FACULTY OF SCIENCE

THE UNIVERSITY OF SYDNEY

SCHOOL OF PHYSICS

ALUMNI Update

OCTOBER 2011

NOBEL PRIZE PHYSICS

The 2011 Nobel Prize in Physics has been awarded to Professor Brian Schmidt (pictured left), Professor Saul Perlmutter and Professor Adam Riess for their discovery of the accelerating expansion of the universe through observations of distant supernovae.

The acceleration is thought to be driven by dark energy, but what that dark energy is remains an enigma - perhaps the greatest in physics today. What is known is that dark energy constitutes about three quarters of the Universe.

Professor Schmidt, an Australian Laureate Fellow and Professor of Astronomy at the Australian National University's Mount Stromlo Observatory, leads the Dark Universe theme within the ARC Centre of Excellence, CAASTRO, which is headquartered in the School of Physics. His unique roles as SkyMapper lead scientist and leader of the High-Redshift Supernova Search team give him an international profile in this area second to none.

The School of Physics warmly congratulates Professor Schmidt and his 2011 Nobel Prize in Physics co-recipients on their extraordinary achievement!

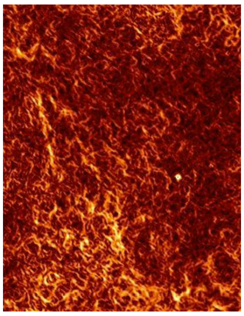
ALUMNI SCHOLARSHIP

Through the generosity of our alumni and friends the Physics Post-Graduate Alumni Scholarship was able to be established. We know that scholarships support and encourage our remarkable Physics students on their academic journey.

Dr Christine Lindstrøm, pictured below with Assoc. Professor Manju Sharma and Professor Dick Hunstead on her graduation day, said, "Receiving the Alumni Scholarship in May this year was very exciting and I was really touched to think that previous students had the foresight to support the next generation of physicists." Christine says she aims to carry on the tradition.

The Spring 2011 Campaign is now underway to raise funds for a Physics Alumni Undergraduate Scholarship. We hope that you will give generously to support our future physicists. For more information contact Alison Muir email: alison.muir@sydney.edu.au or call +61 2 9036 5194.

OUR GALAXY'S A GAS



A pit of writhing snakes, is how the first picture of turbulent gas in our Milky Way has been described by Professor Bryan Gaensler, Director of the ARC Centre of Excellence, CAASTRO, headquartered in the School of Physics. Using a CSIRO radio telescope in eastern Australia, Professor Gaensler and his team were able to make the ground-breaking image that was recently published in Nature.

The image shows that the space between the stars in our Galaxy is not empty but is filled with thin gas that continually swirls and churns. "This is the first time anyone has been able to make a picture of this interstellar turbulence," said Professor Gaensler. "People have been trying to do this for 30 years."

Turbulence makes the Universe magnetic, helps stars form, and spreads the heat from supernova explosions through the Galaxy. "We now plan to study turbulence throughout the Milky Way. Ultimately this will help us understand why some parts of the Galaxy are hotter than others, and why stars form at particular times in particular places," Professor Gaensler explained.

Led by Professor Gaensler, the team studied a region of our Galaxy about 10,000 light-years away in the constellation Norma by using CSIRO's Australia Telescope Compact Array.

"It is one of the world's best telescopes for this kind of work," said Dr Robert Braun, Chief Scientist at CSIRO Astronomy and Space Science.

The radio telescope was tuned to receive radio waves that come from the Milky Way. As these waves travel through the swirling interstellar gas, one of their properties, polarisation - the direction in which waves vibrate, is very slightly altered, and the radio telescope can detect this.

The researchers measured the polarisation changes over an area of sky and used them to make a spectacular image of overlapping entangled tendrils, resembling writhing snakes.

The 'snakes' are regions of gas where the density and magnetic field are changing rapidly as a result of turbulence.

The 'snakes' also show how fast the gas is churning, an important number for describing the turbulence.

Team member, Blakesley Burkhart, a PhD student from the University of Wisconsin, made several computer simulations of turbulent gas moving at different speeds.

These simulations resembled the 'snakes' picture, with some matching the real picture better than others.

By picking the best match, the team concluded that the speed of the swirling in the turbulent interstellar gas is around 70,000 kph, relatively slow by cosmic standards.

Publication: B. M. Gaensler et al. [9 co-authors] "Low Mach number turbulence in interstellar gas revealed by radio polarization gradients." Nature, DOI 10.1038/nature10446.

$20,000 TO KICKSTART

A University of Sydney grant of $20,000 will help the School of Physics Kickstart on the Road program to reach physics students further afield.

"I'm so excited that Kickstart on the Road will be able to be delivered to regional NSW in 2012 and its thanks to the University of Sydney's Compass Widening Participation Grant that this can happen," says Tom Gordon, the School of Physics' Science Communicator, pictured, who secured the funding.

Physics Kickstart on the Road takes School of Physics demonstrators and equipment to regional areas to promote physics as an interesting and fun Higher School Certificate (HSC) subject while also helping students better understand the HSC Physics Syllabus.

The Physics Kickstart workshops introduce Year 11 and 12 physics students to specialist experiments. "It so important to be able to do this as many of the schools that attend the educational program don't have the right equipment. In some cases the students are distance scholars and they meet their teachers for the first time through the Kickstart program," explains Tom.

The Physics Kickstart workshops are interactive with educational sessions specifically designed around the HSC Physics syllabus. While the Kickstart program is well-attended by metropolitan students, those outside of Sydney don't always have the opportunity to learn about physics in a lab or in a tertiary environment.

"Kickstart on the Road is a wonderful opportunity for regional students who wouldn't normally have access to this great program. They are exposed to the specialist experiments and expertise that the School of Physics has to offer," said Tom Gordon.

The Widening Participation Grant, which is generated from the University's Social Inclusion Unit, will keep the Kickstart on the Road program running for another year, a good outcome not only for the School of Physics but also for regional students in NSW.

The Kickstart on the Road Program will be visiting regional centres throughout NSW at the beginning of Term 3, 2012.

In previous years, Kickstart on the Road has been to Wagga Wagga, Armidale and Dubbo.

"To borrow from Willie Nelson's song - we just can't wait to get on the road again," says Tom.

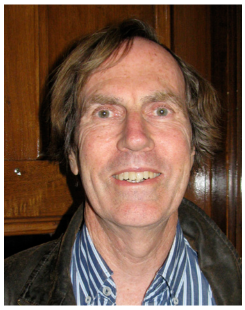
LEARN MORE ABOUT PHYSICS KICKSTART

www.physics.usyd.edu.au/schools_community/kickstart.shtml

NOT SO FREE RADICALS

School of Physics researchers, Professor Marcela Bilek and Professor David McKenzie, both pictured, have developed a revolutionary new technology that is set to have a huge impact on areas as diverse as the early prediction of disease and the production of biofuels.

The breakthrough platform technology uses a layer of carbon and nitrogen, rich in free radicals, that anchors proteins to a surface.



It is this easy and strong adherence of the biomolecules, while still preserving their function that has the science world buzzing.

"Free radicals are often thought of as 'bad guys' which, if allowed to run free in the body, are understood to be involved in degenerative diseases, biological aging and cancer. In our technology we're putting radicals to good use," says Professor McKenzie.

The new technology will be of benefit to implantable medical devices such as stents. The breakthrough allows the surface to cloak itself in the patient's own protein, reducing the chance of medical complications such as inflammation and rejection.

This is due to the fact that the patient's protein retains its 'native' structure and will not trigger adverse reactions such as blood clots or the foreign body response.

"When proteins land on surfaces currently used in implants they unfold and distort, losing their biological function," explains Professor Bilek.

"When our surface is immersed in a fluid containing protein, the protein is bound by reacting with free radicals that are trapped in the surface's under-layer. The radicals do not harm the protein but tether them gently to the surface."

The new surfaces can be integrated into any material using a patented technology that prevents detachment even under extreme deformation, including during the stent expansion process when inserted in an artery.

The breakthrough technology can also be used for the early detection of diseases. "Antibodies can be anchored on the new surface in an array of spots," says Professor Bilek.

"Diseased cells attach themselves to the antibodies in characteristic patterns that enable the disease to be detected long before the symptoms emerge. This will allow early intervention and higher cure rates. We recently demonstrated diagnostic arrays which can detect diseased cells at levels lower than previously possible."

As well the platform technology will have an impact on biotechnology.

Professor McKenzie says that ethanol is a valuable fuel that could be produced from waste cellulose (cardboard and agricultural waste) with special enzymes that will be tethered to the new surface and continue to function.

"This will enable new industrial production methods based on continuous flow rather than batch operation," he explains.

The paper: "Free radical functionalization of surfaces to prevent adverse responses to biomedical devices" by Marcela M. M. Bilek (School of Physics, SoP), Daniel V. Bax (SoP), Alexey Kondyurin (SoP), Yongbai Yin (SoP), Neil J. Nosworthy (SoP), Keith Fisher (School of Chemistry), Anna Waterhouse (School of Molecular Bioscience, SMB), Anthony S. Weiss (SMB), Cristobal G. dos Remedios, and David R. McKenzie (SoP). All authors are from the University of Sydney, is published in the prestigious journal Proceedings of the National Academy of Sciences, USA.

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