In Coherence

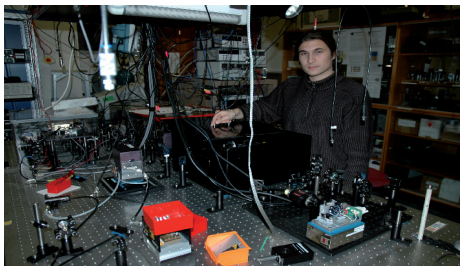
July 2007 Newsletter for ARC Centre of Excellence for Coherent X-Ray Science

Welcome to the Ultra Cold Plasma Source Program!

Dave Sheludko reports on the inner working of the new CXS team - Ultra Cold Plasma Source Program, located at the University of Melbourne.

The Atom Optics lab in the School of Physics is rarely empty. PhD students Simon Bell, Sebastian Saliba and Dave Sheludko keep the lab busy under the enthusiastic (and very patient) guidance of Associate Professor Robert Scholten, the group leader of the new CXS group - Ultra Cold Plasma Source Program. The team is currently focused on the Ultra Cold Plasma project, a new initiative to develop and investigate strongly coupled plasma and frozen Rydberg gas, with direct application to the production of a new type of X-ray source.

Frozen Rydberg gas, and ultra cold plasma, are relatively new and esoteric forms of matter, with new puzzles, and new opportunities. To quote an editorial review in Physics World [1], “these exotic and relatively unexplored states of matter may... help us to understand the surfaces of neutron stars and the centres of planets such as Jupiter”. It is an area of intense innovation, with frequent coverage in the most selective journals. Several experimental research groups are now working in the area, including collaborators at Technische Universiteit Eindhoven (Netherlands), but this project is the first Australian research programme. Some of the fundamental processes and interactions have been demonstrated, and inspiring achievements are published with increasing frequency, but there is great opportunity for innovation both in new concepts and in realising their potential.



Fredric Bouly in the Atom Optics Lab

The starting point for work in this area is a magneto optical trap (MOT), in which a cloud of about 108 rubidium atoms are laser-cooled to micro-Kelvin temperatures and trapped in a region about 1 mm in diameter. The process has often been compared to “throwing ping-pong balls at a tank”, but with lasers, it’s an awful lot of ping pong balls!

Using another high power laser, the atoms can either be excited to very high energy states to form frozen Rydberg gas, or ionised just above the threshold, resulting in ultra cold plasma.

Plasma (like that found in fluorescent light tubes) is usually weakly coupled, meaning that the electrostatic binding between the charged particles is weaker than the thermal energy, and indeed must be so since the plasma is usually formed by heating neutral atoms until they separate. Strongly coupled plasma is found in peculiar astrophysical systems such as white dwarfs and neutron stars, where gravitational and magnetic forces dominate over thermal ionisation.

Ultra cold plasma can also be used to produce X-rays, by accelerating the cold electrons and scattering laser light off the resulting fast electron cloud. Since the electron cloud is cold, this type of electron source has the potential to provide a high brightness source for X-ray production.

Currently, Sebastian is working on modelling a rubidium atom source to load atoms into the MOT, while Dave has recently demonstrated a new imaging technique for cold atoms that will be used to optimise production of the plasma, and study Rydberg atoms. Simon is currently collaborating with researchers in Eindhoven to develop the design of the MOT and vacuum chamber for the Australian research laboratory.

Other experiments in the lab include investigations into quantum squeezing, an atomic clock using electromagnetically induced transparency and ‘slow light’. These are primarily the domain of honours students Liam McGuinness, Martijn Jasperse, Roger Lowden and internship student Frederic Bouly.

[1] Bergeson S, Killian T, Physics world 16 37 (2003)

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Opportunities

Available Scholarships:

- Experimental X-ray Physics
- Theoretical X-ray & Molecular Physics
- Synchrotron Instrumentation Science
- Biochemistry, Cell & Structural Biology
- Femtosecond Laser Physics

FOR MORE INFORMATION PLEASE VISIT OUR WEB SITE AT:

COECXS.ORG/SCHOLARSHIPS.HTML

Employment:

Research Fellow/Senior Research Fellow

School of Physics, Faculty of Science,

Monash University

FOR MORE INFORMATION PLEASE VISIT OUR WEB SITE AT:

COECXS.ORG/EMPLOYMENT.HTML

Meet Sebastian Saliba

Sebastian Saliba in the Atom Optics Laboratory

Sebastian Saliba, a first year PhD student working in the CXS Ultra Cold Plasma Program team, grew up in Melbourne with a rich blend of Macedonian, Spanish, and Australian.

In 2006 Sebastian completed a Science degree with Honours as part of the Astrophysics group at the University of Melbourne. He submitted his thesis under supervision of Dr. Andrew Melatos, analysing the gravitational radiation emitted by an accreting neutron star and evaluating its merit as a potential source for the Laser Interferometer Gravitational Wave Observatory.

His current research is focusing on designing and implementing a new method for loading atoms into the magneto-optical trap where the UCP will be created. The next stage will be the design and construction of the vacuum system required to keep the atoms at such low pressures, eventually moving on to theoretical modelling of various UCP processes.

During his undergraduate degree, Sebastian has been an Activities Office Bearer for the Student Union, Treasurer and President of the Juggling Club, Armourer for the Fencing Club, as well as being involved in the Snowboarding team. His other interests are ultimate frisbee, cycling, hiking, cooking, and badminton. Sebastian hopes to one day combine his many passions and open a café restaurant called the Philosophical Physicist – pop in some time.

In Brief

Publications:

Publications for this quarter include:

M McKenzie, M lazarou, D R Thorburn, M T Ryan, (2007) *Analysis of Mitochondrial Subunit Assembly into Respiratory Chain Complexes using Blue Native Polyacrylamide Gel Electrophoresis,* Anal. Biochem. 364, 128-137

M Lazarou, M McKenzie, A Ohtake, D R Thorburn, M T Ryan, (2007) *Analysis of the assembly profiles for mitochondrial - and nuclear-DNA-encoded subunits into complex I.* Mol. Cell. Biol. 27, 4228-4237

L Tilley, G McFadden, A Cowman, N Klonis (2007) *Illuminating Plasmodium falciparum-infected red blood cells.* Trends in Parasitology 23 (6), 268-277.

K E Jackson, T Spielmann, E Hanssen, A Adisa, F Separovic, M W A Dixon, K R Trenholme, P L Hawthorne, D L Gardiner, T Gilberger, L Tilley (2007) *Selective permeabilization of the host cell membrane of Plasmodium falciparum-infected red blood cells with streptolysin O and equinatoxin II.* Biochemical Journal, 403 (1), 167-175

R Hirana, E Hanssen, M A Gibson (2007) *LTBP-2 specifically interacts with the amino-terminal region of fibrillin-1 and competes with LTBP-1 for binding to this microfibrillar protein.* Matrix Biology, 26 (4), 213-223

X M Wen, L V Dao, J Davis, P Hannaford, S Mokkapati, H H Tan, C Jagadish (2007) *Carrier dynamics in p-type InGaAs/GaAs quantum Dots.* J. Mater Sci:Mater Electron DIO 10.1007/s 10854-007-9214-5

L V Dao, J Davis, P Hannaford, Y Cho, M A Green, E Cho (2007) *Ultrafast carrier dynamics of Si quantum dots embedded in SiN matrix.* Appl. Phys. Lett. 90, 081105

T A Smith, D K Bird, J W Nuske (2007) *A Phase-Locked, 10 MHz Reference Signal for Frequency Domain Time-Resolved fluorescence Measurements.* Rev. Sci. Instr. 78(5), 053715/1-4

D K Bird, K M Agg, N W Barnett, T A Smith (2007) *Time-Resolved Fluorescence Microscopy of Gunshot Residue: An Application to Forensic Science.* J Microscopy, 226(Pt 1), 18-25

CXS Visitors:

Silvia Haase from Bernhard Nocht Institute for Tropical Medicine, Hamberg, Germany is a visiting research student to the Biological Science Program at La Trobe University.

The following guests attend the Detector and Beamline Development Program at Monash University:

- Mr George Pappas, Chair of Monash Medical Research Board,
- Prof. Oscar Moze, Universita'di Modena, Italy,
- The Hon. Kay Patterson, Senator for Victoria
- Dr Fujio Makano, Guest Researcher at Advanced Mission Research Centre, Japan Aerospace Exploration Agency
- Prof. Takahasi and Prof. Ikada of the Japanese Aerospace Exploration Agency

Dr. John Tish, Imperial College London was a guest with the Short Wavelength Laser Source Program at Swinburne University of Technology

In the Media:

An article featuring CXS, *Shattering the crystal lattice* , appeared in the *Australian Science Stories* supplement as part of the 5th World Conference of Science Journalists 2007 publication, pp 11.

A freelance article was written by Jenny Manyweathers, Tsukuba University, Japan titled, *Mitochondria - the good, the bad and the ugly!*

Welcoming New Members:

Welcome Evan Curwood to the Detector and Beamline Development Program at Monash University, and to the entire Ultra Cold Plasma Source Program team.

IP @ CXS Seminar

Are you able to recognise Intellectual Property (IP) when you see it?

More CXS students and staff would say yes to this question after attending the *IP @ CXS - Knowing it when you see it* seminar at the University of Melbourne on 23rd July 2007.

Excellent talks on IP identification, ownership, valuation, protection and the patent system were provided by our guest speakers, Mr. Sossen Woldeamanuel, Dr. Bruce Whan and Mr. David Krenus.

Sossen Woldeamanuel from IP Australia offered information from a government perspective, Dr. Bruce Whan from Swinburne Ventures Ltd. and the Victorian Innovation Centre Ltd. focused on information from a university perspective, and David Krenus from Cyclotek demonstrated IP cases from an industry perspective.

All members in attendance received a comprehensive IP information pack. These packs are available upon request from and CXS node.

The packs include:

- The Innovator's Wheel - *Making money from smart ideas*
- The Process of Patenting chart
- Practice Good Lab Book Practices brochure
- *IP - Don't Give Away Your Most Valuable Asset* booklet
- *IP - Your Rights At A Glance* flyer

As attendance to an IP session is compulsary for CXS students this seminar will now be offered on a yearly basis.

If you would like further information on IP @ CXS or you would like to request an information pack please email: cxsenquiries@ph.unimelb.edu.au

Guest Speakers David Krenus, Sossen Woldeamanuel and Bruce Whan

OMX, A New Paradigm for Wide-Field Optical Microsopy

Sedat Lab at the University of California, San Francisco

On 25th June 2007, the CXS Biological Science Program had the pleasure of hosting a guest lecture by Professor John Sedat at the University of Melbourne.

Professor Sedat, from the Department of Biochemistry and Biophysics at the University of California, San Francisco gave a talk on The Sedat Lab's research into understanding the organisation of chromosomes within the nucleus, the detailed architecture of the chromosomes themselves, and the functional roles this organisation plays in determining chromosome behaviour.

In order to carry out these studies the Lab has developed several new methods of three-dimensional microscopy, including computerised wide-field deconvolution microscopy for multi wavelength fluorescence imaging of living cells, and electron tomography for three-dimensional imaging in the electron microscope.

For more information on The Sedat Lab's research please visit their web site at:

www.ucsf.edu/sedat/index.html

Theoretical Studies in Electronic Systems

This May 28th meeting explored areas of interest to the Theory and Modelling Group of CXS that overlap the activities of the ARC Centre for Antimatter-Matter Studies (CAMS) and the Theoretical Condensed Matter Physics group (TCMP) at the University of Melbourne.

The key areas of common interest were identified as being theoretical approaches to electron-atom and electron-molecule scattering, the development of solutions to mathematical inverse problems, and the quantum electrodynamics of electronic systems interacting non-perturbatively with intense laser fields.

A core activity in CAMS is the calculation of electron-atom scattering and photoionization cross-sections using the convergent close-coupled method.

A detailed description of this approach and of the activities and structure of CAMS was discussed at length. A new and theoretically complete description of atomic scattering processes was also presented, along with the scope of activities within CXS and TCMP.

The meeting concluded with a discussion that identified several areas of common interest that emerged, especially in the areas of imaging and the relativistic theory of electronic structure and quantum electrodynamics. It was agreed that CAMS and CXS would interact more closely in future, and the possibility of exchange study visits between members of the Centres was discussed.

Workshop guests enjoying lunch

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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 of Operations, University of Melbourne Vic 3010, faxed +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 Rosslyn Ball, David Sheludko, Sebastian Saliba and Harry Quiney for their contributions to the July 2007 edition, particularly at such short notice. You guys were great!

THE MEDIA IN FOCUS III - Feeling a bit dissatisfied?

CXS offers the final installment in its Media In Focus series.

There are inevitably, occasions when scientists feel unhappy with the outcome of their dealings with a journalist - in a newspaper article or television programme, or indeed the non-appearance of an article or broadcast item.

If this happens to you, first pause and consider exactly why you are concerned. Is it because you gave your time to help with an article or programme that has been aborted? If so, while common courtesy may mean that you had a right to have been informed, there is invariably nothing else to be done. Many articles, radio and television recordings are never used - for logistical reasons quite unconnected with quality.

Again, if you believe that you have been misrepresented in an article or programme, consider carefully why you believe this to be so. Do you have a genuine grievance?
Or are you really bothered because, for example, too much prominence has been given (in your opinion) to the ideas or achievements of another research group?

In the latter case, discuss the matter with a colleague not involved in the work, wait until the next day and if you still feel as strongly, write a letter or email to the journalist setting out your point of view. This **will** be taken seriously.

In a particularly serious case, and again after talking to colleagues and/or your press officer, it may be appropriate to complain to the editor and/or to send a letter or email for publication. Even when not published, such letters **are** considered carefully and may well be taken on board when that subject is covered in future.

Finally, there are options of reporting the journalist and publications to the Australian Press Council that deals with complaints about the press, or to take legal action if you believe that you have been defamed.

Be Realistic

Some journalists are sometimes mischievous - as are some people in other walks of life. Journalists also make mistakes - as do some scientists. Some of them sensationalise new developments - as do some companies. Yet the vast majority of journalists do not set out to be mischievous, to make mistakes or to sensationalise their material. They work to the best of their ability and, especially given the pressures on their time, their output is of a high standard. Moreover, writers who specialise in areas such as science, medicine and technology have done so because they are keenly interested in those topics. They need your help, just as you may need theirs.

The Australian Press Council

The Australian Press Council is the self-regulartory body of the print media. Its two main aims are to help preserve the traditional freedom of the press within Australia and ensure that the free press acts responsibly and ethically.

To carry out its press responsibility role it serves as a forum to which anyone may take a complaint concerning the press.

For more information regarding the Australian Press Council you can visit their web site at: www.presscouncil.org.au or you can contact:

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Part of this article is an excerpt from the European Federation of Biotechnology article "Dealing with the media" Briefing Paper 5 October 1996; used with permission.