



ONE COMPANY TOTAL SECURITY

**Coherent x-ray scatter (CXS)
for material discrimination at
a checkpoint**

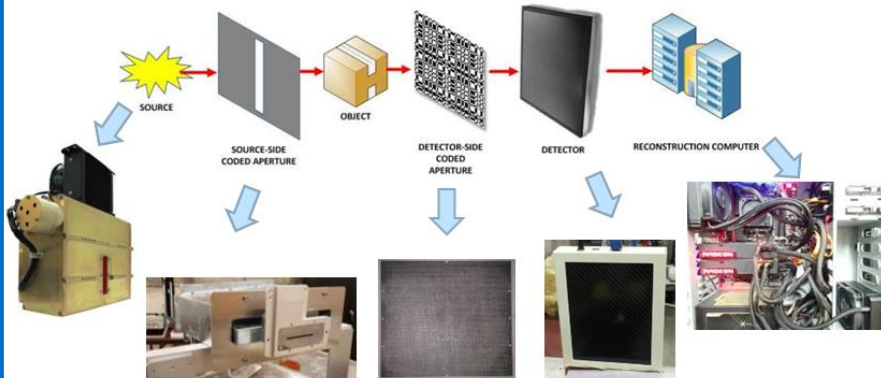
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**Rapiscan[®]
systems**

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Summary

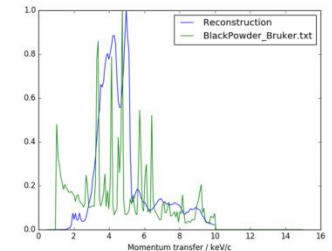
Topic: Baggage Screening



Problem: Improve performance through material discrimination



Is there a threat?



Yes!

Solved how?

- Added a new measurement technique – Coded Aperture X-ray Scatter Imaging (**CAXSI**) to existing DE x-ray transmission imaging scanner
- + x-ray flux, + detectors, + unique signatures, + GPU reconstruction, + data, + classifier for CAXSI signature

So what?

Potential Benefits:

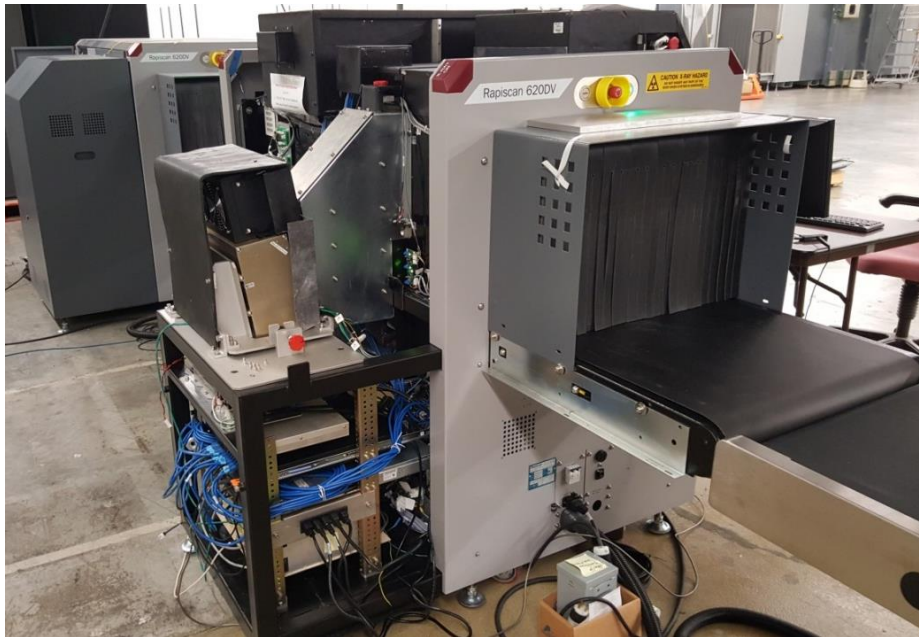
- Reduced false alarm rate
- Usability improvement – automate

Necessary advancements to deploy:

- High-flux, compact, air-cooled x-ray sources
- Efficient 2D detector arrays
- GPUs following published roadmap
- Competitive cost structure

Prototype systems

- Built two TRL-6 systems
 - 620DV-CAXSI uses 2D energy-integrating detector arrays
 - 620XRh-CAXSI uses 2D spectroscopic detector arrays



620DV_CAXSI



620XRh_CAXSI

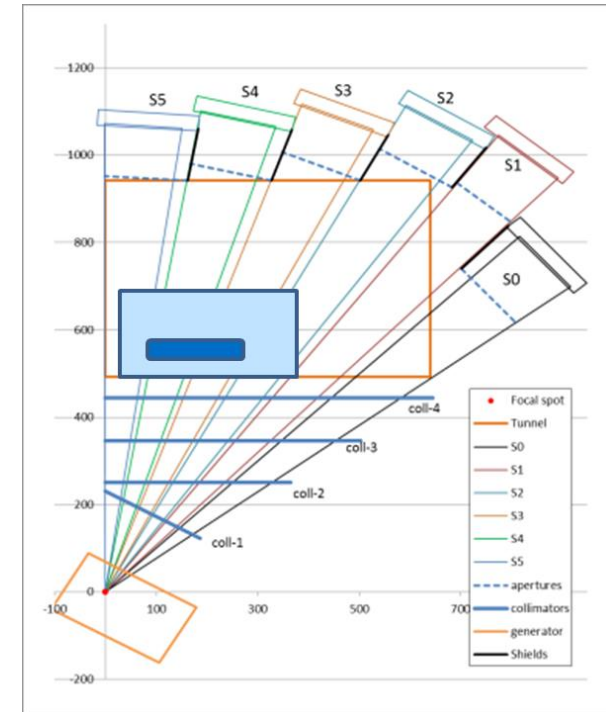
In-house data collection

- 620DV-CAXSI system placed in-line with a 620XR system
 - Data collection used explosives in relevant quantities and dimensions
 - Samples placed in bins and bags with varying amounts of clutter
 - Scatter and dual-energy images obtained for all scans

Test Material	Base Explosive	Thickness or Diameter (mm)
C4	RDX	25, 50, 75
Detcord	RDX	NA
Cast Booster 66	PETN	50
Cast Booster 88	PETN	50
Durasheet	PETN	5
Detasheet	PETN	4.5
TNT flakes	TNT	70
Dynamite	Nitroglycerine	60
Black Powder	Black Powder	50
Detagel emulsion	Ammonium Nitrate	80
Blasting agent emulsion	Ammonium Nitrate	60



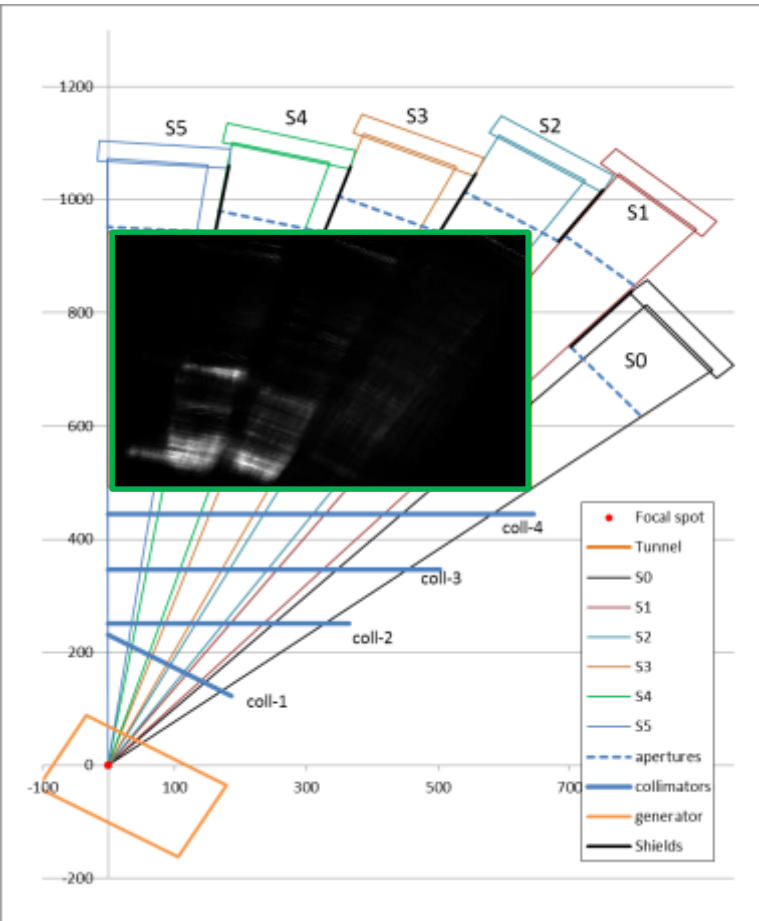
Imaging chain



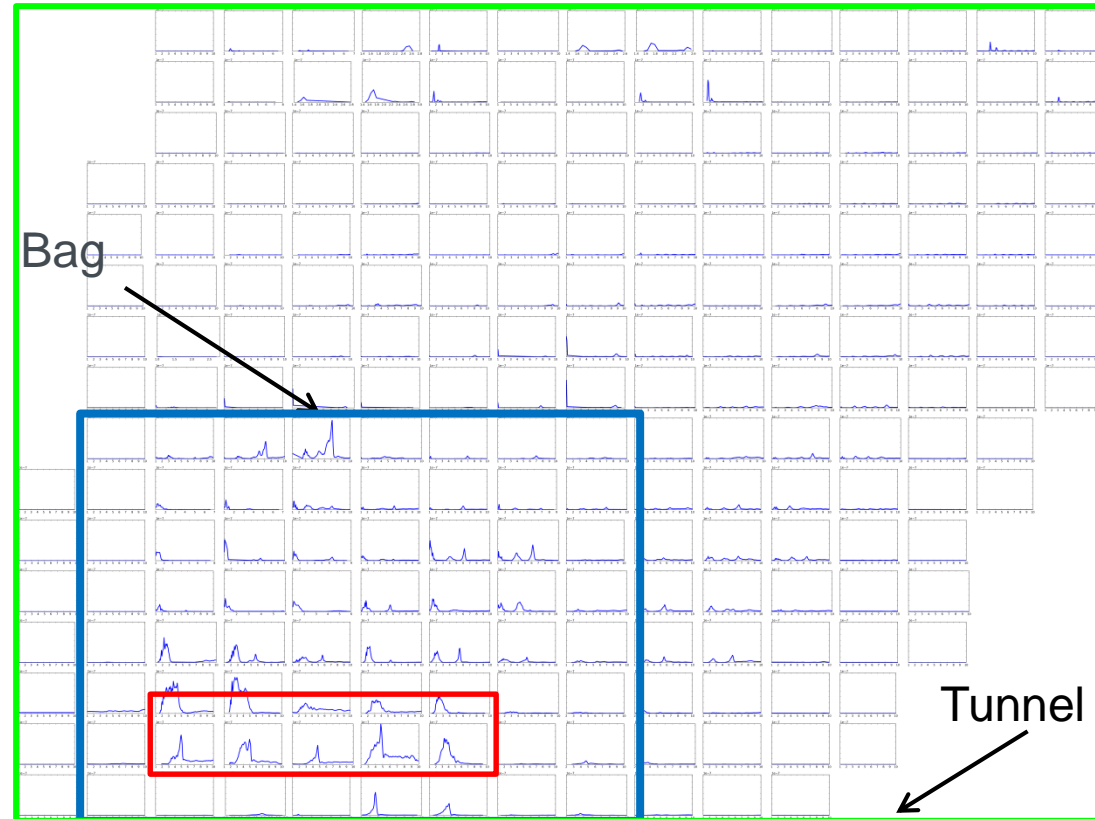
- Dual-energy (DE) image is currently only used to determine the scan slices used in the reconstruction
- DE images will be used to correct for attenuation by the bag in the future

CAXSI signature is localized in the tunnel

Density Image



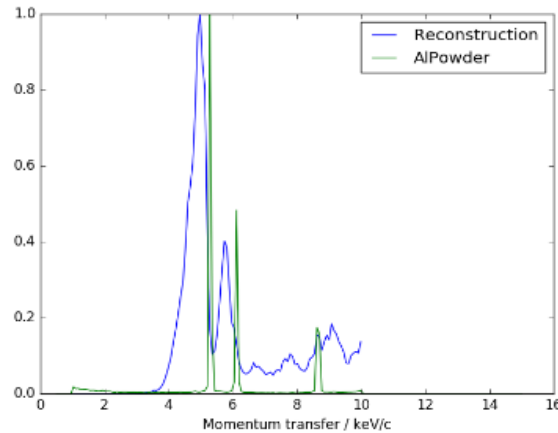
Momentum Transfer



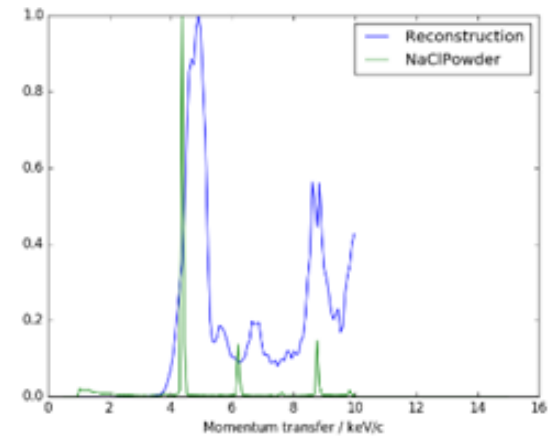
Data analysis



Aluminum Plates



Salt



- Initial results show recovery of the primary momentum transfer peaks
 - They are shifted from their reference locations
 - They are broadened compared to the reference q peaks
 - Additional work is required to determine the origin of the artifacts, how they can be reduced, and their impact on classification

Thank You