a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA

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Physics & Astronomy News

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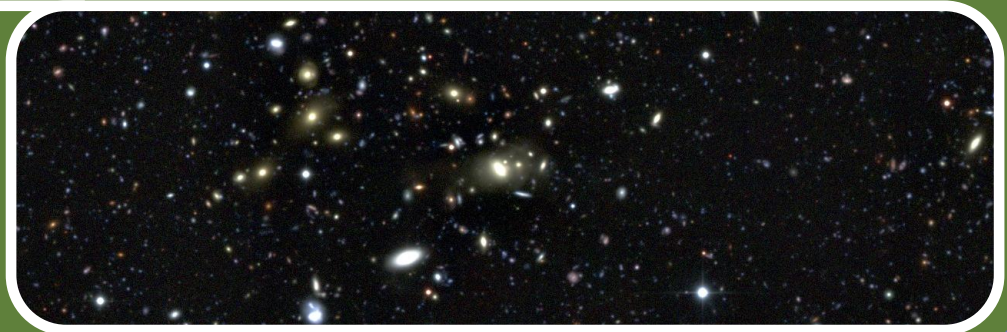

PLUS

Message from the Head

In 2010, UBC was carefully guided through a period of global economic turmoil that has rocked many academic institutions worldwide. While others are facing major challenges, UBC has managed to come through largely unscathed and with continuing optimism for the future. One cause of this optimism is considerable success in fundraising, which has been crucial for the development of new space and facilities on campus. Alumni reading this newsletter will be beneficiaries of this success with the development of a new Alumni Centre to be built near University Boulevard and East Mall, just a few steps away from our department.

Physics and Astronomy has now entered a steady state after a decade of rapid hiring. We have had two new faculty members join us in 2010. Valery Milner has joined the group working on Atomic/Molecular/Optical physics, a team that bridges our department and Chemistry. Sarah Burke is another bridge-building hire, a Canada Research Chair in scanning probe microscopy that is a joint hire between these two departments.

Throughout this newsletter, you will see many other examples of bridge-building through the increasingly interconnected research projects going on in the department, projects ranging from local linkages to major international collaborations. One of these prominent in the news this year was the first successful trapping of antihydrogen by the ALPHA team at CERN. The team involves two of our former graduates, Mike Hayden at SFU and Makoto Fujiwara at TRIUMF, along with Walter Hardy, whose expertise rooted in his work on hydrogen in the last century is being brought to bear on antihydrogen in the 21st century. Our department's researchers are also entering the next exciting phase of high energy physics at CERN with the ramping up of experiments at the Large Hadron Collider.

At the other end of length scales tackled in the department, there has been a multitude of recent advances in Cosmology, Astronomy and Astrophysics. Amongst these, the Wilkinson Microwave Anisotropy Probe (WMAP) completed its mission after almost a decade of breakthrough discoveries and measurements of the Cosmic Microwave background. Mark Halpern has been involved in this project since its early days, following his work with Herb Gush when they raced against COBE to make measurements of the spectrum of radiation from the big bang.

Another international story, in its early days, is the founding of a Quantum Matter Institute, enabling close formal ties and research initiatives to develop between UBC condensed matter researchers and Germany's Max Planck Society. This and the many other international linkages that have been developed by members of our department have steadily raised our research profile and give important opportunities for our students.

On the teaching front the department continues to make great use of funding from the Carl Wieman Science Education Initiative, with projects under way in many of our courses. Perhaps the boldest of these is PHYS 153, our large first year course for engineers. The transformation of this important course has drawn together the talents of some of our most experienced faculty, Don Witt, Kristin Schleich, Mike Hasinoff and Andrzej Kotlicki, with our newest hire Sarah Burke and our teaching and learning fellows Cynthia Heiner and Louis DesLauriers. As with the research discussed in the following pages, our teaching relies on tremendous teamwork that can be built out of the talent in our department.

- Dr. Doug Bonn, Department Head

Alumni Weekend 2011

The 2011 UBC Alumni Weekend will happen on Saturday, May 28, 2011. Join us at this free event and bring your family and friends with you to celebrate! There are many talks, family-oriented activities and entertainments throughout the day. Interested? Register to participate at:

http://www.alumni.ubc.ca/

Physics & Astronomy News

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The newsletter is also available at our website, http://phas.ubc.ca; if you would like to receive your copy electronically, please let us know.

You are receiving this newsletter because you are an alumnus or alumna of the department, or because you subscribed to the newsletter. If you would like to be removed from the subscription list, please contact us at communications@phas.ubc.ca.

First Trapping of Antimatter

UBC Physics and Astronomy professor **Walter Hardy** is part of the team at CERN, along with graduate students Sarah Seif El Nasr and Andrea Guiterrez. He shared his thoughts as news of the discovery broke.

A research team called the ALPHA Collaboration, with a strong contingent of Canadians, has trapped antimatter for the first time at CERN (European Organization for Nuclear Research), the world's largest particle physics lab located in Geneva, Switzerland. Their discovery was published in the November 18 edition of Nature.

UBC Physics and Astronomy professor Walter Hardy is part of the team at CERN. He shared his thoughts as news of the discovery broke.

How did you get involved in this project?

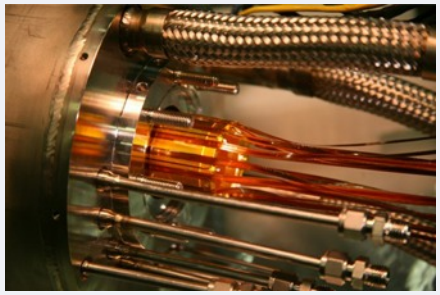
I and Mike Hayden, a UBC graduate and now professor of Physics at SFU, were asked to join the ALPHA project five years ago, mainly because of our work on cryogenic atomic hydrogen in the 1980s at UBC. Mike received his PhD in my group, working on precision spectroscopic measurements in atomic hydrogen in 1991. The ultimate goal of the ALPHA project is to use various spectroscopies to determine whether hydrogen and its antimatter relative, anti-hydrogen, are identical or not.

First, however, the anti-hydrogen had to be produced, and then trapped. The Nature paper details the first successful trapping of antihydrogen, certainly in the world (and probably in the universe!).

Why is this project important?

One of the great mysteries of physics, and particle physics in particular, is: why does the universe consist entirely of matter? Somehow, during the formation on the universe, matter won out over anti-matter.

Conventional theories predict that matter and anti-matter are identical, except for having the opposite charge. So far, the experiments that can be done show this seems to be true, but not to the level of precision that one needs.



The electrodes (gold) for the ALPHA Penning trap being inserted into the vacuum chamber and cryostat assembly. This is the trap used to combine or "mix" positrons and antiprotons to make antihydrogen. (Credit: Niels Madsen, ALPHA /Swansea)

Studying anti-hydrogen, an anti-proton and an anti-electron, to the same precision as for hydrogen, has been a dream project for some time. After 10 years of effort, the all-important first step has been taken and precision studies of anti-hydrogen can begin.

What is your role moving forward?

Prof. Hayden and I have been involved in a variety of projects within the overall collaborative effort. With trapping established, our expertise in precision microwave spectroscopy becomes central to the efforts to compare hydrogen to anti-hydrogen.

Read the research article in Nature: http://www.nature.com/nature/journal/v468/n7324/full/nature09610.html

(Original article published in UBC Reports | Vol. 56 | No. 12 | Dec. 3, 2010. Title photograph by Maximilien Brice, CERN)

Did you know...

- The anti-hydrogen breakthrough was named the 2010 Breakthrough of the Year by Physics World: http://physicsworld.com/cws/article/news/44618
- The ALPHA team is a group of 43 researchers, of which 15 are from Canada, and more than half of them came from the Vancouver area.
- Among the Canadian researchers, Dr. Walter Hardy is a professor at the UBC Department of Physics & Astronomy; Dr. Fujiwara of University of Calgary (also the spokesperson for the ALPHA-Canada team) and Dr. Michael Hayden of Simon Fraser University are both alumni of UBC Physics & Astronomy.
- Generation of anti-hydrogen was extremely difficult: Overall only 38 antihydrogen atoms were generated after mixing 10 million antiprotons and 700 million positrons.

UBC Physicists Make Atoms and Dark Matter Add Up

UBC and TRIUMF physicists have proposed a unified explanation for dark matter and the so-called baryon asymmetry - the apparent imbalance of matter with positive baryon charge and antimatter with negative baryon charge in the Universe.

The visible Universe appears to be made of atoms, and each of these atoms carries a positive baryon charge equal to total number of protons and neutrons in its nucleus.

However, since the discovery of antimatter in 1932, researchers have wondered why the Universe doesn't hold a neutral baryon charge--requiring as much negatively charged antimatter as positively charged matter.

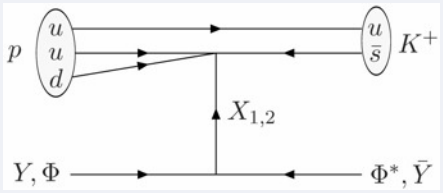
This net asymmetry of particles over antiparticles remains one of the biggest unsolved mysteries in physics.

“We’ve proposed a matter formation scenario where the positive baryon number of visible atoms is in balance with the equal and opposite negative baryon number of dark matter,” says Kris Sigurdson, an assistant professor of Physics and Astronomy at UBC, who worked with colleagues at TRIUMF, Canada’s National Laboratory for Particle Physics, and researchers at Brookhaven National Laboratory in the US, on the theory.

"This links the formation of atoms and dark matter and helps resolve the baryon asymmetry mystery, as the total dark plus visible baryon balance of the Universe is restored."

The proposal was published November 19 in the journal Physical Review Letters.

Observations of the the big bang’s afterglow, the cosmic microwave background, by the WMAP satellite now show about 4.6 per cent of the Universe (by density) is comprised of atoms, with about five times more dark matter (23 per cent).



A Feynman diagram for the rare baryon-destroying Induced Nucleon Decay (IND) process predicted by this type of theory. This represents a novel new way to detect dark matter. An incoming dark matter particle scatters off a proton causing it to decay into an energetic kaon. While an ultra-rare process with an effective lifetime of more than 10^{33} years (given the dark-matter density expected on Earth) this lifetime is interestingly near the current limits on proton decay set by the Super-Kamiokande experiment in Japan.

The cosmic balancing act proposed by the researchers may explain why the measured densities of dark matter and atoms differ only by a factor of five.

The researchers also predict an entirely new method to detect dark matter.

“Occasionally a dark-matter antiparticle may collide with and annihilate an ordinary atomic particle, releasing a burst of energy,” says Sigurdson. “While extremely rare, this means dark matter might be observed in nucleon decay experiments on Earth that look for the spontaneous decay of protons."

Dark matter - first hinted at nearly 80 years ago - is an elusive material inferred to exist from measurements of its gravitational effects on visible matter in galaxies, background radiation, and the Universe as a whole. It interacts very weakly with ordinary matter and, while playing a key role in our Universe, is almost undetectable.

Hooman Davoudiasl, Brookhaven National Laboratory, New York and David Morrissey and Sean Tulin of TRIUMF’s Theory Group, co-authored the letter.

Original article, titled “Unified Origin for Baryonic Visible Matter and Antibaryonic Dark Matter,” is available at: http://prl.aps.org/abstract/PRL/v105/i21/e211304 (subscription might be required)

Read more about it on Physics World: http://physicsworld.com/cws/article/news/44489

(Original article published online by the Faculty of Science on November 24, 2010 at http://www.science.ubc.ca/news/494)

Wieman nominated for White House post

The United States Senate confirmed UBC professor and Nobel laureate Carl Wieman to the position of Associate Director for Science in the White House Office of Science and Technology Policy this fall.

Wieman joined UBC Science in 2007 as professor of Physics and director of the Carl Wieman Science Education Initiative, designed to transform science teaching and learning at UBC and beyond. “The CWSEI has made an indelible impact on thousands of UBC students, and we have no doubt Carl will affect wider change in science education in American schools through his new role,” says UBC president Prof. Stephen Toope. “We wish him the best in Washington, and look forward to him rejoining us.”

Over the past three years, more than 18,000 UBC students have been affected by the CWSEI through the transformation of courses. More than 40 courses in seven science departments are undergoing or have finished transformation. The work has attracted international attention and support, including a $2-million gift from Google’s founding investor and UBC Science alumnus David Cheriton earlier this year. Sarah Gilbert, CWSEI associate director, will serve as acting director during Wieman’s tenure with the Obama administration.

For more information about the Carl Wieman Science Education Initiative, visit www.cwsei.ubc.ca.

(Original article published in Synergy: The Journal of UBC Science, year 2010 issue 2, page 3. Visit the Synergy web site for the complete issue: http://www.science.ubc.ca/research/synergy)

UBC and Max Planck commit to a new Center for Quantum Materials

UBC has forged a formal partnership with the Max Planck Society, Germany's foremost basic research institution and home to 32 Nobel prizes.

UBC President Stephen Toope and Max Planck Society President Peter Gruss were joined in Munich by Thomas Marr, Germany's Minister-Counsellor of Commercial and Economic Affairs, for the signing of a memorandum of understanding (MOU) that will establish the Max Planck-UBC Centre for Quantum Materials.

The agreement also commits both institutions to conducting joint research projects in Canada and Germany, and to increasing scholarly exchanges.

"Today's agreement represents a joining of great strengths within both the Max Plank Society and UBC and will provide the underpinning for future research in advanced materials science," said Prof. Toope. "The knowledge and discoveries generated from these collaborations will profoundly change the lives of present and future generations."

The Max Planck-UBC Centre for Quantum Materials is only the third Max Planck Center to be established. The others are the Indo Max Planck Center for Computer Science in India and the CSIC-MPG Research Unit in Spain, which focuses on early European culture and religion. The first and only Max Planck Institute in North America is in Florida with Florida Atlantic University and is currently under construction.

The MOU signing also marked the start of the Max Planck Society-UBC "Summer School" on Quantum Materials involving five lecturers and 10 graduate students and post-doctoral fellows from UBC and a similar number of participants from Germany.

Established in 1948, the Max Planck Society for the Advancement of Science is a non-governmental, non-profit society that funds 80 institutes and research facilities in Germany and establishes strategic research partnerships with institutions around the world. Scientists from the society – and its precursor, the Kaiser-Wilhelm-Society – have earned 32 Nobel prizes since 1914.

UBC is world renowned for research excellence in quantum materials – including superconductors – with potential applications in lossless power lines, vast improvements in computers and wireless communications, new advances in solar and fuel cells and a new class of medical electronic devices to aid diagnosis and treatment. To date, four Canada Research Chairs (CRC) in the area of condensed matter physics have been awarded to researchers at UBC, more than any other university in the country.

UBC principal investigators to lead research groups in the new Max Planck-UBC Centre include four CRC's and five Fellows of the Royal Society of Canada – two of whom are also fellows of the Royal Society of London. In addition, three of the researchers are among the 100 most cited physicists in the world. They will be led by Prof. George Sawatzky, Canada Research Chair in Physics and Chemistry of Nano-structured Materials (on the left in the photo).

"The partnership with Max Planck is a testament to the caliber of research conducted here, and our researchers enjoy reputations as some of the most internationally collaborative in the world," said John Hepburn, UBC Vice President Research and International, who added that 46 per cent of UBC research is published jointly with colleagues outside Canada.

"Our interdisciplinary research strengths are further complemented by state-of-the-art facilities such as UBC's Advanced Materials and Process Engineering Laboratory, our proximity to TRIUMF, Canada's National Laboratory for Particle and Nuclear Physics, and priority access to the Canadian Light Source Synchrotron."

Over the past 50 years, engineers have succeeded in developing smaller combinations of semiconductors, insulators and metals arranged to function as electronic devices while maintaining their fundamental electronic properties. Scientists at the forefront of advanced materials research are investigating the dramatic changes in properties that occur when such devices dive below current size limitations.

(Original article published online by the Faculty of Science on October 4, 2010 at http://www.science.ubc.ca/news/464)

Article

The Core Sunlighting System

Lorne Whitehead and his research team in the Structured Surface Physics Laboratory have developed a new lighting system that concentrates and then distributes natural sunlight to illuminate the interior of buildings. The Core Sunlighting system is currently being developed into a commercial product by a new UBC spin-off, SunCentral Inc. SunCentral is focusing on the installation of demonstration systems, supported by funding from Sustainable Development Canada and the BC Innovative Clean Energy Fund. The first installation was completed last summer on BCIT's campus in Burnaby, and the second installation is underway in the south wing of the newly-renovated UBC Biological Sciences Complex, where the technology will be installed on all three floors of the building and the electricity savings and light quality will be monitored, while also surveying the occupants' experience of working under natural light conditions.

For more information, visit the Core Sunlighting System website: http://www.phas.ubc.ca/ssp/CoreSun_index.html

For a recent presentation by Dr. Whitehead on lighting efficiency, visit: http://cltc.ucdavis.edu/content/view/942/439/

The Core Sunlighting system installation (completed) on BCIT campus in Burnaby.

The second installation is underway at the newly-renovated UBC Biological Sciences Complex.

Alumni

Alumni - Stay in touch...and why you should

Hennings classroom, 1947. Photograph from the UBC Historical Photograph Collection.

Have you pulled out your graduation class photo and wonder what everyone is doing now? Or saw a student or professor being mentioned in the news and said to yourself – "hey, that's the department I graduated from?" Perhaps you just realized something that you wished you had done in school and wanted to share it with current PHAS students?

This is the time to reconnect with the department if you haven't done so! All students graduated from the department receive this annual newsletter, but we would love to hear from you more often. Here are a few more ways to stay in touch (and make sure you continue to stay in touch…).

- Join the PHAS LinkedIn Group: http://tinyurl.com/phaslinkedin and/or the Engineering Physics LinkedIn Group: http://www.linkedin.com/groups?home=&gid=160891
- Become a mentor for PHAS students: http://www.science.ubc.ca/students/resources/mentoring
- Speak at a student event (career night, student networking event, and more), or help organize a reunion: email communications@phas.ubc.ca. Even if you are not doing something directly related to Physics & Astronomy, we would like to hear how you apply your knowledge in other fields!
- Visit the Faculty Alumni web sites to check out other alumni benefits - get your alumni A-card, receive news about events and workshops, and get a free forwarding email address.

Faculty of Science: http://www.science.ubc.ca/support/alumni

Faculty of Applied Science: http://www.apsc.ubc.ca/alumni/

- Also, remember to update your contact information with us if you are planning a move!

If you have more ideas about how you want to be involved as an alumus/alumna, feel free to contact the departmental Communications Coordinator Theresa Liao at communications@phas.ubc.ca. We look forward to hearing from you!

PS. Don't forget that the Alumni Weekend 2011 is on May 28! See page 2 for more information.

Student Awards

Undergraduate Studies

Some honours garnered by our undergraduate students are:

W H MacInnes Scholarship in Physics and Mathematics - Connor Meehan

Gordon Merritt Shrum Memorial Scholarship - Dennis Huang (shared with the Engineering Physics Program)

Dante Ciccone Memorial Scholarship in Astronomy - Derek Beattie Inman

Erik Cullen Madsen was awarded both **the Bruce Marshall Prize and the Paul Sykes Scholarship in Astronomy**

Premier and Wesbrook Scholarship - Oren Rippel. Oren also placed 5th overall for the 2010 CAP University Prize Exam.

Dorothy Gladys Studer Memorial Scholarship - Jonathan Lloyd Blackman

Arthur Crooker Prize - Christoph Schaub

Physics and Astronomy Undergraduate Scholarship- Minyang Han

Thomas and Evelyn Hebb Memorial Scholarship - Simon James Foreman & Di Leo Wu

Rudi Haering Medal in Physics for 2009W(Head of Class Medal) - Farzin Barekat

Congratulations to these students!

Engineering Physics

The 2010 Rising Stars of Research held at UBC Vancouver Campus includes Engineering Physics students who were selected to represent UBC Engineering. Lazar Milovanovic, poster titled *Quantitative measurement of friction on single cells in microfluidics devices and the effect of polyethylene glycol (PEF) coating*, took **First Place in the Engineering competition**, with Mo Chen (*Guaranteeing safe automated control in discrete space and time*) and Chenchong "Charles" Zhu (*Loss and heating of trapped ultracold gases*) received Honourable Mentions.

Other prizes received by engineering students during the Engineering Physics Project Fair are:

Roy Nodwell Prize - Colin Delaney, Laura Fedoruk, and Andrew Young

Edward G. Auld Prize - Andrew Mahoney and Jackson Semple

Eric Roenitz Prize - Hardeep Sanghera and Amira Eltony

Dorian Gangloff from Engineering Physics received both the **C.K. Choi Scholarship** as well as a **Wesbrook Scholarship**.

EECE PMS Sierra-Sierra Inc. Founders Award - Mo Chen and Inderpreet Singh

ENPH 50th Anniversary Scholarship - Hao Tian Pang

P&A Dept. Head Gorden Merritt SHRUM Memorial Scholarship - Ian Moult

Captain Wu Scholarship - Daniel Da Costa and Shaina Johl

The Banks Award - William Bowden, Kyle Kimura, Jon-Paul Sun, Won Sug Lee, and Tim Kato

The J. K. Zee Award - Kyle Boone

The Novicov Award - Audrey Kostin

The J. Fred Muir Award - Angela Ruthven, Kevin Zhou, and Michael Caverley

Excellent work by the students!

Graduate Studies

Some honours garnered by our graduate students are:

NSERC Canada Graduate Scholarship (Doctoral) - David (Cisco) Gooding, Michael McDermott, Cian Menzel-Jones, Robert Kosztyla, and Juan Mario Michan

NSERC Postgraduate Scholarship (Doctoral) - Tyler Hughes, Matthew Lam, Jennifer Moroz, and Brad Ramshaw

NSERC Canada Graduate Scholarship (Masters) - Haley Clark, Leonard Goff, Jonathan Loranger, Sandra Meyers, Charles Rabideau, and Ariel Sibilia

UBC's Pacific Century Graduate Fellowship (PCGS) - Samantha Lawler and Ali Mohazab

Four-Year Fellowship (4YF) - Arman Akbarian Kaljahi, Elham Alipour Khayer, Jonathan Benjamin, Shun Chi, Aaron Gallant, Kelsey Hoffman, Ali Khademi, Bartholomew Ludbrook, Mark Lundeberg, and Mohammad MahmoudzadehVazifeh

FQRNT (Doctoral) - Andrea Gutierrez

Congratulations to these students!

Quick News

Early Data from Herschel -- Marsden shows how to discover galaxies

UBC post-doctoral fellow Gaelen Marsden recently presented images revealing tens of thousands of newly-discovered galaxies at the early stages of formation - just one billion years after the Big Bang. The images were obtained from data from the infrared camera, SPIRE, aboard the Herschel Space Observatory. The telescope was launched last May, and is now orbiting the sun at the L2 point of the Earth's orbit.

Data collected by Herschel are being analysed by the programme's biggest research project, the Herschel Multi-tiered Extragalactic Survey (HerMES). The project consists of more than 100 astronomers from six countries, including UBC Professors Mark Halpern and Douglas Scott and post-doctoral fellows Ed Chapin, Gaelen Marsden, Elisabetta Valiante and Don Wiebe. Canadians are involved through the support of the Canadian Space Agency.

Stanford Professor gives $2 million to CWSEI

UBC grad David Cheriton, now a computer science professor at Stanford University, has given UBC and CWSEI (Carl Wieman Science Education Initiative) a $2 million gift to revolutionize the way the institute teaches science. The University of British Columbia alumnus is widely credited for mentoring Google's founders and helping establish the company & established a reputation of backing a winner!!

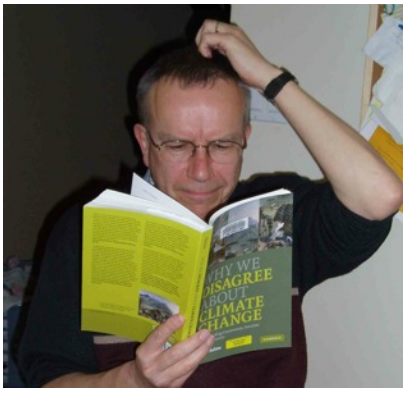
"Prof. Cheriton understands the need and impact of undergraduate science education both from a student and educator perspective," said Wieman, founder & director of CWSEI.

CWSEI's stated goal is "... to achieve highly effective, evidence-based science education for all post-secondary students by applying the latest advances in pedagogical and organizational excellence."

(Continues on page 10)

Physics Teaching for the 21st Century

A project to develop physics teaching materials relevant to everyday issues.



Have you ever wondered…

- Why can't you just turn a nuclear reactor off?
- Does throwing a balsa glider or paper airplane have anything to do with the fuel consumption of a Boeing 747?
- When does cycling cost more in fuel than driving?
- Why does your cat have a better chance of surviving a fall from a large cliff than you?

The answers all have something to do with physics…

Physics is a core subject that deals with many real life issues - clean energy, climate change, and medical advancement. Yet it can be a challenge to link physics concepts to these important issues; most high school and university physics curriculum materials do not contain lessons and problem sets directly related to realistic problems. With this in mind, a team of researchers and instructors from UBC's Department of Physics and Astronomy set out to develop an online database of materials which can support instructors who want to incorporate real world physics examples and problems into their courses. Overviews and teaching materials are available for exploring the interesting questions you saw earlier.

With the support of *Social Sciences and Humanities Research Council of Canada and UBC Teaching and Learning Enhancement Fund* for this project, a website was developed to share teaching materials: http://c21.phas.ubc.ca and research into the impact of the resource is ongoing. The materials on this site were developed by a team of faculty and students at the University of British Columbia and are in the process of being tested by high school teachers, and graduate and undergraduate physics students. Preliminary results have shown enthusiasm for the use of real world contexts by both teachers and students and has also identified barriers teachers encounter when trying to implement the new resource.

Materials on the website are free for teachers and instructors to use for non-commercial purposes under a creative commons license. We look forward to hearing from more users regarding how they utilize materials from this website to enhance their physics teaching.

We are on facebook! Like us on facebook to receive updates: **http://tinyurl.com/outreachc21**

Faraday Show 2010 - Physics of Light and Colour

In 1826, physicist Michael Faraday founded the Children's Christmas Lectures at London's Royal Institution. His goal was to communicate to children the excitement of scientific discovery. In keeping with the spirit of those lectures, every year students and faculty at the Department of Physics and Astronomy present the Faraday Show - this year our topic was the "Physics of Light and Colour." 320 parents and children joined us to learn how optical illusions work and how we can create lights of different colours. We also found out which type of Christmas light decorations consumes the least amount of energy, and how we can use light to generate electricity. Interesting student and faculty projects were presented, and the show ended with a demonstration of the reflection and refraction of laser in water. In addition, we collected more than 10 boxes of non-perishable food items for the Greater Vancouver Food Bank.

Did you miss it this year? The Faraday Show is an annual event suitable for children of all ages, and even for adults who are young at heart! - remember to check our web site in December and mark it down on your calendar next time!

For more information, visit our website: http://outreach.phas.ubc.ca/faraday/

Dr. Chris Waltham demonstrated how laser passes through water with reflection and refraction

The outreach program collected more than 10 boxes of non-perishable food items for the Greater Vancouver Food Bank!

About the Outreach Program: UBC faculty members in the Department have been involved in outreach activities for several decades. In 1995, the Outreach Program was established. Nowadays the program runs annual Phenomenal Physics Summer Camps, the Faraday Show, workshops and classes in physics teaching for teachers and students, several science competitions (such as the Michael Smith Science Challenge and the Physics Olympiad), and support other science events on campus. For more information about the outreach program, visit our website: http://outreach.phas.ubc.ca, or sign up for our newsletter at http://outreach.phas.ubc.ca/emailList/

Transitions

Kim Fugate (Tkaczuk) joined UBC in February of 1987 and joined PHAS as a financial assistant in 1991, and moved into her position as the Director of Finance/Operations in 2001. After many years of service, Kim left the department in 2010, and is now happily settled in Oxnard, California. Kim, we will miss you for sure…

Paul de Leon joined the department as the Director of Finance/Operations in September, 2010.

Lori Boerma re-joining PHAS in September 2010 after having been away on leave. Welcome back Lori!

Andrea Sutherland, who handled the Undergraduate Program Assistant position for many months during Lori's absence, left PHAS in December.

Anilu Skala joined us in the finance clerk role in January 2010.

Sarah Burke joined PHAS in July as an Assistant Professor (joint appointment with Chemistry). She was also recently appointed as the Canada Research Chair in Nanoscience.

Valery Milner joined PHAS in February as an Assistant Professor.

William Hsieh became Professor Emeritus on 1 July, 2010 (at age 55). William continues to supervise grad students and post-docs.

Lastly, one change that happened this year is that we had five scientific engineers working in Lorne Whitehead's lab (managed by Michele Mossman), who transitioned to the new spin-off company, Sun Central Inc. on October 1st. They are:

Allen Upward, Guthrie Cox, Peter Friedel, Derek Fitzpatrick, Jess Britt

Faculty and Staff Awards

This year is another exciting year for many of our faculty and staff members:

Ludovic Van Waerbeke has been named by the Peter Wall Institute for Advanced Studies as a 2010 Early Career Scholar. The objective for this program is to bring outstanding UBC early-career researchers together to share ideas and research approaches. (See a feature article on Ludo's research on page 10)

Mark van Raamsdonk has won the 2010 Gravity Research Foundation Essay Competition. The title of Mark's winning essay is "Building Up Spcetime with Quantum Entanglement" and will be published in the Journal of General Relativity and Gravitation (GRG). The top essay also earns Mark $4,000.

Andrzej Kotlicki recently received the 2009/2010 Rethink Award, given by the student-led group Common Energy, whose mission is to "bring UBC beyond climate neutral." The purpose of the award is to recognize faculty members who are sustainability leaders for their achievements and contributions.

Chris Waltham received the 2009/2010 Faculty of Science Achievement Award (Faculty). The awards recognize staff, students and faculty whose contributions in areas such as service, administration, leadership and outreach have had a significant positive impact in achieving the goals of the Faculty of Science.

Gordon Semenoff received the the 2010 CAP/DCMMP Brockhouse Medal for his seminal contributions to the theory of Graphene and its massless quasiparticles. Prof. Semenoff is an internationally recognized leader in this field with an outstanding publication record. whose work has shown that (quoting Philip Stamp, Director of the Pacific Institute for Theoretical Physics) "the idea that a theorist could predict all the important features of a material that did not even exist,., and have the insight to predict in exactly which kind of system experiments should look for - this seems almost to good to be true." (more on Nobel Prize connection on page 11)

Doug Bryman received the 2011 W.K.H. Panofsky Prize in Experimental Particle Physics. This prestigious award from the American Physical Society will be shared with Laurence Littenberg, Brookhaven National Laboratory and A. J. Stewart Smith, Princeton University. The Prize was established to recognize and encourage outstanding achievements in Experimental Particle Physics.

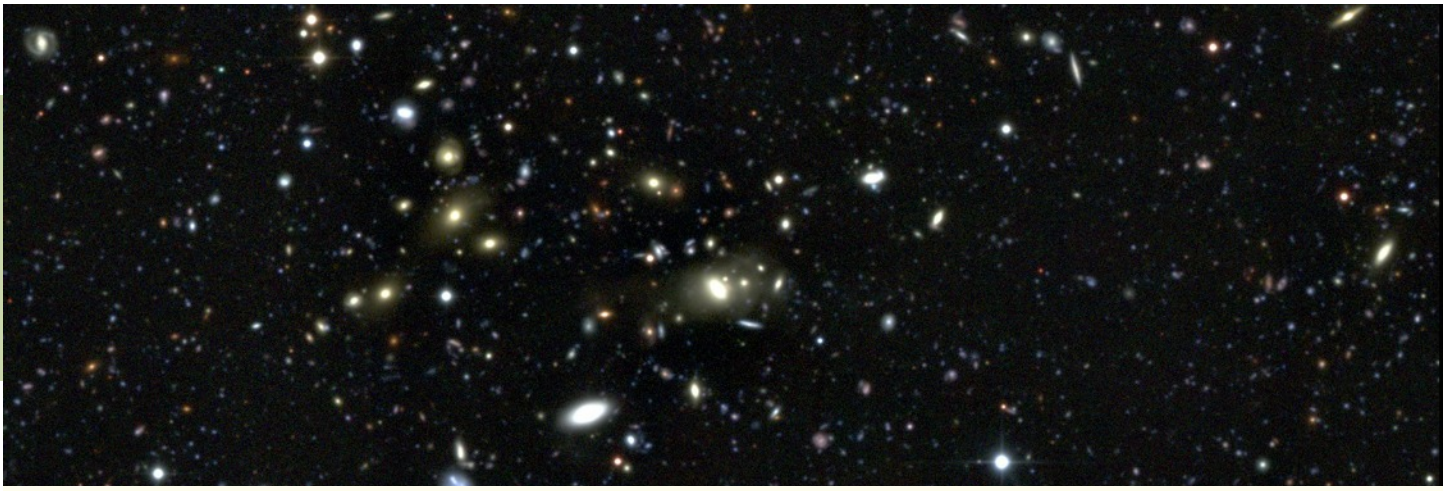
Ian Affleck has been elected as a Fellow of the Royal Society in its 350th anniversary year. The Fellowship of the Royal Society is composed of 1300 of the most distinguished scientists from the United Kingdom, other Commonwealth countries and the Republic of Ireland. Fellows of the Royal Society are elected for life.

Mona Berciu was nominated for the 2010 YWCA Women of Distinction Awards. She was cited for her work in encouraging participation of women in physics. She was the faculty organizer for the annual Physics & Astronomy Welcome Orientation for Women (WOW) event in the past few years.

Students discussed various study options during the 2010 Physics & Astronomy Welcome Orientation for Woman (WOW) event, organized by Mona Berciu.

Joshua Folk received the 2010 Sloan Research Fellowship; fellowships are awarded to 118 outstanding US and Canadian early researchers. The fellowship program is the oldest program of the New York-based Alfred P. Sloan Foundation. Joshua's research focus is the physics of nano structures.

This year two staff members were awarded the Physics & Astronomy Staff Service Award. **Salena Li** was awarded for her tireless contributions to the PHAS undergraduate program. **Gar Fisher** was awarded for his dedicated service to the PHAS Electronics Lab.



Astronomers Confirm Einstein's Theory of Relativity and Accelerating Cosmic Expansion

University of British Columbia astronomer Ludovic Van Waerbeke with an international team has confirmed that the expansion of the universe is accelerating after looking at data from the largest-ever survey conducted by the Hubble Space Telescope.

The astronomers studied more than 446,000 galaxies to map the matter distribution and the expansion history of the universe. This study enabled them to observe precisely how dark matter evolved in the universe and to reconstruct a three-dimensional map of the dark matter and use this to test Albert Einstein's theory of general relativity.

The findings are published in Astronomy & Astrophysics (Volume 516, pages A63+). The study's lead author is Tim Schrabback, an astronomer from Leiden University in the Netherlands.

"Our results confirmed that there is an unknown source of energy in the universe which is causing the cosmic expansion to speed up, stretching the dark matter further apart exactly as predicted by Einstein's theory," says Van Waerbeke, an associate professor in the Dept. of Physics and Astronomy.

Einstein's theory of general relativity predicts that space and time is a soft geometrical structure of which the shape and evolution are entirely determined by the matter within it. Scientists posit that the universe is composed of dark matter and normal matter with a third constituent called "dark energy," which over the past two billion years has been the force behind the accelerated expansion of the universe.

"The data from our study are consistent with these predictions and show no deviation from Einstein's theories," says Van Waerbeke, who is also a scholar in the Cosmology and Gravity program of the Canadian Institute for Advanced Research.

In the late 1990s, Van Waerbeke pioneered weak gravitational lensing to measure the invisible web of dark matter that makes up 80 per cent of the mass of the universe. This technique is similar to taking an X-ray of the body to reveal the underlying skeleton. It allows astronomers to observe how light from distant galaxies is bent and distorted by the web of invisible dark matter as it travels toward Earth. By measuring the distortions seen in these galaxy light patterns, astronomers can then map dark matter structures.

Along with weak gravitational lensing, the study uses data from the Cosmic Evolution Survey (COSMOS), one of the most ambitious undertakings by the Hubble Space Telescope. COSMOS is a joint project of the European Space Agency (ESA) and NASA involving more than 100 scientists from a dozen countries.

To generate the COSMOS survey, a camera aboard the Hubble photographed 575 slightly overlapping views of the same part of the universe. This required nearly 1,000 hours of observations, during which Hubble circled the Earth almost 600 times.

In addition to the Hubble data, the researchers used ground-based telescope data to assign distances to 194,000 of the galaxies surveyed, which was a key factor for reconstructing the three-dimensional picture of the dark matter distribution.

For additional information, visit: http://www.spacetelescope.org/news/html/heic1005.html

Image: Excerpt of the research team's 4 square degree data showing a massive cluster of galaxies at redshift z~0.4. Prominent cluster members are the bright big yellow-ish galaxies towards the center of the image. Clusters like this one are associated with very massive over-densities of dark matter which contribute to the gravitational lensing signal the team used to test General Relativity. Multicolor data from the Canada France Hawaii Telescope (CFHTLS).

(Media release published online by the UBC Public Affairs Office on Mar. 25, 2010 at: http://www.publicaffairs.ubc.ca/2010/03/page/2/)

Ludo joined the department in 2004 and was promoted to Associate Professor in 2009. He also holds a Canadian Institute of Advanced Research Scholarship in the Cosmology and Gravity programme. Ludo's research interests include the study of Dark Matter and related topics in cosmology and fundamental physics. He was recently named by the Peter Wall Institute for Advanced Studies as a 2010 Early Career Scholar.

(Quick News continues from page 7)

Province to invest $31M in Isotope Reseach

A $30.7-million provincial investment in TRIUMF, one of the world's top subatomic physics labs is expected to help lead the way in alleviating future medical isotope shortages, while keeping B.C. and Canada at the forefront of particle and nuclear physics, Premier Gordon Campbell announced today (2010-06-22).

This funding announcement supports ARIEL (Advanced Rare IsotopE Laboratory), a $62.9-million project to build an underground beam tunnel that will surround a ground-breaking linear accelerator.

ARIEL will allow TRIUMF to broaden its research in producing and studying isotopes for medicine and physics, including materials science.

TRIUMF is located on the University of British Columbia's Vancouver South campus. A number of Physics & Astronomy researchers including, Rob Kiefl, Jens Dilling, Chris Hearty, Nigel Lockyer, Andrew MacFarlane, Tom Mattison, Janis McKenna, and Lia Merminga are expected to take part in the research.

Pulsar Timings Improved -- Better Clocks

An international team of scientists including UBC astronomer Ingrid Stairs has discovered a promising way to fine-tune pulsars into the best precision time-pieces in the Universe.

Pulsars--incredibly fast spinning collapsed stars--have been studied in great detail since their discovery in 1967. The extremely stable rotation of these 'cosmic clocks' has enabled astronomers to discover the first planets orbiting other stars and provided stringent tests for theories of the Universe.

However, until now, slight irregularities in their spin have significantly reduced their usefulness as precision tools.

Astronomers have observed that pulsar spin rates slow very gradually over time. The team, led by the University of Manchester's Professor Andrew Lyne, used decades-worth of observations to determine that pulsars actually exhibit two different rates of spin change, not one as previously thought, and switch between them abruptly. The team also discovered that these variations are associated with changes in the pulsar's appearance that can be used "correct" for the shifts.

The discovery could give astronomers a new tool to study the powerful gravitational forces that shaped the universe. The findings were reported in 2010-06-24 issue of Science Express.

Einstein@Home finds new pulsar.

A new pulsar has been discovered with the help of a volunteer network of 250,000 home and office computers around the world in a project known as Einstein@Home. Einstein@Home is a program that uses a computer's idle time to seek out evidence of gravitional waves & to find radio pulsars in binary systems. Data collected from the Arecibo Observatory in Puerto Rico is segmented into "work units" and transferred to volunteer computers for processing.

The 24-milli-second pulsar has been designated PSR J2007+2722 (basically its position in the sky). The computers of Chris and Helen Colvin (Ames, Iowa, USA) and Daniel Gebhardt (Universität Mainz, Musikinformatik,Germany) identified J2007+2722 with the highest significance. The data is then further proccessed and the object is re-observed to confirmthe discovery. UBC researchers Ingrid Stairs, Marjorie Gonzalez, and Laura Kasian helped in this confirmation and are co-authors on the Science Express article.

WMAP completes mission

On 2010-08-20, the Wilkinson Microwave Anisotropy Probe (WMAP) completed its scientific mission after nine nearly flawless years of operation at the second Earth-Sun lagrange point, L2. The ninth year of all sky surveys was completed last week and then 10 days were spend investigating various sources of systematic errors.

WMAP has been stunningly successful, producing what is now called the Standard Model of Cosmology. WMAP measured the age of the universe to 1%, measured that it is spatially flat, again to 1%. We detected the effects of the cosmic neutrino background, set a new upper limit on neutrino masses, and measured several key predictions of inflation theory. See WMAP's Top Ten for more.

UBC's Mark Halpern and his lab represent the only non-US participants in this project.

Nobel Prize in Physics has UBC connection

The Nobel Prize in Physics 2010 was awarded jointly to Andre Geim and Konstantin Novoselov "for groundbreaking experiments regarding the two-dimensional material graphene".

This year's Laureates both studied and began their careers as physicists in Russia. Now they are both professors at the University of Manchester in Great Britain. See the Nobel Prize Press Release

Graphene is a form of carbon only one atom thick, and has has remarkable properties. Not only is it the thinnest material known, but also the strongest. As a conductor of electricity it performs as well as copper. As a conductor of heat it outperforms all other known materials. It is almost completely transparent.

An interesting sidelight is that UBC professor Gordon Semenoff published a theoretical paper in 1984 discussing the properties of graphene -- "Condensed-Matter Simulation of a Three-Dimensional Anomaly". Physical Review Letters 53: 5449.

UBC Researchers help define electron behavior in High Temperature Superconductor

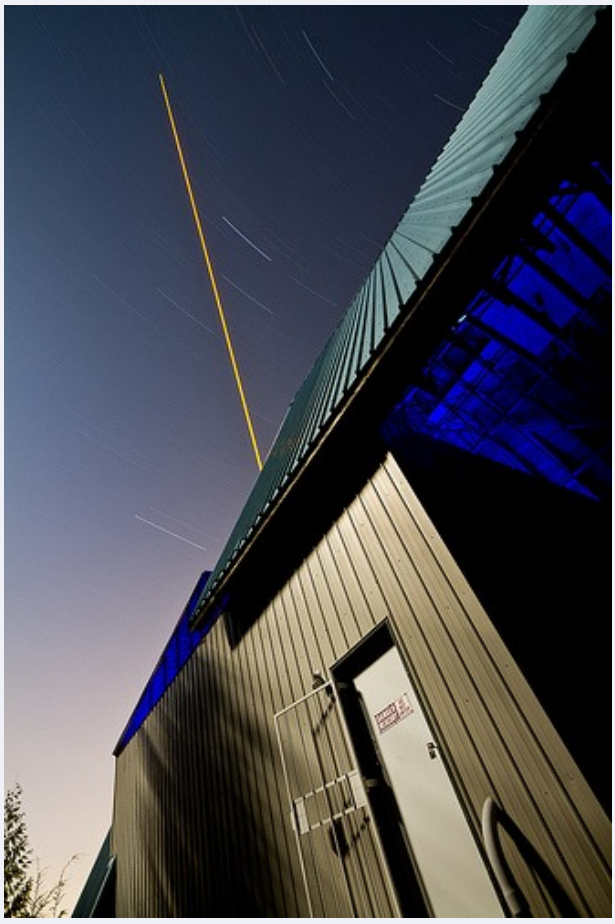
UBC researchers have teamed with others at the Advanced Light Source, Lawrence Berkeley National Laboratory to publish a paper in Nature which helps describe the behaviour of electrons in high temperature superconducting cuprates.

The research indicates that high-temperature superconductivity in copper oxides is linked to what they term 'incoherent excitations'--a discovery that sheds light on the electronic response of these materials before they become superconducting.

The study marks the first time researchers have been able to directly measure when electrons in a super conductor behave as independent well-defined particles, and when they evolve into ill-defined many-body entities.

"We've never been able to directly quantify the nature of electron behaviour within these materials across the entire phase diagram--the transition from non-superconducting to superconducting behaviour," says Associate Professor Andrea Damascelli, Canada Research Chair in Electronic Structure of Solids with the Department of Physics and Astronomy.

Back Page: Laser of the LIDAR system



The Large Zenith Telescope located in Maple Ridge is the world's largest liquid mirror telescope. The laser beam is part of the LIDAR system used to measure the spatial and temporal variations in the sodium layer. Information which is critical for adaptive optics systems that are becoming vital to ground based observations. This 40 minute exposure was taken on a night with a nearly full moon. Image credit: Jon Ben (http://jonbenphotography.com. Jon is a PhD student in Astronomy).

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