



MINISTRY OF DEFENCE



SELEX GALILEO

BAE SYSTEMS

THALES



Roke Manor Research Ltd
a Siemens company

EMRS DTC
Electro-Magnetic Remote Sensing (EMRS) Defence Technology Centre (DTC)

Robert Lamb
Selex Galileo

EMRS DTC Research Theme Leader
EO Systems

EO Systems Research Theme - Overview



Science Providers

Technical Areas

Military Drivers

- Target identification
- Multi-Function Systems
- Detection of new and difficult target classes (non cooperative)
- C-IED
- Situation Awareness
- Battle damage assessment
- Improved exploitation of existing sensor capabilities

- Semi-conductor detector technology (uncooled LWIR and MWIR)
- Computational Imaging
- Photonics devices
- MEMS
- Signal and image processing
- Polarimetric Imaging
- Lasers for remote sensing

- Heriot-Watt University
- Southampton University
- BAE Systems ATC
- University of Strathclyde
- QinetiQ
- Selex Galileo
- Thales
- University of Sheffield
- Waterfall Solutions

Current Research Projects

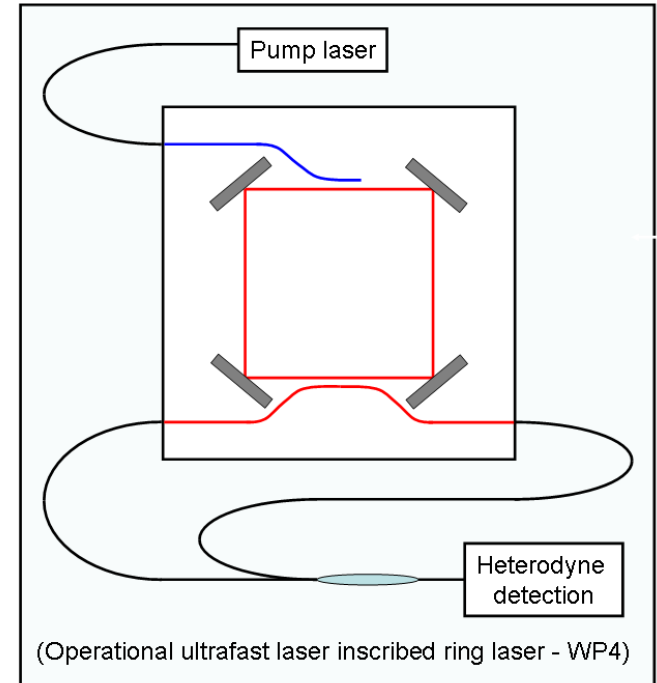
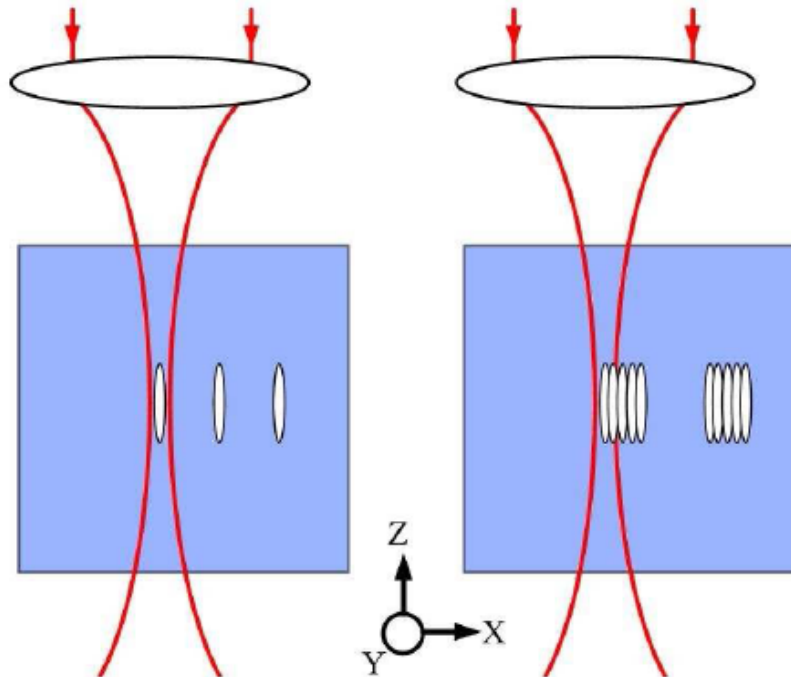
- *Multispectral QWIP LWIR Camera Developments; (Thales)*
- *Multispectral-Polarimetric Sensing For Detection of Difficult Targets; (BAE SYSTEMS)*
- *Luck Sub-frame Selection using Phase Diversity; (QinetiQ)*
- *Atmospherically Independent Spectral Material ID using Parsimonious Features; (Waterfall Solutions)*
- *Detection and Abundance Estimation of Material Classes from Airbourne LWIR Hyperspectral Data; (QinetiQ)*
- *Infrared Photodiodes Based on Type II Superlattices; (Sheffield University)*
- *Femtosecond Laser Inscribed Monolithic LRG; (Heriot Watt University)*
- *Next Generation Hybrid Pulsed Er Lasers; (Southampton University)*
- *Low-Cost LWIR using Spectral Diversity and Computational Imaging; (Waterfall Solutions)*
- *Detectors for IR Algorithmic Spectrometer; (Sheffield University)*
- *Polarimetric Coded-Aperture Imaging; (QinetiQ)*
- *High Storage Density Capacitors; (QinetiQ)*

New Programmes 2009-2010: Three Examples

- **Femtosecond Laser Inscribed Monolithic LRG** (Heriot-Watt University)
 - Application of laser inscribed waveguides to laser ring gyroscope
- **Next Generation Hybrid Pulsed Er Lasers** (Southampton University)
 - High pulse energy laser at $1.6\mu\text{m}$ for BIL
- **Polarimetric Coded-Aperture Imaging** (QinetiQ)
 - Lensless computational imaging technology for vis-LWIR

Femtosecond Laser Inscribed

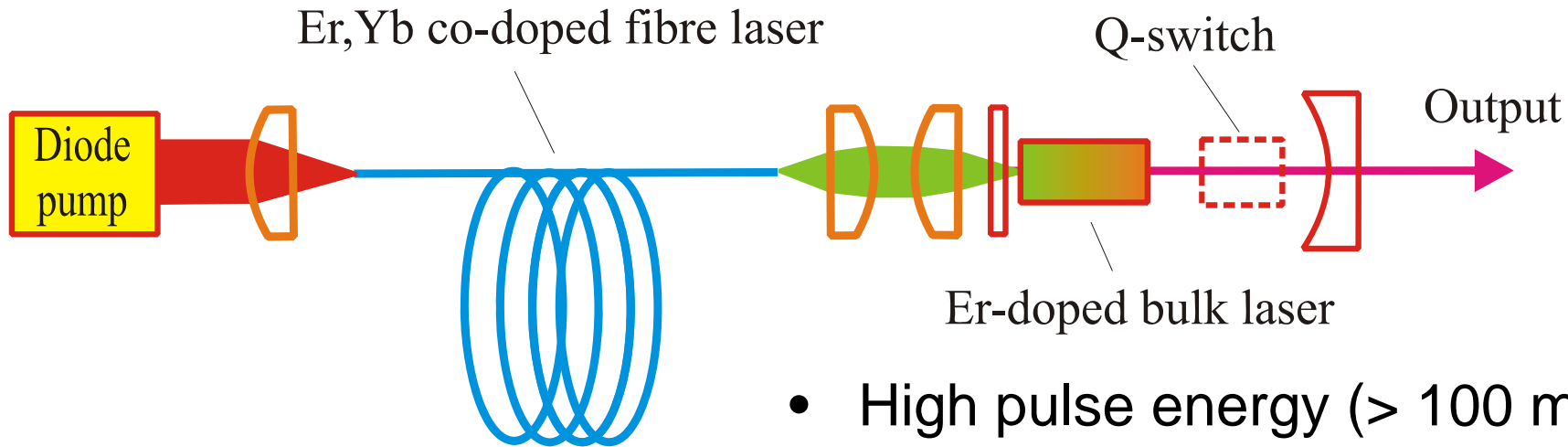
Monolithic LRG Heriot-Watt University



- Three orthogonal LRG could be inscribed in a single block– 3-axis gyroscope.
- Reducing size, cost and weight compared to traditional gas-laser gyros.
- Applications: hand-held navigation devices for non-GPS use
 - e.g. underground, underwater, in forests etc.

Next Generation Hybrid Pulsed Er Lasers

Southampton University



- Er:Yb fibre pumped at 976nm, emits at 1.532 μm
- Quantum defect is $\sim 40\%$
- Emission at 1617nm and 1645 nm

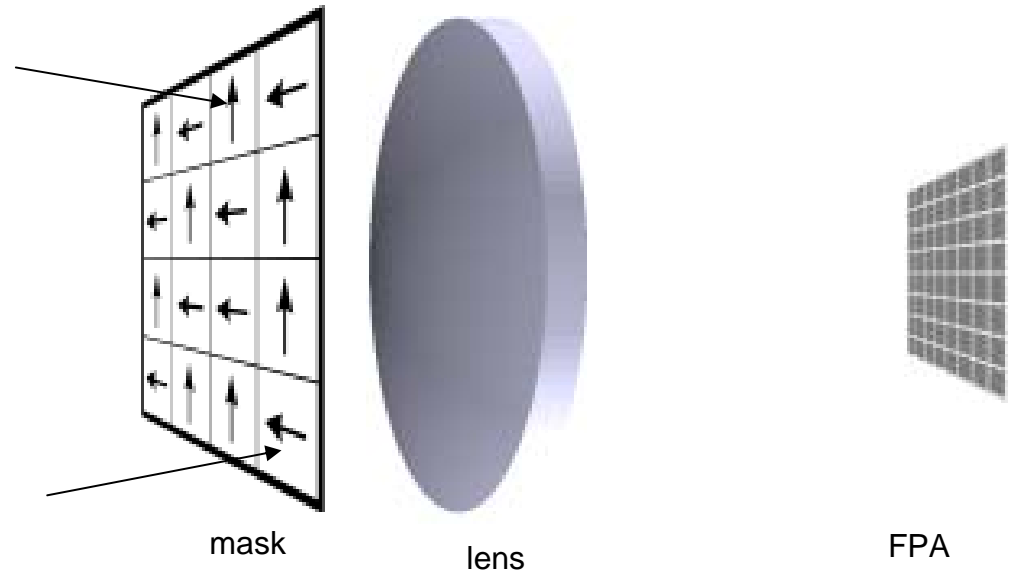
- High pulse energy (> 100 mJ)
- Short pulse duration (10 – 30 ns)
- Good beam quality ($M2 < 5$)
- Emission linewidth ~ 1 nm
- Repetition frequency > 30 Hz
- High efficiency
- Compact and robust construction
- Reliable and low cost

Polarimetric Coded-Aperture Imaging QinetiQ

Resolution
determined by
2D auto-corr
(PSF)

Transmits
vertical

Transmits
horizontal



- Larger optics will increase SNR and improve performance
Trade-off size/weight vs performance
- Limited to pairs of orthogonal polarisation states. Use LC waveplate to switch between H/V and L/R.
- Real time operation: post processing speed vs computing power.

EO Systems- Conference Programme



- **Tuesday, 11:00 to 12:25 in the Fintry Auditorium (Level +3)**
 - Multispectral-Polarimetric Sensing for Detection of Difficult Targets
 - Multispectral QWIP camera developments
 - Lucky sub-frame selection using phase diversity
 - Lunch, Exhibition & Poster Displays in the Cromdale Hall
- **Wednesday, 09:15 to 10:30 in the Fintry Auditorium (Level +3)**
 - Development of LWIR photodiodes based on InAs/GaSb Type II strained layer superlattices
 - Detector for LWIR Hyperspectral Imagers
 - High gain InAs avalanche photodiodes
 - Coffee / Tea, Exhibition & Poster Displays
- **Wednesday, 11:15 to 12:30 in the Fintry Auditorium (Level +3)**
 - Integrated 2-axis MEMS scanners for optical applications
 - Atmospherically Independent Material Identification
 - Detection and Abundance Estimation of Material Classes from Airborne LWIR Hyperspectral Data
 - Lunch, Exhibition & Poster Displays in the Coromdale Hall (Level -2) – Sponsored by UK Aerospace
- **Poster Displays in the Cromdale Hall (Level -2)**
 - throughout the Conference
- **Also, in the Galloway Suite (Level 1)** 1.30pm today and 8:45 and 9:30am tomorrow
 - The MOD Centre for Defence Enterprise - Dr Helen Almey and Dr Nigel Chew
 - The UK Aerospace & Defence KTN - Dr Ruth Mallors and Sameer Savani
 - The MOD Technology Management Seminar - Mr John Yeaman (DE&S FBG)



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Research Theme Leaders – Prof Robert Lamb, Stephen McGeoch
Dstl Knowledge Integrator – Dr Richard Hollins

EMRS-DTC Research Director – Prof Keith Lewis
EMRS-DTC Consortium- Dr Andy Stove, Dr Philip Fentem