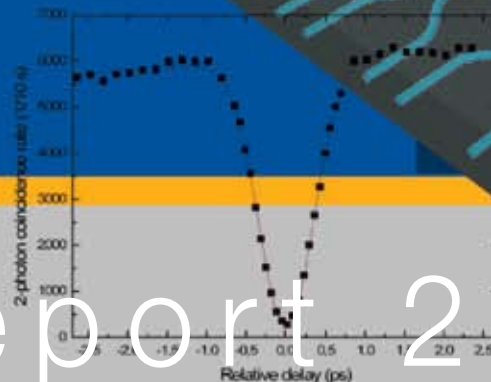
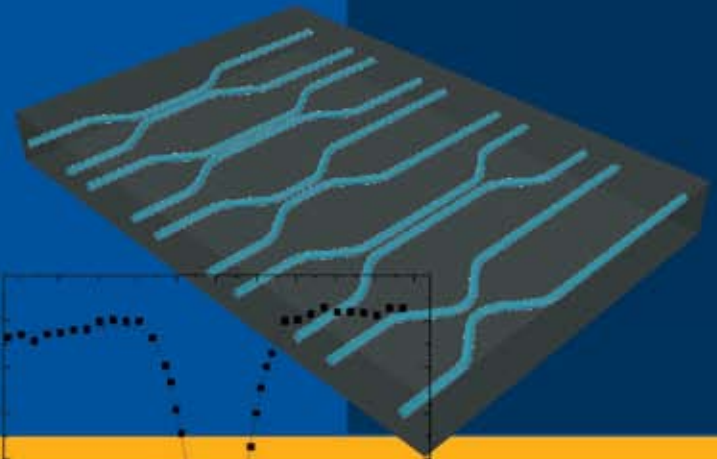
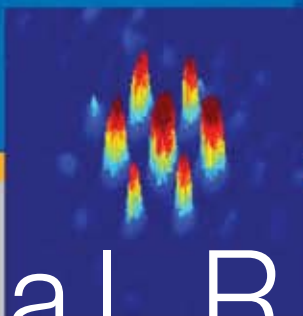
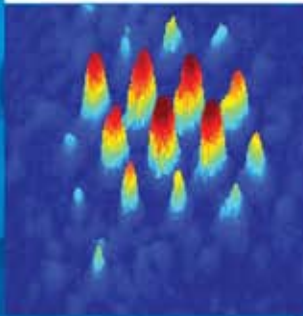
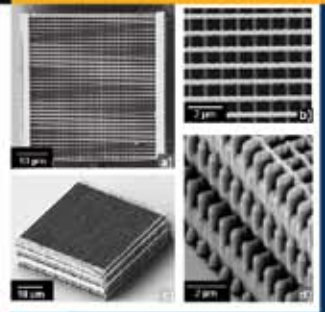
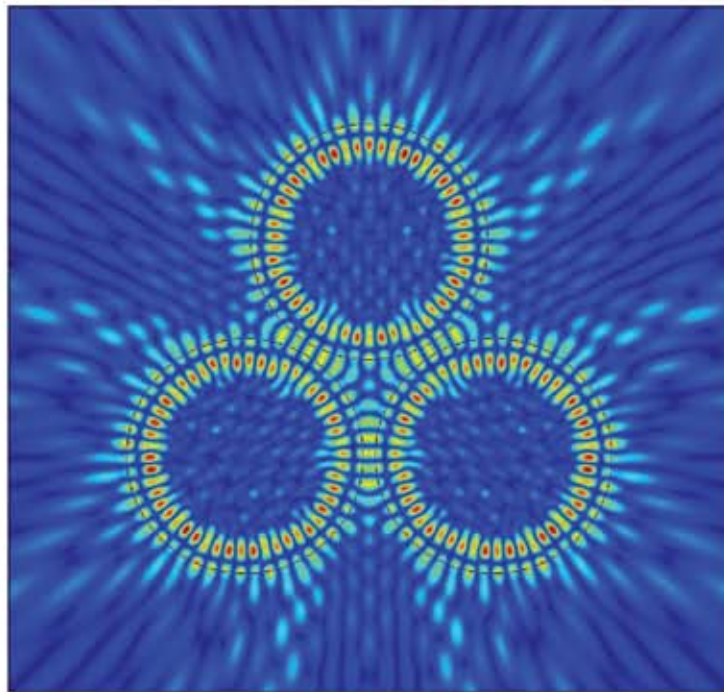
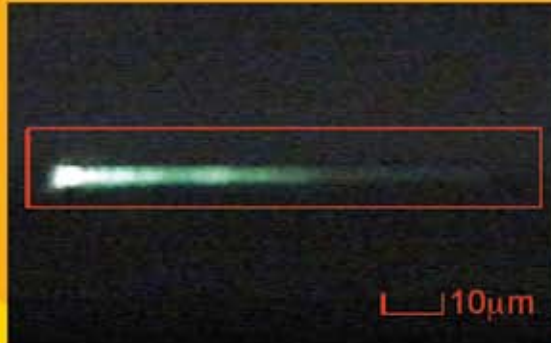


CUDOS

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



Annual Report 2008



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

Vision

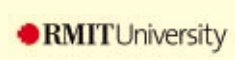
CUDOS is a world-leading Centre in microphotonics, with internationally pre-eminent research underpinning a strategic focus on all-optical signal processing devices.

Mission

CUDOS conducts 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.



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, Swinburne University of Technology and RMIT University. Finally, we are grateful for financial support provided by the New South Wales Government through the Department of State and Regional Development.



Australian Government
Australian Research Council



Department of State and
Regional Development

Research Director's Introduction



◀ Ben Eggleton

2008 was then a year of continuity as our existing Flagships moved closer to their strategic goals, but also a year of renewal as our new Partner and Chief Investigators joined the Centre and a new Flagship commenced.

It was also a year of achievements. These are of course the subject of this report, but mention of a few is appropriate here.

All optical signal processing: The dream of practical switching of ultrahigh bandwidth streams of data was realised by CUDOS teams at Sydney and the ANU, working in collaboration with a team at the Danish Technical University, when we were able to optically strip a 10 Gb/s signal from a 640 Gb/s data stream with minimal system penalty. This result was reported at the 2008 OECC meeting in Sydney and a press release associated with this presentation attracted international media attention.

Compact waveguide laser: Our Macquarie team succeeded in writing (using the most complex "pen" ever developed!) the components of a laser oscillator (waveguide and resonator mirrors) inside a block of solid glass. When pumped by a diode laser, this compact device oscillated at powers of up to 50 mW at a wavelength pre-determined by the Macquarie researchers. This achievement places the team well in front in this internationally competitive field and puts CUDOS in an excellent position to offer a compact, high brightness laser for a variety of end user applications.

Workshops: We organised two Workshops during the year. In February we held our Annual Workshop, in essence our 'kick off' meeting for the extension phase of the Centre. We had nearly 130 attendees including almost all local CUDOS members and Partner Investigators Krauss, Kuipers, Wilson, Richardson and Harvey while Stojan Radic, John Haub, Thas Nirmalathas and Hugo Thienpont sent delegates. Andre Melloni (Milan), Andrei Faraon (Stanford), Tanya Monro (Adelaide), Tom White (St Andrews), Joss Bland-Hawthorn (AAO/Sydney University), Juerg Leuthold (Karlsruhe), and Susumu Noda (Osaka) also attended by invitation.

In September we held a tutorial workshop on the exciting subject of Metamaterials. Our aim was to provide our students and researchers with an overview of the fundamentals and the current research in this extremely topical area, with invited speakers from inside and out of CUDOS.

International Conference Organisation: The largest meeting in optics and photonics to be held in Australia for at least ten years was held at Darling Harbour in July 2008, with CUDOS staff playing leading roles in the organisation. I chaired the Optoelectronics and Communications Conference (OECC), Asia's most prestigious meeting in this area, while CUDOS COO Chris Walsh chaired the Congress of the International Commission for Optics (ICO), a triennial event attended by optics researchers from all fields. The meetings were co-located at Darling Harbour with over 700 attendees.

One of the principal objectives of the Centre of Excellence scheme is to build Australia's human capacity in a range of research areas. The Centre continues to address this objective admirably. A number of our researchers are winning ARC Fellowships and our Chief Investigators continue to win Discovery and Linkage grants in areas that build on, but of course do not overlap with, Centre programs.

As I noted in last year's Annual Report, CUDOS was invited by the ARC in 2006 to apply for an extension to its five year funding arrangement with the ARC that was due to finish at the end of 2007. Our application was successful, and the Centre is now funded through to the end of 2010. We are extremely grateful to the ARC for this vote of confidence in the quality and direction of our research and the outstanding achievements of our researchers and students. We are also extremely grateful to our partner universities (University of Sydney, Australian National University, Macquarie University, Swinburne University of Technology, University of Technology Sydney and from 2008, RMIT University) and the NSW Department of State and Regional Development for their continued support over this extension period.

In our application for extension we proposed a research program built around six Flagship projects. Five of these had taken shape since the Centre's commencement in 2003, while the sixth was a new initiative built around new experimental capabilities brought into the Centre by our new Partner Investigator, Associate Professor Arnan Mitchell of RMIT.

The concept of a Flagship project evolved over the first few years of the Centre. Each Flagship is a research effort based on a strong cross-node team with a wide range of skills. Each Flagship has a goal to develop a key building block of a photonic chip, the long-term strategic mission of the Centre. The Flagship goals are challenging, with significant national benefit, and their achievement requires research of the highest international calibre. Flagship projects provide the scale and focus to our research that characterise a Centre of Excellence.

The evolution of our Flagships led to collaborations with colleagues internationally and at DSTO and NICTA. The invitation to apply for extension funding gave us the opportunity to bring these collaborators into the Centre as Partner Investigators. The extension process also provided the opportunity to bring RMIT into the collaboration.

Of particular note is a Linkage project with Finisar, originally an Australian start up now part of an international company who have developed novel wavelength-selective switching technology with application to optical communications networks. Through the Linkage project, which used the high speed optical facilities built up as part of the Centre of Excellence and the expertise of CUDOS researchers, an entirely new product based on Finisar technology was developed. This is now being marketed world wide, with the Company paying us the ultimate compliment by recruiting the postdoctoral Fellow working on the project.

I thank our Advisory Board, chaired by Dr Bob Watts, for their support during the year. The Board met at the ANU and as always provided me and my colleagues with important strategic advice that continues to strongly influence our perception of what a Centre of Excellence should aspire to in the Australian landscape. One of our new Board members, Mr Laurie Bode of the Department of Defence has been particularly helpful in assisting us to develop strategic links with his industry sector.

As always, I have great pleasure in acknowledging the efforts of all my CUDOS colleagues, both staff and students, for their contributions to making the Centre a success. During the year Professor Min Gu was elected as a Fellow of the Institute of Physics (IoP). I was

delighted to receive the inaugural NSW Science Prize for Physics and Astronomy. Our students continue to demonstrate that they are amongst the top of their cohort, with CUDOS students from Sydney and ANU being recognised for either best publication or best PhD thesis at their universities during 2008.

As I write this, the Centre is nearly half way through its extension phase. We anticipate that at some point in the near future we will have the opportunity to present an application to continue our research in this most exciting area, and we look forward to this. The field of microphotonics and the range of technological opportunities opened up by the development of a photonic chip have exploded in potential impact and scientific opportunity since we commenced in 2003, and I am confident that we have the researchers, the facilities and the expertise to remain international leaders in this exciting area.



Research Director, CUDOS
ARC Federation Fellow

Chairman's Introduction

The CUDOS Advisory Board met once during 2008 and several Board members met one on one with Ben and his team during the year to pursue Board-initiated activities. I'm delighted to report that there have been positive outcomes from this interaction.

Mr Laurie Bode, who directs a program in the Defence Materiel Office to develop and supply airborne self-protection systems to the armed forces, has initiated a strategic engagement between CUDOS and the Defence industry to develop advanced photonic technologies for electronic warfare applications. RMIT (who already have a strong engagement with Defence), Macquarie University and the University of Sydney all have strong potential to contribute to this program, and the Board looks forward to seeing this collaboration develop during 2009.

Dr Steve Frisken, CTO of Finisar Australia, a developer and provider of advanced equipment for telecommunications, visited CUDOS for a detailed briefing on the optical signal processing technology being developed at the Centre to provide a commercial perspective on opportunities for further development. I understand from Ben that this information has been extremely valuable for the Centre in planning its research activities in this area.

Ben and Steve are co-investigators on an ARC Linkage Grant that commenced in 2006. The broad aim was to explore a number of novel areas of application for technology patented and commercialised by Steve and his colleagues at Finisar using the unique skills and facilities at CUDOS. The project was extremely successful, with a product launched at the ICO/OECC meeting at Darling Harbour and the recruitment by Finisar of the research associate hired to conduct the project at the University of Sydney.

While this work was outside the Centre's research program, it is clear that this commercially-motivated project could not have taken place without the capacity built by the Centre under Ben's direction. This is a perfect example of the value added across a range of sectors, both industry and community by a Centre of Excellence

– others include the training given to young scientists and engineers at the Centre, and the engagement with science of the next generation through the Outreach program.

I found out during the year at first hand about another form of engagement the Centre has with the community. I was driving between appointments when I heard, to my great surprise, Ben's voice on my car radio describing the progress that the Centre was making towards a terabit optical chip. It turns out that I was just one of many tens of thousands of Australians who, through radio, television and the daily newspaper, were informed of the CUDOS breakthrough with a Danish collaborator in demonstrating that an optical chip could de-multiplex an ultrahigh bit rate stream to extract data at rates easily managed by conventional electronics. The significance of the result, and the interest shown in it by the man in the street, were attested to by the intense media interest. Congratulations to Ben and his team for the result, and for the successful effort in exciting the taxpayers about the outcomes of their research.



Dr Bob Watts
FAA, FTSE, FRACI
Chair, Advisory Board