AOS News

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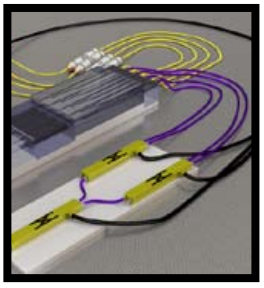
AUSTRALIAN OPTICAL SOCIETY



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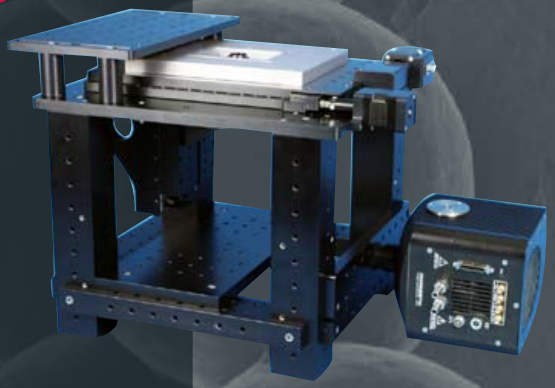

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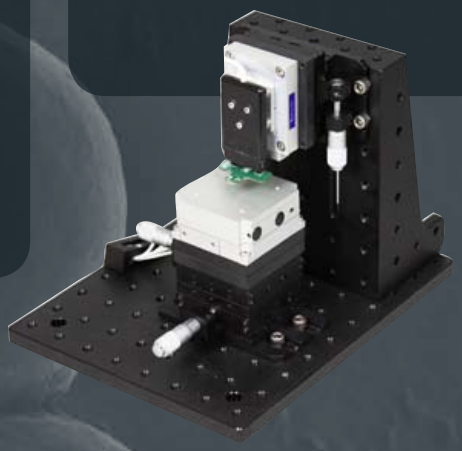

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Submission guidelines

The AOS News is always looking for contributions, especially from AOS members. Here is a short summary of how to make a submission.

How can you submit?

► The easiest way is by email. We accept nearly all file formats. (Famous last words!).

► Submitted articles will be imported into an Adobe InDesign file. It is best if the diagrams and other graphics are submitted as separate files. All common graphics formats are acceptable, but the resolution must be in excess of 300d.p.i.. Be aware that all colour diagrams will be rendered in grayscale, so if you do use colours, choose colours that show up well in grayscale.

► When using Greek letters and mathematical symbols, use font sets such as Symbol or MT Extra. Please avoid using symbols that are in Roman fonts, where the Option or Alt key is used; e.g. Opt-m in Times font on the Mac for the Greek letter mu.

► If using TeX, use a style file similar to that for Phys Rev. Letters (one column for the title, author and by-line, and two for the main body). The top and bottom margins must be at least 20mm and the side margins 25mm. Submit a pdf file with the diagrams included (no page numbers), as well as copies of the diagrams in their original format in separate files.

► If using a word processor, use a single column. If you do include the graphics in the main document, they should be placed in-line rather than with anchors, but must be submitted separately as well.

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- Review Article

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- Conference Report
- News Item
- Book Review
- Cartoon or drawing

Reviewing of papers

On submission of a scientific or review article you may request that the paper be refereed, and if subsequently accepted it will be identified as a refereed paper in the contents page. The refereeing process will be the same as for any of the regular peer reviewed scientific journals. Please bear in mind that refereeing takes time and the article should therefore be submitted well in advance of the publication date.

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Articles

Departments

Cover Pictures:

- Photonis showcase, Sydney, see page 9.
- Insets (left to right)
  - Hybrid photonic circuit for multiplexed single photon sources, see page 14.
  - 2014 OSA President Phil Bucksbaum and 2014 SPIE President Phil Stahl attend ANZCOP, see page 33.
  - The first Single Point Diamond Turning machine in Australia., see page 27.

Submission Of Copy:
Contributions on any topic of interest to the Australian optics community are solicited, and should be sent to the editor, or a member of the editorial board. Use of electronic mail is strongly encouraged, although submission of hard copy together with a text file on CD will be considered.

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Copy Deadline
Articles for the next issue (June 2014) should be with the editor no later than 15 May 2014, advertising deadline 8 May 2014.

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AOS News is the official news magazine of the Australian Optical Society. The views expressed in AOS News do not necessarily represent the policies of the Australian Optical Society.

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President's Report

It is worth taking time out from writing grant proposals to reflect on some of the activities of the past few months. I was delighted to be able to meet a wide range of AOS members at the Australian and New Zealand Conference on Optics and Photonics (ANZCOP) in December in gorgeous Fremantle. The conference was an outstanding opportunity to see the breadth and depth of optics research from Australia and New Zealand as well as to hear from international speakers including three outstanding plenary lecturers. The tutorial sessions were much appreciated by all who attended. Thank you to David Sampson, Michael Withford, Cather Simpson and Robert McLaughlin, along with all the members of the organising and technical program committees, for all their hard work on putting together an excellent program. The ongoing underwriting arrangements with Engineers Australia in their support of ACOFT are also much appreciated. The AOS members' networking breakfast during ANZCOP was well-attended and this was a lovely opportunity to touch base with a broad range of our membership. It was an absolute delight to present the AOS (Beattie Steel) Medal to John Harvey, the Geoff Opat ECR Award to Igor Aharonovich and the Warsash Science Communication Prize to Matt Collins at the conference dinner. John and Igor gave outstanding invited lectures on their work during the conference and we have an article from Matt in this issue of the AOS News.

The AOS Council was very busy during the conference with a Council meeting as well as other discussions with representatives of the leadership of the OSA and SPIE. Meetings were held with Professor Phil Bucksbaum (2014 President of the OSA) and Dr Phil Stahl (2014 President of the SPIE) and Dr Andrew Brown (Senior Director, SPIE Global Business Development). These very constructive meetings explored a range of issues: conferences, student chapters and other initiatives for early career researchers, the International Year of Light and membership benefits. In association with our student chapters, I was also delighted to host Professor Bucksbaum who visited Melbourne OSA Student Chapters the week before ANZCOP. After a tour of the School of Physics at the University of Melbourne, Professor Bucksbaum gave an entertaining lecture to members of various Melbourne student chapters, which was followed by a BBQ and a visit to RMIT.

Over the next few weeks, those of us working in universities will be welcoming large numbers of new and returning students. Some will be looking to major in physics, engineering or another technical discipline, but many will be taking subjects including optics to support further studies in the life and environmental sciences, medicine, optometry or other discipline. This is an ongoing reminder of the enabling nature of optics as a discipline and its impact on broader society. On 20 December 2013 the United Nations proclaimed 2015 the International Year of Light and Light-based Technologies (IYL). This built on the work of numerous organisations (including the AOS) that sponsored the initiative and the support of UNESCO which was announced in 2012. The AOS, the Australian Institute of Physics and other scientific groups and societies will be looking to celebrate light and establish partnerships with cultural organisations and industry to promote the central role of light in society to the wider public. The establishment of an Australian Steering Committee for the IYL is well underway. The AOS will be looking to use our web site (optics.org.au) and our LinkedIn group to communicate with AOS members, and an email address: light2015@aip.org.au has been set-up for anyone interested in communicating with the Steering Committee. The IYL promises to be an exciting year!

—Ann Roberts
AOS president

Editor's Intro

Welcome to the first AOS News of 2014. I hope you managed to have a good break and that the grant writing season is going well with the end in sight very soon. You will see that this issue has a few conference and meeting reports about various events that happened towards the end of last year. Thanks as usual to all those who contributed to this. It is great to see that there are so many wonderful opportunities to see what is happening in optics in Australia and New Zealand. I am always amazed by the range of interesting research that is happening, and there are often ideas or techniques that can be applied to your own work as well as the possibility of new collaborations.

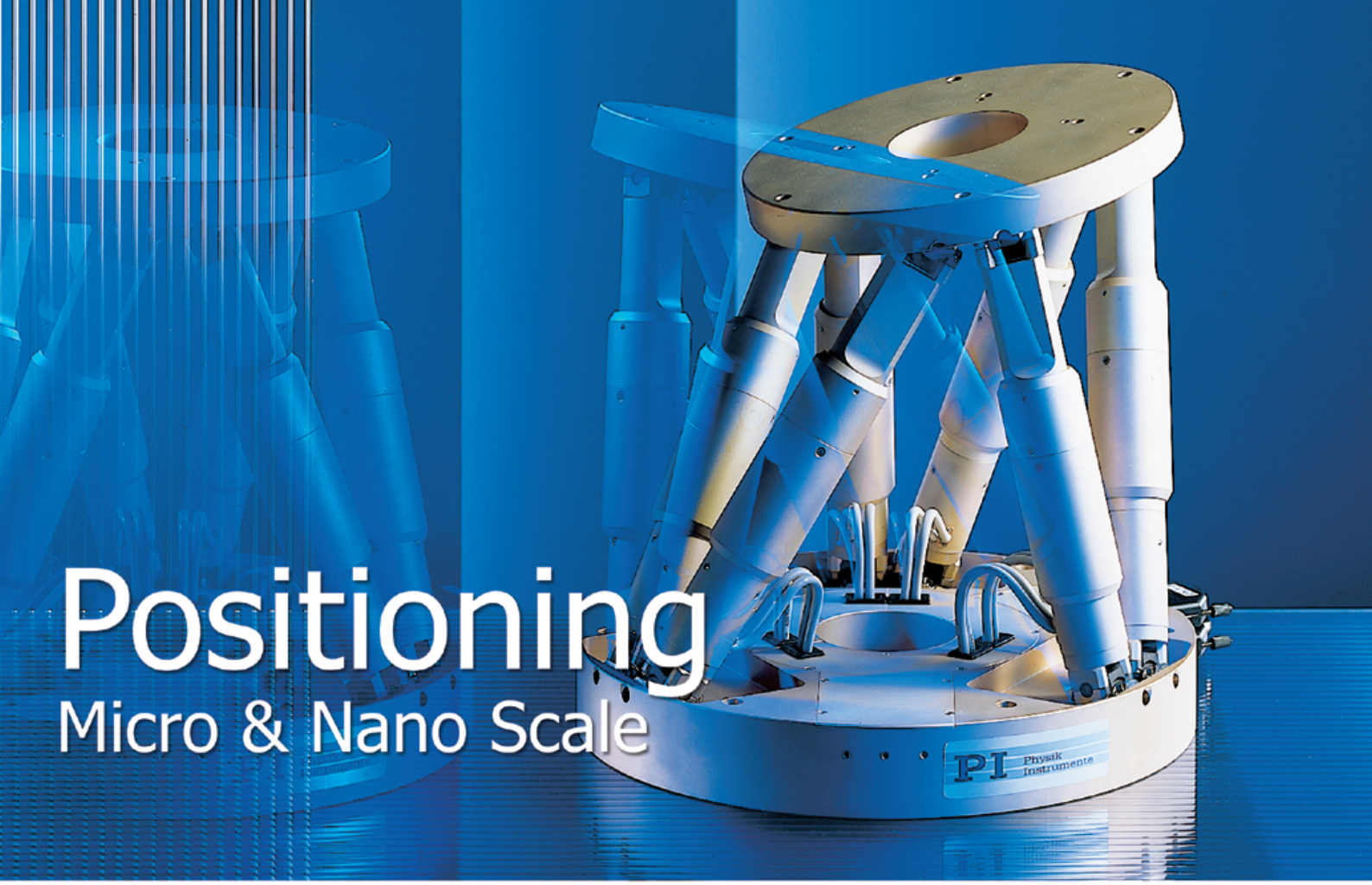
There were many captivating talks at the ANZCOP meeting in Fremantle, and I am hoping that we can provide a selection of articles based on some of these over the next few issues. We will also have articles from the 2013 AOS prize winners coming soon as well as an article from Matt Collins, the winner of the Warsash Science Communication prize in this issue. His article is about some new work that is fascinating, although it is not the winning article as he wanted to provide something more up to date for us. If anyone is interested in applying for an AOS prize this year, the deadline is 31 March, so please see the website for further details, opics.org.au.

As usual, please let me know if you have any suggestions for anything you would like to see in AOS News or have any articles or other items you would like to submit. We do hope that someone else will add to the 'Optics in Everyday Life' section we recently started, so please see if there is anything you can write for us. We are happy to receive book reviews or cartoons as well as lab overviews and articles so that we have a mixture of content we can provide.

The start of the year is a good time for planning, whether it is working out what you want to achieve this year, events that you wish to attend or other details. There are a lot of changes occurring within the university sector at the moment, so making the best of each year is becoming ever more important. If you are contemplating these issues at the moment, then it may be a good time to consider extras that you can do this year in addition to this. If we want to combat the ever decreasing amounts of funding that science research is receiving then as well as trying to get great results we also need more of us to be involved in public engagement. The International Year of Light in 2015 will be a wonderful opportunity to show people how important and integral optics is, and we need to come up with the ideas to do that this year. As Ann has explained, if you have any suggestions or want to get involved, please contact light2015@aip.org.au. As I have mentioned in previous issues, there are many different things we can do to try and help improve the public perception of science and its importance to society, so finding something that suits you should be possible. There are many schemes where we can take part in outreach programs to school students to help inspire the next generation, as well as opportunities for public lectures. Alternatively there is careful use of social media, writing articles for things like 'The Conversation' or many other ways we can take part. Hopefully we can all try and put some of these ideas into our planning for the year as well.

In any case I hope you enjoy this issue of AOS News.

—Jessica Kvansakul
Editor



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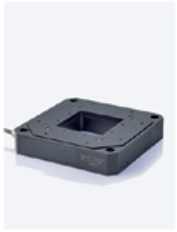

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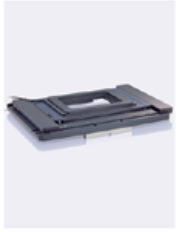

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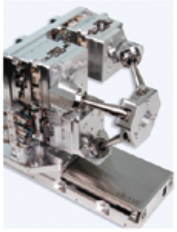

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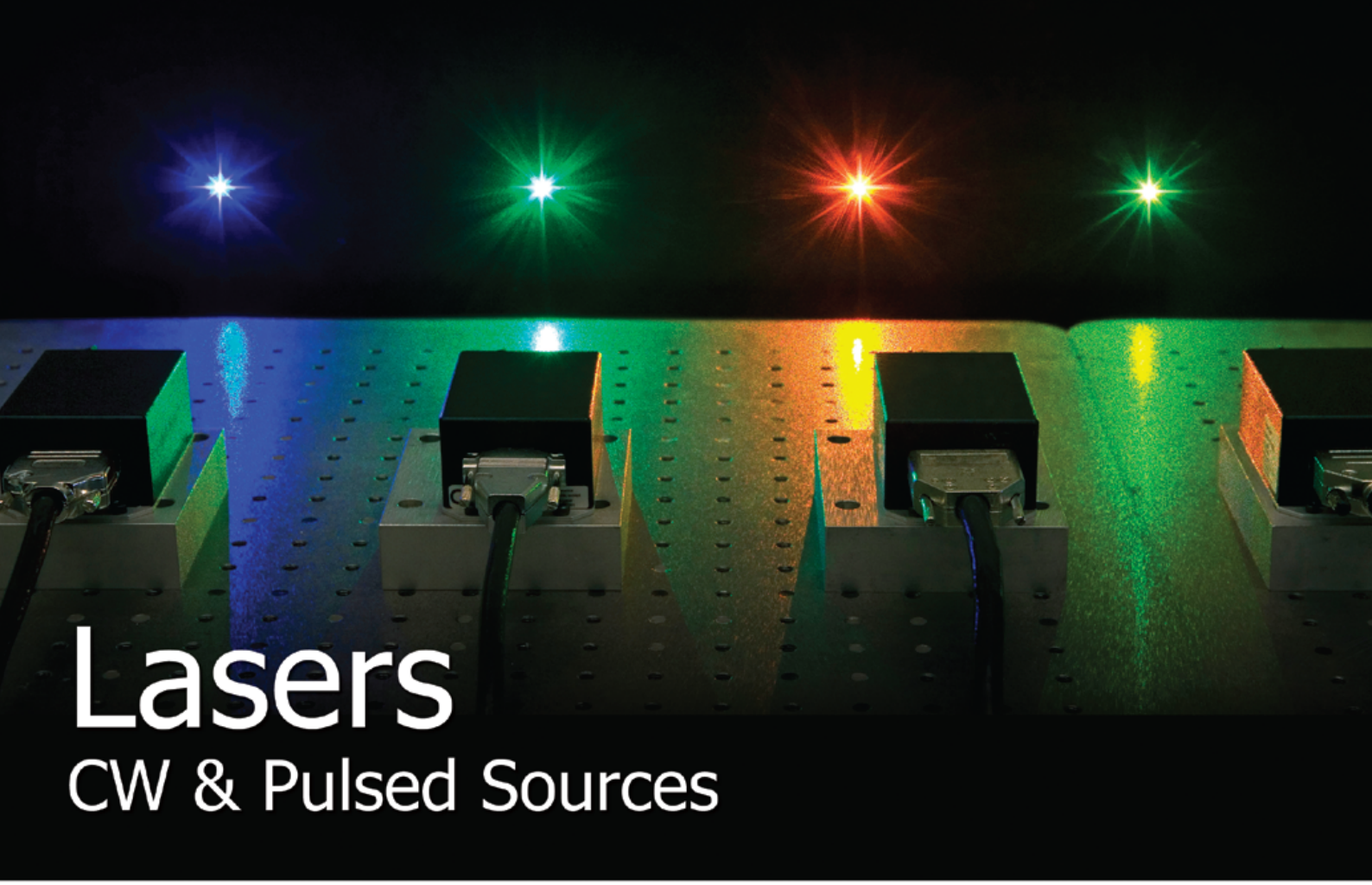

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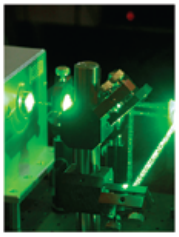

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Photonics Showcase at the Australian Technology Park Draws Large Crowds

by Chris Walsh

The CUDOS Photonics Showcase was held in Sydney on November 22 2013, and proved to be a popular event.

The exhibition area in the Australian Technology Park was well-attended.

Photonics – the generation, control, and detection of light - underpins economic activity across a wide range of industries. Many of the innovations in photonics that find industrial application arise from research. In Australia, photonics exports are estimated at ~$150m p.a. in 2012, a relatively small fraction of the more than $400bn p.a. of the global photonics market. There are many different approaches to increasing our national performance in the commercial exploitation of photonic technologies, but strong links between research in photonics and industrial applications are fundamental.

The CUDOS Photonics Showcase, held at the Australian Technology Park in Sydney on November 22, aimed to build links between researchers and those seeking the next industrial opportunity, and to provide educational resources to the teachers of the next generation of scientists, engineers, and users of photonics technology. CUDOS – the ARC Centre of Excellence in Ultrahigh bandwidth Devices for Optical Systems – is headquartered in the School of Physics at the University of Sydney. Professor Ben Eggleton, a Laureate Fellow in the School of Physics, has led the Centre since its formation in 2003.

The Showcase was attended by around 270 people drawn from industry and secondary school science teachers as well as from photonics research groups in the Sydney Basin, including 80 CUDOS staff and students. CUDOS researchers exhibited a number of 'industry-ready' prototypes of their research including a quantum-based generator of random numbers, a laser source of mid-infrared light for sensing, a 3D nano-printer, and photonic filters for applications from seeing through haze to descrambling microwave signals. Sydney-based groups in CSIRO, DSTO, ANFF, and local company Finisar also exhibited their technology capabilities, products, and services.

The Showcase featured a plenary presentation on photonics from Dr Simon Poole, 2011 NSW ICT Entrepreneur of the Year, recipient of a 2013 ATSE Clunies Ross award, and formerly Technical Director of the Optical Fibre Technology Centre at the University of Sydney. His talk was followed by presentations by CUDOS researchers on their prototypes. High School teachers were treated to a 'show bag' of photonic devices with instructions and tutorials on how to use these as experiments targeting specific HSC learning outcomes.

The Showcase also celebrated the addition of a new nanofabrication tool to the suite of facilities available to researchers across Australia. With the support of a grant awarded by the Australian National Fabrication Facility, The University of Sydney has purchased an i-line stepper, an optical lithography tool used for the rapid production of large area planar devices with feature sizes less than one

Vice Chancellor of the University of Sydney and Principal Dr Michael Spence discussing the applications of quantum-based random number generation with PhD student in the School of Physics Matthew Collins.

Rosie Hicks (CEO of ANFF) speaks during the launch of the i-line stepper.

ten thousandth of a millimetre used in nano-electronics, nano-photonics, solar photovoltaics and novel micro-mechanical devices. This tool, the only one of its kind available for public access in Australia, is presently housed in the Bandwidth Foundry but in 2015 will be moved to the newly constructed Australian Institute of Nanoscience on the Camperdown Campus.

The Showcase was made possible by support from the NSW Department of Trade and Industry, The University of Sydney and the Australian Research Council.

Chris Walsh is with the school of physics, University of Sydney.

Professor Ben Eggleton (University of Sydney) opens the plenary session.

SPIE News

by Amy Nelson

SPIE leaders speak at ANZCOP, meet with AOS, tour labs

SPIE was well-represented at the recent Australian and New Zealand Conference on Optics and Photonics (ANZCOP) in Fremantle, where featured speakers included SPIE President-Elect Philip Stahl as well as SPIE Fellows Bruce Tromberg, Jas Sanghera, Jagadish Chennupati, and Miles Padgett, and SPIE Members Benjamin Eggleton, Brian Wilson, and Ann Roberts.

The SPIE Student Prize for an outstanding presentation was awarded to SPIE Student Member Kelsey Kennedy, from the UWA Optical and Biomedical Engineering Lab (OBEL).

In addition to attending ANZCOP, SPIE leaders met with leaders of the Australian Optical Society, whose annual meeting was held along with ANZCOP. Discussions included brainstorming for how to leverage the International Year of Light in 2015 to raise awareness of photonics. Philip Stahl and SPIE Senior Director Andrew Brown met with members of the AOS Council.

AOS-SPIE leadership.

SPIE leaders also visited several universities for a first-hand look at a variety of advanced research projects.

Stahl and Brown visited the new Hub for Immersive Visualisation and eResearch (HIVE) at Curtin University, directed by SPIE Fellow Andrew Wood. HIVE serves research needs for visualisation, virtualisation, and simulation capabilities for universities across the region. The facility features four large-scale visualisation systems, each with unique characteristics: the Tiled Display, for very high-resolution images; the Cylinder, for immersive stereoscopic panoramas, virtual environments and performance art; the Wedge, supporting stereoscopic 3D content; and the Dome, used to explore 360-degree ultra-realistic panoramas, omnidirectional video and virtual worlds.

At the UWA's School of Physics, Stahl and Brown were hosted by Head of School Ian McArthur for a tour of the facility and laboratories. Paul Luckas from the UWA Centre for Learning Technology provided a tour of the SPICE Physics ICRAR

Philip Stahl presents Kelsey Kennedy with the SPIE student prize.

Paul Luckas and Philip Stahl at the SPIRIT installation.

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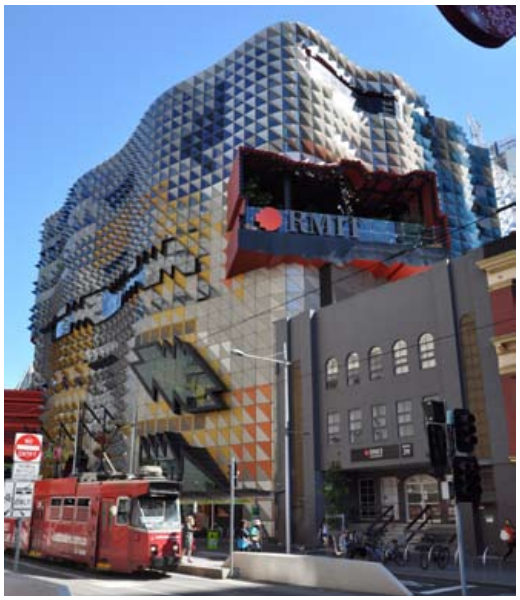
Internet Telescope Project (SPIRIT) which is supported by ICRAR (the International Centre for Radio Astronomy Research) and the UWA School of Physics. The SPIRIT installation allows students at secondary schools access to the same tools used by researchers and astronomers. They also met with David Blair of the Australian International Gravitational Research Centre.

Brown toured the MQ Photonics Research Centre at Macquarie University in Sydney, directed by SPIE Member Mick (Michael) Withford. The center undertakes fundamental and applied research in several areas in lasers and photonics. A highlight of Brown's tour, hosted by Simon Gross, was seeing a torch from the 2000 Olympic Games that was manufactured using technology developed by the institute.

Andrew Brown holding a torch from the 2000 Olympic Games

SPIE Micro + Nano Materials, Devices and Applications Conference, 8-11 December 2013



RMIT

More than 200 international participants gathered at RMIT University in Melbourne for SPIE Micro+Nano Materials, Devices, and Applications 2013.

The conference provided an interdisciplinary forum for collaboration and learning among top researchers in all fields related to nano- and microscale materials and technologies, with emphasis on biomaterials and biological microdevices, micro and nanofluidics, photonics, fabrication, metrology, solar cell technologies, plasmonics, MEMS/NEMS, and nanomaterials.

Three keynote and eighteen invited speakers presented their quality research activities as exemplars of their disciplines, and more than 200 delegates from 24 countries around the world attended to deliver talks, noted conference chair James Friend of RMIT University. Program chair was Hoe Tan of Australian National University.

"A key aim of the meeting was to facilitate cross-disciplinary discussions and the germination of new research activities, in recognition of the necessity in modern research to escape one's speciality in favour of the novel opportunities present outside it," Friend said. A large majority of the presentations were structured with this in mind, as were the break sessions, meals, events, and even the venue itself.

Conference organising committee members began the week with a working dinner Sunday evening at The Old Melbourne Gaol, which closed as a prison in 1929 and now operates as museum.

Early arrivals were also treated to a welcome reception during registration hours Sunday evening.

Opening-session speakers included RMIT Vice Chancellor and Vice-President Science, Engineering and Health Peter Coloe; conference chair James Friend, director of the MicroNano Research Facility at RMIT; Monday plenary speaker Daniel Dapkus, W.M. Keck Distinguished Professor of Engineering at the University of Southern California; and SPIE President-Elect Philip Stahl. Dapkus spoke on on "Semiconductor nanostructures in energy devices."

Plenary talks began the technical sessions on Tuesday and Wednesday. Tanya Monro of the University of Adelaide, spoke Tuesday on "Nanophotonics for biology." Wednesday's speaker was Detlef Lohse, Universiteit Twente, on "Hydrodynamic challenges in inkjet printing."

Audiences found much of interest in the conferences rooms, with sessions on Fabrication, Nanomaterials, Bio, Solar, Photonics, Plasmonics, Microfluidics, Materials, MEMS, and Metrolology/Characterisation.

Tuesday's well-attended poster session provided opportunities to talk one-on-one with authors.

A conference dinner on Tuesday included a poolside reception as well as after-dinner entertainment.

Amy Nelson is PR Manager with SPIE

Organising Committee dinner at The Old Melbourne Gaol

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INSPIRED WORK

Tailoring Heralded Single Photon Sources

by Matt J Collins, Alex S Clark and Benjamin J Eggleton

Typically you cannot create a single photon with a high certainty without also having a high probability of generating two or more photons. This makes it very challenging to obtain a single photon in a truly on-demand fashion. However, using spatial multiplexing, it is possible to tailor a device's photon statistics to better resemble an ideal single photon source.

Generating single photons when and how you want is a fundamental challenge in quantum optics. The non-deterministic nature of photon generation limits the feasibility of next-gen quantum processors that will require multiple simultaneous single photon inputs.

There are three methods typically used to create single photons. First, by exciting an atom-like system a single photon is emitted as it decays to the ground state. The challenge here is the systems available often come with cryogenic requirements or poor emission directivity.

A single photon source can be created by almost completely attenuating a laser – leaving a small probability a single photon reaches the output in a given time. The likelihood of two or more photons reaching the output is even lower. The ratio of single to multi photon probabilities is fixed by Poisson statistics, limiting the usefulness of these sources.

The last method is photon pair generation via a parametric nonlinear process, such as spontaneous four-wave mixing or down conversion. The challenge here again lies in the intrinsic link between the rate of useful single photons creation and how often two or more photons are generated.

In all three cases, generating higher rates of single photons is thus accompanied by a higher proportion of unwanted additional photons, so we wanted to reduce that to a more favourable ratio.

Single photons generated by parametric processes have an advantage – because a photon pair is generated, the detection of one photon heralds the existence of the other. With this added knowledge of when the photon was generated it is possible to deterministically combine the output of several sources. This results in a higher single-photon rate without the corresponding increase in multi-photons, breaking the intrinsic link. Practically this is done by using the herald detections to reconfigure an N×1 low loss optical switch, routing single-photons from multiple sources to a common single mode output.

This idea – called spatial multiplexing – was proposed by Alan Migdall *et al.*, at NIST in 2002[1] and first demonstrated by Xiao-song Ma *et. al.*, from the Zeilinger group at the University of Vienna in 2007[2]. Using a double pumped BBO crystal and free space polarisation switches, Ma *et al.*, achieved a four-fold increase in single photon rate, however the instability of bulk optics impeded scaling to more devices.

The first demonstration of integrated spatial multiplexing was performed at the University of Sydney with help from DSTO and Macquarie University in late 2013, where two photonic crystal waveguide photon sources fabricated at the University of St Andrews and the University of York in the UK were combined on a single silicon chip[3].

This was followed in very recently in early 2014 with a demonstration at Macquarie University, in collaboration with the University of Sydney and the University of Nice Sofia Antipolis in France, that multiplexed 4 monolithic PPLN waveguides, butt coupled to direct laser written silica wavelength division separation components[4]. This demonstrated not only the integration of 4 sources, but also several of the key components needed for multiplexing (Fig. 1).

In the future this idea will need to be extended to combine many more devices onto a single optical chip. Undoubtedly hybrid integration of several material platforms will be required to realise all of the components necessary, including delay lines and fast switches. Multiplexing will allow many single photons to be generated near on-demand, enabling a new regime of complex quantum processing.

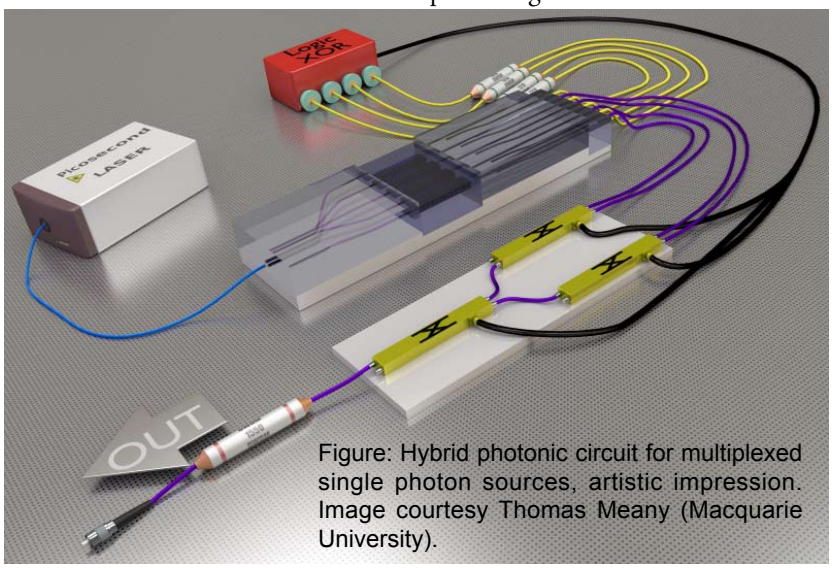

Figure: Hybrid photonic circuit for multiplexed single photon sources, artistic impression. Image courtesy Thomas Meany (Macquarie University).

References

[1] AL Migdall, D Branning and S Castelletto, "Tailoring Single and Multiphoton Probabilities of a Single Photon On-Demand Source," Phys. Rev. A **66** 053805 (2002).

[2] X Ma et al., "Experimental generation of single photons via active multiplexing,' Phys. Rev. A **83** 043814 (2011).

[3] MJ Collins et al., "Integrated spatial multiplexing of heralded single-photon sources," Nat. Commun. **4** 2582 (2013). C Xiong et al., "Bidirectional multiplexing of heralded single photons from a silicon chip," Opt. Lett. **38** 5176-5179 (2013).

[4] T Meany et al., "Hybrid photonic circuit for multiplexed heralded single photon source," Laser Photon. Rev., in press (2014).

Matt J Collins, Alex S Clark and Benjamin J Eggleton are with CUDOS, University of Sydney

Melbourne Convention and Exhibition Centre, **Melbourne, Australia**

6–10 JULY 2014

OECC/ACOFT 2014

OPTOELECTRONICS AND COMMUNICATIONS CONFERENCE 2014

AUSTRALIAN CONFERENCE ON OPTICAL FIBRE TECHNOLOGY

www.oecc-acoft-2014.org

OECC 2014 is entering its 19th year in 2014, and is one of the foremost international conferences for engineers and researchers working in the fields of optoelectronics and optical communication systems. The conference has been providing an outstanding international forum to present and discuss the progress in research, development and their application.

KEY DATES

Abstract submission opens	November 2013
Abstract submission closes	February 2014
Registration opens	March 2014
Notification to authors	April 2014
Early bird registration closes	April 2014

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Professor Shanhui Fan
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United States of America

Mr John Lord
Huawei Technologies Australia,
Australia

Professor Susumu Noda
Kyoto University,
Japan

Dr Masaya Notomi
NTT,
Japan

Professor Alan Willner
University of Southern California,
United States of America

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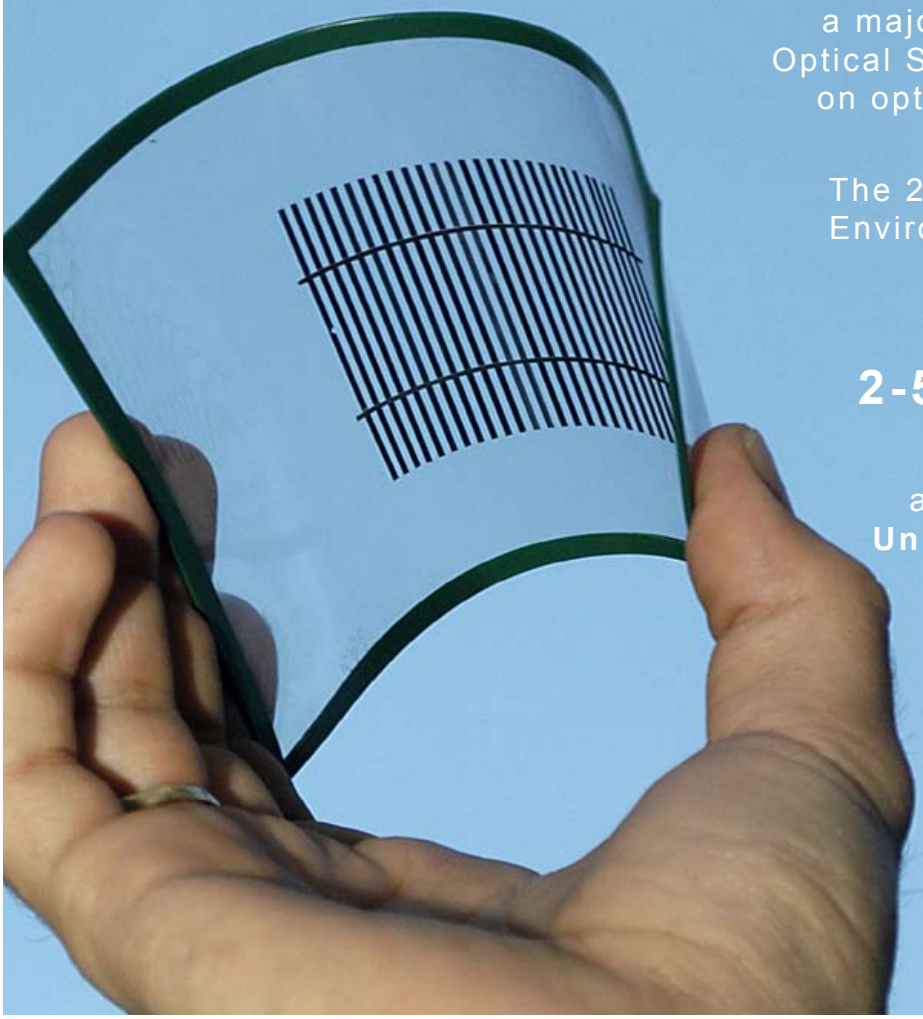
AUSTRALIA TO HOST THE 2014 OSA CONGRESS ON LIGHT, ENERGY AND THE ENVIRONMENT



In 2014 Australia will play host to a major Optics Congress for the Optical Society (OSA) that focuses on optical technology for energy and the environment.

The 2014 Light, Energy and the Environment Congress will take place from

2-5 December 2014

at the **Australian National University (ANU)**, Canberra.

The event is hosted by

Australian National University

ENERGY CHANGE INSTITUTE

energy.anu.edu.au

The Congress is an annual conference grouping that rotates around the world and will appear in Australia for the first time. The 2014 Light, Energy and the Environment Congress (formerly the Renewable Energy and the Environment Congress) comprises four parallel conferences:

- **Optical Instrumentation for Energy and Environmental Applications (E2)**
- **Optical Nanostructure and Advance Materials for Photovoltaics (PV)**
- **Optics for Solar Energy (SOLAR)**
- **Solid State and Organic Lighting (SOLED)**

Professor Ken Baldwin, AOS Councillor and Director of the ANU Energy Change Institute, is Chair of the Congress Local Organising Committee. The AOS is a technical co-sponsor of the Congress.

The 2014 Light, Energy and the Environment Congress will be held the week before the Australian Institute of Physics Congress in which the AOS will be a major participant.

Australia-China Green Photonics Symposia

by Xiangping Li, Baohua Jia and Min Gu

Australian and Chinese leading scientists have joined their efforts to solve the key challenges in green photonics.

Supported by the Australia-China group mission program in 2012, Professor Min Gu initiated a couple of high-level collaborations with China's top universities and institutes through a series of Green Photonics Symposia. The first and second Green Photonics Symposia were co-hosted with collaborators in Tsinghua University in 2012 and 2013, respectively. These symposia were a great success and highly regarded by academics and government offices from both nations.

In order to promote further the high-level networks and extend the collaboration into newly emerging biophotonic, clean energy and information technologies, Professor Qihuang Gong from Peking University, newly elected to the Chinese Academy of Sciences in 2013, together with Professor Min Gu (Australia Laureate Fellow, Fellow of Australian Academy of Science, Fellow of Academy of Technological Sciences and Engineering) from Swinburne University of Technology, hosted the third Green Photonics Symposium at Swinburne City Campus in Melbourne from 13-17 Jan, 2014.

The event was aimed at harnessing photonics related research and applications undertaken by the Australian and Chinese scientific communities and developing bilateral science and technology collaboration. It was proudly sponsored by Swinburne University of Technology and the Education Office, Consulate General, People's Republic of China in Melbourne. On behalf of Swinburne's Vice-Chancellor, Professor Linda Kristjanson, Professor Jennelle Kyd, Swinburne University's Senior Deputy Vice-Chancellor officially opened the symposium by addressing Swinburne's research focuses on nanophotonic solar cells, photonic data storage, and graphene photonics and nanophotonics. Counsellor of Education, Consulate General of the People's Republic of China in Melbourne, Ms Xiaojuan Guo also provided an address on the long-term bilateral science, technology and education collaboration between Australia and China.

Group photo of all the attendees of the third Green Photonics Symposium.

The President of the Australian Optical Society, Professor Ann Roberts, delivered a keynote speech. More than 60 international leading researchers in the nanophotonics field (see photo) from 12 top universities and institutions in China, including Peking University, Tsinghua University, Chinese Academy of Sciences and Huazhong University of Science and Technology, and 4 leading universities in physics in Australia including Swinburne University of Technology, the University of Melbourne, Monash University and Macquarie University attended the symposium and talked about their endeavours for Green Photonics in nanophotonic solar cells, photonic data storage, graphene photonics and Nanophotonics.

"The third symposium is an opportunity to network with professionals and discuss cutting-edge technologies, new findings and research trends. These trends include the newly emerging biophotonic, clean energy and information technologies."

"In order to promote further high-level research networks, we are hoping to develop further collaboration between Australia and China, and to establish a versatile platform for green photonics research," Professor Min Gu said.

The symposium was a great success. A number of high-level collaborative projects were initiated and consolidated with a collaborative memorandum of understanding signed by all the attending institutions/organisations (see photo of signing ceremony). The forth symposium is expected to be held in May 2015 at Peking University in China. It welcomes all the interested Australian and Chinese researchers in the Green Photonics field to attend.

Xiangping Li, Baohua Jia and Min Gu are with the Centre for Micro-photonics, Swinburne Uiversity of Technology.

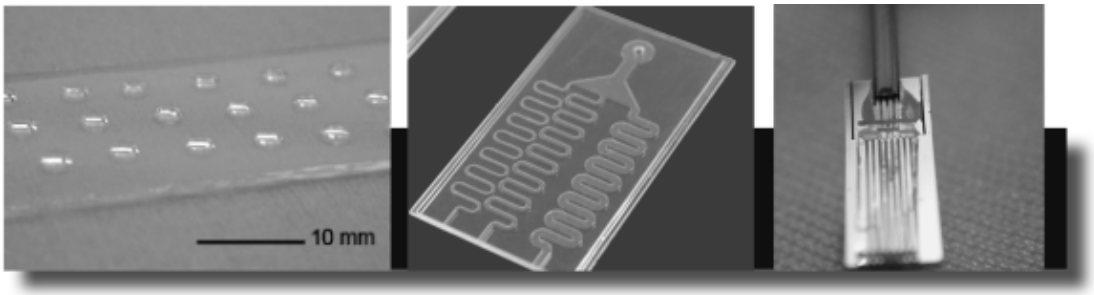
Photo of the signing ceremony for research collaborative MoU between all parties.

KLOÉ - for direct laser lithography

3D Microstructuration

Micropilars

Waveguide network

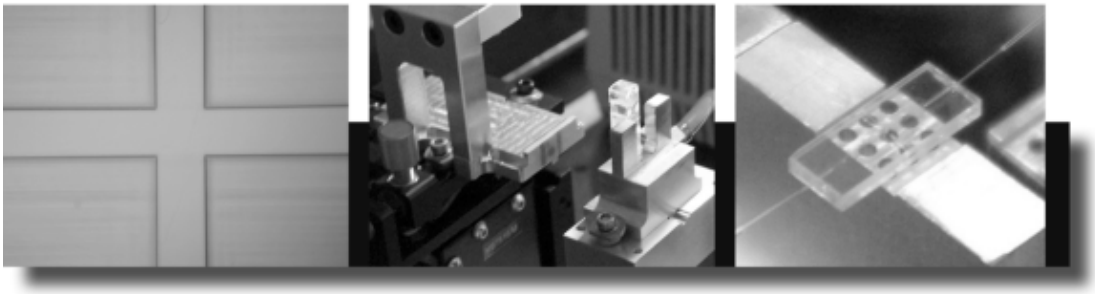


Microfluidics

Nanostructure

Blazed grating

Micromechanics



Optical interconnect

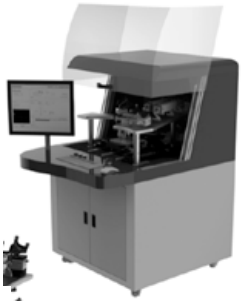
Diffractive grating

Pixlization

Microelectronics

Microlens array

Dilase 250
A high resolution direct laser lithography system for fast prototyping and maskless fabrication. Bench top model



Dilase 650
An advanced direct laser lithography system for mask fabrication and fast prototyping

Dilase 750
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News

New Australian SPIE Student Chapters

Over the last few months two new SPIE student chapters have been formed in Australia. On 16 December, the SPIE student chapter at the University of Melbourne was formally approved and on 7 February the student chapter at ANU came into being. These new chapters join those at Swinburne University of Technology and the University of Sydney in Australia and Otago University in New Zealand.

Declaration of the International Year of Light in 2015 by the UN

On 20 December the United Nations proclaimed 2015 as the International Year of Light and Light-based Technologies. For more information see websites at the European Physical Society: http://www.eps.org/?page=event_iyol, the SPIE http://spie.org/x93905.xml and the OSA http://www.osa.org/en-us/about_osa/global_services/international_year_of_light/.

INTERNATIONAL YEAR OF LIGHT 2015

Defence Trade Controls Act – Update

Following earlier articles in the AOS News expressing concern about the Defence Trade Controls Act and its impact on Australian optics research and industry, summaries of relevant steering group meetings and other information can be found at:

www.exportcontrols.govspace.gov.au.

Announcement of Centres of Excellence

On 17 December 2013, the Australian Research Council announced 12 new Centres of Excellence and it is wonderful to see two recently announced centres in Advanced Molecular Imaging and Nanoscale BioPhotonics joining existing optics-related centres, those in Engineered Quantum Systems, and Ultrahigh Bandwidth Devices for Optical Systems.

AOS member Robert McLaughlin wins 2014 SPIE Startup Challenge

Robert McLaughlin of the University of Western Australia was announced as the winner of the 2014 SPIE Startup challenge during Photonics West on 5 February. The university's product, a microscope-in-a-needle, is a miniaturized optical coherence tomography (OCT) probe capable of 3D imaging that aims to reduce the number of repeat surgeries for breast cancer.

See http://spie.org/x106301.xml for more information. Robert will write an article about this work for a future issue of AOS News.

Robert McLaughlin accepting the SPIE Startup Challenge prize from Jay Kumler of Jenoptik (left) and SPIE President Philip Stahl (right)

AOS Prizes: Nomination/application deadline 31 March

The AOS awards a range of awards and prizes annually.

- The AOS WH (Beattie) Steel Medal is awarded for an outstanding contribution or contributions to the field of optics in Australia;
- The Geoff Opat Early Career Researcher Award recognizes an outstanding early career researcher for their achievements; and
- The AOS Technical Optics award recognises technical achievement.

AOS student members are eligible to receive

- The Postgraduate Student Prize which supports travel to international conferences.
- The Warsash Science Communication Prize in Optics.

Members are urged to apply for these awards or nominate their colleagues and students so that their outstanding contributions to the field can be recognised and rewarded. More information and details of the prizes can be found on the AOS web page:

optics.org.au. Deadline: 31 March

John Harvey received the 2013 AOS WH (Beattie) Steel Medal in December

Joint OSA/AOS Membership

The joint membership option available through the OSA is proving popular, both with Australian-based members of the AOS and also with a number of expatriates looking to reconnect with Australia. For full members using this option, remember to use the VIP code "AOS15" to attract the discount. See optics.org.au for more information.

Product News

Raman Qualitative & Quantitative Analyser of Powders

The new MIXSplitter® from Enspectr reveals hidden properties of mixed substances cheaper and quicker than ever. The system automatically scans and identifies mixed substances' compounds, ensuring up to 0.1% contaminant identification. The performed results of analysis state the number of substances in the mixture and their concentrations.

MIXSplitter is equipped with a two-axis scanning machine (translator) for sample scanning in a two-dimensional subspace vertical to microscope objective's optical axis. Professional software ensures real-time spectra measurements in automatic mode synchronised with step-by-step sample scanning, unknown substance identification and output of data statistics analysis.

KEY FEATURES

- 0,1% additive detection
- 1 Micron-size focus
- Up to 40 000 steps per scanning
- No limits for number of mixture compounds)
- The most affordable tool for Trace Forensics
- No special skills required
- Extremely time-saving analysis
- No spatial separation required
- Results within 20 min

Cobolt Thor™ Series: High Performance Q-Switched Lasers

The new Cobolt Thor™ Series, available from Warsash Scientific, are high performance Q-switched lasers.

The DPSS lasers are compact and powerful. The sophisticated laser cavity design provides a unique combination of high pulse repetition rates, short pulse lengths and exceptional pulse-to-pulse stability.

In addition, the emission is generated in a perfect TEM00 beam and with single-frequency spectral characteristics. The lasers are manufactured using Cobolt's proprietary HTCure™ technology and packaged in a hermetically sealed laser head, offering an outstanding level of robustness and reliability and making these lasers highly suitable for OEM integration in systems for range finding, Raman LIDAR, micromachining and micromarking.

KEY FEATURES

- High performance passively Q-switched lasers at 1064nm
- up to 1.0W average output power, >7kHz pulse repetition rate
- <5ns pulse width and 150µJ pulse energy
- Pulse-to-pulse jitter <1µs
- Single frequency
- Pulse count feedback loop for active pulse rep rate control

For more information, contact Warsash Scientific on +61 2 9319 0122 or sales@warsash.com.au.

Cobolt Odin™ Series: Tunable Mid-IR Lasers

Edinburgh Instruments' mini-τ (Mini-The new Cobolt Odin™ Series Mid-IR lasers are available from Warsash Scientific.

The lasers are ultra-compact, industrial-grade Mid-IR sources based on a fully contained temperature tunable Optical Parametric Oscillator (OPO) and integrated pump laser. Periodically poled nonlinear optical (QPM) crystals are used for efficient and spectrally flexible generation of mid-IR emission from 2-5µm.

Manufactured using Cobolt's proprietary HTCure™ technology, the lasers are packaged in a hermetically sealed laser head, offering a size, robustness and reliability never before achieved for this kind of laser. The result is an ideal source for environmental monitoring and trace gas analysis spectroscopy of, for example methane and ethanol, amongst other gases typically monitored during control of pollution emissions in the petrochemical, automotive and energy production industries.

KEY FEATURES

- Compact and tunable Mid-IR lasers, wavelength selectable 2-5mm
- Standard wavelengths: 3264nm and 3431nm
- Tunable 50nm
- 80mW average output power
- 10kHz pulse repetition rate
- <5ns pulse width, <7µJ pulse energy
- Linewidth <1.5nm

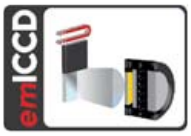
For further information please contact Warsash Scientific at sales@warsash.com.au.

Princeton Instruments New Intensified Camera - emICCD

Princeton Instruments has launched a unique emICCD technology, available exclusively in their PI-MAX®4 camera platform. For the first time ever, one camera combines the advantages of image intensifiers (subnanosecond exposure times) and the benefits of EMCCDs (linear gain and high quantum efficiency) to provide single-photon sensitivity and fully quantitative performance.

For more than three decades, Princeton Instruments ICCD cameras have been the industry standard for time-resolved imaging and spectroscopy applications. The recently introduced PI-MAX4 series of cameras, offers advanced capabilities such as <500 picosecond gating, very high repetition rates, RF modulation, and complete control via the LightField® software platform with an oscilloscope-like user interface.

Traditional intensified cameras, the workhorses of ultrashort, time-resolved applications, are limited by nonlinearity due to microchannel plate (MCP) saturation as well as an inability to distinguish single photons. Alternatively, EMCCD cameras, which have become the main tools for low-light applications, lack ultrashort gating capabilities. By combining these two key technologies for the first time, Princeton has created unique emICCD cameras that are free of the aforementioned limitations, allowing researchers in combustion, ultra-low-light imaging, quantum optics, and time-resolved imaging and spectroscopy to design experiments hitherto not possible.



Photometrics Evolve High-Performance EMCCD

The Evolve range of EMCCD cameras from Photometrics are the industry's fastest and most sensitive EMCCD cameras. Powerful new features, unique to Photometrics, provide researchers with a camera that offers precise, accurate and highly quantitative high speed imaging.

The Evolve's Quant-View is a new technology that provides a repeatable methodology to gather and interpret live image data by reading out pixel values in photoelectrons – a standardised unit of measurement. This offers a vastly different and improved method when compared to cameras that produce output data in arbitrary units, making it easier and less time-consuming to reproduce study results.

Precise measurement is crucial in any experiment, and especially in high-speed, low-light imaging. The Evolve cameras standardised data, in conjunction with its highest frame-rates, sub-electron read noise and stability, provide superior performance. These cameras are ideally suited to any low-light imaging requirement.
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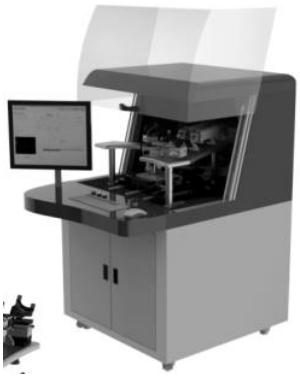
KLOE introduces the Dilase 250 direct laser lithography system

A practical, table-top, high resolution laser lithography system suitable for fast pattern and mask prototyping using a broad range of photoresist thicknesses. The compact design ensures consistent high resolution across the 4" diameter exposure area, by continuously controlling the dynamic trajectory of the motorized writing stages. The laser beams high depth of focus maintains the resolution and guarantees structures with sharp edges on the whole marking surface.

Dilase 650. An advanced direct laser lithography system from KLOE



A user-friendly direct laser lithography system ideal for fast prototyping as it allows for rapid maskless design and pattern generation. Powered by very fast, accurate stages, it allows writing patterns in photosensitive resins deposited on planar substrates up to 6" in diameter and mask blanks up to 7". Suitable for Nanostructures, Microelectronics, 3D structures, Optical interconnections, Microfluidics, Mask lithography, Refractive optics, Micro optical elements, Diffractive gratings, Integrated optical circuits, Pixilized optics, Very large surface optics.

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For more information please contact Raymax at sales@raymax.com.au

Dilase 750 direct laser writing system from KLOE

A powerful, high resolution direct laser lithography system, designed to accommodate large exposure areas even in thick photoresist layers. Patterns can be written in resin layers which are photosensitive to blue or ultraviolet laser wavelengths. The use of these laser sources allows the reproduction of lithographic patterns with submicronic resolution and high speed ratio.

K-Px Optical bonding materials from KLOE

This range of adhesives is synthesized via a sol-gel process using organo-mineral precursors, which yields a structure of overlapping organic and mineral networks. these solutions have a very low coefficient of thermal expansion (CTE), are long shelf life optical adhesives compatible with hybrid bonding on glass, metals, semi-conductors, polymers and more. Custom adhesives can also be provided.

K-CL Negative laser lithography resins from KLOE

These photoresists are specifically intended for use in photolithography and microstructure lithographic applications. The offer flexible use as layers can be deposited by spin, dip or spray-coating techniques onto a range of substrate materials such as glass, semi-conductor, metal polymer and more. Additionally, the thickness of the deposited resin layer can be adjusted from a few hundred nanometers to 150 microns while yielding high resolution lithography on large and small surfaces.

For more information on KLOE products contact Raymax Lasers 02 9560 0122

For more information on KLOE products please contact Raymax Lasers at sales@raymax.com.au, 02 9560 0122

Smart Vacuum Transmitters for Atmospheric Pressure to Ultra High Vacuum

The new Smartline series of vacuum transmitters by Thyracont Vacuum Instruments will be distributed by Ezzi Vision Pty Ltd in Australia. The new devices, which measure from atmospheric pressure to ultra high vacuum, come in a new, sleek design with loads of new options. Through further optimization of the Smartline series, the transmitters offer short response time combined with high resolution and excellent stability.

The devices are available with an integrated, backlight LCD display, which flashes in a bright red color in case of error, compared to the green lighting in the normal mode. The reading can be taken directly at the appliance. All transmitters are designed for industrial applications and have two independent switch points with assigned status LEDs. The data transfer to PC, vacuum controller or SPS is possible direct and digital over RS485 connection or analog with the 0-10 V output or EtherCAT interface.

In a few easy steps, the calibrated sensor heads can be replaced by the user, keeping maintenance time and costs low.

As a new member of the Smartline family the precise combination gauge VSR operates a piezo and Pirani sensor to cover the whole measuring range from 1200 to 1e-4 mbar with high accuracy.

All transmitters can be connected to the 1 channel controller VD9 or the 4 channel vacuum controller VD10 and combined to the requirements of the user. The Thyracont VacuGraph Software offers the possibility to evaluate and save the measured data. Typical applications of the Smartline Series range from coating plants to the semiconductor industry, mass spectrometers or vacuum furnaces.

For more information please contact Ezzi Vision at info@ezzivision.com.au

Laser Quantum opus 1064 - Small Size, Big Power

The latest product release from Laser Quantum sees a staggering 10 W of IR laser power being delivered from the compact opus laser head. Due to the high output power and excellent stability of the opus, it is the ideal tool for optical trapping and manipulation, allowing the 10 W to be shared over multiple traps.

The opus and other Laser Quantum systems have a wide range of applications such as;

- Optical Trapping
- Optical Testing
- Holography
- Raman Spectroscopy
- Fluorescence Imaging

If your application calls for high output power and excellent stability, look no further than Laser Quantum.

Laser QUANTUM
INNOVATIVE RELIABLE INTELLIGENT

Toptica DLC pro Electronics – Touch the Future!

With Toptica's DLC pro, high-end laser control now enters the digital world! The new digital laser controller for Toptica's tunable diode laser DL pro sets new benchmarks with regards to low noise and low drift levels. It provides intuitive touch control and powerful remote operation to run and frequency stabilise the laser. Never before has the use of tunable diode lasers for demanding experiments in quantum optics and spectroscopy been so convenient.

The DLC pro comes with current, piezo and temperature controllers, providing unprecedented noise and drift properties to boost the performance of the established Toptica DL pro systems. The low noise and drift enables linewidths down to 10 kHz to be achieved!

Key features of the DLC pro electronics

- All digital controller for Toptica DL pro
- Extremely low noise and precise control
- Convenient knobs and multi-touch user interface
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Optics in Everyday Life - Zoom and Ultra-Zoom

by Tony Klein

Zoom and even ultra-zoom lenses have become quite commonplace on digital cameras these days. What are they? What is their history, and how do they work?

So-called 'varifocal' lenses, i.e. lenses in which the focal length could be continuously varied, were invented as long ago as 1901, in order that the magnification could be changed, by mechanically moving lens components. For projectors, this allowed the screen to be filled without moving either it or the projector. For cameras, the magnification or framing could be changed without moving closer or further from the object, thus removing the attendant hazards of falling into ditches or lakes while framing the shot. By the 1950s very sophisticated zoom lenses for cameras had been invented, with varying degrees of success in aberration correction and f-number range. (For the early history and many examples, see the classic: *A history of the Photographic Lens* by Rudolph Kingslake AP, San Diego, 1989 and his even more detailed earlier article in JSMPTE 69, 534, 1960).

For our purposes, avoiding the complications of the more modern versions, which have lenses with as many as 14 elements and 24 surfaces, here is a simplified explanation of the basic ideas. As shown in Fig. 1, there are two positions, marked A and B, from which a positive lens L_1 of a given focal length can produce an image in plane I, of an object situated in plane O. The two positions correspond to magnifications of 1 : n and 1 : 1/n respectively – i.e. a magnification (or zoom) range of n^2. Halfway between these position the magnification would be 1 : 1 but the image would be horribly out of focus. Unless, of course, the effective focal length of the lens could be changed. But how?

There is another question that arises right away, with camera lenses: How does one bring the "real world" i.e. the real object plane, which is a long way away, to the previously mentioned object plane O.

Both questions have a simple answer: Insert a negative lens L_2 inside, as shown in Fig. 2, so as to produce a virtual image of "infinity" at the position O, thereby solving the first problem. Then, by mechanically moving this negative lens outwards, as in Fig. 3, to produce the object plane O', the original positive lens will focus a sharp image when halfway between O and I. If this outwards motion of the negative lens is carried out at the same time as the positive lens is moved between the two positions A and B (via the mid-point), the entire range can be imaged in sharp focus.

While the original objective lens is moved from A to B, by means of a continuous helical, screw-type motion inside a cylindrical barrel, the required motion of the negative lens is like a 'there-and-back', side-on U-shaped motion, as shown in the diagram. A cam located in the same barrel as the screw that drives the main lens is what usually controls this motion [Take a look if you have an old SLR Camera handy!].

So, this is how a simple zoom-lens works; for example a range of 4 : 1 (i.e. from 2 : 1 to 1 : ½) is easily accomplished. Of course the aberration corrections are

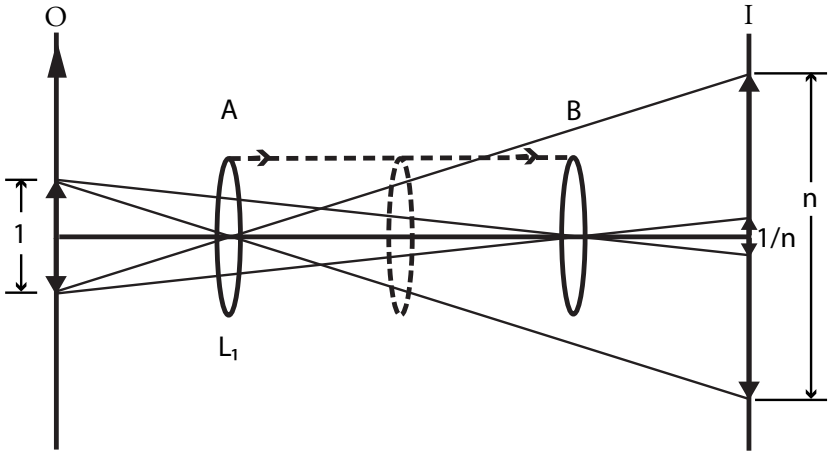


Figure 1. Imaging by a simple lens showing magnifications of 1:n and 1:1/n

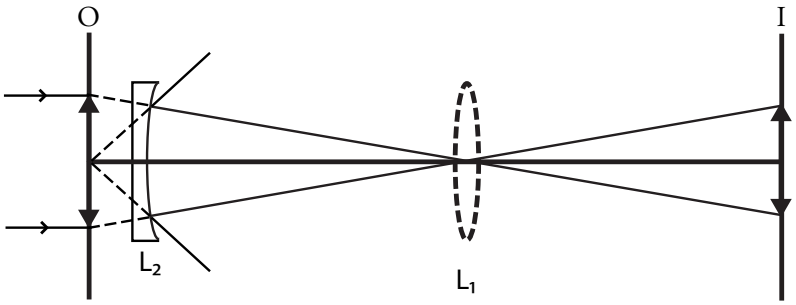


Figure 2. Diagram of camera lens system with negative lens L_2 added.

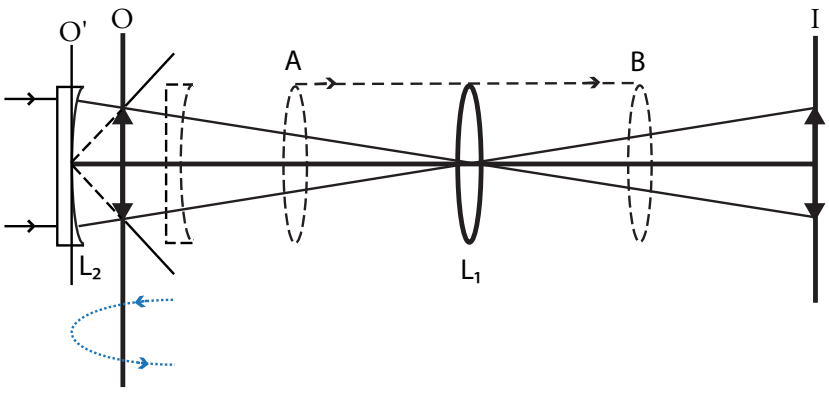


Figure 3. Diagram of zoom lens. L_1 moves between A and B via helical motion, while L_2 moves position following the dotted path shown.

a separate and much more complex issue, as in all modern camera lenses.

An interesting development occurred a few decades ago: The lens designers, such as those in the firms Angenieux and Vivitar, realized that the resolution requirements of TV cameras is greatly relaxed by the fact that TV pictures require only 1 in 625 lines of resolution. Hence much wider zoom ranges can be accommodated with acceptable quality (and hence aberration correction requirements). This was the birth of the ultra-zoom TV camera lenses with which, for example, the flight of golf-balls and footballs is so successfully tracked by expert camera-operators.

But a somewhat simpler and even wider zoom range has appeared in even more recent times, particularly in connection with digital cameras. I am not talking about so-called 'digital zoom', which makes use of software wizardry and eventually, if overdone, produces "pixelated" images. On the contrary, 12 : 1, 18 : 1 and even 30 : 1 *optical* zoom cameras of quite high quality have appeared in recent years, produced, for example by Olympus and by Panasonic – LUMIX, the latter employing lenses designed by the historically famous German LEICA people.

So, how do these miraculous objects, the so-called ultra-zoom cameras work? The clue is the system called auto-focus. The motion of the original objective lens (a marvelously complex super-corrected compound lens, often with aspheric elements) is not directly coupled with the motion of the negative-powered front element. Instead, the system relies on the auto-focus mechanism that independently drives this lens, thereby controlling the sharpness of the image. Thus it restores the focusing, once the objective is moved over the full magnification (or zoom) range, e.g. from 4 : 1 telephoto to 1 : ¼ wide-angle setting, for a full 16 : 1 zoom range.

Sheer trickery! But how does it work? Well, the digital camera incorporates a microprocessor than can rapidly perform a Fast Fourier Transform on a selected line of the CCD-derived image. It then looks at the high-spatial-frequency range, because an out-of-focus picture produces a slow transition instead of a steep step when looking at a sharp edge. The slow transition, of course, suppresses the high spatial frequencies. Conversely a rapid transition produces high spatial frequencies and the system automatically yields the highest spatial frequencies when in focus.

This means that the zoom and the focus functions are only coupled digitally. Thus, one can set the magnification manually (via the zoom lever) and then the auto-focus will drive the focusing lens via an electric motor, to produce the sharpest picture (read: highest spatial frequencies) that it can. Although remarkably quick, sometimes the process takes a little time. Users of zoom (and even more so, ultra-zoom) cameras will, no-doubt, have noticed. And sometimes it doesn't work at all, for example when trying to photograph naturally fuzzy objects, such as fluffy flowers. Human vision is better, in this respect!

Keeping the aberrations within tolerable limits is quite a challenge for even the computer-aided designers of ultra-zoom lenses. Thus, in my modest experience, the widest zoom range cameras are not quite as good as, say the 12 : 1 models which are remarkably good. Furthermore, they are very much cheaper than the super-duper SLR cameras with interchangeable lenses that only professional or highly experienced amateur photographers can use to better advantage.

Emeritus Professor Tony Klein, AM, FAA, AOS Foundation Member and President 1985-6, is with the School of Physics, University of Melbourne.

The Australian Optical Society

AOS Prizes and Awards nomination deadline approaching!

Australian Optical Society members are reminded that the deadline for applications for all AOS awards is 31 March. Please consider applying or nominating students or colleagues. All applications and nominations are to be forwarded to the AOS Secretary. Membership of the AOS is an eligibility requirement for all awards.

AOS W.H. (Beattie) Steel Medal

The AOS WH Beattie Steel Medal is awarded for an outstanding contribution or contributions to the field of optics in Australia or New Zealand by a member of the Australian Optical Society. This Medal is the most prestigious award of the Australian Optical Society and is normally be presented only to a nominee at an advanced stage of his or her professional career with a strong and sustained record of authority, enterprise and innovation in the field of optics in Australia or New Zealand.

The AOS Geoff Opat Early Career Researchers Prize

This Prize recognizes an outstanding early career researcher for her/his contribution to the field of optics. The prize is $1500, awarded annually, and includes an invitation to give an extended presentation at the annual AOS conference. The winner of this prize will also write an article for AOS News.

AOS Postgraduate Student Prize

The Australian Optical Society wishes to encourage participation in national and international conferences by high-quality postgraduate students, and thus the Society has instituted the Australian Optical Society Prograduate Student Prize, which is a grant for conference travel valued up to $1500. Up to one award will be made in each year. Preference will be given in the selection procedures to applicants who intend to use the prize to attend and present their research results at a major conference outside Australia and New Zealand.

AOS Technical Optics Award

This award recognises those who have made a significant achievement in technical optics, not necessarily in a manner manifested by an extensive academic record or a traditional academic reputation. The work for which the award is made must have been carried out principally in Australia or New Zealand. Applications are encouraged from, but not restricted to, young optical workers. The winner will receive a prize consisting of $300 cash, one year’s free membership of AOS, and an invitation to attend the AOS conference and make an oral presentation of his or her work.

AOS Warsash Science Communication Prize in Optics

This Prize is open to AOS student members whose Honours, Masters or PhD research work has been accepted for publication in a refereed journal in the past year. The Prize may only be awarded once to any individual. A submission consists of a 300-word summary of the published research, written in the style of a New Scientist article or similar, explaining the significance of the applicant’s research project to a casual reader outside the field. The $500 Prize is sponsored by Warsash Scientific Pty Ltd.

For more information, visit optics.org.au

A History of Diamond Machining in Australia

by Lyn O'Dwyer

BAE Systems has more than twenty years' experience in diamond machining services, progressing from Defence-funded equipment in 1990, to providing state of the art, precision technology for customers across a wide range of industries and end products.

Australia's first SPDT machine – the Rank Pneumo 2500, purchased by Defence in 1990.

BAE Systems Australia has been providing single point diamond turning (SPDT) services since 1990 when it installed Australia's first SPDT machine – the Rank Pneumo 2500. The machine was purchased for around $1 million by the Australian Government, to bring new manufacturing capabilities to the country and BAE Systems (then AWA Defence Industries) provided the expertise. In the early days, the machine was predominantly used for Defence with some commercial applications.

BAE Systems' employee operating the first Single Point Diamond Turning machine in Australia.

Peter Morcom, BAE Systems' Electro Optics (EO) Production Manager, remembers what that first machine was like, "At first it was frustrating to use it because the technology was so new and different - but 24 years on, we have grown our capabilities to become state of the art." he said.

This new government-supplied capability led to greater Australian manufacturing industry involvement in maintaining Defence-based skills in country. Over the next fifteen years, the demand for precision diamond turning and BAE Systems' capabilities grew to the point that the company was not able to keep up with the demands of its customers which now included government, private and public research, and commercial ventures. By then, BAE Systems was manufacturing a wide range of components, from contact lens moulds to Spaceborne mirrors.

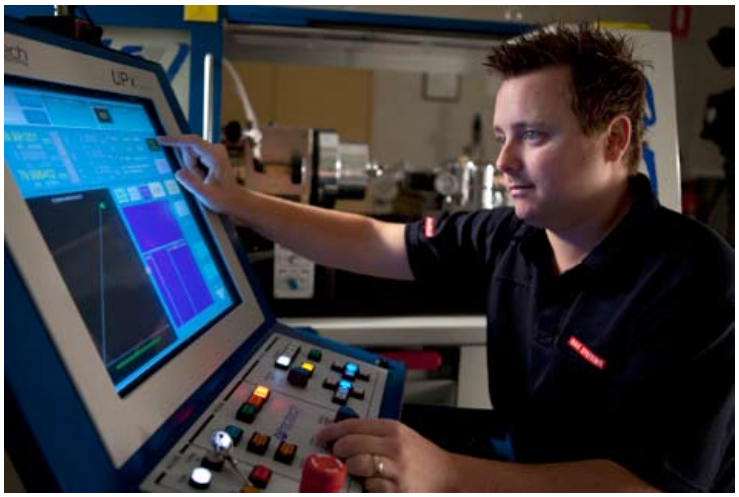
To meet the growing demand, in 2007, BAE Systems purchased the latest technology machine, the Precitech NanoForm 250Ultra, and installed it in a purpose-built Class 100 clean room at its Holden hill facilities in South Australia. This machine delivered increased ability to meet more demanding and sophisticated requirements. Accordingly, the market expanded to include a broader range of industries with exacting requirements, including:

- Resources
- Medical Devices
- Auto component manufacture
- Lasers: Visible through LWIR
- Forensics
- Commercial Optics
- Scientific instruments

"As the science of optical design continues to grow and develop, requiring more complex optic shapes and components, BAE Systems is well placed to meet the challenge," said BAE Systems' EO Products Manager, Andrew Pfeiffer. "Our skills and experience have evolved with the technology. Today, we're unique in our ability to provide these services in Australia."

In 2014, using its Diamond Machining capability, together with Precitech's Ultra-Comp waveform measurement technology (which allows for on board metrology), BAE Systems manufactures:

- On and off-axis Aspheric shapes
- Non-conic and Freeform optics
- Micro-lens arrays
- Diffractives
- Laser cavity mirrors
- Conventional optical shape



BAE Systems' Diamond Turning Specialist, Anthony Hunnisett operating the current SPDT machine – the Precitech NanoForm 250Ultra.

Substrates available:

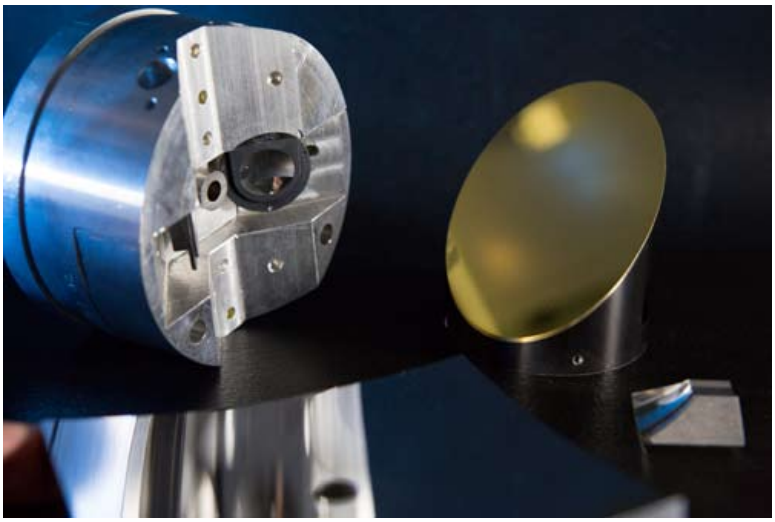
- IR – Germanium, Silicon and many more
- Polymer and Acrylics
- Aluminium and non-ferrous metals

BAE Systems' diamond turning group is fully supported by optical design, optical manufacturing, thin film coating and optical metrology depts.

"Our team has grown, employing local South Australians and skilled employees from as far away as Singapore, the US and UK. They all have world class skills in their areas of expertise." said Peter Whitteron, EO Contracts Manager, BAE Systems. "We now provide SPDT services to over 15 customers across Australia, including some of the most advanced technology companies around, including Maptek. We have developed a particularly strong relationship with this company, based on many years' consistent strong performance".

Maptek is a leading provider of software, hardware and services for the global mining industry, offering an extensive range of products, including 3D modelling and analysis software, laser scanning and imaging, blast accuracy measurement systems and other design and analysis platforms, as well as consulting, training, application integration and outsourcing services.

Andy Newman, Purchasing & Logistics Manager for Maptek, speaks highly of the BAE Systems team and capabilities, "At Maptek, to produce the world's best laser survey equipment, we demand the world's best components. Having a business partner such as BAE Systems on our doorstep producing not just world class but world leading single point diamond turning is a huge advantage. Their expertise, experience and willingness to be involved in projects from the ground floor have been an invaluable contributor to our success."



SPDT products - Gold coated mirror for resource industry and off-axis ellipsoids for government research.

BAE Systems' Laser Technician, Irina Lianikov, cleaning components.

Conclusion

While BAE Systems has more than 20 years' experience in single point diamond turning, they are looking firmly to the future and plans include linking its capability to the growing field of Additive Manufacturing.

Lyn O'Dwyer is with BAE Systems.

A Well-Travelled KOALA

by Björn Sturmberg and Tomonori Hu

2013 was the year KOALA (the Konference on Optics Atoms and Laser Applications) became international. The annual conference, which is organised by students for students, is now in its sixth year and getting bigger every year.

In 2013 the OSA-SPIE student chapter of the University of Sydney had the pleasure of hosting 95 attendees for the week-long conference. These came from 19 institutions travelling from as far away as Scotland, Lithuania, India, China, Malaysia and the United States. The presence of the international contingency made for a special KOALA and was allowed by the travel grants from both the OSA IONS and SPIE FOCUS programs.

The conference never fails to provide a great mix of technical sessions and social networking, and this year also included a public lecture, and an innovation workshop held at ATP innovations. Throughout the week KOALA offers a unique opportunity to hear

On the ferry to Manly for the social day.

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Laser delivery	Jacketed with 3mm PVC material and connector boots behind the connector
Nuclear plasma diagnostics	
Analytical instruments	1 to 3 meter or custom lengths
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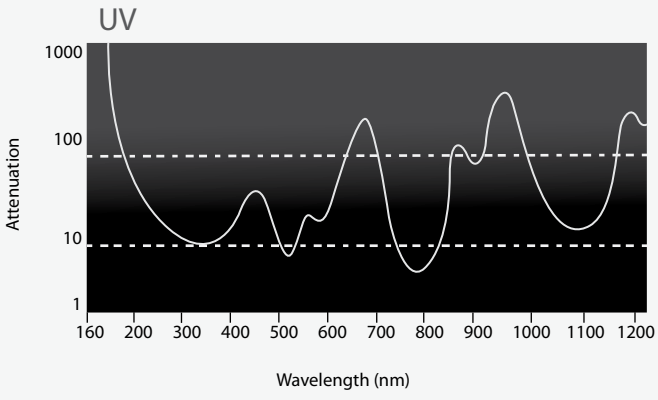

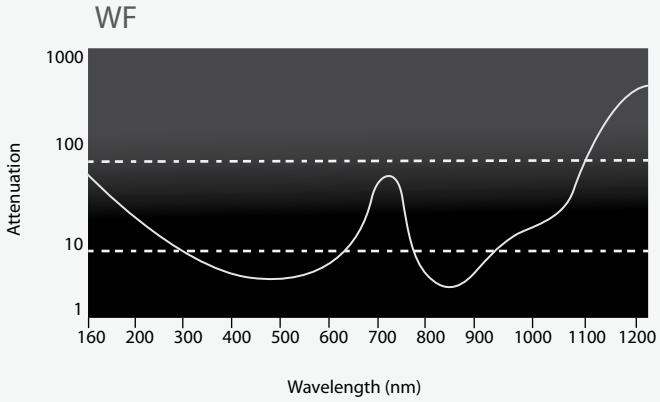

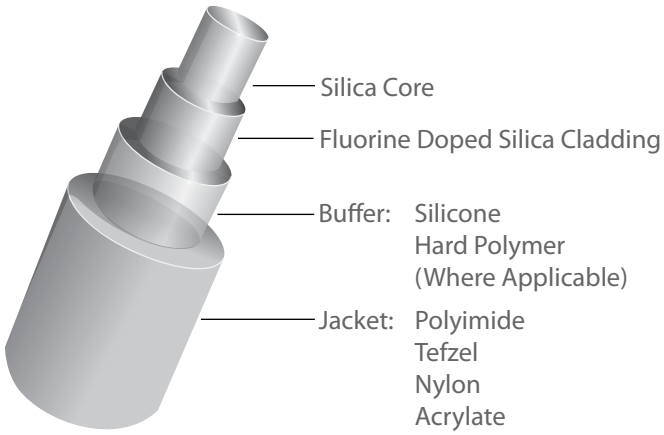

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Prof. Kishan Dholakia gives the KOALA 2013 public lecture

about the fundamentals of the wide variety of research fields represented, as well as the most recent contributions made by one's peers. Combined with the excellent invited talks, tutorials and post lecture conversations the week is truly a rich learning experience.

This year's hot topics included biophotonics, quantum optics and solar energy, which were all featured in talks by the 4 invited speakers: Kishan Dholakia, Michelle Povinelli, Greg Forbes and Greg

Handing the KOALA gauntlet over to Adelaide for 2014

Smith. The invited presentations were a great start to each morning, and it was great to have these regarded physicists enthusiastically involved throughout the week, having long conversations about a whole range of topics with the students.

Another theme of the conference was Sydney Harbour, which was crossed on our way to the social day at Manly beach, and was the beautiful backdrop for the harbour cruise conference dinner.

Lastly we would like to sincerely thank the 18 sponsors for their generous support. It is great to see the Universities, research groups, professional groups and companies all contributing to the ongoing success of KOALA. We look forward to another fantastic week in Adelaide in 2014!

Björn Sturmberg and Tomonori Hu are with the Universiy of Sydney.

Poster session

Conference dinner group photo

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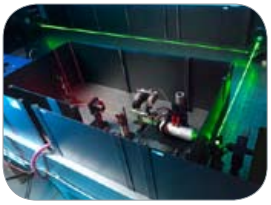

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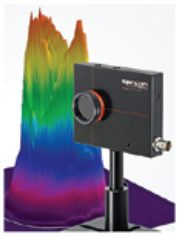

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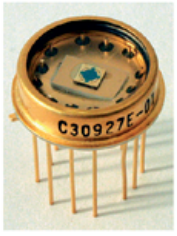

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Vibrant Signs for Optics at ANZCOP 2013

by David Sampson and Michael Withford

The inaugural ANZCOP was held in Fremantle in December last year, and was a big success.

The signs are bright for the health of the Australian and New Zealand Optics and Photonics communities. Almost three hundred participants made the long trek west to participate in the 2013 inaugural Australian and New Zealand Conference on Optics and Photonics (ANZCOP), which incorporated: the Australian Optical Society Annual Meeting; the Australasian Conference on Optics, Lasers and Spectroscopy; and the Australian Conference on Optical Fibre Technology. The meeting was held Sunday to Wednesday at Fremantle's historic Esplanade Hotel and went a long way towards achieving the overall objective of bringing our large community of scientists and engineers closer together than ever before.

The meeting kicked off on the Sunday afternoon with a set of well-attended tutorials with broad coverage and wide appeal. Whilst in one room, novel subdisciplines of photonics were presented, including the SPIE Britton Chance medallist Brian Wilson's Optical Biophysics: Bringing Light to Life, Tanya Monro's tutorial on Fibre Sensors and Mike Ireland's introduction to the mysterious world of Astrophotonics, in the other room, the themes of Nonlinear Photonics, Quantum Optics and Optical Fibres, were presented, respectively, by doyens of their fields, Ben Eggleton, Howard Carmichael and Peter Schultz.

Plenary speaker Bruce Tromberg with Tutorial speaker Brian Wilson

The afternoon ended with an informal get together generously sponsored by Raymax Lasers. The feedback on the tutorials was very positive. They provided a great opportunity for the large contingent of PhD and undergraduate students (some 105 overall) to sample a wide range of optics and photonics specialisations delivered by experts.

The conference proper kicked off with 2013 Australian Academy of Science Frew Fellow and the University of Innsbruck's Rainer Blatt, who delivered an authoritative address on quantum information science with trapped ions. Rainer's talk made this complex subject highly accessible and at the same time left a lasting impression as to the great progress being made in this rich field. The opening plenary was followed by OSA President-elect and Stanford University and SLAC National Accelerator Laboratory's Phil Bucksbaum who gave an invited talk entitled "Ultrafast AMO Physics with strong laser fields: High Harmonic Generation and X-ray Free Electron Lasers". Phil's data on real-time chemical reactions demonstrated just how far science has come in probing at the femtosecond scale chemical reaction dynamics.

The rest of the opening day comprised parallel sessions, winding up scientific proceedings with a poster session. Delegates then made their way the short distance across the park to Little Creatures Brewery where they were treated to Fishing Boat Harbour views, including a close-up view of the Duyfken replica, and refreshments and food, whilst they networked and kicked back after a hard day's conferencing.

Day 2 commenced with a plenary talk from Miles Padgett, a professor in the School of Physics and Astronomy at the University of Glasgow, whose elegant and

Opening ceremony

lucid insights into the effects of orbital angular momentum in optics presented a superb way to start the day. Miles' University of Glasgow USB copies of his talk, "Light in a twist: optical angular momentum" were in high demand at the end of his talk. His talk was followed by AOS W. H. (Beattie) Steel Medalist John Harvey, who spoke on developments in nonlinear optics. John's insightful and accessible talk made it abundantly clear why he had been awarded the AOS's top prize.

At the end of the second day, delegates were bussed to Perth City's Kings Park for the conference dinner, where they enjoyed a gourmet version of the good old Aussie barbeque whilst looking out across the city lights and Perth waters. Conference chair David Sampson welcomed the guests and AOS President Ann Roberts introduced after dinner speaker Emeritus Professor

Plenary speaker Rainer Blatt

Jim Piper from Macquarie University. Overcoming the less than ideal speaking conditions, Jim gave a memorable address commemorating 30 years of the Australian Optical Society. Before the optics and photonics groove got properly into swing, a number of the prizes for student presentations were presented. A highlight of the meeting was the large number of prizes awarded, the result of Technical Programme Co-chair Cather Simpson's enthusiasm and the generosity of the many prize sponsors. Prizes and winners included:

ACOFT Wanda Henry Prize: (student talk): Stine Højer Møller Larsen, DTU Fotonik, Denmark

Technical program co-chair Cather Simpson presents a poster prize to Silvie Ngo from ANU

SPIE Student Prize (best student presentation): Kelsey Kennedy, UWA

OSA Prize (best student poster): Nicolas Riesen, ANU

Student poster prizes: Silvie Ngo, ANU; Michelle Murtagh, Macquarie U.; Blake Klyen, UWA; Wan Zakiah Wan Ismail, Macquarie U.

Student talk prizes: Rory Speirs, U. Melbourne; Xiaorui Zheng, Swinburne University of Technology; Lyle Roberts, ANU and Hoang Vu Le, Swinburne University of Technology; Yangbing (Young) Zhang, University of Sydney.

The final day of the meeting commenced with two superb talks. First, the final plenary was given by a world-leader in biomedical optics, Bruce Tromberg, director of the Beckman Laser Institute and Medical Clinic at the University of California at Irvine, who guided us through the unfamiliar world of clinical applications, in taking us on medical biophotonics journey from the bench to the bedside, in describing the institute's work in cancer detection and biophotonics. Tromberg made reference to his roots as an accidental member of an Australian university rugby team during his university years, which qualified him as an honorary Australian. The ANZCOP delegates appeared pleased to welcome him back.

Ken Baldwin with the OSA President-elect Phil Bucksbaum and SPIE President-elect Phil Stahl

Then Phil Stahl, senior optical physicist at NASA Marshall Space Flight Centre, and SPIE President Elect, took us on a whistlestop tour of the world of space telescopes with his talk "James Webb Space Telescope – the first light machine", including a breathtaking overview of the extent of the existence of other planets and the likelihood of life on them. This talk concluded with a spectacular video showing the simulated deployment of the replacement for the Hubble Space Telescope, the James Webb Space Telescope.

The morning session concluded with a "Town Hall Meeting" led by Ken Baldwin from ANU to discuss the 2015 Year of Light. Many bright suggestions were received.

There were a number of other aspects of the conference worth mentioning. The lunchtime forums were a highlight, with Francois Ladouceur, UNSW, presenting on the path to commercialisation and John Harvey presenting on building a career in Photonics.

Congratulations also go to Nail Akhmedhiev for his successful satellite symposium on Rogue Waves and Extreme Events held during the meeting. The symposium captured a diverse range of activities in this field, including demonstrations of Rogue Wave events on the microscale, in this case in optical fibres, up to the macro-scale in immense wave tanks.

A conference as large as ANZCOP could not take place without the strong commitment and energy of may individuals. We would like to acknowledge especially the efforts of the executive committee members, Ann Roberts, Ken Baldwin, Simon Fleming, John Harvey, Mirerva Holmes, Thas Nirmalathas, and Audra Young and the technical programme committee, ably led by Co-chairs Cather Simpson and Rob McLaughlin and Stream Chairs Dave Kielpinski (Atom, quantum and nonlinear optics, and optical spectroscopy), Dragomir Neshev (Optical materials and devices, including lasers, meta-materials, plasmonics, and nanophotonics), John Canning (Optical sensors and imaging, including microscopy), and Malin Premaratne (Optical Communications and Photonics Systems).

This year, in the spirit of integration and cohesion, we integrated all submissions into a one-page extended abstract reviewed by the Technical Programme Committee. We provided the option of full-length papers as submitted in the past, but this took place post-conference and we have received very few. The feedback on the integrated format has been positive.

Finally, running a conference is expensive and we sincerely thank all our sponsors – they have helped us keep the meeting affordable and allowed us to provide you, the delegates, with the surroundings and experience conducive to good science. We hope you agree.

ANZCOP will not run in 2014, but we believe it will come around again in 2015 – long may it run.

David Sampson, Chair, is with The University of Western Australia. Michael Withford, Technical Program Chair, is with Macquarie University.

Plenary speaker Miles Padgett (left) with AOS president Ann Roberts and others at the dinner

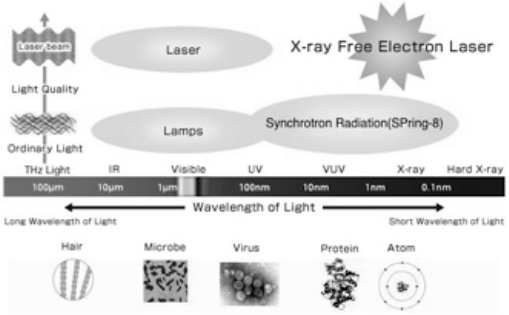
THALES LASER

LPSS LASERS FOR SCIENCE

NEWS ***THALES*** *was recently awarded a contract for 2 x 500 TW laser systems within the SACLA project for Riken Harima/Osaka University Japan*

WHAT IS SACLA ?

'Unlike traditional methods based on the light-emitting properties of materials, the building of an x-ray laser requires accelerating electrons to high energies, manipulating their motion, and using the light emitted during the process of acceleration. Since it is free electrons removed from atoms that are used to produce the x-ray laser, this new type of device is called an X-ray Free Electron Laser, or XFEL. This laser makes it possible for us to observe atoms and molecules in real time.'



http://xfel.riken.jp/eng/sacla/index02.html

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- Optics for Solar Energy (SOLAR)
- Solid State and Organic Lighting (SOLED)

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This comprehensive congress examines the frontiers in the development of optical technologies for energy production, transport and use. It also examines the use of optical and photonic approaches to monitor energy usage and the effects energy production has on the environment. It is designed to foster timely information exchange between the disciplines involved in energy production, usage, cost and environmental and efficiency management.

GENERAL CHAIR: **Professor Kenneth Baldwin,** *Australian National University*

PLENARY SPEAKER: DR. STEVEN CHU

- Nobel laureate, 1997, joint award with Claude Cohen-Tannoudji and William D. Phillips "for development of methods to cool and trap atoms with laser light"
- Former U.S. Secretary of Energy under President Barack Obama
- Current William R. Kenan, Jr. Professor of Physics and Professor of Molecular and Cellular Physiology at Stanford University

Abstract and Summary Submission Deadline: **3 September 2014** (16:00 GMT)

Check **www.osa.org/energyOPC** for updated conference information.

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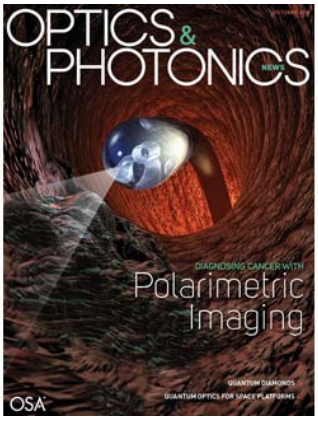

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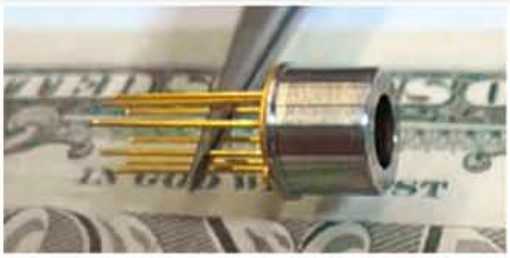

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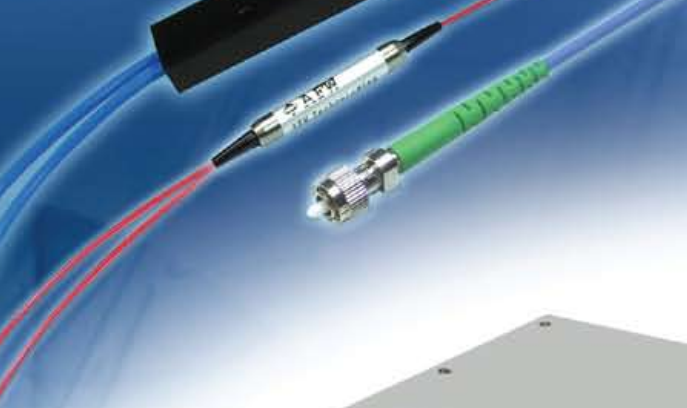

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- Customised fibre length: 50m, 100m, 200m, 1km ~ 5km
- Operating wavelength range: 1260 ~ 1650nm standard
- Fibre type: G.652.D SMF

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- Wavelength range: 980nm, 1064nm, 1310nm and 1550nm
- Low insertion loss <0.4dB and return loss over 55dB
- Narrow key or wide key connectors for FC type

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