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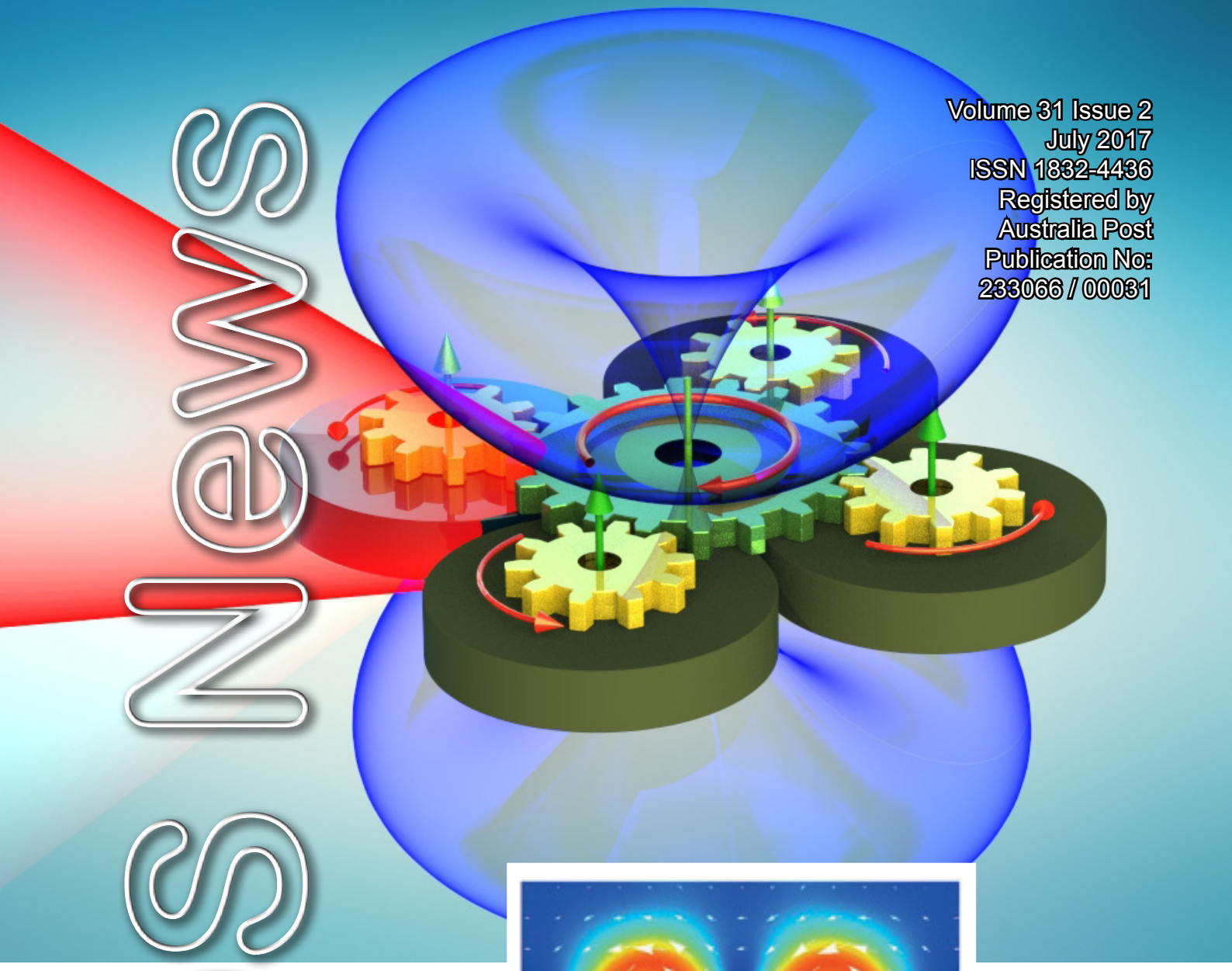

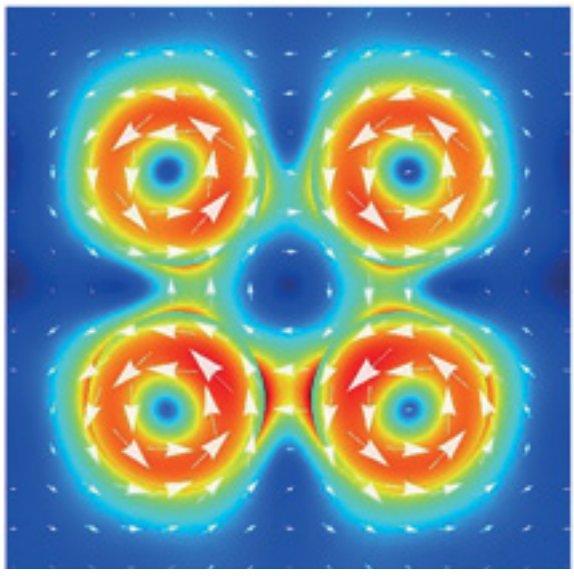

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AOS News is the official news magazine of the Australian Optical Society. Formed in 1983, the Society is a non-profit organisation for the advancement of optics in Australia. Membership is open to all persons contributing to, or interested in, optics in the widest sense. See the back page (or the AOS website) 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.

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 (September 2017) should be with the editor no later than 21 August 2017, advertising deadline 14 August 2017.

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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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- ...and more

July 2017 Volume 31 Number 2

Articles

Departments

Cover Pictures:

- Optical magnetism can be produced through the enhancement of third-harmonic generation in dielectric nanoparticles excited at magnetic Fano resonance, see page 33. The central image shows the vortex-like electric fields generating the optical magnetic response.
- Insets (left to right)
  - Science Meets Parliament gave scientists the opportunity to learn more about the parliamentary process and meet with a number of MPs, see page 12. Image credit: Mark Graham, courtesy of Science Meets Parliament 2017.
  - Aleksandr Prokhorov's story was told through a series of photos by his grandson Alex on a visit to Australia in May, see page 9. Image courtesy of Alex Prokhorov.

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President's Report

I want to take this opportunity to inform you of several initiatives.

Our new website provides scope for the AOS to provide more services and resources for you, our membership. So I am very pleased that we have a volunteer Online Communications Manager, Dr Yiqing Lu, a Research Fellow at Macquarie University. Over the next months we will be exploring how we can develop this website to make it a valuable resource for the Australian and New Zealand optics and photonics communities.

Several initiatives are under discussion, one of which is to facilitate networking across our community, for instance bringing together groups with common interests. These might be to discuss matters such as equity and diversity, or issues faced by ECRs. They might be to discuss scientific or technical topics of special interest. There may also be scope for facilitating collaboration, by identifying people in industry or academia with relevant interests.

We are keen to get your feedback on how we can better serve you through our web and twitter presence, or other social media.

Having a webmaster will make it easier to keep the news section up to date. This news is primarily about the AOS, our events, prizes, and major announcements about our members. For more general news of interest to the Australian and New Zealand optics and photonics community we have created an AOS twitter account: @OpticsAUNZ.

If you have any news that will be of interest to our community, please let us know. You can send it to AusOptSoc@gmail.com. Please also use this email to provide any feedback on these initiatives or the AOS in general.

A major initiative that is starting to gather momentum is to commission a study and report on the optics and photonics ecosystem in Australia and New Zealand. Such studies have been recently undertaken in the USA and Europe, and there have been local studies roughly every decade since the late 1980s. The last national report was in 2005 so it is timely. These reports are important as they provide key data to inform national priorities and public policy.

The intended scope is:

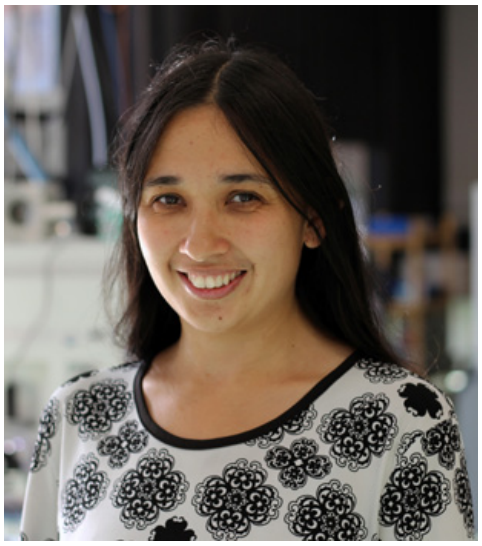
1. Identify technological opportunities for Australian and New Zealand industry arising from recent advances in optics and photonics.
2. Assess the current capabilities in optics and photonics in Australia and New Zealand across academia, publicly funded research agencies and industry. Especially identify where a critical mass of knowledge, researchers or industries exist, and where gaps lie.
3. Identify a set of research priorities, and funding mechanisms which build on current capabilities, extending them and filling gaps, to enable Australia and New Zealand to capitalise on emerging opportunities.
4. Recommend actions to strengthen and develop Australia's and New Zealand's high technology industries in, or underpinned by, optics and photonics.

We have support from the Australian Academy of Science, and are now exploring funding.

Finally, I would like to encourage you all to submit your research to ANZCOP. The website is now live (anzcop2017.nz) and submissions opened on 3rd July, with a deadline of 10th September. ANZCOP is being held in a great venue in New Zealand and it will be an excellent opportunity for Australian researchers to build links with our New Zealand colleagues.

Simon Fleming
AOS president

Editor's Intro



Welcome to another issue of AOS News. We have a number of articles ranging from the visit of Australian born Nobel Prize winner Aleksandr Prokhorov's grandson to a report on Science meets Parliament. There is also an item about optical magnetism and Fano resonances in plasmonic nanostructures. Our 'Optics in Everyday Life' section looks at moiré patterns. 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.

A couple of articles about science journals and scientific publishing came out in June, which were both thought-provoking. The Guardian had a piece on the history of scientific publishing which I highly recommend (theguardian.com/science/2017/jun/27/profitable-business-scientific-publishing-bad-for-science?). The Conversation also had a piece in response to a video with four Nobel Laureates speaking out against aiming for high journal impact factors. The article points out that although in theory it is true that the research counts and not the journal it is in, in practice you can't advise junior researchers to follow this as everyone uses metrics in decision making. It is all very well for Nobel Prize winners to ignore impact factors, but people can't be knowledgeable about everything and so will look at the number and types of papers published when considering things like promotions and funding decisions. I think the most useful thing about the article was the advice of finding balance between solid work, high impact papers and preliminary data so that output is optimised.

The history of scientific publishing and how the current situation developed is fascinating reading. Any non-scientist finds the whole issue of scientific publishing very confusing - scientists create the work, mostly funded by governments and give it to publishers. The publishers pay scientific editors who see if the work is worth publishing and do some polishing, but most of the editorial work - peer review, is done by scientists on a volunteer basis. Publishers sell the journal back to government-funded university and institute libraries to be read by scientists. This means that publishers have high profit margins but there is little sign of the system being able to change. Many see how unfair it is, but even with the advent of open access journals, the current system is too entrenched.

The article shows that it largely started in 1946 when the UK government decided to improve British scientific publishing by pairing a British publishing house with the well-known German publisher, Springer. Robert Maxwell played a key role as he managed the new company and eventually bought out both publishers, forming Pergamon Press. The post war years were when science had large growth, and the number of journals on offer expanded rapidly. Maxwell wooed scientists in new fields, created journals they could edit, and then sold subscriptions to university libraries, seeing that there was essentially no limit to the number of new journals that could be offered. Pergamon and the other publishers did speed up the publication process and make journals look much nicer than when they were just run by scientific societies, and soon they all became seen as a vital part of science.

It wasn't until the mid-70s with the emergence of Cell that publishers started changing the practice of science, which is what ended up linking careers so tightly with the publishing system. Previously people just published where appropriate for their field and were generally accepted as long as the work was rigorous. Cell was the first journal to try and tell a bigger story, rejecting more papers than accepting, and soon everyone followed. Impact factors started to be used and suddenly everyone wanted to publish in high impact journals and they became important for jobs and funding.

Elsevier bought Pergamon in 1991, controlling more than 1000 journals with the combined catalogue. They now own nearly a quarter of scientific journals, with Springer and Wiley-Blackwell another 12% each, so that three companies control half of scientific publishing. Today science is controlled and represented by scientific articles, with journal editors shaping careers and the direction of science itself. It has been suggested that the current style of publishing actually holds back progress as negative results aren't disseminated in the same way as spectacular breakthroughs. It is also worrying how much influence lies with a few scientific publishers and it is up to everyone to decide if there is anything that can or should be done about this.

I hope you enjoy this issue of AOS News,

Jessica Kvansakul
Editor

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Alex Prokhorov Tells the Story of His Grandfather

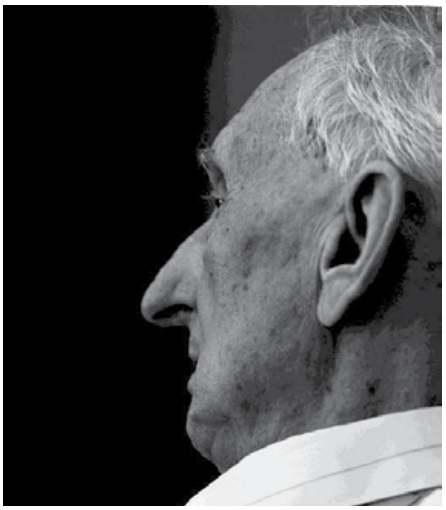
by Stephen Collins

On 3rd May the AIP hosted a public talk at Swinburne University about the Queensland-born Nobel Prize Winner Aleksandr M. Prokhorov given by his grandson.

Prokhorov was born in 1916 at Butchers Creek near Atherton, Queensland at the place known as "Little Siberia" at that time [1]. The talk was delivered by his grandson Alex Prokhorov; this was the first visit to Australia by any family member since his great grandparents departed Australia in 1923 with Aleksandr and two of his sisters (sadly, another sister died in 1921).

Most of his life was spent living and working in Moscow, Russia and, unfortunately, he never visited Australia again. His life was bright and difficult. He lost his sisters (one died in Australia and another on the way back to Russia), he participated in the Second World War, was wounded twice, lost his parents during the war but was able return to science and achieve outstanding results. Together with his PhD student Nikolay Basov and Charles H. Townes they shared the Nobel Prize in 1964. Later he pursued new directions in medicine, fibre optics and crystal growing. He also participated in a Russian "Star wars" program. Last year the family, and Russian scientists, celebrated the 100th birthday of Prokhorov (he died at 85).

Thus the audience were able to appreciate how Prokhorov, despite many challenges including war wounds, became a leading scientist. It was remarkable that at a time when international tensions were high that the Prokhorov and Townes families became good friends. He and his family were able to enjoy a good standard of living, and international travel. Physics runs deep in the family with Prokhorov's son, Kirill, and grandson Alex being PhDs in physics.



Aleksandr Prokhorov.

Aleksandr Prokhorov as a child with his parents and sister.

After the lecture: (from left to right) Stephen Collins, Emeritus prof. John Pilbrow (who met Prokhorov in the UK in the 1960s), Alex Prokhorov, and Emeritus prof. Peter Hanaford (who knows Kirill Prokhorov via international laser conferences).

Shown here are a selection of the photos Alex presented to tell the story of his grandfather.

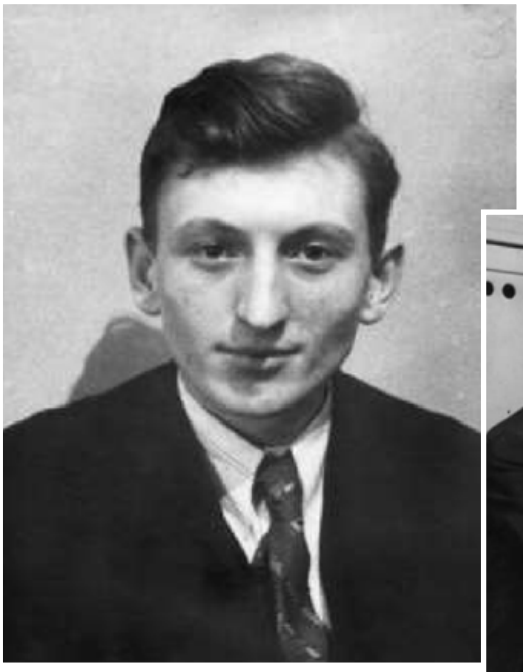
References

[1] SF Collins, *"Aleksandr Prokhorov, Australian-born Nobel Laureate in Physics"*, AOS News, **29** (1), 17-18 (2016).

Acknowledgements

Thanks to Alex Prokhorov for providing the photos from his talk.

Stephen Collins is with Victoria University.



Young Aleksandr.

Learning how to bow to the Swedish King in preparation for the Nobel ceremony.

The 1964 Nobel Prize winners Charles Townes, Nikolay Basov and Aleksandr Prokhorov and their families in a less formal setting as the Prokhorov's guests.

Charles and Aleksandr remained friends, meeting often around the world.

A statue to Aleksandr was finally unveiled last year.

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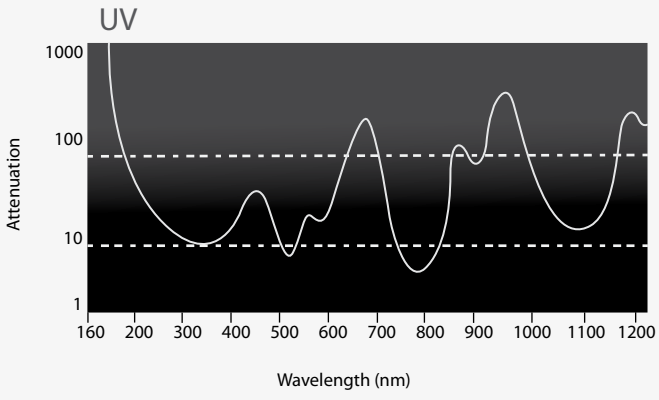

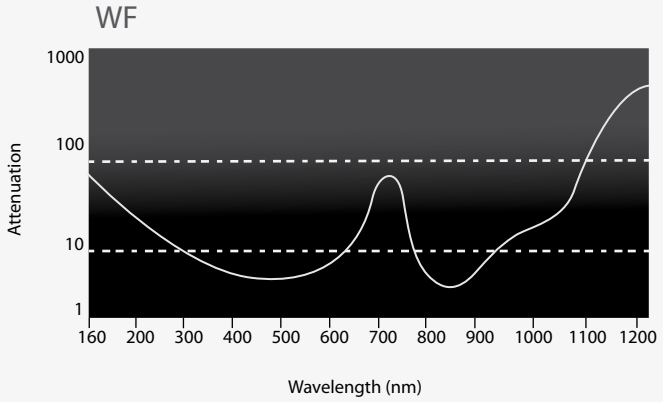

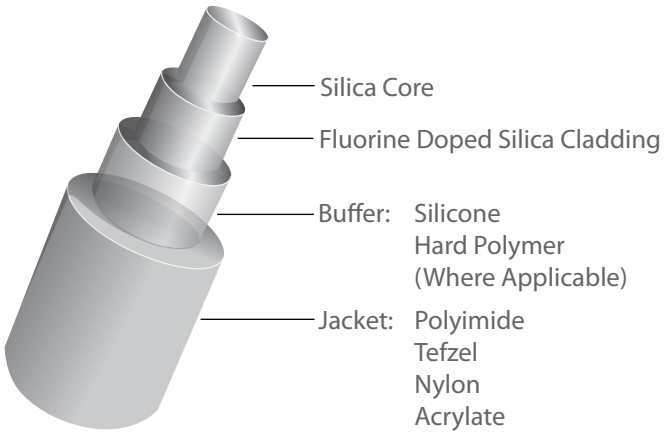

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Let There be Light in Parliament: AOS Meets Parliament 2017

by Daniel Gomez

How to pitch your research, the mechanics of policy making, news, the media & communication. These were some of the items of a two-day agenda where Australian scientists went to Parliament House (both old and new).

All photos are by Mark Graham, courtesy of Science Meets Parliament 2017.

Science Meets Parliament took place in March this year with a number of different sessions.

Science meets Parliament (Twitter #smp17) is an event organised by Science and Technology Australia (@ScienceAU) to bring about 200 scientists to Canberra to meet with Federal politicians & policy makers. The event also provides an opportunity for improving communication skills via a series of seminars and hands-on workshops.

This year, I had the opportunity to participate as a member of the Council of the AOS, in this two-day event that took place on the 21st and 22nd of March. Other members of the AOS Council that participated include Professor Simon Fleming, AOS president and Professor Kenneth Baldwin (who is also the founder of Science Meets Parliament and a past president of STA).

The events of day one were mainly held in Old Parliament House, and consisted largely of interesting speakers and panels giving a range of training and advice on professional development, including highly valuable skills on how to build professional networks and collaborations. Furthermore, the panel members of the event provided advice on how to communicate science to news outlets, how science is used to inform policy making, and how to influence/lobby a politician without directly asking "for more funding", something that is apparently done indiscriminately.

In the evening we were invited to a gala dinner where we had the opportunity to listen to speeches by the leader of the opposition Bill Shorten and Senator Arthur Sinodinos, Minister for Industry, Innovation and Science, where each presented a vision for Australia's science and research. Each table included a range of scientists from different disciplines, plus a Federal politician or two. It was a great opportunity to speak to politicians in a less formal setting, and to network with scientists from other professional societies.

On day two, part of the delegation had the opportunity to listen to Senator Sinodinos' address at the National Press Club, where he articulated the importance of scientific collaboration, his vision for the future of science in Australia, how disruption is the new constant and the importance of women in STEM. He also announced the Australian National Science Statement 2017. A summary of the minister's announcements can be found here [1].

AOS Council member Ken Baldwin (left) and president Simon Fleming (right) on the first day of the event.

Day Two largely took place in Parliament House, with a highlight being the opportunity to meet in small groups with federal members. We had been given advance warning of this and told to prepare something to discuss in advance. We had also been given training to hone our presentation to politicians skills. It was an extremely challenging and educational exercise where we had to pitch the essence of our idea in ever shorter lengths of time. It really reinforced the need to convey your key point in an engaging fashion in the first thirty seconds.

There were multiple other events, including debates, speeches, and the opportunity to observe Question Time, which is even more unbecoming in real life than it appears on television. The real debates between small groups of politicians such as "Science and politics: how do they mix?" were much more rewarding and interesting.

In summary, this was an exciting opportunity that enabled me to get a broader understanding of how scientists and their research outcomes can influence

Prime Minister Malcolm Turnbull was one of the MPs who met with a group of scientists on the second day of the event.

Arthur Sinodinos, Minister for Industry, Innovation and Science released the national science statement at a National Press Club address.

the complex machinery of policy decision making, which in turn influences research priorities and funding. The event was also a fantastic venue for networking, and for discussing how different scientific societies run. I would thoroughly recommend anyone who has the opportunity to attend if they have an interest in how science can influence public policy and politics.

References

[1] http://minister.industry.gov.au/ministers/sinodinos/speeches/national-press-club-address

Acknowledgements

Thanks to Simon Fleming for providing useful suggestions for the article.

Daniel Gomez is with the School of Chemistry and the ARC Centre for Exciton Science, RMIT University.

Opposition leader Bill Shorten was one of the speakers at the Gala dinner.

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SPIE News

by Amy Nelson

SPIE President-Elect Maryellen Giger visits constituents in Australia

SPIE President-Elect Maryellen Giger of the University of Chicago chaired a conference session on biomedical physics and gave an invited talk on "deep learning" in breast-cancer imaging at the 13th Asia Pacific Physics Conference (APPC) in Brisbane last December.

Giger's conference participation was part of a wider trip to meet with research colleagues and SPIE constituents in Australia. SPIE Senior Director Andy Brown also attended the conference and made visits with Giger to the Australian E-Health Research Centre.

The APPC was held in conjunction with the 22nd Australian Institute of Physics (AIP) Biennial Congress and the annual meeting of the Australian Optical Society (AOS).

Giger, a leading expert in quantitative and digital image analysis for cancer diagnoses, presented her research on computer-aided diagnosis (CAD) and deep learning in the medical imaging of breast cancer.

SPIE Fellow Halina Rubinsztein-Dunlop of University of Queensland, along with AIP President Warrick Couch, co-chaired the event. Highlights included SPIE Fellow Eric Mazur of Harvard University and 2015 Nobel Prize recipient Takaaki Kajita of University of Tokyo giving talks on innovative teaching methods and discovering neutron oscillations using the Super Kamiokande neutrino observatory in Japan, respectively.

Giger and Brown also paid a visit to the Macquarie University Photonics Research Centre in Sydney where SPIE Senior Member Mick Withford provided a tour of his labs. Withford's group engages in a broad range of research activities including in laser material processing, 3D printing, optical communications, and the evaluation of ancient materials. The group was also was involved in manufacturing parts for the torches used in the 2000 Summer Olympics, held in Sydney.

The SPIE leaders also visited the Centre for Nanoscale BioPhotonics (CNBP) at Macquarie University with CNBP Deputy Director Ewa Goldys. The tour included a viewing of the largest hologram in the world.

Maryellen Giger speaks at APPC in Brisbane

Shortly before the APPC was held, Brown also made presentations at a meeting of the SPIE Student Chapter at Auckland University; gave a talk on the global photonics market at a meeting sponsored by the University of Otago's Dodd-Walls Centre; and delivered a keynote talk at the IONS KOALA student conference in Melbourne.

Maryellen Giger and Mick Withford

Andy Brown and the SPIE Student Chapter of Auckland University

Geoffrey Spinks joins EAPD course instructor team

Geoffrey Spinks, Materials Engineering Discipline Advisor at the University of Wollongong, has joined the team of instructors of courses on Electroactive Polymer (EAP) Actuators and Devices held at SPIE events and offered for in-company training. Dr. Spinks joined the team at the SPIE Smart Structures and Nondestructive Evaluation conference in Portland, Oregon, USA, in March.

David Sampson featured in high-level session on lung health

David Sampson

A high-level session on lung health featured experts in medicine and optics discussing clinical problems in pulmonary fibrosis and lung transplant rejection, in the conference on Optical Techniques in Pulmonary Medicine during SPIE Photonics West in San Francisco, California, USA, in February.

Among the speakers was David Sampson, Winthrop Professor, Director of the Centre for Microscopy, Characterisation and Analysis, the University of Western Australia's micro-imaging core facility, and a node of the Australian Microscopy and Microanalysis Research Facility and the National Imaging Facility. He heads the Optical and Biomedical Engineering Laboratory in the School of Electrical, Electronic and Computer Engineering.

His talk was on "Technologies for optical elastography in the airways." Sampson serves on the Board of Directors of SPIE, and is a Fellow of the society.

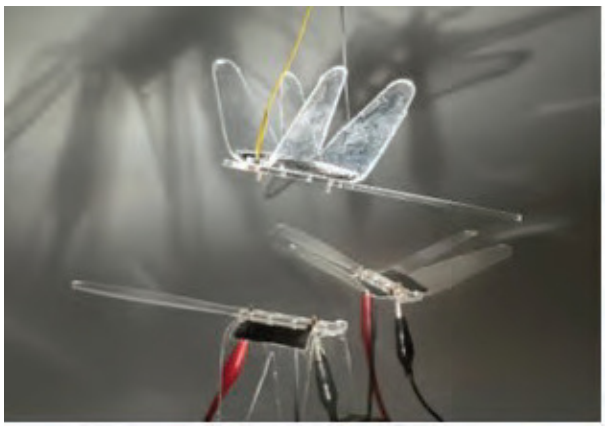
Auckland Bioengineering among top teams in EAP-in-Action competition

A team from the Biomimetic Lab at the Auckland Bioengineering Institute earned one of the top places in the EAP-in-Action competition held as part of the conference on Electroactive Polymer (EAP) Actuators and Devices during SPIE Smart Structures and Nondestructive Evaluation conference in Portland, Oregon, USA, in March.

Team members Markus Henke, Patrin Illenberger, Katie Wilson, Andreas Tairych, Chris Walker, and Iain Anderson were awarded third place from among 15 demonstrations.

They presented:

- The multisensor shirt that can measure stretch at several locations from one input/output.
- The electro-active polymer zoo: self-regulating crawling caterpillars and wing-flapping dragonflies fabricated from printed polymer and electrodes, with no need for electronics.



Electro-active polymer dragonflies

Amy Nelson is PR Manager with SPIE.

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IONS® KOALA 2017

International OSA Network of Students

26 Nov–1 December

The University of Queensland, Australia

The Conference on Optics, Atoms and Laser Applications (KOALA) is held annually in Australia and New Zealand. It is the only conference in the Australasian region organised for students, by students, in the fields of quantum optics and technology, atom optics, optical sensing and laser technology.

KOALA aspires to connect highly-qualified and motivated students from universities all over Australia, New Zealand and the world and aims to prepare them for careers in research and industry through a strong scientific program, networking and professional development.

This year, KOALA returns to home to Brisbane for its tenth anniversary. Co-hosted by the University of Queensland and Griffith University, KOALA will run from 26 November to 1 December on the University of Queensland St Lucia campus.

Abstract submission opens 31 July.

For more information, visit http://ionskoala.osahost.org/

Product News

Kloé Laser Lithography System: Dilase 250

The laser lithography system Dilase 250 is versatile and compact equipment that gives access to laser lithography for a wide range of new applications such as microfluidics, micromechanics or photonics. Dilase 250 is especially well suited for fast prototyping, photomask fabrication and direct microfabrication.

An innovative technology + High depth of focus + Table-top product for convenience

Kloé has developed a new approach of laser photolithography that is mainly sustained by two major innovations:

1. Vectorial writing mode that ensures perfect rendering of edges without stitching or roughness.
2. A specific optical treatment line that induces a large depth of focus and guarantees perfect performance stability of the equipment. That enables the writing into thick photoresists with the same rendering as into thin ones.

OPTEC Laser Micromachining System: MicroMaster

A high performance, multi-featured excimer laser micromachining tool, including short pulse excimer laser, high resolution WYSIWYG optics, PC control of demag., precision part positioning with linear drive stages on rigid granite frame. Sophisticated & user friendly ProcessPower software control includes handy routines, Click & Shoot in a graphics environment and import from industry standard files & CAD. The BIG system in a compact, ergonomic package.

Key features:

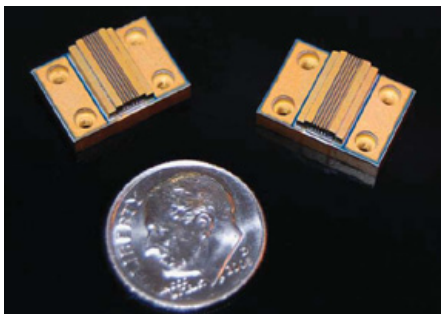
- High laser beam brightness & short pulse.
- Mask projection optics with continuously variable demagnification under PC control.
- X,Y part positioning stages on rigid granite frame, -linear drive, 1µm resolution.
- Motorized Z-axis/focus control.
- TTL & navigation cameras; PRS options.
- Comprehensive ProcessPower software with CAD/CAM interface.
- Fast Set-up times, user friendly s/w routines.

Typical applications:

- Selective polymer removal for wire & contact pads.
- Micro hole drilling/grooving.
- Micro milling/Surface structuring.
- 3D structures, including lenses.
- Thin metal film patterning.
- OLEDs, microfluidics, sensors.

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

High Temperature Laser Diode Arrays



Northrop Grumman Cutting Edge Optronics is a leading manufacturer of high temperature laser diode arrays that are designed to operate in harsh environments. Diode arrays used in automotive or military/aerospace applications often experience operating temperatures ranging from 60-80°C, and CEO has a long history of supplying diode arrays that offer excellent reliability at these temperatures.

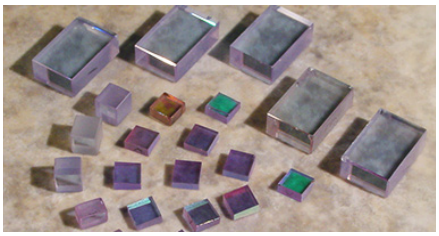
There are a variety of different bar and package types, including standard epitaxial material (excellent performance across wide temperatures) and large optical cavity epitaxial material (excellent reliability at high powers). In particular, CEO has life tested 5-bar arrays at 80°C, 250A, 60Hz for over 600 million pulses. These arrays demonstrate excellent high-temperature reliability over a pulse count well in excess of the requirement of many military applications (e.g. range finders / target designators). This pulse count is also in line with the requirements of many automotive applications.

Summary:

- NGCEO's laser diodes can be combined with hard soldered, CTE matched packaging to create high power arrays for harsh environments
- High Density Stack arrays provide a solution if extremely high power densities are required
- All arrays maintain good slope, threshold and E-O efficiency at temperatures from -40°C to +85°C
- 250A, 80°C life test results show that these arrays are well suited for high temperature operation
- Lower degradation expected at temperatures less than 80°C

For more information please contact LightOptronics Aust. at rons@lightoptronics.com.au or 08 8327 1885

Solid State Laser Materials from Synoptics



Synoptics offers its customers advanced crystal growth research and development (internal and external) and is an industry leader in the manufacture of solid-state laser materials and components:

- Expertise in Czochralski, Hydrothermal and Liquid Phase Epitaxy (LPE) growth techniques
- Diverse fabrication skills in all facets of crystal fabrication from growth, cutting, drilling, grinding, polishing, thin film deposition, and inspection
- Highly talented and experienced manufacturing, measurement, and engineering support to ensure the highest quality standards are met
- World-wide staff of sales representatives
- ISO 9001:2000 certified facility

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- Optical Assemblies
- Diffusion Bonding
- Custom Products & Services

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For more information please contact LightOptronics Aust. at rons@lightoptronics.com.au or 08 8327 1885

New high-power femtosecond lasers

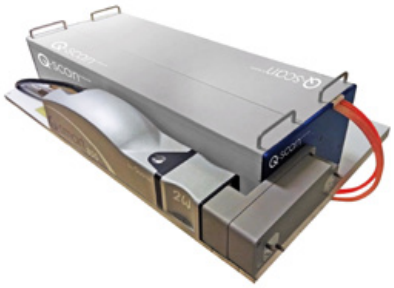
Coherent's original Monaco is a "one box" diode-pumped ultrafast laser delivering 40µJ pulses at 1035nm, with repetition rate variable from single shot to 1MHz. Standard pulsewidth is <400fs and an option is available for variable pulsewidth from <400fs to 10ps.

Coherent has recently released new versions of the Monaco. The Monaco 1035-60 delivers 60µJ pulses at 1035nm with average power of 40W while the Monaco 517-30 delivers 30µJ pulses at 517nm with average power of 20W.

Monaco has outstanding beam quality (M2 < 1.2) making it ideal for demanding micromachining applications in research and industrial environments. Homogenous materials such as glass and metals as well as complex layered structures are readily addressed with Monaco's sub-400fs pulsewidth.

Paul Wardill
paul.wardill@coherent.com.au

Quantel Q-scan – Tunable Dye Laser



Featured at the recent Photonics West 2017 Exhibition, the Q-scan from Quantel represents the latest innovations in dye laser technology.

The Q-scan is a high resolution nanosecond dye laser with wavelength output from 200nm to 4.5µm. High precision mechanics ensure unrivalled wavelength accuracy and linearity (<2pm), making this laser ideal for applications in combustion studies and high resolution laser spectroscopy.

Quantel lasers are known for their ease-of-use and the Q-scan is no exception; "plug-and-play" dye cells make changing wavelength ranges a simple task, in addition to integrated look-up tables for non-linear crystals that enable fast and wide wavelength scans. Furthermore, when coupled with the Q-smart laser, the Q-scan is the most compact and simple dye laser system to ever hit the market.

Jeshua Graham
jeshua.graham@coherent.com.au

Semrock 2017 Master Catalogue

The new 2017 components catalogue from Semrock is now available for download from our website.

Semrock filters are renowned for their exceptional reliability. The filters simple all-glass structure combined with ion-beam-sputtered hard coatings are virtually impervious to humidity and temperature induced degradation. Semrock filters do not "burn out" and can be readily cleaned and handled.

All standard filters are in stock at Semrock NY, available for fast delivery.

Teresa Rosenzweig
teresa.rosenzweig@coherent.com.au

For further information please contact Coherent Scientific at sales@coherent.com.au or 08 8150 5200

MSA-100-3D from Polytec

The MSA-100-3D Micro System Analyzer is designed for 3D vibration analysis with high lateral resolution. It is especially suited for microsystems, precision mechanics parts and for studies on the dynamics of HGAs and secondary actuators in the data storage industry.

The instrument is based on a novel 3D vibrometer setup enabling pm-resolution for both out-of-plane and in-plane motion. It has a frequency bandwidth of 25 MHz. An integrated XY-traverse stage with full software support for high-precision sample movement enables scanned measurements for obtaining 3D deflection shapes.

The MSA-100-3D Micro System Analyzer solves many challenging development tasks. Sub-picometer amplitude resolution is achieved for both Out-Of-Plane (OOP) and In-Plane (IP) motion with a small laser spot resulting in high spatial resolution data. This combined with up to 25 MHz bandwidth real time data will open a realm of entirely new applications for the characterization of MEMS and other micro mechanical structures.

Key features include:

- Real-time measurement with high bandwidth up to 25 MHz
- Sub-pm displacement resolution for both Out-of-Plane and In-Plane motion
- Single-Point and Full-Field scanning measurements
- Small spot size of <4 µm for high lateral resolution
- Large stand-off distance of 38 mm
- Probe station compatible

Q-845 Q-Motion SpaceFAB from Physik Instrumente

Warsash Scientific is pleased to announce the Q-845 from Physik Instrumente (PI), a new parallel kinematic system with a more compact design and higher resolution. Designed for highly accurate positioning with 6 degrees of freedom based on piezo inertia drives the Q-845 has the following key features:

- Travel range: ±7mm in XY and ±5mm in Z
- Minimum incremental motion: 6nm in XY and 20nm in Z
- Rotation range: ±7° in θx, θy and ±8° in θz
- Minimum incremental rotation: 0.9 µrad in θx, θy and θz
- Load capacity: 10N
- Vacuum compatible: 10^{-6} hPa
- Self-locking, no heat generation at rest

Applications include:

- Photonics alignment applications
- Beamline systems
- Microscopy
- Semiconductor technology
- Photonic device assembly

C-WAVE tunable laser source from HÜBNER

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

The C-WAVE is a tunable laser light source for continuous wave emission in the visible and near-infrared wavelength range. Its technology is based on optical parametric oscillation (OPO) and is fully computer controlled. It allows you to tune from blue (450 - 525nm) to red (540 - 650nm) and into the near-infrared (900 - 1300nm) without any change of dyes or optical components.

In addition, the use of the AbsoluteLambda™ software module offers the opportunity for an automated selection of wavelength with high accuracy (set point ±1MHz) and a drift-free wavelength stabilisation (±1MHz) over 12 hours. Control and fine tuning are achieved using intra-cavity elements and piezo-tuning of the cavity length.

Applications include:

- Atomic physics
- Quantum optics
- Metrology
- Spectroscopy
- Biophotonics
- Holography
- Photochemistry

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

Gentec-EO release new Pronto-250-PLUS Laser Power Detector

The new Pronto-250-PLUS pocket-size power meter has 3 measurement modes: single shot power measurements up to 250 W (SSP), continuous power measurements up to 8 W (CWP) and single shot energy measurements up to 25 J (SSE).

Key Features:

- Pocket-Size: This mid to high power handheld probe is so compact it fits in your pocket
- Easy-to-Use: The touch screen colour LCD allows for a friendly user interface. You can make a measurement with just the touch of a button
- User Settable: You can set the wavelength, brightness and screen orientation to adapt to your application
- Data Logging: Save your data to the internal memory and then transfer it to your PC over the USB connection.
- From Low to High Powers: Thanks to a low noise level and high damage threshold, the Pronto can measure powers from 1 W to 250 W
- Fully Calibrated: The Pronto-250 comes fully calibrated: every wavelength between 248 nm and 2.5 micron (YAG), and a real calibration at 10.6 micron (CO2). The Pronto-250-PLUS has all these calibrations and is also calibrated for Energy measurements.
- Hands-Free Operation: Place it on a flat surface or use one of the 2 threaded holes that we have integrated in the casing for safe use with optical stands.

TOPTICA's CTL available at 1050, 1320 and 1470 nm – with up to 110 nm mode-hop-free tuning!

Continuous, mode-hop-free wavelength tuning up to 110 nm is now possible around the new central wavelengths 1050, 1320 and 1470 nm. These new wavelengths complement the portfolio of TOPTICA's laser platform CTL (Continuously Tunable Lasers).

The new wavelengths of the CTL support a variety of applications like spectroscopy, waveguide characterization, studying microresonators, seeding ytterbium amplifiers, as well as testing of ytterbium fibre components. In addition, the CTL at 1470 nm central wavelength lends itself for specific applications in the telecommunication range (s-band and part of e-band), especially where high resolution and low noise are required.

Key Features:

- Mode-hop-free tuning: 915 nm - 985 nm or 1530 - 1620 nm
- Up to 80mW
- Flexible motor, piezo and current tuning with high accuracy and small step sizes
- Low-noise and powerful digital control with DLC pro
- High frequency AC and DC current modulation inputs
- Hands-off operation with SMILE and FLOW

Raptor Photonics launches the Falcon III with third generation EMCCD technology

Raptor Photonics, a global leader in the design and manufacture of high performance digital cameras, has launched its latest camera the Falcon III, Falcon II and Kestrel using ground-breaking EMCCD – GEN III technology.

The Falcon III incorporates a new EMCCD sensor developed by e2v which offers 1MP resolution with 10µm square pixels. A back-illuminated sensor offers a peak QE of >95% offering unsurpassed sensitivity with a total noise floor as low as 0.01 electrons readout noise.

EMCCD – GEN III offers the combination of ultimate sensitivity and speed through a single output amplifier thereby maximising uniformity. It is three times faster than previous generation EMCCDs with superior linearity and low gain performance. Up to 5000 x EM gain can be applied to the sensor using lower voltages resulting in reduced sensor ageing effects. The camera can be cooled to -100°C for lowest possible background events using Raptor's long life ruggedised PentaVac™ vacuum technology.

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Conferences

26 November to 1 December, IONS KOALA 2017

IONS KOALA is the Conference on Optics, Atoms and Laser Applications (KOALA) held annually in Australia and New Zealand as well as an International OSA Network of Students (IONS) conference sponsored by The Optical Society (OSA). IONS KOALA 2017 is being co-hosted by the OSA student chapters at the University of Queensland and Griffith University in Brisbane from 26 November to 1 December. "With the support of many fantastic organisations, our goal is to bring together a large groups of Honours, Masters and PhD students currently conducting research in any field of optics, atoms and laser applications in Australia, New Zealand and the world."

KOALA encompasses a broad variety of topics within the field of optics and photonics. These include but are not limited to atomic, molecular and optical physics, quantum optics, spectroscopy, micro and nanofabrication, biomedical imaging, metrology, nonlinear optics and laser physics research. Most attendees are at the very beginning of their careers, so this is a great way to discover a wide range of possible directions within the world of optics and photonics!

KOALA is designed to allow students to discuss their research whilst providing them with a chance to network with their peers who are working in various universities across a variety of fields. The aim is that students gain a fresh perspective as well as the opportunity to learn about exciting research being conducted. Students will also get the chance to develop valuable communication skills through presenting their research to their peers working in a variety of fields. ionskoala.osahost.org

4-7 December, Australian and New Zealand Conference on Optics and Photonics 2017 (ANZCOP 2017)

The 3rd Australian and New Zealand Conference on Optics and Photonics (ANZCOP) will take place in Queenstown, 4 to 7 December 2017, following on from previous conferences in Adelaide, 2015, and Perth, 2013. ANZCOP 2017 incorporates the Australian Conference on Optics, Lasers and Spectroscopy (ACOLS) and the Australian Conference on Optical Fibre Technology (ACOFT). ANZCOP 2017 is the third such conference, and is run under the auspices of the Australian Optical Society and the Dodd Walls Centre for Photonic and Quantum Technologies. ANZCOP aims to bring together the Australian and New Zealand research community in Optical and Quantum Technologies which have been developed strongly in recent decades.

Optics and photonics research continues to be a dynamic and exciting field of research internationally and within Australasia where we have a diversity of both theoretical and experimental research groups working in the area. It can be used to ask and answer fundamental questions about quantum mechanics and atomic physics and to probe chemical reactions, to make new types of chemical and environmental sensors, new biological sensors and medical diagnostics and devices, better computers and communications systems, better fundamental standards and metrology, and even to measure elusive ripples in the curvature of space-time.

ANZCOP 2017 will include a wide variety of plenary talks, including the Advanced LIGO project and the latest developments in bio-photonics, and a plenary by the 2017 Frew Fellow: Professor Albert Polman FOM Institute AMOLF in Amsterdam, the Netherlands.

Please join us in Queenstown for ANZCOP 2017. Abstracts close 10 September. anzcop2017.nz

Australian Research in the News

Nanodiamond-enhanced MRI

Australian researchers have played a leading role in research towards the development of non-invasive nanodiamond imaging - linking the gold standard magnetic resonance imaging (MRI) technique with synthetic industrial diamonds for targeted drug delivery.

Nanoparticles are rapidly emerging as a viable future medicine technology for the targeted delivery of vaccines and chemotherapy agents and as a means of tracking tumour distribution throughout the body. Scientists in Australia and the United States have devised a means of tracking nanodiamonds noninvasively with MRI, opening up a host of new applications, in a paper recently published in Nature Communications.

The Low-Field Imaging Lab at the Martinos Center develops new magnetic resonance imaging techniques. Image courtesy of Martinos Center.

"With this study, we showed we could produce biomedically relevant MR images using nanodiamonds as the source of contrast in the images and that we could switch the contrast on and off at will," says David Waddington, lead author of the paper and a PhD student at the University of Sydney. Waddington is currently working with Associate Professor Matthew Rosen in the Low-Field Imaging Laboratory at the Martinos Center, Massachusetts General Hospital. "With competing strategies, the nanodiamonds must be prepared externally and then injected into the body, where they can only be imaged for a few hours at most. However, as our technique is biocompatible, we can continue imaging for indefinite periods of time. This raises the possibility of tracking the delivery of nanodiamond-drug compounds for a variety of diseases and providing vital information on the efficacy of different treatment options."

Mr Waddington said the research was three years in the making and was initiated with a Fulbright Scholarship awarded early in his PhD at the University of Sydney, where he works in the team led by Professor David Reilly, in the new $150m Sydney Nanoscience Hub – the headquarters of the Australian Institute for Nanoscale Science and Technology (AINST), which launched last year. Supported by Professor Reilly, Mr Waddington used the Scholarship to establish an ongoing collaboration with Matthew Rosen's lab at Massachusetts General Hospital and Professor Ronald Walsworth's group at Harvard University.

"Key to researchers being able to determine the differences between successful and unsuccessful treatments is the ability to monitor the nanoparticles in vivo, as opposed to in a test tube, which is challenging with current approaches," Mr Waddington said. "In our paper, we detail a new technique we have developed and demonstrated for imaging nanoparticles – this technique is particularly promising as it will enable imaging of nanoparticles over the long timescales necessary for in vivo tracking. As a result of our new research, we can repeatedly perform hyperpolarisation in a biocompatible environment. This enables nanodiamond imaging over indefinitely long periods of time and opening up the study of a range of diseases such as those affecting the brain and liver."

Previously, the use of nanodiamond imaging in living systems was limited to regions accessible using optical fluorescence techniques. However, most potential diagnostic and therapeutic applications of nanoparticles, including tracking of complex disease processes like cancer, call for the use of MRI – the gold standard for noninvasive, high-contrast, three-dimensional clinical imaging.

In the present study, the researchers show that they could achieve nanodiamond-enhanced MRI by taking advantage of a phenomenon known as the Overhauser effect to boost the inherently weak magnetic resonance signal of diamond through a process called hyperpolarisation, in which nuclei are aligned inside a diamond so they create a signal detectable by an MRI scanner. The conventional approach to hyperpolarisation uses solid-state physics techniques at cryogenic temperatures, but the signal boost doesn't last very long and is nearly gone by the time the nanoparticle compound is injected into the body. By combining the Overhauser effect with advances in ultra-low-field MRI coming out of the Martinos Center, the researchers were able to overcome this limitation – thus paving the way for high-contrast in vivo nanodiamond imaging over indefinitely long periods of time.

Mr Waddington said: "Our close collaboration with the Rosen lab at the Martinos Center – world leaders in ultra-low field MRI – has been essential to the completion of this work, which began during the time I spent there on the Fulbright scholarship."

Professor Reilly said the nanodiamond finding was a great example of the benefits of experimental physics in generating unintended discoveries. "It's estimated that such ultra-low field MRI scanners could be produced at a fraction of the cost of conventional MRI scanners, which could lead to this imaging technique being widely accessible in the future," Professor Reilly said.

Source Material: http://www.massgeneral.org/about/pressrelease.aspx?id=2091
http://sydney.edu.au/news-opinion/news/2017/04/26/nanodiamond-tiny-machines-closer-to-reality-with-global-finding.html

Original article: DEJ Waddington, M Sarracanie, H Zhang, N Salameh, DR Glenn, E Rej, T Gaebel, T Boele, RL Walsworth, DJ Reilly & MS Rosen, Nature Communications **8**, 15118 (2017).

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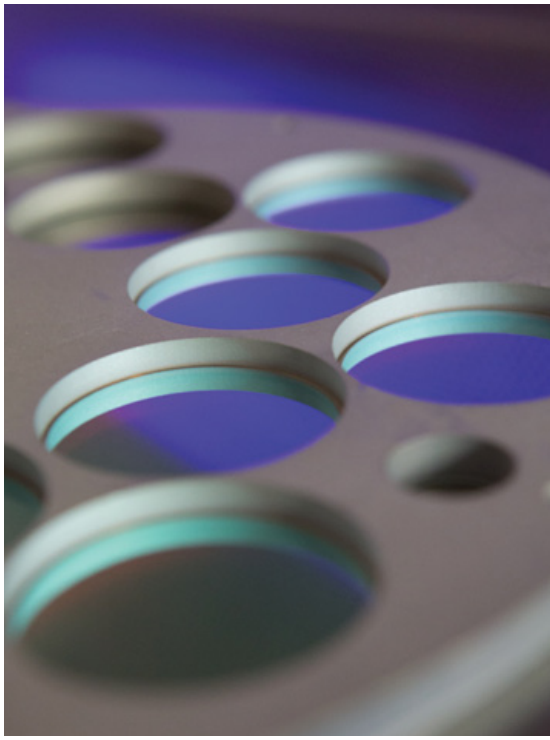

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INSPIRED WORK

World's thinnest hologram paves path to new 3D world

Being able to integrate holography with everyday electronics would make screen size irrelevant. Image courtesy of RMIT.

An Australian-Chinese research team has created the world's thinnest hologram, paving the way towards the integration of 3D holography into everyday electronics like smart phones, computers and TVs.

Interactive 3D holograms are a staple of science fiction – from Star Wars to Avatar – but the challenge for scientists trying to turn them into reality is developing holograms that are thin enough to work with modern electronics. Now a pioneering team led by RMIT University's Distinguished Professor Min Gu has designed a nano-hologram that is simple to make, can be seen without 3D goggles and is 1000 times thinner than a human hair.

"Conventional computer-generated holograms are too big for electronic devices but our ultrathin hologram overcomes those size barriers," Gu said. "Our nano-hologram is also fabricated using a simple and fast direct laser writing system, which makes our design suitable for large-scale uses and mass manufacture. Integrating holography into everyday electronics would make screen size irrelevant – a pop-up 3D hologram can display a wealth of data that doesn't neatly fit on a phone or watch. From medical diagnostics to education, data storage, defence and cyber security, 3D holography has the potential to transform a range of industries and this research brings that revolution one critical step closer."

Conventional holograms modulate the phase of light to give the illusion of three-dimensional depth. But to generate enough phase shifts, those holograms need to be at the thickness of optical wavelengths. The RMIT research team, working with the Beijing Institute of Technology (BIT), has broken this thickness limit with a 25 nanometre hologram based on a topological insulator material – a novel quantum material that holds the low refractive index in the surface layer but the ultrahigh refractive index in the bulk.

The topological insulator thin film acts as an intrinsic optical resonant cavity, which can enhance the phase shifts for holographic imaging. Dr Zengji Yue, who co-authored the paper with BIT's Gaolei Xue, said: "The next stage for this research will be developing a rigid thin film that could be laid onto an LCD screen to enable 3D holographic display. This involves shrinking our nano-hologram's pixel size, making it at least 10 times smaller. But beyond that, we are looking to create flexible and elastic thin films that could be used on a whole range of surfaces, opening up the horizons of holographic applications."

Source material: https://www.rmit.edu.au/news/all-news/2017/may/worlds-thinnest-hologram-new-world

Original article: Z Yue, G Xue, J Liu, Y Wang & M Gu, Nature Communications **8**, 15354 (2017).

Science Journalism is in Australia's Interest, but Needs Support to Thrive

This article was originally published on
THE CONVERSATION

by Joan Leach

The oldest known human bones; the first detection of gravitational waves; the successful landing of a rover on Mars, and the discovery of the Higgs boson particle: all of these highly read global science stories illustrate the public's thirst for the latest research and technological innovations. But is science journalism in the public interest?

Specialist science journalists are vital in our society in a few key ways. These include as public disseminators of sound science that can lead to policy, as identifiers of flawed journalism and "dodgy" (even life-threatening) science, and as gatekeepers between public relations departments in research institutions and the general media.

And yet the number of specialist science reporters in Australia is in serious decline.

Journalism can drive science policy

Over 2012 and 2013 a range of media outlets teamed up with the Australian Medical Association and the Australian Academy of Science to coordinate a national immunisation campaign.

Not only was the story given robust and prominent coverage across Australian news media platforms, the Daily Telegraph and news site MamaMia also ran campaigns encouraging readers to pledge to immunise their children.

In 2013 the Daily Telegraph followed up with a "No jab, no play" concept, promoting the idea that childcare centres should ban children who had not been immunised. State and federal governments have subsequently introduced legislation to effect this proposal. The program is still being monitored.

Linked to this coverage, a successful case was mounted in the NSW Office of Fair Trading against anti-immunisation activist group the Australian Vaccination Network. The network's name was found to be misleading and the group has now re-badged itself as the "Australian Vaccination-Skeptics Network".

Journalism as a gatekeeper for "bad" science

Sound peer review and editorial procedures are in place in many research journals, but sometimes what can best be described as "dodgy" science is published, and this can lead to disastrous results.

The classic example is the (now falsified) study in 1998 that reported on autism-like symptoms and gastrointestinal abnormalities in children associated with the MMR (measles, mumps, rubella) vaccination. The study was small (only 12 children), observational, and submitted for publication without key disclosures from lead author Andrew Wakefield.

In a subsequent press conference, Wakefield expressed his concerns about the MMR vaccine. The media's enthusiastic reporting and less than critical response to these claims took an ethically and scientifically unsound report and turned it into what has been described as "perhaps the most damaging medical hoax of the last 100 years". In 2008 measles was reported to be once again endemic in the UK, a development that has been linked to reduced MMR take-up.

Had the journalists at that initial press conference been equipped to appraise the findings critically, the poor science may have been revealed from the start. The paper was later found to be fraudulent by investigative journalist Brian Deer, who published stories in print and made a documentary revealing the hoax.

Science journalism vs science PR

Science journalism and science public relations (PR) can be difficult to distinguish. The job of the PR specialist is to maximise eyeballs on each story. The job of the journalist is to find the story and report the evidence behind it, no matter whose story it is.

Stories that are written with a university press release - rather than a peer-reviewed science paper - as the main source of evidence can easily cross the line into infotainment rather than independent reporting.

It's also the case that some stories that look like science journalism are heavily sponsored by universities and research institutions. This so-called "native content" - in that it looks appropriate for its context - is becoming more prevalent.

It's a trend exacerbated by the movement of journalists from media organisations into communication roles in academic and research institutions. While the writing style is journalistic, the focus is to promote the science from the institutions that employ them. This bypasses robust and independent examination of the evidence.

Interviewing scientists - shown here is physicist Louise Harra - is a skill that takes experience and in depth knowledge on the part of the journalist. Image credit: O Usher (UCL MAPS). CC-BY-SA.

There may be more of this to come as science journalists become an endangered species.

An endangered species

Embedded in Australian news rooms, the investigative science journalist is a rare beast; the most recent in a long line of casualties are Marcus Strom from The Sydney Morning Herald, and Bridie Smith of Melbourne's The Age, who left Fairfax recently after 16 years.

It seems the ABC is the only mainstream media outlet with a science unit. Here, specialists Anna Salleh and Jake Sturmer, along with experienced science journalists, communicators and broadcasters (Robyn Williams, Natasha Mitchell, Joel Werner, Bernie Hobbs, Ruben Meerman and Dr Karl amongst others) present regular science content on various platforms.

Journalists in specialities such as environment, health and technology do still hold positions at major media platforms, and Cosmos Magazine provides another platform for science content in Australia. Freelance science journalists including Bianca Nogrady, Leigh Dayton and Graham Readfearn work on specific projects across a variety of platforms.

Specialist correspondents develop a deep and complex understanding of their ground over time, and carry a knowledge of what's gone before that surpasses a quick internet search. They might, for instance, recognise that a particular "breakthrough" is simply an old study repackaged, that a study is very small, or that its promises have been made before without amounting to much. Or that the "faster than light" neutrinos were a statistical anomaly (and an error) rather than a tested matter of fact.

The disappearance of the specialist science correspondent means a loss of personnel with the time and the expertise to probe deeply and to ask uncomfortable questions. The consequences are declines in the breadth, depth and quality of science coverage. Pair this with an increased workload, the need for journalists to apply multimedia skills and the constant pressure to publish (driven by the 24-hour news cycle), and the opportunities for genuine investigation are slim.

New ways to cover science

As the number of science correspondents has fallen, the science sector has rushed in to fill the online void with blogs and social media sites (some terrifically successful).

The Australian Science Media Centre (SMC.org.au) is a not-for-profit resource that supports evidence-based science coverage.

Facilities such as the Australian Science Media Centre now work to support and facilitate evidence-based science journalism. The Centre boasts 1,600 subscribers and informs hundreds of reporters who attend regular briefings.

According to chief executive Susannah Elliot:

'When the Australian Science Media Centre started in 2005, there were around 35 specialist science reporters in mainstream newsrooms around the country. Now you need less than one hand to count them.

This loss of specialist reporters means that there is no one to fight for good science in editorial meetings or look for science angles in everyday news stories.

We're all going to have to do everything we can to help general reporters cover science and make sure they don't miss the important stuff.'

The future of science journalism

It may be that science journalism has never enjoyed a consistent position in media outlets - some report that "peak science journalism" happened in 1987. In an important review of the history of popular science, writer Martin Bauer points out that science journalism is prone to a "boom and bust cycle".

The call for more and improved science journalism is based on an assumption that lives are worse off without it. This is an easy leap for academics to make; after all, our very existence is based on the idea that more knowledge is better than less knowledge.

But how can we convince the general public this is the case? Studying the "decline of science journalism" – fewer numbers of journalists, diffuse science reporting, the rise of branded and native content – will not be enough to show that we need more science journalists. We must be able to clearly identify a public good, and convince media-saturated consumers that science deserves a place in their lives.

We must also develop a clear business case that supports science journalism. Relatively new media platforms such as Nautilus and narrative.ly provide some evidence that blending science with creative nonfiction, philanthropic funding, subscription services, paywalls, and hybrid models of journalism and public relations are worth further exploration.

Supported primarily by the university sector, The Conversation publishes science, technology, environment and energy stories that are written by academics.

However there has yet to be a convincing case of overwhelming public support for robust science journalism. In our view, this is a shame. We think academic and media groups, and those private sectors that rely on science and technology, should start articulating the public value of science journalism.

A colleague in New Zealand, Rebecca Priestly, has put some money behind finding out, through establishing a fund for science journalism. Perhaps it's time to do the same in Australia.

Acknowledgements

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Joan Leach is Director of the National Centre for Public Awareness of Science at the Australian National University.

The original article can be found at: https://theconversation.com/science-journalism-is-in-australias-interest-but-needs-support-to-thrive-79106

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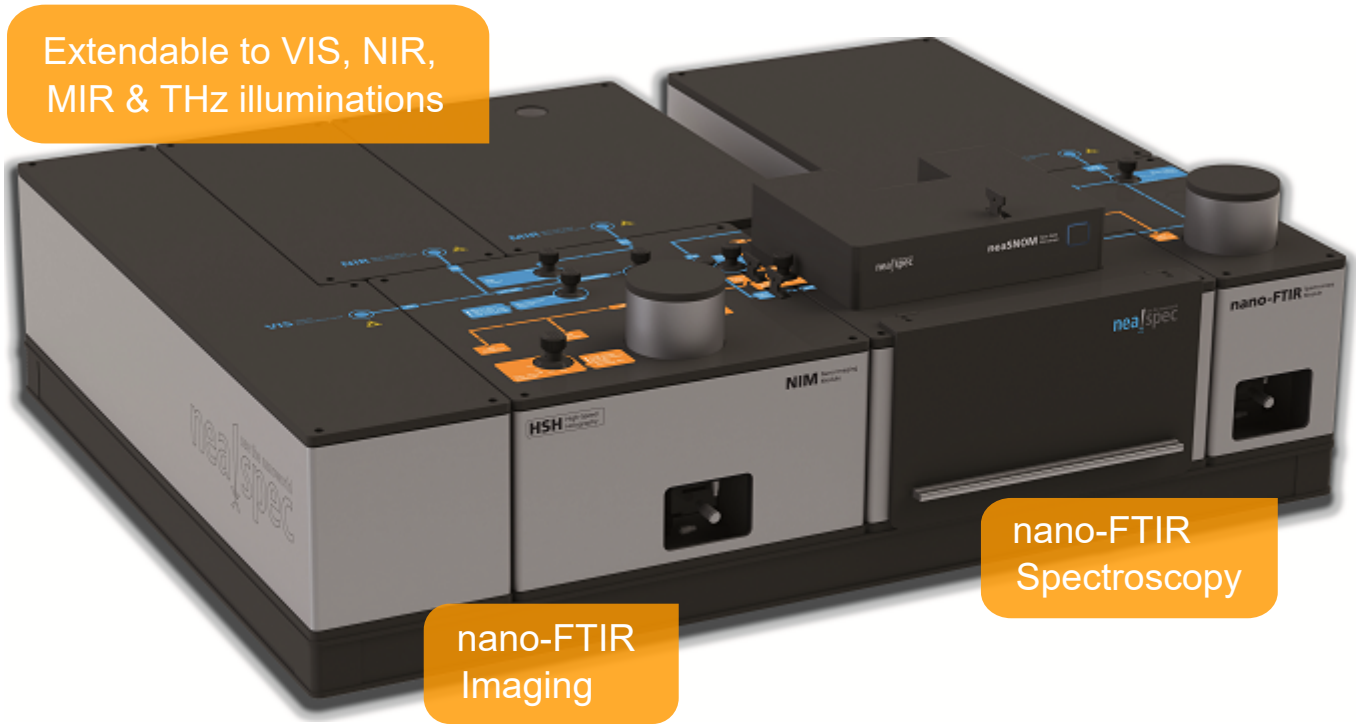

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Extreme Optical Magnetism Enhanced by Fano Resonances

All materials found in nature exhibit negligible magnetic response at optical frequencies [1]. However, this limitation can be overcome with metamaterials designed to support an optically induced magnetic response; typical structures are split-ring resonators made of metals [2]. However, the induced optical magnetism in plasmonic structures is very weak. Recent development of all-dielectric resonant nanophotonics is the key to boost dramatically the magnetic response in subwavelength meta-optics and nanophotonics.

by AS Shorokhov, EV Melik-Gaykazyan, AA Fedyanin, AE Miroshnichenko, DN Neshev and Yu S Kivshar

Nanostructured photonic materials offer novel possibilities for enhancing nonlinear effects by volumetric optical resonances. Magnetic dipole resonances received special attention, and earlier studies revealed a positive correlation of nonlinear optical response strength and magnetic-dipole character of resonances in plasmonic nanostructures, being attributed to the magnetic component of the Lorentz force exerted on electrons in metals [3]. Recently, the study of *optically-induced magnetic Mie-type resonances* was found to exhibit a new type of *magnetic nonlinearity* [4]. Importantly, these magnetic modes can be boosted substantially at the Fano resonance being a general wave phenomenon reported in various fields ranging from atomic physics to optics. In particular, Fano resonances have been observed experimentally in many photonic nanostructures composed of metallic nanoparticles combined in clusters – "oligomers" – due to the excitation of surface plasmon polaritons.

In plasmonic structures, optical Fano resonances appear due to interference of purely electric modes. However, our recent studies of all-dielectric nanoparticle oligomers reveal that subwavelength oligomers consisting of closely spaced dielectric nanoparticles can support both *electric and magnetic Fano resonances* at optical frequencies. This opens multiple opportunities for the study of magnetic Fano resonances that exhibit novel interesting optical properties.

In a recent paper [5], Shorokhov et al. employed magnetic Fano resonance for the first demonstration of a giant nonlinear optical response of all-dielectric nanoclusters. They observed that an interplay between optically-induced individual and collective *magnetic dipolar modes* of a nanoparticle cluster composed of silicon nanodisks, a *quadrumer*, allows for enhanced local fields within the magnetic dipolar response of the constituent disks. With compact size and new functionalities enabled by nonlinear optical magnetic response, the engineered nanoparticle structures are perfect candidates to become the building blocks for novel nonlinear highly-efficient nanoscale devices driven by the optically-induced magnetic response.

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AS Shorokhov, EV Melik-Gaykazyan and AA Fedyanin are with the Faculty of Physics, Lomonosov Moscow State University, Russia. AE Miroshnichenko, DN Neshev and Yu S Kivshar are with the Nonlinear Physics Centre, Australian National University, Canberra.

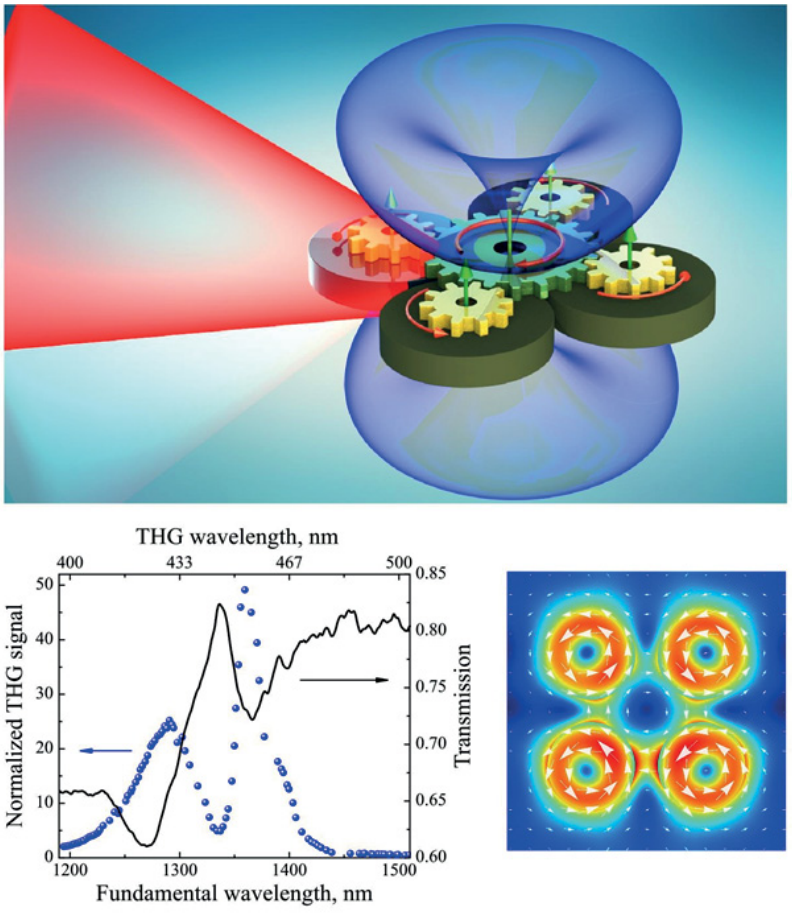

Figure 1 Manifestation of extreme optical magnetism through the multifold enhancement of third-harmonic generation in a quadrumer composed of dielectric nanoparticles excited at the condition of the magnetic Fano resonance. Experimental spectra for transmission (solid) and third-harmonic signal from a sample at the incident angle of 45°, and the vortex-like electric fields generating the optical magnetic response.

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Optics in Everyday Life: Moiré Fringes and Their Applications

by Tony Klein

The optical analogue of the phenomenon of "beats" in acoustics is frequently observed as a set of fringes when images containing strong periodicities are superimposed. They are often a nuisance in the form of "strobing" when periodic objects are imaged on TV or computer screens which themselves have a periodic structure. However, many interesting and unexpected technological applications arise and are described below.

First things first: Moiré (pronounced "mwah-ray") is not named after a person but is the French word for "moistened" because of the pattern seen in multiple layered moistened and pressed silk, an example of which is shown in Figure 1. The woven nature of the partially transparent material contains dominant spatial frequencies, of course. More generally, when transparent patterns are superimposed with slightly tilted or distorted copies of themselves the resultant pattern is equivalent to the product of the two, so that the multiplied periodic functions contain the sum and difference frequencies, as is well known from the basic trigonometric identities for the products of sines and cosines. The difference frequencies manifest themselves as moiré fringes and these two-dimensional "beats" are, of course much richer than the one-dimensional acoustic beats, as we shall see in the examples that follow.

The simplest example is a pattern of equally spaced vertical lines. When a piece of a transparent version of the same pattern is superimposed on this, but slightly rotated (say in a clockwise direction). Since the horizontal component of the spatial frequency is now somewhat greater, a set of horizontal fringes is seen, as in Figure 2. An important application of this is shown in Figure 3a which shows the principle of a linear encoder. When the long grating is moved to the right by one unit, the fringes move downward by one fringe spacing. Using a light source and two detectors a quarter of a fringe spacing apart, an electronic signal feeding a so-called up-down counter can give a digital readout which can be a small fraction of the line spacing. Using a very fine grating an accurate measure of the displacement of the grating is obtained. One practical use of this is shown in Figure 3b, which shows a set of calipers with digital readout, but this is just one example of an optical encoder that is the system used in CNCs - numerically controlled machine tools.

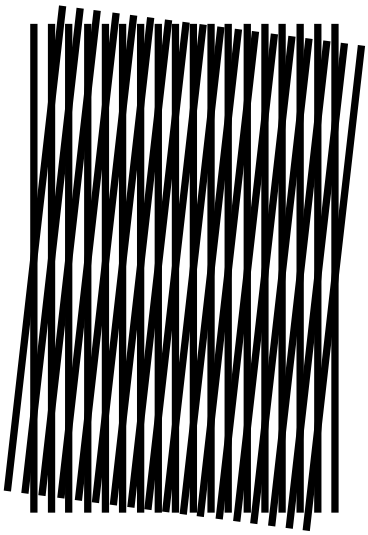

Figure 2. Moiré fringes produced by a pattern of vertical lines.

In a closely related application, the very fine grating is printed not on a straight substrate but on the periphery of a circular glass disk, with a small piece of a slightly tilted version of the same grating pattern mounted on an index plate above it. A cognate fringe pattern is thus produced so that with a light source behind and two detectors in quadrature in front, an angle encoder is obtained with as fine a resolution as a fraction of the line spacing on the circular grating. With a large enough radius, this digital angle encoder

Figure 1. An example of moiré silk showing a moiré pattern of fringes.

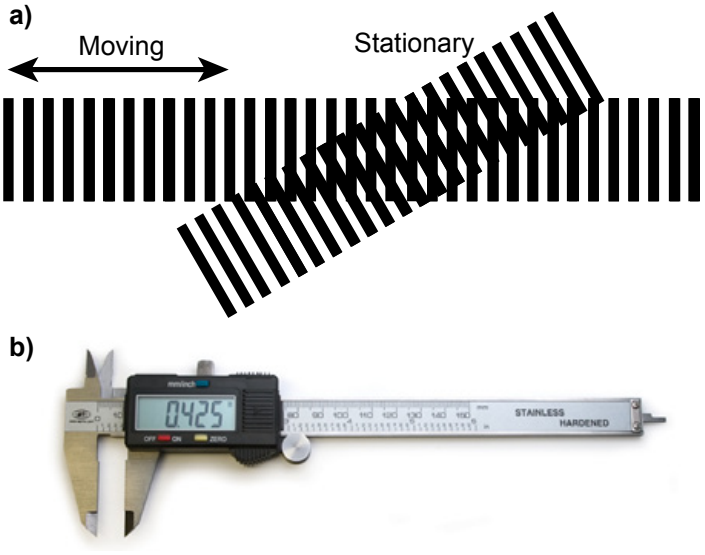

Figure 3. a) Principle of a linear encoder. b) Calipers with digital readout based on this principle.

can resolve very small angles, down to a fraction of an arc second, and is thus useful for telescopes, theodolites etc.

In another simple example, if the transparent copy is tilted about a vertical axis, so that the dominant spatial frequency along a horizontal axis becomes shorter, the moiré pattern becomes a set of vertical fringes (or beats) at the difference frequency. In a related example, a parallel-sided glass container with a liquid inside is interposed between the transparent copy and the original grating. A refractive index gradient in the liquid, caused by a density gradient or a temperature gradient, leads to a distortion in the moiré fringes from which the refractive index variation can be deduced quantitatively. Other applications in industrial situations allow the measurement of distortions, stress analysis and so forth.

In particular, two identical copies of any two-dimensional periodic object can result in a magnified version of the object as may be seen in Figure 4 - an application of this may be called "moiré microscopy". Further details are described in Reference 1.

But more spectacularly, in a process called moiré topography [2], the original transparency with the vertical grating pattern is projected onto a test surface that has a (3-dimensional) relief pattern. Under appropriate conditions of illumination, the projection of the grating pattern produces a shadow on the test surface, and as seen through the original pattern a set of complicated fringes are produced, characterised by the difference of spatial frequencies. Somewhat surprisingly, the outcome looks like a set of contour lines and can be used to describe the test surface quantitatively. An example of this is shown in Figure 5.

In this case the original pattern is produced by closely spaced black threads strung the vertical direction on a large frame [2].

Further examples of moiré patterns, produced by superimposed circular objects, e.g. concentric circles and zone plates, are reproduced in Figure 6. They are geometric analogues of interference patterns, more about which may be seen in Reference 1. Further examples and applications, especially in metrology, may be seen in Wikipedia and other web-based articles.

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Emeritus Professor Tony Klein is a Foundation Member and Past President of the AOS. Tony is with the School of Physics, University of Melbourne.

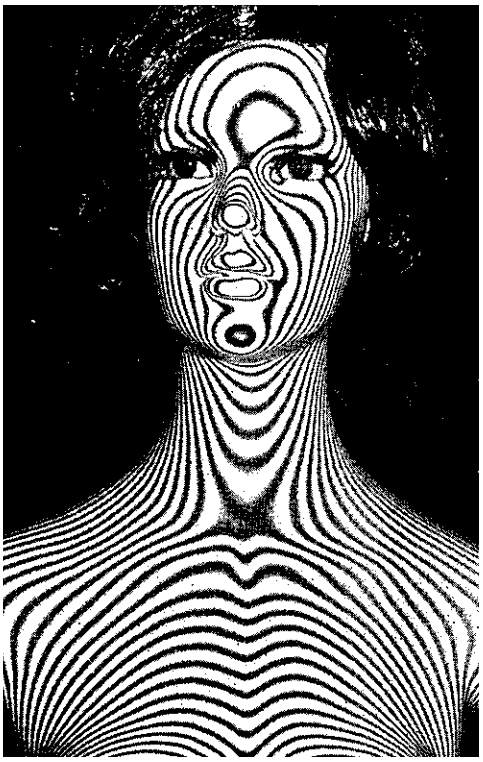

Figure 5. Moiré topography resulting in contour lines. Taken from [1], figure 6.

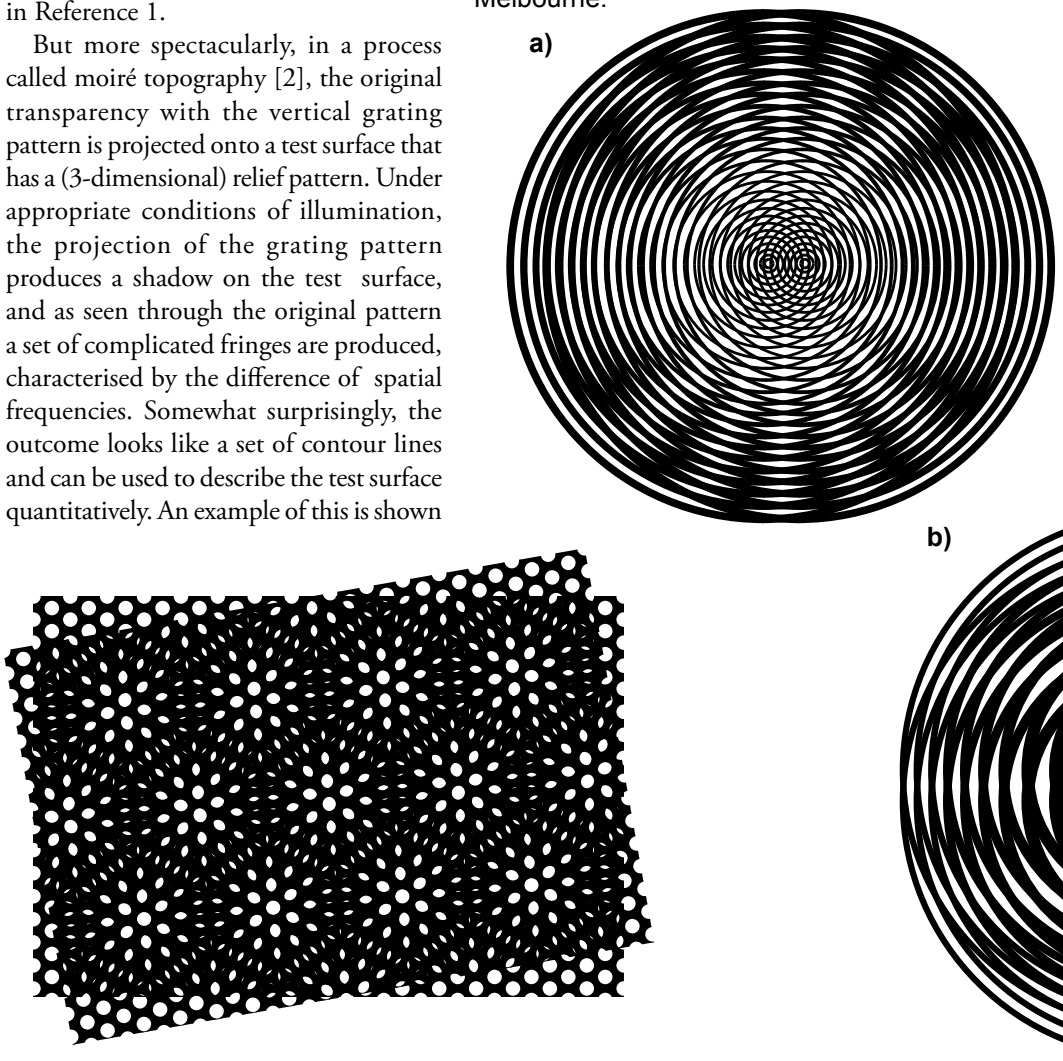

Figure 4. The principle of moiré microscopy

Figure 6. a) Circular moiré pattern. b) Zone plate moiré pattern

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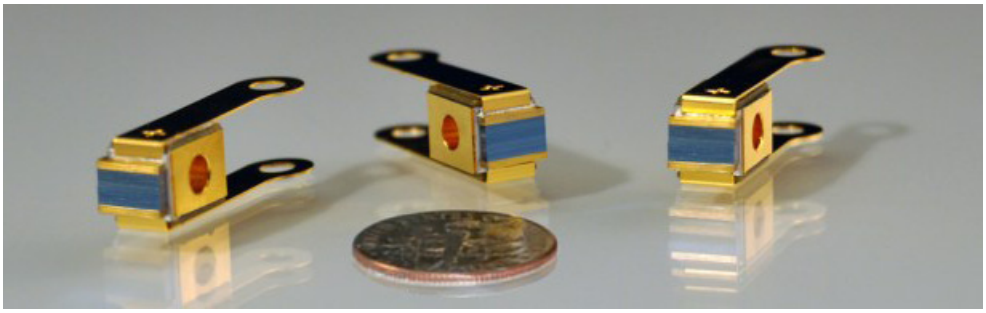

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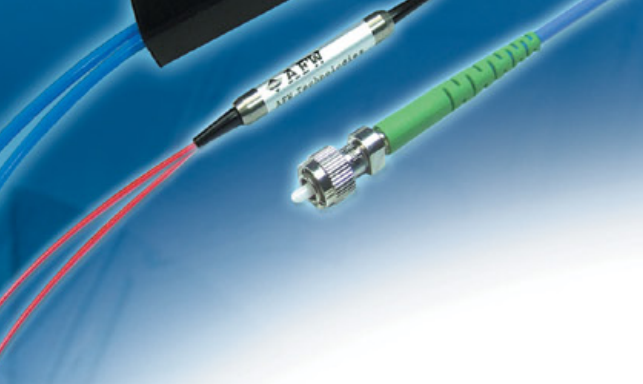

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Key Features

- Insertion loss 0.3 ~ 0.5dB per km
- Customised fibre lengths: 50m,100m, 200m, 1km ~ 5km, 10km, 25km, 40km and 50km
- Operating wavelength range: 1260 ~ 1650nm standard
- Fibre type: G.652.D SMF
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AFW Technologies

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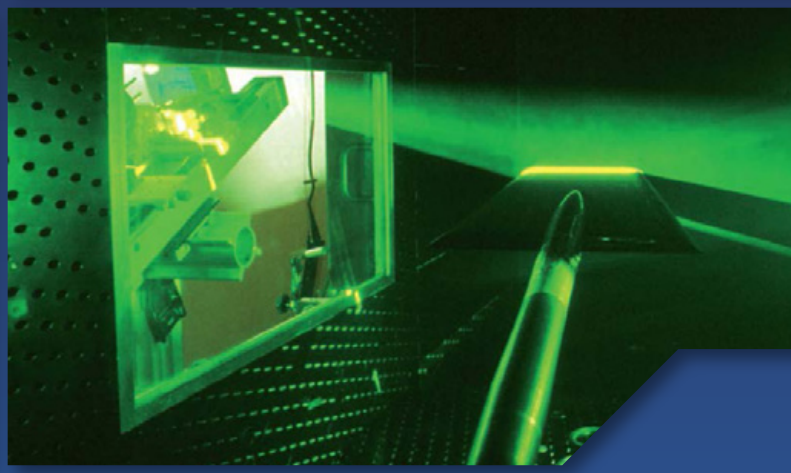

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