MACQUARIE UNIVERSITY | MQ PHOTONICS RESEARCH CENTRE

# NEWSLETTER

Issue 26 – 9 December 2009

***MQ Photonics Newsletter*** is an informal internal publication of the ***MQ Photonics Research Centre*** <http://web.science.mq.edu.au/groups/mqphotonics/>.
We aim to distribute it by e-mail every 3 weeks. Please send copy to <lizb@physics.mq.edu.au> by 9 a.m. every 3rd Tuesday. **Next due date:** ***TO BE ADVISED***

## Focal Points

### The final issue of 2009 ...

Have you noticed that this appears to be a particularly good year for Christmas Bush? It seems to have flowered earlier and to be more brilliant than usual. It is just one more sign that 2009 (pronounced "two thousand and nine") is nearly over and that 2010 (to be pronounced "twenty ten," I gather) will be upon us before we can say "Santa Claus"! We have not yet finalised plans for *MQ Photonics* to have an end/start-of-year get-together, but I know some people are thinking about possibilities. Meanwhile we can look back on 2009 with much satisfaction and forward to 2010 with considerable enthusiasm. The last few weeks have been rather busy, with our Showcase Day, several conferences and the usual end-of-year scramble. Meanwhile, thanks to those who have supported the *Newsletter* during 2009 and warm greetings to all for the festive/holiday season !

### *MQ Photonics* Showcase Day (Friday 20 November) ...


Thanks again to all who made our Showcase Day on Friday 20 November run so successfully. You will recall that it began with the following five invited talks by *MQ Photonics* members (all very well received):

- **Dr Jon Lawrence** "Astrophotonics"
- **Prof. Ewa Goldys** "Biophotonics"
- **Dr James Rabeau** "Nanodiamonds"
- **Eduardo Granados** "Ultrafast lasers"
- **A/Prof. Mick Withford** "Microfabrication – CUDOS@MQ and NCRIS ..."

The talks were followed by a congenial lunchtime poster session allowing us all to learn more about things that are going on in *MQ Photonics* and to the *MQ Photonics* Advisory Board. The posters presented were:

- "Understanding the behaviour of colour centres in nano-scale diamonds," **Carlo Bradac**, **James R. Rabeau**, **Torsten Gaebe1**, A. S. Barnard
- "Enhanced flow-cytometry-based bead immunoassays by using metal nano-structures," **Wei Deng**, **Krystyna Drozdowicz-Tomsia**, **Dayong Jin**, **Ewa Goldys**
- "Generating ultra-short pulses from a Q-switched microchip laser using high-gain materials and SESAMs," **Alex Butler**, **David Spence**, **David Coutts**
- "Theoretical & experimental study of relaxation oscillations in a CW intracavity Raman laser," **Jipeng Lin**, **David Spence**, **Helen Pask**, **Andrew Lee**
- "Dynamics of waveguide writing using a high-pulse-energy (500 nJ) MHz femtosecond oscillator," **Christopher Miese**, **Alex Fuerbach**, **Mick Withford**
- "Direct femtosecond-laser-written waveguides in bulk $Ti^{3+}$:sapphire," **Simon Gross**, **Mick Withford**, **Alex Fuerbach**
- "Biologically active peptide facilitates quantum dot cellular uptake," **Varun K. A. S.**, **Jinjun Sun**, Eun Ju Kim, **Timothy A. Kelf**, Vikram Jagannath Tallapragada, **Ewa Goldys**, Ann Goodchild, **Andrei Zvyagin**
- "Evaluation of skin permeability of ZnO nanoparticles by two-photon excitation microscopy," **Zhen Song**, **Timothy A. Kelf**, Alexey Popov, **Andrei Zvyagin**
- "Insights into Autofluorescence of human Urine," **Sandeep M. Perinchery**, Unnikrishnan Kuzhiumparambil, Subramanyam Vemulpud, **Ewa M. Goldys**
- "Generating nanoparticles using ultrafast laser," **Mushtaq A. Sobhan**, **Martin Ams**, **Mick Withford**, **Ewa Goldys**

### *MQ Photonics* Advisory Board (Friday 20 November) ...

On the same day (straight after the lunchtime poster session), the recently formed *MQ Photonics* Advisory Board held its inaugural meeting. The Board, chaired by Professor John Harvey (U of Auckland, NZ) seemed to be generally impressed by our performance (on the basis of both our Showcase Day presentations and of our 2008/9 Annual Progress Report). However, there is obviously more work ahead for us if we are to follow the Board's recommendations that we need to increase the visibility of *MQ Photonics* (*e.g.*, by producing a glossy publicity brochure) and to improve the governance of our Centre *via* regular "management" meetings.

### *MQ Photonics* 2008/9 Annual Progress Report – welcome feedback ...

We should all consider ourselves complimented by the following e-mail message (received on Tuesday 2 December) from Professor Max Coltheart, who chairs Macquarie University's Research Centre Scheme panel:

> ***Dear Brian,***
>
> ***Many thanks for this report, which is an excellent one. Congratulations on the Centre's numerous successes this year: it is clearly flourishing under your leadership.***
>
> ***Best wishes, Max***
>
> ***Professor Max Coltheart DSc FASSA FAA FBA***
> ***Head, Institute for Human Cognition and Brain Sciences***
> ***Director, Macquarie Centre for Cognitive Science.***
> ***Building C5C Room 495 Macquarie University***

### Well done, Eduardo and Nem!

As previously reported, PhD student **Eduardo Granados** had been selected to represent our Department of Physics and Engineering at the Australian Institute of Physics's AIP Postgraduate Awards on 24 November. Eduardo tells me that he was satisfied with his presentation, but that he was runner-up to Felix Lawrence (a CUDOS student from the University of Sydney). From what we saw of Eduardo's impressive "practice" talk on our Showcase Day, Felix's talk must have been very good indeed!

Brian Orr

Congratulations, too, to PhD student **Nem Jovanovic** ► on winning the Wanda Henry Award for the best student presentation (an invited talk – see below) at the Australian Conference on Optical Fibre Technology part section of the ACOLS/ACOFT 09 meeting. This award should round off many awards accumulated by Nem during his candidature. Nem looks deservedly pleased to be receiving the award from ANU's Professor John Love.

## Conference Reports

It has been a particularly busy time for conferences in recent weeks, as we report below.

### 10th annual Conference on Laser Ablation – COLA 2009 (Singapore, 22–27 November) ...

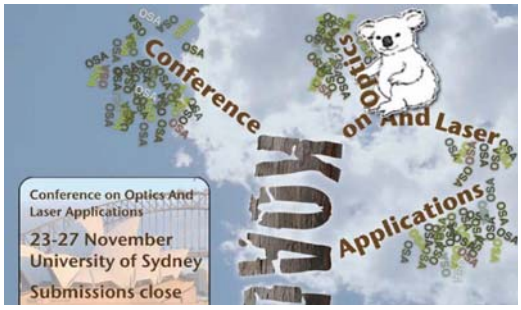
Prof Boris Luk'yanchuk of DSI, A*STAR, (known to many at MQ) chaired COLA 2009 along with Prof Ming Hui Hong (Engineering, NUS). The meeting continues to grow with ~430 papers accepted. In addition to the traditional purpose of the meeting to provide the stage for reporting the latest research in techniques, and the underpinning science (diagnostic, modelling and conceptual) of laser ablation and pulsed laser deposition, the meeting now provides a forum for laser interactions with materials more generally. Plasmonics, metamaterials, nanopatterning referenced to their applications are all included. Areas of strong activity in the program were controlled and systematic nanostructuring of materials with foci on applications in hydrogen storage, biomedicine and advanced materials; nanopatterning and nanoimprinting; and ultrafast light/materials interactions. Particular highlights for me were the work on using GST films and AFM to record near field light patterns with 10-nm resolution (Siegel); some very elegant extensions to using arrays of microspheres as masks for gold evaporated patterning on the underlying surface, and subsequently achieving a broad array of nanochannel geometries using a plasmonic mediated melt with different laser polarisations (Hubenthal); and Miles Padgett presenting the latest magic from his group on controlling the position of (multiple) trapped particles in liquid, in three dimensions. Our own research on laser removal of consolidants from Aboriginal

bark paintings received considerable interest and I have subsequently received invitations to two meetings to present this research in 2010. The ANU group of Prof Andrei Rode *et al.* were very well represented in the COLA program. Approximately 200 full papers from COLA will appear in 4 special volumes of Applied Physics A. I will be the guest editor for one of these volumes. The next COLA will be in Cancun, Mexico between September and November 2011. Please watch for confirmed dates.

Deb Kane

***More information:*** **http://cola2009.org/**

## KOALA (Sydney, 23–27 November) ...




***MQ OSA Student Chapter President Alex Butler writes ...***

"Following the success of the 2008 KOALA conference in Brisbane, this year's KOALA was hosted by the U of Sydney OSA Student Chapter. After a Herculean effort by KOALA chair, Bill Corcoran, in securing sponsorship from both corporate and academic sources, the $50 registration fee was enough to keep all 55 delegates in comfortable accommodation and food for the entire 5 days.

"The conference kicked off with plenary addresses from NASA Senior Optical Physicist, Dr. Philip Stahl, and University of Sydney Visiting Professor, Prof. Joss Bland-Hawthorn. They delivered informative talks on the topics of the James Webb Space Telescope (the Hubble successor) and the use of fibre Bragg gratings and photonics lanterns in the field of astrophotonics. Following this was a series of short courses, held by student delegates, in fields such as X-ray optics, quantum optics, nonlinear optics and Bose-Einstein condensates.

"The programme for the rest of the conference, not counting the social day mid-conference, was filled by presentations from the majority of the delegates. Presentations from *MQ Photonics* students **Carlo Bradac**, **Simon Gross**, **Eduardo Granados** and **Alex Butler** were well received, each generating a wealth of questions. Highlights of the talks (for me) were Katanya Kuntz's 'Purifying Squeezed Single Photons at 1550nm for Coherent State Quantum Computing' from UNSW@ADFA and Ting Han's 'Fabrication of Polysiloxane grating waveguides using soft lithography' from ANU. Above all, I chose these two examples from the hugely varied field of subject talks due to their clarity in presenting what had the prospect of being heavily technical talks. The poster evening on the second day was well attended with *MQ Photonics*'s **Christopher Miese** presenting his work in waveguide writing.

"The two social events planned for the conference were each executed brilliantly. Organising 40+ physicists to the Blue Mountains and then cajoling them through two bushwalks and a ride on the Zig-Zag Railway was no mean feat. In fact, it was likened on the day to trying to herd a clowder of cats. However, the Blue Mountains trip, organised by Christopher Miese, went off without a hitch and all physicists were returned to Sydney safe and sound and very satisfied. The official conference dinner, organised by Nem Jovanovic, was held at a tapas restaurant near USyd and thoroughly enjoyed by all. With near continuous paella and sangria, all delegates were sated and merry. It was at this occasion that the conference mascot, a cuddly toy koala, was passed to the next host – University of Otago's OSA Student Chapter. ***[... but will it cross-breed with a kiwi? BJO]***

"All in all, the KOALA conference is an outstanding event for optics and photonics students. The Antipodean equivalent to the OSA's IONS programme (student optics conference for the Northern Hemisphere), KOALA is an unparalleled opportunity for students from a wide subject base within the field optics to meet, share their ideas and research and to have an overwhelmingly fun time. While most of us hope that it will be some time before the conference returns to Sydney (we're all pretty keen to see some other university locations), we all look forward to KOALA continuing into the far future."

***... and Eduardo Granados writes:***

"I couldn't make it to last year's meeting at the University of Queensland, so I have been waiting for this unique conference for quite a long time! It is probably safe to say that the second annual KOALA conference held in Sydney has been a great success; perfect organization, interesting talks about many different and varied research areas, and an informal and friendly atmosphere between the students. I have been impressed by the quality of the presentations and posters as well as the discussions that some of them originated, even if we were a very heterogeneous group of students.

"On the other hand, we had a great time not only during the talks but also in the social day organized by Christopher Miese. We went to the Blue Mountains for hiking and to catch the beautiful zig-zag steam train (with pensioner discount), it was a perfect opportunity to interact with other students and have fun together. On Thursday we had the conference dinner at the Tapas restaurant in Glebe, where we had a “proper” Spanish dinner (I can tell), even some flamenco dancing after dinner (for the bravest only). All in all, it has been a great experience and I recommend it to all PhD students in optics."

**The following four 30-min papers (out of a total of 26) were presented by *MQ Photonics* HDR students:**

- **Simon Gross**
  *Direct written waveguides in bulk $Ti^{3+}$:Sapphire with a femtosecond oscillator*
- **Alex Butler**
  *Generating Ultra-Short Pulses from a Q-Switched Microchip Laser Using High-Gain Materials and SESAMs*
- **Carlo Bradac**
  *NV centres in nanodiamonds: towards a magnetometer based on single spins*
- **Eduardo Granados**
  *Unlocking the ultrafast potential of Cerium lasers: Status and prospectus*

***More information:*** **http://www.physics.usyd.edu.au/OSA** (OSA Student Chapter Conference)

## LILS (Melbourne, 24–27 November) ...


The FABLS ARC/NHMRC Research Network hosted the inaugural Light in Life Sciences (LILS) Conference at the Sebel Albert Park Hotel in Melbourne, Australia over 24-27 November 2009.

The Co-Chairs (Dr Mark Prescott, A/Prof. Trevor Smith and **Prof. Ewa Goldys**) designed a program to enable interactions between those involved in fundamental and applied aspects of research through cross-disciplinary interactions, across the conference themes of Fluorescent probes, Advanced Imaging and Biophotonics.

A diverse and multidisciplinary group of people, working in the fields of chemistry, physics, optoelectronics and biological and medical sciences gathered to hear cutting-edge research presented by 36 international and local speakers. There were also 16 industry exhibitions to visit and explore during breaks and 2 poster sessions with 44 posters presented by students and researchers from around the world.

The Light in Life Sciences Conference 2009 provided a dynamic forum focusing on world class, timely, innovative research from Australia and around the world. It coincided with the fifth and final gathering of the 'Fluorescent Applications in Biotechnology and Life Sciences' (FABLS) Network and encompassed the 3rd Advanced Optical Imaging Workshop.

FABLS is very grateful for the support of main conference sponsors the ARC, NHMRC, Macquarie University, Becker & Hickl GmbH and Lastek Pty Ltd and will create the Light in Life Sciences Foundation to support the conference into the future and assist in some way to maintain the networking success that the FABLS Network has enjoyed over the past five years.

Leah Boucher

**The following eight poster papers (out of a total of 43) were presented by *MQ Photonics* members:**

- **Christopher Artlett**, **Judith Dawes**, **Graham Marshall** & Peter Balling (U of Aarhus, Denmark)
  *Ultrafast laser ablation of dental enamel*
- **Dayong Jin**
  *Luminescence Silica Nanoparticles for Time-gated Immunofluorescence Cell Imaging*
- **Sandeep Menon Perinchery**, Unnikrishnan Kuzhiumparambil, Subramanyam Vemulpad & **Ewa M Goldys**
  *Insights into autofluorescence of human urine*
- **Varun K A S**, **Jinjun Sun**, Eun Ju Kim (Daegu University, S. Korea), **Tim Kelf**, Vikram Jagannath Tallapragada, **David Inglis**, **Krystyna Drozdowicz-Tomsia**, **Ewa Goldys**, Ann Goodchild & **Andrei Zvyagin**
  *An investigation into the nonspecific binding of commercially available quantum dots*
- **Mushtaq A. Sobhan** & **Ewa M. Goldys**
  *Visible fluorescence from gold nanoparticles*
- **Zhen Song**, **Timothy A Kelf**, Alexey Popov (University of Oulu, Finland) & **Andrei Zvyagin**
  *Evaluation of Skin Permeability of ZnO Nanoparticles by Two-Photon Excitation Microscopy*
- **Wei Deng**, **Krystyna Drozdowicz-Tomsia**, **Dayong Jin** & **Ewa M Goldys**
  *Enhanced Flow Cytometry Based Bead Immunoassays by Using Metal Nanostructures*
- **Jinjun Sun**, **Varun K A S**, Eun Ju Kim (Daegu University, S. Korea), **Tim Kelf**, Vikram Jagannath Tallapragada, Ann Goodchild, **David Inglis**, **Krystyna Drozdowicz-Tomsia**, **Ewa Goldys** & **Andrei Zvyagin**
  *Quantum Dot assisted somatostatin tracking in rat pancreases and pituitary tumor cells*

***More information:*** **http://www.physics.mq.edu.au/research/fluoronet/LILS09/**

## ACOLS/ACOFT 09 (Adelaide, November – 3 December) ...


Many members of *MQ Photonics* enjoyed the recent 2009 ACOLS/ ACOFT conference held at Adelaide University. The meeting was held over 4 days, and featured six plenary speakers and up to five parallel sessions of contributed and invited papers. It also incorporated the International Workshop on Dissipative Solitons 2009. The plenary speakers including Prof Rudi Grimm, Prof David Richardson, Prof Harm Rotermund, Prof Andrew White, Dr Simon Poole and Prof Ken Ghiggino, spoke on topics ranging from quantum computing, fibre lasers, fundamental few body physics of ultracold atoms, ultrafast chemistry and spatial pattern formation on catalytic surfaces, with a lesson on the economics of the Australian Photonics industry from Simon Poole!

The invited speakers included Nem Jovanovic, who was also awarded the Wanda Henry Prize for best presentation at ACOFT. (See photo above!) A number of *MQ Photonics* members gave talks and the poster session was also widely supported with over 80 posters in total. There were a good number of exhibitors and the conference overall had more than 300 attendees. The attendees at the conference dinner were entertained by a jazz band and an after dinner speech on the history of ACOFT by Prof John Love, who was awarded the AOS W.H. (Beattie) Steel Medal for his services to Australian Optics and Photonics.

Judith Dawes

***MQ Photonics* members were involved in the following 15 orally presented ACOLS/ACOFT papers:**

- **127** *Folded Bands in Metamaterial Photonic Crystals*
  P.Y. Chen*, A.A. Asatryan**, C.G. Poulton**, **M.J. Steel**, R.C. McPhedran*, L.C. Botten**, C.M. de Sterke*
  * University of Sydney, Australia ** University of Technology Sydney, Australia
- **136** *Functionalizing Fibre Lasers by Exploiting Direct Written Fibre Bragg Gratings* ***INVITED TALK***
  **Nemanja Jovanovic**, **Robert J. Williams**, Jens Thomas*, M. Åslund**, **Michael J. Steel**, **Graham D. Marshall**, **Alexander Fuerbach**, Stuart Jackson**, S. Nolte*, Andreas Tünnermann*, **Michael J. Withford**
  * Friedrich Schiller University of Jena, Germany ** University of Sydney, Australia
- **143** *Molecular Fingerprinting of Trace Gases*
  T.K. Boyson*, K.J. Conroy*, A.G. Kallapur*, I.R. Petersen*, M.E. Calzada**, T.G. Spence**, **Yabai He**, **B.J. Orr**, K.P. Kirkbride***, C.C. Harb*
  * University of NSW, Australia ** Loyola University New Orleans, USA *** Australian Federal Police
- **148** *Fluorescence Lifetime Characterisation of Nitrogen-Vacancy Centres*
  **Luke A. Stewart**, **Carlo Bradac**, **Judith M. Dawes**, **Michael J. Steel**, **James R. Rabeau**, **Michael J. Withford**
- **209** *Ultrafast Laser Modification of Phosphate Glass: Influence of Polarisation on Waveguide Morphology*
  **Douglas J. Little**, **Martin Ams**, **Peter Dekker**, **Michael J. Withford**
- **230** *Characteristics of Ultrafast Laser Written DFB Waveguide Lasers*
  **Martin Ams**, **Graham D. Marshall**, **Peter Dekker**, **Michael J. Withford**
- **258** *A Multi-Watt Continuous-Wave, Frequency-Doubled, Self-Raman Yellow Laser*
  **A.J. Lee**, **H.M. Pask**, **J.A. Piper**
- **267** *Nonreciprocal Band Structures in Low-Symmetry Two-Dimensional Magnetic Photonic Crystals*
  **Alexander B. Khanikaev**, **Michael J. Steel**
- **314** *Tunable Fibre Bragg Gratings by Resonant Optical Pumping: Applications for Fibre Lasers*
  **Robert J. Williams**, **Nemanja Jovanovic**, **Graham D. Marshall**, **Michael J. Withford**
- **316** *Direct Laser Written Bragg-Grating Couplers*
  Sangwoo Ha*, **Martin Ams**, **Graham D. Marshall**, Dragomir N. Neshev*, Andrey A. Sukhorukov*, Yuri S. Kivshar*, **Michael J. Withford** * Australian National University, Australia
- **317** *Broadband Cladding Mode Reflections of Asymmetric Intracore Fibre Bragg Gratings*
  Jens Thomas*, **Nemanja Jovanovic**, **Michael J. Steel**, Ria Becker*, **Graham D. Marshall**, **Michael J. Withford**, S. Nolte*, Andreas Tünnermann* * Friedrich Schiller University of Jena, Germany
- **361** *Direct Generation of fs Laser Pulses with a Peak Power Exceeding 18 MW Without External Amplification*
  Wolfgang Koehler*, Christoph Bartylla*, Bernd Luerss*, **Christopher Miese**, **Alexander Fuerbach**
  * Femtolasers Produktions GmbH, Austria
- **409** *Mode-Locking Cerium Lasers: Generating Ultrafast Pulses in the Deep Ultraviolet*
  **David J. Spence**, **Eduardo Granados**, **David W. Coutts**

- **417** *A High-Performance Coherent Pulsed Spectroscopic Light Source with Low Chirp and Optical Bandwidth Near the Fourier-Transform Limit*
  Kenneth G.H. Baldwin*, **Yabai He**, Mitsuhiko Kono*, **Brian J. Orr**, **Richard T. White****
  * Australian National University, Australia ** Now at University of Adelaide, Australia
- **419** *Multi-Wavelength, Rapidly Swept Continuous-Wave Cavity Ringdown Spectroscopy, Applied to Sensing of Greenhouse Gases*
  **Brian J. Orr**, **Yabai He**, Ruifeng Kan*, **Florian V. Englich****, Wenqing Liu*
  * Chinese Academy of Sciences, Anhui, China ** Now at University of Adelaide, Australia

***MQ Photonics* members presented the following five ACOLS/ACOFT poster papers:**

- **13** *Fabrication of Channel Waveguides in Lithium Niobate*
  **Yi Lu**, **Benjamin Johnston**, **Peter Dekker**, **Judith M. Dawes**
- **18** *Point-by-Point Written Sampled Fiber Bragg Gratings*
  **Matthias Stecher**, **Robert J. Williams**, **Graham D. Marshall**, **Michael J. Withford**, **Graham E. Town**
- **23** *Electric Field Sensor Based on a Multi-Channel Directional-Coupler with an Electro-Optic Polymer*
  **Ravi J. McCosker**, **Graham E. Town**
- **50** *Direct Femtosecond Laser Written Waveguides in Bulk $Ti^{3+}$:Sapphire*
  **Simon Gross**, **Michael J. Withford**, **Alexander Fuerbach**
- **54** *Thermal Lens Study of CW Self-Raman Laser in Nd:GdVO4 Pumped by 880-nm Laser Diode*
  **J. Lin**, **H.M. Pask**, **A.J. Lee**, **David J. Spence**

***More information:*** **http://www.plevin.com.au/acoftacols2009/**

## 2009 MRS Fall Meeting (Boston MA, 30 November – 4 December) …

This meeting of the MRS (Materials Research Society) was massive, with approximately 40 parallel symposia and about 6000 attendees. I focused on the Diamond Electronics and Biophotonics symposium which contain a good deal information far beyond what the title suggests in diamond growth, spintronics and optical sources. For my own interests, the meeting was remarkable in terms of the number of groups participating in single crystal growth and the low costs of growth with one group reporting several dollars per carat (basically electricity cost). Optical quality and post-processing costs are another thing, but it highlights how potentially cheaply diamonds might one day be produced and foreshadows a hopefully a greatly reduced price barrier for new applications. The University of Melbourne presented a nice paper on Cr doped diamond, a single photon source with record brightness. The trip also included attendance at the Directed Energy Symposium a few weeks earlier in Texas, and I made visits to Nova-Tech Engineering in Wisconsin, M-Squared Lasers in Glasgow, Element Six in London and the University of Strathclyde.

Richard Mildren

## Upcoming conferences


**2010 International Conference on Nanoscience and Nanotechnology**

***More information:*** **http://www.ausnano.net/iconn2010/**


***Deb Kane advises that abstract submission is due 15th Dec 2009.***

***More info:*** **http://cms.messe-stuttgart.de/cms/lpm2010-aboutlpm.0.html**

## *MQ Photonics* seminars:

Time: 12Noon, Wed 9th December Place: C5C 498 **Alex Butler**

TOPIC: **Generating Ultrashort Pulses from a Q-Switched Microchip Laser**

ABSTRACT: Creating short, high energy pulses of light from a mode-locked laser can be a complicated and expensive process. It has been shown that a simple design of Q-switched laser can produce light pulses with duration approaching the mode-locked regime (10's of ps). It is hoped that such lasers can be coupled with a novel energy scavenging amplification technique to provide high energy, short duration pulses. A numerical model, based on the laser rate equations, was used to predict the performance of such laser designs and initial laboratory work has yielded a Q-switched laser system with a pulse duration of 140 ps, operating at a repetition rate of 350 kHz. Further refinements of the laser and numerical model will lead to a laser system which produces pulses of duration < 10 ps with pulse energy in order of 10 μJ.

Time: 12Noon, Fri 11th December Place: TBC **Dr. Brandon Bale**, Photonics Research Group, Aston University, Birmingham, UK

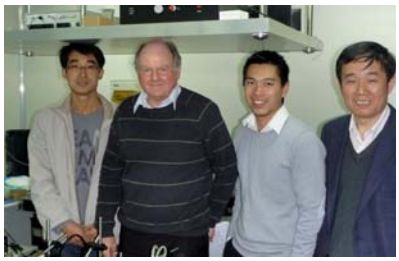
TOPIC: **Intra-cavity pulse dynamics in mode-locked fiber lasers**

ABSTRACT: Nonlinear systems with periodic elements present a very important branch of nonlinear science. Indeed, in most pulsed mode-locked fiber lasers there are periodic variations induced per cavity round trip due to different components in the cavity. A theoretical model is developed which characterizes the intra-cavity pulse evolutions in high-power fibre lasers. Pulse evolutions are observed and characterized depending on the net-cavity dispersion and various cavity elements.

For general fiber laser formats, it is shown that experimentally observed dynamics of the key pulse parameters can be described by a reduced model of ordinary differential equations. Critical in driving the intra-cavity dynamics is the amplitude and phase modulations generated by the discrete elements in the laser. The theory gives a simple geometrical description of the intra-cavity dynamics and possible operation modes of the laser cavity. Further, it provides a simple and efficient method for optimizing the performance of complex multi-parametric laser systems.

## People and Progress

### Visit to China by Andrew Lee, Dayong Jin and Jim Piper ...



***One report from Andrew Lee ...***

For 2 weeks in November, Dayong, Jim & I had the opportunity to visit China. During this time, we each had shared and independent tasks to complete. My visit was focussed on further developing and nurturing the International Science Linkage (ISL) arrangement we have established with Professors Huajin Zhang and Jiyang Wang at the Institute of Crystal Materials at Shandong University (Jinan). We are currently working together to investigate new opportunities in the development of crystals for high power and high efficiency Raman lasers. To this end, I spent a number of days at Shandong University learning about their crystal growth and characterisations methods. During this time, I also had the opportunity to visit and share ideas with Professor Xingyu Zhang. Prof. Zhang (who is located in the Engineering department at Shandong University) shares similar interests in Raman lasers and he has been prolific in publishing papers concerning high-power Q-switched Raman lasers.

In addition to the work at Shandong University, I also had the opportunity to travel with Jim and Dayong throughout China. Indeed, it was a whirl-wind visit as we visited four other Universities including: Tsinghua University and Beijing University in Beijing, Shanghai Jaotong University and East China Normal University in Shanghai, in addition to Shandong University in Jinan. During these visits Jim was promoting the cotutelle-PhD program at Macquarie, of which he was certainly able to generate a lot of interest. A testament to the interest in this scheme is the recent appointment of two new PhD students, Li Xiaoli (Lily) and Lu Yiqing from Tsinghua University. Both Xiaoli and Yiqing have completed part of their PhD programs at Tsinghua University and are now at Macquarie to complete their final years towards their degrees. Xiaoli will be working with Helen, Jim and I on the development of high-efficiency miniature yellow Raman lasers, while Yiqing will be working with Dayong and Jim on a new ultra-high sensitivity fluorescence microscope system. I hope you will all give them a big *MQ Photonics* welcome!

Andrew Lee

***... and another report from Dayong Jin:***

This trip, we witnessed a significant increase for Australian universities to visit China, for example, the day we visited Shanghai Jiaotong University, the DVC was visiting the same university in the morning. The day before

our arrival at Jilin University, the DVC (international) from Sydney university has just left! I do encourage our *MQ Photonics* academics to visit China.


Jim and I visited our long term collaborators at Dalian University of Technology, a group led by Prof. Jingli Yuan, a worldwide well-known biochemist in Lanthanide bioprobes. For the last 3 years, we have been co-authoring 6 journal papers, including *ChemComm*, *Journal of Materials Chemistry*, and *J of Biomedical Optics*. This time, I set up my recent invented time-gated luminescence microscope for this group and we are looking for extended collaboration in the advanced biomedical imaging applications, and nanoparticle based drug delivery applications. Jim delivered a talk promoting *MQ Photonics* research activities, see photos attached. Prof. Yuan's group is preparing with us for next round Australia-China International Science Linkages (ISL) program application.

At Jilin University, the largest Chinese University at the moment, Jim and I attended the MOU signature ceremony between Jilin University and Macquarie University, then we visited their Chemistry Department, the largest in China, where we learned a lot of frontier knowledge in biochemistry and protein engineering chemistry from Prof. Su and Prof. Liu's groups.

Dayong Jin

Please welcome **Nick Cvetojevic**, who has recently started a PhD in the field of astrophotonics. Nick completed his undergraduate and honours at Macquarie last year, and was working at the Anglo-Australian Observatory in early 2009. His PhD research will be on integrated photonic spectrographs for astronomy using planar fabricated arrayed-waveguide gratings.

Jon Lawrence

## Congratulations to some of the CUDOS@MQ team ...

PhD students **Luke Stewart**, **Doug Little** and **Nem Jovanovic** will be submitting their PhD theses this week. Luke has already started work at Finisar Australia, Nem to start soon working on astrophotonics themes with **Dr Jon Lawrence**, and Doug to undertake a short research stint working on photonic crystal experiments with **A/Prof Judith Dawes**. We wish all three success in their future endeavours. Congratulations, too, to **Dr Graham Marshall** for his recent success in the International Science Linkages Science Academies Program 2010–11 Grants program. Graham will be funded to travel to Bristol University to work with Prof. Jeremy O'Brien on a project titled "3-dimensional chip-based quantum information systems".

Mick Withford

## Congratulations to Doug and Kristy Little, and Josh and Alisa Toomey

Doug Little and Josh Toomey have both recently married their long-term girlfriends in ceremonies on the Central Coast. Doug and Kristy were married in a ceremony on Shelly Beach, with a reception at the nearby golf club, while Josh and Alisa were also married in a beach ceremony at Avoca, and had their reception at Terrigal. Fortunately (or unfortunately) for Doug and Josh, both brides turned up and the weddings went very well with a great time had by all. Congratulations to Doug and Kristy Little, and Josh and Alisa Toomey!

Luke Stewart

Doug and Kristy Little

Josh and Alisa Toomey