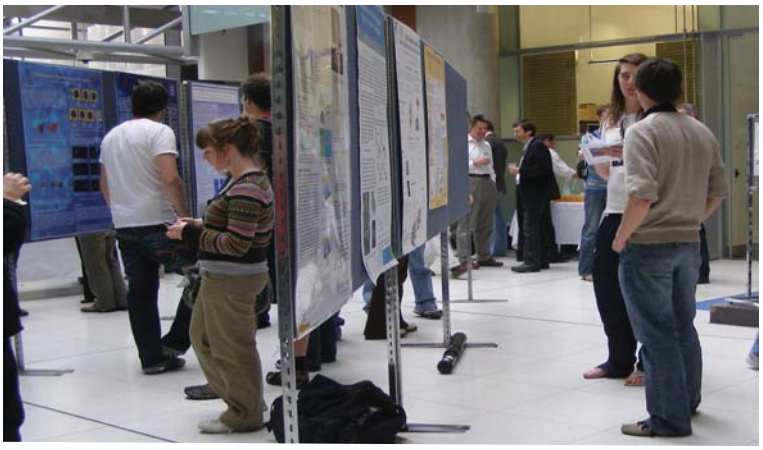
In Coherence

Summer 2009

Newsletter for ARC Centre of Excellence for Coherent X-Ray Science

CXS Annual Workshop 2008 Report: Biologists and Physicists Working Together

Associate Professor Andrew Peele, Professor Leann Tilley and Associate Professor Mike Ryan report on the success of the CXS Annual Workshop. The article below is a condensed version of the report concentrating on international speakers.



Attendees viewing posters in the foyer of Bio21, the location of the CXS Annual Workshop 2008.

The CXS Annual Workshop 2008 was held at the Bio21 Institute, in Melbourne, Australia, 17th-19th September 2008. The workshop aimed to bring physicists and biologists together at a very exciting time for X-ray and other novel imaging techniques. The workshop participants included most of the members of the CXS and other members of the physics, biology and chemistry communities. There were a total of 137 registrants including 12 international speakers from the US, New Zealand and Europe as well as prominent local speakers from CXS and premier institutions in Australia. It was a fantastic opportunity to meet within and across disciplines and countries.

Professor Keith Nugent opened the meeting explaining the goals of the workshop. He gave an overview of the activities within CXS, in particular some of the successes for 2007.Some of the recent CXS results in coherent diffractive imaging were previewed including application demonstrations of the method for full field microscopy. In addition, some impressive developments within CXS in the use of high harmonic generation laser sources for producing coherent beams of X-rays were highlighted.

The aim of the workshop talks was to merge the physics into the biology across the three days. Accordingly, the three day programme showcased the developments in techniques that have taken place worldwide over the last year.

To briefly mention our international guests; Dr Henry Chapman, founding director of the Centre for Free-Electron Laser Science at the University of Hamburg, based at DESY, presented results indicating that high quality imaging using an FEL pulse is in fact possible and described work underway in creating the ability to image single molecules and small clusters of molecules.

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CXS WORKSHOP REPORT 2008

To see the full report please go to:

http://www.coecxs.org/downloads/Media/CXS%20workshop%202008%20webReport%20(3).pdf

NANO PHOTONICS DOWN UNDER 2009: Devices & Applications

Call for papers

June 21 - 24, 2009

Melbourne Convention Centre

www.smonp2009.com

X-RAY SCIENCE GORDON RESEARCH CONFERENCE

August 2, 2009

Colby College in Waterville, Maine, USA

With an international cast of speakers, conference participants will hear about exciting X-ray based science at 3rd generation light sources and scientific plans and early results from 4th generation sources.

In Brief

Publications:

Publications for the previous half include:

Abbey B, Williams GJ, Pfeifer M, Clark J, Putkunz C, Torrance A, McNulty I, Levin TM, Peele AG, Nugent KA, *"Quantitative conherent diffractive imaging of an intergrated circuit at a spatial resolution of 20nm."* Applied Physics Letters 93, 214101 (2008)

Moser HO, Banas K, Chen A, Vo NT, Jian LK, Kalaiselvi SMP, Liu G, Maniam SM, Gu PD, Cholewa M, Li ZL, Wilkins SW, Gureyev TE, Mayo SC,*"Quantitative investigation of phase retrieval from X-ray phase-contrast tomographic images."* Developments in X-ray Tomography VI, 10 - 14 August 2008, San Diego Convention Center, San Diego, CA United States. (2008)

Dilanian RA, Chen B, Teichmann S, Dao LV, Quiney HM, Nugent KA, *"High-harmonics-generation spectrum reconstruction from Young's double-slit interference pattern using the maximum entropy method"*, Opt. Lett. 33, 2341-2443, (2008)

Hall CJ, Lewis RA, *"Detectors for coherent X-ray diffractive imaging." Nuclear Instruments and Methods, Special Edition* (2008).

Curwood E, Hall CJ, Lewis RA, *"Modelling of a hybrid pixel detector for coherent X-ray diffractive imaging."* Proceedings of the PSD8 conference, (2008)

Stojanovski D, Milenkovic D, Muller JM, Gabriel K, Schulze-Specking A, Baker MJ, Ryan MT, Guiard B, Pfanner N, Chacinska A, *"Mitochondrial protein import: precursor oxidation in a ternary complex with disulfide carrier and sulfhydryl oxidase."* J. Cell Biol. 183, 195-202 (2008)

Sugiana C, Pagliarini D, McKenzie M, Krby DM, Salemi R, Abu-Amero KK, Dahl HH, Hutchinson WM, Vascotto KA, Smith S, Newbold RF, Christodoulou J, Calvo S, Mootha VK, Ryan MT, Thorburn DR, *"Mutation of C20orf7 disrupts complex I assembly and causes lethal neonatal mitochondrial disease."* Am. J. HUM. GEN. 83, 468-478 (2008)

CXS Visitors:

Associate Professor Edgar Vredenbregt of Eindhoven University visited the Ultra Cold Plasma Source group at the University of Melbourne in October 2008.

Hiroshi Fukumura of Sendai visted the Short Wavelength Laser Source Program in late November 2008 to discuss X-ray generation from metal tapes and liquid surfaces using ultrafast lasers.

Sheila Akiniry of Emory University USA visited the Biological Science Program for a month at LaTrobe University.

Carolyn Larabel and Mark Le Gros gave a talk at LaTrobe University in December 2008.

Conferences & Workshops:

Dr Quiney presented a talk at the meeting *"Beyond the Schrodinger Equator"*, on relativistic quantum chemistry, 10-13 September 2008 in Auckland, New Zealand.
He also presented a talk, *Ïnteraction with matter and X-ray Free-Electron Lasers"* at a Hamburg workshop, 8 - 10 October 2008.

Janelle williams gave a talk on cell free expression methods at the CSIRO/Bio21 Protein Expression Workshop 2008, 1 August 2008.

Dr Steve Wilkins spoke on *Developments in X-ray Tomography VI* at the SPIE Conference in August 2008, and spoke at the International Union of Crystallography in Osaka, Japan in December 2008.

Dr Jose Varghese was an invited speaker at the International Conference on Medicinal Chemistry, *"Analysis of metal ion tonicity in Alzheimer's Disease by X-ray structural studies of Amyloid Beta and copper ion interactions"* 31 August - 4 September, 2008.
He also was an invited speaker at the Scientists in Schools Symposium, *"Advances in diagnostics and prevention of Alzheimer's Disease"*, WEHI 24 - 25 October 2008.

Dr Garth Williams was an invited speaker at the International Union of Crystallography, *"Divergent beam CDI"* in Osaka, Japan in December 2008.
He also gave an invited talk, *"New Approaches in CDI: diverging and partially coherent beams"* at the Linac Coherent Laser Source Users Workshop at Stanford University, USA on 17 October 2008.

A/Prof Andrew Peele was an invited speaker at the ALS Users'Workshop 2008, *"Recent developments in Fresnel coherent diffractive imaging"* at Berkeley University, USA on 14 October 2008.
He also gave an invited talk, *"Coherent diffractive imaging: a new tool for high resolution X-ray imaging"* at the workshop on X-ray micro imaging of materials devices and organisms, IEEE 2008 at Dresden, Germany on 22 October 2008.

Dr Brian Abbey gave an invited talk at the CXS Workshop, *"Recent advances in coherent X-ray microscopy using curved beams"***,** Melbourne 17 September 2008.

Dr Eric Hanssen was an invited speaker at the Annual Meeting of the NSF Center for Biophotonic Science and Technology, *"Whole cell imaging, an answer for the maurer's cleft puzzle?"* Olympic Valley, California, USA, 14 - 16 July 2008.

Welcoming New Members:

CXS would like to welcome our latest members:
Dr David Vine and Nor Azah Abdul Aziz, Experimental Methods Program, University of Melbourne.
Yi-Lynn Liang, Structure Determination Methods Program,CSIRO.
Minh Tam, Experimental Methods Program, LaTrobe University.
Ved Prakash Mooga and Tim Brown, Biological Sciences Program, LaTrobe University.

In the Media:

CXS featured in Summer 2008 edition of the ARC Discovery Newsletter with its article *ARC Centres, Chocolate - no longer a guilty pleasure*, featured on page 10.

The article, *A sight unseen no more,* appeared in the 7 December, 2008 issue of the Sunday Canberra Times, page 17.

Annual Workshop 2008 Report

Continuing from page 1...

Prof John Spence, Regent's Professor of Physics at Arizona State University, covered a great deal in his talk and left the audience with an array of ideas for development. These included work on powder diffraction data, radiation damage, reducing the effects of multiple scattering and delivery and alignment of molecular clusters in water droplets to the X-ray beam.

Profs. Henry Chapman and John Spence

Prof Simon Hooker of Atomic and Laser Physics at the University of Oxford, and Fellow and Tutor in Physics at Merton College, Oxford, presented work involving the development of high harmonic generation sources. He showed the audience some of the impressive gains that have been made in recent years in terms of HHG intensity and in producing shorter wavelength X-rays by means of quasiphase matching. He also provided a preview of things to come by describing results towards wakefield generation of extremely high energy electron beams.

Dr Edgar Vredenbregt, assistant professor in the Coherence and Quantum Technology group, Department of Applied Physics at Eindhoven University of Technology in the Netherlands, discussed the requirements for the production of ultra-fast high brightness electron sources. These will form the basis for developments such as improving synchrotron and free-electron sources. He described results in producing such sources and demonstrated production of electron temperatures as low as 10K. New approaches involving the use of trapped atom sources were also shown.

Prof Lothar Strüder of Experimental Physics at the University of Siegen and head of the MPI Semiconductor Laboratory of Munich, presented the huge advances in detector development that have appeared in recent years. Results for drift, ccd and active pixel detectors were presented as well as experimental results for the new pnCCD detectors with data taken from synchrotron white beam and from the FLASH source. Developments towards the 5 MHz imager using active pixel technology were also presented.

Prof Rick Millane, head of the Department of Electrical and Computer Engineering at the University of Canterbury, New Zealand presented a discussion of the relationship between the inversion problem for coherent diffractive imaging and for crystallography. He provided a method for quantising uniqueness and presented an overview of reconstruction algorithms; an application of solving for molecular envelopes.

Dr Wenbing Yun, President and Chief Technical Officer of Xradia Inc. described the applications and capabilities of X-ray tomography systems. Both micro-XCT and nano-XCT were presented as well as new developments into the capability for phase imaging.

Prof Werner Kuhlbrandt, Director of the Max-Plank-Institute of Biophysics in Frankfurt presented some of his work describing single particle cryoelectron microscopic imaging, electron crystallography of 2-dimensional protein crystals as well as EM tomographic analysis of protein complexes within membranes. In particular he showed the structure of fatty acyl synthase which acts to sequester metabolites within a cage-like structure. He also showed the organisation of F1Fo-ATPase in the mitochondrial inner membrane and postulated that their arrangement at the cristae ends has functional relevance in funnelling a proton gradient and localised pH changes.

Dr Liz Hewat from the Jean-Pierre Ebel Institute of Structural Biology in Grenoble, France, demonstrated the usefulness of combining structural data from cryoEM with X-ray crystallography. She showed the structure of a human rhinovirus and modelled the positions of a number of viral proteins whose crystal structures have previously been determined. She also demonstrated how the RNA-export channel may open to extrude the RNA into the infected cell.

Dr Rainer Heintzmann, head of the Biological Nanoimaging Research Group, at King's College London, United Kingdom, Heintzmann described his work on super-resolution optical microscopy techniques and detailed his work in the area techniques that break the "defraction barrier", as well as highlighted the similarities with the 'pointilism' techniques of the impressionists.

Drs. Liz Hewat and Connie Darmanin

Professor So Iwata, Director of the Centre for Structural Biology at Imperial College, London, reported on progress in solving technical issues and described some of the exciting insights into molecular mechanism that are emerging from the work of his groups at Diamond Light Source, Oxford and Exploratory Research for Advanced Technology, Human Receptor Crystallography Group, Japan.

In conclusion, the Workshop Organizing Committee would like to thank all of the participants for contributing to such an excellent program and hope you enjoyed the event and found it to be a worthwhile experience.

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The ARC Centre of Excellence for Coherent X-ray Science (CXS) is an Australian Government Initiative which began in July 2005 to explore what can be achieved with coherent X-ray optics; including an understanding of exotic phenomena such as X-ray phase discontinuities.

CXS headquarters is located at the University of Melbourne in Victoria, Australia, with participating nodes at La Trobe University, Monash University, Swinburne University of Technology and the CSIRO. Its mission is to be the world leader in the development of non-crystallographic techniques for the determination of protein structures.

"In Coherence" is produced quarterly by CXS. Contributions are welcome and should be forwarded to Ms. Tania Smith, CXS Chief Operating Officer, University of Melbourne Vic 3010, fax to +61 3 9347 8912, email: cxsenquiries@ph.unimelb.edu.au or Ms. Rosslyn Ball, Administration, email: r.ball@ph.unimelb.edu.au

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Special thanks to Ms Rosslyn Ball, A/Prof Andrew Peele, Prof Leann Tilley and A/Prof Mike Ryan for there contribution to the Summer 2009 edition.

Ms Francesca Calati is assisting CXS with its outreach activities

Rossyln Ball explores the many facets of Ms Calati.

Ms Francesca Calati is an Outreach and Curriculum Development Officer with the Department of Biochemistry, La Trobe University. Previously Francesca was the Program Manager of Accelerated Curricula and Nanotechnology at St Helena Secondary College.

Francesca is a highly experienced teacher who has taught chemistry, general science, maths, Italian and information technology. Recently she has gone back to study part time and is in the last year of a Bachelor of Pharmaceutical Science (Formulation Science) at Pharmacy College Parkville.

In 2005, Francesca devised the idea of developing a curriculum in nanotechnology for secondary school students and it is through her inspiration and innovation that the SHINE Project (St Helena Innovative Nanotechnology Education) evolved.

In 2007, Francesca was the recipient of the Prime Minister's Prize for Science Teaching in 2007, and was also listed in The Age as one of "Victoria's 100 most influential people in education."

Francesca exudes a genuine passion for teaching and making the science world relevant to young people. Her latest project amongst many other outreach programs being piloted at La Trobe University is working with a group of year 10 students from a number of local schools to develop three documentary videos. The aim of these videos is to communicate to the wider community in simple language, the relevance and importance of the cutting edge science research being done by the CXS research teams.

Francesca Calati

When Francesca is not dabbling in things scientific she spends quality time with her husband and three children; bringing harmony to her chaotic household, being creative in the garden and the kitchen, travelling and renovating houses.