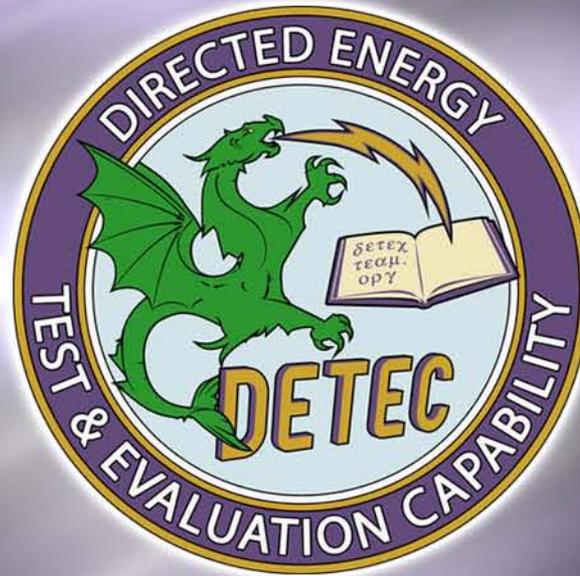


# Directed Energy Test & Evaluation Capability 10 Years Later



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**NDIA Targets, UAVs & Range Ops Symposium**  
Ft Walton Beach, FL



# Overview

- DETEC Mission and History
- Tri-Service Study Shortfalls
- Capabilities Developed
- DET S&T and DETEC Interaction
- Additional Successes
- Tri-Service Study 2011
- Summary



# DETEC Mission



Funded by TRMC's Central Test and Evaluation Investment Program

- Develop Joint T&E MRTFB infrastructure required for T&E of DEW systems
  - Instrumentation
  - Equipment
  - Software tools
- DEW systems supported
  - High energy laser (HEL)
  - High power microwave (HPM)
- Coordinate T&E needs with TRMC S&T efforts



**DETEC** – Directed Energy Test and Evaluation Capability

**MRTFB** – Major Range and Test Facility Base

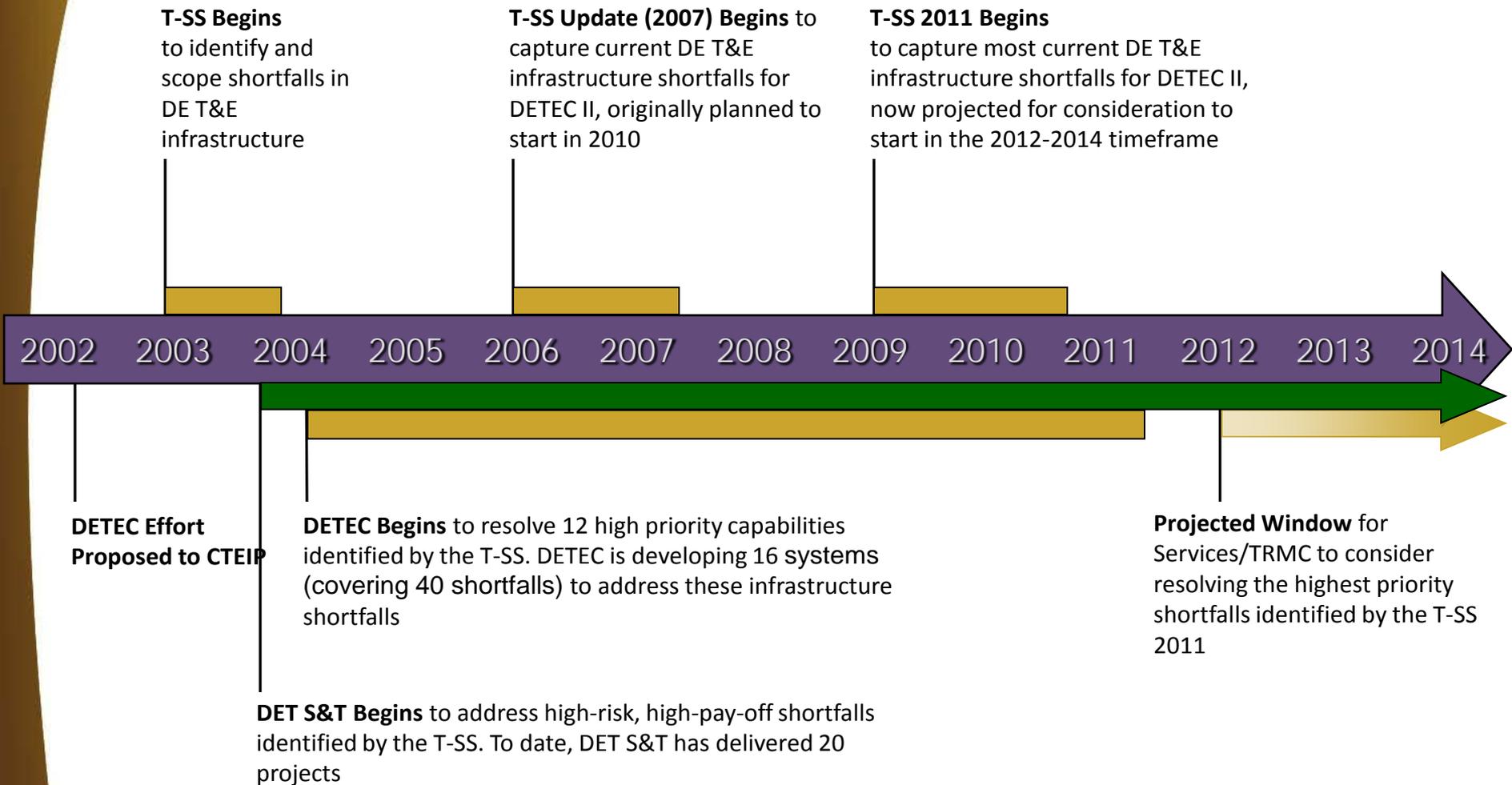
**DEW** – Directed Energy Weapon

**TRMC** – Test Resource Management Center

**T&E** – Test and Evaluation



# DETEC History





# DETEC Tri-Service Study (2004) High Priority Shortfalls

DETEC program to develop 12 Synergies covering 32 shortfalls

## High Energy Laser (HEL)

- Ground Target Irradiance Measurement (GTIM) – H1
- Airborne Target Irradiance and Imagery Measurement (ATIM) – H3
- Target Subsystems Protection (TSP) – H5
- Target Surface Temperature Measurement (TSTM) – H11
- Target Reflected Energy Measurement (TREM) – H12

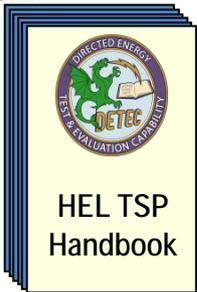
## High Power Microwave (HPM)

- Sensor Suite (SS) – H2
- Propagation Environment Measurement (PEM) – H4
- Test Target Subsystems Surety (TTSS) – H6
- Target Surrogate Materials (TSM) – H7
- Narrowband Threat Systems (NBTS) – H8
- Test Hazard Prediction (THP) – H9
- Wideband Threat Systems (WBTS) – H10

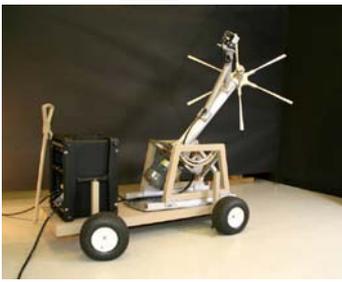


# DETEC Capabilities Overview

DETEC actually developed 16 solutions addressing 40 T-SS shortfalls:



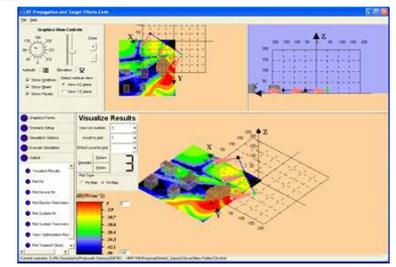
HEL TREM



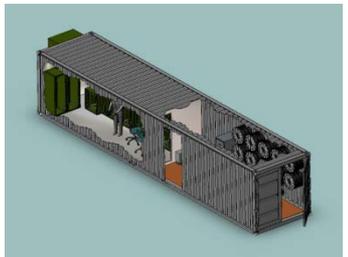
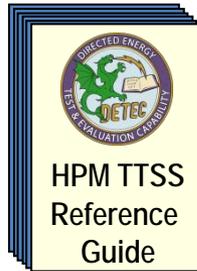
HEL GTIM



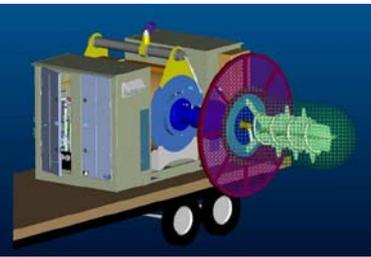
HEL ATIM



HPM THP



HPM SS



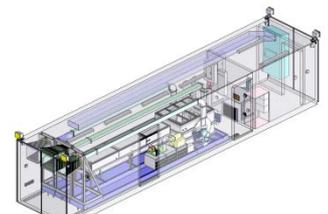
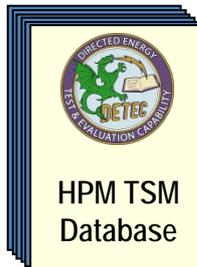
HPM WBTS



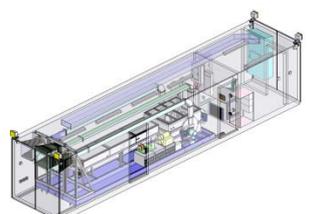
HPM COTS WBTS (2)



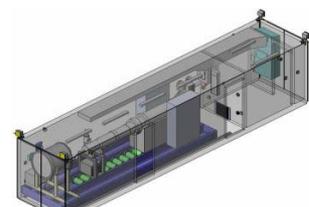
HPM PEM



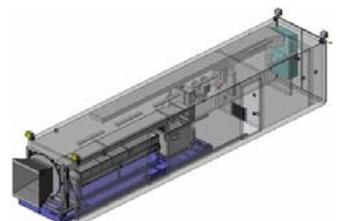
HPM NBTS-A



HPM NBTS-A'

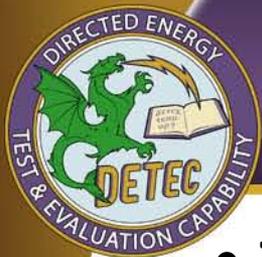


HPM NBTS-B



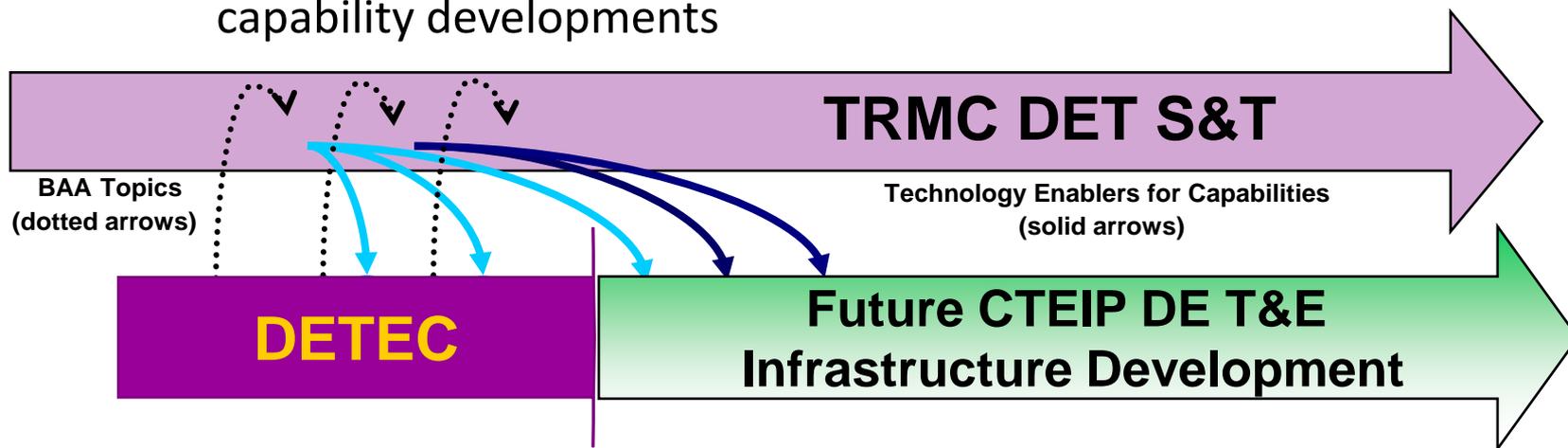
HPM NBTS-C

\* - Purple text indicates additional sources delivered



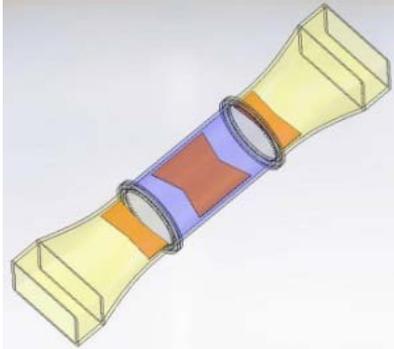
# DET S&T Interaction with DETEC

- **TRMC DET S&T and DETEC under common management**
  - DETEC uses risk reduction requirements for planned capability developments as S&T BAA topics
  - DETEC uses and augments existing IPT structure to generate future S&T topic needs that support capability development timeline
  - DETEC announces annual BAA issued by DET S&T with updated topics
  - DETEC leverages DET S&T projects as risk reductions for DETEC capability developments





# DET S&T Enhancements for HPM NBTS

Rotating Step-Twist Polarizer (RSTP)	Resistive Waveguide Attenuator (RWA)	Microwave Rotary Attenuator (MRA)
		
<p>Rotating step-twist polarizer that enables polarization change without the delays associated with breaking vacuum</p>	<p>Automatic, continuously adjustable attenuator from 0 to ~18 dB, for installation in high-power high-vacuum environment</p>	<p>Enables user to continuously and dynamically vary power output by 0 to ~15 dB</p>
<p>Installed in HPM NBTS-A'3</p>	<p>Installed in HPM NBTS-B</p>	<p>Installed in NBTS-C</p>



# DETEC Capability Support to Major Tests



**HPM NBTS-A**



**HPM NBTS-A'**



**HPM NBTS-C**

HPM Narrowband Threat Systems are in frequent use at WSMR for multi-Service test requirements. Includes numerous Army vehicles, Brigade Combat Team modernization programs, and AFRL projects. Also, the Navy extensively uses the HPM SWBTS2 for aircraft systems.



**HPM SS  
Shield  
Room**

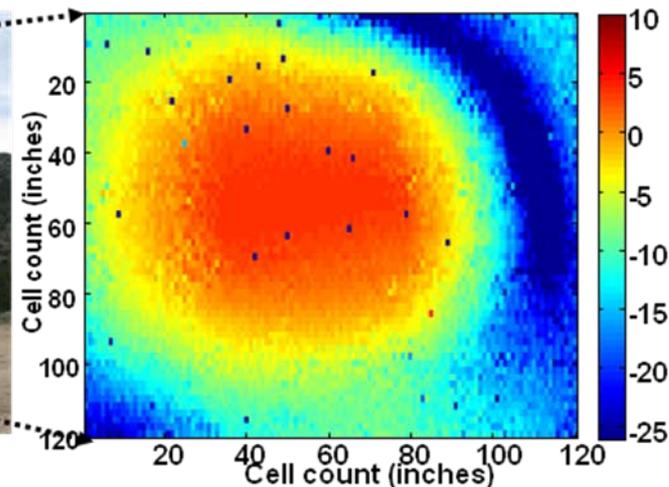


**HPM SS  
used with  
HPM WBTS**

HPM Sensor Suite used with threat systems testing both around and in test articles.



# DET Deliverables Support to Major Tests



Scanning Target Board (STB) used to characterize ADS beam shape at High Energy Test Research Facility, Kirtland AFB



HPM Soil Electrical Properties (HSEP) Brass Board in use at CHAMP initial test location to measure actual soil electrical properties to support modeling.



# T-SS 2011

- **Objective:** Identify and prioritize T&E shortfalls for DE systems planned to enter test in the next 12 years
- Conducted 7-step process to identify DE requirements, existing capabilities, and shortfalls
- Strong participation from Army, Navy, and Air Force throughout the process, including Service
  - Research Laboratories
  - Program/Demonstrator Offices
  - Operational Test Organizations
  - Senior Leadership
- FOUO version available via requests at “[detecteam.org](http://detecteam.org)”



# T-SS 2011 High Priority Capability Shortfalls

#	Domain	Capability Shortfall
1	HPM	Non-intrusive E-field and B-field probes*
2	HPM	X-band surrogate narrowband threat source*
3	HEL	Continuous Wave (CW) irradiance measurement on surface moving target board, towed airborne target board, and actual target*
4	HPM	C-band surrogate narrowband threat source*
5	HPM	Multiple node wireless data acquisition system*
6	HEL	Imagery of airborne targets*
7	HEL	Front target surface temperature*
8	HEL	Dynamic hazard analysis tool (M&S)
9	HEL	Predictive avoidance and airspace deconfliction tools (M&S)
10	HPM	Beam propagation in and near surfaces (M&S)
11	HPM	Test Hazard Prediction (THP)/Builder integration (M&S)

\* Technology investments made through DET S&T program could potentially be leveraged in acquiring a solution to this shortfall.



# Summary

## ***ACCOMPLISHMENTS:***

- Improved MRTFB infrastructure supporting DEW T&E
  - Addressed 40 of 88 original T-SS shortfalls
  - Delivered 4 HEL and 12 HPM capabilities
  - All hardware capabilities transportable between ranges
  - Reference Guides and Software tools distributed widely
  - Integrated several S&T projects improving performance/usability

## ***PATH FORWARD:***

- Recently completed T-SS 2011 Update
  - Identified 11 High Priority Capabilities for CTEIP consideration
  - Identified 16 S&T topics for Test Resource Management Center and Service 'reliance process' consideration



# Acronyms

- APT – Advanced Pointer Tracker  
APOS – Advanced Polymer Optical Sciences  
ATIM – Airborne Target Irradiance and Imagery Measurement  
BAA – Broad Area Announcement  
BOIS - Bi-Static Optical Imaging Sensor  
BITS - Beam Irradiance on Target Systems  
CCB – Configuration Control Board  
COTS – Commercial-off-the-Shelf  
CTEIP - Central Test and Evaluation Investment Program  
CW – Continuous Wave  
DE – Directed Energy  
DET – Directed Energy Test  
DETEC – Directed Energy Test and Evaluation Capability  
DEW – Directed Energy Weapon  
DoD – Department of Defense  
DT&E – Developmental Test and Evaluation  
FTS – Flight Termination System  
GTIM – Ground Target Irradiance Measurement  
HEL – High Energy Laser  
HELSTF – High Energy Laser Systems Test Facility  
HPM – High Power Microwave  
IEMS - Integrated Electro-Magneto-Optic Sensor  
IPT – Integrated Product Team  
LCSP – Life Cycle Support Plan  
LFT&E – Live Fire Test and Evaluation  
MRA - Microwave Rotary Attenuator  
MRTFB – Major Range and Test Facility Base  
M&S – Modeling and Simulation  
MSWG – Modeling and Simulation Working Group  
NBTS – Narrowband Threat Systems  
OT&E – Operational Test and Evaluation  
OTICC - Office of the Secretary of Defense Test Investment Coordinating Committee  
PD – Project Director  
PEM – Propagation Environment Measurement  
PEO STRI - Program Executive Office for Simulation, Training, and Instrumentation  
RAM - Rockets, Artillery, Mortars  
RF – Radio Frequency  
RFI – Request for Information  
RFP – Request for Proposal  
SAIC – Science Applications International Corporation  
SHEF - Skin Heating/Electric Field Strength Measurement  
SIC – Systems Integration Contractor  
SME – Subject Matter Expert  
SMFS - Spectrographic Magnetic Field Sensor  
S&T – Science and Technology  
SRG – Senior Review Group  
SS – Sensor Suite  
STB - Scanning Target Board  
TAOS - T&E Adaptive Optics System  
T&E – Test and Evaluation  
THP- Test Hazard Prediction  
TISM - Temperature and Irradiance Sensory Matrix  
TREM – Target Reflected Energy Measurement  
TRMC – Test Resource Management Center  
TSM – Target Surrogate Materials  
TSP – Target Subsystems Protection  
T-SS – Tri-Service Study  
TTSS – Test Target Subsystems Surety  
WBTS – Wideband Threat System  
WSMR – White Sands Missile Range