

*NEAR-Lab*

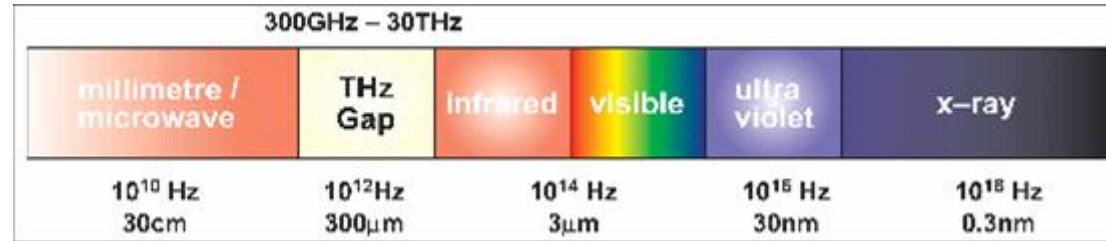
*Northwest Electromagnetics &  
Acoustics Research*

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## **Terahertz Scattering for Detection of Improvised Explosive Devices**

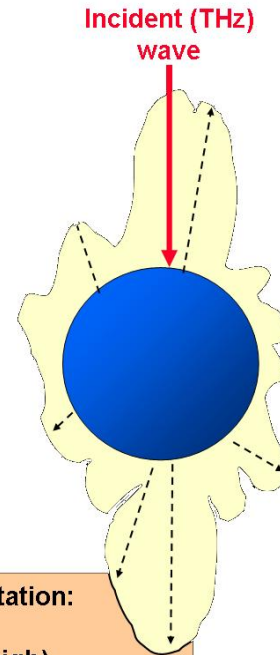
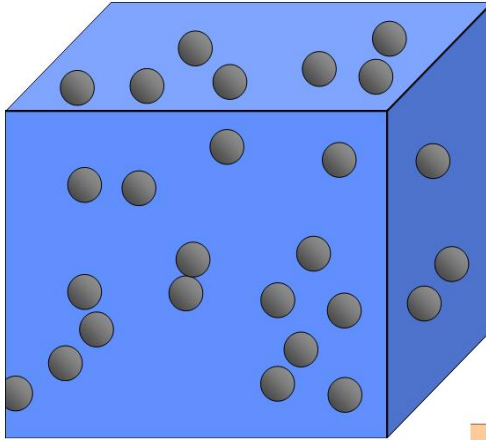
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Standoff detection of explosives using terahertz (THz) radiation is promising because those materials typically display diagnostic series of molecular THz resonances, yet many packaging or concealment materials are semi-transparent at such frequencies. The physical problem of interest is therefore to understand how scattering within target materials (by, for example, granular morphology) or near the target (by packaging) affects observation of characteristic resonances. This project is a coordinated program of experiment and theory, based on wideband, electro-optic THz receivers and transmitters and extension of the quasi-crystalline approximation into the Mie regime. With this approach, we will iteratively develop and test models for THz spectral line distortion and obscuration due to common packaging and target material morphologies. This work is a three year effort (2008-2011) and is in collaboration with the Applied Physics Laboratory at University of Washington.



- "Last Frontier" in electromagnetic research
  - "Terahertz research is one of the most intriguing and challenging fields to emerge in the 21<sup>st</sup> century. In less than a decade, this previously hidden section of the electromagnetic spectrum has caught the imagination of scientists around the world."
    - ~ Gwo-Ching Wang, Physics Chair, RPI
  - "Detecting weapons concealed underneath clothing, or even spotting the onset of cancer; these are just some of the exciting prospects that have been turning terahertz wave research into one of the most talked-about topics in photonics."
    - ~ Opto & Laser Europe
- **New opportunity to utilize THz due to maturing photonics**
  - Unknown scattering and propagation physics!

Explosives, bio-agents, and tissue composed of granular "scatterers"  
• Model as collection of spheres



Scattered field computation:  
• MIE (exact)  
• Small spheres (Rayleigh)  
• Large spheres (Geometric Optics)

### Improvised Explosive Device (IED) Detection



### Imaging using THz



- PSU is teaming with Applied Physics Laboratory/UW for 3 year effort
  - Sponsored by the Office of Naval Research
  - Explore THz detection of IEDs
  
- Future potential in medicine
  - Short wavelength, so high resolution, but long enough to limit excessive scattering
  - No ionization
  - The variation of attenuation with frequency differs between tissues, and between tissues in health and disease