ISLA – Two micrometer Sources and Toolset for Enhanced Material Processing

Forum Optical Metrology and Imaging A2.250

Munich, June 25th, 13:40

Speaker, Dr Andrew Robertson, Gooch & Housego

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This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 287732

ISLA – Integrated disruptive componentS for 2 µm fibre Lasers (ISLA)

In cooperation and with the support of the European Commission, Photonics21 and Messe München AG

ISLA Project facts

Programme type	Seventh Framework Programme
Sub-programme (e)	Core and disruptive photonic technologies
Project cost	4,538,870€
Project funding	2,839,995€
Start date	01-Oct-2011
End date	30-Sep-2014 – extended to 30-June 2015
Duration	45 months

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ISLA Partners

- Seven partners from four nations

- Gooch and Housego [Coordinator]
  - UK component and sub-system manufacturer
  - Fused fibre couplers, photonic packaging, isolators, modulators
- ORC Southampton
  - UK university group
  - Active and passive fibre development
- Trinity College Dublin
  - Irish university group
  - Nano-carbon-based materials development
- II-VI Laser Enterprise (***was Oclaro Switzerland AG***)
  - Swiss laser diode manufacturer
  - 79x pump diode development
- ROFIN
  - German fibre laser system integrator
  - CW and pulsed laser development
- JDSU (***was Time-Bandwidth Products***)
  - Swiss fibre laser system integrator
  - Oscillator and modelocker development
- Vivid Components
  - German SME project managers
  - Project administration & dissemination

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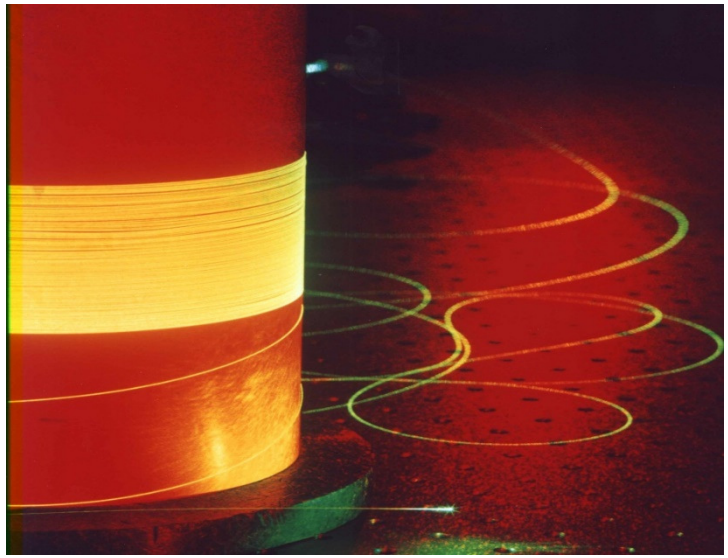
Why 2 µm

- 2µm fibre laser technology has the potential to open whole new areas of ICT & industrial applications
- Power scaling
  - Increased core size
  - Higher non-linear thresholds
  - Tenfold increase in "raw power" compared with current technology
- Wavelength-specific advantages
  - Eye-safe
  - Absorption in glass and plastics
- Many potential applications
  - Industrial processing
  - Free-space communications
  - Medical procedures



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ISLA Objectives

- Develop a set of "building block" components
  - Define an integrated modular common platform for 2 μm Ho-doped fibre lasers
  - Compatible and self-consistent fibre, components and laser diodes
- Develop 2μm high power fibre laser architectures
- Industrial demonstration applications
  - Transparent plastic cutting
  - PV cell scribing
- Industrial user group (ISLA Advisory Group)
  - Identify new applications
  - Aid exploitation routes
  - Results promoted within recognised standards bodies.

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Regional Impact

Maintaining Europe at forefront of Laser Development & Manufacturing

- Developing critical IP and maintaining manufacturing capability
  - Component supply chain
    - Fibre (thulium & holmium)
    - Passive components (couplers, combiners, isolators, mode-lockers)
    - Active components (pump diodes, AOMs, AOTFs)
  - Laser Design
    - CW, tunable, pulsed, mode-locked
- Effective, rapid communication and dissemination
  - ISLA Advisory Group

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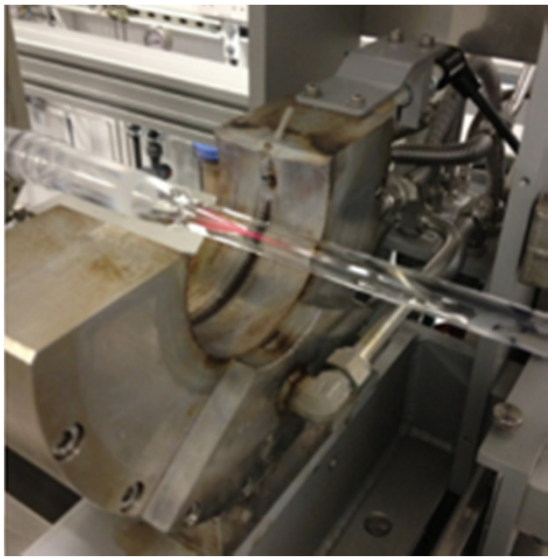
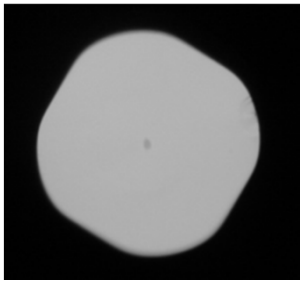
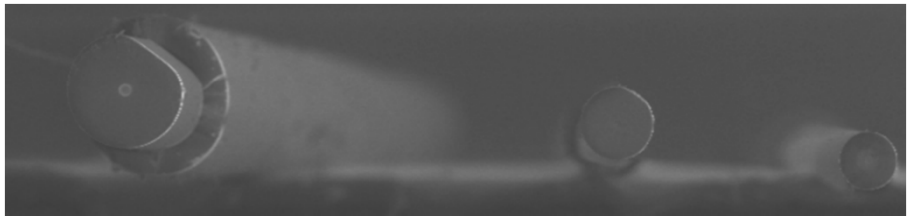
ISLA Fibres



- Improvements in Thulium fibre performance
  - 70% slope efficiency
  - Good thermal handling and output beam quality
- Matched passive fibres developed
  - Ensures optimised component performance



- Holmium fibres manufactured and characterised
  - OH contamination reduced to 0.3ppm
  - 75% slope efficiency



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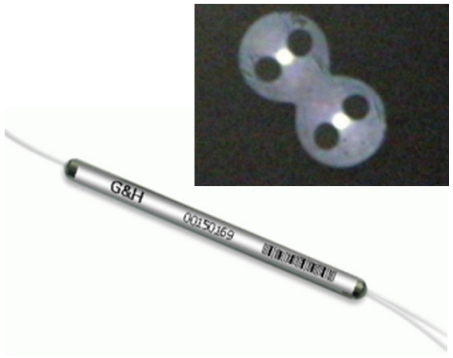
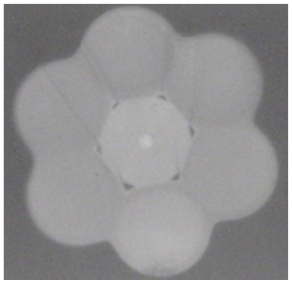
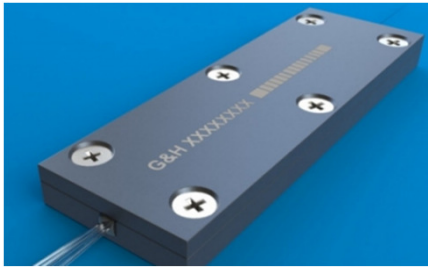
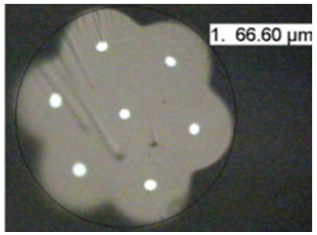
ISLA Passive Components I







- Portfolio of 2µm SM components developed
  - High power tap couplers & power splitters
  - Polarization maintaining components
- Portfolio of MM combiners developed
  - 793nm MM power combiners (7x1, 6+1*1, 2*1+1)
  - Over 500W pump power, over 90% signal Tr
- Additional components
  - 7x Thulium pumps into Holmium MM
  - Tapers for graphene mode-lockers



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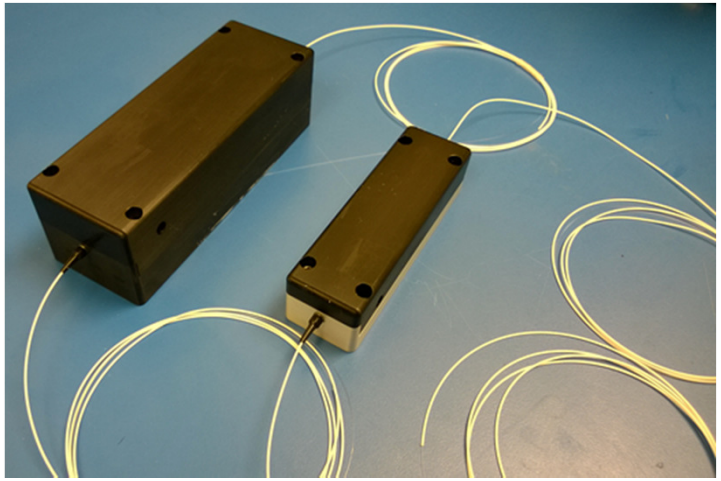
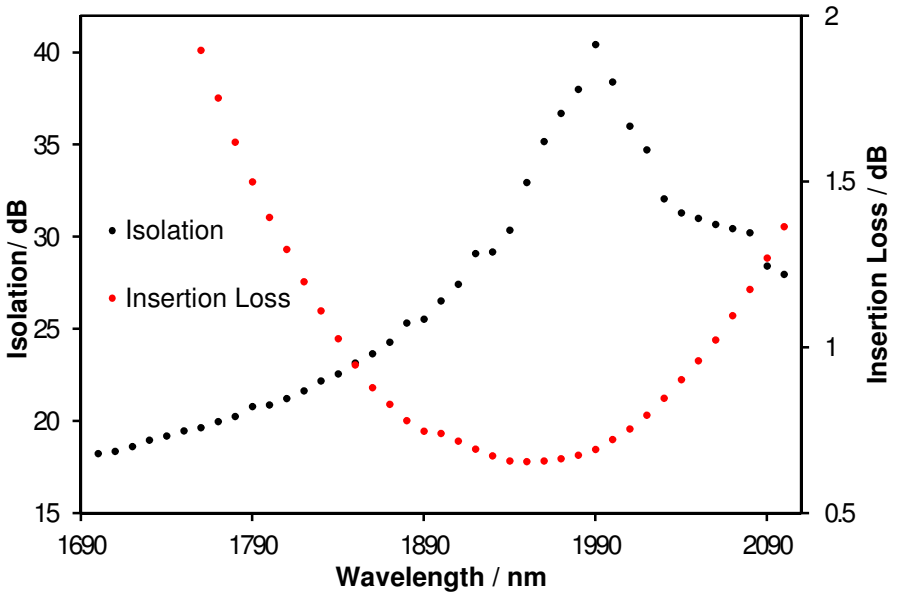
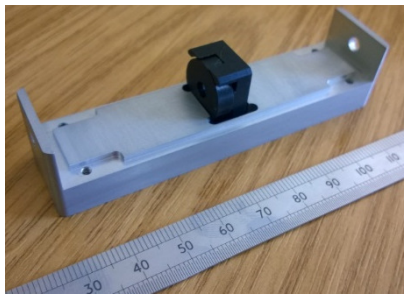
ISLA Passive Components II





- Isolators
  - >35dB Isolation
  - <1dB loss
  - >25dB PER
- Different materials investigated
  - Miniature devices developed for low power



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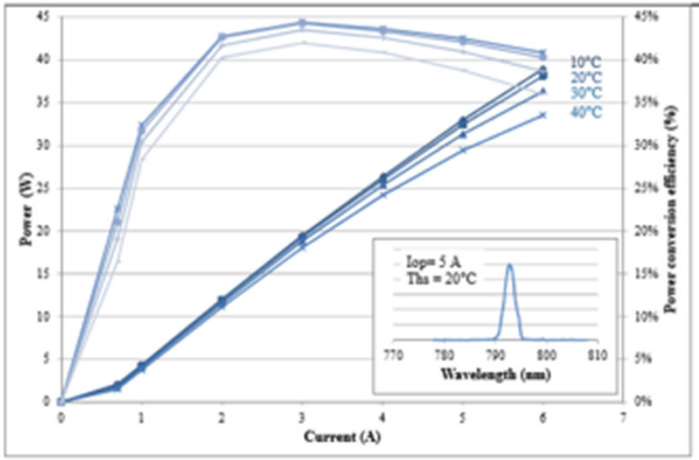
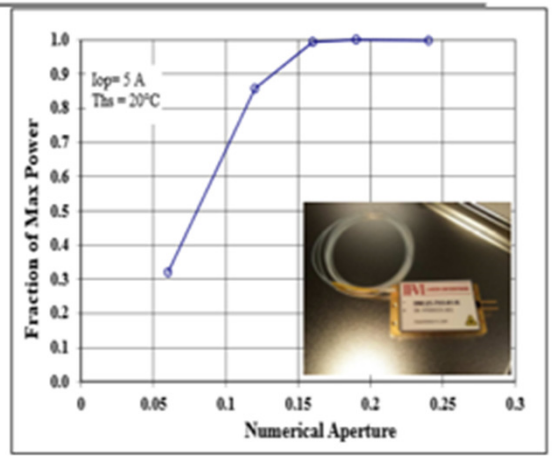
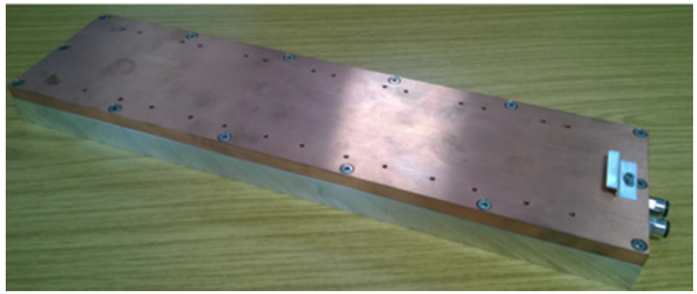
ISLA Active Components I







- 79x nm Pump diodes
  - Over 30W from 105um, 0.15NA fibre
  - Over 4W wavelength stabilized single emmiters
- Pump block
  - 793nm, 220W output, 200um clad fibre

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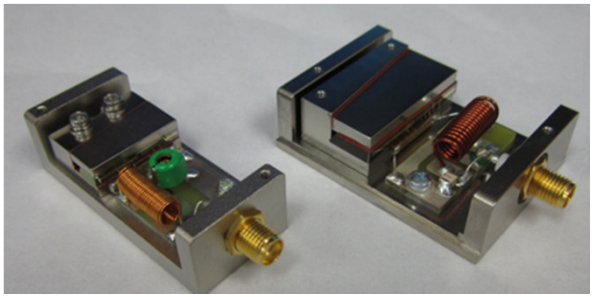
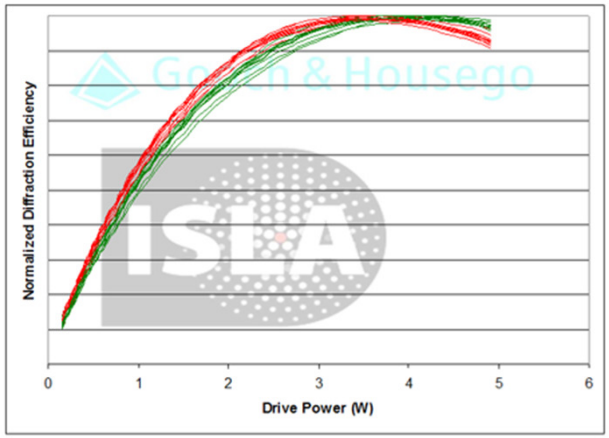
ISLA Active Components II





IL2 Modulator diffraction vs. Drive power (red= vertical polarization, Green = Horizontal polarization)

- Different AO materials
  - Tellurium Dioxide
  - Chalcogenide
- Portfolio of AO devices at 2µm
  - AO modulator (AOM)
  - AO tunable filter (AOTF)
  - Pulse picker
  - Zero frequency shift modulator

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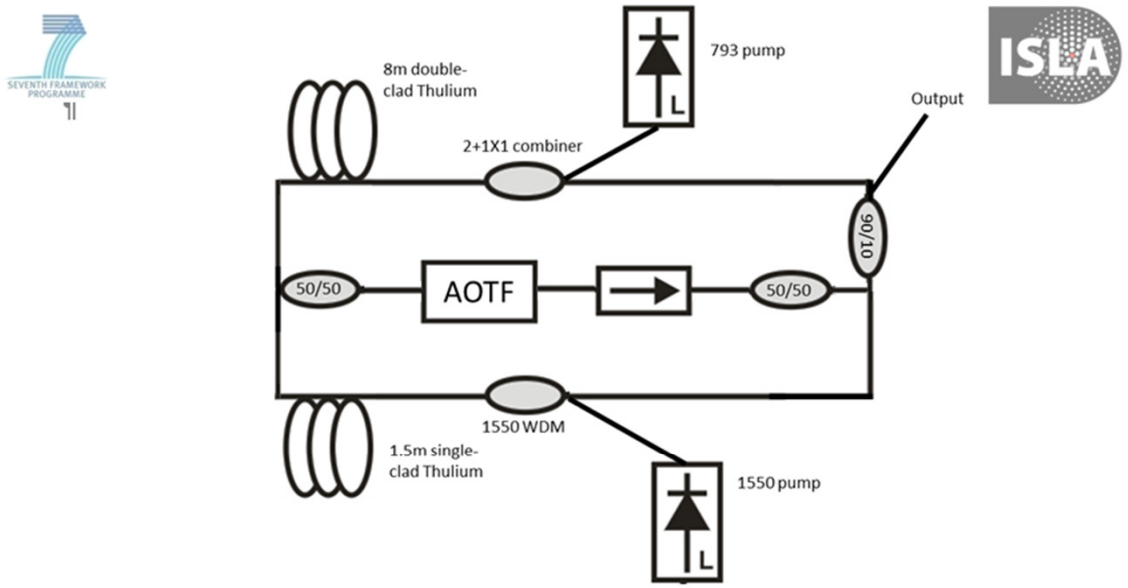
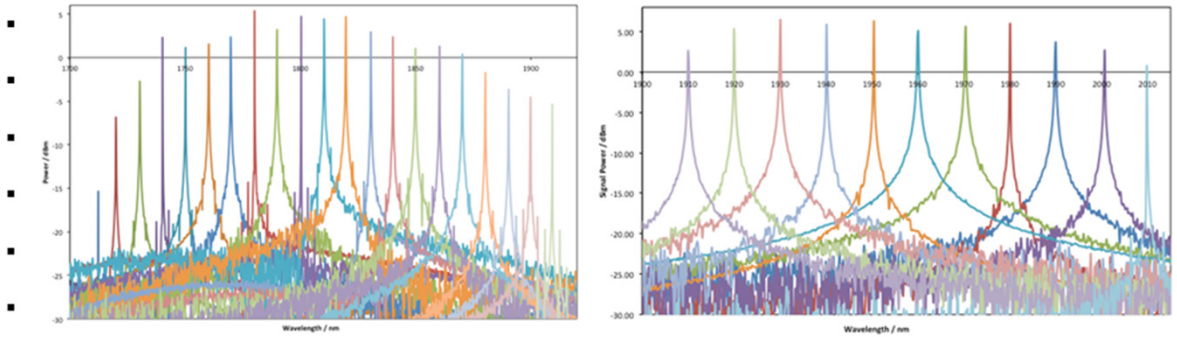
ISLA Laser Configurations - tunable





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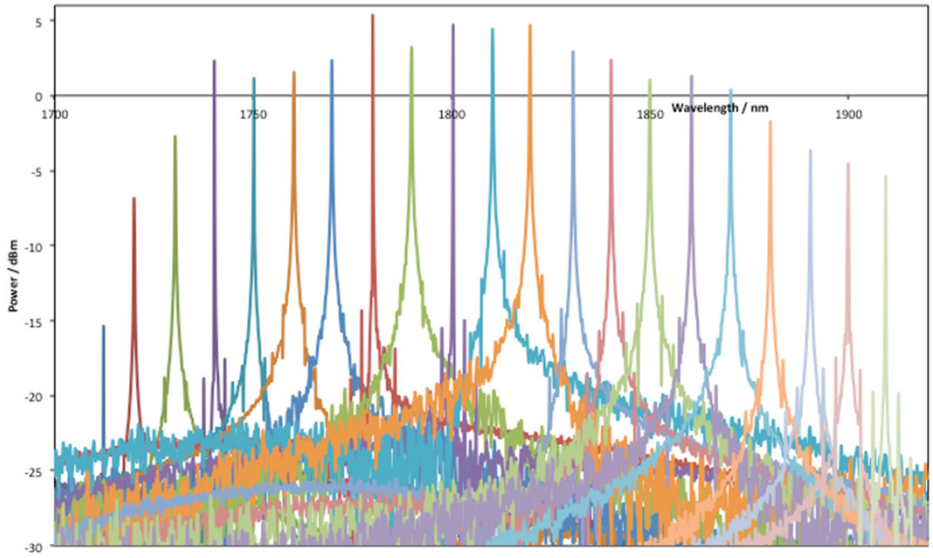
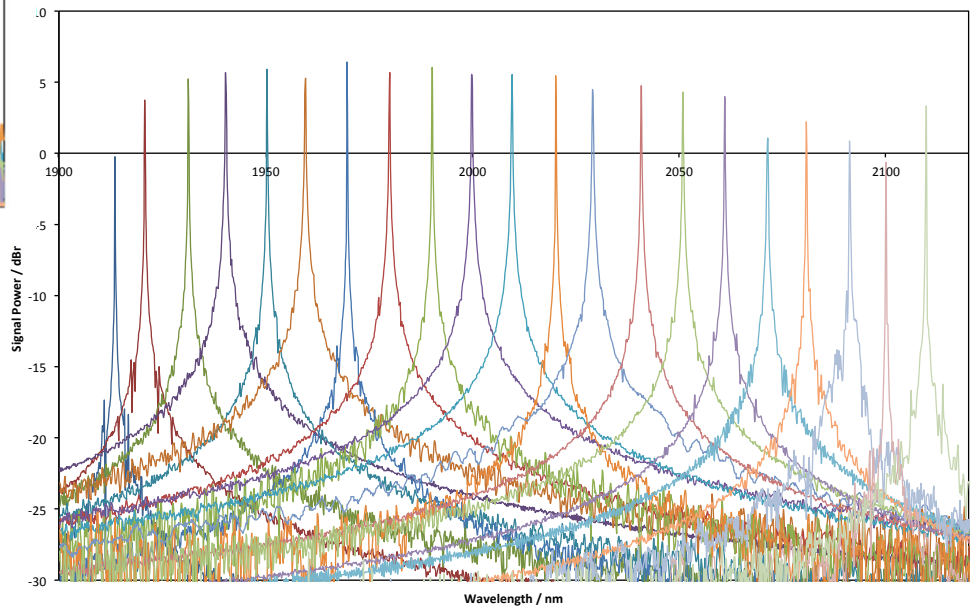
Tuning range



Core-pumped tuning range 1710-1912 nm



Clad-pumped tuning range 1912-2112 nm

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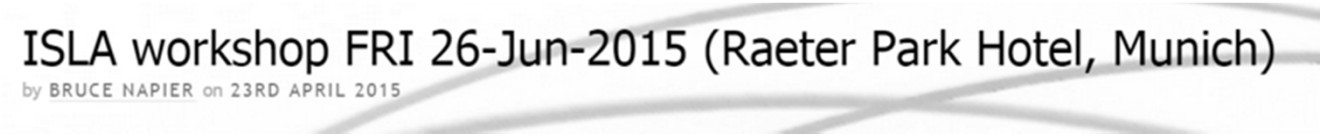
ISLA Additional Outputs

- Publications
  - 6 Journal papers
  - 12 Conference papers
- Active Dissemination
  - ISLA video
  - ISLA participation at cross cutting events
    - E.g. Free space communications
- ISLA Workshop
  - Over 50 participants



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ISLA Lowlights

- Mode-locking with graphene coated tapers not achieved
  - ***But*** much was learned about material properties and coating of fibre tapers
- Difficulties in component development caused delays
  - Resulted in demonstration lasers not being finished during life of project
    - ***But*** all components now in place & work on demonstrator lasers will be completed

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ISLA Highlights

- Excellent advances in fibre manufacture (Thulium & Holmium)
  - High slope efficiency
- Portfolio of passive components developed and demonstrated
  - Couplers, MM combiners, Isolators
- Diode development ultimately successful with 6000hrs lifetime demonstrated
- Portfolio of acousto-optic devices developed and demonstrated
- More than a dozen new products developed
- It has been agreed the demonstration lasers will be completed

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Beyond ISLA

- Topics discussed at Friday's ISLA workshop

2 um laser development and applications
Dr. Samir Lamrini; LISA Laser

Medical applications of 2 um lasers
Dr. Ronald Sroka; Hospital of University Munich

Optical Coherence Tomography for cultural heritage using 2 um broadband lasers
Dr. Haida Liang; Nottingham Trent University

Plastics processing with 2 um lasers
Stephan Fazeny; Trotec Laser

2 um lasers for MIR frequency conversion
Dr. Eric Lallier; Thales Research and Technology

Telecoms applications for 2 um lasers
Prof. David Richardson; ORC Southampton (MODEGAP project)

2 um lasers as pump sources to the mid-IR
Dr. Lasse Leick; NKT Photonics

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