

Technical Program



Fifteenth Annual Directed Energy Symposium

26-30 November 2012
Albuquerque, NM

and

Directed Energy Education
Workshop
30 November 2012

SECURITY NOTE:

Letters listed in this agenda after presentation titles indicate distribution statements as follows:

- C - information is limited to U.S. citizens who are employees of the U.S. Federal Government or its contractors**
- D - information is limited to U.S. citizens who are employees of the U.S. Department of Defense or its contractors**

Symposium Information

Locations of Symposium Events

Most symposium sessions will be held at the Hyatt Regency Hotel in rooms identified in the program.

Exceptions include:

Reception Wednesday evening - National Museum of Nuclear Science and History
Classified Sessions - Offsite Location

Buses

Bus transportation will be provided from the hotel to the classified sessions, the Wednesday evening reception, and the Magdalena Rigde Tour. Buses to the classified facility begin transporting at 1230 Monday and run until 15 minutes after the end of the sessions. Morning buses will leave at 0720 and run continually approximately every 20 minutes. No writing materials, computers, or bags will be allowed on the bus. You may bring cell phones and leave them outside of the sessions, but the area will not be secured. Badges and IDs will need to be visible at all times both on the bus and at the classified facility.

Breakfasts

Breakfast will be served every morning at the Hyatt starting at 0700. Speakers are encouraged to eat breakfast with their session chairs on the day of their presentation. Look for table tents to designate your session's breakfast table.

Lunches and Breaks

Lunch will be served Tuesday - Thursday at the Hyatt. Limited coffee and snacks during breaks will be available Tuesday - Friday.

Directed Energy Education Workshop

The DE Education Workshop is a separate event from the Symposium, scheduled for Friday, 30 November, at the hotel. Any Symposium registrant may attend the Workshop.

Webcasts

Several portions of the Annual Symposium will be webcast. Webcasting will be synchronous, that is, available only in real time. Portions expected to be webcast are noted throughout the agenda.

MONDAY

Short Courses

- 0700 Registration at Hyatt
0800 Morning and all day short courses begin

MORNING COURSES

1. Introduction to High Energy Laser Systems
(*WEBCAST at 0800*)
Hyatt Enchantment Ballroom C
2. Introduction to High Power Microwave Systems
(Limited Distribution C)
Hyatt Enchantment Ballroom A
3. V&V and Quality Code in DT&E
Hyatt Enchantment Ballroom E

ALL DAY COURSES

- 4: Beam Control for Laser Systems
(*WEBCAST at 0800*)
Hyatt Fiesta Ballroom I
 - 5: HPM Simulation Management Software
and ICEPIC HPM Source Modeling Software
Hyatt Fiesta Ballroom IV
- 1200 Break for Lunch
1300 Afternoon short courses begin and all day
courses resume

AFTERNOON COURSES

- 6: Pulsed Laser Effects (Secret)
- 7: Directed Energy Targeting (Secret)
- 8: Fighter 101 (Secret)

TUESDAY MORNING

Plenary Session (Open) (*WEBCAST at 0800*)

Hyatt Grand Pavilion

- 0700 Registration and Breakfast at Hyatt
Start Webcast of Presentations
- 0810 Call to Order, Administrative Remarks
Dr Robert E Peterkin, Conference Chairman
- 0830 Keynote: The US Naval Leadership View of
Directe Energy
*Dr David C Stoudt, Senior Director, Naval
Capabilities and Rediness*
- 0915 Directed Energy, A Transition into the 21st
Century
*Mr Mike Rinn, Vice President, Directed Energy
Systems, The Boeing Company*
- 0945 Barriers, Opportunities, and the Future of
High Energy Lasers
*Mr Dan Wildt, Vice President, Directed
Energy Systems, Northrop Grumman*
- 1015 Break
- 1030 The Need for a National HEL Strategy
*Mr Doug Graham, Vice President, Advanced
Programs, Lockheed Martin Space Systems
Company*
- 1100 The State of HEL, and the 'Bets' Required
to Make Laser Weapon Systems a Reality
*Mr Tom Hastings, Director, Laser Business,
Raytheon Space and Airborne Systems*
- 1130 DEPS Status and Recognitions
Dr Tim Andreadis, DEPS President
- End of Webcast of Presentations*
- 1200 Lunch

TUESDAY NOON

Student Poster Session (Open)

Hyatt Enchantment Ballroom E

1200 Poster Session Begins

Characterizing Optical Properties of Brownout Aerosols in the THz Domain

David Beal, Air Force Institute of Technology

Speckle Correlation

Andrew Braun, Air Force Institute of Technology

Non-Invasive Detection and Characterization of Beams

Theodore Burlison, Colorado State University

Novel Guns for Light Sources

Jonathan Edelen, Colorado State University

Higher Order Wide-Angle Split-Step Spectral Method

Brett Hokr, Texas A&M University

Dynamic Data-Driven Bidirectional Reflectance Distribution Function

Jeffrey Lewoczko, Air Force Institute of Technology

Upgrading a Modeling Tool for Solid State Laser Weapon System Cost, Size, Weight and Power

Zachariah Netzer, Southwest Indian Polytechnic Institute

Numerical Modeling of Nd:YAG HEL Effects in Carbon Fiber Reinforced Polymers

Andrew Tresansky, United States Naval Academy

PITBUL: Physics-Based Imaging and Tracking of Ballistics, UAV's and Leo Satellites

Nathan Wurst, Air Force Institute of Technology

SBS Suppression and Coherent Combination of Fiber MOPAs via Chirped Diode Lasers

Zhi Yang, U.S. Army Research Laboratory

1540 Poster Session Ends

TUESDAY AFTERNOON

Student Session (Open) (WEBCAST at 1320)

Chair: *Don Seeley*, HEL Joint Technology Office

Hyatt Fiesta Ballroom

1300 Novel Guns for Light Sources

Jonathan Edelen, Colorado State University

Start Webcast of Presentations

1320 Measuring Emittance of a Gridded Thermionic Electron Gun

Brian Zhou, Washington University

1340 Mapping Photocathode Quantum Efficiency Using a Digital Micromirror Device

Blake Riddick, University of Maryland

1400 VECSEL Scalability by Modification of the External Resonance Cavity

Joseph Braker, Rose-Hulman Institute of Technology

1420 Sensitivity Analysis and Characterization of Vertical-Cavity Surface-Emitting Lasers for Directed Energy Applications

Eryn Fennig, Rose-Hulman Institute of Technology

1440 SBS Suppression and Coherent Combination of Fiber MOPAs via Chirped Diode Lasers

Zhi Yang, Hunter College (CUNY)

1500 Break

1540 Model of Heat Transferred to Cell Culture from IR Laser for Excitation Purposes

Theodore Schomay, University of Colorado

1600 Analysis of Thermal and Strain Effects in Composites using Fiber Bragg Grating Optical Temperature Sensors

Kyle Elam, United States Naval Academy

1620 Upgrading a Modeling Tool for Solid State Laser Weapon System Cost, Size, Weight and Power

Zachariah Netzer, Southwest Indian Polytechnic Institute

1640 Photoionization in a Rb Alkali Laser

Logan Brandt, US Air Force Academy

1700 Investigation of Vacuum Ultraviolet Emission and Absorption During Pulsed Surface Flashover along Dielectric Interfaces

George Laity, Texas Tech University

1800 Buses Depart Hyatt for Reception

1830 Reception at The National Museum of Nuclear Science and History

TUESDAY AFTERNOON

Free Electron Lasers (Limited/Open)

Chair: *Terry Grimm*, Niowave, Inc

Hyatt Enchantment Ballroom

Session is Limited Distribution C

- 1300 **Development of a High Average Current FEL Injector Using a Gridded Thermionic Electron Gun (C)**
Steven Gold, Naval Research Laboratory
- 1330 **4K Cryotest of a 700 MHz Multi-Spoke Electron Injector (C)**
Boulware Chase, Niowave, Inc.
- 1400 **Megawatt-Class Couplers for Superconducting Navy FEL Injectors (C)**
Brett Kuhlman, Niowave, Inc.
- 1430 **Performance of the Mark II Quarterwave SRF Photoinjector (C)**
Terry Grimm, Niowave, Inc
- 1500 **Break**

Session is now Open

- 1530 **Diffusion, Evaporation, and the Modeling of Controlled Porosity Dispenser Photocathodes for DE Applications**
Zhigang Pan, University of MD College Park
- 1600 **On the Coupled Relationship Between Quantum Efficiency and Emittance for Photocathodes**
Kevin Jensen, Naval Research Laboratory
- 1630 **Self-Healing Cesium Reservoir Photocathodes after Severe Poisoning**
Eric Montgomery, University of Maryland
- 1700 **Advances in Theory and Measurement of the RF-Field Confinement (cage) Cavity**
John Noonan, Argonne National Laboratory
- 1800 **Buses Depart Hyatt for Reception**
- 1830 **Reception at The National Museum of Nuclear Science and History**

TUESDAY AFTERNOON

DE Modeling & Simulation/Numerical Simulation I (Open) (WEBCAST at 1300)

Chair: *Keith Cartwright*, Sandia National Laboratories

Hyatt Grand Pavilion

Start Webcast of Presentations

- 1300 **Modeling and Simulation of Higher-Order Group-Velocity Dispersion of Ultrafast Optical Pulse Propagation**
Matthew David Marko, NAWCAD
- 1330 **Numerical Modeling of the Heat Transfer and Damage Evolution due to HEL Irradiation of Opaque PMMA**
Peter Joyce, U.S. Naval Academy
- 1400 **Effect of Voltage Rise-time and Cathode Morphology on Electron Velocity Distribution in a Relativistic Magnetron**
Sarita Prasad, University of New Mexico
- 1430 **Metamaterial Based Electron Beam Tube**
David French, Air Force Research Laboratory
- 1500 **Break**
- 1530 **Toward a Predictive Laser Lethality Modeling and Simulation**
Howard Lowdermilk, Lawrence Livermore National Laboratory
- 1600 **The Phenomenological and Mathematical Connections of Phased Laser Arrays to Biological Neural Nets as derived from the Life and Work of Donald O. Hebb**
Erik Bochove, Air Force Research Laboratory

End of Webcast of Presentations

- 1800 **Buses Depart Hyatt for Reception**
- 1830 **Reception at The National Museum of Nuclear Science and History**

TUESDAY AFTERNOON

Laser Effects I (Secret)

Chair: *Robert Ulibarri*, Air Force Research Laboratory
Offsite Location

- 1300 **Material Removal by Laser Irradiance Under Representative Airflow Condition (D)**
- 1330 **Navy HEL Testing of Missile Forebody Sections under Supersonic Airflow Conditions (D)**
- 1400 **Engagements of Foreign Mortars at Low Power (F)**
- 1430 **Vulnerability UAS to 1.06 um CW Lasers (F)**
- 1500 **Break**
- 1530 **Pre-Test and Preliminary Post Test Modeling and Data Analysis of a Navy HEL Testing of Missile Forebody Sections under Supersonic Airflow Conditions (F)**
- 1600 **In-Band Pulsed Susceptibility Criteria for MWIR Discrete Detectors (C)**
- 1630 **Defeat Speed of Light Weapons (DSOLW) Project, Laser Effects on a Multi-Surface Complex Target (C)**
- 1700 **Response of Carbon Based Materials to High Energy Lasers (D)**
- 1800 **Buses Depart Hyatt for Reception**
- 1830 **Reception at The National Museum of Nuclear Science and History**

TUESDAY AFTERNOON

Perspectives on DE (Secret)

Chair: *Diana Loree*, Air Force Research Laboratory
Offsite Location

- 1300 **Directed Energy - An Air Combat Command Perspective (F)**
- 1330 **HELLADS-High Energy Liquid Laser Area Defense System (D)**
- 1400 **J-39 Perspective on DE (D)**
- 1430 **Operational Relevancy of Non-Lethal Direct Energy (C)**
- 1500 **Break**
- 1530 **Fires Battle Lab (C)**
- 1600 **Transitioning DE Weapons (C)**
- 1800 **Buses Depart Hyatt for Reception**
- 1830 **Reception at The National Museum of Nuclear Science and History**

WEDNESDAY MORNING

Laser Components I (Open)

(WEBCAST at 0800)

Chair: *Greg Pitz*, Air Force Research Laboratory
Hyatt Fiesta Ballroom

0700 **Registration and Breakfast at Hyatt**

Start Webcast of Presentations

0800 **Scalable Pump Source for Diode-Pumped Alkali Laser**
Bill Hersman, University of New Hampshire and Xemed

0830 **Window Protection Technology for High-Power DPAL**
Bill Hersman, University of New Hampshire and Xemed

0900 **Pulsed vs. CW Thermal Breakdown in Nanolaminate Optical Coatings on Patterned Optics**
Lucas Taylor, University of Minnesota

0930 **Exciplex Pumped Rb-Ar and Rb-Kr Lasers**
Glen Perram, Air Force Institute of Technology

1000 **Break**

1030 **Mid-Infrared Rubidium Vapor Laser**
Glen Perram, Air Force Institute of Technology

1100 **Anderson Tallman Unified Theory of Pressure Broadening for Cs - He, Ne, and Ar Collisions**
Gordon Hager, Air Force Institute of Technology

End of Webcast of Presentations

1130 **Beam Instabilities**
Sandra Biedron, Colorado State University

1200 **Lunch**

WEDNESDAY MORNING

Nuclear Electromagnetic Pulse I (Open)

Chair: *William Prather*, Air Force Research Laboratory

Hyatt Sendero Ballroom

0700 **Registration and Breakfast at Hyatt**

0800 **High-Power Electromagnetic (HPEM) Environments**
D. V. Giri, PRO-TECH

0830 **Electromagnetic Pulse Coupling to Aircraft**
William Prather, Air Force Research Laboratory

0900 **Swept CW Measurement of Electromagnetically Shielded Systems**
William Prather, Air Force Research Laboratory

0930 **Worldwide High-altitude Nuclear EMP (HEMP) Simulators**
Joseph Giles, Los Alamos National Laboratory

1000 **Break**

1030 **Some Residual Nuclear Weapons Effects Test Capability at AFRL**
Hugh Pohle, Air Force Research Laboratory/RDHE

1100 **The Standardization of the High-Altitude Electromagnetic Pulse (HEMP) in the International Electrotechnical Commission (IEC)**
William Radasky, Metatech Corporation

1130 **Nuclear Weapon Source Phenomena: Effects Beyond HEMP**
James Petrosky, Air Force Institute of Technology

1200 **Lunch**

WEDNESDAY MORNING

Panel (Limited) Status and Future of Predictive Avoidance

Moderator: *Kelly Hammett*

Hyatt Grand Pavilion

0700 Registration and Breakfast at Hyatt

0800 Panel Begins

1000 Break

Special Speaker (Open)

1030 Optics and Photonics, Essential
Technologies for our Nation

Paul McManamon, University of Dayton

1200 Lunch

WEDNESDAY MORNING

DE Employment and DE Programs I (Open) (*WEBCAST at 0800*)

Chair: *Dave Robie*, USAF Air Combat Command
Hyatt Enchantment Ballroom

0700 Registration and Breakfast at Hyatt

Start Webcast of Presentations

0800 High Energy Laser Mobile Demonstrator
Update

Blaine Beardsley, Boeing

0830 Power Beaming to UAVs using High-Power
Fiber Lasers

Richard Fischer, Naval Research Laboratory

0900 DE Momentum Beaming (DEMB) for
Innovative Spacecraft Maneuvering

Young Bae, Y.K. Bae Corporation

0930 New Vistas in Fundamental Research for
Directed Energy

John Luginsland, Air Force Office of Scientific
Research

1000 Break

1030 Long Range Projection of High Energy
Densities with Laser Filamentation and
Selected Interaction Studies

Martin Richardson, University of Central
Florida

End of Webcast of Presentations

1110 The CSU Accelerator Laboratory

Sandra Biedron, Colorado State University

1200 Lunch

WEDNESDAY MORNING

RF DE Effects I (Secret)

Chair: *J. Mark DelGrande*, TechFlow Scientific
Offsite Location

- 0700 Registration and Breakfast at Hyatt
0800 X-Band HPM Testing and Effects (C)
0830 Susceptibility Update on Radio-Controlled (RC) Improvised Explosive Device (IED)-Related Devices (C)
0900 Application of the Random Coupling Model to Enclosures with Apertures (C)
0930 Prediction of High-Power Microwave Effects on Targets Within an Enclosure using the Random Coupling Model (C)
1000 Break
1030 High Energy Particle Beam Effects Testing on Electronic Systems (C)
1100 Network-Centric Warfare: The High Power Microwave Simulator (HPM) Effects on Commercially-Available-Off-The-Shelf (COTS) Equipment (C)
1200 Lunch

WEDNESDAY AFTERNOON

Poster Session (Open)

Chair: *David Price*, AFRL
Hyatt Enchantment Ballroom E

- 1330 Poster Session Begins
High Power Microwave Classification Scale Project
Romeo Gallamoza, U.S. Army Public Health Command
Scalable Pump Source for Diode-Pumped Alkali Laser
Bill Hersman, University of New Hampshire and Xemed
Window Protection Technology for High-Power DPAL
Bill Hersman, University of New Hampshire and Xemed
Technologies for MW-Class Free Electron Lasers at the University of Maryland Electron Ring
Timothy Koeth, University of Maryland
Neural Network Control Systems for Energy Recovery Linacs
Auralee Morin, Colorado State University
High Pressure Sealed Hydrogen Spark Switches
Spencer Rendall, Radiance Technologies
Beam Current Results and Progress on the NCRF Photoinjector
Richard Renneke, Los Alamos National Laboratory
Compact Modular High Energy FEG Systems
Zack Roberts, Radiance Technologies
Pulsed vs. CW Thermal Breakdown in Nanolaminated Optical Coatings on Patterned Optics
Lucas Taylor, University of Minnesota
Dynamical Systems Modeling of Electromagnetic Interference in Electronic Networks
Ioana Triandaf, Naval Research Laboratory
Hazard Analysis Directed Energy Simulation (HADES) Role in the Development of High Energy Lasers and High Power Microwave Weapon Concepts
Richard Vickery, 711 HPW/RHDO
Excitation of Slow Wave Structure
Peng Zhang, University of Michigan
Poster Session (Limited)
Hyatt Boardroom North
Fixed Frequency Operation of a Normally-Conducting RF Photo-Injector (C)
Cynthia Heath, Los Alamos National Laboratory

WEDNESDAY AFTERNOON

Energy, Power and Thermal Management for DE I (Open) (WEBCAST at 1430)

Chair: *Siddarth Pratap*, University of Texas at Austin
Hyatt Grand Pavilion

Start Webcast of Presentations

- 1430 **Electrical Contact Resistance**
Peng Zhang, Nuclear Engineering and Radiological Sciences, University of Michigan
- 1500 **Development of a Compact Heat Pipe Oven for Optically Pumped Alkali Laser Research**
Wade Klennert, The Boeing Co.
- 1530 **Compact Modular High Energy FEG Systems**
Zack Roberts, Radiance Technologies
- 1600 **High Voltage Lithium Phosphate Cells for High Power Applications**
Bridget Deveney, Saft America

End of Webcast of Presentations

- 1630 **Megawatt Class Power for Directed Energy Weapons**
Kevin Yost, Air Force Research Laboratory/PRPG
- 1730 **Exhibitor Reception**

WEDNESDAY AFTERNOON

Nuclear Electromagnetic Pulse II (Limited)

Chair: *Hugh Pohle*, Air Force Research Laboratory/RDHE

Hyatt Enchantment Ballroom

Session is Limited Distribution D

- 1430 **Overview of the History and Resurgence of the U.S. Navy's EMP Program (D)**
Alex Solomonik, Naval Surface Warfare Center, Dahlgren Division
- 1500 **Computational Electromagnetic Modeling of EMP Test Methods on DoD Assets (D)**
Edgar Coffey, Applied Research Associates, Inc

Session is now Limited Distribution C

- 1530 **Upset: Either HPM or HEMP - Test Requirements and Results Can Be the Same (C)**
Robert Mason, Los Alamos Technical Associates (LATA)
- 1600 **An Introduction to Electromagnetic Pulse (C)**
David Jones, AFNWC/NCAE
- 1630 **Patuxent River EMP Testing Capabilities: Current and Future (A)**
David Belt, NAWCAD
- 1730 **Exhibitor Reception**

Concurrent Sessions by Room and Time

OPEN	LIMITED	LIMITED AND OPEN	SECRET
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	Grand Pavillion	Fiesta Ballroom	Enchantment Ballroom	Sendero Ballroom	Offsite Location	Offsite Location
Tuesday 1300	DE M&S/ Numerical Simulation I WEBCAST Page 7	Student Session WEBCAST Page 5	Free Electron Lasers Page 6		Laser Effects I Page 8	Perspectives on DE Page 9
Wednesday 0800	Panel Special Speaker Page 12	Laser Components I WEBCAST Page 10	DE Employment and DE Programs I WEBCAST Page 13	Nuclear Electromagnetic Pulse I Page 11	RF DE Effects Page 14	
Wednesday 1300	Poster Session in Enchantment Ballroom E Limited Poster Session in Ballroom North					
Wednesday 1430	Energy, Power and Thermal Management I WEBCAST Page 16	RF Sources WEBCAST Page 21	Nuclear Electromagnetic Pulse II Page 17	Space Synergy Page 20	Laser Programs Page 22	
Thursday 0800	Panel Special Speaker WEBCAST Page 23	RF Components/ FEL Page 25	Beam Control I Page 24	Technical Assessment of DE Capability WEBCAST Page 26	Technical Assessment of DE Capability at 10:30 Page 26	RF Programs Page 27
Thursday 1300	DE M&S/ Numerical Simulation II Page 30	Biological Effects/ Hazard Analysiss WEBCAST Page 31	Beam Control II Page 29	Counter DE & RF DE Effects II WEBCAST Page 28	Technical Assessment of DE Capability Page 32	
Friday 0800	Energy, Power and Thermal Management II & Plasma Effects Page 34	Laser Components II and Laser Effects II WEBCAST Page 33	Beam Control III WEBCAST Page 35	DE Programs II Page 36		
Friday 1300		DE Education Workshop Page 37				

WEDNESDAY AFTERNOON

Space Synergy (Limited)

Chair: *Steven Novotny*, US Air Force Academy
Hyatt Sendero Ballroom

Session is Limited Distribution C

- 1430 **INVITED: An Analysis of Directed Energy in Space for Applications Involving Space Debris and Laser Communications (C)**
Jim Riker, Air Force Research Laboratory/
RV Space Vehicles Directorate
- 1500 **INVITED: Advanced Sensors for Adaptive Optics (C)**
Robert Johnson, Air Force Research
Laboratory/Directed Energy Directorate
- 1530 **INVITED: Plasma Physics Research at the Naval Research Lab with Applications to Directed Energy (A)**
Tom Mehlhorn, Naval Research Laboratory
- 1600 **HPM-Based RF Tomography for Remote Sensing Applications (C)**
Mike Haworth, Air Force Research Laboratory
- 1630 **1030 nm LADAR Transmitter with 20 kHz Sub-Nanosecond Pulse Train at 200 W Average Power (C)**
Robert Stulz, Raytheon
- 1730 **Exhibitor Reception**

WEDNESDAY AFTERNOON

RF Sources (Open)

(WEBCAST at 1430)

Chair: *David French*, Air Force Research Laboratory
Hyatt Fiesta Ballroom

Start Webcast of Presentations

- 1430 **Brillouin Flow in Recirculating Planar Magnetron**
David Simon, University of Michigan
- 1500 **Microwave Oscillation in a Recirculating Planar Magnetron**
Matthew Franzi, University of Michigan
- 1530 **W-Band Sheet Beam Extended Interaction Klystron (EIK)**
John Pasour, Naval Research Laboratory
- 1600 **Design of Megawatt-Class Multiple-Beam Inductive Output Tubes**
Edward Wright, Beam Wave Research Inc.
- 1630 **Incorporating Metamaterial Structures in High Power Microwave Sources**
Edl Schamiloglu, University

End of Webcast of Presentations

- 1730 **Exhibitor Reception**

WEDNESDAY AFTERNOON

Laser Programs (Secret)

Chair: *W. Mark Henderson*, Naval Air Warfare Center
Offsite Location

- 1430 **LaWS: TAKING INDUSTRIAL LASERS TO SEA (D)**
- 1500 **Demonstration of the Navy Laser Weapon System (LaWS) (D)**
- 1530 **HELLADS Laser Design, Technology and Performance (D)**
- 1600 **Investigation of Method to Defeat Red Ground Based Laser (D)**
- 1630 **Solid State Laser Technology Maturation Warfare Analysis Laboratory Exercise (WALEX) (C)**
- 1730 **Exhibitor Reception**

THURSDAY MORNING

Panel (Open) (*WEBCAST at 0800*)

Model-Based Engineering

Moderator: *Grady Patterson*, TechFlow Scientific
Hyatt Grand Pavilion

0700 **Registration and Breakfast at Hyatt**

Start Webcast of Presentations

0800 **Panel Begins**

1000 **Break**

Special Speaker (Open)

1030 **Better Buying Power**

Bill Decker, Defense Acquisition University

End of Webcast of Presentations

1200 **Lunch**

THURSDAY MORNING

Beam Control I (Limited) (WEBCAST at 1120)

Chair: *Darryl Sanchez and Thomas Farrell*, Air Force
Research Laboratory

Hyatt Enchantment Ballroom

0700 Registration and Breakfast at Hyatt

Session is Limited Distribution C

0800 Overview of DoD's Efforts in Distributed
Volume Turbulence (C)

Darryl Sanchez, Air Force Research Lab

0815 AFOSR Perspective-Distributed Volume
Turbulence (C)

Kent Miller, AFOSR

0830 Understanding the Physics of Optical Deep
Turbulence at the Earth's Boundary Layer:
A Preliminary Report on the Field
Campaign (A)

Thomas Farrell, Air Force Research
Laboratory

0900 JTO MRI Overview (C)

Christopher Davis, University of Maryland

0930 Wave Optics of Deep Atmospheric
Turbulence: (AFOSR MURI Overview) (C)

Mikhail Vorontsov, University of Dayton

1000 Break

1030 Comparison of Cn2 Profiles from Weather
Radar Data to Coherent Multi-Beam
Atmospheric Transceiver (COMBAT)
Experiments (C)

Steven Fiorino, AFIT

1050 Measurements in Strong Turbulence with
the SOR Turbulence Sensor (SORTS) (C)

Terry Brennan, the Optical Sciences Company

1110 Worldwide Variability Analysis of
Combined Thermal Blooming and
Turbulence Effects Applying Standard
Model, Probabilistic Climatology, and
Numerical Forecast Atmospheric Profiles (C)

Noah Van Zandt, AFIT

1130 Deep Turbulence Compensation Test
Results Using the Adaptive Tactical Laser
System (ATLAS) (C)

Jeff Barchers, Nutronics, Inc.

1200 Lunch

THURSDAY MORNING

RF Components/FEL (Limited/Open)

Chair: *Brad Hoff*, Air Force Research Laboratory
Hyatt Fiesta Ballroom

0700 Registration and Breakfast at Hyatt

Session is Limited Distribution C

0800 Sheet Beam Klystron for the Navy FEL (C)
Aaron Jensen, SLAC National Accelerator
Laboratory

0830 A Novel High Power RF Zoom Antenna Using
Metal Plate Lenses (C)

Julie Lawrence, Air Force Research
Laboratory/RDHP

Session is now Open

0900 NLTL Modulated Carbon Fiber Cathode (A)
Brad Hoff, Air Force Research Laboratory

0930 Nonlinear Harmonic Selection in an FEL
Undulator System

Sandra Biedron, Colorado State University

1000 Break

1030 High Pressure Sealed Hydrogen Spark
Switches

Spencer Rendall, Radiance Technologies

1100 Rugged High Power Microwave Antennas
Christos Christodoulou, University of New
Mexico

1130 Prevention of Electron Multipactor in HPM
Systems

Jonathan Spaulding, AFRL Directed Energy,
High Power Microwave Division

1200 Lunch

THURSDAY MORNING

Technical Assessment of DE Capability (Open) (WEBCAST at 0800)

Chair: *Micheal Bernard*, Air Force Research
Laboratory

Hyatt Sendero Ballroom

0700 Registration and Breakfast at Hyatt

Start Webcast of Presentations

0800 Recent Trends in Global High Power
Microwave Source Research
Edl Schamiloglu, University of New Mexico

0830 Overview of the Laser Communications
Relay Demonstration
Bernard Edwards, NASA Goddard Space
Flight Center

End of Webcast of Presentations

0900 An International Perspective on Directed
Energy
Patrick Carrick, Air Force Office of
Scientific Research (AFOSR)

0930 Break

Technical Assessment of DE Capability (Secret)

Chair: *Micheal Bernard*, Air Force Research
Laboratory

Offsite Location

1030 Review of Multi-Frequency HPM Sources (F)

1100 Technological Assessment of Foreign HPM
Research (F)

1130 Technological Assessment of RFW Testing
(F)

1200 Lunch

THURSDAY MORNING

RF Programs (Secret)

Chair: *Jeff Alexander*, Sandia National Laboratories
Offsite Location

0700 Registration and Breakfast at Hyatt

0800 Counter Electronics HPM Advanced Missile
Project Ground and Flight Testing
Summary (C)

0830 CHAMP Payload (C)

0900 Results and Lessons Learned of the CHAMP
Pulsed Power System (D)

0930 CHAMP Missile Integration and
Performance (C)

1000 Break

1030 Non-Lethal UAV (NLUAV) High Power
Microwave Payload Program Overview (C)

1100 AFRL Directed Energy Counter-IED (C)

1130 Radiance Technologies DirectStrike Vehicle
Stopping Test (C)

1200 Lunch

THURSDAY AFTERNOON

Counter DE (Limited/Open)

Chair: *W. Mark Henderson*, Naval Air Warfare Center
Hyatt Sendero Ballroom

Session is Limited Distribution C

- 1300 **Materials Coatings and Structures to Counter the Effects of HEL Weapons (D)**
Michael Thomas, Johns Hopkins University
- 1330 **3-D Nonlinear Optical Metamaterials (C)**
Michael Helle, Naval Research Laboratory
- 1400 **All-Dielectric Frequency Selective Surfaces for High Power Microwave Systems (C)**
Jay Barton, EM Lab University of Texas at El Paso

Session is now Open

- 1430 **Burn Through Times for Fiber Laser Irradiated Painted Aluminum and Carbon Fiber Reinforced Polymer Samples in Shear Flow**
Glen Perram, Air Force Institute of Technology
- 1500 **Break**

RF DE Effects II (Open) (WEBCAST at 1530)

Start Webcast of Presentations

- 1530 **Mixed-Level Prediction of Electronic System Response to High-Power Microwaves and Nuclear Electromagnetic Pulse**
Larry Bacon, Sandia National Laboratories
- 1600 **Progress in Electronic Battle Damage Assessment (eBDA)**
Jeffery Williams, Sandia National Laboratories
- 1630 **Prediction of RF Circuit Effects using an Active Thevenin Equivalent Network Approach (ATHENA)**
Jeffery Williams, Sandia National Laboratories

End of Webcast of Presentations

THURSDAY AFTERNOON

Beam Control II (Limited/Open)

Moderator: *Pat Kelly*, Air Force Research Laboratory
and *Denis Oesch*, Science Application
International Corporation

Hyatt Enchantment Ballroom

Session is Limited Distribution C

- 1300 **Characterizing Earth's Boundary Layer (CEBL): A Comparison of Boundary Layer Turbulence Models (C)**
Julie Smith, AFRL
- 1320 **Optical Deep-Turbulence Effects on Light Propagation: Theory and Experiment (C)**
Viatcheslav Tatarskii, Georgia Institute of Technology
- 1340 **Laser Propagation over 149 Km Path Length-Modeling of the Experimental Data (C)**
Rao Gudimetla, AFRL/RDSM
- 1400 **Characterization of Optical Turbulence Using CFD Analysis (C)**
Todd Dorethy, University of Texas at El Paso
- 1420 **Summary and Analysis of Atmospheric Profile Data Collected During Field Tests (C)**
Aaron Dalbey, Air Force Research Laboratory/ RDSE

Session is now Open

- 1440 **Thermal Blooming Experiments Using High-Power Fiber Lasers**
Richard Fischer, Naval Research Laboratory
- 1500 **Break**
- 1530 **In Situ Calibration of Fine Wire Temperature Probes for the Measurement of Optical Turbulence**
Demos Kyrazis, R-Cubed, Inc.
- 1550 **Nonparametric Hierarchical Bayesian Models for the Analysis of Laser Beam Transmission Through Turbulent Atmosphere**
Eric Wang, USNA
- 1610 **Optical Angle-of-Arrival and intensity Fluctuations Observed with Two, Closely Spaced Telescopes in the Atmospheric Surface Layer**
Andreas Muschinski, Northwest Research Associates
- 1630 **Roundtable**

THURSDAY AFTERNOON

DE Modeling & Simulation/Numerical Simulation II (Limited)

Chair: *Grady Patterson*, TechFlow Scientific
Hyatt Grand Pavilion

Session is Limited Distribution D

- 1300 **Performance Predictions Using a Physically Detailed DPAL Model (D)**
John Haiducek, Air Force Research Laboratory /RDLC

Session is Limited Distribution C

- 1330 **Validity of Using Gaussian Schell Model for Scattering of a Fully Coherent Beam from a Rough Impedance Surface (C)**
Santasri Basu, Air Force Institute of Technology
- 1400 **Measurement and Modeling of Probabilistic Variation in High Energy Laser Reflections (C)**
Albert Bailey, TASC
- 1430 **Leveraging GPUs to Optimize System Performance of High Average Power Free Electron Lasers (C)**
Michael Phillips, Advanced Energy Systems
- 1500 **Break**
- 1530 **Modeling and Experiment of High Power Radio-Frequency Effects on Printed Circuit Boards and their Embedded Chipsets (C)**
Sameer Hemmady, TechFlow Scientific
- 1600 **A Hybrid Time-Domain Simulation Analysis Methodology for Predicting the Impact of High Power Electromagnetic Waves on Enclosures, Cables and Circuits (C)**
S. Joe Yakura, Air Force Research Laboratory/RDHE
- 1630 **TMax Time Domain Electromagnetic Modeling of Printed Circuit Board Illuminated by Incident Plane Wave (C)**
Jeff MacGillivray, Air Force Research Laboratory

THURSDAY AFTERNOON

Biological Effects/Hazard Analysis (Open) (WEBCAST at 1300)

Chair: *Stephanie Miller*, 711 HPW/RHDR
Hyatt Fiesta Ballroom

Start Webcast of Presentations

- 1300 **INVITED: OSD Perspective on Joint Collaboration and Roadmapping for Non-Lethal Weapon Bioeffects Research Programs**
Patrick Mason, ASD(R&E)
- 1330 **A Probabilistic Technique for Reflected Laser Risk Analyses**
Edward Early, TASC
- 1400 **Hazard Analysis Directed Energy Simulation (HADES) Role in the Development of High Energy Lasers and High Power Microwave Weapon Concepts**
Richard Vickery, 711 HPW/RHDO
- 1430 **Sunspot: Creating Diffraction Reduced Spots Using Active Denial System (ADS) System**
James Parker, General Dynamics Information Technology
- 1500 **Break**
- 1530 **Sunspot: Preliminary Results**
James Parker, General Dynamics Information Technology

End of Webcast of Presentations

- 1600 **Bioheat Models for Human Exposure to High Average Power Microwaves**
Jason Payne, 711 HPW/RHDR

THURSDAY AFTERNOON

Technical Assessment of DE Capability (Secret)

Chair: *Michael Bernard*, Air Force Research
Laboratory

Offsite Location

- 1300 Foreign Directed Energy Weapons
Developments (C)
- 1330 Technological Assessment of Lasercomm
and QKD (F)
- 1400 Technological Assessment of Foreign EMP
Testing Activities (F)
- 1430 Current State of Ionospheric Research (F)
- 1500 Break

Panel (Secret)

DE Applications in A2/AD Environment

Moderator : *Lawrence Grimes*, Air Force Research
Laboratory

- 1530 Panel Begins

FRIDAY MORNING

Laser Components II and Laser Effects II (Limited/Open) (WEBCAST at 1030)

Chair: *Vincent Chernesky*, NAVSEA
Hyatt Fiesta Ballroom

0700 Registration and Breakfast at Hyatt

Session is Limited Distribution D

- 0800 Modeling the Destruction of a Mortar
Targeted by a Laser Defense System (D)
Gunnar Tamm, U.S. Military Academy
- 0830 Simulation of Ionization and Other
Processes in a Static-Cell Diode Pumped
Alkali Laser (D)
Benjamin Olikier, Air Force Research
Laboratory

Session is Limited Distribution C

- 0900 Kinetic-Theory Model of Dynamic High
Energy Laser Effects on Bidirectional
Reflectance Distribution (C)
Shawn Gay, Metatech Corporation
- 0930 Experimental Results of an Advanced Gas
Laser Pressure Recovery System Diffuser
(C)
Carrie Noren, Air Force Research Laboratory
- 1000 Break

Session is now Open

Start Webcast of Presentations

- 1030 Interaction of Composite Materials with
0.8-micron Wavelength Light
Sheldon Wu, Lawrence Livermore National
Laboratory
- 1100 Demonstration of a Dual Camera Approach
for Detection and Characterization of CW
Laser from Bistatic Geometries
Ike Bendall, SSC Pacific

End of Webcast of Presentations

- 1130 High-Peak Power from Optically-Pumped
Mid-IR Semiconductor Lasers
Andrew Ongstad, Air Force Research
Laboratory/RDLAS

FRIDAY MORNING

Energy, Power and Thermal Management for DE II (Limited)

Chair: *Siddarth Pratap*, University of Texas Hyatt Grand Pavilion

0700 Registration and Breakfast at Hyatt

Session is Limited Distribution C

0800 Integration for Electrical and Thermal System Driving High Power Solid State Lasers (C)
Charles Oberly, UES

0830 Integrated Power and Thermal Management System Demonstration, Team Management and Systems Integration (C)
Steve Gagne, Rolls-Royce North American Technologies, Inc

0900 Modeling, Simulation, and Analysis of an Integrated Power and Thermal Management System for Directed Energy Weapons (IPTMSD) (C)
Michelle Bash, PC Krause and Associates

Plasma Effects (Open)

Chair: *Joseph Penano*, Naval Research Laboratory Hyatt

0930 Enhanced HEL Lethality from Ultrashort Pulse Lasers
Joseph Penano, Naval Research Laboratory

1000 Break

1030 Ionization of Gases with Intense Shaped Laser Beams
Pavel Polynkin, University of Arizona

1100 Aero-Optics Modeling for Directed Energy
Bahman Hafizi, Naval Research Laboratory

FRIDAY MORNING

Beam Control III (Limited/Open) (WEBCAST at 0900)

Chair: *Dan Herrick*, Air Force Research Laboratory Hyatt Enchantment Ballroom

0700 Registration and Breakfast at Hyatt

Session is Limited Distribution C

0800 Advances in Active Optics (C)
Allan Wirth, AOA Xinetics/Northrop Grumman

0830 Challenges of a Laser Beam Director for Submarine Application (D)
Tariq Manzur, Naval Undersea Warfare Center

Session is now Open

Start Webcast of Presentations

0900 Optical Directed Energy Beam Directors: Enabling Capabilities for the War Fighter
Paul Konkola, Eyekon Systems

0930 Directed Electromagnetic Energy Beam Path Bending Downward Due to Refractivity
Michael Thomason, Jacobs/TYBRIN - Edwards AFB

End of Webcast of Presentations

1000 Break

1030 Optical Design and Performance of Multiple Beam Combiners Using Fast Steering Mirrors
Tae Lim, Aerospace Engineering Department United States Naval Academy

1030 Simulated Adaptive Optics Performance for a Single-Path Deep Turbulence Scenario
Michael Steinbock, Air Force Institute of Technology

1200 Lunch

FRIDAY MORNING

DE Programs II (Limited)

Chairs: *Scott Griffiths and David Law*, Joint Non-Lethal Weapons Directorate

Hyatt Sendero Ballroom

0700 Registration and Breakfast at Hyatt

Session is Limited Distribution D

0800 Steps to Deploy Directed Energy (X)
Scott McPheeters, Georgia Tech Research Institute

0830 Multi-Frequency Projected Energy Gun (PEG) (D)
Thomas Cannon, Naval Surface Warfare Center, Indian Head Division

0900 High Energy Land Laser Program at DRDC Valcartier (D)
Dominik Pudo, Defence R&D Canada

0930 Comparison of K, Rb, and Cs DPAL Systems for Tactical and Strategic HEL Applications (D)
Glen Perram, Air Force Institute of Technology

FRIDAY AFTERNOON

DE Education Workshop (Open) (WEBCAST at 1300)

Hyatt Fiesta Ballroom

Start Webcast of Presentations

1300 HEL JTO Introduction
Don Seeley

1310 DEPS Educational Initiative Overview
Sam Blankenship

1320 Air Force Institute of Technology
Ashley Ungericht

1350 Naval Postgraduate School
William Colson

1420 Cranfield University
David James

1450 Break

1510 Colorado State University
Sandra Biedron

1540 University of Arizona
Pavel Polynkin

1610 HEL Center of Excellence
David Hostutler

End of Webcast of Presentations

Symposium Organizing Committee

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