Scientific Report 2012

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Cover: The image was used for the announcement poster of the workshop 'Fundamental Aspects of Friction and Lubrication' that was held at Lorentz Center@Oort in April 2012. The electron microscopy image of gear wheels is by way of illustration of the forces that these transmit from molecular to macroscopic scales.

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Scientific Reports 2012

From the Director

On Thursday 4 October 2012, the official opening of the second venue of the Lorentz Center – Lorentz Center@Snellius – took place. This hugely successful afternoon was the conclusion of 5 years of making plans and preparations and the beginning of a new era at the Lorentz Center. The opening festivities started with two *Master & Pupil* sessions – one by Conny Aerts en Steven Bloemen of the Catholic University of Leuven and the Radboud University Nijmegen on *Stellar Evolution* and another by Marten Scheffer and Ingrid van de Leemput of Wageningen University on *Tipping Points*. Very much in the style of the Lorentz Center, both sessions presented lively discussions between the seniors and their PhD students on cutting edge scientific topics – the most important driving force behind scientific progress. The afternoon then progressed with short but inspiring speeches by representatives of four organizations that are crucial to the past, present and future of the Lorentz Center: Willem te Beest, member of the Governing Board of Leiden University; Wim van Saarloos, director of FOM; Louis Vertegaal, director of NWO-Physical Sciences; and Renk Roborgh, former Director General of the department of Higher Education and Science of the Dutch Ministry of Education, Culture and Science. All radiated that the Lorentz Center is unique in the richness of its scientific spectrum on cross-disciplinary workshops – with a scientific strength and depth that is based on a solid foundation in the exact sciences – and that it has created its own 'evolutionary niche' within the scientific community.

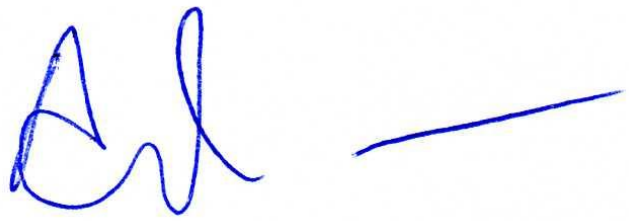
The Lorentz Center now can organize two workshops in parallel: a 'classical' workshop of up to 55 participants in the renamed Lorentz Center@Oort venue, and a smaller Lorentz Workshop@Snellius. The Lorentz Center@Snellius was designed to host a compact group of up to 25 scientists who dedicate a full and intense week to a well-defined research theme. At the time of the opening, the Lorentz Center@Snellius had been in active use for 6 weeks, starting with the workshop *Asteroseismology in Red-Giant Stars*. By then, it was already clear that the 'pressure cooker' recipe indeed works great to stimulate intense and active scientific interactions. The Lorentz Center@Snellius venue also creates opportunities for other types of activities. For instance, the workshop *Modelling the Dynamics of Complex Molecular Systems* ran for a whole 4 weeks: a 'classical' workshop at Lorentz Center@Oort, followed by a 'focus group' at Lorentz Center@Snellius, followed by a second Lorentz Center@Oort/Lorentz Center@Snellius pair. Various aspects of the field could thus be covered from different angles. Some participants came for one (classical) week, some for a 2-week workshop/focus group-pair and some spent the entire 4 weeks in Leiden. Especially the combination of a classical Lorentz Workshop@Oort followed by a more focused Lorentz Workshop@Snellius may become popular in the upcoming years: in the first week scientists discuss and outline their future work and in the second week they can sit down and really do the work in a smaller group. We are also very happy to once again have more opportunities to invest in the younger generation, by organizing schools at the Lorentz Center – as we used to do in the years before the Oort program became too tight. Again, a combination of the two venues seems to be especially appealing: a Lorentz School@Snellius that prepares for a subsequent Lorentz Workshop@Oort.

All these developments have put extra pressure on the staff of the Lorentz Center: starting up the Lorentz Center@Snellius had to be embedded in a smooth way into the essence of the Lorentz Center: organizing exciting workshops. I'm proud to say that our staff succeeded in doing so in an impressive way – especially since everybody had to invest quite some additional energy into their multiple tasks during 2012. The fun aspect of science is a crucial ingredient that the Lorentz Center wants to add to its workshops. I feel that the same fun is

also very present during each and every working day among the relatively small but completely dedicated group of people working at the Lorentz Center. It's great to be part of that.

And indeed, the science was fun again in 2012. A very special example of this is the *Majorana Fermions in Condensed Matter* workshop. When this workshop was proposed, Majorana particles were viewed as somewhat obscure entities mostly interesting to theoreticians. However, as the workshop approached, the first experimental results on the existence of Majorana particles appeared. This breakthrough completely changed the set-up of the workshop and many experimentalists joined in. The field progressed rapidly in the space of one week through direct interactions between experimentalists and theoreticians. Also quite a number of interesting and successful workshops have been organized in the context of our collaborative NIAS-Lorentz Program, such as the workshops *Language Development in Childhood and Adolescence* and *Core Knowledge, Language and Culture,* the latter one being organized as part of the Distinguished Lorentz Fellowship 2011/2012 by Johan Rooryck. Within the field of the computational sciences, the Lorentz Center is doing particularly well too. We have always adhered to a broad definition (or interpretation) of this field, and the impact of the eHumanities workshop *Biblical Scholarship and Humanities Computing: Data Types, Text, Language and Interpretation* shows that this indeed is a fertile point of view. The Lorentz Center has been trying to build bridges between academic and industrial researchers for years. The exciting and very directly relevant workshop *Organs on Chips: Human Disease Models* – with strong involvement of researchers from the pharmaceutical and medical-technological industry – proves that the Lorentz Center is indeed getting a better foothold at the intersection of science and industry.

For me, the year 2012 was a step into a new phase, or even towards a next level. The future is looking bright for the Lorentz Center.



Arjen Doelman
Director Lorentz Center

April 2013

About the Lorentz Center

The Lorentz Center organizes international meetings - workshops - at the frontiers of science. Scientific progress thrives on diversity and antithesis. We therefore promote an open exchange of ideas, and discussions are central to our workshops. We provide a highly stimulating environment in which scientists can interact within or across fields, topics and levels of training, and where collaborations can bloom.

The Lorentz Center's scientific program is broad in scope, covering all disciplines in the natural sciences and technology. Our workshops may be monodisciplinary or interdisciplinary, bringing together scientists with different perspectives and backgrounds. The interdisciplinary workshops may also bridge with the social sciences and humanities, through our collaboration with the Netherlands Institute for Advanced Study in the Humanities and Social Sciences (NIAS). In addition, the NIAS-Lorentz Program includes Distinguished Lorentz Fellows and NIAS-Lorentz Theme Groups, where fellowships at the NIAS campus are combined with a workshop at the Lorentz Center. The Lorentz Center organizes other scientific meetings as well, like summer schools, consortia meetings, or study groups on industrial problems.

The Lorentz Center offers scientists a retreat where they can fully focus on science. Our workshops have proved so popular that we've been able to open a second venue in 2012: the Lorentz Center@Snellius is for groups of up to 25 scientists, whereas Lorentz Center@Oort hosts up to 55. Everything is close at hand at both workshop venues. We have meeting rooms for lectures, plenary or subgroup discussions, and a common room for a drink and a chat. Participants have their own office space to get down to work: exploring ideas, mailing or revising a talk. Both venues are located in the Leiden Bio Science Park, across the street from each other. The campus also hosts the world-renowned research groups of Leiden University's Faculty of Science. As the Netherlands is a compact country, several universities and research institutes are within an hour's drive.

Any scientist from any country – whether academic or from industry – can apply to organize a workshop at the Lorentz Center. The application procedure is simple and fast, so you can have your workshop within a year. Submitted proposals are peer-reviewed by one or more of the Center's seven scientific advisory boards: Astronomy, Computational Science, Informatics, Life Sciences, Mathematics, Physics and the NIAS-Lorentz advisory board. These assess the quality and relevance of the scientific topic, the prospective key participants as well as the workshop program, including the time allocated for discussion. This approach has resulted in an international reputation for state-of-the-art science performed in a highly interactive and open atmosphere.

The Lorentz Center has firmly established itself as the coordinator of year-round workshops in the sciences, typically lasting a week. We take care of all the practicalities, before, during and after the workshop, and we can help you pinpoint your goals and designing your workshop program accordingly. The Lorentz Center also provides financial support for its workshops, enabling organizers to stage workshops on a "no-frills" basis. We pride ourselves in a professional service and a welcoming atmosphere, allowing organizers to focus on the scientific content of their workshop and have fun.

Funding and Figures for 2012

The Lorentz Center's total workshop budget in 2012 was just over € 900,000, of which a third was raised by the workshop organizers from additional funds. We are supported by the Netherlands Organization for Scientific Research (NWO), the Foundation for Fundamental Research on Matter (FOM), and Leiden University. Other sponsors include the Royal Netherlands Academy of Arts and Sciences (KNAW) for the NIAS-Lorentz Program and the Lorentz Fund for theoretical physics workshops. The opening in 2012 of the second venue, Lorentz Center@Snellius, was made possible by a generous grant from the Dutch Ministry of Education, Culture and Science (OCW).

Lorentz Center funding average per week@Oort	€ 11,400
Lorentz Center funding average per week@Snellius	€ 5,900
Funding by organizers average per week@Oort	€ 6,000
Funding by organizers average per week@Snellius	€ 3,200
Weeks of occupancy	57
Weeks@Oort	48
Weeks@Snellius	9
Workshops	46
Schools	5
Study groups	1
Participants	2,372
PhD students	758
Dutch	851
Auditors	179
Announcees	531
Dogs	1
Board members	86
Poster designer	1
Intern students	3
Staff	9
Workshop posters	11,000
Notebooks	5,500
Pens	6,000
Mugs	1,900
Cups of coffee	27,000
Cookies	30,000
Kilograms of cheese	140
Boat trips	31
Conference buses	41
Taxi rides	400
Bicycles	30
Hotel nights	7,500

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NIAS-Lorentz Advisory Board

The collaborative NIAS-Lorentz Program promotes innovative research that brings together perspectives from the Social Sciences and Humanities with those of the Natural Sciences and Technologies. The NIAS-Lorentz advisory board oversees the activities of the Program, including the selection of workshops taking place at the Lorentz Center as well as the NIAS Lorentz Theme Groups and Distinguished Lorentz Fellows residing at NIAS.

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Lorentz 'This Week's Discovery' Lectures 2012

The 'This Week's Discoveries' lunch colloquia highlight recent breakthroughs by scientists of Leiden University's Faculty of Science. The Dean of the Faculty regularly invites prominent participants of Lorentz workshops to present their discoveries for this multidisciplinary audience.

February 14
Mathematical Modelling of Cellular Self-Organization in Protein Gels: How Cells Can 'Read' and 'Write'
Roeland Merks
Center for Mathematics and Computer Science CWI, Amsterdam

April 10
How Bacteria Tell Time
Susan Golden
University of California, San Diego

May 8
Chemical Gardens
Julyan Cartwright & Oliver Steinbock
University of Granada & University of Göttingen

June 12
The Formation of Planetary Systems: New Constraints from Observations
Neal Evans
University of Texas at Austin

November 6
Post-Quantum Cryptography: Long-Term Confidentiality and Integrity for Communication
Tanja Lange
Eindhoven University of Technology

November 27
See Atoms Move in Real Time
Petra Rudolf
University of Groningen

Language Development in Children and Adolescents

9 – 13 January 2012 *@Oort*

This workshop centered on the issues of brain development in late childhood and adolescence, and its role for language development. The idea behind this workshop was to bring together researchers from the fields of first and second language acquisition and developmental psychologists as well as cognitive neuroscientists. The aim was to initiate collaborative research endeavors involving researchers from the fields of language acquisition and brain development. It was the intention to identify a research agenda for the future in the area of neuro-developmentally based language acquisition in childhood and adolescence.

The format of the workshop was keynote overview lectures in the morning given by excellent international speakers including a lot of time for discussions. Speakers were quite interactive and willing to discuss intellectually challenging questions from the audience. Discussion continued during the coffee and lunch break. In the afternoon, there were – over the course of the whole week – three master classes, a number of shorter presentations reporting the latest results in the area of the workshop's topic as well as group discussions. Furthermore, the workshop included a mini-symposium on Artificial Grammar Learning. In addition, posters were presented during the wine & cheese party on the first day of the workshop. Moreover, discussion between participants took place during the social event. Overall, we stuck to the program but took the freedom to allow flexibility in the afternoon sessions as well when we felt this was necessary for the sake of discussion. Taken together, organizers as well as participants were quite satisfied with the diversity of the program and the variety of presentations and presentation formats.

During the workshop it has become clear that the gap between the behavioral research (linguistics, cognitive psychology) on the one hand and the neuroscientific research (neuroscience, cognitive neuroscience) on the other hand still is enormous. It was important to recognize this once again and to make participants aware of this. It became clear to the more behaviorally oriented participants that neuro-cognitive developments are undoubtedly the future way to go, while it became clear to the neuro-cognitively oriented researchers that focusing on one part of language development (i.e. reading) does not cover language development in general. Reading is an artificially acquired form of linguistic behavior whereas speech perception (i.e. speech comprehension) and production (i.e. speaking) are naturally acquired skills of healthy, normally developing children. It is now the task of the participants to work on bridging the gap between the disciplines in order to join forces in the future.

Paul van den Broek (Leiden, Netherlands)
Eveline Crone (Leiden, Netherlands)
Charles Perfetti (Pittsburgh, USA)
Niels Schiller (Leiden, Netherlands)

Cooperation in Multi-Partner Settings: Biological Markets & Social Dilemmas

16 – 20 January 2012 *@Oort*

The terms 'biological markets' and 'social dilemmas' stand for two different forms of complex cooperation among entities ranging from bacteria and insects to monkey groups and nation states. The theoretical developments in the two fields have been largely independent. Moreover, because cooperation has been studied in many different disguises in many different scientific disciplines, there is also considerable scope for interdisciplinary exchange. The workshop was an attempt at cross-fertilisation between these fields and disciplines.
The workshop itself can be seen as an experiment in cooperation. We tried to avoid having a mini-conference dominated by talks prepared before the event. We only invited three participants to give talks during a public evening at the NIAS, which was notably meant to give the NIAS-fellows a glimpse of the workshops' main themes. In view of the number of participants (52) giving traditional talks would have led to an unproductive split into two classes of invited speakers and listeners. Instead we invited all participants to propose themes to be defended by their proposers on the first day. A web-site dedicated to the workshop made its structure, content, program and the theme proposals visible for many months in advance. The main site, which also gives lists of participants with a personal page for each of them, can be found here:
https://sites.google.com/site/multipartnerworkshop/home.

Eight themes were proposed before the start of the meeting of which one was not defended, because the proposer could not attend the first days of the workshop. One additional theme was proposed during the first day. During Monday's last session six themes were formed by recombination out of the original nine and the participants chose the themes they wanted to participate in. This process went surprisingly smoothly. The proposed themes and theme groups formed can be found here:
https://sites.google.com/site/multipartnerworkshop/theme-groups.

The structure of the rest of the workshop was straightforward: full days of discussion in the theme groups (Tuesday and Thursday) were followed by presentations and discussions of the progress in the theme groups in plenary sessions on Wednesday and Friday.
The activities of the theme group continue, whereby communication within and between groups takes place via the workshop intra-site, a second web-site accessible to the participants only, on which each theme has its own page. The workshop will certainly result in a number of review papers and some papers presenting new theoretical models, but at this point in time we haven't decided yet to do this in the form of independent papers or a series of papers in a dedicated issue of a journal.

The echo from the participants about both format and organization was generally very positive. Here are a few quotes from emails we received from participants in the days following the workshop (see also a blog by Joan Strassmann:
http://sociobiology.wordpress.com/)

Uskali Mäki (a philosopher specialised in economics): Great many thanks again for the privilege of being part of a most exciting interdisciplinary endeavour. I learned immensely, not only about the contents of theories used in biology, but also about the disciplinary

culture of reasoning in biology and some cognate fields. In the course of my academic life, I have participated in a very large number of meetings labelled "workshop" - but yours was more workshop-like than any of the others I have experienced. This was truly adventurous and thus risky, but you won - and we all won. Novel ideas and new constellations were sketched, and time will show what the final fruit will be, and how revolutionary they are.

Gergely Boza (a theoretical biologist): Thank you very much for the invitation again, and for organizing such a good workshop. I loved the place and the inspiring environment. Allow me to comment on the workshop structure, and share my feelings. I think the structure turned out very well, I would have only minor observations. For me, it would have been better to have more intra-group discussion, maybe instead of the Wednesday joint session. These two days were not enough for the intense inter-disciplinary discussion (unless the group had some strong preliminary concept already), but was enough to start something useful. The other thing is that inter-group discussion might need to be forced more. So maybe the closing presentations and discussion might need more time, that really motivate people to start discussing. I felt that the time was enough only for some comments, but if one has an hour to say something, they might discuss more. In summary, I think the structure and the idea of such workshops may give a chance to do some good science, and not only at the individual level, but also more at the group level. I hope my comments help you and the Lorentz Center to organize workshops that leave a mark in the future as well.

Michael Gumert (a field-primatologist): I found the workshop intensive and productive, and found the open style a more stimulating form of engagement from the typical style line up of talks all week. It definitely gave us all a week to think about BMT in ways none of us had before – which is a step forward. Was also a good way to meet potentially new collaborators/colleagues.

Shakti Lamba (an evolutionary anthropologist): Thanks very much again for inviting me to the workshop. I really enjoyed it and think I learnt a lot! It was great to be able to spend so much time chatting to people freely about their work. Everything was beautifully organised, as usual, making for a wonderful week! I do have one point of feedback about the way the workshop was organised. I think while the general format of the workshop was really good, it might help if in the future each of the groups was organised around a specific topic that had been pre-identified as one that requires review. The topics could be determined by you or could be proposed in advance by participants themselves (which is what happened this time) but maybe it would help if the topics were specifically identified on the basis that they are areas where some kind of synthesis or review of the literature is required. Then the aim of each group would be to produce a review on their group topic. I know this is what you aimed to do this time while also allowing for flexibility so maybe it's just a matter of being more strict with us lazy participants about pre-identifying reviewable themes! Either ways though, I have come away with plenty of food for thought as I am sure have others!

Ronald Noë (NIAS, Netherlands & Strasbourg, France)
Mark van Vugt (Amsterdam, Netherlands)

GREAT School on the Science and Techniques of Gaia

23 – 27 January 2012 *@Oort*

Gaia is the European Space Agency mission, scheduled for launch in 2013, which will provide a stereoscopic census of our Galaxy through the measurement of very high accuracy astrometry, radial velocities and multi-colour photometry for over 1 billion stars, galaxies, and solar system objects. The GREAT ITN is a Marie-Curie Initial Training Network (ITN) which aims at preparing a generation of young researchers for the scientific exploitation of the Gaia catalogue data. A major aim of this school was to stimulate collaborations within the network by providing the PhD students (and their supervisors) with a broad overview of the science topics covered by the network.

Because the lecture program would be of general interest to anyone interested in the Gaia mission, the school was also open to participants from outside the GREAT network. In total 33 students (including a few postdocs) participated in the school which was also attended by the scientists in charge of the network nodes. Including the lecturers there were 53 participants in total.

The program consisted of two 90 minute lectures in the morning followed in the afternoon by exercises that the students had to carry out in groups. The lectures covered the following topics: Galactic dynamics, formation and evolution of the Galaxy, chemical elements in stars, open clusters, exoplanets, physical properties of asteroids, variable stars, asteroseismology, the distance scale of the universe, and the transient sky. There were also two afternoon lectures on the Gaia mission and spacecraft in order to familiarize the students with the details of the Gaia project.

During the first two afternoons each of the participating students had 5 minutes and one slide in which to present their research. The slides were handed in to the organizers before the workshop. These sessions served the double purpose of learning how to present one's research in this very short format and introducing the students to the senior workshop participants. This very much facilitated subsequent corridor discussions.

The rest of the afternoons were used to let the students work in 10 groups on an exercise which involved interrogating a simulated Gaia catalogue, in order to research various aspects of the structure and dynamics of the Milky Way. The simulated catalogue contains 2 billion stars and represents a non-trivial data set to work with. For these exercises the students used a custom developed Java framework based on Hadoop, provided to them on a virtual machine (containing a small subset of the simulated catalogue) which they installed on their notebooks. The aim was to program a short piece of code that extracted the relevant quantities and then produce a plot. On the Friday the students had to present their plots and interpret them. The senior participants provided comments and background information during the presentation session.

Remarkably, some of the groups were able to run their code on the full catalogue which was stored in the `cloud' on Amazon. This represents an important first test of the concept of `bringing the processing to the data', which the Gaia community is planning to implement as a means of providing access to the real Gaia catalogue.

The exercise sessions ensured that the students worked together and got to know each other well. At the same time they sought help from the senior workshop participants and from the coding experts that were present. The hectic yet friendly atmosphere helped foster contact between the students and very much lowered the threshold for approaching the senior scientists. This ensured that one of the main goals of the workshop was attained, ensuring a successful future collaboration within the research network.

The GREAT school was very successful, providing the students with a broad introduction to the science of Gaia and giving them a first taste of working with the future Gaia catalogue. Having the students present their research in the beginning of the week worked very well, as it meant that they were not worrying about their presentations the rest of the time. The exercises were deliberately kept simple in terms of the astronomical problems in order to make sure that all groups could obtain a result. In view of the time that was available in practice this was a good decision. In the future we would like to organize a workshop fully dedicated to experimenting with advanced catalogue access techniques and a venue such as the Lorentz Center would be ideal.

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

All the lectures have been made available on-line through the following website:
http://great.ast.cam.ac.uk/Greatwiki/GreatItn/ItnSchoolJan2012

Anthony Brown (Leiden Observatory, Netherlands)
Gisella Clementini (INAF-OABo, Italy)
Eva Grebel (ZAH, Germany)
Nuno Santos (CAUP, Portugal)
Caroline Soubiran (CNRS Bordeaux, France)
Nicholas Walton (IoA Cambridge, UK)

Hot Topics in Spin-Hyperpolarization

30 January – 3 February 2012 *@Oort*

The workshop brought scientist working in the different fields of spin-hyperpolarization in magnetic resonance together to explore the overlap between these hitherto largely separate areas. The aim was to identify critical issues of common interest that affect the performance of the hyperpolarization strategy and make the experimental utilization of the high spin polarization difficult. In particular, the workshop aimed to establish discussions in the commonly shared research fields such as relaxation control and analysis, polarization transfer, theoretical modeling and hardware development.
About 55 scientists attended. There were 20 invited talks, 6 contributed talks by junior scientist and about 12 poster presentations. In three times three parallel working groups specific topics were discussed.

In the application, we stated that the workshop will be a success when

1. it extracts current questions and strategies for their solutions,
2. it triggers international communication and collaborations,
3. it is decided that the conferences on spin hyperpolarization will become regular,
4. the COST network gets running.

We can safely state that all four aims have been reached fully or at least to a high degree. The COST Network on spin-hyperpolarization (EuroHyperPol) obtained a jump-start, a number of new contacts and collaborations were established and the community is looking forward to further meetings and summer schools in this area of research.

Nuclear Magnetic Resonance (NMR) spectroscopy and imaging techniques (MRI) are well known and versatile analytical methods. The key issue is frequently sensitivity limiting the applicability. To overcome this problem, various hyperpolarization methods have been developed. Within a new 4-year COST action we bring for the first time together scientists working on those different approaches to stimulate exchange between research communities which hitherto were working in parallel and unconnected.

The workshop gave a full overview of what is done in the field, what strategies and methods are advantageous, what are the current scientific problems and strategies for their solution. The meeting was particularly timely as spin hyperpolarization is a hot topic now. Existence of a long waiting list of almost 40 people who intended to come but could not do so because of the limited capacity of the Lorentz Center confirms that organizing a workshop on this subject was a right decision. The workshop triggered lively discussions, in particular in the discussion groups, and stimulated new collaborations. The workshop was the first action within a COST network and the Lorentz Workshop provided a wonderful start of this four-year process of exchange between the communities. We expect that the hyperpolarization methods discussed during the workshop will find numerous applications in the NMR and MRI.

It is clear that theoretical understanding of DNP mechanisms has improved a lot and can be, perhaps, termed a breakthrough. Due to the recent works on modeling polarization exchange in large spin systems, substantial progress has been achieved in this field that dates back to 1950s. Recent developments of NMR spectroscopy and hyperpolarization techniques using the long-lived spin states and long-lasting spin coherences also have huge

potential in novel NMR applications. Improved spin-exchange optical pumping (SEOP) methods were introduced by several speakers and discussed at the workshop. The SEOP methods now allow even the production of sufficiently high amounts of hyperpolarized quadrupolar nuclei such as 83Kr, which will probably open new possibilities for MRI contrast, e.g., of human lungs.

Most of the participants realized that the exchange between scientists of the different approaches is very valuable since many problems are similar. In particular, this was the case with the solid-state and liquid-state CIDNP: whereas previously the two CIDNP communities did not have a common approach and common experimental systems to study, they will hopefully cooperate after the meeting. We expect that due to the workshop a synergistic effect can be achieved by cooperation of the communities dealing with spin relaxation (in particular, with the long-lived spin states) and with DNP, PHIP and CIDNP. The same is true for the communities interested in hyperpolarization of noble gases which is shown to be feasible by both, SEOP and DNP. Recent advances in experimental setup do now allow the dissolution of substances hyperpolarized by SEOP or PHIP in liquids such as blood. This will e.g. help to image blood flow in the human body.

The advice of the Lorentz Center on the format of the workshop was very helpful. In particular we were suggested to give more room for free discussions and for involvement of younger scientists. Both worked out very well. The workshop offered an optimal combination of plenary talks, poster presentations, discussion rounds and presentations by young scientists. There was also enough time for informal discussions that were very helpful for establishing new scientific contacts and efficient exchange of scientific ideas.

We are very grateful to the staff of the Lorentz Center for their expert handing of all administrative matters. The workshop was a joy to organise with such friendly and professional assistance. The meeting would not have been possible without the Center's generous financial support for which we are most grateful. We are sure that all the participants enjoyed the infrastructure of the Lorentz Center that is optimal for a discussion meeting. It was particularly convenient that each participant had an office space and internet password. The cultural program was also perfectly organized. The only small point of criticism was that the air exchange in the seminar room is not optimal.

Eike Brunner (Dresden, Germany)
Konstantin Ivanov (Novosibirsk, Russia)
Walter Köckenberger (Nottingham, UK)
Jörg Matysik (Leiden, Netherlands)

Biblical Scholarship and Humanities Computing
Data Types, Text, Language and Interpretation

6 – 10 February 2012 *@Oort*

The question central to the workshop was "What are the requirements for text data bases to allow for the systematic study of ancient texts, especially Hebrew, Aramaic or Greek biblical texts, that confront the research with a century long history of production, transmission and translation?"

The workshop has been set up as a meeting place between specialists in the Hebrew Old Testament and scholars in the Greek New Testament. At the same time, information specialists were present to take in the digital aspects of the issues, and to challenge the literary scholars with emerging paradigms in computing science.

The focus and methods of Greek New Testament scholarship differ from that of Hebrew Old Testament research. This is to a large extent due to the unequal manuscript situation for both testaments. The number and variety of manuscripts for the Old Testament is far less than for the New Testament. This is related to the fact that in Old Testament tradition and scholarship, the research is based on the authoritative Manuscript (codex Leningrad) that dates from about the year 1000 and is the product of rabbinic tradition. So in Hebrew studies one actually uses a so-called 'textus receptus'. The additional information coming from Dead Sea Scrolls or Ancient Translations is in fact used first to consider matters of literary historical analysis and only secondarily to make proposals for more original readings in the Hebrew Bible. This is done so since these additional texts often represent stages of the production of the Hebrew Bible rather than stages of its transmission. So by agreeing on using a late text in a way it is easier to reach consensus about a standard text of the OT, but more difficult to observe the effects of history. A standard text is conducive to setting up a program of computer-aided linguistic analysis. In the NT case, computational methods are primarily invoked for making sense of the 5000+ manuscripts and reconstructing their history. In the daily research practice, Hebrew and Greek scholars do not interact that often.

This workshop has built bridges between the OT and NT lines of research. The fact that both types of research need access to the source materials proved a unifying concern. Currently, accessibility leaves a lot to be wished for: openness, transparency and permanence all fall short for a new set of research questions that are lining up.

There are other dividing lines that have been addressed: between the worlds of research, education and application. Commercial Bible software packages a lot of applied scholarship, but the usefulness of those packages in a research context is very limited. Even in educational situations the use of this software was felt as contra-productive. Up to a certain level of knowledge these applications do an excellent job. However, the development of new features is not being driven by the needs of academics, whether research or education.

Perhaps it was more important to articulate the distinct concerns here than to try to bridge them. Yet, between research and education there is a natural continuity that can be exploited, provided that the tool development becomes again driven by academic concerns. In our discussions we have been exploring to what extent open-source tool development could coexist with commercial software manufacturing. There is certainly potential within

academics to come up with tools, but it will take time before they will reach the same sophistication in the user interfaces. More importantly, it is difficult to make certain to what extent research tools are legally allowed to use and spread the original resources.

When we mention tools, it is important to distinguish between tools used for producing research data, such as analytical databases and tools that present the data to end users. And apart from that there are tools that facilitate the collaboration between researchers.

A breakthrough was that the distinction between digitized scholarship and digital scholarship was made. Whereas digitized scholarship uses digital means in order to improve the efficiency of the classical research process, digital scholarship fully employs the revolutionary potential that the digital paradigm has to offer. Networking and visualization are important trends.

Networking can help to direct the effort of many to work in a manner that exceeds the capacity of lone researchers. Visualization can help to highlight significant patterns in masses of data. The digital paradigm is on the rise in many departments of the humanities. We asked ourselves the question: what can we do to make this happen in biblical scholarship?

Most importantly, the sources and the fruit of biblical scholarship should be made readily available to others: for inspiration, for checking, for application, and as the raw material for new kinds of research. In that way, the work of many sustains an ecology where results become cumulative.

Here is a clear incentive to liberate scholarship from the entanglement of commercial interests, to reclaim the sources for research and education.

When studying a text tradition, it might seem logical to first solve the basic problem of what has been written and only after that to deal with higher-level questions such as the interpretation of what has been written. Indeed, a particular phenomenon in a text that can be fully explained in terms of the linguistic system, should not be explained in terms of an author's special intention or a special religious interest. But in fact, we do not always know whether textual phenomena belong to linguistics, literary studies or the history of textual transmission. Problems at a basic level often can only be solved by dragging higher levels into the equation.

At the same time, the quest for the one true version of what has been written has been abandoned in favor of an interest in the historical richness of being read and (re)written that can be gleaned from the texts.

Now, if we can find ways to perform linguistical analysis without recourse to one standard text, Greek and Hebrew scholarship find common methodological ground. And there will be far less dependency on copyrighted editions of the source texts, which is good for the ecology of research.

All days of the workshop had a consistent structure: two morning lectures, one from Hebrew scholarship and one from Greek. After the coffee break there was a reflective and/or challenging lecture from computing science. In the afternoon we broke out in subgroups and reported back in a final plenary session. Only one afternoon we left completely open. We think that the participants made the most of those afternoons, whether in subgroups or on their own. It was certainly quality time.

Although not a revolutionary format, it served very well to elicit much that was in our minds and establish in-depth communication across our usual disciplines.

We are grateful for the excellent setting and organization of this workshop as provided by the Lorentz Center. Even the organizers could immerse themselves fully in the subject matter, as they had very little worries about the logistics and day-to-day running of the workshop. There was a refreshing lack of housekeeping notices.

Jan Krans (Amsterdam, Netherlands)
Bert Jan Lietaert Peerbolte (Amsterdam, Netherlands)
Wido Van Peursen (Leiden, Netherlands)
Dirk Roorda (Den Haag, Netherlands)
Ulrik Sandborg-Petersen (Aalborg East, Denmark)
Eep Talstra (Amsterdam, Netherlands)

Bioinformatics and Systems Biology: Bridging the Divide

14 – 17 February 2012 *@Oort*

This workshop brought together leading researchers from the fields of systems biology and (integrative) bioinformatics. Both fields have a common goal, namely to obtain detailed descriptions of biological systems and their relationship to observed phenotypes. However, they are limited to either detailed models of small systems (systems biology) or highly descriptive models of larger systems (integrative bioinformatics). Therefore, currently the main challenge is to develop ways to combine techniques from both domains in order to obtain quantitative models at a genome-wide scale for complex organisms such as human. The aim of the workshop was to identify general principles for successfully integrating systems biology models and more descriptive bioinformatics models to enhance the accuracy and completeness of the overall model.

Throughout the meeting, extensive notes were taken of the talks and discussions, as input for a white paper that will become a tangible outcome of the workshop. It was very interesting to notice that during the workshop, we more and more started to agree that maybe the problem is not a single 'big' divide between bioinformatics and systems biology. Instead, there are multiple 'smaller' divides, for example between modelling systems with a small or a large number of components, between modelling unicellular or multicellular organisms, and between the scale on which modeling takes place in a multicellular organism (gene, molecule, cell, tissue, organism). This realization led to a more focused discussion during the course of workshop. An important outcome was that a reasonable way to (start to) bridge these different divides is (1) to organize labs differently and include both experimentalists and computational scientists; (2) to also closely collaborate with specialized computational groups that can focus on method development; (3) to train biologists in such a way that they can at least easily communicate with quantitative scientists. Another interesting development in the workshop was to see that people more and more understand the importance of better describing existing models and making models more modular in order to be able to combine them.

The talks and plenary discussion on each day were centered on a particular theme. There were not too many formal talks planned. The workshop was also truly multidisciplinary and brought together bioinformaticians, mathematical modellers, molecular biologists, and (algorithmic) computer scientists. This worked very well and led to a lively workshop with much discussion and interaction between participants. On the final day the participants engaged in small group discussions, on where they would like the field to be in 20 years from now. This led to a lot of concrete input for the white paper that we are currently writing.

Roeland Merks (Amsterdam, Netherlands)
Perry Moerland (Amsterdam, Netherlands)
Bas Teusink (Amsterdam, Netherlands)
Lodewyk Wessels (Amsterdam, Netherlands)

Modeling Strategic Reasoning

20 – 24 February 2012 *@Oort*

With the support of NWO a three year project titled *Modeling strategies in multi-agent systems: from implicit to implementable* was taken up at the University of Groningen between March 1, 2009 and February 29, 2012. In this project, the main focus was on modeling strategic reasoning in multi-agent systems from logical, computational and cognitive aspects. Towards the end of the project, we conceived the idea of organizing a workshop on this topic at the Lorentz Center. Our aim was to bring together creative researchers to explore and provide a comparative overview of the different frameworks that describe strategic reasoning in interactions from the viewpoints of computer science, game theory, cognitive science, linguistics and philosophy.

We were also planning an edited book volume *Modeling strategic reasoning* with contributions from the experts in this field, with the same interdisciplinary aim. We looked forward to the workshop for providing us with a forum where the book contributors interact with young upcoming researchers and other experts so as to aid in the development for the chapters of the book as well as foster new lines of research. The workshop was supported by the Lorentz Center, NIAS and NWO.

As strategies play out in so many different areas of life, the study of strategies has become an integral part of many areas of science: game theory itself, which is usually viewed as part of economics; ethics and social philosophy; the study of multi-agent systems in computer science; the foundations of set theory in mathematics; the study of logic games; evolutionary game theory in biology; strategic reasoning in cognitive science; and the study of meaning in linguistics.

There are already many signs of interdisciplinary cooperation between these fields. However, to take the next step, a clear need was felt for understanding the basic similarities between the perspectives on strategies, and to develop a shared perspective on strategic reasoning among the different communities. That was main focus of this workshop.

The days were structured by having three longer plenary lectures per day, complemented by two or three shorter lectures. The lectures for each day were scheduled to answer specific questions regarding the broader topic of 'strategic reasoning' from different directions. In order to foster interdisciplinary discussion, each keynote lecturer was assigned a discussant, always a researcher from a different area.

Typical topics for the daily lectures at the workshop were:

Monday	Game-theoretic and cognitive viewpoint on strategies
Tuesday	Computational studies on strategies
Wednesday	Logical frameworks of strategies
Thursday	Linguistic studies and social choices
Friday	More on game-theoretic and social choice studies

In addition to lectures and discussions, a part of each workshop day was devoted to commenting on draft chapters for the book. The draft chapters had been circulated among the participants in advance. For most of the envisioned chapters, one or more authors were

present at the workshop, and they usually led the discussion sessions about their own chapter.

We are pleased to report that the workshop has been a great success. More than 40 participants from the Netherlands and abroad took part, of which a sizable number were junior researchers, for example PhD students and junior postdocs from the Netherlands, the UK, Switzerland, India, Italy, Spain and the USA.

The relaxed atmosphere and the unique facilities at the Lorentz Center fostered lively discussions, which often went on into the late evening. The discussions on preliminary versions of book chapters proved to be very useful for the authors. In addition, because authors attended discussions of other chapters as well, there were several cases of cross-fertilization. A final session with the authors on Friday led to many concrete ideas for improvements of chapters. Based on the discussions at the workshop, the authors were able to make extensive revisions on their chapters. We have received extremely positive feedback from many of the participants.

Further details of the workshop can be found at:
http://www.lorentzcenter.nl/lc/web/2012/484/info.php3?wsid=484&venue=Oort.

More information about the book can be found at:
http://www.isichennai.res.in/~sujata/book.html.

Johan van Benthem (Amsterdam, Netherlands)
Sujata Ghosh (Groningen, Netherlands)
Rineke Verbrugge (Groningen, Netherlands)

Exciting CO in the Local and High-Redshift Universe

27 February – 3 March 2012 *@Oort*

The goal of this workshop was to bring together for the first time people from different galactic and extra-galactic key programs, and learn about their observations and favorite analysis tools (PDRs, XDRs, and shocks) and make a detailed inventory and comparison of the models. During the workshop we discussed the observations that were done by the various Herschel observations programs and how they do the interpretation with various available models. We also compared predictions of CO ladders resulting from preassigned theoretical test problems. Although in some case we reached good agreement between the codes, we also saw many discrepancies.

During the workshop we tried to understand the discrepancies, by comparing how different processes were implemented in each other's codes. We agreed to implement key processes in a similar fashion. We will make follow up calculations, which will hopefully result in a paper, where we will highlight the conclusions of the workshop. We also had good discussions between modelers and observers. Observers learned more about using results from modeling, what can be trusted and what not. Modelers learned more about the needs of the observers.

It was a very fruitful workshop, where we had a good balance between presentations and discussion/splinter group meetings. The preassigned test problems made it possible to make a head start, without losing time on too technical details, but focusing on the science right away.

We were very happy about the local organizational part of the meeting. There was ample opportunity to have small meetings, as well as central discussion. We thank all the staff of the Lorentz Center for making this workshop possible.

Edwin Bergin (Michigan, USA)
Ewine van Dishoeck (Leiden, Netherlands)
Lars Kristensen (Leiden, Netherlands)
Edo Loenen (Leiden, Netherlands)
Rowin Meijerink (Amsterdam, Netherlands)
Volker Ossenkopf (Köln, Germany)
Markus Röllig (Köln, Germany)
Ruud Visser (Michigan, USA)

Casimir Physics School – Workshop 2012

5 – 16 March 2012 *@Oort*

The startling realization that was emerged in the last century is that the void, that is, the complete absence of any detectable particles or energy is far from empty. Theoretically this conclusion originated around 1900 from the work of Max Planck and the early pioneers of quantum theory. A consequence of the quantum behavior of electromagnetic fields is that each field mode contains intrinsic 'zero point' energy $\hbar\omega/2$ when it is in the lowest energy state. Thus a field containing no photons - empty space - has a huge intrinsic energy density. This zero-point energy or vacuum energy has numerous observable consequences in atomic or sub-atomic physics. Moreover, two mirrors facing each other in vacuum are mutually attracted to each other by the disturbance of quantum vacuum fluctuations – a phenomenon first predicted in 1948 by the Dutch theoretical physicist Hendrik Casimir.

Though the Casimir effect dates back more than 60 years, the field of Casimir physics has attracted an increasing attention in the last fifteen years, thanks to new experimental techniques based on recent technological developments in nanotechnology including atomic force microscopy, and MEMS devices. A number of novel experiments concerning the static or dynamic Casimir effect have been developed in the last few years in the USA and Europe. New developments have been devoted to observations of the Casimir force in complex geometries and novel materials (phase-change materials, nanoparticles, carbon nanotubes, liquids, metamaterials etc.) with a view to applications, especially in nano-machines. Another focus is on fundamentals such as what the force can tell us about the quantum vacuum, and for example any possible relationship between zero-point energy and cosmological observations such as dark energy. In addition, sufficiently accurate measurements could reveal a departure from Newtonian gravity at sub-micron separations providing insight on the new physics expected to lie beyond the standard model. On the theoretical side, Casimir effect calculations use numerous different methods ranging from quantum field theoretical approaches and renormalization methods to quantum statistical methods and scattering approaches to the wordline formalism.

The importance of the Casimir field, in both fundamental physics and technology has been recognized in Europe and has attracted funding from the European Commission (e.g. the NANOCASE project) and now the ESF CASIMIR network that aims to foster pan-European collaborations on established problems and new trends in Casimir physics in all subject areas including surface and materials science, nanotechnologies to cosmology and quantum gravity.

The combined school-workshop aimed to explore developments on a global scale in the Casimir field as an education and research forum in Casimir physics. The school covered the basics in depth, general formalism, experiments and moving into the more advanced technical aspects, with a clear overview of the state of the art in the field. For this purpose we allowed ample time for young and advanced researchers to get acquainted with each other and to initiate interactions and further collaborations. Subsequently, therefore, the school was followed by a workshop with the aim to further connect people doing current advanced work in the field of surface force measurements and micro/nano technologies with those working on current problems of quantum field theory derived forces. They expand their understanding of these forces in common problems from micro/nano technologies to gravity and laboratory cosmology:

Casimir school
The school was based partly on the CASIMIR network program. The list of topics for the school were grouped into three major topics: Casimir effect: measurement and theory; Challenges in vacuum properties; Casimir interfaces.

School organization
- Class lectures: 120 minutes including discussion/questions (9 lectures)
- Exercises/homeworks were done after the lectures
- Talks and Solutions are posted on the Lorentz Center website of the school

Casimir workshop
The workshop focused on the current advanced Casimir research and common topics including: Progress in Casimir forces for complex geometries - novel topologies; Measurements and calculations of Casimir forces for new materials – MEMS/NEMS; Electrostatics in force measurement: patch effects and contact potentials; Lateral and repulsive Casimir forces; Measurements and manifestations of the thermal Casimir forces; Casimir-Polder interactions with atoms, molecules or nanoparticles; Vacuum energy in quantum field theory and gravitation.

Workshop organization
- Invited talk: 50 minutes including discussion (16 talks)
- Junior Invited talk: 30 minutes including discussion (12 talks)
- Talks are posted on the Lorentz Center website of the workshop

Participants
We had in total 69 participants. Of these, 51 were associated with group members from the RNP CASIMIR (C). The origin of participants was from: the Netherlands, France, Germany, Spain, Austria, United Kingdom, Poland, Norway, Sweden, Italy, Israel, Uzbekistan, Hong Kong, China, Japan, Brazil, Mexico, and the USA. The participation thus covered Europe-Asia-America, giving a global character to the event.

Discussion – Future of RNP Casimir
Discussion on the future of the RNP CASIMIR took place March 13. The decision is to continue on the major focus points of the present scheme and include more application related topics. Moreover, we can further enhance the close collaboration-participation of other Casimir groups from the USA, Latin America and Asia in future efforts. Significant ties were developed during this school-workshop towards this direction. It would be the ultimate aim to achieve the formation of a CASIMIR society with global appeal in science and technology.

Diego Dalvit (Los Alamos, USA)
George Palasantzas (Groningen, Netherlands)
Serge Reynaud (Paris, France)
Vitaly Svetovoy (Enschede, Netherlands)

Noncommutative Algebraic Geometry and its Applications to Physics

19 – 23 March 2012 *@Oort*

The main purpose of the workshop was to create a unified view of the landscape of different noncommutative geometries and their applications in theoretical physics, notably quantum field theory and string theory. As indicated by the title of the workshop, it was our intention to stress in particular the algebraic approaches to noncommutative geometry. Moreover, we wanted to highlight the connections of this theory with geometric invariants, enumerative geometry, string theory, and integrable systems.

The algebraic approach to noncommutative geometry was illustrated by Lieven Le Bruyn, with his algebraic theory of D-branes, Paul Smith (noncommutative curves and Penrose tilings), Gonçalo Tabuada, who gave an introduction to the theory of noncom-mutative motives, and Jan Jitse Venselaar (spin structures on noncommutative tori and their Morita `equivalences'). Related to this aspect of the theory were also the talks by Dimitri Kaledin (about the Hochschild-Witt complex), Yuri Berest (derived representation schemes), Alexander Kuznetsov (Categorical resolution of singularities), Lucio Cirio (categorification of the Kniznhik-Zamolodchikov connection), Sebastian Klein (Chow groups for tensor-triangulated categories).

Links with the physics of quantum fields were established by the talks by Walter van Suijlekom (renormalizability conditions for almost commutative manifolds) and Alexander Gorsky (supersymmetric QCD, integrability and cyclic RG flows). Relations with integrable systems were discussed by Vladimir Sokolov (integrable non-abelian ODE's: a bi-Hamiltonian approach). Interesting applications to the geometry of moduli spaces were proposed by Tom Sutherland (stability conditions for Painlev quivers) Richard Szabo (instantons and noncommutative toric varieties), Ludmil Katzarkov (from Higgs bundles to stability conditions), and Simon Brain (Gauge-theoretic invariants of toric noncommutative manifolds).

Interesting connections with other areas of mathematics were explored by Ralph Kaufmann (noncommutative geometry of wire network graphs) and Matilde Marcolli (Quantum statistical mechanics, Kolmogorov complexity, and the asymptotic bound of codes). It is the opinion of the organizers that the workshop fulfilled its scopes in a satisfactory way. The talks were interesting, and the structure of the workshop has left space for personal discussion. The workshop has allowed many of the participants to get in touch with the most recent advances in the field.

The organization of the Lorentz Center and the work of its personnel have been impeccable and have given a fundamental contribution to the success of the workshop.

Ugo Bruzzo (Trieste, Italy)
Gunther Cornelissen (Utrecht, Netherlands)
Giovanni Landi (Trieste, Italy)
Vladimir Rubtsov (Angers, France)

Astronomy to Inspire and Educate Young Children

26 – 30 March 2012 *@Oort*

The EU Universe Awareness (EU-UNAWE) International Workshop was a big success. The weeklong program of talks and discussions covered several key areas of astronomy education. An overview of the problems in astronomy education and proposed solutions to these issues, which had been discussed in sub-groups throughout week, were presented to all workshop participants

Participants were asked to contribute ideas for one sub-group, so that each topic could be explored in detail. The sub-groups were Curricula for Different Ages, Culture in Astronomy Education, Teacher Training, Resources, and Evaluation. A few of the key findings of the groups are outlined below, and all presentations from the workshop are available on EU-UNAWE SlideShare site: http://www.slideshare.net/unawe. The EU-UNAWE international network will now work towards implementing all action points that arose from the discussions.

Curricula for Different Ages
Teachers need guidelines about suitable topics to introduce into their classroom, but these should take into consideration the different ages that children start school around the world. Furthermore, children in remote villages don't have the same resources at home to follow-up on classroom topics as children in cities. The sub-group proposed that guidelines for suitable topics should be provided in stages or levels, rather than associated to a specific age group, with recommendations for what stages should be used that are based on, for example, the location of the school.

Evaluation
It is vital to evaluate the impact of EU-UNAWE activities around the world. Given the global scale of the program, this may seem like a difficult task, but the sub-group proposes that the methods used to measure impact in inspiring children are the same everywhere. The sub-group gave several examples of tools to measure impact via a survey, such as assessing children's drawings about an astronomy topic before and after an educational workshop.

Educational Resources
Members of the sub-group recognized the need for an online platform to act as a central hub for the many educational materials that are available around the world, which EU-UNAWE has already started to implement through the repository on its website. Such a platform should be easy to search, with materials categorized by, for example, level of difficulty and the languages that they are available in, and that such features should be added to the EU-UNAWE repository. It was also noted that the currently EU-UNAWE repository needs to be populated with more content, but these new materials should be of high quality. In response, Pedro Russo, International Project Manager of EU-UNAWE, spoke of the long-term goal to provide a "Google-like experience" in searching for educational materials and the program's future plans to create a peer review process to review educational materials.

Teacher Training
The sub-group fully supported EU-UNAWE's existing methodology for teacher training in giving educators the confidence to introduce astronomy into the classroom and to listen to

the needs and recommendations of teachers, as they understand the needs of their students. They also recommended the need to follow-up with teachers for maximum impact.

Culture in Astronomy Education
The sub-group proposes a need to collect high quality materials about the connection between culture and astronomy, as it is currently difficult to find such resources. The sub-group noted that it is likely that there will be gaps in available materials, as a lot of stories about astronomy in indigenous cultures haven't yet been recorded in a written format. Furthermore, the sub-group proposes that new hands-on activities should be produced to supplement and support such stories in order to have greater impact when introducing cultural astronomy to young children.

Finally, the EU-UNAWE International Office would like to thank all participants for making this an immensely interesting event. We look forward to welcoming you back next year for the fourth International Workshop!

Mark Bailey (Armagh, UK)
Kevin Govender (Cape Town, South Africa)
Claus Madsen (Garching, Germany)
Sivuyile Manxoyi (Cape Town, South Africa)
George Miley (Leiden, Netherlands)
Carolina Ödman (Cape Town, South Africa)
Franco Pacini (Firenze, Italy)
Andreas Quirrenbach (Heidelberg, Germany)
Rosa Ros (Barcelona, Spain)
Pedro Russo (Leiden, Netherlands)
Cecilia Scorza (Heidelberg, Germany)

Hacking the Biological Clock: Circadian Rhythm and Photosynthesis

10 – 13 April 2012 *@Oort*

This workshop brought together scientists studying the biological clock and photosynthesis, to discuss and accumulate knowledge on the control of the circadian clock in photosynthesis in plants, algae and microorganism. Goal of the workshop was to combine biological, physical and biochemical expertise and to generate alternative strategies to 'hack the biological clock' to improve plant productivity and crop yield. The purpose of the workshop went beyond circadian rhythm and photosynthesis, and explicitly focused on working on possible solutions for food and energy, that can be forged based on the knowledge of the biological clock.

About 58 scientists attended the workshop, including participants and speakers who were both experts in the field as well as young scientists. There were 21 invited talks and about 6 poster presentations. The scientific program was divided into three work packages focusing on major issues related to the biological clock and its coordination with photosynthesis yield. The workshop was connected to the national "Biosolar Cell programme" and with the Leiden University "Honours programme". The workshop organization was similar to Gordon conferences where a long lunch break allowed for informal discussions in small groups. In addition, two times three parallel in-depth discussion sessions were organized in the afternoon which discussed on specific topic belonging to three work packages. A vision and the most promising routs of how the biological clock can be hacked for improved photosynthesis in plants and microorganisms were articulated. This vision was expressed in the form of short scientific notes that were distributed to all participants during the conference and was debated through an open discussion platform.

The workshop was a great success. Several new contacts and collaborations have been established and both the photosynthesis and biological clock communities significantly benefited from the workshop and found common interests and are looking forward for future joint meetings. A white paper is under preparation for summarizing the outcome of this meeting which would serve as a basis for establishing consortia for future funding.

The biological clock, which provides information to the organism about the time of day (or night), is crucial for plant productivity by regulating the various processes that control photosynthesis and regulate the metabolism. However, the regulating mechanisms underlying how the biological clock controls photosynthesis are not understood. Such understanding has the potential of providing a handle on how to enhance plant productivity. Till now scientists studying photosynthesis and the biological clock formed separate communities. Our workshop has for the first time brought the two communities together with the aim to benefit from each other's knowledge and to develop ideas how the biological clock could be hacked for improved photosynthesis in plants and photosynthetic microorganisms.

The workshop triggered lively discussions, both in the plenary sessions and in the parallel in-depth discussion sessions, and stimulated new collaborations. The fundamental functioning of the clock and ways of making use of the clock to increase photosynthetic yields were discussed. The workshop also included discussing how to exploit engineering approaches,

either unbiased, over the entire transcriptome/genome or targeted, for tuning the coordination of the internal clock. An extensive outline of what was concluded in the various parallel in-depth discussion sessions was prepared and it was decided to write a white paper about the workshop for an international scientific journal.

Most of the participants realized that the exchange between scientists of the photosynthesis and biological clock communities and their different approaches is very valuable since many research problems and ultimate targets are in common. Many participants did not realize before the workshop how profound the control of the clock is on the functioning of plants. A breakthrough was announced by Prof Kay, in that field trials are underway to evaluate the productivity of a first crop with a mutation in a clock gene.

The advice of the Lorentz Center was very helpful. In particular we were suggested to give more room for free discussions and for involvement of younger scientists. Both worked out very nicely. We are very thankful to the staff of the Lorentz Center for their expert handing of all administrative matters. The workshop was a joy to organize with such cheerfully reliable support. The meeting would not have been possible without the Center's generous financial support for which we are also most grateful.

A. Alia (Leiden, Netherlands)
Raol Bino (Wageningen, Netherlands)
Wilhelm Gruissem (Zurich, Switzerland)
Paul Hooykaas (Leiden, Netherlands)

Fundamental Aspects of Friction and Lubrication

16 – 20 April 2012 *@Oort*

Fundamental research on friction and lubrication has seen tremendous developments in recent years thanks to improved experimental instrumentation, improved computational methods and novel materials such as graphene. These achievements allow us now to tackle the most important challenges, namely the transition from idealized model systems with single asperities to practically relevant realistic contacts with multiple contact points, elastic deformations, and liquid lubricants.

The goal was opened by an intensive discussion of novel theories of contact mechanics by Martin Müser and Bo Persson. They demonstrated that the classical view of surfaces with a Gaussian distribution of surface roughness is inappropriate in most practical cases and should be replaced by self-similar distributions. Lionel Bureau and Takeshi Fukuma presented the latest advancements in the characterization of solid liquid interfaces and the arrangement of liquid molecules – including in particular water – in the confined geometry of a sliding contact. One of the highlights of the meeting was definitely the presentation of Clemens Bechinger. His experiments with colloidal model systems allow for unique insights into the 'atomistic' processes involved in early stages of plastic deformation. Erio Tosatti chaired a very lively discussion session following this and two other exceptional presentations on novel sliding systems. The academic program was complemented by an impressive lecture by Matthias Scherge from the Fraunhofer Institute for Mechanics of Materials who presented impressive views of mixing flows in nominally solid coatings of bearings.

Next to the stimulating scientific discussions and the very positive response from many participants, the workshop was definitely successful in presenting the Dutch tribology community and in particular the activities of the newly formed FOM consortium (FOM program Fundamental aspects of friction) to the international scientific community. The young researchers from the consortium established personal contacts amongst each other and with the internationally leading researchers in the field. Moreover, new contacts within the lubrication community lead to new initiatives for a follow-up Lorentz workshop as well as a new FOM program on solid-liquid interfaces.

The eleven full invited lectures and four short highlight presentations allowed for enough time for both free and coordinated discussions. The discussion sessions, in particular the chaired ones, were very well received. The senior researchers chosen as chair persons did an excellent job at stimulating the discussions. It was also useful to 'pre-cook' some discussion by stimulating some of the participants beforehand to bring up certain topics and prepare a few slides specifically for the discussion sessions.

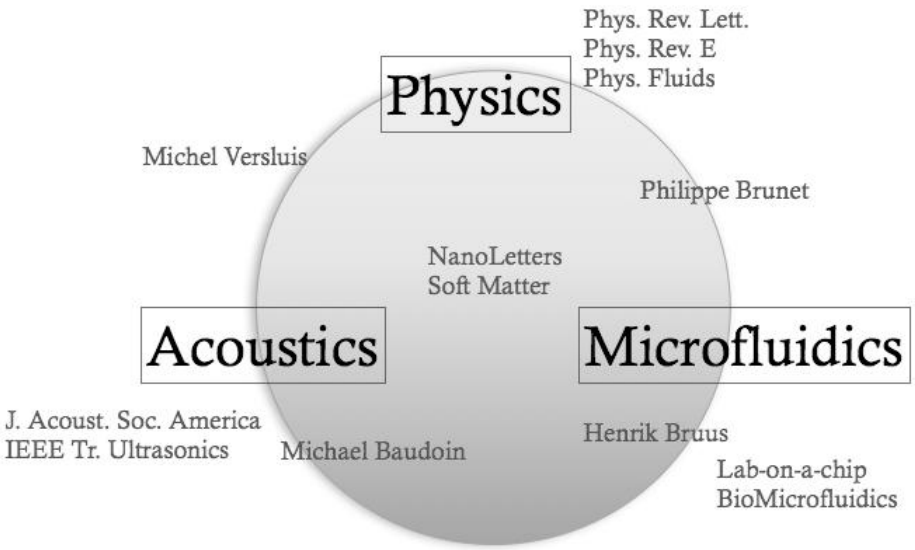
Daniel Bonn (Amsterdam, Netherlands)
Annalisa Fasolino (Nijmegen, Netherlands)
Joost Frenken (Leiden, Netherlands)
Erik van der Giessen (Nijmegen, Netherlands)
Guido Janssen (Delft, Netherlands)
Frieder Mugele (Enschede, Netherlands)
Lucia Nicola (Delft, Netherlands)
Merlijn van Spengen (Delft, Netherlands)

Acoustic Waves for the Control of Microfluidic Flows

23 – 27 April 2012 *@Oort*

The aim of this workshop was to gather together scientists from different backgrounds and interests, who have in common to use ultrasonic acoustic waves to control and actuate fluids at scales smaller than a few millimeters. It was clearly stated that there was a lack of fundamental understanding on the underlying mechanisms coupling acoustic field and fluid motion in different ranges of applications, from fluid mixing, particle sorting or pumping in microfluidics, to medical therapies, single-cell handling, bio-chemical ligands, drug delivery, surface cleaning and drop-on-demand generations. To gather in the same place during one week scientists who use ultrasonic waves for fluid actuation, in different specific set-ups and applications but involving similar physical phenomena, together with physicists more specialized in theoretical acoustics was an expected way to launch a bridge between these different fields.

Below is a simplified scheme of the cross-linked thematics, polarized on three main areas: Physics, Acoustics and Microfluidics. It shows how the different co-organizers are complementarily inserted into these areas, and also in which journals the associated communities generally publish, making it difficult for these communities to know each other's work.



The number of attendees was 52, coming from 12 different countries in Europe and overseas. The audience was mixed between field-leading scientists and young researchers, with also 6 representatives from industry (OCE, Philips and LAM Research). Nine invited speakers, 16 regular talks and about 20 poster presentations (with 5-minutes teasers for each of them) ensured a broad variety of themes exposed. The talks were sorted in different thematic sessions, with 2 or 3 invited speakers for each and 4 regular talks:

- Medical Applications of Acoustics.
- Surface Acoustic Waves for Microfluidics.
- Bubbles and Interface Actuation with Acoustics.
- Ultrasonic Standing Waves and Particle Sorting.

Additionally, a session with industrial thematics gave the opportunity to listen to 4 talks given on drop generation for inkjet printing, surface cleaning, breast-feeding helped by acoustic pumping.

Thematic round tables were organized on Wednesday afternoon, were the themes were proposed by the participants or by the co-organizers, being followed by a 1 hour debriefing by the moderators of the four different themes. Finally, on Friday noon a 1 hour debriefing with the remaining participants set the possible future collaborations and networking that should come out of this workshop. Coincidently, the Physics advisory board of the Lorentz Center planned its annual meeting during this week, which allowed Michel Versluis to give a 30 minutes presentation of the workshop aims.

During the very first sessions, it was obvious that attendees who did not know each other's work before had common fundamental questions. For instance, in medical therapy and in surface cleaning by ultrasounds both applications require accurate generation of cavitation bubbles by ultrasounds, in order to induce the appropriate fluidic mechanisms to clean surfaces without damaging them. In this sense, the invited talk of Lawrence Crum had a special resonance with those of Luc van der Sluis and Frank Holsteyns. Later on, the talk of Detlef Lohse presented the ultrafast visualizations of collapsing cavitation bubbles, and the mechanism of ultrathin liquid jet generation following the collapse (and possibly involved in the damaging process during cleaning) was captured by the Brandaris ultra-high-speed camera (several millions of frames/s). More generally speaking, the Brandaris camera was sort of a «special guest» in this workshop, as more than ten talks or posters showed movies or still images of acoustically-actuated fluids at the time-scale of the acoustic wave. Therefore, attendees from all over the world could realize the power of this unique device, and how insightful this could be for the capture of various acousto-fluidic mechanisms of actuation.

The round table discussions were also crucial during the workshop. Four themes were proposed: (1) Fundamentals and modeling of streaming: flow; (2) Fundamentals and modeling of streaming: interfaces; (3) Cleaning of surfaces: applications; (4) Bubbles and particles in acoustics microfluidics. The issues of theme (3) are partially summarized above. Theme (4) especially focused on the question of the influence of the size of particles on the relative contribution of radiation stress and acoustic streaming, a question emphasized in the talk of Rune Barnkob. This question is reminiscent to particle clustering and sorting, which was one of the major topics of the workshop. Theme (2) received inputs from the presentations of R. Wunenburger on a model experiment of destabilization of plane oil/water interfaces by focused acoustic beams. The discussion was also focused on SAW-actuated drops (free-surface oscillations, internal flow and motion), which was another major subject of the workshop. In both situations, we evaluated orders of magnitude of bulk streaming and radiation stress on interface deformation: streaming alone can cause significant deformation, no need of radiation stress. The effect of confinement (micro-channels, ...) causes a strong decrease of the streaming velocity but not of the acoustic force. Finally, relative magnitudes of two streaming flows, boundary-driven and attenuation-driven (resp. Schlichting and Eckart) were evaluated. Theme (1) was especially stimulated by the theoretical talk of M. Schindler. There are still confusions on the nomenclature of various possible streaming flows, depending on the size of the system, on the acoustic wavelength and on the width of the

viscous boundary layer. A major issue for theoretical approaches is also the separation of time-scales between acoustics and hydrodynamics. Finally, it was stated that there is a crucial need for model experiments, not necessarily application-oriented. In this sense, the dialog between theoreticians and experimentalists in microfluidics was very fruitful, as the latter now know which sort of idealized geometry can help progress theory.

Finally, one of the major outcomes of this workshop is that we have set out to integrate each other's themes in the other research community's conferences. This in fact has already materialized for the joint ASA/International Congress on Acoustics in Montreal, 2-7 June 2013: Acoustics in Microfluidics and for Particle Separation (Lawrence Crum and Michel Versluis), where a special topical session on acoustics microfluidics will be held with two invited speakers from the physics and microfluidics communities.

We would like to thank all of the Lorentz Center staff involved in the organization of this workshop for their amazing availability and efficiency, before and during the workshop.

Michael Baudoin (Lille, France)
Philippe Brunet (Paris, France)
Henrik Bruus (Lyngby, Denmark)
Michel Versluis (Enschede, Netherlands)

Search and Rendezvous

1 – 4 May 2012 *@Oort*

The London School of Economics had organized a annual workshop on search and rendezvous for over a decade, with a small mathematical audience that is based mainly in the UK. This was the first workshop that has been organized abroad, in the Lorentz Center, for a larger and much more international audience. The workshop had a total number of 45 participants, from Canada, France, Germany, Ireland, Israel, Japan, Netherlands, Spain, Switzerland, UK, USA, with a background in biology, computer science, mathematics, operations research, and even forensic science. The Dutch national police (*nationale recherche*) illustrated their search strategy by presenting details of an actual case of a detainee who had dug her way out of Breda prison using a spoon.

The main subjects of the conference were rendezvous between multiple agents on networks, search for mobile and immobile hiders in various geometries, and predator-prey dynamics in biology. These different topics lead to research problems that are surprisingly similar, and it is remarkable that computer scientists can come up with suggestions to study the effect of climate change on fish movements, or that spider movements turn out to be similar to the optimal path of a searcher in an ambush game. Similar, but not the same, and that is why many of the participants found new ideas to proceed on their previous research.

Since most of the participants had never met before, there have been many fruitful exchanges of ideas in the conference room, but it will take some time before such preliminary interactions lead to actual joint research. To establish this, there will be sequels to this workshop in the USA in 2013 and in the UK in 2014. The University of Maryland in College Park will organize the next workshop on Search and Rendezvous in the last week of May 2013.

Steve Alpern (London, UK)
Robbert Fokkink (Delft, Netherlands)
Leszek Gasieniec (Liverpool, UK)
Roy Lindelauf (Breda, Netherlands)
V.S. Subrahmanian (College Park, USA)

Chemical Gardens

7 – 11 May 2012 *@Oort*

Chemical gardens are a class of seemingly simple inorganic precipitation reactions that create macroscopic tubular structures. They are among the oldest experimental chemical systems but continue to attract the interest of laymen, educators, and scientists alike. Today they are studied as examples of chemical self-organization and materials synthesis far from equilibrium. In addition, they have regained relevance in the context of modern origins-of-life research.

The goal of this workshop was to bring together for the first time a group of scientists and educators from different disciplines that actively investigate or use this fascinating type of chemical pattern formation. Beyond the exchange of scientific knowledge, key goals were to identify major research trends and opportunities, work towards a common scientific language across the different disciplines, and discuss the possibility for future meetings and networks.

The workshop brought together scientists from eleven different countries. Among the participants were physical and inorganic chemists, experimental and theoretical physicists, geologists, engineers, as well as one historian and one science-museum educator. The program was based on 23 talks which gave the majority of the 33 participants the possibility of an oral presentation. In addition, there were some ten posters. A key goal of the program was to allow for ample discussion time both immediately after the talks and during free time in the afternoon. The workshop concluded with a plenary discussion.

From the response of the participants, we feel strongly that this workshop was a great success. Throughout the entire week it was apparent that this research topic has a lot of potential and that there was a true need for this meeting. The schedule allowed for sufficient discussion time which was actively used by all participants. The discussions were lively and not dominated by a particular group or individual. It became clear that the differences across the disciplines are not only a matter of language but also of scientific approach and style. Some of us also felt that the vastness of phenomena to be explored (a true strength of the field!) hindered systematic and quantitative progress. The idea to identify a small number of model systems for systematic and common analysis by numerous groups was discussed but no conclusion was reached. However, several of the participants agreed to write a comprehensive review of chemical-garden-type processes and work on this paper is underway. Furthermore, there was a wide spread consensus to hold a similar meeting in 2014. There was no clear consensus whether this meeting should target a similar group of scientists or a wider audience. A hotly debated point concerned the name "chemical garden". Some participants felt that its colloquial character was detrimental to the field while others liked it due to its high recognizability and (seemingly long-standing) history.

Overall this meeting has been a great experience that would have been impossible without the help and financial support of the Lorentz Center and its fantastic staff. Many thanks for allowing us to spend this productive and intellectually stimulating week in Leiden.

Julyan Cartwright (Granada, Spain)
Michael Russell (Pasadena, USA)
Oliver Steinbock (Tallahassee, USA)

Particles in Turbulence

14 – 16 May 2012 *@Oort*

Fluid turbulence is ubiquitous and so is its ability to transport particulate matter such as dust, soot or droplets. The dynamics of particles in a turbulent flow is fundamental to everyday life - examples of open scientific and technological issues include rain formation in clouds, pollution dispersion in the atmosphere, optimization and emission reduction in combustion, plankton population dynamics - and constitute a major scientific challenge with immediate practical implications and applications. Open scientific issues such as inertia, finite particles sizes, collisions, advection in complex flow geometries are examples of fundamental key ingredients which pose challenging theoretical problems and need to be understood in order to have an impact on applications.

The goal of the workshop was to bring together scientists working on the fundamental statistical properties of particle transport in turbulence and related phenomena. The idea was to have a short but intense meeting (the workshop was organized over only 3 full days) bringing together scientists working on experimental, numerical, and theoretical as well as applied aspects.

The format was specifically chosen in order to facilitate exchange amongst scientists with different expertise (plenary meetings, joint working group meetings, time for free individual discussions amongst participants) as well as to stimulate technical discussions and collaborations (e.g. within the four parallel working group sessions).

The workshop was one of the annual activities of the EU COST Action MP0806 "Particles in turbulence" and attracted many participants from within the COST Action. There were 6 keynote plenary lectures aimed at stimulating discussions and at providing an update on the state-of-the-art on few outstanding open issues. The workshop was divided in 4 parallel working groups sessions alternated by plenary discussion sessions. Time was left for individual interaction amongst participants during the conference program as well as during the social events. Scientific presentations have been made available on the Lorentz Center website. At the end of the workshop few research challenges were identified that are starting to attract the attention of several participants both from the experimental, numerical, theoretical or application point of view. These are:

- The dynamics of complex particles, like colloids, which aggregate and break under the influence of turbulent fluctuations and transport.
- The dynamics of particles with complex shapes (e.g. non spherical) or with deformable shape (e.g. droplets).
- The dynamics of active (e.g. swimming) and reactive (e.g. reproducing) biological entities transported by turbulent currents.

The organizers wish to express their sincere gratitude to the Lorentz Center for facilitating the organization of the workshop. We acknowledge financial support from EU COST Action MP0806.

Eberhard Bodenschatz (Göttingen, Germany)
Federico Toschi (Eindhoven, Netherlands)

Ostracism, Exclusion, and Rejection

21 – 25 May 2012 *@Oort*

Research in the area of ostracism, exclusion, and rejection is at an all-time high. We are past the point of simple demonstrations and replications, and are now examining the processes, mediators, and moderators. The goal of this workshop was to bring together the top researchers working on ostracism, exclusion, and rejection, who work on these topics from varying levels of analysis, to determine (a) where we stand, (b) where we agree, (c) where we disagree, and (d) future directions for as yet unexplored research. Many of these researchers had not met personally, yet were interested in the same topics and were aware of the others' research contributions. This gave these researchers a chance to meet, and to forge collaborations for the future.

While no specific tangible outcome was envisioned, an edited handbook on ostracism and exclusion (Williams & Nida) will draw from many of the participants of this conference. It is probably too early to tell if a "breakthrough" occurred, but there were certainly (a) good discussions about what would be necessary to further the claim of pain-overlap theory (that physical pain and social pain are highly similar and use the same brain regions), (b) indications of interesting and important applications of the theoretical work leading to this conference (including assessment of adolescent histories with ostracism and bullying, and downstream consequences of ostracism in the workplace). The inclusion of Doug Fry, an anthropologist, provided an "aha" moment for many participants as they discovered the role of (partial or anticipated) ostracism in early hunter-gather groups in our evolutionary past.

We organized the conference by first providing broad theoretical models of ostracism, exclusion, and rejection. Then we moved from micro-level research and theory (neuro, physiological, genetic) examinations, to intrapersonal levels (effects on cognition, motivation, and emotion), to interpersonal levels (effects on interactions with others), to societal levels (intergroup relations, impact on youth, impact on employees, impact on marginalized religions and societies).

Presenters gave 30-minute talks, followed by lively discussions. An innovation from typical conferences, we were delighted to screen of an upcoming documentary, REJECT, and listen to the director Ruth Thomas-Suh (New York). This film combines real-life narratives of ostracism, exclusion, and rejection with the science (many of whom were in the audience) aimed at understanding these phenomena. The film triggered much discussion, and provided useful connections throughout the week.

We look back at a good workshop, and thank the Lorentz Center staff for helping us immensely at every stage of the workshop.

Ilja van Beest (Tilburg, Netherlands)
Kipling Williams (Purdue, USA)

Core Knowledge, Language and Culture

29 May – 1 June 2012 *@Oort*

The workshop addressed the relation between core knowledge, language, music, and culture, with a view to assessing the current understanding of these questions for a theory of the mind/brain. The participants included scholars from fields as diverse as psychology, linguistics, neurobiology, neurolinguistics, music cognition, and cognitive anthropology. The goal of the workshop was to bring together researchers from these various domains in order to further sharpen a research program that addresses both new and as yet unresolved research questions.

The recorded presentations and discussions at the workshop will be made available on a website. Another tangible outcome of the workshop was the NWO-funded Horizon program Knowledge and culture, that was awarded on 30 June 2012, and whose aims and scope closely correspond to those of the workshop. We believe that the successful funding of this program was greatly facilitated by the organization and visibility of the (nearly eponymous) Lorentz workshop.

We believe the workshop was instrumental in bringing together researchers from various fields who were not necessarily aware that they shared an 'internalist' point of view on matters of core knowledge, language, music and culture. This fostered and unusually intense and fruitful exchange between the disciplines involved.

To give one example, it is puzzling that a notion such as recursion (and the cognate notions of merge or successor function) seems to play a role in apparently unrelated domains such as number/arithmetics, language, and music. Both linguistic and nonlinguistic quantification seem to be built on shared primitives. Such issues are often related to the (dis)similarity or (dis)continuity between the animal and the human domain. The question arises whether core knowledge of number constitutes an intriguing exception to the discontinuity thesis, with potential ramifications for the representation of time and space in the spirit of Kant.

Both organizers and participants were very pleased with the format of the presentations and the discussions. There were about 5 lectures each day, with as much time for the presentations as for the discussions. This arrangement made for an open and relaxed atmosphere that was enhanced by the excellent facilities provided by the Lorentz Center in terms of the offices and the common room. The two video-conferences, by Noam Chomsky and Tom Bever, were also very well integrated in the program and allowed for useful discussion between the participants and these speakers. The presence of a relatively small group (40-50 people) definitely enhanced the quality of the discussions. The unfailing dedication and availability of the Lorentz Center staff was much appreciated by the organizers and the participants. Nevertheless, better recording equipment for presentations and discussions would further add to the already impressive capabilities of the center.

Pierre Pica (Paris, France)
Johan Rooryck (NIAS, Netherlands & Leiden, Netherlands)

Spectroscopy of Star/Planet Forming Regions with Herschel

4 – 15 June 2012 *@Oort*

The meeting comprised two parts, extending over two weeks. The first week was a joint meeting of two teams doing key programs with the Herschel Space Observatory, the WISH and DIGIT teams. These two programs are quite closely related, with many personnel in common, but with significant differences in samples and observing modes. Both projects used the PACS and HIFI instruments to study the emission from spectral lines of molecules and atoms in the far-infrared region. The structure of talks and working groups proved very productive in sharing ideas ranging from the best data reduction techniques to interpretation of line emission. Generally, the groups discussed either the early phases of star formation, with both disks and infalling envelopes, or the later phases, when only a disk is present.

In the second week, some members of both WISH and DIGIT remained and members of 14 other teams joined them. The other teams were chosen to focus on star and planet formation with Herschel, but they included teams focusing on other samples, other instruments, and other stages in the evolution from interstellar gas to planets. The teams included the Gould Belt team, EPOS, HOBYS, HOP, WADI, CHESS, HOPS, PRISMAS, HEXOS, GASPS, DUNES, and DEBRIS, along with representatives of the brown dwarf and Michigan disks groups. The week began with presentations by representatives of each team, followed by discussions of emerging topics. The relatively unstructured week allowed the formation of numerous working groups that addressed the way forward in many aspects of the subject. Examples of working group topics were the initial conditions for star formation, evolutionary sequences, outflows, complex organic species, chemistry in star forming regions, regions forming massive stars, patterns in disk mineralogy, and disk evolution. We also enjoyed a visit to the Sackler lab and talks by theorists.

Ewine van Dishoeck (Leiden, Netherlands)
Neal Evans (Austin, USA)

The Biology and Physics of Bacterial Genome Organization

18 – 22 June 2012 *@Oort*

Defining the compaction and functional organization of genomes is a question of longstanding biological interest in bacteria as well as in other organisms. Nevertheless, we remain far from an integrated model that describes the interactions that organize the bacterial nucleoid. A key tenet of the workshop was that understanding chromosome structure and function requires knowledge spanning different "length scales". On the nanometer scale, the configuration of the DNA is modulated by the action of small chromatin proteins. At an intermediate scale, the genome has been proposed to fold into loops on the order of 10 kbp in size. On the micrometer scale, genomes are divided into independently structured domains on the order of 1 Mbp in size. An interconnecting model describing all of these length scales remains elusive. Aim of the workshop was to bring together people from diverse disciplinary backgrounds to facilitate generating and bridging knowledge on different length scales.

During the last decade numerous researchers, applying novel methodology have entered the field of bacterial genome organization. Thus the study of bacterial chromosomes is in a stage of revival and novel excitement. The workshop gathered about 55 scholars with diverse disciplinary backgrounds and both experimental and theoretical approaches (including but not limited to (micro)biology, (bio)chemistry, bioinformatics, cell biology, polymer physics). The workshop was thematically organized around the three different levels of organization mentioned above. Thus, the participants in this workshop ventured into a multidisciplinary journey to explore different levels of organization.

Many of the participants had not met before. Bringing people of diverse backgrounds together and promote interaction was one of the key aims achieved by the meeting. An important conclusion was that the nucleoid is a dynamic entity, that its components interact with each other differentially over time and that these interactions are encoded within the genome itself. This notion underscores the importance of approaches that are capable of addressing and integrating these different aspects. It seems a feasible issue to tackle for the community present at the workshop and first steps in this direction were indeed already taken. It also brings to the light aspects that were not or hardly addressed by participants during this meeting. For instance, what is the interplay of genome folding with replication? How does the structure of the genome affect damage induction, repair and mutagenesis and vice versa? What role does genome folding play in evolution, incorporation of foreign DNA by horizontal gene transfer etc? Finally, it is fair to conclude that bringing together people from different fields at a meeting like this is not enough. No doubt the workshop has been able to generate more openness to (and understanding of) the types of data generated by the diverse approaches. However, at this stage it is hard to integrate much of the available data as the experimental conditions are so widely different. Clearly new collaborative efforts are required especially in order to compare and integrate data from superresolution imaging, ChIP and 3C. A next workshop, to be organized in two or three years, will show the outcome of newly established collaborations and hopefully address many of the outstanding questions.
The most important new findings and outcomes of the interdisciplinary interactions during the workshop were compiled in a meeting report "Multidisciplinary perspectives on bacterial

genome organization and dynamics" published by Molecular Microbiology (Dame et al., 2012).

The workshop was organized by length scale. Every day a different length scale relevant to the problem was the topic of presentations by speakers. Both the morning and the afternoon sessions were followed by guided discussions of points raised by speakers and participants. On day 5 the most important points were collected and once more discussed from the perspective of knowledge integration. Generally, this format worked well and many of the participants were involved in the discussions. Key to this was the selection of expert chairs for these sessions. In addition to oral presentations we organized a poster session, which served well in people meeting each other and we had long lunch breaks to facilitate ad hoc interactions. Overall, this generated a pleasant, friendly and open atmosphere in which people were freely interacting.

The authors thank all meeting participants for their excellent contributions and the Lorentz Center staff for their superb planning and organization.

Remus Dame (Leiden University, Netherlands)
Olivier Espéli (Gif-sur-Yvette, France)
David Grainger (Birmingham, UK)
Paul Wiggins (Washington, USA)

Future Directions of Molecular Electronics

25 – 29 June 2012 *@Oort*

In June 2012, we gathered a group of excellent academic and industrial scientists in Leiden to discuss the field of molecular electronics. The goal of our workshop was not only to assess the present status of the field, but rather to critically discuss its future directions. We are happy to report that our meeting was very successful. In an open atmosphere, without taboos, we discussed the status and future of the field, based on the input by the scientists present. The open program, the organizational support of the Lorentz Center and of course the enthusiastic contributions of lecturers, moderators and all other participants strongly contributed to this success. As one of the participants noted: "This is truly the ideal setting and atmosphere for such a workshop".

To achieve our goals, we aimed for (and achieved) a group of participants from diverse backgrounds. The core came from the field of molecular electronics, both from the more basic-research side ('molecular transport as a quantum phenomenon') and the industrial side ('self-assembled monolayers' and 'organic electronics'). There were no contributed talks. Instead, we had 14 invited lecturers, given by leaders in the field of molecular electronics, as well as by key scientists in related fields (computing algorithms, molecular boolean logic, bio-inspired systems). All speakers were chosen for their ability to both lecture and contribute to our discussions and were given 60 minutes to talk and 30 minutes for discussion (led by a moderator, see below). This yielded interactive and inspirational talks with few exceptions. Key to the program was also that it included ample time for discussions, both in a plenary manner as in smaller discussion groups. For the latter, four moderators (Michel Calame, Basel; Christian Martin, Nature Materials; Mario Ruben, Karlsruhe; Jan van Ruitenbeek, Leiden) enthusiastically supervised sessions around four themes (or rather propositions). On the last day, the moderators reported on their progress and conclusions in a plenary session.

The most important outcome of the workshop was that it discussed novel research lines, which connect science and industry as well as experiment and theory. Key items to emerge were self-assembled monolayers and molecular interfacing (for industrial applications, possibly in touch screens etc. and for basic research), and the exploration of the quantum nature of molecules even at ambient temperatures (interference effects, spin-spin interactions). Finally, we discussed a rather long-term dream, i.e., to connect to CMOS, either in molecular 2D cross bar structures, in functional molecular devices (e.g. sensors). A vision for the period exceeding ten years was also formulated: to use the third dimension in fabricating devices resulting in 3D molecular reconfigurable networks. For a more extended report on the workshop, we refer to a web publication written as an outcome of the workshop. We expect that the above-mentioned research lines will strongly grow in the near future. Many participants expressed their wish to get together again, say within 2 years from the workshop week, to discuss both progress and new next steps. For this, several participants offered to take up the organization, either in Germany, Switzerland or the Netherlands.

Bernard Doudin (Strasbourg, France)
Sense Jan van der Molen (Leiden, Netherlands)
Mario Ruben (Karlsruhe, Germany)
Stefano Sanvito (Dublin, Ireland)
Herre van der Zant (Delft, Netherlands)

Majorana Fermions in Condensed Matter

2 – 6 July 2012 *@Oort*

The main idea of the workshop was to provide a review opportunity for the experts in the field of Majorana fermions. Due to the lucky timing of the workshop, there were several recent experimental papers claiming observation of these exotic particles, and active theoretical work to explain these is on the way. The workshop shifted focus and now brought together all of the experimental groups that have reported evidence of Majorana fermions and leading theorists working on the topic.

During the workshop it became clear that the current experiments, albeit promising, cannot yet serve as conclusive evidence. The main value of the workshop was to provide an active discussion on various more mundane reasons for seeing the results that were observed in the experiments, which cannot be ruled out yet. This information will be critical in designing the next round of experiments. Since Majorana fermions require utilization of semiconductors, superconductors and knowledge of topology, it is also important to provide knowledge exchange between experts in different subfields.

The workshop was a great success, owing to the fortuitous end of the first round of experiments, but also to its format. Since the workshop was very much focused, we have requested that speakers completely avoid any introduction, and immediately jump to the subject. Together with ample discussion time, this allowed to keep the workshop intense and exciting. The Lorentz Center proved an ideal place for our event, with many participants praising the highly efficient way how everything had been organized, and two researchers from Copenhagen wishing to update their local workshop center by essentially copying the Lorentz Center scheme.

Anton Akhmerov (Leiden, Netherlands)
Carlo Beenakker (Leiden, Netherlands)
Fabian Hassler (Aachen, Germany)
Charles Kane (Philadelphia, USA)
Michael Wimmer (Leiden, Netherlands)

Web Science Summer School

9 – 13 July 2012 *@Oort*

The objective of Web Science is to understand the complex, cross-disciplinary dynamics driving the development of the Web. Web Science is a young discipline, which suffers from mismatch between, on the one hand, the scientific and societal relevance of the research topics involved and, on the other hand, the lack of trained researchers who study these topics. This school was aimed at PhD students to help them understand the wide variety of theories and scientific methods needed to study Web Science problems.

The school was attended by 44 PhD students and junior researchers from 10 countries, including the US, Australia, Ethiopia and Indonesia. More than 50% of the students were female. There were 12 tutors who were all leading researchers in the Web Science field. The background of students and tutors varied; the majority had computer science training, but there were also social scientists, lawyers and economists present.

The program consisted of a mix of lectures (11 in total) and work sessions. Lectures were scheduled for 75 minutes, in which the tutor spent about 45 minutes explaining a key topic in Web Science, leaving ample time for questions and in-depth discussions. The topics of the lectures covered the range of theories and methods relevant for Web Science. A typical example was the talk by Nosh Contractor, a social scientist from Northwestern University, who discussed how techniques from social-network analysis could be applied to the Web. For the work sessions the organizers had prepared a "Call for Proposals". Students were asked to write a grant proposal about a Web Science topic of their choice. Students had to divide themselves into groups of four, as much as possible with mixed background. In the proposal they had to cover scientific and societal objectives, data issues (e.g., availability, privacy), and the Web technology involved. Tutors helped the students during the week in this process. On Friday every group made a pitch presentation about their proposal, with the tutors acting as review panel. The best proposal was awarded a prize by the panel.

The lecture sessions were lively and highly interactive. This contributed to the excellent social atmosphere of the school. The students typically came from mono-disciplinary research settings and really enjoyed the cross-disciplinary nature. Working on the grant proposal was challenging; it took most groups quite some time to get a grip on the topic they wanted to study. This was good because it made them involve a range of tutors with requests for suggestions and feedback. The final presentations exhibited a range of creative ideas formulated as realistic project proposals. A number of proposals would stand a very good chance to get funded.

Although the organizers were relatively late in sending out a Call for Participation, the School was fully booked. The line-up of the lecturers, who were almost without exception internationally well known, helped in this. The format of the work sessions worked out well. Writing a grant proposal forced students to think about fundamental issues in Web Science theories and methods. The school as a whole helped the tutors to understand what is needed in Web Science education. This is an important outcome as many universities are now setting up graduate and undergraduate Web Science programs.

Schools such as this one are somewhat different from the regular scientific workshops in the Lorentz Center. It is the opinion of the organizers that the facilities of the Center are an

excellent fit for such schools, in particular in emerging cross-disciplinary fields. The offices provided the study and work environment required by the school format. The heavy downpourings of rain during this Dutch summer week could not prevent making this a memorable event for all involved.

Hans Akkermans (Amsterdam, Netherlands)
Wendy Hall (Southampton, UK)
Frank van Harmelen (Amsterdam, Netherlands)
James Hendler (New York, USA)
Guus Schreiber (Amsterdam, Netherlands)

Effective Field Theory in Inflation

16 – 20 July 2012 *@Oort*

The aim of this workshop was to work toward a coherent understanding of three approaches to effective field theory in inflation: Symmetry-breaking Universality, Wilsonian coarse graining, and Non-equilibrium QFT. Each of these approaches may provide some insight into understanding high energy physics (such as quantum gravity) from cosmological observables, and which could not be otherwise probed. This is particularly exciting given current cosmological parameters measured at the percent level, and next year's data release of the Planck satellite is expected to improve this by an order of magnitude. If there is an imprint of quantum gravity in today's sky, the correct effective field theory of inflation will be the road to decipher its signature.

The workshop was roundly applauded by all participants. This was the first time all major researchers in this field were brought together at the same venue, and the result was highly rewarding. The rapid developments in both cosmological observation and theoretical understanding left many avenues to be explored, and the organizers felt the workshop more than accomplished this goal. One highlight was a session in which three of the participants energetically discussed a technical point on the difference in their approaches. As a result of this exchange of views, a deeper understanding was formed which overturned a previous result in the literature. This was precisely the integration of different approaches that the organizers had hoped to achieve. The workshop was also very fortunate to have a senior member of the Planck satellite team deliver a lecture on the type of data to be released, and the correct method of interpretation. Following this, an informal "survey" was taken by another speaker to predict the implications of such data. It will be soon be evident how close reality is to this prediction. The overall workshop was so warmly received by participants that from it emerged the organization of another, titled "New Challenges for Early Universe Cosmologists." It will be useful to re-visit some of the issues raised in the present workshop given the year's developments.

The format allowing plentiful discussion time proved essential for the success of the workshop. There was a tremendous amount of participation and discussion, in fact multiple attendees commented that it had been the most "lively" workshop they had ever attended, as well as the best organized.

Ana Achúcarro (Leiden, Netherlands)
Brian Greene (New York, USA)
Mark Jackson (Paris, France)
Jan Pieter van der Schaar (Amsterdam, Netherlands)
Koenraad Schalm (Leiden, Netherlands)
Leonardo Senatore (Stanford, USA)
Gary Shiu (Madison, USA)

Gas, Stars, and Black Holes in the Galaxy Ecosystem

23 – 27 July 2012 *@Oort*

The gas and stars, together with the central supermassive black holes in galaxies form a complex eco-system that is largely responsible for how the galaxies that we see in the universe today developed from their initial structures at high redshift. In the leading cold dark matter theory of galaxy formation, the stellar structure of galaxies forms through star-formation that is fueled by gas accreted from the intergalactic medium. The star-formation is regulated by the feedback from stellar winds, supernovae and active galactic nuclei (AGN). The aim of this workshop was to bring together scientists working in three important and closely related subfields that - when put together - describe this entire process:

1. The Gas and Stars (gas accretion, star formation, starbursts, dust)
2. The Central Engine (black hole accretion, AGN triggering, outflows)
3. Superwinds (AGN and starburst winds, radio jets, feedback, IGM, ICM)

The focus in the workshop was to (1) update the community on the key successes and failures in our current understanding of this complex eco-system; (2) discuss the most relevant new results; (3) explore synergies between different topics and different projects; and (4) present an observational and theoretical outlook to the near future.

The workshop had 55 participants from Europe, Brazil, China, Australia, the USA and Canada, including 7 PhD students and 11 postdocs. A strong feature of this workshop was the fact that it brought together a great number of scientists that work in adjacent or connected fields that do not typically go to the same meetings. To set the stage for this workshop, an honorary review lecture was given on Monday morning by world-renowned expert Tim Heckman, who emphasized the interconnectivity of the key topics of the workshop. The remainder of the workshop followed a structure of mostly expert review sessions and scientific highlight talks before lunch, and poster presentations, group discussions, and offline work sessions in the afternoons.

The discussions focused on (1) stellar populations; (2) the life-cycle of radio AGN; (3) the triggering of luminous AGN; and (4) galaxy outflows. The discussions were led by 1-3 experts in the field, and were experienced as particularly lively owing to the diverse backgrounds of the participants. The discussions brought to light that (1) interpretations of galaxy spectra are still affected by unsolved problems in stellar evolution, although it is not clear whether, or to what level, these problems restrict our ability to measure accurate physical properties; (2) there continues to be mounting observational evidence that radio galaxies could play an important role in the evolution of galaxies and galaxy clusters, even though their exact role as well as the physics of radio AGN are still poorly understood; (3) a connection between AGN activity and galaxy merging is still expected, though differing timescales make it difficult to determine the key observational signatures expected; and (4) outflows are key to understanding the properties of all types of galaxies, but are still observationally challenging especially at high redshift.

The final day of the workshop was reserved for a series of brief talks describing a range of upcoming observational experiments (e.g. CALIFA, SAMI, Manga, Euclid, Muse, LMT, Subaru Prime Focus Spectrograph, and new ultraviolet missions), followed by a discussion on how the interaction between observers and modelers/theorists predictions could be improved in

order to make progress in understanding the important roles of gas, stars, and black holes in galaxy evolution.

We thank the Lorentz Center for financial as well as excellent organizational support.

George Miley (Leiden, Netherlands)
Roderik Overzier (Austin, USA)
Vivienne Wild (St. Andrews, UK)

From Conservative Dynamics to Symplectic and Contact Topology

30 July – 3 August 2012 *@Oort*

The aim of this workshop was to focus on some aspects of symplectic and contact geometry where the interactions of these fields have proved most fruitful and have generated problems of high current interest. Exemplary for such questions are the Weinstein conjecture and the topology of the group of symplectic/Hamiltonian/contact diffeomorphisms.

The Weinstein conjecture is concerned with the existence of closed orbits of the Reeb vector field associated with a contact form, inspired by a result of Rabinowitz on periodic solutions of Hamiltonian systems. A wealth of techniques has been brought to bear on this conjecture since its original formulation in 1979, leading to various partial solutions. Hofer's approach via pseudoholomorphic curves was the first to yield significant results in dimension 3; this case has recently been resolved completely by Taubes, using Seiberg-Witten theory.

With the aid of topological techniques such as open book decompositions, the scope of Hofer's method has been extended significantly, also to higher dimensions. During the workshop, several talks addressed the topic of the Weinstein conjecture. Abouzaid discussed Floer theoretic invariants associated to an exact Lagrangian submanifold of a Weinstein manifold and how this can be used to deduce existence of closed Reeb orbits (and thus verify the Weinstein conjecture) from existence of Reeb chords. Niederkrüger explained how Hofer's proof of the Weinstein conjecture for 3-manifolds with non-vanishing second homotopy group can be generalized to manifolds of dimension five admitting an embedded 3-sphere with a trivial Legendrian open book and which represents a non-trivial homotopy class (joint work with Massot and Wendl).

In his talk, Zehmisch addressed the existence of null-homologous Reeb links (known as the strong Weinstein conjecture) and discussed some results he obtained together with Geiges. In particular, they prove the conjecture for severel classes of manifolds (for instance, manifolds admitting a Giroux open book with subcritical pages).

The group of Hamiltonian/symplectic (resp. contact) diffeomorphism of a symplectic (resp. contact) manifold can be interpreted classically as the symmetries of a mechanical system. Two of the most influential methods in the study of the group of Hamiltonian diffeomorphisms have been Hofer's invention of a metric on this group, and the recent construction of quasi-morphisms on this group by Polterovich-Entov, using Floer theory. During the workshop, Sandon explained the construction of a bi-invariant metric, called the discriminant metric, on the universal cover of the contactomorphism group of any contact manifold (joint work with Colin). She also discussed the relation of this metric to other contact rigidity phenomena, such as non-squeezing. A closely related construction was presented by Albers, using the Rabinowitz action functional.

Further interesting interactions of symplectic/contact geometry with other fields of mathematics were addressed in the talks of Ostrover (geometric analysis), van Koert (celestial mechanics), Polterovich (quantum mechanics), and McLean (algebraic geometry).

The workshop lasted 5 days; with on average four 45 minutes lectures per day. There were two "Short presentations" sessions, on Monday and Tuesday, during which graduate students were given the opportunity to introduce themselves. The program contained a lot of not-allocated time, which allowed for plenty of interaction and collaboration.

The following participants gave a lecture: Mohammed Abouzaid (New York), Peter Albers (Münster), Frèdèric Bourgeois (Bruxelles), Lev Buhovski (Chicago), Albert Fathi (Lyon), Basak Güurel (Nashville), Janko Latschev (Hamburg), Samuel Lisi (Bruxelles), Mark Mclean (Cambridge, US), Klaus Niederkrüger (Toulouse), Yaron Ostrover (Tel Aviv), Leonid Polterovich (Chicago), Sheila Sandon (Nantes), Andras Stipsicz (Budapest), Michael Usher (Athens, US), Otto Van Koert (Seoul), Kai Zehmisch (Köln).

The following junior participants delivered a short presentation: Marta Batoreo (Santa Cruz), Matthew Strom Borman (Chicago), Max Dörner (Köln), Doris Hein (Santa Cruz), Wyatt Howard (Santa Cruz), Arun Maiti (Leipzig), Thomas Rot (Amsterdam), Frol Zapolsky (München).

The quality of the talks during the workshop was extremely good and the topics managed to generate a lot of interest, as demonstrated by the fact that every talk was followed by very animated discussions. The speakers were very happy with the format of 45-minute talks. A particularly successful component of the workshop program was the short presentations delivered by graduate students. Everyone appreciated the fact that the workshop program left ample time for interaction, which in turn created significant new opportunities for exchanges and collaboration. The paper A discontinuous capacity by Zehmisch and Ziltener (arXiv:1208.6000 [math.SG]) is a direct result of the workshop.

The facilities and support of the Lorentz Center and the provided accommodation were excellent. The participants' comments confirm our impressions. One of the speakers wrote us: "The academic atmosphere at the conference was very high. To get the possibility to work at the Lorenz Center was one of the fantastic features..." and another speaker wrote: "Among the participants were not only leading researchers in the field but also a good portion of junior researchers. The latter group presented their research in short talks which turned out to be of very fruitful format. [...] As a matter of fact the amount of interaction before, between and after the talks was astonishing. This certainly was emphasized by the excellent research atmosphere of the Lorentz Center. [...] As for my own research, the conference was enormously valuable. My talk was a report on ongoing work and it is fair to say that it leaped ahead as a consequence of the conference."

Hansjörg Geiges (Köln, Germany)
Viktor Ginzburg (Santa Cruz, USA)
Federica Pasquotto (Amsterdam, Netherlands)
Bob Rink (Amsterdam, Netherlands)
Rob Vandervorst (Amsterdam, Netherlands)

Asteroseismology in Red-Giant Atars

30 July – 3 August 2012 *@Snellius*

The CoRoT and the Kepler space missions are dedicated instruments for asteroseismology. Both satellites are observing a large number of oscillating red-giant stars with an unprecedented photometric accuracy and duration. The observations reveal an amazing wealth of oscillation signatures in the time series of these stars. The staggering amount of details that can be seen in the Fourier spectra offers new opportunities to scrutinize this stage of stellar evolution, but at the same time also poses new challenges.

The aim of the workshop was to perform an effective evaluation and testing of existing and new methodologies for the interpretation of ultra-high precision time series of red giants, and to improve our understanding of the observed oscillations in terms of the internal stellar structure.

The workshop has been hailed by many participants as a great success. During the workshop there was time for interaction between scientists analyzing data with different tools, between scientists who are working on stellar models and between scientists of the different groups. A set of predefined exercises was used to stream the discussions. These discussions created understanding of difficulties and issues that we are facing with respect to the data / models. This lead to very constructive discussions as to how to go forward from here and to a list of projects that was formulated with different participants leading different projects. Additionally, we agreed that such meetings should be organized on a regular basis. Therefore we planned three follow-up meetings: a meeting with a focus on data analysis and interpretation (10-13 December 2012, Amsterdam, Netherlands), a second meeting focused on stellar models (14-18 January 2013, Aarhus, Denmark) and a third meeting with both groups together in late spring / early summer of 2013.

For this workshop each day had a specific topic and the day started with an introductory talk (scheduled to be an hour) to introduce the topic. These talks already generated so much discussion that they often lasted for most of the morning. In the afternoon there was time for discussions and informal contributions showing results of exercises defined prior to the meeting.

The brand new Lorentz Center@Snellius venue was an excellent location for discussions. The walls on which we could write were extensively used as well as the different discussion areas and smaller rooms to work more privately. This workshop was seen by all participants as a very positive and inspiring experience thanks to the excellent organization by the Lorentz Center staff.

SOC: Sarbani Basu (Yale University, USA), Yvonne Elsworth (University of Birmingham, UK), Thomas Kallinger (Leuven University, Belgium), Anwesh Mazumdar (Homi Bhabha Centre for Science Education TIFR, Mumbai, India)

Saskia Hekker (University of Amsterdam, Netherlands)
Joris De Ridder (KU Leuven, Belgium)

The Dynamic Nature of Baryons in Halos

6 – 10 August 2012 *@Oort*

Baryons, the `normal' matter that makes up the periodic table of elements, are the fuel for the formation of stars and galaxies, and thus create the visible Universe. Over time, baryons flow into 'halos', gravitational overdensities that seed the formation of galaxies, and build up the galaxy population we see around us. Some fraction of this material is subsequently ejected through complex and energetic stellar evolution processes, regulating the growth, and shaping the properties of galaxies. An understanding of the dynamic nature of halo baryons is therefore a critical ingredient in a complete theory of galaxy formation, and was the focus of our workshop.

The majority of baryons, however, reside outside of galaxies in a diffuse phase. Their detection and characterization requires observations spanning the energy spectrum from radio wavelengths to Xrays. A key innovation of our workshop was to assemble a team of leading observational astronomers from these complementary, but often disconnected, observational disciplines, in concert with astrophysicists specializing in hydrodynamical simulations of galaxy formation, to build a holistic picture of baryon evolution.

In total, 47 scientists from around the globe participated, contributing to our themes 'An introduction to halo baryons', 'Observational probes of halo baryons', 'Physical processes driving baryon dynamics', 'Identifying future challenges and opportunities', and 'Scientific synthesis'. Discussion oriented scheduling, encouraged by the Lorentz Center, was central to fostering the vigorous discussion between disciplines, particularly following reviews for each theme, from researchers targeted by the SOC. This defining feature of our workshop built strong awareness of synergies between disciplines and fostered new lines of enquiry that have already yielded publications in high impact journals.

The SOC's aim to involve the researchers that represent the future of the field was a notable success. Discussions led by early career researchers were an important element of the program, and able candidates to lead them were targeted by the SOC ahead of the meeting and asked to prepare points for debate. Following the success of one such session, the discussion leader has been offered an invited review at a major international conference.

Feedback from delegates was overwhelmingly positive, particularly in respect of the collaborative environment fostered by the Lorentz Center. We currently plan to hold a follow up workshop, with a very similar format, in late 2013 or early 2014, most likely in Australia.

The SOC is indebted to Ikram Cakir, Mieke Schutte and Henriette Jensenius of the Lorentz Center for their expert advice, enthusiasm and professionalism, without which the workshop could not have been a success.

Joel Bregman (Michigan, USA)
James Bullock (California, USA)
Robert Crain (Leiden, Netherlands)
Benjamin Oppenheimer (Leiden, Netherlands)
Mary Putman (Columbia, USA)
Jason Tumlinson (Baltimore, USA)

Modelling the Dynamics of Complex Molecular Systems

13 August – 7 September 2012 *@Snellius & @Oort*

Mathematics and physical chemistry have a long history of collaboration and interaction, which has been of great benefit to both communities. An even more intense partnership is needed, for the development of sensible computer algorithms and theories which can be "scaled up" to address challenging problems, such as the simulation of proteins and nucleic acids, or prediction of structures in nano-engineered materials. Simply using a larger computer will not work; new principles and methodologies are needed. Crossing scale boundaries requires mathematical approaches that provide a seamless transition between formulations. This program, consisting of four workshops of a week each, brought together researchers interested in the design of new theories and algorithmic principles for a broad range of phenomena formulated at atomistic and coarsened scale regimes, and integrated multiscale approaches. Four threads ran through the program:

1. Mathematics of molecular and stochastic dynamics. This includes the theory of molecular dynamics and numerics for incorporating stochastic perturbations to recover averages in various thermodynamic ensembles.
2. Accessing long time scales by rare event simulation. Here, the aim is the sampling and understanding of rare event processes in complex systems.
3. Accessing larger systems via coarse grained (mesoscale) models. Particularly important is the theory and numerics of techniques behind coarsening the description of a molecular system, while reproducing the thermodynamics as well as dynamic properties.
4. Integrating different levels in multiscale simulations. This integration is paramount in concurrent simulation methods, in which at least two levels of description have to communicate.

No papers have come out of the workshops yet but several collaborations have been started in the workshop period. In addition, an exchange of algorithms and concepts has taken place between researchers. Finally, the two communities that were working parallel to each other have been able to interact and exchange ideas, to the benefit of both.

During the workshops many new and exciting methodologies were discussed connected to each of the daily topics: dynamical integrators, enhanced phase space sampling, trajectories space sampling, non-equilibrium methods, analysis of trajectories. Open questions were identified, including fundamental ones such as: How to correct for sampling errors in rare event methods? How to compute rates with enhanced sampling methods without prior knowledge of a reaction coordinate?

Also more practical issues appeared. Can we develop a software package for rare event methods a la PLUMED? How do we test whether enough collective variables are incorporated in a given approach? Can we introduce benchmarks for our methodology, so that people may compare techniques? In the second workshop we discussed many new approaches and applications of multiscale modeling connected to the daily topics: Coarse graining, Dynamical coarse graining/hydrodynamics, adaptive hybrid multiscale modeling, Lifting/restriction/equation free methods, and reaction coordinates. Fundamental issues were discussed within the topic of coarse graining such as the representability issue. An important new topic is the design of the CG model: which degrees of freedom should be kept and which integrated out? Is bottom up better than top down? Do we want potentials or rather a

Markov model description? If dynamics is important: how do we build it in? In the adaptive multiscale modeling session we worried about several issues: what the applications were, whether one should mix forces and potentials, how to develop an efficient yet simple scheme. The lifting and restriction schemes raised the topic of slow equilibration. On the topic of reaction coordinates, the question was discussed whether it is more informative to have a universal coordinate such as a PCA or diffusion map, or a specific one pertinent only to the system at hand. How do we analyse configurations or trajectories to find good reaction coordinates without performing a full-scale committor test? Can dynamical consistency help? All these discussions pointed to many new developments and a very active community.

The interaction between the mathematics and biophysical chemistry community was excellent. There was certainly overlap between the work of both communities, although of course usually from a slightly different perspective. As an example, many researchers only realized during the discussion on stochastic integrators during the first focus group session how important the correct implementation of the Langevin algorithm is. This realization is tremendously useful.

The format of this series of workshops was rather unique; instead of a single one-week workshop the program comprised two workshops interspersed with two focus groups. The workshops were different in topic and composition, and the outcome was discussed above. The workshops had only limited slots for speakers, leaving plenty of time for discussion. The daily plenary discussion session worked very well, and was truly useful in putting developments in perspective. During the focus groups, a smaller group of people was really working together on several subjects, e.g. an adaptive multiscale modeling with conserved extended Lagrangian. We consider this setup a great success, and so did the participants with whom we spoke. It became clear that this program was a crucial necessity to make the mathematics and physical chemistry communities better aware of each other's work and bring the communities closer together.

Although strictly speaking it is not a research outcome, we mention that a grant preparation meeting was organized by several of the participants during workshop 2. The grant build on themes related to both workshops (diffusion maps, reaction coordinates and molecular integrators), involving math and chemistry collaboration, and this has resulted in a successful bid for over $2M in funds from the EPSRC and the National Science Foundation. A collaborative bid for an EU project involving Wim Briels, Giovanni Samaey and Ben Leimkuhler was also an outgrowth of the second workshop and specifically addressed the theme of coarse graining for complex molecular systems.

During the focus groups (weeks 2 and 4) the schedule was less intense, and there were only one or two talks a day. In fact this left much time to collaboration and discussion, something that people really enjoyed and took advantage of, especially in the first focus group. The Snellius venue was extremely popular with the participants as it provided a close working environment and made possible longer more in-depth discussions. A one hour talk initiated in the morning sometimes continued after the coffee break up to lunch and even till after lunch, as participants felt comfortable to ask very detailed questions. It should be mentioned that the facility can be somewhat noisy and it is important that some care is taken in explaining this to participants at the outset.

The decision to have the final focus group at the end of the workshops meant that this week was less popular resulting in a small group at the very end of the four weeks. Therefore it is

recommended for future long-term programs to put the focus weeks in between workshops rather than at the end. Another recommendation is that the decision to grant a four-week workshop proposal should be made at least a year in advance, rather than the regular period of 4-6 months. This is important in order to secure a long-term commitment from eminent researchers.

The Lorentz Center staff was extremely helpful and reliable in all dealings with the participants and organizers. The hotel was very suitable and well run (if slightly far from the city center).

Peter Bolhuis (Amsterdam, Netherlands)
Bernd Ensing (Amsterdam, Netherlands)
Benedict Leimkuhler (Edinburgh, UK)
Eric Vanden-Eijnden (New York, USA)

Resonance and Synchronization

20 – 24 August 2012 *@Oort*

The aim of the workshop was to bring together scientists from mathematics, physics, biology and engineering to discuss 'resonance and synchronization' from various perspectives. In the past decades there has been some divergence of the languages used in these areas and the urgency is felt to bridge the gaps and to take profit from the ensuing synergy. About 40 participants were present, with a good representation from the different areas involved. Outcome of the workshop may be expected in the form of increasing co-operation between participants. One initial issue is the development of a glossary describing and unifying the terminology in the different areas. One of the surprises for many participants was the striking complexity of even the simplest biological system.

In general there were only 3 to 4 lectures a day with a lot of opportunity for discussion. The lectures were generally well-aimed at the diverse audience. One consequence of this was that we could greatly benefit from the opportunity for discussion, which resulted in a large exchange of ideas.

We felt that the Lorentz Center and its excellent staff played a major rol in letting us enjoy a smoothly organized workshop, where we could really go for the aims we had in mind.

Domien Beersma (Groningen, Netherlands)
Henk Broer (Groningen, Netherlands)
Henk Nijmeijer (Eindhoven, Netherlands)

Modern Perspectives on Thin Sheets: Geometry, Elasticity, and Statistical Physics

3 – 7 September 2012 *@Oort*

The aim of the workshop was to stimulate interaction between various disciplines by bringing together scientists from different but related fields. The main groups that participated were of physicists that study constrained and frustrated thin elastic sheets, biological sheets (essentially from plants), frustrated 2 and 3 dimensional liquid crystal systems, and thermally fluctuating membranes. The workshop included 46 participants from various countries including USA, France, Israel, Chile, UK and the Netherlands.

The workshop was a success. The talks focused on the most recent research in these domains and were of the highest level. These talks were the starting point of several outstanding formal discussions. We also emphasize the numerous informal discussions in groups or pairs that are the essence of a workshop at the Lorentz Center. The merger of the different disciplines succeeded beyond expectations and new insights were generated due to the interactions between the different groups. In the conclusive discussion of the workshop, participants pointed to the following central and new topics of interest that emerged during the workshop:

- The analogy and relation between folding and "scars" patterns that appear on constrained elastic sheets and self-organized sheets made of weakly connected particles.
- The transition from wrinkling to folding or crumpling in elastic sheets. How to distinguish folding and crumpling? Is there a universal scenario for such transitions?
- What is the origin of the anomalous behavior with thickness, observed in unconstrained non-Euclidean hyperbolic sheets?
- What are the characteristics of growth regulation in leaves? Such thin objects grow via expansion of individual cells without buckling (i.e., stress does not accumulate in the leaf). This implies a regulation mechanism(s) where local stresses could affect the cell growth.
- How are the different morphologies observed for confined thin sheet – wrinkling, folding, buckling, scars – affected by thermal fluctuations?

All these topics are interdisciplinary by essence, a clear indicator of a good synergy between the different disciplines participating in the workshop. The questions mark some of the future research directions in this evolving subfield of soft matter physics. The participants agreed that it would be very useful to further strengthen the community created at this workshop by starting a periodic Gordon Research Conference on this topic.

Last but not least, the management and administrative aspects of the workshop were excellently taken care off. The Lorentz Center team created a pleasant atmosphere with excellent conditions for scientific interaction.

Pascal Damman (Mons, Belgium)
Benny Davidovitch (Amherst, USA)
Eran Sharon (Jerusalem, Israel)
Vicenzo Vitelli (Leiden, Netherlands)

Compact Binaries in Globular Clusters

10 – 14 September 2012 *@Oort*

Globular clusters are old, massive and very dense stellar systems, where stellar interactions and collisions are common. Such interactions allow for the active formation of compact binary stars. In particular the formation of systems with neutron star accretors and low-mass companions is enhanced by a factor of more than 100 compared to the outside field. As the compact binaries are formed through very particular evolutionary channels, they are important for constraining models of stellar evolution, and for our understanding of extreme phenomena such as supernova explosions and gamma-ray bursts. The sub-arcsecond spatial resolution of the Chandra X-ray Observatory has allowed a strong observational progress in the field, both through the study of external galaxies and of Galactic globular clusters. At the same time, the advance of computational methods and power has allowed the construction of realistic models of globular clusters. The aim of the workshop was to bring together active researchers involved in the various observational and theoretical communities and to assess the current state of affairs by confronting simulations with observations.

The workshop was attended by around 45 national and international scientists with backgrounds covering the different observational and theoretical topics related to the workshop. The group consisted of a few senior scientist, but mainly young active researchers: young faculty, postdocs and PhD students.

The first day of the program was arranged for everyone to get a good overview of the field through a series of invited overview talks. The following four days were used to discuss the four main topics:

- Theory of formation of compact binaries
- Galactic observations of compact binaries in globular clusters
- Modelling globular clusters
- Extra-galactic observations of compact binaries in globular clustsers

The program then consisted of a few invited overview talks in the morning, followed by a mixture of sessions with discussions and sessions with shorter talks. The days each ended with a longer discussion session, focused on achieving better understanding of the topic of the day.

The workshop was very successful, based on the interaction between the participants and the feedback of the participants at the end. The composition of the participants ensured a thorough overview of all subtopics, and in many of the talks the speakers were able to relate to results presented by their colleagues. The dominance of young active researchers created a friendly discussion climate with lively debates where also the junior researchers were not afraid to express their opinions. Many of the presentations sparked such intense discussions during and after the talks that the organizers had to spontaneously rearrange the program to allow space for this.

The main goal of the meeting was to bring theoreticians and observers together to understand the current state of the field and to learn what is needed to achieve further progress. The meeting was extremely successful in this. The presentations gave a good overview of the subjects and many of the existing paradigms were challenged both in talks

and in the discussions, which also focused on how to test the ideas. Furthermore, a number of collaboration projects were set up between small groups of participants, and it was decided to attempt to set up a larger collaboration with the goal of proposing major observational projects that can lead to large advances in the field.

Matthew Benacquista (Brownsville, USA)
Craig Heinke (Edmonton, Canada)
Christian Knigge (Southampton, UK)
David Pooley (Huntsville, USA)
Simon Portegies Zwart (Leiden, Netherlands)
Rasmus Voss (Nijmegen, Netherlands)

Active Dynamics on Microscales: Molecular Motors and Self-Propelled Particles

17 – 21 September 2012 *@Oort*

Single-molecule protein motors play a fundamental role in biological cells and are responsible for a variety of functions, including force generation in muscles and intracellular transport. Similar to macroscopic machines, their operation involves cyclic internal conformational motions which are transformed into steady translational or rotational movements of the motor through ratchet effects. Energy supply is essential here and nonequilibrium active dynamics at the molecular level is characteristic for such systems. In contrast to macroscopic machines, protein motors need, however, to work in the presence of strong thermal fluctuations and high noise. Hence, robustness of ordered internal motions becomes a primary requirement. On the other hand, nanoscale devices may also actively exploit fluctuations, making them contribute towards the motor function.

Although cell motility has long been studied by biologists, major advances in developing mechanistic descriptions have been made in the past few years. Applications of dynamical systems theory and new experimental methods have led to detailed propulsion mechanisms in terms of molecular machines. We now know, for example, that an intricate synchronization of hundreds of flagella forms the propulsion mechanism for certain algae, and that collective motions of swarming bacteria can lower the effective viscosity of the host fluid. Recently, nonbiological micro- to nano-scale particles have been investigated that convert chemical energy into translational motion. These systems provide an opportunity to explore mechanisms of chemomechanical energy transduction and offer a link to self-propelled particles in living systems.

The workshop has brought together leading experts from a wide range of research areas, with studies of molecular to micro-scale motors forming the common thread. Experimental and theoretical research on biological and nonbiological systems has been presented and discussed, bringing new investigative tools and analyses to the participants. The topics covered in the workshop were wide-ranging yet interconnected. Formal and informal discussions between the participants yielded new mechanistic insights and new investigative tools have been proposed, contributing to the workshop's success. The workshop benefited from the topical mix of biological and nonbiological systems and both theoretical and experimental points of view. A major goal of the workshop was to stimulate discussions between participants specializing in different aspects of molecular motors and self-propelling particles and this goal has been successfully implemented.

This workshop was organized together with the Berlin Center for Studies of Complex Chemical Systems.

Arjen Doelman (Leiden, Netherlands)
Alexander Mikhailov (Berlin, Germany)
Kenneth Showalter (Morgantown, USA)

Organs on Chips: Human Disease Models

24 – 28 September 2012 *@Oort*

"Organs on Chips" are multicellular mini-organs grown in a microfluidic chips that *in vitro* reproduce complex, integrated organ-level physiological and pathological processes. Organs on Chips could, in the future, be used as human disease models for the discovery and development of drugs as well as toxicity testing. A such, they could be used instead of, or in addition to, currently used models based on primary tissues and cells in culture dishes or animal models, that often are not representative of human disease and pathophysiology. The main objective of this workshop was to develop a common view on the required combinations of methods and technologies for creating "Organs-on-Chips" for different organs and diseases.

A number of different technological platforms that could be suitable for Organ on a Chip application were presented during the workshop: platforms based on compartmentalized microfluidic devices, high-throughput microdroplet technologies, hydrogel structuring technologies, and platforms allowing for controlling mechanical environment of cells and tissues. These platforms have already been applied to mimic, on a basic level, the function of various organs: lungs, heart, skin, bloodvessels, gut, breast, spleen. The potential to combine (a number of) those platforms was discussed.

The source of the cells for Organs on Chips is important, and depending on the application and use can be primary cells, tissue slices, hES (human Embryonic Stemcells), iPS (induced Pluripotent Stemcells). The latter cell type provide the very interesting possibilities of creating, in a reproducible manner, disease models with specific genetic backgrounds. Standardization of iPS cell lines and culture conditions and differentiation protocols will be necessary and has started.

Another important topic of the workshop was about read-outs: what to measure and analyze? All kinds of microscopy technologies are expected to be highly valuable for (high throughput) readout tests. Reporter systems enable real time measurements of for example oxygen and lactate, but also specific gene transcription. Still lacking is high resolution 3D fluorescent imaging, required to real time measure fluorescent signals at a single (sub)cell level.

The pharmaceutical industry and agencies such as the NIH, DARPA and the FDA are highly interested in this developing field, and especially stimulate development of a multi-organ-on-chip, as well as driving development of high throughput model systems with high throughput read-out technologies.

As a follow-up to the workshop, a special issue on "Organs on Chips" will be published by the Royal Society of Chemistry in "Lab on a Chip" and "Integrative Biology", which will include a meeting report of the Lorentz workshop.

The mixture of participants, with a wide range of backgrounds ranging from physicists, chemists, engineers, biologists, medical specialists (oncologists, pathologists), representatives from pharmaceutical research, in-vitro-diagnostics (IVD) companies, and a representative from the US regulatory authorities, enabled unique interactions and exchange of experience and expertise, and definitely contributed to the success of the workshop.

The very friendly and inviting atmosphere of the Lorentz Center, the cozy common room, including free drinks, each participant his or her own "Lorentz mug" to drink from, the barbecue on the beach, and the mixture of lectures and discussion time created a very stimulating and pleasant setting, where participants really felt at home, and were willing to very openly share their results, including those they had doubts about. The poster presentations and the poster prize contest were very successful to involve young scientists and give them a stage. Despite the absence of any formal confidentiality agreement, this appeared to be the case for both academic and commercial participants, and resulted in unique discussions, friendships and multiple future scientific collaborations.

Hans Clevers (Utrecht, Netherlands)
Don Ingber (Cambridge, USA)
Christine Mummery (Leiden, Netherlands)
Anja van de Stolpe (Eindhoven, Netherlands)
Jaap den Toonder (Eindhoven, Netherlands)

Holographic Thermalization

8 – 12 October 2012 *@Oort*

Recently a lot of attention has been devoted to non-equilibrium properties of strongly interacting systems, in both high energy physics (the quark-gluon plasma at RHIC and at the LHC experiments) and condensed matter physics (quantum quenches in cold atomic gases). In the absence of established and robust first-principles methods to describe time-dependent configurations of strongly interacting media, an alternative approach based on the gauge-gravity duality emerged. In this new paradigm, certain strongly coupled media can be "holographically" described in terms of higher dimensional curved geometries involving black holes. Remarkable progress has been made in the last 10 years in understanding equilibrium and near-equilibrium properties of holographic strongly coupled systems. Little is known, though, on the far-from-equilibrium regime relevant to the approach to local equilibrium. Holographic investigations of this regime may help understand the mechanism behind the fast thermalization of the quark-gluon plasma observed in heavy ion collisions. They are also relevant to studies of entropy production and various measures of departure from equilibrium in non-equilibrium systems, and can be useful to understand the physics of non-equilibrium condensates in condensed matter experiments, as well as fundamental aspects of black hole physics. Numerical methods are usually required to construct the highly time-dependent dual geometries describing black hole formation and equilibration. Therefore, these investigations require ideas and tools from string theory (the gauge/gravity duality), numerical relativity, as well as many-body physics (QCD and condensed matter theory). Success will require collaboration between members of these communities, whose interactions in the past have been rather limited.

The workshop aimed to facilitate and initiate such interactions by bringing together leading experts on applications of the gauge-gravity duality with a number of key players from the QCD, condensed matter theory and numerical relativity communities. Although initially the organizers planned a meeting with about 40 participants, an overwhelming interest led to the workshop with 55 researchers. The number would be higher, if not logistic constraints on the organizational side.

The workshop had a relaxed schedule with a moderate number of speakers among which nine were invited as leading figures interested in equilibration problems within their disciplines. The remaining eight talks were given to registered participants with four shorter talks delivered by junior researchers. There were also four discussion sessions led by the experts in string theory, information theory, QCD and numerical methods and for each discussion its leaders tried to choose the most interesting set of subjects related to the holographic thermalization. The schedule had generous three hour long lunch breaks, part of which the participants used for working on their own projects and private discussions. The interdisciplinary character of the workshop led to a couple of interesting group discussions, e.g. about the relation between the so-called global AdS spacetime used in their studies by relativists and the so-called Poincare patch of AdS used in most of the studies by string theorists working on holography.

Jan de Boer (Amsterdam, Netherlands)
Paul Chesler (Cambridge, USA)
Ben Craps (Brussels, Belgium)
Michal Heller (Amsterdam, Netherlands)

Modeling of Multicellular Development and Cancer: European CompuCell3D/SBW Hands-on Workshop

8 – 13 October 2012 *@Snellius*

The workshop brought together 30 scientists interested in biomedical modeling of tissue development, homeostasis and disease. The research interest spectrum was quite broad from few cell systems to organ and organism level modeling. Although the workshop was focused on modeling, about 30% of participants identified themselves as core experimentalists. This was very encouraging given that one of the goals of the workshop was to facilitate discussion and collaboration between experimental and modeling research groups. There was also a good mix between senior and junior scientists.

The workshop had several focus areas:

1. Expose participants to cell-based quantitative tissue modeling.
2. Encourage discussions between scientists to start new research collaboration.
3. To facilitate that, each participant gave a 15 minute talk on his/her research
4. Collaboratively work on select modeling projects.

Unlike traditional workshops where people spend most of their time listening to talks, this workshop assumed that participants would try to complete a modeling project within 6 days. This was quite ambitious and challenging given that some of the participants were relatively inexperienced modelers and that the number of possible modeling projects that could be of interest to participants could easily be greater than the number of attendees. Despite these initial challenges, the organizers decided to stick to the project-based format. As it turned out most participants were happy with such workshop style and managed to accomplish more work than they initially anticipated. The key to the workshop's success was to ensure that there were enough modeling experts who would help participants with their projects. After each participant gave a talk, the organizers divided attendees into workgroups. Each workgroup consisted of 1-5 people sharing similar modeling interests.

The participants were allowed to change working groups during the workshop or participate in more than one working group. This created great research opportunity for junior participants who wanted to get exposure to multiple research topics. Because the level of participants sophistication varied, the organizers ensured that people who needed additional introduction to modeling concepts had an opportunity to get it. The lack of formal lectures was slightly inconvenient from organizers' stand point because they were forced to repeat similar material several times. However, given the limited duration of the workshop, squeezing formal lectures into a workshop agenda would have been quite challenging.

The organizers closely monitored progress of the working groups (on a daily basis) and made sure that all groups advance their models. Overall the level of participant involvement was excellent. Although the workshop officially ended at 6 pm, many participants worked longer hours trying to complete as much work as possible.

The workshop was highly successful, judging by the feedback from the participants. The organization was flawless with no logistic glitches of any kind. The Lorentz Center staff organized an excellent social program which allowed participants to engage in discussions in a less formal atmosphere. This had tremendous impact on the formal part of the workshop.

Once people got to know each other better they were able to communicate and work more effectively. The hotel and facilities at the Lorentz Center were excellent. Everybody seemed to appreciate the efforts that Lorentz Center put into organizing this event.

We hoped that this workshop would significantly raise the profile of the QuantTissue Consortium and the Lorentz Center in the area of biomedical modeling, computational tissue biology. Given the level of interest from scientists around the world we feel confident that we were able to convey the message that there exists significant involvement of European organizations (QuantTissue, ESF) in quantitative modeling of development and disease of tissues.

We were very pleased with the talk by invited speaker Carl-Philip Heisenberg. It was a very stimulating talk especially because the topics he discussed (force-based approach to tissue dynamics during zebrafish gastrulation) were directly relevant to the workshop main themes. In particular he has presented an approach based on the Cellular Potts Model (a model that CompuCell3D implements) to study impact of tensile forces on germ layer organization during gastrulation. One of the working groups was modeling gastrulation in chick embryos so Carl-Philip's talk was directly relevant to this group.

This workshop was quite experimental and the organizers were somewhat skeptical whether a project-based workshop format would work out. The big concern was that the level of familiarity with cell-based modeling would vary among the different participants and it would lead to some attendees feeling left out. Since we could not accommodate lectures in the workshop schedule we had to ensure that people who needed to be brought up-to-speed in modeling topics had an opportunity to learn the material as quickly as possible.

For this reason we invited modeling experts who served as instructors for workshop participants. Each time a workshop participant would struggle with completion of particular tasks or needed one-on-one coaching, instructors were available to help. At the conclusion of the workshop all working groups had made significant advancement in their projects. It was somewhat surprising to the organizers to see so much progress being done at the workshop given the relatively short duration of the workshop and the fact that several groups started coding the simulations from scratch. The gastrulation working group was able to finish the project completely and they are ready to submit the paper based on their model. This group, however, started working on the project earlier so it would be unreasonable to expect other groups show a similar level of accomplishment during just a few days.

Besides working in groups, participants had ample opportunities to talk to each other and discuss possible new collaborations. Many graduate students were able to talk with senior researchers and get advice, suggestions or feedback on their research. Such informal conversations have often significant impact on student's careers. Having access to experienced researchers other than student's own advisor allows students to get different perspective on their research, get advice for future research and consequently help students make more informed decisions when they transfer to post-doctoral positions.
Finally, during the workshop we had several short brainstorming sessions on how to improve modeling software. Although most of the suggestions applied mainly to CompuCell3D and SBW, many of the ideas solicited from participants applied to other biomedical packages. Several bugs reported during the workshop were fixed by CompuCell3D and SBW developers and new features which seemed to be important also added to the packages.

Overall, by avoiding a rigid workshop structure, we were able to engage all participants in scientific projects and open discussions. All participants were enthusiastic and it was obvious that the level of interest in quantitative tissue modeling is significant. Given that the registration for the workshop was open for only few weeks we were surprised to see that all the slots were filled and we even had to reject several applications. This clearly shows the importance of cell-based modeling of tissues. Consequently, it is critical that adequate training programs exist for young scientist to embrace state-of-the art tools which will impact how future research is done. QuantTissue Consortium has already made significant investments in outreach and training and we hope that this workshop fulfilled part of the QuantTissue mission.

We have asked all participants to acknowledge QuantTissue and European Science Foundation in any publication that will originate from the research done during the workshop. Overall we were very happy with the workshop outcomes and we hope that ESF and QuantTissue share our enthusiasm.

James Glazier (Bloomington, USA)
Roeland Merks (Amsterdam, Netherlands)
Herbert Sauro (Seattle, USA)
Maciej Swat (Bloomington, USA)

The Future of Phylogenetic Networks

15 – 19 October 2012 *@Oort*

Biologists continue working with phylogenetic trees, even if they realize that it is not the adequate model for the genetic phenomena they study; phylogenetic trees are less suited to capturing reticulate evolutionary phenomena such as hybridisation, recombination or lateral gene transfer. Phylogenetic networks are a generalization of phylogenetic trees that can display such complex evolutionary scenarios; the long-term goal of the workshop is to develop practical algorithms for these networks. This will allow the current tree model, which incorporates only vertical descent from parent to offspring, to be expanded to include horizontal (reticulate) evolution.

The first purpose of the workshop was that biologists from various sub-disciplines explain to mathematicians and computer scientists their specific requirements for phylogenetic network models, in order to make them useful for their work. In return, the mathematicians outlined the inherent mathematical limitations of various algorithmic approaches, and highlight potentially fruitful avenues for future development. By interacting in lectures and group discussions, the key features of phylogenetic networks are identified that are important for any successful algorithm, both from the biological and computational aspects.
The ultimate goal of the workshop was that, through close collaborations, mathematical research on phylogenetic networks will lead to more practical methods, ultimately resulting in more widespread use of phylogenetic network software by biologists.

Although the workshop was not aimed directly at new mathematical or biological results, some subgroups of people, especially mathematicians and computer scientists, have made progress on subjects related to the workshop. The best learning moments of the workshop have been for the math/cs people to see the various ways that biologists are interested in using networks i.o. trees, which each require their own specific model. For the biologists it was to see where the mathematical developments are currently: what they may expect and what not, at the moment. They also realized that they will need to make some effort to define their problems more clearly. Given the goals of the workshop, it was an enormous success, in fact a success beyond expectation.

The organization of the workshop appeared to work out exceptionally well. Two aspects triggered the success. Firstly, the biologists had been selected carefully; all of them feeling the need for networks as an alternative to trees, and being interested to explain why they still were not using existing software/algorithms. Next to that, David Morrison, as the biology organizer of the committee, played an excellent role in moderating the discussions whenever necessary. This made the discussion sessions extremely lively and informative until the very last moment of the workshop.

Secondly, all lecturers were given very precise instructions about what was expected from them. Especially the math/cs researchers were asked to give overview lectures with a lot of empathy for the biologists in the audience. This worked out very well, maybe not in the least because we were lucky - or less moderately, some members of the organizing committee appear to have enough reputation worldwide - that almost all prominent international math/cs/bioinformatics researchers in the field came to the workshop, even from remote places like New Zealand. Thus, the knowledge on the actual state of the art on the

algorithmic side of the subject was present, and they were the perfect group of people to expose the overviews.

At the end of the workshop everybody agreed that we should try to actively keep going the momentum that has been created. For sure, we will actively visit, correspond through and contribute to the blog on phylogenetic networks. We will investigate possibilities to write a EU grant proposal to help us to realize our goals: creating software ready for biologists to help them in their studies and on the way solving a lot of beautiful mathematical challenges.

Leo van Iersel (Amsterdam, Netherlands)
Steven Kelk (Maastricht, Netherlands)
David Morrison (Uppsala, Sweden)
Leen Stougie (Amsterdam, Netherlands)

How to Find Our Nearest Neighbours

22 – 26 October 2012 *@Oort*

The past few years have seen very rapid progress in our understanding of planetary systems, spurred by dramatic technological advances in exoplanet detection techniques, and by investments in dedicated ground-based as well space-borne instrument and facilities. In particular, tremendous strides have been made towards finding planets with ever-lower masses and radii, and towards determining their physical properties. A compelling goal driving many of these developments is the search for habitable worlds, and ultimately for life elsewhere in the Universe. While early proposals for missions aimed at the detection of Earth analogs (DARWIN, TPF-I, TPF-C, SIM) have fallen prey to fiscal pressures, the development of technologies that will enable the discovery and characterization of Earth twins in the Solar neighborhood remains an important goal of the major space agencies.

The aim of the meeting was to bring together experts in all fields of exoplanet detection along with presentations of the latest scientific results and the most recent technological advances relevant to this research. The first part of the week brought younger researchers in for an overview of the exoplanet field, and the second part of the week saw the workshop split into focus groups to examine the different pathways for detection and characterization over the next twenty years. These groups then would write up their findings and the result be consolidated into a "white paper" that will summarize the outcome of the workshop and act as a reference for space and ground-based projects in the decades to come.

Progress from the ground has covered a significant amount of parameter space, and in the context of finding and characterizing exo-Earths in nearby star systems, it became clear that ground based telescopes are becoming more important with respect to more expensive and slower to develop space-based missions.

Notable insights included:

- Radial velocity sensitivities are reaching down to exo-Earth masses for specific targets. The announcement of the exoplanet Alpha Centauri Bb occurred during the week of the workshop!
- Transit spectroscopy from space with Kepler tells us that the rocky planet fraction (eta Earth) is close to unity, meaning that looking around the nearest stars we will likely expect to detect super-Earths around them.
- The higher angular resolution provided by Extremely Large Telescopes on the ground are very competitive and may well trump smaller aperture space-based telescope missions for characterizing exo-Earths.

The Lorentz Center Workshop format was extremely successful in bringing out a dialogue between otherwise disparate groups of exoplanet researchers. The research field is growing rapidly and it is difficult for researchers to keep up to date on the latest findings. Having two days of presentations helped everyone come up to speed on the latest research and findings. Secondly, we invited graduate students and young researchers so that they may gain an insight into how the field is evolving and what technologies are involved and needed.
The small size of the workshop proved an ideal setting for interaction between eminent names in the field both from Europe and from America. At times the large coffee bell was needed to drag people out of their lively conversations and back to the lectures or focus groups!

Having the students form part of the focus groups also encouraged them to interact with the senior scientists and to establish collaborative links for the future. Both the boat trip dinner and the visit to the Boerhaave Museum in Leiden were highly appreciated by all the attendees. The workshop was viewed as a tremendous success for all the participants involved.

Matthew Kenworthy (Leiden, Netherlands)
Malcolm Fridlund (Noordwijk, Netherlands)
Andreas Quirrenbach (Heidelberg, Germany)

Model Integration for Sustainable Bioenergy Supply

22 – 25 October 2012 *@Snellius*

Bioenergy is considered an important option in making future global energy supply more sustainable. However, many questions are being raised with respect to the sustainability of bioenergy and the bio-based economy. For example, what is the net contribution bio-based options can make to mitigate greenhouse gas emissions, accounting for impacts of land use change and agricultural intensification? How can large-scale biomass production and supply be organized over time so that unsustainable price impacts on food markets or undesired land use change can be avoided? Comprehensive answers to these and other questions are not yet available, while the current methodologies and modeling frameworks have insufficient capabilities to answer them. Thus, an improved modeling toolbox is needed that 1) closely integrates economic models, energy models, and biophysical land use models and 2) is fed by detailed technical information. A much improved and more integrated modeling framework is vital for showing how a bio-based economy can be done right and for defining necessary preconditions. Such assessments can then deliver more concrete input for developing proper policy strategies.

In this workshop we brought together leading researchers from the different modeling approaches (i.e. economic modeling, biophysical modeling, land use modeling, energy modeling and bottom-up analysis) in order to discuss the current status and limitations, and future possibilities of model integration for better assessing biomass supplies and impacts. The workshop created many opportunities for researchers from the different disciplines to interact and discuss. At the end of the workshop, we had learned a lot from the different modeling approaches. We were also able to define the key uncertainties and suggest specific ways forward in model integration. We are now in the process of writing an article for an international, peer-reviewed journal in order to disseminate our findings to the broader scientific community.

The workshop was organized in different sessions: On the first day, plenary sessions took place in which the different modeling teams presented the current status of their models. In the following days, breakout groups were organized in which the two main topics were discussed: 1) gaps in existing approaches (interdisciplinary groups), and 2) ways forward in improving modeling activities (one session with disciplinary groups and one session with interdisciplinary groups). After each round of breakout groups we had plenary meetings in which the results from the breakout groups were reported and discussed with all workshop participants. A final session (including both plenary and breakout group discussions) was dedicated to setting up the structure, and writing the first sections, of a journal article to be submitted early 2013. Extended coffee and lunch breaks were useful for additional discussions and for giving participants time to get to know each other.

The Lorentz Center@Snellius venue provided us with a stimulating environment, especially the different work areas, the many white- and blackboards (which were in constant use), and the comfortable common room all facilitated fruitful discussions between individual participants, in breakout groups and in the plenary group. The location and setup strongly contributed to the success of the workshop.
We enjoyed four intense days of productive and valuable discussions. We are grateful to have had the opportunity to use the inspiring facilities for our discussions and for working out our ideas for model integration. We would like to suggest to the organizers to be less

strict on the time requirements for workshops - many of our workshop's participants were not able to attend four days, while on the last day the remaining participants were also tired from the intense discussions of the first three days.

We would like to thank the Lorentz Center for the opportunity for hosting and co-funding our workshop. We are especially grateful to Gerda Fillipo for her support in preparing and hosting the workshop.

Martin Banse (Braunschweig, Germany)
Andre Faaij (Utrecht, Netherlands)
Hans van Meijl (Den Haag, Netherlands)
Edward Smeets (Den Haag, Netherlands)
Detlef van Vuuren (Bilthoven, Netherlands)
Birka Wicke (Utrecht, Netherlands)

Foundations of Biomedical Knowledge Representation

29 October – 2 November 2012 *@Oort*

Basic biomedical knowledge arises from research at different levels: from the molecular level, via the cellular level, at one end of the spectrum, to the patient level at the other end. However, even though there are huge differences in the techniques and methods used by biomedical researchers, there is now an increasing tendency to share research results in terms of formal knowledge representation methods, such as ontologies, statistical models, network models, and mathematical models. In this workshop, we aimed to increase understanding of representation and reasoning among the different research fields and to find possible bridges and opportunities for further research.

The goal of this workshop was to work on a book on biomedical knowledge representation, which will be published by Springer next year. To integrate the different topics that were central to this workshop, we worked significantly on creating a 'map of the field': an overview of the field from different perspectives. We developed an overview of knowledge representations, an overview of tasks where knowledge representation plays a role, and an overview of application areas. This will be published as an introductory chapter of the book, which can be highly useful to other researchers that want to work in this area. Further, we made considerable progress in classifying recent research in major conferences in artificial intelligence in medicine, which gives insight into the current trends in this field. We also intend to publish this work once it has been finalized.

At the start of each day we had a one hour plenary session consisting of a presentation and discussion. After this, we had parallel discussion groups of about 2 hours with more or less random subsets of the group. Initially, members of the discussion group could give short presentations and the chair lead a discussion related to the presented work. In the last few days, the discussion groups worked on parts of the book. At the end of each day, there was another plenary session where the results of the discussion group were presented and further discussed. For the most part, and especially for the last 2 days, there was an intentional lack of organization, in order to promote interaction and creativity. We believe this format worked well to promote collaboration between people having different backgrounds.

The support and available facilities provided by the Lorentz Center are essential to organize a workshop like this one. We think that this made the workshop highly successful and has led to a solid foundation to further move this field forward.

Arjen Hommersom (Nijmegen, Netherlands)
Peter Lucas (Nijmegen, Netherlands)

Summer School on Spin-Hyperpolarization

29 October – 2 November 2012 *@Snellius*

The summer school brought PhD students and young postdocs together with scientist with specific expertise in the different subfields of spin-hyperpolarization in magnetic resonance. Together we aimed to explore these hitherto largely separate areas and the overlap between them. The aim was to enable a new generation of young researchers in the spin-hyperpolarization to learn the specific problems and solutions in the various different approaches to create hyperpolarized nuclear spin systems. Such transfer of knowledge, as it turned out, is possible in various aspects such as relaxation control and analysis, polarization transfer, theoretical modeling and hardware development.

About 20 scientists and 5 teachers attended. There were 13 teaching lessons, student presentations on existing literature on various aspects of hyperpolarization, two poster sessions with the students presenting their own research, guided discussions and time for private communication. Also the common social events allowed for personal and scientific exchange.

In the application, we stated that the workshop will be a success when

1. the basics of the field are transferred to a new generation of scientists,
2. the current discussions in the field are presented allowing the new generation of early state
3. researchers to identify their own area of active research,
4. contacts among young researchers as well as between young and experienced researchers are established,
5. the COST education program gets running and establishes a basic set of literature.

We can safely state that all four aims have been reached fully or at least to a high degree. The educational program of the COST Network on spin-hyperpolarization (EuroHyperPol) obtained a jump-start, the teachers were well prepared and kept a high scientific and educational level, all students were always present and highly motivated, a number of new contacts were established and, last but not least, there was a friendly and open atmosphere during the entire week. The community is looking forward to the next summer school in this area of research.

Nuclear Magnetic Resonance (NMR) spectroscopy and imaging techniques (MRI) are well known and versatile analytical methods. The key issue is frequently sensitivity limiting the applicability. To overcome this problem, various hyperpolarization methods have been developed. Within a new 4-year COST action we brought for the first time together PhD students and young postdocs working on those different approaches to stimulate exchange between research communities and to grow a new generation of scientist able to oversee the entire field.

Existence of a waiting list of almost 10 people who intended to come but could not do so because of the limited capacity of the Lorentz Center confirms that organizing a new type of summer school on this subject was a right decision. The summer school provided sufficient overview of what is done in the field, what strategies and methods are advantageous, what the current scientific problems are and the strategies for their solution. The oral contributions by teachers and students triggered lively discussions, in both the seminar room as well as in

other areas of the Snellius venue. The summer school was the first one within the COST network and the Lorentz Center@Snellius environment provided a wonderful infrastructure. We expect that the new generation in hyperpolarization will be able to use knowledge from all different fields.

It was clearly a teaching event but we feel that the interconnection of the different fields in hyperpolarization has the potential to lead to scientific breakthroughs. It is necessary to educate a new generation of scientists who can move beyond the borders of their own subfield to come up with a generic solution to nuclear hyperlozarization which would revolutionalize the field of magnetic resonance. Thanks to excellent teachers and highly motivated students, many presentations lead to new insights. Sometimes it were the participants who obtained new knowledge, other times new intellectual connections were made.

The advice of the Lorentz Center on the format of the school was very helpful. In particular we were suggested to give more room for free discussions and for involvement of younger scientists. Both worked out very well. The workshop offered an optimal combination of teaching lessons, poster presentations, discussion rounds and presentations of young scientists. There was also enough time for informal discussions that were very helpful for establishing new contacts and efficient exchange of ideas.

We are very grateful to the staff of the Lorentz Center for their expert handing of all administrative matters. The workshop was a joy to organize with such friendly and professional assistance. The meeting would not have been possible without the Center's generous financial support for which we are most grateful. We are sure that all the participants enjoyed the infrastructure of the Lorentz Center@Snellius that is optimal for such small meetings. It was particularly convenient that each participant had an office space and internet password. The cultural program was also perfectly organized. The only small point of criticism was that participants had difficulties to find the Snellius venue at the first day.

Arno Kentgens (Nijmegen, Netherlands)
Jörg Matysik (Leiden, Netherlands)

Post-Quantum Cryptography and Quantum Algorithms

5 – 9 November 2012 *@Oort*

The aim of the workshop was to look into alternative cryptosystems which also withstand attacks using quantum computers - computers which exploit quantum parallelism to solve some problems much more efficiently than is known to be possible on conventional computers, and thus shake up the landscape for computationally secure cryptography. The workshop brought researchers from two different fields together: on one side cryptographers whose focus lies on cryptosystems running on conventional computers which are not broken by quantum algorithms and on the other side researchers in quantum computing who are investigating how to design cryptanalytic algorithms which can be run on quantum computers.

During the first three days there were five tutorial talks - two on quantum computing and three on post-quantum systems (one each for those based on codes, lattices, and multivariate equations). These ensured a solid basis for discussions across the boundaries of the two groups. Spread over the whole week there were seven invited talks on latest results in the different areas. These talks were scheduled after the tutorials which served as introductions to their fields. Moreover, eight participants contributed short talks during the afternoon sessions. The focus of the workshop lay on the working groups. Three groups worked on how to use quantum algorithms for cryptanalysis of cryptosystems based on codes, lattices, and multivariate-quadratic equations. The working groups exceeded our expectations with discussions lasting till after building closure and there was more demand for working group sessions than for presentation sessions. Many more discussions took place during coffee breaks, lunches, and the social event. There is a wiki page which documents the whole week. Participants could edit it themselves and propose talks or document the discussions in the working groups.

It was very fruitful to bring both communities together, so researchers could learn about problems and challenges in quantum computing and post-quantum cryptography. During the breakout groups the algorithms currently under consideration in post-quantum cryptography were scrutinized under possible quantum cryptanalysis. For each of the three main lines of post-quantum cryptography research (code-based crypto, lattice-based crypto, multivariate-systems-based crypto) at least one working group was formed. The cross-pollination between the two communities worked out very well in that experts on the cryptosystems explained the currently best attack methods on conventional computers, the experts on quantum computing gave details on how the algorithms could be modified to run on a quantum computer, and then all members of the working group worked together to analyze and optimize the algorithms in the new setting. Grover's algorithm makes searching faster and this meant that some classical algorithms that gained their speed in load-balancing several smaller lists didn't gain as much as algorithms operating with one big list. As a result, the ranking within the different classical algorithms got changed in their quantum variants. Some groups took this a step further by working out new quantum algorithms beating the adaptations of classical algorithms. These results should not be seen as defeating post-quantum cryptography, rather on the contrary: the improvements to the attacks are of a type that can be dealt with by slightly increasing the parameters in the cryptosystems and the new analysis supports the claims of cryptographers working on codes, lattices, and multivariates that there are alternative systems for the era with quantum computers.

The organizers would like to thank the Lorentz Center for the opportunity to host the workshop in Leiden. In particular, we thank for the financial support and the personal guidance before and during the workshop by Ikram Cakir, Henriette Jensenius, and Mieke Schutte. We would also like to express our appreciation to our other generous sponsors, the European Network of Excellence in Cryptology ECRYPT-II (ICT-2007-216676) and the Institute for Quantum Computing at the University of Waterloo.

Tanja Lange (Eindhoven, Netherlands)
Michele Mosca (Waterloo, Canada)
Christiane Peters (Copenhagen, Denmark)

Multiscale Systems Biology of Cancer

12 – 16 November 2012 *@Oort*

Although cancer is typically seen as a disease of the genes, in fact many phenomena, including tumor plasticity, metastasis, and relapses after therapies, can only be understood if we look beyond the molecules, e.g. at individual cell behavior, cell-cell competition, cell-stroma interactions, and metabolism. Collaborations between experimental and computational biologists are key to unraveling these multilevel interplays. To this end, experimental and computational researchers working at different ends of the multiscale spectrum discussed with one another at this Lorentz workshop. Scales range from the molecular level, the cellular and tissue level, to physiology and public health genomics. The workshop centered around plenary discussions on how to couple different spatial and time scales from experimental, computational, and philosophical viewpoints. The workshop encouraged participants to think "out of their scale" such that they will apply this in their research.

Throughout the meeting, extensive notes were taken of the discussions, as input for a white paper that will become a tangible outcome of the workshop. Also, new collaborations on multiscale modeling were set up; a particularly interesting new direction here are projects to model the feedback between tissue structure and efficiency of metabolism in tumors and in the liver.

A particularly interesting discussion emerged between two apparent "philosophical approaches" to multiscale modeling in biology. Roughly, one approach views the scales in a multicellular organism (genes, molecules, cells, tissues) as an inseparable continuum, that are all equally important for fully explaining any biological phenomenon. In this view, the ideal model would describe the whole organisms in terms of all its molecules, but the model would become too large to compute in reasonable time. Thus in this view, multiscale modeling is primarily a technological challenge to make whole-organism simulations feasible and tractable. An alternative vision is also known as the "middle-out" approach (Noble, The Music of Life; attributed to Brenner). Here a "central scale" is chosen depending on the type of question asked: e.g., the molecular network to ask questions about genetic regulation, the tissue scale to ask questions about biomechanics or physiology. Then, depending on what is needed to explain the phenomenon, relevant detail from the smaller and larger scales will be taken into account in the description, e.g., cellular structure or ion channels in a heart model, or feedback from adjacent cells in a model of a genetic regulatory network. Here, the scales are often chosen based on biological structure, and make use of the inherent, modular, nested structure of biological organisms. Thus, here a multiscale model is seen as a natural representation of an inherently multiscale phenomenon. It was rewarding to see how during the workshop representatives of the two views started to understand and appreciate each other's stances more, and how nevertheless the different views lead to the same modeling choices. Another interesting development in the workshop was to see how experimental biologists use new computational modeling insights to design new experiments and to develop new experimental concepts.

In this workshop there were very few formal talks planned. Instead, most of the time was devoted to plenary discussions, and opportunities for last-minute talks. This format worked very well for us and gave a very dynamic workshop atmosphere. We were with a relatively small group, and after the first day we moved to the Gratama room. The less formal set-up

in that smaller room encouraged all participants, including many students, to participate actively in the discussions.

Roeland Merks (Amsterdam, Netherlands)
Matthias Reuss (Stuttgart, Germany)
Hans Westerhoff (Manchester, UK)

Physics with Industry

19 – 23 November 2012 *@Oort*

The third workshop Physics with Industry was organized in 2012 by the Foundation FOM and Technology Foundation STW at the Lorentz Center in Leiden, the Netherlands. Fifty-nine scientists participated in the workshop, ranging from PhD students to professors. These physicists (and researchers from related disciplines) spent a week working in groups on five industrial problems, which were selected by a program committee from proposals put forward by industry. Following an introduction to the various problems by the companies on Monday, the participants worked on the problems in groups for the rest of the week. Some groups performed real experiments at the laboratories of Leiden University. On the last day, the groups presented their findings to the companies.

Besides the scientific outcomes, the workshop also resulted in new public private contacts that may lead to future collaborations and even one patent was filed. Participants were mostly driven by the sheer pleasure of applying their physics knowledge to new problems, the desire to enrich their scientific network and the interest in gaining hands-on experience with industrial R&D processes. Companies benefited from the scientific input they received and participating in the workshop enlarged their academic network.

The five industrial problems discussed during the week were collected via an open call for proposals in spring 2012. A program committee selected the five 'best problems' for the workshop. The selection criteria used by the committee were:

- it must be possible to solve the problem (or a major solution must be within reach) within one week and physics can make a clear contribution to the solution;
- it should be an urgent problem;
- the company should be willing to share detailed information.

The committee selected problems from the companies Janssen Precision Engineering, MicroDish, NXP, PamGene en Shell - two large companies and three SME's. The proceedings are available via the FOM website. Below is a summary of the five cases.

Janssen Precision Engineering; Cryogenic compatible displacement sensor
The state of the art experiments in low temperature physics require sophisticated instrumentation capable of displacement sensing with high precision and cryogenic environment compatibility. The present report discusses two such designs - μPOT design and OptoGroove design. The former is an all electrical method of position detection which is essentially a miniaturization of the classical potentiometer concept. The design involves measuring the voltage of a sliding probe on a conducting wire, which varies linearly with the position of the probe. The OptoGroove design, on the other hand, is essentially a digital optical encoder. An optical fiber is directed at a side surface of the actuating screw. The side surface has been laser engraved with a series of equally spaced parallel grooves. Time domain reflectometry allows counting the number of grooves during the motion of the actuating screw, which in turn translates to the linear displacement. Both of the above techniques seem to be robust over a large temperature variation.

MicroDish; Can physics tell the difference between a dead and living microorganism?
In this work different techniques are explored to assess the viability of (bacterial) cells on the MicroDish culture chip. The culture chip is composed of thousands of miniature wells on a

porous aluminium oxide layer. The viability of microorganisms is tested by looking at cell growth in the wells using electrical and optical techniques. For the electrical side, a simple setup was investigated where the filling of a well can be detected by attaching electrodes to the top of the well and measuring a change in resistance. Also, more sophisticated electrical techniques, such as finer nano-grids and impedance measurements of cells in suspension were explored. For the optical side, an overview was made of various microscopy techniques. A simple white light interferometer can in principle measure the change of the depth of wells on the MicroDish culture chip, thereby measuring growth of biomass. An experiment was conducted with a Mirau interferometer which showed that it is a potentially feasible method for the fast, cheap, and automated detection of bacterial cell growth. More sophisticated optical techniques may still be a possibility to detect the viability of cells.

NXP Semiconductors; Electrical sensing and actuating of LED wavelength

The light output of light emitting diodes (LEDs) in terms of flux and wavelength varies because of the fabrication process, which is undesirable for most applications. Currently, the LEDs are binned into different wavelength categories prior to being sold. Firstly, this is an expensive and logistically complicated procedure. Secondly, the peak wavelength of the LEDs is influenced by temperature, operating conditions, and aging making binning alone insufficient. It would be useful to have an automated CMOS-integrated process which identifies the optical properties in terms of flux and wavelength of the LEDs. In that case the LED driver can adjust the driving conditions to shift wavelengths to desired values, or even give active feedback on the LED to maintain the desired performance.
Here we discuss how to implement such a wavelength and flux sensing device on the electronic driver chip of the LED without any prior knowledge about its exact optical properties. In particular, we present two possible routes that might be promising for implementation. In the first method the signal is detected optically, which can be precise enough but it requires part of the LED light to fall onto the sensor. In the second method, all the sensing is performed electrically, which is appealing because it always works regardless of the sensor's environment, i.e. its relative position with respect to the LED. In addition to providing two working solutions, we quantitatively show that the small package available for a device in a CMOS chip precludes many optical filtering solutions.

PamGene; PamFreezer: a solution to enable frozen biopsy logistics

Tissue samples that are taken during a biopsy need to be snap-frozen in order to preserve their properties and use the tissue for contemporary molecular biology technologies that may improve the treatment of the patient. There is currently a lack of (safe) methodologies or devices for snap-freezing tissue. Furthermore, there is a lack of knowledge on the optimal cooling rate, which depends on the type of tissue and is important to know in order to avoid damage to the cells.
This report comments on the biological background of the acceptable cooling rates and also describes a design for a new biopsy snap-freezing device. The suggested device fulfils the requirements for use inside a hospital environment. The device consists of a cooling unit and a base station. The copper cooling unit can be pre-cooled on the base station until used. After biopsy, the tissue sample inside a cryovial can be deposited into the cooling unit and is then cooled down at rates between 1-10 K/sec, which is within the biologically safe range for several tissue types. The cooling unit may then be transported for several hours while keeping the tissue sample below 193 K.

Shell; The physics of water and wax in the pores of a working Gas-to-Liquids catalyst

The so-called Fischer-Tropsch catalysis allows to convert natural gas into liquid products and

is the underlying mechanism of commercially used "Gas-to-Liquids" plants. The actual reaction takes place in millimetre sized porous pellets in which active metallic particles are dispersed as catalysts. Due to the reaction the pores of the pellets will become filled with the reaction products ("wax" and water), but it is uncertain if the fluid in the pores can be understood as a single liquid phase, a liquid-gas mixture, or multiple continuous phases. The answer to this question is important for a thorough understanding of the transport processes inside the reactor and can be utilized to improve its efficiency. In this project, a theoretical analysis of the behaviour inside the pores is performed. It is concluded that a liquid water phase might well exist next to the wax phase. However, the analysis is based on very limited experimental data of unknown quality. Therefore, we propose a number of possible experiments to validate the theoretical concepts.

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Floor Paauw (Utrecht, Netherlands)
Wim van Saarloos (Utrecht, Netherlands)

Dynamical Phenomena at Surfaces: the Role of Complexity

26 – 30 November 2012 *@Oort*

Dynamical phenomena at surfaces determine the interaction of solid bodies with their surroundings. Elementary dynamical processes occurring at surfaces and interfaces form the basis of heterogeneous catalysis, and are important to, for example, energy applications, and astrochemistry. Such processes occur in a highly complex environment, and the two central questions addressed at the workshop were: (i) how can we solve the problems associated with the complexity of the surface, and (ii) how can we take advantage of the complexity a surface inherently has, or can take on?

The workshop reported breakthroughs in electronic structure theory, in experimental tools for following dynamics in real time and in the understanding of chirality and friction. As reported by Kresse, calculations on solid-state cohesive energies can now be done with an exact method called full configuration interaction quantum Monte Carlo (FCI-QMC, see also doi:10.1038/nature11770). As discussed in one of the formal discussion meetings, FCI-QMC cannot yet be applied to molecule-surface interactions. However, as discussed by Kresse at the meeting, it is foreseen that diffusion Quantum Monte Carlo method (DFMC) will find increased application to such problems, and that the DFMC method will enable description of these systems with almost chemical accuracy (1 kcal/mol) for reaction barrier heights. Another promising development concerns correlated wave function (CW) theory with embedding in DFT to molecule-surface interactions. Libisch showed that the application of this method to the O2 + Al(111) dissociative chemisorption problem reveals that the barrier to reaction originates from an abrupt charge transfer from the Al to oxygen, and that the most important experimental observations for this system could all be reconciled with the theory using the new method. A problem that still needs to be solved for the CW-embedded DFT method is the convergence of the results with the size of the subsystem treated with CW theory, with current computational resources not yet allowing computations that are converged to within a kcal/mol.

From the experimental point of view, Mansart and Wolf illustrated how atomic movement and electronic structure changes following optical excitation can be followed with time-resolved techniques on the sub-picosecond scale. They pointed out how for atomic and charge dynamics the real observation now matches the timescale previously only accessible in silicio.

In the contributions concerning chirality in two dimensions, De Feyter discussed the interplay between thermodynamics versus kinetics as determining factors for the establishment of a certain structure and pointed out the role of the solvent in self-assembly processes at the liquid/solid interface. In the discussion session lead by Kudernac and De Feyter the need for more theory / modeling was emphasized to better understand the interactions between molecules and surfaces in the presence of a solvent if a realistic picture of local and global effects has to be established. Ernst and Grill illustrated fascinating examples of molecular machines and demonstrated how molecular motion can be controlled at the nanoscale and Kudernac showed how movement at the molecular scale translates into macroscopic property changes at the surface.

Regarding the phenomenon of friction which is not only appealing as a fundamental problem to understand but also crucially important for many applications, de Wijn detailed a new theoretical approach and Frenken highlighted breakthrough developments in experiments.

We had very positive experiences with the format of the workshop, which was such that a formal, general discussion centered on 2-3 of the session themes was held every day. All participants actively participated in the discussions, which were led by scientists who are "top" in the field that was under discussion and which served to summarize the main challenges in these fields. We encourage other organizers to organize formal discussions along similar lines.

Carina Arasa (Leiden, Netherlands)
Geert-Jan Kroes (Leiden, Netherlands)
Petra Rudolf (Groningen, Netherlands)
Meike Stöhr (Groningen, Netherlands)

Is the Stellar Initial Mass Function Universal?

26 – 30 November 2012 *@Snellius*

Stars are believed to form out of gas and dust clouds by gravitational instability. The probability distribution function of the initial mass of the stars is known in astrophysics as the initial mass function, or IMF. In the decades since 1955, when Edwin Salpeter first determined the IMF in the neighborhood of the Sun, only relatively small variations of the IMF have been found within our own Milky Way, despite enormous variations in the physical conditions within star-forming regions - and so the IMF has been assumed to be universal. However, in the past few years a number of independent extragalactic studies have found significant deviations from the IMF as measured in the Milky Way. The observations are based on a variety of independent techniques, ranging from gravitational lensing, to stellar kinematics of elliptical galaxies, to gas kinematics of spiral galaxies, and to spectral diagnostics of stellar populations. Based on these observations, the IMF may in fact depend on the mass of the galaxy and hence on the cosmological time at which the stars formed, possibly reflecting the evolving physical conditions in the expanding universe. The non-universal IMF is a remarkable discovery that, if confirmed, would have profound implications for many areas of astrophysics. In addition to its relevance for star formation theory, a systematic variation of the IMF with galaxy stellar mass, age, or metallicity would have profound implications for understanding the structure and evolution of galaxies and for the reconstruction of the cosmic star formation history.

The workshop brought together star formation theorists, galaxy evolution theorists, Galactic star formation observers, stellar spectroscopists, and some of the extragalactic observers who have published results on deviations from a universal IMF. We critically analyzed both galactic and extragalactic observations of the IMF, with a particular focus on assumptions and possible systematic errors; compared current theories of star formation with these observations to understand the physical origin of any predicted IMF non-universality; and explored the implications of a non-universal IMF for galactic structure and evolution, and for current theories of star formation.

Each day, a set of questions to be addressed during the presentations and discussion of that day was presented. The talks were followed by long discussion periods, at least as long as each talk, and a few hours of working time during the days were available to focus on addressing the questions posed and the additional questions raised. A wiki containing the talks, the questions and their answers was created and is now publicly available at http://imf12.wikispaces.com/. This wiki was invaluable for further discussions even after the workshop.

The most important developments of the workshop were the realization that cross-disciplinary studies were required to address the major questions, which in itself required a long vocabulary lesson for across these boundaries, and then the understanding that while current star formation theories can account for non-universal IMFs, the galaxy formation models are not yet able to incorporate the star formation models at the level required to understand their impact on galaxy evolution. This is a key task for the coming years, and opens the possibility of future workshops to pursue this goal.

The wonderful Lorentz Center@Snellius facility was an ideal location for this workshop: compact, bright, excellently equipped, and perfectly sized for this sort of highly-interactive

workshop. We highly recommend this facility for any organizers who desire a small and highly-focused, interactive workshop that promises significant progress on a single set of themes.

Leon Koopmans (Groningen, Netherlands)
Scott Trager (Groningen, Netherlands)
Tommaso Treu (Santa Barbara, USA)

Elementary Reactive Processes at Surfaces

3 – 7 December 2012 *@Oort*

Surface science attempts to explain the catalytic action that surfaces may show when exposed to gases. For several decades, well-defined macroscopic single crystals and ultra-high vacuum conditions were key components in this field of research. In recent developments, pressure is increased to atmospheric levels and single crystal nanoparticles are replacing macroscopic flat single crystals. In addition, the electrochemical community has started employing both macroscopic single crystals and nanoparticles in their quest to understand chemical reactions occurring at the interface of (mostly) bulk water and metal electrodes. These fields overlap in their use of well-defined surfaces and the search for elementary reactive processes occurring at surfaces of real catalysts. The workshop aimed to evaluate what these fields can learn from each other, and attempted to stimulate the surfacing of new ideas to overcome current impediments, such as the limited repertoire of proven experimental and theoretical methods for electrochemical research.

The program consisted of a wide variety of invited talks, long discussion sessions, and an excursion. Topics were clustered per day and included the structure of well-defined surfaces under varying conditions, real versus model catalysts, and the relevance of defects, and state-of-the-art theoretical research in electrochemistry, gas-liquid interactions and reaction dynamics. The excursion to Shell on Wednesday informed participants on Shell's research activities in the recently built STCA and showed them around in various laboratories. Considering that long discussion sessions were fully used to elaborate on the topics of the day, the program appeared very appropriately chosen. The closing lecture successfully aimed to show how surface science and electrochemistry may benefit from combining research in the fields in a single laboratory and research group.

Apart from the financial contributions from the Lorentz Center and the help from its staff, we benefited from financial or in-kind contributions by Surface Preparation Laboratory, Shell, and Avantium, the CASC research group from Leiden University and Ulm University.

Axel Groß (Ulm, Germany)
Ludo Juurlink (Leiden, Netherlands)
Marc Koper (Leiden, Netherlands)

Assembly and Star Formation of Early-Type Galaxies in 3D

3 – 7 December 2012 *@Snellius*

The goal of this workshop was to bring together a diverse group of observers and simulators to interact on outstanding questions of star formation and mass assembly in early-type galaxies. The workshop was effectively a team meeting of the Atlas3D Project, enabling the team members and a number of people associated with the project to meet and interact. The Atlas3D team is an international group of researchers at various levels of seniority, from PhD students, postdocs, junior group leaders and senior scientists. The project began collecting data 5 years ago, and has since published more than 20 papers.

This was a 5-day workshop, with a similar format for each day, being a series of flexibly scheduled presentations about ongoing work in the morning, and topical discussion of ideas for new lines of investigation in the afternoon. The first two days were used to discuss observational and theoretical progress on the star formation process in early-type galaxies. There is ongoing debate as to whether the apparently regular 'law' of star formation found in spiral galaxies still holds in the more evolved, early-type galaxies. This question is complicated by the large variety of star formation tracers available, and the varying systematic uncertainties involved. These were discussed at length, resulting in plans for progress and publications. The third day was used to hear about the latest results from simulations of galaxy formation using cosmological models re-simulated at high resolution. This was followed by open round-table discussion on galaxy formation scenarios, in an effort to bring the various pieces of information coming from different observables and model predictions into a coherent picture. The last two days were focused on a new large observing initiative using the Canada-France-Hawaii Telescope. This is a multi-year project, combining the data and efforts of two large teams. The discussion was the first on how to structure the new collaboration and conduct the project. Scientific goals were reviewed by the group and the collaborative strategy was established. The workshop met its broad scientific goals, which were to assess and describe the past and present star formation properties of the Atlas3D sample, and to make detailed comparisons of data with simulations in order to understand the galaxy formation paths. Significant progress was made in coordinating the team's efforts to make further progress in the coming months.

This was our first experience in using the Lorentz Center@Snellius venue. Our group was of limited size, and we appreciated the intimacy of the facility. The transparent office spaces mean that people are never really 'absent' from the meeting, and the centralized meeting area gives a lot of opportunities for spontaneous interactions. Support, both financial and administrative, was also generous and effective. As a suggestion, it would be useful to have the possibility of hosting a 'half week' e.g. 3-day meeting for small groups. Such 'mini-workshops' could attract a different, less formal type of meeting, for which the Snellius venue is well suited. In summary, the meeting was an enjoyable success. The Lorentz Center is unique and inspiring, and a great asset to the scientific community.

Davor Krajnovic (Garching, Germany)
Richard McDermid (Hilo, USA)
Tom Oosterloo (Dwingeloo, Netherlands)
Paolo Serra (Dwingeloo, Netherlands)

Genome Mechanics at the Nuclear Scale

10 – 14 December 2012 *@Oort*

This workshop was devoted to chromatin at large scales. Despite its importance and despite of tremendous efforts during several decades this field is still in a state of infancy, largely due to the absence of adequate experimental methods. However, experimental progress in very recent years led to a surge in modeling efforts especially in 2012 (already now called the year of chromosome models) so that the workshop was extremely timely. During the planning of the workshop the organizers had tried to forecast in which groups the main progress would occur and indeed most talks presented brand new, unpublished and highly relevant results.

The workshop had 37 participants from 8 different countries (Netherlands, France, United States, United Kingdom, Germany, Switzerland, Japan, and Italy) with a wide range of backgrounds (physics, chemistry, biology and mathematics). Remarkably, despite of (or because of) this wide range, the discussions in the workshop were extremely lively among all participants. In fact, none of the organizers has ever experienced a workshop that lively before. This can be attributed to the following points: (1) The subject of the workshop was extremely hot with many new ideas emerging; (2) Each talk had a full hour slot allowing to go in depth into the subject; (3) There was plenty of space between most talks allowing to go overtime during discussions if necessary - this turned out to be always necessary; (4) A new idea was that no abstracts or titles of the speakers were given. The organizers knew roughly what to expect from each speaker but many participants did not. As a result the attendance was close to 100% throughout.

Major breakthroughs as a result of the exchange of new ideas between the participants during this workshop are expected. The organizers themselves found several promising ideas for new projects during the workshop, again more than in any other workshop before. We expect new approaches to questions like: Do chromatin fibers exist inside living cells? How important is the second genetic code? Can the large scale structure of chromosomes been understood by equilibrium polymer physics?

The Lorentz Center has been an ideal setting for this workshop. The meeting was made possible by the generous financial support of the Center. Everything organizational has been taken care of by the excellent Lorentz Center staff so that even the scientific organizers themselves could feel like normal participants, unburdened by any organizational details. This is one of only very few places worldwide that can provide that kind of service. We thank the very friendly and highly professional staff of the Lorentz Center that for a week made the participants and organizers feel at home in the 3rd floor of the Oort building!

R. Everaers (Lyon, France)
J. Maddocks (Lausanne, Switzerland)
H. Schiessel (Leiden, Netherlands)

Representing Streams

10 – 14 December 2012 *@Snellius*

Infinite strings of symbols, or streams, appear in many different scientific disciplines. The aim of the workshop was to bring researchers from mathematics and computer science together to discuss their research problems. We kept this workshop at a small scale, as a step up to a larger scale workshop to be organized in the future. Therefore we kept the structure of the workshop very informal. Most talks were short and were built around two series of lectures: one on automatic sequences and one on combinatorics of words.

We filled two afternoons with writing on the wall sessions. Participants stood up, went to the blackboard, and put up their problem. We collected a few of these problems and assembled a list that can be found on the website. In fact, many more problems were written down but were lost to posterity because they were erased quickly during the heated discussions that ensued - which only proves that participants interacted.

The preparations for a follow up in the Lorentz Center@Oort in 2014 are under way and all participants have expressed their desire to participate once more in this larger scale workshop.

Wieb Bosma (Nijmegen, Netherlands)
Robbert Fokkink (Delft, Netherlands)
Jan Willem Klop (Amsterdam, Netherlands)
Cor Kraaikamp (Delft, Netherlands)
Jan Rutten (Nijmegen, Netherlands)
Robert Tijdeman (Leiden, Netherlands)

Innovation at the Verge: Computational Models of Physical/Virtual Space Interaction

17 – 21 December 2012 *@Oort*

The aim of the workshop was to look forward to the fusion of physical and online spaces by focusing on the impact that this integration will have on innovation and creativity. Additional questions involved the effect that online technologies might have on the way the design of buildings and cities need to change to respond to the availability of social media and how new technologies can make best use of physical and spatial contexts.

The workshop was truly interdisciplinary and brought together a variety of junior and senior researchers including computer scientists, architects, language technologists, artists and innovators. Most of the participants didn't know each other before but they all had an interest in common, which is the understanding of the interaction between physical and virtual spaces and its impact on innovation.

The workshop comprised two lectures per day from experts in the field, tackling the main themes from an interdisciplinary perspective. They include: the interactions between physical and online spaces, social media and physical spaces, communication and knowledge in physical and online spaces, as well as the impact of physical and online spaces in fostering innovation. The last day focused on applications. The aim of the talks was to set the basis for the working group discussions, which were very lively. Given the different background of the researchers, they had the purpose to establish common ground and terminology, as well as to explore the potential for follow up activities. Social media researchers discovered that space syntax, a theory for the analysis of physical space, could be used also for the analysis of online space. On the other hand, architects realized that the linked open data initiative and the social web offer invaluable data about users that can be further explored in the design of buildings and cities.

One group of participants focused on theoretical discussions until the end of the workshop while another one actively worked on a concrete task in the last two days. This was the design of a new Lorentz center that could maximally exploit the interaction between physical and online spaces by taking into account some of the criteria explored during the first days. We are considering the possibility of publishing the results of the workshop either in a book format since Ashgate Publisher is interested in it or to explore the format of an e-book. We have decided to maintain the contacts among the participants through the creation of a LinkedIn group and through the possibility to reflect further on the themes of our event with a blog that should trigger all participants to post their ideas. Three of the participants submitted a European project proposal on the themes of the workshop, as a result of their interaction.

The Lorentz Center has been a very appropriate setting for the workshop. The atmosphere was friendly and allowed for extensive networking, the financial support was generous and the organization was very efficient and consolidated. International guests very much appreciated the availability of individual rooms where they could meet and work. It might be helpful to have a wiki and a more interactive website that could facilitate content exchange and preparation before and after the workshop.

Galal Galal-Edeen (Giza, Egypt)
Johan Hoorn (Amsterdam, Netherlands)
Paola Monachesi (Utrecht, Netherlands)
Gert de Roo (Groningen, Netherlands)

Funding Sources of the Lorentz Center

Basic Funding of the Lorentz Center

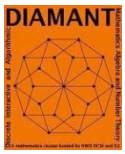
Funding granted to the Lorentz Center, supporting its operational activities and providing a refund budget to meetings held at the Lorentz Center

Leiden University Faculty of Science		Facilities and staff
FOM Foundation for Fundamental Research on Matter		Physics workshops
NWO Netherlands Organisation for Scientific Research		Workshops in Astronomy, Computational Science, Informatics, Life Sciences, Mathematics, and NIAS-Lorentz workshops
OCW Ministry of Education, Culture and Science	Ministerie van Onderwijs, Cultuur en Wetenschap	Lorentz Center@Snellius venue: renovation and interior Workshops Outreach
NIAS Netherlands Institute for Advanced Study in the Humanities and Social Sciences		NIAS-Lorentz workshops
Lorentz Fonds		Physics workshops

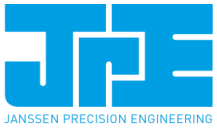
Additional Funding for Specific Lorentz Center Meetings

Funding granted to the scientific organizers of the meetings

Sponsor		Workshop
Agilent Technologies	Agilent Technologies	The Dynamic Nature of Baryons in Halos
ASTRON	ASTRON	Active Dynamics on Microscales: Molecular Motors and Self-Propelling Particles
BCSCCS	BCSCCS	Hacking the Biological Clock: Circadian Rhythm and Photosynthesis
BioSolar Cells	BioSolar Cells	Fundamental Aspects of Friction and Lubrication
BP	bp	Language Development in Childhood and Adolescence
Brain and Development Lab	Brain & Development Lab |	Language Development in Childhood and Adolescence
Brain and Education	B&E Brain and Education Lab Leiden University	> Hot Topics in Spin-Hyperpolarization > Fundamental Aspects of Friction and Lubrication
Bruker	BRUKER	Hot Topics in Spin-Hyperpolarization

Buchem BV		Hot Topics in Spin-Hyperpolarization
CAST		From Conservative Dynamics to Symplectic and Contact Topology
COST		> Hot Topics in Spin-Hyperpolarization > Summer School on Spin-Hyperpolarization > Particles in Turbulence
CWI		Multiscale Systems Biology of Cancer
DIAMANT		The Future of Phylogenetic Networks
Ecrypt 2		Post-Quantum Cryptography and Quantum Algorithms
Elfos		Future Directions of Molecular Electronics
ERC		> Modern Perspectives on Thin Sheets: Geometry, Elasticity, and Statistical Physics > Holographic Thermalization
ESF		> Casimir Physics School - Workshop 2012 > Noncommutative Algebraic Geometry and its Applications to Physics > From Conservative Dynamics to Symplectic and Contact Topology

EU		Particles in Turbulence
EU FP7		Astronomy to Inspire and Educate Young Children: EU Universe Awareness Workshop
EU Universe Awareness		Astronomy to Inspire and Educate Young Children: EU Universe Awareness Workshop
EUROHyperPOL		Summer School on Spin-Hyperpolarization
Florida State University		Chemical Gardens
Foundation Compositio Mathematica		Noncommutative Algebraic Geometry and its Applications to Physics
GQT		Noncommutative Algebraic Geometry and its Applications to Physics
Hebrew University of Jerusalem		Modern Perspectives on Thin Sheets: Geometry, Elasticity, and Statistical Physics
ISE		Elementary Reactive Processes at Surfaces
IQC		Post-Quantum Cryptography and Quantum Algorithms

Janssen Precision Engineering B.V.		Physics with Industry
Johann Heinrich von Thünen-Institut		Model Integration for Sustainable Bioenergy Supply
KNAW		> Cooperation in Multi-Partner Settings: Biological Markets & Social Dilemmas > Compact Binaries in Globular Clusters > Organs on Chips: Human Disease Models > Dynamical Phenomena at Surfaces: The Role of Complexity
LAM Research		Acoustic Waves for the Control of Microfluidics Flows
Leiden University Honours Class		Hacking the Biological Clock: Circadian Rhythm and Photosynthesis
LIBC		Language Development in Childhood and Adolescence
LIC		Elementary Reactive Processes at Surfaces
London School of Economics		Search and Rendezvous
LUCL		Language Development in Childhood and Adolescence

Marie Curie Actions		GREAT School on the Science and Techniques of Gaia
MicroDish		Physics with Industry
Mons University		Modern Perspectives on Thin Sheets: Geometry, Elasticity, and Statistical Physics
Nano Science		Future Directions of Molecular Electronics
NBIC		Bioinformatics and Systems Biology – Bridging the Divide
NCSB		> Bioinformatics and Systems Biology – Bridging the Divide > Multiscale Systems Biology of Cancer
NDNS+		> From Conservative Dynamics to Symplectic and Contact Topology > Active Dynamics on Microscales: Molecular Motors and Self-Propelling Particles
Network Institute		Web Science Summer School
NISB		Multiscale Systems Biology of Cancer
NLDA		Search and Rendezvous

NMR Service		Hot Topics in Spin-Hyperpolarization
NOVA		> Exciting CO in the Local and High Redshift Universe > Studies of Star and Planet Forming Regions with Herschel > The Dynamic Nature of Baryons in Halos > Compact Binaries in Globular Clusters
NWO		> The Dynamic Nature of Baryons in Halos > Elementary Reactive Processes at Surfaces
NXP		Physics with Industry
OCE (Canon Group)		Acoustic Waves for the Control of Microfluidics Flows
PamGene		Physics with Industry
PBL	PBL Netherlands Environmental Assessment Agency	Model Integration for Sustainable Bioenergy Supply
RadioNet		Assembly and Star Formation of Early-Type Galaxies in 3D
Shell		Physics with Industry

SRON	SRON Netherlands Institute for Space Research	The Dynamic Nature of Baryons in Halos
STW	STW Enabling new technology	> Acoustic Waves for the Control of Microfluidics Flows > Particles in Turbulence > Physics with Industry
Tiber	Tiber	Ostracism, Exclusion, and Rejection
TU Delft	TU Delft Technische Universiteit Delft	Search and Rendezvous
UMIACS	UMIACS University of Maryland Institute for Advanced Computer Studies	Search and Rendezvous
University of Birmingham	PER ARDUA AD ALTA	The Biology and Physics of Bacterial Genome Organization
University of Liverpool	UNIVERSITY OF LIVERPOOL	Search and Rendezvous
University of Massachusetts Amherst	UNIVERSITY OF MASSACHUSETTS AMHERST 1863	Modern Perspectives on Thin Sheets: Geometry, Elasticity, and Statistical Physics
Utrecht University	Universiteit Utrecht	Model Integration for Sustainable Bioenergy Supply

VISOR	VISOR | VU Institute for the Study of Religion, Culture and Society	Biblical Scholarship and Humanities Computing: Data Types, Text, Language and Interpretation
Web Science Trust	webscience TRUST	Web Science Summer School