“THz Electronics for the 21st Century”

Dr. Mark Rosker
Program Manager
DARPA / MTO

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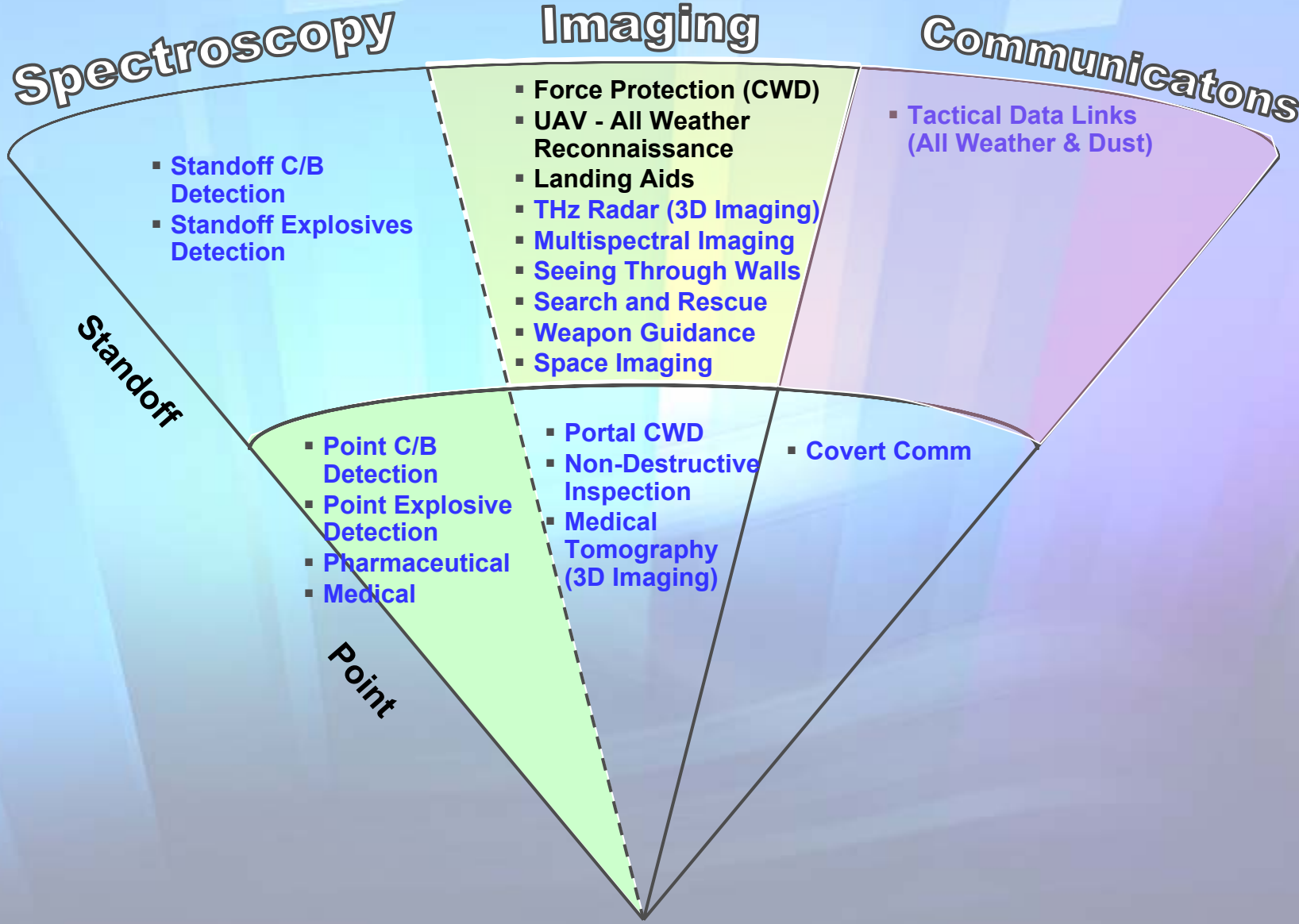
Questions

1. What are two or three important THz system applications that you see arising?
2. What are the critical component developments needed in the next 3 years, 5 years and 10 years to enable these applications?
3. What do you see as the critical challenges in the development of THz systems?
   - Where does more work and/or investment need to be made?
   - What are critical milestone gates?
   - What are potential show stoppers for a particular technology or system?

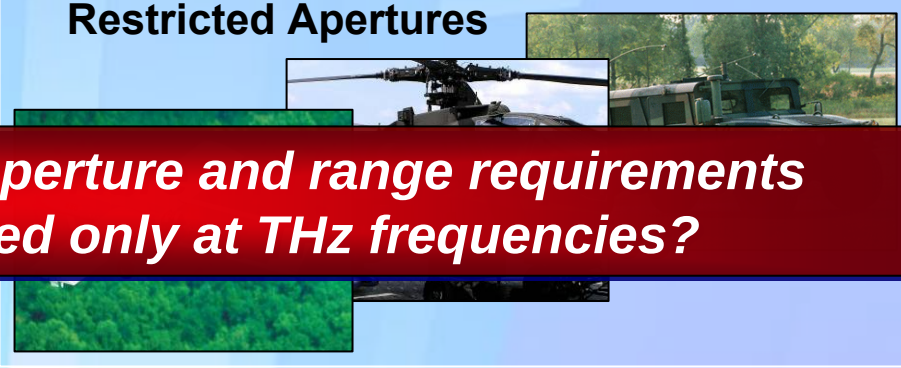
What THz System Applications?



Standoff THz Imaging: Why Bother?

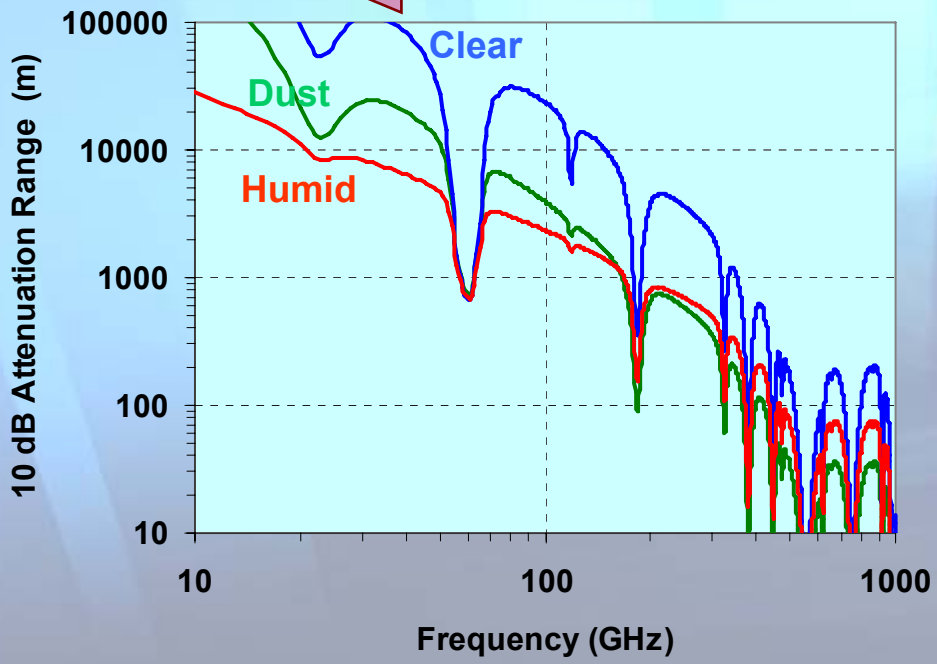
"IR-Blind" Environments

Restricted Apertures

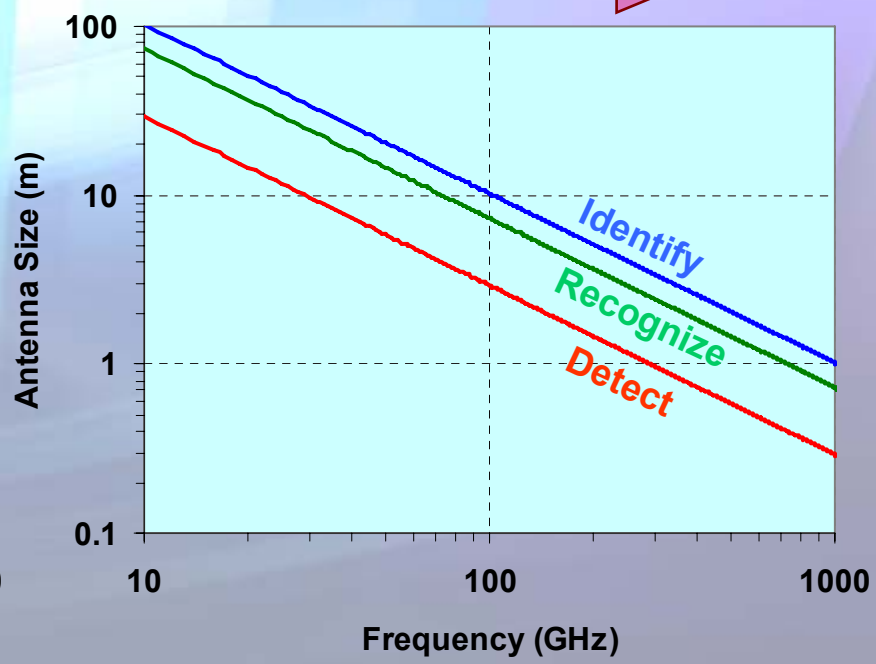


Are there applications for which aperture and range requirements can be simultaneously satisfied only at THz frequencies?

Greater range

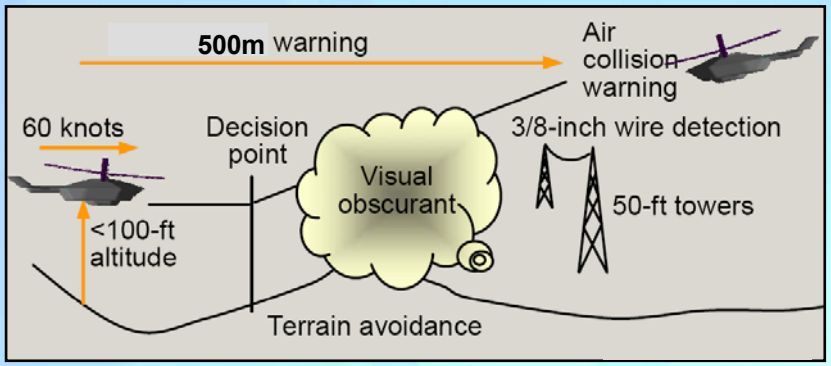


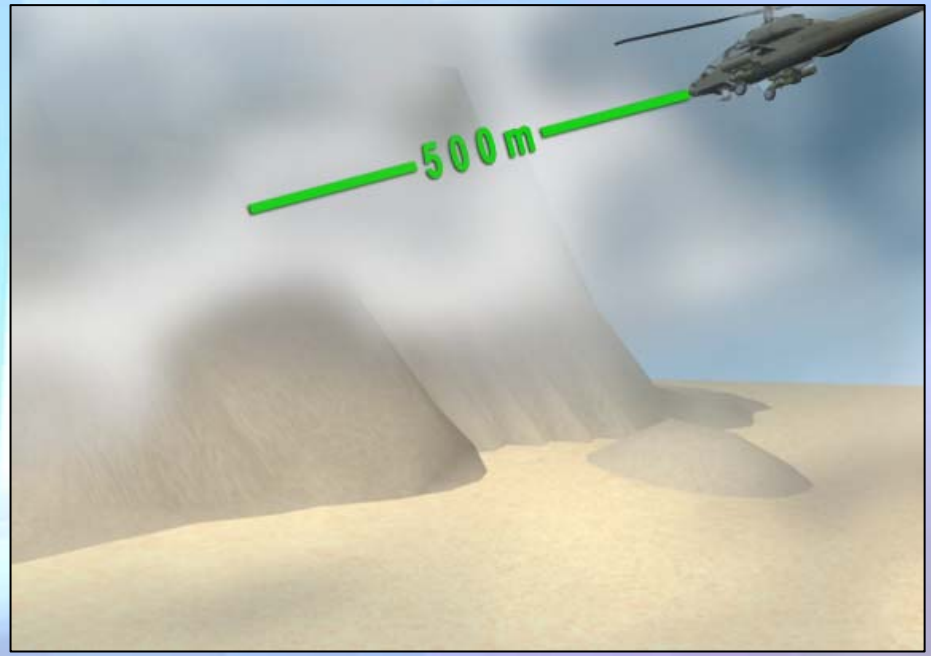
Smaller aperture

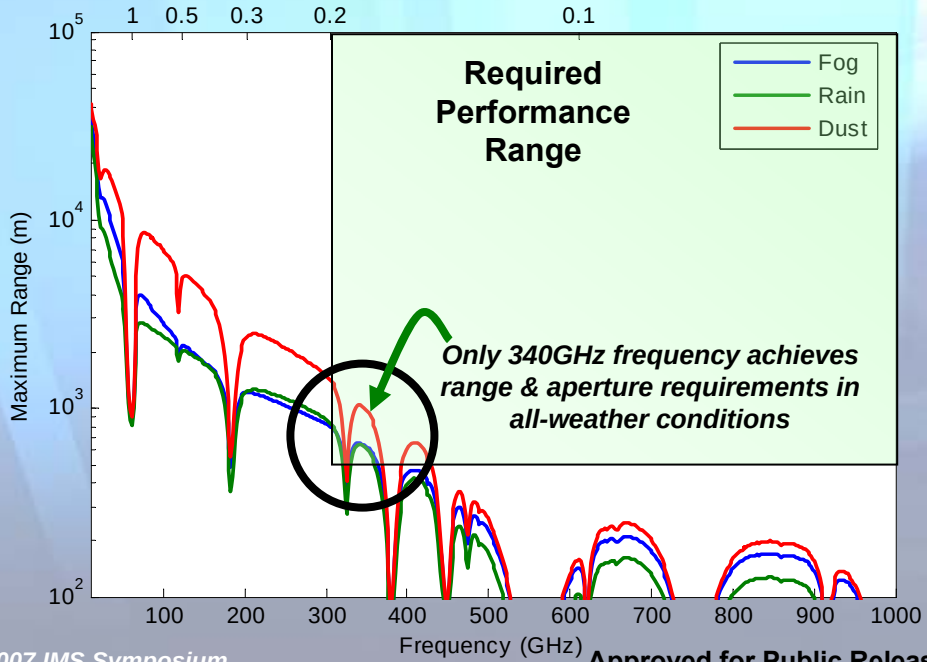


Aircraft Terrain Avoidance

- **Image terrain and other potential obstacles through all-weather conditions**







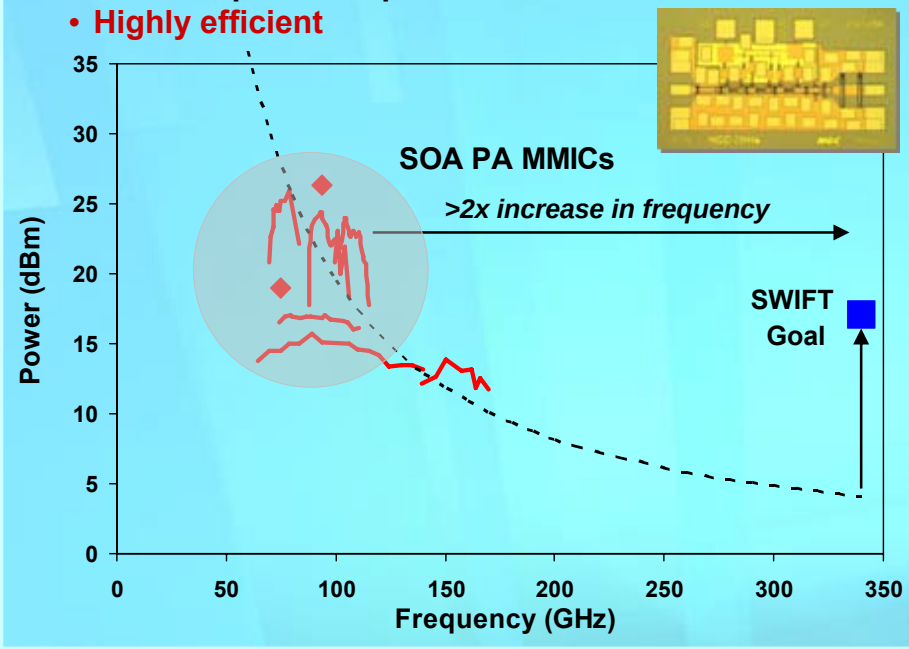
Notional Requirements

- Aperture < platform radome (~0.2m)
- Range up to at least 0.5km
- Resolution = 2m at range
- Good image quality (SNR ≥ 8)
- Frame rate (30 Hz) set by pilot reaction time

Technical Challenges at Sub-MMW Frequencies

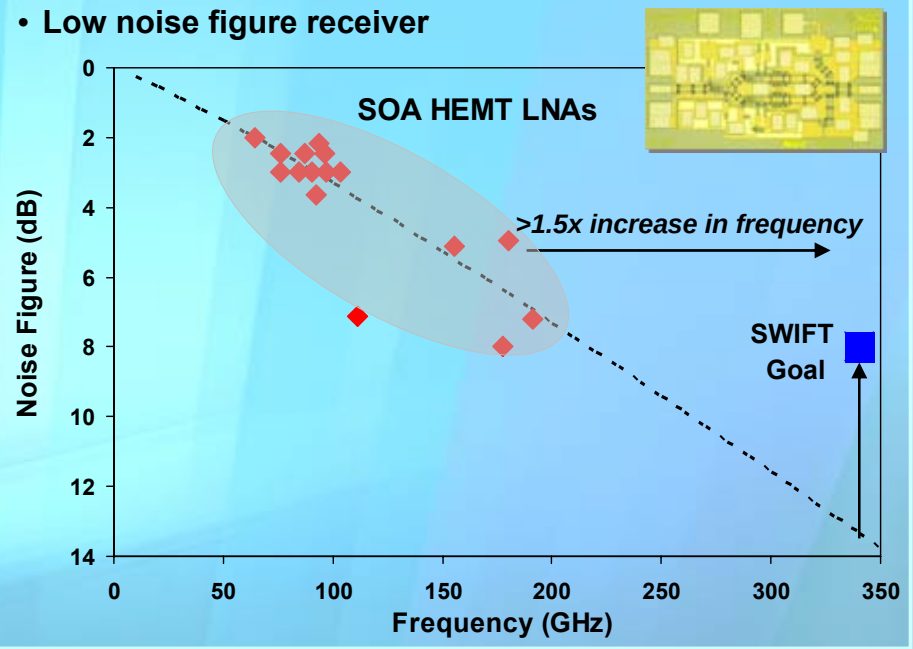
Sub-MMW Sources

- Ultrafast power amplifier MMICs
- Highly efficient



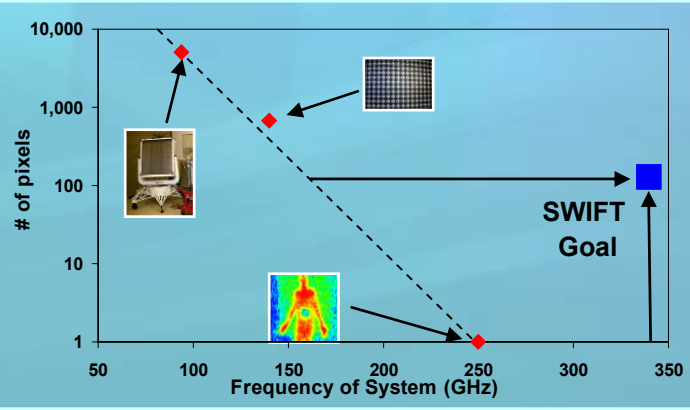
Sub-MMW Receivers

- Ultrafast LNA MMICs and mixers
- Low noise figure receiver



Imaging Array Architecture

- Minimization of LO power
- Low loss interconnects



What Key Technical Challenges?

Sources

- Increase available sub-MMW power by 100X (10 – 100 mW)
- Achieve 20X increase in efficiency (1%)

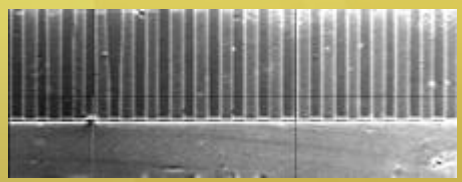
Micromachined Vacuum Electronics

Northrop Grumman

Regenerative Amplifier

Photonic Downcoversion

Stanford



Cascaded OPO

Detectors

- Implement an array-integrable approach achieving at least 100X improvement in NEP' ($1x10^{-12}$ W/√Hz)

Direct Detectors

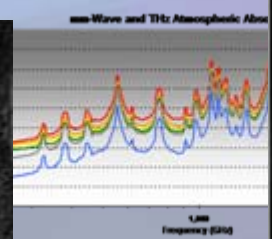
UC Santa Barbara

ErAs Diodes

Phenomenology

- Define FPA requirements for TIFT imaging through IR-blind conditions

THz transmission through materials/Atmosphere

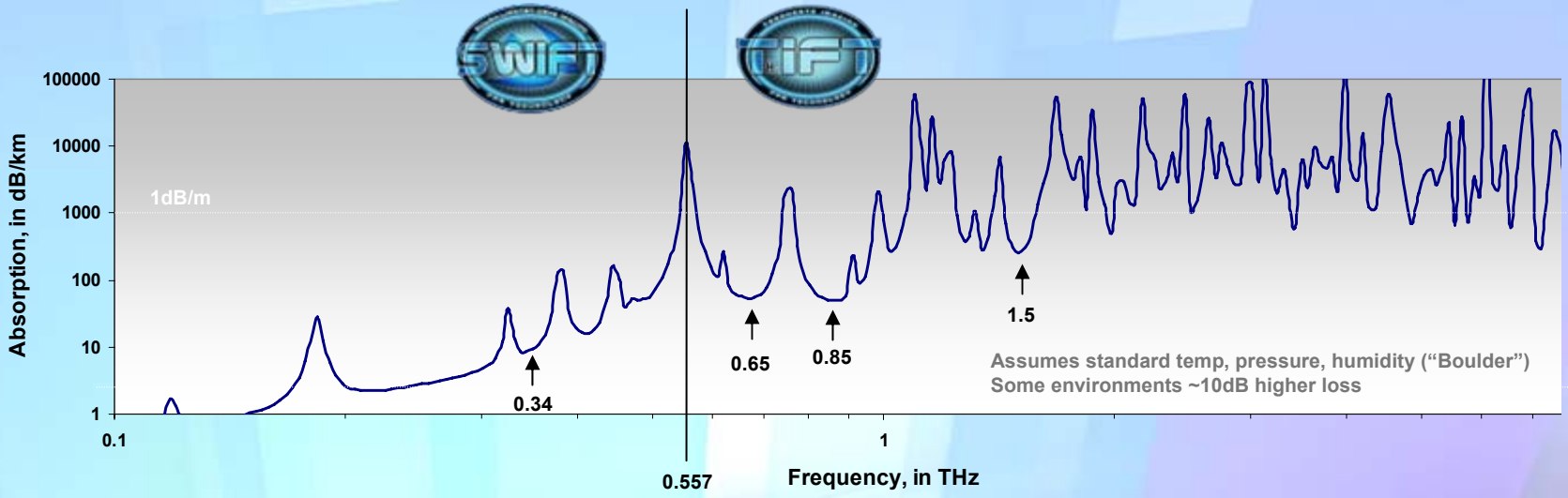


NVESD

Spectral Features of Condensed Matter

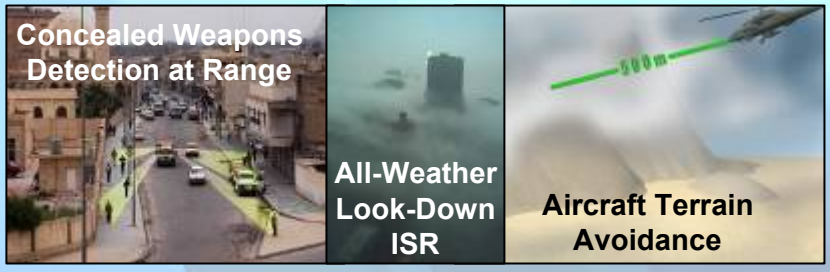
MTO's THz Programs

Phenomenology



Applications

Ranges up to 1 km

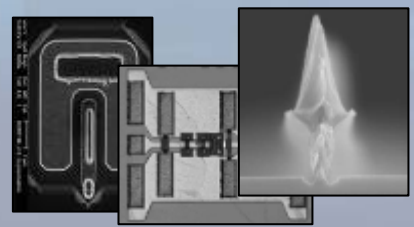


Ranges < 100m

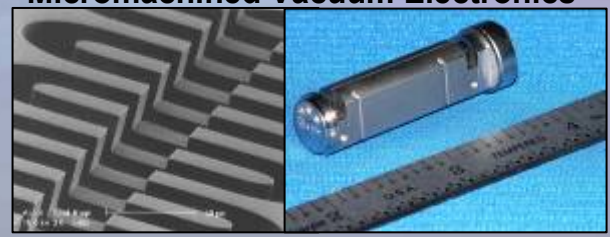
Technologies

Electronic Upconversion

RF MMICs



Micromachined Vacuum Electronics



Photonic Downconversion