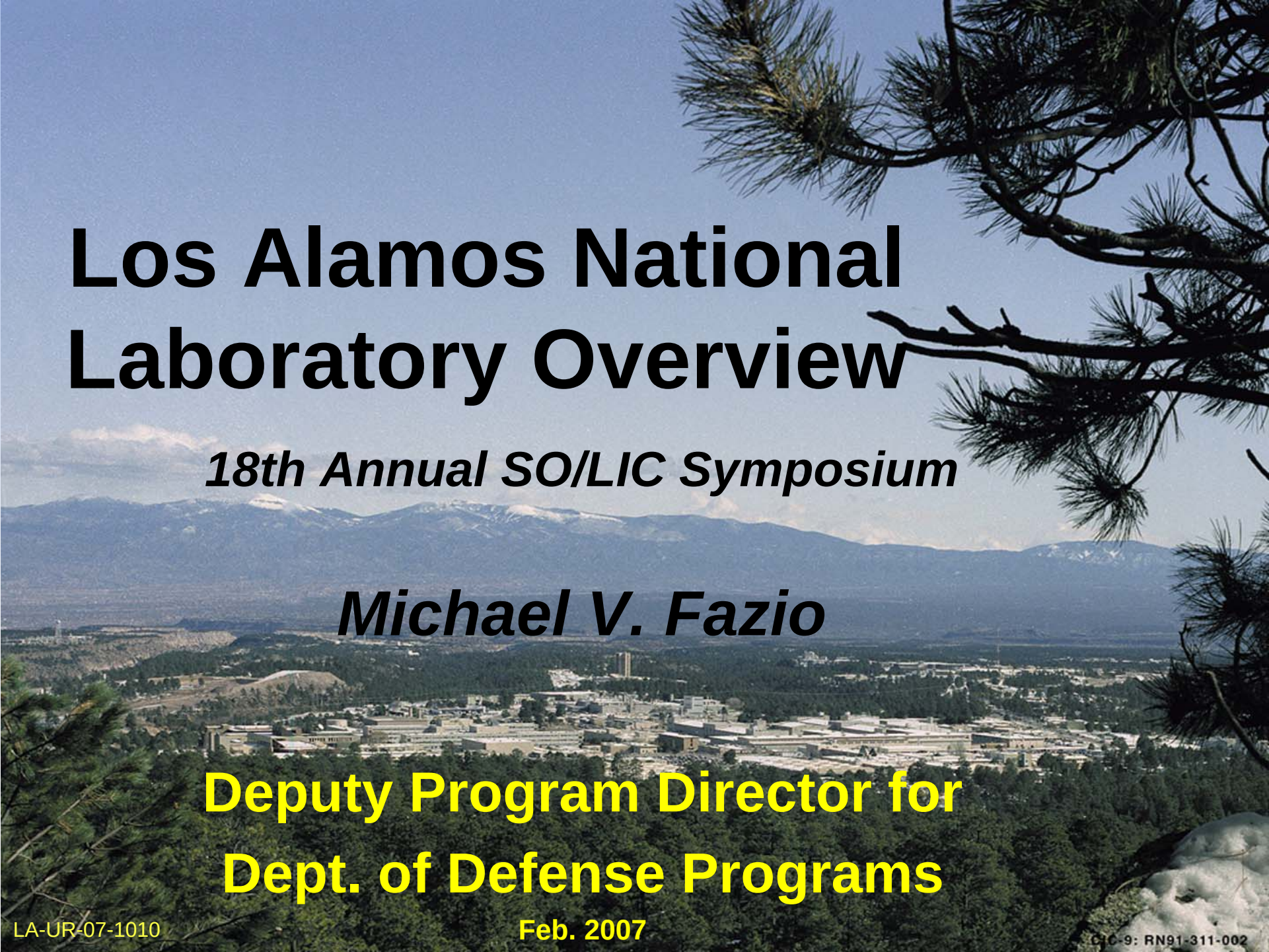


Los Alamos National Laboratory Overview

18th Annual SO/LIC Symposium

Michael V. Fazio

Deputy Program Director for
Dept. of Defense Programs

LA-UR-07-1010

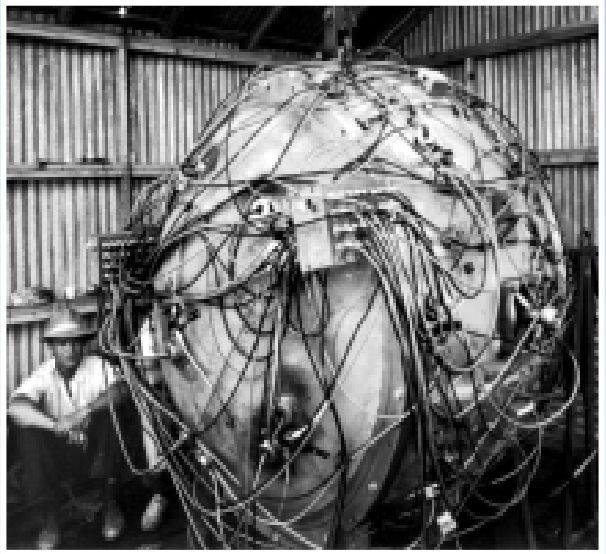
Feb. 2007

CIC-9: RN91-311-002

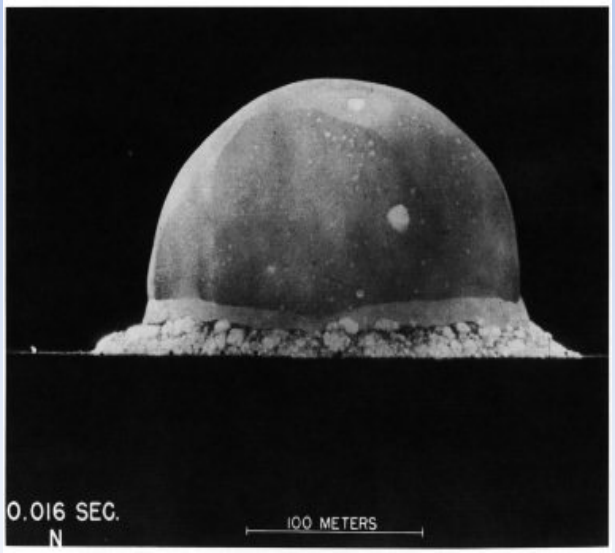
Our Mission - 1943: in the span of two years……..

"the physical sciences were turned up-side down."

PAJARITO PLATEAU



THE GADGET



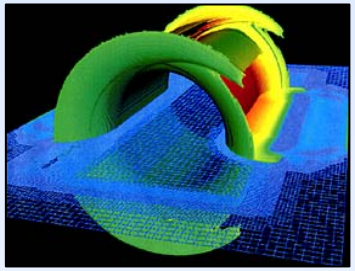
TRINITY SHOT

2007 Mission: Enhance Global Security by

- **Ensuring the safety and reliability of the U.S. nuclear deterrent**
- **Reducing global threats**
- **Solving national problems in defense, energy, environment, infrastructure, and health security**

Los Alamos National Laboratory executes a large and complex set of programs

Weapons Research



Large-Scale Simulation
Stockpile Stewardship

Pit Manufacturing

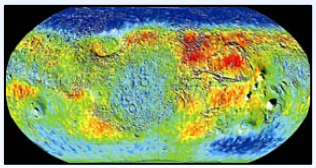
B61-11

W76, W78, W88
for Trident &
Minuteman III

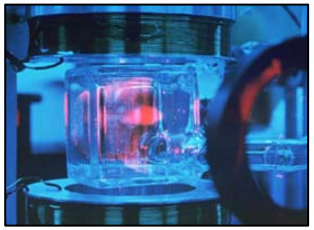
W80 for Advanced
Cruise Missile

Basic Research

Fuel Cell



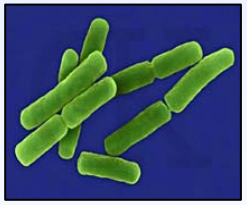
Neutron Spectrometer
Map of Mars



Atom Trapping
and Cooling

Threat Reduction

Nuclear Response



Advanced
Characterization
of Biological Agents

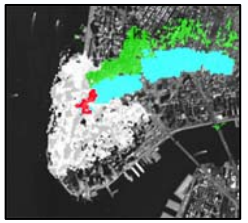


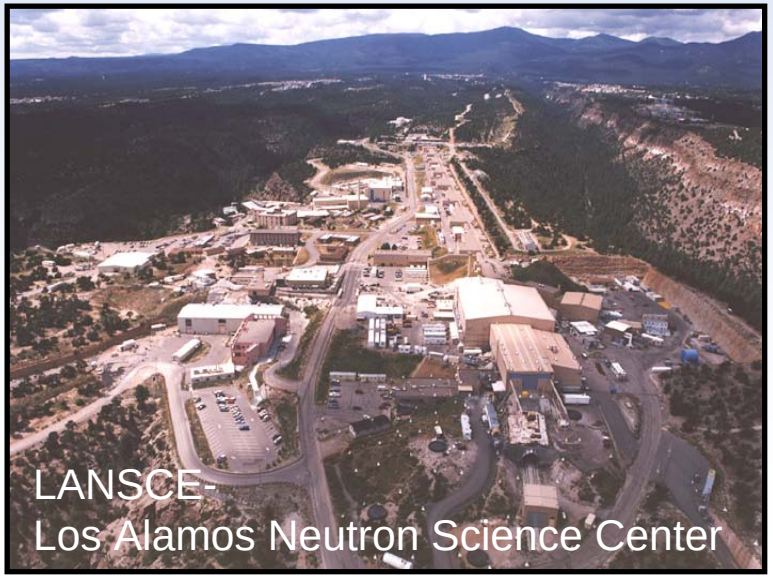
Image Analysis

Los Alamos encompasses a large and complex site

- Core Employees 9000
- Technical Staff 4000
- PhD 2000
- Post-docs 400
- Students 1500
- Operating budget ~$2.2 B
- Land area ~40 square miles

Very broad and deep science and engineering capabilities, driven by critical National needs

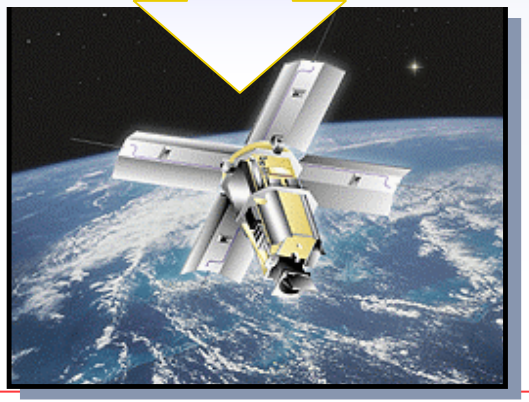
LANL (green) compared with Washington, D.C.



Strategic Thrust Areas for Threat Reduction

Tunable Metastable Interstitial Composite (MIC) Explosives
Nanoscale High Energy Density Materials

Distributed Satellite Sensor Systems



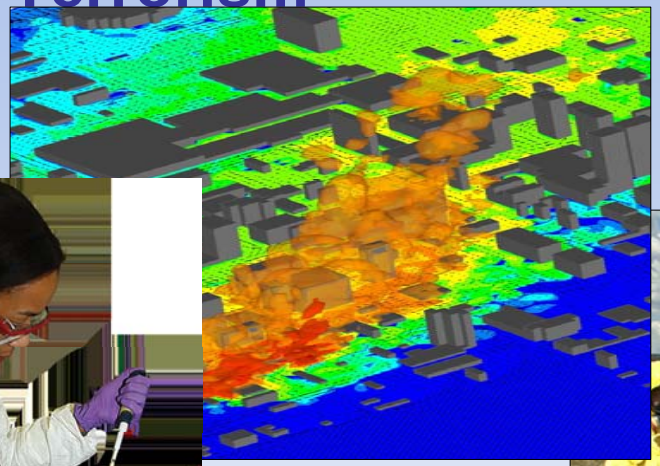
Nuclear Nonproliferation

Defense | **Threat Reduction** | **Homeland Security**

International Technology

"Global Situational Awareness Coupled with Response"

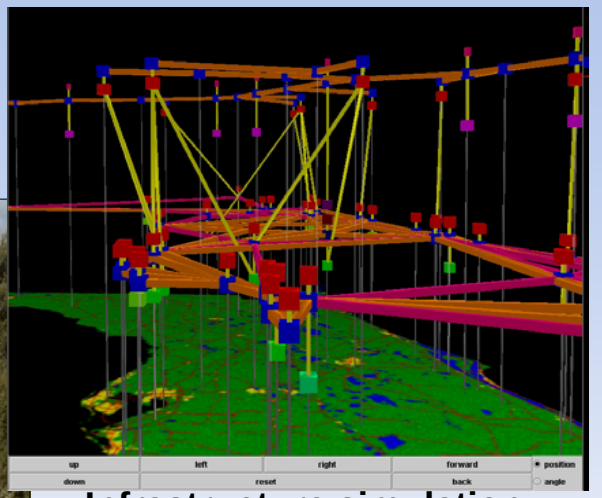
Homeland Security - Reducing Threats of WMD and Terrorism



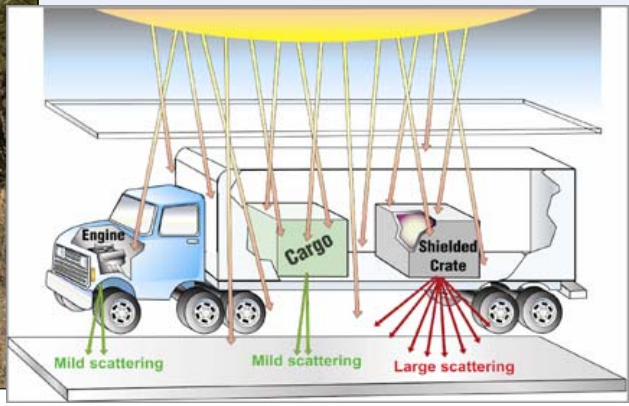
Airborne toxin transport modeling

Bioforensics

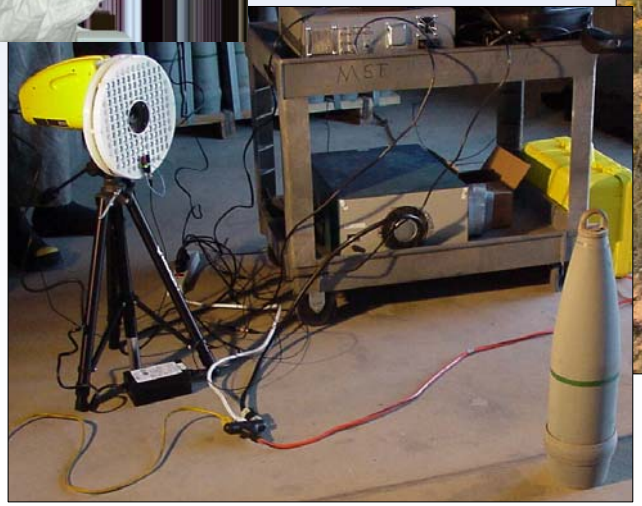
Nuclear emergency aid



Infrastructure simulation & analysis

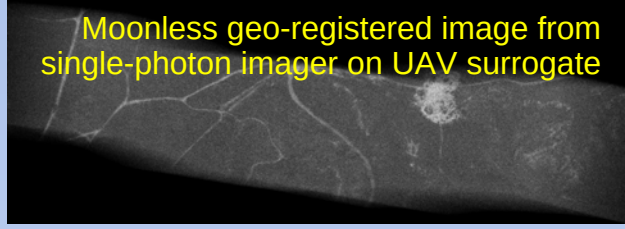


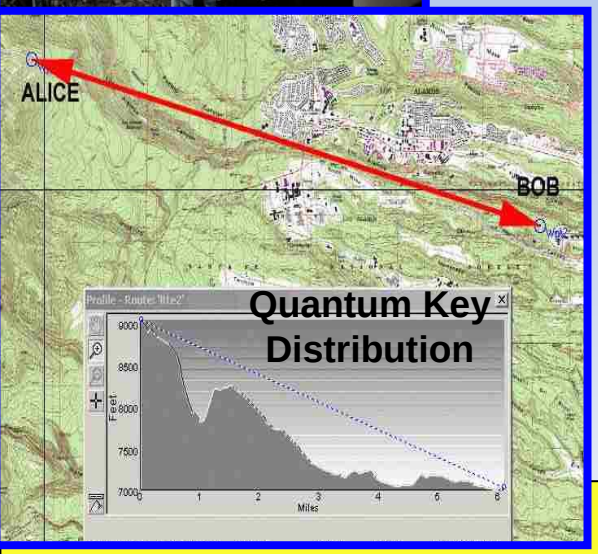
Nuclear detection - passive muon radiography

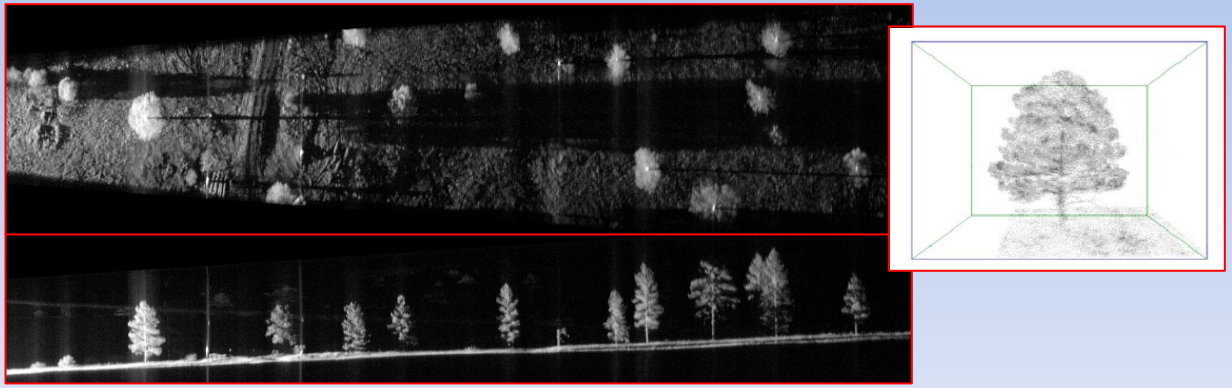


Noninvasive acoustic chemical ID

Defense - *Deter, Detect, Deny, Respond*

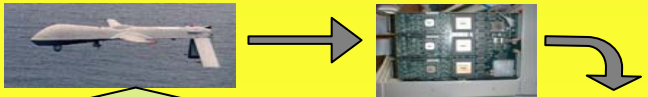






RULLI- Remote Ultra-low light 3D imaging with time tagged single photons

GENIE: GENetic Imagery Exploitation



Automated Scene Classification - translation of expert knowledge into automated knowledge extraction to handle huge data flows

Input Image | Training Image | Test Image | Output of GENIE

Contact: Nancy David, 505-667-8896, ndavid@lanl.gov

Mission Driven Science is a Los Alamos Hallmark - Satellite-Based Nuclear Explosion Monitoring

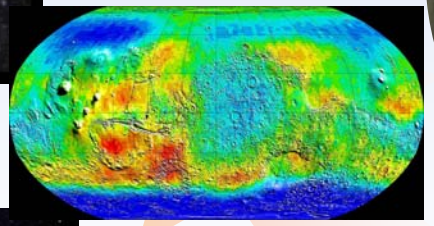
New solutions from science resulting from national needs

New Science Contributions

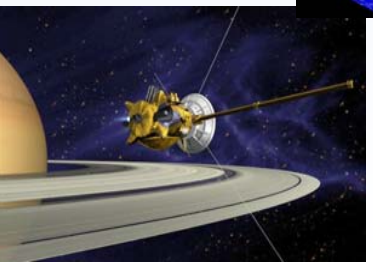
Gamma-ray bursts, water on moon/mars, magnetospheres of earth and planets.

Solutions

Triggering codes, imaging for homeland security, new detectors.



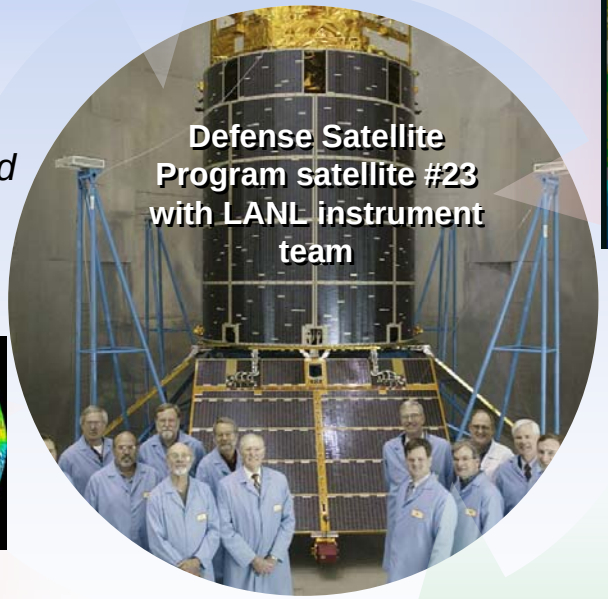
Map of Hydrogen (Water) on Mars



Cassini exploring Saturn's moons and rings 2005

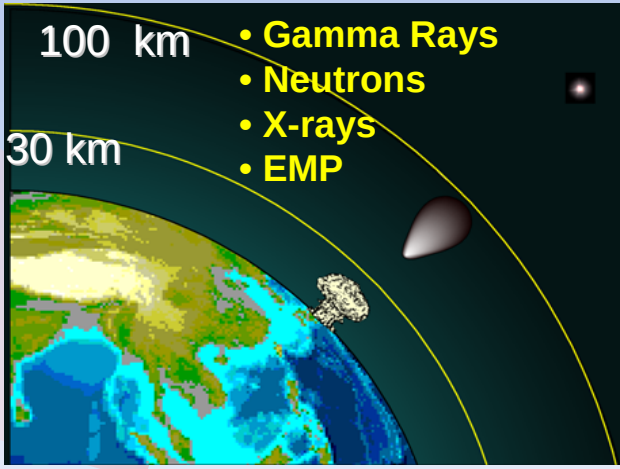
National Need

Detect nuclear explosions in atmosphere and space - everywhere, all the time.



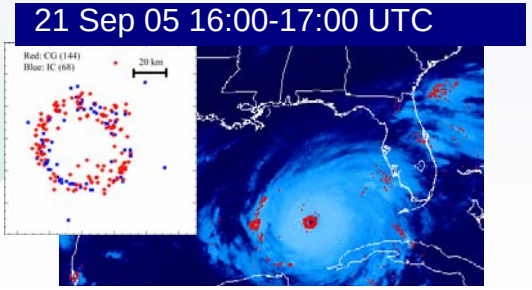
New Capabilities

Coded aperture x-ray imaging, Doppler neutron spectroscopy, neutral-particle imaging.



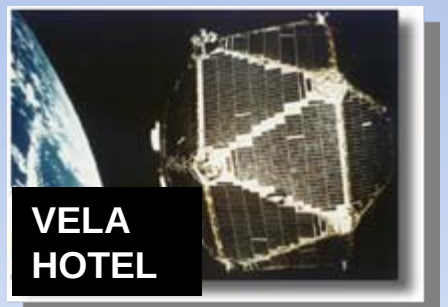
Existing and Emerging S&T

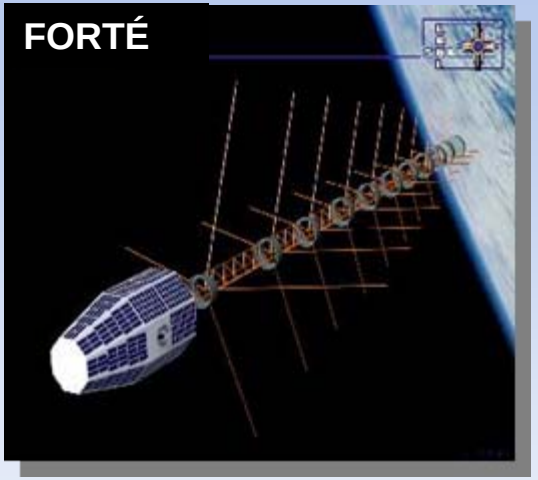
Satellite Instrumentation, x-ray, gamma-ray, neutron, EMP sensors

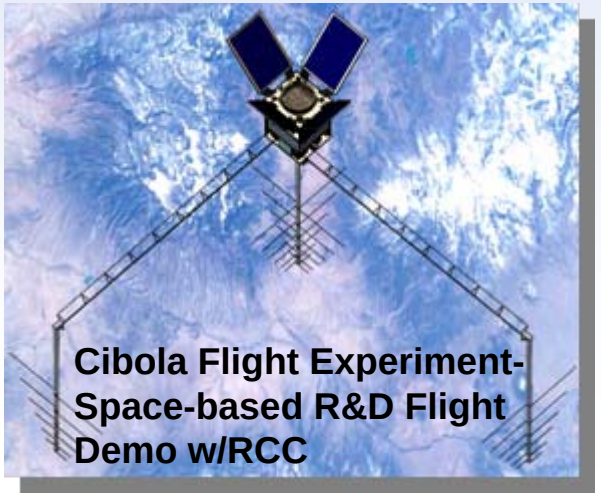


Rita category 5: intense lightning marks boundary of eyewall - EdotX sensors

40 Years of Space Experience - A Headstart on Persistent Surveillance - *1400 sensors, 120 instruments, 60 satellites*

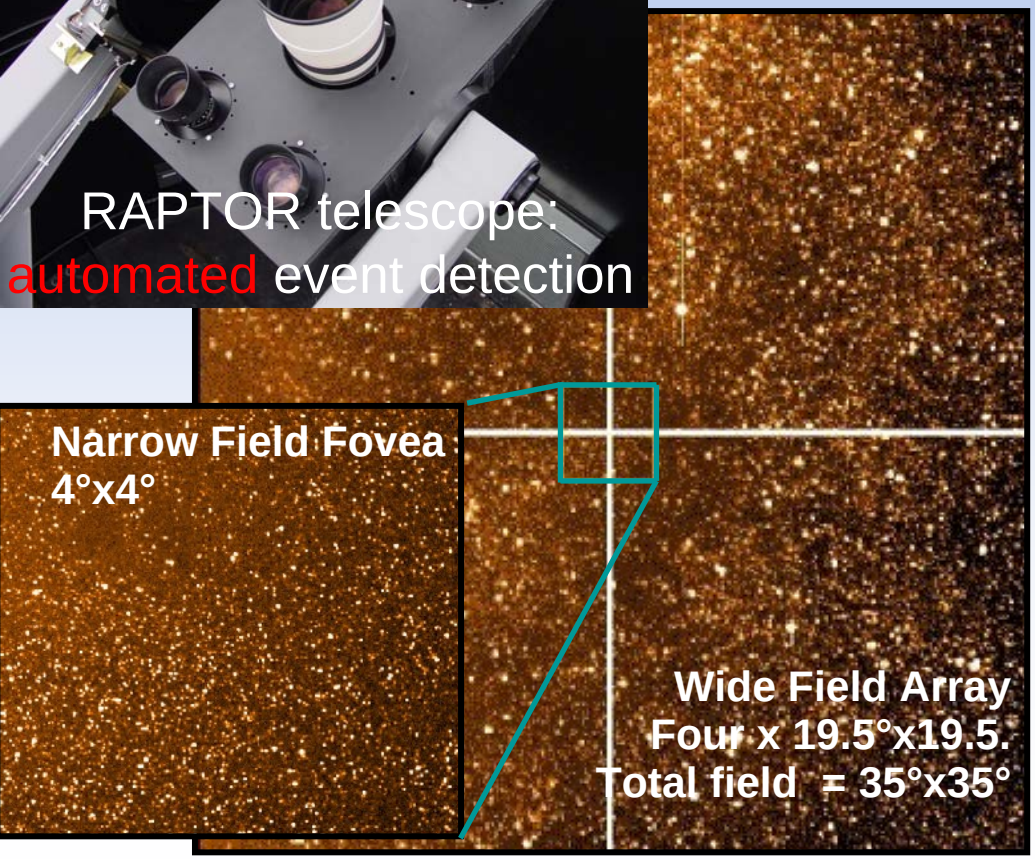






Thinking Telescopes - Find and conduct detailed follow-up observations of transient source anomalies in real time - against a huge background

Nightly variation of the optical sky, even for bright objects, is largely unexplored



Networked Robotic Hardware

- Wide FOV
- Rapid response
- Real time analysis pipeline

Machine Learning

- Automated feature extraction
- --Anomaly detection
- -- Object classifiers

Thinking Telescope

Adv. Database Technology

- Virtual observatories
- -- Distributed disk arrays
- -- Intelligent clients

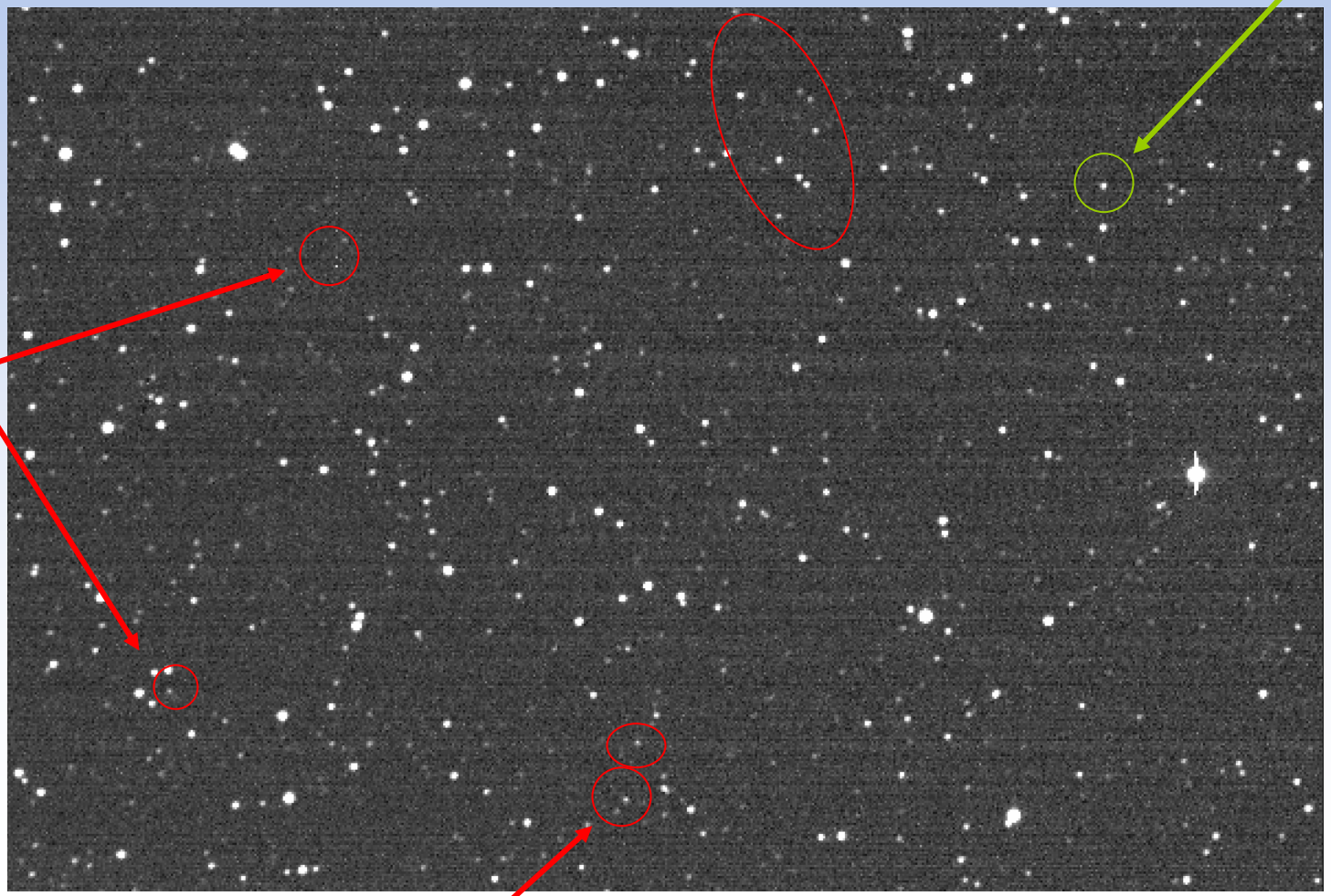
Change detection tools can be applied to terrestrial applications

Contact: Tom Vestrand, 505-665-9542, vestrand@lanl.gov

NNSA National Nuclear Security Administration

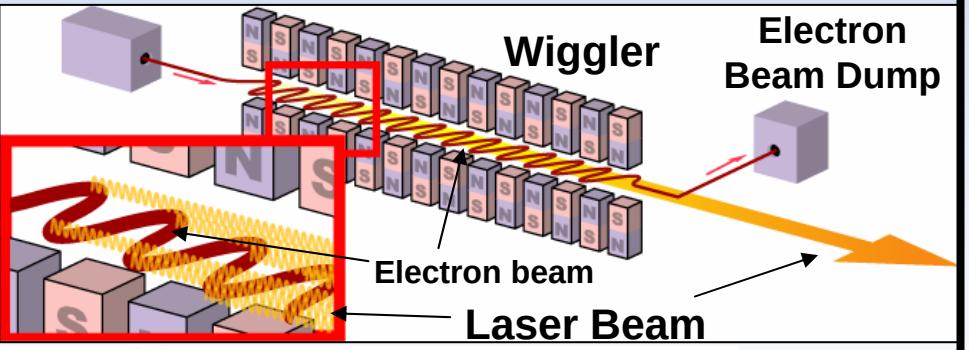
Los Alamos

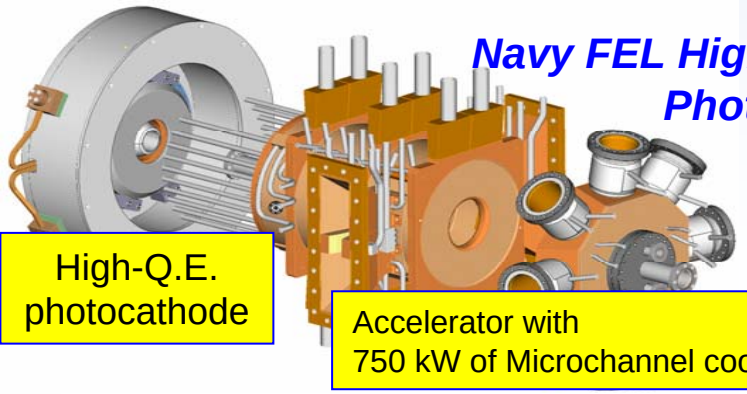
The Problem: 2 Minute Look at 1/50,000 of the Haystack



Directed Energy - Response at the Speed of Light

40 Years of High Average Power Accelerator Experience Supporting Navy ***Free Electron Laser*** *Development*





Navy FEL High Current Photoinjector

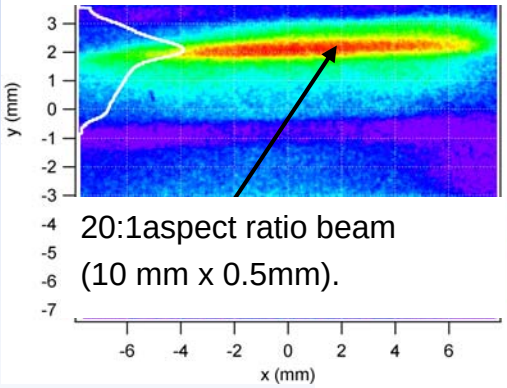
High-Q.E. photocathode

Accelerator with 750 kW of Microchannel cooling

Ultra-Compact High Power (0.5 MW/10kW) 100-300 GHz ***MM-Wave/THz Sources***

Enabling Technology:

- *Sheet beam formation and transport*
- *Planar RF structures*

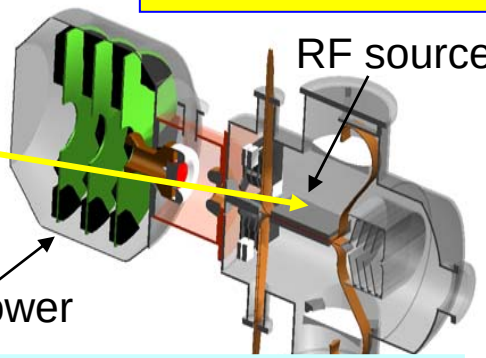


20:1aspect ratio beam (10 mm x 0.5mm).

Enabling technology for:

- Radar
- Hi-Res Imaging
- Covert Comms
- Remote Sensing
- Active denial

Planar RF structure



Ultimate TWT Configuration

Contact: Bruce Carlsten, bcarlsten@lanl.gov

Los Alamos Multi-Disciplinary Capabilities Are Tapped to Look for End to End Solutions

IED - Defeat Chain

INTELLIGENCE **SURVEILLANCE** **DETECTION** **DEFEAT**

Multiple Pathways For Technology Insertion & Deployment

Intel & Analysis

- Intelligence on terrorist threats and emerging capabilities
- Understanding terrorist capabilities in WMD and advanced explosives

Modeling Societies & Intents

- Threat Anticipation Project: simulations of insurgency societies

Sensors & Information Science

- Surveillance and detection of electronics
- Wide area persistent surveillance & real-time data distribution
- Remote Raman-LIBS detection
- Stealthy Insect Sensors of H-E vapor
- High power mm wave deployable sources to detect at-range and/or pre-detonate
- Knowledge engines, decision-making algorithms, data-fusion
- Anomaly, change recognition, identification and tracking algorithms

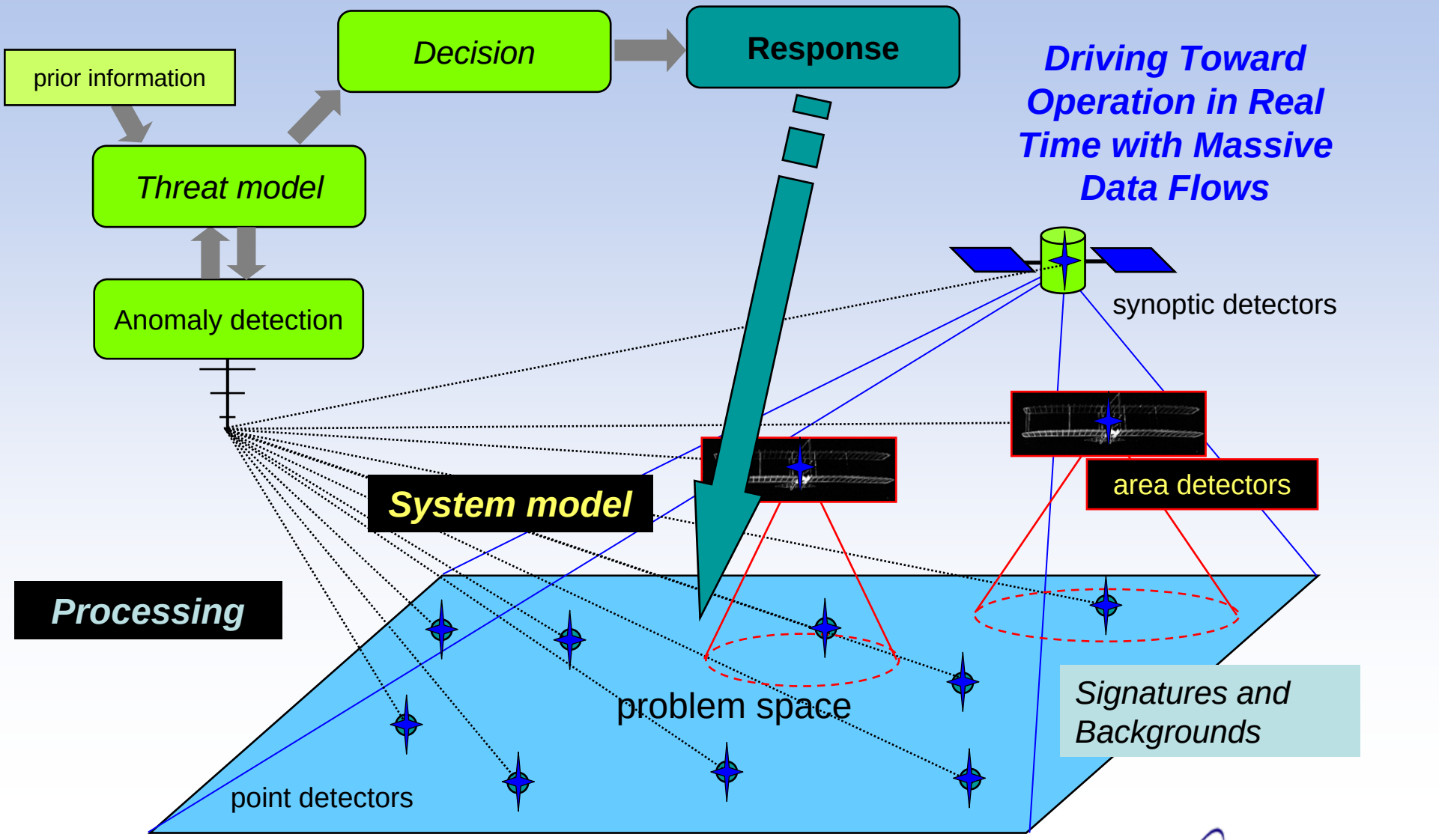
High Explosive Chemistry & Facilities

- Single H-E crystal characterization for detection sensors
- HE signatures

Disable & Defeat Capabilities

- High power microwave defeat of electronics
- Thermite Blanket for IED defeat
- Render Safe Technologies

The Challenge: Event to Knowledge to Action *in Real Time*



Los Alamos Continues a 63 Year History of Paradigm Changing R&D

- Mission-driven science in the National interest
- Underpinned with broad and deep multidisciplinary science and engineering capabilities - *much more than a nuclear weapons laboratory*
- Long history of successfully fielding complex hardware on time scales of days, weeks, & years in harsh environments with autonomous operation
- Portfolio extends across many programs with many sponsors
- Routinely partner and collaborate with other government agencies,industry, and academia

Contact: Michael Fazio, 505-667-3281, mfazio@lanl.gov