

APRIL 2023, ISSUE 8



ARC Industrial Transformation Training Centre for Cryo-electron Microscopy of Membrane Proteins

Quarterly newsletter

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Lorne Proteins 2023

New ICHDRs

New Members and Affiliates

Image credit - Dr Sarah Piper
(@SarahJ_Piper, @PiperProteins)



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CCeMMP acknowledges the peoples of the Kulin, Dharawal, Yuin and Wadi Wadi Nations on whose land the Centre and its Nodes operate. We pay our respects to their Elders, past, present and emerging.

Welcome

Professor Patrick Sexton

Centre Director

Welcome to the 8th instalment of the ARC CCeMMP quarterly newsletter.

In this newsletter we welcome new ICHDRs to Monash, UoW and UoM/Bio21 nodes, our first cohort for 2023, as well as new members/affiliates within the nodes. We provide an update on activities over the last quarter and present recent highlights from our members. We extend a special warm welcome to our new affiliate members from institutions outside of the founding academic institutions who have joined the Centre as part of our strategic plan to expand engagement broadly within Australia.

Key activity highlights include the CCeMMP organised meeting on "Cryo-EM of membrane proteins" that was held as an embedded satellite of the internationally renowned Lorne meetings on Protein Structure and Function, the 2023 recommencement of the CCeMMP seminar series, and submission of our annual report to the ARC.



A handwritten signature in black ink that reads "Patrick Sexton".

Professor Patrick Sexton
Centre Director

Did you know?....April 13th was World Microscope Day

April 13th was World Microscope Day. The term microscope was first used on April 13th, 1625 when Johannes "Giovanni" Faber gave the name 'microscope' to Galileo's compound microscope (Galileo had called it 'occholino', little eye). Microscopes were in fact around at least a century before this, at an awe-inspiring (at the time) 9x magnification. It wasn't until the mid 1670's that the lens quality was refined enough to be able to observe bacteria. In 1826, microscopes became important for medical research with the breakthrough of putting several weak lenses together at given distances in order to achieve greater magnification, without blurring the image. Of course, the 20th century saw further developments and the appearance of various microscopy techniques beyond light microscopy, including electron microscopy.

Microscopes have come a very long way since they were first named. Today, across our Nodes, CCeMMP has access to 13 cryo-electron microscopes [300kV Titan Krios (x3), 200kV Arctica (x3), 200kV Galcios (x1), 120kV T12 (x3), 120kV L120C (x2) and 300kV TF30 (x1)], that can amplify samples by up to 160,000 x magnification (a long way from the 9 x magnification of almost 400 years ago). Our instruments run 7 days per week, up to 24 hours per day and can, collectively, produce 13 terabytes of image data per day. For example, at the University of Wollongong Node, the Titan Krios alone produces 9,600 images per day! Many thanks go to the trainers and managers, at each of our facilities, who maintain the smooth operation of all these instruments and enable the advanced training for our CCeMMP students.

On the cover: "Atomic jewellery" -- Dr. Sarah Piper's entry was Runner Up in the NHMRC Biennial awards; Science to Art, March 29, 2023. In this ball and stick model, the structure of the GLP-1 receptor is in white, with a small molecule bound in blue.

Centre updates

ARC Annual Report

Our annual report to the ARC was submitted in March. The report provides the ARC, our major funder through the Industrial Transformation Training Program, with an update on Centre operations and planning, including our achievements against the Key Performance Indicators for the Centre. This is an important component of our operation and underlies those constant email requests for information on activities and why we also might need to follow up to ensure that we have the right information and details. Thank you everyone for your prompt answers to our KPI questions.



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ICHDR Update

We welcomed our first ICHDR students for 2023, David Safadi, Bhavika Rana and Inamur Rahman who will be at UoW, Monash and UoM/Bio21 Nodes respectively, more about them and their projects in the respective Node updates. Another student will be starting soon at UoM/Bio21. The semester 2 2022 cohort of students have completed their final rotation (membrane protein biochemistry) and will now apply their new skills to their thesis projects, having jumped straight into the electron microscopy training followed by EM data processing shortly after they commenced.

Boehringer Ingelheim Visit

Early February the Monash Node hosted two visitors from Boehringer Ingelheim Pharma GmbH (BI) in Biberach, Germany. Dr. Rebecca Ebenhoch and Dr. Dietmar Weichert are core members of the BI-CCeMMP-MIPS collaboration and have been working closely with the team at MIPS (ICHDRs Dongju Lee and Qinghao Ou; Postdocs Elita Yulianta and Fabian Bumbak).



During their visit to MIPS, Rebecca and Dietmar participated project meetings with their local collaborators, as well as taking the opportunity to attend academic group meetings, including the Wootten/Sexton group's monthly laboratory meeting and their fortnightly cryo-EM subgroup meeting. They participated in general discussions on GPCR biochemistry and cryo-EM data processing giving postdocs and students a chance to exchange of ideas and experiences with our partners. The visit also included a detailed

discussion on sample preparation, cryo-EM data acquisition, and data processing, led by Monash ICPD, Matt Belousoff.

Rebecca and Dietmar also gave generously of their time to provide an opportunistic in-person mentoring session for local CCEMMP members and affiliates to learn about working in industry (with a focus on large pharma). And, of course, our visitors got to experience, in good company, some of the culinary highlights Melbourne has to offer.

Centre Induction

On April 13th we ran a Centre Induction for the new students who commenced between August 2022 and early April 2023. The students heard an overview of the Centre from our Director, as well as summaries of the environments and work performed at individual Nodes, delivered by the respective Node leaders (or their representative). The induction also included an overview of their coursework and training, information on data management, as well as being an opportunity to meet their trainers and student representative. Following the induction, the ICHDRs completed the morning with an Electronic Notebook (Lab Archives) training session delivered by our Educational Partner Organisation, Lab Archives.

Expanding CCEMMP Membership

As part of its strategic plan the Centre has begun reaching out to scientists, outside of the founding academic institutions, who are involved in cryo-EM and membrane protein research to provide opportunities for them to become members or affiliates of the Centre. Of course, we continue to actively seek inclusion of new staff and students from within our existing Nodes, as part of the Centre.

Some of our new members will be familiar faces/names who have presented or participated in our Research Symposiums, our CCEMMP seminar series and/or our satellite meeting on Cryo-EM of membrane proteins at the recent Lorne Proteins 2023 meeting.

New affiliate members from around the country

Dr. Emily Furlong, Group Leader, Australian National University

Dr. Joe Brock, Group Leader, Australian National University and his PhD students Alex Williams and Alice (Jeeun) Shin

Dr Yan Jiang, The University of Sydney

Prof Renae Ryan (Group Leader), The University of Sydney

Dr Alastair Stewart (Group Leader), Victor Chang Cardiac Research Institute

Prof Megan O'Mara (Group Leader), The University of Queensland

You can hear about the research going on in the labs of Dr. Joe Brock, Prof Renae Ryan and Prof Megan O'Mara in the upcoming May, June and August CCEMMP seminars, respectively.

Node Updates

Monash Node

Professor Denise Wootten

Node Leader, Monash University

Introducing ICHDR Student Bhavika Rana

Welcome to our new ICHDR, Bhavika Rana. Bhavika will be working on understanding ligand selectivity of muscarinic acetylcholine receptors (mAChRs) using cryo-EM at the Monash University Node. Her research could open up new insights in comprehending how different types of ligands bind to and activate mAChRs. Other than scrutinizing mAChRs, Bhavika likes to explore art and music, and she loves to travel.

Supervisors: Dr. David Thal, Dr. Celine Valant.





NHMRC Research Excellence and Biennial Awards: Science to Art award

The NHMRC Science to Art award recognises exceptional imagery that has arisen from research that has been funded by the NHMRC. Our very own Director of Scientific Communications, Dr Sarah Piper was runner up in the NHMRC Research Excellence and Biennial Awards; Science to Art award. In 'Atomic jewellery' she has rendered a "ball and stick" model of the glucagon-like peptide-1 receptor (in white) bound to a small molecule agonist (in blue); our cover image in this quarter's newsletter.

Natalie Diepenhorst Awarded Advancing Women's Success Grant 2023 (Monash University)

The careers of academic women are often impacted by carer responsibilities and/or career breaks. The aim of this grant is to reduce this impact by providing funding to support career progression in early to mid-career (high potential) academic women. The long-term goal of the program is to foster talent and progress gender equity in senior roles. Awardees receive funds to support a range of academic activities to maintain/enhance productivity as well as strengthen their academic profile. Dr. Natalie Diepenhorst was awarded an Advancing Women's Success Grant receiving \$10,000 for research support and professional coaching.



Jessica Lu Awarded Lorne Proteins 2023 Poster Presentation Award

Jessica Lu was awarded a Lorne Proteins 2023 Poster Presentation Award (AU\$100) at the 48th Lorne Conference on Protein Structure and Function for her poster "Characterisation of the transducer coupling profiles of PAC1 receptor splice isoforms."

Fabian Bumbak Awarded Best Early Career Oral Presentation Award @ ANZMAG2022

Dr. Fabian Bumbak was awarded the Best Early Career Oral Presentation Award (AU\$500) at the 13th Conference of the Australia and New Zealand Society for Magnetic Resonance (ANZMAG), Dec 4-8, 2022, Marysville, Victoria for his talk "Dynamics of neurotensin receptor 1 (NTS1) allostery and signaling bias"





Theodore Nettleton Awarded CCEMMP Meeting Poster Prize

Theodore Nettleton was awarded the CCEMMP meeting Poster Prize at the Lorne Proteins CCEMMP Embedded Satellite Meeting 2023 - 'Cryo-EM of Membrane Proteins' for his poster "Structure of the pituitary adenylate cyclase-activating polypeptide 1 receptor bound to its secondary signal transducer Gq."

New Members

We welcome new member Dr Dilanka Fernando, and student affiliates Ruohua Gao, Michaela Kaoullas and Elaine Jiang

University of Wollongong Node

Dr. Gökhan Tolun

Node Leader, University of Wollongong

Introducing ICHDR Student David Safadi

Welcome to our new ICHDR, David Safadi. David is a PhD Candidate in the Adams' laboratory at the University of Wollongong Node. His project will involve investigating the structure and function of the GABA(B) receptor upon the binding of analgesic peptides. David first became fascinated about structure-function relationships in protein - particularly from a drug-design standpoint - during his undergraduate at the University of Wollongong, where he majored in medicinal chemistry. Outside of research, he enjoys discovering new music, playing sports, and video games. David will be working in Prof David Adams' group.

Supervisor: Prof. David Adams



Lucy Fitschen Awarded ACMM27 Poster Prize

Lucy Fitschen was awarded a Poster prize (AU\$250) at the 27th Australian Conference on Microscopy and Microanalysis, Jan 29-Feb 2, 2023, Perth, WA for her poster "Towards the cryo-EM structure of the bacteriophage lambda EATR Complex".

New Members

We welcome student affiliates Zahir Siddiqui and Jhonnatan Reales-Gonzalez.

University of Melbourne (Bio21) Node

A/Professor Isabelle Rouiller

Node Leader and Deputy Director, University of Melbourne

Introducing ICHDR Student Inamur Rahman

Welcome to our new ICHDR, Inamur Rahman. Inam is a PhD candidate under the supervision of A/Professor Isabelle Rouiller at the University of Melbourne node. In his PhD, he will use single particle cryo-EM, mass-spectrometry and electron-tomography combined with sub-tomogram averaging to investigate the role of the envelope glycoprotein of HIV-1 in viral entry and its inhibition with antibodies. Inam completed his Masters degree in biotechnology at the Interdisciplinary Biotechnology Unit, Aligarh Muslim University, Aligarh, India. In his free time, he likes to play various outdoor and indoor games and explore new places.

Supervisor: A/Prof. Isabelle Rouiller



New Members

We welcome student affiliates Somavally Dalvi, Doulin Shepherd and Bindusmita Paul.

MRFF Grant Success for Associate Professor Isabelle Rouiller



Associate Professor Isabelle Rouiller was part of a team with CI Prof Damian Purcell that received MRFF funding (MRFCTI000025 Medical Research Future Fund; MRFF 2023-2027; total budget: \$ 4,999,993). The project, RNA Powered Antiviral Antibodies, aims to deliver new mRNA based therapeutic candidates into pre-clinical and clinical development and thus aid Australia's growth in the manufacturing of mRNA-based drugs. Such a project has the potential to place Australia as a leader in this novel therapeutic area with its application extending from infectious disease to immunology and oncology.



Australian Government

Department of Health and Aged Care

WEHI Node

A/Professor Isabelle Lucet

Node Leader, WEHI

New Members

We welcome student affiliate Susovan Das.

External Affiliates Update

Alice (Jeeun) Shin Awarded ANU RSB HDR Conference Presentation Runner-up

Alice (Jeeun) Shin was awarded runner-up award at the ANU Research School of Biology HDR Conference, April 5, for her presentation "Structural investigation pathogenic yeast *Candida albicans* multi-drug efflux ABC transporter (CalbCDR1) using Cryo-EM".



Dr Alastair Stewart Awarded NHMRC Peter Doherty Investigator Grant Award (Emerging Leadership)

New affiliate member, Dr. Alastair Stewart from the Victor Chang Cardiac Research Institute was awarded a NHMRC Peter Doherty Investigator Grant Award (Emerging Leadership) for the project Structure-function relationships in drug transport and inhibition of membrane proteins. This project will study the interaction between bacterial proteins and drug transporters. With the generation of high-resolution models, a detailed understanding of drug binding and transport can be obtained at the molecular level. Such knowledge will facilitate antimicrobial drug development and ultimately improve current drug potency and effectiveness.



Upcoming Events

ARC CCeMMP Seminar Series

Our seminar series continues on the second Tuesday of the month, 10:00 AM-11:00 AM. This quarter we will learn about the research from the laboratories of our new members, Dr Joe Brock (ANU; May) and Prof Renae Ryan (University of Sydney; June). We will also have a seminar from Dr Marc Kschonsak from Genentech, one of our Industry Partner Organisations (July).



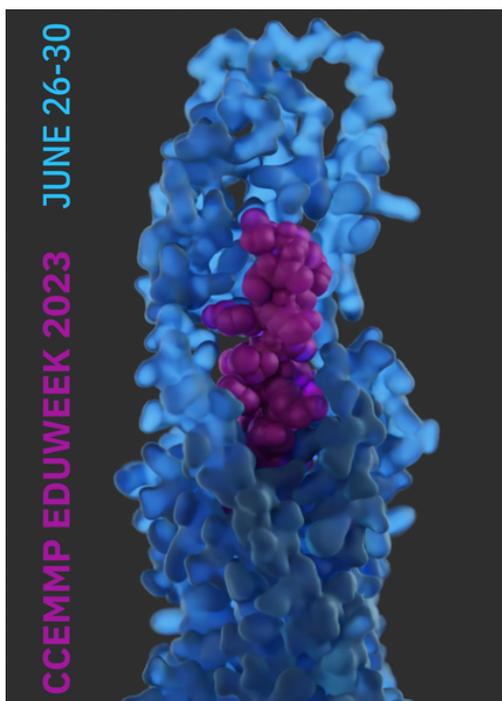
Single Particle Cryo-EM Workshop - June 21-23, 2023

Dr Sepideh Valimehr (ICPD, UoM/Bio21) is organising another single particle cryo-EM workshop at the Ian Holmes Imaging Centre at Bio21, June 21 to June 23. This workshop covers training in grid preparation, screening and data collection. The workshop is free, but registration is essential; candidates will be selected based on their current level of expertise and the cryo-EM needs of their project. To apply, register by May 15 via <https://t.co/imavPi1iq8>

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The workshop is sponsored by our Industry Partner Organisation, Thermo Fisher Scientific.



EduWeek 2023

CCeMMP ICHDR students mark your calendars! EduWeek 2023 will be here the last week of June (26th-30th). As always, this is a chance for the ICHDRs from all four nodes to meet up in person for a week out of the laboratory, focused on professional development. Workshops being held during EduWeek 2023 include: engaging with industry; 'safe conversations' (the student-supervisor relationship); art of visualization; public speaking; scientific writing; mental health. During the week we will also run a student town hall. Some activities will also be open to other members and affiliates.

The following week, we will run optional workshops for PhD and Postdoc members/affiliates: Introduction to Python, theory workshop (2D image formation), advanced microscope training and the Blender3D workshop - watch your inboxes.

Theoretical and Practical Aspects of Cryo-Electron Microscopy; Lecture Series

This is part of 'Rotation 2' training in cryo-EM for our new CCeMMP ICHDR students. This year we have opened up this lecture series to all Centre members and affiliates. We will cover: Introduction to Transmission Electron Microscopy (TEM); Negative stain and its application; Sample preparation & vitrification for SPA of membrane proteins; Introduction to image formation (TEM); General considerations for microscope set up (SPA); Electron detector technology. The Lecture series will be presented by Centre members (Associate Prof Isabelle Roullier, Dr. Debnath Ghosal, Dr Alisa Glukhova, Dr James Bouwer, Dr Matt Belousoff) and our partner organization (Dr Lingbo Yu, Thermo Fisher Scientific) and is directed towards PhD students and Postdocs who wish to improve their cryo-EM knowledge, but any members are welcome. Already there has been great interest in attending these zoom lectures. **This is open to CCeMMP members and affiliates only.**

Data Processing and Analysis Workshop

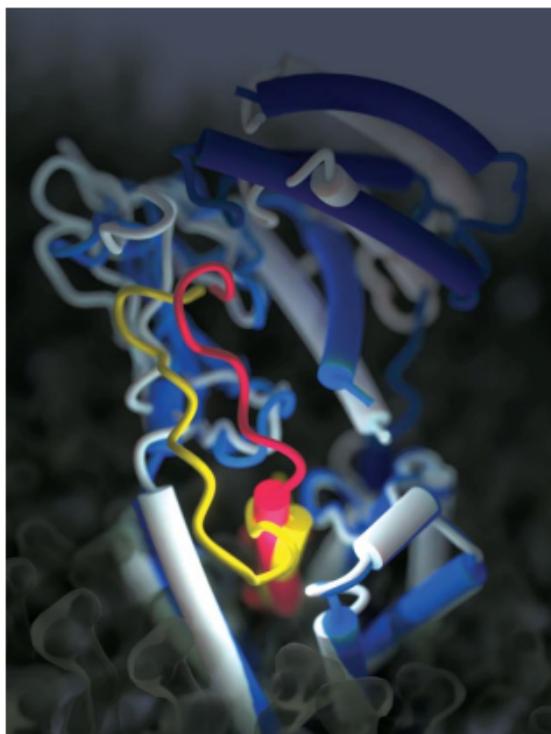
As part of their formal training, our CCEMMP ICHDRs undertake hands-on training in data processing of cryo-EM data. We are progressively providing access to this training opportunity to affiliate student members, subject to available places. This year we have 5 places being offered and interested student affiliates have submitted applications to participate in this “in-person” workshop. Successful applicants will be informed at the end of May. In subsequent years, we expect that more places will be available to Centre members who would like to attend.

Outreach Activities

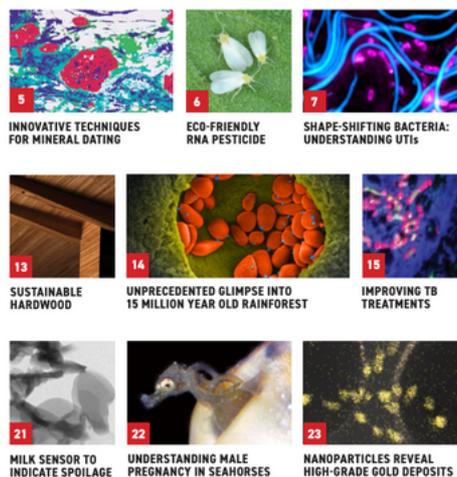
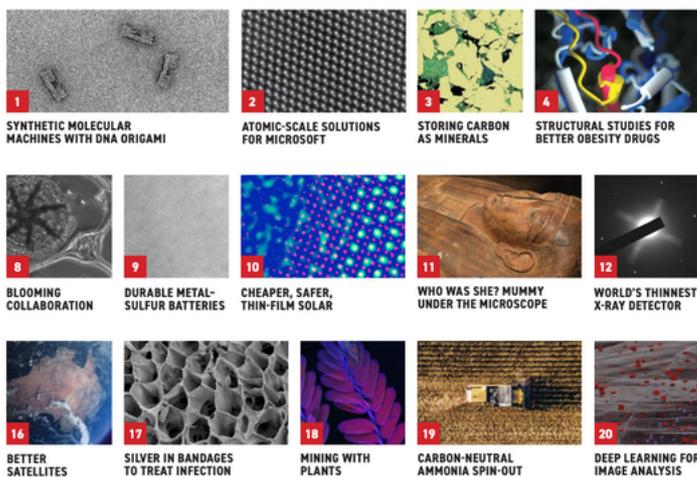
External Recognition

Our research has been highlighted in publications from other organizations' 'Research Highlights';

- Microscopy Australia – Research Outcomes and Impact 2022; Structural Studies for Better Obesity Drugs highlighting Cao et al., *Science*, 2022.
- Thermo Fisher Scientific highlighted the work of Zhang et al., "Evolving cryo-EM structural approaches for GPCR drug discovery, *Structure*, 2021". The article highlighted the application of 200kV EM to resolve drug binding to GPCRs. "Researchers at Monash University have been able to successfully determine the structure of GPCR to 3.2 Å resolution on a 200 kV Glacios Cryo-TEM".



Two overlaid cryo-EM structures showing the differences when amylin-like peptides (yellow) are bound to the receptor (blue) and when calcitonin-like peptides (red) bind to the receptor (light grey). Each receptor is approximately 25nm long. Image created by Dr Sarah Piper @PiperProteins



RESEARCH OUTCOMES & IMPACT

2022

Take a closer look at this year's research highlights – all enabled by Microscopy Australia. With over 3,000 researchers accessing our facilities annually, here are just a few of their recent research highlights.

In the Media

One of our CCEMMP members, Dr. Matt Belousoff, was involved in a paper that was picked up by numerous news outlets across the world (according to Altmetrics, 201 News outlets).

In Grinter R, Kropp A, Venugopal H, Senger M, Badley J, Cabotaje PR, Jia R, Duan Z, Huang P, Stripp ST, Barlow CK, **Belousoff M**, Shafaat HS, Cook GM, Schittenhelm RB, Vincent KA, Khalid S, Berggren G & Greening C. Structural basis for bacterial energy extraction from atmospheric hydrogen. *Nature* 615: 541–547, 2023. <https://doi.org/10.1038/s41586-023-05781-7>, the researchers, led by Dr Rhys Grinter of Monash University, describe an enzyme, Huc, that is able to convert air into energy by turning low amounts of atmospheric hydrogen into an electrical current. The enzyme was extracted from the bacterium, *Mycobacterium smegmatis*. This amazing finding lights the way for creating devices that can make energy, literally, from thin air; a viable alternative to solar-powered devices.



Recent Centre Activities and Achievements

Lorne Proteins CCEMMP Embedded Satellite Meeting 2023 - ‘Cryo-EM of Membrane Proteins’

The ARC CCEMMP was proud to host an embedded Satellite Meeting at the Lorne Proteins 2023 conference on Tuesday 7th February. The meeting brought together experts in cryo-EM of membrane proteins to discuss recent progress within this rapidly advancing field, including 7 field leading international speakers.



Standing room only

Topics ranged from proteins involved in lipid modification and transporter proteins, neurotransmitter receptors, endocytic caveolins, GPCRs, assembly of beta-barrel proteins, and red blood cell membrane scaffolds. Although some satellite meeting sessions ran parallel to the main conference, the room was overflowing with attendees and there were many engaging questions from the audience.

Selected speakers:

- Jesse Mobbs (Monash University)
- Oliver Clarke (Columbia University)
- Rosemary Cater (Columbia University)
- Sarah Piper (Monash University)
- Shu-Sin Chng (National University of Singapore)
- Sulin Li (University of Queensland)
- Tyler Chang (Monash University)

Invited Speakers:

- Radu Aricescu (MRC Laboratory of Molecular Biology)
- Gira Bhabha (New York University)
- Filippo Mancina (Columbia University)
- Melanie Ohi (University of Michigan)
- Denise Wootten (Monash Institute of Pharmaceutical Sciences)
- Matt Doyle (University of Sydney)
- Yan Jiang (University of Sydney)



Professor Melanie Ohi (University of Michigan) presenting cryo-EM structures of caveolin complexes involved in cellular import (endocytosis).



Prof Radu Aricescu (MRC Laboratory of Molecular Biology) presenting on the GABA family of receptors involved in neurotransmission and anaesthesia.

CCeMMP meeting Poster Prize Awardee: Theodore Nettleton (Monash University) "Structure of the pituitary adenylate cyclase-activating polypeptide 1 receptor bound to its secondary signal transducer Gq".

Organising Committee:

- Joshua Hardy (Chair, WEHI),
- Renae Ryan (USyd),
- Shabih Shakeel (WEHI),
- Nazanin Mohebali (Monash),
- Sepideh Valimehr (Bio21/UniMelb),
- Patrick Sexton (Monash).



Dr. Yan Jiang (University of Sydney) presenting on structures of borate transporter, ATBor1.

The ARC CCeMMP would like to acknowledge the generous support provided for the satellite meeting from the Lorne Proteins 2023 meeting, AstraZeneca, Boehringer Ingelheim, Novo Nordisk, Monash Institute of Pharmaceutical Sciences and Thermo Fisher Scientific.



Wish you were here...



CCeMMP Award Winners (left to right): Dr Jesse Mobbs (selected from abstract), Felix Bennetts (main conference student poster prize), Theodore Nettleton (satellite meeting poster prize), Dr Sarah Piper (selected from abstract).



Poster session



Speakers and organising committee



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CCeMMP members at the 2023 Lorne Proteins Conference

Making Atoms Visible: Blender3D Workshop with Brady Johnston

In February 2023 we held a two-day Blender3D workshop led by Dr. Brady Johnston, biochemist and Blender-in-Science expert. The small workshop was organised by Dr Sarah Piper for a limited number of experienced users within each of the Nodes as a trial for a larger workshop to be held later in the year in association with the planned 2023 EduWeek.

Blender3D is a free and open-source 3D computer graphics software used for creating 3D animation movies and video games, and lately has become a useful tool to create engaging scientific renders. In the workshop, Brady taught the group how to use the software interface as well as presenting his Molecular Nodes add-on, which makes it easy to load structural data, such as PDB files, into Blender3D.



Participants of the workshop, led by Brady Johnston (L to R): Brady Johnston, Dongju Lee, Jodi Brewster (on zoom), Sepideh Valimehr, Sarah Piper, Josh Hardy, Jesse Mobbs.

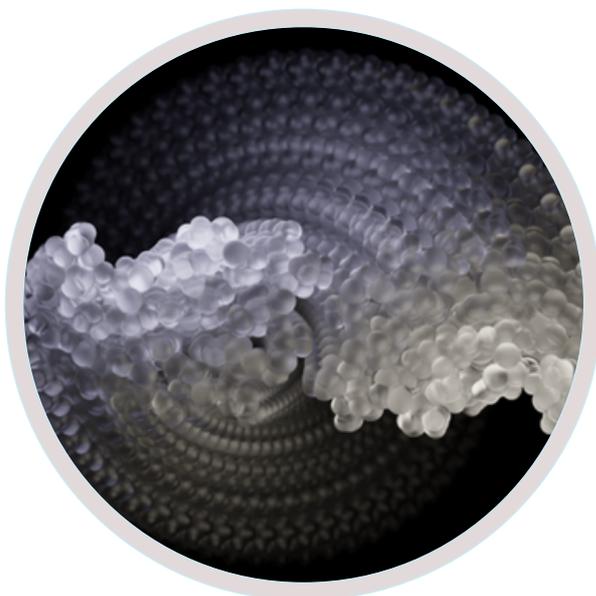
The workshop results were stunning! Check out a few renders from our workshop participants below. A summary video can be found on the CCeMMP website.

Thanks so much to Brady for coming all the way from Perth to teach us how to use Blender3D, and thanks to all participants for sharing their amazing outputs.

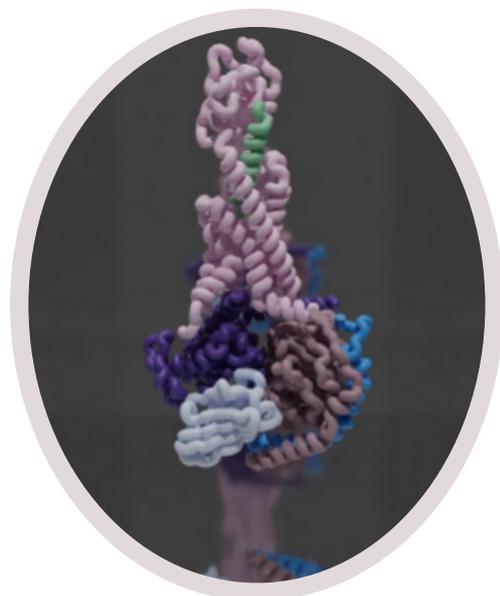


We will be holding a two-day Blender beginner workshop in July, so stay tuned for more info, and register your expression of interest with our outreach committee Chair, Sarah (sarah.piper@monash.edu).

This will be an “in-person” workshop for Centre members and affiliates, subject to availability of places.



Render created by Brian Cary (PDB: 6ZRR) using the Molecular Nodes tool in Blender3D.



Render created by Joshua Hardy (PDB: 8E3Z), using the Molecular Nodes tool in Blender3D.

Industry Engagement

- Patrick Sexton – seminar. *Intersecting structural biology and pharmacology to probe GPCR agonist action*. Septerna Inc., April 7th 2023, San Francisco, USA
- Patrick Sexton – meetings with scientists from Eli Lilly and Novo Nordisk during his visit to Indianapolis, March 2023.
- Dr. Rebecca Ebenhoch and Dr. Dietmar Weichert from our Partner Organisation, Boehringer Ingelheim, visited the Monash Node of the Centre for a week during February 2023 to discuss ongoing projects and to provide insight into working in Industry to Centre members.
- Monthly project meetings with Centre Partner Organisations; Astex Pharmaceuticals, AstraZeneca, Boehringer Ingelheim, Novo Nordisk, Pfizer, Servier and Thermo Fisher Scientific.

International Conference Presentations

Patrick Sexton: **Gordon Hammes Award Lecture**. *Intersecting structural biology and pharmacology to advance understanding of GPCR agonist action*. American Chemical Society, Spring 2023 meeting. March 26th-30th 2023, Indianapolis, USA.

Patrick Sexton: *Integrated approaches to study class B peptide hormone GPCRs*. 2nd European Research Network on Signal Transduction (ERNEST) Training School. March 1st 2023. Zoom meeting.

Jodi Brewster: Invited talk (**Herbert Tabor Early Career Investigator award**)*. *Structures and kinetics of *Thermotoga maritima* MetY reveal insights into the predominant route for methionine biosynthesis in bacteria*. Presented at the American Society of Biochemistry and Molecular Biology Conference (Discover BMB), March 25-28, 2023, Seattle, USA. *Awards are given to the first authors of exceptional JBC papers that appeared in the preceding year.

Jodi Brewster: Poster presentation. *Cryo-EM investigation of a single strand annealing homologous DNA recombination protein, ICP8 annealase from HSV-1*. Presented at the American Society of Biochemistry and Molecular Biology Conference (Discover BMB), March 25-28, 2023 Seattle, USA.

National Conference Presentations

Fabian Bumbak: Oral presentation*. *Dynamics of neurotensin receptor 1 (NTS1) allostery and signaling bias*. Presented at 13th Conference of the Australia & New Zealand Society for Magnetic Resonance 2022 (ANZMAG), Dec 4-8, Marysville. ***Best Early Career Oral Presentation Award**

Yao Lu: Invited talk. *Molecular and structural characterisation of GPR52, a novel target for schizophrenia*. Presented at Dr. GPCR Symposium on 'Recent Advances in Understanding Challenging GPCRs', March 24, online.

Gökhan Tolun: Invited talk. *A half a century long wait is over: Cryo-EM structure of Red β 177 provides insights into the evolution and molecular mechanisms of single strand annealing homologous DNA recombination*. Presented at The 27th Australian Conference on Microscopy and Microanalysis 2023, Jan 29-Feb 2, Perth, WA.

Jesse Mobbs: Oral presentation (selected). *Cryo-EM structures of human arachidonate 12S-Lipoxygenase (12-LOX) bound to endogenous and exogenous inhibitors*. Presented at Lorne Proteins CCeMMP Satellite Session, Feb 7, Lorne. **(\$100 prize)**

Sarah Piper: Oral presentation (selected). *The role of functional disulphide bonds in G protein-coupled receptors using integrative structural approaches*. Presented at Lorne Proteins CCeMMP Satellite Session, Feb 7, Lorne. **(\$100 prize)**

Jason Cao: Poster presentation. *Toward a structural understanding of amylin receptor phenotype: implications for therapeutic development for obesity*. Presented at 48th Lorne Conference on Protein Structure and Function. 5-9 Feb, Lorne.

Natalie Diepenhorst. Poster presentation and short talk. *CryoEM to enable drug discovery at orphan G protein-coupled receptor GPR88*. Presented at EMBO Workshop 'In situ structural biology: from cryo-EM to multi-scale modelling', 8-11 Feb, Heidelberg/online.

Jessica Lu: Poster presentation. *Characterisation of the transducer coupling profiles of PAC1 receptor splice isoforms*. Presented at 48th Lorne Conference on Protein Structure and Function. 5-9 Feb, Lorne. **Lorne Proteins 2023 Poster Presentation Award (\$100 prize)**

Yao Lu: Poster presentation. *Agonist-mediated GPR52 trafficking and their binding pocket revealed by cryo-EM*. Presented at 48th Lorne Conference on Protein Structure and Function. 5-9 Feb, Lorne.

Isabella Russell: Poster presentation. *Stabilisation Methods for the Parathyroid Receptor 1 and its Constitutively Active Mutants*. Presented at 48th Lorne Conference on Protein Structure and Function. 5-9 Feb, Lorne.

Jack Tovey: Poster presentation. *A Structural Investigation into the Allosteric Regulation of the Cholecystokinin Type 1 Receptor*. Presented at 48th Lorne Conference on Protein Structure and Function. 5-9 Feb, Lorne.

Academic Seminar Presentations

Alastair Stewart: Invited talk. *How we think APT synthase works*. Presented to ANU Research School of Biology, March 30, 2023, Canberra.

Alastair Stewart: Invited talk. *Bacterial ATP synthases*. Presented to Max Planck Institute for Multidisciplinary Sciences, April 21, 2023, Göttingen, Germany .

Marielena Georgopoulou: Oral Presentation. *Structural studies of cell signalling receptors*. PhD Confirmation meeting, April 4, 2023 Bio21 Institute.

Panel Discussion for MPharmSci students: Host Karen Gregory, with CCEMMP members, Matt Belousoff, Chris Langmead and Sarah Piper "*Expert views on cryo-EM*". April 6, 2023, Faculty of Pharmacy and Pharmaceutical Sciences, Monash. Parkville.

Social Media



Twitter

69.2 K

Impressions

2.0%

Engagement
Rate

226

Link
Clicks

118

Retweets

511

Likes

598

Followers

Twitter - the last 3 months (all increased from previous quarter)



YouTube

3.2 K

Views

321

Subscribers

Our in-house director of scientific communications and Blender Queen, Dr Sarah Piper, had two of her entries in the NHMRC Biennial Science to Art competition posted by NHMRC. "In Bloom" (pictured right) was posted on the NHMRC instagram page (March 22) . This edition's cover image, "Atomic Jewellery", was posted March 29, on their twitter and instagram.



'In Bloom'

Publications

Bumbak F, Pons M, Inoue A, Paniagua JC, Yan F, Wu H, Robson SA, Bathgate R, Scott DJ, Gooley PR, Ziarek JJ. Ligands selectively tune the local and global motions of neurotensin receptor 1 (NTS1). *Cell Reports* 42(1): 112015, 2023. <https://doi.org/10.1016/j.celrep.2023.112015>

Cary BP, Gerrard EJ, Belousoff MJ, Fletcher MM, Jiang Y, Russell IC, Piper SJ, Wootten D, Sexton PM. Molecular insights into peptide agonist engagement with the PTH1 receptor. *Structure* 31: 1-9, 2023. <https://doi.org/10.1016/j.str.2023.04.002>.

Grinter R, Kropp A, Venugopal H, Senger M, Badley J, Cabotaje PR, Jia R, Duan Z, Huang P, Stripp ST, Barlow CK, **Belousoff M**, Shafaat HS, Cook GM, Schittenhelm RB, Vincent KA, Khalid S, Berggren G & Greening C. Structural basis for bacterial energy extraction from atmospheric hydrogen. *Nature* 615: 541-547, 2023. <https://doi.org/10.1038/s41586-023-05781-7>

Mubarak SSM, Malcolm TR, Brown HG, **Hanssen E, Maher MJ, McColl G**, and Jameson GNL. Biochemical Characterization of *Caenorhabditis elegans* Ferritins. *Biochemistry* 62(9): 1484-1496, 2023. <https://doi.org/10.1021/acs.biochem.3c00005>

Powers AS, Pham V, **Burger WAC**, Thompson G, Laloudakis Y, Barnes NW, **Sexton PM**, Paul SM, **Christopoulos A, Thal DM**, Felder CC, Valant C & Dror RO. Structural basis of efficacy-driven ligand selectivity at GPCRs. *Nat Chem Biol*, 2023 (open access 13 February, 2023). <https://doi.org/10.1038/s41589-022-01247-5>

Valimehr S, Sethi A, Shukla M, Bhattcharyya S, **Kazemi M, Rouiller I.** Molecular mechanisms driving and regulating the AAA+ ATPase VCP/p97, an important therapeutic target for treating cancer, neurological and infectious diseases. *Biomolecules* 13(5): 737, 2023. <https://doi.org/10.3390/biom13050737>

Vuckovic Z, Wang J, Pham V, **Mobbs JI, Belousoff MJ**, Bhattarai A, **Burger WAC**, Thompson G, Yeasmin M, **Leach K**, van der Westhuizen ET, Khajehali E, Liang Y-L, **Glukhova A, Wootten D**, Lindsley CW, Tobin AB, **Sexton PM**, Danev R, Valant C, Miao Y, **Christopoulos A, Thal DM.** Pharmacological hallmarks of allostery at the M4 muscarinic receptor elucidated through structure and dynamics. *eLife* (in press, April 13 2023; 15-09-2022-RA-eLife-83477).

Zhang L, Mobbs JI, May LT, **Glukhova A, Thal DM.** The impact of cryo-EM on determining allosteric modulator-bound structures of G protein-coupled receptors. *Current Opinion in Structural Biology* 79: 102560, 2023. <https://doi.org/10.1016/j.sbi.2023.102560>

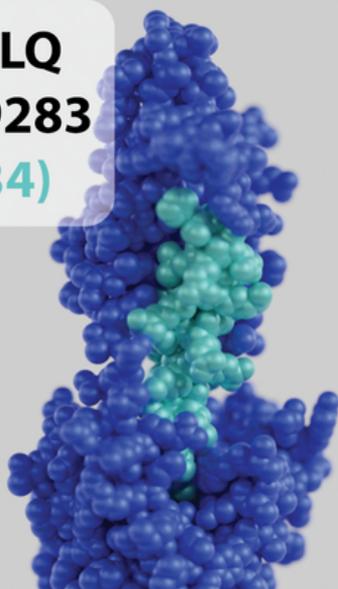
Deposited Structures

Brian Cary, Matt Belousoff, Sarah Piper, Denise Wootten, Patrick Sexton
PDB 8FLQ, PDB 8FLR, PDB 8FLS, PDB 8FLT, PDB 8FLU.

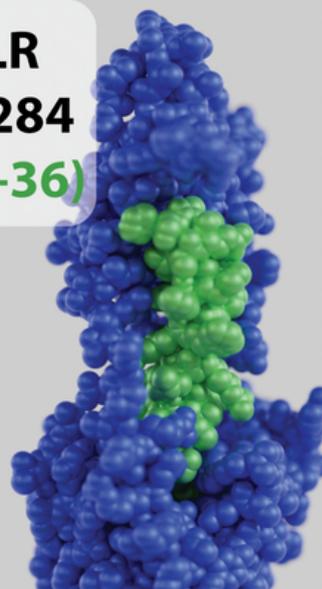
Brian Cary, Matt Belousoff, Sarah Piper, Denise Wootten, Patrick Sexton
EMD-29283, EMD-29284, EMD-29285, EMD-29286, EMD-29287

CCeMMP Cryo-EM Structure Image Gallery

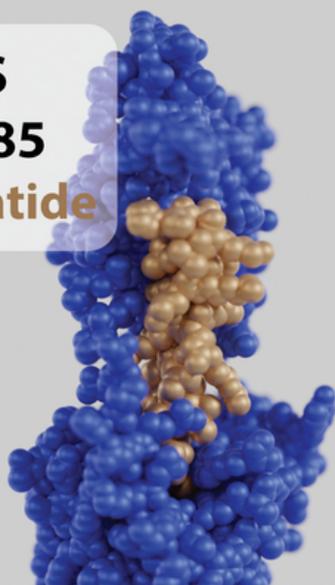
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EMD-29283
PTH(1-34)



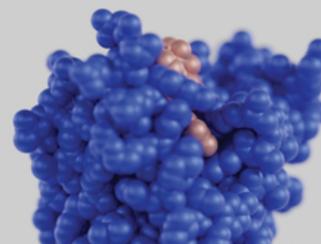
PDB: 8FLR
EMD-29284
PTHrP(1-36)



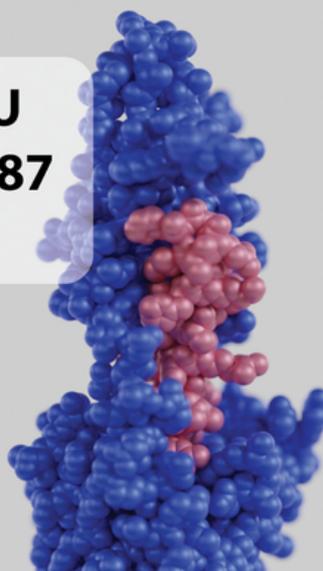
PDB: 8FLS
EMD-29285
Abaloparatide



PDB: 8FLT
EMD-29286
M-PTH(1-14)



PDB: 8FLU
EMD-29287
LA-PTH



*Image credit: Sarah Piper
(@SarahJ_Piper, @PiperProteins)*