



# Adaptive Trace Detection

## ADSA19

Advanced Development for Security Applications  
(ADSA) Workshop 19: Rapid Response to an  
Adapting Adversary

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**David A. Atkinson, Ph.D.**

Senior Research Scientist

Technical Group Manager – Applied Physics

Subsector Manager – DHS Aviation Security/Explosives Detection

National Security Directorate



PNNL is operated by Battelle for the U.S. Department of Energy

# Why should we care

- Trace detection is a critical technology

Understanding how to better implement a core detection technique is always valuable. This concept parallels the earlier work on algorithms which the DHS Center of Excellence was heavily involved in

- There is a pressing need to be adaptive to emerging threats

As new detonable chemicals/mixtures appear, the ability to add these quickly (and effectively) to the detection “suite” is vital

- Risk based screening concepts require adaptive detection systems

The ability to adapt a detection system in real time to passenger risk information is a desired capability. Certainly, trace detection systems can be tweaked quickly to increase sensitivity or reduce false alarms, but that is a trade-off space. Adaptations in sampling methodology can also be adjusted in real time based on threat/risk inputs

- If you’ve seen one airport.....

The adaptation of a detection system to local conditions and changes in those conditions would allow for tailoring of the system to be optimal for the deployment location

**Metadata** is "data that provides information about other data"

What does that mean for trace detection?

- Temporal (time, date)
  - e.g. 9/11, 4/19
  - end of shift
- Environmental (temperature, humidity)
  - Factors that impact sampling and instrument performance
- Sampling location
  - Handles of luggage vs. side, person hands vs. shoes vs. items in pocket
- Sampler/operator
  - Performance variabilities
- Instrument metrics
  - Samples in past hour, RIP intensity



**IONSCAN 500DT**

Explosives and narcotics trace detector

Used at aviation security checkpoints across the globe, the IONSCAN 500DT is a highly sensitive desktop system capable of detecting and identifying trace amounts of explosives and narcotics.



**Itemiser® 4DX**

Aviation approved non-radioactive-based explosives and narcotics detection.



**B220™ Desktop Trace Detector**

Desktop real-time explosives and drugs trace detection

## adaptability

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### NOUN

*[mass noun]*

- 1 The quality of being able to adjust to new conditions.  
*‘adaptability is an advantage in the harshly competitive global economy’*  
*‘the adaptability of cod to climate change’*
  - 1.1 The capacity to be modified for a new use or purpose.  
*‘this is a good example of the adaptability of listed buildings’*

## For trace detection, this could mean:

- Adjustment of system parameters (hardware or software) to emerging threats
- Adjustment of system parameters to changes in local conditions (e.g. humidity, RIP intensity, sample type)
- Adjustment of system parameters based upon provided risk information

# Adaptive Trace Detection

- IMS provides a cost effective system and sensitive response in a reasonable form factor. There is opportunity for the addition of adaptive measures, including risk based adaptations, chemistry adjustments to reduce false alarms and increase sensitivity and adjustments for local conditions
- Mass spectrometry (MS) provides a high resolution platform, however, using this directly for unknowns is unlikely in an operational scenario (still relies on library based identification)
- TOF-MS can reduce false alarms through the use of high resolution peaks (accurate mass) if properly calibrated
- Emerging explosive threats will still need to be laboratory validated before use
- Although trace detection platforms have room for adaptation, understanding response under a variety of environmental and instrumental conditions is vital
- More discussion is warranted to identify the best areas for trace enhancement

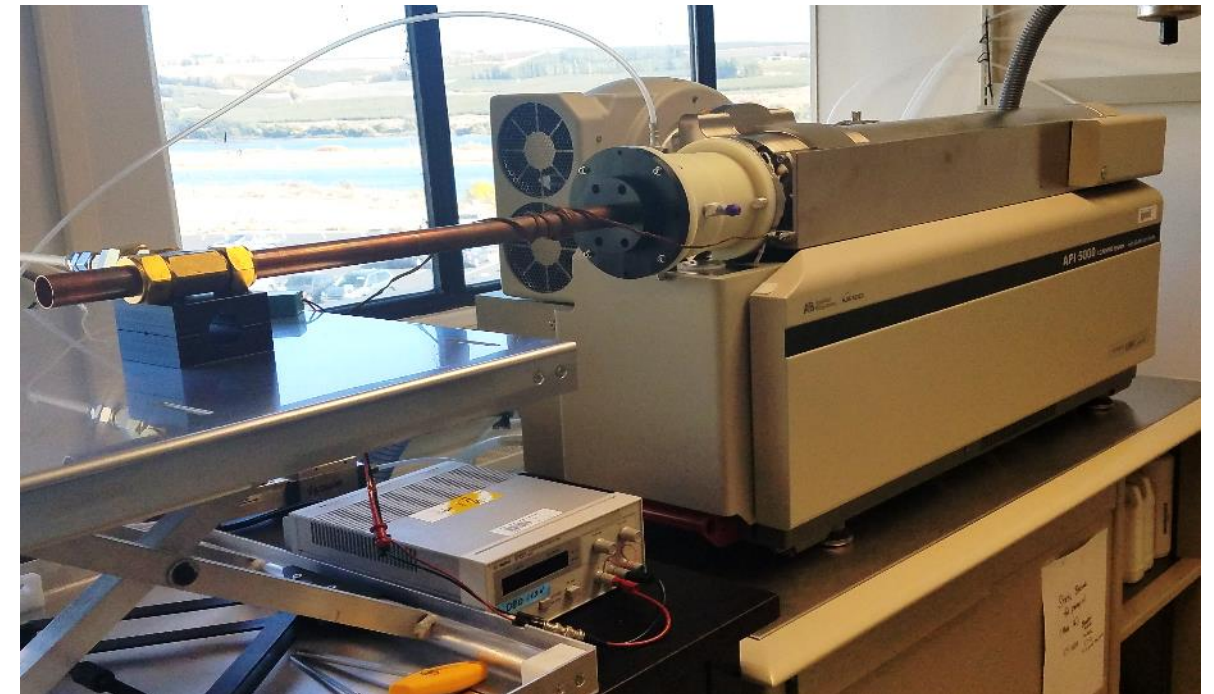
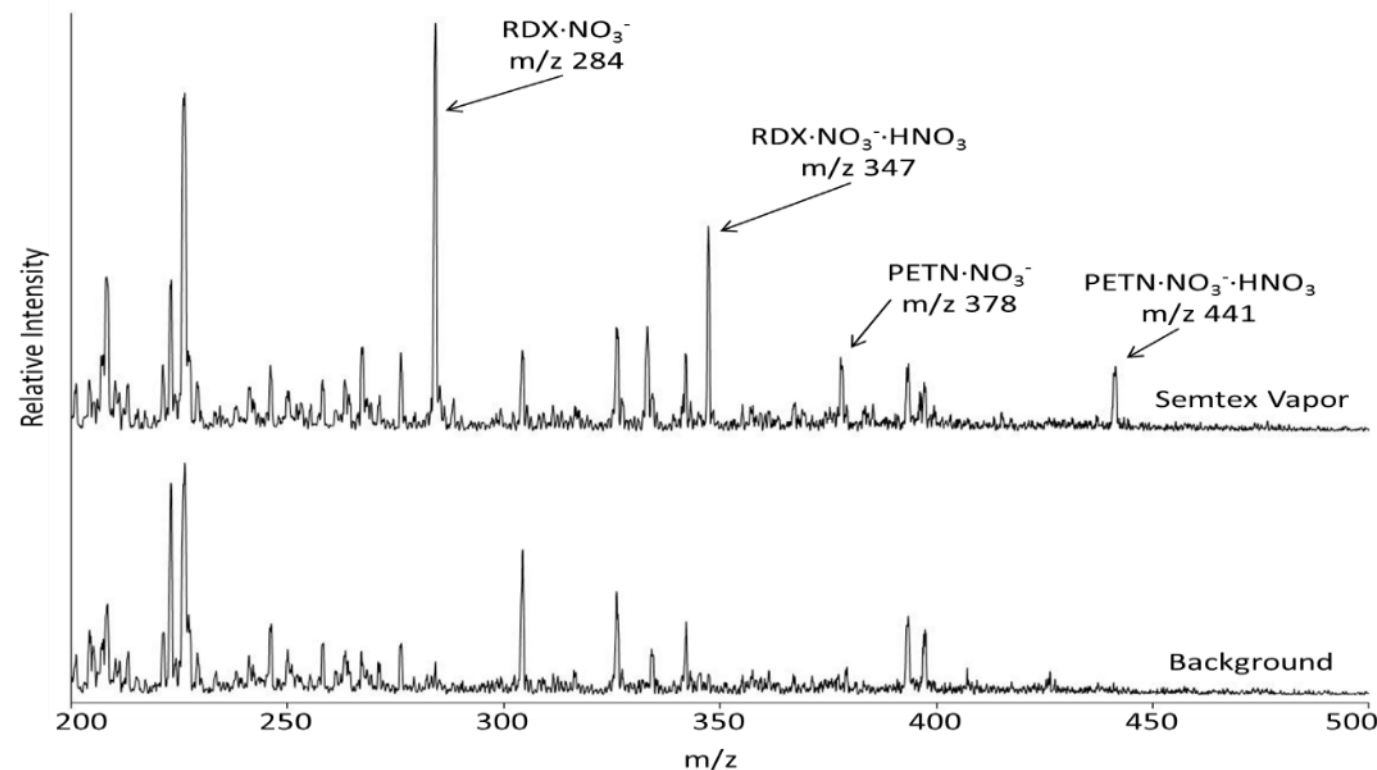


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# Trace Detection Systems

Although ion mobility spectrometry (IMS) systems populate the current “certified” systems list, mass spectrometry is considered by some to be the future of trace detection.

Although the cost benefit/size tradeoffs of using mass spectrometry need to be studied in detail, there is no question that mass spectrometry has the potential to be a more adaptable trace detection system than IMS.



Opportunities to Improve Airport  
Passenger Screening with Mass  
Spectrometry



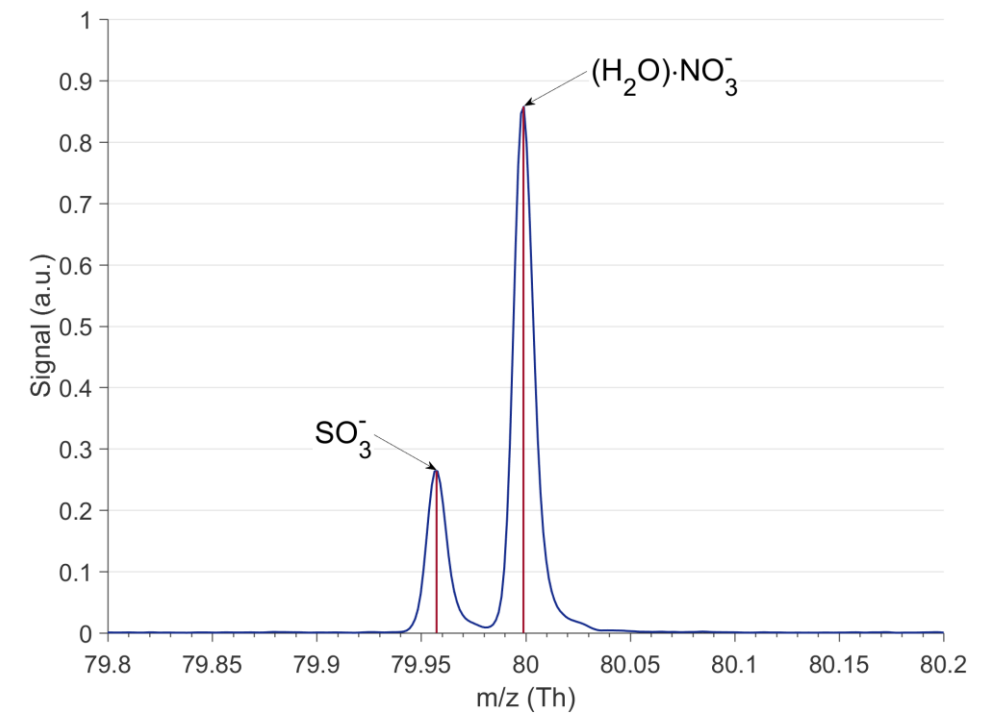
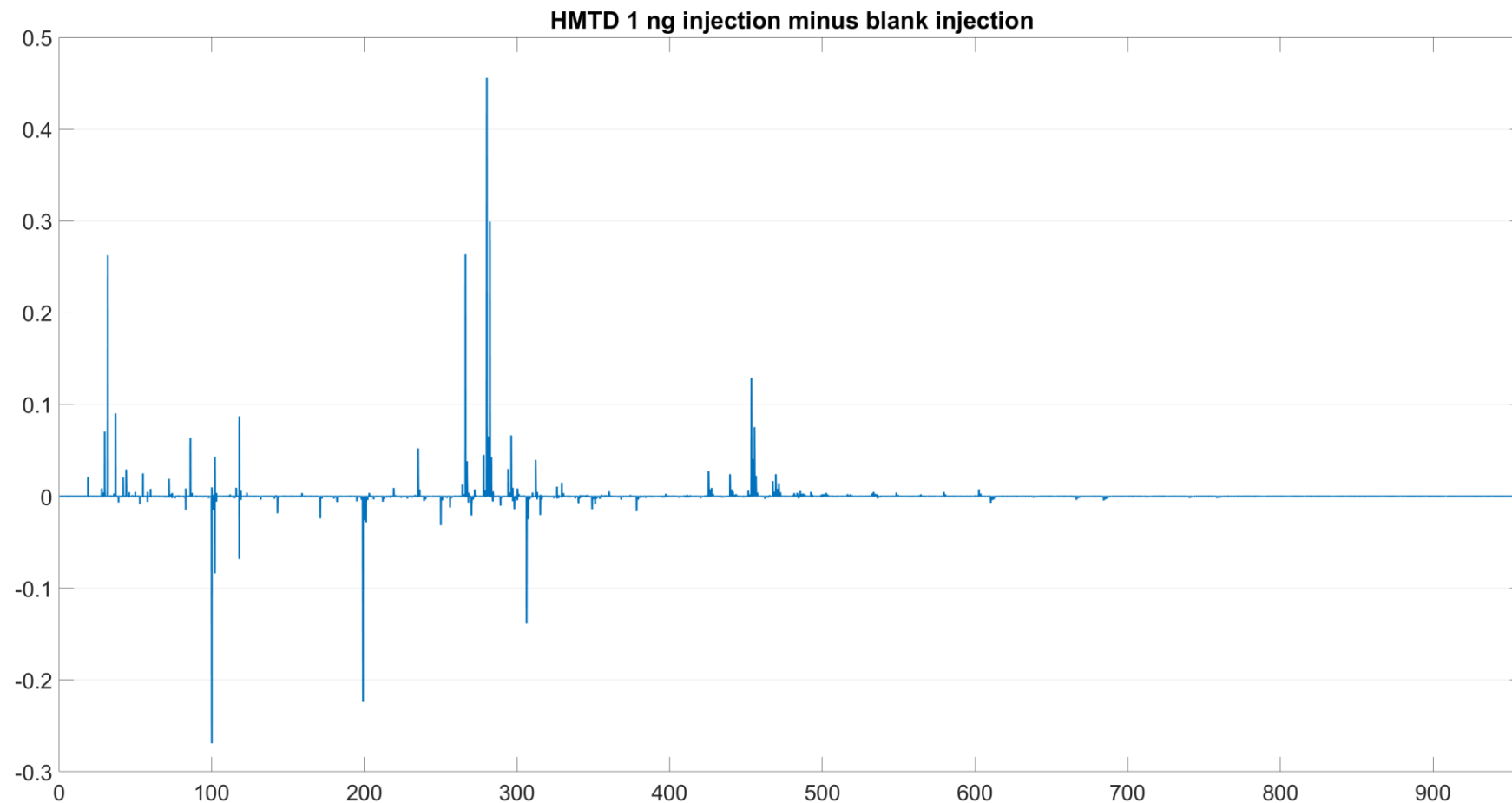
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# Trace Detection Systems



Collaboration between KARSA and PNNL has mated PNNL's patented atmospheric flow tube with a time of flight mass spectrometer (TOF) at KARSA

- TOF provides all ions simultaneously
- TOF mass resolution is high
- Sensitivity was comparable to the triple quad Sciex API 5000 for RDX





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**Thank you**