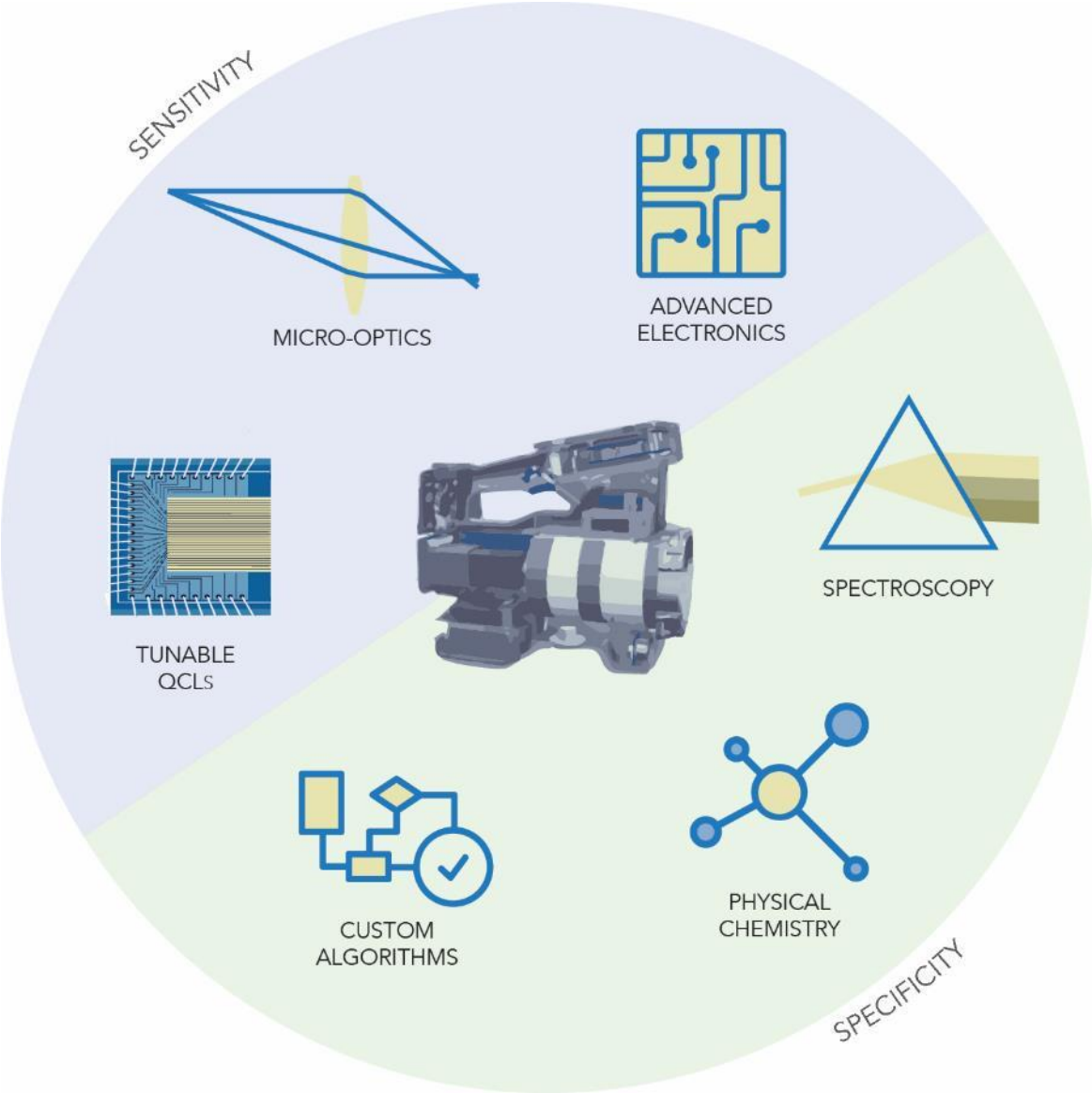
Eyesafe Standoff: Detection of Hazards Using Quantum Cascade Laser Arrays

21 June 2018

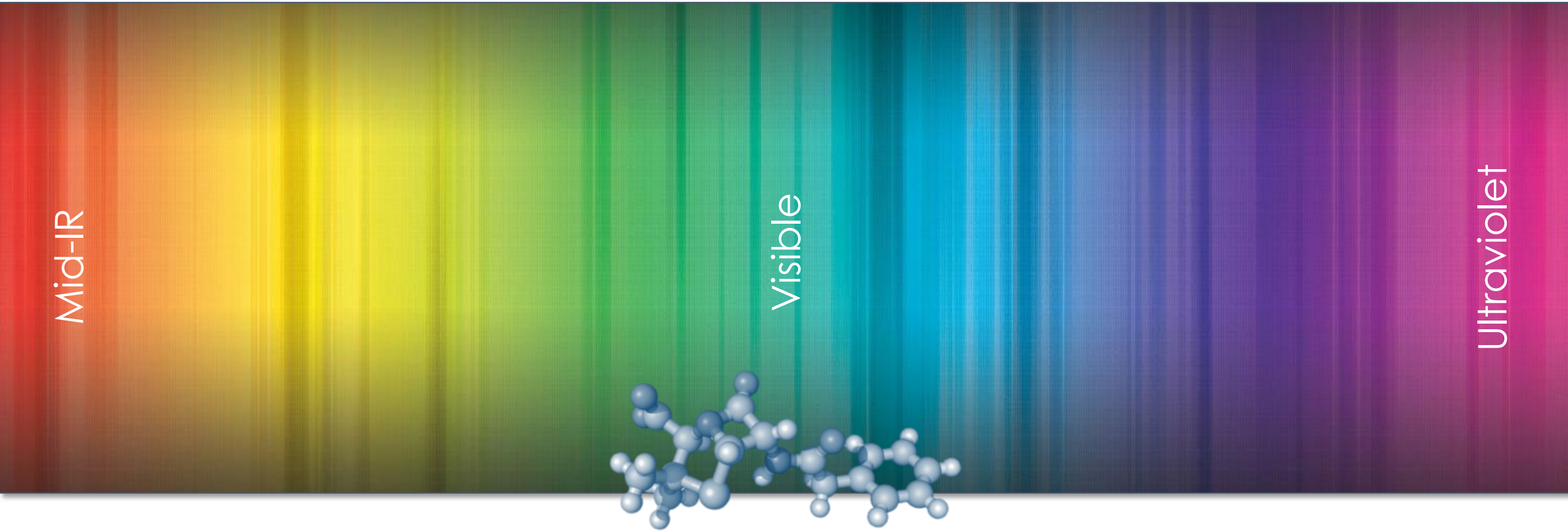
Mark Francis Witinski

PENDAR TECHNOLOGIES

A Capability Need: Portable Eyesafe Proximal *CHEMICAL* ID

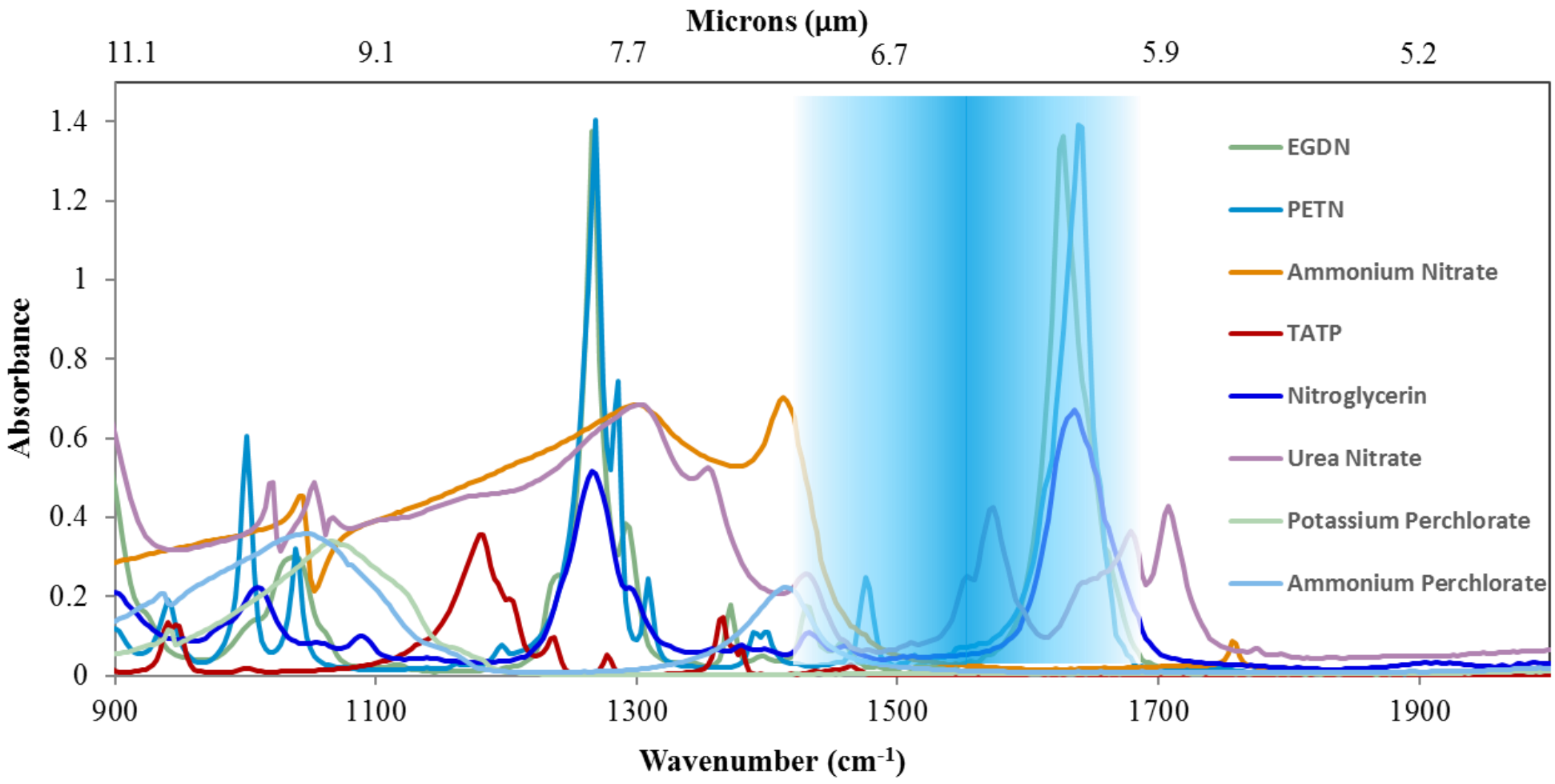


Spectral Options

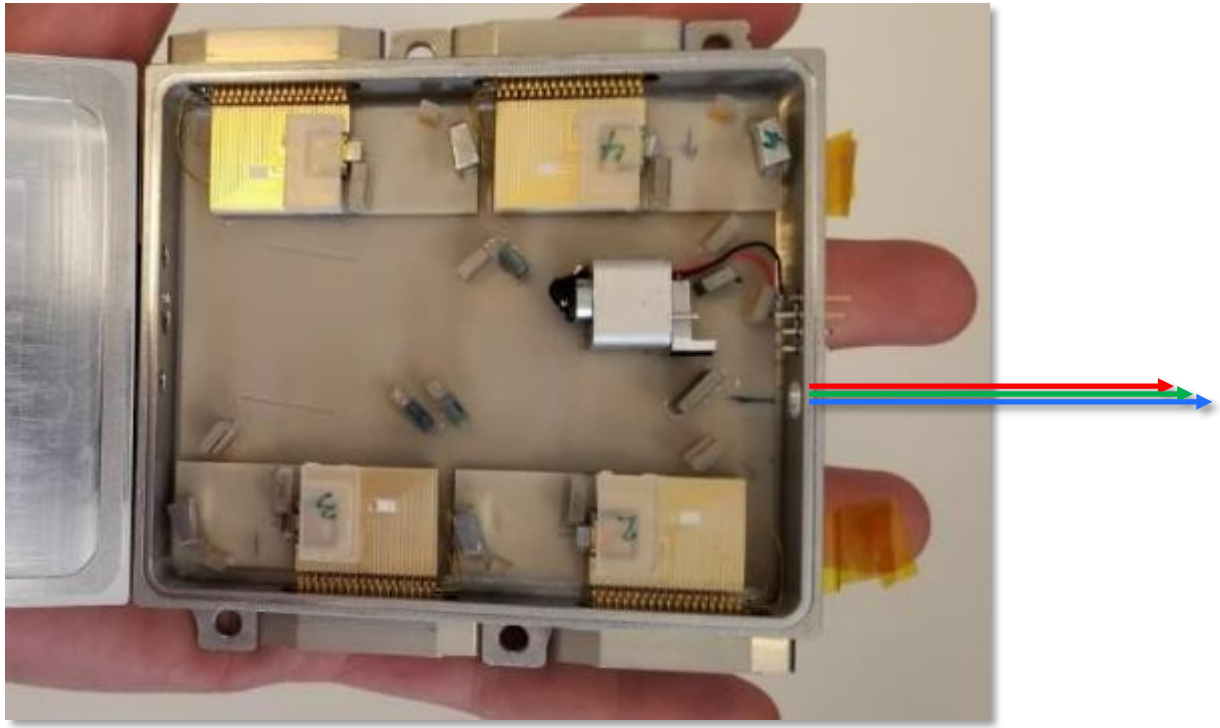


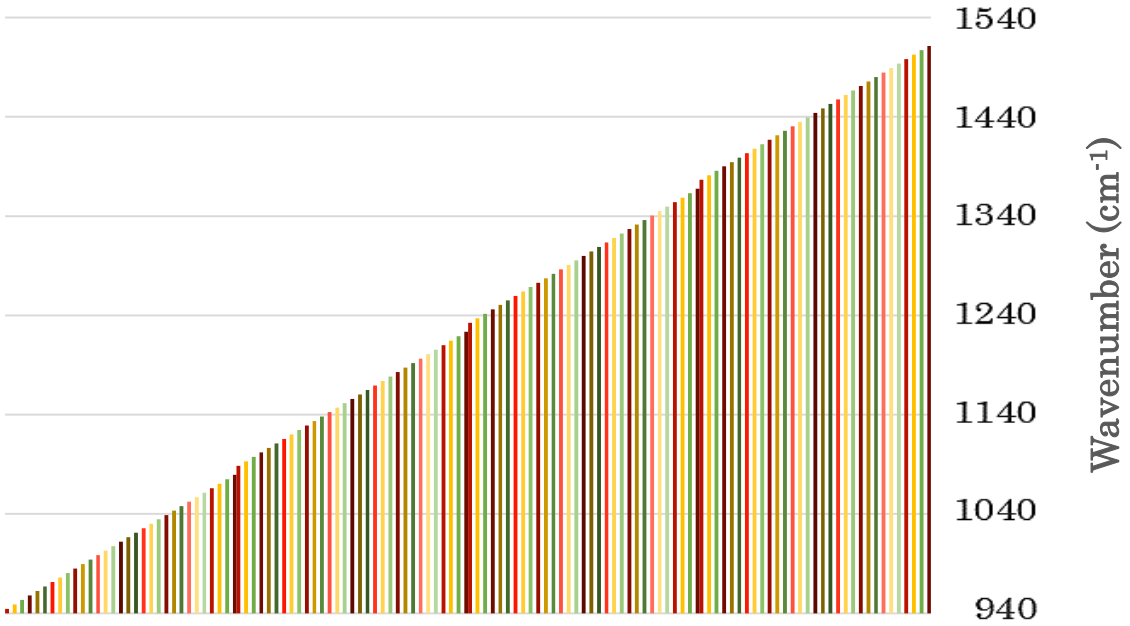
Goal: Detect Explosives, Precursors, CWAs, Fentanyls, and Emerging Threats.

The Long Wave Infrared (LWIR)



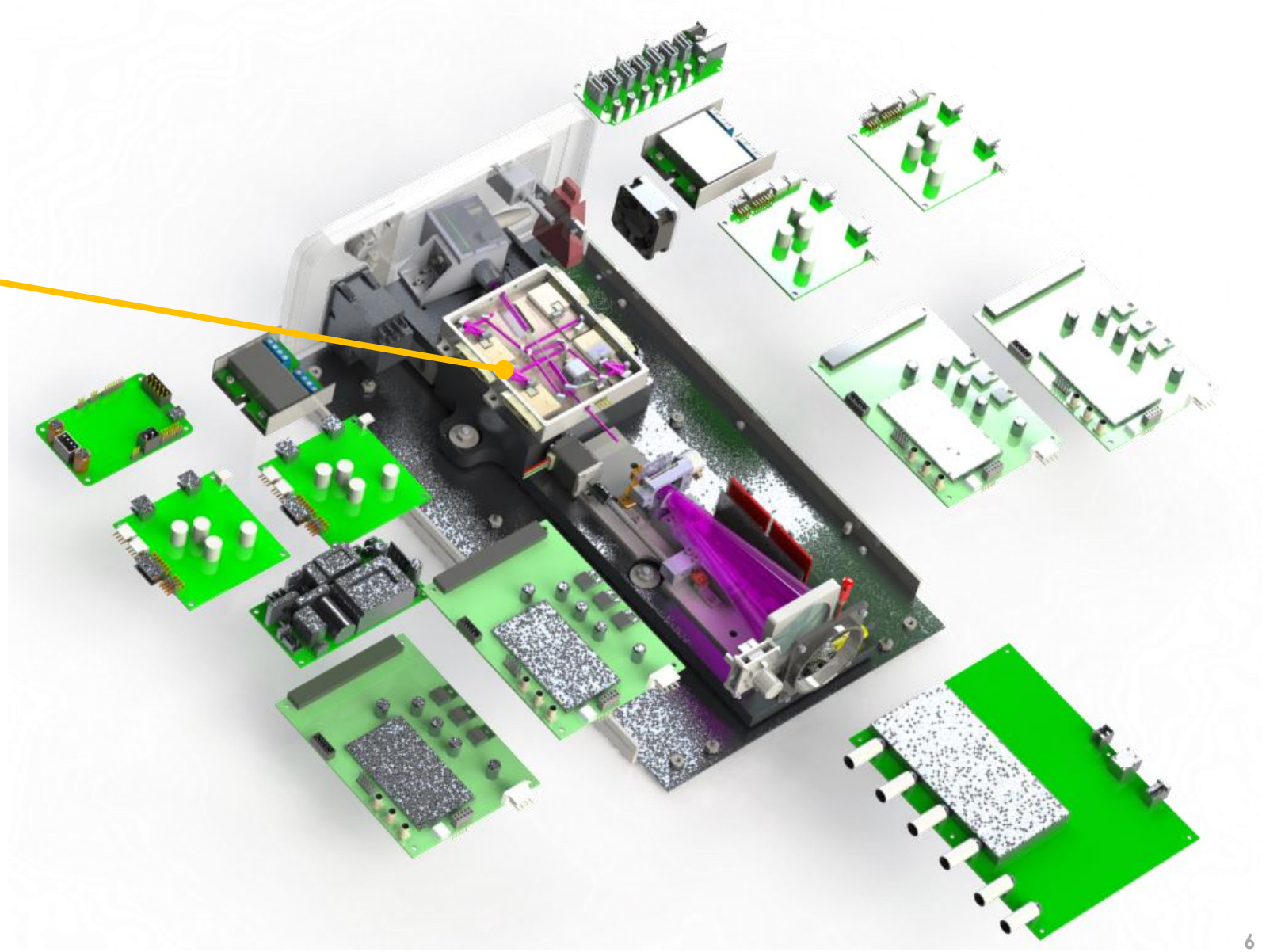
A New Laser Source for the Full Long Wave IR



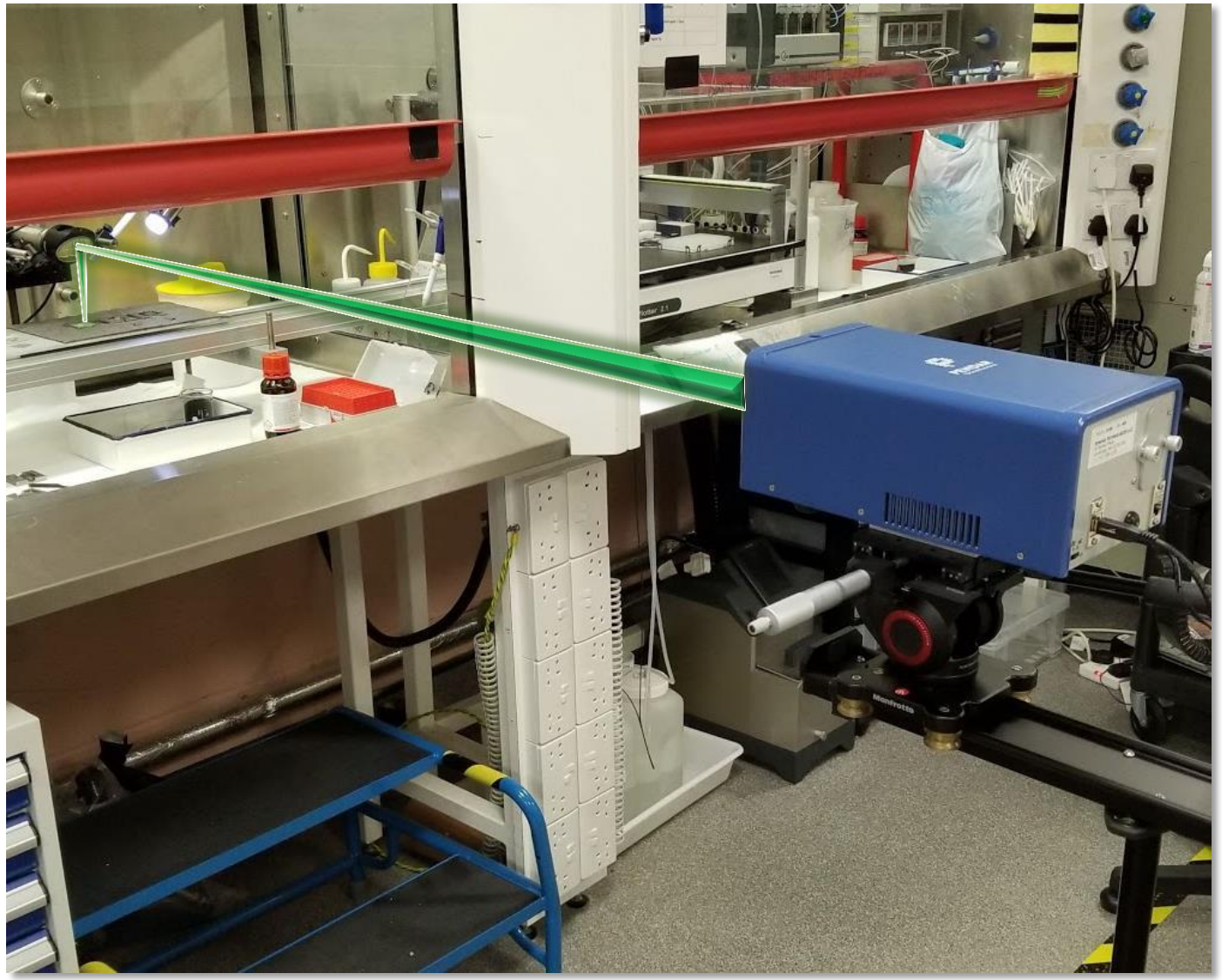


Experimental Result of Combining 128 Lasers (Four Arrays)

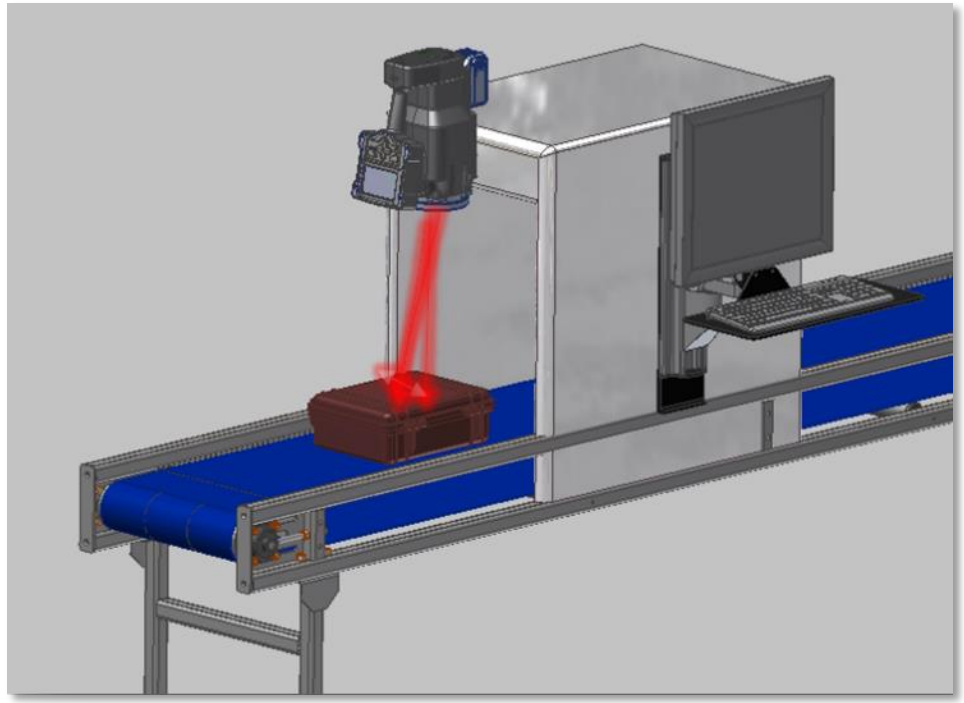
Source Integration with Electronics



Laboratory Testing at 1.3 Meters



Use Case One - TSA

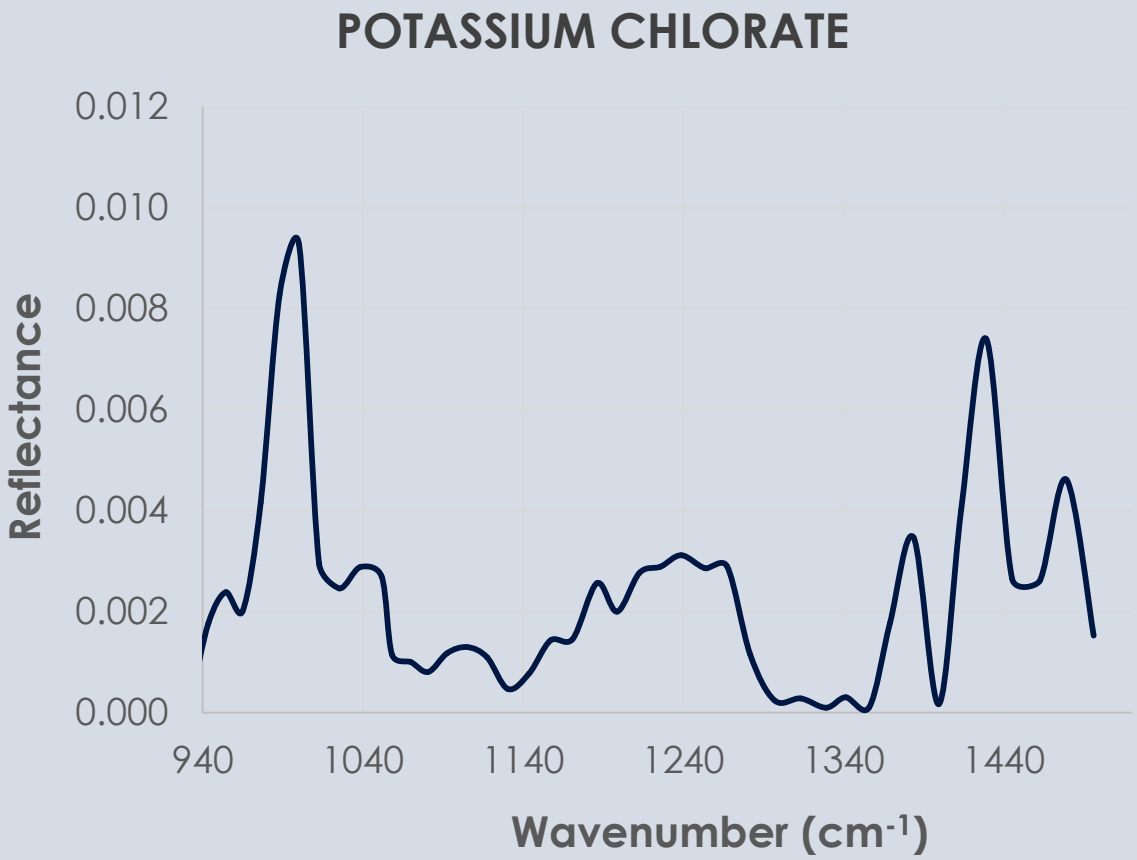


TSA Requires Speed →
Speed Requires Stability <u>and</u> Location

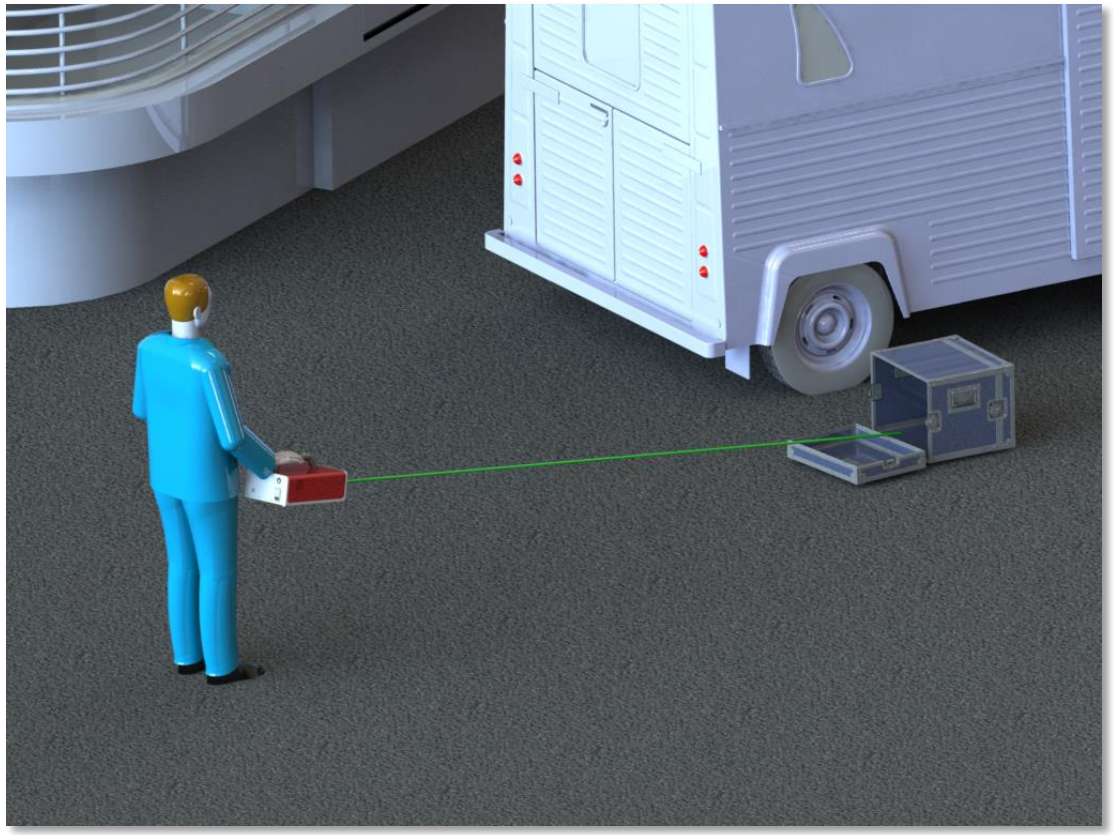
Use Case One - TSA

TSA Requires Speed →
Speed Requires Stability <u>and</u> Location

Testing in the Lab: Precursors



Use Case Two – CBP and Others

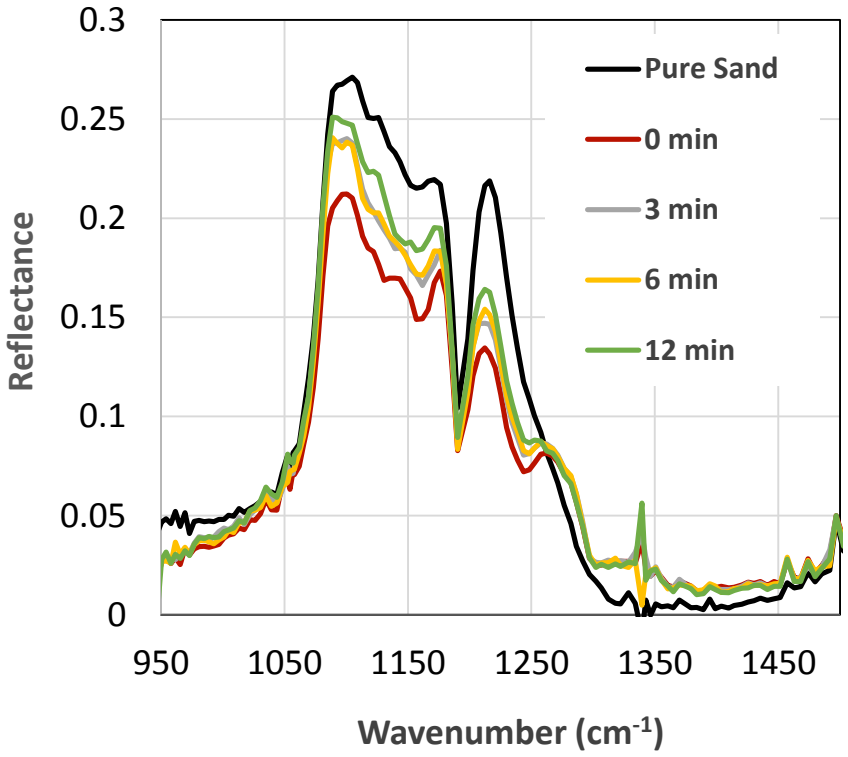


Handhelds Require Speed →
Speed Requires Stability <u>and</u> Location

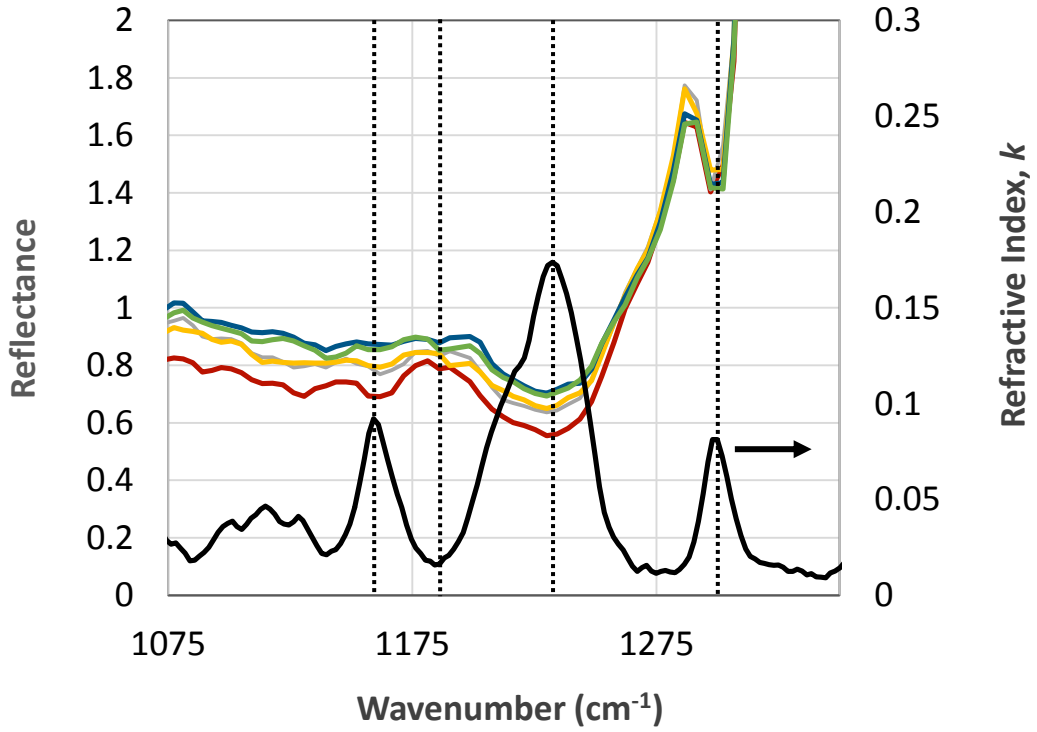
Three Limiting Cases for Liquids:

- Liquid Seepage Into Substrate
- Liquid Spread Over Substrate
- Droplet Dependent Reflectance

Case One: Seepage of VX Into Sand Substrate

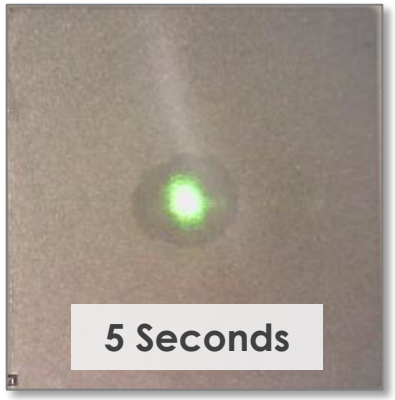


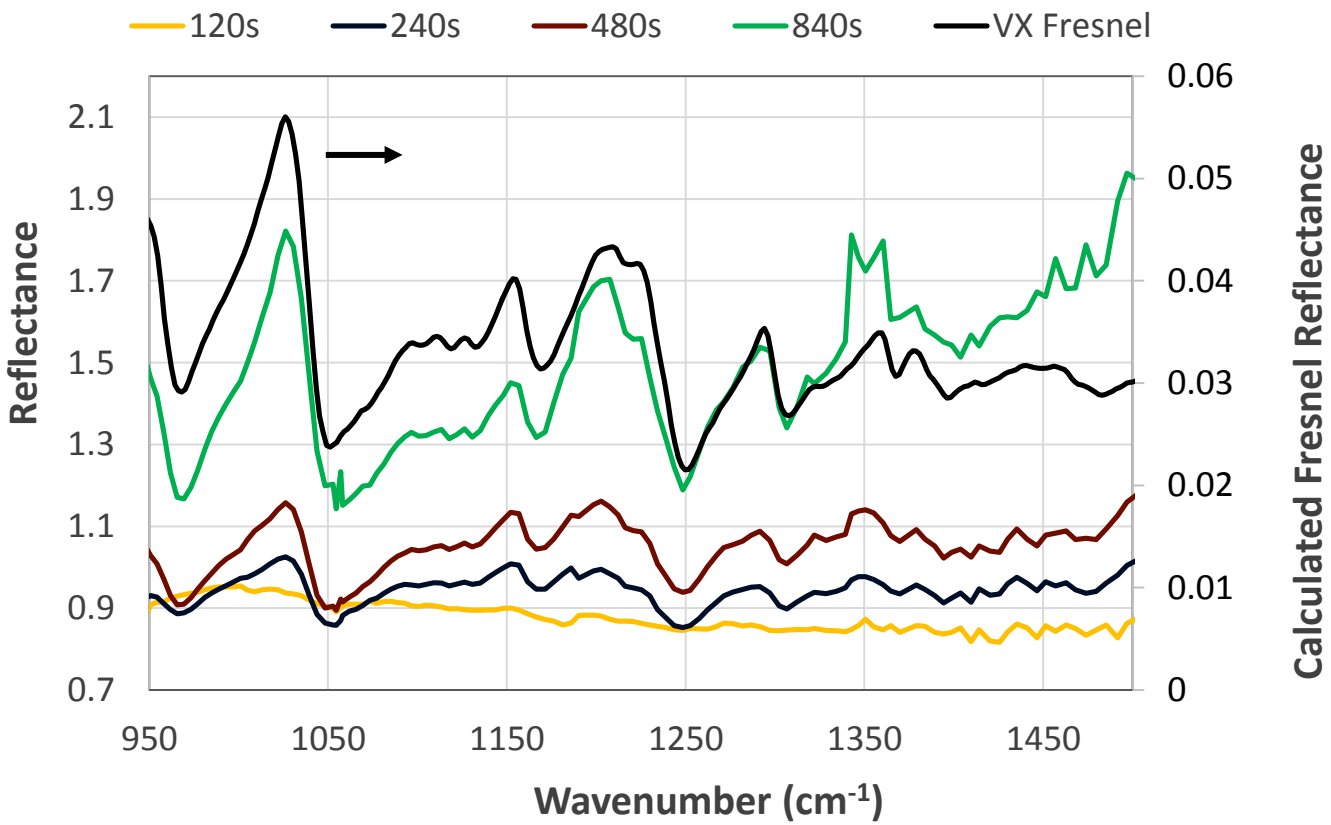
Diffuse reflectance of 60 µL of VX on sand as a function of time.



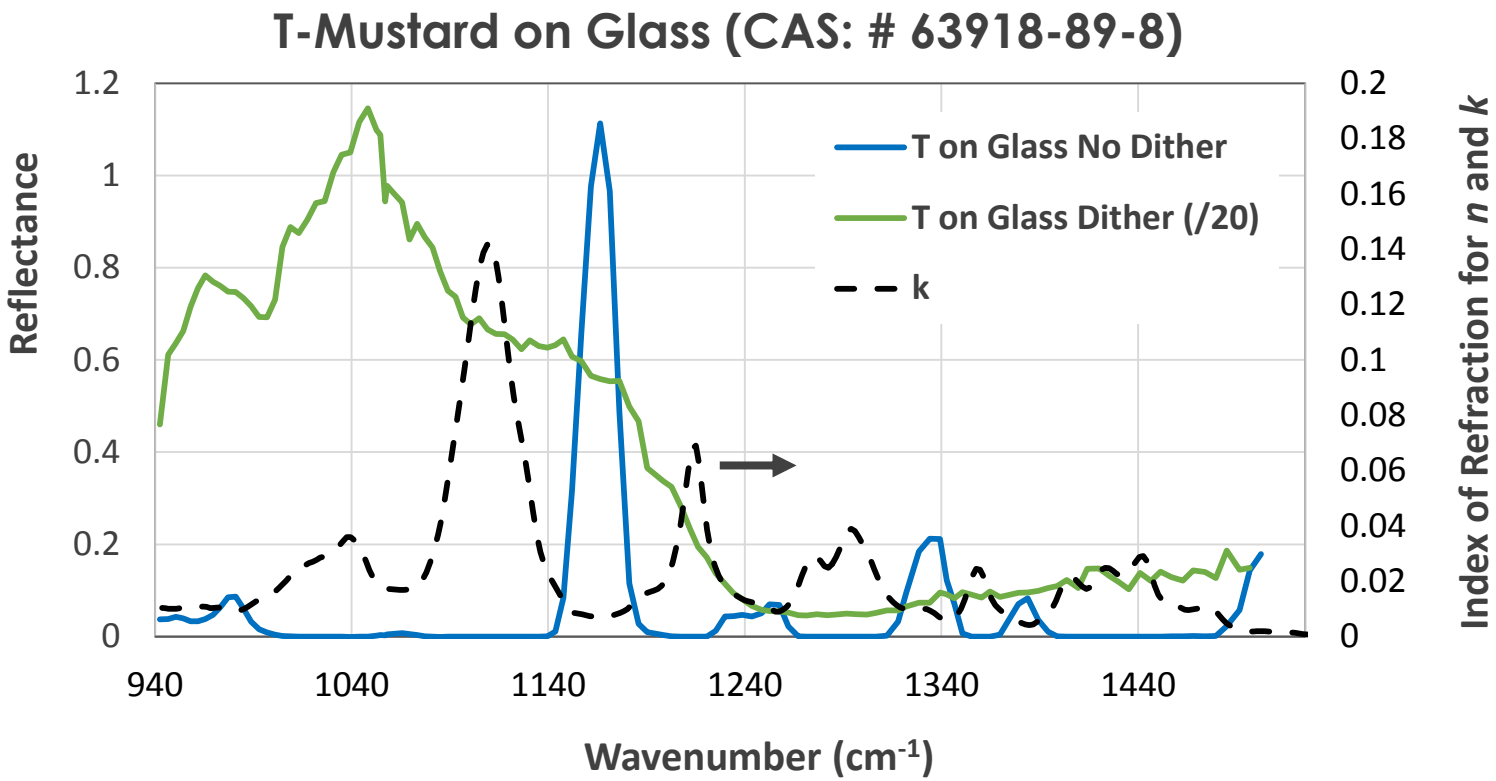
Diffuse reflectance of same divided by that of sand. The black line on right plot is *k* of VX.

Case Two: Droplet Spread of VX Over Substrate





Case Three: Substrate Reflectance and Affinity



Where are we Going?

1. Engage ALL Relevant Chemical Classes (Explosives, CWAs, Fentanyl, Masking Agents)
2. Automate Object Recognition and Scanning
3. Field Testing in Multiple Salient Environments

Thank you.

Mark F. Witinski

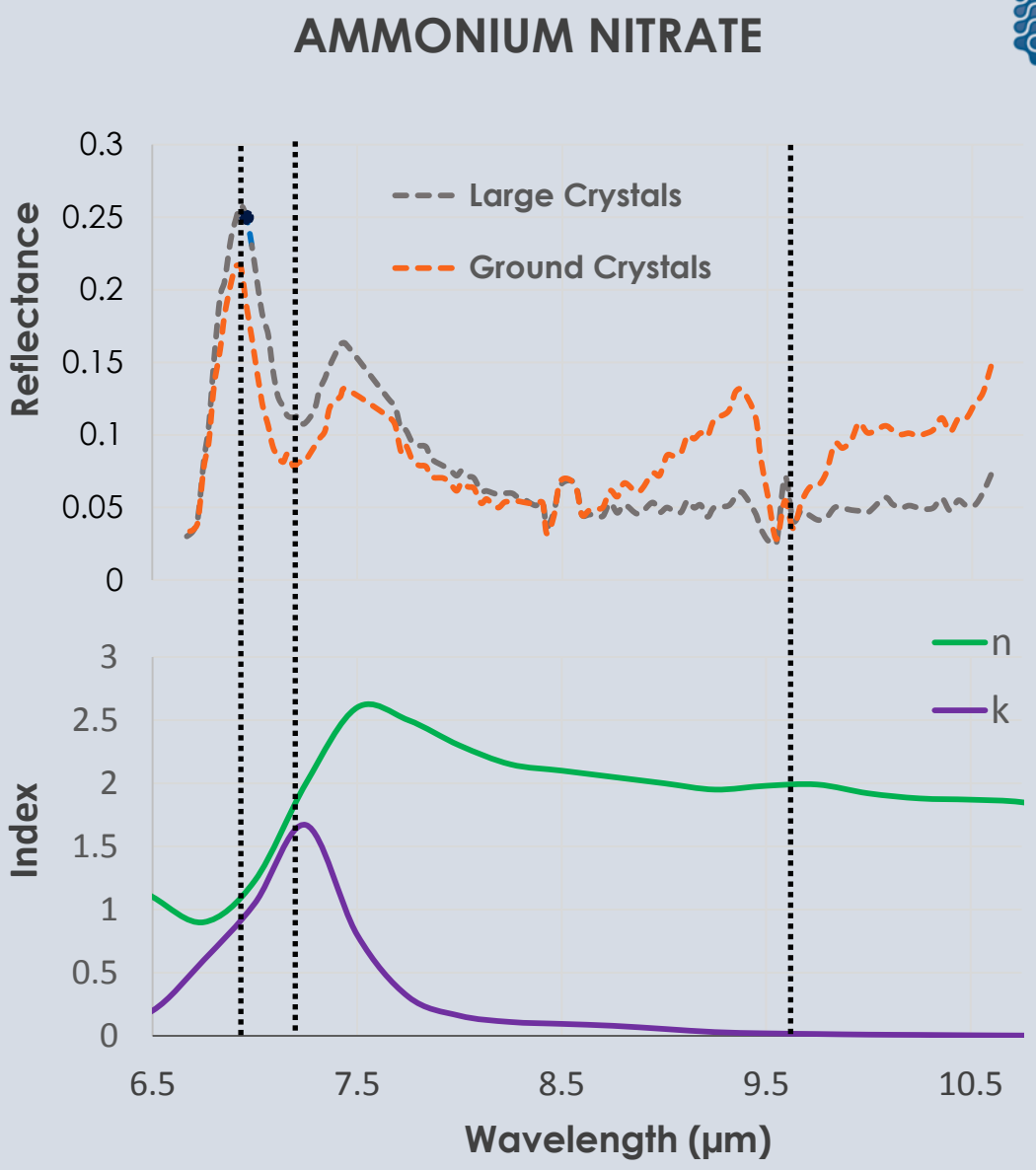
witinski@pendar.com

PENDAR TECHNOLOGIES

Extras

Reflectance Spectroscopy

DIFFUSE REFLECTANCE SPECTRAL INTERPRETATION:

- $n_{eff} = \hat{n} + i\hat{k}$
- $L_{abs} = \hat{n} + \frac{\lambda}{4\pi k}$
- $R = \frac{(n-1)^2+k^2}{(n+1)^2+k^2}$

This introduces many dependencies including: particle size, distribution, polymorphism, angle of incidence, substrate reflectance, etc…