

# **GRAVITAS** Apho 2019 NEWSLETTER ADELAIDE, AUSTRALIA VOL. 6 11 MAY 2019

Gravitas was inspired by the Latin word for 'Gravity', it being the fundamental force of nature that holds our universe together - much like the passion for physics that binds people of diverse backgrounds and aspirations at a momentous occasion like APhO.

# PUSHING THE BOUNDARIES OF QUANTUM PHYSICS

INSIDE

## **APhO ADDRESS**

Royal Society Fellow and 2018 Australian of the Year delivers inspiring address

## REAL-WORLD CHALLENGE

Finding a carbon neutral heating solution

## LOOKING SKYWARD

Printed by Toshiba

Observing the galaxy of stars in the Australian night sky

# FORGING AHEAD WITH QUANTUM COMPUTING

It isn't every day you get to hear from an Australian of the Year. When that person also happens to be an esteemed member of the physics fraternity, it truly makes a highlight in this APhO experience.

Yesterday, APhO delegates had the unforgettable opportunity to hear from Professor Michelle Simmons at the APhO address. A Professor of Quantum Physics at the University of New South Wales, Michelle shared how quantum computing could change the world. One of those ways was using the field in precision forecasting to reduce weather related deaths.

"People often talk about modelling physical systems. For example, as far as the weather goes, it's a very complex system of a lot of variables. If you can have a computer that looks at all those calculations in parallel, then those precisions can help predict the weather."

Other life-changing areas that could see improvements with the use of quantum computing include cancer detection, the development of superior drug-based treatments and the discovery of Earth-like planets using data collected by telescopes. The session ended with a Q&A where students took the golden opportunity to ask some questions from the quantum computing expert.



## Q&A WITH PROFESSOR MICHELLE SIMMONS



#### What is the best advice somebody has given to you?

From my father to me: Do what's easy for a hobby and what's hard for your everyday job – that way you will always be challenged.

#### What is your favourite part of the job?

Creating things that have never existed before. Interacting with students and postdocs in my lab, reading papers, pushing the boundaries of what is known and creating new tools, devices and mathematical models.

#### What do you think are the emerging physics trends to watch?

The application of machine learning to quantum control, new methods in statistical physics and new experimental technologies that allow us to control the world at the quantum limit.

#### Thoughts about closing the gender gap in STEM?

We have to be patient – it is happening. The most important thing is that women don't miss out on the exciting jobs out there in the mathematics, physics and computing space.

#### If you're not in the lab, where else would we find you?

In the library reading papers.

#### Any message to our Physics Olympians?

You live in a great place in the world. You are working in one of the most rewarding fields. Be ambitious and bold and see where pushing the boundaries of your knowledge takes you!



#### YUNUS EMRE PARMAKSIZ Turkey

"Professor Michelle not only clearly explained many technical terms and algorithms but also covered many unique aspects that are not commonly seen in other quantum computing seminars. The content was very comprehensive that I basically understood everything she explained. I got very excited when she mentioned the Shor's algorithm, which is a topic I am quite familiar with. The algorithm is about finding a prime factor of a certain amount of digital numbers. Without it, you can easily decode encryptions in any banking systems. I also asked her a question about how to differ indistinguishable particles and I received an illuminating answer. I've been thinking about pursuing my studies in quantum computing because of my passion for computing, physics and mathematics. Her talk has absolutely encouraged me to advance my knowledge of quantum physics and follow my dream."

# CONNECTING BEYOND CLASSROOM WALLS



It was a test of more than physics know-how when students were put to work yesterday in trying to revive one of Adelaide's iconic buildings, the Bicentennial Conservatory.

Standing tall at 27 metres in the Botanic Garden, the structure was once home to many tropical plant species. However, those species are on a decline as high costs and carbon emissions resulted in the enclosure's heating being switched off.

Keeping those factors in mind, it was up to these 170 brilliant young students to come up with a new heating solution to maintain tropical conditions together with the help of new peers from the Adelaide Botanic High School, which facilitated the Team Field Investigation exercise.

The investigative excursion students split from their country teams and spread into new teams before they were set off on an investigation of the conservatory's function before suggesting innovative solutions.

Assistant Principal of Adelaide Botanic High School Brontë Nicholls said the exercise was an idea in the works for the last 12 months.

"Having some of the best physics minds in the planet putting their ideas into it, whatever possibly comes out of it could be useful. They had some interesting ideas," she shared.

Indeed, some of the ideas the teams came up with included the possibility of using biofuel, solar panels or insulated glass panels to facilitate the heating. Thinking deeper, some teams also presented potential downsides to these ideas. Brontë said that the exercise was more than just about finding potential solutions.

"It's understandable when this type of activity hasn't been done before and probably hasn't been part of what people would associate with the Asian Physics Olympiad. But this has enabled international collaboration and the building of strong relationships across cultures that you don't get through the individual examinations," added Brontë.

## WHY QUANTUM PHYSICS MATTERS?

Quantum physics that emphasises energy interactions at the atomic or subatomic level, has brought significant impacts going well beyond the ultra-tiny world and into our everyday life. For example, the production of all your favourite electronic gadgets relies on the application of quantum physics. By manipulating the electron movement in solid objects, we can create semiconductors with different electronic properties that are essential for fabricating computer chips.

But humans aren't the only ones using the mysterious physics. Scientists have suggested that some birds can navigate via sensing subatomic events happening in their eyes. A light-activated protein in the birds' retina contains a pair of free electrons that can be stimulated by sunlight. Upon the activation, the electron pair becomes 'tangled' and susceptible to the surrounding Earth's magnetic field, informing the bird which direction is the north as a result.

# BENEATH THE AUSTRALIAN SKIES

A trip to Australia wouldn't be complete without a stargazing experience as the country is known for having low-light pollution. In a must-visit tour to the Stockport Observatory, students were greeted by astronomers from the Astronomical Society of South Australia. The astronomers pointed out constellations to the students, including the famous Southern Cross. Students also seized the opportunity to see the Moon and its craters, magnified up to 240 times using the resident telescopes.



It is an Aussie way to call a kangaroo.

E.g. "The baby roo is still in its mom's pouch."



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#### ACKNOWLEDGEMENT OF COUNTRY

Kaurna miyurna, Kaurna yarta, ngadlu tampinthi

The Asian Physics Olympiad Committee acknowledges that we are meeting on the traditional country of the Kaurna people of the Adelaide Plains. We recognise and respect their cultural heritage, beliefs and relationship with the land. We acknowledge that they are of continuing importance to the Kaurna people living today.





# A TRAM RIDE AWAY TO THE BEACH

Another great thing about Adelaide is our proximity to the white sandy beaches that Australia is famous for.

You can hop on a tram out the front of the University of Adelaide, and 25 minutes later you will find yourself at Glenelg Beach, Adelaide's most popular city beach.

It's a great place to relax and immerse yourself in Australian culture. Renowned for its wide beach, stunning sunsets, rich heritage, charming hotels and bustling shops, sidewalk cafés and loads of entertainment; there's no shortage of fun to be had.