



Dear Readers,

June is the month of football. 16 teams will fight to win the silver cup of the European Championship. The ingredients for success: You need players with top performance, commitment and good tactics. An even more important factor is to form an effective team – a virtue also required in science. The Large Hadron Collider (LHC) at CERN provides a good example. The development of ATLAS, one of the major experiments designed to discover the Higgs particle and the nature of Dark Matter, has involved more than 2100 scientists from 169 institutes in 37 countries, including Garching-based MLL (s. page 3.) The LHC will reach its final temperature of 1,9 Kelvin by the end of this month and following some more preparations we can expect the first collisions at maximum energy in spring 2009. So let's keep our fingers crossed for breakthrough results – and, of course, also for our football teams!

Barbara Wankerl, Public Outreach Coordinator

## PICTURE OF THE MONTH



This test bar plays an important role in experiments to determine the neutron life time and its electric dipole moment. Those experiments are conducted by the TUM chair for Experimental Physics, E18, to support the research of the origin and structure of the universe. The photo was taken at the end of April during an experimental phase at FRMII. To learn more, please read our article in "Highlights".

## HIGHLIGHTS

### New functional experiments for the Ultra-cold Neutron Source



Measurement of the phonon density of states of the solid deuterium with the TOFTOF spectrometer at FRM II.

Supported by the Excellence Cluster Universe, a new source for ultra-cold neutrons (UCN) is currently being installed at the FRM II reactor in Garching. At the end of April, the chair for Experimental Physics (E 18) at TUM conducted preparing experiments. One of the experiments, using the TOFTOF spectrometer at the FRM II, was the measurement of the phonon density of states of the solid deuterium. This is a key parameter concerning the UCN production rate.

Neutrons play an important part in the formation of the Universe as we know it today. With the Universe cooling down from initially  $10^{32}$  to  $10^{12}$  Kelvin free quarks combined to build neutrons and

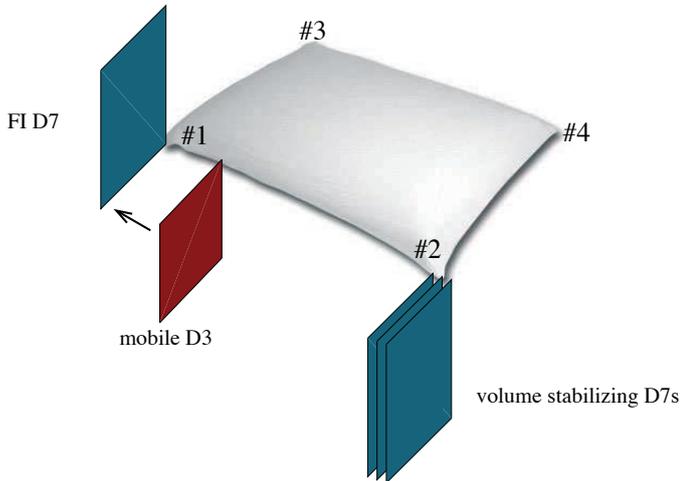
protons. In the primordial nucleosynthesis the fusion of neutrons and protons formed helium and lithium as first chemical elements. Also, the dipole moment of neutrons is a likely candidate for the matter over antimatter asymmetry in the universe: It is due to symmetry violation that matter could prevail. Therefore, the investigation of neutrons is an important research issue at the Excellence Cluster Universe.

The spectrometer TOFTOF uses the direct time-of-flight method in order to select the incident energy of the neutrons in the primary spectrometer as well as their final energy in the secondary spectrometer. The measured signal consists not only of the energy transfer to the sample, but also of the momentum transfer. Since a large energy and scattering angle range can be traced simultaneously, much more information about the dynamics of the sample can be picked up in short time. The data analysis of the first TOFTOF experimental run is in progress. First results show distinct differences to the theoretically calculated phonon density of states. Detailed results will be published as soon as the data analysis has been finished and cross-checked.

The next step will be the installation of a Helium cooling system to produce liquid Helium at a temperature of 4,2 Kelvin. In parallel, the scientists at UCN source are preparing a safety report and performing tests on a converter prototype. Also, the detailed design is currently being completed. The installation of the UCN source at the FRM II is planned for 2009, the start of operation is expected for the end of 2010.

## New string theoretic explanation of Cosmic Inflation

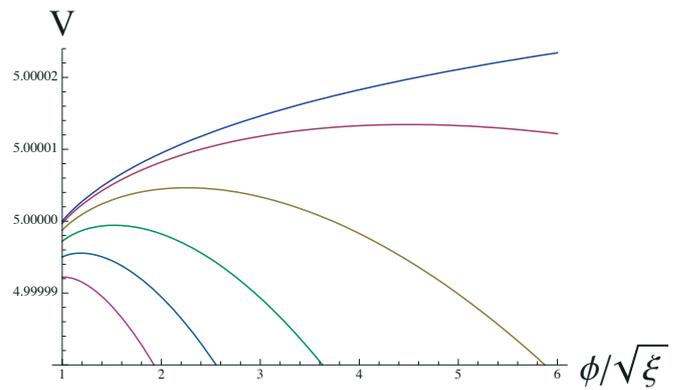
Dieter Lüst, the Coordinator of Research Area A (Planck Scale & Strings), is co-author of a paper that provides an updated and refined analysis on how inflation can arise from strings and branes. In a co-operation renowned string theorists and cosmologists\* investigated the role of D3/D7-branes for inflationary scenarios. They were able to show how D-branes on a special manifold can cause inflation with testable predictions.



This figure shows a simple model of the setup of D3- and D7-branes: The  $Z_2$  operation has 4 fixed points on  $T^2$  and the space  $T^2/Z_2$  has the shape of a pillow with the fixed points at the corners, marked by #1 to #4. At one of the fixed points (#1) there is a single D7-brane (called F1 D7 in the figure) on which a non-selfdual world-volume flux is turned on, breaking supersymmetry.

In their publication the group focused on a revision of the D3/D7-brane inflation model allowing for explicit calculations of the relevant quantum corrections. Moreover, this scenario displays phenomenological properties that are very interesting in view of some recent work on cosmic strings and the cosmic microwave background (CMB). The NASA/ESA satellite WMAP recently delivered new results on observations of the CMB, called WMAP5. Furthermore, current data of the ACBAR experiment, a multi-frequency receiver to measure slight temperature differences in the CMB, have shown that there is an excess power at some specific multipole moments. This finding might indicate an evidence for the existence of cosmic strings with tensions near the observational bounds.

The scientists studied the D3/D7-brane inflation model on a well-investigated background metric  $K3 \times T^2/Z_2$  that is characterized by a high computability. This model provides a valuable laboratory in a controlled setting to investigate various features shared by many of the contemporary string theoretical models on inflation. An important result concerns the inflaton, the presumed bosonic field responsible for cosmic inflation. The inflaton field significantly depends on the torus geometry  $T^2$  but is independent of its volume. The model parameters can be chosen such that they fit the WMAP5 observations, e.g. the observed value of the spectral index  $n_s$ . Therefore, cosmic inflation might be interpreted as a string theoretical phenomenon.



This picture shows the inflaton potential, which is computed from the attractive force between the D3 and D7-branes. This potential depends on the choice of basic parameters of the model, and includes computable string quantum corrections, which result in a non-vanishing mass term for the inflaton (the distance between the D3 and D7-branes on the internal torus). Specifically, the different curves correspond to different values of  $m^2$  (the upper curve corresponds to  $m^2 = 0$ , i.e. vanishing quantum corrections). For all sufficiently small  $m^2$ , the potential acquires a maximum, which allows the regime of eternal inflation starting from the top of the potential.

\* Michael Haack (LMU), Renata Kallosh (Stanford), Axel Krause (LMU), Andrei Linde (Stanford) and Mario Zagermann (MPP)

Link to the publication: <http://arxiv.org/abs/0804.3961>

## Cluster Awards Outstanding PhD Theses

PhD students now have the chance to win a prize for their doctoral theses. The Excellence Cluster will award two outstanding dissertations in the fields of nuclear, particle and astrophysics per year. The prizes will be awarded for an experimental and a theoretical thesis, respectively. Each prize is endowed with 4000 Euro. This year's awardees will have the opportunity to present their theses at the Cluster's Science Week (1-5 Dec. 2008).

Participation is open to all doctoral students who completed and submitted their dissertation between 1 October 2007 and 1 October 2008. Candidates cannot apply for the award on their own initiative, but have to be suggested by their supervisors. These need to be members of the Excellence Cluster Universe. Supervisors have to submit a maximum two-page statement on behalf of the nominees.

Closing date for nominations will be 1 October 2008. The winners will be chosen by a committee of the Excellence Cluster Universe.

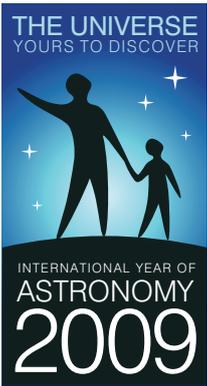
Nominations for the awards should be directed to:

Excellence Cluster Universe  
Dr. Andreas Müller  
Boltzmannstr. 2  
85748 Garching

E-Mail: [andreas.mueller@universe-cluster.de](mailto:andreas.mueller@universe-cluster.de)

## EVENTS

### IYA 2009 – The Current Global Status



On 11 June 2008 the organizers of the International Year of Astronomy (IYA 2009) will give an overview on the status of the worldwide activities for this event. The meeting will be held on 11 June from 14:00 to 14:45 at the ESO Auditorium in Garching, (Forschungszentrum Garching, Karl-Schwarzschild-Straße 2).

IYA 2009 was launched by the International Astronomical Union (IAU) with the claim "The Universe, yours to discover". 2009 marks the 400th anniversary of Galileo Galilei's first astronomical observation through a telescope. The IYA will be a global celebration of astronomy and its contribution to society and culture, with a focus on education and public engagement with events at national and global levels throughout the whole of 2009.

More information on the IYA 2009 can be found at <http://www.iau.org>

### Cluster participates in "Science Mile" at Munich's 850-year-anniversary



In 2008 Munich celebrates its 850th birthday – and organizes a huge celebration event in the heart of the City on the weekend of 19/20 July 2008. This includes a Science Mile on Marstallplatz (just behind the Opera House).

Along with other research institutions the Excellence Cluster Universe presents a program especially for kids and families. Under the motto "Fascinating Universe" the visitors learn how stars are born and die, what experiments scientists use to understand cosmic puzzles and why umbrellas don't protect from cosmic radiation showers ...

Information on the Altstadttingfest at <http://www.muenchen.de/Rathaus/850jahre/programm/altstadtring/211903/index.html>

### Meetings in Research Area G

Following a general Research Day on 30 April 2008, RA G invites its members for a meeting on "Nuclear Physics and Astrophysics concerning  $^{60}\text{Fe}$ " on 15 July 2008 at the MPE Seminar room. It is widely assumed that the radioactive iron isotope  $^{60}\text{Fe}$  is ejected by supernova explosions. This workshop will discuss open questions on the generation of  $^{60}\text{Fe}$  and supernova frequencies in our galactic neighborhood. The program starts at 9:30 and ends at 13:00 followed by lunch for all participants.

Program of the day: <http://www.universe-cluster.de/MaKaC/conferenceDisplay.py?confId=623>

### Introductory Course on Particle and Nuclear Physics

From 16 to 20 June 2008 Cluster Coordinator Stephan Paul will give an introductory course on particle and nuclear physics. The purpose of this lecture is to make non-experts familiar with the basics and current research questions in this research field. It is intended to help astronomers/cosmologists to efficiently interact with the nuclear/particle physics community in the Cluster. The lecture will take place in the new seminar room in the basement of the Cluster building.

Details on the lecture program: <http://www.universe-cluster.de/MaKaC/conferenceDisplay.py?confId=493>.

### Scientific Program with Lectures, Talks and Colloquia

<http://www.universe-cluster.de> ->Events

### MLL Day on 15 May 2008



With the tandem accelerator and other instruments the Maier-Leibnitz-Laboratorium (MLL) is a vibrant hub in experimental and theoretical nuclear, particle and astro-particle physics – this became clear at this year's MLL Day on 15 May. The Universe Cluster supports start-up investments for new projects at the MLL, e.g.



Reiner Krücken

the building of the ultra-cold neutron (UCN) source.



Dorothee Schaile

As a joint lab of TUM and LMU, the MLL contributes to a number of large experiments as LHC at CERN or Borexino in the Gran Sasso Lab and was "the incubator of the Excellence Cluster Universe", as MLL director Reiner Krücken put it. More than 100 participants were then provided with an update on current research at MLL, spanning from "classical" nuclear physics and ion beam applications to astro-particle physics and string cosmology. In her talk, Dorothee Schaile, the Coordinator of Research Area B, gave an update on the roadmap of the ATLAS detector in the Large Hadron Collider (LHC) at CERN, stressing MLL's support in obtaining third party funds. Stephan Paul, → next page

⇒ the Coordinator of the Excellence Cluster Universe, presented the roadmap and progress of the UCN source. He pointed out that the FRM II reactor in Garching offered all experiments required for particle physics with neutrons. The major challenge to face now was “to become the global leader in the UCN field”. However, the application areas of MLL are not limited to purely physical experiments. The instruments are also used in interdisciplinary research, e.g.

for biological experiments to investigate DNA repair mechanisms and in materials research. Further experimental scenarios emerge in the field of laser acceleration and applications. In his talk, Dieter Habs from the MAP Cluster reported on recent experiments relevant for medicine and energy generation. As every year, the event was concluded with a traditional “Bayerische Brotzeit” offering the ideal setting for discussions on the talks of the day.

## PEOPLE

### Welcome to the Cluster!

#### Guests:

Prof. Dr. Lih Sin The (Clemson University, USA), RA G, 17.05. – 27.06.08 ++  
 Dr. Elena Gallo (UC Santa Barbara, USA), 16.06. – 27.06.08 ++ Prof. Skigeki Sugimoto (Nagoya University, Japan), 28.06. – 12.07.08 ++ Prof. Hiroshi Toki (RCNP/Osaka University, Japan), 01.07. – 31.08.08 ++ Prof. Anatoli Afanasjev (Mississippi State University), 08.07. – 11.07.08 ++ Prof. Georgios Lalazissis (Aristoteles University, Thessaloniki), 07.07. – 31.07.08



Andrea Merloni

### Interview with Andrea Merloni

In April 2008, Dr. Andrea Merloni, previously a Postdoctoral research assistant at the Max Planck Institute for Extraterrestrial Physics (MPE), has joined the Excellence Cluster Universe as Research Fellow. Born and educated in Rome, Merloni received his PhD from the Institute of Astronomy at Cambridge University. He will be part of

the Cluster’s research area F “Black Holes”. Within the next two years he plans to study the physical relations between the various energetic processes involving astrophysical black holes and their impact on the structure and appearance of their cosmological environments.

*In April you have joined the Excellence Cluster Universe. What are your expectations?*

*After five years spent in two different Max-Planck Institutes here in Garching I came to know quite well the largest, and probably most important astrophysics center in Europe. The Excellence Cluster represents a great opportunity to strengthen connections among various groups and individuals within this unique community and with other physicists active in the Munich area. I do expect to learn new ideas and ways of doing science that can enrich and stimulate my own research. At the same time, I hope I can contribute to make such a large community of scientists more aware of each other’s work, prospects and methodologies. In a few words, I see the Excellence Cluster as a chance to encourage advancement of science through coordinated and collaborative efforts, rather than in isolation. Playing an active role in such an endeavor is both a challenge and a unique opportunity.*

*You are part of RA F, which aims to solve the question how black holes formed and evolved. What will you contribute?*

*I have always tried to give my research activity some breadth and perspective. One of the most important results of my recent work has been the establishment of a unified framework, both theoretic-*

*ally and observationally, to interpret the properties of black holes of very different masses. These range from the small stellar remnants in our own Milky Way, with a mass slightly larger than our sun, to the true giants lurking in the center of other, distant galaxies, with masses as large as a billion times the sun. My research will continue investigating the physical connection between black holes of different classes, trying to solve the puzzle of how, and in what forms, energy can be released by matter falling onto their horizons. My next frontier, however, is the understanding of the deeper role black holes may have in shaping the observable Universe over cosmological timescales. I am currently involved in a project trying to constrain, as accurately as possible, the history of the growth of the black hole population as a whole. A fundamental aspect of such a project is the need for coordinated efforts from theorists and observers active in almost all wavelengths domains. In this view, my position in Garching, and within the Excellence Cluster in particular, is a great advantage.*

*You have spent the last five years in Munich.*

*Do you already feel local?*

*I was born and bred in Rome, and there are probably few other cities in the world that leave an imprint on its sons as strong as Rome does. However, Munich welcomed my family and me like no other place. For me, summer afternoons at the Englischer Garten, or the visits to a Biergarten after a day of work, the amazing architectures of the Olympia Park, or the view of the Alps on my way back home in the evening are now an essential part of my life as much as Roman piazzas are.*

## LINKS

Get in touch with Europe: *signandsight* is an online cultural magazine that translates outstanding articles by non-English language authors bringing them to a worldwide audience. It features articles on a variety of topics, aiming to foster trans-European debates. It is the English language service of *perlentaucher.de*, a German online service for all those who’re interested in culture. [www.signandsight.com](http://www.signandsight.com)

Philip Plait is not a bad astronomer – he just writes about astronomy that is bad. Besides, he has given up research and now dedicates himself full-time to writing about science. In his blog he covers science related themes including how science has been and is being misused and misrepresented. [www.badastronomy.com](http://www.badastronomy.com)

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