

# Annual Report 2004



The Centre for Ultrahigh bandwidth Devices for Optical Systems (CUDOS)  
An Australian Research Council Centre of Excellence

# Education and Training

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First the numbers: they look very good! In all student categories the numbers have gone up: during 2004 we had 22 PhD students (13 in 2003), 4 MSc students (3 in 2003), and 7 honours students (6 in 2003). Significantly, we have been attracting honours students both from science and from engineering, so we appeal to students from both communities. Our international profile is also strong enough to attract no less than nine students from abroad who won travelling scholarships from their host Universities and elected to spend part of their doctoral studies working at CUDOS.

If you think we get too excited about quantity, let's look at the quality. Many of our students received awards and distinctions during the year. Ilya Shavidrov was awarded no less than two international prizes, while Darren Freeman, Yinlan Ruan, Paul Steinvurzel, Ben Johnston and Tom White all received national prizes. Stewart Wilcox received first class honours and a University Medal for his achievements as an undergraduate student and was ranked first of 300 Honours students in the Faculty of Science at the University of Sydney. To top it off, Ilya and Tom were named joint winners of the AOS Postgraduate student prize.

We like to think that the prizes also reflect the high-quality research environment that we provide. Particular examples of this are the visits and collaboration between the nodes in which students are involved. For example, Sam Myers from Macquarie University is doing part of his research in the experimental laboratories at the University of Sydney. Vahid Ta'eed from the University of Sydney has visited Barry Luther-Davies and his group on numerous occasions for joint research on chalcogenide glass and the use of the Focused Ion Beam at ANU to fabricate Bragg gratings in silicon on isolator structures. Yinlan Ruan from the ANU made reciprocal visits to Sydney to study fibre coupling to chalcogenide waveguides. Similarly, Michael Ventura from Swinburne visited the ANU for joint research on bandstructure calculations. Finally, many of the students at Sydney are supervised on weekly basis jointly with Lindsay Botten from UTS.

Students also benefit strongly from our international partner investigators and visitors. A case in point is Michael Ventura, who spent 6 months with Prof Kawata's group at Osaka University, learning about photopolymerization for photonic crystal fabrication. The students at ANU and Martin Ams

from Macquarie benefited from Prof Kathleen Richardson's visit to Australia from Orlando, Florida, to brush up on chalcogenide glasses. David Fussell worked extensively with Assoc. Prof. Marc Dignam from Queen's University in Canada during his visit to the University of Sydney on an 8 month sabbatical. Marc's involvement led to a significant extension of David's thesis work. Many of the students have also benefited from interactions with Dr Mike Steel from the RSoft design group, vendors of some of the most widely commercial software for photonic crystal and microstructured optical fibres. Mike is an Honorary Associate at the University of Sydney.



▲ **Michael Ventura in Osaka.**

CUDOS encourages undergraduate students to work with us on projects. Often these students have come through talented programs at their different Universities and we are delighted to have the opportunity to provide them with challenging projects to enthuse them with science. During 2004 we hosted twelve of these scientists of the future.

The highlights of our student program were the awards our students have won during 2004:

- Ilya Shavidrov was awarded the Young Scientist Award at the URSI meeting that was held in Pisa, an OSA/Bookham travel grant to travel to the USA to attend a conference of the Optical Society of America, and (with Tom White) won the AOS Postgraduate Student Prize.
- Yinlan Ruan was awarded a "Endeavour Australia Cheung Kong Award," supporting a travelling scholarship to enable her to study device fabrication in Japan.
- Darren Freeman and Tom White jointly received the Wanda Henry prize for the best student paper presented at the ACOFT meeting.



▲ **Paul Steinvurzel receives his travel award from SPIE President, Professor Malgorzata Kujawinska.**

- Paul Steinvurzel received the AOS Student Prize for an outstanding student paper at the AOS conference.
- Ben Johnston received a prize for his Honours thesis from the New South Wales branch of the Australian Institute of Physics.
- Tom White was awarded the 2004 Postgraduate Student Prize from the Australian Optical Society, and with Ilya Shadrivov was joint winner of the AOS Postgraduate Student Prize.

CUDOS is very generous with travel funds, and most PhD students can expect to attend at least one overseas conference. This year students attended international conferences in the US, Sweden, Italy and Japan. They also attended the Australian Optics and photonics conferences, as well as the CUDOS workshop in Melbourne.

The list of CUDOS students, showing their year of commencement, thesis advisers and thesis title are shown in the following table.

### Teaching

CUDOS staff played an active role in teaching photonics-related courses during the year. At Sydney, an Honours-year course on Optical Physics and Devices was taught by Professor Eggleton and colleagues while Professor de Sterke taught a third year course on optics. Dr Ian Littler taught a course on Optics for Engineers in the second year Engineering – this was a new course that involved an in depth study of optics in a range of devices employing advanced optics, compact disc players for example.



▲ Ben Johnston receives the Australian Institute of Physics prize for best Honours thesis.

Students working on CUDOS-related projects during 2003 are shown in the table below.

PhD students	Began	University	Supervisors	Thesis title
Tom White	2002	Sydney	McPhedran de Sterke Botten	Novel photonic crystal devices
Sam Campbell	2004	Sydney	McPhedran de Sterke Botten	Radiation losses in photonic crystals
David Fussell	2002	Sydney	de Sterke McPhedran Botten	Radiation dynamics in photonic crystals
Francisco Letters	2004	Sydney	McPhedran de Sterke Botten	Surface effects in photonic crystals
Ross McKerracher	2002	Sydney	Blows de Sterke	Frequency conversion using four-wave mixing
Audrey Lobo	2001	Sydney	de Sterke	Novel fibre gratings
Peter Domachuk	2003	Sydney	Eggleton	Microfluidic optical devices
Paul Steinvurzel	2003	Sydney	Eggleton de Sterke Steel	Arrow photonic crystal fibres
Hong Nguyen	2004	Sydney	Eggleton	Tapered photonic crystal fibres: fundamental and applications
Vahid Ta'eed	2003	Sydney	Eggleton	Bragg gratings in highly nonlinear planar waveguides
Joe Mok	2003	Sydney	Eggleton	Nonlinear pulse propagation in complex Bragg gratings
Aaron Mathews	2004	ANU	Kivshar Gu	Bandgap engineering in nonlinear photonic crystals
Ilya Shavidrov	2002	ANU	Kivshar McPhedran	Left-handed materials and negative refraction
Steve Morrison	2004	ANU	Kivshar	Electromagnetic waves and scattering in nonlinear photonic lattices
Christian Rosberg	2004	ANU	Kivshar Neshev Krolikowski	Bragg scattering in nonlinear photonic lattices



Darren Freeman	2004	ANU	Luther-Davies	Chalcogenide photonic crystals
Yinlan Ruan		ANU	Luther-Davies	Advanced optical wavelength devices
Michael Ventura	2003	Swinburne	Gu Straub	Fabrication and characterisation of photonic crystal devices
Michael Byrne	2003	UTS	Botten	Modal formulations for photonic crystal devices
Martin Ams	2002	Macquarie	Withford Dawes Piper	Laser-written waveguides and amplifiers
Andrew Lee	2001	Macquarie	Withford Dawes	Laser fabrication of microstructures
Ben Johnston	2004	Macquarie	Withford	Periodically poled devices
<b>Masters students</b>				
Trina Ng	2004	Sydney	Eggleton Blows	Optical performance monitoring using four-wave mixing
Brendan Hanna	2003	ANU	Krolikowski Neshev Kivshar	Gap solitons in photonic lattices
Sam Meyers	2003	Macquarie	Dawes McPhe dran Eggleton	Radiation dynamics in tapered photonic crystal fibres
Liz McNamara	2003	Macquarie	Withford Dawes Savrides	Fabrication of MEMS devices for photonic applications
<b>Honours students</b>				
Stewart Wilcox	2004	Sydney (phys.)	de Sterke McPhe dran Botten	Defect modes in infinite photonic crystals and microstructured fibres (H1M)
Cameron Smith	2004	Sydney (EE)	Eggleton	Transverse probing tapered photonic crystal fibres
Yi Lun Miao	2004	Sydney (EE)	Eggleton	Efficient coupling to planar nanowire using taper microstructured optical fibres
Tom Liu	2004	Sydney (EE)	Eggleton Blows	Raman scattering in silica fibre
Jovana Brnovic	2004	Sydney (EE)	de Sterke Botten McPhe dran	Photonic crystal waveguide tapers
Luke Stewart	2004	Macquarie	Withford Marshall	Self-assembly of photonic crystal structures (H1)
Doug Little	2004	Macquarie	Withford Marshall	Near-field optical microscopy (H1)
<b>International students</b>				
Rossella Zoli		Sydney		University of Bologna, Italy
Rebecca Schaeftz		Sydney		Tufts University, USA
Yannick Lize		Sydney		Montreal Polytechnique, Canada
Lukasz Wolf		ANU		Chalmers University of Technology, Sweden
Henrike Trompeter		ANU		Fridrich Schikker University Jena, Germany
Ray-Kuang Lee		ANU		National Chaio-Tung University, Taiwan
Ling Xiao Zhu		ANU		Royal Institute of Technology, Sweden
Christian Motzek		ANU		University of Darmstadt, Germany
Michihiro Takii		Swinburne		Shizuoka University, Japan