



WISDOM a GPR for the ExoMars Rover Mission

(Water Ice Subsurface Deposits Observation on Mars)

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WISDOM onboard the ExoMars rover : a powerful panoramic instrument

Investigate and remotely characterize the subsurface

- To understand the origin, evolution, current state, and resources of the landing site through an investigation of the subsurface features (layers, blocks,..)
- To understand the local subsurface distribution and state of H₂O (such as segregated ground ice, ice-wedges associated with polygonal ground).

Identify the most interesting locations

- To perform in situ analysis by other instruments of the payload
- To collect samples either from the surface or from the subsurface

Complement the information obtained by the camera to give the geologic context

The instrument

The Instrument's Main Characteristics

A Ground Penetrating Radar (GPR)

- Broad band UHF GPR : from 0.5 to 3 GHz
- Step frequency
- Bi-static and polarimetric measurements (XX - XY - YX - YY)

Anticipated performances

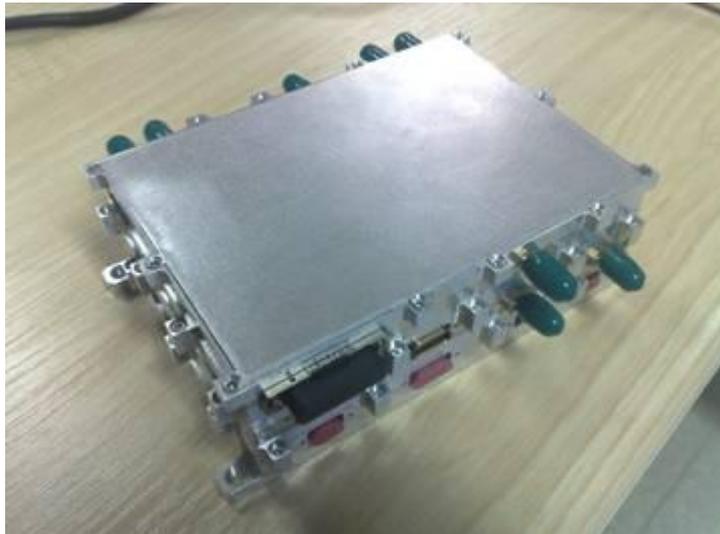
- Vertical resolution of a few centimeters
 - Penetration depth (~2 m)
- } Depending on the environment

Operating modes (depending on the rover speed)

- Rover in motion : Decametric horizontal resolution / Co-polar measurements along the Rover path
- Rover stopped : Decimetric Horizontal resolution / Full polarimetric measurements on a grid -> 3D mapping

The Electronics

The WISDOM electronics are included in a single stand-alone mechanical box. This box is made of 3 stacked modules for EMI



Electronics mechanical housing

The mass of the electronic module is around 600 g

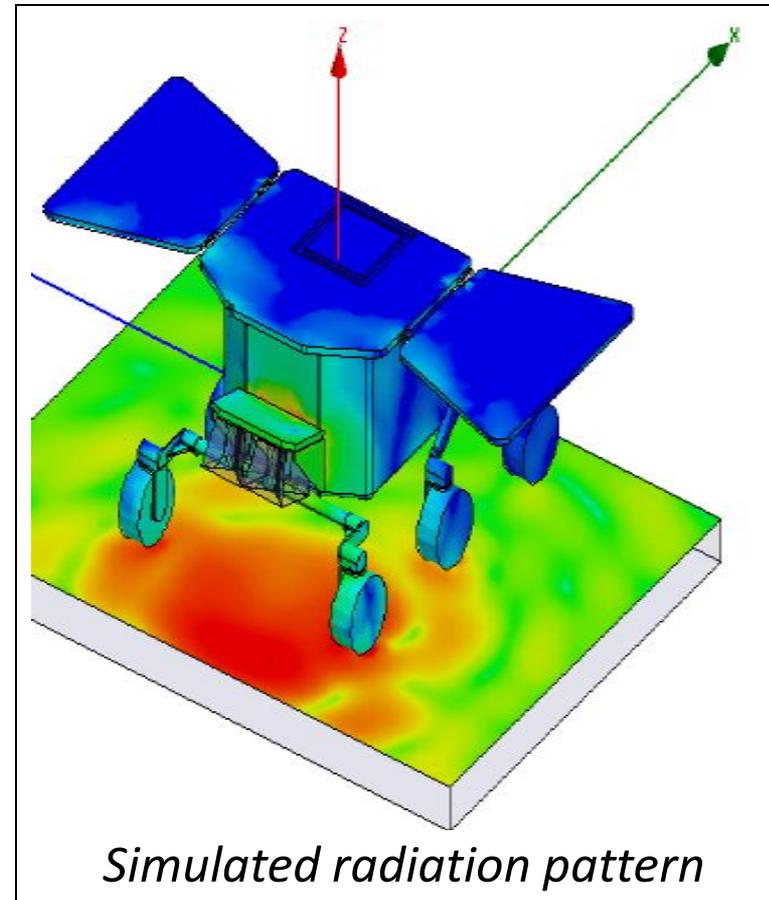
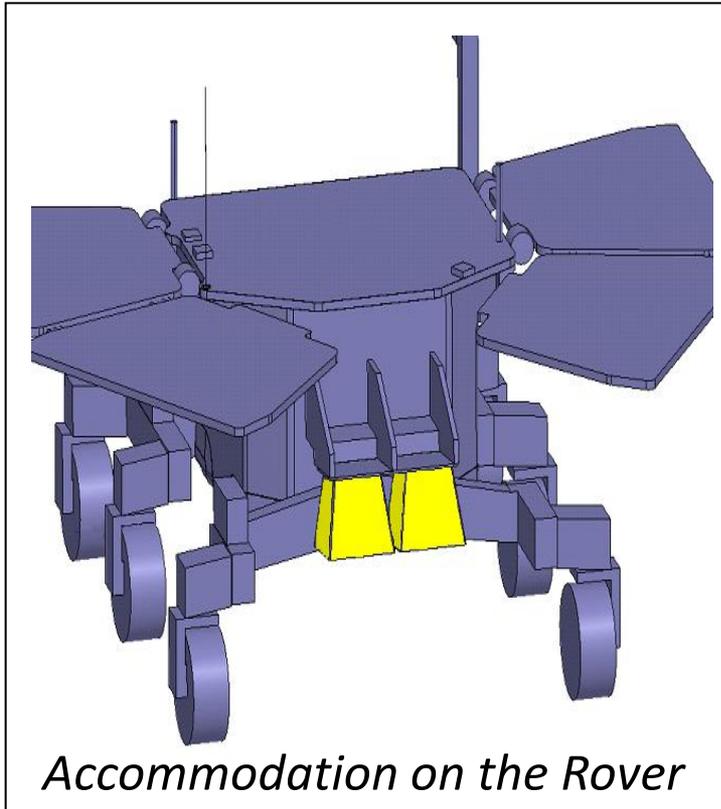
The Antennas' Structure

Two identical dual-feed, fully polarized Vivaldi horns for transmission and reception



The mass of the whole antennas structure is around 500 g

Antenna Accommodation



Instrument Performance Validation

Lab measurements

Electronic unit

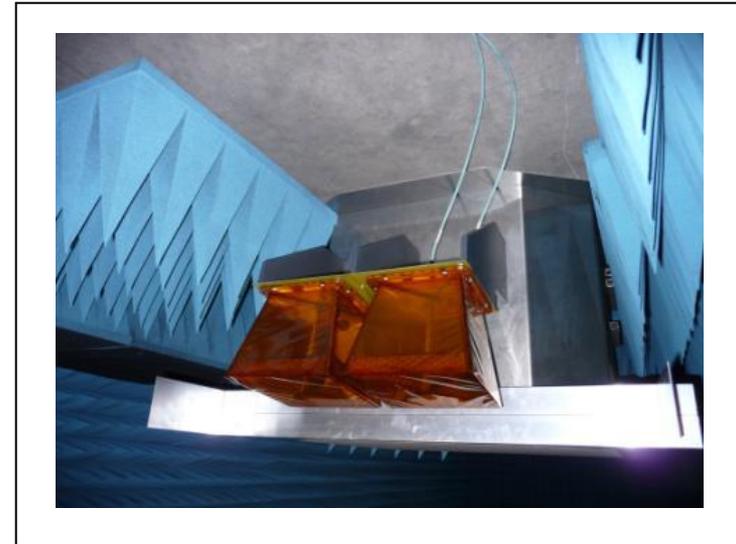
- Without antennas



Anechoic chamber

- With the WISDOM antennas

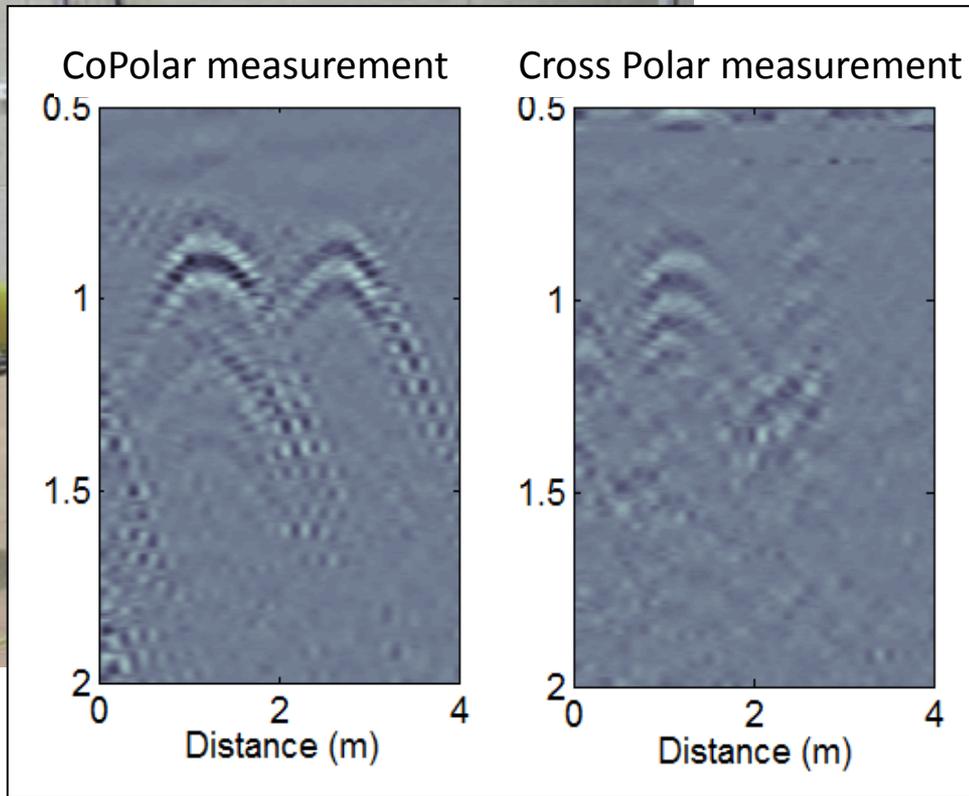
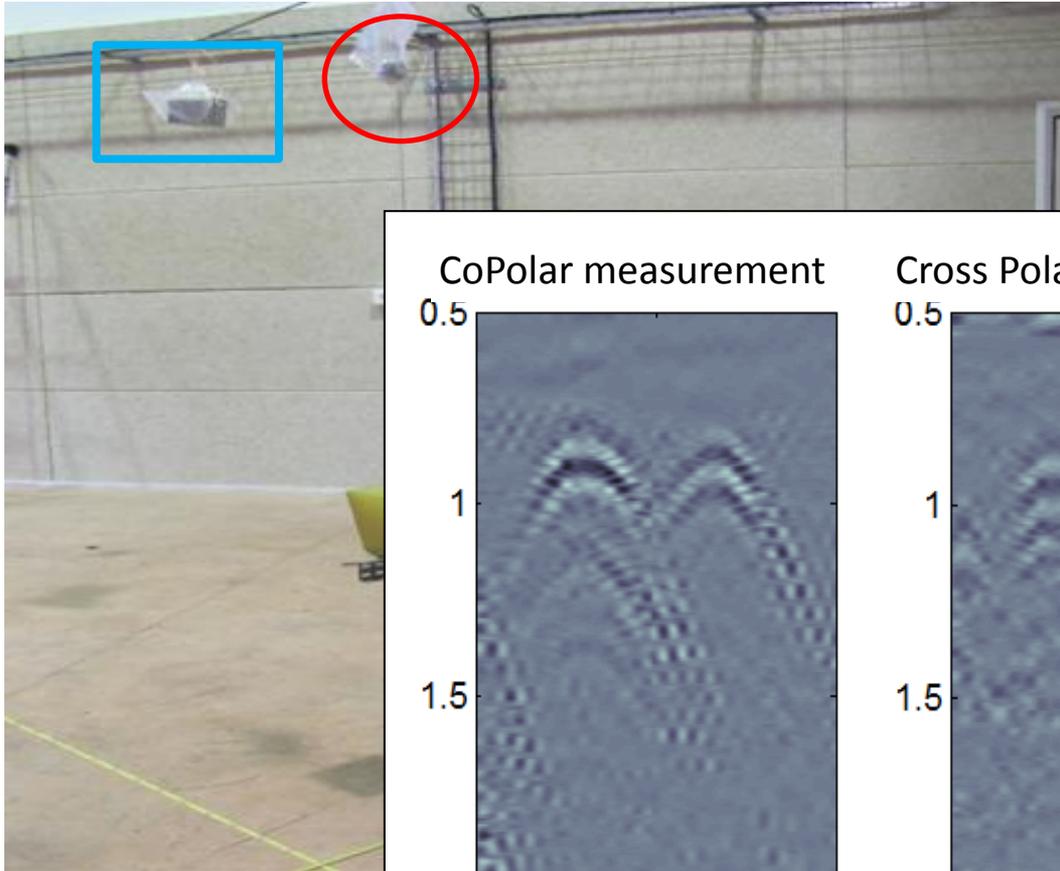
- With a mock-up of the rover structure



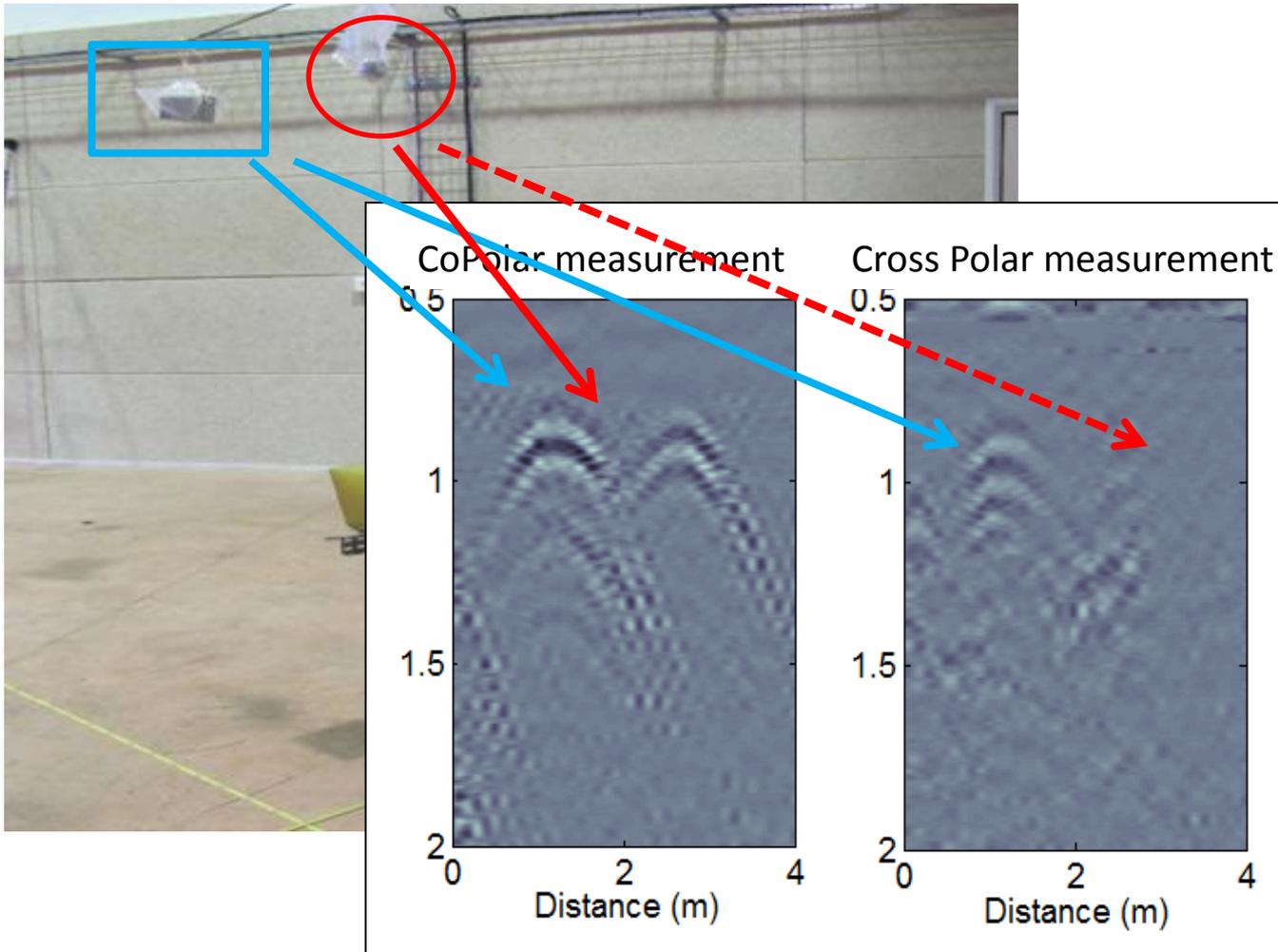
Polarimetric measurements on known targets in the air



Polarimetric measurements on known targets in the air

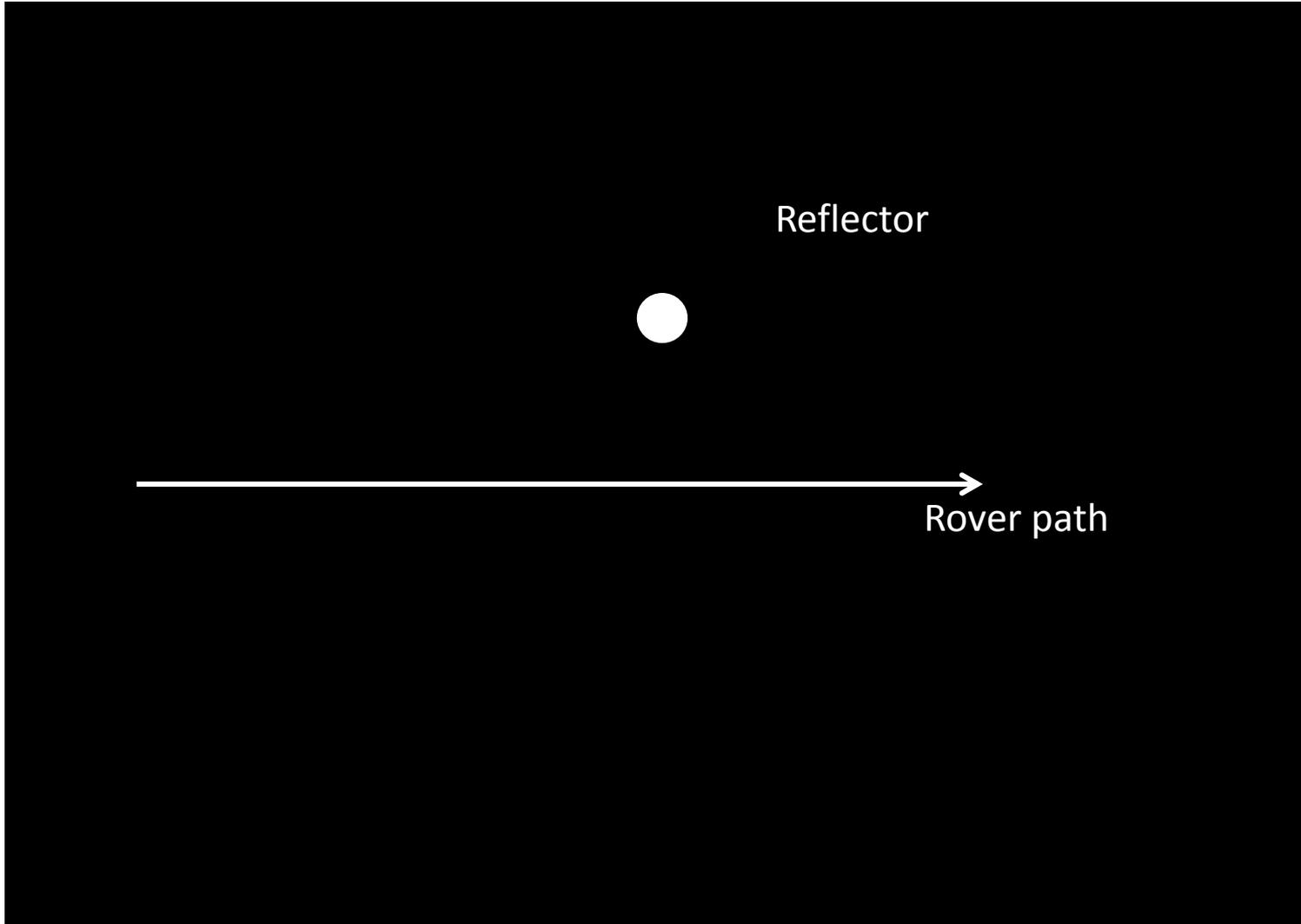


Polarimetric measurements on known targets in the air

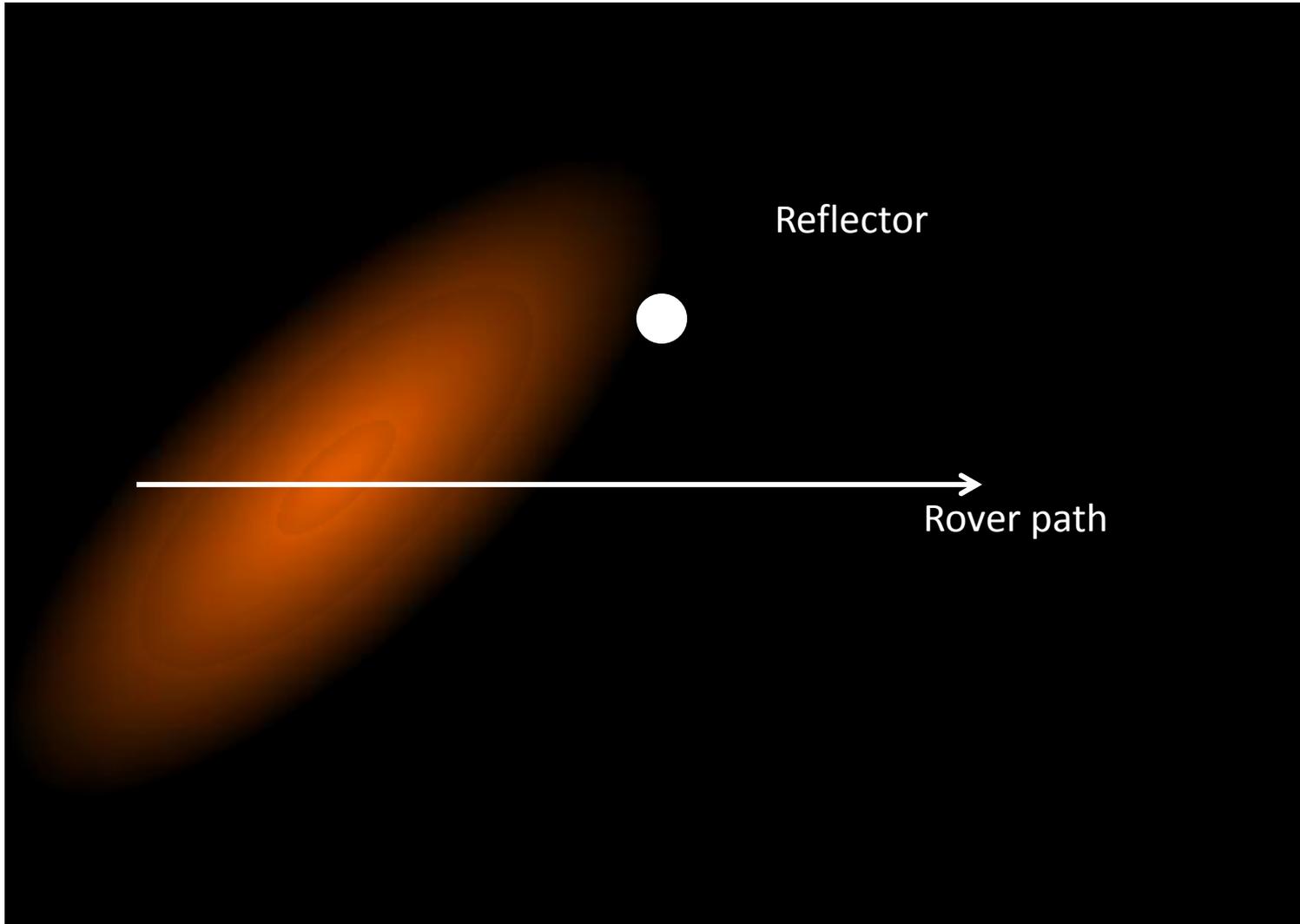


Polarimetric measurements give information on the reflector shape

CoPolarimetric measurements on a single target

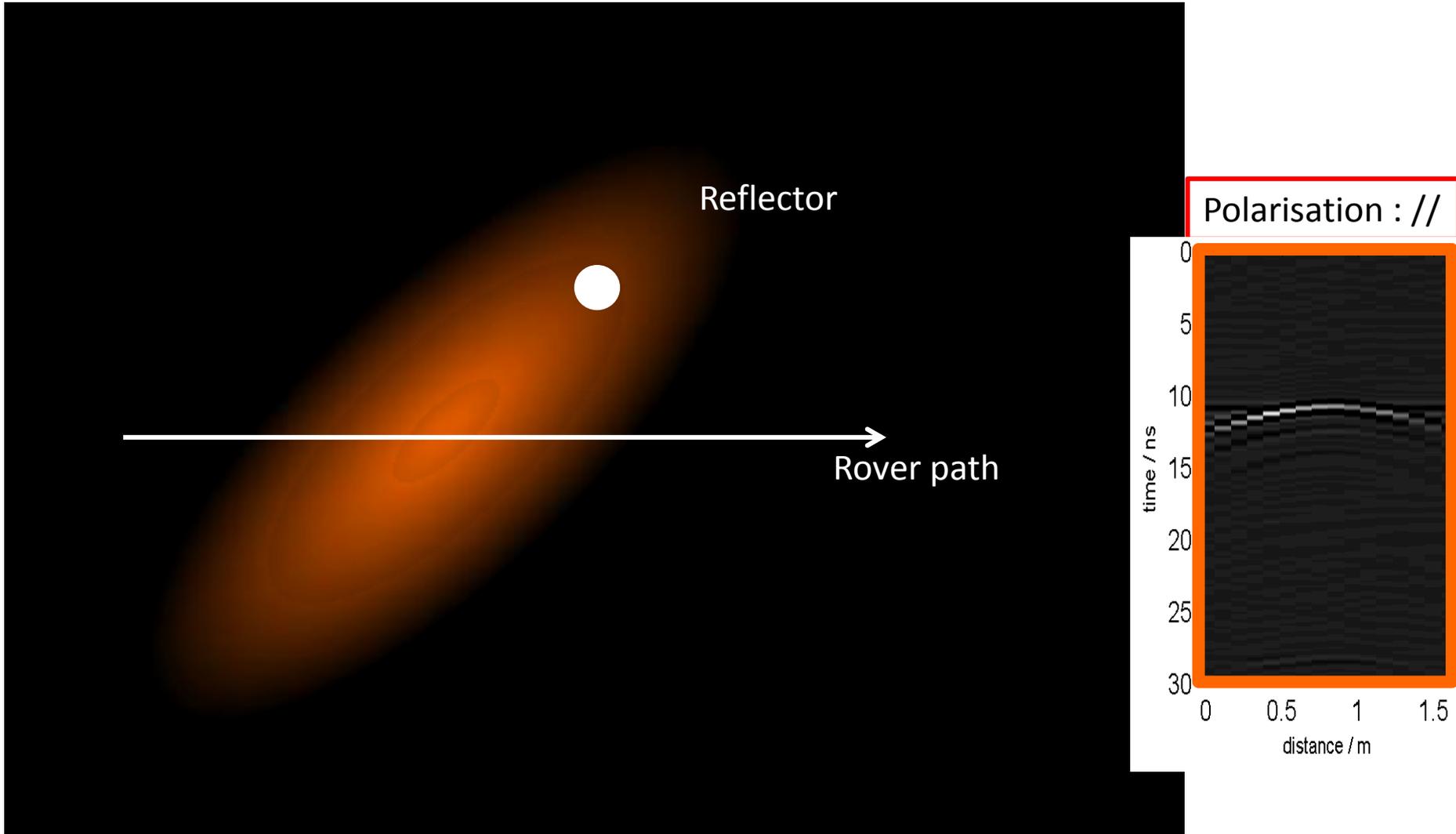


CoPolarimetric measurements on a single target



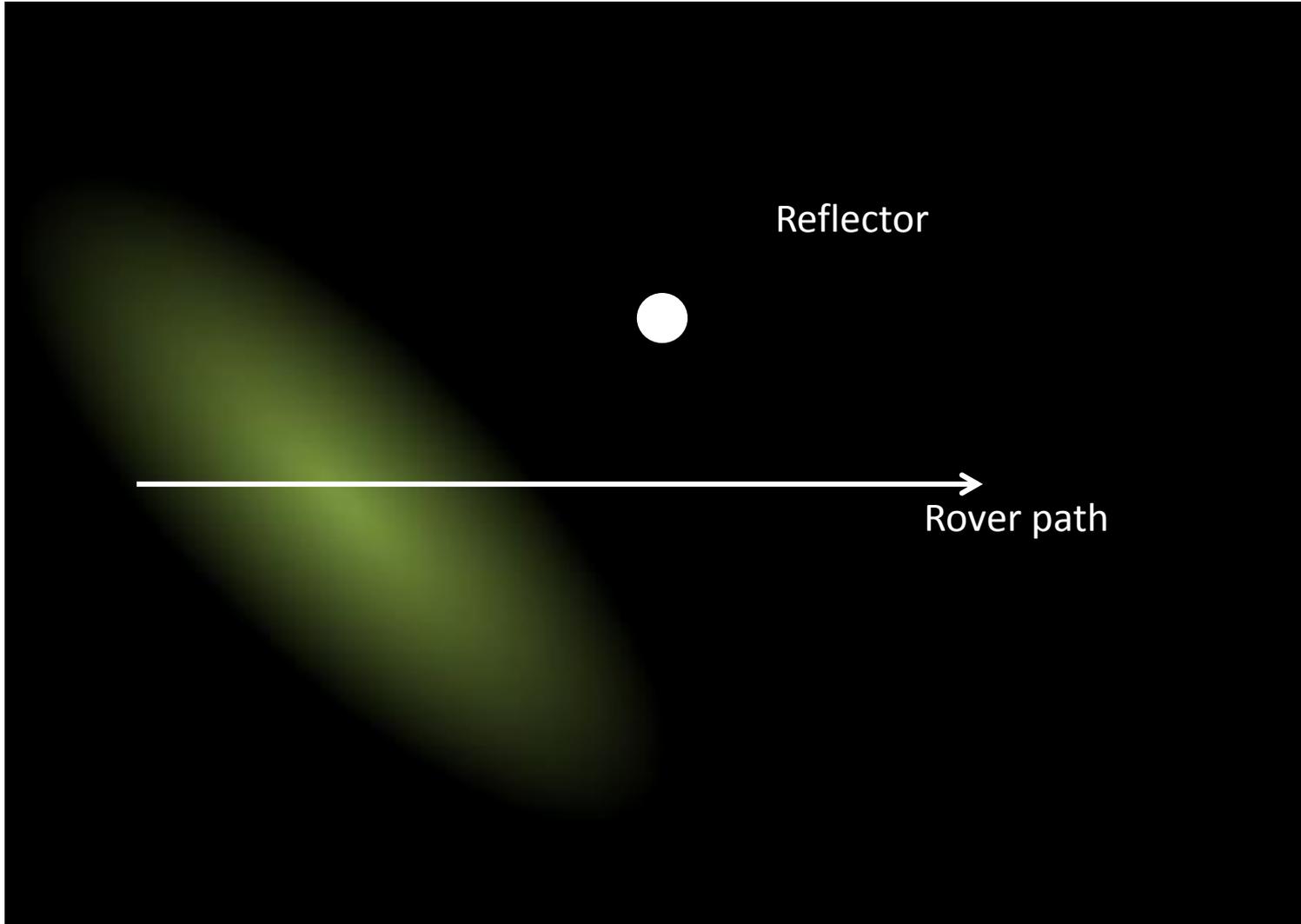
Reflector and antenna foot print seen from above

CoPolarimetric measurements on a single target



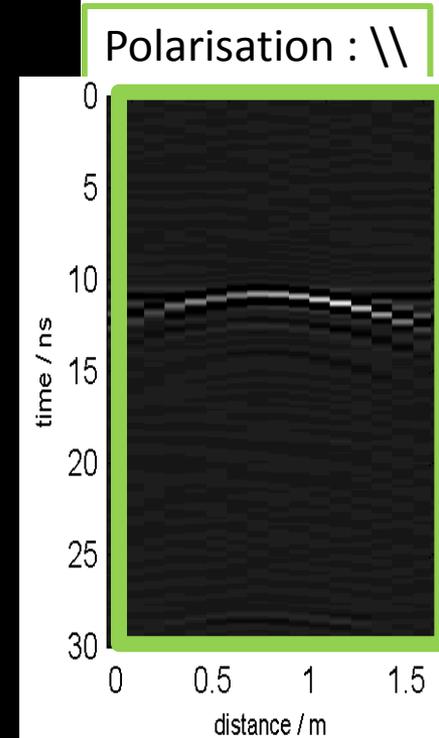
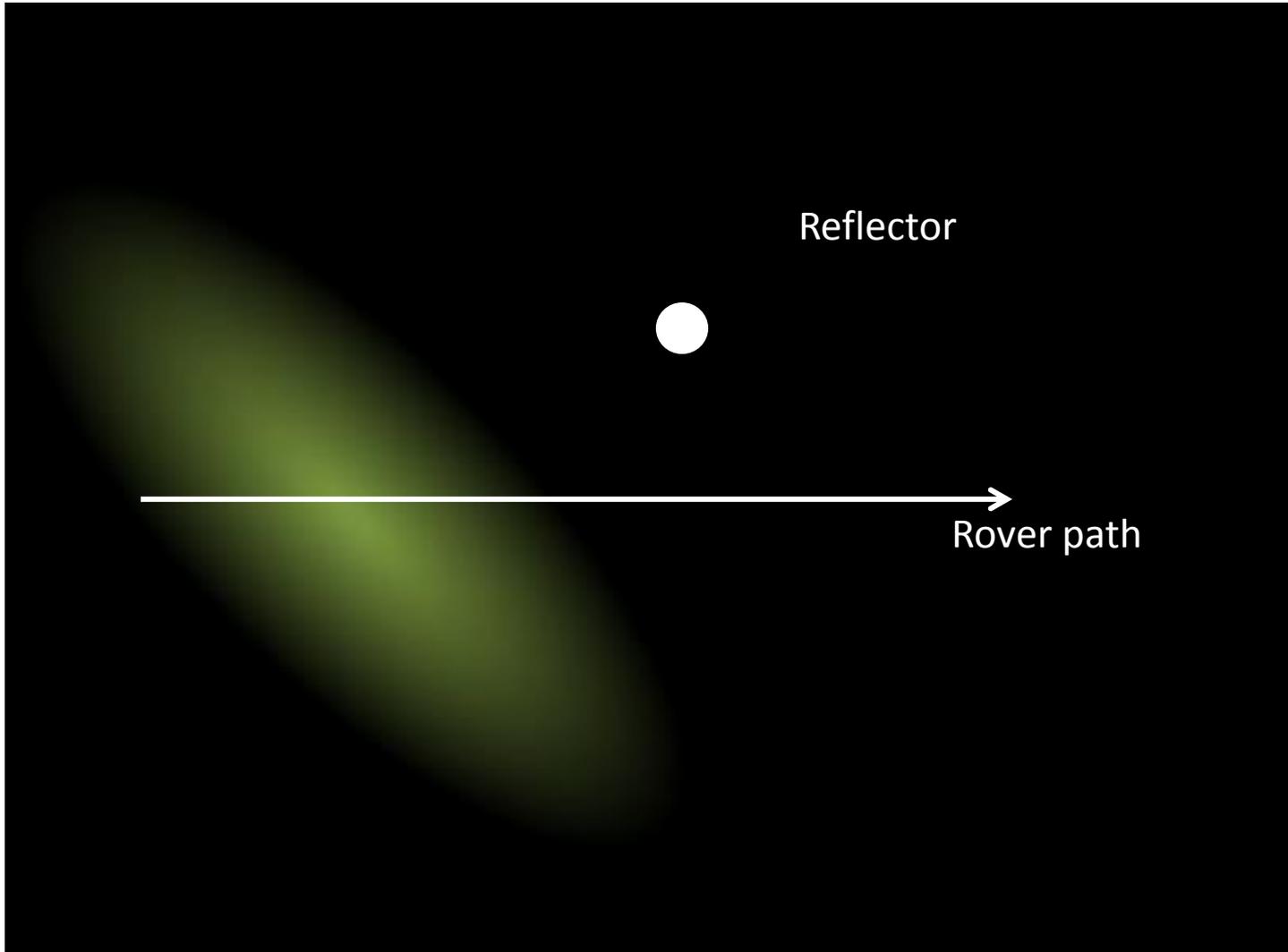
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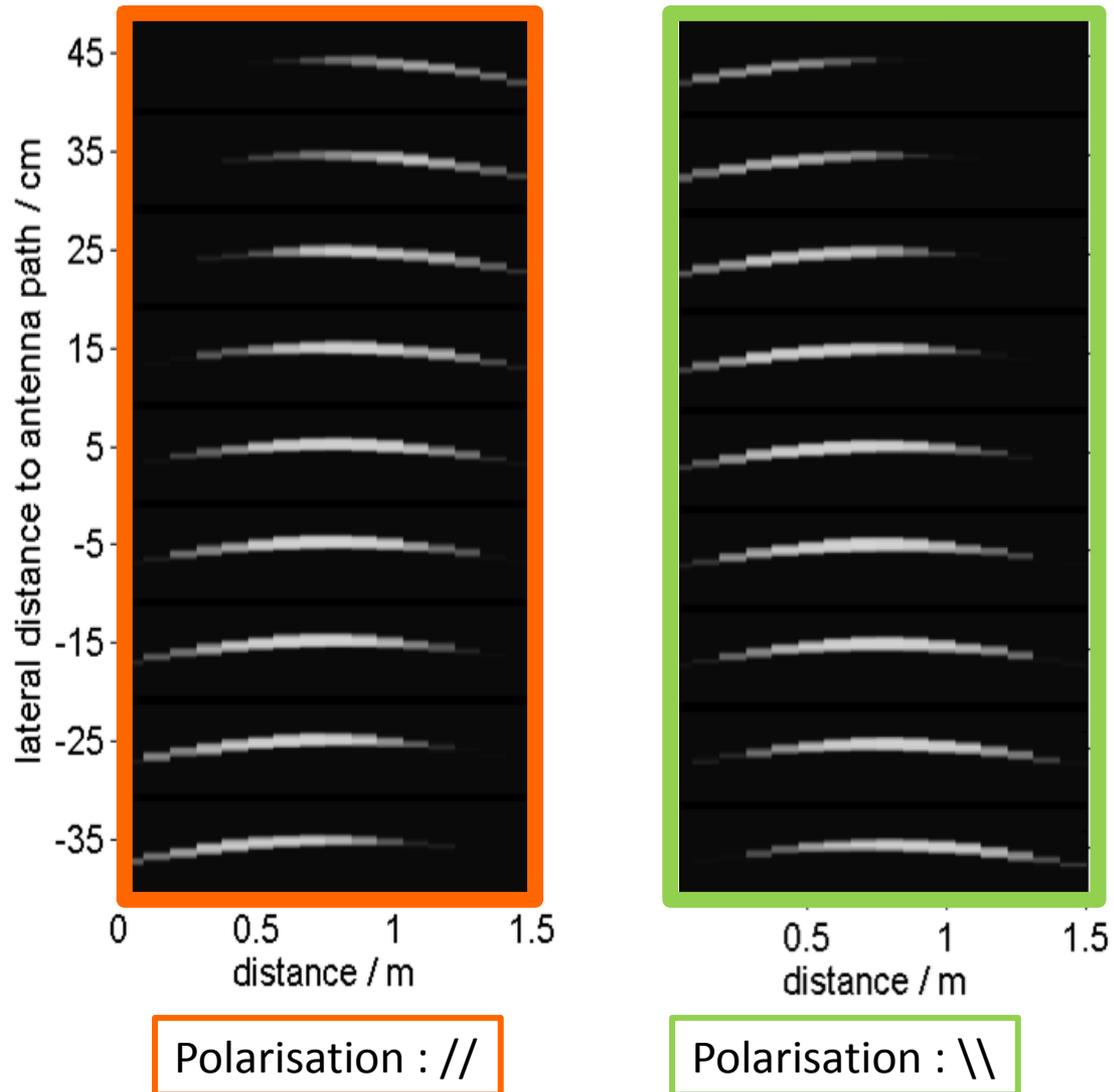
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CoPolarimetric measurements on a single target

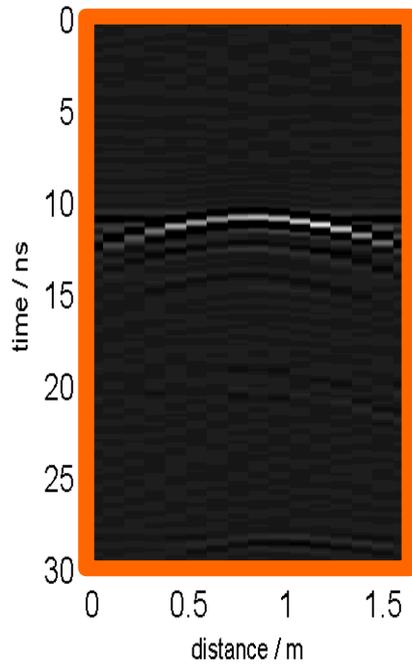


Reflector and antenna foot print seen from above

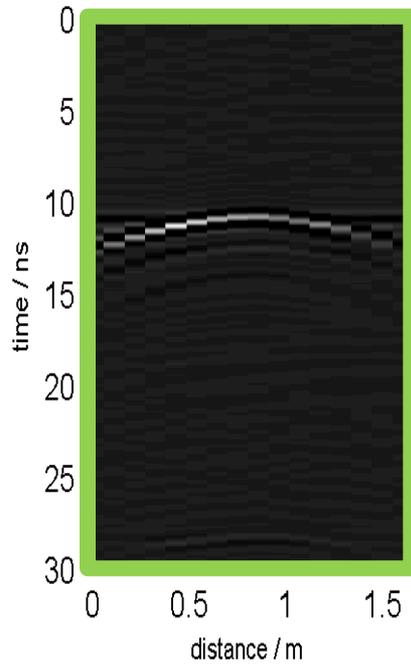
CoPolarimetric measurements on a single target



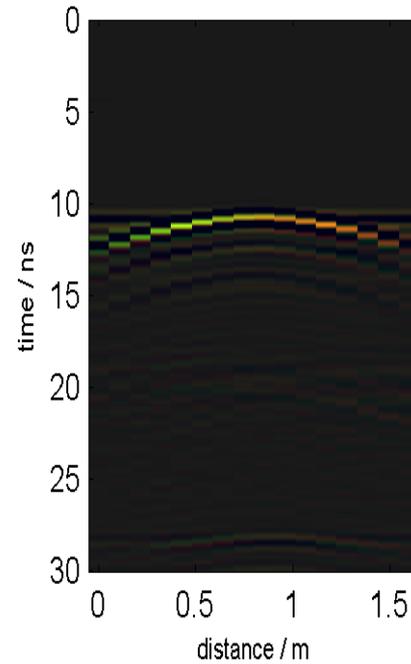
CoPolarimetric measurements on a single target



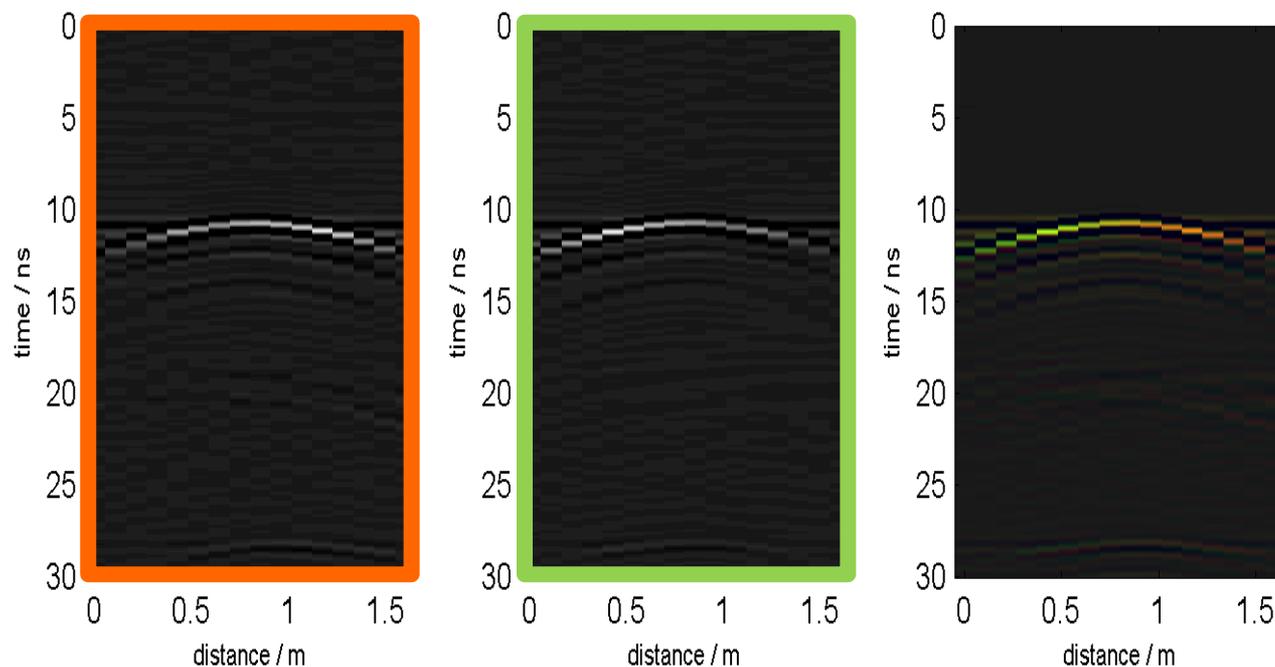
Polarisation : //



Polarisation : \\



CoPolarimetric measurements on a single target



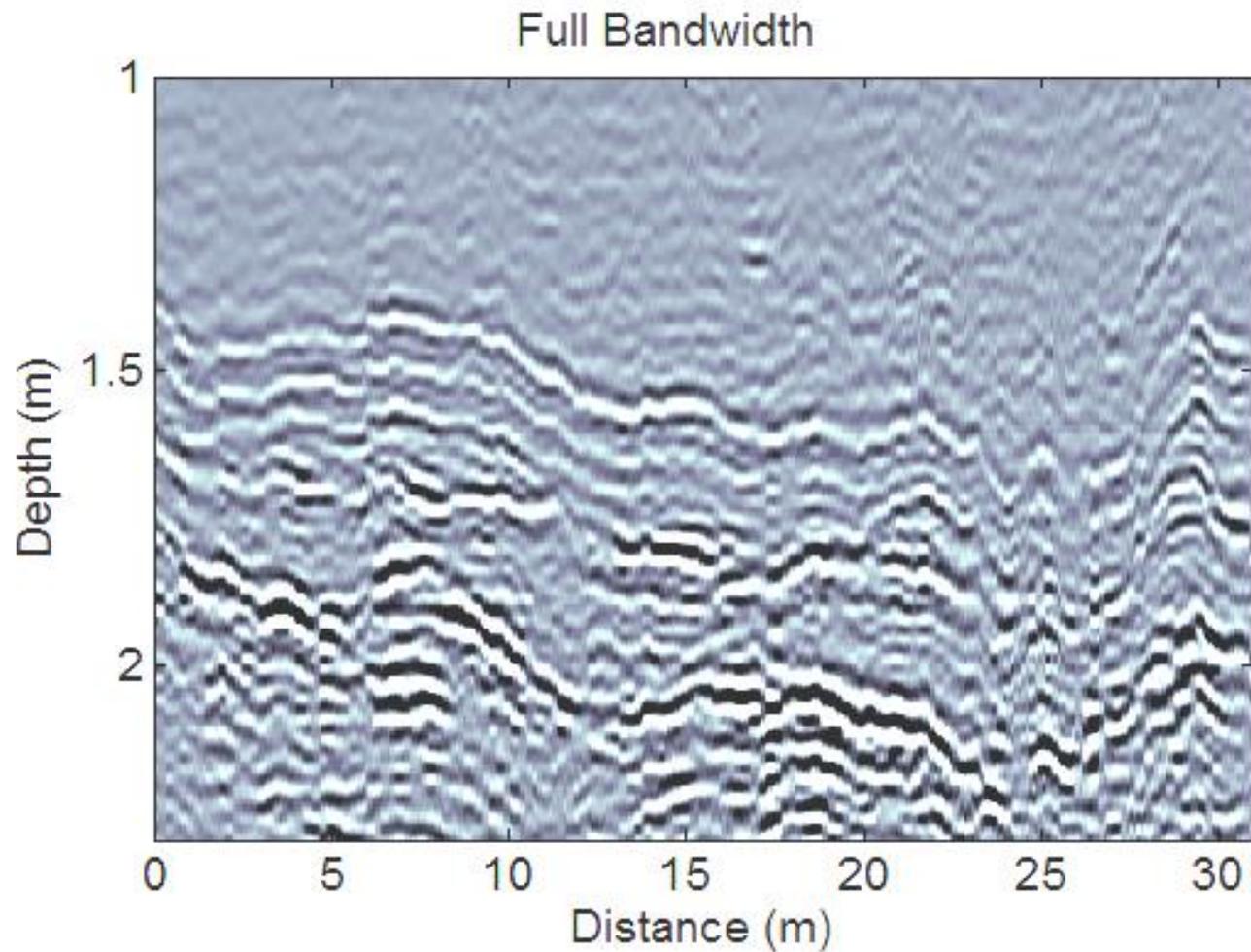
Reflector located
on the left

Polarisation : //

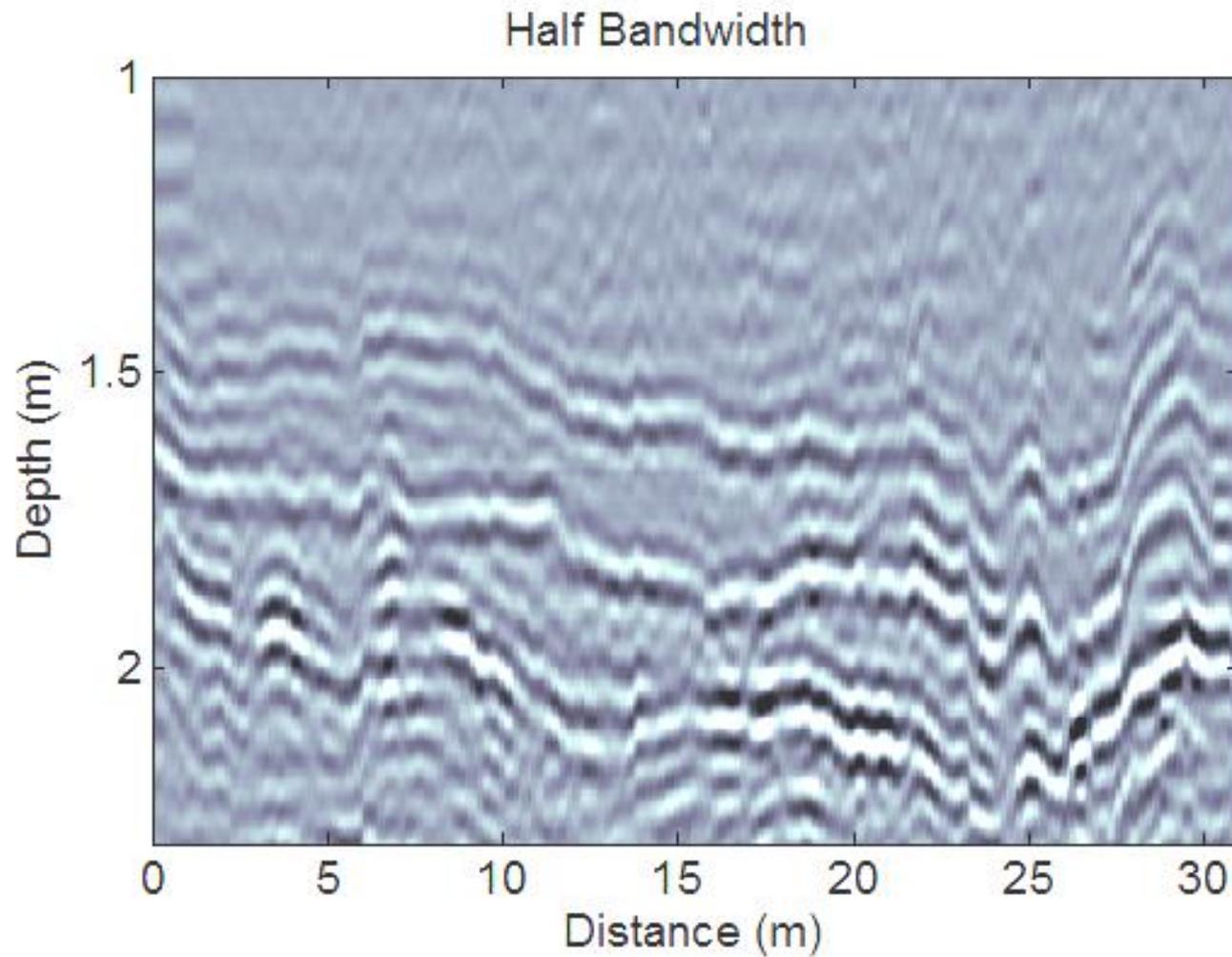
Polarisation : \\

The comparison of the two copolar radargrams provides an indication of the location of off track reflectors

Vertical resolution



Vertical resolution



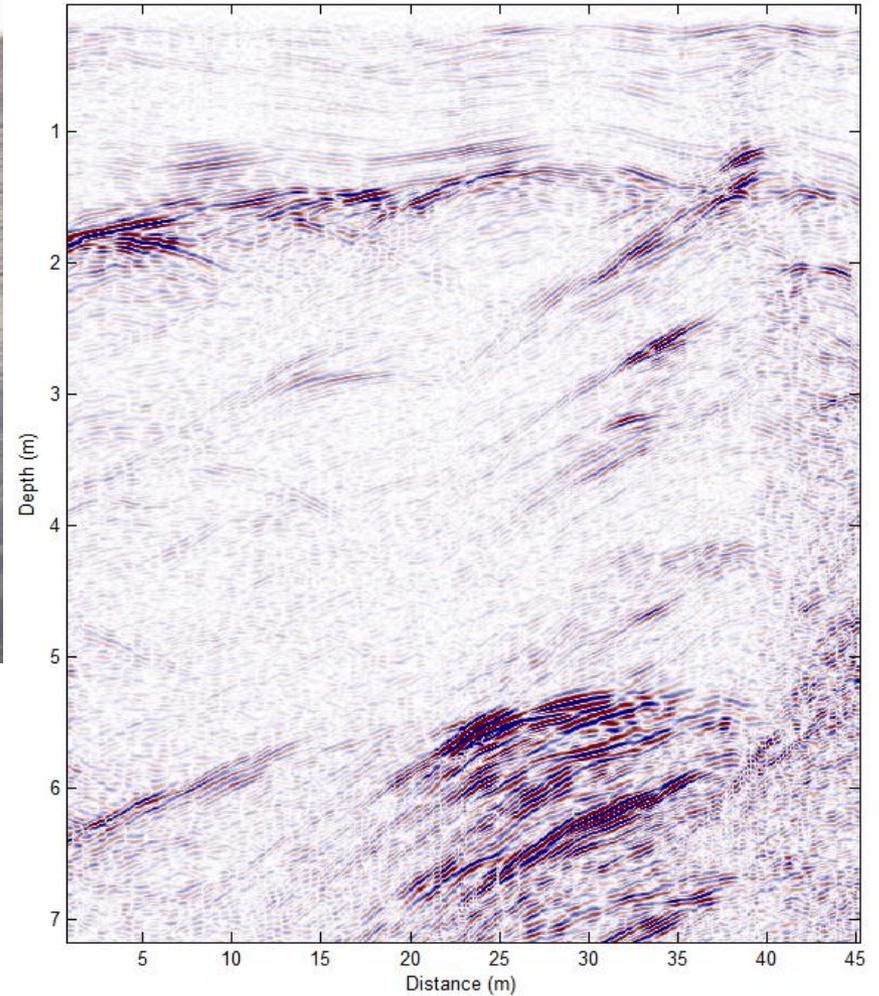
Tests in artificial and natural environments

Tests in natural cold environment Glacier (Alps)



Tests in natural cold environment

Glacier (Alps)

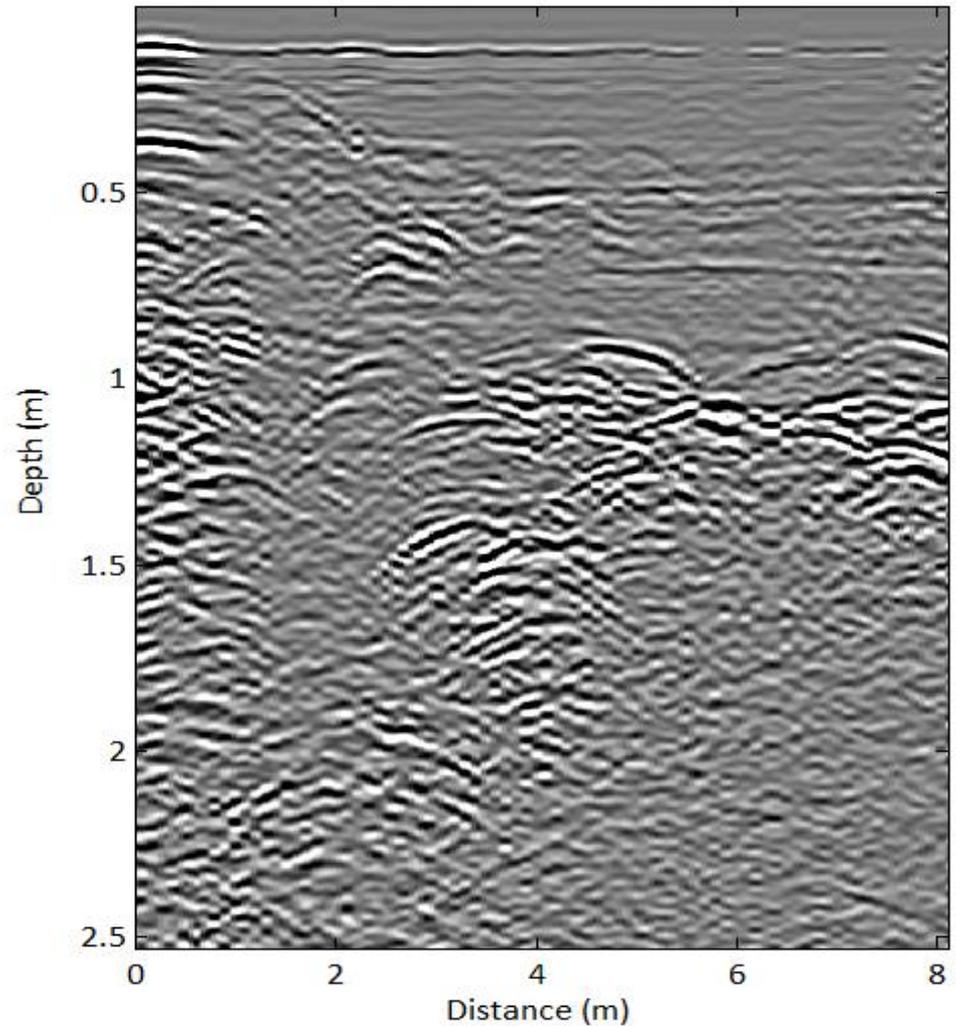


Tests in natural cold environment

Dachstein caves

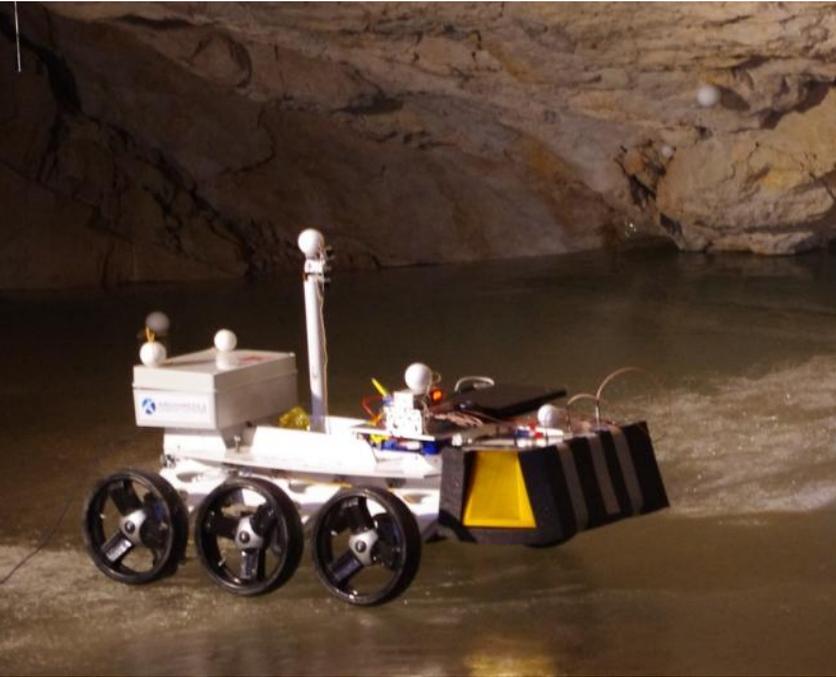


Tests on MAGMA2 during the POLARES experiment (Dachstein Austria)

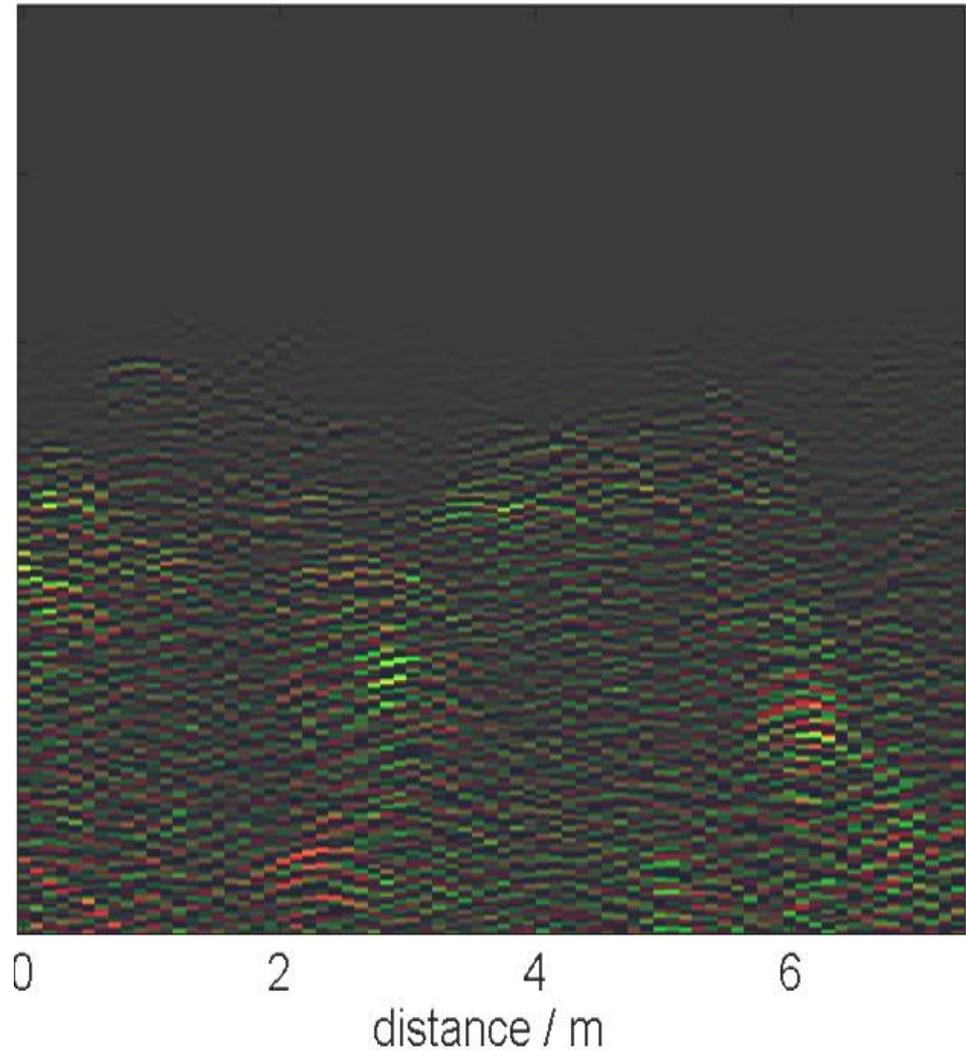


Tests in natural cold environment

Dachstein ice caves



Tests on MAGMA2 during the POLARES experiment (Dachstein Austria)



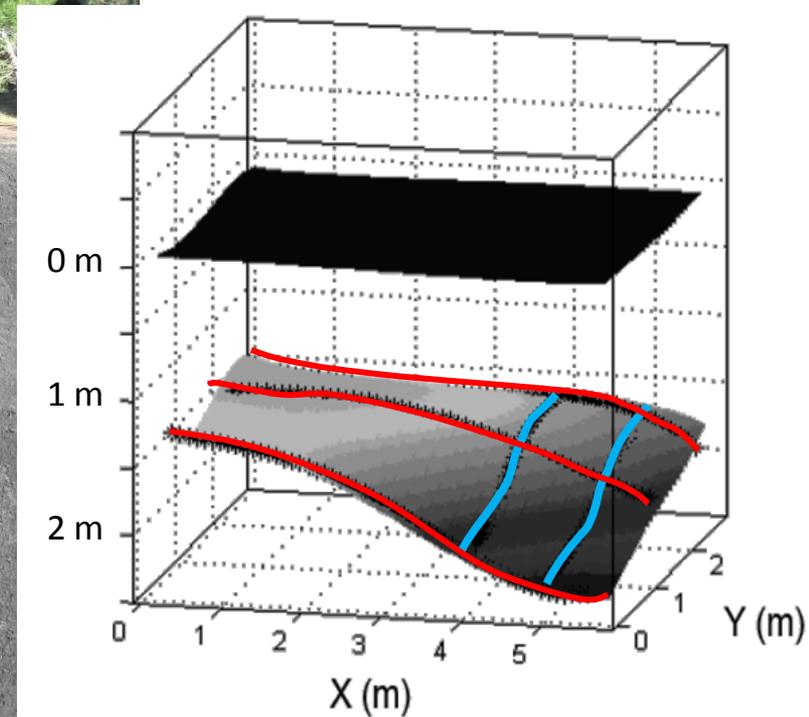
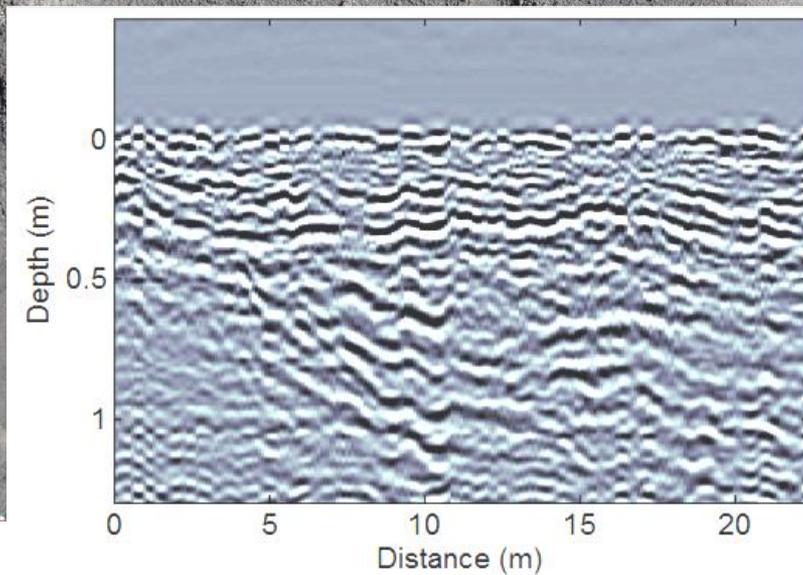
Field tests in natural environments

Pyroclastic deposits (Mount Etna)



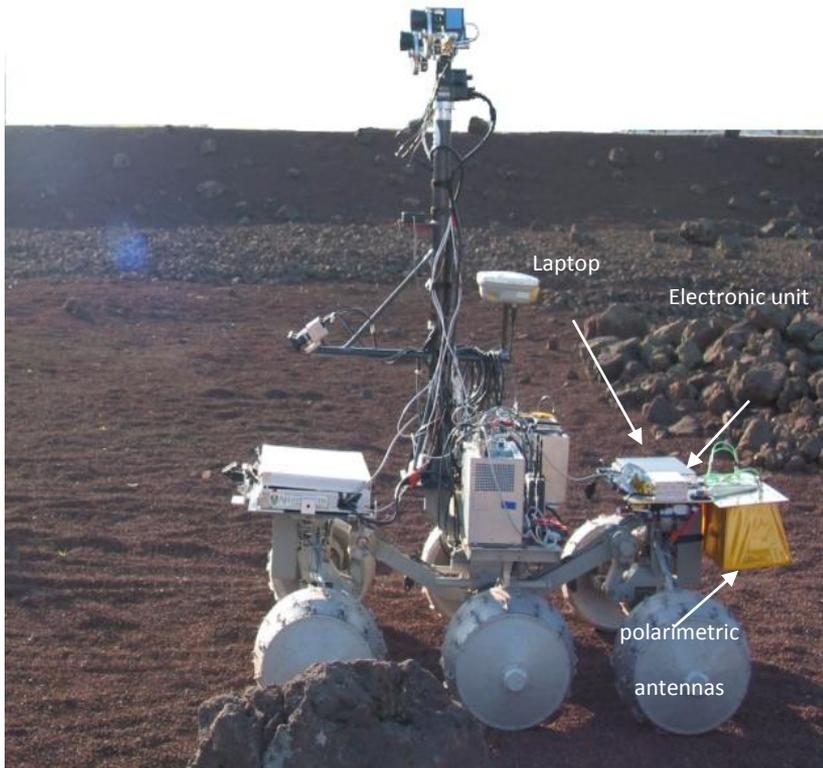
Field tests in natural environments

Pyroclastic deposits (Mount Etna)



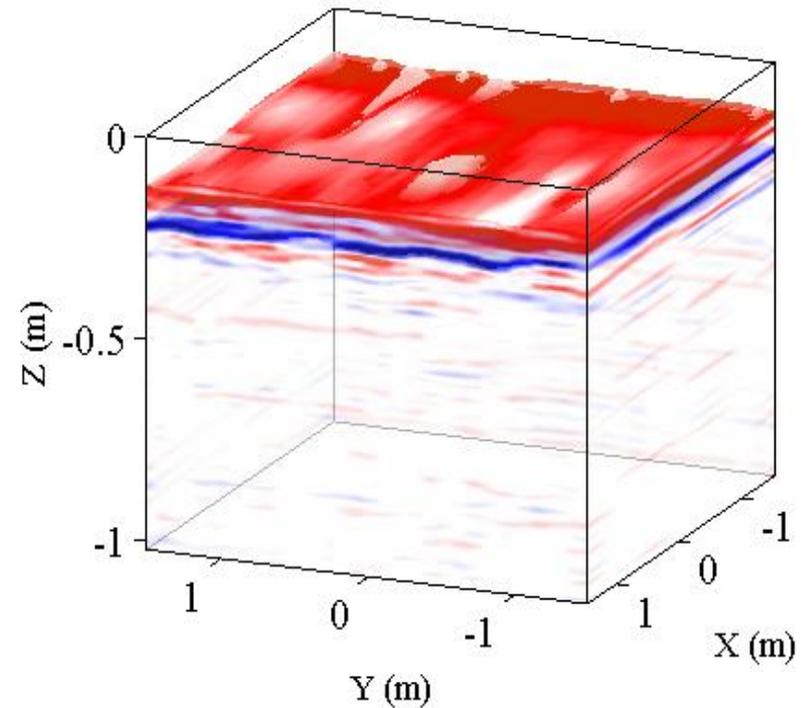
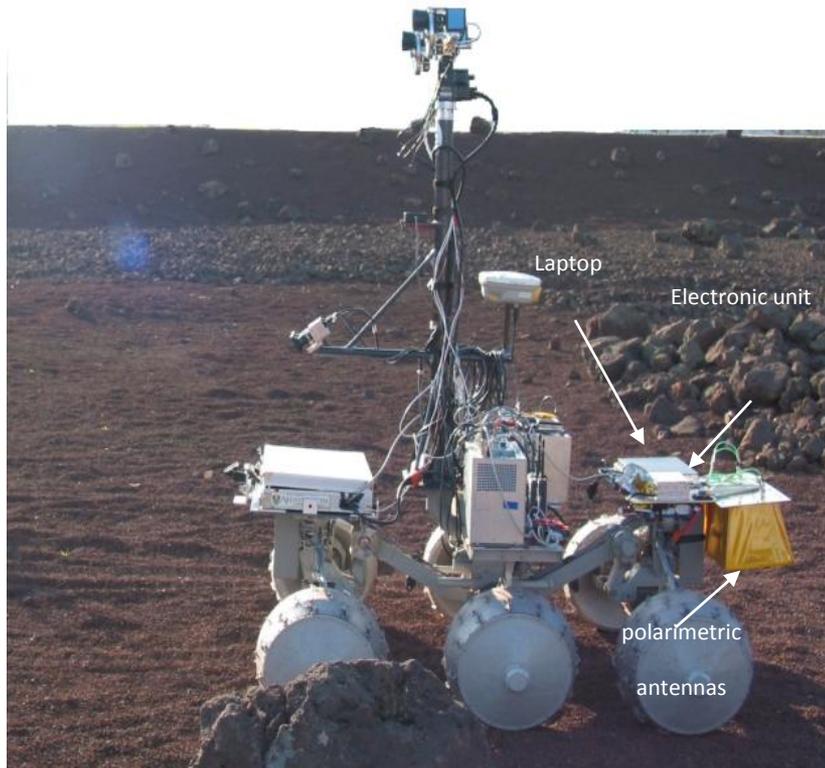
Collaboration with other panaramic instruments

ESTEC-CNES Remote Experiment #2 With PanCam and CLUPI



Collaboration with other panoramic instruments

ESTEC-CNES Remote Experiment #2 With PanCam and CLUPI



Synergy with other payload instruments

**Surface visualization
Cameras**

Navigation Location
Surface characterization

**Samples collection
Drill, arm ...**

Geological context
Selection of the location

Samples analysis

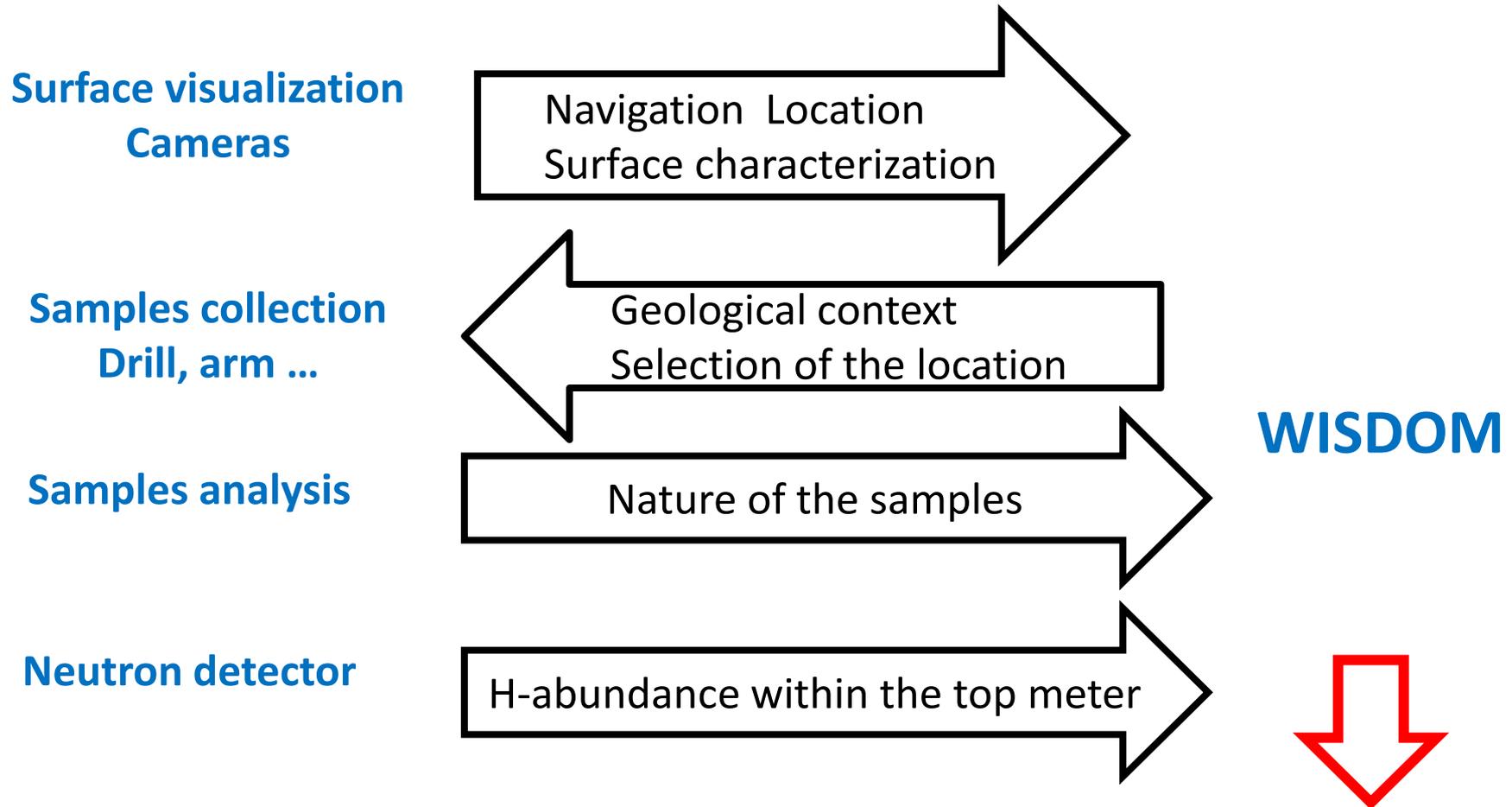
Nature of the samples

Neutron detector

H-abundance within the top meter

WISDOM

Synergy with other payload instruments



3D mapping of the subsurface