

Focal Points

How is the Federal Budget likely to affect us?

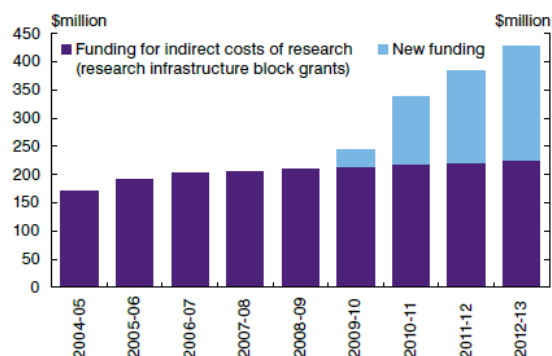
Everyone is entitled to their own distinctive, personal reaction to the Federal Budget that was announced last week. Collectively, it is helpful to be aware of the likely impacts at the University, Departmental and Research Centre levels. It is often difficult to work this out from material in the broadcast, TV and print media, but one can find out more from Government publicity at: <www.budget.gov.au/2009-10/>. It is particularly informative to read the glossy material about "Universities, Innovation & Education Revolution" at: <www.budget.gov.au/2009-10/content/glossy/education/html/education_overview_01.htm> and assorted infrastructure funding (*aka* "Nation Building for the Future") at: <www.budget.gov.au/2009-10/content/glossy/infrastructure/html/infrastructure_overview_01.htm>.

From the point of view of Macquarie U itself, Jim Piper (our DVCR and *MQ Photonics* colleague) has circulated the following view: "The highlights for Macquarie are \$16.6M for infrastructure for the Advanced Surgical Training Facility in ASAM (our Australian School of Advanced Medicine), and \$19.5M for the Sydney Institute of Marine Science, which we share as major partners with UNSW, Sydney and UTS. There were also substantial new (NCRIS) allocations to Bioplatforms, National Fabrication Facility and Integrated Marine Observing System of which MQ has substantial parts."

I have been told that members of the science & technology (Oops! – I think the Government prefers "innovation" rather than "technology" these days) community in the pre-Budget lock-up broke into spontaneous applause when some of the science and "innovation" infrastructure funding was announced.

Our astrophysical colleagues will receive \$80M for WA to compete with South Africa as the site for the \$3 billion Square Kilometre Array radio-telescope. Closer to home, a \$21 M grant will secure the future of the AAO and Australian optical astronomy – reassuring for *MQ Photonics's* recent initiatives in astro-photonics.

Additional funding for the indirect costs of research



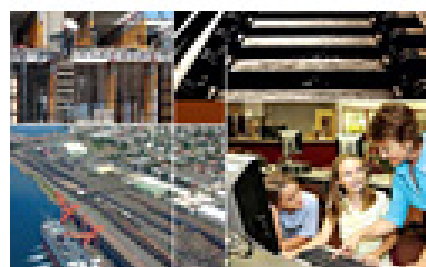
Consistent with recommendations of the Bradley Report and the Government's declared pursuit of a "knowledge-driven economy," we should soon start to feel the effects of a set of major Budget initiatives and higher-education reforms, which include:

- an uncapped demand-driven university system from 2012;
- boosting research funding and encouraging research excellence;
- \$512M (in 4 years) extra for universities' indirect research costs;
- a 10% increase in 2010 Australian Postgraduate Award stipends;
- \$27M for 100 extra Future Fellowship-type postdoctoral awards;
- \$36M to improve measurement of research standards *via* ERA;
- facilitation of collaboration between industry and researchers.

I hope that the third of these initiatives ▲ will encourage Macquarie U to revise its Faculty Funding Model so that research activity is more equitably supported. This should be an opportunity for us in *MQ Photonics*, with our strong research profile – but it is also an ongoing challenge for us to sustain that research performance!

An even bigger challenge will be for us to ensure that our research performance is assessed as favourably as possible. This may be of some comfort to those who participated (very capably, I must say!) in recent AUQA2 (Australian Universities' Quality Audit) interviews. It may also be some consolation to those of us who have been struggling with the idiosyncracies of Macquarie U's new ARIS data-entry protocol for reporting to ERA (Excellence in Research Australia) – a vital task, even if it diverts us from actual research time.

At this stage, the effect of the budget on ARC grants overall, on its imminent next Centres of Excellence round, and on other non-ARC research funding schemes is far from clear – but it is being closely watched!



2009 Macquarie University Innovation Awards



Macquarie U's Innovation Awards Dinner on Wednesday 6 May 2009 must have been an exciting occasion for the members of *MQ Photonics* who were there, because we carried the first three of the eight contested Awards that were announced, "Oscars"-style. Hearty congratulations to the *winning teams* (see below)! Please visit <www.mq.edu.au/innovationawards/winners.htm> to view video-clip presentations that describe their inventions.

The following research teams from *MQ Photonics* were winners of 2009 Innovation Awards:

- **Invention Disclosure:** "Diamond Laser System for Advanced Ablative Microsurgery"
Dr Richard Mildren
- **Innovation in Research:** "Quantum Informatics on a Chip"
Dr Graham Marshall, Dr Martin Ams, Dr Peter Dekker & Assoc. Prof. Michael Withford
(with Prof. Jeremy O'Brien, Mr Alberto Politi & Mr Jonathan Matthews from U of Bristol, UK)
- **Research Students' Innovation:** "Highly Functional and Robust, Monolithic Fibre Laser Systems"
Mr Nemanja Jovanovic, Dr Graham Marshall, Dr Alexander Fuerbach, Assoc. Prof. Michael Steel & Assoc. Prof. Michael Withford (with Jens Thomas, Stefan Nolte & Andreas Tünnermann from Friedrich-Schiller Universität, Jena, Germany)

Congratulations, too, to Dr Helen Pask and her colleagues, who were Highly Commended in the Commercial Innovation category for their "Continuous Wave Yellow Raman Laser" invention.

More focus on biophotonics in this issue ...

This issue of the *MQ Photonics Newsletter* continues to feature biophotonics, as in the previous issue. Thanks to Ewa Goldys and her colleagues for additional material that was not available 3 weeks ago ...

Brian Orr

Fresh vistas – focus on biophotonics

Light in Life Sciences Conference, Melbourne 24–27 November 2009 ...

We are pleased to invite you to attend the inaugural international *Light in Life Sciences Conference 2009* to be held in Melbourne, Australia on 24–27 November 2009.



Recent and ongoing interdisciplinary research into the application of light (fluorescence) based technologies is accelerating existing and creating new directions in many fields including the life sciences. This conference will showcase high profile international and Australian presenters, working at the cutting edge of life and other sciences specifically in the areas of Advanced Imaging, Fluorescent Probes and Biophotonics.

Designed to both inform of and build upon recent advances in pioneering technologies and their applications, this conference is aimed at researchers from universities, research institutes and companies, students, and a broader audience of researchers and industry organisations who, in their research or products, have an interest in applying light (fluorescence) based technologies towards areas of relevance to the Life Sciences.

For more information, including a list of confirmed speakers, please see the website:

<http://www.physics.mq.edu.au/research/fluoronet/LILS09/>

Please take advantage of Discounted Early Bird Registration – NOW OPEN until 15 August, 2009.

We look forward to seeing you in Melbourne.

Kind regards,

Dr Mark Prescott
Conference Co-Chair
Monash University
Melbourne

A/Prof Trevor Smith
Conference Co-Chair
Melbourne University
Melbourne

Professor Ewa Goldys
Conference Co-Chair
Macquarie University
Sydney

Phillip Butterworth joins the Nanobiophotonics Group ...

It is a great pleasure to announce that Dr Philip Butterworth has joined the Nanobiophotonics Group that is associated with *MQ Photonics*. He will work on the Bioanalyser Project sponsored by Agilent Life Sciences. Phillip has just completed his PhD in Astrobiology working with Professors Malcolm Walter and Peter Bergquist. He will bring to the group his skills in biotechnology and microbiology. The Bioanalyser Project will focus on ultrasensitive RNA assays and it will be carried out in a partnership with Ian Paulsen (Biomolecular Frontiers CORE) and Russell Connally.



Nanobiophotonics gathers strength on the theoretical side ...

With a string of new experiments underway and large datasets to be interpreted, we have been canvassing the world to seek new partnerships supporting our needs in theoretical analysis. We have been fortunate in being able to attract to Macquarie U a leading specialist in plasmonics and advanced electromagnetic field theory, Dr Nils Calander who will join Macquarie U in August 2009 as an Associate Professor. Nils is originally from Norway, but has spent most of his working life in Sweden, and recently in the USA. Nils will be working with Krystyna Tomsia on surface-plasmon-resonance-active structures, and hopes to interact more broadly with the *MQPhotonics* community.

Ewa Goldys

Fresh vistas – DSTO/TTCP Workshop on 27 May



DSTO's Opto-electronics Hub in conjunction with TTCP Sensors Technical Panel 5

Final announcement for the Workshop on Laser and Electro-optic Technology for Defence Applications

DSTO Edinburgh, SA • 27 May, 2009

Helen Pask, Mick Withford and I have each been invited to give 15-minute presentations at the DSTO/TTCP Workshop on 27 May.

Workshop aims: to review Australian & international research; enhance the meeting of TTCP Sensors Technical Panel 5; to expand links between universities, DSTO & international partners with a view to collaborative work; to maximise use of indigenous resources in lasers and optics to optimise benefits to the Australian Defence Organisation & its allies.

Subject areas: fibre/solid-state lasers; laser power scaling; frequency conversion; mid-IR detectors; emerging mid-IR materials; laser atmospheric propagation; defence and novel applications of the above.

Please suggest topics that you would like us to include in our talks.

TTCP Panel 5 will be visiting MQ Photonics on the afternoon of Friday 29 May – Mick Withford is coordinating things.

Brian Orr

Publications

Recently accepted / in-press articles:

M E Dokukin, A V Baryshev, **A B Khanikaev** and M Inoue¹, "Reverse and enhanced magneto-optics of opal-garnet", accepted for publication at *Optics Express*.

Abstract: Magnetophotonic heterostructures comprising two thin opal films and a layer of bismuth-substituted yttrium iron garnet were fabricated. Such heterostructures combined properties of 1D, 2D and 3D photonic crystals. Their spectra demonstrated various optical resonances resulting in reverse and enhanced magneto-optical responses.

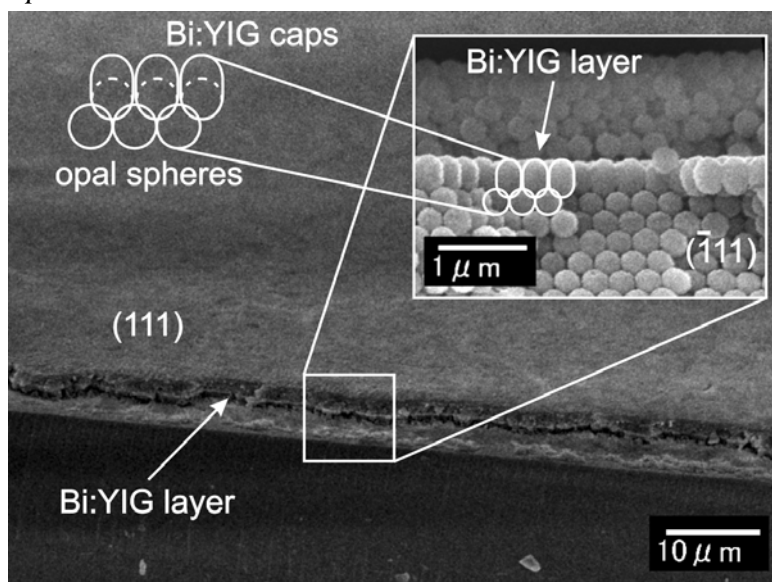


Fig. 1. SEM image of an opal/Bi:YIG/opal heterostructure. The patterned Bi:YIG defect layer is sandwiched in between two opal films. Inset shows a cross-section of the opal/Bi:YIG/opal structure.

Yabai He and B.J.Orr, "Self-adaptive, narrowband tuning of a pulsed optical parametric oscillator and a continuous-wave diode laser *via* phase-conjugate photorefractive cavity reflectors: verification by high-resolution spectroscopy," *Applied Physics B*, accepted 13 May 2009; 56 MS pages, 117 references, 16 figures; in press, DOI: 10.1007/s00340-009-3582-0 (2009).

Abstract: A dynamic self-adaptive Bragg grating formed in a photorefractive crystal is shown to be a convenient way to attain single-longitudinal-mode (SLM) operation and narrowband tuning *both* in a pulsed, injection-seeded optical parametric oscillator (OPO) *and* in a continuous-wave (cw) extended-cavity diode laser. The pulsed OPO cavity comprises a Rh:BaTiO₃ photorefractive (PR) crystal, a periodically poled KTiOPO₄ nonlinear-optical crystal, and a dielectrically-coated end mirror. A continuous-wave seed beam at 820 – 850 nm from a tunable SLM diode laser traverses firstly the Rh:BaTiO₃ crystal and then is retro-reflected by the end mirror; this creates a wavelength-selective Bragg grating reflector in the PR crystal, thereby completing the OPO cavity. The cavity stays automatically resonant with the seed radiation, with no need to actively control its length or to make any other mechanical adjustment. One form of injection seeder comprises a novel extended-cavity diode laser (ECDL) design incorporating a self-pumped photorefractive phase-conjugate reflector and a compact, high-finesse tunable intracavity ring filter. This combination facilitates robust tunable single-frequency operation with narrow optical bandwidth. The performance characteristics of the OPO and the ECDL are evaluated by recording high-resolution atomic and molecular spectra. Notably, fluorescence-detected sub-Doppler two-photon excitation at 822 nm, of the $8S \leftarrow 6S$ transition in atomic Cs, provides a crucial linewidth test.

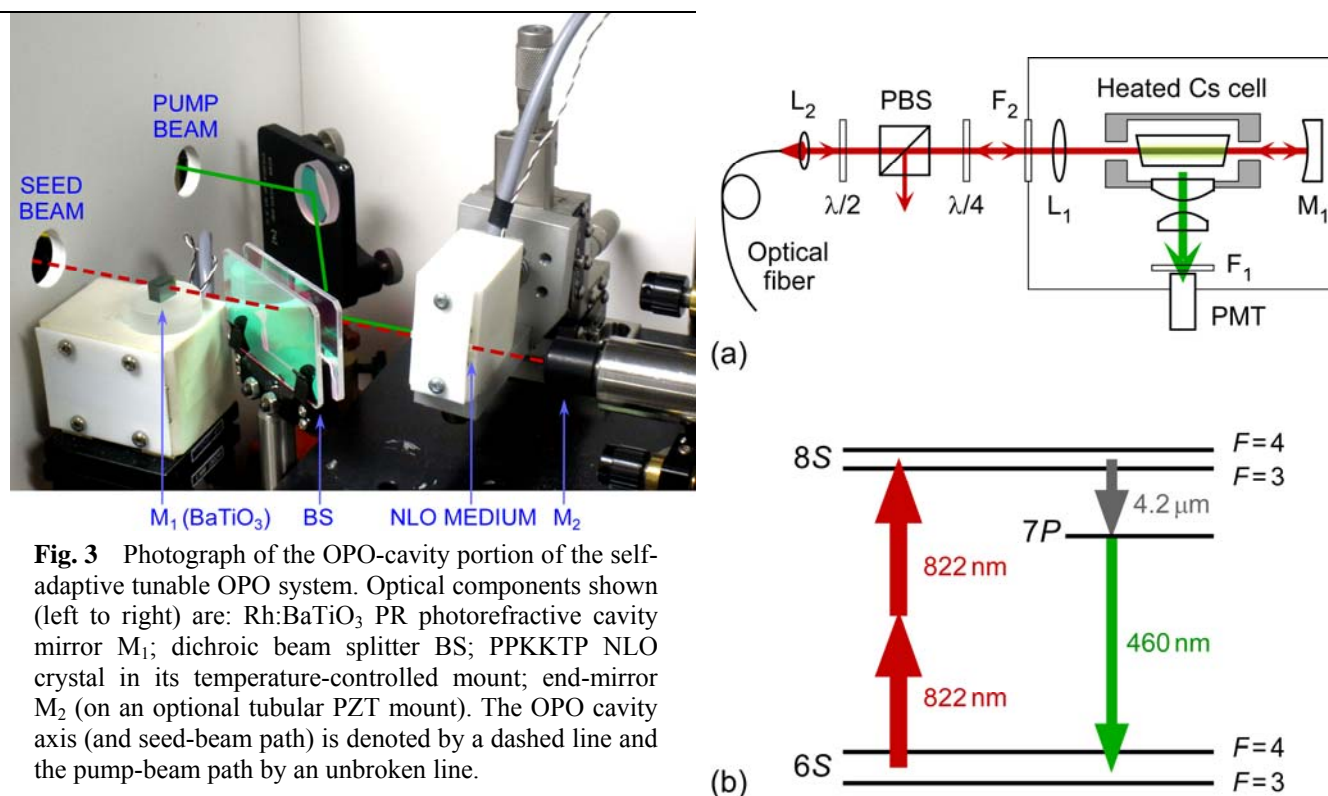


Fig. 3 Photograph of the OPO-cavity portion of the self-adaptive tunable OPO system. Optical components shown (left to right) are: Rh:BaTiO₃ PR photorefractive cavity mirror M₁; dichroic beam splitter BS; PPKTP NLO crystal in its temperature-controlled mount; end-mirror M₂ (on an optional tubular PZT mount). The OPO cavity axis (and seed-beam path) is denoted by a dashed line and the pump-beam path by an unbroken line.

Fig. 12 Sub-Doppler two-photon excitation (TPE) spectroscopy of atomic Cs. **Part (a):** experimental setup, in which a single-mode optical fibre delivers tunable coherent radiation at ~822.5 nm from *either* a cw diode laser *or* a pulsed OPO; sub-Doppler TPE by counter-propagating laser beams is detected by spontaneous fluorescence. **Part (b):** $8S \leftarrow 6S$ TPE of Cs has two hyperfine components, each with $\Delta F = 0$, at 822.4595 nm ($F = 3$) and 822.4689 nm ($F = 4$), detected by cascaded $7P \rightarrow 6S$ fluorescence at ~460 nm.

Seminars and Visitors

MQ Photonics Seminars:

Time: 12 Noon, Wed 20th May Place: C5C 498 **Mushtaq Sobhan**

TOPIC: "Production of colloidal gold nanoparticles using femtosecond laser ablation technique"

ABSTRACT: Previous studies, investigating the role of the operating parameters on ultrafast laser ablative generation of gold nanoparticles, have reported a wide range of nanoparticle size distribution and plasmon resonant properties. In some cases the reported role of fluence and other parameters is contradictory. In this systematic investigation we deconstruct and examine the role of the component parts of fluence, namely

pulse energy, pulse repetition frequency and ablation spot size, on nanoparticle generation. Other parameters such as exposure time and scan speed are also studied. We show that the nanoparticle average size and distribution is related to different contributions from pulse energy, pulse repetition frequency and spot size. We also correlate the average particle size and distribution with the wavelength and width of the plasmon resonance peak, and apply Mie theory in order to develop clearer physical insights into the mechanisms dominating nanoparticle generation. Finally, we show that under different conditions the nanoparticle population can form either stable or unstable colloids in water.

Time: 1pm-2pm, Tue 26th May Place: E7B 161 **Pre-conference practice talks #1**

Douglas Little (CLEO/IQEC in Baltimore):

"Polarization Dependence of Photo-Ionization in Glasses and Applications to Direct-Write Photonics"

Martin Ams (CLEO/IQEC in Baltimore and CLEO-Europe/EQEC in Munich):

"Ultrafast-Laser Inscription of Active Devices in Glass"

(2 more slots are available from 12Noon to 1pm)

Time: 12 Noon, Wed 27th May Place: C5C 498 **Sandeep Menon**

TOPIC: 'Distinctive autofluorescence of urine samples from individuals with bacteriuria compared with normals'

ABSTRACT: This study investigates the potential of autofluorescence as a clinical diagnostic tool for screening of urine samples for bacteriuria (presence of *E coli* or mixed bacteria in the urine). Urinary tract infections (UTI) are common in general population as well as in hospitalised patients and account for 30-40% of all hospital acquired infections. Bacteriuria (presence of bacteria in the urine) is the hallmark of UTI. Several methods are available to diagnose bacteriuria, the most reliable one being the bacteriological culture. However, it takes about 24 hours for the culture result to be available. Hence there is a need for a reliable and rapid method for the detection of bacteriuria.

The autofluorescence was measured at (290, 310, 340, 400, 450 and 500 nm) excitation wavelengths for thirty three urine samples which were also analysed at diagnostic pathology laboratories by conventional methods. The data were subjected to Principal Component Analysis (PCA) which revealed statistically significant differences between the fluorescence spectra for samples with bacteriuria and control group. The results indicate the applicability of using the fluorescence spectrum of urine at 290 nm excitation wavelengths as a diagnostic tool to differentiate between normal urine and urine with bacteriuria.

Time: 12Noon-2pm, Thu 28th May Place: E7B 161 **Pre-conference practice talks #2**

Yabai He, (CLEO/IQEC in Baltimore): "Multi-Wavelength Sensing of Greenhouse Gases by Rapidly Swept Continuous-Wave Cavity Ringdown Spectroscopy"

Graham Marshall, (CLEO/IQEC in Baltimore): "Quantum Optics in Laser-Written Waveguide Circuits"

(2 more slots are available from 1pm to 2pm)

Time: 12Noon-2pm, Fri 29th May Place: E7B 161 **Pre-conference practice talks #3**

Eduardo Granados (CLEO-Europe/EQEC in Munich):

"Continuous-wave and picosecond mode-locked output from an ultra-violet Ce:LiCAF laser"

Eduardo Granados (CLEO/IQEC in Baltimore):

"Continuous-wave mode locked yellow Raman laser at 559 nm based on a KGW crystal"

Helen Pask, CLEO-Europe/EQEC in Munich)

"A self-Raman, Nd:GdVO₄ laser generating 2.5W CW output at 586 nm"

(1 more slot is available from 1:30pm to 2pm)

Time: 12Noon-2pm, Wed 10th June Place: E7B 161 **Pre-conference practice talks #4**

Dayong Jin (Nanophotonics Conference in Melbourne):

"Advanced Cell Detection Using Luminescence Silica Nano-probes"

Time: 12 Noon, Wed 24th June Place: C5C 498 **Luke Stewart**

TOPIC: "Functionalising Opals"

ABSTRACT: TBA

Visitors

Professors Jiyang Wang and Huajin Zhang from Shandong University in China visited *MQ Photonics* and the Raman laser group in particular on Thursday and Friday last week (14th and 15th May). As Helen Pask announced: "They are esteemed crystal growers (many different types of optical crystals) ... who are collaborating with us through the International Science Linkage scheme." Many of us enjoyed meeting them during their visit. I found it fascinating to see them pull marvellous exotic crystals (both finished and boules) from their pockets – a bit like conjurers!

Brian Orr

People and Progress

Macquarie OSA student chapter – update for May

There are potentially two upcoming events in May, we would appreciate the staff encouraging students in lectures and labs to attend these events.

What:	Lab tour of the optics company: Finisar
When:	20 th May, 3:30pm
Where:	Finisar Australia Pty Ltd 244 Young Street Waterloo, NSW 2017, Australia
Who is welcome?:	Any student interested in or studying optics (Please RSVP to Nem so he can organise car pooling)
What:	Optics and Photonics trivia night
When:	25 th May, 5:30 pm
Where:	U@MQ bar
Who is welcome?:	Any student interested in or studying optics

Nemanja Jovanovic