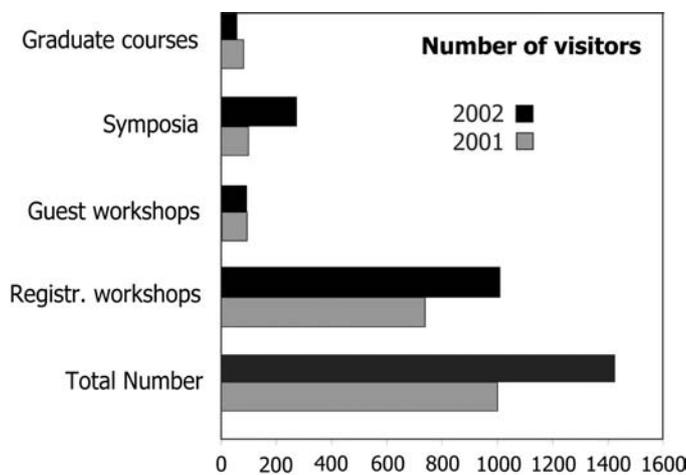


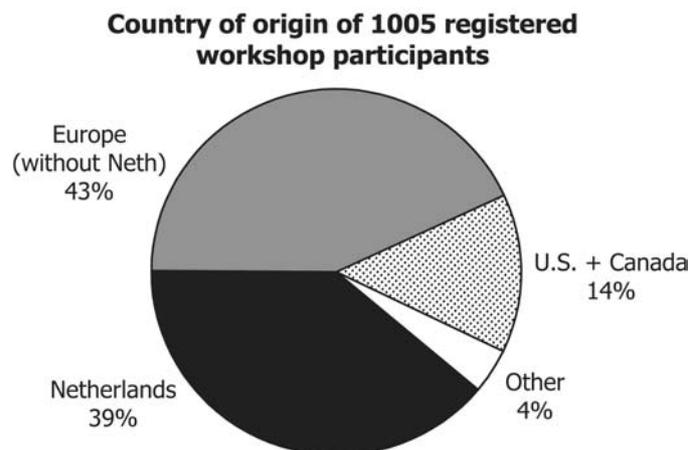
# Introduction

As the individual reports of the various workshops below will show, 2002 has in almost every respect been a very successful year for the Lorentz Center.

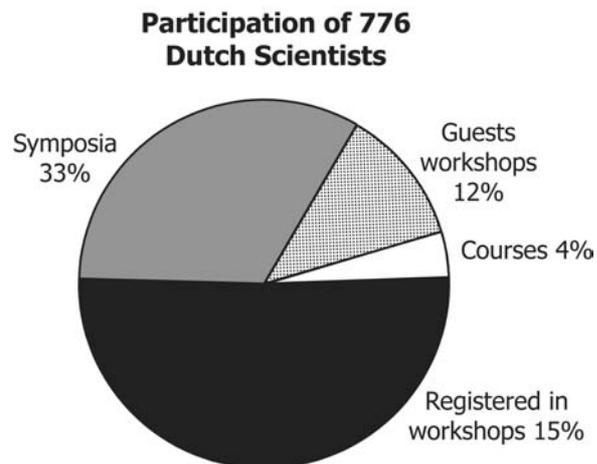
The Lorentz Center aims to host and stimulate workshops in the natural sciences which are aimed at promoting science and scientific interactions through organizing workshops, so a natural measure of its success is the scientific program and the attendance of the workshops. As this report shows, the scientific program in 2002 has been very strong. This is reflected by the continuous growth in the number of participants at workshops, symposia and courses. The total number of visitors was about 40% higher than in 2001: 1421 visitors in 2002 and 1002 in 2001. The number of registered workshops participants increased from 735 to 1005. In 2002 we organized 23 workshops. In a few cases a workshop turned out to be so popular that we had to close the registration in order not to exceed the maximum number of participants that the center can host at one time.



Detailed information on the country of origin of our guests at the workshops can be found in the graphs below. Not reflected in these numbers is the fact that there is a noticeable increase in the number of requests to organize a workshop at the center; undoubtedly this growth will be reflected in the future program.



Of the total number of 1421 visitors in 2002 were 776 Dutch scientists. In the graph below their participation to the different types of meetings is shown.



We are very grateful to the Research Council Physical Sciences (GB-E) of the Dutch national science foundation NWO and the physics funding foundation FOM for their continued financial support for the workshops at the center and for their decision to renew our grant by extending it for the years 2003-2005. The support from these foundations and from the Lorentz Fund is crucially important for the possibility to organize our workshops.

Organizationally, we have made an important step forward by installing four program advisory boards for astronomy, computer science, mathematics and physics. These boards, whose members are listed on the next page, play an important role in reviewing proposals for future workshops, in identifying important developments and in soliciting new workshops. Most external proposals are judged and commented on by the board via email, as we strive to take a go/no-go decision on a proposal within about three weeks after submission. As we stress in the "call for proposals" available on our website, proposing a workshop remains open to any scientist from any country.

We have also been able to further improve our facilities. A computer management system was developed in-house to optimize registration of participants via the web and to automate many of the organizational details. In addition we had one of our lecture rooms rebuilt and refurnished with financial help from the Gratama Stichting. The new room is not only larger, but is also found to be more flexible and to promote a stimulating and interactive atmosphere.

I hope the present report entices you to participate at one of our future activities or even to propose a workshop yourself!

Wim van Saarloos  
Director of the Lorentz Center

Scientific Report

# The XMM Large Scale Structure Survey

January 8-10, 2002

Over the last two decades there has been tremendous growth in efforts to systematically map the matter distribution in the universe. This has been motivated by questions which are fundamental to cosmology. Firstly, how much matter is there; secondly, what form does it take; and thirdly, how is it distributed?

Taking advantage of the unrivaled sensitivity of the X-ray Multi Mirror satellite (XMM-Newton), a wide area survey is being carried out with the aim of mapping the large scale structure (LSS) of the universe out to a redshift of  $z \sim 1$  as traced by clusters and quasars: the XMM-LSS Survey. The X-ray survey is coupled with an extensive follow-up programme of radio, optical and IR observations, making use of state-of-the-art observational facilities.

The wide scope of the project has motivated the set-up of a large consortium in order to carry out both the data reduction/management and the scientific analysis of the survey. The XMM-LSS Consortium comprises the following institutes: Saclay (Principal Investigator), Birmingham, Bristol, Copenhagen, Dublin, ESO/Santiago, Leiden, Liège, Marseille (LAM), Milan (AOB), Milan (IFCTR), Munich (MPA), Munich (MPE), Paris (IAP), Santiago (PUC) as well as two US Scientists, S. Snowden (NASA/GSFC) and G. Bryan (MIT). The XMM-LSS team has also a well defined collaboration with the team carrying out the SIRTf Wide-area InfraRed Extragalactic Survey (PI, C. Lonsdale).

The consortium that is carrying out the XMM-LSS survey met at the Lorentz Center Jan 8-10. Each of the partaking institutes was present with a small delegation, resulting in a total number of participants of 25.

The format of the meeting was as follows. After a short presentation of the XMM status and standard data analysis/delivery, the first results from the XMM survey were discussed. Further items on the agenda included:

- the status of the observing and funding proposals submitted,
- activities of the Working Groups and of the general organization,
- review and discussion of the methods used for reduction of the X-ray data.
- planning of further XMM, optical and radio observation,
- collaboration with SIRTf survey SWIRE,
- meetings of the various working groups (X-ray analysis, Catalogue, X-opt identifications,...).

Thanks to the efficient and very helpful staff of the Lorentz Center the meeting was a very well organized. The meeting clearly contributed to the success of this ambitious project.

Huub Röttgering (Sterrewacht Leiden)

# Science with the Low Frequency Array

January 21-25, 2002

The Low Frequency Array (LOFAR) is a radio telescope that will operate at the lowest frequencies that are accessible from earth. It is being developed by ASTRON, based in Dwingeloo (the Netherlands), the Naval Research Laboratory in Washington DC (USA) and MIT's Haystack Observatory (USA). LOFAR's goal is to open a new, high-resolution window on the electromagnetic spectrum from  $\sim 10$ –250 MHz (corresponding to wavelengths of 1.5–30 m).

Main goal of the workshop held at the Lorentz Center in Leiden was to come to a consistent set of requirements for the instrument that would be able to cover the needs of the Scientific Community. Some forty participants from the three partner institutes (see above), and European and Dutch universities attended the meeting.

The outcome was a set of (top level) requirements that would be needed to carry out observations in the following key science areas.

- **The High Redshift Universe:** the study of the most distant radio galaxies and quasars. Main tool for this application will be a series of (about 5) deep wide angle surveys that will be used to select sources for further study. This application makes use of the unique opportunity that LOFAR offers of being able to detect extremely steep-spectrum radio sources. The surveys will be a gold-mine for all sorts of interesting objects. One important example are the relic cluster radio sources. The ability of LOFAR to detect these sources in greater numbers than ever before and out to high redshifts will be used to unravel their formation and evolution.
- **The Epoch of Reionization:** detection of the global signature, and mapping of structures. Detecting the reionization signal is a great challenge, but only a telescope like LOFAR will be able to do it. The requirements that were discussed during the meeting included array configuration and data processing aspects.
- **Mapping Galactic Cosmic Rays:** to map the 3D distribution of the Galactic cosmic ray electron gas. This is essentially a galactic counterpart to the High Redshift Surveys listed above. However, in order to make deep images of the galactic plane requires markedly different data gathering and data processing techniques. Ideas on this topic were discussed.
- **The Bursting and Transient Universe:** to detect short lived transient events – bursts from Jupiter-like planets, merging and interacting compact objects. This observing mode is unique to LOFAR. No other radio telescope will be able to see a significant fraction of the entire sky all the time. Preparing for such a novel way of performing astronomical observations takes some getting used to. The discussions that took place in the course of the week were very useful in defining how LOFAR will operate in this observing mode.
- **Solar-Terrestrial Relationships:** to detect Coronal Mass Ejections, possibly in combination with a Solar Radar, and to study the Earth's Ionosphere. The LOIS consortium is planning to build a transmit facility in southern Sweden. This transmitter can be used for both solar and ionospheric applications. The chairman of the LOIS team presented the current LOIS proposal.

Two further aspects that were also discussed in some detail are

- The calibration of the array. Calibratability has been an important consideration in the design of LOFAR. The current plans were discussed in some detail.
- Tied Array requirements. If LOFAR can operate as a single phased array, it may prove to be a valuable resource for pulsar observations. The technical difficulties peculiar to this observing mode we also discussed.

Michiel van Haarlem (ASTRON, Dwingeloo)

# Nonlinear Phenomena in Science

March 18-29, 2002

Nonlinear partial and ordinary differential equations appear in mathematical models for many problems in science and engineering. Many interesting phenomena are due to the nonlinearity of the equations. The desire to describe and predict such phenomena by mathematical analysis of the equations and their solutions continues to have a profound impact on the research objectives in both pure and applied mathematics. This has strongly influenced the development of the modern theory of nonlinear partial differential equations, as well as that of finite and infinite dimensional dynamical systems, nonlinear functional analysis and numerical analysis.

This meeting brought together a group of experts from different fields, its main aim was to create interactions. The Lorentz Center provided this a priori relatively heterogeneous group of participants with a stimulating atmosphere in which the various points of view – fundamental, applied, formal – could be brought together and interact. The infrastructure of the Lorentz Center, for instance the combination of having offices (with extensive computer facilities) for all participants with a very pleasant common room, was crucial for the success of the workshop.

The workshop had a number of main themes:

- Equations of higher order (Dal Passa, McKenna, Rottschäfer, Wieland).
- Localized patterns (Berestycki, Fife, Haragus, Kuske, Sandstede, Yew).
- Nonlinear diffusion equations (Aronson, Hilhorst, King, Yaunwei).
- Critical behavior in scalar equations (Bandle, Fila, Quiros, Weisler).

However, due to the character of the participants and their lectures, it was clear that there are many connections among these main themes and the various sub-themes (such as free boundary problems, self-similar solutions).

The main impact of the workshop was that these cross-connections became explicit. An interesting and relevant example of connections that were established during the workshop, and that includes the majority of the above mentioned themes and sub-themes, is the insight that localized pulses in reaction diffusion equation may blow-up in finite time by following a critical self-similar solution of a scalar equation.

The richness of the backgrounds of the problems discussed during the workshop indicated the relevance of the workshop outside the field of mathematics. Models originated from diverse fields ranging from life sciences (tumor growth, transport of medicine, population biology) and chemistry (autocatalytic reactions) to hydrodynamical and geophysical flows (water waves, shear flows, porous media, thin films) and mechanical systems (suspension bridges).

Embedded in the workshop was the 'afscheidsrede' ('retirement address') of the guest of honor, Bert Peletier (on Friday March 22). One day of the workshop was devoted to (short) lectures by 'friends and family' (including previous students, etc.). This was a highly successful day, especially since it indicated the significance of Bert Peletiers 'heritage' for all themes of the workshop.

Arjen Doelman (UvA)

Scientific Report

## Dutch Astrophysics Days 2

April 3-4, 2002

The second edition of the Dutch Astrophysics Days was hosted at the Lorentz Center on April 3 and 4, 2002. The meeting the year before had been such a success that Garrelt Mellema and Inti Pelupessy (Leiden) were happy to be able to organize a second edition. The meeting's intention is to bring together annually, Dutch scientists interested in more theoretical astrophysics, a community which has been growing recently.

The meeting was attended by 22 scientists from all Dutch universities with astronomy institutes or groups (Amsterdam, Groningen, Leiden, Nijmegen, Utrecht), as well as FOM Rijnhuizen: staff, postdocs, as well as graduate students. The program reflected the wide interests of the Dutch astrophysical community:

- Verolme: Schwarzschild modelling of triaxial systems
- Pelupessy: SPH modelling of galactic structure
- van de Ven: Triaxial Galaxies with separable potentials
- van de Weijgaert: Forming filaments in hierarchical scenarios
- Romano-Diaz: Tracing tidal influence
- Schaap: Cosmic Field Reconstruction
- Portegies Zwart: Globular clusters near the Galactic Centre
- Moortgat: Gravitational Waves in Gamma Ray Bursts
- Keppens: MHD spectroscopy of accretion disks
- Kamp: Two-fluid disk models for Lamda Boo stars
- Dessart: Radiation hydrodynamics modelling of hot star winds
- Macquart: Scintillation in the interstellar medium
- Icke: Blowing up non-planar disks

As in the first edition, we had a non-astronomer guest speaker. This year dr. A. van den Berg (Earth Sciences, Utrecht) gave an interesting lecture on 'Thermal convection and compositional differentiation in the planetary evolution of Earth and Mars', showing how earth sciences and astronomy can meet.

There was also time scheduled for discussion on collaboration and contacts between the different theoretical groups. Some aspects of this discussion led to an effort to define a theoretical effort within the context of the proposal for the second round of funding for the Netherlands Research School for Astronomy (NOVA), which is due in mid 2003.

We would like to thank NOVA and Leiden Observatory for the financial support to host this meeting, and the Lorentz Center for the excellent facilities and logistic support. We intend to organize another edition of the Dutch Astrophysics Days in 2003.

Garrelt Mellema (Sterrewacht Leiden)

# **SUPERCONDUCTORS AND HYBRID STRUCTURES AT EXTREME SCALES AND CONDITIONS**

April 22 – May 3, 2002

The Workshop brought together leading researchers engaged with the theory of nanometer-size superconductors and hybrid structures. This new field of condensed matter physics appeared as a response of the mesoscopic community to the quest of the emerging nanotechnology for a scientific base for the new generation of the telecommunication, memory and recording, and computational devices and quantum computing. The format of the Workshop (about forty five participants; two theoretical talks in the morning and one experimental talk in the afternoon) was designed to provide a forum for discussion and collaboration on scientific issues and topics crucial to the current nanoscale science and its related technological applications. The Workshop was organized jointly by the Lorentz Center, Materials Theory Institute at Argonne National Laboratory, and Kamerlingh Onnes Laboratory at Leiden University as a part of a broad international partnership, International Collaboration on Advanced Materials (ICAMP) initiated by MTI and the Lorentz Center. The partnership aims at establishing a highly interactive and cooperative environment for efficient research in materials science crucial for nanotechnology. The main body of invitees constituted scientists who had already initiated several joint research programs during the previous workshop at Argonne National Laboratory in October – November 2001, joined by the researchers from TU Delft, Twente University, and other local institutions. The wide representation of experimentalists from TU Delft, one of the world-leading institutions engaged with the nanoscale physics was of special importance. The workshop was also beneficial to graduate students and young researchers from local institutions who were actively attending both theoretical and experimental presentations. During the workshop the projects initiated earlier at Argonne National Laboratory were continued and several new scientific programs were seeded.

I consider the atmosphere of intense discussions set by the Workshop as one of its major achievements. This was specifically advantageous for younger researchers who had a rare opportunity to have their work thoroughly and friendly scrutinized by the leading experts in the field, and who, in their turn, could question senior experts in detail pursuing complete clarity.

The response of participants was extremely positive. They evaluated highly the scientific program and appreciated the light talk schedule leaving enough room for discussions (although indicating that restricting lecture schedule to morning hours could be even more advantageous); all participants explicitly expressed their high opinion about the well-equipped offices, computer services, and the excellent meeting room. The more than excellent professional support from the Workshop coordinators, Dr. M. Kruk and Mrs. B. ten Hove, made the Workshop mechanism to work as smooth as Swiss watches; without their contribution and enthusiasm such an enjoyable and fruitful workshop would have been impossible. Prof. W. van Saarloo's generous and efficient help is highly appreciated. Many participants referred to the Workshop as to one of the best workshops they attended ever. All in all, I do not hesitate to rank Lorentz Center and its environment as the best scientific conference facility in Europe. While here at Argonne we, as I believe, can well match Lorentz Center in terms of the friendliness and efficiency of personnel, we still concede in terms of computer services and office space.

**Highlights:** The Workshop focused mainly along the topics of nanophysics crucial to rapidly developing quantum computing. The issues covered can be divided conditionally to the problem of decoherence-related problems, and the topics related to implementation of qubits and work of other quantum devices. Among the issues discussed, a new kind of design of the Josephson-junction circuit-base qubit implementing the error-correction scheme, the current noise in superconductor/normal metal heterostructures, the tunneling properties of a single spin, coherent low energy transport in a diffusive S-N-S junction, the temperature dependence of dephasing, quantum ratchets, entanglement and quantum measurements of Josephson-junction circuits, spectral flow dissipation in superconducting point contacts, Josephson devices with intrinsic  $\pi$ -phase shifts, possible realization of an ideal quantum computer in Josephson junction array, should be mentioned. Two contributions

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deserve to be marked specifically: Hans Mooij delivered an excellent introduction into quantum dynamics of Josephson junctions. Leo Kouwenhoven delivered a beautiful review of electronics of quantum dots within the framework of Ehrenfest Colloquium, where together with an excellent introduction into the subject, the latest exciting developments and results, such as Kondo-effect related phenomena were presented.

Among the new projects, the study of tunneling through Andreev levels in superconducting constrictions and the perspective investigation of proximity effects and related phenomena in superconductor/ferromagnet heterostructures is to be mentioned.

In conclusion, we would like to thank again the team of the Lorentz Center on behalf of the participants for hospitality and efficient work in providing the fruitful and supporting environment. Lorentz Center is a unique facility and we look forward participating in the next Workshop at Leiden.

Valerii Vinokur

# **EARA Workshop on The Side-Effects of Star Formation**

May 6-7, 2002

The European Association for Research in Astronomy is a collaboration between five European Astronomy Institutes, namely the Institute of Astronomy at Cambridge (UK), the Institute d'Astrophysique Paris (France), the Instituto Astrofisica de Canarias (Spain), the Max Plack Institut für Astrofysik (Germany), and Leiden Observatory (The Netherlands). As part of the collaboration there are regular workshops on areas of common interest. The year 2002 was Leiden's turn to organize a workshop.

The choice fell to focus on 'the side-effects of star formation', on how the presence of young (mostly massive) stars influence their environment on different scales.

The local Leiden EARA deputy, Garrelt Mellema, stood for the organization. There were 14 participants from nearly all participating institutes. We gratefully acknowledge financial support from the Lorentz Center, as well as the EARA institutes.

The program consisted of 11 presentations, addressing the influence of the stellar UV photons on the large and small scales, how stars change the chemical composition of their galaxies and the intergalactic medium, and aspects of starburst galaxies.

One of the main aims of EARA is to promote the contact between young researchers, and this workshop was an excellent example of this. Most participants were either postdocs or graduate students, and there was ample time to get to know each other in a friendly and open atmosphere. The scientific discussions were also fruitful, showing how the influence of stars stretches from the molecular clouds where they were formed, to the intergalactic medium, thus bringing together astronomers from different communities.

The response of the participants was very positive, and they were especially pleased with the excellent infrastructure and support staff provided by the Lorentz Center.

Garrelt Mellema (Sterrewacht Leiden)

# Hunting for Planets

## GENIE VLTI-Instrument: a DARWIN technology demonstrator

3-6 June 2002

This workshop was held at the Lorentz Center on the 3-6 June 2002. The rationale for holding such a workshop was to bring scientists and industry together to hear about the European Space Agency (ESA) and European Southern Observatory (ESO)'s plans for a pre-cursor experiment to the DARWIN space mission. The number of registered participants was 85, nearly 3 times as many as originally envisaged. Consequently a support was given by ESA to the workshop.

DARWIN is maybe the most technologically challenging mission that ESA has undertaken to carry out, which is not surprising given its goal: To search for and study in detail planets like our own Earth, orbiting other (nearby) stars. This has hitherto been impossible for the simple reasons that the planet – at interstellar distances – will be incredibly faint and at the same time very close on the sky to the parental star (its sun) which is tens or hundreds of billions times brighter. To carry out the observations, DARWIN is foreseen to utilize the new technology of nulling interferometry. This is an interferometrical technique where one couples several telescopes, with appropriate phase delays, together to mimic a very much larger telescope in resolution – and at the same time extinguishing any bright source on the optical axis (the parental star of the planet). Under those circumstances, it is not strange, that a lot of technology development is required. One of the elements in this development is called GENIE: Ground based European Nulling Interferometry Experiment. It is a model of the DARWIN experiment, which will work on the ground, using the Very Large Telescope Interferometer of ESO as an input. While it can of course not detect the Earth-sized planets, which are the goal of DARWIN, the GENIE-VLTI combination is nevertheless capable of carrying out interesting science. The primary goal is, however, to serve as a technology demonstrator. GENIE is foreseen to be built by a consortium of scientists and industry.

The workshop at the Lorentz Center served as an informative meeting/discussion forum for the involvement of scientists and industry in this program. Six sessions were held over the four days that the workshop lasted:

- Introduction/ Nulling experiments (describing the project, the programmatics and the technology). This session described the new ESA program after the restructuring: A number of activities leading up to a DARWIN mission in 2014 or beyond include GENIE, SMART, COROT, Eddington on the ESA side. The structure of the GENIE program, the Keck and Large Binocular Telescope nuller, as well as the status of the DARWIN/TPF program was described.
- Laboratory experiments (to date). The Technology Research Program (TRP) initiated by ESA was described by industry.
- ESO VLTI infrastructure (VLTI first generation instruments). Here VLT and VLTI were described, as well as the first generation instruments PRIMA, MIDI, AMBER, VINCI and FINITO. Followed by a description of next generation instrument needs, as well as requirements on VLTI posed by those new instruments (including GENIE).
- Nulling technology Here detectors, configurations, modulation schemes, OPD-control, fringe tracking and amplitude control was covered. Demonstration of high contrast nulling in the thermal IR, spatial filtering and phase shifters was also covered, as well as integrated optics.
- Science (apart from Exo-planets): Keck nuller science program, T-Tauri and debris disks, YSO's by IR Interferometry and Active Galactic Nuclei were all covered here.
- How to get involved (ground rules for industry/science teams)

The workshop was an outstanding success, which fulfilled every wish of the organizers. The information flow was very full and required significant discussion. A large amount of information was brought back to the ESA and ESO about how the scientific community and industry see the development of GENIE. Several representatives of DARWIN's US sister project (and ultimate partner) the Terrestrial Planet Finder (TPF), and associated pre-cursor projects, participated actively in the workshop, representing this time the flow of information back and forth across the Atlantic required by the project.

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The infrastructure and logistics of the workshop worked 100% perfect – in spite of it being nearly 3 times as large as envisaged. It is extremely important during a workshop so large that ample possibilities for the off-line discussions required are present. Also this was the case at the GENIE workshop. Even the very pleasant social event was the venue of many fruitful discussions, quite a part from showing off Holland from its absolutely best side. The feedback from the participants was very positive.

Malcolm Fridlund (European Space Agency)

# **Explicit Methods in Galois Theory and Arithmetic**

June 10-14, 2002

In the year 2000 a Research Training Network of the European Community was started under the name 'Galois Theory and Explicit Methods in Arithmetic'. In this project 13 mathematical research institutions in Europe have funding for joint research efforts in the area of inverse Galois problems, geometric Galois theory, number theory and differential Galois theory. The network sponsors postdoc positions, visiting researchers and network meetings, such as this one.

This particular meeting served three purposes. First of all it was an opportunity for network members to meet up and discuss ongoing research projects. Secondly, it served to go through the midterm evaluation process of the European Commission. And thirdly, it was an occasion to work with experts in the field outside the network as Jochen Koenigsmann (Konstanz) and Alan Lauder (Oxford) and to introduce Dutch researchers, especially PhD students to the network projects. The focal point of the meeting was the research carried out by junior researchers (postdocs) in the network, and the three invited lectures.

The congenial atmosphere at the Lorentz Center, the setup with offices around a pleasant common room and the social program all contributed to make this a very pleasant and productive meeting. Participants were invariably impressed with the facilities, and the excellent organization of the Lorentz Center. The support from the Lorentz staff, both in preparations, and during the meeting was very good and much appreciated.

Bart de Smit (UL)

Scientific Report

# Economic Dynamics

June 17-28, 2002

A two week workshop on Economic Dynamics was held from June 17-28, 2002, at the Lorentz Center. The workshop focused on theoretical, empirical as well as experimental work on modeling dynamic phenomena in economics and financial markets. Mathematical and statistical methods and their applications to economics and finance played a central role in the workshop. In addition, recent results from laboratory experiments were also discussed. Central workshop themes included:

- endogenous fluctuations; interacting agents modelling;
- expectations and learning; bounded rationality;
- complex adaptive systems;
- applications of nonlinear dynamics in economics and finance;
- nonlinear time series analysis.

Each day there were three one-hour lectures, two in the morning and one in the late afternoon. These lectures (a total number of 28) were all given by experts in the field. Between the lectures there was plenty of time for discussions in the common room or in smaller groups in one of the offices.

Sometimes these discussions led to an informal presentation at the small seminar room at the Lorentz Center. In addition, there were poster presentations, mainly by participants who could not give a talk, since the total number of talks had been kept small to stimulate discussions.

The format of workshops at the Lorentz Center is unique in the Netherlands. In particular, the fact that all participants have offices with computer facilities, as well as a common room and an additional small seminar room, provides a unique opportunity for scientific discussions and international cooperation. Such facilities are available only in the world's very best universities or research centers. They remind us of the Stanford Institute for Theoretical Economics (SITE), having a long tradition in organizing this type of workshops during the summer. The SITE workshops are very well known and have a large international reputation in economics. This format stimulates international cooperation very much and the workshop provided important feedback on the research of our CeNDEF group in Amsterdam. The results of the workshop will be published in a special issue of the Journal of Economic Dynamics and Control, to be published in 2003.

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

- the Lorentz Center (financed by the Netherlands Organization of Scientific Research (NWO))
- the Center for Nonlinear Dynamics in Economics and Finance (CeNDEF), financed by a NWO-MaG Pionier grant.

We would like to thank the staff of the Lorentz Center, Prof. W. Saarloos, Dr. M. Kruk and Mrs. B. ten Hove for their essential and efficient support before and during the workshop. Everything was organized extremely well, so that the organizers of this workshop could just concentrate on participating in its scientific part.

Cars Hommes (University of Amsterdam)

*Dr. Vernon Smith, participant of this workshop, became Nobel Prize Winner in Economics, 2002.*

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# **FIRES Faint InfraRed Extragalactic Survey: Evolution of Galaxies**

July 8-12, 2002

The workshop was intended to bring together all scientists who are collaborating on the FIRES project. This project focuses on the evolution of galaxies measured on the basis of ultra deep, ground based Near-IR imaging data obtained with the VLT. We were able to bring together 15 scientists from 7 institutions in Europe and the US. The format of the meeting was chosen to be like a true workshop: 1 hour presentations interspersed by periods of discussions in smaller groups, and periods of work at the computers. A wide range of topics was discussed: from clustering, to photometric redshifts, to sizes, active nuclei, and luminosity functions. Based on the discussions and work we were able to do in the Lorentz Center, we have now submitted 4 papers, and many more are now to be submitted soon. Furthermore, we planned observational projects to follow-up on the results already obtained.

The facilities of the Lorentz Center are uniquely suited to bring together scientists who are working on a common project. These collaborations are getting larger and larger, and astronomy departments do not have the facilities to provide such a large number of visitors with working space, and the meetings rooms like the Lorentz Center can. We made extensive use of the computer facilities of the Lorentz Center, the meeting rooms with overhead projectors and 'beamers', and the common room for discussions. We thank Gerda Filippo and all others for their excellent support. Furthermore, we gratefully thank the Lorentz Center for the financial support of the meeting.

Marijn Franx (Univ. Leiden)

# **Type Ia Supernovae: Theory Meets Observations**

July 15-26, 2002

The Lorentz Center has provided the Supernovae community with a unique opportunity of exploring one of the most outstanding issues in the field – the nature of the progenitors of these exploding stars. The workshop hosted 45 people from Europe, the USA, Japan, and Australia, including many of the fields' leading theorists and observers. The workshop served to facilitate a synthesis of state of the art theory and observations, to help define how best to make rapid progress on understanding supernovae – an especially important area of endeavor given the role these objects have played in defining the Cosmological Paradigm – a Universe dominated by a Cosmological Constant.

The format of the workshop included a series of review lectures given by leaders of the field during the first week, followed by a series of short specific talks by people presenting new (unpublished work). We defined 6 theme leaders (3 theorists, 3 observers) to lead discussions on key areas, and these leaders reported the progress within these area made by the workshop, during presentations at the end of our workshop. For the rest of the time, participants broke into small work groups investigating individual topics of mutual interest; these formed naturally without much guidance.

Several groups took advantage of the Lorentz Center to help organize their future. For example, members of the High-Z SN Search worked on finishing their analysis of distant supernovae, and had a team meeting. Members of the European supernova research and training program had a team meeting and planned future observing strategies.

Of particular value was the direct comparison of various theoretical groups' supernova explosion simulations, radiation transfer computations, and binary synthesis predictions. These comparisons are difficult to make without direct contact and showed that there is now broad agreement on most theoretical issues, but also showed where the discrepancies lie.

The facilities of the Lorentz Center were essential to the success of our workshop, and we have received nothing but praise from our participants, with the most common comment – “when are we going to do this again?” The computation and network facilities allowed our participants to feel as though the Center was their home away from home, with the Audio Visual equipment exactly appropriate to our needs.

We thank the Lorentz Center and its funding agencies for the support, and believe the workshop was a fantastic success. The scientific outcomes are already flowing, and should continue for several years to come.

Brian Schmidt (The Australian National University)

## **SAURON Team Meeting**

July 29 – August 2, 2002

In the last week of July, the Lorentz Center hosted a meeting of the SAURON team, attended by nearly twenty participants from France, Germany, England, Spain, the USA, and the Netherlands, including about a dozen graduate students and postdocs. The SAURON team is carrying out a comprehensive census of the kinematics and linestrength distributions of 72 nearby early-type galaxies (ellipticals, lenticulars and bulges) with a unique custom-built panoramic integral field spectrograph called SAURON, funded in part by NWO, built at the Observatoire de Lyon, and operated as a private instrument on the 4.2m William Herschel Telescope on La Palma. The SAURON data are supplemented with imaging and spectroscopy obtained with OASIS on the Canada France Hawaii Telescope on Mauna Kea, and with the Hubble Space Telescope. The data are analyzed with state of the art dynamical models to determine the intrinsic shapes and the masses of central black holes. Stellar population modeling reveals the spatial distribution of age and metallicity in the galaxies, and constrains the history of starformation in these systems.

The SAURON project started in spring 1999, and the observations of the 72 survey objects were completed in spring 2002. All data have been reduced, a number of new analysis tools have been developed, and papers on individual galaxies are in progress. During the meeting all aspects of the project were addressed, with emphasis on the status of the dynamical and stellar population modeling, the properties of the ellipticals, lenticulars and bulges as a group, and the plans for follow-up observations, and future collaborations. The participants presented results on components of this large project, ranging from development of data reduction tools, to higher level interpretative analysis, dynamical model construction, and analysis of individual galaxies. As the team is dispersed geographically, this intense interaction period contributed greatly to the success of the project, and was in particular valuable for the younger members of the team.

P.T. de Zeeuw (Leiden University)

# Quantum Spin Collective Phenomena in Condensed Matter Physics

August 5-16, 2002

The workshop on 'Quantum spin collective phenomena in condensed matter physics' was held in the Lorentz Center from Aug 5 to Aug 16, 2002. Around 45 people attended the workshop, 24 of whom were invited speakers. Scientists who attended the workshop are from the USA, Canada, France, Israel, Brazil, Japan and the Netherlands. Researchers in the following areas were attracted to the workshop.

- Low dimensional quantum spin systems: A. Abanov (Stony Brook), I. Affleck (Boston), A. Calderia (Unicamp, Brazil), D. Van de Marel (Groningen), R. Moessner (ENS, Paris), O. Starykh (Hofstra, New York) and Jan Zaanen (Leiden).
- Competing orders in HT<sub>c</sub>: A. Auerbach (Technion, Haifa), E. Altman (Technion, Haifa), M. Berciu (Vancouver, Canada), E. Demler (Harvard), E. Fradkin (UIUC, Urbana) and S.C. Zhang (Stanford).
- Strongly correlated electron liquids: H. Hansson (Princeton), Qi Miao Si (Rice, Houston), B. Spivak (Seattle), G. Tatara (Osaka) and P. Wiegmann (Chicago).
- Quantum molecular magnets: B. Barbara (CNRS, Grenoble), Niu Qian (Austin, Texas) and P. Stamp (Vancouver, Canada).
- Strongly correlated spin one bosons: Fei Zhou (Utrecht) and K Schoutens (UvA).

Because of the diversified backgrounds of scientists in the workshop, the multi-culture workshop turned out to be inspirational and stimulating. There were averagely three one hour talks each day, followed by extended discussions. Many speakers reported their very recent research results and had open minded discussions with others. All of us felt that it is one of very few workshops where people working in one area are able to meet and communicate with the people from other areas. This is particularly important because of revolutions in a few fronts in today's condensed matter physics. The following subjects were highlighted in this workshop.

- Existence of spinons and fractionalization in two dimension antiferromagnets. This subject recently received a lot of attentions because of new progress in numerics on triangle lattices and crossed chains problem. R. Moessner (ENS, Paris) and O. Starykh (Hofstra) gave review talks on this subject.
- Charge and Magnetic orders in cuprates. E. Demler and S. Zhang talked about their recent progress on competing orders in vortex states. There are growing experiments on this subject and we expect more future activities in this direction. A. Auerbach and E. Altman reported evidence of pairing of holes in doped antiferromagnets using contractor real space renormalization approach. E. Fradkin reported the possibility of using STM to study fluctuating order in cuprates and interpreted the recent data of a Stanford group.
- Molecular quantum magnets. B. Barbara who just won the Agilent European physics price talked about the experimental observation of quantum tunneling in molecular magnets. Two theorists, Qian Niu and P. Stamp presented their theories on quantum magnets. Qian Niu discussed the spin jamming phenomenon in molecular magnets; Stamp addressed the mechanism of the magnetic field tuned decoherence. These results could have profound impacts on quantum information technologies.
- Strongly correlated electron liquids. B. Spivak proposed a new quantum liquid close to the Wigner crystal-Fermi liquid phase transitions. P. Wiegmann demonstrated fingering of incompressible quantum hall liquids. Qi Si discussed the non-fermi liquid behaviors at a quantum critical point. Jan

## Scientific Report

Zaenen argued that quantum disordered states can be studied in a dual representation using disorder parameters. Finally, Ian Affleck reported interesting results on persistent currents and conductance of quantum dots ("Kondo impurities") embedded in quantum rings.

- Correlated spin one bosons. K. Schoutens reported clustering states in rotating BECs. F. Zhou reported quantum condensates of fractionalized atoms and valence bond crystal states in Mott insulating states. Possible application towards quantum computation has been discussed.

At last, we would like to thank the Lorentz Center for providing funds for this workshop, especially W. van Saarloos for his unreserved supports. The facilities in the Lorentz Center are world class ones and the supporting crew are very accessible. All people in the workshop are very impressed by the efficiency and professionalism shown by the managing crew. We all want to thank Dr. Martje Kruk and Bertie ten Hove for the time they put in this workshop. Their hard works made the workshop possible and our visit in the center a pleasant experience.

Fei Zhou (Utrecht University)

## Formation of Structures in Granular Matter

August 19-30, 2002

Granular materials, such as sand, coffee powder or rice, exhibit a wide range of solid and liquid-like phenomena, some familiar, others remarkable, but almost always poorly understood. Despite a long history of research and obvious technological relevance, the description of granular media is still in its infancy: there are no models that describe, let alone predict, its general behavior.

What is generating much excitement within the rapidly expanding community of physicist who study granular matter are recent experiments that have uncovered an enormous range of unexpected and exotic behaviors: when shaken or stirred, granular matter display glassy behavior, hysteresis, shear banding, pattern formation, memory effects, segregation, convection and compaction. New theoretical concepts, such as jamming, fragility and granular temperature, are hotly debated.

The Workshop brought together more than 50 scientists (over the course of two weeks) to discuss recent developments in the field. The group consisted of a mix of established researchers and people who more recently turned their attention to granular matter. Around twenty long (45-60 min) and ten short (10-20 min) talks were presented, which reflected the broad range of current topics (force-chains, wet sand, granular flow, non-equilibrium properties, nano-particles...). The main strength of the workshop were the lively debates that occurred in between, and often during, these presentations. The Lorentz Center is uniquely suitable for hosting meetings where discussions are central, and this was clearly appreciated by the participants, who on a number of occasions expressed their gratitude for the relaxed and friendly atmosphere. In addition, the staff at the Lorentz Center has been invaluable in making the organization of the workshop a pleasant and relatively simple task.

A substantial amount (around 20) of participants from the Netherlands were present; granular efforts are sprouting up at, e.g., the VU, UvA, Twente, Utrecht, Delft and Leiden. The workshop has served to 'put the Netherlands on the granular map', and contacts and collaborations between more established international groups and Dutch efforts were created and strengthened. As an example of a concrete spinoff, German-Dutch plans have been made for a (nano) powder conference to be held at the Lorentz Center in 2003.

The talks of Andreotti and Douady on singing sand attracted the attention of the media, and on the 31st of August both the NRC and the Volkskrant featured articles on this in their science sections. The superb press release that was prepared by the Lorentz Center staff certainly helped here in communicating the message that science can be fun.

In my view, the workshop has been a marvelous success and without the Lorentz Center it would not been half as nice.

Martin van Hecke (Leiden University)

# **On High-Dimensional Data, $p \gg n$ in mathematical statistics and bio-medical applications**

September 9-22, 2002

Modern statistics differs from classical statistics in a number of respects. The analysis of DNA micro-arrays is one example, and there are many others (financial data, marketing data, sensor and satellite data, ...) where we need statistical methods to reduce the very large number of measured variables to a limited number of relevant ones. The problem is how to store, make accessible, and use enormous amounts of data, and how to carry out a statistical analysis which takes into account the complexity of these large data sets. Think for example of a test for the 2 times 2 contingency table, carried out 70.000 times. What kind of significance criteria can one use for such a large number of tests, and is it possible to actually point down the significant outcomes among these tests?

In this workshop, several specialists have gathered to discuss questions of this type. In the first week, the emphasis was on theoretical methodology, whereas the second week focused on applications, mainly to micro-array data.

The theoretical week revealed that some reflection on the methods commonly used in practice was quite useful. For example, it turned out that certain resampling techniques were far off in reproducing the covariance structure of the problem at hand. Another topic that was discussed extensively was the method of penalizing a too complex model. It was considered from various angles. There was the Bayesian angle, where shrinking of coefficients is commonly used, and the frequentist angle, where the conclusion was that one should not try to estimate something when the noise level is comparable to the signal. The participants shared their interpretation of certain methods, showing for instance that naive Bayes had an interpretation as assuming an independence structure, or that empirical Bayes can be seen as model selection technique.

In the second week there was much emphasis on micro-array data, where each chip contains information about the expression level of 10-30 thousand genes. Three different statistical challenges were discussed: how to group genes in a sensible way, how to compare gene expression levels between groups of individuals and select interesting genes and how to predict clinical outcome (success of therapy) on the basis of such high-dimensional data. Different strategies were discussed such as data-reduction by principal components as often done in chemometrics or gene selection by mixture models. As in the first week an important issue in the discussion was the use of Bayesian methods and penalized likelihood methods and the relation between these two approaches.

There were participants attending only part of the program, but also many people were actively taking part in both weeks. Bringing together people from theory and practice turned out to be mutually benefiting. The guest of honor of this workshop, David Donoho, knew how to link the various methods and ideas, and contributed substantially to the lively discussions we had.

There was a wonderful common spirit during this workshop, and during the social gatherings we had at the common room as well as at dinners and in pubs. The Lorentz Center has been a great host, and many compliments were made on its facilities and the management and staff.

This workshop has been a very productive one. Most of the invited speakers will submit their work to a special issue 'On High-Dimensional Data' of the journal Bernoulli.

Hans van Houwelingen (LUMC Leiden)  
Sara van de Geer (Leiden University)

## Explicit Algebraic Number Theory

September 23 - October 2, 2002

The workshop on explicit algebraic number theory, which took place during the period September 27 - October 2, 2002, was preceded by an instructional part ('Stieltjesweek') in which H.W. Lenstra and P. Stevenhagen presented preparatory material for the topics discussed during the workshop. R. Schoof and B. de Smit contributed here as well.

Over 40 participants registered for this instructional part, and most of them stayed for the workshop itself. Among them were a large number of young Hungarian participants which were supported by an NWO-OTKA grant.

The workshop itself attracted over 50 number theorists. Invited speakers were Yuri Bilu (Bordeaux), Jean-Marc Couveignes (Toulouse), Ronald Cramer (Aarhus), Bas Edixhoven (Leiden), Juergen Klüeners (Kassel), Guenter Lettl (Graz) and Michael Pohst (Berlin).

An attractive range of topics was covered, including the recent proof of the 158 year old Catalan conjecture by Preda Mihailescu and the at the time 1 month old discovery of a polynomial time primality proof by the Indian mathematicians Agrawal, Kayal and Saxena. In fact, Lenstra was already able to present substantial improvements of the original primality proof during the workshop. As intended, many young researchers were able to give short talks about their research during the workshop.

Rene Schoof - Applications of class field theory

Capi Corrales - The support problem

Bas Edixhoven - Complex multiplication and Galois action

Juergen Klüeners - Constructive Galois theory

Andrzej Schinzel - On power residues

Bart de Smit - Arithmetically equivalent fields of small degree

Ronald Cramer - Optimal black box sharing over arbitrary abelian groups

Jean-Marc Couveignes - Modular correspondences and computing the canonical lift

Ronald van Luijk - Rational points on surfaces

Richard Groenewegen - Torelli for number fields

Pieter Moree - On the distribution of the order and index of  $(g \bmod p)$  over residue classes

Michael Pohst - On factoring polynomials over global function fields

Peter Olajos - Power integral basis in orders of composite fields

Szabolcs Tengely - On the equation  $F(x)=G(y)$

Alf van der Poorten - Periodic continued fractions and torsion on the jacobians of hyperelliptic curves

Guenter Lettl - On solving families of Thue-equations

Istvan Gaal - An application of inhomogeneous Thue equations to resultant type equations

Istvan Jarasi - Calculating the 'small' solutions of resultant type equations

Istvan Pink - On the differences between polynomial values and perfect powers

Yuri Bilu - Catalan's conjecture (after Mihailescu)

Lajos Hajdu - On the diophantine equation  $n(n+d) \dots (n+(k-1)d) = by^l$

Csaba Rakaczki - On the equation  $x(x-1) \dots (x-(m-1)) = \lambda y(y-1) \dots (y-(n-1)) + l$

Hendrik Lenstra - Primality testing using Gauss periods

Wolfgang Schmid - On the set of integral solutions of  $X^2 - dY^2 = 1$  in number fields

Herman te Riele - New class number computations and the Cohen-Lenstra heuristics

Christiaan van de Woestijne - Quadratic forms over finite fields

# **ISMA 2002 'Internet Statistics and Metrics Analysis' 'Multiresolution and correlation analysis of global Internet measurements'**

October 7-11, 2002

The Lorentz Center once again proved itself an ideal place to hold a workshop on Internet measurements and data analysis. After last year's (2001) workshop on 'Multiresolution Analysis of Global Internet Measurements', coordinated by Ogielski and Cybenko with great success, CAIDA pursued a similar collaboration with the Lorentz Center for its annual ISMA workshop. The Lorentz Center demonstrated such success in 2001 as a faithful vehicle for building sustainable channels of intellectual exchange for the Internet research community, that CAIDA wanted to explore the possibility of further establishing such a channel of collaboration among researchers in the American and European, especially Dutch, communities.

The Lorentz Center environment allowed CAIDA to hold a workshop it could not hold at its home institution in the United States; the unique environment of the Lorentz Center facilitated more of a 'retreat' or even 'sabbatical' milieu rather than the conference/symposium motif so typical of this and many other fields.

The content of this year's workshop focused on Internet inter-domain routing and topology analysis. Talks ranged from discussions of the performance of the root Domain Name System to fine scale quantification of BGP behaviors. Representatives from industry (Interoute, Global Crossing, Akamai, Agilent, Sprint, IBM) provided valuable calibration to 'real world' Internet behavior and practice for academic and laboratory researchers from both the U.S. and Netherlands. The overall theme and discussions centered around analysis of current inter-domain routing system behavior, in hopes of grounding a superior design of the next generation's Internet routing system. Prepared talks and follow-up discussions also covered current and proposed community data collection efforts (a key such current effort is based at [www.ripe.net](http://www.ripe.net) in Amsterdam), as well as verification/calibration across both the data sets and analyses of them for the last two years.

The commercial participants provided insight into how providers overprovision their backbone topologies, and how external routing policy as well as performance measurements affects the engineering of both backbones as well as CDNs (content distribution networks). The mathematicians provided reminders, in the way of inquiry, of the gap that persistently remains between where we are now and a formal model of the real Internet.

One interesting discussion touched on the recent cybersecurity-focused federal government organizations in the U.S., interested in garnering a 'synoptic' view of the Internet. While everyone admits that we do not have a precise definition of what that means, all agree that the first step is attempting to characterize 'normal' Internet behavior, from which we can begin to taxonomize various behaviors we might consider 'abnormal', in terms of stability or service quality.

Topics introduced with preliminary investigation but requiring future attention include:

(1) correlations between:

- (a) DNS and BGP (e.g., ccTLD request behavior with routing changes);
- (b) forward [traceroute] path and reverse [BGP-announced];
- (c) forward and reverse AS paths;
- (d) routing changes and and TCP/UDP performance;
- (e) large-scale Internet worm activity and effects on BGP behavior

and

- (2) predictive topology-based indicators of performance
- (3) more sophisticated analysis of large scale topologies.

Other topics discussed included clarification of prevailing mis-assumptions about routing table growth and churn, and strategies for testing BGP/router performance in a test lab (with suitable forwarding load on the test router).

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We would be eager to collaborate on another workshop in 2003, drawing on the feedback from this year's participants. In particular, we would propose a workshop to help foster collaboration for a recently funded community project: 'Correlating Heterogeneous Measurement Data to Achieve System-Level Analysis of Internet Traffic Trends' (<http://www.caida.org/projects/proposals/nsf98120/>) seeking substantial input (participants) from the mathematics and statistics community, and hopefully with a co-organizer from the Netherlands (Henk Uijterwaal from RIPE is an option). If the Lorentz Center has resources to help sponsor such a workshop once again, CAIDA would be more than happy to oblige. The Lorentz Center has consistently facilitated an intellectually rich experience for all involved.

We find The Lorentz Center to be extremely special: few other places in the world can support and sustain such an environment and retain the vibrancy and vitality of the research energy that Lorentz Center maintains. Because the Lorentz Center provides such a great environment (personal offices, bicycle rentals, hotel funding, local administrative support), it means that as an organizer, I am much more likely to convince workshop attendees that their 'attendance fee' is a sustained future collaboration with a Dutch scientist in the room, as well as assistance with articulating future funding priorities for both the US and Dutch governments. It has worked great for both years that I have participated in Lorentz Center workshops!

KC Claffy (CAIDA, USA)

Scientific Report

## **ASTRO-WISE Course**

# **Developer and advanced user tutorials on Wide-field image pipeline, Python, SQL and Oracle**

October 28 – November 1, 2002

The ASTRO-WISE consortium organized an advanced course about its planned computing system. The course was intended both for developers and for advanced users who plan to write application programmes in the ASTRO-WISE environment. A total of 29 participants from all major ASTRO-WISE nodes and a few external observatories came to the workshop.

During the morning sessions classical tutorials were given, while in the afternoon practical exercises on the many workstations of the Lorentz Center were done, or splinter meetings were held. The highly informal course was a perfect setting for the information exchange so very necessary at this early stage of the development. The future advanced users were introduced the concepts of the ASTRO-WISE environment and the developers were confronted with the specific requirements of users that will in the future operate the ASTRO-WISE pipeline at their ASTRO-WISE node.

Because the participants in this meeting consisted from both the management group and the practical developers a good mix of theoretical and practical design issues could be tackled. This made the meeting highly effective and we could progress rapidly.

Several splinter meeting were held throughout the workshop ranging from management meetings to practical implementation meetings such as the Beowulf splinter. Both the management meetings and the more technical splinters did build on the sequence of earlier meetings held at the different ASTRO-WISE nodes, but due to the concentration at the workshop were highly productive.

All participants indicated the willingness to return to a similar meeting at the Lorentz Center next year.

We are very grateful to the Lorentz Center for both their organizational and financial support.

Erik Deul (Leiden University)

# **First International Symposium on Formal Methods for Components and Objects (FMCO 2002)**

November 5-8, 2002

From the 5th to the 8th of November 2002, 26 invited international scientists, leading experts in the fields of Theoretical Computer Science and Software Engineering, gathered together at the Lorentz Center in Leiden to offer their view of the use of formal methods for object-oriented and component-based systems. They all were invited to the first International symposium on Formal Methods for Components and Objects, organized by Marcello Bonsangue (LIACS) and Frank de Boer (CWI, Amsterdam), Susanne Graf (Verimag, France) and Willem-Paul de Roever (University of Kiel, Germany).

The opening tutorial was by Bertrand Meyer, who discussed the topic of reusable components of guaranteed quality and reported an outline of a Component Quality Model. On the same day, David Harel in his tutorial presented a novel requirements methodology for reactive systems in which scenario-based requirements are 'played in' directly from the system's GUI, and behavior can then be 'played out' freely, adhering to all the requirements. Other invited talks on this first day were about new formal models of components (Farhad Arbab, Martin Wirsing, and Joseph Sifakis) or application of existing reasoning methods to components (Amir Pnueli and Jozef Hooman).

On the second day, Ernst-Ruediger Olderog gave a tutorial in place of Werner Damm on a semantical foundation for UML. The rest of the morning was dedicated to invited talks on existing tools for the verification of Java (Rustan Leino) and component based systems (John Hatcliff). In the early afternoon there were two talks, by Emil Sekerinski and Kaisa Sere, reporting the state of the art of the use of weakest precondition based methods for reasoning about object-oriented systems. The day concluded with an interesting visit to the Leiden museum of ethnology and an exquisite dinner at the Prentenkabinet in Leiden.

On November 7, Clemens Szyperski illustrated in his tutorial the confluence of software components and web services toward the key notion of software as a service. The other tutorial of the day was by Manfred Broy, who presented an example of a fully formally based language for the modeling and the specification of component interfaces, their modular refinement, hierarchical decomposition, composition, and implementation by state machines. The morning of was dedicated to software architecture. Oscar Nierstrasz argued in his talk that difficulties in component based architectures lie on composition rather than on components themselves. In his invited talk, David Garlan explored the connection between software architecture and control system theory in order to design systems capable to adapt themselves reliably at run time. In the afternoon we had three invited talks: Ernst-Ruediger Olderog, Ugo Montanari and Leslie Lamport. The latter argued that many popular fads, including architectural properties like reusability and modifiability, are found to be irrelevant to high-level specification.

On last day, Perdita Stevens discussed the implications for future tools of her vision of a software development process as a game, involving strategizing, exploring options, and balancing objectives. UML (Bernhar Rumpe) and coordination (Paul Klint) have been the topic of the morning session, while the afternoon session was entirely dedicate to Java, with invited talks by Bart Jacobs, Gary Leavens and Erika Abraham-Mumm. The closing tutorial was by Jos Warmer, who explained the role of the Object Constraint Language in the Model Driven Architecture.

It was an exciting symposium, a place to learn of the great wealth of research currently taking place, and to meet with those researchers who are at the cutting edge. The 95 participants, from more than 15 countries, guaranteed for lively discussions. The Lorentz Center guaranteed for a nice and informal working space and meeting point among the speakers, who have highly appreciated the local organization.

Marcello Bonsangue (Leiden University)

## **Radio Galaxies – past, present and future**

November 11-15, 2002

This workshop was held at the Lorentz Center on November 11 to November 15, 2002. The number of participants was around 55, with a large component coming from the UK, but with many others from the USA, France, Germany, Canada, Australia as well as The Netherlands. All administration was handled by the Lorentz Center, in particular Gerda Filippo and Martje Kruk. Scientific matters was organized by Dr. Matt Jarvis and Dr. Huub Röttgering from Sterrewacht Leiden.

The workshop was the first for five years, which concentrated solely on radio galaxies and radio-loud active galaxies. The workshop was split into 6 main areas, these were (i) inside the host galaxy, (ii) cosmological evolution and triggering, (iii) the gaseous environments, (iv) clusters and large scale structure traced by radio galaxies, (v) radio surveys and (vi) future prospects. We had review speakers in all of these fields as well as a large number of contributed talks.

It became very apparent at an early stage of the meeting that there has been a huge number of advances in our knowledge of radio galaxies over the last few years. Also highlighted were ways in which to probe wider cosmological questions using radio galaxies, the most fruitful of which being the ability to trace large scale structure using radio galaxies as beacons, work at high redshift, which has been pioneered somewhat by the Leiden group.

However, it was also clear that this was not the only advance in the last few years. We are now at a stage where we are able to probe the mass of black holes in these objects by various means and to investigate why these galaxies produce such powerful emission at radio wavelengths (which cannot solely be a function of black-hole mass and/or accretion rate). New and exciting simulations were also presented in which the structure of radio sources could be explained, a problem which has been around since the first radio galaxy was discovered and which is still not fully understood now.

For the summary of the workshop we chose to adopt a strategy which would bring out the most exciting (and amusing) moments from the meeting. For this we asked four PhD students to guide the summary with the help of a senior figure. This worked very well and brought some amusement to the end of the meeting when various comments made during the week were alluded to.

After some very positive feedback from the participants we believe the workshop was both enjoyable and scientifically stimulating. The proceedings of the workshop are to be published in *New Astronomy Reviews* in mid-2003.

We thank the Lorentz Center for all of the help in organizing this successful workshop, much of which would not have been a success without such help.

Matt Jarvis (Leiden University)

Scientific Report

# **Branes and Cosmology**

November 18-22, 2002

The aim of this workshop was to bring together, in an informal atmosphere, scientists from the theoretical physics and astronomy community to discuss the most recent developments at the interface of strings/branes and cosmology, in particular the Randall-Sundrum scenario, the brane cosmology, the recent observational constraints from astronomy and the de Sitter/CFT correspondence.

The workshop was structured around two one and a half hour talks per day on the whiteboard with informal discussions afterwards. The speakers were, in chronological order: Vafa, Gregory, Turok, Sakellariadou, Gibbons, Bachas, Sanders, Fischler and Balasubramanian. The topics included braneworlds (Gregory), cyclic universes (Turok), models versus experiments (Sakellariadou, Sanders), de Sitter spaces (Balasubramanian) and tachyon cosmology (Gibbons).

During all talks the speakers were frequently interrupted with questions leading to animated discussions. The schedule was flexible enough to allow for such discussions. The total number of participants was around fifty, which is just right for this kind of workshop. Due to this set-up all speakers and the remaining participants were accessible for extended informal discussions with each other. This is also what actually happened and which was highly appreciated by speakers and participants. In this sense the Leiden workshop clearly distinguished itself from the standard conference format where there are much more talks, transparencies are used and there is less time for discussions.

On Wednesday evening one of the speakers, Neil Turok, gave the Ehrenfest colloquium in which he gave an overview of the present status of cosmology versus experiment and where he described his so-called cyclic universe scenario. In this way the workshop was also exposed to a wider audience.

The reactions received by the participants afterwards were very positive and the high quality infrastructure of the Lorentz Center (offices, computers, printers, secretaries, etc.) were much appreciated.

Eric Bergshoeff (Univ. Groningen)

# **Representations of Lie Groups, Harmonic Analysis on Homogeneous Spaces and Quantization**

December 9-13, 2002

This concentration period (rather than a workshop) aimed to mark a point of reflection in a longstanding cooperation program, under the same title, of Leiden University with universities in Moscow, St. Petersburg and Tambov. Its purpose was twofold:

- to discuss what had been achieved so far
- to draw new lines of research for the future.

We had therefore brought together about 35 specialists in the subjects of the title from all over the world. A main topic was the study of weighted Bergman spaces, Berezin kernels and quantization, but also contributions from other related branches of mathematics were discussed. Though there were several lectures, the emphasis was on discussion and interaction. Young scientists were particularly encouraged to take part in the concentration period.

The atmosphere in the workshop was excellent. Plans for new projects were made during the meeting and future visits and meetings were discussed as a result of the workshop. There was also great support to publish proceedings of this meeting. We are in contact with two publishers (one agreed already) about the precise format of the proceedings. A main item was also the unanimously felt success of the program of cooperation with the Russian Federation. We shall opt, if possible, for a continuation of this program.

The facilities of the Lorentz Center were very much appreciated by the participants. In particular the Russian participants felt to be in paradise. But also the colleagues from other countries praised the common room, the separate offices with computers and the large room for presentations. 'I would that my university had such a center', was a spontaneous reaction by one of the participants.

As usual, the support of the staff of the Lorentz Center was excellent.

The concentration period was made possible thanks to financial support of the Lorentz Center and NWO: Cooperation program with Russian Federation

NWO – EW

Thomas Stieltjes Institute for Mathematics  
Mathematical Institute Leiden University

G. van Dijk (Leiden University)

## **The Atacama Large Millimeter Array: science related issues**

December 18 – 20, 2002

The Atacama Large Millimeter Array (ALMA) project is an international collaboration between Europe and North America to build an array of 64x12m telescopes that will operate at millimeter and submillimeter wavelengths at the high-altitude (5000m) Chajnantor site in Chile. It will provide a major leap forward in (sub)millimeter astronomy, allowing fundamental questions in the formation of galaxies, stars and planets to be addressed. The aim of the Lorentz Center workshop was three-fold:

1. stimulate interaction between the ALMA and Herschel-HIFI communities on issues of common interest, in particular calibration, data analysis and modeling;
2. discuss face-to-face the workplan for the European ALMA science team in 2003, in particular regarding calibration;
3. develop plans for ALMA proposals in connection with the EU FP6 Framework announcement of opportunity.

The first day of the workshop coincided with the last day of a large meeting at Leiden on the science program for the HIFI instrument on the Herschel Submillimeter Observatory. This mission will fly in the same timeframe ( $\geq 2007$ ) as when ALMA becomes operational, and there is a large synergy between the scientific programs for these two facilities. The program on Wednesday afternoon centered around preparatory studies for both missions, ranging from the availability of line catalogs to modeling tools. It was clear that both ALMA and HIFI will benefit from the ongoing activities.

The morning of the second day focused on calibration issues. Two introductory talks presented the calibration methods for the two facilities. Herschel-HIFI has the advantage that it is above the Earth's atmosphere (the main source of uncertainty for ALMA), but ALMA has the advantage of much higher sensitivity and spatial resolution. An in-depth presentation on the uncertainties of the primary calibrators for both missions (the planets Mars and Uranus, asteroids) was given by B. Butler. The subsequent discussion focused on how the two missions may benefit from each other (e.g., ALMA mapping and tracking the secondary calibrators for HIFI), and it was agreed to keep each other informed by assuring that the relevant people are on each other's mailing lists.

Thursday afternoon was devoted to a presentation of the antenna configuration design by J. Conway, which is now in its final stages, followed by a discussion on the science team tasks for 2003. This was also the time for informal discussions, making excellent use of the Lorentz Center offices and facilities. In parallel, discussions on an ALMA proposal within the Marie-Curie framework 6 program continued in the Lorentz Center offices.

Most of Friday was devoted to progress reports on the European ALMA science team tasks. These ranged from a lively discussion on science examples for calibration, to in-depth presentations of the different absolute calibration methods, the construction of water vapor radiometers and associated modeling tools, and the development of an ALMA simulator.

The meeting was attended by  $\sim 20$  scientists from many different countries. On behalf of the ALMA science team, I would like to thank the Lorentz Center for the hospitality and financial support. I have received positive feedback from many people, and all participants were highly impressed by the Lorentz Center facilities. It is likely that one of them will put in a proposal for another ALMA-related workshop in the future!

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