

## January 2018 **ISSUE HIGHLIGHTS**

### HAPPENINGS

- A warm welcome to our visitors
- 13th China-Singapore Joint Symposium on Research Frontiers in Physics
- Departmental Staff Retreat 2018

### INTERVIEWS

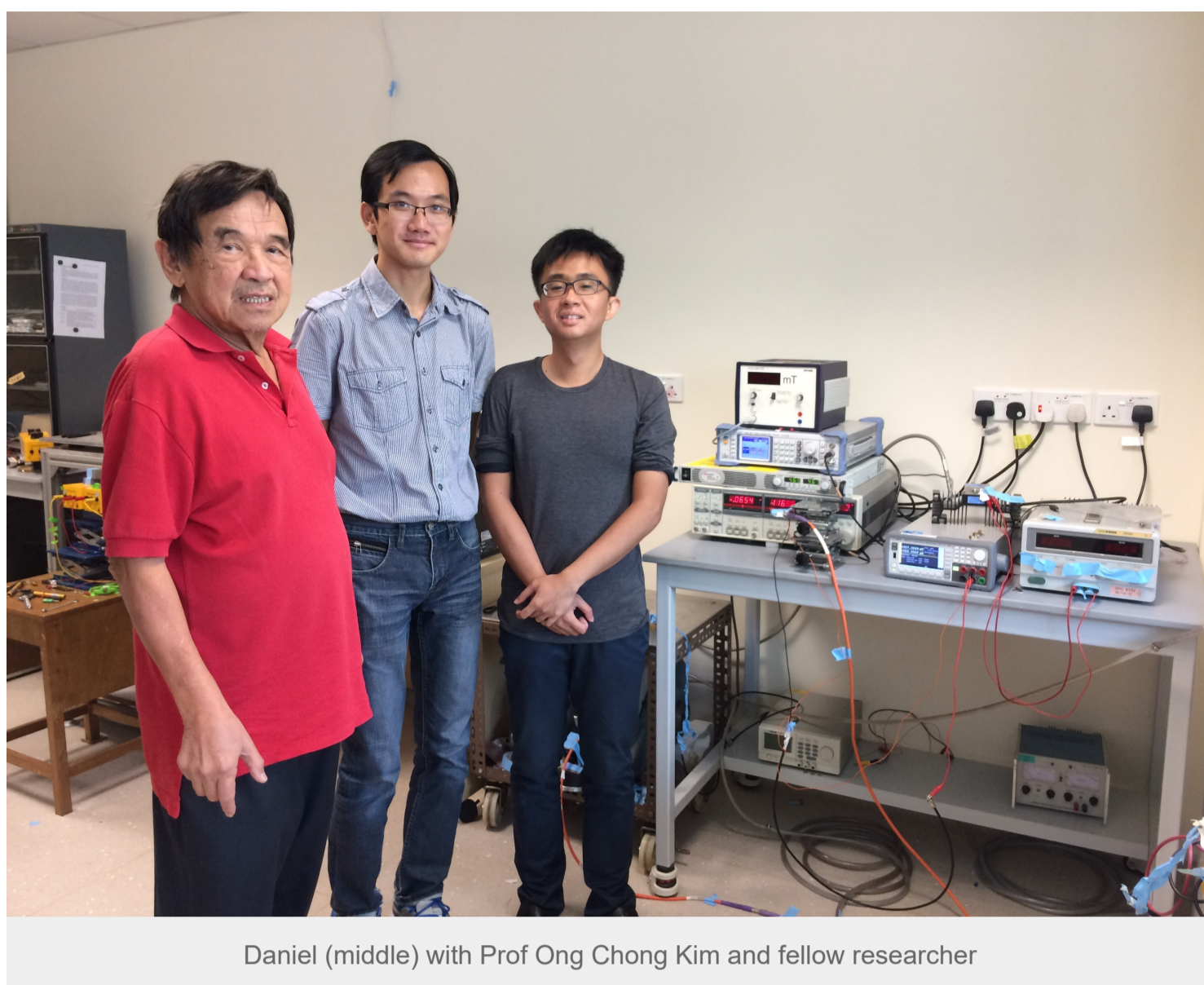
- Winning the Outstanding Undergraduate Researcher Prize - Mr Tay Zhi Jian Daniel
- Our Alumnus Speaks ... Be it rain or be it shine - Dr Jackson Tan
- Our Alumnus Speaks ... Take me to my destination - Dr Goh Jing Qiang
- A Day in the Life of ... Mdm Lee Lai Bay



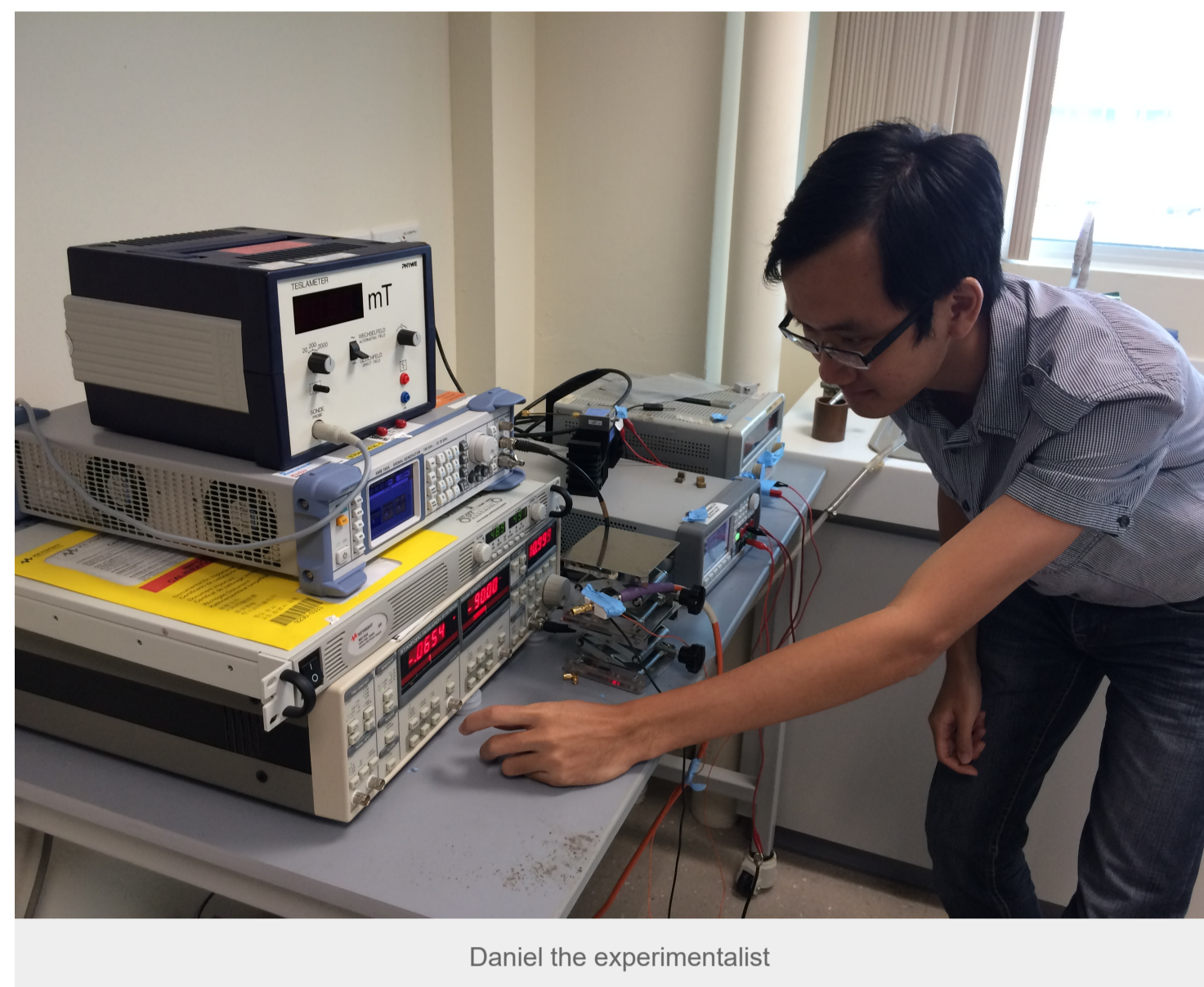
Experiencing physics at work

# Winning the Outstanding Undergraduate Researcher Prize

Congratulations to our year 4 physics student Mr Tay Zhi Jian Daniel for winning the Outstanding Undergraduate Researcher Prize (OURP) for AY16/17. The following is an email interview with Daniel to find out more about his research endeavour.



Daniel (middle) with Prof Ong Chong Kim and fellow researcher



Daniel the experimentalist

## Before you embark on your undergraduate research, what ideas concerning research did you have in mind?

I was fortunate in that while studying in secondary school, I had the chance to take part in the Science Mentorship Programme in which I worked under Dr Nikolai Yakovlev, a senior scientist at ASTAR working on magnetic thin films. Subsequently in junior college, I chose to do my H3 in Science Research, again under Dr Nikolai. Hence I was fairly familiar with the research process even before entering university. In university, when choosing my UROPS project, I naturally chose to work under Prof Ong Chong Kim whose lab, the Centre for Superconducting and Magnetic Materials (CSMM), has done extensive research works in the field of magnetic films. Of course, the level of scientific rigor is very different as an undergraduate, but the sense of wonder and excitement while pursuing research is definitely the same.

## Share with us more about your research topic.

As every science student knows, electrons are particles with electric charge and magnetic spin. Most everyday devices (laptops, iPhones, televisions etc) typically work by manipulating electric charges. However, a growing field of study known as spintronics seeks to explore ways to utilize magnetic spins to create novel devices. In my project, I studied one type of proposed spintronic device consisting of a metamaterial split ring resonator and a ferromagnetic yttrium iron garnet film. I was able to show that my device could be used to control microwave transmission.



*I have learnt that contrary to popular belief, most physics research groups today work closely with the industry. So it is important for physics students to be acquainted with the latest technological developments.*

— Mr Tay Zhi Jian Daniel

## What were some challenges you faced during your research and your approach to solve them?

One key challenge I faced was that as the device being studied was relatively novel, there was a need to seek resources outside of the CSMM lab for the necessary equipment and facilities. I was thankful for the assistance given by the physics department which enabled me to conduct my experiments successfully at the end. Much of the lithography work to fabricate the split ring resonator was done with the help of the facilities at the Centre for Iron Beam Applications (CIBA) while the cutting and drilling were done at the workshop.

Another key challenge for me was that the microwave measurements generated more than 20 GB of data—far too much data to be analysed using simple tools such as excel. So I had to write my own code in MATLAB to process and analyse the data produced in the experiment.

## If you have a chance to redo your research, what do you think you would have done differently?

In my project, a lot of time was wasted during the lithography process, which was plagued with various unfortunate and unnecessary problems. On hindsight, this was mainly due to the mistake of designing my device solely by theoretical considerations and neglecting to consider the practical aspects of how my proposed design would be fabricated in the lab. This flawed design approach gave rise to an end product that was extremely problematic to fabricate via lithography, which consumed far longer time than previously anticipated. If I had a chance to redo my research, I would have studied the lithography process in more detail, spoken to the people in charge of the lithography equipment in CIBA to understand its limitations and taken these limitations into account during the design stage of the project.

## What has your research experience taught you?

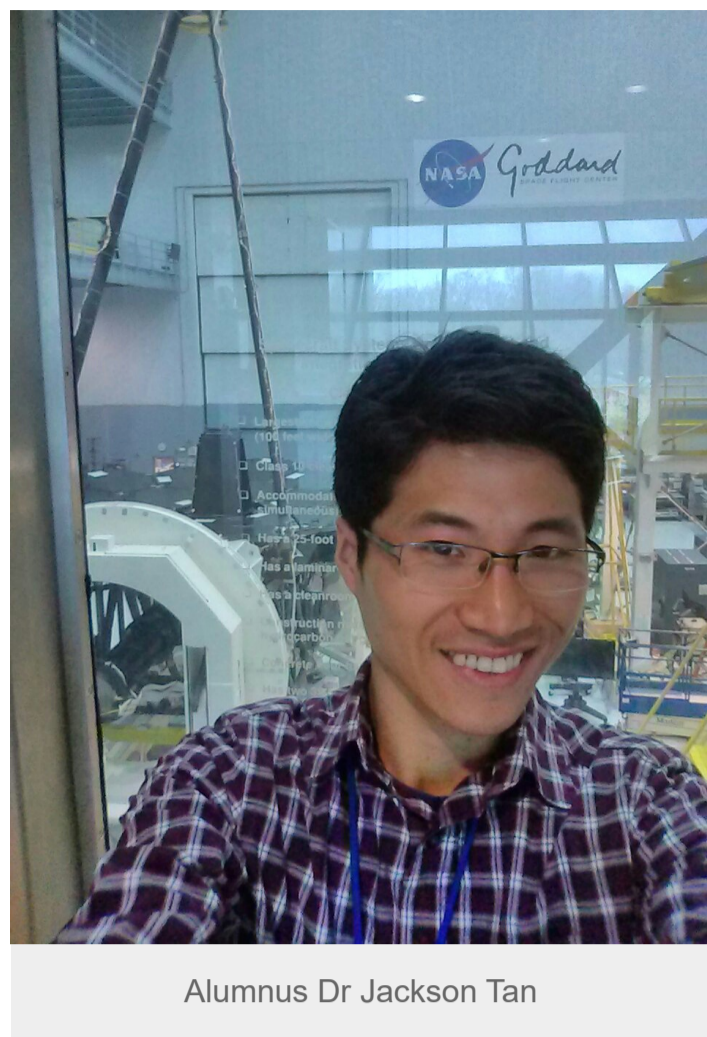
I would like to share two key takeaways here. Firstly, physics research often conjures the image of physicists like Albert Einstein and Stephen Hawking who predominantly work with theory. While highly theoretical sub-disciplines of physics do exist, I have learnt that contrary to popular belief, most physics research groups today work closely with the industry. So it is important for physics students to be acquainted with the latest technological developments.

Secondly, I have learnt that coding is an indispensable part of modern physics research. Due to the vast amount of experimental data that is collected in the course of one's research, it is almost impossible to analyse the data "by hand". Instead, specialised software and/or self-written code often has to be used to analyse the data, so it is important for physics students to have at least some familiarity with coding.

# Our Alumnus Speaks ...

## Be it rain or be it shine

Alumnus Dr Jackson Tan [BSc (Hons) 2009] pursued his PhD in Atmospheric Science at Monash University (Melbourne, Australia) and graduated in 2014. He shared about his current work at NASA Goddard Space Flight Centre in Greenbelt, Maryland, USA.



Alumnus Dr Jackson Tan

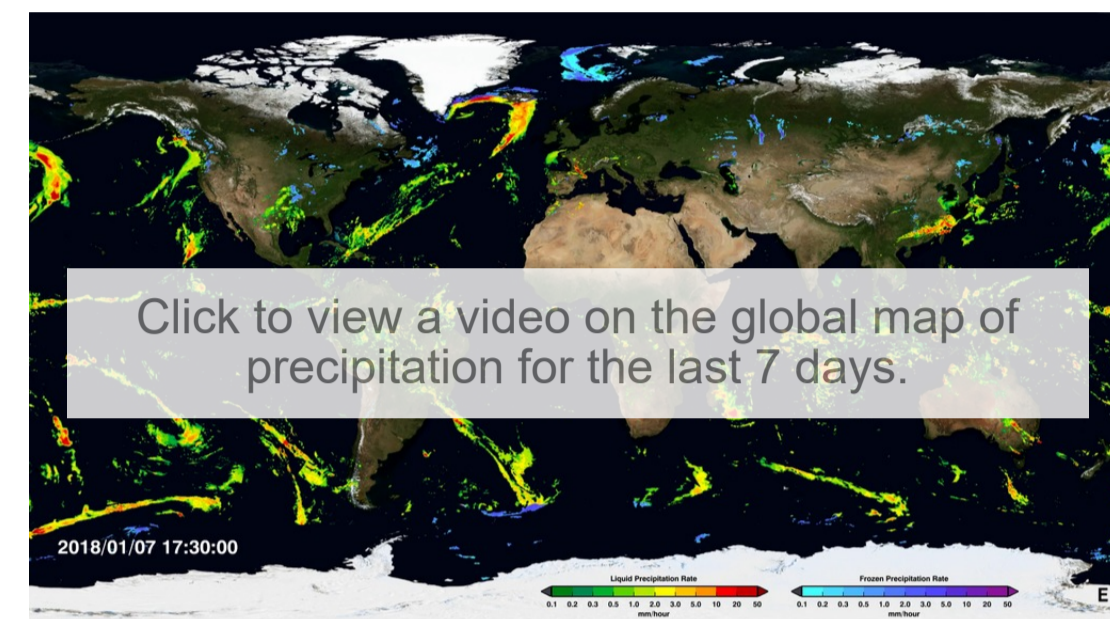
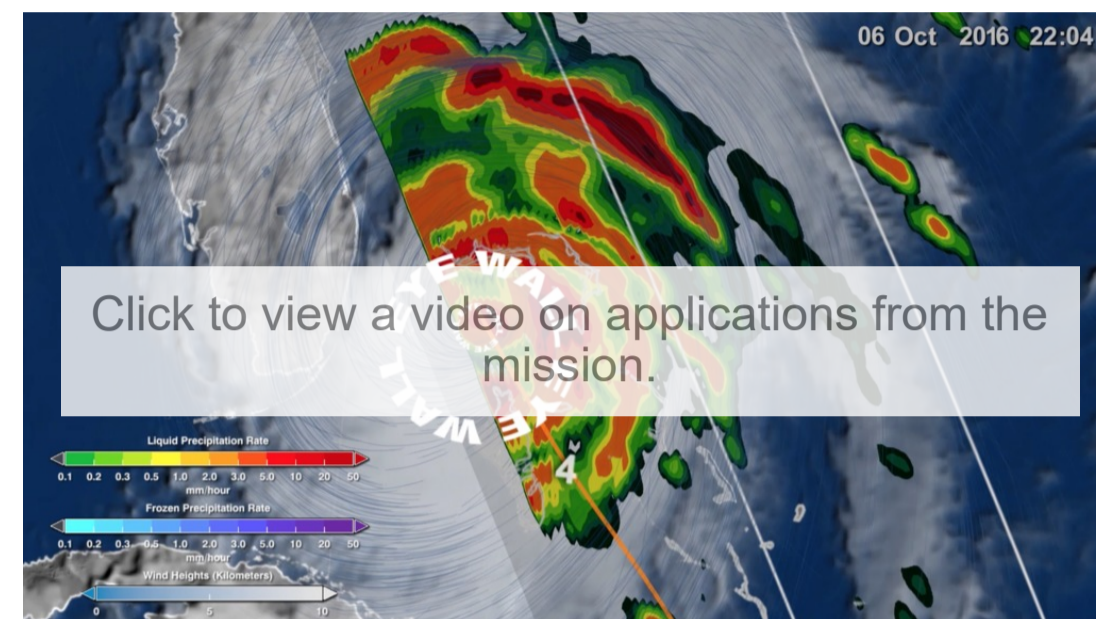
### What do you have in mind to embark on upon graduation?

I did my honours project in quantum mechanics. After graduation, I was not sure what I wanted to do, but I knew I like computational-based research and I wanted to work on a more applied field that is directly relatable to the real world. I have always had an interest in climate science and the environment, which was re-ignited when I took the module Environmental Sustainability in my final semester. (Yes, those cross-faculty modules are great!) So upon graduation, I did a Masters in Earth Sciences and got hooked on the myriad of problems and interdisciplinary nature of climate science.

### Share with us your current field of work.

My current field of work is on precipitation i.e. rain and snow. Precipitation is critically important to society, but for a variety of reasons, it is hard to quantify and forecast with precision and there is considerable uncertainty on how it will change in a warming climate.

I work on the Global Precipitation Measurement (GPM) mission, which is a joint satellite mission by NASA and JAXA (Japan Aerospace Exploration Agency) to improve our understanding of precipitation around the world. One of the objectives of the GPM mission is to provide a global map of precipitation at very high space and time resolutions, so it can be used to improve predictions of natural hazards such as hurricanes, floods, and landslides. I am currently working on the algorithm in producing this map of global precipitation from a constellation of satellites, working on an aspect to fill in gaps in the data so the map will be complete.



Other areas of my research interest involve understanding how precipitation is connected to other aspects of the atmosphere, quantifying using observations the relationship between clouds, precipitation, circulation, and atmospheric water vapour.

### How relevant is a physics education to your present work?

A physics education imparts a rigorous analytical and mathematical thinking that is important to many applied science disciplines. This is perhaps best illustrated by two examples in my experience.

There were generally two classes of background people (including myself) enrolled in the PhD in climate science came from: meteorologists and scientists/engineers. Meteorologists have it easy at first because they are already familiar with many of the climate science concepts, whereas we scientists/engineers have to figure it as we go along. However, it is not long before we catch up with the meteorologists and, with our superior grasp of math and logic, sail past them. That shows the value of a solid foundation in math and logic that a physics education can instill.

In the remote sensing of precipitation, physics may not be directly used in day-to-day work, but it provides the tools to understand the theoretical underpinnings. One source of precipitation observation is from infrared measurements of cloud tops on board geostationary satellites, which are used to infer the surface precipitation rates. However, the relationship is indirect—cloud heights do not correlate strongly with surface rain intensity—and often leads to significant inaccuracies. It has long been recognized that observations in the microwave spectrum can pass through clouds and precipitation can be observed directly; this is due to absorption and scattering: the size of cloud droplets is comparable to the visible/infrared wavelengths while the size of precipitation droplets is comparable to microwave wavelengths (physics!). However, microwave has a much longer wavelength, which leads to a lower resolving power than visible and infrared (physics again!), so they are often put only on low-earth orbit satellites which are about 90 times closer than geostationary satellites (physics once more!), at the tradeoff of a limited and changing view over Earth at any one time. The understanding of this knowledge behind the work I am doing is facilitated by my physics background.

### What are some challenges you face at work and how do you manage them?

Even though I am working on one project at the moment, there are often multiple tasks demanding my attention, so juggling between them is necessary. Almost always, there is never enough time to do everything, so prioritization and time management are critical.

Most science endeavours are collaborative, so I often need to work and rely on other people. Therefore, it is important to build good relationships. It pays to be polite and understanding, but also know when to stand your ground but with tact.



Jackson at the White Mountains

### What are some skills you think are important for graduates to acquire to succeed in today's workforce?

Skills are more important than knowledge. You may not end up using what you learn from electrodynamics, but your experience in vector calculus will come in handy when looking at atmospheric flows! More generally, your ability to apply math where relevant and when needed is always a plus.

Networking skills are often undervalued in the sciences. Get to know people, maintain good relationships, and reciprocate all the goodwill you receive.

Creative thinking—ability to think outside the box and come up with new ideas—is what separates humans from robots. Physics is not about knowing how to calculate stuff—that's a job for Mathematica—but to interpret results, draw conclusions, and devise new explanations or conjectures.

### Finally, any words of encouragement for your juniors?

It is important to find joy in what you do. Related to this, you should also work on something that relies on your aptitude. Do you like fiddling around with math? Do you like programming? Do you prefer fieldwork? How about teaching? Science outreach? Leverage what you are good at and improve on the necessary skills that you lack of.

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— Dr Jackson Tan

# Our Alumnus Speaks ...

## Take me to my destination

Alumnus Dr Goh Jing Qiang [BSc (Hons) 2010; Msc 2012] pursued his PhD in Science (Technology) at Tampere University of Technology (Finland) and graduated in 2016. He shared about his present undertaking at the Public Transportation Experimentation Unit of NEC Laboratories.



Alumnus Dr Goh Jing Qiang

### What do you have in mind as a career option upon graduation?

Upon the completion of my doctoral study, I was looking forward to the research/data analytics opportunities in the private industry. One of the key motivations here is to develop solutions to enhance the efficiency of operational tasks such as the manufacturing processes and transportation. I have been fortunate to have found employment in NEC Laboratories Singapore and that my research can contribute to the optimisation of public bus schedules which improves commuter experience.

### Share with us your present undertaking.

I am currently a researcher with the Public Transportation Experimentation Unit of NEC Laboratories Singapore. My current research focuses on creating social solutions in the public transportation domain by leveraging advanced information and communication technologies. I apply machine learning and optimisation techniques to develop public transportation planning solutions, with the aim to improve the efficiency of bus services in real-time and smoothen commuters' travel experience.

The public transportation domain has evolved immensely with the arrival of the Internet of Things (IoT), which allows devices/sensors to be closely connected via network. In this manner, valuable data can be processed in real-time to support the planning process. For instance, the automatic public transport fare collection system allows us to keep track of real-time demands of commuters on a certain route service. Images captured by cameras installed at buses or bus interchange platforms can provide useful information for understanding neighbouring traffic conditions.

In recent years, machine learning techniques have received huge attention in the transportation community as they could offer effective travel-time prediction as compared to traffic simulations. Moreover, data such as weather conditions can be taken into consideration by the machine learning model in predicting traffic flow. Research in the transportation domain has changed greatly due to the advent of machine learning, information and communication technologies.

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Regardless of which  
era we are in, those  
who are active learners  
and never stop learning  
will likely to succeed in  
today's workplace.

— Dr Goh Jing Qiang



Dr Goh Jing Qiang, ensuring a smooth commuter experience

### How does physics fit into your current field of work?

My training in physics was focused on computational physics, and this required me to design optimised codes in performing demanding simulations. The training encouraged me to devise effective ways in processing the input and output data of different formats and to identify the root causes of programming errors by breaking problems into smaller pieces.

My physics education covered aspects such as optimisation and reasoning from the first principles. These help me to adopt the mentioned practices, which are essentially the commonalities of data handling processes employed by modern data scientists. In addition, I personally appreciate an education in quantum mechanics as it offered me the insight into probabilistic and uncertainty theories. The counter intuitive ideas taught in quantum mechanics have played a role in shaping my resilience in being at peace with uncertainty encountered at work or personal life, and I become more open to new ideas.

### What are some lessons you have picked up in your workplace that help you along the way?

This could be trivial to many of us, but I cannot stress enough the importance of an effective communication, especially in conveying ideas to people of a different background. In my undergraduate days, I was mainly surrounded by peers from the same background, and it was straightforward to discuss any technical terms during my study. However, an effective teamwork in the workplace requires us to work with people of varying backgrounds. I still have room for improvement on this. I found that drawing diagrams helps me to communicate my ideas better. The sequence of diagrams can guide the thinking processes of the parties involved, and it helps the other party understands the picture better and to be able to seek further clarifications when doubts arise.



A happy Jing Qiang enjoying winter

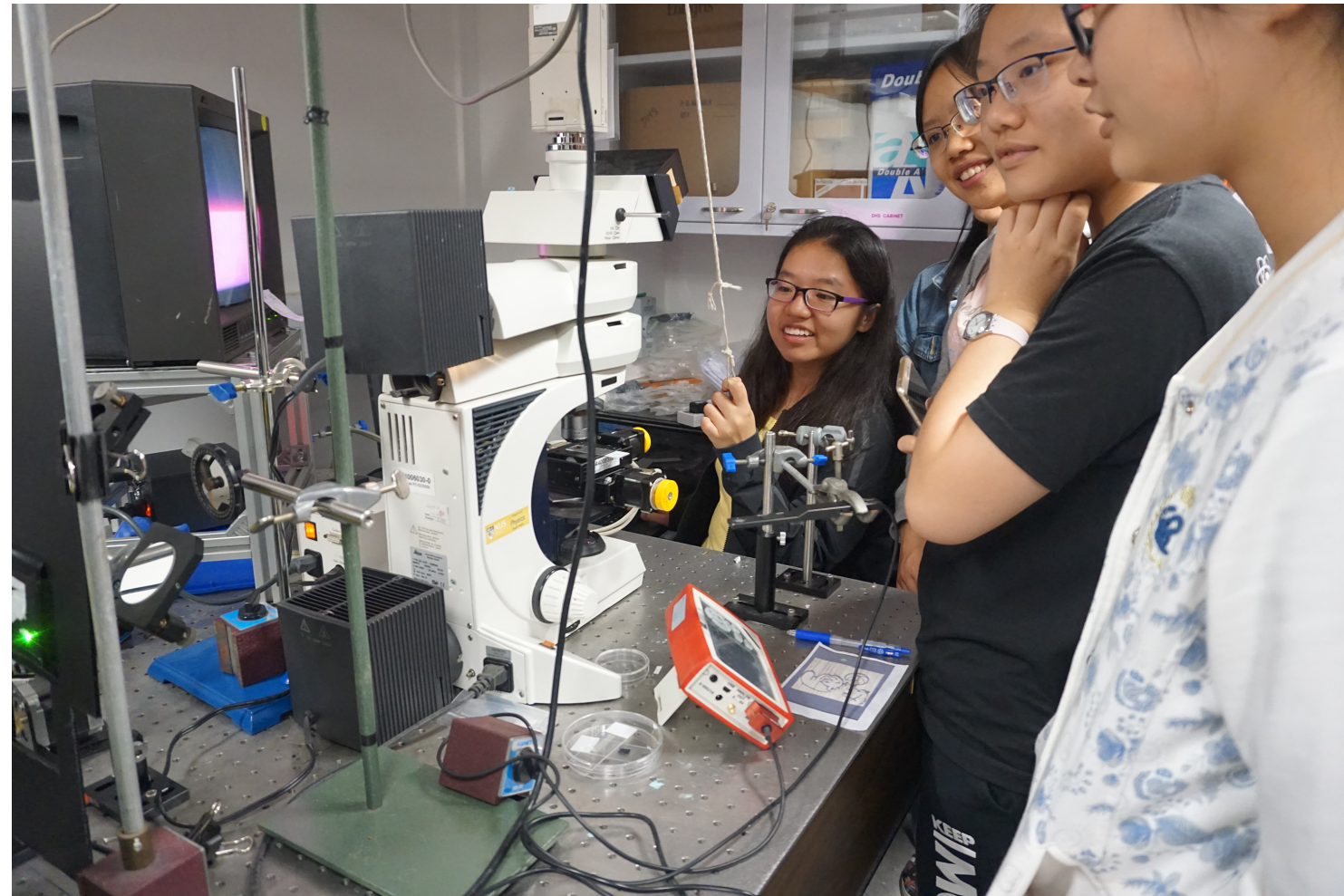
### How do you think our undergraduates could better equip themselves to succeed in today's workplace?

On a hindsight, I could have done better by leveraging the learning opportunities offered by NUS. I like to encourage my juniors to explore on their other interests that are not solely confined to the fields of quantitative subjects. Reading on different topics can offer us a wider perspective on the behaviours of this world, which includes the "laws" outside of physics. This also encourages us to become life-long learners.

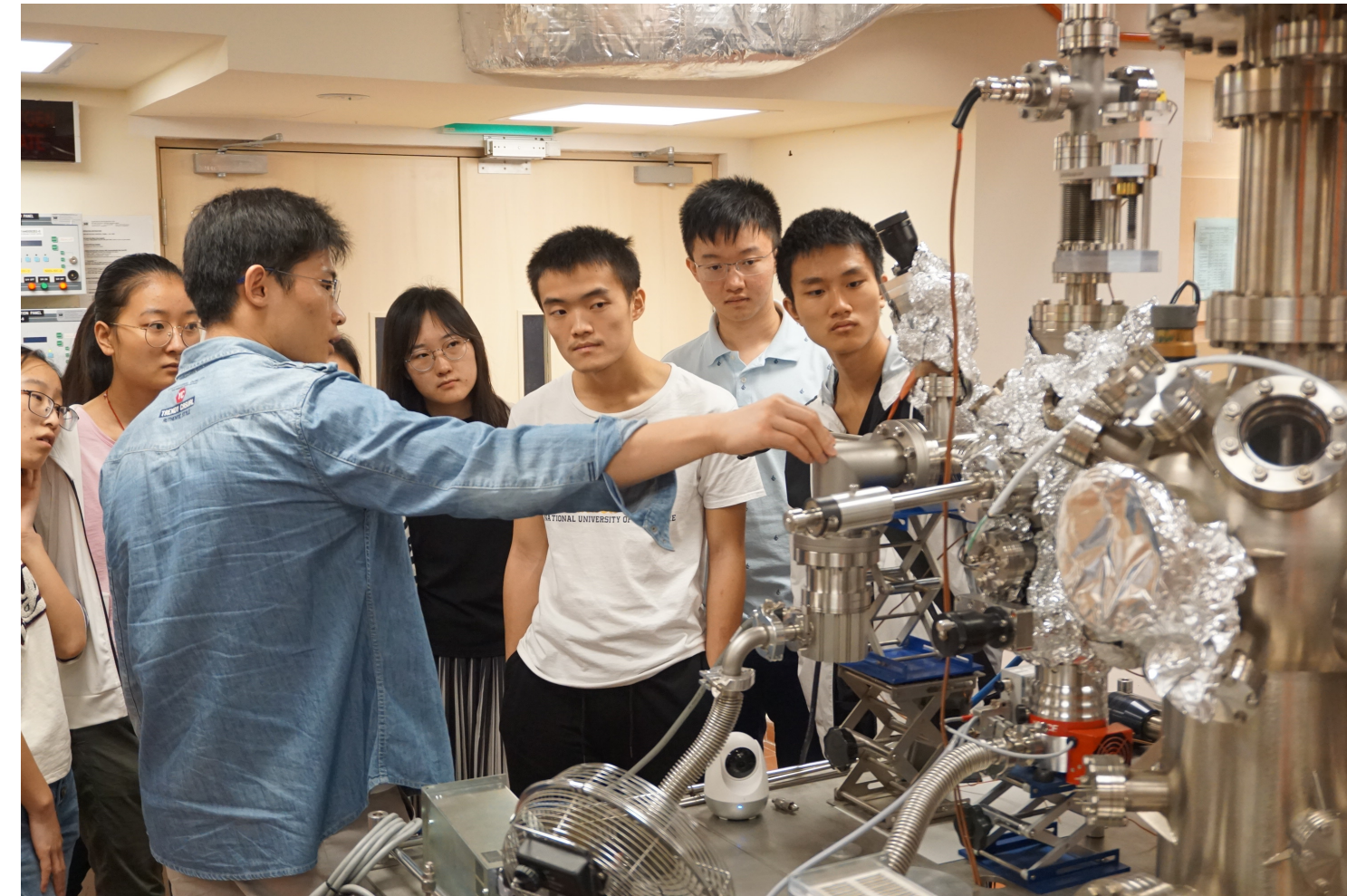
I am a believer that one does not need to restrict one's career options according to the degree one has obtained. Regardless of which era we are in, those who are active learners and never stop learning will likely to succeed in today's workplace. My personal practice is to mark down any important learning points or references in online documents such as Google Docs. This is especially useful for my current work as I often encounter similar data processing solutions that I did in the past. Keeping a good learning diary will help us to recall the learned knowledge, and become effective life-long learner ourselves.

# A warm welcome to our visitors

The department hosted a group of 68 SM2 scholars on 23 November 2017 as part of their one-year bridging course with the university. The objective of the visit was to orientate them to the fun of learning physics.



A visit to the lab



Looking at research taking place

The senior middle school students from China were briefed about the physics curriculum, research opportunities and the various career options open to physics graduates. Lab visits were also arranged for the students. They also had a chance to engage in some hands-on activities after watching some live physics demonstrations.



Experiencing physics at work



Physics is fun indeed!

The department wishes all the SM2 students a great learning experience as they continue their academic journey in the university.

# 13th China-Singapore Joint Symposium on Research Frontiers in Physics

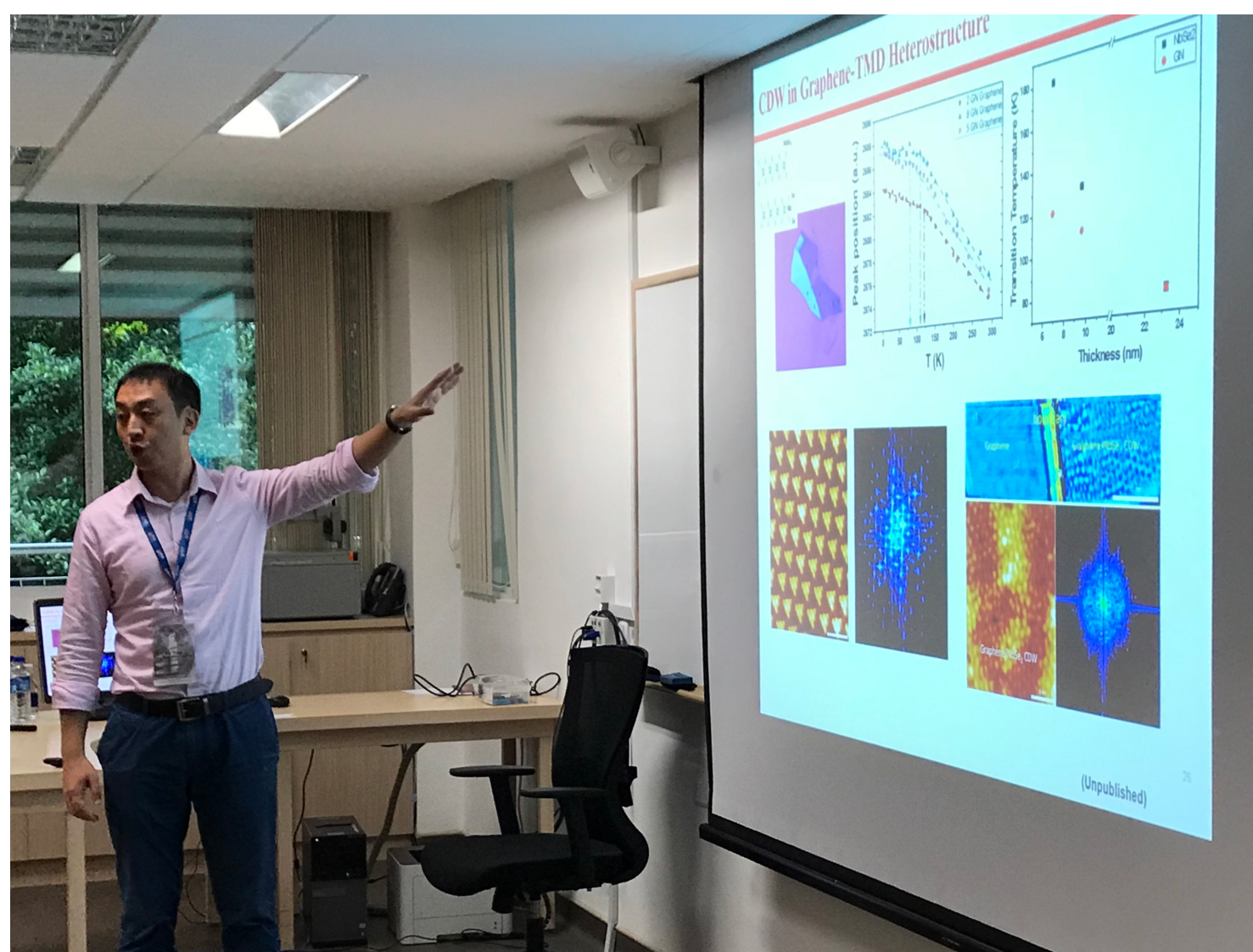


The 13th China-Singapore Joint Symposium

The China-Singapore Joint Symposium on Research Frontiers in Physics is an annual symposium that provides great opportunities for exchange of scientific ideas and in-depth discussion on the latest research endeavours by physicists from China and Singapore. The topics presented at the 13th Symposium held from 7–9 Dec ranged from biological physics, 2D materials, oxides to novel topological materials.

The Department of Physics was proud to host the symposium which attracted over 40 participants. An invitation was also extended to scientists from Nanyang Technological University and the department was encouraged by the excellent responses and feedback received at the end of the session.

It is hoped that this interactive platform will serve to inform researchers of works done at both sides, elicit discussions on the latest findings and prospective advances in the various fields as well as open up the possibilities of collaborations amongst the participants.



Presentation by Prof Yu Ting from NTU



Interaction time

# Departmental Staff Retreat 2018

A total of 39 faculty convened at Shangri-La's Rasa Sentosa on 12 Jan just before term commenced for a day of retreat. Amid the idyllic sea setting, thoughtful discussions took place among faculty throughout the day. In the agenda was a review of the department's lab curriculum and practices, identifying any new strategies and rooms for improvement, internships for physics students and outreach focus to increase physics undergraduate intake.



Prof Sow addressing staff at Staff Retreat 2018



Enjoying a tea break

Staff were divided into five groups to facilitate the discussions and presentations. An important point raised was the intended learning outcome of the undergraduate lab curriculum. Would a less-structured, more discovery-based and technical-assisted experimental design be a better approach? Issues regarding lab component weightage, manpower and resources were also brought up.



Breaking into groups for discussion



A sharing session

Evolving job landscape today will require our physics graduates to acquire more than just knowledge in the field of physics. Skills such as programming, modelling, machine learning and data analytics are becoming necessary in many emerging industries. This would imply the adjustment to emphasise more related topics in the present curriculum. Also put forward was the need to engage with industries so as to improve the employment prospect of our physics graduates.

## A Day in the Life of...

Laboratory technologist Mdm Lee Lai Bay shared about a day in her life at work. Mdm Lee is also a recipient of the IPS Crescendas Award for Outstanding ITE Engineering Physics Lecturer 2016.



Laboratory technologist Mdm Lee Lai Bay

Operating machine tools to produce precision parts and fixtures using aluminium alloy and stainless steel may sound like a masculine job but it is no tough feat for Mdm Lee Lai Bay. As a lab technologist of over 10 years with the department's workshop, Mdm Lee takes every job assigned to her seriously. Before joining NUS, Mdm Lee was already familiar with precision engineering having been in the private tool and die industry for a long time.

Appearing calm and collected as always, Mdm Lee beamed with delight as she shared unreservedly about her work. Screening through every job requirement assigned to her is something she will approach conscientiously. Not every job may be feasible given the limited resources and at times the engineering demanded. She will make sure that the technical drawings submitted are proper and does not hold any sense of ambiguity. Verifying details with the requestor is necessary if things are not clear. She also has to check the availability of tooling and material before proceeding further. A job may take a day, week or even months to complete depending on its complicity.

Whether it is serving university faculty, researchers or students, Mdm Lee handles every request with care. "My greatest job satisfaction comes when a job is completed much earlier than expected with the best quality," remarked the former ITE lecturer. Currently a judge for World Skills Singapore in the category of Computer Numerical Control (CNC) Turning, Mdm Lee has to constantly keep up with her knowledge of turning and milling technology. Her willingness to devote her time and effort to advance the course of technical education has won her the IPS Crescendas Award for Outstanding ITE Engineering Physics Lecturer last year.



*My greatest job satisfaction comes when a job is completed much earlier than expected with the best quality.*

— Mdm Lee Lai Bay



Mdm Lee Lai Bay at the department workshop

Although technology like CNC may ease or speed up the manufacturing of products, the human element involved in visualising, designing and programming the step-by-step instructions is nonetheless still paramount in the whole engineering process. A recent job request attested to this. A mechanical fixture that was to be part of a tool for a research on DNA was requested. Due to the high cost and high precision involved, no external vendors were willing to take up the job. When the workshop was approached for assistance, Mdm Lee studied its feasibility and took on this challenging task. The result was nothing short of a workable product. And more orders have come in since!

Mdm Lee believes not only in working hard but also paddling hard. An avid sea sports fan, diving, canoeing and swimming are Mdm Lee's favourites activities. She used to coach canoeing and swimming in her spare time and was honoured to be part of the National Canoeing Squad from the seventies to nineties. For some 15 years Mdm Lee represented Singapore in canoeing and was the proud recipient of multiple medals. Now she still goes kayaking though more leisurely at the MacRitchie Reservoir every weekend.



Paddling leisurely at MacRitchie Reservoir

# Awards

Congratulations to our colleagues for being the recipients of various awards!



A group photo of our awardees. Photo credits: Science Dean's Office.

## Faculty Teaching Excellence Award AY2016/2017

- Dr Chan Taw Kuei
- Prof Gong Jiangbin
- Dr Ng Wei Khim
- Dr Wang Qinghai

## Teaching Assistant Award (Full-time) AY2016/2017

- Ms Angeline Shu Sze Yi
- Mr Raditya Weda Bomantara

## Teaching Assistant Award (Part-time) AY2016/2017

- Mr Andrew Johnathan Schauf
- Mr Tan Huei Ming

## Outstanding Service Award 2017

- Ms Goh Bee Hwee
- Ms Lau Siew Keok

## National Day Awards 2017 - Public Administration Medal (Silver)

- Prof Ekert, Artur Konrad

## National Day Awards 2017 - Long Service Medal

- Ms Achuthan Prasanna
- Assoc Prof Osipowicz Thomas

## Staff Movements

Welcome all our colleagues who have just come on board! The department also thanks our ex-colleagues for all their contributions and wishes them all the best!

### Welcome On Board!

- President's Asst Prof Loh Huanqian
- Asst Prof Travis Lee Nicholson
- Ms Tao Ye
- Mr Darryl Foo Chuan Wei

### Farewell and Best Wishes!

- Prof Kuok Meng Hau
- Prof Ong Chong Kim
- Adjunct Assoc Prof Ng Chee Mang
- Ms Rosalind Wong Siaw Khiaw

### Farewell reception for Ms Rosalind Wong Siaw Khiaw on 31 Aug 2017

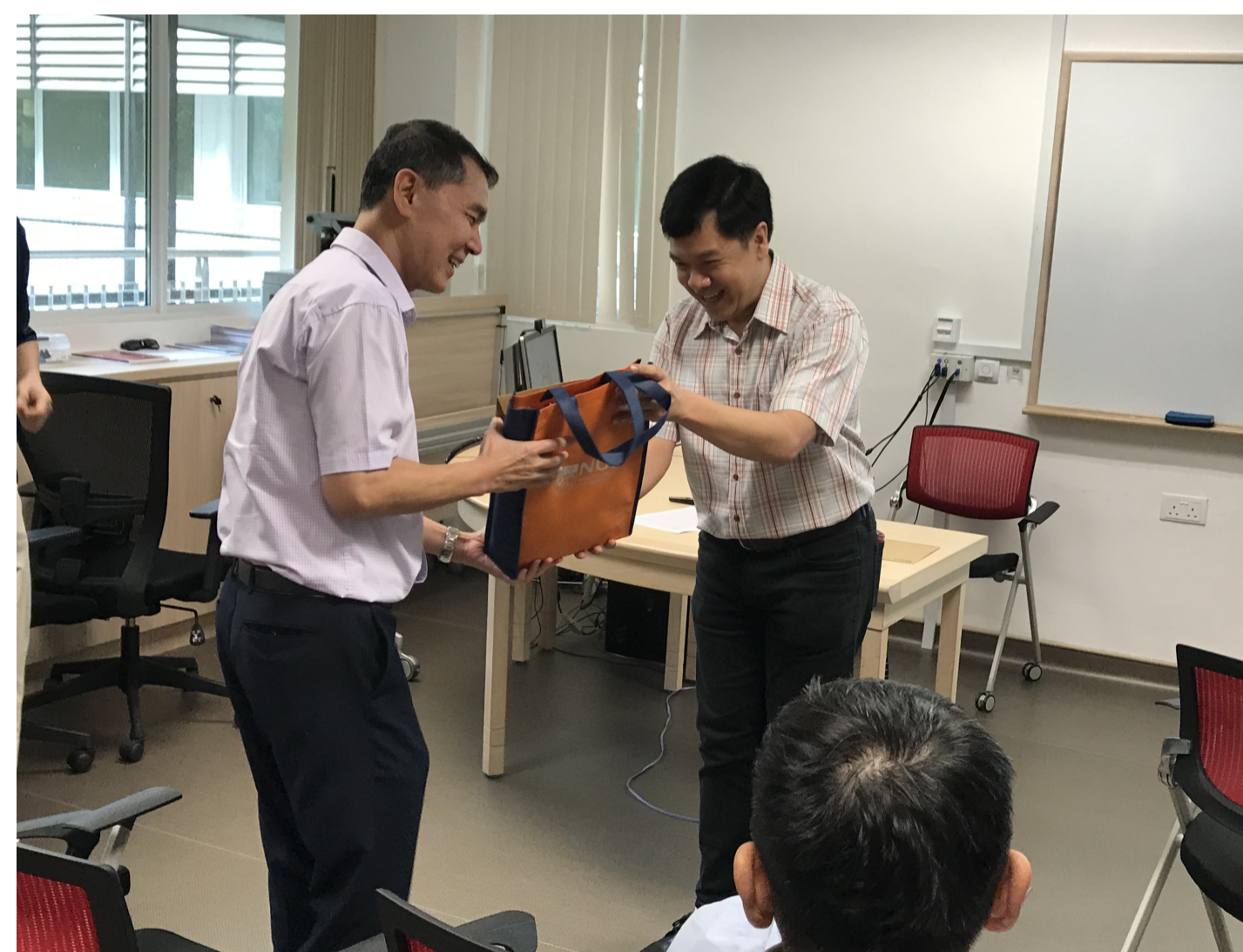


Farewell tea for Rosalind

### Farewell reception for Prof Kuok Meng Hau and Prof Ong Chong Kim on 28 Dec 2017



Farewell tea for our Profs



Prof Kuok receiving a farewell gift from Prof Sow



Reminiscing the good old days



Thank you Profs for your contribution!