

**Technical Program  
2022 UK / US  
Directed Energy  
Workshop**



**18 – 22 July 2022  
Shrivenham, United Kingdom**

**A Joint UK-US Symposium**

## General Information

### Security

- UK/US Workshop is SECRET/UK US ONLY
- Attendees will be issued Cranfield ID badges on site and must have valid gov't ID available at all times
- Wireless electronic devices are prohibited in classified sessions
- Classified materials must be processed through security
- Classified discussions must only take place in designated meeting rooms
- Audio and video recording are prohibited
- Security concerns should be addressed to a Security Team member
- Failure to adhere to security standards could result in denied/revoked Workshop registration

### Coaches

Coaches will run from the Swindon Marriott Hotel and the Jury's Inn to Shrivenham each morning and back again each evening. Workshop attendees must check in for ID check and loading of the coach each morning at 0730. Please confirm in advance you are on the access list. Do not bring cell phones, laptops, or notebooks to the offsite location. The staff will not be responsible for your items.

### Meals

- Monday and Friday breakfast snacks and lunches are available for short course attendees only
- Breakfast is included with the room rate for hotel guests at the Marriott Hotel and the Jury's Inn
- Coffee, tea and pastries will be available at the conference each morning
- Lunch is available Tuesday - Thursday at the Defence Academy
- Refreshment services are available throughout the week

### Oxford Outing

An evening outing to Oxford is scheduled on Wednesday. A coach will be provided to the historic city, leaving the Marriott Hotel at 1600. See the DEPS staff to sign up. Coaches will depart from Oxford promptly at 2130.

### Reception

A light welcome reception will be held at the Marriott Hotel on Tuesday evening at 1800

### Workshop Phone Numbers

General Information:

Cynnamon Spain +1-505-450-1165

Short Course Information

Cristina Crowson +1-505-980-5560

## SHORT COURSES

All courses will be held at the Marriott Hotel

### Monday July 18

0800 Short Courses (until 1200)

**Course 1: Introduction to High Energy Laser Systems (Open)**

**Course 2: Beam Control for Laser Weapon Systems (Open)**

**Course 3: Principles and Practicalities of HPM Sources and Amplifiers (Open)**

1200 Lunch, Marriott Dining Room

**Course 4: Cancelled**

**Course 5: Atmospheric Laser Propagation (Limited C)**

**Course 6: Introduction to HPM Systems (Open)**

1300 Short Courses (until 1700)

### Friday July 22

0800 Short Courses (until 1200)

**Course 7: HEL Lethality Science (Limited C)**

**Course 8: Laser Deconfliction (Limited D)**

**Course 9: HPM Effects & Data Collection (Limited C)**

1200 Lunch, Marriott Dining Room

**Course 10: HEL Modeling (Limited C)**

**Course 11: Systems Engineering for DE Systems (Open)**

1300 Short Courses (until 1700)

Release authorised to the Department of Defense (DoD), The Ministry of Defence (MOD), and their affiliated contractors in accordance with MIEM UK-AF-16-0001 (RF DEW IEA) and/or MIEM UK-US-19-0001 (Laser Weapon Systems IEA)

## TUESDAY MORNING

### Plenary Session

Chair: *Matt Cork, Dstl*

- 0700 & 0715 **Coach Check-In at Hotel**
- 0730 **On Site Registration Opens**
- 0845 **Welcoming Remarks**  
*Matt Cork, Dstl*
- 0900 **Keynote Speaker**  
*Mr. Shimon Fhima, UK Ministry of Defence, Director of Transformation*
- 0915 **Keynote Speaker**  
*Mr. David Tremper, US Office of Secretary of Defense, Acquisition & Sustainment, Electronic Warfare*
- 0945 **An Overview of the UK Novel Weapons Programme**  
*Dr. Charlotte Woolley, UK MoD, Deputy Head Novel Weapons*
- 1015 **Break**
- 1030 **Directed Energy Weapons Overview: Where Are We and Where Are We Going**  
*Dr. Kip Kendrick, US OSD, Research & Engineering, Acting Principal Director, Directed Energy*
- 1055 **USINDOPACOM Theater Threat Brief**  
*Dr. Mark Spencer, USINDOPACOM*
- 1120 **UK Threat Brief (Secret)**
- 1140 **UK MOD Team Hersa - DEW Capability Demonstrators and Supporting Lines of Development**  
*Holli Kimble, UK MoD*
- 1200 **Lunch**

## TUESDAY AFTERNOON

### HEL Effects, Testing, and Facilities

Chairs: *Sobit Thapa, Dstl & Dr. Michael Sheyka, AFRL/RDLE*

- 1300 **Flight Diagnostics Capability for Laser Testing (F)** *Mr. Robert Ulibarri, AFRL/RDLE*
- 1320 **Surrogation Tool Update (D)** *Dr. Michael Sheyka, AFRL/RDLE*
- 1340 **HEL Testing Capabilities at TISTEF (A)** *Prof. Martin Richardson, CREOL, UCF*
- 1400 **MBDA Vulnerability Test Facility Overview (Secret)**
- 1420 **HELCAP - Planning for Joint Testing Activities (D)** *Matthew Ketner, Office of Naval Research*
- 1440 **Break**
- 1500 **Optical Damage Evaluation Capabilities (F)** *Robert Ulibarri, AFRL/RDLE*
- 1520 **LaserFX Tool Update (D)** *Dr. Michael Sheyka, AFRL/RDLE*
- 1540 **Effectiveness of Clothing Against High Energy Lasers (C)** *Dr. Semih Kumru, 711 HPW/RHDO (AFRL)*
- 1600 **Correction for Sample Averaging in Sonic Anemometry Turbulence Measurements (C)** *Jack McCrae, Air Force Institute of Technology (AFIT/ENP)*
- 1620 **Laser Material Interactions for a COTS Laser on a Mobile Platform (C)** *Matthew Balkey, Sandia National Laboratories*
- 1640 **Systematic Study of Supercontinua Generated by Sub-Picosecond Ultra-Short Pulse Lasers in Optical Materials (D)** *Dr. Trenton Ensley, DEVCOM U.S. Army Research Laboratory*
- 1800 **Evening Reception at the Swindon Marriott**

## TUESDAY AFTERNOON

### RF/HPM Technology & Components

Chair: *Prof. Bucur-Mircea Novac*, Loughborough University

- 1300 **Ultra Low Frequency Magnetic Penetration of Thick Metallic Walls (UK-SEN)** *Prof. Bucur-Mircea Novac*, Loughborough University
- 1320 **Development of High Frequency, High Power Microwave Sources for Electromagnetic Spectrum Superiority (A)** *Prof. Edl Schamiloglu*, University of New Mexico
- 1340 **Development of a Variable Gain Antenna for High Power DEW (UK-SEN)** *Michael Duffield*, Teledyne UK ltd
- 1400 **Multi-Megawatt Magnetron Combining (UK-SEN)** *Michael Duffield*, Teledyne UK ltd
- 1420 **RF DEW R&T Programme 2021 - 2022 (UK-SEN)** *Peter Leask*, MBDA
- 1440 **Microwave Frequency Oscillator Sources (Secret)**
- 1500 **Break**
- 1520 **Solid-State High-Voltage Nanosecond Pulse Generator Based on Commercial Rectifier Diodes (UK-SEN)** *Philip Mason*, MBDA
- 1540 **First Experimental Operation of an X-band Self-Insulating Backward Wave Oscillator (A)** *Dr. Philip MacInnes*, ABP Group, Physics Department University of Strathclyde
- 1600 **Reaching Towards Larger Power at Higher Frequencies Using a Radial Backward Wave Oscillator (C)** *David Simon*, AFRL
- 1620 **Enabling Technologies for HPM Arrays (ETHR) (D)** *Jack Chen*, NSWCCD
- 1640 **HPM Vessel Stopping: Target Susceptibility and Safety (Secret)**
- 1700 **Session Adjourns**
- 1800 **Evening reception at the Swindon Marriott**

## WEDNESDAY MORNING

### HEL System Engineering & Integration

Chairs: *Ian Dibsall*, QinetiQ & *Dana Teague*, AFRL/RDLA

- 0700 & 0715 **Coach Check-In at Hotel**
- 0730 **On Site Registration Opens**
- 0800 **BC-TRAIL: AFRL Beam Control Test Bed for Component Integration and System Demonstration (C)** *John-Paul Sena*, Air Force Research Laboratories
- 0820 **DragonFire Active Tracking Trials (Secret)**
- 0840 **DragonFire High Energy Laser Firing Trials (UK-SEN)** *Andy Tait*, MBDA
- 0900 **HEL Integration onto a Tactical Aircraft (D)** *Dr. Donald Wittich*, AFRL/RDLA
- 0920 **UK/US Cooperative Pulsed Laser Research (Secret)**
- 1000 **Break**
- 1020 **Minimum Atmospheric Characterization Requirements for HEL Research, Test, and Operations (D)** *Dr. Steven Fiorino*, AFIT/ENP
- 1040 **Thales Integrated Airspace Protection Systems TBD**
- 1100 **Thales Integrated Airspace Protection Systems TBD**
- 1120 **Panel Discussion: Layered Laser Defense Against Surrogate Cruise Missiles—with Lockheed Martin and Rolls Royce (A)**  
Panel:  
*Mr. Rajeev Verma*, Lockheed Martin UK  
*Mr. Rob Afzal*, Lockheed Martin  
*Mr. Ray Davis*, Rolls Royce Defense  
*Mr. Paul Shattuck*, Lockheed Martin
- 1200 **Lunch**

## WEDNESDAY MORNING

### RF/HPM Weapon Concepts and Systems Engineering

Chairs: *Matthew Webster & Peter Leask, MBDA*

- 0700 & 0715 **Coach Check-In at Hotel**
- 0730 **On Site Registration Opens**
- 0800 **RF Munitions (Secret)**
- 0820 **Distinguishing Between HPEW, HPM, EW, and CYBER (D)** *Dr. Themistoklis Andreadis, Naval Research Lab*
- 0840 **Investigation into Potential for Directed Energy to Counter Hypersonic Threats (Secret)**
- 0900 **Air-Emplaced High Power Microwaves for Offensive Electronic Attack: PTERA Program Overview (D)** *Dr. Travis Fields, University of Missouri-Kansas City*
- 0920 **Delivered CUAS Effector Based on RF DEW (Secret)**
- 0940 **Picking the Best Target: The Human Contribution to System Resilience (D)** *Richard Farry, QinetiQ*
- 1000 **Break**
- 1020 **Kill Effects for sUAS and Technology to Realize Electromagnetic Lethality (KESTREL) Requirements Analysis and Conceptual Designs (Secret)**
- 1040 **Vessel Incapacitating Power Effect Radiation (VIPER) System Update (C)** *Jason Hochman, Parsons*
- 1100 **Portable High Power Microwave Disabler (C)** *Sean Torrez, Physical Sciences, Inc. (PSI)*
- 1120 **Ealing Overview (Secret)**
- 1140 **NLTL Effects and Components: Understanding How the Effects Can Differ in a High Repetition Rate World (Secret)**
- 1200 **Lunch**

## WEDNESDAY AFTERNOON

### JOINT SESSION: HPRF/HPM/HEL

Chairs: *Prof. Martin Hubbard & Kevin Burrett, Dstl*

- 1300 **Protecting Operational Advantage Within a DEW Threat Environment (UK-OFF)** *Miss Jenny Evans, UK Ministry of Defence, Defence Science & Technology Laboratory*
- 1320 **European Office of Aerospace Research and Development (EOARD) Directed Energy Portfolio (C)** *Dr. Nathaniel Lockwood, Air Force Office of Scientific Research European Office of Aerospace R&D (EOARD)*
- 1340 **High-Power Microwave Research at the University of Strathclyde (UK-OFF)** *Kevin Ronald, Department of Physics University of Strathclyde*
- 1400 **The Directed Energy Center at the University of New Mexico (DEC@UNM) (A)** *Prof. Edl Schamiloglu, University of New Mexico*
- 1420 **Directed Energy Research and Development Programs at UCF (A)** *Prof. Martin Richardson, CREOL, UCF*
- 1440 **Project PULSAR: Defence & Security Applications of Ultra Short Pulsed Lasers (OS/CUI)** *David Lynn, Richmond*
- 1500 **Session Adjourns**
- 1600 **Tour to Oxford - Bus Departs from Swindon Marriott**

## THURSDAY MORNING

### HEL Source Technologies

Chairs: *Ian Elder*, Leonardo & *Dr. Brian Anderson*, AFRL/RDLT

- 0700 & 0715 Coach Check-In at Hotel
- 0730 On Site Registration Opens
- 0800 Advancements in Pump Components for Directed Energy Laser Systems (A)  
*John Goings*, Leonardo Electronics US
- 0820 Filament-Mediated Disruption of Laser Propagation (A) *Dr. Craig Stacey*, LumOptica Limited
- 0840 High Power kW Class All-Fibre MOPA (UK-SEN) *Dr. Ian Elder*, Leonardo UK Ltd
- 0900 The Importance of Freeform Optics in Directed Energy Systems (A) *Dr. Stephen Kidd*, PowerPhotonic Ltd
- 0920 Design Tolerances on TMI Performance for Beam Combinable Multi-kW Fiber Amplifier (D) *Brian Anderson*, AFRL

### Laser Weapon Systems and Support

Chairs: *Mark Owen*, MBDA & *Dr. Steve Fiorino*, AFIT

- 0940 Overview of Current Laser-focused NATO Task Groups (A) *LeAnn Brasure*, ManTech
- 1000 Break
- 1020 Probabilistic Risk Assessment Modelling for Laser DEW Systems (UK-OFF) *Dr. Brian Flemming*, Leonardo UK Ltd
- 1040 Embedded Sensors for Structural Health Monitoring and High Energy Laser Strike Detection on UAS (A) *Dr. Peter Joyce*, U.S. Naval Academy
- 1100 Optical Turbulence Measurements Using Differential Motion of Image Contrast Features (UK-OFF) *Russell Reed*, Qinetiq
- 1120 North Atlantic Treaty Organization SCI-316 Maritime High Power Laser Propagation Test at TISTEF (UK-OFF) *Kevin Burrett*, Dstl
- 1140 HEL Power and Thermal Management Architectures and Technologies (D) *Dana Teague*, AFRL/RDLA

1200 Lunch

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## THURSDAY MORNING

### RF/HPM Modeling & Simulation

Chair: *Ian Jerram*, Dstl

- 0700 & 0715 Coach Check-In at Hotel
- 0730 On Site Registration Opens
- 0800 Weapon Effects Analysis for the HIJENKS Program (Secret)
- 0820 Modelling diffraction of Very Short Pulse-Length High-Power Electromagnetic (HPM) Emissions (UK-OFF) *Jessica McComb*, Dstl
- 0840 A New Method for HPM UAS Lethality Modeling through Effects Testing (Secret)
- 0900 Time Reversal Technique (UK-SEN)  
*Isabelle Gessey*, MBDA
- 0920 A Statistical Approach to Gain Optimization of Time-Reversal Pulse Compression Cavities (C) *Dr. Bisrat Addissie*, U.S. Naval Research Laboratory
- 0940 MBDA Capability for Modelling and Prediction of RF DEW Effects (Secret)
- 1000 Break
- 1020 Comparison of the RF DEW Models RFDEW CDM (Directed Energy Weapon Collateral Damage Model) and JREM (Joint Radio Frequency Effectiveness Model) (Secret)
- 1040 Evaluation of HPM Performance in a Layered Defense against Unmanned Aerial Systems Through Modeling and Simulation (D) *Dr. Travis Fields*, University of Missouri-Kansas City
- 1100 An Alternative Approach to RFDEW Mission Modelling in AFSIM (UK-OFF) *Joseph Peake*, Defence Science and Technology Laboratory
- 1120 Expanding UAS Target Sets (Secret)
- 1140 MAST Mission Modeling of High Power Microwave (HPM) against Counter Unmanned Aerial Systems (CUAS) (D)  
*Dr. Laura Wessels*, NSWCCD
- 1200 Lunch

**HEL Modeling & Simulation**

Chairs: *Darren Kewley, DES & Dr. Darren Luke, AFRL/RDLE*

- 1300 **Deep Learning for Deep Turbulence: A Coherent Sensing Framework (A)** *Dr. Mark Spencer, USINDOPACOM*
- 1320 **Thermo-Mechanical Modelling of Steel in LS-DYNA for LDEW Application (UK-OFF)** *Matthew Ross, Dstl*
- 1340 **Pulsed and CW Laser Effects Modeling (D)** *Dr. Darren Luke, AFRL/RDLE*
- 1400 **Multi-Physics Framework for Laser Effects Modeling (D)** *Dr. Darren Luke, AFRL/RDLE*
- 1420 **RADHEL Laser Engagement Modeling Tool & Aimpoint Comparisons (D)** *Dr. Chris Wilcox, AFRL/RDLE*

**Beam Control Technology**

Chairs: *Alan Miller, Thales & Mark Dubinskiy, ARL*

- 1440 **Fiber Laser-Based Track and Beacon Illuminator Research at ARL (D)** *Mark Dubinskiy, US Army Research Laboratory*
- 1500 **Break**
- 1520 **High Energy, Variable PRF, Er:YAG Track Illuminator Laser (TILL) (D)** *Dr. Nikolay Ter-Gabrielyan, US Army Research Laboratory*
- 1540 **Leonardo DragonFire LDEW Beam Director (A)** *Alistair Downie, Leonardo*
- 1600 **Coherent Beam Combination of Photonic Crystal Surface Emitting Lasers for Directed Energy Applications (UK-OFF)** *Roy McBride, Power-Photonic Ltd*

**Laser Weapon Concepts & Military Utility**

Chairs: *Mark Owen, MBDA & Adam Aberle, USA SMDC*

- 1620 **Army DE MSHORAD Progress (D)** *Corry Cox, US Army RCCTO Directed Energy Project Office*
- 1640 **M&S to Support Range Safety and Test Planning/Execution (Secret)**
- 1700 **Enhancement of a Layered, Counter-Threat Defense Utilizing Ultrashort Pulse Lasers (Secret)**
- 1720 **Session Adjourns**

**Optoelectronics Research Centre (ORC) Tour**

A tour of the ORC at the University of Southampton has been arranged for HEL participants who are interested.

Bus will depart at lunch on Thursday from Shrivenham. Sign up is available at the DEPS registration desk.

## THURSDAY AFTERNOON

### RF/HPM Effects and T&E

Chair: *Richard Hoad, QinetiQ*

- 1300 **Device Characterization and Effects with HPM (Secret)**
- 1320 **High Power Electronic Warfare (HPEW) Testing and Effects (Secret)**
- 1340 **Characterization of HPM Effects Mechanisms in Receiver Components (Secret)**
- 1400 **RF-DEW for Short-Pulse, Counter UAS Effects Testing (Secret)**
- 1420 **Comparative Testing of the Teledyne e2v Vehicle and Vessel Stopping System (Secret)**
- 1440 **Kill Effects for sUAS and Technology to Realize Electromagnetic Lethality (KESTREL) Lethality Testing Summary (Secret)**
- 1500 **Break**

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- 1520 **Understanding Disruptive Effects of Pulses on Electronic Circuits and Components (Secret)**
- 1540 **A Novel Methodology for the Design and Development of Targeted  $\mu$ wDEW Attack Waveforms (Secret)**
- 1600 **Exploration of Sensitivity of Electronics to RF Attack (Secret)**
- 1620 **Short Pulse Research and Evaluation for sUAS (OSPRE): Program Update (D)**  
*Dr. Travis Fields, University of Missouri-Kansas City*
- 1640 **Automated Recording and Control of HPM Exposure Response (ARCHER) (D)** *Jonathan Jerothe, NSWCCD*
- 1700 **Concept Validation Testing for Low-Power Training Evaluation System (LTES) Testing (UK-SEN)** *James Smith, QinetiQ*
- 1720 **Conference Adjourns**



**RF DEW Co-Chairs:**

*Martin Hubbard, Dstl*

*Ryan Hoffman, ONR*

**Laser DEW Co-Chairs:**

*Kevin Burrett, Dstl*

*Dr. Nick Morley, AFRL*

**Workshop Coordinator:**

*Cynnamon Spain, DEPS*

**Payments and Receipts:**

*Dawn Gutierrez, DEPS*

**Security:**

*Kat Gonzales, DEPS*

**Technical Program Coordinator and Short**

**Courses:**

*Cristina Crowson, DEPS*

**Presentations and Release Forms:**

*Carolyn Bowman, DEPS*

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