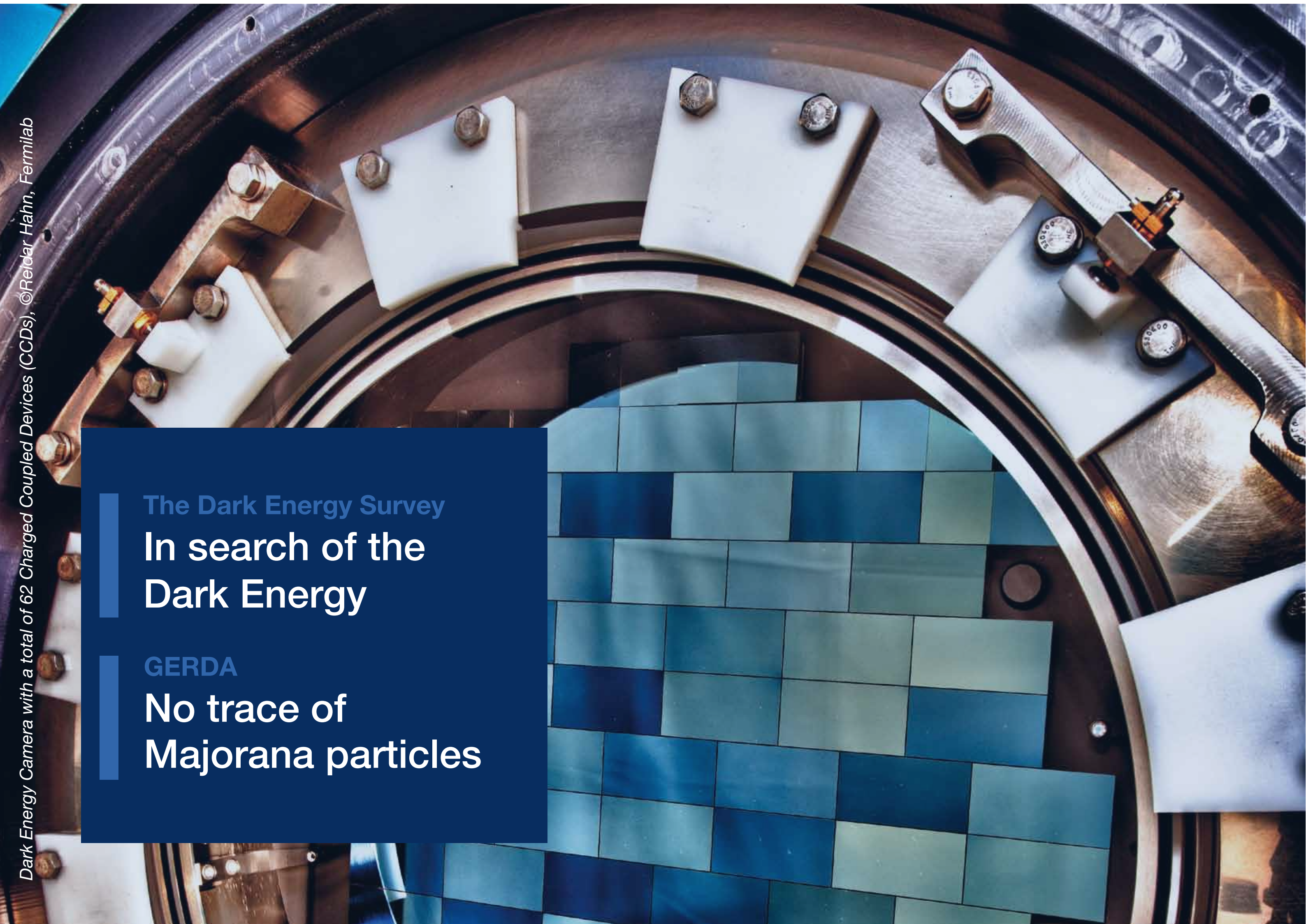
Excellence Cluster
Universe

UniverseNews

Excellence Cluster Universe | Issue 2/2013



Dark Energy Camera with a total of 62 Charged Coupled Devices (CCDs), ©Reidar Hahn, Fermilab

The Dark Energy Survey

In search of the Dark Energy

GERDA

No trace of Majorana particles

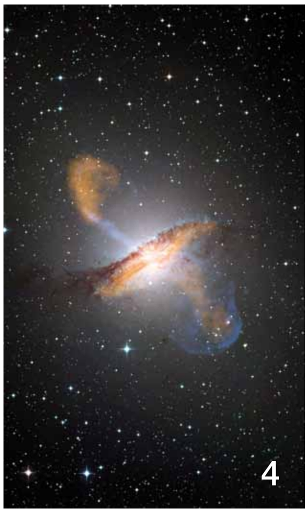
Dear readers,

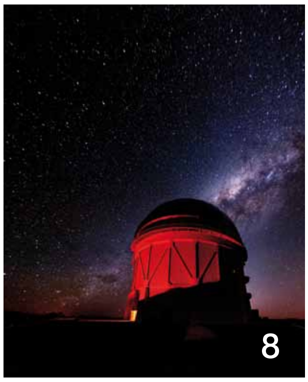
We present the new issue with a new look and a new name „UniverseNews“.

The motto of the second round of funding of the Excellence Cluster Universe is “sowing & harvesting”: With the new Seed Money Program, the cluster provides start-up financing for innovative ideas from scientists. The goal is to grow these “seed grains” into longer-term projects, which - after a successful start at the Cluster - could receive further funding at national or European level.
Some of the “fruits of the second round are the launch of the new space mission Dark Energy Survey and the first results of the experiment GERDA.

In November, the cluster will start a new lecture series „Fruits of the Universe“ with a lunchtime snack as well as “intellectual food” served by a researcher.

***Petra Riedel,** PR Manager*





Review

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Planck-Lecture
15.05.2013

Huge interest in the results of the Planck mission launched in March: The lecture “The Big Bang’s trace of light” by Prof. Dr. Simon White from the Max Planck Institute for Astrophysics in the Hall of Fame of the Deutsches Museum was fully booked within a short time, with many people landing on a waiting list.The ones who got a place gained a deeper insight into the latest findings of solved and unresolved puzzles about our universe. The Excellence Cluster Universe organized the lecture in cooperation with the Deutsches Museum.

Day of Physics
17.07.2013

“Dress code: Bavarian” applied for this year’s “Day of Physics” of the TUM, organized by Prof. Dr. Peter Fierlinger and Prof. Dr. Laura Fabbietti from the Cluster. Bavarian style leather trousers and dirndl dresses were mandatory for the presenters – which meant that some had to buy new outfits for the occasion. Prof. Dr. Andreas Burkert, who owns a Lederhose, however, wears this traditional Bavarian costume only at the Oktoberfest. For his talk on “A gas cloud on its way to the Milky Way’s black hole”, he rolled into the lecture hall on a spectacular motorized sleigh.

Girls & Technology
19.07.2013

Great ”role models“ had the young participants of the 2nd Bavarian Girl’s Technics Congress in the Bavarian village of Königsdorf. PhD student Katharina Fierlinger from the University Observatory Munich crafted star maps and showed the girls how to orient themselves in the night sky. Dominika Wylezalek, doctoral student from the European Southern Observatory (ESO), took the girls on a short “Time travel to the Big Bang”. About 50 girls participated in the two Excellence Cluster Universe workshops; a total of 270 students had come to Königsdorf.

First results of the GERDA experiment

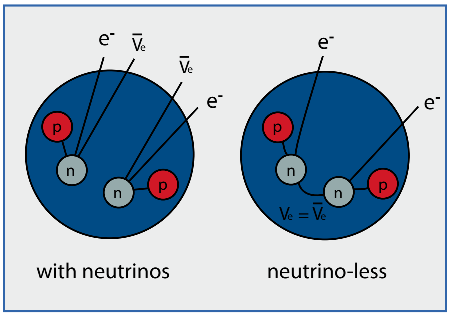
No trace of Majorana particles

In the 1930s, the Italian physicist Ettore Majorana proposed a theory that implies that neutrinos were their own antiparticles. 80 years later, the researchers of the GERDA collaboration try to verify Majorana's theory with an elaborate experiment in the Italian Gran Sasso underground laboratory. However, after completion of the first measurement phase, the researchers have found no reference to this neutrino feature within the mass range studied. This result rules out an earlier claim for a signal.

According to the Standard Model of particle physics, neutrinos have no mass. Nevertheless, it is experimentally confirmed that neutrinos have a small but non-zero rest mass. A theory proposed by Ettore Majorana (1906 - 1938) could solve this problem: Unlike all other particles that form the known matter around us, neutrinos may be their own antiparticles. This in turn could explain, why there is so much more matter than antimatter in the universe.

The GERDA (GERmanium Detector Array) experiment in the Italian Gran Sasso underground laboratory, which pursues Majorana's theory, investigates the double beta decay processes of the germanium isotope Ge-76. In normal beta decay, as found in radioactive decay, a neutron inside the nucleus decays to a proton, an electron and an anti-neutrino. For nuclei such as Ge-76, normal beta decay is energetically forbidden. However, the simultaneous conversion of two neutrons with the emission of two neutrinos is possible. The decay has recently been measured by GERDA with unprecedented precision. It is one of the rarest decays ever observed with a half-life of about 2 x 10^{21} years – which is about 100 billion times the age of the universe.

If neutrinos were their own antiparticles, the two neutrinos could annihilate each other at the moment of the double decay – emitting a very characteristic amount of energy. This event should occur with an even lower rate. Up to now, the scientists' analyses revealed no signal of neutrinoless double beta decay in Ge-76. The result leads to the world's best lower limit for the half-life of 2.1 x 10^{25} years. Combined with information from other experiments, it rules out an earlier claim for the signal.



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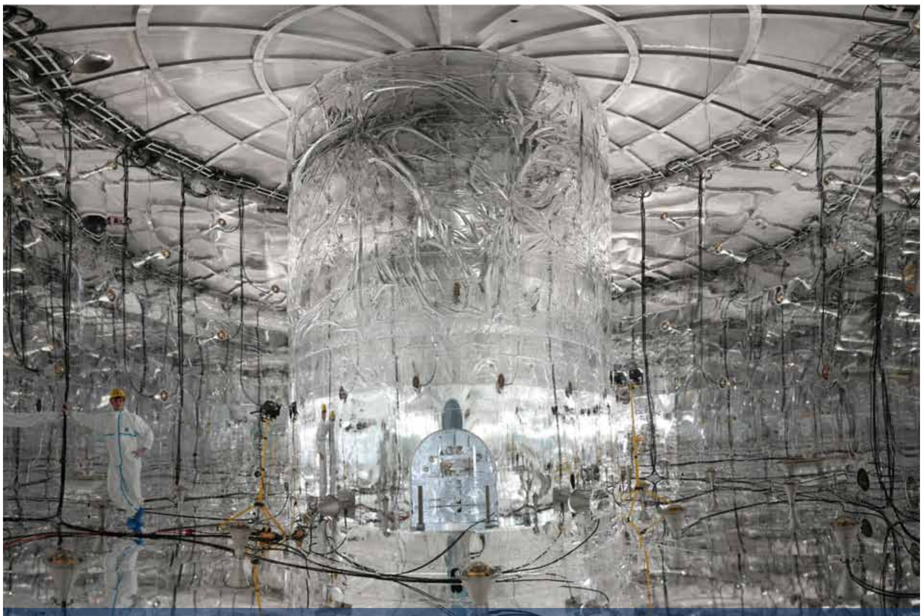
In Ge-76 nuclei the simultaneous conversion of two neutrons with the emission of two neutrinos is theoretically possible. A neutrino-less reaction could occur, if neutrinos were their own antiparticles.



The GERDA detector in the Italian Gran Sasso underground laboratory: The experiment investigates the double beta decay process of the germanium isotope Ge-76.

©Kai Freund/Uni Tübingen

In GERDA germanium crystals are both source and detector. Ge-76 has an abundance of about eight percent in natural germanium and its fraction was therefore enriched more than 10-fold before the special detector crystals were grown.

The observation of the extremely rare process requires very delicate techniques to suppress backgrounds, since cosmic particles, the natural radioactivity of the surroundings and even the experiment itself produce background at a rate of at least a billion times higher than double beta decay. "Our group made major contributions to reduce background to a record level", says Prof. Dr. Stefan Schönert, who is a full professor at the Chair for Experimental Astroparticle Physics at the Physics Department of the TUM, Principal Investigator at the Excellence Cluster Universe and spokesman for the GERDA collaboration. Prof. Dr. Schönert is also one of the initiators of the experiment. The scientists met the challenge by mounting the detectors in the centre of a huge vessel that is filled with extremely clean liquid argon, lined by ultrapure copper, which in turn is surrounded by a 10-meter-diameter tank filled with highly pure water. The whole installation is located underground, below 1,400 meter of rock.

Data taking started in fall 2011 using eight detectors the size of a tin can and weighting two kilograms each. Subsequently, five additional detectors were commissioned. The next steps for GERDA will be to add additional newly produced detectors effectively doubling the amount of Ge-76. Data taking will then continue in a second phase after some further improvements are implemented to achieve even stronger background suppression.

GERDA Collaboration/PR

Interview with Dr. Paola Popesso

"Our universe was once a much more violent place"

The astronomer Dr. Paola Popesso is an expert on cosmic X-ray and infrared observations and leader of a new junior research group at the Excellence Cluster Universe. She and her group will investigate the "Formation and evolution of the cosmic large-scale structure". One of her major projects will be to gain a better understanding of the cosmic star formation. *Interview: Petra Riedel*

As our own Milky Way galaxy, NGC 6744 is one of the massive ga billion years ago and show little evidence of recent star formatio

Paola Popesso

Dr. Paola Popesso graduated from the University of Padua with a Laurea degree in 2001. From 2001 to 2004 she was a graduate student at the Max Planck Institute for Extraterrestrial Physics (MPE) in the International Max Planck Research School (IMRS), followed by a GOODS-Fellowship at the European Southern Observatory (ESO) until 2006. After receiving her PhD at the Ludwig-Maximilians-Universität, Munich, in 2006 with the work "The RASS-SDSS galaxy cluster survey: Correlating X-ray and optical properties of galaxy clusters", she was Junior Scientist in the Infrared Group at MPE and member of the Herschel PACS Instrument Control Center (ICC). At these positions Paola Popesso gained extensive experience in processing and analyzing huge datasets at different wavelength. Since May 2013, Paola Popesso is Junior Research Group Leader at the Excellence Cluster Universe.

What do we know about the star formation in the Milky Way?

The cosmic history of star formation is our own history. It is only through the lives and deaths of successive generations of stars that the universe reached its content of elements as we know it today. We live in a fairly stable and peaceful cosmic epoch, and indeed our galaxy appears to be evolving gently and steadily, forming stars at the relatively modest rate of about three solar masses per year. On agerage, every year three stars of the mass of our sun are born. However, we know that the universe was once a much more violent place, with stars being formed at a much higher rate than it is seen around us today. What we still do not know, is what caused this dramatic change.

So, the star formation changed over cosmic time periods?

Definitely. After the primordial gas has cooled down enough, the star formation grew rapidly in the first two billion years after the Big Bang and stayed roughly constant for a long period of time, with a slightly sloping level. The most striking feature of the cosmic star formation history of our universe is that it shows a dramatic drop of an order of magnitude since a redshift of z ~ 1, that is, eight billion years ago, to the present day.

Why?

We don't know exactly yet. A quenching process is required to cause such an abrupt decrease of the galaxy star formation activity. The most obvious reason for a galaxy to stop forming stars is the lack of gas supply. Indeed, primeval galaxies show a larger gas content with respect to the present star forming systems. The most accredited models of galaxy formation advocate as main mechanism the feedback injected into the galaxy interstellar medium by the central black hole.

What is a feedback?

Indeed, we know that there is a massive black hole at the center of every galaxy. When the central black hole accretes to a given mass threshold, it starts to inject energy in the surrounding gas through jets or winds. This black hole feedback is powerful enough to sweep away the gas and quench at the same time the black hole accretion and the galaxy star formation. However, observations have difficulties in finding evidence for the existence of such feedback for common galaxies. Thus, a different quenching process, or a combination of many of them, perhaps including a black hole feedback, is required to explain the observations.

alaxies in the nearby universe that is overwhelmingly dominated by old stars formed more than ten n activity.

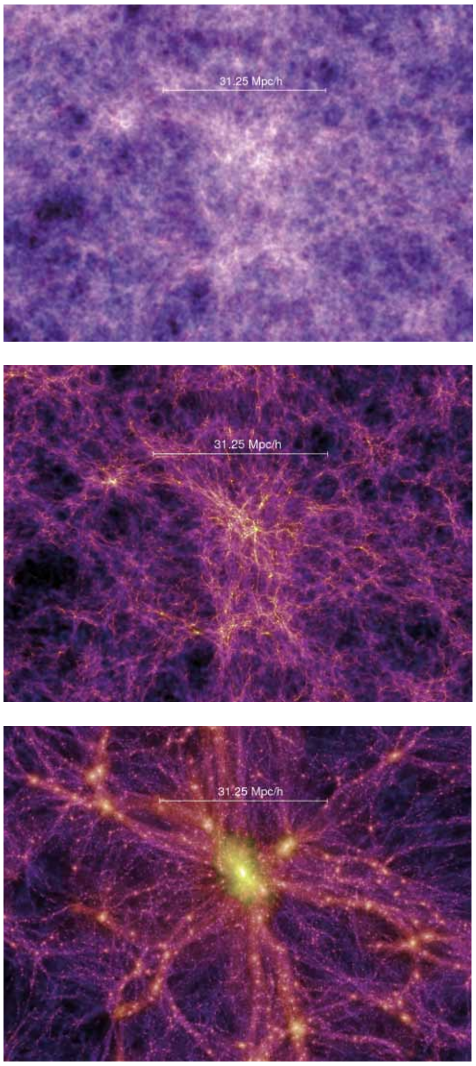
Are jets from a galaxy's central black hole really the main reason for the decline in the cosmic star formation?

What do you suggest?

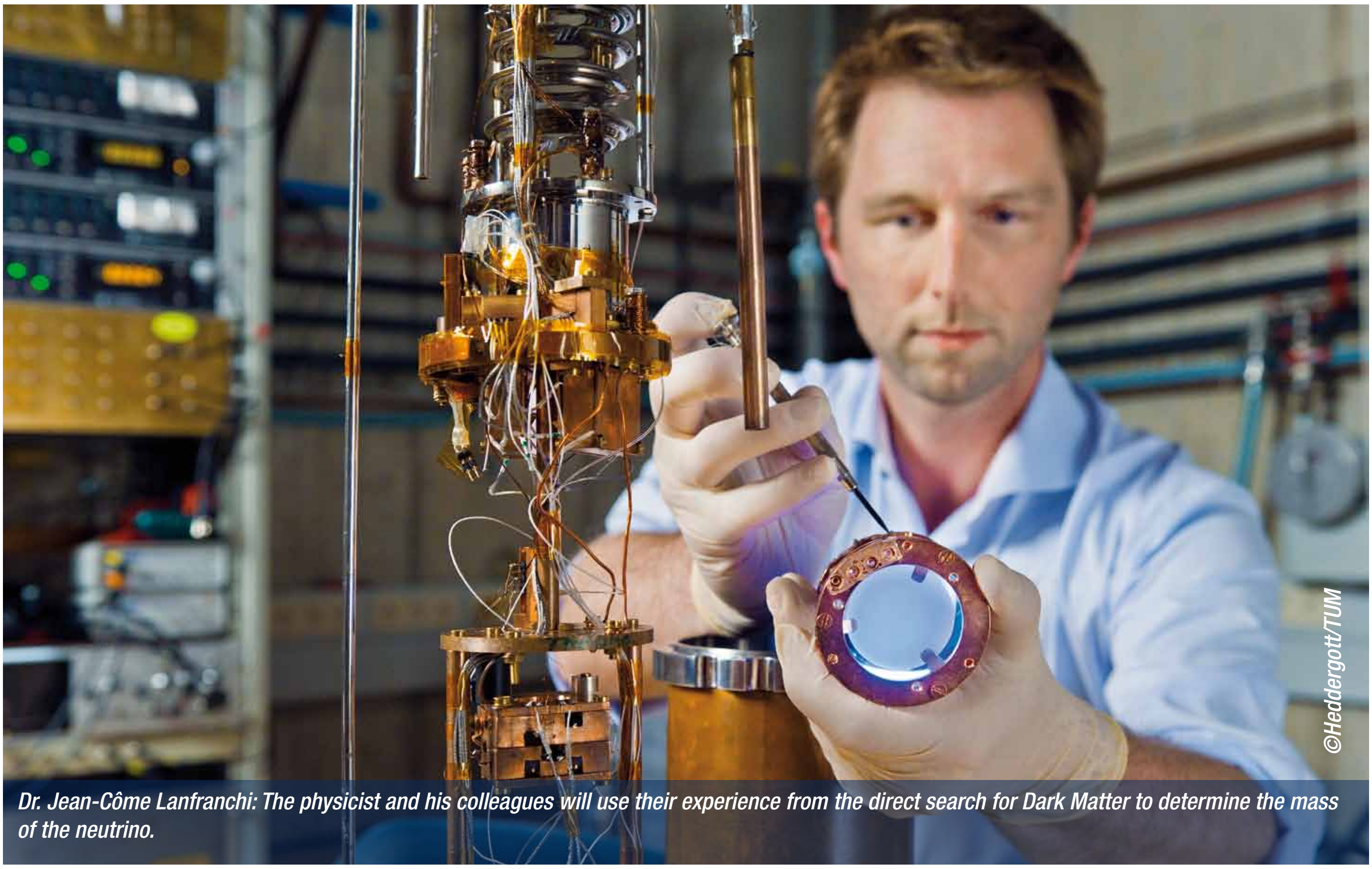
The key difference between the universe at a redshift of z ~ 1 and the local one, is, that the number density of massive Dark Matter halos, such as groups and clusters of galaxies with masses larger than about ten trillion solar masses, was a factor ten lower. As a consequence, since z ~ 1 a progressively larger fraction of galaxies experienced the group and cluster environment. As a matter of fact, there is an inverse correlation between the progressive decline of the star formation activity since z ~ 1 and the late-time increase in the number density of massive dark matter structures. It is, then, mandatory to follow this tantalizing lead and to ask if the very same process of assembly and growth of structures may be the main cause or, at least, one of the major drivers of the one order of magnitude decline in the cosmic star formation history of our universe.

How can you test your suggestion?

The goal of our project is to measure the contribution of galaxies in Dark Matter halos of different masses to the cosmic star formation history of the Universe up to z ~ 1. To achieve this goal we have to create a complete census of galaxies in terms of star formation activity and associate to each galaxy the parent halo mass information. For this purpose it is mandatory to sample at any epoch a volume large enough to gather a statistical sample of galaxies and to probe in a statistical sense the whole Dark Matter halo population. Three ingredients are necessary to fulfill this requirement: a deep very wide X-ray survey to identify massive halos, a highly complete spectroscopic survey to define the halo galaxy membership, a deep mid and far infrared survey to accurately measure the galaxy star formation activity. In 2014, the instrument eRosita will be launched on-board of a Russian satellite mission. It will perform the first imaging all-sky survey in the medium energy X-ray range up to 10 keV with an unprecedented spectral and angular resolution. Thus, within the next three or four years, we have the chance to learn much more about whether the formation of huge Dark Matter halos really slowed down the star formation in the universe.



Simulation of the evolution of the large scale structures in the universe: Eleven billion years ago (image above), the cold Dark Matter was distributed more finely, but through gravitational instability, structures grew hierarchically (middle) until present days (below), building massive clusters of galaxies.



Dr. Jean-Côme Lanfranchi: The physicist and his colleagues will use their experience from the direct search for Dark Matter to determine the mass of the neutrino.

The Excellence Cluster Universe promotes innovative ideas

Future Investment

A lack of ideas is a rare problem among scientists. Rather, there is a lack of money to realize them. Therefore, the Excellence Cluster Universe has launched the Seed Money Program in the second round of the Excellence Initiative: Innovative projects with potential for new scientific knowledge can apply for start-up funding. The goal is to grow these "seed grains" into longer-term projects, which – after a successful start at the Cluster – could receive further funding at national or European level. This year, the start-up capital goes to the projects of eleven research groups. Three examples.

Study of neutrino-less double beta decay

The search for the neutrino-less double beta decay is not only underway at the GERDA experiment (see page 3). Now, Dr. Jean-Côme Lanfranchi, Prof. Dr. Stefan Schönert and Prof. Dr. Andreas Erb of the Technische Universität München (TUM) want to follow an alternative path.

The researchers can thereby use their detector know-how from the experiment CRESST (Cryogenic Rare Event Search with Superconducting Thermometers), which aims at directly detecting Dark Matter. Just as the GERDA experiment, CRESST is performed at the Gran Sasso underground laboratory. Highly pure crystals are used as Low Temperature Detectors. Incident particles are detected and distinguished via the light and heat they produce within the crystal. Underground signals are suppressed by a combination of different highly efficient methods. For the observation of neutrino-less double beta decay, the researchers want to use a zinc molybdate crystal, which is enriched with the isotope Molybdenum 100. Besides Ge-76, Mo-100 is one of the few isotopes, in which the neutrino-less double beta decay is theoretically possible. The new method is expected to achieve a higher sensitivity so that the mass of the neutrinos could be determined more precisely.

The team of researchers will receive 62,000,- EUR to perform an initial feasibility study.

Tracking of X-rays and low and high-energy neutrons

A detector, which not only records the intensity and energy of the incoming X-rays and neutrons, but can also read out the direction from which they came, is of great interest for many research projects. However, the tracking of X-rays as well as high- and low-energy neutrons is a big

©Biebel/LMU

Promising first results: a gold-coated cathode as X-ray converter.

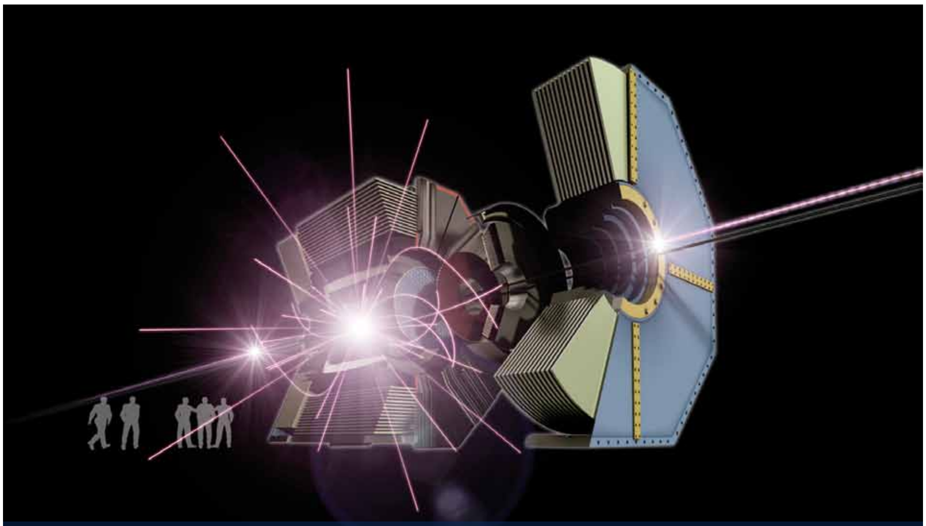
challenge. Prof. Dr. Otmar Biebel and Dr. Ralf Hertenberger from the Ludwig-Maximilians-Universität (LMU), Munich, use MicroMegas detectors (Micro-Mesh Gaseous Structure) for their approach. This detector technology was invented about 20 years ago. As in every gas detector, gas ionization is used as proof of a particle traversal.

In the gas volume of a MicroMegas detector, close to the readout-anode, there is a metallic micro-mesh which generates a strong electric field at the anode. When a gas atom is ionized in the upper gas volume, the free electron is attracted to the anode. Reaching the micro-mesh, it is accelerated by a strong electric field and gains enough energy to force further electrons out of atoms. Thus, an avalanche of ion/electron pairs is created. Using a two-dimensional read-out-electrode, the three-dimensional particle track can be reconstructed using the arrival time and place of the electrons. Though, detection and tracking of X-rays and neutrons in a MicroMegas gas detector requires at first a conversion into charged particles in order to be measured by the detector.

Otmar Biebel's and Ralf Hertenberger's approach is to complete the conversion at the cathode, rather than in the gas volume: placing suitable foils (e.g. gold for X-rays; nylon, Rilsan or bakelite for neutrons) next to the cathode, X-rays and neutrons would be converted into charged particles which are easy to localize.

While for X-rays a rough direction is immediately obtained from the direction of the detected photo-electrons, at least two high-energy neutrons are required to reconstruct their source area. "The challenge will be to find highly efficient X-ray and neutron converters", says Otmar Biebel. First experiments with a gold-coated cathode showed promising results for X-rays.

The scientists will be given 24,700,- EUR as start-up capital for their project.



Artistic impression of the future BELLE II experiment: Should the neural network based track trigger be successful, it could be implemented there one day.

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Development of a neural network based track trigger

At the time of the Big Bang, matter and antimatter particles were created in equal numbers from a tremendous energy density – to annihilate each other subsequently. According to this theory, today's universe should not exist at all. Scientists explain this "victory" of matter over antimatter, to which we owe our existence, with a tiny

To test the pattern recognition of the neural network based track trigger, algorithms must be ported to special hardware.

©Chen/TUM

imbalance in the decay of heavy particles and their antiparticles: Apparently, the heavy particles produced more matter than antimatter. Possible causes will be investigated at the new BELLE II experiment at SuperKEKB accelerator in Japan.

From the year 2015 on, bunches of electrons will be accelerated and brought to collision with their antiparticles, the positrons. The particles being created in the collisions and their decay products formed will be measured and analyzed in the BELLE II experiment. However, only a small number out of the tens of thousands of events generated per second are of interest for the researchers. At the moment of creation, the interesting information is filtered out online. A trigger initiates the data storage so that the event can be analyzed later.

To further reduce the selection time, the physicists Prof. Dr. Christian Kiesling from the Max Planck Institute for Physics, Prof. Dr. Stephan Paul from TUM, Prof. Dr. Jochen Schieck from LMU and the computer scientist Prof. Dr. Alois Knoll from TUM are pursuing a completely new approach, which is based on artificial neural networks. "Promising experience was gained as part of a master thesis", says Christian Kiesling. Yet, in order to transfer the method to the BELLE II experiment, the algorithms must first be ported to special hardware, Field Programmable Gate Arrays (FPGAs). "Within the next year, we want to show that the neural network track trigger works successfully. The next step will be to think about a concrete implementation at the BELLE II experiment."

The scientists will get 25,000,- EUR as seed money to start their project with porting the algorithms.

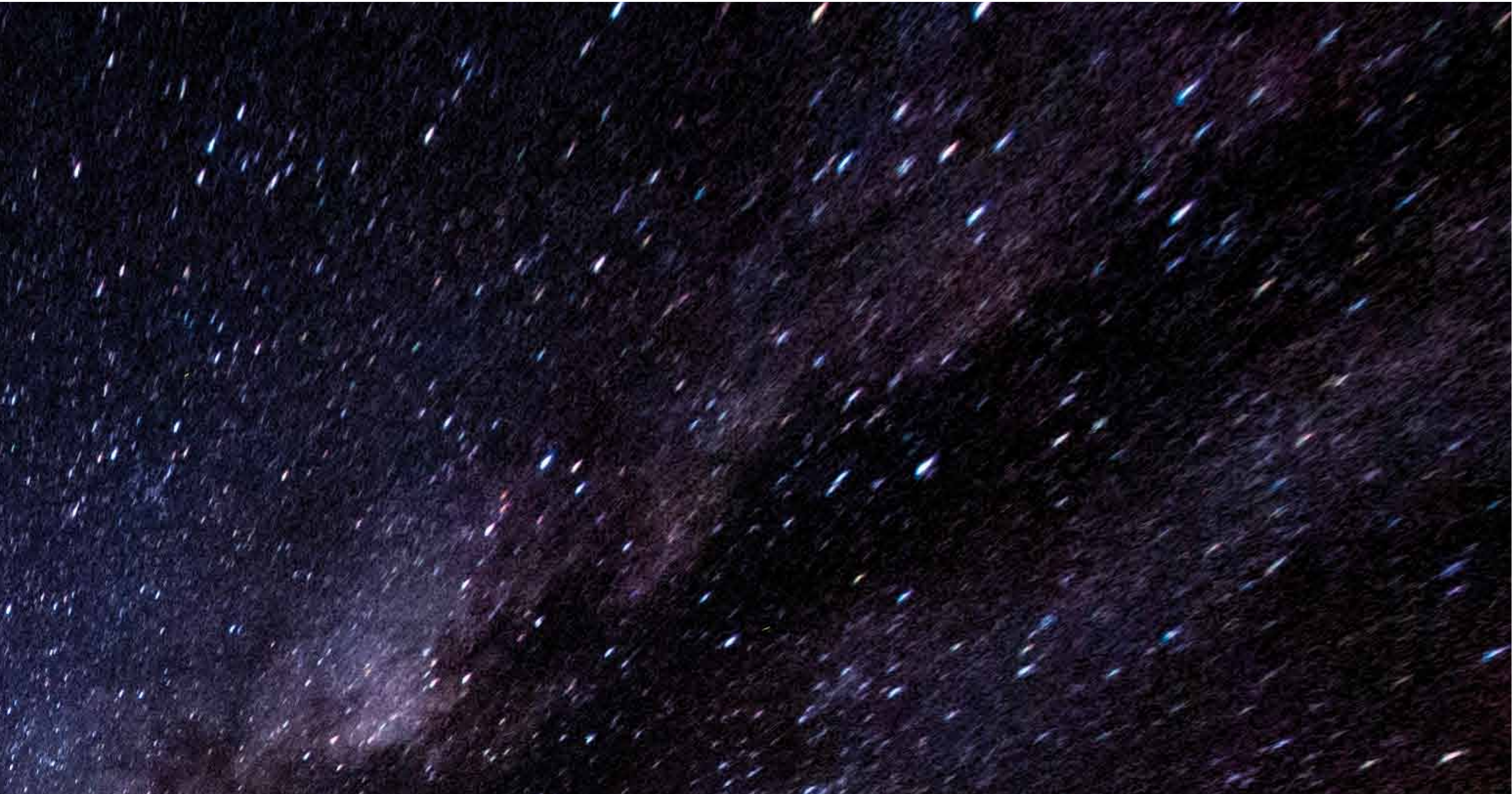
Christiane Lorenz/Petra Riedel

The Dark Energy Survey begins five-year mission

In search of the Dark Energy

From now on, the world's most powerful digital camera will turn its lenses skyward: For the next five years, the 570-megapixel camera of the Dark Energy Survey will provide colour images of one-eighth of the sky in unprecedented accuracy. An international team of physicists and astronomers, including members of the Excellence Cluster Universe, will use this remarkable machine to ascertain why the universe is expanding faster and faster. Working from an observatory in Chile, they aim at solving the mystery of Dark Energy, the energy, which is believed to be causing the acceleration.

The Cerro Tololo Inter-American Observatory in the Andes in Chile: From there, the Dark Energy Camera turns it lenses towards the southern sky to solve the mystery of Dark Energy.



In 1998, two teams of astronomers studying distant supernovae made the discovery that the expansion of the universe is speeding up. However, the finding is in strong contrast to the hitherto favoured theory that the universe is expanding continuously. To explain the new observation, cosmologists have postulated a new form of energy that makes up about two thirds of the universe: Dark Energy, which exhibits a gravitational force opposite to the attractive force of ordinary matter. Alternatively, Einstein's General Relativity must be replaced by a new theory of gravity on cosmic scales.

To ascertain why the universe is expanding faster and faster, an international collaboration has started the Dark Energy Survey (DES). One of the founding members is Prof. Dr. Joseph Mohr, astrophysicist from the Faculty of Physics at Ludwig-Maximilians-University (LMU), Munich. The survey's goal is to find out why the expansion of the universe is speeding up, instead of slowing down, and to probe the mystery of Dark Energy, the energy believed to be causing that acceleration. The main tool of the survey: The Dark Energy Camera, a 570-megapixel digital camera, mounted on a telescope at the Cerro Tololo Inter-American Observatory in the Andes Mountains in Chile. The camera includes five precisely shaped lenses, the largest nearly a meter in diameter. After ten years of planning, construction and testing, the Dark Energy Survey officially started on 31 August 2013. 120 physicists and astronomers will systematically map one-eighth of the sky. Since 2010, the Excellence Cluster Universe is part of the collaboration. "The observations of the Dark Energy Camera will tell us about the fundamental nature of matter, energy, space and time", says astrophysicist Prof. Dr. Jochen Weller from the LMU Faculty of Physics. Just like Prof. Dr. Joseph Mohr, he is a Principal Investigator of the Excellence Cluster Universe and member of the DES collaboration.

The survey will use four methods to probe Dark Energy:

✷ Counting galaxy clusters: The Dark Energy Camera will see light from 100,000 galaxy clusters billions of light years away. Counting the number of galaxy clusters at different points in time sheds light on this cosmic competition between gravity and Dark Energy.

✷ Measuring supernovae: By measuring how bright a supernova appears on Earth, we can tell how far away it is. Scientists can use this information to determine how fast the universe has been expanding since the star's explosion. The survey will discover 4,000 of these supernovae (Ia type), which exploded billions of years ago in galaxies billions of light years away.

✷ Studying the bending of light: When light from distant galaxies encounters Dark Matter in space, it bends around the matter, causing those galaxies to appear distorted in telescope images. The survey will measure the shapes of 200 million galaxies, revealing the cosmic tug of war between gravity and Dark Energy in shaping the lumps of Dark Matter throughout space.

✷ Using sound waves to create a large-scale map of expansion over time: When the universe was less than 400,000 years old, the interplay between matter and light set off a series of sound waves traveling at nearly two-thirds the speed of light. Those waves left an imprint on how galaxies are distributed throughout the universe. The survey will measure the positions in space of 300 million galaxies to find this imprint and use it to infer the history of cosmic expansion.

The Dark Energy Camera is the most powerful instrument of its kind. With each snapshot, it will be able to see light from more than 100,000 galaxies up to eight billion light years away. The survey's observations will not be able to visualize Dark Energy directly. However, by studying the expansion of the universe and the growth of large-scale structures over time, the survey will give scientists the most precise measurements to date of the properties of Dark Energy.

DES Collaboration/PR

New entries, an award and a farewell

People

Prof. Dr. Viatcheslav Mukhanov received a major award, two young scientists will continue their academic career at the Excellence Cluster Universe and Prof. Dr. Jochen Schieck will leave Munich for a new position in Vienna.

©C. Olesinski/LMU

Prof. Dr. Viatcheslav Mukhanov from the LMU and Principal Investigator of the Excellence Cluster Universe received the Gruber Cosmology Prize together with the Russian researcher Alexei Starobinsky. Endowed with 500,000 Dollar, the prize honours leading cosmologists that substantially contribute to the understanding of the universe.

From 1st October, Prof. Dr. Jochen Schieck from the LMU and head of the research group "Heavy Quarks" at the Excellence Cluster will be the new Director of the Institute for High Energy Physics of the Austrian Academy of Sciences in Vienna. Jochen Schieck is a member of major international collaborations such as BELLE II and ATLAS.

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Since 1st September, Dr. Torsten Dahms leads the new Junior Research Group "Studying the quark- gluon plasma via low-mass dilepton with ALICE" at the Cluster. After completing his PhD at Stony Brook University, USA, in 2008, he was a fellow at CERN and researcher at the École Polytechnique, France.

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Since 1st September, the new Junior Research Group "Interplay between direct and indirect searches for new physics" at the Excellence Cluster Universe is lead by the theoretical particle physicist Dr. David Straub. In 2010, he completed his doctorate at the TUM and has now returned to Munich.

©FRM II/TUM

The Cluster mourns the death of Klaus Schreckenbach

The Excellence Cluster Universe mourns the death of its founding member Prof. Dr. Klaus Schreckenbach, who unexpectedly died on 13 September.
Klaus Schreckenbach, born in 1943 in Marienwerder, studied and graduated at the TUM, where he was habilitated in 1985. After research stays at the Institute Laue-Langevin (ILL) in Grenoble and the Brookhaven National Laboratory, USA, he returned to the TUM in 1991 as professor for experimental physics and, shortly after that, became the Technical Director of the "Atomic Egg", the first research reactor in Garching. As Technical Director of the new Research Neutron Source in Garching (FRM II), he continued his work from 1999 until his retirement in December 2005. After his retirement as professor in 2009, Klaus Schreckenbach took over many important tasks at the Excellence Cluster Universe. He supported the Cluster with his wisdom and his selfless advice in many decisions. We are deeply shaken by his sudden death, because he was not only a colleague but a long-time friend for many of us. Our deepest sympathy goes to his family, especially this wife and the two sons.

Scientific & Public Events

Preview

Within the next couple of months, the Exzellence Cluster Universe will organize numerous scientific and public events. The conferences and workshops highlighted in blue are primarily addressing experts. All other events are aimed at the interested public.

26.09.2013, 10:00 - 17:00	Research Area C Science Day: “Particle Flavour and Messengers for new Physics”	TU München, Institute for Ad-vanced Study, Lichtenbergstr. 2 (4. floor), Garching
08.10.2013, 19:00	Cafe & Kosmos www.cafe-und-kosmos.de	Vereinsheim, Occamstr. 8, Munich
09.10.2013, 20:00	ArtScience: Exploring new Worlds, Realizing the Imagined Exhibition & Discussion	Deutsches Museum, New Technologies Centre
16.10.2013, 19:00	Wissenschaft für jedermann Dr. Martin Treiber, TU Dresden: “Traffic dynamics modelling and -simulation – fighting the traffic jam with Maths”	Deutsches Museum, Hall of Fame
starting 16.10.2013 every Wednesday, 16:30	Universe Colloquium followed by wine & cheese	Excellence Cluster Universe, Boltzmannstr. 2 (seminar room, basement), Garching
17.10.2013, 14:00 - 18:30	Research Area D Science Day: “Probing the Standard Model of particle physics”	TU München, International Graduate School of Science and Engineering, Boltzmannstr. 17, Garching
19.10.2013, 11:00 - 18:00	Open day www.forschung-garching.de	Research Campus Garching
21. - 25.10.2013	Conference “Physical Processes in the ISM” www.ism-spp.de	MPI for Extraterrestrial Physics, Giessenbachstr. 1, Garching
23.10.2013, 19:00	Wissenschaft für jedermann Dr. Stefan Gillessen, MPE: “Fireworks around the black hole in the centre of the Milky Way	Deutsches Museum, Hall of Fame
28. - 30.10.2013, 10:00 - 16:00	TUM pupil‘s autumn university: “The simulated cosmos” www.maedchenmachentechnik.de	Excellence Cluster Universe, Boltzmannstr. 2, Garching
12.11.2013, 19:00	Cafe & Kosmos www.cafe-und-kosmos.de	Vereinsheim, Occamstr. 8, Munich
starting 21.11.2013 every Thursday, 12:30 - 13:00	Fruits of the Universe A Lunch Talk with Food for Body and Mind with Prof. Dr. Scott Tremaine, University of Princeton, USA	Excellence Cluster Universe, Boltzmannstr. 2 (Foyer, 1st floor), Garching
27.11.2013, 19:00	Wissenschaft für jedermann Prof. Dr. Alexander Heisterkamp, Uni Jena: “Living Optics”	Deutsches Museum, Hall of Fame
02. - 06.12.2013	Excellence Cluster Universe Science Week	MPI for Extraterrestrial Physics, Giessenbachstr. 1, Garching
17.12.2013, 19:00	Cafe & Kosmos www.cafe-und-kosmos.de	Vereinsheim, Occamstr. 8, Munich

ArtScience: Exhibition & Discussion on 9 October at the Deutsches Museum

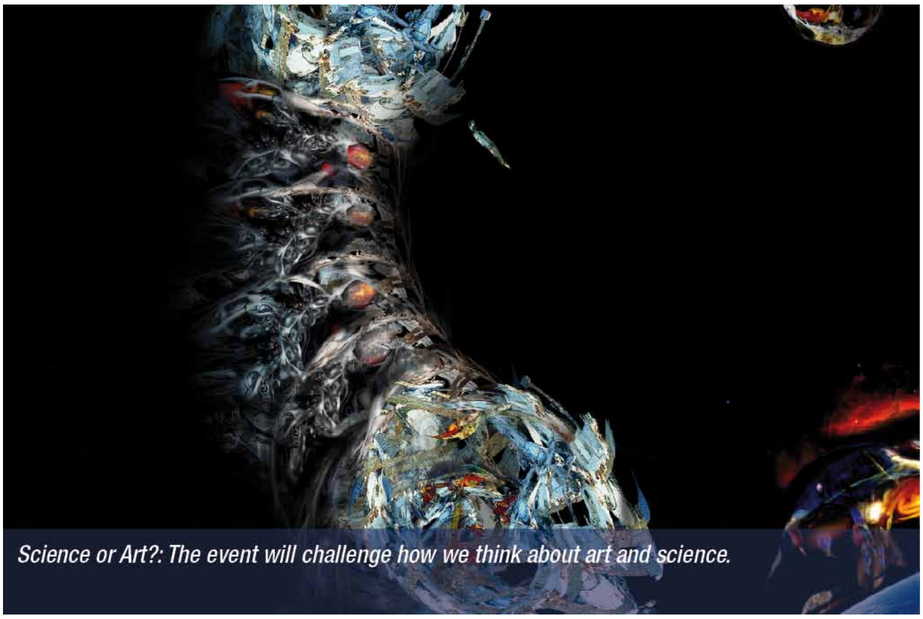
Science or Art?

At the Deutsches Museum New Technologies Centre, an interesting experiment will take place on 9 October: Artists and scientists will exhibit their pictures – but which picture belongs to which discipline? The evening with the motto "ArtScience: Exploring new Worlds, Realizing the Imagined" illuminates the sometimes blurred boundaries between science and art.

Science is considered to be purely objective, art as subjective. Researchers discover the reality, artists work with their imagination. However, upon closer examination, the boundaries between the two disciplines are sometimes not as clearly defined.

The core principles and concepts in science are not formulated exclusively by deduction and logical reasoning, but are mostly found through intuition and insights that were only confirmed through experiment and observation at a later stage. The discipline of art on the other hand concerns itself with creating constructs of perceptions that reflect our reality.

The evening at the Deutsches Museum New Technologies Centre, which is organized by Prof. Dr. Elisa Resconi from the Excellence Cluster Universe, aims at demonstrating that the boundaries between science and art are often not as clear as expected - and artists and scientists are concerned with very similar questions: How to convey meaning? How to engage the audience? How to cross boundaries?



Science or Art?: The event will challenge how we think about art and science.

Courtesy R. Armstrong, P. Watson & J. Morris

ArtScience: Exploring new Worlds, Realizing the Imagined, **Exhibition & Discussion on 9 October 2013**

19:30: opening of the exhibition
20:00: panel discussion (in English)
seat reservation required:
artscience@universe-cluster.de

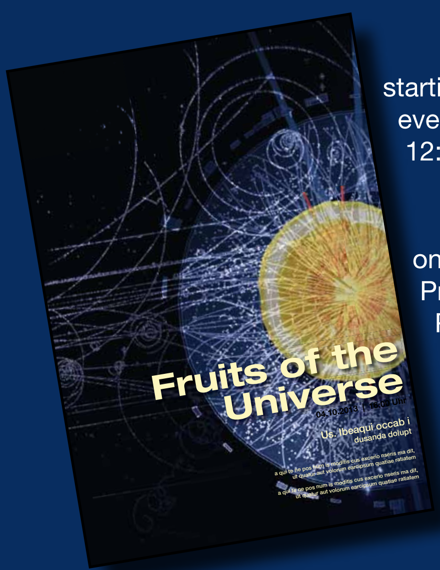
Panelists: Prof. Dr. Wolfgang Heckl, Dr. Christian Spiering, Dr. Mark David Hosale, Prof. Dr. Francis Halzen

The event is organized by the Excellence Cluster Universe in cooperation with the Deutsches Museum.

Fruits of the Universe

A Lunch Talk with Food for Body and Mind

New Lecture Series



starting 21 November 2013
every Thursday from
12:30 to 13:00

on 21 November 2013 with
Prof. Dr. Scott Tremaine, University of Princeton, USA

Excellence Cluster Universe,
Boltzmannstr. 2 (Foyer, 1st floor),
Garching

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