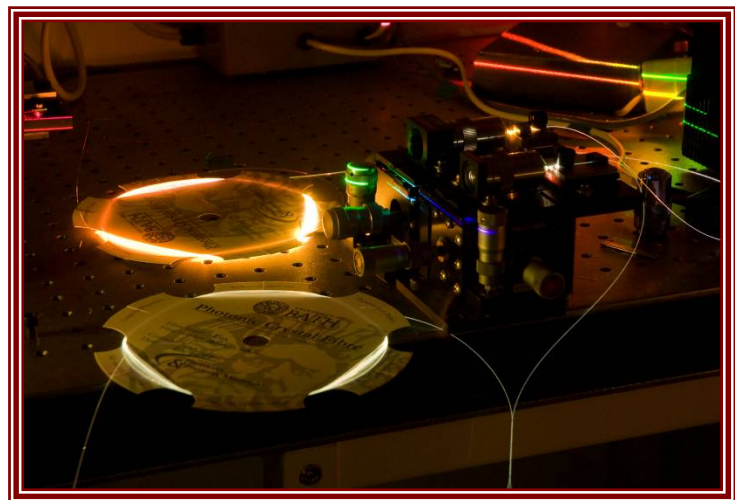


Centre for Photonics and Photonic Materials Review of 2005-2008



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Executive summary

The Centre for Photonics and Photonic Materials was formed in July 2005, and formalised the existing collaborative working relationships amongst a group of academics in the Department of Physics. The Centre currently consists of 7 full-time academic members, 2 technicians, 7 postdoctoral researchers and 13 graduate students.

During the three years since its formation the Centre has been very successful in attracting funding (new income valued at £4.86 million) and generating significant scientific results. The academic output over the three years is encapsulated in the 106 papers published in peer-reviewed journals (including several in the top journals Nature, Science and Physical Review Letters) and some 44 Invited Talks over the three years, including invitations to most of the important conferences in Optics and Photonics. Over the same period, the Centre has graduated 10 PhD students, and another 13 are currently registered. Our postdoctoral researchers come from a range of countries in Europe and beyond, and we have an excellent record for career progression, with many of our former PDRA's now holding permanent academic positions. The Centre has an outstanding reputation at the international level for the quality of its scientific output, and can look forward to a productive period of consolidated growth.



Comments from the Director

Welcome to this review of the first three years of existence of the Centre for Photonics and Photonic Materials. The time has passed rapidly, but much has happened and this three-year point provides an ideal opportunity to review our progress. This report provides both a review of the first three years of the CPPM and also a snapshot of the current state of the Centre.

The three years have seen the emergence of a strong international identity for the CPPM, developed from an excellent starting position through a large number of high-profile talks and highly-cited papers, a strong graduate cohort and an excellent record of career progression for researchers, as well as a well-maintained and active web site (see <http://www.bath.ac.uk/physics/groups/cppm/index.php>). The Centre relies on the excellence of its students and research staff, and reputation and image are critical in maintaining momentum.

The staff members of the CPPM have done a magnificent job of developing its reputation through outstanding scientific achievement. It has been a pleasure to see several well-deserved promotions during the period under review, reflecting the strength of our staff but also strong commitment from the University and the Department to our research area. Of course, the new building 3WN which houses the fabrication cleanrooms and a suite of optical laboratories is very concrete evidence of support from the Institution. Institutional support has also been forthcoming in the form of an ad-hoc allocation of funds to support new grants, which has provided a very valuable way to satisfy minor requirements which have been difficult to fund from any single grant. With support from the Department of Physics, we have initiated a programme of office refurbishment, starting with academic and student offices. We hope to complete this cycle in the coming years.

Our work has been possible only because of the very strong support we have had from the Department of Physics. It is especially worth noting the efforts of Eva Ashford and her team and of Adrian Hooper in dealing with the constant flow of new employees, students, and visitors of various sorts, most of whom require both administrative assistance and network access, and many of whom have no idea of how to engage with a large and complex administration. Many thanks. On a technical level, our CPPM staff and students benefit from specialised technical support from Wendy Lambson, Pete Sykes, Spartaco Landi and others, while general support is provided by all the physics technical staff.

Research funding in the CPPM is running at an all-time high, with the current portfolio running at over £3.5 Million. This bodes well for the future research output, and also ensures the medium-term financial health of the Fibre Fabrication Facility. The Facility has also been rented out commercially at regular intervals, ensuring that it is used efficiently. This is just one aspect of increased commercial engagement by



the CPPM – looking through the grants awarded later in this report will reveal a number that are collaborative with either the UK or European industrial sector. These growing links, along with the help of the University Research and Innovation Services, is resulting in closer engagement of the CPPM with the commercial world, to the benefit of the University, the Centre, and our students and postdocs.

Before finishing and moving on to the more serious part of this report, let me express my own pleasure at having been able to take the role of Director of the CPPM these past three years. It has been a privilege to be a part of such a strong and motivated team, working to the highest international standards, and I look forward to being a member of a strong Centre for the foreseeable future. As I pass the Directorship on, I will take this opportunity to wish all the members of the CPPM the best for the future.

A handwritten signature in black ink, appearing to read 'J. Knight', written in a cursive style.

Jonathan Knight, Outgoing Director

People

The CPPM was formed in 2005, following the departure of Professor Philip Russell from the University of Bath. Since then, both Fetah Benabid and William Wadsworth have taken permanent academic positions (both now Readerships in Physics) within the CPPM. We have been joined by Steve Renshaw as Technician. Alan George has taken on some additional responsibilities as Technical Manager for Physics, but without compromising his valued assistance to the CPPM research effort. We have also said farewell to Stefan Maier (moved to Imperial College London in 2007). The Department of Physics is currently looking to recruit a new member of academic staff, and the areas of nanophotonics and nonlinear photonics are amongst those targeted.



Academic staff

Dr Fetah Benabid has recently been promoted to Reader in the Department of Physics. He currently has an EPSRC Advanced Research Fellowship, enabling him to devote much of his time to research. He works in the field of gas-laser interactions in hollow-core photonic crystal fibre, designing and fabricating purpose-engineered fibres for his applications, and incorporating them into experiments. Particular highlights over the period under review include his EPSRC grant “All fibre universal optical waveform synthesiser” (£714k, 42 months) and his recent paper “Generation and photonic guidance of multi-octave optical-frequency combs,” published in Science.



Particular highlights over the period under review include his EPSRC grant “All fibre universal optical waveform synthesiser” (£714k, 42 months) and his recent paper “Generation and photonic guidance of multi-octave optical-frequency combs,” published in Science.

Professor David Bird is Head of the Department of Physics and is a member of the CPPM management team. He is a

theoretical physicist who develops means to compute (among other things) the behaviour of light in microstructured materials and photonic crystal fibres. He has developed very efficient and reliable codes to compute the response of photonic bandgap fibres, which have been used to gain insight into hollow-core fibres at infra-red wavelengths, all-solid photonic bandgap fibres, and bend loss in bandgap fibres.

Professor Tim Birks is Professor in the Department of Physics. His interests are centred on waveguide modes – novel optical fibre structures, mode transformers and couplers, post-processing optical fibres, and fibre devices. He was recently awarded a grant by the EPSRC to investigate the use of aerogels as materials for optical fibre devices (£489k, four years) and over the past few years has published a series of papers showing how post-processed photonic crystal fibres can be used as highly efficient and very compact all-fibre mode converters. In 2007 he was elected Fellow of the Optical Society of America.



Professor Jonathan Knight is outgoing Director of the CPPM. His work is focussed on fabrication of high-performance photonic crystal fibres and applications in nonlinear optics. He has a developing interest in applications to biomedicine and is a member of a recently-funded European consortium (FP7, £340k, 3 years) to develop CARS microscopy for cancer diagnosis. Recent work includes the development of a blue-enhanced supercontinuum generation fibre, which is the subject of a patent application currently being exploited under agreement by Fianium Ltd, a UK-based laser company.



Dr Dmitry Skryabin is a Reader in Physics, and leads the CPPM effort on theoretical and computational nonlinear optics. Recently funded work includes “Localised structures of light” (EPSRC, £144k, 3 years) and his work of the recent past has identified a number of completely new features of solitons in unusual waveguide structures, with implications for, among others, mechanisms behind fibre-based supercontinuum generation.

Dr Paul Snow is a Senior Lecturer in Physics. His work in the CPPM revolves around the etching of Silicon, which he



uses to make optical and acousto-optical devices and structures. The work which is primarily funded by the EPSRC (£380k, 4½ years) has led to understanding of acoustic band-gap structures formed in porous silicon.



Dr William Wadsworth has recently been promoted to Reader in the Department of Physics, and is currently a

Royal Society University Research Fellow. He uses photonic crystal fibres to manipulate and transform light – a recent example being the work on non-classical interference and entanglement performed jointly with collaborators in Bristol. He has enjoyed particular success with grant applications in the recent past, most notably his £493k award from the Technology Strategy Board.

Technicians



Mr Alan George is Technical Manager for the Department of Physics and lead technician for the CPPM. He advises on all aspects of technical support and safety, co-ordinates input from other technicians and the Estates Department, and has overall responsibility for the running of the fibre cleanroom area. He has special expertise and long experience in photonic crystal fibre fabrication and is often called in to advise on the toughest problems.



Mr Steve Renshaw runs the fibre fabrication cleanroom area, both in terms of maintenance and supplies, and in terms of working with users to achieve their objectives. He also maintains the CPPM web site and publications database.

Research staff

The postdoctoral researchers at the CPPM are key to its continued success. They are a group of highly talented and motivated young scientists, who integrate with both academics and PhD students while driving forward the research agenda. They come from a range of backgrounds – some of them have stayed on after completing their PhDs, others come from the other side of the world – and go on to careers in some of the top laboratories in Europe and elsewhere. Two members of our current academic staff were originally employed at Bath as postdocs.



Postdoctoral researchers at the CPPM, June 2008. (From the left) Dr Correa, Dr Nandi, Dr Xiao, Dr Couny, Dr Delgado-Pinar, Dr Aliev, Dr Gorbach.

Graduate students

PhD students graduated (supervisor)

Dr. Francois Couny (2008, Benabid)
 Dr. Wei Ding (2006, Russell, Maier)
 Dr. Aimin Wang (2006, Knight)
 Dr. Fabio Biancalana (2005, Skryabin)
 Dr. Feng Luan (2005, Knight)
 Dr. Greg Pearce (2006, Bird)
 Dr T Hedley (Bird, 2006)
 Dr Greg Antonopoulos (2006, Benabid,
 Knight)
 Dr Elliot Davies (2005, Russell)
 Dr Sergio Leon-Saval (2005, Birks)



Current PhD students (supervisor)

Year 1

Michael Grogan (Birks)
 Alex McMillan (Wadsworth)
 Charles de Nobriga (Knight)
 Leigh-Anne Thomas (Snow)
 YingYing Wang (Benabid)
 Natalie Wilding (Benabid)

Year 2

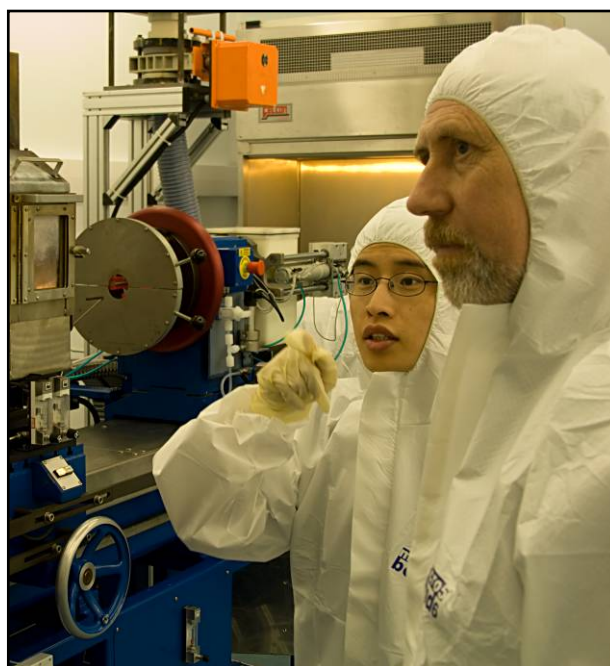
Chris Benton (Skryabin)
 Matthew Welch (Knight/Wadsworth)

Year 3

Chunle Xiong (Wadsworth)
 James Stone (Knight)

Year 4

Matthew Burnett
 Agata Witkowska (Birks)
 Phil Light (Benabid)



Academic visitors 2005-2008

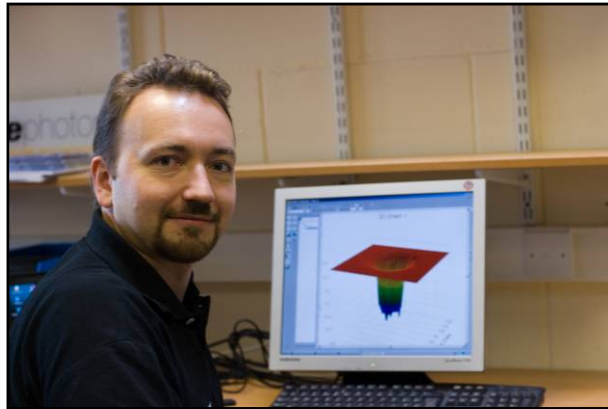
Dr Gordon Gong (1 year visiting Snow)
 Dr Hou Jing (National University of Defence Technology, 1 year visiting Knight)
 Dr Weimin Sun (Harbin Engineering University, 6 months visiting Birks)
 Dr Toshiki Taru (Sumitomo Electric Corp, 18 months visiting Knight)
 Dr Yanfeng Li (Tianjin University, 3 months visiting Bird)

Other visitors

There is a constant stream of short-term academic visitors and visiting students to the CPPM, typically staying for a period between a month and a year. On average there are around 3 visitors present at any given time. These visitors result in publishable research: sometimes, their stay results in new grant applications or further collaboration.

Visits are usually (although not always) funded by the home

institution or government, often with a bench fee attached in the case of visiting students. Visitors over the past three years have come from China, Brazil, Australia, Russia, France, Spain, United States, Germany and other countries.



Infrastructure, equipment and resources

Researchers at the CPPM are able to use state-of-the-art facilities for processing optical fibres. These facilities have been built up by the Centre members over a period of time, and their continued availability will be critical to the continued high level of research income and output. As well as a dedicated PCF drawing tower/fibre-drawing tower, the facilities include other equipment within the fibre fabrication cleanroom (vertical and horizontal lathes, fibre re-winder, stacking benches, tapering tower, soft glass tower) and the ultrafast laser system (modelocked Ti:Sapph oscillator, regenerative amplifier and two OPAs) also located in the cleanroom area. The fibre fabrication facility is run as a University Facility, and use of the facility is charged to research grants.

We also have a range of other test gear, including a wide variety of pulsed and CW laser sources, fibre-based supercontinuum sources (developed from our research), fibre tapering stations, fibre characterisation equipment and ultrashort pulse measuring equipment. The equipment is largely housed in optical laboratories in



YingYing Wang and Steve Renshaw working on the fibre tower.

buildings 3W and 3WN, in which we have a total of 13 laboratories.

Office space is at a premium in building 3W. The CPPM is fortunate in having established a virtually contiguous series of offices on 3W level 3, housing 7 academics and some 25 postdoctoral and postgraduate researchers and visitors. Alan George and Steve Renshaw have offices elsewhere in 3W and in building 3WN.



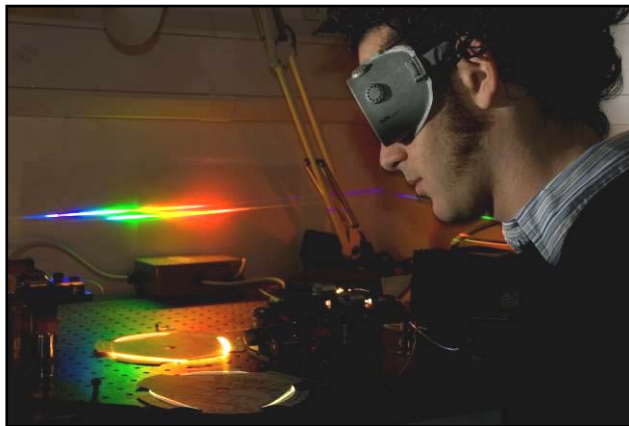
The recently refurbished student desk space on the 3W/Wessex house corridor.

Impact

Work done at the CPPM has impact scientifically, on the research being performed by others elsewhere in the world, and also commercially, both in terms of developments based on our published work and also directly in terms of patenting or licensing deals done by the University of Bath. During the period under review members of the CPPM have published well over 100 journal papers and given a large number of conference presentations. As a result



of this exposure, they have been invited to give over 40 invited presentations at conferences. This feeds back into increased visibility for the Centre: more visitors and job applicants, more PhD students, more collaborators, and ultimately better science.



Researchers work closely with partners from industry and from other scientific disciplines. For example, we currently work in a large European-funded consortium (NextgenPCF – see www.nextgen-pcf.eu) containing a number of major multinational optical fibre companies) to commercialise several aspects of our research. We are also working with a UK-based fibre laser supplier (Fianium Ltd.)

to enhance several aspects of their products, and with Vesta Ceramics on aspects of our porous silicon work. Members of the CPPM have held six consultancies over the previous three years, with a total value of approximately £70k.

Centre for Photonics and Photonic Materials

Research Funding since September 2005

New Grants started during the 3 years under review

| <u>PI</u> | <u>Amount</u> | <u>Dates</u> | <u>Source</u> | <u>Title</u> |
|----------------------|---------------|-------------------|----------------|-----------------------------|
| JCK | 97500.00 | 1/09/05-31/3/07 | Sumitomo | Visiting Research Fellow |
| TAB | 834304.00 | 1/11/05-30/4/07 | EPSRC | Photonic Crystal fibres |
| TAB | 1280.00 | 31/3/06 | RS | Conference grant |
| SM | 14769.00 | 1/4/06-31/5/07 | RS | THz Plasmonics |
| SM | 1180.00 | 1/7/06-31/7/06 | Royal Society | Gordon Research |
| Conference | | | | |
| SM | 120082.00 | 1/3/05-28/2/08 | EPSRC | Plasmonics & near field |
| optics | | | | |
| PAS | 380119.00 | 5/9/05-4/2/10 | EPSRC | Sound-light interactions |
| in silicon | | | | |
| SM | 48601.00 | 1/10/05-30/11/06 | AFOSR | THz Plasmonics |
| TAB | 25058.00 | 8/2/06-8/2/09 | AA Observatory | Multimode to single |
| mode transitions | | | | |
| WJW | 219052.00 | 1/4/06-31/3/08 | DTI | Ultrafast lasers |
| DVS | 144107.00 | 1/2/07-1/2/10 | EPRSC | Localised structures of |
| light | | | | |
| SM | 5500.00 | 1/8/06-31/7/08 | Royal Society | International Joint |
| project | | | | |
| JCK | 243773.00 | 1/6/06-31/5/09 | CEC IP FP6 | Next generation PCF |
| JCK | 26420.00 | 1/4/07-31/5/10 | EPSRC | Stimulated Brillouin |
| scattering | | | | |
| FB | 714877.00 | 1/6/07-30/6/10 | EPSRC | All fibre universal optical |
| waveform synthesiser | | | | |
| JCK | 100983.00 | 1/12/06-20/11/09 | Korber | UV sources |
| SM | 23024.00 | 1/3/07-30/9/09 | EOARD | THz metawires |
| DVS | 10922 | 1/3/07-28/2/08 | Royal Society | Non-linear SOI nano- |
| wires | | | | |
| SM | 2500.00 | 15/2/07-1/6/08 | EOARD | European MRS meeting |
| SM | 79095.00 | 1/5/07-31/10/08 | AFOSR | Terahertz metawires |
| WJW | 328874.00 | 1/9/07-31/8/10 | EPSRC | Quantum information |
| TAB | 489549.00 | 01/12/07-30/11/11 | EPSRC | Aerogels in Fibre-optics |
| PAS | 3000.00 | 01/01/08-31/12/08 | B.Council | Light and nanostructures |
| DVS | 3872.00 | 2/5/08-30/8/08 | Royal Society | Parametric amplification |
| JCK | 339862.00 | 1/3/08-28/2/11 | EC-FP7 | CARS Explorers |
| WJW | 493000.00 | 1/7/08-30/6/10 | TSB | Whitelase |
| WJW | 106000.00 | 1/4/08-31/3/12 | EC-FP7 | nEuropt |

Total new funds £4,859,713

Grants awarded prior to September 2005 but running the 3 years

| | | | | |
|-----------|-----------|-----------------|--------------------|-------------------|
| Wadsworth | 391450.57 | 1/10/01-30/9/09 | RS - Fellowship | Nonlinear PCF |
| JCK | 435216.00 | 1/7/03-1/7/08 | EPSRC | Photonic crystals |
| Benabid | 227648.00 | 1/9/03-31/8/08 | EPSRC - Fellowship | Hollow-core PCF |

Grand Total £5,914,028

Centre for Photonics and Photonic Materials

Invited talks August 2005-July 2008

1. J. C. Knight, , NLGW 2005 paper ThC1, Dresden, Germany (2005) **(Invited)**
2. J. C. Knight, ECOC'05 tutorial We3.1, Glasgow, UK (2005) **(Invited)**
3. J. C. Knight, *Integral Field Spectroscopy: techniques and data production*, Durham, UK (2005) **(Invited)**
4. D. V. Skryabin, IEEE Optics and Optoelectronics conference, Warsaw, Poland, (2005) **(Invited)**
5. F. Benabid, LEOS 2005 Annual Meeting, Sydney, Australia (2005) **(Invited)**
6. W.J. Wadsworth, OPTO 2006 paper 6128-18, Photonics West, San Jose, California (2006). **(Invited)**
7. T.A.Birks, Optical Fiber Communication Conference, Workshop on Comparing Conventional and Microstructured Optical Fibers, paper OMD1, Anaheim, California (2006) **(Invited)**.
8. T. A. Birks, Optical Fiber Communication Conference paper OFC7, Anaheim, California (2006) **(Invited)**
9. J. C. Knight *et al.* IPR/Nano paper NFC1, Connecticut (2006) **(Invited)**
10. J. C. Knight, ESG Conference of Glass Science and Technology '06, paper D2.2, Sunderland, UK (2006) **(Invited)**
11. J. C. Knight, A. Kudlinski and T. Taru, European Optical Society Annual Meeting, Paris, France (2006) **(Invited)**
12. T.A.Birks and S. Leon-Saval, Extremely Large Telescopes Design Study - Innovative Concepts Workshop, Durham, UK (2006) **(invited)**
13. J. C. Knight, Rank Prize Funds Meeting on *Metamaterials in Nature and Technology*, Windermere, UK (2006) **(Invited)**
14. J. C. Knight, *Workshop on Plastic Optical Fibers (WorkPOF)*, Campinas and Rio de Janeiro, Brazil (2006) **(Invited)**
15. P. A. Snow, PSST-2006 (Porous Semiconductors - Science & Technology) Sirtges-Barcelona (2006) **(Invited)**
16. T.A.Birks *et al.* Optoelectronics and Communications Conference OECC 2006, paper 5D2-1, Kaohsiung, Taiwan (2006) **(Invited)**
17. J. C. Knight, Photon '06, Manchester, UK (2006) **(Invited)**
18. T.A.Birks, European Conference on Optical Communication ECOC '06, Workshop on Photonic Crystal Fibres versus Classical Fibres for Telecommunications, Cannes France (2006) **(Invited)**
19. F. Benabid, Proceedings of SPIE Volume: 6128 Photonic Crystal Materials and Devices IV (2006) **(Invited)**
20. T.A.Birks, "Photonic crystal fibres", India-UK Workshop on Optical Fibre Sensors and Components, Delhi, India (2006) **(Invited)**
21. T.A.Birks, "Tapering of photonic crystal fibres", India-UK Workshop on Optical Fibre Sensors and Components, Delhi, India (2006) **(Invited)**
22. D. V. Skryabin, Nonlinear effects in fiber optics, Berlin, Germany (2006) **(Invited)**
23. J. C. Knight, Photonics '06 paper 1907INV, Hyderabad, India (2006) **(Invited)**
24. J. C. Knight, Photonics'06, Hyderabad, India (2006) **(Tutorial)**
25. T.A.Birks, Conference on Lasers and Electro-Optics CLEO '07, paper CFK3, Baltimore, Maryland, (2007) **(Tutorial)**
26. D. V. Skryabin, Nonlinear Physics in Periodic Structures and Metamaterials, Dresden, Germany (2007) **(Invited)**
27. J. C. Knight, International Congress on Materials, paper F-1_IN1, Singapore (2007) **(Invited)**
28. T.A.Birks *et al.* International Conference on Transparent Optical Networks ICTON '07, paper We.B2.1, Rome, Italy (2007) **(Invited)**
29. J. C. Knight, , International Centre for Theoretical Physics Spring School on Optics, Trieste, Italy (2007) **(Tutorial)**
30. D. V. Skryabin, 49th British Applied Mathematics Colloquium, Bristol, UK (2007) **(Invited)**

31. F. Benabid, "Fibre creuse à cristal photonique: mécanismes de guidance et applications", SFO Optique 2007, Grenoble, France (2007) **(Plenary)**
32. J.C. Knight, *OptoEI'07*, Bilbao, Spain (2007) **(Invited)**
33. D. V. Skryabin, ICONO 2007, (International Conference on Nonlinear Optics) Minsk, Belarussia, (2007) **(Invited)**
34. W.J. Wadsworth, 4th International Summer School 'New Frontiers in Optical Technologies', Tampere, Finland, (2007) **(Tutorial)**
35. S.G.Leon-Saval et al. IEEE/LEOS Winter Topical Meeting paper WD2.1, Sorrento, Italy (2008) **(Invited)**
36. W.J. Wadsworth, European Training Day on Photonic Crystal Fibres, Lille, France (2008) **(Tutorial)**
37. F. Benabid, IEEE/LEOS Winter Topical meeting 2008, Sorrento, Italy (2008) **(Invited)**
38. A. K. George, Workshop on Photonic Crystal Fibres Fabrication, Campinas, Brazil (2008) (Invited)
39. F. Benabid, PhotonicsWest 2008, San Jose, USA (2008) **(Invited)**
40. D. V. Skryabin, SIAM Conference on Nonlinear Waves and Coherent Structures(NW08) Rome, Italy (2008) **(Invited)**
41. F. Benabid, CLEO 2008, San Jose, USA (2008) **(Invited)**
42. D. V. Skryabin, International Conference on Nonlinear Waves, Beijing, China (2008) **(Invited)**
43. J. C. Knight, ICOOPMA'08, Edmonton, Alberta (2008) **(Invited)**
44. D. V. Skryabin, Laser Optics 2008, St.Petersburg, Russia (2008) **(Invited)**

Centre for Photonics and Photonic Materials

Journal papers August 2005 - July 2008

1. A. Cerqueira, J. M. C. Boggio, A. A. Rieznik, H. E. Hernandez-Figueroa, H. L. Fragnito, and J. C. Knight, "Highly efficient generation of broadband cascaded four-wave mixing products," *Optics Express* **16**, 2816 (2008).
2. W. Ding, C. Benton, A. V. Gorbach, W. J. Wadsworth, J. C. Knight, D. V. Skryabin, M. Gnan, M. Sorrel, and R. M. De la Rue, "Solitons and spectral broadening in long silicon-on-insulator photonic wires," *Optics Express* **16**, 3310 (2008).
3. N. Gayraud, L. W. Kornaszewski, J. M. Stone, J. C. Knight, D. T. Reid, D. P. Hand, and W. N. MacPherson, "Mid-infrared gas sensing using a photonic bandgap fiber," *Applied Optics* **47**, 1269 (2008).
4. F. Gerome, P. Dupriez, J. Clowes, J. C. Knight, and W. J. Wadsworth, "High power tunable femtosecond soliton source using hollow-core photonic bandgap fiber, and its use for frequency doubling," *Optics Express* **16**, 2381 (2008).
5. A. V. Gorbach and D. V. Skryabin, "Soliton self-frequency shift, non-soliton radiation and self-induced transparency in air-core fibers," *Optics Express* **16**, 4858 (2008).
6. J. Hou, D. Bird, A. George, S. Maier, B. T. Kuhlmey, and J. C. Knight, "Metallic mode confinement in microstructured fibres," *Optics Express* **16**, 5983 (2008).
7. R. Amezcua-Correa, F. Gerome, S. G. Leon-Saval, N. G. R. Broderick, T. A. Birks, and J. C. Knight, "Control of surface modes in low loss hollow-core photonic bandgap fibers," *Optics Express* **16**, 1142 (2008).
8. D. A. Sidorov-Biryukov, A. Fernandez, L. Zhu, A. Verhoef, P. Dombi, A. Pugzlys, E. E. Serebryannikov, A. M. Zheltikov, J. C. Knight, and A. Baltuska, "Solitonic dynamics of ultrashort pulses in a highly nonlinear photonic-crystal fiber visualized by spectral interferometry," *Optics Letters* **33**, 446 (2008).
9. J. M. Stone and J. C. Knight, "Visibly "white" light generation in uniform photonic crystal fiber using a microchip laser," *Optics Express* **16**, 2670 (2008).
10. C. R. Williams, S. R. Andrews, S. A. Maier, A. I. Fernandez-Dominguez, L. Martin-Moreno, and F. J. Garcia-Vidal, "Highly confined guiding of terahertz surface plasmon polaritons on structured metal surfaces," *Nature Photonics* **2**, 175 (2008).
11. A. Witkowska, S. G. Leon-Saval, A. Pham, and T. A. Birks, "All-fiber LP11 mode converters," *Optics Letters* **33**, 306 (2008).
12. C. Xiong and W. J. Wadsworth, "Polarized supercontinuum in birefringent photonic crystal fibre pumped at 1064 nm and application to tuneable visible/UV generation," *Optics Express* **16**, 2438 (2008).
13. K. Cook, C. Xiong, and W. J. Wadsworth, "Enhanced four-wave mixing and parametric oscillation in photonic crystal fibre," *Journal of Optics A-Pure and Applied Optics* **9**, 1095 (2007).
14. F. Couny, F. Benabid, P. J. Roberts, M. T. Burnett, and S. A. Maier, "Identification of Bloch-modes in hollow-core photonic crystal fiber cladding," *Optics Express* **15**, 325 (2007).
15. F. Couny, F. Benabid, P. J. Roberts, P. S. Light, and M. G. Raymer, "Generation and photonic guidance of multi-octave optical-frequency combs," *Science* **318**, 1118 (2007).
16. F. Couny, F. Benabid, and O. Carraz, "Enhanced SRS in H-2 filled hollow core photonic crystal fibre by use of fibre Bragg grating," *Journal of Optics A-Pure and Applied Optics* **9**, 156 (2007).
17. F. Couny, F. Benabid, and P. S. Light, "Reduction of fresnel back-reflection at splice interface between hollow core PCF and single-mode fiber," *IEEE Photonics Technology Letters* **19**, 1020 (2007).
18. F. Couny, F. Benabid, and P. S. Light, "Subwatt threshold cw raman fiber-gas laser based on H-2-filled hollow-core photonic crystal fiber," *Physical Review Letters* **99**, (2007).

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