

Muography @DLR

Institute for the Protection of Maritime Infrastructures

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Cargo Scanning

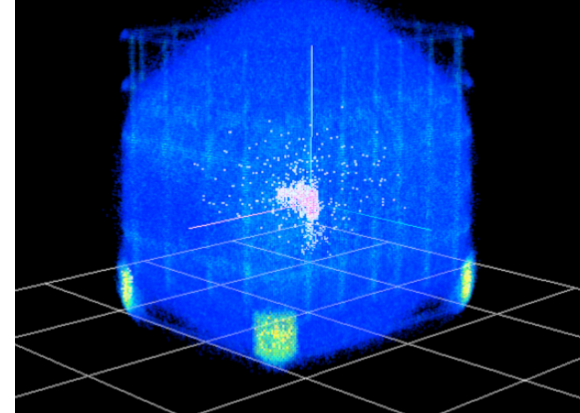
- Partner in SilentBorder
- Coordinator of SilentBorder2
- Focus on algorithmic development and generalisation of technology to suit operational needs
- Assessment of LPA systems for border security

Silent
Border²

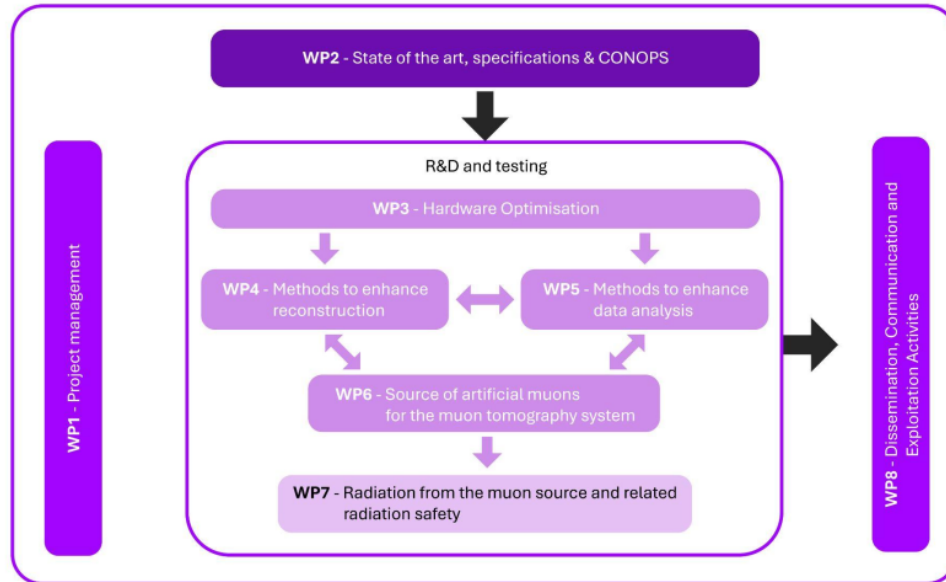
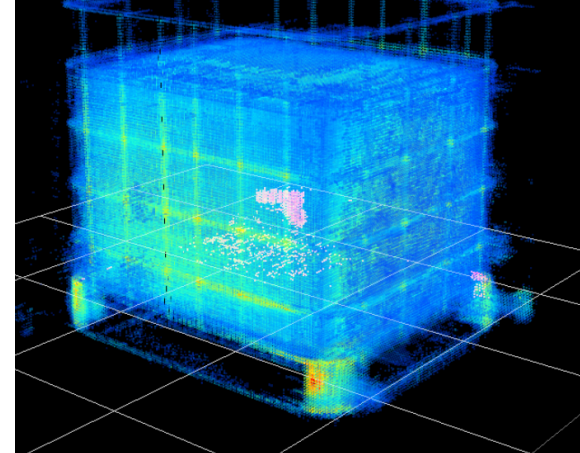
Silent Border



Cosmic muons (4h) + ASR

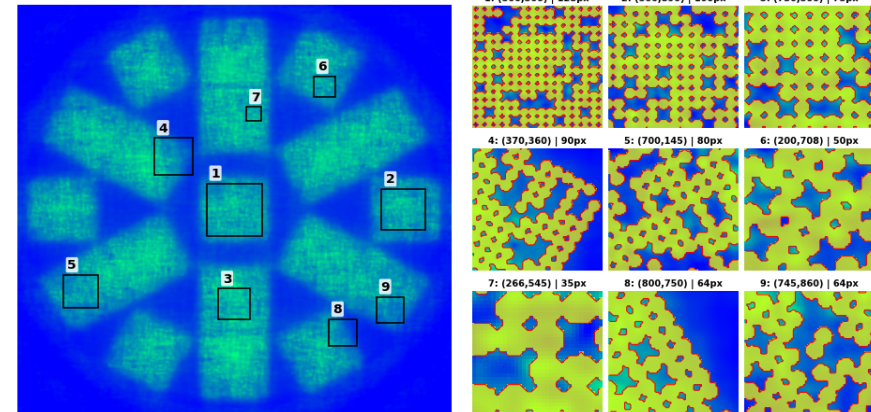
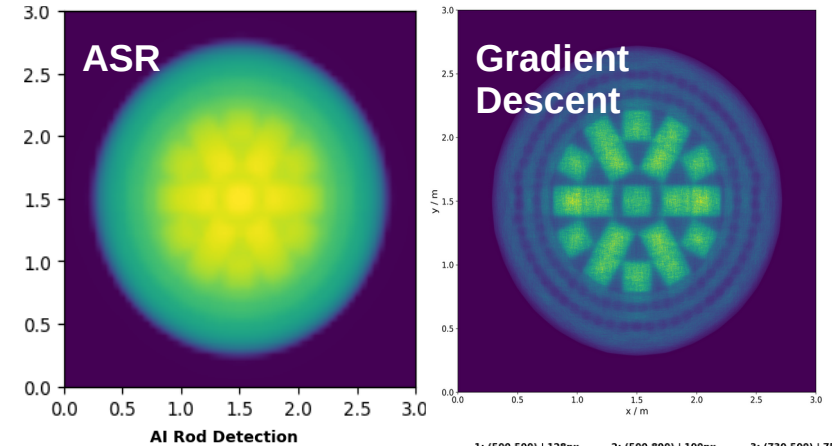


Beam muons (~s) + ASR



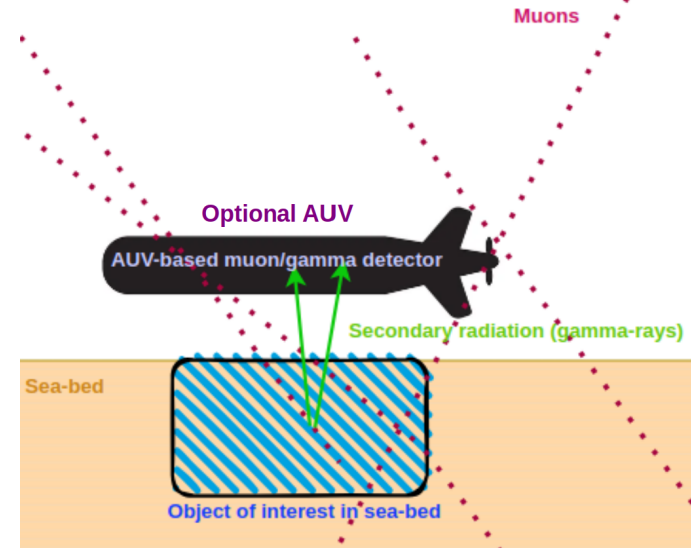
Nuclear Monitoring

- **CACTUS/CACTUS2 Projects** in collaboration with BGZ
- Novel and **efficient reconstruction method based on gradient descent** implemented
- Clear **demonstration of feasibility for single and sub-rod resolution** using 75h of ideal data
- **For the future :**
 - Optimization studies for practical implementation
 - Reconstruction with of templates, dynamic voxelisation or voxel-free analysis to reduce computational time
 - Refinement of AI methods for automatic and generalized defect detection
 - Experimental validation of results (campaigns to begin soon)



Underwater Applications

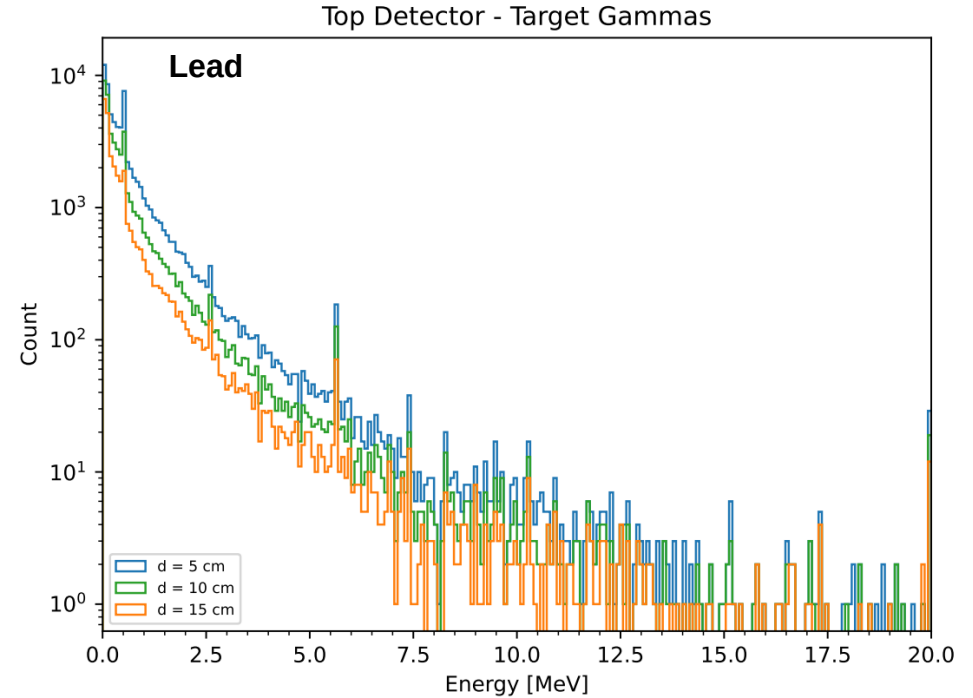
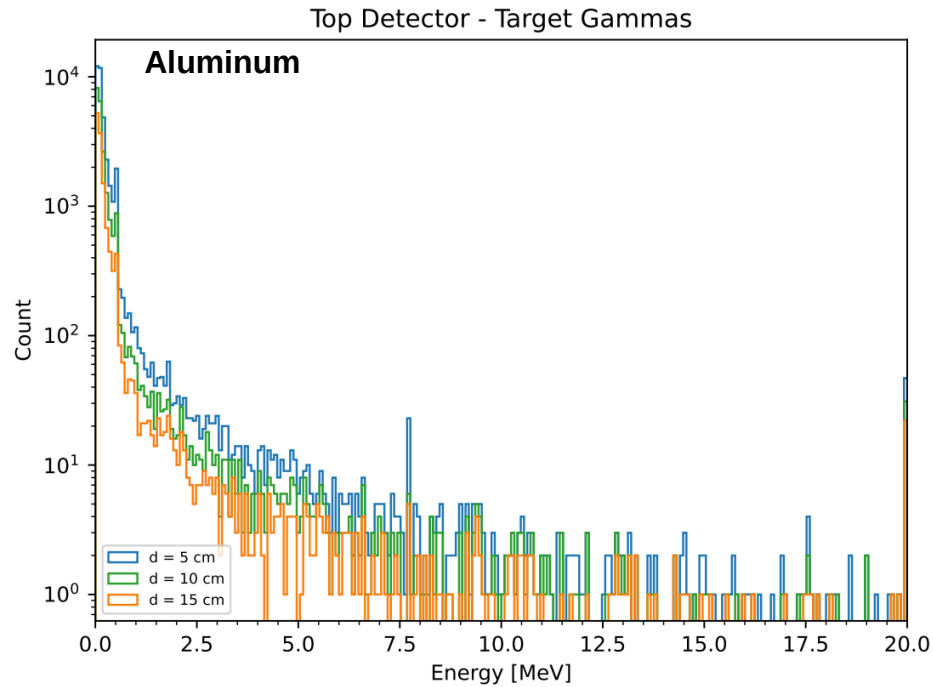
- CRIGS (**Cosmic-ray induced gamma-ray spectroscopy**) technique under study at DLR
- Focuses on the **detection and characterization of element specific gamma-rays** resulting from cosmic ray muon interactions with target
- Feasibility proved in principle from **secondary particle analysis in the domain of muon tomography**
- Experimental program beginning 2026 but will suffer from **low gamma-ray flux due to fixed natural muon flux and muon absorption in water**
- Plans to expand this further with X-ray, neutron and possibly LPA illumination



CAEN GAMON Diver

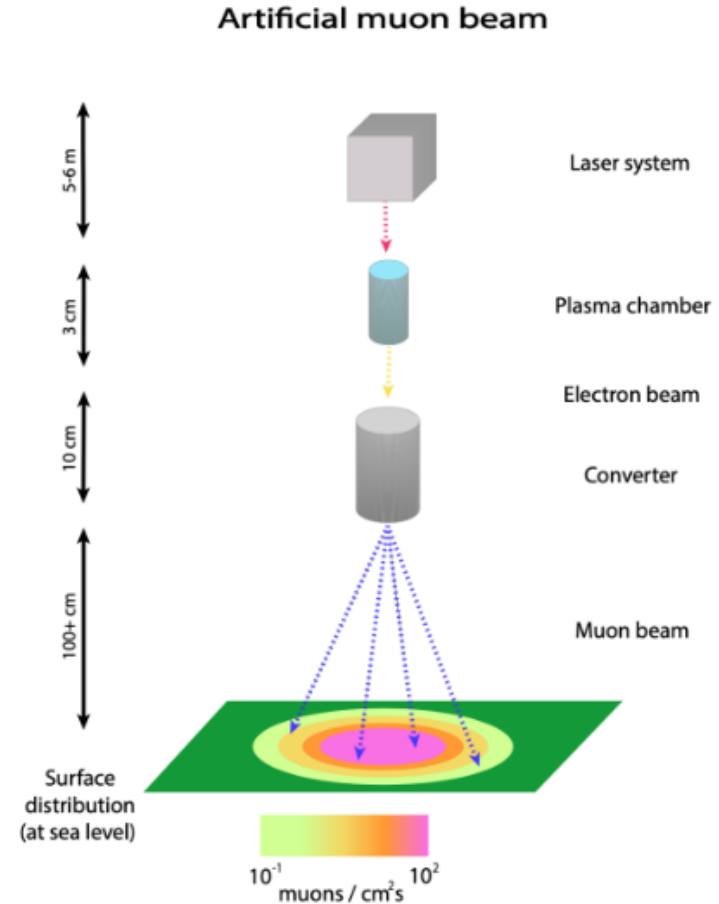
Underwater Applications

2.5m water depth



Planned Applications

- **LPA driven research for :**
 - Muon imaging over large baselines
 - Imaging over large and dense volumes (e.g. Faraday cages)
 - Imaging within subterranean tunnels
 - Support dedicated detector development
 - ...



Hardware Available

- Detection system recently acquired
- Two GScan hodoscopes
- Active area : roughly 0.78m x 1.54m
- 3 layer scintillating fiber detectors with (soon) single channel output

