NEW ZEALAND SYNCHROTRON GROUP LIMITED
CAPABILITY BUILD FUND
CALL FOR PROPOSALS
(due 30 March 2023)

With support from MBIE, New Zealand Synchrotron Group Ltd (NZSG) has established a Fund to expand and build capability in synchrotron science in the New Zealand research community. A call is being made for proposals to undertake small research projects that will lead to researchers using and gaining experience on the new beamlines that are being constructed at the Australian Synchrotron. A full description of the BRIGHT Program and the eight new beamlines can be found at the end of this document.

The first of the new beamlines have recently started their user programs. These are:

- Micro-Computed Tomography (MCT)
- Medium Energy X-ray Absorption Spectroscopy 1 & 2 (MEX 1 & 2)
- Biological Small Angle X-ray Scattering (BioSAXS)

The remaining new beamlines are expected to be ready from late 2024 onwards. These are:

- Macromolecular Crystallography (MX3)
- Advanced Diffraction and Scattering 1 & 2 (ADS 1 & 2)
- Nanoprobe

The Capability Build Fund has two components – a Small Project Funding Scheme and a Travel Grant Scheme. Through the Small Project Scheme, 18 projects with a combined total value of $361,200 have already been funded. The Travel Grant Scheme has a value of $60,000 from which 4 grants have already been made and there is provision for a further 4 grants of up to $7,500 to successful applicants.

Small Project Grants
In this call, grants of up to $30,000 (excl GST) are available for projects targeted at any of the eight new beamlines, although priority will be given to applications focused on the MX3, ADS 1 & 2 and Nanoprobe beamlines.

The grants are expected to enable the successful recipients to undertake research leading to the production of samples that will require analysis on one of the new beamlines. As the Fund's purpose is to expand and build capability, priority will be given to proposals from new synchrotron users and from existing users where the expansion of capability by using the new beamlines can be clearly demonstrated.

Time on the new beamlines will be allocated through a competitive application process; however, NZSG has negotiated an additional amount of preferred access time on each new beamline for a period of 6 years from commissioning. Priority for beamtime from NZSG's entitlement will be given to projects that have received Capability Build funding.

Travel Grants
The grants are expected to enable the successful recipients to travel to use synchrotrons which have beamlines similar to those being constructed at the Australian Synchrotron. As the Fund's purpose is to expand and build capability, priority will be given to proposals from new synchrotron users and from existing users where the expansion of capability by using the new beamlines can be clearly demonstrated.

It is understood that securing beamtime at any synchrotron can take time, therefore applications can be for intended use of other facilities at any time within the next two years (up 30 June 2025), however payment of a grant will not be made until confirmation of beamtime has been received.

Successful applicants will also be expected to apply for beamtime on the relevant new beamline at the Australian Synchrotron once they become available. NZSG has negotiated an additional amount of preferred access time on each new beamline for a period of 6 years from commissioning. Priority for beamtime from NZSG's entitlement will be given to recipients of Capability Build Funding.

Proposals will be accepted from researchers or students from the following institutions:

- AgResearch Ltd
- Massey University
- University of Canterbury
- University of Waikato
- Auckland University of Technology
- University of Auckland
- University of Otago
- Victoria University of Wellington

Instructions to Applicants

Using no more than 4 A4 pages (12 pt Times New Roman, single-line spacing, standard margins), please prepare an application containing the following sections. In addition, CVs in standard Marsden/HRC/MBIE format of the members of the research team should be appended (limit of 5 pages per person).

1. Introduction	Summarise the proposal and describe the main reasons for, and benefits of, the proposed research
2. Research Project Description	Describe the project to be undertaken
3. Use of the Synchrotron	Describe which new beamline will be used, why it is necessary to use that beamline and any special considerations required to undertake analysis of your samples
4. Research Team	List the members of the proposed research group and their research status (academic staff member, technician, post-doctoral fellow, PhD student, etc.)
5. Capability Development	Describe the capabilities and experience (if any) in synchrotron science techniques and other similar techniques relevant to the target beamline
6. Budget (Small Project Applications)	Outline how you would spend the money (consumables, small equipment needed for sample preparation, testing samples on similar beam lines at synchrotrons other than the Australian Synchrotron, access to essential complementary techniques, personnel, etc.)
Budget (Travel Grants)	It is expected that the grant will contribute to the cost of travel and accommodation. Provide details of any other sources of funding for the proposed travel.

Items 4 and 5 together should not exceed one page. Item 6 should not exceed 1 page

Please send proposals, as a single pdf file, to synchrotron@royalsociety.org.nz by 4 pm on Thursday, 30 March 2023. All applications will be acknowledged. Applicants will be advised of the outcome of their proposals in late April.

BRIGHT PROGRAM – DESCRIPTION OF THE NEW BEAMLINES

The Australian Synchrotron is a major research facility located in Melbourne, adjacent to Monash University. It is one of Australia's most significant pieces of scientific infrastructure. It produces powerful beams of light that are used at individual experimental facilities to examine the molecular and atomic details of a wide range of materials. The advanced techniques are applied to research in many important areas including health and medical, food, environment, biotechnology, nanotechnology, energy, mining, agriculture, advanced materials and cultural heritage.

New Zealand has been a substantial partner in the Australian Synchrotron from its inception in 2006 and has provided funds towards the cost of both the beamlines upon which the experiments are undertaken and towards the cost of operations. These funds have been provided through a long-term partnership between MBIE and the New Zealand research sector, whose interests are managed by the New Zealand Synchrotron Group Ltd (NZSG).

The Australian Synchrotron was originally provided with 10 beamlines which have provided a range of techniques based on the X-rays and infrared radiation produced in the facility. The Synchrotron was designed with the capability to house 36 beamlines and recently, after the acquisition of the Synchrotron by ANSTO on behalf of the Australian government, the Australian and New Zealand research communities have come together to fund an additional eight beamlines that offer new capability and new techniques to expand and enhance the measurement capabilities of the facility. This is known as the BRIGHT Program.

For New Zealand, the new beamlines provide the opportunity to expand the range of research fields taking advantage of the new measurement techniques that will become available. Additionally, some existing work can be transferred to the new beamlines to obtain higher quality and higher resolution measurements and thereby maintain the world-class quality of New Zealand's research.

The eight beamlines and their expected completion dates are summarised in the table below and are followed by a brief description. A more technical description is given in the appended document together with a comparison of the capabilities of the new beamlines with those of the existing beamlines.

Beamline	**Original Date**	**Revised Date**
Micro-Computed Tomography (MCT)	Q3 2021	In operation
Medium Energy X-ray Absorption Spectroscopy 1 & 2 (MEX 1 & 2)	Q3 2021	In operation
Biological Small Angle X-ray Scattering (BioSAXS)	Q3 2022	In operation
Advanced Diffraction Scattering 1 & 2 (ADS 1 & 2)	Q3 2023	Q3 2024
Macromolecular Crystallography 3 (MX3)	Q3 2023	Q1 2024
Nanoprobe	Q3 2024	Q2 2025

<u>Advanced Diffraction & Scattering Beamline (ADS 1 & 2)</u>

High energy diffraction, pair distribution function analysis, Laue diffraction, energy dispersive diffraction imaging, time-resolved and extreme environment powder diffraction.

The ADS beamline will provide capabilities previously unavailable in Australasia and will remove barriers to world-class science conducted locally. It will be optimised for a range of leading-edge diffraction and scattering techniques including: studies of mineral formation and recovery under extreme conditions of temperature and pressure; non-destructive detection of cracking, fractures, textures, strains and deformations in large manufactured objects across the energy, automotive, transport, defence and aerospace sectors; maintenance and component failure studies of engineering infrastructure; and studies of corrosion and cracking in aluminium alloys used in aircraft and marine platforms

Complements the existing powder diffraction beamline (PD).

Biological Small Angle Scattering Beamline (BIOSAXS)

Small angle scattering structural characterisation of biomolecules (proteins, protein assemblies, viruses and hormone) using dedicated supporting infrastructure for high-throughput sampling.

The BIOSAXS beamline will be specifically designed for structural biology and will have equal or better specifications than the current SAXS beamline, combined with specialised facilities for protein work, giving scientists and industry unprecedented access to the most sophisticated tools available.

Applications include a great impact in the study of the structure of larger biomedical molecules involved in the critical functions of human cells, such as proteins and the nucleic acids that comprise the genetic material within cells, and the study of interactions between biological molecules and new drugs.

The ADS beamline will complement the existing Small Angle X-ray Scattering (SAXS) beamline and the Macromolecular and Micro Crystallography (MX1 and MX2) beamlines, both of which are heavily used and oversubscribed by New Zealand researchers.

Micro-computed Tomography Beamline (MCT)

High resolution 3D imaging with applications in the biosciences, geomaterials, palaeontology and materials science.

Micro-computed tomography opens a window on the micron-scale 3D structure of a wide range of samples relevant to many areas of science including life sciences, materials engineering, anthropology, palaeontology and geology. The MCT beamline will enable high-throughput and dynamic micro-CT down to submicron resolution. A key feature will be speed of data collection, focusing both on applications where many samples are imaged and experiments where a single specimen is imaged many times to observe dynamic responses to temperature, pressure, strain or other changing environmental conditions.

The MCT beamline will complement the existing Imaging and Medical (IM) beamline.

Medium Energy XAS Beamline (MEX 1 & 2)

Tender to hard X-ray absorption spectroscopy and microspectroscopy.

The MEX beamline will provide medium energy absorption spectroscopy optimised for cutting-edge applications in biological, agricultural and environmental science. It will cover an energy range not currently available to Australian and New Zealand researchers, allowing X-ray absorption spectroscopy measurements of a group of very important elements such as sulphur, phosphorus, silicon and chlorine. Focusing optics will add microprobe

Applications include environmental studies of inorganic, organophosphate and organochlorine pollutants, water pollution, plant growth, micro-nutrient transport and soil salinity, as well as
studies of biomineralisation.

The MEX beamline will complement the existing X-ray Absorption Spectroscopy (XAS) and X-ray Fluorescence Microscopy (XFM) beamlines.

Macromolecular Crystallography 3 (MX3)

Micro-focus macromolecular crystallography for small and/or poorly diffracting samples.

The most important targets for the design of novel drugs include difficult large assemblies, which rarely produce crystals of sufficient size for analysis using traditional macro or micro-molecular crystallography beamlines. The MX3 beamline (originally known as the High Performance Macromolecular Crystallography Beamline) will enable the study of sub-5μm crystals, providing a state-of-the-art high-throughput facility for researchers to study very small, weakly diffracting crystals of protein fragments and solution studies of protein fragments.

Applications include: in membrane proteins and receptors; virology; and materials science. The beamline will take advantage of the latest developments in high-throughput crystallography, including robot handling of 96-well crystallisation plates.

The MX3 beamline will complement the existing Macromolecular (MX1) and Micro Crystallography (MX2) beamlines.

High Coherence Nanoprobe Beamline (Nanoprobe)

High resolution X-ray microspectroscopy and elemental mapping, coherent diffraction imaging.

Capable of accessing the K-edges of elements from phosphorous to silver, the HCN beamline will suit applications in chemistry, biological sciences, condensed matter physics, nanotechnology, environmental sciences and geology. The high coherence properties of the beamline will make it suitable for the development of new techniques in coherent X-ray science – an area that has been undergoing tremendous growth across the globe.

The Nanoprobe beamline will complement the existing X-ray Fluorescence Microscopy (XFM) beamline.