NEWSLetter
Excellence Cluster Universe

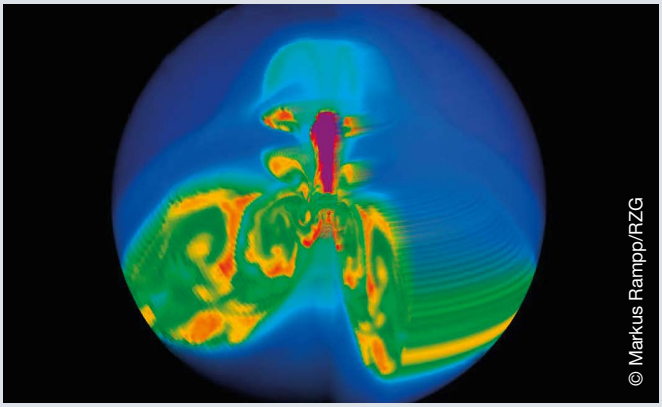
Issue 5 December 2008

Dear Readers,

while I'm writing this, the Universe Cluster is hosting its annual Science Week – four days for Cluster members and their guests to show and discuss their research. At our second Science Week we celebrate the first winners of our "Universe PhD awards". We are proud to have awarded three instead of two young doctors, given the high quality of the submitted theses! The Science Week also sets a final highlight for the year 2008 – which was indeed a prolific year. We appointed six new leaders for our Junior Research Groups, five more research fellows arrived – bringing many new faces and projects to our community. We organised quite a few small and big events, ranging from public talks and exhibitions over scientific workshops up to our mid-year international Symposium. And we have an interesting year ahead: 2009 is the International Year of Astronomy – and I wish you an excellent start for it!

Barbara Wankerl, Public Outreach Coordinator

PICTURE OF THE MONTH



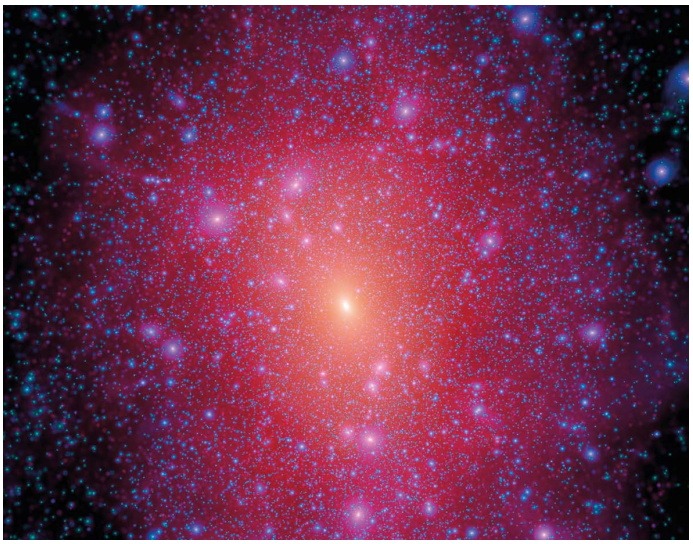
Snapshot of an Exploding Star

This artwork shows a snapshot of a beginning supernova. The simulation was performed by Andreas Marek and Hans-Thomas Janka (Max-Planck-Institut für Astrophysik) on several high-performance computers. The scientists investigate what mechanisms cause the explosion of stars. In their recent work they found evidence that very tiny particles – neutrinos – provide the energy required to make stars of a certain size bang. The complete paper will be published in Astrophysical Journals soon – we'll keep you posted!

HIGHLIGHTS

Supercomputers Predict where to Look for Dark Matter

An international team of astrophysicists, among them also members of the Universe Cluster, has used some of Europe's largest supercomputers to help NASA's newest satellite observatory to find the mysterious dark matter (Nature, 6 November 2008). The team was led by Volker Springel from the Max-Planck-Institut für Astrophysik (MPA).



Projected dark matter density in the simulated Milky Way sized dark matter halo. A myriad of dark matter subclumps is embedded within the virialized region of the galaxy's halo. Their dense centers they may emit energetic gamma-rays from the annihilation of dark matter particles.

NASA's Fermi telescope has already been mapping the sky for several months using gamma-rays. Within a couple of years it may detect a glow from the dark matter whose gravitational effects astronomers first detected more than 75 years ago. However, the dark matter has so far remained stubbornly invisible to all telescopes even though it apparently accounts for 85% of all cosmic matter. Most cosmologists believe that this dark matter is a new kind of elementary particle yet to be detected on Earth. Scientists hope for the Large Hadron Collider at CERN to provide evidence for it once its magnets are fixed. Under the right conditions these particles may produce enough gamma-rays for Fermi to detect them.

But where should Fermi look to see this gamma-ray signature of dark matter? A team of astrophysicists from Germany, the UK, Canada and the Netherlands (the "Virgo consortium") have used one of the largest of all European supercomputers to simulate the formation of the dark matter structure that surrounds a galaxy like our own Milky Way. Such "dark matter halos" are more than a trillion times as massive as our Sun and are the basic units of cosmic structure.

Simulations by the Virgo team show how the Milky Way's halo grew through a series of violent collisions and mergers from millions of much smaller clumps that emerged from the Big Bang. Most of these were disrupted during the formation process, but some survive, the largest harboring familiar satellites of the Milky Way such as the Large and Small Magellanic Clouds or the Sagittarius dwarf galaxy. Other clumps were too small to make any stars, but are still predicted to lurk in our Galaxy's halo, so far undetected by any telescope.

⇨ next page

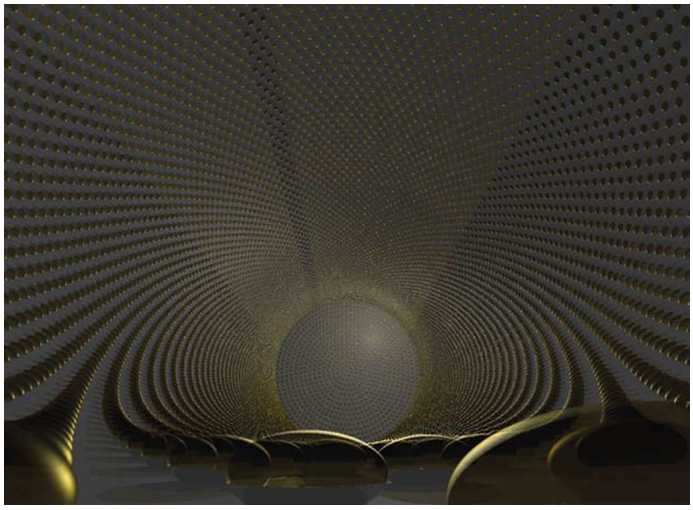
⇨ Gamma-rays are produced in regions of high dark matter density when the particles collide and annihilate in a puff of radiation. Many cosmologists have argued that Fermi should search for gamma-rays from the Milky Way's satellites, since their centres should be very dense. The Virgo team's simulations demonstrate that this is not the best place to look. Their careful calculations show that by far the most easily detectable signal should come from regions of the Milky Way well inside the Sun's position. Looking right at the centre would be a poor strategy for Fermi because of the danger of confusing the signal with gamma rays coming from other sources, such as the remnants of supernovae or the gas clouds where stars form. Instead, the Virgo team recommend looking 10-30 degrees off-centre, where they predict that the dark matter should glow in gamma-rays in a smoothly varying and characteristic pattern. The largest simulation took 3.5 million processor hours to complete. Volker Springel was responsible for shepherding the calculation through the machine and said: "At times I thought it would never finish." Eventually it did – the efforts being awarded by a Nature publication and much attention by the research community.

The simulations were carried out on three of the largest supercomputers in Europe:

- The Leibniz-Rechenzentrum München (LRZ) supercomputer where the main simulation was performed
- The Cosmology Machine at the Institute for Computational Cosmology, University of Durham, UK
- The STELLA Supercomputer of the LOFAR Project at the University of Groningen, the Netherlands

Milestone for Neutrino Physics: Start of Design Study for LAGUNA

Neutrinos are messengers from astrophysical objects as well as the Early Universe and can give us information on processes happening in the Universe, which cannot be studied otherwise. The first successful detection of neutrinos from the supernova SN-1987A by the Kamiokande underground experiment (Japan), recognized with the Nobel Prize in 2002, has opened the field of low energy neutrino astronomy, to date a 20-year long tradition of incredibly rich physics with large underground detectors.



Artist's view into the inner volume of LENA. The walls are paved with large photo-sensors.

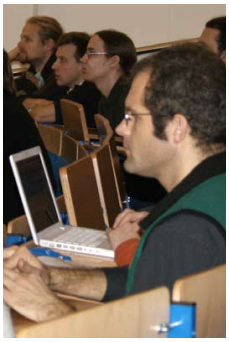
A European collaboration of 26 research institutes including the Technische Universität München (TUM) is working on building a next-generation observatory for neutrino detection: The new, giant underground laboratory is called LAGUNA (Large Apparatus for Grand Unification and Neutrino Astrophysics). October 2008 was the official start of a design study to evaluate seven European sites for LAGUNA: Finnland, Poland, Rumania, Italy, France, Spain, England. The study is expected to be accomplished by 2010.

The core of the new lab will be one or several neutrino detectors. As there are different detector options, a further decision step deals with the question, which detector(s) is or are best suited to meet the requirements for research with LAGUNA. One of the three detector options, a 50 kiloton liquid scintillator detector (LENA), is currently being investigated with the help of the Excellence Cluster Universe. The two remaining detector types are a 700 kiloton water detector (MEMPHYS) and a 100 kiloton liquid argon detector (GLACIER). All detector types will have to be evaluated for all seven sites.

EVENTS

International Experts join for Workshop on Hydrodynamics

From 17 to 19 November 2008, the Excellence Cluster welcomed more than 50 experts from both industry and research institutions. They gathered at the Institut für Plasmaphysik (IPP) in Garching to discuss the mechanisms of hydrodynamical instabilities from different perspectives. The participants were pleased with the quality of the talks. Says Fabian Heitsch, University of Michigan: "It was an excellent event! I have learned a lot about hydrodynamical applications". This view is shared by Norbert Grün, BMW Group: "To see different approaches from other disciplines was very inspiring." The event was chaired by Andreas Burkert, deputy coordinator of the Universe Cluster. "We are very pleased with the broad range of application areas and topics. You don't find too many events where an engineer who works on car aerodynaymics and an astrophyicist who investigates star formation discuss hydrodynamical models", summarizes Burkert.



Open the Curtains for IYA2009

The old year goes, a new year comes. But it's not just a new year, but a very special one: 2009 is the international year of astronomy. IYA2009 will be a global celebration of astronomy and its contributions to society and culture, highlighted by the 400th anniversary of the first use of an astronomical telescope by Galileo Galilei. More than 130 countries will contribute to IYA2009 activities on a national, regional and local level. The big international opening will take place in Paris on 15 and 16 January 2008.

Also the Universe Cluster embarks upon some projects for the year of astronomy. One of them is a special service for schools, planetaria and other organisations who look for interesting talks for students or visitors. In collaboration with the Astronomische Gesellschaft the Cluster will build a web-based speakers' database that helps organisers of school and public events to find suitable speakers for their audiences. The database will be available at the beginning of February 2009 at www.universe-cluster.de.

Also the Cluster will participate in the „100 Hours of Astronomy", a Cornerstone Project of the IYA 2009. It is a worldwide event with a wide range of activities including live webcasts, observing events and more, taking place during a 100-hour period from 2-5 April, 2009, a good phase for observations. The Excellence Cluster Universe will engage in „sidewalk" observations in the city of Munich – and allow as many people as possible to take a look at the nightly skies.

Furthermore, the Excellence Cluster Universe is an official sponsor of the IYA2009 and also supports the national opening event on 20 January in Berlin. But that's not really all – there are still some IYA 2009 surprises in the box. Read more about these in the coming issues of our newsletter!

More information at
http://www.astronomie2009.de/
http://www.astronomy2009.org/

PEOPLE

Shawn Bishop Becomes New Professor for Experimental Nuclear Astrophysics

Shawn Bishop

The Excellence Cluster Universe is pleased to announce the appointment of Shawn Bishop as professor for Nuclear Astrophysics. In this position, Shawn Bishop will be involved in both research activities of the TUM Physics Department and the Universe Cluster.

Shawn Bishop was born and raised in Canada. He finished his study in the department of Physics, Simon Fraser University, with a PhD work on the measurement of the astrophysical ^{21}Na(p,g) ^{22}Mg reaction. Prior to his arrival at TUM and the Universe Cluster, he was a Postdoctoral Fellow at the Nishina Center Radioactive Ion Beam Factory, in Japan.

In one of their major research activities, his group will enhance the Tandem facility in the Maier-Leibnitz-Laboratory by building at least three new experimental facilities. Two of these experiments will be dedicated to nuclear astrophysics studies of the rp-process in supernovae and X-ray bursts, and proton-capture rates important for novae nucleosynthesis. "The lifetimes of excited nuclear states are critical ingredients for astrophysical reaction rates", explains Bishop. "We will measure them employing the Tandem accelerator after having installed a new Doppler Shift lifetime station."

He adds: "I am thrilled to be here at TUM. I look forward to teaching and becoming involved in making the local lab a center for nuclear astrophysics research!"

Peter Fierlinger Appointed as Speaker for nEDM Collaboration

Prof. Dr. Peter Fierlinger, was appointed as spokesperson of the European nEDM Collaboration. Peter Fierlinger has been leading the Unverse Cluster's research group "Fundamental Physics with Neutrons" since August 2008.

The collaboration has been founded in 2004 and consists of 14 renowned institutions, including the Universe Cluster and Technische Universität München (TUM). It is dedicated to measure a special symmetry-breaking property in the neutron: Although neutrons are electrically neutral particles, one can observe two electrical poles inside the neutron, one being positively, the other negatively charged. Measuring this electrical dipole moment (EDM) helps scientists to better understand the asymmetry of matter and anti-matter in the Universe.

Therefore, the collaboration is performing a series of measurements starting with test-setups at the Institut Laue-Langevin (ILL) in France and at the Paul Scherrer Institut (PSI) in Switzerland. These preparations will lead to a completely new experimental environment. It is being built with support of Fierlinger's group and will start operation in 2010. Both the TUM as well as the PSI are currently developing sources for ultra-cold neutrons, providing the fundament for EDM research in neutrons.

And the Universe PhD Awards go to...

The winners of the Universe PhD Awards have now been chosen. The Excellence Cluster Universe congratulates three young researchers on their outstanding dissertations. The annual Universe PhD Awards "Theory" and "Experiment" were assigned for the first time. Winners of the prize are awarded with 4,000 Euros each and are invited to present their research at the Universe Cluster's "Science Week" from 1-4 December 2008.

The five members of the award committee, emeriti of TUM and LMU, were pleased by the high scientific level of all PhD theses submitted. Indeed, the decision was hard too make – resulting in three instead of two prizes: The original call was intended to award two candidates only.

Steve Blanchet

The Universe Award "Theory" goes to Steve Blanchet (MPP), for his dissertation "A new Era of Leptogenesis". According to the award committee, the thesis gives a competent, innovative and vivid account of the different aspects of leptogenesis in connection with unsolved puzzles in cosmology and particle physics. The laudatio further emphasizes that Blanchet's dissertation provides "an excellent example of a synoptic work within the scope of the Universe Cluster".

Petra Haefner

In the category "Experiment" the committee identified two evenly matched candidates. Petra Haefner (LMU) won the prize for her research work "Measurement of the Top Quark's Mass with the Matrix Element Method in the Semileptonic Decay Channel at D0". In her thesis, Haefner has significantly improved the method to measure the mass of the top quark, the heaviest of all quarks, thereby limiting the systematic inaccuracy to 1 GeV. The laudatio stresses the far-reaching importance of Haefner's results: The mass of the top quark plays an important role in the standard model. Therefore the measurements are expected to have an impact on the mass determination of the Higgs boson.

Rüdiger Picker

Rüdiger Picker (TUM) was awarded for his PhD thesis on "PENeLOPE and AbEx on the Way Towards a New Precise Neutron Lifetime Measurement". In his project, Picker developed a new method for the high-precision lifetime measurement of neutrons, being the fundamental parameter for the formation of the first elements in the Universe. Picker developed a vertical magnetic bottle for ultra-cold neutrons (UCN) that allows to directly measure the protons released in the beta-decay of neutrons. The work is a highly sophisticated design project that was considered "to have been realised in an excellent approach".

Welcome to the Cluster!

Research Fellows: Maximo Ave Pernas (University of Chicago, 1 January 09)
Guests: Prof. Stefan Hofman (30 November - 21 December 08) ++ Prof. Luigi Guzzo (INAF Brera, Italy, 30 November - 5 December 08) ++ Prof. Karlheinz Langanke (GSI, Darmstadt, 1 - 2 December 08) ++ Bart Wakker (University Wisconsin, USA, 7 -14 December 08)
Postdocs: Kolja Prothmann (1 December 08) ++ Virginia Corless (1 December 08) ++ Andreas Moll (8 December 08) ++ Katja Seidel (1 January 09)

Start-up Funding for Professor Laura Fabbietti

Prof. Dr. Laura Fabbietti has been granted a start-up funding of 15,000 euros. The sponsorship is part of a special program of the Bavarian Ministry for Science to support newly appointed female professors at Bavarian universities. Explains Dr. Ines Jung, program coordinator at the funding agency Universität Bayern e.V.: „The support is given to junior professors with a promising scientific career ahead. We identify the candidates deserving support on the ground of their publications and previous funding activities."

In this year 36 young female professors have been awarded the grant. The new program will be continued in 2009. Candidates have to be nominated by their universities and are selected by an independent committee. Deadline for the next funding cycle is 15 January 2009.

More information can be found at the website of Universität Bayern e.V.
www.uni-bayern.de

LINKS

If you ever tried to invite – let's say four – of your colleagues to a meeting, you know how tricky it can get. You propose a date, A and B have time, but C is in Santa Cruz for a conference and D has to give her weekly seminar. So you start all over again, taking one round after round. Doodle.com provides an easy tool to choose dates and timeslots and send them as a link to all people you want to join.
http://www.doodle.com

With "Dilbert" cartoonist Scott Adams has created the living cliché of a software programmer: a guy fighting the challenges of a cubicled office and eternal singlehood. Now Dilbert leaves his motionless existence and becomes animated – with a new story everyday!
http://dilbert.com

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