NEW ZEALAND
SYNCHROTRON GROUP

ANNUAL REPORT 2022

Contents

CHAIRMAN'S REPORT

The past year, the sixteenth in which the New Zealand Synchrotron Group Ltd (NZSG) has provided support for New Zealand researchers using the Australian Synchrotron, has been one of a slow but steady recovery from the impact of the Covid pandemic. Researchers have, until recently, been unable to travel to Melbourne to use the Australian Synchrotron so until early 2022 it was necessary to postpone work that could not be undertaken remotely. The pandemic also presented the research sector in New Zealand with financial and operational challenges that have led to a decrease in research activity with a consequential reduction in the previous high demand for synchrotron beamtime.

Despite those issues, it was still possible to select and award beamtime to high quality research projects from the proposals submitted. ANSTO and the staff at the Australian Synchrotron have given priority to ensuring that New Zealand has received as much beamtime as possible. In particular, they have been extremely helpful in rescheduling around lockdowns and travel restrictions, making extra time available to undertake the experiments where necessary. More than 311 shifts of beamtime were delivered by the Australian Synchrotron to New Zealand researchers during the past year, most by remote access where samples were shipped to Melbourne and facility staff undertook the measurements. When travel resumed in April 2022, most of the backlog from earlier rounds was cleared and as of June 2022, only 15 shifts remained which are expected to be delivered by December 2022.

COVID has also affected the timetable for the construction of the new beamlines at the Australian Synchrotron. A year ago, only small delays were indicated, however, ongoing manufacturing delays with equipment suppliers, shipping issues and staff recruitment delays have meant that there have been further delays in the completion of all the new beamlines. Nevertheless, progress has been made and the first of them, the MCT beamline, will commence its User Programme in November 2022 and will be quickly followed in early 2023 by the next three beamlines. The remaining four beamlines are now expected to be ready for operation in 2024 and 2025. New Zealand is a major contributor of funding for the new beamline programme and NZSG has committed to providing A$12 million towards the programme, A$10.8 million of which has already been paid.

In 2020 the company secured funding from MBIE to establish a $400k Capability Build Fund to support the investment in the new beamlines at the Australian Synchrotron by seed-funding new projects and travel to enable researchers to be ready for the new beamlines as each is commissioned. This is important as the new beamlines offer new measurement techniques and for some beamlines it is likely that researchers who are unfamiliar with synchrotron science techniques will be potential new users. After a small delay caused by COVID, the Fund was launched in February 2021 with the first eight projects with a value of $183k being funded. A second round was held in February 2022 and a further ten projects with a value of $179k were selected. These projects will be run for up to two years and have already been reflected in applications to use the new beamlines. The travel grant component of the Fund was delayed because of the Covid travel restrictions but was finally launched in May 2022. This part of the Fund assists researchers to travel to other synchrotrons to learn the new techniques.

The company had budgeted for a small operating loss of $17,326 for the year, arising mainly from a decision to waive $60k of income that would normally have been received from the funding institutions to support the company’s operations. However, there was a significant and unexpected consequence of the fall in the exchange rate between the New Zealand and Australian dollars during the year. This caused the value of the financial derivatives held by the company to protect against such an event, and of the Australian currency funds held in the company’s bank accounts, when reported as New Zealand dollars for the Financial Statements, to increase. The gain in value of the financial derivates was $54,769 and on foreign exchange fluctuations was $23,327. These, together with small savings due to many of the usual synchrotron science support activities not being able to be undertaken during the year resulted in the company producing a final result of a $129,138 surplus. The surplus will be used to strengthen future synchrotron science support activities such as student attendance at workshops and training schools. Shareholder equity rose from $632,395 to $761,533.

As indicated in previous reports, changes in the exchange rate are one of the largest challenges the company faces. This has been managed by taking a series of forward contracts to lock in and provide certainty around future cash flow. The company holds forward contracts to cover the annual payments to ANSTO until 2024 and in October 2021 purchased vanilla options to provide protection against a substantial fall in the exchange rate for the final payments in 2025 and 2026.

The board has been very well supported by the Royal Society Te Apārangi who provide secretariat services to NZSG. In particular, I would like to acknowledge the contribution make by Dr Don Smith in assisting the board, administering the New Zealand Synchrotron Support Programme and looking after our interests in Australia and on the Asia Oceania Forum for Synchrotron Radiation Research. I would also like to acknowledge the contribution from the Chair of the Access Committee, Emeritus Professor Geoff Jameson and its members Professor Vic Arcus, Associate Professor Vladimir Golovko and Associate Professor Geoff Waterhouse who have evaluated all requests for access.

Finally, I would like to welcome Dr Brett Cowan who joined the Board in November 2021 and thank him and fellow directors, Emeritus Professor Geoff Jameson, Professor Catherine Day and Professor Jim Metson.

G.A. Carnaby

GA Carnaby
Chair

BUSINESS REVIEW

COVID-19 Impact

As mentioned in the Chairman's Report, the Covid pandemic continued to have an impact on the company's operations over the past year. The most noticeable effect was that New Zealand users of the Australian Synchrotron were unable to travel to Melbourne and had to have their experiments or measurements run remotely by the Synchrotron staff. In some instances, work had to be postponed until travel resumed. In other instances, only some of the planned experiments or measurements could be made. The resumption of travel from April 2022 has alleviated that situation. The more significant impact, perhaps for the medium future, has been the reduction in research activity during the pandemic, particularly in the universities, due to the reduction in the numbers of postgraduate students and postdoctoral researchers and staff having to divert their time to online teaching. The number of proposals for merit beamtime received during the year was not quite sufficient to fully use the merit beamtime entitlement that New Zealand receives each year. There is some concern about the rate at which demand will recover. This may be exacerbated by the commencement of operations of the first of the new beamlines with some research that would have used the existing beamlines being diverted to the new beamlines. This situation will be addressed both through the institutions and by workshops for new and potential users to encourage increased interest.

On the positive side, and with the cooperation of the staff at the Australian Synchrotron, the resumption of travel has enabled almost all of the backlog of work that had had to be postponed to be completed. 331 shifts of merit beamtime were delivered in the 2021/22 year, well above the standard 267 shift entitlement.

Also as mentioned previously, ANSTO also demonstrated its support by agreeing to a proposal from NZSG to modify the timetable for the annual payments over the remaining life of the Bright Funding Agreement to recognise the financial impact of COVID on institutions. Variations were made to both the Bright Funding Agreement and the Funders' Agreement in 2020 which meant that institutions did not have to make any access payment for 2020/21 and payments were set at the 50% level in for 2021/22 and 2022/23. Increased payments will be made in the subsequent three years so that the full contracted amount is paid. By then, the annual contribution to the new beamlines will have been completed, so the change agreed to more evenly balances the cash flow for institutions from the 2021/22 year until the end of the contract period.

Investment in the Australian Synchrotron and Access Rights

The New Zealand research community has been a significant stakeholder in the Australian Synchrotron since its inception in 2007. At that time, the Synchrotron was predominantly owned by the Victorian government. Through NZSG, New Zealand held shares in both the ownership and operating companies set up at the time. In 2016, ownership of the Australian Synchrotron was transferred to the Australian government and was vested in the Australian Nuclear Sciences and Technology Organisation (ANSTO).

Although the Synchrotron is now operated by an entity independent of the original foundation investors, its operations are overseen by a Stakeholders Committee that monitors the Synchrotron's operations, budget and development and provides advice to ANSTO. New Zealand, as the largest single contributor towards the cost of the new beamlines being added to the facility and a significant user group, is a key stakeholder. The NZSG board appointed its Executive Officer, Dr Don Smith, as the company's representative on the Stakeholders Committee. Dr Smith is also the contact person for day-to-day matters associated with access arrangements and user liaison with ANSTO.

New funding and access arrangements were negotiated in 2017 which gave New Zealand an extended period of guaranteed access until June 2026, increased the number of merit shifts on the existing beamlines from 201 to 267 per year, and established access rights to both merit and preferred access beamtime on the new beamlines that will be constructed over the next 5 years. New Zealand makes an annual payment of A$1.5 million towards the cost of access and is contributing A$12 million towards the cost of the new beamlines. Access and capital costs are equally shared by the New Zealand research sector and the government. The government's A$6 million contribution was paid to ANSTO during the 2017/18 financial year. The sector's share is being paid in 5 instalments, the fourth of which was made in 2021/22.

By virtue of their participation in the joint funding arrangement with the government, researchers and students from the Universities of Auckland, Canterbury, Otago and Waikato, Auckland University of Technology, Massey University, Victoria University of Wellington and AgResearch Ltd are eligible to apply for merit beamtime on the Australian Synchrotron.

Decisions on Access and Funding Support

The funding and access agreement with ANSTO allows the company to decide how our entitlement to merit beamtime is allocated, giving best advantage to New Zealand. This includes being able to decide the distribution of beamtime between beamlines, and on the ranking of the New Zealand proposals to each beamline. New Zealand researchers from the institutions that are providing funding are eligible to apply to the Australian Synchrotron for beamtime. Their applications are first assessed on a merit basis by the Synchrotron's beamline panels and the final selections are made by an Access Committee that was established by the board to make the decisions on applications for beamline access. The members of the Committee for the past year were:

Emeritus Professor Geoff Jameson, Massey University (Chair)
Professor Vic Arcus, University of Waikato
Associate Professor Vladimir Golovko, University of Canterbury
Associate Professor Geoff Waterhouse, University of Auckland

The Committee held Zoom meetings throughout the year to make their selections. The table at the end of this section of the Annual Report lists the New Zealand researchers who have gained beamline access to the Australian Synchrotron from July 2021 onwards and summarises any travel funding or sample shipping support provided.

Use of the Australian Synchrotron by New Zealand Researchers

Approximately 80% of the available beamline time on the ten beamlines is assigned to a “merit access” pool and competitive applications are sought from researchers worldwide, including from New Zealand. Every four months, the Australian Synchrotron makes calls for proposals. Applications are made directly to the Australian Synchrotron, but as explained above, NZSG oversees the ultimate selection of which New Zealand applicants receive beamtime. Since late 2008, in recognition of the contribution New Zealand makes to operating costs, the Australian Synchrotron began contributing towards the travel costs for New Zealand researchers who obtained beamtime at the Australian Synchrotron on an equal basis with Australian researchers. These funds are administered through NZSG. During most of the past year when travel was not possible, the funds were used instead to reimburse the cost of shipping samples to Australia.

Under the access regime agreed with ANSTO in 2017, New Zealand researchers are entitled to receive 267 shifts of merit beamtime which is approximately 6.6% of the available beamtime. Prior to Covid there was significant demand for beamtime and the number of shifts requested substantially exceeded the entitlement. In 2019/20 only 61% of the beamtime requested was able to be awarded. But, as mentioned above, a reduction in research activity, particularly in the universities, and the restrictions on travel has resulted in fewer applications for beamtime being received. All applicants during the past two years whose proposals met the required quality standard received beamtime. The statistics for the past year are summarised in the table and graphs below.

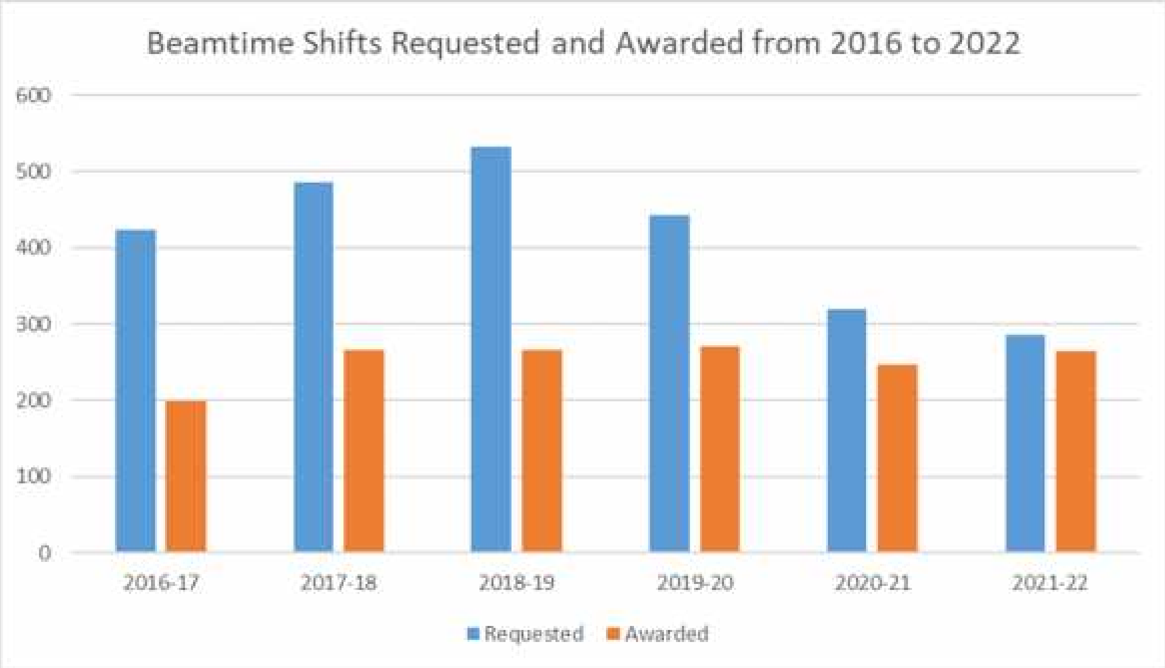
Table 1: Success Rate for NZ Beamtime Applications – 2021/22

Beamline*	**No. Shifts Requested**	**No. Shifts Awarded†**		**No. Appl’ns. Received**	**No. Awarded Beamtime**	
IMBL	21	15	71%	2	2	100%
IRM	36	33	92%	3	3	100%
PD	0.4	0.4	100%	1	1	100%
SAXS	31	33	106%	5	5	100%
SXR	27	30	111%	2	2	100%
THz	9	9	100%	1	1	100%
XAS	30	30	100%	5	5	100%
XFM	12	15	100%	2	2	100%
Subtotal	**166.4**	**165.4**	**99%**	**21**	**21**	**100%**
MX (CAPs)	119	99	83%	8	8	100%
Overall	**285.4**	**264.4**	**93%**	**29**	**29**	**100%**

† In four instances, more beamtime was awarded than was requested

* A description of the beamlines and the abbreviations used are given on pages 19-20

Figure 1: Beamtime demand and shifts awarded in the last 6 years



Science Achievements

New Zealand researchers are strong contributors to the scientific output of the Australian Synchrotron. In the past year 44 refereed papers arising from previous work at the Synchrotron were published (7% of the total output of papers from all sources), 10 of which were in high-impact journals (impact factor > 7). This is a reduction on previous years, a trend which has been seen across all Synchrotron users due to the reduction in research activity.

Five of the New Zealand papers highlighted by the Australian Synchrotron in their annual report to the user community are described below.

Professor Konstantin Pavlov, Professor Ben Kennedy, Dr Thomas Li and Samantha Alloo from the University of Canterbury and colleagues at Monash and CSIRO arising from work on the Imaging and Sensing (IM) beamline ***Dark-field tomography of an attenuating object using intrinsic X-ray speckle tracking***, *Journal of Medical Imaging, 9, 031502 (2022)*

> This study investigated how an intrinsic speckle tracking approach to speckle-based X-ray imaging can be used to extract an object's effective dark-field (DF) signal, which is capable of providing object information in three dimensions. The effective DF signal was extracted using a Fokker–Planck type formalism, which models the deformations of illuminating reference beam speckles due to both coherent and diffusive scatter from the sample. Effective DF projection images, as well as the DF tomographic reconstructions of the wood sample, are presented. DF tomography was performed using a filtered back projection reconstruction algorithm. The DF tomographic reconstructions of the wood sample provided complementary, and otherwise inaccessible, information to augment the phase contrast reconstructions, which were also computed.

Another, arising from studies on the SAXS beamline was by Professor Richard Haverkamp, Dr Hannah Wells and Stephanie Gunn from Massey University and a colleague from ANSTO ***Collagen arrangement and strength in sausage casings produced from natural intestines,*** *Food Hydrocolloids, 129, 107612 (2022)*

> Natural sausage casings are made from the submucosa of intestines, a collagen-rich layer traditionally obtained from bovine, porcine and ovine sources. Collagen provides strength to animal tissues, in part due to the structural arrangement of the collagen fibrils. Synchrotron-based small angle X-ray scattering (SAXS) was used to determine the collage fibril orientation, orientation index (OI) and D-spacing of bovine, porcine and ovine sausage casings. Tear strength was measured both parallel and perpendicular to the length of the intestine. The D-spacing is similar in materials from all three species. The OI measured edge-on is similar in the three species; however, the OI measured normal to the surface showed clear differences, being highest for bovine, then porcine, and then ovine. When normalized for thickness the tear strengths are similar for all species. The differences in absolute strength (bovine > porcine > ovine) are thus due to differences in thickness. The material properties of the sausage casings from all three species are similar, which is surprising since in other tissues (e.g. dermis) there are marked differences in the structural arrangement of collagen and these differences lead to fundamental differences in the mechanical properties of these materials.

Another was from Dr Lauren Macreadie formerly of Massey University and now the University of Sydney and colleagues at Manchester, RMIT and CSIRO arising from MX2 studies. ***Reversing Benzene/Cyclohexane Selectivity through Varying Supramolecular Interactions Using Aliphatic, Isoreticular MOFs****, ACS Applied Materials Interfaces, 13, 30885–30890 (2021)*

> Effective solid-state adsorbent materials, such as metal organic frameworks (MOFs), rely upon tailored void spaces for selective adsorption of one component from a mixture. This is particularly crucial when separating challenging mixtures such as benzene (Bz) and cyclohexane (Cy) requiring a highly expensive and energy intensive process. Employing bulky "3D-linkers" to construct MOFs leads to materials with unique, contoured pore shapes which consequently allow for significant control over guest adsorption preferences. In this study, the authors explore the selectivity path between planar and 3D-linkers and their preference to adsorb either Cy or Bz. To validate this principle, the adsorption selectivity of Cy and Bz in 3DL-MOF-1 ([Zn4O(pdc)3] (pdc = bicylo[1.1.1]pentane-1,3-dicarboxylate), CUB-5, and MOF-5 was explored. MOF-5 exhibits a selective preference for Cy adsorption at low pressures, contrary to popular belief, while CUB-5 and 3DL-MOF-1 are Bz selective.

Dr Courtney Ennis, Dr Jonathan Falconer and Dr Carla Meledandri from the University of Otago and Seok J. Lee from Massey University from studies on the THz beamline ***Nanoscale Cu(II) MOFs Formed via Microemulsion: Vibrational Mode Characterization Performed using a Combined FTIR, Synchrotron Far-IR, and Periodic DFT Approach****, Journal of Physical Chemistry C, 125, 20426-20438 (2021)*

> Two Cu(II) metal–organic frameworks (MOFs) were prepared on the nanoscale at room temperature using a microemulsion method, namely, [Cu_3(BTC)2(H2O)$_3$] (BTC = benzene-1,3,5-tricarboxylate), known as HKUST1 (1), and [Cu_2(OH)(BTC)(H_2O)]·2H2O (2). Thermochemical and gas sorption properties of the microporous topologies were characterized by mid- and far-infrared vibrational spectroscopy, supported by periodic density functional theory calculations. The mid-infrared profile of 1 appeared altered in response to gas sorption under variable

temperature and pressure conditions. Vibrational mode analysis indicated the most sensitive infrared peaks were associated with the internal vibrations of organic linker moieties indirectly coupled to the Cu(II)– gas coordination site, activated by a lowered symmetry induced by guest interactions. Synchrotron far-infrared spectroscopy was shown to be a useful diagnostic for the microstructure of 1 and 2 where different temperature dependences were displayed in the low-frequency region. The loss of residual water during the activation of 2 at elevated temperature coincides with peaks indicative of free paddle-wheel moieties emerging in the far-IR spectra. As demonstrated for both materials 1 and 2, vibrational mode analysis was effective in screening MOF materials for their propensity toward gas uptake and, inversely, the diffusion of guest species such as adsorbed water from the microporous environments.

Another is a paper by Associate Professor Geoff Waterhouse from The University of Auckland, Professor Paul Kruger from the University of Canterbury and Professor Shane Telfer from Massey University together with colleagues from China. ***Developing new high-capacity porous sorbent catalysts to efficiently extract uranium from seawater***. *H. Yang, X. Liu, M. Hao, Y. Xie, X. Wang, H. Tian, G. I. N. Waterhouse, P. E. Kruger, S. G. Telfer, S. Ma, Advanced Materials. 2021, 33, 2106621.*

Uranium extraction from seawater provides an opportunity for sustainable fuel supply to nuclear power plants. Herein, an adsorption-electrocatalysis strategy is demonstrated for efficient uranium extraction from seawater using a functionalized iron-nitrogen-carbon ($Fe-N_x$ -C-R) catalyst, comprising N-doped carbon capsules supporting FeN_x single-atom sites and surface chelating amidoxime groups (R). The amidoxime groups bring hydrophilicity to the adsorbent and offer surface-specific binding sites for UO_2^{2+} capture. The site-isolated FeNx centres reduce adsorbed UO_2^{2+} to UO_2^{+} . Subsequently, through electrochemical reduction of the FeN_x sites, unstable U(V) ions are reoxidized to U(VI) in the presence of Na^+ resulting in the generation of solid $Na_2O(UO_3 \cdot H_2O)_x$, which can easily be collected. $Fe-N_x$ -C-R reduced the uranium concentration in seawater from ≈3.5 ppb to below 0.5 ppb with a calculated capacity of ≈1.2 mg g^{-1} within 24 h. To the best of the knowledge, the developed system is the first to use the adsorption of uranyl ions and electrodeposition of solid $Na_2O(UO_3 .H_2O)_x$ for the extraction of uranium from seawater. The important discoveries guide technology development for the efficient extraction of uranium from seawater.

A full list of the researchers who received merit beamtime over the past year is presented on pages 11-18. These projects cover a very broad range of science topics, and many have involved training of young researchers.

Capability Build Funding and Other Support for Synchrotron Scientists

In late 2022 the first of the new beamlines at the Australian Synchrotron will be commissioned and become available for user access. New Zealand has preferred access rights to all 8 new beamlines and it will be important to take up the full entitlement. Recognising that some of the new beamlines offer new techniques and that there will opportunities for researchers who are not currently familiar with the Synchrotron, NZSG has created a Capability Build Fund to provide seed funding for projects that will generate samples for researchers to use on the new beamlines and also to provide travel funding, either for travel during the commissioning period or for researchers to use similar beamlines at other synchrotrons. The purpose of the Fund is to introduce and upskill New Zealand researchers in the techniques which will become available on the new beamlines and extend the range and quality of science New Zealand is able to undertake. NZSG secured $300,000 funding from MBIE through an extension to the existing SIFF contract and is contributing $100,000 from reserve funds. After a delay caused by COVID-19, the Fund was launched in February 2021 for project seed funding only with 8 projects with a value of $183k being selected. A second small project round was held in February 2022 and a further 10 projects were selected. The travel funding component of the Fund was launched in April 2022 and 3 travel grants have since been awarded. The small project awards made in 2021/22 are listed in Table 2.

Table 2: Recipients of Capability Build Fund project funding

Applicants	**Institution**	**Beamline**	**Project Title/Topic**	**Funding**
Small Project Grants – Round 2				
Fellner	Otago	MX3	Three projects to develop capability for the MX3 beamline	$20k
Hartinger	Auckland	Nanoprobe	Cancer Cell Mitochondria Targeted with Triphenyl-phosphonium-functionalised Organometallic Anticancer Agents: A Synchrotron Investigation	$20k
Richena et al	AgResearch	MEX2	Distribution of mechanically disrupted disulfide bonds in tensile stressed wool fibres observed using medium energy X-ray absorption spectroscopy	$22k
Verbeek et al	Auckland	ADS1, MCT	Characterising the Degree of Crystallinity and Orientation of Recycled Thermoplastic Blends in the Fibre-Matrix Interphase by In-Situ Tensile Tests on the ADS-1/MCT Beamlines	$20k
Allison et al	Canterbury	MX3	1. Integral membrane protein of Campylobacter jejuni N-linked glycosylation pathway 2. Membrane-associated pore-forming proteins associated with type VII secretion systems 3. TRAPS (TRipartite ATP-independent Periplasmic (TRAP) transporters)	$20k
Giles	Otago	Nanoprobe	Organoselenium drugs to Selectively Target Triple Negative Breast Cancer	$18.2k
Alloo et al	Canterbury	MCT	Development of experimental and theoretical protocols for DF tomography using a SBXI technique and testing a new phase-retrieval technique	$10k
Calvelo-Pereira et al	Massey	MCT	Linking carbon stabilisation with pore structure in paleosols	$18k

Applicants	Institution	Beamline	Project Title/Topic	Funding
Johnston et al	Canterbury	MX3	Looking inside the active site using tiny crystals: Molecular level insights into the enzyme catalysis and novel regulation mechanisms	$20k
Allen et al	Canterbury	MEX, Nanoprobe	X-ray Adsorption Spectroscopy on MEX 1&2 and Chemical Mapping on the X-ray Fluorescence Nanoprobe to Investigate the Phosphonic Acid and Sulfur Modification of β-Ga2O3 Surfaces	$10k
Total				**$178.2k**

As well as overseeing New Zealand researcher access to the Synchrotron, NZSG provides additional support by administering the travel funding available from the Australian Synchrotron, to which all groups awarded merit access are entitled.

Support was provided for students or emerging researchers to further develop their knowledge of synchrotron science techniques through attendance at the annual User Meeting held at the Australian Synchrotron and at the annual Synchrotron Radiation School run by the Asia Oceania Forum for Synchrotron Radiation Research (AOFSRR), of which NZSG is a member. The most recent User Meeting was held as a virtual meeting in November 2020. The last AOFSSR School was held at the National Synchrotron Radiation Research Center in Tawian in November 2019. Due to COVID-19, the School was not held in 2020 or 2021. The 2022 School has also been postponed and now will be held in March 2023 in Thailand.

D K W Smith
Executive Officer
Secretariat

New Zealand Research Groups Awarded Beamtime (July 2021 – June 2022)

The following New Zealand research groups were awarded or received merit time at the Australian Synchrotron between July 2021 and June 2022. The table also shows the value of any travel or sample shipping funding provided.

Researchers	Institution	Cycle	Beamline	Access	Funding
Prof Martin Allen Prof Roger Reeves Liam Carroll Dr Rodrigo Gazoni	Canterbury Canterbury Canterbury Canterbury	2021-2	Soft X-ray Spectroscopy (SXR) "Sulfur passivation of the electron accumulation at the surfaces of square SnO_2 nanostructures and other technologically-important oxide semiconductors"	Merit Access 9 shifts 6-9 July	$0
Dr Adam Middleton Prof Kurt Krause Dr Peter Mace Prof Catherine Day Assoc Prof Sigurd Wilbanks Assoc Prof Brian Monk Dr Matthias Fellner	Otago Otago Otago Otago Otago Otago Otago	2021-2	Macromolecular Crystallography (MX1) "University of Otago Structural Biology Group"	Merit Access 3 shifts 11-12 July Beamtime not used.	$0
Prof Emily Parker Prof Geoff Jameson Dr Ron Ronimus Prof Vic Arcus Dr Andrew Sutherland-Smith Assoc Prof Wayne Patrick Dr David Comoletti	VUW Massey AgResearch Waikato Massey VUW VUW	2021-2	Macromolecular Crystallography (MX1) "Protein Structure and Function: AgResearch NZ, Ferrier Institute and Waikato, Victoria and Massey Universities"	Merit Access 3 shifts 13-14 July	$6,652
Assoc Prof Chris Squire Dr Ghader Bashiri Dr Richard Kingston Assoc Prof Shaun Lott Dr David Goldstone Dr Ivanhoe Leung	Auckland Auckland Auckland Auckland Auckland Auckland	2021-2	Micro Crystallography (MX2) "2021 CAP Program"	Merit Access 3 shifts 16-17 July	$6,523
Dr Adam Hartland Sebastian Hoepker	Waikato Waikato	2021-2	X-ray Fluorescence Microscopy (XFM) "High-resolution reconstruction of past New Zealand hydroclimate variability from stalagmite trace elements"	Merit Access 6 shifts 20-22 July	$0

Researchers	Institution	Cycle	Beamline	Access	Funding
Dr Ingrid Ukstins Prof Shane Cronin Dr Jie Wu Madison Anae	Auckland Auckland Auckland U. Iowa	2021-2	Infra-red Microscopy (IRM) "Quantifying OH, CO and Hydrocarbons in mantle-derived olivine, Auckland Volcanic Field: Insights into mantle volatiles and magma ascent rates"	Merit Access 15 shifts 27 Jul-1 Aug	$0
Prof Emily Parker Prof Geoff Jameson Dr Ron Ronimus Prof Vic Arcus Dr Andrew Sutherland-Smith Assoc Prof Wayne Patrick Dr David Comoletti	VUW Massey AgResearch Waikato Massey VUW VUW	2021-2	Micro Crystallography (MX2) "Protein Structure and Function: AgResearch NZ, Ferrier Institute and Waikato, Victoria and Massey Universities"	Merit Access 2.5 shifts 5-6 August	Incl in MX1 funding above
Zainab Makinde Prof David Williams Prof Duncan McGillivray Aakanksha Rani	Auckland Auckland Auckland Auckland	2021-2	Small/Wide Angle X-ray Scattering (SAXS) "Assembly in Langmuir Blodgett films of peptides and polyoxometalates"	Merit Access 3 shifts 5-6 August	$0
Prof Richard Haverkamp Dr Peter Kappen Dr Katie Sizeland Dr Celia Kueh Prof Chris Cunninghan	Massey Austr Synch ANSTO Massey Massey	2020-2	X-ray Absorption Spectroscopy (XAS) "Rhodium supported on carbon for the electrochemical reduction of nitrogen". **COVID Affected Rescheduled from 2020**	Merit Access 9 shifts 6-9 August	$0
Dr Duane Harland Dr Jitraporn Vongsvivut Dr Jeffrey Plowman Dr Marina Richena Dr Santanu Deb-Choudhury	AgResearch Aust Synch AgResearch AgResearch AgResearch	2021-2	Infrared Microscope (IRM) "Distribution of mechanically disrupted disulfide bonds and protein structures in tensile stressed wool fibres observed using synchrotron-IR microspectroscopy, Part 2"	Merit Access 15 shifts 11-16 August	$199
Dr Adam Middleton Prof Kurt Krause Dr Peter Mace Prof Catherine Day Assoc Prof Sigurd Wilbanks Assoc Prof Brian Monk Dr Matthias Fellner Bahram Pooreydye Dr Ashley Campbell Dr Prasanth Padala	Otago Otago Otago Otago Otago Otago Otago Otago Otago Otago	2021-2	Micro Crystallography (MX2) "University of Otago Structural Biology Group"	Merit Access 2.5 shifts 13-14 August	Incl in MX1 funding above
Assoc Prof Tilo Soehnel Martin Spasovski Sneh Patel	Auckland Auckland Auckland	2021-2	Powder Diffraction (PD) "Investigating phase transitions in trirutiline and bixbyite compounds through Synchrotron PXRD"	Rapid Access 2 hours Unknown date	$0

Researchers	Institution	Cycle	Beamline	Access	Funding
Assoc Prof Tilo Soehnel Mark Appletree Sneh Patel	Auckland Auckland Auckland	2021-2	Powder Diffraction (PD) "Crystal structure determination of cobalt oxides"	Rapid Access 1.5 hours Unknown date	$0
Assoc Prof Chris Squire Dr Ghader Bashiri Dr Richard Kingston Assoc Prof Shaun Lott Dr David Goldstone Dr Ivanhoe Leung	Auckland Auckland Auckland Auckland Auckland Auckland	2021-3	Micro Crystallography (MX2) "2021 CAP Program"	Merit Access 3 shifts 25-26 Sept	$0
Prof Emily Parker Prof Geoff Jameson Dr Ron Ronimus Prof Vic Arcus Dr Andrew Sutherland-Smith Assoc Prof Wayne Patrick Dr David Comoletti	VUW Massey AgResearch Waikato Massey VUW VUW	2021-3	Micro Crystallography (MX2) "Protein Structure and Function: AgResearch NZ, Ferrier Institute and Waikato, Victoria and Massey Universities"	Merit Access 5 shifts 7-8 October and 27-28 October	$3,526
Assoc Prof Aaron Marshall Megan Girdwood Dr Chris Bumby	Canterbury Canterbury VUW	2021-3	X-ray Absorption Spectroscopy (XAS) "XAS of the vanadium oxide phase separated from NZ ironsand and vanadium-rich steel-mill slag"	Merit Access 6 shifts 9-11 October	$0
Dr Adam Middleton Prof Kurt Krause Dr Peter Mace Prof Catherine Day Assoc Prof Sigurd Wilbanks Assoc Prof Brian Monk Dr Matthias Fellner Bahram Pooreyde Dr Ashley Campbell Dr Prasanth Padala	Otago Otago Otago Otago Otago Otago Otago Otago Otago Otago	2021-3	Macromolecular Crystallography (MX1) "University of Otago Structural Biology Group"	Merit Access 3 shifts 15-16 October	$7,548
Assoc Prof Johan Verbeek Dr Mark Tobin Daniel Nguyen Priyal Yappa	Auckland Austr Synch Auckland Auckland	2021-3	Infrared Microscope (IRM) "Molecular orientation near the interface in polymer blends"	Merit Access 9 shifts 19-22 October	$0
Assoc Prof Aaron Marshall Prof Sally Brooker Assoc Prof Vladimir Golovko Johan Hamonnet	Canterbury Otago Canterbury Canterbury	2021-3	X-ray Absorption Spectroscopy (XAS) "XAS analysis of carbon-supported cobalt phthalocyanine CO_2 reduction catalysts"	Merit Access 6 shifts 20-22 October	$0

Researchers	Institution	Cycle	Beamline	Access	Funding
Prof Emily Parker Prof Geoff Jameson Dr Ron Ronimus Prof Vic Arcus Dr Andrew Sutherland-Smith Assoc Prof Wayne Patrick Dr David Comoletti	VUW Massey AgResearch Waikato Massey VUW VUW	2021-3	Macromolecular Crystallography (MX1) “Protein Structure and Function: AgResearch NZ, Ferrier Institute and Waikato, Victoria and Massey Universities”	Merit Access 3 shifts 23-24 Oct	Incl in MX2 claim above
Dr Joanna Hicks Prof Geoff Jameson Prof Vic Arcus Prof Emily Parker Dr Elen Harjes Ruby Roach Tracy Hale Dr Gerd Mittelstaedt Yu Bai	Waikato Massey Waikato VUW Massey Massey Massey VUW VUW	2013-3	Small/Wide Angle X-ray Scattering (SAXS) “Protein Complexes and Conformational Change”	Merit Access 9 shifts 23-25 October And 26-27 October **COVID Affected** 3 shifts postponed to 2022	$1,605
Assoc Prof Chris Squire Dr Ghader Bashiri Dr Richard Kingston Assoc Prof Shaun Lott Dr David Goldstone Dr Ivanhoe Leung	Auckland Auckland Auckland Auckland Auckland Auckland	2021-3	Macromolecular Crystallography (MX1) “2021 CAP Program”	Merit Access 6 shifts 29-30 Oct and 29-30 Nov	$0
Dr Adam Middleton Prof Kurt Krause Dr Peter Mace Prof Catherine Day Assoc Prof Sigurd Wilbanks Assoc Prof Brian Monk Dr Matthias Fellner Bahram Pooreyde Dr Ashley Campbell Dr Prasanth Padala	Otago Otago Otago Otago Otago Otago Otago Otago Otago Otago	2021-3	Micro Crystallography (MX2) “University of Otago Structural Biology Group”	Merit Access 5 shifts 6-7 Nov and 26-27 Nov	Incl in MX1 claim above
Dr Courtney Ennis Dr Lauren Macreadie	Otago Sydney	2021-2	THz/Far-infrared (THz) “Surveying Negative Thermal Expansion in Metal-Organic Frameworks at Low Frequency”	Merit Access 9 shifts 30 Nov-3 Dec **COVID Affected**	$0
Dr Adam Hartland Sebastian Hoepker	Waikato Waikato	2022-1	X-ray Fluorescence Microscopy (XFM) “High-resolution stalagmite trace element records of New Zealand’s hydroclimate through the last millennia”	Merit Access 6 shifts 4-6 Feb	$0
Dr David Everett Prof Ben Boyd Patrick Tai Dr Andrew Clulow	AgResearch Monash Massey Monash	2020-2	Small/Wide Angle X-ray Scattering (SAXS) “Liquid-ordered phases in milk fat globule membrane and its role in digestion”	Merit Access 9 shifts 5-9 Feb **COVID Affected** **Originally scheduled in 2020 and then in 2021**	$1,478

Researchers	Institution	Cycle	Beamline	Access	Funding
A/Prof Geoff Waterhouse	Auckland	2022-1	Soft X-ray Spectroscopy (SXR) “Mesoporous N-doped carbons supporting highly exposed metal single atom sites for efficient ORR/OER catalysis”	Merit Access 15 shifts 8-13 Feb	$270
Assoc Prof Chris Squire Dr Ghader Bashiri Dr Richard Kingston Assoc Prof Shaun Lott Dr David Goldstone	Auckland Auckland Auckland Auckland Auckland	2022-1	Macromolecular Crystallography (MX1) “2022 CAP Program”	Merit Access 6 shifts 5-6 March and 7-8 April	$12,077
Prof Emily Parker Prof Geoff Jameson Dr Ron Ronimus Prof Vic Arcus Dr Andrew Sutherland-Smith Assoc Prof Wayne Patrick Dr David Comoletti	VUW Massey AgResearch Waikato Massey VUW VUW	2022-1	Micro Crystallography (MX2) “Protein Structure and Function: AgResearch NZ, Ferrier Institute and Waikato, Victoria and Massey Universities”	Merit Access 6 shifts 10-11 March and 5-6 April	$13,553
Prof Peng Cao Yuguang Pu Tingxuan Yang Kumar Debajyoti Jena Dr Bernt Johannessen	Auckland Auckland Auckland Auckland Austr Synch	2022-1	X-ray Absorption Spectroscopy (XAS) “Unveiling the local structure and relationship between oxidation states and reaction mechanism during the thermal catalytic processes of the high-entropy oxide catalyst”	Merit Access 6 shifts 11-13 March	$0
Dr Adam Middleton Prof Kurt Krause Dr Peter Mace Prof Catherine Day Assoc Prof Brian Monk Dr Matthias Fellner Bahram Pooreydy Ashley Campbell Prasanth Padala	Otago Otago Otago Otago Otago Otago Otago Otago Otago	2022-1	Micro Crystallography (MX2) “University of Otago Structural Biology Group”	Merit Access 6 shifts 17-18 March and 27-28 April	$8,410
Assoc Prof Chris Squire Dr Ghader Bashiri Dr Richard Kingston Assoc Prof Shaun Lott Dr David Goldstone	Auckland Auckland Auckland Auckland Auckland	2022-1	Micro Crystallography (MX2) “2021 CAP Program”	Merit Access 6 shifts 24-25 March and 30 Apr-1 May	Incl in MX1 claim above
Dr Joanna Hicks Prof Geoff Jameson Prof Vic Arcus Prof Emily Parker Dr Elena Harjes Ruby Roach Tracy Hale Dr Gerd Mittelstaedt Dr Yu Bai	Waikato Massey Waikato VUW Massey Massey Massey VUW VUW	2022-1	Small/Wide Angle X-ray Scattering (SAXS) “Protein Complexes and Conformational Change”	Merit Access 9 shifts 25-27 March 7-8 August **COVID Affected 3 shifts not used and postponed until Aug 2022**	$1,715

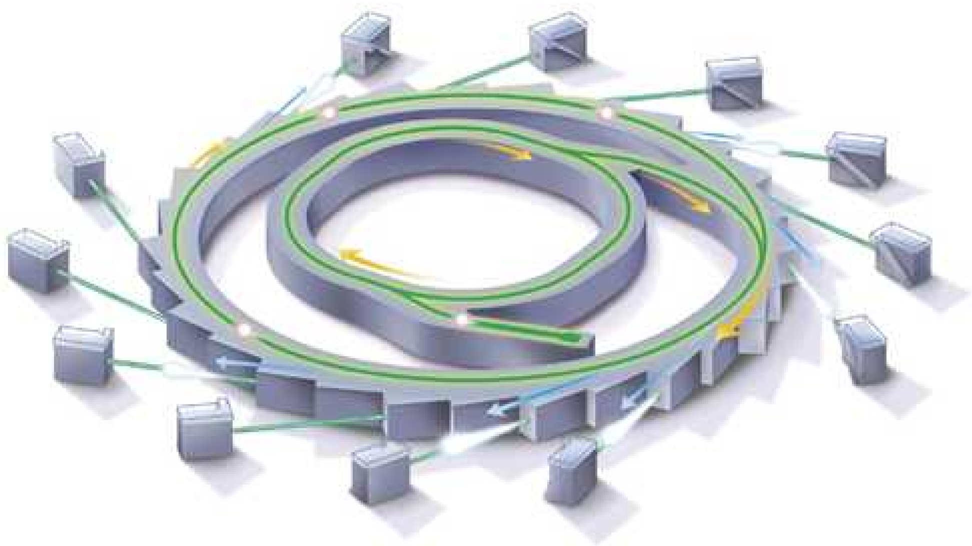
Researchers	Institution	Cycle	Beamline	Access	Funding
Dr Grant Pearce Assoc Prof Ren Dobson Dr Jodie Johnston Dr Ali Nazmi David Wood Michael Currie	Canterbury Canterbury Canterbury Canterbury Canterbury Canterbury	2022-1	Small/Wide Angle X-ray Scattering (SAXS) "University of Canterbury SAXS Proposal 2022/1"	Merit Access 6 shifts 31 Mar-2 Apr	$2,680
Assoc Prof Daniel Holland Tenaya Driller Assoc Prof Matthew Watson Jamie Robinson Matt Rennie Matthew Watson Justin Morgenroth Dr Abby van den Berg Prof Brendan Choat Assoc Prof Michael Clearwater	Canterbury Canterbury Canterbury Canterbury Canterbury Canterbury Canterbury U. Vermont U West Syd Waikato	2020-2 Suppl.	Imaging and Medical (IM) "Visualizing the microscopic changes in water status within a tree stem in response to induced freeze-thaw cycles: An in-situ experiment on maple saplings."	Merit Access 12 shifts 7-11 April **COVID Affected Rescheduled from 2020**	$4,897
Prof Richard Haverkamp Dr Peter Kappen Andrea Marie Matinong Prof Chris Cunninghan Grace van Cingel Georgina Harris	Massey Austr Synch Massey Massey Massey Massey Massey	2022-1	X-ray Absorption Spectroscopy (XAS) "in-operando Rh electro-catalyst study for the electrochemical reduction of nitrogen".	Merit Access 9 shifts 21-24 April	$4,237
Xin Song Sherry Xu Dr Saifang Huang Kumar Debajyoti Jena	Auckland Auckland Auckland Auckland	2021-3	Imaging and Measurement (IM) "Investigation into the lithium dendrite growth of composite solid-state electrolyte batteries"	Merit Access 3 shifts 28-29 April **COVID Affected Rescheduled from 2021**	$3,260
Dr Ingrid Ukstins Prof Shane Cronin Dr Joali Paredes Mariño Mila Huebsch	Auckland Auckland Auckland Auckland	2022-2	Imaging and Medical (IM) "A preliminary investigation of magma fragmentation and vesiculation processes in the Hunga-Tonga-Hunga Ha'apai eruption of 15 January 2022."	Merit Access 12 shifts 1-5 June	Claim not received yet.
Assoc Prof Michael Rowe Michela Dobson Dr Keith Bambery Prof Martin van Kranendonk Dr Andrew Langendam Dr Jeff Havig Bronwyn Teece Dr Ayrton Hamilton Dr Silvina Slagter Ema Nersezova Barbara Lyon	Auckland Auckland Aust Synch UNSW Aust Synch U. Minnesota UNSW Auckland Yale Auckland Auckland	2022-2	X-ray Absorption Spectroscopy (XAS) "Oldest evidence of microbial filaments in the geologic record? Putative palisade biosignatures in the 3.48 Ga Dresser Formation, Pilbara Craton NW Australia"	Merit Access 9 shifts 2-5 June	$3,055

Researchers	Institution	Cycle	Beamline	Access	Funding
Assoc Prof Deborah Crittenden Dr Rosalie Hocking Prof Aaron Marshall Assoc Prof Alex Yip Sara Mirzakhani	Canterbury Swinburne Canterbury Canterbury Canterbury	2022-2	X-ray Absorption Spectroscopy (XAS) “Structure and evolution of atomically precise copper clusters under high pressure CO_2 Hydrogenation”	Merit Access 3 shifts 8-9 June	$0
Prof Richard Haverkamp Dr Celia Kueh Dr Katie Sizeland Mandrea Matinong Grace van Cingel	Massey Massey ANSTO Massey Massey	2020-2 Suppl.	Small/Wide Angle X-ray Scattering (SAXS) “Mechanoselective enzymatic degradation of collagen”	Merit Access 5 shifts 16-18 Jun **COVID Affected Rescheduled from 2020**	$3,000
Assoc Prof Chris Squire Dr Ghader Bashiri Dr Richard Kingston Assoc Prof Shaun Lott Dr David Goldstone	Auckland Auckland Auckland Auckland Auckland	2022-2	Macromolecular Crystallography (MX1) “2022 CAP Program”	Merit Access 6 shifts 21-22 June and 26-27 July	$11,351
Dr Adam Middleton Prof Kurt Krause Dr Peter Mace Prof Catherine Day Assoc Prof Brian Monk Dr Matthias Fellner Bahram Pooreyde Dr Ashley Campbell Dr Prasanth Padala Alex Bohles	Otago Otago Otago Otago Otago Otago Otago Otago Otago Otago	2022-2	Micro Crystallography (MX2) “University of Otago Structural Biology Group”	Merit Access 6 shifts 21-22 June and 11-12 August	$6,870
Assoc Prof Tilo Soehnel Martin Spasovski Andrew Chan Dr Samuel Yick Nargiss Taleb Ryan Silk	Auckland Auckland Auckland Auckland Auckland Auckland	2021-3	THz/Far-infrared (THz) “Mechanistic study for the magnetoelectric effect in Cu_3TeO_6	Merit Access 9 shifts 21-24 June **COVID Affected Rescheduled from 2021**	$3,115
Assoc Prof Franck Natali Assoc Prof Ben Ruck Prof Joe Trodahl Dr Jay Chan Dr Anna Garden Dr Caitlin Casey-Stevens Dr Will Hewett-Holmes	VUW VUW VUW VUW Otago Otago VUW	2022-1	Soft X-ray Spectroscopy (SXR) “Breaking molecular nitrogen under mild conditions with an atomically clean lanthanide”	Merit Access 15 shifts 28 Jun-3 Jul **COVID Affected Rescheduled from Mar 22**	Claim not received yet
Prof Emily Parker Prof Geoff Jameson Dr Ron Ronimus Prof Vic Arcus Dr Andrew Sutherland-Smith Assoc Prof Wayne Patrick Dr David Comoletti	VUW Massey AgResearch Waikato Massey VUW VUW	2022-2	Micro Crystallography (MX2) “Protein Structure and Function: AgResearch NZ, Ferrier Institute and Waikato, Victoria and Massey Universities”	Merit Access 3 shifts 30 Jun-1 Jul	$0

Researchers	Institution	Cycle	Beamline	Access	Funding
New Zealand Researchers with Projects in Australian Based Collaboration Access Programs					
Prof Paul Kruger Lily Hermansplan Brooke Matthews Chris Fitchett Nathan Harvey-Reid	Canterbury Canterbury Canterbury Canterbury Canterbury	2022 Full Year	Macromolecular Crystallography (MX1) "Spin-Crossover Materials, Coordination Cages and Metal Organic Frameworks"	Merit Access MX1 1.0 shift Various dates	
Dr Tim Allison Dr Ngoc Anh Thu Ho James Titterington	Canterbury Canterbury Canterbury	2022 Full Year	Macromolecular Crystallography (MX1) and Micro Crystallography (MX2) "Exposing the intricate interactions of membrane-associated bacterial machinery"	Merit Access MX1 0.5 shift MX2 2.0 shifts Various dates	
Dr Jodie Johnson Dr Ngoc Anh Thu Ho Dr Fiona Given	Canterbury Canterbury Canterbury	2022 Full Year	Macromolecular Crystallography (MX1) and Micro Crystallography (MX2) "Microbial Enzyme Studies: Understanding and Engineering Enzyme Allostery & Inhibiting Essential Enzymes from Human Pathogens"	Merit Access MX1 1.0 shift MX2 1.25 shifts Various dates	
Assoc Prof Ren Dobson Dian Munoz Lintz Dr Michael Currie David Wood Sarah Manners Tyler Johns David Coombes Aimee Harper Amanda Board Michael Newton-Vesty Dr Joshua Wright	Canterbury Canterbury Canterbury Canterbury Canterbury Canterbury Canterbury Canterbury Canterbury Canterbury Canterbury	2022 Full Year	Macromolecular Crystallography (MX1) and Micro Crystallography (MX2) "Integral membrane proteins; Protein-DNA interactions; Enzymes for drug discovery; Alternative food proteins"	Merit Access MX1 1.0 shift MX2 2.0 shifts Various dates	
Dr Ali Reza Nazmi Dr Ngoc Anh Thu Ho	Canterbury Canterbury	2022 Full Year	Macromolecular Crystallography (MX1) and Micro Crystallography (MX2) "Enzymatic synthesis of novel high-value polymers"	Merit Access MX1 0.5 shift MX2 0.75 shift Various dates	

Australian Synchrotron

A synchrotron is a large research facility that generates an extremely intense beam of electromagnetic radiation (‘light’) that can be used for scientific experiments. The radiation is produced by taking a stream of electrons travelling at close to the speed of light, and deflecting them with magnetic fields. The light covers the electromagnetic spectrum from the infrared to the hard x-ray region.



Electrons are generated in the linear accelerator (linac), and progress into the smaller ‘booster’ ring, where they are further accelerated up to their final velocity (99.99% of the speed of light, a kinetic energy of 3.0 GeV). At this point they are ‘injected’ into the larger storage ring, where they circulate for a period of hours to days. The electron beam is steered and focused by magnetic fields. At each point where the beam is deflected, electromagnetic radiation is produced tangential to the beam path. ‘Insertion devices’, undulators and wigglers, are periodic magnet structures that serve to increase the radiation flux by up to five orders of magnitude. The radiation produced can be used in many different experiments and techniques. The light is channelled from the ring down a number of ‘beam lines’, each of which is optimised for a particular experimental technique.

The facility currently has ten beamlines that have been operating for some time with a further eight approved for design and construction over the next six years. The existing beamlines are:

- Protein crystallography (MX1) was the first beam line to become operational and began accepting general users in January 2008. This technique uses x-ray diffraction to determine the structure of proteins, used in drug design and understanding biochemical interactions.
- Infrared spectroscopy and microscopy (IR) also came online in early 2008. The beam line features two endstations: an FTIR spectrometer (THz) and an infrared microscope (IRM). The beamline is ideally suited to the analysis of microscopic samples, such as small particles and thin layers within complex matrices, or thin coatings on surfaces.
- Powder diffraction (PD) began taking general users in February 2008 and was fully operational by May 2008. This beam line is a general purpose diffraction

beam line with several sample environments for observing changes in materials structure as a function of temperature, pressure, time, etc.

- The Soft X-ray Absorption Spectroscopy (SXR) beamline was available for general users from late 2008. It operates at low x-ray energies and is most useful for surface studies.
- Final commissioning of the X-ray absorption spectroscopy (XAS) beam line was completed at the end of 2008 and became available to general users from January 2009. This technique is useful for probing elemental valence states and determining the local structure around an atomic species of interest.
- Small-angle x-ray scattering (SAXS), combined with wide-angle x-ray scattering (WAXS) is a useful technique for determining large scale (1-100 nm), short-range order in materials. This beamline came online at the beginning of 2009.
- The commissioning of the second protein crystallography and small-molecule crystallography beamline (MX2) was completed in mid 2009. It complements the original MX1 crystallography beam line and is able to measure micron-sized crystals and other weakly-scattering or hard to crystallise systems.
- The microspectroscopy beamline (XFM) construction was also completed in early 2009. This beamline combines the high spatial resolution of a microscope with the information that can be gleaned through x-ray fluorescence spectroscopy.
- The Imaging and Medical beamline (IM) came into full use in 2013. It was redesigned from its original concept to include a 150 m long enclosure which extends well outside the Synchrotron building. It has the world's widest x-ray beam and can provide dynamic 3D x-ray imaging at very high resolution. In addition to its medical applications it is being used by geoscientists for tomography studies.

The New Zealand Synchrotron Group was one of ten foundation investors, each of whom has contributed A$5 million towards the initial suite of beam lines. This investment secured preferred (as-of-right) access for each foundation investor, spread over all the beam lines in addition to unrestricted access to the merit beamtime pool. The preferred access arrangements for foundation investors ceased in August 2013.

Following a transfer of ownership from the Victorian government and the other original foundation investors to ANSTO in 2016 and the securing of guaranteed operating funding for the next ten years, thoughts turned to the possibility of adding new beamlines to expand the facilities capabilities. Another campaign to raise funds was initiated which to date has raised in excess of A$94 million which is being used to add a further eight beamlines to the facility. The new beamlines will add significant capacity and new capability to the Australian Synchrotron.

As part of the re-financing of New Zealand's funding of the new beamlines and the ongoing operations of the Synchrotron, it was possible to secure an increase in the amount of merit beamtime set aside for New Zealand researchers from 201 shifts to 267 shifts per year, as well as receiving proportionate rights to the merit and preferred access shifts that will become available as each new beamline is commissioned. The agreement does not expire until June 2026. The agreement also guaranteed that the new BioSAXS beamline, which has capability of particular interest to New Zealand researchers, would be one of the first beamlines to be added to the facility. Design work on the first three beamlines commenced in July 2017, three more in July 2018 and the final two in July 2019. New Zealand is contributing A$12 million towards the new beamlines with a 50:50 contribution from the New Zealand research sector and the government.

Prior to COVID, all the new beamlines were on track to be completed on time. However, shutdowns in Melbourne from early 2020 resulted in the periodic closure of the Australian Synchrotron. Similar shutdowns in Europe where important components were being manufactured also caused delays. There have been restrictions on people coming to Australia which has affected equipment installation and more recently a contract to source an insertion device from Russia as originally intended has further complicated construction plans. The net effect is that the first four beamlines are about 9 months behind the original completion date and the remaining four beamlines will be 12-18 months late.

Details of the new beamlines are:

Medium Energy XAS (MEX1 and MEX2)
Expected User Program Start Dates: MEX1 Nov 2022, MEX2 Apr 2023
The MEX beamline will have two independently operated end-stations and provide medium energy absorption spectroscopy optimised for cutting-edge applications in biological, agricultural and environmental science. They 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 include a 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.

Micro-Computed Tomography (MCT)
Expected User Program Start Date: Sep 2022
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.

BioSAXS (BSX)
Expected User Program Start Date: Mar 2023
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.

Advanced Diffraction and Scattering (ADS1 and AD2)
Expected User Program Start Dates: ADS1 & ADS2 Sep 2024
The ADS beamline will also have two independent end-stations providing capabilities previously unavailable in Australasia with two high energy beamlines for polychromatic and monochromatic x-ray diffraction and imaging. Applications include: 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

High Performance Macromolecular Crystallography (MX3)
Expected User Program Start Date: Mar 2024
This ultra-high flux micro-focus macromolecular crystallography beamline is intended 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 HMX 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.

X-ray Fluorescence Nanoprobe
Expected User Program Start Date: May 2025
The multimodal nanoprobe beamline will be optimised for fluorescence detection, allowing the mapping of metals inside samples with extremely high resolution and sensitivity. It will have three operating modes: high resolution mapping (80nm), high-flux mapping (160nm resolution) and spectroscopy (160nm resolution).

Applications will come from researchers in physics, chemistry, biology, nutrition and health, geosciences, engineering, environmental research, soil science, agriculture, cultural heritage, and materials science.

CORPORATE GOVERNANCE

Board Composition

The company operates with a board comprising of up to 5 directors, including an independent chairman. Interim directors were appointed initially. These were replaced by a permanent board following elections which were held in April 2007.

The Directors during the period 1 July 2021 to 30 June 2022 were:

Dr Garth Carnaby, Chair
Dr Brett Cowan, Institute of Environmental Science and Research Ltd
Professor Catherine Day, University of Otago
Emeritus Professor Geoffrey Jameson, Massey University
Professor James Metson, The University of Auckland

Dr Cowan was elected to the Board at the AGM on 26 November 2021 to fill the vacancy left by the resignation of Professor Michael McWilliams in November 2020..

Indemnities and Insurance

The board has taken Directors and Officers Liability Insurance with NZI. Coverage of up to $6 million has been obtained.

Attendance at Board Meetings

The following table shows the attendance at meetings of the board for each director and the fees paid.

Director	**No. meetings held during the year**	**No. meetings attended**	**Fees paid**
Dr Garth Carnaby	6	6	$9,000
Dr Brett Cowan	4	4	-
Professor Catherine Day	6	6	
Emeritus Professor Geoffrey Jameson	6	6	-
Professor James Metson	6	6	-

Donations

The company did not make any donations during the period from establishment up to 30 June 2022.

Interests Register

During the course of undertaking its normal business activities in supporting the development of synchrotron science, the company provides assistance towards the travel costs for research staff from its shareholders. The practice at meetings of the board is for directors from organisations who are receiving financial support to declare an interest and to refrain from voting on that particular matter.
The following significant entries relating to the directors were recorded in the Interests Register during the year.

Director	Organisation/Entity	Nature of Interest
Dr GA Carnaby		
Shares Held	GA Carnaby & Associates Ltd	Controlling majority
Beneficiary of Trusts	Carnaby Trust	Trustee and discretionary beneficiary
	National Provident Fund	Annuity/Defined benefit
Offices Held	Dodd-Walls Centre of Research Excellence	Chair
	BioResource Processing Alliance	Chair
	Wool Industry Research Ltd	Chair
Dr BR Cowan		
Offices Held	ESR	GM and Chief Scientist
	Cowan Consulting Ltd	Director and shareholder
	Jatby Investments Ltd	Director and shareholder
	Matai Medical Research Institute	Trustee
	Atanga Trust	Trustee
Other	Financial Markets Authority	Daughter (Jenika Phipps) has a lead role in sustainability reporting
Professor CL Day		
Offices Held	University of Otgao	Employee
	Maurice Wilkins CoRE	Member - AI
Shares Held	Fairholm Farming Ltd	Minority shareholder
Emeritus Prof GB Jameson		
Shares Held	Tower Ltd	Minority shareholder
Beneficiary of Trusts	Estate of MEB Jameson	Discretionary beneficiary
Offices Held	Massey University	Emeritus Professor
Other Interests	Te Manawa Museums Trust Board	Board member
	Science Centre Trust, Palmerston North	Trustee
	Riddett Institute	Member - PI
	MacDiarmid Institute	Member - AI
	Maurice Wilkins Centre	Member - AI
Prof JB Metson		
Shares Held	Vector Energy	Minority shareholder
Offices Held	University of Auckland	Deputy Vice-Chancellor Research
	Brain Research New Zealand	Board Member
	Maurice Wilkins Centre for Molecular Biodiscovery	Board Member
	Medical Technologies Centre of Research Excellence	Board Member
	Te Pūnaha Matatini	Board Member
	Dodd Walls Centre	Board Member
	Ngā Pae o te Maramatanga	Board Member
	High Value Nutrition National Science Challenge	Board Member
	Auckland UniServices Ltd	Director
	Research and Education Advanced Network New Zealand (REANNZ)	Director
	Rotary Science & Technology Forum Trust	Trustee

New Zealand Synchrotron Group Limited
Financial statements
for the year ended 30 June 2022

Contents

Directors

G A Carnaby (Chair)
B R Cowan
C L Day
G B Jameson
J B Metson

Registered Office

11 Turnbull Street
Thorndon
Wellington

Nature of business

The purpose of the company is to provide research access in the Australian Synchrotron for researchers from New Zealand. The company also promotes synchrotron science, assists in the capability of New Zealand researchers in synchrotron science and manages the travel funding for New Zealand researchers using the Australian Synchrotron.

Company Registration number

1865516

Independent auditor

Grant Thornton New Zealand Audit Limited

The Board has pleasure in presenting the annual report of the New Zealand Synchrotron Group Limited ("NZSG") incorporating the financial statements and the auditors' report, for the year ended 30 June 2022.

The Company has taken advantage of the reporting concessions available to it under sections 211(3) of the Companies Act 1993.

The Board of NZSG has authorised these financial statements presented on pages 7 to 20 for issue on 21 October 2022.

For and on behalf of the Board

G A Carnaby
Chair

21-Oct-2022

J B Metson
Director

21-Oct-2022

INDEPENDENT AUDITOR'S REPORT

Grant Thornton New Zealand Audit Limited
L15, Grant Thornton House
215 Lambton Quay
P O Box 10712
Wellington 6143

T +64 4 474 8500
F +64 4 474 8509
www.grantthornton.co.nz

TO THE SHAREHOLDERS OF NEW ZEALAND SYNCHROTRON GROUP LIMITED FOR THE YEAR ENDED 30 JUNE 2022

The Auditor-General is the auditor of New Zealand Synchrotron Group Limited (the Company). The Auditor-General has appointed me, Brent Kennerley, using the staff and resources of Grant Thornton New Zealand Audit Limited, to carry out the audit of the financial statements of the Company on his behalf.

Opinion

We have audited the financial statements of the Company on pages 7 to 20, that comprise the statement of financial position as at 30 June 2022, the statement of comprehensive revenue and expenses, statement of changes in net assets and statement of cash flows for the year ended on that date and the notes to the financial statements that include accounting policies and other explanatory information; and

In our opinion:

- the financial statements of the Company on pages 7 to 20:
  - present fairly, in all material respects:
    - its financial position as at 30 June 2022; and
    - its financial performance and cash flows for the year then ended; and
  - comply with generally accepted accounting practice in New Zealand in accordance with Public Benefit Entity International Public Sector Accounting Standards Reduced Disclosure Regime ('PBE IPSAS RDR'); and

Our audit was completed on 21 October 2022. This is the date at which our opinion is expressed.

The basis for our opinion is explained below. In addition, we outline the responsibilities of the Board of Directors and our responsibilities relating to the financial statements, we comment on other information, and we explain our independence.

Basis for our opinion

We carried out our audit in accordance with the Auditor-General's Auditing Standards, which incorporate the Professional and Ethical Standards and the International Standards on Auditing (New Zealand) issued by the New Zealand Auditing and Assurance Standards Board. Our responsibilities under those standards are further described in the Responsibilities of the auditor section of our report.

We have fulfilled our responsibilities in accordance with the Auditor-General's Auditing Standards.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Responsibilities of the Board of Directors for the financial statements

The Board of Directors is responsible on behalf of the Company for preparing financial statements that are fairly presented and that comply with generally accepted accounting practice in New Zealand. The Board of Directors is responsible for such internal control as it determines is necessary to enable it to prepare financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, the Board of Directors is responsible on behalf of the Company for assessing the Company's ability to continue as a going concern. The Board of Directors is also responsible for disclosing, as applicable, matters related to going concern and using the going concern basis of accounting, unless the Board of Directors intends to liquidate the Company or to cease operations or has no realistic alternative but to do so.

The Board of Directors' responsibilities arise from the Crown Entities Act 2004 and the Education Act 1989.

Responsibilities of the auditor for the audit of the financial statements

Our objectives are to obtain reasonable assurance about whether the financial statements, as a whole, are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion.

Reasonable assurance is a high level of assurance, but is not a guarantee that an audit carried out in accordance with the Auditor-General's Auditing Standards will always detect a material misstatement when it exists. Misstatements are differences or omissions of amounts or disclosures, and can arise from fraud or error. Misstatements are considered material if, individually or in the aggregate, they could reasonably be expected to influence the decisions of readers taken on the basis of these financial statements.

For the budget information reported in the financial statements, our procedures were limited to checking that the information agreed to the company's operational budget 2021-2022.

We did not evaluate the security and controls over the electronic publication of the financial statements.

As part of an audit in accordance with the Auditor-General's Auditing Standards, we exercise professional judgement and maintain professional scepticism throughout the audit. Also:

- We identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
- We obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Company's internal control.
- We evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the Board of Directors.
- We evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.
- We conclude on the appropriateness of the use of the going concern basis of accounting by the Board of Directors and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Company's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the Company to cease to continue as a going concern.

We communicate with the Board of Directors regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

Our responsibilities arise from the Public Audit Act 2001.

Other information

The Board of Directors are responsible for the other information. The other information comprises the information included on page 4, but does not include the financial statements and our auditor's report thereon.

Our opinion on the financial statements does not cover the other information and we do not express any form of audit opinion or assurance conclusion thereon.

In connection with our audit of the financial statements, our responsibility is to read the other information. In doing so, we consider whether the other information is materially inconsistent with the financial statements or our knowledge obtained in the audit, or otherwise appears to be materially misstated. If, based on our work, we conclude that there is a material misstatement of this other information, we are required to report that fact. We have nothing to report in this regard.

Independence

We are independent of the Company in accordance with the independence requirements of the Auditor-General's Auditing Standards, which incorporate the independence requirements of Professional and Ethical Standard 1 (Revised): *Code of Ethics for Assurance Practitioners* issued by the New Zealand Auditing and Assurance Standards Board.

Other than the audit, we have no relationship with or interests in the Company.

Brent Kennerley
Grant Thornton New Zealand Audit Limited
On behalf of the Auditor-General
Wellington, New Zealand

	Note	2022 (Unaudited) Budget $	2022 Actual $	2021 Actual $
Revenue from non exchange transactions				
Revenue for Australian Operations	3	*2,892,395*	2,708,507	2,241,868
Revenue from exchange transactions				
Revenue for NZ Operations	4	*60,000*	193,650	137,250
Other revenue	4	*120,217*	133,596	138,822
Total Revenue		*3,072,612*	3,035,753	2,517,940
Expenses				
Australian Synchrotron Group costs	5, 18	*1,332,490*	1,290,458	828,592
(Gain) / Loss on fair value of derivatives		-	(54,769)	(5,368)
Other operating expenses	6	*1,757,448*	1,670,926	1,665,249
Operating expenditure		*3,089,938*	2,906,615	2,488,473
Total surplus/(deficit) for the year		(17,326)	129,138	29,467
Other comprehensive income		-	-	-
Total comprehensive revenue and expense		***(17,326)***	**129,138**	**29,467**

These financial statements should be read in conjunction with the accompanying notes on pages 11 - 20.

New Zealand Synchrotron Group Limited
Statement of changes in net assets
for the year ended 30 June 2022

	Notes	Share capital $	Accumulated losses $	Total equity $
Balance as at 30 June 2020		2,912,162	(2,309,234)	**602,928**
Net surplus		-	29,467	29,467
Other comprehensive income		-	-	-
Total comprehensive revenue and expenses		-	29,467	29,467
Balance as at 30 June 2021		**2,912,162**	**(2,279,767)**	**632,395**
Net surplus		-	129,138	**129,138**
Other comprehensive income		-	-	-
Total comprehensive revenue and expenses		-	129,138	**129,138**
Balance as at 30 June 2022		**2,912,162**	**(2,150,629)**	**761,533**

These financial statements should be read in conjunction with the accompanying notes on pages 11 - 20.

ASSETS	Note	2022	2021
		$	$
Current assets			
Cash & cash equivalents	7	367,778	1,000,251
Investments	7	421,301	-
Trade and other receivables from exchange transactions	8	79,196	41,661
Prepayments	8	2,200	1,925
Derivative financial instruments	9	47,123	6,749
Total current assets		**917,598**	**1,050,586**
TOTAL ASSETS		**917,598**	**1,050,586**
LIABILITIES			
Current liabilities			
Trade and other payables	11	156,065	354,796
Derivative financial instruments		-	63,395
Total current liabilities		**156,065**	**418,191**
TOTAL LIABILITIES		**156,065**	**418,191**
Net assets		**$ 761,533**	**$ 632,395**
EQUITY			
Share capital	15	2,912,162	2,912,162
Accumulated losses		(2,150,629)	(2,279,767)
TOTAL EQUITY		**$ 761,533**	**$ 632,395**

For and on behalf of the Board

G A Carnaby
Chair

21-Oct-2022

J B Metson
Director

21-Oct-2022

These financial statements should be read in conjunction with the accompanying notes on pages 11 - 20.

Grant Thornton New Zealand Audit Limited
Marked for identification purposes

New Zealand Synchrotron Group Limited
Statement of cash flows
for the year ended 30 June 2022

	Notes	2022 $	2021 $
Cash flows from operating activities			
Receipts			
Receipts from non exchange transactions		2,708,507	2,241,868
Receipts from exchange transactions		275,548	241,106
Interest	4	14,163	10,069
Total cash received		**2,998,218**	**2,493,043**
Payments			
Australian Synchrotron Group Costs		(1,290,458)	(828,592)
Less: Cash applied to Derivative Asset		(49,000)	-
Other expenses		(1,869,932)	(1,658,071)
Total cash applied		**(3,209,390)**	**(2,486,663)**
Net cashflows from operating activities	17	***(211,172)***	***6,380***
Cash flows from investing activities			
Payments			
Purchase of investments		(421,301)	-
Total cash applied		**(421,301)**	-
Net cash flows from investing activities		***(421,301)***	-
Net (decrease)/increase in cash and cash equivalents		*(632,473)*	*6,380*
Cash and cash equivalents at 1 July	7	1,000,251	993,871
Cash and cash equivalents at 30 June	7	**367,778**	**1,000,251**

These financial statements should be read in conjunction with the accompanying notes on pages 11 - 20.

Note 1. General information

New Zealand Synchrotron Group Limited ("the Company" or "NZSG") was incorporated on 13 September 2006. The Company is a Public Sector Public Benefit Entity. The purpose of the Company is to provide research access to the Australian Synchrotron for researchers from New Zealand. In addition, the Company also promotes synchrotron science, assists the development of capability of New Zealand researchers in synchrotron science and manages the travel funding for New Zealand researchers using the Australian Synchrotron. It has twelve shareholders who are all either New Zealand universities, Crown Research Institutes or Crown Entities. The company is managed by a five person board elected by the shareholders, including an independent Chair. The Chair receives remuneration; the other directors do not. The Royal Society of New Zealand has been contracted to provide secretariat services to the Board.

The Company's revenue consists of fees paid by both shareholders and the Ministry of Business Innovation and Employment ("MBIE") to provide support services and funds provided by the Australian Synchrotron for travel funding grants. Its registered office is 11 Turnbull Street, Thorndon, Wellington.

The financial statements are prepared on a going concern basis. The Company has entered into agreements for future access to the Australian Synchrotron up until 30 June 2026.

The Board has authorised the financial statements on 21 October 2022.

Note 2. Significant accounting policies

(a) Basis of preparation

The financial statements of the Company have been prepared in accordance with Generally Accepted Accounting Practice in New Zealand (NZ GAAP). They comply with New Zealand Public Sector Public Benefit Entity International Accounting Standards Reduced Disclosure Regime (PBE Standards RDR) and authoritative notices that are applicable to entities that apply PBE Standards.

The Company is eligible and has elected to report in accordance with Tier 2 PBE Standards RDR on the basis that the Company has no public accountability and is not large as defined in XRB A1. The Directors have elected to report in accordance with Tier 2 PBE Accounting Standards and in doing so have taken advantage of all applicable Reduced Disclosure Regime ("RDR") disclosure concessions.

The significant accounting policies adopted in the preparation of the financial statements are set out below. These policies have been consistently applied to all the periods presented, unless otherwise stated.

Statutory base

New Zealand Synchrotron Group Limited ("NZSG" or the "Company") is a company registered under the Companies Act 1993.

The financial statements have been prepared in accordance with the Financial Reporting Act 2013.

Basis of measurement

These financial statements have been prepared under the historical cost convention, as modified by the revaluation of financial instruments at fair value through surplus or deficit.

(b) Changes in accounting policy

There have been no changes in accounting policy.

(c) Foreign currency translation

Functional and presentational currency

The financial statements are presented in New Zealand dollars, which is the Company's functional and presentation currency.

Foreign currency transactions are translated into the functional currency using the exchange rates prevailing at the dates of the transactions. Foreign exchange gains and losses resulting from the settlement of such transactions and from the translation at year end exchange rates of monetary assets and liabilities denominated in foreign currencies are recognised in the statement of comprehensive revenue and expenses.

(d) Revenue recognition

Revenue from exchange transactions

Revenue from exchange transactions comprises the fair value for the sale of goods and services, excluding Goods and Services Tax, rebates and discounts. Revenue is recognised when services are rendered.

Interest income

Interest income is recognised on a time proportion basis using the effective interest method. When a receivable is impaired, NZSG reduces the carrying amount to its recoverable amount, being the estimated future cash flow discounted at the original effective interest rate of the instrument, and continues unwinding the discount as interest income. Interest income on impaired loans is recognised using the rate of interest used to discount the future cash flows for the purpose of measuring the impairment loss.

Other funding

Other funding includes grants from shareholders, contributions from Australian Synchrotron and other kinds of funding that meet the definition of exchange transactions. Other funding is recognised as revenue when it becomes receivable in the accounting period in which the services or activities related to the funding are rendered or completed. This is by reference to completion of the specific transaction assessed on the basis of the actual service provided or the activity completed as a proportion of the total service to be provided or activity to be completed.

Revenue from non-exchange transactions

Revenue from non-exchange transactions comprises the fair value received from a third party without directly giving approximately equal value in exchange.

Government grants

Contract income from the Ministry of Business, Innovation and Employment is a primary source of income for the Company. Government grants and non-government grants are recognised as revenue when they become receivable unless there is an obligation to return the funds if conditions of the grant are not met. If there is such an obligation, the grants are initially recorded as grants received in advance and recognised as revenue when conditions of the grant are satisfied.

(e) Income Tax

From 1 July 2009 the NZSG has been granted a Tax Exemption under Section CW49 of the Income Tax Act 2007. As a consequence NZSG will have no ongoing liability for Income Tax.

(f) Goods and Services Tax (GST)

The statement of comprehensive revenue and expenses has been prepared so that all components are stated exclusive of GST. All items in the statement of financial position are stated net of GST, with the exception of receivables and payables, which include GST invoiced.

(g) Cash and cash equivalents

Cash and cash equivalents includes cash on hand, deposits held at call with financial institutions, and other short term highly liquid investments with original maturities of three months or less, that are readily convertible to known amounts of cash, and which are subject to an insignificant risk of changes in value.

(h) Financial Assets and Financial Liabilities

(h.1) Financial Assets

Initial recognition and measurement

Financial assets and financial liabilities are recognised when the Company becomes a party to the contractual provision of the financial instrument.

Financial assets are classified, at initial recognition, as financial assets at fair value through surplus or deficit, receivables, held-to-maturity investments, available-for-sale financial assets, and derivatives. All financial assets are recognised initially at fair value.

Purchases or sales of financial assets that require delivery of assets within a time frame established by regulation or convention in the marketplace (regular way trades) are recognised on the trade date, i.e. the date that the Company commits to purchase or sell the asset.

The Company's financial assets include: cash and short term deposits, trade and other receivables, held to maturity investments and derivative financial instruments.

Grant Thornton New Zealand Audit Limited
Marked for identification purposes

(h.1) Financial Assets - *continued*

Subsequent measurement

For the purpose of subsequent measurement financial assets for NZSG are classified in three categories:
-Financial assets at fair value through surplus or deficit
-Trade Receivables
-Held-to-maturity investments

(h.1.1) Financial assets at fair value through surplus or deficit
Financial assets at fair value through surplus or deficit include financial assets held for trading and financial assets designated upon initial recognition at fair value through surplus or deficit. Financial assets are classified as held for trading if they are acquired for the purpose of selling or repurchasing in the near term. Derivatives, including separated embedded derivatives, are also classified as held for trading.
Financial assets at fair value through surplus or deficit are carried in the statement of financial position at fair value with net changes in fair value presented as other expenses (negative net changes in fair value) or other revenue (positive net changes in fair value) in the statement of financial performance.

(h.1.2) Trade receivables
This category of financial assets is the most relevant to the Company. Trade receivables are non-derivative financial assets with fixed payments. After initial measurement, such financial assets are subsequently measured at amortised cost using the effective interest rate method, less impairment. Amortised cost is calculated by taking into account any discount or premium on acquisition and fees or costs that are an integral part of the effective interest rate.
The recoverability of trade receivables is reviewed on an ongoing basis. Debts which are known to be uncollectible are written off. A provision for doubtful receivables is established when there is objective evidence that NZSG will not be

(h.1.3) Held-to-maturity investments
Financial assets with fixed or determinable payments and fixed maturities are classified as held to maturity when the Company has the positive intention and ability to hold them to maturity. After initial measurement, held-to-maturity investments are measured at amortised cost using the effective interest rate method, less impairment.
Amortised cost is calculated by taking into account any discount or premium on acquisition and fees or costs that are an integral part of the effective interest rate. The effective interest rate amortisation is included as finance income in the statement of financial performance.

Derecognition
The Company derecognises a financial asset or, where applicable, a part of a financial asset when the rights to receive cash flows from the asset have expired or are waived, or the Company has transferred its rights to receive cash flows from the asset or has assumed an obligation to pay the received cash flows in full without material delay to a third party; and either;
- the Company has transferred substantially all the risks and rewards of the asset; or
- the Company has neither transferred nor retained substantially all the risks and rewards of the asset but has transferred control of the asset.

(h.2) Financial Liabilities

The Company's financial liabilities include trade and other creditors. These amounts represent liabilities for goods and services provided to NZSG prior to the end of financial year which are unpaid. All financial liabilities are initially recognised at fair value and subsequently measured at amortised cost using the effective interest method. The amounts are unsecured and are usually paid within 30 days of recognition.

(h.3) Derivative financial instruments

Derivative financial instruments are initially recognised at fair value on the date on which a derivative contract is entered into and are subsequently remeasured at fair value. Derivatives are carried as financial assets when their fair value is positive and as financial liabilities when their fair value is negative.

Gains and losses arising from changes in the fair value of the derivative financial instruments are presented though the statement of financial performance. Any gains or losses arising from changes in the fair value of derivatives are taken directly to surplus or deficit. The fair value of derivative financial instruments are determined by using valuation techniques. Valuation techniques used include the use of comparable recent arm's length transactions, reference to other instruments that are substantially the same, option pricing models and other valuation techniques commonly used by market participants making the maximum use of market inputs and relying as little as possible on entity-specific inputs.

Financial assets at fair value through surplus or deficit are subject to review for impairment at each reporting date. Derivatives are then impaired when there is any objective evidence that the derivatives are impaired. Impairment losses are incurred if there is objective evidence of impairment as a result of one or more events that occurred after the initial recognition of the derivatives and that loss event has an impact on the estimated future cashflows of those derivatives that can be reliably estimated.

(i) Sponsorship and donations expense

Through the ordinary course of its activities the Company provides sponsorships and makes donations to advance its stated objectives. The Company recognises a liability for this expenditure when the recipient meets any eligibility criteria attached to a sponsorship or donation agreement.

(j) Statement of Cash Flows

The following are the definitions of the terms used in the Statement of Cash Flows:

i) Cash is considered to be cash on hand, cash in transit, bank accounts and deposits with a maturity of no more than 3 months from the date of acquisition;

ii) Investing activities are those relating to acquisition, holding and disposal of investments and investments not falling within the definition of cash;

iii) Financing activities are those activities which result in changes in the size and composition of the capital structure of the Company. This includes equity, debt not falling within the definition of cash.

All other activities are classified as operating activities.

Grant Thornton New Zealand Audit Limited
Marked for identification purposes

Note 3.	**Revenue for Australian operations**	**2022**	**2021**
		$	**$**
	Revenue from non-exchange transactions		
	Ministry of Business Innovation and Employment	1,012,000	987,294
	Shareholders - contribution to Aust. Synchrotron beamlines	1,279,223	1,254,574
	Shareholders	417,284	-
		2,708,507	2,241,868

The Company receives support from the Government and shareholders for Australian Synchrotron costs.

Note 4.	**Revenue for New Zealand operations**	**2022**	**2021**
		$	**$**
	Revenue from non-exchange transactions		
	Ministry of Business Innovation and Employment	133,650	137,250
	Revenue from exchange transactions		
	Grants from shareholders for operating costs of NZSG	60,000	-
	Other Revenue		
	Contribution from the Australian Synchrotron towards travel costs	96,106	96,577
	Foreign exchange gains / (losses)	23,327	32,176
	Interest	14,163	10,069
		133,596	138,822
		327,246	276,072

Note 5. Australian Synchrotron Group costs

Under the agreement with Australian Nuclear Science and Technology Organisation (ANSTO), and as detailed in note 10(a), the Company is required to make an annual contribution to the ongoing operating costs of the Australian Synchrotron.

Note 6. Other operating costs

(a) Remuneration of auditor

During the year the following fees were paid or payable for services provided by the Auditor General appointed auditor - Grant Thornton New Zealand Audit Limited.	**2022**	**2021**
	$	**$**
Statutory audit services	6,825	6,610

(b) Foreign exchange (gains) / losses

During the year the following exchange (gains) / losses were made on transactions between New Zealand and Australia.	**2022**	**2021**
	$	**$**
Foreign exchange (gains) / losses	0	0

Grant Thornton New Zealand Audit Limited
Marked for identification purposes

(c) Support for Synchrotron Science

During the year the following fees were paid or payable for services provided.

	2022 $	2021 $
Travel costs reimbursed to shareholders	92,576	94,150
Contribution to Australian Synchrotron for new beamlines	1,288,521	1,275,634
Capability Build expense	178,200	183,000
User Meetings	1,041	2,146
Asia Oceania Forum for Synchrotron Radiation Research Membership	-	0
	1,560,338	1,554,930

(d) Secretariat and other operating costs

During the year the following fees were paid or payable for services provided.

	2022 $	2021 $
Secretariat services from the Royal Society of New Zealand and Board costs	99,174	99,401
Insurance	4,308	4,125
Other	281	183
	103,763	103,709
Total other operating costs	**1,670,926**	**1,665,249**

Note 7. Cash & cash equivalents and Investments

	2022 $	2021 $
Cash	146,318	693,161
Foreign currency - AUD	221,460	307,090
Cash & cash equivalents	367,778	1,000,251

	2022 $	2021 $
Term Deposits > 3 months (NZD)	300,000	-
Term Deposits > 3 months (AUD)	121,301	-
Investments	421,301	-

All the bank balances and investments are held with the Bank of New Zealand.

Note 8. Other current assets

(a) Trade and other receivables from exchange transactions

	2022 $	2021 $
Trade receivables	59,440	36,853
Other receivables	2,581	-
Goods and Services Tax receivable	17,175	4,808
Total trade and other receivables	79,196	41,661

(b) Prepayments

	2022 $	2021 $
Prepayments	2,200	1,925
Total Prepayments	2,200	1,925

Note 9.	**Derivative financial instruments**	**2022**	**2021**
		$	**$**
	Western Union Forward cover	47,123	(56,646)
	Derivative financial instruments	**47,123**	**(56,646)**

The following derivatives have been entered into with Western Union.

(a) *Forward foreign exchange contracts*

At 30 June 2021	Notional	Deal rate	Fair Value
Forward exchange contract (Maturity: February 2022)	$833,333	0.9000	(26,015)
Forward exchange contract (Maturity: February 2023)	$833,333	0.9000	(21,239)
Forward exchange contract (Maturity: February 2024)	$833,333	0.9000	(16,141)

At 30 June 2022	Notional	Deal rate	Fair Value
Forward exchange contract (Maturity: February 2023)	$833,333	0.9000	342
Forward exchange contract (Maturity: February 2024)	$833,333	0.9000	2,271

(b) *Forward foreign exchange options*

At 30 June 2021	Notional	Strike Price	Fair Value
Forward foreign exchange option (Maturity: February 2022)	$735,294	1.02	$242
Forward foreign exchange option (Maturity: February 2023)	$735,294	1.02	$2,166
Forward foreign exchange option (Maturity: February 2024)	$735,294	1.02	$4,341

At 30 June 2022	Notional	Strike Price	Fair Value
Forward foreign exchange option (Maturity: February 2023)	$735,294	1.02	$199
Forward foreign exchange option (Maturity: February 2024)	$735,294	1.02	$2,612
Forward foreign exchange option (Maturity: February 2025)	$882,353	0.85	$18,445
Forward foreign exchange option (Maturity: February 2026)	$882,353	0.85	$23,254

Note 10. Commitments

(a) Agreement with Australian Nuclear Science and Technology Organisation (ANSTO)

Agreements have been signed on the 14th August 2017, between NZSG and ANSTO whereby NZSG undertakes to provide AUD $12.0m over six years towards the cost of new beamlines and AUD $1.5m per year for nine years (with an inflation adjustment) in return for 6.639% of the access. As part of the Funders' Agreement entered into with 10 of the shareholders and the SIFF Contract with MBIE, these funds will be received directly from the Participants or MBIE when required to fulfil these obligations.

New Zealand shareholders who are party to the Funders' Agreement are irrevocably committed to contribute a total of AUD $12.308m (GST exclusive).

(b) Agreement with Ministry of Business, Innovation and Employment (MBIE)

The company has entered into an agreement with MBIE for Crown Funding totalling AUD $6m plus NZD $10,552,364 over the period 1 July 2017 to 30 June 2026.

Note 11. Trade and other payables

	2022 $	2021 $
Creditors	-	-
Accruals	126,965	192,046
Income in Advance	29,100	162,750
Goods and Services Tax payable	-	-
Total trade and other payables	156,065	354,796

The amount owed to related parties was nil as at 30 June 2022. (2021: nil).

Note 12. Contingent assets and contingent liabilities

There were no significant contingent assets or contingent liabilities at 30 June 2022 (2021: nil).

Note 13. Related parties

Related parties comprise the shareholders identified in Note 15 and Board members identified in the Directory. There have been a number of related party transactions during the year ended 30 June 2022.

Directors

Transactions with board members include payment of fees. During the year ended 30 June 2022, a total of $9,000 was paid to the Chair (2021: $9,000). As at 30 June 2022, there was no outstanding balances with board members (2021: $0).

Shareholders

Transactions with shareholders during the year ended 30 June 2022 include grants, as per Note 4, amounting to $0 (2021: $0). Also, as per Note 10, under the agreement with ANSTO the Shareholders who are party to the Funders Agreement are required to contribute a total of AUD $12.308m (GST exclusive) over the nine years of the agreement to 2026. In the year ended 30 June 2022, a total of AUD $1.20m (2021: AUD $1.20m) was contributed by Shareholders who are party to the Funders Agreement and, as at 30 June 2022, there was no outstanding balance with shareholders (2021: nil).

Note 14. Events occurring after balance date

There were no significant events occuring after balance date that affect the financial statements (2021: nil).

Note 15. Share capital

Shareholding at cost	2022	2021
	$	$
The University of Auckland	509,217	509,217
The University of Waikato	190,357	190,357
Massey University	428,317	428,317
Victoria University of Wellington	237,966	237,966
University of Canterbury	285,546	285,546
Lincoln University	28,557	28,557
University of Otago Holdings Ltd	285,546	285,546
AgResearch Ltd	285,546	285,546
Institute of Geological and Nuclear Sciences Ltd	190,357	190,357
The New Zealand Institute for Plant and Food Research Ltd	190,357	190,357
Callaghan Innovation	192,270	192,270
Auckland University of Technology	88,126	88,126
	2,912,162	2,912,162

The shares held at 30 June are:	2022	2021
	# of shares held	# of shares held
The University of Auckland	436,319	436,319
The University of Waikato	163,104	163,104
Massey University	367,001	367,001
Victoria University of Wellington	203,897	203,897
University of Canterbury	244,668	244,668
Lincoln University	24,467	24,467
University of Otago Holdings Ltd	244,668	244,668
AgResearch Ltd	244,668	244,668
Institute of Geological and Nuclear Sciences Ltd	163,104	163,104
The New Zealand Institute for Plant and Food Research Ltd	163,104	163,104
Callaghan Innovation	163,104	163,104
Auckland University of Technology	163,104	163,104
	2,581,208	2,581,208

The amount recognised in the balance sheet as paid in capital is the New Zealand dollar equivalent at the date of issue.

Note 16. Financial instruments

Classification of financial assets by category	**Fair value through Profit or Loss**	**Loans and Receivables**
2022	**$**	**$**
Cash and cash equivalents	-	367,778
Investments	-	421,301
Trade & other receivables	-	79,196
Prepayments	-	2,200
Derivative financial instrument	47,123	-
Total	**47,123**	**870,475**
2021		**$**
Cash and cash equivalents	-	1,000,251
Trade & other receivables	-	41,661
Prepayments	-	1,925
Derivative financial instrument	6,749	-
Total	**6,749**	**1,043,837**

Classification of financial liabilities by category

Measured at amortised cost

	2022	2021
	$	$
Trade & other payables	156,065	354,796
Derivative financial instrument	0	63,395
Total	**156,065**	**418,191**

Note 17. Reconciliation of profit with cash flows from operating activities

	2022	2021
	$	$
Net (Deficit)/Surplus for the year	129,138	29,467
Movement in working capital		
Trade and other receivables	(37,535)	(24,897)
Derivative financial instruments	(103,769)	(5,368)
Trade and other payables	(198,731)	5,520
Prepayments	(275)	1,658
Net Cash outflow from operating activities	**(211,172)**	**6,380**

Note 18. COVID-19 Pandemic and impacts

The global COVID-19 pandemic that was declared in early 2020 persisted throughout the year and continues to affect the Company's operations. Although the Australian Synchrotron reopened in July 2020, it has been subject to periodic shutdowns or restrictions in operations and, until April 2021, travel restrictions have prevented New Zealand researchers going to Melbourne to use the facility. Wherever possible, planned experiments have been carried out by Synchrotron staff using samples shipped to Australia. During the past 12 months most of the delayed work from the previous year and the work intended for 2021-22 has been able to be completed, but there has been a downturn in demand for beamtime on the facility due the reduced research effort in some institutions because of the low numbers of international postgraduate students and the slow return of postdoctoral researchers to New Zealand. Institutions expect that it will take some years to fully recover, financially, from the pandemic. This increases the risk that one or more institutions will want to withdraw from the contractual arrangements to provide their share of the New Zealand funding for the Australian Synchrotron.

Due to the inherent uncertainty of the impact of the pandemic it is not practicable to determine the full impact that the virus will have on the Company going forward, however the Directors' assessment is that any shortfall in income caused by the withdrawal of an institution from the arrangement can be met from reserves or invoking the clause in the Company's contract with ANSTO to purchase less beamtime. Therefore, the Board continues to consider it appropriate to apply the going concern basis of accounting to these financial statements.

In recognition of the reduced level of activity during 2020 and the financial impact the pandemic had on the research community in New Zealand, especially universities, it was agreed with ANSTO that component of the annual payment for 2020-21 relating to the contribution towards operating costs would be reduced to 50% of the original requirement and 75% for the 2021-22 and 2022-23 financial years and increased to 133% of the original value for the following three years. With MBIE's agreement, the reductions (in earlier years) and increases (in latter years) are being met by adjusting the payments due from the Funding Institutions. The net effect for Institutions for 2021-22 was that their payment towards the Synchrotron operating costs was at 50% of original level. The Company also adjusted its operating budget for the 2021-22 year to recognise the reduced level to travel and other synchrotron science support that could be provided during the pandemic and reduced the usual requirement for a contribution of $120,000 from Institutions towards the Company's operating costs to $60,000 (refer Note 4).