MACQUARIE UNIVERSITY | MQ PHOTONICS RESEARCH CENTRE

NEWSLETTER

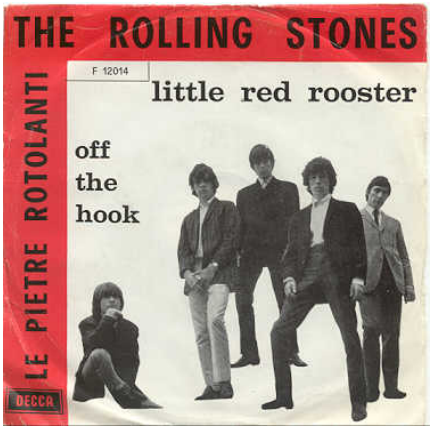
Issue 18 – 10 May 2009

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. every 3rd Tuesday. **Next due date: Tue 30 June '09.**

Focal Points

MQ Photonics Newsletter approaching its first anniversary ...

Our *Newsletter* is approaching its first anniversary, given that Issue 1 was released on 18 June 2008. In introducing that first *Newsletter*, I wrote that it is intended to "keep us up-to-date and in touch with what is going on" and "a popular initiative when it was suggested at a *MQ Photonics* staff meeting". I also expressed the "hope that everyone who wants it to be successful will do their bit by contributing copy to Liz Bignucolo ... I trust that she will not get to feel like the Little Red Hen (if you recall the story) …". I could add that I was not keen myself to feel like the Little Red Rooster! In fact, *Newsletter* production has proved to be rather time-consuming and to divert us from getting a few other things done in a timely fashion. The central question is whether it is all worth doing. We did a bit of soul-searching in this regard in August/September 2008 (Issues 6 & 7) and concluded that it was. Unless we hear otherwise, we presume that this is still the case!



en.wikipedia.org/wiki/Little_Red_Rooster

During the last 12 months, the *Newsletter* has undergone a few superficial changes (*e.g.*, the dread logo saga!) and has evolved progressively but it has maintained much of its original concept and purpose. I am still concerned and disappointed that it often proves very difficult to gather comprehensive information about *MQ Photonics* activities (*e.g.*, latest publications, seminars, visitors, etc.) and that some of us have to chase others of us to do their bit. But at least it's not as bad as the farmyard in which the Little Red Hen found herself!

A bumper issue of *AOS News* ...

The May 2009 issue of *AOS News* contains several contributions from *MQ Photonics* members: an article on mode-locked Ce lasers by Eduardo and the two Daves, a report on PECS VIII by Mike and a review of *Science Meets Parliament* by Judith Dawes. By the way, have you renewed your AOS membership?

DSTO Workshop and MQ lab visit by The Technical Cooperative Program (TTCP)…

MQ Photonics featured strongly at the recent Workshop held at the DSTO, Adelaide. This Workshop was followed by a tour of many of the MQ Photonics by a TTCP delegation including representatives from the US, UK and Canada. Dr Ken Grant has passed on his appreciation for all those who participated.

The midyear conference Exodus is underway ...

The customary season of summer conferences north of the Equator is underway, with the result that we have been having a busy time with practice talks (which, everybody knows, I insist are a Very Good Thing!) and farewelling people bound to attend those conferences. We wish everyone involved safe travel, successful conference presentations, eye-opening experiences, and return with renewed enthusiasm ...

Incidentally, Judith Dawes has sent us a brief account of her experiences at the CLEO/IQEC conference in Baltimore last week. Judith writes:

> "A number of *MQ Photonics* people have just finished their presentations at CLEO/IQEC in Baltimore. The conference was busy, with talks in 14 parallel sessions from morning to night, and the exhibit hall offered some nice displays. Baltimore was Baltimore, with warm humid weather and some rain. We caught up with old friends and made some new ones, and perhaps we will come again next year!"

Changing of the guard ...

Firstly, Mark Wardle's term as Head of Department of Physics & Engineering and the Mathematics, Physics & Engineering Cluster has come to an end and he has handed over responsibilities to our own David Coutts. We thank Mark for his much-appreciated service on behalf of us all and wish David well as he faces a similarly daunting task! I think they both know that they are assured of strong support from us in *MQ Photonics*.

Secondly, most of you already know that I shall be joining the above-mentioned midyear conference Exodus to attend CLEO-Europe in Munich, followed by a substantial period of Annual Leave in Europe. While I am away, Mick Withford has kindly agreed to serve as Acting Director of the *MQ Photonics* Research Centre. I

am sure that he will keep the wheels rolling with your cooperation (including taking charge of this and the next 2 or 3 issues of the Newsletter). I expect to be away from the internet for substantial periods while we are on vacation – Liz will know about my accessibility. I shall do my best to keep an eye on Centre of Excellence developments (if any) and be ready for the fray when I get back.

Brian Orr

Fresh vistas – focus on Astrophotonics

This issue of the *MQ Photonics Newsletter* features Astrophotonics – the most recent addition to *MQ Photonics*'s research focus areas. Jon Lawrence has written something to keep us informed. Please note, too, that Jon has a number of new publications listed later in this issue. The AAO are also in a stronger financial position following the recent announcement of the next Federal Budget. This will hopefully result in new opportunities to build strategic links between the AAO and MQ Photonics.

Mick Withford

Astrophotonics and Antarctic astronomy

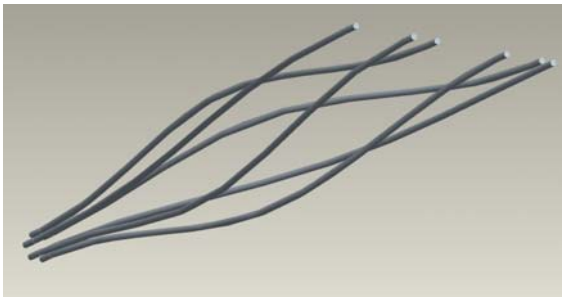
This is a belated introduction (after starting my joint MQ/AAO position in January) aiming to give an idea of my research plans. Firstly, one of my priorities is to take advantage of the wealth of experience of the *MQ Photonics* researchers in the area of ultrafast direct laser writing of waveguides. I am keen to study this technique's potential to provide devices, such as image slicing units and integrated or micro-spectrometers, that will radically improve the capabilities of astronomical instruments.

In addition, I am currently working on several astrophotonics projects in collaboration with the Anglo-Australian Observatory and the University of Sydney. Projects include fibre Bragg gratings for suppression of atmospheric OH emission at near-IR (1–2.5 μm) wavelengths, the application of fibre Bragg gratings for high-resolution temporal spectral astronomy, the use of planar arrayed-waveguide gratings as miniature spectrometers, and pupil reformatting devices for stellar interferometry.

Finally, I have spent the last 8 years working in the field of Antarctic astronomy at the University of New South Wales. I intend to continue this collaboration with a view to ensuring that MQ and the AAO have a role to play in any future large-scale astronomical facility on the Antarctic plateau. There are currently two main projects (for which a series of papers are now in press) that I am involved in: the PILOT optical/infrared telescope at Dome C and the PLATO observatory at Dome A. What has Antarctic astronomy got to do with photonics? – well obviously it's a stretch but "it's all about photons right".

Jon Lawrence

Concept design for the 2.5 metre diameter optical/IR PILOT telescope, enclosure & 30 m high tower



Concept design for a 3-dimensional integrated pupil remapping device for an astronomical telescope, consisting of a series of waveguides fabricated via ultrafast direct laser writing.

Fresh vistas – ACOLS/ACOFT 09 Call for Papers (due 3 August)

More information: **http://www.plevin.com.au/acoftacols2009/**

Publications

Recently published articles:

J.S.Lawrence, M.C.B.Ashley, S.Hengst, D.M.Luong-Van, J.W.V.Storey, H.Yang, X.Zhou, Z. Zhu, "The PLATO Dome A site-testing observatory: Power generation and control systems", *Review of Scientific Instruments*, 80, 064501, 2009.

Abstract: The atmospheric conditions above Dome A, a currently unmanned location at the highest point on the Antarctic plateau, are uniquely suited to astronomy. For certain types of astronomy Dome A is likely to be the best location on the planet, and this has motivated the development of the Plateau Observatory PLATO. PLATO was deployed to Dome A in early 2008. It houses a suite of purpose-built site-testing instruments designed to quantify the benefits of Dome A site for astronomy, and science instruments designed to take advantage of the observing conditions. The PLATO power generation and control system is designed to provide continuous power and heat, and a high-reliability command and communications platform for these instruments. PLATO has run and collected data throughout the winter 2008 season completely unattended. Here we present a detailed description of the power generation, power control, thermal management, instrument interface, and communications systems for PLATO, and an overview of the system performance for 2008.

Recently accepted / in-press articles:

M. V. Rybin, **A. B. Khanikaev**, M. Inoue, K. B. Samusev, **M. J. Steel**, G. Yushin, M. F. Limonov, "Fano Resonance Between Mie and Bragg Scattering in Photonic Crystals", accepted, *Physical Review Letters*.

Abstract: We report the observation of a Fano resonance between continuum Mie scattering and a narrow Bragg band in synthetic opal photonic crystals. The resonance leads to a transmission spectrum exhibiting a Bragg dip with an asymmetric profile, which can be tunably reversed to a Bragg rise. The Fano asymmetry parameter is linked with the dielectric contrast between the permittivity of the filler and the specific value determined by the opal matrix. The existence of the Fano resonance is directly related to disorder due to non-uniformity of *a*-SiO_2 opal spheres. Proposed theoretical "quasi-3D" model produces results in excellent agreement with the experimental data.

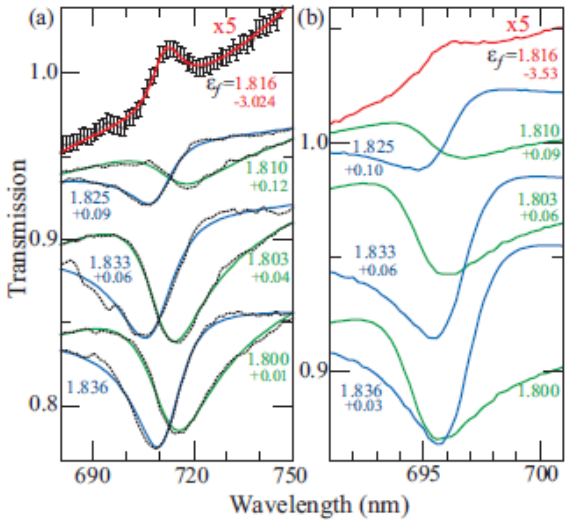


FIG. 3: (color) (a) The transmission spectra of an opal sample (D=316 nm, thickness ≈ 0.6 mm) as a function of the filler permittivity εf in the region of the (111) photonic band (black curves). The color curves (red, blue and green) are the results of fitting with a Fano function. (b) The results of calculations of the transmission spectra using the "quasi-3D" model of disordered opal structure described in the text: number of layers was taken to be 1000 and averaging was done over 40000 realizations for εf =1.816 and 10000 realizations for other values of εf . In (a) and (b) the curves are shifted vertically by the values shown.

J.S.Lawrence, M.C.B.Ashley, J.Bailey, D.Barrado y Navascues, T.Bedding, J.Bland-Hawthorn, I.Bond, F. Boulanger, R.Bouwens, H.Bruntt, A.Bunker, D.Burgarella, M.G.Burton, M.Busso, D.Coward, M.-R.Cioni, G. Durand, C.Eiroa, N.Epchtein, N.Gehrels, P.Gillingham, K.Glazebrook, R.Haynes, L.Kiss, P.O.Lagage, T.Le Bertre, C.Mackay, J.P.Maillard, A.McGrath, V.Minier, A.Mora, K.Olsen, P.Persi, K.Pimbblet, R.Quimby, W. Saunders, B.Schmidt, D.Stello, J.W.V.Storey, C.Tinney, P.Tremblin, J.C.Wheeler, P.Yock, "The Science Case for PILOT I: Summary and Overview", accepted, *Publications of the Astronomical Society of Australia*, (preprint: arXiv:0905.4432), 2009.

Abstract: PILOT (the Pathfinnder for an International Large Optical Telescope) is a proposed 2.5 m optical/infrared telescope to be located at Dome C on the Antarctic plateau. Conditions at Dome C are known to be exceptional for astronomy. The seeing (above ~30 m height), coherence time, and isoplanatic angle are all twice as good as at typical mid-latitude sites, while the water-vapour column, and the atmosphere and telescope thermal emission are all an order of magnitude better. These conditions enable a unique scientific capability for PILOT, which is addressed in this series of papers. The current paper presents an overview of the optical and instrumentation suite for PILOT and its expected performance, a summary of the key science goals and observational approach for the facility, a discussion of the synergies between the science goals for PILOT and other telescopes, and a discussion of the future of Antarctic astronomy. Paper II and Paper III present details of the science projects divided, respectively, between the distant Universe (i.e., studies of first light, and the assembly and evolution of structure) and the nearby Universe (i.e., studies of Local Group galaxies, the Milky Way, and the Solar System).

J.S.Lawrence, M.C.B.Ashley, A.Bunker, R.Bouwens, D.Burgarella, M.G.Burton, N.Gehrels, K.Glazebrook, K.Pimbblet, R.Quimby, W.Saunders, J.W.V.Storey, J.C.Wheeler, "The Science Case for PILOT II: the Distant Universe", accepted, *Publications of the Astronomical Society of Australia*, (preprint: arXiv:0905.4616), 2009.

Abstract: PILOT (the Pathfinder for an International Large Optical Telescope) is a proposed 2.5 m optical/infrared telescope to be located at Dome C on the Antarctic plateau. The atmospheric conditions at Dome C deliver a high sensitivity, high photometric precision, wide-field, high spatial resolution, and high-cadence imaging capability to the PILOT telescope. These capabilities enable a unique scientific potential for PILOT, which is addressed in this series of papers. The current paper presents a series of projects dealing with the distant (redshift > 1) Universe, that have been identified as key science drivers for the PILOT facility. The potential for PILOT to detect the first populations of stars to form in the early Universe, via infrared projects searching for pair-instability supernovae and gamma-ray burst afterglows, is investigated. Two projects are proposed to examine the assembly and evolution of structure in the Universe: an infrared survey searching for the first evolved galaxies at high redshift, and an optical survey aimed at characterising moderate-redshift galaxy clusters. Finally, a large-area weak-lensing survey and a program to obtain supernovae infrared light-curves are proposed to examine the nature and evolution of dark energy and dark matter.

J.S.Lawrence, M.C.B.Ashley, J.Bailey, D.Barrado y Navascues, T.Bedding, J.Bland-Hawthorn, I.Bond, H. Bruntt, M.G.Burton, M.-R.Cioni, C.Eiroa, N.Epchtein, L.Kiss, P.O.Lagage, V.Minier, A.Mora, K.Olsen, P. Persi, W.Saunders, D.Stello, J.W.V.Storey, C.Tinney, P.Yock, "The Science Case for PILOT III: the Nearby Universe", accepted, *Publications of the Astronomical Society of Australia*, (preprint: arXiv:0905.4636), 2009.

Abstract: PILOT (the Pathfinder for an International Large Optical Telescope) is a proposed 2.5 m optical/infrared telescope to be located at Dome C on the Antarctic plateau. The atmospheric conditions at Dome C deliver a high sensitivity, high photometric precision, wide-field, high spatial resolution, and high-cadence imaging capability to the PILOT telescope. These capabilities enable a unique scientific potential for PILOT, which is addressed in this series of papers. The current paper presents a series of projects dealing with the nearby Universe that have been identified as key science drivers for the PILOT facility. Several projects are proposed that examine stellar populations in nearby galaxies and stellar clusters in order to gain insight into the formation and evolution processes of galaxies and stars. A series of projects will investigate the molecular phase of the Galaxy and explore the ecology of star formation, and investigate the formation processes of stellar and planetary systems. Three projects in the field of exoplanet science are proposed: a search for free-floating low-mass planets and dwarfs, a program of follow-up observations of gravitational microlensing events, and a study of infrared light-curves for previously discovered exoplanets. Three projects are also proposed in the field of planetary and space science: optical and near-infrared studies aimed at characterising planetary atmospheres, a study of coronal mass ejections from the Sun, and a monitoring program searching for small-scale Low Earth Orbit satellite debris items.

Seminars and Visitors

MQ Photonics Seminars:

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: to be advised

People and Progress

Baby Jessica ...

The following e-mail (27 May) from David Spence says it all. Mother Kristie is well known to most of us as a *MQ Photonics* researcher, too! We have great hopes for Jessica ...

"Hello all!

"Introducing Jessica Amy, born on 26th May at 9:30 am, 45 minutes after arriving at Manly hospital.

"She is a week premature, 3.05kgs and 55 cm tall already.

"She's the slightly less hairy one at the front. Mother and baby (and dad) doing well if a bit stunned.

"Thanks for all the messages, we'll speak to you all soon when we get it all together and have a decent phone line ...

"Dave and Kristie and Jessica"

Latest reports from Dave (who was in at MQ the other day) is that they are all doing well.

Brian Orr

Macquarie OSA student chapter – update for June

The end of the 1st teaching semester of 2009 is over. With it, the first semester of outreach activities run by the Macquarie OSA student chapter has also concluded. The first semester was jam packed including events such as:

- two talks by University of Sydney students followed by pizza sessions,
- talks by international guests,
- a tour of the Finisar labs,
- a BBQ,
- lab tours of the MQ labs,
- and last but not least, an optics and photonics trivia night.

With each event the chapter managed to draw more and more undergraduates, who left from each event invigorated, enthusiastic and asking for the next event. I believe we have managed to finally reach the undergraduates and create a relaxed social network in which the undergraduates are willing to engage and learn on a regular basis.

With the next Chapter President, Alex Butler, elected to take up the role from August, the second teaching semester promises to be even more successful than the first. I would like to take this opportunity to thank all the staff and OSA student chapter members who have helped us with organizing and running our events and look forward to your cooperation in the future.

Nemanja Jovanovic

MQ Photonics postgrads and undergraduate students outside the Finisar facility prior to their tour.