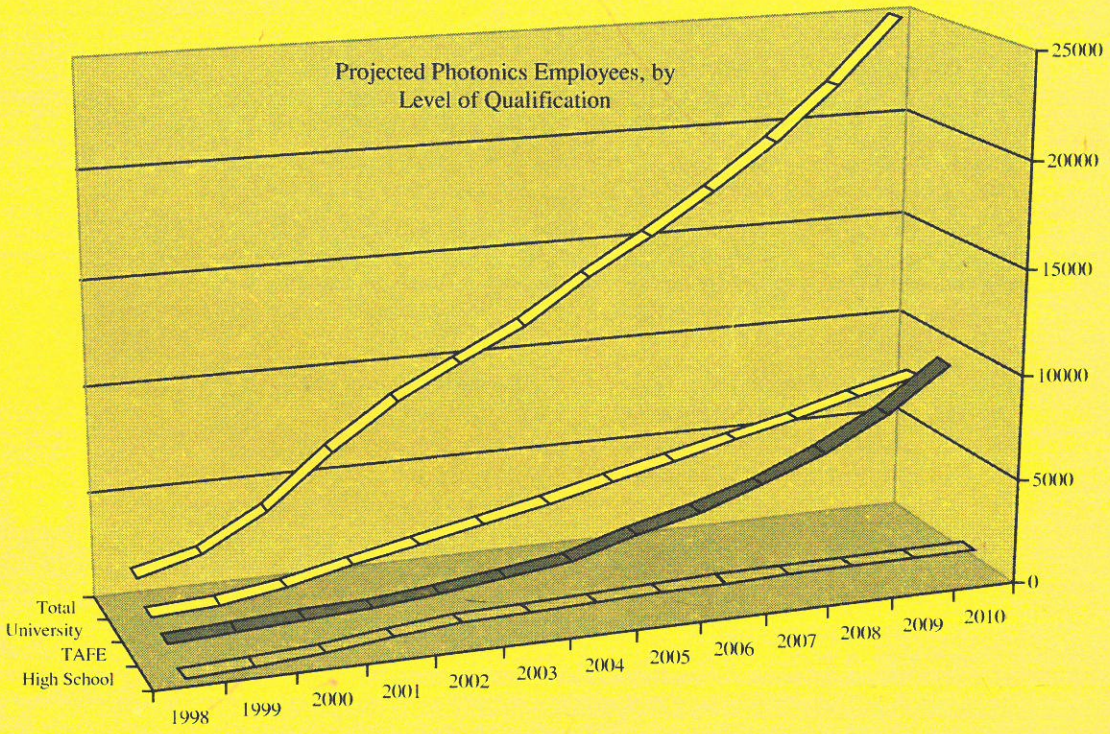
Australian Optical Society

NEWS



Photonics - Jobs For Everyone ?

Volume 14 Issue 2

December 2000

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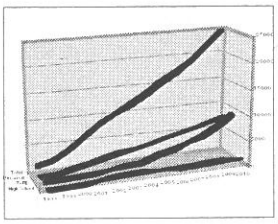

COVER :
The graph on the cover of this issue indicates the extremely rapid growth that is predicted for the photonics industry in Australia. The total number of jobs expected to be created by the year 2010 is extraordinarily large. To adequately fill these jobs, our education programs in schools, universities and technical colleges will have to respond to the challenge. (See the article on page 6 of this issue).

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

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AOS NEWS

ARTICLES

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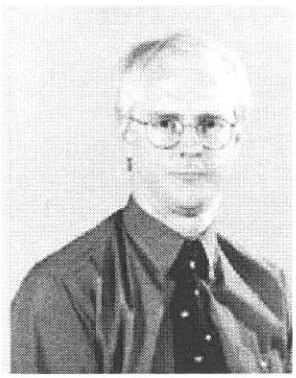
President's Report



I have just returned from the AIP congress in Adelaide which was, I am sure you will all agree, a very successful meeting. It was great to meet up with friends and colleagues as well as broaden our knowledge of what is going on in physics and in optics in Australia and around the world.

The AOS held a council meeting to discuss a variety of issues that are concerning us. At the meeting we were delighted to host Richard Hoover, President-Elect of SPIE, and Richard Powell, President-Elect of the OSA, and discuss the ongoing relationship between our organisations. I think it is fair to say that the members of the AOS will stand to benefit quite substantially from the relationships that are evolving with our (much) bigger cousins overseas. I also think that these initiatives will lead to much better value for money from those of you who are also members of these US based societies.

Another issue that we discussed was the nature of our continued conference participation. Next year the AOS conference will be located within an ACOLS meeting to be held at the University of Queensland. The following year will see an AIP congress in Sydney and we must determine whether the AOS conference will be held within that forum. I am inclined to the view that it should, but I think we need to find ways of retaining our AOS identity. This will be a matter for debate within the AOS council in the coming year. Please let me know if you have any views.

In my opinion, this is a time of considerable excitement in the field of optics. There has been a considerable buzz around physics departments in Australia as news spreads about the enormous demands for physics and engineering graduates in the burgeoning photonics industry. This is a message that needs to get out. We all know the difficult situation of university physics departments around Australia. The reasons for this are manifold, and the Federal government has a large part to play, but physics has particular difficulties because students do not perceive it as offering a rewarding career structure. I also think that physics departments around the country have historically been reluctant to embrace the new disciplines spawned by physics (such as computer science and much of electronic engineering). Physicists and engineers throughout Australia should let people know about the opportunities being created by the boom in high technology. I certainly hope that these developments will lead to a considerable growth in the corporate membership of the AOS.

There is more reason to be optimistic about next year with the expectation of increased funding in the ARC. Those of us who work in academic circles know the level of morale created by the miserly research support available in this country. More importantly, a thriving research community is essential to a powerful economy and I genuinely feel that, unless the government recognises what is driving the rest of the world, Australia is not going to thrive as a wealthy advanced economy. I think that message has finally been heard! In that regard, AOS councillor Ken Baldwin has played a leading national role in raising the profile of science and its importance in Australia and I would like to acknowledge the debt of gratitude that we all owe to Ken.

My institution, the University of Melbourne, is approaching the end of an era with the retirement of Geoff Opat. Geoff was President of the AOS in 1989 and his contribution to physics and education are enormous. In recognition of this contribution, Geoff was elected to Life Membership of the Australian Optical Society at the recent AOS council meeting. On behalf of all members, I offer my congratulations to Geoff on this well-deserved honour. His nomination document is printed in this issue of *AOS News*.

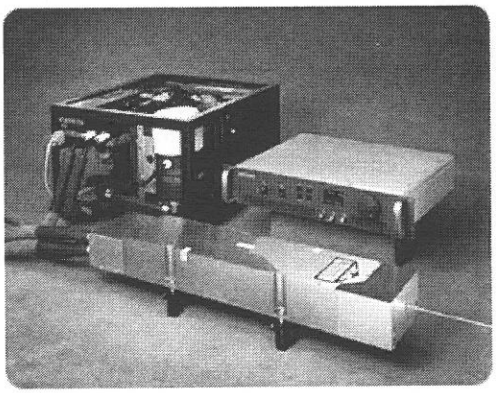
I hope that 2001 brings prosperity and happiness to all AOS members.

Keith Nugent
President of the Australian Optical Society
December 2000

Q: How does Santa deliver presents all over the world on Christmas Eve?

A: With Rudolf the red-shift reindeer

RAYMAX APPLICATIONS - Product Review



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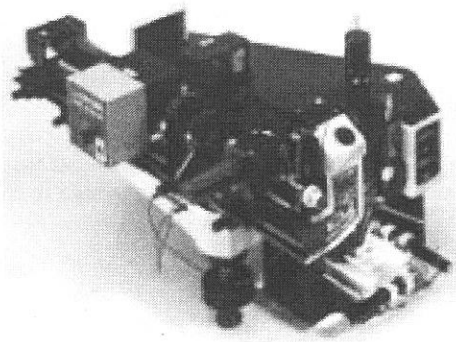

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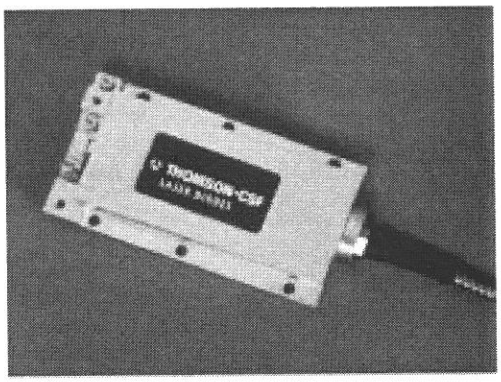

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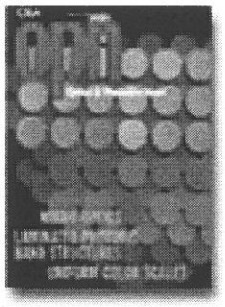

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The Business of Bandwidth

THE FUTURE OF PHOTONICS IN AUSTRALIA

Mark Sceats and Elizabeth Elenius
Australian Photonics CRC

History

Many AOS members will be familiar with the story of the establishment of the Australian Photonics Cooperative Research Centre, but it may be useful to recap for new members and other readers.

The Centre, established in 1992, brought together four research groups: the *Optical Fibre Technology Centre* at the University of Sydney, an interdisciplinary research centre with a history of inter-university/industry collaboration established through sponsorship of OTC (which merged with Telecom to become Telstra); the *Photonics Research Laboratory* at the University of Melbourne, also established through support of OTC and Telecom; the *Optical Communications Group* at the University of NSW with a long history of optical fibre research; and the *Optical Sciences Centre* at the Australian National University where some of the seminal basic research into waveguides and waveguide theory has been conducted. The Centre was initially supported by five industry participants – Telstra, Siemens, Fibernet, TransGrid and NEC, joined by eight additional industry participants in 1997, including two of the CRC's first spin-off companies.

Australian Photonics CRC was renewed in 1999 and now has twenty-nine participants[1] - five universities, DSTO, TAFE NSW, two venture capital companies, as well as five CRC start-ups and other industry participants. We have attracted a total commitment, including the $27.4M of Commonwealth funding, of $168,220,000 over seven years. This might seem a substantial amount but it is allocated between five Programs – Research and Development, Education and Training, Commercialisation, Business Development and Communications supported by an Administration Program operated through the Centre's technology management and marketing company, Australian Photonics Pty Ltd (owned by the Centre participants in proportion to their equity in the Centre). A substantial portion of the industry support is committed to Commercialisation.

The mission of the Centre is to conduct high quality research which is taken up by industry, the outcome of which provides social and economic benefit to Australia. We have adopted a number of different strategies to fulfill our objectives.

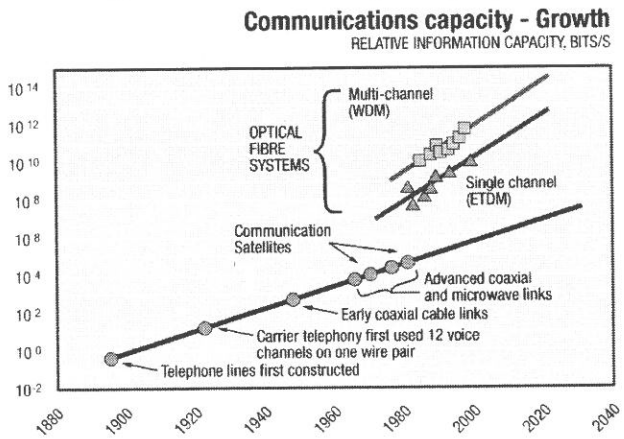
When the Centre was established, we envisaged that our industry participants would commercialise our research. However, it became apparent early on that our "user" partners were not into manufacturing; and our "systems integrator" companies (potential suppliers to user companies such as Telstra) whose head offices and R&D centres were located offshore, were difficult to persuade to take up Australian technology. So we realised that if we were to achieve our objectives, we would have to set up companies ourselves.

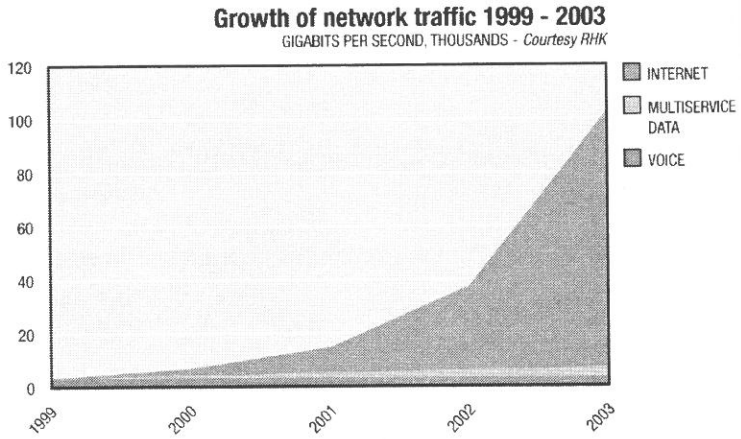
We established our first spin-off, Indx, in 1996, seeding it with CRC funding allocated for Commercialisation in its business plan approved by the Commonwealth Government (subsequently repaid). And, as they say, the rest is history.

The innovation from the Australian Photonics CRC has created ten companies, some of which have been sold or merged, but all of which have a substantial part of their operations, including manufacture, in Australia. Some of the companies are growing at a rate in excess of 200% pa.

So what is driving the growth of the photonics industry?

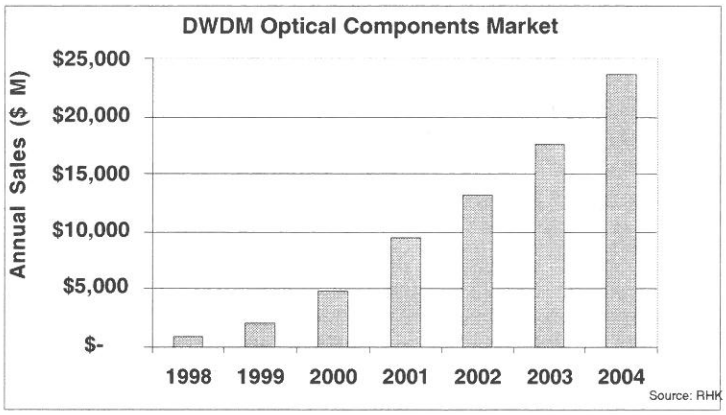
Growth of the Global Industry

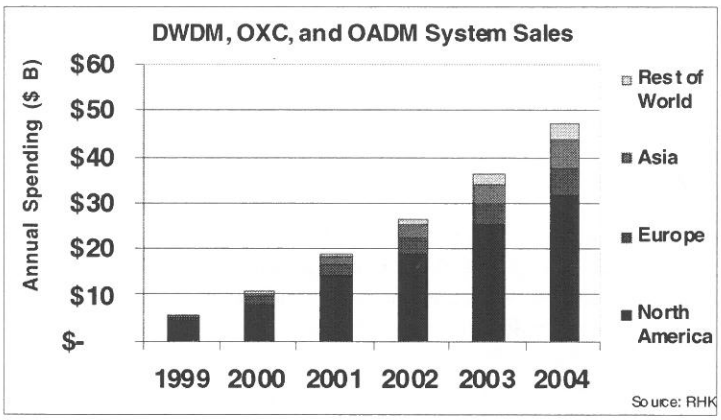




Photonics is the control, manipulation, transfer and storage of energy and information using photons. Optical fibre is the enabling technology for photonics, but worldwide is used at less than 0.1% of its capacity. Five years ago it was used at 0.01% of its capacity.

Optical fibre in the 1980s was initially used in undersea





and long haul links; in the 1990s the focus of optical fibre technology has been in interexchange and Metropolitan Area Networks (MANs); in the 2000s the emphasis is on customer access and Local Area Networks (LANs). Photonic technologies unleash the latent capacity of optical fibre and enable ultra-high bandwidth core networks (terabits/second).

The driver for the uptake of photonics is the growth in internet traffic. IP traffic will increase 30-fold in just four years from 1999 and, in 2000 has overtaken demand for telephony.

Optical fibres have increased system information carrying capacity to the extent that voice and image transmission now enable the explosive growth of the Internet. This rate of growth in system performance, more than 100 times per decade, defines the path of a "killer technology" that is destined to pervade all aspects of society[2].

The Centre has been focusing much of its R&D effort in recent years on developing new products for the Dense Wavelength Division Multiplexing (DWDM) components and sub-system market. Networks with DWDM equipment require multiple numbers of lasers, detectors and filters to allow multiple channels to transmit through one fibre optic cable. DWDM has largely been limited to submarine and terrestrial long-haul distances. Now the demand has also increased for metro-DWDM where customers want a smaller number of channels to send signals, but greater versatility, and at reduced cost.

In turn, these components will be installed in DWDM systems. RHK, the leading US Photonics Market Research firm, is forecasting continued growth in system sales, driven by network traffic growth, competition, and continued lower cost-per-bit.

Growth of the Australian Industry

In 1996 the Australian photonics industry was $238M and comprised around 1.2% of the global market. It has grown rapidly since then, in part as a consequence of the commercial activities spinning out of the Australian Photonics CRC.

From the sale of our first spin-off company, Indx, to Uniphase (now JDS Uniphase) from which we received around $10M, we have been able to support the establishment of the Redfern Photonics group of companies. The CRC through its technology marketing company, Australian Photonics, is the main owner of Redfern Photonics. Earlier in 2000, the company raised over $7M from Australian investors who included VCs, 'angel' investors, Australian Photonics CRC staff and other investors. The role of Redfern Photonics is to incubate photonics start-ups. To date, six companies have been established including:

Redfern Fibres Pty Ltd manufactures Application Specific Optical Fibres for a global market and was established in February 1998. In its first year of trading, sales exceeded the business plan by 100%. In March 2000, it received additional funding from strategic US investors. It is now NuFern Inc, headquartered in the US, its principal market, but with its manufacturing located in Sydney. Redfern Photonics still has a substantial stake in the company.

Redfern Broadband Networks Pty Ltd established in February 1999 to develop, manufacture and market broadband telecommunications equipment has grown from a staff of two, to over seventy at the end of 2000 and with plans to grow to 100 by mid 2001. RBN has created the *RBN GigaWave*™ photonic wavelength management system which enables multi-gigabit metropolitan area solutions using DWDM technology. It is modular and scalable from 1 Gigabit per second to 1 Terabit per second. The first units will be installed in Snowynet's MAN in Cooma, enabling possibly the most advanced ultra broadband network, certainly in Australia, if not the world. In November, 2000, RBN attracted $50M from US and Australian investors.

The other Redfern Photonics companies are *Redfern Optical Components*, *Redfern Integrated Optics*,

Redfern Interlink and *Redfern Polymer Optics*, all of which are gearing up for major product market pushes in 2001.

Redfern Photonics is also a partner in a joint venture in China, *Jiangsu Fasten Photonics* which is well advanced in establishing a major telecommunications optical fibre manufacturing plant in Jiangsu. Redfern Photonics is providing intellectual property (IP) and cash investment into what looks like being a very successful venture.

Redfern Photonics is establishing a flexible approach to winning the investment required to grow the companies, at all times keeping in mind the need to ensure that the strategies result in benefit to Australia. Joint ventures, mergers[3] and various levels of investment, including full sale if the price is right, have been implemented over the past four years.

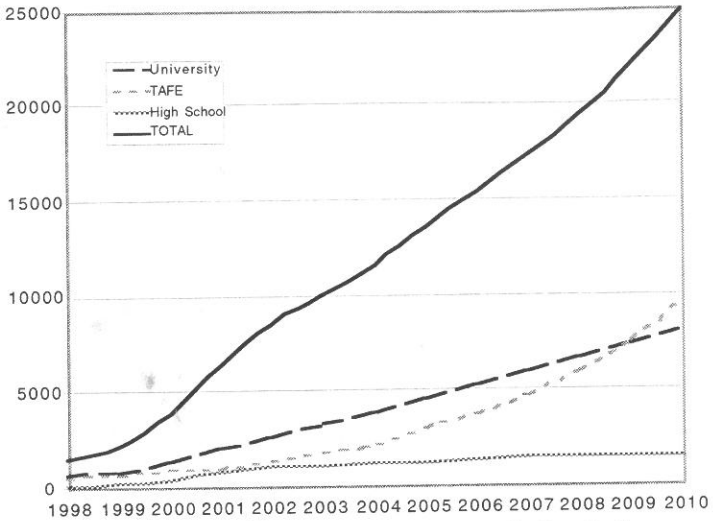
In addition to the companies spinning out of the CRC R&D, the Australian photonics industry also includes rapidly growing component manufacturing companies such as Photonic Technologies which spun out of OTC when it merged with Telecom and has now been acquired by Nortel Networks and Canberra-based ADC/AOFR, both of which have announced plans for major expansion, requiring hundreds of additional staff.

Just to retain its market share, the Australian photonics industry will have to grow at an average 29% pa from 1996 to 2010 to $8.5billion, employing 26,500 people. It will grow in relative size of Australia's GDP by a factor of 18 to 0.72% of the economy. Return on public investment in R&D and education programs could be as high as 25%.

Implications

Research - Australian Photonics CRC is now probably the largest telecommunications infrastructure R&D centre remaining in Australia. However, its R&D actual expenditure in the CRC (cash and in-kind) has been declining in recent years. The decrease is even greater in real terms. Contributing factors are changes in the political and business climate, including the introduction of competition and regulation in the telecommunications industry, plus a general decline in effective government incentives for industry and public sector R&D investment. In addition, the CRC was unable to make new commitments in view of the uncertainties relating to the continuation of the CRC Program itself and the subsequent delays in getting the renewal funding round started. The success of the CRC in commercialisation through transfer of staff to Australian industry and spin-offs has depleted the capacity for research in several key areas. The current rebuilding phase is providing great opportunities for the next generation of photonics researchers.

The Australian Photonics CRC – the only "hardware" CRC in the IT&C sector – aspires to become the "Bell Labs" of Australia through university, industry and government and industry support. For the photonics industry in Australia to be successful it must be



Projected photonics employees by level of qualification 2000 - 2010

supported by a continuing flow of research innovation to product. Some of the ideas now coming out of the production line had their gestation in the theoretical research conducted in our universities in the 1980s and early 90s. The funding base for the CRC's R&D will have to increase substantially to meet the challenges facing this fledgling industry in terms of transforming it from the cottage industry stage it is in now, to full automation.

Education – A further significant challenge is the industry's demand for skilled people. Our first spin-off, now JDS Uniphase, employed around six people when we sold it in 1996. It now employs 260 and will move into new expanded premises in Sydney, early in 2001. Redfern Broadband Networks had two employees at the end of 1999 and anticipates staff levels in excess of 70 by the end of 2000.

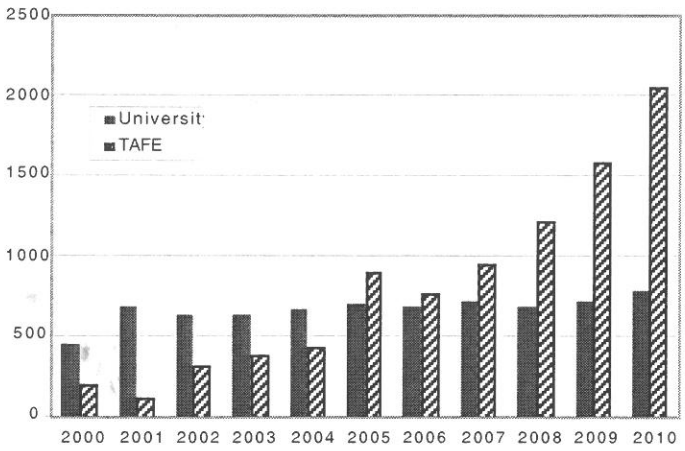
A recent survey of ten Australian photonics companies on their skills requirements to 2010 confirmed and indeed expanded the earlier projections undertaken by the CRC. Extrapolated to the industry as whole, it is anticipated that 26,500 jobs will be created by 2010. And the skills required are changing. In the early growth phase of the Redfern companies, postgraduate qualification in physics, chemistry and electrical engineering were sought. But with the challenges in moving to mass production and automation, companies are now seeking a wide range of qualified people including mechanical, mechatronic and software engineers, in addition to the traditional photonics disciplines. The mix of university and VET-trained graduates will also change as the industry matures. The CRC has recently won $1.5M through the Government's Science Lectureships Initiative to develop photonics educational modules. The objective is to boost the amount of photonics content taught in Australian universities. A feature of the project is that the modules will be shared. A challenge will be to persuade Universities to change their student profiles to make available places for additional students in relevant science and engineering programs. Photonics is emerging as a discipline in its own right, but its broad interdisciplinary base suggests that such

compartmentalising would be counterproductive. The Government has not increased the total number of students allocated to each University, so photonics will have to compete within established disciplines – and more realistically – with the Humanities for student places. Encouraging trends are new programs to be launched in 2001 – the B.Photonics at the University of Newcastle and revamped undergraduate Science and Engineering degrees with a strong photonics focus at the Australian National University. These new undergraduate programs will complement the successful B.Tech (Optoelectronics) at Macquarie University which has been supplying the CRC and its associated companies with "photonics-ready" graduates for a number of years. Swinburne University, VUT, the University of Melbourne, the University of Sydney and the University of NSW, in addition to those institutions mentioned above, are all collaborating with the CRC to boost the level of photonics offerings in their undergraduate programs. The University of Sydney is also launching the Certificate, Diploma and Masters in Applied Science (Photonics) to commence in 2001.

We are also working with the Department of Education, Training and Youth Affairs, ANTA and the IT&T ITAB to achieve the inclusion of a number of photonics modules in the Telecommunications training package for offering by TAFEs around Australia.

The CRC has established the Photonics Institute to provide a one-stop shop for photonics education in Australia. It will market the programs of universities and TAFEs associated with the Centre's educational initiatives, and coordinate the development of innovative modules and new delivery modes. In this regard, we have just signed an agreement with Questacon to develop innovation outreach programs for high school students, teachers and career counsellors. Activities will include demonstrations and workshops, but the success of these will depend on the involvement of university student volunteers in the various states to share the excitement of photonics careers. We are also developing a 30 minute educational video on photonics for schools, to be launched early in 2001.

Australia – The last great challenge is to generate an Australian market for the products of our spin-off and associated photonic companies. At present most of our products are sold to overseas markets. Our vision is to roll-out an ultra high bandwidth demonstrator network, initially in NSW, linking universities, research and education institutions, government agencies across Australia, to not only showcase our Australian photonics products, but also to provide cheap terabit/second bandwidth for data transmission, interactive classrooms (in real time), telemedicine, etc. It would also provide a platform for the development of new internet services and products and boost the "dot.com" industry sector which is stuck in the narrowband services market. We have noted the success of Canada's CANARIE demonstrator network



Industry demand for TAFE and University graduates with photonics skills 2000 - 2010

in underpinning the growth of companies such as Nortel, Cisco and JDS Uniphase.

Conclusion

The Australian photonics industry is at a critical point. During a recent visit to Australia, the recently retired CEO of JDS Uniphase, Kevin Kalkhoven, explored the exciting prospects for the industry but warned that we have two years to get it right. In particular he pointed out that manufacturing and automation were the key to future growth. We believe we have set in place a framework for success, but don't underestimate the challenges in finding the resources to maintain the R&D and education base necessary to provide our companies with skills and innovation.

Prof. Mark Sceats, CEO
Australian Photonics CRC

Elizabeth Elenius, Manager, Communications
Australian Photonics CRC

[1]ABB Transmission & Distribution Ltd, AOFR Pty Limited, Allen and Buckeridge Pty Ltd, Australian Photonics Pty Ltd, AEEMA, A E Bishop Innovations Pty Ltd, The Australian National University, BAE Systems Australia Ltd, CEOS Pty Ltd, Coherent Australia Scientific Pty Ltd, DSTO, Ericsson Australia Pty Ltd, Filtronic Components Pty Ltd, Future Fibre Technologies Pty Ltd, JDS Uniphase Pty Ltd, Macquarie Photonics Pty Ltd, Nextrom OY, Photonic Technologies Pty Ltd, Redfern Fibres Pty Ltd, Redfern Photonics Pty Ltd, RMIT University, TAFE NSW, Telstra Corporation Ltd, TransGrid, The University of Melbourne, The University of NSW, The University of Sydney, Virtual Photonics Inc, Vision Abell Pty Ltd

[2]The Economics of Science: from photons to products, Lionel C Kimerling, in *Optics & Photonics News*, October, 1998, pp19 - 22

[3]The CRC's second spin-off company, Virtual Photonics which merged with its only international competitor to become Virtual Photonics Inc, with centres in Berlin, San Francisco, New Jersey and Melbourne. Australian Photonics retains a small share in this company founded by two CRC engineers to commercialise photonic CAD software developed in the CRC.

Nomination to Honorary Life Membership

PROFESSOR GEOFFREY IVAN OPAT

AOS President 1989

Geoffrey Opat was born in Melbourne on 16 November, 1935 and entered the University of Melbourne in 1954 as Dux of Brighton Grammar School. He graduated with a BSc in 1956 and MSc in 1958. In 1961 he obtained his PhD with a thesis on theoretical aspects of Photonuclear Physics which contained results that are still being quoted to this day. He spent the following 3 years as a Fullbright Fellow at the University of Pennsylvania, with Professor Henry Primakoff, then one of the leading theoretical physicists in the U.S.A.

He returned to Australia in August 1964 and was appointed a Senior Lecturer in Physics. Although his training was in theoretical physics, he formed a research group in experimental high-energy physics which flourished for over a decade. This research group was one of the first to obtain funding from the predecessor of what is now the ARC and this enabled its members to travel to the large accelerator laboratories in the USA and bring back millions of bubble-chamber photographs for analysis here in Melbourne. This activity was highly successful for over a decade and resulted in a large number of publications on the interactions between antiprotons and neutrons.

Geoffrey Opat was appointed to the Chair of Experimental Physics in 1973. His wide-ranging interests and his genuine enthusiasm for teaching at all levels made this one of the most successful internal professorial appointments in the history of this University. Although his initial research field was High Energy Physics, he soon diversified his activities in an extremely fruitful and long-lasting collaboration with Tony Klein, carrying out fundamental experiments with neutrons. This work continued for the next twenty years and gave rise to numerous publications in the most prestigious international journals and culminated with the joint award of the Water Boas Medal of the Australian Institute of Physics in 1990. He served as President of the Australian Optical Society for 1989.

At the same time, Opat conducted experimental work in one of his other favourite areas of study, namely gravitation and its effects on the electrical properties of solids. He also broadened his neutron optics work in the direction of the optics with atomic and molecular beams. From 1995 onwards, in collaboration with Dr Peter Hannaford of the CSIRO, several groundbreaking investigations into optical elements for atomic beams were carried out resulting in many highly cited publications. He was elected a Fellow of the Australian Academy of Science in 1994.

Geoffrey Opat's enormous influence on the teaching of physics at the undergraduate and postgraduate levels cannot be under-estimated. With a broad as well as profound knowledge of all the major branches of Physics he has initially reformed and later kept under constant review the curricula in the School of Physics.

At the same time he has also had a profound influence on physics teaching in high schools, through his membership of the examining bodies and other government-appointed committees in Victoria. Examples of Geoffrey Opat's service to the teaching community include the highly successful "Physics Gymnasium" – a programme of enrichment activities for senior high-school students; his regular lecture in the annual "July Lectures in Physics", and his participation in the "In-Service Teaching Programme" for high school teachers. He is also the organiser of the Victorian chapter of the Australian Academy of Science and a Board Member of the Museum of Victoria. The latter activities, together with his continued involvement with research projects, will guarantee a busy life in retirement.

His enthusiasm for teaching physics at all levels, from kindergarten to postgraduate, and his enormously creative ideas in many different areas have been the hallmarks of a remarkable career, and of wonderful service to the optics profession.

I commend Professor Geoffrey Opat FAA to the Australian Optical Society as an extremely worthy recipient of Honorary Life Membership.

Keith Nugent
President, Australian Optical Society

December 6, 2000

SPIE
THE INTERNATIONAL SOCIETY FOR OPTICAL ENGINEERING

SPIE - What's In It For You?

Most AOS members are by now aware that they are entitled to a discount on SPIE membership dues, but many are unaware of what SPIE is, and the benefits of joining.

SPIE was formed in 1955 as the Society for Photo-optical Instrumentation Engineers, and has been dedicated to providing the best possible service to the optical engineering community. SPIE is an international technical society dedicated to promoting the engineering and scientific applications of optical, photonic, imaging and optoelectronic technologies through its education and communications programs, meetings and publications.

SPIE offers...

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Today SPIE is the largest international professional engineering society serving the practicing engineer and scientist in the field of optics and photonics. The Society serves the global technical and business communities, with over 14,000 individual, 320 corporate, and 3,000 technical group members in more than 75 countries worldwide. Advance professionally through networking and visibility among your peers. Learn from others and gain access to the voices, ideas, and the energy of a global community.

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Among the many services the Society offers are the sponsorship, planning, and execution of technical conferences, product exhibitions, and symposia. SPIE's technical meetings and symposia are internationally-acclaimed gatherings of engineers and scientists working in optics, optoelectronics, and many related fields. They take place in large and small venues, from specialised topics to cross-disciplinary information exchanges, complete with extensive programs including short courses, workshops, and other special activities.

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...and More

In addition, SPIE provides numerous services to its members, including on-line electronic databases, electronic bulletin board and networking services, and employment assistance. To further serve the public good, the Society sponsors a number of awards, scholarships, and educational grants every year, and publishes a comprehensive catalogue of educational resources in the optics field, *Optics Education*.

To join SPIE: Complete the online membership form at *www.spie.org/membership_form.html*, print and fax it to SPIE along with a copy of your AOS dues receipt. (Be sure to indicate that you are eligible for the US$20 discount as an AOS member). Any queries can be directed to Mr Paul Giusts at *membership@spie.org*

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The Swinburne Optronics & Laser Laboratories (SOLL)

Wayne Rowlands

This article gives an introduction to one of Australia's newest University-based research centres dedicated to optics and lasers. The various research centres involved are described, and an overview given of their research activities.

Introduction - Strategic Initiatives

Swinburne University of Technology has not traditionally been associated with optics research. Indeed, until very recently, the University did not have a very strong research focus. This is reflected in the fact that many academic and research professionals around Australia are essentially unaware of Swinburne's existence or physical location, much less its research interests (for the record, Swinburne is a multi-campus university in Melbourne, with its main research laboratories located in the inner suburb of Hawthorn).

Over the past several years, the Vice-Chancellor of Swinburne has been aggressively pursuing the aim of establishing an internationally recognised research-intensive university of technology. To realise this aim whilst remaining a relatively small university, Swinburne has chosen several niche research areas in which to focus its investment of resources. The approach has been for the Chancellery to identify key areas, recruit recognised research leaders, and establish state-of-the-art facilities; all of this through Swinburne's "Strategic Initiative" funding program. Strategic Initiatives that have been successfully established to date cover a wide range of disciplines. In the area of physical sciences these include centres for astrophysics and supercomputing, numerous programs within the Industrial Research Institute Swinburne (IRIS), and several optics and laser centres located in the Swinburne Optronics and Laser Laboratories (SOLL).

Co-ordination, Co-operation, Collaboration - SOLL

The Swinburne Optronics and Laser Laboratories (SOLL) comprises four distinct research groups, each of which will be discussed in detail in the following sections. The four groups are

- Swinburne Centre for Ultrafast Laser Spectroscopy (SCULS)
- Centre for Micro-Photonics (CMP)
- Centre for Imaging and Applied Optics (CIAO)
- Optics Research at the Industrial Research Institute Swinburne (IRIS)

The first three of these centres exist within the School of Biophysical Sciences and Electrical Engineering (BSEE). The individual groups are independent and self-directed. SOLL came into existence primarily as a way to facilitate and co-ordinate a wide range of common issues that affect the centres. The grouping of the University's optics-based research under the umbrella of SOLL has already shown many benefits. Primary amongst these is that it has helped to foster a strong feeling of co-operation between the groups, leading to the development of collaborative projects. Another major function of SOLL is to co-ordinate some of the shared resources of the research groups, including laboratory space, buildings and infrastructure. A more obvious function of SOLL, particularly to people outside of the organisation, is aiding in response to the oft-asked question "What the heck is happening with optics at Swinburne University?".

Facilities & Infrastructure

The new purpose-built facility that SOLL occupies was formerly the ground-floor car park of the Applied Science Building, and was completed in two stages. The first stage, completed in February 1999, was officially opened by Prof. Ahmed Zewail of CalTech, who went on to receive the 1999 Nobel Prize for Chemistry (there is no causal link between the two events!). The total area of the complex was more than doubled with the completion of stage two in April 2000. SOLL now has in excess of 800 square metres of building space, with 11 individual laboratory spaces, a precision machine workshop, student workshop, meeting room, library, student and staff office space. All of this has been designed with a mind to the cleanliness, air conditioning, lighting and other infrastructure requirements for quality optics and laser laboratories.

Teaching Programs

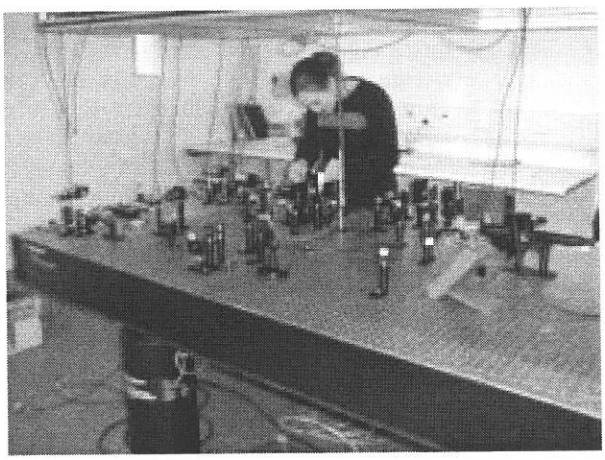
An important aspect of any research laboratory is the training of future research scientists. SOLL embraces this responsibility in a number of ways, including the traditional involvement of higher degree students (PhD and MSc) in the research groups. Additionally, two new honours-level courses have been created in BSEE. The new courses (beginning in 2001) are Honours in Optronics and Lasers, and Honours in Biophotonics. The one-year courses will provide academically

challenging coursework combined with appropriate research projects in one of the groups comprising SOLL.

Swinburne University also runs a specialist undergraduate "R&D" double degree, BEng/BAppSc (Research & Development) for a small number of academically strong students (ENTER scores > 95). As part of this degree, students undertake semester-long research projects at several stages through their course. Many of the R&D students choose research projects within SOLL, and often contribute as strongly as Honours year students. SOLL is also heavily involved in the development of plans for Swinburne to run a specialised undergraduate course in Photonics.

Swinburne Centre for Ultrafast Laser Spectroscopy (SCULS)

Established in 1998, SCULS was the first of the optics-based strategic initiatives to be set up at Swinburne University. It was conceived by Prof Peter Hannaford, who is director of the centre, and has had many years experience leading the Laser Spectroscopy group in CSIRO. A large part of the research direction of SCULS deals with various applications of ultrashort laser pulses. The main experimental facility consists of an ultrafast laser system, including ~50 femtosecond Ti:sapphire laser oscillator, Ti:sapphire regenerative amplifier, and dual independently tunable optical parametric amplifiers, which cover the full wavelength range from the ultraviolet to the infrared. Current research projects that use this facility include: ultrafast molecular dynamics, investigation of biological molecules, femtosecond coherence spectroscopy, and femtosecond laser ablation.



Another aspect of the research at SCULS is the generation and application of ultracold atoms and molecules. Very recently, three senior scientists (formerly with the CSIRO Laser Spectroscopy group) have joined SCULS to extend their work on magnetic optical elements for cold atoms, with application to atom interferometry and integrated atom optics. Along similar lines is a separately funded Strategic Initiative project investigating the new concept of ultracold molecules. With the arrival of Prof Tien Kieu in the group, another new line of research is developing in the area of quantum information theory.

Molecular Dynamics

One of the rapidly developing research areas at the moment is that of "femtochemistry". Using the ultrafast laser at SCULS, the precise nature of chemical reactions, the making and/or breaking of chemical bonds, are studied in the "clean" environment of a supersonically-cooled molecular beam. In addition to pump-probe spectroscopic measurements, femtosecond coherence spectroscopy techniques are being developed to probe the structure of atoms and molecules.

Biological Molecules

Many important processes in biologically-active molecules occur on sub-picosecond timescales. SCULS presently has an experimental project to investigate myoglobin and hemoglobin, two molecules responsible for the storage and transport of oxygen in biological systems. Techniques used include two-colour pump-probe spectroscopy, and transient grating diffraction.

Femtosecond Laser Ablation

In conventional laser ablation work, short high-power laser pulses are used for the precise machining of surfaces and substrates. The *ultrafast* high-power pulses generated at SCULS are opening a new regime of micromachining, where new mechanisms are involved in the removal of material from the surface. This work is a collaboration with the micromachining group at IRIS (see below).

Atom Optics

The techniques of laser trapping and cooling of neutral atoms offer new advances in optics based on matter waves. The pioneering work on magnetic atomic mirrors that was begun at CSIRO (by Hannaford and other members of SCULS), in collaboration with the University of Melbourne, is being extended to atomic gratings and microfabricated integrated atom optical elements. This will be combined with a new experimental endeavour involving Bose-Einstein condensation, with the goal of demonstrating a precision atom interferometer.

Ultracold Molecules

Although the techniques of laser trapping and cooling of neutral atoms have become well developed over the past decade, the extension to molecular systems is only a recent development. The ultracold molecule project aims to investigate efficient photoassociation schemes for producing ultracold molecules from laser-cooled atoms , and to then trap the molecules in optical traps for subsequent high precision and ultrafast spectroscopy.

Centre for Micro-Photonics (CMP)

CMP is the most recent strategic initiative group to be established at Swinburne, and it significantly expands the scope of research within SOLL. It is led by Prof Min Gu, who had already established a substantial research program whilst at Victoria University of Technology. CMP was officially opened on October 26 2000 by Professor Gordon Kino from Stanford University. The official opening also included a scientific workshop, including presentations from international visitors Gordon Kino and P.C. Chen, as well as some acknowledged Australian leaders in relevant areas of optics, including Jim Piper, Colin Sheppard, and Keith Nugent.

In 2000, CMP includes two academic staff members, four postdoctoral research fellows, one administrative assistant, one senior technical officer, four PhD students, one MAppSc student, one honours student, three fifth year electrical engineering students and two visiting scholars (a total of 19 people). The centre is divided into three research groups in the area of biophotonics, photonic data storage and devices, and nano-photonics.

Biophotonics

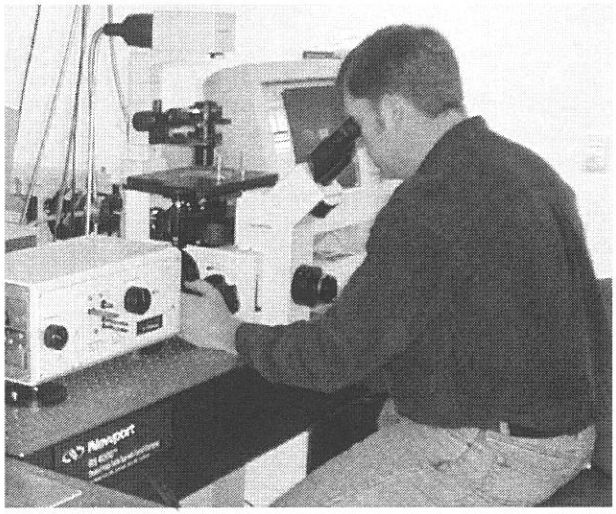
Biophotonics has become a key foundation in the biotechnology industry in most of the developed countries and will be one of the important disciplines in the new century. Biophotonics research in CMP is focused on two aspects:

- *Optics:* femtosecond optics; near-field optics, nonlinear optical microscopy (superresolution), fibre optics, laser trapping.
- *Optics and lasers in health care*: laser-tissue interactions; fibre-optical endoscopes, detection and treatment of tumours; laser tweezers in biological studies; confocal microscopy in biological studies; near-field microscopy in biological studies; biochips; image reconstruction through tissue.

Photonic Data Storage and Devices

High density data storage is one of the key aspects in information technology. Photonics crystals - the optical analogues of electronic crystals - are materials patterned with a periodicity in dielectric constant. They provide the opportunity to shape and mould the flow of light for photonic information technology. New photonics crystals based on polymer materials may hold the key to producing all-optical integrated circuits. Research work at CMP is focused on the following aspects:

- *High-density optical data storage:* three-dimensional optical data storage methods in low cost polymers (3DCD); commercialisation of 3DCD.
- *Photonic Crystals*: fabrication of new photonic crystals using photopolymer materials; development of novel lasers and detectors using new photonic crystals.



Nano-Photonics

Nano-photonics is a new area which involves the development of photonic devices at micro- and nano-scales. Research in this group is centred in the following areas:

- *Laser trapping*: lasing in micro-cavities for near-field microscopy; laser trapping for single molecule detection.
- *Nano-particles*: development of biochips with nano-particles/crystals.

The combined activity of the above three focus areas within CMP results in a large number of individual research projects. Currently these include:

- Three-dimensional microscopic image reconstruction through complex tissue-like media for cancer detection
- Multi-photon micro-spectroscopy for early cancer detection
- Two-photon fluorescence resonance energy transfer microscopy
- Three-dimensional optical data storage with photorefractive polymer materials
- Development of compact three-dimensional optical data storage systems
- Fabrication of photonic crystals using two-photon induced polymerisation
- Super-resolving fibre-optical nonlinear microscopy
- Laser tweezers for single molecule detection
- Lasing in micro-cavities
- Near-field scanning imaging based on optical trapping

CMP has rapidly established itself at Swinburne, and now operates an impressive technologically advanced research facility. Four complete and independent laser laboratories are amply supported by a computing laboratory and office space for students, post-docs and visiting staff. CMP is well set up with regard to lasers, microscopes, and associated optics, and is in the quite unique position of having three independent femtosecond pulsed laser systems.

Centre for Imaging and Applied Optics (CIAO)

CIAO commenced operations in 1998, and is directed by Dr Alex Mazzolini, who has been involved in optics research and teaching at Swinburne for more than ten years. The initial focus was in the areas of medical and industrial applications of confocal microscopy and other imaging techniques, and optical fibre sensors. With the arrival of Prof. David Booth in 1998, the scope of research was expanded to include work on the spectroscopy of rare-earth doped optical materials, and the development of diode-pumped solid-state lasers.

Optical Fibre Sensors

Recent work at CIAO has involved the development of a fibre optic respiratory plethysmograph (FORP), in collaboration with the Royal Children's Hospital in Melbourne. Research on the FORP is continuing to study its application in the characterisation of high frequency ventilation in neo-nates (extremely premature babies), as well as the detection of sleep apnoea events in adults.

Projects currently under development include fibre optic techniques for sensing displacement and velocity in micromachined structures, and fibre optic sensing in "smart structures". There is considerable interest in the application of smart structure techniques, such as absolute interferometric fibre sensors for strain and vibration, to civil engineering.

Microscopy

The Scanning Laser Microscopy Laboratory in CIAO is mainly focused on the development of innovative designs of optical microscopy instrumentation (confocal and 2-photon scanning laser microscopy) and allied technologies. This work has been centred around a collaboration with Optiscan Imaging Ltd., and investigations of new fibre optic based microscopes, with the potential to be miniaturised for biomedical use (endomicroscopes).

Fibre & Laser Materials

The work on new optical materials for solid state lasers has concentrated on heavily doped rare-earth ions in a variety of glass hosts. Glasses under investigation include fluorozirconate, fluoroaluminate, and phosphate hosts, with the principal active dopant ions being erbium, thulium, and holmium. In some materials, co-dopants such as ytterbium and terbium are added to aid selective pumping or de-activation of particular levels. Spectroscopic measurements have included a range of fluorescent intensity and lifetime studies, using CW and, more recently, the tunable high-power short-pulse OPO light sources available in CIAO. The materials are produced in collaboration with the Amorphous Materials Group at Monash University.

The approach to understanding the behaviour of these materials has been to construct detailed mathematical models of the energy level dynamics. These models are used to predict optimum lasing conditions for new materials, which are subsequently tested experimentally. Recent work on Er doped fluorozirconate materials identified and quantified new ion-ion energy exchange mechanisms.

Optics Research at the Industrial Research Institute Swinburne (IRIS)

The fourth research group that comprises SOLL is physically separate from the rest of SOLL (indeed, they are at the opposite end of the campus, although Swinburne Hawthorn is only a small campus). The IRIS component of SOLL complements the other groups in many ways, not least of which is their very close alignment to the industrial applications of optics and lasers. IRIS is a participant in several relevant CRCs with this work: the CRC for Microtechnology, the CRC for Intelligent Manufacturing Systems, and the CRC for Cast Metals Manufacturing.

There are two areas of industrially-focussed optics and laser research at IRIS: micromachining technology and high-power laser processing.

Micromachining Technology

This work is led by Associate Prof. Erol Harvey, and aims to combine various technologies (including lasers) to construct highly integrated systems at micron and sub-micron scales. Examples of such systems include nebulisers, micromotors, medical implants, flat panel displays, microspectrometers, micropumps, optical network components, chemical sensors, and force-microscope tips. Much of the research uses a state-of-the-art excimer laser micromachining system, using mask projection to write structures by laser ablation of the surface. Some typical research projects include:

- Patterning Thin Films for Sensors
- UV Modification of Polymers for Enhanced Bio-compatibility
- Novel Structures Using Rotating Masks
- SU-8 Ablation for Rapid High Aspect Ratio 3D Microfabrication
- Dynamic Measurements of Microsystems
- Micro Optics for Atom Lithography
- New Machining Strategies for Glass
- New Machining Strategies Using Excimer Mask and Workpiece Dragging.
- Femtosecond Laser Ablation (in collaboration with SCULS)

High Power Laser Processing

This laboratory, led by Associate Prof. Milan Brandt, is involved with the research and development of new products and processes with industrial partners in the areas of laser surfacing, laser welding and laser cutting. The facilities include a 3 kW Nd:YAG laser, delivered through a 0.6 mm diameter optical fibre, combined with a four-axis fully integrated CNC system.

Typical research projects involving high-power lasers include:

- Development of laser drilling technology for production of fine perforations in metal shims.
- Investigation of laser technology for cleaning tyre mould microvents
- Pulsed laser cladding with Nd:YAG lasers and optical fibres.
- Thick plate cutting with Nd:YAG and CO2 laser
- Experimental and theoretical investigation in laser cutting of metals with a pulsed laser
- Microstructure and mechanical properties of WC/Ni clad layers produced with a pulsed Nd:YAG laser and optical fibres

Summary

This article has attempted to give an introduction, with a little added detail, to the recently developing optics and laser research groups at the Swinburne Optronics and Laser Laboratories. Much of the information here has been very general in nature, but further detail can be obtained by contacting the groups directly (see below). It is still "early days" for SOLL, although it appears that with the addition of sustained hard work, the investment of resources into this new facility should pay off with some excellent science being developed.

More Information

Additional information (including contact details) about the various centres can be found on the SOLL website at

http://www.swin.edu.au/optics/

Wayne Rowlands
Swinburne Centre for
Ultrafast Laser Spectroscopy

AOS MEDAL

AUSTRALIAN OPTICAL SOCIETY

The Australian Optical Society is seeking nominations for the fifth award of this medal, which is for an outstanding contribution or contributions to the field of optics in Australia by a member of the Australian Optical Society.

Previous winners of the medal have been:

1995: Mr Bill James, James Optics, Melbourne
1996: Dr Parameswaran Hariharan, University of Sydney and CSIRO
1997: Professor Jim Piper, Macquarie University
1999: Professor Dan Walls, University of Auckland

This Medal is the most prestigious award of the Australian Optical Society. It would normally be presented only to a nominee at an advanced stage of his or her professional career and with a strong and sustained record of authority, enterprise and innovation in the field of optics in Australia.

Nominations for the 2001 AOS Medal Winner should include brief personal details and a curriculum vitae emphasising the main contributions made by the nominee to Australian optics. Two letters of recommendation should also be provided. Nominations may be made either by or on behalf of any eligible candidate. The selection panel reserves the option to seek additional information about candidates for the award. It is hoped that the person selected to receive the medal will be able to do so at the next AOS Conference.

The closing date for nominations is **15 February 2001**.

Nominations should be sent to the Secretary:

Dr Peter Farrell
Department of Applied Physics
Victoria University
PO Box 14428, MCMC Melbourne,Vic. 3001
Fax. (03) 9688 4698

ADVERTISEMENT

Lastek New Product Announcements:

Below are presented several new products from Spectra-Physics Lasers, where advances in scaleable, solid state technologies are leading to new families of compact, high-power lasers. These devices are enabling tools for emerging applications in telecommunications, materials processing and biological imaging:

• Spectra-Physics release *Vanguard*: All-new High power solid state UV Laser

- Spectra-Physics Lasers (Mountain View, CA) has announced the release of a completely new type of all solid state laser that provides over 4 watts of quasi-cw output at 355 nm.
- The *Vanguard* is the first high power, commercial laser to utilise SBR (Saturable Bragg Reflector) technology, under license from Lucent Technologies. This simple, robust mode-locking mechanism results in a pulsed, high repetition rate output, making this laser well suited to applications currently using cw gas lasers.
- The Vanguard is a frequency-tripled Nd:YVO4 laser with a pulse repetition rate of 80 MHz and pulse duration of 10 picoseconds. It is based on the proven FCbar diode-pumping design successfully used in Spectra-Physics solid state lasers since 1992.
- Both SBR and FCbar are readily scaleable technologies and Spectra-Physics indicates this laser is just the first in a series of new high power infrared, visible, and UV quasi-cw solid state lasers.
- The Vanguard is intended for demanding OEM applications, and features TEM00 output (M2 <1.2), excellent beam pointing characteristics, and rugged industrial packaging.
- The laser will find wide spread usage in image recording, novel materials processing, medical diagnostics, wafer inspection, and a variety of applications in computer and microelectronics manufacturing.

❖ *Tornado*: New High Power, Industrial DPSS Lasers

- Spectra-Physics Lasers (SPL) has introduced the *Tornado*, a new line of industrial grade, high power, DPSS lasers. These products have been specifically designed to retain the benefits of Spectra-Physics' single mode/lower power products, while providing sufficient multi-mode output power to enable applications such as high speed marking and materials processing.
- The Tornado series utilises non-imaging optics to couple the output of an economical, 200 W diode laser stack into the end of a Nd:YAG rod. End pumping delivers several key benefits over side pumping — the approach used in most traditional high power Nd:YAG lasers that have been adapted from lamp pumped predecessors.
- Specifically, end pumping permits the resonator itself to be completely sealed, eliminating contamination and thereby extending operating lifetime and reducing maintenance downtime. This arrangement even allows the pump source to be replaced in the field, without any realignment whatsoever. End pumping also yields superior transverse mode quality and beam uniformity.
- The first Tornado laser available delivers >35 W of average power (at 10 kHz) at 1064 nm, with a nominal 2 mm beam diameter characterised by a near flat top beam profile. The laser head is cooled with a closed loop chiller. Other system components include an air cooled, compact diode driver and laser power supply. These both fit in a standard 19" rack mount, and are only 1.5" and 7" tall respectively.

❖ SPL and Sirah release new *Sirah* Pulsed Dye Laser

- Spectra-Physics is pleased to announce further expansion of the Quanta-Ray product line with a new series of high performance dye lasers. These robust, high energy lasers are the result of a strategic partnership between Spectra-Physics (Mountain View, CA) and Sirah GmbH (Kaarst, Germany). They deliver a combination of extended wavelength tunability (330-740 nm) and narrow spectral bandwidth (* 0.03 cm–1), using a novel cavity design that requires no etalon. Frequency doubling and mixing modules can extend the tuning range from 200 nm to 4 microns.
- Dye laser technology represents a mature, reliable source of tunable high energy laser pulses. These new Quanta-Ray products maximise these proven advantages with a state-of-the-art design that offers both high performance and ease of use. For example, a precision direct sine bar mechanism provides simple linear wavelength tuning with excellent repeatability. And the use of interchangeable dye cells makes switching laser dyes fast and simple.
- When combined with the Quanta-Ray INDI, LAB or PRO series Nd:YAG, the Sirah laser is a complete system solution designed to meet the demands of a wide variety of scientific and industrial applications. Typical applications include state-resolved photochemistry, photobiology, multiphoton spectroscopy, remote sensing and LIDAR.

Report from FASTS

Toss Gascoigne
Executive Director, Federation of Australian Scientific and Technological Societies

REPORT SUMMARY

1. PRESIDENT'S REPORT

"Our main task now is to maintain the momentum behind the Chief Scientist's report, "Chance for Change". We have seen many such reports, including the West report on higher education, sink without trace. Budget 2001 is the nation's last chance to change and we cannot let this opportunity be lost. Maintaining the momentum without antagonising the policy makers of today and of tomorrow is an interesting challenge."

An extract from Sue Serjeantson's President's Report to the AGM. The full report begins on page 21.

2. "SCIENCE meets PARLIAMENT" DAY

Three quarters of all federal Parliamentarians had individual appointments with scientists on November 1, in the second "Science meets Parliament" Day. Feedback from participants has been positive, with the event scoring eight and a half out of ten overall.

The address by Dr Neal Lane, Bill Clinton's science adviser, was a highlight, as were briefings by Parliamentarians and parliamentary staffers.

The event had a clear and immediate impact, with over 30 speeches and questions in the House and the Senate on November 1. TV showed up the number of MPs wearing the blue "SmP" badges.

Media coverage was good, and included ABC News, Radio National Breakfast, the PM program, ABC TV News; as well as articles in the Sydney Morning Herald, Australian, Adelaide Advertiser, Hobart Mercury, Aust Financial Review, and West Australian.

FASTS is now suggesting that scientists everywhere should invite their local MP or Senator out to inspect an experimental site or laboratory. This should be a gumboots-and-labcoats occasion, rather than a time for corporate suits. Introduce the MP to your colleagues. (But first check corporate guidelines on how to handle invitations and visiting rights.)

3. "SCIENCE meets PARLIAMENT" 2001

The FASTS Board has decided to hold "Science meets Parliament" Day again in 2001, provided the election scheduled for next year does not interfere with our timing.

It will be a new Parliament with a significant number of new members. We need to meet these new members as well as reinforce our contacts with existing members.

4. THE FASTS PRESIDENT ELECT

Professor Chris Fell, Deputy Vice-Chancellor of the University of New South Wales is to be the next President of Australia's peak council for scientists and technologists.

Professor Fell will take up his position as President of the Federation of Australian Scientific and Technological Societies (FASTS) in November 2001, at the conclusion of my term.

He has been responsible for the research, international and information technology activities of the University of New South Wales since 1991.

Trained as a chemical engineer, he worked in industry before joining UNSW. Research in his group led to the establishment of the high technology company Memtech Limited. Professor Fell played a pivotal role in the birth of the CRC for Waste Management and Pollution Control.

He was elected at the Annual Council meeting of FASTS.

The Executive of FASTS for 2000-2001

President	Professor Sue Serjeantson *(ANU, Canberra)*
President-elect	Professor Chris Fell *(University of New South Wales)*
Vice-Presidents	Ms Jan Thomas *(Victoria University of Technology, Melbourne)*
	Dr David Denham *(President, Australian Geosciences Council)*
Secretary	Dr John Rice *(Flinders University, Adelaide)*
Treasurer	Professor Snow Barlow *(University of Melbourne)*

5. PETER CULLEN RETIRES

Peter Cullen did a great job as President of FASTS, and with the election of Chris Fell, severs his formal ties with FASTS. Peter's biggest asset was his ability to earn the trust and respect of the people he dealt with, politicians as well as scientists.

He joins a distinguished group of former Presidents of FASTS who still contribute most valuably to the organisation. Graham Johnston and Joe Baker are prime examples of this group.

My thanks to retiring Board Member John Pilbrow, a great contributor to the interests of Physical Sciences; and Rob Norris who represented the Deans of Science with distinction.

6. GOVERNMENT STATEMENT ON SCIENCE BY EARLY 2001

A statement by Minister Minchin on 17 November:

"The recommendations of Dr Batterham's Report will assist the Government in identifying and addressing future science and innovation priorities for Australia...

"The Report of the Australian Science Capability Review and the ISIG (Innovation Summit Implementation Group) Report will be jointly considered in developing important elements of the Government's Innovation Action Plan which will be in place by early in the new year."

The Chief Scientist's final report is available on the Department of Industry, Science and Resources website at:

http://www.isr.gov.au/science/review

7. BRIEFING PARLIAMENTARIANS

FASTS has stepped up briefing sessions with Parliamentarians. In the last months, we have briefed the Coalition Committee of Industry, Science and Resources on stem cell research, a lively and valuable discussion for an hour.

Earlier we met the ALP Caucus committee looking at GM issues on plant breeding.

FASTS has also met with the Shadow Minister Dr Carmen Lawrence and given evidence to the Senate Committee examining the new ARC bill.

8. ARC EXPERT ADVISORY PANELS

The ARC has asked FASTS to nominate appropriately qualified people to positions on these panels. The areas concerned are:

- Biological sciences and biotechnology
- Engineering and environmental science
- Mathematics, information and communication sciences
- Physical and earth sciences
- Social, behavioural and economic sciences
- Humanities and creative arts

Any Societies interested in making nominations should send names and CVs to FASTS by December 4.

9. FASTS' OCCASIONAL PAPER NO. 3: *"Mathematical Sciences In Australia"*

"Mathematical Sciences in Australia: Looking for a Future", was written by FASTS' Vice-President Ms Jan Thomas and published by FASTS.

"No discipline can afford the kind of haemorrhaging documented in the report and remain vibrant, creative and innovative", Ms Thomas said.

"We're exporting our best talent to countries which appreciate the value of an investment in knowledge and ideas. We have all heard stories about the brain drain, and now we can put numbers to it."

The complete Paper is available on the FASTS' web site: www.fasts.org

PRESIDENT'S REPORT MEETING OF THE COUNCIL OCTOBER 31 2000

FASTS has made considerable progress in putting the matter of research and development on the national agenda for the next federal election Increasingly, the broader community is becoming convinced that private and public support for R&D is an investment in the nation's future prosperity. Of course, for any lobby group or peak body, it is impossible to demonstrate a direct relationship between the effort and the outcome. That said, we are seeing increased interest in our views by the popular press and by influential radio interviewers, such as Graham Richardson and Alan Jones, as well as by our traditional outlets such as the ABC and The Australian. The issue of investment in R&D is getting the attention of esteemed economists and the cartoonists; next, talk-back radio!

Our main task now is to maintain the momentum behind the Chief Scientist's report, "Chance for Change". We have seen many such reports, including the West report on higher education, sink without trace. Budget 2001 is the nation's last chance to change and we cannot let this opportunity be lost. Maintaining the momentum without antagonising the policy makers of today and of tomorrow is an interesting challenge.

I have watched other organisations, such as the Australian Medical Association (AMA), undergo serious divisions on the matter of style. The AMA is divided between those who prefer a cosy relationship with the Minister and those who think it is more effective to bleat from the side-lines.

During my Presidency I have attempted to steer the middle course, continuing the non-partisan record of FASTS that I inherited from my predecessors, Peter Cullen, Joe Baker and Graham Johnston. The Minister may not have ordered three bottles of champagne for us in the early hours of the morning, as did Dr Wooldridge for the former AMA team, but we have had the occasional quiet beer or breakfast with members of parliament and officers of ISR. This has

not prevented our public comment on issues of importance to FASTS. FASTS is perceived, by one Cabinet Minister at least, as a 'good player'.

The first shock to the President of FASTS is to fully appreciate how limited the resources truly are. Following an increase in fees this year, individual members pay a maximum of $5.00 per year plus 50 cents GST, tax deductible. While the individual subscriptions are modest, the total fee for any individual society can be substantial. I would urge societies to list the FASTS contribution as a separate item on personal subscription invoices. The subscriptions support an Executive Director and one part-time office manager. So we are dependent, in the most vulnerable way, on volunteer scientists in the area of policy development, on our sponsors, and on our membership societies, for sustainability.

When I looked at this situation, I decided that the immediate strategy had to be one of increasing the standing of FASTS. That is, our volunteers need to gain professional recognition for their contributions to the Federation and sponsors need to be assured that that are supporting a highly professional organisation deserving of their respect. Our members need to know that they are getting value for money and are proud to be associated with FASTS.

I cannot pretend that this is an easy or short-term task and it has been an ongoing one for my predecessors. Some of our most talented volunteers have not been given the recognition that they deserve in terms of their professional development, and this is of great concern to me. I want association with FASTS, whether as office bearers, as board members, or as member societies, to be keenly sought and also to be valued by those outside the organisation.

One indicator of progress in promoting the profile of FASTS is that sponsorship of FASTS' activities has increased significantly. Generous support of our events has been given willingly, and for that I thank our traditional and new supporters. Another indicator is increasing requests for private briefings to government officers on draft policy papers or to journalists on science- related media stories.

One other indicator, and the most important element for FASTS, is society membership. Essentially, over the past twelve months the membership status quo has been maintained, with two societies giving notice of withdrawal and CAPA joining. I'm truly delighted to have our young scientists join us and to have their fresh ideas put forward at Board meetings. We have made some progress in forging relationships with other organisations, such as the CRC Association, the Institution of Engineers, Australia; and the Australian Society for Medical Research. But we need to do more to recruit new corporate member societies.

Our achievements speak for themselves and I direct people to the list of Year 2000 activities undertaken by FASTS listed on our website. Other useful contributions, in terms of science policy and in promoting science, have been made through FASTS' ex officio membership of the Prime Minister's Science, Engineering and Innovation Council, PMSEIC. The non-Ministerial members have responsibility for developing agenda items for PMSEIC. I chaired the item Science and Technology in Fighting and Preventing Crime for the June 2000 meeting and am deputy chair of an item on Molecular Medicine for the November 2000 meeting of PMSEIC. In 1999, Peter Cullen co-chaired a PMSEIC working group on Salinity, and that work has continued to make important contributions to federal and state government policy on this issue.

The highlights for FASTS this year have been our two high-profile events, the Forum "Science & Technology in the Boardroom" and our second "Science meets Parliament Day". The success of these events is due to the stellar contributions of Toss Gascoigne and Robyn Easton. In addition, Toss is responsible for the strong media position of FASTS, working hard to maintain personal contacts, submit press releases in a timely way and ensure the ready availability of commentators.

I would like to thank the members of the Board, of the Executive and of the Policy Committee for your terrific support during the year and to say that it is a privilege to be your President. I hope the next twelve months, and the election budget, realise some returns for our efforts.

Sue Serjeantson AO PhD.
FASTS President
18 November 2000

The experimentalist comes running excitedly into the theorist's office, waving a graph taken off his latest experiment. "Hmmm", says the theorist, "That's exactly where you'd expect to see that peak. Here's the reason... (long, logical explanation follows)." In the middle of it, the experimentalist says "Wait a minute", studies the chart for a second, and says, "Oops, this is upside down. He fixes it. "Hmmm", says the theorist, "you'd expect to see a dip in exactly that position. Here's the reason..."

Australian Optical Society on the World Wide Web

http://www.physics.mq.edu.au/~aos/

Stay in touch with your own professional society via the world wide web. Find out about:

- Objectives of the AOS
- Affiliated bodies
- Employment opportunities
- Joining/renewing membership
- Corporate members
- Conferences
- AOS Council members
- Prizes and Awards
- AOS News (the publication you are reading!)

There are also many links to websites of interest to AOS members.

http://www.physics.mq.edu.au/~aos/

New from WARSASH Scientific

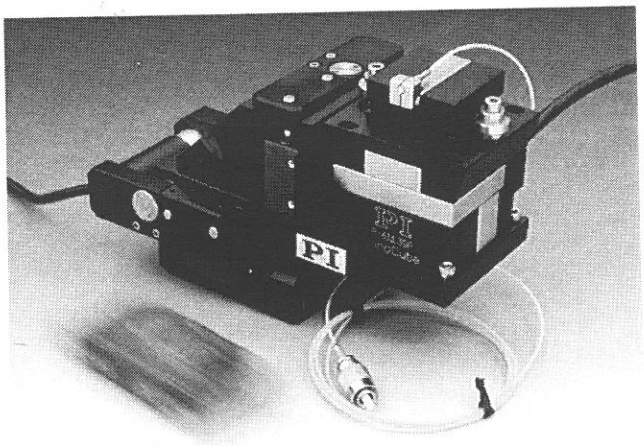
PI

XYZ Micro

New from Physik Instrumente (PI) comes the F-130 XYZ micro / nanopositioner. The features include:

- 15 x 15 x 15 mm motor driven travel range
- Nanometric scale resolution
- 100 x 100 x 100 µm piezo travel
- Large selection of control electronics and programmable controls
- Low Cost

The F-130 excels through its ultra-fast scanning and settling speed, ideal prerequisites in photonics packaging, microscopy, mass storage, electrophysiology, micro-machining, semiconductor technology, optical instrumentation, and metrology.



Single Photon Counting Module

PerkinElmer optoelectronics

The SPCM is a self-contained photon counter which features include:

- Response range from 400 nm to 1100 nm
- Photon detection efficiencies which exceed 70% at 650 nm.
- An integral 2-stage TE cooler, cooler controller, amplifier, discriminator and TTL output driver.
- Contains a high-voltage DC-to-DC converter and is powered from a single 5-V source.

The module utilizes a patented active-quench circuit which allows it to count over 10 million photons per second. With units available with dark-count rates less than 25 counts/second, these are ideal tools for measuring extremely low light level occurrences like fluorescence in analytical samples.

WARSASH Scientific

Suite 7 The Watertower – 1-9 Marian St – Redfern – NSW – 2016 (Adjacent to the Australian Technology Park)
Tel: +61 (02) 9139 0122 – Fax: +61 (02) 9318 2192 - e-mail: sales@warsash.com.au - URL: http://www.warsash.com.au

New from WARSASH Scientific

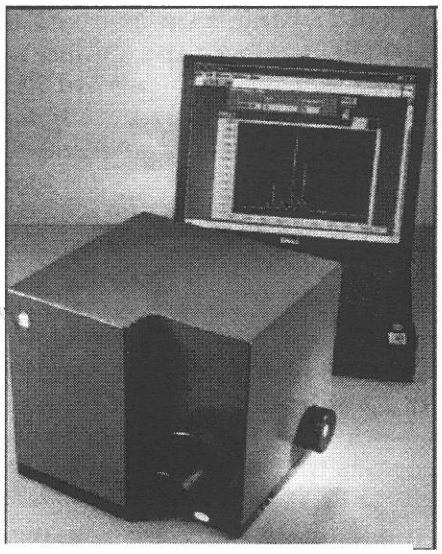
IL2000 SpectroCube

international light

ilsales@intl-light.com • +1.978.465.5923

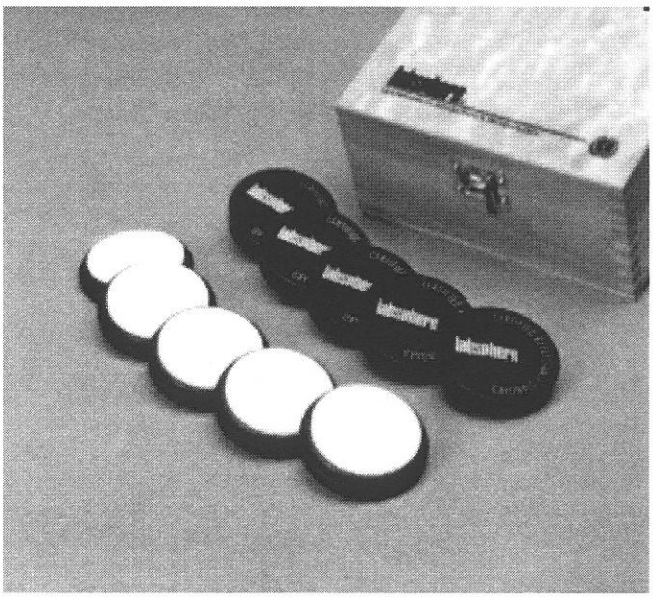
International Light combines the latest technical innovations in the new IL2000 SpectroCube spectroradiometer. Features include:

- Double-pass single grating optics that provide a scatter figure of 1×10^{-6} and dispersion of 4 nm/mm.
- Response from 250 - 1100nm
- Autoranging over eight decades from 200 pW/cm^2/nm at 500nm with an f/4 focal ratio and ±0.5nm wavelength accuracy
- Compact 9" x 9" x 9" in size
- Integrated Lock-in amplifier
- Firmware for optical wavelength self-calibration
- LabView software user interface
- Can be remotely controlled by a PC via a telephone line.



Spectralon Custom Reflectance Standards

labsphere.



Labsphere, manufacturers of integrating sphere's and diffuse reflectance technology now offer custom reflectance standards to meet unique spectral or colorimetric requirements.

- Spectralon material provides high diffuse reflectance, thermal stability and durability required for consistent, reproducible spectral data.
- Spectralon standards are ideal for reflectance, grey scale, colour, fluorescence and wavelength calibration applications.
- Applications include biomedical instruments, (eg. blood analysis instrumentation), remote sensing, densitometers, spectrophotometers, photographic and video equipment, reflectometers, spectrofluoremeters, optical equipment, colourimeters.
- Spectralon's high reflectance and readily machineable qualities also lend itself to OEM applications inc. laser cavities, flat panel reflectors and backlight illuminators.

WARSASH scientific

Suite 7 The Watertower – 1-9 Marian St – Redfern – NSW – 2016 (Adjacent to the Australian Technology Park)
Tel: +61 (02) 9139 0122 – Fax: +61 (02) 9318 2192 - e-mail: sales@warsash.com.au - URL: http://www.warsash.com.au

FASTS Responds to Changes in ABC TV Science

Recently it was announced that ABC TV's long-running science show, Quantum, has been axed after 15 years and the public broadcaster's 15-member science unit is to be disbanded. An ABC spokeswoman said Quantum's run "was a long time to have one type of science program", and the ABC was looking at new ways of "exploring output" of science programs.

In response, FASTS (of which the AOS is a member) has sent the following letter to Jonathan Shier, Managing Director of the ABC:

4 December 2000

Mr Jonathan Shier
Managing Director
Australian Broadcasting Corporation

Dear Mr Shier

Coverage of science by the ABC

Australian scientists and technologists regard the ABC as one of the prime ways of keeping the Australian public informed of developments in science. The importance of this has been underlined in two major reports currently before Government - the Batterham Review and the Innovation Summit Implementation Group. Both make a major point of the need for a greater national awareness of the possibilities and limitations of science.

There is a growing view in political circles that science and technology hold the key to our prosperity, but first Australians need to change the way they think about science and its applications. Both reports urge an engagement of the public in science, technology and innovation; as a means to bringing about a cultural change in Australia.

Clearly the ABC has a major role to play if this national objective is to be achieved, as an authoritative nation-wide source of information and as a critical investigator on scientific matters. An important part of this equation is that scientists trust the ABC to report their research accurately and will therefore cooperate with the ABC, whereas they are less likely to participate in any program that relies on sensationalism.

For 16 years Quantum has made a valuable contribution to informing Australians of new scientific achievements. We regret the decision of the ABC to bring this successful program to an end, while recognising there may be advantages in lookjng at new ways of producing a high-quality program to bring the best of Australian (and international) science to a national audience.

We seek your assurance that ABC will continue to produce high quality science programs for television. What plans do you have for a replacement program?

Our view is that while there is room for commissioning some work from outside production units, the ABC needs to retain a solid core of scientific expertise. This expertise should have responsibility for in-house production and for commissioning the best of the external production houses to do particular segments or programs.

The retention of scientific expertise within the ABC is vital. To be producers or commissioning agents for good science programs, the ABC needs to be an active player in the field. This will provide continuity, balance, impartiality, corporate memory and resistance to commercial pressures.

FASTS is a national body representing 60,000 working scientists and technologists in all disciplines. We work actively with the ABC in news, current affairs and programs in helping them make contact with appropriate experts in different scientific fields; and would seek to continue this relationship with those involved in the successor to Quantum.

Yours sincerely

Sue Serjeantson
President, FASTS

Dark Suckers

This article introduces a brief synopsis of the darksucker theory, which proves the existence of dark and establishes the fact that dark has great mass, and further, that dark is the fastest known particle in the universe. Apparently, even the celebrated Dr. Albert Einstein did not suspect the truth; that just as COLD is the absence of HEAT, LIGHT is actually the ABSENCE of DARK... light does not really exist!

1. Introduction

For years the electrical utility companies have led the public to believe they were in business to supply electricity to the consumer, a service for which they charge a substantial rate. The recent accidental acquisition of secret records from a well known power company has led to a massive research campaign which positively explodes several myths and exposes the massive hoax which has been perpetrated upon the public by the power companies. The most common hoax promoted the false concept that light bulbs emitted light; in actuality, these 'light' bulbs actually absorb DARK which is then transported back to the power generation stations via wires. A more descriptive name has now been coined; the new scientific name for the device is DARKSUCKER.

2. Theoretical Overview

The basis of the darksucker theory is that electric light bulbs suck dark. Take, for example, the darksuckers in the room where you are. There is much less dark right next to them than there is elsewhere, demonstrating their limited range. The larger the darksucker, the greater its capacity to suck dark. Darksuckers in a parking lot or on a football field have a much greater capacity than the ones in used in the home, for example. It may come as a surprise to learn that darksuckers also operate on a celestial scale; witness the Sun. Our Sun makes use of dense dark, sucking it in from all the planets and intervening dark space. Naturally, the Sun is better able to suck dark from the planets which are situated closer to it, thus explaining why those planets appear brighter than do those which are far distant from the Sun. Occasionally, the Sun actually oversucks; under those conditions, dark spots appear on the surface of the Sun. Scientists have long studied these 'sunspots' and are only recently beginning to realise that the dark spots represent leaks of high pressure dark because the Sun has oversucked dark to such an extent that some of actually leaks back into space. This leakage of high pressure dark frequently causes problems with radio communications here on Earth due to collisions between the dark particles as they stream out into space via the black 'holes' in the surface of the Sun.

As with all manmade devices, darksuckers have a finite lifetime. Once they are full of dark, they can no longer suck. This condition can be observed by looking for the black spot on a full darksucker when it has reached maximum capacity: you have surely noticed that dark completely surrounds a full darksucker because it no longer has the capacity to suck dark at all.

3. Various Applications

A candle is a primitive darksucker. A new candle has a white wick. You will notice that after the first use the wick turns black, representing all the dark which has been sucked into it. If you hold a pencil next to the wick of an operating candle, the tip will turn black because it got in the way of the dark flowing into the candle. Unfortunately, these primitive darksuckers have a very limited range and are hazardous to operate because of the intense heat produced.

There are also portable darksuckers called torches. The bulbs in these devices cannot handle all of the dark by themselves, and must be aided by a dark storage unit called a battery. When the dark storage unit is full, it must be either emptied (a process called 'recharging') or replaced before the portable darksucker can continue to operate. If you break open a battery, you will find dense black dark inside, evidence that it is actually a compact dark storage unit.

The darksuckers on your automobile are high capacity units with great range, thus they require much larger dark storage units mounted under the hood of the vehicle. Since there is far more dark available in the winter season, automobile dark storage units reach capacity more frequently than they do in the summer, requiring 'recharging', or in severe cases, total replacement.

4. Dark Mass

Dark has great mass. When dark is drawn into a darksucker, friction caused by the speed of the dark particles (called anti-photons) actually generates substantial heat, thus it is unwise to touch an operating dark sucker. Candles represent a special problem, as the dark must travel into a solid wick instead of through clear glass. This generates a great amount of heat, making it very dangerous to touch an operating candle.

Because dark has such great mass, it is very heavy. If you swim just below the surface of a lake, you see a lot of 'light' (absence of dark, to be more precise). As you go deeper and deeper beneath the surface, you notice it gets darker and darker. When you reach a depth of approximately fifteen metres, you are in total darkness. This is because the heavier dark sinks to the bottom of the lake, making it appear 'lighter' near the surface.

The power companies have learned to use the dark that has settled to the bottom of lakes by pushing it through turbines, which generate electricity to help push the dark into the ocean where it may be safely stored for

their devious purposes. Prior to the development of turbines, it was much more difficult to get the dark from the rivers and lakes to the ocean. The Native Americans recognized this problem, and developed means to assist the flow of dark on it's long journey to the ocean. When on a river in a canoe travelling in the same direction as the flow of dark, they paddled slowly, so as not to impede the flow of dark; but when they travelled against the flow of dark, they paddled vigorously to help propel the dark along its way.

6. Speed of Dark

Scientists are working feverishly to develop exotic new instrumentation with which to measure the actual speed and energy level of dark. While such instrumentation is beyond the capabilities of the average layman, you can actually perform a simple test to demonstrate the unbelievable speed of dark, right in your own home. All that is required for the simple test is a closed desk drawer situated in a bright room. You know from past experience that the tightly shut drawer is FULL of dark. Now, place your hand firmly on the drawer's handle. Quickly yank the drawer open: the dark immediately disappears, demonstrating the blinding speed with which the dark travels to the nearest darksucker!

7. Conspiracies

The secrets of dark are at present known only to the power companies. Dark must be very valuable, since they go to such lengths to collect it in vast quantities. By some well hidden method, more modern power 'generation' facilities have devised methods to hide their collection of dark. The older facilities, however, usually have gargantuan piles of solidified dark in huge fenced in areas. Visitors to these facilities are told the huge black piles of material are supplies of coal, but such is not the case.

The power companies have long used code words to hide their activities; D.C. is Dark Conspiracy, while A.C. is Alternate Conspiracy. The intent of the A.C. is not yet known, but the D.C. is rapidly yielding it's secrets to the probing eyes and instruments of honest scientists around the world. New developments are being announced every day, so pay close attention to all of your usual sources (web, newspaper, AOS News etc.) for updates.

EDITORIAL

There will no doubt be more than a few AOS members who are disappointed with the December 2000 edition of the AOS News. Some will note with tired resignation that it will be at least the end of January 2001 before they receive their copy. Others will take exception to the fact that the editor has contributed a self-penned article promoting his own institution. And certain people may be annoyed at the inclusion of a hackneyed joke article on Dark Suckers. Hopefully there will even be those who are so peeved that they write a letter to the editor - I think a "Letters" column would be an excellent addition to the AOS News.

I apologise that this issue is not as enthralling as I believe the AOS News should be. It is certainly no reflection on the excellent article contributed by Mark Sceats and Elizabeth Elenius, or the informative reports from the AOS President and FASTS. However, things will change. In an effort to avoid such pathetic and apologetic editorials in future editions, I implore all readers of this publication to think hard about what they could possibly contribute. Our society is full of intelligent, witty, well-read scientists, and it should present no challenge for a quarterly journal to be bursting with interesting, informative and vital articles.

Well, off my soapbox now. The AOS 2000 Conference in Adelaide was by all accounts a great success. The President's Report in this issue makes a few brief comments, and a detailed report on the conference should be forthcoming in the March 2001 edition. Don't forget that nominations for the AOS Medal close in February (see page 17), and keep in touch with other happenings via the AOS web page. I look forward to hearing from many of you soon.

Wayne Rowlands

Meetings Calendar

The following list of optics-related conferences is compiled from several sources and should be used as a guide only.

Date	Meeting 2001	Contact	Location
Jan 9-11	Optics in Computing	OSA	Lake Tahoe, USA
Jan 10-12	Ultrafast Electronics and Optoelectronics	OSA	Lake Tahoe, USA
Jan 20-26	Photonics West®	SPIE	San Jose, USA
Jan 29-31	Advanced Solid-State Lasers	OSA	Seattle, USA
Feb 5-8	Fourier Transform Spectroscopy	OSA	Coeur d'Alene, USA
Feb 5-8	Optical Remote Sensing of the Atmosphere	OSA	Coeur d'Alene, USA
Feb 17-23	Medical Imaging	SPIE	San Diego, USA
Feb 25-Mar 2	Microlithography	SPIE	Santa Clara, USA
Mar 4-8	Smart Structures & Materials/ NDE for Health Monitoring & Diagnostics	SPIE	Newport Beach, USA
Mar 17-22	Optical Fibre Communication Conference	OSA	Anaheim, USA
Mar 25-28	Nonlinear Guided Waves and Their Applications	OSA	Clearwater, USA
Mar 27-30	Large Lenses and Prisms	SPIE	London, UK
Apr 4-6	10th European Conference on Integrated Optics	OSA/LEOS	Paderborn, Germany
Apr 10-11	Opto-Northeast	SPIE	Rochester, USA
Apr 16-20	AeroSense: Aerospace/Defense Sensing and Controls	SPIE	Orlando, USA
Apr 22-25	Optical Data Storage	SPIE	Santa Fe, USA
Apr 25-27	Photomask Japan	SPIE	Yokohama, Japan
May 6-11	CLEO - Conference on Lasers and Electro-Optics	OSA	Baltimore, USA
May 6-11	QELS - Quantum Electronics and Laser Science Conference	OSA	Baltimore, USA
May 10-13	Correlation Optics 2001	SPIE	Chernivtsi, Ukraine
May 16-18	International Symposium on Laser Precision Microfabrication	SPIE	Singapore
May 21-23	5th International Conference on Quality Control by Artificial Vision	SPIE	Le Creusot, France
May 28-Jun 1	Third International Conference on 3D Digital Imaging and Modeling	OSA	Quebec City, Canada
May 30-Jun 1	Microelectronic and MEMS Technologies	SPIE	Edinburgh, UK
Jun 4-6	Complex Adaptive Structures	SPIE	Hutchinson Is., USA
Jun 6-8	Meteorological Optics	OSA	Boulder, USA
Jun 6-8	Optical Engineering for Sensing and Nanotechnology (ICOSN 2001)	SPIE	Yokahama, Japan
Jun 10-13	International Conference on Quantum Information	OSA	Rochester, USA
Jun 13-16	Eighth Rochester Conference on Coherence and Quantum Optics	OSA	Rochester, USA
Jun 17-20	European Conferences on Biomedical Optics (ECBO)	OSA	Munich, Germany
Jun 18-22	Industrial Lasers and Optoelectronic Devices	SPIE	Munich, Germany
Jun 20-22	Laser and Laser Information Technologies (ILLA 2001)	SPIE	Vladimir, Russia
Jun 26-Jul 1	XVII International Conference on Coherent and Nonlinear Optics (ICONO 2001)	SPIE	Minsk, Belarus
Jul 1-5	OECC/IOOC/ACOFT - OptoElectronics and Communications Conference + Integrated Optics and Optical Fibre Communication Conference + Australian Conference on Optical Fibre Technology		Sydney, Australia
Jul 16-19	CLEO/Pacific Rim 2001 The 4th Pacific Rim Conference on Lasers and Electro-Optics	OSA	Chiba, Japan
Jul 29-Aug 3	International Symposium on Optical Science and Technology (SPIE Annual Meeting)	SPIE	San Diego, USA
Sep 3-7	IV Iberoamerican Meeting of Optics (IV RIAO) and the VII Latin American Meeting of Optics, Lasers & Applications (VII OPTILAS)	SPIE	Tandil, Argentina
Sep 17-20	Advanced High-Power Lasers and Applications	SPIE	Kyoto, Japan
Sep 17-21	Remote Sensing	SPIE	Toulouse, France
Sep 17-21	X-Ray and Neutron Capillary Optics	SPIE	Zvenigorod, Russia
Sep 17-18	Opto-Southwest	SPIE	Tuscon, USA
Oct 3-5	Photomask Technology	SPIE	Monterey, USA
Oct 22-24	2nd International Symposium on Multispectral Image Processing and Pattern Recognition	SPIE	Wuhan, China
Oct 22-25	Micromachining and Microfabrication	SPIE	Santa Clara, USA
Oct 28-31	ISAM/EIS	SPIE	Boston, USA

CONT. OVER PAGE

Nov 7-10	Optoelectronics and Microelectronics	SPIE	Nanjing, China
Nov 12-16	APOC 2001-Asia-Pacific Optical Communications Conference and Exhibits	SPIE	Beijing, China
Nov 26-30	Photonics and Applications	SPIE	Singapore
Nov 27-30	Education in Optics	SPIE	Singapore
Nov 26-28	ETOP 2001: The 7th International Conference on Education and Training in Optics and Photonics	SPIE	Singapore
Dec 17-19	Microelectronics and Micro-Electro-Mechanical Systems	SPIE	Adelaide, Australia

Further information on the above conferences can be obtained from:

OSA
(The Optical Society of America)
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Submission Guidelines

The *AOS News* is always looking for contributions from its members. Here's a short summary of the how to make a submission.

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. Authors of scientific or review articles will receive proofs by fax.
* ***Conference Report***
If you have been to conference recently, writing a short report would be greatly appreciated.
* ***News Item***
Any newsworthy stories in optics from Australia or abroad.
* ***Book Review***
If you have read an interesting (and relatively new) book in some field of optics please consider a review for the *AOS News*.
* ***Cartoon or drawing***
If you have some artistic bent why not consider submitting a cartoon!

How can you submit?

The easiest way is by email. Either send the document text in your mail, or attach a word processor file. We accept nearly all file formats. (Famous last words!).

If you don't have an email account, or cannot send diagrams or pictures via email, we can accept hard copies. (One copy only is required).

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