Attn: Science Dept. Heads, Science & Physics Teachers Sign up for this newsletter: www.phas.ubc.ca/outreach

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University of British Columbia

PHYSICS & ASTRONOMY

Outreach Program News

In This Issue…

Upcoming Events
- The Michael Smith Challenge
- Physics Olympiad
- Junior Physics & Engineering Competition
- TRIUMF Saturday Morning Lectures
- Phenomenal Physics Summer Camps

UBC Programs
- Engineering Physics at UBC

Turn Ideas into Reality
- UBC Science One Program

Integrated First Year Science Program
- TRIUMF Free Teacher Internships
- The New PHYS 100

Introductory Physics for First Year Students

Physics Research News
- High T_c @ UBC

Welcome to the first issue of **UBC Physics & Astronomy Outreach Program News**! In this Outreach Program News, you will find the information regarding our upcoming local, provincial, and national events, introduction to UBC Physics & Astronomy academic programs, and exciting UBC research news.

The UBC Physics & Astronomy Outreach Program News will be published 3 to 4 times each year. If you would like to continue receiving this newsletter with the most updated information through email, please sign up at **http://www.phas.ubc.ca/outreach/web/emailList.php**.
For more information, or to download the most recent version of this newsletter, please visit our website: **http://www.phas.ubc.ca/outreach**.

Feel free to contact us if you have any question or comment regarding this newsletter. We look forward to seeing you at UBC!

Contact Us

Theresa Liao
Coordinator, Physics & Astronomy Outreach Program
University of British Columbia
6224 Agricultural Road
Vancouver, BC V6T 1Z1
Email: outreach@phas.ubc.ca
Phone: 604-822-3675
Fax: 604-822-5324

Register Now!!

The Michael Smith Challenge (National) – April 7th

A Challenge on Logical Thinking for Astronomy, Biology, Chemistry, Earth Science, and Physics

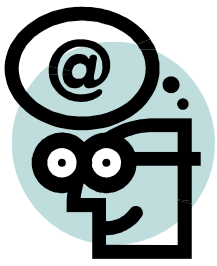
The Michael Smith Science Challenge is a **national** competition written by students currently taking **Grade 10 Science or lower**. **This event is run at the students' school (hence no travelling!)** It emphasizes logical thinking, and covers material in the science curriculum common to all provinces. It is named in honour of UBC's Nobel Prize Winner Dr. Michael Smith, and is sponsored by the UBC faculty of Science and NSERC PromoScience.

PRIZES:
Nationally: 1st - $500, 2nd - $250, 3rd - $100
Provincially: $100 for top student without a national prize, $50 for each student in a tie
Teachers: $50 for a teacher with a prize-winning student

WHEN: 9-10am Pacific Time, April 7, 2008
COST: $5.00 /script (cost of marking one exam)

For more information or to register, visit: **http://www.physics.ubc.ca/outreach/web/smith/**

Contact **mschall@phas.ubc.ca** if you have any question regarding this event!



Upcoming Events

Physics Olympiad (Western Canada) – March & April

WHO: Canadian high school students from BC, AB, SK, MB, YT, or NT who are under the age of 20 and have never taken university courses.

WHAT: Write a selection examination to qualify for the Western Canada Physics Olympiad Weekend camp in Edmonton.

WHERE: Details can be found online at **http://www.phys.ualberta.ca/olympiad/**

WHEN: The selection exam will be posted online from March 21-28; no pre-registration is required. The Olympiad Weekend camp will take place from April 26-27.

WHY: Because solving interesting problems can be fun and Canada will send a team of five students, who are best of the National Competition, to the International Physics Olympiad competition in Vietnam in July 2008.

For more information, write to **olympiad@phys.ualberta.ca**

Junior Physics & Engineering Competition (Greater Vancouver & Lower Mainland) – May 2nd

JPEC is a you-build-it competition designed for **junior science students (grades 8-10)** in **Greater Vancouver/ Lower Mainland**. Its purpose is to build stuff, learn some physics, and have fun. In years past we've had showdowns between spaghetti bridges, catapults, balloon cars, and water towers, to name a few.

JPEC takes place on **May 2nd, 2008** (the first Friday in May). Teams bring two pre-build contraptions for the morning of competition, then face off in a "mystery event" after lunch, followed by a physics show (not your garden-variety demonstrations!). This year's pre-build events are a **Zip Line Egg Bomber** (think; out of control gondola) and a **Crack Attack Widget** (a weight bearing device that fits in a crack).

Interest in JPEC has been growing; last year we registered 34 teams from 17 different high schools. We anticipate another year full of great designs and keen competition. Registration for JPEC is **free** but will be limited to **2 teams per school (maximum 5 junior science students per team)** until such time as everyone has had a fair chance to register.

Finally, the **T-shirt Design Competition** is open once again. The past two years have been great! Give a heads up to your art teachers and encourage all interested students in your school to visit the link and submit their designs. Enrolment in JPEC is not a requirement.

Registration Deadline: March 31st, 2008

For more information, visit the JPEC website: **http://www.junior_olympics.phas.ubc.ca/**

To register, send your request and 411 to: **mike_hengeveld@hotmail.com**

TRIUMF Saturday Morning Lectures (Greater Vancouver & Lower Mainland) - Saturdays

TRIUMF & The UBC Physics and Astronomy Department are proud to offer a series of **physics lectures** specifically designed for **high school science students.** These lectures address current issues in the world of physics that would interest the general population.

The talks are held in the TRIUMF Auditorium, which is located in the UBC South Campus. There is **no charge** for admittance, and students are encouraged to bring friends and interested family members. **Teachers and members of the public are also welcome.** Free parking is available.

The next upcoming lecturers are on **April 12, 2008**: "**Nuclear Astrophysics"** and "**Panning for plutonium on the sea floor: linking the heavy elements to supernova**."

For more information, contact (604)222-7525.

To register or for more information, please visit: **http://www.triumf.info/public/students/lectures.php**

Upcoming Events

Phenomenal Physics Summer Camps (Greater Vancouver & Lower Mainland) - July

The **UBC Physics Outreach Summer Camps** are for kids **(Grades 2 - 10)** who enjoy building things and learning new cool science stuff! Come build planes, go SCUBA diving, learn the physics of sound, build a Martian habitat or a cardboard boat. We offer four different week long camps that cater to a range of ages and interests. Please check out the schedule and description below.

Registration for summer 2008 is online now and operates on **a first come, first served** basis.
Spots fill up fast...So register now!

To register or for more information, please visit: **http://www.physics.ubc.ca/outreach/web/summercamps/**
Questions? Email us at **camps@phas.ubc.ca**

Fun with Physics Camp (Grades 2-4) - $200.00
This camp will be run twice: July 7-12 and July 14-18
*Have fun with...*building rockets, boats, and airplanes!
*Learn about...*molecular structure through crystals, waves with musical instruments, and fluids with tornado tubes!
*Enjoy...*daily outdoor games, two pool sessions, a tour of UBC's telescope, and a physics show with ice cream made from liquid nitrogen!!

Astronomy Camp (Grades 4-6) - $250.00
This camp will be run once: July 14-18
Let's explore our universe! Build Martian habitats, view stars in a planetarium, and explore the properties of rockets.
How does a telescope work? Visit UBC's telescope and then build one!
What's it like without gravity? Discuss weightlessness and experience it during a **SCUBA diving session**!
Excited about new discoveries in astronomy? Hear the talks by expert astronomers from UBC's Physics & Astronomy department
*Also enjoy...*The week includes two pool sessions, daily outdoor games and the physics show and ice cream party.

Advanced Physics Camp (Grades 5-7) - $250.00
This camp will be run twice: July 7-12 and July 21-25
Up for a challenge ?
Study... motion with motion detectors and computer graphing software, build a tri-colour flashlights, design life sized cardboard boats that and experience concepts such as pressure and buoyancy through **SCUBA DIVING LESSONS!**
Also enjoy... two pool sessions, tours of UBC's research labs, daily outdoor games, guest speakers and a fabulous physics show.

Chemistry, Physics and Astronomy Camp (Grades 8-10) - $250.00
This camp will be run once: July 21-25
Chemistry - Conduct chromatography, combustion, and polymer chemistry activities in a **UNIVERSITY LAB!**
Physics - Design hovercrafts, run electricity experiments, study and experience amusement park physics, and explore motion using motion detector probe technology.
Astronomy - Build a planetarium, tour UBC's telescope, and experience weightlessness while **SCUBA DIVING!**
*Also enjoy...*two pool sessions, daily outdoor games, guest speakers and the fabulous physics show.





Academic Programs

Engineering Physics at UBC

...Turn Ideas into Reality...

Engineering Physics at UBC is a **challenging interdisciplinary degree** designed to train those who wish to work at the **leading edge of scientific and technological innovation**. By applying the fundamentals of physics with the practicality of engineering, our students are given the skills to become tomorrow's inventors, technology leaders, discovers of new science, and developers of new medical techniques.

The Engineering Physics program combines an **Honours Physics degree with an Engineering degree in Electrical, Mechanical, Computer, or Mechatronic options**.

For more information, please visit: **www.engphys.ubc.ca** (or see the brochure included)
Or, contact the UBC Engineering Physics Program
Tel: 604-822-6451; Fax: 604-822-5324
Email: **andre@physics.ubc.ca** (Director Andre Marziali)

Passionate about Science but concerned about big first-year classes and impersonal teaching? Consider:

UBC Science One Program

An Integrated First-Year Science Program at the University of British Columbia

Program Features:

- Integrated Science
- 1st Year (both terms)
- 72 students
- 8 faculty members
- 25 credits
- Small-group learning
- Proven results

Observe... the natural world and universe around you

Describe...use mathematics to speak precisely about the world around you.

Understand...experience the joy of insight

Synthesize...use fundamental principles to form a wholistic view of the subatomic realm, chemical reactions, genetics, ecology, climatology and cosmology.

Apply...what you have learned to entirely new situations.

Learn...how to learn

Think...like a scientist

Become...a scientist

For full information and application webform: www.scienceone.ubc.ca

You will be asked to write a short essay describing your passion for science.

A separate application to the UBC Faculty of Science is also required.

Academic Requirements:
BC Math12, Phys12, Chem12, Biol11, or 12 (or equivalents). Calculus 12 is an asset.

Questions? Email Lucia Balabuk at **science1@interchange.ubc.ca**

TRIUMF Free Teacher Internships (British Columbia)

Secondary school teachers from anywhere in BC are invited to **TRIUMF** for a p**rofessional development opportunity** not to be missed!

You get:
- 3-7 days at TRIUMF, **a world-class subatomic physics research laboratory**, to take part in a live subatomic physics experiment
- Travel to/from TRIUMF plus meal costs covered by our travel grant
- Subsidized room (if necessary) at nearby TRIUMF House
- **NEW this year:** subsidy for substitute teachers for locals not requiring travel or housing

We ask:
- Only that you provide a teaching resource based on your experience

What a deal! Internship positions are available for Spring and Fall 2008

For more information, contact: TRIUMF Outreach Coordinator
Tel: 604-222-7525; Fax: 604-222-1074; Email: **outreach@triumf.ca**
http://www.triumf.info/

Academic Programs

The New PHYS 100 – Andrzej Kotlicki

The recent public revelation that global warming is upon us is beginning to swing the momentum back toward to the physical sciences from the life sciences that have held the public imagination for the past couple of decades. Among the physical sciences, earth and ocean sciences and physics lie at the centre of the focus. The first brings the problem to the table, and the second hopefully will bring a solution, either by finding new sources of energy or new ways to use our existing resources more efficiently.

This renewed focus has driven changes in our outreach programs (for example, the theme of the department Faraday lecture in 2007 was "Energy and the Environment") and our curriculum, especially the introductory physics course, PHYS 100.

This introductory physics course is taught with strong connections to real-world examples of conservation of energy, energy consumption, and sustainability. We teach the concept of conservation of energy in the context of home heating and the Earth's energy balance. We introduce the concepts of dynamic equilibrium and feedback which are necessary to understand the physics of the Earth's climate.

We teach kinematics in the context of transportation and associated energy consumption and fuel efficiency, drawing connections to earlier ideas of energy and environmental impact. We cover basic concepts in electricity such as voltage, current, and resistance in the context of home wiring, transmission lines and electrical energy savings. We discuss various methods of electrical energy generation and various sources of electrical energy.

By making explicit connections between the course materials and examples of everyday physics we hope to increase the students' ability to see physics happening in the real world, and to generalize their knowledge outside of the classroom.

The lab and tutorial sessions were changed from biweekly to weekly which has two main benefits: It enables better synchronization of the lectures with the lab and tutorial material, and it allows us to schedule the same graduate student Teaching Assistant (TA) with a particular group of students in both lab and tutorial each week. We hope that this will improve the interactions between the students and their teaching assistant and facilitate more questions and discussions during the laboratory and tutorial sessions. During tutorial time students work in groups of four on context-rich problems, similar to those developed by Heller and colleagues at the University of Minnesota.

These problems consist of an explanation of a real-world problem or challenge, and are structured to reinforce the development of a structured problem-solving methodology. Periodically a tutorial test is given, which is worked on and marked in the student groups.

For the first time, the students are also required to present a final project in a ten-minute talk. The students prepare the talk in small groups on a topic of their choice that is related to the course. In particular, the students should attempt to answer a scientific question quantitatively or find reasonable estimates.

As an example, a possible topic is the question of how much energy would be saved if all households in British Columbia switched from incandescent light bulbs to compact fluorescent lights. In summary, the tutorials focus on context-rich lifelike situations and emphasize teamwork, and communication skills that are both crucial skills in the job market and in life.

The labs have been altered to increase student engagement by focusing on learning the material before the lab and making predictions. In this way the labs more closely follow the scientific method: to make predictions, to build and test models and to draw conclusions.

This year a general departmental teaching assistant training was introduced which stresses student-centered teaching methods such as teaching by questioning (Socratic questioning), use of structured problem solving techniques and helping students to make connections between their course materials and their existing knowledge.

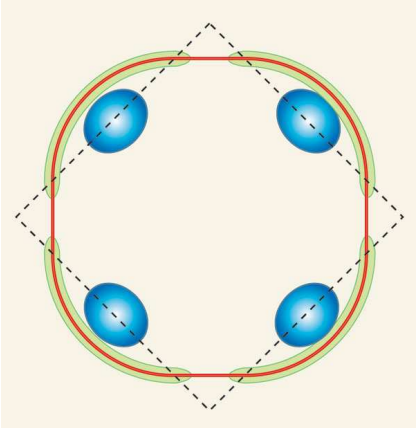
The methods introduced in the TA training are reinforced through weekly TA meetings and the introduction of a Mentor TA program. The weekly TA meetings increase communication between the TAs and faculty, allow TAs to reflect on their teaching experiences, and provide a forum to discuss specific approaches for teaching the upcoming lab and tutorial sessions. The Mentor TAs are senior TAs who help to train and support TAs in developing their teaching and also assist faculty to develop the course content, tutorial and lab problems.

All told we hope that these changes to our introductory physics program will help to inform a new generation of leaders for British Columbia and beyond by fostering critical thinking on possibly the most pressing issue of our time.

The initial idea of these course changes was formulated during discussions with Chris Waltham who introduced similar changes in Science One. The implementation was the result of the effort of course faculty (Fei Zhou, Georg Rieger and myself), mentor TAs (Sandy Martinuk, Joss Ives and Melanie Gendre), lab coordinator (Evert Koster) and lab technician (Joe O'Connor). Sandy Martinuk was conducting reasearch on the effect of the course changes with a lot of advice from Carl Wieman. Discussions with Marina Milner, who was teaching the course last year, and with Fran Bates influenced many of the lab changes.

Andrzej Kotlicki is course coordinator for PHYS 100 and spearheaded the revitalization of this cornerstone course in our curriculum

High T_c @ UBC



The Fermi surface in $YBa_2Cu_3O_{6.5}$ In an ordinary metal the Fermi surface is simply connected (solid line), but in the underdoped cuprates it is split into several regions (light grey or dark grey areas).

A team of University of British Columbia researchers has contributed to the greatest advancement in superconductor research in a decade by "growing" the purest samples of superconductors to date.

Superconductors are a class of materials that conduct electricity with no resistance. They are already used in MRI medical imaging scanners, levitating trains, and power lines. High temperature superconductors have no resistance at temperatures as high as –140 degrees Celsius, but advances in this area have been stalled due to a lack of understanding of their fundamental properties.

"Up to now, it was unclear whether these materials were metals or insulators," said UBC Physics Prof. Douglas Bonn, adding that the materials are extremely sensitive to contamination -- the slightest trace of dirt or impurity can alter their properties completely.

"We were able to supply our collaborators with the purest sample ever developed, leading to the discovery of quantum oscillations," said Bonn. "This provides unequivocal proof that these materials are metals."

The UBC team also includes Prof. Emeritus Walter Hardy and Materials Scientist Ruixing Liang.

Findings of the project, led by Université de Sherbrooke physicist Louis Taillefer and involving researchers and funding from the Canadian Institute for Advanced Research (CIFAR), are published in the journal Nature. The experiments were carried out at the National Pulsed Magnetic Field Laboratory in Toulouse, France.

"The results are crystal clear," said Taillefer. "High-temperature superconductors were discovered in 1987, and only now do we finally have concrete knowledge about their deep nature. This discovery gives both theorists and experimentalists something real to work with."

The experiment determined that high-T_c superconductors like metals have a Fermi sea of filled electron states. Furthermore the experiment estimated the size of the sea. The purity and regularity of the UBC-produced sample was key to the measurement.

In metals electrons fill energy levels up to a certain point, the surface of the Fermi sea. The crystalline structure of the material and any correlations between the electrons determine the topography of the sea floor and therefore the shape of the coastline of the Fermi sea. This Fermi sea exists not in real space but the space of the possible velocities that the electrons can take, and if the sample is not pure and regular its structure can vary from place to place.

The UBC sample of $YBa_2Cu_3O_{6.5}$ was not only unique in its purity and regularity of its crystalline structure, but also regular on larger scales. The extra oxygen atom per two formula units was also distributed regularly, making for a clear structure for the Fermi sea.

The experiment literally measured the coastline of the sea. A strong magnetic field applied to the sample forces the electrons to lie in Landau levels effectively breaking up the Fermi sea into droplets. As the field is increased, the number of droplets decreases, and whenever a droplet of Fermi sea disappears the conductivity of the sample varies dramatically; therefore, by counting the wiggles in the conductivity as the field increased, they counted the droplets and measured the size of the Fermi sea.

Strong magnetic fields are required to break up the sea into only a few droplets so the oscillations are visible. Thermal fluctuations effectively add a spray above the Fermi sea and crystalline impurities change the contour of the sea from place to place in the sample. Both cloud the measurements; consequently low temperatures (two degrees above absolute zero, well below the transition temperature) and ultra-pure UBC samples are required.

They found that the Fermi sea was much smaller than expected and furthermore, the sign of the oscillations was the opposite of expectations. This may be because the samples were underdoped relative to the samples used previously, but regardless, it means that there is still more to understand about this intriguing material, and the UBC effort to produce samples will still play a central role in the study of high-temperature superconductors.

Despite their name, high-temperature superconductors cannot function in temperatures higher than 100 degrees Celsius below zero. The discovery brings scientists one step closer to the ultimate goal of creating room-temperature superconductors, which could result in laptop-sized MRI machines, loss-less power lines, and vast improvements in computers and wireless communications.

Source: UBC Press Release, *Nature*