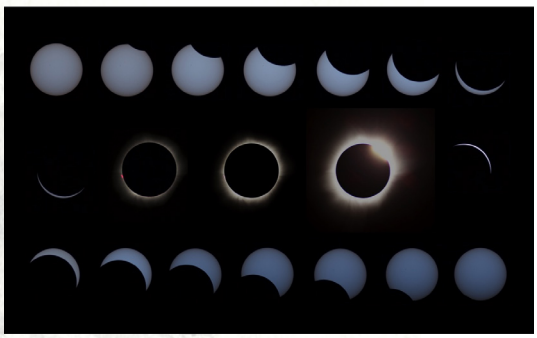
JULY 2016

Physics Matters

Solar Eclipse @ NUS

9 March 2016 was a day to remember for astronomy enthusiasts here in Singapore. The sun was obscured by almost 90% at the peak of a solar eclipse. To commemorate this rare astronomical phenomenon, the department organised an evening of public lectures, astrophotography exhibition and overnight stargazing session which culminated in a solar eclipse observation the following morning. Physics students Laurentcia Arlany and Edmund Yuen were in Sulawesi, Indonesia, where a total solar eclipse was filmed and telecast live for many watchful eyes at the campus football field. Dr Abel Yang and Dr Cindy Ng were interviewed by local TV news media reporting the event. The next solar eclipse visible from Singapore will be on 26 Dec 2019.



⇧ Solar eclipse compilation

For a fuller report, read http://www.science.nus.edu.sg/newshub/1572-solar-eclipse-2016-nus

Inside this issue :

Department of Physics

NUS National University of Singapore

Prof Oh Conferred Emeritus Professorship

⇦ Prof Oh receiving the award from Provost Prof Tan Eng Chye

⇨ Prof Baaquie in his new jacket

It was a celebrative occasion for the department as Prof Oh Choo Hiap was conferred the Emeritus Professorship Award on 21 Jun by Provost Prof Tan Eng Chye. This highly prestigious award recognises the sustained contributions in distinguished scholarship and service to the university by an outstanding retiring professor.

At the conferment ceremony, Prof Tan described Prof Oh as being instrumental in laying the foundations of the Department of Physics and the Center for Quantum Technologies (CQT). CQT Director Prof Artur Ekert also praised Prof Oh for being the driving force behind quantum information science even when the field was just emerging ten years ago. Department head Prof Sow Chorng Haur remembered Prof Oh as an excellent teacher.

Prof Oh was modest about receiving the award and attributed it to colleagues, friends and students who had helped him whether at the departmental, research or management level. In particular he thanked Prof Lai Choy Heng for his guidance and sharing of insights. For all that Prof Oh has contributed, he is indeed, in Provost Prof Tan's words, very befitting of the award.

Farewell to Prof Baaquie

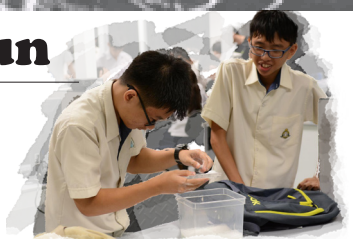
It was a farewell that was mood-lifting. On 6 May Prof Belal Baaquie was all smiles as he recalled fondly how the Department of Physics had always felt so close to his heart. He thanked the department heads, past and present, and colleagues for the enjoyable work environment which he would miss after leaving the department.

Prof Baaquie had over three decades of teaching experience in the department. He was actively involved in the University Scholars Programme as well as instrumental in planning for the General Education curriculum during their initial phase. Prof Baaquie was also an accomplished author, having published several highly acclaimed books on subjects he is passionate about, in fields as diverse as quantum finance.

Department head Prof Sow Chorng Haur thanked Prof Baaquie for his varied contributions to the department and presented him with a token of appreciation on behalf of the department—a lightweight warm up jacket specially sewn with an emblem of particle and wave. Prof Baaquie is, after all, a physicist.

Physics Enrichment Camp, 31 May–3 Jun

This year's Physics Enrichment Camp attracted over 600 secondary and junior college students. Besides morning lectures, guided lab tours, briefing on sophisticated equipment like the scanning electron microscope, participants also experienced many interesting activities. For a fuller report, read http://www.science.nus.edu.sg/newshub/1739-physics-enrichment-camp-2016.



⇨ Physics becoming alive!

Germany Immersion Trip (GIT) 2016, 29 May–22 Jun

⇧ Group photo taken in Munich

We visited Munich, Gottingen and for the first time ever in GIT Berlin during the 24-day trip. It was an educational experience as we learned albeit on the surface the culture of physics and technology in both academia and industry.

We attended lectures with chalk board discussion and experimental demonstrations. The latter emphasised the importance of experimental work, a key element I found missing from the Powerpoint style physics teaching I received as an undergraduate. The two colloquiums we attended (one by Prof Englert) were eye-opening. The exchanges during Q&A were fierce and to us young Asians, the tension was through the roof. Despite this, the professors still hang out like buddies after that.

For our industrial experience, we visited the Otto Bock manufacturing facilities in Gottingen. We saw behind-the-scene prosthetics production and most importantly, the vital role of physics in the business. In the wake of uncertain job prospects at home, it's encouraging to know where physicists are in demand.

We visited various museums including Deutches Museum, an outstanding science and technology museum. An exclusive guided tour was arranged for us which to me was the best part of GIT2016. We learnt so much about the physics behind various technologies such as missiles, diving suits, boats, etc. With museums like Deutches, it's no wonder Germany has such a strong tradition in science and technology.

GIT2016 had been a unique experience for us with Zi Heng in our midst. We were happy to have made the trip as memorable for him as he had for us.

⇧ Artificial limbs from Otto Bock

⇧ Galileo's room in Deutches Museum

Contributed by Mr Lee Yuan Zhe, honours graduate. All photo credits go to Mr Tan Bo Xue, honours graduate

My Lindau Experience

⇧ President Dr Tony Tan with Dr Dai Jibo (second from right) and the Singapore representatives.

Before attending the 66th Lindau Nobel Laureate Meeting, I was told by many that it was a "once-in-a-lifetime experience" not to be missed. Indeed it was!

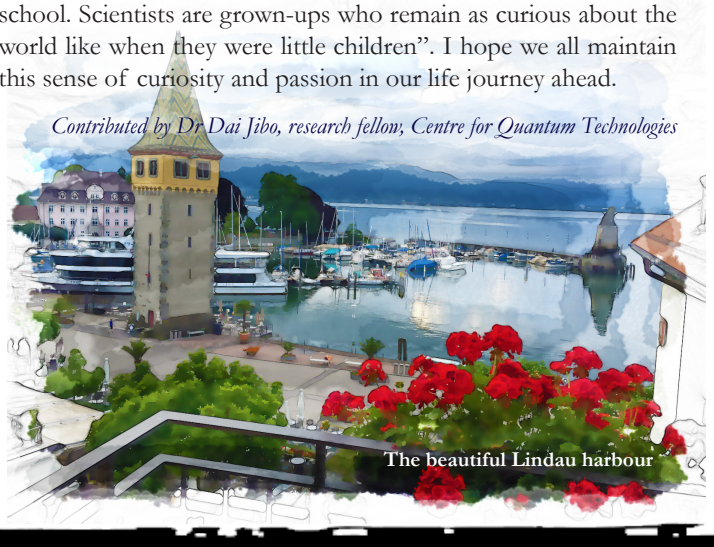
Started in 1951, the Lindau meeting is an annual scientific conference held in the beautiful island of Lindau, south Germany, with the aim to foster scientific exchange across generations and cultures. This year's meeting from 26 Jun to 1 Jul was dedicated to physics with around 30 Nobel laureates and over 400 selected international young scientists invited. I was privileged to be among them.

We had one week of eventful programmes including plenary lectures by Nobel laureates, panel discussions, master classes and scientific breakfasts. The topics discussed were wide-ranging, including the standard model, cosmology, quantum technology, biophysics and the future of science education. The Singapore delegates were honoured to meet guest of honour Dr Tony Tan, President of Singapore. Dr Tan encouraged us to get the best out of this prestigious meeting.

I was very inspired by the devotion and perseverance of the Nobel laureates. They were passionate to share their thoughts and experiences with everyone. Prof Hiroshi Amano, Nobel Prize winner for his invention of efficient blue light-emitting diodes, shared about how he failed time and again before succeeding in his pursuit in research. I was also thrilled to spot familiar faces like Prof Serge Haroche, a regular visitor and lecturer at CQT.

I am truly grateful for the Lindau experience. I like to encourage my physics juniors here by quoting from Prof Martin Karplus, "Very young children are curious and constantly trying to understand the world around them. But often their curiosity becomes stifled in school. Scientists are grown-ups who remain as curious about the world like when they were little children". I hope we all maintain this sense of curiosity and passion in our life journey ahead.

Contributed by Dr Dai Jibo, research fellow, Centre for Quantum Technologies



The beautiful Lindau harbour

My Physics Journey

Honours graduate Mr Kho Zhe Wei shares what he learns about physics after four years as an undergraduate.

To the uninitiated, the mere mention of "physics" is often enough to evoke a sense of apprehension, replete with images of tangled messes of incomprehensible equations. Certainly, the study of physics is not an easy endeavour, but the potential insights that this promises to shed on the intricacies of nature itself are well worth the efforts.

Physics is a very rich and diverse field spanning the entire spectrum from the atomic to the astronomical. But what fascinates me the most is not any particular subfield, be it astrophysics or quantum mechanics, but rather the overarching themes of universality and emergence that pervade almost all of physics itself. A set of simple microscopic laws may yield surprisingly complex behaviour, while phenomena across different scales and contexts can be described using similar effective frameworks. It is perhaps this fusion of sheer elegance and explanatory power that first drew me to physics and which still continues to drive my passion for it.

Apart from physics, my undergraduate journey was also enriched by my involvement in the University Scholars Programme (USP) and the Special Programme in Science (SPS). As a student mentor in SPS, I had the opportunity to assist in conducting classes as well as guiding junior students. While juggling this supervisory role concurrently with my studies proved to be challenging at times, it was definitely an insightful experience that provided me with a different perspective.

Notably, the interdisciplinary nature of SPS not only broadened my horizons significantly, but also led me to ponder more deeply over the roles that physics can play in fields outside of its traditional realms, which range from ecological models inspired by field-theoretic ideas to notions of self-organised criticality in neuronal networks. Physics seems to be unreasonably effective. Perhaps, physics is not merely a scientific discipline that examines a particular class of phenomena, but further represents a philosophy, a certain way of thinking about and understanding the world around us.

As the knowledge and application of physics continue to straddle boundaries, it is indeed an exciting time to be doing physics – and to be bringing ideas and methods from physics beyond the confines of its conventional domains. There is no reason why physics should be limited to whatever transpires within the Department of Physics. The next time someone asks you, "What can you do with a physics degree?", tell them this: "You can do anything with a physics degree."

Our Alumnus Speaks ...

Alumnus Dr Wong Loke Yuen (BSc 2006; PhD 2011) shares how learning physics has shaped his life from young.

Studying physics was a natural choice to me as I have always been fascinated by astronomy since young. Much of my growing up years was spent in stargazing activities and devouring astronomy books in the libraries. I was thrilled to read about the vast expanse of space and the endeavours undertaken by man to explore beyond our natural habitat. I was also inspired to pursue physics by my physics teachers who themselves are alumni of the NUS Physics Department.

During my undergraduate years, I did the Undergraduate Research Opportunities Programme (UROPS) under the guidance of A/P Peter Ho. It was refreshing to learn via a very hands-on approach as oppose to the traditional passive lecturing and tutoring. I began to enjoy research and seized on the opportunity to pursue a PhD when the offer came.

After my PhD graduation, I decided joining the industry was an appropriate step for me. Applied Materials, a materials engineering solution company for semiconductor and display industries, was then recruiting engineers to work in their newly established Asia Product Development Center. I applied and thankfully got hired.

Currently I work as a global product manager in charge of chemical vapour deposition products. My job requires substantial travelling for internal and customer meetings. Meetings with customers enable us to understand the technical requirements and challenges customers face. Our product development team works hard to develop a solution that hopefully will clinch a business deal. To spot the largest business opportunities, I keep myself abreast with technology trends. This in turn defines our product roadmaps and strategy. I also draw up configurations for our products to meet technical and commercial requirements besides addressing queries from the sales team regarding product features and benefits.

My physics education has taught me the art of simplifying nature's complexity down to the fundamental equations. The process of this thinking exercise is valuable. Once you know the fundamental ways of describing a particular phenomenon, you can extrapolate them (of course within certain boundary conditions and assumptions) to solve problems or innovate to create new products to meet the required specifications. My physics training empowers me to deal with uncertainty and be my own teacher, eventually finding answers to solve whatever problems at hand. These are very useful skills to my work as an engineer and now a product manager.

My advice to juniors is to stay curious and seize the ample opportunities offered by the department and NUS to learn and push beyond your boundaries.

'Entrepreneuring' Physics

What started out as an enthusiasm to capture the night sky turns out to be a successful startup. *Physics Matters* catches up with Mr Grey Tan, CEO of TinyMOS, a company specialising in easy and affordable astrophotography.

⇧ The full moon and Milky Way taken with Tiny1

⇧ Tiny1 – The world's smallest and smartest social astronomy camera

⇧ Mr Grey Tan (second from right) with fellow founders of TinyMOS

How did it all begin?

My interest in astronomy started when I took the module *Einstein and Quantum Weirdness* taught by A/Prof Phil Chan. His classes were very entertaining in the sense that I would always be learning something new and strange about the world we live in.

Once, I went on an astronomy learning trip to Punggai where seniors told us that they could see the Milky Way. I could not due to light pollution and I genuinely did not know what to look for. I brought my Nikon digital single-lens reflex (DSLR) camera for the trip but went home empty handed. The trip got me intrigued and I signed up for another stargazing trip to Mersing led by Mr Remus Chua. This time we saw the Milky Way, visible to the naked eye, spanning from horizon to horizon.

At first I could not capture the sight even though I was a professional photographer. I did not know the correct settings to use and also did not possess a lens wide enough. But with help from fellow astronomy enthusiasts, I did manage to capture the Milky Way. However, it took a lot of effort as the picture was a mosaic of six images using a 35-mm F1.4 lens and a DSLR costing about $1000 and over $4000 respectively. Further editing using Photoshop was also necessary.

If only there could be a camera designed to reduce the complexities of astrophotography through smart automation. So birthed my idea of Tiny1. The product features and ideas were bounced off from conversations I had with the local astronomy group and the lecturer and tutor of another module *Sky and Telescopes* I took, Dr Abel Yang and Mr Leong Qi Xiang. They highlighted a few challenges and I came out with some solutions which were cross verified with them.

What does TinyMOS do?

TinyMOS stands for "Tiny CMOS". TinyMOS simplifies astrophotography. The camera Tiny1 helps with the planning, capturing, processing and sharing of celestial images on social media.

Using an augmented reality star map, Tiny1 guides users to the stars and astronomy features, helping users plan what they can capture for the night. The star map pairs with the automated pre-sets to give the best image settings, which are often complex and not available with conventional cameras. The camera does advanced noise reduction that preserves fidelity using a patent pending dark noise subtraction library. It saves time, reduces sensor heating and tailors the noise reduction to environmental factors more precisely than manually performed dark noise subtraction. Using a built-in WiFi, users can share their images at high speed in social media via their smart phone.

Share with us the 'entrepreneuring' process.

TinyMOS was launched in April 2014. I was joined by Mr Ashprit Singh Arora and Mr Chia Lih Wei who have engineering background. The TinyMOS team from investors to interns are all NUS students or alumni. It was not something we planned but we do get very strong support from like-minded people on campus.

We spent the first six months refining our business and product plans, speaking to user groups for feedback and investors for funds. Finally, after six months of drawing zero salary, Mercatus Capital invested in us followed by NUS alumnus Ms Lim Qing Ru (co-founder of Zopim).

Our development started earnestly with the funds in hand. We met with various suppliers and design teams from Singapore, India, San Francisco, San Diego and Taiwan. We tested the camera in Singapore, Malaysia, Japan, Australia and United States and also showcased our product in trade shows in Silicon Valley and Tokyo. Large corporations such as Land Rover and Young & Rubicam (watch https://www.youtube.com/watch?v=aWuvGHs3LLA) even became our partners.

Most recently we launched our crowdfunding campaign on Indiegogo and raised our target US$100,000 in just four hours! It was a most eye-opening experience which was impossible without all the people who believe in us. The support came especially from NUS Physics Department and NUS Business School.

Share with us your current and future plans.

We are doing our best to deliver the Tiny1 camera to backers on schedule. We are in negotiation with various manufacturing partners worldwide to ensure a smooth delivery. In order to make astrophotography more accessible, we are also working on various accessories to simplify cosmos imaging even further.

Our future plan is to put Tiny1 in the hands of every curious explorer for them to capture and share their astronomy experience with the world. We hope to gather interest in the astronomy space as we believe that space exploration will be a significant part of the future human civilisation.

Discovering Physics: Generation and detection of correlated pairs of photons aboard a nanosatellite

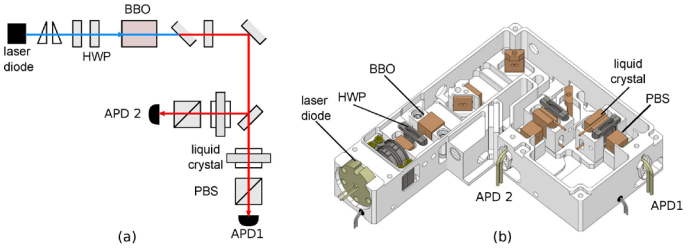
On 16 Dec at 8:30 pm, a 2-kg nanosatellite named Galassia was launched successfully from the Satish Dhawan Space Centre in Andhra Pradesh into a near-equatorial orbit. A small device within the nanosatellite designed and built by our group measured the photon correlations generated and reported the data back to Earth. The first set of data came after 36 days. I like to share the motivations and results of our space experiment here.

Conventional public key cryptography, while effective, is still inferior to quantum key distribution (QKD) which has gained much research interest due to its superior privacy underpinned by quantum mechanics. In essence, QKD is the art of generating a private key shared by two parties which can then be used to encrypt and decrypt messages. Our group is interested in entanglement-based QKD in which entangled photons are distributed between two parties.

Photon pairs could be distributed using either optical fiber or free space. However, both methods suffer from losses, and to establish a quantum link between two widely separated parties using photons, a distance limit of the order of 100 km has to be imposed. To go beyond this distance limit, one could beam photons to widely separated receivers from a spacecraft. A major milestone in this direction would be to demonstrate an entangled photon pair source in low Earth orbit (LEO). But space missions are exorbitant and require a long development cycle.

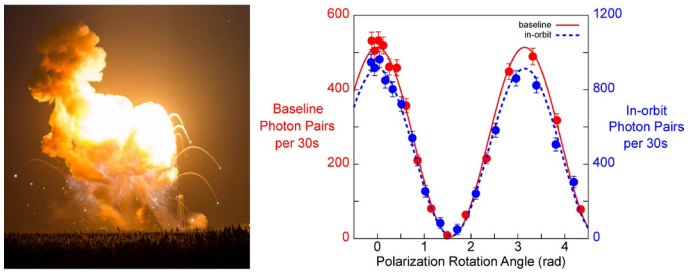
A cost-effective approach is to capitalise on emerging nanosatellite technology such as CubeSats. A typical 1U CubeSat is a 10-cm cube weighing 1 kg. Now we need a source that can fit into a nanosatellite. If this sounds trivial, try walking into any optics laboratory and you will find that a typical source easily occupies an entire optical table. So our great challenge was to build a source compatible with the size, weight and power requirements of the nanosatellite.

To establish a space heritage of our components, we conducted an in-orbit photon-counting experiment in a nanosatellite. We measured the polarisation correlation between pairs of photons. This prototype could be rapidly converted to produce polarisation-entangled photon pairs. The source emitted classically correlated photon pairs based on type-I collinear spontaneous parametric downconversion (SPDC) in a single crystal (beta barium borate, BBO). During SPDC, a pump photon at 405 nm interacts with the BBO crystal and downconverts into two daughter photons which we call signal (760 nm) and idler (867 nm) according to the conservation laws.



⇧ **Fig. 1: (a) Schema of components in the photon pair source. A 405-nm laser diode supplied the pump photons and their polarisations were prepared by a half-wave plate (HWP). Signal and idler photons were separated by a dichroic mirror before the photons were analysed by liquid crystals and polarisation beam splitter (PBS). Avalanche photodiodes (APD) were used to detect the photons. (b) 3D model of the optics.**

The source layout is shown in Figure 1. We performed various environmental testing including a weather balloon test [1]. Following the success of our balloon test, we tried to transport our source to the International Space Station but the launch vehicle exploded shortly after launch. We managed to recover the source from the debris and were surprised that it was still operational with minimal degradation [2]. After gaining confidence about the robustness of our source (hey, it is bombproof!), we worked with our partners at NUS engineering to put the source in LEO (550 km) with an inclination of 15 degrees on the Galassia nanosatellite.



⇧ **Fig. 2: (a) Explosion of Antares rocket on 28 Oct. Our source was later retrieved from a beach near the launch site. (b) Polarisation correlation (after background subtraction) recorded in space and on Earth.**

During the experiment, the liquid crystal device for the idler photon was supplied with a voltage that enabled maximum transmission of horizontally polarised photons to APD 1. The rotator for the signal photon was then stepped through a series of voltages that corresponded to a certain polarisation rotation. We were interested in the coincidental events in which signal and idler photons arrived at the APDs at the same time. As we rotated through the signal liquid crystal device, a sinusoidal pattern of the coincident pair counts was observed as shown in Figure 2(b). The contrast (or visibility) determined the quality of the source and we could see that there was no degradation in the quality of the source after it had spent 36 days in space!

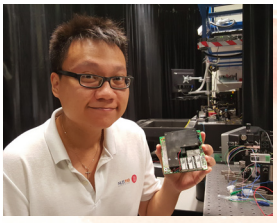
This in-orbit experiment validated our design. It was clear evidence that nanosatellites, despite being small in size, can play an important role in cost-effective space-based quantum technology. We are currently upgrading our source to deliver entangled photon pairs and hope to launch it next year. Stay tune for more rocket science!

References

[1] Z Tang *et al*, Near-space flight of a correlated photon system, *Sci Rep* **4**, 6366 (2014).

[2] Z Tang *et al*, The photon pair source that survived a rocket explosion, *Sci Rep* **6**, 25603 (2016).

[3] Z Tang *et al*, Generation and analysis of correlated pairs of photons aboard a nanosatellite, *Phys Rev App* **5**, 054022 (2016).



Mr Tang Zhongkan Xavier is currently pursuing his PhD at the Centre for Quantum Technologies. His current research interests include nonlinear optics, designing entangled photon experiments on low-resource mobile platform and satellite instrument development.

9th India-Singapore Joint Physics Symposium

The 9th India-Singapore Joint Physics Symposium was held at the department from 24 to 26 Feb. The symposium served to inform faculty of some of the high quality research done in India and also increase the visibility of NUS in India. Besides providing a platform for interaction and collaboration, the symposium also opens up opportunity for joint supervision of PhD students under the Indian Institute of Technology-National University of Singapore joint PhD program.

⇧ 14 foreign delegates attended the joint symposium

IPS Meeting 2016

SUTD, venue of IPS Meeting 2016

The Institute of Physics Singapore (IPS) Meeting 2016 was held on 7 and 8 Mar. It was the first time the meeting was hosted on the new campus of the Singapore University of Technology and Design. Organised by the Institute of Physics Singapore, IPS meetings connect researchers in Singapore as they exchange ideas on their current research endeavours. This year, the range of topics spanned across a wide spectrum from nanodevices, surface physics, spectroscopy to quantum information.

Visit by Foreign Student Delegates

⇨ Boling-Nankai University student delegates

About 30 students and staff from Boling-Nankai University visited the department on 16 Feb. Besides attending a briefing session by the department head, they were brought to the demonstration lab for some interesting live physics demonstrations.

A Day in the Life of...

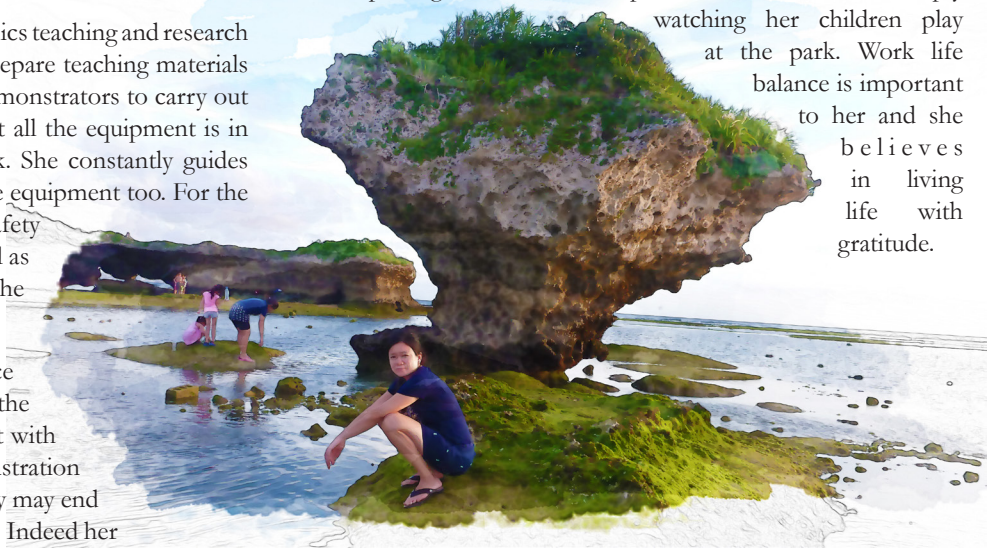
Ms See Sin Yin's passion in science finally led her to graduate with a chemistry degree. Her starting job as a chemist gave her much exposure to the chemical industry. But still she believes her calling to be in an educational environment. So after several years in the industry, she decided to settle as a scientific officer at the Department of Physics.

Currently Sin Yin is attached to the biophysics teaching and research labs. For the teaching lab, she needs to prepare teaching materials for experiments and also train new lab demonstrators to carry out any specific experiment. Making sure that all the equipment is in good shape is a crucial part of her work. She constantly guides students and staff on the operation of the equipment too. For the research lab, she has to look into the safety and maintenance of the equipment as well as the purchasing process of any parts of the machine.

A day for Sin Yin starts with the maintenance of equipment and housekeeping in the teaching lab. Any paper work will be dealt with later in the day. Assisting in any lab demonstration or experiment is also of top priority. A day may end with a good inspection of the research lab. Indeed her greatest job satisfaction is to be able to assist any staff or student resolve their problems and thus ensuring that any project on hand could run with no hiccup.

Sin Yee is happy to be part of the big family in the department. She appreciates all her senior colleagues whom she always find to be friendly and helpful.

A doting mother, Sin Yee savours every quality moment spent with her family. Her favourite pastimes include a visit to the Singapore Zoo, exploring Sentosa island, picnic at the beach or simply watching her children play at the park. Work life balance is important to her and she believes in living life with gratitude.



Here's a pictorial walkthrough of events in the department.

Solar Eclipse Event

⇧ Getting ready to capture the event

⇧ Audience at the evening lectures delivered by A/P Phil Chan, Mr Grey Tan and Mr Alfred Tan

⇧ Exhibition outside LT27

⇧ The sunspotter

⇧ Solar eclipse observation at the campus football field

Physoc Events

⇧ Chinese New Year steamboat dinner

⇧ Physics Orientation Camp 2016

Departmental Lunch

⇧ Happy meal time @ the Carousel Restaurant

Welcome on Board!

The department welcomes Asst/P Duane Loh Ne-Te on board.

Farewell and Best Wishes!

The department thanks Prof B V R Chowdari, Prof Belal Baaquie, Dr Wang Haifeng, Dr Qiu Leiju and Mr Cheng Kok Cheong for all their contributions to the department and wishes them all the best!

Awards

Congratulations to our colleagues!

Annual Teaching Excellence Award

A/Prof Tay Seng Chuan

Dr Chammika N B Udalagama (ATEA Honour Roll)

⇧ Prof B V R Chowdari

⇩ Prof Belal Baaquie

⇧ Dr Wang Haifeng

⇩ Dr Qiu Leiju

⇧ Mr Cheng Kok Cheong

Congratulations Class of 2016!

Bachelor of Science

Cheng Suxu
Chow Zhi Wan
Liana Nadhirah bte Saheid
Ng Shi Ming Tammy
Ray Chew Wei Jin
Rima Melissa bte Mahmud
Tan Tian Hock
Tee Kai Yuan
Yong Kenneth
You Jincheng Roger
Yuen Wee Siang Edmund
Zhang Wenjing

Doctor of Philosopy

Chen Weiqiang
Chu Leiqiang
Di Kai
Durga Venkata Maheswar Repaka
Gavin Koon Kok Wai
Hou Chenguang
Jiang Kai
Lee Sin Yi
Lim Yen Kheng
Liu Meihan
Liu Shuanglong
Ma Haijiao *(Materials Research Society of Singapore Medal)*
Mi Zhaohong
Orhan Kahya
Qiu Wu
Radhu Subha (IIT-NUS)
Tan Peng Kian
Tarapada Sarkar
Toh Chee Tat
Turaga Shuvan Prashant
Wu Jing
Xiang Du
Yang Chengyuan
Zhao Qin
Zhou Long Wen

Bachelor of Science with Honours

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Alvis Mazon Tan Chang Siong
Amirul Hakim B Abdul Malik C
Ang Wan Teng, Roslyn
Ang Xing Yang Ian
Bai Jie
Chau Thanh Tri
Cheah Sin Ean Donavan *(SPS)*
Chua En Hui Rebekah
Cong Wan
Dai Kun Lun
Darrell Lim Ting Xuan
Ding Yi
Foo Yun Shuen Cassandra
Hew Kai Ming
Hoe Wei Qi
Hue Jun Hao *(SPS)*
Joel Ong Jia Mian *(IPS Medal, Jurong Shipyard Prizes, SPS)*
Justin Zhou Yong
Kenneth Ho Kang Neng *(SPS)*
Kho Zhe Wei *(Lijen Industrial Development Medal, Jurong Shipyard Prize, USP Scholar, SPS)*
Koh Hui Xin Madeline
Lai Junhao
Lai Zixin
Lee Yuan Zhe *(Tan Siak Kew Gold Medal, Jurong Shipyard Prizes, SPS)*
Li Zixi
Lim Zheng Jie
Lu Jung Hsuan
Ng Yi'En
Samuel Seah Rui Yi
Seng Leng Kiat
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Tang Jia Hao
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Laurentcia Arlany
Lee Gah Hung
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Lu Yaofeng
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Zhou Yu

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Charlotte Marie Isabelle Constans
Friedmann Edwin
Misko Adrien Alexandre Charles Henri

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