

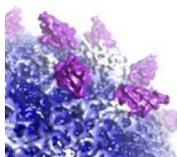
# OCEM Highlights

March 2014

Otago Centre for Electron Microscopy

*The OCEM is an electron microscopy research support facility for the University of Otago. We are located at 270 Great King St. in the basement of the Anatomy Department (Ph 479 5642 or 479 7301). For further contact details see page 4.*

## Workshop: 3D Microscopy



From March 31<sup>st</sup> to April 3<sup>rd</sup> the OCEM is running a **three dimensional electron microscopy workshop** covering subjects ranging from sample preparation techniques to advanced image processing techniques.

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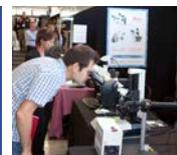
## Mike Stauss: Visiting Scientist



From February to July 2014 the OCEM will host Dr. Mike Strauss, a Research Fellow at Harvard Medical School, and a highly recognised figure in the EM community.

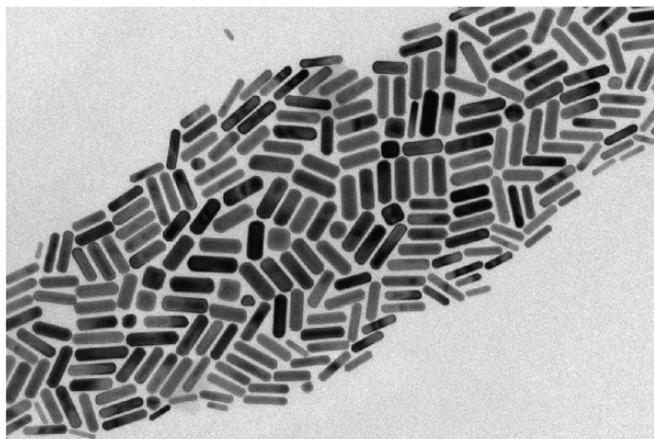
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## Conference: MNZ 2015



From February 2<sup>nd</sup> to February 6<sup>th</sup> 2015 the OCEM and OCCM will host the 27<sup>th</sup> New Zealand Conference on Microscopy at the University of Otago.

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## 2014 Calendar

Calendars are available from the unit or online as a PDF. Thank you to all who submitted images. The deadline for submissions of micrographs to be considered for the 2015 OCEM calendar is 30th November 2014. For more information visit <http://ocem.otago.ac.nz/gallery.html>.

*Above: Gold nanorods. By Neha Nitin Parayath and Dr. Sebastien Taurin, Department of Pharmacology and Toxicology, University of Otago.*



## It's Here!

The new JEM-2200FS Field Emission Electron Microscope from JEOL is up and running. The microscope has a high contrast, high resolution camera and a built-in energy filter which is designed to reduce the inelastically scattered electrons that contribute to chromatic aberration. The improved resolution will allow imaging of thick sections which, when combined with the ability to tilt the specimen to 80°, can be used to create electron tomograms or 3D reconstructions of the internal structure. The energy filter will also allow very accurate elemental mapping and chemical analysis of

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## New Academic Director

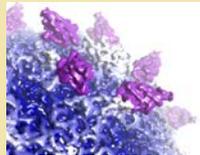


In mid 2013 we welcomed Dr. Mihnea Bostina to the OCEM team as the new Academic Director of the unit. The appointment of an Academic Director to the unit is a strategic initiative that is associated with the installation of a 200kv cryo-TEM. Expertise in cryo-transmission electron microscopy and electron tomography would utilise the microscope to its maximum capability.

Dr. Bostina completed his PhD in Biophysics and Structural Biology at the Max Planck Institute of Biophysics in Frankfurt, Germany. He subsequently embarked on a research fellowship at Harvard University in Boston, USA. His research interest is in the use of single particle reconstruction to study the structural biology of viruses. Dr. Bostina holds a 0.5 FTE appointment as Academic Director of the OCEM and a 0.5 FTE appointment as a Senior Lecturer in the Department of Microbiology and Immunology where he is involved in teaching and graduate supervision.

## Three Dimensional Electron Microscopy Workshop

The OCEM is organising a three dimensional electron microscopy workshop that will run from March 31st to April 3<sup>rd</sup> 2014. The course will cover subjects ranging from sample preparation techniques to advanced image processing techniques. The format will consist of a combination of lectures aimed at a wider audience stressing the capabilities and limitations of various methods (in the mornings) and practical sessions focusing on more technical details involved in data collection and three dimensional reconstruction (in the afternoons). The course is aimed at students, postdocs, and principal investigators who intend to use electron tomography or single particle reconstruction in their research. The fees are \$50 for the morning sessions and \$150 for the morning and afternoon sessions.



### Programme

- Introduction to 3D electron microscopy.
- Image formation, contrast transfer function and energy loss imaging.
- Sample preparation: cryo fixation, chemical fixation and sectioning.
- Data collection: electron tomography.
- Data collection: frozen hydrated samples.
- Image processing: 2D alignment and classifying single particle images.
- Single particles analysis: 3D reconstruction and refinement.
- Electron tomography: reconstruction, segmentation and averaging.
- Hybrid methods: correlative microscopy, molecular modelling.

If you would like to register for the workshop fill in the form at [ocem.otago.ac.nz/news](http://ocem.otago.ac.nz/news) or contact Dr. Mihnea Bostina, [mihnea.bostina@otago.ac.nz](mailto:mihnea.bostina@otago.ac.nz).

## It's Here! The New Cryo-TEM

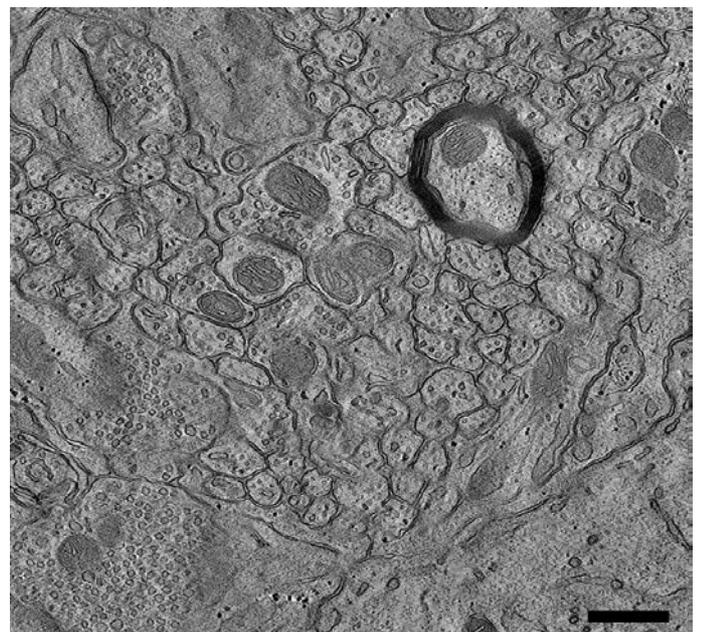
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The cryo capabilities will enable imaging of samples that have been frozen rather than chemically fixed (which can introduce artefacts) and will reduce damage to the samples caused by the electron beam. It will also allow single particle reconstruction - which takes many images of viruses or proteins at different orientations and averages them together to produce a 3D reconstruction of the particle. The combined image has much stronger and easily interpretable features than individual images which contain much more noise. The nominal resolution of the new microscope is 0.27 nanometres.

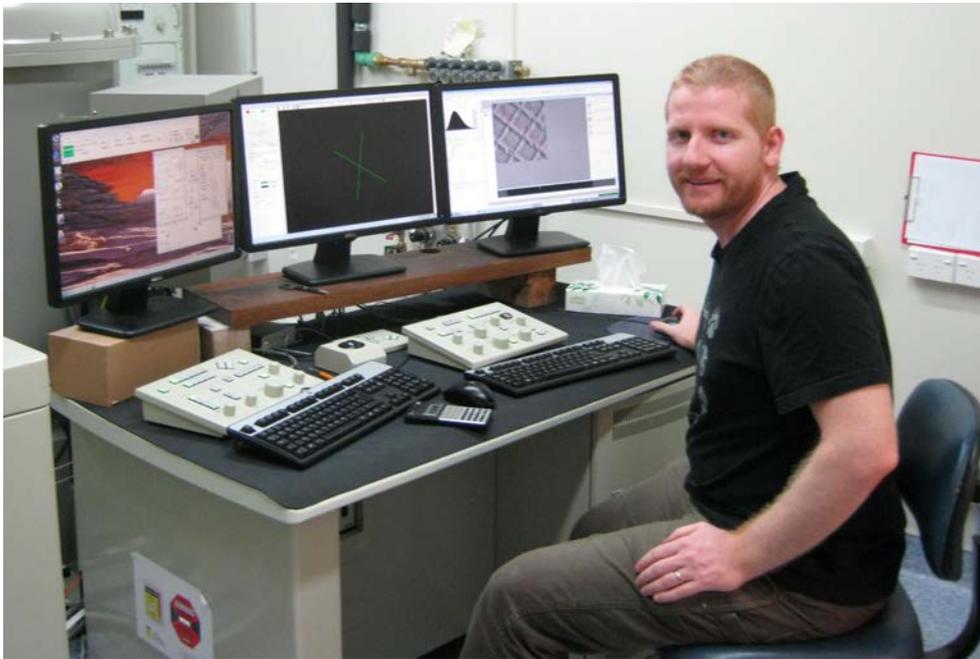
The microscope will also have STEM (scanning transmission electron microscopy) capability. This enables the use of other of signals that cannot be spatially correlated in a conventional TEM, including secondary electrons and scattered beam electrons. One potential biological research use of STEM is immunolabelling tissue with nanometer-size gold particles without the need to silver enhance the samples.

The OCEM's specialty is in cryo-preparation techniques such as freeze-fracture, plunge and slam freezing, cryo-ultramicrotomy, cryo-substitution and cryo-SEM. The addition of the new cryo-TEM will allow the unit to continue to develop and expand their cryo-electron microscopy capabilities and offer techniques unavailable anywhere else in New Zealand such as cryo-tomography and STEM.

If you are interested in learning more about the new microscope or would like to discuss a potential project email Richard or Mihnea (contact details on page 4).



Above: Slice of a tomogram taken of rat cerebellum on the new JEM2200FS. Scale bar = 50nm.



## Visiting Research Fellow Dr. Mike Strauss

During the first 6 months of 2014 the OCEM will host Dr. Mike Strauss, a Research Fellow at Harvard Medical School, and a highly recognised figure in the EM community. Mike completed his PhD research at the Max Planck Institute of Biophysics in Frankfurt and his Masters degree at the University of Toronto in Canada. His work covers cryo-electron tomography, high-resolution single particle reconstruction, energy-filtered imaging, cryo-correlative light and electron microscopy, phase plate development, and cryo-transfer devices design.

While at Otago, Mike will provide training to OCEM staff and ensure the cryo-TEM is set up to achieve its maximum potential. One of the techniques we hope to become familiar with is scanning transmission electron microscopy (STEM) - a dark-field imaging technique that creates better contrast than conventional TEM, especially for thick samples. This will allow the OCEM to carry out detailed morphological studies of relatively thick sections, such as whole bacteria, organelles or eukaryotic cells.

We will also be testing our capability to perform energy-filtered transmission electron microscopy (EFTEM) and electron energy loss spectroscopy (EELS), which are electron microscopic approaches capable of yielding chemical information of a sample. Mike has co-authored several papers in the field of three-dimensional elemental mapping of phosphorus in chromatin in situ by combining EFTEM with electron tomography. "The addition of this new microscope greatly expands the breadth of research possibilities at the OCEM. I am confident that the capable staff here will soon be proficient at cryoEM, EFTEM and other techniques, and I hope the investigators at Otago, and throughout NZ, will take full advantage of this great new instrument."

During the visit Academic Director of the OCEM, Dr. Mihnea Bostina, and Dr. Mike Strauss will continue their collaborative work utilising cryo-electron tomography and single particle reconstruction.

## Recent Publications

Saunderson, S.C., Dunn, A.C., Crocker, P.R., and McLellan, A.D. (2014) CD169 mediates the capture of exosomes in spleen and lymph node. *Blood*, **123**(2):208-16. doi:10.1182/blood-2013-03-489732. **IF=9.1**

Billia, M.A., Timms, N.E., Toy, V.G., Hart, R.D. and Prior, D.J. (2013) Grain boundary dissolution porosity in quartzofeldspathic ultramylonites: Implications for permeability enhancement and weakening of mid-crustal shear zones. *Journal of Structural Geology*, **53**:2-14.

Li, K.C., Waddell, N.J., Prior, D.J., Ting, S., Girvan, L., van Vuuren, L.J., and Swain, M.V. (2013) Effect of autoclave induced low-temperature degradation on the adhesion energy between yttria-stabilized zirconia veneered with porcelain. *Dental Materials*, **29**(11):263-270.

Loch, C., Grando, L.J., Schwass, D.R., Kieser, J.A., Fordyce, R.E., Simões-Lopes, P.C. (2013) Dental erosion in South Atlantic dolphins (Cetacea: Delphinidae): A macro and microscopic approach. *Marine Mammal Science*, **29**(2): 338-347.

Oorschot, D.E., Voss, L., Covey, M.V., Goddard, L., Huang, W., Birchall, P., Bilkey, D.K. and Kohe, S.E. (2013) Spectrum of short- and long-term brain pathology and long-term behavioral deficits in male repeated hypoxic rats closely resembling human extreme prematurity. *The Journal of Neuroscience*, **33**(29):11863-11877. **IF=6.9**

Vercoe, R.B., Chang, J.T., Dy, R.L., Taylor, C., Gristwood, T., Clulow, J.S., Richter, C., Przybilski, R., Pitman, A.R. and Fineran, P.C. (2013) Cytotoxic chromosomal targeting by CRISPR/Cas systems can reshape bacterial genomes and expel or remodel pathogenicity islands. *PLOS Genetics*, **9**(4):e1003454. **IF=8.5**

**For a full list of publications visit [ocem.otago.ac.nz/publications.html](http://ocem.otago.ac.nz/publications.html)**

To acknowledge the OCEM in your publications, please consider using the following statement: "The authors acknowledge the facilities as well as the scientific and technical assistance from staff at the Otago Centre for Electron Microscopy (OCEM)."

## Your friendly electron microscopy team are...

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## The OCEM and OCCM are hosting the 2015 MNZ Conference

We are pleased to announce that the OCEM and OCCM will host the 27th New Zealand Conference on Microscopy. The conference will be held from Monday the 2nd of February to Friday the 6th of February 2015 and will feature a diverse program of seminars and workshops. There will be plenty of opportunity to meet and mingle with the keynote speakers and other conference delegates. The programme includes a social welcome night, exhibition and poster evening, conference dinner and end-of-conference barbeque. Seminars take place over first three days (2nd - 4th of February) and will be followed by two days of workshops on the 5<sup>th</sup> and 6<sup>th</sup> of February.

The conference will cover all forms of microscopy and will be of interest to researchers in a wide range of fields. There are six workshops on offer: **Cryo-TEM**; **Correlative Light Electron Microscopy**; **Electron Back Scatter Diffraction**; **Image Analysis**; **Electron Diffraction**; **Atomic Force Microscopy**.



## Register Now

Do you supervise post-graduate students? We are currently accepting abstracts for oral or poster presentations. The closing date for submissions is the **7<sup>th</sup> of November 2014**. This is a great opportunity for students and researchers to share their research without the expense of travelling internationally.

[Microscopy2015.otago.ac.nz](http://Microscopy2015.otago.ac.nz)

## International Keynote Speakers



### Professor Werner Kuelbrandt

*Max Planck Institute of Biophysics*  
Werner studies the structure and mechanisms of membrane proteins by X-ray and electron crystallography, single-particle cryo-EM, electron tomography and biophysical methods.



### Dr. Paul Verkade

*University of Bristol*  
Paul utilises high-pressure freezing and correlative light electron microscopy (CLEM) to study the sorting mechanisms in intracellular transport pathways.



### Dr. Azdiar Gazder

*University of Wollongong*  
Azdiar is a physical metallurgist who utilises EBSD for a lot of his work such as characterising and modelling the mechanical, microstructure and crystallographic texture properties of ultra-fine grained materials.



### Professor Joanna Etheridge

*Monash University*  
Joanna researches the theory of electron scattering in solids and its application to the development of new methods for determining the atomic structure and defect structure of materials.