

Physics Matters

Higgs, Hip, Hooray!

It all began with a quest by physicists to understand the origin of mass for some fundamental particles though they should be massless theoretically. In 1964, the Belgian physicist François Englert from the Université Libre de Bruxelles, Brussels, and his colleague Dr Robert Brout (who died in 2011) and the British physicist Peter Higgs from the University of Edinburgh proposed a mechanism that addressed this fundamental issue.

Both Dr Englert and Dr Higgs won the Nobel Prize in Physics 2013 “for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN’s Large Hadron Collider”.

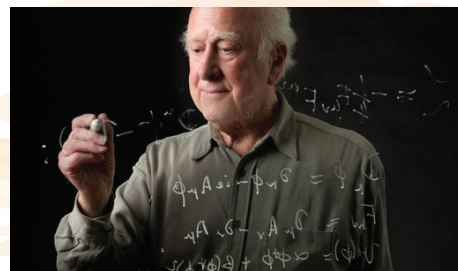
The Higgs boson is the last missing component of the Standard Model of physics that describes the fundamental make-up of the universe. The Higgs field has been likened to a kind of cosmic molasses, dragging on particles as they move through it. Particles that interact with the Higgs field have mass. Without the Higgs mechanism, all particles would travel at the speed of light and atoms would not exist.

Almost half a century after the first prediction, the existence of the “God particle” (as sometimes popularly coined) was finally detected in 2012 at CERN’s giant, underground particle collider near Geneva. The project to hunt for the elusive particle proved an arduous journey and involved more than 6,000 physicists and cost over US\$10 billion.

In conjunction with the Nobel Physics Prize announcement, Dr Albert De Roeck, a senior research scientist and staff member at CERN, delivered a talk on “The Higgs Boson at the Large Hadron Collider (LHC)” at the department on 29 Oct 2013. Dr De Roeck shared about the implication of the discovery and the CMS and ATLAS experiments at CERN.

The Institute of Advanced Studies (IAS), NTU, organised a Mandarin public lecture on “God Particle” on 2 Nov 2013. Prof Phua Kok Khoo (Director, IAS, NTU) and Prof Oh Choo Hiap (Physics Department & CQT, NUS) discussed the historical background, theory and impact of the Higgs discovery on science, culture and technology, as well as the future directions of high energy physics.

The Higgs discovery is surely a cause for celebration for scientists as it has brought them closer to unlocking the mystery of the universe. Indeed it’s Higgs, hip, hooray!



↑ Portrait of Peter Higgs, during a visit to CERN in 2008.

Photo: Claudia Marcelloni. Copyright © CERN 2007
Kindly provided by CERN



↑ François Englert visits the ATLAS cavern.

Photo: Claudia Marcelloni. Copyright © CERN 2007
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Department of Physics



↓ Public lecture by Prof Phua Kok Khoo and Prof Oh Choo Hiap



↑ Dr Albert De Roeck delivering his talk at the department

Physics Induction Workshop, 22 January

“Envision your journey from a physics major... to a physicist...”

At the advent of this semester, the department, for the very first time, organised an Induction Workshop. The workshop was intended at guiding our physics majors on how they can widen their perspectives and step up their performance in their undergraduate studies.

Students got an opportunity to interact with six professors from different fields of expertise. Some professors addressed topics concerning the core aspects of physics like ‘How to approach the theoretical and experimental aspects of physics?’, ‘What should be kept in mind while doing NUS physics modules’ and ‘Is philosophy relevant in science?’. Other professors spoke on the ‘Career prospects for physics majors’ and ‘Opportunities offered in NUS to bridge the career gaps’.



↑ Participants at the Physics Induction Workshop

Through the workshop, students got a chance to glimpse at their journey both as physics students and as physicists. To lighten the atmosphere, the Physics Society held a Physics Trivia Quiz and gave away exciting prizes to the audience.

The feedback received from students has been positive. Having created this platform, the department would like to encourage more student-staff interaction so that the student community can benefit from it. For any suggestion or feedback, please contact Hariom Jani (phyhkj@nus.edu.sg).

Visit by Nobel Laureate Prof Anthony Leggett



↑ Prof Leggett with students at the dialogue session

The department was delighted to host Prof Anthony Leggett at the beginning of the year. Here in Singapore also to attend the 6th International Science Youth Forum organised by NTU, the Nobel Laureate is a familiar name in the department, being its Distinguished Visiting Professor since Jul 2007.

During his visit here, Prof Leggett had a dialogue session with students on 17 Jan. Also the speaker at the Condensed Matter Seminar Series on 22 Jan, Prof Leggett delivered a seminar on the prospects of topologically protected quantum computing. Prof Leggett's sharing sessions had been valuable and both staff and students will gain from his insight.

The Spark is Back!



↑ PhySoc President (center) with speakers Laurencia and Zhong Hao

Spark the Gap—the forum for physics students—was back for a second run! Organised by the NUS Physics Society (PhySoc), the second forum held on 21 Oct 2013 saw a shift in venue from the former Physics conference room to LT 26. The titles presented were ‘Physics in Science Fiction’, ‘Econophysics’, the GEK module ‘Sky and Telescope’ and the ‘Germany Immersion Trip (GIT) 2013’.

Mr Alpin Novianus Tatan, the current President of PhySoc, shared with *Physics Matters* how he felt students could gain from the forum: “I think the audience will benefit from the exposure to various fields in physics available in NUS. They also learn about interesting modules the department offers and enhancement programmes such as the GIT. Students could then better plan their studies to take advantage of the options available to them.”

He hopes with better publicity the next round, attendance would go up especially among junior students. PhySoc is also exploring the possibility of getting faculty members to be the forum speakers.

Physics Graduates Symposium 2013

The department welcomed 40 new faces at the Physics Graduate Symposium 2013 cum briefing for new graduate students on 6 Aug 2013. An important event for graduates, it is hoped that the symposium will provide a platform for graduates to share their research works and also to boost the research enthusiasm among graduates.

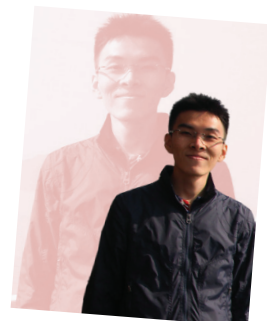


↑ Some graduates enjoying lunch at the symposium

What I learn about Physics...

This is the second of a two-part series (the first part appears in the Jul 2013 issue) featuring the views of non-physics majors who took the GEM and GEK modules offered by the department last semester.

Einstein's Universe and Quantum Weirdness has been one of the most engaging modules I took. With a two-pronged approach that involves learning physics from both a scientific and philosophical perspective, it slowly but surely debunks the myth that physics is a subject heavily based on maths. Behind the complex equations and bizarre observations, there is almost always a philosophical foundation that inspires and drives the scientist. At times, the philosophy is of primary importance, whereas the maths is simply a numerical representation of it. It seems physics is not a most popular choice for a music student. However, it is very applicable to many peripheral areas of music. Einstein's theory of relativity can be easily applied in many related fields such as acoustics and hearing science.



Chung Kang Rui Conrad, YST Conservatory of Music

"I have always pondered over my wish 'how great it would be if energy were free'. When I started searching for electives to take in Semester 1, the module *Clean Energy and Storage* caught my attention immediately. This module introduced me to many methods of clean energy production and storage which I had previously not known. As an environmental engineering student, I have always worked towards the goal of a more sustainable future. Through this module it is really reassuring to have learnt that so many people are working on clean energy production to make the world a better place to live in.

Goh Kai Ren, Faculty of Engineering



Whenever friends mentioned to me that they major in Physics, I would inwardly go "ick". I never understood that dazed distant smile on their face till I took *Remote Sensing for Earth Observation*. Through it, I discovered a plethora of quirky but intriguing things I had never thought of before, like "Why are typhoons named after people?" or "Can satellites be used to spy on others?" I had to re-engage myself with some mathematical manipulations to understand how satellites function. It took arduous work, but I nevertheless found unexpected joy in discovering how these physics formulas lead to startling miraculous inventions, and that I could still manoeuvre through alien-looking formulas despite being out of touch!



Lee Li Fang, School of Design and Environment

The *Physics in Life Sciences* module was anything but enriching and I am very glad to have taken it. Being the first GEM that I took in NUS, I did not have very high expectation but all the classes were surprisingly enjoyable. Many business students like me would shun from a module that involves physics, chemistry and biology. But if you wish to see how these are interconnected in many aspects of life then this module would be very rewarding for you. This lecture has strengthened my scientific perspective on things and made me appreciate the subtle processes that make the world go round.

Marissa Bte Mohd Fuad, School of Business



Having an interest in astronomy, *Sky and Telescope* has been one of the most enjoyable modules I took. I gained hands-on experience in finding out how the sky looks like, including things that cannot be seen with the naked eye. It is an enjoyable experience with learning physics as an additional benefit. I also learned how to take interesting photos of the sky and process them to make them fabulous. Now sometimes I will spontaneously bring out my binoculars to search for interesting stuff out in the sky.

Tan Kang Wei Lincoln, Faculty of Science



Three new GEK/GEM modules launched

GEK1536 Computation and Machine: Ancient to Modern

From ruler and compass, abacus, mechanical calculator all the way to the digital computer, students get to explore not only the ancient methods of computations in different cultures but also the workings of the modern computer. The future role of quantum computer is also discussed.

GEM1537 Nanotechnology for Everyone: From Smart Phone and Beyond - Shaping the Future

This module introduces students to the future smart phone, enabled by nanotechnology. The making, design and multiple functions of the smart phone are explored together with its business opportunities and social implications. Field trips to a number of cutting edge research facilities will be arranged.

GEK2508 Sky and Telescopes

Through this module students learn the movements of celestial objects, their properties and telescopic instrumentations. In addition, there will be astronomy field trips and observatory visits and students will learn how to read star charts, operate telescopes and take astro-photographs.

Physics in Action! Condensed Matter Physics and Materials Science at the Graphene Research Centre (GRC)

Prof Antonio H Castro Neto, Director of Graphene Research Centre (GRC), Science Faculty, NUS, shares his views on graphene research and accomplishments at GRC.

What is graphene?

Condensed matter physics is the cornerstone for the understanding on how materials behave electronically, magnetically and structurally, and hence, the basis for essentially everything that surrounds us today.

Graphene, an atomically thin crystal made out of pure carbon, was discovered by exfoliation of graphite using the so-called “scotch tape technique”. Since this discovery the field has evolved significantly to the production of graphene via more controlled techniques such as epitaxial growth and chemical vapor deposition (CVD).

Although graphene is one atom thick, it has the properties of a good metal, although its electronic properties do not fit the standard theory of metals. Graphene is also resistant against extrinsic impurities because its chemical bonding is very specific. Consequently graphene conducts electricity better than any other semiconductor, including Si, and even Cu. Moreover, graphene is one of the strongest materials ever measured. The only other material that is comparable in strength is diamond. Nevertheless it is one of the softest and the only example of a metallic membrane. It can be used as an ultra-sensitive nano-mechanical resonator besides being highly impermeable. Hence it is not surprising that so many industries are interested in developing graphene-based devices for a plethora of applications.

Harnessing graphene at GRC

With the advent of graphene a new field of research and technology was created—the field of two-dimensional crystals (2DC). Graphene is only one example of a large class of materials where the atoms bind strongly in-plane, forming 2D structures. These 2D crystals interact weakly with each other to form 3D bulk materials. Transition metal dichalcogenides, oxides, black phosphorus, for instance, are layered materials with unique properties such as magnetism and superconductivity, and that can be exfoliated or synthesized artificially into 2DC.

GRC is developing new synthetic methods to grow these materials, characterize them in situ, and develop new devices where these new materials can be used. This is a field still in its infancy and a lot of work, experimental and theoretical, is needed until we understand and ultimately control the properties of 2DC.

Theory vs experiment at GRC

Although GRC is still in its infancy, it has already written its name in some of the most important scientific journals and magazines. GRC in its 3 years of existence has surpassed 140 publications in high impact journals such as *Science* and *Nature*, with more than 1,500 citations.

In 2012 GRC researchers published in *Reviews of Modern Physics*, the highest impact journal in Physics, a manuscript entitled “Electron-electron interactions in graphene: current status and perspectives” which summarizes the theoretical knowledge of the effects of electron-electron interactions in graphene. This work represents in great part the theoretical effort at GRC in the last few years.

NUS cannot become a leader in science and technology if it does not develop theoretical science at the same level it has done with experimental science. Experimental science has obvious tangibles such as machines and laboratories, but theoretical science is more subtle as it deals with models and concepts. In fact, Singapore stills lags behind in terms of theoretical science and has essentially no international representation. GRC is working to change this situation.



↑ At the Graphene Research Centre (GRC)

An example of collaboration between experimentalists and theorists is the paper entitled “Colossal Enhancement of Spin-Orbit Coupling in Weakly Hydrogenated Graphene” published in *Nature Physics* **9**, 284 (2013). GRC experimentalists have been able to control the strength of spin-orbit coupling in graphene by adding minute amounts of hydrogen. Inspired by theoretical prediction (*Phys Rev Lett* **103**, 026804 (2009)), this work is having a tremendous impact in the field of spintronics using 2DC since the manipulation of the electron spin requires spin-orbit coupling which is absent in ordinary graphene. The journal *Nature* in 2012 has pointed out that NUS is one of the world leaders in publications in the area of graphene, surpassing universities in the USA and Europe.

In technology, the best way to predict the future is to create it. GRC is exploring science at its frontiers and creating new disruptive technologies that can have direct impact in Singapore's society by creating new markets and job opportunities.



Contributed by Prof. Antonio H Castro Neto

Discovering Physics: Magnetic oxides are more than fun

When you think of a magnet, the first image flashing in your mind will be pieces of iron nails or fillings stuck to a magnet. Magnetism in a solid such as iron stems from an interaction between the spins of electrons on neighboring atoms. The use of magnets in heavy duty motors to tiny toys and hard disk data storage are widely known, but the potential application of magnets in magnetic refrigeration, thermal power generation or drug delivery are not commonly heard of.

I am interested in creating new magnetic materials, oxides in particular, with multifunctional capabilities and understanding its fundamental physics behind. My current research includes ferroelectric electrical control of magnetism and vice versa, magnetically tunable strain and shape (magnetic shape memory alloys), magneto- and electroresistance, magnetocaloric and magneto-Seebeck effects. Our recent works related to the last two phenomena are briefly highlighted here.

A paramagnetic or ferromagnetic material heats up in a magnetic field and cools down upon removal of the magnetic field adiabatically. This is known as the magnetocaloric effect and its origin is related with a change in the magnetic entropy of the spin system by the external magnetic field. Paramagnetic salts such as ferric ammonium sulphate are used to attain milliKelvin temperature range. Due to environmental problem such as ozone layer depletion related to the release of chlorofluoro carbon (CFC) from home and industrial refrigerators, magnetic refrigerators are currently attracting a great attention.

The ferromagnetic metal gadolinium cools to -16°C in a magnetic field of 7 Tesla. However, gadolinium is an expensive material and easily oxidizes which reduces its performance after a few cycles. New magnetic materials are needed which can be used for magnetic refrigeration near room temperature as well as refrigeration over a wide temperature. We found that some of the manganese-based magnetic oxides show remarkable values of magnetic entropy change and identified different mechanisms contributing to the magnetic entropy change[1].

In a recent joint paper from Prof Wang Jian Sheng's and my groups, we reported the highest value of the magnetic entropy change ($\approx 40 \text{ J/kg.K}$) ever found in oxides[2]. The material investigated is $\text{Eu}_{1-x}\text{Ba}_x\text{TiO}_3$ ($x = 0$ to 0.9), which is ferroelectric and magnetic for certain Ba content. It is suggested that suppression of the spin entropy of $\text{Eu}^{2+}4f7$ spins by the external magnetic field is responsible for the observed giant magnetocaloric effect. Interestingly, we have also found colossal magnetoresistance and magnetodielectric effects in this series of compounds.

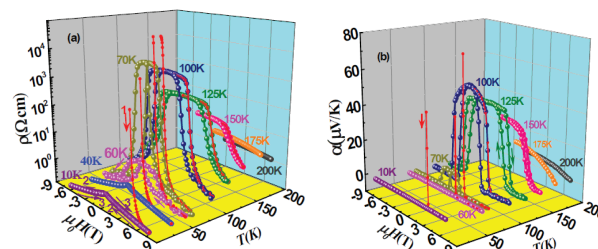
While the magnetocaloric effect is associated with cooling or heating of a magnetic substance, the Seebeck effect also known as thermopower refers to the generation of electrical voltage by a temperature gradient in a substance.

A thermoelectric device made up of p- and n- junctions can convert heat into electricity and it can also cool when connected to a voltage source externally. The latter phenomenon known as the Peltier effect is used in battery operated picnic cooler. Recently, the Japanese firm Sieko introduced thermoelectric wrist watches that make use of body heat as a battery.

In contrast to numerous studies of thermoelectricity in non-magnetic metals and semiconductors, thermoelectricity in magnetic oxides and the effect of magnetic field on thermopower have been scarcely studied.

In a recent publication, my student D V Maheshwar Repaka and I show the occurrence of a giant magnetothermopower in a magnetic oxide (Na-doped NdMnO_3)[3]. It is shown that the antiferromagnetic insulating sample transforms into a ferromagnetic metal upon application of a high magnetic field and such a transformation is accompanied by a change in thermopower value as much as 80 – 100%.

It suggests that heat transport is spin-dependent in this system, ie whether neighbouring spins align parallel or antiparallel. A close correlation between magnetoresistance and magnetothermopower was demonstrated suggesting that a common mechanism may be active. This phenomenon can be used for designing magnetically tunable thermal switches and thermal energy harvesting. The interplay between magnetism and heat transport is still poorly understood and is now perceived under the title of "spincaloritronics".



↑ Temperature and field dependences of (a) resistivity (ρ) and (b) thermopower (α) in $\text{Nd}_{0.75}\text{Sr}_{0.25}\text{MnO}_3$. Note that an abrupt decrease in resistance with increasing field is also accompanied by thermopower. Thermopower shows irreversible and reversible phenomena similar to the resistivity.

References:

- [1] V B Naik et al., *Appl Phys Lett* **98**, 112506 (2011).
- [2] Km Rubi et al., *Appl Phys Lett* **104**, 032407(2014).
- [3] D V Maheshwar Repaka and R Mahendiran, *Appl Phys Lett* **103**, 162408 (2013).

A/Prof Ramanathan Mahendiran's main areas of research are magnetic oxides, multiferroics, high-frequency magnetotransport, magnetothermal effects and spintronic materials. He obtained his PhD in experimental physics from the Indian Institute of Science (Bangalore, India) in 1997. Before joining NUS as an Assistant Professor in Feb 2005, he held positions at the University of Zaragoza (Spain), CNRS laboratoire CRISMAT, Caen (France), Pennsylvania State University (USA) and Japan Science and Technology Agency, Tsukuba (Japan). He has published 113 papers (63 of them from NUS) which have received more than 3600 citations. A/Prof Mahendiran has keen interest in developing new experimental techniques.



Condensed Matter Seminar Series

We started the Condensed Matter Seminar series in January 2013, mostly to provide a regular platform for lively and sustained discussions on the latest research fronts in condensed matter physics. Prior to this initiative, seminars were arranged on an ad-hoc basis with some weeks having several speakers clustered together and large periods without any activity. We hoped that by having a regular meeting (Wednesdays at 11am in the Physics Conference Room) and a bit of organisation, we could increase the visibility and attendance of these talks. Overall, last year, we had 55 seminars, 85% of which was delivered by visitors from abroad, including several speakers from the topmost physics departments worldwide.

We hope that such a seminar series is beneficial in many ways beyond showcasing cutting-edge research. For example, the high calibre of the speakers and the regularity of the program conveys to the outside world the active, engaged and vibrant nature of condensed matter research in our department. The breadth of topics advertises the large scope of our research interests as well. Our experience has been that the interactions with guest speakers sustains beyond their time in Singapore, eventually leading to new research collaborations and directions.

Our department is visited by various international researchers every month—more than one might imagine! The main goal of the seminar series is to coordinate such visits so that they ideally do not cluster in the same week. This has the added advantage of

increasing the audience for each visitor who comes to NUS and allowing the entire community to interact with the visitor, instead of limiting these interactions to a single research group.

This program relies entirely on visitors hosted by research groups, visitors to the department and condensed matter researchers within Singapore. We welcome all at NUS to attend the seminar and suggest their visitors, collaborators or research staff as potential speakers. We are extremely grateful to all within the department who attended, especially those who recommended their visitors. Special thanks also go to Hilary, Wei Fen and Rosalind for all their logistical help. Indeed many people contributed to making the seminar series a success in 2013.



From left: Asst/P Vitor M Pereira and Asst/P Adam Shaffique



A Day in the Life of...

With online information increasingly in demand, it is imperative to create and maintain a web presence for every successful enterprise. Mr Cheong Mun Yin, the department webmaster, can certainly attest to this. Together with a few colleagues, Mr Cheong, or Cheong as he is fondly called, assists the department with web maintenance. He makes sure that all relevant information is made available in the department website and also that it is kept updated on a daily basis.

A day for Cheong the Lab Technologist begins with sieving through his stack of emails for any work requests which could range from students' appeals for courses, responding to students' feedback to instructing academic staff concerning the use of IVLE, an integrated virtual learning tool for the NUS teaching community and students.

Typically during the crucial course bidding period for students when the term starts, Cheong would be busy advising students about their module registration and

providing them with support wherever possible. It gives him great job satisfaction whenever he is able to help students resolve their enrolment problems. "I believe in doing my best in whatever I do. Then it will leave me with no regrets whether it turns out to be successful or not. Well, at least I have tried."

During the examination period, Cheong would be tied up with providing administrative support for all examinations taking place within the department premises. It is a task he takes seriously. A recipient of several service awards, what does Cheong like about working in the department? "The Physics department is a great place to work in because colleagues are supportive and willing to guide you when you are not sure of the work procedures."

On the lighter side, Cheong is an avid soccer fan and now eagerly awaits the upcoming FIFA world cup. To stay fit, he swims occasionally on the weekends. Happenings around the world interest Cheong who makes an effort to keep abreast with current affairs. Cheong is deeply charmed by the beautiful sceneries in New Zealand and hopes to visit the country again.



↑ Cheong at work in the computer lab

An Interview with Prof Wang Jian-Sheng

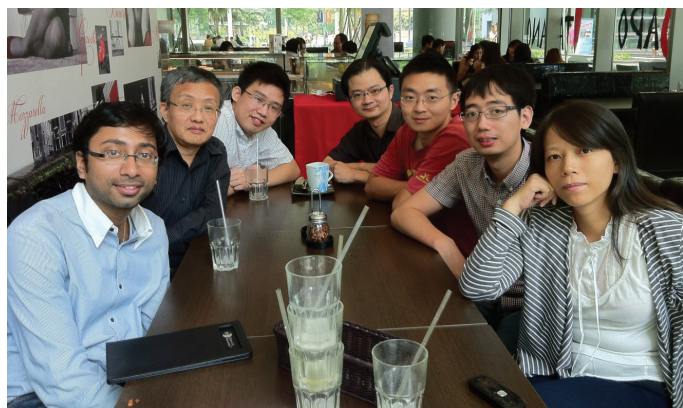
Prof Wang Jian Sheng, deputy head (research) shares his thoughts and insight with *Physics Matters*.

What are some challenges that computational physicists like yourself face in the course of your research pursuit and how do you overcome them?

The great challenge facing a computational physicist or any researcher is the rapidly changing research landscape. A hot field may become less so in a decade, so one must be open to exploring new fields and new possibilities. I would like to say that changing field every ten years or so may be the way forward and to remain relevant.

What qualities do you think a good researcher should possess?

Instead of following the crowd, a good researcher should think deeply about the problems at hand and stay sharply focused. Perhaps, if you are lucky, something new and original could be discovered.



↑ Prof Wang with some members of his research group

Staff Outing, 20 November

More than 60 departmental staff was greeted with fine weather and rustic scenery at the Celestial Ubin Beach Resort as they headed there for a time of fun and relaxation. The highlight was a treasure hunt for “food ingredients” followed by a time of culinary challenge. Staff was divided into teams to cook up the best meal they could with limited resources. At the end of the day, it was not so much about food but camaraderie among staff. But it is also true that everyone’s appetite was whetted up as they got ready to sample each other’s food!

How do you think we could encourage the Physics undergraduates in our department to pursue more research activities?

We have already several possibilities in place in the department, for instance the UROPS and honours year projects. Students should take the initiative to talk to the professors and join their groups to find out more.

What are some of the most satisfying moments in your academic life so far?

These ‘eureka’ moments don’t happen so often. But to see my students and postdoctoral fellows surpassing me is satisfying.

What is one important message you wish to share with our Physics graduates today?

To be persistent and pay attention to details.

If there is one thing you wish could change in the world, what would that be and why?

This is something for me to ponder about. Everything seems to be developing fast and man always wants more. We need to think of the limitations of humanity.

Share with us your hobbies or interests.

I almost became a professional artist but was rejected by the art schools. I ended up being a scientist. This sounds contradicting but it is true. I do not have much time now to explore any hobbies but in my free time, I hope to go back to drawing just to relax myself.



Awards

Congratulations to our colleagues in the department for being the proud recipients of various awards in the year 2013!

Faculty Teaching Excellence Award AY2012/2013

A/P Chan Aik Hui, Phil
A/P Gong Jiangbin
A/P Sow Chorng Haur
A/P Tay Seng Chuan
A/P Tan Meng Chwan
Dr Chammika N B Udagama
Mr Hong Chong Ming, Kenneth

Faculty Honour Roll AY2012/2013

A/P Chung Keng Yeow

Teaching Assistant (Full-time) Award AY2012/2013

Mr Lim Yen Kheng
Dr Ng Wei Khim
Ms Qiu Leiju

Young Scientist Award 2013

Asst/P Ariando

Outstanding Service Award 2013

Mr Abdul Karim s/o Idroos
Mr Ang Han Siong
Mrs Lee Soo Mien
Mr Lim Geok Quee
Mdm Ng Seok Guat
Mrs Phua Swee Wah
Miss Teo Hwee Sim
Mr Wong How Kwong

It is an honour to receive this service award and I would like to take this opportunity to thank my colleagues and students for their support. I will continue to excel in my service to the department and faculty.

Mr Wong How Kwong

Commendation Award 2013

Mr Ali Bin Haji Omar

IPS President's Award 2013

Prof Thirumalai Venky Venkatesan

I feel very encouraged, happy and fulfilled to be able to get this award for the second time in a row, and I will continue to do my best for my students for as long as I can.

A/P Tan Meng Chwan

I'm excited to learn that our work is recognized by the community. I'd like to thank my group members, collaborators, and my family for making this possible!

Dr Eda Goki

I am deeply honoured and delighted to have been selected for this award. Here in the department, we work as a team and each award/achievement is an acknowledgement of the accomplishment of this team. I like to take this opportunity to express my thanks to A/P Chung Keng Yeow, Prof Chowdari, Mr Wu Tong Meng and Dr M V Reddy for their support.

Mr Abdul Karim s/o Idroos

IPS World Scientific Award 2013

Prof Barbaros Özyilmaz

IPS Omicron Nanotechnology Award 2013

Asst/P Goki Eda

IPS Crescendas Award (Junior College) 2013

Dr Lim Jit Ning

National Day Long Service Award 2013

Mr Abu Mansor Bin Haji Na'Man
Mr Chen Gin Seng
Mrs Gracey Segran
Mr Ho Kok Wen
Mr Lim Geok Quee
Miss Ng Hwee Lang

SMP Outstanding Mentor Award 2013

Dr M V Venkatesh Reddy

Science Safety Day 2013

Safety Video Competition – Two minutes of Safety

Mr Dicky Seah (Consolation)

Safety Slogan Competition

Mrs Lee Soo Mien (1st Runner Up)

Housekeeping Campaign Award 2013

Research Category

A/Prof Johan van der Maarel
A/Prof Liu Xiang Yang
A/Prof Wang Zhisong

Core Facility Category

Mr Ho Kok Wen (Core/Shared Fac)

Announcements

International Conference on Flavor Physics and Mass Generation

10 – 14 Feb

Nanyang Executive Center, NTU

More info at <http://www.ntu.edu.sg/ias/upcomingevents/FPHY14/Pages/default.aspx>

7th India-Singapore Joint Physics Symposium

24 – 26 Feb

Indian Institute of Technology (IIT), Bombay

More info at <http://www.phy.iitb.ac.in/physics.pdf>

IPS meeting 2014

26 – 28 Feb

University Town, NUS

More info at <http://ipsmeeting.org>

Germany Immersion Trip 2014

June 2014

Contact: A/Prof Thomas Osipowicz

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