Technical Program

2009 Directed Energy Systems Symposium

Beam Control Conference
DE Effects Mitigation Conference
DE Modeling and Simulation Conference
Employment of DE Weapons Conference
HEL Lethality Conference

6 - 10 April
Monterey, California
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General Information

Security
- DE Systems Symposium is SECRET/ NOFORN
- DEPS issued ID badges & valid gov’t ID are required
- Wireless electronic devices are prohibited in classified sessions
- Classified materials must be processed through DEPS security
- Classified notes MAY ONLY BE TAKEN IN NOTEBOOKS
  PROVIDED BY SECURITY STAFF
(No note-taking in Opening Plenary)
- Classified and sensitive but unclassified conversations and discussions are restricted to
designated meeting rooms only
- Cameras and photography must be authorized by the DEPS Symposium security manager
- Audio and video recording is prohibited
- Security concerns should be addressed to a DEPS Security Team member - identified by a RED BADGE
- Failure to adhere to security standards could result in Denied/Revoked Symposium registration

Meals
Breakfast is available Tuesday through Friday in San
Carlos IV at the Marriott.
Lunch is available at Hermann Hall at NPS
Tuesday, Wednesday, and Thursday. Lunch is available
Wednesday in San Carlos IV at the Marriott.
Refreshment services will be available at all
locations throughout the week.
The Welcome Reception will be held on Tuesday
in the exhibit hall at the Marriott.
The Thursday evening reception will be held at the
Monterey Bay Aquarium.

Buses
The buses will begin at 0700 on Monday and
run as follows:

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
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<tbody>
<tr>
<td>Monday</td>
<td>0700 - 1230</td>
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<tr>
<td>Thursday</td>
<td>0700 - 2230</td>
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<tr>
<td>Friday</td>
<td>0700 - 1230</td>
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Buses will leave from the Marriott and drop off at
various locations at NPS. One bus will circle from the
Hyatt to the Marriott. We encourage attendees to not
bring cell phones, laptops, or notebooks to NPS.
Buses will run on Thursday evening starting at 1900
from the Marriott to the Monterey Bay Aquarium.
### Short Courses

<table>
<thead>
<tr>
<th>Time</th>
<th>Course Description</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>0700</td>
<td>Registration at Marriott</td>
<td>Marriott</td>
</tr>
<tr>
<td>0800</td>
<td>Short Courses Begin</td>
<td>Marriott</td>
</tr>
</tbody>
</table>

**Introduction to Beam Control** (OPEN)  
Paul Merritt, University of New Mexico  
Marriott Hotel

**Aero Optics** (OPEN)  
Eric Jumper, Notre Dame  
Marriott Hotel

**HELEEOS** (LIMITED)  
Richard Bartell, Steven Fiorino, Matthew Krizo,  
Air Force Institute of Technology  
Marriott Hotel

**Wargaming** (LIMITED)  
Matt Caffrey, Air Force Research Laboratory  
Marriott Hotel

**Laser Induced Sensor Effect** (SECRET)

**DE Weapons & Bio-Effects** (SECRET)

**Beam Directors 101** (LIMITED)  
William Decker, Defense Acquisition University  
Marriott Hotel

1200  
1300  
Break for Lunch  
Short Courses Begin/Resume

**Basic Contracting Information for Technical Personnel** (free special lecture)  
Linda Buix, AFRL Contracting Officer

**Image Tracking** (OPEN)  
Chris Musial, Boeing  
Marriott Hotel

**Effects Measurements** (LIMITED)  
Nicholas Morley, Air Force Research Laboratory  
Marriott Hotel

**HELCoMES** (LIMITED)  
Troy Rhoadarmer, Keith Wojciechowski, Science Applications International Corporation  
Marriott Hotel

1715  
Last bus returns from NPS

### TUESDAY MORNING

**PLENARY SESSION**

**Opening Plenary** (SECRET)  
NPS, King Hall

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>0700</td>
<td>Registration and Breakfast at Marriott</td>
</tr>
<tr>
<td>0715</td>
<td>Buses begin to NPS</td>
</tr>
<tr>
<td>0800</td>
<td>Call to Order and Introduction</td>
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<tr>
<td>0810</td>
<td>Welcome</td>
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<tr>
<td>0815</td>
<td>Integration of DE with Kinetic Operations</td>
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<tr>
<td>0900</td>
<td>Directed Energy and Defense Science &amp; Technology</td>
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<td>0930</td>
<td>Game Changing Technology</td>
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<tr>
<td>1000</td>
<td>Break</td>
</tr>
<tr>
<td>1030</td>
<td>Naval S&amp;T Interest in Directed Energy Weapon Systems</td>
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<tr>
<td>1100</td>
<td>Army Perspective on Directed Energy</td>
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<tr>
<td>1130</td>
<td>High Energy Laser Weapons: Progress on the Horizon</td>
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<tr>
<td>1200</td>
<td>Lunch at NPS only</td>
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</table>
**TUESDAY AFTERNOON**

### BEAM CONTROL

**Phased Arrays (SECRET)**
NPS, ME Auditorium
Chair: Dan Marker, AFRL/RDS

- 1300 Meeting the Premise and Promise of Phased Array Laser Systems
- 1330 Atmospheric Turbulence Correction Using Coherent Detection
- 1355 Coherent Beam Combining with the Interferometric Phased Array Laser System
- 1415 Sharing Sub-Apertures in a Phased Array (HEFL) Transceiver: Issues and Approach
- 1430 Break
- 1450 Adaptive Array of Phase-Locked Fiber Collimators: Analysis and First Experimental Demonstration of Dynamic Phase Distortion Compensation
- 1530 Next-Generation Adaptive Photonic Phase-Locked Elements (APPLE) System
- 1555 Performance tests of the DARPA APPLE Phase 1 array
- 1620 Improved Mission Effectiveness of HEL Systems With Phased Array Beam Control
- 1645 Trade Studies of Phased Array Laser Concepts for Tactical Aircraft Applications
- 1715 Last bus leaves NPS
- 1730 Welcome Reception at Marriott in the Exhibit Hall

### EFFECTS MITIGATION

**Mitigating Laser Effects (SECRET)**
NPS, Ingersoll Hall
Chairs: Stephanie Miller and Noel Montgomery, AFRL

- 1300 Sensor Protection
- 1330 Battlefield Laser Effects and Tactical Mitigation Strategies
- 1400 InGaAs Focal Plane Array Jamming and Damage Baseline Studies
- 1430 Break
- 1500 Forecasting DE Personnel Protection Requirements

**Mitigating RF Effects (SECRET)**
Chairs: Stephanie Miller and Noel Montgomery, AFRL

- 1530 Directed Energy Personnel Protection
- 1600 Microwave Shielding Technology
- 1715 Last bus leaves NPS
- 1730 Welcome Reception at Marriott in the Exhibit Hall

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Visit www.deps.org for Daily Updates
TUESDAY AFTERNOON

MODELING & SIMULATION

Atmospheric Propagation Effects Modeling and Simulation (LIMITED)
Marriott Hotel, San Carlos I
Chair: Steven Fiorino, AFIT/ENP
1300 Continuum Type Absorption in the NIR Atmospheric Windows: Experimental Approaches
William Torruellas, Johns Hopkins University
1330 Continuum Type Absorption in the NIR Atmospheric Windows: Models
Michael Thomas, Johns Hopkins University
1400 Broad Spectrum, Three-Dimensional Optical Turbulence Assessments from Doppler Weather Radar
Jannette Cohen, AFIT/ENP
1430 Break

Beam Combination and Database Modeling and Simulation (LIMITED)
Chair: Steven Fiorino, AFIT/ENP
1500 Performance Model of Laser Weapon Systems Comprised of Multiple Tiled Subapertures
Richard Bartell, AFIT/ENP
1530 Modeling and Simulation of a 19-Element, Tiled-Aperture Fiber Laser Array
Raymond Motes, AFRL/RVS
1600 Beam Merging Concepts for Systems Efficiency of High Power Free Electron Lasers
Michael Phillips, Advanced Energy Systems
1630 Covariance Based Performance Analysis
Jeff Barchers, Nutronics, Inc.
1730 Welcome Reception at Marriott in the Exhibit Hall

HEL LETHALITY

Foreign Threat Description (SECRET)
NPS, Glasgow Hall
Chair: Michael Richardson, NSWCDD
1300 Unmanned Aerial Vehicle (UAV) Threat Prioritization
1430 Break

System / Subsystem Test Results
Chair: David Lyman, SAIC
1500 Vulnerability of a High Explosive Target to HE Fiber Lasers
1530 Cylinder Validation Test (CyIVA) Supporting Development of the ABAQUS Progressive Damage Model
1600 SWARM UAV Laser Vulnerability Assessment
1630 HEL Engagement Testing of a Surface-to-Air (SAM) Radome Inside a High Speed Wind Tunnel
1715 Last bus leaves NPS
1730 Welcome Reception at Marriott in the Exhibit Hall

Agenda Subject to Change
Visit www.deps.org for Daily Updates
**WEDNESDAY MORNING**

### Beam Control (LIMITED)

**Systems**

Marriott Hotel, San Carlos II  
Chair: Brian Hankla, NSWC Dahlgren

- **0800** Design of a Coherent Optical Multi-Beam Atmospheric Testbed (COMBAT) for Deep Turbulence Effects Characterization and Mitigation Over 149 km Propagation Path  
  *Mikhail Vorontsov*, ARL

- **0830** ABL Adjunct Mission Low-Power Test Bed (LPTB) Description and Data  
  *Dave Swain*, LM

- **0900** BILL-Less Wavefront Sensing for HEL Systems  
  *Rich Hutchin*, OPC

- **0930** Preliminary Design for the High Energy Laser Technology Demonstrator (HEL TD)  
  *Heather Hudson*, USASMDC

**Aero-Optics (LIMITED)**

Chair: Mike Zenk, University of Notre Dame

- **1000** Break

- **1030** DEBI-BATL, Directed Energy Beam Improvement Using Binary Control for the Advanced Tactical Laser  
  *Valdis Kibens*, Boeing

- **1100** Laboratory Tests of Adaptive Control for Aero-Optics Compensation  
  *Matt Whiteley*, MZA

- **1130** Predictive Control Using a priori Effective Wind Velocities in Adaptive Optics  
  *Sean Grove*, AFIT

- **1200** Lunch at Marriott or NPS
WEDNESDAY MORNING

EFFECTS MITIGATION
General DE Mitigation (LIMITED)
Marriott Hotel, San Carlos I
Chairs: Stephanie Miller and Noel Montgomery, AFRL
1000    Break
1030    Advances in Modeling Laser Eye Protection
        Physical and Visual Compatibility and
        Vulnerability to Laser Threats
        Martin LaFrance, AFLR/RHDO
1100    Determination of Bioeffect Threshold
        for Nanosecond Electrical Pulse
        Exposure in Mammalian Cells
        Bennett Ibey, AFRL/RHDR
1200    Lunch at Marriott or NPS

WEDNESDAY MORNING

DE MODELING & SIMULATION
Directed Energy Weapon Device
Modeling and Simulation - Lasers (SECRET)
NPS, Ingersoll Hall
Chair: Richard Berdine, AFRL/RDPT
0700    Registration and Breakfast at Marriott
        Buses begin to NPS
0800    Solving the Heat Conduction Problem in
        a Gain Medium Using Pseudospectral
        Methods: An Alternative to Finite-
        Difference and Finite-Element Methods
0830    High-Fidelity Modeling of Diode Pumped
        Alkali Laser Systems
0900    A COIL Improvement Model for Technology
        Insertion and Trade-Off Studies
0930    Model-Based Design Optimization for
        Directed Energy Weapons Systems
1030    Small Scale Pulsed System for Autonomous
        Vehicles
1100    Tmax Model Validation for Wideband
        Threat Source Antenna Pattern
1130    ADS BattleStorm Simulator
1200    Lunch at Marriott or NPS
**WEDNESDAY MORNING**

**EMPLOYMENT OF DE WEAPONS**

*Airborne Systems (SECRET)*  
NPS, ME Auditorium  
Chair: Walter Cole, USMA

- **0700** Registration and Breakfast at Marriott  
  Buses begin to NPS

- **0800** Directed Energy Technologies for Space Protection

- **0825** Conceptual Laser Weapon System for the Next Generation Fighter

- **0850** Sensor Optimization for Remote Laser Tagging, Tracking, and Locating Operations

- **0915** Safe Employment of Directed Energy Weapons in the Air Force

- **0940** HELLADS Electric Laser on a B-1 Bomber

- **1200** Lunch at Marriott or NPS

**WEDNESDAY MORNING**

**HEL LETHALITY**

*Test Facilities, Instrumentation, Diagnostics and Techniques (LIMITED)*  
Marriott Hotel, San Carlos I  
Chair: Chris Behre, NSWC DD

- **0700** Registration and Breakfast at Marriott

- **0800** Tri-Service Study Update Project  
  Mike Bertin, SAIC

- **0830** Development of On-Board Diagnostic Systems for HEL Testing  
  David Thomas, AEgis

- **0900** Ghosting and Other Anomalies Observed in Near IR Camera Beam Diagnostics  
  Ralph Rudder, Cavalla Inc.

- **0930** Object Viewing Capabilities Under High Intensity Light  
  Courtney Rister, AFRL/RDLE

- **1000** Break

- **1200** Lunch at Marriott or NPS
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<td>BEAM CONTROL</td>
<td>EMPLOYMENT</td>
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<td>EFFECTS MITIGATION</td>
<td>M&amp;S</td>
<td>JOINT SESSION</td>
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<td><strong>San Carlos I</strong></td>
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<td>LETHALITY / EFFECTS MITIGATION</td>
<td>M&amp;S</td>
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<td><strong>San Carlos II</strong></td>
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WEDNESDAY MORNING

HEL LETHALITY

System Engineering Modeling and Analysis (SECRET)
NPS, Glasgow Hall
Chair: Stan Patterson, USA AMRDEC
0700 Registration and Breakfast at Marriott
0800 Laser Damage to Multiple Layer Metal Targets
0830 Drift Analysis
0900 Selection, Development, and Validation of the Progressive Damage Based High Fidelity Modeling Methodology for Laser-Target Interations
0930 Scaling of Nonlinear Interactions for Small Spot Sizes
1000 Break

Component Response (SECRET)
Chair: Mike Libeau, NSWCDD
1030 Susceptibility of a Quadrifilar Helical Antenna to 1.07 Micron Laser Irradiation

EO / IR Sensor Susceptibility (SECRET)
Chair: Michael McAullife, AFRL/RDLE
1100 Modeling of Out-of-Band Jamming Experiments on an IR MANPADS Seeker
1130 Non-Linear Response of Insb Focal Plane Array to 4 µm Nanosecond Laser Pulses: From Dazzling to Damage
1200 Lunch at Marriott or NPS

WEDNESDAY AFTERNOON

JOINT SESSION

M&S and Lethality Joint Session (SECRET)
NPS, Ingersoll Hall
Chair: Kurt Chewning, JTCG/ME
1300 Joint Service Target Data Standardization Group (JSTDSG) Overview and Review and Approval Process Team (RAPT) Process
1330 Joint Lethality Effects Interface for Modeling and Simulation
1400 Overview of HEL JMEM
1430 Break
1500 Creation of an Integratable Laser Lethality Model
1530 Overview of Joint RF Effects Model
1600 Panel: The Way Forward for DE Target Vulnerability Analysis
1715 Last bus leaves NPS
**BEAM CONTROL**

**Aero-Optics Beam Control (LIMITED)**
Marriott Hotel, San Carlos II  
Chair: *Mike Zenk*, University of Notre Dame  
1300 Inertial Column Adaptive Optics (ICAO)  
*Darryl Sanchez*, AFRL/RDSA  
1330 Multi-Grid Approach for Predictive Wavefront Estimation  
*Jeff Barchers*, Nutronics  
1400 Aero-Optics Wavefront Measurements from an Air-Breakdown Beacon  
*Matt Whiteley*, MZA  
1430 Break

**Hardware (LIMITED)**  
Chair: *Larry Sher*, ABL Program Office  
1500 Initial Characterization of a MEMS Deformable Mirror  
*Darryl Sanchez*, AFRL/RDSA  
1530 Novel Plate-Type Deformable Mirrors and Adaptive Optics Systems for High Power Lasers  
*Justin Mansell*, MZA  
1600 An Articulated (Woofer) Secondary Mirror in a Very Fast Off-Axis Telescope  
*Chan McKearn*, Raytheon  
1630 Long-Burn Deformable Mirror  
*Marc Jacoby*, OPC

**EMPLOYMENT OF DE WEAPONS**

**Counter IED (SECRET)**
NPS, ME Auditorium  
Chair: *John Hartke*, US Military Academy  
1300 Joint IED Defeat Organization 101  
1325 DE and the Counter-IED Fight  
1350 Employment of Directed Energy on the Battlefield for IED Defeat  
1415 Design, Test and Performance Review of a Tactical Directed Energy System  
1440 Break

**HPM and Seaborne Systems (SECRET)**  
Chair: *John Hartke*, US Military Academy  
1515 Navy Laser Weapon System (LaWS) UAV Design Reference Mission Analysis  
1540 The Complementary Nature of Active Denial System and Kinetic Weapons  
1605 Testing HPM Wideband and Narrowband Threat Sources for National Test Ranges  
1715 Last bus leaves NPS
THURSDAY MORNING

JOINT SESSION

Symposium Joint Session (SECRET)
NPS, King Hall
Chair: J. Thomas Schriempf, NAVSEA

0700 Registration and Breakfast at Marriott
Buses begin to NPS

0800 Laser Weapon System (LaWS) Demonstration Update

0825 Test and Validation of Laser Close In Weapon System (CIWS) Testbed

0850 AFRL/RD Technologies for C-UAS Applications

0915 ATL Extended User Evaluation Program

0940 Break

1005 Airborne Laser (ABL) Program Highlights

1030 HELLADS Overview

1055 Solid State Laser Testbed Experiment (SSLTE) Overview

1120 ONR Test Programs

1200 Lunch at NPS Only
THURSDAY AFTERNOON

DE MODELING & SIMULATION

Mission-Level Modeling and Simulation (SECRET)
NPS, Ingersoll Hall
Chair: David Dubuque, AEgis
1300 Midcourse Discrimination of Ballistic Missiles Using High Energy Lasers
1330 Joint High Powered Solid State Laser Based Directed Energy Weapon System Optimization Through Scenario Modeling and Simulation
1400 B-1B Laser Weapon System Military Utility Study
1430 Break
1500 Conducting HPM Military Worth Analysis
1545 Benchmarking Low-Level Test Data To Tier I Simulations: A Top-to-Bottom Anchoring Of Live Test Data To A Campaign-Level Directed-Energy M&S
1630 Airborne Laser Interactive Concept Evaluator (ABL-ICE)
1715 Last bus leaves NPS
1915 Buses begin to Aquarium
1930 Strolling Dinner at the Aquarium

THURSDAY AFTERNOON

BEAM CONTROL

Control (SECRET)
NPS, ME Auditorium
Chair: Mikhail Vorontsov, ARL
1300 Precision HEL Boresight Sensor
1330 Reference Beam Free Phase Locking of High Power Fiber Amplifier Arrays
1400 Fine Beam Steering Simulation using 19- and 37-Element, Tiled-Aperture Fiber Laser Arrays
1430 Break

Propagation (SECRET)
Chair: Albert Ogloza, HEL JTO
1500 Laboratory Investigation of Compensation and Beacon Anisoplanatism in Strong Scintillation
1530 The Potential of Tomography to Address the Deep Turbulence Challenge
1600 Atmospheric Compensation via Separate Return Path Remote Phase Locking
1630 An Overview of the Creation and Evolution of Branch Points and Implications to Adaptive Optics
1715 Last bus leaves NPS
1915 Buses begin to Aquarium
1930 Strolling Dinner at the Aquarium

BEAM CONTROL

Control (SECRET)
NPS, ME Auditorium
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THURSDAY AFTERNOON

EMPLOYMENT OF DE WEAPONS

System Acquisition (LIMITED)
Marriott Hotel, San Carlos I
Chair: John Wachs, SMDC
1305 Closed-Form Solution of Partially-Coherent and Multi-Aperture Beam Source Propagation through Atmospheric Distortion
D.H. Tiszauer, Lockheed Martin
1330 Transitioning DE from the Laboratory to Program of Record
William Decker, Defense Acquisition University
1355 Is It Worth It? Defense Procurement Impacts at the Sub-State Level
Nicole Myers, USMA
1415 Break

Ground Based Systems (LIMITED)
Chair: John Wachs, SMDC
1445 Finite Element Thermal Model with Dynamic Simulation for a Projectile Targeted by a 100kW High Energy Laser
Christopher Larson, USMA
1520 HEL Characteristics’ Impact on Neutralization of an Incoming 82 mm Mortar
Dan Gluzko, USMA
1545 Raytheon Laser Centurion Demonstrator: Progress Developing of a Capabilities Based Near Term HEL Counter Mortar Weapon
James Horkovich, Raytheon
1610 Army HEL System Fieldability Status
Gerald Wilson, PEO-Missiles and Space
1635 Electronic Warfare and the Role of Directed Energy
Scott McPheeter, PEO-Missiles and Space
1715 Last bus leaves NPS
1915 Buses begin to Aquarium
1930 Strolling Dinner at the Aquarium

THURSDAY AFTERNOON

HEL LETHALITY

Material Interactions (SECRET)
NPS, Glasgow Hall
Chair: Paul Fleitz, AFRL/RXP
1300 HEL Effects Testing of UAV Materials and Components
1330 Change in the Absorption of Laser Radiation Due to Paint Content
1400 Dynamic BRDF Variability
1430 Break
1715 Last bus leaves NPS
1915 Buses begin to Aquarium
1930 Strolling Dinner at the Aquarium

Agenda Subject to Change
Visit www.deps.org for Daily Updates
THURSDAY AFTERNOON

JOINT SESSION

Symposium Poster Session (SECRET)
NPS, Spanagel Hall
Chair: Coutney Rister, AFRL/RDLE

Laser Detector Damage Summary

Radar Observations of Turbulence Using MST and FMCW Radar

Long-Burn Deformable Mirror

Data Summary: High Energy Laser Lethality Testing on Thermal Protection Materials

Direct Experimental Comparison between a MEMS Segmented Deformable Mirror and a Xinetics Deformable Mirror

Simulation Results for Spatial Filtering of Deformable Mirror Commands for Mitigation of the Waffle Mode Instability

FRIDAY MORNING

JOINT SESSION

M&S and Beam Control Joint Session (SECRET)
NPS, Ingersoll Hall
Chair: Eric Magee, MZA Associates

0700 Registration and Breakfast at Marriott
0715 Buses begin to NPS
0800 ATL Turret Aerodynamics Effects

0830 Speckle Analysis of Adaptive Optics Systems: Application to ABL LPSI Flight Data

0900 Directed Energy Engineering Analysis Center (DE2AC)

0930 AFRL/RD Active Track Science Team Research Progress

1000 Break
FRIDAY MORNING

HEALTHY LETHALITY

Bio-Effects (SECRET)
NPS, Glasgow
Chair: Alfred Felipe, AFRL/RDLET
0700 Registration and Breakfast at Marriott
0715 Buses begin to NPS
0800 Assessment of Collateral Hazards for High Energy Lasers in Counter-RAM Scenarios
0830 Hyperion Phase 1 + 2: High Energy Laser Bioeffects
0900 Hyperion Phase 3: High Energy Laser Bioeffects
0930 A Review of Near-IR CW Laser Ablation Mechanisms
1000 Break

FRIDAY MORNING

PLENARY SESSION

Closing Plenary Session (SECRET)
NPS, King Hall
1030 Call to Order
1040 Directed Energy Beam Control
1100 Directed Energy Modeling & Simulation
1120 Employment of Directed Energy Weapons
1140 High Energy Laser Lethality
1200 DE Effects Mitigation
1220 Adjourn
1230 Symposium Adjourns
1245 Last bus leaves NPS
Symposium Organizers

Symposium Co-chairmen:

Thomas Meyer
Jack Catton

Symposium Program Coordinator:

David Loomis

Conference Chairmen:

Dan Herrick, DE Beam Control
Stephanie Miller, Effects Mitigation
Linda Lamberson, DE M&S
John Hartke, Employment of DE Weapons
Nicholas Morley, HEL Lethality

Symposium Coordinator:

Cynnamon Spain

Registration / Short Courses:

Donna Storment