NEWSLetter
Excellence Cluster Universe

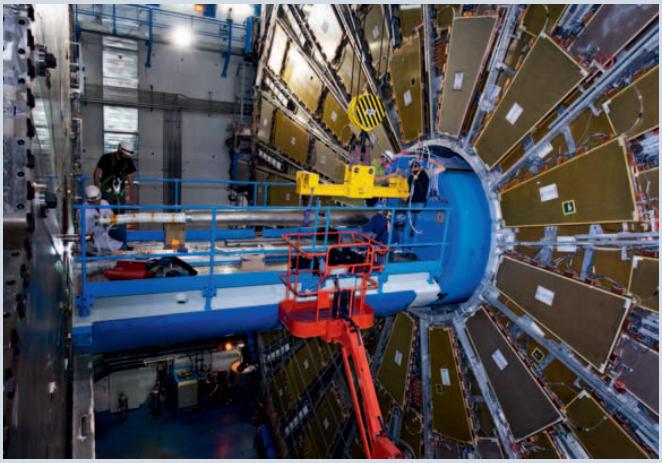
Issue 3 August 2008

Dear Readers,

in these days, NASA is celebrating its 50th anniversary. What began as a cold war project to catch up the Soviet head start in the space race, is now the world's biggest organisation for astronomical research. Both as a partner and a stand-alone player, NASA contributes to ambitious space-based telescope projects like Hubble and GLAST, as well as planetary and spatial explorations by unmanned probes, shuttle missions and so on. From high in the sky to a subterranean experiment: We want to take you 100 meters below the earth's surface to CERN and give you an update on the ATLAS detector at the LHC. Scientists all over the world – of course also in the Universe Cluster – are waiting for the first proton beams to happen there. Back on the earth's surface, the Cluster is excited to grant about € 1.000.000 for additional projects in 2008. A good start and great success for all of them!

Barbara Wankerl, Public Outreach Coordinator

PICTURE OF THE MONTH



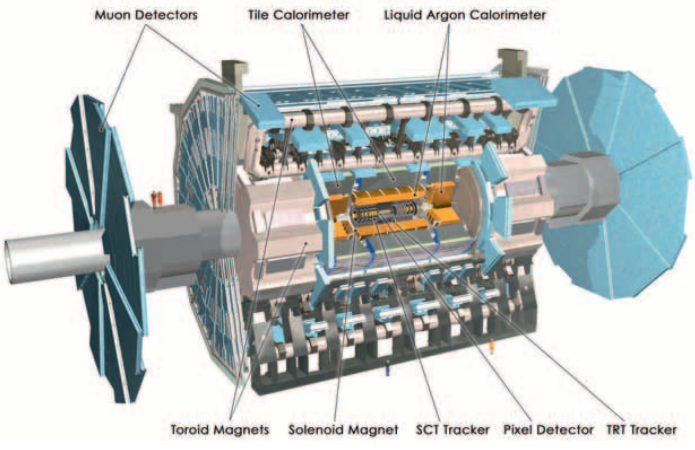
Last works at ATLAS

The installation of the beam pipe at the ATLAS experiment is one of the last major works done in the LHC. Currently, each of the eight sectors is in the final stages of cooling, electrical testing, equipment testing and powering. The current plan is to have the machines ready for the first circulation of a beam in a few weeks.

HIGHLIGHTS

Muon Spectrometer in ATLAS: All Pieces in Place

The ATLAS experiment has now been furnished with its complete outer shell, the muon spectrometer. A couple of weeks ago, the working groups involved in the project announced the installation of the last detector module in the barrel spectrometer. Scientists of the Cluster's Research Areas B and C* made a major contribution: They designed, constructed, commissioned and installed 88 high precision muon detector modules in the spectrometer. In total, 656 muon detector modules of sizes ranging from half a square meter up to 11 square meters were mounted within a 41-month period. Altogether these modules cover an area the size of several football fields.



The structure and the different layers in the ATLAS detector

ATLAS consists of several detector layers wrapped around the accelerator tube, the outermost being the muon spectrometer. They will track the particles and measure their energies resulting from proton-proton collisions. But why is it important to hunt muons when everybody is looking for still undetected particles?

LHC and ATLAS

ATLAS is the largest of four major experiments of the Large Hadron Collider (LHC) at CERN. The protons in the LHC will collide at the highest energies ever been produced in a particle accelerator. Expectations run high for LHC and ATLAS: Scientists all over the world hope to detect the Higgs boson. This particle would solve the question, why the basic matter particles have different masses. Furthermore, ATLAS will allow scientists to look for supersymmetric particles and investigate the substructure of known particles.

"Muons are elementary particles that belong to the family of leptons in the standard model of particle physics. As the electrons – their more prominent relatives in the lepton family – they are electrically charged, but have about 200 times their mass. Isolated high-energy muons are typical signatures in new physical phenomena", explains Otmar Biebel. One of those events might indeed be the detection of the Higgs boson. These particles may decay into two Z-bosons followed by the formation of four muons. Therefore, the muon spectrometer will play an important part in the discovery of new particles by ATLAS. Besides its impressive size the muon spectrometer also has a magnetic field of its own to deflect the electrically charged muons. In contrast to the inner detector systems this magnetic field doesn't run parallel to the proton beam, but in concentric circles ⇨ *next page*

around the accelerator tube. This toroidal magnetic field is induced by 8 large superconducting coils that measure 25 meters in length and 5.5 meters in height each. They allow for a highly accurate measurement of the muon momentum.

Measurement-setup for the calibration of the ATLAS muon chambers in Garching

The construction and the installation of the muon detection chamber involved over 370 scientists and engineers from 48 institutions in 12 countries. "The project was very complex – just imagine a huge 3-dimensional puzzle", says Otmar Biebel. "We had 656 modules with different sizes, containing up to 432 signal channels each made of a single sense wire in the centre of an aluminum tube. These had to be put into the right place with a precision of less than a millimeter, as the spectrometer is subdivided into different segments, detector layers and sectors. So we had to invent a special jargon to give names to all modules." Without going into further detail, a special tribute to the last piece of the puzzle shall be paid by disclosing its name to our readers: The module is called BIL6A13.

*The muon detector construction and commissioning project at Munich was initiated and is managed by the chair of Prof. Dr. Dorothee Schaile at the Ludwig-Maximilians-Universität (LMU) and by the working group of Prof. Dr. Siegfried Bethke at the Max-Planck-Institut für Physik (MPP). The project's activities are led by Prof. Dr. Otmar Biebel (LMU) and PD Dr. Hubert Kroha (MPP).

Dusty Corners in the Young Universe

It was just a year ago that the Swift satellite detected an old Gamma-Ray Burst (GRB). According to the detection date on 2 August 2007 the newly discovered burst was named GRB 070802. Using the GROND instrument, scientists of the Excellence Cluster Universe are now investigating this GRB – here are the first results of their follow-up observations.

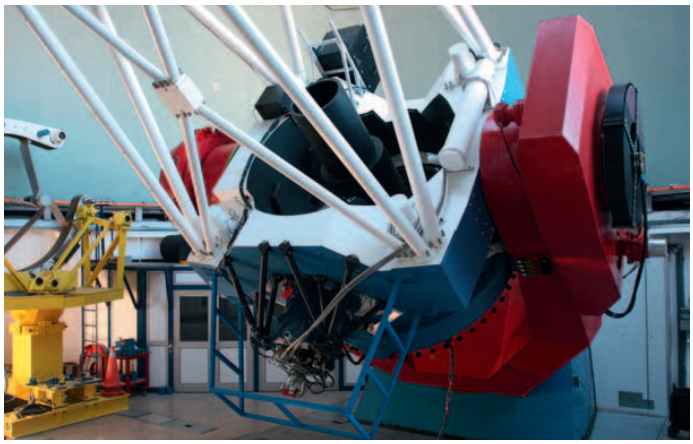
Gamma-Ray bursts are intense extragalactic flashes of γ-rays with durations between several tenths of a second and a couple of minutes. Long GRBs are the most luminous events in the universe we know of after the Big Bang. As GRBs release enormous amounts of γ-ray energy that are usually unaffected by dust or gas absorption, their light reaches us from great distances – and therefore allows us to look into the past of the universe. Their characteristics make GRBs potential tools to learn about the history of star formation and the forming of chemical elements in the universe. Long GRBs are most probably caused by the collapse of very massive, fast rotating stars. As the death and the birth of massive stars are located in the same region of a galaxy, GRBs also are an indicator for massive star formation in their host galaxies. GRBs are followed by afterglows that range from short wave lengths in the X-ray spectrum to long radio waves.

GROND in short

The GROND instrument, designed and operated by the Max-Planck-Institut für extraterrestrische Physik (MPE) in collaboration with the Thüringer Landessternwarte Tautenburg is primarily designed for the rapid follow-up of Gamma-Ray bursts. GRBs are detected by space satellites that downlink the position coordinates of the event to allow ground-based observers to follow up on the afterglow. With the GROND instrument operating since May 2007 at the 2.2m ESO/MPI telescope at La Silla observatory (Chile) researchers now have the unique capability of observing afterglows in a broad wavelength range (350 nm to 2400 nm, i.e. from the very blue to near infra-red light) simultaneously in seven broad band filters.

GRB 070802 can be dated back to about 11 billion years ago, when the universe was just 2.7 billion years old. Studying the afterglow of GRB 020807 with the GROND telescope, Thomas Krühler and his colleagues* found an interesting analogy to our home galaxy, the Milky Way. Although very old and very distant, the birth galaxy of GRB 070802 contains the same kind of "dust" that we know from the Milky Way. This dust stems from stellar explosions and can be associated with organic carbon in the shape of graphite grains. The interstellar material can be detected by a typical absorption in the ultraviolet (UV) wavelength band at 2175 Angstrom, also referred to as "2175 Angstrom dust bump".

"The Angstrom feature is not completely understood yet", says Thomas Krühler. "However, we know it is linked to the absorption of graphite particles. It is the first time we see it in such a distant galaxy. And this clearly shows that the form of dust we know from our Milky Way has already formed in significant amounts at a relatively early stage of the universe."



The GROND instrument at the 2.2m ESO/MPI telescope

*A. Küpcü Yoldas (MPE), J. Greiner (MPE), C. Clemens (MPE), S. McBreen (MPE), N. Primak (MPE), S. Savaglio (MPE), A. Yoldas (MPE) G.P. Szokoly (MPE, Eötvös University), S. Klose (Thüringer Landessternwarte Tautenburg)

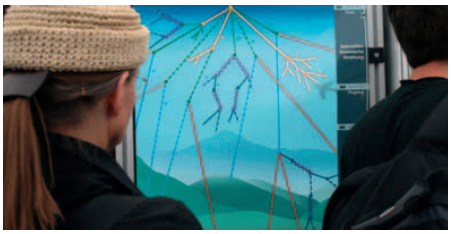
Cluster Grants € 1.000.000 for Research Projects

The Excellence Cluster Universe will allocate almost 1 million Euros to additional projects in the fiscal year 2008. Grants of further 300.000 Euros are still pending, consent for most projects being expected. Following a decision of the research board's meeting on 24 July 2008 the budget will be made available for innovative projects. One of these is the design of a prototype of a Time Projection Chamber with GEM read-out that will be used to investigate the strong interaction in the PANDA experiment. Another example is the development of silicon photo multipliers. These build the core technology for the future hadron collider ILC and will be deployed at the MAGIC telescope and the EUSO project. Funds will also be granted to a project measuring the Doppler-shift lifetime of excited nuclear states connected to the rp-processes in supernovae. The Cluster will also support a collaboration of a field- and a string-theoretical group that will study the link between inflation and particle physics.

EVENTS

Busy Cluster Booth at the Science Mile

Munich celebrated its 850th anniversary, and hundred of thousands came to the city's Altstadtring-party on 19 and 20 July to watch performances and exhibitions. Among these, the Science Mile was a major attraction. The booth of the Excellence Cluster on the „Fascinating Universe" was crowded with visitors keen to learn about stars, black holes, cosmic radiation and the scientists' toolbox. The new Cluster brochure went like hotcake, and 700 visitors participated in our Universe Quiz, hoping to win one of the attractive prizes like a telescope, books and DVDs.



Particle Physics meet Astrophysics

From 23 to 25 June 2008, more than 100 astronomers and physicists joined the conference "Symmetries and Phases in the Universe". The 15 talks given by renowned scientists from international research institutions were followed by lively discussions that were highly appreciated by the participants. Says Jesper Sommer-Larsen, a visiting scientist at the Cluster: "The symposium started off a better communication and understanding between different research fields". Cluster Coordinator Stephan Paul stated that the first international symposium organized by the Cluster turned out a big success: "We succeeded in bringing together outstanding scientists of different disciplines, including Nobel Prize winner George Smoot. I'm sure the attendees benefitted from this unique constellation of people and issues at the symposium."

George F. Smoot

Just after the Symposium, on 27 June, George Smoot followed an invitation of the Cluster to give a public talk on his research. A big crowd came together to listen to Smoot's lively presentation. He told the audience, how he and his research colleagues discovered the temperature fluctuation of the cosmic microwave background – and why it is recommendable to win a Nobel Prize: "You sit next to a real princess at a very nice dinner". Before his talk, Smoot was welcomed by deputy Cluster Coordinator Andreas Burkert and by TUM's vice president Liqiu Meng, saying she was pleased Smoot followed the invitation of the Cluster, "the sparkling star of our university".

Travel to the Universe: Astronomy Day at the Deutsche Museum

Along with the TUM and the TUMLab, the Universe Cluster organizes the Astronomy Day hosted by the Deutsche Museum in Munich. The event takes place on **6 September 2008 from 10 am to 4 pm**. What happened after the big bang? How can you watch stars during daytime? Are we all alone in the universe? These and other questions are addressed in talks by Harald Lesch and Andreas Müller, by experiments, an exhibition and a live connection to a Hawaiian telescope.

More information at *www.universe-cluster.de*

Training for Teachers

Following a reform of the Bavarian secondary school system in 2003 students and teachers face new challenges: The duration of the Gymnasium was reduced from 9 to 8 years, and new topics and educational approaches are to improve secondary education. One change will be the introduction of cosmology and astrophysics in the 10th grade physics curriculum. Therefore, the Excellence Cluster Universe offers a one-day training for physics teachers. The course takes place on **18 September 2008 from 9 am to 5 pm** and covers topics like the Big Bang as well as the formation, the expansion and the evolution of the universe.

More information and registration at *www.universe-cluster.de*

PEOPLE

Mikhail Revnivtsev new Cluster Fellow

Mikhail Revnivtsev

The Excellence Cluster Universe welcomes Dr. Mikhail G. Revnivtsev as a Research Fellow. Starting on 1 August, he will be part of the Cluster's research areas E and F.
Born and educated in Russia, Revnivtsev received his PhD and habilitation from the Space Research Institute in Moscow. For the last six years he held a Postdoc position at the Max-Planck-Institut für Astrophysik (MPA) in Garching. At MPA, Revnivtsev initiated a project which aimed to find a solution for the 25-year long problem of the origin of the Galactic ridge X-ray emission (GRXE). This is fundamental for our understanding of the energy content of the stellar and interstellar components of our Galaxy.

At the Cluster, Revnivtsev will continue this project. In combination with the deep ground-based (RTT150) and space based (Hubble, Spitzer) observations of the selected regions of the Galaxy, he is positive about finding an answer to this problem within the next couple of years.

Welcome to the Cluster!

Fellows: Dr. Mikhail Revnivtsev (since 1 August 08)
Guests: Prof. Samoil Bilenki (Joint Institute of Nuclear Research, Russia, 1 August - 30 November 08) ++ Prof. Dietrich Müller (University of Chicago, 1 September - 30 November 08) ++ Prof. Jim Truran (University of Chicago, 21 - 27 September 08) ++ Prof. Tetsuo Hatsuda (University of Tokyo, 22 September - 5 October 08) ++ Dr. Gabriel Martinez-Pinedo (GSI, Darmstadt, 23 - 25 September 08)
Postdocs: Dr. Mikhail Putivtsev (since 1 August 08)

Interview with Peter Fierlinger

Peter Fierlinger

From August on Prof. Dr. Peter Fierlinger will create and lead a new experimental Junior Research Group at the Excellence Cluster Universe. This group will focus on particle physics with neutrons to gain understanding of fundamental symmetries like T-violation in the baryon sector, for example, by searching for an electric dipole moment of the neutron. After completing his PhD studies at the University of Zurich, Fierlinger spent two years as Postdoc and Fellow at Stanford University. His past research activities were mainly in the fields of slow neutrons at PSI/ILL and neutrino physics with recent "excursions" into applied physics.

At the Cluster, he will concentrate on experimental tests of the standard model of particle physics using very slow neutrons. He intends to work primarily on the search for the electric dipole moment of the neutron (nEDM) and of nuclei. Another emphasis will be the work on the decay of neutrons into a bound state and measurements of gravity effects on ultra-cold neutrons.

You spent two years as Postdoc and Research Fellow at Stanford University. What made you decide to leave the US and join the Excellence Cluster Universe?
I really enjoyed working at Stanford, where I had many possibilities and a lot of freedom, but after some time I wanted to start my own project. Applying as a Junior Research Group Leader, I realized the Excellence Cluster offered a unique chance to do so. The research environment in Garching, the positive attitude and motivation of the people I met here reminded me of Stanford, and the starting conditions turned out to be very nice. In addition, after several years of having had a long distance relationship, my wife and I can finally live in the same place in Munich, which significantly improves my quality of life.

What do you aim to achieve at the Cluster?
My goal is to build great experiments to find new physics and try to pass on my enthusiasm to students who work with me. I would like to achieve good reputation in the new field of physics I chose to continue working in Munich and to advance my teaching skills. More personally, the goal for the time here is to combine family and work better than in the last years.

Do you miss the "American way of life" or do you already enjoy the "Bavarian life-style"?
Being an Austrian citizen, it is much easier for me to adopt the Bavarian rather than the American life-style. Initially, I was mainly attracted to the US because of work and after more than two years in the US I still don't understand many aspects of the American way of life. Although I miss various things from the US, like some friends, the ocean and food-stores that are open all night, it is rather easy to adapt to living in Munich.

LINKS

Discover the European perspective of the NASA/ESA space telescope: *spacetelescope.org* features great video and photo material on the latest findings of the joint project. Highly recommendable: Joe Liske's Hubblecast.
http://www.spacetelescope.org/

We cannot provide a daily update on the progress at LHC and ATLAS. If you want keep track of the latest developments there, we suggest to visit the CERN website. All colliders and experiments are explained in an easy-to-understand way - although only in English and French.
http://cern.ch

This newsletter is distributed bimonthly by the **Excellence Cluster Universe**
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Realisation: Ulrike Ollinger (Layout) · Barbara Wankerl (Conception & Text)
Contributions: Prof. Dr. Otmar Biebel, Thomas Krühler, Prof. Dr. Dorothee Schaile, Alexandra Wolfelsperger
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The Excellence Cluster Universe is supported by the German Excellence Initiative