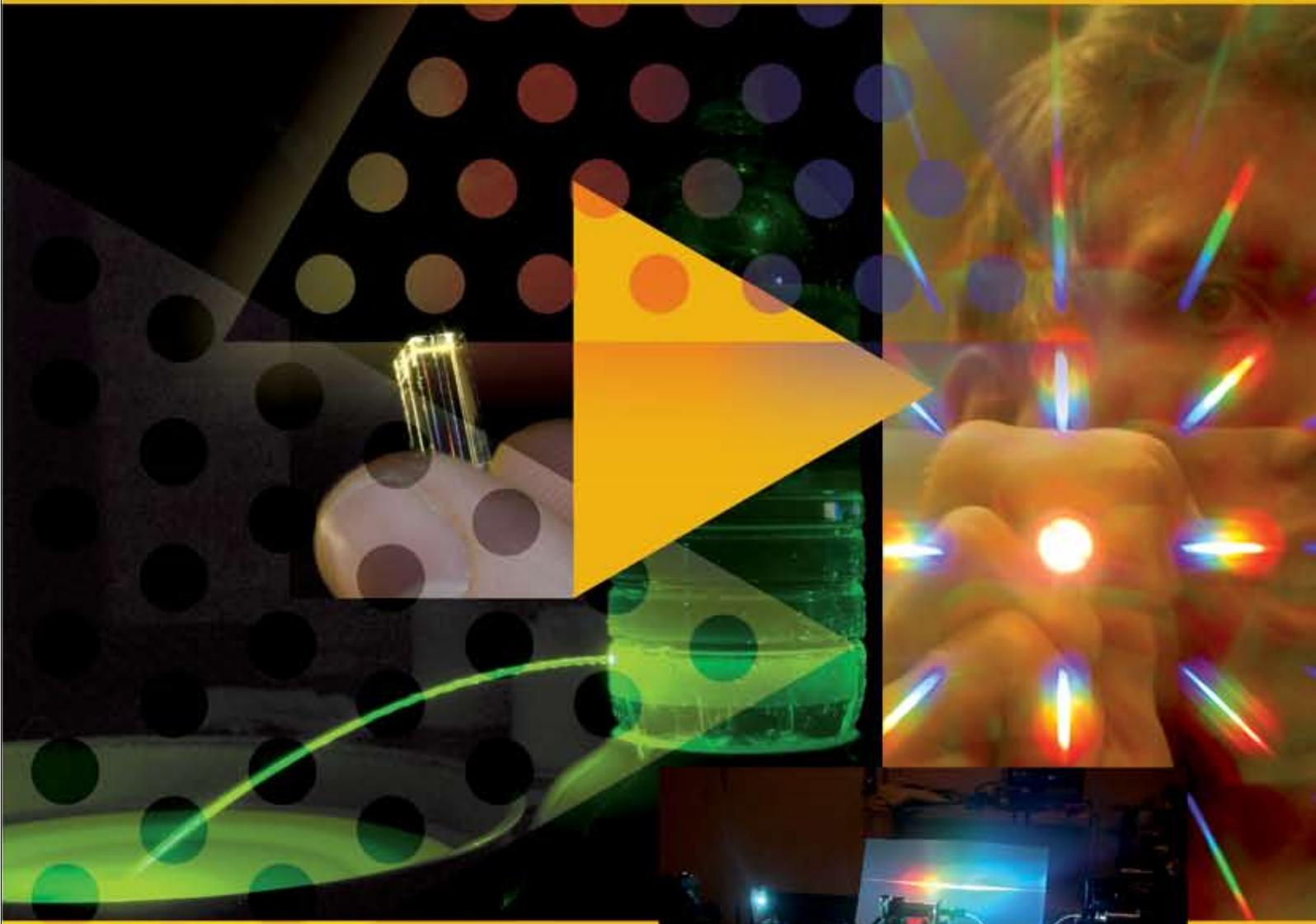


CUDOS

The Centre for Ultrahigh bandwidth Devices for Optical Systems (CUDOS)



A N N U A L R E P O R T
2006

Contents

Research Director's Introduction	2
Chairman's Introduction	3
Research Overview	4
Flagship Projects	8
Chief Investigator Reports	24
Education and Training Report	52
Links and Commercialisation	54
Communications and Outreach	58
Centre Management and Governance	60
The 2006 CUDOS Team	62
Performance Indicators	64
Financial Statement	66
2006 Publications	67



The Centre for Ultrahigh bandwidth Devices for Optical Systems (CUDOS)

VISION

CUDOS will be a world-leading Centre in microphotonics, with internationally pre-eminent research underpinning a strategic focus on all-optical signal processing devices.

MISSION

CUDOS will conduct fundamental strategic research aimed at demonstrating and developing technology for optical processing devices that will enhance Australia's communications infrastructure and our status as a technologically-advanced economy.

KEY FACTS

- 55 researchers, 36 students and 4 administrative staff across five nodes.
- 19 visiting researchers during the year including three visiting students.
- 81 publications in refereed journals, with an average impact factor of 3.1 (4.1 for the 55 top-ranked publications) and three book chapters.
- More than 30 plenary and invited presentations at national and international meetings.
- Cash income \$4.1M in 2006 with in-kind and indirect support of \$6M. The Centre also received cash support through laboratory and equipment upgrades (\$350,000), student stipends (APA, UPA and IPRS) and competitive grant funds awarded by the five Universities.
- 3 provisional patents filed.

CUDOS gratefully acknowledges the support of the Australian Research Council. We also acknowledge the financial and in-kind support provided by the Collaborators – the University of Sydney, the Australian National University, Macquarie University, the University of Technology Sydney and Swinburne University of Technology. Finally, we are grateful for financial support provided by the New South Wales Government through the Department of State and Regional Development.



The University of Sydney



Australian Government

Australian Research Council



**NSW WE MEAN
BUSINESS**
Department of State and Regional Development



Ben Eggleton



The end of 2006 marks the completion of four years' existence for CUDOS. Our initial five-year tranche of funding has been extended by three years, to the end of 2010, so we are now half way through our eight year life span. Looking back, I am amazed at how far we have come. Looking forward, I am tremendously excited about what is to come in the next four years.

Research Achievements

The quality of the Centre's research output, if measured by number and quality of publications, is extraordinary.

In 2006 we published nearly ninety articles in refereed journals, with the top 55 (the ARC target, revised upwards from 40 in 2005) having an average impact factor of 4.1. Included in our publications was an article in *Nature* (Physics) reporting observations of slow light associated with the production of gap solitons in a fibre Bragg grating, and six publications in *Physical Review Letters*. These covered fundamental studies of solitons, Bloch waves and Zener oscillations, experimental studies of the formation of micro-voids in material using ultrashort pulse lasers and calculations of the radiation properties of coupled micro-cavities in a photonic crystal using a Local Density of States approach.

Our efforts to demonstrate all-optical switching and an all-optical signal regenerator in an integrated planar structure have achieved major milestones that are significant steps towards a photonic chip. In these projects our efforts are focused on chalcogenide material, whose use we have pioneered for nonlinear applications with results that are receiving international interest and attention. Development of an integrated waveguide laser has taken a step closer to realization with the demonstration of a point by point laser written Bragg grating in an optical waveguide, itself written with the same laser.

Collaboration across the Centre continues to be a major strength of our research program. Every Flagship draws upon staff and students from at least two and in some cases four Universities, while our theory groups across UTS, Sydney and ANU work closely with the experimental groups at Swinburne, Macquarie, Sydney and ANU.

Centre Reviews and Extension

The Centre was delighted to have the opportunity to apply for an extension of its funding for three years following the end of the first five year tranche. As part of this process we took the opportunity to develop a new strategic plan for our research, to organise this into seven major projects, and to identify new Partner Investigators who could collaborate with us in driving these projects forward. This process was energising for all concerned and has led to a Centre with new international collaborations in place for immediate

commencement. In fact, most of our new PIs will attend our 2007 Centre Workshop, to be held in February.

During 2006 we also convened a second Science Review. The Committee (drawn from professional peers in Australia, Europe and the US) attended our August 2006 Workshop and over two days assessed our science, our staff and students and the overall research strength of the Centre and its collaborations. Their report was unequivocal in assessing the Centre as world-class in all aspects. We were particularly gratified to see our European colleagues identify the effectiveness of our collaborative strategies as a model for Centres of this kind.

Research Management

Our research activities were re-structured during the year to provide management and support for our Flagship projects. As part of this restructuring we created a new role, that of Project Manager, giving opportunities for some of our younger researchers to undertake this responsibility and develop new leadership skills.

Education and Training

Students who started with CUDOS in 2003 commenced graduating during the year. They have found employment in the private sector, in government and as postdoctoral fellows with other Universities. A highlight of our E&T program was the student competition, which this year challenged the students to write an article on their research suitable for publication in a popular journal. The winning article by Peter Domachuk was published in the science magazine "Cosmos".

Outreach

2006 was the year that CUDOS made a significant and formal commitment to Outreach. We appointed an Outreach Coordinator, Ms Kali Madden at Macquarie, who worked with the Executive to develop a cohesive plan for outreach activities spanning all nodes. We achieved strong recognition in the national media for a number of our research outcomes. We put a schools program in place by developing presentation material, building links into local high schools and encouraging our staff and students to present talks to school students. The program has been immediately successful, with five school visits by our students in the ACT and NSW during 2006 and several presentations to science teachers' workshops and internships by teachers in CUDOS laboratories.

Personnel

CUDOS staff continue to receive peer recognition both in Australia and internationally. Yuri Kivshar was awarded the 2006 Walter Boas medal of the Australian Institute of Physics and will also receive the 2007 Lyle Medal from the Australian Academy of Sciences, while I will receive the 2007 Pawsey Medal, also from

the AAS. Min Gu was made a Fellow of the Australian Academy of Technological Sciences and Engineering and was appointed a Vice President of the International Commission for Optics. Wieslaw Krolikowski was elected as Fellow of the Optical Society of America (OSA). I congratulate my fellow Chief Investigators on these awards.

CUDOS played a leading role in the organisation of the extremely successful seventh International ETOPIIM (Electrical, Transport and Optical Properties of Inhomogeneous Media), with Ross McPhedran the Conference Chair and Dr Boris Kuhlmeiy the secretary of the Local Organising Committee. The meeting was held at Darling Harbour with over 70 international and 70 local delegates.

Martijn de Sterke has taken up the position as Editor in Chief of the OSA journal Optics Express. This journal, which is only available on-line, has shown a remarkable increase in its impact factor over the last few years and is now ranked on this score as highly as the prestigious journal Optics Letters. It is a strong indication of the high international regard in which Australian Optics is held that Martijn was offered this significant role.

Another area where CUDOS exercises leadership in Australian optics and photonics is through the Australian Optical Society, where I serve on the Council as Vice President (and President-elect), while Martijn de Sterke is a Councillor.

Finally I congratulate a number of our junior researchers who have been awarded ARC Fellowships to work on projects with CUDOS – Guangyong Zhou, Boris Kuhlmeiy, Christian Grillet and Christelle Monat (APDs) and Andrei Sukurokhov (QEII). I'm also delighted that the first two student chapters of the OSA in Australia were formed by CUDOS students – Christian Rosberg at the ANU and Hong Nguyen at Sydney.

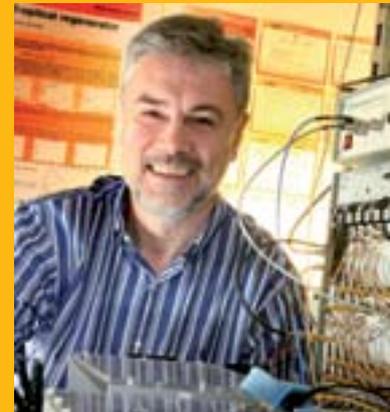
The effort, achievement and peer recognition at all levels in CUDOS has assisted in positioning us at the centre of optics and photonics both in Australia and internationally. I am proud to be working with such an outstanding group of researchers, both staff and students.



Professor Benjamin J Eggleton

Research Director and Federation Fellow

Simon Poole



The Board was delighted to hear that the Centre's period of funding has been extended by the Australian Research Council from five to eight years out to 2010. As I remarked in my Chairman's report last year, the timescales required to discover, develop and take a new technology to market extend well beyond the initial five year lifetime of the Centre. While the basis for the Centre's existence is its high quality research, CUDOS offers substantial returns to the Australian community through exploitation of the outcomes of its research by industry, and I applaud the decision by the ARC to offer the Centre the opportunity to continue its program of research leading to delivery of these benefits.

I see a Centre that, as of the end of 2006, has built on its research excellence to develop technologies with real potential for commercialisation. I anticipate that over the next few years Centre researchers will attract significant support for this from non-ARC and University sources. The Board looks forward to working with Ben Eggleton and his team to assist in this process wherever possible.

I also see a Centre that has become a respected and recognized entity amongst the international photonics research community. CUDOS researchers are presenting invited talks at world-leading conferences in the US, Europe and Asia, and the Centre is playing a role in a number of European consortia. This is reflected in the outstanding Partner Investigators who will join the Centre as it moves into its next phase.

I thank all the Board members for their input and enthusiasm during the year. I acknowledge the contributions of Dr Scott Rashleigh, who has indicated that he wishes to step down from the Board and I welcome Professor Merlin Crossley, who is representing the University of Sydney in his capacity as Deputy Vice Chancellor (Research). I look forward to working with Ben, his team and all the Board members over the coming year.



Dr Simon Poole

Chairman, Advisory Board