

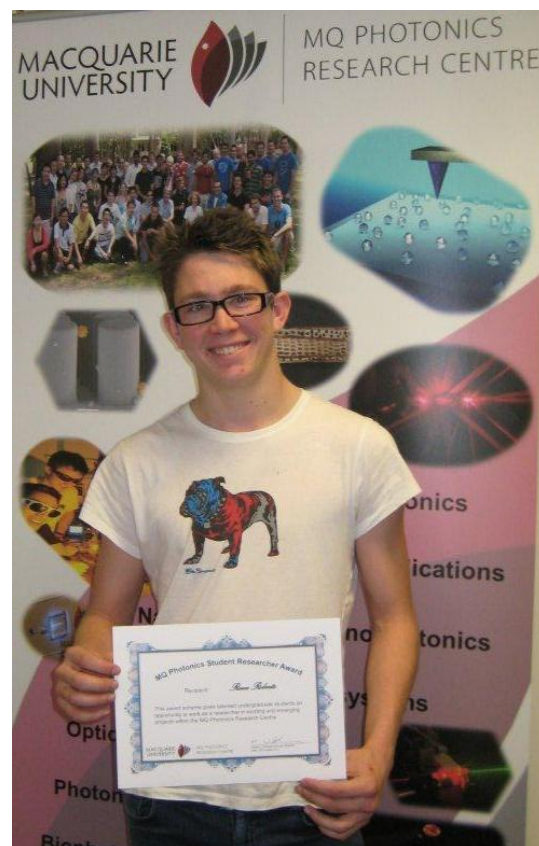
Focal Points

A new Centre initiative rolled out in July was the MQ Student Researcher Award. The intent of this scheme is to complement the Department Vacation Scholarship scheme by offering MQ Photonics staff members an alternative opportunity, namely one where they can apply for research funding on behalf of a particular undergraduate student. The overarching goal being to enhance our engagement with talented undergraduate students. The inaugural round for this scheme closed in August and I'm pleased to announce the winner is 3rd year student Reece Roberts who will be working with A/Prof Richard Mildren on Diamond Photonics. I hope this will be the first of many MQ Student Researcher Awards of this type.

Nemanja Jovanovic flew out last weekend to take on his new post-doctoral position at the Subaru Telescope, Hawaii. On behalf of all of MQ Photonics I would like to acknowledge and thank him for his contribution to Centre life. Noteworthy examples include his leadership establishing the OSA Student Chapter and his mentorship of many of our micro- and astro-photonics students.

MQ Photonics members (Ewa Goldys, Jin Dayong and I) will form part of a University delegation attending the CsC showcase and visiting several universities in China this October. This initiative represents a great opportunity to attract future postgraduate students, following on from Jin's success from a similar activity last year. I look forward to reporting on this in the next newsletter.

Michael Withford



Reece Roberts, winner of the MQ Student Researcher Award 2012

Conference Reports – and congratulations ...

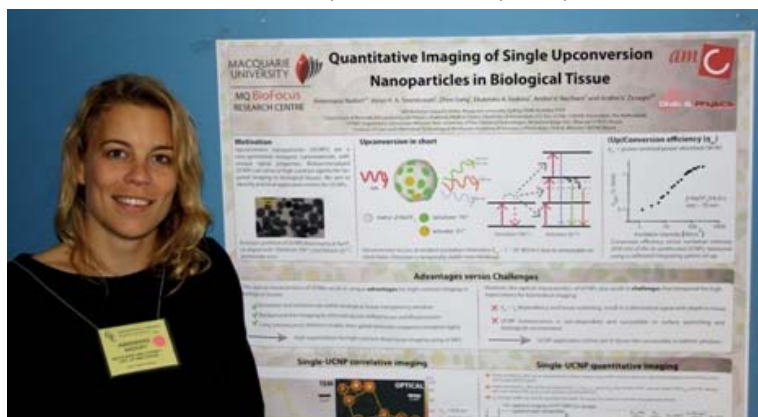


Gordon Research Conferences, Lasers in Medicine & Biology
Towards Molecular Imaging In Vivo
July 22-27, 2012 Holderness School, Holderness, NH, USA

Congratulations to Annemarie Nadort for winning the Outstanding Poster Award.

Title: Quantitative imaging of single upconversion nanoparticles in biological tissue

Authors: A Nadort, V K A Sreenivasan, Z Song, E A Ivukina, A V Nechaev, A V Zvyagin



The poster describes quantitative imaging of upconversion nanoparticles for biomedical applications. Upconversion nanoparticles are

a new-generation luminescent biocomplexes that can help to image biological targets with a superior contrast compared to conventional imaging techniques based on fluorescent agents. This is due to their unique optical properties, of which the most important property is the ability to emit light with higher energy than the absorbed light, at moderate excitation intensities. Upconversion nanoparticles can therefore offer ultrahigh sensitivity in clinically significant areas, such as in breast tumor imaging, as was presented in the poster.

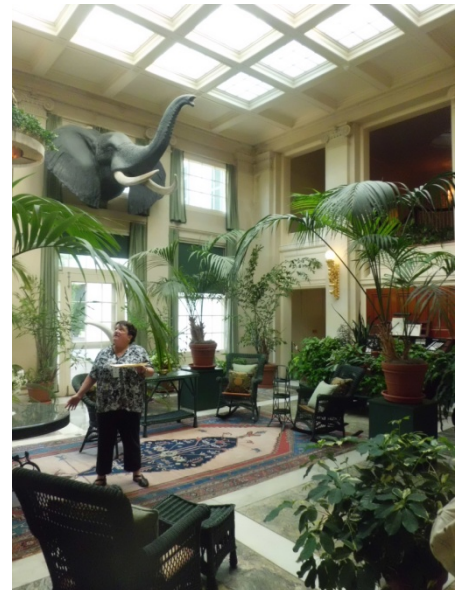


ICPEPA-8 8th International Conference on Photo-Excited Processes and Applications,
Rochester, USA, 12-17 Aug 2012

The core themes to this conference are laser induced ablation and material modification, and laser microfabrication. The conference has a particular emphasis on time resolved picosecond and femtosecond laser phenomena, and femtosecond laser processing. Many of my colleagues in femtosecond laser processing were in attendance as invited speakers, including Ajoy Kar, Koji Sugioka and Razvan Stoian from their respective institutions of Heriot Watt University (UK), RIKEN (Japan) and University of St. Etienne (France). Peter Balling (a past MQ Photonics visiting scholar) was also in attendance and conveyed his well-wishes to the group.

The location, close to the city of Rochester, also permitted a sobering opportunity to walk around the recently closed KODAK factory site and visit the stately home of its founder George Eastman. You will note from the left hand image the sad sight of a mostly empty car park that at one stage had to accommodate 10's of thousands of employees spread across several hectares of factory complex. I was also intrigued by George Eastman's breakfast atrium shown on the right as something to aspire to. Every morning at 7am Eastman would have his personal organist arrive at his home, sit at the organ behind the foliage on the right hand side of the image, do his best to second guess Eastman's mood as he walked from his bedroom to his breakfast table (the edge of which is to the left of the curator) and commence to play for the duration of his meal.

Michael Withford



Upcoming Conferences



Registrations are now open for the AIP Physics in Industry Day at CSIRO, Lindfield on Thursday 8th November. <http://physics-industry.com>

Great speakers has been lined up on the topic of Telecommunications – with a wealth of local excellence in science, commercialisation and infrastructure.

We would like to draw your attention to the Ken Doolan memorial poster prize for student research. It offers a generous prize of \$1000 for first place (and \$500 and \$250 for 2nd and 3rd). With a maximum of 30 entrants the competition represents an exceptional winning opportunity.

Details at: <http://physics-industry.com/2012-Competition.html>

Deb Kane



Early Bird Registration will close on 12th October, see website for more details: <http://www.aip2012.org.au/>

Brian Orr

Publications

Recently published articles

A J Lee, H M Pask, D J Spence, “Control of cascading in multiple-order Raman lasers”, *Optics Letters* 37 (18), 3840-3842 (2012)

Abstract: In this work we explore a method for controlling Raman cascade within an intracavity Raman laser, with a view to maximising output power at desired visible wavelengths. Sum-frequency-generation (SFG) is used to suppress unwanted Stokes orders, and prevent their build up. Using this method to control the Raman cascade, we demonstrate increases in output power of 40% at 532 nm, 42% at 559 nm, and 67% at 586 nm.

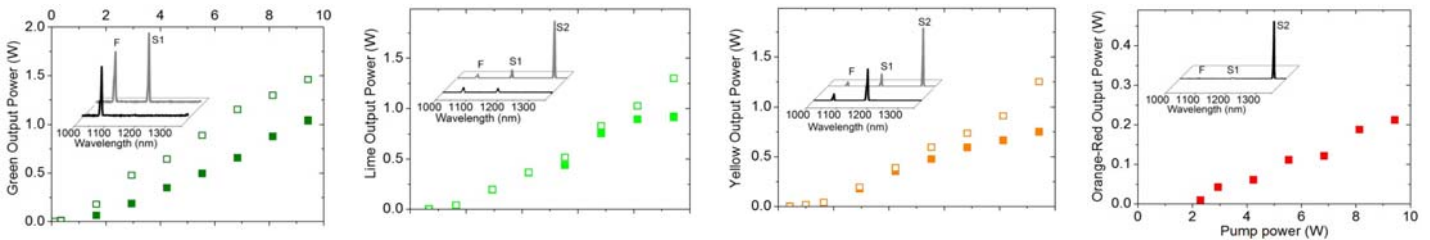


Fig. 2. (Color online) Plots showing power scaling at each visible wavelength as a function of absorbed pump power with and without Stokes cascade control, open and closed squares respectively. Inset are plots of residual IR fields observed through M2 for 8 W absorbed pump with and without Stokes cascade control, black (lower) and grey (upper) lines respectively.

X Li, A J Lee, Y Huo, H Zhang, J Wang, J A Piper, H M Pask, D J Spence, “Managing SRS competition in a miniature visible Nd:YVO₄/BaWO₄ Raman laser”, *Optics Express* 20, 19305-19312 (2012)

Abstract: We demonstrate the operation of a compact and efficient continuous wave (CW) self-Raman laser utilising a Nd:YVO₄ gain crystal and BaWO₄ Raman crystal, generating yellow emission at 590 nm. We investigate the competition that occurs between Stokes lines in the Nd:YVO₄ and BaWO₄ crystals, and within the BaWO₄ crystal itself. Through careful consideration of crystal length and orientation, we are able to suppress competition between Stokes lines, and generate pure yellow emission at 590 nm with output power of 194 mW for just 3.8 W pump power.

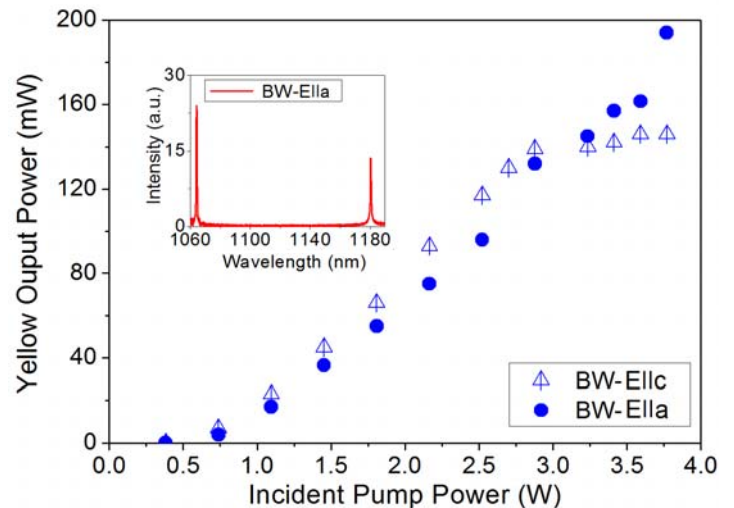


Fig.4 Yellow laser performance with crystal combination of 1 mm-long Nd:YVO₄ and 3 mm-long BaWO₄, oriented with the fundamental field polarized along its a-axis (circles), and its c-axis (umbrellas). Shown inset is a spectrum of the IR wavelengths leaking from the output coupler at maximum pump power.

D J Spence, X Li, A J Lee, H M Pask, “Modeling of wavelength-selectable visible Raman lasers”, *Optics Communications* 285, 3849-3854 (2012)

Abstract: We derive a numerical model of visible Raman lasers that employ simultaneous intracavity Raman shifting and intracavity second-harmonic or sum-frequency generation. We show excellent agreement with previous experimental results, and explain the mechanism by which sum-frequency generation can inhibit the generation of the Stokes field. We predict that increased output powers should be achieved using unusually short crystals of only few millimeters length.

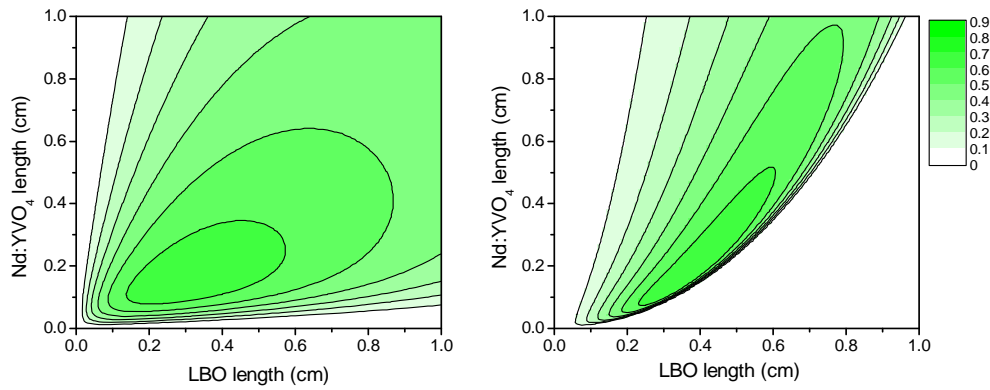
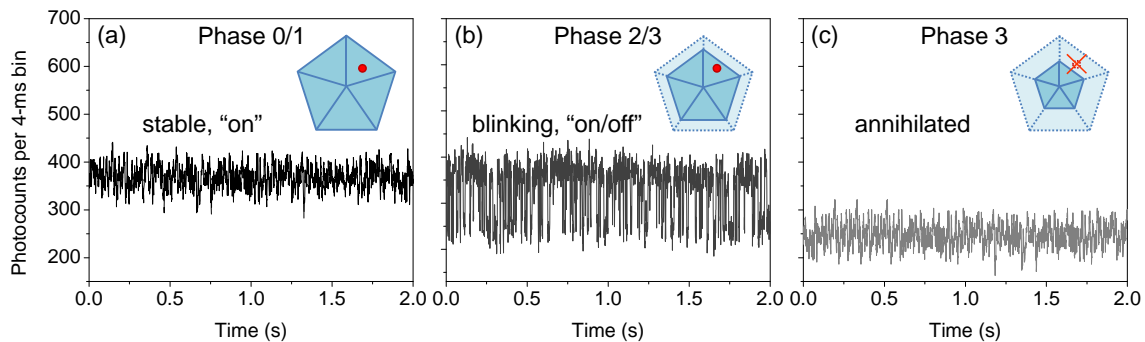


Fig. 5. Theoretical predictions for yellow (left) and lime (right) power output (watts) from the laser as a function of the LBO length and Nd:YVO₄ length. Note that as the crystal lengths change, the pump absorption and cavity losses are scaled accordingly, but the mode size is fixed.

Recently accepted articles

C Bradac, T Gaebel, C I Pakes, A V Zvyagin, J R Rabeau, “Effect of the nanodiamond host on a nitrogen-vacancy colour-centre emission state”, *Small*, accepted 22nd August 2012

Abstract: Controlling the quantum states of an individual luminescent nitrogen-vacancy (NV) colour-centre in a nanodiamond demands careful design of the crystal host, with the key parameters being size, surface functional groups and interfacing substrate. Firstly, we demonstrate the possibility of such control over the emission of NV centres in nanodiamonds (NDs). Progressive etching of the nanodiamond host allowed switching the NV centre from latent (“off”), through continuous (“on”) emission states to intermittent (“blinking”). The “on”, “off” and “blinking” states could be selected by redressing the ND surface functional groups. Secondly, we elucidate the blinking mechanism of NV centres in nanodiamonds, where effects of the surface, substrate, and NV proximity to these are scrutinised. A qualitative model of the NV centre fluorescence intermittency in nanodiamonds based on its electron(s) tunnelling to acceptor site(s) appears to explain the critical dependence of blinking phenomenon on the substrate material and its proximity to the NV centre. The blinking NV tunneling barrier was estimated in the framework of this model.



People and Progress

Welcome to **Dr. Run Zhang**, a synthetic chemist, is joining the Advanced Cytometry Labs on a postdoctoral research fellow appointment. Dr. Zhang received his B. Sc. degree (2006) in Applied Chemistry from Changchun Institute of Technology and Ph. D degree (2012) in Analytical Chemistry from Dalian University of Technology under the supervision of Macquarie's long-term collaborator Prof. Jingli Yuan. Dr. Zhang's PhD focused on the synthesis of transition metal complexes, and their application as molecular biosensors in cell biology. He succeeded in several smart biosensors using Ruthenium chelating complexes in the field of responsive bioprobes. This series of molecularly-specific biosensors (nine journal publications) are targeting the biomedically important molecules in the cardiovascular, immune, and nervous systems, as well as biosensors for photodynamic therapy. As an example, during cancer chemo-/radio-therapies the drugs will generate significant amounts of reactive oxygen/nitrogen species to kill tumor

cells, but it is also critical to maintain a good balance and minimize the side-effects to damage too many normal healthy cells. Therefore, quantitative monitoring of these species is essential to guide clinical decisions of the amount of drugs to be applied to the patients. Dr. Zhang is sitting in E7B room 165. Welcome! and we wish him future success in both research and fellowship applications.



Dayong Jin

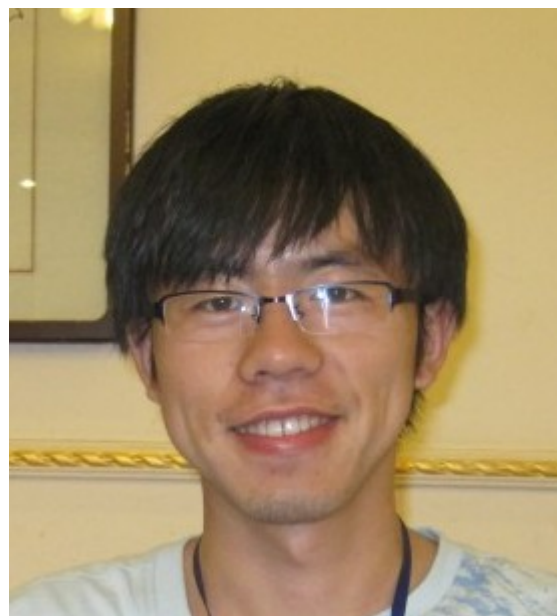


Welcome to **Lennart Piro**, who is spending a couple of months doing an internship with us in CUDOS. He is completing a BSc majoring in Physics at Karlsruhe Institute of Technology, and is sponsored by DAAD during his stay. Lennart will be working on amplifying surface plasmons with Thanh Phong Vo, Judith Dawes et al.

Please make him welcome!

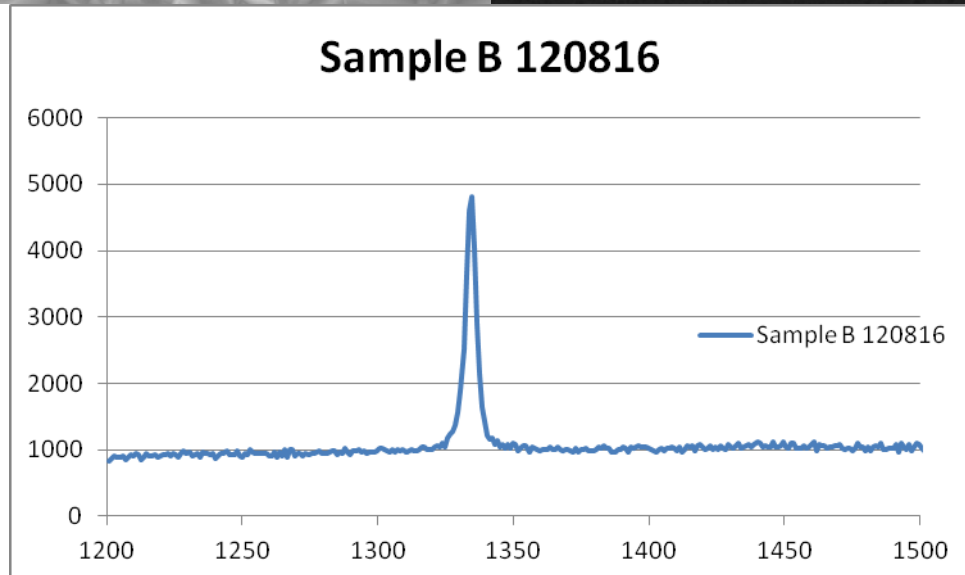
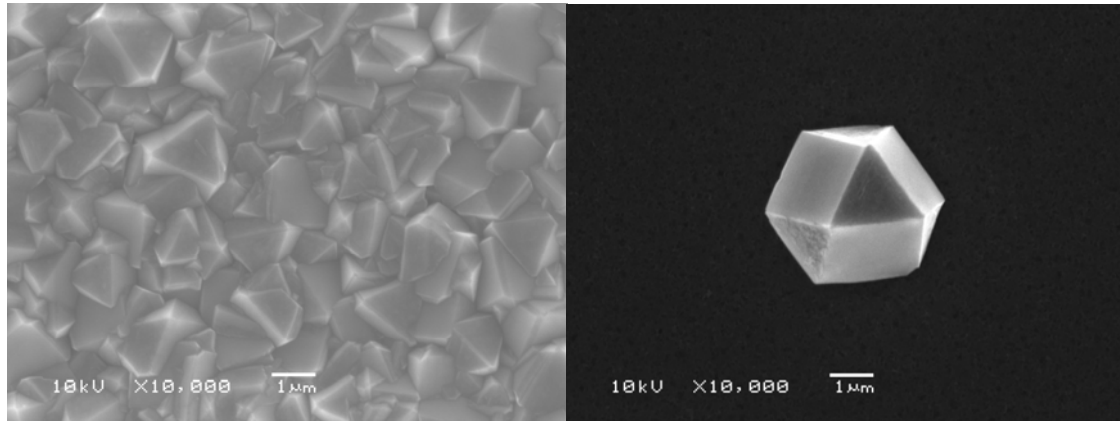
Judith Dawes

Welcome to **Deming Liu**, who has received competitive scholarships from both Chinese Scholarship Council and Macquarie University, and joined the Advanced Cytometry Labs as a PhD candidate (Prof. Ewa Goldys and myself as supervisors). Deming received his B. Sc. degree (2009) in Micro-electronics and M. Sc. degree (2012) in Nanomaterial Sciences from Jilin University (the largest Chinese University, Ranked as # 76 in Chemistry in Academic Ranking of World Universities). Deming will be working on an exciting project to challenge both advanced syntheses to demonstrate the brightest upconversion nanocrystals and new applications for cellular and molecular diagnostics in the context of high-speed cytometry. Deming is sitting in room 165 E7B, Tim Zhao's desk (Tim moved to room 363 E7B). We wish Deming an outstanding PhD thesis with lots of high impact publications in 3.5 years!



Dayong Jin

Diamond Facility of OptoFab @ MQ has successfully grown some large area diamond films (see left-hand image) as well as individual particles (see right-hand image) on various substrates including silicon and quartz. The diamond characteristic has been confirmed by Raman Spectroscopy and Scanning Electron Microscopy. Dr. Peter Ha as the Diamond growth facility manager said “This is only the beginning, we are continuing to expand our capability and we anticipated to be able to provide services to a wide range of industries and universities.” For more information, please visit the facility website <http://optofab.org.au/diamondCVD.html> or contact Dr. Peter via email: peter.ha@mq.edu.au



Peter Ha

Macquarie OSA Student Chapter

The OSA student chapter has conducted a number of outreach activities in the last few weeks, the biggest of which was a visit to the German International School in Terry Hills. We set up the laser maze, laser graffiti, and laser telephone in the gymnasium along with a small talk. It was highly successful, entertaining and educating kids ranging from kindergarten to year 11, a testament to the quality and versatility of the activities.

Coming up, we have a number of activities, so start saving the dates!

- OSA Soccer tournament is on the 4th of October, contact Barbara or Annemarie to enter your teams (barbara.zittermann@mq.edu.au, annemarie.nadort@mq.edu.au) and enjoy the costumes, prizes, and beer... and if there is time, soccer.
- Astronomy Open Night is on the 12th of October, where we will be setting up a number of parallel Laser Graffiti activities. No laser maze this year I am afraid, a thousand kids running around in the dark is getting a bit much to handle.
- Also, stayed tuned for a possible trip to see the total solar eclipse on Nov 14th in Queensland.

Lastly, I wish to let you know that the OSA has elected new ~~imperial council~~ officers. Henrique Baltar remains our secretary, consolidating the roll of webmaster as well, with Ondrej Kitzler taking over as treasurer from Geraldine Marien. Barbara Zittermann is our new vice president, and Thomas Meany takes over my position

as OSA student chapter president.

Thanks to all the previous officers for your work and dedication, to the department staff for their support, and the best of luck to the new members!

Nick Cvetojevic
OSA Student Chapter President

Below are photos from MQ Open Day on 8th of Sep, where the laser maze and laser graffiti was demonstrated in the 2nd year physics labs. **Thank you to all the volunteers** on the day.

