



THE UNIVERSITY OF
SYDNEY

The University of Sydney Physics Foundation

Annual Report 2020



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President's Report

It is my privilege and pleasure to present the 2020 Annual Report for the University of Sydney's Physics Foundation. This has been a challenging and tumultuous year. The University of Sydney has made dramatic changes to its teaching and research programs to accommodate the travel and enrolment restrictions on international and domestic students and researchers. All staff have been managing to work from home and to transfer meetings and lessons to online mode. It has been difficult, and all staff and students are to be congratulated on the way they have responded to the limitations imposed by this nasty pandemic.



Despite the challenges, the Foundation has had a productive year, with the prizes and scholarships for outstanding achievement in physics by students awarded in virtual ceremonies. The Grand Challenges initiative of the Head of School was begun in 2019 and the two successful projects from that inaugural call have made good progress, with their annual reports included later in this Report. The 2020 Grand Challenges presentations were held on October 9 with seven excellent projects presented via zoom. My thanks go to the Panel who gave of their time to evaluate the projects – Professor Jodie Bradby, President of the AIP, Mr Wayne Fitzsimmons OAM, Chair of the Pearcey Foundation, Dr Sarah Pearce, Deputy Director CASS, Professor Susan Pond AM, Sydney University, and five Foundation Council Members – Mr Trevor Danos AM, Life Governor of the Physics Foundation, Mr James Kirby, Director of the James N. Kirby Foundation, Dr Gregory Clark AC, Professor Gregory McRae, Mr Michael Winternitz. I was privileged to Chair the Panel. More detail on the winning projects is given later. Briefly, there were two projects fully funded – “Nanoscale brain navigation for targeted drug delivery”, led by Drs Shelley Wickham and Ben Fulcher, and “Positronium, the key for cancer annihilation”, led by Yaser Hadi Gholam. A further three projects were awarded seed funding.

It is with sadness that we record the passing of Lord Robert May, arguably one of Australia's most influential scientists. His Memorium later in this Report describes some of his most important achievements, discoveries and honours. His support of the ISS and his friendship with Professor Harry Messel was deep and long-standing.

Lord May, universally known as Bob, will be long remembered for his rapier intelligence, eclectic and wide-ranging expertise and his wicked sense of humour. A true polymath who will be sadly missed by us all.

2021 should have been the year for the next ISS. Planning was under way, when the pandemic disrupted the schedule. It was decided that holding an ISS in 2021 in the usual way would not be feasible – bringing 150 national and international students to Sydney in July was not going to be possible. A decision was taken to defer the School until 2022. However, to keep momentum for the program, the Faculty is planning a special lecture series with several interactive activities.

The overarching topic that had been chosen for the next School included Artificial Intelligence, robotics and the wider interaction of advanced technology in our lives. Deferring ISS for one year provides an opportunity to review the program structure and to change the way the students are supervised and mentored. As ever, it is an ongoing challenge to continue to fund the ISS in line with the legacy of Professor Harry Messel and his fundamental goal of the pursuit of excellence in science.

We were not able to hold the Physics for Girls Workshops in 2020, but the Foundation's support for improving the gender and diversity numbers in STEM subjects is an ongoing goal.

The reconstruction of a representative version of the Narrabri Stellar Intensity Interferometer, which was funded by Harry Messel and the brainchild of Professor Robert Hanbury Brown, has been completed. The mirrors are being finely adjusted and the model is scheduled to be located in the Sydney Nanohub foyer. A ceremony to celebrate the project and recognize the legacy of the research undertaken with the Interferometer is planned for 2021.

It is with great appreciation that the very generous Professor John Graham Bequest was granted to support programs of science education, and this has been realised in 2020 by funding the teaching fraction of some of the outstanding teaching staff in the School of Physics, and through the purchase of some experimental equipment to support their teaching laboratories. The Messel Fellowship was not taken up at the end of 2019 and there are plans to readvertise and appoint an outstanding young female researcher in 2021. We gratefully acknowledge all donations to the Foundation and the Messel Endowment to enable such support to continue.

Professor The Honorable Dame Marie Bashir AD CVO and Mr Trevor Danos AM FTSE both stepped down from Council at the 2020 AGM of the Physics Foundation. Prof. Bashir has been a wonderful supporter of the Foundation and the ISS, as Patron for more than a decade when she was Governor of NSW and Chancellor of the University of Sydney, and subsequently as a member of Council. Her contribution has been outstanding and we extend our deep appreciation to her for her support. Mr Danos has also made an exceptional contribution to the Foundation and the ISS, as a past President of the Foundation and a significant contributor to the programs of the ISS. He is continuing his association with the Council as Observer, which is greatly welcomed and appreciated. Both Prof Bashir and Mr Danos have been appointed Life Governors of the Foundation and we thank them both for their ongoing interest and support.

In this unprecedented year, I would like to congratulate Professor Celine Boehm, the Head of the School of Physics and Director of the Foundation, on her leadership and management of the School, its research, teaching and administration.

Despite the challenges, there has been good progress with exciting new projects for the Foundation that are well aligned with our mission to promote excellence in science.

We are very appreciative of the support from Professor Iain Young as Executive Dean of Science and University Officer, and there has been excellent support and resourcing from the Faculty Staff with the amended plans for the ISS. My thanks to all the Council members for their commitment to the Foundation over this past year, in particular to Mr Michael Winternitz in his role as Deputy President.

Thank you to Ms Grace Schiavello, School Executive Officer, and to Ms Sian Edwards for their outstanding administrative support throughout the year and we are appreciative of the assistance given by Ms Clara Spencer, School Manager, and to the several staff who have supported the role of School Executive Assistant.

Finally, it is timely that I step down as President of the Foundation. It has been an enormous privilege and honour to hold this appointment and I have tried my best to continue to uphold Harry's goals and aspirations for the Foundation and the ISS. I plan to continue to serve as a Member of Council and extend my congratulations and good wishes to Mr Michael Winternitz as the incoming President and Mr James Kirby as the incoming Deputy President. The Foundation is in good hands and it is with great anticipation that we look forward to an amazing year of achievement in the pursuit of excellence in all our endeavours.

Yours sincerely

Emeritus Professor Anne J. Green FTSE, FRSN, FAIP, FASA
President, Physics Foundation

Physics Foundation Objectives and Aims



The University of Sydney Physics Foundation, established in 1954 by Emeritus Professor Harry Messel AC CBE, was the first Foundation established within the University of Sydney and the first of its kind within the British Commonwealth.

The Foundation was to support the School of Physics as a voluntary philanthropic association of individuals and private organisations dedicated to the pursuit of excellence in science education, research, training and communication. Today, the Foundation still carries out this important role.

Aims of Foundation

To support the School of Physics and to generate philanthropy, promote careers and broaden knowledge and understanding of science (in particular physics) in the wider community.

Objectives of the Foundation

To increase the resources of the University (by fundraising or by otherwise securing gifts and grants or by securing the provision of services or other non-financial contributions) to assist the Senate and the Vice-Chancellor in the promotion of the field of physics, through the School of Physics and

To cooperate with the School of Physics, the Faculty of Science and the University in promoting the significance of science and developing an understanding of its importance both within Australia and internationally.

Foundation activities in support of its objectives

- Raising funds from fees, donations, bequests and sponsorships.
- Building a strong financial position to ensure the Foundation can continue to meet its objectives in the long term.
- Providing additional funding to support the work of the School of Physics, through its scholarships, the purchase of equipment, and the underwriting of other initiatives.
- Promoting seminars, courses and workshops in the field of physics.
- Inspiring senior secondary school students through the Professor Harry Messel International Science School (ISS) to continue studies in science, and physics in particular, and to take up science careers.
- Any other initiatives and activities as the Foundation determines appropriate.

The Messel Endowment & Donations to the Foundation

The Messel Endowment

The Physics Foundation established the Messel Endowment in 1999 to ensure the Professor Harry Messel International Science School (ISS) continues in perpetuity.

Currently there are over 200 supporters to the Messel Endowment. These generous supporters are acknowledged in the Messel Endowment Honour Board that is published on the Physics Foundation website.

The two largest donors to date have each donated over \$1 million. These donors are classed as Extra Galactic Donors and are:

- Australian Government through the then Department of Industry.
- Mr Lee Ming Tee, through Mulpha Australia.

As at 31st December 2020, the Endowment holds \$6,035,119 in funds. During 2020, donations and bequests to the Foundation totalled \$599.

The Physics Foundation is appreciative of all our donors to the Messel Endowment. Without this valued support the ISS could not continue its important work of honouring excellence in outstanding Year 11 and 12 science students from Australia, China, India, Japan, New Zealand, Singapore, Thailand, the UK and the USA and encouraging them to pursue careers in science.

The Endowment seeks to accrue further funds through gifts, grants and bequests to ensure the ISS can be run in perpetuity with due allowance for inflation over the years.

Donations of \$2 and over are tax-deductible. Pledged gifts (donations spread over a three to five year period) are welcome and are also tax-deductible.

Careers and achievements

The ISS now has over 5000 alumni with many going on to outstanding career achievements in their chosen fields including science, medicine, engineering and technology.

Please help us in continuing to offer this world-class program to these talented students who come from diverse cultures and backgrounds.

Donations to the Messel Endowment can be made online, or via mail.

A donation to the Messel Endowment is an investment in the future of science.

For more information visit:

<https://sydney.edu.au/science/schools/school-of-physics/physics-foundation.html>



The Professor John Graham Bequest

In 2018 the Foundation Council and the School of Physics were saddened to hear of the passing of Emeritus Professor John Graham, a distinguished astronomer and long-time supporter and enthusiastic friend of the Physics Foundation. It is with great appreciation that we received in 2020 a very generous donation totalling AUD 8,667,971 from John Graham's Estate (via the USA Foundation). The terms of the Bequest are that these funds be directed towards the programs of science education by the Physics Foundation at the University of Sydney.

A targeted program to fund key teaching academics in the School of Physics who are inspiring their students through world class research, has been implemented for five years, starting in 2020. A modest amount from the Bequest will be used to purchase modern equipment to support the program in the teaching laboratories. The intention is to preserve the capital of the Bequest, as much as is practicable.

2020 Physics Foundation Members

Foundation staff

Professor Celine Boehm Head, School Of Physics
Ms Grace Schiavello - Executive Officer
Ms Sian Edwards

Patron

Her Excellency the Hon. Margaret Beazley AC QC

Past Presidents (initial year of presidency shown)

Dr Richard GC Parry-Okeden (1954)
Sir James N Kirby CBE (1957)
Sir Frank Packer KBE (1960)
Sir Noel Foley CBE (1963)
Sir Walter Leonard DFC (1966)
Sir Robert Norman (1969)
Mr James A Macpherson (1972)
Sir Walter Leonard DFC (1973)
Mr J Keith Campbell CBE (1975)
Mr Herman D Huyer AO OON (1978)
Mr Raymond J Kirby AO (1982)
Mr John R Slade (1986)
Mr Peter Douglas (1989)
Dr Peter Jones AM FTSE (1993)
Mr Paul Slade (1996)
Mr Graham Hall (1999)
Mr Pat Donovan AM RFD ED (2002)
Mrs Louise Davis AM (2005)
Mr Trevor Danos AM FTSE (Observer) (2008)
Mr Jim O'Connor (2011)
Mr Albert Wong AM (2013)

Past Directors (initial year of directorship shown)

Emeritus Professor Harry Messel AC CBE (1954)
Emeritus Professor Max Brennan AO FAA (1987)
Professor Lawrence Cram (1991)
Emeritus Professor Richard Collins FTSE (1997)
Professor Bernard Pailthorpe (2002)
Associate Professor Robert Hewitt (2003)
Emeritus Professor Anne Green FTSE (2006)
Professor Clive Baldock (2010)
Professor Tim Bedding (2012)

Foundation Council 2020

Office Bearers of the Foundation

Emeritus Professor Anne Green FTSE, President
Mr Michael Winternitz - Deputy President

University Officer

Professor Iain Young, Dean of Science

Council Members

Dr Gregory Clark AC FTSE
Mr Trevor Danos AM FTSE (Observer)
Professor Gemma Figtree FRACP FCSANZ FAHA
Mr James R Kirby
Professor Greg McRae

University Ex Officio Council Members

Ms Melinda Deerling
Ms Melissa Bonevska

Foundation Members

Founder

Emeritus Professor Harry Messel AC CBE

Life Governors

Mrs Louise Davis AM
Associate Professor Robert Hewitt
Dr David Mills AM
Mr Jim O'Connor
Mr Martin Rogers
Mr Paul Slade
Mr Albert Wong AM
Prof. The Hon. Dame Marie Bashir AD CVO
Mr Trevor Danos AM

Honorary Governors

Mr Tony Aveling
Emeritus Professor Max Brennan AO FAA
Emeritus Professor Richard Collins FTSE
Professor Lawrence Cram
Mr Raymond Kirby AO

Individual Members

Professor Dame Marie Bashir AD CVO
Dr Gregory Clark AC FTSE
Mr Trevor Danos AM
Professor Gemma Figtree FRACP FCSANZ FAHA
Emeritus Professor Anne Green FTSE
Mr James R Kirby
Professor Greg McRae
Mr Michael Winternitz

Corporate Members

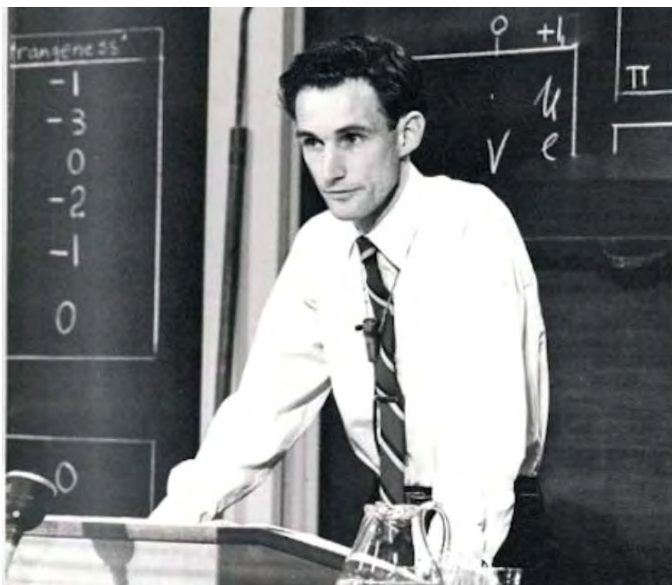
The James N. Kirby Foundation
The Nell and Hermon Slade Trust

In Memorium Lord Robert May OM AC KT FRS

Lord Robert May (known universally as Bob) was one of Australia's most distinguished scientists, with achievements in an extraordinary range of disciplines, including theoretical physics, population biology, theoretical ecology, economics and public policy. His pioneering work in biology led to the development of chaos theory. It is with great sadness that we mark the passing of a polymath of great influence, humour and humility. Bob died in Oxford on 28 April 2020, aged 84, following a period of ill health.

Following outstanding undergraduate achievements in physics, mathematics and chemical engineering at Sydney University, Bob completed his PhD in theoretical physics at Sydney in 1959, before taking a lectureship in applied mathematics at Harvard University (1959–61) and subsequently returning to the University of Sydney in 1962 where he was appointed to a Chair in Theoretical Physics, in 1969, at the young age of 33. He then went to Princeton as Professor of Zoology, where he made pioneering advances during the 70s and 80s in the field of population biology through the application of advanced mathematical techniques. He played a key role in the development of the field of theoretical ecology, subsequently applying these methods to the study of disease and biodiversity and these advances led to the development of chaos theory.

From 1988 to 1995 he held a Royal Society Research Professorship at Imperial College and the University of Oxford, where he was appointed a Fellow of Merton College, a position he held until his retirement. He served as the Chief Scientific Adviser to the UK Government and head of its Office of Science and Technology between 1995 and 2000 and was President of the Royal Society between 2000 and 2005.



Bob received many honours, prizes and accolades, including Knight Bachelor in 1996, Companion of the Order of Australia in 1998, and the prestigious Order of Merit in 2002. He became one of the first life peers in the House of Lords in 2001. His Fellowships include the Royal Society in 1979, Corresponding Member of the Australian Academy of Science in 1991, Foreign Member of the United States National Academy of Sciences in 1992, Academia Europaea in 1994, and Fellow of the Royal Society of New South Wales in 2010.

He has received honorary degrees from universities in Sweden, the United States, Switzerland, the United Kingdom and Australia. His honours include the Weldon Memorial Prize by the University of Oxford (1980), the American Ecological Society MacArthur Award (1984), the Medal of the Linnean Society of London (1991), the Frink Medal of the Zoological Society of London (1995), the Royal Swedish Academy's Crafoord Prize (1996), the Swiss-Italian Balzan Prize (1998), the Japanese Blue Planet Prize (2001) and the Royal Society's Copley Medal (2007), its oldest and most prestigious award. In 2008 awarded the Lord Lewis Prize by the Royal Society of Chemistry.

Bob has left an enduring legacy in many areas and has been hugely influential in the careers of many scientists and students. He was well-loved for his wit, humanity and salty language, but above all for his towering intellect and insight. Bob is survived by his wife, Judith, of nearly 60 years, and his daughter Naomi. He was passionate about so many things and he will be greatly missed but long remembered.

The Physics Grand Challenges

In 2019, the Head of School opened a new research initiative called the Grand Challenges, funded by the Physics Foundation, to support innovative projects for a period of up to two years, that would be unconventional and interdisciplinary. The projects should aim to open a new area of research that would be sustainable beyond the initial funding and that would be attractive to new research students.

The inaugural year of the program attracted 13 high quality projects, which were evaluated at a special event. Short presentations were made to the Selection Panel, comprising Council Members and some external experts. The two successful projects selected for 2019 are "Big data visualization of supply chains as a strategy to combat slavery" (the OAASIS Project), led by Dr Joy Murray and "Mission to α -Centauri", led by Professor Martijn de Sterke. Reports from these projects are included in this Annual Report. Five additional projects were highly commended and given small seed grants to enable them to develop their proposals further.

For 2020, the pandemic restrictions created some challenges for the program. However, after some delay there was a Zoom event on 7 October, with presentations from 7 innovative projects covering a wide range of topics. A distinguished Selection Panel comprised Professor Jodie Bradby, President of the Australian Institute of Physics, Mr Wayne Fitzsimmons OAM, Chair of the Pearcey Foundation, Dr Sarah Pearce, Deputy Director CSIRO Astronomy & Space Science, Professor Susan Pond AM, Sydney University, and 5 Foundation Council Members – Mr Trevor Danos AM, Life Governor of the Physics Foundation, Mr James Kirby, Director of the James N. Kirby Foundation, Dr Gregory Clark AC, Professor Gregory McRae, Mr Michael Winternitz.



The Foundation President, Emeritus Professor Anne Green, chaired the Panel. More detail on the winning projects is given later. Briefly, there were two projects fully funded, each at \$250,000 over two years – "Nanoscale brain navigation for targeted drug delivery", led by Drs Shelley Wickham and Ben Fulcher, and "Positronium, the key for cancer annihilation", led by Dr Yaser Hadi Gholam. A further three projects were each awarded seed funding of \$50,000. They were supported through another source, not Physics Foundation funds. The projects given seed funding, with their lead investigator, are:

- "Neurobridge: A universal neurophotonic interface" (Assoc. Prof. Stefano Palomba)
- "Organo- a building set for replacement body parts" (Professor Simon Fleming)
- "Silent but deadly: environmental methane sources & impacts" (Assoc. Prof. Maryanne Large)



School of Physics team supporting Grand Challenges 2020 Presentations.

An innovation this year was for the projects to demonstrate the capacity to attract new research students, and also to indicate how undergraduate students could be included in activities, with a view to encouraging them to continue with a career in physics.

Grand Challenges 2019 – The OAASIS Project

Modern Slavery affects around 43 million people. Australia's Modern Slavery Act came into force in 2018. It requires large organisations to report on modern slavery in their supply chains. However global companies and NGOs working at the centre of the 'combatting modern slavery' agenda identify a profound lack of knowledge on what constitutes a supply chain and what to do if modern slavery is found. In proposing to fill this knowledge gap, Integrated Sustainability Analysis (ISA) and Sydney Institute for Astronomy (SIfA) were recipients of funding through the School of Physics inaugural Grand Challenge. And thus the OAASIS Project was born

<https://sydney.edu.au/science/our-research/research-areas/physics/big-data-combatting-modern-slavery.html>

Community and business members of the OAASIS research team have worked at the forefront of combatting modern slavery for many years including changing lives on-the-ground and at sea through practical intervention (Thai Union's Sea Change program), corporate social responsibility (CSR Asia's human rights program) and education (Be Slavery Free's corporate and civil society field trips to SE Asia and Australia-wide school programs). All are world renowned for their work.

The aim of the OAASIS project is to provide materials to support businesses and civil society to understand what a supply chain is and how to trace it (Stages 1 & 2); and how to recognise modern slavery and know how to address it (Stage 3). Stages 1 & 2 are funded by the Grand Challenge grant. Together they will constitute the proof of concept that top down (big) and bottom up (small) supply chain data can be integrated to drive a virtual reality (VR) data visualisation environment. Stage 2 will also include 360degree video of a small part of a farmer's supply chain (e.g. a trip to a local supplier). This will be used to prove the concept that video can be 'stitched' to data visualisation to provide a whole supply chain experience.

Stage 1 will provide the data foundation for the supply chain data visualisation. For Stage 1 we are collecting bottom-up small data from cocoa farmers in Ghana. The data will be 'married' with existing top-down big data from the Eora global supply chain database (<https://worldmrio.com/>).

In Stage 2 the combined data will be used to drive a virtual reality environment.

Together these two stages will prove the concept that big data and small data, including video, can be combined and presented in VR to illuminate supply chains.

We will use this proof of concept to apply for funding to develop a VR supply chain 'journey' linking the supply chain with modern slavery (Stage 3). Stage 3 will build on stage 2 to develop materials to educate businesses on what constitutes modern slavery, what constitutes an organisation's supply chain, how to trace it, what to do if slavery or forced labour is found in it and the benefits that accrue to business from addressing it. This will address the two knowledge gaps identified by businesses as an impediment to addressing modern slavery in the supply chain. In doing so we hope to contribute towards eliminating this scourge on humanity.

Grand Challenges 2019 – Mission to α -Centauri Project

Overview

The Breakthrough Starshot initiative, coming out of the USA, aims to send small probes, with a mass of approximately 1 gram each to α -Centauri, the star closest to Earth. Everything about this project is extreme: the probes, which have the shape of a sail, will be propelled by reflecting light that is emitted by a large, earth-based laser with a diameter of about a kilometre. The sails will need to reach 20% of the speed of light within the first 15 mins or so of their journey, by which time they will have travelled almost as far as the distance to the Sun. The associated acceleration is 60,000 times that of the gravitational acceleration on Earth. The project has a number of well-defined physics-related challenges, two of which we are addressing.

Thermal management of the sail

Even though the sails are meant to reflect all the incoming light, it is inevitable that some of it is absorbed, leading to heating; since the mass of the sails is so low, the heating can be quite substantial, likely several 100's of degrees. In space, the only mechanism to shed heat is by thermal radiation. The thermal properties of the sail are therefore very important, particularly the thermal emission properties at wavelengths between 4 and 10 μm . This is an aspect that thus far seems to have been overlooked. Thus, the material used needs to have a high refractive index at laser wavelength, probably around 1 μm , needs to be strongly emissive at longer wavelengths and needs to have a low density. We have evaluated different materials and are working on a Figure of Merit that allows us to compare the suitability of different materials.

Sail mechanics

While a sail is being accelerated by the laser beam, it is very sensitive to small variations in the laser intensity. The distances are so large and the speed so high that any active feedback control of the laser is too slow—by the time the laser has corrected the beam and the light has reached the sail it will be too late. The sails therefore need to be self-stabilising. There have been different approaches discussed in the literature, but these lead to a side-to-side motion of the sail. Damping this sideways motion is very difficult, and no solutions have been reported. Any solution to this problem requires the sails to have internal degrees of freedom, i.e., not to be stiff, for example it needs to be able to flap and thereby absorb the energy of the sideways motion. However, calculating the three-dimensional motion of such objects is challenging.



α -Centauri the star closest to Earth. Image credit: NASA/JPL-Caltech

We have approached the problem in a collaboration with Prof Holger Dullin from the School of Mathematics and have developed a general framework to address these problems. This is being included in a computer program that we have written to calculate the motion of the sail, so we will be able to evaluate the effectiveness of different strategies.

Other activities

We were delighted to appoint Dr Mohammad Rafat to work on the project as a Research Fellow. In addition to the research activities listed above we have supervised approximately ten undergraduate students in research projects, have given a presentation to PHYSOC, and we are working on a light pressure experiment for use in the undergraduate laboratory. We have also reached out to the members of the Starshot program in the US and to colleagues at the ANU who working on other aspects of the Starshot initiative.

ISS2021 - Update

Wait for it ... ISS2021 becomes ISS2022!

After ISS2019 wrapped up we began preparing for the next event, scheduled for July 2021. By mid 2020, however, it was clear that the global COVID-19 pandemic was going to force a major change in our plans, as entire countries locked down and domestic and international borders closed.

Late in 2020 the Physics Foundation and the ISS organising team decided to postpone the ISS2021 program for one year. Assuming the pandemic can be brought sufficiently under control in the remainder of 2021, ISS2022 will go ahead in July next year, commencing a programming shift from odd- to even-numbered years.

Introducing ISS Online

If we can't bring talented and enthusiastic science students to Sydney for the ISS in 2021, then we'll just have to take the ISS to them instead!

This year we are planning a new, fully online program of talks and activities, scheduled to run in July 2021. The ISS Online program will be advertised to students across Australia, and may be extended to select students overseas through our partner organisations around the world.

The ISS Online program will provide a stimulating, inspiring and enjoyable week of science talks and activities for talented senior high-school students.



The full in-person ISS experience will return bigger and better than ever in 2022



ISS Online will use the technology so many of us have grown familiar with to bring exciting, inspiring science to top science students, wherever they are!

For several hours each day, participants will take part in talks by leading researchers, live tours of research facilities and labs, hands-on experiments and activities designed for students to participate in remotely, and other activities designed to stretch their minds and horizons.

One important aspect of the in-person ISS is the interactions between the scholars and their staffies, particularly through the small, class-sized staffie groups. The new online program will capture some of this experience through retaining the staffie group structure, and organizing pre-event gatherings for online briefings and social activities to help the participants meet each other, make new connections, and get to know some of the alumni staffies.

Applications for a place at ISS Online will open in Autumn 2021, and will involve a similar process to past programs. A student's application will need to be supported by their school, and they will submit their academic grades and a supporting document outlining why they hope to attend.

While the events of the past year have forced this major change of direction for the ISS program, we are excited about the challenge ahead and the possibilities of the new online format. We look forward to presenting a truly inspiring ISS Online program for 2021.

Dr Karl Kruszelnicki AM | Julius Sumner Miller Fellow

The Science Foundation established the position of Julius Sumner Miller Fellow within the School of Physics in 1995. Dr Karl Kruszelnicki has been the championing Fellow since, making science accessible for students and the public alike. This year especially, the value of Science, and how it is communicated, became more important than ever. First Australia was engulfed by extraordinary bushfires and then a pandemic swept the world.

Kalinga Prize

The year began with a letter of congratulations from Senator the Hon Marise Payne, Minister for Foreign Affairs and Minister for Women, acknowledging Karl's UNESCO Kalinga Prize for the Popularisation of Science awarded in late 2019.

Staff

Isabelle Benton continued working alongside Dr Karl as his producer. Chris Norris continued as technical producer for the University of Sydney podcast 'Shirtloads of Science'.

National Science Week

Karl hosted an online expert panel tackling 'The Big Questions of Science' as part of The Australian Museum's 'Sydney Science Trial' and wowed the online audience with his University of Sydney show 'Dr Karl's House Party!' He also made a virtual visit to the Starlight Express rooms answering questions from kids in hospitals around Australia.

University of Sydney Events

Events included the Sydney Science Experience, Welcome Week and a Lunchbox Science Live Webinar. Karl gave an online talk on 'How to Give a Science Presentation' for 1st year PhD students and a Leadership in STEM seminar for students in the University's high-achievers Dalyell stream. Karl also gave several presentations for the STEM Teacher Enrichment Academy.

Dr Karl filmed a Covid-19 explainer video for University of Sydney social media channels and wrote and recorded a revelatory five-part lecture series for a new first-year class in the Open Learning Environment Unit Sustainability: Climate and Energy.



Newborough Primary Q&A

Schools

School Q&As continued throughout the year. Skype and Zoom were platforms in use, but Microsoft Teams was added allowing more students to participate from home during lockdowns. Karl did 77 Q&As. Planned school visits transformed into virtual visits such as the Northern Beaches Secondary College which covered four of their campuses.

Eureka School Prize

The University of Sydney Sleek Geeks Eureka Schools Prize is now into its fifteenth year. Over the course of 50 radio interviews Australia wide Dr Karl inspired kids with science experiments to do at home and explained how to enter the one-minute video competition. Dr Karl's extraordinary effort in promoting the competition had an enormous impact on the number of entries. The finalists in all categories enjoyed a Zoom afternoon tea with Karl and Adam Spencer and Karl later joined the Dean of Science Professor Iain Young for a live broadcast to announce the winners.

Television

Dr Karl continued with his regular appearances on Today Extra and recorded segments for The Project for their 'Family Survival Guide' during a pandemic. Dr Karl appeared on ABC's Play School in two episodes on Sea and Space and a third episode on Play School Storytime.

Dr Karl was also a guest on ABC's Julia Zemiro's Home Delivery. Karl's wife Mary joined him for an interview about the shirts she makes for him on ABC's The Mix.

Karl had a couple live TV appearances for DELFI TV in Lithuania discussing science topics and taking questions. Karl farewelled the year with a comedic appearance on ABC's New Year's Eve: Early Night Show.

Radio

Thanks to Dr Karl's home broadcast studio, he continued his five hours of national ABC radio segments. In the context of Covid-19 lockdowns, radio became an even more important source of connection and information; as a public service it really came into its own. Dr Karl teamed up with Dr Norman Swan and Teagan Taylor for a series of coronavirus triple j science segments. The triple j audience in just the five capital cities alone attracts over 750,000 listeners, while the podcast downloads for 2020 were 4.6 million.

Interwebs

Dr Karl consistently engages and activates his fans across numerous channels of social media and actively promotes the University of Sydney. His followers continue to grow with Facebook numbers rising dramatically from 55K to 156K. Instagram followers are up from 85.5K to 91.4K. Twitter followers are up from 321K to 336.3K.

As the year came to a close TikTok opened up to the world of Karl. Stay tuned in 2021 for Science fun on TikTok: 58.3K followers within two weeks and counting...



Dr Karl read the very apt 'Mr Archimedes' Bath' by Pamela Allen that illustrates water displacement for ages three and up!

Karl's website, drkarl.com is the go-to hub of all things Karl.

Dr Karl's ABC Webpage is currently responsible for almost one-half of all visits to the ABC Science webpage, and about 5% of all Internet traffic to the ABC.

Podcasts

Dr Karl has two ABC podcasts and a weekly University of Sydney podcast 'Shirtloads of Science' (average download per episode is 15K). Shirtloads features numerous University of Sydney academics. Professor Eddie Holmes (virologist) joined Dr Karl for an informative three-part series on Covid-19. 'Shirtloads of Science' holds its position worldwide within the top 60 podcasts on iTunes in its category.

Books and Writing

Book number 46 was released in October. 'Dr Karl's Surfing Safari Through Science' is a full-colour large format paperback with bonus pop-up holograms! Dr Karl continued his regular columns in Australian Geographic magazine and University of Sydney's Science Alliance newsletter (4000 members).

Mentoring and Media/Speaker Training

Dr Karl's mentoring of University of Sydney students continued throughout the year over the phone, email, twitter and also in-home visits to join him for radio broadcasts and podcasts.

Overseas Online Activities

Dr Karl gave presentations for New Scientist Christmas Special Live, The Cosmic Shambles Network (July and December) and The Royal Institution's Christmas Crackers show.

Communication is Key

Karl's science stories have educated and entertained generations of people. More than ever, 2020 called on Karl's unique skills to interpret research and data, interview specialists, and create engaging content to explain, translate and guide for health, well-being and common good.

Foundation Governance Statement

University Foundations are required to report to Senate. Summarised below is the Governance Statement Section to be reported upon as part of the Annual Report. The Annual Report prepared by a Foundation is to be submitted via the CFO to Finance and Audit Committee of the Senate.

The University of Sydney Physics Foundation recognises the importance and benefit of reviewing its adoption and alignment with governance principles and provides the following report.

Principle 1 – Lay solid foundations for management and oversight

Nature of the entity

The Physics Foundation is a part of the University of Sydney ABN 15211513464 and not separately incorporated under a state or commonwealth Act. The Foundation is required to gain prior approval for its fundraising activities from the appropriate University delegate. The Foundation's activities are not-for-profit and covered by the DGR status of the University of Sydney. The University is exempted from the requirement to hold an Authority to Fundraise and obligations upon holders of such an authority but is still required to comply with the balance of provisions of the Charitable Fundraising Act.

Roles of board / council and management

The Foundation operates under the authority of the Senate of the University of Sydney, as approved in 1954, and has no powers of delegation. The Foundation conducts its affairs pursuant to the Foundation Rules and the relevant policies of the University. The Foundation had its annual fundraising plan approved and was able to meet its objectives.

Principle 2 – Structure of the council to add value

The Council of the Foundation in 2020 consisted of the following members. They were all eligible to attend two meetings in 2020, as well as the Annual General Meeting.

Executive

President, Emeritus Professor Anne Green FTSE
Appointment term: 2017 AGM until 2021 AGM
Meetings attended: 3

Deputy President, Mr Michael Winternitz
Appointment term: 2018 AGM until 2021 AGM
Meetings attended: 3

Professor Iain Young, Dean, University Officer
Meetings attended: 0

Members

Professor Celine Boehm (Ex-officio Head of School)
Meetings attended: 3

Dr Gregory Clark AC FTSE
Meetings attended: 2

Mr Trevor Danos AM FTSE (Observer)
Meetings attended: 3

Professor Gemma Figtree FRACP, FCSANZ, FAHA
Meetings attended: 3

Mr James R. Kirby
Meetings attended: 3

Professor Gregory McRae (Overseas Member)
Meetings attended: 3

Council members were elected at the Foundation's AGM on 4 March 2020. There is not a separate nomination committee of Council. All terms are annual, with the exception of the President and Deputy President, who are elected for two years. The full Council resolves on nominations for co-opting of members to fill vacancies outside of the process of election at the AGM] There was no performance evaluation of the Council undertaken in the reporting period.

Principle 3 – Promote ethical and responsible decision-making

Council members have been provided with the University of Sydney Foundation Rules, Code of Conduct, Work Health & Safety policy and the External Interests policy. All these policies are available on the University's Policy Register, as are other relevant University policies regarding harassment, grievance procedures and the Delegations of Authority.

Principle 4 – Safeguard integrity in financial reporting

The annual accounts of the Foundation are prepared by the financial staff of the University, signed off by the Finance Director, Divisions of Natural Sciences, Engineering & Information Technologies and Business, and included in this Annual Report to the Senate. The Foundation is part of the University and therefore does not have its own audit sub-committee. While the Annual Financial Report of the University is audited by the Audit Office of NSW, the Annual Report of the Foundation has not itself been audited.

The Foundation undertook the following fundraising appeals during 2020: Donations.

In conducting those appeals the Foundation took all reasonable steps to ensure that commissions paid or payable to any person as part of a fundraising appeal did not exceed one-third of the gross money obtained by that person in the appeal and appropriate particulars of all items of gross income received or receivable, all items of expenditure incurred, including the application or disposition of any income obtained from the appeal and particulars of those transactions to which they related were recorded in the minutes of the Foundation.

Principle 5 – Make timely and balanced disclosure

The Foundation complied with the reporting and disclosure requirements of the Senate. These include an annual budget and this Annual Report

Members and Council have been made aware of the processes for disclosure pursuant to the Code of Conduct, External Interests policy, which include protected disclosure to the ICAC, to the Ombudsman or the Auditor General.

Principle 6 - Respect the rights of shareholders, members, staff, volunteers, clients, & other stakeholders

The Foundation Council and/or membership consist of members of the community, industry bodies and the University whose input is invited via the Annual General Meeting and Council meetings of the Foundation. The following forums/mechanisms have been held during the year to involve stakeholders in election of the Council, activities of the Foundation or other stakeholder participation. Invitations are issued to the Annual General Meeting and two Council meetings per year.

Under the Charitable Fundraising Act, the University may be questioned about any appeal on details of the purpose of the appeal such as the appeal target, objectives, distribution of proceeds, and the process to provide answers. During the year the Foundation published information on its website, via email newsletter and outlines those activities in this annual report. Specific requests for information are responded to by the Foundation office. Other enquiries may have been made to other parts of the University.

Principle 7 - Recognise and manage risk

The Foundation recognises its activities within University premises or other premises require risks such as health and safety, environmental protection, privacy, trade practices, and compliance with the Charitable Fundraising Act to be considered and managed. The Foundation has managed these risks during the year by adhering to University policies concerning events, publications and external relations activities.

Principle 8 – Remunerate fairly and responsibly

No member of a Council is entitled to receive any remuneration for acting in that capacity except reasonable remuneration on a basis which has first been approved in writing by the University Officer (Foundations)

Members of the Foundation Council may be reimbursed for reasonable expenses after written approval of the University Officer (Foundations). Any such instances are recorded in the minutes of the Council.

2020 Finance Statement



THE UNIVERSITY OF
SYDNEY

Annexure 1

NSW 2006 AUSTRALIA

TO: Financial Control and Treasury

FROM: University Officer (Foundation)

SUBJECT: Certificate of Operations

CERTIFICATION

I hereby certify that the activities reflected in the Financial Statements for the year ended 31 December 2020 of the Physics Foundation fully complies with the Foundation Rules.

Any areas of non-compliance or departure from such governing rules have been advised in writing to the Provost / Deputy Vice-Chancellor responsible for overall governance of the Foundation's operations.

Signature: _____

Professor Iain Young

University Officer (Foundation)

Date: 26th February 2021

2020 Balance Sheet

The University of Sydney

Uni of Syd Physics Foundation (L7500_SCI_FND_PHYS)

Balance Sheet

as at 31 December Calendar Year 2020

	Note	31 December CY2020	31 December CY2019
ASSETS			
CURRENT ASSETS			
Short Term Funds	3	1,923,709	1,011,140
Total Current Assets		1,923,709	1,011,140
NON CURRENT ASSETS			
Medium/Long Term Investments	3	29,043,180	21,258,242
Total Non Current Assets		29,043,180	21,258,242
TOTAL ASSETS		30,966,889	22,269,382
LIABILITIES			
CURRENT LIABILITIES			
Payables		0	(27)
Total Current Liabilities		0	(27)
NON CURRENT LIABILITIES			
TOTAL LIABILITIES		0	(27)
NET ASSETS		30,966,889	22,269,409
EQUITY			
Accumulated Funds		30,966,889	22,269,409
TOTAL EQUITY		30,966,889	22,269,409

Notes to Financial Statements

1. Accounting Policies

- The financial statements have been prepared on a modified accrual accounting basis.
- All fixed assets are expensed in the year of purchase.
- Employee entitlements for Long Service Leave are held centrally in the University's accounts.
- The University (including the Foundations) is exempt from income tax.

2. The funds reported herein are overseen by the Physics Foundation, which was set up by the late Professor Harry Messel to promote education and research in the physical sciences. These funds are used to support the International Science School (which runs biennial events for high achievers in senior high schools throughout the world), with surplus, annual investment returns made available, subject to Foundation and University Treasury approvals, to support the School of Physics in its teaching and research endeavours.

3. Short Term and Long Term Investments include \$6,035k of the Messel Endowment (\$5,982k in 2019) managed by the University of Sydney to retain its value in accordance with the commitments made by the Foundation when the Endowment was established.

2020 Statement of Changes in Equity

The University of Sydney
Physics Foundation (L7500_SCI_FND_PHYS)

Statement of Changes in Equity

for the Year Ended 31 December 2020

	Note	Foundation Operations (L7501)	Messel Endowment (L7505)	International Science School (L7502)	Total
		\$	\$	\$	\$
Balance as at 1 January 2019 [ISS Year]		15,598,308	5,779,020	118,827	21,496,155
Add (Less): Accumulated Funds Adjustments		(1,374)	0	20	(1,354)
Add: External Income (excluding Gain/Loss on Investments)		22,868	19,199	111,981	154,048
Add (Less): Gain / (Loss) on Investments		1,569,077	482,730	0	2,051,807
Add (Less): Intra-Foundation Funds Transfer		0	(283,363)	283,363	(0)
Less: Funds Transferred to Physics	4	(750,000)	0	0	(750,000)
Less: Expenditure		(154,225)	(15,481)	(511,542)	(681,248)
Balance as at 31 December 2019		16,284,654	5,982,105	2,649	22,269,408
Balance as at 1 January 2020 [Non-ISS Year]		16,284,654	5,982,105	2,649	22,269,408
Add (Less): Accumulated Funds Adjustments	5	48,535	0	0	48,535
Add: External Income (excluding Gain/Loss on Investments)	6	8,692,305	6,662	111,158	8,810,125
Add (Less): Gain / (Loss) on Investments		301,201	46,353	0	347,554
Add (Less): Intra-Foundation Funds Transfer		0	0	0	0
Less: Funds Transferred to Physics	4	0	0	0	0
Less: Expenditure		(436,614)	0	(72,120)	(508,734)
Balance as at 31 December 2020		24,890,081	6,035,120	41,687	30,966,888

Notes to Financial Statements (...continued)

4. During 2019, the Foundation approved a total of \$7.0m to \$7.5m amount of funds to be utilised by the School of Physics to support its Grand Challenges (research) seed-funding requirements, plus other teaching- and research-related initiatives. Of this total amount, \$4m had been derived from prior year investment returns, while the remaining 3.5m (= ~\$0.7m x 5) will be derived from current and future annual investment returns. So far, only an amount of \$750k had been transferred to the School during 2019. That \$750k amount was part of the first tranche of \$1.4m to \$1.5m annual allocation approved by the Foundation for a five year period, which was planned to begin in 2019/20 and end in 2024/25. The global pandemic (COVID-19) had disrupted the planned timeframe and related activities, such that the five year period might need to be extended. During 2020, no Foundation funds were transferred to the School of Physics accounts, although two Grand Challenges research projects ("Brain Navigation" and "Positronium") were awarded \$250k each. These 2020 awarded GC project funds (totaling \$500k) will be transferred to the relevant recipients' School accounts during 2021 and 2022 when expenses are incurred.

5. The favourable Accumulated Funds Adjustments total of \$49k in 2020 is an adjustment to the Central Cost Allocation (formerly known as "UEM") overhead charges that were automatically (but incorrectly) debited against the Foundation accounts during 2019.

2020 Statement of Income

The University of Sydney

Uni of Syd Physics Foundation (L7500_SCI_FND_PHYS)

Income Statement

for the Year Ended 31 December Calendar Year 2020

	Note	31 December CY2020	31 December CY2019
INCOME			
Grants		105,985	0
Scholarships, Donations and Bequests	6	8,668,670	5,821
Business and Investment Income		23,333	29,270
Realised Gain / (Loss) on Investments		365,748	259,716
Unrealised Gain / (Loss) on Investments		53,796	1,900,622
Investment Administration Fee		(71,991)	(68,530)
Internal and Other Income		12,138	362,318
Total Income		9,157,679	2,489,217
EXPENDITURE			
Salaries	7	246,731	140,702
Consumables		171	17,478
Equipment and Repairs/Maintenance		29,744	2,648
Services and Utilities	4	5,666	1,016,267
Travel, Conferences, Entertainment		55	431,400
Contributions to University areas		0	127
Consultants and Contractors		9,677	7,255
Student Costs and Scholarships		32,009	38,417
Other expenses	8	184,683	60,315
Total Expenditure		508,734	1,714,609
Surplus / (Deficit)		8,648,944	774,608
Accumulated Funds		22,269,409	21,496,155
Accumulated Funds Adjustments	5	48,535	(1,354)
Total Accumulated Funds		30,966,889	22,269,409

Notes to Financial Statements (....continued)

6. During 2020, a very generous donation totalling AUD 8,668k (= \$205k + \$8,463k) was received from the Estate of Late John Archibald Graham (via the USA Foundation). These funds are currently invested in the University's Long Term Investment Funds. The donor's wish is that these funds be directed towards the programs of science education by the USYD Science Foundation for Physics.

7. The 2020 salary expenditure of \$247k includes International Science School (ISS) salary expenses (including salary oncosts) for Megumi Kikuchi (\$55k) and Christopher Stewart (\$16k). It also includes \$176k of funding support for the salaries of eight School of Physics staff members: Maryanne Large (\$87k), Fiona Lawrence (\$57k), Vicky Tzioumis (\$11k), Daan van Schundel (\$8k), Daniel Naoumeno (\$6k), Joshua Pritchard (\$2k), Sian Edwards (\$2k), and Georgio Katsifis (\$2k).

8. "Other expenses" totaling \$185k in 2020 includes \$171k of Central Cost Allocation (formerly known as "UEM") overhead charges, which are automatically debited against all University (including Physics Foundation) accounts based on staff numbers and other cost drivers. This \$171k amount will be adjusted during 2021 if deemed appropriate.

I certify that the Income Statement and Balance Sheet of the Foundation have been prepared in accordance with the University's accounting practices and procedures. These Foundation accounts form part of The University of Sydney's financial reports.

Jong Nheu

Jong Nheu
Finance Manager
School of Physics
26th February 2021

Carma Du Plooy
Finance Director
Financial Services - Science, Engineering and Architecture
26th February 2021

Audit Report ISS 2019



The University of Sydney
Physics Foundation
40th Professor Harry Messel International Science School

Income Statement

1st January 2018 to 31st December 2019

	31 December CY2019 \$ L7502 All Projects \$	31 December CY2018 \$ L7502 All Projects \$	ISS2019 2018 and 2019 \$ L7502 All Projects \$
INCOME			
Grants (NSW Department of Education)	103,400	0	103,400
Scholarships, Donations and Benequests	2,106	13,856	15,963
Business and Investment Income	419	2,414	2,833
Messel Endowment contribution	289,418	0	289,418
Total Income	395,344	16,270	411,614
EXPENDITURE			
Salaries	61,058	47,739	108,797
Consumables	778	0	778
Equipment and Repairs/Maintenance	2,648	87	2,735
Services and Utilities (Note 1)	15,152	7,364	22,515
Travel, Conferences, Entertainment (Note 2)	420,244	6,042	426,286
Contributions to University areas	127	0	127
Student Costs and Scholarships	677	0	677
Other expenses (Note 3)	10,857	1,594	12,451
Total Expenditure	511,542	62,826	574,368
Operation Margin	(116,198)	(46,555)	(162,753)
Accumulated Funds (Beginning Balance)	118,828	165,383	165,383
Accumulated Funds Adjustments	19	0	19
Accumulated Funds (Ending Balance)	2,649	118,828	2,649

Note

- The 2019 Services and Utilities expenditure (\$15,152) includes ISS catering and function costs incurred at the Women's College and other venues.
- The 2019 Travel, Conferences and Entertainment expenditure (\$420,244) includes airfare, harbour cruise, accommodation and conference expenses incurred during ISS2019.
- Other Expenses include printing, stationery, motor vehicle and miscellaneous expenses.

Professor Iain Young
Dean, Faculty of Science
The University of Sydney

25 May 2020



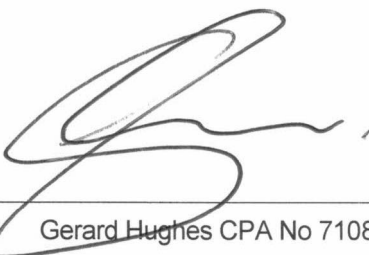
Independent Audit

I have audited the financial report, being a special purpose financial report **of the 40th Professor Harry Messel International Science School at the University of Sydney** for the period of 1 January 2018 to 31 December 2019.

My audit was conducted in accordance with the Australian Auditing Standards. The procedures included examination, on a test basis, of evident supporting the amounts and other disclosures in the financial report. These procedures have been undertaken to form an opinion on whether, in all material respects, the financial report is presented fairly in accordance with the predominantly cash basis of accounting whereby revenue is recorded when it is received, expenses are recorded when they are paid, and no material assets or liabilities, other than cash are recorded.

I hereby certify that the attached Statement of Income and Expenditure is true and fair. The funding has been expended in accordance with the DEST funding agreement and all interest generated by the \$1,000,000 capital contribution has been fully expended in contributing to the costs of the International Science Schools.

Yours sincerely



Gerard Hughes CPA No 710863

15/5/2020.

Date

For more Information
Contact Us
physics.foundation@sydney.edu.au
sydney.edu.au/science/schools/school-of-physics/physics-foundation.html

