UWA

Summer Down Under :

(actually in winter)

Research Internship

2020 Projects

THE UNIVERSITY OF WESTERN AUSTRALIA

Application Procedure

Applications from 1 - 29 Feb 2020

Review this list of projects and select up to 2 preferred projects

Use this link to apply: 2020 UWA Summer Down Under Research Internship Application or QR code

Application preparation:

You will need to attach the most up to date

- Transcript
- CV (no more than 1 page)
- English results (not required for native speakers)

You will also be required to answer the following questions:

- Explain why your previous experience makes you suited to this project? In particular, address any prerequisites that have been outlined by the supervisor. (max 200 words)
- Outline any previous research or laboratory experience that you have. Please name that research group and the leader of that research group at your home university. (max 100 words)
- Why are you interested in this program? (max 200 words)
- What are your future career plans? (max 200 words)

You may contact the supervisor(s) if you have questions regarding the project(s). Please note: as student selection is based on a competitive process, please do not discuss acceptance.

Contact your university's international/mobility office to let them know of your plans

Timeline

1 Feb 2020 Applications open
29 Feb 2020 Applications close
1 – 30 March 2020 Candidate section
2 April 2020 Release of application results
2 April – 5 May 2020 Acceptance of offer
6 July – 28 August 2020 Summer Down Under: Research Internship (SDU:RI) Program

Optional English language programs

Option 1

Summer Down Under intensive IELTS Examination preparation program (AUD $1,500):
• Five-week program (at 15 hours per week)
• Run concurrently with Summer Down Under Research Internship program
• IELTS test can be taken at course completion (exam fee AUD $340)

Option 2

This will benefit students whose English level is below IELTS 6.5. To be run prior to the Summer Down Under Research Internship program UWA CELT Bridging Course:
• 10 or 20 week direct English pathway (AUD $5,000 per 10 week term)

Option 3

English language programs run in five-week blocks throughout the year (AUD $1,975 per 5 week term):
• General English
• English for Academic Purposes
• IELTS Examination preparation courses

2020 Projects:

Faculty of Arts, Business, Law and Education

Faculty of Science

Faculty of Engineering and Mathematical Sciences

FACULTY: FACULTY OF ARTS, BUSINESS, LAW AND EDUCATION **SCHOOL: LAW SCHOOL**	
Main Supervisor : Prof Erika Techera	**Co-supervisor(s) :**
Project title:	**Oceans governance**
Project description: The project will explore international environmental law that addresses the problem of marine invasive species. The focus will be on exploring the different pathways for introduction of species and in particular ballast water and bio-fouling of ships. Whilst there is a new treaty on ballast water, there is no binding international law directly addressing bio-fouling. The research will involve collating literature on the extent of the marine invasive species challenge and its causes, examining existing international law that addresses these causes, analysing in detail the specific laws for ballast water and bio-fouling, and identifying some potential ways forward to improve oceans governance.	
Required skills, knowledge or experience: Knowledge of international environmental law. The student need not be a law student, but if not, s/he must have studied international environmental law. It is possible that a law student who has studied public international law, but not international environmental law, may be suitable depending upon other subjects undertaken.	
Keywords: International environmental law, oceans, biodiversity conservation, governance, invasive species	
Supervisor Contact email: erika.techera@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

FACULTY: FACULTY OF ARTS, BUSINESS, LAW AND EDUCATION **SCHOOL: SCHOOL OF SOCIAL SCIENCES**	
Main Supervisor : Dr Clare Mouat	**Co-supervisor(s) :**
Project title:	**Socialising conflict transformation towards resilient peace-building in planning and governance: transferrable lessons and lingering challenges**
Lab/Group: Geography and Planning	
Project description: Urban planning decisions defining our urban futures are often marked by conflict. Conflict in planning is inevitable but too-often it is poorly or violently managed. Arguably there is under-examined democratic potential especially in socialising conflict transformation across multiple urban scales. Already climate change and large infrastructure projects, for example, exacerbates the need for conflict transformation to manage injustice, resource conflict and trade-offs at all scales and across borders. We need to better learn how to disagree so communities and individuals can make better decisions towards achieving the places we need: restorative justice, sustainable development (SDG16 – Peace, Justice and Strong Institutions and SDG11 – Sustainable Cities and Communities). This project aims to interrogate the democratic potential for reorientating how local governments and planners deal with conflict in urban planning by drawing on insights from the resilient peace project and conflict transformation literature and divided societies/cities or other critical cases. The research will include a literature review, collection of critical case studies and policies as comparative exemplars, and possible adaptations into (West) Australian local government settings.	
Required skills, knowledge or experience: Postgraduate student or senior undergraduate preferred. Suggested Undergraduate major in human geography, planning, politics or political science, law, environmental science, anthropology, sociology; qualitative/quantitative research skills training. Student contribution: the exact details of the student's role will be worked out in consultation with the student. The student will likely be involved in qualitative data design, case study and data collection, analysis, research management, data entry and analysis, plus written and graphic communication of findings.	
Keywords: Conflict transformation, urban planning, governance, social innovation, community	
Supervisor Contact email: clare.mouat@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks (can be extended to 12 weeks)
Total number of project(s) offered by supervisor: 3	**Total number of place(s) available with supervisor:** 7(5 for this project)

Faculty: Faculty of Arts, Business, Law and Education
School: School of Social Sciences

Main Supervisor : Dr Clare Mouat	**Co-supervisor(s) :**

Project title:	**Wise city planning for healthy Local Urban Nightscapes across Australasia: the pathways, policies and priorities for sustainable Artificial Lighting Regimes (LUNAR)**

Lab/Group: Geography and Planning

Project description:

Many sustainability projects routinely focus on day-time conditions and activities in a climate of global change. Yet the way we plan, develop, and live in our cities and homes during the night needs our urgent attention. This project aims to better understand how artificial lighting regimes (ALR) affect (more-than-) human and ecological health and the politics of light in cities by firstly understanding how communities and stakeholders understand ALR in terms of commons and ecological light pollution in local urban places. The project may use surveys and policy development to explore the range of healthy and unhealthy ALR to find ways for communities to appreciate and create healthier and more sustainable ALR in their local and significant places across Australasia. Consequently, communities can collaborate with local councils and developers to better inform how we plan, promote, and develop safe and healthy cities (SDG11).

About the WUN Project: "The Healthy Polis" is funded to develop understanding and continuing research into
1. challenges posed by climate change and NCDs in cities,
2. international approaches to healthy urban planning and sustainability, and
3. integrated assessment of urban planning interventions.

This project serves all three WUN Healthy Polis research priorities to understand how communities live, work, and play in their local landscapes at night (nightscapes).

Wise cities, rather than smart cities, are needed to balance urban development, ecological wisdom, and planning practices. Urban nightscapes have ALR that dramatically affect economic, social, and ecological sustainability. ALR are regulated systems of night lighting – permanent and temporary – including streetlights; lighting from industrial, residential, civic, commercial, festival, and construction sources. While lighting at night offers many benefits (productivity, safety, and entertainment, for example), it can also cause problems for human and non-human health through light and ecological pollution. Light pollution includes sky glow from ALR sources that obscure the night sky (today more than one third of humanity cannot see the Milky Way). More broadly, ecological light pollution disrupts ecological health of humans and non-humans (plants, animals, and insects) in a wide variety of ways. For healthy urban development, planners need a better understanding about how communities relate to the night sky and nightscapes of their urban places, and communities need to better understand the technologies and systems that offer or restrict lighting innovations. In so doing, communities and planners can better appreciate the trade-offs and effects of ALR and the wise city imperatives for healthy and sustainable nightscapes.

Required skills, knowledge or experience:

Suggested undergraduate major in human geography and planning, environmental science, anthropology, sociology, public health; qualitative or quantitative research skills training.
Student contribution: the exact details of the student's role will be worked out in consultation with the student. The student will likely be involved in qualitative and/or quantitative data collection and analysis, including individual and focus group interviews, data entry, analysis, plus written and graphic communication of findings.

Keywords: Artificial lighting, urban planning, health, community governance, wise cities

Supervisor Contact email: clare.mouat@uwa.edu.au

Project done on Crawley campus: Yes with some off-campus fieldwork	**Length of project:** Standard 8 weeks (can be extended to 12 weeks)
Total number of project(s) offered by supervisor: 3	**Total number of place(s) available with supervisor:** 7(1 for this project)

Faculty: Faculty of Arts, Business, Law and Education
School: School of Social Sciences

Main Supervisor : Dr Clare Mouat	**Co-supervisor(s) :** Dr Katie McClymont

Project title:	**Challenging geographies of super-rich urban development by infrastructuring an ethics of care over time and place**

Project description:

Relevant Research Sub-themes (WUN In-Herit)

• Resilience, place and place-making: What is the role of heritage in identity and ontological security?

• Contested urban spaces: Can an understanding of cultural heritage support healthy, inclusive, and just development in urban public space?

Dr Clare Mouat (UWA) and Dr Katie McClymont (University of the West of England, Bristol, UK) are the chief investigators in an ongoing project mapping the contours and curation of an ethics of care: reorientating critical infrastructure planning in super-prime development of Nine Elms, London, UK. Nine Elms is a £15 billion multi-level governance partnership project; the package (including a London Underground Northern Line extension) is currently one of Europe's largest regeneration schemes. We are keen for projects which explores the tensions and opportunities evidenced in this project either in the same location or in others globally which can deepen, extend or challenge our conceptualisations.

Our project explore the vital need to better recognise how cultural heritage is- or could be differently- co-opted as a critical infrastructure and postsecular ethics of care. This is especially where such super-rich urban development threatens to displace or impoverish existing communities. Addressing the subthemes above, we aim to witness the contours and curation of an ethics of care by secular and postsecular actors as noted in the ongoing regeneration of the Vauxhall Nine Elms Battersea Opportunity Area in London, UK ("Nine Elms"). Several key Opportunity Areas are nominated along the Thames within the Diocese of Southwark. The Diocese represents a significant participatory curator of care by invoking history and heritage, through non-financial notions of ownership and belonging. Moreover, their strategic planning and ambitions for #AGoodCity create a paradoxical tension with secular local governments democratically-sanctioned strategic spatial frameworks seek to promote community health and wellbeing. A range of qualitative data collection techniques will capture and chart the distinctive heritage and future development of Faith-based organisations and actors using a postsecular lens and grounded theory. We aim to provoke deeper inquiry and assess actual and potential planning implications in and beyond this extraordinary postsecular situation.

Required skills, knowledge or experience:

Undergraduate major in human geography and planning, politics, anthropology, sociology, history, qualitative or quantitative research skills training.

Student contribution: the exact details of the student's role will be worked out in consultation with the student. The student will likely be involved in qualitative and/or quantitative data collection and analysis, including individual and focus group interviews, data entry and analysis and report writing. We are open to student-initiated projects in a range of different geographical locations which pick up on the key concerns raised by our project but explore how these play out elsewhere.

Keywords: Urban regeneration/renewal, ethics, care and wellbeing, heritage, postsecular

Supervisor Contact email: clare.mouat@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks (can be extended to 12 weeks)
Total number of project(s) offered by supervisor: 3	**Total number of place(s) available with supervisor:** 7(1 for this project)

Faculty: Faculty of Arts, Business, Law and Education
School: School of Social Sciences

Main Supervisor : Prof Loretta Baldassar	**Co-supervisor(s) :**

Project title: **Ageing and New Media**

Project description:

Project 1

Project is a collaborative research project that examines how support networks for older people are affected by their mobility and the dispersal of their family, friends and care services. Co-ordinated by Loretta Baldassar (Anthropology and Sociology, The University of Western Australia) and Raelene Wilding (Sociology, Social Inquiry, La Trobe University), this four year project is funded by the Australian Research Council (2015-2020).

The aim of this project is to highlight the current and potential role that new media can play in fostering local, distant and virtual support networks of older Australians. This will help to update both aged care policy and service delivery. The research includes a survey of the sector as well as participant observation, ethnographic life history interviews, and network analysis to compare experiences of diverse older migrants and non-migrants in both urban and regional locations, at home and in institutional care. The project will examine the impact of mobility and migration on the dispersal of older people's support networks; evaluate the current and potential role of new media in fostering new and existing networks; and extend theoretical, policy and practice understandings of healthy 'ageing in place' by introducing what we call a 'mobilities and new media' perspective.

Access to social networks and a capacity to belong and engage with other people is now understood as a significant indicator of healthy ageing. Importantly, the increasing uptake of new communication technologies means that social activities, social interactions and a sense of belonging are no longer limited to local, proximate networks and communities. What remains unknown, and will be addressed by this project, is the role of distant and virtual support networks in the lives of older Australians, and the potential and actual role of new media in older people's experiences and uses of effective support networks.

Required skills, knowledge or experience:

Undergraduate major in anthropology, sociology, gerontology, public health; qualitative or quantitative research skills training.

Student contribution: the exact details of the student's role will be worked out in consultation with the student. The student will likely be involved in qualitative and quantitative network data analysis and visualisation in VennMaker.

Keywords: Ageing, migration, new media, social support networks, social network analysis, VennMaker.

Supervisor Contact email: loretta.baldassar@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 3	**Total number of place(s) available with supervisor:** 3

Faculty: Faculty of Arts, Business, Law and Education **School: School of Social Sciences**	
Main Supervisor : Prof Loretta Baldassar	**Co-supervisor(s) :** Lukasz Krzyzowski
Project title:	**Internationalisation at Home - Student Research Project**
Lab/Group Link: http://blogs.uwa.edu.au/lorettabaldassar/home/iah/	

Project description:
Project 2

Internationalisation at Home - Student Research Project

Built-in as part of the formal curriculum in the 4th year Anthropology and Sociology Honours unit, ANTH4101 Advance Qualitative Methods: Interviews and Focus Groups, this project both develops initiatives that offer guided opportunities for local and international students to engage with each other, and allows students to collect data on international/local student interaction that contributes to their own personal research assignments and a broader research project.

These objectives respond directly to the UWA Strategic Plan in improving the student experience, developing research and research training and the teaching/research nexus. As part of their contribution to this research project, students produce a research report and poster based on their analysis of the data they collected. For a detailed look at these reports and posters please click here. International student partners will audit this unit and collaborate on joint student-led projects.

Required skills, knowledge or experience:

Undergraduate major in anthropology, sociology, youth studies, social work, human geography, public health; qualitative or quantitative research skills training.

Student contribution: the exact details of the student's role will be worked out in consultation with the student. The student will likely be involved in qualitative and/or quantitative data collection and analysis, including individual and focus group interviews, data entry and analysis and report writing.

Keywords: Student study abroad; internationalisation at home	
Supervisor Contact email: loretta.baldassar@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 3	**Total number of place(s) available with supervisor:** 3

Faculty: Faculty of Arts, Business, Law and Education
School: School of Social Sciences

Main Supervisor : Prof Loretta Baldassar	**Co-supervisor(s) :**

Project title: **YMAP Youth Mobilities**

Lab/Group Link: https://www.ymapproject.org/

Project description:
Project 3

YMAP: Youth Mobilities, Aspirations and Pathways Projects - Current ARC Discovery Project

Loretta Baldassar, Anita Harris (Research Professor in the Alfred Deakin Institute for Citizenship and Globalisation at Deakin University, Melbourne) and Shanthi Robertson (Senior Research Fellow in migration studies and globalization at the Institute of Culture and Society at Western Sydney University) are the chief investigators on the YMAP Project, funded by the Australian Research Council (2017-2022).

The project examines transnational mobility amongst young people moving both in and out of Australia in order to understand its real-life effects on their economic opportunities, social and family ties, citizenship and transitions to adulthood. Young people increasingly migrate abroad for work and education and Australia is a significant hub for sending and receiving. Much of this mobility is encouraged by current migration and education policies and is expected to provide youth with enhanced competitive skills. This project examines transnational mobility amongst young people moving both in and out of Australia in order to understand its actual effects on their economic opportunities, social and familial ties, capacity for citizenship and transitions to adulthood. It charts how youth from various cultural backgrounds productively manage mobility and develop economic, social and civic benefits – for themselves and the broader community. The project involves a five-year longitudinal study of 2000 young people aged 18-30 of Indian, Chinese, Italian and British ancestry, including both Australian citizens/permanent residents who have left Australia for 6+ months, and overseas citizens/permanent residents who have entered Australia for 6+ months.

Required skills, knowledge or experience:

Undergraduate major in anthropology, sociology, youth studies, social work, human geography; qualitative or quantitative research skills training.
Student contribution: the exact details of the student's role will be worked out in consultation with the student. The student will likely be involved in qualitative and/or quantitative data collection and analysis, including individual and focus group interviews, data entry and analysis and report writing.

Keywords: Youth studies; youth mobility; young people and transitions

Supervisor Contact email: loretta.baldassar@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 3	**Total number of place(s) available with supervisor:** 3

Faculty: Faculty of Science **School: School of Biological Sciences**	
Main Supervisor : Prof David Edwards	**Co-supervisor(s) :** Dr Philipp Bayer
Project title:	**Applied bioinformatics**
Lab/Group: UWA applied bioinformatics group **Lab/Group Link:** http://www.appliedbioinformatics.com.au/ **Publications:** https://scholar.google.com.au/citations?user=AxsOkqYAAAAJ&hl=en	
Project description: We develop custom projects in the area of applied bioinformatics depending on the student's interests and experience. Projects mostly align with ongoing activities in plant genomics, applying big data to understand plant evolution and crop performance using high performance computing and diverse approaches including machine and deep learning.	
Required skills, knowledge or experience: Students require an understanding of biology and experience of working in a Linux environment. Coding may be required for some projects.	
Keywords: Genomics, plants, bioinformatics, machine learning, evolution	
Supervisor Contact email: Dave.Edwards@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks (can be extended to 12 weeks)
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 5

<table>
<tr><td colspan="2">Faculty: Faculty of Science
School:School of Biological Sciences</td></tr>
<tr><td>Main Supervisor : Prof Jacqui Batley</td><td>Co-supervisor(s) :</td></tr>
<tr><td>Project title:</td><td>Genomics of Plant Pathogen Interactions</td></tr>
<tr><td colspan="2">Lab/Group: Batley Lab
Lab/Group Link: www.batleylab.net</td></tr>
<tr><td colspan="2">Project description:

Research on the interactions between plants and pathogens has become one of the most rapidly moving fields in the plant sciences, findings of which have contributed to the development of new strategies and technologies for crop protection. A good example of plant and pathogen evolution is the gene-for-gene interaction between the fungal pathogen Leptosphaeria maculans, causal agent of Blackleg disease, and Brassica crops (canola, mustard, cabbage, cauliflower, broccoli, Brussels sprouts). The aim of this project is to use whole genome sequencing technologies to characterise the diversity and evolution of these genes in different wild and cultivated Brassica species. This will involve phenotypic analysis of the disease in a variety of cultivars and species and genetics to link to the phenotype</td></tr>
<tr><td colspan="2">Required skills, knowledge or experience:
Keen interest in plant biology, with knowledge of DNA and genetics</td></tr>
<tr><td colspan="2">Keywords: Genome sequencing, plant pathogen interactions, crop protection, evolution, food security</td></tr>
<tr><td colspan="2">Supervisor Contact email: Jacqueline.batley@uwa.edu.au</td></tr>
<tr><td>Project done on Crawley campus: Yes</td><td>Length of project: Standard 8 weeks (can be extended to 12 weeks)</td></tr>
<tr><td>Total number of project(s) offered by supervisor: 1</td><td>Total number of place(s) available with supervisor: 3</td></tr>
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Faculty: Faculty of Science **School:School of Molecular Sciences**	
Main Supervisor : Associate Professor Keith Stubbs	**Co-supervisor(s) :**
Project title:	**Development of scaffolds to inhibit carbohydrate-processing enzymes involved in biological processes**
Lab/Group: Stubbs **Lab/Group Link:** https://research-repository.uwa.edu.au/en/persons/keith-stubbs	
Project description: The enzymes that regulate the structures of glycans (carbohydrates) are extremely important and have been implicated in a wide variety of diseases and thus are targets for therapeutics. The laboratory studies a wide variety of enzymes that have been implicated in a wide variety of diseases and biological processes. The project will be to design and synthesize a new inhibitor, that can then be used to investigate the role of a new carbohydrate-processing enzyme	
Required skills, knowledge or experience: Students interested in synthetic chemistry or synthetic chemistry & biochemistry are ideal for this project.	
Keywords: Carbohydrates, Synthesis, Inhibitors, Disease, Biological Function	
Supervisor Contact email: keith.stubbs@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 1

Faculty: Faculty of Science
School: School of Molecular Sciences

Main Supervisor : Dr Martha Ludwig	**Co-supervisor(s) :**

Project title: **A Molecular Biology Approach to Food, Fibre and Fuel Security**

Project description:

Terrestrial plants are typically grouped according to the biochemical pathway by which they use atmospheric CO2 to make carbohydrates - the C3 plants, which include crop species such as rice and wheat as well as nearly all trees; the C4 plants, which include highly productive crop plants like corn and sugarcane; and the Crassulacean Acid Metabolism (CAM) plants, which include cactuses, orchids and pineapple. C4 and CAM plants evolved from C3 plants. Some groups of C4 plants have left "evolutionary footprints" that give us insights into how this process has occurred at the molecular level. The aim of the work in the lab is to understand the molecular biology and genetics, biochemistry and cell biology of the enzymes in the C4 photosynthetic pathway in an evolutionary context. This includes the identification of the control regions of the genes coding for these enzymes. We do this work by comparing the proteins and genes of C4 plants to those of closely related C3 plants.

To meet global demand for food, production must increase by 30% by 2030 and by 70% by 2050. Current and forecasted production scenarios indicate we are not on-track to meet these demands, and major challenges face agricultural sectors and governments with respect to food, fibre and fuel securities. Increasing productivity is unlikely to be accomplished only by conventional breeding methods. A "green revolution" that includes biotechnology is inevitable for some crops and regions. The higher photosynthetic rates, greater efficiency in the use of water and nitrogen of C4 plants relative to C3 plants in arid and saline environments - environments that are expanding in many parts of the world due to global climate change - are desirable traits, which if introduced into C3 crop plants, have the potential to increase yield. In other words, we are looking to "supercharge" C3 crops like rice and wheat by giving them a C4 pathway.

We are using tools of cell and molecular biology and molecular genetics to gain insight into the evolution of photosynthesis and the plasticity of plants in obtaining nutrients and water from their environment. This information will open avenues for manipulating these pathways in economically valuable plants and will increase our knowledge of how plants may respond and cope with predicted future climate scenarios.

Projects include:

• Comparison of gene expression patterns of key enzymes in C3 and C4 species and in closely related species that do a type of photosynthesis that is biochemically intermediate to C3 and C4. This is known as C2 photosynthesis and is thought to represent an evolutionary intermediate pathway between C3 and C4 photosynthesis.

• Identification of the proteins with which C4 enzymes interact.

• Identification of regulatory regions and elements that control the expression of genes encoding photosynthetic / enzymes.

Depending on the specific project, the following techniques will be used: polymerase chain reaction (PCR) and quantitative PCR, transcriptome sequencing (RNA-Seq), microscopy, immunoblotting methods, cloning, DNA sequencing, recombinant protein production and characterisation, and plant cell transformation.

Required skills, knowledge or experience:

Students should have completed at least one course/unit in biochemistry, molecular biology and/or cell biology. Undergraduate laboratory experience in these fields is also desirable.

Keywords: Evolution, Photosynthesis, Gene Expression, Plants, C4 Plants

Supervisor Contact email: martha.ludwig@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 1

<table>
<tr><td colspan="2">Faculty: Faculty of Science
School: School of Molecular Sciences</td></tr>
<tr><td>Main Supervisor : A/Prof Michael Considine</td><td>Co-supervisor(s) : Dr Joanne Wisdom</td></tr>
<tr><td>Project title:</td><td>The photoperiod regulon of dormancy transitions in grapevine</td></tr>
<tr><td colspan="2">Lab/Group: Grapevine Biology Lab
Lab/Group Link: https://research-repository.uwa.edu.au/en/persons/michael-considine
www.vinebiology.com</td></tr>
<tr><td colspan="2">Project description:
<u>Project 1</u>
Grapevine is the most commercially important fruit crop and a scientific model woody plant. It is highly dependent on seasonal change to regulate growth cycles, however there is very little knowledge of how the onset of dormancy is regulated.

This study will carry out qPCR of homologues of key flowering regulators. In other woody species, these show specific patterns of control, which do not appear to apply in grapevine.

This study would be highly publishable.</td></tr>
<tr><td colspan="2">Required skills, knowledge or experience:
Molecular biology, specifically qRT-PCR</td></tr>
<tr><td colspan="2">Keywords: Gene expression, Molecular biology, Plant development, Grapevine</td></tr>
<tr><td colspan="2">Supervisor Contact email: michael.considine@uwa.edu.au</td></tr>
<tr><td>Project done on Crawley campus: Yes</td><td>Length of project: Standard 8 weeks (can be extended to 12 weeks)</td></tr>
<tr><td>Total number of project(s) offered by supervisor: 2</td><td>Total number of place(s) available with supervisor: 3 (1 for this project)</td></tr>
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<table>
<tr><td colspan="3">Faculty: Faculty of Science
School: School of Molecular Sciences</td></tr>
<tr><td colspan="2">Main Supervisor : A/Prof Michael Considine</td><td>Co-supervisor(s) : Dr Joanne Wisdom</td></tr>
<tr><td>Project title:</td><td colspan="2">Regulation of antioxidant synthesis during dormancy transitions in grapevine</td></tr>
<tr><td colspan="3">Lab/Group: Grapevine Biology Lab
Lab/Group Link: https://research-repository.uwa.edu.au/en/persons/michael-considine
www.vinebiology.com</td></tr>
<tr><td colspan="3">Project description:
<u>Project 2</u>
Grapevine is the most commercially important fruit crop and a scientific model woody plant. It is highly dependent on seasonal change to regulate growth cycles, however there is very little knowledge of how the onset of dormancy is regulated. Of particular interest is that of antioxidants ascorbate and glutathione, which perform critical functions in signalling.

This study will carry out qPCR of homologues of the synthetic pathway of ascorbate and glutathione. Time permitting, the student would also measure ascorbate and glutathione concentrations.

This study is highly novel and would be publishable.</td></tr>
<tr><td colspan="3">Required skills, knowledge or experience:
Molecular biology and/or biochemistry. Specifically qPCR or metabolite assays.</td></tr>
<tr><td colspan="3">Keywords: Gene expression, Antioxidant and redox signalling, Plant development, Molecular biology and biochemistry</td></tr>
<tr><td colspan="3">Supervisor Contact email: michael.considine@uwa.edu.au</td></tr>
<tr><td colspan="2">Project done on Crawley campus: Yes</td><td>Length of project: Standard 8 weeks (can be extended to 12 weeks)</td></tr>
<tr><td colspan="2">Total number of project(s) offered by supervisor: 2</td><td>Total number of place(s) available with supervisor: 3 (2 for this project)</td></tr>
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<table>
<tr><td colspan="2">Faculty: Faculty of Science
School: School of Molecular Sciences</td></tr>
<tr><td>Main Supervisor : Dr Monika Murcha</td><td>Co-supervisor(s) :</td></tr>
<tr><td>Project title:</td><td>Labelling organelles with fluorescent tags</td></tr>
<tr><td colspan="2">Lab/Group: Murcha Lab
Lab/Group Link: murchalab.com</td></tr>
<tr><td colspan="2">Project description:
<u>Project 1</u>

This project will utilise both plant molecular techniques and fluorescent microscopy to generate and confirm transgenic lines with GFP/RFP/YFP labelled organelles. Mutant plants will be investigated to identify any changes to organelle numbers and dynamics. Furthermore, biolistic transformation of various organelle proteins will be carried out to determine protein localisations.</td></tr>
<tr><td colspan="2">Required skills, knowledge or experience:
Lab safety and genetic handling online course</td></tr>
<tr><td colspan="2">Keywords: molecular biology, science, plants, microscopy, molecular science</td></tr>
<tr><td colspan="2">Supervisor Contact email: monika.murcha@uwa.edu.au</td></tr>
<tr><td>Project done on Crawley campus: Yes</td><td>Length of project: Standard 8 weeks</td></tr>
<tr><td>Total number of project(s) offered by supervisor: 2</td><td>Total number of place(s) available with supervisor: 2 (1 for this project)</td></tr>
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Faculty: Faculty of Science **School: School of Molecular Sciences**	
Main Supervisor : Dr Monika Murcha	**Co-supervisor(s) :**
Project title:	**Identification of novel interacting partners**
Lab/Group: Murcha Lab **Lab/Group Link:** murchalab.com	
Project description: **Project 2** The TIM17/23/22 family of proteins have been shown to be involved in protein import mechanisms in mitochondria. They are also located in both mitochondria and chloroplast but for some, very little is known about their function. This project will utilise biochemical techniques to purify tagged protein from isolated mitochondria and chloroplasts to identify novel interacting partners via immunoprecipitation and mass spectrometry.	
Required skills, knowledge or experience: Lab safety and genetic handling online course	
Keywords: molecular science, plants, molecular biology, proteomics, science	
Supervisor Contact email: monika.murcha@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2 (1 for this project)

Faculty: Faculty of Science
School:School of Molecular Sciences

Main Supervisor : Prof Paul Low	**Co-supervisor(s) : Prof George Koutsantonis**

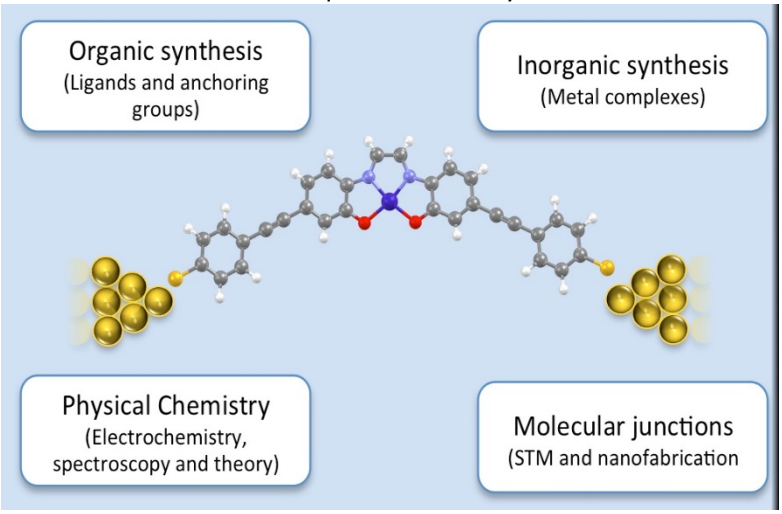
Project title: **Metal complexes for molecular electronics**

Lab/Group: Low group (Organometallics and Molecular Electronics)
Lab/Group Link: https://research-repository.uwa.edu.au/en/persons/paul-low

Project description:

Project1

Molecular electronics research explores the capacity of discrete molecular structures to mimic the electrical response of conventional electronic components when contacted between two electrodes in a molecular junction. Although much of this effort has been directed towards understanding the role of organic compounds as models of wires, switches and transistors, more recent work has begun to examine metal complexes in molecular electronics and also the potential to engineer molecular electronic materials that have unique function beyond conventional solid state devices.



This project will focus on developing new synthetic routes to 'wire-like' metal complexes of iron and other first row transition metals. We will use ligands that ensure the metal centre is 'insulated' from the environment and potential short circuits, and introduce appropriate surface binding groups to allow connection into molecular junctions.

Depending on student interests, background and availability there will be options to further explore the complexes developed in molecular junctions, to explore redox behaviour using spectroelectrochemical methods and develop an understanding of electronic structure using DFT methods.

Required skills, knowledge or experience: A background in synthetic chemistry (organic, inorganic or coordination chemistry) is essential. An interest in physical methods and willingness to learn techniques including electrochemistry and spectroscopy would be a distinct advantage

Keywords: Synthetic chemistry, inorganic chemistry, electronic structure, materials

Supervisor Contact email: paul.low@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks (can be extended to 12 weeks)
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Science
School:School of Molecular Sciences

Main Supervisor : Prof Paul J Low	**Co-supervisor(s) :** Prof George Koutsantonis

Project title: **Novel 'carbon-rich' metal complexes**

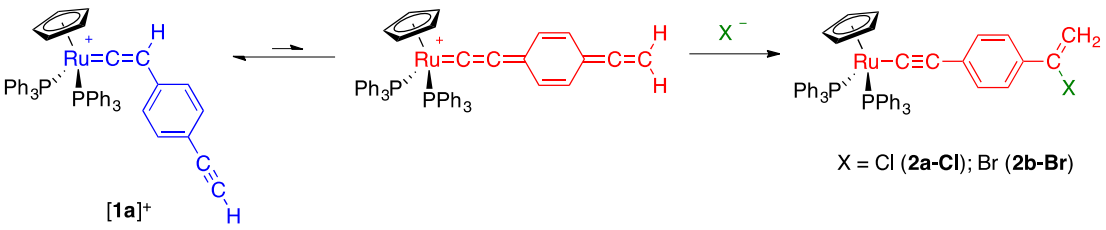
Lab/Group: Low group (Organometallics and Molecular Electronics)
Lab/Group Link: https://research-repository.uwa.edu.au/en/persons/paul-low

Project description:

Project 2

The coordination chemistry of vinylidenes (:C=CR_2) and allenylidenes (:C=C=CR_2), which are the first members of a family of unsaturated carbene ligands, has been well developed through many years of persistent investigation. In contrast, very few examples of complexes with butatrienylidene (:C=C=C=CR_2) and longer cumulated ligands have been isolated due the highly reactive nature of the extended unsaturated carbon chain. The existence of these highly conjugated species is more usually inferred from the nature of reaction products, with a pattern of alternate electrophilic [C(α), C(γ), C(ε), etc] and nucleophilic [C(β), C(δ), C(ζ), etc] character of the carbon atoms along the cumulated chain being identified.

More recently, a range of intriguing electronic and electrical properties associated with cumulated carbon chains have been identified, such as an increasing electronic transmission with increasing length through even-carbon cumulenes and fascinating, helical orbital character in odd-carbon C_2-symmetric cumulenes. The identification of similarly helical molecular orbitals in a range of bimetallic C_4-bridged radical cations that would require valence bond descriptions between the butadiyndiyl (-C≡C-C≡C-) and cumulated butatrienylidiene (=C=C=C=C=) forms provides further indications of the emerging areas of interest in the chemistry and electronic structures of cumulated carbon chains.



This project will explore novel routes to cumulated carbon compounds that are stabilized through coordination to metal complexes, and investigate the reaction chemistry of these peculiar molecules. We will choose reactions that vary from simple nucleophilic and electrophilic additions to more complex 2+n cyclisations and oxidative couplings, and seek to explore new reactions that would be extraordinarily difficult, if not impossible, to achieve via conventional organic chemistry methodologies.

Required skills, knowledge or experience: A background in synthetic chemistry (organic, inorganic or coordination chemistry) is essential. An interest in reaction mechanism and willingness to learn techniques including in situ NMR spectroscopy would be a distinct advantage.

Keywords: Chemistry, organic chemistry, organometallic chemistry, mechanism

Supervisor Contact email: paul.low@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks (can be extended to 12 weeks)
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Science **School:School of Molecular Sciences**	
Main Supervisor : Dr Sharon Perrella	**Co-supervisor(s) :** A/Prof Donna Geddes, Dr Stuart Prosser
Project title:	**Evaluation of Maternity Services at One For Women**
Lab/Group: Hartmann Human Lactation Research Group **Lab/Group Link:** http://humanlactationresearchgroup.com	
Project description: **One For Women** offers a comprehensive multidisciplinary team-based approach to maternity care. There is a focus on screening, education and referral for mental and physical health concerns in pregnancy and the postnatal period, breastfeeding and adjustment to parenthood. The aim of this approach is to mobilise support and early interventions, therefore enhancing satisfaction and adjustment, and reducing the impact of postnatal health and breastfeeding issues. As the service has now been available for 12 months, we are conducting an evaluation of maternal satisfaction with their pregnancy and postnatal care, as well as clinical outcomes of the service.	
Required skills, knowledge or experience: We require a student (preferably health sciences) with skills in data extraction, data entry and descriptive statistics. Knowledge of medical terminology related to pregnancy, birth and breastfeeding would be an advantage.	
Keywords: Evaluation, pregnancy, postnatal, health outcomes	
Supervisor Contact email: sharon.perrella@uwa.edu.au	
Project done on Crawley campus: 50% of the time. Most of the data extraction will need to be performed at the One For Women clinic in Midland – easy access by public transport from the city.	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 1

Faculty: Faculty of Science **School:School of Psychological Science**	
Main Supervisor : Dr Darja Kragt	**Co-supervisor(s) :**
Project title:	**Work factors and retirement adjustment**

Project description:

Project 1

This project aims to investigate work factors that contribute to retirement adjustment. The increased duration of retirement presents challenges (such as health care costs), but also opportunities to involve retirees in activities that are meaningful for them and the society. Investigating factors that contribute to a better life in retirement, therefore, is of importance. Retirement adjustment is defined as the process of getting used to life changes resulting from retirement. Because for majority of individuals retirement involves transition from working to not working, workplace factors play an important role in determining how individuals will experience their retirement. The aim of the project is to conduct a meta-analytical review of the literature.

The student involved in the project will likely assist with the coding process and some writing.

Required skills, knowledge or experience:

Undergraduate major in psychology, sociology, business, public health; qualitative or quantitative research skills training.

Keywords: Retirement adjustment, aging, workplace	
Supervisor Contact email: Darja.kragt@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Science **School:School of Psychological Science**	
Main Supervisor : Dr Darja Kragt	**Co-supervisor(s) :**
Project title:	**The future of leadership in the age of AI**

Project description:

Project 2

This project aims to investigate how the advancement of artificial intelligence (AI) systems will change the nature of the workplace and, specifically, what impact this will have on leadership. The analysis of the future workplace relationships between human leaders, subordinates and machines is conducted through the lens of well-known organisational behaviour theory of social power. It will be argued that social power has been rarely acknowledged as part of leadership theorising in the past, but in the future technological workplaces it might hold the key to understanding new leadership challenges. Leading an intelligent machine (and humans) by relying on hierarchy and power abuse is highly ineffective. Instead, it is suggested that future leadership will exert influence through becoming experts in (human) relationships and/or will lead by focusing on a greater social good. It is also likely that a shift to more shared/distributed forms of leadership will be required to respond to the threat of a leadership takeover by the AI.

The student involved in the project will assist with conducting the literature review and some writing.

Required skills, knowledge or experience:

Undergraduate major in psychology, business, engineering, computer science; quantitative research skills training.

Keywords: Leadership, artificial intelligence, workplace relations	
Supervisor Contact email: Darja.kragt@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Science
School: School of Psychological Science

Main Supervisor : Dr Diana Tan	**Co-supervisor(s) :** Prof Murray Maybery

Project title:	**An investigation of facial phenotypes associated with neurodevelopmental disorders**

Lab/Group: Cognition, Autism and Neurodevelopment
Lab/Group Link: http://canlab.org.au/

Project description:
The face and the brain develop in very close coordination during pregnancy; they unfold from the same group of cells during the early stages of fetal development. Therefore, it has been hypothesised that facial structures may give us clues about the psychopathology of neurodevelopmental disorders such as autism spectrum disorder and schizophrenia. The development of three-dimensional (3D) photogrammetry has given us the ability to conduct in-depth investigations on the differences in facial morphology associated with neurodevelopmental disorders such as autism spectrum disorder (see relevant papers here: https://scholar.google.com.au/citations?user=zTvxhfps61QC&hl=en). Through this programme of research, we aim to use facial information to advance our understanding of the psychopathology of neurodevelopmental disorders

In this project, students will use a state-of-the-art technology to collect 3D facial images from adult participants who will complete questionnaires assessing levels of autistic and/or schizotypy traits. Students will also be given training on conducting 3D facial and statistical analyses to test the hypotheses formulated for this study.

Required skills, knowledge or experience:

This project would suit a Psychology undergraduate student with a working knowledge of research methods and statistics. Student will be expected to work with other Honours and PhD students in the lab so good communication skills is essential. Prior experience in research is desired but not an essential experience.

Keywords: Facial morphology, neurodevelopment, autism, schizophrenia, psychopathology

Supervisor Contact email: diana.tan@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Science
School:School of Psychological Science

Main Supervisor : Research Prof Flavie Waters	**Co-supervisor(s) :**

Project title: **Risky health behaviours and sleep in mental health inpatients**

Lab/Group: https://research-repository.uwa.edu.au/en/persons/flavie-waters

Project description:

People with a mental health disorder experience disproportionate levels of morbidity and mortality. Risk behaviors include lower physical activity, smoking, poor diet and suboptimal sleep. Amongst these behaviors, poor sleep plays a pivotal role but has been studied to a lesser extent than other health behaviors. In particular, the relationship between sleep problems and risky health behaviours such as smoking, drug and alcohol use, poor nutrition and lowered physical activity remains to be better understood. This project aims to examine the nature of the relationship between sleep and risky health behaviours in a sample of inpatients diagnosed with severe mental illness. The methods will include an audit using validated scales with a sample of inpatients diagnosed with severe mental illness.

Required skills, knowledge or experience:

- Experience or interest working with people with severe mental illness
- Emotional maturity
- Experience administering questionnaires

Keywords: psychology, mental health, sleep, health promotion

Supervisor Contact email: flavie.waters@uwa.edu.au

Project done on Crawley campus: Yes (student is based at UWA, project conducted in Claremont)	**Length of project:** Standard 8 weeks (can be extended to 12 weeks)
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 3

Faculty: Faculty of Science
School:School of Psychological Science

Main Supervisor : Dr Julie Ji	**Co-supervisor(s) :** Prof Emily Holmes (Uppsala University);

Project title: **Imagining the future and mental health**

Lab/Group: Centre for the Advancement of Research on Emotion (CARE)
Lab/Group Link: http://www.ermcare.com/

Project description:

This internship project will contribute to the Raine Medical Foundation Cockell Research Collaboration Grant project "*Investigating "flashforward" mental imagery of self-injury as a proximal risk barometer and modifiable treatment target*", awarded to Dr Julie Ji (UWA) and Prof Emily Holmes (Uppsala University).

Background

In the general population, more than 17% of 10-17 year olds, and 13% of 18-24 year olds, engage in self-harm (intentional self-injury without suicidal intent)[1]. Prevalence rates also appear to be *rising* in this age group[2]. Self-harm behaviours, such as self-cutting and self-hitting, are performed to gain temporary relief from aversive emotional states[3]. Due to its emotionally rewarding nature, self-harm is *repetitive* and *self-reinforcing*[4]. Intense *urges* compel individuals to self-harm during times of distress or numbness, making it difficult to relinquish[5].

About the project:

Predicting *when* someone is about to self-harm is key to its prevention, and personalised technology harnessing psychological science offers this possibility. This project will be the first to evaluate smart phone-based real-time tracking of *flashforward imagery* (intrusive mental visualisations of acts of self-harm) asa dynamic and proximal risk "barometer" of self-harm urge and behaviour. Daily monitoring of *flashforward imagery* frequency and intensity will be *combined* with analysis of linguistic imagery content descriptions to understand how changes in an individual's experience of *flashforward* imagery predicts self-harm urge and behaviour.

Data will be collected online, thus there is no face to face interaction with participants. It is anticipated that preliminary data collection will be underway at the time of the internship, thus intern students will have the opportunity to contribute to data collection, data screening and cleaning, statistical analyses and interpretation.

Required skills, knowledge or experience:
Required: background in psychological science and statistical methods for psychological science
Desirable: data science background, knowledge/experience of machine-learning and Natural Language Processing (NLP) analysis

Keywords: mental health; intrusions, mental imagery, self-injury, emotion, motivation

Supervisor Contact email: julie.ji@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 1

Faculty: Faculty of Science
School: School of Psychological Science

Main Supervisor : Liz Pritchard (Organisational Psychologist)	**Co-supervisor(s) :** Dr Serena Wee

Project title: **Workforce Diversity Benchmarking**

Lab/Group: Psychology at Work Lab
Lab/Group Link: https://www.uwa.edu.au/research/industrial-organisational-psychology-and-human-factors

Project description:
Diversity and inclusion is a strategic focus for many organisations but most organisations face significant challenges when it comes to measuring, understanding and implementing practices to meet this objective.

Industry is driven by both legislative obligations as well as a performance orientation when making decisions to embed diversity in their workplaces. To illustrate, the Workplace Gender Equality Act 2012 requires non-public sector employers with 100 or more employees to submit a report to the Workplace Gender Equality Agency on an annual basis as a means of tracking performance against key diversity metrics. Further, regular advice is issued from corporate governance leaders such as ASX recognising the productivity that comes from embracing diversity.

There are innumerable benefits to having a diverse workforce where differences are appreciated and valued (Wrench, 2005). Diversity is thought to deliver competitive advantages via inclusive organisational cultures, yet the evidence base for these effects can be patchy (Hicks-Clarke & Iles, 2000), with some recognising there can be unintended negative consequences. To mitigate these risks organisations can benefit from critically reflecting and assessing the outcomes and processes they wish to achieve via diversity management, ensuring these goals are aligned with other key organisation drivers. In order to do this effectively, it is necessary to understand the current state, desired future state, and the organisational process that needs to be supported to make that transition.

Valid and reliable measurement of diversity and inclusion practices underpins the effective diagnostic process, which is an essential part of understanding the organisational picture.

The focus for the Summer Down Under internship will be to assist the team in the development of the diagnostic benchmarking tool. This process will involve meeting with a few key stakeholders to understand their needs, as well as undertaking literature reviews, market appreciation analysis, and considering marketability in the development of the benchmarking tool.

Wrench, J. (2005). Diversity management can be bad for you. Race & Class, 46(3), 73-84.
Hicks-Clarke, D., & Iles, P. (2000). Climate for diversity and its effects on career and organisational attitudes and perceptions. Personnel review, 29(3), 324-345.

Required skills, knowledge or experience:
Background and interest in psychology, specifically work and organisational psychology. Skills in measurement, literature reviews and diversity desirable.

Keywords: Organisational psychology, diversity, inclusion, bench marking

Supervisor Contact email: liz.pritchard@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Science
School: UWA School of Agriculture and Environment

Main Supervisor: Prof Graeme Martin	**Co-supervisor(s):** Prof Phil Vercoe

Project title:	**Genetic resistance of sheep to gastro-intestinal worms – reducing our reliance on drugs.**

Project description:

In ruminant livestock, gastro-intestinal worms (helminths) reduce productivity. In most cases, the worms also cause diarrhoea (or 'scouring') and, in Merino sheep, the diarrhoea leads to faecal contamination around the anus (or 'breech') that attracts blowflies, leading to flystrike. Moreover, in Australia and around the world, the worms are becoming resistant to anthelminthic drugs. This 'worm-fly complex' costs the Australian Merino industry up to $700m pa.

After 25 years of genetic selection, the WA Department of Primary Industries and Regional Development (DPIRD) has produced helminth-susceptible and helminth-resistant sheep (the 'Rylington' flock). Resistance to helminth infection is assessed by worm egg counts (WEC) and the incidence of diarrhoea is assessed by the 'dag' score, a subjective assessment of the amount of faecal material adhering to the wool around the anus.

Breeding worm-resistant sheep is very effective, but a significant proportion of the worm-resistant animals still develop diarrhoea because they become hypersensitive to low-mild levels of worm infection. To explain the hypersensitivity, we need to identify the components of the immune system that are affected by worm infection and by genetic selection for worm resistance. The work involves characterising the humeral arm of immune response (concentrations of anti-worm antibodies in blood) and the cellular arm of immune response (cytokine concentrations in blood).

We expect these measurements to lead to a combined genetic trait that will allow simultaneous selection for resistance to both worms and diarrhoea. For livestock industries, this outcome would see improvements in profitability, animal welfare and marketplace image.

Required skills, knowledge or experience: studies in in animal science or veterinary science. Desirable but not essential: animal industry, animal physiology, genetics, immunology, parasitology.

Keywords: Animal industry; Animal physiology; Genetics; Immunology

Supervisor Contact email: Graeme.Martin@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks

Project is suitable for students from any University: Airlangga University

Total number of project(s) offered by supervisor: 1	**Total place(s) available with supervisor:** 4

Faculty: Faculty of Science
School:UWA School of Agriculture and Environment

Main Supervisor : Dr Judith Lichtenzveig	**Co-supervisor(s) :** Dr Janine Croser Dr Maria Pazos-Navarro

Project title: **Phenology of wild relatives of chickpea**

Lab/Group: Lichtenzveig & Croser

Project description:

Chickpea, *Cicer arietinum*, evolved under domestication as a spring crop [1]. The closest wild relatives of chickpea, *C. reticulatum* and *C. echinospermum*, are adapted to autumn germination and spring/summer maturity. The project aims at evaluating the phenology (*i.e.* the life cycle) of wild *Cicer* in response to changing growth conditions (*e.g.* temperature, photoperiod, light quality). The project builds upon the team's expertise in accelerated single seed descendant platforms [2].

The project provides opportunities to develop skills in plant science, physiology, genetics, data mining and statistical analysis. The outputs of this project will benefit the agriculture industry and will enhance the collective understanding of crop evolution.

1) Abbo S., Shtienberg D., Lichtenzveig J., Lev-Yadun S. and Gopher A. (2003) The chickpea, summer cropping, and a new model for pulse domestication in the ancient Near East. The Quarterly Review of Biology 78(4):37-50.
2) Ribalta, F. M., Pazos-Navarro, M., Nelson, K., Edwards, K., Ross, J. J., Bennett, R., Munday, C., Erskine, W., Ochatt, S. J. & Croser, J. S., Precocious floral initiation and identification of exact timing of embryo physiological maturity facilitate germination of immature seeds to truncate the lifecycle of pea. Plant Growth Regulation, 81(2): 345-353.

Required skills, knowledge or experience:

Strong interest in genetics and/or plant sciences demonstrated by having completed units in biology, genetics, botany and/or agriculture.

Keywords: Evolution, Adaptation, Genetics, Legume Crops

Supervisor Contact email: Judith.Lichtenzveig@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks (can be extended to 12 weeks)
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Science **School: UWA School of Agriculture and Environment**	
Main Supervisor : Prof Kadambot Siddique	**Co-supervisor(s) :** Dr Jiayin Pang
Project title:	**The effect of terminal drought on chickpea reproduction and grain yield**

Project description:

Water shortage during the reproductive phase, a situation referred to as 'terminal drought', is one of the major abiotic stresses limiting chickpea production and causes up to 50% yield losses. Chickpea is the second most important grain legume globally, and is the largest pulse crop in Australia. Our previous glasshouse study in 80-L wheelie bins found that the failure for chickpea pod/seed set is associated with the increased level of abscisic acid and/or the reduction of photosynthesis and assimilate supply to the seeds under terminal drought.

The project aims to investigate the role of sucrose on pod/seed set at both early and later stages of seed development, and associated enzymes and hormones related to sucrose processing in chickpea, through exogenous sucrose application.

Required skills, knowledge or experience:
Students interested in plant physiology, keen to understand how plants function in response to terminal drought and to develop high-level skills in glasshouse and laboratory.

Keywords: Chickpea, Enzymes, Physiology, Sucrose, Terminal drought	
Supervisor Contact email: Kadambot.Siddique@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 1

<table>
<tr><td colspan="3">Faculty: Faculty of Science
School: UWA School of Agriculture and Environment</td></tr>
<tr><td colspan="2">Main Supervisor : Dr Sae Chi</td><td>Co-supervisor(s) : Prof Sharon Biermann,
Dr Doina Olaru and Dr Chao Sun</td></tr>
<tr><td>Project title:</td><td colspan="2">Quantifying economic impacts of emerging technologies in the transport sector</td></tr>
<tr><td colspan="3">Lab/Group: Planning and Transport Research Centre (PATREC)
Lab/Group Link: https://patrec.org/</td></tr>
<tr><td colspan="3">Project description:

This project reviews potential economic impacts of emerging technologies in the transport sector such as Mobility-as-a-Service (MaaS) and how they can be quantified.</td></tr>
<tr><td colspan="3">Required skills, knowledge or experience:
Economics or Civil Engineering</td></tr>
<tr><td colspan="3">Keywords: Transport economics, transport engineering, emerging technologies</td></tr>
<tr><td colspan="3">Supervisor Contact email: sae.chi@uwa.edu.au</td></tr>
<tr><td colspan="2">Project done on Crawley campus: Yes</td><td>Length of project: Standard 8 weeks (can be extended to 12 weeks)</td></tr>
<tr><td colspan="2">Total number of project(s) offered by supervisor: 3</td><td>Total number of place(s) available with supervisor: 5</td></tr>
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<tr><td colspan="3">Faculty: Faculty of Science
School: UWA School of Agriculture and Environment</td></tr>
<tr><td colspan="2">Main Supervisor : Dr Sae Chi</td><td>Co-supervisor(s) : Prof Sharon Biermann,
Dr Doina Olaru and Dr Chao Sun</td></tr>
<tr><td>Project title:</td><td colspan="2">Assessing future uncertainties within existing transport infrastructure investment assessment frameworks</td></tr>
<tr><td colspan="3">Lab/Group: Planning and Transport Research Centre (PATREC)
Lab/Group Link: https://patrec.org/</td></tr>
<tr><td colspan="3">Project description:

This project reviews potential impacts and implications of future uncertainties in the transport sector. It then explores how they can be quantified and assessed within existing transport infrastructure investment assessment frameworks.</td></tr>
<tr><td colspan="3">Required skills, knowledge or experience:
Economics or Civil Engineering</td></tr>
<tr><td colspan="3">Keywords: Transport infrastructure, transport engineering, future uncertainties, infrastructure investment</td></tr>
<tr><td colspan="3">Supervisor Contact email: sae.chi@uwa.edu.au</td></tr>
<tr><td colspan="2">Project done on Crawley campus: Yes</td><td>Length of project: Standard 8 weeks (can be extended to 12 weeks)</td></tr>
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<tr><td colspan="3">Faculty: Faculty of Science
School: UWA School of Agriculture and Environment</td></tr>
<tr><td colspan="2">Main Supervisor : Dr Sae Chi</td><td>Co-supervisor(s) : Prof Sharon Biermann,
Dr Doina Olaru and Dr Chao Sun</td></tr>
<tr><td>Project title:</td><td colspan="2">Port planning</td></tr>
<tr><td colspan="3">Lab/Group: Planning and Transport Research Centre (PATREC)
Lab/Group Link: https://patrec.org/</td></tr>
<tr><td colspan="3">Project description:

This project reviews how port options are assessed in other jurisdictions (other states and overseas) and how they can be applied to the Perth context.</td></tr>
<tr><td colspan="3">Required skills, knowledge or experience:
Economics or Civil Engineering</td></tr>
<tr><td colspan="3">Keywords: Transport, port planning, infrastructure investment, planning</td></tr>
<tr><td colspan="3">Supervisor Contact email: sae.chi@uwa.edu.au</td></tr>
<tr><td colspan="2">Project done on Crawley campus: Yes</td><td>Length of project: Standard 8 weeks (can be extended to 12 weeks)</td></tr>
<tr><td colspan="2">Total number of project(s) offered by supervisor: 3</td><td>Total number of place(s) available with supervisor: 5</td></tr>
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Faculty: Faculty of Science **UWA Institute of Agriculture**	
Main Supervisor : Dr Sheng Chen	**Co-supervisor(s) :** Prof Wallace Cowling
Project title:	**Improving canola heat tolerance - a coordinated multidisciplinary approach**
Lab/Group: Canola Genetics and breeding	
Project description: Extended period of high temperature stress and short periods of heat shock are major threat to canola grain and oil yield in canola grown regions in Australia and worldwide. This project proposes a new program of canola genetic research, which will build upon outputs from previous National Brassica Germplasm Improvement Program and the international collaboration in canola pre-breeding project among Australia, China and India. This project will address a major impediment to achieving improved rate of genetic gain for complex quantitative traits such as heat stress. The lack of accurate and relevant field phenotyping approaches coupled with the long cycle times in conventional breeding programs have historically limited genetic progress. The initial progress made in controlled environment screening will be validated and translated into breeder-deployable field phenotyping protocols using novel techniques. In order to develop a prototype heat tolerance screening method, two heat phenotyping facilities are newly constructed at UWA. This prototype improves on published designs and is practical for screening large pre-breeding populations in +/- heat stress conditions. The facility has temperature control and irrigation to avoid the confounding effects of drought stress. Once the prototype heat tolerance screening facility is developed and validated, the protocol and the design will be made available to canola breeders in Australia. This project will also exploit potential new genetic variability for tolerance to high-temperature within the large number of canola lines.	
Required skills, knowledge or experience: Basic training in Biology, Plant Physiology and Genetics is required. Knowledge or experience in climate change and environment control would be desired.	
Keywords: Climate change, High Temperature Stress, Plant Physiology Under Abiotic Stress, Genetics and Genomics, Canola	
Supervisor Contact email: sheng.chen@uwa.edu.au	
Project done on Crawley campus: Yes (field work at UWA Field Station in Shenton Park)	**Length of project:** 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences
School: Engineering

Main Supervisor : Prof Gia Parish	**Co-supervisor(s) :** A/Prof Adrian Keating / Prof Murray Baker

Project title: **A new material for energy conversion; nanoporous gallium**

Lab/Group: Advanced Quantum and Sensing Technologies/Microelectronics Research Group
Lab/Group Link: https://www.uwa.edu.au/research/advanced-sensing-and-quantum-technologies

Project description:

Project 1

Hydrogen generation from sunlight is of great interest to address climate change and energy security concerns. Gallium nitride (GaN) is a material that has been commercially applied to light emitting diodes, lasers, and high power transistors, but also has the ideal energy band and chemical stability properties for zero-bias hydrogen generation from solar energy applications and water splitting using sunlight (photoelectrolysis). Fabrication of nanoporous (NP) GaN allows for a tremendous increase in surface-to-volume allowing for much higher energy conversion efficiency of PEC reactions.

This project will assist in the development of a photoelectrochemical (PEC) etching process to fabricate NP-GaN from thin films, for future application to water splitting. The project is multi-faceted and you may work on aspects such as:

- Literature survey of published NP-GaN fabrication methods particularly for water splitting
- Consideration of safety aspects for undertaking PEC of GaN to create NP-GaN
- Adaptation of existing PEC equipment in our lab to fabricate NP-GaN OR building an entirely new PEC setup
- Implementing PEC of GaN to create NP-GaN
- Microscopy and optical measurement techniques to characterise the etched GaN.

Required skills, knowledge or experience:
Students are sought with backgrounds in chemistry, materials science, nanotechnology/nanoscience, electronic engineering, materials engineering, chemical engineering or physics.

Keywords: electrolysis, porous materials, nanotechnology, water splitting, hydrogen generation

Supervisor Contact email: giacinta.parish@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 4

Faculty: Faculty of Engineering and Mathematical Sciences
School: Engineering

Main Supervisor : Prof Gia Parish	**Co-supervisor(s) :** Prof Brett Nener / Prof Murray Baker / Dr Matthew Myers (CSIRO)

Project title: **Transistor-based chemical sensors for monitoring water contaminants**

Lab/Group: Advanced Quantum and Sensing Technologies/Microelectronics Research Group
Lab/Group Link: https://www.uwa.edu.au/research/advanced-sensing-and-quantum-technologies

Project description:

Project 2

Reliable, economically accessible technology for in-situ monitoring of contaminants in water has the power to transform health, industry, and society the world around. Applications of such monitoring range from process control monitoring and optimisation for industry, to water supply quality and wastewater monitoring, to environmental monitoring for resource extraction, and beyond. One example is contamination of environmental water bodies with heavy metal pollutants which are known to be extremely toxic metals and can lead to an irreversible damage to the health of humans and animals. In pursuit of miniaturised, robust, and ultrasensitive sensors, we are developing ion-selective field effective transistors (ISFETs) for various chemical sensing applications. . We have demonstrated various sensors (pH and nitrate, mercury and calcium ions) and are currently investigating different methods to improve the sensitivity by varying the ion-selective functionalisation layer. We are also currently investigating ways to improve reliability by modifying packaging and measurement conditions. Elimination of drift will enable in situ, real-time contaminant monitoring that is accurate, reliable and low-cost.

Places are available for multiple students to work on one or more of the following integrated project components:
1. Physical, chemical, and materials characterisation of functionalisation methods for nitrates and heavy metals
2. Electrical, chemical, and physical characterisation and optimisation of functionalised sensors
3. Mechanical, electrical and chemical characterisation and optimisation of packaging techniques

Required skills, knowledge or experience:
Students are sought with backgrounds in electrical/electronic engineering, materials engineering, chemical engineering, chemistry, physics, materials science or nanotechnology/nanoscience. Prior studies/experience in semiconductor device technology or chemical sensors is desirable though not essential.

Keywords: Sensors, Transistors, Water, Environment, Chemical

Supervisor Contact email: giacinta.parish@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 4

Faculty: Faculty of Engineering and Mathematical Sciences **School: Engineering**	
Main Supervisor : Prof Hui Tong Chua	**Co-supervisor(s) :** Prof Andy Fourie
Project title:	**Bauxite residue remediation through centrifugation**
Lab/Group Link: https://research-repository.uwa.edu.au/en/persons/hui-chua	
Project description: This project is in collaboration with a local company, South32, which has kindly provided confidential data of the bauxite residue from Worsley alumina refinery, and bauxite residue for the experiments. The student will assist with conducting the experiments and analyse the data. The student will also participate in reporting to the company as to the implication to the refinery in terms of remediation of the bauxite residue, which is a huge liability to the industry. The student is required to sign a deed poll with UWA as he/she will be given access to confidential information.	
Required skills, knowledge or experience: The student should be from Mechanical or Chemical Engineering background and is familiar with using Excel spreadsheet.	
Keywords: Mechanical, Chemical, Engineering, Heat and Mass Transfer, Thermodynamics	
Supervisor Contact email: huitong.chua@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks (can be extended to 12 weeks)
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 6

Faculty: Faculty of Engineering and Mathematical Sciences **School:Engineering**	
Main Supervisor : Dr Sally Male	**Co-supervisor(s) :**
Project title:	**Empathy in Engineering**
Lab/Group: Engineering & Science Education, Society and Work **Lab/Group Link:** https://www.uwa.edu.au/research/engineering-and-science-education-society-and-work	
Project description: Strobel, Hess, and others, have found that engineers in the USA and Europe consider empathy and care to be important for engineering practice. This project would be part of a larger project involving a collaboration between UWA and University of Missouri. Empathy has not traditionally been taught in engineering degree programs. We are studying Australian engineers' perceptions of the importance and relevance of empathy in engineering to inform engineering education. You would use threshold concept theory, which is a curriculum development theory. You would be guided in understanding threshold concept theory and developing interview skills. You would interview a small number of practising engineering graduates about their experiences of threshold concepts related to empathy in engineering and analyse your transcripts to identify potential threshold concepts related to empathy in engineering. Note: The Australasian Association for Engineering Education Postgraduate Winter School will be held at UWA 13-17 July 2020. There could be an opportunity to join this.	
Required skills, knowledge or experience: This project would suit an engineering student with an interest in engineering practice and engineering education. Strong communication skills (reading, writing, and interacting with others) would be essential.	
Keywords: Engineering, education, threshold concepts, empathy, interviews	
Supervisor Contact email: sally.male@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 1

<table>
<tr><td colspan="2">Faculty: Faculty of Engineering and Mathematical Sciences
School: Engineering</td></tr>
<tr><td>Main Supervisor : Prof Thomas Braunl</td><td>Co-supervisor(s) :</td></tr>
<tr><td>Project title:</td><td>Autonomous Driving</td></tr>
<tr><td colspan="2">Lab/Group: Renewable Energy Vehicle Project (REV)
Lab/Group Link: http://revproject.com</td></tr>
<tr><td colspan="2">Project description:
We are working on a new autonomous vehicle, based on an electric shuttle bus. It is equipped with several sensor systems, including GPS, camera, Lidar, IMU (inertial measurement unit) and wheel encoders. The project operates as a student led team with support and mentorship from faculty, PhD students and industry professionals and has a strong history of academic publication.
We are using the latest automotive control hardware with an Nvidia Jetson AGX Xavier system which provides real-time sensor processing and accelerated deep learning capabilities and currently utilise a Robot Operating System (ROS) based software stack with C++ and Python nodes. This project also includes high-reliability embedded systems and a hardware-in-the-loop simulation system for software development.</td></tr>
<tr><td colspan="2">Required skills, knowledge or experience:
- Good programming experience in C++ or Python is required
- Experience in Robot Operation System (ROS) is desirable</td></tr>
<tr><td colspan="2">Keywords: Autonomous driving, software design</td></tr>
<tr><td colspan="2">Supervisor Contact email: tb@ee.uwa.edu.au</td></tr>
<tr><td>Project done on Crawley campus: Yes</td><td>Length of project: Standard 8 weeks (can be extended to 12 weeks)</td></tr>
<tr><td>Total number of project(s) offered by supervisor: 1</td><td>Total number of place(s) available with supervisor: 4</td></tr>
</table>

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Dr Carl Blair	**Co-supervisor(s) :** Prof Chunnong Zhao/ Prof Ju Li

Project title: **Measuring the temperature distribution in Advanced LIGO test masses using vibrational eigenfrequencies**

Lab/Group: Gravitational Wave Detector Instrumentation Group
Lab/Group Link: https://www.gravity.uwa.edu.au
https://www.uwa.edu.au/research/gravitational-wave-technology-and-education
https://www.ozgrav.org

Project description:
In this project measurements of the vibrational frequencies of LIGO test masses will be used to estimate their temperature distribution. These measurements will be compared to existing thermal models of the test mass. The models will then be improved with the new information discovered in these investigations.

This project is motivated by the current quantum manipulation of the Advanced LIGO and VIRGO gravitational wave detectors. In LIGO's Observation Run 4 beginning in 2021 LIGO will introduce frequency-dependent squeezing. To achieve a large degree of quantum squeezing of shot noise and radiation pressure noise, the optical losses must be kept to a minimum. Some of the optical losses come from scattered light in optical cavities and some come from beams being distorted by thermal gradients in mirror substrates reducing 'mode matching' between optical cavities. Additionally, quantum shot noise can be reduced by increasing optical power. LIGO design optical power is 800kW in the arm Fabry Perot cavities. The Third Observing Run was expected to run with ~400kW. However, it has been limited to ~200kW by non-uniform absorption in the mirror coating. This non-uniform absorption thermally deforms the mirror resulting in increased scatter and 'mode mismatch' optical losses.

The project will consist of a data analysis task. Data from LIGO containing the eigenmodes of the test mass will be analysed. A novel technique proposed by Dr Blair, Prof Levin and Prof Thrane will be used to infer the temperature distribution and by extension parameters of the thermal model of the LIGO test masses. These measurements will be compared to finite element modelling of the mirror thermal diffusion and deformation.

The applicant will get experience with: finite element modelling, loss mechanisms in optical cavities and working with LIGO data, data may be processed locally or on LIGO clusters.

Required skills, knowledge or experience:
Experience with Matlab and finite element modelling would be highly desirable.
Any experience with optical cavities, and/or Mathematica would be desirable.

Keywords: Optical cavity thermal gravitational wave

Supervisor Contact email: carl.blair@ligo.org

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks (can be extended to 12 weeks)
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Chunnong Zhao	**Co-supervisor(s) :** Prof. Li Ju / Dr. Xu Chen

Project title:	**Optical Springs and Optical Dilution —Beating the Standard Quantum Limit**

Lab/Group: Gravitational Wave Detector Instrumentation Group, Physics
Lab/Group Link: http://gravity.uwa.edu.au

Project description:
Gravitational wave instrumentation research in Australia began at UWA, where we pioneered one of the world's first high sensitivity resonant mass gravitational wave detectors. Today our research is focused on the development of advanced techniques to improve the sensitivity of gravitational wave detectors.
Our team is part of the LIGO Scientific Collaboration (LSC) and contributed some key technologies towards the first detection of the gravitational waves. We are part of the ARC centre of Excellence for Gravitational Wave Discovery (OzGrav). Our research areas include precision measurement, quantum optics, high optical power suspended cavities, advanced vibration isolation techniques and control systems. The research is exploring exciting new physics phenomena and techniques that have applications beyond gravitational wave detectors, including quantum measurement technologies and airborne exploration devices.
A specific area of research explores new concepts in amplification and measurement based on the interactions between optical photons and acoustic phonons. Devices based on this frontier of measurement technology require very low loss opto-mechanical systems in which light and sound (or mechanical vibration) interact very strongly without being contaminated by thermal fluctuations. We are testing and inventing many novel opto-mechanical resonators, including nano-scale optical pendulums made from synthetic crystalline mirrors, others made from photonic and phononic crystals, and some made from ultrapure crystals of quartz. With these devices we observe and predict many new phenomena such as optical springs, optical dilution, optomechanically induced transparency, frequency dependent optical squeezing, negative dispersion and white light resonance. The phenomenon of white light resonance (that violates the normal theory of resonance) offers enormous opportunities for improving the sensitivity of gravitational wave detectors, which in turn will allow new astrophysical phenomena to be explored.
This project will involve simulating various mechanical micro-resonators using Finite Element Modelling software (ANSYS or COMSOL), characterising the mechanical and optical properties of the micro-resonators, as well as tuning and testing the opto-mechanical interactions with the resonators inside an optical cavity.
We are a vibrant, friendly and international group. We welcome highly motivated students to join us.

Required skills, knowledge or experience:
Student should have
-Basic knowledge of optics, such as Gaussian beams, optical cavities. Many of the basic concept of the optics could be easily found online.
-Mechanical resonator, frequency domain
-Some skill of comment computer software such as Matlab, and a fast learner to use different computational package.

Keywords: Optical Experimentation and simulation

Supervisor Contact email: li.ju@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks (can be extended to 12 weeks)
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences **School: Physics, Mathematics and Computing**	
Main Supervisor : Prof Jingbo Wang	**Co-supervisor(s) :** Sam Marsh, Gareth Jay, Mitchell Chiew, Kooper De Lacy
Project title:	**Quantum Machine Learning**
Lab/Group Link: http://www.physics.uwa.edu.au/research/quantum-dynamics-computation	
Project description: Quantum computing has come a long way since the discovery of Shor's factoring (1995) and Grover's search (1996) algorithms. We now know a quantum computer can solve enormously large set of linear equations, can simulate a wide range of Hamiltonians representing chemical and biological systems, can perform various linear transformations including Fourier transforms, and can efficiently evaluate inner products and distances in super high dimensional vector space, the last of which is particularly useful in machine learning. In this project, we will explore applications in machine learning, taking advantage of intrinsic quantum correlations and quantum parallelism. In particular, we will examine which parts of classical machine learning algorithms can speed up in the quantum setting with deterministic queries.	
Required skills, knowledge or experience: Quantum physics, linear algebra, and basic programming skills	
Keywords: Quantum computing, quantum information, quantum walk, machine learning, optimisation, graph theory	
Supervisor Contact email: jingbo.wang@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 1

Faculty: Faculty of Engineering and Mathematical Sciences **School: Physics, Mathematics and Computing**	
Main Supervisor : Dr John Winterflood	**Co-supervisor(s) :** Prof. Li Ju and Mr Joshua McCann (PhD student)
Project title:	**Tilt/Rotation Sensor**
Lab/Group: Gravitational Wave Detector Instrumentation Group **Lab/Group Link:** http://www.gravity.uwa.edu.au https://www.ozgrav.org/	
Project description: The detection of gravitational waves started a new era of gravitational wave astronomy. It is the fastest growing field of astronomy as we discover more and more sources of gravitational waves across the universe. The improvement of detectors, and development of new detectors is crucial for the field to continue to advance. We are building a very sensitive tilt/rotation sensor and feedback systems to actively suppress the ground tilts to improve the low frequency performance of gravitational wave detectors. Traditional inertial sensors could not distinguish tilt and horizontal motion. Our tilt/rotation sensor incorporate many innovative design such as cross flexure to enable arbitrary mounting angle, magnetic anti-spring to reduce the resonant frequency and precision optical walk-off interferometric readout system. The student will participate in the characterisation of the instrument (both mechanical system and optical readout system), as well as any upgrade/improvement design. This project suits both Physics students and Engineering students. We are part of the national ARC Centre of Excellence for Gravitational Wave Discovery (OzGrav). Our team is part of the LIGO Scientific Collaboration (LSC) and contributed some key technologies towards the first detection of the gravitational waves. We are a vibrant, friendly and international group. We welcome highly motivated students to join us.	
Required skills, knowledge or experience: -Basic vibration isolation knowledge -Some CAD drawing skill would be preferable	
Keywords: Precision sensing, vibration isolation	
Supervisor Contact email: li.ju@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 1

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Dr Joris van Heijningen	**Co-supervisor(s) :** Prof. Li Ju

Project title: **Generating error signals for cavity mode matching**

Lab/Group: Gravitational Wave Detector Instrumentation Group
Lab/Group Link: http://gravity.uwa.edu.au

Project description:
The theory of General Relativity, published by Albert Einstein in 1915, describes gravity as the curvature of space-time. Einstein realised soon after publishing that his theory produces wave solutions. Gravitational waves (GW) are minute ripples in the curvature of space-time that are produced by violent astrophysical events. They propagate through space at the speed of light like the waves in a pond after a pebble is thrown onto its surface. Because the curvature of space-time and gravity are interconnected, a gravitational wave will change the way freely falling objects fall with respect to each other. We can therefore measure gravitational waves by accurately monitoring the apparent motion of suspended test masses, which is done by using kilometre-scale laser interferometers. After the first detection in September 2015, we are now detecting GW on a weekly basis. The study of gravitational waves has opened up a whole new window on the Universe and we are discovering something new almost on a weekly basis!

Part of the instrumentation section of our group focuses on the high frequency part of improvements to the overall sensitivity curve of the detector collaboration we are a part of: LIGO, two 4-km-arm interferometers in the USA. The strain sensitivity to be reached at design sensitivity of Advanced LIGO nears the 1×10-24 1/√Hz level in the most sensitive frequency range. Minimising any optical losses in a gravitational wave detector is important if advanced techniques, such as squeezing or the white light cavity, are to be fruitful. When input beam waist position and/or size are not matched to those of the cavity, we speak of mode mismatch. Mode mismatch is a source of optical loss and therefore we need error signals to control it to a minimum.

This project combines optical design and experiment towards a novel mode matching control technique, which could be used in GW detectors all around the world in the future. You will simulate the proposed set-up in Finesse, an optical simulation tool used in the GW community. In this simulation you will, for instance, will determine the position and preferred characteristics of all optical components. You will then help build this optical set-up to validate its performance.

Learning goals:
- How GW are measured and why mode matching is necessary;
- Advantages and limitations of the proposed solution;
- Design of optical systems and subsequent simulation of these designs;
- Characterisation of prototype optical systems.

Required skills, knowledge or experience:
General data analysis tools, e.g. Python, Matlab, Mathematica or similar.

Keywords: Gravitational Waves, Optical experiment, Optical simulation

Supervisor Contact email: li.ju@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

<table>
<tr><td colspan="3">Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing</td></tr>
<tr><td colspan="2">Main Supervisor : Prof Kenji Bekki</td><td>Co-supervisor(s) :</td></tr>
<tr><td>Project title:</td><td colspan="2">Deep learning for classifying the synthesized images of galaxies from computer simulations</td></tr>
<tr><td colspan="3">Project description:
Learning is classifying. Therefore, classifying galaxies can lead us to learn important aspects of galaxy formation and evolution. In this project, students will try to develop a new convolution neural network (CNN) to classify the synthesized images of galaxies produced by high-resolution computer simulations of galaxies. First, students in this project will use a million of synthesized galaxy images to train the CNN for an automated classification of galaxies. Then they will classify the observed images of galaxies from telescopes using the trained CNN in an automatic way. This novel galaxy classification scheme will be able to be used for real scientific research to discover something new (e.g., new discovery of hidden spiral arm structures, massive black holes, and dark matter etc).</td></tr>
<tr><td colspan="3">Required skills, knowledge or experience:
Programming skills of Python and Keras/Tensorflow (AI libraries) and some basic knowledge / about deep learning are required.</td></tr>
<tr><td colspan="3">Keywords: Artificial intelligence (AI), astronomy, computer simulations</td></tr>
<tr><td colspan="3">Supervisor Contact email: kenji.bekki@uwa.edu.au</td></tr>
<tr><td colspan="2">Project done on Crawley campus: Yes</td><td>Length of project: Standard 8 weeks</td></tr>
<tr><td colspan="2">Total number of project(s) offered by supervisor: 1</td><td>Total number of place(s) available with supervisor: 3</td></tr>
</table>

Faculty: Faculty of Engineering and Mathematical Sciences **School: Physics, Mathematics and Computing**	
Main Supervisor : Prof Li Ju	**Co-supervisor(s) :** Dr. Carl Blair, Harmid Satari PhD Candidate
Project title:	**Seismic Imaging Array**
Lab/Group: Gravitational Wave Detector Instrumentation Group **Lab/Group Link:** http://www.gravity.uwa.edu.au https://www.ozgrav.org/	
Project description: The detection of gravitational waves started a new era of gravitational wave astronomy. It is the fastest growing field of astronomy as we discover more and more sources of gravitational waves across the universe. The improvement of detectors, and development of new detectors is crucial for the field to continue to advance. To improve the low frequency sensitivity, it is necessary to study the seismic environment around the detectors. We are building a seismic array network around our Gingin research centre where we have an 80m long suspended high power optical cavity. By correlate array data, we could get information about surface wave direction, speed ect, and would help to create the seismic waves "image". This information could be used either in feedback control of the vibration isolation system for the detectors, or in detector signal data analysis. This project will involve deploy low frequency seismometers, collect and analyse array data. This project suits both Physics students and Engineering students. We are part of the national ARC Centre of Excellence for Gravitational Wave Discovery (OzGrav). Our team is part of the LIGO Scientific Collaboration (LSC) and contributed some key technologies towards the first detection of the gravitational waves. We are a vibrant, friendly and international group. We welcome highly motivated students to join us.	
Required skills, knowledge or experience: -Basic vibration isolation knowledge -Some knowledge on data analysis such as cross correlation, Fourier analysis	
Keywords: Seismic motion, Data Analysis	
Supervisor Contact email: li.ju@uwa.edu.au	
Project done on Crawley campus: 85% on campus and a few days at Gingin site	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Dr Luca Cortese	**Co-supervisor(s) :** Dr Amelia Fraser-McKelvie / Dr Alfred Tiley

Project title: **A panchromatic view of galaxy evolution**

Lab/Group: International Centre for Radio Astronomy Research
Lab/Group Link: https://www.icrar.org/
https://corteseluca.wordpress.com/

Project description:
One of the most outstanding challenges in extragalactic astronomy is to identify the astrophysical processes responsible for transforming simple dark matter haloes into the heterogeneous population of galaxies inhabiting today's Universe. How did different morphological types form and evolve? Does the environment where a galaxy lives influence its evolution? Inevitably, the answers to these questions entail a detailed investigation of all the components of the interstellar medium (gas, dust, metals) and their relation to stellar properties, kinematics and environment. This clearly requires multi-frequency information (e.g., including ultraviolet, optical, infrared and radio observations) for statistically significant samples of galaxies across the cosmic web, which are becoming available only now.

Our research group investigates the physical properties of galaxies and their dependence on redshift and environment using large, multi-wavelength datasets. The multi-wavelength approach is at the foundation of our research, as it is the only way to trace all the baryonic constituents of galaxies and to reveal how the Universe formed and evolves.

We offer projects spanning a wide range of topics, and taking advantage of observations obtained with state-of-the-art ground- and space-based facilities. The expectation is that, during this internship, the student will gain the ability of handling and analyzing multi-frequency observations of galaxies, with specific focus on state-of-the-art integral field spectroscopic observations, providing a 3D view of the distribution and kinematics of stars, gas and metals in galaxies (e.g., SAMI, MANGA, KROSS). S/he may also be involved in the publications of the project results on refereed journals in the field. In particular, the student will have the opportunity to work on on-going projects aimed at understanding the physical processes regulating the star formation activity of galaxies and the interplay between galaxy kinematics and visual morphology.

Required skills, knowledge or experience:
Basic knowledge of observational extragalactic astronomy (e.g., completion of introductory unit to galaxies).
Basic experience in handling astronomical observations (e.g., use of ds9/SAOImage and knowledge of FITS format).
Basic programming knowledge with Python or R (i.e., ability to produce plots).
Basic knowledge of statistical methods and their application to large datasets.

Keywords: Galaxies, Star formation, Telescopes, Big data

Supervisor Contact email: luca.cortese@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks (can be extended to 12 weeks)
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Mark Reynolds	**Co-supervisor(s) :** Prof Jingbo Wang

Project title: **Logic via Quantum Computing**

Lab/Group: Quantum information simulation and algorithms Research Cluster
Lab/Group Link: https://www.uwa.edu.au/research/quantum-information-simulation-and-algorithms

Project description:
Can quantum computers calculate anything faster than classical computers? A famous result from 1994 shows that theoretically they can factor integers exponentially faster than any known classical algorithm. But that does not prove that classical computers are slower: there might be classical methods as yet unknown which solve this problem.

A new 2018 result from an IBM research lab finds a class of problems and shows that a certain type of quantum algorithm, fixed circuit depth ones, can solve such problems. However, no fixed circuit depth classical algorithm can solve the problems.

See the blog and video at https://www.ibm.com/blogs/research/2018/10/quantum-advantage-2/

One important fixed circuit depth problem is 3-SAT which is a famous NP-complete decision problem. This is the problem of determining whether a Boolean, or classical propositional logic formula (in a certain restricted format) is satisfiable, or could be made true by choice of truth values of its propositional atoms.

This project aims to see if any speed-up can be hoped for in using Quantum Computing on related propositional logic search algorithms.

Required skills, knowledge or experience:
Good linear algebra skills

Keywords: Quantum Computing, Logic, Algorithms, Complexity

Supervisor Contact email: mark.reynolds@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 4	**Total number of place(s) available with supervisor:** 5

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Mark Reynolds	**Co-supervisor(s) :** Dr Du Huynh

Project title: **Road Puddle and Splash Identification in Video**

Lab/Group: Systems for Knowledge Discovery from Data, Research Cluster
Lab/Group Link: https://www.uwa.edu.au/research/systems-for-knowledge-discovery-from-data

Project description:
Implement image processing algorithms for the automatic detection of hazardous and nuisance amounts of water splashing on to a major Perth road from a fixed traffic camera video.

There is an area of one of the busy main Perth freeways that is along a river and is susceptible to getting river water splashed on to it from waves and wind. This causes issues for motorists and could be hazardous. There is a fixed video traffic camera trained on this location providing a constant stream of image frames.

This project will use current UWA CSSE video processing techniques and machine learning identification algorithms to attempt to automate the detection of when splash situations are occurring in real-time. There is separate data from on road water detectors which can be used to judge the effectiveness of the detection.

The team works closely with Main Roads WA on traffic image processing and this project fits in as part of that work.

Required skills, knowledge or experience:
Good Python programming knowledge

Keywords: Machine Learning, Image Processing, Data Science

Supervisor Contact email: mark.reynolds@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 4	**Total number of place(s) available with supervisor:** 5

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Mark Reynolds	**Co-supervisor(s) :** Dr Du Huynh

Project title: **Bat Call Identification via Machine Learning**

Lab/Group: Systems for Knowledge Discovery from Data, Research Cluster
Lab/Group Link: https://www.uwa.edu.au/research/systems-for-knowledge-discovery-from-data

Project description:
Bats are useful indicator species in ecological surveys. Typically a device will record ultrasonic echolocation calls in the field and the subsequent data will be analysed to identify the bat species present. This is a laborious process that is amenable to machine learning. One such proprietary system has been used successfully to classify several years of calls in the South Coast region of WA.

However, some bat species, especially of the genus nyctophilus, are not amenable to the zero crossing techniques commonly used. McKenzie and Bullen (2003, 2009, 2012) have shown that the sharpness quotient, Q, of the fundamental harmonic and the characteristic frequency of the bat call cluster rather distinctly between different species of bats including nyctophilus.

The aim of this project is to examine whether similar techniques might be used for machine learning of call identification for the bats of the South Coast region.

You would be provided with full spectrum recordings covering several years in WAC/WAV files plus zero crossing analysis data and probable bat identification.

There would be a requirement to complete a Bush Heritage Australia research project form which details IP and the like.

Required skills, knowledge or experience:
Good Python programming knowledge

Keywords: Machine Learning, Signal Processing, Data Science

Supervisor Contact email: mark.reynolds@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisors: 4	**Total number of place(s) available with supervisor:** 5

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Mark Reynolds	**Co-supervisor(s) :** Dr Du Huynh

Project title: **Bee Identification and Tracking in Video**

Lab/Group: Systems for Knowledge Discovery from Data, Research Cluster
Lab/Group Link: https://www.uwa.edu.au/research/systems-for-knowledge-discovery-from-data

Project description:
Understanding bee behaviour is important for ecological and economic reasons. In the Australian Government funded Cooperative Research Centre (CRC) for Honey Bee Products, researchers record videos of bee activities near flowers in the Australian bush.

Currently useful information such as bee species identification, bee numbers and bee movement between flowers is extracted from the recording by human observers.

This project will use current UWA CSSE video processing tracking techniques and machine learning identification algorithms to attempt to automate most of the information extraction. Related work will explore the geographical spatial distribution of bee activities in the areas under study.

The student will work closely with CRC scientists.

Required skills, knowledge or experience:
Good Python programming knowledge

Keywords: Machine Learning, Image Processing, Data Science

Supervisor Contact email: mark.reynolds@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 4	**Total number of place(s) available with supervisor:** 5

Faculty: Faculty of Engineering and Mathematical Sciences **School:Physics, Mathematics and Computing**	
Main Supervisor : Dr Michael Giudici	**Co-supervisor(s) :**
Project title:	**Permutation groups and graph symmetry**
Lab/Group: Centre for the Mathematics of Symmetry and Computation **Lab/Group Link:** https://www.cmsc.io/	
Project description: Permutation groups measure the symmetry of an object. One way in which they arise are as the symmetries of a graph. Knowledge of group theory then enables the construction and classification of families of symmetric graphs. Equally, graphs can be used to study group, for example Cayley graphs. This project will explore some of these connections.	
Required skills, knowledge or experience: A first course in group theory	
Keywords: Group theory, graph theory	
Supervisor Contact email: michael.giudici@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 1

<table>
<tr><td colspan="2">Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing</td></tr>
<tr><td>Main Supervisor : Prof Michael Small</td><td>Co-supervisor(s) : Dr Correa, Dr. Zaitouny</td></tr>
<tr><td>Project title:</td><td>Machine learning and predictive maintenace</td></tr>
<tr><td colspan="2">Lab/Group: Complex Systems, ARC Training Centre of Transforming Maintenance through Data Science.
CSIRO</td></tr>
<tr><td colspan="2">Project description:
<u>Project 1:</u>

This proposal can accommodate multiple students

Machine learning and dynamical systems techniques will be applied to study and augment predictions of failure of machinery. Specifically, predictive maintenance is the schedule of maintenance tasks based on predictions of imminent or likely failure. Machine learning based on historical data will be applied to augment this. Dynamical systems techniques based on the ideas of tipping points will be used to quantify likely onset of failure.</td></tr>
<tr><td colspan="2">Required skills, knowledge or experience:

Advanced mathematics (dynamical systems, complex systems, topology, would all be advantageous), scientific programming (at least one of Julia, python, Matlab, Mathematica or R).</td></tr>
<tr><td colspan="2">Keywords: Complex Systems, Dynamical Systems, Chaos, Topology</td></tr>
<tr><td colspan="2">Supervisor Contact email: michael.small@uwa.edu.au</td></tr>
<tr><td>Project done on Crawley campus: Yes</td><td>Length of project: Standard 8 weeks (can be extended to 12 weeks)</td></tr>
<tr><td>Total number of project(s) offered by supervisor: 2</td><td>Total number of place(s) available with supervisor: 4(2 for this project)</td></tr>
</table>

Faculty: Faculty of Engineering and Mathematical Sciences **School: Physics, Mathematics and Computing**	
Main Supervisor : Prof Michael Small	**Co-supervisor(s) :** Dr Walker
Project title:	**Persistent homology of complex networks**
Lab/Group: Complex Systems	
Project description: **Project 2:** **This proposal can accommodate multiple students** Techniques exist to represent dynamical systems observed through time series data as complex networks. These networks have a complicated variegated structure which encodes specific features of the underlying deterministic dynamics. The aim of the project is to apply techniques from computational topology to quantify these features and thereby link that quantification to the original (and interesting) dynamics. For example, chaotic dynamics generates particular structures in the network and persistent homology is to be employed to characterise the scale-dependent features of those structures. This will link quantities such as Lyapunov exponents and entropy to the rate of growth of topological properties.	
Required skills, knowledge or experience: Advanced mathematics (dynamical systems, complex systems, topology, would all be advantageous), scientific programming (at least one of Julia, python, Matlab, Mathematica or R).	
Keywords: Machine Learning, Dynamical Systems, Predictive Maintenance	
Supervisor Contact email: michael.small@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks (can be extended to 12 weeks)
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 4(2 for this project)

Faculty: Faculty of Engineering and Mathematical Sciences **School:Physics, Mathematics and Computing**	
Main Supervisor : Prof Michael Tobar	**Co-supervisor(s) :**
Project title:	**Investigation of 3D printed and taped superconducting resonators**
Lab/Group: Centre of Excellence for Engineered Quantum Systems **Lab/Group Link:** https://equs.org/fml	
Project description: **Project 1** The aim of this project is to advance the new discipline of 3D Printed superconducting technologies. Currently, the application of advanced superconductors is being hampered by our inability to produce complex geometries from materials with adequate superconducting properties. The intended outcome of this project is the ability to design the next generation of superconductors, along with the knowledge of how to produce them using metal 3D Printing. The ability to manufacture geometric complex, bulk superconducting structures with tuneable magnetic characteristics will lead to significant advances in many practical applications including dark matter detection and quantum computing. In particular this project will test various resonant structures, at 4K and mK and test the response to external magnetic fields. There is also the possibility we will implementing resonators with surfaces made from superconducting tape.	
Required skills, knowledge or experience: Physics or Electrical Engineering Major	
Keywords: Superconductors, 3D printing, Low temperature physics	
Supervisor Contact email: michael.tobar@uwa.edu.au	
Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks (can be extended to 12 weeks)
Total number of project(s) offered by supervisor: 3	**Total number of place(s) available with supervisor:** 3

<table>
<tr><td colspan="2">Faculty: Faculty of Engineering and Mathematical Sciences
School:Physics, Mathematics and Computing</td></tr>
<tr><td>Main Supervisor : Prof Michael Tobar</td><td>Co-supervisor(s) :</td></tr>
<tr><td>Project title:</td><td>Search for Axion Dark Matter</td></tr>
<tr><td colspan="2">Lab/Group: Centre of Excellence for Dark Matter
Lab/Group Link: https://www.darkmatter.org.au/ and https://equs.org/fml</td></tr>
<tr><td colspan="2">Project description:
<u>Project 2</u>
This project will assist the research group in the quest to search for axion dark matter. The axion is a particle that is believed to exist to solve the strong CP problem on why the neutron has no dipole moment even though it is made of charged quarks. The axion should also be produced in the early universe, and because it interacts very weakly with matter, the particle is a leading candidate to explain cold dark matter. To try and detect the axion we use the weak coupling to photons and novel microwave resonators and electronics at low temperatures to enhance the signal. This project will involve contributing to developing these devices under the umbrella of the ORGAN experiment which will search for cold dark matter in a range predicted by theorists.</td></tr>
<tr><td colspan="2">Required skills, knowledge or experience:
Physics and Electrodynamics</td></tr>
<tr><td colspan="2">Keywords: Axion, Dark Matter, Precision Measurements, Low Temperature Physics</td></tr>
<tr><td colspan="2">Supervisor Contact email: michael.tobar@uwa.edu.au</td></tr>
<tr><td>Project done on Crawley campus: Yes</td><td>Length of project: Standard 8 weeks (can be extended to 12 weeks)</td></tr>
<tr><td>Total number of project(s) offered by supervisor: 3</td><td>Total number of place(s) available with supervisor: 3</td></tr>
</table>

Faculty: Faculty of Engineering and Mathematical Sciences
School:Physics, Mathematics and Computing

Main Supervisor : Prof Michael Tobar	**Co-supervisor(s) :**

Project title: **Cryogenic Crystal for the Detection of WIMP Dark Matter**

Lab/Group: Centre of Excellence for Engineered Quantum Systems
Lab/Group Link: https://equs.org/fml
https://www.darkmatter.org.au/

Project description:

Project 3

Weakly interacting massive particles (WIMPs) are hypothetical particles that are thought to constitute dark matter. Broadly, a WIMP is a new elementary particle which interacts via gravity and any other force (or forces), potentially not part of the standard model itself, which is as weak as or weaker than the weak nuclear force, but also non-vanishing in its strength. A WIMP must also have been produced thermally in the early Universe, similarly to the particles of the standard model according to Big Bang cosmology, and usually will constitute cold dark matter. Typically experiments to detect WIMP dark matter are at energy/mass scales of 100 GeV, however due to the lack of success in detection experiments are expanding towards techniques to search for lower energy particles. This project will focus on new methods to implement crystal detection technology.

Cryogenic crystal detector techniques are currently used by a range of experiments, including the Cryogenic Dark Matter Search (CDMS) detector at the Soudan Mine. This detector relies on multiple very cold germanium and silicon crystals. The crystals (each about the size of a hockey puck) are cooled to about 50 mK. A layer of metal (aluminium and tungsten) at the surfaces is used to detect a WIMP passing through the crystal. This design hopes to detect vibrations in the crystal matrix generated by an atom being "kicked" by a WIMP. The tungsten transition edge sensors (TES) are held at the critical temperature so they are in the superconducting state. Large crystal vibrations will generate heat in the metal and are detectable because of a change in resistance. CRESST, CoGeNT, and EDELWEISS run similar setups but with a range of different crystals.

This project will cool such detector crystals to low temperatures, to study the electromagnetic properties at microwave frequencies from room temperature to low temperatures. It is envisaged by measuring the properties of the crystal that heating and phonon effects may be measured more accurately than before, allowing a breakthrough in improved sensitivity. At low temperatures a range of very interesting condensed matter physics also occurs. The project will include the investigation of this physics.

Required skills, knowledge or experience:
Physics or Electrical Engineering Major

Keywords: WIMPs, Crystal resonators, Low Temperature Physics, Dark Matter

Supervisor Contact email: michael.tobar@uwa.edu.au

Project done on Crawley campus: Yes	**Length of project:** Standard 8 weeks (can be extended to 12 weeks)
Total number of project(s) offered by supervisor: 3	**Total number of place(s) available with supervisor:** 3

<table>
<tr><td colspan="2">Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing</td></tr>
<tr><td>Main Supervisor : Dr. Zeyi Wen</td><td>Co-supervisor(s) : Prof Ajmal Mian</td></tr>
<tr><td>Project title:</td><td>Automatic Machine Learning</td></tr>
<tr><td colspan="2">Lab/Group Link: https://zeyiwen.github.io/</td></tr>
<tr><td colspan="2">Project description:
Machine learning has achieved great success in recent years. However, machine learning techniques are still not accessible to many practitioners who are knowledgeable in their domains, but unfamiliar with machine learning techniques (e.g., hyper-parameter tuning). Automatic machine learning can help increase the accessibility of the techniques to the wider communities.

This project will visit key areas of automatic machine learning. The research tasks in this project include:
(i) experimental studies to demonstrate pros and cons of existing automatic machine learning techniques;
(ii) applications with automatic hyper-parameter tuning techniques;
(iii) case studies on automated feature engineering techniques.</td></tr>
<tr><td colspan="2">Required skills, knowledge or experience:
Good programming skills in Python, Java or C/C++;
Basic knowledge in machine learning</td></tr>
<tr><td colspan="2">Keywords: Machine Learning, Artificial Intelligence, Computer Science</td></tr>
<tr><td colspan="2">Supervisor Contact email: zeyi.wen@uwa.edu.au</td></tr>
<tr><td>Project done on Crawley campus: Yes</td><td>Length of project: Standard 8 weeks (can be extended to 12 weeks)</td></tr>
<tr><td>Total number of project(s) offered by supervisor: 1</td><td>Total number of place(s) available with supervisor: 3</td></tr>
</table>

Faculty: Faculty of Engineering and Mathematical Sciences
School: Oceans Graduate School

Main Supervisor : Dr Adi Kurniawan	**Co-supervisor(s) :** Dr Hugh Wolgamot and Dr Jana Orszaghova

Project title: **Wave energy devices with adaptive geometry**

Lab/Group: Wave Energy Research Centre

Project description:
Project 1

Modern wind turbines are equipped with mechanisms to alter the orientation of the rotor and the blades relative to the wind direction and wind speed. This serves to regulate power output as well as mitigate loads in severe conditions. Such adaptability is key to an economic design in a variable environment. It allows a structure to survive the worst loading scenarios without being overdesigned and maximises energy absorption under constantly changing environmental conditions.

In contrast to wind turbines, many wave energy devices proposed to date do not have such adaptability incorporated into their design. The aim of this project is therefore to explore the potential of innovative adaptive geometry in a wave energy device. The hypothesis is that a wave energy device with adaptive geometry is potentially able not only to reduce loads but also to improve its power absorption performance across a wide range of wave conditions.

In this project, we will consider a wave energy device in the form of a bottom-mounted arm supporting a wide flap. Power is absorbed through rotation of the arm about a hinge on the sea bed. This so far sounds like yet another bottom-mounted flap device. However, the device is designed such that the flap can rotate and translate relative to the arm, thus adding an adaptive geometry feature to an otherwise ordinary flap. A numerical model will be developed to study the effects of flap orientation and position on the device power capture and loads. The geometry of the device will be optimised with the goal of achieving a cost-effective wave energy device.

Required skills, knowledge or experience:
Experience with programming languages such as MATLAB or Python is essential. Experience with hydrodynamic packages such as WAMIT, HydroStar, or NEMOH are desired.

Keywords: Waves, Energy, Modelling, Ocean, Engineering

Supervisor Contact email: adi.kurniawan@uwa.edu.au

Project done on Crawley campus: No (The project will be carried out mainly at the Wave Energy Research Centre in Albany - 6weeks*)	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2 (1 for this project)

*Accommodation will be organised for student in Albany

Faculty: Faculty of Engineering and Mathematical Sciences
School: Oceans Graduate School

Main Supervisor : Dr Adi Kurniawan	**Co-supervisor(s) :** Dr Hugh Wolgamot and Dr Jana Orszaghova

Project title: **Which wave energy device is the best?**

Lab/Group: Wave Energy Research Centre

Project description:
Project 2

Although many fundamental results concerning wave power absorption have already been discovered about four decades ago, harnessing wave energy in an economical manner remains an open question. There are yet no signs of wave energy technology converging into a single solution.

While there are numerous separate studies looking at specific wave energy devices, comparative studies of different devices are rare, and thus little is known about how devices measure against each other.

In this project, we will collect existing data on the power capture of various wave energy devices available in the literature. We will use these data to evaluate various performance metrics of each device, including not only the capture width ratio but also other potentially better non-dimensional metrics to more accurately measure the economic potential of a wave energy device. We will then compare the various devices on the basis of these metrics. One further aspect of the study is to compare the performance of these devices at different sites around the world, covering both the northern and southern hemispheres, thus providing a general correlation between wave climates and device economics. Albany will be used as one of the sites for this study.

The goal is to provide a comparison of the relative cost-effectiveness of different wave energy devices, and by doing so identify the most promising ones.

Required skills, knowledge or experience:
Experience with programming languages such as MATLAB or Python is essential.

Keywords: Waves, Energy, Engineering, Economics, Ocean

Supervisor Contact email: adi.kurniawan@uwa.edu.au

Project done on Crawley campus: No (The project will be carried out mainly at the Wave Energy Research Centre in Albany - 6weeks*)	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2 (1 for this project)

*Accommodation will be organised for student in Albany

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