

Annual Report 2004



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

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

Vision: CUDOS will be an international leader in nonlinear photonics, producing innovative outcomes that will deliver major social and economic benefits to Australia.

Mission: CUDOS will demonstrate all-optical processing applications and develop devices that enhance the capacity of ultra-high bandwidth optical communications systems.

Key facts

- 95 members of the CUDOS team across five nodes, including 32 honours and postgraduate students and 56 researchers (including CIs).
- 50 publications during 2004 with an average impact factor for the 40 papers in the top ranking journals of 3.5.
- 21 invited presentations at national and international meetings.
- Centre cash income of \$3.41M in 2004 and in-kind and indirect support of \$5.8M. The Centre has also received new equipment funding from University partners totalling \$0.75M during 2004 and has preferential access to other new facilities valued at \$1.2M.

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 NSW 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



Year Two Highlights:

- Exceptionally strong publication record exceeds performance targets
- Major research results coming from strong collaborations between CUDOS nodes
- Staff complement complete
- New major facilities
- Launch of new Flagship projects
- Major recognition for CUDOS researchers

Welcome to the second annual report from CUDOS, the new Australian Research Council Centre of Excellence. In last year's inaugural report we described the hard work that had been put in during our first year of operation to get our Centre up and running. In this report you will find the first results of that hard work, along with a tremendous sense of optimism for future years. In 2004 we can demonstrate exciting research results obtained through strong collaborations between the partners and continued development of links with external organisations. We have developed exciting new projects that showcase our major goals. CUDOS researchers, both at the most senior level as well as our students, have achieved major peer and community recognition during the year. We hope this Report will demonstrate the progress that CUDOS is making to establishing itself amongst the pre-eminent photonics research groups in the world.

Let me briefly summarise some of the highlights in this Report:

Our publication record: At the workshop hosted by the Academy of Science on "Measuring Excellence in Research and Research Training" ([\[ceedings/researchexcellence/index.htm\]\(#\)\) the validity of using publications to evaluate research excellence was unambiguously affirmed. This year CUDOS researchers have published over fifty papers in refereed journals with the top forty of these in journals having an average impact factor of around 3.5. Five papers \(all from Professor Kivshar's group\) appeared in Physical Review Letters.](http://www.science.org.au/pro-</p></div><div data-bbox=)

Exciting research results: Year one of the Centre was all about developing capabilities. Year two has been focused on developing all-optical processing concepts and experimental demonstrations, and developing a platform of microfabrication capabilities that will take us into the phase of demonstrating microphotonic optical processors in year three. I am delighted to report that our researchers have demonstrated remarkable progress in each area. We have now produced two and three dimensional photonic crystals using a variety of approaches, and have demonstrated an all-optical processing system that performs wavelength conversion while at the same time monitoring the quality of the signal. We have the first signs of a microphotonic platform with a strongly nonlinear optical response, and a range of photonic devices have been explored theoretically. Spectacular results have been achieved in theoretical and experimental studies of soliton effects and left handed materials.

Strong Collaborations: In a research sense, the "value add" in a Centre like CUDOS is the development of new, synergistic relationships through the shared vision of research opportunities. This is happening in a quite profound way with CUDOS, with beneficial long-term implications for Australian photonics research. Theoreticians and experimentalists have joined together to provide a powerful, integrated research capability at the frontiers of photonics while on the experimental side, researchers with expertise in materials and materials modification processes (lithography, laser micro-machining etc) are working closely with other researchers looking to design and demonstrate advanced photonic concepts using these materials and modification processes. One quarter of CUDOS publications are now coming from cross-node collaborations, and we expect this fraction to increase, even as the total number of publications also increases.

"Flagship" projects: As a Centre of Excellence, CUDOS aims to deliver a range of social and economic benefits to Australia. The CUDOS project leaders met for a weekend of brainstorming in the Blue Mountains during August 2004

to select “Flagship” projects from the range of CUDOS activities that represent pinnacles of achievement over the Centre’s lifetime. We selected projects that satisfied a range of criteria including significant social and commercial benefits that would be immediately apparent to the broader community, leading edge science and projects where CUDOS had a distinct research advantage over other groups. We identified opportunities that built on existing CUDOS projects with outcomes that would be of sufficient interest to warrant coverage by Australian newspapers – we colloquially call these “Page Three” projects. Teams have been assembled with plans to achieve the “page three” outcomes in the next two years of operation of the Centre.

Recognition of CUDOS researchers: I am delighted that a range of CUDOS researchers have been recognised during the year. I was honoured to be awarded the Malcolm McIntosh Prize for Physical Scientist of the Year – the ceremony in Canberra was a personal highlight for 2004. My colleagues Ross McPhedran and Jim Piper received peer acclamation of the highest order through their awards of the Medal of the Australian Optical Society (Ross) and the Carnegie Centenary Professorship at Herriot-Watt University (Jim), while Min Gu and Lindsay Botten were each made Fellows of the Optical Society of America. I take particular pleasure in the recognition achieved by six of our students: Ilya Shadrivov, Yinlan Ruan, Darren Freeman, Ben Johnston, Paul Steinvurzel and Tom White, who won an impressive array of awards for conference and thesis presentations.



Professor Ben Eggleton
Research Director

Chairman’s Introduction



Simon Poole

As you will see from this report, the CUDOS research team has grown into a major force in Australian photonics research, as well as building the international reputation so critical for attracting and retaining the most able students and researchers from both Australia and overseas. Under the enthusiastic and inspiring leadership of Professor Ben Eggleton, the Centre is delivering on its research goals and is well-placed over the next three years to tackle the demanding goal of demonstrating an integrated optical signal processor or “photonic chip”.

Great research requires a huge amount of work ‘beneath the surface’ and on behalf of Ben and all the researchers I would like to thank all Advisory Board members for their assistance during the year. I would particularly like to thank those members who, from pressure of competing obligations have stepped down from the Board: Professor Arun Sharma, Dr Greg Clark, and Professor Mark Sceats. Professor Kerry Pratt (Swinburne) has been replaced on rotation by Professor Jim Piper representing Macquarie. I would like to thank Kerry for his contribution and welcome Jim to the Board. I also welcome the other new members: Dr Ian Ritchie, Dr Steve Duvall, Professor Simon Fleming and Professor Rod Tucker. With these members we continue to maintain strong links with a range of stakeholder groups in industry, government (both state and federal) and venture finance as well as to other photonics research providers including NICTA and the Photonics CRC.

It has been a pleasure for me to be associated with the Centre over the past two years, and I look forward to its continued success in the future.



Dr Simon Poole
Chair, Advisory Board