

Physics matters

Our Distinguished Speakers

The Science Faculty, NUS, has been the proud host for a number of prominent speakers in a series of public lectures since the beginning of the year.

Prof **Jocelyn Bell Burnell**, Visiting Professor at Oxford University, was here for an event called **Rhapsody on an Equatorial Evening** jointly organised by the NUS Centre for the Arts and the Physics Department in conjunction with the Science Faculty's 80th Anniversary celebration. The first female physicist to be conferred the IPS Honorary Fellowship award, Prof Bell is an accomplished radio astronomer who discovered pulsating radio stars or pulsars. She enthused her audience with talks on these bizarre and incredible objects in the universe which have stretched our knowledge of the behaviour of matter and also served as clocks to test Einstein's theories.

Prof **Richard Henry Friend** is the acknowledged pioneer and

leader of the science and technology of polymer organic semiconductor devices. A Cavendish professor with Cambridge University, Prof Friend also has strong research links with the university. His talk **Plastic Electronics for Large Area Displays and Solar Cells** focused on the challenges and prospects of new applications for polymeric semiconductors. The impact of new technology will prove immensely useful, like lowering the production cost of semiconductor circuits.

Ever wonder what the universe's thinnest material and also the strongest ever measured is? It's called graphene. Its discoverer was Prof **Andre Geim**, Langworthy Research Professor at the University of Manchester, a prolific researcher in materials science and condensed matter physics. Graphene exhibits high charge mobility as well as current densities (million times higher

than copper). In **Graphene, Magic of Flat Carbon**, Prof Geim inspired his audience with his passionate sharing about graphene's fascinating electronic and optical properties as well as speculations about future applications.

Recipient of the Nobel Prize in Physics (2007) together with his colleague, Prof **Peter Gruenberg** from the Institut für Festkörperforschung was honoured for his discovery of giant magnetoresistance (GMR). The GMR effect led to a breakthrough in gigabyte hard disks, now found in every computer. It also created an entirely new research area known as spintronics, which holds applications in micro and nanoelectronics. Prof Gruenberg's talk on **Spintronics and its Applications** truly spun his audience's minds into the future promises that fundamental research and novel technology hold. Prof Gruenberg was also conferred the IPS Honorary Fellowship award.

Inside this issue:

Physics Enrichment Camp 2009	2
Exchange Programme	3
Physics in Action	4
Awards	4
Discovering Physics	5
Conference News - ICMAT 2009	6
A Day in the Life of...	6
Our Graduating Students	7
News from the NUS Physics Society	8
Announcements	8

A Word from the Head of Department

It gives me great pleasure to announce the advent of our biannual newsletter – *Physics Matters*. I would like to first of all thank the publishing team for their commendable efforts!

You may see the Physics Department as huge given the amount of activities it engages in. However, looking at our enrolment size, we are small by the university standard. This facilitates greater interactions of staff and students. Indeed many students have benefitted from such close relationship, but I

believe there is still much room for improvement! I hope this newsletter will link us up further and create a deeper sense of identity with one another and the department.

This newsletter serves to acquaint staff and students on matters of the department, with emphasis on issues close to the hearts of our students. I hope you will enjoy reading it and find the contents relevant to you. Everyone in the department is welcome to contribute to the newsletter!

Let us all work together to provide a wonderful educational experience for our students!

Prof Feng Yuan Ping
Head, Physics Department



Physics Enrichment Camp 2009

The Physics Enrichment Camp is an annual event organized by the Physics Department with the aim of reaching out to junior students with the message that physics is fun.

Into its 13th year, the Physics Enrichment Camp 2009 was held from 4 – 5 and 8 – 9 June, and attracted over 600 participants from 20 secondary schools and 10 junior colleges.

On the first day, faculty from the department presented three talks, the topics of which ranged from particle physics, nanoscience to astrophysics. The passionate sharing by the physics faculty indeed aspired young minds to pursue deeper knowledge in physics.

**THE STUDENTS
WERE
INTENSELY
ENGROSSED IN
THE ACTIVITIES
AND HAD FUN AT
THE SAME
TIME ...**

Students enjoyed the sumptuous buffet lunch prepared for them. In the afternoon, they were engaged in a series of hands-on activities, mechanics experiments and interactive sessions with student demonstrators.

The hands-on activities involved racing yttrium barium copper oxide (YBCO, a high temperature



superconductor) on magnetic track. In the Cartesian diver competition organised by the Physics Society, students had to think about making a controllable Cartesian diver.

The students were intensely engrossed in the activities and had fun at the same time as they tried to outperform their opponents. Indeed learning through games was the primary objective and winning was just secondary!

A quiz was organized on the second day. The students participated actively and were enthusiastic about solving every puzzle. Handsome prizes and trophies awaited the winners who at the same time brought home their big smiles!

We received positive feedback from the students themselves and their teachers at the end of the camp. This would not be possible without the support of faculty, lab officers and student demonstrators.

We strongly believe that the students have gained considerably through the sharing, lab tours, demonstrations, hands-on activities, competitions and quizzes. Hopefully they also experienced for themselves the lighter side of physics!

The physics department without doubt looks forward to organising the next camp so that once again it could arouse young minds in physics!

*Contributed by Chang Sheh Lit,
an honours-year physics major*



Exchange Programme

At the point of writing this article, I was on the coach bus to Cambridge University for a visit. Seeing the green summer plains and static cows passing by while the coach flew down the highway brought back to my mind the many rich ETH Zürich memories. I had just completed my last examination and should be feeling elated as I embarked on my tour around Europe. However, I found myself having mixed feelings about leaving ETH Physics.

I missed the rigorous mathematics laden lectures and blackboard style oral examinations from which I had gained enormously. The ETH students are brilliant in mathematics due to their demanding mathematics curriculum in their first two years as undergraduates. In one graduate module I took, the graduate students were extremely active in initiating group discussions among classmates. I volunteered for a presentation on the non-classicality of quantum theory.

I also had a chance to visit CERN in the capacity of a novice high-energy experimentalist and it was definitely an unforgettable experience! I still vividly remembered taking bus "CERN" towards its main entrance. Deep down within me I was expecting to see the world's largest science laboratory in its full glory swarming with scientists and engineers. After all, this much hyped laboratory holds the future promises for understanding our universe!

Upon alighting from the bus, what I saw before me was instead a place very much like the United Nations headquarters, solemn and discreet. Not that I wasn't aware of the famous LHC tunnel (27km in circumference!) beneath my feet, rather, intuitively, I was expecting a place bustling with activities and enthusiastic followers of science. But I had yet to witness the best ...

Soon after, Prof Regenfus, my course professor, met and drove me to the laboratory where I was introduced to his group of scientists who were working on their search for the Higgs and dark matter particles. What amazed me here were the diversified roles played by the scientists who could be physicists at one instant but electronics or chemical

Group discussions on QIT



At CERN's 14-TeV Large Hadron Collider, LHC



The new AeqIS in construction



engineers or data analysts next.

My attention was also drawn to their new and upcoming experiment called "AeqIS", which is an attempt to measure the gravitational coupling to anti-hydrogen. If there is really a difference in the coupling strength to anti-particles, then one may be able to ascribe an additional quantum property to relate gravity and electromagnetic forces in a similar fashion to weak isospin.

Lastly, I would highly recommend any physics student to do an SEP with ETH Zürich to be further exposed and gain valuable insights on how physics is viewed in another part of the world. You will be assured of an entirely different school of thought and become richer in physics.

Contributed by Charles Lim Civen, an honours-year physics major who was on an exchange programme at ETH (Swiss Federal Institute of Technology) from January to August 2009



Physics in Action

Material Physics Made Alive in the Kitchen!

Wheat flour contains proteins called gluten. When water is added and the mixture is kneaded to form dough, the gluten molecules cross-link to form a sub-microscopic network that gives rise to the elastic nature of the dough. One can then perform a series of test to study the material characteristics of the dough.

This idea dawned upon us while we were designing a practical term project for the general education module GEM2507 Physical Questions in Everyday Life. As the module title suggests, we would like the project to be affordable, typically reproducible in any household kitchen and incorporate elements commonly found in daily life.

On the other hand, we also wanted to introduce the element of research and scientific methodology into the project at the same time. We were not looking for so-called "correct" results or conclusion. Rather, we encouraged students to place emphasis on the creativity, experimental design and thoroughness in the execution of experimental techniques.

In the project, students were instructed to prepare the dough with different water-to-flour volume ratio. The dough was then rolled to form dumpling skins of various thicknesses. Three experiments were performed on the dumpling skin to measure its toughness, hardness and tensile strength. The details of the procedures were described in our published article.

Further investigations could be carried out with the addition of extra materials like shredded papers, nylon strings, hairs or cotton wool to the dough. This would expose students to the concept of composite material. Similar tests were then repeated, and the results could be compared with the ones without the composites (see figure).

Students had found their project to be creative and educational. They had fun engaging themselves in every stage of the project, from the making of the dough, gathering of experimental data, interpretation of results to the drawing of inferences. They were given minimal instructions and a lot of freedom in designing their experimental procedures.

The benefits of the project were clearly evident by the students becoming highly motivated experimentalists as they explored how to turn physics into action and at the same time discovered the truths of what they had been learning in class!

The full article of this condensed version appears in Physics Education, 44, 180-183 (2009).

The abstract is available at <http://www.iop.org/EJ/abstract/0031-9120/44/2/010/>

Contributed by Mr Andreas Dewanto, Instructor and Dr Roland Su Jong Hea, Senior Lecturer



Awards

Professor Tang Seung Mun, currently the Vice President of Nanyang Academy of Fine Arts, received the IPS President's Medal. He made outstanding contributions in leadership when he was the Head of the Physics Department, NUS, and also in research at the Centre for Ion Beam Applications, CIBA, NUS.



Professor Vedral Vlatko from Wolfson College, Oxford University, received the World Scientific (Physics Research) Medal and Prize for his outstanding contributions to Quantum Information research at NUS which has received international recognition. He is also Centenary Professor of Quantum Information Science at Leeds University.



Assistant Professor Chen Wei received the IPS Omicron Nanotechnology Medal and Prize for his outstanding research in molecular electronics, organic electronics and graphene-related devices at NUS which has received international recognition. He was also a Lee Kuan Yew Postdoctoral Research Fellow.



Discovering Physics

Phononics: An emerging science and technology in processing information with phonons and controlling heat flow

Electrons are used daily in information processing. Indeed, it is almost impossible to function normally in our modern life without the use of a variety of electronic devices like mobile phones and computers. Very soon, phonons or heat pulses rippling through a crystal might also become a major carrier of information.

My team and I at the Centre for Computational Science and Engineering have demonstrated this possibility using different theoretical models for thermal devices such as thermal diode and thermal transistor.

Indeed, by combining thermal transistor in different ways, one can build up thermal logic gate (Phys Rev Lett 99, 244101 (2007)), which opens up the possibility of using heat energy already present in abundance in electronic devices to process information and even

to perform computation. Moreover, we have also demonstrated that phononic information can be read and stored in phononic memory (Phys Rev Lett 101, 267203 (2008)).

The more important application of phononics is in the control of heat flow. The phononic devices mentioned above

can be used to manipulate and control heat flow which will be extremely useful in devising functional and energy saving material. This will certainly revolutionize the consumption of thermal energy by mankind.

Our discoveries have been featured in leading journals and publications such as Physics News Updates (APS), Physics World, Science News, New Scientist, PhysOrg and Lianhe Zaobao. This emerging science and technology in processing information with phonons and controlling heat flow has been coined "phononics" by the Physics World magazine. NUS is thus considered the birth place of phononics.



Measurement setup for our research in phononics

Contributed by Prof Li Baowen
Director, Centre for Computational
Science and Engineering



About Prof Li Baowen:

Prof Li obtained his BSc from Nanjing University, MSc from the Institute of Acoustics, Chinese Academy of Science, Beijing. He did his PhD in Germany after receiving the Max-Planck Scholarship and within two years, he got the Dr.rer.nat degree from the Universität of Oldenburg. He joined the Physics Department, NUS, in 2000 as an assistant professor and was promoted to associate professor with tenure in 2003 and then full professor in 2007. He is currently the Executive Director of the NUS Graduate School for Integrative Sciences and Engineering and also Director of the Centre for Computational Science and Engineering.

Prof Li has published more than 110 papers in refereed journals including 19 in Phys Rev Lett. He has delivered more than 110 keynote speeches and invited talks and is a recipient of multiple awards (NUS Young Researcher Award (2003), Temasek Young Investigator Award (2004), National Science Award (2005), Overseas Chinese Physics Association (OCPA) Asia Achievement Award (2005) & IOP World Scientific Prize and Medal (2007)).

Prof Li also holds professorship with Nanjing University and is a guest professor at both Beijing Normal University and Huazhong University of Science and Technology. He is also advisory professor at East China Normal University.

His research interests include but are not limited to heat conduction in low dimensional systems, energy transport in nanoscale materials, thermoelectric effect in nanostructures, effect of

quantum chaos on quantum computation, complex networks and systems biology, non-equilibrium statistical mechanics, inverse scattering problem, waves propagation and scattering in random/turbulent media. In collaboration with Prof J. Thong from the Electrical and Computer Engineering Department and Prof Barbaros Özyilmaz from the Physics Department, Prof Li's team is also conducting experiments on different thermal (phononic) devices.



Prof Li Baowen (seated in the front row) and his team. Currently there are 20 PhD students, 10 postdoc, 2 visiting professors, 1 UROPS student, 3 high school students and 3 visiting scholars in his lab.

Conference News - icmat2009, Suntec Singapore, 28 June to 3 July

The 5th International Conference on Materials for Advanced Technologies (ICMAT) attracted over 2000 participants from 50 countries. 23 symposia covering contemporary topics of importance for the science, engineering and technology of materials were held. About 50 international exhibitors also showcased their products and equipment.

Opening Ceremony



from left: Prof Tan Eng Chye, Deputy President (Academic Affairs) & Provost, NUS, Dr Ng Eng Hen, Minister for Education and Second Minister for Defence, Prof B.V.R. Chowdari, Executive Director, NUS-India Research Initiatives and GEM, Prof Howard E. Katz, President, IUMRS, Johns Hopkins University

Prize Presentation



from left: Prof Andrew Wee, Dean of Science, NUS, Nobel Laureate Prof Peter Gruenberg, Nobel Laureate Prof Peter C. Doherty, Prof George Radda, Chairman of BMRC, A*Star, Prof B.V.R. Chowdari, Executive Director, NUS-India Research Initiatives and GEM



A plenary session



Panel discussion



Exhibition showcase

A Day in the life of ...



Mr Choo Theam Fook is a familiar face in the Physics Department. As he himself chirped,

"I have been with the department for as long as Singapore's independence." A Laboratory Technologist, Mr Choo's

main responsibility is to maintain the 3.5 MV Singletron in working order to facilitate research using its ion beam.

A typical day for Mr Choo involves checking that all facilities are in functional order in the CIBA (Center for Ion Beam Applications) laboratory. He will devote himself to helping any experimenter in need of setting the proton or alpha beam before getting on with other general technical and administrative duties. He also makes an effort to network with colleagues in the other laboratories in order to share knowledge and to be updated of happenings.

Ask Mr Choo what makes his day and his immediate reply would be to be part

of the CIBA team and working with the professors who are very passionate about their work. He finds great satisfaction too in knowing and working with researchers and graduate students from all over the world.

An avid sportsman of tennis and badminton, Mr Choo enjoys listening to Gold 90.5 FM and solving Sudoku puzzles. He's a great fan of Asian food especially Vietnamese cuisine. His favourite pastime includes having his fill of good food when travelling in Sydney. A friend of the environment, Mr Choo is always conscious about efforts to minimize damage to our habitat. He hopes everyone will, like him, take the message of the green culture seriously.

Our Graduating Students

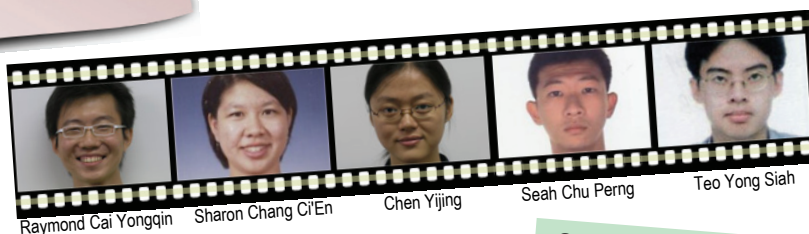
Our Honours Students

- 1 Cai Yongqin Raymond
Outstanding Undergraduate Research Prize and USP Scholar
- 2 Chang Ci'En Sharon
IPS Medal, Jurong Shipyard Prize and Outstanding Undergraduate Research Prize
- 3 Chen Yijing
Jurong Shipyard Prize
- 4 Seah Chu Perng
Jurong Shipyard Prize
- 5 Teo Yong Siah
Lijen Industrial Development Medal



*Congratulations
Class of 2009*

- 6 Adam Zaman Chaudhry
- 7 Chai Wee Jie
- 8 Chua, Cassandra Joyce Li
- 9 Harinder Kaur Dollie
- 10 Ho Tianyu, Basil Caleb
- 11 Ho Yew Hung Derek
- 12 Leng Yi Ren
- 13 Liew Meiqi Jacinth
- 14 Lim Jin Yi
- 15 Lim Jing Kai
- 16 Lim Yen Kheng
- 17 Lim Yoke Kuang
- 18 Lim You Ching
- 19 Lin Laiyi
- 20 Lin Nan
- 21 Lu Xin
- 22 Ong Qin-An Dominic
USP Scholar
- 23 Phoon Han Quan
- 24 Sim Yong Ming
- 25 Su Yingzhu Herbert
- 26 Tan Boon Sze Jackson
- 27 Tan Meng Ho
- 28 Tan Peng Kian
- 29 Tan Ting Rei
- 30 Tan Wei-En
USP Scholar
- 31 Tao Ye
- 32 Teng Po-Wen Ivan
- 33 Teo Zhan Rui
- 34 Wang Ning
- 35 Wong Swee Liang
- 36 Yao Yao
- 37 Yeo Cheng Leong Jaesson
USP Scholar



Our BSc Students

- 1 Chan Chee Sing
- 2 Chang Shao Chung
- 3 Chen Guanjie
- 4 Choo Hsu Fen Ivana
- 5 Chua Qing Jun
- 6 Kwek Liang Wei
- 7 Lee Yong Heng
- 8 Mohamed Faizal B Mohamed Yusuf
- 9 Mok Li Hui
- 10 Poh Jinn Yang
- 11 Tan Li Yong
- 12 Tanzin Iqbal Anik
- 13 Teo Chea Choon
- 14 Wu Jinfeng
- 15 Yasniati
- 16 Zhuo Limin

Our PhD Students

- 1 Ah Qune Lloyd Foong Nien
- 2 Binni Varghese
- 3 Chang Chew Wai
- 4 Dai Liang
- 5 Foo Pek Hui
- 6 Li Zhipeng
- 7 Lin Xin
- 8 Ling Euk Jin, Alexander
- 9 Lui Wai Yi, Lena
- 10 Tey Meng Khoon
Wang Gungwu Medal & Prize
- 11 Wang Zhikui
- 12 Zhang Ce
- 13 Zhang Jie
- 14 Zhang Zheng

Our MSc Students

- 1 Hong Zhenxi
- 2 Imam Makhfudz
- 3 Ravishankar Ramanathan
- 4 Suleni Tunggal Mulia
- 5 Yong Zhihua
- 6 Zhang Hongliang



News from the NUS Physics Society

Greetings from the NUS Physics Society! Also known as Physoc for short, we are a club led by a committee of 14 physics majors. Our presence serves the needs of any physics major and we also hope to bridge the gap between staff and students in the Physics Department.

Besides participating in matriculation fair and orientation every year, we also organize various events and gatherings (eg games challenge and mid-autumn celebration) in the department for both staff and students to mull about and mingle

around. Being undergraduates ourselves, we could understand the academic stress faced by any student and so, as an incentive to our physics majors, we provide solutions to past-year physics exam papers as well!

Physoc is always open to anyone – from one who needs to find his/her way around in campus, to another who needs academic advice to still another who needs just a listening ear. Of course, we offer assistance only wherever we can; if not, at the very least, we will direct you to someone whom we think might be

able to offer you help!

Physoc welcomes all Physics majors to join us! For those of you who like to know more about us, you're welcome to pop by our function room at the Science Faculty, Blk S13, 02-08. Or, if you take the elevator located between Blks S12 and S13 and stop at level two, you could just look straight out and smack right in front of you is the Physoc notice board!

Admittedly, we still have loads to learn. Thus, we'd welcome advice from anyone. We don't promise to assimilate every suggestion brought to us, but we will definitely think it over.

Do help us improve Physoc! Feel free to check out our web: www.physics.nus.edu.sg/~physoc or email us: nusphysoc@yahoo.com any time!

Contributed by Angeline Shu,
Secretary, NUS Physics Society



Mooncake festival celebration



Staff & Student games



Chinese New Year celebration



Announcements

Field Trips:

Friday Stargazing Sessions

Venue: NUS Football Field

Dates: 28 Aug, 18 Sept, 16 Oct, 6 Nov

Time: 6.30 - 10.30 pm

Weekend (2D2N) astronomy trips to Punggai, Johor, Malaysia

Contact:

A/P Phil Chan

phycabp@nus.edu.sg

or Dr Cindy Ng

phynsc@nus.edu.sg



Public Lectures:

Talks by Lord Martin Rees (LKY Distinguished Visitor)

24 & 27 Aug

Register at www.lkydvp.sg

Conference in Honour of Prof Murray Gell-Mann's 80th Birthday

24 - 26 Feb 2010

Register at:

www.ntu.edu.sg/ias/upcomingevents/GM80Conference



Any comments or suggestions
send to:
Lydia (phylampf@nus.edu.sg) or
Phil (phycabp@nus.edu.sg) or
Siew Lee (phykohst@nus.edu.sg)



We're on the web!

www.physics/newsletter/newsletter.pdf