

# Deposition of P-Terphenyl & Test of Vertical Drift Tiles

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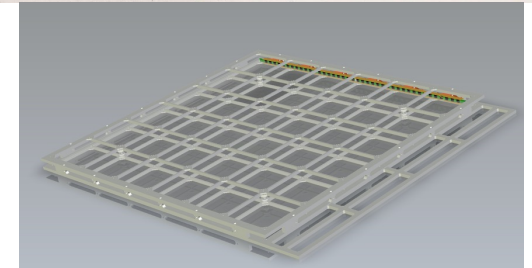
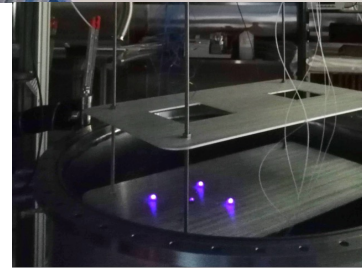
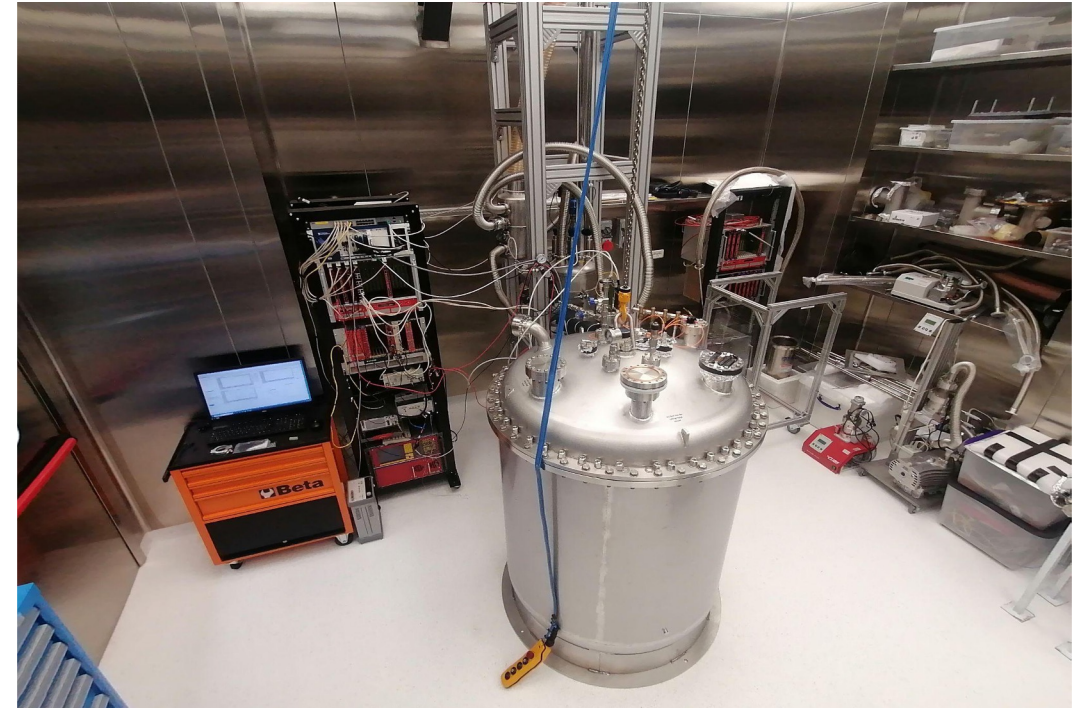
# Outlines

- **Activities at Naples**
  - Megacell test for Module-0 ProtoDUNE Vertical Drift
  - PDE studies of XA-Megacell
  - Evaporation Site for PTP coating
  - Update on SiPM PDE measurement system
- **Activities at Pavia**
  - Refurbishment and upgrade of system for Quantum Efficiency measurement
  - Measurement of the diffusivity, reflectivity and transparency of samples
- **Conclusions**



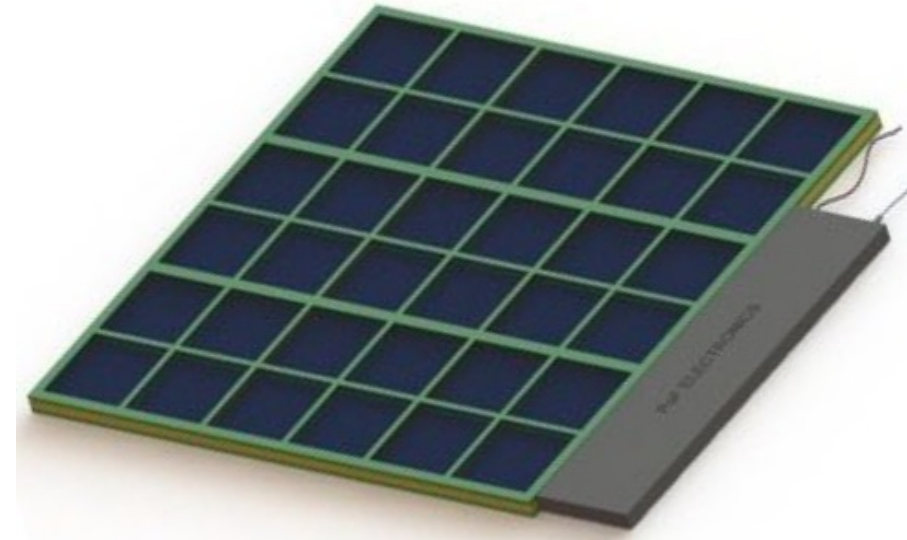
# Test of ProtoDUNE XA-Megacells

- Custom made cryostat located inside the INFN Naples Cryolab cleanroom (1.15 m diameter – 1.57 m height) coupled with a single wall domed flange)
- System developed by DarkSide collaboration as main part of PDU Test Facility
- Equipped with PT1000 temperature/level meter sensors, pressure gauges and analog pressure indicator, service output flanges
- Cryostat and cryogenic system designed for automatic LN filling (~7 hrs) and draining (~15 hrs)
- Illumination system with optical feedthrough and light diffusers
- 405 nm laser available, procurement of UV led source



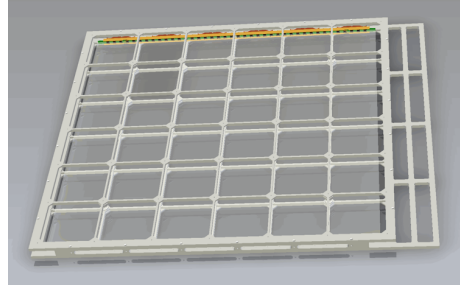
# Test of ProtoDUNE XA-Megacells in LN

- Characterization of the electronics
- Measurement and characterization of the dark count rate
- No LAr VUV light response evaluation
- Pulsed laser (or UV led) illumination
  - SPE measurement
  - GAIN and S/N ratio measurement at different OverVoltages
- Possible time slot for the test of Megacells in Naples cryostat in January 2023 (depending on the countinuously changing schedule)



Picture courtesy of C.M. Cattadori  
INFN-Milan Bicocca

# PDE measurement of XA-Megacells in LAr: goal

- XA-Supercell efficiency of 2.9% found in the best conditions
  - Geometry of XA-Megacell ( $62 \times 62 \text{ cm}^2$ ) different from XA-Supercell
  - SiPM coverage in the XA-Megacell (SiPM number  $\times$  area over dichroic number  $\times$  area) about half with respect to XA-Supercell
- Evaluation of PDE in XA-Megacell needed
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- ✓ PDE evaluation through the measurement of  $N_\gamma$  from  $^{241}\text{Am}$   $\alpha$ -source (and estimation from simulation and possible contribution from reflected photons)
    - Correction factors: SiPM secondary pulses, LAr purity
    - LAr purity evaluation by analyzing VUV light triplet component (possible cryogenic PMT used as reference)
  - ✓ XA-Megacell different implementation of WLS plane-flex circuit coupling to check the relative response





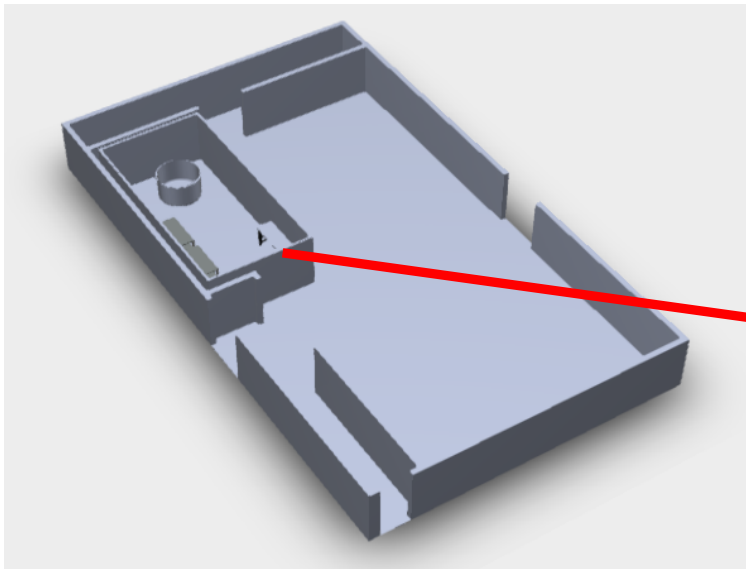
# PDE measurement of XA-Megacells in LAr: operations

- Dedicated XA-Megacell fully assembled needed for the test
  - Refurbishment of old XA-Megacell from prototypes
  - Dichroics and PTP evaporation from Campinas (possible participation from Naples Group to evaporation campaign)
  - Bias and signal readout «in copper»
- Manipulation system (rotation+translation) holding  $^{241}\text{Am}$   $\alpha$ -source ( $\sim 250$  Bq activity) to be installed
- Installation of cryogenic PMT used as reference for evaluation of LAr scintillation light triplet component
- Cryostat filled with 5.0 liquid argon purified by an in-line Trigon filter
- Recirculation options (against logistics and main activities scheduled for DarkSide):
  - 1) No Ar recirculation implemented (baseline option)
  - 2) GAr recirculation system and purification with hot getter implemented (under evaluation)



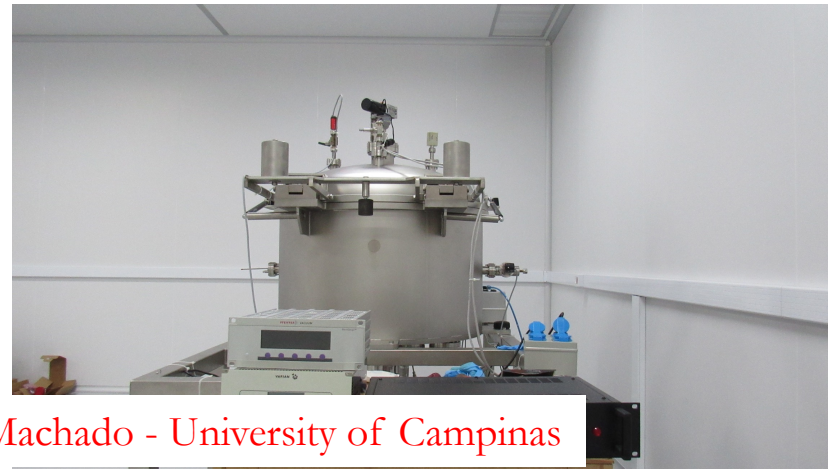
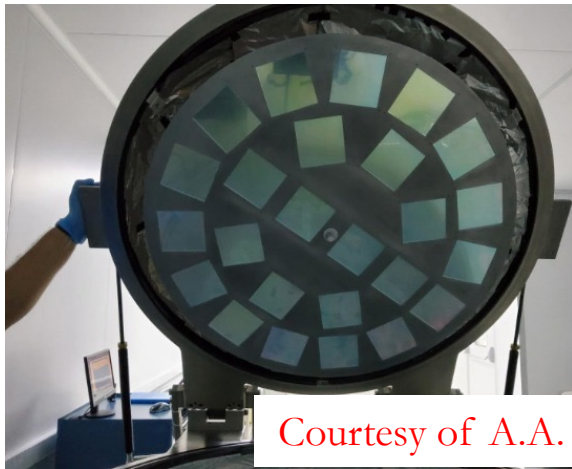
# WLS coating evaporation site

- Need of an european site for PTP coating complementary to the Campinas evaporation site
- DUNE Naples Group funded for the procurement and construction of an evaporation system for the primary PTP coating
- Dedicated clean area (to be built) at INFN Naples and Physics Dept – University of Naples already assigned to host the evaporation system



# PTP coating evaporation system

- Design of evaporation system already done
- System able to provide 2 cycles per working day
- Dimensions of the chamber to host  $\sim 40$  ( $10 \times 10$  cm<sup>2</sup>) filters
- Dedicated support plates to hold different types of filters
- Procedures to validate the coating process
- Need of further equipment for a quick characterization of the coated filters



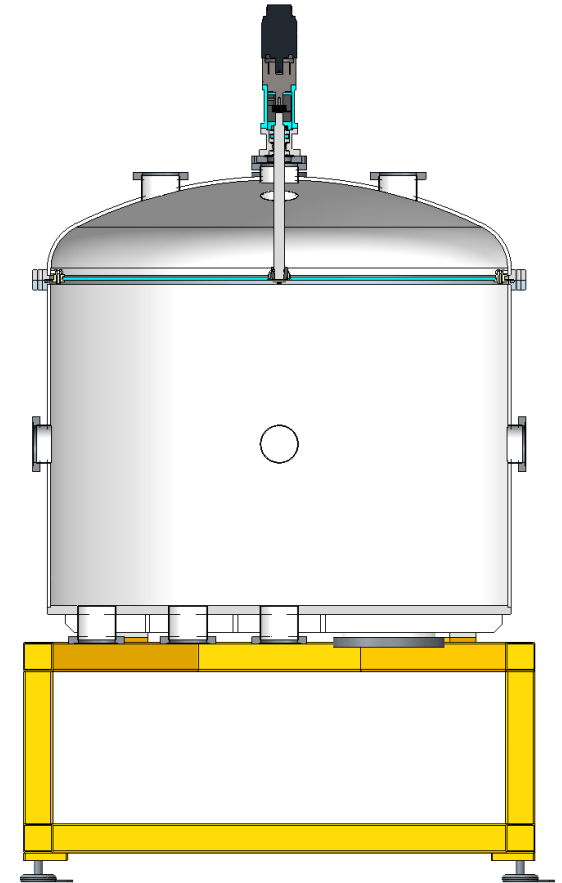
Courtesy of A.A. Machado - University of Campinas



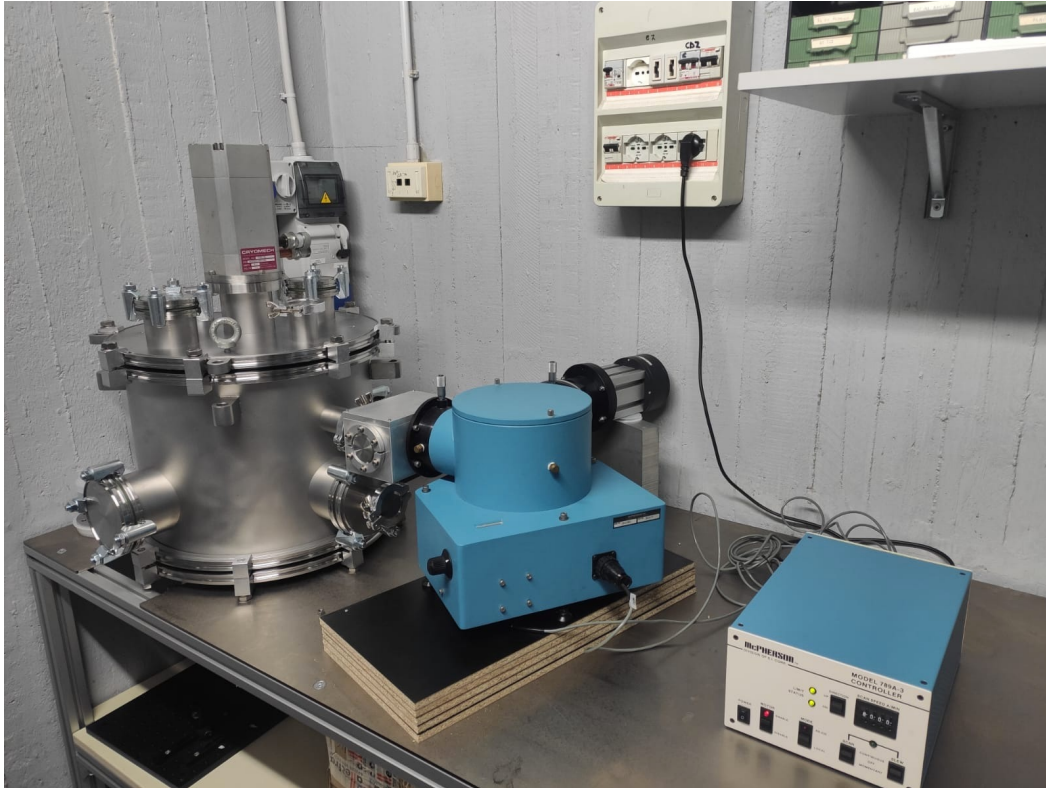


# PTP evaporation system: main technical specifications

- Evaporator dimensions: 120 cm diameter, 70 cm height chamber
- Vacuum level of the chamber  $\sim 10^{-5}$  mbar
- Complete removable top flange dome with a dedicated crane
- Pumping station composed by a primary dry pump ( $\sim 40$  m<sup>3</sup>/h) and turbopump ( $\sim 2000$  l/s)
- Matrix of 3 Knudsen effusion cells distributed on the bottom flange to allow for good deposition uniformity
- Quartz sensor for the deposition thickness estimation during the process
- Step rotating motor mounted on the dome holding the filters support structures
- Evaporator chamber mounted on the proper support structure allowing for operations and inspection of the parts



# SiPM PDE system update



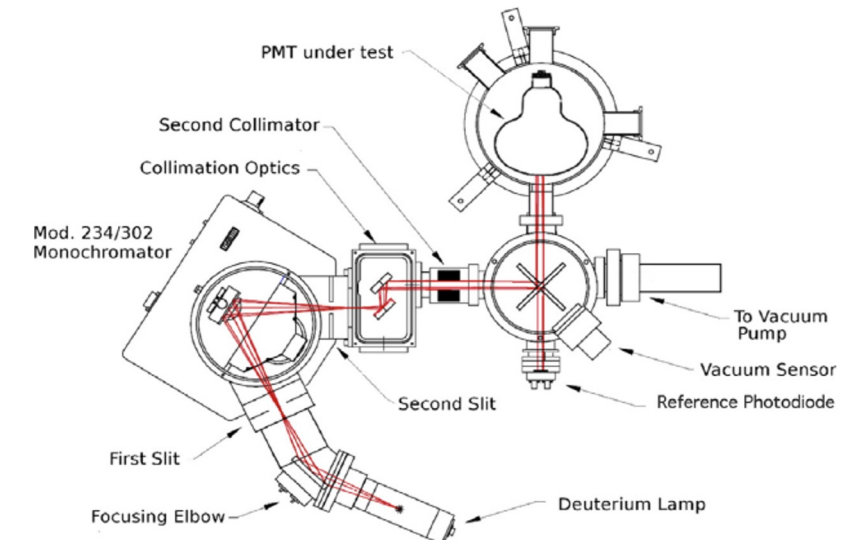
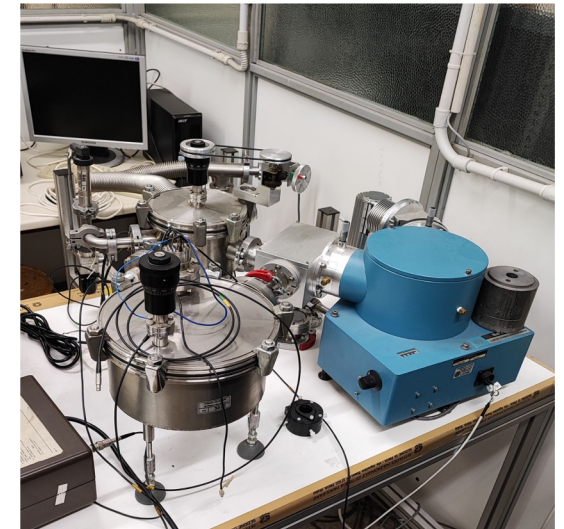
- Monochromator and chamber assembled
- Cryocooler compressor refurbished
- Motors with sample holder order procured (not yet delivered)
- Reference PMT to be implemented

## *Next steps:*

- Monochromator grating mounted and calibration in progress
- Tests to be performed: vacuum, temperature trend, alignment, beam mapping
- Software development: unique interface for monochromator driver, sample holder motors, electrometer and waveform digitizer

# INFN-Pavia Contribution

- Upgrade of the already installed system based on a VUV monochromator (McPherson 234/302):
  - deuterium lamp
  - rotating mirror (Al+MgF<sub>2</sub>)
  - calibrated photo-diode used as a reference
  - chamber hosting the photo-detector
- Allows for absolute measurement of Quantum Efficiency on detectors up to 8" diameter in the range 120-220 nm
- QE can be measured along a selected axis through movement/rotation of the device under test
- Instrument already successfully used in the past to test the new ICARUS PMTs presently operating at FNAL



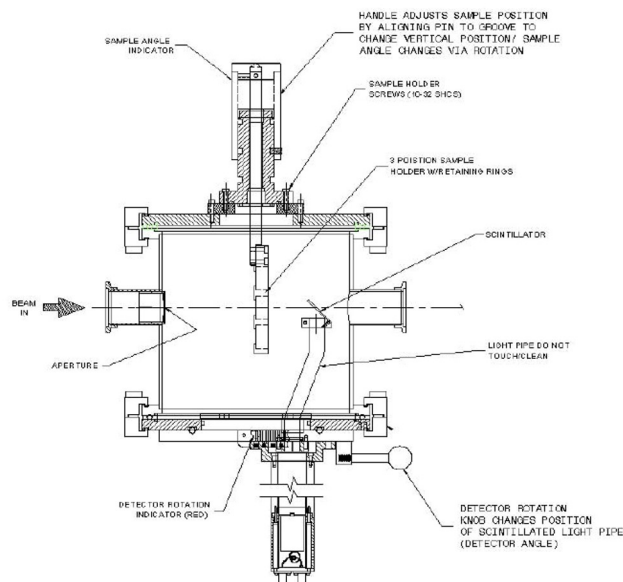
Slide from Pavia Group



# INFN-Pavia Contribution

Upgrade of the system: vacuum chamber with a support system for the sample under test+a light detector placed on a goniometer to measure the light transmitted and/or reflected and/or diffused by the sample on an angle between 15 and 180 degrees with respect to the direction of the light beam

McPherson Model 121 Sample Chamber



## Contribution to DUNE

Measurement of the diffusivity/reflectivity/transparency of sample materials in the VUV, in particular for:

- the characterization of the dichroic filters used in DUNE
- measurements on materials presently used by ProtoDUNE

Slide from Pavia Group





# Conclusions

- **Activities at Naples**
- Test facility in Naples operative and ready for XA-Megacell qualification for ProtoDUNE
- Feasibility of PDE measurement of XA-Megacell in Naples Cryogenic laboratory ongoing
- WLS PTP european site funded at INFN-Naples
- Experimental area for the evaporator already allocated
- Evaporation system design ready, construction in the next months
- PDE system assembly ongoing towards the final configuration prior the commissioning
  
- **Activities at Pavia**
- Contribution on characterization of the dichroic filters and measurements on materials presently used by ProtoDUNE
- Refurbishment and upgrade of a system for measurement of the diffusivity/reflectivity/transparency of sample materials in the VUV range

