HGSFP

NEWSLETTER

Heidelberg Graduate School of Fundamental Physics

No. 6/February 2011

Main Topics:

- Students report back
- IMPRS-PTFS inaugurated
- The Penning precision mass spectrometer
- Personalia
- Planets formed out of cosmic dust
- Atom interferometry beyond classical limits

Editorial

We are pleased to note that some of the ideas in the Graduate School have now become fixed events, that are enthusiastically planned by their respective organisers. On the one hand, the Winter School, organised by the students themselves, has become an event not to be missed, while the »Graduate Days« have settled into becoming an event that many are keen to attend. Through the student representatives, we are getting clear messages of what we can and should improve.

Most importantly, we are pleased that the scientific output of our students and staff is of the highest standards, and we encourage you to continue on this road of development. Do keep in mind that you are warmly welcome to provide contributions and feedback to us at any time.

Sandra Klevansky and Markus Oberthaler

Students report back

The most recent of the student projects was the long awaited HGSFP Soccer Cup 2010. Already much of a fun event in the past, it was recently revived and was a big success - especially for the team from the MPIK (see photo) that won the challenge cup and will organise the next tournament. During the last month, the HGSFP has hosted another popular student event, namely the winter school from 16th to 20th of January. It has taken place for the fourth time, which means that it is now a well-established part of Graduate life in our school. This time the organisers even managed to increase the number of participants.

Having worked on the *»Supervision Guidelines for the HGSFP«* for quite a while, they finally passed through the department boards and will soon be distributed to the students and the supervisors. The document itself presents a set of rules from which we all will hopefully benefit in a sense that it clarifies several aspects related to doctoral studies.

The MPIK team wins

These student projects form an essential part of the Graduate School and there is always room for more participation and active contribution. Whenever a good idea for a well-suited project crosses your mind please come forward with suggestions!

Now it is time to pass the torch to the newly appointed student representatives, Raoul Haschke and Steffen Wetzel (see photos overpage), who will be your contact persons for the next year. Please approach either of them with your ideas, worries and considerations related to doctoral life in general or in your particular case. There is a special email address for contact: studentreps@gsfp.uni-heidelberg.de

We, the outgoing representatives, would like to thank the HGSFP students for enabling us to work for and hopefully improve the Graduate School!

The new representatives would like to appeal to all: »We are more than 250 doctoral students in the HGSFP. If every single student contributes one idea or one suggestion this year, we will improve the HGSFP a lot!« ◀

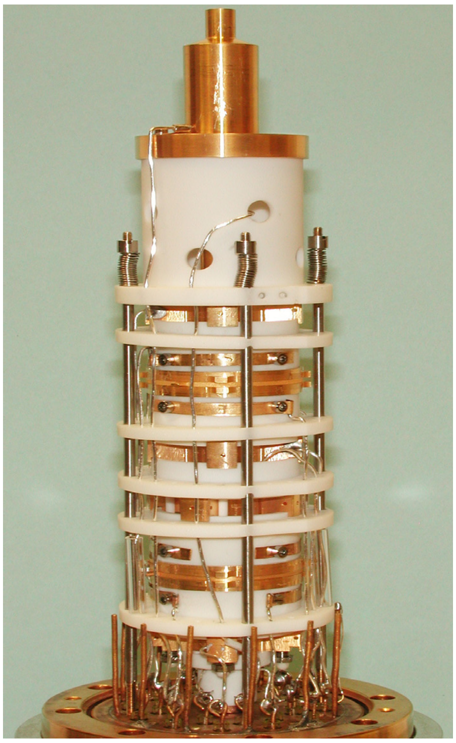
IMPRS-PTFS inaugurated

On November 2nd 2010, the inauguration of the International Max Planck Research School for Precision Tests of Fundamental Symmetries (IMPRS-PTFS) took place at the Max Planck Institute for Nuclear Physics (MPIK). The new school covers theoretical and experimental aspects in precision particle, nuclear, atomic and astroparticle physics and is a joint effort of the MPIK and the University of Heidelberg. Spokesperson Prof. Manfred Lindner opened the ceremony in the Otto Hahn Lecture Hall followed by the inauguration lecture *»What can we say about the Higgs boson mass?«* given by Humboldt laureate Prof. Mikhail Shaposhnikov (Lausanne). ◀

Prof. Mikhail Shaposhnikov at the inauguration ceremony of the IMPRS-PTFS

Penning precision mass spectrometer

Originally developed at the University of Washington in Seattle, the Penning Trap Mass Spectrometer now fully commissioned at MPIK is dedicated to a precise determination of the mass-ratio of ^{3}H to ^{3}He, from which the mass difference of these two nuclei connected by beta-decay and the corresponding energy release of the decay can be derived. Such an independent measurement of the Q-value will serve as an important systematic check in the determination of the antielectron neutrino mass by the Karlsruhe Tritium Neutrino Experiment (KATRIN), the results of which are expected to have fundamental importance for particle physics. ◀



The heart of the mass spectrometer: The trap tower consisting of trap and transport electrodes sits on top of a vacuum flange with electrical feedthroughs for electrode biasing and signal pickup.

Cornelis Dullemond

Christian Groß

Raoul Haschke

Steffen Wetzel

Personalia

■ In this edition of our newsletter, we profile Cornelis (»Kees«) Dullemond, who has joined us as a new professor, profile one of our alumni and introduce Raoul Haschke and Steffen Wetzel, who are our new student representatives.

Cornelis (»Kees«) Dullemond, a theoretical astronomer, works in the field of protoplanetary structure, which is sketched in an article below. Cornelis Dullemond's formative years were in the Netherlands, where he completed his schooling and his university studies in physics at the University of Amsterdam. His master's thesis was on solitons in string theory at NIKHEF. Following this, he turned to astronomy, completing his doctoral thesis on »Radiative transfer in compact circumstellar nebulae«. He then moved to the Max Planck Institute in Garching, doing research there in the period 1999-2004. After this, he moved to the Max Planck Institute for Astronomy in Heidelberg, where he has been up to this year. He has taken up a position as Professor at the Institute for Theoretical Astrophysics (ITA) at the University of Heidelberg since October 2010, and we are pleased to welcome him as an active member of our School.

Alumni: In this edition of our newsletter, we profile one of our alumni, Christian Groß, an experimental physicist, who completed his doctoral degree at the HGSFP in 2010. Christian Groß studied physics at the University of Mainz, where he received his Diploma in 2006. During his graduate studies at the Kirchhoff Institute of Physics he worked in the group of Markus Oberthaler on entangled quantum states in Bose-Einstein condensates to obtain his doctorate. In 2011 he will move on to the group of Immanuel Bloch at the Max Planck Institute of Quantum Optics in Garching where he has obtained a position as a junior group leader. We wish him and our other alumni much success on their chosen paths!

New to the Directorate of the HGSFP are our two student representatives, Raoul Haschke and Steffen Wetzel. Raoul Haschke's interest in astronomy started early on in life. He is currently working in the observational branch, determining distances and structures of the Magellanic clouds. He is based at ARI.

Steffen Wetzel is doing his doctorate in the group of Annemarie Pucci at the Kirchhoff Institute of Physics. His project deals with the development and physical origin of infrared spectral features that arise during condensation and solid phase reactions of Fe in Mg silicate systems. The work is related to laboratory astronomy, as the results from their experiments are also aimed at contributing to improve astrophysical modelling.

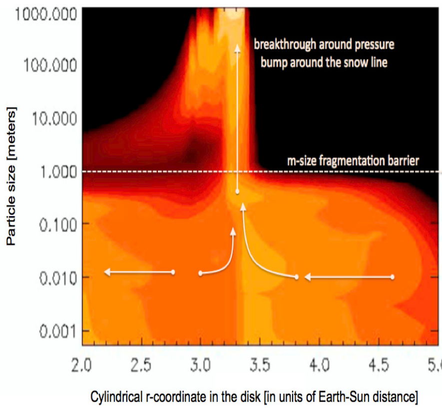
We look forward to new ideas from our student representatives! ◄

Planets formed out of cosmic dust

■ The research of Cornelis Dullemond focuses on the question how planets are formed out of cosmic dust, both the planets in our own Solar System as well as planets in exoplanetary systems. This is a challenging problem because it covers growth from particles smaller than a micron to planets of many thousands of kilometers radius. This involves over 13 factors of ten in size, or in other words: one has to stick 10^{40} particles together to form a single planet. His research involves developing new methods and numerical algorithms to study this problem, and to compare the results of these models, through the use of radiative transfer programmes, to observations obtained with the most powerful telescopes today: The Very Large Telescope, the Spitzer and Herschel Space Telescopes, and in the next years the Atacama Large Millimeter Array in Chile. Results of a model calculation are displayed in the figure. ◄

You're welcome:

... to send us suggestions of topics which you would like to be mentioned in the next newsletter: info@gsfp.uni-heidelberg.de



Above: Model of the formation of kilometer-size »planetesimals« out of cosmic dust in a disk surrounding a young star. X-coordinate: the radial coordinate in the disk (distance from the center). Y-coordinate: the particle size. The colour (the »z-coordinate« so to speak): How much of the solid mass is in the form of particles at that radial position and that particle size is shown in a snapshot at some time during the process. Particle growth would mean that movement of the »colour« toward the top of the diagram occurs. Growth is evidently not possible due to the »meter size barrier«, except at x=3.3, where material is attracted, concentrated and breaks through the barrier, thus forming planetesimals.

Atom interferometry beyond classical limits

■ The precision of conventional interferometers – either optical or atomic – is limited by quantum projection noise. This is the »classical« bound, often called the shot-noise limit, imposed by the granularity of independent particles used in a measurement. However, this limit is not fundamental and can be surpassed by the use of many particle entangled quantum states in the interferometer.

In the work of Christian Groß in the group of Markus Oberthaler, such a non-linear interferometer with ultra-cold atoms that uses a »spin-squeezed« entangled state as its quantum resource was realized. »Spin squeezing« means that quantum fluctuations are redistributed among two conjugate variables, i.e. two orthogonal spin directions that map to relative atom number and phase fluctuations. By suppression of quantum phase noise – most critical for the performance of interferometers – they achieved a precision 15% above the classical shot-noise limit.

Their measurement shows that entanglement can indeed be used as a resource for quantum metrology with atom interferometers. ◄

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