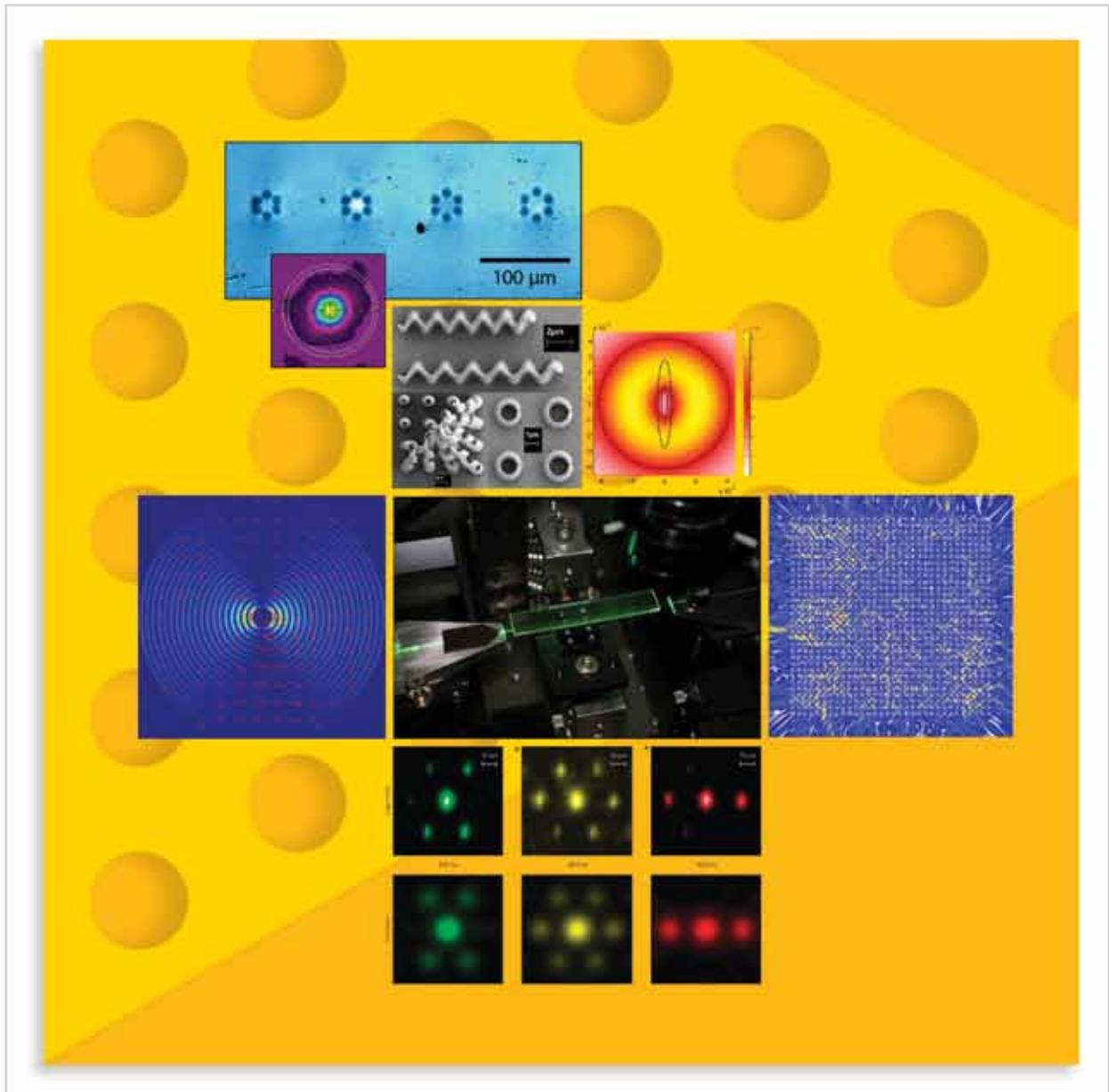


# ANNUAL 2009 REPORT



## CUDOS

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

# Links and Commercialisation

CUDOS draws much of its vitality from linkages between the research nodes within the Centre, and from strong collaborations with its Partner Investigators, with other research consortia, and with industry. These links have reaped strong rewards through publications in major journals, training opportunities for our students in other laboratories, and the initiation of student exchange programs between different Universities.

In 2009 approximately 30% of all refereed publications involved two or more nodes of the Centre, while over 50% of the publications were co-authored by Partner Investigators or external collaborators. These figures demonstrate the strength of and the benefits from the links that Centre researchers have forged with their collaborators.

Our Partner Investigators are key to building strong links at a group level. Professor Kuipers (FOM Amsterdam) and Professor Krauss (St Andrews) are both Partner Investigators and collaborate with CUDOS through their participation in an EU-funded project. Our collaboration with Professor Wilson (Oxford) has led to a series of visits by Dr Martin Booth (Oxford) funded by an international collaboration grant from Leverhulme Trust (UK). While Prof Wilson's original collaboration with CUDOS was with our Swinburne group to develop aberration free imaging inside high refractive index materials, this has broadened to a second activity with our Macquarie group to develop ways of producing focal spots whose axial and transverse dimensions are equal, thus ensuring the production of high quality circular waveguides using the femtosecond laser direct write technique.

Professor Leuthold (Karlsruhe) is a long-term collaborator of the Centre on a peer-to-peer level. He recently obtained funds for a large EU project with the acronym SOFI, an ambitious project to develop high speed photonic signal processors fabricated using different materials integrated to capture the unique benefits of each material with one package. This 'hybrid integration' approach to photonic devices is an area of intense interest world wide as it is now clear that there is no one material with all the optical properties required for a practical photonic signal processor. CUDOS

was written into this project because of our unique expertise in chalcogenide materials, our ability to integrate this onto substrates of different materials, and our sophisticated facilities for testing the performance characteristics of these hybrid optical devices. As in other EU projects presently under review for funding, our unique capabilities and world-leading track record have positioned us as the partner of choice for major international projects in the area of photonic processing.

We were delighted once again to see a number of our collaborators and Partner Investigators at our 2010 Workshop including Professors Krauss, Kuipers and Leuthold.

UDOS is a Centre with strong national and international links and agreements in place. In Australia NICTA, DSTO and the Anglo-Australian Observatory are collaborators through the involvement of scientists from each institution as Partner Investigators. Centre researchers also collaborate with Optium Inc via a Linkage Grant and Redfern Polymer Optics, where co-location on the ANU campus has led to arrangements for shared facilities of significant benefit to both parties. The Centre also has links with Bandwidth Foundry International (equipment sharing) and makes its facilities at different nodes available as required for external users.

Internationally, the Centre now has formal collaborative agreements in place with two European Networks of Excellence (PHOREMOST and NEMO) and with Projects funded under the European Commission's Future and Emerging Technologies program. We are also formally a member of Action 299 of the European Cooperation in Science and Technology (COST) Program.

Funding from the International Science Linkages Program has been obtained to support the collaboration with the Slow Photon Light Activated Switch (SPLASH) project and with Professor Martin Pemble and the Tyndall Institute, Ireland. In each case the grants provide funds for collaborative activities outside, but highly complementary to, the CUDOS CoE program. Technical aspects of each project are discussed in the Slow Light and 3D Photonic Crystal Flagship reports.



Partner Investigators and visitors at the CUDOS Workshop in 2010



Over 200 PECS participants enjoyed perfect Sydney autumn weather for their meeting.

## Conference and Workshop Activities

### PECS Meeting

The eighth International Photonic and Electromagnetic Crystal Structures (PECS) meeting was held in Sydney in April 2009, with Ben Eggleton and Yuri Kivshar as Co-Convenors. This specialist meeting in photonic crystals, metamaterials and sub-wavelength optics has become the premier meeting internationally for this exciting and rapidly developing field. As an invitation to present is considered an honour, the list of speakers looks like a 'who's who' of the leading researchers and research groups.

The opportunity to host the meeting was a coup for CUDOS and for Australian research in this area, and can be considered a mark of respect for the two co-convenors as well as the strength of the field in Australia. The list of invited speakers, headed by Sir John Pendry of cloaking fame and Martin Green who spoke on applications of photonic crystals to photovoltaics, included Eli Yablonovitch (UCLA), Costas Soukoulis (Ames Laboratory), and Sajeev John (Toronto), all pioneers of this field, Professors Baba, Notomi and Noda from Japan, Jelena Vukovic and Shanhui Fan (Stanford) as well as CUDOS Partner Investigators Krauss and Kuipers. The full list is at <http://pecs8.mtci.com.au/PECS-8Speakers.html>.



John Sipe giving his Plenary Talk.

Nearly 50% of CUDOS students and researchers attended this meeting and enjoyed a once in a lifetime opportunity to rub shoulders with researchers who can truly be referred to as world leaders.

### 8th CUDOS Workshop

The 2009 Annual Workshop was held at Lake Crackenback Resort on the NSW Snowy Mountains over four days in February. The Workshops have become a "not to be missed" part of the calendar not only for our researchers and students but also for our Partner Investigators, who support the event strongly and in fact value it for the networking opportunities, the quality of the science and the sheer enthusiasm, camaraderie and commitment of all participants, particularly the students.

The meeting started off with a presentation from John Sipe of Toronto on 'Nonlinear quantum optics on a chip', an area of significant future interest for the Centre given the success of the directly written waveguide technology in this field. Other invited speakers, either Partner Investigators or those representing the PI included Tony Wilson (Oxford); Hugo Thienpont, Nathalie Vermeulen, Christof Debaes (VUB) along with Jurgen van Erps who spent three months at the University of Sydney following the Workshop; John Harvey (Auckland); Tobias Kampfrath (AMOLF) representing Kobus Kuipers; Nikola Alic (UCSD) representing Stojan Radic; and Leif Oxenlowe (DTU), our collaborator in the 640 Gb/s OTDM experiment.

## Commercialisation

The Waveshaper ([www.waveshaper.net](http://www.waveshaper.net)), commercialised by Finisar P/L following a collaborative project between the Company and Centre researchers, continued to grow in commercial success with increased sales and further hires to work on product development, engineering and manufacture. This product grew out of the results of a collaborative project funded under a Linkage grant but which drew substantially on CUDOS facilities and the expertise of CUDOS researchers.

## What is WaveShaper?

- The **WaveShaper™** family of Programmable Optical Processors is a new breed of instruments for optical R&D
- Based on high-resolution LCoS technology developed by Finisar, the WaveShaper S-Series provides arbitrary control of the optical transfer function of a filter or DWDM channel.
- The WaveShaper S-Series is available as either a Programmable Optical Filter (WS1000S - top) or a Multiport Optical Processor (WS 4000S - bottom), with both C- and L-band versions available.
- Control Software runs under Windows, with LabVIEW driver also supported.



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Waveshaper information and images courtesy of Michael Roelens of Finisar.

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