MACQUARIE UNIVERSITY | MQ PHOTONICS RESEARCH CENTRE

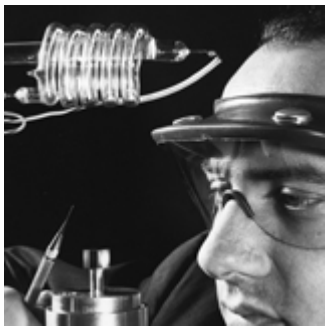
NEWSLETTER

Issue 32 – 11 May 2010

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. on the due date. **Next due date: Tue 1 June 2010.**

Focal Points

Fifty years ago – personal reminiscences of the early days of lasers ...



http://aip.org/history/exhibits/laser/sections/therace.html

Next Sunday (16 May) marks the 50th anniversary of Theodore ('Ted') Maiman's ► discovery of the laser – a device on which many of us in *MQ Photonics* have based our careers. How times have changed! To put things into perspective, I read in last weekend's *SMH* that the preceding Sunday (9 May – our Mothers' Day, ironically) was the 50th anniversary of the US FDA's approval of the first (pharmaceutically produced) oral contraceptive pill – arguably a much more momentous development for people around the world than that of the laser.

At that time, I had just entered my first year of a Science degree at the University of Sydney. It seems poignant that I do not recall any mention of "laser" in any class during my three years of undergraduate study – an object lesson for subsequent generations of lecturers and students alike. I was, of course, aware from the media of the possibilities that lasers promised, although this was more about Buck-Rogers-style science-fiction "Death Rays" than the photonic revolution that was to follow. By the time I did my Honours year in 1963, the research group that I joined in Chemistry possessed a HeNe laser (a modest Scientifica & Cook unit) but sodium resonance lamps and quartz-halogen projector bulbs were still preferred as light sources in their lab instruments. The same group relied for routine manual data processing on two un-believably expensive and bulky Facit electro-mechanical calculators, augmented by late-afternoon visits to the the big SILLIAC "supercomputer" down the road in Physics – an extremely laborious procedure entailing paper tape (not even Hollerith cards!) to do matrix-diagonalisation calculations that have been a snack for HP- and TI-style pocket calculators for many (pre-PC) years. When it came to preparing my Honours thesis, I had to rely on the Prof's secretary's expertise with an IBM 'golf-ball' typewriter to generate multiple carbon copies, with hand-written algebra and figures inserted by my ball-point pen on each copy – nerve-wracking!. The University's only accessible Xerox photocopier was in Fisher Library and we often generated "photocopies" of key papers by photographing them on 35-mm film and making prints. It is salutory to think how much of our printing (including this *Newsletter*) nowadays relies on solid-state diode lasers so miniscule that few of us in the early '60s would have believed them possible – given the scale of the early lasers and their power supplies.

http://www.repairfaq.org/sam/laserpic/sphhpics.htm

When I moved on to Bristol in mid-1965 to do my PhD, my experimental research relied on a Spectra-Physics 125 ◄ HeNe laser, generating ~40 mW at 632.8 nm; it was ~2 m long – "one of the largest HeNe laser models ever built" (ion lasers had only just been invented). This enabled us to make definitive temperature-dependence measurements of electric birefringence (i.e., the electro-optic Kerr effect) for a few molecular gases, in order to separate polarisability-based 'orientation' terms from underlying nonlinear-optical 'distortion' terms. This put me in a box seat to observe the fascinating emergence of nonlinear optics in the mid-sixties and to make some fundamental contributions to it.

After Bristol, I went in mid-1968 to Ottawa for a postdoctoral job at the National Research Council of Canada, where I was presented with an early 50-W cw CO_2 laser to work on. Its construction had been supervised by François Legay from the CNRS in Paris. Legay deserves to share the credit with Bell Labs' Kumar Patel for his independent co-discovery of the line-tunable high-power N_2-CO_2 laser – one of many issues concerning precedence in laser discovery (take the Gordon Gould / Townes & Schawlow / Basov & Prokhorov questions, for instance.) I recall one afternoon when the leading NRCC spectroscopist Gerhard Herzberg brought an esteemed Indian colleague, R.K. Asundi, to see my CO_2 laser in operation. Asundi was contemplative and quiet for a while, then he explained how, ~40 years beforehand, he had been working with a long, water-jacketed cw discharge tube with multiple-reflection end mirrors and a flowing gas mixture containing CO_2 and N_2 – very similar to the CO_2 laser that he now saw, apart from its infrared-transmissive NaCl Brewster-angle end windows. I have often speculated where we would all be now if Asundi had accidentally discovered CO_2 laser action 30 years before Maiman's celebrated experiments at Hughes Research Laboratories!

A footnote to my CO_2-laser experiences in Ottawa is that a few days before I was due to leave, Alec Douglas (Director of the NRCC spectroscopy group) asked me to visit his office and there gave me a set of (what were then top-secret) plans for the new transversely excited (TE) pulsed CO_2 lasers that had been developed in the Defence Research Establishment Valcartier in Québec. "You may find these useful," Alec said. So I returned to Australia at the end of 1969 bearing those plans, which helped me to set about building TE pulsed CO_2 lasers when I took up my Lectureship in Physical Chemistry at UNSW. The only people in Australia working on CO_2 lasers then were L.E.S. Mathias *et al.* at the Defence Standards Laboratories in Maribyrnong, Vic.

Other Australian groups active in laser research around 1970 included those at ANU (Frank Irons & Barry Luther-Davies in Physics, setting up big solid-state lasers that could make use of ANU's homopolar generator, and Jim Ferguson & Ben Selinger in Chemistry), at U of Armidale (Syd Haydon & Ian McIntosh), Monash U (Rod Tobin), U of Newcastle (Ralph Cooney & John Hall), UNSW (Pak Chu, in Electrical Engineering – a supportive ally in my early days in Chemistry there), U of Queensland (David James), U of Sydney (Ian Falconer & Brian James in Physics; Bob Armstrong & John Mackie in Chemistry).

The local laser research scene, ten years after Maiman's discovery, was soon to change in the mid-'70s, as a wave of young researchers in Australian science and engineering labs recognised that lasers provided a vital means to various research ends. Among them was Jim Piper, who arrived to take up a Lectureship in Physics at Macquarie U in 1975, from U of Otago, NZ *via* Oxford, UK. I visited Jim in his lab soon after his arrival, which marked the start of a fruitful collaboration over the next 35 years (although we have never published a paper together!). During the next 20 years, Australia's standing in laser physics and its applications was sufficiently strong for us to be selected to host the 1996 International Quantum Electronics Conference here in Sydney – a successful event that many of us recall with satisfaction.

Brian Orr

LaserFest Sydney ...

That brings us to Macquarie University's (and *MQ Photonics*'s) involvement in **LaserFest 2010** – the year-long celebration of the 50th anniversary of the laser, for which the following flier has just been released:

LaserFest 2010 is a collaborative venture between the American Physical Society, the Optical Society (OSA), SPIE and IEEE (see **www.laserfest.org/**). In 2009, some of us from *MQ Photonics*/Physics applied for a LaserFest grant to run **LaserFest Sydney**. We were successful, and the grant of US$10k has been supplemented by $10k from DVC(Research) and additional funds from *MQ Photonics* and the Faculty of Science. So we have an opportunity to prepare some interesting, fun and different activities.

The primary mission of LaserFest Sydney is to showcase the prominence of the laser in today's world as far as the community is affected. It is largely an outreach activity – to school students, university students, industry and the community at large. But we also intend to promote awareness of *MQ Photonics*, and Macquarie U's Physics Department.

Dr Helen Pask and her LaserFest Sydney team have lots of activities planned, including Lecture Series, School workshops on De-mystifying lasers, a competition for school students, and several events in partnership with a major holography exhibition by the Art Gallery at Macquarie U, the second Astronomy night in October this year and Movies at Macquarie. The Macquarie OSA Student Chapter is independently pursuing its Laser Graffiti and Laser Maze activities, separately funded by LaserFest.

The first activity on the LaserFest Sydney timetable is a **Schools' Video-Conference Day** on 20 May, with talks by Deb Kane, Judith Dawes, Martin Ams and Helen Pask. Much more will be underway in June and July.

Brian Orr

MQ Photonics moving right along ...

A number of things will be happening in the *MQ Photonics* area over the next couple of months, including:

- We expect to get our Management Committee structure underway in the very near future.
- Two-way exchange visits are being arranged to and from DSTO (Edinburgh, SA) – bound to be stimulating.
- The next ***MQ Photonics*** **Showcase Day** will coincide with the visit of its Advisory Board on 7 June – the format will be similar to that of our previous Showcase Day on 20 November (see *Newsletter* Nos 25 & 26).
- After 7½ years as Director of *MQ Photonics* and its predecessor, the Centre for Lasers & Applications (CLA), I shall (not unexpectedly) be handing over the reins to a successor – expressions of interest for appointment of a new *MQ Photonics* Director are being circulated by Head of Department David Coutts.

I am confident that, in all of these developments, we are heading in the right direction ...

Brian Orr

Fresh vistas

Research funding opportunities – external schemes

Australian Government
Australian Research Council

ARC LIEF (Linkage Equipment & Facilities) Grants (LE11) – for funding commencing in 2011

Expressions of interest to Research Office: 5 pm, Wed 14 April
Final ARC LE11 closing date: Wed 26 May

ARC Linkage Projects (Round 1, for funding commencing in 2011)

Review & feedback due – 21 April; Submit to Research Office – 5 May; Submit to ARC – 12 May

Research funding opportunities – internal schemes

Macquarie University Linkage Projects Seeding Grants (MQLSG) – Stage 2

Open 21 Aprr 2010 Closed 28 May 2010 Outcome 11 Jun 2010

Publications

Recently published articles

nature nanotechnology

LETTERS

PUBLISHED ONLINE: 11 APRIL 2010 | DOI: 10.1038/NNANO.2010.56

Observation and control of blinking nitrogen-vacancy centres in discrete nanodiamonds

C. Bradac[1,2], T. Gaebel[1,2], N. Naidoo[1], M. J. Sellars[3], J. Twamley[1], L. J. Brown[4], A. S. Barnard[5], T. Plakhotnik[6], A. V. Zvyagin[2]* and J. R. Rabeau[1,2]*

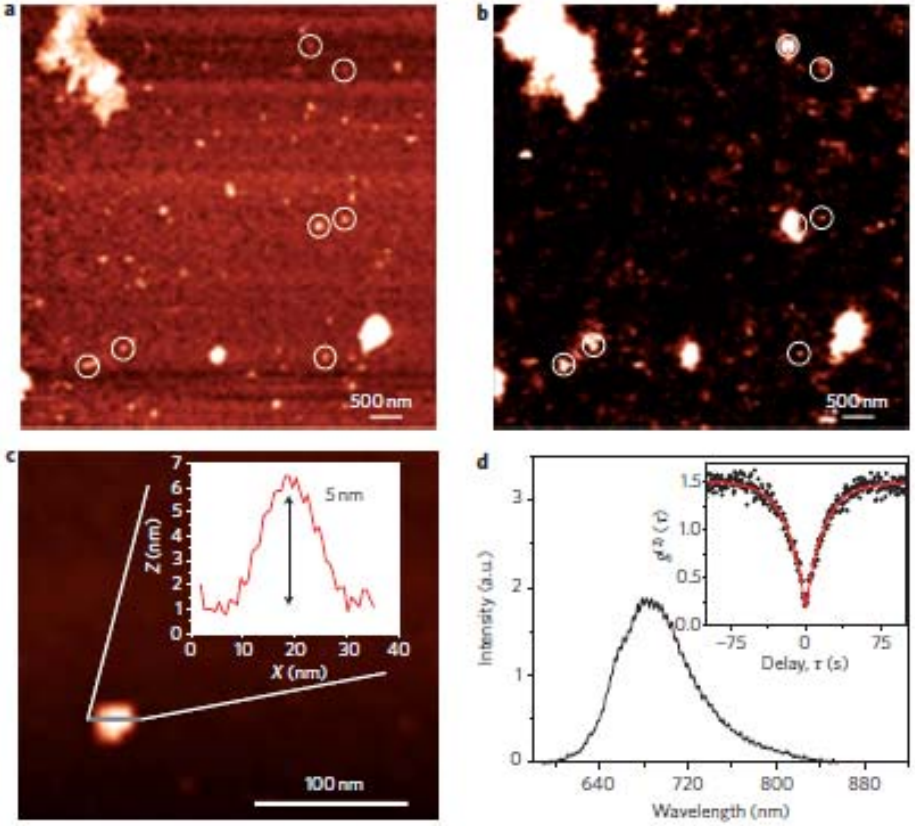


Figure 1 | Characterization of discrete 5-nm diamonds on a glass coverslip. a, AFM image of nanodiamonds. The brightness of the spots is proportional to the height of the crystals (circles highlight the correspondence between the AFM image and the confocal image of **b**). **b**, Corresponding confocal scanning fluorescence microscopy image. Bright spots indicate NV emitters. **c**, Magnified AFM image and corresponding surface profile (inset) of a representative nanocrystal 5 nm in height. **d**, Emission spectrum of an NV centre in a 5-nm crystal host and corresponding second-order correlation function $g^{(2)}$ (inset).

Vol. **5**, pp. 345 – 349 (May, 2010)

Abstract: Nitrogen-vacancy (NV) colour centres in diamond can undergo strong, spin-sensitive optical transitions under ambient conditions, which makes them attractive for applications in quantum optics[1], nanoscale magnetometry[2, 3] and biolabelling[4]. Although NV-centres have been observed in aggregated detonation nanodiamonds[5] and milled nanodiamonds[6], they have not been observed in isolated nanodiamonds[7] only 5 nm in size. Here, we report the first direct observation of NV-centres in discrete 5-nm nanodiamonds at room temperature, including evidence for intermittency in the luminescence from the nanodiamonds (that is, blinking). We also show that it is possible to control this blinking by modifying the surface of the nanodiamonds.

This article has clearly had a strong initial impact, being favorably cited both in the Editorial (p. 311) and in a *News and Views* article by Joerg Wrachtrup (pp. 314–5) – see below.

Well done to James Rabeau and his team of co-authors!

Brian Orr

editorial

Perfectly imperfect

Defects in nanostructures have their advantages.

news & views

NANOPARTICLES

Switching blinking on and off

Diamonds with a diameter of just 5 nm are capable of supporting colour centres and emitting fluorescence, and encapsulating these nanodiamonds in a polymer stops them blinking.

Joerg Wrachtrup

Conference Presentations

Accepted Papers at the forthcoming CLEO/QELS:2010 conference

MQ Photonics members have a number of papers at the CLEO/QELS 2010 conference next week.

Brian Orr

http://www.cleoconference.org/Conference_Program/index.aspx

CMBB3 • Monday 2:00 p.m.

"Femtosecond Bessel Filaments for High Aspect-Ratio and Taper-Free Micromachining of Dielectrics"

Francois Courvoisier[1], Manoj K. Bhuyan[1], Maxime Jacquot[1], Pierre-Ambroise Lacourt[1], Luca Furfaro[1], **Michael J. Withford**[2], John M. Dudley[1]

[1] Univ. de Franche-Comte, France, [2] MacQuarie Univ., Australia.

Femtosecond Bessel beams are demonstrated for high aspect ratio machining in the filamentation regime with water assistance. Taper-free microchannels and micro-trenches are demonstrated with aspect ratio up to 40 and diameters down to 2 μm.

CTuJ1 • Tuesday 8:00 a.m.

"Diamond Raman Lasers" ***INVITED PAPER***

Richard P. Mildren, **A. Sabella**, **E. Granados**, **D. J. Spence**

MQ Photonics Res. Ctr., Macquarie Univ., Australia.

We summarize our recent research in Raman lasers based on undoped single crystal diamond. Highly efficient visible external cavity lasers operating in nanosecond and picosecond regimes are reported.

QTuE3 • Tuesday 3:00 p.m.

"Performance of a Pulsed Tunable Nonlinear-Optical Coherent Ultraviolet Light Source, Verified by Sub-Doppler Two-Photon Spectroscopy of Krypton"

Kenneth G. H. Baldwin[1], Mitsuhiko Kono[1], Richard T. White[2], **Yabai He**[3], **Brian J. Orr**[3]

[1] Australian Natl. Univ., Australia, [2] Adelaide Univ., Australia, [3] Macquarie Univ., Australia.

A minimal-chirp nanosecond-pulsed nonlinear-optical system generates tunable coherent ultraviolet light at ~212.5 nm. Its frequency stability and optical bandwidth are verified by means of novel sub-Doppler coherent heterodyne-assisted two-photon spectroscopy of krypton.

CWH5 • Wednesday 2:45 p.m.

'Pulse Compression Dynamics in Synchronously Pumped Continuous Wave Mode-Locked Raman Oscillators'

Eduardo Granados, **Helen M. Pask**, **Richard P. Mildren**, **David J. Spence**

Macquarie Univ., Australia.

We present a numerical model that explains the pulse compression dynamics occurring in synchronously-pumped Raman oscillators based on transient Stimulated Raman Scattering equations. Excellent agreement is found between our theoretical results and the experimental data.

Poster JWA24 (Wednesday p.m.)

"Characterisation of Emission Lifetime of Nitrogen-Vacancy Centres in Nanodiamonds"

Luke Stewart, **Carlo Bradac**, **Judith Dawes**, **Michael Steel**, **James Rabeau**, **Michael Withford**

Macquarie Univ., Australia.

We show that the lifetime of nitrogen vacancy emitters can be increased by incorporating nano-diamonds inside opals and the lifetime variance may be reduced by placing them on the surface of opals.

Upcoming conferences

There will be at least three *MQ Photonics* papers at the forthcoming BGPP conference next month:

Bragg Gratings, Photosensitivity and Poling in Glass Waveguides (BGPP)
Karlsruhe, Germany; June 21–24, 2010

More information: **http://www.osa.org/meetings/topicalmeetings/BGPP/default.aspx**

BGPP will be collocated with four other OSA Topical Meetings:
Access Networks and In-house Communications (ANIC)
Nonlinear Photonics (NP)
Optical Sensors (Sensors)
Signal Processing in Photonic Communications (SPPCom)
and: The Renewable Energy 2010 Optics & Photonics Congress

2010 IPOS SYMPOSIUM – *Biophotonics*
University of Sydney; 9:30am – 6pm, 1–2 July, 2010

More information: **http://www.usyd.edu.au/ipos/news_events/events/symposium.shtml**

The 2010 IPOS Symposium is a two-day meeting focusing on Biophotonics and designed to bring together photonics and bio-science researchers from IPOS and the wider domestic and international communities. We hope to engender communication between participants to identify areas of collaboration across disciplines, with the aim of advancing research and producing real solutions in the bio-sciences and medicine.

MQ Photonics seminars

Time: 12Noon, Thu 13th May Place: C5C 498 Presented by: **Jipeng Lin**

TOPIC: Temporal dynamics study of CW Raman laser

ABSTRACT: The first continuous-wave (CW) intracavity crystalline Raman lasers, reported in 2005, have attracted considerable attention due to their capability to access to the spectral region between 1.1 and 1.5 μm. By further incorporating intracavity frequency-doubling, the yellow and orange spectral region can also be accessed; laser wavelengths in this region are of considerable interest for applications in defense, atmospheric science, biomedical diagnostics, and laser therapies.
In the presentation, I'll present some of our studies on temporal dynamics of a CW Raman laser, including (1) *relaxation oscillation frequency of intracavity CW Raman laser* and (2) *amplitude noise of a frequency-doubled Raman laser*.

Time: 12.30pm, Wed 19th May Place: C5C 498 Presented by: **Prof. Graham Town**

TOPIC: **Proposed Cooperative Research Centre: Fiber-To-The-Premises (FTTP)**

ABSTRACT: The broad aim of the project is to develop the technology that will be required to upgrade the National Broadband Network in 10 to 20 years time.
A key element of the proposal of relevance to Macquarie researchers is to integrate both optical and wireless communication functionalities in a wireless-electro-optic "system on a chip" (WOESOC). Wireless "systems on a chip" were pioneered at Macquarie University over a decade ago. Integrated optics (i.e. silicon photonics) has developed radidly over the last 5 years, a result of substantial investments by DARPA and Intel. A major remaining challenge is to bridge the gap between the wireless and optical domains in a compact and cost-effective way.

Time: 12Noon, Thu 3rd June Place: C5C 498 Presented by: **Nick Cvetojevic**

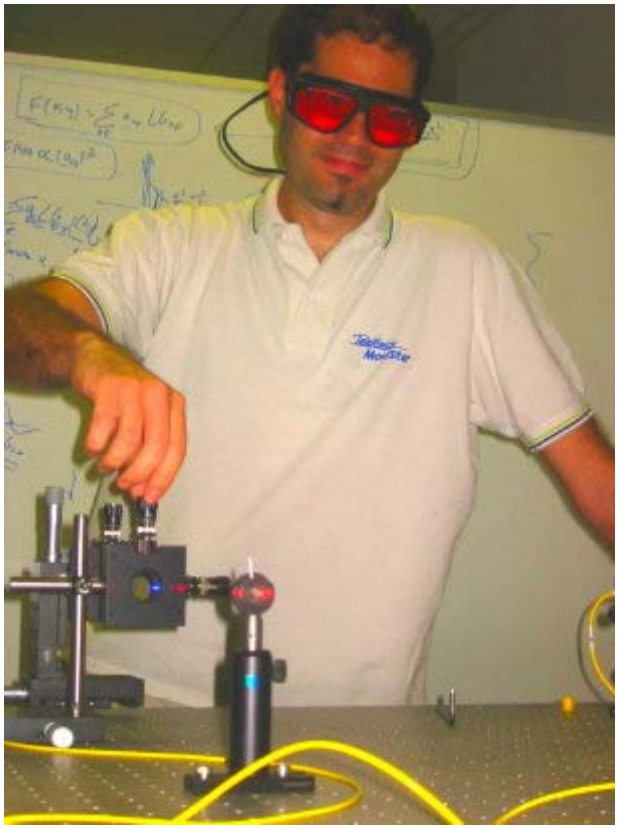
TOPIC: **The Integrated Photonic Spectrograph - Arrayed Waveguide Gratings for Astronomy**

ABSTRACT: The increased physical scale of astronomical instrumentation has led to rising costs in terms of both implementation and operation. This is particularly true for the next generation of large and extremely large ground-based telescopes and a major cost contributor to any space based mission. There are currently a number of cutting-edge astrophotonic technologies being developed around the world that offer the potential to revolutionise the nature of telescope instrumentation. These devices perform complex manipulation of photons on microscopic scales, which will enable mass produced, complex, and miniaturised spectrographs to be implemented on telescopes.

The Integrated Photonic Spectrograph (IPS) is a miniature integrated photonic circuit with an Arrayed Waveguide structure, allowing incoming light from a standard optical fibre to be output as a spectrum on the focal plane of the device. In the talk, I will present results from a laboratory characterisation of a prototype IPS, and an on-sky demonstration at the 3.9 m Anglo-Australian Telescope. We also explore the use of off-axis input waveguides and cross-dispersion to enhance the multiplexing capability.

People and Progress

Welcome to Dr Gabriel Molina-Terriza



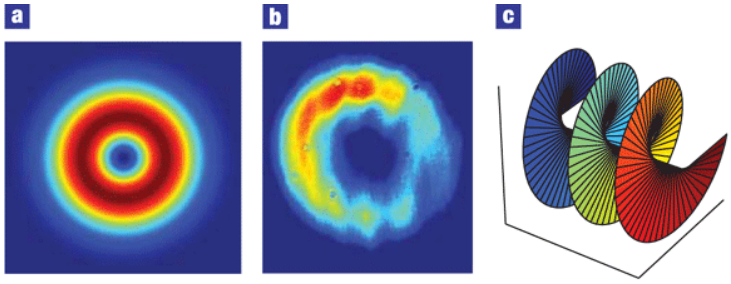
Most of us will have seen David Coutts's e-mail earlier this week, in which he warmly welcomed our most recently appointed Senior Lecturer in Physics, **Dr Gabriel Molina-Terriza**, to the Department. Gabriel comes to us from the Institut de Ciµencies Fotµoniques. Barcelona, Spain (ICFO) where he was an ICREA Junior Fellow. His previous appointments include a Ramon y Cajal Fellowship at ICFO, a research position at the University of Singapore's Quantum Information Lab, and a Marie Curie Fellowship to study in Vienna with Professor Anton Zeilinger in Vienna.

Gabriel's research has focused on quantum optics – both experimental and theoretical. In particular, he is famous for his discoveries about the quantum photonics of light with orbital angular momentum – so-called "twisated photons". Here at Macquarie U, Gabriel is setting up a laboratory to explore the quantum and classical properties of light interacting with nanostructures - a vibrant new field which so far has no counterpart within Australia. We in *MQ Photonics* are very pleased to welcome Gabriel as a colleague.

His lab will be in E7B 246, his office is C5C 356, his phone is ext. 6371, and his e-mail is: gterriza@science.mq.edu.au .

ILLUSTRATIONS:

Top right: Gabriel twisting some photons? [QISS website]
Below: Sketch from Gabriel's much-cited Progress Article in *Nature Physics* **3**, 305-310 (2007) – read it!
Lower right: Can *Fusilli* pasta emulate twisted photons? [http://www.physics.gla.ac.uk/Optics/play/photonOAM/]



Welcome to Markus Päsch

Markus was born in Rottweil, a small town at the edge of the Black Forest and grew up in a small village called Dormettingen. This region has produced people such as Otto Hahn, Gottlieb Daimler, the princely family Hohenzollern and Albert Einstein.

He successfully completed an apprenticeship as an electronics technician at Bizerba GmbH, and was trained and worked as a network administrator. He is now studying medical engineering at the University of Applied Sciences in Ulm, Germany. Medical engineers aim to develop medical tools for diagnostics e.g. X-ray diagnostic devices, magnetic resonance instruments, tools for therapy, surgery and endoscopy, and devices for rehabilitation, such as cardiac pacemakers, implantable hearing aids, etc. Markus likes doing sports and discovering new countries and cities (Sydney). A favourite hobby at the moment is to enjoy these delicious Australian cupcakes ... Markus is working on a research project internship for 6 months with Judith Dawes and others in *MQ Photonics* and CUDOS on fabrication and characterisation of opal photonic crystals and aims to incorporate nanoparticles into opals and inverse opals to enhance their optical properties.

Judith Dawes

Welcome to Shingo Miyauchi

Shingo worked as a research technician for several years in the University of Auckland, New Zealand after completing his MSc. He was involved in various molecular-biological research projects such as production of monoclonal antibodies against type-2 Diabetes Mellitus, mapping of biodiversity in Antarctica, and development of a DNA extraction and amplification kit for forensic purposes in accordance with *ZyGEM Ltd* (http://zygem.com/) and *ESR*, the New Zealand national forensic institution, (http://www.esr.cri.nz/). He recently submitted his PhD thesis on the theme of developing a fungal protein expression system for biopharmaceutical and industrial applications (supervised by Profs Helena Nevalainen and Peter Bergquist). The PhD project involved molecular techniques such as data mining for fungal genes, design and construction of expression vectors, cloning and expression of recombinant products in a fungal host, He also gained extensive experience in identifying and characterising proteins by enzymatic activity assays and proteomic and glycoproteomic analyses. The research was conducted in conjunction with *Applimex Systems Ltd* (www.applimexsystems.com/) and the technology developed via the PhD work was patented in early 2009.

Shingo is currently performing the practical lab work on nucleotide extraction, hybridisation and amplification with Qβ replicase in order to develop a simple and fast detection system for bacteria in horticultural environments. He was appointed under a fellowship sponsored by Physics to investigate a scoping project for Horticulture Australia. He is under the supervision of Prof. Peter Bergquist and Dr. Russell Connally.

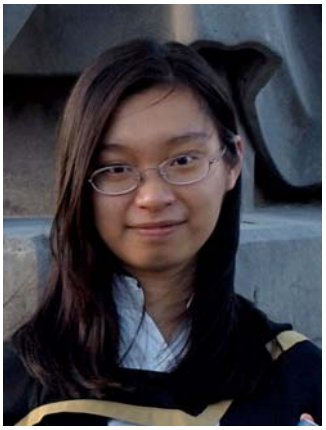
Russell Connally

Welcome to Peter Ha

Macquarie Optoelectronics graduate Peter Ha is a new appointment in Physics/MQ photonics working as a postdoctoral research fellow with Rob Carman on an ARC Linkage project with partners at the ANU and BluGlass Pty Ltd. From 2002, Peter began his PhD at the University of Sydney (USyd) under the Australian Postgraduate Award in industry (APAI) with project title "Carbon Coatings on Cutting Tools for Industrial Applications". In 2003, Peter was nominated to be one of the 16 young scientists of the year and received Australia wide media coverage and training. From there on he has appeared in a number of newspapers such as Sydney Morning Herald, The Advertiser Adelaide and The Daily Telegraph (21st August 2003). In 2004, Peter received the Endeavour Australia Cheung Kong Award (EACKA) which supported him to a Joint PhD program with the City University of Hong Kong. During the time he spent in Hong Kong, he has appeared in many Hong Kong newspapers such as Apple Daily News, HK Daily News, HK Economics Times, Oriental Daily News, SingTao, Sun (Feb. 7 2005). In 2005, upon thesis submission, Peter was offered a post-doc position in the Microelectronics Division of the school of Electrical and Electronic Engineering at Nanyang Technological University in Singapore. He was a senior Research Fellow in the Nanoelectronics Laboratory at Nanyang Technological University, Singapore. Working on the "High Performance Polymer Devices" which the team jointly received the Institution of Engineers, Singapore (IES) Prestigious Engineering Achievement Award in 2007. The project was jointly funded by Ministry of Education (MoE) and A*-Star funding agency (524,920.00 SGD). Recently, he has been a co-investigator engaging on an industrial project funded by Defence Science Organisation (DSO) National Laboratory of Singapore. He has over 35 journal/conference publications to date.

Robert Carman

Welcome to Qiang Liu (Jocelyn)



Ms Qiang Liu (aka Jocelyn) has joined the CUDOS group as a new PhD student.

Jocelyn grew up in Nanning in Guangxi province. She received her BEng degree in Electronic Information Technology at Guilin University of Electronic Technology in 2008. In 2009 she completed a Masters in Information Technology at Heriot-Watt University in Edinburgh with a thesis on Reconfigurable Devices for Wireless Communication Systems.

Liu Qiang will be working with Mike Steel and Mick Withford on developing nonreciprocal laser-written glass waveguides.

Mike Steel

Welcome to Emmelia Mary Williams – congrats, Rob & Kelly

Robert Williams and wife Kelly have a new addition to their family: a baby girl born at 6:20 am on 7 May @ 3.14 kg. Great news!

Michael Withford