Focal Points

Surprise, surprise! After promising you a 3-week cycle in Issue 7 of the MQ Photonics Newsletter, we have brought forward Issue 8 to its original 2-week cycle, to fit in with Liz's school holiday commitments. The schedule for the rest of the year is now expected to be as follows:

<table>
<thead>
<tr>
<th>Issue number</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>1 ('09)</th>
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<td>Copy due (Tue, 9 am)</td>
<td>14/10</td>
<td>4/11</td>
<td>25/11</td>
<td>16/12</td>
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<tr>
<td>Publication date (Wed)</td>
<td>15/10</td>
<td>5/11</td>
<td>26/11</td>
<td>17/12</td>
<td>21/1</td>
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Coping with change #1: unveiling the new MQ image …
We are all invited to a special preview of "the new Macquarie voice and image" (Macquarie Theatre, Tuesday 30 September at 1pm, with a light lunch to follow). See: [http://www.announcements.mq.edu.au/events/New_Image](http://www.announcements.mq.edu.au/events/New_Image)

Coping with change #2: pulling down those lab posters …
It seems that part of "the new Macquarie … image" may be to spare those on stage during graduation ceremonies the apparent discomfort of having to view MQ Photonics and CUDOS posters on the distant balconies, rather than a neater vision of pristine brick walls. We have not yet worked out how the bare walls are supposed to promote Macquarie University's research-active image …

Coping with change #3: MQ physics graduates do it better!
Some good news about coping with change is that physics graduates seem to do it well, being remarkably versatile and adaptable in finding interesting, satisfying careers. This was a recurring theme on Tuesday last week at the 2008 Careers Night for Physics, Optical Technology, and Astronomy students. A pizza-sated audience heard lively presentations from five such physics graduates: Dr Jon Lawrence (BTech Opto Hons, now an Antarctic astronomy researcher based at UNSW), Louise Howells (BTech Opto, directing photonic component quality control at Redfern Optical Components), Ben Smith (BTech Opto Hons, active in MQ's technology management but now taking up a new job at BCS Innovations), Dr Kristie Spence (née Johnson; BSc DPhil from Oxford U, and now a science teacher at Queenwood Girls School), and (soon-to-be Dr) Peter Brooke (MSc from Durham U, who has transited from quantum optics theory to financial modelling). I was most encouraged and impressed by the event – thanks to Judith and Carol for organising it!

Brian Orr

MQ Photonics meets Ophthalmology

You will all be aware that buildings for the University's new hospital and the Australian Advanced School of Medicine are starting to tower over the north-eastern corner of the campus, but did you know that we now have a Department of Ophthalmology and Visual Science there? Its Professor, Stuart Graham, and Associate Professor Alex Klistorner have been busy discussing possible collaborative research projects with some of us. In fact, a MQ External Collaborative Grant has just been awarded to them, with Judith Dawes as a co-applicant. That project aims to develop a novel prototype for testing the human field of vision, with specially designed optics to monitor eye fixation. Yabai He will also be involved in this work.
In view of the potential of such collaborations, I have recently invited both Stuart and Alex to become members of MQ Photonics. We look forward to arranging for Stuart to present a general-interest Physics Department Colloquium in the not-too-distant future.

I suggest that the executive action that I have taken in this regard might serve as a model for us to invite other active researchers from outside ICS to join MQ Photonics. I should be keen to discuss suggestions of this type that you might have in mind – the main criterion would be common research interest and activity.

Brian Orr

Fresh vistas

Macquarie University New Staff Research Grants Scheme
http://www.research.mq.edu.au/researchers/funding/internal/mqns
Closing date: 17 October 2008

Macquarie University External Collaborative Grants Scheme
http://www.research.mq.edu.au/researchers/funding/internal/mqexternal
Closing date: 17 October 2008

ARC Linkage Projects: (Round 2)
Closing date: 24 October 2008

2008-09 Australian Government co-funding of chemical, biological and radiological countermeasure research projects
Closing date: 3 October 2008

Don't forget the search capabilities of the SPIN database at
http://www.research.mq.edu.au/researchers/funding/external_schemes/spin_instructions

Michael Steel

Publications

Recent Invited Journal Publication:

In this paper, we discuss the challenges facing researchers using the femtosecond laser direct-write technique with specific emphasis being placed on the suitability of fused silica and phosphate glass as device hosts for different applications.

Martin Ams
Currently accepted:

The Raman laser group has recently had 2 papers accepted for publication, which you may wish to list in the Newsletter.

Pask, Mildren, Piper, "Optical field dynamics in a wavelength-versatile, all-solid-state intracavity cascaded pulsed Raman laser" will be published online in Applied Physics B very shortly.

Abstract: Monitoring the optical field energies in an intracavity cascaded crystalline pulsed Raman laser enables us to probe the dynamics and optimise the performance of the laser, which produces up to 2.1W average output power at 4 wavelengths between 532nm and 636nm selectable by simple angle tuning.

Pask, Dekker, Mildren, Spence, Piper, "Wavelength-versatile visible and UV sources based on crystalline Raman lasers" has been accepted for publication in Progress in Quantum Electronics, and should be in print within the next couple of months.

Abstract: By combining stimulated Raman scattering and sum frequency generation within the same laser system, indeed often within the same resonator, it is possible to achieve frequency conversion to a wide range of output wavelengths that are useful for a number of applications. This paper reviews the concepts, principles of operation and performance characteristics of visible and UV laser systems based on these two nonlinear processes. The systems we review include fixed wavelength operation in the yellow-orange spectral region (pulsed and CW), discretely-tunable pulsed sources operating across the green-red spectral region, and discretely-tunable UV sources spanning the entire UV-B region.

Helen Pask

Yabai He and Brian J. Orr, "Robust tunable single-frequency operation of a diode laser by a self-pumped phase-conjugate reflector and a high-finesse filter" (accepted by Optics Letters, 6 September 2008)

The abstract of this paper appeared in Issue 1 of the Newsletter. It has been accepted (Doc. ID 97552) and is now on OL's Early Posting website at http://ol.osa.org/upcoming.cfm. Here is a "comic-strip" version …

Fig. 1. Novel optical feedback scheme for diode laser frequency stabilization and tuning based on wavelength-selective self-pumped phase-conjugate reflection by a photorefractive crystal and intracavity single-longitudinal-mode (SLM) filtering.

Fig. 4. Doppler-free two-photon-excitation spectrum of the 8S → 6S, F = 4 hyperfine transition of atomic Cs, recorded by tuning radiation from the extended-cavity cw diode laser (~822.4689 nm, 3 mW), together with a Lorentzian fit.

Brian Orr

In this month’s issue of Optics Express with the Optical Fibre Technology Centre:

This article reports on the apparent photodarkening of point x point gratings written by ultrafast lasers. This study shows that the photodarkening properties (namely the wavelength dependent losses observed below 1 µm) of this type of grating differs markedly from conventional gratings. In particular, conventional gratings suffer photodarkening as a result of colour centre formation whereas the point x point gratings are shown to be associated with Mie scattering. This study has implications for fibre laser development which is also discussed in the paper.

**Theses:**

**Growth and Characterization of Crystalline Waveguides**

I submitted my Ph. D. thesis “Growth and Characterization of Crystalline Waveguides” in August 2008. In this thesis, the fabrication of planar waveguides and channel waveguides by Liquid Phase Epitaxy (LPE) technique was investigated. The microscopic image of the side face of a lithium niobate planar waveguide sample was shown in Figure 1.

The sample characterization experiments were carried out in the terms of composition characterization, spectra characterizations waveguide beam probing and propagation loss measurements and non-linear properties characterization.

Lithium niobate channel waveguides have been fabricated by LPE method on laser machined substrate. The microscopic image of the top view surface was shown in Figure 2. The LPE growth was confined in the machined channel with good crystalline quality. The sample was characterized by single mode beam probing.

**Dual-polarised neodymium-doped ceramic and crystalline lasers for radio-frequency generation**

In my thesis I developed and investigated the performance of dual-polarisation solid-state lasers. A tuneable photonic-based microwave source based on the beating of orthogonally-polarised optical modes was demonstrated for frequencies up to 100 GHz. Based on neodymium-doped ceramic and crystalline YAG, the lasers have complex dynamics and coupling mechanisms between orthogonally-polarised eigenstates of a single longitudinal mode. I modelled the rich dynamics which included anti-phase dynamics, self-organising behaviour and gain-dominated coupling in various orientations of crystalline and ceramic Nd:YAG. Polarisation mode coupling, based on Lamb’s coupling constant, was investigated in terms of polarisation hole-burning effects and order or disorder of the gain material. The coupling in ceramic Nd:YAG was more than four-times stronger when compared to its crystalline counterpart, and, on average, proportionally stronger beat-note signals. The polarisation mode coupling was a good figure of merit (along with gain bandwidth, cavity length and pump characteristics) for stable dual-polarisation operation and optimal laser design of dual-polarisation lasers.

**Fabrication Of Optical Waveguide Devices In Bulk Materials Using Femtosecond Laser Pulses**

MQ Photonics student Martin Ams has recently completed his PhD candidature. His thesis, titled ‘Fabrication Of Optical Waveguide Devices In Bulk Materials Using Femtosecond Laser Pulses’, was submitted in March 2008 and has been accepted.
The thesis explores the contributions, carried out in his candidature, to the field of femtosecond laser direct-written waveguide devices. In particular, novel femtosecond laser beam delivery techniques were developed in order to fabricate low-loss photonic waveguide devices for application in technologies such as telecommunications. Beginning with the fabrication of a simple linear waveguide in fused silica, the unique capabilities of the direct-write technique were then used to create many monolithic photonic devices, both passive and active in 2D and 3D. The functionality and performance of curved waveguides, evanescent directional couplers, X-couplers, Y-splitters, waveguide Bragg gratings, waveguide amplifiers and a waveguide laser oscillator is demonstrated in his thesis.

The development of the ‘slit method’ (left) was a major milestone in Martin’s thesis which ultimately led to the world’s first demonstration of a waveguide Bragg grating (centre) and a monolithic waveguide laser (right) fabricated in bulk glass using the femtosecond laser direct-write technique.

Congratulations to Marty on this momentous occasion in his career. Marty has employment at MQ for now and will be continuing to contribute to MQ Photonics and CUDOS research.

Martin Ams

Seminars and Visitors

Visitors:

Professor Takashige Omatsu (Chiba University, Japan) arrived in Sydney during the weekend. He is primarily visiting the Raman laser group, but he knows that he is welcome throughout MQ Photonics whenever he visits us. Takashige will be here until 4 October, so please make the most of his visit.

I was fortunate to have Takashige host my visit to Japan in July, attending a very nice conference that he organised in Chiba. But that’s not all! I found that, come Friday night, Professor Omatsu turns into Karaoke-San! In case you don’t believe me, just ask Brian May (lead guitarist from Queen). ▶▶

Perhaps we should invite Takashige to perform Bohemian Rhapsody for us while he is at Macquarie …

Brian Orr

Dr Ruifeng Kan arrived last week to spend six months at MQ Photonics, working with Yabai He and me. We have agreed to call him "Kan." Welcome, Kan!

He is an expert in highly sensitive diode laser spectroscopy for atmospheric sensing of greenhouse gases (e.g., carbon dioxide), gas pipeline leakages, carbon monoxide in combustion media, acetylene on-line monitoring, etc. Kan is a research staff member at the Institute of Optics and Fine Mechanics at Anhui (P. R. China) – the same city at which Yabai He studied before he went off to Germany to take his PhD.

Brian Orr

MQ Photonics Seminars:

<table>
<thead>
<tr>
<th>Time: 12 Noon, Wed 24th September</th>
<th>Place: E6A 102</th>
<th>Presented by: Razibul Islam</th>
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<tr>
<td>TOPIC: Radio over fibre research: review and future directions</td>
<td>ABSTRACT: I will present an overview of my PhD work including the review in radio over fibre research and possible future directions of my work.</td>
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</table>

| Time: 12 Noon, Wed 1st October | Place: E6A 102 | Presented by: Prof. Takashige Omatsu, Chiba University, Japan. |
Department of Physics / AAO joint colloquium:

Time: 3pm, Thur 25th September  
Place: E6A 102  
Presented by: Dr Daniel Zucker,  
Institute of Astronomy,  
University of Cambridge

**TOPIC:** Galaxy Assembly on Our Doorstep

**ABSTRACT:** In hierarchical scenarios, large galaxies like the Milky Way and M31 form via the merger and accretion of smaller systems, and evidence of these processes can be found in the stellar streams and the surviving satellites surrounding each galaxy. The advent of large-area astronomical surveys like the Sloan Digital Sky Survey (SDSS) has revolutionised our ability to find and study Local Group stellar structures at unprecedentedly faint surface brightnesses, and these capabilities are expanding, with numerous projects now underway or starting in the next few years -- e.g., RAVE, SDSS-III/SEGUE, PanSTARRS and Skymapper, and the Gaia mission. I will give an overview of the flood of recent stream and satellite discoveries in the Local Group made with data from SDSS and other surveys, and present the results of detailed follow-up observations with both ground- and space-based telescopes. These new discoveries are already providing important constraints for models of galaxy formation, as well as yielding clues to the behaviour of dark matter on the smallest scales. In coming years, the symbiotic evolution of observational resources and theoretical models will lead to a new understanding of the processes involved in galaxy formation in the Local Group -- and by inference, the Universe.

People and Progress

**Update from France:**

I am still in a hectic period of preparing and delivering seminars and talks. Opened the “series” with a 2 hour seminar for the Network of Excellence on Micro-Optics (NEMO) Summer School on laser microfabrication. Students attending the School ranged from Finland (many of whom asked whether I knew Juha), Germany, Austria, Spain and France. Also visited local manufacturer of lithium niobate modulators Photline (www.photline.com) and the Hubert Curien Laboratories at the Universite Jean Monnet at Saint Etienne (near Lyon).

My talk at the Hubert Curien Laboratories was well received and should result in a collaboration with Dr Razvan Stoian’s group within that institution. In between I have been participating in conferences. Delivered a talk on behalf of Alex Fuerbach and team at Europhoton in Paris. Have another post-deadline talk to deliver at the end of the month at the European Optical Society Annual Meeting, again in Paris. Which leaves the activities with John Dudley’s group at the Universite of Franche-Comte Besancon. Once again I have engaged in talks and workshops with his group aimed at developing research themes. Looking forward to the next phase.....getting into the lab and perhaps relaxing!

Michael Withford