THE AUSTRALIAN INSTITUTE OF NUCLEAR SCIENCE AND ENGINEERING

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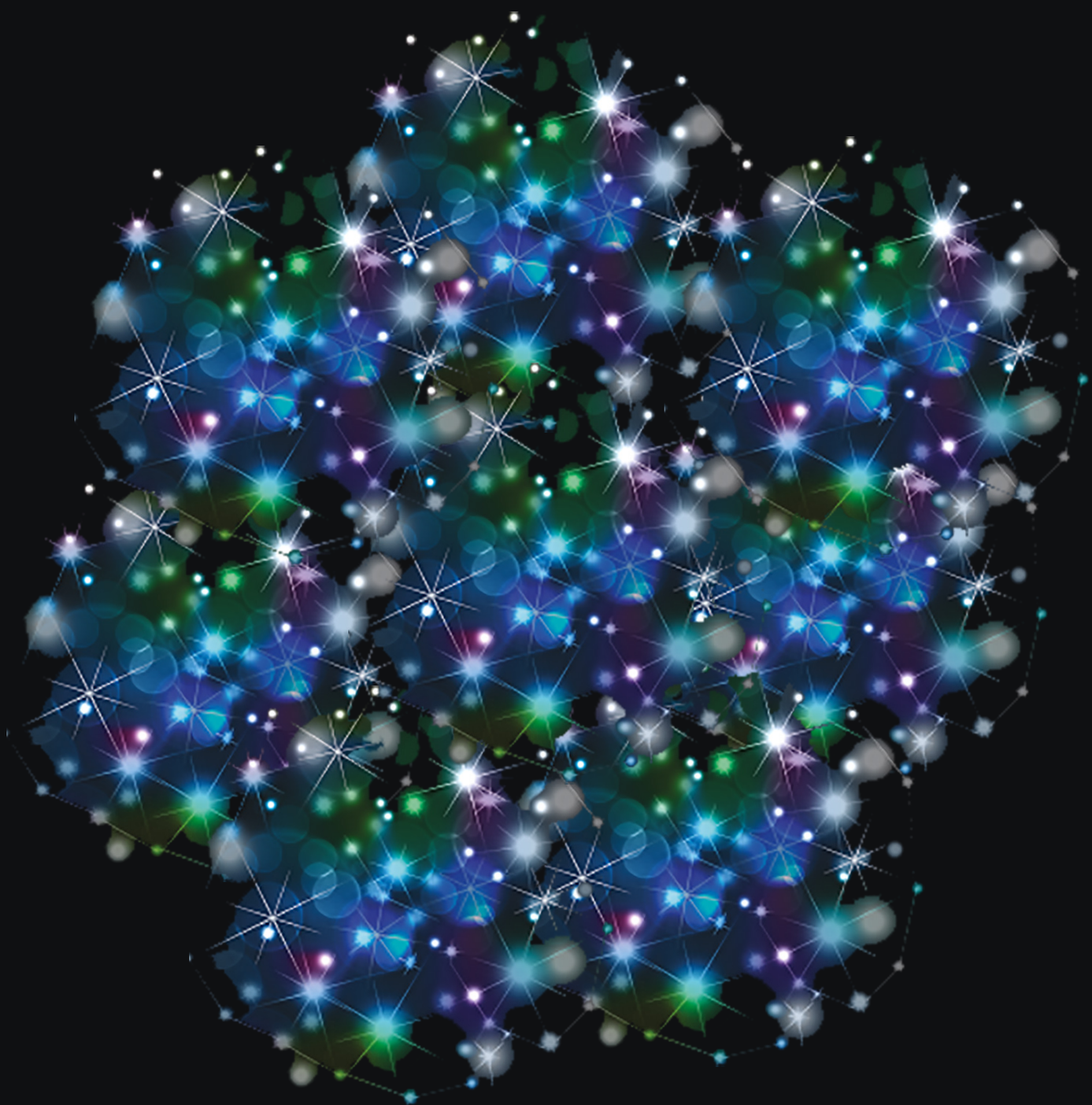

Annual Report 2016

Facilitating **Access** to landmark scientific infrastructure

Engaging with **Industry** to enhance funding opportunities and ensure relevance of nuclear education and training

Providing an effective **Network** between all stakeholders of nuclear science and engineering

Stimulating and supporting students and early career researchers in pursuing a career in nuclear science and engineering

Playing a leading role in nuclear **Education** and training

AINSE THE AUSTRALIAN INSTITUTE OF NUCLEAR SCIENCE AND ENGINEERING

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AINSE 2016 Annual Report

From the President and the Managing Director

2016 was a busy and fruitful year at the Australian Institute of Nuclear Science and Engineering (AINSE). Highlights included changes in the constitution to facilitate new membership categories, new leadership, various networking events, and continued and new programs aimed at achieving AINSE's vision of enhancing capability in nuclear science and engineering by facilitating world class research and education.

This year AINSE has undergone a change in leadership. In April 2016 Dr Paul Di Pietro the Managing Director, on secondment from the Australian Nuclear Science and Technology Organisation (ANSTO), left AINSE to undertake a new role as the Head of Integration and Innovation at ANSTO. We thank Paul for his service to AINSE. Prior to leaving, Paul finalised the signing of a memorandum of understanding between AINSE and ANSTO to confirm the commitment of both parties to continue their positive relationship in supporting nuclear science and engineering.

Ms Michelle Durant was appointed as Interim Managing Director in April whilst recruitment was undertaken by the AINSE Board to fill the role. Michelle was successful in this recruitment process and her term appointment confirmed in October. Michelle brings a deep knowledge of the AINSE business and AINSE is able to take advantage of her extensive operational talents and utilise her leadership talents.

Other changes include welcoming the new AINSE President Professor Claire Lenehan, who replaced E/Professor Robert Burford as President at the end of May 2016. AINSE welcomed Claire to this role and we thank Rob for his stewardship of AINSE in changing times. Rob had been instrumental in board recruitment and providing stability for the company. Rob continues to remain as a Director on the AINSE Board.

At the Annual General Meeting in May the members voted for a change to the constitution to have three membership levels. The membership categories are now: institutional members (this includes the 41 university members, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Defence Science and Technology Group (DSTG) and ANSTO), industry members and individual members. This change will allow for a new growth in membership numbers in the future. This is a very exciting opportunity for AINSE to assist in undertaking a role in linking institutions and industry and to invite individuals to be a part of this new diverse range of members. This change supports AINSE's strategic priority to diversify the membership base.

AINSE held two networking events this year. The first was a combined specialist committee and council dinner prior to the Annual General Meeting in May and the second at the general meeting in December. These events bought together representatives from our existing membership base, to network and build collaborations and links between organisations.

Two roadshows were held in 2016 to highlight the facilities at ANSTO and the offerings available through AINSE. These were held in South Australia and Queensland. The South Australian event was hosted by the University of Adelaide, with researchers and students also attending from Flinders University and the University of South Australia. The roadshow in Queensland was hosted by the University of Queensland, giving the opportunity for students and researchers to attend from the neighbouring university members, the Queensland University of Technology, Central Queensland University and Griffith University.

AINSE staff participated at various conferences as a part of the outreach for the company with opportunities to talk at the Australasian Soft Matter Scattering Workshop, the Radiation Damage Conference and the Australian Synchrotron New User Symposium in Victoria, the Australian Earth Sciences Convention in South Australia, and the Society of Environmental Toxicology & Chemistry (SETAC) conference in Tasmania. Staff also gave presentations at RMIT University and the University of Tasmania.

AINSE continued to offer a suite of scholarships that attracted excellence in research. Thirty-one new PhD students were welcomed in 2016 bringing the total cohort in the year to 80 students from 28 universities. Honours scholarships were awarded to 27 students from 15 different universities as well. There was a strong representation of applications from across all of the specialist committees in archaeology and geosciences, environmental sciences, materials science and engineering and biotechnology and biomedical sciences.

Fourteen students from 10 different universities were funded for international travel scholarships to allow support for them to present their research in 11 different countries. AINSE also participated in an international exchange program with

France, the Australian National University and ANSTO by supporting a student from France to undertake an internship at the University with a component of work experience at ANSTO. This led to further discussion and the development of a possibility of signing a memorandum of understanding with ANSTO and the French Embassy to further collaborations in nuclear science and engineering between the 2 countries.

AINSE applied in September 2016 for funding under the government National Innovation and Science Agenda (NISA) for the Women In STEM and Entrepreneurship program. It was announced in December 2016 that AINSE was successful and was one of 24 organisations to receive funding under this new government initiative. AINSE will now be able to hold a school for first year undergraduate female students from its institutional member universities in late 2017.

The announcement of the Australian Synchrotron transferring to ANSTO occurred in 2016 and allows AINSE the ability to expand its offerings to researchers at the Australian Synchrotron. This change is welcomed by all members and will expand the opportunities for all AINSE researchers to interact with facilities in multiple locations.

The AINSE Winter School was a huge success celebrating 20 years of participation. We thank Honorary Fellow Professor Henk Heijnis from ANSTO for his service to AINSE in being a key player in almost every Winter School undertaken by AINSE. The theme this year was 'Extreme Environments' and we were fortunate to have a panel of environmental scientists to lead us on this journey. The students were also fortunate to attend a presentation by Dr Paul Fraser from CSIRO during this event and to spend time with Dr Adi Paterson the Chief Executive Officer of ANSTO who gave an inspiring talk to the students at the official close of the school.

This year for the first time AINSE took the lead role for Australia by organising celebrations for Nuclear Science Week with the Managing Director participating on the international steering committee for this event. Nuclear Science Week is an initiative organised by the Smithsonian affiliated, National Museum of Nuclear Science & History in Albuquerque, New Mexico. This week is celebrated every year in the USA and globally and coincided with the AINSE Post Graduate orientation week. AINSE invited different nuclear societies such as the Australian Nuclear Association (ANA), the Australian Young Generation in Nuclear group (AusYGN), Women in Nuclear (WiN), the Australian Neutron Beam User Group (ANBUG) and all ANSTO staff to participate in these celebrations. The keynote speakers were Dr Maria Rost-Rublee from Monash University, who gave a talk on what nuclear means to Australians, and Dr Helen Brand who gave an overview of research in planetary sciences at the Australian Synchrotron and the Australian Centre for Neutron Scattering.

In 2016 our members that were awarded facility time through the ANSTO portal were provided travel and accommodation support by ANSTO. This was an agreement made under the ANSTO and AINSE memorandum of understanding and is an important benefit for eligible members.

We would like to thank the AINSE team for their commitment to the company in 2016. The AINSE secretariat is a small multitasking team that helps the company grow and seek new opportunities wherever possible and we are very grateful for their efforts this year. We would also like to thank our member organisations that are represented through their councillors and extend thanks to the CEO of ANSTO Dr Adi Paterson for his support and the continued support of the ANSTO staff.

Lastly we finish by congratulating our Gold Medal recipients for 2016. Gold Medals were announced for Professor George Collins (posthumously), Dr Emily Reynolds and Professor Ian Gentle. These medals reflect the scientific excellence achieved through the AINSE and ANSTO collaborations and provide recognition for this excellence in research in nuclear science and engineering.

We look forward to more opportunities for AINSE members in 2017 and beyond and present this report with great enthusiasm.

Professor Claire Lenehan - President

Michelle Durant - Managing Director

Enhancing Australia's capability in nuclear science and engineering by facilitating world-class research and education

AINSE Board 2016

E/Prof Robert Burford
President / Independent Director

Prof Claire Lenehan
University Representative / President

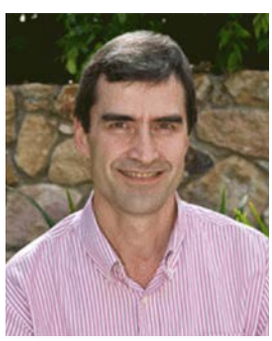
Dr Paul Di Pietro
Managing Director
(resigned 03/04/2016)

Ms Michelle Durant
Managing Director
(appointed 04/04/2016)

Dr Peter Coldrey
Independent Director

Prof Lyndon Edwards
ANSTO Representative

Dr Richard Garrett
ANSTO Representative



Prof Ian Gentle
University Representative

Ms Roslyn Hatton
ANSTO Representative

Prof Ian Smith
University Representative

Research Highlights

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Materials Science and Engineering p. 23

ITRAX, ^{13}C NMR and radiometric dating reveal distinct histories of carbon sequestration across four coastal wetlands

Jeffrey J. Kelleway[1,2], Neil Saintilan[2], Peter I. Macreadie[3], Jeffrey. A. Baldock[4], Henk Heijnis[5], Atun Zawadzki[5], Patricia Gadd[5], Geraldine Jacobsen[5], and Peter J. Ralph[1]

[1] University of Technology Sydney; [2] Macquarie University; [3] Deakin University; [4] CSIRO; [5] ANSTO

Jeffrey Kelleway collecting soil cores from Port Stephens estuary, NSW

Coastal wetlands including saltmarshes and mangroves are being increasingly recognised for their capacity to naturally sequester carbon from the atmosphere. This is because: (1) these wetlands are highly productive in converting CO_2 into plant biomass; (2) they can trap particulate organic carbon from local and/or catchment sources; and (3) their biogeochemical conditions slow the decay of organic matter. Subsequently, carbon rich sediments and biomass may continue to accrete over centuries and millennia, doing so faster and more permanently than most terrestrial habitats.

Despite the stability implied by such carbon preservation, coastal wetlands are actually dynamic systems, which respond to changes imposed by geomorphic evolution, climatic, sea-level and anthropogenic influences. In this study we reconstructed environmental histories and biogeochemical conditions in four wetlands in SE Australia, with the broad objective of assessing the importance of historic factors to contemporary organic carbon stocks and accumulation rates. ^{210}Pb profiles were used to determine rates of surface sediment accretion and carbon accumulation, while targeted ^{14}C dating of organic materials was used to determine timelines of carbon inputs and preservation.

Despite the four study sites showing similarities in terms of their surface vegetation composition, our reconstruction showed distinct environmental histories among the sites. High carbon stocks were associated with the presence of a mangrove phase below the contemporary saltmarsh sediments in just two of the four study sites. ^{13}C NMR analyses showed the historic mangrove root carbon to be remarkably stable in its molecular composition despite some samples being in excess of 1500 years old. Magnetic susceptibility and elemental ratios determined by ITRAX core-logging showed the importance (and temporal variability) of catchment inputs to some sites, while substantial amounts of charcoal carbon derived from catchment fires were observed in one of the four sites.

Together, these results highlight that vegetation history, biogeochemical conditions and catchment processes all influence the storage and preservation of carbon in coastal wetlands. This study has also demonstrated the ways in which radiometric dating, ITRAX and spectrometric methods can increase our understanding of coastal wetland development and carbon storage.

This project was supported by AINSE PGRA (ALNSTU11903); the Climate Change Cluster (University of Technology Sydney), CSIRO Coastal Carbon Cluster, and the ANSTO Institute for Environmental Research. •

Preserved plant roots make an important contribution to the long-term storage of carbon in coastal wetlands.

What is the role of fire in driving long-term coupled terrestrial-aquatic ecosystem dynamics? An integrated biophysical and geochemical analysis

Dr Michael-Shawn Fletcher and Kristen Beck
The University of Melbourne, School of Geography

Tropical El Niño Southern Oscillation (ENSO) is an important influence on natural systems and cultural change across the Pacific Ocean basin. El Niño events result in negative moisture anomalies in Australia and are implicated in droughts and catastrophic wildfires. An amplification of tropical El Niño activity is reported in the east Pacific after ca. 6.7 ka; however, proxy data for ENSO-driven environmental change in Australia suggest an initial influence only after ca. 5 ka.

We reconstructed changes in vegetation, fire activity, and catchment dynamics (e.g. erosion) over the last 14.6 ka from part of the southwest Pacific in which ENSO is the main control of interannual hydroclimatic variability: Paddy's Lake, in northwest Tasmania (1065 masl), Australia. Our multi-proxy approach includes analyses of charcoal, pollen, geochemistry, and radioactive isotopes to reconstruct fire, vegetation, and catchment dynamics.

Our results reveal a high sensitivity of the local vegetation to climatic change, with an expansion of non-arboreal pollen between ca. 14.6-13.3 ka synchronous with the Antarctic Cold Reversal and a hypersensitivity of the local vegetation and fire activity to ENSO variability recorded in the tropical east Pacific. Early Holocene rainforest vegetation shows a response to an increase in moisture delivered by the Southern Westerly Winds, while the mid to late Holocene (between ca. 6.3 ka and 3.4 ka) are characterised by increased fire activity in response to increases in tropical El Niño activity.

We observe a regional hydroclimatic shift at ca. 6.7 ka, synchronous with the first period of 'modern' ENSO variability recorded in the tropical Pacific (Figure 2), and we detect local-scale shifts in vegetation, fire, and sediment geochemistry at ca. 6.3, 4.8 and 3.4 ka, simultaneous with increases in El Niño activity in the tropical Pacific (Figure 2). Finally, we observe a fire-driven shift in vegetation from a pyrophobic association dominated by rainforest elements to a pyrogenic association dominated by sclerophyllous taxa following a prolonged (>1 ka) phase of tropical ENSO-amplification and a major local fire event at ca. 3.4 ka.

Our results reveal the following key insights: (1) that ENSO has been a persistent modulator of southwest Pacific climate and fire activity through the Holocene; (2) that the climate of northwest Tasmania is sensitive to long-term shifts in tropical ENSO variability, and (3) that there has been possible stationarity in the spatial influence of ENSO over this region through the Holocene.

We would like to acknowledge AINSE for granting this award (ALNGRA15003) and the assistance of Geraldine Jacobsen and Henk Heijnis, where XRF data (Figure 2) and a robust age model (Figure 1) has assisted in determining the importance of ENSO at Paddy's Lake, Tasmania. The findings of the research are part of a wider ongoing study by Dr. Michael-Shawn Fletcher tracking the drivers, impact and legacy of fires in southeast Australia (Australian Research Council award: DI110100019 and IN140100050). •

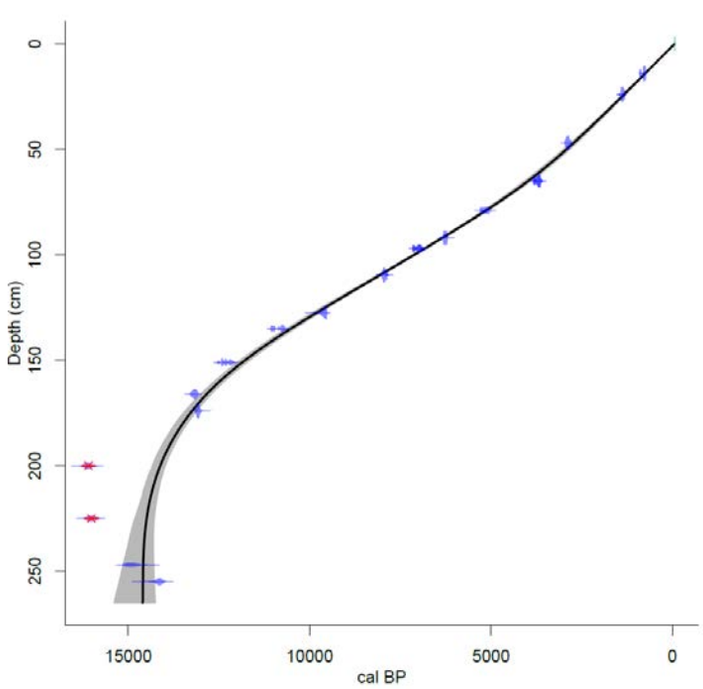

Figure 1 Age-depth model developed in clam v2.2 (Blaauw, 2010) using SHCal13 (Hogg et al., 2013) and employing a smooth spline (factor=0.50; goodness-of-fit of 83.38). Outliers are marked in red.

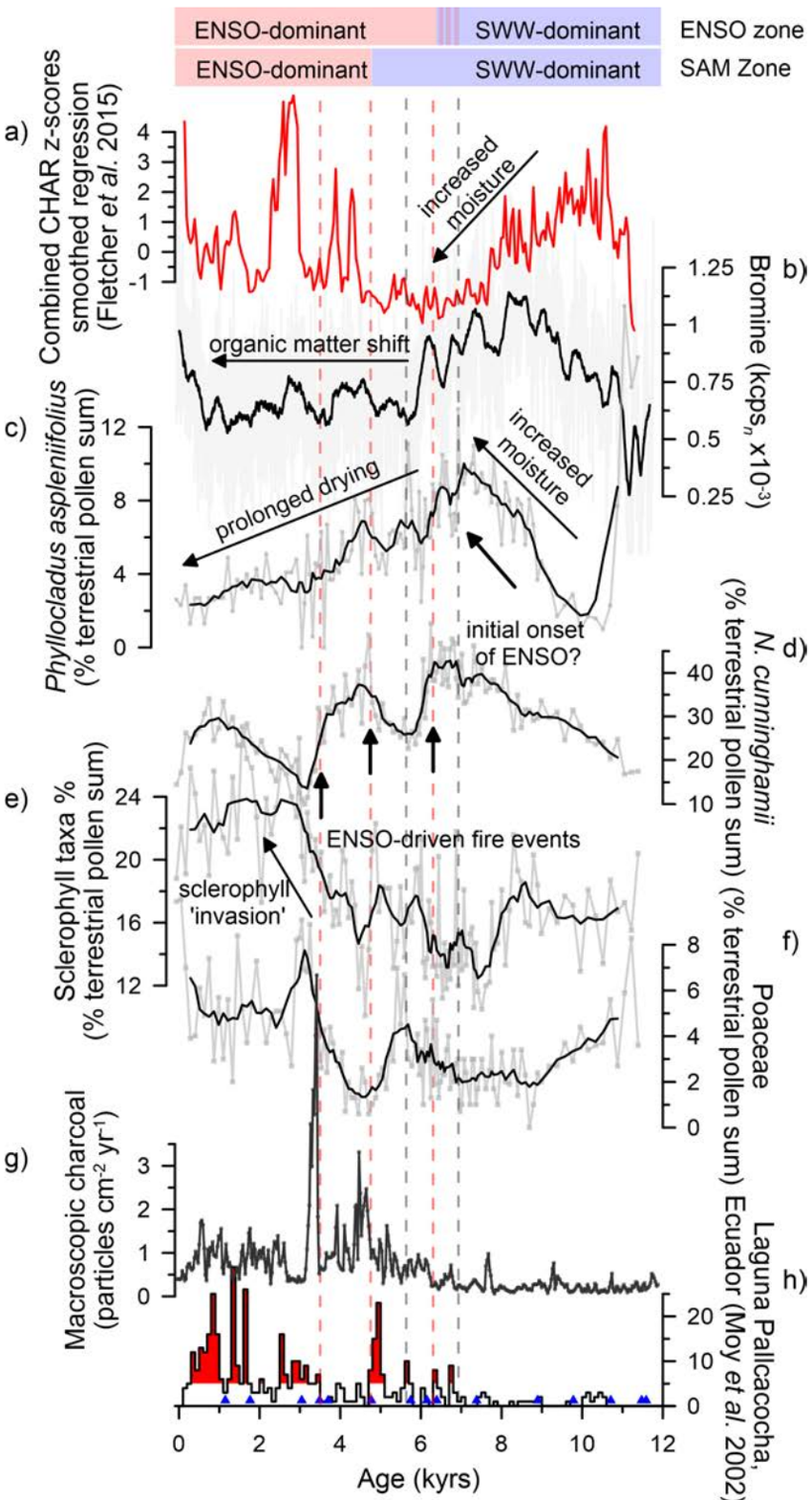

Figure 2 Summary plot of Holocene palaeoecological data : a) Lake Nancy and Lake Gwendolyn combined charcoal z-score regression (red) interpolated to 80-year time-steps and z-scores calculated from an average of pre-European (12-0.2 ka) charcoal values and smoothed weighted averaging regression (window width=9) (Fletcher et al. 2015); b) Paddy's Lake Bromine data (kcps$_n$ x10^{-3}) in grey with weighted average (black, window width= 51); Paddy's Lake pollen percent data (grey line-scatter) with a weighted average (black line, window width=7) for: c) Phyllocladus aspleniifolius*; d)* Nothofagus cunninghamii*; e)* sclerophyll taxa*; f) Poaceae; g) Paddy's Lake macroscopic charcoal (particles/ cm^3 yr^{-1}); and h) the number of El Niño events in 100-year overlapping windows from Laguna Pallcacocha, Ecuador (Moy et al., 2002) red shading indicates significant El Niño events. Red dashed lines indicate significant fire events and vegetation response and blue triangles indicate locations of ^{14}C dates. Grey dashed lines show shifts in* P. aspleniifolius *(signalling regional hydroclimate) that occur during periods of increased El Niño frequency.*

Dating the ancient harbour sediments of Rome for geoarchaeological and paleomagnetic investigations

Agathe Lisé-Pronovost[1], Ferréol Salomon[2], Jean-Philippe Goiran[3], Guillaume St-Onge[4], Andy I. R. Herries[1], Jean-Carlos Montero-Serrano[4], David Heslop[5], Andrew P. Roberts[5], Vladimir Levchenko[6], Atun Zawadzki[6], Henk Heijnis[6]

[1]The Australian Archaeomagnetism Laboratory (TAAL), Palaeoscience Labs, Department of Archaeology and History, Melbourne Campus, La Trobe University, Bundoora, VIC 3086, Australia
[2]Department of Archaeology, University of Southampton, Southampton, United Kingdom
[3]Centre national de la recherche scientifique, Maison de l'Orient et de la Méditerranée, Lyon, France
[4]Institut des sciences de la mer de Rimouski (ISMER), Canada Research Chair in Marine Geology, Université du Québec à Rimouski and GEOTOP, Rimouski, Québec, Canada
[5]Research School of Earth Sciences, Australian National University, Canberra, ACT 2601, Australia
[6]Australian Nuclear Science and Technology Organisation (ANSTO), Lucas Heights, NSW 2234, Australia

Ancient harbours are rich archives of human-environment interaction. However, dating harbour deposits and correlating their stratigraphy is a major challenge because of typically high sedimentation rates over short time periods and possible dredging and flood events. Ancient Mediterranean harbour deposits typically have sedimentation rates of about one to four centimeters per year (e.g., Goiran and Morhange, 2001; Salomon et al., 2012). These high sedimentation rates are promising for obtaining high-resolution paleoclimate archives at similar resolution to tree ring and ice core records, and often with the advantage of having abundant historical reports.

A major aim of this work was to apply for the first time sedimentary magnetism in an ancient harbour context as part of a multi-proxy approach. Another aim was to improve the chronostratigraphy of Portus, the ancient harbour of Rome. Portus was built on the Tyrrhenian Sea during the first century AD (Keay et al., 2005; Keay and Paroli, 2011). It is one of the best-studied ancient harbour sites and an archetypical artificial harbour basin, yet age-depth models from Portus are mostly vertical with several metres of mud having the same age.

For the first time at Portus we used hydraulic piston coring to recover the sedimentary sequence. Our analyses include CT-scans prior to core opening, paleo- and rock-magnetism, grain size, bulk and clay mineralogy, and high precision radiocarbon dating and Bayesian age modelling. Magnetic analysis and CT scans were performed by A. Lisé-Pronovost at laboratories in Canada (ISMER) and Australia (La Trobe University and ANU). The mineralogy work was performed by J.-C. Montero-Serrano at ISMER. Work at ANSTO was supported by an AINSE research grant and includes radiocarbon analyses by V. Levchenko at the ANTARES AMS facility and grain size analyses by A. Lisé-Pronovost and A. Zawadski at the Institute for Environmental Research.

The results demonstrate the utility and versatility of magnetic properties for geoarchaeological investigations. In particular, magnetic and grain size data were crucial for identifying and characterizing reworked event deposits, which were key to improve the Portus chronostratigraphy combined with high precision radiocarbon dating and Bayesian age modelling. Our record covers a period of ~165 years from ca 135-300 AD, with average sedimentation rates greater than 1 cm per year. A dredged deposit and hyperpycnal deposit were identified. The nature of these deposits and the multi-proxy signature of river input into the harbour deposit through time also shed light on harbour technologies at the height of the Roman Empire (Lisé-Pronovost et al., submitted). •

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ACKNOWLEDGEMENTS
This work builds on more than a decade archaeological work at Portus by the team of Prof. Simon Keay (http://www.portusproject.org/), and is the result of international collaborations between Australian, Canadian, French and British laboratories. This work was supported by a La Trobe University Transforming Human Societies Research Focus Area Research Fellowship and a postdoctoral fellowship of the Fonds de recherche du Québec pour la nature et les technologies (FRQNT) to A. Lisé-Pronovost. Other financial and logistical support was provided by the Natural Sciences and Engineering Research Council of Canada (NSERC Discovery grants to G. St-Onge and J.-C. Montero-Serrano), the Young Scientist Program of the Agence Nationale de la Recherche (ANR 2011 JSH3 002 01 to J.-P. Goiran), the European Research Council "Roman Mediterranean Ports program" (ERC 102705), and the Australian Institute of Nuclear Science and Engineering (AINSE ALNGRA15016). •

Location map of Portus near the Tiber River mouth in Italy and photos of the archaeological site. Stationary hydraulic piston coring of the ancient harbour sediment was performed in September 2011 with the Centre d'Étude Techniques de l'Équipement *(CETE)* Méditerranée.

Developing a Radiocarbon-Based Chronology for Tel Azekah, Israel: The First Stage

Lyndelle Webster[1], Yuval Gadot[2] and Yann Tristant[1]

[1] Department of Ancient History, Macquarie University
[2] Sonia and Marco Nadler Institute of Archaeology, Tel Aviv University

Tel Azekah is an ancient Near Eastern city mound of the 3rd through 1st millennia BCE, currently being excavated by an Israeli-German-Australian team (Figure 1). It is strategically located in the Judean foothills, overlooking major ancient access routes. With a long occupation history and multiple destruction layers that preserved dramatic moments and rich material culture, Tel Azekah is an ideal site at which to build a robust radiocarbon chronology that will contribute to critical debates in the region. Absolute dating for this time range in the southern Levant has traditionally been built using ceramic typology and links to external (especially Egyptian) political-historical chronologies. Radiocarbon dating is playing an increasingly important role now, facilitating development of independent local chronologies, and challenging some long-held views.

The first stage of radiocarbon dating at Tel Azekah was completed in 2015 as a Masters research project by Lyndelle Webster, with supervision from Dr Yann Tristant (Macquarie University) and Dr Yuval Gadot (Tel Aviv University), and specialist radiocarbon support from Dr Geraldine Jacobsen (ANSTO) and Dr Quan Hua (ANSTO). Fifteen short-lived samples from Middle Bronze to Hellenistic period occupation layers were processed. A major focus was the Late Bronze Age – the peak period of occupation, as evidenced by multiple phases of public architecture on the periphery of the site (Area S2).

At Azekah we have an unusual window on a city that continued to prosper through the so-called 'Crisis Years', while the civilisations and international network of the Mediterranean Late Bronze Age were collapsing. Initial dating placed a monumental building of Area S2 (Figure 2) in the late 13th and 12th centuries BCE. We were unable to reliably date the pre-monumental building phase during the Masters project, but have since obtained secure dates close to 1300 BCE. Azekah was eventually destroyed towards the end of the 12th century BCE, though this last phase is yet to be radiocarbon dated. Bayesian modeling is being used to improve precision by combining radiocarbon data with prior stratigraphic information; this approach is particularly critical for this period where the radiocarbon calibration curve exhibits 'wiggles' and plateaus.

A second important outcome of the initial dating project was the attribution of a Middle Bronze II-III destruction layer (Area S1) to the 17th or 16th centuries BCE. Based on context and comparative data from other sites, the 16th century seems more probable. This destruction is part of a widespread pattern in the southern Levant, often attributed to campaigns of the early 18th Egyptian Dynasty. Good data for the Persian period occupation – close to 400 BCE – was also obtained as part of this project.

This promising research is now being expanded into a PhD. Lyndelle works closely with the Azekah excavation team each season, to integrate radiocarbon dating into this large archaeological project.

This project was supported by AINSE (PGRA) and ANSTO, a Macquarie University Research Training Pathway scholarship, MQU Ancient History department funding, and the Sir Asher Joel scholarship. Technical assistance in the radiocarbon laboratory from Fiona Bertuch is gratefully acknowledged. •

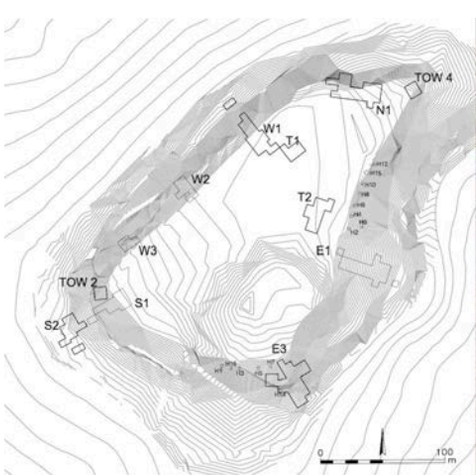

Figure 1 Excavation areas of Tel Azekah.

Figure 2 Monumental public building in the lower city (Area S2), dated to the late 13th and 12th centuries BCE.

3D architecture of articular cartilage: Comparison of collagen fibre orientation distributions from SAXS and MRI

Monique C. Tourell[1+], Sirisha Tadimalla[1+], Robert Knott[2], Konstantin I. Momot[1]

[1]Chemistry, Physics and Mechanical Engineering, Queensland University of Technology, Brisbane
[2]Bragg Institute, Australian Nuclear Science and Technology Organisation
[+]These authors have contributed equally to the work

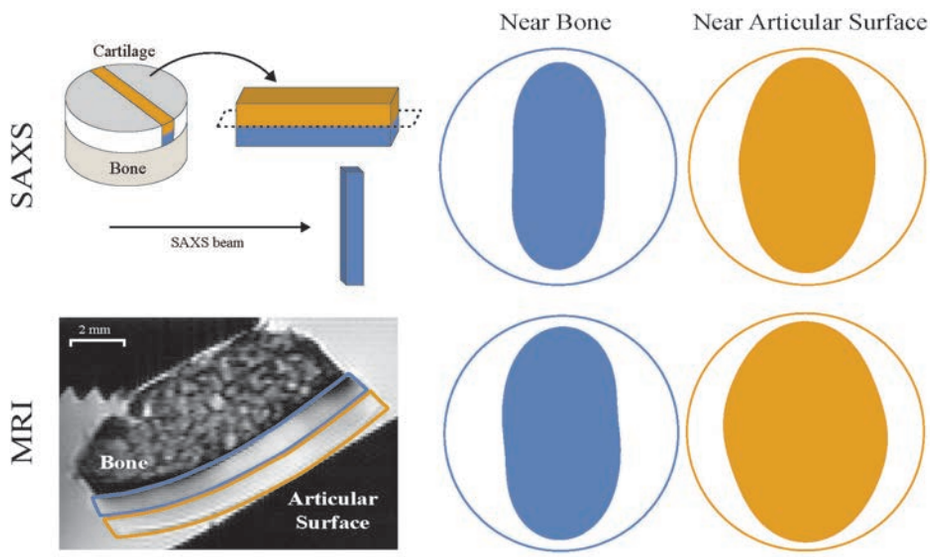

Figure 1 Left: SAXS (top) and MRI (bottom) experimental set up; the diameter of the bone/cartilage cylinder was ~ 1 cm. Middle and Right: Fibre orientation distributions (FODs) obtained in an articular cartilage sample near the bone (blue; middle column) and articular surface (yellow; right column) from SAXS (top row) and MRI (bottom row) measurements.

Articular cartilage is a connective tissue that covers the articulating surfaces in the knee, hip and other moveable joints. The biomechanical function of the tissue is intimately related to the three-dimensional architecture of the extracellular matrix, which is characterised by a highly organised collagen fibre network. Both the degree and predominant direction of collagen fibre alignment in the network change across the depth (from bone to articular surface) of the tissue. Interrogation of this fibre network by interpreting diffusion magnetic resonance imaging (dMRI) data using the diffusion tensor model is a widely accepted approach in cartilage imaging. But this method can only provide limited information about the organisation of the collagen network: the diffusion tensor reports on the predominant direction of collagen alignment but provides only indirect information about the dispersion of collagen fibre orientations.

In this work, constrained spherical deconvolution (CSD), an alternative means of analysing dMRI data, was used to extract the complete collagen fibre orientation distribution (FOD) function from ten bovine articular cartilage samples. While this technique has been used extensively in brain imaging, it remains untested in articular cartilage or related collagenous tissues. The distributions obtained from the dMRI were compared to those obtained from small angle x-ray scattering (SAXS) experiments for validation; ligament samples was used as the deconvolution reference.

Our results show good agreement between the fibre orientation distributions obtained from each technique. The slightly narrower distribution obtained from SAXS (as observed in Figure 1) may be the result of dehydration of the cartilage prior to the SAXS measurements. Additionally, the full, voxel by voxel FOD maps obtained from dMRI data are consistent with the generalized collagen architecture in articular cartilage; with wider FODs obtained in the region of cartilage closer to the articular surface, then those obtained near the bone.

This approach could represent a significant paradigm shift in cartilage imaging, enabling a comprehensive and non-invasive analysis of cartilage microstructure. The non-invasive nature of MRI means that the detailed microstructural analysis of collagenous tissues can be carried out non-destructively and eventually in vivo. This will lead to new insights into the macromolecular basis of load processing in load-bearing collagenous tissues, particularly understanding of the interrelationships between ECM architecture, physiological environment, load and deformation patterns.

Acknowledgements. The authors acknowledge research funding from the Australian Institute of Nuclear Science and Engineering (grants ALNGRA14051 and ALNGRA15025). •

Novel imaging agents to target tumour hypoxia – Generation II

Deborah Sneddon[1], Nigel A. Lengkeek[2], Paul A. Pellegrini[2], Ivan Greguric[2] and Sally-Ann Poulsen[1]

[1]Eskitis Institute for Drug Discovery, Griffith University, Brisbane, Australia.
[2]LifeSciences Division, Australian Nuclear Science and Technology Organisation (ANSTO), Sydney, Australia.

Tumour hypoxia contributes to resistance to conventional chemo- and radiotherapy. The identification of hypoxic tumours is key to therapy planning to implement a hypoxia-guided clinical management strategy. Molecular imaging provides a repeatable, non-invasive, in vivo measurement of several critical parameters of which Positron Emission Tomography (PET) imaging has shown superior sensitivity. There are no established methods in routine clinical use to detect hypoxia that are non-invasive and can be routinely prepared. Hypoxic tumours may be indirectly identified by detection of carbonic anhydrase IX (CA IX) expression, an enzyme upregulated to stabilise the pH of hypoxic tumours.

Recently, in a collaboration between the Eskitis Institute for Drug Discovery, Australia, the Australian Nuclear Science and Technology Organisation (ANSTO), Australia, and Maastricht University, The Netherlands, we evaluated our first generation (Generation I) of small molecule imaging agents for imaging CA IX expressing tumours with PET.1 It was demonstrated that our lead compound, [68Ga]-2, showed specific accumulation in CA IX expressing tumours with low uptake in blood (Figure 1).[1]

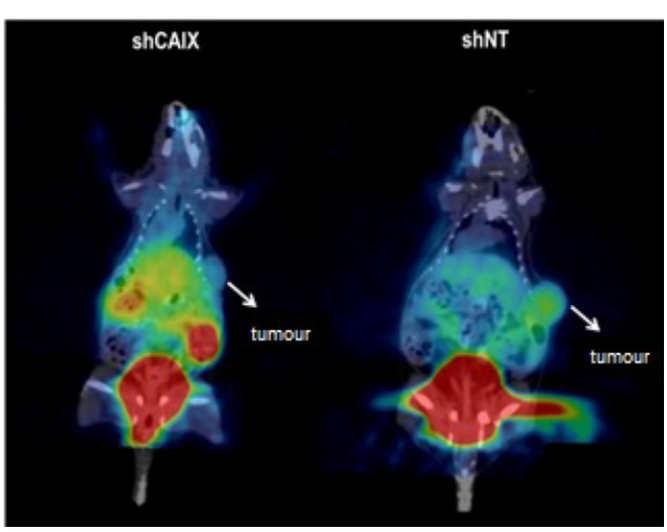

Figure 1 Representative μPET/CT fusion images of [^{68}Ga]-2 uptake in mice bearing CA IX-knockdown or CA IX-expressing tumours at 1 h p.i.[1]

These imaging agents utilised a DOTA (1, 4, 7, 10-tetraazacyclododecane) reporter group, a workhorse for radiometal chemistry that can chelate a variety of metals. In an attempt to improve selectivity for $^{67/68}$Ga and stability of the final radiolabelled complex, a second generation (Generation II) of imaging agent precursors were designed and synthesised. Novel imaging agents were designed that comprise of: (i) a sulfonamide moiety (-SO_2NH_2) for CA IX targeting in vivo; (ii) a variable linking chain to allow fine tuning of pharmacokinetic properties, and (iii) an alternative reporter group from Generation I which has an optimal cavity size for $^{67/68}$Ga (Figure 2).

With additional AINSE support, we have optimised radiolabelling conditions for natGa and ^{67}Ga for two imaging agents, precursors to generate radioactive PET tracers that target CA IX. Of these, [^{67}Ga]-1ii, was radiolabelled with an efficiency of > 99% quantified by RP-HPLC (Figure 3), and could be labelled with ^{67}Ga robustly down to 10 nmol concentrations.

Although further in vitro and in vivo validation is required to assess the suitability of these compounds as imaging agents for tumour hypoxia, the suitability of these agents as ^{67}Ga chelators has been shown. These compounds represent the next class of imaging agents for tumour hypoxia.

The authors thank the following organisations for financial support of this research: The Eskitis Institute for Drug Discovery, Griffith University, Cancer Council Queensland, KWF Kankerbestrijding and the Australian Institute of Nuclear Science and Engineering (AINSE, Postgraduate Research Award to DS (2015-2016) and AINSE Award to SAP (ALNGRA15021).

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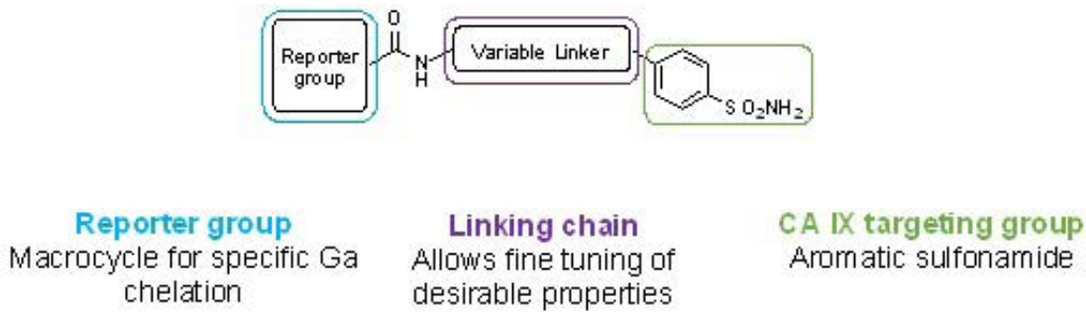


Figure 2 General structure of Generation II single modal imaging agents for PET.

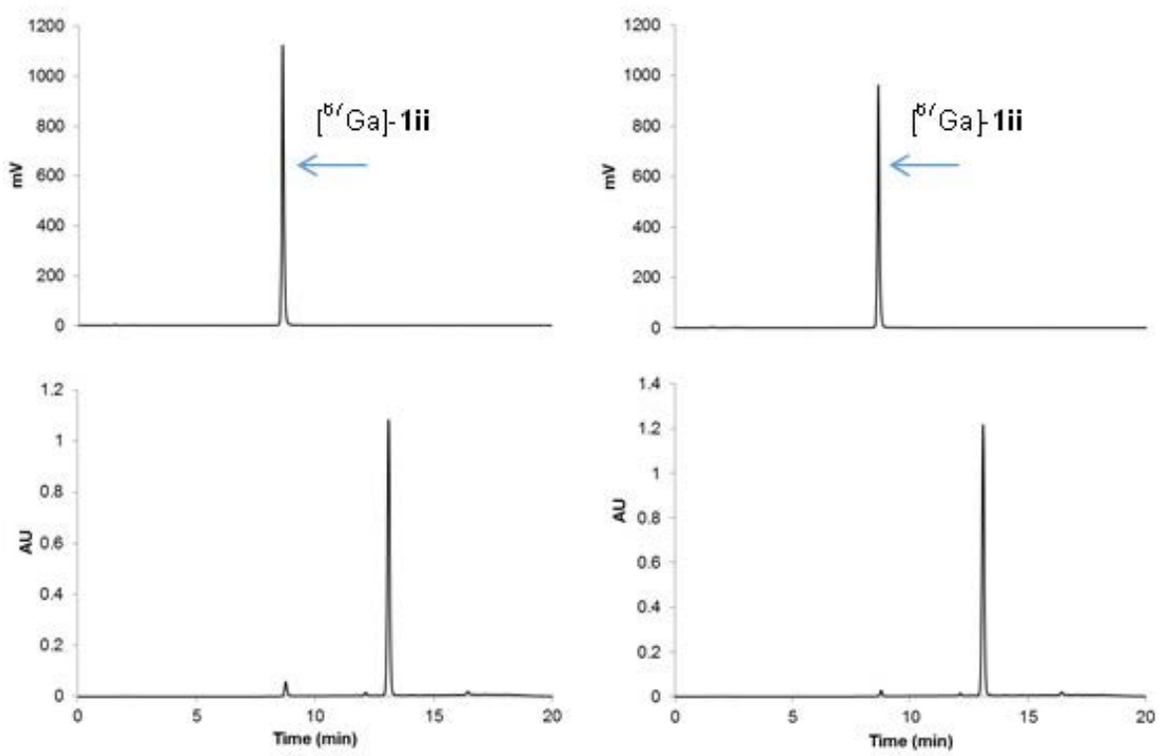
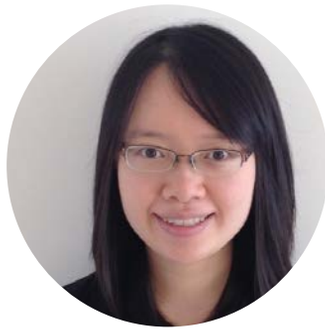


Figure 3 Analytical RP-HPLC radio-trace chromatograms (top) and UV (260nm) chromatograms (bottom) of [^{67}Ga]-1ii produced from either 100 nmol (left) or 20 nmol (right) of imaging agent precursor (1ii). Waters Atlantis® T3 4.6 × 150 mm, 3 µm, 1.25 ml/min flow rate (95:5 → 10:90 H_2O + 0.1 % TFA/MeCN + 0.1% TFA).

Gamma-ray sterilisation of peptide- and protein-coated polymer and metal surfaces



Giselle C. Yeo[1], Miguel Santos[1,2], Alexey Kondyurin[1], Jana Liskova[3], Anthony S. Weiss[1], Marcela M. M. Bilek[1]

[1] The University of Sydney, NSW 2006, Australia
[2] The Heart Research Institute, Newtown, NSW 2050, Australia
[3] Academy of Sciences of the Czech Republic, Prague CZ-14220, Czech Republic

Bone implants are commonly manufactured from titanium (Ti) or zirconium (Zr) based alloys due to its strength-to-weight ratio, durability, and resistance to corrosion. While these metals are somewhat biocompatible, metal-based orthopaedic implants can often fail because of inadequate integration between the living bone and the surface of the implant. Our work aims to improve osseointegration by functionalising the implant with specialised plasma treatment followed by covalent immobilisation of a cell-active biomolecule, tropoelastin, which is found in the extracellular matrix of connective tissues such as ligaments. Our secondary aim is to determine the capacity of the bioactive coating to be sterilised, as the implants will be used in a surgical setting where the ability to perform end-point sterilisation is critical.

We found that majority of the tropoelastin molecules remained on the plasma-treated Zr surfaces in a functional conformation after gamma irradiation up to 40 kGy (Figure 1), with full retention of bone cell binding ability (Figure 2).

Bone cells cultured on the sterilised surfaces also progressively increased in numbers within a week-long incubation period, with significantly increased proliferation rates on the tropoelastin-coated surfaces compared to bare surfaces (Figure 3).

These bio-functionalised materials promote expression of early bone markers such as alkaline phosphatase (Figure 4), eventually leading to increased calcium deposition indicative of higher bone mineralization (Figure 5).

In summary, we report a process for improving integration of metal implants with local bone tissue. The bio-functionalized material was resistant to medical-grade sterilization by gamma-ray irradiation, and supported significantly increased bone cell adhesion, proliferation, early-stage bone marker expression, and bone mineral deposition compared to bare Zr. These findings have the potential to be readily translated to the development of improved metal implants for accelerated bone repair.

Gamma-ray irradiation services were provided by Connie Banos and Justin Davies of ANSTO as part of the AINSE Research Award (ALNGRA13025 and ALNGRA14526). •

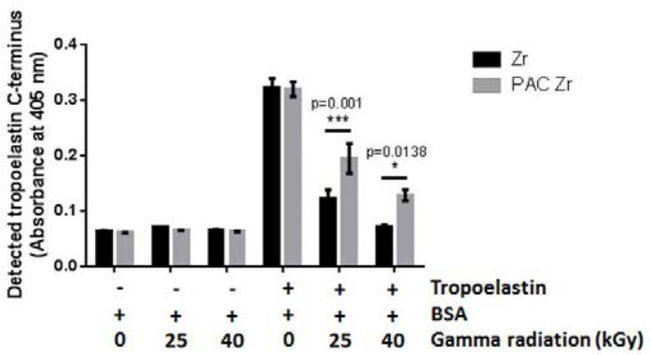


Figure 1 Antibody detection of a tropoelastin C-terminal cell-binding region on Zr samples before and after sterilization by gamma ray irradiation at different doses.

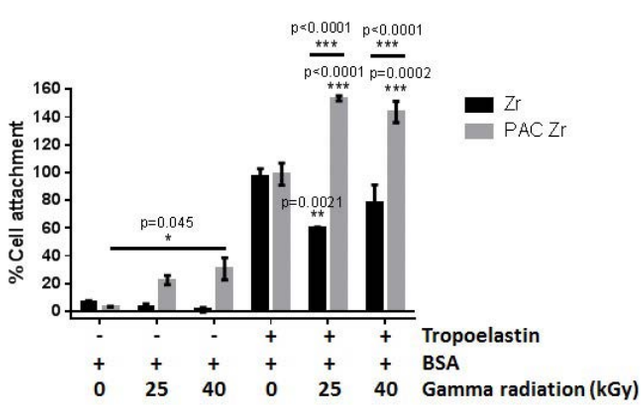


Figure 2 Human osteoblast-like osteosarcoma cell (MG63) adhesion to Zr samples before and after sterilization by gamma ray irradiation at different doses. Where present, significance markers directly on top of columns indicate comparisons against the corresponding non-irradiated tropoelastin-coated PAC Zr or Zr sample.

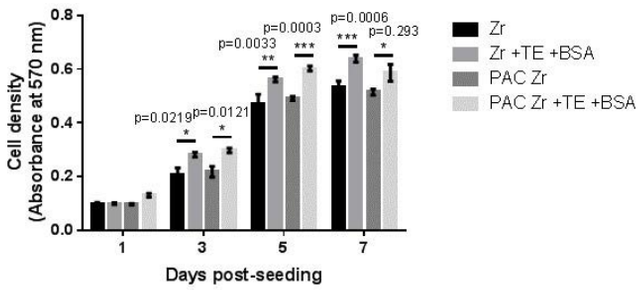


Figure 3 MG63 cell proliferation on Zr samples sterilized by gamma irradiation at 40 kGy. Substrate-bound cells were quantified at 1, 3, 5 and 7 days post-seeding. Pairwise comparisons were performed between bare and tropoelastin-coated samples.

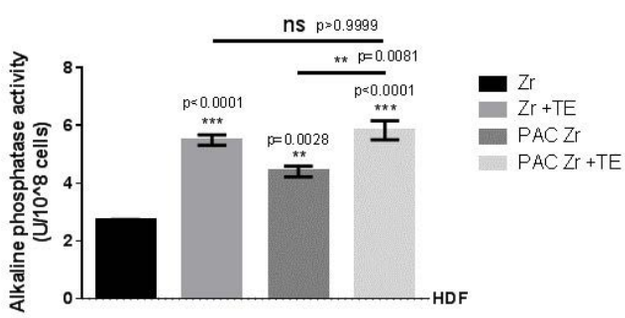


Figure 4 Extracellular ALP secretion by human osteosarcoma cells (SAOS-2) cultured on Zr surfaces. Enzyme levels were normalized to cell numbers. ALP production by human dermal fibroblast controls is indicated.

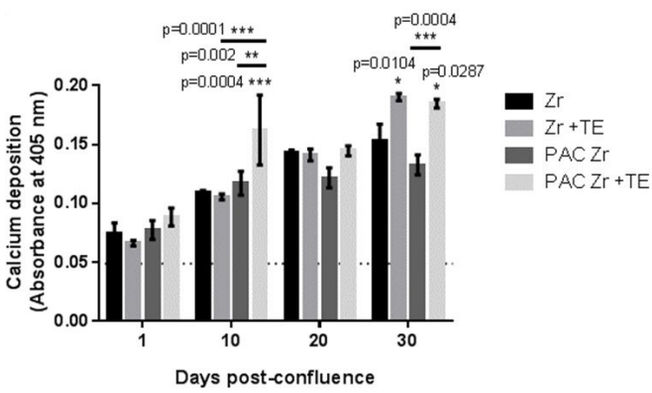


Figure 5 Bone nodule formation by MG63 cells grown on Zr surfaces in osteogenic media. Calcium deposition was quantified using Alizarin Red S staining of cells at 1, 10, 20 and 30 days post-confluence. Where present, significance markers directly on top of columns refer to comparisons against standard Zr at the corresponding time point. Dotted lines indicate the background absorbance of control samples without cells.

Investigating accumulation of trace metals in a marine invertebrate using radioisotope tracers

Rebecca B. Hull (The University of Melbourne), Tom Cresswell (ANSTO)

All organisms accumulate trace metals from their environment. Some trace metals have an important function in metabolism ('essential' metals) whilst others are not required within the body ('non-essential' metals) and may have deleterious effects unless expelled. Trace metals may be acquired from the environment in numerous ways, e.g. from the surrounding water for aquatic organisms or via food. The way in which organisms accumulate trace metals, however, is likely dependent on both the source of exposure (e.g. food, water, etc.) and the specific trace metal (essential, non-essential).

A common marine invertebrate (the ascidian or sea squirt Styela plicata) was exposed to the radioisotope tracers ^{109}Cd and ^{65}Zn in the laboratory in one of two ways – as a dissolved exposure (in filtered seawater) or associated with food (the microalga Tetraselmis sp.). In using radioisotope tracers, the whole-body accumulation of metals could be quantified using gamma spectrometry and the internal distribution of metals was assessed using autoradiography.

When exposed to trace metals via water, ascidians accumulated a similar amount of Zn regardless of a co-occurring non-essential metal (Cd). Conversely, more Cd was accumulated and retained in the presence of Zn (cf. Cd in isolation). Consequently, ascidians would likely accumulate increased concentrations of Cd in nature – organisms are naturally exposed to cocktails of trace metals, rarely a single metal. The internal distribution of metals also differed for each metal. Zn was accumulated within the branchial basket (analogous to gills) where Zn is likely removed from the water for circulation around the body (Figure 1A). Cd accumulated in the stomach, likely a strategy to minimise damage elsewhere in the body, and in the tunic or test – a protective body casing, unique to ascidians (Figure 1B). The pattern of Cd accumulation within the test reflects the distribution of blood vessels, a likely means for storing Cd but this warrants further investigation.

Following exposure to trace metals in the diet, Cd was lost comparatively quickly whilst more Zn was retained. As for the dissolved exposure, Cd was accumulated within the stomach but not in the test. There was no specific accumulation of Zn within the body, however, despite its greater overall retention. The accumulation of trace metals differed according to their non-essential or essential nature and the way in which the organism was exposed. This suggests important and differing physiological mechanisms for handling trace metals of differing characteristics and origin.

This project was supported by an AINSE PGRA and through collaborative links between the ANSTO Institute for Environmental Research (Tom Cresswell), ANSTO Human Health Research (Paul Callaghan), ANSTO Radiobiology and Bioimaging (An Nguyen and Zoe Williams) and CSIRO Land and Water (Merrin Adams). •

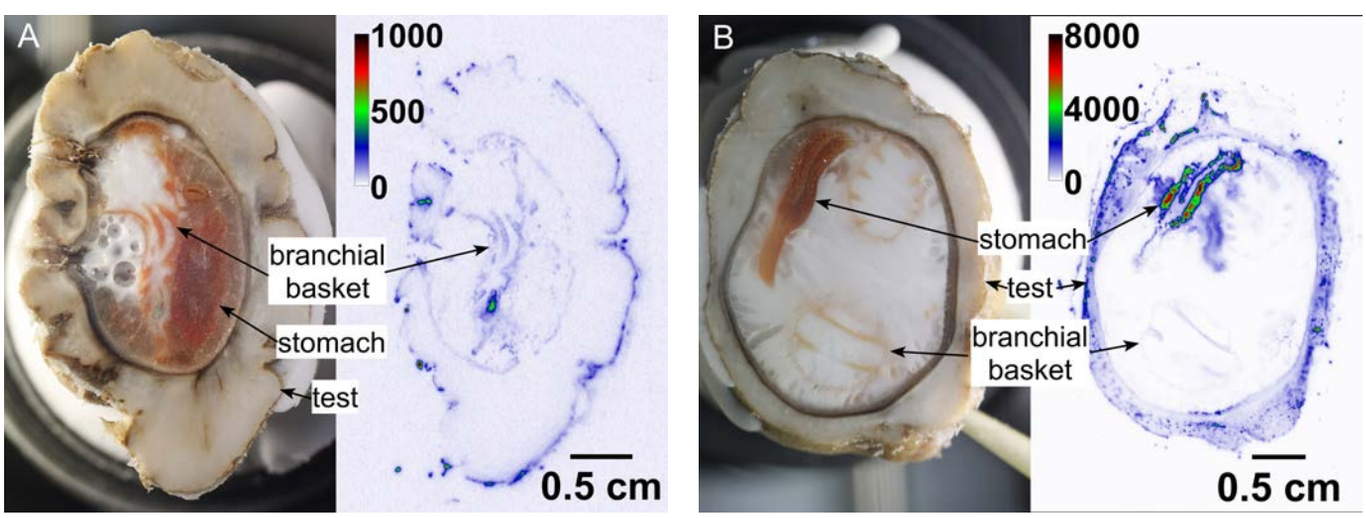


*Figure 1 Internal distribution of ^{65}Zn (A) and ^{109}Cd (B) in an ascidian (*Styela plicata*) following exposure to dissolved radioisotopes for four days. Colour bars on autoradiographs represent intensity of ^{65}-Zn and ^{109}-Cd per cm^2.*

Aluminium Speciation in Coastal Acid Sulfate Soil-Impacted Drainage Waters

Adele M. Jones[1], Youjia Xue[1], Andrew S. Kinsela[1,2], Klaus M. Wilcken[2], David Fink[2] and Richard N. Collins[1]

[1] School of Civil and Environmental Engineering, University of New South Wales, Sydney, NSW, Australia 2052
[2] Institute for Environmental Research (IER), Australian Nuclear Science and Technology Organisation (ANSTO), Lucas Heights, NSW, Australia 2234

There are approximately 6 million ha of coastal acid sulfate soils or sediments (CASS) along Australia's coastline. The drainage of these soils has resulted in the enhanced oxidation of iron sulfide minerals contained within, resulting in the production of sulfuric acid which 'dissolves' the soils and releases toxic concentrations of aluminium (Al) to drains, creeks and rivers. The north-eastern coast of Australia is an area particularly well known for high rainfall and associated coastal acid sulfate soil discharge events which can result in significant fish kills (Figure 1). The speciation of metals affects their toxicity. For example, the degree to which metals complex with natural organic matter has a large bearing on its bioavailability as it is generally considered that these complexes are more bioavailable relative to inorganic colloids, yet less bioavailable than inorganic species. The aim of this study was to combine Donnan dialysis with a radioactive tracer of Al, ^{26}Al, to determine the speciation of natural Al in a large range of water samples collected from the Tweed Shire, north-eastern NSW (Figure 2). ^{26}Al is a rare isotope of Al requiring Accelerator Mass Spectrometry facilities at ANSTO for its analysis. We observed that Al primarily existed as dissolved negatively-charged or neutral (in)organic complexes that would be readily bioavailable. These results could not, however, be reconciled with current theoretical thermodynamic equilibrium speciation models and demonstrated that research is required to accurately determine the stability constant of the $Al(SO_4)^{2-}$ complex. This information is critical to the development of reactive transport models that can predict the soil/water conditions that result in massive fish kills and so, in turn, guide the adoption of suitable on-ground management practices for their prevention.

Dr Richard Collins gratefully acknowledges the support provided by AINSE (ALNGRA15039), the Australian Research Council (LP110100480, FT110100067) and industry partners the Tweed Shire Council, NSW Canegrowers' Association and NSW Milling Cooperative to undertake this research.

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Figure 1 Massive fish kill in the Richmond River by run-off from acid sulfate soils, Ballina, north-eastern NSW.

Figure 2 Dr Adele Jones in her waders ready to collect water samples from the Tweed River floodplain, north-eastern NSW.

Working towards better air quality through study of atmospheric aerosol in Suva, Fiji

Cynthia F Isley, Peter F Nelson & Mark P Taylor
Department of Environmental Sciences, Macquarie University, Australia



Fine aerosol particles are known to cause negative impacts on human health. In the Pacific Islands, there has increasing concern about air pollution from burning activities, yet air quality data have not been available. Focussing on Suva, the largest city of the Pacific Island Countries, this study set out to characterise the fine particle air quality and to identify the contributing emissions activities. Understanding the air pollution sources allows emissions control and air quality improvement strategies to be targeted most effectively.

Air sampling of $PM_{2.5}$, fine particles with aerodynamic diameter of 2.5 µm or less, was carried out in Suva during 2014 and 2015 using an ANSTO-built ASP sampler. Elemental concentrations of 20 elements were determined by ion beam analysis using ANSTO's STAR accelerator. Black carbon concentrations were determined by the laser integrating plate method at ANSTO. Results were statistically analysed, by positive matrix factorisation, to quantify source contributions to the total $PM_{2.5}$ mass. Atomic mass spectrometry for carbon 14 content, also using the STAR accelerator, was used to determine percentages of modern carbon on air particulate samples from Suva City and Fiji's most densely populated residential area (Kinoya, in Suva).

Suva's annual average $PM_{2.5}$ concentrations, at 7.3 ± 0.3 µg/m^3 for the City area, are generally within the World Health Organisation guideline of 10 µg/m^3 (Isley, Nelson et al. 2017). Concentrations in residential areas may exceed these guidelines, however measurements in these areas were limited. Black carbon concentrations in Suva City however, were comparatively high, at 2.2 ± 0.1 µg/m^3, as compared with the $PM_{2.5}$ and for the population size. These black carbon levels are similar to larger, more industrialised cities. The positive matrix factorisation analysis showed more than half of Suva's $PM_{2.5}$ to be from combustion sources; namely fossil fuel smoke, vehicle emissions, open burning and shipping. This has also been confirmed in an emissions inventory prepared for Suva, which shows diesel combustion by vehicles, followed by open burning of wastes, to be large contributors to Suva's $PM_{2.5}$.

In the city area, 80 ± 2 % of the carbon in air particulate samples was fossil carbon, meaning that diesel vehicles and industries burning diesel oils are the main contributors. Residential areas showed much higher contributions from waste and biomass burning, with 49 ± 2 % modern carbon. This reflects the widespread waste burning that happens in Suva's residential areas, which affect air quality and therefore also impact upon health.

Particles containing black carbon are more strongly associated with mortality and health risk than $PM_{2.5}$ considered alone (Jansen, Larson et al. 2005), particularly diesel exhaust (Straif, Cohen et al. 2013). Suva's elevated black carbon levels demonstrate the need for waste burning activities and diesel emissions, from vehicles and industry, to be addressed in Suva. Consultation with Fijian and other Pacific Island authorities is currently underway to determine the most effective strategies for improvement of air quality.

The authors would like to thank AINSE Ltd for providing financial assistance: awards ALNGRA14537 and 15531 for ion beam analysis and 15532 for carbon 14 determination. •

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Jansen, K. L., T. V. Larson, J. Q. Koenig, T. F. Mar, C. Fields, J. Stewart and M. Lippmann (2005). "Associations between Health Effects and Particulate Matter and Black Carbon in Subjects with Respiratory Disease." Environmental Health Perspectives 113(12): 1741-1746.

Straif, K., A. Cohen and J. Samet (2013). Air Pollution and Cancer, International Agency for Research on Cancer,. IARC Scientific Publication No. 161: 229 pp.

Figure 1 Waste burning is widely practiced across Suva. This image shows a rubbish pile with items that have been burned, including a mattress and household waste; as well as more items to be burned: textiles, cardboard etc.

Figure 2: Most vehicles in Suva, particularly trucks and buses, emit visible smoke.

Tracing water quality changes in water level manipulated lakes in central Tasmania using high resolution core scanning and isotopic dating techniques

Bernadette Proemse, School of Biological Sciences, University of Tasmania
Leon Barmuta, School of Biological Sciences, University of Tasmania

Great Lake and Woods Lake, located on the Central Plateau of Tasmania, are shallow lakes that are water level manipulated by Hydro Tasmania for power generation and irrigation supply. This has led to concerns regarding the ecological stability of these lakes under varying water levels. Hydro Tasmania has been maintaining and recording lake levels since their damming in the early and mid 1900s: Water level measurements for Great Lake exist since 1916, and for Woods Lake since 1968. These unique long-term water level records show that both lakes underwent significant water level fluctuations over the past few decades.

Generally, the lake waters are oligotrophic and therefore low in nutrients, and anthropogenic pollutant or nutrient fluxes from nearby streams and atmospheric deposition are negligible due to the lakes' remote locations. The majority of nutrients entering the water column may therefore be derived from sediment resuspension. Sediment resuspension is a key mechanism increasing turbidity and internal nutrient loading to the water column (Bloesch, 1995). Decreasing lake water levels may significantly increase a lake's susceptibility to wave agitation, thereby increasing shear stresses acting on the sediment surface. This may lead to large scale sediment resuspension events and high turbidity levels, deteriorating water quality and habitat conditions (Bloesch, 1995). Central Tasmania is in the zone of the prevailing roaring 40s, strong westerly winds that create wave heights >1 m. It is therefore crucial to understand the water level – sediment resuspension relationship within lakes that suffer substantial fluctuations in water levels.

In this project we reconstructed the history of sedimentation during the past 150 years to investigate changes in nutrient fluxes and sediment resuspension since and prior to damming of the lakes in the early 1900s, using ^{210}Pb dating techniques and high resolution X-ray Fluorescence core scanning (ITRAX). Most lakes in Tasmania are not suitable to investigate recent (<150 years) changes in environmental conditions due to extremely low sedimentation rates. However, the damming of Woods Lake and Great Lake has caused significant increases in sedimentation rates, making them also suitable for investigating changes in atmospheric deposition of anthropogenic pollutants.

Our results suggest that water level changes due to water level manipulation since the damming of the lakes have not significantly affected the ecological functioning of the lakes, but the damming itself increased sedimentation rates and burial rates of nutrients (nitrogen, phosphorus). ^{210}Pb dating also revealed that sediment resuspension did not occur to a greater depth (>1 cm), even at times of low lake levels. The outcomes of this project will inform water level management strategies that aim to maintain the lakes' water quality and ecosystem values.

Acknowledgements:

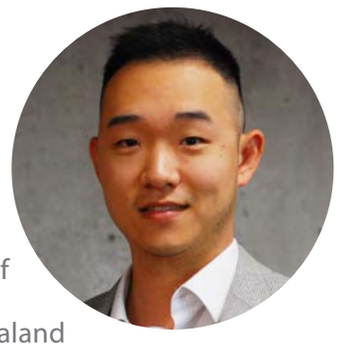
The AINSE Research Award provided funding for ^{210}Pb dating and ITRAX core scanning, completed by Atun Zawadzki and Patricia Gadd. Field work support was provided by Hydro Tasmania and Entura, as part of an Australian Research Council Linkage Project (LP130100756).

References:

Bloesch, J. (1995): Mechanisms, measurements and importance of sediment resuspension in lakes. Mar. Freshwater Res., 46, 295-304.

Figure 1 Great Lake, Tasmania, viewed from Tods Corner during low level conditions in summer 2015/2016.

Polymer electronic composites that heal by solvent vapour



Paul Baek,[1,2] Nihan Aydemir,[1,2] Omer Javed Chaudhary,[1,2] Eddie Wai Chi Chan,[1,2] Jenny Malmstrom,[2,3] Tim Giffney,[3] Roshan Khadka,[1,2] David Barker,[1] and Jadranka Travas-Sejdic[1,2*]

[1]Polymer Electronics Research Centre, School of Chemical Sciences, University of Auckland, Auckland, New Zealand
[2]The MacDiarmid Institute of Advanced Materials and Nanotechnology, New Zealand
[3]Chemical and Materials Engineering, Faculty of Engineering, University of Auckland, Auckland, New Zealand

Recent advances in organic electronic devices have reached a new milestones in performance and function, and are used in applications ranging from displays to sensory devices. However, they still present limitations in mechanical flexibility and electrical durability following the damages caused during their lifetime.[1]

Herein, we present a simple route to prepare conducting polymer composites that can address some of these issues through solvent vapour-induced healing of cracks formed within conducting polymer composites.[2] Conducting polymer composites were prepared by solution blending of poly(3-hexylthiophene) (P3HT) and poly(dimethylsiloxane) (PDMS)-containing urea segmented copolymer (Figure 1).

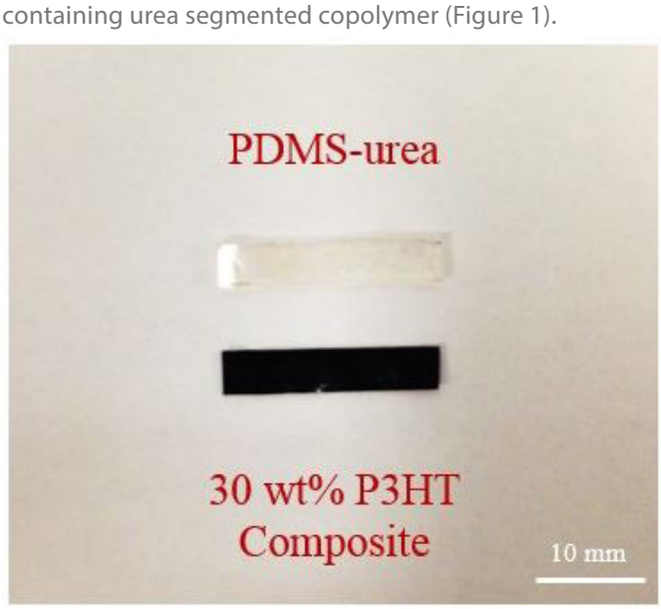


Figure 1 Optical images of free-standing PDMS-urea and 30 wt% P3HT composite films.

The bicomponent composites with various weight fractions of neutral P3HT were used to demonstrate their electroactivity whereas the electrical conductivity, mechanical and solvent vapour-induced self-healing studies were carried out with composites with various weight fractions of $FeCl_3$-doped P3HT. Mechanically bisected free-standing film with 30 wt% of doped P3HT was observed to be readily healed through exposure to solvent vapour at room temperature (Figure 2), with mechanical healing efficiency of 55 ± 24 % and restoration of electrical conductivity up to 82 ± 1%.

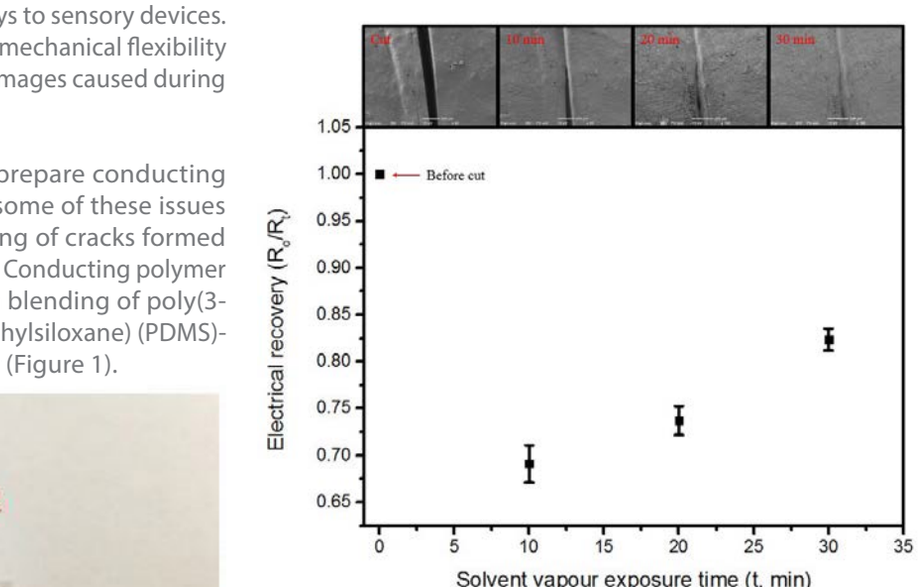


Figure 2 Top: SEM images showing healing of free-standing 30 wt% P3HT composite film at the bisected interface as a function of solvent vapour exposure time (t). Bottom: Electrical recovery (R_t/R_o) of the free-standing composite film as a function solvent vapour exposure time, t. R_o and R_t are the resistance before cutting the composite film and after various solvent vapour exposure time, t, of the bisected composite film.

This research has been undertaken by AINSE PGRA-holding PhD student, Paul Baek, and others under the supervision of Prof. Jadranka Travas-Sejdic. It has been recently published in RSC Advances (RSC Adv., 2016, 6, 98466).

The authors thank the following organisations for the financial support of this research: The University of Auckland, New Zealand, for the doctoral scholarship and the Australian Institute of Nuclear Science and Engineering, Australia, for the PGRA. •

1. Benight et al., Progress in Polymer Science 2013, 38 (12), 1961-1977.
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Gamma irradiation effects in endlessly single mode photonic crystal fibre Bragg grating sensors

Steven Hinckley (Edith Cowan University), Desmond Baccini (Edith Cowan University), Gary Allwood (Edith Cowan University), Graham Wild (RMIT University), Justin Davies (ANSTO), Connie Banos (ANSTO), John Canning (iPL, Sydney University & UTS), Kevin Cook (iPL, Sydney University & UTS).

The primary scientific objective of this study was to investigate and report the effects of Cobalt-60 gamma irradiation on optical fibre Bragg grating (FBG) sensors, and in particular, Photonic Crystal Fibre (PCF) Bragg grating sensors. This allowed us to establish and determine the suitability of new generation FBG sensors (such as PCF-FBGs) for use in the area of gamma dosimetry. FBGs are spectral filters fabricated within the core of optical fibres which reflect light at a narrow wavelength range centred about a peak wavelength, known as the Bragg wavelength.

During the past decade, research has shown that FBGs have the capability for detecting ionizing radiation through radiation induced changes in the silica fibre [1]. This is applicable to radiation environments such as nuclear areas with high dose rates, and in space with low dose rates. The accuracy and reliability of optical sensors as potential radiation dosimeters is still a subject of current research. Irradiated single mode fibres (SMFs) with hydrogen loading and germanium (Ge) doped FBGs have shown relaxation of induced changes. Unfortunately, the Bragg wavelength shift only partially recovers after the gamma source is removed [2].

Results to date indicate that single-material silica PCF has a superior recovery time compared to conventional fibres [3]. To help quantify and establish the effect of gamma irradiation on FBGs, we examined the effect on the Bragg wavelength during three irradiation exposures and three subsequent relaxation periods in FBGs written in silica solid core endlessly single mode PCF (Figure 1).

The FBGs were fabricated in the PCF at iPL (Sydney University). Gamma irradiation was conducted at ANSTO using the Gamma Technology Research Irradiator (GATRI) under AINSE Award ALNGRA15540. A Cobalt-60 radiation source, with a dose rate of 2.41 kGy/hour, was used for each of the three exposure stages of irradiation. Measurements were recorded at 30 minute intervals. Each exposure period amounted to exactly 50.6 kGy for a time period of 21 hours, followed by 3 hours of relaxation (no irradiation). A total accumulated dose of 151.8 kGy was reached.

During relaxations, there is a short-wavelength shift back towards the original grating value. On average there is a 39pm drop. Total recovery was nearly achieved after 151.5 kGy of gamma irradiation. The start wavelength was 1540.806 nm and final wavelength inclusive of relaxation is 1540.818 nm (Figure 2), so that the total Bragg wavelength shift over the entire irradiation period was 12 pm.

The overall result indicates that the PCF-FBGs consistently show significant recovery, larger than that reported for FBGs in standard germanosilicate SMF [2]. Results indicate that PCF–FBGs are a strong candidate as optical sensors for radiation dosimeters compared to SMF-Ge FBGs.

Acknowledgements: The authors would like to thank Dr Peter Reece of the Optoelectronics Laboratory at The University of New South Wales for the loan of their Optical Spectrum Analyser. Special thanks must go to the staff at AINSE and ANSTO for their support and assistance. This work was undertaken on an AINSE Research Award (ALNGRA15540), and is a continuation of work performed on a number of previous AINSE Awards, which provided access to the ANSTO Gamma Irradiation facility.

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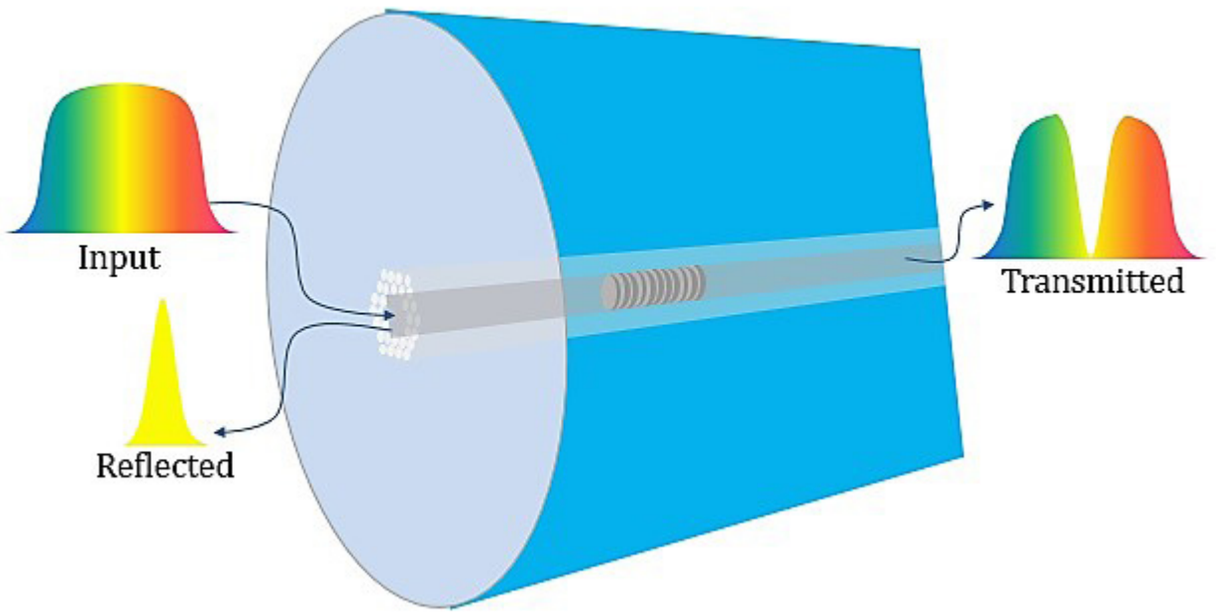


Figure 1 Image of solid core endlessly single mode PCF-FBG, showing light reflected and transmitted by the FBG.

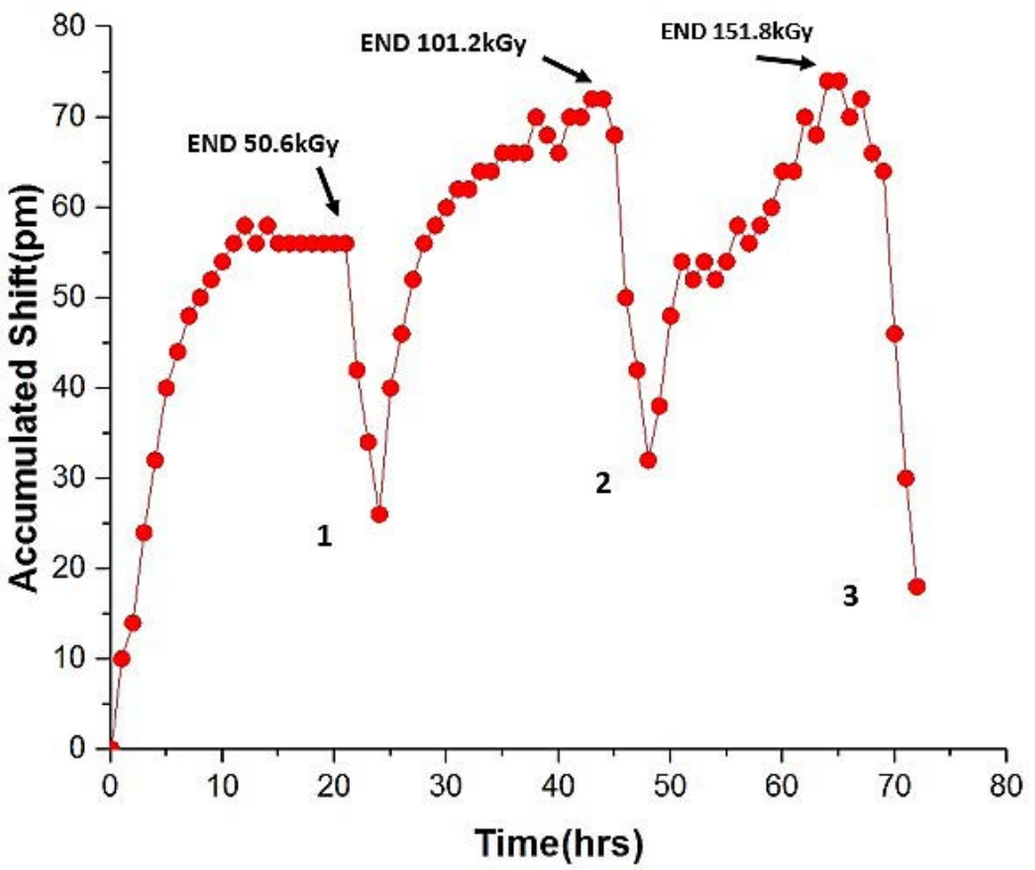


Figure 2 Graph showing FBG cumulative Bragg wavelength shift of three irradiation periods and corresponding relaxation periods (labels 1,2,3 indicate where the relaxation ceased).

Molecular geometry and magnetism: Investigation of lanthanoid-based single molecule magnets

Michele Vonci (The University of Melbourne), Marcus J. Giansiracusa (The University of Melbourne), Robert W. Gable (The University of Melbourne), Willem Van den Heuvel (The University of Melbourne), Kay Latham (RMIT University), Boujemaa Moubaraki (Monash University), Keith S. Murray (Monash University), Dehong Yu (ANSTO), Richard A. Mole (ANSTO), Alessandro Soncini (The University of Melbourne), Colette Boskovic (The University of Melbourne)

Measurements on the Pelican time-of-flight spectrometer have contributed to a better understanding of the molecular geometry and magnetic properties of a prospective material for quantum computing. The investigation was led by chemist Associate Professor Colette Boskovic and Dr Alessandro Soncini from the University of Melbourne, including lead author Michele Vonci, who completed some of his PhD research at ANSTO.

The study, published in Inorganic Chemistry, used a range of experimental techniques and ab Initio calculations to characterise a family of lanthanoid-polyoxometalate single-molecule magnets (Ln-SMMs). Inelastic neutron scattering at ANSTO provided measurements of crystal field excitations in the series that showed good agreement with theoretical computations. In the Ln-SMMs, a lanthanoid ion sits in the middle of a cluster of tungsten and oxygen anions, surrounded by a network of water coordinated sodium cations. Although neutron scattering has been used to study the SMMs, there have only been a handful of papers on single ion lanthanoid SMMs. The lowest lying energy levels in the geometric structure of the lanthanoid ions binding with polyoxometalate ligands are dominated by crystal field splitting of the f-orbitals. The crystal field splitting can result in a slow relaxation of magnetisation, even at relatively high temperature. The quantum tunnelling of a particle's spin through a potential energy barrier from one orientation to another (reversing direction) was first observed in lanthanoid single molecule magnets in 2003. Since then a much larger body of research has focused on how the quantum nature of this ground state of these Ln-SMM's can be used as qubits in quantum computers.

Collaborators were building on previous research (published in Chemical Communications in December 2015) that elucidated the sensitivity of the electronic structure of the ground and excited states of a terbium analogue to small structural distortions from axial symmetry. In the first magnetisation study on Pelican, the researchers discovered a polymorphism, in which the same molecule has a different crystal structure, in the terbium analog. They found the polymorphism when trying to resolve a discrepancy in the neutron data, which observed four well resolved peaks (transitions) instead of the predicted two peaks.

Calculations and X-ray diffraction data enabled them to determine that the INS spectra had captured two distinct co-crystallised polymorphic phases. After synthesising the samples separately and repeating the INS measurements, they confirmed the ground state transitions for each phase and energy shifts. Minute differences in crystal structure, like one or two degrees in the torsion angle, give a 1 meV difference in energy.

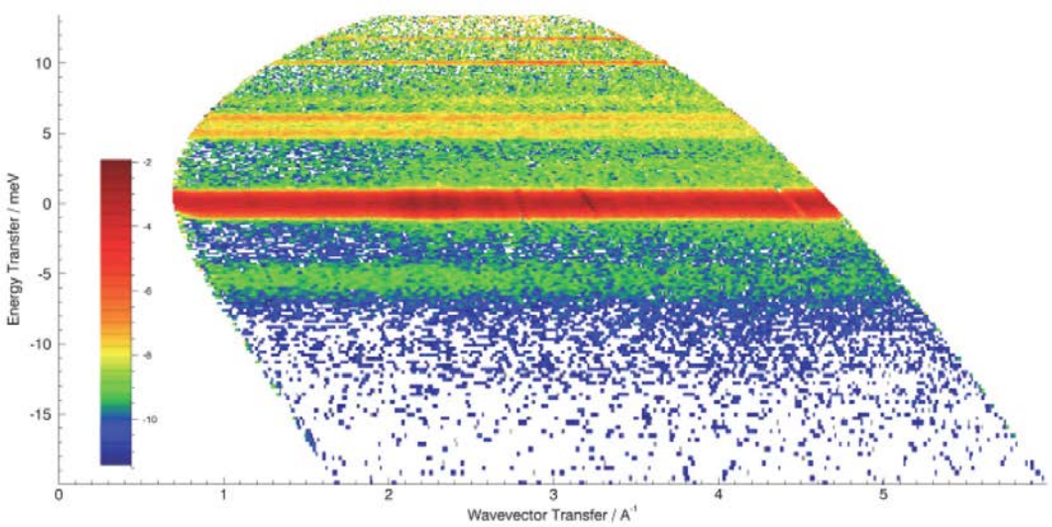
Understanding the interaction, that such a small change in coordination geometry can have on electronic structure, was important and led the group to a more comprehensive further investigation of the Ln-SMMs. Experimental techniques included single crystal X-ray diffraction, magnetic measurements, deuteration, INS with data analysis and refinement, theoretical calculations and ab initio calculations of magnetic properties and INS spectral simulations. There have been relatively few neutron scattering measurements of the lanthanoid-polyoxotungstates, because they absorb neutrons to a greater or lesser degree and are also very difficult to make in pure forms.

The work on single molecule magnets will continue with the awarding of an Australian Research Council Discovery project grant late in 2017 to A/Prof Boskovic from the University of Melbourne and a team which includes Dr Mole.

We thank the Australian Research Council for funding and AINSE Ltd for providing financial assistance to Michele Vonci and Marcus J. Giansiracusa. We thank the Bragg Institute for beam time and technical support. Willem Van den Heuvel thanks the University of Melbourne for a McKenzie Post-Doctoral Fellowship.

Vonci, M., M. J. Giansiracusa, R. W. Gable, W. Van den Heuvel, K. Latham, B. Moubaraki, K. S. Murray, D. Yu, R. A. Mole, A. Soncini and C. Boskovic (2016). "Ab initio calculations as a quantitative tool in the inelastic neutron scattering study of a single-molecule magnet analogue." Chemical Communications 52(10): 2091-2094. 10.1039/C5CC07541F

Vonci, M., M. J. Giansiracusa, W. Van den Heuvel, R. W. Gable, B. Moubaraki, K. S. Murray, D. Yu, R. A. Mole, A. Soncini and C. Boskovic (2017). "Magnetic Excitations in Polyoxotungstate-Supported Lanthanoid Single-Molecule Magnets: An Inelastic Neutron Scattering and ab Initio Study." Inorganic Chemistry 56(1): 378-394. 10.1021/acs.inorgchem.6b02312 •



Pelican instrument INS spectra HoD at 50 K.

AINSE Winter School 2016 - 20th Anniversary

Monday 18th July to Friday 22nd July 2016

The purpose of the Winter School is to encourage undergraduates to take an interest in nuclear science and engineering and to learn how to apply these techniques in their future research. The Winter School accommodated 46 students this year, which included 41 students from 36 universities across Australia and New Zealand, and 5 AINSE postgraduate student helpers. A lottery of reserve students was run to fill vacant spaces. The feedback from the students has been phenomenal with students stating they are inspired and thankful for being given the experience.

"Because of the amazing work that AINSE does to facilitate students, I am seriously considering combining my university honours degree with Research at ANSTO."

This year's theme was "Extreme Environments" and the line-up of speakers did not disappoint. The first guest speaker was Dr Mike Kuiper, who has worked as a field scientist in the Antarctic, and is currently a computational molecular researcher for the Victorian Life Sciences Computation Initiative, helping scientists simulate proteins on supercomputers. AINSE was also fortunate to have Dr Gail Iles present at the school. Gail is an expert in subjecting herself to extreme environments – as well as being a skydiver and a scuba-diver, Gail has also flown over 500 parabolas in a zero-gravity airbus. She entertained the students with amazing microgravity stories and footage during her presentation. It was our pleasure as well to have Dr Paul Fraser as a guest speaker, FTSE, CSIRO Fellow, and CSIRO Marine and Atmospheric Researcher, to present his work on climate change and ozone depletion. Dr Fraser also joined the extreme environments panel at the close of the school, which was a great success. The AINSE team would like to thank the other participants in this panel Dr Krystyna Saunders, Dr Scott Chambers and Dr Gail Iles for their expertise and exciting presentations. Dr Adi Paterson closed the winter school with an inspiring talk and was supported by the AINSE President, Professor Claire Lenehan during the certificate ceremony.

"The integration of social activities into the Winter School helped the groups cohesiveness and put people at ease, which made it a rich environment for learning and networking."

This year's winter school was once again another great opportunity to showcase the research at ANSTO. The presentations from the staff were inspiring and informative, and AINSE would like to take this opportunity to thank the presenters for their time, making the winter school another great success! The presentations were also complemented by the student project booklet, and research roundup dinner, with over 20 ANSTO researchers attending and networking with the students. Students were encouraged to discuss prospective projects with the researchers during the poster session on Thursday evening.

Following the feedback from the students from previous years, many of the social activities were included in the program, such as a movie and trivia night as well as the popular Sydney Harbour cruise, where ANSTO staff were invited to attend and mingle with the students under the brilliant backdrop of Sydney.

AINSE continues to encourage and promote nuclear science and engineering to senior undergraduate students through successful programs like the AINSE Winter School, and this would not be possible without the dedication and efforts of all those involved.

2016 attendance:

46 students

Previous year's attendance:

2015 - 44 students

2014 – 42 students

2013 – 42 students

2012 – 38 students

2011 – 41 students

2010 – 37 students

"A very good program. I will definitely recommend this to other students. Well structured, and plenty of interesting activities."

2016 Students

Kevin Aldcroft	CQUniversity
Michael Ashelford	Macquarie University
Michael Badart	University of Otago
Adrian Bonica	Federation University
Abbey Bromley	Southern Cross University
Christopher Buhlmann	Murdoch University
Isabelle Capell-Hattam	University of New South Wales
Thomas Cernev	University of Adelaide
James Christian	The University of New South Wales*
Nadia Craven	Charles Darwin University
Luke Crea	RMIT University
Lara Cullinane	The University of Queensland
Sherilyn D Costa	Monash University
Anthony Doman	Flinders University
Lilly Donnelly	Massey University
Tim Doughney	RMIT University
Gabriella Farrugia	Swinburne University of Technology
Redbird Ferguson	James Cook University
Emer Foyle	Canterbury University
David Graves	University of the Sunshine Coast
Daniel Ho	Curtin University
Edwin Johnson	University of Newcastle
Mitchell Klenner	Curtin University*
Bijay Lamsal	Charles Darwin University*
Chelsea Long	University of Tasmania
Joseph Lovie-Toon	The University of Queensland
Lydia Mackenzie	The University of Queensland*
Racheal Mahlknecht	The University of Adelaide
Lyall McDonald	Massey University
Isaac Millburn	Charles Sturt University
Nicholas Mondello	Edith Cowan University
Teck Quan Ng	The University of Melbourne
Daniel Pincher	University of South Australia
Kirsten Piner	Monash University
Herleen Ruprai	University of Western Sydney
Liam Salter	The University of Western Australia
Tianna Schiller	The University of New England
Xinyang (Gary) She	The Australian National University
Logan Smith	The University of New South Wales*
Lynley St George	University of Waikato
Jane Stone	Southern Cross University
Sarah Stone	University of Wollongong
Jianxin (Jake) Sun	The University of Auckland
Lana Tranter-Edwards	La Trobe University
Matthew Wiggins	Queensland University of Technology
Justin Wilson	Griffith University

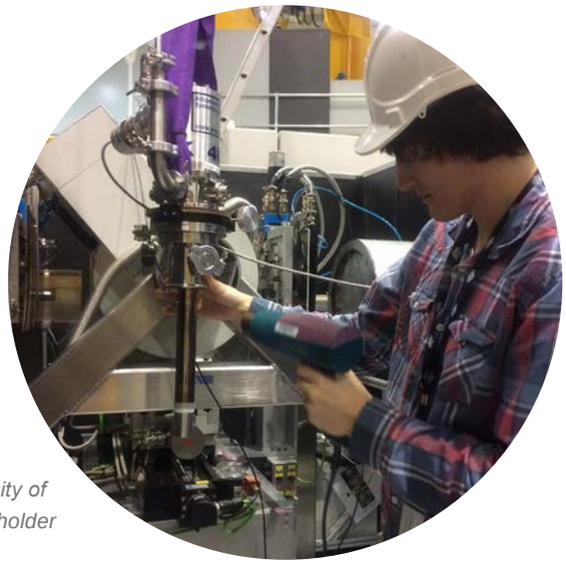
** Student Helpers*

Disciplines / Area of Study

Students came from a large background of disciplines:

Agricultural Food Science
Antarctic science
Archaeology
Biochemistry
Biology
Biomedicine
Biotechnology
Chemical Engineering
Chemistry
Civil Engineering
Computer Science
Ecotoxicology
Engineering
Environment Management
Environmental Chemistry
Environmental Earth Science and Environmental Geology
Geology
Geophysics
Marine Science
Materials Chemistry
Materials Engineering
Materials Science
Mathematics
Medical Imaging
Metallurgical Engineering
Molecular and Cell Biology
Nuclear Engineering
Organic Chemistry
Physics
Process Engineering

AINSE Honours Scholarships 2016



Student, Oliver Paull, University of Wollongong, heating sample holder

In 2016 AINSE continued the Honours program which first commenced in 2011. This program provides Honours Scholarships to a small number of excellent students who have a project which utilises the research facilities at ANSTO. The scholarships provide a stipend of $5,000.

The purpose of the scholarships are to provide a link between the Winter School and the other AINSE programs. There were 46 applications from 24 Universities received in 2016.

The 27 successful students and their projects are listed below:

Tara Brown, University of Wollongong
Can bismuth-NSAIDs be used as bowel cancer chemopreventives

Andrew Chapman, University of Adelaide
Oxygen isotopes in lake sediments as archives for Holocene climate variability

Catherine Clark, Massey University
Effects of molecular structure on the interfacial layer properties of modified milk proteins

Cherie Colyer-Morris, University of Newcastle
Trophic fractionation and turnover by estuarine crabs: stable isotope evidence to support field studies

Alexander Craze, Western Sydney University
Construction of metal organic frameworks using coordination cage incorporating 3d and 5f metal ions

Michael Currie, University of Canterbury
Investigating the evolution of allostery in pyruvate kinase mutants

Geordie Donaldson, University of New South Wales
1931 Waikari River tsunami: New Zealand's largest historical tsunami

Jaclyn Elliott, Charles Sturt University
Efflux of Tc 99m MIBI from tumours in mice due to caffeine and other purines

Caitlyn Gibson, Curtin University
Hydrogen sensing on mesoporous metallic electrodes

Stephen Harris, The University of New South Wales
Genesis and evolution of the manuka Zn-Pb-Ag deposits, central-western New South Wales

Michael Healy, The University of Queensland
Structural investigations of endosomal trafficking proteins in neurodegenerative disease

Jasmine Hunter, University of Wollongong
Pacific rainfall variability in the 15th Century

Andrew King, University of Technology Sydney
Development of sulfony-[18F] fluoride based radiosynthon for applications in nuclear medicine

Bijay Lamsal, Charles Darwin University
An engineering design solution to drain permanently flooded paddy fields to increase agricultural productivity, Sumba, East Nusa Tenggara, Indonesia

Sarah Lilley, University of Canterbury
Allostery and inhibition of ATP-phosphoribosyl transferase

Harriet Love, University of Otago
Ice grain growth kinetics

Daniel McDougall, The University of Auckland
Understanding impacts of trace metals on marine biomineralisation

Tashya Miranda, The University of New South Wales
Surgeonfish on the move and the tropicalisation of temperate marine ecosystems

Mandy Moore, University of Wollongong
Statistical methods for quantitative whole body PET imaging

Sumaya Mozumder, University of New South Wales
Determining the utility of the TSPO Radioligand 18F-PBR111 as a pre-atherosclerotic lesion detection agent

Kasih Norman, The University of Queensland
Quantitative analyses of Homo Sapien migration pathways to pleistocene Australia: A new migration window

Oliver Paull, University of Wollongong
Neutron guide focussing for improved efficiencies during polarised neutron reflectometry investigations of magnetic thin films

Kaan Sozen, The University of New South Wales
Measurement of residual stress in welded components

Luke Steller, University of New South Wales
A geochemical analysis of tourmaline crusts linked to the earliest evidence of life to determine the environmental parameters of an Archean environment

Irene Wynne Susanto, University of New South Wales
Characterization of microstructures and mechanical properties in ion and neutron irradiated oxide dispersion strengthened and other ferritic stainless steels

Bernard Walker, University of Tasmania
Forest soils and palaeosols of the Styx Valley: implications for palaeoclimate and geoconservation

Campbell Young, University of Wollongong
Application of isotopic techniques to understand the elevation and vegetation dynamics of an estuarine wetland on the Tweed River

Postgraduate Research Award Orientation "O" Week 2016

Sunday 16th – Wednesday 19th October 2016

Thirty-one new Postgraduate Research Awards were awarded to students across Australia and New Zealand in 2016. Building on the success of the PGRA Orientation week of last year, the 2016 students were invited to attend the orientation week run in mid-October. The Orientation Week (or O-Week) was developed to provide students with additional support in their goal of achieving a postgraduate qualification. As part of O-Week, students had a great opportunity to meet fellow students through student presentations and social activities, meet ANSTO staff members, co-supervisors and collaborators, as well as familiarise themselves with the Lucas Heights site and facilities. The students were also fortunate to visit the control room on level 13 of the reactor and the Centre for Accelerator Science.

"It was great to meet all the students using the same methods in such varied environments. Also important to meet supervisors"

The Managing Director of AINSE, was in close consultation with the Nuclear Science Week committee in the USA, leading up to O Week, to team up and unify the two events. To celebrate nuclear science week the nuclear science associations such as the Australian Neutron Beam Users Group (ANBUG), Australian Nuclear Association (ANA), Women in Nuclear (WiN) and the Australian Young Generation in Nuclear (AusYGN) were also invited to attend the presentations and network with the students.

The O Week program was pleased to have two high profile guest speakers from Melbourne. Dr Maria Rost Rublee, School of Social Sciences, Monash University, who engaged the audience on Monday evening with the topic "What does "nuclear" mean to Australians?" Dr Rublee's talk focused on how the social construction of "nuclear" has shaped Australian policy about nuclear weapons, nuclear disarmament, and nuclear energy. Dr Helen Brand a Powder Diffraction Scientist at the Australian Synchrotron, discussed her research on determining the thermoelastic properties and crystal chemistry of a range of minerals which are of interest in a variety of environmental, planetary geology and industrial settings. Dr Brand highlighted the links between the research at the Australian Synchrotron with research at the ANSTO Lucas Heights facilities.

The O Week was a good forum for students to connect with the AINSE Staff, and gain guidance in visiting and accessing the ANSTO Facilities, including working through the security paperwork and inductions. The program was also privileged to have experienced ANSTO staff, who gave presentations on science communication, writing for publication and comprehensive overviews of the new themes and platforms of the Nuclear Science and Technology Landmark Infrastructure (NSTLI) team. The social activities encouraged the students to get to know each other and build lasting friendships and collaborations. The feedback from all involved was very positive, and provides evidence of another successful program AINSE offers its members.

"This was a great experience! Really interesting to see the diversity of work at ANSTO and how broadly nuclear science can be applied. Also great to meet the AINSE staff and other PGRAs."

2016 PGRA Cohort

13th AINSE-ANBUG Neutron Scattering Symposium (AANSS 2016)

29 - 30 November 2016, AINSE, Lucas Heights, Sydney

AINSE hosted the 13th annual AANSS symposium on the 29-30 November 2016. This symposium is the annual meeting of the neutron scattering community in Australia and New Zealand, and also welcomes the many international users of the Australian OPAL research reactor. The AANSS meetings are unique points on the annual conference calendar because they bring together a diverse community of scientists, engineers, mathematicians and programmers to explore the future of neutron-based science in Australia in an informal, collegial environment.

AINSE Early Career Researcher Talks

AINSE offers its members and local community the opportunity to attend lunch time early career researcher talks throughout the year, allowing students to showcase their research and to meet fellow students and senior researchers from across disciplines and campuses. The talks are a success, building collaborations not only between speakers, but the nuclear science, technology and engineering community, including ANSTO scientists. AINSE coordinated the students' ECR talks with their visit to ANSTO, making it economical for both AINSE and the students. The students that presented in 2016 included:

Ryan Schwamm - Victoria University of Wellington - "Pyridine-Supported Bicyclic Guanidines as Superbases"

James Christian - The University of New South Wales - "Investigating New Materials for Next Generation Batteries"

Corey Goodwin - University of Canberra - "Impact of gamma-irradiation of human cells upon nuclear versus mitochondrial forensic genotyping and relationship to oxidative stress biomarkers"

Gianna Evans - University of Auckland - "Holocene drivers of environmental change from high-resolution lake sediment sequences in northern New Zealand"

Heather Haines – Griffith University - "Using Tree-Rings to Reconstruct Rainfall in the Australian Subtropics: A multi-technique approach"

Mitchell Klenner – Curtin University - "Designing PET-Optical Multimodal Agents"

Three of AINSE's PGRA students were also invited to present at the ANSTO Big Ideas Forum, which was run from the 14-18 November 2016. The students were asked to present to year 10 students, with a focus on nuclear science techniques from a broad range of disciplines, including environmental, materials and medical topics.

AINSE Gold Medal Ceremony 2016

On the 1st of December 2016, AINSE Hosted the AINSE Gold Medal Ceremony

The AINSE Gold Medal is awarded for excellence in research, which acknowledges AINSE support. The AINSE Gold Medal may be awarded jointly to collaborating researchers and one medal is reserved for graduate students, including those who have recently completed their PhD projects.

In 2016, three gold medals were announced for recipients Professor Ian Gentle, Dr Emily Reynolds and Professor George Collins (posthumously).

Professor Gentle, from The University of Queensland has provided significant service and leadership to the AINSE and ANSTO scientific communities over a period of many years. He is an internationally recognized leader in surface science, and utilizes a wide array of cutting edge surface and interface analysis techniques in his research including neutron and X-ray reflectivity (NR and XRR). It is in the context of NR and XRR that he has had an association leading to an extensive list of publications affiliated with ANSTO staff involving the support of AINSE. Professor Gentle will be available to receive his gold medal at the next ceremony in May 2017.

Dr Emily Reynolds, from The University of Sydney joined the Goodwin group in December 2015 as an early-career Research Fellow, Department of Chemistry, University of Oxford after completing her PhD. Due to Emily's location she was unable to attend the ceremony. Dr Gordon Thorogood, Emily's ANSTO co-supervisor and mentor accepted the award on Emily's behalf. Emily's University supervisor was Professor Brendan Kennedy, The University of Sydney.

The next award was for the late Professor George Collins, who also had a very strong link with Dr Thorogood. During Dr Thorogood's speech, it was highlighted that Professor Collins was influential in his PhD, "because he saw the potential in me and supported me in doing it".

Professor Collins made a significant impact to ANSTO and the broader Australian Research community and was a prominent supporter of AINSE. Professor Collins was on the AINSE Council from 2002 to 2008, including being on the AINSE Board, and played a significant leadership and mentoring role for AINSE. Professor Collins' family attended the event, with wife Evelyn, and children Christopher, Alexi and Elodie accepting the gold medal on his behalf.

After the ceremony, everyone was invited to attend the AINSE Council Dinner, at the Waterfront Function Centre, San Souci. This was a great opportunity for networking with AINSE Councillors, ANSTO staff, and other invited guests.

On behalf of AINSE we would like to extend our congratulations and thanks to all who attended and participated in the ceremony.

Top: Professor George Collins' Family (Christopher, Elodie, Evelyn, Alexi) with Ms Michelle Durant, Managing Director of AINSE, Dr Gordon Thorogood, ANSTO Middle: Professor George Collins' Family, Michelle Durant and Dr Adi Paterson, CEO of ANSTO (far right), Bottom: Council Dinner after ceremonies.

2016 Conferences and Workshops

2016 International Travel Scholarships

Throughout the year, students from AINSE member organisations are invited to apply for travel support to attend international conferences and workshops. AINSE conference support and international travel scholarships encourage students to attend and participate with conferences and workshops to exchange ideas and network with the nuclear science and engineering community. The international travel scholarship offers up to $1,000 towards travel.

AINSE awarded fourteen (14) scholarships to students to present and attend several high profile international conferences in 2016.

Student	University	Conference Attended	Location of Conference
Catherine Mackenzie	The University of Queensland	European Geosciences Union General Assembly 2016	Vienna, Austria
Georgina Falster	The University of Adelaide	15th International Swiss Climate Summer School	Grindelwald, Switzerland
Songbai Hu	The University of New South Wales	2016 MRS Spring Meeting	Phoenix, Arizona
Tim Ditcham	Flinders University	RANC2016	Hungary, Budapest
Leonie van't Hag	The University of Melbourne	The 4th International Soft Matter Conference (ISMC2016)	Grenoble, France
Guang Wang	Deakin University	The 4th International Soft Matter Conference (ISMC2016)	Grenoble, France
Stephanie Florin	The University of Queensland	World Archaeology Congress 8	Kyoto, Japan
Greer Gilmer	University of Otago	SCAR 2016	Kuala Lumpur
Adam Trewarn	Federation University Australia	ECSA 56 - Coastal Systems in Transition	Bremen, Germany
Bo Zhang	Monash University	European Association of Nuclear Medicine 2016	Barcelona, Spain
Michela Mariani	The University of Melbourne	Australasian Quaternary Conference	Auckland, New Zealand
Emily Field	The University of Queensland	AQUA 2016 biennial meeting	Auckland, New Zealand
Michela Mariani	The University of Melbourne	Sweep and Shape Workshop	Santiago, Chile
Heather Haines	Griffith University	AQUA 2016 biennial meeting	Auckland, New Zealand

2016 Conferences and Workshops

AINSE conferences play a major part in the information exchange process for scientific and technological information, providing a forum for debate and an opportunity for young researchers to present their work. In 2016 AINSE supported the following conferences, which included assisting with travel and accommodation to attend AINSE supported conferences. AINSE was also invited to sponsor several events throughout 2016. As part of the sponsorship, AINSE presented at the events promoting AINSE programs and networked with the delegates.

Name of Event	Date of Conference	Venue	Students Supported	Student Universities
14th International Workshop on Radiation Damage to DNA (IWRDD)	20-24 March 2016	Treasury Theatre, Melbourne	9	The University of Adelaide The Australian National University Griffith University Flinders University University of Wollongong
30th Australian Colloid and Surface Science Student Conference	1-4 February 2016	Kioloa Coastal Campus, Kioloa NSW	33	33 students were supported for transport to the event
Australasian Soft Matter Scattering Workshop (ASMS2016)	11-12 February 2016	RMIT University, Melbourne	4	The Australian National University Deakin University Griffith University The University of New South Wales
Australian Earth Sciences Convention	26-30 June 2016	Adelaide Convention Centre, Adelaide	4	Curtin University of Technology The University of Melbourne Monash University The University of Tasmania
14th South Pacific Environmental Radioactivity Association Conference (SPERA)	5-9 September 2016	Sanur Paradise Plaza, Bali	1	The Australian National University
Australian Radiation Protection Society 2016	11-14 September 2016	Adelaide Convention Centre, Adelaide		Event Sponsorship
8th AONSA Neutron School	15-19 November 2016	Bhabha Atomic Research Centre (BARC), Mumbai, India	2	University of Wollongong
ANSTO - Australian Synchrotron New User Symposium	6th September 2016	National Centre for Synchrotron Science, Melbourne	11	University of Canterbury Curtin University of Technology James Cook University The University of Newcastle Southern Cross University University of Tasmania The University of Western Australia
National Science Week (13-21 August 2016). Flinders University in conjunction with the SA National Science Week	13-21 August 2016	Rundle Mall's Adelaide City Centre		Event Sponsorship
24th Annual RACI R&D Topics Conference in Analytical and Environmental Chemistry	5-7 December 2016	Melbourne		Event Sponsorship
Australian Archaeological Association Annual Conference (AAA2016)	6-8 December 2016	Crowne Plaza, Terrigal, NSW	5	Griffith University, James Cook University, University of Queensland, University of Western Australia, University of New England
Society of Environmental Toxicology and Chemistry Conference - SETAC 2016	4-7 October 2016	Hotel Grand Chancellor, Hobart		Event Sponsorship Presentation at student night

2016 AINSE Outreach Activities

Science Meets Parliament

March 2016

Michelle Durant (Business Manager & Scientific Coordinator) and Dr Paul Di Pietro (AINSE Managing Director) attended this event on behalf of AINSE. This event was organised by Science Technology Australia.

Roadshows

March & July 2016

Two AINSE Roadshows were run in 2016. In March, The University of Adelaide hosted the first roadshow of the year for South Australian members. The University of Queensland hosted a roadshow in July for the Queensland members.

ANSTO Staff Forum

August 2016

Michelle Durant, Managing Director of AINSE was invited to talk at the ANSTO Staff Forum, Lucas Heights.

Science Meets Business

October 2016

Michelle Durant, Managing Director and Professor Claire Lenehan, President of AINSE attended this event on behalf of AINSE. This event was organised by Science Technology Australia.

Conferences
Throughout the year

- **Higher Education Conference 2016 (Universities Australia)**, Canberra, Rachel Caldwell (Business Manager) shared a booth with ANSTO at the event
- **Australasian Soft Matter Workshop 2016**, Melbourne, Rachel Caldwell (Business Manager) presented at the conference
- **14th International Workshop on Radiation Damage to DNA Conference 2016**, Melbourne, Dr Paul Di Pietro (Managing Director) presented at the conference & Rachel Caldwell assisted with the event
- **Australian Earth Sciences Convention 2016**, Adelaide, Michelle Durant (Managing Director) presented at the student hour
- **SAGE Symposium 2016**, Sydney, Michelle Durant (Managing Director) & Rachel Caldwell (Business Manager) networked at the event
- **New User Symposium**, Melbourne, Michelle Durant (Managing Director) presented at the event
- **ARPS 2016**, Adelaide - Michelle Durant (Managing Director) attended and networked at the event and shared a booth with ANSTO
- **SETAC 2016**, Tasmania, Michelle Durant (Managing Director) presented at the student night
- **ANFC 2016**, Adelaide, Professor Claire Lenehan attended and networked at the event

AINSE Board Dinners
Throughout the year

AINSE invites Board members, Councillors and other guests to the four board dinners each year. In 2016 Adelaide, Sydney and Brisbane hosted the board dinner events.

Other Visits
Throughout the year

Michelle Durant, Managing Director attended several meetings and discussions throughout the year for networking and promotion of AINSE:

- French Embassy
- RMIT 3rd Year Nuclear physics Lecture
- The University of Melbourne Meeting
- Victoria University Meeting
- The University of Sydney Meeting
- Peter MacCallum Tour and Network
- University of Tasmania AINSE lecture
- ANSTO Department of Industry
- Innovation & Science Graduates 2016
- Big Ideas Forum.

AINSE Council 2016 Member Organisations and Representative at Council

Two Meetings of Council were held in 2016. There was an Annual General Meeting on the 25th May 2016 and a general meeting held on the 2nd December 2016.

Abbreviations	Organisation	Membership Commenced	Councillor	Meetings Attended
ACU	Australian Catholic University	2001	Dr Duncan Cook	1
ADE	The University of Adelaide	1958	Emeritus Professor Richard Keene	2
AKL	The University of Auckland	1995	Professor Jadranka Travas-Sejdic	2
ANS	ANSTO	1958	Dr Richard Garrett (b)	2
ANS	ANSTO	1958	Mrs Roslyn Hatton (b)	2
ANS	ANSTO	1958	Professor Lyndon Edwards (b)	2
ANU	The Australian National University	1958	Professor Keith Fifield	1
			Dr Anton Wallner	1
CAN	University of Canterbury	2005	A/Professor Greg Russell	1
CBR	University of Canberra	1996	Professor Bill Maher	2
CDU	Charles Darwin University	1995	A/Professor Krishnan Kannoorpatti	1
CQU	CQ University	1991	Professor Owen Nevin	2
CSI	CSIRO	2010	Dr Patrick Hartley	1
CSU	Charles Sturt University	1995	Dr Padraig Strappe	1
			Dr Julia Howitt	1
CUR	Curtin University of Technology	1989	Professor Craig Buckley	2
DEA	Deakin University	1997	Professor Peter Hodgson	0
DST	Defence Science & Technology Group	2016	Dr Mark Petrusma	0
ECU	Edith Cowan University	1996	A/Professor Stephen Hinckley	2
FED	Federation University Australia	1997	Dr Jessica Reeves	1
			A/Professor Kim Dowling	1
FLI	Flinders University	1966	Professor Claire Lenehan (President) (b)	2
GRI	Griffith University	1975	Professor Evan Gray	2
JAM	James Cook University	1970	A/Professor Scott Smithers	1
LAT	La Trobe University	1966	Dr Andy Herries	0
MAC	Macquarie University	1966	Professor Barbara Messerle	0
MAS	Massey University	2014	Professor Richard Haverkamp	1
MEL	The University of Melbourne	1958	A/Professor Damian Myers	1
			A/Professor Rachel Caruso	1
MON	Monash University	1961	Professor Ian Smith (b)	1
MUR	Murdoch University	1985-1997 - rejoined 1998	Dr Aleks Nikoloski	2
NCT	The University of Newcastle	1965	Professor Erich Kisi	0
NSW	The University of New South Wales	1958	A/Professor John Stride	2
OTA	University of Otago	2007	Professor Gary Wilson	0
QLD	The University of Queensland	1958	Professor Ian Gentle (b)	1
QUT	Queensland University of Technology	1992	Professor Godwin Ayoko	2
RMI	Royal Melbourne Institute of Technology	1988	Professor Gary Bryant	2
SCU	Southern Cross University	1994	Professor Bill Boyd	2
SWI	Swinburne University of Technology	1991	Professor Elena Ivanova	1
SYD	The University of Sydney	1958 - rejoined 2016	Professor Laurent Rivory	0
SYN	Australian Synchrotron	2010	Professor Andrew Peele	0
TAS	University of Tasmania	1958	Professor Andrew McMinn	0
UNE	The University of New England	1958	Dr Chris Fellows	1
USA	University of South Australia	1991	Professor Enzo Lombi	2
USC	University of Sunshine Coast	2010	Professor John Bartlett	0
UTS	University of Technology Sydney	1988	Professor Michael Cortie	2
UWA	The University of Western Australia	1958	A/Professor Pauline Grierson	1
UWS	Western Sydney University	1993	A/Professor Gary Dennis	1

Abbreviations	Organisation	Membership Commenced	Councillor	Meetings Attended
VUW	Victoria University of Wellington	2010	Professor Mike Wilson	0
WAI	The University of Waikato	2011	A/Professor Graham Saunders	2
WOL	University of Wollongong	1975 - rejoined 2016	Professor Will Price	1
	AINSE		Michelle Durant, Managing Director	2
	President / Independent Director		E/Professor Robert Burford (b)	2
	Independent Director		Dr Peter Coldrey (b)	1

Alternate Representatives and other attendees

Abbreviations	Organisation	Representative	Meetings Attended
LAT	La Trobe University	Dr Matthew Meredith-Williams	1
MAC	Macquarie University	A/Professor Damian Gore	1
MAC	Macquarie University	Professor Robert Willows	1
NCT	The University of Newcastle	Dr Andrea Borsato	1
SWI	Swinburne University of Technology	Dr Peter Mahon	1
SYD	The University of Sydney	Professor Steven Meikle	1
SYN	Australian Synchrotron	Professor Michael James	1
UNE	The University of New England	Dr Brendan Wilkinson	1
VUW	Victoria University of Wellington	Professor John Spencer	1
VUW	Victoria University of Wellington	Professor David Harper	1
ANU	The Australian National University	Dr Anton Wallner (o)	1
MEL	The University of Melbourne	A/Professor Rachel Caruso (o)	1
SYN	Australian Synchrotron	Professor Michael James (o)	1
	Escott Aston Chartered Accountants	Mr David Aston (AINSE Auditor)	1

(o) denotes observer
(b) denotes AINSE Board Member

AINSE Board Meetings

Five Board Meetings, including extra board meetings were held in 2016.

Executive Member	Office/Position	Organisation	Meetings Attended
E/Professor Robert Burford	President, Independent Director	Independent	5
Professor Claire Lenehan	University Representative, President	Flinders University	5
Dr Paul Di Pietro	Managing Director (resigned 3/4/16)	AINSE	1
Ms Michelle Durant	Managing Director (commenced 4/4/16)	AINSE	4
Dr Peter Coldrey	Independent Director	Independent	5
Professor Lyndon Edwards	ANSTO Representative	ANSTO	3
Dr Richard Garrett	ANSTO Representative	ANSTO	5
Ms Roslyn Hatton	ANSTO Representative	ANSTO	5
Professor Ian Gentle	University Representative	The University of Queensland	4
Professor Ian Smith	University Representative	Monash University	3
Observers			
Mr Robert Burdock	AINSE Consultant		1

AINSE Staff

Managing Director
Dr Paul Di Pietro, BE (Hons), PhD, MAICD (January - April 2016)
Ms Michelle Durant, BSc, BFinAdmin (April 2016)

Secretariat
Dr Rachel Caldwell, BMarSc, PhD
Mrs Sandy O'Connor (part-time)
Mrs Nerissa Phillips (part-time)
Mr Chris Munn (casual), BExSc

Starting from the front: Sandy O'Connor, Paul Di Pietro, Michelle Durant, Nerissa Phillips, Rachel Caldwell, Chris Munn.

AINSE Winter School Committee

Professor Thomas Millar	Western Sydney University
Ms Michelle Durant	AINSE
Dr Rachel Caldwell	AINSE
Ms Connie Banos	ANSTO
Dr Ben Fraser	ANSTO
Dr Andrew Studer	ANSTO
Dr Tamim Darwish	ANSTO
Mr Rod Dowler	ANSTO
Prof Mihail Ionescu	ANSTO
Ms Patricia Gadd	ANSTO
Ms Danielle Fierro	ANSTO
Dr Henk Heijnis	ANSTO
Ms Atun Zawadzki	ANSTO
Dr Gordon Thorogood	ANSTO
Ms Tina Paneras	ANSTO
Dr Gail Iles	ANSTO
Ms Shelley Levy	ANSTO

AANSS 2016 Committee

Dr David Cortie	Australian National University
Dr Rachel Caldwell	AINSE
Dr Stephen Holt	ANSTO
Dr Moeava Tehei	University of Wollongong
Dr Anna Paradowska	ANSTO
Prof Vanessa Peterson	ANSTO
Dr Neeraj Sharma	University of New South Wales

AINSE Specialist Committees - 2016

The Managing Director, AINSE, is an ex-officio (non-voting) member of all Committees. Committees met in May and in October. (a) indicates 'alternate' (c) indicates AINSE 'Councillor'

Archaeology and Geosciences Committee (AGS)

Dr Jessica Reeves (c) - Convenor	Federation University Australia
Dr Quan Hua	ANSTO
Dr Michael-Shawn Fletcher	The University of Melbourne
Dr Craig Sloss	Queensland University of Technology
A/Professor Patrick Moss	The University of Queensland
Vladimir Levchenko (a)	ANSTO

Biotechnology and Biomedical Sciences Committee (BBS)

A/Professor Damian Myers (c) – Convenor	Victoria University
Professor Pam Sykes	Flinders University
Professor Roger Price	University of Western Australia
Dr Ben Fraser	ANSTO
Dr Guo Jun Liu	ANSTO

Environmental Sciences Committee (ENV)

Dr Greg Skrzypek – Convenor	University of Western Australia
A/Professor Paul Augustinus	The University of Auckland
Professor Andrew McMinn (c) - Convenor	The University of Tasmania
Professor Isaac Santos	Southern Cross University
Dr Dioni Cendon	ANSTO
Dr Henk Heijnis	ANSTO

Materials Science and Engineering Committee (MSE)

Professor Gary Bryant (c) – Convenor	RMIT University
Dr Leigh Sheppard	Western Sydney University
Professor Raman Singh	Monash University
Dr Aleks Nikoloski (c)	Murdoch University
Professor Mihail Ionescu (a)	ANSTO
Dr David Cohen	ANSTO
Dr Stephen Holt	ANSTO
Professor Roland De Marco	University of Sunshine Coast
Dr Ludovic Dumee	Deakin University
Dr Victor Streltsov	The University of Melbourne
Dr Garry McIntyre	ANSTO
Professor Lyndon Edwards	ANSTO

2016 AINSE Finances

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Financial Statements
For the Financial Year Ended 31 December 2016

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The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Director's Report
For the Financial Year Ended 31 December 2016

Your Directors present their report on the Company for the financial year ended 31 December 2016.

Directors

The names of Directors in office at any time during or since the end of the year are:

Emeritus Professor Robert Burford
Dr Paul Di Pietro (resigned 3/4/2016)
Ms Michelle Durant (appointed 4/4/2016)
Professor Lyndon Edwards
Professor Ian Smith
Professor Ian Gentle
Dr Peter Coldrey
Ms Roslyn Hatton
Professor Claire Lenehan
Dr Richard Garrett

Directors have been in office since the start of the financial year to the date of this report unless otherwise stated.

Principal Activities

The principal activities of the Australian Institute of Nuclear Science and Engineering (AINSE) during the financial year was to advance research, education and training in the field of nuclear science and engineering and related fields within Australasia by being, in particular, the key link between universities, the Australian Nuclear Science and Technology Organisation (ANSTO), other member organisations and major nuclear science and associated facilities.

The company's short-term objectives are to:

- Offer Research Grants, Postgraduate top up Scholarships, and Honours Scholarships to people in 44 member institutions for the conduct of research principally at ANSTO
- Organise conferences in specific areas relating to nuclear science and engineering and in related fields that utilise nuclear techniques and analysis
- Support travel and accommodation for students and academics to present their AINSE supported research at conferences both within Australia and overseas

The company's long-term objectives are to:

- Be an effective link between all stakeholders of nuclear science and engineering
- Play an advocacy role for the Australasian nuclear community
- Play a leading role in nuclear education and training
- Facilitate the development of multilateral and multidisciplinary strategic research initiatives
- Utilise new streams of funding to increase its impact

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Director's Report
For the Financial Year Ended 31 December 2016

STRATEGIC PLAN

OUR VISION

Enhancing Australia's capability in nuclear science and engineering by facilitating world-class research and education.

OUR MISSION

AINSE will reach its vision through

- being an effective link between all stakeholders of nuclear science and engineering
- playing an advocacy role for the Australasian nuclear community
- playing a leading role in nuclear education and training
- facilitating the development of multilateral and multidisciplinary strategic research initiatives
- Utilising new streams of funding to increase its impact

STRATEGIC CONTEXT

AINSE has identified the following key trends and uncertainties influencing the future environment in which AINSE will operate.

Trends

- Integration of technologies at discipline boundaries
- Increasing role of science and technology in addressing grand societal challenges
- Ever-increasing flood of big data
- Increasing importance of large-scale strategic research
- Increasing importance of metric-driven funding
- Declining international competitiveness of the Australian manufacturing industry
- Increasing risks related to capex investments
- Declining industry Research and Development
- Low level of innovation in some Australian companies
- Evolution of the CRC system as a funding model

Uncertainties

- Ongoing funding for established infrastructure (both ANSTO and Universities)
- Ongoing debate about nuclear energy
- Industry appetite for nuclear research
- State of the Australian Research Council
- Research environment in nuclear areas in Asia
- Changes in geopolitical priorities
- Incentives for researchers to engage with industry

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Director's Report
For the Financial Year Ended 31 December 2016

STRATEGIC PRIORITIES

AINSE has defined the following seven strategic priorities for its Strategic Plan. These will drive the focus, resource allocation and how the Company monitors its success over the life of the Strategic Plan.

1. **Effectively communicate AINSE's purpose to a wide range of different stakeholders**

   - Clearly enunciate AINSE's value proposition and align it with the science priorities of Government, ANSTO and the Universities.
   - Enhance AINSE's outreach activities to reach a wider audience beyond nuclear scientists and engineers.
   - Work with outcome-focused advocacy groups to enhance the impact of nuclear technology.
   - Re-evaluate the metrics AINSE uses to measure and demonstrate its performance.
   - Constantly review how we best serve our stakeholders.

2. **Create an appropriate balance between funding project-based research and funding/facilitating multilateral and multidisciplinary collaboration**

   - Explore future opportunities for funded collaborative projects through workshops related to thematic areas.
   - Ensure continued relevance of AINSE programs.
   - Consider focused program style grants in strategic areas.
   - Maintain small grants opportunities.
   - Encourage a broad engagement within member organisations.

3. **Demonstrate leadership in the education of Australasia's next generation of scientists with an interest in nuclear science and engineering**

   - Expand AINSE's role in engaging the next generation of scientists with an interest in nuclear science.
   - Engage with Universities at the executive level to be aware of, and align with, Universities' strategic priorities.
   - Consider University accreditation for some AINSE activities (e.g. short/intensive courses).

4. **Develop AINSE's role as a credible advocate for the Australasian nuclear science and engineering community**

   - Maintain and strengthen AINSE's independence while providing value to ANSTO.
   - Speak with a coherent voice representing universities on nuclear aspects.
   - Become a facilitator of increasing industry awareness (e.g. promotions, training courses, education, and professional development).
   - Maintain and further develop a network of experts to communicate the state of the art in nuclear science and technology.
   - Draw on AINSE alumni as a resource of support and expertise.
   - Develop and maintain a catalogue of key messages that decision makers should be aware of.
   - Provide leadership in the development of a decadal plan for nuclear infrastructure investment.

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Director's Report
For the Financial Year Ended 31 December 2016

5. **Provide an effective and efficient link between different capabilities related to nuclear science and engineering**

   - Support the user base across the facilities at ANSTO, Australian Synchrotron, and other AINSE-supported facilities.
   - Become a facilitator for collaboration and complementary use of scientific infrastructure.
   - Effectively access the expertise within AINSE to facilitate optimum use of capabilities.
   - Make effective use of the expertise and enthusiasm of ANSTO staff.
   - Re-establish AINSE's reputation with the ARC and NHMRC as credible lead organisation for funding proposals (e.g. LIEF, Centres of Excellence).

6. **Seize new opportunities for funding beyond AINSE's traditional sources**

   - Be prepared to take advantage of new funding opportunities when they arise.
   - Develop links with the philanthropy community through the AINSE Trust.
   - Exploit our developed authority to leverage joint industry/government funding for innovation initiatives.
   - Use our wide membership base and coherence as a credible argument to demonstrate an effective and efficient return on government/industry investment.

7. **Diversify AINSE's membership and stakeholder base**

   - Increase the range of opportunities for existing members through flexible membership arrangements and new services.
   - Review our membership fee calculation.
   - Explore how to expand our stakeholder base, e.g. medical research organisations, international and environmental organisations, industry.

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Director's Report
For the Financial Year Ended 31 December 2016

Information on Directors

The Directors in office at the date of this report are listed below with particulars of qualifications, experience and special responsibilities (if any).

Robert Burford – Board Member
Board Member since May 2014
37 years at UNSW.
Most recent appointment was at the University of Technology Sydney as Head of School, The School of Mathematical and Physical Sciences.
BSc (Hons), PhD, FRACI, FIEAust, FIChemE

Claire Lenehan – President
Board Member since March 2014
18 years' experience in scientific research.
BSc (Hons), PhD, MRACI

Michelle Durant – Managing Director
Board Member since April 2016
26 years' experience in roles in museum operations, scientific administration and business management.
BSc, BFinAdmin

Lyndon Edwards – Board Member
Board Member since 2008
33 years' experience in academia and scientific research in Australia and UK.
MA, DPhil(Oxon), FIMMM, CEng

Roslyn Hatton – Board Member
Independent Board Member until September 2014
Board Member representing ANSTO since December 2014
26 years in public (ANAO) and private (Ernst & Young) sector audit and 8 years at the Commonwealth Bank in a financial accounting role.
Currently the Manager – Government and Financial Reporting at ANSTO.
BComm (Accounting, finance and information systems) UNSW
FCA

Richard Garrett – Board Member
Board Member since January 2015
32 years' experience in synchrotron radiation research and research management in Australia and the USA.
BSc (Hons), PhD

Peter Coldrey – Board Member
Board Member since August 2012
40 years' industrial research experience in the chemical and ophthalmic lens industries.
FTSE, BE,PhD, BCom

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Director's Report
For the Financial Year Ended 31 December 2016

Information on Directors continued

Ian Smith – Board Member
Board Member since August 2014
42 years' experience in Medical Research,
Research Administration and Industry Engagement,
most recently as Vice Provost (Research and Research Infrastructure)
Monash University
UK and Australia
PhD

Ian Gentle – Board Member
Board Member since August 2014
34 years' experience in academia and scientific research and research management.
BSc (Hons), PhD

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Director's Report
For the Financial Year Ended 31 December 2016

Meetings of Directors

During the financial year, 5 meetings of directors were held. Attendances by each director were as follows:

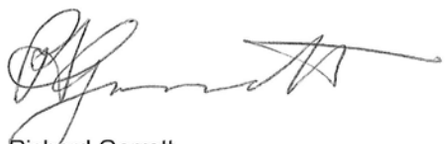
	Number eligible to attend	Number attended
Emeritus Professor Robert Burford	5	5
Professor Claire Lenehan	5	5
Dr Paul Di Pietro (resigned 3/4/2016)	1	1
Ms Michelle Durant (appointed 4/4/2016)	4	4
Professor Lyndon Edwards	5	3
Professor Ian Smith	5	3
Professor Ian Gentle	5	4
Dr Peter Coldrey	5	5
Ms Roslyn Hatton	5	5
Dr Richard Garrett	5	5

The Company is incorporated under the Corporations Act 2001 and is a company limited by guarantee. If the company is wound up, the constitution states that each member is required to contribute a maximum of $10 each towards meeting any outstanding obligations of the Company. At 31 December 2016, the total amount that members of the company are liable to contribute if the company is wound up is $440 (2015: $450).

Auditors Independence Declaration

The lead auditor's independence declaration for the year ended 31 December 2016 has been received and can be found on page 51 of the report.

Signed in accordance with a resolution of the Board of Directors.



Richard Garrett
Director

Michelle Durant
Director

Dated this 31st day of March 2017

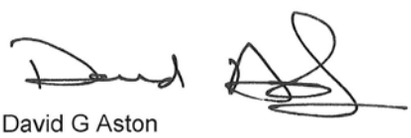
The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Auditor's Independence Declaration to the Directors
For the Financial Year Ended 31 December 2016

In accordance with the requirements of section 60-40 of the *Australian Charities and Not-for-profits Commission Act 2012*, I declare that, to the best of my knowledge and belief, during the year ended 31 December 2016 there have been no contraventions of:

i. The auditor independence requirements as set out in the *Australian Charities and Not-for-profits Commission Act 2012* in relation to the audit; and

ii. Any applicable code of professional conduct in relation to the audit.

Escott Aston
Chartered Accountants



David G Aston
Partner

RIVERWOOD NSW 2210

Dated 15/2/2017

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Statement of Comprehensive Income – by Nature
For the Financial Year Ended 31 December 2016

	Note	2016 $	2015 $
Revenue	2	2,260,653	3,339,715
Other income	2	86,850	108,572
Employee benefits expense		(467,355)	(513,467)
Depreciation expense	3	(12,815)	(12,813)
Audit, legal and consultancy expense		(61,970)	(141,716)
AINSE Awards		(1,586,882)	(2,180,840)
Other expenses		(284,080)	(308,081)
(Deficit)/surplus before income tax		**(65,599)**	**291,370**
Income tax expense		-	-
(Deficit)/surplus for the year		**(65,599)**	**291,370**

The accompanying notes form part of these financial statements.

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Statement of Financial Position
As At 31 December 2016

	Note	2016 $	2015 $
ASSETS			
CURRENT ASSETS			
Cash and cash equivalents	4	2,734,982	2,946,748
Trade and other receivables	5	124,736	183,665
Other	6	13,225	14,981
TOTAL CURRENT ASSETS		2,872,943	3,145,394
NON-CURRENT ASSETS			
Property, Plant & Equipment	7	21,327	34,142
TOTAL NON-CURRENT ASSETS		21,327	34,142
TOTAL ASSETS		**2,894,270**	**3,179,536**
LIABILITIES			
CURRENT LIABILITIES			
Trade and other payables	8	22,152	281,518
Employees provisions	9	101,230	74,326
TOTAL CURRENT LIABILITIES		123,382	355,844
NON-CURRENT LIABILITIES			
Employees provisions	9	21,031	8,236
TOTAL NON-CURRENT LIABILITIES		21,031	8,236
TOTAL LIABILITIES		**144,413**	**364,080**
NET ASSETS		**2,749,857**	**2,815,456**
EQUITY			
Awards reserve	12	875,887	723,887
Accumulated surplus		1,873,970	2,091,569
TOTAL EQUITY		**2,749,857**	**2,815,456**

The accompanying notes form part of these financial statements.

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Statement of Changes in Equity
For the Financial Year Ended 31 December 2016

	Awards Reserve $	Accumulated Surplus $	Total $
Balance at 1 January 2015	**2,205,514**	**318,572**	**2,524,086**
Net surplus/(deficit) attributable to the company	-	291,370	291,370
Transfers to and from awards reserve	(1,481,627)	1,481,627	-
Balance at 31 December 2015	**723,887**	**2,091,569**	**2,815,456**
Net surplus/(deficit) attributable to the company	-	(65,599)	(65,599)
Transfers to and from awards reserve	152,000	(152,000)	-
Balance at 31 December 2016	**875,887**	**1,873,970**	**2,749,857**

The accompanying notes form part of these financial statements.

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Cash Flow Statement
For the Financial Year Ended 31 December 2016

	Note	2016 $	2015 $
CASH FLOWS FROM OPERATING ACTIVITIES			
Receipts from operations		1,886,413	2,262,270
Interest received		65,013	82,081
Award related payments		(1,219,637)	(1,195,104)
Payments to suppliers and employees		(943,555)	(964,985)
Net cash generated from operating activities		**(211,766)**	**184,262**
CASH FLOWS FROM INVESTING ACTIVITIES			
Payment for property, plant and equipment		-	(16,274)
Net cash used in investing activities		**-**	**(16,274)**
Net (decrease)/increase in cash held		**(211,766)**	**167,988**
Cash and cash equivalents at beginning of financial year		2,946,748	2,778,760
Cash and cash equivalents at end of financial year		**2,734,982**	**2,946,748**

The accompanying notes form part of these financial statements.

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Notes to and forming part of the Financial Statements
For the Financial Year Ended 31 December 2016

Note 1 – Statement of Significant Accounting Policies

The financial statements cover The Australian Institute of Nuclear Science and Engineering Limited (AINSE) as an individual entity. The Australian Institute of Nuclear Science and Engineering Limited is a Company limited by guarantee, incorporated and domiciled in Australia.

Basis of Preparation

The Australian Institute of Nuclear Science and Engineering Limited applies the Australian Accounting Standards – Reduced Disclosure Requirements as set out in AASB 1053: Application of Tiers of Australian Accounting Standards and AASB 2010-2: Amendments to Australian Accounting Standards arising from Reduced Disclosure.

The financial statements are general purpose financial statements that have been prepared in accordance with Australian Accounting Standards – Reduced Disclosure Requirements of the Australian Accounting Standards Board and the *Australian Charities and Not-for-profits Commission Act 2012.* The Company is a not-for-profit entity for financial reporting purposes under Australian Accounting Standards.

Material accounting policies adopted in the preparation of these financial statements are presented below and have been consistently applied unless stated otherwise.

The financial statements, except for the cash flow information, have been prepared on an accruals basis and are based on historical costs, modified, where applicable, by the measurement at fair value of selected non-current assets, financial assets and financial liabilities. The amounts presented in the financial statements have been rounded to the nearest dollar.

The financial statements were authorised for issue on 31 March 2017 by the directors of the Company.

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Notes to and forming part of the Financial Statements
For the Financial Year Ended 31 December 2016

Significant Accounting Policies

Revenue and Other Income

Grant revenue is recognised in the statement of comprehensive income when the Company obtains control of the grant, it is probable that the economic benefits gained from the grant will flow to the Company and the amount of the grant can be measured reliably.

If conditions are attached to the grant which must be satisfied before it is eligible to receive the contribution, the recognition of the grant as revenue will be deferred until those conditions are satisfied.

When grant revenue is received whereby the Company incurs an obligation to deliver economic value directly back to the contributor, this is considered a reciprocal transaction and the grant revenue is recognised in the statement of financial position as a liability until the service has been delivered to the contributor, otherwise the grant is recognised as income on receipt.

Donations and bequests are recognised as revenue when received.

Interest revenue is recognised using the effective interest method, which for floating rate financial assets is the rate inherent in the instrument.

Revenue from the rendering of a service is recognised upon the delivery of the service to the customers.

All revenue is stated net of the amount of goods and services tax.

Property, Plant and Equipment

In the event the carrying amount of plant and equipment is greater than its estimated recoverable amount, the carrying amount is written down immediately to its estimated recoverable amount and impairment losses are recognised either in profit or loss or as a revaluation decrease if the impairment losses relate to a revalued asset. A formal assessment of recoverable amount is made when impairment indicators are present.

Plant and equipment that have been contributed at no cost, or for nominal cost, are valued and recognised at the fair value of the asset at the date it is acquired.

Depreciation

Plant and equipment are depreciated on a straight line or diminishing value basis over their useful lives to the Company commencing from the time the asset is held ready for use.

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Notes to and forming part of the Financial Statements
For the Financial Year Ended 31 December 2016

The depreciation rates used for each class of depreciable asset are:

Plant and equipment	15-35%
Motor vehicles	25%
Furniture and fittings	10-25%

The asset's residual values and useful lives are reviewed, and adjusted if appropriate, at the end of each reporting period.

Gains and losses on disposals are determined by comparing proceeds with the carrying amount. These gains or losses are included in the statement of comprehensive income. When revalued assets are sold, amounts included in the revaluation reserve relating to that asset are transferred to retained earnings.

Financial Instruments

The Company's financial instruments consist mainly of deposits with banks, local money market instruments, short-term investments and accounts receivable and payable.

Initial Recognition & Measurement
Financial assets and financial liabilities are recognised when the Company becomes a party to the contractual provisions to the instrument. Financial instruments are initially measured at fair value plus transaction costs, except where the instrument is classified "at fair value through profit or loss" in which case transaction costs are recognised immediately as expenses in profit or loss. Subsequent to initial recognition these instruments are measured as set out below.

Classification and Subsequent Measurement
Financial instruments are subsequently measured at either fair value, amortised cost using the effective interest method, or cost. Where available, quoted prices in an active market are used to determine fair value. In other circumstances, valuation techniques are adopted.

Amortised cost is calculated as the amount at which the financial asset or financial liability is measured at initial recognition less principal payments and any reduction for impairment, and adjusted for any cumulative amortisation of the difference between that initial amount and the maturity amount calculated using the effective interest method.

Fair Value
Fair value is determined based on current bid prices for all quoted investments. Valuation techniques are applied to determine the fair value for all unlisted securities, including recent arm's length transactions, reference to similar instruments and option pricing models.

Loans and Receivables
Loans and receivables are non-derivative financial assets with fixed or determinable payments that are not quoted in an active market and are subsequently measured at amortised cost. Gains or losses are recognised in profit or loss through the amortisation process and when the financial asset is derecognised.

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Notes to and forming part of the Financial Statements
For the Financial Year Ended 31 December 2016

Held-to-Maturity Investments
Held-to-maturity investments are non-derivative financial assets that have fixed maturities and fixed or determinable payments, and it is the entity's intention to hold these investments to maturity. They are subsequently measured at cost. Gains and losses are recognised in profit and loss through the amortisation process and when the financial asset is derecognised.

Financial Liabilities
Non-derivative financial liabilities (excluding financial guarantees) are subsequently measured at amortised cost. Gains or losses are recognised in profit or loss through the amortisation process and when the financial liability is derecognised.

Impairment of Assets

At the end of each reporting period, the Company assesses whether there is objective evidence that a financial asset has been impaired. A financial asset (or a group of financial assets) is deemed to be impaired if, and only if, there is objective evidence of impairment as a result of one or more events (a "loss event") having occurred, which has an impact on the estimated future cash flows of the financial asset(s).

In the case of financial assets carried at amortised cost, loss events may include: indications that the debtors or a group of debtors are experiencing significant financial difficulty, default or delinquency in interest or principal payments; indications that they will enter bankruptcy or other financial reogranisation; and changes in arrears or economic conditions that correlate with defaults.

For financial assets carried at amortised cost (including loans and receivables), a separate allowance account is used to reduce the carrying amount of financial assets impaired by credit losses. After having taken all possible measures of recovery, if management establishes that the carrying amount cannot be recovered by any means, at that point the written off amounts are charged to the allowance account or the carrying amount of impaired financial assets is reduced directly if no impairment amount was previously recognized in the allowance account.

When the terms of financial assets that would otherwise have been past due or impaired have been renegotiated, the Company recognises the impairment for such financial assets by taking into account the original terms as if the terms have not been renegotiated so that the loss events that have occurred are duly considered.

Employee Benefits

Provision is made for the Company's liability for employee benefits arising from services rendered by employees at the end of the reporting period. Employee benefits that are expected to be settled within one year have been measured at the amounts expected to be paid when the liability is settled. Other employee benefits payable later than one year have been measured at the present value of the estimated future cash outflows to be made for those benefits.

Cash and Cash Equivalents

Cash and cash equivalents include cash on hand, deposits held at-call with banks, other short-term highly liquid investments with original maturities of three months or less, and bank overdrafts. Bank overdrafts are shown within short term short term borrowings in current liabilities on the statement of financial position.

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Notes to and forming part of the Financial Statements
For the Financial Year Ended 31 December 2016

Goods and Services Tax (GST)

Revenues, expenses and assets are recognised net of the amount of GST, except where the amount of GST incurred is not recoverable from the Australian Taxation Office (ATO).

Receivables and payables are stated inclusive of the amount of GST receivable or payable. The net amount of GST recoverable from, or payable to, the ATO is included with other receivables or payables in the statement of financial position.

Cash flows are presented on a gross basis. The GST components of cash flows arising from investing or financing activities which are recoverable from, or payable to, the ATO are presented as operating cash flows included in receipts from customers or payments to suppliers.

Income Tax

AINSE Limited is exempt from income tax under section 50-5 of the *Income Tax Assessment Act 1997 as the Company is established for the purpose of enabling scientific research to be conducted in Australia.*

Trade and Other Payables

Trade and other payables represent the liabilities for goods and services received by the Company during the reporting period that remain unpaid at the end of the reporting period. The balance is recognised as a current liability with the amounts normally paid within 30 days of recognition of the liability.

Description of Awards Reserve

The awards reserve represents the future commitments for funding to scientists for research in three categories: Research awards, Postgraduate research awards and Fellowships. Research awards provide opportunities twice a year for academics to apply for funding for a period of 12 months. Postgraduate research awards provide support to post graduate students at an entry point in their qualification and last for the duration of their underlying primary scholarship. Fellowships are for a three-year appointment extendable to five years. AINSE currently has one Fellow and has not offered any new Fellowships since 2013.

Comparative Figures

When required by Accounting Standards, comparative figures have been adjusted to conform to changes in presentation for the current financial year.

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Notes to and forming part of the Financial Statements
For the Financial Year Ended 31 December 2016

	Note	2016 $	2015 $
Note 2 – Revenue and Other Income			
Revenue			
Payments from members		1,843,153	3,339,715
ANSTO promotion fee		417,500	-
		2,260,653	3,339,715
Other income			
Conference registrations		16,655	33,450
Sponsorships		3,000	-
Interest received		67,191	75,122
Foreign currency gain		4	-
		86,850	108,572
Total revenue and other income		2,347,503	3,448,287
Note 3 – (Deficit)/surplus for the Year			
The (deficit)/surplus for the year has been determined after charging as expenses:			
Depreciation of property, plant and equipment		12,815	12,813
Note 4 – Cash and Cash Equivalents			
Cash at bank		2,733,982	2,945,748
Cash on hand		1,000	1,000
Total cash and cash equivalents		2,734,982	2,946,748
Note 5 – Trade and Other Receivables			
Trade receivables		6,486	145,776
Less: Provision for impairment		-	-
		6,486	145,776
Other receivables		118,250	37,889
Total trade and other receivables		124,736	183,665
Note 6 – Other Current Assets			
Accrued interest		13,225	11,047
Prepayments		-	3,934
Total other current assets		13,225	14,981

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Notes to and forming part of the Financial Statements
For the Financial Year Ended 31 December 2016

	Note	2016 $	2015 $
Note 7 – Property, Plant and Equipment			
Plant and equipment – cost		11,831	11,831
Less: Accumulated depreciation		(4,397)	(2,802)
		7,434	9,029
Furniture and fittings – cost		10,485	10,485
Less: Accumulated depreciation		(4,194)	(2,097)
		6,291	8,388
Motor vehicles – cost		45,613	45,613
Less: Accumulated depreciation		(38,011)	(28,888)
		7,602	16,725
Total property, plant and equipment		21,327	34,142

(a) Movements in Carrying Amounts

Movements in the carrying amounts for each class or property, plant and equipment between the beginning and the end of the current financial year.

	Plant & Equipment $	Furniture & Fittings $	Motor Vehicles $	Total $
Balance at 1 January 2016	9,029	8,388	16,725	34,142
Additions	-	-	-	-
Disposals	-	-	-	-
Depreciation	(1,595)	(2,097)	(9,123)	(12,815)
Balance at 31 December 2016	7,434	6,291	7,602	21,327

Note 8 – Trade and Other Payables			
Trade and other payables		20,176	280,723
Employees – accrued salary and wages		1,976	795
Total trade and other payables		22,152	281,518

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Notes to and forming part of the Financial Statements
For the Financial Year Ended 31 December 2016

	Note	2016 $	2015 $
Note 9 – Employee Provisions			
CURRENT			
Annual leave		58,806	34,115
Long service leave		42,424	40,211
		101,230	74,326
NON CURRENT			
Long service leave		21,031	8,236
Total employee provisions		122,261	82,562

Note 10 – Key Management Personnel Compensation

Any person(s) having authority and responsibility for planning, directing and controlling the activities of the entity, directly or indirectly, including any director (whether executive or otherwise) of that entity is considered key management personnel.

The totals of remuneration paid to key management personnel (KMP) of the Company during the years are as follows:

Key management personnel compensation		224,588	233,728

Compensation includes salary and wages, superannuation, fringe benefits and secondment.

Key management personnel compensation includes a rate of $1,000 per meeting provided to Independent Board Members and secondment of ANSTO employee.

Note 11 – Other Related Party Transactions

There were no related party transactions during the financial year.

Note 12 – Awards Reserve

Opening balance at 1 January		723,887	2,205,514
Transfer to other comprehensive income		152,000	(1,481,627)
Balance as at 31 December		875,887	723,887

The awards reserve was established to provide for the value of unexpended grants at the end of each year. It consists of commitments for Research awards up to 6 months (2015: 6 months in advance), Fellowships and Postgraduate awards.

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Notes to and forming part of the Financial Statements
For the Financial Year Ended 31 December 2016

	Note	2016 $	2015 $

Note 13 – Financial Risk Management

The Company's financial instruments consist mainly of deposits with banks, local money market Instruments, short-term investments, accounts receivable and payable, and leases.

The carrying amounts of each category of financial instruments, measured in accordance with AASB 139 as detailed in the accounting policies to these financial statements, are as follows:

Financial Assets		
Cash and cash equivalents	2,734,982	2,946,748
Trade and other receivables	124,736	183,665
Total financial assets	2,859,718	3,130,413
Financial Liabilities		
Trade and other payables	22,153	281,518
Total financial liabilities	22,153	281,518

Note 14 – Events after the Reporting Date

The Directors are not aware of any significant events since the end of the reporting period.

Note 15 – Company Details

The principal place of business of the Company is:

The Australian Institute of Nuclear Science and Engineering Limited
New Illawarra Road
LUCAS HEIGHTS NSW

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Directors' Declaration
For the Financial Year Ended 31 December 2016

The Directors of the Company declare that:

1. The financial statements and notes, as set out on pages 52 to 64 satisfy the requirements of the *Australian Charities and Not-for-profits Commission Act 2012* and *Not-for-profits Commission Regulation 2013*, and;

   (a) comply with Australian Accounting Standards – Reduced Disclosure Requirements, and

   (b) give a true and fair view of the financial position as at 31 December 2016 and of its performance for the year ended on that date.

2. In the directors' opinion there are reasonable grounds to believe that the Company will be able to pay its debts as and when they become due and payable

This declaration is made in accordance with a resolution of the Board of Directors.

.....
Richard Garrett
Director

.....
Michelle Durant
Director

Dated this 31st day of March 2017

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Independent Auditor's Report to the Members of
The Australian Institute of Nuclear Science and Engineering Limited
For the Financial Year Ended 31 December 2016

Audit Opinion

Opinion

We have audited the financial report of The Australian Institute of Nuclear Science and Engineering Limited (the Company), which comprises the statement of financial position as at 31 December 2016, and the statement of comprehensive income, statement of changes in equity and cash flow statement for the year then ended, and notes to the financial statements, including a summary of significant accounting policies, and the declaration by those charged with governance.

In our opinion, the accompanying financial report of the Company is prepared, in all material respects, in accordance with *the Australian Charities and Not-for-profits Commission Act 2012, the Not-for-profits Commission Regulation 2013*.

Basis for Opinion

We conducted our audit in accordance with Australian Auditing Standards. Our responsibilities under those standards are further described in the *Auditor's Responsibilities for the Audit of the Financial Report* section of our report. We are independent of the Company in accordance with the ethical requirements of the Accounting Professional and Ethical Standards Board's APES 110 *Code of Ethics for Professional Accountants* (the Code) that are relevant to our audit of the financial report in Australia. We have also fulfilled our other responsibilities in accordance with the Code. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Information Other than the Financial Report and Auditor's Report Thereon

Those charged with governance are responsible for the other information. The other information comprises the information included in the Company's annual report for the year ended 31 December 2016, but does not include the financial report and our auditor's report thereon.

Our opinion on the financial report does not cover the other information and accordingly we do not express any form of assurance conclusion thereon.

In connection with our audit of the financial report, our responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the financial report or our knowledge obtained in the audit or otherwise appears to be materially misstated.

If, based on the work we have performed, we conclude that there is a material misstatement of this other information; we are required to report that fact. We have nothing to report in this regard.

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Independent Auditor's Report to the Members of
The Australian Institute of Nuclear Science and Engineering Limited
For the Financial Year Ended 31 December 2016

Responsibilities of Management and Those Charged with Governance for the Financial Report

Management is responsible for the preparation of the financial report in accordance with *the Australian Charities and Not-for-profits Commission Act 2012, the Not-for-profits Commission Regulation 2013*, and for such internal control as management determines is necessary to enable the preparation of the financial report that is free from material misstatement, whether due to fraud or error.

In preparing the financial report, management is responsible for assessing the Company's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the Company or to cease operations, or has no realistic alternative but to do so.

Those charged with governance are responsible for overseeing the Company's financial reporting process.

Auditor's Responsibilities for the Audit of the Financial Report

Our objectives are to obtain reasonable assurance about whether the financial report as a whole is free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with Australian Auditing Standards will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of the financial report.

A further description of our responsibilities for the audit of the financial report is detailed in Appendix A to the Auditor's Report.

Escott Aston
Chartered Accountants

David G Aston
Partner

RIVERWOOD NSW 2210

Dated 31/3/2017

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Independent Auditor's Report to the Members of
The Australian Institute of Nuclear Science and Engineering Limited
For the Financial Year Ended 31 December 2016

APPENDIX A to the Auditor's Report

As part of an audit in accordance with Australian Auditing Standards, we exercise professional judgement and maintain professional scepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the financial report, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.

- Obtain an understanding of internal control relevant to the audit in order to design procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Company's internal control.

- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.

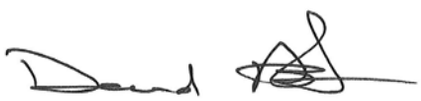
- Conclude on the appropriateness of management's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Company's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial report or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the Company to cease to continue as a going concern.

We communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Auditor's Disclaimer
For the Financial Year Ended 31 December 2016

The additional data presented in the Detailed Profit & Loss Statement is in accordance with the books and records of The Australian Institute of Nuclear Science and Engineering Limited (our client) which have been subjected to the auditing procedures applied in the statutory audit of the Company for the year ended 31 December 2016. It will be appreciated that the statutory audit did not cover all details of the financial data and no warranty of accuracy or reliability is given. Neither the firm nor any member or employee of the firm undertakes responsibility in any way whatsoever to any person (other than our client) in respect of such data, including any errors or omissions therein however caused.

Escott Aston
Chartered Accountants



David G Aston
Partner

RIVERWOOD NSW 2210

Dated 31/3/2017

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Detailed Profit & Loss Statement
For the Financial Year Ended 31 December 2016

		2016 $		2015 $
Operating Revenue				
Payments from Members		1,843,153		3,339,715
ANSTO Promotion Fee		417,500		-
Interest Received		67,191		75,122
Sponsorships				
AANSS	3,000		-	
Conference Registrations		16,655		33,450
Foreign currency gain		4		-
Total Operating Revenue		2,347,503		3,448,287
Operating Expenses				
Wages & Salaries		420,106		442,030
Superannuation		47,249		71,437
AINSE Awards				
Postgraduate Awards				
ANSTO Facility Costs	82,500		400,881	
Travel & Accommodation	96,925		63,484	
Stipends	587,669		507,311	
		767,094		971,676
Winter School		4,333		5,844
Research Fellowships		102,119		224,744
Research Awards				
ANSTO Facility Costs	679,965		715,850	
Minor Equipment & Materials	2,559		3,000	
Travel Accommodation	35,412		254,226	
Other (Recoverable)/Costs	(4,600)		5,500	
		713,336		978,576
Conference Subsidies		92,031		104,189
Conference Management		19,387		8,189
Publication & Promotions		21,035		28,264
Meetings & Committees		84,673		110,108
AINSE Secretariat				
Audit Fees	20,475		15,963	
Bank Charges	611		980	
Depreciation	12,815		12,813	
Office Supplies	3,520		4,264	
Postage & Telephone	878		1,155	
Insurance	11,731		9,262	
Entertaining	375		1,831	
Books & Software	2,844		2,627	
Office Equipment & Repairs	-		(1,892)	

The Australian Institute of Nuclear Science and Engineering Limited
ABN: 18 133 225 331
Detailed Profit & Loss Statement
For the Financial Year Ended 31 December 2016

		2016 $		2015 $
Administration & Staff Training	9,425		12,981	
Travel & Accommodation	9,200		18,651	
Vehicle Expenses	8,692		12,893	
Consultancy Fees	4,793		116,042	
Staff Recruitment	1,162		-	
FBT Expense & Payments	5,907		3,427	
Credit Card Expense	192		660	
Legal Expenses	36,702		9,711	
Miscellaneous	12,417		(9,508)	
		141,739		211,860
Total Operating Expenses		2,413,102		3,156,917
(Deficit)/surplus for the Year		(65,599)		291,370

AINSE Postgraduate Research Awards (PGRA)

Student, Geoffrey Lerner, Taking notes on Mt. Taranaki's most recent summit lava dome.

An AINSE Postgraduate Research Award (PGRA) is a top-up scholarship. To be eligible for one of these awards, an applicant must hold an Australian Postgraduate Award (APA) or equivalent scholarship. The PGRA may be held until the expiry of the primary scholarship.

In addition to providing a student with a stipend of $7,500 pa, the award provides access to ANSTO's world-class facilities and expertise. An allowance for travel expenses for two visits and a total of one month's accommodation to Lucas Heights per annum is also awarded.

31 new AINSE postgraduate research projects were supported by a PGRA in 2016. 18 projects were finalised and continue without funding until a thesis is provided. The total number of scholars supported in 2016 were 80. AINSE received 12 theses and has now helped train 383 students through its PGRA program, in aspects of nuclear science and associated techniques of analysis. Many more students have been assisted with their research by gaining access to Lucas Heights facilities through AINSE Awards made to their supervisors. The Council believes that one of the most valuable roles fulfilled by AINSE is the provision of these scholarships.

PhD theses of Postgraduate Scholars received during 2016

Improving the surface activity of attached biomolecules
Peter Akers, School of Chemical Sciences, The University of Auckland
Commenced 1/7/2012

Geochemical investigations of corchia speleothems: Implications for past climate change
Petra Bajo, Resource Management & Geography, The University of Melbourne
Commenced 1/7/2011

Understanding sediment sources to inform catchment management in data-poor regions an example from Sumba, Eastern Indonesia
Sarah Elizabeth Hobgen, Research Inst for Environment & Livelihoods, Charles Darwin University
Commenced 1/7/2011

Using sediment cores to reconstruct historical pollution records: Digging up the Yarra's dirty past
Anna Lintern, Faculty of Engineering, Monash University
Commenced 1/7/2014

Palaeoecology of the South Wellesley Archipelago. A history of human occupation and environmental change
Lydia Mackenzie, Geography, Planning & Environment Management, The University of Queensland
Commenced 1/7/2013

Single-cell isolation using light-activated electrochemically-switchable surfaces
Stephen Geoffrey Parker, Chemistry, The University of New South Wales
Commenced 1/7/2011

Structural effects of ammonium and hydronium in jarosite minerals
Henry Spratt, Chemistry, Queensland University of Technology
Commenced 1/7/2010

The fate of atmospheric metal pollutants in the landscape, Snowy Mountains, South-Eastern Australia
Nicola Stromsoe, Geography, The University of Queensland
Commenced 1/7/2011

Nanostructures across oppositely charged surfactant - polymer interfaces
Kristian Tangso, Drug Delivery Disposition & Dynamics, Inst Pharmaceutic, Monash University
Commenced 1/7/2012

Examination of catalytically relevant palladium N-Heterocyclic carbene complexes
Catriona Vanston, School of Chemistry, University of Tasmania
Commenced 1/7/2012

Developing a radiocarbon-based chronology for Tel Axekah: The first stage
Lyndelle Webster, Ancient History, Macquarie University
Commenced 1/07/2015

Biological parameter estimation for longitudinal imaging in the rodent brain
Catriona Wimberley, Brain & Mind Research Institute, The University of Sydney
Commenced 1/7/2012

Postgraduate Scholars, and their projects, who were supported during 2016

TiO_2-Based Semiconductors for Solar Energy Conversion, including Ta-Doped TiO_2
Mohammad Alim, Solar Energy Technologies, Western Sydney University
Commenced 1/7/2016

Revealing nanoscale interactions and electro-migration mechanisms during desalination by electro-dialysis in mixed solvents by SANS
Francois-Marie Allioux, Institute for Frontier Materials, Deakin University
Commenced 1/7/15

Development of a platform for rapid antibiotic viability testing
Jakob Andersson, Chemical & Physical Sciences, Flinders University
Commenced 1/7/15

Calibration of advanced hydrologic and isotopic palaeoclimate models with lake monitoring
Martin Ankor, School of Physical Sciences, The University of Adelaide
Commenced 1/7/2016

Resolving changes in hydration state and the role of nanoparticles during the nucleation, growth and evolution of calcium carbonate minerals
Jonathan Avaro, Southern Cross Geoscience, Southern Cross University
Commenced 1/7/15

Morphology effect of novel poly(p-phenylene vinylene) brush thin films on their photoluminescence in solid-state
Paul Baek, School of Chemical Science, The University of Auckland
Commenced 1/7/2014

Exploring magnetoelectric coupling in ferroics; neutron scattering experiments probing the magnetic phases of $BiFeO_3$
Stuart Burns, School of Materials Science and Engineering, The University of New South Wales
Commenced 1/7/2016

The Last Interglacial: an analogue for future climate change?
Micheline Campbell, School of Earth and Environment, The University of Western Australia
Commenced 1/7/15

Functional Magnetic Interface Phenomena in Nano-Architectures Studied by Polarised Neutron Reflectometry
Grace Causer, Institute for Superconducting and Electronic Materials, University of Wollongong
Commenced 1/7/2016

Landscape evolution of the Kimberley region and rock art dating using cosmogenic ^{10}Be and ^{26}Al
Gael Cazes, School of Earth and Environmental Sciences, University of Wollongong
Commenced 1/7/2016

Novel Oxynitride Photocatalysts for Solar Hydrogen Production
Andrew Chan, School of Chemical Sciences, The University of Auckland
Commenced 1/7/15

Search for novel multiferroic materials: Magnetic and Structure Phase Transition Study in $Cu_{1-x}Zn_xFe_2O_4$ and $SrCoO_{3-x}$
Fenfen Chang, Physics, The University of New South Wales
Commenced 1/7/2014

Charge collection characterisation of new laterally depleting 3D microdosimeters
Lachlan Chartier, Centre for Medical Radiation Physics, University of Wollongong
Commenced 1/7/2016

Neutron and electron diffraction studies of anion order in perovskite oxynitrides
Wan-Ting Chen, Chemistry, The University of Auckland
Commenced 1/7/15

Materials for New Generation of Batteries
James Christian, Chemistry, The University of New South Wales
Commenced 1/7/15

Late Holocene hydroclimate at Kangaroo Island, South Australia
Bronwyn Dixon, Earth Science, The University of Melbourne
Commenced 1/7/15

Using Stable Isotope Analysis and Carbon 14 to Assess the Feeding Ecology of Southern Hemisphere Humpback Whales
Pascale Eisenmann, SOPOPP, Griffith University
Commenced 1/7/2014

Designed nanoparticles for dual-modality imaging and drug/radiopharmaceutical delivery: combining SPECT/PET and MRI
Lars Esser, Monash Institute of Phamaceutical Sciences, Monash University
Commenced 1/7/2014

Holocene drivers of environmental change from high-resolution lake sediment sequences in northern New Zealand
Gianna Evans, School of Environment, The University of Auckland
Commenced 1/7/15

A Late Quaternary Climate and Environmental Reconstruction from Sub-Tropical Queensland
Michael Evans, Geography, Planning & Environmental Management, The University of Queensland
Commenced 1/7/2016

Assessing terrestrial climate variability over the last glacial-interglacial transition: a new quantitative, high-resolution, multi-proxy record from south-eastern Australia
Georgina Falster, Earth Sciences, The University of Adelaide
Commenced 1/7/15

Radiocarbon age of dissolved organic carbon under contrasting land uses in NSW Australia
Rubeca Fancy, School of Environmental & Rural Science, The University of New England
Commenced 1/7/2016

Skyrmion system in a chiral multiferroelectric thin film of Cu_2OSeO_3
Nastaran Faraji Ouch Hesar, School of Materials Science and Engineering, The University of New South Wales
Commenced 1/7/2016

Unlocking the Kimberley's Environmental Past: Late Quaternary Multi-Proxy Analysis of Tropical Mound Spring Peat Cores
Emily Field, Geography, Planning and Environmental Management, The University of Queensland
Commenced 1/7/15

Radiocarbon dating of Kimberley rock art
Damien Finch, School of Earth Sciences, The University of Melbourne
Commenced 1/7/2016

Stable carbon isotope analysis of Pandanus sp. drupes: A proxy for ancient foraging practices at Madjedbebe (Malakunanja II)
Stephanie Florin, Social Sciences, The University of Queensland
Commenced 1/7/15

Surface Chemistry of a Complex Mineral System: Mineralogy and Sorption Processes in Modified Bauxite Refinery Residues
Tiago Freire, School of Environment, Science and Engineering, Southern Cross University
Commenced 1/7/2012

A Breath of Fresh Air for Cystic Fibrosis
Melanie Fuller, School of Chemical and Physical Sciences, Flinders University
Commenced 1/7/2016

Reconstructing the post-glacial history of the subantarctic Auckland Islands from marine sediment cores using ITRAX XRF and AMS Radiocarbon
Greer Gilmer, Geological Sciences, University of Otago
Commenced 1/7/15

Unravelling the complex relationship of the coral holobiont and its responses to metal contaminants
Francesca Gissi, School of Chemistry, University of Wollongong
Commenced 1/7/2016

Understanding the mode of action of analgesic conotoxin Vc1.1 and other analgesic conotoxins
Ellen Gleeson, Chemistry, Monash University
Commenced 1/7/2014

Impact of gamma-irradiation of human cells upon nuclear versus mitochondrial forensic genotyping and relationship to oxidative stress biomarkers
Corey Goodwin, Forensic Studies, University of Canberra
Commenced 1/7/15

Interactions between meteoric, surface and ground water in fractured rock: Upper Murrumbidgee catchment
Sharon Gray, Research School of Earth Sciences, The Australian National University
Commenced 1/7/2016

Developing the first long-term (>150yrs) rainfall record for Southeast Queensland
Heather Haines, Australian Rivers Institute, Griffith University
Commenced 1/7/2014

Deciphering the mechanisms of antibacterial activity and resistance of polymyxins in Gram-negative bacteria
Meiling Han, Monash Institute of Phamaceutical Sciences, Monash University
Commenced 1/7/2016

Quantifying Anthropogenic Impacts on Dust Flux and its Interaction with Recipient Ecosystems
James Hooper, School of Earth & Environmental Sciences, University of Wollongong
Commenced 1/7/2016

Investigating the Role of Cholesterol in the Metamorphic Protein CLIC1's Membrane Interactions
Khondker Rufaka Hossain, Medical & Molecular Biosciences, University of Technology Sydney
Commenced 1/7/2013

Oxygen Ordering Induced Magnetic Phase Transition in Strain Tuned SrCoO3-x Thin Film
Songbai Hu, Materials Science and Engineering, The University of New South Wales
Commenced 1/7/2014

Investigating accumulation of trace metals in a colonial and solitary marine invertebrate using radioisotope tracers
Rebecca Hull, Bioscience (Zoology), The University of Melbourne
Commenced 1/7/15

Confinement effects on the stimulus response of polymer brushes
Ben Humphreys, Chemistry, The University of Newcastle
Commenced 1/7/2016

Using atmospheric and plant-based sampling of C-14 to constrain local and regional fossil fuel emissions
Wenwen Huo, School of Earth Sciences, The University of Melbourne
Commenced 1/7/2016

Mineral controls on soil carbon stability along the subtropical giant podzol Cooloola chronosequence
Andrew Jones, School of Agriculture and Food Science, The University of Queensland
Commenced 1/7/15

Hydrogen Depth Profiling of High Strength Steels
Oluwole Kazum, Chemical Engineering, James Cook University
Commenced 1/7/15

210Pb and radiocarbon dating reveal history of carbon sequestration in coastal wetlands
Jeffrey Kelleway, Plant Functional Biology and Climate Change Cluster, University of Technology Sydney
Commenced 1/7/15

Tomographic imaging of residual elastic strain fields in whole components via Strain Tomography
Henry Kirkwood, Chemistry and Physics, La Trobe University
Commenced 1/7/15

Synthesis and Photophysics of Metal-Fluorine(18) Radiopharmaceutical Complexes as Optical-Positron Emission Multimodal Diagnostic Agents
Mitchell Klenner, Chemistry, Curtin University of Technology
Commenced 1/7/15

In-situ investigation of the mechanism of proton conduction in phosphotungstic acid impregnated mesoporous silica based proton exchange membranes for high temperature direct alcohol fuel cells
Krystina Lamb, Faculty of Science, Health, Education & Engineering, University of the Sunshine Coast
Commenced 1/7/2013

Developing a spatio-temporal model for mass flow hazards at stratovolcanoes, Mt. Taranaki, New Zealand
Geoffrey Lerner, School of Environment, The University of Auckland
Commenced 1/7/2016

Structural investigation of the Munc18:SNARE protein complexes required for neurotransmission and blood glucose control
Emma Livingstone, Institute for Molecular Bioscience, The University of Queensland
Commenced 1/7/2016

Inorganic nanoparticles/metal organic frameworks hybrid membrane reactors for simultaneous separation and conversion of CO_2
James Maina, Institute for Frontier Materials, Deakin University
Commenced 1/7/2016

Using nuclear techniques to reconstruct fire driven environmental changes in Western Tasmania
Michela Mariani, School of Geography, The University of Melbourne
Commenced 1/7/2016

Particle-size dependence on arsenic distribution in historical gold mine wastes: Investigating the pathways for human exposure
Rachael Martin, School of Science, Information Technology & Engineering, Federation University
Commenced 1/7/2013

Investigation and development of molten salt reactor designs
Lance Maul, Mechanical & Manufacturing Engineering, The University of New South Wales
Commenced 1/7/2014

Controlling interfacial properties and dispersion of graphene analogues
Thomas McCoy, School of Chemistry, Monash University
Commenced 1/7/2016

Structure-stimulus relations in responsive polymer brushes
Timothy Murdoch, Chemical Engineering, The University of Newcastle
Commenced 1/7/15

Making low cost Australian carbon fibres
Srinivas Nunna, Institute of Frontier Materials, Deakin University
Commenced 1/7/2014

Investigating transfer and accumulation of trace metals up the food chain; using radiotracers to observe the uptake of contaminants in prawns and fish from seawater and dietary ingestion
Kaitlyn O'Mara, Australian Rivers Institute, Griffith University
Commenced 1/7/2016

Sea ice extent and diatom primary production in the Ross Sea, Antarctica: the response to post-glacial warming
Rebecca Parker, Geology, University of Otago
Commenced 1/7/2016

Inter-aquifer connectivity - investigating groundwater movement through regional aquitards utilising uranium isotopes
Stacey Priestley, School of the Environment, Flinders University
Commenced 1/7/2014

Plasma equilibrium and stability in presence of flow and pressure anisotropy in a linear pinched helicon discharge
Zhisong Qu, Plasma Research Laboratory, The Australian National University
Commenced 1/7/2014

Use of Small Angle X-ray and Neutron Scattering Techniques to Construct Quantitative Models that Correlate the Morphology Fluctuations of Graphene-based Disordered Lamellar Structures with the Transport of Liquids, Ions, and Gasses within these Materials
Ashley Roberts, Materials Engineering, Monash University
Commenced 1/7/2014

Carbon burial and vertical accretion rates in seagrass sediments in Moreton Bay
Jimena Samper-Villarreal, Marine Spatial Ecology Lab, The University of Queensland
Commenced 1/7/2012

In situ characterization of microstructural evolution during thermal cycling of materials at elevated temperatures by neutron diffraction
Madjid Sarvghad Moghaddam, Chemistry, Physics and Mechanical Engineering School, Queensland University of Technology
Commenced 1/7/2016

Synthesis and Stabilities of Heavy Main Group Metal Hydrides
Ryan Schwamm, SCPS, Victoria University of Wellington
Commenced 1/7/15

Neutron Reflectometry for the Kinetic Study of Biomimetic Calcium Phosphate Growth on a Zein Protein Template
Rayomand Shahlori, School of Chemical Sciences, The University of Auckland
Commenced 1/7/2014

Using C-14 to resolve mangrove carbon cycling
James Sippo, Centre of Coastal Biogeochemistry, Southern Cross University
Commenced 1/7/2016

Development of imaging agents to target tumour hypoxia
Deborah Sneddon, Eskitis Institute for Drug Discovery, Griffith University
Commenced 1/7/15

An archaeological and palaeoenvironmental investigation into prehistoric occupation of the Namadgi Ranges in the southeast Australian uplands
Fenja Theden-Ringl, Archaeology and Natural History, The Australian National University
Commenced 1/7/2013

Radio frequency wave dynamics in the H-1 Heliac and MagPIE
Alexander Thorman, Plasma Research Laboratory, The Australian National University
Commenced 1/7/2014

Sourcing historical contamination in the Gippsland Lakes, Victoria
Adam Trewarn, Applied and Biomedical Science, Federation University
Commenced 1/7/15

Location and conformation of encapsulated amphipathic peptides within bicontinuous cubic lipidic mesophases
Leonie van 't Hag, Manufacturing Flagship, CSIRO
Commenced 1/7/15

Neutron tomography and scattering in speleothems: the influence of porosity and texture on the accuracy of palaeoclimate interpretations
Valentina Vanghi, School of Environmental & Life Sciences, The University of Newcastle
Commenced 1/7/2016

Inelastic Neutron Scattering studies of Crystal Field Splitting in Lanthanoid-Polyoxometalate Single-Molecule Magnets
Michele Vonci, Chemistry, The University of Melbourne
Commenced 1/7/2014

Reorientation of mesochannels templated from hexagonal lyotropic liquid crystals under electric field and its structure reconstruction
Guang Wang, Institute for Frontier Materials, Deakin University
Commenced 1/7/15

Using ITRAX XRF, multi-dimensional isotope analysis and silica microfossils to study the palaeo-ecology of sclerophyll sites in the Atherton Tablelands, northeastern Australia
Loraine Watson-Fox, Geography, Planning & Environmental Management, The University of Queensland
Commenced 1/7/2016

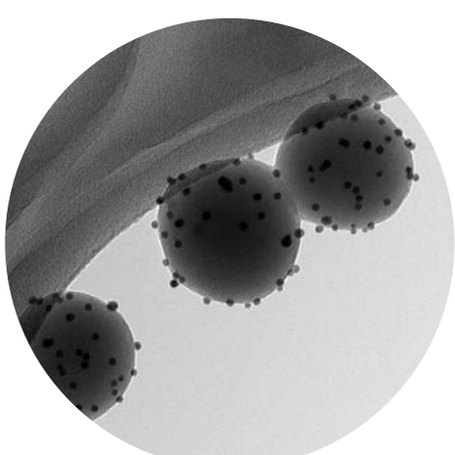
The character and evolution of upland chain-of-ponds: Developing a geomorphic framework for conservation and rehabilitation
Rory Williams, Environment & Geography, Macquarie University
Commenced 1/7/2014

Novel fluorinated radioligands of the tyrosine kinase, MERTK, for imaging and diagnosis in multiple sclerosis
Siu Wai Wong, Monash Institute of Pharmaceutical Sciences, Monash University
Commenced 1/7/2016

Investigation of metal oxides as high energy density cathode materials in lithium-ion batteries
Ross Wood, Science & IT, The University of Newcastle
Commenced 1/7/15

Synthesis, radiolabelling and bio-conjugation studies of [18F]ethenesulfonyl fluoride (ESF) - a new innovative tool for radiopharmaceutical development
Bo Zhang, School of Chemistry, Monash University
Commenced 1/7/2016

Electrostatic effects on chemical reactivity; oriented double layer effects on chemical bonding kinetics and thermodynamic
Long Zhang, Intelligent Polymer Research Institute, University of Wollongong
Commenced 1/7/2016



AINSE Research Awards 2016

AINSE Research Awards - 2016

Australian Catholic University

ALNGRA16030 **Vaughan Monamy** $8,775
Dietary preferences of insectivorous bats over inland rivers and adjacent agricultural crops

Australian Catholic University Total $8,775

The University of Adelaide

ALNGRA16003 **Cameron Barr** $23,120
A multi-proxy record of climatic and environmental change over a glacial-interglacial cycle from sub-tropical Australia

The University of Adelaide Total $23,120

Australian National University

ALNGRA16012 **Matthew Prebble** $7,600
Calibrating late Holocene precipitation changes in the SPCZ using Pb210 dating of lake sediments

Australian National University Total $7,600

University of Canterbury

ALNGRA16026 **Ian Hawes** $9,800
Holocene evolution of Lake Vanda, Antarctica

University of Canterbury Total $9,800

Charles Sturt University

ALNGRA16017 **Geoff Currie** $11,000
Purine mediated efflux of 99mTc Sestamibi in melanoma

Charles Sturt University Total $11,000

Flinders University

ALNGRA16011 **Rachel Popelka-Filcoff** $8,795

Elemental Characterisation of Australian and International Uranium Ores with Neutron Activation Analysis

ALNGRA16014 **Wendy van Duivenvoorde** $10,360

Dating the Phoenician Shipwreck from Bajo de la Campana, Spain

Flinders University Total $19,155

Griffith University

ALNGRA16028 **Jon Knight** $21,400

Dating mangrove roots as an indicator of both ecogeomorphic response and sea level change in coastal wetlands

ALNGRA16029 **Steven Melvin** $20,280

Bioaccumulation kinetics, tissue distribution, and toxicological effects of trace element exposure throughout larval amphibian development

Griffith University Total $41,680

La Trobe University

ALNGRA16016 **Peter Barnard** $8,680

Labelling bifunctional N-heterocyclic carbene-based ligands with Tc-99m and functionalised macrocyclic ligands with Zr-89

ALNGRA16005 **Richard Cosgrove** $9,800

Mid- to late-Holocene transition in southwestern Wimmera, Jadawadjali country

ALNGRA16010 **Tim Murray** $6,630

Who are the Chagga? Reconnoitering the pre-colonial chiefdoms and the emergence of social complexity in Kilimanjaro, Tanzania

ALNGRA16013 **Nicola Stern** $6,435

Hunter Gatherer Societies at Lake Mungo During the Last Glacial Maximum

La Trobe University Total $31,545

Macquarie University

ALNGRA16031 **Peter Nelson** $14,000

Radiocarbon analysis of organic and elemental carbon in carbonaceous PM2.5 samples

Macquarie University Total $14,000

The University of Melbourne

ALNGRA16023 **Michael-Shawn Fletcher** $7,540
Influences of fire and climate on terrestrial-aquatic ecosystem change: Understanding the role of nutrient inputs and landscape dynamics in Tasmania

ALNGRA16024 **Michael-Shawn Fletcher** $12,725
First Australian pollen-based quantitative vegetation reconstruction: a proof of concept from Western Tasmania

ALNGRA16008 **Helen Green** $12,630
Radiocarbon dating of mineral accretions associated with Kimberley region rock art

The University of Melbourne Total $32,895

Monash University

ALNGRA16020 **Ian Cartwright** $18,645
The age of dissolved organic carbon exported from headwater catchments

ALNGRA16006 **Bruno David** $4,200
Dating the ancestral migration village site of Popo, Orokolo Bay, Papua New Guinea

ALNGRA16022 **Ana Deletic** $9,315
Fate of 32P in greywater biofiltration systems

ALNGRA16027 **Adam Kessler** $3,290
Measuring metal fluxes from cable bacteria in Yarra River sediments

Monash University Total $35,450

Murdoch University

ALNGRA16035 **Manickam Minakshi** $18,440
Synthesis of cobalt molybdate for energy storage applications : Ion beam and microscopic analyses

ALNGRA16036 **Hans Oskierski** $10,290
Optimisation of heat activation strategies for the extraction of lithium from spodumene and petalite

Murdoch University Total $28,730

The University of Newcastle

ALNGRA16025 **Troy Gaston** $12,075
Trophic fractionation and turnover by estuarine crabs: stable isotope evidence to support field studies

ALNGRA16018 **Adrienne Elizabeth (Liz) Milward** $6,500
Mapping iron accumulation and associated inflammatory and degenerative changes in the lung and other tissues of mouse models of iron loading disease

The University of Newcastle Total $18,575

The University of New South Wales

ALNGRA16033 **Mahmud Ashraf** $6,645
Material and mechanical characterization of additively manufactured Titanium alloy micro struts

ALNGRA16004 **David Cohen** $10,080
Quantifying the uptake of rare earth elements in spinifex: A crucial step in developing effective biogeochemical exploration for heavy REEs in the Tanami Desert, Australia

ALNGRA16007 **Judith Field** $10,500

Pathways to the Interior: The archaeology of the Simbai-Kaironk Valleys, Madang Province PNG

ALNGRA16034 **Pramod Koshy** $34,600

Manipulating Inter-Valence Charge Transfer Between Dopant Ions to Enhance the Photocatalytic Efficiency of TiO2 Thin Films

The University of New South Wales Total $61,825

University of Otago

ALNGRA16002 **Dimitri Anson** $5,550
Refining the chronology of the Lapita to post Lapita period on the Watom Lapita site, Papua New Guinea

ALNGRA16015 **Gary Wilson** $12,279
A new cross-disciplinary paleogenetic method to resolve Terrestrial Antarctica's elusive climate record

University of Otago Total $17,829

RMIT University

ALNGRA16021 **Matthew Currell** $23,570
Groundwater age dating to constrain rates of contaminant movement in an urban re-development precinct

RMIT University Total $23,570

University of Tasmania

ALNGRA16019 **David Bowman** $12,450
Aging Callitris glaucophylla trees from the driest landscape in Australia

University of Tasmania Total $12,450

The University of New England

ALNGRA16032 **Rhiannon Smith** $11,675
Determining the drivers of water-related river red gum dieback in the northern MDB

The University of New England Total $11,675

The University of Western Australia

ALNGRA16009 **Malcolm McCulloch** $15,260
Tracing the Penetration of 14C Into the Deep Waters of the Perth Canyon

The University of Western Australia Total $15,260

Victoria University of Wellington

ALNGRA16001 **Brent Alloway** $7,000
A widespread historic tephra marker bed in east-central Java, Indonesia, and its role in the stability of 13th century AD Javanese-Hindu-Buddhist kingdoms

Victoria University of Wellington Total $7,000

Total In-Kind value of AINSE research awards funding approved in 2016 $431,934

AINSE Supported Facility (ASF) Funding - 2016

The University of New South Wales

ALNGRA16502 **Sean O'Byrne** $3,100
Characterisation of an argon helicon plasma using diode laser absorption spectroscopy

ALNGRA16503 **Philippe Lorrain** $2,000
Plasma Source Characterisation for Development of Ionospheric Aerodynamics Material Research Facility

The University of New South Wales Total $5,100

University of South Australia

ALNGRA16501 **Eric Charrault** $2,480
Investigating the porosity of amorphous dielectric films with positrons.

University of South Australia Total $2,480

Total AINSE ASF funding approved in 2016 $7,580

Travel & Accommodation Support for AINSE Members - 2016

Support for travel and accommodation is provided by ANSTO to AINSE members that are awarded access through the ANSTO portal. The following AINSE members received support in 2016:

The University of Adelaide
The University of Auckland
Australian National University
University of Canterbury
CQ University
CSIRO
Deakin University
Federation University Australia
Flinders University
La Trobe University
Massey University
The University of Melbourne
Monash University
Murdoch University
The University of Newcastle
The University of New South Wales
University of Otago
The University of Queensland
RMIT University
Southern Cross University
Swinburne University of Technology
The University of Sydney
University of Tasmania
The University of New England
University of South Australia
The University of Western Australia
The University of Waikato
University of Wollongong

AINSE Research Fellows

AINSE, in conjunction with the Australian Nuclear Science and Technology Organisation (ANSTO) in 2006 established a Fellowship Scheme to add impetus to member Universities' growing stature in nuclear science and engineering and in related fields. The first two Fellowships were awarded in 2006. Fellowships were for a three-year appointment in the first instance with the possibility of an extension to five years where subsequent continuing appointment at the university is foreseen. The AINSE Board decided not to offer any more new Research Fellowships from 2013.

Since the commencement of the program in 2006 AINSE has awarded the following Fellowships:

2011 Alison Blyth, Current Fellow, Curtin University of Technology
Molecular, stable isotopic and radiocarbon analyses of organic matter preserved in terrestrial records

2006 Darren Goossens, The Australian National University
Study of the nature and role of nanoscale order in complex materials
Concluded November 2011
Dr Goossens is employed in the Research School of Chemistry, ANU as a research associate.

2006 Daniel Riley, The University of Melbourne
Use of ultra-fast in-situ diffraction in the development of advanced materials
Concluded June 2010
Dr Riley is employed at ANSTO as a research scientist in the Institute of Materials Science.

2007 Duncan McGillivray, The University of Auckland
Probing the mechanisms of biomembrane interactions
Concluded December 2010
Dr McGillivray is employed as a senior lecturer in the School of Chemistry at The University of Auckland.

2007 Moeava Tehei, University of Wollongong
Study of relationships between function, structure and dynamics of biological molecules by neutron scattering
Concluded March 2013
Dr Tehei is employed as the Scientific Leader Diagnostics and Therapeutics at IHMRI.

2008 Lizhong He, The University of Queensland
The physical states of pharmaceutical proteins and self-assembled proteins
Concluded December 2011
Dr He is employed as a senior lecturer School of Chemical Engineering at Monash University.

2008 Helen McGregor, University of Wollongong
El Niño in context: reading the coral record of past climate extremes
Concluded October 2013
Dr Helen McGregor is employed as ARC Future Fellow at University of Wollongong

2009 David Turner, Monash University
Structural studies of metal organic materials for gas storage and anion exchange
Concluded December 2012
Dr Turner is employed as ARC Future Fellow at Monash University.

2009 John Daniels, The University of New South Wales
Application of advanced diffraction techniques for component and material design in functional, biological and structural applications
Concluded February 2015
A/Professor John Daniels is employed as a senior lecturer in the School of Materials Science and Engineering at University of New South Wales

2010 Rachel Popelka-Filcoff, Flinders University
Geochemical characterisation of Australian ochre by k0-neutron activation analysis for characterisation and sourcing of aboriginal Australian mines and artefacts
Concluded June 2016
A/Professor Popelka-Filcoff is employed as an Associate Professor in the Faculty of Science & Engineering, School of Chemical & Physical Sciences at Flinders University

2010 Roman Dronov, Flinders University
Design of advanced optical biosensors through neutron based surface analysis
Concluded 2013

2012 Dr Neeraj Sharma, The University of New South Wales
Developing improved materials for energy generation and storage
Concluded December 2015
Dr Neeraj Sharma is employed as a lecturer in the School of Chemistry at University of New South Wales

AINSE Supported Publications 2016

Australian Catholic University

Bajo, Ruth
Bajo, R. (2015). "Microbat habitat and resource use: A stable isotope and acoustic survey approach" Honours Thesis

The University of Adelaide

Lavigne, Olivier
Lavigne, O., E. Gamboa, J. Griggs, V. Luzin, M. Law and A. Roccisano (2016). "High-pH inclined stress corrosion cracking in Australian and Canadian gas pipeline X65 steels." Materials Science and Technology **32**: 684-690, 10.1080/02670836.2015.1132030

Lockier, Elizer
Lockier, E. (2016). "Hydroclimate variability during the past millennium: a new record from West Basin Lake, Victoria" Honours Thesis

The University of Auckland

Akers, Peter
Akers, P. (2016). "Improving the surface activity of attached biomolecules" PhD Thesis

Allen, Melinda
Melinda S. Allen, Alex E. Morrison, Andrew M. Lorrey, Jian-Xin Zhao and Geraldine E. Jacobsen (2016). "Timing, magnitude and effects of late Holocene sea level drawdown on island habitability, Aitutaki, Cook Islands" Archeology in Oceania **51**: 108-121, 10.1002/arco.5102

Chen, Wan-Ting
Wan-Ting Chen, Dr. Geoff Waterhouse, and Prof. Jim Metson (2016). "Low-Cost CuO/TiO_2 Photocatalyst System for Solar H_2 Production" The 9th Annual Dodd-Walls Centre Symposium, Millennium Hotel, Queenstown, 27th June - Friday 1st July 2016

Chen, Want-Ting
Chen, W. (2016). "Low Cost Photocatalysts for Solar H_2 Production from Water and Biofuels" The 9th Annual Dodd-Walls Centre Symposium, Millennium Hotel, Queenstown, 27th June - Friday 1st July 2016.

Goodacre, Dana
Goodacre, Dana (2015). "Inorganic materials for photon manipulation in sustainable energy applications" Honours Thesis

Goodacre, Dana
Goodacre, D.G., Waterhouse, G.I.N. (2015). "M/TiO_2 (M = Au, Pd, Pt or Au-Pd) photocatalysts for solar energy capture and H2 production from alcohol-water mixtures" 9th CIGR Section VI International Technical Symposium, Auckland, New Zealand, November 16-20, 2015

Hemar, Yacine
Yang, Z., Y. Hemar, L. Hilliou, E. P. Gilbert, D. J. McGillivray, M. A. K. Williams and S. Chaieb (2016). "Nonlinear Behavior of Gelatin Networks Reveals a Hierarchical Structure" Biomacromolecules **17**: 590-600, 10.1021/acs.biomac.5b01538

Soehnel, Tilo
Haku, T., K. Kimura, Y. Matsumoto, M. Soda, M. Sera, D. Yu, R. A. Mole, T. Takeuchi, S. Nakatsuji, Y. Kono, T. Sakakibara, L. J. Chang and T. Masuda (2016). "Low-energy excitations and ground-state selection in the quantum breathing pyrochlore antiferromagnet $Ba_3Yb_2Zn_5O_{11}$" Physical Review B **93**: 220407, 10.1103/PhysRevB.93.220407

Un, Joanna
Un, J. (2015). "Synthesis and Characterisation of Silica Structures Inspired by Nature" Honours Thesis

Xun, Yang (Gloria)
Ryan, T. M., Y. Xun, N. P. Cowieson, J. P. Mata, A. Jackson, B. R. Pauw, A. J. Smith, N. Kirby and D. McGillivray (2016). "Combined pressure and temperature denaturation of ribonuclease A produces alternate denatured states" Biochemical and Biophysical Research Communications **473**: 834-839, 10.1016/j.bbrc.2016.03.135

The Australian National University

Corkery, Robert William
Li, Y., Y. Lin, C. J. Garvey, D. Birch, R. W. Corkery, P. C. Loughlin, H. Scheer, R. D. Willows and M. Chen (2016). "Characterization of red-shifted phycobilisomes isolated from the chlorophyll f-containing cyanobacterium Halomicronema hongdechloris" Biochimica et Biophysica Acta (BBA) - Bioenergetics **1857**: 107-114, 10.1016/j.bbabio.2015.10.009

Liu, Yun
Lu, T., A. J. Studer, L. Noren, W. Hu, D. Yu, B. McBride, Y. Feng, R. L. Withers, H. Chen, Z. Xu and Y. Liu (2016). "Electric-field-induced AFE-FE transitions and associated strain/preferred orientation in antiferroelectric PLZST" Scientific Reports **6**: 23659, 10.1038/srep23659

Liu, Yun
Lu, T., A. J. Studer, D. Cortie, K. Lau, D. Yu, Y. Feng, H. Chen, Z. Xu, R. L. Withers, G. J. McIntyre and Y. Liu (2016). "Susceptible Ferroelectric/Antiferroelectric Phase Transition near the Surface of Nb-Doped Lead Zirconate Stannate Titanate from Surface Processing" ACS Applied Materials & Interfaces **8**: 14313-14317, 10.1021/acsami.6b02868

Qu, Zhisong
Z. S. Qu, M. J. Hole, and M. Fitzgerald (2016). "Energetic Geodesic Acoustic Modes Associated with Two-Stream-like Instabilities in Tokamak Plasmas" Physical Review Letters **116**: 10.1103/PhysRevLett.116.095004

Theden-Ringl, Fenja
Fenja Theden-Ringl (2016). "A reassessment of technological change models for the Australian high country" Archeology in Oceania, 10.1002/acro.5105

Theden-Ringl, Fenja
Theden-Ringl, F. (2016). "Aboriginal presence in the high country: new dates from the Namadgi Ranges in the Australian Capital Territory" Australian Archaeology **82**: 25-42, 10.1080/03122417.2016.1163955

Wright, Adelle
A M Wright, Z S Qu, J F Caneses and M J Hole (2016). "An experimentally constrained MHD model for a collisional, rotating plasma column" Plasma Physics and Controlled Fusion **59**: 1-11, 10.1088/1361-6587/59/2/025003

University of Canterbury

Currie, Michael
Michael Currie (2016). "Probing the catalytic mechanism of N-acetylmannosamine-6-phosphate 2-epimerase from methicillin-resistant Staphylococcus aureus" Honours Thesis

Currie, Michael
Michael Currie (2016). "Understanding the catalytic mechanism of MRSA NanE" University of Canterbury Annual Biology Conference, University of Canterbury, 20th October 2016. p.6,

Plowman-Holmes, Matthew
Plowman-Holmes, M. (2015). "An investigation into the mechanism of allosteric regulation in α-isopropylmalate synthases from Neisseria meningitidis and Mycobacterium tuberculosis" Honours Thesis

Charles Darwin University

Hobgen, Sarah Elizabeth
Hobgen, S. E. (2016). "Understanding sediment sources to inform catchment management in data-poor regions an example from Sumba, Eastern Indonesia" PhD Thesis

Lamsal, Bijay
Lamsal, B. (2016). "An engineering solution to drain permanently flooded rice paddy fields to increase agricultural productivity, Sumba, East Nusa Tenggara, Indonesia." Honours Thesis

Curtin University of Technology

Beloborodov, Roman
Beloborodov, R., M. Pervukhina, V. Luzin, C. Delle Piane, M. B. Clennell, S. Zandi and M. Lebedev (2016). "Compaction of quartz-kaolinite mixtures: The influence of the pore fluid composition on the development of their microstructure and elastic anisotropy" Marine and Petroleum Geology **78**: 426-438, 10.1016/j.marpetgeo.2016.09.030

Blyth, Alison
Andy Baker, Catherine N. Jex, Helen Rutlidge, Martijn Woltering, Alison Blyth, Martin S. Andersen, Mark O. Cuthbert, Christopher E. Marjo, Monika Markowska, Gabriel C. Rau, Stuart J. Khan (2016). "An irrigation experiment to compare soil, water and speleothem tetraether membrane lipid distributions" Organic Geochemistry **94**: 12-20, 10.1016/j.orggeochem.2016.01.005

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Members

ACU	Australian Catholic University
ADE	The University of Adelaide
AKL	The University of Auckland
ANS	ANSTO
ANU	The Australian National University
CAN	University of Canterbury
CBR	University of Canberra
CDU	Charles Darwin University
CQU	CQ University
CSU	Charles Sturt University
CSI	CSIRO
CUR	Curtin University of Technology
DEA	Deakin University
DST	Defence Science & Technology Group
ECU	Edith Cowan University
FED	Federation University
FLI	Flinders University
GRI	Griffith University
JAM	James Cook University
LAT	La Trobe University
MAC	Macquarie University
MAS	Massey University
MEL	The University of Melbourne
MON	Monash University
MUR	Murdoch University
NCT	The University of Newcastle
NSW	The University of New South Wales
OTA	University of Otago
QLD	The University of Queensland
QUT	Queensland University of Technology
RMI	RMIT University
SCU	Southern Cross University
SYD	The University of Sydney
SYN	Australian Synchrotron*
SWI	Swinburne University of Technology
TAS	University of Tasmania
UNE	The University of New England
USA	University of South Australia
USC	University of the Sunshine Coast
UTS	University of Technology, Sydney
UWA	The University of Western Australia
UWS	Western Sydney University
VUW	Victoria University of Wellington
WAI	The University of Waikato
WOL	University of Wollongong

* Membership from January to June 2016

Specialist Areas

AGS Archaeology and Geosciences
BBS Biotechnology and Biomedical Sciences
ENV Environmental Science
MSE Materials Science and Engineering

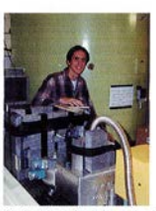
Notes

AINSE

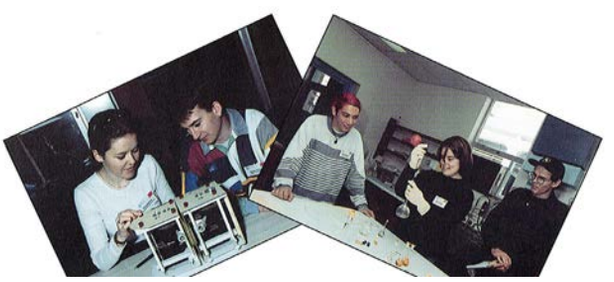
Celebrating 20 years of the AINSE Winter School

1996 - 2016

Julia Lock, from the University of Adelaide, pipetting reagent in the radiation chemistry experiment.



Nathan Langford, from the University of Queensland, taking measurements in the neutron scattering experiment.



Left to right: Rodi Sferopoulos from Victoria University, Betine Nuhiji from Deakin University and Matthew McMinn from the University of Tasmania getting acquainted on the harbour cruise

Anthony Mays from Monash University at one of the neutron scattering instruments on HIFAR

Students enjoying the AINSE Winter School, social activites, experiments and tours over the past 20 years

AINSE – The Australian Institute of Nuclear Science and Engineering

Locked Mail Bag 2001
Kirrawee DC NSW 2232

New Illawarra Road
Lucas Heights NSW 2234

Tel: 61 – 2 - 9717 3376
E: ainse@ainse.edu.au
W: www.ainse.edu.au

AINSE Ltd ABN: 18 133 225 331

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