AOS News

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AUSTRALIAN OPTICAL SOCIETY

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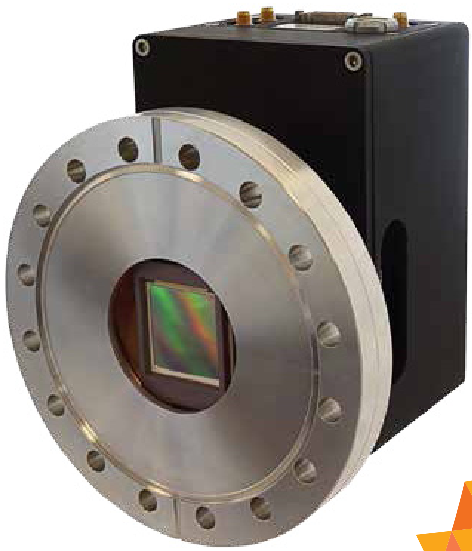

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AOS News is the official news magazine of the Australian Optical Society. Formed in 1983, the Society is a non-profit organisation for the advancement of optics in Australia. Membership is open to all persons contributing to, or interested in, optics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

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Aug/Sep 2018 Volume 32 Number 2

Articles

Departments

Cover Pictures:

- (Top left and right) The first plymer banknotes were introduced 30 years ago as a more secure alternative to paper notes, see page 30. Image credit RBA.
- (Centre) The first winner of the AOS photo competition is Stephane Coen. The photo shows an ice-bow, also known as a 22-degree halo, around the sun. The rainbow-like ring is caused by high altitude ice crystals, see page 11.
- Insets (left to right)
  - This year marks the fortieth anniversary of the First Australian National Laser Conference, see page 13.
  - The International Day of Light Inauguration Ceremony was held in Paris on May 16th, see page 9.

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 (Dec 2018) should be with the editor no later than 19 Nov 2018, advertising deadline 12 Nov 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:
http://www.optics.org.au

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President's Report

I would like to start off by congratulating all the AOS members who have been recognised with honours, awards and prizes since my last report.

AOS Councillor, Prof. Halina Rubinsztein-Dunlop was a recipient of the Officer (AO) in the General Division of the Order of Australia in June, the AOS W.H. (Beattie) Steel Medal at the start of August and a Eureka Prize at the end of August. AOS members did well at the Eureka Prizes with Prof. Andre Luiten and Dr Mohsen Rahmani also winning prizes. Mohsen then went on to win the AOS Geoff Opat Early Career Researcher Prize in September. AOS Councillor Fred Vanholsbeeck was awarded OSA Diversity & Inclusion Advocacy Recognition in August. Of course, I am also very pleased to announce the first winner of our photo competition - Stephane Coen. Please see page 11, and put in your entry for this regular competition.

The Council met in the last quarter, since the last report. We aim to have two proper meetings a year plus e-meetings. We have actually been holding an e-meeting through much of the year as there have been many operational matters to address, largely to do with finances and conferences. The recent real meeting addressed some of the more complex or contentious issues that are more suited to live debate than email discussion.

One of these was the rather confusing situation we now have with our domestic conferences with ANZCOP, ACOFT, ACOLS and AOS Conference. There are historical reasons for this set of conferences, but this does not seem to serve us well for the future. We will be putting forward a discussion document in the near future to explore the issues, and we expect to put this to the AGM in December.

We have also been progressing reciprocal arrangements with OSA, IEEE Photonics Society and the Taiwan Photonics Society, and would anticipate these being finalised soon. Additionally, we have been exploring options for some collaborative activities with SPIE.

The long proposed Australia / New Zealand survey of Optics and Photonics is making some progress and we hope in the next month or so to have a viable way forward to perform this.

We have been making greater use of the new website. In particular, emails to members are now being sent directly from this system rather than MailChimp which should ensure much more up-to-date email lists. The membership glitches in the transition are now, I believe, largely ironed out (let me know if you disagree). We have also made an initial exploration of forums for members - the functionality looks fine, so if anyone wishes to trial a members forum on a particular topic, let me know. We are planning a revamp of the AOS website soon to make key information more accessible, and modernise the appearance.

I encourage everyone to attend the AIP Congress in Perth in December, this includes our annual conference and will be the location for the AGM. In 2019 we hope to run ANZCOP collocated with the SPIE event in Melbourne (although this is yet to be confirmed). And of course in 2020 we have CLEO Pac Rim in Sydney.

Simon Fleming
AOS president

Editor's Intro

Welcome to another issue of AOS News. We have a number of articles ranging from a report on the International Day of Light inauguration ceremony in Paris to an item about the invention of polymer bank notes. There is also an article looking back at the first Australian laser conference that took place forty years ago and details about how the new NSW physics curriculum no longer contains details of women's contributions to the field. Our 'Optics in Everyday Life' section looks at the Zeno paradox in optics and Tony Klein has provided the answer to the quiz from the previous issue. We also have the first winner of our photo competition and details on how to enter for anyone who missed the email. 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 you will have noticed, I am interested in science communication and increasing science awareness with the general public. I read an article in The Conversation recently about how to increase support for science funding. It was with a US focus, but should be similarly applicable to Australia. The article states that most people agree that the government should support scientific research, and don't agree with cutting science funding but notes that less than half of people see the need for increased funding. The article focuses on factors that lead people to support government science funding, looking at whether an interest or understanding of science means that people support it. A study looking at people who became more interested or knowledgeable about science over time showed support for the idea that those who have higher interest in science are more likely to support increasing government science funding, but that those who became more knowledgeable about science weren't any more likely to support an increase. This suggests that whilst it is important to have science literacy within the general public and increase their knowledge about science it is even more important to foster interest and excitement.

As well as taking part in public science events and outreach activities or writing popular science articles, there are other ways to help foster interest in science. Citizen science has become more popular over recent years and allows the general public to take part in useful forms of research with specific outputs. Many examples use the internet and offer training to participants before getting them to view images and work out if they contain items of interest. Humans are very good at looking for specific patterns or identifying things in images and even with the advent of improved machine learning and AI in the future, people can still help train these algorithms. Not only is this useful in some fields where there are large amounts of data, but it also provides real-time access to scientific discoveries and gives good public engagement. During an ABC special show over three evenings last year focusing on stargazing, amateur astronomers helped to find new exoplanet systems and this year found two supernovae. The excitement and engagement of this project highlights what citizen science can achieve. There are also schemes that ask people to play games where they are actually helping to solve scientific problems such as folding proteins or mapping the brain or that allow users to donate spare computer processing time to researchers. This is alongside more traditional aspects of citizen science where people are asked to observe conditions or wildlife and report on these to allow a large amount of information covering diverse geographic areas to be collected.

Yet another way of getting people involved that is starting to become more common is crowdfunding. I read an article in Science magazine about a number of platforms that are available. There are researchers that ask for crowd funding on websites such as Kickstarter that are more used to hosting ideas for new products or offering support for humanitarian projects. If scientists are working on something that has public appeal this can be a way to raise small amounts of funding as well as build public support and awareness for the research. There are also new science-specific crowdfunding sites such as 'Experiment' and 'Crowd.Science' that offer a platform for those wanting to explore this avenue. It can be useful for seed funding of projects and has been used by students and postdocs who wouldn't normally get grants as a way to investigate their ideas as well as by more established researchers. As with all social media engagement this method requires time and effort in creating campaign information and promoting it, but some people find this less stressful than traditional grant writing and like the way that it builds community and public interest. Crowd.Sciene also allows researchers to get help from companies that want to support the project. 'Thinkable' is another program that matches researchers with foundations that want to support certain causes and offers the opportunity for organisations to host science competitions.

As you can see there are a number of different ways in which public interest and engagement can happen that can be beneficial to scientists as well as the general public. Hopefully you can consider some of these when you're next thinking about public engagement.

I hope you enjoy this issue of AOS News,

Jessica Kvansakul
Editor

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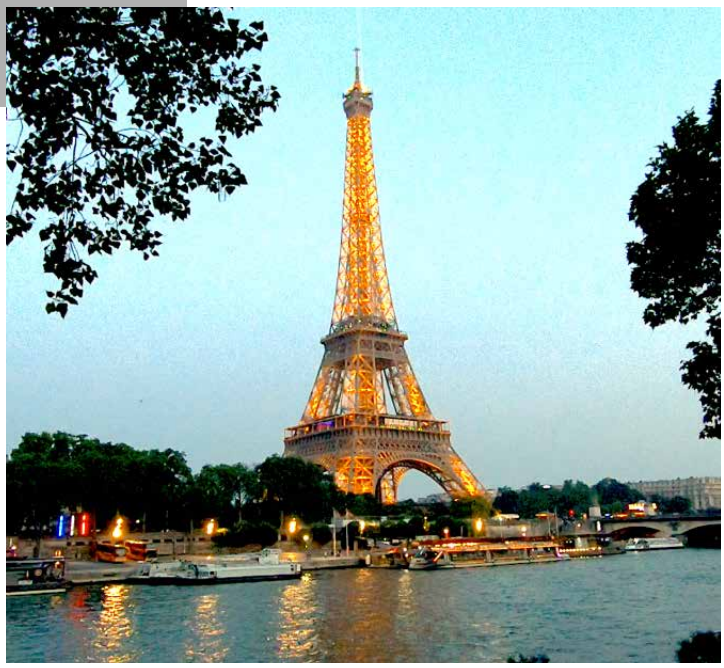
International Day of Light

What do Paris, a textbook heavy enough for practical experiments, the movie Interstellar and the International Day of Light Inauguration Ceremony have in common? Read on to find out ...

by Tim Davies



The International Day of Light Inauguration Ceremony was held in Paris on May 16th.

The International Day of Light Inauguration Ceremony was held at the UNESCO building in Paris on May 16th, no doubt after many events in Australia and New Zealand had already been put to bed.

But this was the inauguration ceremony and so was special anyway. It was an event that was not focussed solely on the science of light but to celebrate the diversity and humanity that light can bring.

As such it was full of interesting people such as Nuno Maya, the founding partner and creative director at OCUBO studio who specialise in creative displays using light, based on the super-bright digital projectors now used in cinemas. Or the wonderful Katerina Mina, the British soprano in a stunning sequin dress that reflected and dazzled as she sung an adaption by Linda Lamon of a classical guitar piece, with lyrics inspired by the late Stephen Hawking who spoke of looking into the cosmos for hope. Or Anna Bossman from Ghana who told us how technologies involving light were essential for energy, medicine, agriculture and sustainability in her country. Or even the crazy Finnish artist Kari Kola who creates extraordinary outdoor light art that involves lighting up whole mountains or vast tracts of Greenland to make people ask "Why?" Or perhaps even Gihan Kamel, the infrared beam line scientist from the newly opened SESAME synchrotron light source in Lebanon, who gave an impassioned speech about how the pursuit of collaborative science breaks down political and cultural divides in a region torn apart by war and suffering.

And that was what the International Day of Light was all about.

It wasn't about securing more funding for research or making us feel good about being scientists, but about how light in all its infinite complexity couples into humanity and all our infinite complexity to create a better world. Which, of course, is a major aim of the United Nations Educational, Scientific and Cultural Organisation, to build peace through international cooperation in Education, the Sciences and Culture.

The International Day of Light came about as a response to the International Year of Light to maintain focus on the importance of light in modern society. The 16th of May was chosen as it was the day laser emission was first seen in 1960 and, by a coincidence, was the day SESAME (Synchrotron-light for Experimental Science and Applications in the Middle East) first fired up. I was interested to learn that SESAME was promoted by UNESCO using the same model they used to promote CERN in the late 1950s, to create an international collaborative science hub to break down barriers between nations who had been at war. Or as the representative from SESAME put it so well, science and science diplomacy for peace. Although I did feel a little sad during the panel discussion on science policy when they spoke about how scientists can help their Ministers for Science do their job, seeing as Australia doesn't have one, or does the Minister for Tourism handle that one now?

The problems of Australia aside, it was a wonderful event, so enjoyable and I thank the Australian Optical Society for providing the opportunity to attend (i.e.

Nobel Laureates Kip Thorne and Claude Cohen-Tannoudji.

the entry ticket).

But there are two more things I need to say.

It was pointed out by the New Zealand delegation, and there were a lot of them because John Dudley, the Chair of the International Day of Light Steering Committee is a Kiwi, that New Zealand is the first country to see the rising sun on a new day (something to do with the international dateline) and therefore are always first to the see the light and are ahead of the rest of the world. We can argue that with them over a beer some other time.

And the final thing I need to mention was the wonderful talk by Professor Kip Thorne, Nobel Laureate, who spoke about how light was used to observe and measure gravitational radiation for the first time. (So by now you should have the answer to the quiz question, if you hadn't guessed already.) As my Ph. D. was on gravitational radiation and its interaction with matter I was particularly keen to speak to one of the heroes of my previous life (pictured above with Claude Cohen-Tannoudji - hmmm, clearly Nobel Laureates are not Fermions) and tell him how well his book interacted with gravity, a fact he seemed to know already. I guess that was the only thing that wasn't light at all …

Tim Davies is with the School of Physics, University of Melbourne.

News

Professor Halina Rubinsztein-Dunlop awarded Queen's Birthday Honours and Beattie Steel Medal

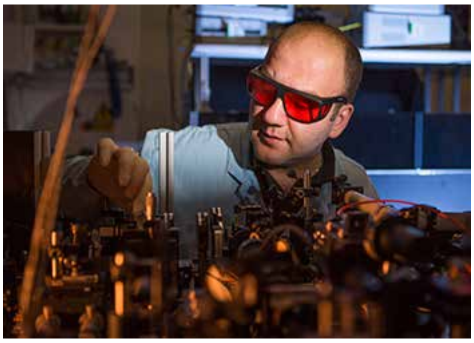
Congratulations to AOS member Halina Rubinsztein-Dunlop who has been made an Officer in the General Division (AO) of the Order of Australia. She was recognised for distinguished service to laser physics and nano-optics as a researcher, mentor and academic, the promotion of educational programs, and women in science. She is also the recipient of the 2018 AOS WH (Beattie) Steel Medal for her contributions to diverse fields of optics, including laser physics, linear and nonlinear high-resolution spectroscopy, laser micromanipulation, atom cooling and trapping and nano-optics. She is one of the originators of laser-enhanced ionisation spectroscopy and is a pioneer of laser micromanipulation and transfer of angular momentum of light and all optical drive micromechanics. Halina initiated the experimental programs in laser micromanipulation and atom optics at the University of Queensland. She has served the Australian and New Zealand optical community as President of the Australian Optical Society and as a member of the Council for many years, as well as serving on many conference committees. She has been a mentor and role model for many, as the first woman Professor of Physics in Australia.

Eureka Prizes for AOS members

Congratulations to AOS members Halina Rubinstein-Dunlop, Andre Luiten and Mohsen Rahmani who were part of teams awarded Eureka prizes recently. Prof. Halina Rubinstein-Dunlop was part of the University of Queensland team that won the 2018 UNSW Eureka Prize for Excellence in Interdisciplinary Scientific Research for "Optical Physics in Neuroscience". The Optical Physics in Neuroscience team looked at how the brain processes movement by using lasers to trick zebrafish into thinking they were moving even though they remained still so that imaging could take place. The team used optical trapping and novel microscopes to successfully image the functioning brain circuits of zebrafish that process gravity and motion.

The Sapphire Clock Team.

Prof. Andre Luiten was part of "The Sapphire Clock Team", from The Institute for Photonics and Advanced Sensing, University of Adelaide and Cryoclock Pty Ltd, that won the 2018 Defence Science and Technology Eureka Prize for Outstanding Science in Safeguarding Australia. Timing precision is critical in fields like radar technology, radio astronomy and quantum computing. The 'Sapphire Clock' produces extremely pure signals that are 10 to 1,000 times more accurate than any competing technology. Their research is improving timing precision to help Australian defence agencies identify threats to the nation.



Mohsen Rahmani also won the AOS Geoff Opat Early Career Researcher Prize.

Dr Mohsen Rahmani, from the Australian National University, won the 2018 Macquarie University Eureka Prize for Outstanding Early Career Researcher. Mohsen has developed a new class of nanoscale surfaces that have transformed the capabilities of today's miniaturised consumer devices. This technology has led to night-vision technology, adjustable lenses and ultra-sensitive biochemical detectors. Mohsen is also the recipient of the 2018 AOS Geoff Opat Early Career Researcher Prize.

For more details, including links to videos, see https://australianmuseum.net.au/2018-eureka-prizes-winners

AOS Councillor Dr Frédérique Vanholsbeeck awarded OSA Diversity & Inclusion Advocacy Recognition

Congratulations to Dr Frédérique Vanholsbeeck from the University of Auckland, who has been awarded OSA Diversity & Inclusion Advocacy Recognition based on her profound influence on the practices of her university and more generally in New Zealand science, and through her work on the AOS Council. She been a vocal promotor of gender parity in selecting invited conference speakers, based on her belief that this is central to giving these conferences, and scientific fields they represent, a positive image to junior female students. Thanks to her involvement and drive, ACOFT 2016 was seen as a shining example amongst the meetings of OSA's Photonics and Fiber Technology congress in Sydney. Amongst other things, as AOS Councillor she promoted a policy that AOS only sponsors events that have appropriate gender and diversity policies, and she has argued to ensure that each AOS prize has at least one female applicant.

AOS Photo Competition

Help us demonstrate the beauty of optics and photonics.

Please submit photographs that capture some aspects of optics and photonics, and are aesthetically pleasing. They can, for instance, be of your research, of optical phenomena, of optical devices.

We want your assistance in generating photographs that we can use to promote Australian and New Zealand optics and photonics in print and online. We will publish the best photograph on the front cover of AOS News, and whoever submits this will get a year's membership free.

To enter, you need to send to ausoptsoc@gmail.com:

1) The photograph (see required specifications below)
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4) A covering email, that states "I ____full_name____ took this photograph and own the copyright. I hereby provide a royalty-free, perpetual, non-exclusive license to the Australian Optical Society to reproduce this photograph in print, online or other format."

The photos will be judged by a panel including three AOS Councillors, the Editor of the AOS News and the AOS Webmaster.

The Small Print: The competition will continue on a quarterly basis with judging for each issue of AOS News. AOS reserves the right to carry forward good entries from one quarter to the next, and in any particular quarter to award multiple winners or to award no winner. The competition will initially run until end of 2019. AOS may extend this date or terminate earlier, advising by email, through AOS News, or other reasonable communication.

Photo Specifications JPG, PNG or TIF, at least 300 dpi, 3600x2400 pixels (otherwise ask first).

Queries to ausoptsoc@gmail.com

Our first winner is pictured here. Congratulations to Stephane Coen from the University of Auckland. The photo shows an ice-bow, also known as a 22-degree halo, around the sun. The rainbow-like ring is caused by high altitude ice crystals. The photograph is taken in the mountains above Tilcara in North West Argentina, at an altitude of 2800m, next to the Garganta del Diablo (The Devil's Throat) on 18 Jan 2018. As the location is very close to the tropic of Capricorn, and the date was not that long after the solstice, the sun is very near the vertical - the photo is taken straight up.

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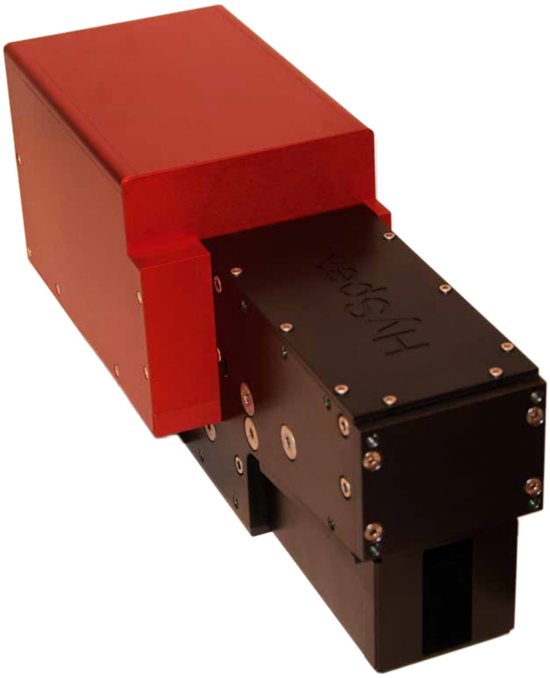

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The First Australian Laser Conference (March 1978): Reflections and Resonances

This year marks the fortieth anniversary of the First Australian National Laser Conference (FANLC).

by Brian J. Orr

How it all began …
2018 marks the fortieth anniversary of the First Australian National Laser Conference (FANLC), which was held in Canberra on 20–23 March 1978. Lasers were first reported in 1960 – the year that I commenced my B.Sc. studies at The University of Sydney – and laser technology and its applications had developed enormously, both internationally and locally, during the subsequent 18 years. Many early laser practitioners in Australia tended to adopt a "build-it-yourself" approach – owing to the limited availability of suitable commercial systems and (inevitably) funding constraints. This resulted in an admirable pioneering spirit within Australia's laser community, such that most scientists using lasers had gained considerable experience as laser engineers. We were just starting to see the more recent situation where a diverse range of highly sophisticated laser systems could be purchased from commercial suppliers for many of the applications of interest.

In 1978, the aforesaid "Australian laser community" was widely dispersed and not particularly well connected. Nevertheless, there were small pockets of collaborative activity in which expertise and resources were shared (for instance, my group's early work on pulsed CO_2 lasers was much assisted by contact with colleagues such as Ian Falconer and W.I.B. Smith (University of Sydney) and John Eberhardt and Arthur Pryor (AAEC, Lucas Heights). Many of us relied on various linkages with international colleagues and through local conference series (such as the Australian Spectroscopy Conferences and Australian Institute of Physics Congresses) where laser applications were becoming increasingly prominent. That is how it was in the mid-1970s when a Conference Organising Committee was assembled to lay plans for the FANLC.

The President of the Conference was the illustrious Professor Sir Ernest Titterton, CMG, FAA who in 1950 had accepted an invitation from (the even more illustrious) Professor Sir Mark Oliphant to become Foundation Professor of Nuclear Physics in the newly established Research School of Physical Sciences at The Australian National University (ANU) in Canberra. Titterton had performed significant developmental work at Los Alamos within the Manhattan Project (on the ignition system for the "Fat Man" atomic bomb that was exploded at Nagasaki). After returning to the UK in 1947, he engaged in nuclear physics research at AERE in Harwell and consulted on development of British nuclear weapons at AWRE in Aldermaston. He later witnessed many of the British nuclear tests in the 1950s at Maralinga in South Australia and faced fiery hearings of the McClelland Royal Commission in 1984 and 1985. Both Titterton and Oliphant had given ANU a notable role in "big" (i.e., high-energy) physics. This led in turn to an interest in laser physics (perhaps as a possible application for energy sources such as ANU's immense 500-MJ homopolar generator) at a time when laser-based nuclear fusion and isotope separation were hot topics.

By the time that the FANLC was being planned, Sir Ernest had relinquished his controlling roles as Dean and Director of the Research School and was evidently keen to pursue new ventures and to promote the fortunes of laser physics at ANU and elsewhere in Australia. He was capably supported by his ANU colleagues Drs Len Hughes and Frank Irons as Conference Secretary and Treasurer, respectively. Listed on the FANLC Conference Digest is an

assortment of "Advisers" – some of them no longer with us but a few still active in local optical physics circles: Mr J. Dunne, Dr N. Frankel, Mr W.N. Garwoli, Dr G. Gillman, Dr S. Hamberger, Prof. S. Haydon, Dr F.E. Irons, Dr B. Luther-Davies, Mr L.E.S. Mathias, Dr P. Morgan, Dr B. Orr, Dr C. Pask, Dr L. Shanahan, and Dr G. Troup.

… and how the FANLC came to pass
The Conference Digest for the FANLC (of which the cover artwork is shown above) comprised 16 pages – probably typed on a classic IBM "golf-ball" machine. It outlines a lively programme of more than 80 oral papers extending from the morning of Monday 20 March to midday on Thursday 23 March. Most of the talks were presented in the Australian Academy of Science's "Shine Dome", with parallel sessions on Tuesday afternoon, all day Wednesday and Thursday morning in ANU's nearby Institute of Anatomy (now occupied by the National Film and Sound Archive). The opening address on Monday was given by Sir Ernest – some recall it as being "highly political." The major invited speaker was Dr John Emmett (Director of the Laser Fusion Project at Lawrence

Livermore National Laboratory, USA); he gave two scientific talks on Monday and a public lecture entitled “Progress in Laser Fusion” on the Wednesday evening. Other keynote talks on the Monday were given by Prof. Syd Haydon (University of New England, Armidale), Dr Barry Luther-Davies (ANU), L.E.S. Mathias (DSTO Materials Research Laboratories, Maribyrnong), Dr Yu V. Senatskiĭ (Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow), Prof. Heinrich Hora (University of NSW), and Dr Arthur Pryor (Australian Atomic Energy Commission, Lucas Heights). Setting the tone of the conference, these talks surveyed high-power excimer lasers, neodymium lasers, carbon dioxide lasers, laser fusion, and the feasibility of laser enrichment of uranium. Other advertised FANLC activities included the Conference Dinner (with Guest Speaker scheduled to be Sir Mark Oliphant, who at the time was Governor of South Australia) on the Tuesday evening and, on the Thursday afternoon, the choice of a visit to the Orroral Valley Laser Tracking Complex or a tour of the ANU Laser Laboratories.

The various scientific papers in the body of the Conference covered a diverse range of laser technology and scientific applications, most of it performed within Australia. It is notable that the concluding paper in the final session on “Lasers in Biology and Medicine” was about “lasers used in retinal photo-coagulation and iridotomy” and was presented by the inimitable Alex Stanco (Quentron Optics, Adelaide). A review of the FANLC was subsequently published by Yu V. Senatskiĭ and J.L. Hughes [Sov. J. Quantum Electron., 9(2), 257–261 (1979)]. This highly informative article mentions that Titterton’s introduction included “greetings from the Director of the USSR Academy of Sciences, Academician N.G. Basov” and concludes, as a fair comment, with the following paragraph:

“The First Australian National Laser Conference can be summarized by noting that it revealed for the first time the breadth of laser research carried on at the Australian scientific-research and industrial centers. The Conference demonstrated also the high professional level of Australian investigators working on lasers and their applications. At the final session of the Conference, it was resolved to convene the next National Laser Conference in 1980.”

The Australian National Laser Conferences did indeed continue as a series, with subsequent stand-alone meetings in Canberra (September 1981) and Melbourne (August/September 1982). The Fourth Australian Laser Conference, chaired by Prof. Jim Piper at Macquarie University in Sydney on 28–30 August 1985, was merged with the Third Conference of the relatively new Australian Optical Society. Some of us remember the opening address by PM Bob Hawke's Minister for Science, Barry Jones, during which he persistently scribbled on the next page of his lecture notes while continuing to deliver his speech – an amazing intellect, reflecting his earlier rise to fame in 1960–67 as a TV quiz champion on Bob Dyer's "Pick a Box" show! Barry opened his talk with characteristic provocation: “Did you know that an Australian invented the laser?” – noting that Alexander Prokhorov had been born in 1916 in North Queensland and lived there with his family until they returned in 1923 to Russia, where he performed the research on masers/lasers for which he would share the 1964 Nobel Prize with C.H. Townes and N.G. Basov.

That 1985 meeting attracted an impressive group of eminent international invitees (e.g., M. Bass, J.G. Eden, T.W. Hänsch, J. Reid, C.V. Shank, H. Walther, …) as well as more than 120 presentations from local scientists. This amply fulfilled the earlier promise of the 1978 FANLC and served as a precursor of subsequent conferences (e.g., ACOLS 1987–2009, IQEC 1996, ACOFT 1999–2009, IQEC/CLEO Pacific Rim 2011, and ANZCOP 2013–…) with which AOS is intimately connected. For a tabular summary of all such conferences (with links to their Digest in many cases) visit: http://optics.org.au/AOS-Conference.

Reflections and resonances

It is a pleasure to acknowledge that this article was suggested by our ever-active AOS colleague Stephen Collins who, in March 2018, circulated an e-mail encouraging reminiscences from some of the 1978 FANLC delegates. A few of their responses are collected below.

Peter Hannaford (then at CSIRO Division of Chemical Physics, now at Swinburne University of Technology in Melbourne) recalls that FANLC was “an interesting conference” although its scientific programme seemed to have been assembled at fairly short notice. He describes John Emmett’s opening talk as “absolutely superb and one I shall always remember.” He also remembers well the talk of Heinrich Hora on “nonlinear processes in laser fusion” and “many talks on applications of lasers to medicine … a very important new application of lasers at the time.” Peter reminds us that continuously tunable dye lasers that worked reliably only became readily available in the second half of the 1970s, so that the FANLC sessions on “Lasers in Chemistry” were especially topical. During that period, both Peter and I acquired commercial systems in which a pulsed N_2 laser pumped a Hänsch-style dye oscillator (apart from HeNe lasers, this was the first laser system that I and my co-workers had not had to build ourselves). Such continuously tunable dye lasers made a big difference to our laser-spectroscopic capabilities prior to the later eras of Nd:YAG-pumped dye lasers, OPOs, Ti:sapphire lasers, various forms of diode laser, and ultrafast-laser approaches.

David Booth (then at Footscray Institute of Technology, which became Victoria University, and later at Swinburne University of Technology in Melbourne) comments that “the field was far from new at the time” and recalls his involvement with lasers at the Department of Supply (now DSTO) since 1966, with “two laser groups one at DSL Maribyrnong and one at WRE in Salisbury in SA.” He notes that, at the

FANLC in 1978, "the Universities were prominent but in a whole range of smaller groups or individuals as they did not have access to the large funds that Government labs did" and that the latter "could only present a limited range of their work and this would have severely restricted much of the most ground-breaking stuff." For those interested in the very early days of laser research in Australia during the 1960s, a useful review has been provided by Stuart Jackson (Macquarie University) in Australian Physics, 52(4), 117–120 (2015).

Norman Heckenberg (University of Queensland, Brisbane) recalls that "stories of giant lasers and giant budgets were somewhat inspirational and I was able to talk to several other people interested in CO_2 and far infrared lasers at that time." He supposes that "Sir Ernest was involved because the latest Big Thing was laser isotope separation, or perhaps because laser fusion research generated useful data for hydrogen bomb design." Norm also recalls that his drive down from Brisbane with his first PhD student and two Honours students "had its moments like a visit to the Parkes radiotelescope and a prang on the way back."

Labouring the above laser-related play on words, these reminiscences (multiple reflections?) show us with hindsight that the FANLC in 1978 helped to encourage many resonances (personal/scientific, rather than optical!) that have enriched Australian optical science over later years, many of them surviving to this day.

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Conferences

4-8 December, IONS KOALA 2018

The International OSA Network of Students Conference on Optics, Atoms and Laser Applications, IONS KOALA 2018 will be held in Sydney at Macquarie University from Tuesday 4 to Saturday 8 December. The conference is a student-run conference for undergraduate and postgraduate physics students from all around the world. IONS KOALA 2018 is being co-hosted by the OSA student chapters at Macquarie University and the University of Sydney. www.ionskoala.osahost.org

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. www.aip2018.org.au

Year 11 and 12 Students in NSW Will No Longer Learn About Women's Contributions to Physics

by Kathryn Ross and Tom Gordon

This article was originally published on THE CONVERSATION

The new Higher School Certificate (HSC) physics syllabus for NSW will contain no mention of the contributions of female physicists to the field. Not teaching students about their contributions to the field denies young women role models, and denies all students important knowledge about physics.

An education system which simultaneously claims to praise women in STEM, yet erases them from a physics syllabus cannot be seen as thorough. This needs to be fixed before long lasting damage is done to Australia's next generation of scientists.

Physics has a multitude of female physicists to celebrate. These outstanding women could inspire passion in young female students, while providing all students with a broader perspective of the universe we all call home.

Complete deletion, really?

In 2018, NSW introduced a new HSC physics syllabus, which focuses on complex topics such as thermodynamics and quantum physics, and requires a more technical understanding of physics concepts. It focuses on the physics itself and its modern usage, rather than how we discovered and developed physics in the first place.

The outgoing syllabus includes more background and the history of the development of physics. The discoveries women have contributed to the field are taught in this syllabus, but it fails to identify a single woman by name in the 47 scientists mentioned 93 times. The new syllabus has 25 scientists mentioned 56 times. But no women are referred to by name, nor are any contributions women have made to physics included.

This new syllabus focuses completely on male physicists and their work. Women have been and continue to be told physics is primarily a male endeavour.

You can't be what you can't see

Science is filled with interesting characters, insights and discoveries. Teaching about a scientist or their work celebrates their contributions, highlights their efforts and recognises how they influenced and developed knowledge.

The new syllabus fails to provide female role models. Role models are important because they foster pro-science aspirations and attitudes. This is true for both women and men, but young girls miss out if we only provide students with male role models.

This syllabus conveys the message that female physicists aren't significant enough to mention. This is not only incorrect, but discouraging to female students. When we focus entirely on male scientists, we devalue women and their work in this field.

Remarkable female scientists

There are many examples of outstanding women that could have been included in the syllabus. Each have made major contributions to their field. Students would benefit greatly from learning about these women (plus many others) and their work in physics lessons. Here are four examples of bad-arse female physicists:

Ruby Payne-Scott

Australia's own Ruby Payne-Scott was one of the first radio astronomers in the world. Payne-Scott was at the forefront of radio astronomy in the 1940s. She developed techniques that have defined the field and her work made Australia the global leader it is today. Payne-Scott even

Ruby Payne-Scott was an Australian radio astronomer. Image credit Peter Hall, CC BY-SA.

discovered three types of radiation bursts coming from the sun.

Professor Marie Curie

Marie Curie is one of the most well-known female physicists.

Dual Nobel laureate, Professor Marie Curie started the field of radioactivity.

Her work included the discovery of two new radioactive elements, which was only possible because of her impeccable experimental skills. Her research of radioactivity is still influencing physics. Her notebooks are still radioactive and will likely be for the next 1,500 years.

Dr Rosalind Franklin

Rosalind Franklin used X-ray diffraction to image DNA. Image credit Jenifer Glynn.

Dr Rosalind Franklin's unique approach to X-Ray crystallography was the first successful research delving into the structure of our cells. This helped us understand the double helix structure of DNA. Her work was revolutionary but has been attributed to Watson and Crick, who won the Nobel Prize for the discovery.

Dame Professor Jocelyn Bell Burnell

Jocelyn Bell Burnell is best known for her discovery of pulsars. Image credit (1967) Roger W Haworth - Flickr, CC BY-SA.

Dame Professor Jocelyn Bell Burnell discovered an entirely new type of star called pulsars on a radio telescope she essentially made herself while she was a PhD student. These rapidly rotating neutron stars changed what astronomers thought possible and is still an active area of research. Bell-Burnell originally called them LGM for Little Green Men as she did not want to rule out the fact the source could have come from alien life forms.

Teaching our students women have had and continue to have no role in physics is not only incorrect, it's harmful. We need equal representation to normalise women in physics and encourage their engagement and further study. A syllabus that correctly represents people in the field of physics can help reduce unconscious bias and demonstrate to young women there's a place for them in this field.

Kathryn Ross and Tom Gordon are with the Sydney University Physics Education Research Group, University of Sydney.

The original article can be found at: https://theconversation.com/year-11-and-12-students-in-nsw-will-no-longer-learn-about-womens-contributions-to-physics-102988

23RD AUSTRALIAN INSTITUTE OF PHYSICS CONGRESS

Joint with

Australian Optical Society (AOS) Conference; 43rd Australian Conference on Optical Fibre Technology (ACOFT); 2018 Conference on Optoelectronic and Microelectronic Materials and Devices (COMMAD 2018)

9-13 December 2018 Perth, Western Australia **aip2018.org.au**

Invitation to a magnificent week of world-class science

The Australian Institute of Physics and the Australian Optical Society, with the support of the Australian National Fabrication Facility (ANFF) and the Australian Nanotechnology Network (ANN), warmly welcome you to the 23rd AIP Congress and the Australian Optical Society Conference that will be held jointly with the 43rd Australian Conference on Optical Fibre Technology (ACOFT) and with the 2018 Conference on Optoelectronic and Microelectronic Materials and Devices (COMMAD). Seamlessly integrated to form one of Australia's foremost science forums, the meeting will take place in beautiful Perth on the leafy campus of the University of Western Australia, during 9-13 December 2018.

To Australia's industries, we welcome your presence at the congress and look forward to your suggestions as to how to make the Congress most relevant to you! To Australia's science teachers, we want to include you as part of the Congress and look forward to your involvement. To all university academics, government and industry scientists, to all science students and to our international colleagues, please help us make this a big success by submitting your best work to this conference.The conference strongly supports the principles of equity and diversity and encourages contributions from all. The Congress organisers will strive to achieve gender balance and are committed to equal representation of male and female speakers in plenary and invited talks.

On behalf of the Australian physics, science and technology community, welcome to Perth!

Product News

Daylight Solutions: Spero QT

Spero QT is the next breakthrough in label-free chemical imaging. Spero QT builds on the original Spero platform, delivering high-resolution, wide-field imaging driven by Daylight Solutions' quantum cascade laser technology, but what's new?

The ability to produce twice as much data in a tenth of the time with unprecedented signal-to-noise ratio.

The Spero QT has been designed specifically for mid-IR spectral imaging of biological and material samples by utilising Daylight Solutions' proven expertise in mid-IR QCLs, offering spectral coverage across the entire "fingerprint region". It is now possible to perform rapid acquisition of hyperspectral data cubes in both transmission and reflection modes and our large format focal plan array (FPA) does not require any liquid nitrogen to operate, which is typical of traditional IR imaging systems. Spero QT now also comes in a more compact footprint and with increased stage travel to accommodate up to three slides.

Features & Benefits

- Real-time, high-throughput spectral imaging enabled by ultra-high brightness QCL technology
- No stains or molecular tags required for bio imaging
- Label-free IR spectroscopy displays pure chemistry of samples
- No cryogenic cooling needed
- Quick setup means more time for analysis

Applications

- Materials testing and analysis
- Real-time reaction monitoring
- Biomedical imaging of tissues, cells, and fluids

- Cancer research
- Pharmaceutical testing of tablets, powders, and liquids
- Protein secondary structure and aggregation testing
- Forensics
- Chemical detection and identification

Large Area CCDs for Astronomy

Andor's 4 MPixel iKon-L camera is well established in many astronomy projects, including SuperWasp and the Next Generation Transit Survey exoplanet programs. Andor has now released iKon-XL, offering a very large 61.4 x 61.6mm format from a 4096 x 4108 array with 15µm pixel size.

The new camera uses Andor's ColdSpace technology to provide cooling of the very large sensor to -100°C without requiring liquid nitrogen or unreliable cryo-coolers. Well depth is 350,000 electrons and read-noise only 2.1 electrons, thus allowing a very large dynamic range, supported by 18-bit digitisation.

Applications include deep space observation, wide-field spectroscopic detection, exoplanet detection and radial velocimetry.

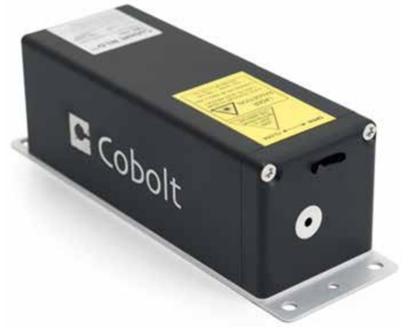
For further information please contact Coherent Scientific at sales@coherent.com.au or 08 8150 5200

New laser wavelengths for Raman

Cobolt AB, a part of HÜBNER Photonics, introduces new wavelengths on the 08-01 Series of 457 nm, 473 nm, 515 nm, 660 nm and 1064 nm, complementing already available wavelengths of 405 nm, 532 nm, 561 nm and 785 nm. The 08-01 series of single frequency and narrow linewidth lasers are ideal for Raman spectroscopy applications.

The 08-01 Series consists of high performance, ultra-compact, single longitudinal mode (SLM) diode pumped lasers (08-DPL) up to 400 mW and narrow linewidth diode lasers (08-NLD) up to 500 mW, all having exceptional wavelength stability and spectral purity. With totally integrated electronics, an integrated optional optical isolator and clean up filter, the lasers from the 08-01 Series are easily integrated into high end Raman based systems or other analytical instrumentation.

All Cobolt lasers are manufactured using proprietary HTCure™ technology and the resulting compact hermetically sealed package provides a very high level of immunity to varying environmental conditions along with exceptional reliability. With demonstrated lifetime capability of >60 000 hours and several thousand units installed in the field, Cobolt lasers have proven to deliver unmatched reliability and performance both in laboratory and industrial environments, and are offered with market leading warranty terms.



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

Single frequency, ultra-low noise 532nm DPSS laser

Lighthouse Photonics announce the release of the Sprout Solo, a single frequency, ultra-low noise, high power CW 532nm diode pumped solid-state (DPSS) laser with up to 10W output power. The Sprout Solo produces near-perfect spatial beam quality with extremely high power stability and is specifically designed for applications that require high quality performance.

The laser head is a monolithic 3-dimensional design for ruggedness and compactness to minimize the space consumed in your lab or instrument. The fiber-coupled pump diode package contained in the power supply has a typical mean time to failure of more than 50,000 hours.

Key applications include:

- Holography
- Interferometry
- Raman spectroscopy
- Atom trapping, optical lattices
- Pumping Ti:S and dye lasers.

TC15 LAB Series temperature control

Wavelength Electronics has released the TC15 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 TC15 (15A, 20V) is an ultra-stable digital controller for thermoelectric and resistive heaters where tight temperature stability is required. Designed using the latest technology, stability better than 0.0009ºC 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 15A.
- Temperature stability better than 0.0009ºC.
- 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.

EnSpectr R1064 express IR Raman Analyser

Enhanced Spectrometry, a manufacturer of portable Raman and luminescent spectrometry solutions for real-time testing and for quality control, announce the release of the EnSpectr R1064 IR Raman Analyser.

The EnSpectr R1064 is a unique instrument that enables the user to obtain Raman spectra in applications where the Raman signal is typically dominated by fluorescence. With the EnSpectr R1064, you can easily analyse oils, dyes, paints, organic substances, etc. due to its record wide spectral range. It is the only portable 1064nm device which can see the water Raman line. This makes it a comprehensive tool for analysis of liquids through transparent and semi-transparent packaging.

The EnSpectr R1064 has the following key features:

- Wavelength: 1064nm
- Laser power: 300mW
- Spectral range: 200-3600cm^{-1}
- Spectral resolution: 15-21cm^{-1}
- Dimensions: 222x145x55mm

P-616 NanoCube multi-axis alignment system

Physik Instumente, a global leader in the design and manufacture of high precision motion control systems has launched the P-616.3C parallel-kinematic multi-axis alignment system.

The NanoCube's parallel-kinematic design offers the highest stiffness in all spatial directions as well as high dynamic motion and resonant frequencies with friction free motion and is highly suited to applications that require fast, precision positioning. The P-616.3C has the following key features:

- Travel range: 100x100x100µm
- Resolution: 0.4nm
- Resonant frequency: 700Hz
- Highly compact form factor
- Dimensions: 40x40x40mm

Applications include:

- Fibre alignment
- Microscopy applications
- Two-photon polymerisation
- Nanotechnology and nanomanufacturing

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

Cobalt Skyra: Multi-line laser platform with up to four lasers

Cobolt AB, Swedish manufacturer of high performance lasers, introduces a revolutionary multi-line laser platform, Skyra™. The Skyra™ can integrate up to four laser lines into a single laser unit.

Unlike laser combiners the Skyra™ is a highly compact (70 x 134 x 38mm), fully integrated multi-line laser that requires no external electronics. The range of laser lines that can be incorporated into the laser are; 405, 445, 473, 488, 515, 532, 553, 561, 633, 638, 647 and 660nm. The individual laser lines can be directly intensity modulated with output powers of up to 100mW each. The Skyra™ is perfectly suited for easy-to-use analytical instruments and application in the life sciences, such as microscopy and flow cytometry.

All Cobolt lasers are manufactured using proprietary HTCure™ technology and the resulting compact hermetically sealed package provides a very high level of immunity to varying environmental conditions along with exceptional reliability. Lasers built using the HTCure™ technology have been shown to withstand multiple 60G mechanical shocks in operation without any sign of degraded performance. With thousands of installed units in the field, HTCure™ has proven to be one of the most reliable methods for making industrial grade lasers.

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

TeraSpeed, Superfast Terahertz Screening Platform from Toptica

- Extremely fast measurements of terahertz pulse intensities (patent pending)
- Photoconductive terahertz emitter + high-bandwidth Schottky receiver
- Digital output: Data rates up to 500 kS/s, "snapshot" and "continuous" measurement modes
- Analog output: Detection of individual terahertz pulses @ 100 MHz repetition rate
- Robust setup without any delay stages or mechanically sensitive components

The TeraSpeed serves applications in quality control and process monitoring that require no spectral information, but call for terahertz intensity measurements at "extreme" speeds: the system is capable of detecting individual terahertz pulses at repetition rates as high as 100 MHz. An integrated data-processing unit converts the detected pulses to RMS values, enabling data streams at sampling rates up to 500 kHz – orders of magnitude faster than conventional terahertz systems. Bringing together several cutting-edge technologies, the TeraSpeed takes advantage of mature fibre laser technology, powerful photoconductive emitters and fast yet sensitive Schottky receivers.

New Finder Insight Portable Raman Spectrometers from Zolix!

The new Finder Insight, multifunction Portable Raman Spectrometers, based on new designs, attaining superior user friendliness and sensitivity, can meet the requirements of on-site rapid diversification detection.

Advantages:

- Fast response - Can be carried on the inspection cars for constants, trace analysis of criminal investigation, security, emergency disposal.
- Microscope functionality - The most cost-effective and flexible microspectrometer solution, it can meet the demand of users microscopic analysis.
- Adaptable - Built-in rechargeable lithium battery for easy portability, can work more than four hours continuously, it provides research grade Raman capabilities wherever needed.
- High sensitivity - With the application of deep cooling detector, the system offers greatly improved sensitivity.
- Versatile sample chamber: Special light tight sample chamber allows measurement of a wide range of samples of different shapes and sizes.

For more information please contact Lastek at sales@lastek.com.au or 08 8443 8668

Ocean Optics Ocean HDX, the New Spectrometer for High Quality Results

The new Ocean HDX spectrometer uses specialised materials and precision engineering to maximise optical resolution, increase throughput, reduce stray light and maintain thermal stability.

Key Features:

- Low stray light performance improves dynamic range and absorbance linearity for determining the concentration of analytes in solutions
- High throughput and a back-thinned CCD detector deliver high sensitivity performance for low light applications including fluorescence
- Optical resolution of <1.0 nm (FWHM) and extraordinary peak symmetry deliver superior performance for applications such as absolute color accuracy

For more information please contact Lastek at sales@lastek.com.au or 08 8443 8668

SPI redENERGY® Pulsed Fiber Lasers

Laser Series Explained (RM, HS & EP):

RM Series (Reduced Mode)

- Entry level products with limited pulse options
- Basic software and hardware interfaces
- Models can benefit from 2 PulseTune waveforms and have limited pulse repetition frequency of up to 500 kHz

HS Series (High Spec)

- Benefits from PulseTune technology
- Pulse width variable (25 pre-set waveforms)
- Enhanced control and modulated CW functionality
- Up to 1 MHz pulse repetition frequency.

EP Series (Extended Performance)

- Up to 40 optimised PulseTune waveforms
- Most versatile Fiber Laser source
- Enhanced control and modulated CW functionality
- Increased pulse energy and peak power performance
- Pulse width range of 3-2000 ns.
- Up to 4 MHz pulse repetition frequency

Beam Quality Options:

S Type – Single mode M^2 <1.3
Generating very fine spot size <20 microns with high power stability and large depth of focus. Ideally suited to applications requiring small feature sizes.

Z Type – M^2 <1.6
Offering higher peak power and pulse energy with only minor increase in spot size with good depth of focus.

L Type – Low Mode M^2 1.6 – 2.0
General marking applications giving slightly larger spots and features that are more appropriate to making marks visible to the naked eye.

H Type – High mode M^2 2.5 – 3.5
Offering high pulse energies, and peak powers and even larger spots ideal for wide lines, filled font type applications and large area coverage.

M Type – Multimode (M^2 4.0 – 6.0) *Coming soon
Highest pulse energies and longer pulse durations ideal for welding and cleaning.

Feature Combinations

At a glance	PulseTune Functionality		
Beam Quality	RM	HS	EP
S Type		20W, 50W	20W, 50W
Z Type	20W, 30W, 50W, 70W		20W, 50W, 70W, 100W, 130W, 200W
L Type		20W	
H Type		40W, 70W	
M Type			130W, 200W

HySpex VNIR-1800 Hyperspectral camera

All HySpex cameras are pushbroom hyperspectral imagers. When acquiring data, the camera captures **all spectral information simultaneously** from a narrow line of the spatial scene. As the camera is scanned across the scene, or the scene in front of the camera, the spatial scene is captured and added to the hyperspectral cube.

The output data product thus contains both a spatial scene together with the contiguous spectral information from each pixel in the spatial scene. The camera can easily be equipped with custom close-up lenses, allowing the end user to utilize the same camera for applications where high spatial resolution is required (spatial resolution as high as 24µm is obtainable using the microscope lens for VNIR), as well as applications with a long working distance (airborne and field measurements).

HySpex VNIR-1800

- Spectral range 400-1000nm
- 1800 spatial pixels
- 186 channels
- >255 peak SNR
- 260 fps max speed

HySpex SWIR-384

- Spectral range 930-2500nm
- 384 spatial pixels
- 288 channels
- >1100 peak SNR
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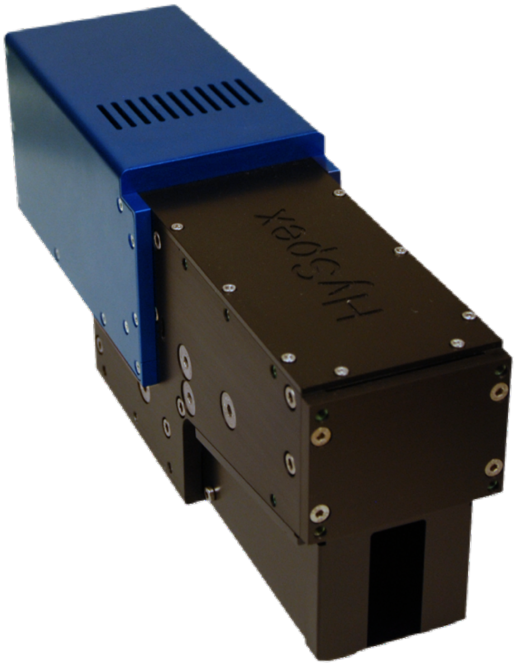

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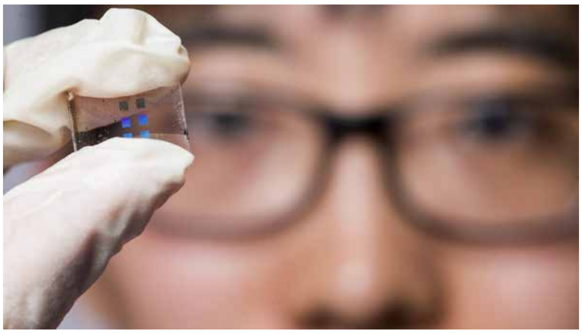
Australasian Research in the News

Tiny camera lens may help link quantum computers to network

An international team of researchers led by the Australian National University has invented a tiny camera lens, which may lead to a device that links quantum computers to an optical fibre network. Quantum computers promise a new era in ultra-secure networks, artificial intelligence and therapeutic drugs, and will be able to solve certain problems much faster than today's computers. The unconventional lens, which is 100 times thinner than a human hair, could enable a fast and reliable transfer of quantum information from the new-age computers to a network, once these technologies are fully realised.



Kai Wang holding a sample with multiple metasurface camera lenses. Image credit Lannon Harley, ANU.

The device is made of a silicon film with millions of nano-structures forming a metasurface, which can control light with functionalities outperforming traditional systems. Associate Professor Andrey Sukhorukov said the metasurface camera lens was highly transparent, thereby enabling efficient transmission and detection of information encoded in quantum light. "It is the first of its kind to image several quantum particles of light at once, enabling the observation of their spooky behaviour with ultra-sensitive cameras," said Associate Professor Sukhorukov, who led the research with a team of scientists at the Nonlinear Physics Centre of the ANU Research School of Physics and Engineering.

Kai Wang, a PhD scholar at the Nonlinear Physics Centre who worked on all aspects of the project, said one challenge was making portable quantum technologies. "Our device offers a compact, integrated and stable solution for manipulating quantum light. It is fabricated with a similar kind of manufacturing technique used by Intel and NVIDIA for computer chips," he said. The research was conducted at the Nonlinear Physics Centre laboratories, where staff and postgraduate scholars developed and trialled the metasurface camera lens in collaboration with researchers at the Oak Ridge National Laboratory in the United States and the National Central University in Taiwan.

Source material: http://www.anu.edu.au/news/all-news/tiny-camera-lens-may-help-link-quantum-computers-to-network

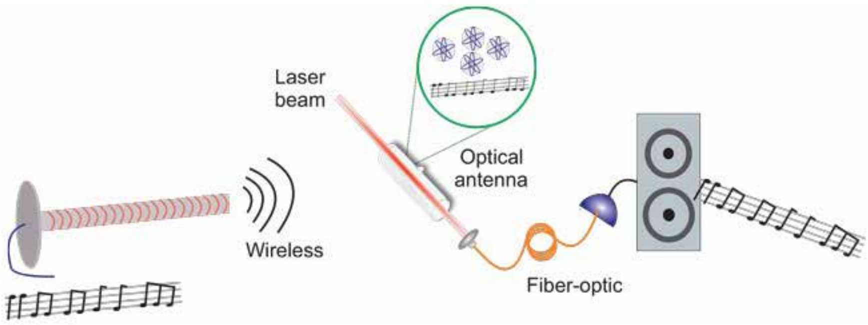
Original article: K Wang, JG Titchener, SS Kruk, L Xu, HP Chung, M Parry, II Kravchenko, YH Chen, AS Solntsev, YS Kivshar, DN Neshev, AA Sukhorukov, *Quantum metasurface for multiphoton interference and state reconstruction.* Science, **361**, 6407, 1104-8 (2018); https://doi.org/10.1126/science.aat8196

Otago researchers develop ground-breaking communication technology

In the ongoing quest for better, faster and higher-quality wireless communication, University of Otago researchers are leading the way. Dr Amita Deb and Associate Professor Niels Kjærgaard, of the Department of Physics, have created world-leading technology in the form of an optical antenna. Their development, published in Applied Physics Letters, simplifies how we currently communicate wirelessly.

Dr Deb says the widespread use of smart phones and appliances have "fuelled an unprecedented demand for high bandwidth wireless networks". The emerging 5G network will feature greater bandwidth, but its signal is prone to significant weakening and interference. The optical antenna the Otago researchers have developed enables the transmission of high frequency signals, with the advantage of being non-metallic, and with no electrical connection required, mitigating the issue of interference.

"You can communicate information without electrical interference. Because this is optical – just laser light, no metal, no electronic connections – it is cleaner and clearer. Optical fibre cables can also transmit light hundreds of kilometres with very little loss," Dr Deb says. The technology interfaces wireless data with fibre optic data. It encodes a radio frequency signal within a laser beam – via an antenna in the mere form of a glass bulb filled with atomic particles – which can be transported via fibre-optic channels. This would be like a radio station playing a song which is picked up by a laser beam, through a glass bulb, into an optical fibre. At the end of the fibre, light is detected and the song comes out of a speaker. The work was funded by grants from the Marsden Fund and Otago Innovation Limited, with the next step being to increase the speed of the technology and reduce its size.



The new technology interfaces wireless data with fibre optic data.

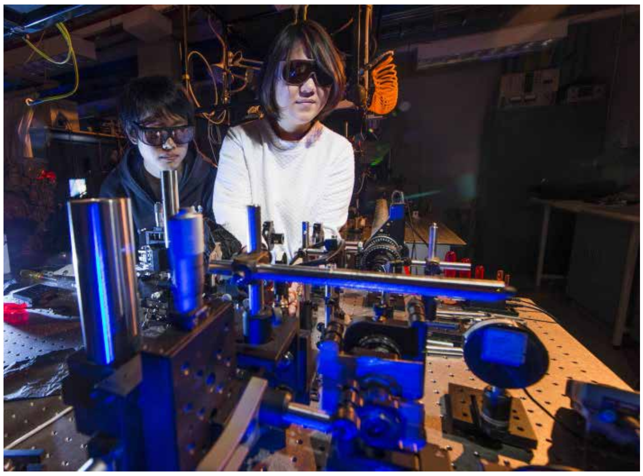
"The delivery of wireless data via optical fibre is a highly sought after technology in emerging high-speed technology applications and people in the industry have been really excited about this development," Associate Professor Kjærgaard says. He believes the optical antenna has military applications because it can't be wiped out via an electro-magnetic pulse, as well as in avionics. Miniaturised versions could also be used in biomedical settings such as electrophysiology, which measures the electrical activity of cells and tissues including the heart and brain.

Source material: https://www.otago.ac.nz/physics/news/otago687486.html

Original article: AB Deb and N Kjærgaard, Radio-over-fiber using an optical antenna based on Rydberg states of atoms, Appl. Phys. Lett. **112**, 211106 (2018); https://doi.org/10.1063/1.5031033.

ANU invention could help turbo-charge internet speeds

Australian scientists have invented a new ultra-thin device that can turn invisible light into the visible and change the colour of light, with the potential to be used to help turbo-charge internet speeds around the world. A change in light's colour alters its frequency, which is a vital process in optical technologies including next-generation telecommunications. The new device could be developed in partnership with prospective industry partners to enhance the capacity and speed of telecommunication channels that are essential for delivering high-speed internet.



Shan Liu (left) and Yan Sheng test nanocrystals in the lab. Image credit ANU.

Professor Wieslaw Krolikowski, one of the lead researchers from ANU, said the device, which is a new type of nonlinear photonic crystal that is as thin as a human hair, was a major advance in the field. "Our device can produce different types of light and in different colours, simply by changing the angle that we shine a laser beam into the device, and it is reusable for different purposes," said Professor Krolikowski from the Laser Physics Centre within the ANU Research School of Physics and Engineering. "This is the first time these feats have been achieved by scientists. Scientists had previously been restricted to one- or two-dimensional structures in nonlinear photonic crystals, which had limited scope to change light, but we found an innovative way to modify them in three dimensions to unlock exciting new capabilities."

Co-researcher Dr Yan Sheng from ANU said the research team conducted numerous experiments by using ultrashort laser pulses to change the internal structure of a nonlinear crystal, which was able to convert an invisible light beam into visible light. "We provide the first proof that it is possible to engineer nonlinear crystals in three dimensions for the purpose of light conversion," said Dr Sheng from the Laser Physics Centre within the ANU Research School of Physics and Engineering. The research team aims to make millimetre-sized devices that will be able to convert light much more efficiently. "We will also apply our technique to more popular and less expensive materials, making it more attractive to potential commercial partners," Dr Sheng said.

Source material: http://www.anu.edu.au/news/all-news/anu-invention-could-help-turbo-charge-internet-speeds

Original article: T Xu, K Switkowski, X Chen, S Liu, K Koynov, H Yu, H Zhang, J Wang, Y Sheng & W Krolikowski, *Three-dimensional nonlinear photonic crystal in ferroelectric barium calcium titanate.* Nature Photonics **12**, 591–595 (2018); https://www.nature.com/articles/s41566-018-0225-1

Invitation to a magnificent week of world-class science

The Australian Institute of Physics and the Australian Optical Society, with the support of the Australian National Fabrication Facility (ANFF) and the Australian Nanotechnology Network (ANN), warmly welcome you to the 23rd AIP Congress and the Australian Optical Society Conference that will be held jointly with the 43rd Australian Conference on Optical Fibre Technology (ACOFT) and with the 2018 Conference on Optoelectronic and Microelectronic Materials and Devices (COMMAD). Seamlessly integrated to form one of Australia's foremost science forums, the meeting will take place in beautiful Perth on the leafy campus of the University of Western Australia, during 9-13 December 2018.

To Australia's industries, we welcome your presence at the congress and look forward to your suggestions as to how to make the Congress most relevant to you! To Australia's science teachers, we want to include you as part of the Congress and look forward to your involvement. To all university academics, government and industry scientists, to all science students and to our international colleagues, please help us make this a big success by submitting your best work to this conference.The conference strongly supports the principles of equity and diversity and encourages contributions from all. The Congress organisers will strive to achieve gender balance and are committed to equal representation of male and female speakers in plenary and invited talks.

On behalf of the Australian physics, science and technology community, welcome to Perth!

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Proceeds of Crime: How Polymer Banknotes Were Invented

by Tom Spurling and David Solomon

This article was originally published on THE CONVERSATION

Optics plays a part in helping to keep banknotes secure. Here is a story behind the development of the polymer notes used today.

The Reserve Bank of Australia (RBA) and CSIRO's 20-year "bank project" resulted in the introduction of the polymer banknote – the first ever of its kind, and the most secure form of currency in the world.

The project commenced in 1968 and continued until 1988 with the release of the A$10 bicentennial commemorative banknote. But it's the story behind this story – a personal note of forgeries, underworld figures and CSIRO – that is just as impressive.

Australia's transition from the pound to the dollar – on Decimal Day, February 14 1966 – was a momentous occasion. The new currency was seen as being a marker of our independence from the mother country, and the changeover from pound to dollar was well-planned and executed. (A little-known fact: a nationwide competition was held to find a name for our new currency with an "Australian flavour". Among the more than 1,000 submissions were the "austral", "boomer", "kwid" and "ming", but "dollar" was chosen.)

By April 1966 most of the old imperial banknotes had been removed from circulation, and a new range of state-of-the-art dollars and coins were doing the rounds of the nation's tills, wallets and pockets. With designs by leading Australian artists and cutting edge security features such as watermarks and metal thread, things couldn't have been better for the note-issuer, the RBA.

But the new notes were not infallible, and it didn't take long for counterfeiters to strike.

The first polymer banknotes. One side symbolised European settlement and the other, the original discovery and settlement of Australia 40–60,000 years earlier. Image credit RBA.

Enter the forgers

By the end of the year, a team of amateurs from suburban Melbourne, armed with simple office equipment and a desire to make some money, were able to produce a batch of fake notes with no intaglio printing, no watermark and no metal thread that would net them almost A$800,000 worth of forgeries. (That figure's not to be sneezed at – it would be worth A$10.4 million in 2018.)

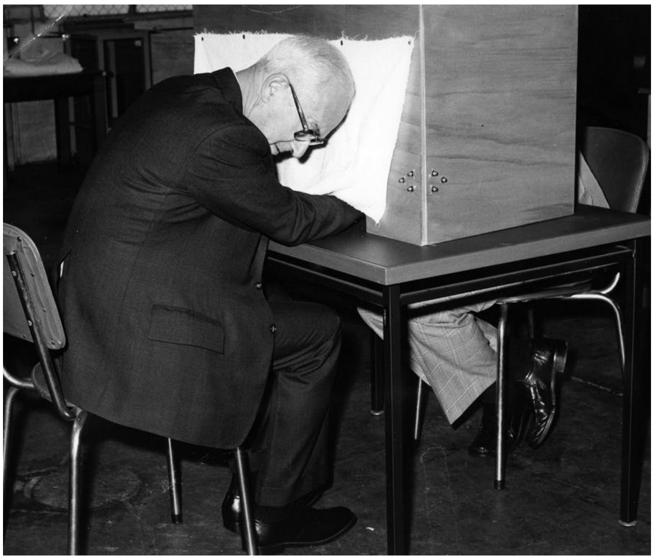
The nucleus of this team were two "regular joes" with no real criminal history: Francis Papworth, an artist from Bentleigh, and Jeffrey Mutton, who owned a failing milk bar in Moorabbin near a printing plant where Papworth worked.

As with many great schemes, this one was hatched over a beer – Papworth and Mutton often met at the Boundary Hotel in East Bentleigh. It was January 1966, only a few weeks before the introduction of the dollar, and the two mates were looking for an easy way to reverse their fortunes. Papworth worked at a printing plant … so why not print some money?

Deciding it was a "goer", they enlisted a third contemporary, Dale Code, along with Ron Adam (a professional photographer) and Bert Kidd, a notorious career criminal who was to provide the funding for the scheme. Their original target was the ten shilling note, but on the release of the A$10 note on Decimal Day they decided that the new version was going to be even easier.

What followed was a tale of ingenuity, intrigue and deceit. Using only their basic printing equipment, the forgers were able

The first A$10 notes, featuring architect Francis Greenway on the front and poet Henry Lawson on the back. Image credit RBA.



Dr Spurling conducting a 'feel test' with Governor Phillips. Image credit CSIRO, Author provided.

to produce three batches of fake notes – each more sophisticated than the next – that would stay in circulation for many years. But despite their initial success, the authorities soon picked up on their activities.

Adam, Code and Mutton were tried and found guilty of forgery in 1967 but Papworth, who had been a police informant, was found not guilty. Kidd was arrested in 1969 after Mutton, who was already serving time, gave evidence against him.

News of the forgery soon became public, and a period of unrest followed. Instructions were issued by the Reserve Bank on how to spot the forgeries, which were then to be handed to authorities. But anybody turning a note in would not receive a genuine note in return, so many continued to be circulated.

A general distrust of A$10 notes permeated Australian society – at one stage, members of the Amalgamated Engineering Union refused to accept them as part of their pay packet.

Call in the scientists

The RBA's Governor, HC (Nugget) Coombs turned to science – or, more specifically, to CSIRO. The challenge was set: could we create the world's most secure banknote?

After some preliminary planning, the "bank project" began. Coombs originally enlisted seven top Australian scientists – five physicists and two chemists – to help the RBA develop a more secure banknote. They met on April 1, 1968, and despite the date, these were no April fools – the two chemists were Jerry Price, who went on to become chairman of CSIRO, and Sefton Hamann, chief of the CSIRO Division of Applied Chemistry.

The group was introduced to the general principles of banknote design and production, and sent off to think about it before reconvening for a second meeting at Thredbo in June 1968.

Two more scientists were invited to Thredbo: Neil Lewis, recently retired from Kodak, and David Solomon, a young, award-winning polymer scientist from CSIRO. It was during these first few years that Dr Solomon first hit on the idea of a plastic banknote after being given a business card printed on plastic by a visitor from Japan.

By February 1972, CSIRO and the RBA had agreed to commence a project to develop polymer banknotes with a range of optically variable security devices. The CSIRO team soon developed a "proof of concept" and presented it to the RBA.

The concept had:

- a see-through panel
- an embedded diffraction grating
- and it was, of course, plastic.

As well as being difficult to forge, these new notes were also more durable than the traditional "rag notes", more environmentally friendly and less likely to carry dirt and disease.

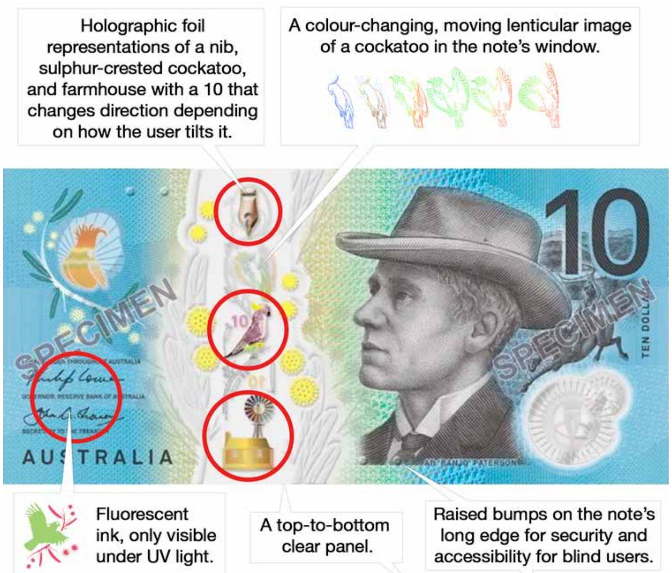
These technical improvements were made within the first ten years of the bank project, but behind-the-scenes delays prevented the issue of these revolutionary notes until the bicentennial year 1988. In a defiant gesture to Papworth, Mutton and co, the first note issued was – you guessed it – A$10.

Today, there are more than 30 different denominations totalling some three billion polymer notes in service in 22 countries worldwide.

For more information, The Plastic Banknote: from concept to reality is available to buy from CSIRO Publishing.

Tom Spurling is Professor of Innovation Studies, Swinburne University of Technology and David Solomon is Professorial Fellow in Engineering, University of Melbourne. They were both at CSIRO during the development of the polymer banknote.

The original article can be found at: https://theconversation.com/proceeds-of-crime-how-polymer-banknotes-were-invented-34642



The new $10 notes released last year have a number of added security features. Image credit RBA/The Conversation.

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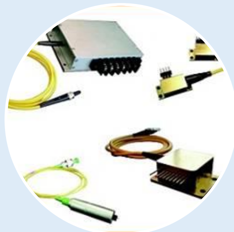

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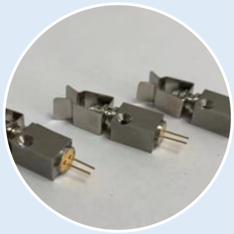

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Optics in Everyday Life: The Zeno Paradox in Optics

Here we learn about Zeno's arrow paradox; the quantum mechanical effect to which it is related, and an effect in classical optics, that may be considered analogous.

by Tony Klein

Ancient Greek Philosopher Zeno of Elea (c.490 – c.430 BC) is famous for his paradoxes, one of which, *Zeno's arrow paradox*, states that because an arrow in flight is not seen to move during any single instant, it cannot possibly be moving at all. (Not unless one understands the concepts of calculus, which came two millennia later!).

However, in quantum mechanics, John von Neumann's early work on its mathematical foundations [1], in particular the rule sometimes called the "reduction postulate" showed that, indeed, one can "freeze" the evolution of a system by measuring it frequently enough in its known initial state. Sometimes this is interpreted as saying that "a system can't change while you are watching it" or, more facetiously, "a watched kettle never boils".

The way this works is as follows: the time evolution operator for a time ΔT, of a system with Hamiltonian H, is given by:

$|\exp((-i/\hbar)H\Delta T)|^2 \approx 1 - 1/2\, [(i/\hbar)\, H\Delta T]^2$ provided that $[(i/\hbar)\, H\Delta T]$ is small enough.

Being quadratic in $[(i/\hbar)\, H\Delta T]$, this is simply equal to unity, meaning that if "observed" after a very short time, the system remains *unchanged*. Furthermore, if the observation is repeated at sufficiently small time intervals ΔT, the system can be prevented from evolving at all.

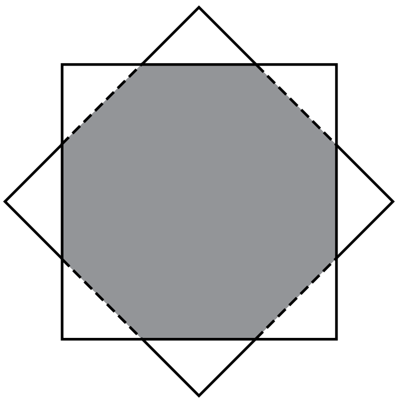

Figure 1. Two sheets of Polaroid, the one behind turned by an angle θ (here shown at 45 degrees) allows the plane of polarisation of the transmitted light to be turned by the angle θ and the transmitted intensity be multiplied by cos θ, shown shaded.

This is what is called the Quantum Zeno effect [2]. This is far from obvious but it has been verified experimentally and has been discussed in hundreds of articles [3].

Quite a similar effect occurs in optics and illustrates quite vividly a phenomenon that may also be termed a Zeno Effect. Here is how it works:

Consider a piece of polaroid in the shape of a square. Now imagine behind it an identical piece, rotated by an angle θ (Figure 1, where θ = 45 degrees). The transmission of light going through both is proportional to cos θ which, for small angles $\Delta\theta$ is approximately equal to $(1 - \Delta\theta^2/2)$ i.e. negligibly different from unity, for sufficiently small $\Delta\theta$ (e.g. 5 degrees as in figure 2).

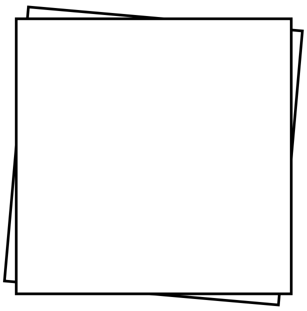

Figure 2. A piece of polaroid with a second piece placed behind at angle Δθ (5 degrees).

Now do it again with another sheet of polaroid, behind the first two, rotated by a further 5 degrees … and keep doing this 9 times for a total of 45 degrees (Figure 3). As you can you see, the transmitted fraction of light through this stack remains near enough to one, i.e. zero absorption or zero change from the incident intensity - hence a "Zeno Effect".

However while absorption is to first order negligible, the angle of polarisation ends up being rotated by 5 degrees through every sheet, to a cumulative total of 45 degrees, in this example. So, by being "measured" at sufficiently small intervals, the transmitted intensity is thereby being kept near enough equal to unity. However, the angle of polarisation can be rotated to any desired angle by a stack of a sufficiently large number of polarising sheets, gently rotated about the incident axis. A way of visualising this is by imagining a stack of Polaroids contained in a rectangular rubber tube, the back of which can be gently twisted with respect to the front so that the total angle is subdivided by N where N is the number of Polaroid sheets. (Circular Polaroids in a circular rubber tube would be easier to organise, of course, but would be harder to draw!).

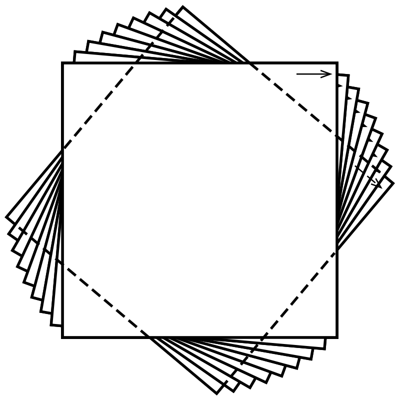

Figure 3. Sheets of polaroid separated by 5 degrees. 9 sheets leads to a change of polarisation angle of 45 degrees, whilst the intensity is unchanged.

While this cumulative polarisation shift is essentially a classical effect, a quantum mechanical analogue has been shown [4] to lead to a geometrical phase shift i.e. a Berry phase since that is a result of a first order variation of the parameter Δt. It is the second order variation $(\Delta t)^2$ that gives rise to the quantum mechanical Zeno Effect.

So, what about the original "arrow paradox" invented by Zeno? If we can think of the position of the arrow as due to a first order changes of the time parameter, (the "instant") then the effect is clearly cumulative and results in the motion of the arrow, and hence there is no paradox. However, if we consider second-order changes of the "instant", interpreted as the velocity of the arrow, then of course, the velocity will stay constant! Is that what Zeno had in mind? But, of course, he didn't have calculus at his disposal!

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[3] Wayne M. Itano, *Perspectives on the Quantum Zeno Effect*, Journal of Physics Conference Series **196** 012018 (2009).

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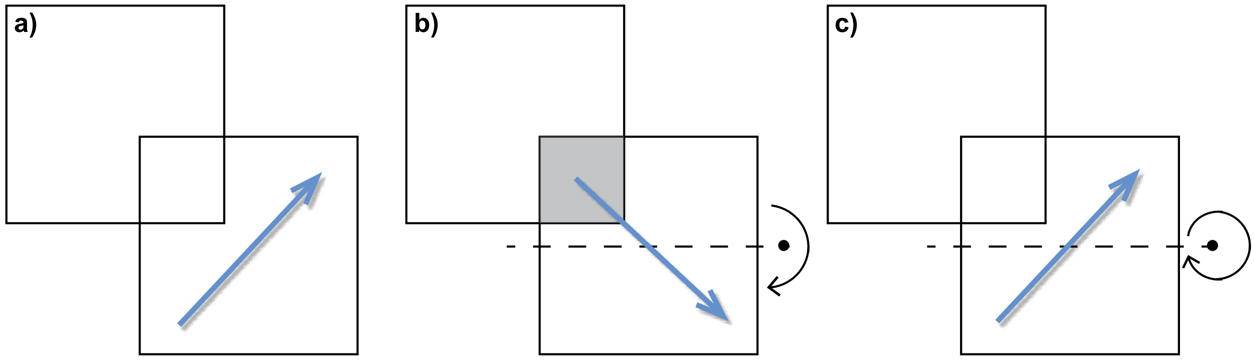
Emeritus Professor Tony Klein is with the School of Physics, University of Melbourne.

"Super - Polaroid" Quiz: Answer

Did you guess the answer? If not, you'll kick yourself: It's simpler than you think!

by Tony Klein

You were misled by the unwarranted assumption that the axis of polarisation was along one of the sides of the square. No! The polarisation axis was simply at 45⁰ to the sides. It was cut out of a sheet of ordinary polaroid, at 45⁰ to the sides and behaves as shown in the diagrams a), b) and c) below.



A similar "trick" is used by optometrists at the final stage or testing for astigmatism. A test object in the form of a ¼ diopter cylindrical lens, with its axis at 45⁰ to the vertical, is inserted into the test lens and is flipped about its vertical axis to find out which position gives a clearer image (Is this better or worse?), thereby adding or subtracting a ¼ dioptre of cylindrical correction to the prescription of the test lens. Look out for it next time you get your eyes tested!

Emeritus Professor Tony Klein is with the School of Physics, University of Melbourne.

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