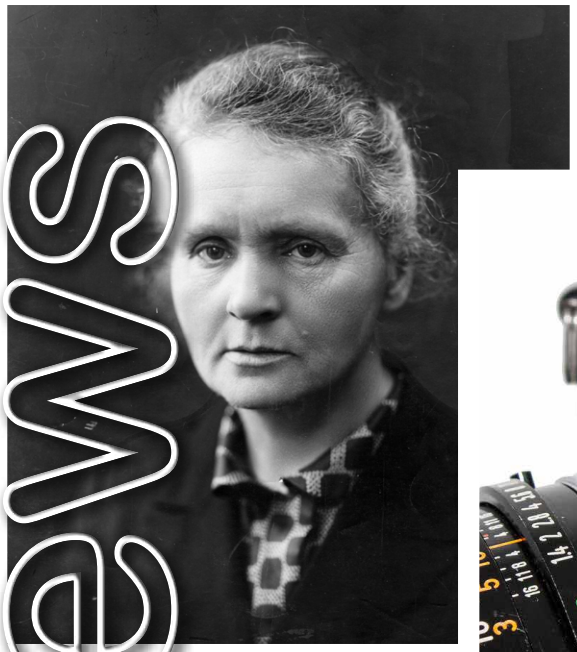
AOS News



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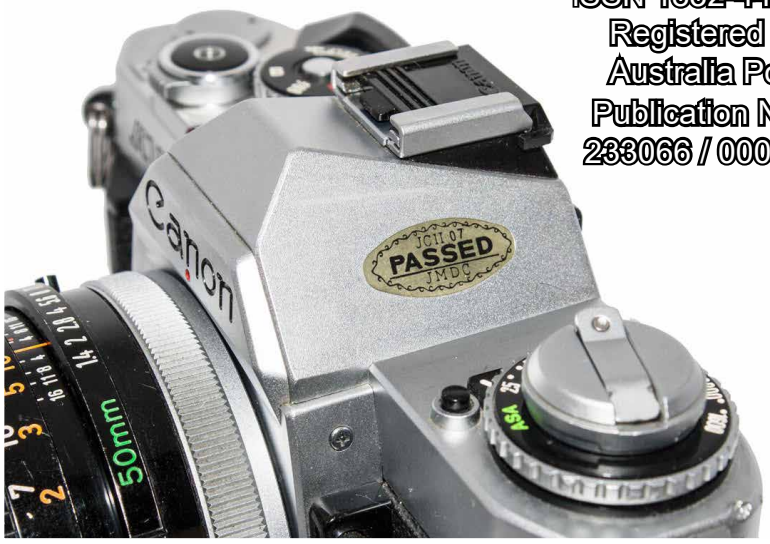
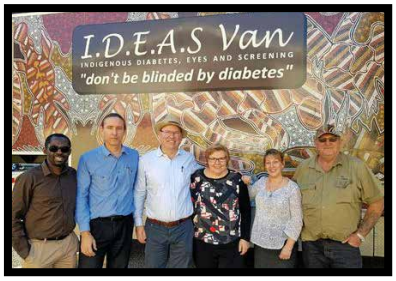


AUSTRALIAN OPTICAL SOCIETY



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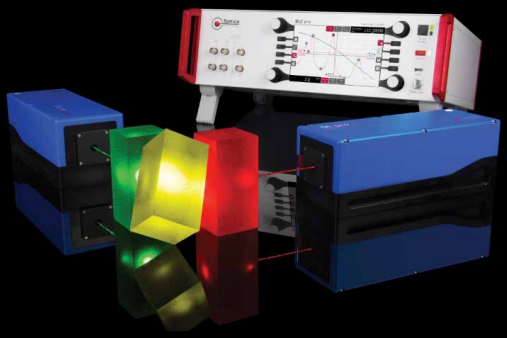

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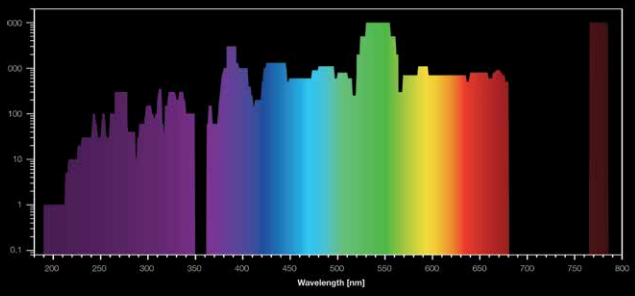

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AOS News is the official news magazine of the Australian Optical Society. Formed in 1983, the Society is a non-profit organisation for the advancement of optics in Australia. Membership is open to all persons contributing to, or interested in, optics in the widest sense. See the AOS website www.optics.org.au for details on joining the Society.

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.

Call for submissions!

Please consider writing something for the next issue.
We are looking for:

Scientific articles on any aspect of optics

Review articles on work in your lab

Conference reports from meetings you attend

Articles for the Optics in Everday Life section

General interest articles

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.

What can you submit?

- Scientific Article: A scientific paper in any area of optics.
- Review Article: Simply give a run down of the work conducted at your laboratory, or some aspect of this work.
- Conference Report
- General Interest Article: Any item of interest to members such as reports on community engagement, science in society, etc.
- Article for Optics in Everyday Life section: An explanation of the optics behind any interesting effect, phenomenon, or device.
- News Item
- Obituary
- Book Review
- Cartoon or drawing
- Crossword or puzzle

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.

December 2017 Volume 31 Number 3

Articles

Departments

Cover Pictures:

- (Top left) Marie Curie remains one of the most successful female scientists of all time and is certainly the most well-known. Born 150 years ago, is she still a good role model for girls? See page 17.
- (Top right) Camera lenses have come a long way since the invention of photography in the 1830s, see page 27. Image credit: R Flynn Marr, http://flynngraphics.ca.
- (Centre) Australian researchers have looked at the colour vision of honey bees and discovered a new mechanism for processing colour information, see page 15. Image credit: Luis Mata/RMIT.
- Insets (left to right)
  - The IDEAS Van (Indigenous Diabetes Eyes and Screening) is a specialist treatment centre that travels to regional hubs around Queensland allowing remote communities regular access to vision screening, see page 9.
  - Science & Technology Australia (STA) have a new executive team, see page 13.

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 AOS council. Use of electronic mail is strongly encouraged, although submission of hard copy together with a text file on CD will be considered.

Advertising:
Potential advertisers in AOS News are welcome, and should contact the editor.
Rates: Colour pages $345, Black and White pages $175, with a surchargee for choosing a specific page for the ads (rates excl. GST). 1-2 Black and White pages in the main body of the newsletter are free to corporate members.

Copy Deadline
Articles for the next issue (March 2018) should be with the editor no later than 19 February 2018, advertising deadline 12 February 2018.

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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.

Australian Optical Society website:
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President's Report

When I started writing this I had just returned from Queenstown, New Zealand and a very successful ANZCOP. This conference sets a new high benchmark: great speakers, great networking events, well organised, embodied our equity principles, fantastic location, and even very good weather. I had a really productive, useful and enjoyable time. Thanks John, Fred and Harald. I anticipate a proper write-up in AOS News soon.

ANZCOP comprises ACOFT and ACOLS. This was the first time ACOFT had been held in New Zealand in 42 years, and the third time for ACOLS. The society embraces members of the optics and photonics community on both sides of the Tasman Sea and this was a great opportunity to build links. ACOFT 2018 will be held in Perth 9-14 December along with the AOS Conference as part of the AIP Congress. I am pleased to advise Robert McLaughlin will be TPC Chair. We plan to hold the next ANZCOP in December 2019 and we had constructive discussions with SPIE to avoid the clash with their meeting.

We held the AOS Council and AGM during ANZCOP. An important function of the AGM is to elect Councillors (the AOS operates as a company under Australian law, and the Council is the Board, and you the members elect us). Five Council positions were up for election. Ken Baldwin and Halina Rubinstein-Dunlop stood again. Baohua Jia, Robert McLaughlin and Peter Veitch did not stand for re-election. Heike Ebendorff-Heidepriem, Arnan Mitchell, and Michael Steel stood for election. With five vacancies and five candidates there was no need for election. I am delighted to welcome the incoming Councillors. I would like to thank Baohua, Rob and Peter for their service to AOS as Councillors. Baohua warrants special mention as she also served as Treasurer. In this time she did the really important, and challenging, task of moving our membership system and subscription payments online. Importantly this gives us a solid base on which to offer new online services.

As we approached the election it became apparent that we risked losing diversity and geographical spread on the Council. For me this highlighted the need to actively encourage a diversity of voices, experiences and views into representative positions. Part of the solution lies with "the old white men" (like myself): when approached to serve on a committee or similar, consider passing the opportunity to a strong candidate from an under-represented group.

As this is the end of my first year, I thought I should review progress on the three main aims I set out at the start of my term: 1. Continue to build on our equity and diversity initiative, 2. Commission a review / roadmap of optics and photonics in Aus and NZ, 3. Improve member engagement.

Our equity policy, especially in terms of gender, is having an impact. ANZCOP was the first major event we have sponsored and the line-up of speakers attested to the impact. Nationally, STA is interested in what we are doing and in drawing on our experience for other Australian societies. Internationally our initiative has been recognised by OSA and our policy on cosponsoring conferences has opened up a discussion with OSK. This is a good start, but we can always do better and we welcome suggestions.

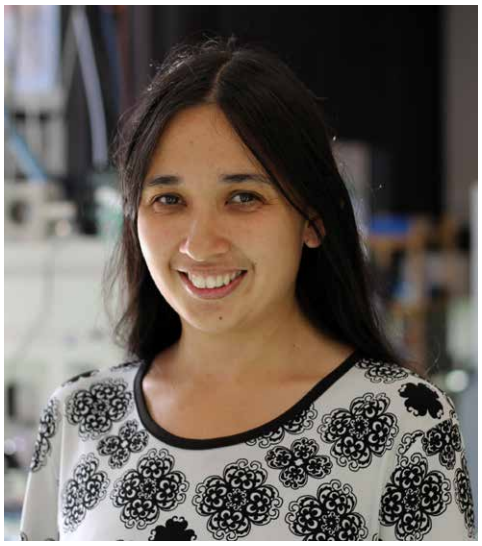
It is well over ten years since the last review or roadmap of optics and photonics. Similar exercises have been recently completed in USA and EU. We have been steadily building support but progress is slow. For engaging the membership, the new website and webmaster allow us to post news and job adverts, our new Twitter account provides access to news and events on the Aus/NZ optics community and we also send out approximately monthly emails. I am keen we do more, with engagement involving information flow from members to Council, and facilitating communication between members.

The society is in pretty good shape. The main operational issue has been that the load on the Treasurer, with both the finances and the new website involving the transfer of membership records, has resulted in some of our financial affairs running behind, in particular the audit report (which will be made available in due course).

I wish you all the very best for a rewarding and enjoyable 2018.

Simon Fleming
AOS president

Editor's Intro



Welcome to another issue of AOS News. Apologies for the delay in this issue reaching you. We have a number of articles ranging from details of outreach work with remote communities to an item about Marie Curie's place as a role model for modern female scientists. There is also news from SPIE and the general optics community in Australia, and our 'Optics in Everyday Life' section looks at the history and evolution of camera lenses. I particularly want to highlight a report on the number of papers on laser physics and photonics published in Australia that investigates how well we're doing compared to the rest of the world. I hope you enjoy reading them all. 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. As it is the last issue of the year I would like to thank everyone who has contributed articles to AOS News during 2017 and particularly to Tony Klein for all his work on the Optics in Everyday Life section.

I read a couple of interesting articles in The Conversation recently - one about changing how scientists write papers by Zoe Doubleday and Sean Connell from the University of Adelaide. The authors argue that peer-reviewed publications are difficult to digest and not enjoyable to read. They talk about the importance of 'Ingredient X', objective charisma, that they published a paper on (https://doi.org/10.1016/j.tree.2017.06.011), which they describe as creativity and clarity, using narrative and prose with the reader being all-important rather than the writer. They propose that authors should try and think about their audience and help them absorb the information rather than only be easily understood by a few people in the field. They are not advocating sensational writing, but suggest that creative elements could be used to make scientific writing clearer, more accessible and interesting without losing objectivity or accuracy. Scientific writing is traditionally boring and hard to read for no obvious reason according to the authors of the article, but they point out that this is not an effective means of communication, so would ideally be changed. It is an interesting viewpoint and one that might improve collaboration as it could aid enhanced understanding of neighbouring areas and is certainly something to think about, even if it is not easily implemented. The authors suggest that it would increase the influence of publications and lead to science that is 'read, understood and remembered'.

The other article was about possible gender differences in student ability depending on the way questions are worded by Kate Wilson and David Low from UNSW and Anna Wilson from Abertay University. This was in the physics context, where the authors noticed a gap in performance in year 11 students on some of the questions in an Australian physics Science Olympiad test. After looking at 8 years of data they saw that projectile motion in particular shows the largest gender difference in scores, with a typical gap of 25-30%. The authors suggest that as this appears to be the case, perhaps in places where projectile motion is covered at the start of a year 11 physics course, it could be moved later in preference of a subject that has a smaller difference between genders. This is to avoid girls feeling discouraged or that physics isn't for them merely due to the fact that the first topic is one where they may be disadvantaged. They also recommend that teachers should examine assessments for gender gaps by question and that if large differences are found an investigation is made to see if the most important concepts are being assessed and if changes could be made to avoid gender bias.

There are a number of possible reasons for the gender difference seen on certain topics, particularly projectile motion, but if large variations are in part due to the way questions are asked, the way a topic is assessed, or the order in which topics are presented, then finding this out and making changes would be worthwhile. I remember talking to one of the authors at the AIP Congress in 2016 about this work and it is very thought-provoking and concerning if there is a real difference in test performance depending on the way questions are worded. It is certainly an issue that is worth thinking about and will be interesting to see further outcomes and suggestions of what can be done, particularly if it could have an effect on girls' confidence and feeling of being able to do physics whilst at high school. As one of the authors says: 'I think our future depends on encouraging diversity of thought across many fields. If we can make simple changes to our curriculum and/or assessment that can avoid reducing diversity at an early stage, we stand more chance of getting people who think about things in a different way through to the levels where they can make a difference, and become role models for people like themselves.'

I hope you enjoy this issue of AOS News, and wish you all the best for 2018,

Jessica Kvansakul
Editor

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Community Outreach to Provide Glasses and Vision Tests in Nigeria and Remote Australia

Dr Levi Osuagwu recently completed his PhD at the School of Optometry and Vision Sciences, Queensland University of Technology and was President of the QUT Optical Society student chapter. He is passionate about giving back to the community and is involved in programs to provide free optometry to people in need in Nigeria and to Indigenous Australians in remote areas of Queensland.

Levi Osuagwu. Photo: Jacqueline Henry.

Passionate about giving back to his home country, optometrist Levi Osuagwu organised a medical outreach trip to Nigeria in April where he will be recycling reglazed glasses donated by Australians and providing eye screening services. Along with fellow optometrists and final year optometry students from QUT, Levi will be visiting his community, Ihitte-Uboma LGA of Imo State in Eastern Nigeria, where his mum and three siblings still live.

During the visit, Levi will partner with his local church in Nigeria, Saviours Evangelical Church, to administer free eye screenings and examinations, referrals and to dispense glasses. The visit will also provide training for the young optometrists and expose them to using modern equipment. From previous experience, Levi plans to administer approximately 500 eye screenings over 3-4 days.

Thanks to donations from the community, Levi will have nearly three hundred pairs of glasses to distribute, and anything he doesn't use during his stay will be left for trained staff to continue to administer.

Levi says, "This is the third outreach trip I have been on to Nigeria and it's great to see our work making a difference in the lives of people who are surrounded by such poverty. I migrated from Nigeria to Australia in January 2014 and I know how lucky we are to live in a country where eye care is subsidised and readily available to those experiencing problems with their sight. It is estimated that 4.25 million adults aged 40 years and above in Nigeria are currently visually impaired or blind. In 84% of cases, blindness was avoidable. I am looking forward visiting my home country of Nigeria, I know this is one way I can make an impact in my community."

Levi collected pre-loved prescription and reading glasses donated by local residents to give to people in need in Nigeria. "Every pair collected will make a huge difference to the lives of those suffering from poor eye sight and will provide individuals with a clearer, brighter future." says Levi. The Specsavers where Levi works supported the effort to collect and reglaze the donated glasses.

Levi also works with IDEAS Van (Indigenous Diabetes Eyes and Screening), which is a mobile fully equipped ophthalmology and optometry specialist treatment centre that travels to regional hubs around Queensland allowing remote communities regular access to vision screening. "I joined the IDEAS Van initiative to provide world class eye care and diabetic care to indigenous Australians." says Levi. "Caring for indigenous Australians is very similar to caring for the Nigerian community - cultural beliefs are often held high above proven scientific solutions. Even with your qualifications, expertise, you need to be fully accepted by the community, trusted and gain their confidence for people to allow you to provide them with the eye care service they very urgently need. Indigenous people are more likely to go blind due to diabetes than non-indigenous Australians. Learning and understanding their culture is at the very crux of providing effective service. There is so much work left to be done."

Levi and the IDEAS Van team.

For more information on IDEAS Van visit www.ideasvan.org.

Source material:
www.specsavers.com.au/news/every-pair-counts-specsavers-taigum-gains-perspective-on-world-sight

SPIE News

by Amy Nelson

SPIE NanoPhotonics Australasia drew world experts to Melbourne

Researchers from across the diverse fields of nano- and microscale materials and technologies convened from around the world in Melbourne from 10–13 December to share their latest findings at SPIE NanoPhotonics Australasia. The symposium was held on the campus of event co-organiser Swinburne University of Technology.

On the organising committee from Swinburne were symposium chairs David Moss and Saulius Juodkazis and conference chairs James Chon and Baohua Jia.

Researchers, scientists, and engineers from around the globe presented more than 230 papers, highlighted by plenary talks by:

- Demetrios Christodoulides, CREOL, College of Optics and Photonics, University of Central Florida, on Parity-Time Symmetry in Optics and Photonics
- Benjamin Eggleton, University of Sydney, on Harnessing Opto-Acoustic Interactions in Nanoscale Integrated Circuits
- Alexander Gaeta, Columbia University, on Silicon-Chip-Based Nonlinear Photonics
- Chennupati Jagadish, Australian National University, on Semiconductor Nanowires for Optoelectronics Applications
- Eli Yablonovitch, University of California, Berkeley, on The Optical-Antenna LED, Faster than the LASER
- Yuri Kivshar, Australian National University, on All-Dielectric Nanophotonics and Metasurfaces Driven by Mie Resonances.

Ewa Goldys, David Moss named Senior Members of SPIE

Ewa Goldys, Macquarie University

Ewa Goldys of Macquarie University and David Moss of Swinburne University of Technology are among 150 named in 2017 as Senior Members of SPIE, the international society for optics and photonics.

Professor Goldys was recognised for her achievements in fluorescence technology, and professor Moss for his achievements in CMOS-compatible photonic integrated chips for nonlinear optics.

Read more in the SPIE press release: www.spie.org/x127386.xml.

David Moss, Swinburne University of Technology

SPIE Board of Directors member leads off session to honour optical trapping pioneer

Halina Rubinsztein-Dunlop (University of Queensland) introduced a session during SPIE Optics and Photonics in San Diego, California, USA, on 8 August honouring the work of optical trapping innovator Monika Ritsch-Marte of Innsbruck Medical University.

The session, part of the conference on Optical Trapping and Optical Manipulation chaired by Kishan Dholakia (University of St. Andrews) and Gabriel Spalding (Illinois Wesleyan University), highlighted Ritsch-Marte's pioneering work resulting in a number of methods of the use of spatial light modulators in microscopy and optical trapping. Her methodology established techniques that include spiral phase contrast, wide-field CARS imaging, and trapping of motile micro-organisms.

Rubinsztein-Dunlop is a Fellow of SPIE and a member of the society's Board of Directors.

From left, Gabriel Spalding, Halina Rubinsztein-Dunlop, Monika Ritsch-Marte, Kishan Dholakia

Read more about the event at:
www.spie.org/about-spie/press-room/spie-optics--photonics-2017-news-highlights-and-photos#RitschMarte

Amy Nelson is PR Manager with SPIE.

Conferences

29 January to 2 February, ICONN 2018

The 2018 International Conference on Nanoscience and Nanotechnology (ICONN 2018) will take place at Wollongong University, NSW, from Monday 29 January to Friday 2 February. The aim of ICONN is to bring together Australian and International communities (students, scientists, engineers and stakeholders from academia, government laboratories, industry and other organisations) working in the field of nanoscale science and technology to discuss new and exciting advances in the field. ICONN will cover nanostructure growth, synthesis, fabrication, characterisation, device design, theory, modeling, testing, applications, commercialisation, and health and safety aspects of nanotechnology.

The conference will feature plenary talks followed by technical symposia (parallel sessions) consisting of invited talks, oral and poster presentations. http://www.ausnano.net/iconn2018/

9-14 December, AIP Congress 2018

The Australian Institute of Physics 2018 Congress will be held in Perth from Sunday 9 to Friday 14 December at the University of Western Australia. Following on from the success of the AIP Congress in Brisbane in December 2016, the 2018 congress aims to continue the tradition of being a big celebration of science, at the highest international level. The Organising Committee look forward to welcoming the world of physics and the broader community to a scientifically intense yet socially relaxed celebration of science. The conference incorporates the AOS annual meeting. https://aip2018.org.au/

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News

AOS and SPIE renewed Memorandum of Understanding

AOS and SPIE have renewed our Memorandum of Understanding (MoU) for another three years. The agreement was signed on 28th October by Halina Rubinsztein-Dunlop and Glenn Boreman. The purpose is to promote optics and photonics research and education and serve members of the international optical science and engineering community. The terms of the MoU include information exchange, joint promotion of events and activities, leadership exchange visits, and an SPIE student prize at our annual conference.

Halina Rubinsztein-Dunlop and Glenn Boreman sign the MoU between AOS and SPIE.

2017 AOS Awards winners

The AOS Geoff Opat Early Career Researcher Prize has been awarded to Dr Sergey Kruk from ANU.

Both the AOS Postgraduate Student Prize and the AOS/Warsash Science Communication Prize in Optics have been awarded to Ms Litty Thekkekara from RMIT University.

The 2017 W.H. (Beattie) Steel Medal has been awarded to Professor Yuri Kivshar in recognition of his leadership and significant contributions to the field of optics, particularly in nonlinear photonics and metamaterials.

Look out for articles in forthcoming issues of AOS News from the winners.

The new STA executive team.

Science & Technology Australia

Congratulations to Professor Judith Dawes on her appointment to the role of Treasurer of Science & Technology Australia (STA). Thanks also to outgoing STA President Professor Jim Piper for his advocacy of Australian science throughout his Presidency.

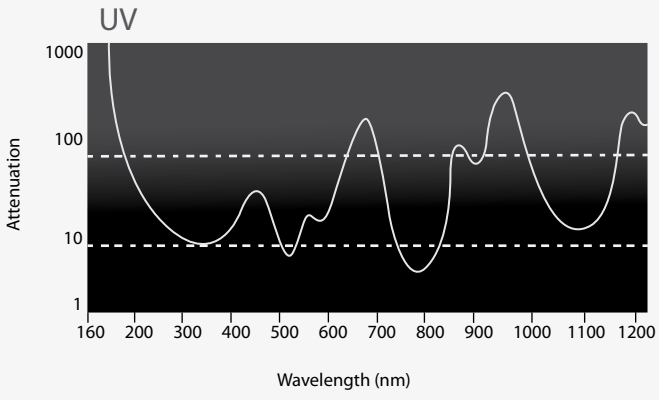
https://scienceandtechnologyaustralia.org.au/new-leading-voices-for-science-and-technology-in-australia

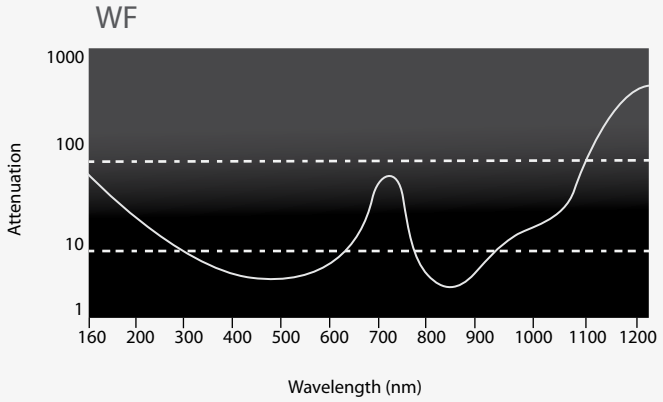
Fibre Optic & Photonic products

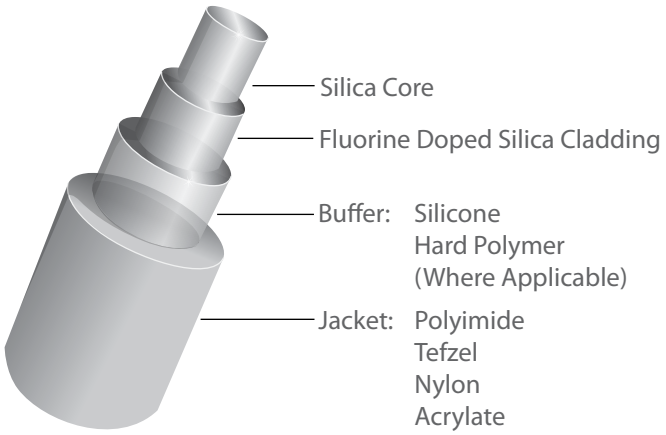
Large diameter core multimode fibre cable assemblies for broad UV/VIS/NIR spectral range

AFW supplies optical fibre and assemblies for various industry and research applications.
We offer several fibre core sizes terminated with SMA, ST or FC type connectors.

Applications	Features
Spectroscopy	Broad UV / VIS / NIR spectral range
Sensors	Low NA 0.12, standard NA 0.22
UV photolithography	Pure silica core and doped fluorine silica cladding
Laser welding / soldering / marketing	Core/cladding 105/125, 100/140, 200/220, 400/440, 600/660, 800/880 um
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
Laser diode pigtailing	FC, SMA 905 or ST type connectors
Semiconductor capital equipment	FC, ST or SMA adaptors







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Australian Research in the News

Understanding bee colour vision could pave the way for better cameras in phones, drones and robots

A honeybee. Photo credit: Luis Mata/RMIT

Identifying colour in complex outdoor environments is extremely difficult because the colour of light is continuously changing. Researchers in Melbourne looked to see how honeybees solve this problem and discovered a totally new mechanism for processing colour information. The results of the work by academics at RMIT, Monash, University of Melbourne and Deakin were published in the journal, Proceedings of the National Academy of Sciences of the United States of America (PNAS). The project, supported by an Australian Research Council (ARC) grant, was coordinated by Associate Professor Adrian Dyer from RMIT. He has been working with Professor Marcello Rosa at Monash and the ARC Centre of Excellence for Integrative Brain Function to solve this classic problem of how colour vision works.

Dyer said: "For a digital system like a camera or a robot the colour of objects often changes. Currently this problem is dealt with by assuming the world is, on average, grey. This means it's difficult to identify the true colour of ripe fruit or mineral rich sands, limiting outdoor colour imaging solutions by drones, for example." Bees have three extra eyes (ocelli) on the top of their head that look directly at the sky, and lead author Dr Jair Garcia (RMIT) and a multidisciplinary team discovered that the ocelli contain two colour receptors that are perfectly tuned for sensing the colour of ambient light. Bees also have two main compound eyes that directly sense flower colours from the environment. Garcia said: "Physics suggests the ocelli sensing of the colour of light could allow a brain to discount the naturally coloured illumination which would otherwise confuse colour perception. But for this to be true the information from the ocelli would have to be integrated with colours seen by the compound eyes."

To test if this happened, Dr Yu-Shan Hung (University of Melbourne) mapped the neural tracings from ocelli and showed neural projection did indeed feed to the key colour processing areas of the bee brain. Professor Andrew Greentree from the ARC Centre for Nanoscale BioPhotonics at RMIT said: "It is rare that physics, biology, neuro-anatomy and ecology all fit together, but here we have it." The system closely predicts previously observed behaviour of bees foraging in complex environments and provides a new solution for illuminations as diverse as natural forest light, sunlight, or shade. Dyer said: "We're using bio-inspired solutions from nature to tackle key problems in visual perception. This discovery on colour constancy can be implemented into imaging systems to enable accurate colour interpretation."

Source material: https://www.rmit.edu.au/news/all-news/2017/jul/bee-brains-open-way-for-better-cameras-coloured-light

Original article: JE Garcia, YS Hung, AD Greentree, MGP Rosa, JA Endler, AG Dyer. *Improved color constancy in honey bees enabled by parallel visual projections from dorsal ocelli.* PNAS, 114, 29, 7713-7718 (2017); doi: 10.1073/pnas.1703454114

World-first optical fibre laser could revolutionise detection of gases

An international research group, led by Macquarie University scientists, has developed a world-first optical fibre technology which can help detect a wide range of gases with unprecedented sensitivity, with potential applications ranging from breath analysis to air-quality monitoring. The discovery, which has been published in the journal Optica, outlines the development of an optical fibre device which encompasses an infrared laser coupled to an ultra-broadband supercontinuum generator – two elements that researchers have never managed to combine to a single optical system before. "The new supercontinuum technology that we've developed is capable of being used to detect an array of gases, including methane, carbon dioxide and nitrous oxide – gases that can be harmful to humans in high levels and have implications in climate change," explained lead researcher Dr Darren Hudson from Macquarie University.

Over the last decade, researchers around the world have worked to create high-brightness sources of infrared light. While this work has revolutionised how we detect and measure a staggering range of molecules, the current technology still requires large laser systems, optical laboratory conditions, and an expert user to operate. This new fibre optic-based system will make this technology much smaller and easier to use, said Dr Hudson. "While previous research has led to ultra-broadband supercontinuum sources, we've managed to squeeze this technology into a system that can be completely fibre integrated, protecting it from outside influences and making it much easier to use in an array of scientific and medical situations, including operating in harsh environments."

To achieve the first "all fibre" system, researchers first developed a new kind of fibre laser that emits infrared light in extremely short bursts (180 millionths of a nanosecond). They then fired these laser pulses into a special type of microwire fibre, developed by collaborators at McGill University and Laval University in Canada. "The resulting supercontinuum performance of the new fibre optic technology matches the best performance from large laser systems, but in a package that could one day fit in the palm of your hand," said Associate Professor Alex Fuerbach, co-leader of the research group that produced the study, from Macquarie University. The researchers are now looking to work with collaborators to test different ways the technology can be used.

Source material: www.mq.edu.au/newsroom/2017/09/29/world-first-optical-fibre-laser-promises-to-revolutionise-detection-of-gases-including-in-medical-settings-climate-management-and-mining-applications

Original article: DD Hudson, S Antipov, L Li, I Alamgir, T Hu, M El Amraoui, Y Messaddeq, M Rochette, SD Jackson, and A Fuerbach, *Toward all-fiber supercontinuum spanning the mid-infrared*, Optica **4**, 1163-1166 (2017); https://doi.org/10.1364/OPTICA.4.001163

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Is Marie Skłodowska Curie Still a Good Role Model for Female Scientists at 150?

This article was originally published on
THE CONVERSATION
by Monica Grady

Sometimes I'm glad I'm old(ish) and have made it up the career ladder. I can't imagine what it must be like to be a young woman trying to become established today. Not only are they likely to be saddled with a large debt from university tuition, they must also contend with discrimination and harassment, no matter what field they wish to enter. Academia, unfortunately, is no exception.

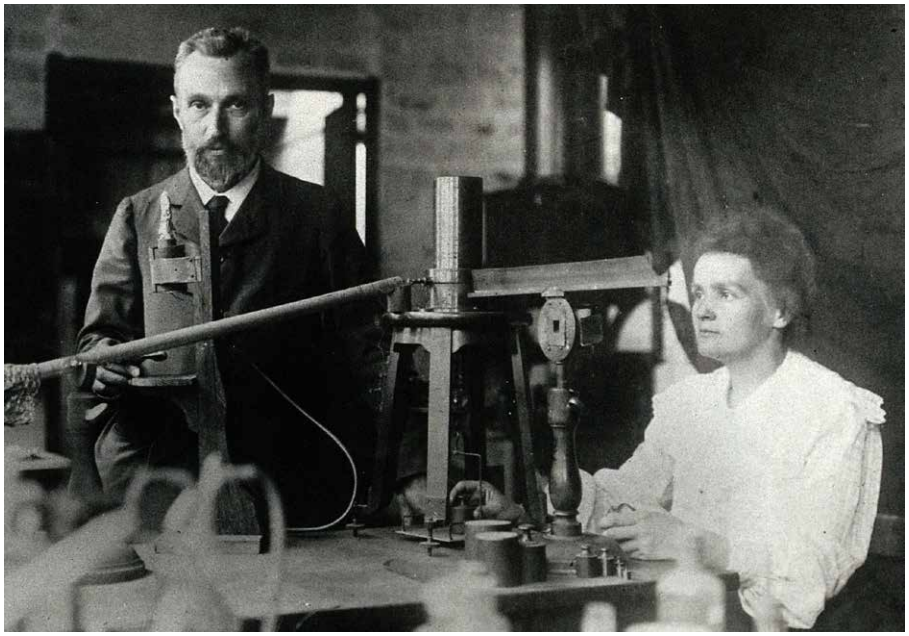
It is salutary to look back at the hurdles the most famous female scientist had to overcome on her journey to two Nobel prizes in separate disciplines – physics and chemistry – one of only four individuals to be honoured in this way. Marie Skłodowska Curie (November 7, 1867 – July 4, 1934) is a role model like no other – and practically the only female scientist that many people can name. She is particularly known for her groundbreaking work on radioactivity.

I reread Skłodowska Curie's biography recently, and she certainly deserves her place of honour in any list of leading scientists. Her work impacts my own field of space sciences on a daily basis – not least as we use radioactive decay as a power source for the spacecraft that help us shed light on our solar system.

Skłodowska Curie's life story seems more compelling than ever. She faced the problems that scientists experience today: shortage of funding, inadequate laboratory facilities and having to manage a teaching load with research time. Add to that two daughters, and the issue of juggling childcare and career adds a familiar refrain.

But she was also an immigrant. In her native country of Poland, women could not go to university, so she went to France for her higher education. She could not go until she had raised sufficient money to pay her tuition fees, so she worked as a governess for two years, finally leaving for France in 1891.

Fast forward a few years, and Maria Skłodowska, now Marie Skłodowska Curie, had overcome the difficulties of her background, and in 1903, became the joint recipient, with her husband Pierre Curie, of the Nobel Prize in physics. Surely a life of success beckoned? No such luck. Widowed less than two years later, Skłodowska Curie continued to struggle, mainly with health issues related to her research on radioactivity.



Marie and Pierre Curie.

Marie Curie.

She received further honours, becoming the first female professor at the Sorbonne. But as her fame grew, again, as happens so frequently, success led to vilification. Her daughter Eve related in the 2001 autobiography: "Her origins were basely brought up against her: called in turn a Russian, a German, a Jewess and a Pole, she was 'the foreign woman' who had come to Paris like a usurper to conquer a high position improperly."

Much of the vitriol came to the fore in 1910, when she was nominated for membership of the Académie des sciences – an honour never previously awarded to a woman. She lost out by one vote, and the first female full member was not elected until 1979.

Modern icons?

Skłodowska Curie really is a splendid role model and a feminist icon – but you don't have to go through all that grief, or even dissolve up several tonnes of uranium ore to serve as an example of what women can accomplish.

In my own field, there are many amazing women who have been the

first in their sphere. Just think of the first women astronauts: the Russian cosmonaut Valentina Tereshkova, the British astronaut Helen Sharman and the US space shuttle astronaut Sally Ride.

Vera Rubin, an astronomer who discovered powerful evidence of dark matter, died recently without winning the Nobel Prize that many people thought she deserved – having suffered from sex discrimination during her entire career.

A lot of successful women in science go completely unnoticed. The recent film, Hidden Figures, highlighted the prejudices that three black women (Katherine Johnson, Dorothy Vaughan and Mary Jackson) working for NASA in the 1960s had to overcome. These women made some enormous achievements and their lack of recognition is appalling.

In the 1970s, another woman, Charlotte Whitton, the first Canadian female mayor summarised the situation women faced: "Whatever women do they must do twice as well as men to be thought half as good. Luckily, this is not difficult." This may be a little unfair, but it did reflect the frustration of the time. Things are getting better – there are more women in positions of seniority across all fields and disciplines, and it is becoming less of a talking point when a woman is successful.

But we are still failing to develop the talents of many young women. In a society that is woefully short of the scientists and engineers that it needs, we lose a lot of the potential workforce when we fail to excite young women to continue studying science subjects like physics beyond the age of 15 in schools. And many women who do get into science fail to reach senior positions.

What role models are required to persuade girls that they can become scientists and engineers? What will persuade them that physics isn't boring?

Space shuttle astronaut, Sally Ride.

How can we ensure that there are sufficient students in our universities to provide the specialists we will need to maintain the pace of discoveries that we have come to expect in our digital age? Is the life and example of Marie Skłodowska Curie still relevant, or do we need someone a little more contemporary?

Maybe a culture change is required – and that is more than any role model, no matter how charismatic, can enforce. As we have seen, the past is coming back to haunt men who have abused positions of privilege to harass women. Perhaps we are, at last, going to attain the equality of status that women have been fighting for for decades. Women should no longer feel under threat in the workplace. It should be a matter of no moment when a woman is appointed or promoted. The UK's Athena Swan charter was established to advance gender equality in STEM subjects in universities, and has been successful. There is still a long way to go, though, and ensuring equality doesn't engender excitement.

Skłodowska Curie and her husband are immortalised as the Curie (Ci), the unit of radioactivity, and as curium (Cm), the element in the periodic table with atomic number 96. 7000 Curie is an asteroid. But it just seems such a shame that 150 years after her birth, we still haven't got the role of women in science and engineering at the level of attainment that means we can stop talking about it.

Monica Grady is Professor of Planetary and Space Sciences, The Open University.

The original article can be found at:
https://theconversation.com/is-marie-sklodowska-curie-still-a-good-role-model-for-female-scientists-at-150-87025

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Product News

LightMachinery - Hornet Spectrometer

The Hornet series of spectrometers are based on LightMachinery's high finesse etalons. They are designed primarily for measuring laser spectra in real time, for characterising passive components, and for solar spectroscopy.

Specifications

- Resolution: sub 20pm at 532nm (resolving power > 25,000)
- Accuracy: < 20pm following calibration
- Dynamic Range: >10^8 for the system, 1000 in a single measurement
- Wavelength range: Visible to near IR (260nm to 16000nm), factory setup from 50nm to 300nm width based on customer's requirements
- Simultaneous range / resolution: >10,000 at 532nm
- Acquisition and processing speed: >2Hz typical, >10 Hz over narrow wavelength bands
- Calibration: a narrow band (<10pm) external reference source is required

Features

- Wavelength range: 50nm anywhere in the visible or NIR, or the full visible
- <30pm resolution
- Fibre coupled
- Simple USB interface
- LabView Drivers
- No Moving parts
- Can be triggered externally

Benefits

- Average range-over-resolution ratio up to 13000
- Ultra compact
- Can measure the spectrum of both CW and pulsed sources
- Fast, real-time measurements (up to 10Hz)
- Ultra reliable
- Easy to calibrate

Southern Photonics – NEW Femtosecond Fibre Laser

This all-PM fibre laser system is designed as a high reliability femtosecond laser system producing high peak power in a compact package. The FLS100H laser produces linearly chirped pulses capable of compression to sub-picosecond duration (using the FLC unit) at a variety of repetition rates.

Suitable for - Nonlinear microscopy and materials surface processing.

Key Features:

- Robust all PM fibre construction
- No saturable absorber
- No free space optics
- Self starting
- Variable repetition rates 2MHz-20MHz

Specifications: FLS100
Centre wavelength: 1030nm
Repetition rate: 2-20MHz (customer specified)
Bandwidth: 5-20nm (depending on power and repetition rate)
Pulsewidth: 30-50ps; <200fs with FLC
Ave Output power: 10mW
Output polarization: Linear
PC Interface: RS232 or RS485
Dimensions: 260x260x65mm
Power supply: 5VDC 15W

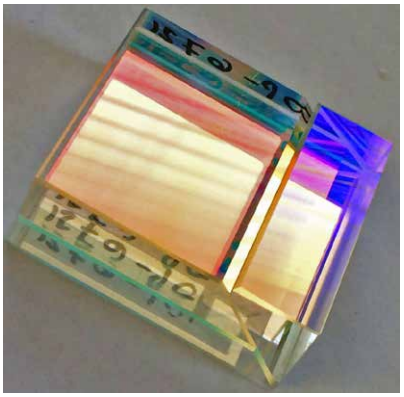
Specifications: FLS100H
Centre wavelength: 1030nm
Repetition rate: 2-20MHz (customer specified)
Bandwidth: 5-20nm (depending on power and repetition rate)
Pulsewidth: 150ps; <300fs with FLC
Ave Output power: 350mW
Output polarization: Linear
PC Interface: RS232 or RS485
Dimensions: 260x260x130mm
Power supply: 5VDC20W

Optics from LightMachinery

Fluid jet polishing is turning the world of optical fabrication upside down.

LightMachinery's patented fluid jet polishing system uses a fine stream of slurry to accurately remove nanometres of material from an optical surface, enabling some very complex and difficult optical fabrication tasks to be achieved and is opening up a new era of optical device manufacturing.

- The adjustment of the shape and flatness of optical components such as etalon mirrors to within a few nanometres
- Very thin components, such as wafers and thin etalons, that are impossible to accurately polish using conventional technology
- The ability to measure the final performance of complex assemblies such as Michelson Interferometers and then to make arbitrary surface corrections to correct the overall performance
- Arbitrary optical surfaces such as phase plates, corrector plates, axicons and cylindrical axicons



For more information please contact Raymax at info@raymax.com.au or 02 9979 7646

Microlight 3D Printer

An ultra high-resolution 3D-printing-machine for use in bio-printing and tissue engineering. Based on two-photon-absorption direct laser writing, compatible with bio-printing and tissue engineering. The system can produce extra-cellular matrix, scaffolds, and micro-parts, with micrometre resolution.

Key features

- Compatible with biomaterials (collagen...), biocompatible and biodegradable materials, as well as a wide range of polymers
- High writing precision and resolution (better than 1 µm)
- Adjustable writing resolution for high speed writing
- Compatible with any CAD models and files
- Highly compact machine
- Compatible with sterile and controlled environment

Key benefits

- High writing speed, even for complex 3D structures
- Free design of 3D biocompatible scaffold
- No shape constraints on 3D micro-parts
- Used in the study of cells and tissue engineering

For more information please contact Raymax at info@raymax.com.au or 02 9979 7646

Quad-PID Feedback Loop with PLL Capability

Zurich instruments just added the MF-PID option with 4 independent PID (proportional - integral - derivative) controllers to their MFLI, a 500 kHz/5 MHz lock-in amplifier. The MF-PID option builds on class-leading specifications of the MFLI such as low input noise of 2.5 nV/√Hz and a high dynamic reserve of 120 dB. Each controller is seamlessly integrated with the lock-in amplifier, using inputs from a multitude of internal measurement data and analogue input signals. The maximum control loop bandwidth is 50 kHz.

When setting up a new control loop, the user is well supported by the LabOne PID-Advisor which offers a selection of models that can be picked and adjusted to have a close match with different applications. After defining the target bandwidth, the PID-Advisor suggests a set of parameters and graphically displays the corresponding transfer-function and step-response. Once the feedback loop is running, the auto-tune function optimises the parameters to minimise the residual PID error. The software toolset included in LabOne also offers a parametric sweeper, oscilloscope and spectrum analyser. These tools can be used to efficiently analyse the performance of the loop and compare to the selected model. In phase-locked-loop (PLL) mode, phase unwrapping extends the input range to ±1024π, meaning a reliable feedback at start-up and robust operation throughout.

The MF-PID option can be used in many applications, including frequency combs, frequency-transfer-locks, optical fibre noise-cancellation, atomic force microscopy (AFM), scanning tunneling microscopy (STM), scanning near-field optical microscopy (SNOM), MEMS resonators and gyroscopes.

U-523 and U-723 PILine Stages from Physik Instrumente

Physik Instumente, a global leader in the design and manufacture of high precision motion control systems has launched the U-523 linear and U-723 XY stages with the PILine ultrasonic piezomotors. The stages are highly suited to applications that require fast, precision positioning with low duty cycles. The U-523 and U-723 have the following key features:

- Travel range: 22mm and 22x22mm
- Velocity: 200mm/s
- Resolution: 10nm
- Self-locking at rest (no heat generation)
- Highly compact form factor
- Vacuum compatible: 10^{-6} hPa

Applications include:

- Micromanipulation
- Automation
- Sample positioning

For more information, contact Warsash Scientific at sales@warsash.com.au or 02 9319 0122

Radially and Azimuthally Polarized Beams Generated by Liquid Crystal Elements

ARCoptix's Radial Polarizer converts a linearly polarized beam into a beam that has a continuous radial or azimuthal polarization distribution. This unique technology is based on a special alignment of the nematic liquid crystal molecules which are capable of locally rotating the orientation of the linearly polarized laser beam. Either azimuthally or radially distributed polarization is obtained depending on the orientation of the device with respect to the laser polarization.

This device has a working wavelength range from 350 to 1,700 nm, contained in a compact 6 x 4 x 1.5 cm housing with a 10 mm diameter active area. The input/output extinction ratio is ~100 at 633nm. It can be driven with a standard function generator or the ARCoptix USB liquid crystal driver.

Potential applications for the Radial Polarizer include creating Laguerre-Gaussian beams for superresolution microscopy, optical trapping and laser cutting, as well as being a key component for a polarization axis finder system.

L-731 XY Stage from Physik Instrumente

Physik Instrumente, a global leader in the design and manufacture of high precision motion control systems, has launched the L-731 XY stage. Designed for applications in industry and research the L-731 is a high precision large platform XY stage with non-contact optical encoders that measure the position of the motion platform so that nonlinearity, mechanical play or elastic deformation have no influence on position measuring.

With a travel range of 205 x 205mm, 2-phase stepper or DC motor options and a resolution and repeatability of 50nm and 0.1µm respectively, the L-731 is an industry leading motion control solution.

TC10 LAB Series Temperature Control

Wavelength Electronics has recently released the TC10 and TC5 LAB Series temperature control instruments. The TC LAB Series of temperature controller integrates high-end digital control with a precision output current drive stage to offer the best stability temperature control instrument commercially available.

The TC10 (10A, 15V) and TC5 (5A, 15V) are ultra-stable digital controllers for thermoelectric and resistive heaters where tight temperature stability is required. Designed using the latest technology, stabilities better than 0.0009°C can be achieved with thermistors. Wavelength Electronics proprietary IntelliTune™ intelligent tuning algorithm, adapts the PID control coefficients as you change setpoint or tuning mode, always keeping the load optimally controlled.

With Wavelength Electronics plug and play instrument you have the ability to quickly set the controls using either the instrument touch screen or a remote computer, and the results are easy to monitor.

Key features include:

- Output current 10A
- Temperature stability better than 0.0009°C
- Compatible with most sensor types
- Intuitive user interface touchscreen
- IntelliTune™ PID control
- Adjustable over current limits
- Over- and under-temperature protection
- USB and Ethernet interfaces

C-FLEX Laser Combiner from HÜBNER

Warsash Scientific is pleased to announce the C-FLEX from HÜBNER Photonics, a leading manufacturer of laser, terahertz and radar system solutions.

The C-FLEX is a highly-flexible and extremely compact laser combiner that lets you combine up to six wavelengths from a possible 30 commercially available wavelengths from different laser manufacturers. The lasers can be controlled either separately or via a common USB port. The C-FLEX is field upgradable for when additional lasers are purchased. Individual AOM modulators can be integrated to five of the wavelengths for fast modulation of DPSS lasers. Free space or fibre coupling of the output is available.

Applications include:

- Fluorescence microscopy
- Flow cytometry
- Optogenetics
- Single particle spectroscopy
- Photochemistry

For more information, contact Warsash Scientific at sales@warsash.com.au or 02 9319 0122

Updated 871 Series Wavelength Meter from Bristol Instruments

Bristol Instruments, the leader in wavelength meter technology, has recently updated the performance of their existing 871 series wavelength meters. The new version of the 871A now provides 60MHz accuracy (at 1000nm), and also provides the highest sustained measurement rate of any wavelength meter on the market.

In addition to the improved accuracy of the new 871A, a unique Fizeau etalon design enables measurement of both pulsed and CW lasers, the 871 series calibrates automatically with a built-in wavelength standard and is available for operation from 375nm to 1700nm. Pre-aligned fibre-optic input ensures optimum alignment, resulting in uncompromised accuracy. In addition, an integrated proportional-integral-derivative (PID) controller benefits researchers who need active regulation of their laser frequency.

Contact Jeshua Graham (0499) 177 540 or Jeshua.graham@coherent.com.au.

New Intelligent Spectrograph from Andor

Kymera 328i is Andor's next generation "intelligent" spectrograph for applications in Physical and Life Sciences. It is designed to provide maximum configurability and flexibility, high spectral performance and enhanced user-experience.

Combined with Andor's high resolution and high sensitivity CCD, EMCCD, ICCD and sCMOS detectors, it offers the perfect platform for a wide range of routine and more advanced spectroscopy experiments.

- Patented active focus technology
- Motorised quad grating turret with RFID
- Dual input and output camera ports
- Active resolution control option
- Highest wavelength repeatability
- Micro-spectroscopy modular interfaces

For further information please contact Paul Wardill or Jeshua Graham.

New High-Power Femtosecond Lasers

Coherent's original Monaco is a "one box" diode-pumped ultrafast laser delivering 40µJ at 1035nm, with repetition rate variable from single shot to 1MHz. Standard pulsewidth is <400fs and an option is available for variable pulse width from <400fs to 10ps.

Coherent has recently released new versions of the Monaco. The Monaco 1035-80 delivers 80µJ at 1035nm with average power of 40W while the Monaco 517-30 delivers 30µJ at 517nm with average power of 20W.

Monaco has outstanding beam quality (M^2 < 1.2) making it ideal for demanding micromachining applications in research and industrial environments. Homogeneous materials such as glass and metals as well as complex layered structures are readily addressed with Monaco's sub-400fs pulsewidths.

Contact Paul Wardill (0419) 810 220 or paul.wardill@coherent.com.au.

New from Quantel: Q-smart DPSS

Quantel has set the standard yet again, this time with their new DPSS laser system based on the highly successful Q-smart platform. Q-smart DPSS lasers are the most cost effective high performance diode pumped Nd:YAG lasers. Delivering up to 650mJ at 100Hz, they combine high energies with high repetition rate in the most compact package, with no need for an additional amplifier stage.

The Q-smart DPSS series benefits from high efficiency laser diodes and gain modules designed and manufactured in house. With its robust and stable monolithic design, it is ideal for applications demanding both high peak power and high average power.

Best of all, this new addition to the Quantel family provides all of the user friendly features of the Q-smart platform:

- Plug-and-play harmonic modules for easy access to 532nm, 355nm, 266nm and 213nm
- Automatic phase matching
- 2 year warranty on all components, 2 billion shot warranty on diodes
- Lightweight and compact design
- Quick-connect cables and cooling lines for fast installation

The Q-smart DPSS is also available in semi-custom configurations up to 200Hz repetition rate, making it suitable for a wide range of applications such as OPO and dye laser pumping, particle image velocimetry, LIBS and PLD.

Contact Jeshua Graham.

TMC Sale

The annual TMC sale is now on.

Savings are available on TMC's range of optical tables, active vibration isolation products, workstations and breadboards (standard products only).

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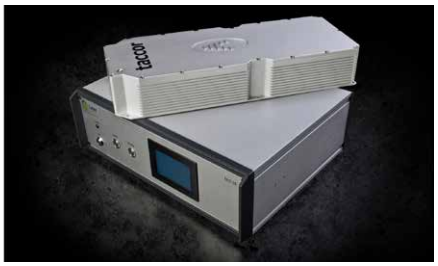

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Optics in Everyday Life: The Evolution of Camera Lenses

by Tony Klein

From the "Camera Obscura" to the iPhone 9: they've come a very long way...

A small aperture in the wall of an otherwise darkened chamber ("*Camera Obscura*") projects a coloured but dim (and upside-down) image on the opposite wall. A converging lens of the right focal length, mounted in the aperture, which could now be much larger, results in a much brighter image. This much was known, even before the invention of photography in 1839, when Louis Daguerre placed a light-sensitive plate on the opposite wall of the "camera", thereby recording the image by a silver-based photo-chemical process.

Surprisingly, a bi-convex lens used in a *camera obscura* turned out to be much less satisfactory than a meniscus–shaped lens invented by Chevalier, its improved version invented by noted British physicist Wollaston (figure 1a), and the enhanced doublet called the French Landscape Lens (figure 1b), which greatly reduced the chromatic aberration by combining two types of glass. Improved versions followed later, for example by H. Dallmeyer, (figure 1c). These lenses, which were quite adequate for recording landscapes on coated glass plates, had woefully small apertures (e.g. f/15) and hence required very long exposure times, adequate for recording landscapes but led to grim, unsmiling "Daguerrotype" portraits of people, who had to keep very still for very long times. The quest to develop "faster" lenses was the subject of a French competition that resulted in the famous "Portrait Lens" designed by a Hungarian professor of mathematics, Joseph Petzval, in 1840, figure 1d. Petzval did not win the prize, by the way, because he wasn't French! (The fascinating story of Petzval's work is described in reference 1).

Progress was very slow because trial-and-error methods were used, until better theories were developed. For example, it had been known ever since Descartes in the 16th Century that spherical surfaces were not optimal for accurate focusing, but it was not until the 1850s when von Seidel analysed the formation of images and identified the five independent, first order, primary aberrations (over and above chromatic aberration and focal defect) namely: spherical, coma, astigmatism, distortion, and curvature of field. In general, one degree of freedom in the design (e.g. one curved surface) is required to correct for each of these, resulting in complicated-looking lens systems with many surfaces. For example an extra lens element called a "field flattener" is often used, to get rid of curvature of field.

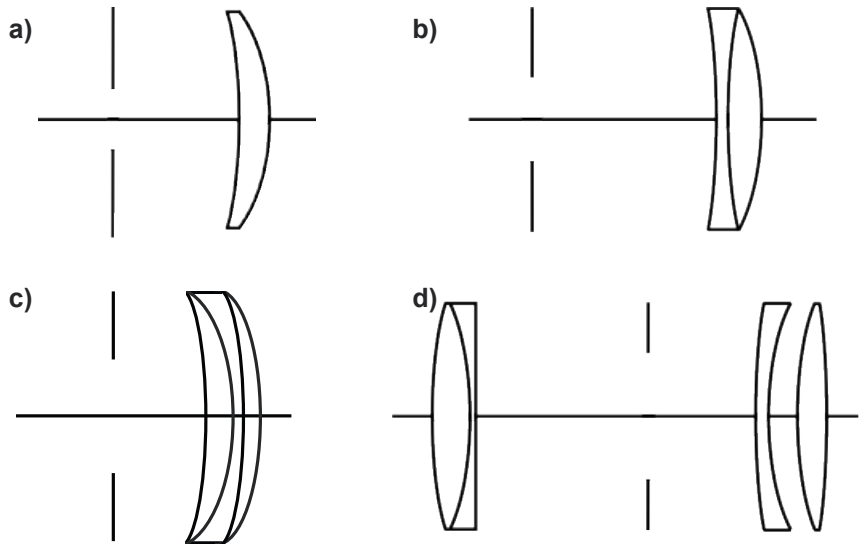

Figure 1. a) Wollaston Landscape Lens (1812) b) French Landscape Lens (1839) c) Dallmeyer's Rapid Landcape Lens (1880) d) Petzval's Portrait Lens (1878).

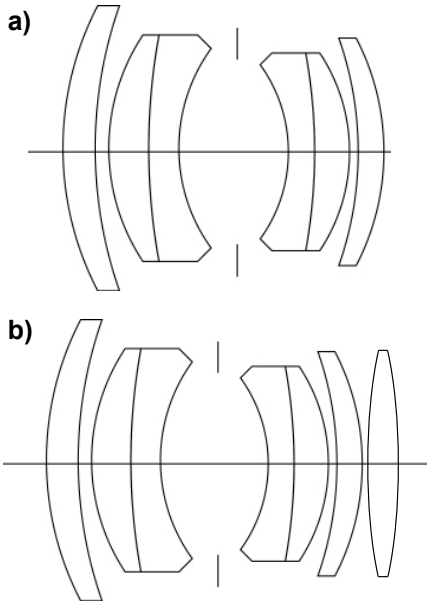

Figure 2. a) and b) "Double Gauss" symmetrical designs from Zeiss.

It was soon discovered empirically that a symmetrical set of surfaces was very effective at reducing several aberrations at once and a series of proprietary designs followed, several of them called a "double Gauss", based on a telescope objective originally designed by Gauss. Examples are shown in figure 2, often using new types of glass (e.g. Barium Crowns), introduced by Ernst Abbe and Otto Schott of the Zeiss company in Germany.

Another successful empirical design family was the "Cooke Triplet", from the British Firm of Taylor and Hobson, shown in figure 3, which also utilised Barium Crown glass.

Until the advent of digital computers in the 1960s ray-tracing was a slow and very tedious process and a great variety of patented lenses, mostly with patented names, dominated the field, claiming a range of advantages. In fact, the patent

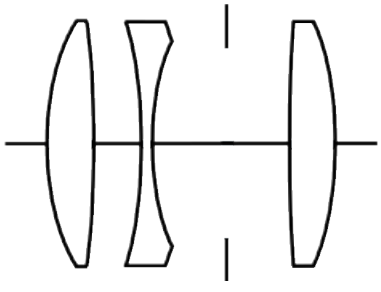

Figure 3. "A Cooke Triplet " by Taylor and Hobson.

Figure 4. Japanese Lens and camera bearing the JMDC "PASSED" Sticker. Image credit: jpmatth, CC BY-NC-ND 2.0 (left) and R Flynn Marr, flynngraphics.ca (right).

literature shows a vast proliferation of lens designs and books have been written about them [1, 2]. It is fair to say that up until after WWII, apart from a few French, British and American firms, the field of photographic equipment was dominated by German firms, such as the famous Zeiss Company, of Jena. Apart from specialised areas such as telephoto, wide-angle, single-lens reflex and zoom lenses, the principal differences consisted of larger and larger apertures, down to f/1.4, and the correction of higher-order aberrations. These are the aberration terms subsequent to the first-order ones recorded by Seidel and require prodigious computational efforts to calculate, but they present no great challenge to modern computers. By the way, one of the principal exponents of the theory of such calculations was a European refugee in Australia, the late Professor Hans Buchdahl of the University of Tasmania and the Australian National University [3].

So much for ancient history, dominated by European and American firms. However, the most remarkable advance in the 1950s, as part of the post-war reconstruction of Japanese industry, the Japanese Manufacturing Development Corporation (JMDC) was established and decided to concentrate on the design of high quality technological products, such as electronics, watches and cameras, rather than producing cheap copies of European and American goods as had been the case before. Using scientific principles and computer-aided design, a remarkable range of very high quality cameras were produced in the 1950s and later, comprising highly corrected lenses and sophisticated electronic controls. Strict export quality controls were instituted so that only the top quality cameras, marked with the gold label "PASSED" (figure 4) could be sold overseas. Marked with brands such as PENTAX, NIKON, CANON, PANASONIC etc, the consumer market came to be dominated - to the detriment of the famous pre-war German and European brands whose manufacturers went literally broke and many were sold to South-East Asian companies.

In later decades, the digital revolution led to a photographic revolution, whereby film was being replaced by Silicon sensor arrays. Utilising ever-better lenses, the chief features of which were aspheric elements, allowed even more accurate aberration correction with many fewer elements. See for example figure 5.

The manufacture of aspheric surfaces out of glass required very expensive processes. However, plastic elements could be cast into high precision moulds and combining these with glass elements led to highly affordable, high quality cameras, with increasingly finer pixel size, down to 1 micrometre, – hence a finer resolution of many megapixels.

In more recent times, we have seen the incorporation of digital cameras into mobile phones, leading to extraordinary progress in the design of remarkable miniaturised lenses. Sensor arrays with pixel sizes down to one micron allowed the design of complete cameras no thicker than the 5mm or so of the complete iPhone. The corresponding lens systems, incorporating aspheric elements, of which figure 6 are examples, are triumphs of the lens designer's art.

While originally of a quality adequate enough for social purposes, smartphone cameras have more recently evolved to be of remarkable quality, so much so that they are now said to be preferred even by some professional photographers. This is partly due to the very small pixel size, a very large depth of field as well as some digital post-processing of the image. So, except for specialist applications, the smartphone camera poses a significant commercial threat to the future of amateur photography.

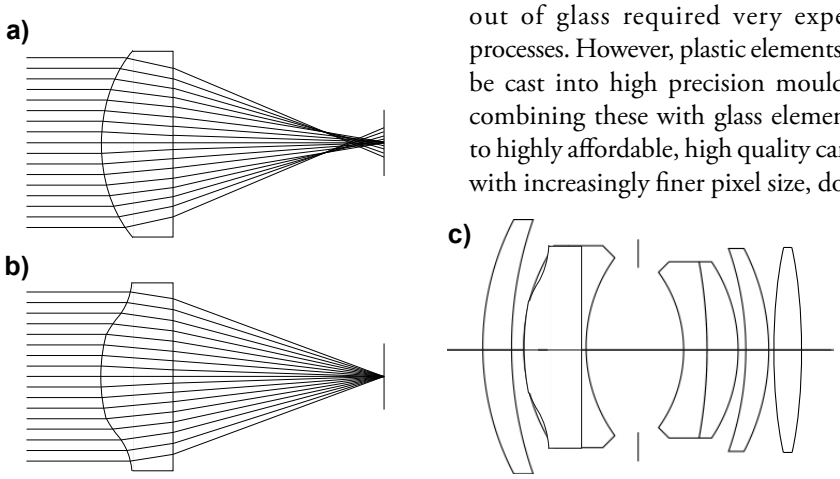

Figure 5. a) Spherical lens b) Aspheric lens c) Lens system containing an aspheric element.

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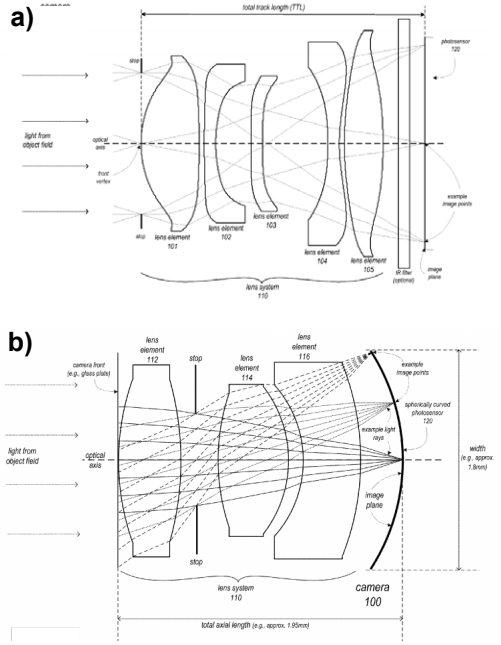

Figure 6. Examples of smartphone camera lenses [4].

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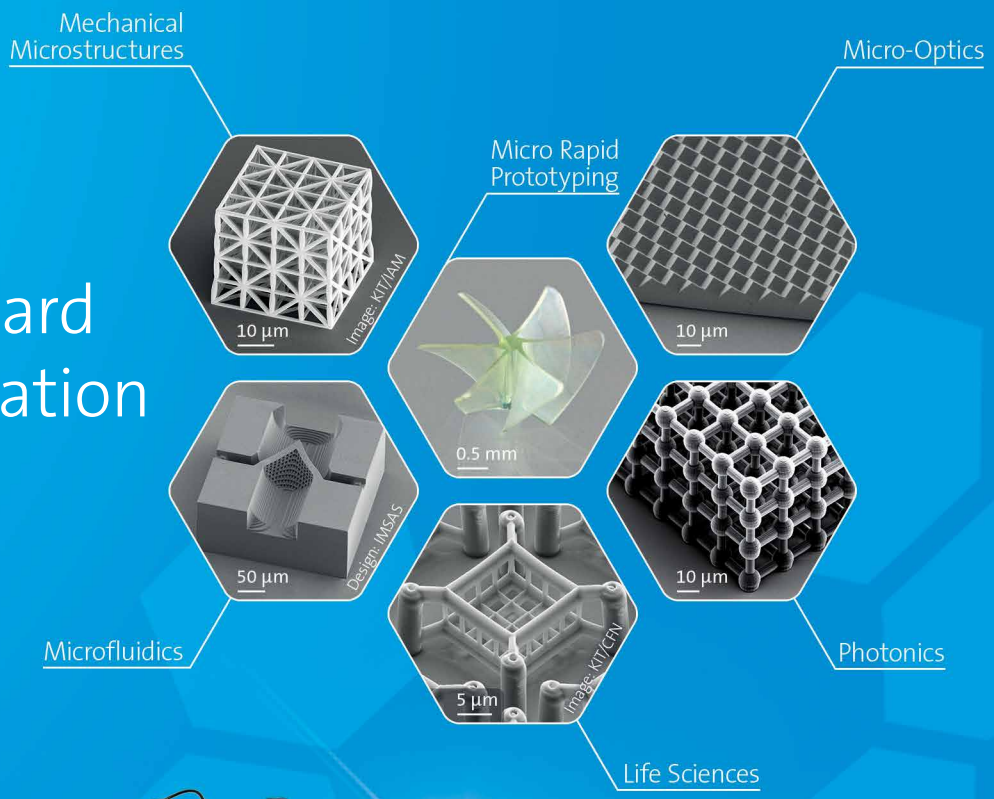

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Australia's Place in the World of Scientific Publishing on Laser Physics and Photonics

by Deb Kane

The role of being Chair of the International Union of Pure and Applied Physics (IUPAP) Commission on Laser Physics and Photonics (LP&P) from 2015-2017 came with reporting responsibilities on this area of physics to IUPAP as a whole. As part of leading and contributing to the report to the 29th General Assembly (GA) of IUPAP [1] I undertook some analysis of scientific publications in LP&P, by the country of the address of the authors, to give insight into the distribution of LP&P publication activity in the world.

In the LP&P Commission report to IUPAP [2] the focus was on the overall profile of activity. In what countries was activity growing? Does this measure suggest the fields are in good health. Is there any evidence of decline? In the Australian context it is of interest to know how Australia benchmarks with the rest of the world. In this article I present the graphs included in the IUPAP LP&P (Commission 17) report [2], add to them, and discuss them from an Australian perspective. For anyone interested to know more about the 29th IUPAP GA a report on that will appear in Australian Physics [3].

To give some sense of the scale of research activity in LP&P, and how it is distributed around the world, publishing metrics analysed by country are presented in figures 1-3†. The graphs were generated with data from the Web of Science, accessed on the 7th May 2017. The search was done on topic: figure 1 "Laser"; figure 2 "Laser Physics"; and figure 3 "Photonics". The finds were analysed by the country of the authors. The three year periods were chosen to correlate with the interval between General Assemblies of IUPAP. They start and finish at a year before the year of a GA so that data is as up to date as possible (for 2017) and includes 3 complete years. The top 30 nations by total number of publications were retained in each triennium for inclusion in the graphs. These graphs should be regarded as containing indicative data rather than robust data as papers commonly have authors from more than one nation and such papers will have been doubly or multiply counted by the methodology

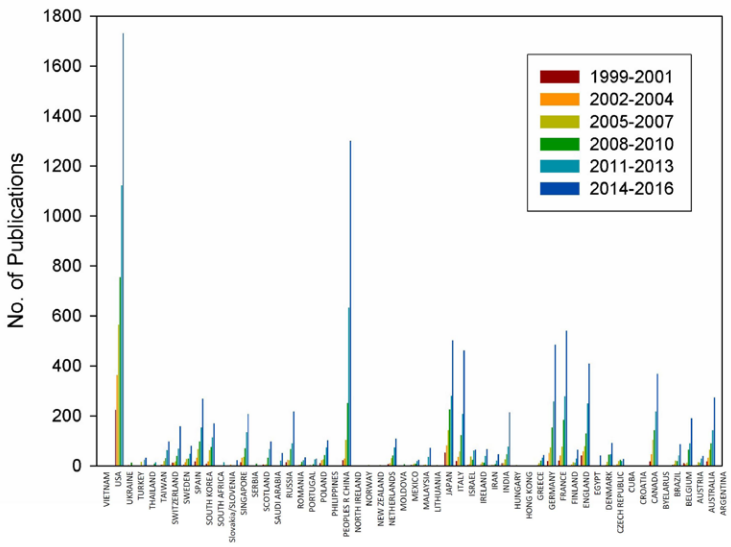

Figure 3 Total number of publications, Web of Science topic search "Photonics", plotted for the six triennia 1999-2001 through to 2014-2016 as colour coded bars, for the countries named along the horizontal axis. Data accessed 7th May 2017.

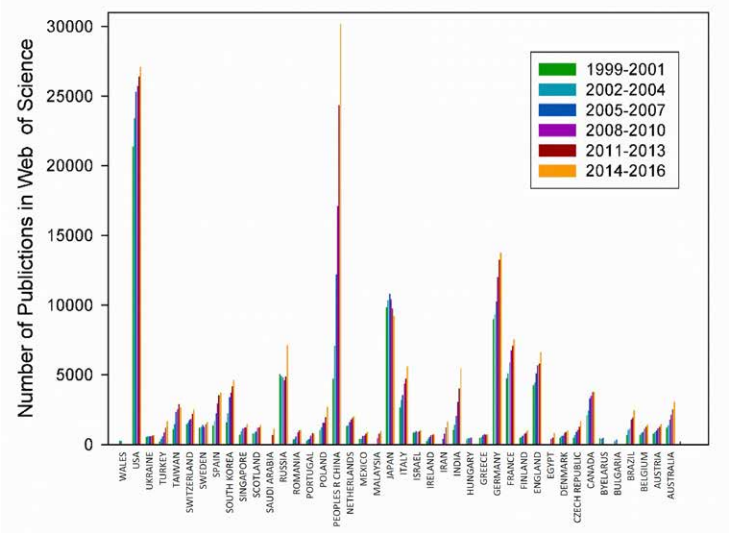

Figure 1 Total number of publications, Web of Science topic search "Laser", plotted for the six triennia 1999-2001 through to 2014-2016 as colour coded bars, for the countries named along the horizontal axis. Data accessed 7th May 2017.

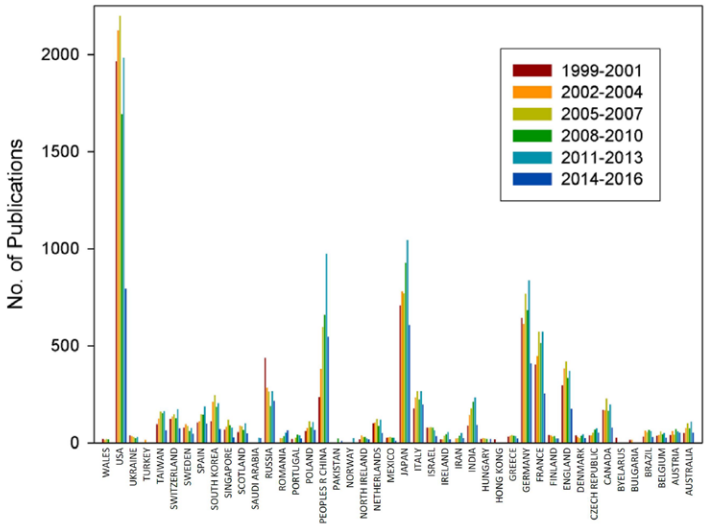

Figure 2 Total number of publications, Web of Science topic search "Laser Physics", plotted for the six triennia 1999-2001 through to 2014-2016 as colour coded bars, for the countries named along the horizontal axis. Data accessed 7th May 2017.

† These graphs can be enlarged for better viewing in the electronic version online: optics.org.au/news

Triennium	"Laser" Number	"Laser" Rank	"Laser" Percentage
1999-2001	1207	15th	1.602
2002-2004	1359	15th	1.623
2005-2007	1783	14th	1.817
2008-2010	2125	14th	1.961
2011-2013	2572	14th	2.006

Table 1 Total number of publications with "laser" as a topic and Australia as an author address, listed against the triennium of publication. Subsequent columns show the corresponding rank in the world and the percentage of total publications on the topic. Data accessed from the Web of Science, 7th May 2017.

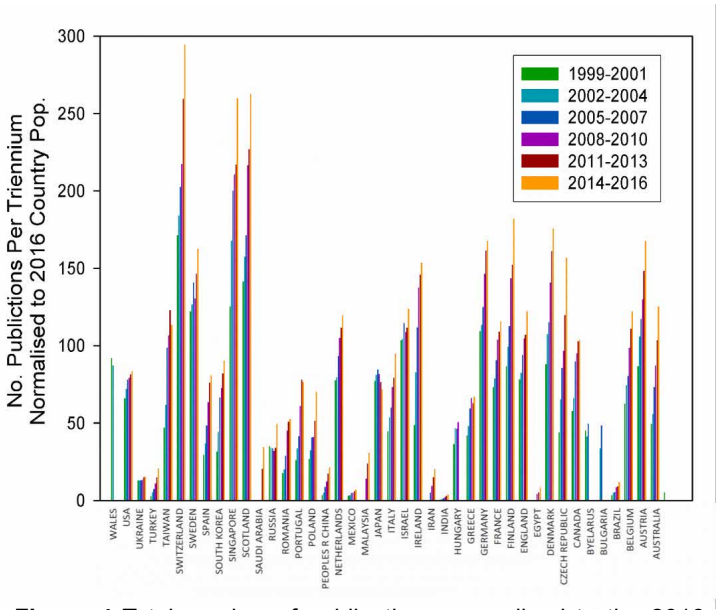

Figure 4 Total number of publications normalised to the 2016 population of each country, Web of Science topic search "Laser" plotted for the six triennia, 1999-2001 through to 2014-2016 for the countries named, in reverse alphabetical order, along the horizontal axis.

used.

Figures 1-3 show that publication numbers for "laser" and "photonics" continues to grow. Publication in "laser physics" has been steady, but with quite large fluctuations from triennium to triennium for many nations, and it has dropped in the 2014-2016 triennium for almost all nations. It will be interesting to see if this is a real drop that continues in the 2017-2019 triennium, or whether it is a larger than usual fluctuation. It may just reflect less use of the words laser physics in publications that report laser research. Publication numbers for "laser" are more than an order of magnitude larger as compared to "laser physics and "photonics". The rapid growth of publications on "laser" from the People's Republic of China stands out, with the total number of publications exceeding that from the United States for the first time for 2014-2016. The United States, People's Republic of China, and Germany are the top three nations in terms of total numbers for "laser". The use of "photonics" as a topic has emerged since 1999 but it is still comparatively little used in the publications context despite its strong use as an overall umbrella term. A similar trend was evident in analysis of "nanotechnology" publications undertaken in a different context some years back. It is a pointer to authors that if they want publications to be captured as "photonics" then they need to make sure they use it in the indexing words and phrases. France, Italy and Japan join Germany, PRC and USA as countries of top total productivity in publishing on "photonics". Overall the fields are growing which is a sign of good health.

In order to further interrogate Australia's place in publishing in these areas, Tables 1 and 2 show the total number of publications from Australia, and the associated rank in the world and the percentage of the total publications. Australia is about the 53rd most populous nation, representing a bit more than 0.3% of the world's population so these ranks and percentages could be taken to indicate that Australia is punching above its weight in these research areas. But is it? Analysing the data on a per capita basis is one way to explore this question. This has been done using the data on "laser".

In order to normalise to population an analogous graph to figure 1 is produced by normalising the total number of publications from each country to a recent (2017) population in millions [4], as shown in figure 4†. The y-axis of the graph is now total number of publications in the triennium per million people of population. As the population of most nations increases over time the values for the earlier triennia in the range are underestimated by this measure. This point is explored further for a selected range of countries later. It should also be noted that many developed countries that did not rank in the top thirty by total publications, largely by virtue of low population, would compare favourably in this normalised plot, but they have not been reintroduced. New Zealand would be one such nation. Switzerland, Singapore and Scotland are the standout top three when research publications are normalised to population. The People's Republic of China drops away and is comparable to Turkey. The USA loses its top three position. Australia is ranked 11th in 2014-2016 having improved from ~17th for 2011-2013, and having been ranked below that in the previous triennia where the normalisation to the 2016 population introduces a systematic error.

It is quite difficult to access accurate population data for individual countries over the period 1999-2016. A subset of countries: Australia, Austria, Canada, Germany, PRC, Scotland, Singapore, Switzerland, Taiwan, and the USA; has

Triennium	"Laser Physics" Number	"Laser Physics" Rank	"Laser Physics" Percentage	"Photonics" Number	"Photonics" Rank	"Photonics" Percentage
1999-2001	51	15th	0.99	16	9th	2.4
2002-2004	76	15th	1.3	31	10th	3.0
2005-2007	99	14th	1.6	65	9th	3.8
2008-2010	74	14th	1.3	89	10th	3.5
2011-2013	107	14th	1.63	142	10th	3.53
2014-2016	53	13th	1.7	213	9th	4.12

Table 2 Total number of publications with "laser physics" as the topic, and, separately, with "photonics" as a topic, and Australia as an author address, listed against the triennium of publication. The corresponding ranking in the world and the percentage of total publications on each topic is also included. Data accessed from the Web of Science, 7th May 2017.

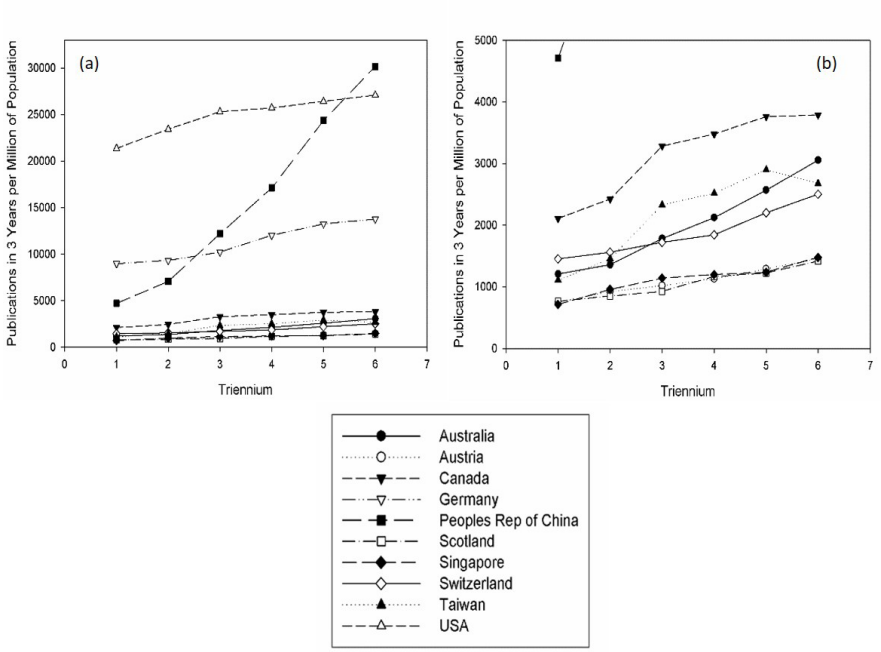

Figure 5 (a) Total number of publications per triennium on "laser" plotted against triennium: 1 (1990-2001), 2 (2002-2004), 3 (2005-2007), 4 (2008-2010), 5 (2011-2013), 6 (2014-2016) for ten countries as listed in the legend box. (b) Same data on an expanded scale.

been selected for further analysis using the best population data for each country [5 – 7], that could be found by internet searching, to estimate the average population of the country, within each of the six triennia considered. These populations are used to generate a more accurate value for the number of publications within a triennium per million of population. Figure 5(a) shows the data from figure 1 for these ten countries. Figure 5(b) has an expanded scale for the publications per million population so that the relativities for nations with smaller populations can be seen. Figure 6(a) shows the data for the ten countries replotted from figure 4. Figure 6(b) shows this data corrected by using more accurate data for the population of the countries over time. It is important to remember that Australia was ranked 11th in the world in 2014-2016 with Finland, Denmark, Sweden, Czech Republic, and Ireland ahead of it in addition to the 5 countries ahead of Australia included in figure 6. In earlier triennia, Australia additionally trailed some or all of Israel, England, Wales, Japan, Belgium, Finland, Netherlands, Canada, USA and France having had a lowest rank of 21st for the 2002-2004 triennium. Australia has been on a trajectory of passing other nations on this measure which is a trend that should be continued and potentially enhanced by strategic planning. However, while Australia has grown its productivity more quickly than USA, Taiwan and Canada, the top nations for "laser", including Switzerland, Singapore and Scotland, as the stable top three throughout the 18 year period, continue to grow their productivity. We are not getting any closer to these nations. Giving attention to how they achieve the levels of productivity they do, and knowing that this correlates with high technology economic activity yielding economic benefit, is worthy of further research. Perhaps such research to inform policy can be carried out within the remit of a relevant government department. Some factors that are likely to be relevant include the fraction of the population who are employed as scientists and engineers, relative investment in basic and industrial research, and the benefit of having held these advantages for extended periods of time. The strategic investment and build in optoelectronics in Scotland over more than twenty years has clearly been a successful strategy.

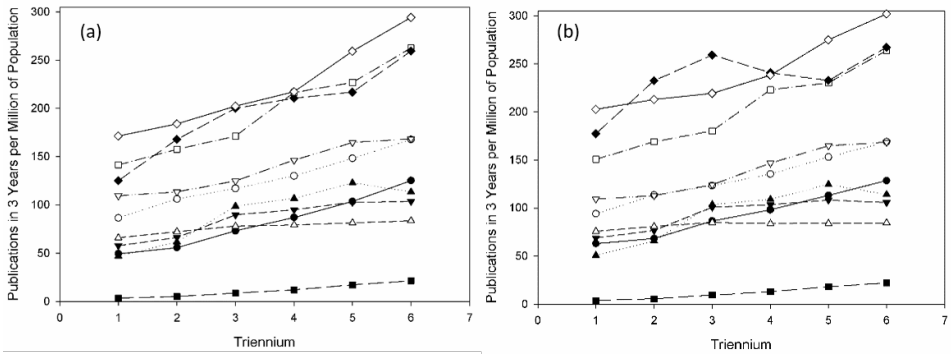

Figure 6 (a) Number of publications per triennium, normalised to the 2016 population in millions, on "laser" plotted against triennium: 1 (1990-2001), 2 (2002-2004), 3 (2005-2007), 4 (2008-2010), 5 (2011-2013), 6 (2014-2016) for ten countries as listed in the legend box with figure 5. (b) Same plot as (a) but normalised using the average population of the country for the specific triennium in millions.

For those of us who work in these research areas in Australia we can assert with high confidence that we are as productive, relative to our resources, as the best in the world. Thus, I think we do need to look to the systemic reasons that we are not gaining on, nor achieving the productivity that is being achieved by Switzerland, Singapore and Scotland. Are there not enough of us? Are we under resourced? We have three times the total population of Switzerland and more than four times the population of Scotland. We are second equal in the world, with Switzerland, on the Human Development Index (HDI) with an HDI of 0.939 (reported in 2017 using 2015 data) [8]. Scotland, as part of the UK, is sixteenth in the world on this measure (0.901). 16.4% of the world's population has a very high HDI defined as between 0.8 and 1.0. If we sensibly restrict the population that contributes to research in the world to this subset of the world population then we are producing publications on "laser" at about the right percentage. Australia represents 1.9% of the world population with an HDI above 0.8. The percentages of world output as given in Table 1 has grown from 1.6% to 2.3% over the six triennia. Australia is performing at about the productivity level expected if it is pro-rating to population. But, with an HDI at the highest values would we not expect to do better than pro-rated? Switzerland has just 0.67% of the world population with an HDI above 0.8 and has produced between 1.7% and 1.9% of the world's "laser" publications over the six triennia – almost three times the population pro-

rated productivity. Scotland, with 0.44% of the population, has been producing between 0.94% and 1.1% of the "laser" publication productivity over the 18 years. This is consistently more than twice the pro-rated productivity. These are measures we can use to set and track the implementation of strategic planning to build areas of research strength, if decisions are taken to have some focus on particular sub-topics in science and engineering for research support.

The National Committee of Physics, under the umbrella of the Australian Academy of Science [9] oversees the process of nominations of Australian physicists for possible election as members of Commissions of IUPAP ahead of each General Assembly. When doing this ahead of the 29th GA the nominations were targeted to areas of physics that were identified as being strong in Australia. LP&P was clearly one such sub-discipline. Professor Andre Luiten from the University of Adelaide, was nominated to C17 and was subsequently elected [3] to be a member for 2018-2020. Thus, whether by design or happenstance, Australia does have LP&P as a current area of strong and productive research. The data and its analysis described here-in presents one measurand that can be harnessed to monitor further improvement. Other strategic advances can involve linking the research more directly to the economic benefits it does and can facilitate. The South Australian Government, with the encouragement of leading staff at the Institute of Photonics and Advanced Sensing (IPAS) at the University of Adelaide, has already commissioned and launched a report that presents a roadmap for the development of the photonics industry in South Australia [10]. Funding of $200k was the investment that was required to lead to such a roadmap. The investment needed to back its implementation will be orders of magnitude larger. Planning for national impact would require State, Territory and Federal engagement with such processes. We have Switzerland, Singapore and Scotland to look to, to know that such roads can be laid and used for national benefit. The responsibility for all of this does not sit with LP&P researchers but we can improve the part we play if the broader network develops in appropriate ways.

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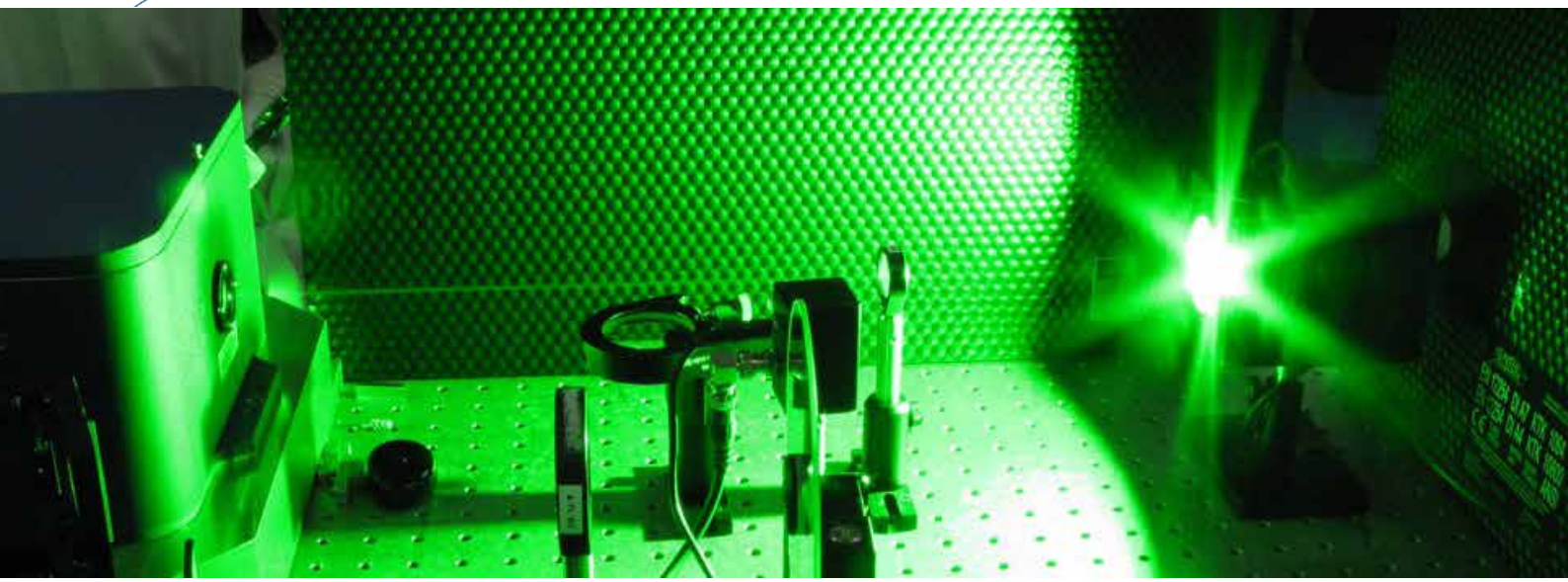

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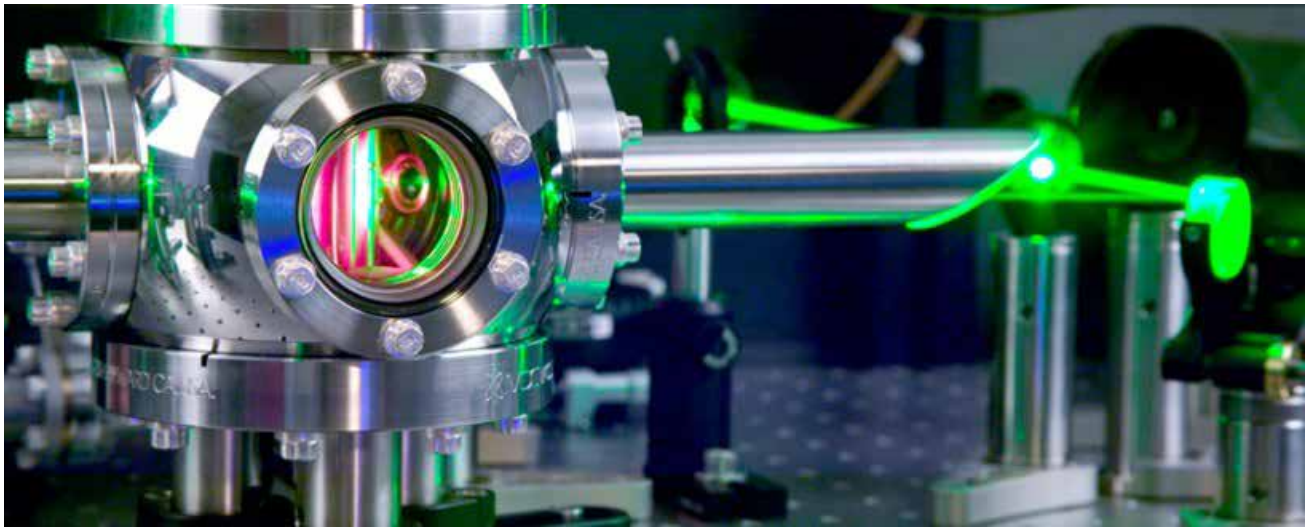

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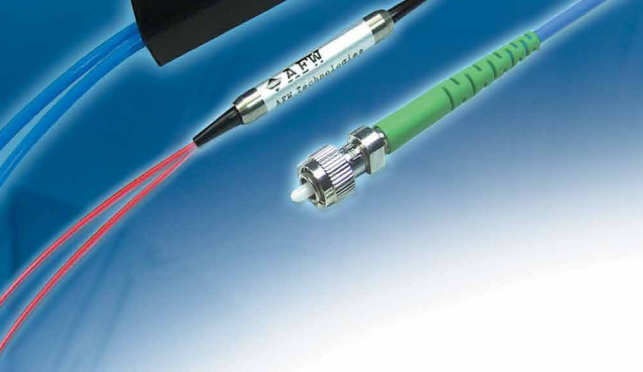

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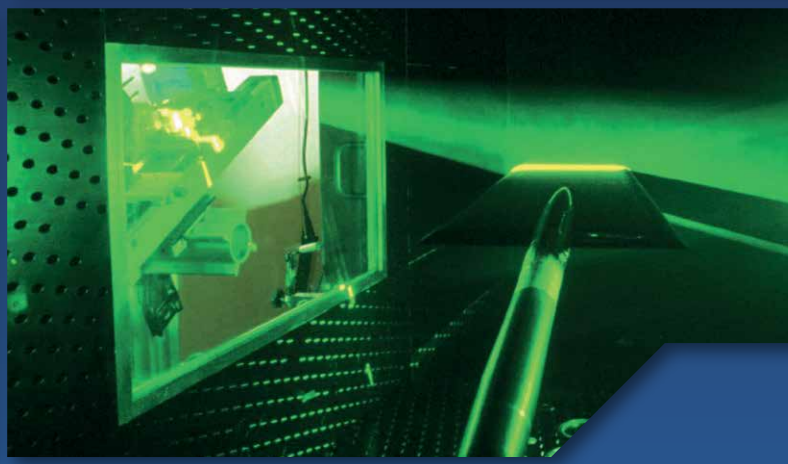

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