JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Facilities for DM detector development at JGU Mainz

Alexander Deisting for the Mainz group

XLZD collaboration meeting - 1st of July, 2025

Johannes Gutenberg-Universität Mainz

- Mainz is located in the Rhein valley in Germany
- Conveniently close to Frankfurt airport
- Famous for the Fastnacht (carnival), wine, and *excellent* particle physics research

PRISMA+

PRISMA DETECTOR LAB

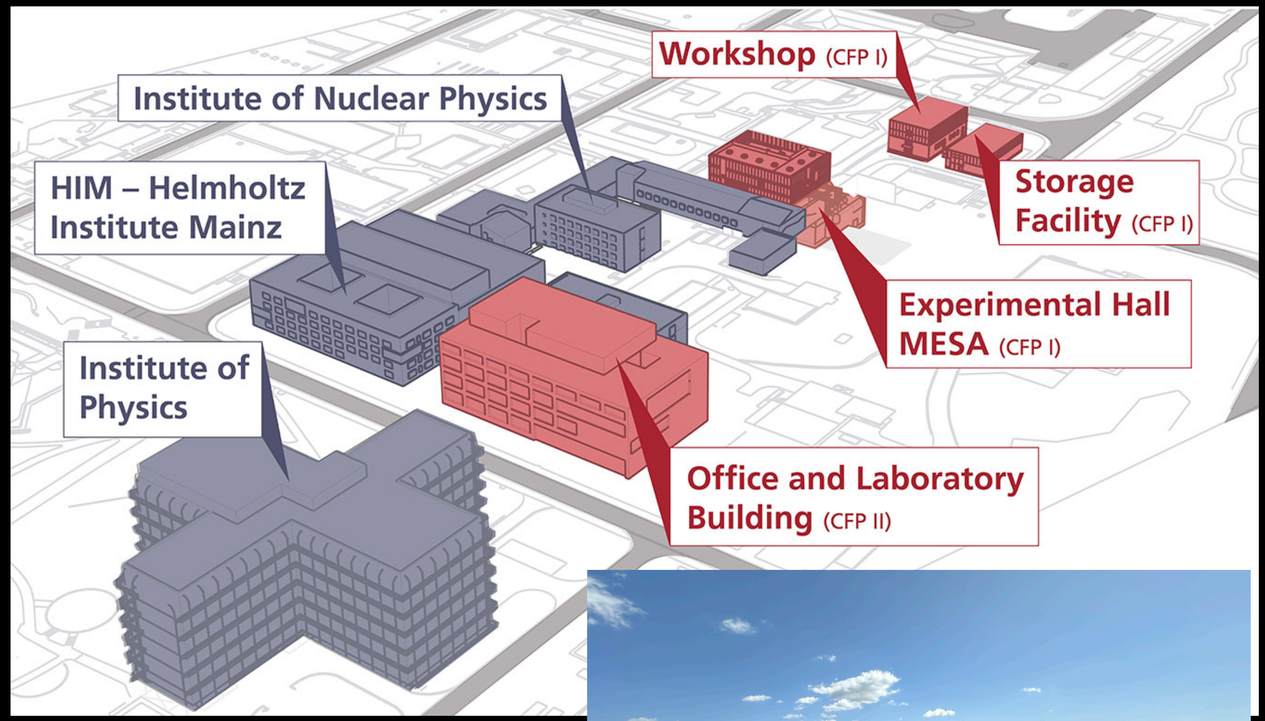
Facilities relevant for XLZD

- CFPII: Laboratory space, including two laboratories with a direct liquid xenon supply by **XeLIPs**

1. **XeLIPs: Xenon liquefaction, purification and storage system**

2. Set-up to assay electrodes

3. TRIGA reactor: Production of ^{37}Ar by neutron bombardment



XeLIPs: Goals

(Xenon liquefaction, purification and storage system)

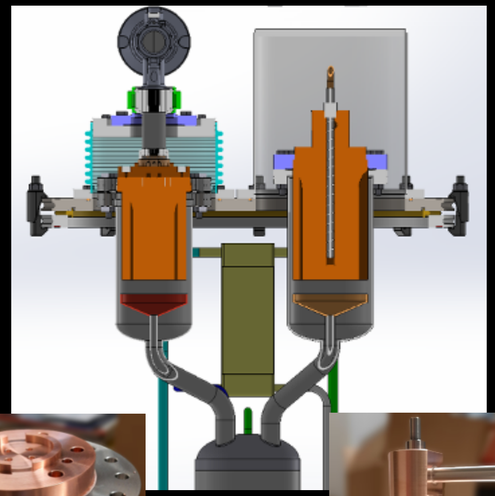
- Fast filling and evacuation of LXe from experimental set-ups
- Continuous purification
- Save storage of up to 500 kg LXe at room temperature

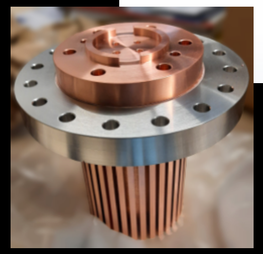
Xenon lab

basement

XeLIPs: Some details

- Storage tank: LN_2 condenser (500 W) and electric heater (200 W) for temperature and pressure control, LN_2 shroud (max 1000 W) in the vacuum gap
- *Cold Box:* PTR (~130 W) and LN_2 cryocooler (max 170 W) in the to supply the experimental set-up
- Purification by one or two NuPure Omnia 2000 getters (target: 20 slpm) on the warm side of plate heat-exchanger in the *Cold Box*
- Currently being commissioned

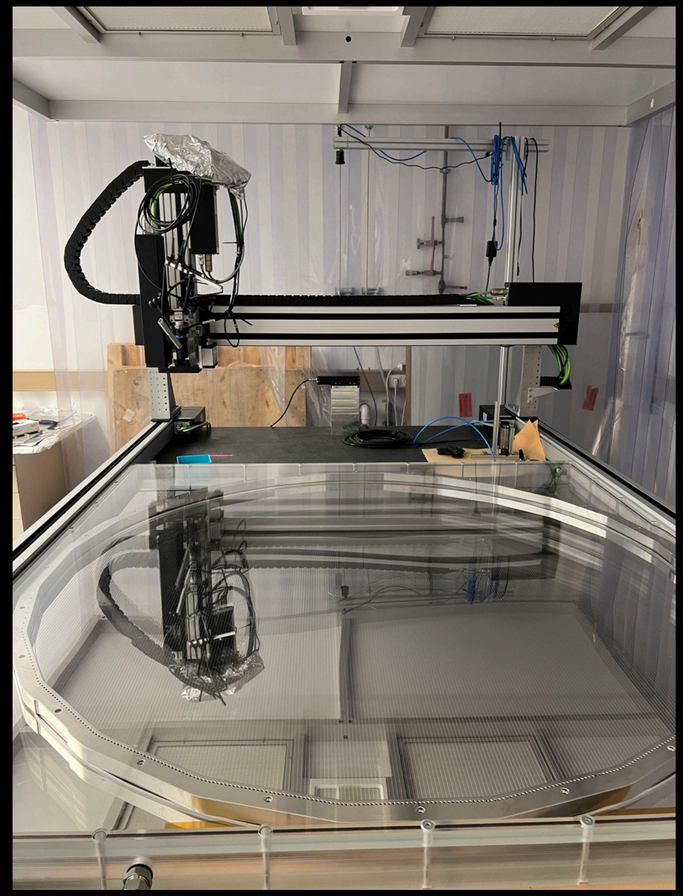




See Francesco Lombardi's poster!

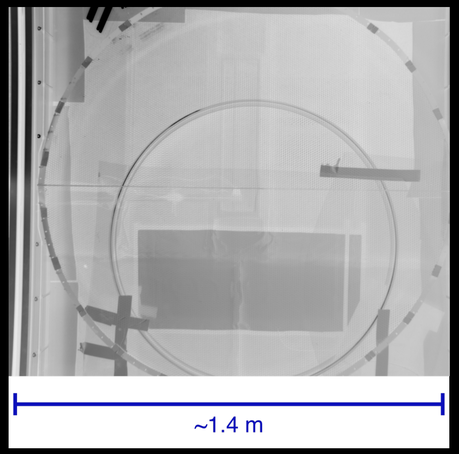
Electrode scanning set-up

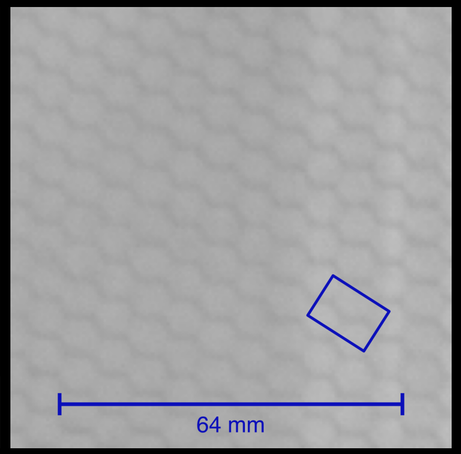
- Set-up built on a granite table with a gantry moveable in xyz - active surface of ~2 m by 1.5 m
- Acrylic test box (~1.4 m by 1.4 m by 4 cm) with a mirror polished, flat plate as floor (e.g. to be used as ground electrode)
- Equipped with high voltage (HV) feed-throughgs and flushable with gas, e.g. argon for particular HV tests

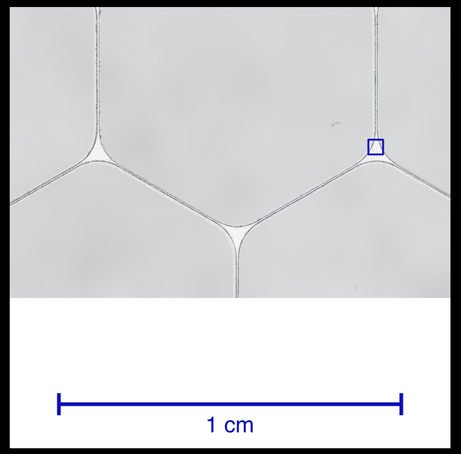


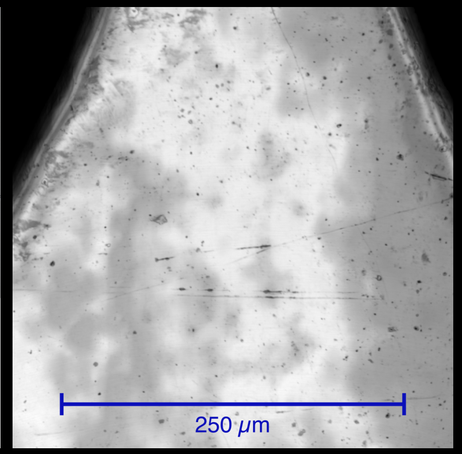
Imaging devices

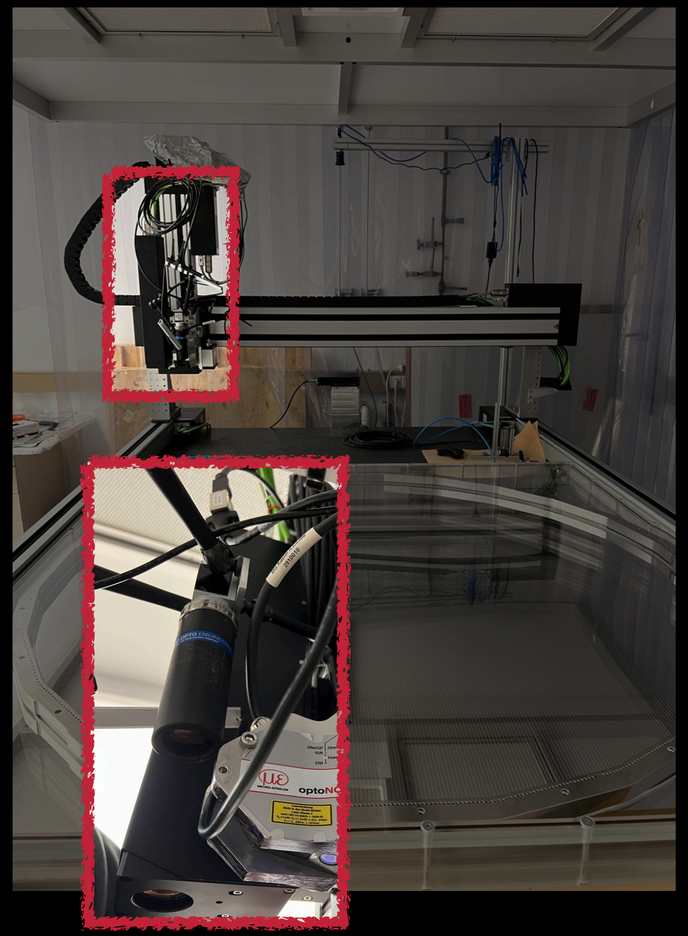
- Overview camera (*5 Mpixel, 1.5 m by 1.5 m imaged area*)
- High resolution camera (*15 Mpixel, 1.23 cm by 0.87 cm*)
- Confocal microscope (*1.4 Mpixel, x10, x20, x50 lenses*)





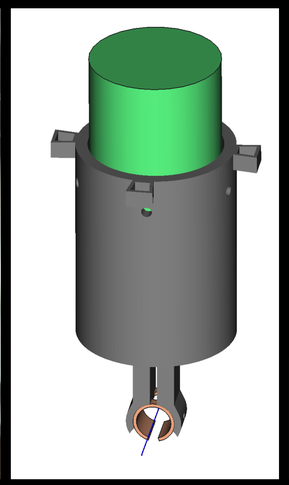


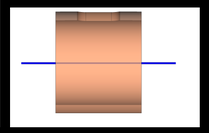


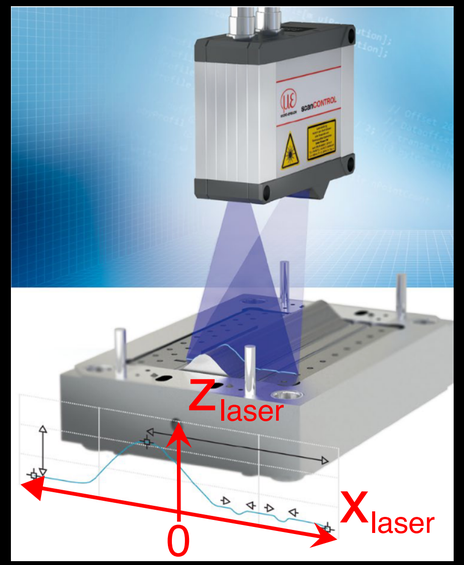


Laser scanners

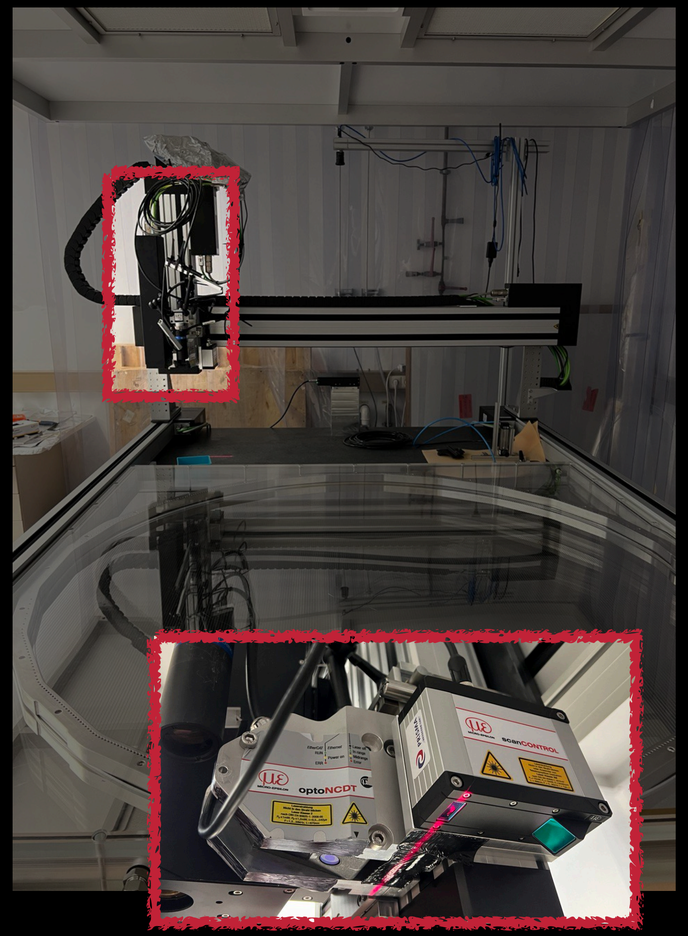
- Laser distance sensor
- 2D profile laser distance sensor
- Local HV scanning tool







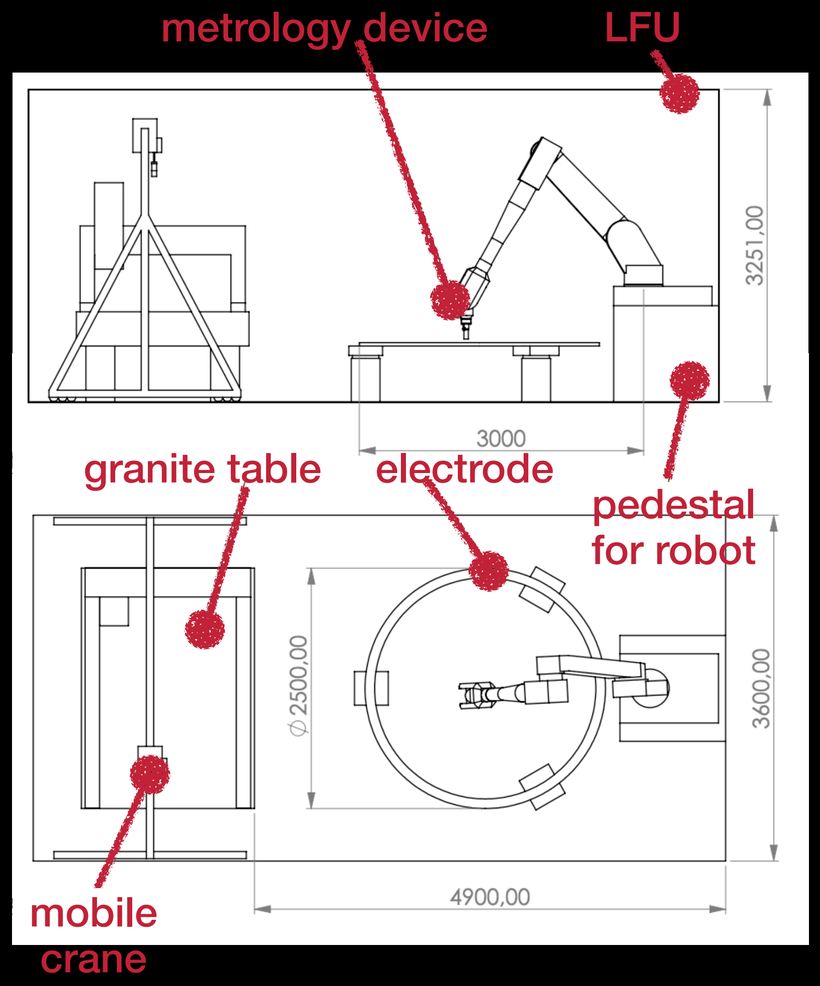
More information in Alexander Deisting's poster



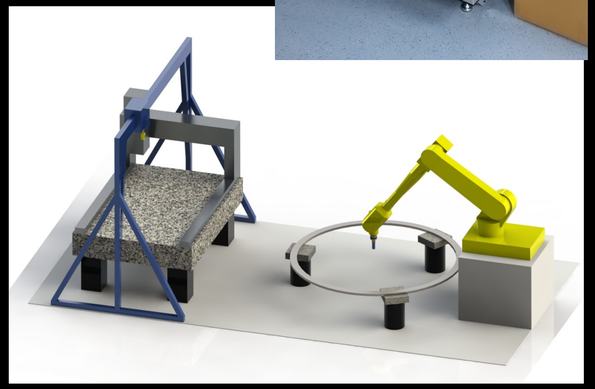
Capabilities

- High resolution imaging of wire or mesh electrodes (high resolution camera)
- Correlate spots/regions-of-interest in images with currents to analyse possible defects (HV scanning tool and high resolution camera)
- High resolution measurements of electrode’s reliefs (confocal microscope)
- Measurements of electrode sagging with and without HV (laser distance sensors)

Towards XLZD's electrodes



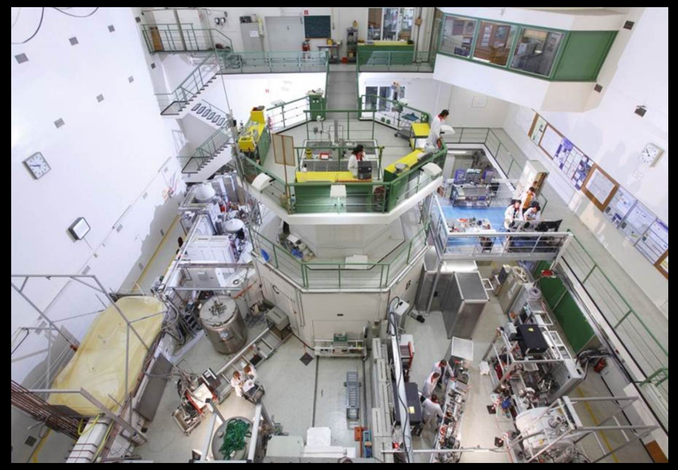
- New facilities are expected to become available with JGU's new research building
- Including an already purchased collaborative robot (cobot)
- Using the experience with the granite-table set-up electrode assays for XLZD will be possible

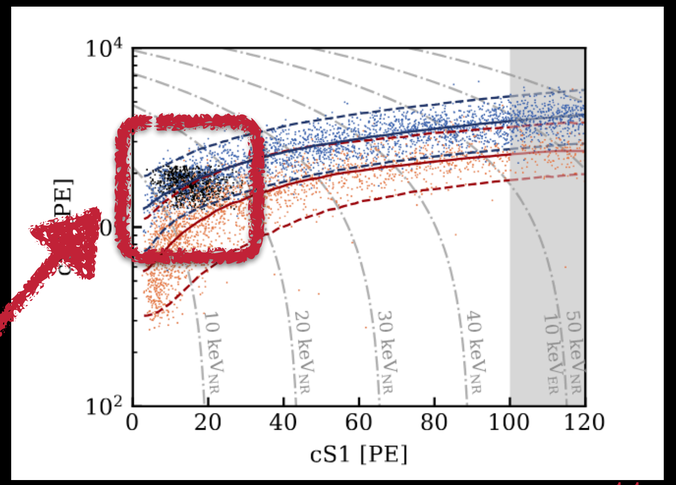


^{37}Ar source by the TRIGA reactor

(TRIGA: Training, Research, Isotope Production, General Atomic)

- 100 kW (or 250 MW pulsed, 25 ms) research reactor at the chemistry department (link) of JGU
- Allows to irradiate samples with fast neutrons (as well as their insertion into the reactor core)
- ^{37}Ar for XENON1T and XENONnT have been produced in Mainz through irradiation of enriched ^{36}Ar samples
- See e.g. Christopher Hils's thesis for details





^{37}Ar calibration data

Summary

- Significant experience in detector R&D at the PRISMA(++) cluster of excellence
- For XLZD existing and new facilities (being commissioned) will be available:
  - XeLIPs
  - Set-up for electrode quality assurance
  - TRIGA reactor
- Looking forward to your ideas!