Proposal for a PDE Measurement of VD X-ARAPUCA Modules @ CERN

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Motivation

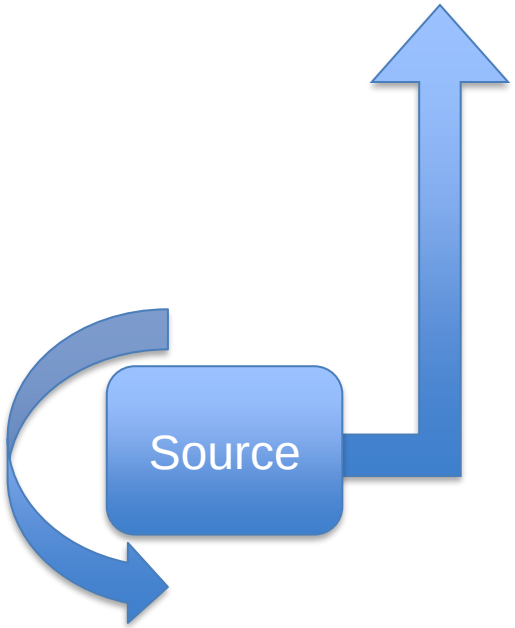
- The absolute PDE for the HD benefitted from having two independent measurements in Italy and Spain
- A facility at CERN is available for an independent measurement; it is already commissioned and currently unused
- The setting up of a VD XA module PED measurement at CERN could happen with a relatively small demand of time and effort, allowing us to cross-check the measurements performed in Naples and possible test different technologies
- This proposal is based on a discussion during this meeting on the 28th of Feb 2023

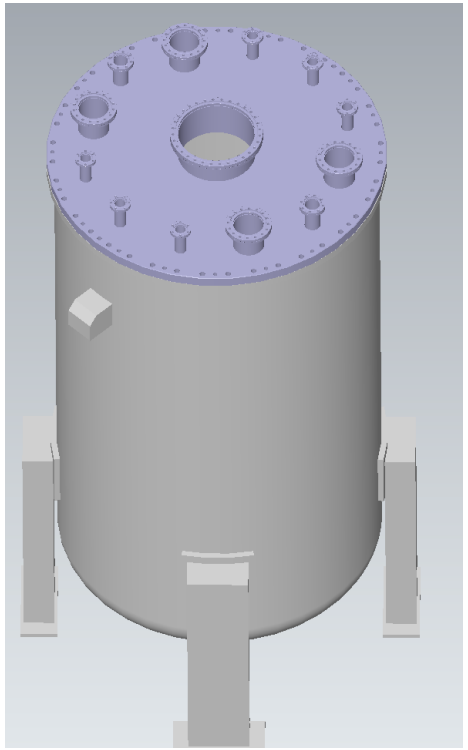
CERN Facility @ Building 182

- The facility consists of a cylindrical cryostat (1.8m deep, 96cm diameter), and a source manipulation arm
- The facility is booked for April for the 200kV feed-through test; it is available before and after that period

The Dewar

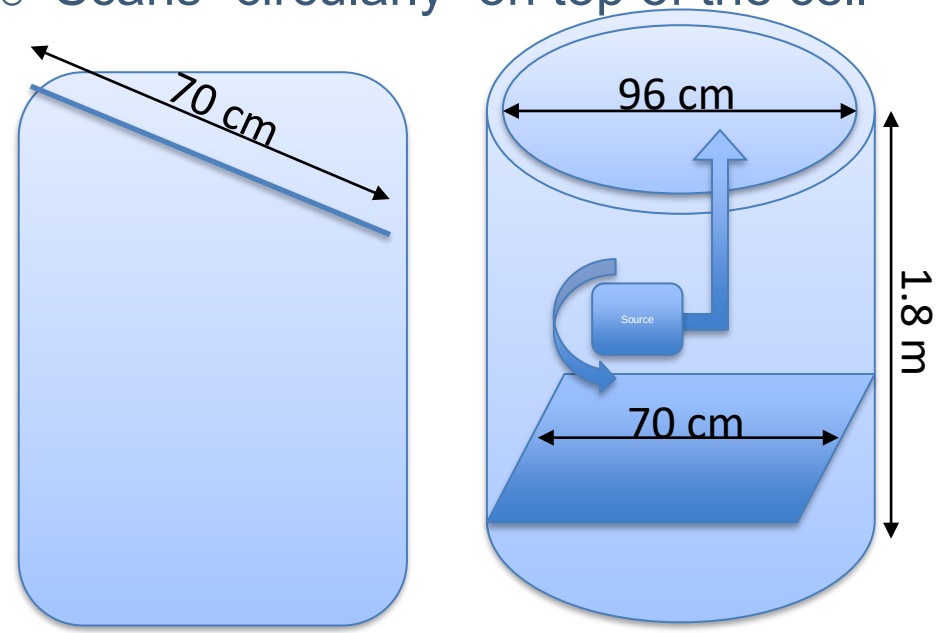
- The cryostat is filled (3 kg/minute) by means of an oxisorb/Hydrosorb filter for high purity (τ_t > 1 μs, constant in time); when full, it consumes 2l LAr/h
- The source manipulation arm can be mounted on any of the Dewar flanges, it moves the source along the z axis and the azimuthal angle

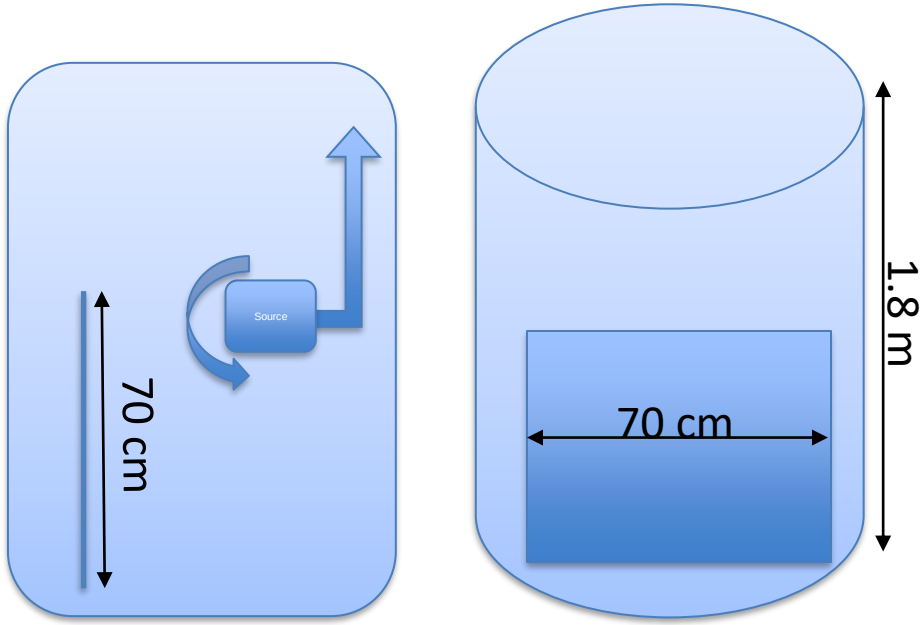




Cell Orientation Inside the Dewar

- The dimension of the cryostat the reach of the source manipulation arm (30-40cm above the bottom) allows for two possible settings
  - Horizontal cell: reduce LAr consumption
  - Need a ~15° to fit the cell in the entrance
  - ~0.3 m^3 of LAr to cover cell and source
  - Scans “circularly” on top of the cell
  - Vertical cell: no need to tilt
  - Need twice as much Lar
  - Scans “vertically” on a cell side
  - Can test double-sided cells with two sources





Elements Needed for the Facility

- The XA module will be suspended on the dewar lid, so a mechanical suspension system similar to that designed @ NIU would be needed
- Cryogenic FE and warm-stage electronics (plus cables, connectors, etc.) should be prepared before testing
- An LED system with optical fiber has to be purchased
- Finally, we need modules to test, ideally with SiPM from both vendors (currently we only have FBK) – modules could be exchanged between facilities (Naples, CIEMAT) for cross-check and/or test different technologies
- ..and the manpower

A Module to Test and Someone to Test It

- A VD module to be tested
  - We currently have 4 spare WS Plates available (1 without dimples)
  - We have enough FBK flexes for 2 modules, some of the SiPM flexes can be recovered from old modules tested in the cold box, but in principle we would need FBK flexes as well
  - A new mechanical frame for the module should be provided by CSU
  - New filters (enough for 3 modules) have been purchased at Zaot, rectangular spares are currently used in cold box tests
  - Cold (DMEM & 2 x Cold Amplifiers) + warm electronics available in Milano

- For the manpower, we would need >2 people on-site, plus some preparatory work

Estimated Costs

- For the LAr we need 300l for a fill w/ horizontal module (~600 € / fill)
- Mechanical framework (~200 €)
- Missions at CERN (~ 1 k€ / week x person)
- New Zaot Filters (2.3 k€)

Conclusions

- A facility for the PDE measurement of VD modules (of both type Module-0 and Module-1) is available at CERN and can be used relatively soon (in principle May 2023)
- It requires little preparation and employs a system that is already commissioned, allowing us to perform a measurement with a relatively short time span
- It allows to scan the Module with good flexibility and in highly-pure LAr
- A preliminary estimation of needed elements, manpower, and costs, was shown here
- For these reasons, the CERN facility is a viable alternative to other proposed PDE measurements