Monash Business Breakfast Seminar Series

The Imaging Continuum
Exploring Inner Space

PROFESSOR IAN SMITH
PRO VICE-CHANCELLOR (RESEARCH AND RESEARCH INFRASTRUCTURE)
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PROFESSOR ANDREW PEELE
HEAD OF SCIENCE, AUSTRALIAN SYNCHROTRON
What is the Australian Synchrotron really?

A suite of laboratories with a wide range of unique analytic capabilities

• Minerals & Mining
• Medical Imaging & Therapy
• Polymers/Semicon/ Ceramics/Metals
• Surfaces & Coatings
• Materials Development
• Pharmaceuticals
• Agriculture
• Protein structure
Approach:
Using synchrotron tools and animal models (rabbits), Australian Scientists have imaged in real-time the first breath of newborn mammals.

Problem:
How can we improve the health prospects for premature babies?

Benefit:
The insights derived from this research have been so dramatic that changes are already being made to the way that neonatal infants are assisted with their first breath.

Collaborators:


National Research Priority: promoting and maintaining good health.
C. elegans
Protein structure, pharmaceuticals
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PROFESSOR JOANNE ETHERIDGE
DIRECTOR, MONASH CENTRE FOR ELECTRON MICROSCOPY
Expert Staff
(Priceless!!)

Ultrastable building
($14 million)

World class Instruments
($26 million)
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DR GEORG RAMM
MONASH MICRO IMAGING
Optical microscopy, electron microscopy and multimodal imaging

Molecules, Organelles, Cells, Organs and Organisms

Business Breakfast, Park Hyatt, Melbourne, 24 May 2012

Georg Ramm
Head MMI Bio EM facility
Deputy Director Monash Micro Imaging (Director Ian Harper)
Group Leader, Membrane Biology, Department of Biochemistry
Clive and Vera Ramaciotti Centre for structural cryo EM  
(currently being established at Monash)

Perforin pore structure
X-ray structure (Australian Synchrotron) fitted into cryo EM density map (Birkbeck College London)

Law, Saibil, Whisstock *Nature* 2010
Correlative Light and Electron Microscopy

- Molecules
- Organelles
- Cells
- Organs
- Organisms
Chicken embryo expressing brainbow

Rios, Marcelle, EMBL Australia/ARMI *Nature* 2011

Molecules  Organelles  Cells  Organs  Organisms
Rob Bryson-Richardson, International Monash Micro Imaging Live Cell Course 2011
Fly egg
X-ray fluorescence microscopy tomography (synchrotron) and SEM

Richard Bourke, Martin de Jonge, Sam Murphy
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PROFESSOR GARY EGAN
DIRECTOR, MONASH BIOMEDICAL IMAGING
Monash Biomedical Imaging - Operational Summary

Magnetic Resonance Imaging Scanners

3 Tesla MRI – Siemens Skyra
- first scan January, 2012
- operational March, 2012

9.4 Tesla small animal MRI – Agilent
- installation Feb-April, 2012
- operations from May, 2012

Contact: Prof Gary Egan
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Molecular CT Imaging Scanners

Bioscan PET-CT - located in the Australian Synchrotron
- installation November 2011
- fully operational February 2012

PET-SPECT-CT small animal
– Siemens Inveon
- installation Dec, 2011
- operational April, 2012

Fluorescence CT Imaging Scanners

Bioscan FLECT-CT Scanner
- located at Monash Institute for Pharmaceutical Sciences
- installation May, 2012
- operations from July, 2012
Clinical Research
MR scanner

First scans
9 January, 2012
Advanced Brain Imaging Research
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DR WOJTEK JAMES GOSCINSKI
COORDINATOR, MULTI-MODAL AUSTRALIAN SCIENCES IMAGING AND VISUALISATION ENVIRONMENT
Perforin pore structure.

(a) Negative stain and Cryo images showing the structure of the perforin pore. 

(b) 3D reconstruction of the perforin pore structure. 

(c) Top view of the perforin pore structure. 

(d) Diagram of the perforin molecule with highlighted regions. 

(e) Electron microscopy images of perforin under different conditions: 
- Perforin alone 
- Perforin + Con A 
- Perforin + anti-histidine antibody 
- Perforin + perforin-GFP 

These data were merged and processed using XDS$^{31}$, POINTLESS and SCALA$^{32}$. Five per cent of the data sets were flagged as a validation set for calculation of the $R_{\text{free}}$ with neither a $\sigma$ nor a low-resolution cut-off applied to the data. Experimental phases (Supplementary Table 1) were obtained by the MIRAS method; a native (Native1) data set and three heavy atom derivatives (ethylmercury phosphate, ammonium hexachloroiridate(iii) and iodine) were used for phasing. Experimental phasing was carried out using autoSHARP$^{33}$; heavy atom positions were located using SHELXC/SHELXD$^{34}$ and refined using SHARP$^{35}$ with resulting isomorphous (acentric) and anomalous phasing powers of 0.982 and 0.950, respectively. The initial phases were improved by solvent flipping using SOLOMON$^{36}$ and density modification using DM$^{37}$, which dramatically increased the figure of merit (FOM) from 0.34 to 0.86. Such a large increase in FOM is probably due to the very high solvent content of the crystal (70.2%). One molecule was found per asymmetric unit and an initial model was generated using BUCCANEER$^{38}$. Model building was performed using COOT$^{39}$ while refinement was performed using PHENIX$^{40}$, REFMAC$^{41}$ and
Diamond – Optique Peter optomechanics + pco.Edge sensor (scientific grade CMOS)

Amethyst – ScintX DXI 11000 Fibre coupled, columnar grown CsI faceplate to CCD.