

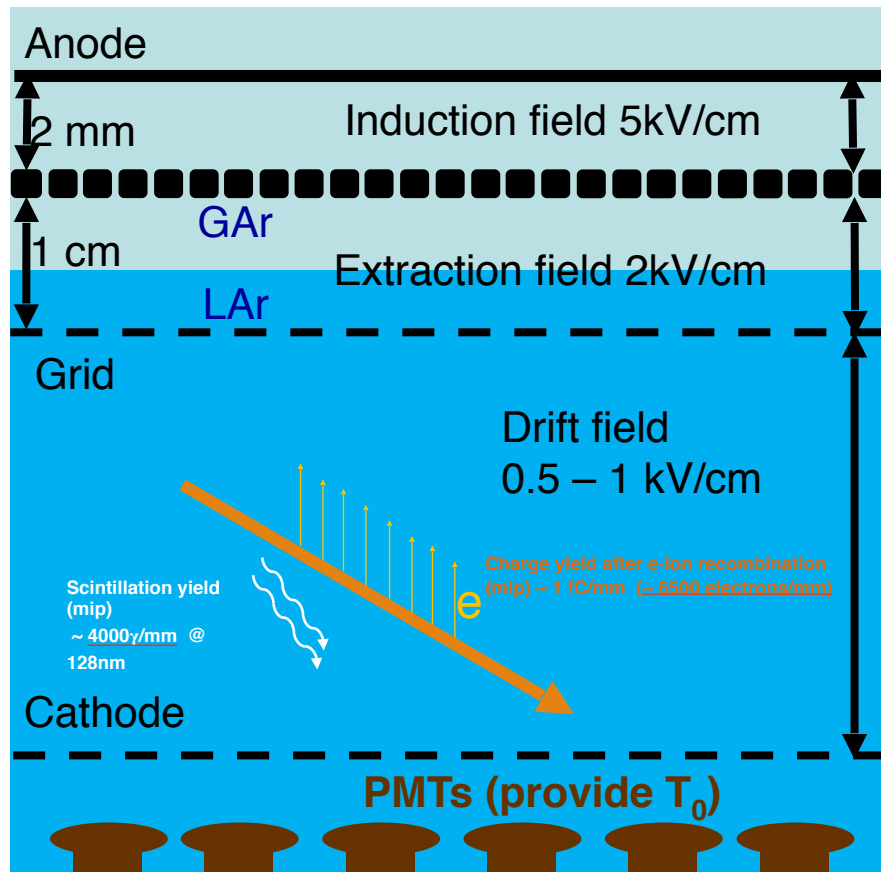
Status of WA105-3x1x1 experiment

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F. Sergiampietri and T. Viant and S.Wu

Institute for Particle Physics, ETH Zurich

RD51 Collaboration Meeting, 07-11 March 2016

Concept of double-phase LAr TPC (Not to scale)

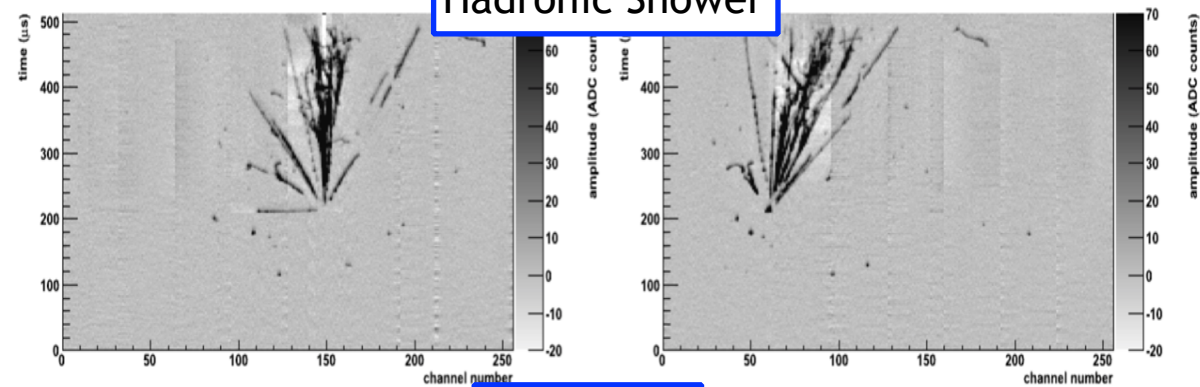


Large scale LAr TPC for LB neutrino oscillation physics, astrophysics, and nucleon decay search (GUT physics)

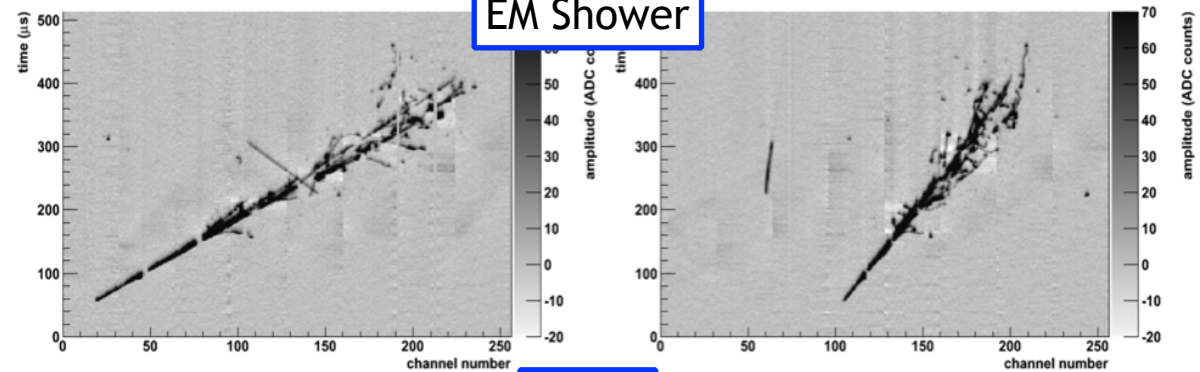
- Single cryo-tank based on industrial LNG solution to house O(10) kton of LAr mass
- Double-phase for charge readout with amplification:
 - **Long drift distances**
 - **Low energy detection thresholds**
 - **readouts with only collection views**
 - **maximise active LAr volume whilst minimising the number of channels.**

GLACIER concept. (A. Rubbia, Experiments for CP-violation: A giant liquid argon scintillation, Cherenkov and Charge imaging experiment? hep-ph/0402110.)

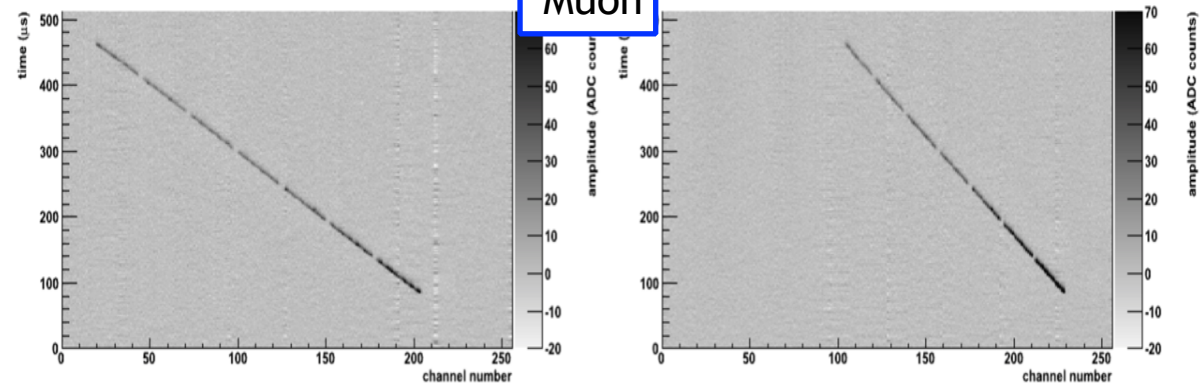
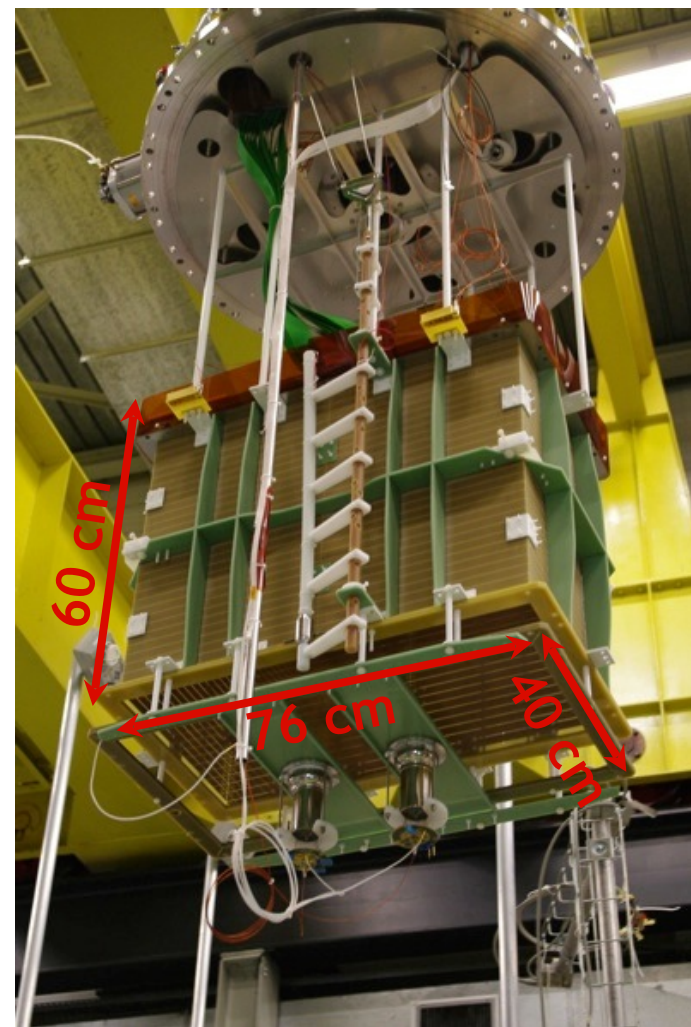
Hadronic Shower



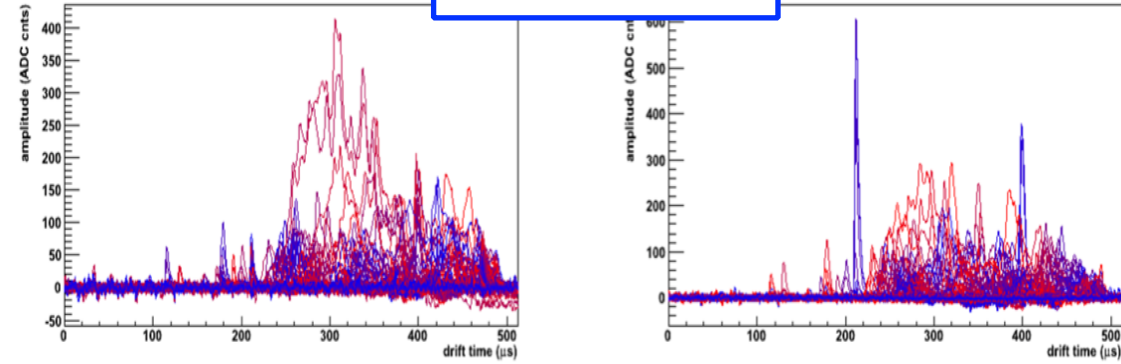
EM Shower



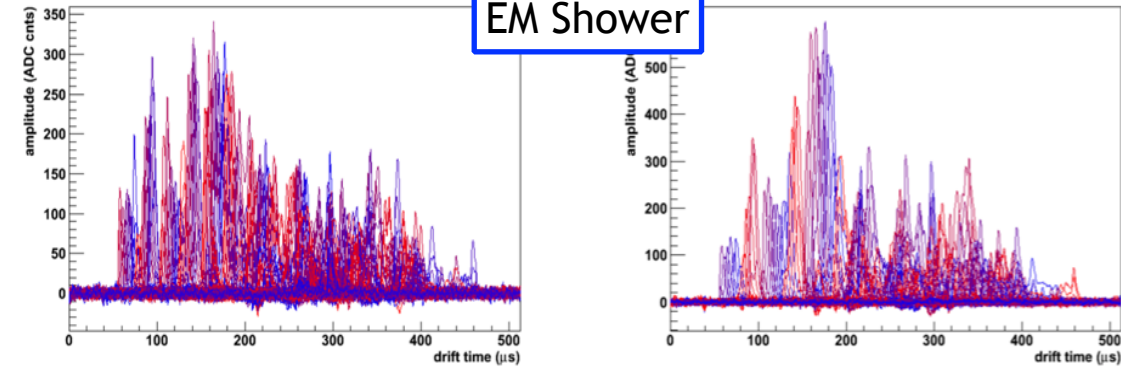
Muon

40x76x60 cm³ LAr LEM TPC

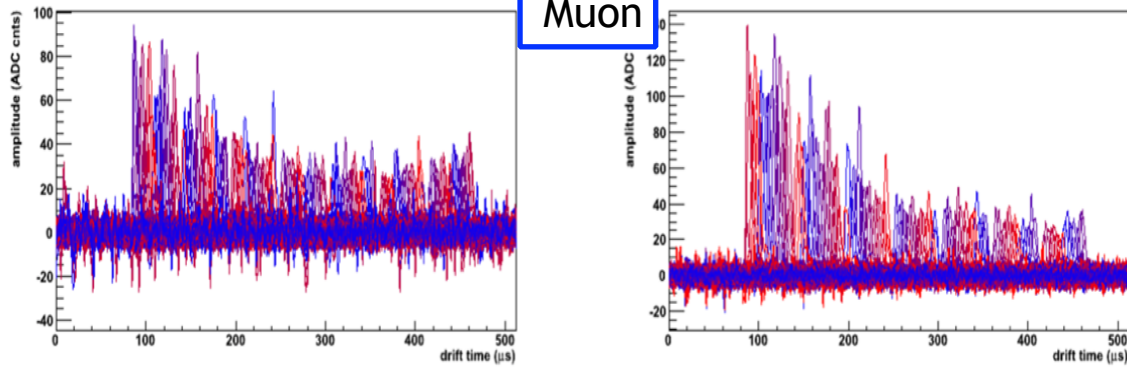
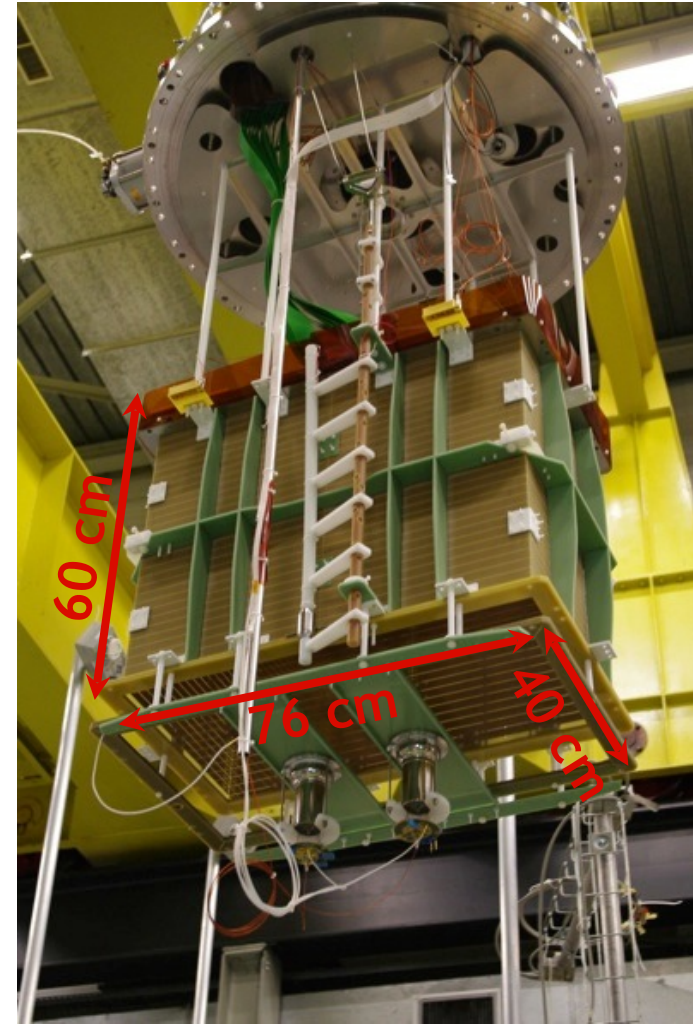
Hadronic Shower



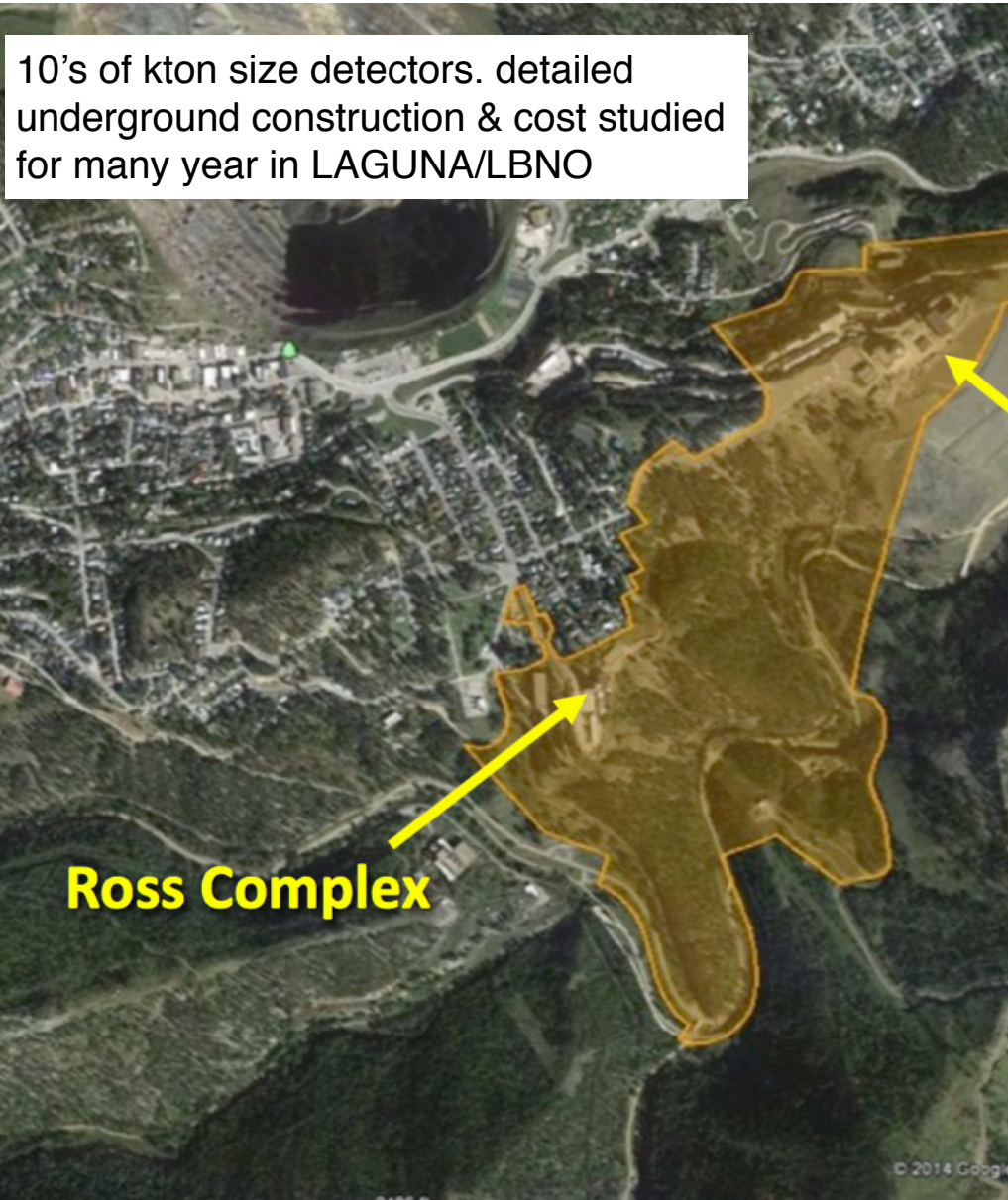
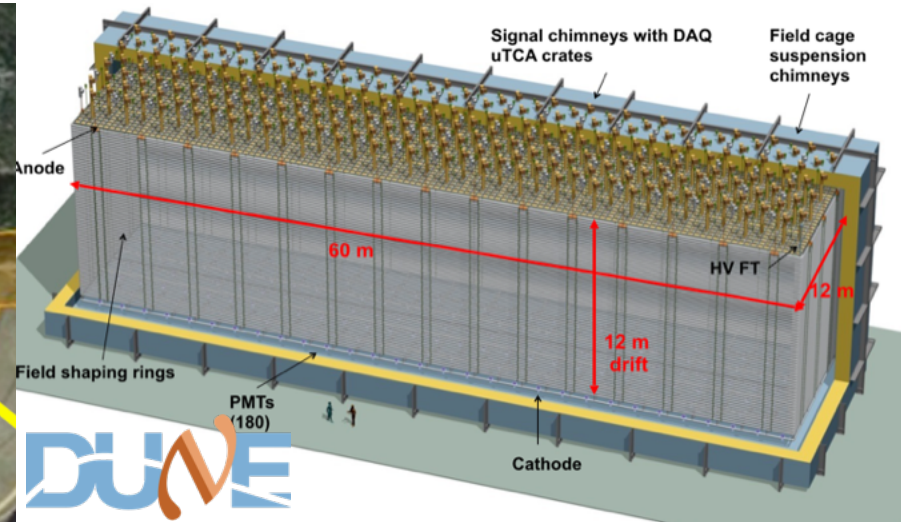
EM Shower



Muon

40x76x60 cm³ LAr LEM TPC

10's of kton size detectors. detailed underground construction & cost studied for many year in LAGUNA/LBNO



Yates Complex

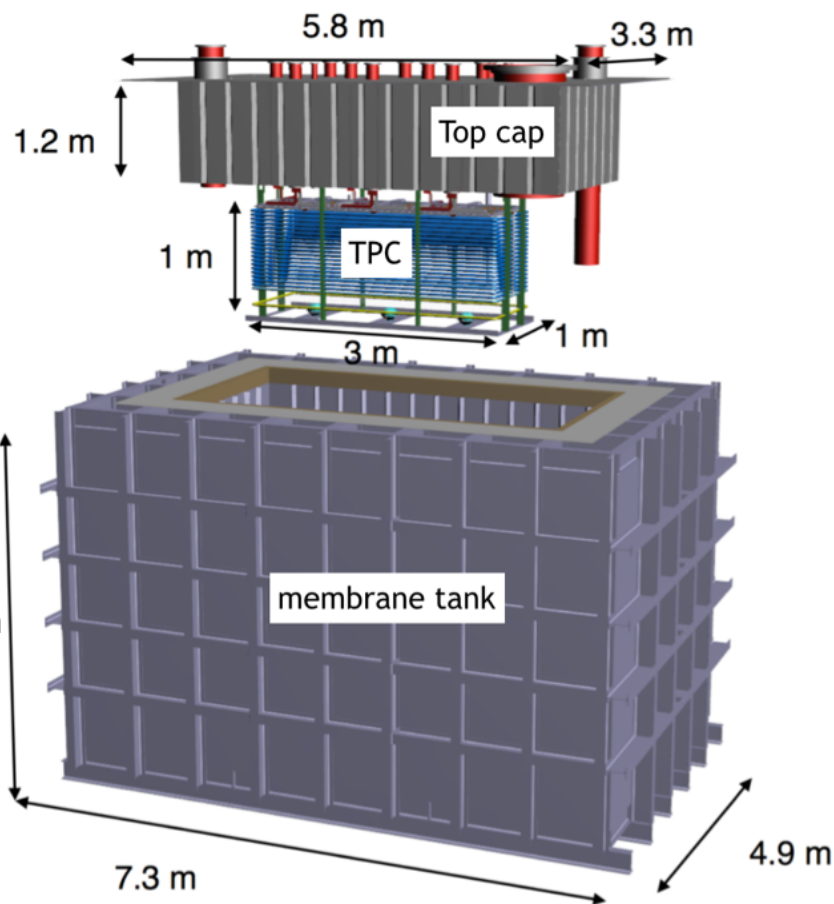
Ross Complex

Property Summary
186 acres (surface)
7700 acres (underground)

– large double phase LAr LEM TPC demonstrators

3x1x1 m³ DLAr-proto

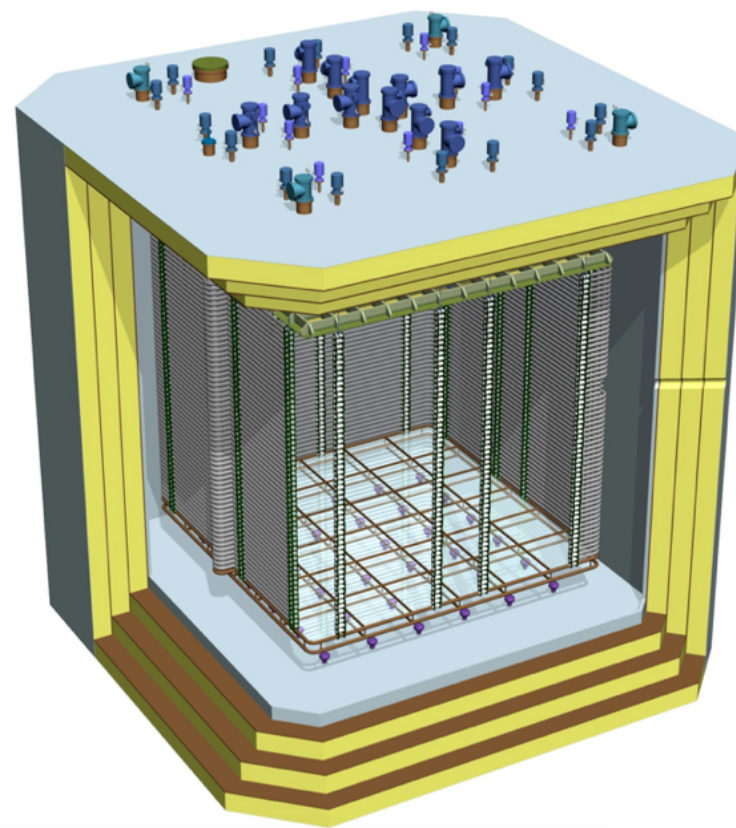
12 50x50 cm² LEMs



Timescale: 2015-2016

6x6x6 m³ DLAr in beam test

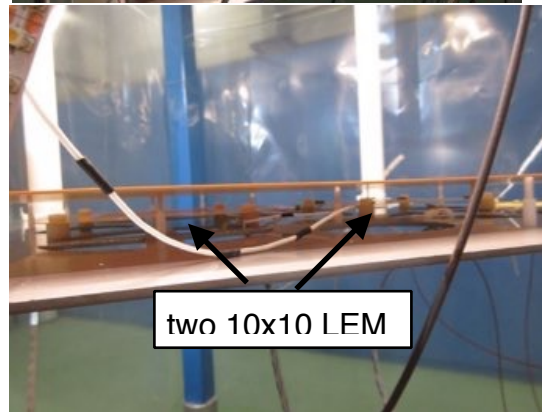
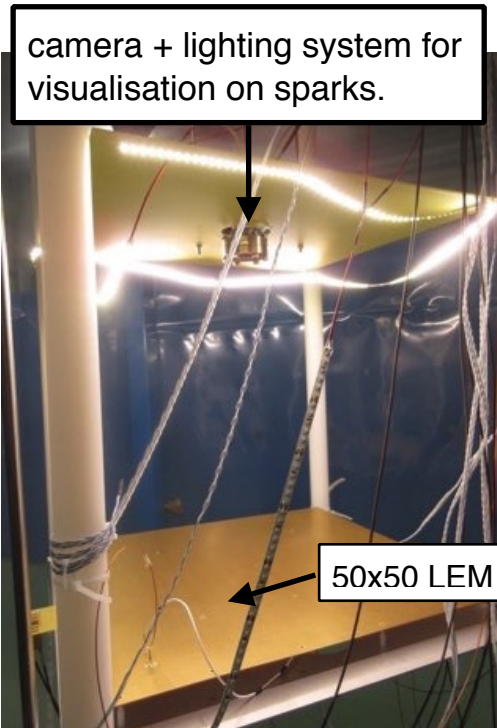
144 50x50 cm² LEMs



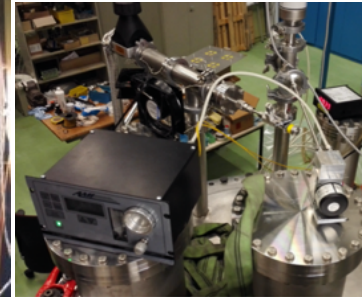
Timescale: 2016-2019



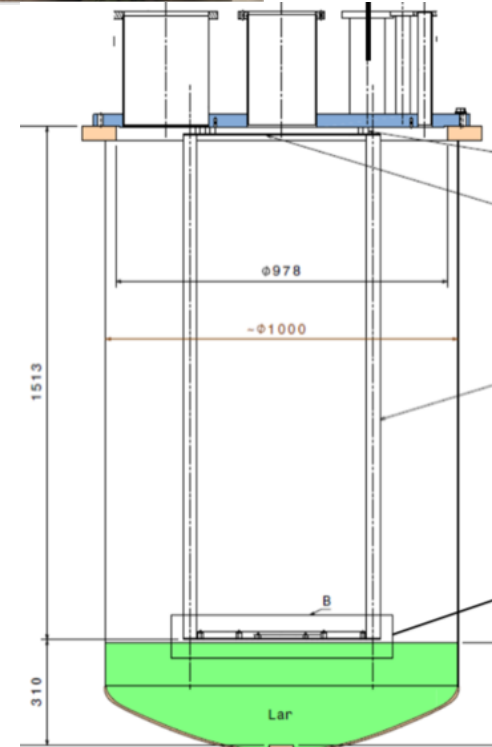
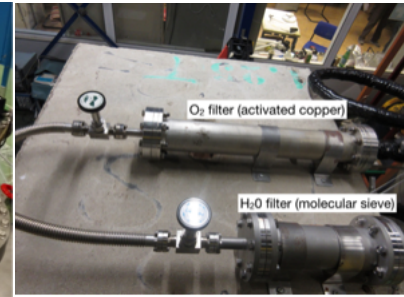
Shuoxing Wu ETHZ



oxygen analyser

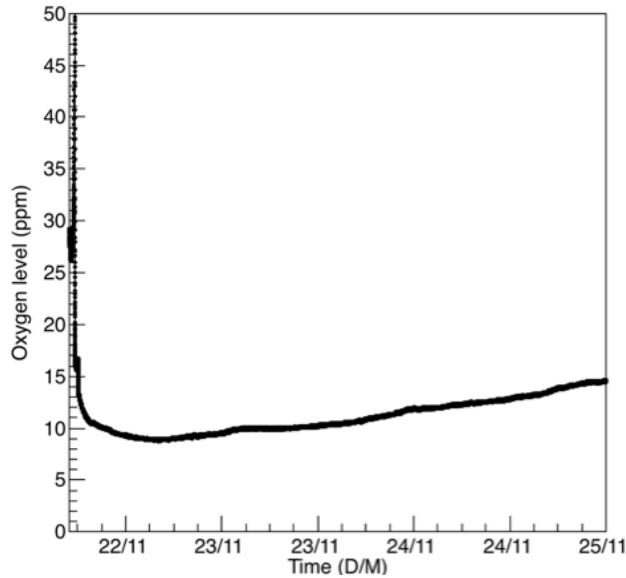


Ar filter

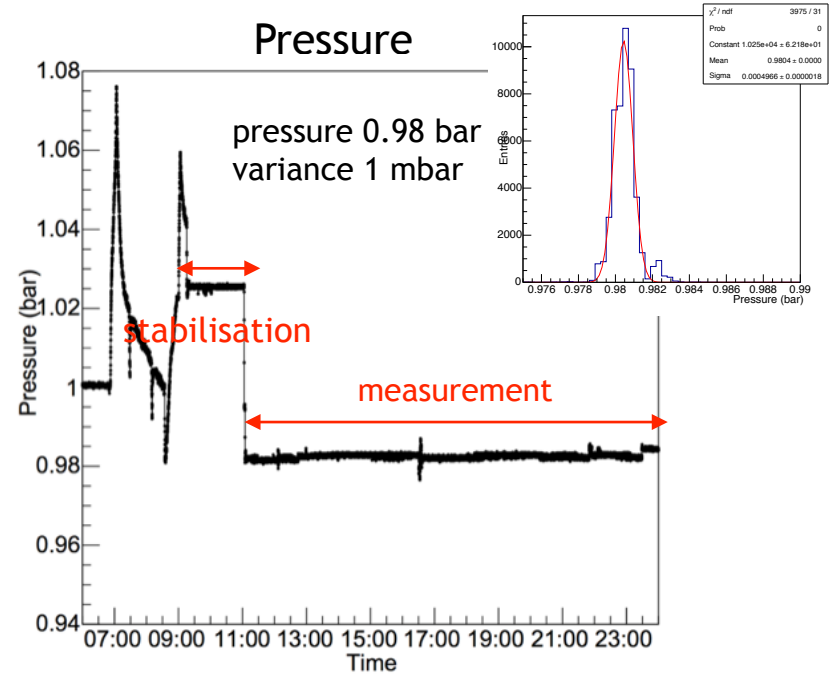


RD51 collaboration meeting, March 2016

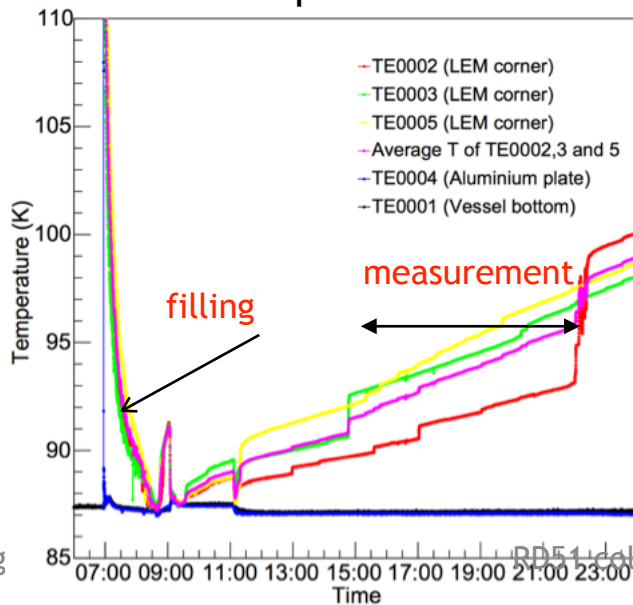
Oxygen level ~ 10 ppm

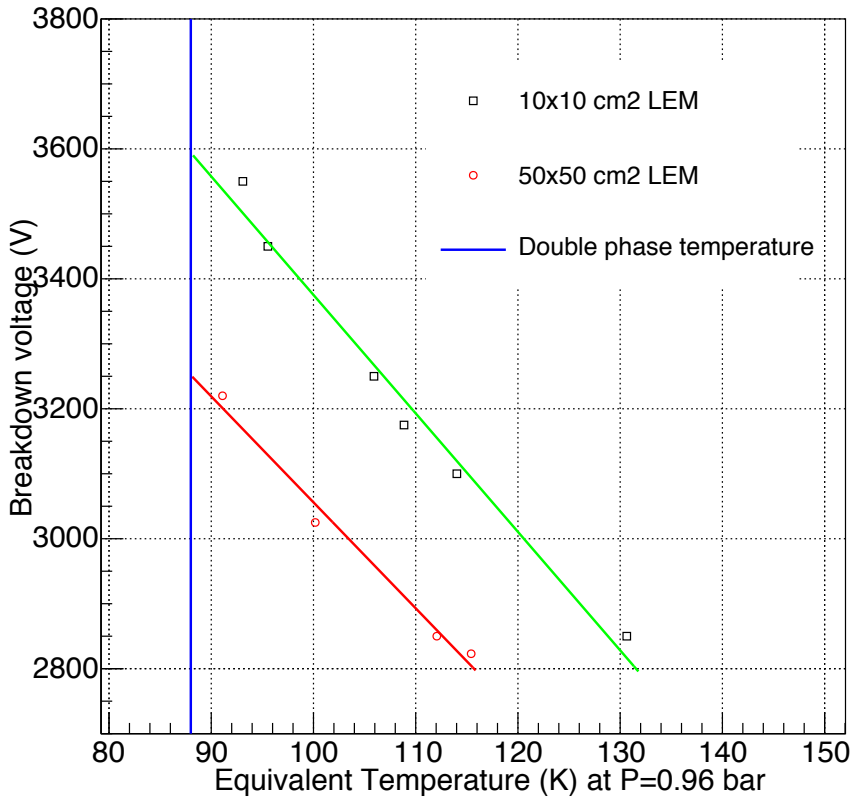


Pressure

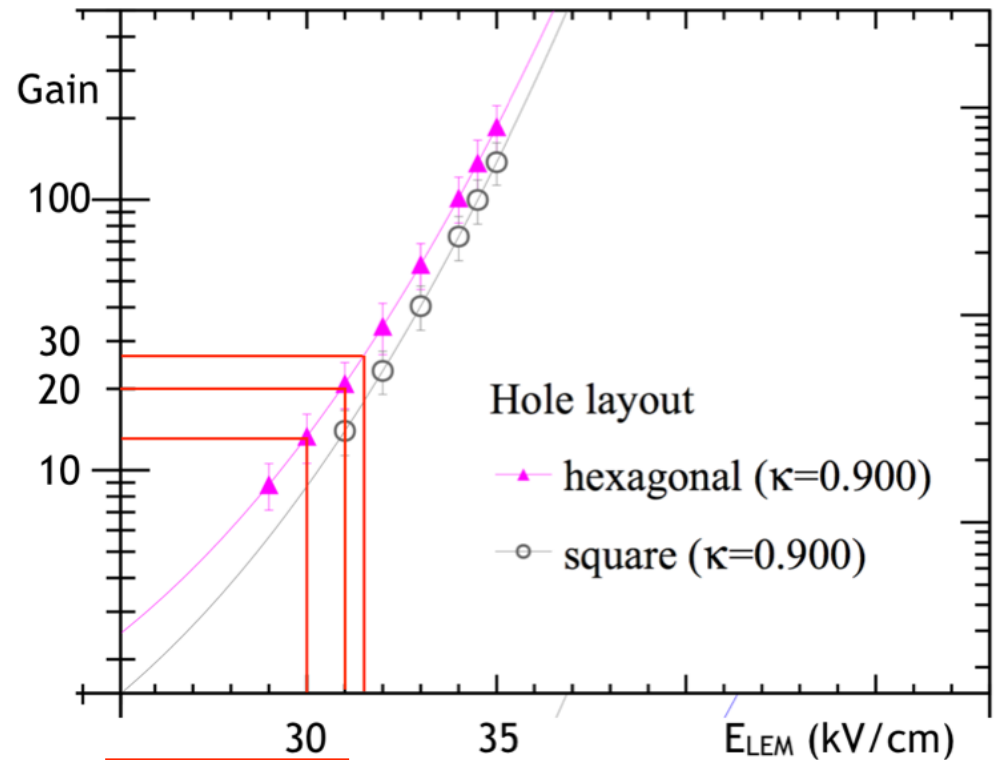


Temperature



$V_{\text{Breakdown}}$ vs temperature

Measured gain vs LEM field

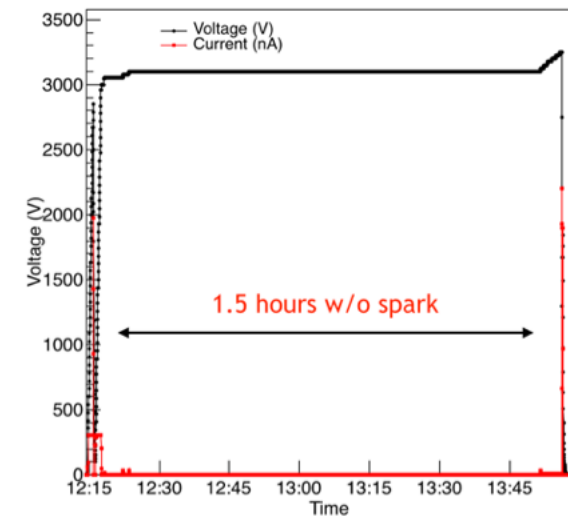
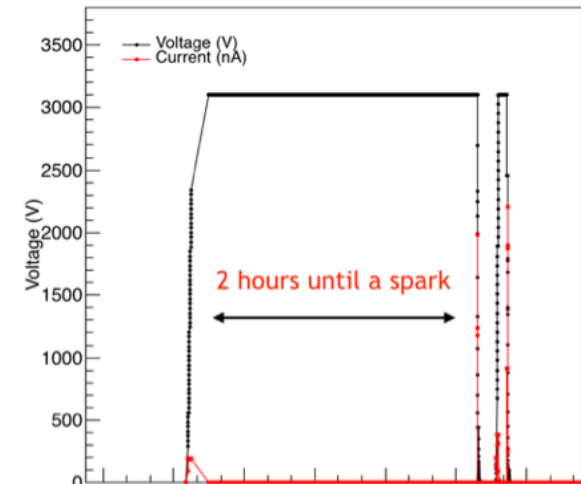
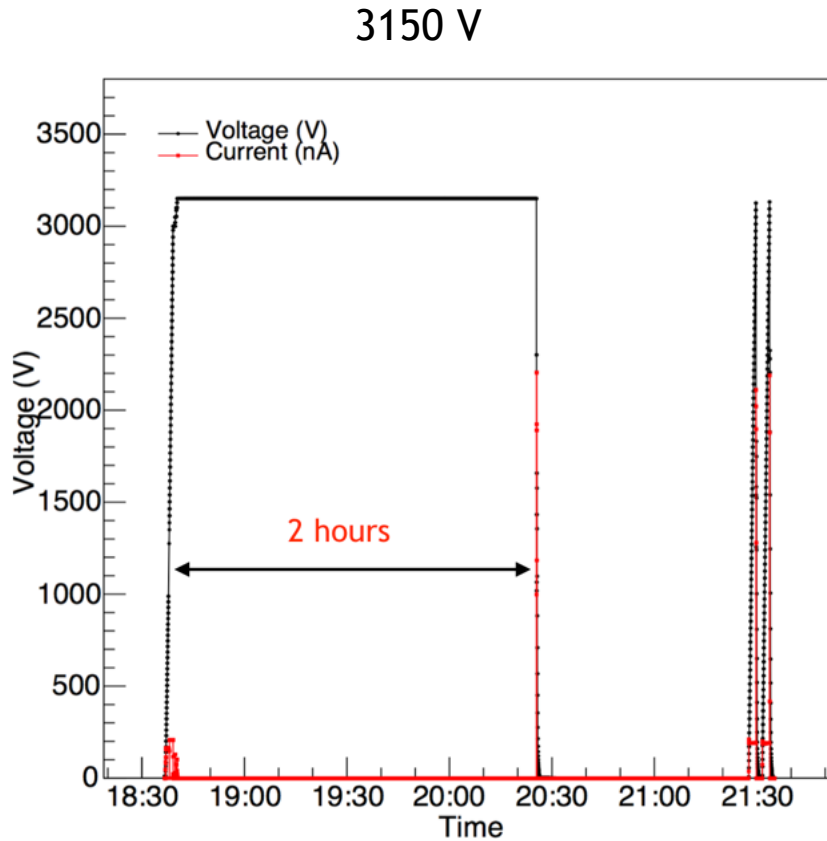


V_{LEM} (V)	Initial Gain
3000	15
3100	20
3150	25

[2015 JINST 10 P03017](#)

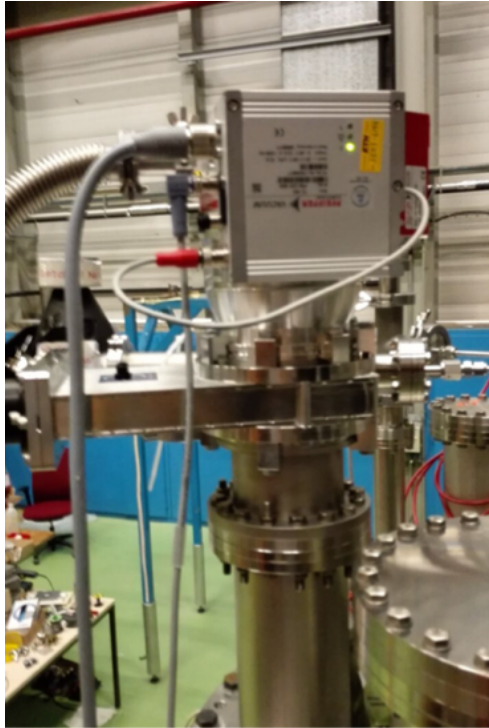
- $V_{\text{Breakdown}} \sim 3250\text{V}$ at T 88K and P 0.96 bar for 50x50 LEM corresponding to a gain > 30 achievable in very stable T,P conditions (as expected in real dual phase operation)

3100 V

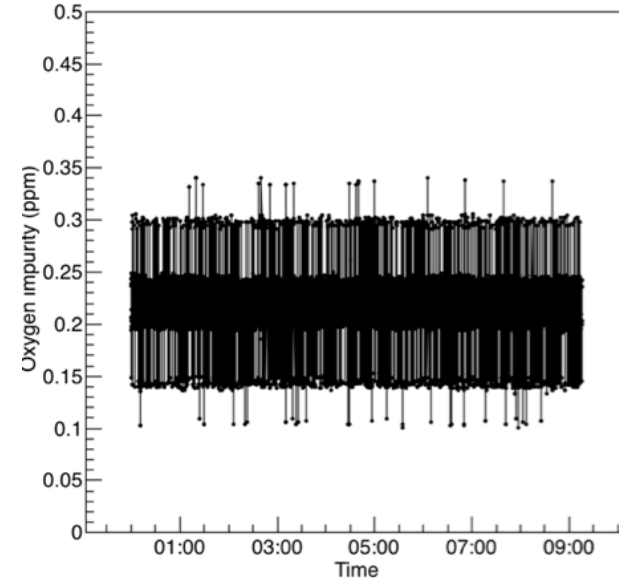


- **Stable LEM operations at 3100V - 3150V** corresponding to gain of 20-25. Need to study effect of charging up.
- Spark rate will further decrease after charging-up.

New turbo pump directly on top flange



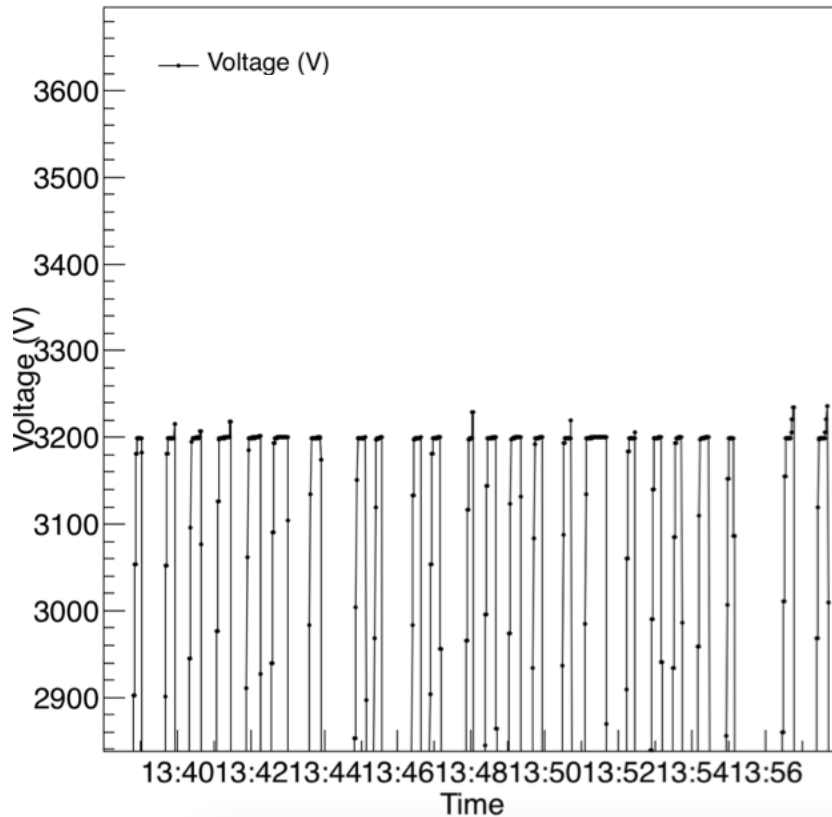
Oxygen impurity stayed at ~0.2 ppm



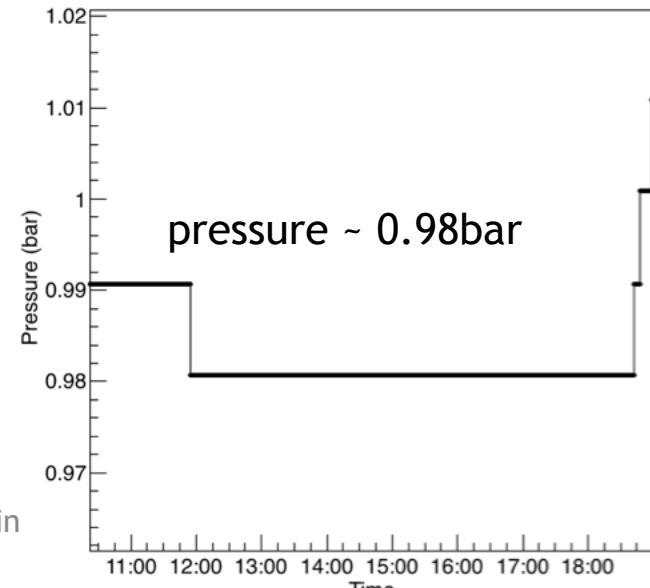
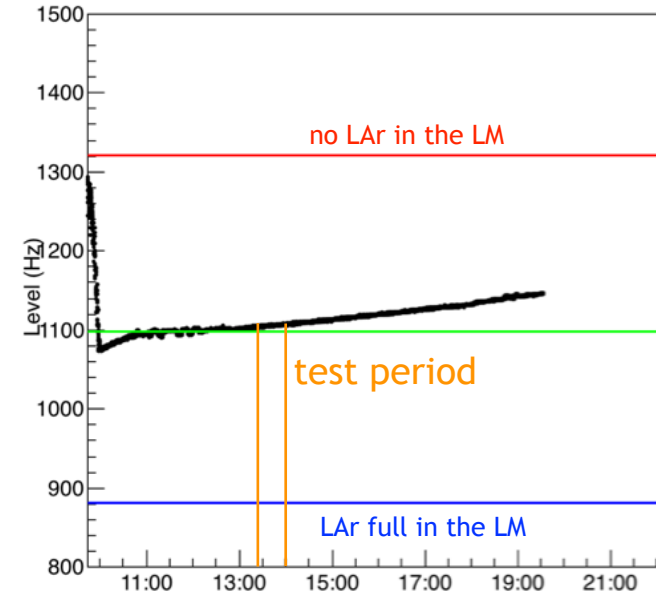
Nitrogen impurity level consistent with 0 ppm



LAr level

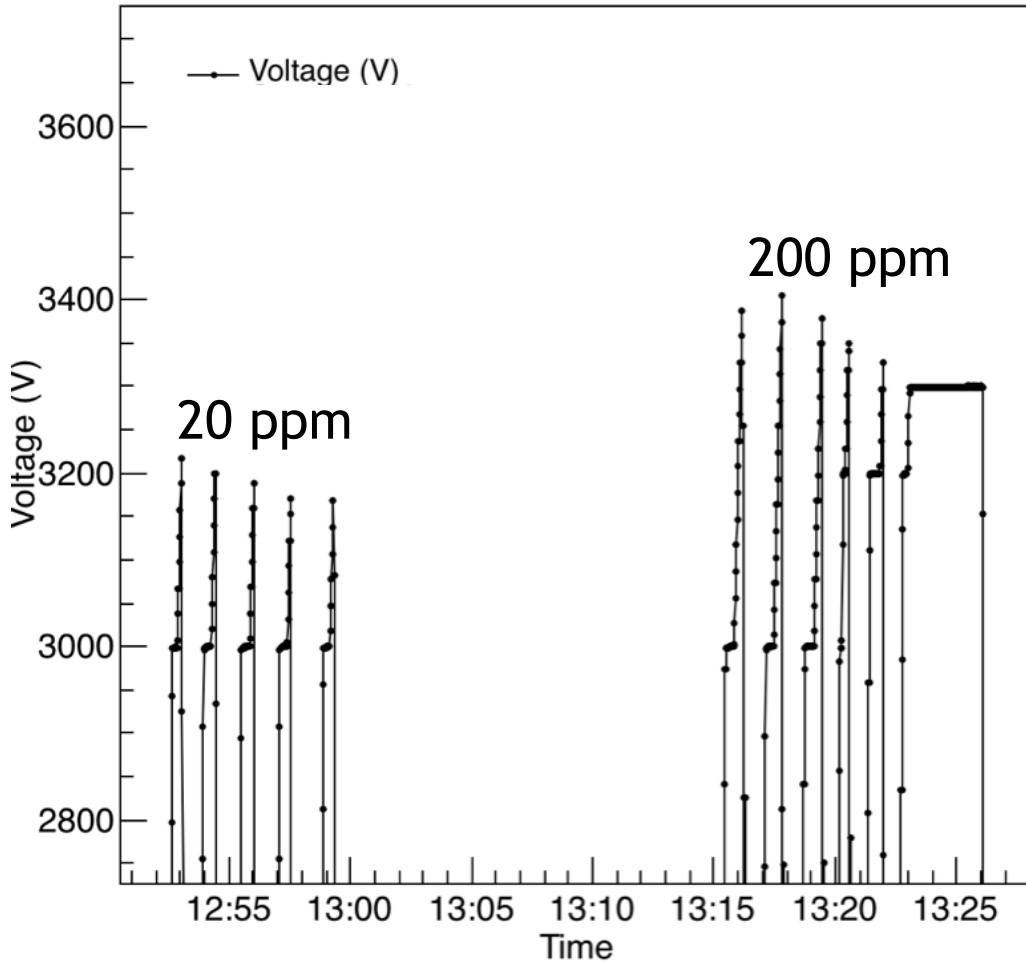


- $V_{\text{Breakdown}} \sim 3200\text{V} - 3250\text{V}$ at P 0.98 bar and LAr level 5mm below the LEM for 50x50 LEM



Could we improve the breakdown voltage?
 – Injecting N₂ (46) injection through purifier

20 ppm

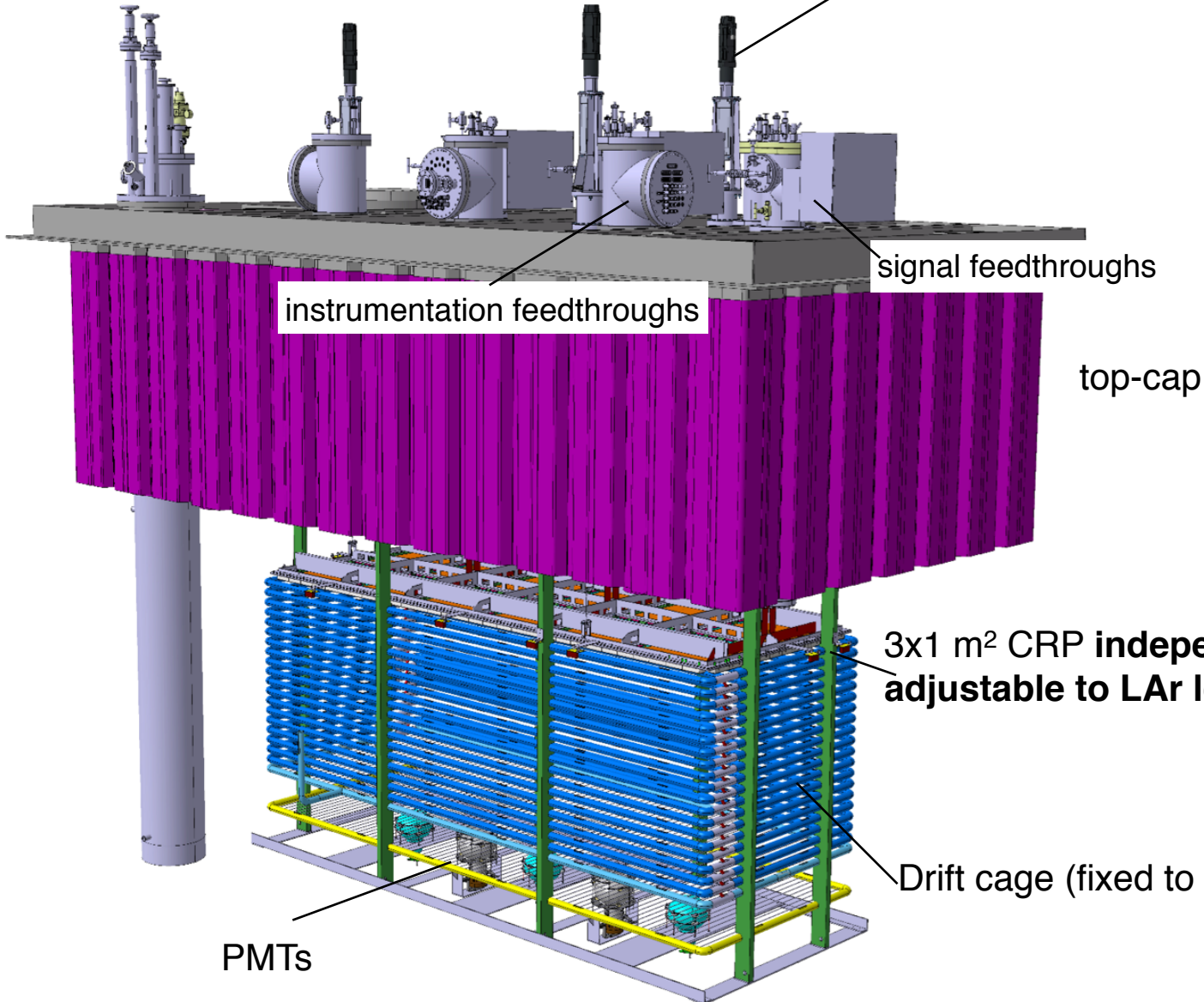


200 ppm



cryogenic pump tower

3 point suspension feedthroughs



instrumentation feedthroughs

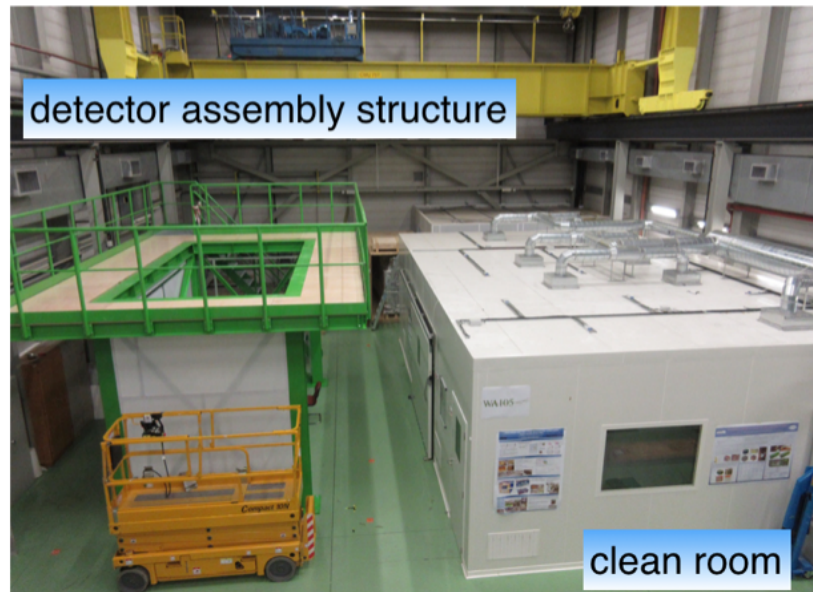
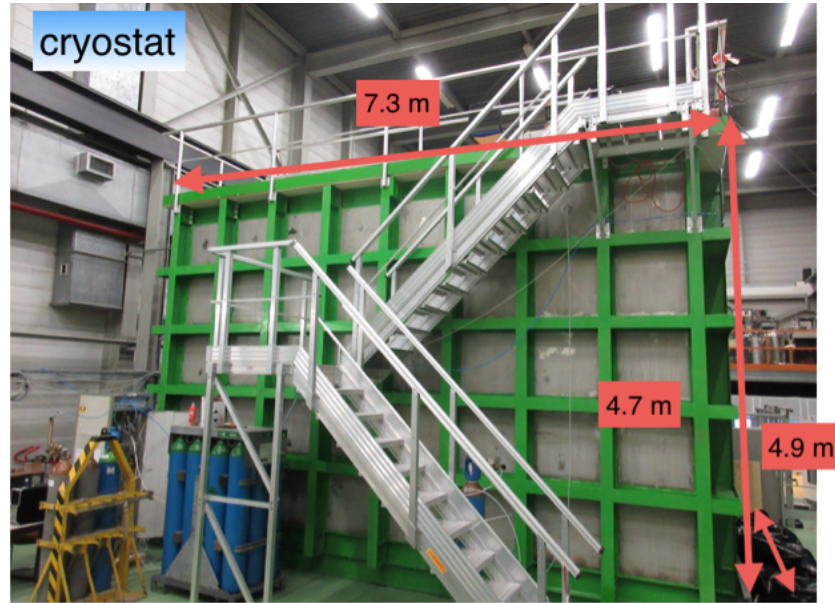
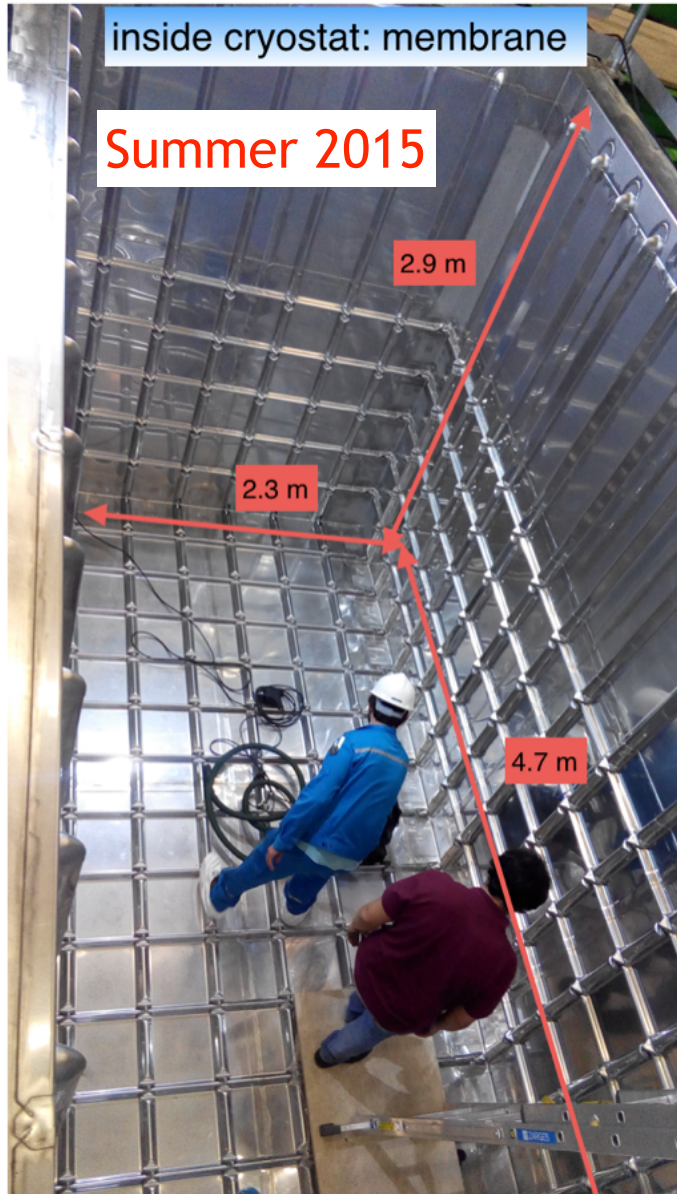
signal feedthroughs

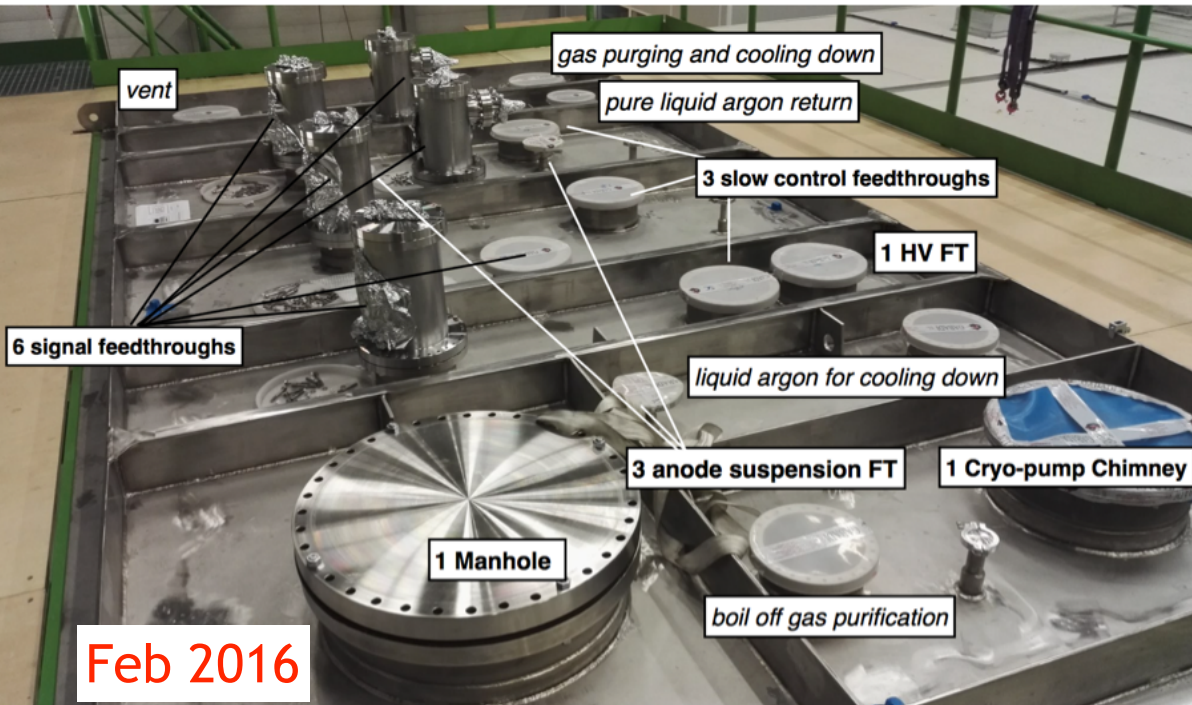
top-cap

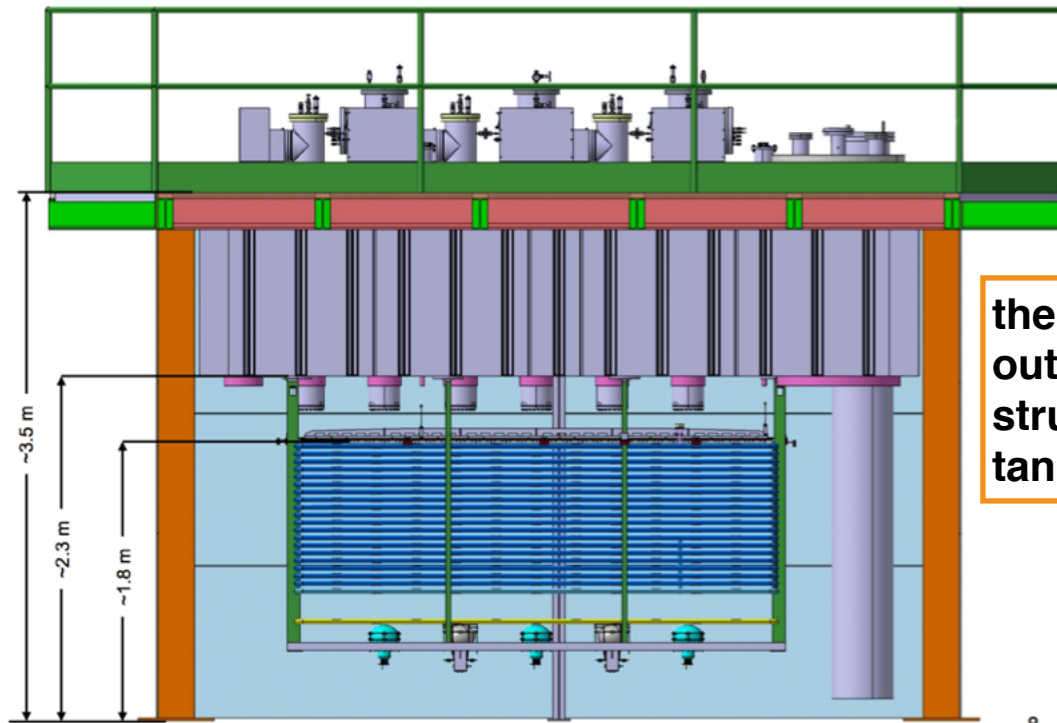
**3x1 m² CRP independent of drift cage
adjustable to LAr level**

Drift cage (fixed to top-cap)

PMTs





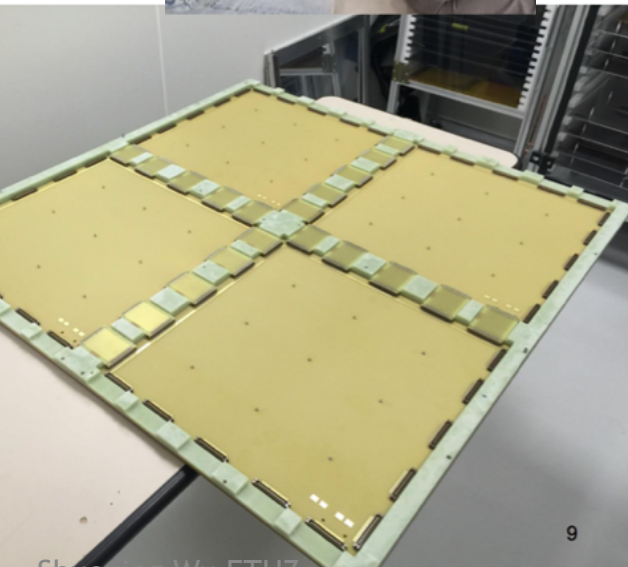
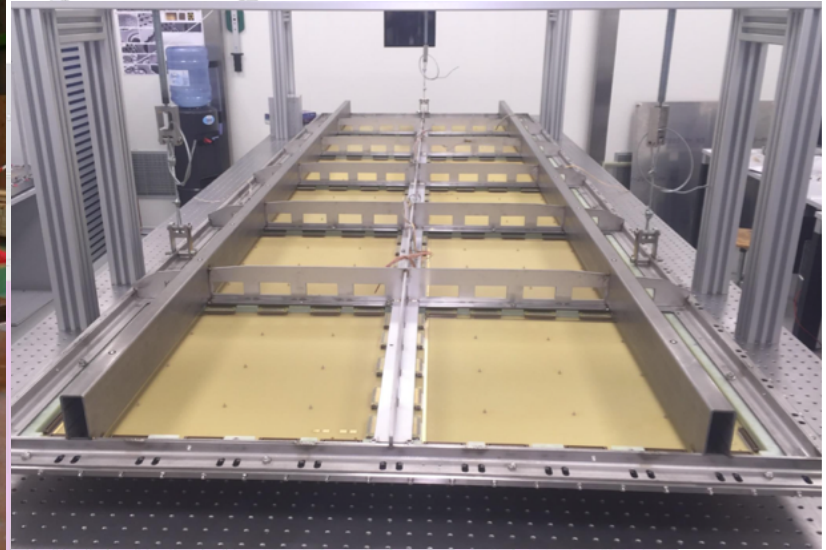


the entire detector is assembled outside the cryostat in a dedicated structure and then lifted inside the tank

installation begins now!

8

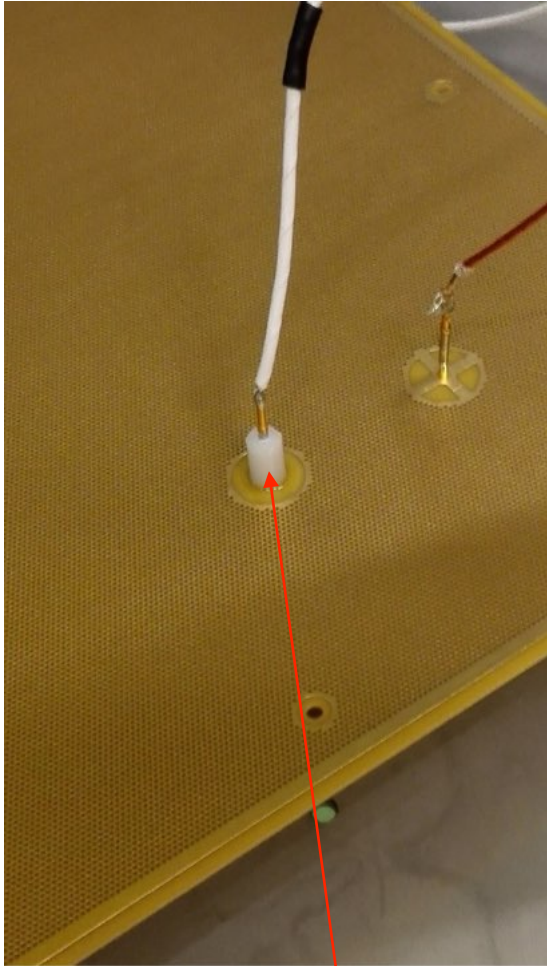
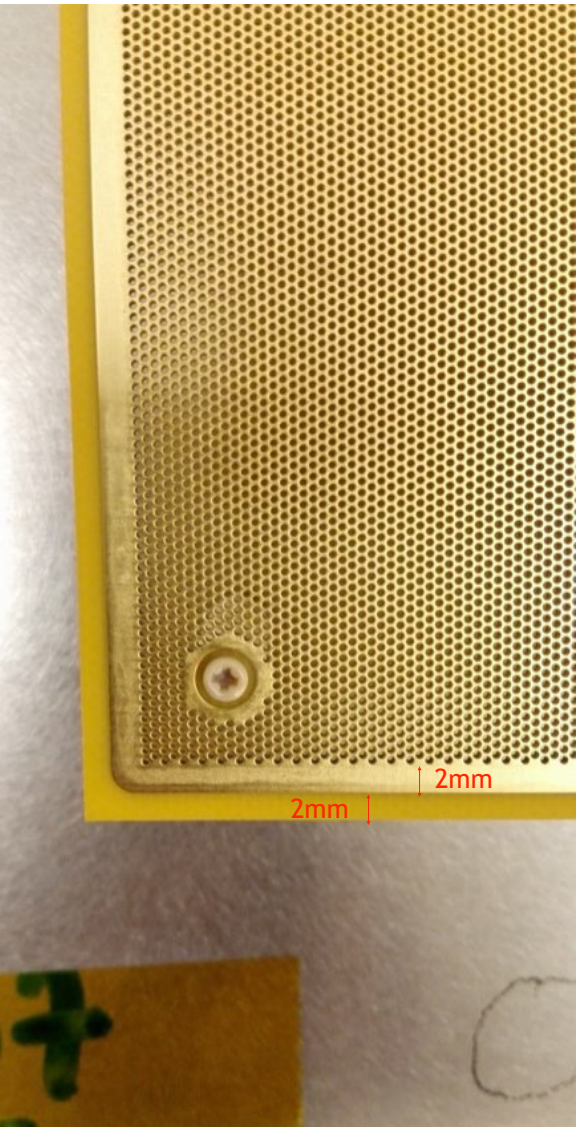
- **February** : top-cap delivered.
- **Feb+ spring**: detector installation and cabling in assembly structure + testing.
- **June**: move top-cap with detector to cryostat and install internal cryo-piping.
- **Summer**: installation of cryogenics
- **Fall**: test in liquid argon



1. Breakdown voltage of LEM is between 3200-3250V in both (0.2+-0.1) ppm O₂ and 0 N₂ purity conditions (real purity condition for the 3x1x1) and 10 ppm O₂ level corresponding to a gain over 30.
2. With 20 ppm N₂, the breakdown voltage is similar to 0 ppm N₂. With 200 ppm N₂, there is a hint that the breakdown voltage is increased by ~ 200V. However, this N₂ level is too high for the argon scintillation signal.
3. The 3x1x1 m³ detector has a tight schedule to be operational this fall. Detector installation already started.

Thank you for your attention!

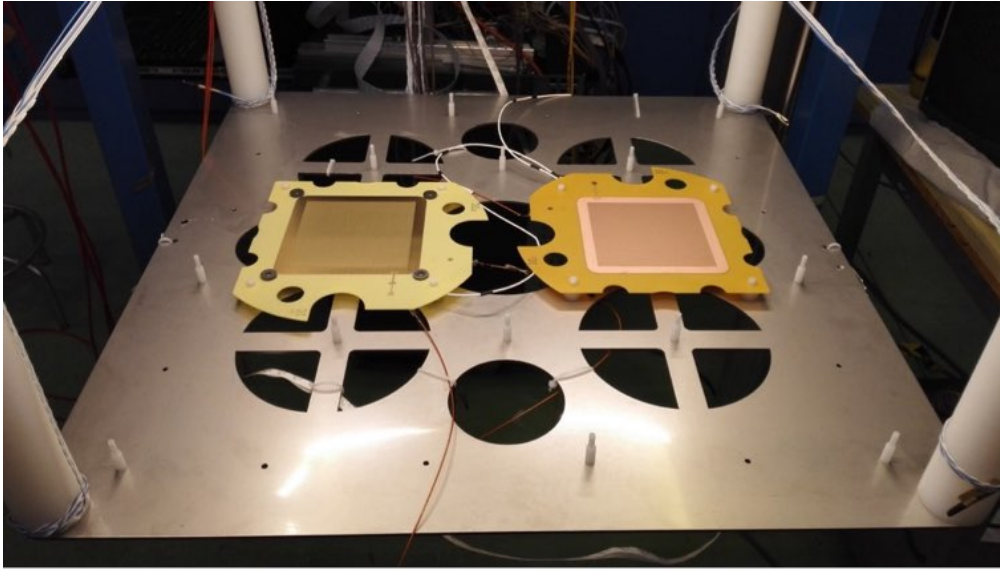
New LEM with 2mm guard ring and 2mm FR4 clearance



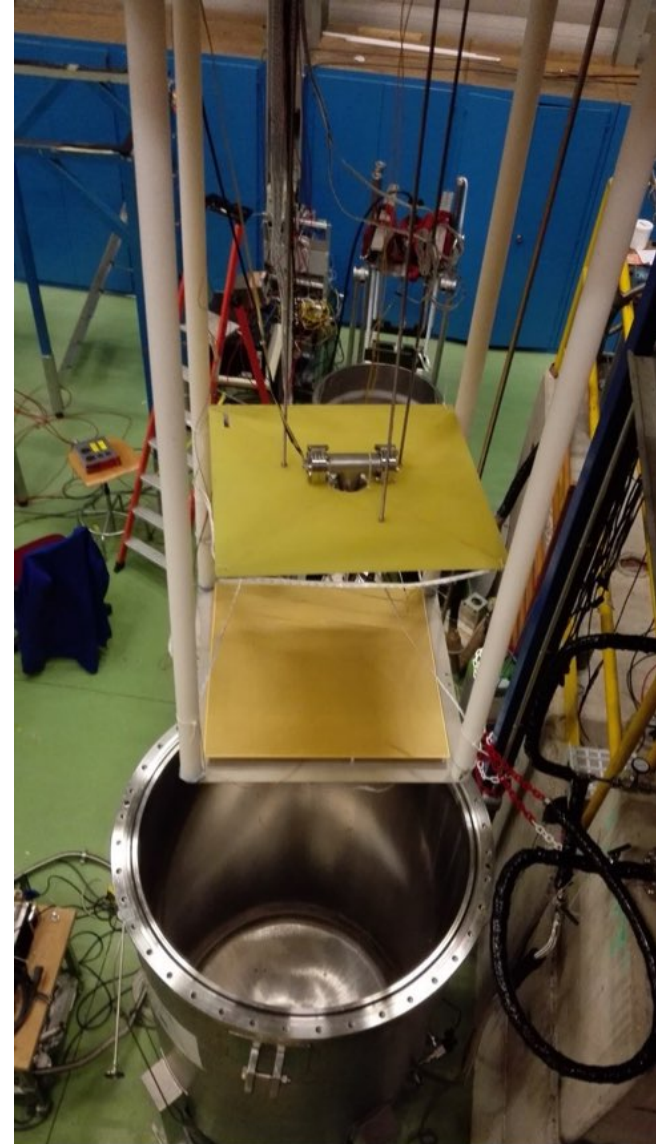
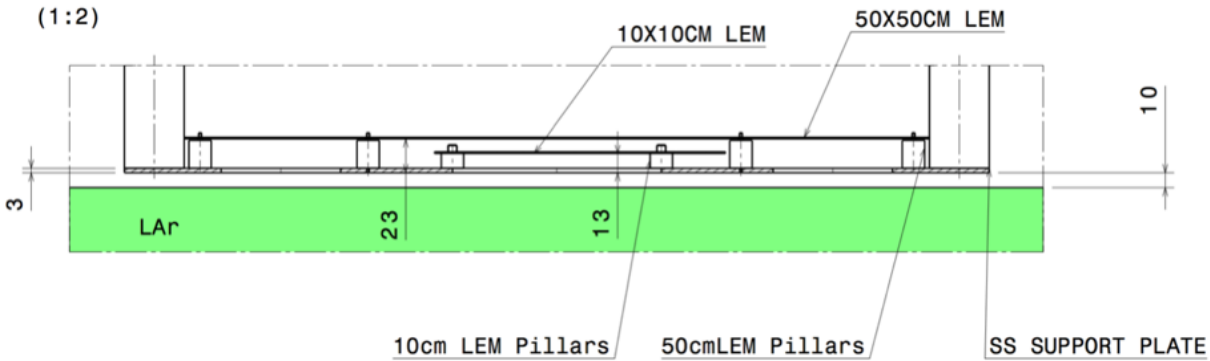
HV pin insulation

Installation

2 10x10 LEMs

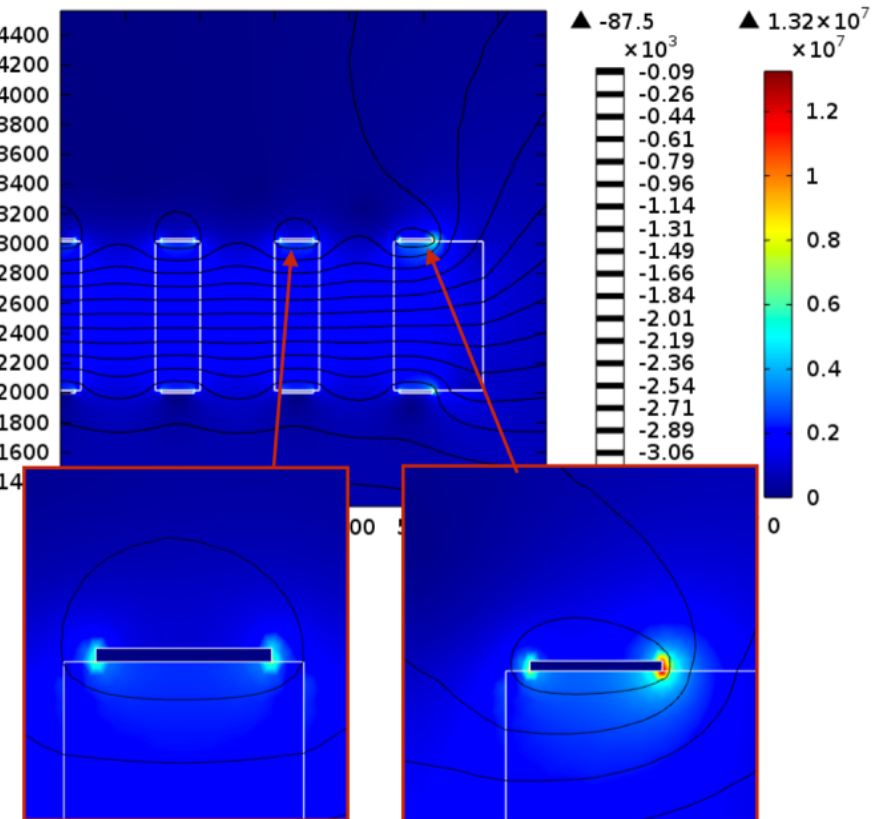


DETAIL B
(1:2)

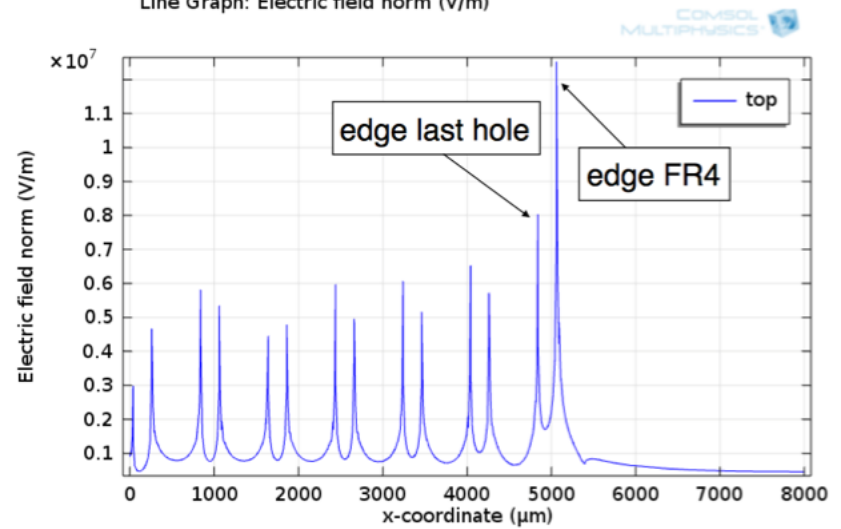


Electric field configuration with
100 μm guard ring, 500 μm FR4 clearance

Surface: Electric field norm (V/m)
Contour: Electric potential (V)



Line Graph: Electric field norm (V/m)



Gain Map near the Edge of the GEM

