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

Summer Research Projects 2026/2027

How to apply

Applications for Summer Research Assistant (RA) positions are submitted through the online form. Send copies of CV, transcript, and expression of interest letter with subject line "RE: Summer RA Programme 2026/2027" to rri-admin@vuw.ac.nz .

Projects

Other project opportunities may become available later. We will update this list if those opportunities arise. Keep an eye on the website.

Application deadline is Friday 31st of July.

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Submersible liquid nitrogen pump development

Primary Supervisor: Dr Grant Lumsden

Co-supervisor: Mike Davies

Project Description

Design, analysis and prototype testing of electric motor-driven pumps for liquid nitrogen transfer

Required Skills

1. Mechanical design and analysis
2. Thermal analysis
3. Proficient with CAD (Solidworks)
4. System design, and component selection
5. Experience having prototype parts manufactured by suppliers

Project Outcomes

Pump(s) that can be used for LN2 transfer for lab experiments the 2026/26 project delivered an initial pump prototype. This project aims to further develop the prototype through experimentation and redesign. Specifically, improving the pressure and flow rate of the pump.

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Investigating superconducting switches for flux pumps

Primary Supervisor: Dr Dominic Moseley

Co-Supervisor: Dr Ben Mallett

Project Description

Superconductors allow the construction of innovative magnets and power systems beyond the capabilities of existing technologies. One potential application is magnetic confinement in clean, sustainable, fusion energy systems. These applications require stupendously high currents (>10,000 A) vastly beyond present commercial technologies or frameworks. Therefore, new design philosophies and techniques for creating, charging, and cooling these systems are necessary. At the Robinson Research Institute, we are a world leader in a superconductor technology which offer an efficient way to produce these high currents – "flux pumps". Flux pumps are an exciting technology with the potential to revolutionise many superconducting applications.

In this project, you will be a 'hands-on' part of team exploring different methodologies for flux pump design. Your focus will be on one element: the superconducting switches inherent for flux pump operation. In close contact with the team, you will operate existing experimental systems and analyse the data. Therefore, a desire to understand fundamental superconducting principles and utilise electromagnetic modelling techniques will be necessary. Furthermore, developing and modifying these systems may be required meaning that previous experience in CAD could prove useful. The expectation is that academic papers will be generate from this work.

Project Outcomes

The aims of project are to:

1. operate existing cryogenic systems and instrumentation to create exciting new datasets,
2. interpret this data using analytical understanding and modelling techniques,
3. potentially, modify the experimental apparatus on the basis of your results.

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Solid-state superconducting switches

Primary Supervisor: Dr Shen Chong

Secondary Supervisor: TBC

Project Description

For many superconducting applications being developed both locally and internationally, there is an urgent need for fast, compact, solid-state superconducting switches to overcome the current problems associated with modulation by temperature or magnetic field, which have slow response times and limited modulation depth.

Here we propose a multilayer thin-film device that, in its simplest form, comprises a layer of high-temperature superconductor (HTS) deposited on a spin-polarised current source layer, or vice versa. The HTS carries the current to be switched and, through the injection of spin-polarised current (either spin-up or spin-down) into the HTS, electronic carriers with parallel aligned spins cause a suppression of superconductivity, which relies on oppositely aligned spins.

Such a switching device would have important applications for charging superconducting magnets, power systems and superconducting logic circuits under cryogenic conditions.

Project Outcomes

The RA will investigate and develop expertise in novel heterostructures that integrate a spin-polarised current source, e.g. manganites ($La_{1-x}Ca_xMnO_3$) or $Y_3Fe_5O_{12}$ (YIG), with copper oxide (cuprate) high-temperature superconductors such as $Bi_2Sr_2CaCu_2O_{8+\delta}$ (Bi2212) and $YBa_2Cu_3O_{7+\delta}$ (Y123).

The RA will acquire skill in thin-film deposition using either magnetron sputtering or pulsed-laser deposition, as well as in the physical characterisation of the resulting films via scanning electron microscopy (SEM) and powder X-ray diffraction (XRD), and in magnetic and electronic characterisation using Robinson's high magnetic field measurement systems.

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Condition monitoring in superconducting cable for fusion magnets

Primary Supervisor: Dr Bart Ludbrook

Secondary Supervisor: Dr Shahna Muhammad Haneef

Project Description

This summer research project focuses on testing optical fibre sensors integrated into high-temperature superconducting (HTS) cables for quench detection in fusion magnet systems. The research assistant will contribute to the design and fabrication of instrumented cable samples, and undertake laboratory testing including thermal cycling, mechanical loading, and hotspot/quench experiments.

Tasks will include developing test rigs, integrating fibres into conductor stacks, and analysing sensor performance under representative operating conditions. This work will help validate sensing approaches for compact, robust quench protection systems and contribute to advancing sensing technologies for next-generation fusion magnets.

Project Outcomes

Demonstrate durability of fibre installed in HTS cable. Adapt instrumentation to measure temperatures, strains, and small voltage signals in test pieces. Set up strain cycling measurements. Thermal cycling. Collect and analyse data.

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Interface reactions of rare earth nitrides with superconducting electrodes

Primary Supervisor: Dr Catherine Pot

Secondary Supervisor: Dr Martin Markwitz

Project Description

Superconducting spintronics is a topical area of research for a low energy alternative to standard electronics in data centres. The choice of compounds is typically limited by chemical compatibility, including at interfaces. Al is commonly used as a superconducting electrode in such devices. Previous work has found undesirable interface reactions taking place between Al and insulating ferromagnetic GdN layers.

The Research Assistant will adjust experimental parameters to mitigate these interface reactions to enable GdN to be integrated with state-of-the-art superconducting electronic systems. The Research Assistant will use a molecular beam epitaxy system for growth of multilayer structures containing GdN and Al and will characterise the structures with conventional x-ray diffraction and magnetometry.

Project Outcomes

The Research Assistant will prepare a series of Al, AlN, and GdN layers (and combinations thereof) using molecular beam epitaxy and will study how this influences the topographic, crystallographic, and magnetic properties of the Gd-containing layers. The wider scalable cryogenic electronics team will rely on this work in the future to study the effects of GdN in Al superconducting spintronics applications.

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Megawatt-level superconducting rotor development

Primary Supervisor: Dr James Storey

Secondary Supervisor: Dr Sebastian Hellman

Project Description

High-power-density superconducting electric motors are needed to decarbonise large aircraft. Robinson Research Institute has a project underway to develop a lightweight, high-current, vibration tolerant superconducting rotor. We are looking for a motivated candidate with a physics or electrical engineering background to join our team to undertake experiments in this area.

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.

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Investigation of market size of superconducting motors for land and marine usage

Primary Supervisor: Prof. Zhenan Jiang

Secondary Supervisor: Dr James Storey

Project Description

Robinson Research Institute, Victoria University of Wellington is developing fully superconducting motors for aviation applications. The same technology can be applied to land and marine applications. However, the market size of fully superconducting motors for those applications are not well known.

The RA will investigate potential market size and supply chain of the fully superconducting motors for land and marine applications in combination of fuel-cell/liquid hydrogen technology, in particular, on heavy duty trucks and ferry ships. The RA will closely work with Robinson Research Institute supervisors and staff members of Wellington UniVentures (WUV, the commercialization arm of VUW). We are looking for a highly motivated business/commerce students with some science background who are doing their second- or third-year projects.

Project Outcomes

Project outcome will be a report which can inform the research direction of fully superconducting motors for land and marine applications.

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Next generation flux-pump design for space bound magnet systems

Primary Supervisor: Max Goddard-Winchester

Secondary Supervisor: Dr Ben Mallett

Project Description

The mass budget of a space-bound payload can be one of the most restrictive parameters in its development. Keeping mass down is often achieved by optimising the structural design over many constituents, with small savings coming from each. A significant mass reduction from the rework of a single component affords greater flexibility in the payloads overall design, and should be investigated when such an opportunity arises.

A superconducting magnet system developed at the Robinson Research Institute has recently flown to the International Space Station as a technology demonstration for applications in electric propulsion for spacecraft. A significant portion of the mass of the magnet system came from the self rectifier flux-pump: a superconducting power supply integral to the sustained operation of the magnet without incurring the resistive losses of traditional copper current leads.

In this project, you will be investigating the design of a next generation flux-pump for space bound magnets, with the aim of reducing their overall mass and footprint. Such optimisations are imperative for applications in superconducting space systems, as well as other terrestrial technologies like fusion. Your focus will be the design and build of a test-bed to experiment with design iterations in the context of a flux-pump. Experience with CAD software and the construction/operation of electrical systems would be valuable for the design/build aspects of the project respectively. To draw meaningful conclusions, competence in quantitative analysis and knowledge of electro-magnetic theory is required for the interpretation and processing of measured data.

Project Outcomes

- Construction and operation of an experimental rig for testing design iterations
- Characterise the electrical trade-offs of proposed design iterations
- Identify an optimal configuration in a given system

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