NEWSLetter
Excellence Cluster Universe

Issue 3 / 2011

Dear Readers,

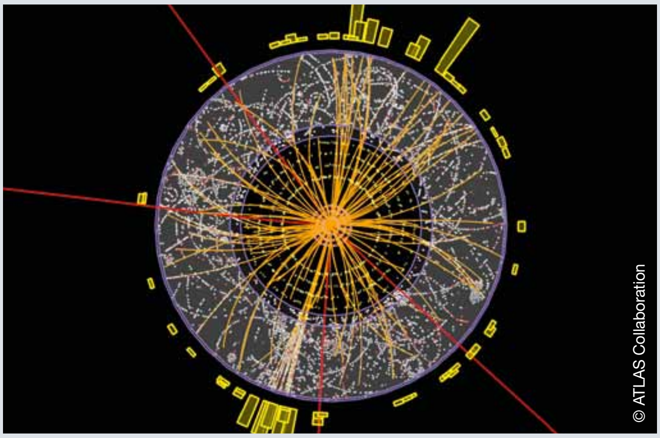
the beginning of a New year is an arbitrary break in time. In general, life in the New year just carries on without the unexpected suddenly happening. This is our wish for the Universe Cluster. The application for the funding period 2012 until 2017 is well under way and will be subject of a review by the experts in January 2012. After that we will have to wait until June 2012 when the DFG will announce which projects of the excellence initiative will be further funded.

There are some news, however: as if timed for Christmas, CERN just surprised the world with their latest status report which identifies further important clues in the search for Higgs. The other news is that starting with this issue we will introduce books on the physics of the Universe from time to time.

On behalf of the Universe Cluster I wish you a Happy Christmas and a successful New Year 2012.

Barbara Wankerl, PR Manager

PICTURE OF THE MONTH



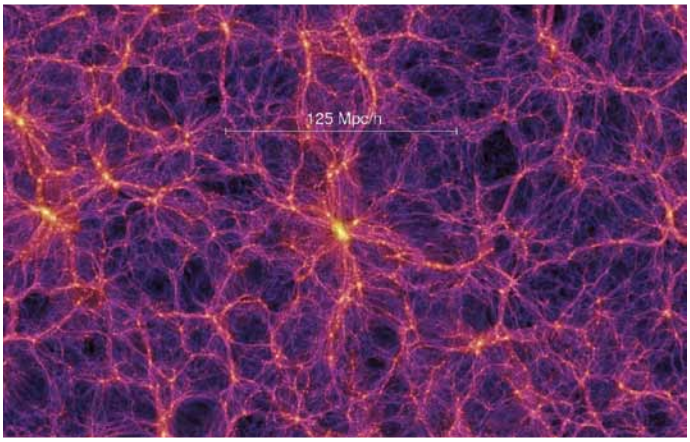
Not much room left for the Higgs

It has not been found yet - the Higgs boson that is responsible for the mass of matter. However, the two experiments ATLAS and CMS have surfaced importants hints for the existence of the Higgs in the tiny range of 124 to 126 GeV. Scientists face a lot of work to prove these results also statistically. They have to evaluate a huge number of further events - maybe they can announce the discovery of the Higgs as early as in 2012.

RESEARCH

Gravitational Lensing: Focus on Dark Matter

As the name implies, the dark matter in the Universe is invisible – simply because it doesn't emit electromagnetic radiation. Dark matter remains hidden to telescopes, as these instruments catch and observe light at different wavelengths. There are several reasons, why scientists are convinced of the existence of dark matter. One of them is the strange gravitational behavior of galaxies. The gravitational force that makes planets rotate around the Sun in our solar system makes also stars move in galaxies. However, looking at the rotational velocities of remote stars in the periphery of spiral galaxies, scientists found they move at similar speed as stars much closer to the center. This can only be explained by assuming that there is more gravitational mass than provided by just the visible matter, i.e. stars and interstellar gas.



This computer simulation ("Millennium Simulation") shows the large scale structure of the Universe. One can recognize knots and filaments with dense distribution of galaxies and galaxy clusters.

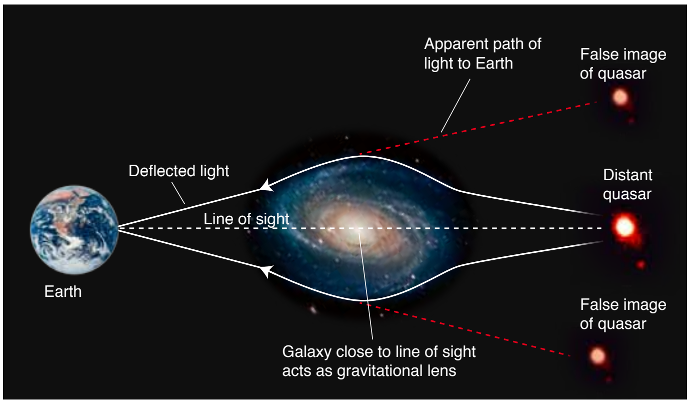
In recent years, both astronomical observations and simulations have delivered a clear picture of how the Universe looks like at large scales: Galaxies and galaxy clusters are not distributed equally in the Universe. They seem to form a gigantic, three-dimensional cosmic web with filaments and knots of high density and interspersed empty regions, known as voids. It is assumed that dark matter shapes the template for this large-scale structure of the Universe, providing the gravitational "seed" for the accumulation of visible matter.

In the past issues of this newsletter, we discussed the nature of dark matter and how particle physicists try to directly detect dark matter particles using a special kind of underground detectors. Astronomers and cosmologists have devised different sophisticated methods to study and pin down dark matter in the Universe. One of them is gravitational lensing, making use of the fact that light is bent by matter - both visible and dark.

Recently two Research Fellows at the Universe Cluster, Dr. Lise Christensen and Dr. Claudio Grillo teamed up to study an interesting gravitational lensing system. "By studying gravitational lenses we can measure the amount and distribution of dark matter in galaxies compared to their luminous components", explains Claudio Grillo. "The analysis of the physical properties of the lenses living in different environments helps us to get more insight into the way luminous and dark matter interact."

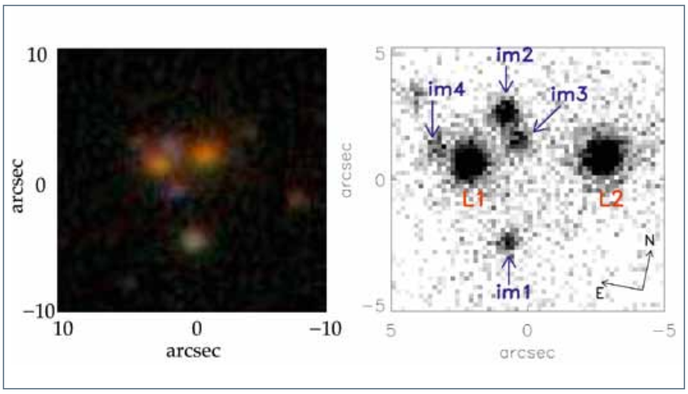
The principle of a gravitational lens follows the same physical laws as optical lenses used in a microscope or simply in reading glasses. The rays of light are bent, creating an image that differs from the original: it may be inversed, bigger, smaller or somewhat distorted. In a gravitational lens, the same effects occur, only at a much larger distance. In this case, an object, e.g. a galaxy, deflects the light rays of a source, e.g. a star, quasar or another galaxy. The observer or rather a telescope sees the distorted image as so-called Einstein circles or arcs. The shape and position of these artifacts tell scientists about the mass properties of the lens - and give hints to the distribution of visible and dark matter.

Christensen and Grillo investigated a lensing system known as Cassowary 5 (CSWA 5) (1). It consists of a light source at redshift z=1.069 and a tandem of two galaxies at z=0.388 (2). As early as May 2010, Christensen had published a paper, confirming the finding of this new lensing system, which lenses the source into four distinct images. In her work, Christensen studied the fundamental properties of the source to see whether all images were connected to one single source.



The principle of gravitational lensing

In a paper issued in September 2011 , the two scientists took the lensing system under a closer scrutiny. According to their findings, the CSWA 5 galaxies form a huge halo of dark matter, the system being rather old with most of the interstellar gas used up to form stars. The combination of different data sets has allowed for the first time to quantify precisely the amount of dark matter present in what is a very likely galaxy group acting as a lens. In detail, they found that the amount of dark matter present in the studied lens galaxies is almost a factor four larger than in field lens galaxies with comparable luminous masses. In the CSWA 5 lens galaxies approximately 80% of the projected total mass within the half light radius (i.e. the radius inside which half of the total light of a galaxy is included) is in the form of dark matter.



The left image shows four distinguished pictures of the galaxy produced by the CSWA 5 lens. The image on the right indicates the lensing images in blue color (im1-im4). The lensing galaxies are titled L1 and L2.

"The CSWA 5 system we characterized is just a small building block in the complete architecture of the Universe," says Claudio Grillo. "But similarities and differences to isolated galaxies are crucial to better understand the formation and evolution of cosmological structures."

Original publication: http://arxiv.org/abs/1108.0678

(1) The acronym stands for the CAmbridge Sloan Survey Of Wide ARcs in the SkY, a catalogue in which the galaxies were suggested to be a lensing system.

(2) Redshift is a measure of time rather than distance. z=0 refers to current spacetime, whereas z=0,3 indicates a time 3 billion years ago, z=1 a time 6 billion years ago (age of the Universe: ca 13.7 billion years).

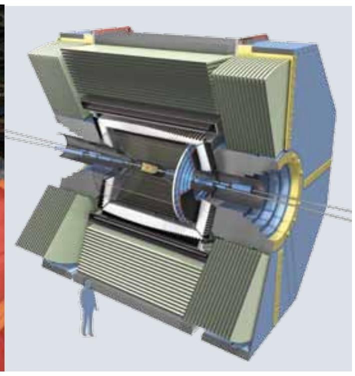
In Search of Antimatter: Full Speed Ahead

Science City is the name of the city of Tsukuba, situated about 60 kilometers northeast of Tokyo. One of the technical installations of this scientific stronghold is the KEK, the Japanese Center for High Energy Physics. Here physicists are searching for something that no longer exists in the Universe – antimatter. In order to find it they cause electrons and their antiparticles, the positrons, to collide with one another at high speed in the particle accelerator KEKB. The securing of evidence takes place after the particle crash: A huge detector with the lovely name „Belle" records the collision events and analyzes them.

On 18 November 2011 the starting signal was given for extensive upgrade work in the accelerator apparatus. Precision technology "made in Germany" is being implemented for the successor detector, "Belle II". A German collaboration, in which the Excellence Cluster Universe is participating (see Newsletter 2/2011), is building a pixel-vertex detector (PXD) for this purpose, which is based on the innovative DEPFET technology (Depleted P-Channel Field Effect Transistor). It will be installed directly at the hot spot of the experiment where the particle bundles collide. In the case of the detector it is a type of digital high-power camera with 8 megapixels, which records the chaotic tangle of the collision traces at a high resolution and analyzes the results.

As far as the measurements are concerned, Belle II is confronted with a truly Herculean task: The accelerator KEKB, which accelerates the particles in 3-kilometer long rings with traffic in opposite directions, is supposed to be raised to life again as the significantly more powerful "SuperKEKB". The particles will then fly through the accelerator at almost the speed of light. In addition, they will be more densely bundled and the bundles will be sent at a higher frequency. Thus the chances of collision will also increase. The operators estimate that with the start of the Belle II the collision rate will increase 40-fold. Belle II and especially the PXD must then process huge amounts of data.

"The PXD will take 30,000 measurements per second, so that we are ensured that we have the 8,000 collisions that are expected to occur `in the box' and can evaluate them", explains Professor Christian Kiesling of MPP (Max Planck Institute for Physics) as the speaker for the group, which is financing and building the PXD. "This means 30 gigabytes of data in each second." The PXD performs precision work during this process: It measures exactly to the micrometer which particles originated where and in which direction they are moving. This delivers inferences as to the types of particles produced during the collisions.



Left: Small but precise – Jochen Schieck shows the model of the PXD.
Right: Scheme of Belle II – the PXD will be installed centrally at the collision site.

And what does all this have to do with antimatter? Professor Jochen Schieck of the Excellence Cluster Universe and the LMU Munich says: "Shortly after the Big Bang 13.7 billion years ago matter and antimatter particles originated from an enormous energy density. If two of these opposite particles collide they

Sight of the KEKB accelerator ring which has been out of operations since summer 2010 due to reconstruction works.

annihilate each other." In this scenario however enduring matter could never have formed. There would also never have been any stars, planets or galaxies. Schieck: "At some time a tiny excess of matter must have formed, from which the Universe as we know it originated. Here we are talking about a symmetry breaking, also known as CP violation. And this does not fit in with conventional physics, as described in the Standard Model of particle physics".

The scientists are seeking to understand the matter-antimatter imbalance with the help of quark/antiquark pairs in so-called B mesons. B mesons are common collision products of the electron positron collisions in the KEK collider – and they too come in matter and antimatter variants. Through the close study of the B mesons, the scientists are hoping to find possible deviations from the Standard Model and thus actually discover "new physics". "Thanks to the precision measurements of Belle II, even tiny shifts in position can be recorded and analyzed", Kiesling says. "If the decays should occur in any way that is asymmetrical, the chances are good that this can be proved by means of this experiment".

The physicists must still be patient nevertheless until they can continue with the symmetry puzzle: The modernized SuperKEKB installation is planned to go into operation in 2014. Belle II is then intended to record the first data in the year 2015.

(1) DEPFET: Depleted P-Channel Field Effect Transistor

EVENTS

Science Week 2011

The Universe Cluster's Science Week was held for the fifth time during the week of 28 November through 1 December 2011. An interesting and current mix of topics covering all research areas of the Cluster was presented to the visitors. For example, Bruno Leibundgut (ESO) – a former member of the team supporting Adam Riess and Brian Schmidt – reported on the discovery of the accelerated cosmic expansion which was awarded this year's Nobel Prize in Physics. Ramy Brustein, from Ben Gurion University in Israel, gave a presentation during his evening talk about the much discussed Opera experiment which recently discovered neutrinos travelling faster ‚than permitted', i.e. faster than the speed of light.

During the Science Week, several topical presentations provided information on interdisciplinary topics such as neutrino physics, formation of stars or the search for the Higgs boson.

In addition, scientists representing all Research Areas (RA) gave an overview of their current research activities. On Thursday, the coordinators of the seven Research Areas presented the research highlights of the past year. These presentations also served as a basis for discussion during the meeting of the Research Board with the members of the Scientific Committee of the Universe Cluster held on 2 December. The ceremony for the "Universe Theses Awards 2011" was another highlight. This year the two awards were given to Dr. Hanna Kotarba (LMU) and Dr. Christoph Hinke (TUM).

Professor Andreas Burkert hands the certificates to the awardees.

General Assembly 2011: A Glimpse into the Cluster's Future

The yearly General Assembly was also held during the Science Week. Cluster Coordinator Stephan Paul presented the most important activities of the year 2011. One of the main topics was the Renewal Proposal for the years 2012 through 2017 which was submitted to the Deutsche Forschungsgemeinschaft (DFG) on 1 September 2011. Following the defense in early 2012 a decision for the second round of funding for the Excellence Initiative will be made in June. Paul gave special praise to the strong engagement of the Cluster community and thanked everybody who participated in completing the application. He is confident that it will lead to a positive result.

Against this background the designated RA coordinators presented the goals and project ideas of all nine future Research Areas. In addition to the existing seven RAs with clearly defined scientific research topics, there will two other cross-disciplinary RAs during the next funding period. The new Computational Center C^2PAP will provide a basis (hardware and personnel) for complex calculations and simulations in astro- and particle physics. Through ^{M}IAPP the Cluster also plans a workshop center in which scientists from all over the world will be able to perform inter-disciplinary work for a certain time on superordinated problems. An international guest program will also be part of this effort.

Major projects of the Cluster during the first funding period are the participation in the extension of the Wendelstein Observatory, the installation of the ultra-cold neutron source in the neutron source Maier-Leibnitz (FRM II), the construction of an underground laboratory for the preparation of astro-particle physics experiments as well as investments in computation for particle and astrophysics. These projects as well as several other, smaller projects have been successfully completed or will be completed shortly.

At the moment, approximately 100 research teams are working on problems ranging from the Universe's very beginnings, through its formation and to its future. During the year 2011, the Cluster welcomed 40 guests from around the world; the Research Fellow program currently employs six scientists. Paul was very pleased with the career opportunities that were presented to former Fellows – they all moved on to professorships at other universities, or obtained employment in other scientific institutions or in the industry.

Insight into the Universe – Open Day Event at the Garching Cambus

On 15 October, several departments and Institutes at Garching Forschungszentrum opened their doors. The Excellence Cluster Universe gave also insight into its research work. Together with the other Munich based Excellence Clusters, the Universe Cluster presented itself with a stand at the Excellence Center of the Technische Universität München (TUM).

Here, the visitors had the chance to watch demonstrations or even to experiment themselves. A so called cloud chamber visualized tracks of cosmic particles and with a computer simulation visitors were able to form stars or to cause collisions of galaxies. A special photo experiment showed what happens to light and matter in the vicinity of a black hole: The participants were photographed and received their pictures which showed them extremely deformed and altered in terms of color.

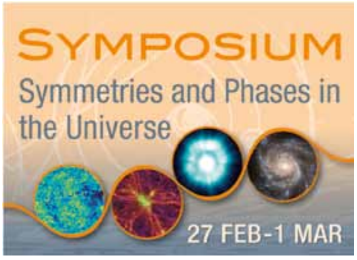
Catching the audience's attention: comedian Georg Eggers and Junior Research Group Leader Jean-Côme Lanfranchi.

The fact that science does not have to be humorless was also proven by the physicist and comedian Dr. Georg Eggers. In three entertaining talks, he explained the physics of "failure".

More serious but not less entertaining were the talks at the Excellence Center's "Science Café". Here, scientists shortly explained their respective research field and then answered the questions of the audience. The Universe Cluster was represented by the Junior Research Group leaders Dr. Jean-Côme Lanfranchi, who talked about his search for Dark Matter and by Professor Jochen Schieck, who discussed the results of the Large Hadron Collider.

As the doors at the Forschungszentrum closed at 6pm, it turned out that this open house day was again a great success. Approximately 10,000 science lovers came to the campus and experienced the varied program of TUM, the Max-Planck-Institutes and ESO.

Symposium "Symmetries and Phases in the Universe"



For the second time, the Excellence Cluster Universe will host the symposium "Symmetries and Phases in the Universe". The event will take place from 27 February until 1 March 2012 again at Kloster Irsee (Allgäu).

Cosmology and the physics of the Universe is a broad and interdisciplinary research field, which has been addressed by physicists from different communities. The Universe Cluster aims to create a network between scientists working in this field and to connect the areas of particle-, nuclear-, plasma-, and astrophysics. As a result, new synergies between the single communities will evolve and new research approaches will develop, which may eventually address the unsolved questions of cosmology.

Within the unique atmosphere of the former monastery, renowned scientists of the different physics communities will discuss current findings and developments as well as their impacts on neighboring subject areas. CERN's General Director Rolf-Dieter Heuer will talk about the currents results of the Large Hadron Collider (LHC). The theoretical physicist John Ellis will discuss the relevance of LHC physics on cosmology, and Johanna Stachel, professor for experimental physics at the University of Heidelberg, will also focus on particle accelerators with her talk on heavy ion collisions.

The field of Astronomy and Astrophysics will be presented by internationally renowned experts, like Bruno Leibundgut from the European Southern Observatory (ESO), who studied the accelerated expansion of the Universe as a team member of this year's Nobel Prize winners Brian Schmidt and Adam Riess. He will report on new developments within this field. In his talk, Jeremiah Ostriker from Princeton University will address massive black holes and active galactic nuclei (AGN) in connection with the evolution of galaxies.

Registration until 31 January 2012:
http://www.universe-cluster.de/irsee2012

■ PORTRAIT

Stars and Dust

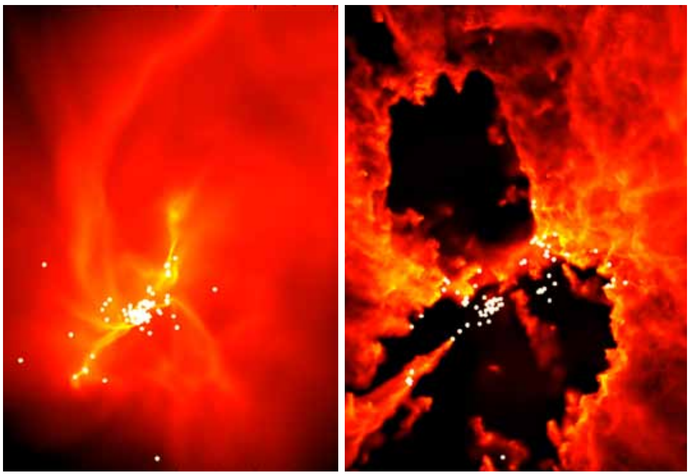
New stars are bred and born in dark "corners" of the Universe – in huge clouds of molecular gas and dust. One famous star-forming region is the Horsehead nebula in the Orion constellation, extending over several hundreds of light-years. In the Excellence Cluster Universe, Professor Barbara Ercolano and her group "Theoretical Astrophysics" study the complex processes necessary to create new stars and planets: To this day it is unclear what percentage of stars develop planetary systems and what are the most favorable conditions for the formation of planets. In addition, just as human infants new-born stars cause quite a riot in their immediate surrounding – in this case the interstellar medium. Ercolano and her team also investigate these effects, which play an eminent role with massive stars.

The Horsehead nebula – not only impressive by its esthetics, but also one of the best known star forming regions in our galaxy.

In principle, the processes involved in the formation of stars are well understood. Stars are formed exclusively in gigantic clouds mainly consisting of molecular hydrogen and – in much smaller extents – carbon, oxygen, neon, magnesium, sulphur and nitrogen. Silicates as well as carbon-based dust particles are another important component in the interstellar clouds. However, these clouds have to achieve very special conditions, such as high densities and low temperatures of only few Kelvin (close to absolute zero corresponding to -273 degrees centigrade Celsius), in order to gravitationally collapse and form stars and planets.

Stars indeed begin to form when these conditions are met somewhere in the cloud and matter starts to lump together due to gravity. This can only happen when this force is stronger than the internal pressure acting “outwards”, due to the kinetic energy of the particles within the cloud. Once a compact globule of gas and dust has formed and becomes dense and hot enough – about 4 million Kelvin – the star is set alight: Hydrogen nuclei merge by releasing energy as electromagnetic waves, observable as visible light. Depending on the mass of the star, the fusion reactor will burn for billions of years – like our Sun.

“Our research focuses on the way massive stars form”, explains Ercolano. “Astrophysicists refer to a star as ‘massive’ when its mass is higher than eight to ten solar masses. Massive stars are quite rare, but of outmost importance for the chemical and dynamical evolution of the interstellar medium, and they dominate the energy output of the stellar component of galaxies.” Unlike less massive stars, they can synthesise heavy elements beyond helium, carbon and oxygen, e.g. calcium and iron and they return this chemically enriched gas as they explode as Supernova at the end of their lives. Heavy elements as well as dust particles produced by these stars are then mixed back into the interstellar medium and used to form new stars, in a sort of cosmic recycling scheme.

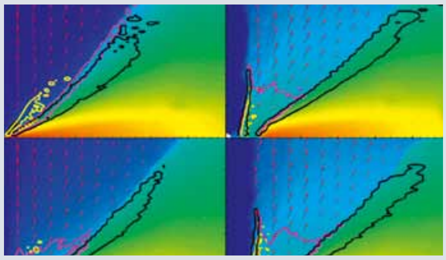


Two computer simulations illustrate the impact of massive stars onto dark molecular clouds. The left image shows the development of the cloud without massive stars. Right is the same cloud with massive stars, the radiation of which tears apart parts of the cloud wheras other areas are condensed. The pillar-like condensed structures can be observed in real molecular clouds, e.g. the Horsehead nebula *(see p. 5)*

Ercolano’s team investigates the influence newly formed massive stars have on the surrounding space. The birth of a star is not an isolated event. With the nuclear fusion processes starting, the stars emit high-energy radiation in the ultraviolet spectrum. Through their radiation massive stars are able to shape the interstellar medium and influence the process of star formation itself – in a two-fold way, as Ercolano describes: “Massive stars produce radiation and stellar winds that move through the cloud at high speeds pushing aside gas and dust. In doing so, they leave behind regions with little or no material, interrupting star formation. By these events, however, other areas in the cloud are compressed to higher densities, leading to an enhanced proliferation of stars.”

Today, scientists also assume that the radiation of massive stars is able to blow away gas and dust resident in planetary disks of other stars, thus preventing the stars to give rise to planets. “In recent years, astrophysicists succeeded in discovering more than 700 planets in our Galaxy”, says Ercolano. “However, there is little we know about planets form from protoplanetary disks. We cannot study these processes by observation, but assume that radiation from the central (low-mass) star as well as from surrounding high mass stars is likely to play a very important role in the evolution and dispersal of the disks and hence in the formation of their planetary progeny. To study radiation effects produced by young stars, Ercolano and her team work with sophisticated computer simulations, imitating the conditions in

Junior Research Group: Theoretical Astrophysics



Professor Barbara Ercolano has been leading the Junior Research Group “Theoretical Astrophysics” since December 2010. She received her PhD in 2002 from the University College London. Afterwards Ercolano held several postdoctoral positions at Harvard University and the University of Cambridge. In 2009 she was awarded the UK Science and Technology Facility Council Advanced Fellowship for theoretical work on star and planet formation. One year later Ercolano received the Royal Astronomical Society Fowler Prize for the development and application of the MOCASSIN code. After a short stay as lecturer at the University of Exeter (UK), Ercolano became a professor for Theoretical Astrophysics at the Universitäts-Sternwarte (LMU).

Research Group

Barbara Ercolano’s team consists of the post docs Til Birnstiel and James Dale, the PhD students Cornelius Kaschinski and Giuseppe Rosotti as well as the master student Christine Köpferl. Ercolano works with T. Birnstil, G. Rosotti and C. Köpferl to understand the conditions of and the early stages of planet formation. Together with J. Dale and C. Kaschinski she investigates the field of massive stars and their impacts on the interstellar medium.

Research Interests

Barbara Ercolano works in the field of computational Astrophysics. She builds large numerical and theoretical models to better understand the formation of stars and planets. Using the MOCASSIN code, she studies the role of radiation in star-forming regions and supernova remnants.

Collaborations

Within the Universe Cluster, Barbara Ercolano’s group works together with the “Computational Astrophysics (CAST)” team led by Professor Andreas Burkert at the University Laboratory (LMU). Furthermore she collaborates with international experts in the field of star and planet formation as Professor Cathie Clarke (Cambridge University, UK), Professor Al Glassgold (University of Berkeley) and Dr. Jeremy Drake (Harvard Smithsonian Center for Astrophysics).

molecular clouds as to density, temperature and internal movements. She developed an award-winning computer code called MOCASSIN (Monte Carlo Simulations of Ionised Nebulae), designed to study the transmission of electromagnetic radiation in gas and dust regions as in star formation regions, protoplanetary discs and dusty supernova remnants. "Gas clouds are complex, three-dimensional structures characterized by strong turbulence and thermo-dynamical instabilities", explains Ercolano. "MOCASSIN allows us to simulate and analyse radiation effects on different geometries and density conditions. These data help us understand the influence of radiation on the star and planet formation process."

PEOPLE

Mentoring for Female Students

Katharina Fierlinger und Elisabeth Zistler

With its multi-faceted teaching program the Excellence Cluster Universe aims to fill girls and boys with enthusiasm about natural sciences. Some Cluster scientists are engaged in regular lectures at schools, others act as tour guides through the special exhibition "Evolution of the Universe" in the Deutsche Museum.

Katharina Fierlinger, PhD student at the Cluster, is furthermore involved in the project "CyberMentor" which is a mentoring program for female students who are going for the so called MINT-subjects (mathematics, informatics, natural science and technology). Each participant of the program has a personal female mentor from the MINT sector whom she can contact and exchange emails on a regular basis.

Since May 2011 Katharina has had such a lively exchange of emails with the 16-year old Elisabeth Zistler from a small village in the Bavarian Forest. This regular activity has now led to the first success: in this year's CyberMentor competition "MINT stands up for sustainability" they won the first prize with their project "Climate Savers' Breakfast". Despite the fact that Katharina's research concentrates on the development of heavy elements in the Universe, she was immediately attracted by the subject of sustainability. "We planned the project together and exchanged tips for reading matter" Katharina and Elisabeth said. While Katharina designed a web page showing the most important CO_2 data, Elisabeth concentrated on planning, research and documentation. The first prize is a three-day trip to Sheffield in England where they will attend a special workshop about mentoring programs for women. It is quite possible that they will return with new ideas for future projects.

Elisabeth will do her A-levels in two years' time. It is not clear yet what the future holds for her, but she says "I can easily see myself taking up natural science".

Andrzej Buras honored with membership of the Polish Academy of Arts and Sciences


Andrzej Buras

Professor Andrzej Buras, professor of theoretical elementary particle physics at the Technische Universität München (TUM) and founding member of the Excellence Cluster Universe has been elected a foreign member of the Polish Academy of Arts and Sciences in Cracow/Poland.

Educated both in Poland and Denmark, Buras belongs to the world's leading researchers in the field of applied quantum field theory, dedicating himself to Flavor Physics in particular. He is elected to the Academy on the basis of his studies regarding Quantum Chromodynamics (QCD), a theory of the strong interaction, and his extensive studies of the physics beyond the Standard Model.

The Polish Academy of Arts and Sciences was founded in 1872. Its scientific work is focused mainly on commission and subcommission work. There are more than twenty subject commissions in different classes and all of them publish their own papers, periodicals or other publication series according to their respective subjects.

All international members of the Academy maintain active contact with the Polish science community. Besides Andrzej Buras, other foreign members who are theoretical particle physicists include James Bjorken and the Nobel Prize winners Martinus Veltman and Frank Wilczek.

"The Polish Academy of Arts and Sciences has a great reputation among Polish academics. Therefore, it has been a great honor for me to become a member" Buras said. For his research work, he was also honored with a Carl von Linde Senior Fellowship of the Institute for Advanced Study (IAS) in 2007 and with the membership of the Bavarian Academy of Sciences and Humanities in 2010. Only recently he received a grant of the European Research Council, which will support his work over the next five years with a funding of 1.6 million Euros.

Andreas Burkert President of the Astronomische Gesellschaft

Andreas Burkert

Professor Andreas Burkert, vice-speaker of the Excellence Cluster Universe, was elected President of the Astronomische Gesellschaft (AG) at their recent Annual Meeting. The Astronomische Gesellschaft is the largest association of astronomers in Germany and also includes foreign members. A merger of the AG and the Rat der Deutschen Sternwarten (RDS), the official board of German astronomical institutes, is the view of the future.

The President will represent the Astronomische Gesellschaft on a national and international level and coordinate its activities. This includes the organization of scientific conferences, the sponsorship of junior researchers as well as public relations events. A particular focus will be placed on a stronger integration of astronomical subjects in schools. Furthermore, the Astronomische Gesellschaft awards prizes for outstanding scientific achievements and it honors individuals for successfully communicating scientific topics to the general public.

During his 3-year term of office Burkert will concentrate on achieving a wider international awareness for the Astronomische Gesellschaft. Another priority is to consolidate the collaboration with astronomical societies abroad, such as for example the joint Spring Conference with the Royal Astronomical Society next year. He further stated: “We will also heavily promote the media presence of the AG in Germany in the coming years – making the AG first point of contact for all topics in the world of astronomical and space research”.

New Research Fellow

Christoph Bobeth

The Excellence Cluster Universe welcomes Dr. Christoph Bobeth as new Research Fellow. The theoretical particle physicist will work within research area “C” for the next two years, which explores the origin of particle masses and the reason for their hierarchy.

Bobeth’s research work focuses on Flavour physics beyond the standard model of particle physics. After his Ph.D. studies at the Technische Universität München (TUM), he held Postdoc positions in San Diego, Dortmund, and Strasbourg. In fall 2010, Christoph finally returned to TUM, where he examined the phenomenological studies of B meson decays in the Standard Model and beyond. Now he will continue these studies within the Excellence Cluster Universe.

BOOK PRESENTATION

Swimming with the Quantum Fish

Here we take the opportunity to introduce a few books in no particular order, which deal with topics all about the “Physics of the Universe”. At the same time these books are not intended for experts but for readers who want to know what mysteries the Universe holds and how scientists are going about solving them.

In his book “Quantenfische – Die Stringtheorie und die Suche nach der Weltformel” (Quantum Fish – The String Theory and the Search for the Theory of Everything) the author Dieter Lüst (1) begins by introducing a new species: The quantum fish, which are discovered one day by perfectly normal fish in a pond as the fundamental building blocks of their world. This is a groundbreaking finding for the fish but not the end of the story: Observations and calculations teach the fish that their pond universe is only one of many worlds – and that they can send their quantum fish to distant fishponds in order to investigate them.

With this analogy Lüst prepares his readers for a long journey which he takes through the world of physics comprising (known) particles and forces before he sets out on another expedition: His destination is the Theory of Everything with which all physical phenomena in the microcosm and macrocosm can be explained uniformly. Up to now scientists have needed the quantum theory AND the gravitational theory. In the course of this book the author not only explains the way to the string multiverse, but also documents as a “travel journalist” the history and the pioneers of the string theory and the multiple universes.

The book is written in an understandable and entertaining fashion even though the concepts being described are sometimes difficult to grasp. The quantum fish and other inhabitants of the fishpond accompany the reader as constant companions swimming through the chapters. Lüst dedicates the last chapter of his Theory of Everything book to the critical philosophical view of his own research area: Due to the many possible mathematical solutions the string theory cannot be disproved at present. That is, it cannot be falsified in the strictly scientific sense. For this reason, it is viewed by many physicists as “unscientific”. The author is confident however that the multiverse will join the ranks of the canon of empirical natural sciences in due course. One thing is certain: The story of the quantum fish is by no means over.

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