

Celebrating Physics Down Under: the 20th Asian Physics Olympiad in Adelaide, Australia

MATTHEW VERDON AND ALIX VERDON
AUSTRALIAN SCIENCE INNOVATIONS, CANBERRA, AUSTRALIA
ASMS, FLINDERS UNIVERSITY, ADELAIDE, AUSTRALIA

The Australian Science Innovations, together with strong support from the Department of Industry, Innovation and Science of the Australian Government, the University of Adelaide, Flinders University and the University of South Australian, successfully organized the 20th Asian Physics Olympiad (APhO) from May 5-13, 2019 in Adelaide, Australia. More than 200 of the region's best and brightest teenagers from 22 countries and regions participated in the nine-day event.

Australian events usually commence with a Welcome to Country, a ceremony performed by an Indigenous Australian Elder to welcome visitors to the traditional lands of their people. Adelaide is sited on the land of the Kurna people, and the beautiful Welcome to Country

was performed by Jack Buckskin, a Kurna and Narunga man and speaker of the Kurna language. Jack incorporated the didgeridoo, a traditional instrument of the Yolngu people from Northern Australia and one of the oldest instruments in the world, into his welcome.

Australia's former Chief Scientist and Patron of Australian Science Innovations Professor Ian Chubb AC, Chief Scientist of South Australia Professor Caroline McMillen and Professor Fred Watson, Australia's Astronomer-at-Large attended the ceremony and welcomed the students to Adelaide. These science powerhouses also expressed their pride in standing before some of the best talented young people who have the potential to become game changers in physics.

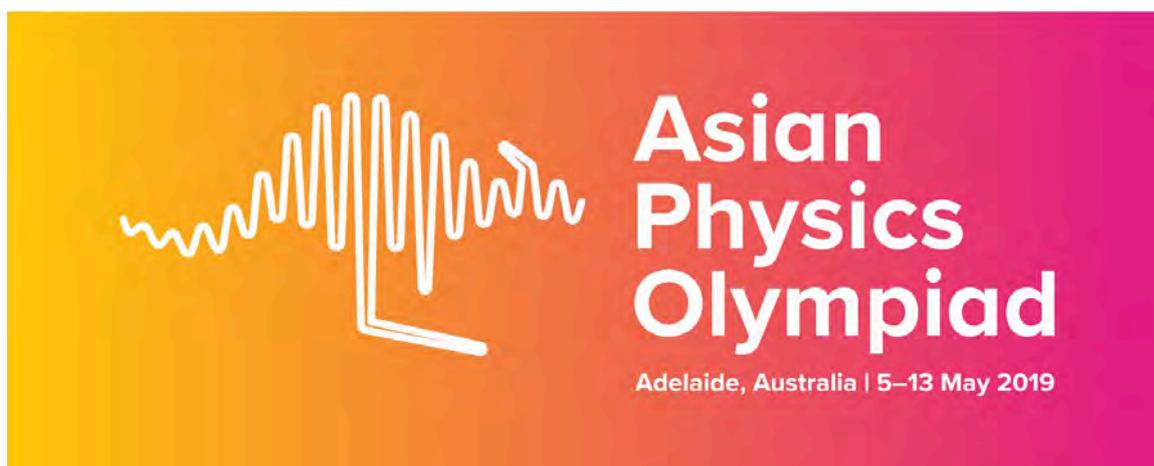




Fig. 1: Jack Buckskin at the Opening Ceremony.

For the APHO competition, the students sat for two grueling five-hour examinations, testing their skills in both theoretical and experimental physics. In the experimental competition, the students needed to figure out the properties of a ferrofluid. Ferrofluids are suspensions of nanoparticles of magnetite (Fe_3O_4) in a carrier medium, and are strongly affected by magnetic fields without holding a permanent field. Their behavior is sometimes described as superparamagnetic. Alexander Lin from the Australian team summarized the thoughts of the students: "I think ferrofluid is a deep concept for almost everybody, but it was explained very clearly. I also found it interesting to see the effects, like the peaks that formed when you put magnets nearby."

There were three interesting problems in the theoretical examination. Australia has made immense contributions to the field of quantum computing and this field was the essential motivation for the first question: a question on RF reflectometry for spin readout for silicon quantum computing. One part in the question requires the student to consider a single electron transistor comprising a quantum dot and estimating the tunneling time for a

quantum dot in terms of the effective resistance of the tunnel junction and the capacitance.

Question 2 in the theory paper focused on the topic of X-ray jets from active galactic nuclei. Active galactic nuclei are supermassive black holes which form the centers of galaxies, and emit large amounts of energy in radiation and particle flows. A special feature of many AGN are jetted outflows, which can be observed through radio emission, and sometimes in other parts of the electromagnetic spectrum, including X-rays. These jets are large flows of plasma at relativistic speeds, over lengths of order 10^{20} m, which is tens of thousands of light years away. The X-ray emission from the jets is usually dominated by synchrotron emission from relativistic electrons gyrating in the magnetic field of the jet. The students were required to consider a 1D fluid model of the jet and applied it to the Centaurus A jet.



Fig. 2: Wolfgang Pauli And Niels Bohr is a photograph by Margrethe Bohr Collection, Niels Bohr Archive, American Institute Of Physics/science Photo Library.

A Tippe top is a special kind of top that can spontaneously invert once it is set spinning. The problem of the motion of this top intrigued Wolfgang Pauli and Niels Bohr at the inauguration of the new Institute of Physics at Lund, Sweden, 1954. The third question centers around the problem of the Tippe top.

Sabine Dragoi from the guest country, Romania, aptly summed up the feelings about the theory examination. "The theoretical exam has three problems and one of them was mechanics, but it was pretty challenging be-

cause it has three different reference systems and we need to choose which one to use. The other question was related to quantum computing, and the final one was about super productive astronomical jets involving protons and particles.”

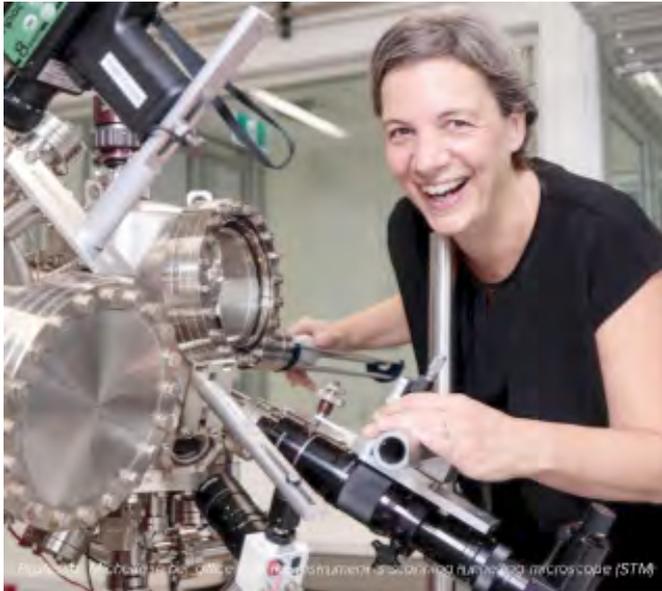


Fig. 3: Michelle Simmons with her toys at the University of New South Wales.

The 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.

Michelle said: “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.”

Many leaders, comprising principally of University pro-

fessors, officials and teachers from the Ministry of Education from various countries and regions, were deeply impressed with the quality of the examination questions and the warm hospitality of the organizers throughout the event. One of the leaders, Fabiola Lip from Singapore, remarked at the end of the Olympiad, “The Australians are very hospitable and despite the cool weather you just feel warmth everywhere. They go out of their way to make us feel very welcome. I have been involved in the Olympiads for the last 18 years and always looked forward to Australia hosting the Olympiads. It’s finally here now.”

The Olympiad ended with the total award of 9 Gold medals, 16 Silver medals, 33 Bronze medals and 29 Honorable Mentions to the participants. Grigorii Bobkov. (Russia) received the Absolute winner Award, Ruoyu Chan (China) received the Best Performance in Theoretical Examination and Rassul Magauin (Kazakhstan) received the Best Performance in Experimental Examination. The Association of Asia Pacific Physical Societies typically also awards two prizes at the Olympiad: Grigorii Bobkov (Russia) received the best male contestant award and Shu Ge (Singapore) received the best female award. The Material Research Society of Singapore gave away two prizes: Grigorii Bobkov (Russia) for theory and Chun-Wang Chau (Hong Kong) for experiment.



Fig. 4: The "I need help" sign at the experimental round at the Olympiad: The experimental problem was an interesting question on ferrofluids.



Matt Verdon has a PhD in plasma astrophysics. He has been Director of the Australian Physics Olympiad program with Australian Science Innovations since 2009, and has worked at the Australian Science and Mathematics School (ASMS) since 2014.



Alix Verdon has a PhD in space plasma physics and has worked with Australian Science Innovations in the Physics Olympiad, as Deputy or Assistant Director, since 2010. Matt was the Chairperson for the Academic Committee at the 20th Physics Olympiad and Alix was the Head of Examinations.