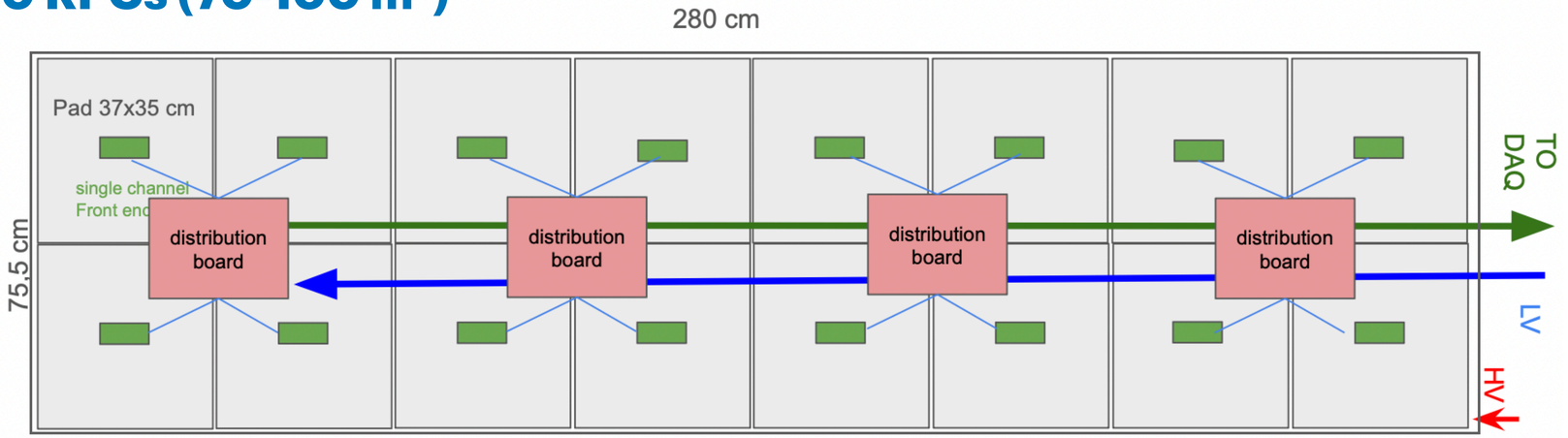
RPC activity for SWGO

RPC chambers x SWGO

PNRR CTAplus, Working Package 1520, INAF + INFN

Funds for About 30 RPCs (70-100 m²)

RPC layout - ver. 2.1



Dimensions: 288 x 80 cm x cm
Weight = 30 kg

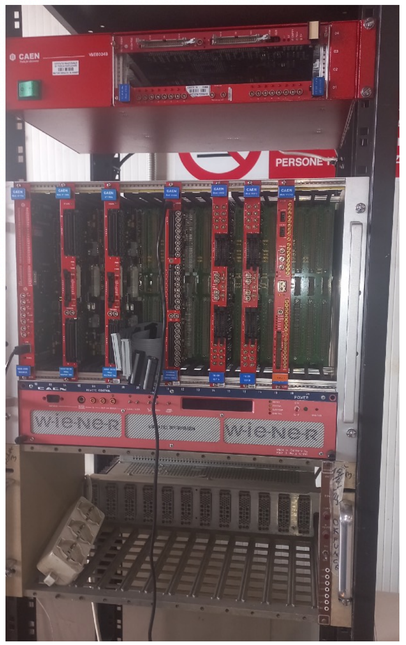
1 LV cable

4 ethernet cables (signal) + 1 (DCS)

1 HV cable

2 Full size chambers under test
DAQ station under preparation:
- prototype of DAQ system under development and similar to what we propose for the pathfinder

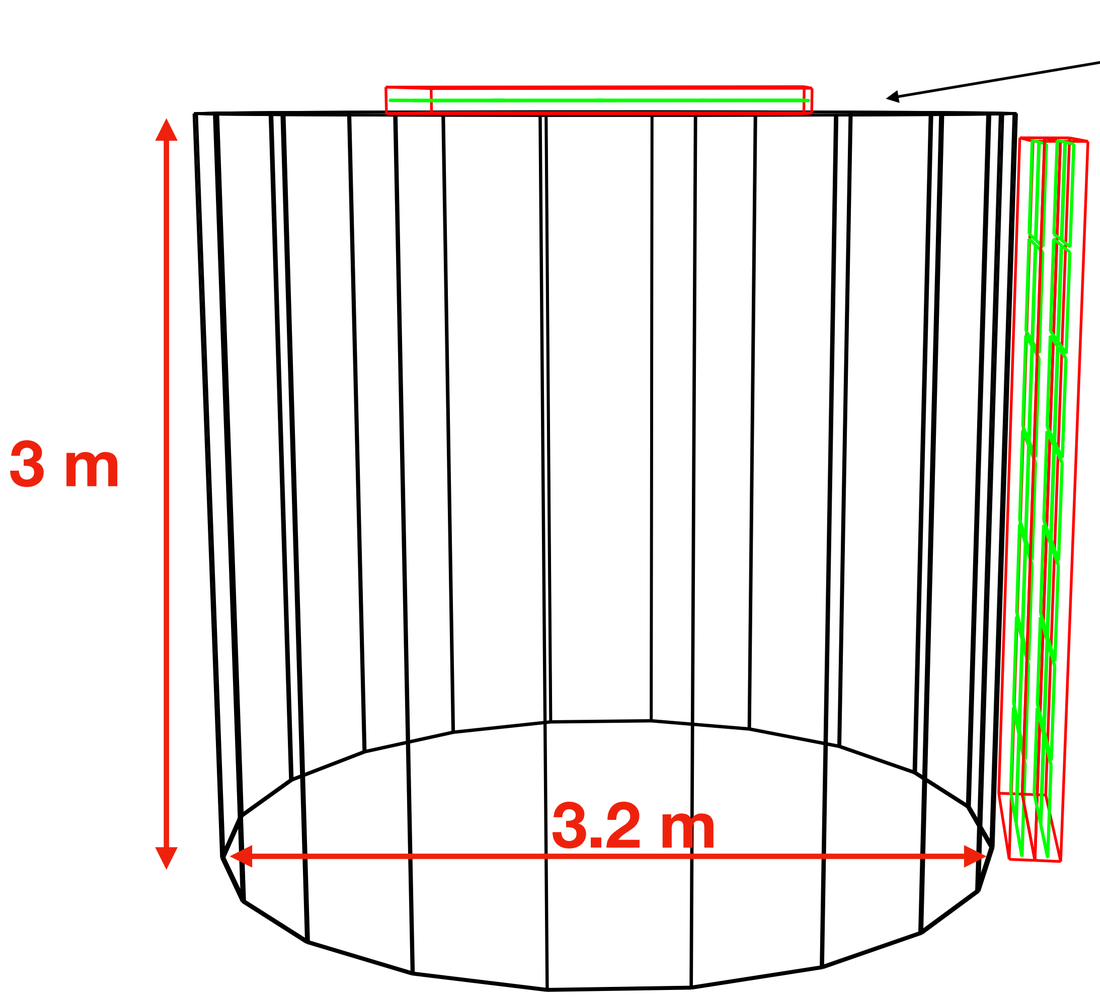
One more RPC in preparation

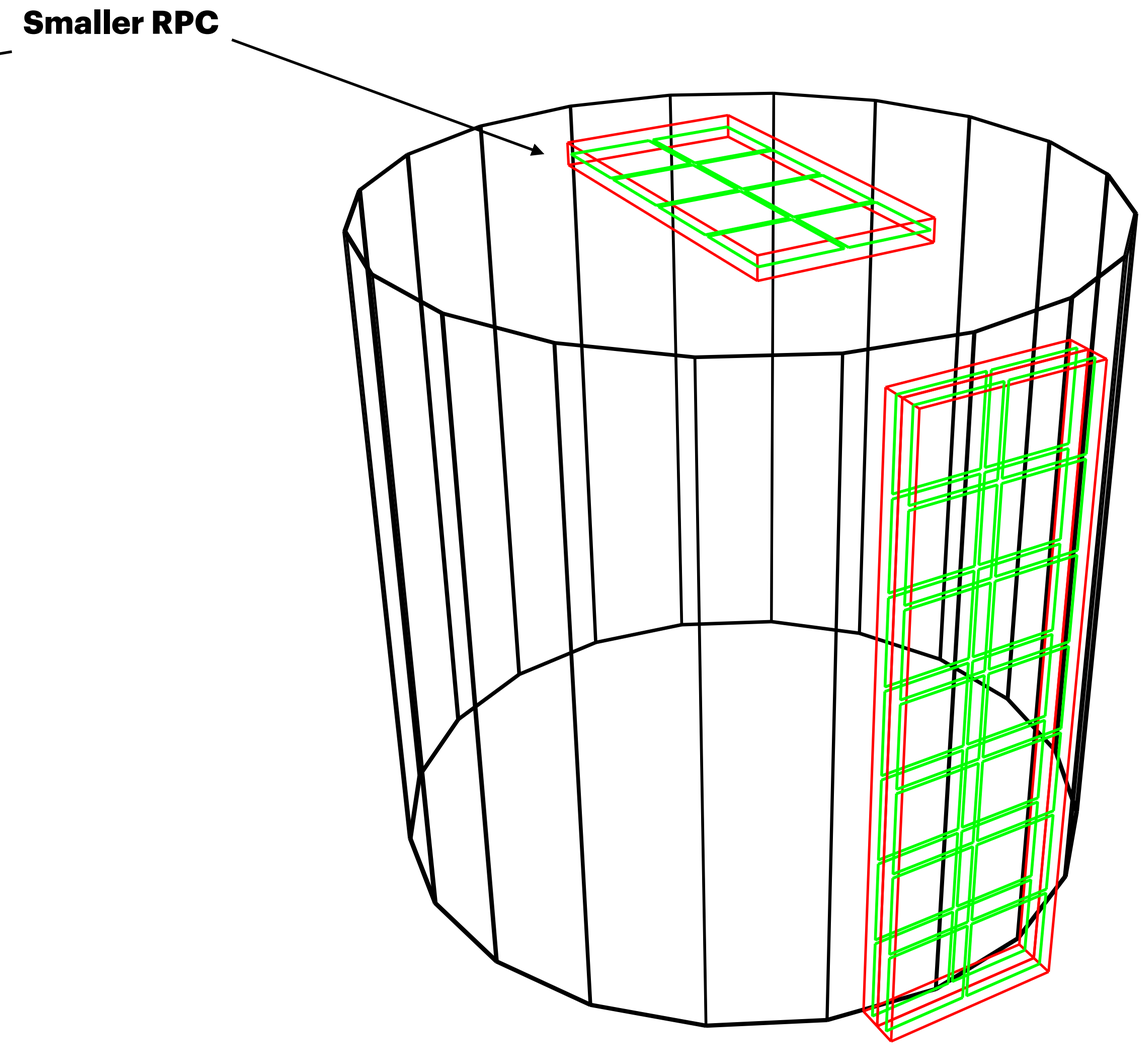


Layout for Milano test

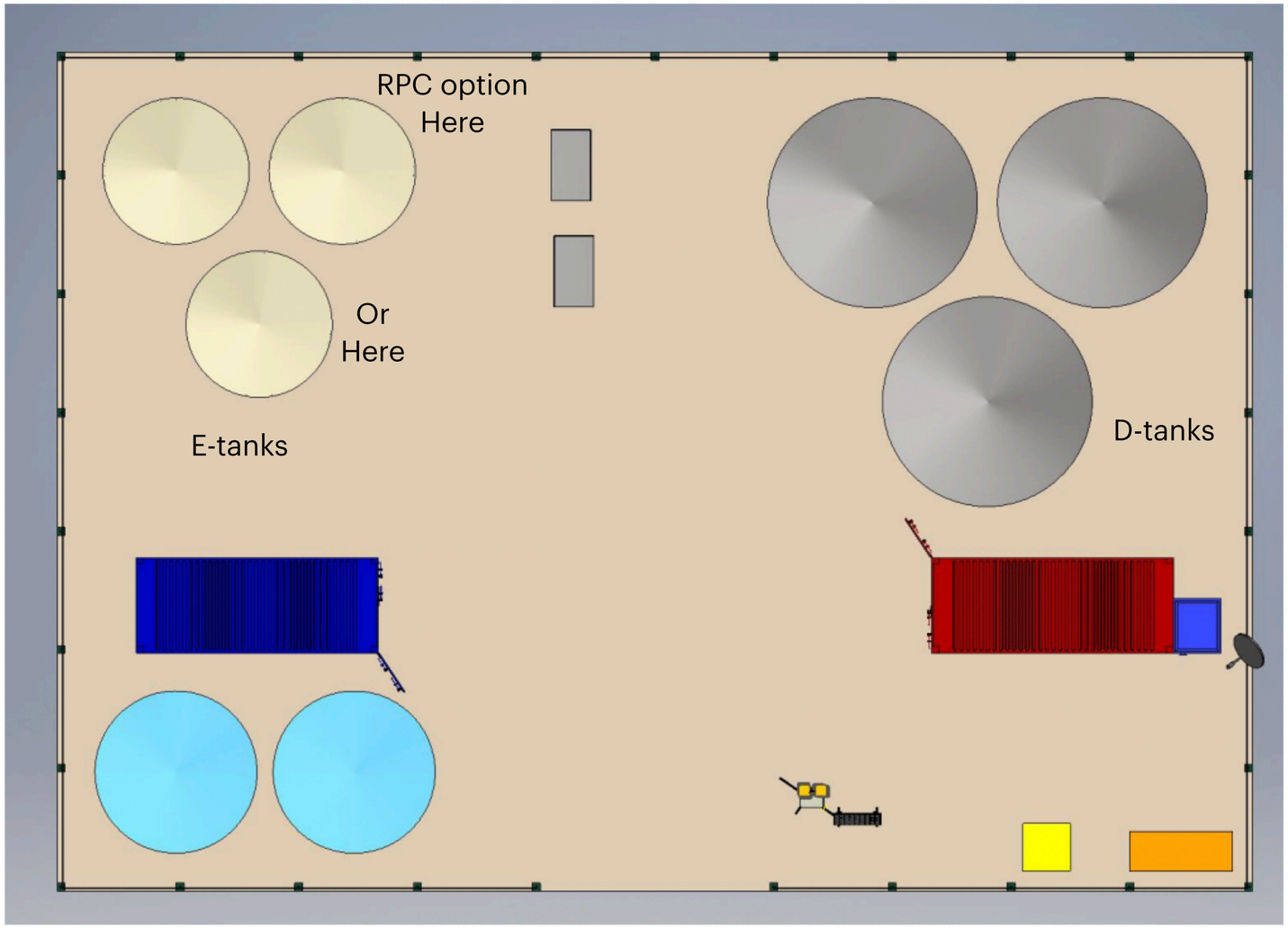
Tank dimeter 3.2 m
Tank height = 3 m

TOP: 1 RPC layer and 1 Chamber **1.6 m x 0.8 m**
LATERAL: 2 RPC layers with 1 Chamber each **2.8 m x 0.8 m**





Pathfinder in Pampa La Bola (Chile)

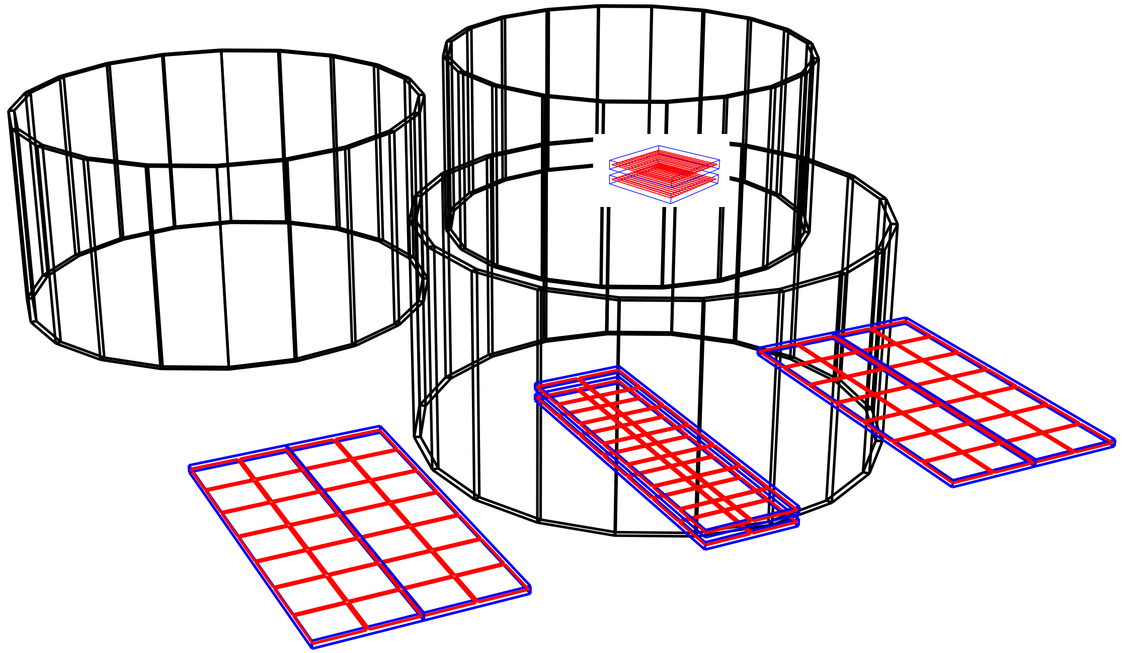


Pathfinder layout: possible options

Assumptions:

- tanks placed on a concrete basement and 6 RPCs placed in a slot of the basement (2 under the tank) 2-4 on the sides
- Something on the top (to be studied the possibility to place RPCs on top): simple baseline solution assume 2 small RPCs (50x50 cm^2). Possibility to place 2 RPCs full size

Baseline proposal



Possibility to trigger on several typologies of cosmic muons:

- **from top to bottom**
- **From top to lateral**

Possibility to trigger on showers according to pad multiplicity or to Give informations on muon isolation

Summary

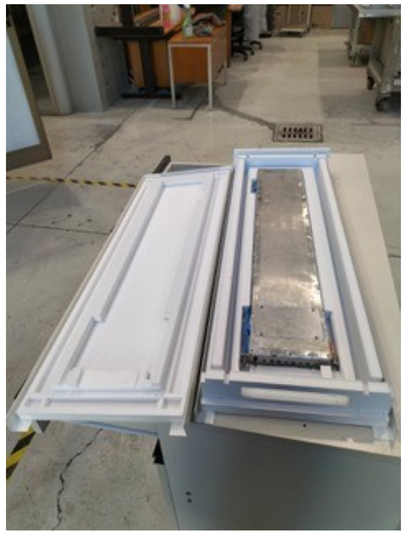
- **Two of the three full size chambers ready and under test in Tor Vergata**
- **Test in Milano planned in May. DAQ almost ready.**
- **Pathfinder layout proposal presented in SWGO for 1 e-tank**
  - **The project has been integrated in pathfinder plans**
  - **Gas problem: are the r134a or HFO1234ze authorized in the site ?**
  - **Help needed for DAQ**
    - We have a clear plan for Milano. Not so clear if it can be used in Chile. Not big support form SWGO Collaborators
  - **Costs**
    - 80 % of the project costs covered by PNRR funds
    - 50% of remaining cost (missing DAQ boards, cables, connectors) will be recovered in Tor Vergata/LNF
    - Gas to operate pathfinder - thermal jacket - consumption still missing: O(10 KEuro) Commissione 2 ?
    - Concrete prefab + footboard on side RPCs missing: Not clear if SWGO will help ?

Backup

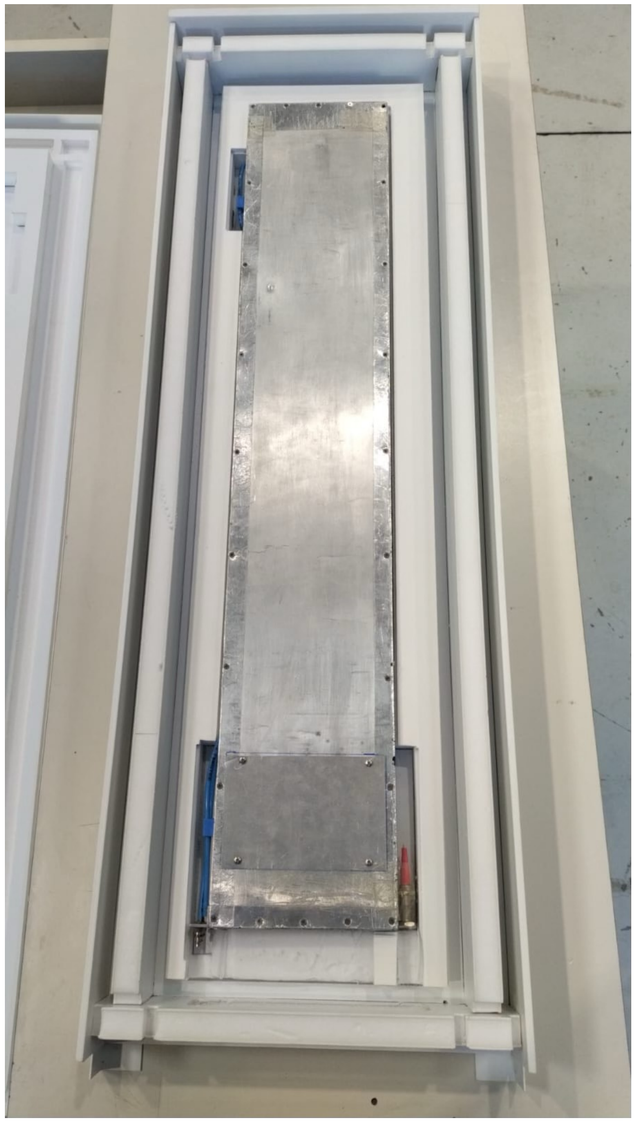
Thermal coverage

- Thermal coverage for outdoor operations



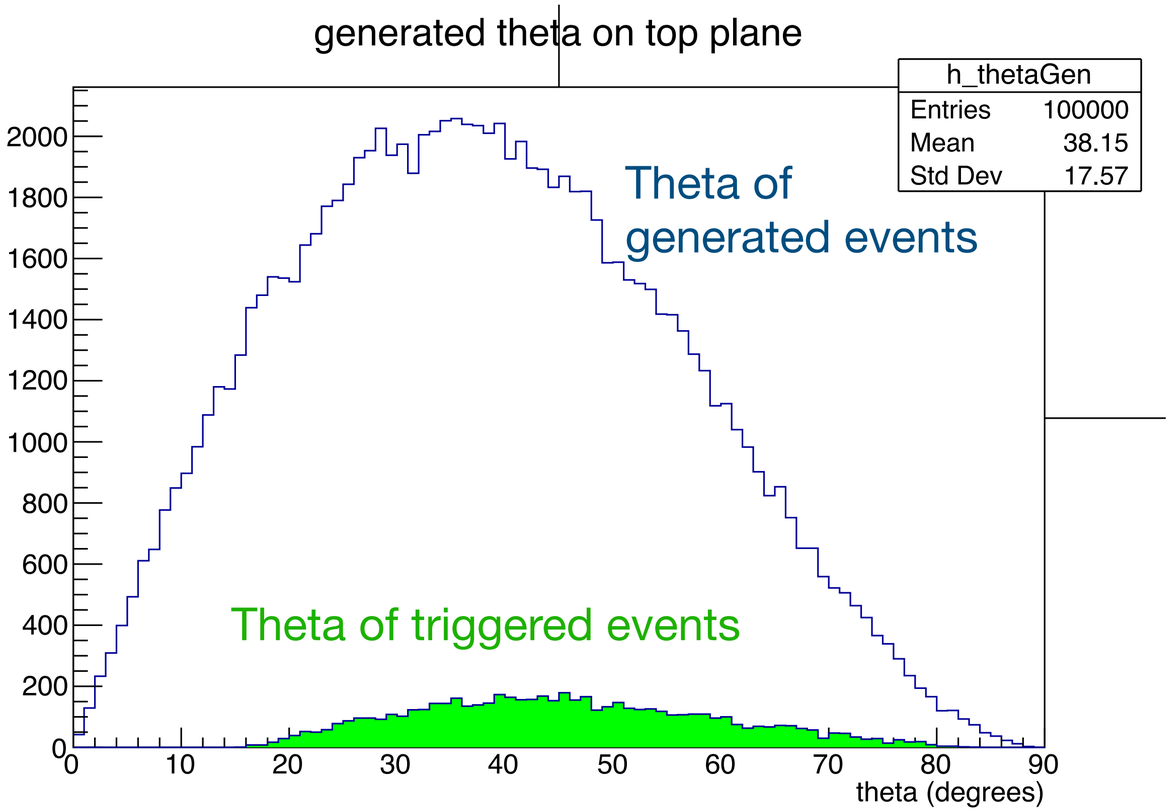



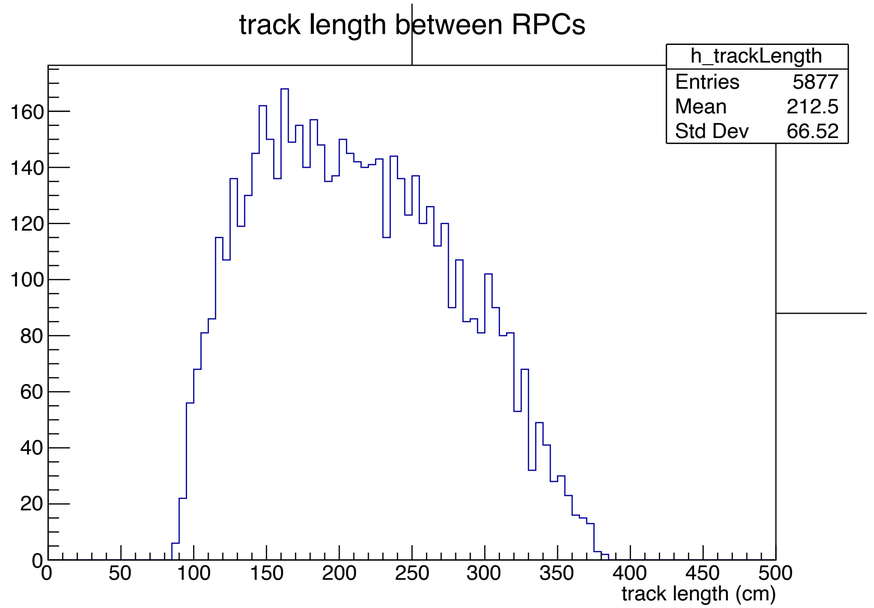
- Prototype for small chamber designed and produced
- Test of temperature cycles ready to start

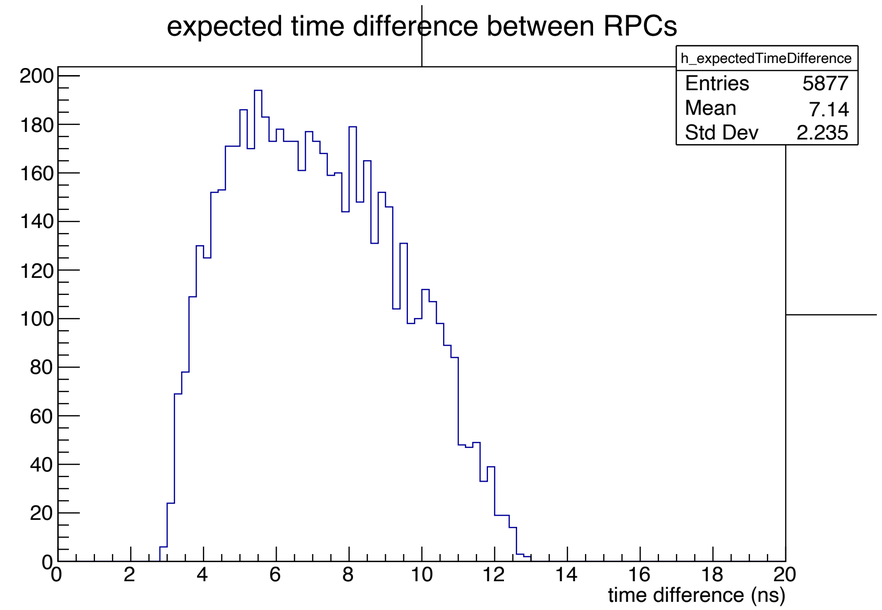


Simulated Cosmic Muons for Milano test

100000 Muons simulated on **TOP RPC** (**Area=1.28 m²**)
5877 Muons triggered
Geometrical Acceptance = **5.9%**
Expected Coincidence rate = 100 hz/m² * 1.28 m² * 0.059 = **7.5 hz**



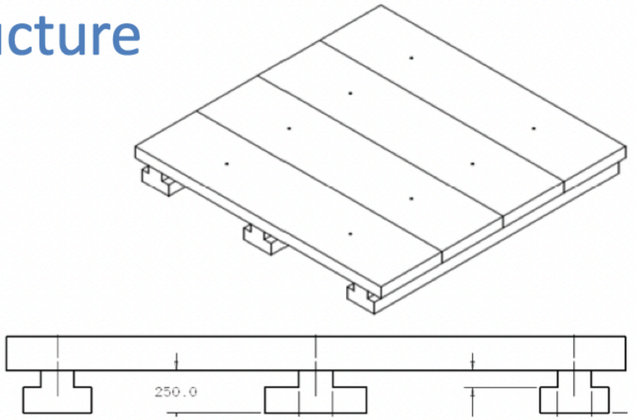


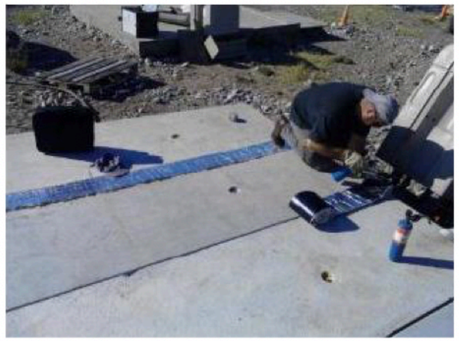


RPC on the bottom: concrete basement from Auger test

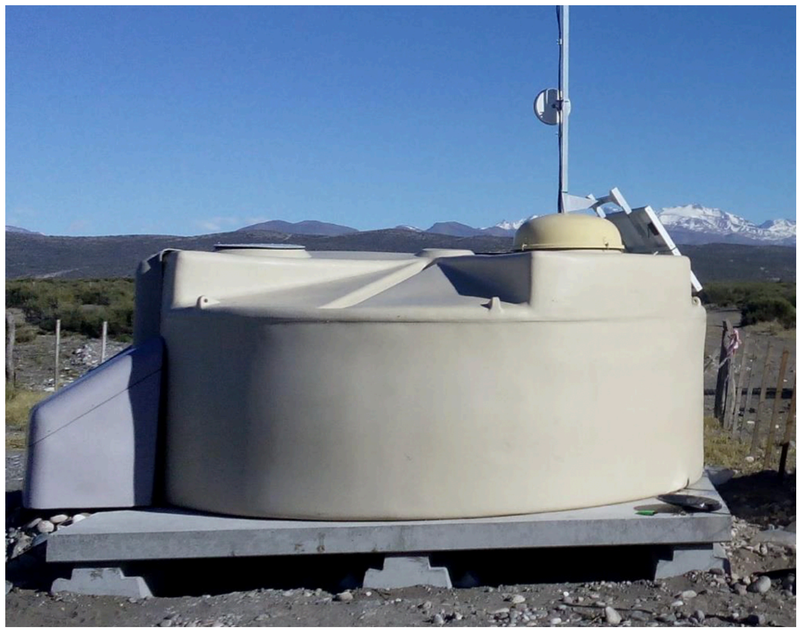
The support structure

Precast structure built at the observatory
Transported to the field
Installed in a couple of hours
(Emptying/Filling the tank
is more time consuming)





From a presentation of Lisboa Group



Gas system

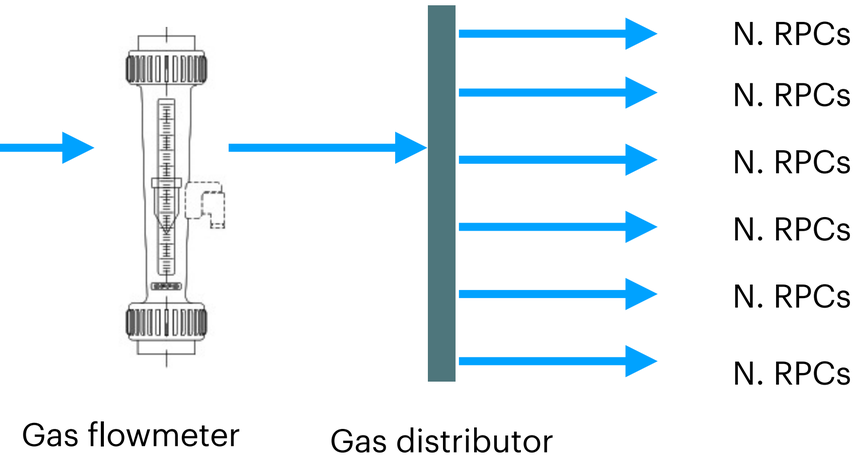
- Simplified gas system assuming operations in **pure HFO1234ze ($H_3C_2F_4$) or TFE ($H_2C_2F_4$).**
  - **Non flammable, works at vapor pressure of few bars**
  - No need for a gas mixer
  - **Pure TFE tested by Lisbon colleagues for MARTA RPCs in Auger**
  - **Pure HFO to be tested in laboratory in Tor Vergata and LNF**

- From the gas bottle to a a simple flowmeter to control the flow, and via pipes to RPCs
  - Specific layout of gas distribution will depend on final design (mix flow in parallel/series)

- Low flow rate: **3 Volumes/day**

- Typical HFO bottle (40 kg - price order of 1500 Euro)
- Typical TFE bottle (40 kg - price order of 800 Euro)
- enough for 4 months (assuming 6-8 operating RPCs)

- **Gas bottle to be placed in a hole done on ground and a small cabinet** on top (Liquefaction temperature around -20 °c)



PRELIMINARY LAYOUT

HV-LV power systems

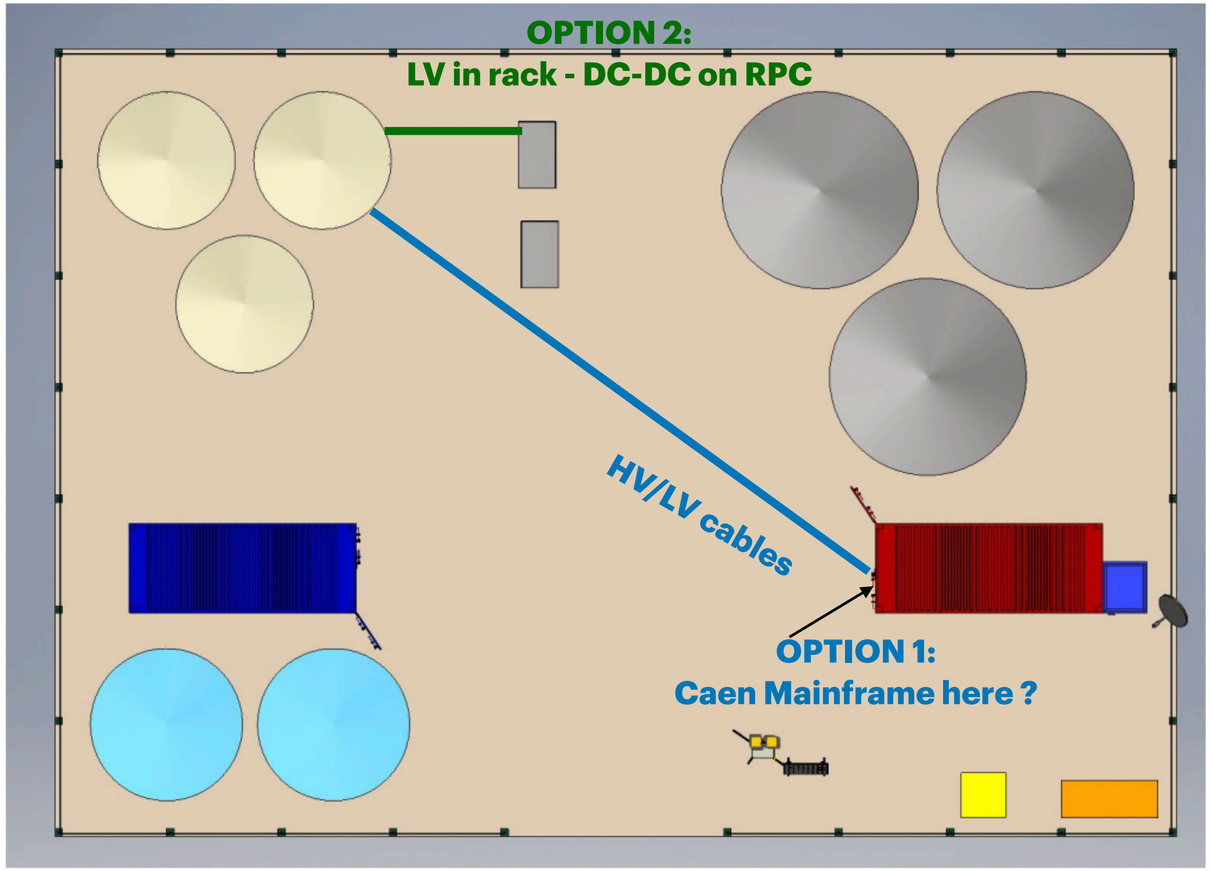
OPTION 1: will be tested in Tor Vergata and on Milano tank

- CAEN mainframe (6U unit - **depth 80 cm**):
  - **One HV board (mod.):** 6 channels,15 kV, 1 mA per channel
    - Max current per chamber 100 uA -> 1.1 Watt/chamber
    - Total power for 8 chambers about 9 Watt (15 Watt considering 60% efficiency)
  - **One LV board (mod. A1517A): 6** channels (7 V, 4 A)
    - Front end board power 0.07 Watt/card -> 1.12 Watt/chamber
    - Total power for LV (8 chambers): <9 W (15 Watt considering 60% efficiency)

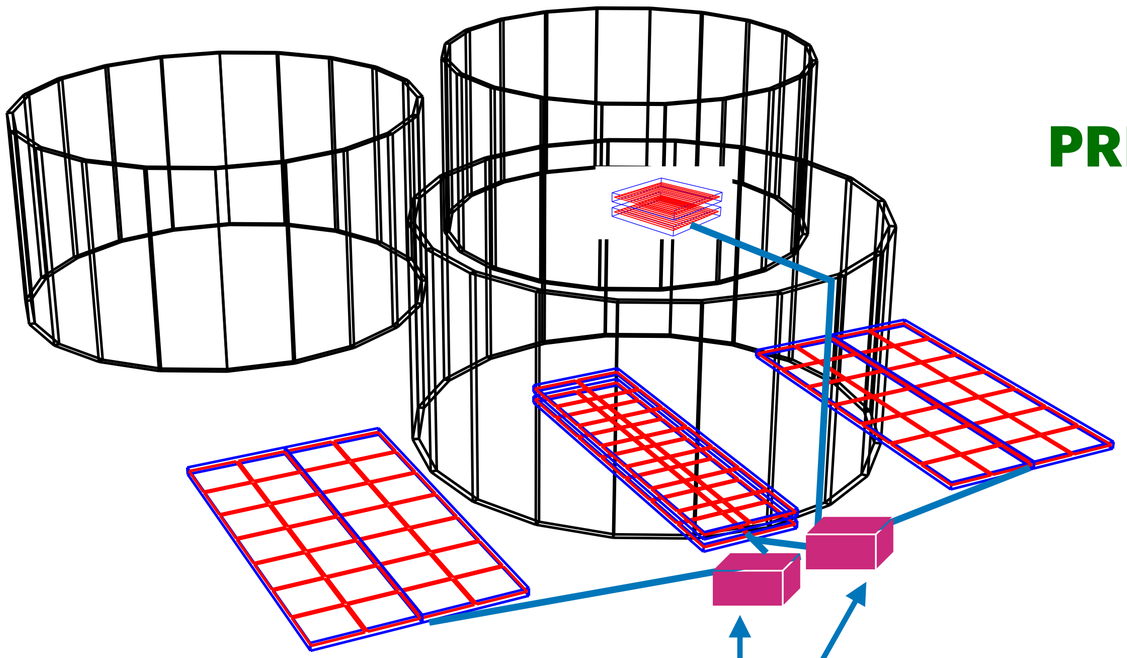
CAEN power supply mainframe

OPTION 2: under development and test in Tor Vergata

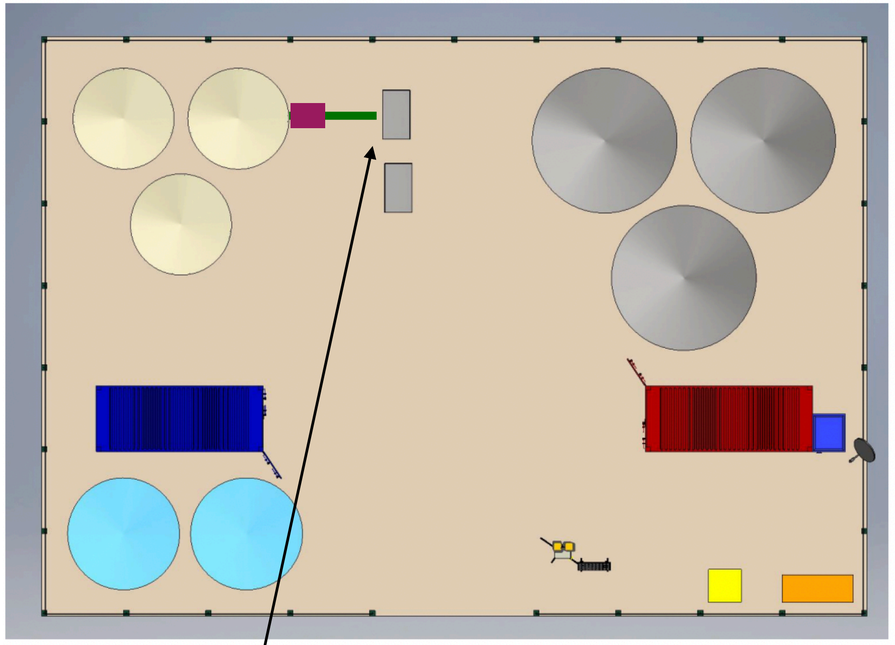
- LV power supply
  - Can we take the LV from the field node rack ?
  - How can we control it ? Power on/off -rump up/down
- DC-DC converter for HV mounted on RPC:
  - Under test



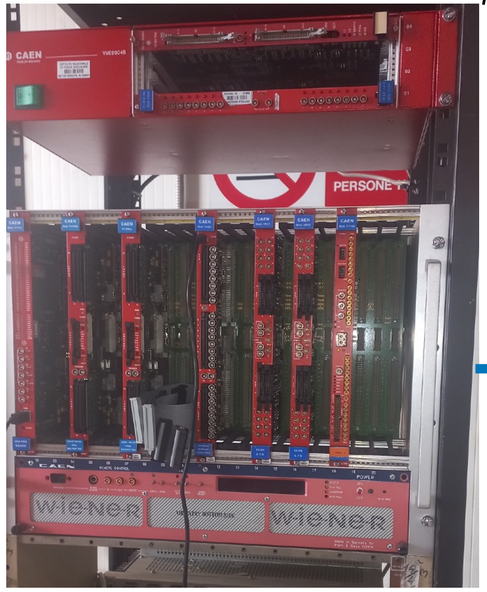
DAQ (baseline option)



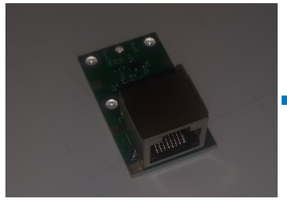
PRELIMINARY



VME crate in rack



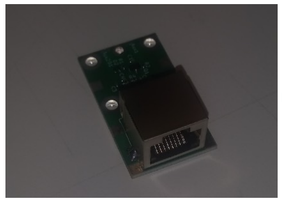
Front End board on RPC



Cluster distributor box

5 Ethernet cables/chamber

20 Ethernet cables/splitter box (4 chambers)



5 Ethernet cables/chamber

20 Ethernet cables/splitter box (4 chambers)

How to synchronize with PMT DAQ ?

Power budget and hardware location (preliminary)

Power budget Option 1 (option 2 about 80 Watt less)

Number of RPCs	8				
HV mainframe sy5527	Units	Power per unit (W)	Power (W) assuming 0,6 efficiency (average)	Power (W) assuming 0,6 efficiency (maximum)	**Needs 230 V AC**
CPU+AC/DC	1	20	20	20	
Fan speed	1	20	20	60	
HV current RPC	8	1	13,3	15	
LV RPC	128	0,07	14,9	15	
Total SY5527			68	110	
DAQ VME	Units	Power per unit (W)	Power (W) assuming 0,6 efficiency (average)	Power (W) assuming 0,6 efficiency (maximum)	**Needs 230 V AC**
TDC V1190A	1	26	43	43	
Logic unit V2495	1	5	8	10	
Digitizer VME	1	30	50	50	
VME controller	1	4	7	7	
Fan speed	1	20	20	60	
CPU+AC/DC	1	20	20	20	
Total VME			148	190	
Splitter + DCS	Units	Power per unit (W)	Power (W)	Power (W)	
splitter	2	6,5	13	13	
Pc + NI boards	0	180	**0**		
Total ancillary			13	13	
Total			230	313	

Hardware location

	Option 1	Option 2
POWER SYSTEM		
HV mainframe	Server container	
HV board	Server container	
LV board	Server container	VME crate field node
DC/DC converter		Cluster box
DAQ VME		
VME crate	Field node	Field node