Update on WA105

Sebastien Murphy
on behalf of the WA105 Collaboration

The collaboration

WA105

22 institutes 122 physicists

UNIVERSITY of OULU

UNIVERSITÀ DI PISA

UCL

Sofia University St. Kliment Ohridski Bulgaria

CERN

ETH Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

KEK HIGH ENERGY ACCELERATOR RESEARCH ORGANIZATION

UNIVERSITY OF JYVÄSKYLÄ

ИНСТИТУТ ЯДЕРНЫХ ИССЛЕДОВАНИЙ РОССИЙСКОЙ АКАДЕМИИ НАУК
INSTITUTE FOR NUCLEAR RESEARCH OF RUSSIAN ACADEMY OF SCIENCES

Institut de Física d'Altes Energies IFAE

LPNHE PARIS

lapp

University of Glasgow

UNIVERSITÉ DE GENÈVE

cea SACLAY

ipnl

APC

IN2P3 Institut National de Physique Nucléaire et de Physique des Particules

Goals of WA105

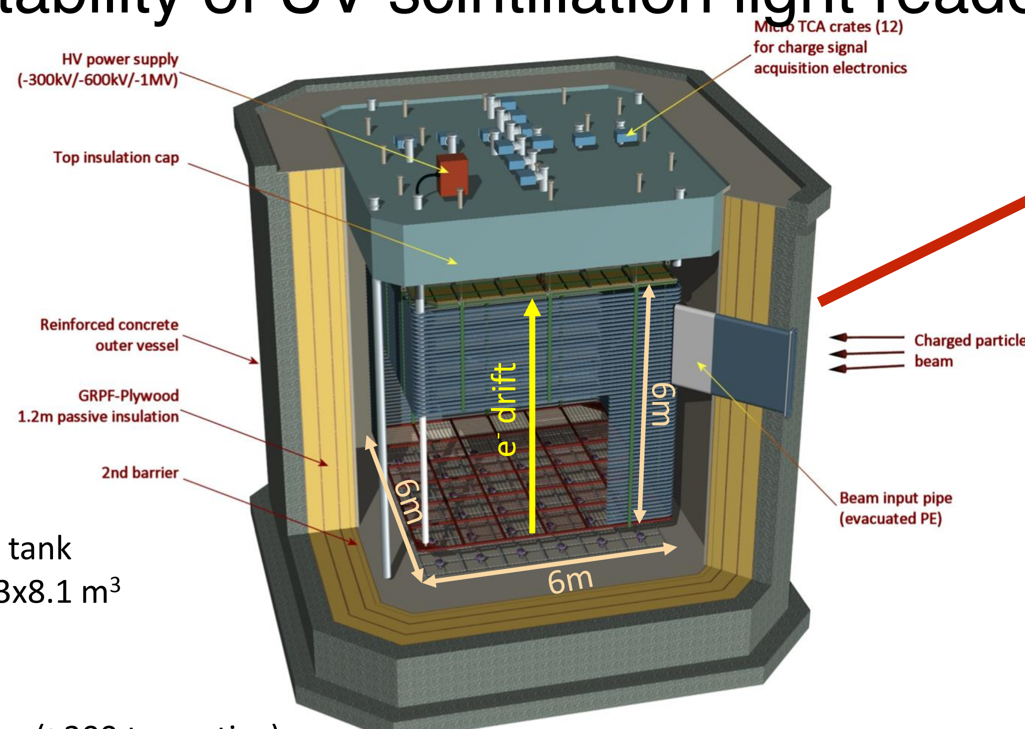
WA105 aims at demonstrating the operation of the novel large liquid argon double-phase time projection chamber (DLAr TPC) and the modern techniques for magnetised MIND detectors.

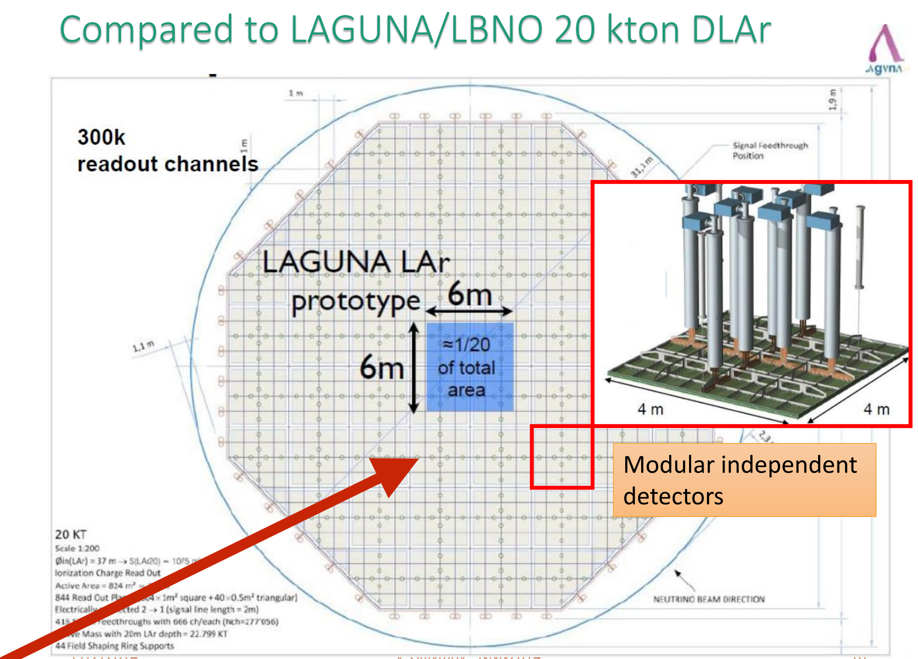
- A new concept for an **affordable and underground liquid argon detector** has been proposed, developed over several years, and tested on ever growing prototypes.
- In the coming years we intend to focus on the realisation and operation of **large-scale demonstrators**, whose technical designs have been presented in a comprehensive "Technical Design Report" (CERN SPSC-2014-013, SPSC-TDR-004).
- Two independent demonstrators have been approved:
  - 6x6x6m3 DLAr double phase liquid argon TPC
  - BabyMIND magnetised iron neutrino detector
- Efforts on this scale aimed at **demonstrating novel concepts are best realised on surface** in laboratories. The WA105 demonstrators would be **the "last step" before an underground deployment of tens of kton-scale detectors.**
- **They represent concrete work and achievements upon which contributions to the international LBL programmes will be proposed.**

WA105: important Technical milestones

Build and operate a large scale prototype to demonstrate the feasibility of LAGUNA/LBNO DLAr TPC design for O(10kt) detectors

- A 1:20-scale of 20kt “demonstrator” & industrial solutions
- Technical proof-of-principle:
  - Purity in non-evacuated tank
  - Large hanging field cage structure
  - Very high voltage generation
  - Large area charge readout
  - Accessible cold front-end electronics
  - Long term stability of UV scintillation light readout





Some detector parameters:

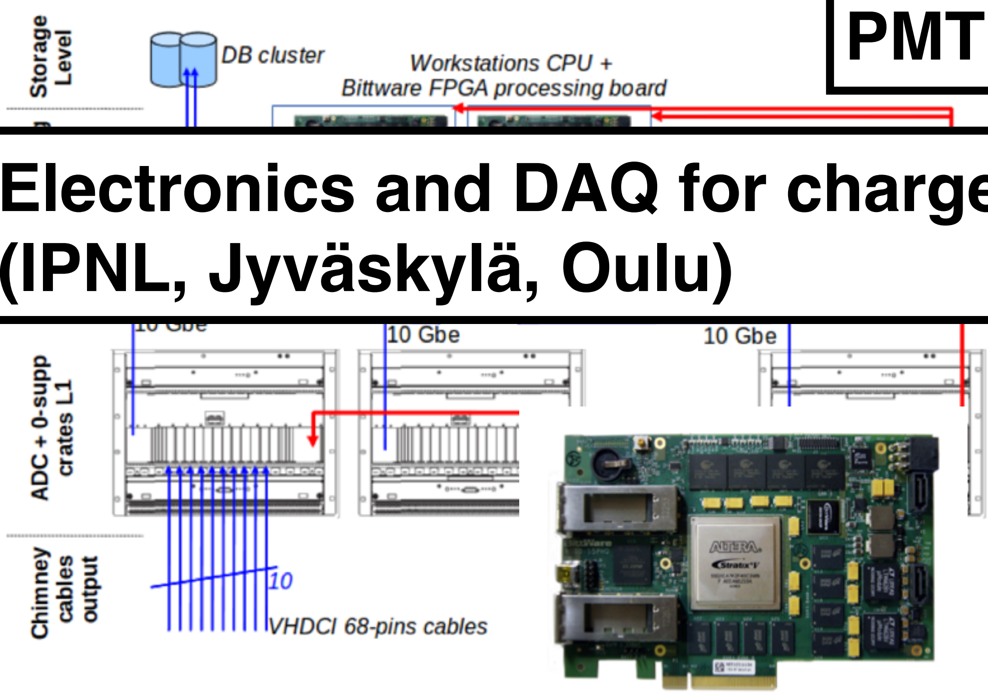
- Insulated membrane tank
  → inner volume 8.3x8.3x8.1 m^3
- Active area 36 m^2
- Drift length 6 m
- Total LAr mass 705 ton (~300 ton active)
- Hanging field cage & readout plane
- # of signal channels: 7680 in 12 signal FT
- # of PMTs: 36

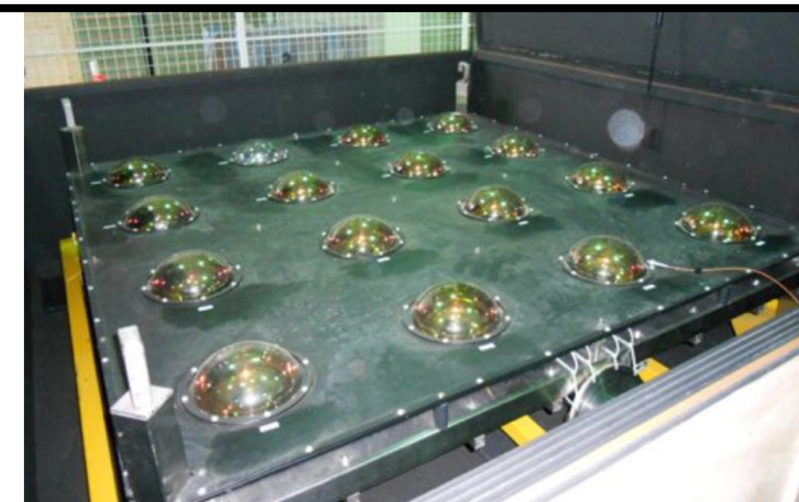
LBNO-DEMO: design work in progress

WA105

PMT light readout (APC, Barcelona, CIEMAT, KEK,LAPP)

Electronics and DAQ for charge readout (IPNL, Jyväskylä, Oulu)

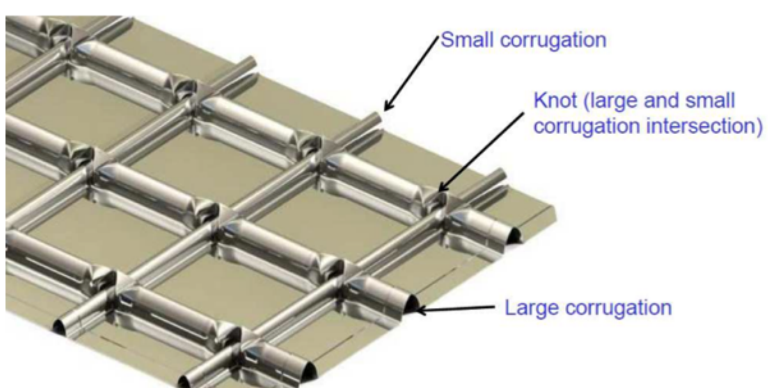




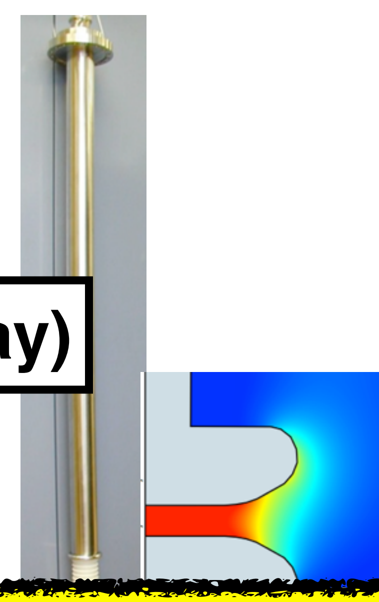
SiPM light readout (INR, Genève)

Field cage (Bucarest, Saclay, IFINHH)

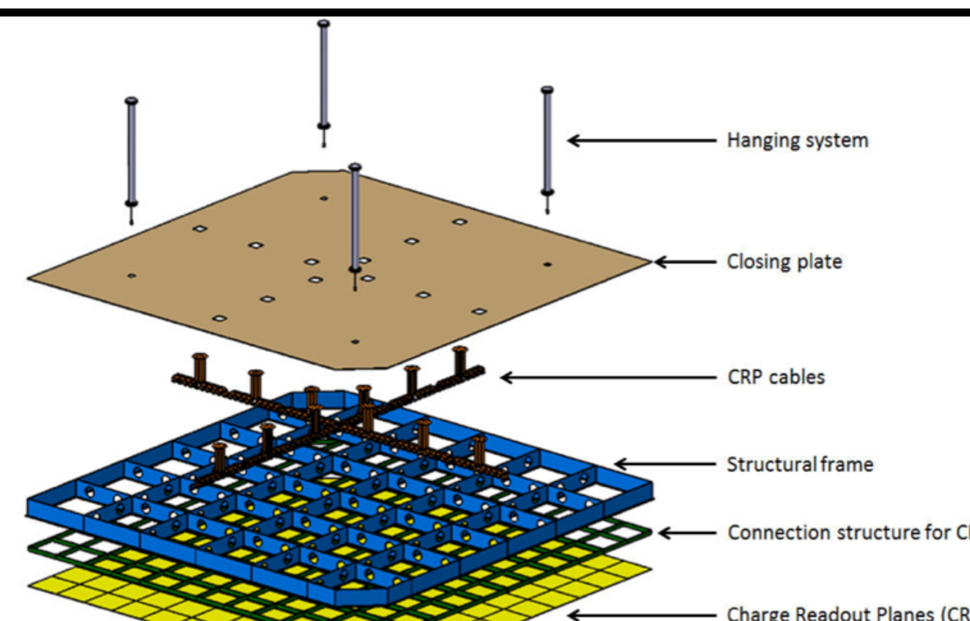
membrane tank (ETHZ, CERN)



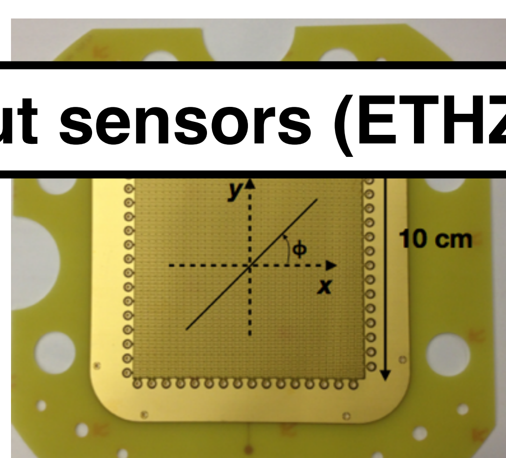
HV (LPNHE, ETHZ)



anode deck suspension (LAPP)

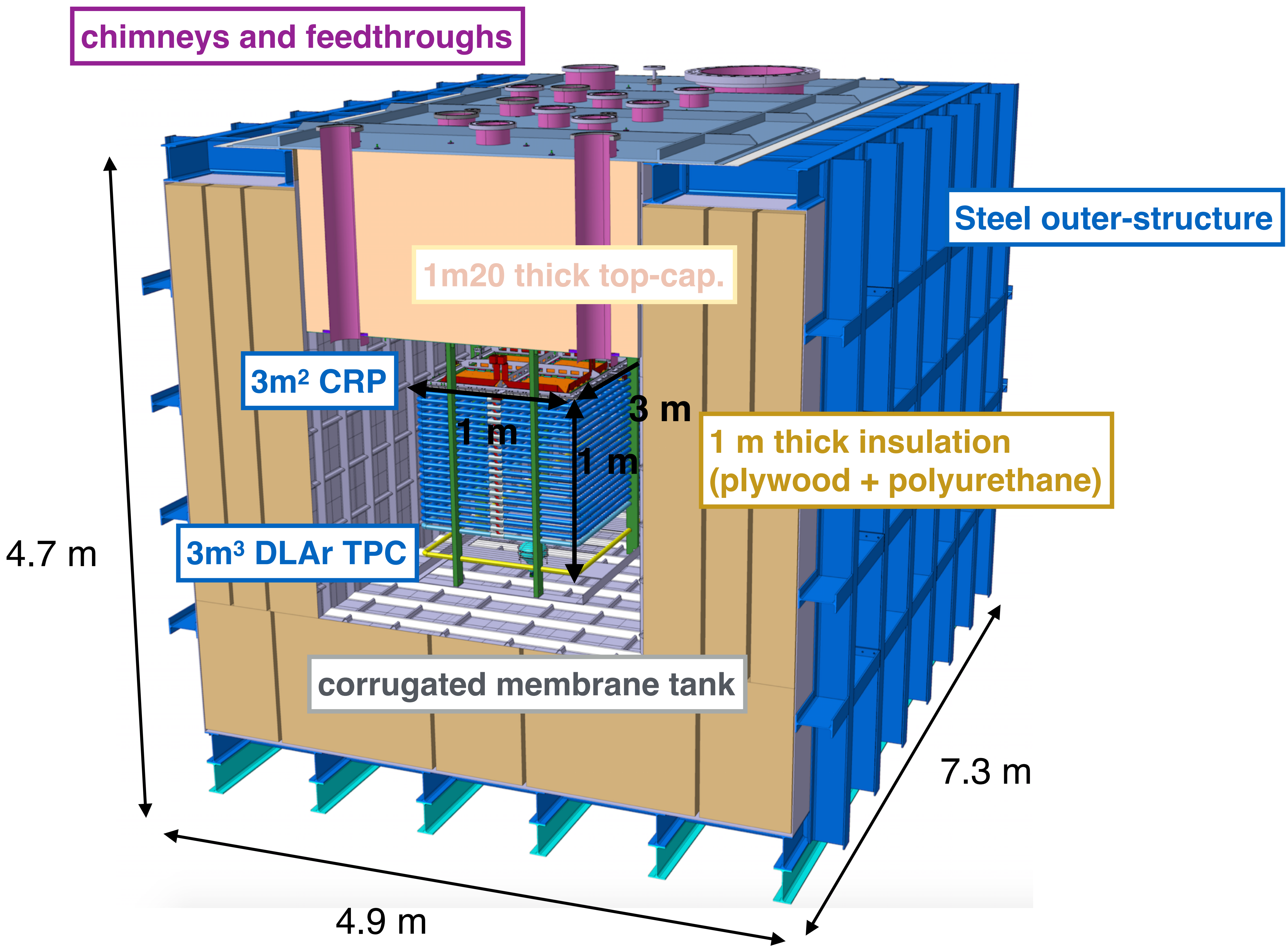


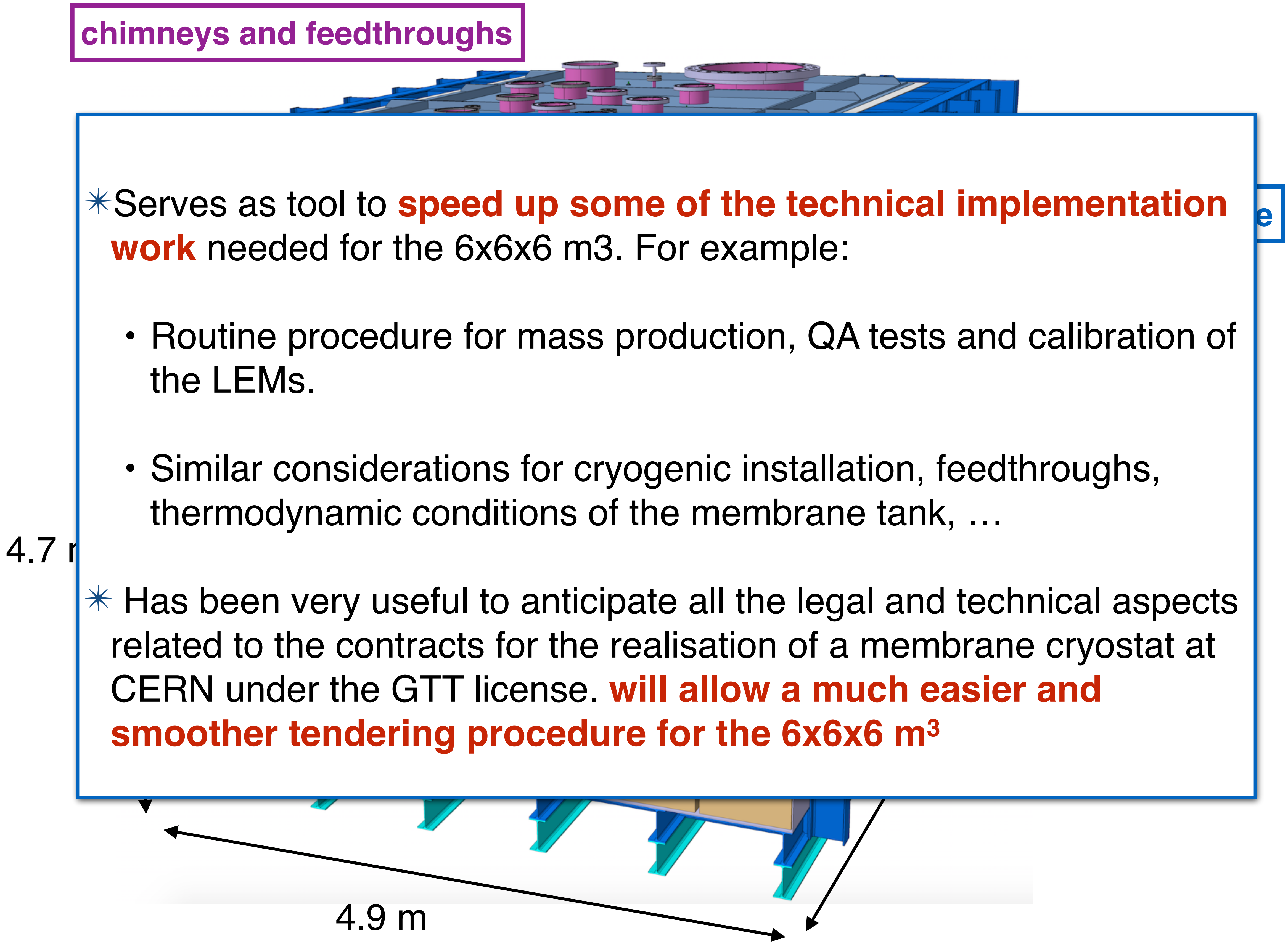
charge readout sensors (ETHZ, Saclay)



all groups involved in software and data analysis

WA105-3x1x1


chimneys and feedthroughs
Steel outer-structure
1m20 thick top-cap.
3m² CRP
1 m
3 m
1 m
1 m thick insulation
(plywood + polyurethane)
3m³ DLAr TPC
4.7 m
corrugated membrane tank
7.3 m
4.9 m



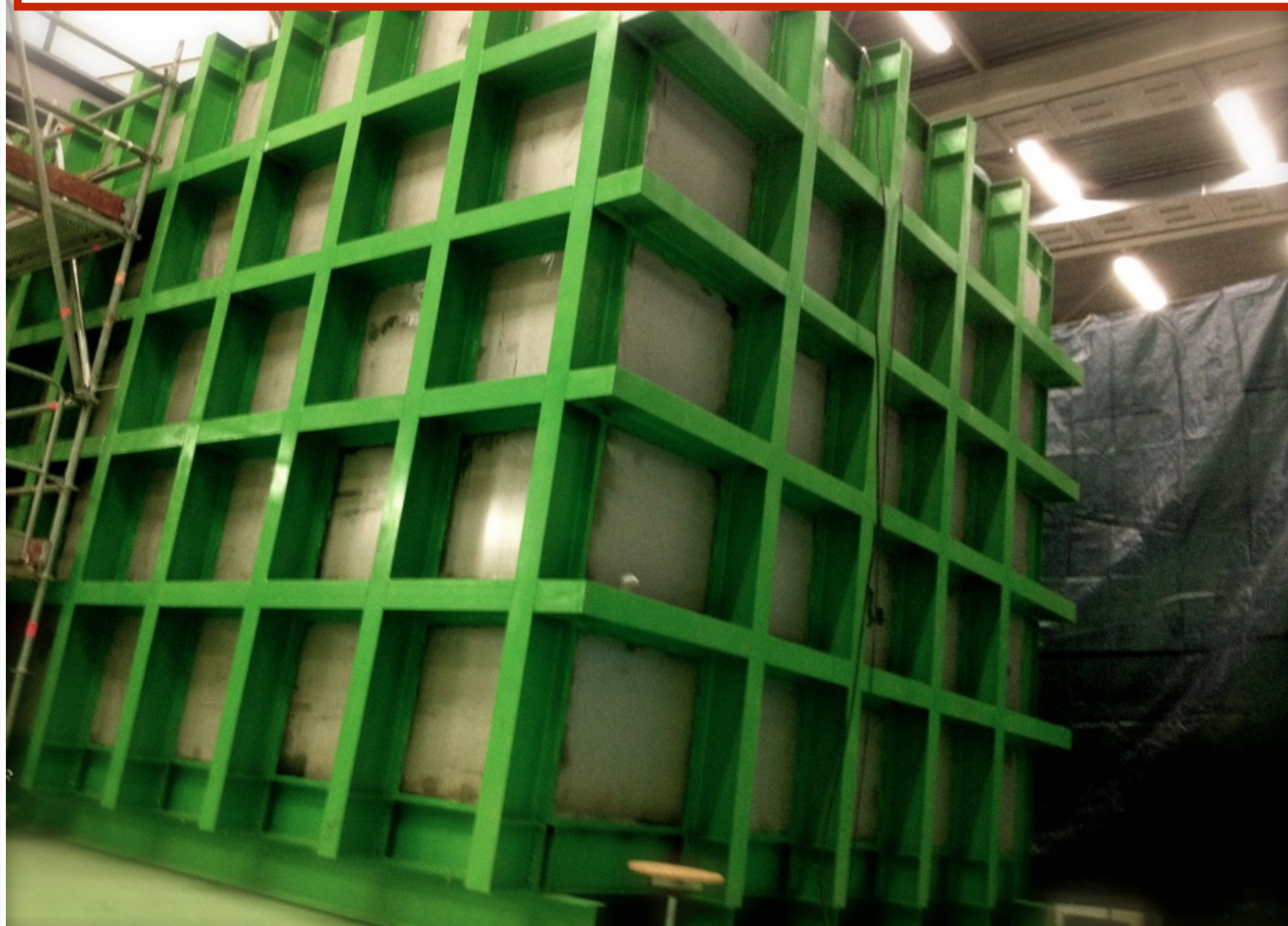
✳Serves as tool to **speed up some of the technical implementation work** needed for the 6x6x6 m3. For example:

- Routine procedure for mass production, QA tests and calibration of the LEMs.
- Similar considerations for cryogenic installation, feedthroughs, thermodynamic conditions of the membrane tank, …

✳ Has been very useful to anticipate all the legal and technical aspects related to the contracts for the realisation of a membrane cryostat at CERN under the GTT license. **will allow a much easier and smoother tendering procedure for the 6x6x6 m^3**

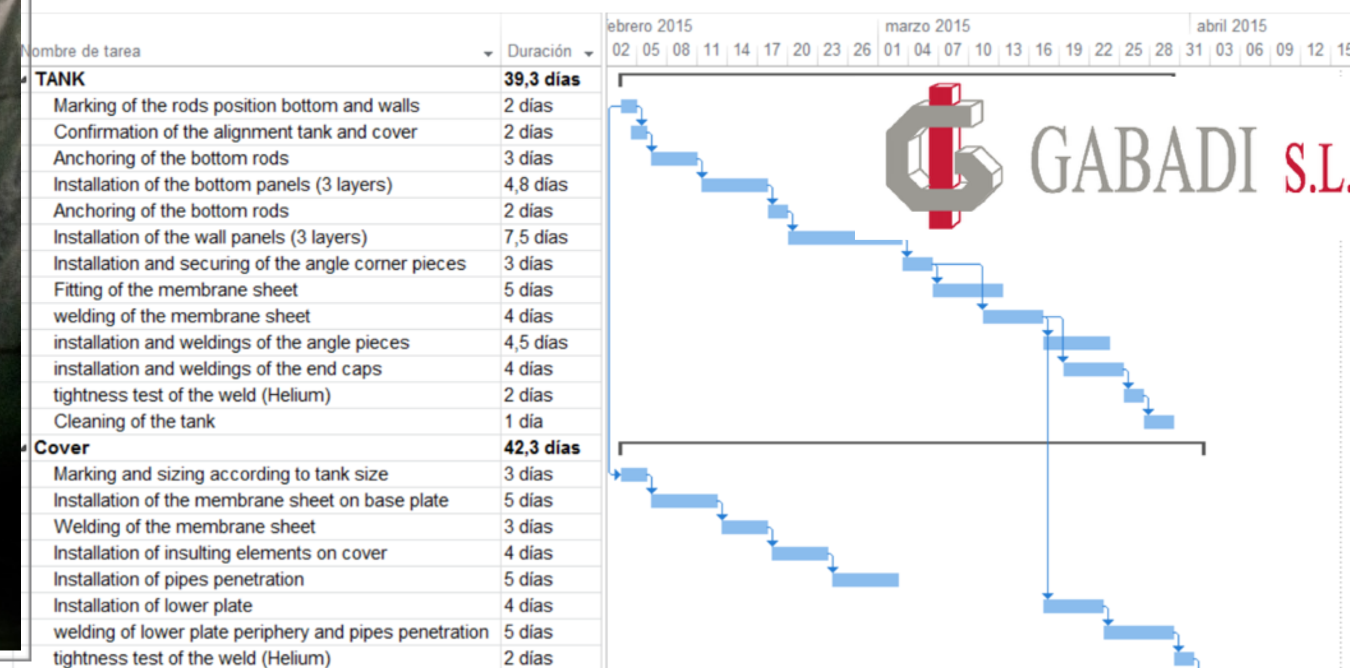
Cryostat

Outer structure was installed before christmas



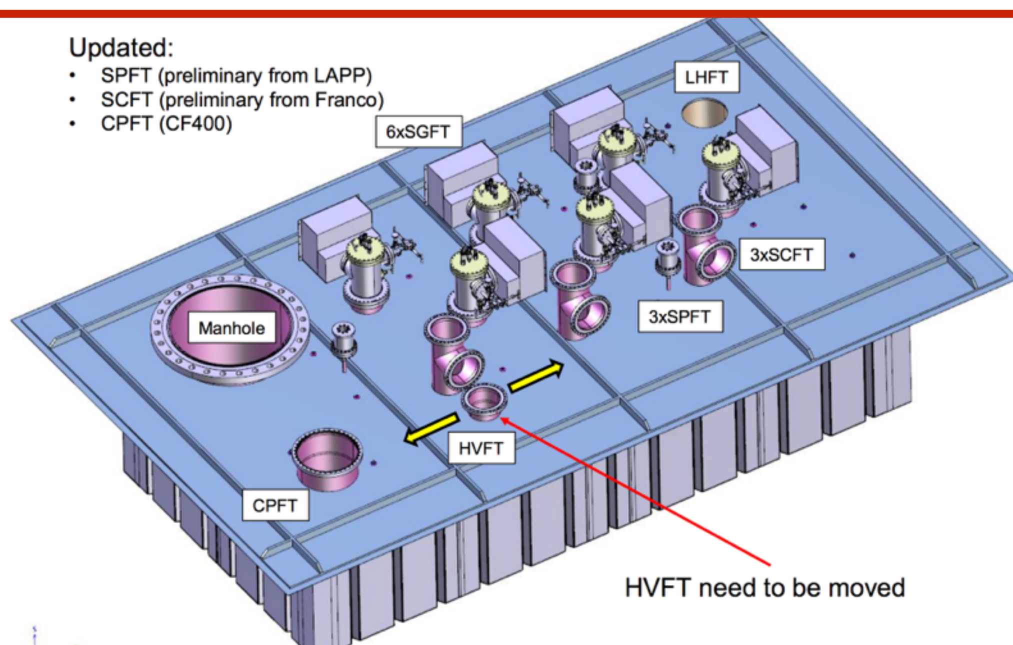
click here to download movie:

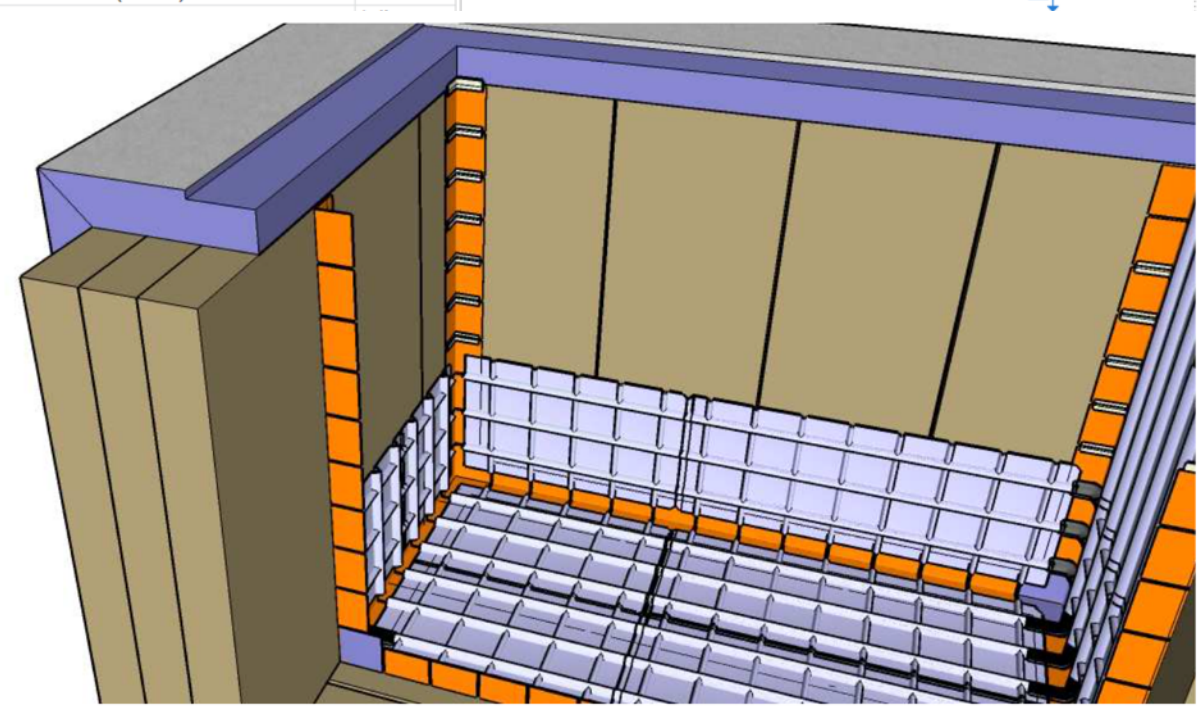
[outer-structure-construction-time-lapse]



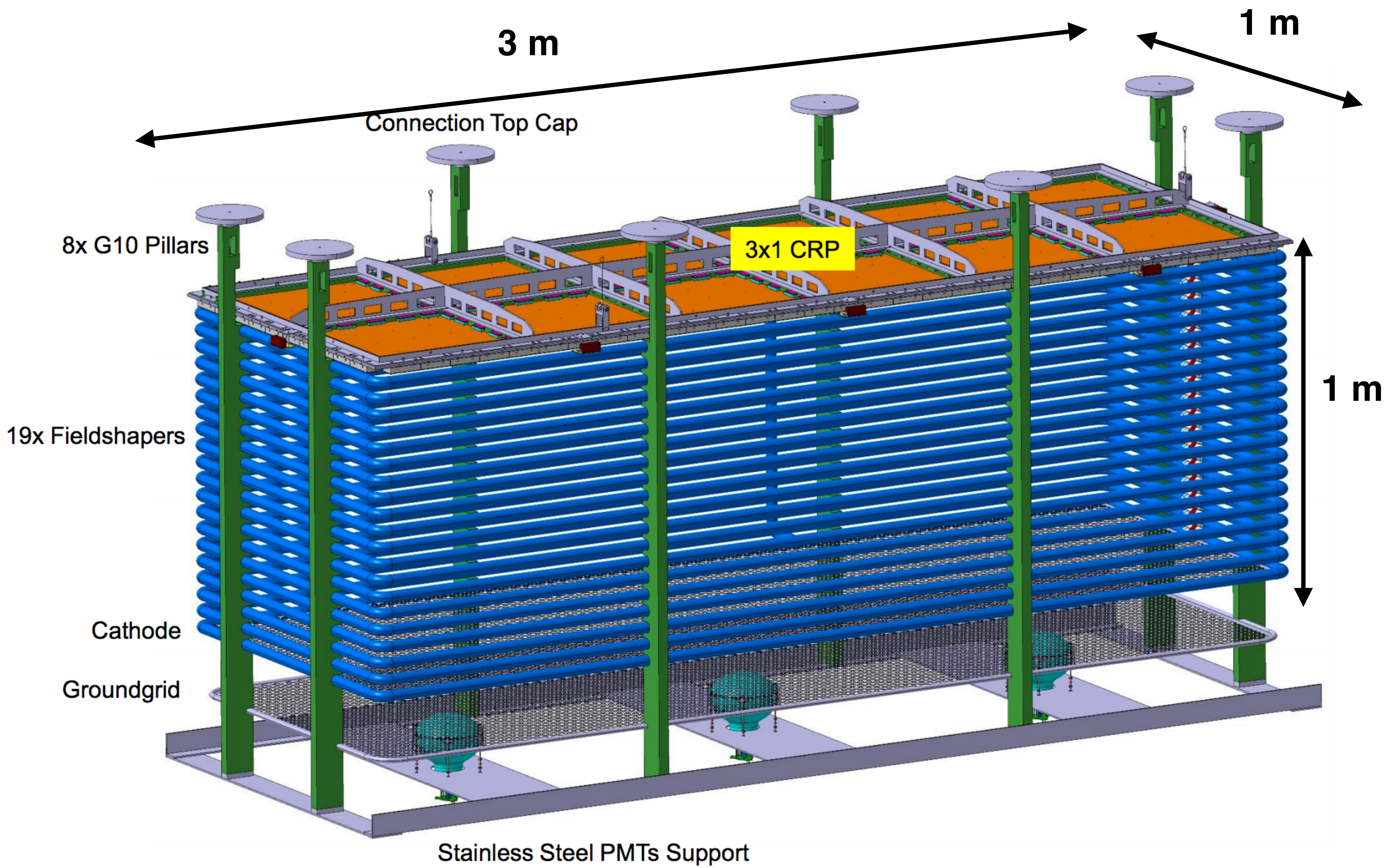
Nombre de tarea	Duración
TANK	**39,3 días**
Marking of the rods position bottom and walls	2 días
Confirmation of the alignment tank and cover	2 días
Anchoring of the bottom rods	3 días
Installation of the bottom panels (3 layers)	4,8 días
Anchoring of the bottom rods	2 días
Installation of the wall panels (3 layers)	7,5 días
Installation and securing of the angle corner pieces	3 días
Fitting of the membrane sheet	5 días
welding of the membrane sheet	4 días
installation and weldings of the angle pieces	4,5 días
installation and weldings of the end caps	4 días
tightness test of the weld (Helium)	2 días
Cleaning of the tank	1 día
Cover	**42,3 días**
Marking and sizing according to tank size	3 días
Installation of the membrane sheet on base plate	5 días
Welding of the membrane sheet	3 días
Installation of insulting elements on cover	4 días
Installation of pipes penetration	5 días
Installation of lower plate	4 días
welding of lower plate periphery and pipes penetration	5 días
tightness test of the weld (Helium)	2 días

and insulation + membrane + top-cap by April



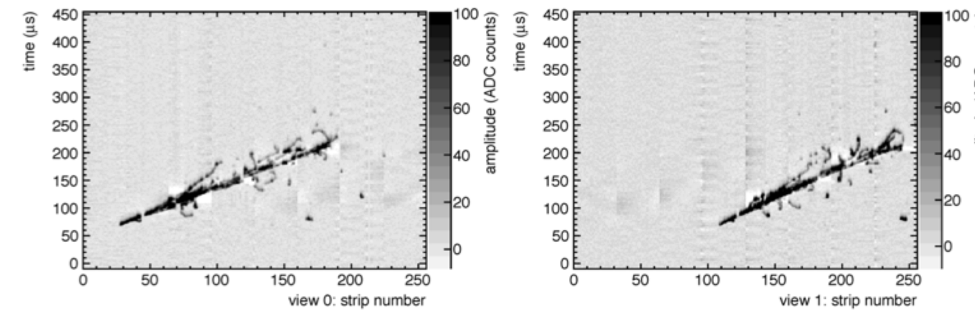


3x1x1 m^3 detector



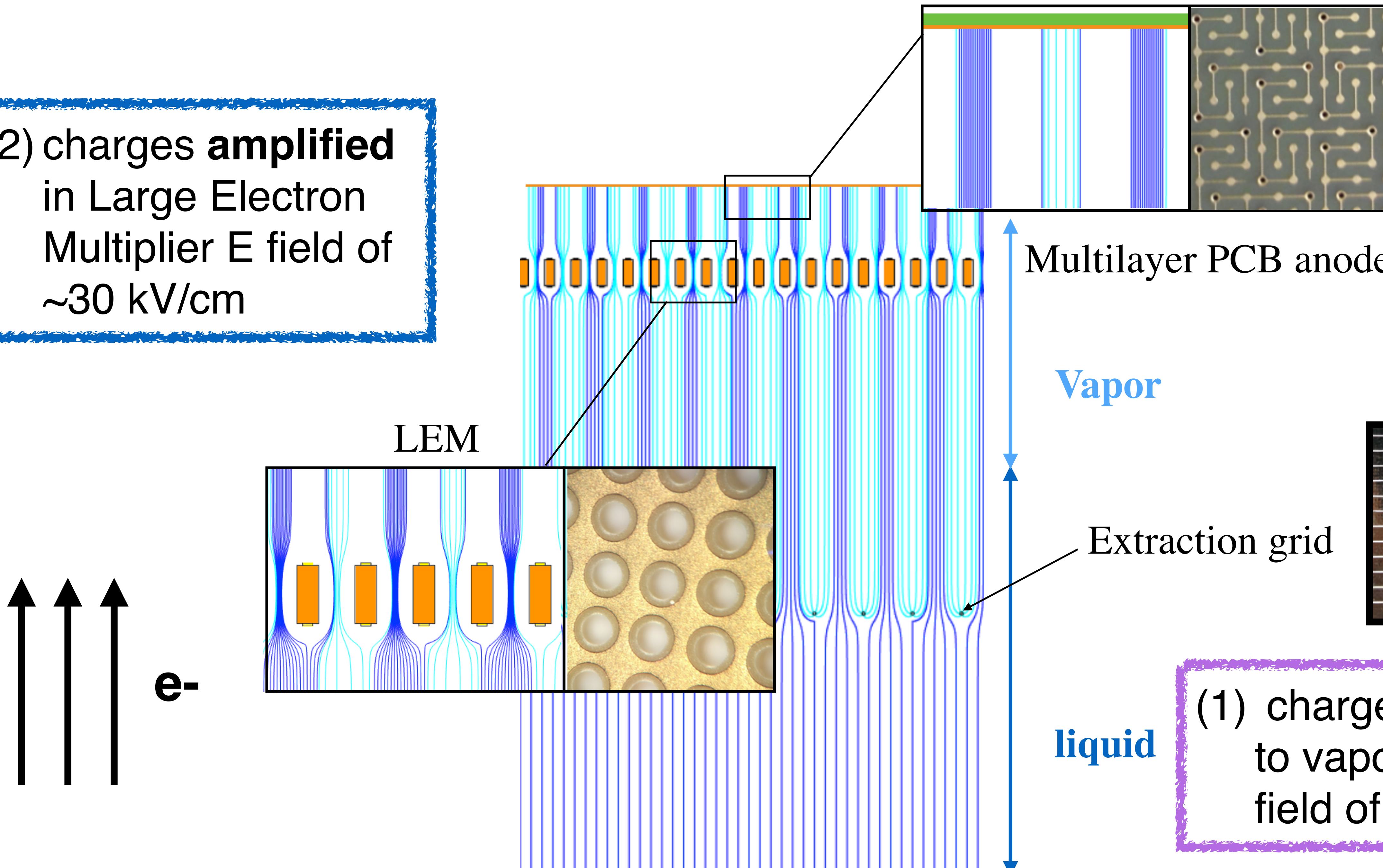
Double phase readout

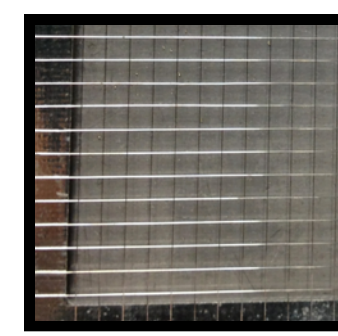
data collected on a 40x80 cm² DLAr TPC at CERN



(3) charges **collected** on specially designed two view anode. Both views see the same amount of charge and have **identical signals**

(2) charges **amplified** in Large Electron Multiplier E field of ~30 kV/cm





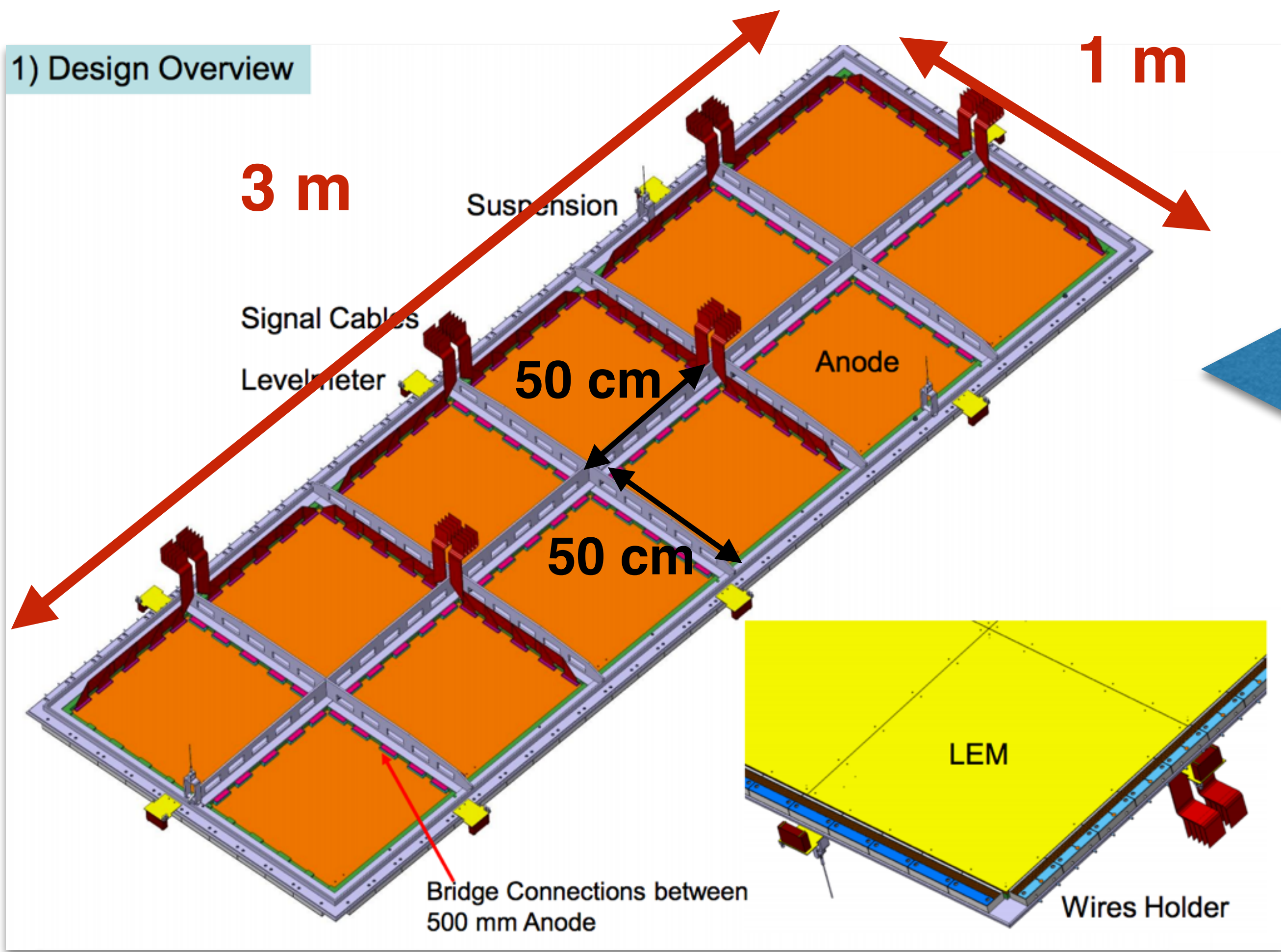
(1) charges **extracted** to vapor phase E field of ~2 kV/cm

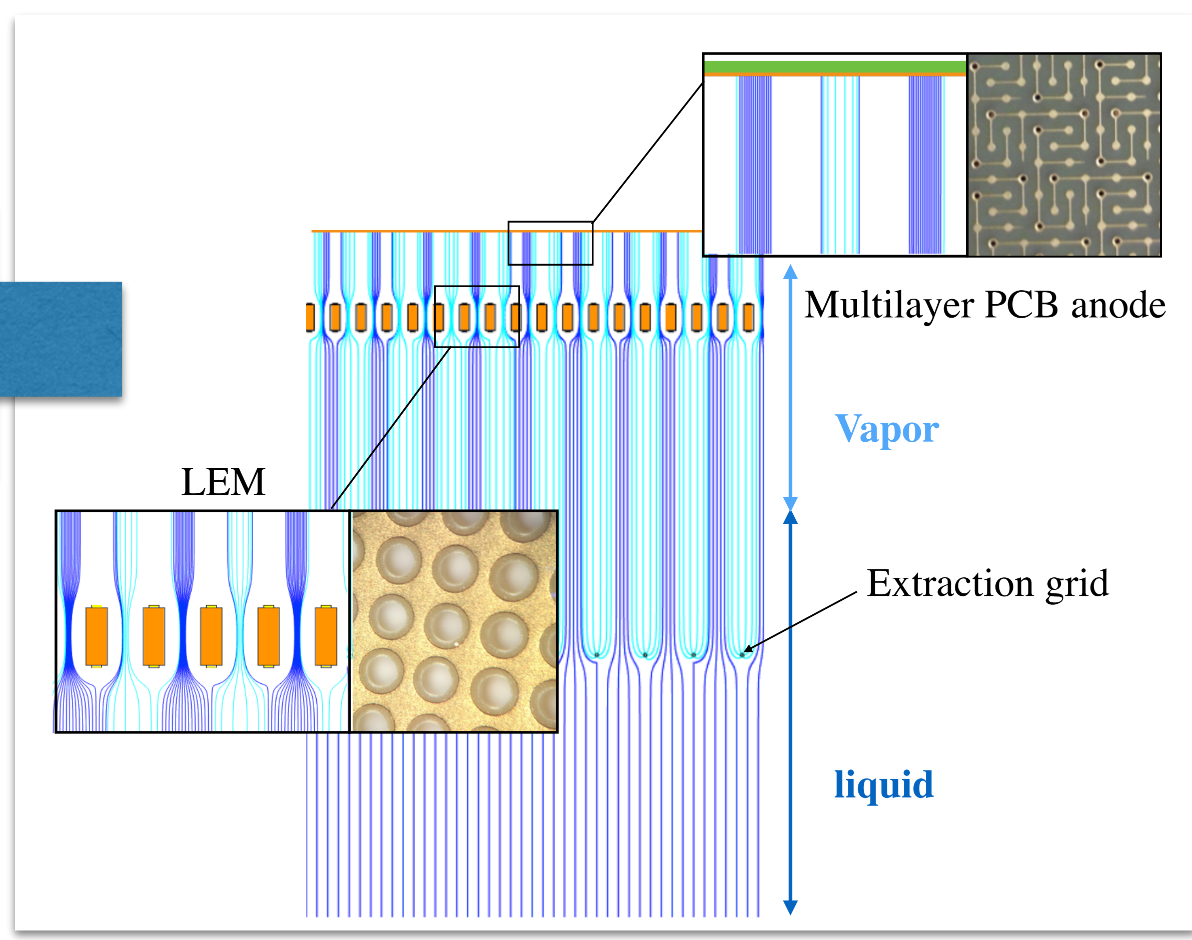
The detector: Charge Readout Plane

an important detector component that will be tested in the 3x1x1 is the charge readout plane. The extraction grid LEM and anodes are all combined in one module adjustable to the LAr level: the charge readout plane (CRP)

extraction grid-LEM and anode all in one single module

50x50 cm² LEM+anodes mounted in readout modules of 1m² on a 1x3 m² frame

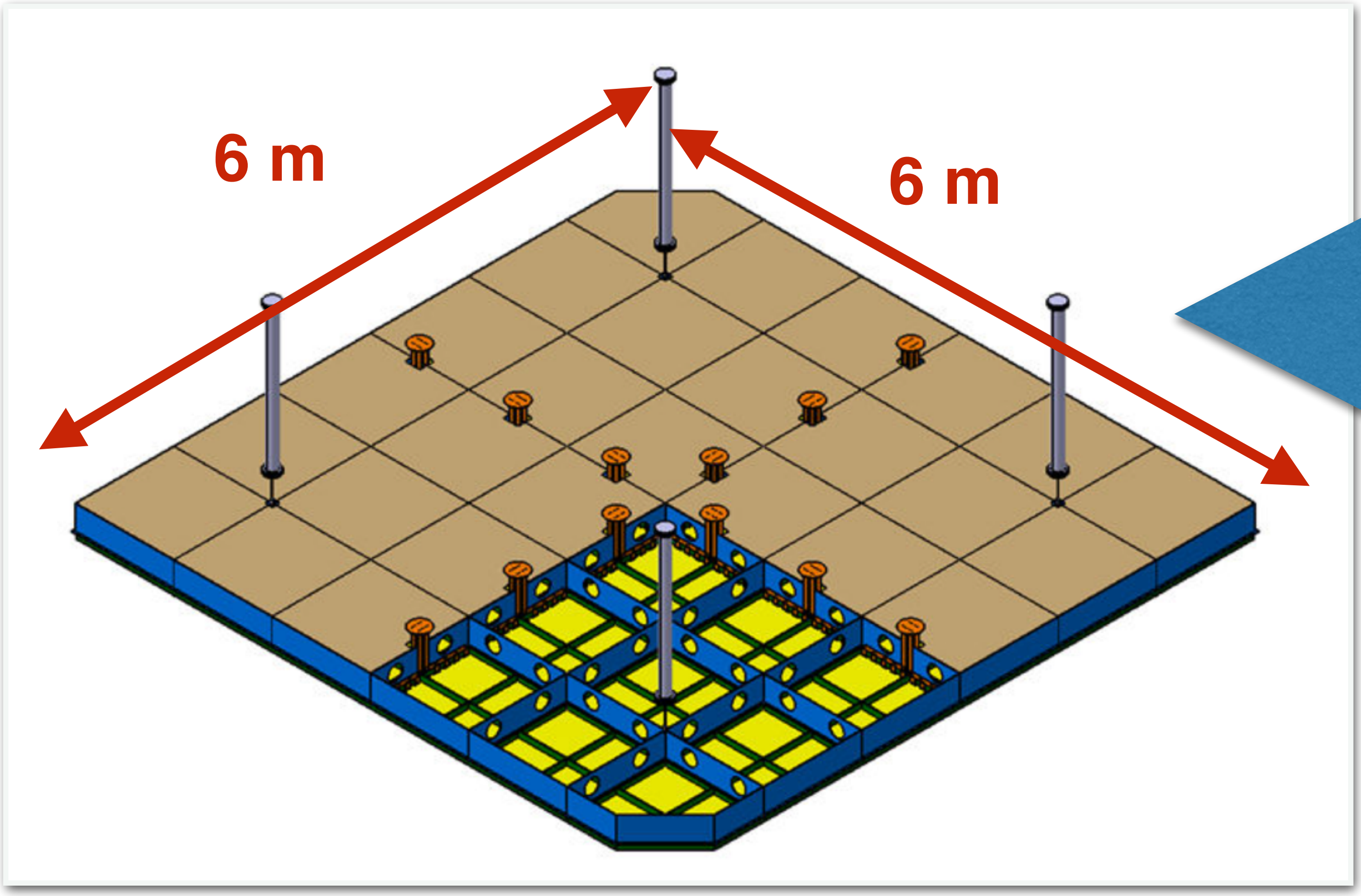


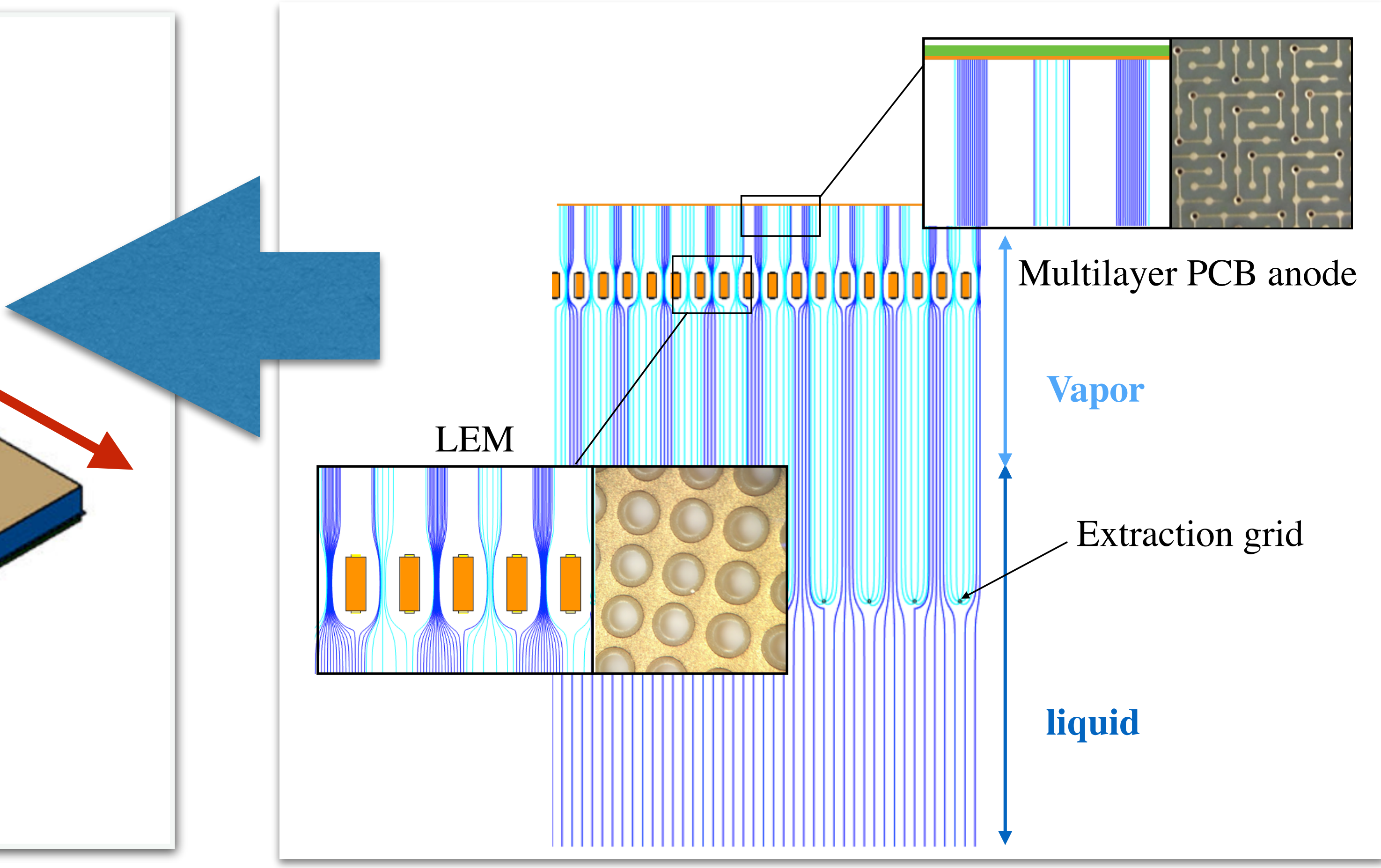


The detector: Charge Readout Plane

The same principle will be adapted to the LBNO-DEMO. We will learn from the “prototype” 3x1 m^2 CRP.

baseline idea is the same.
Fully active but independent **LEM/anode modules of 50x50 cm^2**



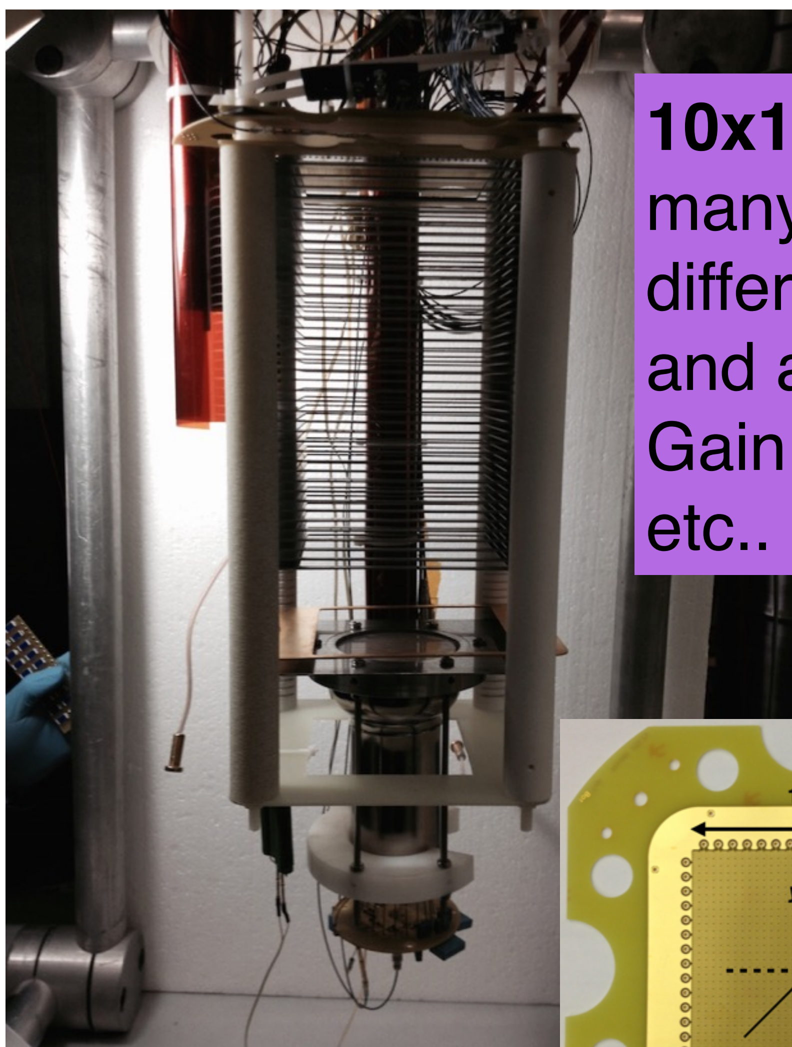


Developing square meter readout

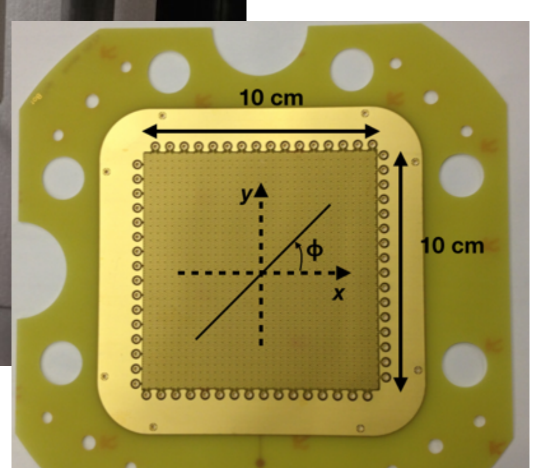
From the point of view of the readout the goals can be largely summarised as:

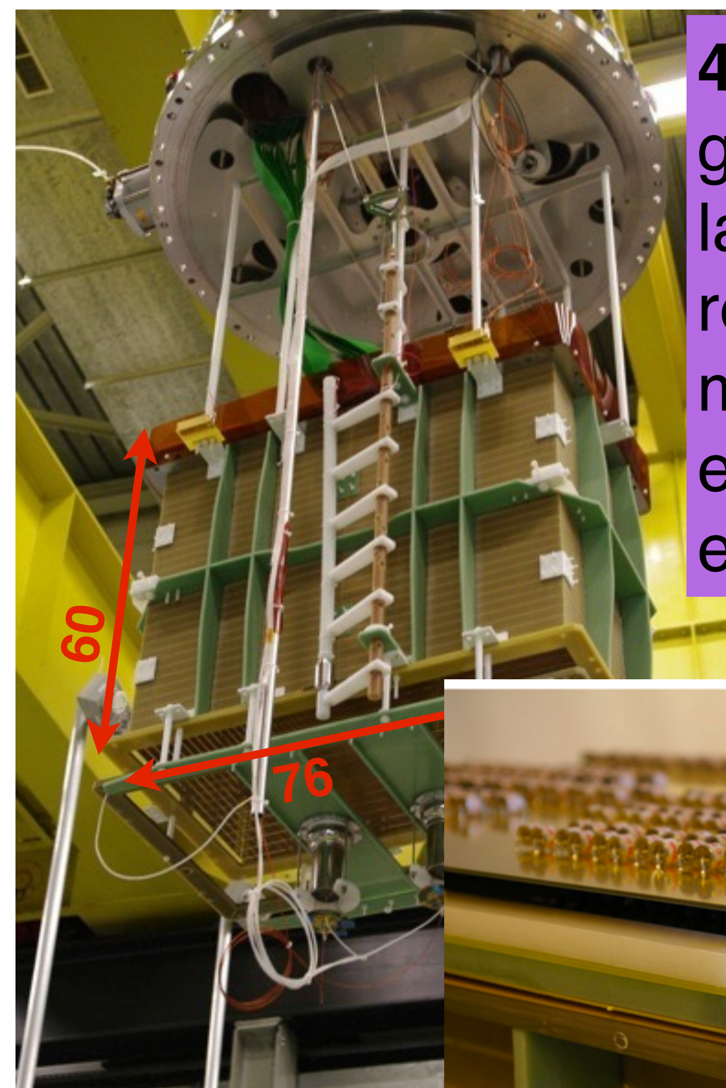
- we want to **amplify** the drifting charges by operating **50x50 cm² LEMs** in pure Argon vapor at 87K with the largest possible stable gain
- we want to readout the amplified charges on **meter long strips** with the lowest possible electronic noise.

A. Badertscher et al. JINST 8 (2013)P04012,

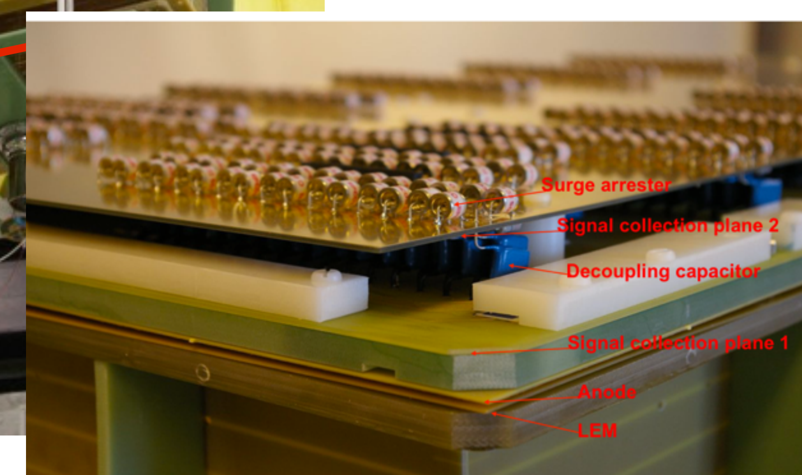


10x10 readouts
many test of different LEMs and anodes.
Gain stability etc..





40x80 readout
gain behaviour on large areas.
reconstruction of more complex events (d-rays etc..)



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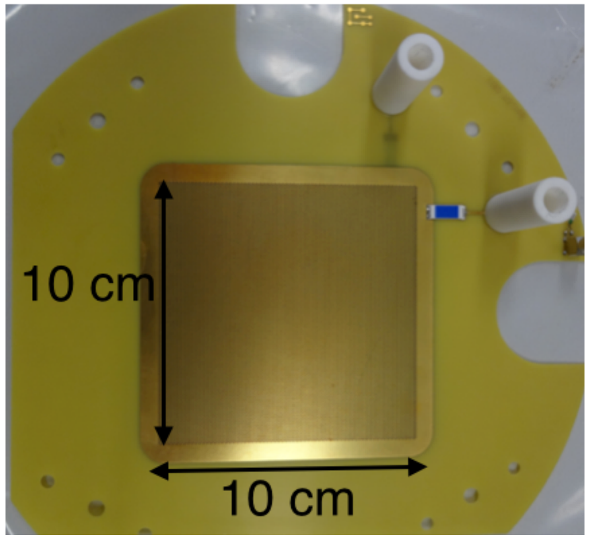
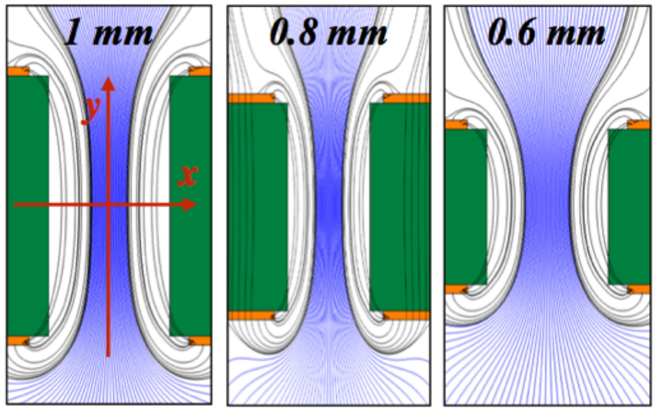
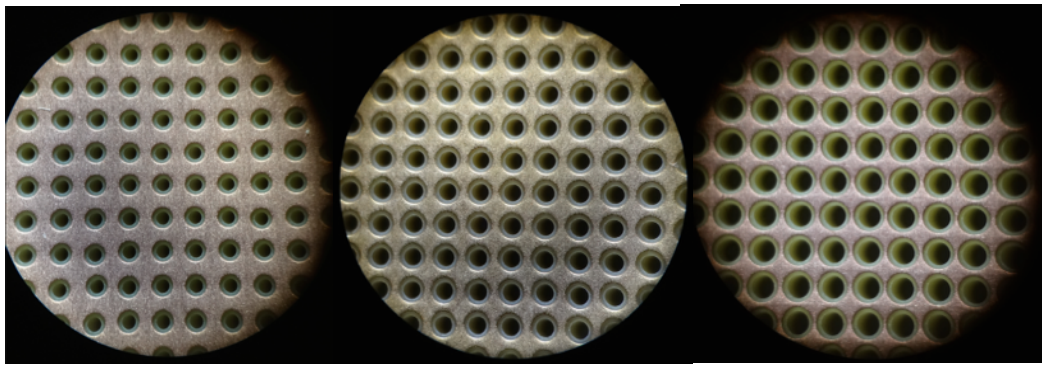
a) LEM optimisation

arxiv 1412.4402 Dec. 2014 (accepted in JINST)

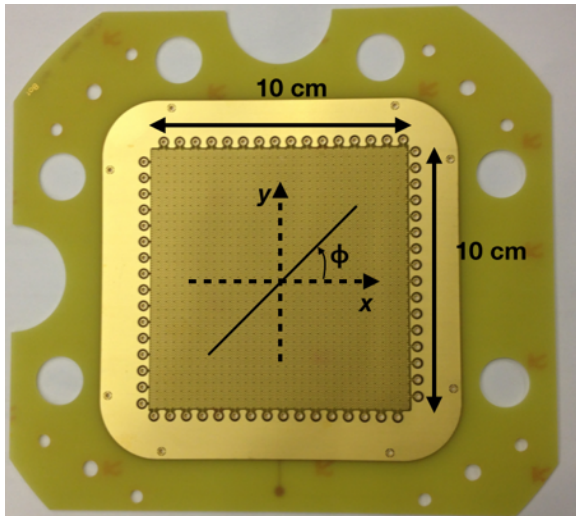


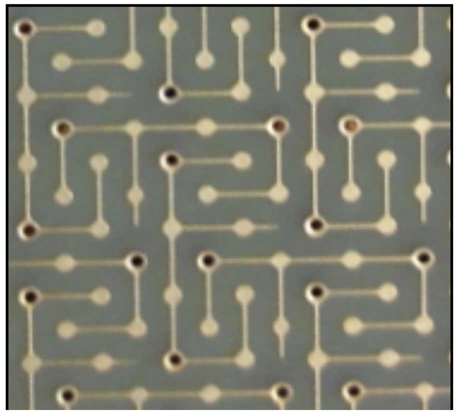




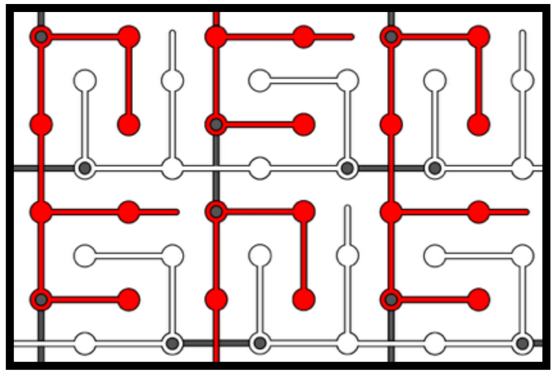
b) Anode optimisation

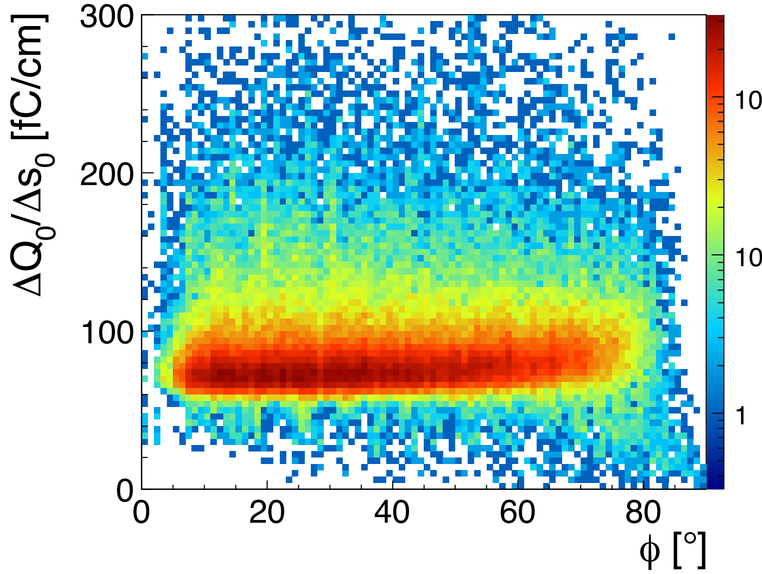
C Cantini et al 2014 JINST 9 P03017





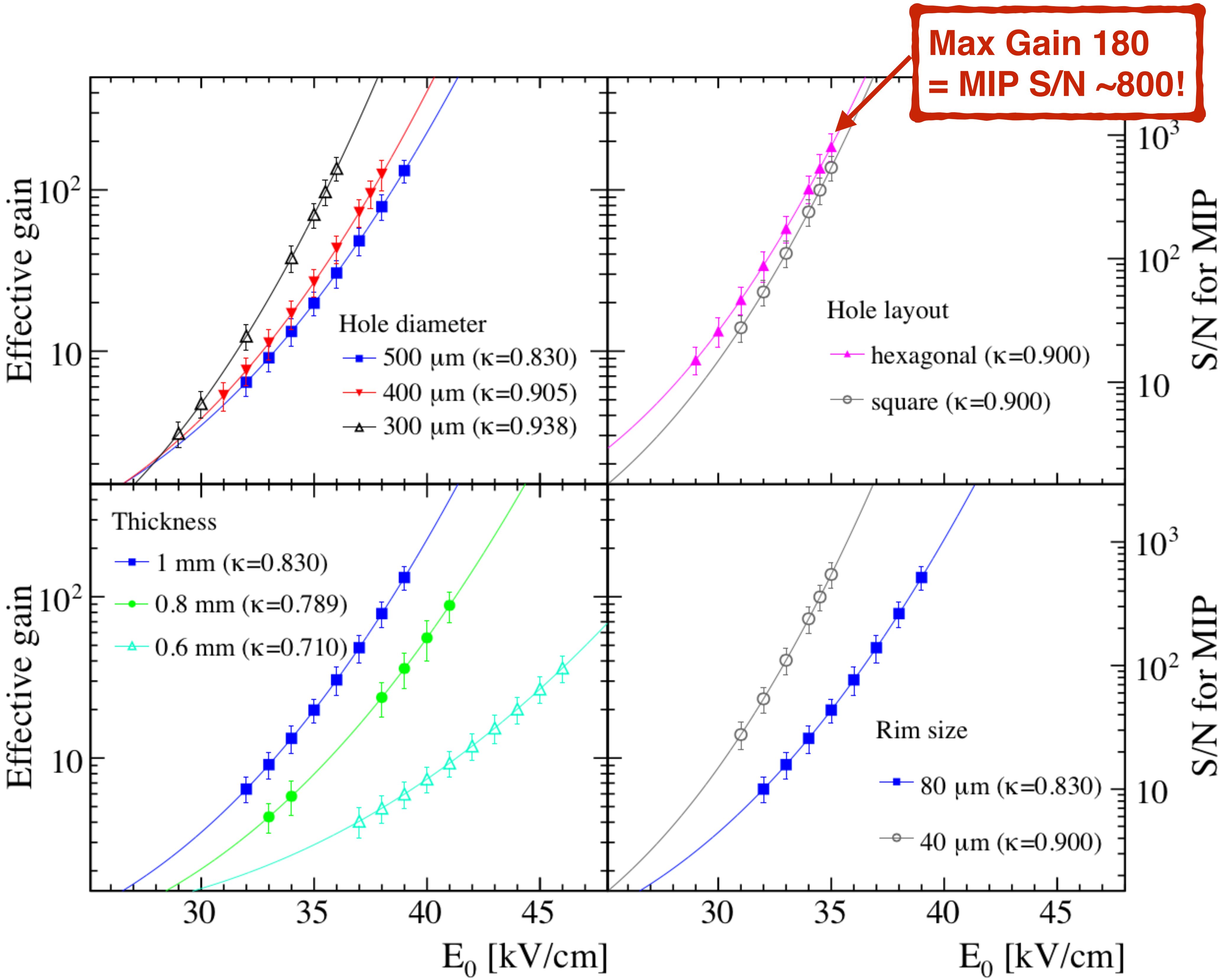
dC/dl ~ 150 pF/m



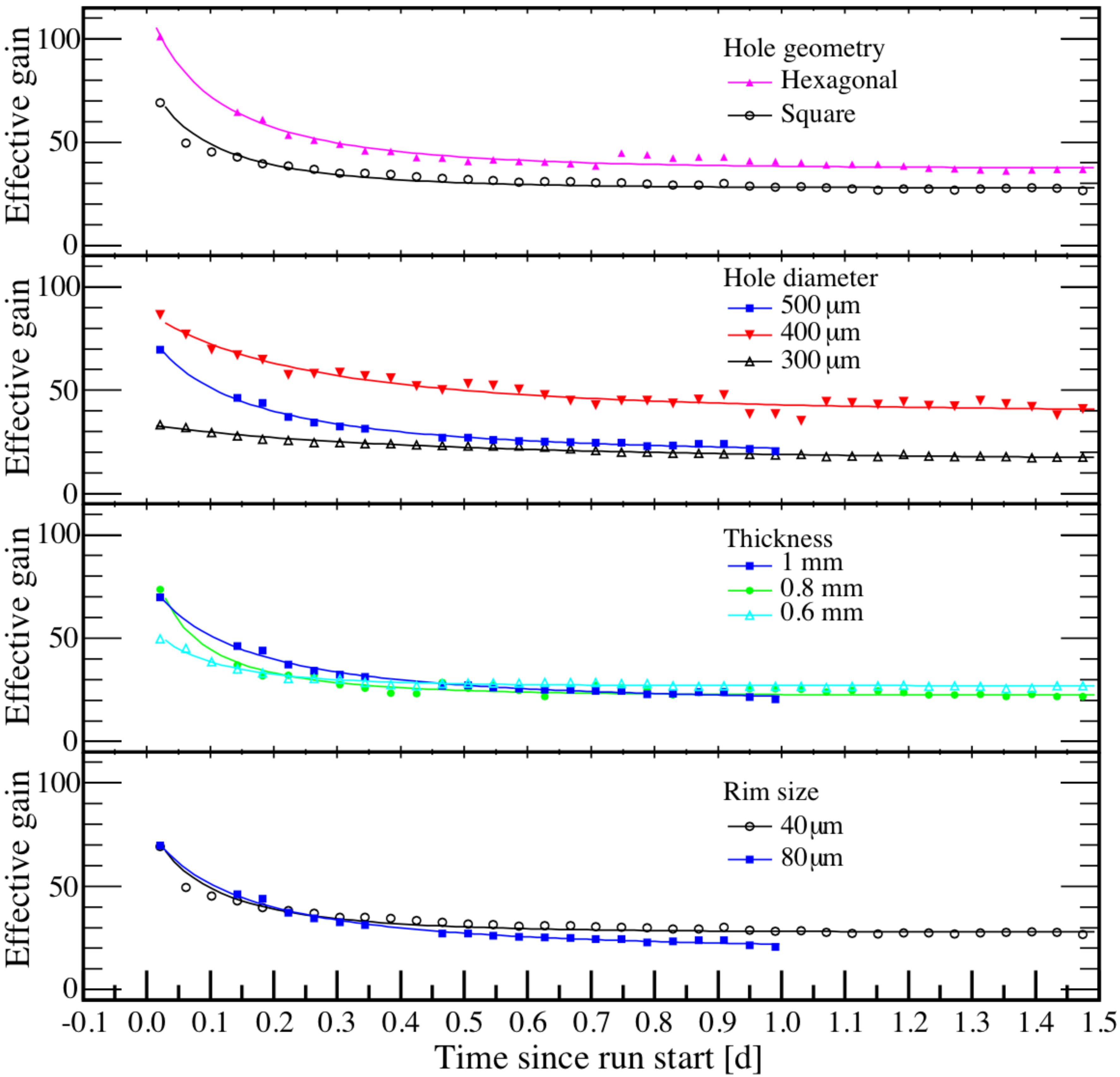


Latest paper on LEM

Fitting function: $G_{eff}(E,\rho,t) \equiv \mathscr{T} e^{\alpha(\rho,E)x} \times \mathscr{C}(t) \quad \alpha(\rho,E) = A\rho e^{-B\rho/E}$



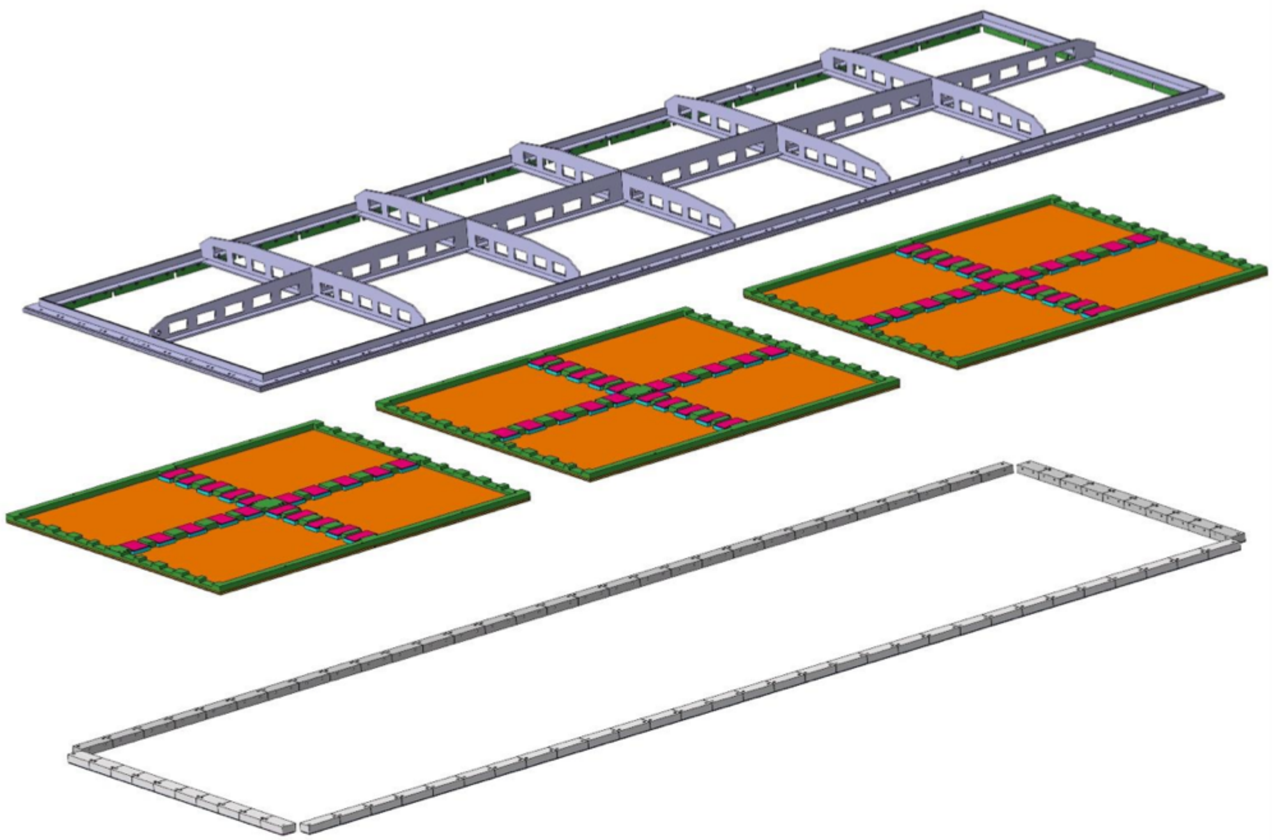
LEM gain stability



the LEMs have different charging up characteristics but all could be **operated stably at gains of at least 20**.

arxiv 1412.4402 Dec. 2014 (accepted in JINST)

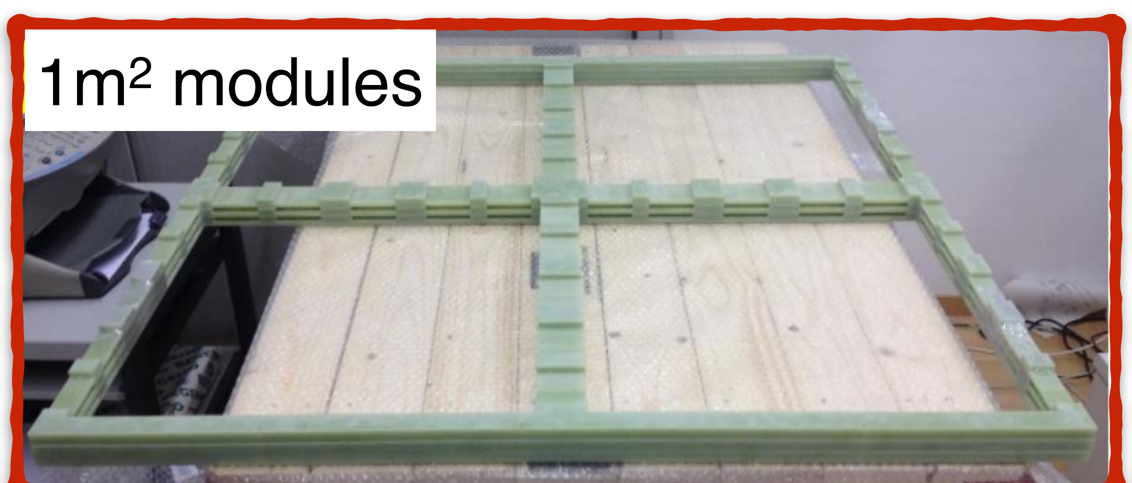
The 3m3 Charge Readout Plane (CRP)



Stainless steel frame

3 individual 1m² modules for anode+LEM

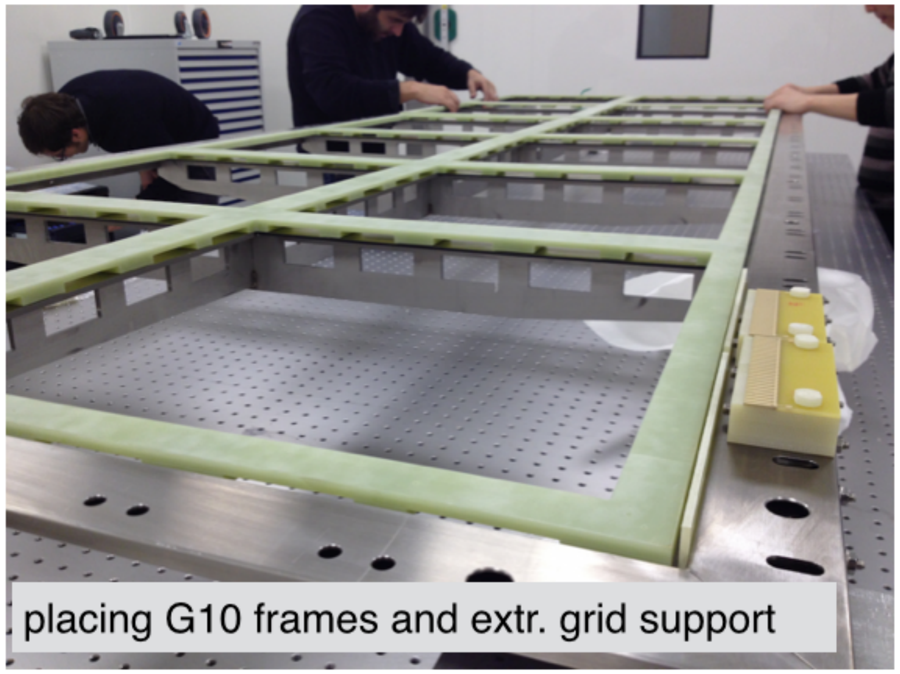
wire holders for extraction grid



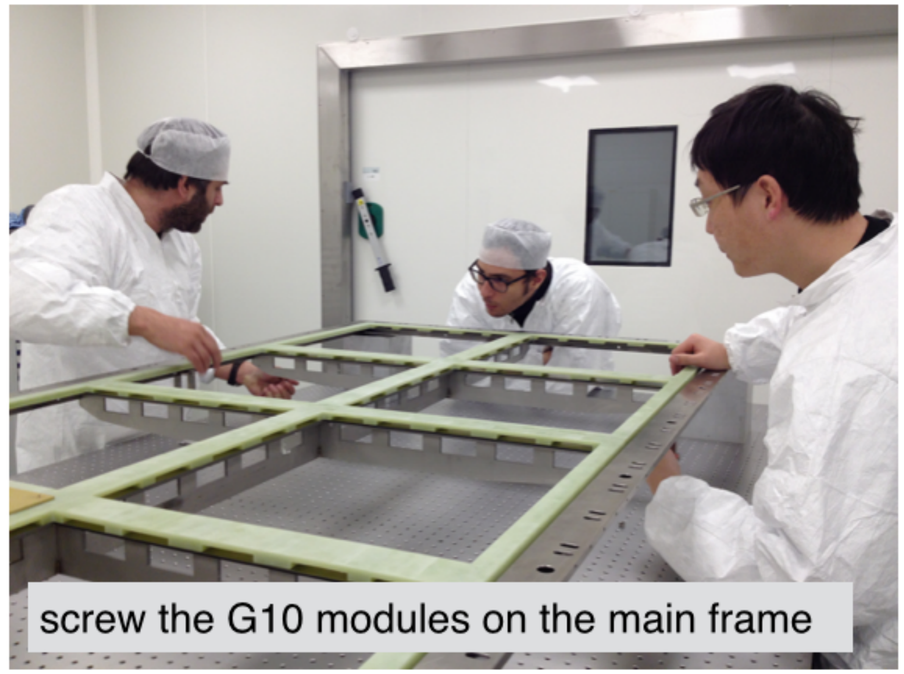
CRP mechanical frame

The CRP mechanical frame arrived in the b 182 clean room in January. Was assembled successfully. First check of flatness, uniformity etc.. looks ok.

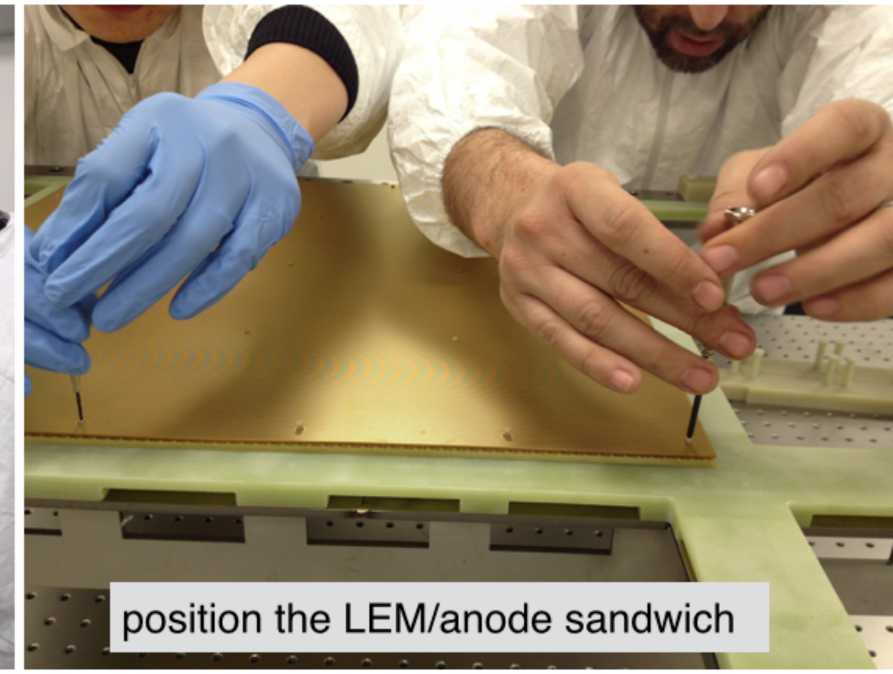
Assembly sequence



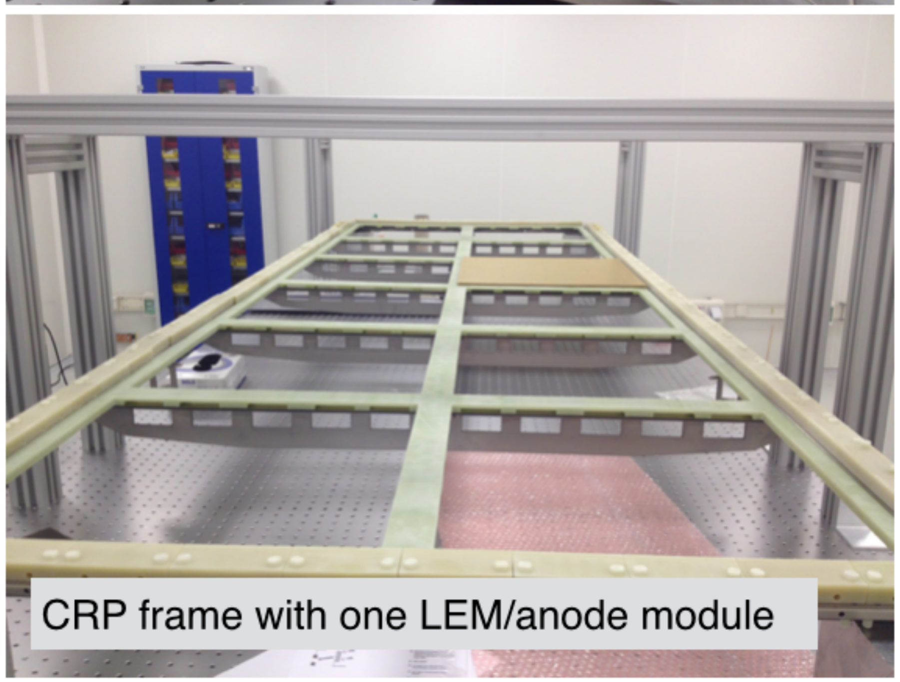
placing G10 frames and extr. grid support



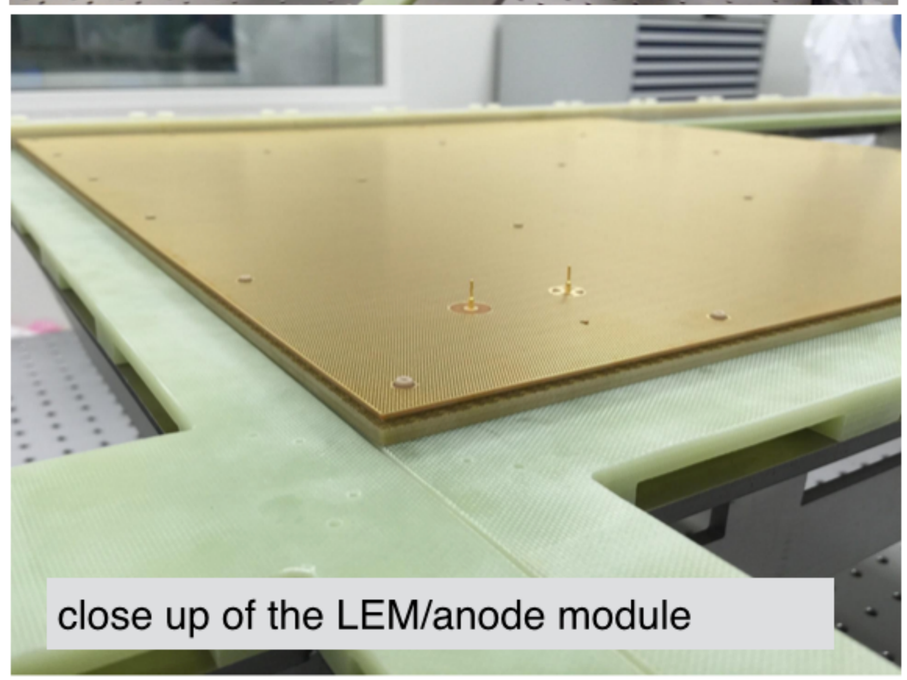
screw the G10 modules on the main frame



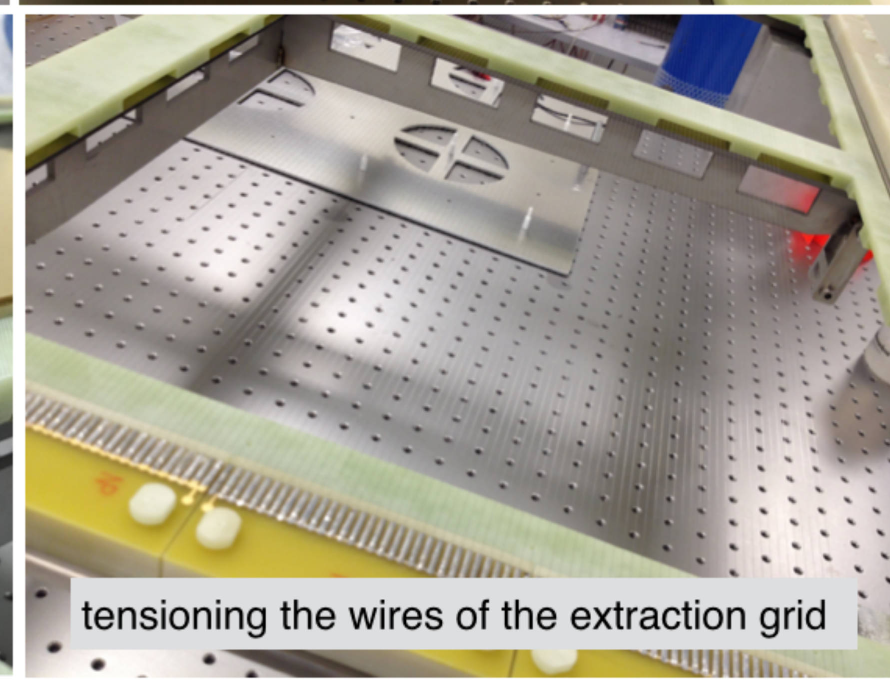
position the LEM/anode sandwich



CRP frame with one LEM/anode module



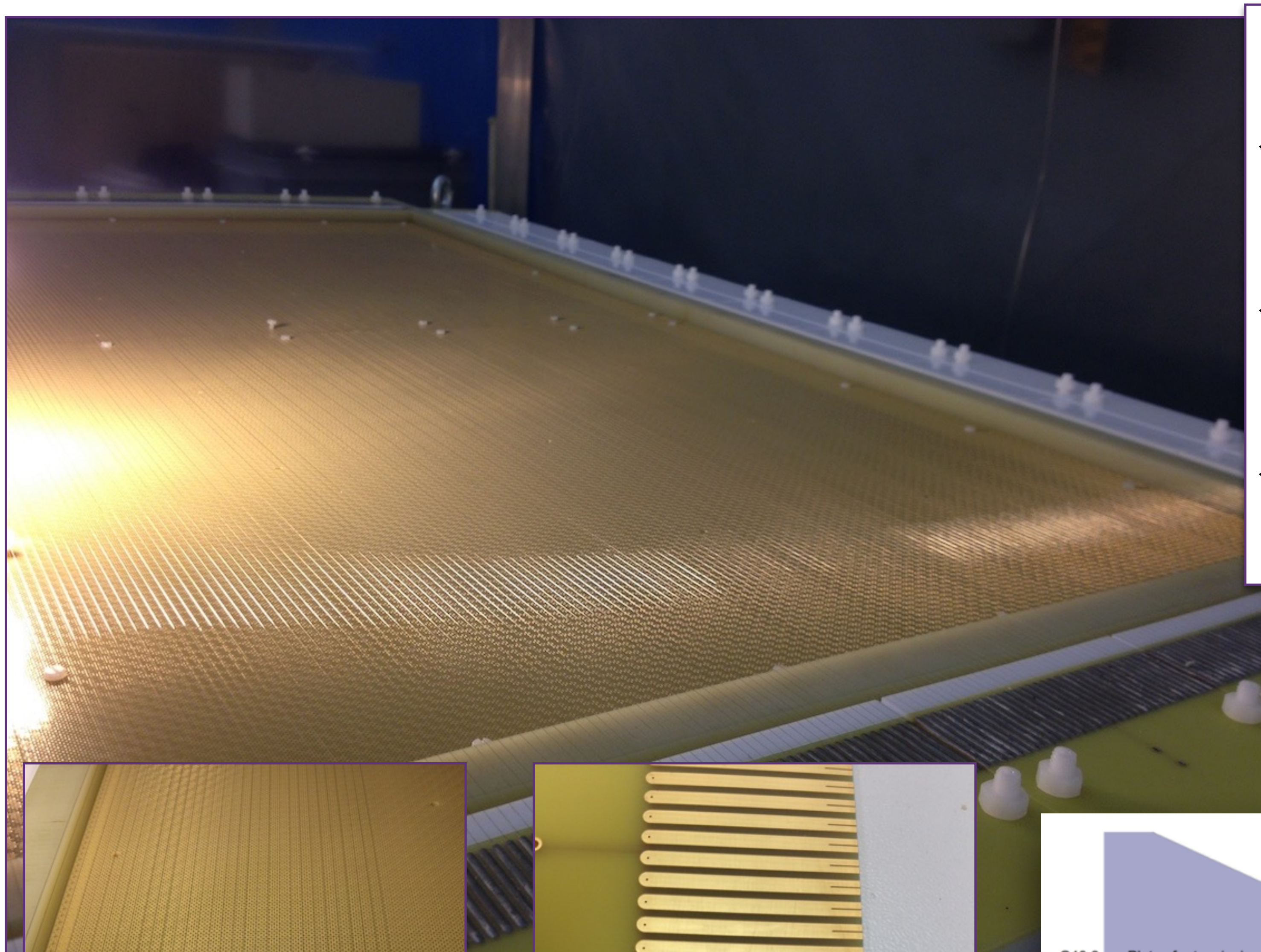
close up of the LEM/anode module

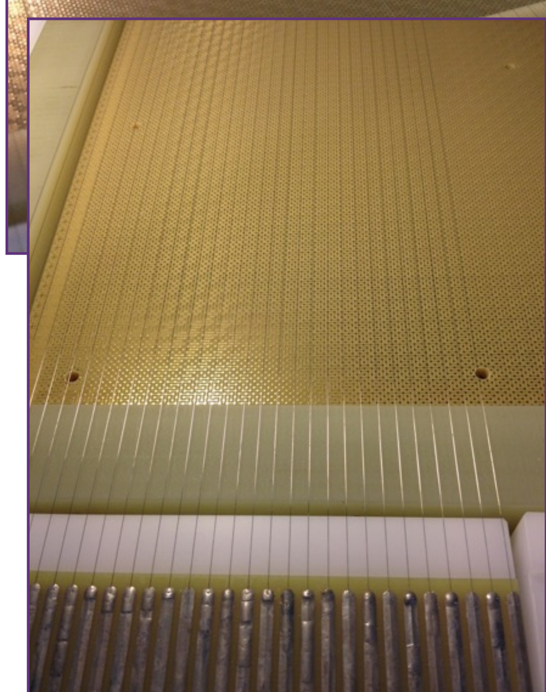


tensioning the wires of the extraction grid

The extraction grid

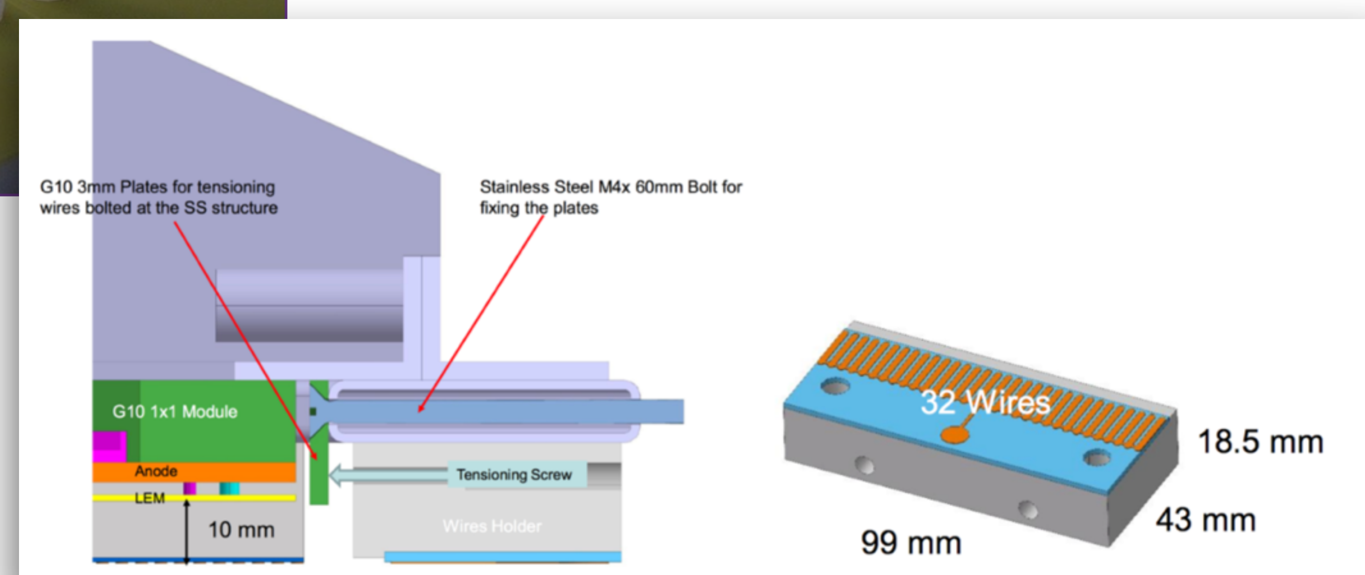
Charges need to be extracted from the liquid to the Ar vapour. Requires 2 kV/cm in the liquid, larger than the drift field of 500 V/cm.





Extraction grid

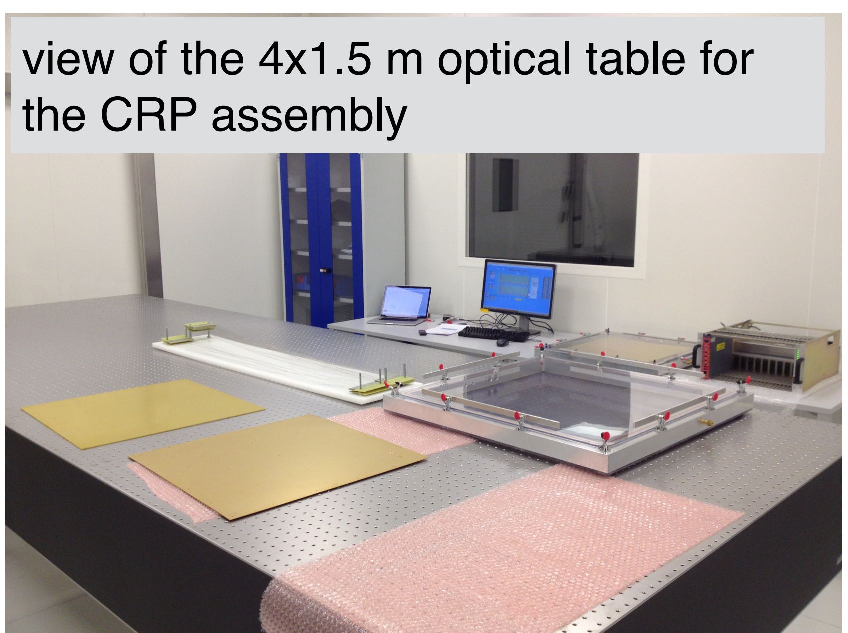
- ✓100 micron stainless wire with 3 mm pitch in x and y directions
- ✓effect on gain uniformity tested in LAr on 10x10 cm^2 readout
- ✓design has been extensively tested on a 1 m^2 prototype.

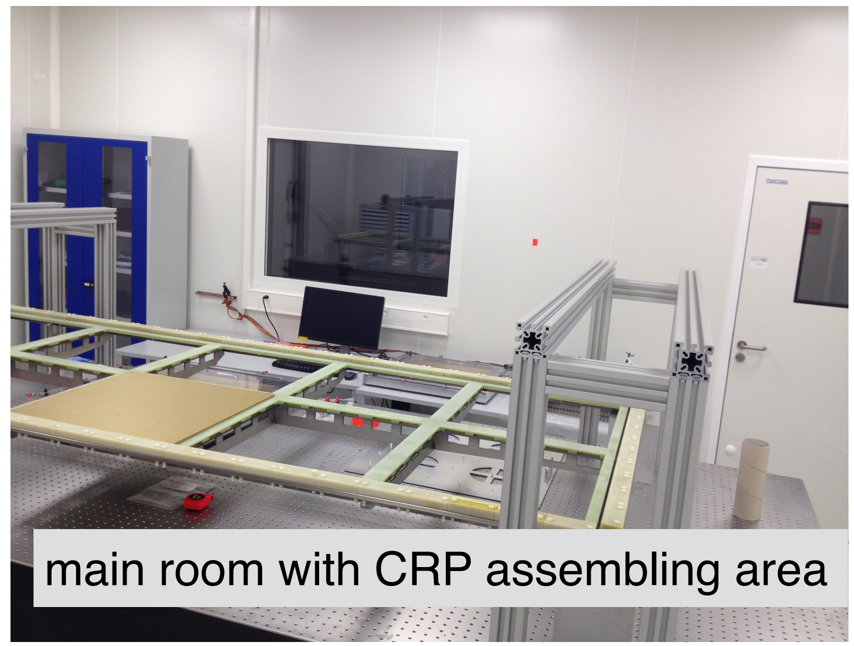


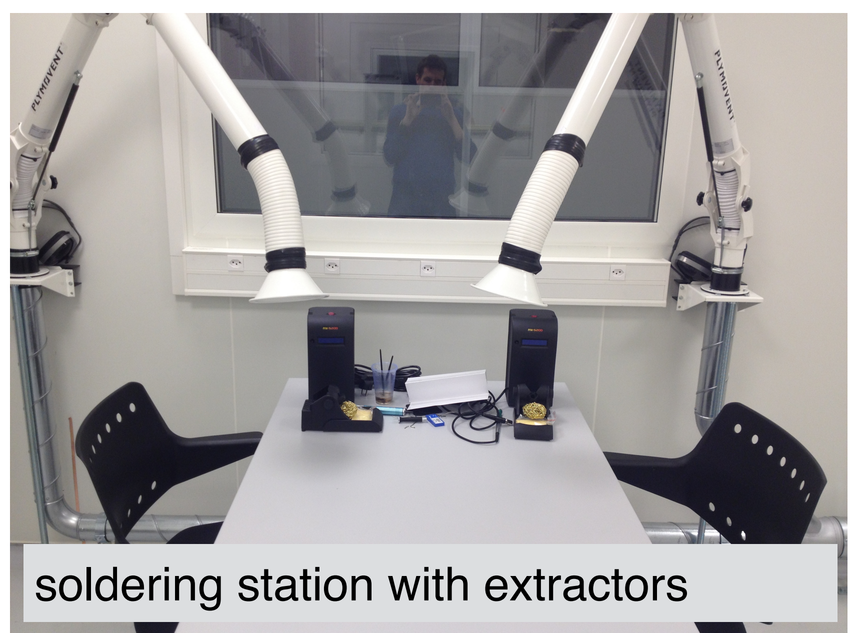
New operational clean room in b. 182

Fully operational with measured better than ISO 8 class.

the clean room inside b. 182


view of the 4x1.5 m optical table for the CRP assembly


main room with CRP assembling area


soldering station with extractors


view of the soldering room

LEM and anode production

LEM

- **1.** Purchase of FR4 (Supplier: Panasonic)
- **2.** Making of the LEM (ELTOS SPA)
- **3.** Soldering HV connectors (CERN)
- **4.** cleaning (CERN)
- **5.** HV testing (CERN)
- **6.** Storage (CERN)

Anode

- **1.** Purchase of FR4 (Supplier: Panasonic)
- **2.** Making of the Anode (ELTOS SPA)
- **3.** inspection of signal continuity (ELTOS SPA)
- **4.** Soldering signal connectors + contact testing (CERN)
- **5.** Storage (CERN)

Anode+LEM

- **1.** Assembly LEM+Anode (CERN)
- **2.** Gain characterisation (CERN)
- **3.** Storage (CERN)
- **4.** assembly on CRP (CERN)

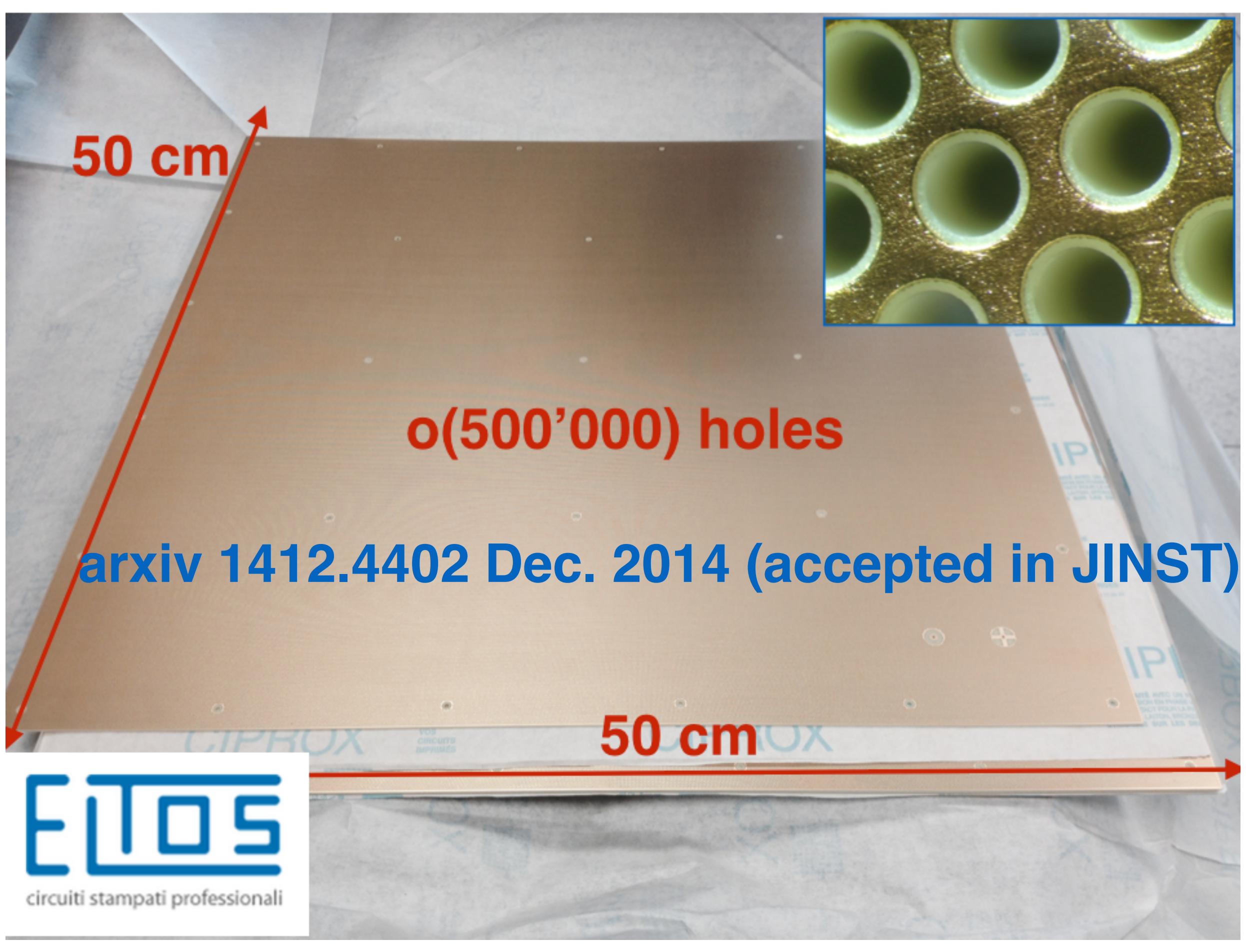
This is the standard procedure that is being also applied to the 6x6m2 CRP.

LEM & ANODE

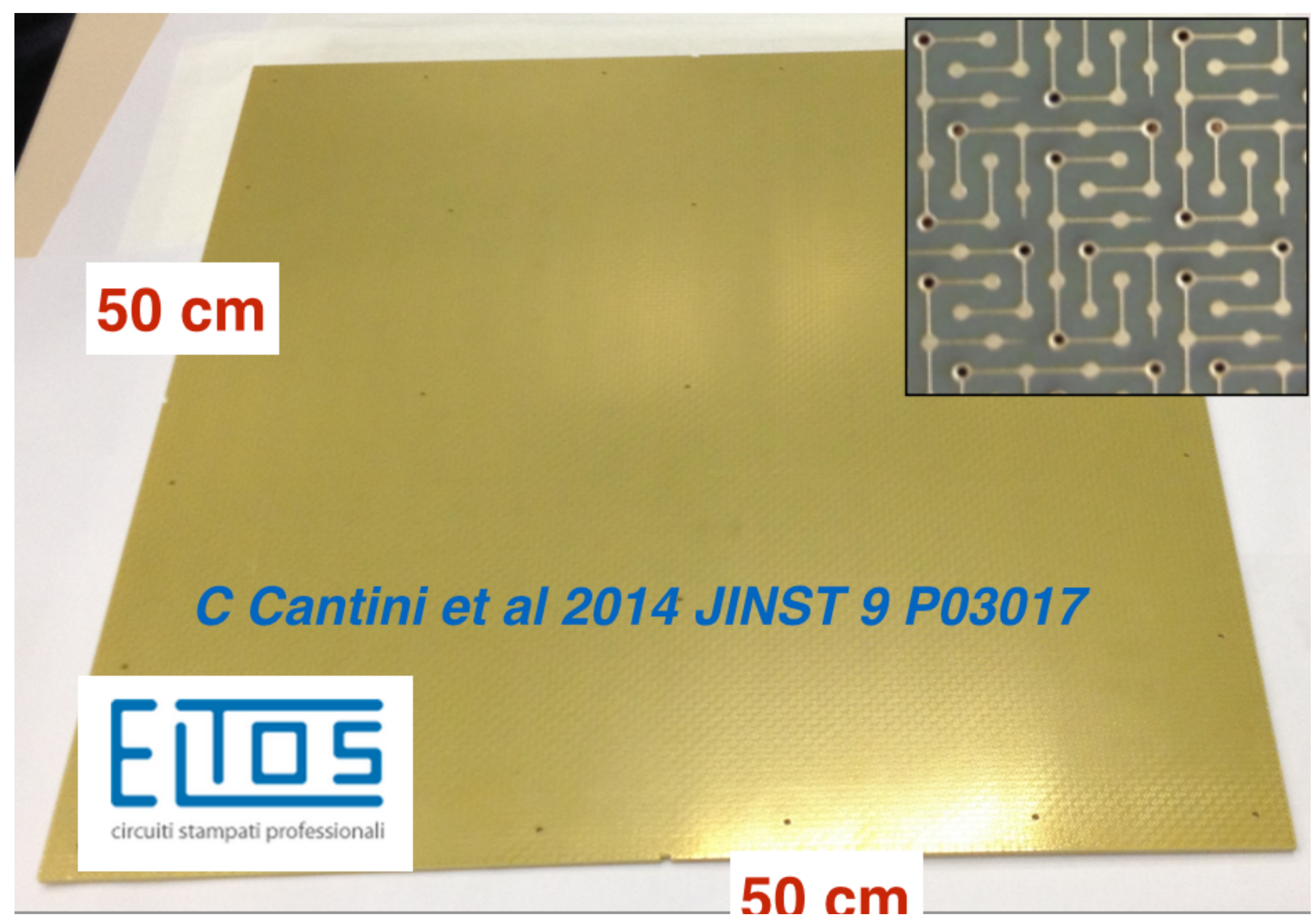
for the 3x1x1 we have ordered 20 LEMs and 15 anodes from ELTOS. We need 12 of each.
LEMs have started to arrive by batch of 5 every week. We already have 10.
Anodes are foreseen to arrive in a few weeks. We already have 2 prototypes.

For the 6x6x6 we will order 150 anodes and 200 LEMs. We need 144 of each. They will arrive by batch of 30 every months.

50x50 cm² LEM

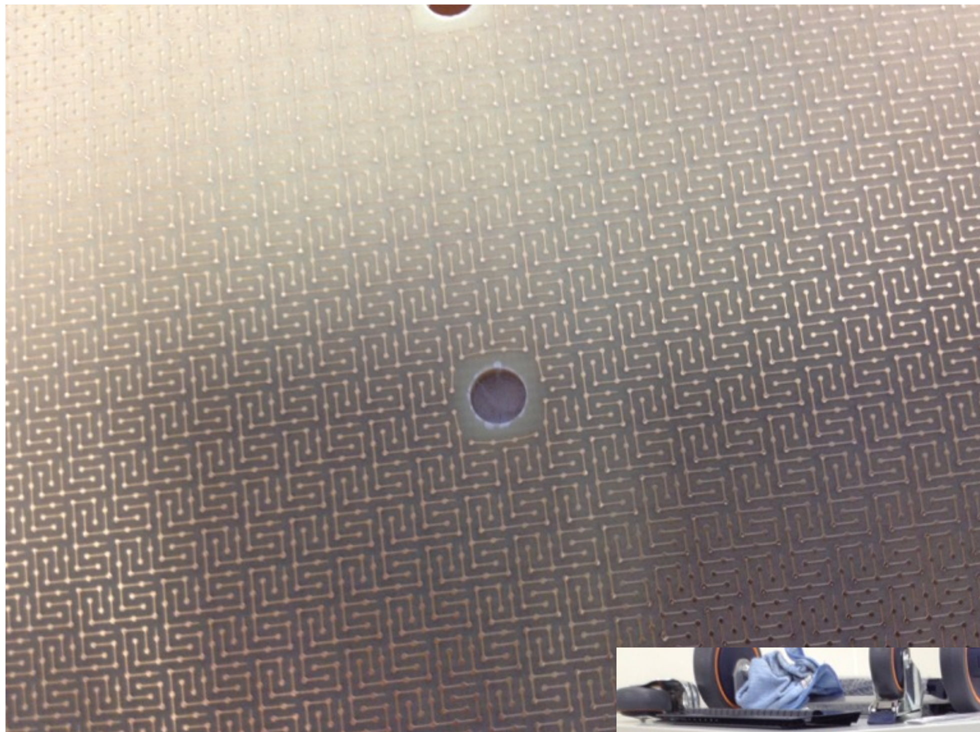


50x50 cm² Anode

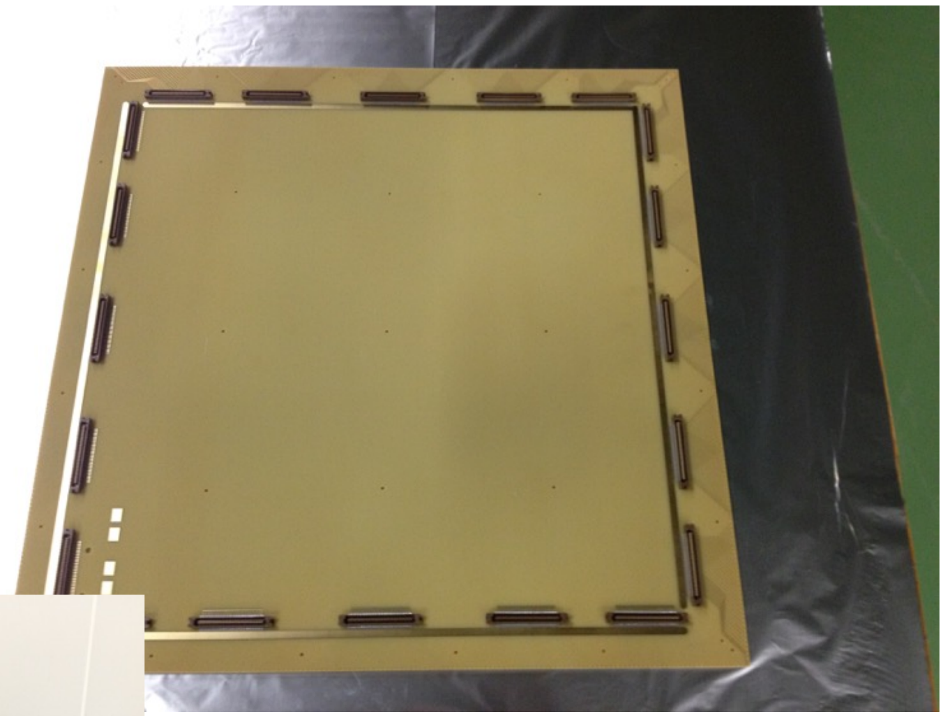


Anode procedure

production & check of signal continuity at ELTOS



soldering of connectors at CERN SMT workshop + check of connection (~2hrs per anode)



Storage in clean room

LEM procedure

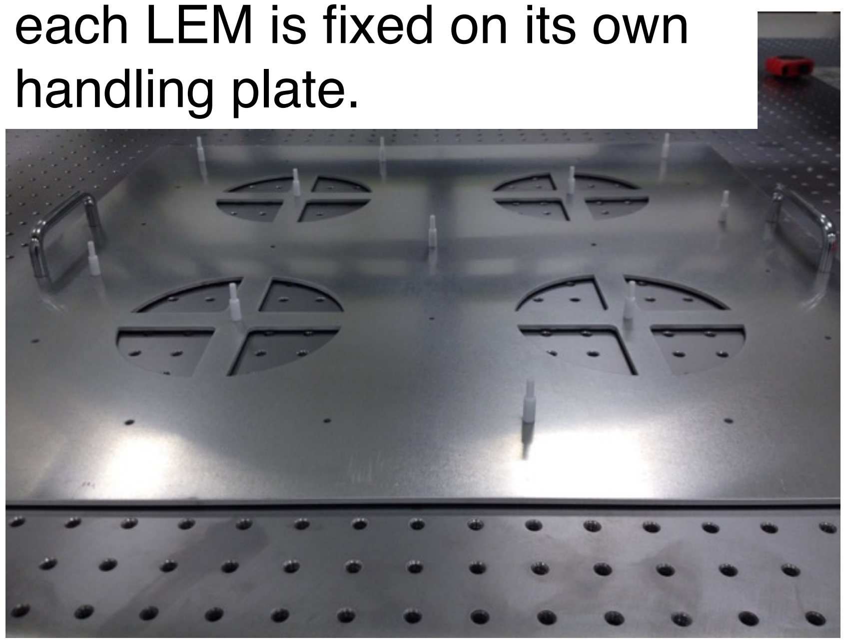
- CNC drilling
- mechanical polishing
- permanganate bath +rince — *removes glass fibber from holes*
- Rims by global etching — *acide sulphuric bath*
- passivation (Chromic acid)
- Ni/Au plating
- lessive (soap) bath at 68°C
- ultrasonic bath DM water — *removes grease*
- high pressure DM water — *removes dust/dirt in holes*
- baking 4h 180°C (only once) or 1hr at 80°C (2nd,… iterations) — *polymerisation of the glass fibber (only 1st iteration) or drying*
- HV test — *goal no discharges at 3.5 kV*
- HV test not ok → back to ultrasonic bath DM water
- HV test ok → storage + test

• at ELTOS: one machine with 6 independent drills each capable of ~7 holes per second. They can drill 6 50x50 LEM in 24 hours. The timescale for the rest of the procedure depends on the organisation of production line.

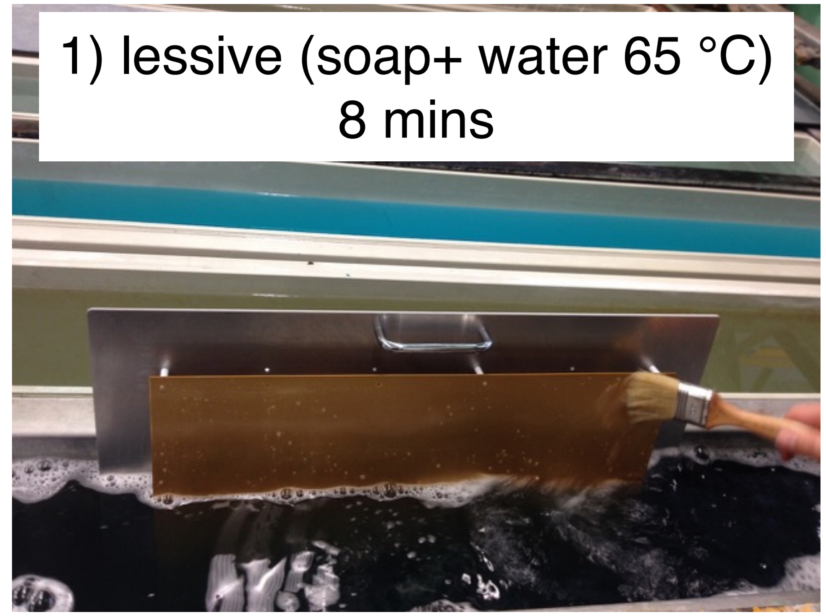
• Cleaning is done at CERN. procedure takes about 6hrs per LEM (mainly due to baking time)

LEM cleaning

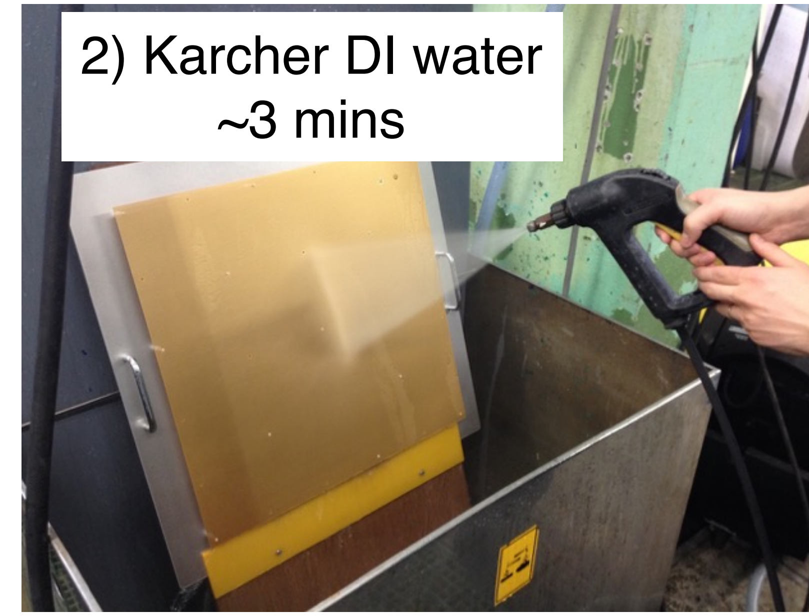
each LEM is fixed on its own handling plate.



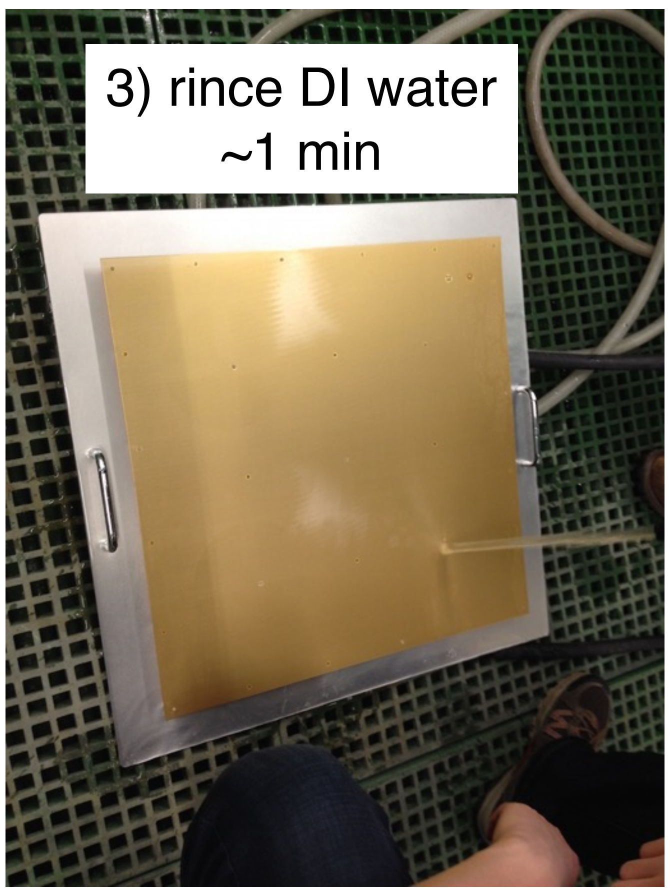
1) lessive (soap+ water 65 °C) 8 mins



2) Karcher DI water ~3 mins



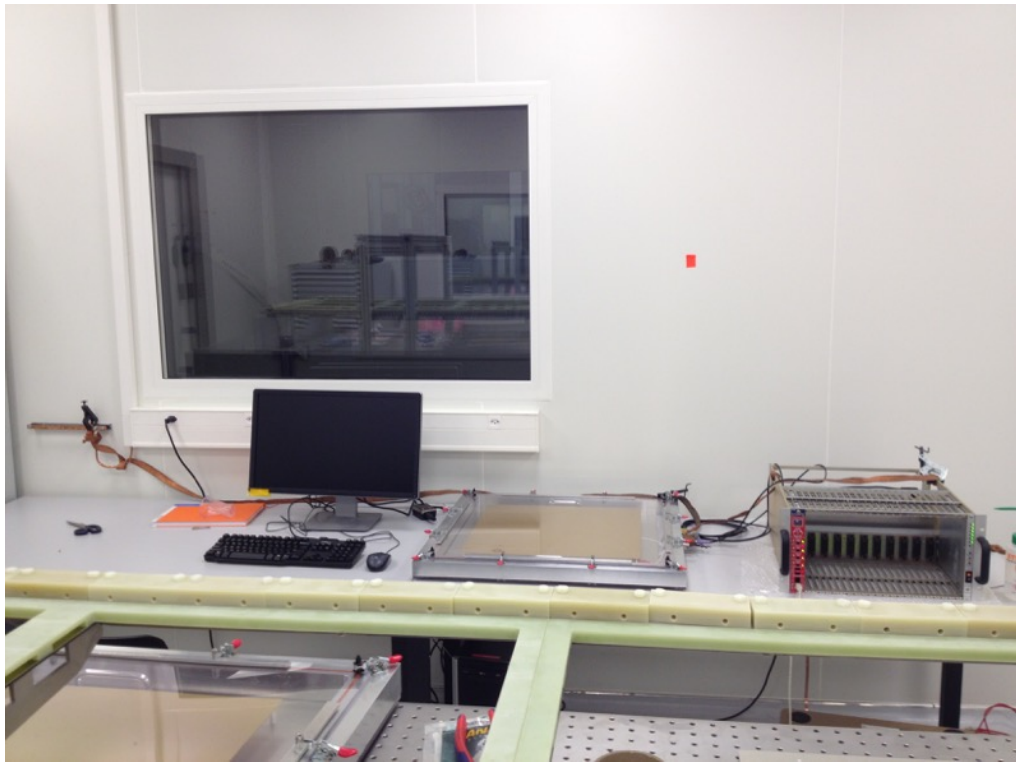
3) rince DI water ~1 min

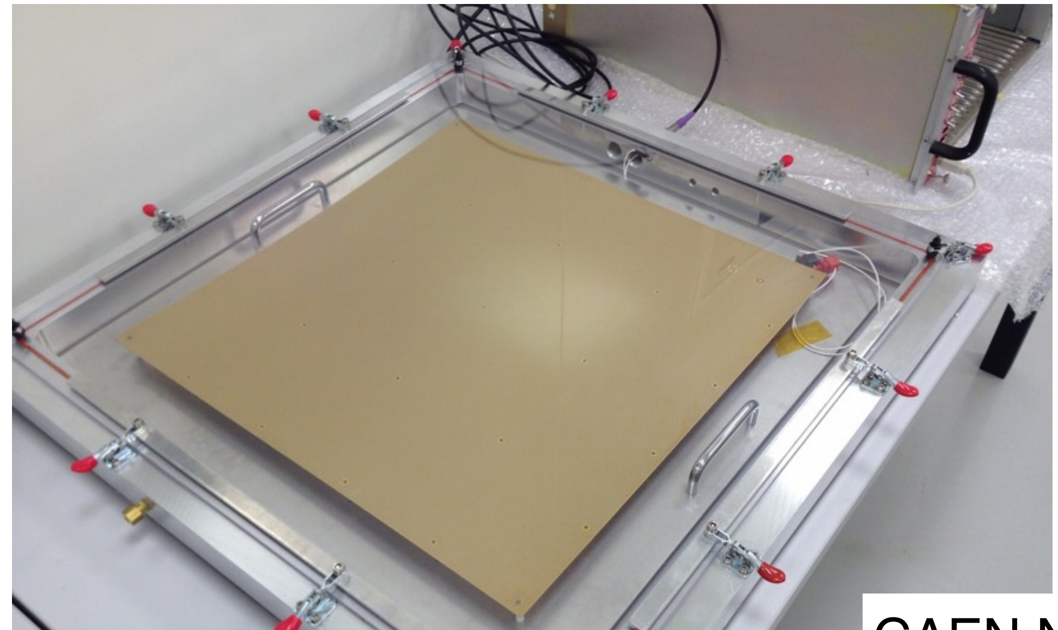


4) U-bath DI Water 10 mins
5) Baking 180 °C 4 hours (only 1st iteration)
6) HV test

7) Storage

Long term HV powering of the LEM

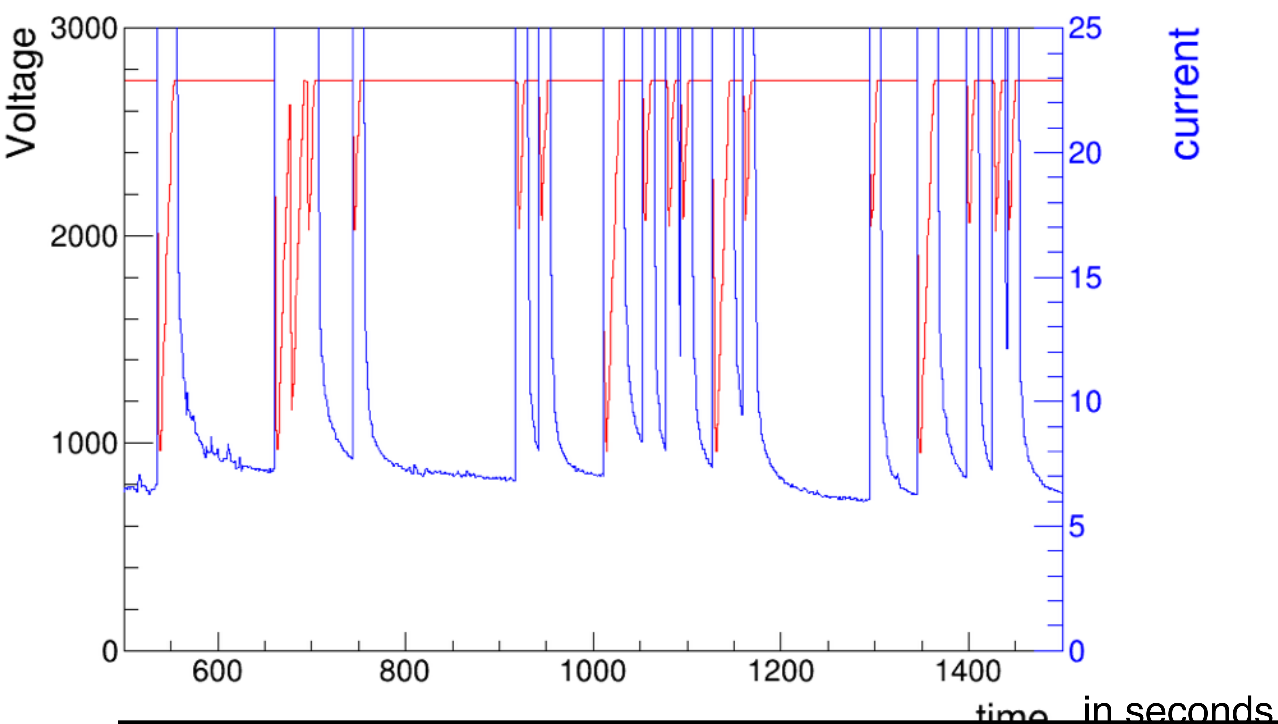




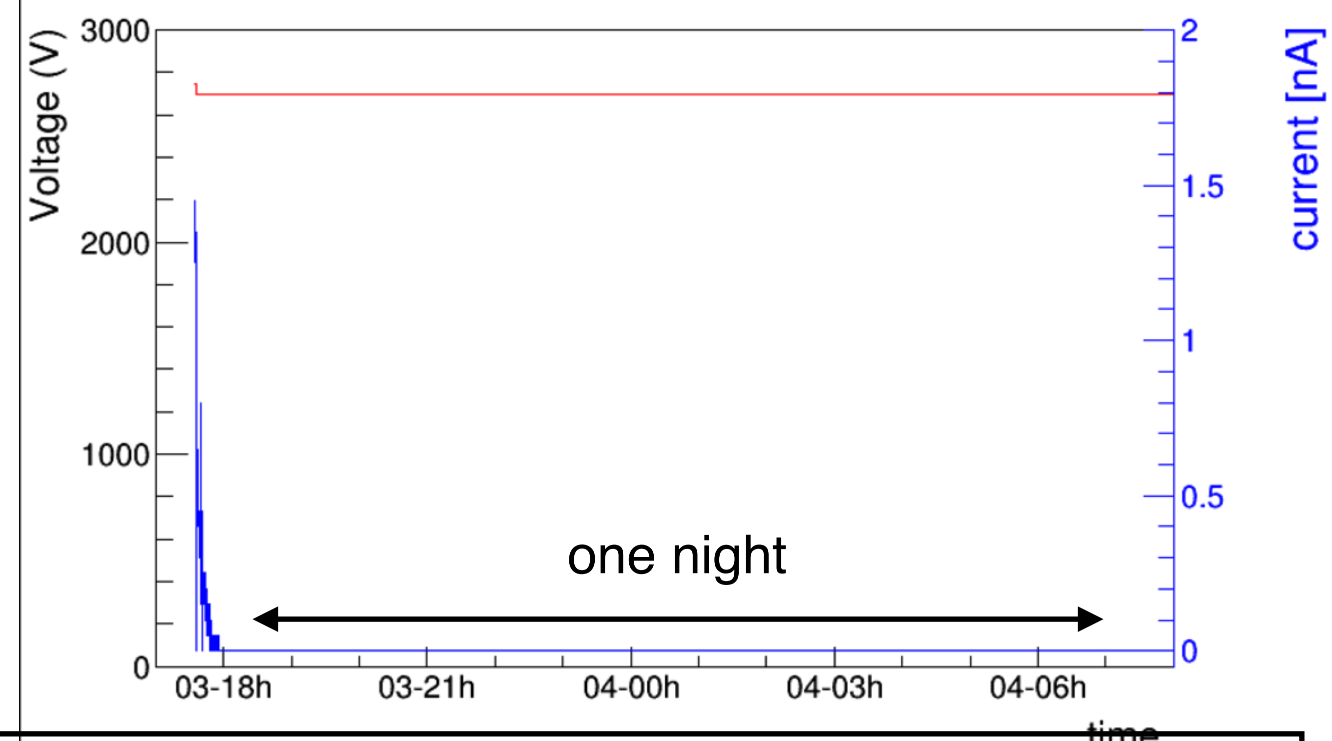
LEM HV testing box.
(no flow of inert gas for the moment)

CAEN N1471H 50 pA current resolution. Labview controllable

before cleaning.



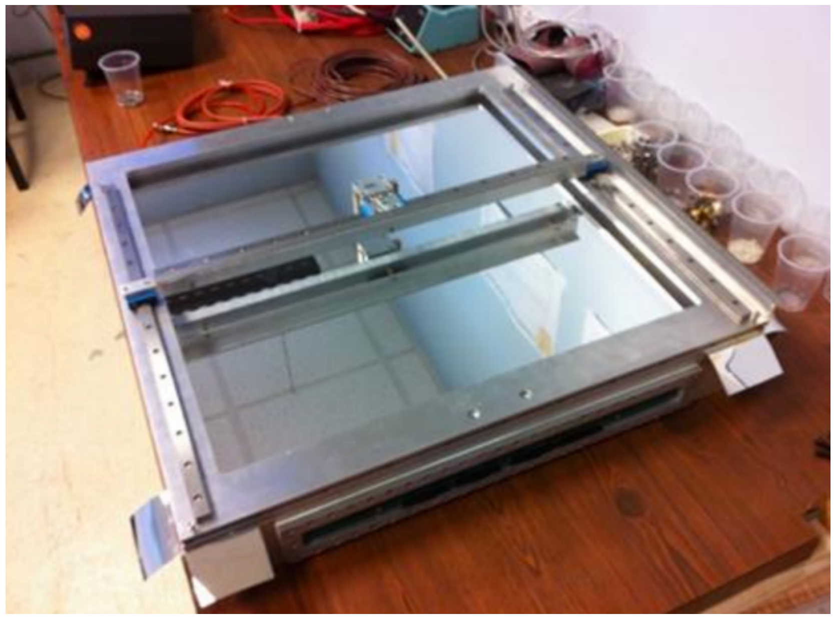
after cleaning.

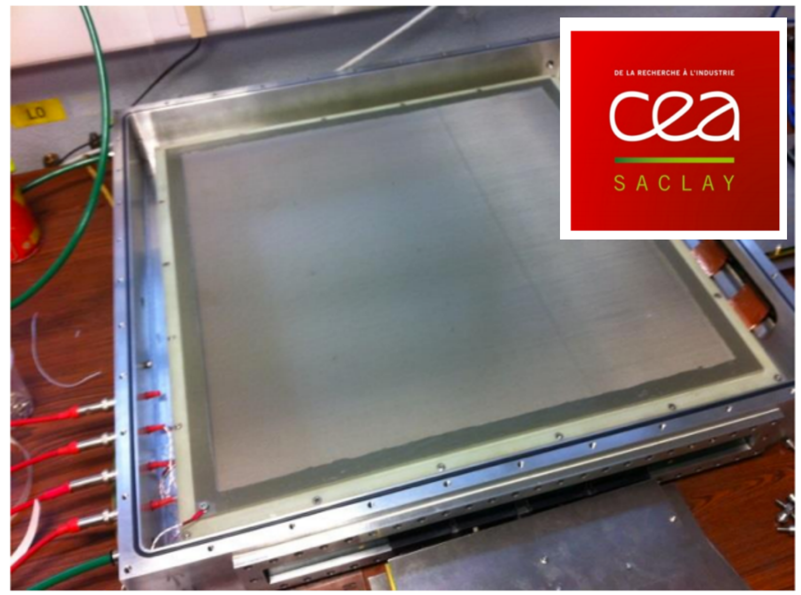


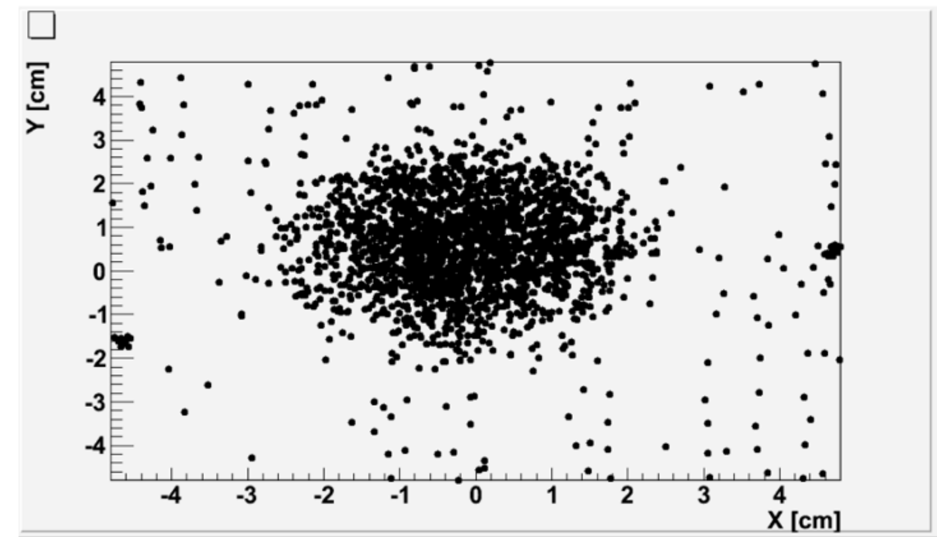
So far we have a LEM that has been for 48hrs at 4 kV (40 kV/cm field). With few sparks. Sparking rate clearly decreasing with time.

Gain characterisation

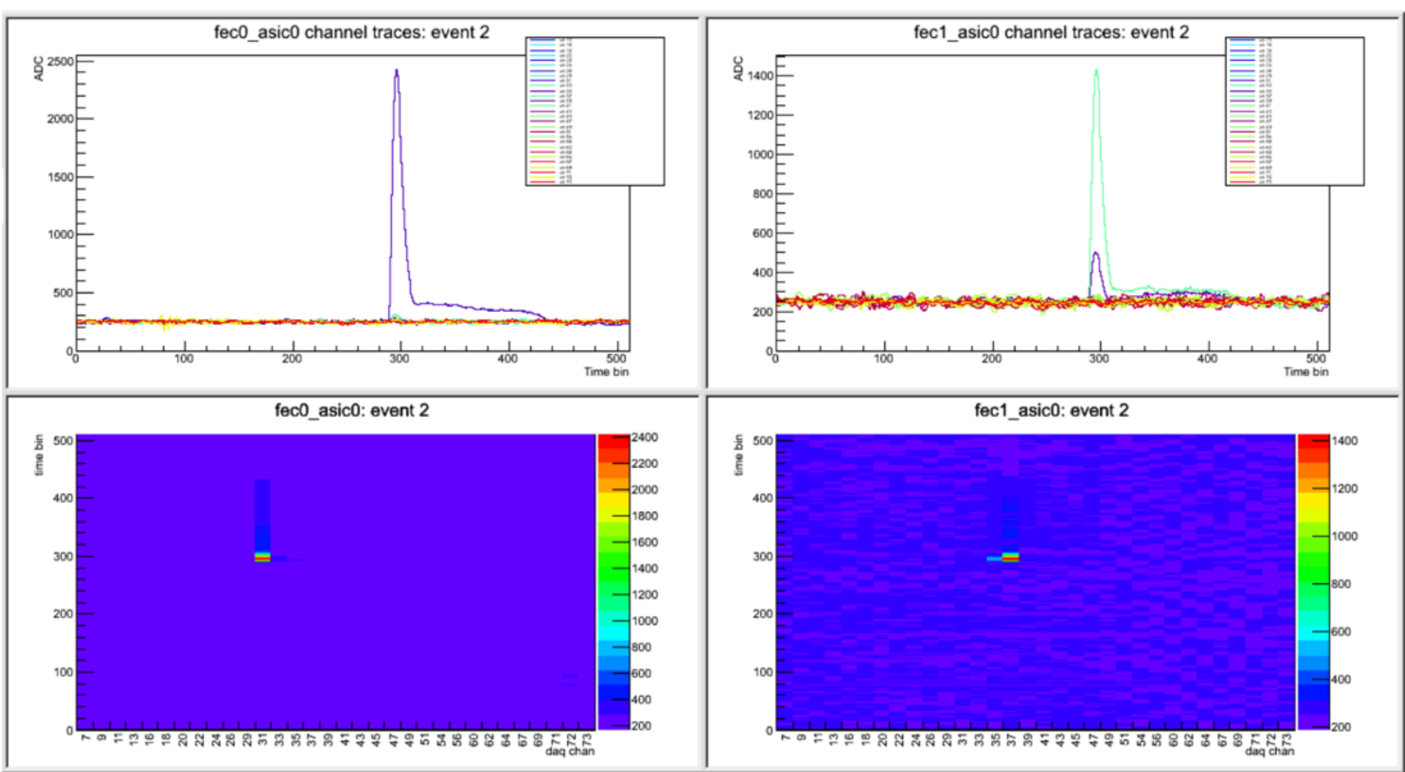
Characterisation of the LEM gain with a ^{55}Fe source in warm gas (Ar:Isobutane 95:5)
Here example of results on a 10x10 LEM

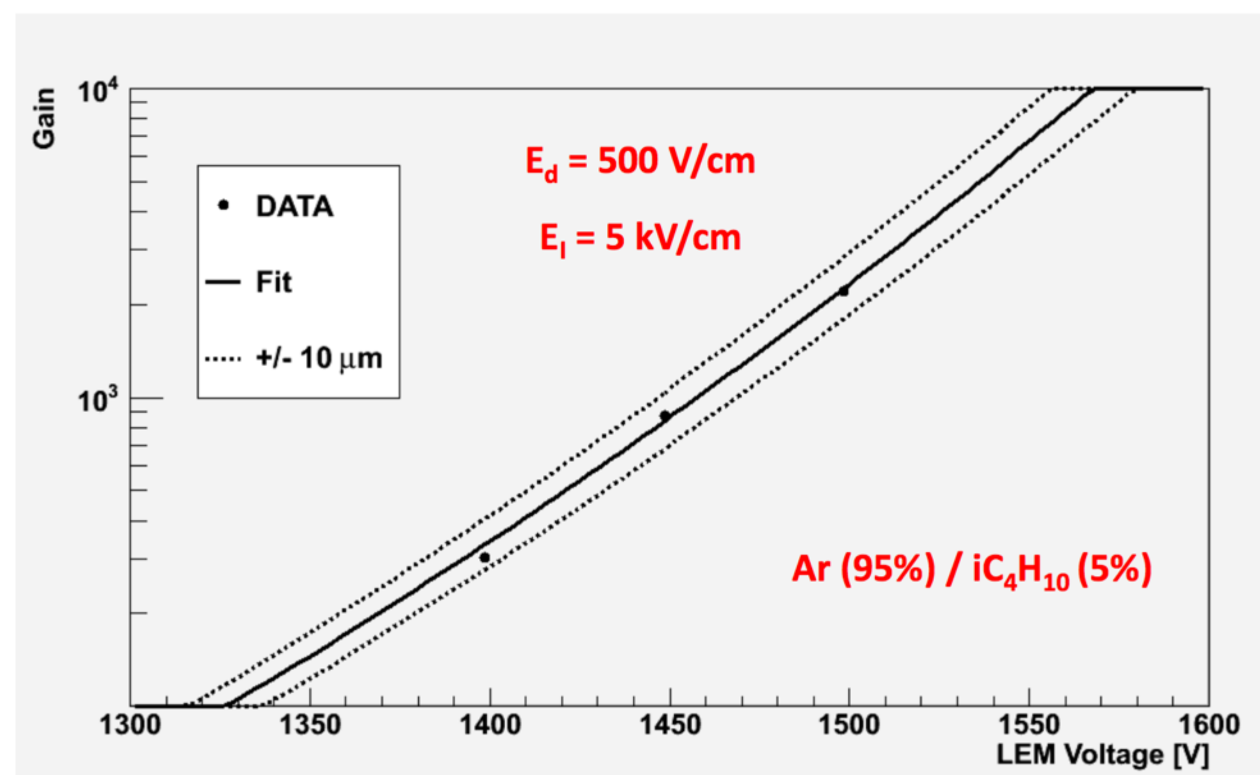






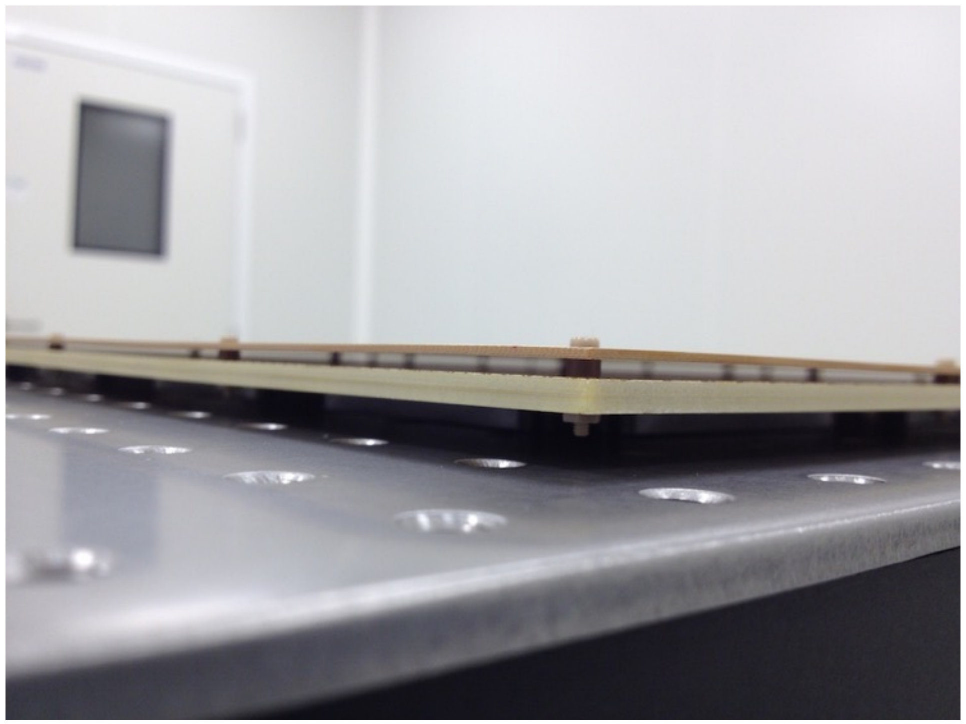
E_{LEM} = 15 kV/cm, E_d = 500 V/cm

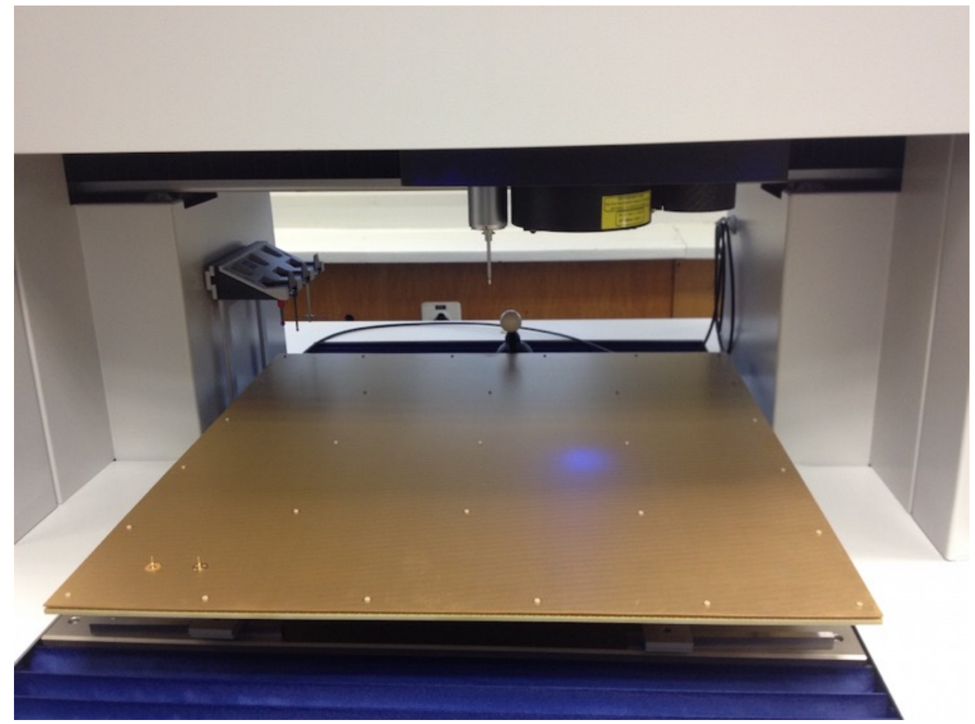


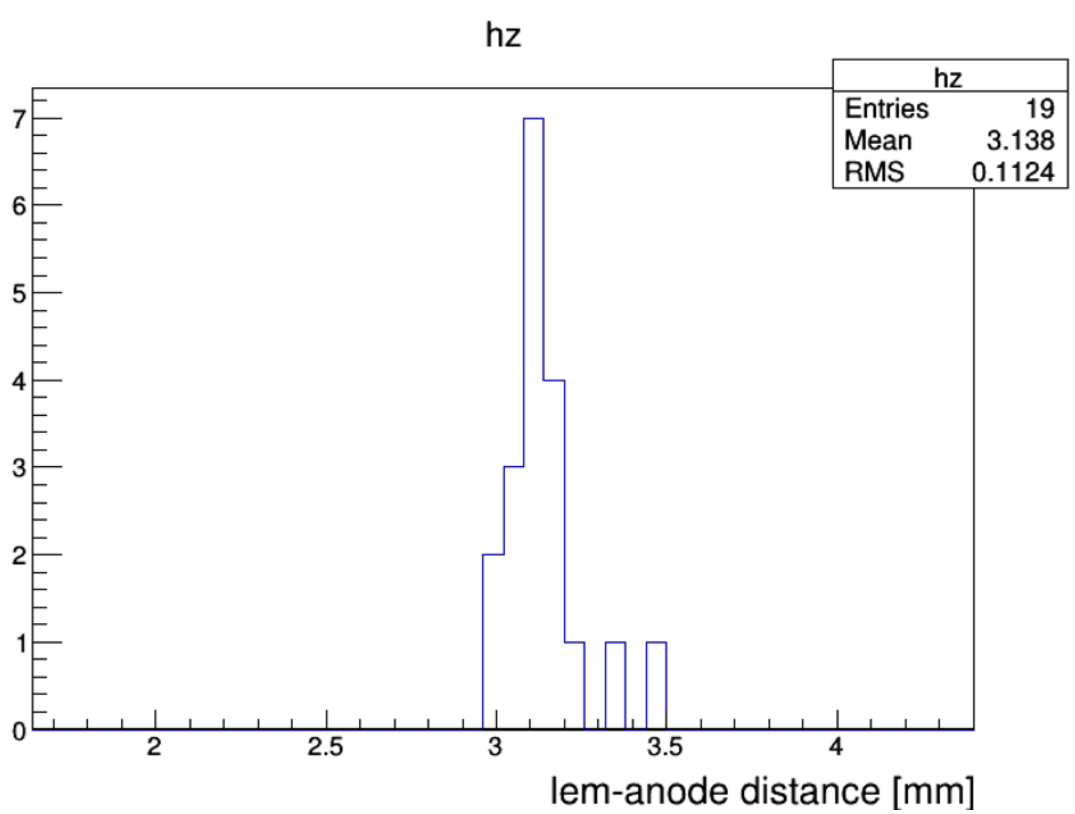


LEM + anode sandwich distance

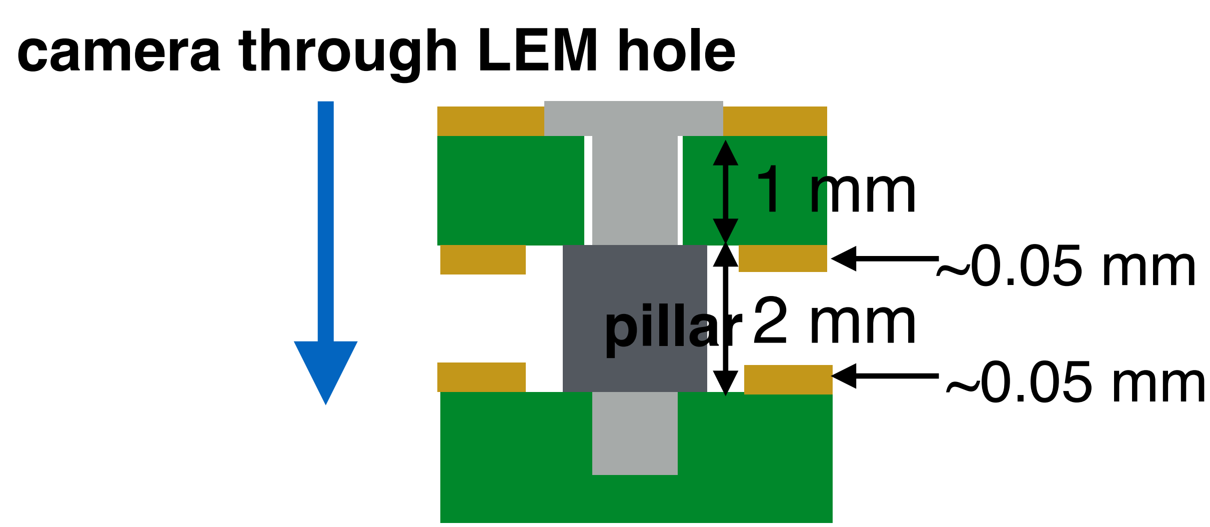
distance between LEM & anode should be kept constant since it affects the gain. Here we had one module surveyed at the metrology lab. Planarity is within ~100 microns which is very acceptable in terms of gain variation (< 5 %).







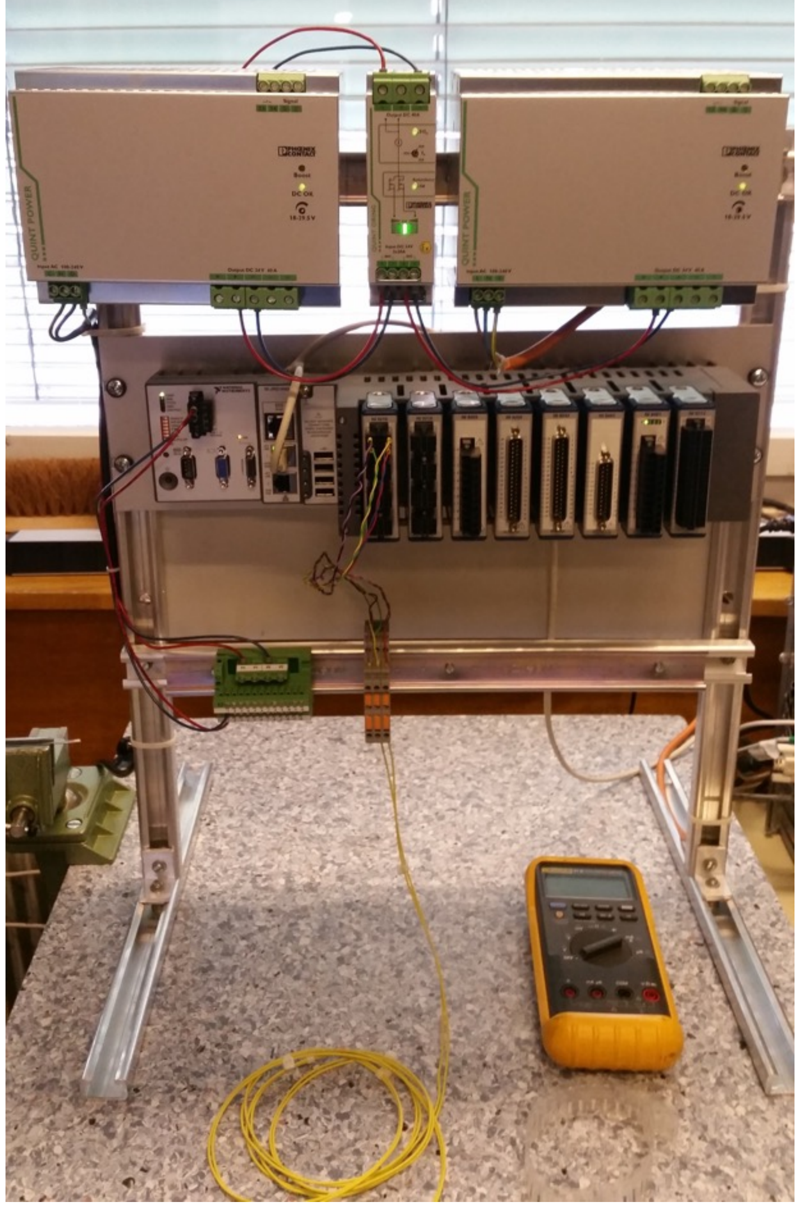
nominal ~ 2 (LEM-anode) + 1 (LEM thickness) + ~.05 mm ≈ **3.05 mm**



Slow Control

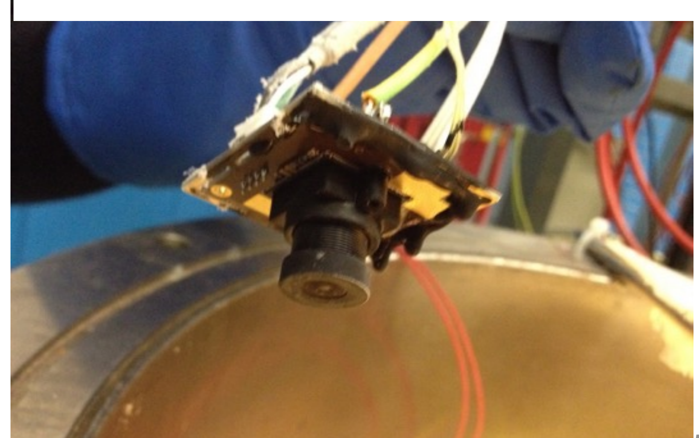
We have a range of sensors to be tested and calibrated (Pts, strain-gauge, cryo-cam, heaters, HV etc..). We use the NI compact-RIO system present on already many CERN experiments.

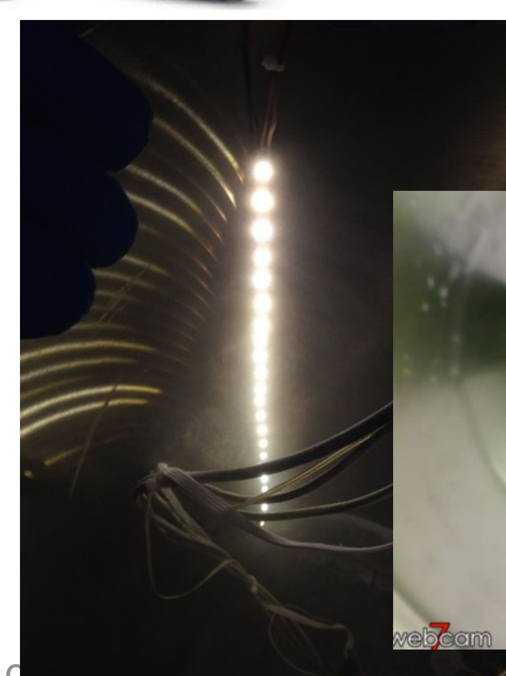
Testing of NI modules has started in collaboration with Gilles Maires (PH-DT)



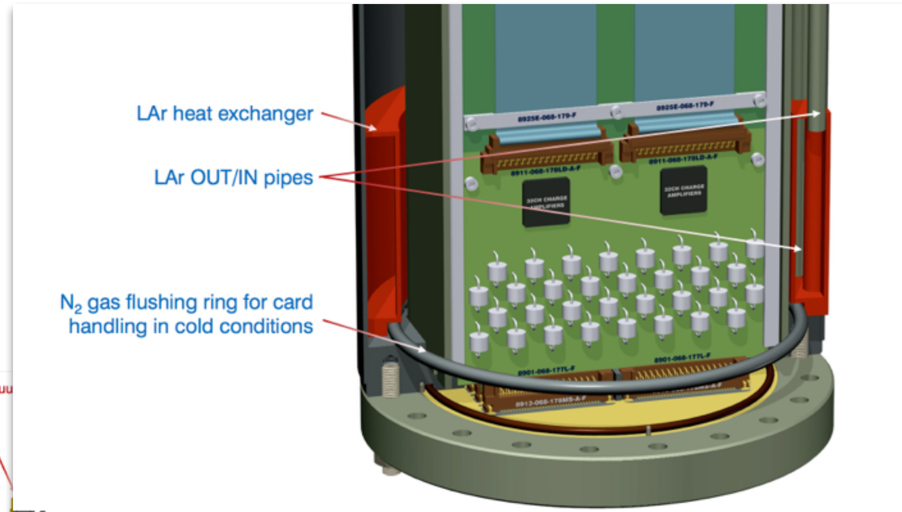
	Sensor	# Sensors	Range	Res.	# pins on FT flange	Electronic Interface	# NI module	PVSS
Temperature	Pt10K	80	80-300K	0.1 K	256 D-SUB 50	-	28 NI9219	PCS Remote IO
	Pt1K	24						
Pressure	Keller PAA-21Y	8	0-2 bar	10E-05mBar	Dedicated plug	EV 06 Keller Display 4-20 mA	1 NI9208	PCS Remote Monitor
Liquid Argon level	coaxial	2	all the drift length	T.B.T (below 100 um)	26 SMA	Self made electronics 4-20 mA	2 NI9203	PCS
	parallel plate	11	2 cm					
Strain Gauge	350 ohm	24	? To be understood ?	T.B.T	96 D-SUB 50	Full Bridge	6 NI9237	PCS Remote IO
[illegible]	[illegible]	[illegible]	visible range, 1Pt	few cm	10 pin each	USB	Real Time Controller	PCS
					20	-	3 NI9481+PSU	PCS
					-	-	1 NI9203	PCS

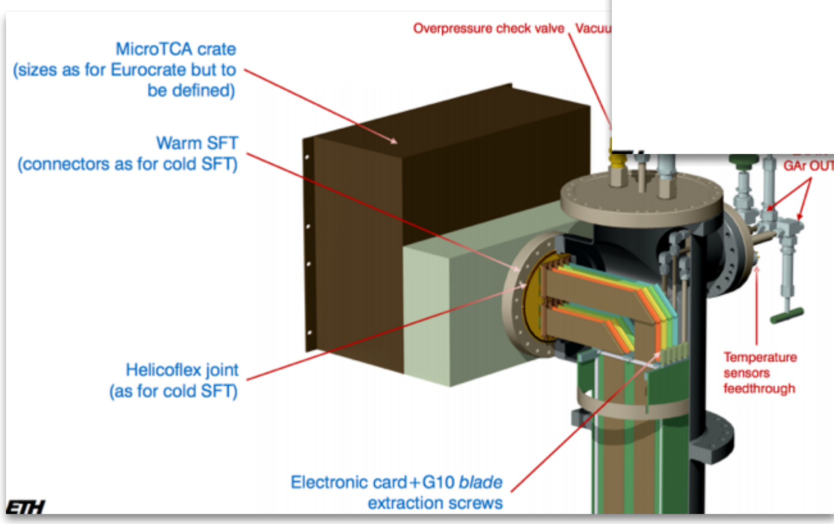
cryo camera +LED to visualise LAr surface





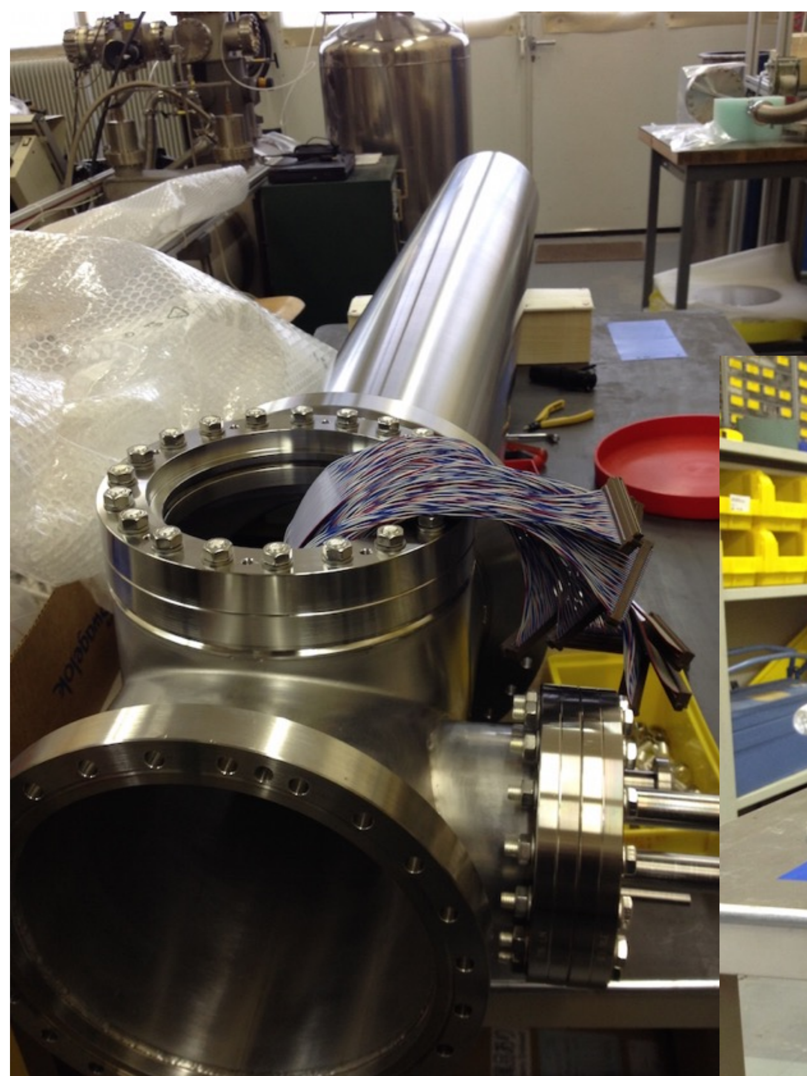
Signal Feedthrough Chimney





ASIC preamps in cold as close as possible to the anodes (~50 cm cable). fixed on insertable cards thus can be accessed without opening the detector. 1 chimney has 5 cards and reads 320 channels.

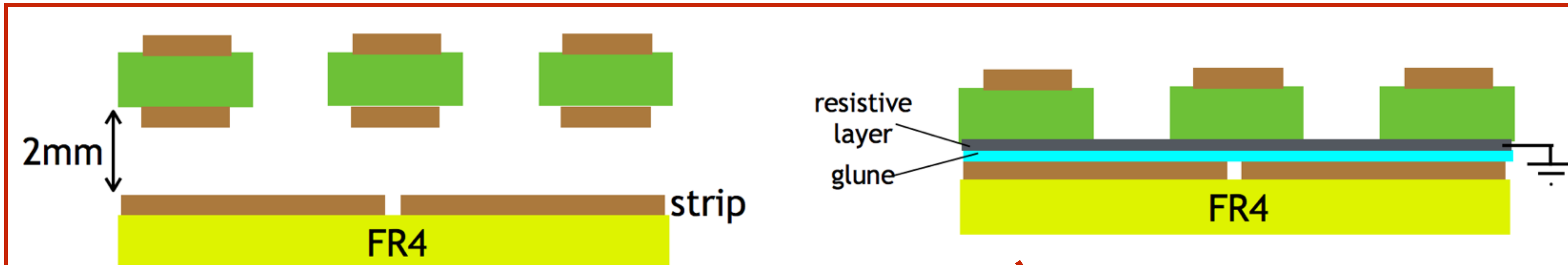
1st prototype arrived at CERN.
Card insertion tested ok.
Ongoing checks such as contacts, tightness, ….

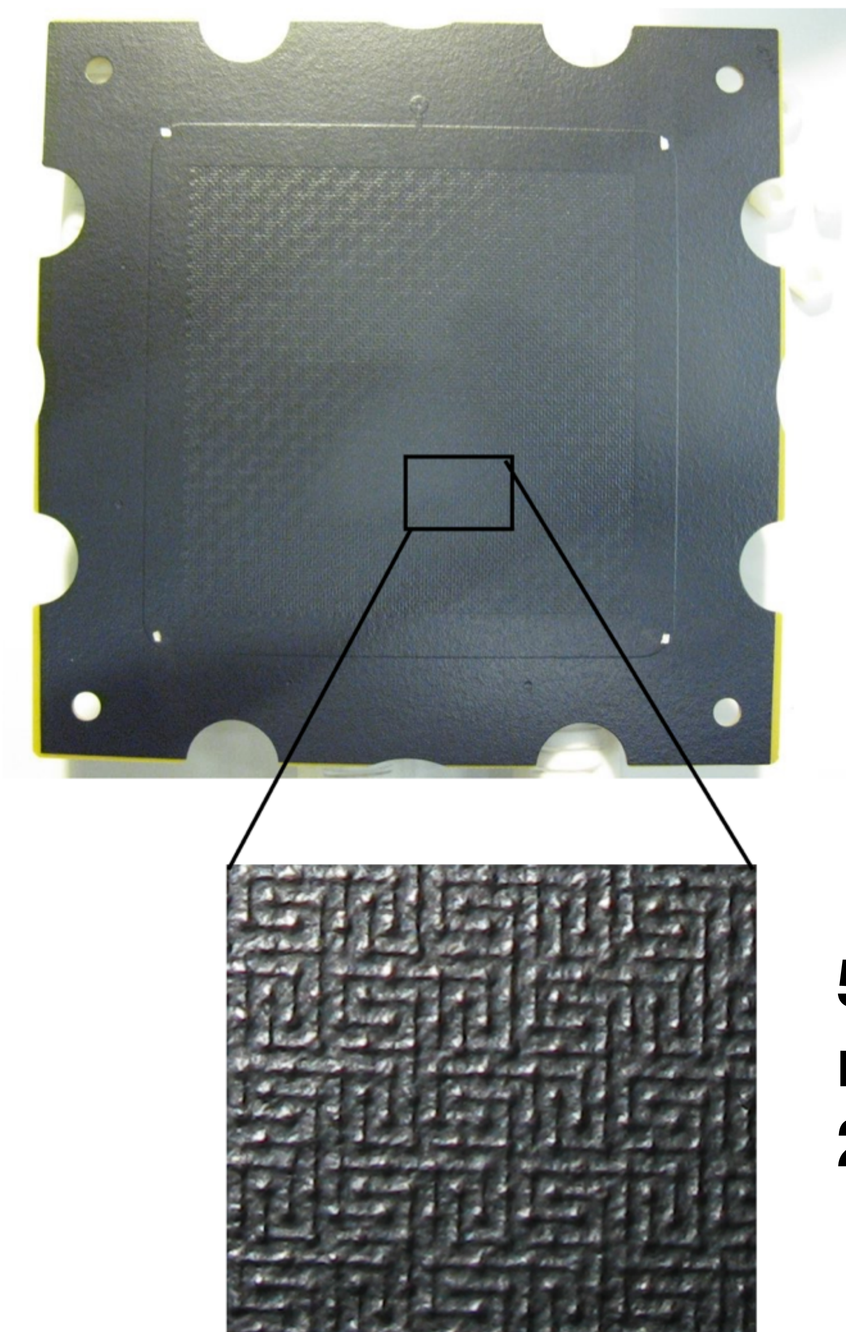


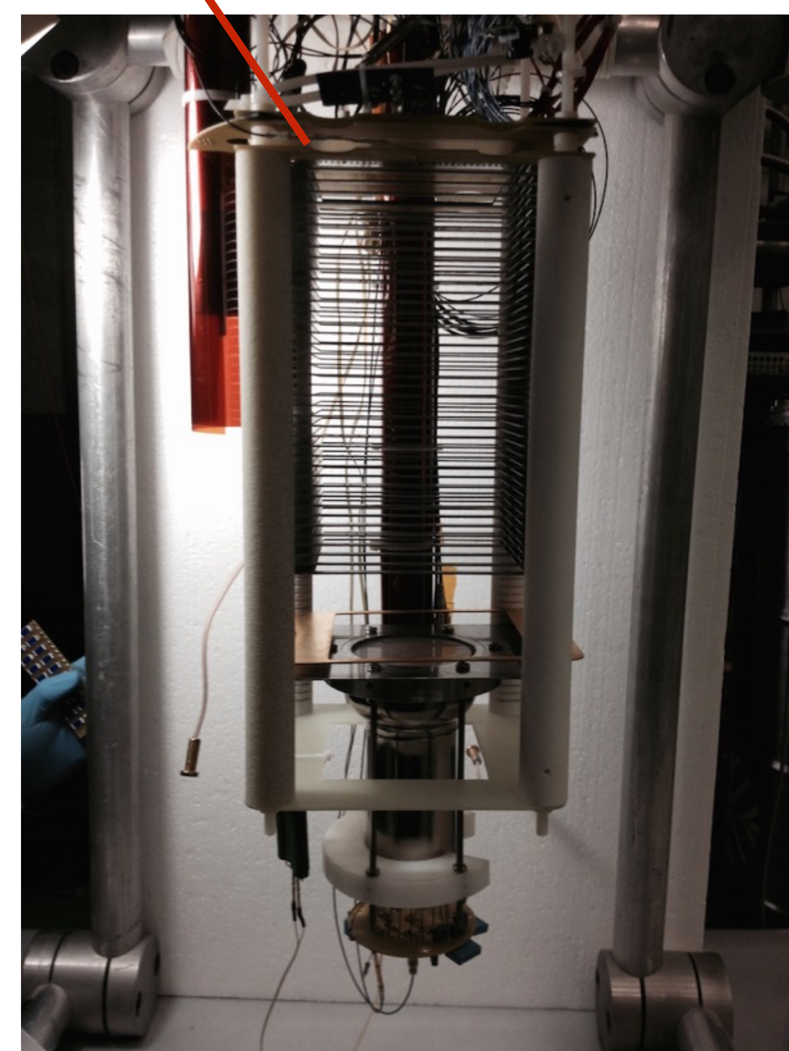
5 fake FE boards inserted from top

First tests of resistive RP-Well

“classic” LEM | **RP-Well**

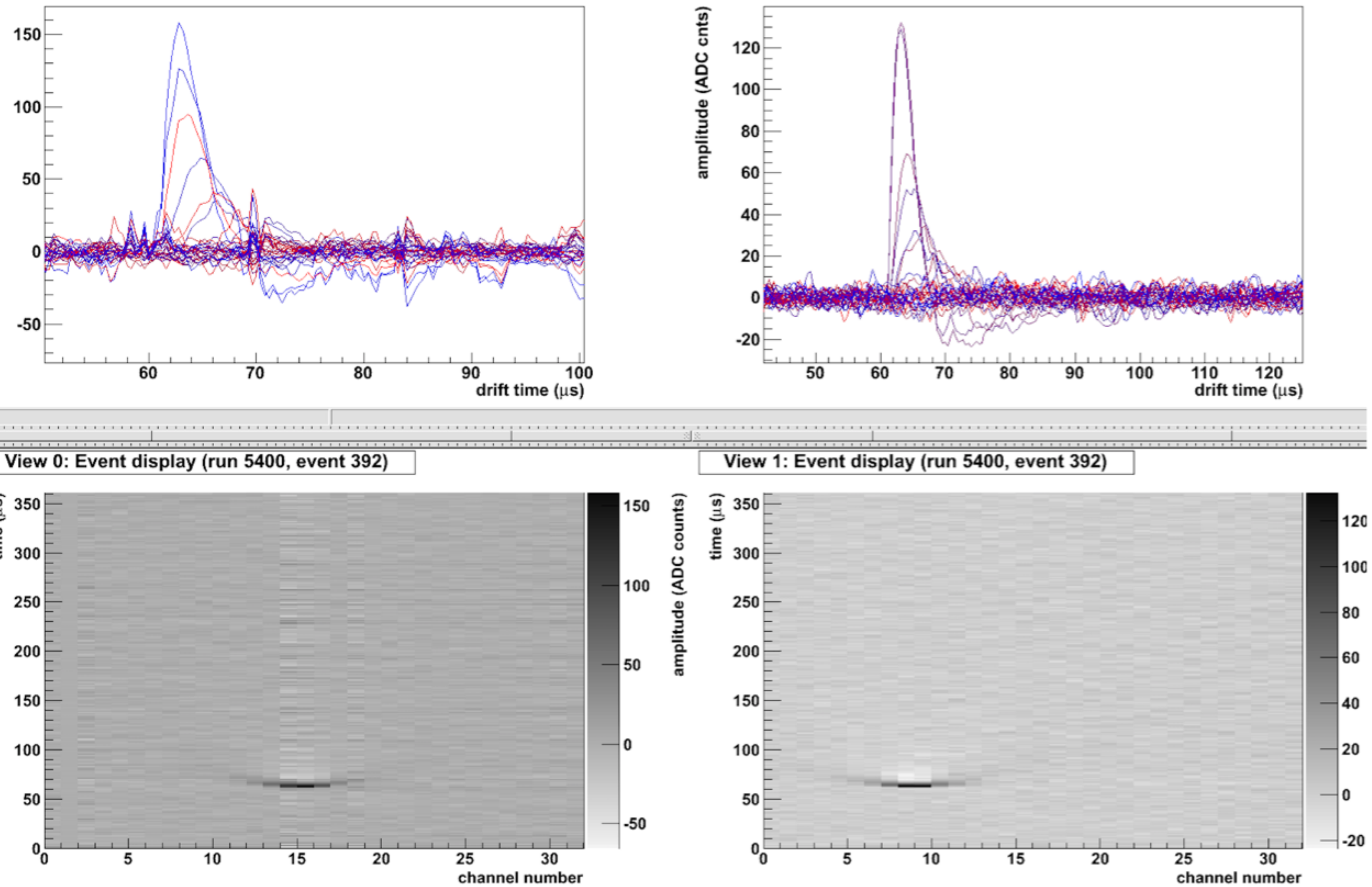


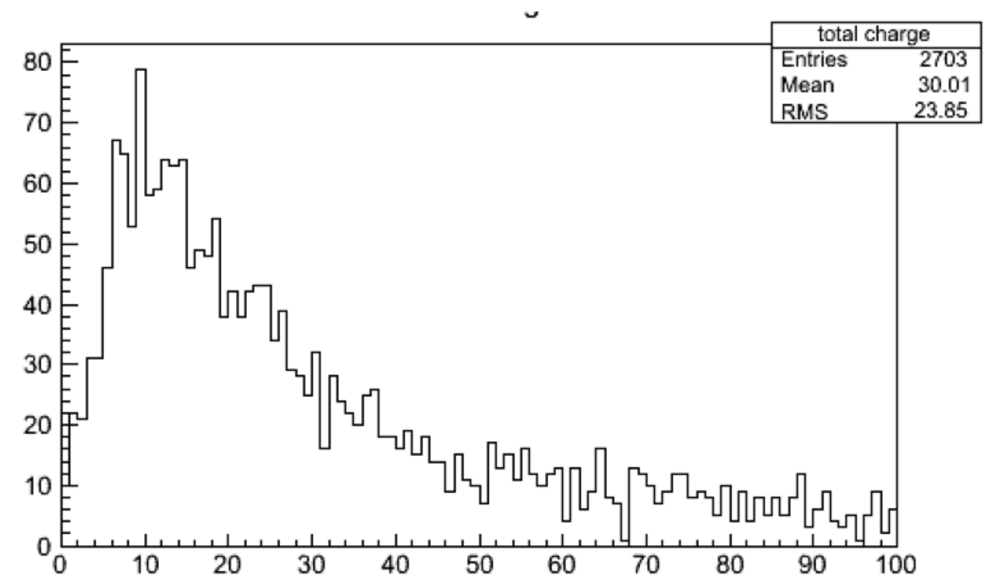




5 Mohm/sqr Kapton resistive layer.
25 um thick.

First results in gas





fC

Gain~1000

Large spread of charge => possible to use resistive layers with larger resistivity

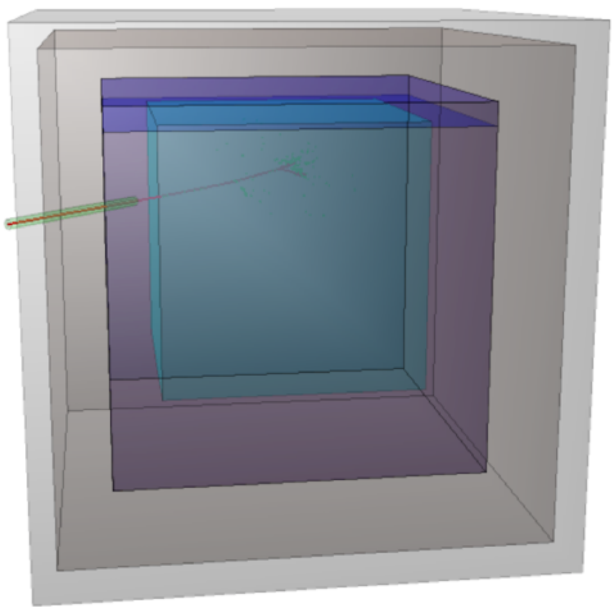
Open issues:

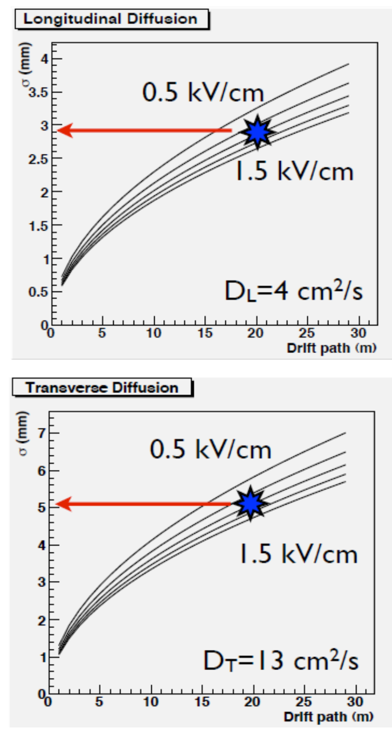
Gain? Resistivity in cold? Outgassing? gain Uniformity? Charge sharing? Is it possible to scale design to large 50x50 area LEM/Anodes?

Extra slides

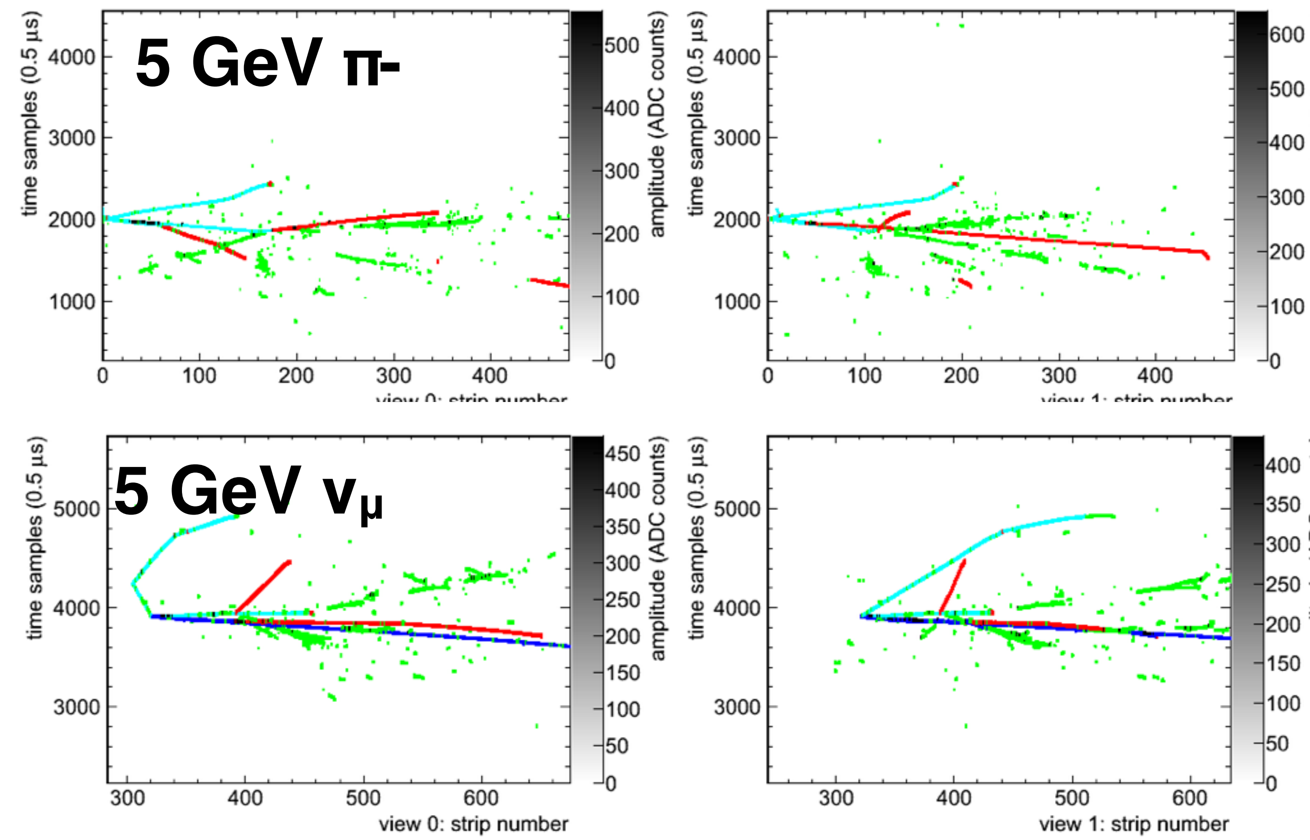
WA105: important Physics milestones

test reconstruction on fully contained events from charged particle beam (well defined primary particles and energies)





pions, electrons/positrons, protons, muons



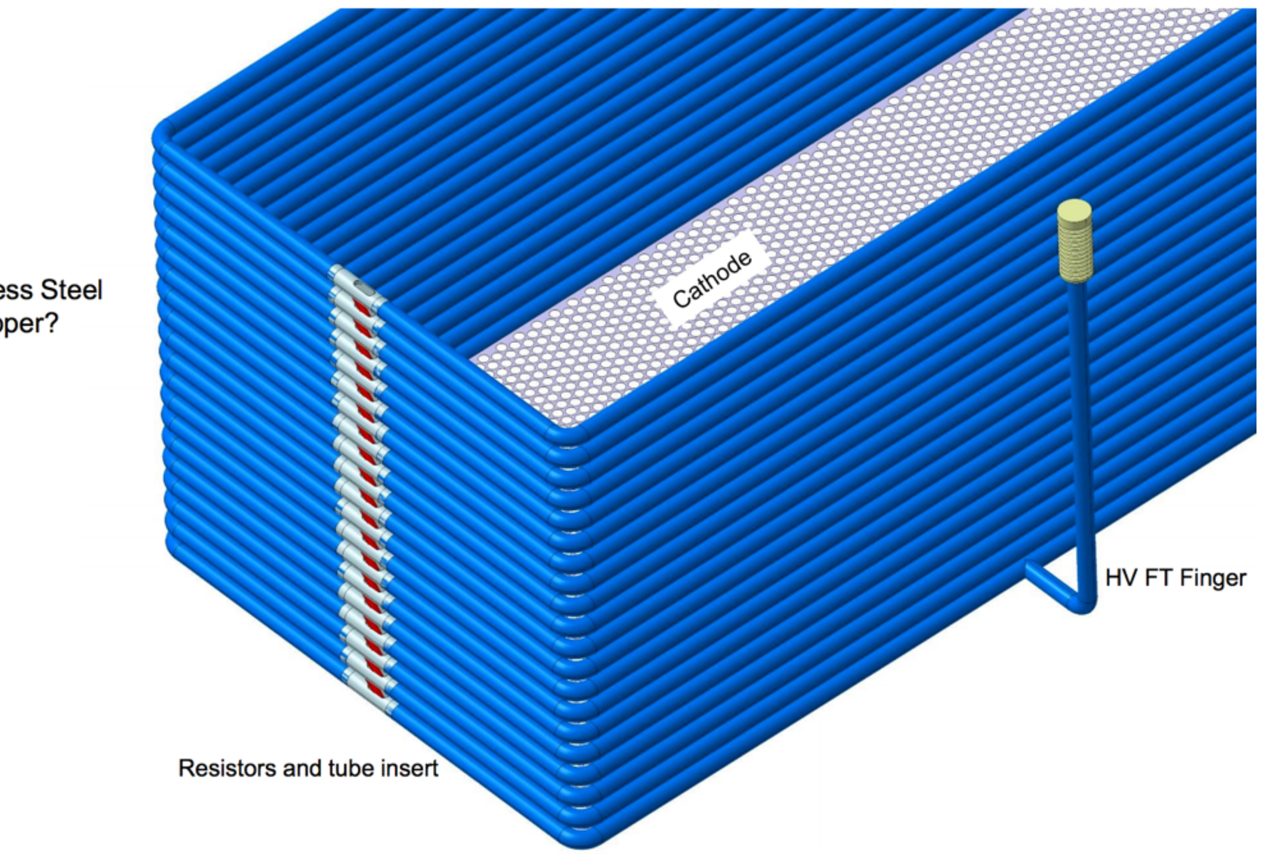
- LAr TPC provide a fully active homogeneous medium
- High granularity 3x3 mm² ← two orders of magnitude better than most granular calorimeters
  - e.g., CALICE AHCAL prototype has 3x3 cm²
- Additional handle from dE/dx

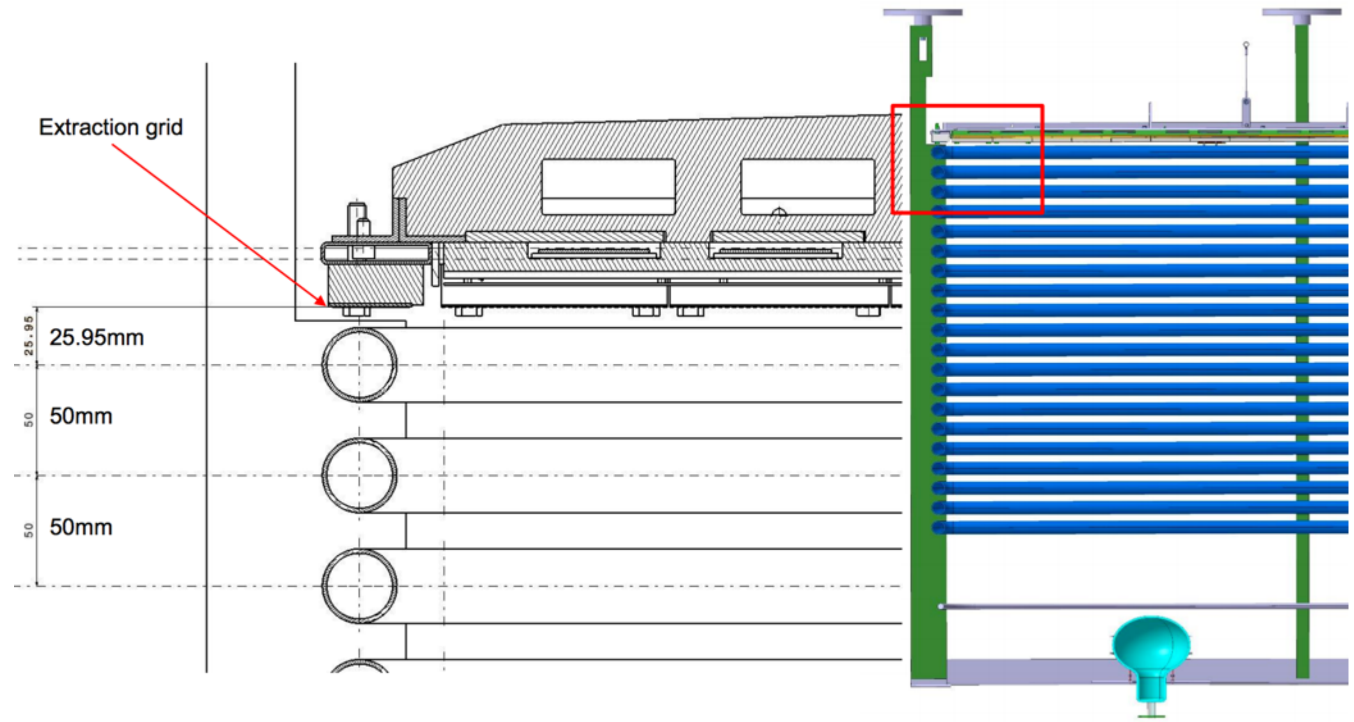
Opportunity to provide unprecedented measurements of hadronic shower development to HEP community

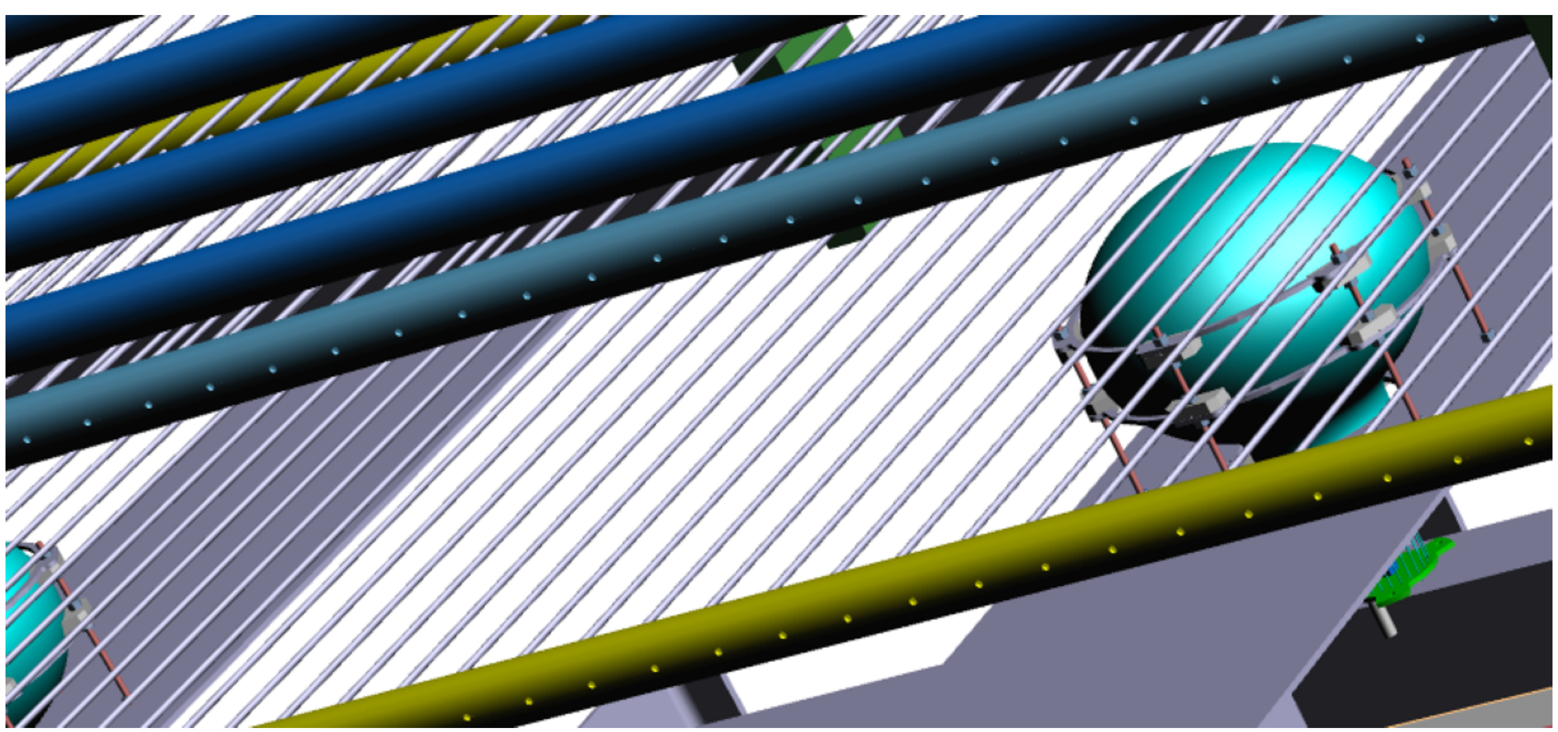
Some goals

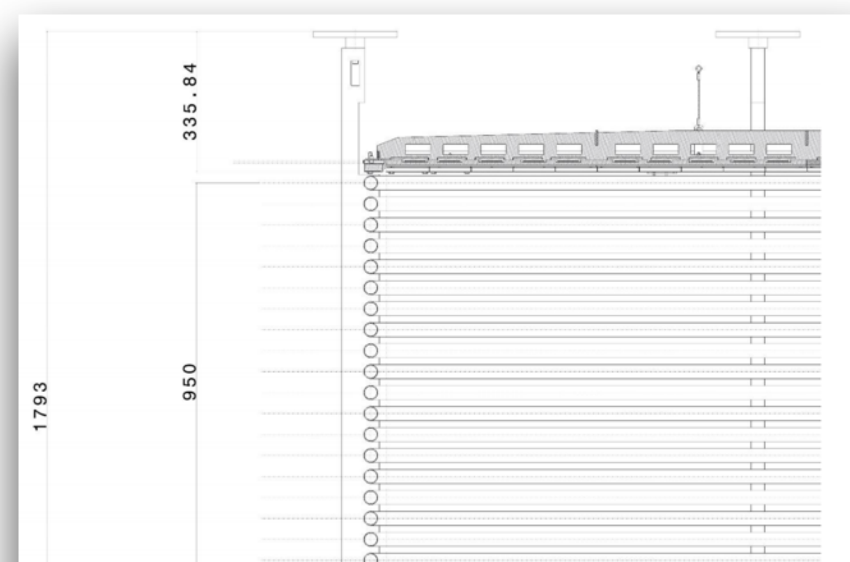
- Development of automatic event **reconstruction**
- **test NC background rejection** algorithms on "ν_e free" events
- Charged **pions** and proton **cross-section** on Argon nuclei.

Drift Cage



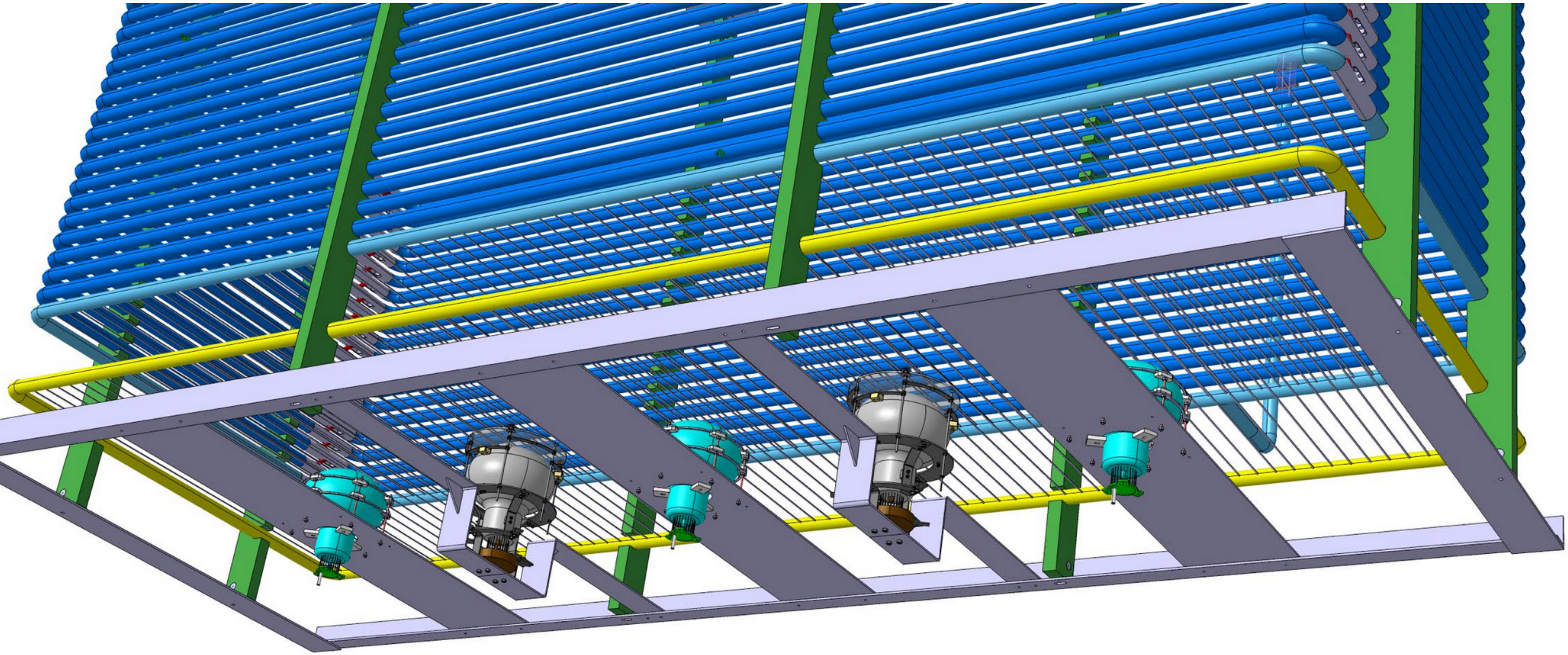




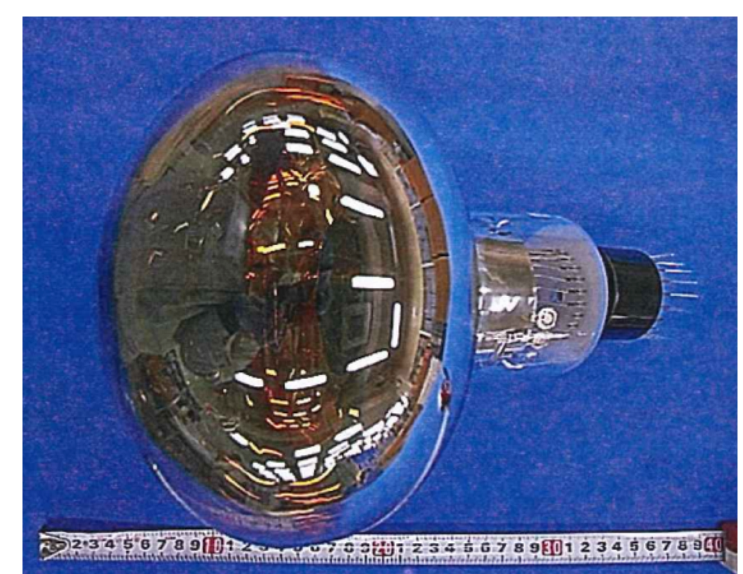


- ✓Following similar design to ArDM's drift-cage.
- ✓Assembled off-site and delivered to CERN.

Light Readout



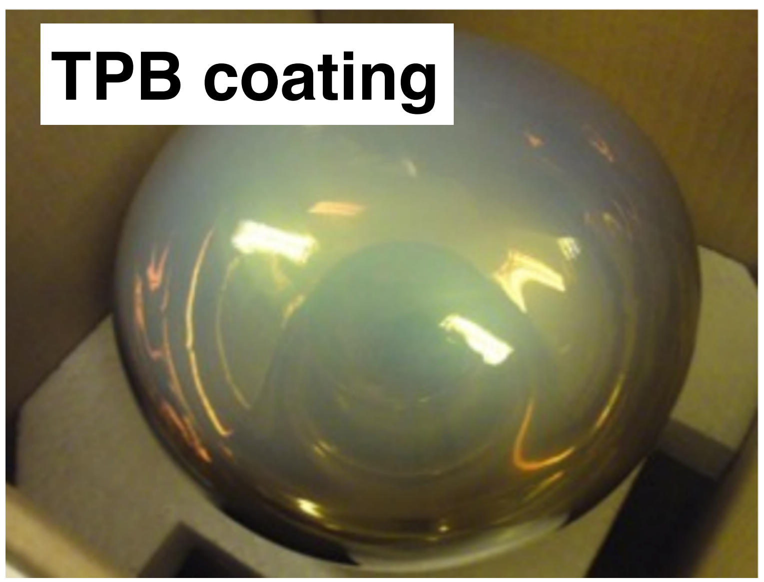
5 TPB coated Hamamatsu 8'' R5912-02MOD PMTs.
2 of them serve as test bench for the 6x6x6m3 detector.
-same mechanical base design that is foreseen in the 6x6x6m3
-electronic bases that allow propagation of signal + HV through one signal cable (dedicated R&D ongoing in Spanish groups).

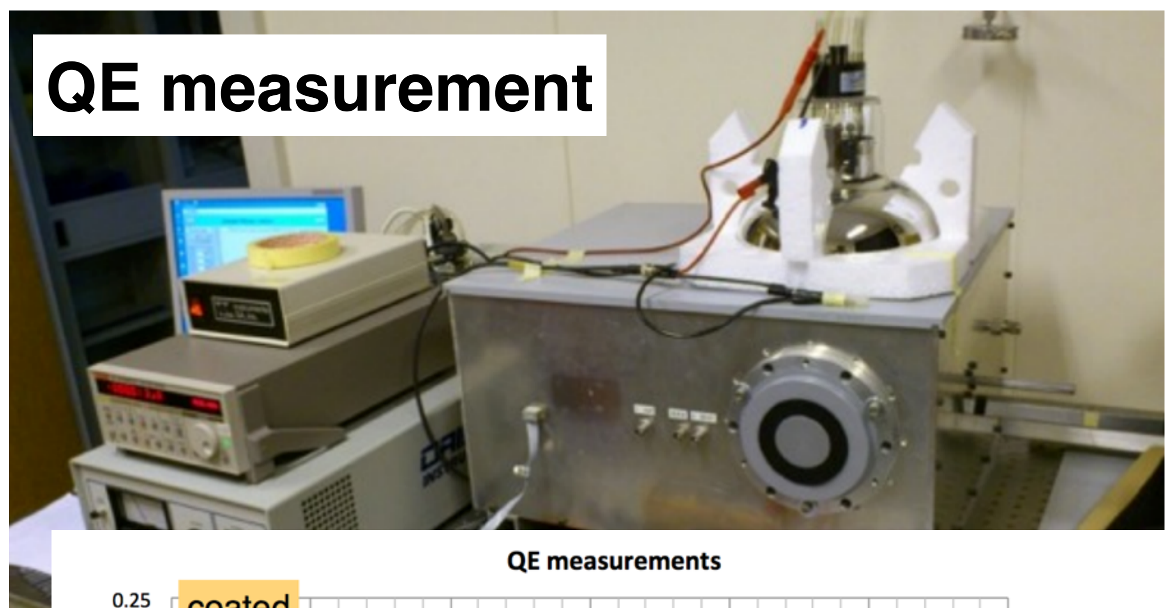


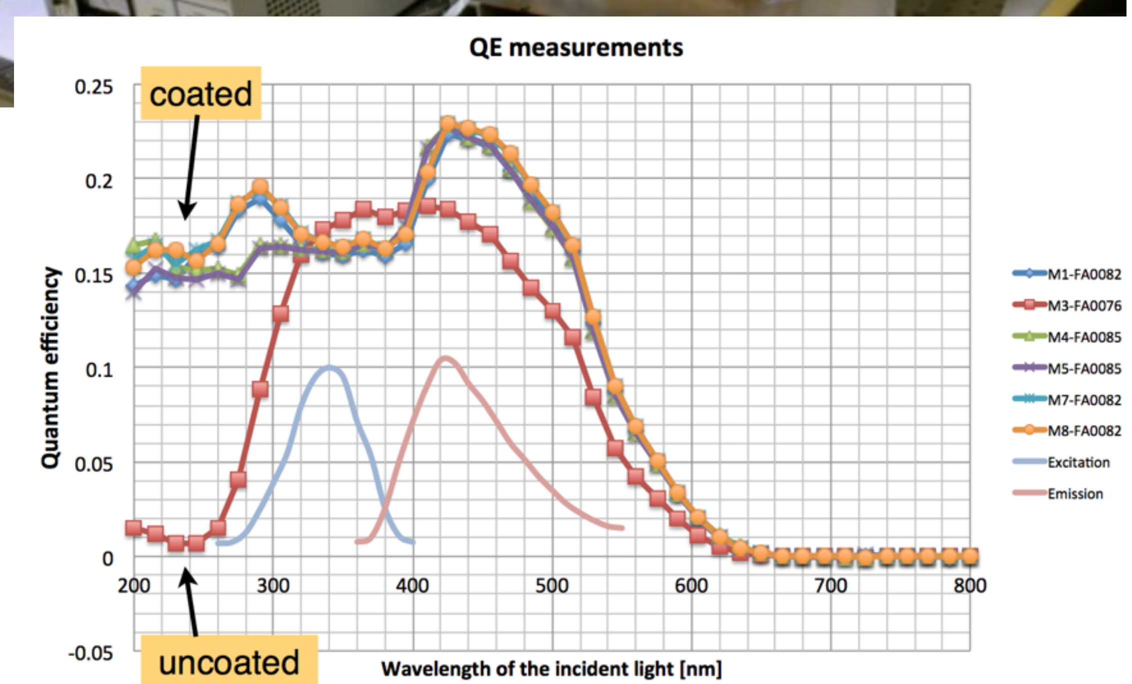
Light Readout

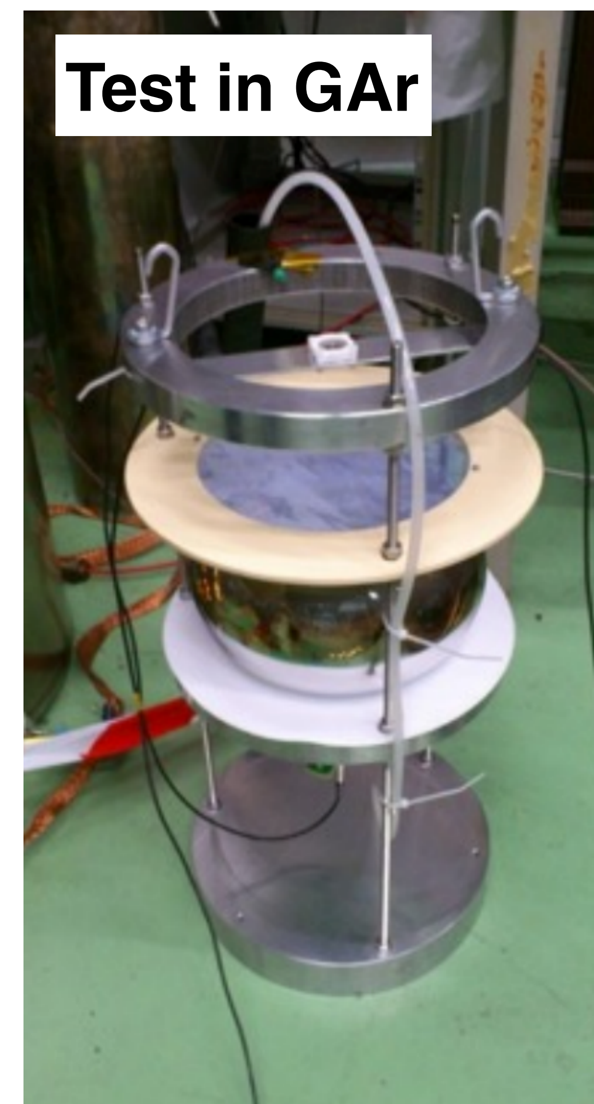
Plan to do the coating and QE test of the PMTs around May at CERN. Already have the setup ready and the experience from ArDM.

1. dipping the PMTs in LN2 to test mechanical resistance
2. QE measurement
3. Coating at CERN thin film lab (evaporation)
4. QE measurement after coating
5. test in GAr.





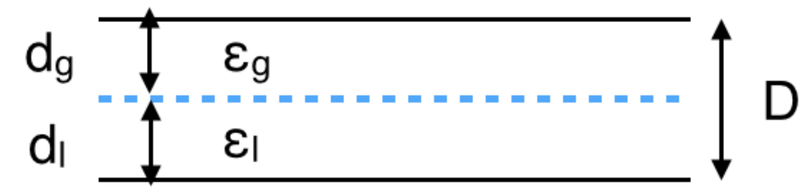


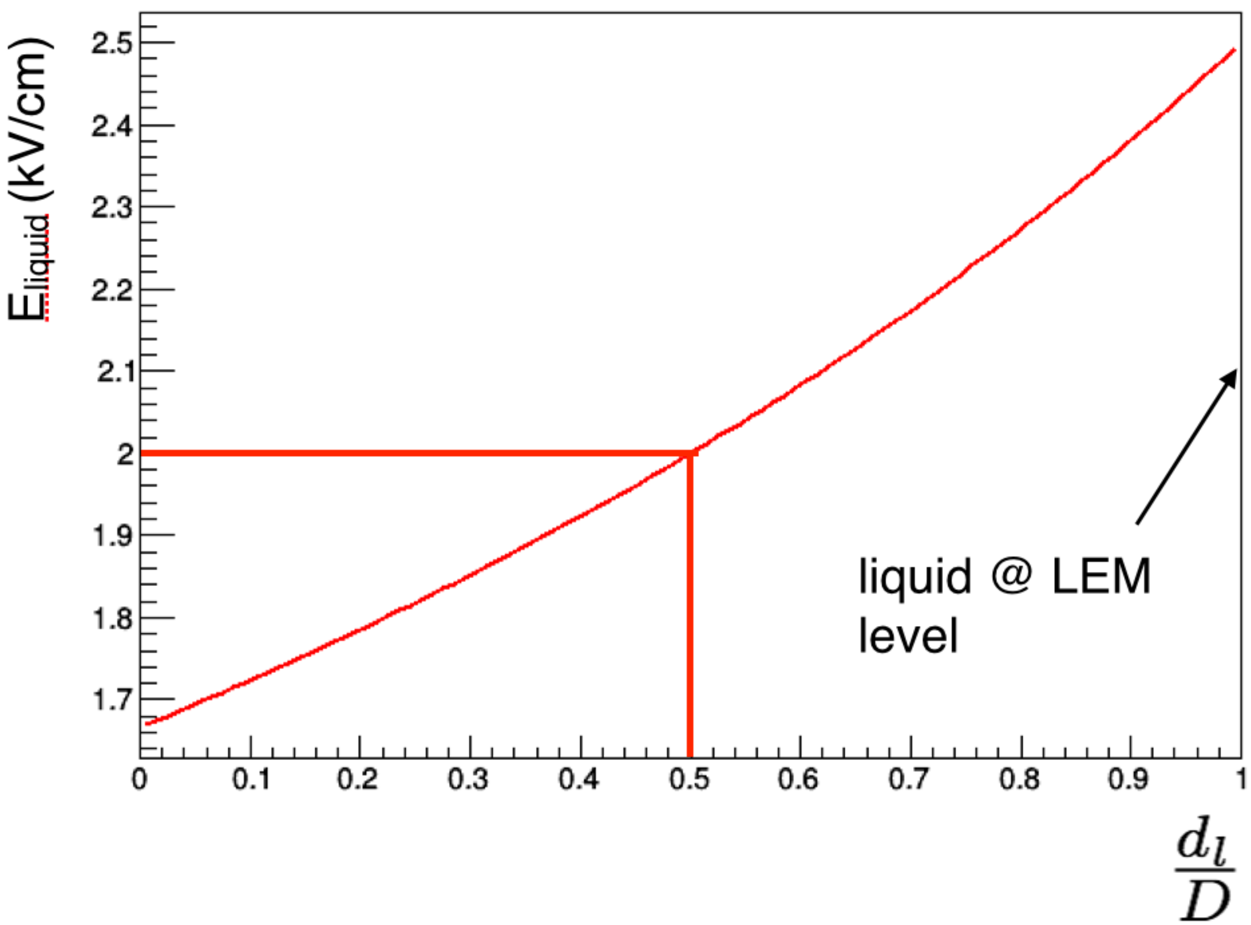


CRP interstage distances: level of liquid

$$E_{liquid} = \frac{\Delta V}{D[\frac{d_l}{D}(1-\frac{\epsilon_l}{\epsilon_g})+\frac{\epsilon_l}{\epsilon_g}]}$$

E_l= E in liquid
E_g= E in gas
at the interface E_g*ε_g=E_l*ε_l

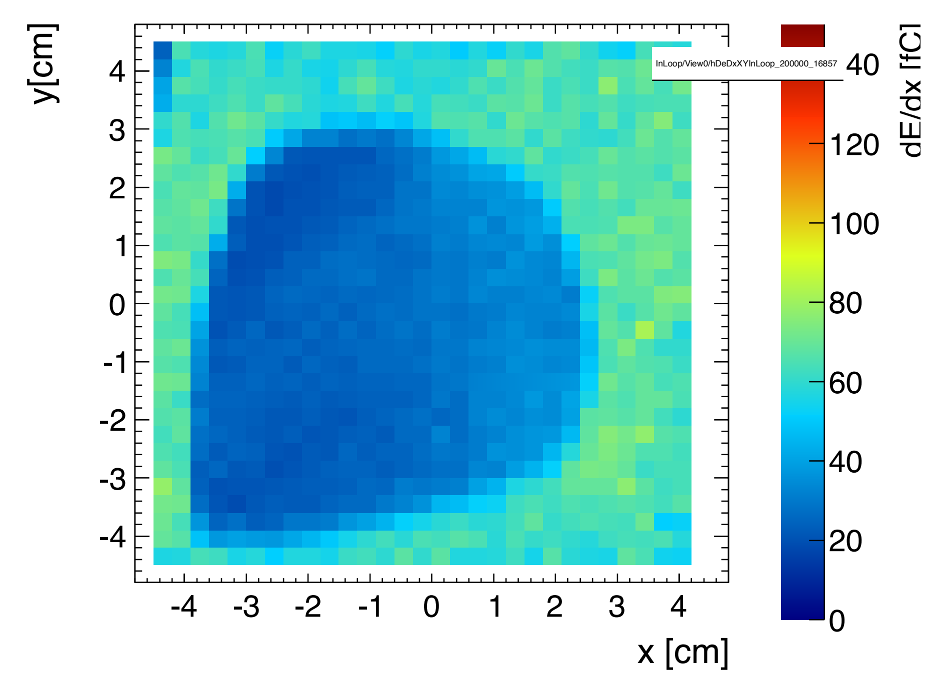




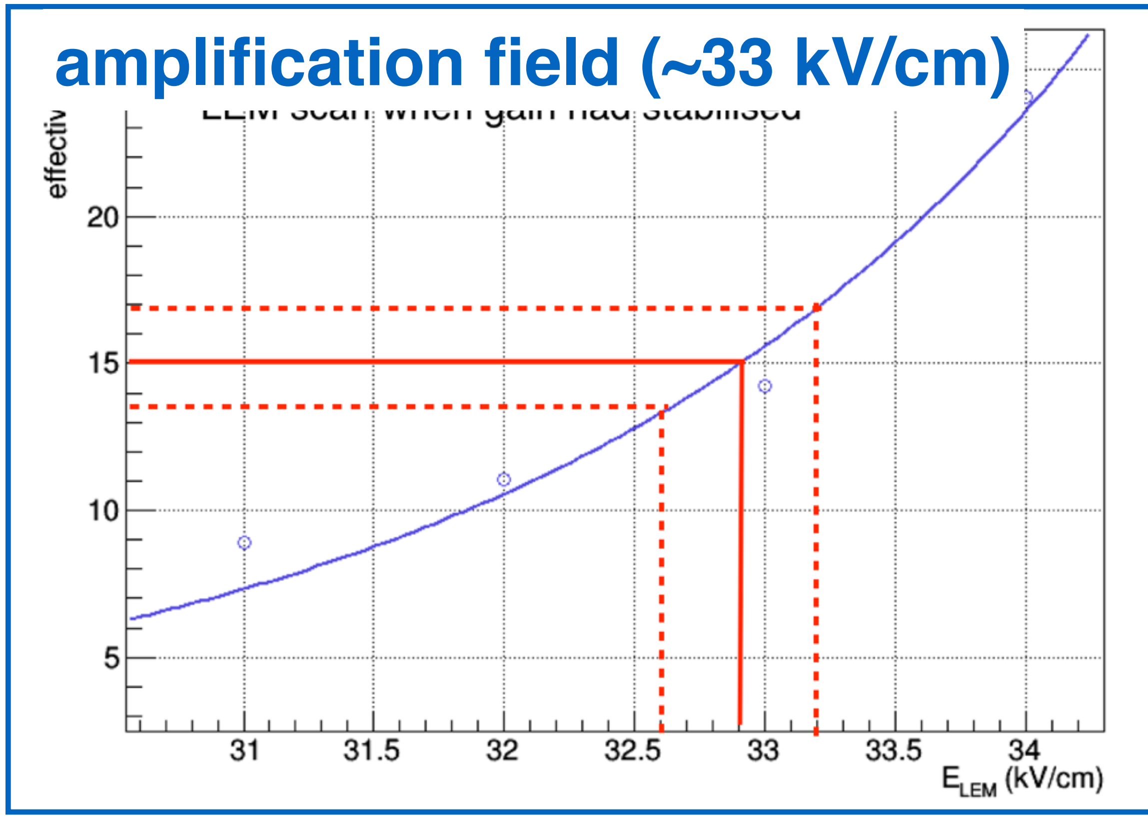
variation of the extraction field in liquid as a function of liquid level.

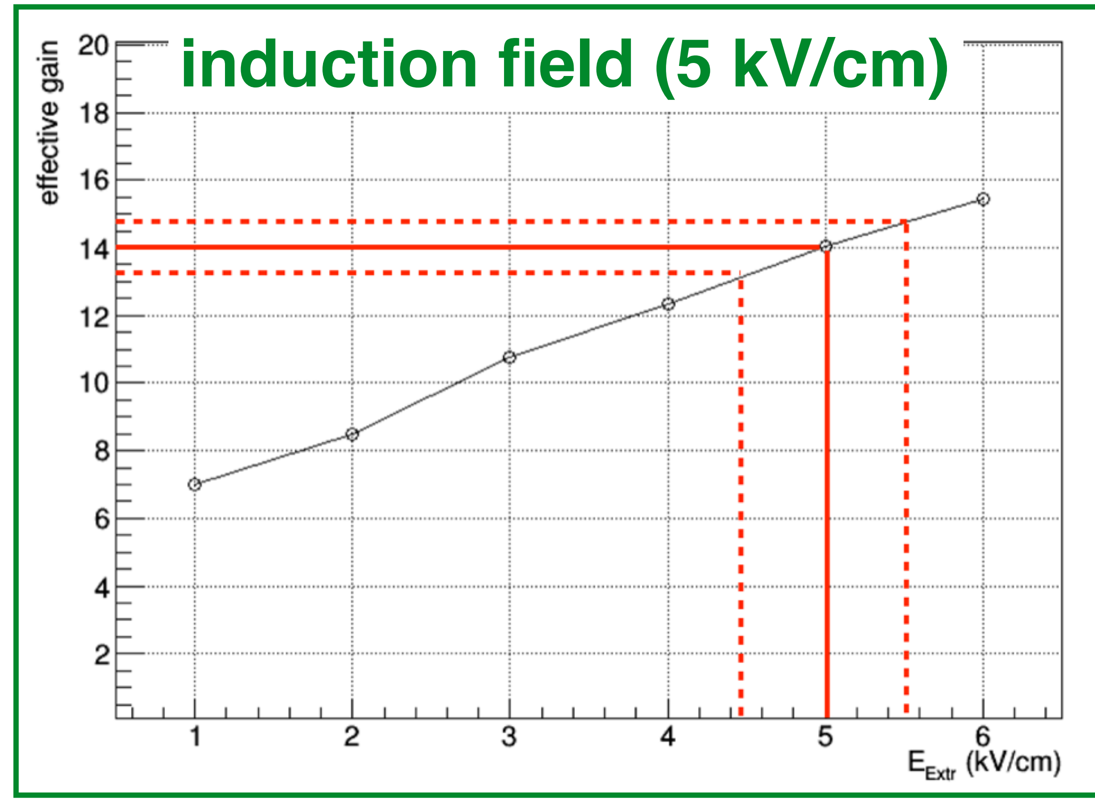
Important remark: from this plot (and from 3l experience) it is clear the liquid level influences the extraction field very little. main situation to avoid: that the LAr "wets" the LEM.

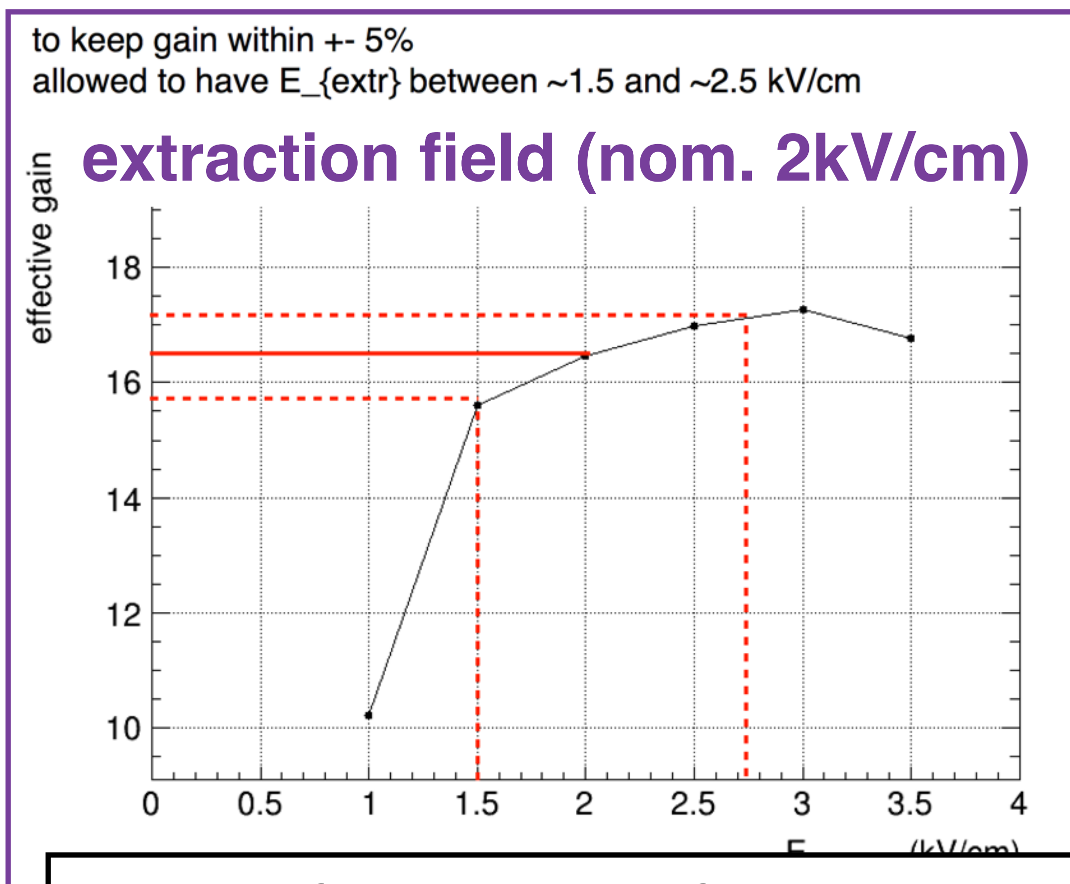
example on the 10x10 cm² readout where the LEM center is still "wet" after filling.

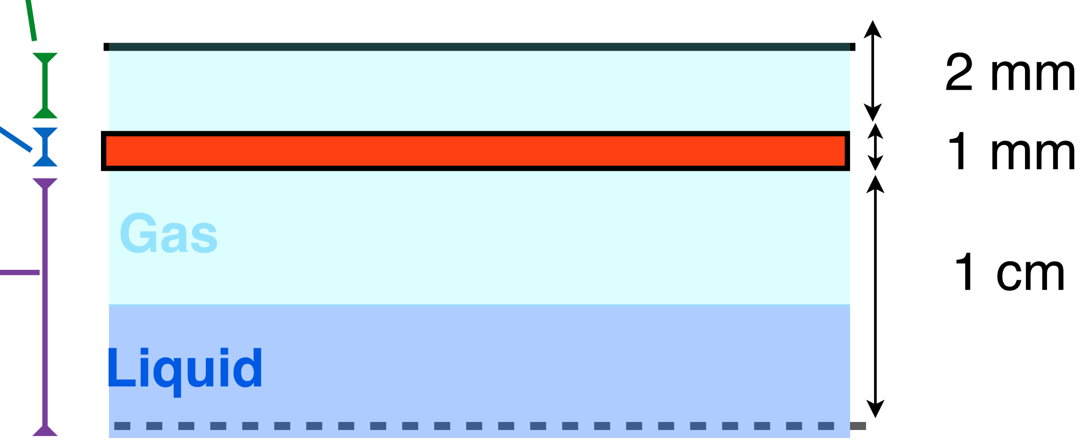


CRP interstage distances







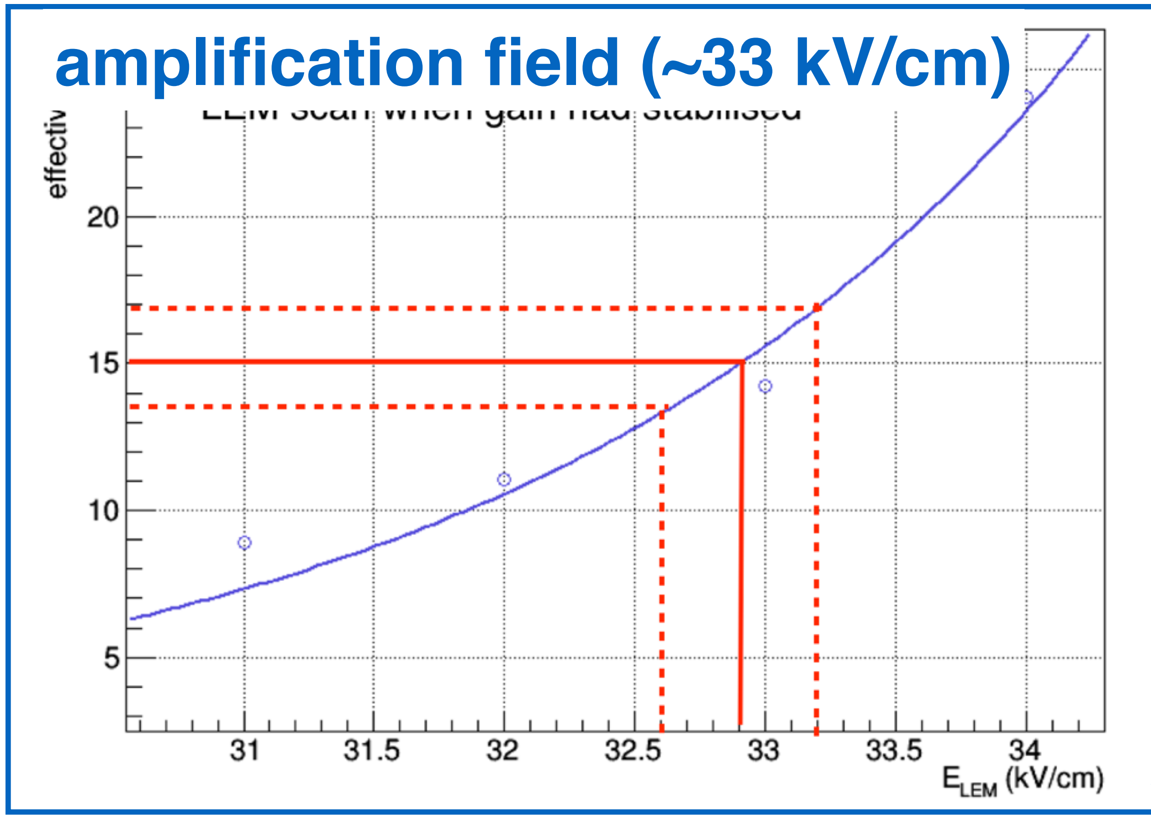


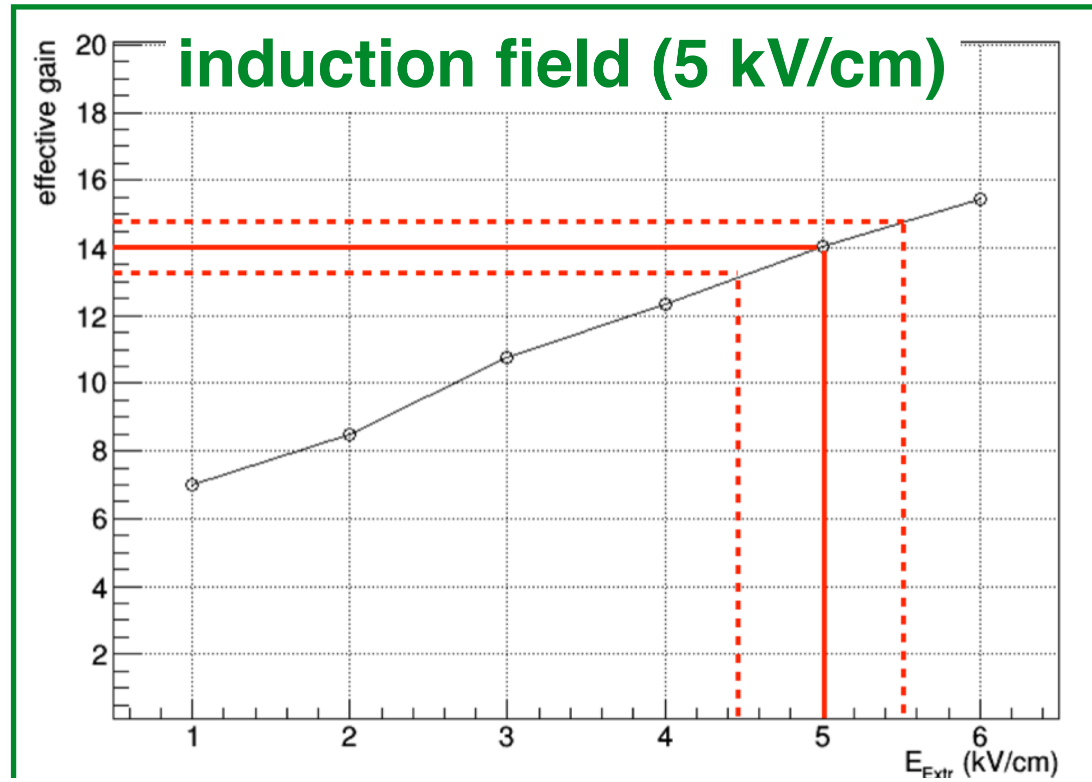
in red: ± 5% variation on the gain

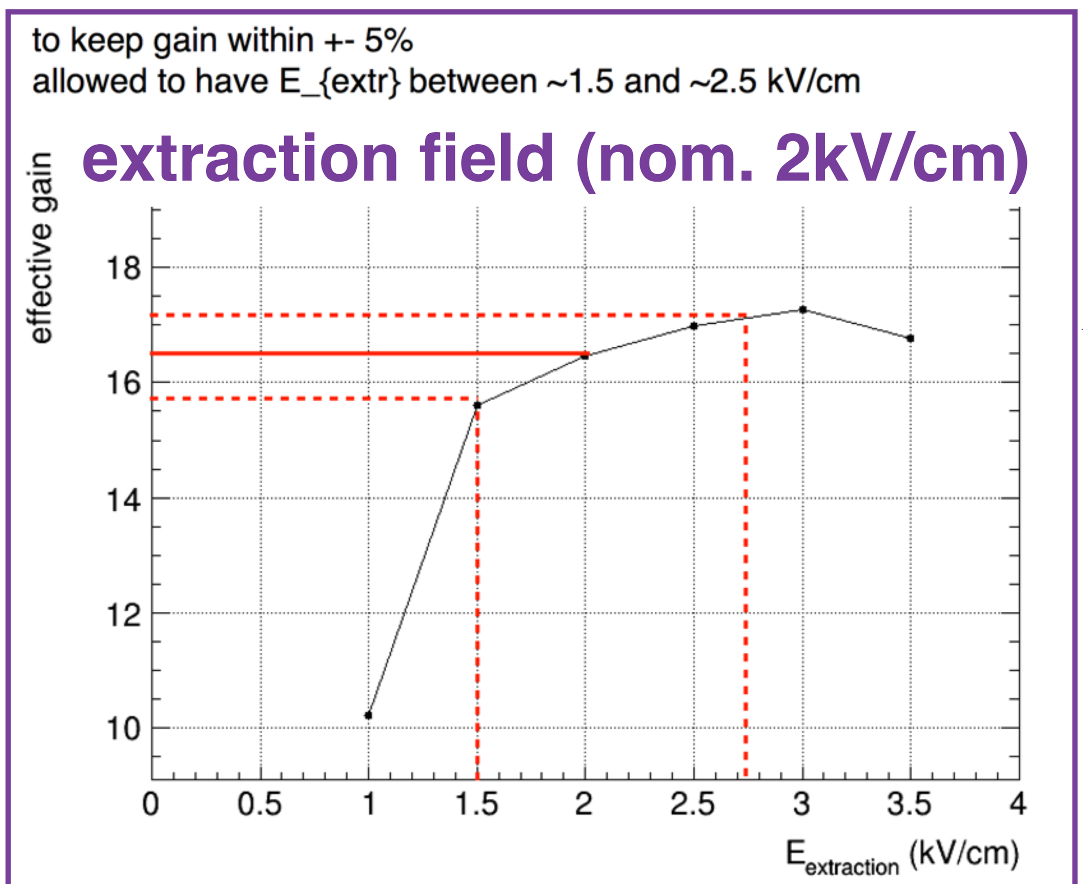
important to keep fix distances between each stage.
=>one single mechanical frame

all plots from electric field scans on the 3l

CRP interstage distances





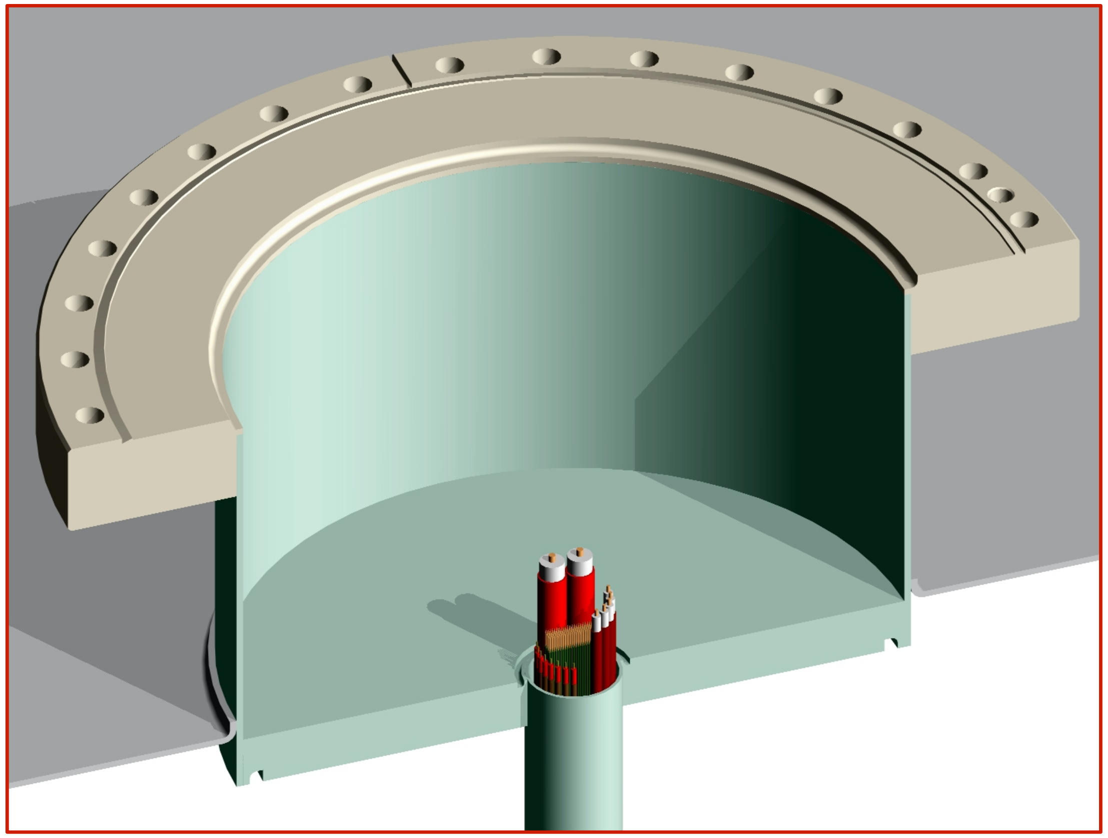


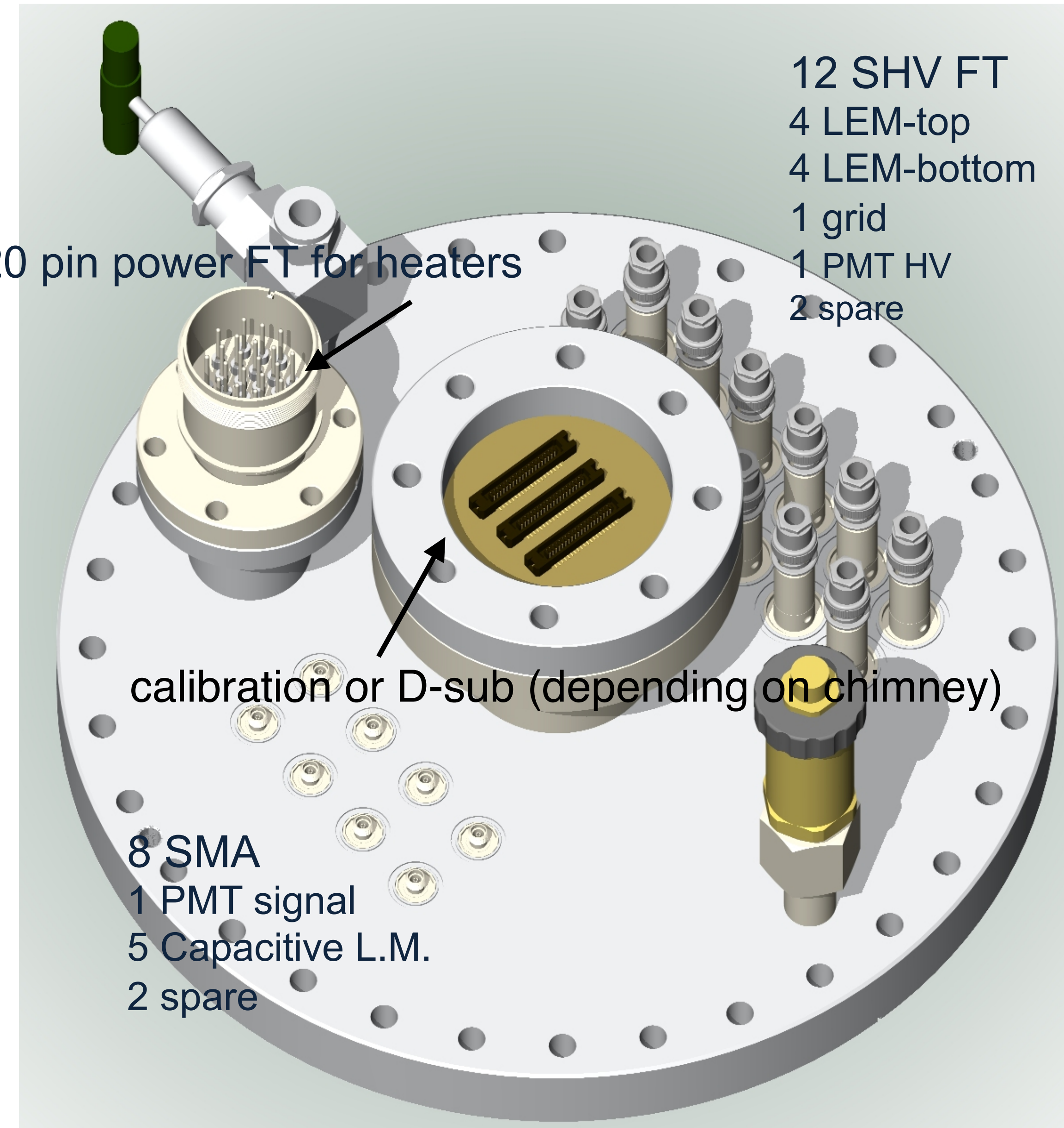
in red: ± 5% variation on the gain

	distance [mm]	tolerance [mm]
anode-LEM	2	0.1
LEM thickness	1	0.01
LEM-grid	10	0.5
LEM-LAr	5 (from grid)	0.5
x-y position of the 50 cm^2 modules	500	0.1

Keep constant distances between each stage.
=>one single mechanical frame

Design of instrumentation chimney



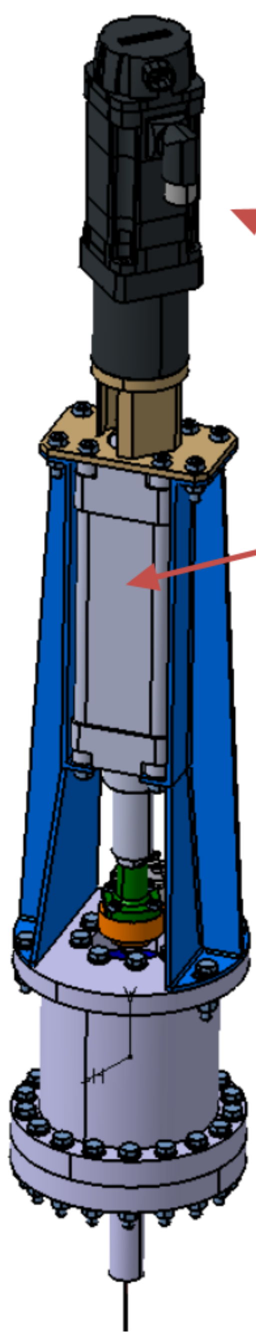


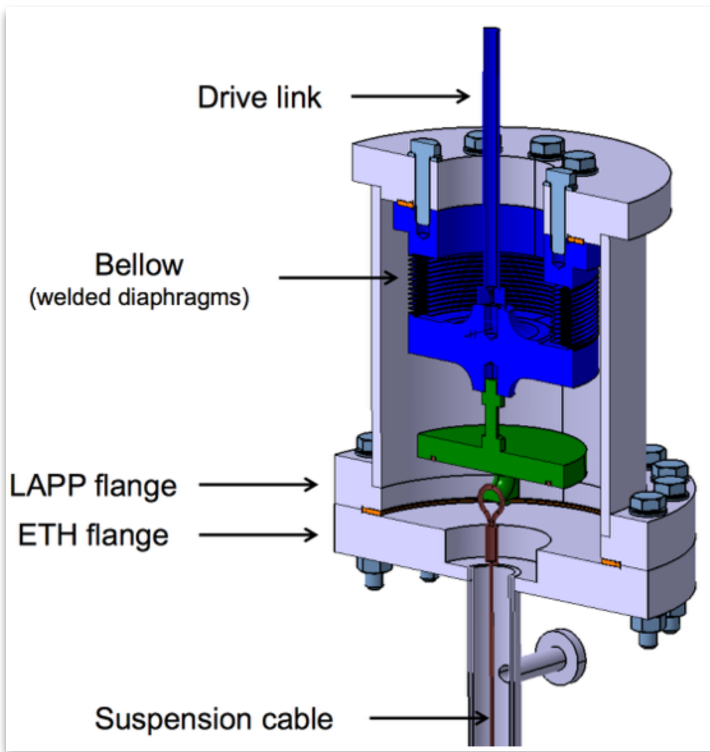
fit all cables in 3 cm diameter crossing pipe. possible to extend diameter for 6x6x6.
But then limitation is number of connectors on the flange. Here CF 250 (NB occupancy of connectors not at maximum).
Identified company to provide custom made flanges with wieldable connectors.
Need to order 1st piece to check design.

Chimneys & feedthroughs

CRP suspension feedthrough

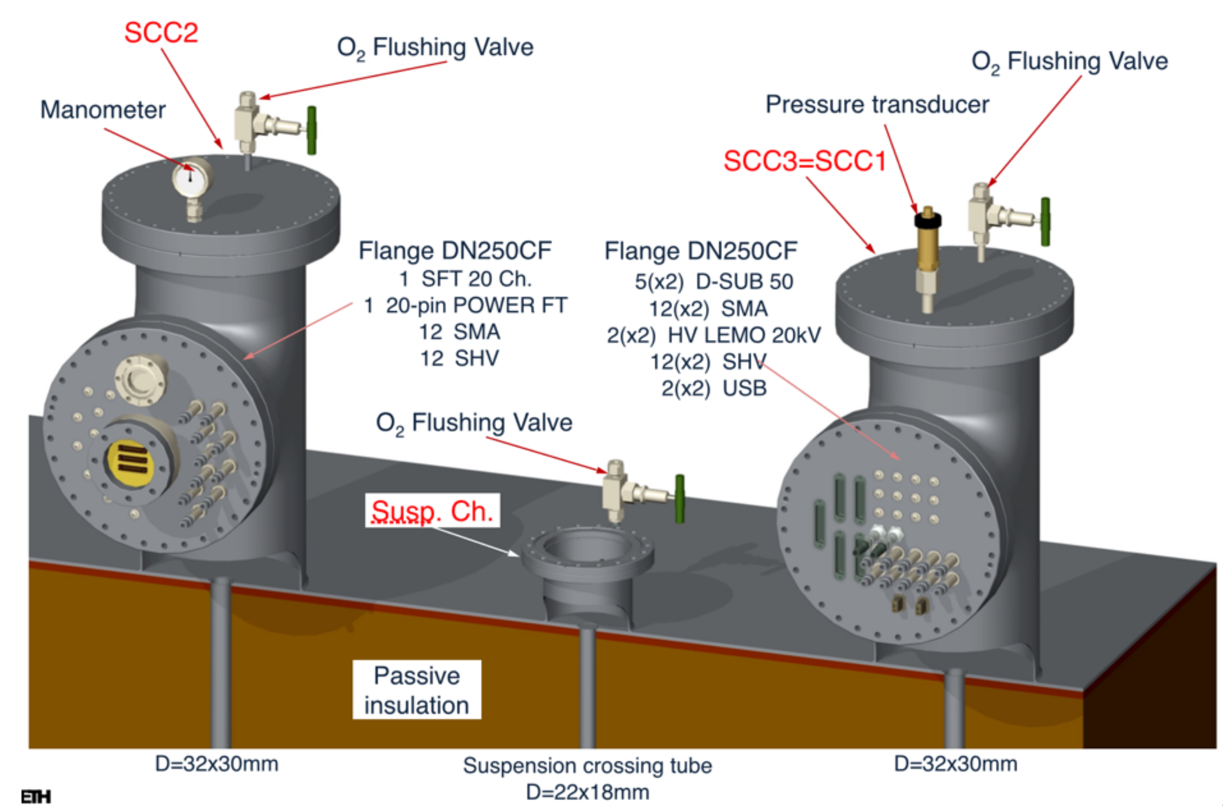
design final. Parts ordered.
on schedule for summer 2015 at CERN





Slow control chimney

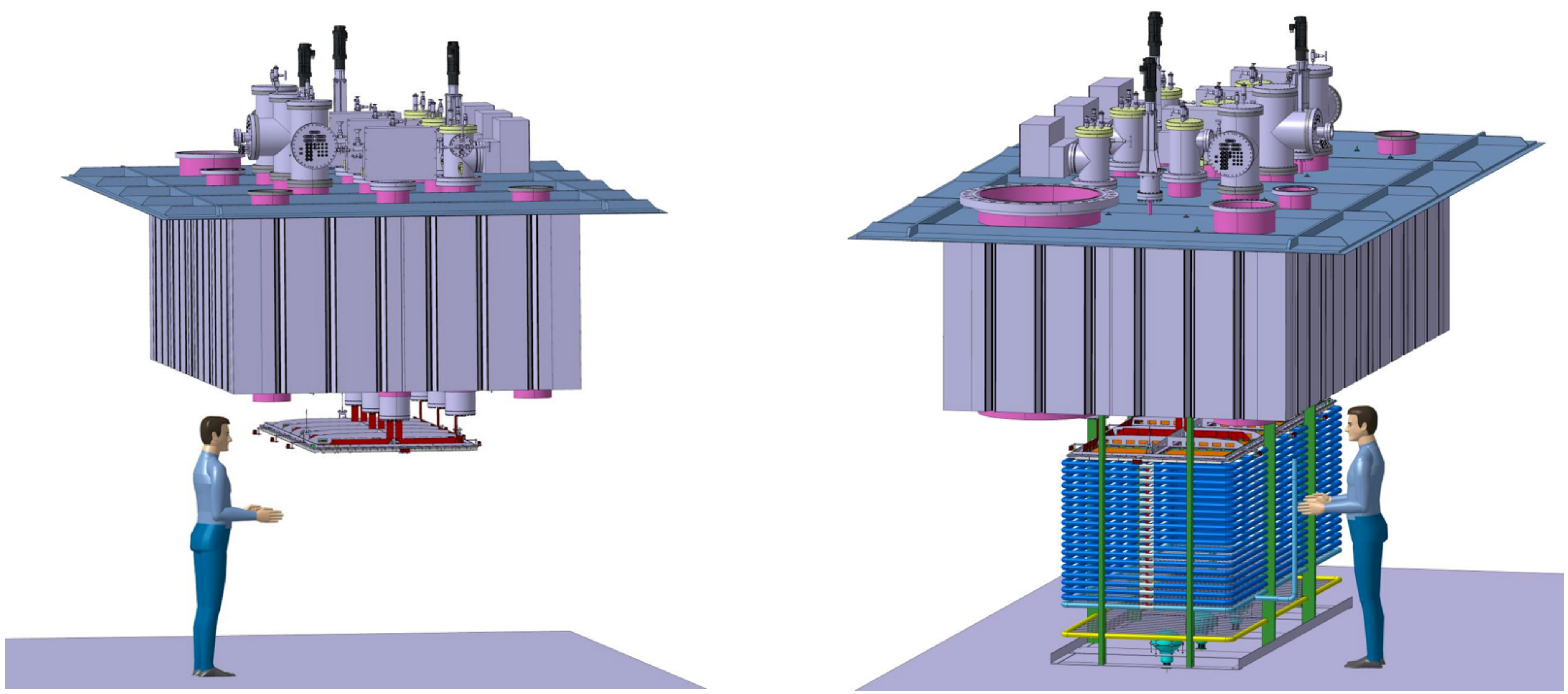
3 Slow control chimneys. Tailored flange to host a variety of connectors that are needed for all sensors + HV connections. Connectors to be welded on the flange are about to be purchased.



Final Detector assembly

top cap will be positioned next to the detector and lifted to the desired height. A temporary clean-tent will be constructed around.

1. inserting chimneys into top cap crossing pipes
2. installing CRP under top cap (connection to chimneys and signal testing)
3. install drift cage under top cap (including PMTs and connection to chimneys + testing)
4. lift top cap+CRP+drift-cage in tank.
5. welding of top cap and outside connections.



Where we are

WA105

Construction plan constantly checked (here only final assembly section shown).
Every part is on schedule for the moment. Apart from liquid handling.
Goal to close and do first gas purge purity test before christmas.

Level	Activity	Responsible institute/person	Dec 14	Jan 15	Feb 15	Mar 15	Apr 15	May 15	Jun 15	July 15	Aug 15	Sep 15	Oct 15	Nov 15	Dec 15	Status	
1	FINAL ASSEMBLY	CERN / ETH															con
1.01	MILESTONE: conducting GAr purity test	CERN / ETH															add
1.02	lifting and welding top cap to outer-structure														x		
1.03	Outside connections (liquid pipes, electronic cables etc.) to tank / cap	CERN technicians / ETH												x x			
1.04	MILESTONE: welding of top cap	CERN / ETH									BUFFER PERIOD (summer holiday)						
1.05	Installing top-cap+CRP+drift-cage in tank	CERN technicians / ETH / Gabadi											x	x			
1.06	Installing drift-cage below top-cap	CERN technicians / ETH											x				
1.07	Installing CRP under top-cap	CERN technicians / ETH											x x x				sur 4 to
1.08	Inserting chimneys into top-cap	CERN technicians / ETH										x x					
1.09	Site preparations for final assembly (all components and cranes in place)	CERN technicians / ETH										x x					
2	TANK	CERN / ETH														in progress	
3	LIQUID INFRASTRUCTURE (LI)	ETH / CERN														in progress	
4	TOP CAP CONSTRUCTION	CERN / ETH														in progress	
5	CHIMNEYS & FT	ETH / LAPP														in progress	
6	CHARGE READOUT PLANE (CRP)	ETH / ELTOS														in progress	
7	DRIFT CAGE +CATHODE + PMT	ETH / KEK														in progress	
8	SLOW CONTROL	CERN / ETH														in progress	
9	ON-SITE INFRASTRUCTURE	CERN														in progress	

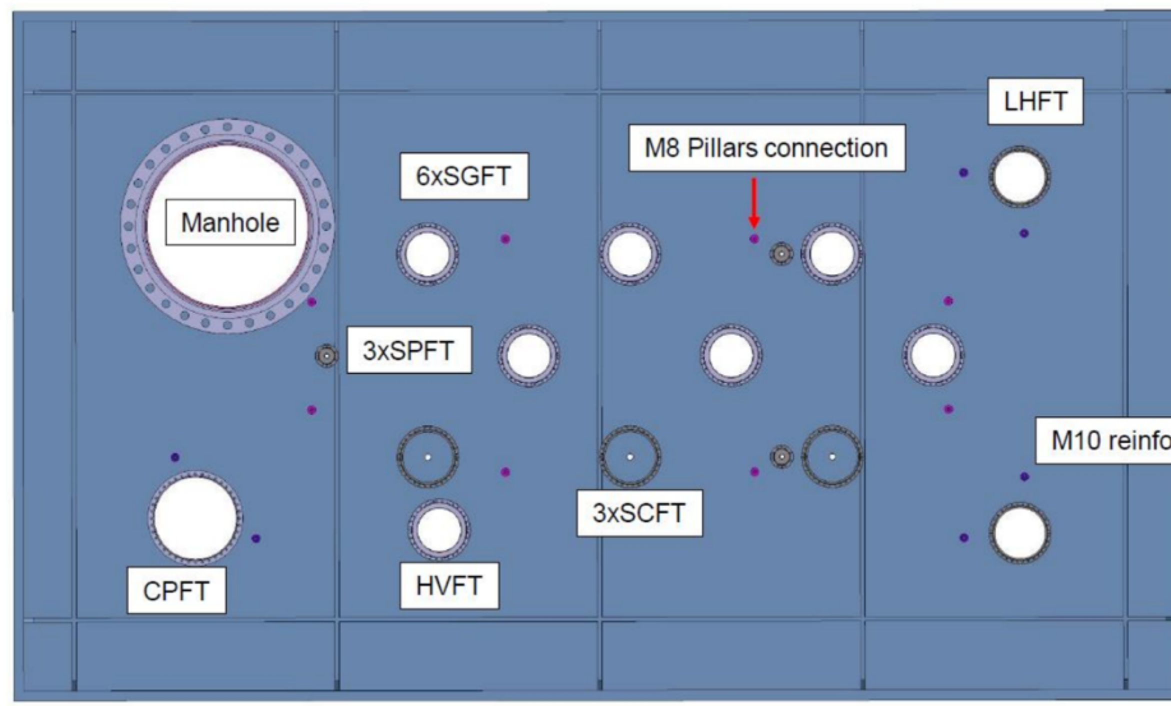
Top Cap

	Title: WA105 Top Cap Requirements & Crossing Pipes	Page:	1 of 21
		Rev:	0.3 | Date: 16/02/2015
		Author:	Gendotti A.
		Checked:	

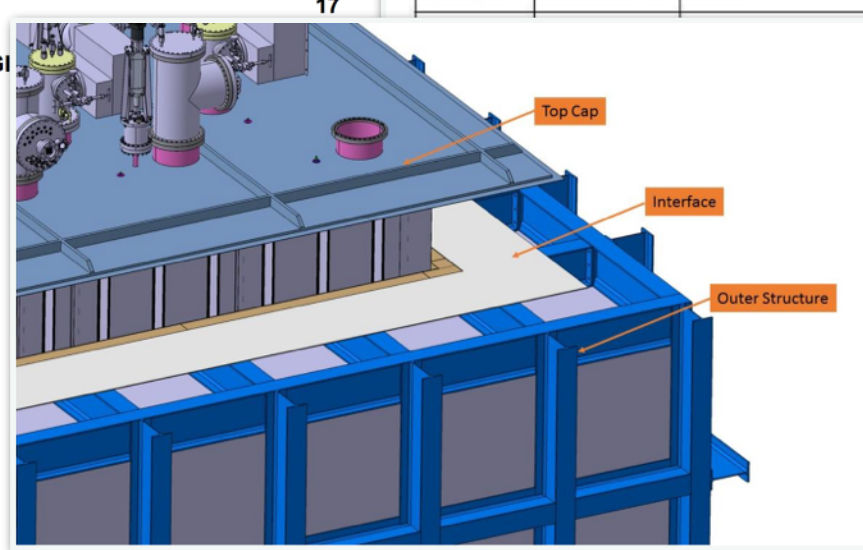
Top Cap is now fully designed on our side. All specifications summarised in a document provided to GTT. Still on schedule to be delivered around June.

WA105 Top Cap Requirements & Crossing Pipes

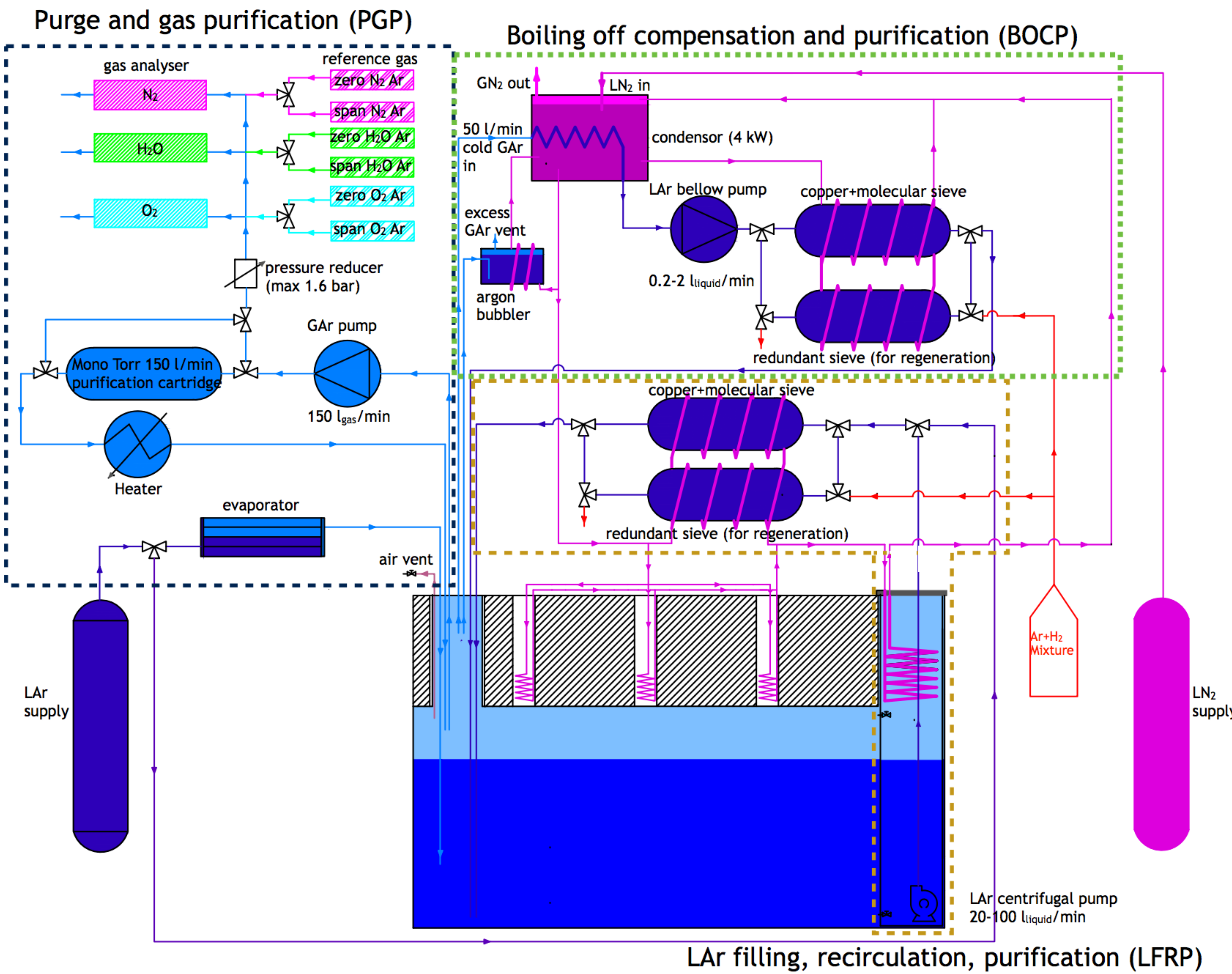
INDEX



amount	abrievation	Def.	Flange	chimney ø		crossing pipe ø	
				internal	external	internal	external
			CUSTOM	-	-	797.16	812.56
			CF 250	-	-	215.1	219.1
			CF 250	250	254	30	32
			CF 250	250	254	105	108
			CF 400	-	-	408	412
		T	CF 250			250	254
			CF 125	-	-	28	20

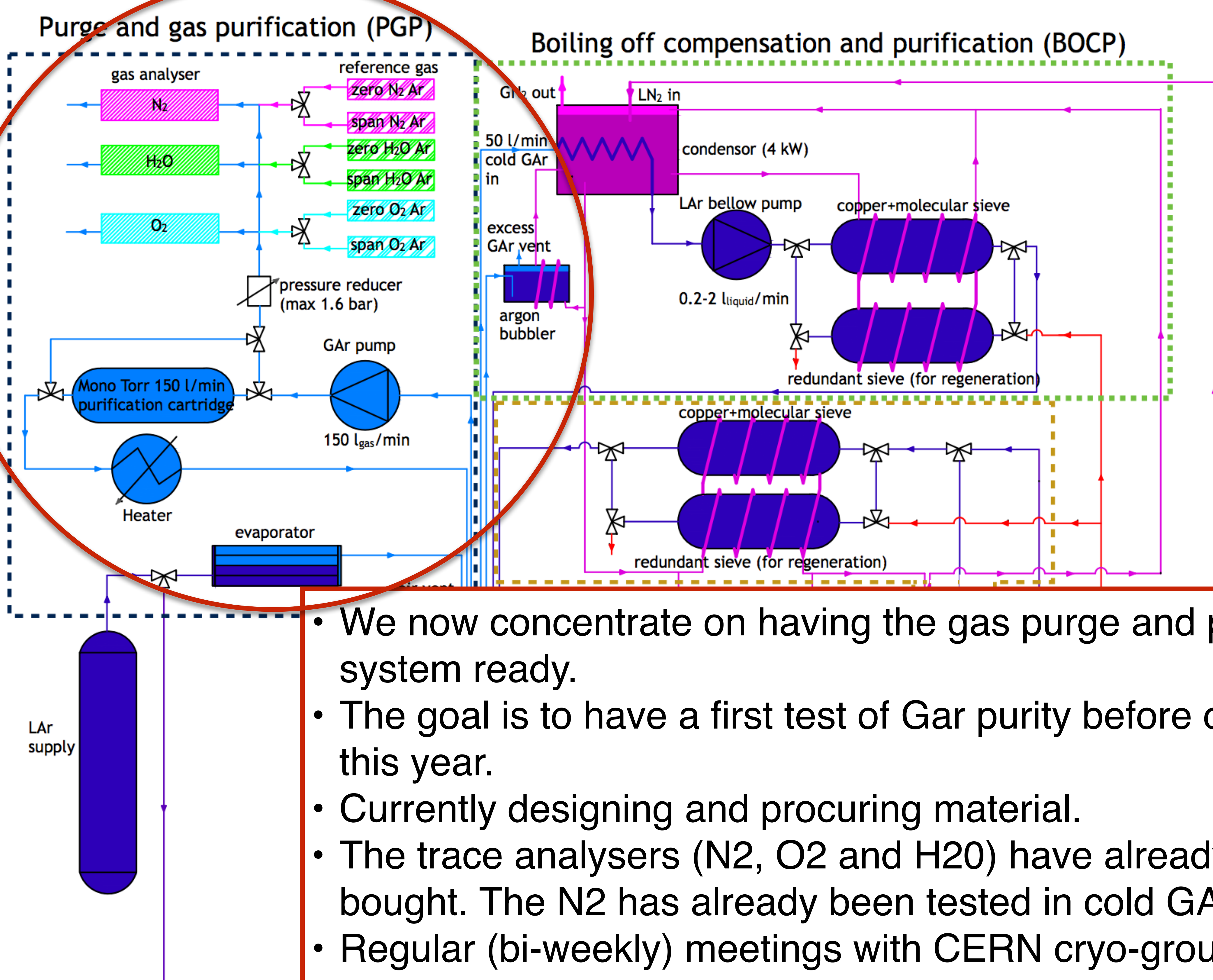


Cryogenics



Purge and gas purification (PGP)
gas analyser
reference gas
N_2
zero N_2 Ar
span N_2 Ar
H_2O
zero H_2O Ar
span H_2O Ar
O_2
zero O_2 Ar
span O_2 Ar
pressure reducer
(max 1.6 bar)
GAr pump
Mono Torr 150 l/min
purification cartridge
150 l_{gas}/min
Heater
evaporator
air vent
Boiling off compensation and purification (BOCP)
GN_2 out
LN_2 in
50 l/min
cold GAr
in
condensor (4 kW)
LAr bellow pump
copper+molecular sieve
excess
GAr vent
argon
bubbler
0.2-2 l_{liquid}/min
redundant sieve (for regeneration)
copper+molecular sieve
redundant sieve (for regeneration)
LAr
supply
Ar+H_2
Mixture
LN_2
supply
LAr centrifugal pump
20-100 l_{liquid}/min
LAr filling, recirculation, purification (LFRP)

Cryogenics

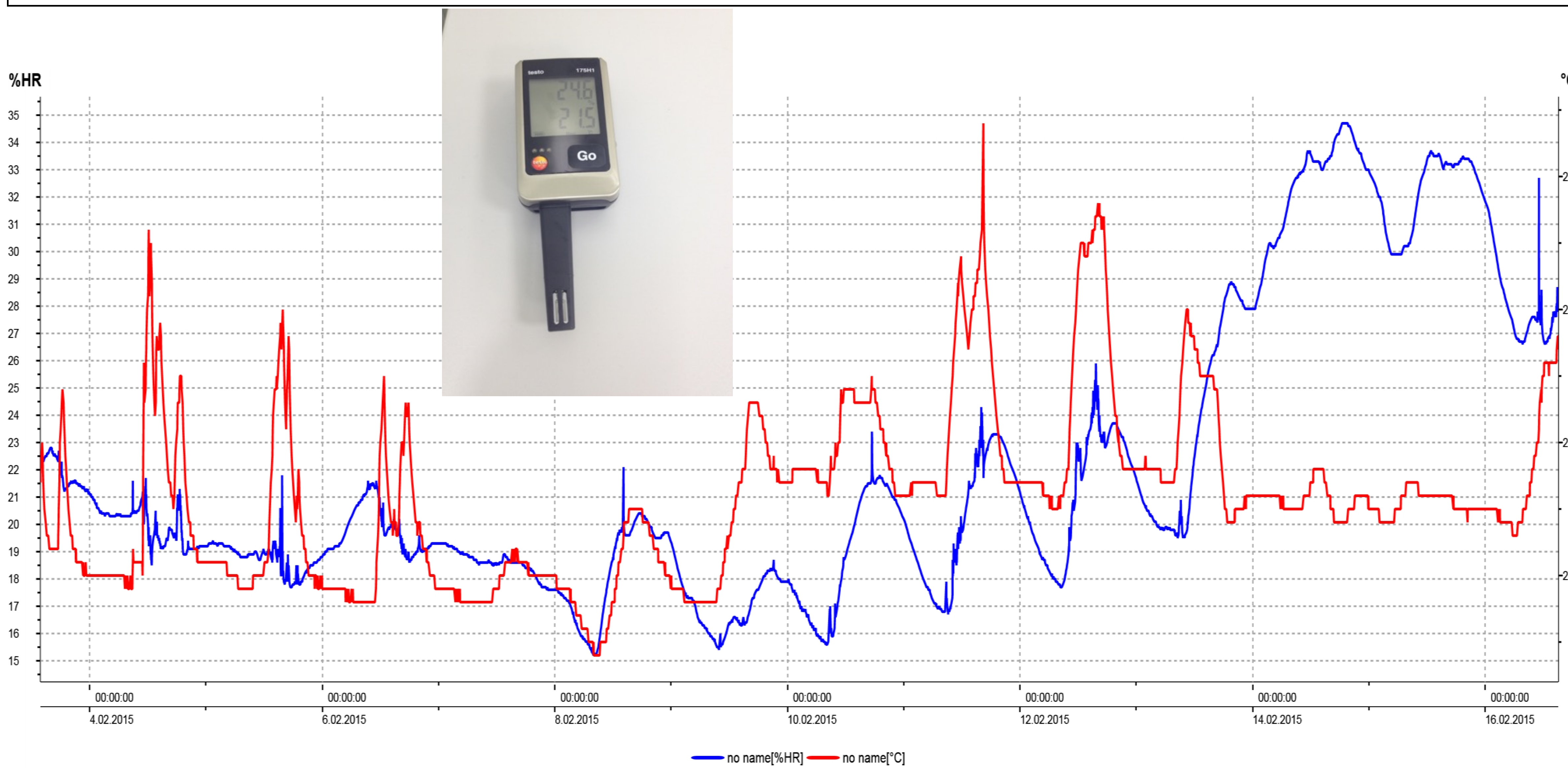


- We now concentrate on having the gas purge and purification system ready.
- The goal is to have a first test of Gar purity before christmas of this year.
- Currently designing and procuring material.
- The trace analysers (N2, O2 and H20) have already been bought. The N2 has already been tested in cold GAr.
- Regular (bi-weekly) meetings with CERN cryo-group to define the entire layout

Temperature & RH inside clean room

~13 days

Nom de l'appareil:		16/02/2015 15:10:36			Page 1/1
Temps du démarrage: 03/02/2015 13:47:39		Minimum	Maximum	Moyenne	Limites
Temps de l'arrêt: 16/02/2015 15:07:39	no name [%HR]	15.20	34.70	22.044	0.0/100.0
Canaux de mesure: 2	no name [°C]	19.40	23.40	20.586	-20.0/55.0
Valeurs: 9401					
SN 40334300					



Conclusion

- WA105 is a collaboration of 120 physicists with the goal of constructing and operating the 6x6x6 in the North Area.
- We have alternating bi-weekly meetings dedicated to the 6x6x6 installation. One week on software and the other on technical aspects (integration in NA, …). We are closely following the progress and schedule update of the EHN1 extension.
- Construction of the 3x1x1 is progressing well and on schedule.
- procedure for LEM+anode for the 666 will be adapted from what we learn from the 3x1x1 and adapted to fit larger scale demands.
- In general a lot of the work that is and has being done for the 3x1x1 is being used for the construction planification of the 6x6x6 (purchase of the tank, light readout, LEMs, slow control.…)