MACQUARIE UNIVERSITY | MQ PHOTONICS RESEARCH CENTRE

NEWSLETTER

Issue 52 – 12 December 2012

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 <Elizabeth.Bignucolo@mq.edu.au> by 9 a.m. on the due date. **Next due date: to be advised**

Focal Points

It has been a great year for MQ Photonics. As I disclosed at my recent "State of the Nation" talk, we have exceeded our performance indicators in published outputs (70 journal papers published), international collaborations (37 co-authored papers) intellectual property activities (9 invention disclosures, 6 of which are proceeding to PCT), 6 PhD completions and 11 new PhD students enrolled. It is important to note that the majority of our papers are in leading journals. These values reflect continued growth by the Centre, a feature that bodes well for next year.

I would like to welcome Prof Candace Lang as a new member of the Centre. For those unfamiliar with Prof Lang, she is Macquarie's new Head of Mechanical Engineering. Despite her relatively short time here she is already interacting with many of our members. In addition, I would like to welcome many new members to both the Centre and the University. You can find out more about them below. I would also like to take this opportunity to acknowledge those members that have left to pursue new pursuits throughout 2012. Thanks once more for your valuable contributions to Centre life.

Special thanks to David Inglis for running a vibrant MQ Photonics seminar series this year. I'm sure his replacement, Andrew Lee, will continue that strong legacy. Thanks also to PhD student Ondrej Kitsler for flying the flag at the recent KOALA conference. His presentation reviewing MQ Photonics is noted as a highlight of the conference (see below) by an impartial attendee at that meeting!

Finally, even though my attendance was limited, I was thrilled to see Centre members making a strong impression at the recent AIP / ACOFT conference, particularly in our new look polo shirts.

Enjoy your break and have a Merry Christmas. I look forward to a fruitful 2013.

Michael Withford

Congratulations to **Dr. Run Zhang** for being awarded one **Macquarie University Research Fellowship** 2013 -2015! His new fellowship project, to be carried out in Department of Chemistry and Biomolecular Sciences, aims to establish a method to visualize and quantify molecular interactions within living cells using in-situ scanning cytometry. A new family of biosensors will be developed for detection of specific enzymes. This leads to disease diagnostics and drug response study at single cell level.

JIN, Dayong

Fresh vistas

Australian Laureate Fellowships

The *Australian Laureate Fellowships Funding Rules for funding commencing in 2013* are now available on the ARC website.

Open for applications on RMS: **Monday 10 December 2012**

The closing date for submission of Proposals to the University Research Office for review is 5:00pm, **Thursday 10 January 2013.**

The closing date for submission of Request not to Access to the Research Office is 5:00pm, **Monday 14 January 2013.**

For further information, see: http://www.arc.gov.au/ncgp/laureate/laureate_default.htm

Future Fellowships

The *Future Fellowships Funding Rules for funding commencing in 2013* are now available on the ARC website.

Open for applications on RMS: **Wednesday 19 December 2012**

The Eligibility Exemption Request forms for *Future Fellowships* for funding commencing in 2013 are now available on the ARC website.

The closing date for submission of Eligibility Exemption Requests to the Research Office is 5:00pm, **Monday 7 January 2013.**

The closing date for submission of Proposals to the Faculty and University Research Office for review is 5:00pm, **Wednesday 23 January 2013**.

The closing date for submission of Request not to Access to the Research Office is 5:00pm, **Monday 4 February 2013.**

For further information, see: http://www.arc.gov.au/ncgp/futurefel/future_default.htm

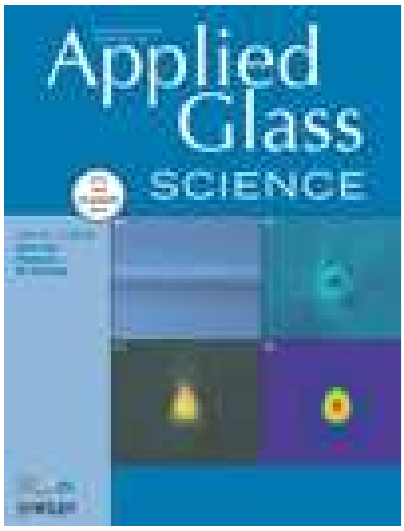
Conference Reports

A large cohort of Macquarie staff and students presented talks and posters at the Australian Optical Society and ACOFT meetings under the umbrella of the AIP2012 Congress from Dec 9-13 at the University of New South Wales. Optics highlights of the meeting included invited presentations from Sir Peter Knight, Prof. Andrew Dzurak and Prof. Donna Strickland. MQ Photonics contributed significantly to the conference organisation with Judith Dawes serving on the organising committee and Mike Steel and David Spence sitting on the AOS program committee which had of order 150 submissions.
The next AIP congress will be in Canberra in December 2014.

Mike Steel

Publications

Recently published articles



Invited paper and Journal cover - CONGRATULATIONS

S Gross, **M Ams**, **G Palmer**, **C T Miese**, **R J Williams**, **G D Marshall**, **A Fuerbach**, D G Lancaster, H Ebendorff-Heidepriem, **M J Withford**, "Ultrafast Laser Inscription in Soft Glasses: A Comparative Study of Athermal and Thermal Processing Regimes for Guided Wave Optics", *International Journal of Applied Glass Science*, 3 (4), 332-348 (2012)

Abstract: The combination of ultrafast laser inscription and engineered soft glasses is enabling a new class of photonic devices offering long wavelength transparency, high nonlinearity, and optical gain. However, this field of research also possesses its own unique set of fabrication challenges, which range from the predictable, such as self-focusing effects, material stress, and damage to the unexpected, such as photo-induced index changes of different sign. In this article, we review many of the fabrication challenges surrounding ultrafast laser-written soft-glass photonics and highlight these by comparing and contrasting laser processing of common soft glasses in both the athermal and thermal writing regimes.

N Jovanovic, P G Tuthill, B Norris, **S Gross**, P Stewart, N Charles, S Lacour, **M Ams**, **J Lawrence**, A Lehmann, C Niel, G **D Marshall**, G Robertson, **M Ireland**, **A Fuerbach**, **M J Withford**, "First starlight demonstration of an integrated pupil-remapping interferometer: A new technology for high contrast exoplanetary imaging", *J. Monthly Notices of the Royal Astronomical Society*, Vol. 427(1), pp. 806-815 (2012)

Abstract: In the two decades since the first extra-solar planet was discovered, the detection and characterization of extra-solar planets has become one of the key endeavors in all of modern science. Recently direct detection techniques such as interferometry or coronography have received growing attention because they reveal the population of exoplanets inaccessible to Doppler or transit techniques, and moreover they allow the faint signal from the planet itself to be investigated. Next-generation stellar interferometers are increasingly incorporating photonic technologies due to the increase in fidelity of the data generated. Here, we report the design, construction and commissioning of a new high contrast imager; the integrated pupil-remapping interferometer; an instrument we expect will find application in the detection of young faint companions in the nearest star-forming regions. The laboratory characterisation of the instrument demonstrated high visibility fringes on all interferometer baselines in addition to stable closure phase signals. We also report the first successful on-sky experiments with the prototype instrument at the 3:9-m Anglo-Australian Telescope. Performance metrics recovered were consistent with ideal device behaviour after accounting for expected levels of decoherence and signal loss from the uncompensated seeing. The prospect of complete Fourier-coverage coupled with the current performance metrics means that this photonically-enhanced instrument is well positioned to contribute to the science of high contrast companions.

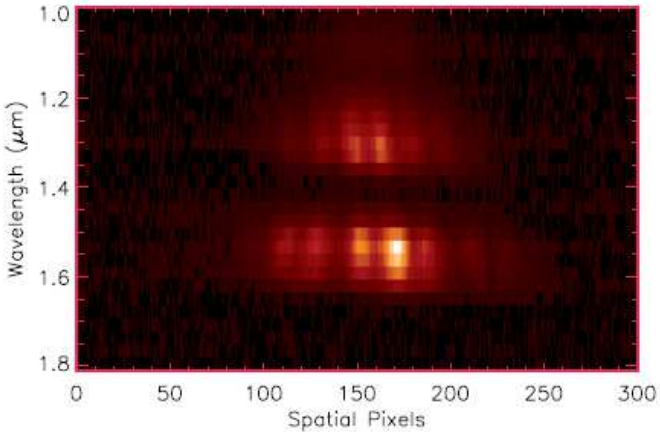


Fig. 6.| A single image of a spectrally dispersed fringe pattern taken on-sky at the AAT while observing Antares.

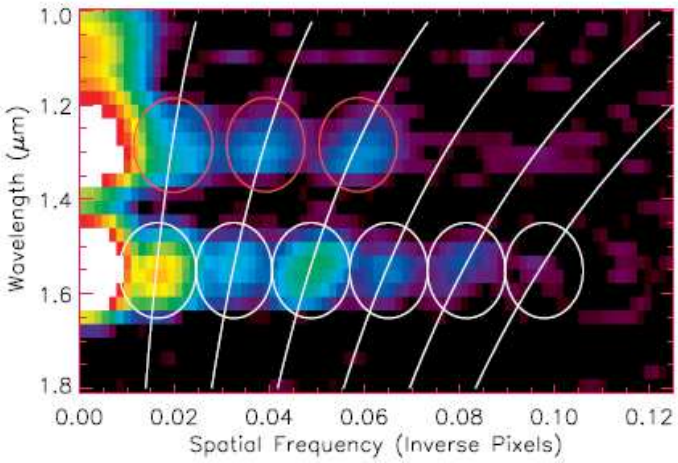


Fig. 7.| Power spectrum of the interference fringes recorded by the instrument. The horizontal axis gives the spatial frequency, in inverse pixels, for the Fourier components. All fringes were well sampled. The white lines depict the theoretically expected spatial frequencies of fringes for our given remapping chip, reimaging optics and computed dispersion of the prism. The red and white circles highlight the detected spatial frequency components in J and H bands respectively.

J U Thomas, **N Jovanovic**, R G Krämer, **G D Marshall**, **M J Withford**, A Tünnermann, S Nolte, **M J Steel**, "Cladding mode coupling in highly localized fiber Bragg gratings II: complete vectorial analysis", *Opt. Exp.*, Vol. 20 (19), pp. 21434-21449 (2012)

Abstract: H (ghly localized fiber Bragg gratings can be inscribed point-by-point with focused ultrashort pulses. The transverse localization of the resonant grating causes strong coupling to cladding modes of high azimuthal and radial order. In this paper, we show how the reflected cladding modes can be fully analyzed, taking their vectorial nature, orientation and degeneracies into account. The observed modes' polarization and intensity distributions are directly tied to the dispersive properties and show abrupt transitions in nature, strongly correlated with changes in the coupling strengths.

M Collins, A Clark, J He, D-Y Choi, **R Williams**, A Judge, S Madden, **M Withford**, **M Steel**, B Luther-Davies, C. Xiong, B Eggleton, "Low Raman-Noise Correlated Photon-Pair Generation in a Dispersion Engineered Chalcogenide As_2S_3 Planar Waveguide", Opt. Lett., Vol. 37 (16), pp. 3393-3395 (2012)

Abstract: We demonstrate low Raman-noise correlated photon-pair generation in a dispersion-engineered 10 mm As2S3 chalcogenide waveguide at room temperature. We show a coincidence-to-accidental ratio (CAR) of 16.8, a 250 times increase compared with previously published results in a chalcogenide waveguide, with a corresponding brightness of

3×105 pairs·s−1·nm−1 generated at the chip. Dispersion engineering of our waveguide enables photon passbands to be placed in the low spontaneous Raman scattering (SpRS) window at 7.4 THz detuning from the pump. This Letter shows the potential for As2S3 chalcogenide to be used for nonlinear quantum photonic devices.

N Charles, **N Jovanovic**, **S Gross**, P Stewart, B Norris, J O'Byrne, **J Lawrence**, **M Withford**, P Tuthill, "Design of Optically Path Length Matched, Three-Dimensional Photonic Circuits Comprising Uniquely Routed Waveguides", *Appl. Opt.* Vol 51 (27), pp. 6489-6497 (2012)

Abstract: A method for designing physically path-length-matched, three-dimensional photonic circuits is described. We focus specifically on the case in which all the waveguides are uniquely routed from the input to output—a problem that has not been addressed to date and that allows for the waveguides to be used in interferometric measurements. Circuit elements were fabricated via the femtosecond laser direct-write technique. We demonstrate via interferometric methods that the fabricated circuits were indeed optically path-length matched to within 45 μm, which is within the coherence length required for many applications.

S Gross, **M Ams**, D G Lancaster, T M Monro, **A Fuerbach**, **M J Withford**, "Femtosecond direct-write überstructure waveguide Bragg-gratings in ZBLAN", *Opt. Lett.*, Vol. 37(19), pp. 3999-4001 (2012)

Abstract: Strong waveguide Bragg gratings (10.5 dB transmission dip) were fabricated using the femtosecond (fs) laser direct-write technique in ZBLAN glass. The Bragg gratings are based on depressed cladding waveguides and consist of planes, periodic according to the Bragg condition, which are constructed from a transverse hexagonal lattice of smaller point features. Such gratings are a key step toward the realization of mid-infrared monolithic waveguide lasers using the fs laser direct-write technique.

T Meany, **M Delanty**, **S Gross**, **G D Marshall**, **M J Steel**, **M J Withford**, "Non-classical interference in integrated 3D multiports", *Opt. Exp.*, Vol. 20(24), pp. 26895-26905 (2012)

Abstract: We demonstrate three and four input multiports in a three dimensional glass platform, fabricated using the femtosecond laser direct-write technique. Hong-Ou-Mandel (HOM) interference is observed and a full quantum characterization is performed, obtaining two photon correlation matrices for all combinations of input and output ports. For the 3-port case, the quantum visibilities are accurately predicted solely from measurement of the classical coupling ratios.

A Arriola, A Rodriguez, N Perez, T Tavera, **M J Withford**, **A Fuerbach**, S M Santiago, "Fabrication of high quality sub-micron Au gratings over large areas with pulsed laser interference lithography for SPR sensors", *Opt. Mat. Exp.*, Vol. 2 (11), pp.1571-1579 (2012)

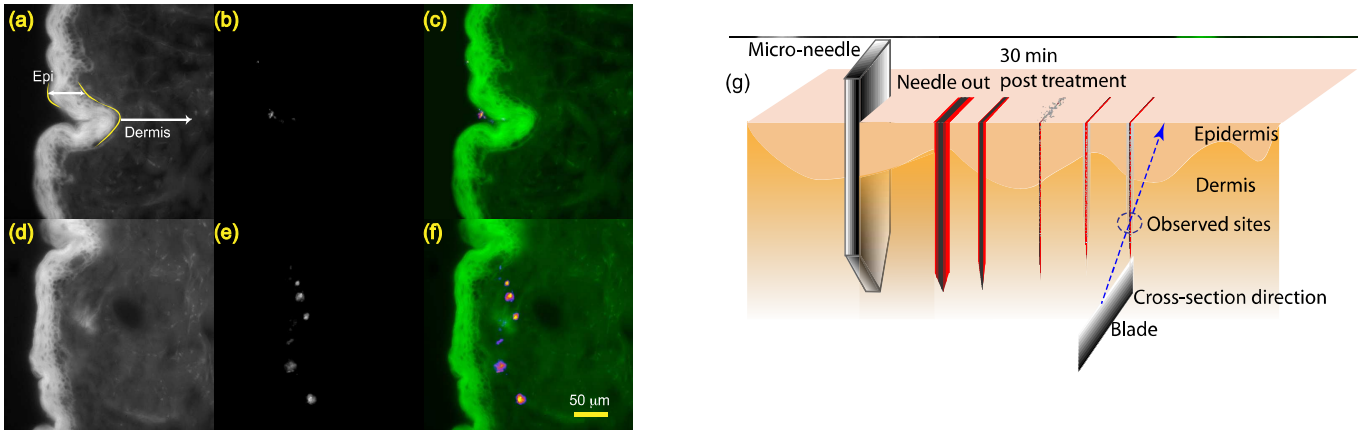
Abstract: Metallic gratings were fabricated using high energy laser interference lithography with a frequency tripled Nd:YAG nanosecond laser. The grating structures were first recorded in a photosensitive layer and afterwards transferred to an Au film. High quality Au gratings with a period of 770 nm and peak-to-valley heights of 20-60 nm exhibiting plasmonic resonance response were successfully designed, fabricated and characterized.

D G Lancaster, **S Gross**, **A Fuerbach**, H Heidepriem-Ebendorff, T M Monro, **M J Withford**, "Versatile large-mode-area femtosecond laser-written Tm:ZBLAN glass chip lasers", *Opt. Exp.*, Vol. 20 (25), pp. 27503-27509 (2012)

Abstract: We report performance characteristics of a thulium doped ZBLAN waveguide laser that supports the largest fundamental modes reported in a rare-earth doped planar waveguide laser (to the best of our knowledge). The high mode quality of waveguides up to 45 um diameter (~1075 μm^2 mode-field area) is validated by a measured beam quality of M^2~1.1 ± 0.1. Benefits of these large mode-areas are demonstrated by achieving 1.9 kW peak-power output Q-switched pulses. The 1.89 μm free-running cw laser produces 205 mW and achieves a 67% internal slope efficiency corresponding to a quantum efficiency of 161%. The 9 mm long planar chip developed for concept demonstration is rapidly fabricated by single-step optical processing, contains 15 depressed-cladding waveguides, and can operate in semi-monolithic or external cavity laser configurations.

Z Song, Y G Anissimov, **J Zhao**, A V Nechaev, **A Nadort**, **D Jin**, T W Prow, M S Roberts, **A V Zvyagin**, "Background Free Imaging of Upconversion Nanoparticle Distribution in Human Skin", *Journal of Biomedical Optics* 18(6) 061215 (2012). doi:10.1117/1.JBO.18.6.061215

Abstract: Widespread applications of nanotechnology materials have raised safety concerns due to their possible penetration through skin and concomitant uptake in the organism. This calls for systematic study of nanoparticle transport kinetics in skin, where high-resolution optical imaging approaches are often preferred. We report on application of emerging luminescence nanomaterial, called upconversion nanoparticles (UCNP), to optical imaging in skin that results in complete suppression of background due to the excitation light back-scattering and biological tissue autofluorescence. Freshly excised intact and micro-needle-treated human skin samples were topically coated with oil-formulation of UCNPs and optically imaged. In the first case, 8-nm and 32-nm UCNPs stayed at the topmost layer of the intact skin, *stratum corneum*. In the second case, 8-nm nanoparticles were found localised at indentations made by the micro-needle spreading in dermis very slowly (estimated diffusion coefficient, D_{np} = 3 - 7×10^{-12} cm^2.s^{-1}). The maximum possible UCNP imaging contrast was attained by suppressing the background level to that of the electronic noise, which was estimated to be superior in comparison with the existing optical labels.



Eight nanaometer nanoparticle (NaYF4:Yb,Tm, sample UC2) distribution in (top row) intact and (bottom row) microneedle-treated human skin, respectively, following topical application of the upconversion nanoparticle (UCNP) formulated in capric/caprylic triglyceride (CCT) oil. (a), (d), Ultraviolet (UV; 365 nm) excited autofluorescence images of skin; (b), (e) images of UCNPs excited by a 980-nm laser; (c), (f), pseudo-colour overlaid images of (a), (d) showing UCNPs (purple color) in the skin furrow and dermis (green color), respectively. (g) Schematic diagram of the procedure of the application of a microneedle (here, one-blade microneedle, for clarity). From left to right: the microneedle blade is removed from the skin, leaving a perforation that takes the shape of the blade. This cut closes within several minutes followed by application of the formulated upconversion nanoparticles that penetrate to dermis through random perforation pores. At the skin preparation stage, thin skin cross-sections are microtomed with a blade, so that a line of randomly distributed UCNP sites at the intersection of the microneedle and microtome blades are clearly observable.

Y Lu, P Xi, **J Piper**, Y Huo, **D Jin**, "Time-gated Orthogonal Scanning Automated Microscopy (OSAM) for High-speed Cell detection and Analysis", *Scientific Reports* (a new Nature Publishing Group online journal) DOI: 10.1038/srep00837

Abstract: We report a new development of othogonal scanning luminescence microscopy (OSLM) incorporating time-gated detection to locate rare-event organisms regardless of autofluorescent background. The necessity of using long-lifetime (hundreds of microseconds) luminescent biolabels for time-gated detection implies long integration (dwell) time, resulting in slow scan speed. However, here we achieve high scan speed using a new 2-step orthogonal scanning strategy to realise on-the-fly time-gated detection and precise location of 1-μm lanthanide-doped microspheres with signal-to-background ratio of 8.9. This enables analysis of a 15 mm × 15 mm slide area in only 3.3 minutes. We demonstrate that detection of only a few hundred photoelectrons within 100 μs is sufficient to distinguish a target event in a prototype system using ultraviolet LED excitation. Cytometric analysis of lanthanide labelled Giardia cysts achieved a signal-to-background ratio of two orders of magnitude. Results suggest that time-gated OSLM represents a new opportunity for high-throughput background-free biosensing applications.

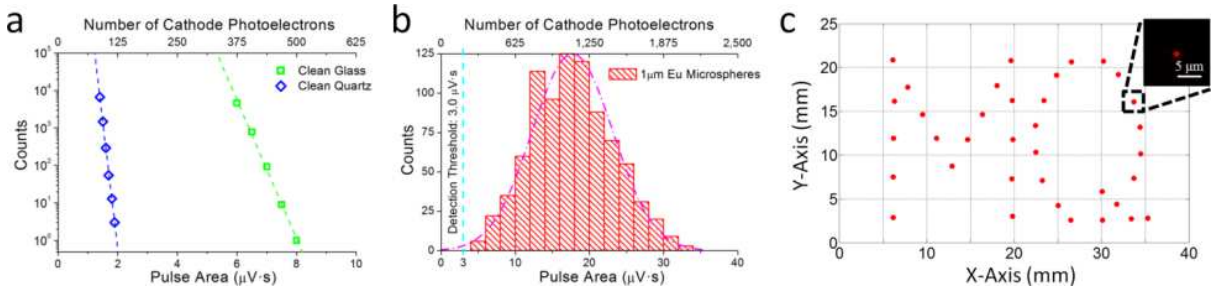
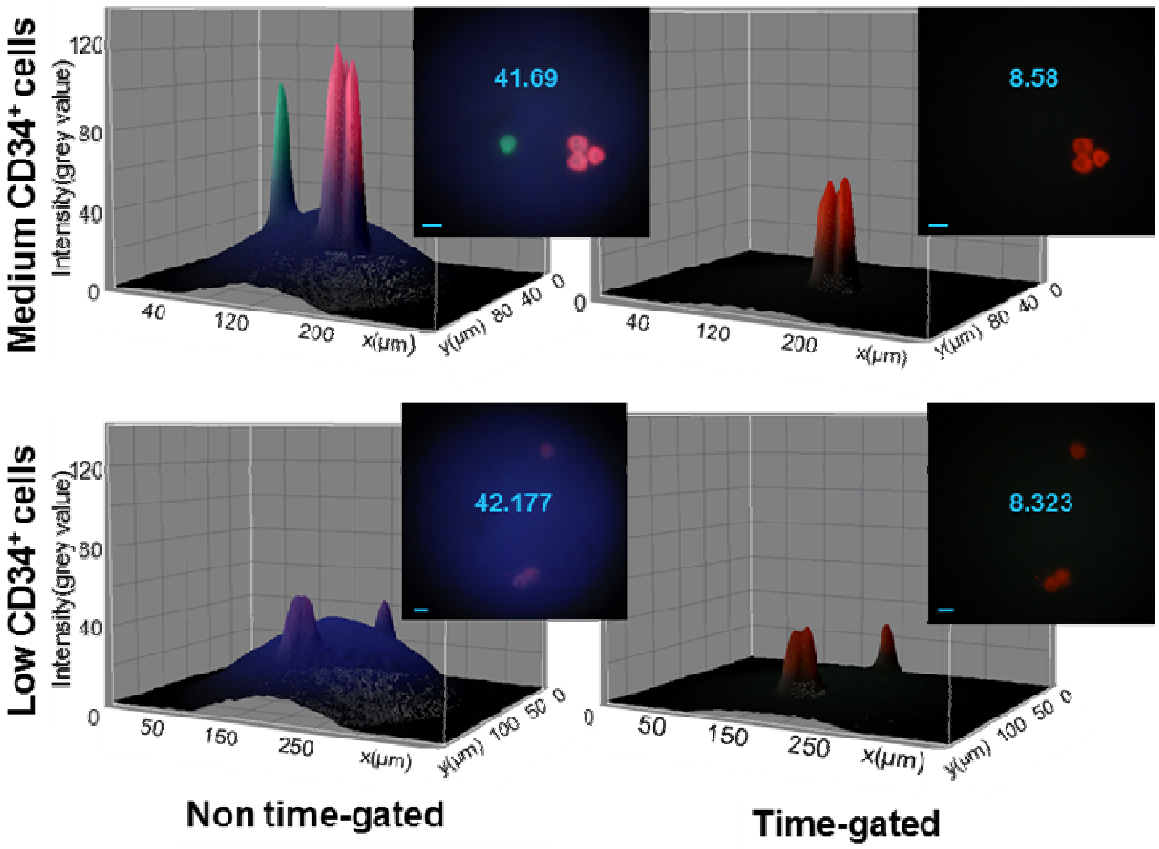


Figure 4: Determining the sensitivity of the prototype OSAM.
(a) draws the number of artefacts on a clean glass slide and clean quartz slide when varying the recording threshold of pulse area, indicating the detection limit on each substrate. (b) is a histogram of the luminescence intensity from a total number of 854 1-μm Eu-containing microspheres prepared on seven quartz slides, with the area threshold set to 3.0 μV·s. (c) shows the mapping result of a quartz slide carrying exact 36 1-μm Eu

microspheres, which were selectively arranged by flow cytometer sorting to form a “MQ” pattern (CCD camera exposure time 150 ms).

J Lu, J Martin, **Y Lu, J Zhao**, J Yuan, M Ostrowski, **J A Piper,** I T Paulsen, **D Jin**, "Resolving Low-expression Cell Surface Antigens by Time-gated Luminescence Scanning Cytometry" *Analytical Chemistry* - 84 (22), pp 9674-9678 (2012)

Abstract: We report a highly sensitive method for rapid identification and quantification of rare-event cells carrying low-abundance surface biomarkers. The method applies lanthanide bioprobes and time-gated detection to effectively eliminate both non-target organisms and background noise, and utilizes the europium containing nanoparticles to further amplify the signal strength by a factor of ~ 20. Of interest is that these nanoparticles did not correspondingly enhance the intensity of non-specific binding. Thus the dramatically improved signal-to-background contrast enables the low-expression surface antigens on single cells can be quantified. Furthermore, we applied an on-the-fly scanning cytometry technique to rapidly process a large population of target-only cells on microscopy slides, leading to quantitative statistical data with high certainty. Thus, the techniques together resolved nearly all false negative events from interfering crowd including many false positive events.



E P Schartner, **D Jin**, H Ebendorff-Heidepriem, **J A Piper**, T M Monro, "Lanthanide upconversion within microstructured optical fibers: improved detection limits for sensing and the demonstration of a new tool for nanocrystal characterization" *NanoScale* - (2012) *DOI: 10.1039/C2NR32583G*

Abstract: We investigate a powerful new sensing platform based on the excitation of upconversion luminescence from $NaYF_4$: Yb/Er nanocrystals loaded in solution within a suspended-core microstructured optical fiber. We demonstrate a substantial improvement in the detection limit that can be achieved in a suspended-core fiber sensor for solution-based measurements using these nanocrystals as an alternative to more traditional fluorophores, with sensing of concentrations as low as 660 fM demonstrated compared with the 10 pM obtained using quantum dots. This nanocrystal loaded suspended core fiber platform also forms the basis for a novel and robust nanoscale spectrometry device capable of capturing power-dependent spectra over a large dynamic range from 10^3 W cm^{-2} to 10^6 W cm^{-2} using a laser diode. This serves as a useful tool to study the multiple energy levels of rare earth luminescent nano-materials, allowing the two sharp emission bands to be studied in detail over a large dynamic range of excitation powers. Thus, in addition to demonstrating a highly-sensitive dip sensor, we have devised a powerful new approach for characterizing upconversion nanoparticles.

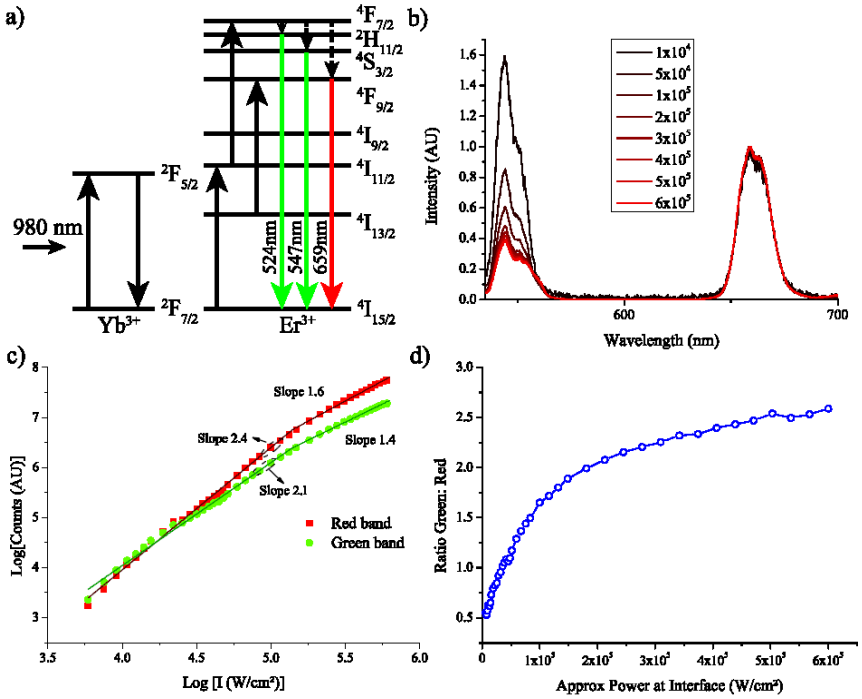


Figure 3 - (a) Er Yb energy levels (b) Nanoparticle emission in fiber, normalized to the peak value of the emission in the red (c) Variation in slopes for both red and green emission bands with varied exitation power. The legend shows the corresponding power at the interface (d) Ratio of green to red for same excitation power range as (c)

People and Progress

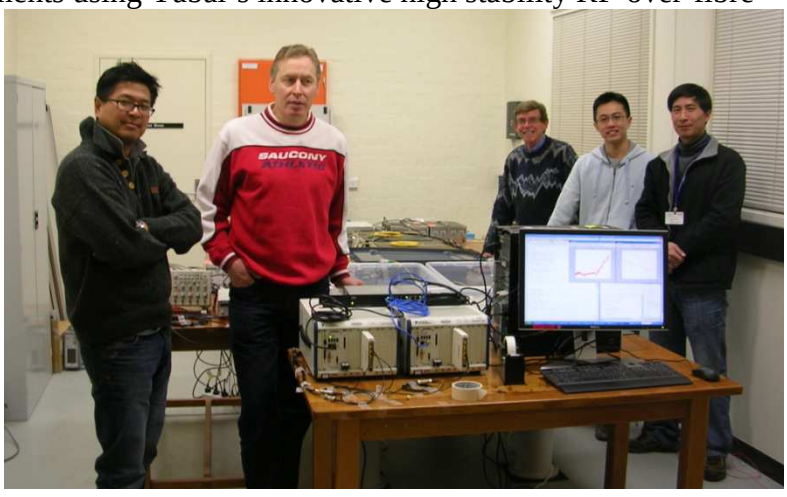
Progress on several fronts …

Brian Orr and his research colleagues have been progressing on several fronts and are associated with a total of six talks at the AIP2012 Congress at UNSW this month.

Work on Macquarie University's role in the CSIRO Sustainable Agriculture Flagship Livestock Research Methane Cluster (LMRC) involves **Yabai He**, **Ian Jamie** (CBMS) and visiting Chinese PhD student **Chunjiang Jin** from Hefei in Anhui province. They are developing novel multiplex fibre-coupled cavity ringdown spectroscopic (CRDS) sensors that will be used (together with various other sensing techniques provided by other LMRC participants) to monitor methane greenhouse gas emissions from cattle in extensive collaborative trials at a CSIRO agricultural field station near Armidale in February 2013.

Similar CRDS techniques might also be used to monitor methane greenhouse gas emissions from individually identified cows in a dairy herd, with prospects of future funding under the Department of Agriculture Fisheries and Forestry's "Filling the Research Gap" scheme within its Carbon Farming Futures program.

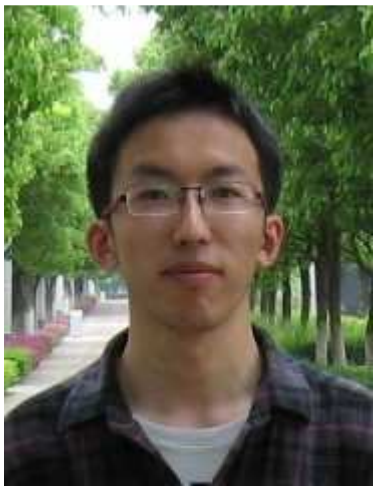
Brian Orr and **Yabai He** are also actively involved in a wide-ranging ARC Linkage Project collaboration, entitled "Creating a National Time and Frequency Network (NTFN) for Australia". This major project is proceeding well, with long-path (>100 km) experiments using Yabai's innovative high stability RF-over-fibre transfer technique recently performed in July and December using the ICON fibre-optical link in Canberra, in preparation for trials in collaboration with CSIRO CASS on north-western NSW radio telescopes at Mopra and Narrabri; these are planned in February and March 2013. The ultimate aim is high-fidelity transfer of Australia's time and frequency standards from the National Measurement Institute in West Lindfield across the continent to the recently approved Square Kilometre Array (SKA) radio astronomy facility. An expression of interest in the SKA Preconstruction Phase has just been approved, to give our Dept of Physics & Astronomy a likely role in the overall SKA project.



Jong Chow (ANU), Mal Gray (NMI), Brian Orr (MQ), Magnus Hsu (NMI) and Yabai He (MQ & NMI) in the lab at ANU after their initial RF-over-fibre experiments on the ICON link last July.

Another major activity for Brian and Yabai is an ongoing ARC Discovery Project, entitled "Using high-resolution lasers to test quantum electrodynamics," in collaboration with ANU. Their work on sub-Doppler two-photon spectroscopy of 33 Rydberg levels in atomic xenon excited at 205–213 nm has revealed diverse isotopic and hyperfine structure; a major paper is about to be submitted to in *J. Phys. B: At. Mol. Opt. Phys*.

Brian Orr



Welcome to **Yujia Liu**

Yujia is joining the Advanced Cytometry Labs as a cotutelle PhD candidate (home institution: Peking University and Shanghai Jiaotong University). Over the last three years, Yujia obtained comprehensive skills in multi-photon confocal microscopy. One of his best publications to date has appeared in PLoS ONE, "Achieving λ/10 Resolution CW STED Nanoscopy with a Ti:Sapphire Laser from a Two-photon Fluorescence Microscope"

http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0040003.

Yujia will spend two years at Macquarie and investigate lanthanide bioprobes for nanophotonics applications, with specific aim to establish new principle achieving low-power STED nanoscopic imaging. Welcome to MQPhotonics Research Centre! We wish him future success in developing an outstanding PhD thesis with more high impact publications!

Dayong Jin

Welcome to Zhizhong Yan

Zhizhong has recently joined the CUDOS@MQ group as an experimental postdoctorate researcher in quantum photonics. He previously worked in the group of Prof Thomas Jennewein at the University of Waterloo, Canada, both as a PhD student and later as a post-doc. Zhizhong has a strong track record developing single photon sources and single photon detection systems. I encourage you to ask him about his previous, extensive research activities.

Mick Withford

Welcome to Zachary Chaboyer

Zach has also recently joined the CUDOS@MQ group, in this case as a new PhD student also working in the field of experimental quantum photonics. Zach is also from Canada, having completed his BSc and MSc, the latter on fibre lasers and applications, at Lakehead University, Thunder Bay, Ontario. I recall from our (Mike Steel and I) first online meeting with Zach (12 months ago) that he has a particular fondness for shovelling snow at this time of year. I trust you will all make him feel welcome has he struggles to fill that void!

Mick Withford

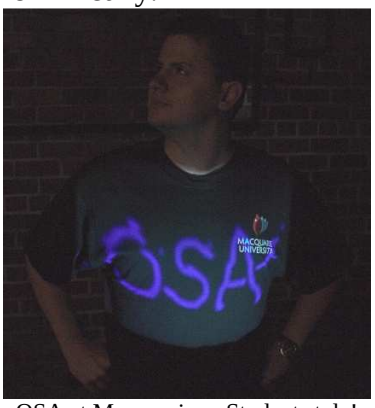
OSA Student Chapter Update

Astronomy Open Night

The Macquarie OSA student chapter was delighted to be involved in the Astronomy department's outstandingly successful open night. Nearly 1,000 people from the local community were in attendance so it was an excellent opportunity for some fun outreach. The MQ OSA setup 3 parallel sessions of laser graffiti, which attracted many curious passer-bys and also some amazing artists (see photos). This couldn't have been organised without the help of Alex Arriola, Nick Cvetojevic, Ondrej Kitzler and Tom Meany.

The guys...Working hard...

Fun outdoor artwork!



OSA at Macquarie.... Student style!

KOALA/ACOF student conference

Macquarie's OSA student chapter was proudly represented at the recent KOALA student conference held in Griffith University in sunny Brisbane. Highlights were a talk given by Ondrej Kitzler on what Macquarie University's Photonic Research centre has to offer students. In addition Ondrej and Ekaterina Ivukina both gave talks on their recent research. There were also plenty of poster presentations (Ali, Barbara, Jocelyn and Zakiah) and in particular Barbara Zittermann was awarded runner up for her poster entitled "Mode-locked deep UV lasers based on CE:LiCAF". Congrats Barb! MQ were also well represented at social events and outings sowing a wide array of skills such as hole digging and beer drinking...! Some great fun was had by all and thank you to our gracious hosts Griffith University OSA student chapter.

Our Barb, Proud as punch! (Left) Serious engineering projects Ozzie style (Middle) and tours of Griffith's state of the art Quantum Technology labs (right)

Enjoying the Koalas at Koala!

OSA Soccer Competition

The OSA held a soccer tournament was held this year with a great turnout and everyone from undergrads to lecturers got stuck in and had great fun! Apart from a few nasty tackles (blame the Germans...) it was a day to be remembered. The Winner was the team "No time for losers" ($50 and a trophy) and the best costume prize (cake made by "Team Cake") went to "OptChicas". Congrats guys!

No time for losers relishing victory! (left) OptChicas celebrating a well deserved best dressed! (middle) Serous talent on display, including Del Piero and Cahill up for a ball. (right)

A good day had by all....