magnetic frustration in classical spin systems

Roland Berger
Strategy Consultants

R. De Adelhart Toorop
From theoretical physics to strategy consulting

H. Silverwood
Indirect dark matter detection with γ rays

VU

A.J. Licup
Origins of non-linear elasticity in fibrous networks

N. Alkofer
Spectral dimensions from the spectral action

Are you a Master or PhD student in Theoretical Physics?
Join the DRSTP PhD Day!

Booth Hall,
Library Utrecht University
Heidelberglaan 3
3584 CS Utrecht, De Uithof

Registration is open till 26 September 2014 on DRSTP webpage
http://web.science.uu.nl/drstp

PhD Day poster, 2014
Appendix E | National seminars

Theoretical High Energy Physics (THEP)

- **Date:**
  21 November 2014

  **Location:**
  Nikhef-WCW, Amsterdam, the Netherlands

  **Scientific organizers:**
  A. Achúcarro (UL); R. Fleischer (Nikhef)

  **Lecturers:**
  G. Arutyunov (Hamburg and UU): *Integrable deformations of the AdS5 x S5 superstring and mirror duality*

  L. McAllister (Cornell): *Planckian axions in string theory*

  A. Smirnov (MPIK Heidelberg and ICTP Trieste): *Lepton mixing: what is behind?*

  W. Waalewijn (UvA and Nikhef): *QCD at the LHC*

- **Date:**
  21 March 2014

  **Location:**
  Nikhef-WCW, Amsterdam, the Netherlands

  **Scientific organizers:**
  A. Achúcarro (UL); R. Fleischer (Nikhef/VUA)

  **Lecturers:**
  D. Baumann (Cambridge and UvA): *B-modes in the sky?*

  D. Boer (RUG): *Odd manifestations of color in high-energy scattering processes*

  A. Romanino (SISSA/ISAS and INFN Trieste): *Perspectives of supersymmetry and BSM physics in the LHC era*

  F. Saueressig (RU Nijmegen): *Renormalization group flows for anisotropic gravity models*
Condensed Matter Physics (CMP)

- **Date:**
  9 April 2014

- **Location:**
  University of Twente, the Netherlands

- **Scientific organizers:**
  H. Hilgenkamp (UT): H. Zandvliet (UT)

- **Lecturers:**
  C. Beenakker (UL): *Nonlocal Josephson effect, Majorana fermions & jellyfish*

  M. Golden (UVA): *Writing in the Dirac energy of bulk-insulating topological insulators*

  P. van der Straten (UU): *Hydrodynamic excitations in a ultra-cold Bose gas*

  J. Ye (RUG): *Two-dimensional electronics at liquid/solid interfaces*
Appendix F | Statistics

On 31 December 2014 one-hundred and nineteen (119) PhD students were affiliated to the DRSTP. In 2014 twenty-seven (27) PhD students joined the DRSTP.

Nineteen (19) PhD degrees were granted in 2014 (three to women). The average duration of their PhD research (from start of contract to PhD exam date) was 49.4 months (53.3 in 2013).

Statistics 2007-2014
PhDs (AIO/OIO) granted
1 January 2007 - 31 December 2014
(per theme)

<table>
<thead>
<tr>
<th>Theme</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
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<td>10</td>
<td>11</td>
<td>8</td>
<td>13</td>
<td>16</td>
<td>14</td>
<td>87</td>
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<td>Theme 2</td>
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<td>7</td>
<td>5</td>
<td>10</td>
<td>8</td>
<td>9</td>
<td>13</td>
<td>5</td>
<td>62</td>
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<tr>
<td>Total</td>
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<td>15</td>
<td>15</td>
<td>21</td>
<td>16</td>
<td>22</td>
<td>29</td>
<td>14</td>
<td>149</td>
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</table>
PhD efficiency

In the period 1 January 2007 - 31 December 2014, 149 PhD degrees were granted. Of these students 72% finished their PhD research within four years and six months. The full distribution is as follows:

- within 4 years: 56 (38%)
- within 4 years and 6 months: 108 (72%)
- within 5 years: 131 (88%)
- more than 5 years: 18 (13%)

The fraction of PhD degrees granted to women in the period 1 January 2007 - 31 December 2014 is 11%.
## Employment following the PhD 2007 – 2014

<table>
<thead>
<tr>
<th>Postdoctoral positions in theoretical physics:</th>
<th>Amount</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>the Netherlands</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>EU</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Abroad elsewhere</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>87</strong></td>
<td><strong>64%</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Positions in academia and in public (research) institutions not related to theoretical physics:</th>
<th>Amount</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical research position</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>PhD position</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Other research position</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>15</strong></td>
<td><strong>11%</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Positions in the government and in government-related organizations:</th>
<th>Amount</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>Ministry of Justice</td>
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<td></td>
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<tr>
<td><strong>Subtotal</strong></td>
<td><strong>0</strong></td>
<td><strong>0%</strong></td>
</tr>
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<table>
<thead>
<tr>
<th>Positions in commercial companies:</th>
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<th>%</th>
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<tr>
<td>Technology</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Finance</td>
<td>10</td>
<td></td>
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<tr>
<td>ICT companies</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Consultancy</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>30</strong></td>
<td><strong>22%</strong></td>
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<table>
<thead>
<tr>
<th>Teaching positions:</th>
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</thead>
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<tr>
<td>High School teacher</td>
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<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>5</strong></td>
<td><strong>4%</strong></td>
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<table>
<thead>
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<th>Other:</th>
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</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>0</strong></td>
<td><strong>0%</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total</th>
<th>Amount</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>137</td>
<td>100%</td>
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</table>