Paihau—Robinson Research Institute
VICTORIA UNIVERSITY OF WELLINGTON TE HERENGA WAKA

Summer Research Projects 2023/2024

How to apply

Applications for projects are submitted through the online form. Send copies of CV, transcript, and expression of interest letter with subject line “RE: Summer RA Programme 2023/20234” to rri-postgrad@vuw.ac.nz .

Projects

For more information about your project of interest, please email rri-postgrad@vuw.ac.nz

Back to proposal list

Development of Advanced Spectroscopy Systems

Supervisor: Dr Kai Chen

Project Description

We are seeking an enthusiastic summer student to join our world-leading research team in ultrafast spectroscopy. The student will have the exciting opportunity to aid in developing a state-of-the-art spectroscopy system to obtain ultra-high temporal and high energy resolution. This will be a challenging yet rewarding experience where you can gain hands-on exposure to design and implement cutting-edge spectroscopy platforms.

Key Responsibilities:

- Spectroscopy System Development: Assist in creating an advanced spectroscopy system by utilising ultrafast femtosecond laser sources. The student will actively participate in system design, troubleshooting, and improvement.
- Automation Control Implementation: Play an integral part in the incorporation of automation control to the spectroscopy system.
- Subsystem Construction and Testing: Participate in the construction and rigorous testing of subsystems for the ultrafast spectroscopy platform.
- Photophysics Research Assistance: Employ the new spectroscopy system in practical research to study the photophysics of phototherapy molecules and advanced optoelectronic materials.
- Sample Platform Development: Assist in developing a versatile sample platform to accommodate various types of samples and experiment conditions.

Ideal Candidate:

The ideal candidate will have an academic background in physics and engineering, or a related field, coupled with an avid interest in spectroscopy and cutting-edge technology. Previous experience or familiarity with LabView, optics, and automation control would be advantageous but not a strict requirement.

This position is an excellent opportunity for students seeking valuable experience in a leading research environment, exposing them to innovative spectroscopy techniques and their practical applications in real-world scientific research.

Project Outcomes

1. High-Impact Publications: The summer student will be involved in projects that have the potential for high-impact publications
2. Spectroscopy Subsystems Design and Prototyping: By the end of this project, students would have successfully designed and prototyped various subsystems for the ultrafast and nonlinear spectroscopy platform.
3. Advanced Laser Source Utilisation: As a result of this project, students will have experience using advanced laser sources, crucial elements in modern photonics research and applications.

Back to proposal list

4. World-Class Facility Experience: Students involved in this project will have gained invaluable experience in world-class laser facilities, dealing with advanced optics and nonlinear optics systems.
5. Project Report/Presentation: The project will culminate with a comprehensive report and presentation at the specified institute.

Back to proposal list

Plasma rocket test chamber

Supervisor: Dr Ben Mallett

Project Description

The space team at Robinson is building a plasma-rocket for in-space propulsion. This plasma rocket needs a large, high-vacuum chamber to be tested in. The pumps that generate the high vacuum need to cope with the large amount propellant flowing through the rocket. To improve the quality of our ground tests of this rocket, we want to build the most powerful high-vacuum pumps in NZ! That is the goal of this project.

This project involves;

(i) assembling the high-vacuum cold-trap pumps for the vacuum chamber (skills developed include: mechanical assembly of high-vacuum components, potential design minor additional bracketry, wiring/instrumentation install).
(ii) install and commissioning.
(iii) running a series of performance tests, compiling and reporting of the data.

The project would particularly suit someone studying physics or engineering who enjoys working in a laboratory setting. CAD skill/experience would be favourable.

Project Outcomes

1. assembling the cold trap pumps (parts already in place)
2. install and commissioning in GERALDINE
3. running a series of performance tests, compiling and reporting of the data.

Back to proposal list

Mechanochromic thin films via ion-beam sputtering

Supervisor: Dr Shen Chong and Dr Peter Murmu (GNS)

Project Description

The Robinson Research Institute is world-renowned for research and development of advanced materials. This summer, we require a keen and hands-on summer RA to contribute to a research project that contributes toward a new magnetostrictive- mechanochromic (magneto-chromic) composite materials aimed for optical-based magnetic field sensing.

This work will contribute towards the development of the world's first multi-functional sensing system for distributed magnetic field and temperature sensors. These novel sensors contain single optical fibres coated with magneto-chromic nanocomposites for magnetic field sensing, and fluoroperovskite nanoparticles for temperature monitoring.

We welcome anyone with physics, engineering or chemistry background to apply.

Project Outcomes

The RA will work closely with our research partner at GNS Science, Gracefield, to prepare thin film magneto-chromic composite samples using NZ's only ion-implantation facility at GNS Science.

Thin film samples will be fabricated by ion-beam sputtering at GNS Science and post annealing done at Robinson Research Institute. Sample characterisations will be carried out at Robinson Research Institute and the ion-beam analysis at GNS Science.

At the conclusion of this summer project, the RA shall be familiar with the thin film deposition processes, analysis of magnetisation data, the basic structural and chemical characterisation using powder x-ray diffraction and Rutherford Backscattering Spectroscopy.

Back to proposal list

High-Temperature Superconducting tape jointing study using different solder types

Supervisor: Dr Adam Francis

Project Description

Clean sustainable fusion energy, zero carbon aviation, and modern health technology all rely on cryogenic superconductors. Want to be part of making these happen?

High temperature superconductors (HTS) can transport large currents without resistance. Electrical circuits made from HTS are usually made using superconducting tape that require ohmic joints to complete a circuit. These joints are made using solder and pressure and even under the best of circumstances are a point of resistance. The resistance of these joints can change the behaviour of HTS circuits substantially and must be reliably made and have as small a resistivity as possible. Currently there is a hole in the literature around how different types of solder affect the total resistivity of these joints and we wish to investigate it. The outcomes of such a study will be of great use to the entire field of applied superconductivity.

We need a summer research assistant to revitalise and recalibrate pre-existing electronically controlled pneumatic jointing equipment. This equipment will then be used to study the effects of solder type on the resistance of HTS tape joints. Additionally, we would like to compare the resistance of such joints across a variety of HTS manufacturers and batches. The results of this study will then be published in a scientific journal.

Project Outcomes

1. Revitalising and recalibrating a pre-existing pneumatic jointing press
2. Using the pneumatic jointing press to create joints between HTS tapes
3. Testing the resistance of these joints in liquid nitrogen

Back to proposal list

High-speed Superconducting Levitation Bearings

Supervisor: Dr James Storey

Project Description

Robinson Research Institute has recently developed experimental test beds for studying the physics of high-speed superconducting magnetic levitation bearings (see https://robinson.ac.nz/newsmedia/#bearing). The target application for these bearings is high-speed motors that might one day propel electric aircraft.
We are looking for a motivated candidate to join our team to run experiments using this system to help inform bearing designs.

Project Outcomes

By the end of the project the assistant will have carried out a number of experiments, processed and analysed the data and presented the results in written and oral form.

Back to proposal list

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Quench propagation dynamics in high temperature superconducting magnets

Supervisor: Dr Shahna Haneef

Project Description

High-temperature superconducting magnets (HTS) are an essential part of next generation tokomak nuclear fusion energy system. Stability of these superconducting magnets is crucial, and an open issue that hampers the stability of the magnet is a quench event which occurs when a section of the superconductor ceases the superconducting state and transitions into a normal state. A rapid and reliable quench detection system is necessary to prevent HTS magnets traversing into a thermal runaway and protect the system from the catastrophic failure. This necessitates the need to understand the dynamics of normal zone development.

Optical fibres with a continuous array of Bragg gratings (Ultra long fiber Bragg grating array) have been identified as a potential candidate to monitor the temporal response to the perturbations along the magnet. In this project, we aim to mimic the quench events on the fusion magnets through controlled experiment at Robinson's facility by creating localized perturbations on high temperature superconducting magnets cooled to 80 K.   A high speed interrogator along with a custom made poly-chromatic array of Bragg gratings will be used in this study to investigate the normal zone development and propagation in superconducting tapes.

Project Outcomes

The project aim is to study the quench propagation dynamics in HTS tapes by

- Performing a series of controlled experiment on a polychromatic ultra-long FBG array embedded on a HTS tape (with and without current load) using the high-speed optical interrogator.
- Optimizing the data acquisition and signal processing algorithm for studying the quench propagation in HTS tape

Back to proposal list

Testing new superconducting current source

Supervisor: Grant Lumsden

Project Description

Robinson Research has substantial expertise in the field of contactless superconducting current sources (aka flux pumps). To provide current to coils in superconducting motors that are proposed for high powered electric aircraft thrusters, a variety of different current supplies are being evaluated. We are currently building a prototype that will need to be comprehensively tested to characterise it and thereby inform subsequent designs. Steps will include:

- Mechanical assembly of the exciter

- Wiring and circuit checks

- Programming the controller circuitry (arduino or LabView) to achieve a range of excitation waveforms

- Setup data acquisition (Labview)

- Test and characterise waveform driver circuits

- Subcomponent tests at room temperature

- Assembled tests at cryogenic conditions with a range of waveforms

- Rebuild/retest with a range of different mechanical configurations

- Data analysis and reporting

Project Outcomes

Current pump performance curves for a range of excitation waveforms
Current pump performance curves for a range of mechanical configurations

Back to proposal list