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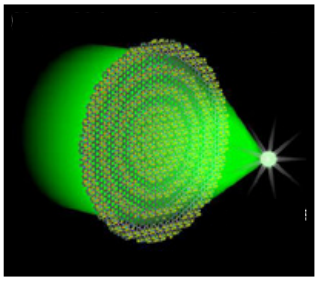
AUSTRALIAN OPTICAL SOCIETY



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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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Articles

Departments

Cover Pictures:

- Upper: The 9th IONS KOALA student meeting was held in Melbourne in 2016. Group photo taken before the conference dinner cruise, see page 15.
- Lower: The Optical Society (OSA) turned 100 in 2016 with celebrations across the globe, see page 9. OSA representatives John Taylor, Elizabeth Rogan (CEO) and Eric Mazur (President-Elect) hosted a Centennial Reception at the APPC-AIP conference in Brisbane in December.
- Insets (left to right)
  - Augustin Fresnel is examined in our Optics in Everyday Life section, see page 25.
  - Ultrathin flexible graphene oxide lenses could revolutionise next-gen technologies, see page 32.
  - Recent years have seen growth in the science of cultural materials conservation and its use of light-based technologies, see page 28. These can be used to image and create full scale copies of works, such as of the statue of The Winged Victory of Brescia shown here.

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

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

Copy Deadline
Articles for the next issue (March 2017) should be with the editor no later than 20 February 2017, advertising deadline 13 February 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:
http://www.optics.org.au

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President's Report

On taking on the role of President I am pleased and honoured to have the opportunity to serve the AOS membership and the Australian and New Zealand optics and photonics communities.

At our Annual General Meeting last month we saw some healthy turnover in the AOS Council. Ann Roberts, at the end of her term as Past President, and Maryanne Large did not stand for re-election. Frederique Vanholsbeeck, from Auckland, and Daniel Gomez, from RMIT, join the Council. Stephen Collins moves to Past President, me to President, and John Harvey was elected to Vice President.

I want to thank those who have retired from the Council for the very strong contributions they made to the Society, especially Ann who has served the society for a long time, including as President. I also want to thank Stephen for his leadership of the Society in years where we had significant highlights to celebrate: the international Year of Light in 2015, and the Prokhorov centenary in 2016.

I was very pleased that Fred and Daniel stood for election. It is really important for the Council that we have a good balance between continuity and new ideas. I am looking forward to working with them. It is also good to have two New Zealanders on the Council - whilst we have Australian in our name we welcome members from New Zealand.

There are several things that I hope to accomplish over the next couple of years as President, and this first report seems as a good a place as any to set this out.

1. I want to continue with our good start on gender equity. Our recently announced policy makes a clear statement. However, we need to follow through with this and ensure it has real impact. Our initial focus has been on conference events that we support, and we need to ensure that this is implemented effectively. We also need to explore how to broaden the impact.

2. It is timely that we seek to influence national policies relating to the development of optics and photonics. There have been significant recent initiatives in the USA and Europe (see for instance the US "Optics and Photonics: Essential Technologies for Our Nation"). The last similar exercise in Australia was 2005.

3. I am keen to find out from our current membership, and potential members, what more we could do to provide better support and services. This might be better use of modern media. It might be initiatives to assist in finding collaborators with particular expertise or facilities, or linking researchers with potential industry partners. I would like to hear your thoughts on what the Society could do for you.

At the AGM the 2016 prizes were announced and I offer my congratulations to the winners: the W.H. (Beattie) Steel Medal to Emeritus Professor Tony Klein, the Geoff Opat Early Career Researcher Prize to Dr Andrea Blanco Redondo, the Postgraduate Student Prize to Dhruv Saxena, the Technical Optics Prize to Dr Nicolas Riesen, and the Warsash Science Communication Prize to both Katie Chong and Xiaorui Zheng. The quality of the applications made it both a pleasure and challenge being involved in the judging.

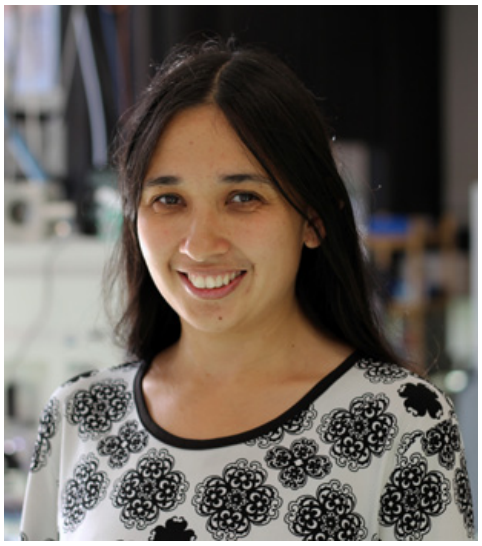
The deadline for the 2017 applications will be coming up, 30th April, so consider applying or encouraging others to apply. From this year the Technical Optical Prize will be renamed the John Love Prize to be awarded for innovations and technical advances in the field of optics.

As incoming President I am keen to hear from any member your thoughts on how the Australian Optical Society can serve you better, or how we can better support the optics and photonics communities in Australia and New Zealand.

I'll conclude by wishing you all a happy and productive new year.

Simon Fleming
AOS president

Editor's Intro



Welcome to another issue of AOS News. We have a range of articles for this issue, with reports on some of the activities that took place as part of the celebrations for the 100th anniversary of the Optical Society (OSA) and an article from one of the winners of the 2016 Warsash Science Communication Prize, Xiaorui Zheng. Katie Chong and Xiaorui both won the prize, but Katie already reported on her work in the last issue of AOS News. Other items in this issue include a report on the student-led IONS KOALA meeting that took place in Melbourne recently and an article on how optics is being used in cultural heritage. Our 'Optics in Everyday Life' section looks at the life and work of Augustin Fresnel. 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.

We welcome Simon Fleming as the new AOS president and I look forward to working with him and seeing the direction he takes the society as his ideas sound very inspiring. I would like to thank Stephen Collins for all his help while he was president and Ann Roberts now that she has stepped down from the Council for all of her support in my role as editor. She has continued to help with suggesting articles and finding news items even after her term as president and I am very grateful for this. As it is the last issue of the year I would like to thank everyone who has contributed articles to AOS News this year and particularly to Tony Klein for all his work on the Optics in Everyday Life section.

The issue of women in science and equity in general is one that is becoming increasingly important. It was great to see a number of sessions on this topic at the recent APPC-AIP conference in Brisbane. There was a good turnout at these sessions even if it was still worrying to see some of the trends, particularly the percentage of women in senior compared to junior positions as well as the problems faced across the region. There are difficulties at all levels, with low numbers of girls studying physics at high school at one end and apparently half of women leave the field at some stage, with a particular drop from level C onwards. We were also presented with information from the AIP awards showing that women are not applying for all of the top prizes available, so lack of self-promotion in many aspects is an issue. A recent paper from the office of the chief scientist on women in STEM (Science, technology, engineering and maths) was mentioned, which chooses four myths about women in science and engineering and then gives the facts about these subjects. They suggest that there are three main influences for people choosing to study STEM subjects; identity, perceived ability and aspiration. This highlights the importance of role models, increasing confidence and having inclusive STEM cultures. There are also statistics included in an accompanying datasheet, showing the lower confidence of girls in their own maths abilities, low percentages of female graduates in physics, IT, maths and engineering and that only 17% of STEM professors are female even though around 40% of junior academics are female.

Many factors contribute to these findings and there are programs in place to try to combat individual areas. The AIP Women in Physics lecture tour is one scheme that provides a great role model and there are a number of programs available for girls and working towards gender equity in STEM institutions (such as the SAGE pilot and the Male Champions of Change for STEM). The issue of girls' low confidence in maths and science ability needs to be addressed and it has been suggested that in some cases there can be teacher gender bias in marking maths tests at primary levels, with some teachers giving boys higher marks than girls if the gender is known. There has also been research into the way that the wording and type of questions in tests can affect the outcome differently for boys and girls. If this is the case then there are additional issues at play that could affect the number of girls studying maths and physics at high school which of course has flow-on effects. At APPC-AIP we were told of programs offering specific mentoring and advice to aid with promotions to help with the issue of women not applying for advancement to level D and E. Another positive suggestion was to create a list of women who can talk on various physics topics so that when people are looking for speakers there is choice available. Many scientific societies, including the AOS have introduced policies for conferences regarding gender equity in order for support to be given. This shows that even though there are many issues, people are taking note of these and working towards finding ways to tackle them so that hopefully the next report can show some improved statistics.

I hope you enjoy this issue of AOS News, and wish you all the best for 2017.

Jessica Kvansakul
Editor

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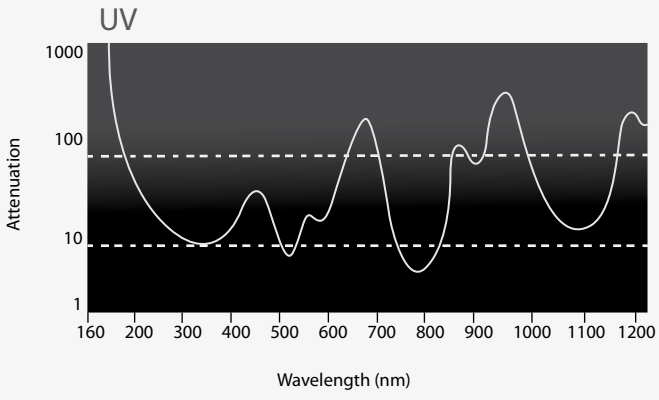

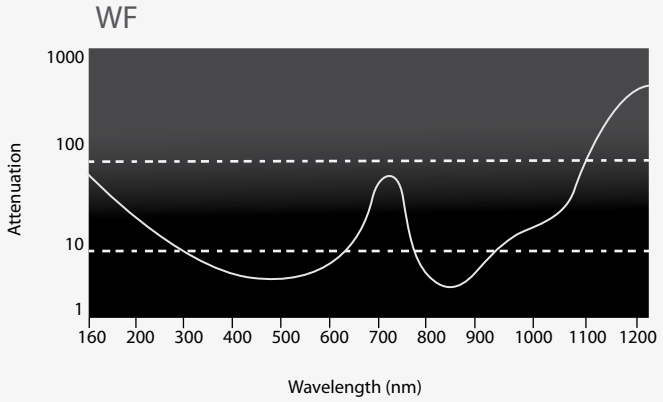

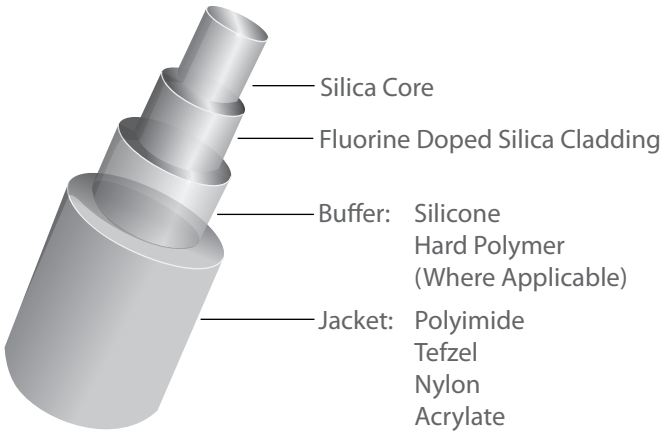

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The Optical Society Celebrates 100th Anniversary

by Joshua Miller

The Optical Society celebrated 100 years since its inception this year with a number of events around the globe.

IONS KOALA 2016 celebrated the OSA Centennial year with a cake.

Since 1916, The Optical Society has united a global community of scientists, engineers, business leaders, and students whose work in optics and photonics has transformed the world. The founders and 30 charter members organised around the themes of photography, vision, optical materials and optical instruments. One hundred years ago, we did not know the universe was expanding. Modern medicine was in its infancy. Radio had just been invented. Television did not exist. The biotech industry wouldn't develop for another sixty years. There was no internet, of course, because there were no computers. Transistors had not been invented. Optical fibres did not exist. The first lasers were decades away from being built.

Today, OSA has more than 19,000 members, including 34 Nobel Laureates, from 100 countries. The society offers the largest peer-reviewed collection of optics and photonics content in the world with 17 peer-reviewed journals and manages more than 50 topical meetings, incubators and conferences on subjects ranging from biomedicine and sensors, to telecommunications and high performance computing - impacting more than 270,000 scientists and engineers in the photonics industry.

"Our Centennial is not only an opportunity to capture the legacy of the Society and the optics field, but also a chance to explore the future of innovation enabled by and related to optics," stated Alan E. Willner, 2016 President of The Optical Society and Steven & Kathryn Sample Chair in Engineering, University of Southern California, California, USA. "2016 has been an amazing and inspiring year. A global consortium of scientists and engineers confirmed the existence of gravitational waves – about a century after Einstein's prediction. Optics, of course, played a key role in the instrumentation of LIGO, and this represents a fundamentally new way of looking at the cosmos. Over the past century, there has been a dramatic advance in our understanding of light and the capabilities of optics technologies, as well as an explosion in light-enabled applications. Undoubtedly, there remains tremendous potential to address societal challenges, such as supporting health and medicine as well as the continued exponential growth of the Internet. We are still only at the beginning of what optical technologies can enable, and The Optical Society and its members will continue to be at the forefront of advancing the science of light."

Many events across Australia included celebrations for the OSA centennial year as can be seen in the images here and the report on the QUT OSA student chapter's lecture series. The IONS KOALA meeting had celebratory centennial cake as shown above and the OSA held a celebration at their stand one evening during the recent APPC-AIP conference in Brisbane.

Learn more at osa.org/100.

OSA representatives John Taylor, Elizabeth Rogan (CEO) and Eric Mazur (President-Elect) hosted a Centennial Reception at the APPC-AIP conference in Brisbane and are pictured here with members of the QUT OSA student chapter and AOS News editor.

Joshua Miller is PR Manager with The Optical Society (OSA).

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Second Guest Lecture Series for the OSA Centennial Year Celebration at QUT

by Uchechukwu L Osuagwu, Amithavikram R Hathibelagal, Dipesh Bhattarai and Sekar Ulaganathan

The OSA Student chapter at Queensland University of Technology organised a second lecture series to mark the Centenary year of the Optical Society, aiming to highlight applications of optics.

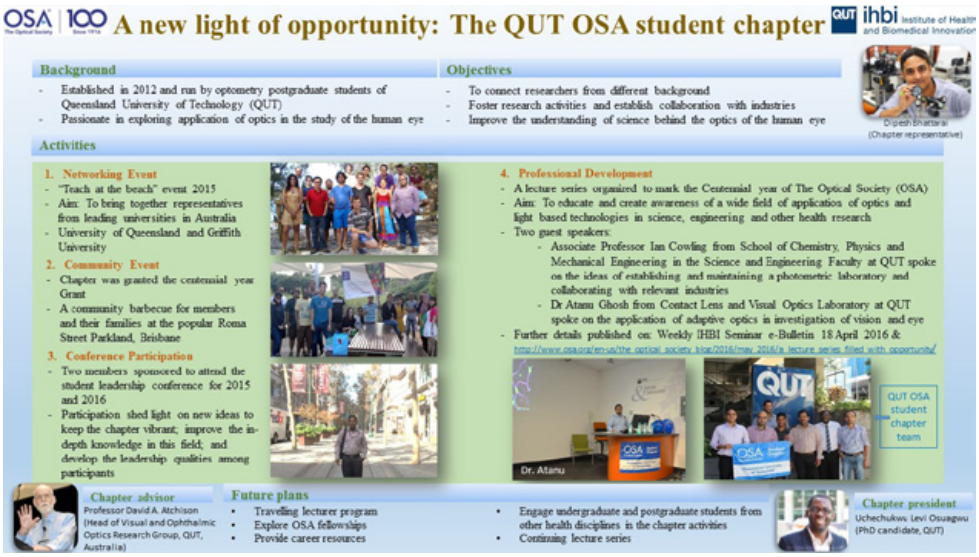
The higher degree research students in the School of Optometry and Vision Science at Queensland University of Technology (QUT) continued to demonstrate their immense passion in exploring the application of optics in their research activities by organising a second lecture series to mark the Centenary year of the Optical Society. This event was a joint collaboration between the QUT OSA student chapter and the QUT school of Optometry and Vision Science. The objective of the event was to educate and spread awareness of the wide field of applications of optics and light based technologies in science, engineering and health research. In addition to that, we also wanted to highlight the achievements of our team and the challenges faced by the chapter. These were made clear to the audience in the Chapter President's welcome speech. The hallmarks of these achievements included: the success recorded by the Chapter to bring on board graduate students from the Physics department; and the Chapter's "Best Poster award" at The Optical Society Student Leadership Conference (2016) in Rochester, New York, USA. The poster was presented to the audience by Mr Dipesh Bhattarai, the chapter representative at the conference, who beat representatives from 250 global student chapters to win the competition. The poster he presented illustrated the activities of the QUT OSA student chapter, including their networking activities, lecture series and the Teach at the Beach event, which featured optics students from QUT, UQ and Griffith (see below for a copy of the poster).

In April this year, the QUT OSA student chapter organised its first ever OSA lecture series to mark the Centenary year of The Optical Society. The event witnessed two notable speakers and the proceedings from the event was published in the OSA blog (osa.org/en-us/the_optical_society_blog/2016/may_2016/a_lecture_series_filled_with_opportunity) and in the October issue of Australian Optical Society (AOS) News [2016; 30 (3): 8-9]. Following this, the chapter hosted a second lecture series with presentations from two other notable speakers. The event was held at the Institute of Health and Biomedical Innovation building on 7th December 2016.

QUT OSA student chapter members with the speakers.

The first speaker Dr Danuta Sampson is an OSA Ambassador and an early career research fellow currently based at the Lions Eye Institute and the University of Western Australia, Perth. She joined these institutions in 2014, bringing with her expertise in optics, optical microscopy, and image processing acquired during her time at Nicolaus Copernicus University in Torun, Poland, where she completed her PhD working with the Optical Biomedical Imaging Group. Her PhD research project concentrated on the development of spectral-domain optical coherence tomography for applications in Biology and Ophthalmology under the supervision of two of its founders, Professors Andrzej Kowalczyk and Maciej Wojtkowski. On this day, she shared results from ongoing projects in their laboratory under the supervision of Dr Fred Chen. Her talk shed light on "What we can learn from multimodal imaging of the human retina?" as she explained how a combination of different imaging technologies could increase the sensitivity of diagnosing ocular diseases.

The second speaker Dr Fan Yi is a Senior Research Fellow in the Contact Lens and Visual Optics Laboratory, School of Optometry and Vision Science, QUT. Dr Yi was trained as a laser and optical engineer from the Huazhong University



Winning poster presented by the QUT OSA student chapter representative at the OSA student leadership conference.

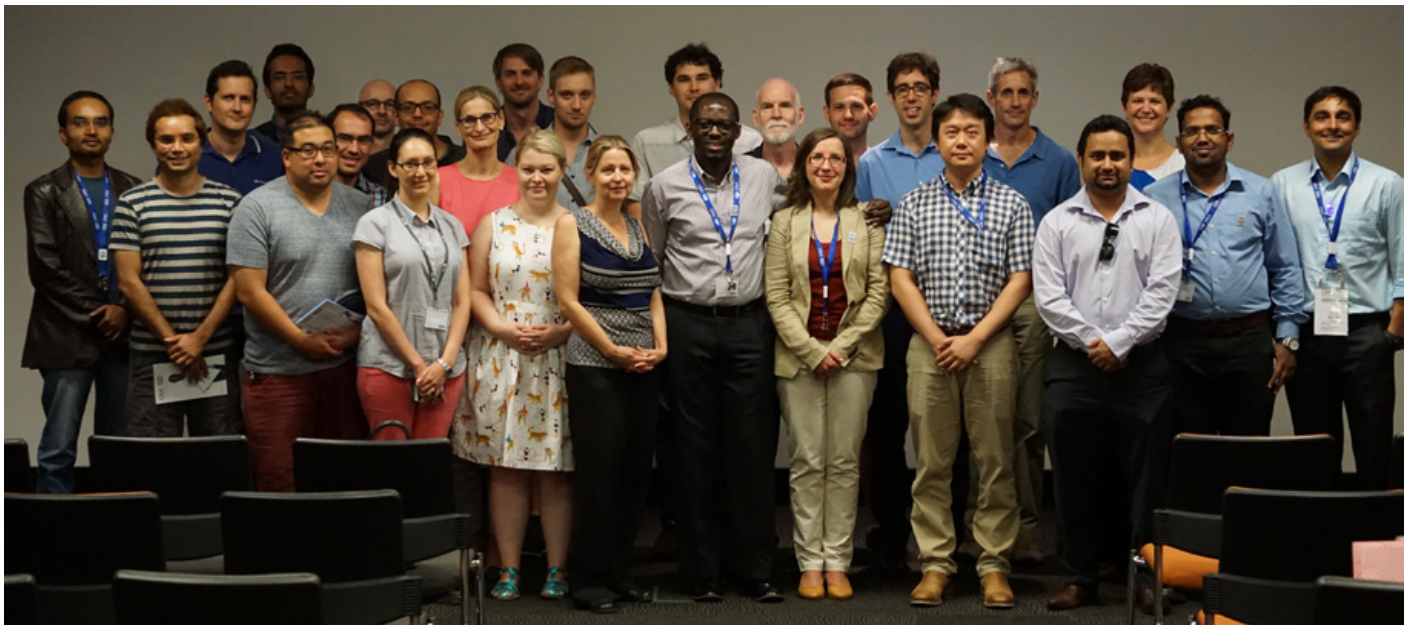
Speakers Danuta Sampson and Fan Yi with QUT OSA student chapter president Uchechukwu Osuagwu.

of Science and Technology, China, where he graduated with a Bachelor of OptoElectronic Engineering in Laser Device Design and Fibre Communication Systems in 2002. He obtained a Master of Philosophy degree in Electronics in 2006 from Griffith University, Australia before joining QUT in 2007 to start his PhD under the supervision of Professor Robert Iskander and Professor Michael Collins. During his PhD, he designed and constructed an adaptive optics system which he used to investigate the impact of wavefront aberrations on the depth of focus of the human eye. Dr Fan Yi's current research interests include visual optics, optical system design for ophthalmic applications, and wavefront aberrations. He has published in various vision and optics journals, and has delivered invited lectures at various international symposia. Dr Yi's presentation during this event was on the Adaptive optics visual simulator which he built. He shed light into how this instrument could be used to simultaneously induce and correct ocular aberrations to improve contact lens designs and performance.

This second lecture series event was well appreciated by the audience who also stayed back for a group photo with chapter members and guest speakers. The speakers were honoured with gifts from the QUT OSA student Chapter President. There were 30 attendees at the event and we expect it will grow in the future. The audience included undergraduate students, postgraduate students, and faculty staff from QUT School of Optometry and Vision Science. There were opportunities to network with each other and with the guest speakers after the event. A brief lunch and refreshments sponsored by the student chapter followed immediately after the event and the Chapter members sat down for a chat with the OSA ambassador Dr Danuta Sampson who told of her contentment with the event organisation and expressed her interest for future collaboration with the chapter.

There are plans to hold these lecture series at least twice each year. The achievements of this chapter in 2016 would not be possible without the generous support from The Optical Society (OSA) Centenary Grant that was awarded to our chapter. We would also like to extend our gratitude to Dr Katie Edwards from the QUT School of Optometry and Vision Science and the Institute of Health and Biomedical Innovation at QUT for help in organising the event.

Uchechukwu Osuagwu and Dipesh Bhattarai are with the Visual and Ophthalmic Optics Laboratory, Amithavikram Hathibelagal is with the Visual Science and Medical Retina Laboratories and Sekar Ulaganathan is with the Contact Lens and Visual Optics Laboratory. All are PhD students at the Institute of Health and Biomedical Innovation, School of Optometry and Vision Sciences, Queensland University of Technology, Brisbane.



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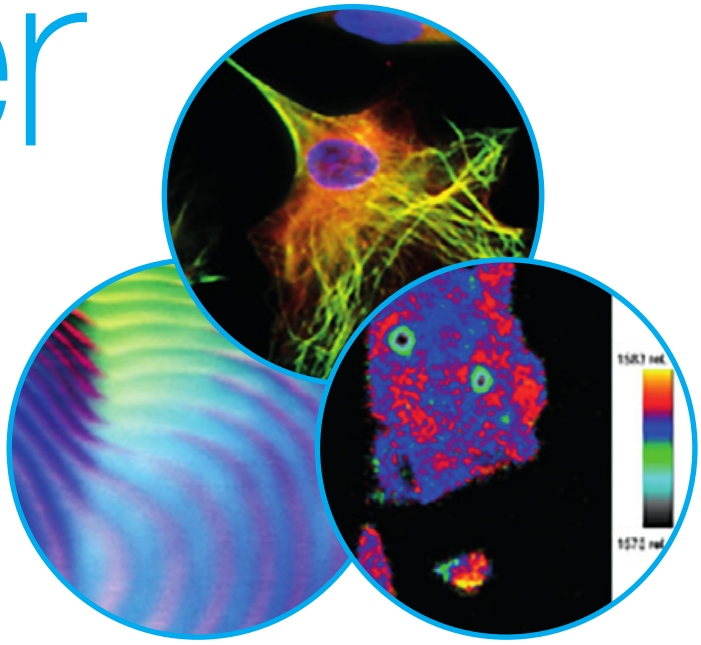

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IONS KOALA 2016

by Shaun Johnstone

IONS KOALA was held in Melbourne in 2016, and again saw many students take part in the annual optics conference designed for students and run by the students themselves.

The 9th Conference on Optics, Atoms and Laser Applications (KOALA), part of The Optical Society (OSA)'s International OSA Network of Students (IONS) program, was held at Monash University Clayton campus from 27 November – 2 December 2016, organised by students from the Monash University OSA Student Chapter and the Swinburne Optics & Photonics (SOAP) joint OSA & SPIE student chapter. IONS KOALA is held annually in Australia or New Zealand and brings together a large group of Honours, Masters and PhD students from Australia, New Zealand and beyond, from a wide variety of optics-based fields. The conference aspires to foster an environment where young researchers can share their expertise, discuss new ideas, relax, and socialise, while building long-lasting networks that will continue to support them throughout their careers.

This year, IONS KOALA continued expanding internationally, thanks in part to the generous support of the OSA Centennial celebration. 86 students attended the conference, coming from 24 different institutions, across 11 countries, including; 67 from Australian institutions, 7 from New Zealand, and 12 from further abroad (Ireland, Poland, China, The Philippines, India, Japan, Malaysia, USA and Canada). These students contributed research presentations on a wide range of fields, including; Bose-Einstein condensates, waveguides, quantum optics, micro- and nano-fabrication, super-resolution imaging, plasmonics, sensing, laser development, optical trapping and biomedical applications.

An addition to the IONS KOALA programme this year was the chance for all attendees to give an oral presentation, with the inclusion of 2 minute "poster preview" talks. This gave our 38 poster presenters an opportunity to present an outline of their research, enticing the audience to visit their poster for further insight during the traditional poster session on Tuesday evening. We also had 44 presentations from students as well as 6 student-run workshops aimed at ensuring that every student had some background knowledge about research being presented at the conference outside their own field.

We were fortunate to host three international plenary speakers, who covered a range of topics. Síle Nic Chormaic travelled from the Okinawa Institute of Science and Technology (OIST) in Japan to present a range of applications of ultra-thin optical fibres, James Wyant travelled from the College of Optical Sciences at the University of Arizona, USA to speak of the advances in interferometric surface measurement, as well as of his experiences starting businesses, and Yasaman Soudagar travelled from Canada to speak both about her graduate research in quantum optics, and her experiences beyond graduation, founding a neuroscience based company Neuresence. 2016 OSA Ambassador Alvaro Casas Bedoya also travelled from Sydney to present a professional development workshop, whilst Andrew Brown from SPIE visited from the USA to give a keynote address at our Industry and Innovation Evening where attendees could also network with representatives from our sponsoring organisations.

Yasaman Soudagar presents her plenary presentation, inspiring attendees to think like an entrepreneur.

In addition to the scientific and professional development programs, IONS KOALA maintains a strong social aspect, allowing students to connect with their peers. On Wednesday, we took a day off from the scientific program, as per tradition, and took attendees on a tour of Mt Dandenong and the Yarra Valley. We drove up the mist-covered mountain in the morning to explore the National Rhododendron Gardens before continuing into the valley for lunch. On Thursday evening, we embarked on a cruise around the mouth of the Yarra River for our conference dinner. This was the social highlight of the conference; we presented awards and travel grants, danced in a laser light show and cut a birthday cake honoring 100 years of OSA.

On behalf of the IONS KOALA 2016 organising committee, I'd like to sincerely

Recipients of travel grants, along with conference co-chairs Seb & Xuewen, and OSA representative John Taylor.

thank our sponsors, attendees and invited speakers, all of whom made the conference a great success!

Next year marks the 10th KOALA, which will be held at the conference's birth place, the University of Queensland. To Sarah Lau and her team, good luck, organising the conference is a rewarding experience - I'm sure you'll make 2017 another IONS KOALA conference to remember!

Shaun Johnstone is with Monash University and is the IONS KOALA 2016 Secretary.

IONS KOALA 2016 group photo taken before the conference dinner cruise.

The KOALA mascot is passed on to the University of Queensland, who will host IONS KOALA 2017.

Some of the organising committee members, along with 2016 OSA Ambassador Alvaro Casas Bedoya and OSA Foundation board member Yasaman Soudagar.

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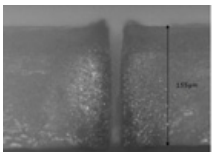

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Scientists Have Much to Gain by Sharing Their Research with the Public

This article was originally published on
THE CONVERSATION

by Marina Joubert

This article looks at some of the benefits of communicating science to the general public as an academic.

Academic life is a juggling act. It involves research, teaching, applying for grants, writing scientific articles and peer reviewing others' work. There's also student supervision and administration.

These days, academics face an extra demand: to make their work more visible and accessible to the public and policymakers. But what's in it for these time-stressed, busy scientists?

"Science can be very lonely," admits distinguished Swedish astrophysicist Bengt Gustafsson. We were chatting after he'd delivered a talk at Stellenbosch University and I asked what motivated him to make time for public engagement. He replied:

'Occasions like these where I can share my work with people, especially children, keep me going. It gives meaning to my work and even sparks new ideas for my research.'

Gustafsson's attitude is echoed in a report from the UK: What's in it for me? The benefits of public engagement for researchers [1]. It emphasises how public engagement can open up fresh perspectives on research and encourage more people to embark on scientific careers.

But these intrinsic rewards aren't enough to convince many researchers that public engagement is worth their while. Luckily the evidence is mounting to show them how it can be done and why it's time very well spent.

Professional rewards

Scientific articles in accredited journals, book chapters, whole books and monographs all add to a researcher's professional reputation. These achievements count towards promotions. In South Africa, they also bring significant financial reward from the Department of Higher Education and Training.

But where are the rewards for writing a popular article, doing a radio interview, speaking at a science café, or tweeting about your research findings?

Science communicator Matt Shipman has offered some answers to this question [2]. He argues public communication helps scientists to attract top students, impress their funders, network with other researchers, form new collaborations and draw interest from industry and government.

His stance is bolstered by peer-reviewed evidence. A group of US social scientists has demonstrated a link between "h-index" – a measure of the quality and influence of a researcher's work – and whether the researchers in question interacted with journalists and were mentioned on Twitter [3].

"Doing both – traditional media and social media – is more powerful in boosting citations than doing just one of the two," Dominique Brossard, University of Wisconsin-Madison professor of life sciences communication, told me. She took part in the research project.

'Instead of thinking of time spent on social media as a distraction, researchers should see it as a way of making their work more accessible to broad audiences.'

Conrad Matthee, an evolutionary genetics researcher at Stellenbosch University, has seen for himself how media visibility can boost reach within the scientific community.

He was the corresponding author of a recent research paper that estimated white shark numbers along the South African coast based on dorsal fin photos and genetic data. The research was featured on global media channels, including CNN and the BBC. The number of downloads of the original paper skyrocketed.

"This proves that getting media exposure for research is a sure-fire way of getting other scientists to take note of your work," he said during an interview with me.

Universities also crave publicity for their academics' work. "Our research needs to be visible. This is absolutely critical for ensuring sponsorship and sustaining support from government and industry partners," says Therina Theron, research director at Stellenbosch University.

If professional rewards aren't enough

Getting up close and personal with science has huge benefits – for the scientist, too. Image credit: Steven Lang.

to convince researchers about public engagement, there are other factors to consider.

What about the moral imperative?

Researchers have privileged access to new evidence that can underpin informed decision-making. It is often argued that scientists have a duty and even a moral obligation [4] to be heard in public debates and to influence public policy. If scientists keep quiet, these public debates may be dominated by people with questionable credibility and doubtful agendas.

Andrew Wright, an environmental scientist at George Mason University, has called advocacy "an almost inescapable part of modern science" [5]. He argues that scientists have a societal obligation to deliver credible information to those who can use it. Failing to do so, he suggests, leaves scientists at risk of becoming irrelevant.

Accountability is another principle reason for researchers to share their work with the public. After all, the bulk of research in public universities and science councils is funded by taxpayers. Scientists have a responsibility to tell the public what they are doing with its money.

David Eagleman, the director of Texas' Baylor College of Medicine's Initiative on Neuroscience and Law, has written a manifesto, Why Public Dissemination of Science Matters [6]. In it, he stresses scientists' responsibility to inspire critical thinking. He also says that although most scientists may not be specifically trained to communicate to the public, they have what it takes.

'You have been trained to think with rigor, to integrate large bodies of data, to weigh evidence, to value intellectual humility, to retain nuance when speaking about complex issues, and to write precisely what you mean to say. So speak up. The future needs your voice.'

Getting started

Scientists who are up for the challenge will find that there are many spaces in which to start sharing their research with the public. These include:

- Researchers can use social media throughout the research cycle to bolster collaboration and make new findings available to broad audiences, including science journalists [7].
- Videos drive traffic and shares on social media, so platforms such as YouTube and Vimeo cannot be ignored [8].

Planning communication into research, and making it part of one's research identity, will not necessarily deliver overnight fame and fortune. But it has the potential to connect scientists to new audiences and add value, meaning, reach and impact to their work. It is a way to see how their science makes a difference to real people.

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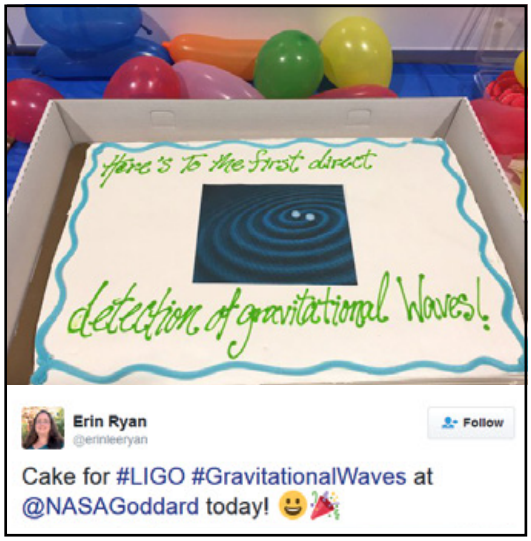

Social media can be used to communicate science to the public, but care should be taken about the contents and timing of releases.

Marina Joubert is with the Centre for Research on Evaluation, Science and Technology, Stellenbosch University, South Africa.

The original article can be found at https://theconversation.com/scientists-have-much-to-gain-by-sharing-their-research-with-the-public-64129

News

Congratulations to new OSA Fellows

The AOS would like to congratulate a number of AOS members who have been elected as 2017 Fellows of the Optics Society (OSA). John Canning, University of Sydney & University of Technology Sydney interdisciplinary Photonics Laboratories (iPL), Adrian Carter, Nufern, Deborah Kane, Macquarie University and Ann Roberts, University of Melbourne, were included in the list of 96 OSA members from across the globe who were elected as 2017 OSA Fellows. Fellows are selected based on several factors, including specific scientific, engineering, educational and technological contributions, technical or industry leadership in the field as well as service to OSA and the global optics community.

John Canning

Adrian Carter

Deborah Kane

Ann Roberts

"Heartiest congratulations to the 2017 OSA Fellows, who are excellent examples of optics and photonics innovators and will be outstanding representatives of The Optical Society," said Alan Willner, 2016 President of The Optical Society and Steven & Kathryn Sample Chair in Engineering, University of Southern California, California, USA. "The new Fellows join an illustrious group who have collectively had great impact on our field and society at large."

Fellows of The Optical Society are members who have served with distinction in the advancement of optics and photonics. The OSA Fellow Members Committee reviews nominations submitted by current OSA Fellows, then recommends candidates to the OSA Awards Committee and OSA Board of Directors. No more than 10 percent of the total OSA membership may be chosen as Fellows, making the process both highly selective and competitive.

"The 2017 Fellows reflect a diverse group of OSA members who are leaders in optics and photonics." said Elizabeth Rogan, CEO, The Optical Society. "It's an honour to recognise the 2017 OSA Fellows class for their accomplishments, achievements and continued contributions to our industry."

The new Fellows will be honoured at OSA conferences and meetings throughout 2017.

osa.org/en-us/about_osa/newsroom/news_releases/2016/the_optical_society_announces_2017_fellows_class

The Australian Optical Society

AOS Prizes and Awards 2017

Australian Optical Society members are reminded that the deadline for applications for all AOS awards is 30 April. Please consider applying or nominating students or colleagues. All applications and nominations are to be forwarded to the AOS Secretary. Membership of the AOS is an eligibility requirement for all awards.

AOS W.H. (Beattie) Steel Medal

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

The AOS Geoff Opat Early Career Researchers Prize

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

AOS Postgraduate Student Prize

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

AOS John Love Technical Optics Award

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

AOS Warsash Science Communication Prize in Optics

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

For more information, visit optics.org.au

Conferences

24-28 April 2017 International Conference on Optical Fiber Sensors

The 25th International Conference on Optical Fiber Sensors (OFS) will be held in scenic and beautiful Jeju Island, Korea from 24 to 28 April 2017. OFS was established in 1983, and is acknowledged as the world's leading conference on all topics related to photonic sensing technologies. The conference provides a forum for reporting and exchanging ideas on the latest advances in research and development on fiber-optic and photonic sensing. It has also contributed significantly to industrialization and standardization of the related devices and systems for field deployment. OFS will offer plenary and invited talks, contributed oral and poster presentations, workshops, and exhibition of commercial products. Social and cultural events will also take place to foster networking among the participants in a friendly setting. Early registration closes 20 March 2017. ofs-25.org

30 April - 1 May 2017 International Conference on Biophotonics

The International Conference on Biophotonics represents a unique meeting forum, the 5th in the series and the first in the southern hemisphere, to explore strategic directions for this vital field – the study and use of light in biology and medicine. It brings together today's research leaders and aspiring leaders from around the globe. It will be held in Freemantle, WA, from 30 April to 1 May 2017. Late abstracts are still being accepted. Early registration closes 29 March 2017. icob2017.com

Australian and New Zealand Conference on Optics and Photonics 2017 (ANZCOP 2017)

The Australian and New Zealand Conference on Optics and Photonics (ANZCOP) conference series integrates the Australian Conference on Optics, Lasers and Spectroscopy (ACOLS) and the Australian Conference on Optical Fibre Technology (ACOFT). ANZCOP 2013 was held in Perth and ANZCOP 2015 was held in Adelaide.

Planning is underway for ANZCOP 2017, to be held in late November or early December 2017.

www.ofs-25.org

Early Registration closes 20 March 2017

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Optics in Everyday Life: Augustin Fresnel – an Unsung Hero

by Tony Klein

Augustin-Jean Fresnel (pronounced "Freynel") (1788 – 1827) was the French Engineer/Physicist who, along with English physician (i.e. medico) and physicist Thomas Young, was mainly responsible for the wave theory of light.

Figure 1. Augustin-Jean Fresnel (1788 – 1827).

However, he is known today - if at all - mainly for theatre spotlights containing the stepped lenses invented by him for use in lighthouses and known by the anglicised name pronounced "Freznel".

Son of an architect, Fresnel was born in provincial France and entered the famous École Polytechnique at the tender age of 16 where he graduated with distinction. He then pursued his Civil Engineering studies at another great engineering school, the École des Ponts et Chaussées (Bridges and Roads) where he was taught Physics by some of the most famous names in French physics: Biot and Arago, with whom he kept in touch by correspondence. In subsequent years he begged them to send him some more challenging tasks while engaged in pretty humdrum engineering projects in the provinces.

Back in Paris in around 1814, they alerted him to a competition sponsored by the French Academy, aimed at providing an explanation for the phenomenon of diffraction. He submitted his "Memoir on the Diffraction of Light" in 1918, to be judged by a panel of luminaries such as Laplace, Biot, Poisson, Arago, Gay-Lussac and other famous academicians. The memoir, containing both theoretical and experimental material, dealt mainly with the bright and dark regions, which we call fringes, that surround the shadow of objects illuminated by bright point sources of light.

A well-known story recounts the fact that, upon studying Fresnel's memoir, the noted mathematician/physicist Siméon Poisson came to the conclusion that it must be wrong! The supposed "death-blow" to Fresnel's theory was that it led to the seemingly absurd conclusion that right in the middle of the shadow of a perfectly round object, Fresnel's theory predicted that there should appear a bright spot. (We know, of course that this spot is the result of the constructive interference of the waves diffracted around the boundary, but this seemed absurd at the time).

However, setting up an experiment in a long underground tunnel and using a candle as the distant source, Fresnel's old friend François Arago, academician and member of the judging panel, managed to demonstrate to everyone's astonishment that the "absurd" bright spot is indeed there!

So, in due course Augustin Fresnel won the competition and received the Academy's prize in 1919, thereby receiving almost instant recognition. However, the famous bright spot became known not as Fresnel's spot after the man who predicted it nor as Arago's spot after the man who demonstrated it but as Poisson's spot, after the man who doubted its existence. Such is fame!

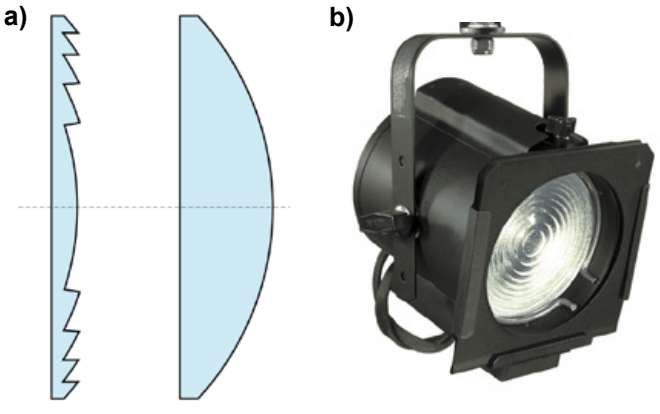

Figure 2. a) Fresnel lens vs ordinary lens. b) "Freznel" theatre spotlight.

Around the same time, Fresnel was the first to devise and construct the type of stepped lens shown in figure 2a. This kind of Fresnel lens is fully equivalent to much larger and heavier lenses and is still used in theatre spotlights today ("Freznels", shown in figure 2b), as well as in traffic lights and other similar applications (but long since replaced by lasers in lighthouses - their original use). Flat plastic magnifying glasses in common use today are based on the same principle and use refraction by very fine rings to give images of acceptable quality. Invented as a substitute for mirrors in lighthouses (see figure 3a and b), Fresnel lenses received rapid adoption and earned him the plum job of Commissioner of Lighthouses in France.

Further discoveries and mathematical deductions, building on experimental work by Thomas Young of England, with whom he was in close touch, led him to be unanimously elected as a member of the Académie Française in 1823. One of the most important works was his proof that light was a transverse wave, capable of polarisation, as opposed to the view of Thomas Young at the time. This led to his election to the Royal Society of London in 1827, in the year of his death. Having spent most of his life in crowded and unhygienic Paris, he died of tuberculosis at the age of 39.

Returning to his work on diffraction, one of the examples contained in his prize-winning Memoir [1] concerned the division of circular obstacles into concentric rings of equal areas which he

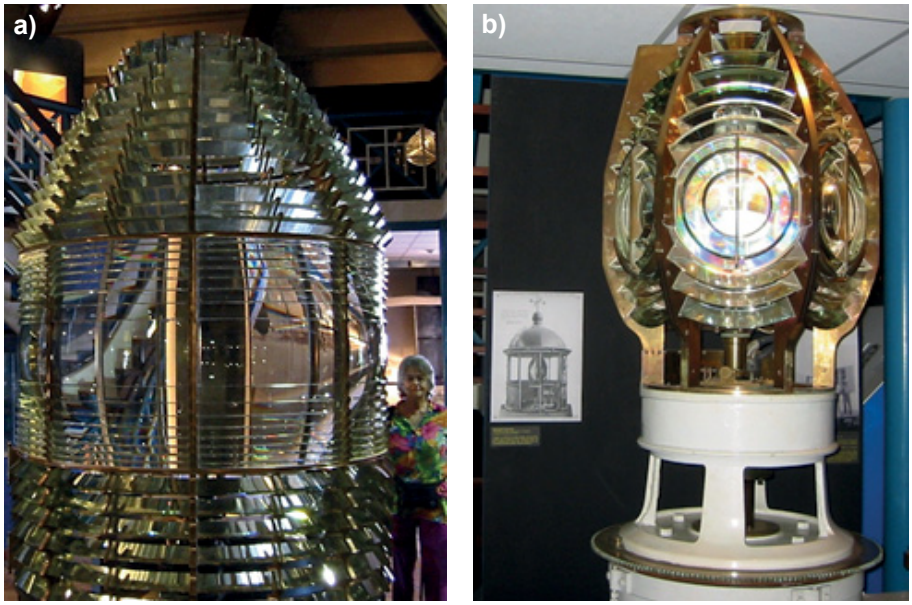

Figure 3. a) Lighthouse lens. b) Another lighthouse lens. Both are now replaced by lasers, of course. Photos by the author at the Maritime Museum, Noumea.

called zones (figure 4a). Suppose that such a circular diffraction grating is placed at O, at right angles to the axis between a point source of light at A and a plane of observation B, in such a way that the distance from A to B via any of the zone boundaries increases in multiples of half a wavelength from the direct distance ab, so that

$$ab_n = ab + n\lambda/2$$

It follows that if every second zone is blocked off (as first devised by Soret [2]), the light that is transmitted via the remaining zones will show constructive interference, and the point of observation, B, will become a focus.

Therefore the corresponding object, called a Fresnel Zone Plate, of which the central region is shown in figure 4a, acts like a lens but works by diffraction, rather than by refraction. In the special case of the source at an infinite distance away, shown in figure 4b, the waves incident on the zone plate are plane waves. Then if the path lengths from every second zone boundary (i.e. l_n and l_{n+2}) differ by one whole wavelength, there will be constructive interference of the diffracted spherical waves at point B, at a distance f away from O. The corresponding radii of the zone boundaries, r_n follow from the geometry of the diagram and it also follows that the successive areas of the zones are all equal, to a very good approximation.

If instead of being blocked off, every second zone is coated by enough refractive material to produce a one-half wavelength of phase shift, the resultant zone plate will produce interference from each zone and lead to a fourfold gain in intensity at the focus.

This form of zone plate was invented by Lord Rayleigh and was implemented by R.W. Wood, the famous American physicist who used such an object as a camera lens [3]. (The fact that the panchromatic black-and-white film restricted the range of wavelengths recorded was a great help, because zone plates suffer from significant chromatic aberration: The focal length is proportional to the wavelength).

For visible light, for which refractive lenses are available, zone plates may have only limited applications. But for wavelengths for which this is not the case, e.g. far ultraviolet and even x-rays, they are extremely useful. Indeed, zone plates for x-rays [4] are of great use in some experiments at synchrotrons.

Furthermore, making use of the wave-like properties of slow neutrons, with deBroglie wavelengths in the nanometre range, the focusing and imaging properties of specially produced Fresnel zone plates have also been demonstrated [5], making Fresnel one of my personal 'heroes'.

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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.

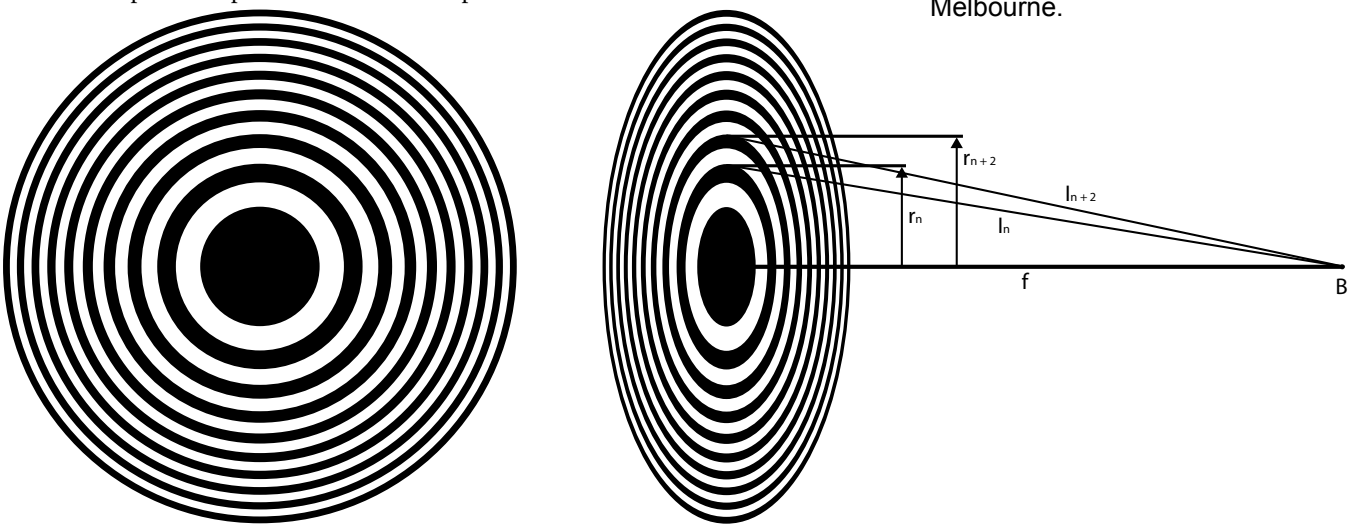

Figure 4. a) Central portion of a Fresnel Zone Plate. b) Special case of plane waves incident on a Zone plate with outgoing spherical waves focused at B.

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Preserving and Understanding Our Past....Optically

by Tim Wess

Recent years have seen growth in the science of cultural materials conservation and its use of light-based technologies. This is a brief review of the most common techniques in use today.

We place a great deal of importance on the physicality of objects as a symbol of our cultural identity that cannot be replaced by digital replicas – although sometimes something is better than nothing. The significance of each iconic object goes beyond the imagery or data content and speaks to our identity. Preserving our heritage is therefore not just about digitising resources but also understanding how they are changing and how to preserve them. There also is a major intersect with tourism where much of the tourism revenue of a country is based on the man-made augmentation of natural beauty.

Think of cultural heritage as easel paintings, paper/ink artefacts, stone monuments, wall paintings, ceramics, photographs, architecture and sculpture. These are complex objects where often the surface contains pigments, binders, supports, varnishes, glazes, additives etc.; all have rich spectral properties and all are subject to change. I have been careful to use the term change here as opposed to damage, because change is an objective term and damage is subjective. Think of the patina on a bronze, this is technically corrosion but also lustre is an intrinsic part of the appeal.

The last twenty years have seen an emergence of cultural heritage science into the mainstream, arguably because we have a better understanding of the imperative to preserve and also the technological opportunities to collect scientific data on a sample. Contactless analysis has allowed us to understand change without destroying the object we treasure, or may treasure in the future.

The interpretation of optical analysis here is the use of electromagnetic radiation to probe a sample. This can be used to digitise an image (to build a physical or virtual replica), clean objects for display, define the pigments and chemistry of a composition (and their change), or detect under drawing, underpainting and alterations to detect abandoned compositions.

The types of technology that can be used to record spectral and spatial information are through measurement of reflection, refraction, interference, scattering, transmission, polarisation, luminescence and fluorescence. By technique this can be described as the following. Optical Coherence Tomography (OCT), X-ray laminography and radiography measure sub-surface stratigraphy. Multi and hyperspectral imaging, laser induced breakdown spectroscopy, FTIR and THz spectroscopy determine surface properties and surface pigments. Digital photogrammetry and laser scanning are used for 3D reconstruction of objects.

Taking three specific examples:
Optical Coherence Tomography

OCT is a white light low intensity interferometry technique that utilises the different refractive indices of materials forming a substratum to be identified. The technology is probably best known in optometry where retinal scanning is now a regular High Street service. A recent review of the use of OCT by Targowski and Iwanicka [1], describes the inroads made into Cultural Heritage science by this technique. OCT is now used on whole paintings to identify changes of the substratum such as delamination and can also be used to measure the effect of restoration treatments such as removal of discoloured varnishes. Previously, the only way to obtain similar information would be to take small physical samples from the painting and examine them under a microscope. OCT allows whole paintings to be scanned, with research working towards a combination of higher resolution and increased penetration depth using longer wavelengths [2].

A study by Rouba et al. [3] provides an example of the use of OCT as a non-invasive technique to examine artworks. Change and attempts at restoration of a painting were detected using OCT. A tomogram from an oil painting is shown in figure 1, where surface damage in the upper varnish layer is seen as well as a crack between this layer and the layer below (indicated by the arrow). This delamination would not have been seen with typical techniques.

Laser Ablation cleaning

Laser ablation cleaning has emerged as a contactless controllable cleaning technology for Cultural Heritage objects. Compared to OCT, the radiation intensity is much larger and more akin to the lasers used for corneal and retinal surgery. This approach to cleaning removes the need for the use of solvents that can often cause complications with conservation processes, such as the conversion of highly fragmented collagen to gelatine in parchments; with the loss of structural integrity. However, the laser cleaning process itself can cause change to objects, with a yellowing of laser-cleaned stone objects sometimes identified. More recently a two wavelength approach to laser cleaning shows promise of a greater fidelity, here a synchronous combination of different levels of 1064 and 355nm

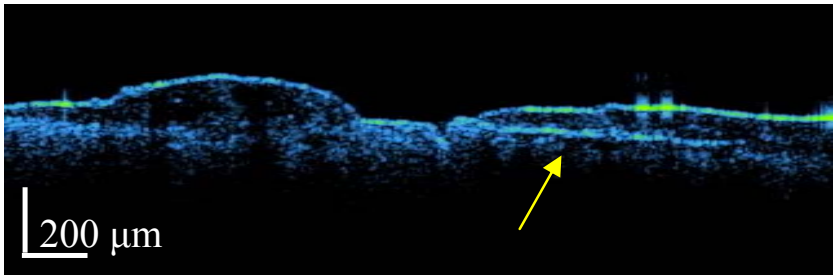

Figure 1 An OCT tomogram of the area of an oil painting showing surface abrasion. A delamination (arrow) can be seen underneath the varnish layer from the damage in the centre of the tomogram [3].

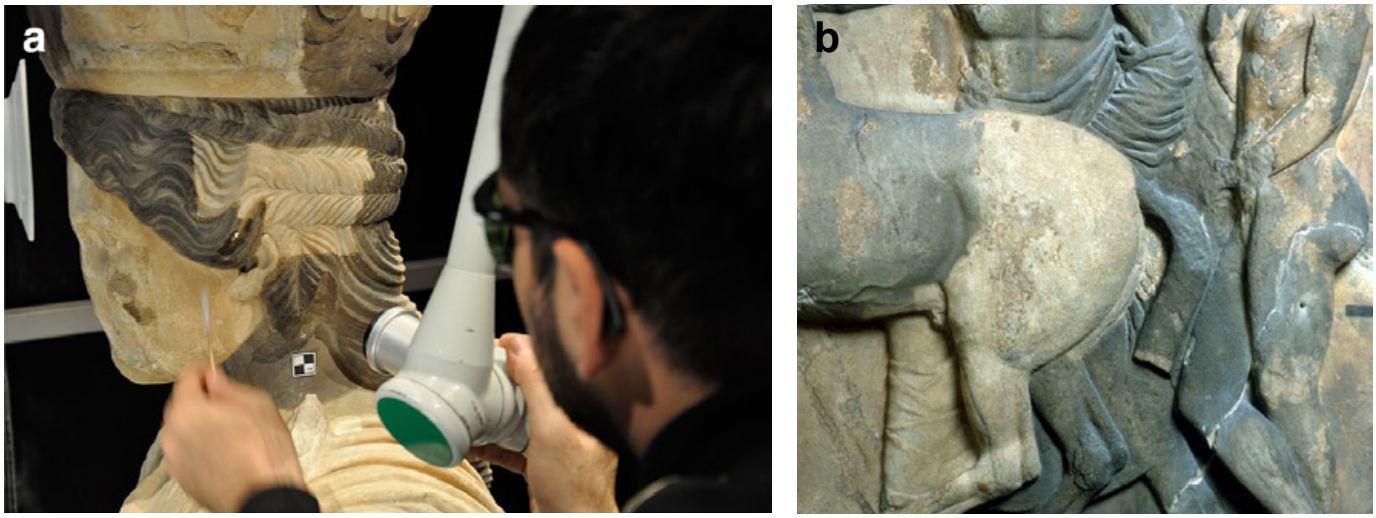

Figure 2. a) The Laser cleaning of Caryatid "A" inside the in situ laser laboratory at the Acropolis Museum [4]. b) Part of the Parthenon West Frieze during laser cleaning. The horse's rear and one leg has been laser cleaned.

lasers allows the differential penetration of radiation to be modulated with IR for more solid crusts and UV for surface soiling.

The Work of Pouli et al. [4] shows the development of a prototype laser system that was used to clean historic Greek monuments of the Athenian Acropolis that had suffered surface changes due to environmental pollution. The white marble surfaces became blackened with soot, heavy metals, gypsum and atmospheric particles which formed encrustations that needed to be removed. Figure 2a shows the system in action, with each sculpture processed individually but remaining in the gallery at the Acropolis Museum. Figure 2b shows a frieze that has been partially cleaned, with a clear difference visible of original and laser cleaned areas.

3D imaging

3D imaging for contactless acquisition of cultural heritage objects has grown rapidly with relatively versatile technology in the passive and acquisitional modes being used to model sculptures for reproduction and automated classification of pieces. Techniques such as photogrammetry obtain reliable 3D models by means of photographs. In digital photogrammetry digital images are used to recreate a three dimensional surface model. The information content can be elaborated by camera calibration and orientation, image point measurements, 3D point cloud generation, surface generation and texture mapping.

The work of Sansoni et al., [5] shows the imaging of the Winged Victory of Brescia, Santa Giulia City Museum, Italy, in figure 3. On the left is the original 2 metre high statue, and on the right is the full scale copy produced by rapid prototyping.

From the foregoing, optical sciences have been key to the analysis of objects in ways which were not thought of a decade ago. These can reveal information from objects that tell us about for example change, provenance, composition and validity of authorship. Most importantly many of these techniques respect the

Figure 3. The Winged Victory of Brescia. (left) The original statue. Image credit: Giovanni Dall'Orto. (right) The full scale copy of the statue [5].

need not to sample and also not to alter (damage) the object by irradiation.

2015 was the Year of Light. The journal Heritage Science set about collecting a series of publications showing the cutting edge of optical methods that have recently emerged or have been applied in innovative contexts for cultural heritage science. The collection was published this year. In addition, the third Gordon Research Conference on Scientific Methods in Cultural Heritage was held in 2016 and showed the maturation of this field in mainstream science. However, the field is so large and ripe for the application and development of cutting edge science, we've only just scratched the surface - figuratively speaking of course.

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Australian Research in the News

Ghost imaging with atoms

A team from ANU has used the technique known as 'ghost imaging' to reconstruct an image of an object from atoms that have never interacted with the object. This is the first time that ghost imaging has been achieved using atoms, although it has previously been demonstrated with light, leading to applications being developed for imaging and remote sensing through turbulent environments. The atom-based result may lead to a new method for quality control of nanoscale manufacturing, including atomic scale 3D printing.

Results obtained using ghost imaging with ultracold helium atoms of a mask with the ANU logo.

Lead researcher Associate Professor Andrew Truscott from the ANU Research School of Physics and Engineering (RSPE) said the experiment relied on correlated pairs of atoms. The pairs were separated by around six centimetres and used to generate an image of the ANU logo. "One atom in each pair was directed towards a mask with the letters 'ANU' cut-out," Associate Professor Truscott said. "Only atoms that pass through the mask reach a 'bucket' detector placed behind the mask, which records a 'ping' each time an atom hits it. The second atom in the pair records a 'ping' along with the atom's location on a second spatial detector.By matching the times of the 'pings' from pairs of atoms we were able to discard all atoms hitting the spatial detector whose partner had not passed through the mask. This allowed an image of 'ANU' to be recreated, even though - remarkably - the atoms forming the image on the spatial detector had never interacted with the mask. That's why the image is termed a 'ghost'."

Professor Ken Baldwin, also from the RSPE team, said the research may eventually be used for quality control in manufacturing microchips or nano devices. "We might one day be able to detect in real time when a problem occurs in the manufacturing of a microchip or a nano device," Professor Baldwin said.

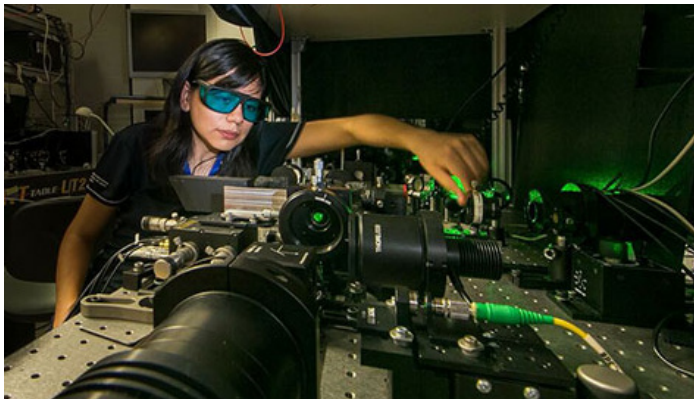
Co-author Dr Sean Hodgman said that on a fundamental level, the research could also be a precursor to investigating entanglement between massive particles, which could help the development of quantum computation. "This research could open up techniques to probe quantum entanglement," Dr Hodgman said. The ANU team also included PhD students Roman Khakimov, Bryce Henson and David Shin.

Source Material: Australian National University. www.anu.edu.au/news/all-news/anu-demonstrates-ghost-imaging-with-atoms

Original article: RI Khakimov, BM Henson, DK Shin, SS Hodgman, RG Dall, KGH Baldwin, AG Truscott, *Ghost imaging with atoms,* Nature, 540 (**7631**) 100 (2016). DOI: 10.1038/nature20154

New possibilities for night vision glasses

ANU scientists have designed a nano crystal around 500 times smaller than a human hair that turns darkness into visible light and can be used to create light-weight night-vision glasses. Professor Dragomir Neshev from ANU said the new night-vision glasses could replace the cumbersome and bulky night-vision binoculars currently in use. "The nano crystals are so small they could be fitted as an ultra-thin film to normal eye glasses to enable night vision," said Professor Neshev from the Nonlinear Physics Centre within the ANU Research School of Physics and Engineering. "This tiny device could have other exciting uses including in anti-counterfeit devices in bank notes, imaging cells for medical applications and holograms."



PhD student Maria del Rocio Camacho-Morales. Image courtesy of ANU.

Co-researcher Dr Mohsen Rahmani said the ANU team's achievement was a big milestone in the field of nanophotonics, which involves the study of behaviour of light and interaction of objects with light at the nano-scale. "These semi-conductor nano-crystals can transfer the highest intensity of light and engineer complex light beams that could be used with a laser to project a holographic image in modern displays," said Dr Rahmani, a recipient of the Australian Research Council (ARC) Discovery Early Career Researcher Award based at the ANU Research School of Physics and Engineering.

PhD student Maria del Rocio Camacho-Morales said the team built the device on glass so that light can pass through, which was critical for optical displays. "This is the first time anyone has been able to achieve this feat, because growing a nano semi-conductor on a transparent material is very difficult," said Ms Camacho-Morales from the Nonlinear Physics Centre at ANU.

The innovation builds on more than 15 years of research supported by the ARC through CUDOS, a Centre of Excellence, and the Australian National Fabrication Facility.

Source Material: Australian National University. www.anu.edu.au/news/all-news/anu-invention-to-inspire-new-night-vision-specs

Original article: R Camacho-Morales et al, Nonlinear Generation of Vector Beams From AlGaAs Nanoantennas, Nano Lett, 16(11) 7191-7197 (2016). DOI: 10.1021/acs.nanolett.6b03525

Ultrathin Flexible Graphene Oxide Lenses

by Xiaorui Zheng

Ultrathin graphene lenses just a billionth of a metre thick could revolutionise next-gen technologies. Xiaorui Zheng is one recipient of the 2016 Warsash Science Communication Prize in Optics for this article.

Human beings are naturally equipped with a pair of lenses to experience the surrounding world from birth to burial. In fact, optical lenses are indispensable components in many aspects of our daily life from cameras, glasses, microscopes and telescopes to optical sensors and detectors. The ever-increasing demands on device miniaturisation, flexibility and high performance have been the major driving force towards ultrathin flat lenses. Conventional lenses are made from a variety of engineered glass materials with a high transparency. Technologically, reducing the size of the lens and maintaining its high performance represent a major challenge since the performance of the lens is determined by how much its geometric shape is curved. Realising an ultrathin flat lens has been a dream for a long time that was only achieved with compromised performance a few years ago by nanofabrication of sophisticated structures.

We tackled this challenge by using the wonder material, graphene, which is inherently ultrathin and flexible. With a simple and cheap 3D laser printer, by writing a few concentric rings, we have realised an ultrathin graphene oxide lens of less than one millionth of a metre thick that can provide three-dimensional focusing on tiny details such as bacteria which the current technologies struggle to image. Our lens concept guarantees a 30-times efficiency enhancement compared to state-of-the-art flat lenses and has a broadband light focusing from the visible to the near infrared regions. Moreover, these flexible graphene oxide lenses are mechanically robust and can maintain excellent focusing properties under high stress. And best of all, the graphene oxide flat lenses are readily scaled up and integrated with any devices, including those with complex 3D surfaces.

Being tiny, flexible and of high performance, the graphene flat lens has enormous potential to revolutionise the technologies in medical diagnosis and treatment by viewing, manipulating, monitoring and trapping the tiniest particles in real time. A lighter and thinner smart phone with thermal imaging capabilities can be made possible by implementing our flat lens. Integrating the lens directly with a fibre can lead to the smallest endoscopes for surgery, reducing pain in medical surgery. And the weight of satellites can be dramatically reduced to save enormous launching fees. Last but not least, highly efficient photonic chips in supercomputers and superfast broadband distributions can be enabled by the lens. Just imagine wearing flexible wristband cameras using paper-thin lenses within the next five years!

Acknowledgements

Baohua Jia was supported in this work by the Australian Research Council through the Discovery Early Career Researcher Award scheme (DE120100291). Min Gu thanks the Australian Research Council for its support through the Laureate Fellowship scheme (FL100100099). Min Gu and Baohua Jia acknowledge the support from the Australian Research Council (DP140100849). We thank Dr Ye Chen for assisting in characterisation using the Nikon NSTORM system, Dr Benjamin Cumming for assisting in DLW and Dr Boyuan Cai for assisting in the filtration method.

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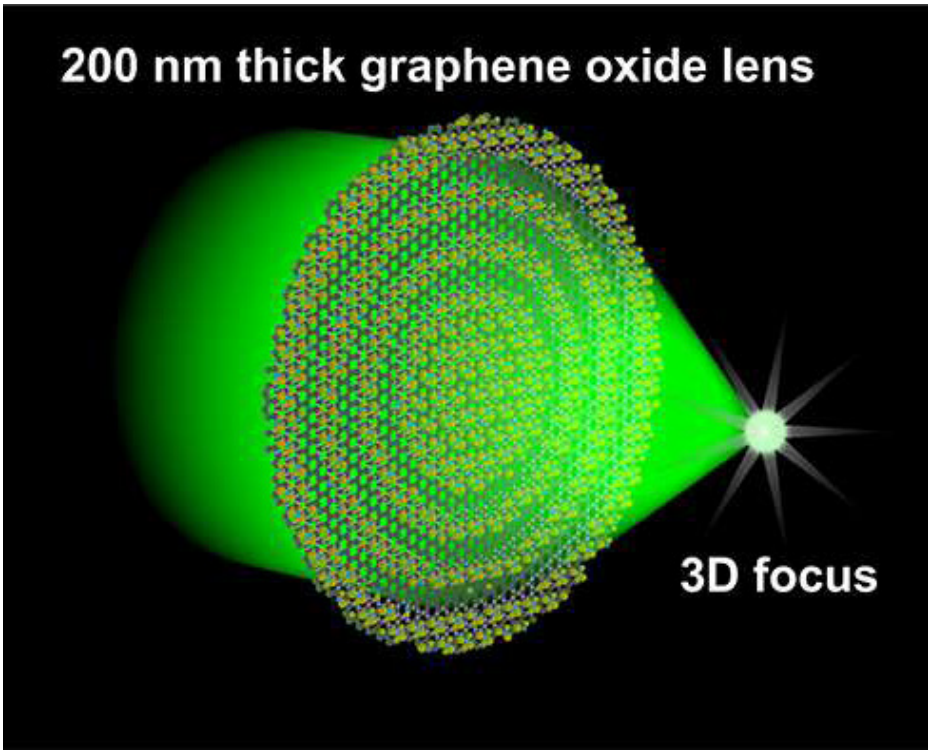
Xiaorui Zheng is with the Centre for Micro-Photonics, Faculty of Science, Engineering and Technology, Swinburne University of Technology.



The conceptual design of the ultrathin flexible graphene oxide lens.

Product News

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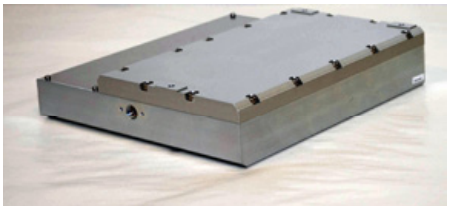

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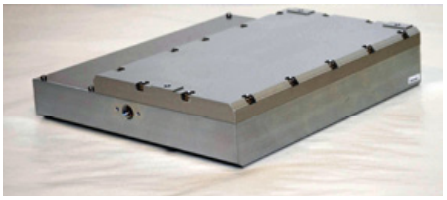

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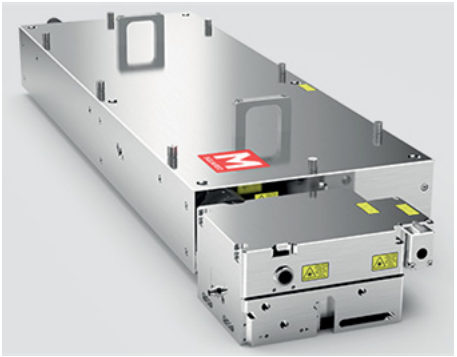

M Squared Lasers has launched its new External Mixing Module (SolsTiS-EMM), designed to complement the award-winning 'SolsTiS', CW narrow linewidth Ti:Sapphire laser.

SolsTiS-EMM enables access to previously hard to reach wavelengths in the UV, visible and IR regions, whilst also featuring the narrow linewidth, ease of use and ultra-stable output for which SolsTiS is well-known.

This new addition now gives M Squared's SolsTiS platform unrivalled wavelength coverage from 210 nm to 3.2 µm, achieved through a variety of extensions which feature doubling, sum frequency and difference frequency mixing schemes.

In particular, this all-solid state, hands free solution for wavelength coverage now supersedes dye lasers, removing the hazards and instabilities associated with this toxic gain material.

SolsTiS represents a step-change in continuous-wave Ti:Sapphire laser technology. It's a super-compact system with a completely sealed, alignment-free cavity unique to M Squared Lasers. It offers hands-free operation with an unprecedented tuning range, unrivalled power, and the ultimate narrow linewidth, low noise output. Cutting-edge applications for such tuneable, narrow linewidth visible light sources include unravelling cell biology to characterising single quantum emitters in quantum computation research.

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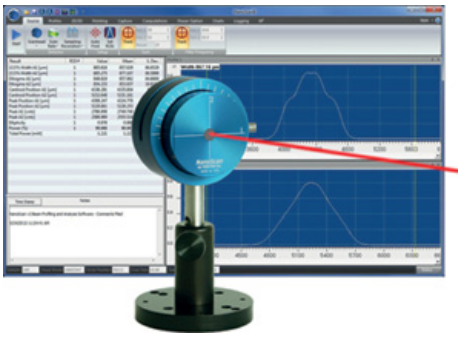
NanoScan 2s Beam Profiler



Warsash Scientific is pleased to announce the release of the latest version of NanoScan™2s scanning slit laser beam profiler for sub-micron measurement of beam position and size from Ophir-Spiricon, global leader in precision laser measurement equipment and a Newport Corporation company.

Now available in a more compact size, NanoScan 2s is a NIST-calibrated profiler that instantly measures beam position and size with sub-micron precision for CW and kilohertz pulsed lasers with measurement update rates to 20Hz. The profiler offers silicon, germanium, or pyroelectric detectors; this allows profiling lasers of any wavelength from UV to far infrared, to 100µm and beyond.

NanoScan 2s uses moving slits – one of the ISO standard scanning aperture techniques – to measure beam sizes from µm to cm at beam powers from µW to kW. The natural attenuation provided by the slit allows the measurement of many beams with little or no additional attenuation required. The digital controller provides deep, 16-bit digitization of the signal for high dynamic range up to 35dB power; this makes it possible to measure beam size and beam pointing with 3-sigma precision to several hundred nanometres. The silicon or germanium detector-based NanoScan 2s's include an integrated 200mW power meter that displays both total power and individual power in each of the beams being measured.

NanoScan 2s software can measure from one to 16 beams in the aperture with sub-micron precision. A beam can be found in less than 0.3 seconds and real-time updates can be displayed to 20Hz. The user can configure the display interface however it is desired; displaying only those results of most interest on one easy-to-read screen, or on multiple screens. The software controllable scan speed and a "peak-connect" algorithm allows the measurement of pulsed and pulse width modulated lasers with frequencies of 10kHz and higher. The NanoScan 2s software comes in two versions, STD or PRO. The Professional version includes ActiveX automation for integrating the profiler into OEM systems or creating custom user interface screens using C++, LabVIEW, Excel, or other software packages.

Precision Impedance Analyzer and LCR Meter

With the launch of the 5 MHz MFIA, Zurich Instruments is introducing a new type of impedance analyzer and precision LCR meter. The instrument is based on Zurich Instruments' proven lock-in amplifier technology, allowing more accurate (0.05%, typical) and faster (upto 20 ms per measurement point) measurements over a larger frequency range in comparison to conventional impedance analyzers.

The MFIA impedance analyzer is ideal for impedance measurements from 1 mΩ to 10 GΩ in the frequency range 1 Hz to 5 MHz; DC measurements can also be performed.

The instrument's LabOne user interface comes with a number of new features specifically designed for impedance analysis: the Compensation-Advisor supports the user step-by-step through the elimination of unwanted parasitic effects between the instrument and the probe; the Confidence-Indicator calculates the reliability level of the measurement based on the measurement parameters and sets a warning flag in critical cases; the Parametric Sweeper allows fast and simple automation of measurement tasks.

An embedded webserver makes software installation unnecessary, with the instrument being easily accessible via a web-browser. Measurement data can be transferred directly to PC and, for programmers, APIs and examples for LabView, MATLAB, Python and C are included.

The MFIA can be used for a broad range of applications including the characterization of semiconductor materials, components, and solar cells as well as dielectric spectroscopy, bio-impedance, and microfluidics.

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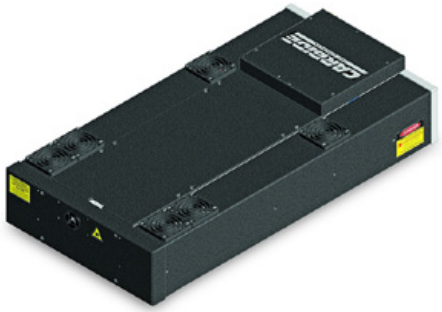
Light Conversion offers the CARBIDE, an industrial femtosecond laser. Featuring output power of >5 W at 1028 nm wavelength, with highest pulse energies of >85 µJ, it maintains all the best features of its predecessor PHAROS: variable pulse repetition rate in the range of 60 – 1000 kHz (amplifier internal clock) with the built in pulse picker feature for pulse output control, computer controllable pulse duration 290 fs – 10 ps.

In addition to the usual parameters CARBIDE brings in a few new technologies, one of the most important being a few times higher output average power to wall plug efficiency. It also features a novel approach to a cavity design where oscillator, stretcher / compressor and amplifier are integrated into a single housing, optimised for volume production. One of the most impressive features of CARBIDE is its size of 631×324×167mm including integrated power supply and air cooling unit. This represents about a 7 times reduction in system volume as compared to PHAROS, already one of the most compact ultrafast lasers on the market.



Ocean Optics QE Pro the highest performance miniature spectrometer

The QE Pro is a high-sensitivity spectrometer ideal for low light level applications such as fluorescence, DNA sequencing and Raman analysis. The QE Pro's back thinned CCD detector has high quantum efficiency and its robust design yields great signal to noise performance and stability. An optional internal shutter is available for effective management of dark measurements. In addition, the interchangeable slit option allows users to switch between absorbance and fluorescence measurements easily.

At a Glance:

- Wavelength range: Configurations support the range of 185 – 1100 nm
- User interchangeable entrance slits
- Optical resolution: 0.14 - 7.7 nm (FWHM) depending on configuration
- Internal shutter (optional) for effective management of dark measurements
- System SNR: 1000:1
- A/D resolution: 18 bit
- Dynamic range: 85,000 (typical)
- Stray light: <0.08% at 600 nm; 0.4% at 435 nm
- Buffering: 15,000 spectra
- TEC: Cooling to -40 ºC below ambient -40 ºC to +50 ºC temperature limits-ons

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

Watt pilot from Altechna - motorized attenuator enhanced for high energy and ultrashort laser pulses

Altechna's enhanced watt pilot version incorporates a rotating quartz λ/2 phase waveplate and one or two thin film polarizers which separate s-polarized and p-polarized beams. The intensity ratio of these two beams is continuously tuned by rotating the waveplate. Watt Pilot is essential in systems where stable laser power adjusting is necessary. Despite the stand-alone device look, the motorised attenuator is very compact and it can be easily integrated in custom optical systems.

Specifications:

- Clear aperture: 15 mm
- Bandwidth: Up to ±20 nm
- Configuration: Reflection and transmission modes
- Attenuation range @ CWL: Up to 0.3-99%
- Typical application: High power CW and pulsed lasers, LDs
- Damage threshold: >5 J/cm^2 10 Hz, 10 ns, 1064 nm; or >100 mJ/cm^2 1 kHz 100 fs, 800 nm
- Dimensions 91 x 63 x 108 mm - reflection mode
- Time between min and max attenuation: 3 sec
- Resolution: 41.54 arcsec/step
- Step accuracy in full rotation: ± 4 steps
- Backlash: ± 4 steps

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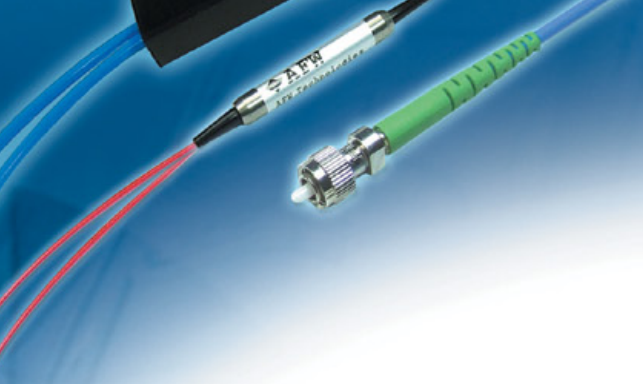

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