Australian Optical Society
NEWS

Volume 20 Issue 2
June2006

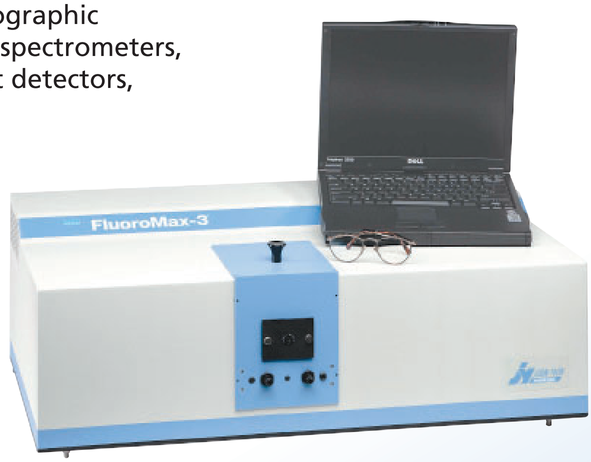
ISSN 1832-4436

Registered by Australia Post
Publication No: 233066 / 00021

JOBIN YVON HORIBA

Since 1819 – a name you can rely on for high performance spectroscopy

Jobin Yvon have pioneered the development of holographic diffraction gratings, optical spectrometers, emission spectrometers, spectrofluorometers, ellipsometers, plasma endpoint detectors, Raman spectrometers and forensic equipment.



Fluorescence
Compact Steady-State Spectrofluorometer
Modular Steady State Spectrofluorometers
Frequency domain Fluorescence Lifetimes
Time domain TCSPC Fluorescence Lifetimes
(Time correlated single photon counting)
Phosphorescence, Polarization

Raman
Laboratory, research and process instruments
From UV to NIR
Cathodoluminescence accessory for SEM
Photoluminescence
MicroRaman and Micro FTIR

Thin Film
Thin Film characterisation
Ellipsometry and Reflectometry from DUV to NIR
Real time process control by
Optical Emission Spectroscopy and
Imaging Interferometery

Optical Spectroscopy
Monochromators
Imaging Spectrographs
CCD and IR Detector Arrays
Light Sources and other accessories
Custom application-oriented solutions
SynerJY software powered by Origin

LAS TEK

Lastek Pty Ltd
Thebarton Campus, University of Adelaide,
10 Reid Street, Thebarton SA 5031 Australia
Ph (08) 8443 8668 Fax (08) 8443 8427
Email: sales@lastek.com.au Lastek website: www.lastek.com.au

JOBIN YVON HORIBA

LTWAM3968

www.jobinyvon.com

HORIBA GROUP

FLUORESCENCE • FORENSICS • OPTICAL SPECTROSCOPY • RAMAN • EMISSION • OEM&GRATINGS • THIN FILMS

Experimental Instruments

Modularized Multifunctional Grating Spectrometer

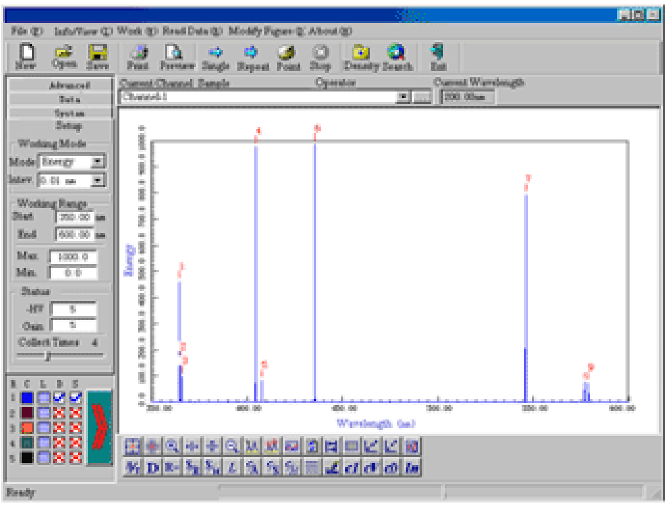
This instrument is designed for universities, colleges and research institutions. Its modular structure makes experiments and tests much easier. With powerful software, the product offers an advanced tool to users for sample testing.

Key Features

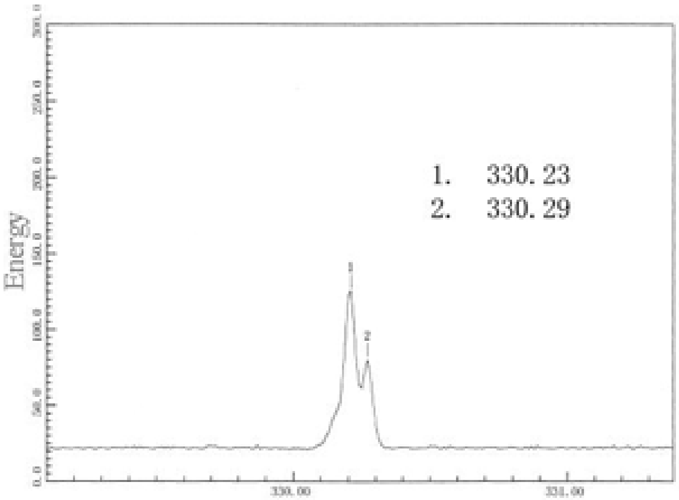
- Modular structure aims at developing student's ability
- Equipped with both a PMT and a linear CCD
- High resolving power, can be used in Hydrogen-Deuterium and Sodium spectrum experiments

Specifications

Model	LEOI-100	LEOI-101
Wavelength Range	PMT: 200 ~ 800nm, CCD: 300 ~ 900nm	PMT: 200 ~ 660nm, CCD: 320 ~ 660nm
Wavelength Resolution	<= 0.1nm	<= 0.06nm
Wavelength Accuracy	<= ± 0.4nm	<= ± 0.2nm
Slit Width	0 ~ 2mm adjustable, resolution:0.01mm	0 ~ 2mm adjustable, resolution:0.01mm
Stray light	<= 10^{-3}	<= 10^{-3}
Focal Length	500mm	500mm



Windows-based software interface



Sodium spectrum principal line: 330.23 330.29 nm

www.lambdasci.com

Lambda Scientific Pty Ltd
2/147, Buxton Street, North Adelaide SA 5006 Australia
Phone: +61 8 8267 2686
Fax: +61 8 8267 2689
E-mail: sales@lambdasci.com

AUSTRALIAN OPTICAL SOCIETY

ABN 63 009 548 387

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

AOS News - Editorial Board

Robert Ballagh
Physics Department,
University of Otago
PO Box 56 Dunedin
New Zealand

Christopher Chantler
School of Physics,
University of Melbourne,
Parkville, Vic 3010

Ben Eggleton
Director, CUDOS
School of Physics
University of Sydney
Sydney NSW 2006

John Love
Optical Sciences Group
Australian National University
RSPhysSE
Canberra ACT 0200

Halina Rubinsztein-Dunlop
Department of Physics,
University of Queensland,
QLD 4072

David Sampson
School of Electrical, Electronic & Computer Engineering, University of Western Australia, 35 Stirling Highway,Crawley WA 6009

Submission guidelines

The *AOS News* is always looking for contributions, especially from AOS members. Here is a short summary of how to make a submission.

What can you submit?

* ***Scientific Article***

A scientific paper in any area of optics.

* ***Review Article***

Simply give a run down of the work conducted at your laboratory, or some aspect of this work.

* ***Conference Report***

* ***News Item***

* ***Book Review***

* ***Cartoon or drawing***

Reviewing of papers

On submission of a scientific or review article you may request that the paper be refereed, and if subsequently accepted it will be identified as a refereed paper in the contents page. The refereeing process will be the same as for any of the regular peer reviewed scientific journals. Please bear in mind that refereeing takes time and the article should therefore be submitted well in advance of the publication date.

How can you submit?

⏭ The easiest way is by email. We accept nearly all file formats. (Famous last words!).

▶ Submitted articles will be imported into an Adobe Pagemaker file. It is best if the diagrams and other graphics are submitted as separate files. All common graphics formats are acceptable, but the resolution must be in excess of 300d.p.i.. Be aware that all colour diagrams will be rendered in grayscale, so if you do use colours, choose colours that show up well in grayscale.

▶ When using Greek letters and mathematical symbols, use font sets such as Symbol or MT Extra. Please avoid using symbols that are in Roman fonts, where the Option or Alt key is used; e.g. Opt-m in Times font on the Mac for the Greek letter mu.

▶ If using TeX, use a style file similar to that for Phys Rev. Letters (one column for the title, author and by-line, and two for the main body). The top and bottom margins must be at least 20mm and the side margins 25mm. Submit a pdf file with the diagrams included, as well as copies of the diagrams in their original format in separate files.

▶ If using a word processor, use a single column. If you do include the graphics in the main document, they should be placed in-line rather than with anchors, but must be submitted separately as well.

June 2006 **Volume 20 Number 2**

AOS NEWS

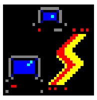
ARTICLES

Regular Articles

DEPARTMENTS

Cover Picture: A billet of bismuth glass and a preform of lead silicate glass for making high nonlinearity optical fibres. The preform was produced at the University of Adelaide's new Centre of Expertise in Photonics. Photo courtesy of Dr Heike Ebendorff-Heidepriem.

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


<

ADVERTISING:
Potential advertisers in *AOS News* are welcomed, and should contact the editor.
Rates: Colour A4 adverts, $250 +GST per issue,
Page 1 Black and White $100 + GST,
Black and White in main body of newsletter - free to corporate members.
Conference announcements are free.

COPY DEADLINE
Copy for the next issue (Jun 06) should be with the editor no later than 8 June 2006.

EDITOR (acting)
Murray Hamilton
The University of Adelaide
Physics Department
Adelaide SA. 5005
Tel: (08) 8303 3994
Fax: (08) 8303 4380
murray.hamilton@
adelaide.edu.au

AOS News is the official news magazine of the Australian Optical Society. The views expressed in *AOS News* do not necessarily represent the policies of the Australian Optical Society.

Australian Optical Society website
http://aos.physics.mq.edu.au

- News
- Membership
- Optics links
- Prizes/awards
- Conferences
- Jobs/Scholarships
- Affiliated societies
- ...and more

AUSTRALIAN OPTICAL SOCIETY

ABN 63 009 548 387

AOS EXECUTIVE

PRESIDENT
Murray Hamilton
Department of Physics, University of Adelaide, Adelaide, SA 5005
Tel: (08) 8303 3994
Fax: (08) 8303 4380
murray.hamilton@adelaide.edu.au

VICE-PRESIDENT
Hans-A Bachor
ARC Centre of Excellence for Quantum-Atom Optics, Building 38
The Australian National University,
Canberra ACT 0200
Tel: 02 6125 2811
Fax: 02 6125 0741
hans.bachor@anu.edu.au

SECRETARY
John Holdsworth,
School of Mathematical and Physical Sciences, University of Newcastle,
Callaghan 2308 NSW
Australia
Tel: (02) 4921 5436
Fax: (02) 4921 6907
John.Holdsworth@newcastle.edu.au

HONORARY TREASURER
Stephen Collins
Optical Technology Research Lab
Victoria University
PO Box 14428, Melbourne, VIC 8001
Tel: (03) 9919 4283
Fax: (03) 9919 4698
stephen.collins@vu.edu.au
z

PAST PRESIDENT
Barry Sanders
Institute for Quantum Information Science, University of Calgary
2500 University Drive NW
Calgary, Alberta, Canada T2N 1N4
Tel: +1 403 210 8462
Fax: +1 403 289 3331
bsanders@qis.ucalgary.ca
http://qis.ucalgary.ca/~bsanders/

AOS COUNCILLORS

Chris Chantler
School of Physics,
University of Melbourne
VIC 3010
Tel: (03) 8344 5437
Fax: (03) 9347 3732
chantler@physics.unimelb.edu.au

Ben Eggleton
CUDOS
School of Physics,
University of Sydney
Sydney NSW 2006
Tel: 0401 055 494
Fax: (02) 9351-7726
cwalsh@physics.usyd.edu.au

John Love
Optical Sciences Centre,
Research School of Physical Sciences and Engineering
The Australian National University
Canberra ACT 0200
Tel: (02) 6249 4691
Fax: (02) 6279 8588
jd1124@rsphysse.anu.edu.au

Halina Rubinsztein-Dunlop
Department of Physics,
University of Queensland,
St Lucia, QLD 4072
Tel: (07) 3365 3139
Fax: (07) 3365 1242
halina@kelvin.physics.uq.oz.au

Martijn de Sterke
School of Physics
University of Sydney NSW 2006
Tel: (02) 9351 2906
Fax: (02) 9351 7726
desterke@physics.usyd.edu.au

Keith Nugent
School of Physics,
University of Melbourne
VIC 3010
Tel: (03) 8344 5446
Fax: (03) 9439 4912
kan @physics.unimelb.edu.au

Ken Baldwin
Laser Physics Centre
ANU, RSPSE
Canberra ACT 0200
Tel. (02) 6125 4702
Fax. (02) 6125 2452
kenneth.baldwin@anu.edu.au

Adam Weigold
Photon Engineering Pty Ltd
PO Box 122 Rundle Mall, Adelaide, SA, 5000, Australia
Tel: + 61 - 8 - 8232 3444
Fax: + 61 - 8 - 8232 9333
Email: aweigold@ozemail.com.au

AFFILIATES
OSA
(Optical Society of America)
SPIE
(International Society for

CORPORATE MEMBERS

ARC COE for Quantum-Atom Optics
Australian Fibre Works
Bandwidth Foundry
Bitline System
Coherent Scientific
CUDOS
Francis Lord Optics (Avtronics)
Lambda Scientific
Laserex
Lastek
NewSpec
Optiscan
Photon Engineering
Raymax Applications
Warsash Scientific
Wavelab Scientific

President's Report

This is now the last of these reports that I'll be writing. Actually I've been a bit surprised by the amount of work that this job has entailed over the last two years. Mainly this has been due to some rather large changes in the conference landscape in Australia. The changes are not over with yet, either!

Changes to how the ACOLS series of conferences are managed is probably the most topical issue at the moment. There has been an ongoing consultation with what might be called the ACOLS community. This is a rather vaguely defined group of people; although the ACOLS Liaison committee is a properly constituted body, attending an ACOLS conference probably qualifies one for membership of the community. This in itself is not a problem, but defining the ownership of the $60,000 or so in funds that the ACOLS conferences have accumulated is tricky. The essential change that is proposed is that these funds will become part of the general revenue of the AOS. The AOS will continue to apply these funds to providing floats and underwriting for future ACOLS conferences.

The process of change has involved a working meeting of all interested attendees at the last ACOLS conference in December 2005, publication of the resolutions of that meeting in the AOS News, plus consultation on a one to one basis by the chairman of the ACOLS Liaison committee. The last stage in this process should take place at the AOS AGM next month with a formal decision taken to make the proposed change. I should add that people who consider themselves part of the ACOLS community are most welcome to attend this meeting and participate in the decision making on this issue.

From my point of view at the helm of the AOS, the financial exposure of the AOS to conferences that it organises, and which can make substantial losses, requires that the cash reserves of the AOS be increased. Merging the ACOLS funds with those of the AOS (which are of a similar order of magnitude) is one way to provide the AOS with the ability to cope with a loss-making conference. After all, in the past and probably in the future, the AOS is the "guarantor of last resort" for the ACOLS conferences.

The conference that the AOS is organising at the moment which is stretching it financially is the ICO Congress which is to be held in Sydney in 2008. While the financial exposure of the AOS is limited, it doesn't take a large share of the necessary float funds that are projected, to stretch a small organisation like the AOS quite severely! I'm being a little vague here because just now Chris Walsh is putting a lot of work into reducing some of the costs involved here, so the budget is in a state of flux.

A second issue that the the AOS is in the process of dealing with is that of taking over the 50% ownership of the ACOFT series of conferences. Again this change is still ongoing, with formalisation of this process still to take places. Decisions that are still to be completed are the makeup and function of the ACOFT steering committee, and the form of the agreement between the AOS and the owner of the other 50% of the conference series, Engineers Australia. I hope that further progress on this issue can be made at the ACOFT/AOS conference next month.

In the last round of announced Federation fellowships Keith Nugent was awarded a second fellowship as well as having success in the bid that he led for a Center of Excellence in Coherent X-Ray Science. This is a very impressive achievement for Keith and on behalf of the whole AOS, I heartily congratulate him. Also this is the third of the Centres of Excellence for Optics in Australia which speaks highlyof the discipline.

Murray Hamilton
President, Australian Optical Society
June 2006.

** ACOLS = Australasian Conference on Optics Lasers and Spectroscopy*
ACOFT = Australian Conference on Optical Fibre Technology

Position Vacant
Australian Optical Society Newsletter

Editor

The AOS is seeking (still!) an editor for the newsletter. This is a quarterly publication conveying optics news, scientific articles and optics advertising to the Australian Optics community.

The editor will be paid an honorarium of $2000 p.a or $500 per issue.

Applications and enquiries for this position should be addressed to the President of the Society, Dr Murray Hamilton

Tel: (08) 8303 3994
Fax: (08) 8303 4380
murray.hamilton@adelaide.edu.au

Australian Institute of Physics (AIP) 17th National Congress
3 – 8 December 2006

Brisbane Convention and Exhibition Centre, Queensland, Australia

The Australian Institute of Physics (AIP) National Congress is held approximately every two years and is the largest and foremost national conference for physicists in Australia. The Congress is composed of Plenary Sessions of general interest, and meetings of the topical groups of the Australian Institute of Physics as well as affiliated societies. The program is developed through a Program Committee constituted by local members of the topical groups and affiliated societies. The theme of the meeting will be RiverPhys, celebrating a meeting that will facilitate the presentation of contemporary physics research in Australia, on the banks of the beautiful Brisbane river.

We are delighted the following distinguished plenary speakers have accepted invitations to speak at the Congress:

Professor Sandra Chapman - Head of the Space and Astrophysics Group, University of Warwick, United Kingdom

Dr Pierre-Gilles de Gennes (1991Nobel Prize in Physics) Institut Curie, Paris, France

Professor Athene Donald - Cavendish Laboratory, University of Cambridge, United Kingdom

Professor John Hall - University of Colorado, JILA; National Institute of Standards and Technology Boulder, USA *Professor John Hall is the winner of the 2005 Nobel Prize in Physics.*

Professor Sir Chris Llewellyn Smith, FRS (Director of UKAEA fusion program and the Joint European Torus) Culham Science Centre, England

Professor David Southwood - Director of Science European Space Agency, United Kingdom

Dr Eric Mazur (2001 NSF Director's Distinguished Teaching Scholar Award) Division of Engineering and Applied Sciences, Harvard University, Cambridge, USA

Professor Michael Wiescher, (2003 Hans Bethe Prize), Director of the Joint Institute for Nuclear Astrophysics Department of Physics, University of Notre Dame, Notre Dame, USA

Professor Joe Wolfe, (2004 International Medal of the French Acoustical Society) School of Physics, University of New South Wales, Sydney, Australia

Professor Anton Zeilinger (2000 Senior Humboldt Fellow Prize) Institute of Experimental Physics, University of Vienna, Austria

For more information please visit www.aipc2006.com

Advanced Notification

Department of Education Science & Training (DEST) French-Australian Science & Technology (FAST) program and Australian Research Council (ARC) Australian Research Network for Advanced Materials (ARNAM) presents

1st International Workshop on Multiphoton Processes in Glass and Glassy Materials

Darlington Centre, University of Sydney, Sydney, Australia, **Dec 11-12 2006**

(Sponsors: CUDOS, Raymax Applications Pty Ltd and Time Bandwidth Switzerland)

Multiphoton processes are initiated by high intensity laser light, increasingly operating in the femtosecond domain. Applications extend from simple material processing, microfluidic channel formation and waveguide manufacture to photonic bandgap structures in 1, 2 and 3 dimensions. Processing of silica remains particularly relevant, although other glassy systems are increasingly attractive. The processes underpinning excitation deep into the band edge of a material remain complex and are the subject of intense research. This workshop brings together experts in the field for the first time to debate and discuss these processes and how they can be exploited to further utilise and optimise the multiphoton approach to optical engineering of materials and devices.

A particular ambition of this workshop is to expose Australian students and early career researchers working in this field to the latest thinking from around Australia and the world, as well as provide an opportunity to network and link up with the groups leading the way in multiphoton processing.

The workshop is an advanced specialised workshop and the audience numbers will be capped to 50. Expression of interest for attendance are sought in the first instance from those who work in the field or work in applications that make use of such technology. Remaining seats will be generally open. *More information: j.canning@oftc.usyd.edu.au*

BOSE-EINSTEIN CONDENSATES ON A MAGNETIC FILM ATOM CHIP

S. Whitlock, R. Anderson, B. Hall, P. Hannaford and A. Sidorov.

ARC Centre of Excellence for Quantum-Atom Optics and Centre for Atom Optics and Ultrafast Spectroscopy, Swinburne University of Technology, Melbourne, Australia, 3122.

Over the last few decades a dramatic increase in the performance of electronic devices has been accomplished mainly through the miniaturisation and integration of electronic components. Soon integrated photonic devices will become wide-spread thanks to the high degree of control now also possible with light. A new type of device, the 'atom chip', is now capable of controlling ultracold atoms in a similar manner. At extremely low temperatures quantum effects begin to dominate the behaviour of atoms. An atom chip provides tailored magnetic fields capable of storing, cooling, transporting and manipulating clouds of atoms above a surface. It is likely that quantum behaviour of atoms will be exploited for on-chip atom interferometry and quantum information processing.

Towards absolute zero

Since the advent of laser cooling techniques in the 1980s and the subsequent award of the 1997 Nobel Prize in physics [1], atom optics has emerged as a flourishing and competitive field of research.

A basic description of laser cooling is as follows. In Doppler laser cooling, moving atoms are made to preferentially scatter many photons with opposite momentum to the atoms. This is usually achieved by red-detuning the laser wavelength with respect to the atomic transition so that a Doppler shift of the resonance frequency provides a velocity dependent force. Techniques which extend Doppler cooling, such as polarisation-gradient cooling are based on similar principles but make use of light induced shifts. The practical limit to laser cooling is related to the energy associated with the photon recoil and is of the order of 1 mK.

At these ultralow temperatures the thermal de Broglie wavelength l_{dB} becomes large; that is, individual atoms can be regarded as a wavepacket with a size on the order of $l_{dB}=(h^2/2pmk_BT)^{1/2}$ where h is Planck's constant, m is the atomic mass, k_B is Boltzmann's constant and T is the temperature. After laser cooling the de Broglie wavelength is typically large enough (l_{dB} > 100 nm) for the atoms to exhibit wave-like properties making atom-optical elements possible, analogous to those used in classical optics for light. This behaviour of laser cooled atoms has already been demonstrated in a wide range of experiments including atom reflection, diffraction, atomic beam-splitting and atom interferometry [2,3].

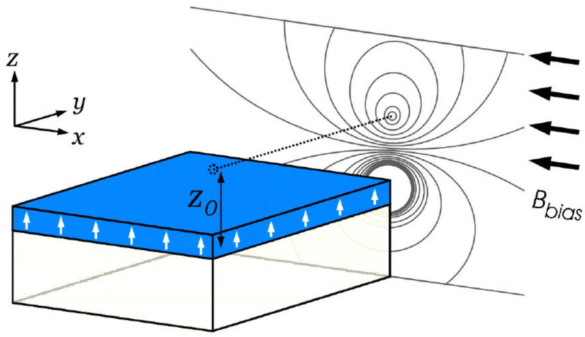


Fig 1. A semi-infinite perpendicularly magnetised film in combination with a uniform bias magnetic field B_{bias} produces a magnetic microtrap for ultracold atoms.

After laser cooling, the atoms are typically cold enough to be trapped in vacuum for several minutes using magnetic fields. Even lower temperatures can then be achieved by applying an evaporative cooling stage. In radio frequency evaporative cooling, atoms with higher than the average energy are coupled to a radio frequency field and ejected from the trap while the remaining atoms rethermalise to a lower temperature. This technique can be very efficient (low loss of atoms per decreasing temperature interval) as long as the cloud of atoms undergoes many rethermalising collisions within the trap lifetime.

The combination of laser cooling and evaporative cooling has now made it possible to reach below one-billionth of a degree above absolute zero [4]. At temperatures of approximately 100 nK, l_{dB} can become comparable to the mean separation between atoms so that individual atomic wave-packets overlap; that is, the atoms can undergo a phase transition to become a quantum-degenerate gas. A Bose-Einstein condensate is a type of quantum-degenerate gas consisting of bosonic atoms occupying the quantum ground state. The 2001 Nobel Prize in physics was awarded in recognition of the achievement and early fundamental studies of BEC in dilute atomic vapours [5].

The early studies were mostly aimed at understanding the coherence properties of BEC and included the first realisation of an atom laser [6] and the observation of high contrast interference fringes from two overlapping condensates [7]. Currently an ever increasing variety of atomic and molecular species are being cooled to quantum degeneracy. Meanwhile, other experimental efforts are directed toward the development of more robust and portable methods for producing BEC [8]. These developments will be instrumental for proposed applications such as BEC interferometry and quantum information processing.

Integrated atom optics

The miniaturization of electronic components into microelectronic devices is an excellent demonstration of the benefits of scaling down the dimensions of an experimental device and integrating its components. In 1995, the 'atom chip' was proposed as a simple method for confining and manipulating clouds of ultracold atoms in magnetic fields tens of micrometers above a micro-fabricated surface of conductors [9]. Moreover, the chip can provide a good reflective surface which can be used as the basis for a mirror magneto-optical trap (MMOT), a means of laser cooling and trapping the atoms close to a surface [10]. With this, one can imagine a device with integrated laser and atom sources, atomic waveguides, beam-splitters, and detection schemes all combined into a single integrated atom-optical circuit.

Atom chips have a number of advantages over a conventional BEC apparatus. By miniaturisation it is possible to achieve very large magnetic field gradients to provide tight confinement, excellent mechanical stability and low power dissipation. Atom chips have been used to realise fine structured magnetic potentials and may become instrumental for the study of macroscopic quantum effects such as quantum reflection, tunnelling and Josephson oscillations using a BEC. They are also naturally suited to investigating atom-surface interactions such as the Casimir-Polder potential [11]. Perhaps most appealingly, atom chips can exploit the unique properties of a BEC and are already finding practical applications, particularly as sensitive probes for measuring small magnetic and electrostatic forces [12].

Currently, three main technical limitations affect atom chips using current-carrying wires. Most noticeably, small spatial deviations in current-flow significantly alter the potential experienced by atoms leading to fragmentation of the BEC. These deviations are constant from day to day, and can be attributed mainly to imperfections in the fabrication process [13]. Secondly, thermal fluctuations associated with Johnson noise in conductors lead to a loss mechanism when atoms are moved closer to the surface [14]. Finally, very high current densities typical of fine structured wire patterns can lead to excessive heating and breakdown of the wires. All of these problems may be overcome with the development of novel materials and techniques for extremely high quality micro-fabrication.

Permanent magnetic microtraps

In 2005 Bose-Einstein condensates were produced using atom chips incorporating permanent magnetic materials [15,16]. At Imperial College in London, anatom chip was constructed using a sinusoidally magnetised video-tape. Trapped atoms near the surface have a relatively long lifetime due to the inherent reduction of Johnson noise in the thin electrically insulating tape [17]. Soon after, BEC was realised on an atom chip at Swinburne University of Technology in Melbourne using a tailored magneto-optical film. Magneto-optical films, unlike videotape, have perpendicular magnetisation and can be patterned with high precision and complex magnetisation patterns. They can also produce large magnetic fields, providing extremely tight confinement without the technical problems associated with high current densities in micro-fabricated wires. Atom chips that incorporate permanent magnetic materials are a promising alternative to current-carrying wire devices.

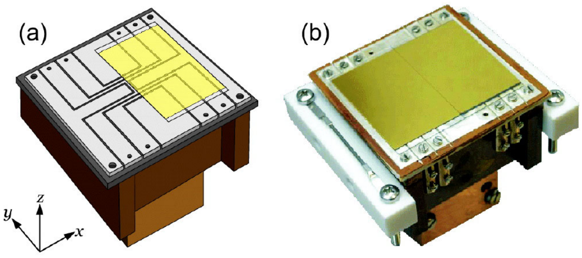


Fig 2. A schematic (a) and photo (b) of the Swinburne atom chip. Pictured is the TbGdFeCo magnetic film (with gold overlayer) and the machined silver foil structure. The two Rb dispensers are pictured in (b) either side of the chip.

The Swinburne atom chip

Magnetic materials with large perpendicular anisotropy are commonly used in high density information storage devices. These materials are optimised for small scale and high quality magnetic patterning. Magnetic films designed for atom optical applications also require large remanent magnetisation that is robust in the presence of external magnetic fields, extreme homogeneity to produce smooth magnetic potentials and a relatively high Curie temperature to prevent demagnetisation during the vacuum bake-out [18]. GdTbFeCo magneto-optical films can posses all of these properties.

The Swinburne atom chip is implemented in the 'side-guide' geometry (Fig. 1). This consists of the boundary of a uniformly magnetised film resulting in an azimuthal magnetic field with its origin at the film edge,

$B_{film}=\mu_0 tM/(2\pi z)$, where t is the film thickness, M is the remanent magnetisation and z is the distance from the surface. When the field from the film is combined with a uniform bias magnetic field, a magnetic tube is formed, centred at a distance controlled by the strength of the uniform field. Ultracold, paramagnetic atoms can then be guided in this tube potential. A three dimensional trap is formed by passing current through two parallel end-wires beneath and perpendicular to the tube.

A schematic diagram and photo of the permanent magnetic film atom chip is shown in Figure 2. A GdTbFeCo film of a total thickness approaching 1 μm is deposited on a glass slide substrate. A current-carrying structure beneath the substrate provides time-dependent magnetic fields for loading and transporting atoms to the surface. This layer consists of a 0.5 mm thick silver foil machined in an H-shape geometry. By controlling the current paths through the H-shape, it is possible to produce a mirror magneto-optical trap (MMOT) for laser cooling (U-shape configuration) or a purely magnetic trap for evaporative cooling (Z-shape configuration). End-wires are included for the magnetic film trap, doubling also as an in-built radio frequency antenna for evaporative cooling. The magnetic film, machined silver foil and two rubidium (Rb) dispensers are then fixed to a copper heat-sink to complete the chip. This is all mounted upside down in a stainless steel vacuum chamber and electrical connections are made to a 12 pin vacuum feed-through. The vacuum chamber and atom chip are then baked to remove water vapour and obtain a base pressure below 1◊10^{-11} Torr.

Bose-Einstein condensation

A typical experiment begins by pulsing current through a Rb dispenser for 8 seconds. This increases the Rb pressure in the chamber so that a cloud of 2◊10^{8} atoms can be collected in the MMOT about 5 mm from the surface. Atoms are held in the MMOT for 15 seconds while the vacuum recovers. The cloud is then compressed by increasing the current in the U-shaped current path. The cloud temperature after laser cooling is approximately 40 μK. A short optical pumping light pulse is then applied to orient the spin of each atom. After optical pumping, each atom can be pictured as a single magnetic dipole aligned opposite to the local magnetic field, such that the potential energy of the atom is lowest at a magnetic minimum. To magnetically trap the cloud, the compressed MMOT is quickly replaced by a Z-wire magnetic trap and further compressed, thereby increasing the collision rate and the cloud temperature. Prior to evaporative cooling, the cloud is located 0.5 mm from the surface at a temperature of approximately 400 μK.

Radio frequency (RF) radiation resonant with the Zeeman splitting of ^{87}Rb can be used to couple the atomic spin from a trapped state to an anti-trapped state which expels the atoms from the trap. Evaporative cooling works by tuning the radio frequency to regions of high magnetic field (the outer regions of the potential) where the most energetic atoms are mostly located. Typically, a 10 second logarithmic frequency ramp between 20 and 1 MHz is used to cool the cloud from 400 μK to 5 μK, still above the BEC transition. Here we decrease the current in the Z-wire to transfer the cloud to the permanent magnetic film trap located 0.1 mm from the film surface. An additional 4 s RF evaporation ramp further decreases the cloud temperature to below 400 nK to produce a Bose-Einstein condensate of 1x10^5 atoms. The apparatus is presently capable of producing a new BEC in the magnetic film trap every 40 s.

Initial experiments with BEC

It is possible to use the BEC itself to probe the film magnetisation and calibrate the atom chip operation. The small spatial extent of a condensate is an inherent advantage for measuring the azimuthal magnetic field. In the side-guide geometry (Fig. 1), the trap centre is located at a position where the magnetic field from the film exactly cancels an externally applied magnetic field. The applied field has been accurately calibrated by measuring the Zeeman splitting of falling cold atoms with a spectroscopic technique. The position of the cloud relative to the surface is determined with a resolution of ~5 μm by absorption imaging. The position of the BEC as a function of the calibrated external field provides a measure of the field strength of the film.

In-trap heating of the atomic cloud due to technical noise such as magnetic field fluctuations or trap vibration can dramatically limit the lifetime of a trapped condensate.

The heating rate is determined by preparing a thermal cloud in the magnetic film trap just above the transition temperature. The typical means for measuring the temperature of an ultracold gas is to release the cloud from the trap and monitor the rate of ballistic expansion. The cloud width after some expansion time (typically a few milliseconds) is determined by a short, resonant laser pulse which produces a shadow image of the cloud on a CCD camera. The mean thermal velocity of expansion is related to the cloud temperature, $k_B T = mv^2$. The cloud temperature measured at increasing intervals of the hold time provides the heating rate (Fig. 3). A

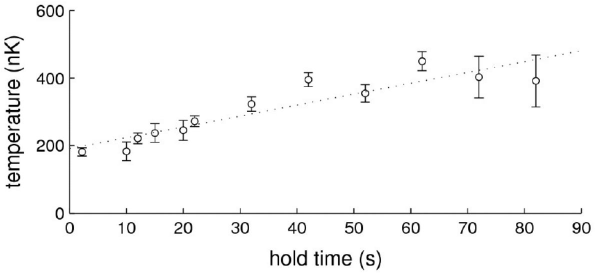


Fig 3. A cloud of atoms with an initial temperature just above the BEC transition are held in a permanent magnetic film microtrap. The rate of increase in temperature is a measure of the in-trap heating rate. For this data set the heating rate is 3 nK/s.

cloud trapped using permanent magnetic fields on our atom chip experiences a heating rate of only 3 nK/s which is much lower than observed under similar conditions using the Z-wire (270 nK/s) and to our knowledge the lowest reported on an atom chip.

Multiple Bose-Einstein condensates

Another property of ultracold clouds of atoms near the film surface is the presence of fragmentation. Longitudinal clumping of atomic density familiar to current-carrying wire atom chips has been observed close to the magnetic film surface. The fragmentation is associated with spatial magnetic field variations along the film edge which becomes significant when the kinetic energy (or temperature) of the confined cloud becomes as small as the amplitude of the variations in the trap potential. As the kinetic energy of the cloud is lowered further by cooling, the atoms become localised in isolated regions, the positions of which can be used to reveal the spatial distribution of the longitudinal magnetic field. As the energy associated with ultracold atoms or a Bose-Einstein condensate is extremely low, the atoms act as an ideal probe to profile tiny magnetic field corrugations.

An *in-situ* study of the corrugation has been performed with trapped ultracold atoms using a novel technique. Radio frequency spectroscopy combined with high spatial resolution typical of absorption imaging is used to profile the magnetic field landscape experienced by the trapped atoms. Firstly, a thermal cloud (with energy larger than the corrugations) is released along 5 mm of the film edge by reducing the end wire current. Narrow-band RF radiation is then applied to the trapped atoms. Atoms are expelled from regions of the potential where the RF is resonant with the Zeeman splitting. Immediately after applying the RF an absorption image of atomic density is taken. Regions of reduced atomic density correspond to a particular magnetic field contour. Repeated measurements by varying the radio frequency can be compiled to form a complete map of the magnetic field landscape. This technique provides an unambiguous, absolute, and intrinsically calibrated measure of magnetic fields with a combined sensitivity and spatial resolution capable of rivalling common-place techniques for imaging magnetic fields.

An accurate picture of the rich magnetic field structure gives an insight into the wide variety of cold atom experiments available. It is possible, for example, to prepare an array of condensates by minimising the magnetic field difference between each minimum along the film edge. In this way, we have simultaneously formed a string of independent condensates. The minimum of the magnetic field in each position along the film was first found using radio frequency spectroscopy. The two end wires are then operated independently in order to compensate for linear and quadratic magnetic field variations across the full length of the imaging field of view (~5 mm). Finally, the difference in field strength at the trap bottom across 11 independent sites was tuned to less than 200 nT. This allowed simultaneous formation of 11 Bose-Einstein condensates spanning across 3 mm of the structured magnetic potential (Fig. 4). To our knowledge this is the first realisation of an array of magnetically confined Bose-Einstein condensates. The mean spacing of ~300 μm facilitates addressability by both optical and radio frequency methods and might have applications as an atomic register for storing quantum information.

What is to come?

The central region of the film (Fig. 4, near y=0) is particularly interesting. This region is used as a tuneable double-well potential for manipulating a condensate. The barrier height can be accurately controlled by moving the trap closer to the surface which increases the barrier height. Furthermore, the symmetry of the wells can be controlled by adjusting the current in each end-wire.

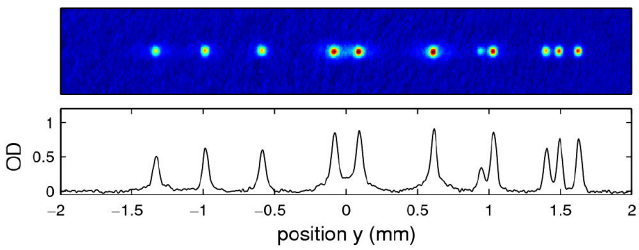


Fig 4. A string of Bose-Einstein condensates are simultaneously produced in the corrugated magnetic potential. The large separation between condensates (~ 300 mm) allows good addressability.

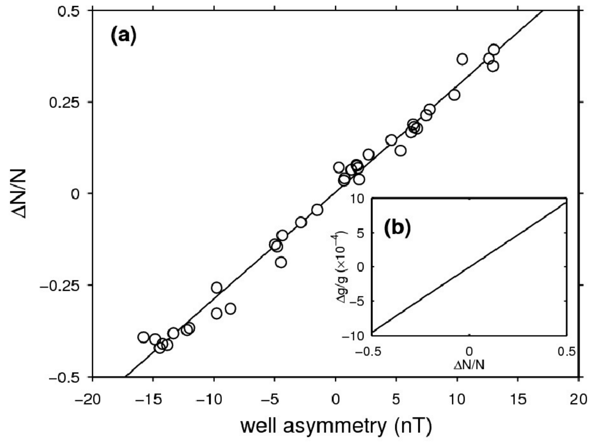


Fig 5. Adiabatic splitting of a BEC in the double-well potential is uneven in the presence of a small asymmetry between wells. The process is calibrated against a known magnetic field gradient (a) and can be used to estimate the expected sensitivity to gravity gradients (b).

We initially form a condensate in a single potential well at $y = 0$, far from the surface and then adiabatically transform the potential into a double-well for splitting the BEC. This constitutes the fundamental basis for a double-well atom interferometer, where splitting, phase evolution, recombination and readout stages are required. The splitting is performed by slowly moving the single condensate closer to the surface (by adjusting B_{bias}) by about 50 μm over 500 ms. In order to split the condensate evenly it is necessary to carefully tune the relative depth of each well so the potential is symmetric to less than 500 pT. The final population of each well after splitting was found to be extremely sensitive to any time varying gravity or magnetic field gradients which imbalance the potential (Fig. 5). This concept has proven ideal for monitoring long-term drifts in the apparatus. In the future we propose to utilise the splitting of a BEC as a tool for monitoring small gravity gradients such as tidal forces due to the moon's orbit. Good estimates of the technical limitations of this sensor should provide valuable insight into the practical limits of integrated atom interferometers.

Concluding remarks

Atom chips have proven to be a robust and relatively simple means for producing Bose-Einstein condensates close to a surface. The permanent magnetic film atom chip developed at Swinburne University is an ultra-stable device for manipulating condensates in potentials with complex structure. Corrugations in the potential have been characterised using a novel technique incorporating radio frequency spectroscopy with high spatial resolution. The magnetic landscape is then exploited to produce a string of condensates. The central region of the potential resembles a tuneable double-well potential and has been used to split a single condensate into two parts. This may ultimately provide the basis for an integrated atom interferometer. Currently, though the double-well potential can be used as a highly sensitive probe of gravity and magnetic field gradients.

References

[1] S. Chu, Rev. Mod. Phys. **70**, 685 (1998), C. N. Cohen-Tannoudji, Rev. Mod. Phys. **70**, 707 (1998), W. D. Phillips, Rev. Mod. Phys. **70**, 721 (1998)

[2] E. A. Hinds and I. G. Hughes, J. Phys. D: Appl. Phys. **32** R119 (1999)

[3] See, for example, the special issue on atom interferometry [Appl. Phys. B **54**, 321 (1992)]

[4] A. E. Leanhardt *et al*, Science **301**, 1513 (2003)

[5] E. A. Cornell and C. E. Wieman, Rev. Mod. Phys. **74**, 875 (2002), W. Ketterle, Rev. Mod. Phys. **74**, 1131 (2002)

[6] M.-O. Mewes *et al*, Phys. Rev. Lett. **78**, 582 (1997)

[7] M.R. Andrews *et al*, Science **275**, 637 (1997)

[8] S. Du *et al*, Phys. Rev. A **70**, 053606 (2004)

[9] R. Folman *et al*, Phys. Rev. Lett. **84**, 4749 (2000), and references therein

[10] J. Reichel *et al*, Phys. Rev. Lett. **83**, 3398 (1999)

[11] H. B. G. Casimir and D. Polder, Phys. Rev. **73**, 360 (1948)

[12] S. Wildermuth *et al*, Nature **435**, 440 (2005)

[13] J. Estève *et al*, Phys. Rev. A **70**, 043629 (2004)

[14] M. P. A. Jones *et al*, Phys. Rev. Lett. **91**, 080401 (2003)

[15] C. D. J. Sinclair *et al*, Phys. Rev. A**72**, 031603 (2005)

[16] B. V. Hall *et al*, J. Phys. B: At. Mol. Opt. Phys. **39** 27 (2006)

[17] C. D. J. Sinclair *et al*, Eur. Phys J. D, **35**, 105 (2005)

[18] J. Y. Wang *et al*, J. Phys. D: Appl. Phys. **38**, 4015 (2005)

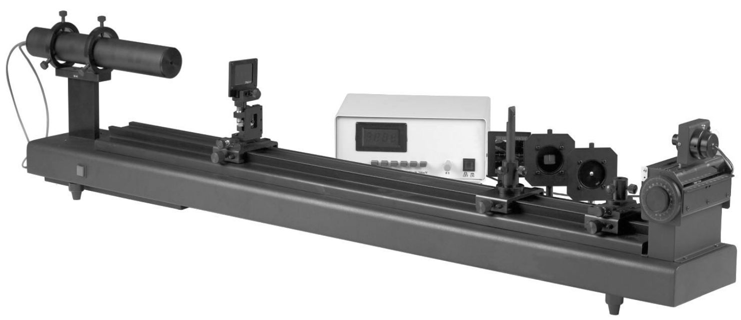
[This article first appeared in *Australian Physics* (#2 2006) and is reprinted here with permission.]

Experimental Instruments

LEOI-30 Diffraction Intensity System

This system enables students to understand the basic principle of Fraunhofer diffraction and measure the intensity of diffraction. It features stable performance, easy operation, visual results and accurate reading

- Photocell receiver: optical current amplifier, 20μW ~ 200mW
- Multi-hole plate: 8 holes from 0.1mm to 2mm
- Photocell displacement range: 80mm with resolution of 0.01mm
- He-Ne laser: 1.5mW@632.8nm



LEOI-50 Experimental Device for Semiconductor Laser Pumping

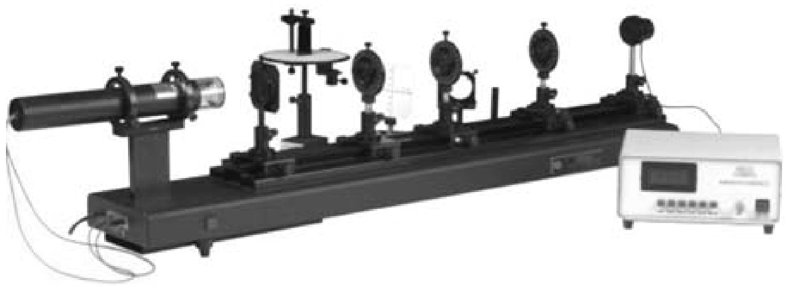
Designed for non-linear optical experiments in modern physics taught at universities and colleges. It has an open structure for accessibility of individual parts adjustment. Through the experiments, students can gain basic knowledge on laser principle and laser technology.

- Nd: YVO4 is the active medium to be studied
- Pumping: 808nm semiconductor laser
- KTP crystal inside cavity for frequency doubling
- Measurement of frequency doubling efficiency, phase matching angle and other basic parameters

LEOI-40 Experimental System for Polarized Light

This is an experimental system for polarized light received by a photocell. Students can complete the following experiments through manual operation:

- Polarizing reflection
- Measuring Brewster angle
- Verifying Malus' Law



www.lambdasci.com

Lambda Scientific Pty Ltd
2/147, Buxton Street, North Adelaide SA 5006 Australia
Phone: +61 8 8267 2686
Fax: +61 8 8267 2689
E-mail: sales@lambdasci.com

`

Optical Breadboards and Supports

Optical Breadboards

Specifications

- **Top plate**: Magnetic stainless steel, 5mm thick
- **Bottom plate**: Magnetic stainless steel, 5mm thick
- **Thickness**: 60mm or 100mm
- **Mounting holes**: M6 on top on 25mm grid
- **Flatness**: ± 0.1mm over 600 × 600mm area
- **Distance of fist hole to edge**: 50mm
- **Weight density**: 60mm thick, approx. 95kg/m^2
  100mm thick, approx. 105kg/m^2

Rigid Support Frame

Rigid support frames are used to mount optical breadboards. The breadboard bottom surface rests on four heavy-duty bolts on the top of the support frame

- Four adjustable legs at the bottom
- Leveling on frame top to support breadboard
- Four heavy-duty precision castor wheels

Standard Metric Breadboards (mm)

300 × 300 × 60	900 × 600 × 100
600 × 300 × 60	900 × 900 × 100
600 × 450 × 60	1200 × 600 × 100
900 × 600 × 60	1200 × 900 × 100
900 × 900 × 60	1500 × 900 × 100
1200 × 600 × 60	1800 × 900 × 100
1200 × 900 × 60	
1500 × 900 × 60	

900 × 600 × 60 Plus support frame with casters, FOB in Adelaide

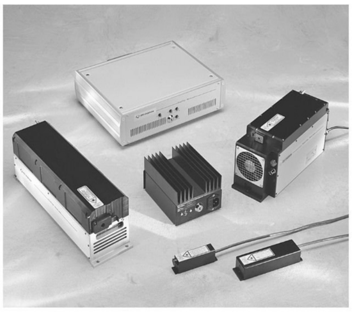
$1,169

Lambda Scientific Pty Ltd
2/147, Buxton Street, North Adelaide SA 5006 Australia
Phone: +61 8 8267 2686
Fax: +61 8 8267 2689
E-mail: sales@lambdasci.com

Photon Engineering

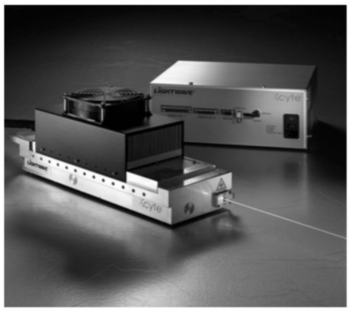
Photon Engineering Pty Ltd
PO Box 122 Rundle Mall
Adelaide SA 5000 AUSTRALIA
Tel: +61 - 8 - 8232 3444
Fax: +61 - 8 - 8232 9333
info@photonengineering.com.au
www.photonengineering.com.au

Specialists in Solid-State Laser and Diode Laser Technologies



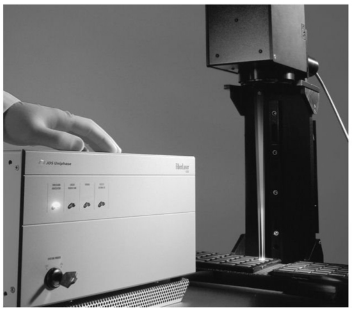
Compact DPPS Lasers

Single Frequency DPPS Lasers



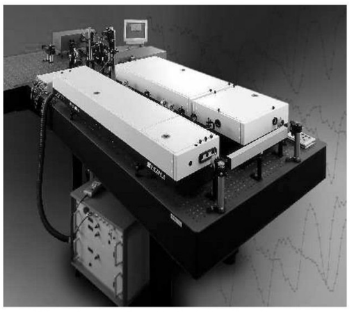
Multi-Watt IR, Green & UV DPSS Lasers

Diode Lasers & Fibre Lasers



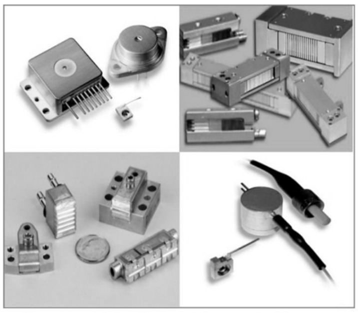
Integrated Industrial Lasers

Tunable Lasers & OPO's



Custom Solid-State Lasers

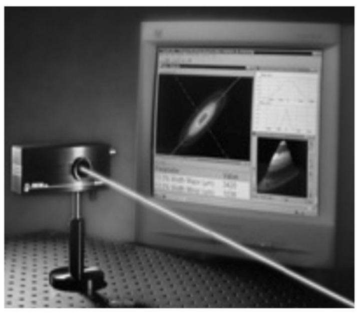
DPSS Pump Modules



Laser Diodes, Bars & Arrays

Fibre Optic Components & Sub-systems

Optics, Optical Mounts & Micropositioners



Laser Beam Profilers, Power & Energy Meters

Conference Report - CLEO/QELS 2006 - A Graduate Student's Perspective

Aidan Brooks
Department of Physics,The University of Adelaide, Adelaide SA, 5005
aidan.brooks@adelaide.edu.au

It's not hard to imagine that a secret memo was sent out in advance to all the staff, exhibitors and academics present at CLEO/QELS 2006. A directive stating that the behaviour of all participants should reflect the tone, mood and theme of this year's conference. A fanciful idea, maybe, but based upon the running and execution of CLEO/QELS 2006, such a memo would have read: "The theme of this year's conference is 'inclusion'. We would like everyone involved to end their week with the realization that they are a genuine part of the global lasers and optics community".

The annual Conference on Lasers and Electro-Optics, or CLEO, in conjunction with the Quantum Electronics and Laser Science Conference (QELS), was held this year from May 21st to 26th in Long Beach, California; one of the world's largest shipping ports and the resting place of the great ship, the Queen Mary. CLEO, the principle conference organised by the Optical Society of America (OSA), has been running for more than 20 years and is a forum for the lasers and optics community, researchers and businesses, to gather and share their latest insights and products.

This year, over 1500 papers were submitted, of which 849 were selected for oral presentations. The paper I submitted discussing work done at the University of Adelaide on a tomographic Hartmann sensor was fortunate enough to be selected. Funding to cover conference attendance was provided by prizes from the Australian Optical Society (AOS) and the SPIE. For this conference report, I'd like to reflect upon three aspects of the conference that, for me, made the experience worthwhile and engaging; the range of services for students, the plethora of commercial exhibitors and the vast number and quality of presentations.

CLEO was clearly designed to encourage students to participate. This began at the very moment of conference registration - the cheapest form of registration was for Student Members; effectively encouraging students to join the OSA - a nice touch! The OSA kicked off the student services on Monday morning at 7am, (a bit too early for my taste), with "Breakfast with the Board"; a casual meal to allow students to get to know the current board members. I was seated at a table with Peter Delfyett, General Co-Chair of CLEO, and several other international graduate students. The topics of discussion ranged from the projects we were all working on to the best way to cook kangaroo steaks! Immediately following this was a brief workshop with senior OSA members on how to get the best out of the conference - "be proactive, asks questions, go up to new people and talk to them; you might be intimidated, but delegates are always keen to discuss their own research and answer questions". This advice certainly made me relax and feel that I was respected by my peers.

Over the rest of the week, the OSA had organised several other student events to allow students to network with each other. This worked very successfully; I now have many new friends from several different countries. These events were capped off with the first annual Newport Student Researcher Party! Originally intended for only 100 students, but ultimately accommodating 298. I'm glad I wasn't picking up the drinks bill!

CLEO is also an opportunity for manufacturers to showcase existing and brand new products. Picture a giant three dimensional lasers and optics catalogue; one where you can browse at your leisure and you can stop and play around with whatever technology takes your fancy. This is what greeted us as we entered the Exhibition Hall on Tuesday.

Now, although getting free t-shirts, toys, pens and laser pointers is appreciated, and playing around with all the different technology is fun, perhaps the most rewarding thing was the opportunity to meet the people who worked for all the companies. They were willing, eager even, to hear complaints and comments about their products. It became obvious that as the *consumers* of their products, our research drives the direction of their businesses, not the other way around. In fact, I personally witnessed the president of Thorlabs decide to bring a discontinued lens mount back into production after a discussion with a conference attendee.

Of course, the wealth of technologies available in the one room was also an terrific opportunity to scout out new solutions to problems faced in my own research. I found an ideal incoherent light source for our Hartmann Sensor - a brand new fibre-coupled superluminescent LED from Power Technologies.

A conference really wouldn't be anything without all the oral presentations, though. In fact, my only major criticism of the event is that there were simply too many presentations to attend. There were four types of increasing duration; Technical, Invited, Tutorials and Plenary, of which I'll discuss three. The technical talks were limited to only 12 minutes - a very difficult duration for a talk because it only allows for a short introduction and 2 or 3 main points to be made. I attended as many of these sessions as I could. I particularly enjoyed the talk on Silicon Carbide Cooled Solid-State Laser by G. Alex Newburgh from the US Army Research Laboratory; if only because I found it interesting to compare and contrast the "optical headspreader" technique he discussed with work done in my own research group on heat removal in high power solid-state lasers.

The Tutorials were of varying quality. All were very well presented, but in terms of the content, some seemed to be too much history and not enough physics, while others seemed to contain too many technical details and not enough context. However, as "introductions to important issues in lasers and electro-optics", they provided enough information to make these areas of research quite accessible. The tutorial on Phase-Conjugate Solid-State Lasers, given by David Rockwell from Raytheon, was very interesting. Finally, the four Plenary sessions were all well attended. David Payne gave a very entertaining presentation on the next generation of Fibre Lasers.

And my own presentation? I've given talks before, but this was the largest and most prestigious conference that I have attended so far, so I was a little nervous. However, my talk was on Monday morning, immediately following the OSA student events. The friendly atmosphere and encouraging words at these events put me at complete ease and I was very happy with the final execution of my presentation. Inevitably someone asked me a question for which I didn't have a prepared answer, however, after a moment's reflection I felt I gave a reasonably cogent and coherent response. I actually found it be encouraging to have someone else consider my work from a new perspective and several interesting discussions followed from that initial question.

CLEO/QELS 2006 was a fantastic opportunity to be exposed to the global optics community and actively play a part in it, and I now feel very enthusiastic about the field of optics and lasers. Attending the conference is also an ideal opportunity for graduate students who are near completion to talk to businesses, academics and researchers about potential employment. I encourage all current Ph.D. students to consider attending CLEO/QELS 2007: remember, abstracts are due by December 1st. Many thanks to the AOS and SPIE for providing the funds to attend this event. Lastly, I'd like to thank Thu-Lan Kelly and my supervisors, Jesper Munch and Peter Veitch, for their assistance with my research.

(Yep, that's Aidan alright! ed.)

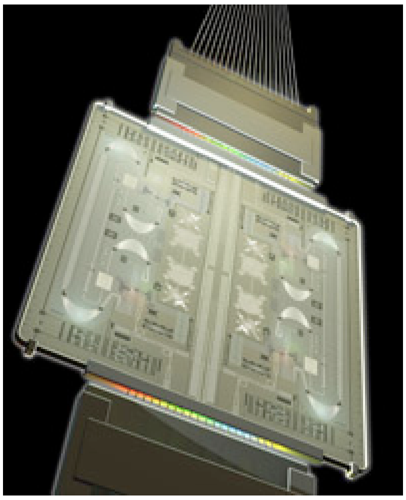
CUDOS and Next Generation Optical Networks

CUDOS is carrying out fundamental scientific research leading directly to the key building blocks of next generation optical communications systems. Why is this research important? To find the answer, look at the major changes in telecommunications systems presently underway in which carriers are investing multi-billion dollar sums in completely revamping their telecommunications infrastructure so that all networks – voice and data – will be based on a single internet protocol (IP) platform. With these new platforms, carriers will provide a wide range of new services based on broadband internet access including internet TV and video telephony. These services will be provided to a market of broadband users that is growing at 70% per year across OECD countries.

The fundamental architecture of modern optical communications networks is changing to better manage these complex and vast data flows. The ability to dynamically switch and optimise internet traffic through the network will be crucial. The following are required to do this:

- Real time fault monitoring in the optical domain;
- Rapid equalisation of data transmission along paths of the network. This relies on rapid switching of data from one path to another, and/or rapid switching of data from one wavelength channel to another as it moves through the network;
- Optical regeneration – reamplification, reshaping and retiming – of data signals at "node points" throughout the mesh. As the mesh increases in complexity, electronic regeneration becomes increasingly impractical.

The development of "photonic integrated circuits" (PICs) is viewed by most as integral to the realisation of this vision, in much the same way as electronic integrated circuits are integral to the operation of present-day computers. PICs produced using semiconductor foundry techniques, similar to today's silicon-based integrated circuits are the only technology able to address the requirements of improved functionality and decreasing transmission costs in next generation optical networks. The development of PICs, and the development of optical functions like regeneration that can ultimately be "encapsulated" in a PIC, are the core of the CUDOS research mission.



The image above, from www.esa.int/SPECIALS/GSP/SEM6AEO3E4E_2.html, shows that a PIC would look little different to an electronic integrated circuit, except that signals are coupled in and out along optical fibres.

In a report published by the US National Science Foundation in 2005, PICs were identified as one of the key enabling technologies for optical networks of the future. As the workshop report states, "… to improve the transmission capacity, configuration capabilities, and flexibility of networks based on fixed optical fibres, while sharply reducing operational costs, … networks will have "end-to-end dynamic (transparent) optical circuits that can be automatically set up in a matter seconds, rather than today's days or weeks provisioning time." As the report convincingly argues, such flexibility can only be achieved through the development of PICs.

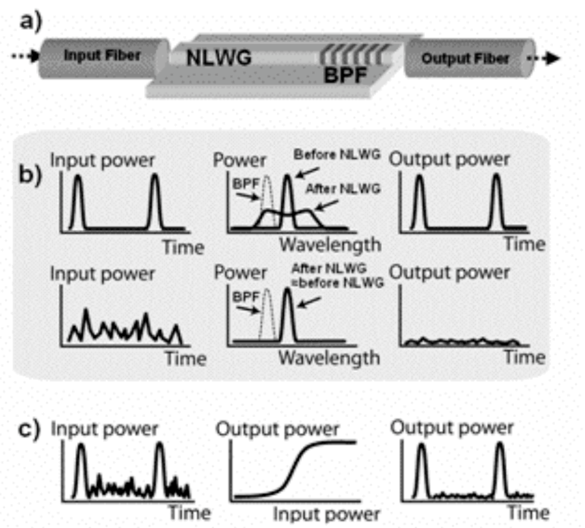
The encouraging developments in the marketplace strengthen the CUDOS mission to develop novel technologies for ultrahigh bandwidth communications technologies, while the recommendations of the NSF workshop validate the research directions of the CUDOS program.

CUDOS conducts research at the fundamental level but also with a focus on applications. In our work on optical regenerators we study the basic physics of nonlinear materials in order to develop an optical signal regenerator.

As signals are transmitted through a telecommunications network they suffer distortion and attenuation. *Regeneration* is the process of recovering the signal quality and involves re-shaping the signal, re-amplifying it and possibly also re-timing it. In present-day systems, which operate at bit rates up to 10Gb/s, regeneration is done electronically. Replacement of the O-E-O stage with an *all-optical regenerator* has become an increasingly important challenge in photonics research.

Regeneration requires a nonlinear relationship between the input and output optical signals (see figure). This nonlinearity must have a response time of less than 100 fs. Chalcogenide glasses have high coefficients of Kerr nonlinearity with response times less than 20 fs and so are potential material systems in which to develop a compact optical regenerator.

The all-optical regenerator that CUDOS is developing is shown below. NLWG is NonLinear WaveGuide and BPF is BandPass Filter. The regenerator is built on a planar substrate of chalcogenide glass and is highly compact.



The regenerator works as follows. A short length of waveguide etched in a planar chalcogenide glass film is followed by a Bragg grating filter produced in the waveguide. The filter pass band is offset from the signal wavelength so that at low intensities the optical signal is blocked by the filter ((b) in the diagram). On the other hand, higher intensity pulses, representing logical "1's", undergo spectral broadening due to a nonlinear effect. As the spectrum broadens with increasing input power, a portion of it overlaps with the transmission band pass filter and consequently is transmitted ((a) in the diagram). The result is the "S-shaped" nonlinear power transfer curve, shown in (c) of the figure. This reduces noise on both the signal "0's" and "1's" and improves both the optical signal to noise ratio (OSNR) and, for bits that contain information, the Bit Error Rate (BER). This device is potentially very fast (>1 Tb/s) since it is based on the pure Kerr nonlinearity.

In the past year CUDOS has demonstrated all-optical signal regeneration with 1.5 ps pulses. The device is based on As_2S_3 chalcogenide glass which has attracted significant interest in the past few years as one of the most promising nonlinear optical materials. The glass we use was developed in CUDOS, and deposited as a thin film for subsequent lithography and etching to produce the waveguide. Waveguide gratings were written near the exit facet of the waveguide with green light using a Sagnac interferometer. This yielded extremely high quality gratings in terms of both width and strength depth, with very sharp edges - critical for the successful performance of this device.

For more information on this project, contact Dr David Moss, d.moss@physics.usyd.edu.au, or Professor Ben Eggleton, b.eggleton@physics.usyd.edu.au.

sales@lastek.com.au

Laser Accessories

Vibration Isolation Tables, Platforms & Workstations

Kinetic Systems offers a comprehensive range of passive or active vibration isolated optical tables, workstations & platforms offering:

- Large Range of Sizes & Performance Levels
- SPILLPRUF Spill Management System
- Variety of TableTop Materials
- Optional Accessories Including Casters, Guard Rails, Armrest, Faraday Cages, Enclosures, Additional Shelves & Many More
- Custom Designs Available

Nano Positioning Systems

- 1 to 6-axis Systems Available
- Travel up to 1mm
- Sub-nanometre Resolution
- Sub-nanometre Repeatability
- Analogue or Digital Control Electronics
- New Integrated PIMCA Ceramics Offer Greatest MTBF
- Control Options include Patented Input Processing for Shortest Step & Settle Time.

Micro Positioning Systems

- Systems with 1 to 6+ Degrees of Freedom
- Travel up to 300 mm
- Nanometre Resolution
- Sub-micron Repeatability
- Complete with Labview drivers (+ others)
- Standalone or PC Based Controllers
- National Instruments Interface Available

Laser Power & Energy Meters

- Dual Channel Power/Energy Meter
- Variety of Power & Energy Heads Available
- Simultaneous Power & Energy Readings
- USB Interface with Remote Control to LabVIEW
- SD Card for Data Logging
- Digital, Analogue Bar & Graphic Options
- Hand Held Power Probes Also Available

Detectors

Warsash offers a comprehensive range of detectors from the UV to the far IR including:

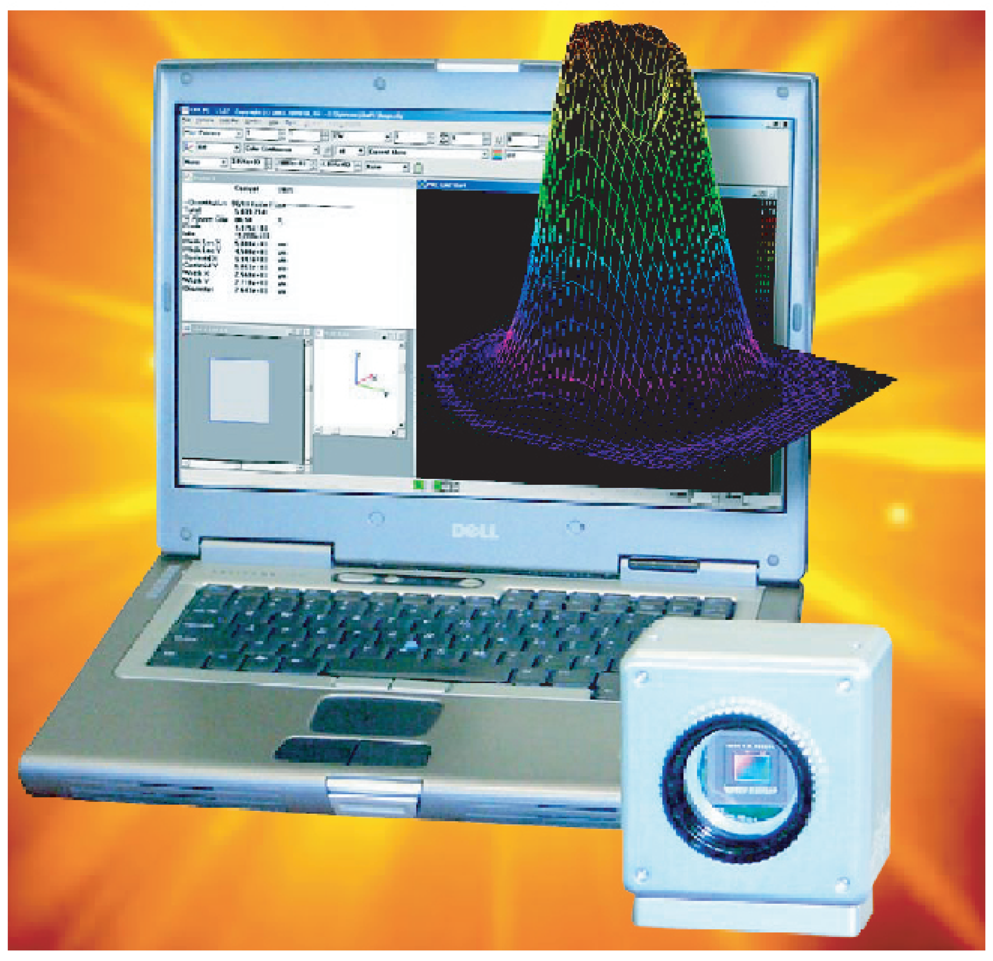
- Silicon PN, PIN & APD Detectors (Including Photon Counting Modules)
- InGaAs PIN & APD Detectors (Extended Versions Available)
- HgCdTe Detectors (Photoconductive & Photovoltaic Available)
- Full range of Ge, PbSe, PbS, InSb & InAs Detectors
- Channel Photomultipliers (Including Photon Counting Modules)
- Comprehensive Range of Controllers, Amplifiers, Voltage Supplies, Coolers etc

Laser Safety Products

Warsash can supply a complete range of Laser Safety products including:

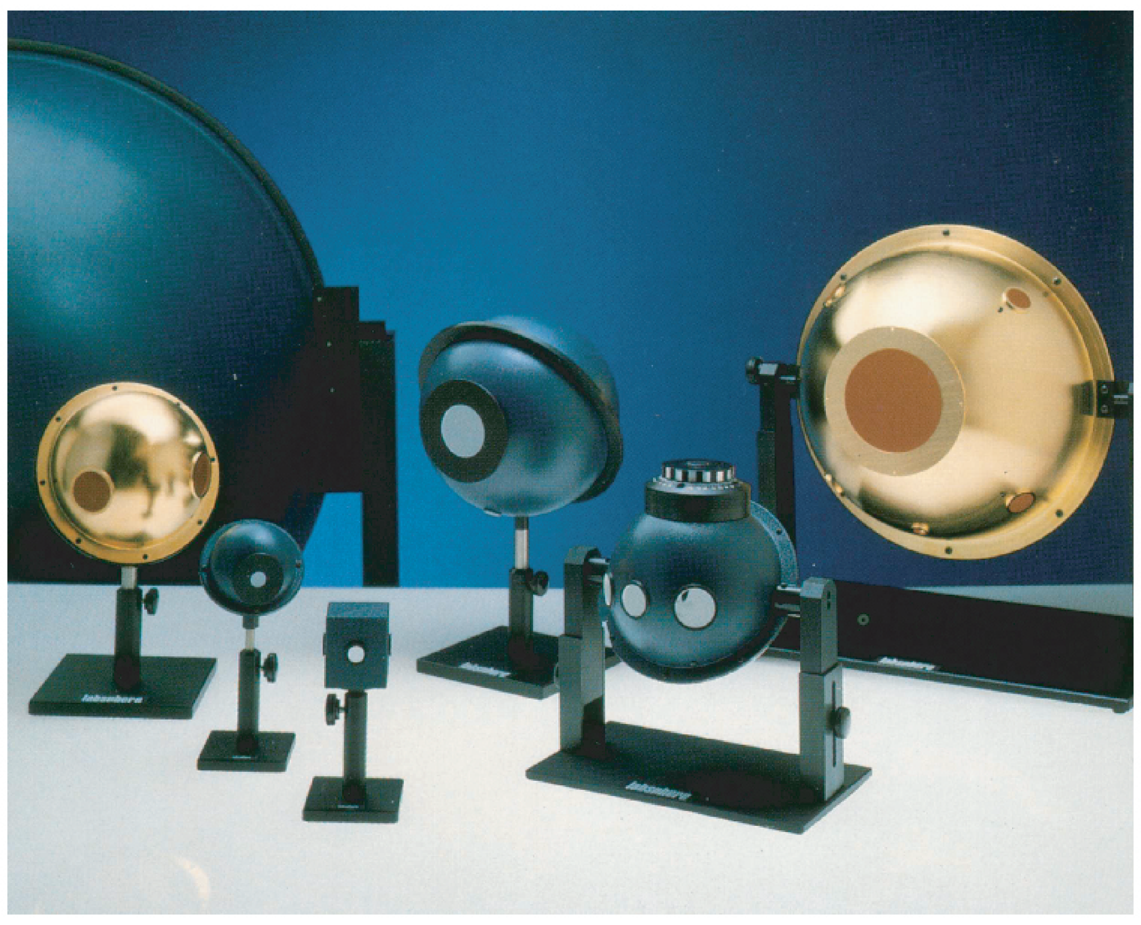
- A Comprehensive Range of Protective Eyewear Frames & Filters (Including Prescription Lenses & CE Certified)
- Laser Barriers & Screens
- Laser Safety Windows
- Interlock Systems & Warning Signs
- Advise on Suitable Protective Measures

Laser Beam Analyser Systems



With Spiricon's range of laser beam analyser systems you can accurately analyse your laser beam in real time. The Spiricon systems offer the following advantages:

- Compatible with Nearly all Commercially Available CCD Cameras
- UV to IR Systems Available (Including Cost Effective 1550nm Systems)
- Analogue (8 to 14 bit), Digital (auto 8 to 16 bit) & FireWire versions Available
- Patented UltraCal Technology Accurately Measures the Baseline
- M² & Hartmann Wavefront Analysers Available



Integrating Sphere Systems & Reflectance Material

Warsash offers a full range of Integrating Spheres & reflectance materials including:

- 2" to > 2m Diameter Spheres
- >99% Reflectance Material from the UV to IR
- Uniform Source Systems
- Calibrated Measurement Sphere Systems
- Reflectance Standards & Targets
- Custom Reflectance Coating & Machining Service

WARSASH Scientific
Advanced Instruments for Research & Industry

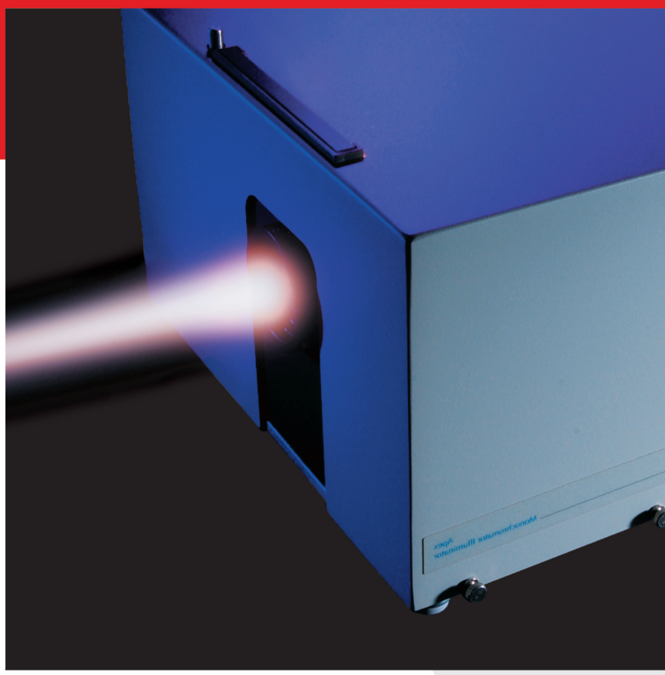
Sydney
PO Box 1685
Strawberry Hills
NSW 2012
Tel: (02) 9319 0122
Fax: (02) 9318 2192
sales@warsash.com.au
www.warsash.com.au

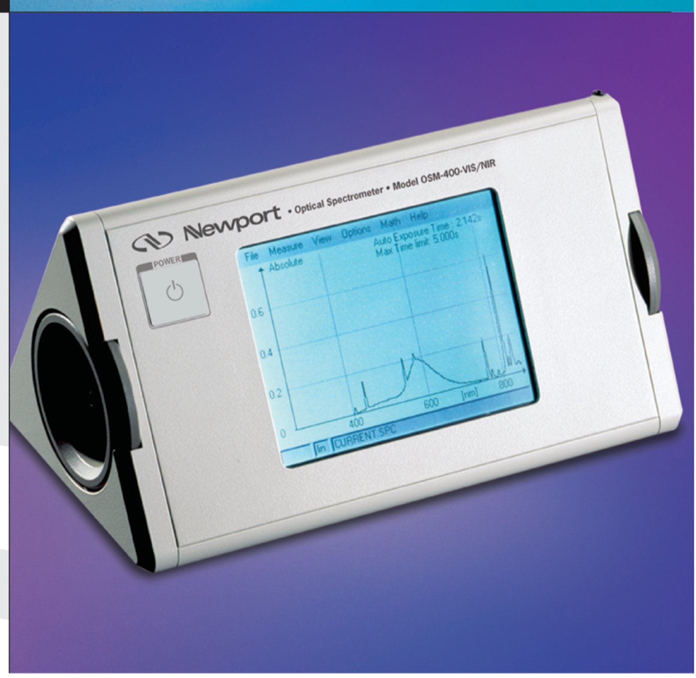
Newport
Experience | Solutions

Spectra-Physics
A Division of Newport Corporation

Make, manage & measure light with Oriel

Spectra-Physics, including Oriel Instruments, Hilger Crystals, Corion Filters and Richardson Gratings are now part of the complete solution at NewSpec
One Company, One Source, One Solution.





Products & systems to make light:
> Laser systems > Gas lasers > Solid state lasers
> Diode lasers > Lamp sources > Hg and Xe Arc lamps
> QTH lamps > Deuterium lamps > Calibration lamps

Products & accessories to manage light:
> Lenses, mirrors, prisms, windows, beamsplitters, polarisers and filters
> Mirror mounts, lens holders, post and rod systems, bases and brackets, rail systems, specialty mounts
> Linear, vertical and rotational stages and positioners

Products & systems to analyse & measure light:
> Oriel Spectrographs > Oriel Monochrometers
> Optical power and energy meters
> Ultrafast detectors > Beam analysers
> FROG – ultrafast pulsed measurement systems

Contact us for a copy of the Oriel light re-source catalogue

NewSpec

Freecall 1800 153 811
Phone 08) 8273 3040
Fax 08) 8273 3050
sales@newspec.com.au
www.newspec.com.au
83 King William Road
Unley SA 5061
ABN 82 882 831 899

ZEMAX DEVELOPMENT CORPORATION

WAVELAB SCIENTIFIC Innovative Solutions

Dear valued customer,
We are pleased to announce WaveLab Scientific is the sole distributor of ZEMAX optical design software for Asia pacific region. Having Singapore as head quarter we have full authorization to distribute ZEMAX software in Singapore, Malaysia, Indonesia, Thailand, Philippines, Vietnam, Myanmar, India, China, Taiwan, Hong Kong, Australia and New Zealand. In addition to that we offer training courses on How to use the ZEMAX software effectively and in general optics.
To serve you better now we have our training course "Optical Design Using ZEMAX" in Australia.

- **ZEMAX Course Fee**

Register Per Person

AUS $1600

Group Discount 20%

(Min. 3 or more persons)

Optical Design Using ZEMAX Australia

03-07 July 2006

Venue: RMIT University

5 Days Course (9 am - 5 pm Daily)

Tel: 65-6564 3659 Fax: 65-6564 9627

Email: info@wavelab-sci.com

For more information on course contents, please visit our webpage:
http://www.wavelab-sci.com/Training_ODUZ.htm

Introduction to our Lecturer

Ms Malar R. K., Optics Software Specialist, WaveLab Scientific Pte Ltd.
Ms Malar obtained her Bachelor of Engineering degree in Electrical and Electronics discipline, and a Mster degree in Photonics from Nanyang Technological University of Singapore.
She has received entire training at ZEMAX Development Corporation USA and conducted training courses in Singapore successfully.

OPTICAL DESIGN USING ZEMAX COURSE - REGISTER FORM

Name:______________________________

Company:______________________________

Address:______________________________

Address:______________________________

Country:______________________________

State or City:______________ **Zip Code:**______________

Phone:______________ **Fax:**______________

Email:______________________________

☐ **Please tick here if you have 3 or more person to register the courses.**

Terms & Conditions
The course registration fee is AUS $1,600.00 for each course. Please contact us for discount pricing if you plan to send 3 or more attendees to a single class. Payment must be received with this registration form in order to hold your seat.

A limited number of seats are available for each course; please call to verify that space is acailable. Registration forms without payment will not hold a reserved seat. Please note that WaveLab does not accept purchase orders or credit terms for short courses.

Payment may be made by cheque, wire transfer or by Visa or MasterCard in Australian Dollars. Registration fees are not refundable unless the short course is canceled by WaveLab Scientific Pte Ltd; who reserves the right to cancel any of short courses for any reason.
All courses run from 9:00 AM to 5:00 PM daily. The short course fees includes instruction, discussion, course notes, and hands-on exercises using computers. One computer will be provided for every attendee. the short course fee does not include travel expenses, lodging, meals or any other personal expense of the attendee.

Wavelab Scientific Pte. Ltd.

BLK 2, Bukit Batok St.24, #06-09, Skytech Building, Singapore 659480

| Tel: 65-6564 3659 | Fax: 65-6564 9627 | Email: info@wavelab-sci.com | Website: www.wavelab-sci.com |

AUSTRALIAN RESEARCH COUNCIL
CENTRE OF EXCELLENCE FOR
QUANTUM-ATOM OPTICS

www.acqao.org

The Australian Research Council Centre of Excellence for Quantum-Atom Optics (ACQAO) is one of Australia's contributions to the rapid development of quantum science that is happening around the world.

The Centre brings together scientists working in three cities, at the Australian National University (ANU) in Canberra, the University of Queensland (UQ) in Brisbane and the Swinburne University of Technology (SUT) in Melbourne, and links them with scientific partners in Europe and New Zealand.

Quantum science will play a major role in future technology and eventually our daily lives.

One area will be optics and wave effects for both light and atoms. Scientifically we are now able to investigate the quantum behaviour of larger objects, involving thousands and even millions of atoms, and see the transition from the microscopic world of a few particles to the macroscopic world of classical effects.

Technically we are now able to use the process of entanglement that was just a concept in the 1930s, and employ it in practical applications, such as communication systems.

We now have the technology for cooling atoms to unimaginably low temperatures and for creating Bose-Einstein condensates. Combining these, we are at the threshold of turning fundamental science into practical applications over the next two decades.

The Centre concentrates on fundamental science questions. It combines our well-established track record in quantum optics with our leading groups in atom optics and laser cooling into one team with common goals. We are combining pioneering theoretical work with experimental projects.

The Centre of Excellence is part of the vision of the Australian Research Council to promote excellence in the most successful fields of research and to give them the opportunity to become players in the international arena.

The funding and support provided by the Australian Research Council, the three Universities ANU, UQ and SUT and the Queensland and Australian Capital Territory governments will allow us to tackle ambitious Outreach projects, to have an intensive exchange of people, to provide opportunities for young scientists and to build the required research facilities.

AUSTRALIAN RESEARCH COUNCIL
CENTRE OF EXCELLENCE FOR
QUANTUM-ATOM OPTICS

www.acqao.org

UQ Professor delivers keynote address for Nobel Prize-winner

UQ Professor of Theoretical Physics, Peter Drummond, gave the keynote introductory address for a festive symposium honouring the 2005 Nobel prize-winner in Physics, Roy Glauber of Harvard University, on the occasion of his eightieth birthday.

The international symposium took place in Germany's Erlangen University, in May 2006, and included many leading scientists from around the world, including Germany, France, Austria, Sweden, Norway, Hungary, New Zealand and the USA. Professor Glauber was also awarded an honorary PhD.

The University of Queensland and the ARC Centre of Excellence for Quantum-Atom Optics have had a long association with Glauber's pioneering research into quantum optics. Professor Drummond presented a paper outlining the progress at UQ in computational physics and coherence theory, extending Glauber's ideas to the new science of atom lasers.

This field has many applications to communications, optical clocks, precision measurements, ultra-sensitive detectors and fundamental tests of quantum theory.

Professor Roy Glauber

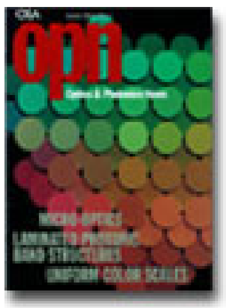
OSA®
Optical Society of America

Make The Most of Your Connection

The Optical Society of America is your inside track to the optics and photonics community and your link to an international network of more than 12,000 optical scientists, engineers, and technicians in some 50 countries. This connection, combined with OSA's strong programs and services, makes OSA membership a valuable resource for you. Join now!

Connect to Colleagues

- Employment and Career Services
- Technical groups
- Monthly magazine, *Optics & Photonics News*



- Major conferences and specialised topical meetings

Connect to Technical Information

- Technical exhibits
- Affiliation with the American Institute of Physics (AIP)
- Electronic products and services
- Technical books
- Peer-reviewed journals, incl:*JOSA AJOSA BOptics LettersApplied OpticsJournal of Lightwave TechOSA Translation*

Connect to Savings and Value

- Reduced meeting registration fees (CLEO, OFC, and others)
- As an OSA member, you are also a member of AIP. You'll receive the monthly magazine, *Physics Today*, plus discounts on other AIP publications
- Substantial discounts on journal subscriptions and publications
- Join up to 5 OSA technical groups and 2 application areas, free
- Membership discount to AOS members

Optical Society of America
FAX: +1 202 416-6120 WEB: http://www.osa.org
2010 Massachusetts Avenue, NW, Washington, DC 20036 USA

SPIE The International Society for Optical Engineering

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

International Networking

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.

Meetings

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.

Publications

A major activity of SPIE is the publication and distribution of archival professional journals, full-manuscript conference proceedings, newsletters, and optics-related texts and monographs. SPIE publications deliver timely, high-quality technical information to the optics, imaging, and photonics communities worldwide. Membership includes a subscription to *OE Reports*, a monthly newspaper that provides news and commentary on cutting-edge technology.

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*

SPIE International Headquarters
Tel: +1 360 676 3290 *Fax*: +1 360 647 1445 *email:* spie@spie.org
web: http://spie.org
PO Box 10, Bellingham WA 98227-0010 USA

10Gbps PIN detector modules – InGaAs PIN integrated with low noise TIA, 1280nm to 1580nm, MSA butterfly package
10GHz PIN photodetector – 10GHz 3dB bandwidth, InGaAs/InP planar photodiode, 1100nm to 1650nm operating wavelength
Pigtailed photodiode – 2GHz 3dB bandwidth, low cost
Optical power monitor – photodiode packaged with tap coupler, low cost optical power monitoring, 2GHz 3dB bandwidth

2.5Gbps receiver modules – multi-rate clock and data recovery circuits (four different bit rates), APD or PIN photodetector, high sensitivity, analog optical input level monitor, +5V single power supply, DIP metal package

DFB / FP laser diodes – coaxial pigtailed or butterfly package, 1310nm, 1490nm and 1550nm, integrated TEC and PD monitor, high output power, high modulation bandwidth, applications in analog and digital optical links.

Optical transceivers for passive optical networks – EPON OLT and ONU transceivers, 1.25Gbps, burst-mode, single fiber bi-directional, 1310nm/1490nm WDM, +3.3V single power supply, metallic package, 10km and 20km reach.
Multimode transceivers – 1.25Gbps, 62.5/125μm multimode fiber links

Optical couplers – single mode, multimode, wideband, multi-band, miniature package, polarization maintaining, 1x3, 1x4, star or tree couplers, special wavelengths (from 460nm to 1625nm).
WDM couplers – 1310, 980, 1480 or 1064nm WDM couplers, multimode WDM couplers
Triplexer WDM Couplers for FTTH – 1310, 1490 and 1550nm mux/demux
Customized WDM devices – red band splitter, 1310nm combiner, etc.

Optical attenuators – fixed attenuators, variable attenuators (all fiber device, collimator type or low cost adapter type), benchtop VOA instrument
Optical switches – opto-mechanical switches, 1x1, 1x2, 2x2, 1x4, or MEMS based switches

Bitline System Pty. Ltd.
Tel: 02-9597 2689
Fax: 02-9597 1959
Email: sales@oemarket.com

WDM modules – DWDM Mux/Demux modules, 100GHz, 200GHz channel spacing, 4 to 32 channels, user-defined channel arrangement; CWDM Mux/Demux modules, 4 or 8 channels; DWDM or CWDM one channel add/drop filters

Wide band optical isolators – cover S, C and L bands (1460nm ~ 1620nm), polarization maintaining isolators
Multimode isolators – 1310 or 1550nm, MM fiber networks
Special wavelength isolators – 1480nm or 1064nm

Optical circulators – 3 ports or 4 ports, polarization maintaining, wide band (C+L bands)

Patch cords – various connector types, including LC, MT-RJ, MU, ST, E2000; polarization maintaining, multimode
Optical adapters – FC, SC, ST, LC, MU, MTRJ, hybrid adapters

ASE light source – Mini size, various output power levels, gain flattening filter option
Optical amplifiers – Mini size EDFA, single or multi-channel applications, pre-amp, power booster or inline amp.

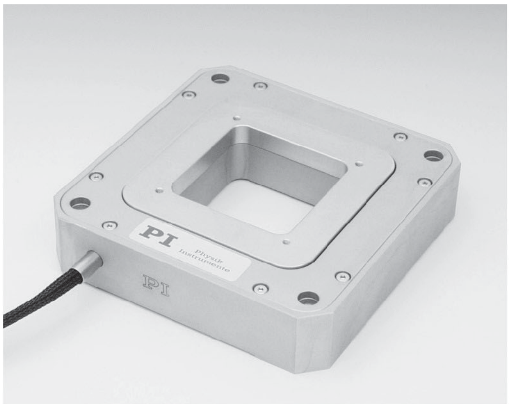
Laser sources – DFB or FP laser sources, CWDM, DWDM ITU grid wavelengths, automatic power and temperature control, internal and external modulation options.
Handheld laser sources – single, dual and three wavelength sources, battery driven and rechargeable, ideal for field use, 650, 850, 1310 and 1550nm

Optical power meters – handheld, pocket-size and desktop power meters, PC interface option, memory for data notes, large dynamic range, low-cost solutions
Handheld optical switches – fast 1x2 switching, very useful in fiber optical testing and measurement.
Fiber identifier and visual fault finder

Bitline System Pty. Ltd.
Tel: 02-9597 2689
Fax: 02-9597 1959
Email: sales@oemarket.com

Products for NanoPositioning

Piezoelectric Flexure NanoPostioners



- Ultra Precision Trajectory Control, Ideal for surface analysis and scanning microscopy
- Flatness in sub-nanometer range
- Integrated capacitive sensors for 0.1 nm resolution
- Linear travel ranges to 800 µm
- Up to 6 axes available - X, Y, Z, □x, □y and □z
- Ultra-Fast response scanning - better than 0.1% in 17 ms

Low Profile Piezo Motor Driven Stages

- One & two-axis systems
- Travel up to 50mm
- Sub-micron resolution
- Velocities up to 800mm/sec
- Acceleration up to 20g
- Lightweight & low-profile
- Excellent position stability
- 20,000 MTBF
- Vacuum versions to 10^{-8} available

Microscope Objective NanoPositioners & Scanners

- Remotely positions objectives with sub-nanometer resolution
- Travel up to 350 µm
- Straightness of travel < 30 µrad
- Settling time of 20-30 ms
- Compatable with Universal imaging software
- Full scale nanometer repeatability
- Wire-cut flexures are modelled for zero stiction / friction

WARSASH Scientific
Advanced Instruments for Research & Industry

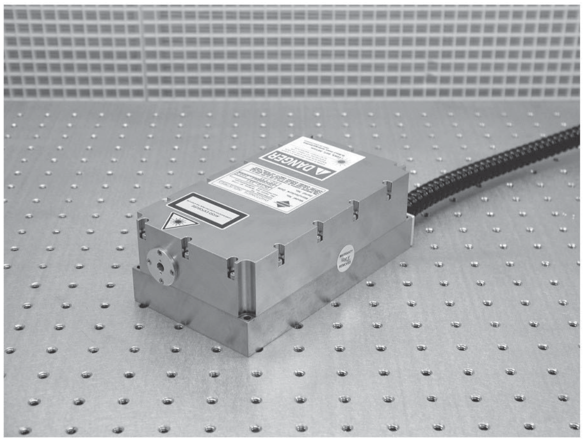
Sydney
PO Box 1685
Strawberry Hills
NSW 2012
Tel: (02) 9319 0122
Fax: (02) 9318 2192
sales@warsash.com.au
www.warsash.com.au

Diode Pumped Solid State (DPSS) Laser Systems

Photonics Industries
International, Inc.

DC Series - Deep UV to IR

- Compact, Rugged Design
- Powers up to 4W
- TEM00 Beam with M2 < 1.1
- Pulse Rates from Single Shot to 100 kHz
- IR, Green, UV, and Deep UV Wavelengths Available
- RS232 Computer Control
- Patented Harmonic Generation Technology
- External TTL Triggering
- Choice of Nd:YLF, Nd:YAG, and Nd:YVO4 Based Lasers

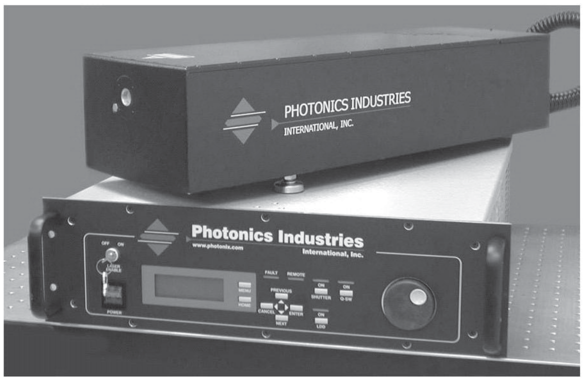


DS Series - Deep UV to IR

- Powers up to 15W
- TEM00 Beam with M2 < 1.1
- Pulse-to-Pulse Instability <1%
- Pulse Rates from Single Shot to 100 kHz
- IR, Green, UV, and Deep UV Wavelengths Available
- RS232 Computer Control
- Patented Harmonic Generation Technology
- External TTL Triggering
- Choice of Nd:YLF, Nd:YAG, and Nd:YVO4 Based Lasers

DM Series - 532nm Nd:YLF

- Highest Energy Per Pulse (up to 50mJ @ 1kHz)
- High Stability (<1% RMS)
- Compact, Rugged, Industrial Design
- Uniform Beam Profile
- Long Diode Lifetime (10,000 hours)
- Low Cost of Ownership
- Pulse Rate from Single Shot to 10kHz
- RS-232 Interface & Computer Control Software Included
- Double Pulse option for PIV applications



WARSASH Scientific
Advanced Instruments for Research & Industry

Sydney
PO Box 1685
Strawberry Hills
NSW 2012
Tel: (02) 9319 0122
Fax: (02) 9318 2192
sales@warsash.com.au
www.warsash.com.au

NEWSLETTER

COMMISSION INTERNATIONALE D'OPTIQUE ● INTERNATIONAL COMMISSION FOR OPTICS

ICO becomes Scientific Associate of ICSU

The International Commission for Optics has been accepted as an International Scientific Associate of the International Council for Science.

ICO's Pierre Chavel, former secretary-general.

ICO is the global umbrella organization for optics – "the place where the world of Optics meets" – representing about 50 Territorial Committees and all major internationally active optical societies. The election of ICO as an ICSU International Scientific Associate (ISA) is one further step towards the recognition of optics as a scientific discipline of its own. However, ICO will keep its status as an Affiliated Commission of the International Union of Pure and Applied Physics (IUPAP). Optics still has its roots deeply in physics and this will remain so.

At the age of 58, ICO is moving ahead to better and more visibly fulfil its mission as "the place where the world of Optics meets". It was elected an ISA at the ICSU general assembly in October 2005. This improves the recognition of optics as a discipline connected in many ways to all the other disciplines within science and technology. Let us explain why this is the case, and review what ICSU is and why the move is beneficial for ICO.

The International Council for Science has retained the acronym ICSU of its original name, the International Council of Scientific Unions. An independent international organization, it represents all disciplines, promotes their interaction in interdisciplinary actions, and fosters scientific research through its links with other international bodies – in particular in relation to the global challenges that humanity is facing such as sustainable development, earth observation, energy, and food security. ICSU has four categories of members: International Unions, National Members, International Scientific Associates, and National Associates.

The concept of national membership in ICSU extends to many members of the ICSU family: this is really why, since it was created in 1947, ICO's membership is primarily based on national membership, the Territorial Committee Members in current ICO terminology. In addition, ICSU has members that represent scientific disciplines at an international level. These are the ICSU International Union Members. One of the 25 or so Union Members is IUPAP. Within the ICSU structure, IUPAP itself has national members and commissions representing the various branches of physics.

Among the commissions, a few enjoy the status of an independent organization and have their own membership and budget: these are the IUPAP Affiliated Commissions, a status that ICO has shared since its creation.

An important step in the recent history of ICO, though, is the creation in 1999 of a new category of membership, the International Society Members. This recognizes the fact that most international scientific conferences nowadays, as opposed to the situation in 1947, are organized by large societies that have individual members and that are explicitly active internationally. As of today, ICO has 50 Territorial Committee Members and six International Society Members. With this structure, ICO can fairly claim to be representing the whole field of optics on an international scale.

By becoming an ICSU ISA, ICO wants to make it clear that with the continuous development of science and technology in research and industry, the relationship between optics and physics has become more complex. Optics still has its roots deeply in physics and this will remain so – let it be enough to mention at this point the 2005 Nobel Prize for Physics, which was awarded to Roy J Glauber, John L Hall and Theodor W Hänsch for outstanding upstream work in optics with practical implications.

ICO will keep its status as an IUPAP Affiliated Commission. Yet, large branches of optics have developed where scientists and engineers do not consider themselves physicists and are not considered as such by physicists. This applies, for example, to most work in optical systems and optical telecommunications. Optics courses and research activities at many universities are increasingly being promoted to fully fledged departments. The recognition of optics professions and degrees by accredited institutions is a significant issue in various countries. This all boils down to one conclusion: optics is more and more perceived as a scientific discipline of its own. The recognition of ICO as an ICSU International Scientific Associate is a further step in that direction.

In this new position within the ICSU constellation, ICO will be an equal partner of the other 25 or so ISAs, along with Water Resources, Geometry and Oceanic Resources, to name but a few. It will participate in the appropriate ICSU activities and liaise between the optics community and ICSU by bringing up and promoting opportunities for actions involving optics that bear a global dimension both geographically and topically. This includes, in line with a clear ICO priority, actions for supporting science and technology in regions of the world that require special measures, such as its long-standing collaboration with the Abdus Salam International Centre for Theoretical Physics at Trieste.

Optics is relevant to most ICSU priorities on the global role of science and technology. The admission of ICO as an ISA recognizes ICO as a global organization, the primary international group that, especially through its members, coordinates the dissemination and advancement of scientific and technical knowledge in the broad fields of optics (by making contacts, providing expertise, offering a neutral international character, and so on). More importantly, it is a step forward for the recognition of the importance of optics for science and for society in the 21st century. ICO will strive to make the best use of this opportunity, and calls upon its members and the many parts of the optics community that they represent to join it and contribute new initiatives.

For more information see www.ico-optics.org

Pierre Chavel, ICO–ICSU Relations.

Moya-Cessa receives ICO/ICTP Award

Dr H M Moya-Cessa.

ICO president A Friberg (left), chair of the ICO/ICTP Award Committee A Wagué (centre) and winner of the ICO/ICTP Award H Moya-Cessa.

The annual ICO/ICTP Award ceremony took place on 1 February at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, during the Winter College. Héctor Manuel Moya-Cessa has been awarded the prize for 2006.

Dr Moya-Cessa was born in Acayucán, Veracruz, Mexico, in June 1966. He did a BSc at Universidad Autónoma Metropolitana in Mexico City then an MSc at Centro de Investigaciones en Optica in León, Guanajuato. In 1990 he went to England to study for a PhD at Imperial College London under the supervision of Prof. Peter L Knight.

He graduated in 1993 and got a research position at the Instituto Nacional de Astrofísica, Optica y Electrónica, in Puebla, Mexico. He has worked there ever since, with two sabbaticals – one in 1999 at the Universita di Camerino, Italy, and the other 2005/2006 at the University of Ulm, Germany.

His research is on atom-field interactions in high-Q cavities, where he has shown that reconstruction of quasi-probability distribution functions can be achieved in the case of a dissipative cavity. In ion-laser interactions he has shown that the problem may be treated in a complete analytic form, even when micro-motion is included. He has published more than 50 articles on these topics. Moya-Cessa is a member of the Mexican Academy of Sciences, a fellow of the Alexander von Humboldt Foundation and a regular associate of the ICTP.

Moya-Cessa has organized two international conferences, has been invited to present his work at more than 10 international conferences, and has been invited to deliver courses at Cuzco, Peru, and Tucson, Arizona, in the US. He was the invited editor of the June 2004 issue of *Journal of Optics B*.

The ICO/ICTP Award Committee has recognized the merits of Moya-Cessa – a young scientist achieving a great deal in his country of origin, which is considered a developing country by the UN. Moreover, the prize is awarded for his outstanding research activities on the foundations of quantum optics and for his involvement in organizational activities aimed at spreading interest in quantum optics around Latin America.

The ICO/ICTP Award Committee consists of A Wagué (chair), A Consortini (ICO), G Denardo (ICTP) and M Danailov (ICTP).

For more information see www.ictp.it/pages/mission/prizes.html.

Territorial Committees work for the World Year of Physics

A summary of some of the activities of the ICO Territorial Committees celebrating the World Year of Physics 2005.

The World Year of Physics (WYP), as declared by the UN in celebration of Einstein's *annus mirabilis*, has come to an end. It is now time to look back and analyse the impact of the activities organized by the world of optics and ICO in particular, not only in our community but also on spreading knowledge of optics through society. Here is a résumé of the activities that were reported by the ICO Territorial Committees and that were organized by their local initiatives. The list is not intended to be exhaustive.

- **Cuba** TECNOLASER 2005 took place in the Almendares Hall of the Hotel Kohly, City of La Havana, on 21–22 July. It was opened by the presidential board: J G Darias, president of the organizing committee of TECNOLASER 2005 and director of the Center of Tech-

Participants at the 1st International Workshop on Photoluminescence in Rare Earths: Photonic Materials and Devices, held in Trento, Italy, in May.

Exhibition of optical industries held at ICOL 2005 in Dehradun, India.

Lecture presentation at ICOL 2005 (Prof. Arthur Chiou, Yang-Ming University, Taipei).

Evening lecture at the 11th Engelberg Lectures in Optics, Switzerland, on 6–10 March 2005.

nological Applications and Nuclear Development (CEADEN); Tomás López, advisor to the chancellor of the University of Computer Sciences and collaborator of TECNOLASER; V L Fajer Avila, president of the Cuban Society of Physics (SCF); and O Morales, vice-president of the organizing committee of TECNOLASER 2005 and vice-director of CEADEN.

The event was sponsored by CEADEN and co-sponsored by ICO and the SCF. Bearing in mind the quantity and quality of the presentations, the organizers agreed to maintain the frequency of every other year for TECNOLASER. The next one will be on 17–19 May 2007.

• **India** The International Conference on Optics and Optoelectronics (ICOL) 2005 & XXXI Symposium of the Optical Society of India (OSI) was organized by the Instruments Research and Development Establishment (IRDE) in Dehradun on 12–15 December. J A R Krishna Moorty was chair, A K Gupta was co-chair and Ashok Kaul was the convenor.

The aim of ICOL 2005 was to provide a wide forum for interaction and the exchange of ideas between scientists, engineers and researchers actively engaged in optics and optoelectronics. The conference featured technical sessions including plenary talks, invited lectures, oral and poster presentations, exhibitions, opportunities for networking and social events. The conference theme was “Optics and optoelectronics for strategic applications”.

ICOL 2005 was sponsored by India’s Defence Research and Development Organization (DRDO) and co-sponsored by ICO and OSA, and in co-operation with SPIE.

• **Italy** The 1st International Workshop on Photoluminescence in Rare Earths: Photonic Materials and Devices was held in Trento on 2–3 May under G C Righini’s initiative and sponsored by the Italian Society of Optics and Photonics (SIOF).

The workshop aimed to be a forum for material scientists, chemists and physicists to debate the state of the art and views on photonic materials based on rare earth ions. More than 60 experts attended the workshop from eight countries, who presented original contributions on both fundamental photoluminescence properties and application-oriented materials investigations. A special session was devoted to optical losses in low-phonon-energy glasses for infrared fibres.

All the participants appreciated greatly the informal atmosphere, the warm hospitality and the excellent scientific level, so it is very likely that the workshop will be organized again in 2007. Under the framework of the WYP the workshop also celebrated Einstein’s publication in 1917 of the basis of the theory of spontaneous and stimulated emission.

• **Japan** Many projects were planned in Japan for the WYP. These were later adjusted by the Japanese Committee for the WYP, which comprised many Japanese academic societies related to physics. The projects were classified into eight categories: Physics Dialogue Projects, Physics Content Projects, Physics Instrument Projects, Physics Booklet Projects, Physics Friends Projects, International Relation Projects, and Publicity and Coordination. In relation to optics the Optical Society of Japan organized a special talk for WYP2005 at Optics Japan 2005, which was held in Tokyo on 23–25 November.

• **New Zealand** The 2005 Australasian Conference on Optics Lasers and Spectroscopy (ACOLS 2005) took place on 5–9 December in Rotorua. ACOLS 2005 is the region’s showcase of R&D in all aspects of optics, lasers and spectroscopy. ACOLS 2005 was the seventh conference in the ACOLS series and incorporated the 18th Australian Optical Society Conference, the 10th Australian Laser Conference and the 20th Australian Spectroscopy Conference.

Associated with this event was a satellite meeting. The New Zealand and Australian Quantum-Atom Optics Workshop took place from 29 November to 1 December in Queenstown. A technical exhibition was planned in conjunction with the conference. The aim of the organizers was to feature leading Australasian suppliers of equipment in the field of optics, lasers and spectroscopy.

• **Switzerland** The Swiss Society of Optics and Microscopy (SSOM), through the Workgroup on Biomedical Photonics, organized the 11th Engelberg Lectures on Optics. The chairs were G Delacrétaz, M Frenz, R P Salathé and M Wolf. The Engelberg Lectures are addressed to an interdisciplinary audience of physicists, engineers, computer scientists, physicians, biologists, and key industry players from all parts of Switzerland and neighbouring countries. The programme included speakers from scientific, technical and medical backgrounds.

There was also ample time for personal interaction with the speakers, a unique feature of the lecture series providing an opportunity to exchange ideas, make contacts and form collaborations. The talks were of a tutorial style, but highlighted new developments as well.

On the last day new technical developments were discussed, with special attention paid to those technical developments showing particular promise.

• **Tunisia** The Tunisian Optical Society (STO) planned for the WYP2005 with activities dedicated to the spread of information through workshops, schools and seminars at the national, regional (Africa) and international level. A school on active learning in optics and photonics was held from 26 March to 2 April in Monastir with 40 participants

The winners of the L'Oréal-UNESCO Award 2005 for women in science. The president of the Tunisian ICO Territorial Committee, Prof. Z Ben Lakhdar, can be seen at the far left.

(two from Algeria, two from Cameroon, six from Morocco, one from Ethiopia, one from South Africa and 28 from Tunisia). A résumé of that activity was presented at ETOP 2005 in Marseille, France, last October. A conference on photography was held by M Pelletier on 15 April. A seminar with high-school teachers took place on 20 April at OMRANE School and had 50 participants, and discussed physics education at secondary school – what is the best way to interest a class? Is optics a good way to introduce education in physics?

Various conferences were delivered by Z Ben Lakhdar (one of the winners of the L'Oréal-UNESCO Award 2005 for women in science) in different regions and on various subjects with the objective of enhancing interest in physics and encouraging young people to join the physics community.

● **Ukraine** The 7th International Conference on Correlation Optics was held on 6–9 September in Chernivtsi. This conference, chaired by O Angyelsky, is biannual and began in 1993. Participants from 17 states took part in this meeting and presented reports on the hot topics of modern optics, such as the informative content of statistical optical fields (including optical chaos and singular optics), optical correlation devices based on diffractive optical elements, including optical and digital holography, fractal optics and optical sensors, optical correlation diagnostics, interferometry and microscopy of rough surfaces and random media, and new applications of correlation optics in biology and medicine.

The conference programme included 28 invited lectures, 28 oral presentations and 77 poster presentations. Contributions from abroad totalled 31.5%. The conference was organized by ICO, OSA, SPIE, SPIE Ukraine, SPIE Russia, Ukrainian Optical Society, Chernivtsi National University, Institute of Semiconductor Physics, National Academy of Sciences of Ukraine, Ukrtelecom and Bukovinian State Medical University.

Another event was the VI International Young Scientists Conference: Optics and High Technology Material Science (SPO 2005), held at Kyiv National University, under the initiative of SPIE Ukraine Chapter. The event was supported by ICO, and the organizers have published the abstracts from the conference.

Contacts

International Commission for Optics (www.ico-optics.org).

Bureau members (2005–2008)

President A T Friberg
Past-president R Dändliker
Treasurer A Sawchuk
Secretary M L Calvo, Departamento de Óptica, Universidad Complutense, 28040 Madrid, Spain. E-mail: mlcalvo@fis.ucm.es.
Associate secretary G von Bally
Vice-presidents, elected
S N Bagayev, A M Guzmán, G F Jin, B Y Kim, M Kujawinska, H Lefèvre, J Love, I Yamaguchi
Vice-presidents, appointed
M Gu (OWLS), I C Khoo (IEEE/LEOS), G Sincerbox (OSA), P Stahl (SPIE), A Wagué (LAM), EOS representative to be appointed
Senior adviser (ad personam)
P Chavel
IUPAP Council representative
Y Petroff

IoP

Forthcoming events with ICO participation

Below is a list of events with ICO participation coming up in 2006. For more information see www.ico-optics.org/events.html.

19–20 April 2006
Optique '06. Rabat, Morocco. Contact: Prof. Esmail Ahouzi. E-mail: ahouzi@inpt.ac.ma. Web: www.inpt.ac.ma/~optique06/indexooptiue06_archivos/Page871.htm.

5–7 June 2006
5th International Workshop on Information Optics. Toledo, Spain. Contact: Dr G Cristóbal. E-mail: gabriel@optica.csic.es. Web: www.iv.optica.csic.es/wio-06/WIO062.htm.

28–31 August 2006
International Conference "Micro to Nano-Photonics – ROMOPTO 2006". Sibiu/Hermannstadt, Romania. Contact: Prof. V I Vlad. E-mail: vlad@nipne.ro.

4–7 September 2006
ICO Topical Meeting on Optoinformatics 2006/Information Photonics 2006. Saint Petersburg, Russia. Contact: Dr Ekaterina Yutanova. E-mail: Pavlov@soi.spb.ru. Web: http://ysa.ifmo.ru/tmo2006/.

26–29 October
7th Int'l Young Scientists Conference "Optics and High Technology Material Science SPO 2006". Kiev, Ukraine. Contact: Dr Viktor O Lysiuk. E-mail: lysiuk@univ.kiev.ua.

13–17 November 2006
Ist Andinean and Caribbean Conference on Optics and its Applications. Santiago de Cali, Colombia. Contact: Prof. E Solarte. E-mail: esolarte@calima.univalle.edu.co.

3–10 December 2006
8th LAM Workshop on Physics and Applications of Lasers. Addis Ababa, Ethiopia. Contact: A Asfaw. E-mail: araya@phys.aau.edu.et.

6–8 December 2006
5th International Conference on Optics – Photonics Design and Fabrication ODF '06. Nara, Japan. Contact: Prof. Tsuyoshi Hayashi. E-mail: hayashi@pac.ne.jp. Web: www.odf.jp/in.html.

12–16 December 2006
8th International Conference on Optoelectronics, Fiber Optics and Photonics. Hyderabad, India. Contact: Prof. D N Rao. E-mail: dnrsp@uohyd.ernet.in.

Responsibility for the accuracy of this information rests with ICO. President: Professor Ari T Friberg, Royal Institute of Technology, Optics, Electrum 229, SE-164 40 Kista, Sweden; e-mail: ari.friberg@imit.kth.se. Associate Secretary: Gert von Bally, Laboratory of Biophysics, Medical Centre, University of Münster, Robert-Koch-Str. 45, D-48129 Münster, Germany: e-mail: lbiophys@uni-muenster.de.

TMC™
Technical Manufacturing Corporation

Vibration Isolation Systems
... A Perfect '10'

TMC's industry-standard 63-500 Series high performance lab table with a Type II Faraday Cage

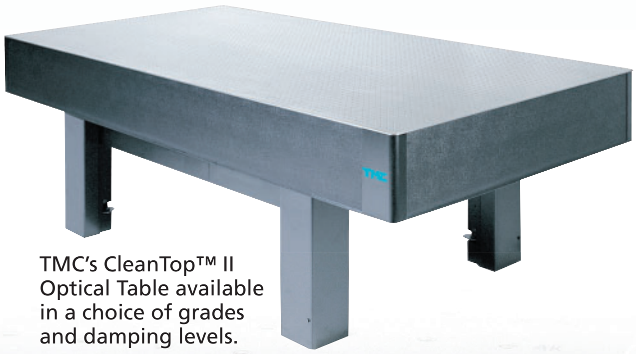
Why your next vibration isolation table should be from TMC:

"10... Quality, service, price" — *UC Santa Barbara, Physics Dept.*

"10... Very reliable/good quality and workmanship" — *Howard University*

"10... This is our fourth TMC purchase. Price and fast delivery" — *University of New Mexico*

"10... Let me tell you that your table is working beautifully. There is no vibration in the tip of the electrode! Thanks again, you made my life much easier." — *Baylor College of Medicine*



TMC's CleanTop™ II Optical Table available in a choice of grades and damping levels.

Industry leading designs include:

1. 50% smaller core cell size, assuring the highest stiffness and greater core-to-skin bonding contact area.
2. Only two bonding layers: top skin to core & core to bottom skin. No third bonding layer: top skin to plastic to core to bottom skin, which severely weakens the structure.
3. Sidewalls are thick, damped, cold-rolled formed steel. No moisture absorbing particle board used by other manufacturers.

STACIS®
Active Vibration Cancellation Systems

Engineered to meet the floor vibration specs of metrology and lithography tools. Facilitates optimal tool performance and resolution in noisy fabs.

LAS TEK

Lastek Pty Ltd
Thebarton Campus, University of Adelaide,
10 Reid Street, Thebarton SA 5031 Australia
Ph (08) 8443 8668 Fax (08) 8443 8427
Email: sales@lastek.com.au website: www.lastek.com.au

TMC

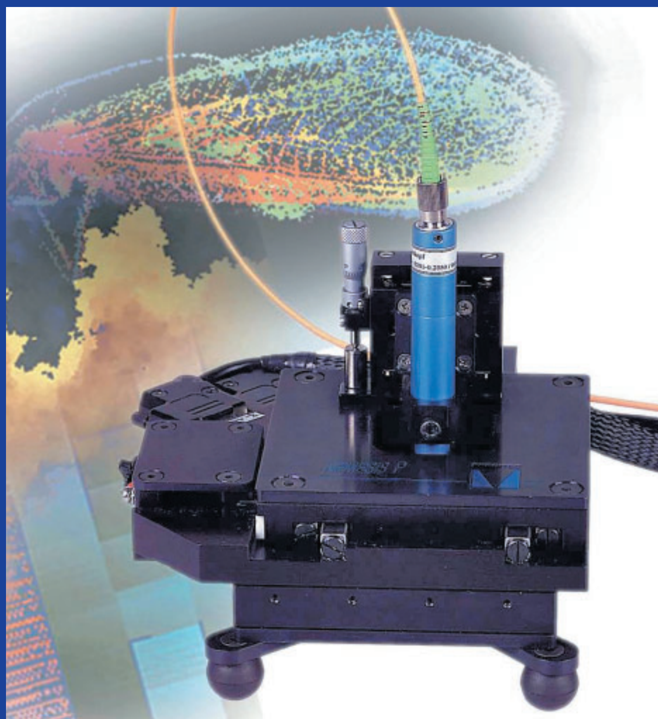
LTWAM4187

Contactless

PRECITEC

Measuring Technology

Measure distance and thickness – Scan all surfaces

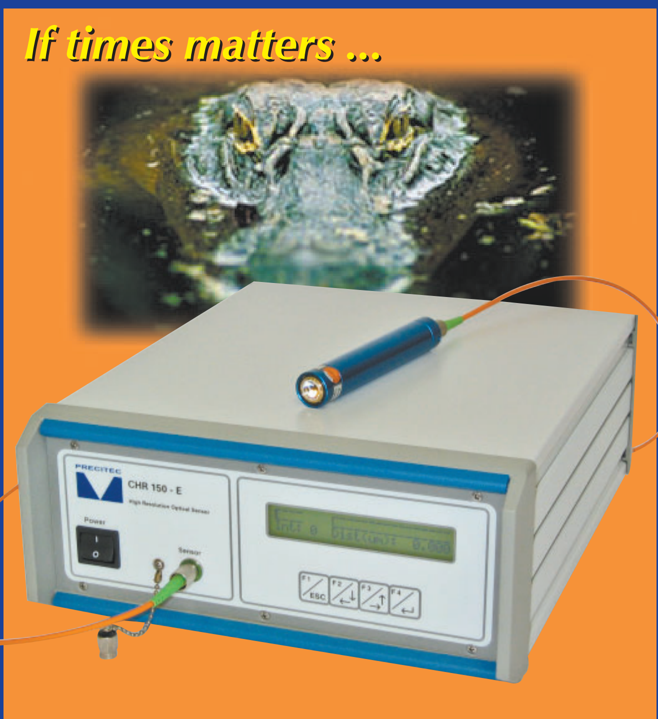


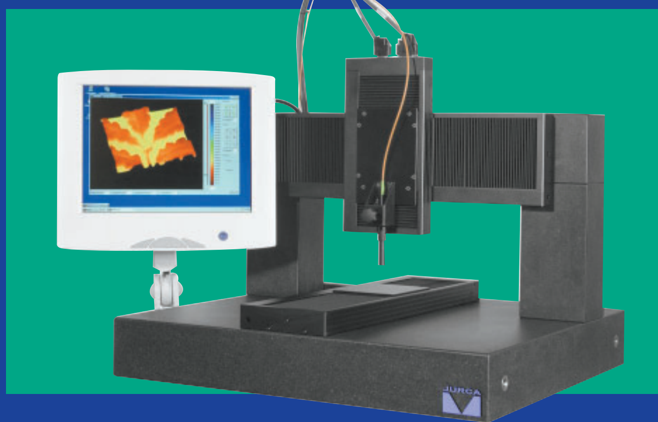
CHROCODILE:

Delivers contactless measurement of distances and layer thicknesses with up tp 10nm resolution.

NEMESIS:

High resolution 3D contactless measurement of profiles, topographies, layer thicknesses, contours, etc.





LAS TEK

Lastek Pty Ltd
Thebarton Campus, University of Adelaide,
10 Reid Street, Thebarton SA 5031 Australia
Ph (08) 8443 8668 Fax (08) 8443 8427
Email: sales@lastek.com.au Lastek website: www.lastek.com.au

www.precitec-optronik.de

LTWAM4529

Index to Advertisers

Corporate Member Address List

ARC COE for Quantum-Atom Optics
Building 38A, Science Road,Australian National University, Canberra ACT 0200
Tel: (02) 6125 2811
Fax: (02) 6125 0741
Hans.bachor@anu.edu.au, http://www.acqao.org

Australian Fibre Works
Suite 15, 88-90 Walker Street
Dandenong, Victoria 3175, Australia
Tel: +61 3 9702 4402
Fax: +61 3 9708 6883
Email:don@afwtechnology.com.au
Web: www.afwtechnology.com.au

Bandwidth Foundry Pty Ltd
Suite 102, National Innovation Centre,
Australian Technology Park, Eveleigh, NSW, 1430
Tel: (02) 8374 5300
Fax: (02) 8374 5301
info@bwfoundry.com
http://www.bwfoundry.com

Coherent Scientific Pty Ltd
116 Sir Donald Bradman Drive
Hilton, SA, 5033
Tel: (08) 8150 5200
Fax: (08) 8352 2020
scientific@coherent.com.au, http://www.coherent.com.au

CUDOS
School of Physics,
University of Sydney, NSW, 2006
Tel: (02) 9351 5897
Fax: (02) 9351 7726
cwalsh@physics.usyd.edu.au

Francis Lord Optics (Avtronics)
33 Higginbotham Rd, Gladesviile, NSW, 2111
Tel: (02) 9807 1444
Fax: (02) 9809 7136

Lambda Scientific Pty Ltd
2/147 Buxton St , North Adelaide, SA 5006, Australia
Tel.: +61 8 8267 2686
Fax: +61 8 8267 2689
email michaellee@lambdasci.com
http://www.lambdasci.com

Laserex Technologies Pty Ltd
5A Corbett Court, Export Park SA 5950, Australia
Tel. +61 8 8234 3199
Fax.+61 8 8234 3699

Lastek Pty Ltd
GPO Box 2212, Adelaide, SA, 5001
Tel: (08) 8443 8668
Fax: (08) 8443 8427
alex@lastek.com.au, http://www.lastek.com.au

NewSpec Pty Ltd
83 King William Rd, Unley, SA 5061
Freecall 1800 153 811
Tel: (08) 8273 3040
Fax: (08) 8273 3050
sales@newspec.com.au, http://www.newspec.com.au

oeMarket.com - Bitline System Pty Ltd
8 Princes St
BEXLEY NSW 2207
Tel:02 9597 2689
Fax:02 9597 1959
info@oemarket.com,http://www.oemarket.com/

OptiScan Pty Ltd
PO Box 1066, Mt. Waverley MDC, VIC 3149
Tel: (03) 9538 3333
Fax: (03) 9562 7742
rogerw@optiscan.com.au, http://www.optiscan.com.au

Photon Engineering
PO Box 122, Rundle Mall, Adelaide, SA 5000
Tel: (08) 8232 3444
Fax: (08) 8232 9333
info@photonengineering.com.au
www.photonengineering.com.au

Raymax Applications Pty Ltd
PO Box 958, Unit 1/303 Barrenjoey Road
Newport Beach, NSW, 2106
Tel: (02) 9979 7646
Fax: (02) 9979 8207
sales@raymax.com.au
http://www.raymax.com.au

Warsash Scientific Pty Ltd
PO Box 1685, Strawberry Hills, NSW, 2012
Tel: (02) 9319 0122
Fax: (02) 9318 2192
sales@warsash.com.au

WaveLab Scientific Pte Ltd
Blk 2, Bukit Batok St 24, #06-09 Skytech Building,
Singapore 659480
Tel: 65-65643659
Fax: 65-65649627
bob@wavelab-sci.com, http://www.wavelab-sci.com

AUSTRALIAN OPTICAL SOCIETY
ABN 63 009 548 387

2006

Subscription Renewal Form

Postal Address

Title | Initials

First Name(s)

Surname

Employer/Institute/Company

Telephone Number

Facsimile Number

email

Affiliations (please tick) AIP ☐ OSA ☐ SPIE ☐

Main Activities (number up to three, in order of importance)

First ☐ Second ☐ Third ☐

1 astronomical optics
2 atmospheric optics
3 communications and fibres
4 electro-optics
5 fabrication and testing
6 information processing
7 lasers
8 optical design
9 optical physics
10 radiometry, photometry & colour
11 spectroscopy
12 thin films
13 vision
14 quantum optics
15 nonlinear optics
16 teaching
17 holography
18 (.....................................)
19 (.....................................)
20 (.....................................)

Email Notices: Notices will be sent to the email address provided.
Do you wish to receive posted notices as well? *Yes* ☐ *No* ☐

SUBSCRIPTION RATES (inc. GST): Corporate: A$ 290 p.a. Member A$ 43 p.a. Student A$ 16 p.a.

PAYMENT METHOD *(please tick*

*Cheque** ☐ *MasterCard* ☐
Money Order ☐ *Bankcard* ☐
Visa ☐

Send form and payment to:

A/Prof Stephen Collins, Hon Treasurer AOS
OTRL (F119), Victoria University, PO Box 14428
Melbourne, Vic 8001, AUSTRALIA
Tel: (+61) 03 9919 4283; Fax: (+61) 03 9919 4698
email: stephen.collins@vu.edu.au

Cheques payable to "THE AUSTRALIAN OPTICAL SOCIETY" (Please do not staple cheques to this form; use a paperclip)

If paying by credit card please complete ALL boxes in this authorisation. Incomplete forms cannot be processed.

EXPIRY DATE /

CARD NUMBER ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

CARDHOLDER

AMOUNT **A$**

SIGNATURE

DATE

Photon Engineering

Introducing

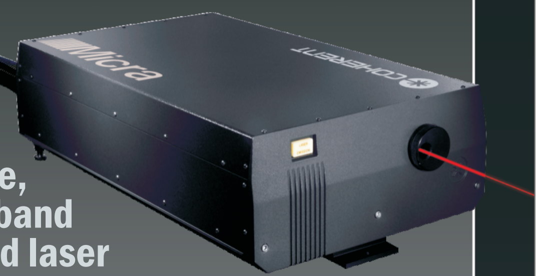
High Power DPSS Lasers from JDSU (formerly Lightwave Electronics)

Opto-Mechanics & Micro-Positioners from SD Instruments

Contact us on (08) 8232 3444 or sales@photonengineering.com.au

www.photonengineering.com.au

New Product Releases from Coherent Inc



The Micra integrated, compact, ultra-flexible, ultra-broadband femtosecond laser

- Wavelength tuning from 750nm to 860nm
- Average power of 300mW (5W pump) or 750mW (10W pump)
- Bandwidth selectable from 30nm to 100nm
- Bandwidth can support pulses as short as 7fs
- 18W pump with 8W available to pump amplifier
- The legendary reliability and low noise of the *Verdi* pump laser
- The flexibility of open architecture and flat bed oscillator with the convenience of a "one box" package
- Options include; carrier envelope phase stabilisation, pulse synchroniser, external compressor and cavity dumper/pulse picker

The Legend-USP-HE regenerative amplifier

- Repetition rates from 0 - 5kHz
- Energies from 0.3mJ to 10mJ
- Cryo cooling available for higher average power systems
- Ultrashort femtosecond, femtosecond and picosecond pulse versions
- Compatible with *Verdi* pumped *Micra, Mira* and *Vitesse* oscillators
- Compatible with *Silhouette* pulse shaper
- Compatible with *Evolution* pump lasers
- OPA's and harmonic generators available for wavelength extension
- Compatible with *Hidra* amplifiers for energies up to 100mJ (Terawatt)

Newly released at CLEO 2006

Silhouette ultrafast laser pulse shaper

- Optimises ultrafast laser pulse characteristics by measuring and compensating phase and amplitude
- Compatible with new and existing oscillators and amplifiers
- Can compensate for oscillator, amplifier, and delivery or other downstream optics
- Eliminates need for other diagnostics such as SPIDER or FROG
- Low loss design - can be left in place while operating to continually compensate for drift etc
- Intelligent algorithm allows compensation for minimum pulse duration or tailored pulse characteristics

What's new in yellow?

COMPASS 561 compact CW diode-pumped solid state modules

- Output energy of 10mW and 20mW @ 561nm
- Ultra-low noise (0.25% rms)
- Superior beam quality and reliability
- Contamination free, robotic-assisted clean room manufactured
- Permanently aligned using patented *PermAlign* technology
- Better performance, less downtime, lower cost of ownership

Newly released at CLEO 2006

OPerA-TOPAS-White

The latest in white-light continuum ultrafast OPA's

- Low output noise due to white-light seeding
- Computer controlled tuneable output
- Base system tuning from 1150nm - 2600nm
- Standard modular options for extended tuning from 240nm - 20micron
- High energy conversion efficiency
- High pump-energy models available
- Multiple OPA's can be pumped with one Ti:Sapphire amplifier
- Specified for operation with any standard Coherent *Legend, Libra* or *Hidra* amplifier
- Picosecond and femtosecond models available

116 Sir Donald Bradman Drive,
Hilton SA 5033
Phone (08) 8150 5200
Fax (08) 8352 2020
Freecall 1800 202 030
sales@coherent.com.au
www.coherent.com.au

Coherent SCIENTIFIC
Established in 1989

Coherent Scientific Pty. Ltd., Inc. in South Australia, ABN 20 008 265 969