



Research Group
Annual Report
For Academic Year
2007/2008

(1) **Research Group Name:**

Optics Research Group

(2) **Provide an Overview on Research Group (400 words) to include the following:**

The Optics Research Group (ORG) is a multi-disciplinary, multi-school group, based in the Department of Computing, Maths and Physics. Since its inception in 1994, it has played a significant role in the development of a broad research capability in WIT, contributing primarily in the area of optical science, with particular emphasis on telecommunications and sensing applications. Initially, the research focus of the group was the development of interferometric techniques for the optical characterisation of transparent materials and interrogation of fiber Bragg gratings and other fiber optic components. In the years since, the skills base of the group has broadened to include many different branches of optical science; current projects range from discrete device fabrication, characterisation and analysis, to the design and testing of novel fibre optic systems.

Key Research Interests

Fibre optics

- Fibre optic amplifiers & lasers: development, experimental and theoretical characterization
- Polarization phenomena in fibre optics: polarization mode dispersion, polarization dependent gain and losses
- Fibre Bragg gratings for telecom and sensor applications
- Spun fibres for telecom and sensor applications
- Theoretical and experimental characterization of erbium-doped glasses: upconversion and migration
- Development of novel fibre optic components e.g. tapers and inserts for systems integration and miniaturisation
- Smart erbium-doped fibre amplifier gain control systems for telecom and distributed sensor networks
- Analysis of Raman fibre devices for provision of wide bandwidth gain for development of long-distance metro/access networks

Solid-state photonic devices

- Quantum dot semiconductor amplifiers for non-linear optical switching applications
- High-brightness semiconductor lasers
- Electro-absorption properties of novel materials
- Monolithic semiconductor mode locked lasers

Nanophotonics & Biosensing

- Interferometer-based nano-particle detection
- Modelling microcavity - based biosensors

Structural Health Monitoring

- Fibre Bragg grating-based temperature and strain sensors
- Interferometers & spectrometers for fibre sensing applications
- New sensing technologies based on distributed and lumped fibre Raman lasers

Lasers and Spectroscopy

- Modelling of complex dynamics operations and spatial structures in lasers

- Polarization phenomena in laser physics and spectroscopy: light induced anisotropy and orientation relaxation processes (Brownian rotation, Förster resonance energy transfer (FRET), conformation of molecules etc.)
- Effect of noise/delay/injection on the coherence properties of non-linear systems, stochastic and vibrational resonance
- Mode-competition and coupling in high brightness semiconductor lasers and arrays

Applied Mathematics

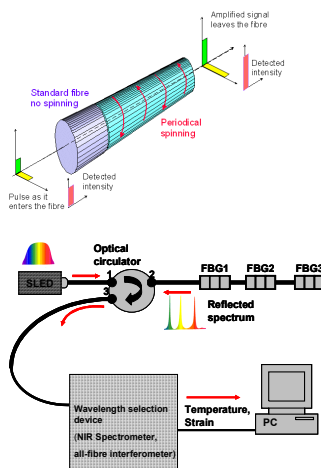
- Monte Carlo simulation techniques, application of stochastic methods to complex systems: fibres with random birefringence, ensemble of organic molecules and rare-earth ions
- Self-organized phenomena: patterns formation, periodic and aperiodic structures, and spatial-temporal chaos.

Application of research in an industrial/societal context

In the ORG, a primary focus is the development, characterisation and analysis of novel photonic components and systems. The application of such devices and systems are varied and new applications continue to emerge as traditional methodologies are renewed. Broadly, these application areas include:

- communications & multimedia networks
- sensing networks including local and remote monitoring
- production & supply chain management, quality monitoring, process analytical technology
- test, measurement & characterisation equipment for chemical and biological industries
- materials processing
- laboratory biological & chemical sensing
- medical diagnostics & procedures.

In addressing these areas, we have developed a number of novel technologies such as



Distributed fibre Raman amplifier with reduced polarization impairments (polarization mode dispersion (PMD) and polarization dependent gain (PDG))

Novel approach to fibre spinning to reduce PMD and PDG values to the low levels acceptable for high-speed long-haul and ultra-long-haul optical transmission.

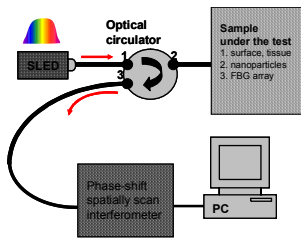
High-resolution infrared spectrometer for structural health monitoring applications

Near infrared spectrometer (NIRS) with bandwidth of 70 nm, sub-picometer resolution of 0.3 pm and full scan speed of 30 ms has been developed and tested for Structural Health Monitoring applications.

High-resolution all-fibre Michelson interferometer for structural health monitoring applications

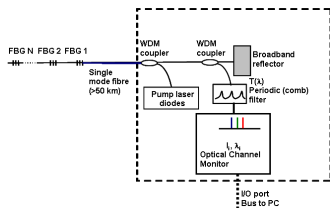
High speed strain and temperature measurements in a distributed Bragg grating sensor network based on all-fibre Michelson interferometer with application of Hilbert transform signal processing technique.

Emerging technologies in the group include:



Phase-shift spatially scan interferometer for optical coherence tomography, nanoparticles sizing and structural health monitoring

Cost-effective technical solution for simultaneous elimination of the vibrations and mitigation of the source intensity noise and background scattering noise in interferometer.



Multi-wavelength fibre Raman laser for remote and local strain and temperature sensing

Remote and local sensing systems based on integration of fibre Bragg grating array and a wide bandwidth fibre Raman amplifier with tailored polarization properties into a multi-wavelength/tunable fibre Raman laser (FRL).

Key thematic areas for postgraduate students

Due to the considerable mix in expertise of ORG members and the highly multi-disciplinary nature of optical science, postgraduate students in the group focus on developing skills and expertise in a broad range of theoretical and practical areas. A typical project in the group will contain elements covering many disciplines in science (e.g. material science, solid state physics, optics, spectroscopy, applied mathematics). In addition, very useful engineering skills can be developed (e.g. automation, control, component specification, signal processing techniques), such skills and experience in past graduates has proved highly desirable to industry.

As is typical of a modern research group, all graduate students work directly with the group’s international collaborators to develop networking and interpersonal skills. In addition, they will engage in multiple training visits and project meetings and eventually generate peer-reviewed publications and attend appropriate conferences for the dissemination of their work. Together with the extensive array of generic skills courses available, these activities ensure that the graduate student emerges from their MSc or PhD studies in the ORG with a high level of technical and scientific expertise, coupled with a broad set of skills appropriate to the needs of our modern knowledge economy.

(3) Group Academic Staff Members:

Name	Department
Dr. John Houlihan	Computing Maths & Physics
Dr. Claire Keary	Computing Maths & Physics
Dr. P.J. Cregg	Engineering Technology
Dr. Mohammad Alhourani	Computing Maths & Physics

(4) **Group Postdoctoral Researchers:**

Name	Department
Dr. Sergey Sergeev	Computing Maths & Physics
Dr. Dominic F. Murphy	Computing Maths & Physics
Dr. Kieran O'Mahoney	Computing Maths & Physics

(5) **Registered Postgraduate Students:**

Student Name	Department	Masters / PhD	On Funded Research Project (Yes/No)
Ronan O'Byrne	Computing Maths & Physics	PhD	Yes
Kerstin Schade	Computing Mathematics & Physics	International MSc	Financed by DAAD (Germany)

(6) **Key Achievements & Performance Outputs of Group Members in academic year 2007/2008:**

Publications:

Author	Title	Journal/Book Reference	ISBN	Rep
J. Houlihan and C. Kelleher	Stability properties of current profiled quantum dot lasers'	Opt. Commun., 281, 1156 (2008)		
I. O'Driscoll, T. Piwonski, J. Houlihan, G. Huyet, R.J. Manning and B. Corbett	Phase dynamics of InAs/GaAs quantum dot semiconductor optical amplifiers'	Appl. Phys. Lett., 91, 263506 (2007)		
D. Goulding, S. Melnik, D. Curtin, T. Piwonski, J. Houlihan, J. P. Gleeson and G. Huyet	Kramers' law for a bistable system with time-delayed noise	Phys. Rev. E., 76, 031128 (2007).		

I. O'Driscoll, T. Piwonski, C.-F. Schleussner, J. Houlihan, G. Huyet and R. J. Manning	'Electron and hole dynamics of InAs/ GaAs quantum dot semiconductor optical amplifiers'	Appl. Phys. Lett., 91, 071111 (2007).		
T. Piwonski, I. O'Driscoll, J. Houlihan, G. Huyet, R.J. Manning, A.V. Uskov	Carrier Capture Dynamics of InAs/GaAs Quantum Dots	Appl. Phys. Lett., 90 122108 (2007).		
T. Erneux, E. A. Viktorov, P. Mandel, T. Piwonski and G. Huyet, J. Houlihan	The fast recovery timescale of a quantum dot semiconductor optical amplifier	Accepted for publication, Optics Express (2008)		
S. Sergeyeve, S. Popov, A. T. Friberg,	Spun fibre Raman amplifiers with reduced polarization impairments	<i>Optics Express</i> , 16, 14380 (2008)		
Sergey Sergeyeve, Kieran O'Mahoney, Sergei Popov, and Ari T. Friberg	Upconversion assisted self-pulsing in a high-concentration erbium doped fiber laser	Central European J. Physics (2008), accepted		
Sergey Sergeyeve, Sergei Popov, and Ari T. Friberg	Raman amplification with reduced polarization impairments in the fibre with tailored spin profile	Central European J. Physics (2008), accepted		
Sergei Popov, Lin Dong, Sergey Sergeyeve, and Ari T. Friberg	Spatial light modulator as reconfigurable intracavity dispersive element for tunable lasers	Central European J. Physics (2008), accepted		
Rui Zhang, Sergei Popov, Ari T. Friberg and Sergey Sergeyeve	Efficiency Enhancement in Microcavity Solid-state Dye Laser with Bragg-grating Reflectors	Central European J. Physics (2008), accepted		
S. Popov, S. Ricciardi, A. T. Friberg, S. Sergeyeve	Odd-mode depletion in microcavity solid-state dye laser	Journal of Physics: Conference series 100, 052048 (2008)		
Ronan P. O'Byrne, Sergey V. Sergeyeve, Dónal A. Flavin, David N. Nikogosyan, Julian D. C. Jones	Strain and temperature characterization of fiber Bragg gratings written by high intensity UV pulses	IEEE Sensors Journal, 8,1256 (2008)		
Sébastien Ricciardi, Sergei Popov, Ari T. Friberg, Sergey Sergeyeve	Thermally induced wavelength tunability of microcavity solid-state dye lasers	Optics Express 15, 12971 (2007).		
S. Sergeyeve, S. Popov, A. T. Friberg	Polarization Dependent Gain and Gain Fluctuations in a Fiber Raman Amplifier	J. Opt. A: Pure Appl. Opt. 9, 1119-1122 (2007)		
Sergei Popov, Sébastien Ricciardi, Ari T. Friberg, and Sergey Sergeyeve	Mode suppression in a microcavity solid-state dye laser	JEOS - Rapid publications, 2 , 07023 (2007)		
S. Sergeyeve, S. Popov	Statistical model of migration-assisted upconversion in high-concentration EDFA	JEOS - Rapid publications , 2 07027 (2007).		
S. Ricciardi, S. Popov, A. T. Friberg, S. Sergeyeve	Impact of cavity symmetry on mode suppression and increase of free spectral range in solid-state dye microlaser	Chinese Optics Letters, 5, 651-653 (2007).		

Papers in Conference Proceedings

S. Sergeyeve, S. Popov, and A. T. Friberg	Spun Fiber Raman Amplifiers	OSA annual meeting Frontiers in Optics (FiO)/Laser Science, October 19-23, 2008 Rochester, USA, presentation number FTuG1		
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S. Popov, R. Zhang, A. T. Friberg, S. Sergeev	Microcavities and Lasers,	OSA annual meeting Frontiers in Optics (FiO)/Laser Science, October 19-23, 2008 Rochester, USA, presentation number FTuAA6		
R. Zhang, S. Popov, A. T. Friberg, S. Sergeev,	Tolerance of polymeric microcavity laser against shape imperfections	The OSA topical conference on Nanophotonics, (NANO, May 26-29, 2008, Nanjing, China).		
S. Sergeev, S. Popov, and A. T. Friberg	Characterization of Randomly Varying Birefringence in Long Single Mode Fibers	OFC'2008 (San-Diego, USA) Pres. no.: OWG2		
Ronan P. O'Byrne, Sergey V. Sergeev, Dónal A. Flavin, David N. Nikogosyan	Strain characterization of fiber Bragg gratings inscribed by high intensity femtosecond UV pulses	Third European Workshop on Optical Fibre Sensors, Antonello Cutolo, Brian Culshaw, José Miguel López-Higuera, Eds., Proceedings of SPIE Vol. 6619, 661918, (2007).		
Sergei Popov, Sebastien Ricciardi, Ari T. Friberg, Sergey Sergeev	Even-mode generation in microcavity dye laser	Proceedings of SPIE - The International Society for Optical Engineering, v 6729, ICONO 2007: Coherent and Nonlinear Optical Phenomena, 2007, p 67292M-1 - 67292M-9.		
Sergei Popov, Sebastien Ricciardi, Ari T. Friberg, Sergey Sergeev	Tunable microcavity solid-state dye laser for biometrics applications	Proceedings of SPIE - The International Society for Optical Engineering, v 6729, ICONO 2007: Coherent and Nonlinear Optical Phenomena, 2007, p 67292N-1 - p 67292N-9.		
Sergey Sergeev,	A new statistical model of upconversion in erbium doped fibers	Proceedings of SPIE - The International Society for Optical Engineering, v 6729, ICONO 2007: Coherent and Nonlinear Optical Phenomena, 2007, p 67292R-1 – 67292R-9		
Sergey V. Sergeev, Sergei Yu. Popov, Ari T. Friberg	A new PMD measurement technique	Proceedings of SPIE - The International Society for Optical Engineering, v 6731, International Conference on Lasers, Applications, and Technologies 2007: Advanced Lasers and Systems, 2007, p 67310S-1 - 67310S-8.		
S. Popov, S. Ricciardi, A. T. Friberg, S. Sergeev	Mode depletion in micro-sized solid-state dye laser,	Proceedings of The OSA Topical Conference on Nanophotonics, (NANO, June18-21, 2007, Hangzhou, China), pp. 116.		
S. Ricciardi, S. Popov, A. T. Friberg, S. Sergeev	Thermo-elastic tunability of microcavity solid-state dye laser	Proceedings of The OSA Topical Conference on Nanophotonics, (NANO, June18-21, 2007, Hangzhou, China),pp. 61.		
S. Popov, S. Ricciardi, A. T. Friberg, S. Sergeev	Odd-mode depletion in microcavity solid-state dye laser	International Conference on Nanoscience and Technology (ICN+T 2007, July 2 - 6, Stockholm, Sweden) .		
S. Ricciardi, S. Popov, A. T. Friberg, S. Sergeev	Thermoelastic wavelength tunability of microcavity solid-state dye laser	International Conference on Nanoscience and Technology (ICN+T 2007, July 2 - 6, Stockholm, Sweden).		
Frank Walsh, Sasitharan Balasubramaniam, Dmitri Botvich, William Donnelly, Sergey Sergeev	Development of Molecular based Communication Protocols for Nanomachines	Conference Nano-Net 2007, Catania, Italy		

Sasitharan Balasubramaniam, Dmitri Botvich, Frank Walsh, William Donnelly, Sergey Sergeev, Stephen F. Bush,	Applying Compartmentalization techniques for Communication Protocol of BioNano/MEM Devices,	Broadband Communications, Networks and Systems, 2007. BROADNETS 2007. Fourth International Conference , 323 – 325 (2007)		
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Conference Presentations:

Presenter	Title	Event	Type of Presentation/ Conference
Sergey Sergeev	Upconversion assisted self-pulsing in a high-concentration erbium doped fiber laser,	“Advanced Laser Technologies ”, Hungary, 2008	Invited lecturer/ International Conference
John Houlihan	Carrier Dynamics of Quantum Dot Semiconductor Optical Amplifiers	“Nonlinear dynamics in semiconductor lasers”, Berlin 2007	Invited speaker/ International Conference
Sergey Sergeev	Raman amplification with reduced polarization impairments in the fibre with tailored spin profile	“Advanced Laser Technologies ”, Hungary, 2008	Poster/ International Conference
Sergey Sergeev	Spatial light modulator as reconfigurable intracavity dispersive element for tunable lasers	“Advanced Laser Technologies ”, Hungary, 2008	Poster/ International Conference
Sergey Sergeev	Efficiency Enhancement in Microcavity Solid-state Dye Laser with Bragg-grating Reflectors,	“Advanced Laser Technologies ”, Hungary, 2008	Poster/ International Conference
Sergey Sergeev	Characterization of Randomly Varying Birefringence in Long Single Mode Fibers,	OFC’2008 (San-Diego, USA) 2008	Oral presentation/ International Conference
Ronan P. O’Byrne	Strain characterization of fiber Bragg gratings inscribed by high intensity femtosecond UV pulses	Third European Workshop on Optical Fibre Sensors, Italy 2007	poster/ International Workshop
Ronan P. O’Byrne	Comparison of depolarisation approaches for high resolution spectroscopic FBG measurements	Photon08 26 – 29 August 2008 Edinburgh	Oral presentation/ International Conference
Sergey Sergeev	Even-mode generation in microcavity dye laser	ICONO 2007: Coherent and Nonlinear Optical Phenomena, 2007	poster/ International Conference
Sergey Sergeev	Tunable microcavity solid-state dye laser for biometrics applications	ICONO 2007: Coherent and Nonlinear Optical Phenomena, 2007	poster/ International Conference
Sergey Sergeev	A new statistical model of upconversion in erbium doped fibers	ICONO 2007: Coherent and Nonlinear Optical Phenomena, 2007	poster/ International Conference
Sergey Sergeev	A new PMD measurement technique	ICONO 2007: Coherent and Nonlinear Optical Phenomena, 2007	Oral presentation/ International Conference
Dr. D.F. Murphy	Pre-diffusion effects in Couplers	Photonics Ireland 2007	Poster
Dr. D.F. Murphy	Non-mechanically scanned low-coherence interferometric measurement of differential dispersive group delay	Photonics Ireland 2007	Poster
Dr. D.F. Murphy	Adiabatic dilated standard and speciality optical fibres	Photonics Ireland 2007	Poster

Sergey Sergeyev	A New PMD measurement technique with a fiber Raman amplifier,	CLEO EUROPE, Munich, June 17-22 (2007)	poster/ International Conference
Kerstin Schade	Extrinsic Fabry-Perot Interferometer-based Real Time Monitoring of Epoxy Curing	Photonics Ireland 2007, Galway, Sept. 24-26 (2007)	Poster/National Conference

Types of presentation include keynote speech/oral presentation/poster presentation/guest lecturer, etc.
Types of conference: Please specify if International or National. Please specify format of conference, e.g., symposium, etc.

Patents:

Author	Title	Status
D.F. Murphy, N. Healy & C.D. Hussey	Method for forming small diameter bends in polarisation maintaining optical fibres	Provisional Filed
N. Healy, D.F. Murphy & C.D. Hussey	Optical fibre packaging	Provisional Filed
N. Healy, D.F. Murphy & C.D. Hussey	Optical fibre device sealing	Provisional Filed
Ronan P. O'Byrne, Sergey V. Sergeyev, and David N. Nikogosyan	Fibre Bragg grating based temperature and strain sensor	patent disclosure submitted.
D.F. Murphy, S. Sergeyev, C.D. Hussey and J. Houlihan	Fibre amplifiers and lasers	patent disclosure in preparation.

Types of conference: Please specify if International or National. Please specify format of conference, e.g., symposium, etc.

Please list all thesis submissions for academic year 2007/2008

Student Name	Type (MSc/PhD)	Thesis Title	Date
Kerstin Schade	MSc (Germany)	Extrinsic Fabry-Perot Interferometer (EFPI) based Monitoring of Epoxy Curing	01.03.2007 31.01.2008
Kieran O'Mahoney	PhD	Fourier Transform Spectroscopic Demodulation of Fibre Bragg Grating Arrays	Sept. 2008.

(7) Funding Received by Group Members in academic year 2007/2008:

Group Member	Funding Agency	Funding Programme	Project Title	Amount €
All Group	HEA	Facilities Enhancement	Telecommunications	(undisclosed)
J. Houlihan, D.F. Murphy, S. Sergeev	IOTI	Strand III	Integrated Fibre Optics Systems (approved for funding, awaiting budget)	379,082
Sergey Sergeev	EI	Technology Development	Application of multi-wavelength fibre Raman laser for remote and local strain and temperature sensing	270,000
Sergey Sergeev	EI	Technology Development	Infrared Spectroscopic Demodulation for Bragg Grating Sensor Arrays	276,000
D.F. Murphy	EI	Proof of Concept	Gratings from fibres twisted	94667
Sergey Sergeev	EI	Proof of Concept	High-concentration erbium doped fibre/waveguide optical amplifier with a smart gain control system for telecom and distributed sensor networks	86,000
John Houlihan	IOTI	Strand I	Spatial profiling of quantum dot lasers	46,000
Sergey Sergeev	IOTI	Strand I	Spectroscopic Measurement System for Bragg Grating Sensor Networks	37,000

Note that the Department of Computing, Maths and Physics also made significant salary contributions for the post-doctoral researchers in the group during this period.

(8) Collaborations during the academic year 2007/2008:

Academic:

Optics Group, Royal Institute of Technology, Stockholm (Sweden) in the fields of fibre optics, biosensing and optical instrumentation. This collaboration has resulted in a large number of joint publications.

Femtosecond Group, Physics Department, UCC, Cork in the field of fibre optic temperature and strain sensors. This collaboration is part of the EI, CFTD project “Application of multi-wavelength fibre Raman laser for remote and local strain and temperature sensing”. This collaboration already has resulted in 2 papers and one invention disclosure.

Applied Photonics Group, Heriot-Watt University, Edinburgh in the field of fibre Bragg grating based temperature and strain sensors This collaboration already has resulted in 2 papers.

Photonic Device Dynamics Group, CIT and Tyndall National Institute, Cork in the area of dynamics of quantum dot semiconductor optical amplifiers. This collaboration has resulted in 3 joint applied physics letters in the current reporting period.

Photonics Device Group, Tyndall National Institute, Cork in the area of high brightness edge emitting semiconductor lasers. This collaboration has led to 2 joint journal publications and the awarding of a strand I project.

Photonics Systems Group, Tyndall National Institute, Cork on the use of quantum dot semiconductor optical amplifiers as non-linear switching element on photonic networks. This collaboration has resulted in the publication of 3 joint applied physics letters in the current reporting period. This group has also supplied a letter of support for the approved “Integrated Fibre Optics Systems” Strand III application and expressed interest in partnering in research work proposed in the “Next Generation Networks” project for telecomms through Enterprise Ireland’s Industry Led Research Programme

Institut non-linéaire de Nice, France, on the non-linear dynamics of novel semiconductor photonic devices. This collaboration has led to the submission of a COST European proposal, currently under review.

Centre for Communications Research, University of Bristol on the dynamics of dilute nitride based semiconductor optical amplifiers. This collaboration has led to a submission for funding to the Royal Irish Academy (currently under review) and a student-training visit.

Theoretical Nonlinear Optics Group, Université Libre de Bruxelles on the dynamics of quantum dot semiconductor optical amplifiers and electro-absorbers. This collaboration has led to the publication of 1 paper in the current reporting period. An additional 2 papers have been submitted and are currently under review.

Lightwave Technology Research Centre, University of Limerick, Limerick
Has supplied letter of support for the approved “Integrated Fibre Optics Systems” Strand III application., is a collaborating partner on approved “Gratings from Fibres Twisted” Enterprise Ireland, Proof of Concept application and has expressed interest in partnering in research work proposed in the “Next Generation Networks” project for telecomms through Enterprise Ireland’s Industry Led Research Programme

Centre for Photonics and Photonic Materials, University of Bath, Bath, UK has supplied letter of support for the approved “Integrated Fibre Optics Systems” Strand III application, expressed interest in collaborating on future research programmes and proposals with offers to review same and offered to host summer research visits.

Center for Optical Materials Science and Engineering Technologies, Clemson University, Clemson, South Carolina, USA has supplied letter of support for the approved “Integrated Fibre Optics Systems” Strand III application and expressed interest in proposed Enterprise Ireland Commercialisation Fund Technology Development submission on “Optical Fibre Amplifier & Lasers”

Industrial:

VPI systems Inc. (GERMANY), Corning Inc. (USA) has already provided a letter of support which has demonstrated interest to the technology suggested by Dr. S.Sergeyev, namely simultaneous suppression of polarization mode dispersion (PMD) and polarization dependent gain (PDG) in distributed fibre Raman amplifiers.

Firecomms Ltd., 2200 Airport Business Park, Cork has expressed interest in informing research work in the “Next Generation Networks” project for telecomms through Enterprise Ireland’s Industry Led Research Programme and supplied letter of support for the approved “Integrated Fibre Optics Systems” Strand III application

Intune Networks Ltd., ParkWest, Dublin 12, has expressed interest in informing research work in the “Next Generation Networks” project for telecomms through Enterprise Ireland’s Industry Led Research Programme and supplied letter of support for the approved Enterprise Ireland, Proof of Concept project, “Gratings from Fibres Twisted”

Eblana Photonics, Trinity College Enterprise Centre, Pearse St., Dublin 2 has expressed interest in informing research work in the “Next Generation Networks” project for telecomms through Enterprise Ireland’s Industry Led Research Programme

Fibrepulse, Castlebar Technology Park, Co. Mayo has expressed interest in informing research work in the “Next Generation Networks” project for telecomms through Enterprise Ireland’s Industry Led Research Programme and supplied letter of support for the approved “Integrated Fibre Optics Systems” Strand III application.

Georgia Tech. Ireland, Athlone Business and Technology Park, Co. Westmeath has expressed interest in partnering in research work proposed in the “Next Generation Networks” project for telecomms through Enterprise Ireland’s Industry Led Research Programme

Kigre Inc., Hilton Head, South Carolina, USA has supplied letter of support for the approved “Integrated Fibre Optics Systems” Strand III application and expressed interest in proposed Enterprise Ireland Commercialisation Fund Technology Development submission on “Optical Fibre Amplifier & Lasers”

Chiral Photonics Inc., Pine Brook, New Jersey, USA has supplied letter of support for the approved Enterprise Ireland, Proof of Concept project, “Gratings from Fibres Twisted”

(9) Equipment Secured during academic year 2007/2008:

Please list equipment purchase during the current reporting period to support your Research Group.

List of Equipment	Cost €	Funding Source
Fibre optic in-line polarimeter	12,000	EI

(10) Assessment of Group Impact on Teaching & Learning and / or Postgraduate Studies:

To date, the ORG has played a guiding role in the development of various teaching and learning activities in the department. The undergraduate Physics offering, the BSc in Applied Physics with Computing, contains Optics and Photonics as one of its 3 main themes in 3rd and 4th year, as a result of the obvious advantages of aligning the degree with the leading Physics research group in the Institute. The first graduates will emerge from the course at the end of the 2008/2009 academic year, many of these will undertake funded postgraduate studies with the group and feedback into

the degree by undertaking undergraduate project support. In the current year, the ORG has secured investment for relocation and upgrading of the group's laboratory facilities that include significant capacity for undergraduate project placement at the core of the research activities. As a result, undergraduate students will have the opportunity to engage in core projects and collaborations and develop associated skills and experience. In the reporting period, the group has graduated 1 PhD student (Kieran O'Mahony), transferred one student from MSc to PhD registers (Ronan O'Byrne) and supervised 1 visiting MSc student (Kerstin Schade).

(11) Key Outputs & Developments Planned for September 2008 to August 2009:

The target number of publications in 2009: peer-reviewed journal papers – 15, peer-reviewed papers in conference proceedings - 15, invention disclosures - 7.

The target funding streams: SFI Stokes lectureship – 1 application, SFI Principal Investigator -2 proposals, EI CFTD – 1 proposal, EI PoC – 2 proposals, development of a European network towards attaining FP7 funding

External links will continue to be established with companies and research centres specialised in photonics R&D, particularly in the areas of fibre optic sensing and telecommunications, optical coherence tomography and nano-particle sizing.

In the current year the ORG has been involved in the organisation of an industry grouping of Irish companies to collaborate in the development of fibre optic components and systems for applications in fibre optic telecom and sensing. The companies currently involved are Intune Networks Ltd., Eblana Photonics, Firecomms Ltd. and Fibrepulse Ltd.. It is envisioned that this grouping will drive an industry focused, research agenda that can enhance both industrial and academic activities and provide greater value to Irish industry from academic research programs. The fruits of this grouping will include increased research funding for the group and closer support of Irish industrial photonics by the academic units.

The group is also planning to establish R&D partnerships with international companies to commercialise recently proposed and developed technologies, namely near-infrared spectrometers, spatially scan interferometers, multiwavelength fibre Raman lasers and technologies for simultaneous mitigation of polarization dependent gain in distributed fibre Raman amplifiers. The fields of application for the technologies mentioned are fibre optic sensing and telecommunications, optical coherence tomography and nanoparticle detection and characterisation. The potential licensees and industrial partners for the proposed technologies are: Brookhaven Instruments Corporation, USA; Malvern Instruments Ltd, UK; GWT-TUD GmbH, Germany; Ferro Corporation Pharmaceutical Technologies, USA (nanoparticle sizing); Thorlabs, USA (optical coherence tomography); SMARTEC, Switzerland; Micron Optics, USA; (Structural Health Monitoring).

Identify plans for postgraduate research students

Topics for PhD theses include:

- Fast and slow light based interferometry
- Polarization phenomena in fibre Raman amplifiers and lasers with random birefringence and different fibre spin profiles
- Phase-shift spatially scanned interferometry

- Dynamic waveforms control in high concentration erbium doped fibre amplifiers
- Development of high brightness laser and arrays
- Modal and coherence properties of high brightness quantum dot arrays
- Fiber tapers for integration of solid state devices into fibre-optic systems
- Taper inserts for miniaturised photonic systems