
Aerosol Triggers

Thomas H. Jeys

New England Bioterrorism Preparedness Workshop

3-4 April 2002

MS-15436

This work was sponsored under Air Force contract F19628-00-C-0002. The views expressed are those of the Author and do not reflect official policy or position of the United States Government.

50
years

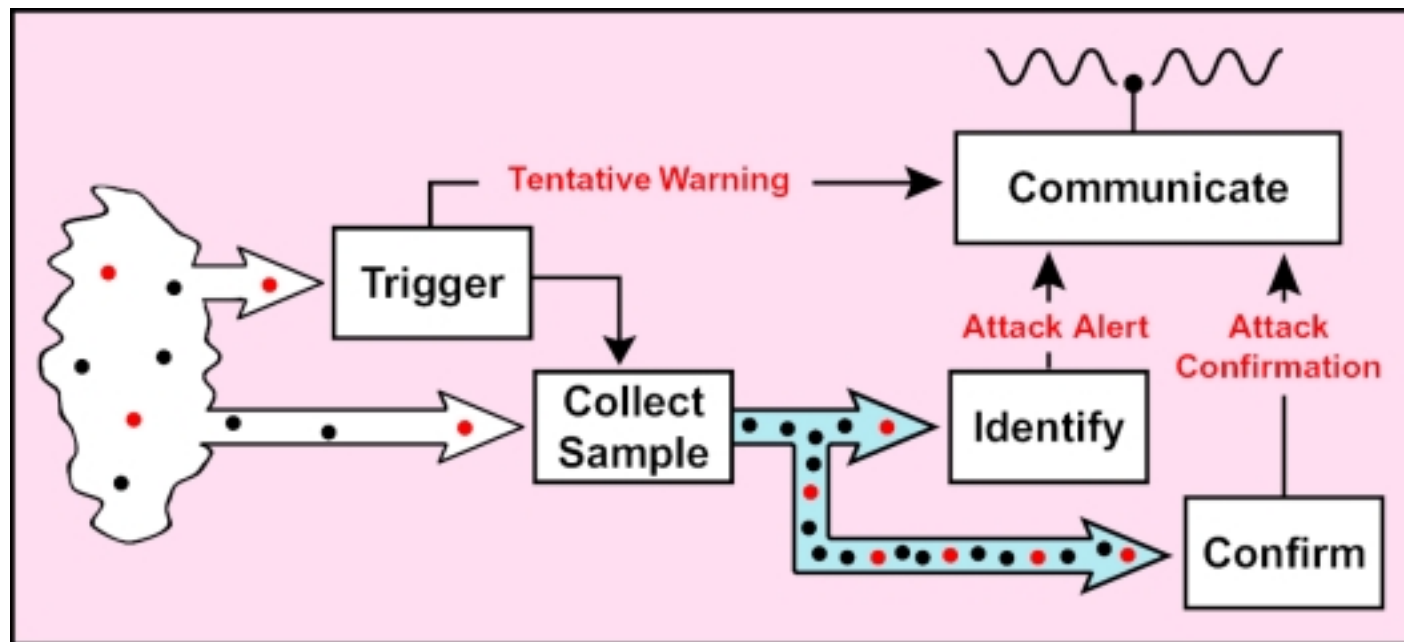
MIT
LINCOLN LAB

Report Documentation Page

Report Date 03APR2002	Report Type N/A	Dates Covered (from... to) 03APR2002 - 04APR2002
Title and Subtitle Aerosol Triggers	Contract Number F19628-00-C-0002	
	Grant Number	
	Program Element Number	
Author(s) Jeys, Thomas H.	Project Number	
	Task Number	
	Work Unit Number	
Performing Organization Name(s) and Address(es) MIT Lincoln Laboratory	Performing Organization Report Number	
Sponsoring/Monitoring Agency Name(s) and Address(es) Air Force ESC/XPK (Richard Axtell) Hanscom AFB, MA 01731	Sponsor/Monitor's Acronym(s)	
	Sponsor/Monitor's Report Number(s)	
Distribution/Availability Statement Approved for public release, distribution unlimited		
Supplementary Notes Workshop paper from the New England Bioterrorism Preparedness Workshop held 3-4 april 2002 at MIT Lincoln Laboratory, Lexington, MA, The original document contains color images.		
Abstract		
Subject Terms		
Report Classification unclassified	Classification of this page unclassified	
Classification of Abstract unclassified	Limitation of Abstract SAR	
Number of Pages 16		

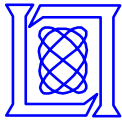


Biosensor Architecture



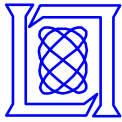
- **Trigger (< 60 s)**
 - Continuous operation
 - Alert of potential threat aerosol
- **Collector (5 min)**
 - Activated by trigger
 - Provide sample of aerosol particles

- **Identification (15 min)**
 - Preliminary identification of agent
- **Confirmation (4 – 24 hr)**
 - Final identification of agent
 - “Gold Standard” tests
 - Performed in laboratory (TAML)



Bio-Aerosol Triggers

- **Raw Particle Counters**
 - Small, low cost
 - Nondiscriminatory - very high false trigger rates
- **Fluorescent Particle Counters**
 - **Ultra Violet Aerodynamic Particle Sizer (UVAPS)**
Trigger for Biological Integrated Detection System (BIDS)
Manufactured by TSI Inc. (St. Paul, MN)
Fluorescence Aerodynamic Particle Sizer (FLAPS)
Different trigger algorithm than UVAPS
Trigger for Canadian Integrated Biological Agent Detection System (CIBADS)
 - **Biological Agent Detection Sensor (BAWS)**
Trigger for Joint Biological Point Detection System
Manufactured by Intellitec (Deland, FL)



Biological Agent Warning Sensor (BAWS)

- **Army Advanced Technology Demonstration**
 - Began BAWS development in 1996
- **Four design generations developed**
- **Extensively tested**
 - Performance
 - Environmental
- **Integrated into the Joint Biological Point Detection System**
 - Development transitioned to JBPDS in 1999.

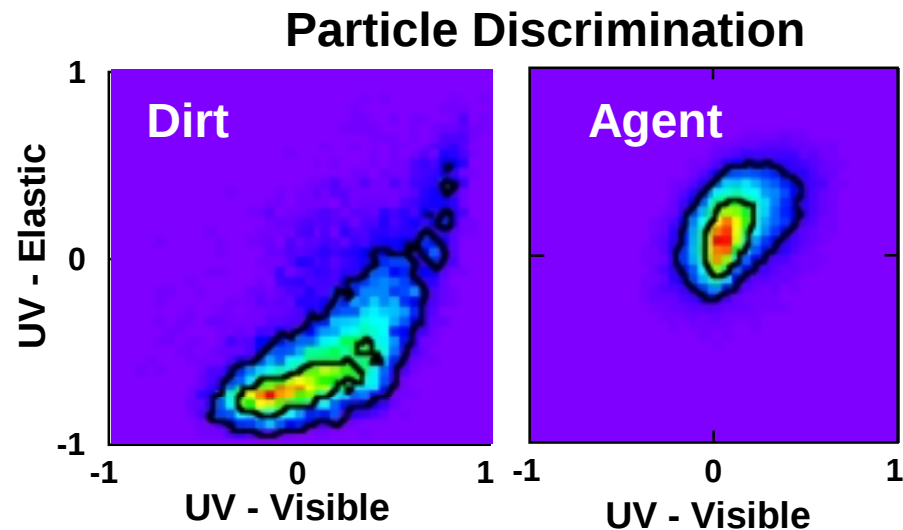
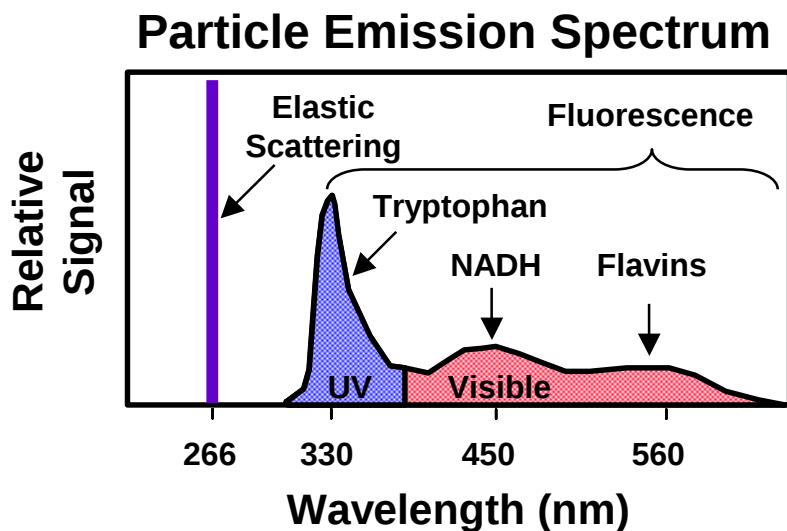
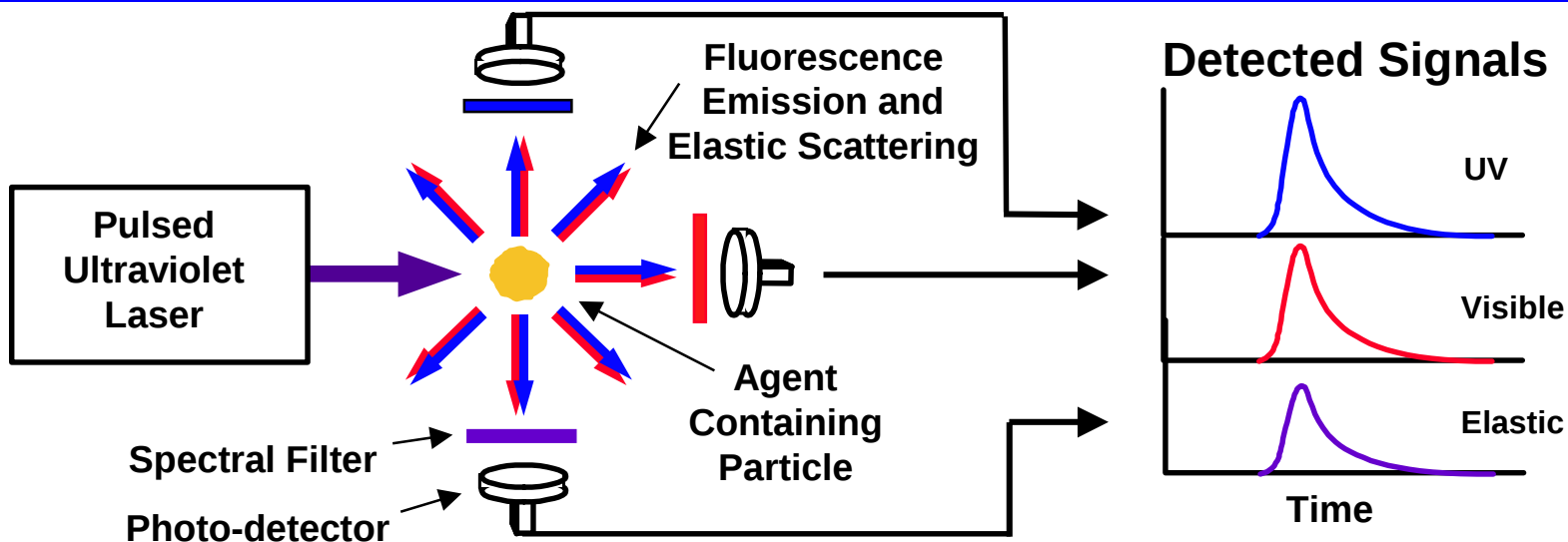
BAWS III



Size	0.8 ft ³
Weight	19 lbs
Power	35 W



BAWS Concept





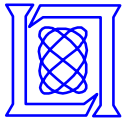
Joint Biological Point Detection System



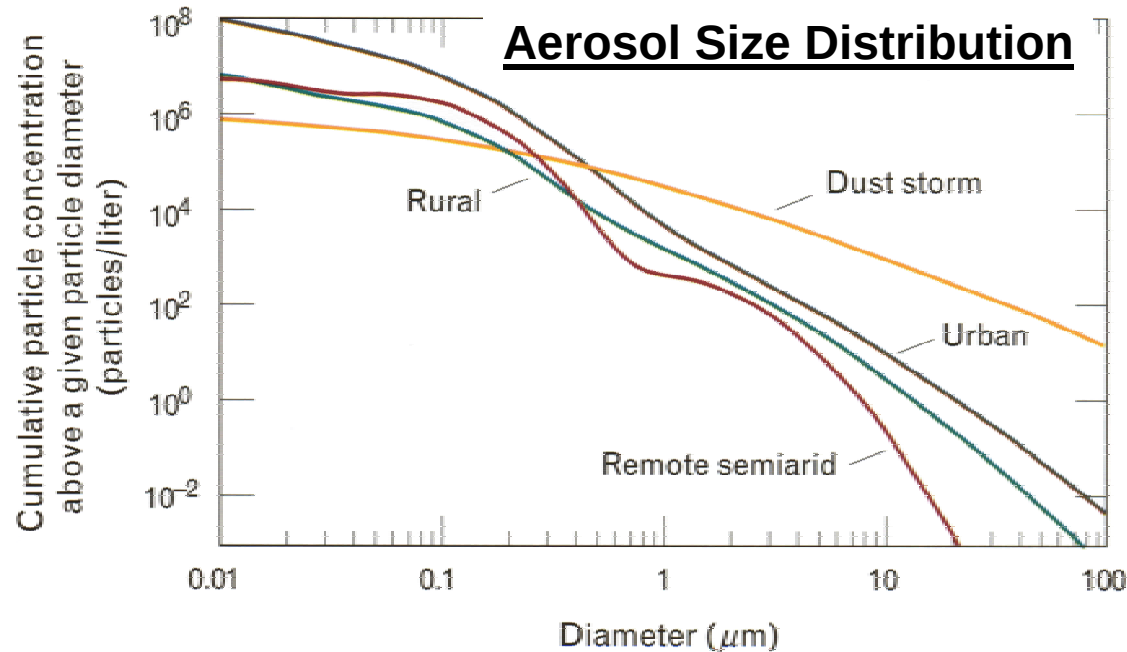
- Automated suite of sensors for detection and identification of biological attacks
 - Trigger – BAWS
 - Collector – Wetted Wall Cyclone
 - Identifier – Immunoassay
 - Confirmatory Samples



BAWS



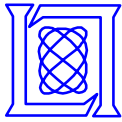
The Atmospheric Aerosol Composition



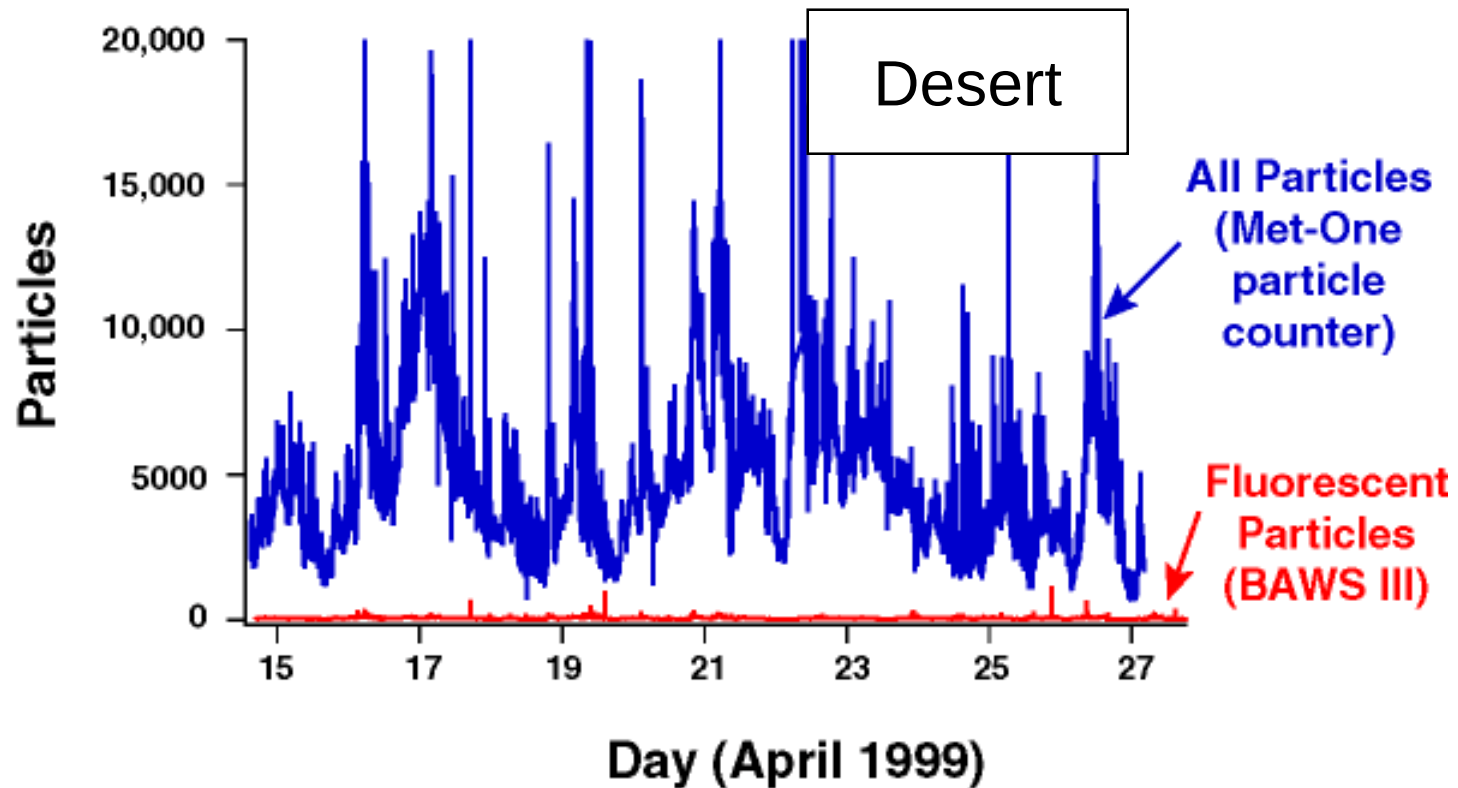
*After R. Jaenicke in Aerosol-Cloud-Climate Interactions, P. Hobbs editor (1993).

Composition of Coarse (>1 micron) Aerosol

Organic Aerosols	Particles per Liter		Inorganic Aerosols
Man Made	0 – 2000	100 – 10,000	Clays, Sands, Composites
Fungi	0 – 100		
Bacteria (culturable)	0 – 1		
Pollen	0 – 1		



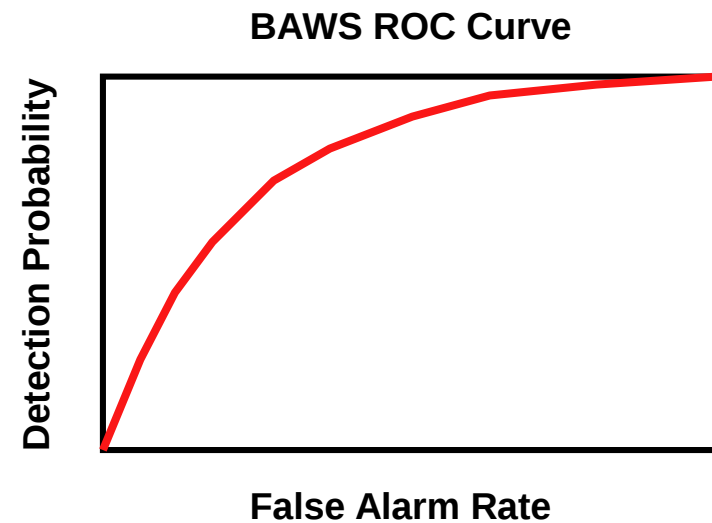
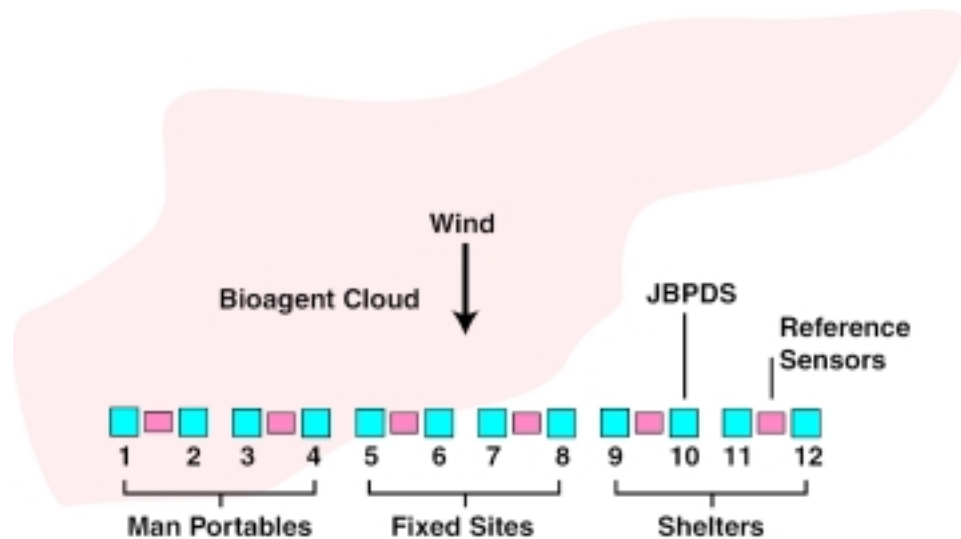
Total vs. Fluorescent Particles



- Most sand particles do not fluoresce and are “invisible” to BAWS

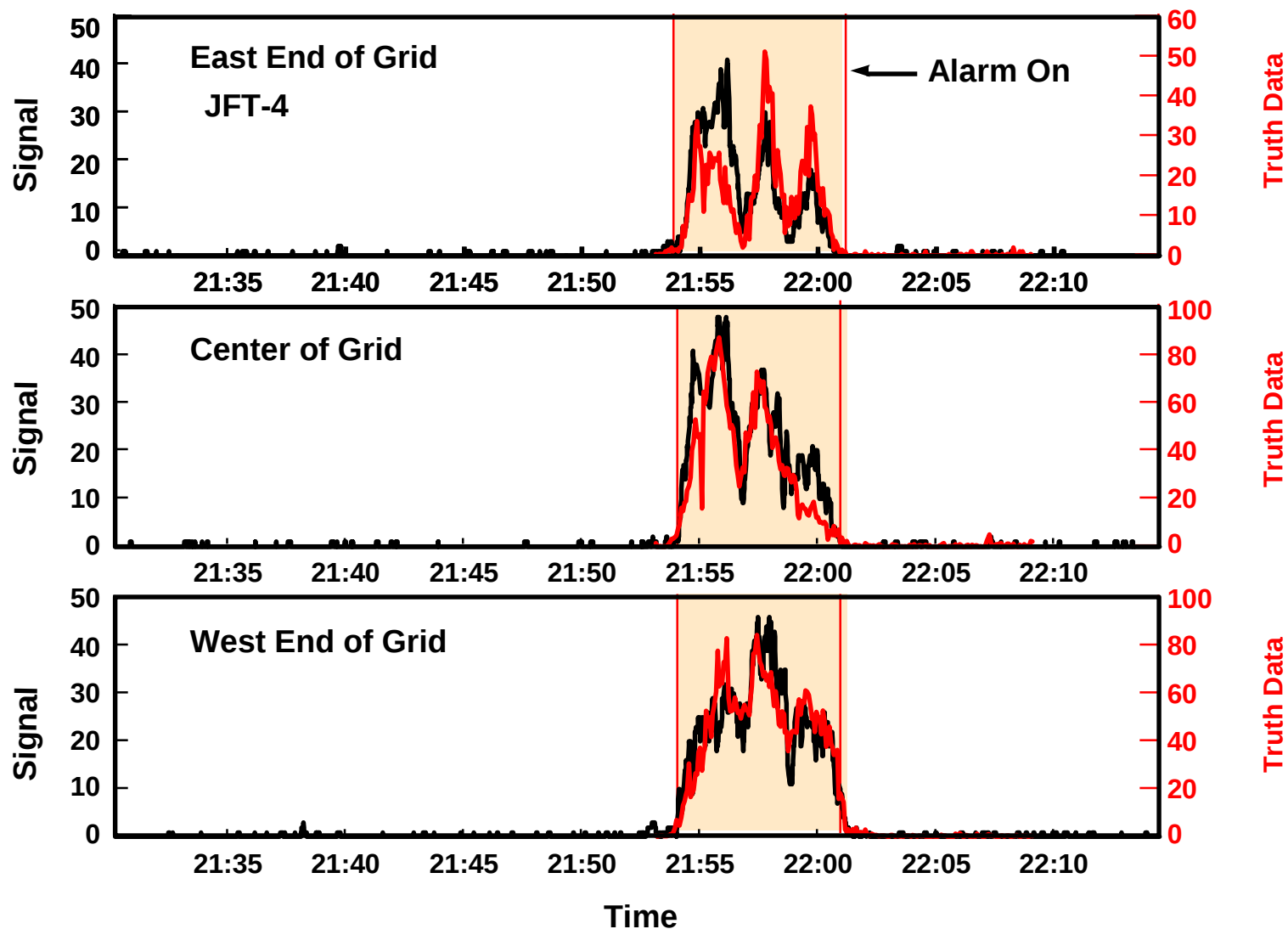


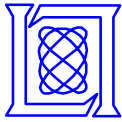
Field Trials





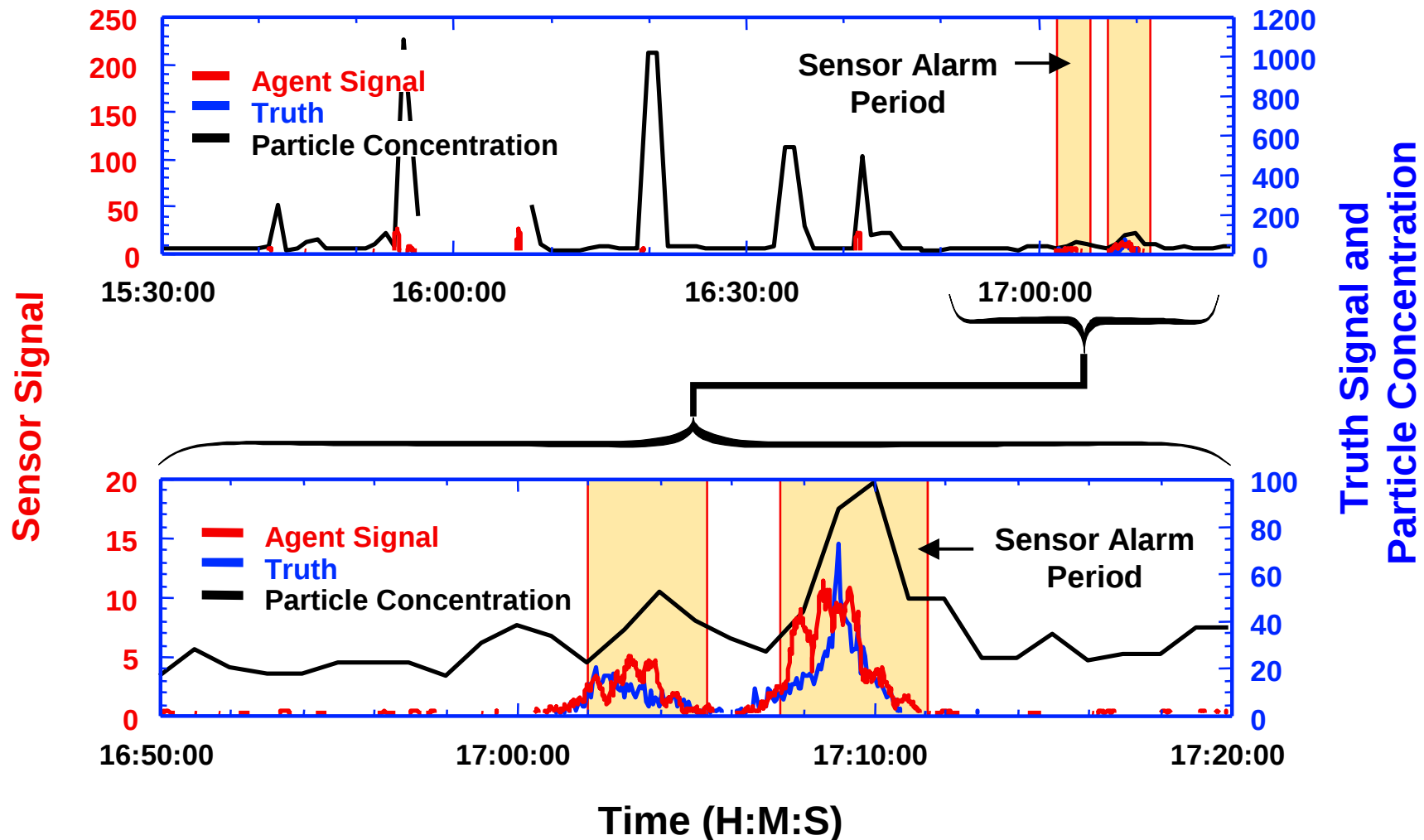
Response of BAWWS Array to Agent Aerosol

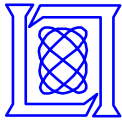




Response of BAWS to Interferent and Agent Aerosol

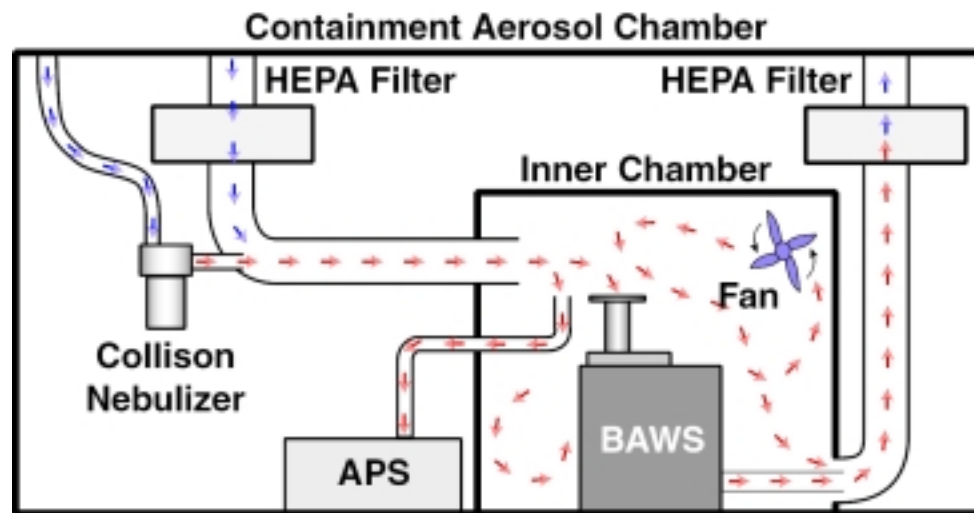
Sensor at East End of Grid



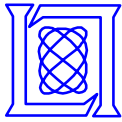


Live Agent Tests of BAWS

- Comparison of BAWS response to real agents and simulant agents
 - Simulant Agents; BG, *Erwinia herbicola*, Ovalbumin, MS2
 - Three Real agents

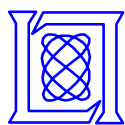


- Results: BAWS detects live agents as well as, or better than, simulant agents
 - Equivalent sensitivity
 - Equivalent discrimination

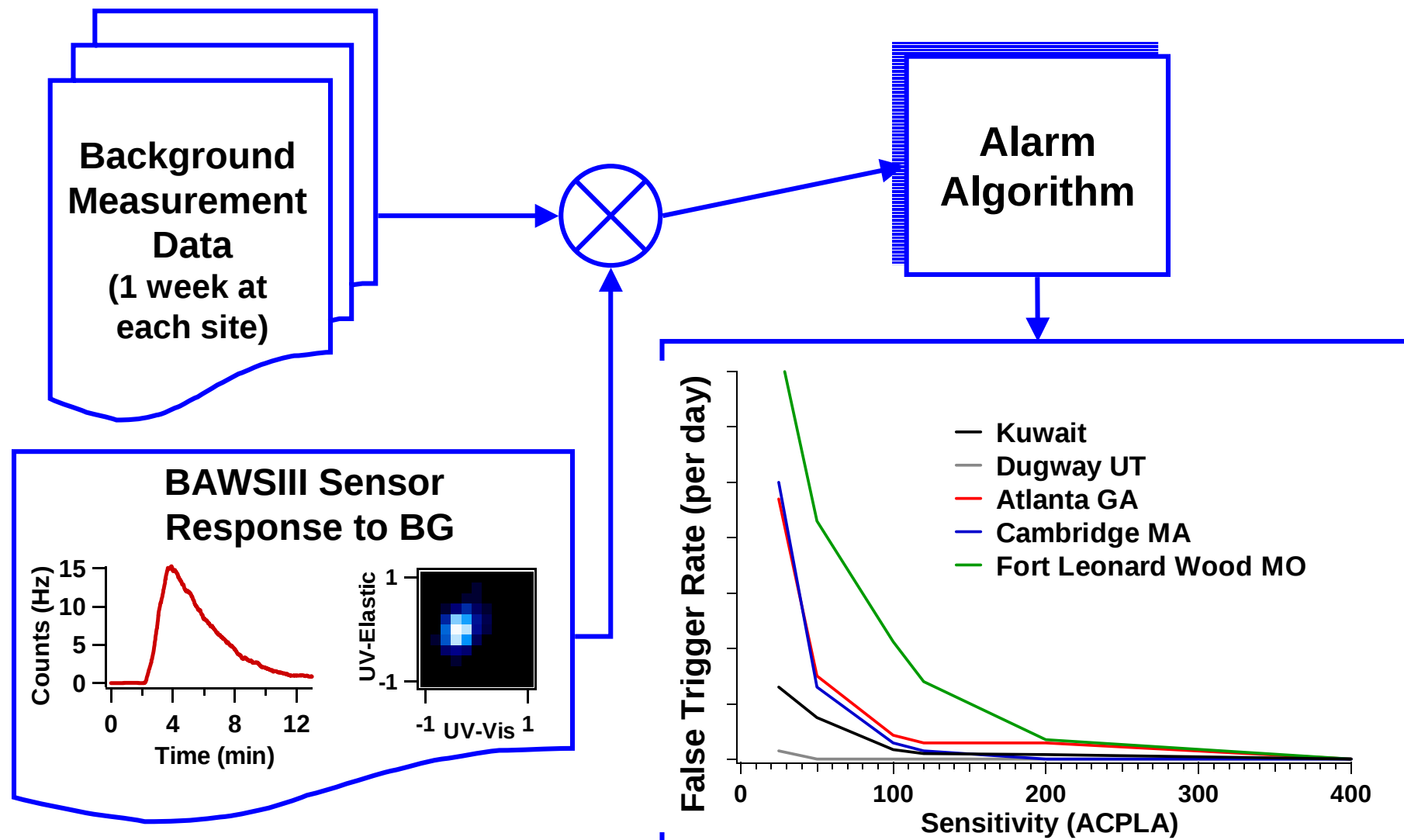


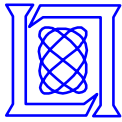
BAWS Performance Testing

- **Joint Field Trials**
 - JFT 3, Dugway Fall '96
 - JFT 4, Dugway Fall '97
 - JFT 4.5, Dugway Spring '98
 - JFT 6, DRES Canada Fall '00
- **Army ATD Field Trials** Spring '99
- **Joint Biological Point Detection System Field Trials**
 - Mini Field Trials Fall '99
 - Gamma-Killed Bio-Agents Spring '99
 - PPQT Spring '00
 - Live Agents Summer '00
 - Porton Down, UK Fall '00
 - Ambient Breeze Tunnel, Battelle Spring '01
 - Operational Assessment 2 Fall '01
- **Background Measurements**
 - USA tour '98 – '99
 - Kuwait Spring '99
 - Altitude study Fall '00
 - Salt Lake City Spring '01
 - Hawaii Summer '01



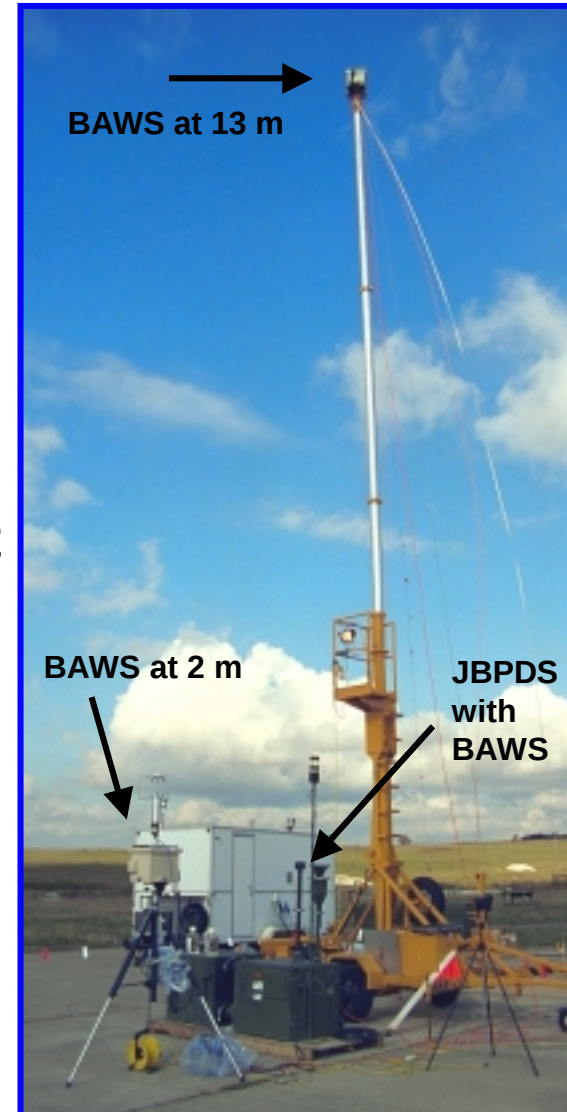
Simulation of BAWS Response to Agent Attacks in Different Environments

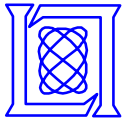




Detector Position vs. False Trigger Rate

- **England (Sep '00)**
 - One week of measurements
 - 21 agent simulant challenges
 - 8 interferent challenges
- **Sensor Performance vs. sensor height**
 - BAWS at 2-m and 13-m height
 - Ten times fewer false triggers at 13-m height





Summary

- **BAWS developed for early warning of a biological agent attack**
 - continuously operating point detector
 - small size, low weight, low power consumption
- **Generic detection (not identification) of threat aerosol**
 - Individual detection of aerosol particles
 - Discrimination of threat particles from non-threat particles
 - Sensitive, low false alarm rate, fast response
- **Subjected to extensive testing**
 - Performance
 - environmental
- **BAWS integrated into JBPDS**