NEWSLetter
Excellence Cluster Universe
Issue 2 / 2011

Dear Readers,

"Knowledge" has a limited lifetime: an insight is true as long as it won't be falsified. Perhaps the studies of Viola Allevato on black holes in galaxies are a first step to "new" knowledge?
In this issue we look behind the doors of the TUM crystal laboratory. Here's the place where the crystals for the CRESST experiment, designed to detect dark matter particles, grow.
Dark matter is also one of the themes of a conference that takes place from 5 to 9 September in the Munich Künstlerhaus. Close to 400 scientists will get together to discuss "Topics in Astrophysicle and Underground Physics".
As in every issue we present a working group in the Cluster: the scientists of "Heavy Quarks" try to get a little closer to the mystery of the loss of antimatter in the Universe.
Have fun reading!

Barbara Wankerl, PR Manager

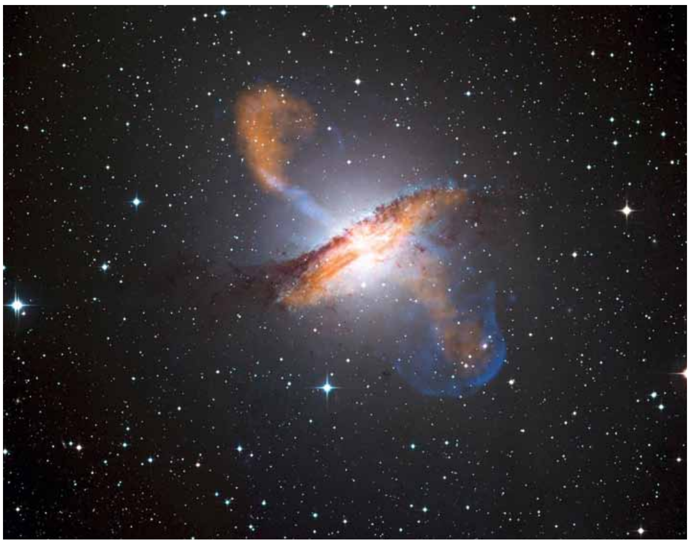
PICTURE OF THE MONTH

Atlantis' Final Flight
An era ends: one of the last images of space shuttle Atlantis that just successfully terminated its last mission on 21 July 2011. The image was taken from the International Space Station and shows Atlantis flying over the Bahamas.

RESEARCH

What Activates a Supermassive Black Hole?

A new astronomical study has turned up a surprise. Most of the huge black holes in the centers of galaxies in the past 11 billion years were not turned on by mergers between galaxies, as had been previously thought. This is the outcome of an international research work under the lead of the Excellence Cluster Universe at the Technische Universität München, combining data of ESO's Very Large Telescope and ESA's XMM-Newton X-ray space observatory. The results will appear in the *Astrophysical Journal* in August 2011.



The black hole in the center of galaxy Centaurus A

At the heart of most, if not all, large galaxies lurks a supermassive black hole with a mass millions, or sometimes billions, times greater than that of the Sun. In many galaxies, including our own Milky Way, the central black hole is quiet. But in some galaxies, particularly early on in the history of the Universe, the central monster feasts on material that gives off intense radiation as it falls into the black hole.

One unsolved mystery is where the material comes from to activate a sleeping black hole and trigger violent outbursts at a galaxy's center, so that it then becomes an active galactic nucleus. Up to now, many astronomers thought that most of these active nuclei were turned on when two galaxies merge or when they pass close to each other and the disrupted material becomes fuel for the central black hole. However, new results indicate that this idea may be wrong for many active galaxies.

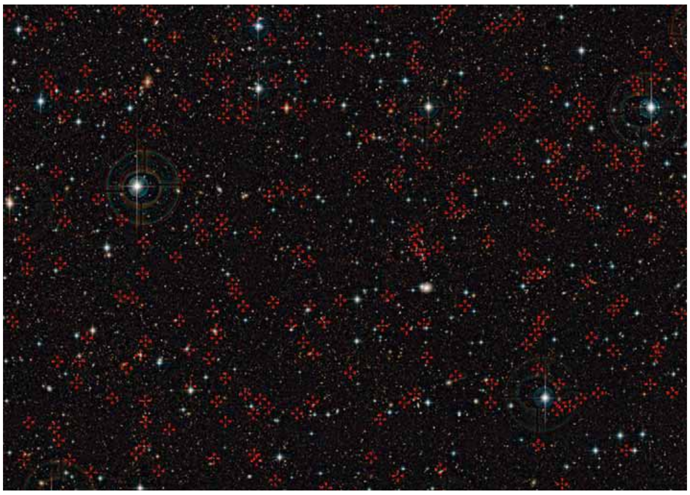
Viola Allevato from the Excellence Cluster Universe and an international team of scientists from the COSMOS collaboration have now looked in detail at more than 600 of these active galaxies in an extensively studied patch of the sky called the COSMOS field. As expected, the astronomers found that extremely brilliant active nuclei were rare, while the bulk of the active galaxies in the past 11 billion years were only moderately bright. But there was a surprise; the new data showed that the majority of these more common, less bright active galaxies, even looking back far into the past, were not triggered by mergers between galaxies.

The presence of active galactic nuclei is revealed by the X-rays emitted from around the black hole, which were picked up by the XMM-Newton space observatory. These galaxies were subsequently observed using the Very Large Telescope, which was able to measure the distances to the galaxies. When combined, the observations allowed the team to make a three-dimensional map showing where the active galaxies lie.

The astronomers could use this new map to find out how the active galaxies were distributed and compare this with predictions from theory. They could also see how the distribution changed as the Universe aged — all the way from about 11 billion years ago to almost the present day.

The team found that active nuclei are mostly found in large massive galaxies with lots of dark matter. This was a surprise and not consistent with the prediction from theory — if most active nuclei were a consequence of mergers and collisions between galaxies it had been expected that they would be found in galaxies with moderate mass (about a trillion times the mass of the Sun). The team found that most active nuclei reside in galaxies with masses about 20 times larger than the value predicted by merger theory.

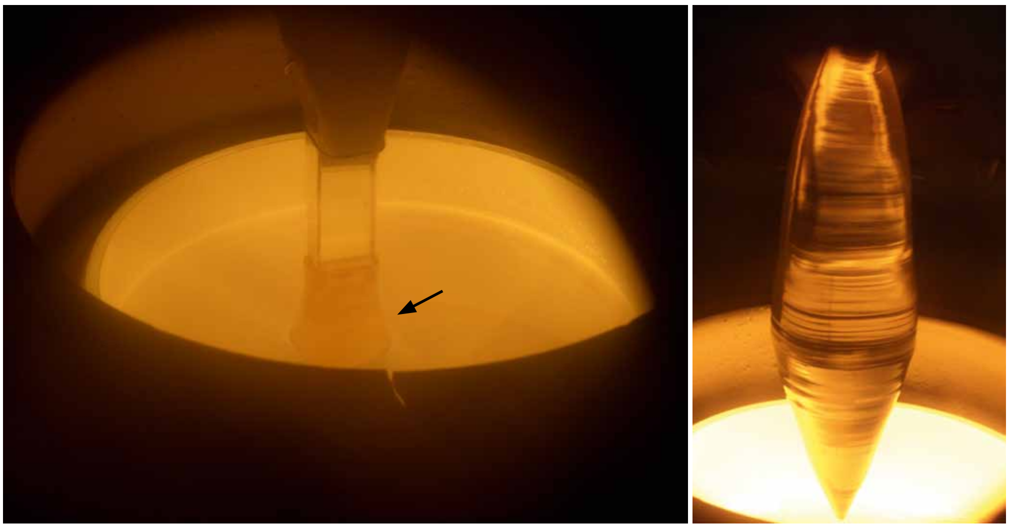
"These new results give us a insight into how supermassive black holes start their meals," said Viola Allevato, who is lead author of the new paper. "They indicate that black holes are usually fed by processes within the galaxy itself, such as disc instabilities and starbursts, as opposed to galaxy collisions."



The COSMOS field that was intensly studied by the scientists

Original publication: "The XMM-Newton Wide field survey in the COSMOS field: redshift evolution of AGN bias and subdominant role of mergers in triggering moderate luminosity AGN at redshift up to 2.2", The Astrophysical Journal, (Allevato et al. 2011, ApJ, 736, 99), http://stacks.iop.org/0004-637X/736/99

Dark Matter Search with Crystals



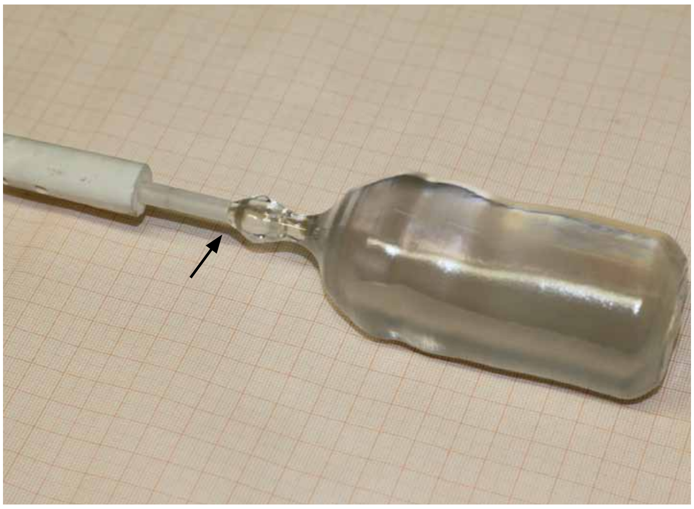
Left: Seed crystal and growing crystal after about three hours; the arrow marks the growth front. Right: Grown crystal above the melt; temperature 1600 degrees Celsius.

In the search for Dark Matter the low-temperature calorimeter CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) has been fully installed and put into operation in the Gran Sasso Underground Laboratory over the past years. Astroparticle physicists want to find evidence of so-called WIMPs (Weakly Interacting Massive Particles) using these detection methods. These are relatively heavy, but only weakly interactive particles, which could make up the Dark Matter observed by astrophysical means. CRESST is a project involving several research institutes, including the Max-Planck-Institut für Physik and the Technische Universität München (TUM) along with the Excellence Cluster Universe.

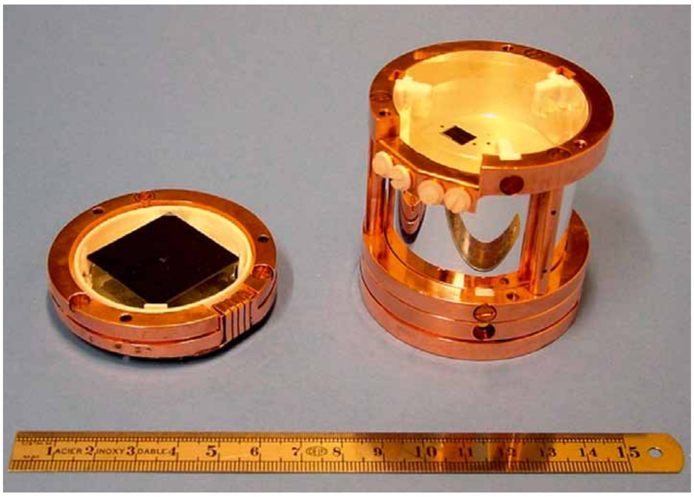
Calcium tungstate crystals ($CaWO_4$) are used as detector material in the CRESST experiment. If a WIMP collides with an atom nucleus, the crystal lattice begins oscillating gently. In order to measure this tiny pulse, however, potential interfering signals must be eliminated, for example, the thermal movement of the crystal molecules. For this reason, the crystals used in the experiment are cooled to temperatures barely above absolute zero.

The sensitive experiment places the highest demands on the purity of the $CaWO_4$ crystals, which commercial providers cannot meet reliably. The CRESST cooperation is thus committed to its own crystal production in the crystal laboratory of the TUM Physics Department. The laboratory was founded in 1970 by Heinz Maier-Leibnitz, erstwhile Chair of Technical Physics at the TUM. The laboratory is currently under the leadership of Dr. Andreas Erb of the Walther-Meißner-Institut. Single crystals are grown, characterized and machine finished in the laboratory in order to study the physical properties of new materials. Against this background close cooperation has developed between the Cluster Junior Research Group "Astroparticle Physics" of Dr. Jean-Côme Lanfranchi and the crystal laboratory.

Initial experiments on an older crystal growth apparatus resulted in the general producibility of such detector crystals at the TUM as early as 2007. However, in order to be able to produce crystals of sufficient size and purity for the CRESST experiment, the laboratory had to be completely modernized: The purchase of a new Czochralski apparatus was necessary, with which the crystals could be grown from a crucible at high temperatures of up to 1600 degrees Celsius. This crystal growth furnace and the corresponding crucible of 1.4 kilograms of pure rhodium were financed by the Excellence Cluster Universe.



Crystal of calcium tungstate (1 kilogram) after 18 hours of crystal growth. The ceramic seed holder can also be seen from which the oriented seed protrudes. The arrow marks the location of growth.



Complete CRESST detector module composed of a calcium tungstate single crystal with a vacuum-metalized calorimetric low-temperature thermometer and a "Silicon on Sapphire" (SOS) light detector.

High-purity calcium tungstate crystals have been successfully produced in the crystal laboratory of the TUM since June 2011 with a weight of up to 1.8 kilograms. The actual production of the crystals corresponds to the usual Czochralski process: A small seed crystal of calcium tungstate is attached to a rotating ceramic holder and dipped into the melted material at just above the melting temperature. At the suitable temperature the melted calcium tungstate crystalizes at the seed crystal and takes over its orientation. From this moment on the seed can be slowly grown upwards (see pictures on page 2). The circumference of the crystal can be determined via the temperature changes in the melt. In this way the melted material hardens to a bottle-shaped crystal which exhibits the crystal orientation of the seed across its whole volume.

Alongside CRESST the group "Astroparticle" Physics will also make use of the planned European large-scale experiment EURECA (European Underground Rare Event Calorimeter Array) in the future, in which the calcium tungstate crystals produced in Garching are also used.

Universe Cluster and SISSA Enter into a Partnership

The Excellence Cluster Universe and the "Scuola Internazionale Superiore di Studi Avanzati" (SISSA) in Trieste have recently signed a cooperation agreement. In this context both institutions have agreed on an intensive cooperation which involves the exchange of scientists and doctoral students, as well as research issues which are of mutual interest. Scientific colloquia and conferences are particularly important for the cooperation: The institutions have agreed to work together closely in this area with reciprocal invitations to researchers of the respective partner institutions.

SISSA was founded in 1978 and is among the leading research institutions for cutting-edge research and the training of doctoral students in Italy. The university specializes in natural scientific research in the areas of physics, astrophysics, mathematics, biology and neurosciences. It was also the first Italian university to introduce the internationally recognized PhD degree.

EVENT

Nightshifts with the Nuclear Reaction Code

From 10 to 17 April 2011 the Excellence Cluster Universe and the Joint Institute for Nuclear Astrophysics (JINA), offered a unique learning opportunity for young researchers by way of a specialized research school on "Nuclear Reaction Network". Venue was the Island of Frauenwörth at the Bavarian lake Chiemsee. The school was designed to young researchers an opportunity to learn and utilize, with a direct "hands on" approach, a research-class "Nuclear Reaction Network Code" used in nuclear astrophysics.

Good bye from an intense and successful working week at the school "Nuclear Reaction Network".

The code helps to bridge a significant divide: on the one hand, there are scientists who do experiments measuring nuclear physics quantities, on the other hand there are scientists who model the explosive stellar phenomena in which the measured nuclear physics quantities are used. Applying the code, researchers can employ various nuclear reactions coupling them with the thermodynamical evolution of the explosive phenomena under study.

A total of 34 student and postdoc participants took part in the school, coming from e.g. Germany, Russia, the USA, Japan and Canada. The lectures were given by Bradley Meyer, the initiator of the nuclear reaction network code, Prof. Hendrik Schatz of Michigan State University and the two Cluster members Prof. Shawn Bishop (TUM) and Dr. Friedrich Röpke of the Max-Planck-Institut für Astrophysik.

The teaching format of the school was structured around two morning lectures: one to provide walk-throughs of the reaction network code itself, followed by a lecture discussing the physics of various astrophysical scenarios and processes. Afternoons were focussed entirely on having the groups work with the code, grappling with how to use it and followed by applying it to actually solve the abundance outputs of the physical scenario chosen by their group. The scenarios ranged from novae and x-ray bursts, to the r-process and p-process scenarios.

Evenings were planned as free time for the participants, but as a surprise to all of the instructors, throughout the school, evening hours were spent by many participants returning to group work well into the late evening.

The outcome of this research school was therefore "a smashing success", as Shawn Bishop described it. "It is my hope that, in the coming years, some of those who participated will continue to use this tool, profit from its use in their research, and use it to enhance their scientific publications", says Bishop.

"Enrichment for School Lessons"

The history of teacher training by the Universe Cluster goes back to the spring of 2008. At that time the physics teacher of a Munich Gymnasium (secondary school) contacted the Deputy Cluster Leader Prof. Andreas Burkert requesting him to offer teacher training on "Aspects of Modern Cosmology" – a subject area of the teaching curriculum for the 10th class of Gymnasium.

Hans-Ulrich Käufl demonstrates spectroscopy with a gas flame.

The Cluster subsequently drafted a concept for one-day training. The course was so well received the first time it was offered in the summer of 2008 that it has been held every year since at the end of July at the Deutsches Museum. The idea of holding an additional teacher training for astrophysics originated at the beginning of 2011. The course was intended for physics teachers who teach "astrophysics" as an alternative curriculum topic in the 12th year. The teacher training took place from July 6 to 8 for the first time and was a complete success.

The curriculum for the new elective course covers the five subject areas "Orientation in the Sky", "Overview of the Solar System", "The Sun", "Stars" and "Large Structures in the Universe". As each of these subject areas places high demands and should be well taught, the training was scheduled for two and a half days. The group of participants was restricted to 20 teachers, so that the participants had enough time for consultation and discussions with the scientists.

The Bavaria-wide teacher training offer met with a positive response right from the start – within a very short period of time all places were reserved. The success of the event is due to the dedication of the lecturers Hans-Ulrich Käufl (European Southern Observatory), Harald Lesch (Ludwig-Maximilians-Univerität), Andreas Müller (Universe Cluster) as well as Ewald Müller and Simon White from the Max Planck-Institut für Astrophysik. The quality of the training was evaluated positively by the majority of teachers. One of the participants resumed: “The experts delivered good suggestions for planning an interesting lesson because they made us aware of surprising aspects which can enrich lessons.”

Hadron2011: In Search of Exotic Particles

The participants of the Hadron2011 gather in the courtyard of the Künstlerhaus in Munich.

From 13 to 17 June the Künstlerhaus in Munich was staging a large international conference. At “Hadron2011”, which took place for the 14th time this year, around 250 scientists were concerned with the smallest building blocks the Universe has to offer – elementary particles. The topic of the conference is the particles quarks and gluons, which together form hadrons. As the building blocks of protons and neutrons they also represent the fundamental components of matter.

Through the investigations the particle physicists are hoping to gather further findings on the interaction between the different quarks and gluons – the latter are the particles which hold the quarks together like Super Glue. The scientists assume that a better understanding of the quark-gluon constellations will also answer the question as to how stable matter was able to form from the hot plasma of the early Universe.

At Hadron2011 scientists were able to announce a few successes: They presented several new discoveries from the particle world, which were found with the help of accelerator experiments in the USA, Japan and the Large Hadron Collider in Geneva. Scientists of the COMPASS experiment reported a breakthrough in hadron research: A team under the leadership of scientists of the Technische Universität München (TUM) succeeded in confirming the existence of exotic particles which theoretical calculation had predicted quite a while ago.

Particle combinations with a heavy b-quark, whose properties are still unclear, caused quite a stir and provided plenty of topics for discussion. It is quite evident that they make an appearance as the partners of other lighter particles. Scientists have been racking their brains over these particles for quite a few years as they have not yet been able to classify them in the framework of the standard model of hadron physics. Observations indicate that the interaction of quarks and antiquarks at long time intervals is still always good for a surprise.

Prof. Stephan Paul, Leader of the Excellence Cluster ‘Universe’ at the TUM and one of the two main organizers of Hadron2011 was very pleased with how well the conference went: “We were able to make significant progress in a wide range of areas of hadron physics. I am very confident that not only the high-energy experiments at the Large Hadron Collider at CERN in particular, but also future experiments in Japan will deliver further exciting results. Little by little these results will help us unravel the mystery of the formation of matter in the Universe”.

Left: Prof. Stephan Paul opens the Hadron2011.
Right: Lively after-hour discussions

Astroparticles and Cosmology - 12th TAUP will take place in Munich

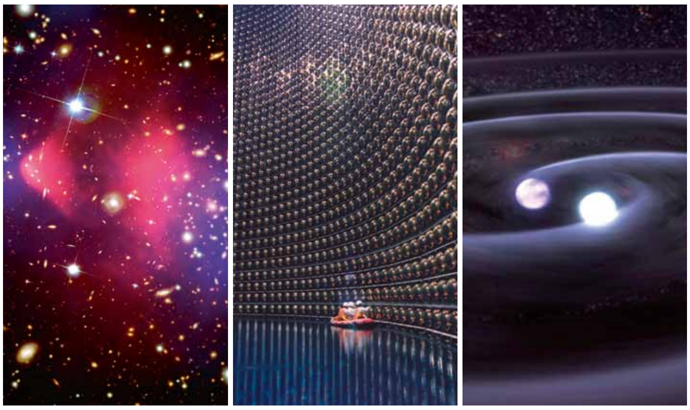
2011 MUNICH TAUP

Astroparticles and their significance for our understanding of the Universe are the main focus of attention of TAUP: scientists will be discussing new approaches to research and results concerned with this topic at the Münchner Künstlerhaus from 5 to 9 September 2011.

The international conference “Topics in Astroparticle and Underground Physics” has been taking place every two years since 1989 in different locations. This year the conference will be coming to Germany for the first time, where astroparticle physics has experienced an enormous upswing over the past years. Approximately 400 scientists from all over the world are expected to attend. TAUP deals with topics such as cosmology, gravitational waves and dark matter – from theoretical as well as experimental perspectives. Laboratory experiments that are performed underground and thus protected from natural cosmic radiation (“unterground physics”) will play particularly significant roles.

The organizers of this year‘s TAUP are scientists from the Max-Planck-Institut für Physik, the Technische Universität München and the Excellence Cluster Universe. The scientific plenary program is subdivided into the main topics cosmology, dark matter, the physics of neutrinos, as well as gravitational waves, high-energy particles and photons which serve as astrophysical messengers harboring important information. In addition to this, there will be seven parallel lecture series, in which the main topics will be dealt with in detail. Dark matter in particular promises to be an exciting topic: Scientists have been endeavoring for years to detect the particles which make up dark matter. WIMPs are considered the most promising but not the only candidates. WIMPs are weakly interacting massive particles.

The organizers were able to attract renowned international experts as lecturers. Francois Bouchet the scientific leader of the “Planck” satellite mission, initiated in 2009, will talk about the current research results of cosmic microwave background radiation. Eli Waxman from the Weizman Institute in Israel will report on new findings in astronomy with high-energy radiation. With Manfred Lindner of the Max Planck Institute für Kernphysik und Angela Olinto from the University of Chicago the organizers are welcoming two other expert researchers from the field of astroparticle physics. The closing speaker will be Hitoshi Murayama, leader of the Institute for Mathematics and Physics of the Universe in Tokyo. He will summarize the outcome of the plenary meetings and provide a look at the years to come.



The images represent the issues discussed at TAUP: Dark matter in the Bullet Cluster, the neutrino observatory Super-Kamiokande and gravitational waves resulting from the merging of two neutron stars (left to right).

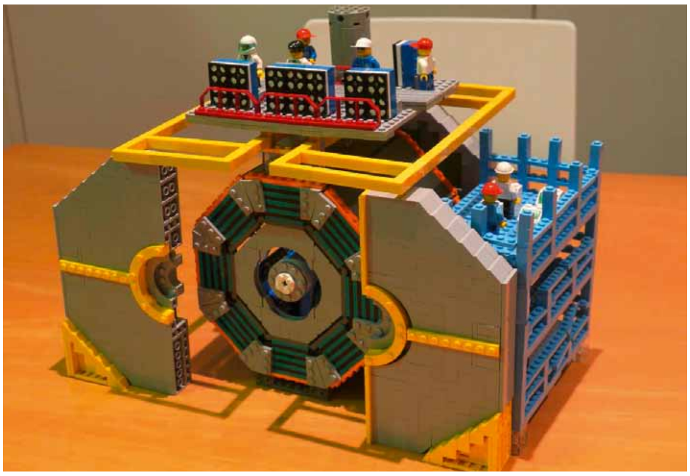
PORTRAIT

In Search of the Lost Antimatter

Antimatter not only fires the imaginations of book and film authors: All over the world physicists are working on theoretical models and experiments, which are supposed to explain why the original equilibrium between matter and antimatter was thrown out of kilter in the young Universe. This “disproportion” ensures that we live in a matter-dominated Universe, in which there are galaxies, stars and planets. With Prof. Dr. Jochen Schieck of the LMU, who leads the “Heavy Quarks” Group at the Universe Cluster, we are introducing a scientist who follows the trail of antimatter. He is involved in two large-scale experiments which are intended to explain the physical basis for the “CP violation”. This is a necessary prerequisite for the matter-antimatter imbalance.

When matter and antimatter particles collide they annihilate each other and release energy at the same time. According to today’s understanding, as many heavy matter particles as antimatter particles were formed at the time of the Big Bang 13.7 billion years ago. After a short period of time they decayed to yield the familiar particle families of quarks and leptons, as well as the corresponding antiparticles during this process. Protons are produced from the quarks, which form the atom nucleus together with neutrons. Electrons, muons and tauons are counted among the leptons. For unknown reasons, the decay of the heavy original particles did not proceed consistently, so that in the end more protons than antiprotons evolved. This minimal excess of matter ensured that the matter particles gradually lost their anti-reaction partners. For this reason, matter was left over in the end.

Jochen Schieck and his group are feeling their way through the dawn of the Universe with their research. Their instrument is an accelerator experiment with which the events shortly after the Big Bang can be simulated. The Large Hadron Collider (LHC) accelerates the proton beams in opposite directions to almost the speed of light. In the ATLAS experiment the protons are then brought to collision. Their decay traces are investigated with the help of different detectors. "For the investigation of the CP violation we are concentrating on a specific particle type, which is called the B meson", Jochen Schieck explains. "B mesons are composed of quark-antiquark particles, for example a bottom and an anti-down quark. Makato Kobayashi and Toshihide Maskawa have laid the theoretical foundation for the CP violation in the decay of particles and their antiparticles, which was discovered in B mesons in 2001. They received the Nobel Prize for Physics for this discovery in 2008."

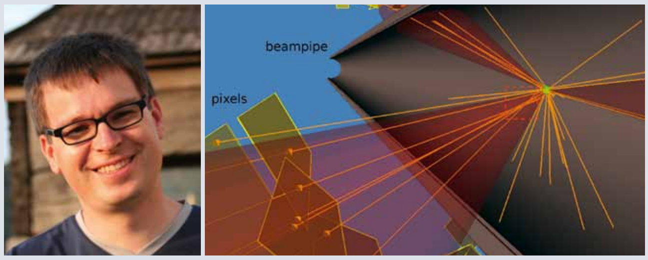


A model of the future Belle II detector ... made of Lego by students of the University of Tokyo

Now the task at hand for experimental physicists is to find sound evidence of a deviation in the decay pattern. "In order to be able to document the different aspects of CP violation soundly, we must evaluate a great amount of data", Jochen Schieck says. "Furthermore we are attempting to approach the problem from various angles". For this reason, Jochen Schieck is participating in a second large-scale experiment with his group, which is to be built on the KEK acceleration apparatus in Japan in the coming years. In the style of its predecessor the new instrument is called Belle II – and in contrast to LHC the collision products of electrons and their anti-particles, so-called positrons, are studied here.

Jochen Schieck describes the characteristics and advantages of the two experiments: "Both experiments produce different B mesons, which opens a broader spectrum for investigation. Moreover, the experiments work very differently. Through its high energy density the LHC produces an enormous number of decay events, which from a statistical point of view, increases the likelihood of finding a relevant result. The KEK accelerator does indeed supply much lower energies than the LHC (10 gigaelectronvolts versus 14 teraelectronvolts). The Belle II detector, however, "specializes" in B mesons. For this reason, there is a good chance that interesting

Junior Research Group: Heavy Quarks



Prof. Dr. Jochen Schieck (LMU) has been leading the "Heavy Quarks" Group at the Excellence Cluster Universe since April 1, 2010. He did his doctorate in Heidelberg and came to the Max-Planck-Institut für Physik in Munich after spending two years at the Stanford Linear Accelerator Center (SLAC) in California. At Stanford he was involved in the development of the ATLAS experiment for the Large Hadron Collider (LHC) at CERN and the OPAL/JADE experiment.

The main focus of his research group is on the analysis of collision events with bottom (b) quarks in the ATLAS detector. His team is also involved in the construction of a pixel vertex detector (DEPFET) for the Belle II experiment, which is being installed in the Japanese Research Center for Particle Physics KEK. This experiment is concerned with B physics, especially the CP violation of B mesons.

Research Group

The "Heavy Quarks" Group is made up of the scientists Dr. Stefan Rummel, Dr. Louise Oakes, Pavel Reznicek, the PhD student Claudio Heller and currently two graduate students. The team also has the engineer Andreas Seiler on board.

Current Activities

- Analysis of data from the ATLAS detector at the Large Hadron Collider (LHC) at CERN
  - Measurement of the CP-violating phase of B_S-mesons
  - Development of an algorithm for the identification of particles with the help of the TRT detector in the ATLAS experiment
  - Performance measurements for the trace detector of the ATLAS experiment
- Participation in the construction of the DEPFET pixel detector for the new Belle II experiment at the KEK laboratory in Japan
  - Development of a system for the electric power supply
  - Performance measurements
  - Studies relating to the integration of the DEPFET detector in the Belle II experiment

Scientific Collaborations

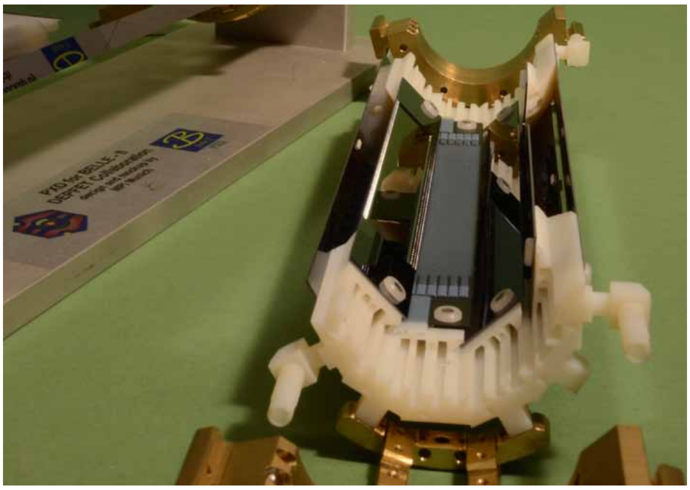
Jochen Schieck works together with researchers from the universities of Bonn, Gießen, Göttingen and Heidelberg, as well as the Karlsruhe Institute of Technology in the DEPFET collaboration. He works closely with scientists from CERN, the University of Lancaster and the University of Valencia in the ATLAS experiment. In the Excellence Cluster the physicist maintains a close scientific exchange with the work groups of Research Area B (Symmetry between Matter and Forces), Research Area C (Masses and Hierarchy of Particles), and Research Area E (Dark Components of the Universe) that work both theoretically and experimentally.

decays will be discovered." With the combination of Belle II and ATLAS, Jochen Schieck is hoping to find new evidence of the CP violation and thus extend the standard model of particle physics.

Belle II, however, still seems a long way off. The corner stone for the new experiment is likely to be laid in November; the first measurements are expected in 2015. The contribution of the German consortium comprises a high-precision detector inside Belle II. Jochen Schieck explains what the detector is capable of. "If one hurls a water glass on the floor, it is smashed into countless numbers of shards which scatter in all directions. The collision of particles behaves in a similar manner; first you are standing before a confusing chaos of traces. The physicists, however, know the precise mass and energy of the particles at the time of collision, so that they can draw conclusions from the length and curvature of the traces of decay. Thanks to the high resolution capability of the detector, the decays of the B mesons can be identified practically without a doubt."

For the development and construction of the DEPFET (Depleted P-Channel Field Effect Transistor) detector, its full title, seven German universities and the Max-Planck-Institut für Physik are co-operating together. The group at the Excellence Cluster Universe is responsible for the power supply. In order to run one of 20 DEPFET modules 20 different voltage values have to be generated. Thus the team is faced with a demanding interdisciplinary task. For this reason, Jochen Schieck also employs electricians in addition to physicists. In the case of the important topics voltage control and system stability, Jochen Schieck's team also co-operates with a spin-off company of the "Robotics and Embedded Systems" Chair at the TUM. This company develops the software for controlling the DEPFET.

The physicists working with Jochen Schieck are not only entering "uncharted frontiers" with the construction of the detector: The collaboration between experimental and theoretical physicists also produces completely new perspectives. "At the Excellence Cluster Universe, scientists from many different disciplines are concerned with the same questions. The example of CP violation



The high-precision pixel vertex, detector (DEPFET) co-developed by J. Schieck's group will be able to identify the decays of B mesons

is teaching us to speak one common language. This enables us to better translate the particle combinations required by theory into the design of our experiments. On the other hand, our findings can be discussed and interpreted among physicists in different areas of expertise: We sit together with experts for astrophysics and flavor physics and discuss to what extent the results provide an indication of supersymmetry, for example. This constellation is unique in Germany."

PEOPLE

New Leader for the Junior Research Group "Astroparticle Physics"

Jean-Côme Lanfranchi

The Junior Research Group (JRG) "Astroparticle Physics" of the Excellence Cluster Universe has a new leader. Jean-Côme Lanfranchi is the successor of Tobias Lachenmaier who switched to the University of Tübingen in fall 2010.

Jean-Côme Lanfranchi, who was born and raised in Switzerland, has been part of the Technische Universität München (TUM) since his student days. He studied and earned his doctorate at the Chair for Experimental Physics E15 in the area of experimental neutrino physics. He then remained at Chair E15 as a post-doctoral researcher and later as leader of the "Cryogenic Group".

Lanfranchi's main area of research is the direct search for Dark Matter with the help of the low-temperature calorimeter CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) at Gran Sasso Laboratory in Italy and the future European large-scale experiment EURECA (European Underground Rare Event Calorimeter Array).

In their search for Dark Matter, the JRG "Astroparticle Physics" also uses the underground and the crystal laboratories at the Garching campus. The Excellence Cluster has helped fund both of these facilities. The underground laboratory comprises a laboratory area of over 130 square meters located under a mound six meters thick. It serves as a development and test station for detectors used to track down neutrinos and the elementary particles of the Dark Matter. These detectors are implemented in international research projects; these include CRESST and EURECA. Thanks to the new technologies and instruments in the crystal laboratory of the TUM, Lanfranchi's work group has recently been in the unique position of even being able to produce calcium tungstate crystals on their own. These crystals are used as target materials in both of these experiments (see article on page 2).

IMPRINT

Realisation: Ulrike Ollinger (Layout), Barbara Wankerl (Conception & Text)

Authors: Barbara Wankerl, Alexandra Wolfelsperger-Essig

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