2018 UWA International Research Internship Program (IRIP)

Projects

Contents

Faculty of Arts, Business, Law and Education - School of Social Sciences	
Main Supervisor : Prof Loretta Baldassar	Co-supervisor (s) :
Project title: **Ageing and New Media**	
Group:	

Project description:
Project 1

Ageing and New Media 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 three-year project is funded by the Australian Research Council (2015-2018).

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/or quantitative data collection and analysis, including individual and focus group interviews, data entry and analysis and report writing.

Keywords: ageing, migration, new media, social support networks	
Contact email: loretta.baldassar@uwa.edu.au	
Project done on Crawley campus: No (residential care facility in Osbourne Park)	
Total number of project(s) offered by supervisor: 3	Total number of place(s) available with supervisor: 3

Faculty of Arts, Business, Law and Education - School of Social Sciences	
Main Supervisor : Prof Loretta Baldassar	Co-supervisor (s) :
Project title:	**Internationalisation at Home - Student Research Project**
Group: 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

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

Project done on Crawley campus: Yes

Total number of project(s) offered by supervisor: 3	Total number of place(s) available with supervisor: 3

Faculty of Arts, Business, Law and Education - School of Social Sciences	
Main Supervisor : Prof Loretta Baldassar	Co-supervisor (s) :
Project title: **YMAP Youth Mobilities**	
Group: 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	
Contact email: loretta.baldassar@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 3	Total number of place(s) available with supervisor: 3

Faculty of Engineering and Mathematical Sciences - Oceans Graduate School	
Main Supervisor : Prof Ryan Lowe	Co-supervisor (s) : Dr Dirk Rijnsdorp / Arnold van Rooijen PhD Candidate
Project title:	**Simulating the hydrodynamics within coastal canopies using a state-of-the-art non-hydrostatic wave model**
Group: Ocean and Coastal Dynamics - https://www.oceanchange.com.au/	

Project description:
Project 1

Research objective: Over the past decades many researchers have focused on the effect of coastal canopies formed by aquatic vegetation (e.g. seagrasses or mangroves) or corals on hydrodynamic processes in the coastal zone. Coastal canopies can play a major role in attenuating wave energy and limiting wave run-up at shorelines. Canopies also substantially reduce wave-induced velocities adjacent to the seabed, which can influence a number of important coastal processes, such as sediment and nutrient transport. However, most numerical models used in coastal engineering / oceanography do not incorporate this effect yet.

The objective of this project is to better understand the wave-driven canopy flow that is relevant for many coastal ecosystems around the world. Amongst others, the project will include a detailed study into the capabilities of a state-of-the-art wave model SWASH (http://swash.sourceforge.net/) in reproducing such complex flow patterns, and to use this model to improve our understanding of the hydrodynamic processes in and around coastal canopies.

Approach: For this project we have two spots available: it is envisioned that this project will be carried out by two students in which they will be able to collaborate, but also have a clear independent component. The students will first learn how to use the SWASH model through some tutorials / examples, and then apply the model to simulate flows through canopies. This will include validating the model using a number of existing datasets for the following processes:

- Flow reduction;
- Turbulent flow structure;
- Attenuation of non-breaking waves;
- Attenuation of breaking waves;
- Influence on wave setup and wave runup.

Finally a number of model setups will be defined, and detailed hydrodynamic processes such as wave attenuation, canopy flow, and turbulent kinetic energy will be investigated.

Required skills, knowledge or experience:
Background in oceanography, ocean dynamics, coastal dynamics, coastal engineering or similar
Experience with numerical modeling (preferred)
Experience with programming in MATLAB or PYTHON (preferred)

Keywords: Physics, oceanography, nearshore, ecohydraulics, modeling

Contact email: arnold.vanrooijen@research.uwa.edu.au

Project done on Crawley campus: Yes

Total number of project(s) offered by supervisor: 1	Total number of place(s) available with supervisor: 2

Faculty of Engineering and Mathematical Sciences - School of 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**
Group: Microelectronics Research Group - http://www.mrg.uwa.edu.au/	

Project description:

Project 1

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

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

Project done on Crawley campus: Yes

Total number of project(s) offered by supervisor: 1	Total number of place(s) available with supervisor: 3

Faculty of Engineering and Mathematical Sciences - School of Engineering	
Main Supervisor : Prof Thomas Braunl	Co-supervisor (s) :
Project title: **Embedded Robotics**	
Group: robotics.ee.uwa.edu.au	
Project description: <u>Project 1</u> We developed a new small mobile robot platform, based on a Raspberry-3 controller, using vision, PSD distance sensors, odometry and a color display. For this project we are looking at implementing practical robot applications for: - Motion controller for driving straight lines and curves - Establishment of Robotics image processing library for visual navigation. Suitable for: Computer Science, Software Eng., Electrical Eng., Mechatronics Eng. See details: http://robotics.ee.uwa.edu.au/eyebot7/Robios7.html	
Required skills, knowledge or experience: Good programming skills in C or C++ are a prerequisite for this project.	
Keywords: robotics; mobile robots; hardware; hardware design;	
Contact email: tb@ee.uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 2	Total number of place(s) available with supervisor: 4

Faculty of Engineering and Mathematical Sciences - School of Engineering	
Main Supervisor : Prof Thomas Braunl	Co-supervisor (s) :
Project title: **VisualHardware Design**	
Group: robotics.ee.uwa.edu.au	
Project description: <u>Project 2</u> Retro is a hardware simulation system on register-transfer level; including registers, function units, memory units. Working CPUs can be created by using a graphics editor from library components. System has been designed for educational purposes and is routinely used in teaching labs at a number of universities. Project tasks: - Add new components to hardware simulation system - Build simulated SIMD parallel processing system using simple processing elements Suitable for: Computer Science, Software Eng., Electrical Eng., Mechatronics Eng. See details: http://robotics.ee.uwa.edu.au/retro/	
Required skills, knowledge or experience: Good programming skills in Java and some digital hardware skills are a prerequisite for this project.	
Keywords: robotics; mobile robots; hardware; hardware design;	
Contact email: tb@ee.uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 2	Total number of place(s) available with supervisor: 4

Faculty of Engineering and Mathematical Sciences - School of Engineering		
Main Supervisor : Prof Hui Tong Chua		Co-supervisor (s) :
Project title:	**Geothermal air conditioning: LandCorp Cool Earth Project**	
Group: Hyperlink to an introduction to the project with the Western Australian State Government: https://www.landcorp.com.au/Residential/Cool-Earth/		
Project description: Project 1 The student will work with my team to help evaluate the performance of ground source heat pump against conventional air source heat pump. This is done with two occupied houses, one fitted with a ground source heat pump, and another with a conventional air source heat pump. The two residential properties are fitted with extensive instrumentations. The two houses are in a new suburb, with representative plot size and occupancy. Excitingly, these were sold in the open market and members of the public are actively contributing to the research, which is subject to Human Research Ethics Approval. The monitoring will be done remotely. The team liaises regularly with the State Government and other stakeholders.		
Required skills, knowledge or experience: Mechanical or Chemical Engineering background		
Keywords: Energy, Air Conditioning, Geothermal, Monitoring		
Contact email: huitong.chua@uwa.edu.au		
Project done on Crawley campus: Yes		
Total number of project(s) offered by supervisor: 2		Total number of place(s) available with supervisor: 2

Faculty of Engineering and Mathematical Sciences - School of Engineering	
Main Supervisor : Prof Hui Tong Chua	Co-supervisor (s) :
Project title:	**Geothermal swimming pool**
Group: http://www.web.uwa.edu.au/person/huitong.chua	
Project description: Project 2 This is an ongoing project that actively monitors and models the performance of geothermal swimming pool. Western Australia is the most active State in terms of the uptake of geothermal energy. Presently it has at least 12 Olympic-sized swimming pools that are actively heated by geothermal energy. Some of these directly access the tepid geothermal water at depth through bore holes, and some make use of ground source heat pumps. We are currently actively monitoring two such swimming pools and modelling their thermal behaviour. The student will assist in the data analyses, modelling and could visit the monitored site to gain familiarity. To date, we have developed the most reliable modelling protocol for such swimming pools.	
Required skills, knowledge or experience: Mechanical or Chemical Engineering, heat transfer	
Keywords: heat transfer, mass transfer, energy, geothermal, evaporation	
Contact email: huitong.chua@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 2	Total number of place(s) available with supervisor: 2

Faculty of Engineering and Mathematical Sciences - School of Engineering	
Main Supervisor : Dr. Karol Karnowski	Co-supervisor (s) : Gavrielle Untracht, PhD Candidate
Project title: **Nanoscope in a needle**	
Group: Optical+Biomedical Engineering Laboratory - http://obel.ee.uwa.edu.au/	
Project description: Project 1 and 2 The project seeks to develop new capacity in needle probes to probe deeply into living animal and human systems – by driving the spatial resolution previously achieved into the nanoscale, and by developing new sensing capability that complements morphology (structure) with function and biochemical information. We will develop ultrasmall-footprint microscopy and sensing needles, much smaller than existing devices, that probe nano- and micro-scale volumes deep in tissue. We are daveloping optical probes warking with following imaging modalities: optical coherence tomography, fluorescence, Raman spectroscopy, and stimulated emission-depletion microscopy (STED).	
Required skills, knowledge or experience: We are looking for students with set of skills including: opto-mechanical systems, robotics, optical design, optics experimentation, signal processing and modelling. Practical skills in using Zeemax (or other light propagation modeling software), Matlab, or C++ would be advantage, but not mandatory.	
Keywords: Optics, Robotics, Programming, Modelling, Signal Processing	
Contact email: karol.karnowski@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 2	Total number of place(s) available with supervisor: 2

Faculty of Engineering and Mathematical Sciences - School of Engineering	
Main Supervisor : Prof. Barry Cense /Dr Karol Karnowski	Co-supervisor (s) : Qingyun Li, PhD candidate
Project title:	**Measurement of poralisation proerties of the aging retina**
Group: Optical+Biomedical Engineering Laboratory - http://obel.ee.uwa.edu.au/	
Project description: <u>Project 1</u> By analyzing changes in the polarisation properties (e.g. fast axis orientation) of retinal tissue, we hope to find biomarkers for retinal diseases associated with aging such as glaucoma and age related macular degeneration. / Possible subprojects for internship students might include optical and mechanical desing of polarisation sensitive optical coherence tomography system for retinal imaging, measurements with the system, developing signal processing algorithms to extract local polarisation properties, or data processing and visualisation.	
Required skills, knowledge or experience: Students with biomedical, ophthalmology, computer science background will be suitable for this project. Set of skills that we are looking for varies from optics experimentation or desing skills, to software (Matlab, C++, GPU) skills for data processing.	
Keywords: ophthalmology, retina, glaucoma, optics, programming	
Contact email: karol.karnowski@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 1	Total number of place(s) available with supervisor: 2

Faculty of Engineering and Mathematical Sciences - School of Engineering		
Main Supervisor : Dr Peijun Gong		Co-supervisor (s) : Prof David Sampson
Project title:	**Label-free optical imaging of blood and lymphatic vessels**	
Group: Optical+Biomedical Engineering Laboratory - http://obel.ee.uwa.edu.au/		
Project description: Project 1 In OBEL, we have been working on the development of non-invasive optical imaging of blood and lymphatic microvessels in humans, which is important in skin scarring and healing, diabetes, and in retinal diseases. This project will involve the development of data processing algorithms to extend the functionality of our current imaging techniques. This project will provide the student with a chance to learn and use an imaging technique, termed optical coherence tomography (OCT), which forms the base technique for blood and lymphatic microvessel imaging in OBEL.		
Required skills, knowledge or experience: Basic programming skills with MATLAB		
Keywords: Engineering, optical imaging, data processing, image processing, blood and lymphatic vessels		
Contact email: peijun.gong@uwa.edu.au		
Project done on Crawley campus: Yes		
Total number of project(s) offered by supervisor: 1		Total number of place(s) available with supervisor: 1

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Dr David Glance	Co-supervisor (s) : Dr Wei Liu
Project title:	**Automated consumer cybersecurity risk assessment and other machine learning applications**
Group: UWA Centre for Software Practice	
Project description: <u>Project 1</u> Automated discovery of Cybersecurity risks for personal environments. This is a project aimed at helping ordinary people work out what vulnerabilities and threats they have to concern themselves with. Once discovered, the aim would be to provide automated advice on treatment of those risks.	
Required skills, knowledge or experience: Computer Science, Programming, some machine learning ability but not strictly necessary	
Keywords: Machine Learning, Computer Science, Programming, Cybersecurity	
Contact email: david.glance@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 2	Total number of place(s) available with supervisor: 2

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing		
Main Supervisor : Dr David Glance		Co-supervisor (s) : Dr Wei Liu
Project title:	**Automated consumer cybersecurity risk assessment and other machine learning applications**	
Group: UWA Centre for Software Practice		
Project description: <u>Project 2</u> General machine learning - use in medicine - a potential project for matching kidney donors based on a range of data that is available. Kidney donor matching is currently not as optimised as it could be. There are potentially other applications of machine learning approaches to diagnosis/prediction etc that could be worked on instead.		
Required skills, knowledge or experience: Computer Science, Programming, some machine learning ability but not strictly necessary		
Keywords: Machine Learning, Computer Science, Programming, Cybersecurity		
Contact email: david.glance@uwa.edu.au		
Project done on Crawley campus: Yes		
Total number of project(s) offered by supervisor: 2		Total number of place(s) available with supervisor: 2

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing		
Main Supervisor : Dr Michael Giudici		Co-supervisor (s) :
Project title:	**Permutation groups and graph symmetry**	
Group: Centre for the Mathematics of Symmetry and Computation - http://www.cmsc.uwa.edu.au/		
Project description: Project 1 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		
Contact email: michael.giudici@uwa.edu.au		
Project done on Crawley campus: Yes		
Total number of project(s) offered by supervisor: 1		Total number of place(s) available with supervisor: 1

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Prof Michael Small	Co-supervisor (s) : Dr David Walker
Project title: **Converting Time Series to Complex Networks**	
Group: Complex Engineering Systems Group	
Project description: Project 1 Time Series measurements occur everywhere in Science and Society — electrocardiograms, financial market indicators, weather and climate patterns, seismic activity and laser dynamics are all typical examples. In many cases the system underlying the observed time series is a nonlinear deterministic dynamical system (and this is where we depart from statistical linear time series analysis). Such nonlinear systems may give rise to chaotic dynamics. We are developing new methods to construct, from the time series, a network structure that represents the underlying system dynamics. There are a variety of different ways to do this, and right now we are trying to determine which is best. Roughly, each of these methods leads to a network where the nodes of the network are representative of distinct dynamical states. The question then is what can the quantitative measures of network science tell us about the underlying deterministic dynamics? How are measures such as assortativity, and betweenness (the Google page-rank algorithm — for example) related to properties such as bifurcation and unstable periodic orbits? We will explore these relationships on fundamental test systems (the usual chaotic dynamical systems undergoing bifurcation), and we will apply the methods to a variety of real experimental time series. An interesting open question is how to extend the network extraction and analysis to look for synchronisation between signals or when one possess multi-dimensional time series.	
Required skills, knowledge or experience: Basic programming skills required, preferably some experience in Matlab, Python, R, or Mathematica. Some knowledge in dynamical systems, time series analysis, statistics, or graph theory is of advantage.	
Keywords: Complex networks, nonlinear time series analysis, dynamical systems	
Contact email: michael.small@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 4	Total number of place(s) available with supervisor: 4

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Prof Michael Small	Co-supervisor (s) : Dr David Walker
Project title:	**Nonlinear diagnostics to detect system change**
Group: Complex Engineering Systems Group	
Project description: <u>Project 2</u> Complex dynamical systems can have tipping points signalling a sudden change in dynamical behaviour. Classical fault diagnosis, or critical point detection, is either statistical or linear, and relies on the decomposition of incoming data to frequency components for further diagnosis. We have developed nonlinear diagnostic methods that have been applied to physiological time series data to diagnose the imminent onset of, for example, cardiac arrhythmia and respiratory distress. Using the same theoretical foundation we are applying methods from nonlinear time series analysis and (possibly) complex network analysis to identify mechanical wear, damage and failure. These data analysis techniques also have potential for application in geophysical exploration and resource characterisation to find generic early-warning signatures to indicate if a critical threshold or tipping point is drawing near.	
Required skills, knowledge or experience: Basic programming skills required, preferably some experience in Matlab, Python, R, or Mathematica. Some knowledge in dynamical systems, time series analysis, statistics, or graph theory is of advantage.	
Keywords: Complex networks, nonlinear time series analysis, dynamical systems	
Contact email: michael.small@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 4	Total number of place(s) available with supervisor: 4

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Prof Michael Small	Co-supervisor (s) : Dr Thomas Jungling
Project title: **Reservoir Computing**	
Group: Complex Engineering Systems Group	
Project description: <u>Project 3</u> Many machine-learning methods are inspired by how the neurons in the brain process information from external stimuli. Reservoir Computing (RC) is such a technique which imitates neural signal processing on a fundamental level. Among many exotic variations, a numerical form of RC is based on artificial neural networks: A randomly wired network of nonlinear dynamical units is driven by an information-carrying signal. This is typically an audio signal, an ECG or EEG recording, or a chaotic time series from weather, climate, or from nonlinear electronic or photonic circuits. The response of all the artificial neurons in the network can be then easily processed to obtain a desired output, like a prediction or classification, often with remarkable performance. The general idea of RC is to use arbitrary physical dynamical systems that are capable of sophisticated nonlinear response. In this project, besides numerical simulation, we will also explore the RC technique experimentally, using electronic circuits as an excitable medium. The main focus will be on the nonlinear dynamics of the artificial neurons, as well as on the mathematical and physical principles behind this unconventional form of computation.	
Required skills, knowledge or experience: Basic programming skills required, preferably some experience in Matlab, Python, R, or Mathematica, ideally also LabView. Lab experience, ideally knowledge and skills with low-voltage/low-frequency analog and digital electronics, is required. Basic knowledge of nonlinear dynamics, time series analysis, statistics, or artificial neural networks is of advantage.	
Keywords: Unconventional computing, complex systems, nonlinear dynamics, time series analysis, electronic circuits	
Contact email: thomas.jungling@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 4	Total number of place(s) available with supervisor: 4

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Prof Michael Small	Co-supervisor (s) : Dr Debora Correa / Dr Thomas Jungling
Project title: **Singing voice detection**	
Group: Complex Engineering Systems Group	
Project description: <u>Project 4</u> The task of detecting parts of a polyphonic audio track is particularly useful for applications such as audio segmentation, singer identification, real-time tracking and synchronisation or vocal extraction. A huge variety of audio features and selection methods have been proposed so far, which usually require high computational efforts making them unfeasible for real-time applications. In this project, we will investigate whether methods of nonlinear time series analysis can reliably capture the presence of a human voice. Essentially, we would study the methods of complex systems towards the detection of differences between human voice and an instrument.	
Required skills, knowledge or experience: Basic programming skills required, preferably some experience in Matlab, Python, R, or Mathematica. Knowledge of statistical learning theory, especially support-vector machines, is of advantage, as well as of audio- or general signal processing and filtering methods. Background in music is welcome, but not necessarily required, as the focus lies on mathematical and computational methods.	
Keywords: Machine learning, music, time series analysis, complex networks, signal processing	
Contact email: debora.correa@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 4	Total number of place(s) available with supervisor: 4

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing		
Main Supervisor : Dr Chunnong Zhao		Co-supervisor (s) : Prof Li Ju
Project title:	**Optomechanical system for improving the sensitivity for gravitational wave detectors**	
Group: ARC Centre of Excellence for Gravitational Wave Discovery, UWA node, Gravitational wave Instrumentation - http://www.gravity.uwa.edu.au/		
Project description: Project 1 This project is to develop techniques for improving the gravitational wave detector sensitivity. Specifically, The project will be focused on working (both simulation and experimental) with a very low loss coupled optical cavity with novel resonator design, and testing optical spring effect. We are collaborating with researchers in Austria, Taiwan, Holland and France to fabricate the "thermal noise free" resonators. Build on preliminary experiments, this project involves modelling the resonator using finite element analysis, tuning the coupled optical cavities in vacuum (preliminary experiment done in air) to observe optical spring effect, and ultimately optical dilution to achieve very low loss resonators. This scheme has the potential of measuring macroscopic objects with resolution better than the "standard quantum limit" predicted by naïve application of quantum mechanics. This offers a new technique for improving gravitational wave detectors as well as allowing a range of new experiments in quantum experiments.		
Required skills, knowledge or experience: Physics students with some basic knowledge on modern optics and mechanical resonators		
Keywords: Physics, optical cavity, mechanical resonator		
Contact email: li.ju@uwa.edu.au		
Project done on Crawley campus: Yes		
Total number of project(s) offered by supervisor: 1		Total number of place(s) available with supervisor: 2

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Dr David Coward	Co-supervisor (s) :
Project title:	**Searching for the first optical counterparts to gravitational waves**
Group: Zadko Telescope - http://lanl.arxiv.org/abs/1609.06445	
Project description: Project 1 In 2015 gravitational waves were discovered for the first time from colliding black holes. In the following years LIGO is expected to detect the first binary neutron star mergers. To fully exploit these ground-breaking discoveries requires finding an electromagnetic source, such as a gamma ray burst. This will enable a new probe into the most violent events in the Universe. / The project will employ the UWA Zadko Telescope (1-m fully robotic - automated) to search for the optical counterparts to neutron star mergers detected by LIGO. Zadko is also robotically linked to the NASA satellite Swift that detects gamma ray bursts. The student will be participating in new discoveries at the frontier of science.	
Required skills, knowledge or experience: Background in programming, computing, engineering and a keen interest to learn new skills in robotic astronomy and image analysis, with the aim of making unique discoveries.	
Keywords: space science, programming (willing to learn python), astronomy, gravitational waves	
Contact email: david.coward@uwa.edu.au	
Project done on Crawley campus: 1	
Total number of project(s) offered by supervisor: 2	Total number of place(s) available with supervisor: 2

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Dr David Coward	Co-supervisor (s) :
Project title:	**Searching for hazardous Space Junk and Near Earth Asteroids and other exotic transients using the UWA Zadko Telescope**
Group: Zadko Telescope - http://lanl.arxiv.org/abs/1609.06445	
Project description: Project 2 The UWA Zadko Telescope is a 1-m fully robotic (automated) optical telescope. In 2013, more than a dozen new asteroids were discovered using the Zadko Telescope. The student will learn to schedule, manage and analyse image data, focusing on the search for hazardous Near Earth Asteroids and space junk.This project will aim for an initial exploration of the astrometric, photometric and coarse spectral parameter space of space debris in geosynchronous orbit with the one metre Zadko telescope - toward an ultimate goal of rapid object classification. Practical skills working with a metre-class robotic telescope system will be developed, together with image analysis and multivariate discrimination techniques.	
Required skills, knowledge or experience: Background in programming, computing, engineering and a keen interest in space science and willing to learn new skills in robotic astronomy and image analysis, with the aim of making unique discoveries.	
Keywords: space science, programming (willing to learn python), astronomy, gravitational waves	
Contact email: david.coward@uwa.edu.au	
Project done on Crawley campus: 1	
Total number of project(s) offered by supervisor: 2	Total number of place(s) available with supervisor: 2

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Dr Luca Cortese	Co-supervisor (s) : Dr. Barbara Catinella
Project title:	**The life-cycle of galaxies in the Universe**
Group: International Centre for Radio Astronomy Research - https://www.icrar.org/	

Project description:
Project 1

One of the most outstanding challenges in extragalactic astronomy is to identify the astrophysical processes responsible for transforming simple dark matter haloes into the heterogenous 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-wavelength information 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.

See also https://corteseluca.wordpress.com/phdmaster-projects

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. A list of possible topics currently offered is presented below. However, we are always willing discuss additional projects triggered by student's interests.
-The role of angular momentum in shaping the Hubble sequence
-Looking at galaxy morphology with HI glasses
-The connection between dark and visible matter in nearby galaxies
-Are gas-rich galaxies more turbulent than our own Milky Way?
- Revealing the paths to galaxy retirement
- Dense cold gas in galaxies across the Universe

Required skills, knowledge or experience:
Basic knowledge of astronomy and statistics.
Basic programming skills with either Python, R, IDL (or similar programming languages)

Keywords: Astrophysics, Galaxy Evolution, Data Science

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

Project done on Crawley campus: Yes

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

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Dr Vincent Wallace	Co-supervisor (s) : Dr Tony Fitzgerald / Dr Sergii Romanenko
Project title: **Terahertz Biomedical applications**	
Group: http://www.physics.uwa.edu.au/research/terahertz	
Project description: Project 1 and 2 Terahertz (THz) typically refers to the electromagnetic waves with the frequency ranging from 0.1 to 10 THz and the wavelength is between 30 to 3000 □m. Due to the lack of coherent sources, these frequencies, situated in the spectrum regime between optical and electronic techniques, were referred to as a THz gap. Nowadays, more and more techniques have been investigated to bridge this gap, and the applications of Terahertz cover a wide range from astronomy, security check to chemical and biomedical applications. Terahertz is strongly attenuated by water, thus very sensitive to the change of water content in biological tissues. Unlike X-ray, the photon energy of terahertz is very low that it does not pose any ionization hazard for human beings. Moreover, some collective inter-molecular vibrational modes lie in the terahertz frequencies. These unique features have made it a potential tool in biomedical research field. The student will work with a team of researchers on developing THz technology for biomedical applications which can involve data collection and processing, development of analysis and software interfaces.	
Required skills, knowledge or experience: Background: Students with electronics, physics, biomedical engineering or other related backgrounds are welcomed. Skills: General knowledge in electromagnetic wave theory, physics and optics, signal processing, MATLAB or other coding language.	
Keywords: terahertz, physics, biology, medical, biomedical	
Contact email: vincent.wallace@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 2	Total number of place(s) available with supervisor: 2

Faculty of Engineering and Mathematical Sciences - School of 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**	
Group: http://www.physics.uwa.edu.au/research/quantum-dynamics-computation	
Project description: <u>Project 1</u> 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	
Contact email: jingbo.wang@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 3	Total number of place(s) available with supervisor: 3

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Prof Jingbo Wang	Co-supervisor (s) : Sam Marsh, Gareth Jay, Mitchell Chiew, Kooper De Lacy
Project title:	**Quantum walk based algorithms**
Group: http://www.physics.uwa.edu.au/research/quantum-dynamics-computation	
Project description: Project 2 Quantum walks display remarkably different properties from their classical counterparts, most notably their fast spreading characteristics, interference and intrinsic quantum correlation. For example, they were proven to provide an exponential algorithmic speedup for traversing a randomized glued-tree graph. However, despite such potentially superior efficiency in quantum random walks, they have yet to be applied to problems of significant practical importance. This project aims to develop useful quantum algorithms utilizing quantum interactions, interference and entanglement. Analytical and numerical methods will be developed to study the characteristics of the associated quantum walks and to analyze the computational complexity of quantum walk based algorithms. Potential applications include quantum simulation of chemical or biological dynamics, network characterization, relational quantum search, graph isomorphism, and quantum Bayesian learning, each leading to a separate honours or masters project.	
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	
Contact email: jingbo.wang@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 3	Total number of place(s) available with supervisor: 3

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Prof Jingbo Wang	Co-supervisor (s) : Sam Marsh, Gareth Jay, Mitchell Chiew, Kooper De Lacy
Project title: **Quantum Combinatorial optimisation**	
Group: http://www.physics.uwa.edu.au/research/quantum-dynamics-computation	
Project description: Project 3 Combinatorial optimization is to find an optimal solution over an ordering of a discrete set of objects. For many such problems, an exhaustive search is not feasible due to the exponentially large number of possible orderings. A well-known combinatorial optimization problem is the traveling salesperson problem, which is NP-hard. The intrinsic parallelism offered by quantum computing provides a simultaneous evaluation of all possible combinations and permutations, which may lead to powerful quantum algorithms capable of solving classically intractable problems. The aim of this project is to investigate one of the following quantum optimisation schemes for finding approximate solutions to combinatorial optimisation problems via (1) nonlinear quantum dynamics, (2) the quantum adiabatic theorem, and (3) a quantum genetic algorithm.	
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	
Contact email: jingbo.wang@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 3	Total number of place(s) available with supervisor: 3

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Prof Michael Tobar	Co-supervisor (s) : Prof Eugene Ivanov / Dr Jeremy Bourhill / Dr Maxim Goryachev
Project title:	**Direct Detection Dark Matter Experiments in the Lab**

Group:
Engineered Quantum Systems, Frequency and Quantum Metrology Lab

Project description:
Project 1

The composition of Dark Matter(DM)is one of the greatest outstanding issues in physics. One of the most promising dark matter candidates is a hypothetical family of particles referred to as the Weakly Interacting Slim Particles (WISPs). These particles have origins in particle physics yet also make excellent dark matter particles. They are extremely light (sub-eV masses) and interact gravitationally and very weakly with known standard model particles.

Efforts to search for WISPs typically involve exploiting WISP-to-standard model particle coupling mechanisms, (such as photons, spins, nucleons etc. including the associated fundamental constants). Purposefully designed precision measurements that probe these quantities can be designed to be sensitive to so called “Dark Sector “ particles.

Such dark sector particles include spin 0 bosons (aka the Axion). Currently we have funding to build experiments in mass ranges where they are likely to exist [1-3] with the funded ORGAN detector. Another possible candidate include spin 1 bosons (aka the Dark Photon) with new precision experiment proposed and to be developed in the future [4]. Finally we are interested in proposed scalar particles that can be detected with acoustic oscillators or by searching for variation in fundamental constants.

We are looking for capable and motivated students to join our team and work at the forefront of this exciting field of modern physics. There will be opportunities to develop skills in a variety of areas, including low noise oscillators and clocks, microwave electronics, low noise measurement techniques, low temperature (sub-mK) systems, quantum-limited measurements and electromagnetic simulations and theory. This project will assist on of our many projects on the detection of Dark matter.

References
[1] BT McAllister, G Flower, EN Ivanov, M Goryachev, J Bourhill, ME Tobar, “The ORGAN experiment: An axion haloscope above 15 GHz,” Physics of the Dark Universe, vol. 18, pp. 67–72, 2017.
[2] BT McAllister, SR Parker, ME Tobar, “Erratum: Axion Dark Matter Coupling to Resonant Photons via Magnetic Field [Phys. Rev. Lett. 116, 161804 (2016)]”, Phys. Rev. Lett., vol. 117, 159901, 2016. /
[3] BT McAllister, SR Parker, ME Tobar, “3D lumped LC resonators as low mass axion haloscopes”, Phys. Rev. D 94, 042001, 2016.
[4] SR Parker, JG Hartnett, RG Povey, ME Tobar, “Cryogenic resonant microwave cavity searches for hidden sector photons,” Phys. Rev. D, 88, 112004, 2013.

Required skills, knowledge or experience:
Experimental Physics

Keywords: Dark Matter, Precision Measurements, Axions

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

Project done on Crawley campus: Yes

Total number of project(s) offered by supervisor: 5	Total number of place(s) available with supervisor: 5
Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Prof Michael Tobar	Co-supervisor (s) : Prof. Alexey Veryaskin
Project title:	**Electromagnetic Gradiometry: A New Low Risk Highly Sensitive breast Cancer Detector**
Group: Engineered Quantum Systems, Frequency and Quantum Metrology Lab https://equs.org/fml http://www.physics.uwa.edu.au/research/frequency-quantum-metrology	
Project description: Project 2 Graphical representation of measured data sets is a well established way of assessing different features that can not be identified from original raw data. Well-known examples are mammograms, X-ray images, geophysical maps, etc. UWA has developed the first in the world an Extremely Low Frequency electromagnetic gradiometer that is capable of measuring the quadrature (out-of-phase) spatial gradient components of the secondary magnetic field that is generated inside human tissue. One of the obvious applications of this technology is a possibility of detecting breast cancer at its early stage, when all other existing methods are not effective. The gradiometer measures two spatial B-field gradients (Bxz and Byz) as grid-based or continuosly recorded data sets. This project is aiming at developing most informative graphical representation of such data sets which would identify anomalously conducting spots in human tissue. The B-field gradient components can be visualised independently or as a combination of the two. Examples are density plots, contour plots, etc. Also, such visualisation may include special filtering techniques.	
Required skills, knowledge or experience: Computer programing and modeling, experimental physics	
Keywords: Gradiometry, precision measurement, breast cancer	
Contact email: michael.tobar@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 5	Total number of place(s) available with supervisor: 5

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing		
Main Supervisor : Prof Michael Tobar		Co-supervisor (s) : Prof Eugene Ivanov / Dr Jeremy Bourhill
Project title:	**Extremely high quality factor resonance search**	
Group: Engineered Quantum Systems and the frequency and Quantum Metrology Lab		
Project description: <u>Project 3</u> The world's best frequency standards are used in many applications from radar to tests / of fundamental physics. They rely on narrow frequency resonances within some media, / such as crystals or a cloud of ultra-cold atoms. Locating these resonant features in / frequency space can be a very time consuming task - trying to find a needle in a hay / stack. This project will focus on creating software designed to automate this search.		
Required skills, knowledge or experience: Familiarity with a programming language		
Keywords: High-Q, Resonator, Whispering Gallery Modes, Acoustic Modes		
Contact email: michael.tobar@uwa.edu.au		
Project done on Crawley campus: Yes		
Total number of project(s) offered by supervisor: 5		Total number of place(s) available with supervisor: 5

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Prof Michael Tobar	Co-supervisor (s) : Dr Maxim Goryachev / Dr Jeremy Bourhill
Project title:	**Spins in solids: Solid-state clock transitions**
Group: Engineered Quantum Systems, Frequency and Quantum Metrology Lab https://equs.org/fml http://www.physics.uwa.edu.au/research/frequency-quantum-metrology	
Project description: Project 4 The project will be to realize a microwave cavity coupled to spins in a solid crystal. Such crystals can include magnon spin wave modes in YIG or Lithium Ferrite. Only recently we discovered the first magnon wave clock transition in Lithium Ferrite reported in arXiv:1711.09980 [cond-mat.str-el], in this project we will design a new re-entrant cavity to strongly couple to this clock transition. The cavity will then exhibit a hybrid quantum system, which to first order in independent to magnetic frequency fluctuations.	
Required skills, knowledge or experience: Experimental Physics	
Keywords: Hybrid Quantum Systems, Spin Waves, Clock Transition	
Contact email: michael.tobar@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 5	Total number of place(s) available with supervisor: 5

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Prof Michael Tobar	Co-supervisor (s) : Dr Maxim Goryachev / Dr Jeremy Bourhill / Prof Eugene Ivanov
Project title:	**Transfer of quantum encoded information between microwave and optical frequencies**

Group:
Engineered Quantum Systems, Frequency and Quantum Metrology Lab
https://equs.org/fml
http://www.physics.uwa.edu.au/research/frequency-quantum-metrology

Project description:
Project 5

In the future quantum communication networks will distribute entangled states over a large scale computing architecture [1,2]. The core elements of future quantum networks, i.e., quantum repeaters [3] as well as network nodes, can be realized by using qubits and quantum memories of diverse physical nature [4,5]. Today, elementary quantum networks linking two remote single atoms have been demonstrated [6,7]. Solid-state systems such as superconducting quantum circuits [8], nanomechanical devices [9], and spin doped solids [10] potentially offer larger scalability and faster operation time compared to systems based on the single atom approach. However, such solid-state devices operate at microwave and radio frequencies, which are less suitable for long-range quantum communication than optical channels due to losses in cables and the high noise temperature of antennas of about 100 K for radio-relay communication. To establish a fiber-optical link between them, one has to use a quantum media converter, i.e., a device, which coherently interfaces matter and photonic qubits. One of the promising ways towards implementation of such a converter relies on using optically active spin ensembles in a hybrid quantum architecture [15–17]. Among these, rare-earth (RE) ion doped crystals are very attractive for application in hybrid systems due to their high spin tuning rate [18] and long optical and spin coherence time [19–21]. Another alternative is coupling optics to phononics, currently we are working with Electrical Engineering to devlop phonon-photon coupled systems at low temperatures (below 100 mK). / This project will see the expertise of FQM group on microwave and phononic resonators combine with German expertise in optics at Saarland University in Saarbrücken, and with Melbourne University to create one of the first quantum microwave-optical convertors using spins or phonons in crystals, which will be developed as both microwave and optical resonators. The research will investigate different crystal hosts such as Silicon YLF, YAP and YSO. The end goal will be to resonantly to couple to both the microwave and optical transitions simultaneously, achieving strong coupling. The FQM group has funding for the necessary exchange between institutes, with equipment funding existing through the ARC CoE in Engineered Quantum Systems.

[1] J. I. Cirac, P. Zoller, H. J. Kimble, and H. Mabuchi, Phys. Rev. Lett. 78, 3221 (1997).
[2] H. J. Kimble, Nature (London) 453, 1023 (2008).
[3] N. Gisin and R. Thew, Nat. Photonics 1, 165 (2007).
[4] L. Tian, P. Rabl, R. Blatt, and P. Zoller, Phys. Rev. Lett. 92, 247902 (2004).
[5] K. Stannigel, P. Rabl, A. S. Sørensen, P. Zoller, and M. D. Lukin, PRL. 105, 220501 (2010).
[6] S. Ritter, et. al., Nature (London) 484, 195 (2012).
[7] J Hofmann, et. al., Science 337, 72 (2012).
[8] J. Clarke and F. Wilhelm, Nature (London) 453, 1031 (2008).
[9] A. D. O'Connell et al., Nature (London) 464, 697 (2010).
[10] H. Wu, et. al., Phys. Rev. Lett. 105, 140503 (2010).
[11] E. Togan et al., Nature (London) 466, 730 (2010).
[12] E Saglamyurek, N Sinclair, J Jin, J Slater, D Oblak, F Bussieres, M George, R Ricken, W Sohler,

W.Tittel, Nature (London) 469, 512 (2011).
[13] C. Clausen, et. al. Nature (London) 469, 508 (2011).
[14] K. D. Greve et al., Nature (London) 491, 421 (2012).
[15] K. Tordrup, A. Negretti, and K. Mølmer, Phys. Rev. Lett. 101, 040501 (2008).
[16] J.Verdu et. al. Phys. Rev. Lett. 103, 043603 (2009).
[17] P. Bushev et. al., Phys. Rev. B 84, 060501(R) (2011).
[18] I. N. Kurkin and K. P. Chernov, Physica (Amsterdam) 101B, 233 (1980).

Required skills, knowledge or experience: Experimental Physics	
Keywords: Optical, microwave, resonators, quantum hybrid systems	
Contact email: michael.tobar@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 5	Total number of place(s) available with supervisor: 5

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

Main Supervisor : Prof Mikhail Kostylev	Co-supervisor (s) :

Project title: **A self-consistent model for spin wave excitation in nano-confined geometries [Theory/computation]**

Group: Spintronics and Magnetisation Dynamics Research Group - http://www.physics.uwa.edu.au/research/spindynamics

Project description:

Project 1

Spin waves (or magnons in quantum picture) are waves of magnetisation in magnetic materials. They exist in the microwave frequency range. Technologically important are materials in the form of long stripes with stripe cross-section sizes in the nanometre range. Similar to optical fibres, which are conduits for light, the magnetic stripes represent conduits (waveguides) for spin waves [1]. It has been shown that logic devices can be built based on spin waves waveguides [2]. Furthermore, spin waves in similar planar geometries are prospective candidates for information carriers in Quantum Information devices [3].

Important for the success of these novel technologies is the possibility to theoretically model functionality of these devices. The first step of constructing the model is developing a theory and a numerical code based on it for excitation of spin waves in the stripes by localised external sources of microwave photons.

The goal of the proposed study is to construct the linear excitation theory. An integral equation will be derived for the microwave current in the source exciting spin waves. A self-consistent solution for the excitation problem will be obtained by numerically solving the equation. Once the solution has been constructed, the student will carry out a number of numerical simulations with the model in order to understand how spin waves are excited, localised and guided in the confined geometry of the nanostripes and how they can be manipulated in this geometry in order to perform logic operations.

If successful, this project will result in a publication in a high-impact physical journal, such as Journal of Applied Physics.

[1] M. Kostylev et al., Phys. Rev. B 76, 054422 (2007).
[2] T. Schneider et al., Appl. Phys. Lett. 92, 022505 (2008).
[3] B. Bhoi et al. J. Appl. Phys. 116, 243906 (2014).

Required skills, knowledge or experience:
Good command of electrodynamics, some idea of magnetism. Command of some computational software such as MathCAD, MatLab or Mathematica (preferably MathCAD).

Keywords: Physics of Solid State, Magnetism, Electromagnetism, Radio-Engineering

Contact email: mikhail.kostylev@uwa.edu.au

Project done on Crawley campus: Yes

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

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Prof Mikhail Kostylev	Co-supervisor (s) : Charles Weiss, PhD candidate
Project title:	**Investigation of magnetic interface phenomena**

Group: Spintronics and Magnetisation Dynamics Research Group - http://www.physics.uwa.edu.au/research/spindynamics

Project description:

Project 2

Interfaces of magnetic films with non-magnetic metals demonstrate a host of interesting phenomena, such as Perpendicular Magnetic Anisotropy, Interface Dzyaloshinskii-Moriya Interaction (IDMI), and Spin Pumping (SP) [1]. They are of interest in areas involving non-volatile magnetic memory and logic [2] as well as in sensing hydrogen gas (H2) [3], and together can be of importance for the advent of the Internet of Things (IoT) [4].

The proposed PhD research project aims to explore the interplay between IDMI and SP and the impact of the two on ferromagnetic resonance (FMR) [5] and travelling spin waves (TWS) [6], in order to develop an integration of magnetic and TWS logic [7] with magnetic H2 sensors for IoT.

The student will take part in fabrication of advanced multilayered magnetic thin films and nanostructures. Then, he/she will characterise them with FMR and TWS. If successful, this project will result in a publication in a high-impact physical journal, such as Journal of Applied Physics.

[1] B.N.Engel et al., Phys. Rev. Lett. 67, 1910 (1991); Y.Kajiwara et al., Nature (London) 464, 262 (2010) ; I.E.Dzyaloshinskii, Sov. Phys. JETP 5, 1259 (1957); A.Stashkevich et al., Phys. Rev. B, 91, 214409 (2015).
[2] ; C.Chappert et al., Nature Mat. 6, 813 (2017); R.L.Stamps et al., IEEE Trans. Mag. 51, 0800511 (2015)
[3] C.S.Chang, et al., Appl. Phys. Lett. 102, 142405 (2013) ; S.Watt et al., arXiv:1705.07547v2 (2017).
[4] C.Perera et al., Trans. Emer. Telecom. Tech 25 81 (2014).
[5] I.S.Maksymov, M.Kostylev, J. Phys. E 69, 253 (2015).
[6] V. Vlaminck and M.Bailleul, Science 322 410 (2008).
[7] T.Schneider et al., Appl. Phys. Lett. 92, 022505 (2008);

Required skills, knowledge or experience:
Understanding of electrodynamics, some idea of magnetism.

Keywords: Solid State Physics, Magnetism

Contact email: mikhail.kostylev@uwa.edu.au

Project done on Crawley campus: Yes

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

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing	
Main Supervisor : Prof Mikhail Kostylev	Co-supervisor (s) : Stuart Watt, PhD candidate
Project title:	**Investigation of the Spin Hall Effect in ferromagnetic metals (experimental)**

Group: Spintronics and Magnetisation Dynamics Research Group - http://www.physics.uwa.edu.au/research/spindynamics

Project description:

Project 3

Our Spintronics and Magnetisation Dynamics Group at UWA has a major interest in using the Spin Hall Effect in Pd/ferromagnetic metal bi-layer films for applications in nanoscale hydrogen gas sensors [1]. The inverse Spin Hall Effect manifests itself as a dc voltage across a Pd layer when a ferromagnetic metal layer interfaced with it is driven to a natural magnetic resonance in the material called "Ferromagnetic resonance" (FMR). More recent experiments, performed in our group by a visiting RTP student from USTC - Yunshu Shi, revealed an unexpected behaviour – a strong dc voltage formed under the same conditions across a single layer ferromagnetic cobalt film not interfaced with Pd. This effect was identified as the intrinsic inverse Spin Hall Effect in Co [2-4]. This phenomenon is quite a new discovery and not much detail is known about it. Furthermore, the same experiments by Yunshu indicated that there might be a strong interplay between the intrinsic and extrinsic iSHE for bi-layer Pd/Co films. This may have important implications for the magnetic hydrogen sensing.

The proposed project will investigate the physics behind this phenomenon. To this end, the student will grow layers of cobalt (has a strong spin-orbit coupling (SOC)) and iron (no SOC) of different thicknesses and compare dc voltages induced in the layers driven to FMR. Values of Spin Hall angle for the materials will be extracted from the measurements. If successful, this project will result in a publication in a high-impact physical journal, such as Journal of Applied Physics.

1. S. Watt, R. Cong*, C. Lueng, M. Sushruth, P. Metaxas and M. Kostylev, IEEE Mag. Lett., 9, 3101004 (2018)
2. Y.-C. Weng, Y. Luo, C.-T. Liang, and J. G. Lin, IEEE Trans. Mag., DOI 10.1109/TMAG.2017.2704591 (2017).
3. A. Tsukahara, Y. Ando, Y. Kitamura, H. Emoto, E. Shikoh, M. P. Delmo, T. Shinjo, and M. Shiraishi, Phys. Rev. B 89, 235317 (2014).
4. A. Azevedo, R. O. Cunha, F. Estrada, O. Alves Santos, J. B. S. Mendes, L. H. Vilela-Leao, R. L. Rodrıguez-Suarez, and S. M. Rezende, Phys. Rev. B, 92, 024402 (2015).
*RTP student from USTC

Required skills, knowledge or experience:
Understanding of electrodynamics, some idea of magnetism.

Keywords: Solid State Physics, Magnetism, Spintronics

Contact email: mikhail.kostylev@uwa.edu.au

Project done on Crawley campus: Yes

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

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

Main Supervisor : Prof Mikhail Kostylev	Co-supervisor (s) : Thomas Scheffer, PhD candidate

Project title:	**Alloys of Pd with ferromagnetic metals as a new active medium for hydrogen gas sensors**

Group: Spintronics and Magnetisation Dynamics Research Group - http://www.physics.uwa.edu.au/research/spindynamics

Project description:
Project 4

Hydrogen gas as renewable energy resource will become very important in the future, especially as a fuel for automobiles [1,2]. The proposed project is aimed at a new, safe type of hydrogen gas sensor, which will find potential application in fuel cells for hydrogen-fuelled electrically-powered cars. Our research group - the Spintronics and Magnetisation Dynamics Research Group at UWA - has recently suggested a new highly promising concept of a sensor [3], [4]. We found that a palladium/ferromagnetic bilayer system in combination with ferromagnetic resonance (FMR) spectroscopy can be employed for efficient and fast hydrogen gas sensing. This principle eliminates drawbacks from which competing hydrogen gas sensors suffer [5].

The proposed project will focus on Pd containing alloy films [6] instead of the bi-layer ones [3] as a sensing medium. It is expected, that employing alloys instead of bilayer films will lead to faster, simpler and more robust sensors. The student will take part in fabrication of CoPd and FePd films and CoFePd films. Then, he/she will characterise them with FMR in the presence of hydrogen gas. If successful, this project will result in a publication in a high-impact physical journal, such as Journal of Applied Physics.

[1] C. Watanabe, “Japan’s Big Push for Hydrogen Fuel Cells,” Bloomberg.com, 09-Feb-2017.
[2] S. Samuelsen, “The Automotive Future Belongs to Fuel Cells Range, Adaptability, and Refueling Time Will Ultimately Put Hydrogen Fuel Cells Ahead of Batteries,” IEEE Spectr., vol. 54, no. 2, pp. 38–43, 2017.
[3] C. S. Chang, M. Kostylev, and E. Ivanov, “Metallic Spintronic Thin Film as a Hydrogen Sensor,” Appl. Phys. Lett., vol. 102, no. 14, p. 142405, Apr. 2013.
[4] C. Lueng, P. Lupo, P. J. Metaxas, M. Kostylev, and A. O. Adeyeye, Adv. Mater. Technol. 1, 1600097 (2016).
[5] T. Hübert, L. Boon-Brett, G. Black, and U. Banach, “Hydrogen Sensors – A Review,” Sens. Actuators B Chem., vol. 157, no. 2, pp. 329–352, Oct. 2011.
[6] C. Lueng, P. Lupo, P.J. Metaxas, A.O. Adeyeye and M. Kostylev, ArXiv:1801.08324 (2018).

Required skills, knowledge or experience:
Understanding of electrodynamics, some idea of magnetism.

Keywords: Solid State Physics, Magnetism

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Project done on Crawley campus: Yes

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

Faculty of Engineering and Mathematical Sciences - School of Physics, Mathematics and Computing		
Main Supervisor : Dr Mark Reynolds		Co-supervisor (s) :
Project title:	**TBA**	
Group:		
Project description: TBA		
Required skills, knowledge or experience:		
Keywords:		
Contact email: mark.reynolds@uwa.edu.au		
Project done on Crawley campus:		
Total number of project(s) offered by supervisor: 1		Total number of place(s) available with supervisor:

Faculty of Science - School of Human Sciences	
Main Supervisor : Prof Shane Maloney	Co-supervisor (s) : Dr Dominique Blache
Project title:	**Stress and ultradian patterns of body temperature in mammals**
Group:	

Project description:
Project 1

Introduction: Metabolic processes control the flow of energy and protein in the body, helping to maintain biological functions. One function central to metabolism in mammals and birds is the regulation of body temperature. In species that do not enter torpor, changes in the pattern of the daily rhythm of core body temperature can be described and quantified using cosinor analysis, an analysis that generates descriptive parameters of the daily pattern such as the daily mesor, amplitude, minimum, and maximum of body temperature (Maloney et al., 2013). In addition to the circadian rhythms of body temperature, there exist very short episodic increases in temperature (also called ultradian events). These ultradian cycles have been hypothesised to be related to the preparedness of animals to respond to stimulation (Blessing and Ootsuka, 2016). Exposure to external stressors, such as change in food intake or exposure to high temperature, are known to affect circadian rhythms (Maloney et al., 2013, Goh et al., 2016) but the impact of these external factors on the frequency and amplitude of ultradian events is not clearly understood. We have a large database of body temperature records in different species of mammals (alpacas, sheep, rat, etc) exposed to different diets or ambient temperature.

Aims: 1) to analyse the ultradian events that are present in the body temperature profiles and 2) to determine the impact of external factors on the frequency and amplitude of the ultradian events. Methods: The temperature profiles, which are time series, will be analysed using a continuous wavelet transform (CWT) package in R. CWT divides the continuous-time function into wavelets and, unlike Fourier transform, offers very good time and frequency localization.

Blessing, W. and Ootsuka, Y. (2016) Timing of activities of daily life is jaggy: How episodic ultradian changes in body and brain temperature are integrated into this process. Temperature, 3, 371-383. 10.1080/23328940.2016.1177159
Goh, G.H. Mark, P.J. and Maloney, S.K. (2016) Altered energy intake and the amplitude of the body temperature rhythm are associated with changes in phase, but not amplitude, of clock gene expression in the rat suprachiasmatic nucleus in vivo. Chronobiology International, 33, 85-97.
Maloney, S.K. Meyer, L. Blache, D. and Fuller, A. (2013) Energy intake and the circadian rhythm of core body temperature in sheep. Physiological Reports, 1, e00118 1-9.

Required skills, knowledge or experience:
Animal physiology, mathematics, statistical analysis, integrated physiology, experience with the software package R would be advantageous.

Keywords: Chronobiology, animal, temperature, statistics, physiology

Contact email: dominique.blache@uwa.edu.au

Project done on Crawley campus: Yes

Total number of project(s) offered by supervisor: 1	Total number of place(s) available with supervisor: 3

Faculty of Science - School of Molecular Sciences	
Main Supervisor : Dr Joshua Mylne	Co-supervisor (s) : Assoc Prof Keith Stubbs and Dr Joel Haywood
Project title: **Hunting new herbicide targets**	
Group: Mylne Lab - www.mylne.org	

Project description:
Project 1

At the recent Global Herbicide Resistance Challenge conference it was said that "no new herbicide mode of action discoveries had been made" and that there are "no new ones coming in the foreseeable future".

This problem coupled with decades of over-reliance on the highly effective glyphosate means there has never been a greater need for new, effective and safe herbicides.

The Mylne lab recently found an exciting connection between plants and drugs made for human to protect against malaria. This in turn has led to the discovery of new herbicidal compounds and spurred new ways of thinking about herbicide targets.

Student can pursue a genetic, biochemical or chemical project:
Chemical: Taking some of the most promising starting points, we will synthesize chemical variants and assess the different compounds for better herbicidal activity guided by a recent analysis of herbicidal properties and their rules, which we did (Gandy et al. 2015. Org. Biomol. Chem - DOI: 10.1039/c5ob00469a).
Genetic: Using forward genetics in the model plant Arabidopsis thaliana, we will use mutagenesis and mapping to identify targets of new herbicidal compounds for which the target is not known. Some mode of action information is know from working with agrochem giant BASF. The chemicals were published in Angewandte Chemie (2017, doi: 10.1002/anie.201705400) and Pest Management Scinece (2018, in press).
Biochemical: Screening done by our lab has identified a raft of potential new targets. To improve the efficacy of compounds against them we propose making the new herbicide target proteins in bacteria and solving crystal structures for them as well as performing biochemical assays against them.

This project will be done in close collaboration with Assoc Prof Keith Stubbs, an expert in organic synthetic chemistry also based in the UWA School of Molecular Sciences.

Required skills, knowledge or experience:
Depending which project area selected (genetic, biochemical or chemical), the project will involve the genetic model plant Arabidopsis thaliana based plant assays, synthetic organic chemistry, as well as possibly plant chemical mutagenesis, screening and genetic mapping of chemical resistance.

Keywords: herbicides, protein, plants, organic chemistry, chemical biology

Contact email: joshua.mylne@uwa.edu.au

Project done on Crawley campus: Yes

Total number of project(s) offered by supervisor: 3	Total number of place(s) available with supervisor: 2

Faculty of Science - School of Molecular Sciences	
Main Supervisor : Dr Michael Considine	Co-supervisor (s) :
Project title: **Physiological and genetic regulation of meristem activity**	
Group:	

Project description:
Project 1 and 2

Our lab investigates plant quiescence and dormancy at multiple scales. Quiescence is the reversible pause in the cell cycle. Dormancy is a mode of quiescence that requires environmental entrainment, such as chilling (similar to vernalisation). Both are the property of meristems, and because plants have no fixed body plan, quiescence and dormancy regulate plant architecture and crop productivity. At the cellular level, we're interested in how oxygen and reduction/ oxidation (redox) cues regulate the cell cycle; at the meristem level, how redox and oxygen status regulates transcription and protein stability; and at the organ and whole plant level, how the regulation of quiescence and dormancy differ.

Two projects are on offer:
1. Gradients in redox and oxygen status in meristems.
The role of oxygen and redox status in regulating stem cell activity and fate in animals is well-described (Considine et al., 2017; http://dx.doi.org/10.1016/j.tplants.2016.11.013), but most certainly different to the network in plants. This project will use a combination of physiological and histological studies, using arabidopsis plants, including genetic reporter lines. This project would suit someone interested in understanding how physiological cues influence cell activity and fate.

2. The TOR kinase is a central hub of energy signalling in eukaryotes, regulating cell division in response to energy status. TOR kinase directly activates expression of canonical cell cycle regulators. Very recent insights show TOR kinase in plants may be regulated by other physiological signals, including oxygen. The central plant oxygen signalling pathway was only recently resolved, as a function of the post-translational stability of Group VII ERF transcription factors. Knowledge of responses under oxygen and energy deficit suggest the ERF-VII proteins also regulate TOR kinase, but this has not been explored (Considine, 2018 http://dx.doi.org/10.1016/j.tplants.2017.09.013). This study will use bioinformatic tools to identify candidate signalling intermediates or functions that can later be tested in genetic studies to decipher the signalling network. This study would suit a student with skills and interest in plant bioinformatics, and particularly cis- and trans-regulation.

Required skills, knowledge or experience:
Project 1
Light, fluorescent and confocal microscopy and histology (plants).

Project 2
Ability in use of bioinformatic tools to indentify cis- and trans-regulatory motifs. Additional bioinformatic skills and R-programming language preferred.

Keywords: Cell division, Plant development, Redox signalling, Oxygen signalling, Transcription factors	
Contact email: michael.considine@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 2	Total number of place(s) available with supervisor: 2

Faculty of Science - School of Molecular Sciences	
Main Supervisor : Prof Amir Karton	Co-supervisor (s) :
Project title: **Computational and Theoretical Chemistry**	
Group: https://www.chemtheorist.com/	

Project description:
Projects 1-4

During the past decade, computational chemistry has had an increasingly important impact on almost all branches of chemistry as a powerful approach for solving chemical problems at the molecular level. The increasing computational power provided by supercomputers and the emergence of highly accurate theoretical procedures make contemporary computational chemistry one of the most detailed "microscopes" currently available for examining the atomic and electronic details of molecular processes. In my lab, we use supercomputers in conjunction with very accurate theoretical methods to elucidate the reaction paths, kinetics, and the mechanisms involved in salient organic, organometallic and enzymatic systems.

Possible projects are:
1. Computational Design of Ionic Liquids for Biomass Dissolution, see: ACS Sustainable Chemistry & Engineering, in press (2018). http://dx.doi.org/10.1021/acssuschemeng.7b04489 .
2. Computational Antioxidant Design, see: Journal of the American Chemical Society 134, 19240–19245 (2012). http://dx.doi.org/10.1021/ja309273n .
3. Modeling the Chemical Mechanisms Underlying Enzymatic Catalysis and Computational Design of De Novo Antioxidant Enzymes, see: Journal of Biological Chemistry 286, 18048–18055 (2011). http://dx.doi.org/10.1074/jbc.M111.232355 .
4. Development of Economical Quantum Chemical Methods, see: Wiley Interdisciplinary Reviews: Computational Molecular Science, 6, 292–310 (2016). http://dx.doi.org/10.1002/wcms.1249 .

Required skills, knowledge or experience:
1) We are looking for highly motivated students who are interested in the area of theoretical chemistry
2) A strong background in organic and/or biological chemistry is required
3) Background in programming (e.g. C, Perl, or Fortran) and a UNIX environment is an advantage but not necessary

Keywords: Computational chemistry, Molecular design, Catalysis, Reaction mechanisms, Density functional theory

Contact email: amir.karton@uwa.edu.au

Project done on Crawley campus: Yes

Total number of project(s) offered by supervisor: 4	Total number of place(s) available with supervisor: 3

Faculty of Science - School of Molecular Sciences	
Main Supervisor : Prof Reto Dorta	Co-supervisor (s) :
Project title: **Organometallic Chemistry and Catalysis**	
Group: http://dortagroup.scb.uwa.edu.au	

Project description:
Project 1 and 2

Our research is directed toward the preparation of reactive transition metal complexes for stoichiometric and catalytic applications. We focus our attention on the development of new chiral and non-chiral auxiliary ligand systems which are able to bind, activate and functionalize the substrates at the metal center. The ultimate goal of the research program is to identify new ligand families and their corresponding metal complexes for new, more selective or more widely applicable catalytic transformations. Short-term projects will be such as to provide real insights into new developments in the field of catalyst development and organic synthesis within the timeframe of the project.

PROJECTS

1. Ligand Systems Based on Chiral Sulfoxides and Their Use in Late-Metal Chemistry and Catalysis
   One of our recent research goals is to identify and apply chiral chelating sulfoxides as sulfur-based ligands in latetransition metal chemistry. First results show that these ligands indeed are able to perform well in a conjugate addition reaction catalyzed by Rhodium. The short-term projects available in this area of our research will focus on novel ligand systems and will expand catalytic reactivity to other reactions. For additional information on our research, please consult the following publications: R. Mariz et al., J. Am. Chem Soc. 2008, 130, 2172; J. J. Bürgi et al., Angew. Chem. Int. Ed. 2009, 48, 2768; R. Mariz et al., Chem. Eur. J. 2010, 16, 14335; G. Sipos et al., Chem. Soc. Rev. 2015, 44, 3834; G.-Z. Zhao et al., Adv. Synth. Catal. 2016, DOI 10.1002/adsc.201500975.

2. New N-Heterocyclic Carbene Ligands in (Asymmetric) Catalysis
   In the last few years, we have initiated a research program that proposes the synthesis of new classes of monodentate, chiral NHCs that incorporate substituted naphthyl sidechains on the nitrogen atoms. In doing so, we are indirectly relying on a very successful design motif in chiral ligand synthesis that goes back to Noyori's bis-phosphine ligand BINAP. These new types of ligand systems allow for the synthesis of new transition metal complexes, where our focus lies on the isolation of highly unsaturated precatalysts. Current emphasis in applications is put on the identification of more active chiral rhodium and iridium NHC compounds in catalysis. For some previous data from our group on this project, see: X. Luan et al., J. Am. Chem. Soc. 2008, 130, 6848; X. Luan et al., Org. Lett. 2008, 10, 5569; M. Gatti et al., J. Am. Chem. Soc. 2009, 131, 9498; M. Gatti et al., J. Am. Chem. Soc. 2010, 132, 15179; X. Luan et al., Org. Lett. 2010, 12, 1912: L. Wu et al., Angew. Chem. Int Ed. 2012, 51, 2870.

Required skills, knowledge or experience:	
Keywords:	
Contact email: reto.dorta@uwa.edu.au	
Project done on Crawley campus:	
Total number of project(s) offered by supervisor: 2	Total number of place(s) available with supervisor: TBA

Faculty of Science - School of Psychological Science	
Main Supervisor : Prof Romola Bucks	Co-supervisor (s) : Dr Michael Weinborn
Project title: **Healthy Cognitive Ageing**	
Group: Healthy Ageing Research Program (HARP)	

Project description:
Project 1 and 2

HARP is the umbrella name for a series of programmatic research studies focused on typical and atypical ageing. Projects have included evaluating predictors of independent functioning in healthy ageing individuals, and exploring the cognitive burden of obstructive sleep apnoea and its response to treatment.

Regardless of which project interns choose, all projects also involve assessment of cognitive and emotional functioning, as well as functional outcomes, using measures standard in clinical practice. This means that HARP offers an exciting opportunity for an intern to gain experience in the administration (or observation), scoring, coding and interpretation of a wide range of computerized and pencil and paper measures.
The measures typically include assessments of mood (e.g. depression and anxiety); of sleep disturbance, sleepiness and fatigue; of memory complaints, and objective cognitive functions (including memory and executive abilities). Together, these have the potential to impact on older individuals' ability to function within their everyday lives.

Project 1 Title: The longitudinal modelling of cognitive reserve
The concept of cognitive reserve was created to explain why some older adults maintain a normal level of thinking and memory performance, despite having advanced pathology in their brains. Although it has appeared in a wealth of research in the past two decades, the measurement of cognitive reserve is still evolving. Recently a group of researchers developed a novel method of quantifying cognitive reserve by using a combination of brain imaging, neuropsychological, and clinical measures. The current study aims to validate this method by studying its trajectories over time in a cohort of older adults with normal cognitive functioning, mild cognitive impairment, and Alzheimer's disease. This is an opportunity for the student to contribute to data screening, cleaning, and statistical analyses using brain imaging, neuropsychological, and clinical data.

Project 2 Title: Examining the risk factors of hallucinations in healthy older adults
Hallucinatory experiences have, typically, been considered to indicate the presence of psychopathological disorders such as schizophrenia. However, more recently, evidence is accumulating that hallucinations occur in healthy older individuals, without the presence of these kinds of disorders. The current study aims to evaluate the risk factors for hallucinations in healthy older adults. The focus of this study is examining sensory (e.g., hearing and visual decline) and cognitive decline as potential predictors of hallucinatory experiences in healthy older adults. Interns working on this study will be trained to assess participants using a cognitive screening test (the telephone adapted version of the Montreal Cognitive Assessment). Interns working on this study will also be required to help with data entry and the recruitment of participants for this study.

Required skills, knowledge or experience:
Project 1: The longitudinal modelling of cognitive reserve
Experience: background and interest in statistical analyses for psychology or social sciences, with a particular interest in cognitive ageing and Alzheimer's disease.

Project 2: Examining the risk factors of hallucinations in healthy older adults

Experience: background and interest in psychology and behavioural sciences, with a particular interest in hallucinatory phenomena and healthy ageing.	
Keywords: cognitive ageing, memory, quality of life, cognitive reserve, hallucinations	
Contact email: romola.bucks@uwa.edu.au/michael.weinborn@uwa.edu.au	
Project done on Crawley campus: Yes	
Total number of project(s) offered by supervisor: 2	Total number of place(s) available with supervisor: 2

Faculty of Science - UWA School of Agriculture and Environment	
Main Supervisor : Dr Dominique Blache	Co-supervisor (s) : Prof Shane Maloney
Project title: **Molecular basis of sheep temperament**	
Group:	

Project description:
Project 1

If sheep are stressed, their efficiency of production, their health, and the quality of their meat are all compromised (Colditz, 2008, Warner et al., 2010). This project will test the impact of genetic markers that are linked to low stress responses on the health and meat quality of sheep raised in intensive systems (Bickell et al., 2010). Temperament traits reflect the ability of sheep to adapt to environmental stress in terms of their physiological responses to stressors (Blache and Bickell, 2010). Sheep that have been selected to have a low response to social stressors are also less reactive to other stressors and are able to reproduce and produce when fed a maintenance diet (Blache and Bickell, 2010, Hawken et al., 2012, van Lier et al., 2017), all of which reduces the cost of production. Recently, the phenotypic and genetic heritability of temperament traits have been measured in both Merino and Coriedale sheep (Brown et al., 2015, Zambra et al., 2015), revealing that the heritability is high enough to suggest that selection will lead to genetic improvement. However, the phenotyping of temperament is not practical because it is based on expensive behavioral tests and cannot be performed in very young animals (Blache and Bickell, 2010). Recently, two genetic markers (polymorphisms) have been identified that are associated with the temperament of sheep (Qiu et al., 2016). One genetic marker, DRD2 snp939, is involved in the perception of stress through dopaminergic pathways. The other genetic marker, CYP17 snp628, influences cortisol production in response to stress (Qiu et al., 2016). While the dopaminergic pathways are important in the expression of temperament, other central pathways, such as serotoninergic and oxytocinergic pathways, are known to be involved in the expression of personality and temperament in humans. The role of these pathways in sheep is not known (Qiu et al., 2017). We hypothesise that polymorphisms in components of the serotoninergic and oxytocinergic pathways will be associated with temperament in sheep. To identify these polymorphisms, we will use samples from a large blood databank of sheep of known temperament.

Bickell, S.L. Durmic, Z. Blache, D. Vercoe, P.E. and Martin, G.B. (2010) Rethinking the management of health and reproduction in small ruminants. Proceedings of the XXVI World Buiatrics Congress – November 14-18, 2010, Santiago, Chile.
Blache, D. and Bickell, S.L. (2010) Temperament and reproductive biology: Emotional reactivity and reproduction in sheep. Revista Brasileira de Zootecnia, 39, 401-408.
Brown, D.J. Fogarty, N.M. Iker, C.L. Ferguson, D.M. Blache, D. and Gaunt, G.M. (2015) Genetic evaluation of maternal behaviour and temperament in australian sheep. Animal Production Science, 56, 767-774.
Colditz, I.G. (2008) Allocation of resources to immune responses. In: Rauw, W. (ed.) Resource allocation theory applied to farm animal production. Oxford University Press, Oxford, UK.
Hawken, P.a.R. Williman, M. Milton, J. Kelly, R. Nowak, R. and Blache, D. (2012) Nutritional supplementation during the last week of gestation increased the volume and reduced the viscosity of colostrum produced by twin bearing ewes selected for nervous temperament. Small Ruminant Research, 105, 308-314.
Qiu, X. Ledger, J. Zheng, C. Martin, G.B. and Blache, D. (2016) Associations between temperament and gene polymorphisms in the brain dopaminergic system and the adrenal gland of sheep. Physiology & Behavior, 153, 19-27.
Qiu, X. Martin, G.B. and Blache, D. (2017) Gene polymorphisms associated with temperament. Journal of Neurogenetics, 31, 1-16.

<table>
<tr><td colspan="2">Van Lier, E. Hart, K.W. Vinoles, C. Paganoni, B. and Blache, D. (2017) Calm merino ewes have a higher ovulation rate and more multiple pregnancies than nervous ewes. Animal, 7, 1196-1202.
Warner, R.D. Greenwood, P.L. Pethick, D.W. and Ferguson, D.M. (2010) Genetic and environmental effects on meat quality. Meat Science, 86, 171-183.
Zambra, N. Gimeno, D. Blache, D. and Van Lier, E. (2015) Temperament and its heritability in corriedale and merino lambs. Animal, 9, 373-379.</td></tr>
<tr><td colspan="2">Required skills, knowledge or experience:
Molecular biology, bio-informatics, animal behaviour, neurosciences</td></tr>
<tr><td colspan="2">Keywords: Animal, temperament, behaviour, molecular biology</td></tr>
<tr><td colspan="2">Contact email: dominique.blache@uwa.edu.au</td></tr>
<tr><td colspan="2">Project done on Crawley campus: Yes</td></tr>
<tr><td>Total number of project(s)
offered by supervisor: 1</td><td>Total number of place(s)
available with supervisor: 2</td></tr>
</table>

Faculty of Science - UWA School of Agriculture and Environment	
Main Supervisor : Prof Kadambot Siddique	Co-supervisor (s) : Dr Jiayin Pang and Dr Yinglong Chen
Project title:	**Efficient root system for abiotic stress tolerance in crops**
Group: The UWA Institute of Agriculture - http://www.ioa.uwa.edu.au/	

Project description:
Project 1 and 2

Plant survival and fitness are dependent on root system architecture (RSA). In Australia, root systems of major agricultural crops are poorly adapted to soils that mostly have poor water holding capacity and nutrient deficiencies. Decreasing water availability due to drying and variable climate in the Australia's grain-belt exacerbates these soil-related stresses. Development of future crop genotypes with efficient root system for enhanced abiotic stress tolerance is essential for improved crop adaptation. Root traits that overcome abiotic constraints are critical to maintaining structural and functional properties, and are considered first order targets in breeding programmes for rainfed environments. Root traits, such as deep root systems, increased root density in subsoil, increased root hair length and density and / or xylem diameters, may contribute to enhanced water and nutrient uptake. Narrow-leafed lupin genotypes with increased capacity to take up water from deep soil horizons were linked to increased yield potential; similar relationship exists in wheat, soybean and upland rice.

Modification of RSA could contribute to improvements of desirable agronomic traits / such as yield, drought tolerance, and resistance to nutrient deficiencies. Wide-scale use of root / related genetic information in breeding programs relies on accurate phenotyping of relatively large mapping populations. Such large-scale phenotyping of root-related traits remain the most important issue in translating recent physiological and genetic advances in understanding the role of root systems in improved adaptation to abiotic stress and enhanced productivity of agricultural crops.

The candidate will be involved in measuring root systems of crop plants using some innovative / techniques during the project period.

Required skills, knowledge or experience:
Interest in undertaking plant based experiments in the glasshouse and controlled environment

Keywords:
root system architecture, crop physiology, water and nutrient use efficiency

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Project done on Crawley campus: Yes

Total number of project(s) offered by supervisor: 2	Total number of place(s) available with supervisor: 2