AGC Technology Overview

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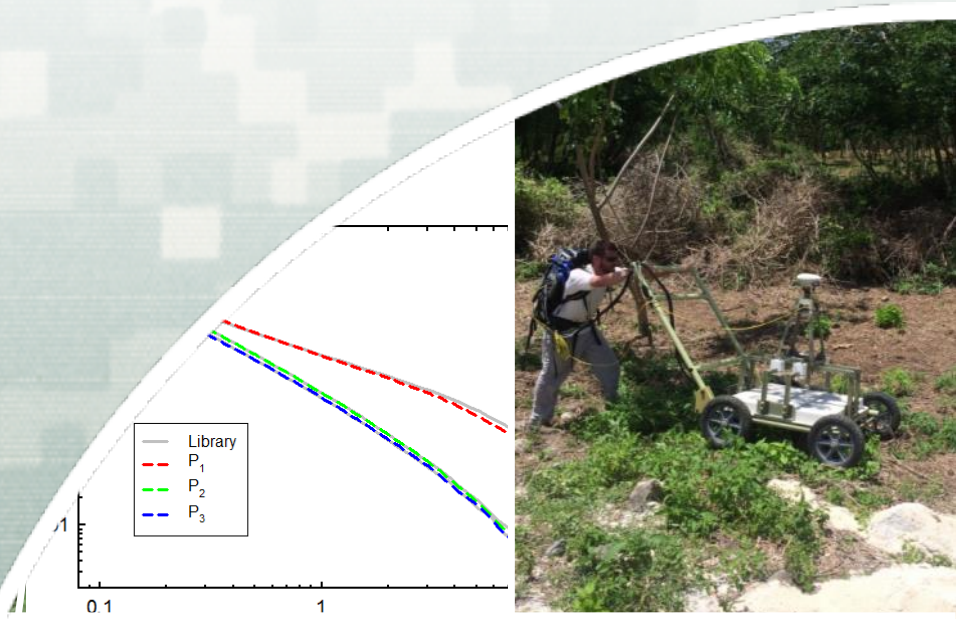

US Army Corps of Engineers
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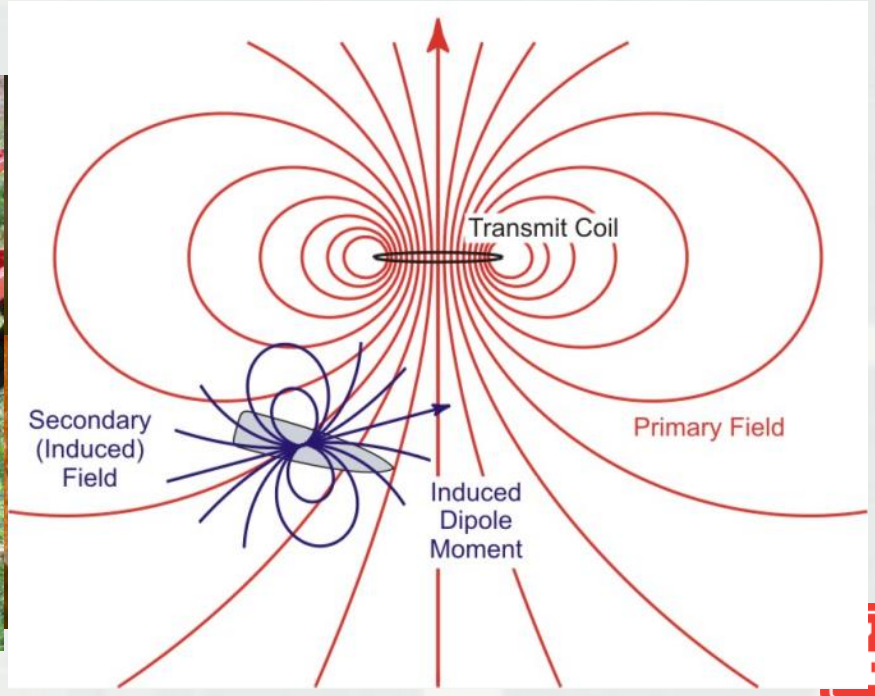
Outline

1. How the sensors work and what they look like
2. How we utilize the acquired data
3. How the classification decision is made

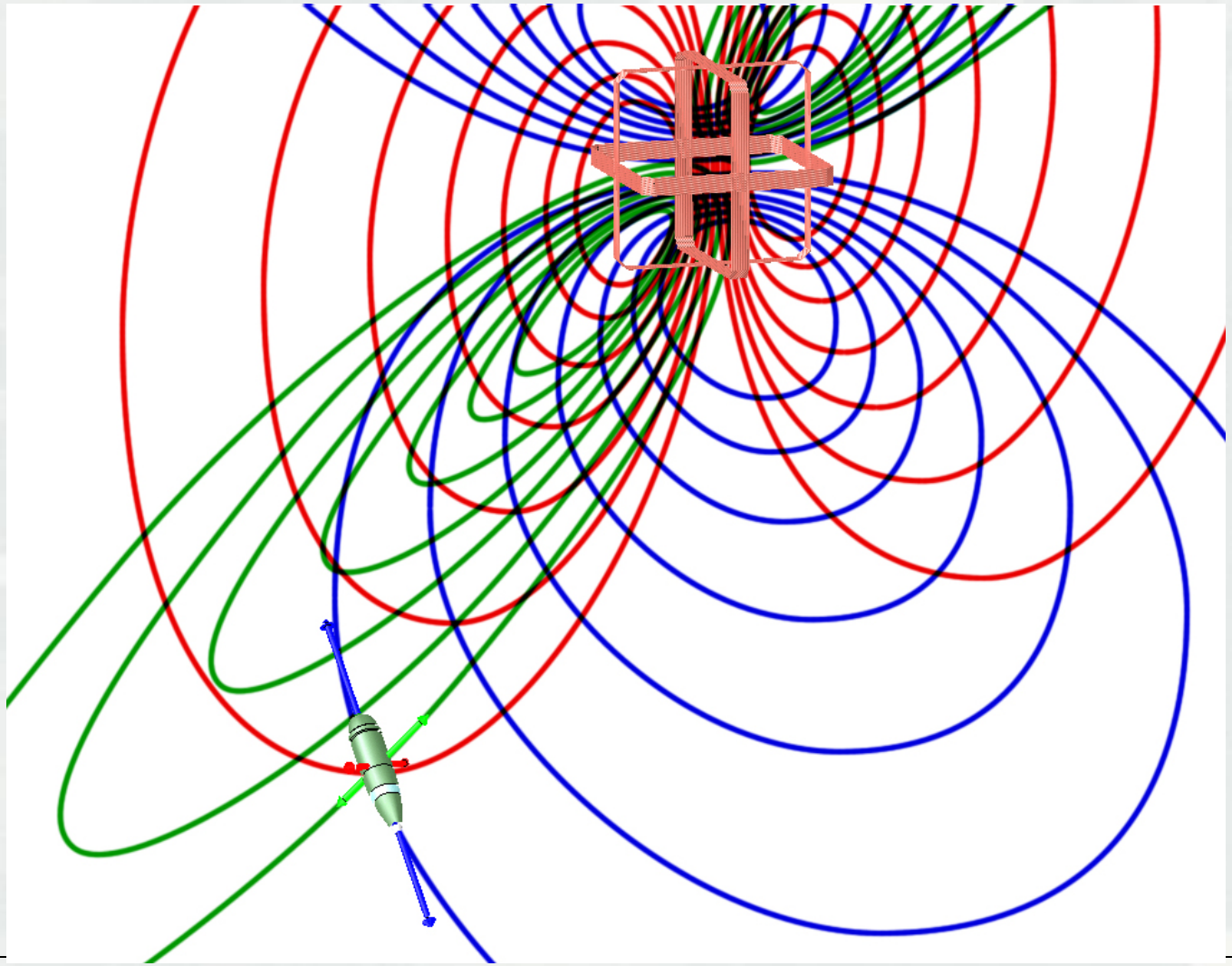
EMI Sensors

- Electromagnetic Induction (EMI) sensors measure the response of nearby metal objects to magnetic fields created by currents running through a loop of wire


Geonics EM61

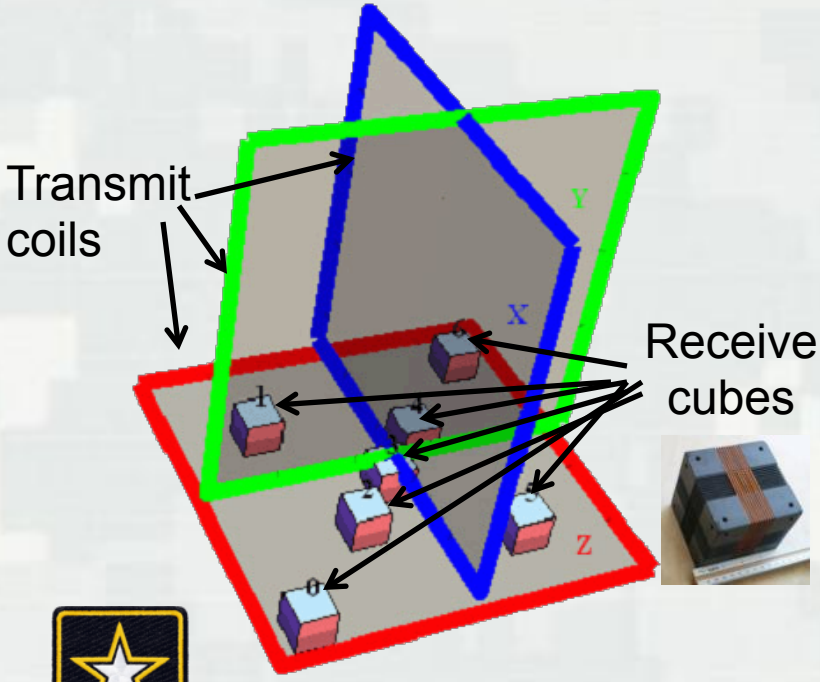


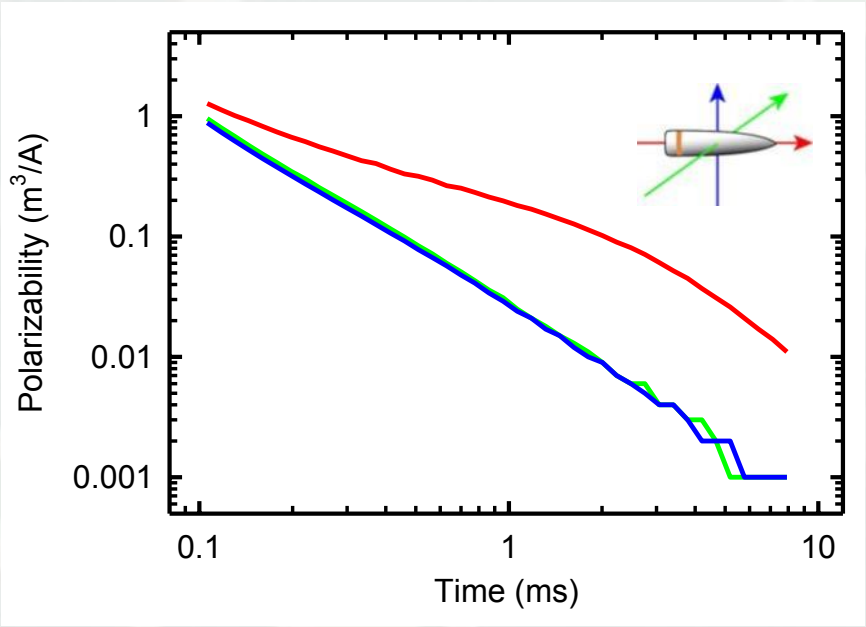
Advantages of a Multi-Axis Sensor



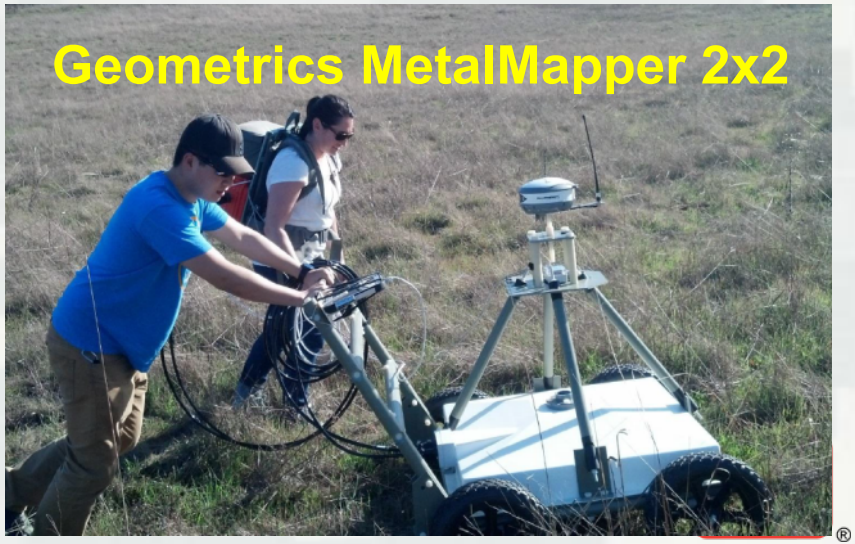
Classification Sensors

- Same EMI physics
- Specifically designed for munitions classification
- Now we can separate the information useful for classification (answer independent of location)

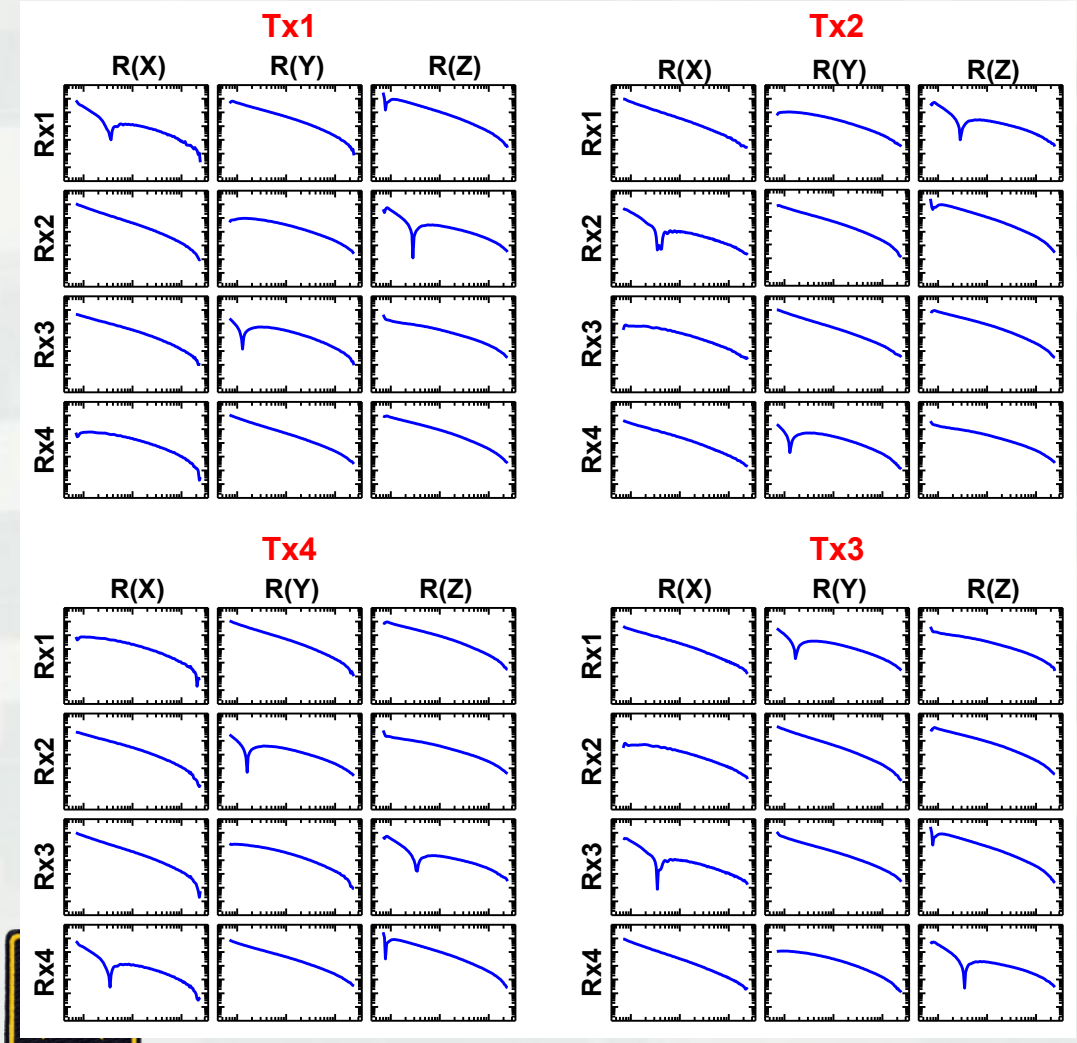


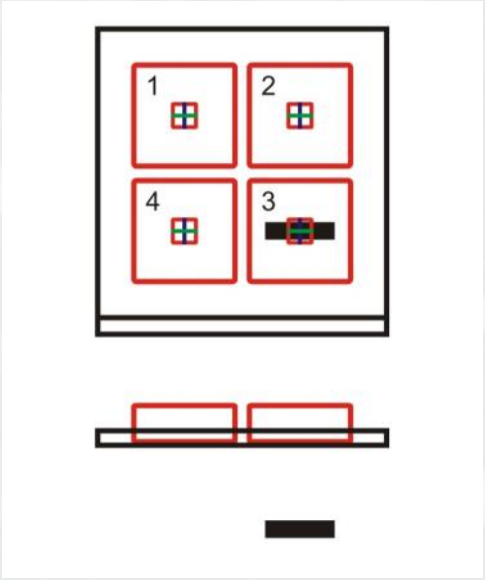


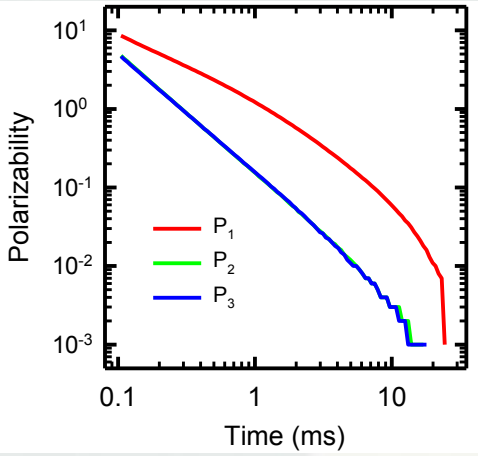
Sensors



You Can't Make Decisions Using Only the Measured Decays







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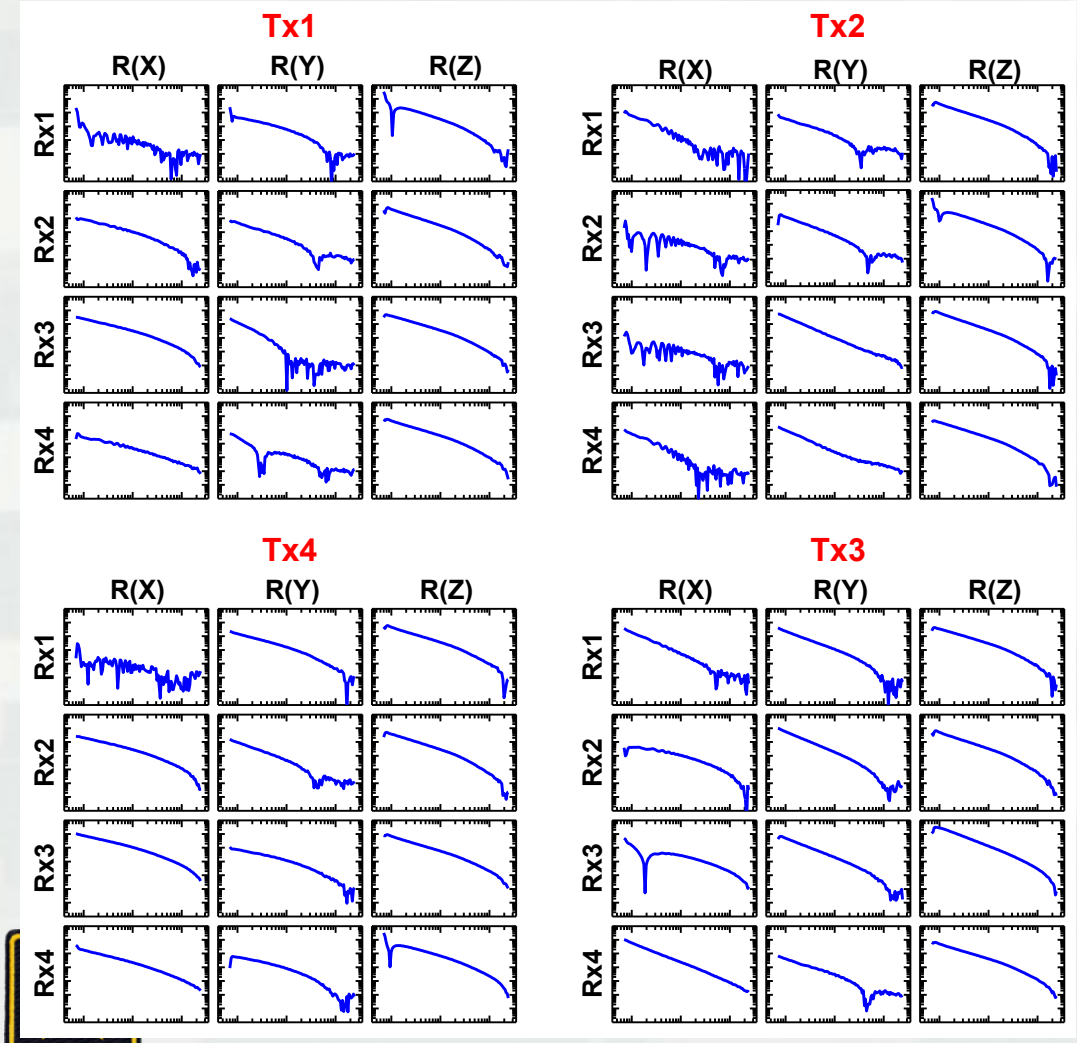

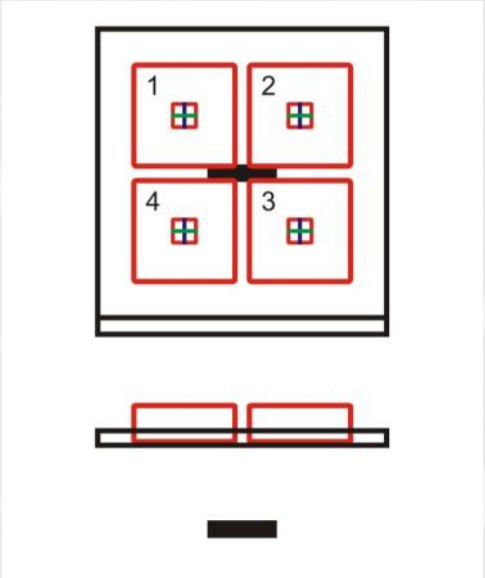

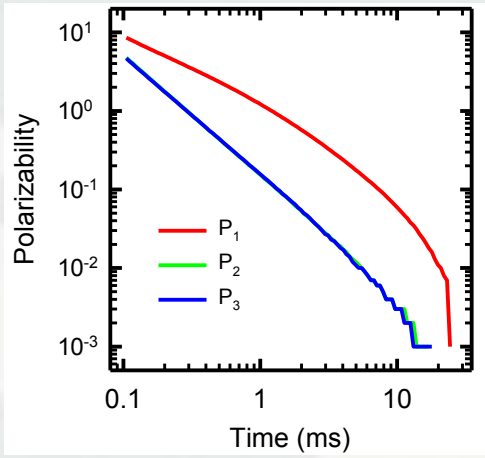

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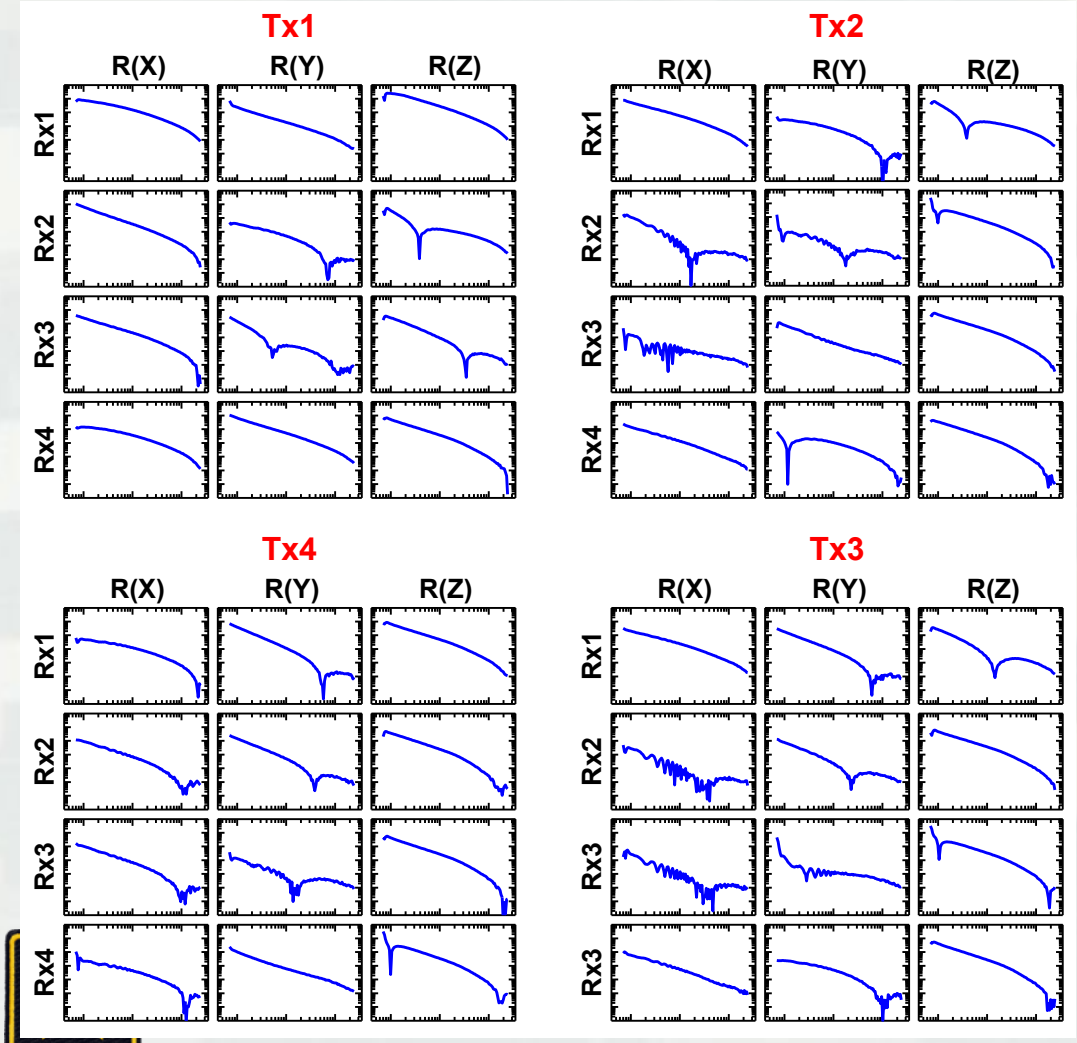
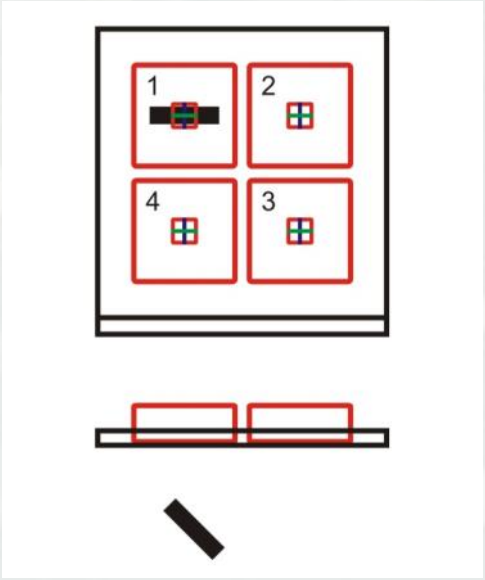
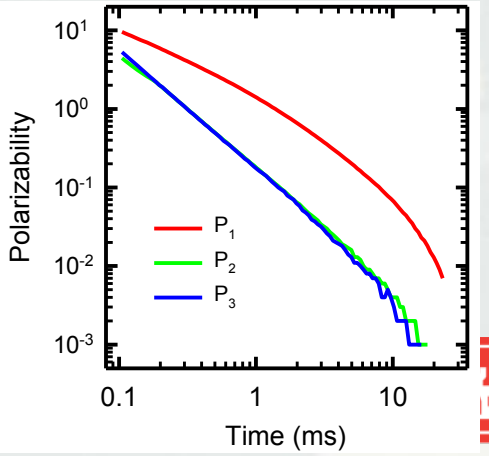


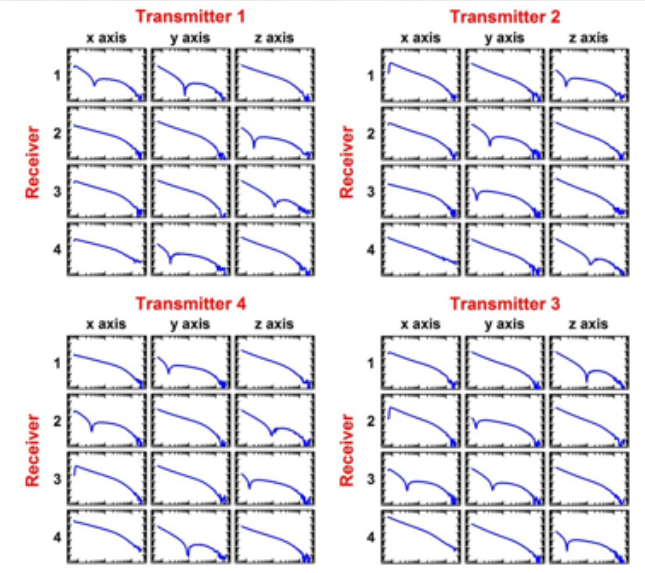




Process data to remove effects of burial depth and object orientation

Mathematical Model for the EMI Response

Pre-Process
- Remove sensor effects
- GPS coordinates



Sensor Data

location & orientation
(extrinsic properties)

+

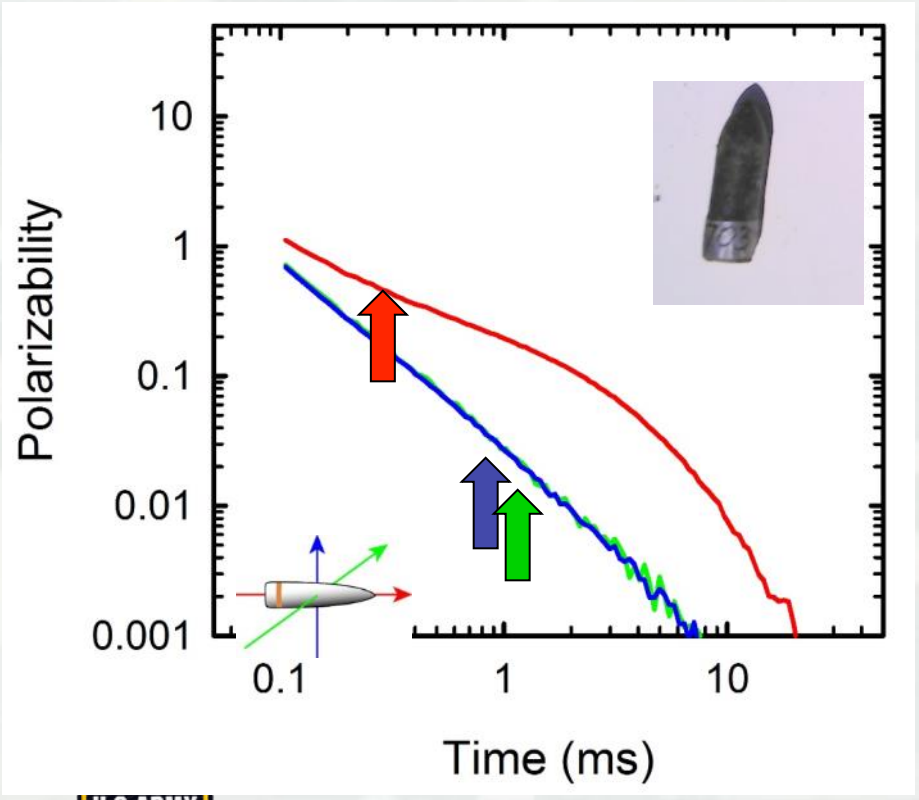
polarizabilities
(intrinsic response; NOT affected by burial depth or orientation)

UXO are usually axial symmetric, clutter are not

Object Shape → Axial Symmetry

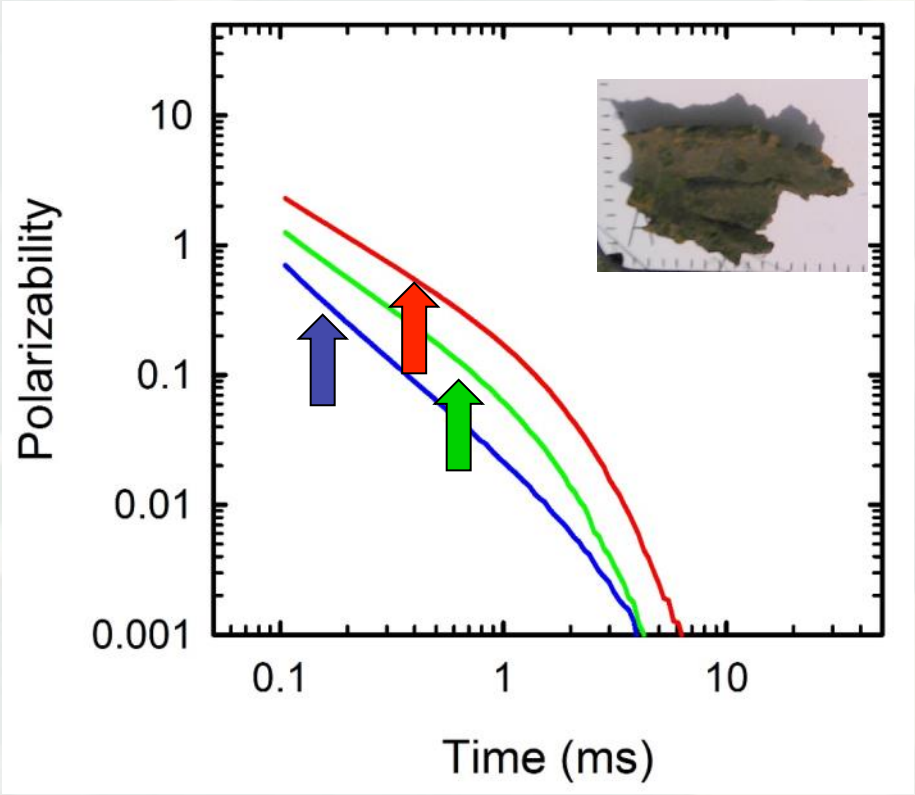
UXO

Cylindrical, axial symmetry



Non-UXO

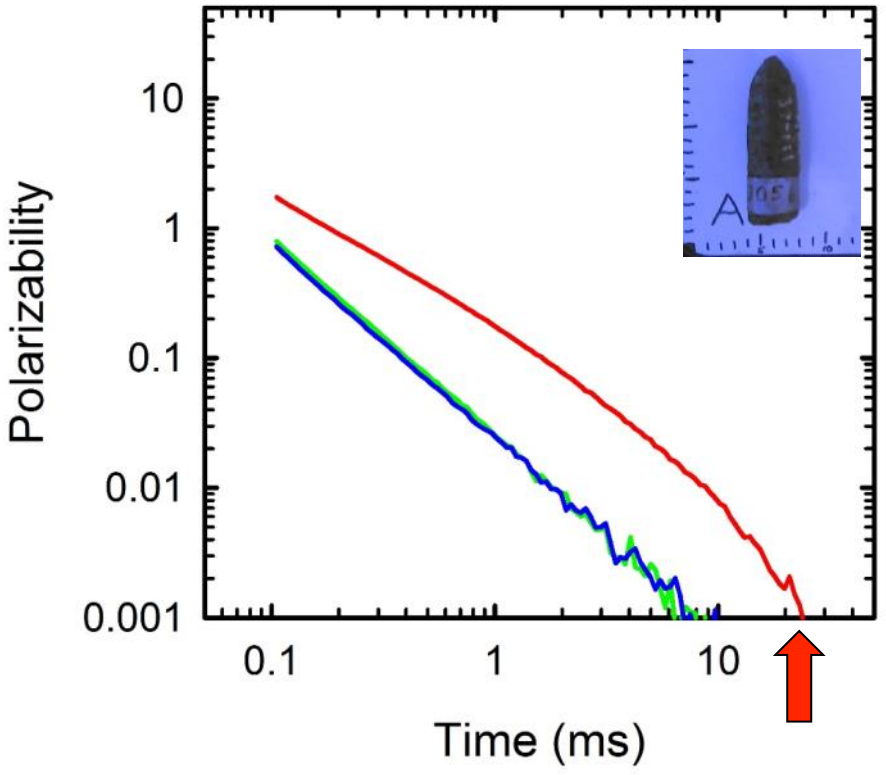
Variable, often asymmetric



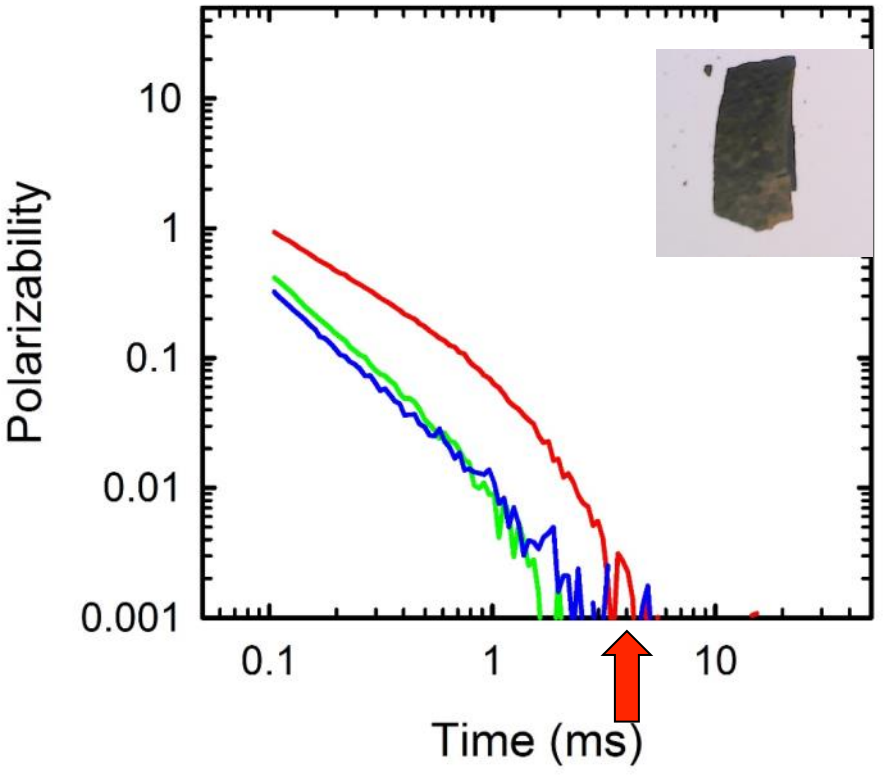
Thick-walled metal decays slower than thin-walled debris and clutter

Wall Thickness → Decay Rate

UXO
thick wall & slow decay



Non-UXO
thin wall & fast decay

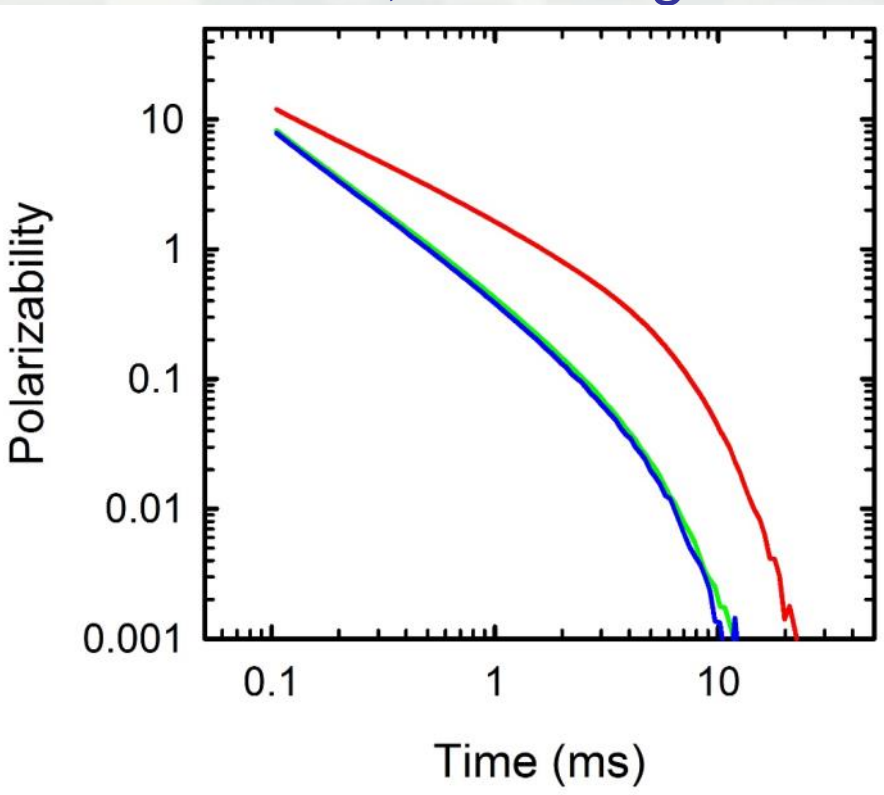


UXO vary in size (20mm to 155mm) but clutter is generally small

Size (volume) → Magnitude

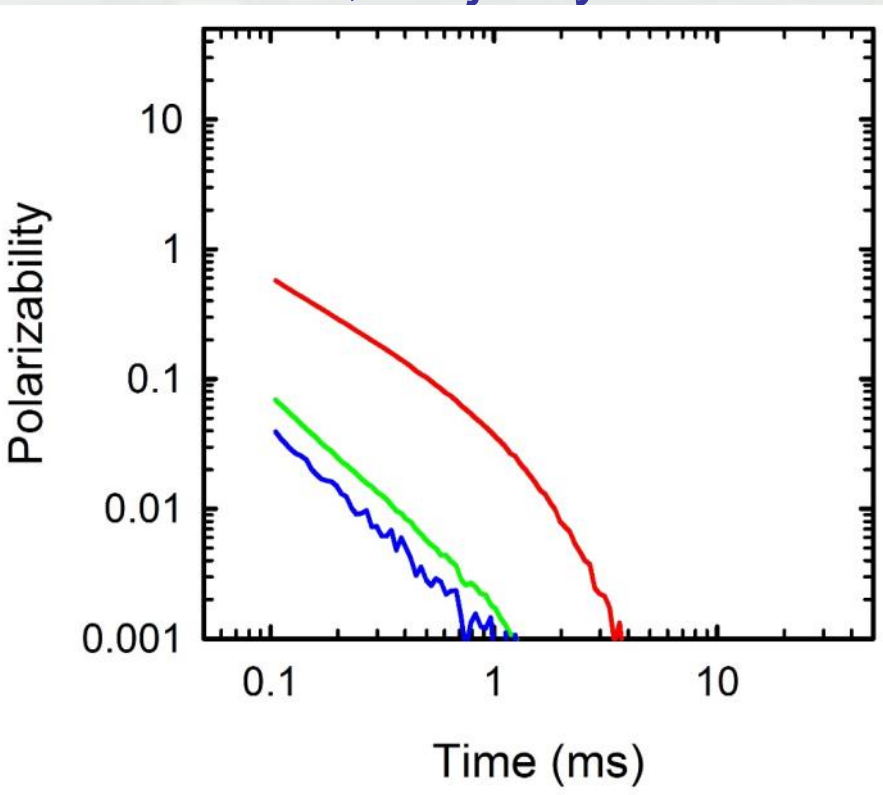
UXO

Variable, often larger

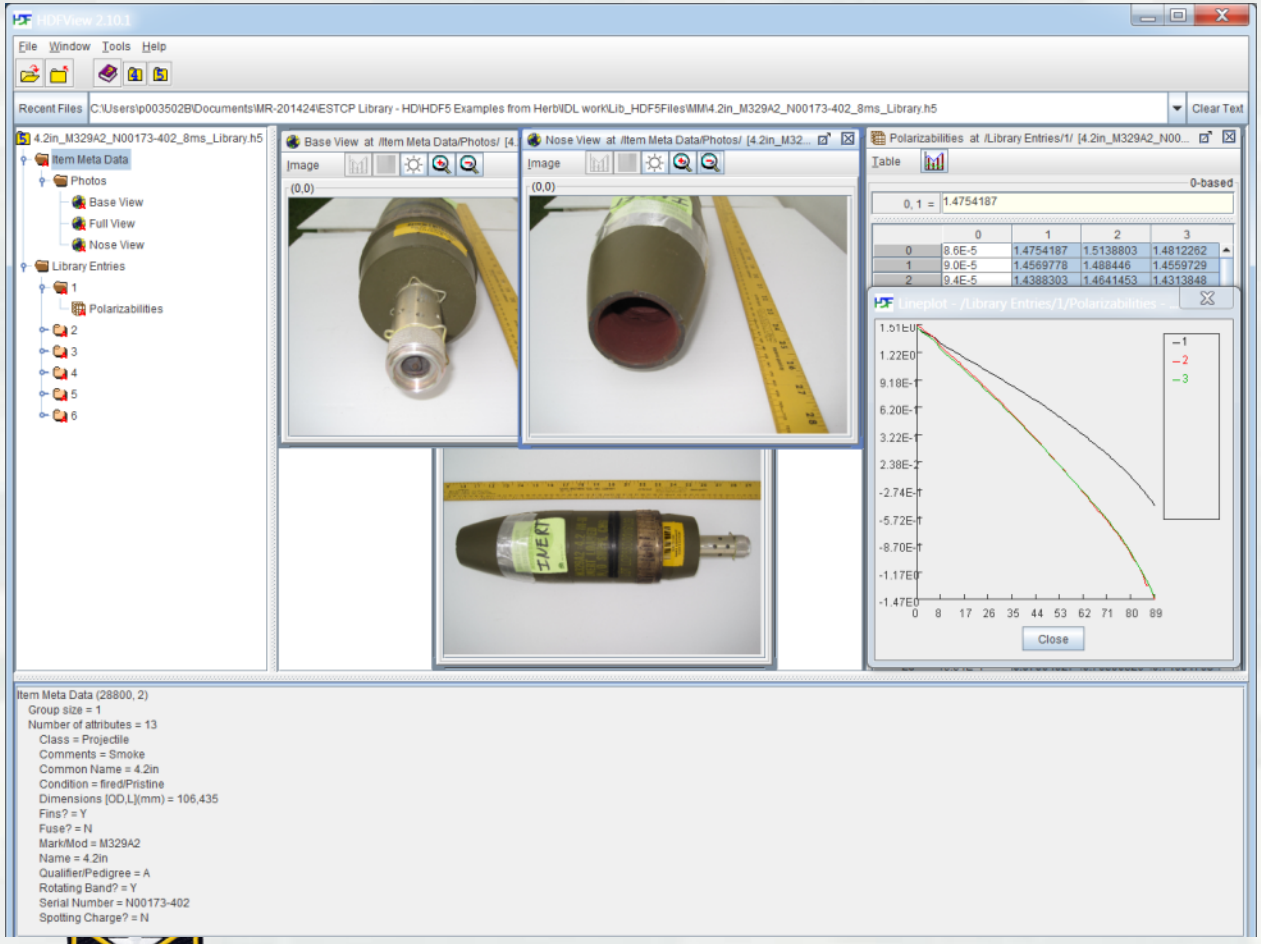


Non-UXO

Variable, majority are small



Target of Interest (TOI) Library



Collection of TOI signatures:

1. metadata,
2. sensor data, and
3. polarizations

ESTCP generated
DOD maintained

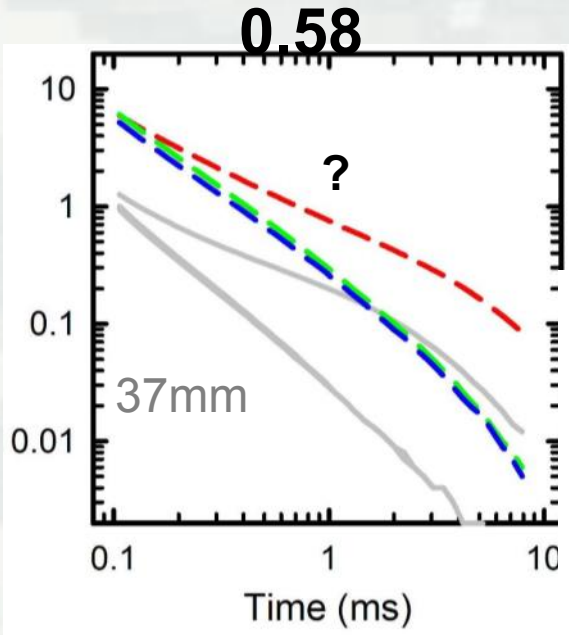
Decision Process

We prioritize the sources from those that are most similar to UXO (our library) from those that are not…

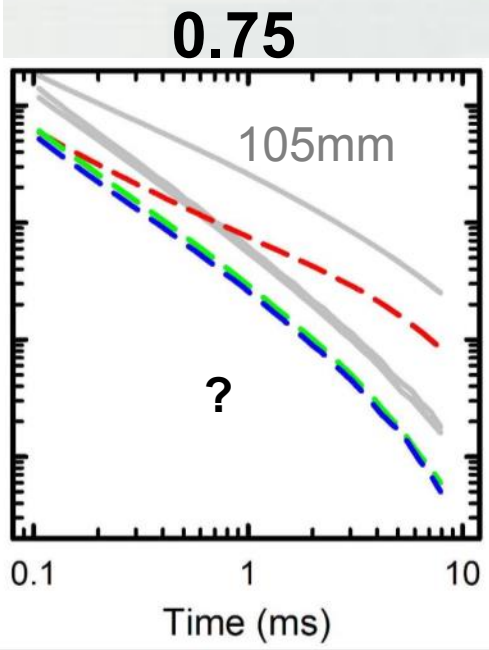
<u>3 ways to get on the dig list:</u>

1. Look like an item in the library
2. Be part of a cluster
3. Be big and deeply buried

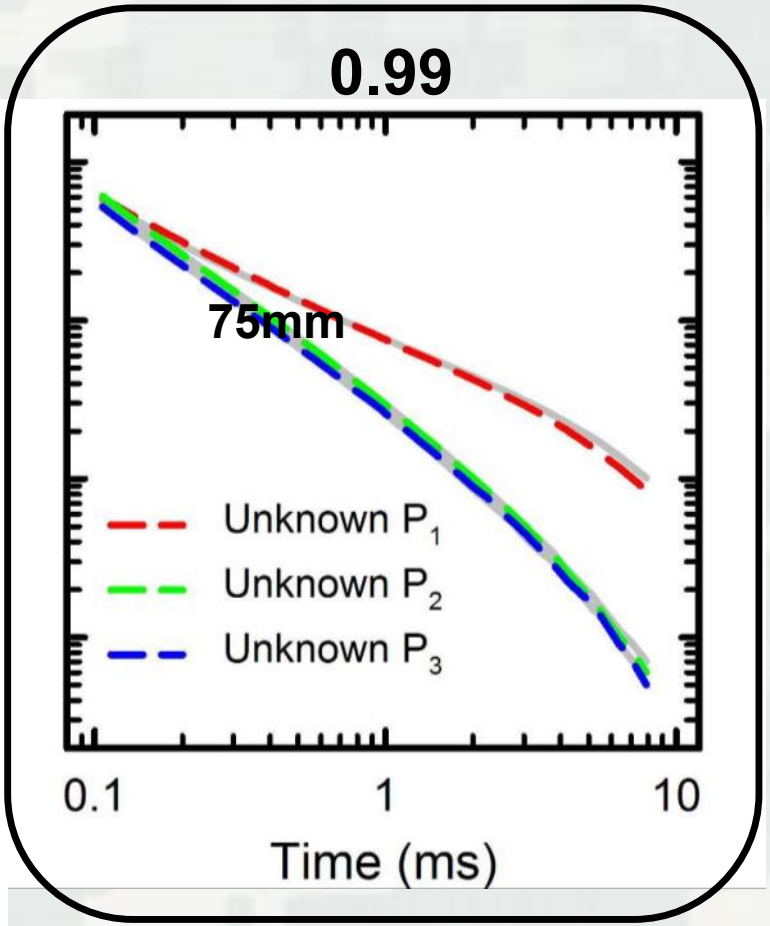
Compare each item to signatures in the library



...too large for 37mm



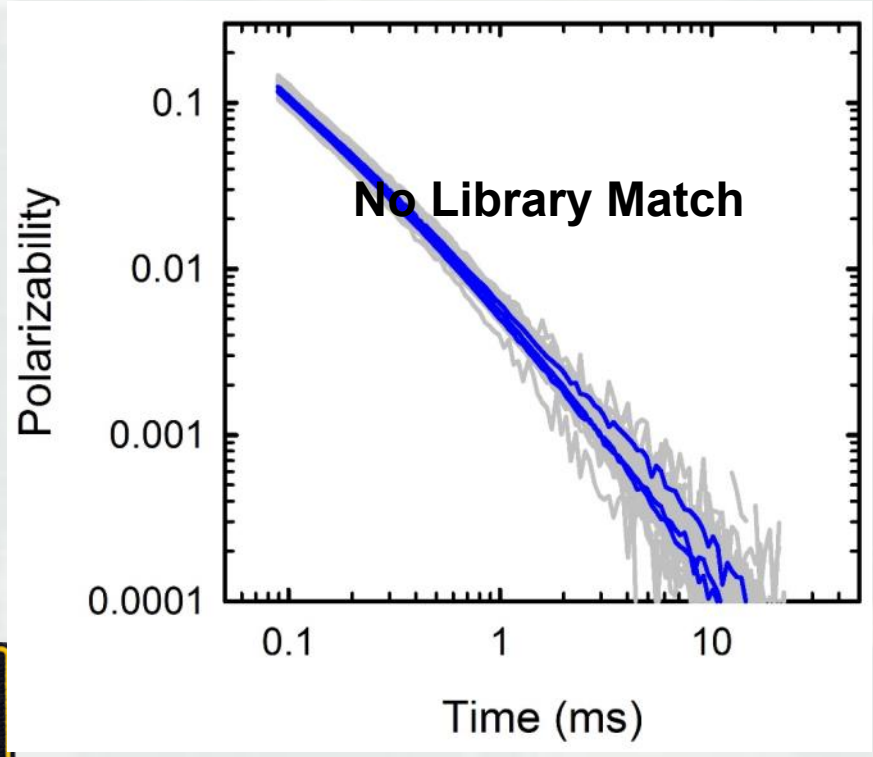
…too small for 105mm



…just right. MATCH

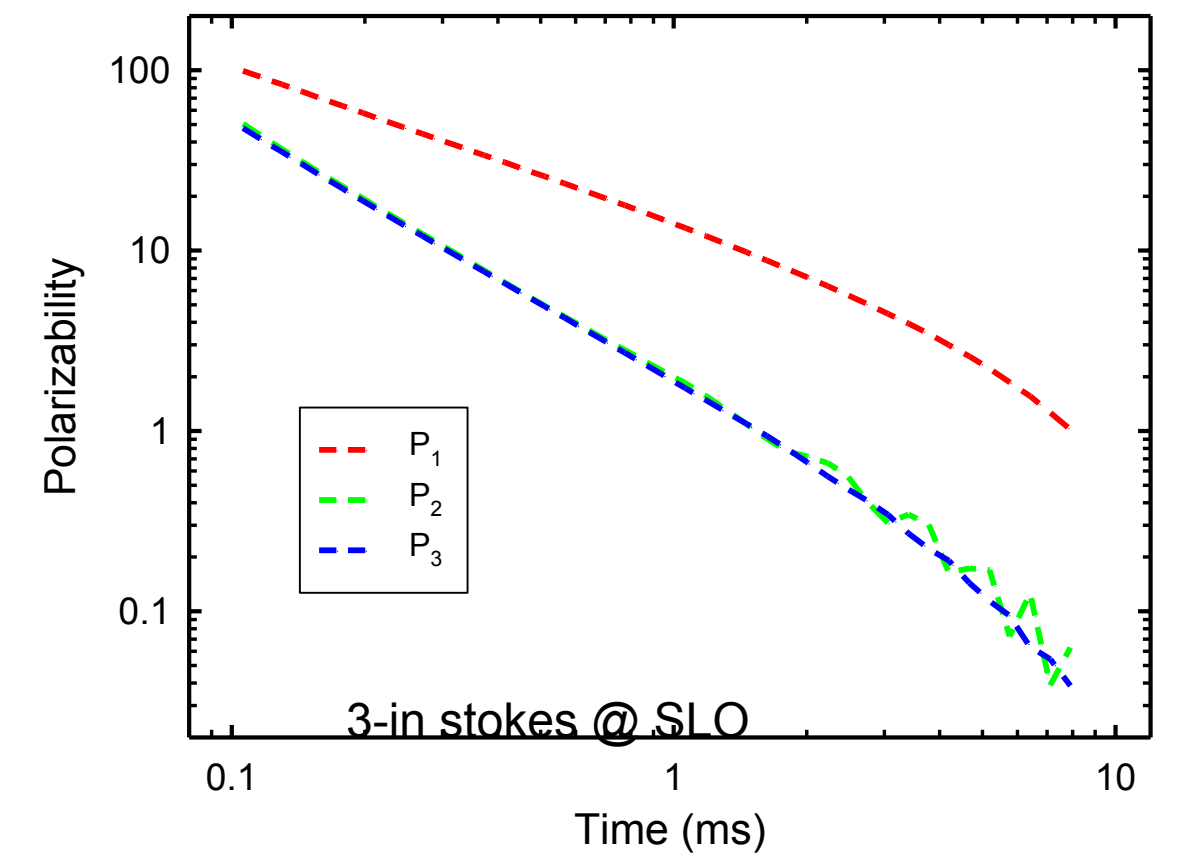
Compare each signature to all other signatures on site

- If there are clusters of items that do not match the library signatures, we excavate some of them and proceed accordingly…



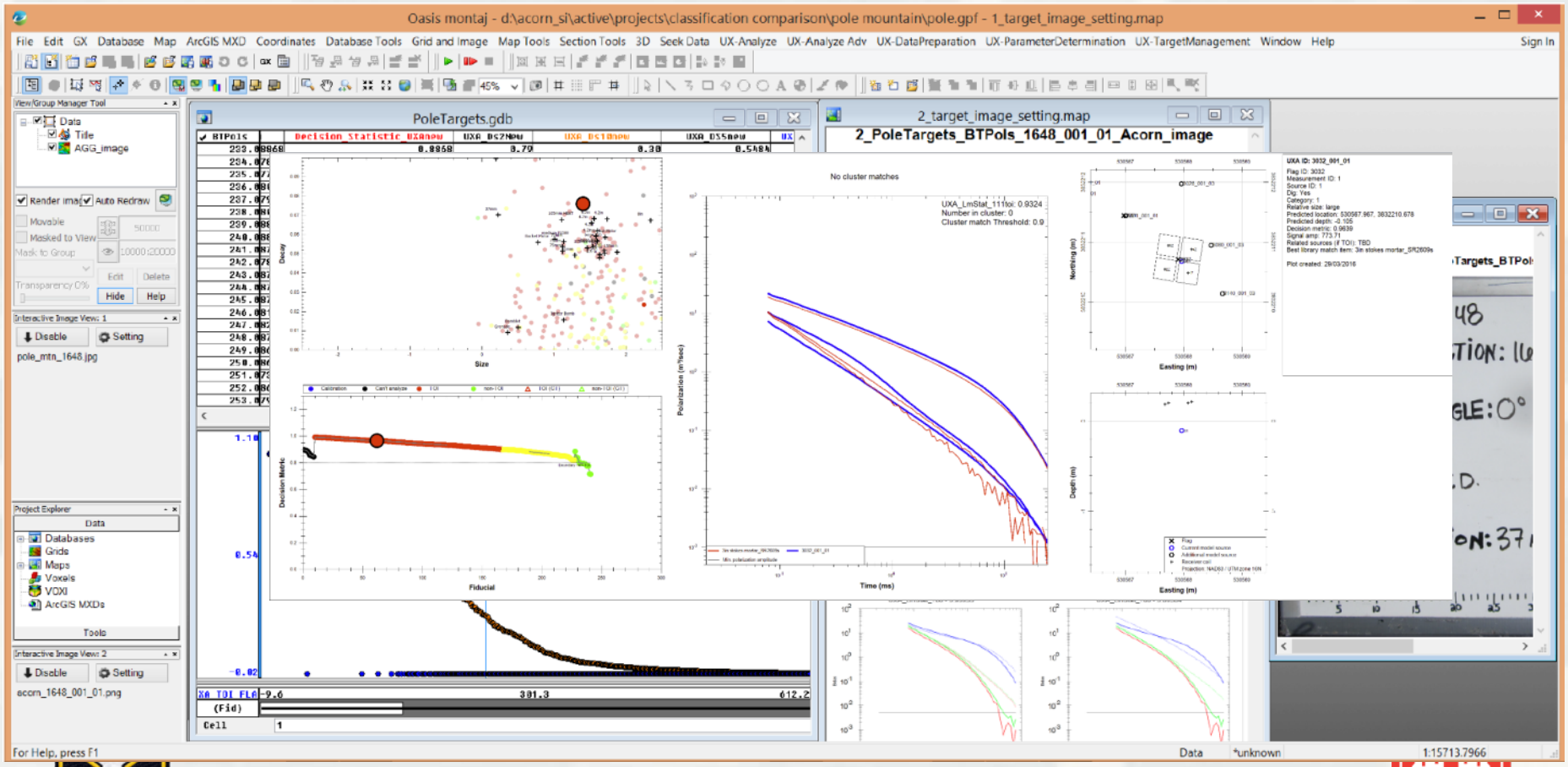
T-Bar Fuze
Non-hazardous clutter,
did not add to library

Look for unexpected Big, Symmetric, Thick-walled items



Software

- UX-Analyze (Geosoft Oasis Montaj)
- UXOLab



Reference Materials

- ESTCP https://www.serdp-estcp.org/Featured-Initiatives/Munitions-Response-Initiatives/Classification-Applied-to-Munitions-Response
- ITRC http://itrcweb.org/Guidance/ListDocuments?TopicID=16&SubTopicID=3
- Previous M2S2 webinars https://clu-in.org/live/archive/