Outreach and engagement in Australia and the Indo-Pacific region

A J Mitchell
Department of Nuclear Physics, Research School of Physics, The Australian National University, Canberra, ACT 2601, Australia

aj.mitchell@anu.edu.au

Abstract. Outreach and engagement activities have been core functions of the Australian National University Department of Nuclear Physics for many years. Staff and students of the Department play an important role in educating local high school students, Australian Federal Government employees and the general public. As the ‘national’ university, we also accept a social responsibility to undertake endeavours that align with Australia’s broader strategic priorities. One of these is to make a positive, sustained contribution to the overall growth and development of our geographical neighbours. Here, I report on the existing program of local outreach at the ANU Heavy Ion Accelerator Facility, selected international engagement activities and comment on opportunities for future growth.

1. Why bother?
Inquiry-based learning is known to improve science literacy and confidence in students [1]. Physics undergraduates at the Australian National University (ANU) are often exposed to research projects of international quality at an early stage. Granting access to the university’s world-leading research infrastructure also presents a special learning opportunity for the ‘next generation’ of scientists: the high school students. The ANU Department of Nuclear Physics has made a sustained contribution to outreach projects with the Canberra community for many years. Benefits of these activities are multifaceted, but the primary goal is to deliver a positive contribution to physics education at the secondary level. By exposing these young minds to cutting-edge research and communicating the excitement of science research, the value-add of these activities is that many decide to continue into further education and choose ANU as their place to do so. An additional benefit comes through opportunities for graduate students to gain experience in communicating their research to a non-technical audience.

The ANU is one of the most international universities in the world. As Australia’s ‘national’ university, it delivers academic activities that are not only vital to the nation, but also to the neighbouring Asia-Pacific region. A prosperous region ultimately benefits Australia, through economic growth and political stability. Yet, the relationships are complex and delicate, spanning 12,000 km, 60% of the world’s population, over 50 nations, and dozens of cultures. This is noted as a core ‘Strategy for Change’ in the ANU Strategic Plan 2019-2022 [2].

The ANU College of Science is committed to expanding engagement in the region through research and education activities. Academic staff in the Department of Nuclear Physics are playing a leading role in delivering these goals. Some of these projects leverage on existing relationships, while
others are the result of new partnerships between institutions that have formed for the first time. This article provides a very brief overview of some of the outreach and engagement activities of the ANU Department of Nuclear Physics.

2. Local activities of the Department of Nuclear Physics

Many of the local NP outreach activities are undertaken at the ANU ‘Heavy Ion Accelerator Facility (HIAF)’ [3]. HIAF is the largest component of the ‘Heavy Ion Accelerators (HIA)’ project funded by the Australian Government’s ‘National Collaborative Research Infrastructure Strategy (NCRIS)’ program [4]. The HIAF laboratory is the national facility that supports Australia’s experimental research in fundamental nuclear science, accelerator mass spectrometry and advanced materials development with accelerated heavy ions.

At the heart of the facility is the 14UD tandem Van de Graaff accelerator; a 6-MeV/q superconducting ‘booster’ linear accelerator is also available. Ten working beamlines deliver energetic ions to bespoke research stations, each one optimised for its particular purpose. In addition to being a world-class research facility, the HIAF laboratory offers a unique learning experience for the hundreds of external visitors that are welcomed each year. HIAF houses a dedicated teaching laboratory, that is made up of semi-retired research equipment. Two stations with lead-shielded High-Purity Germanium (HPGe) detectors and six NaI(Tl) scintillator detectors are available on a permanent basis. Additional space is available for ad-hoc operation of a variety of other radiation-detection experiments, as and when they are required.

2.1. Secondary-level Education at HIAF

The ANU Research School of Physics makes a sustained contribution to secondary-level physics education through on-campus demonstrations and visits to local schools [5]. HIAF operates 10-15 outreach events, on average, each year. The majority of these are from school groups, with which long-standing relationships have been developed over many years. Groups of 20-30 students ranging from ages 14-18 are common. On a typical school visit, each group is divided into two. Half of the students will be taken on a walking tour of the HIAF accelerator laboratory, where they learn about the equipment and local research programs that are ongoing. At the same time, the other students conduct experiments in the teaching laboratory. Here, they are exposed to the variety of different radiation-detection techniques, gather data, perform simple tasks such as performing energy calibrations and identifying unknown radioactive material from their gamma-ray signature. At the mid-way point, the groups swap over, before coming back together at the end for a summary and closing remarks. Anecdotal feedback from the teachers and students suggest that the school visits area highly valuable part of their learning. “Ionising radiation and nuclear reactions” is a major component of the national senior secondary physics curriculum [6]. The hands-on activities undertaken on these visits allow a deeper understanding of the content to be developed.
2.2. Broader engagement with the Australian community
While we are proud of our sustained contribution to local education, it is important to consider these activities with a view to access and equity. There are many socio-economic factors that might inhibit a school’s ability to travel to HIAF – constraints on annual budgets being a primary concern. Australia is the sixth largest nation, yet it’s population density of 3 people per square kilometre makes it one of the most sparsely populated in the world – more than 80% of the population lives within 100 km of the coastline. However, what about the other 20%? Away from the urban sprawl, equitable access to many opportunities remains challenging in remote and very remote areas. On attempt to address this is to make content available online. A virtual tour of HIAF, featuring videos and explanations of the science and research infrastructure is now available online [7]. Data from the gamma-ray experiments performed in the HIAF teaching lab are also freely available on request, along with worksheets and instructions for teachers.

More broadly, the ANU Physics Education Centre is engaged with the high-school curriculum through the ‘Modular Education Resources in STEM (MeriSTEM) project [8]; a volunteer-driven initiative that delivers online teaching resources on the Year 11 and 12 Physics Curriculum to schools across Australia. Academics and students from ANU also contribute regularly to public outreach events across Canberra, such as the popular “Physics in the Pub” and “Science in the Pub” events.

3. Engagement in the Asia-Pacific region
Strengthening engagement in The Pacific is one of the highest priorities outlined in the Australian 2017 Foreign Policy White Paper [9]. The aim here is to build a region that is secure, economically and politically stable. Since its beginnings, the ANU has made a leading contribution to understanding Australia’s role in the region; the Research School of Pacific Studies was a founding institution of the university in 1946. This ethos continues to this day and forms a major component of the ANU Strategic Plan 2019-2022 [2]. More recently, Physics at ANU has taken on a growing level of engagement with the region. Much of this work has developed through relationships in research and education that have grown over many years; others are still in their infancy. Development and capacity building through education has opened new opportunities for collaboration in the last three years. Two examples are outlined below: Myanmar and Timor-Leste.

3.1. Myanmar
The ANU is home to one of the largest centres for Myanmar/Burma research in the world and plays a central role in regional debate on the country’s political, social and economic change and reform. First contact between the ANU Department of Nuclear physics and the University of Yangon (UY) in

Figure 2. Tertiary-level engagement in Yangon, Myanmar (November 2018). A group of University of Yangon academics in STEM areas attend a training workshop in ‘Research Excellence and Student Supervision’ delivered by a cross-disciplinary team from the Australian National University. Photograph supplied ©AJ Mitchell.
southern Myanmar came in 2016. The ANU Myanmar Research Centre put out a call for academics, with particular emphasis on science disciplines, to apply for funding that would facilitate reciprocal visits between ANU and UY staff. The UY Department of Physics has a long-standing interest in nuclear science, dating back to at least the early 1980s Technical Co-operation Projects with the International Atomic Energy Agency [10]. And so, a collaboration based on capacity building through research training and education was begun and has continued to flourish over the last three years.

The UY Department of Physics staff and students exude passion for their research areas but have limited access to many vital resources. Commodities that are often taken for granted in Australia, such as steady power supply and internet access, are intermittent. However, there is a real passion for change within the university and a strong commitment to raise the standards in research and education. ANU-UY physics partnership seeks to address both of these areas. To date, activities in Yangon have included delivery of an intensive short course in ‘Fundamentals of Nuclear Science’ to ~50 academics and students from the Yangon area in 2017, and multidisciplinary ‘Research Excellent and Student Supervision’ and ‘Curriculum Design’ workshops with ~60 UY senior lecturers in 2018. Future engagement in this space is likely to be focused on UY’s desire to create a new cross-discipline flexible undergraduate curriculum that integrates opportunities for research and internships; something that ANU is well placed to contribute to.

3.2. Timor-Leste

Physics at ANU is also engaged in capacity building through basic education in developing nations, such as Timor-Leste. Timor-Leste lies just 700 km northwest from the city of Darwin on Australia’s northern coastline, making it one of the nation’s closest neighbours and accessible by air in little more than an hour. Timor-Leste became the first new sovereign state to be declared in the 21st century; emerging from decades of conflict that left most of its public services and government structures severely depleted. The current Government identified education as a priority in its Strategic Development plan (2011-2030) [11]. However, large classrooms, a lack of resources and a curriculum written in Portuguese but delivered in Tetum are contributing factors to limited growth in this area.

The ANU College of Science has been training East Timorese high-school teachers for four years now. Academics from the Research Schools of Biology and Physics travel with Canberra-based high school teachers to the Bobonaro district, 150-km southwest of the capital, Dili. This project is coordinated through the Colegio Maliana and, each year, 30-40 local teachers attend training and development workshops delivered by the Australian team. The primary goal is to upskill the teachers in classroom management, scientific methods, and practical demonstration and application of concepts that would normally be attempted via, challenging, rote-learning methods. The team will travel to Timor-Leste again in late 2019, with an added focus on building teacher confidence and development of these experiment demonstrations in their own classroom.

![Teacher training in Malinana, Timor-Leste (October 2018). The proximity of Timor-Leste to Australia places increased importance on positive bilateral relations. Photograph supplied ©AJ Mitchell.](image-url)
4. Future prospects

Personal relationships are the key to evolving ideas in the space into successful, sustainable activities. Patience, open-mindedness and a willingness to step outside traditional comfort zones go a long way as well. Expansion of engagement and outreach activities in the Asia-Pacific region is a strategic priority of ANU Physics. Many exciting projects are on the horizon, spanning over 12,000 km from India to Samoa. Variation in cultures and levels of development across this vast region are broad-ranging, and so each opportunity is considered on a case-by-case basis. Physics is one of the most internationally collaborative Research Schools at the ANU; it is hoped that some of the emerging partnerships in education and training will lead to new long-lasting research collaborations.

The Australian National Centre for the Public Awareness of Science (ANU CPAS) is currently undertaking the ‘Science Circus Pacific’ education research project [11], sponsored by the Australian Government Department of Foreign Affairs and Trade. This project aims to build capacity in the Pacific Island Nations through science outreach and training using low-cost everyday materials. Through CPAS, ANU Physics has begun communicating with the University of South Pacific about potential teacher-training opportunities. These will be explored in greater depth in early 2020.

Acknowledgements

The broad range of activities discussed above are only possible thanks to the countless hours that are volunteered by a large number of people. Prof Greg Lane has been a leading figure in operating and developing the HIAF laboratory and developing the relationships the Department has with local high schools. Dr Ed Simpson has created excellent online material, such as the HIAF online tour and Colourful Nuclear Chart. Enthusiastic contributions from NP research students are an essential part of the work we do. Sustained efforts of HIAF technical staff in maintaining the accelerator facility are gratefully acknowledged. Dr Margaret Kiley and Dr Charlotte Galloway (ANU College of Arts and Social Sciences) were collaborators on the 2018 training activities in Myanmar. Dr Robert Sharwood (ANU Research School of Biology and ARC Centre of Excellence for Translational Photosynthesis), David Johns and Carly Conlan (St. John Paul II College, Canberra) were collaborators on the 2018 training activities in Timor Leste. AJM wishes to acknowledge financial support of the international projects from the ANU Research School of Physics, ANU College of Science, ANU Myanmar Research Centre, ARC Centre of Excellence for Translational Photosynthesis and Australian Government Department of Foreign Affairs and Trade.

References

[1] Gormally, Cara; Brickman, Peggy; Hallar, Brittan; and Armstrong, Norris (2009) "Effects of Inquiry-based Learning on Students’ Science Literacy Skills and Confidence,” International Journal for the Scholarship of Teaching and Learning: Vol. 3: No. 2, Article 16. Available at: https://doi.org/10.20429/ijisotl.2009.030216
[2] Australian National University Strategic Plan 2019-2022, last accessed 23 August 2019, <https://www.anu.edu.au/about/strategic-planning/anu-strategic-plan-2019-2022>.
[3] Australian National University Heavy Ion Accelerator Facility, last accessed 23 August 2019, <https://physics.anu.edu.au/nuclear/hiaf.php>.
[4] Australian Government National Collaborative Research Infrastructure Strategy information sheet on the Heavy Ion Accelerators project, last accessed 23 August 2019, <https://docs.education.gov.au/documents/information-sheet-heavy-ion-accelerators-hia>.
[5] Australian National University Outreach program, last accessed 23 August 2019, <https://physics.anu.edu.au/engage/outreach>.
[6] The Australian Curriculum: Senior Secondary Education, last accessed 23 August 2019, <https://www.australiancurriculum.edu.au/senior-secondary-curriculum>.
[7] Australian National University Heavy Ion Accelerator Facility Online Tour, last accessed 23 August 2019, <https://physics.anu.edu.au/tour>.
[8] Australian National University Physics Education Centre MeriSTEM project, last accessed 23 August 2019, <https://physics.anu.edu.au/engage/outreach>.
[9] The Australian Curriculum: Senior Secondary Education, last accessed 23 August 2019, <https://www.australiancurriculum.edu.au/secondary-curriculum>.
[10] Australian National University Heavy Ion Accelerator Facility Online Tour, last accessed 23 August 2019, <https://physics.anu.edu.au/tour>.
[11] Australian National University Physics Education Centre MeriSTEM project, last accessed 23 August 2019, <https://physics.anu.edu.au/engage/outreach>.
August 2019, <http://meristem.anu.edu.au/>.

[9] Australian Government 2017 Foreign Policy White Paper, last accessed 23 August 2019, <https://www.fpwhitepaper.gov.au/>.

[10] International Atomic Energy Agency Department of Technical Co-operation, Country Program Summary IAEA-CPS-95/22 (1995).

[11] Science Circus International, Australian National Centre for the Public Awareness of Science, last accessed 23 August 2019, <https://cpas.anu.edu.au/research/research-projects/science-circus-international-capacity-building/>.