

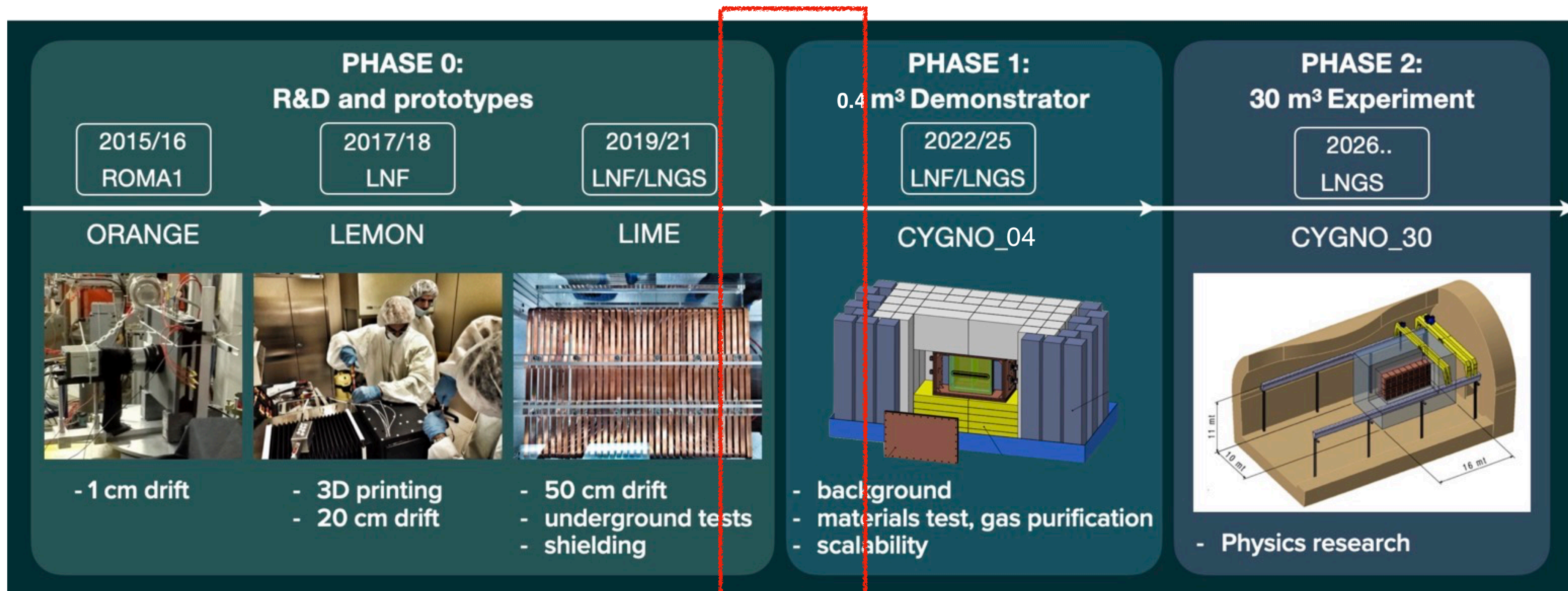
CYGN004 Technical Review Meeting

22/7 G. Mazzitelli

CYGNO-04 project scientific objective

CYGNO a large TPC for dark matter and neutrino study

exploiting the progress in **commercial scientific Active Pixel Sensors (APS)** based on CMOS technology to realise a large **gaseous Time Projection Chamber (TPC)** for **Dark Matter and Solar neutrino search**.



low-energy (1–100 keV) nuclear recoils
10⁵ beta/gamma rejection

now!

introduzione 1/3

- la collaborazione CYGNO nel 2022 ha presentato **un TDR ai LNGS/CSN2** per dimostrare la **sostenibilità economica e realizzabilità** del progetto e quindi avere la disponibilità degli spazi (sala F) dove installare.
- il TDR prevede che le **spese “core”** del progetto - compresi i lavori infrastrutturali ai LNGS - siano coperte dall'ERC INITIUM e i **running cost** dalla CSN2.
- il progetto è stato di fatto “accettato” e si è passati ad una **fase esecutiva** chiudendo la **PHASE0 di R&D** e passando alla **PHASE1 di costruzione** del dimostratore CYGNO04

project organization

working package and management

- WP1 - **Physics** E. Baracchini (GSSI)
- WP2 - **Analysis** G. Dho (LNF)
- WP3 - **Simulation** G. D’Imperio (RM1)
- WP4 - **Detector design & construction** G. Mazzitelli (LNF)
- WP5 - **Auxiliary service** A. Messina (RM1)
- WP6 - **R&D** D. Pinci (RM1)
 - and task leder: run coordinator, GEM leader, etc. etc

2 spokesperson (E. Baracchini/D. Pinci),

Technical Manager (G. Mazzitelli),

Steering Committee (F. Petrucci, international representatives...); periodic meeting slides ecc: <https://agenda.infn.it/category/1149/>

Physics WP1		Analysis WP2		Simulation WP3		Detector WP4		Services WP5		R&D WP6		Management WP7	
Elisabetta Baracchini		Emanuele Di Marco		Giulia d'Imperio		Giovanni Mazzitelli		Francesco Renga		Davide Pinci		Elisabetta Baracchini Giovanni Mazzitelli Davide Pinci	
Task	Coordinator	Task	Coordinator	Task	Coordinator	Task	Coordinator	Task	Coordinator	Task	Coordinator	Task	Coordinator
Dark Matter	G. Dho	Reconstruction Development	E. di Marco	Prototypes with GEANT	G. d'Imperio	Design	S. Tomassini	DAQ	A. Messina	ECO-GAS studies	D. Piccolo	INFN Responsible	D. Pinci
Solar Neutrinos	S. Torelli	Online-Offline software integration	G. Mazzitelli	Nuclear Interactions with SRIM	F. di Giambattista	Integration	G. Mazzitelli	Trigger	H. Lima	Negative Ions	E. Baracchini	Technical Coordination	G. Mazzitelli
Super Nova DM	E. Baracchini	Data Analysis	E. di Marco	Gas properties with Garfield	D. Pinci	CMOS sensor	R. Nobrega	HV	F. Renga	Gas Mixtures	F. Amaro	Publications and Conferences	G. Maccarrone
Sensitivities and discovery potential	G. Dho	Software Maintenance	E. di Marco	Sensor performance	R. Nobrega	GEM	L. Benussi	Gas System and Slow Control	F. Renga	Field Cage	G. Mazzitelli	International Collaborations	E. Baracchini
Migdal	A. Messina	Infrastructures	G. Mazzitelli	Integration	F. Petrucci	Performance Studies	D. Pinci	Gas Purification	R. Gregorio	Gas Luminescence	D. Pinci	Safety and Environment	G. Mazzitelli
LNGS Neutron Flux	F. di Giambattista			Infrastructures	G. Mazzitelli	Light Sensors	F. Iacoangeli	Calibration	G. Cavoto	Alternative MPGD	E. Baracchini	Call Applications	E. Baracchini
								Storage and Networks	G. Mazzitelli				

Table 8.2: Working Packages (WP) and WP leaders of the CYGNO/INITIUM project

ending PHASE0

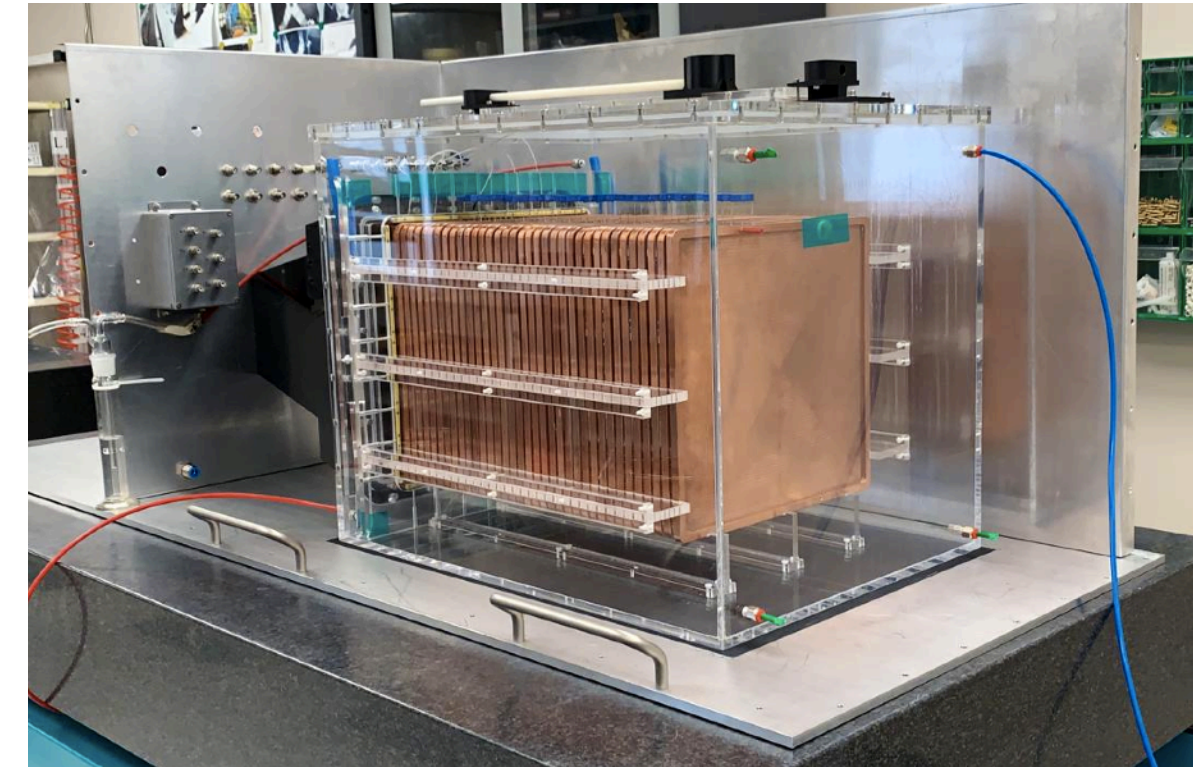
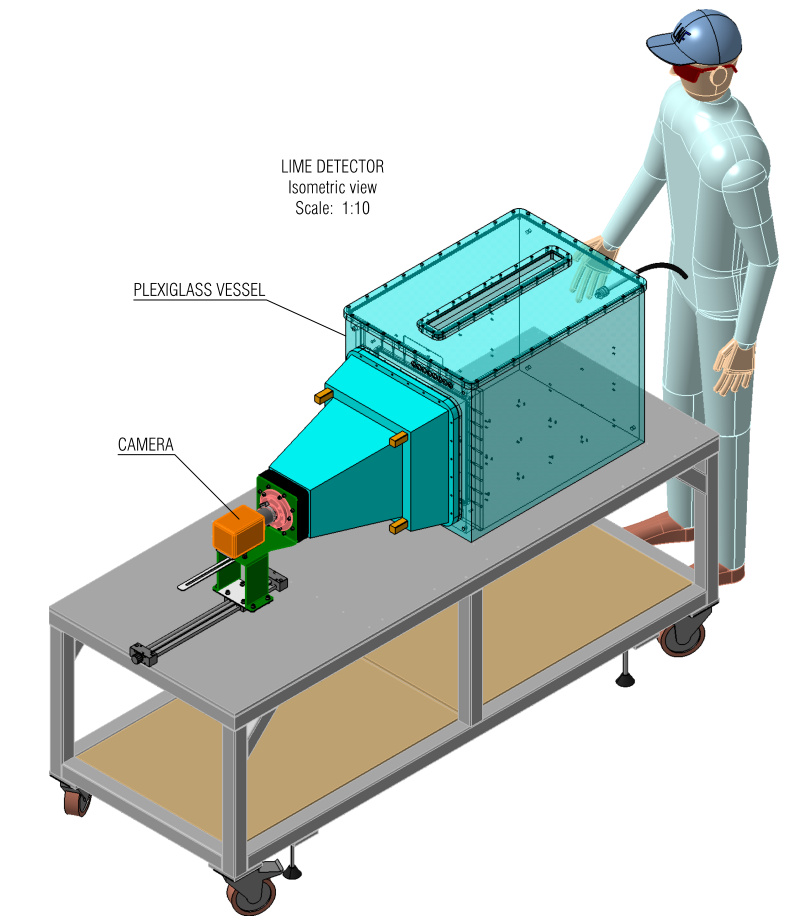
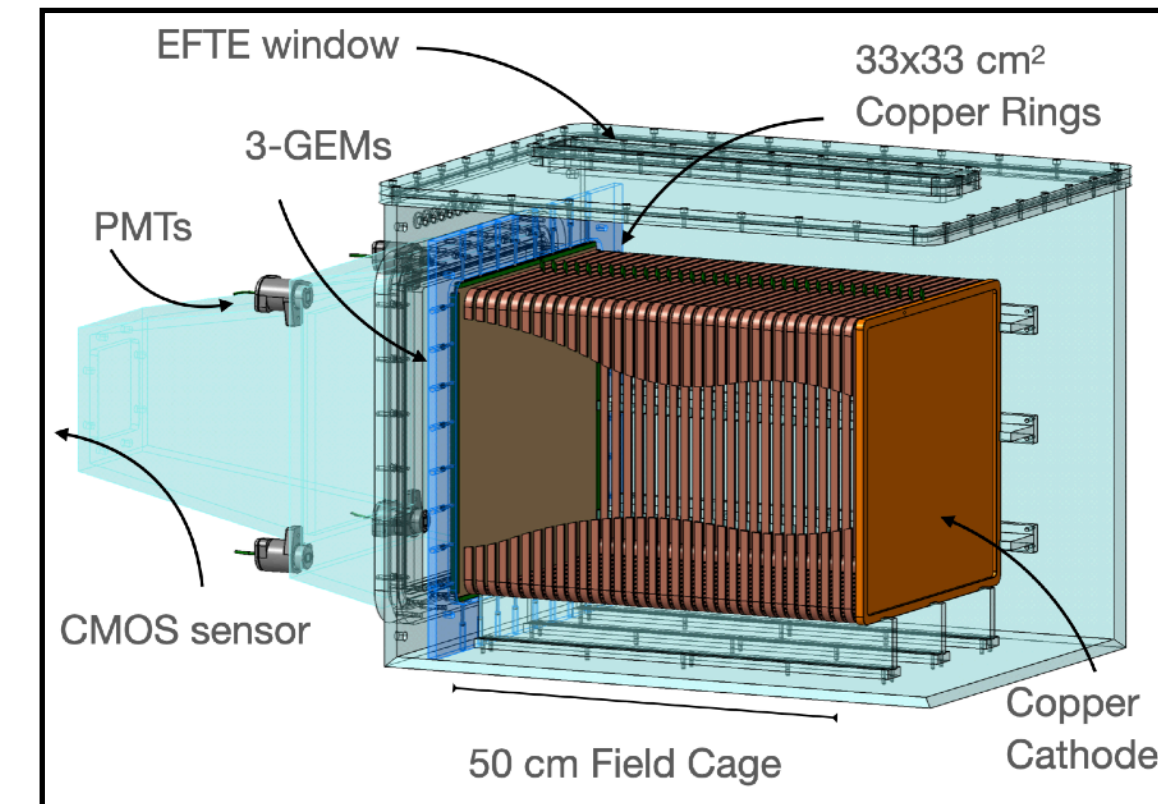


last step of PHASE0

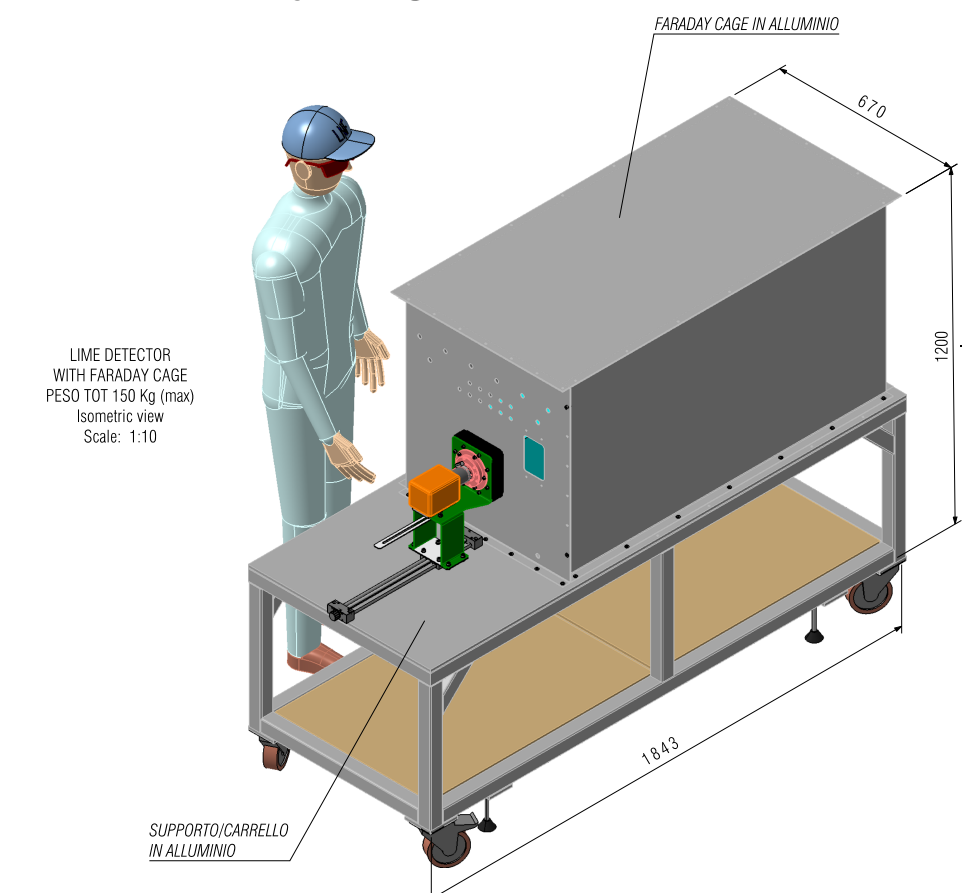
LIME prototype

LIME setup at LNGS is going to end phase0 dedicated to R&D with the objectives:

- to training us for the **design and construction** capability to realise a larger detector at LNGS;
- test the **auxiliary systems**, gas and DAQ, to be exploit in CYGNO-04 and prepare the data taking, analysis, computing etc for PHASE1;
- **validating Montecarlo** simulation

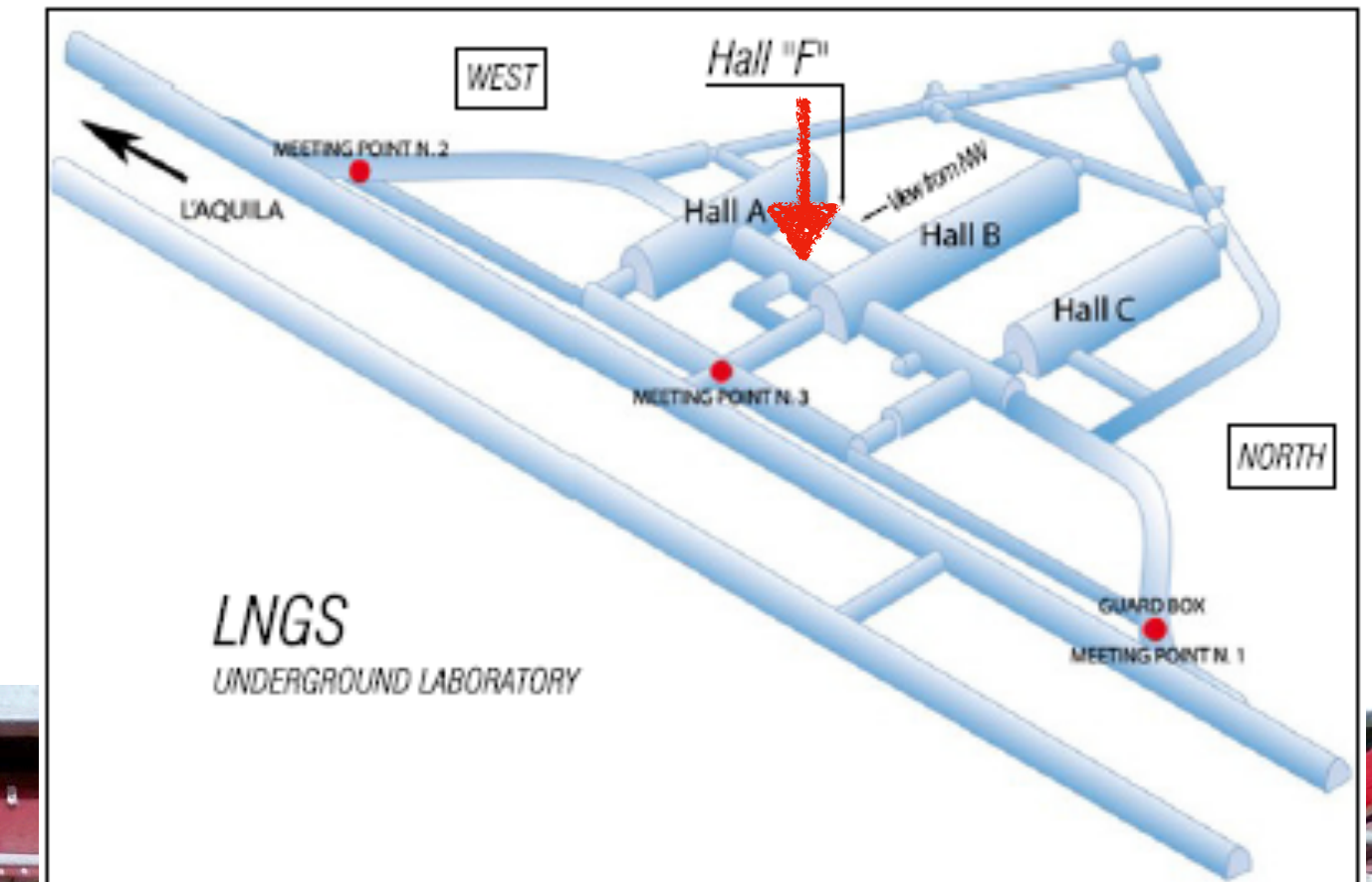


- 50 cm drift made of Cu ring 33*33 cm
- 50kV Cu cathode (up to 1kV/cm)
- triple GEM stack amplification stage
- low radioactivity PMMA vessel
- a single sCMOS Active Pixel Sensors (APS) HAMAMATSU camera + Schneider commercial optics
- 4 PMT symmetrically placed around the sensor for time shape
- Aluminum faraday cage



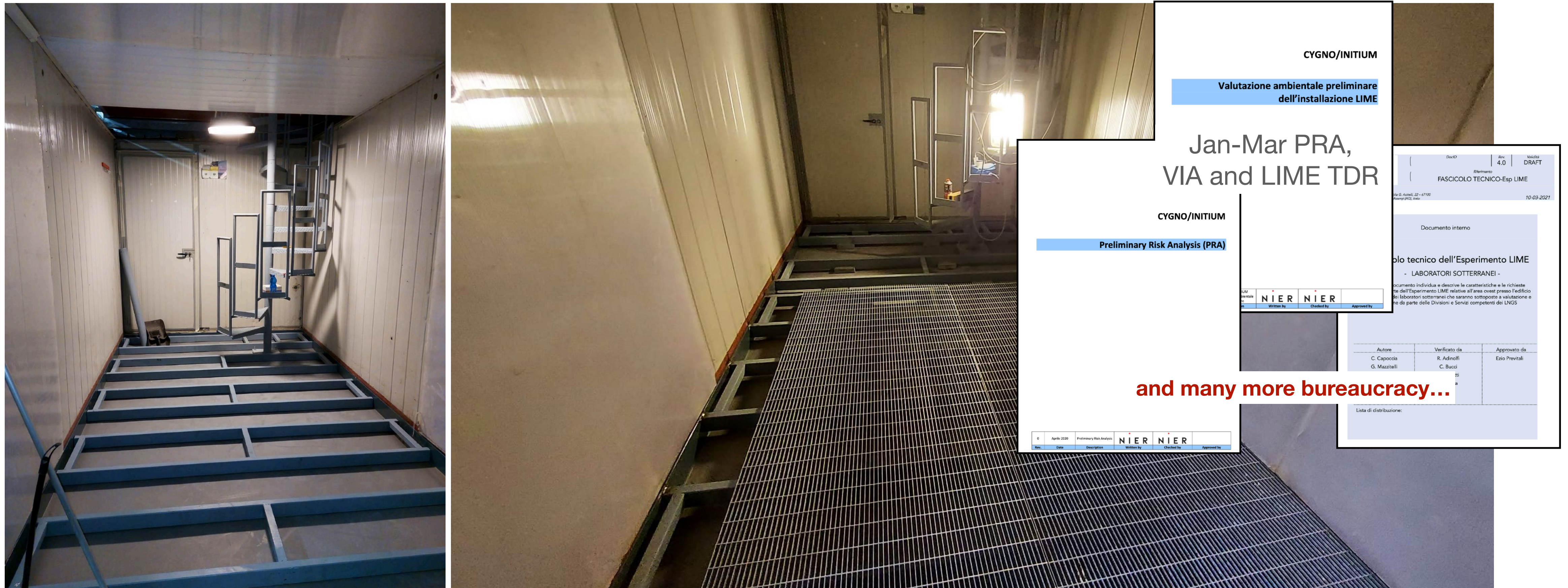
start of ending PHASE0

site refurbishing



LNGS LIME site refurbishing

water vessel (example of environmental and cost constraint)

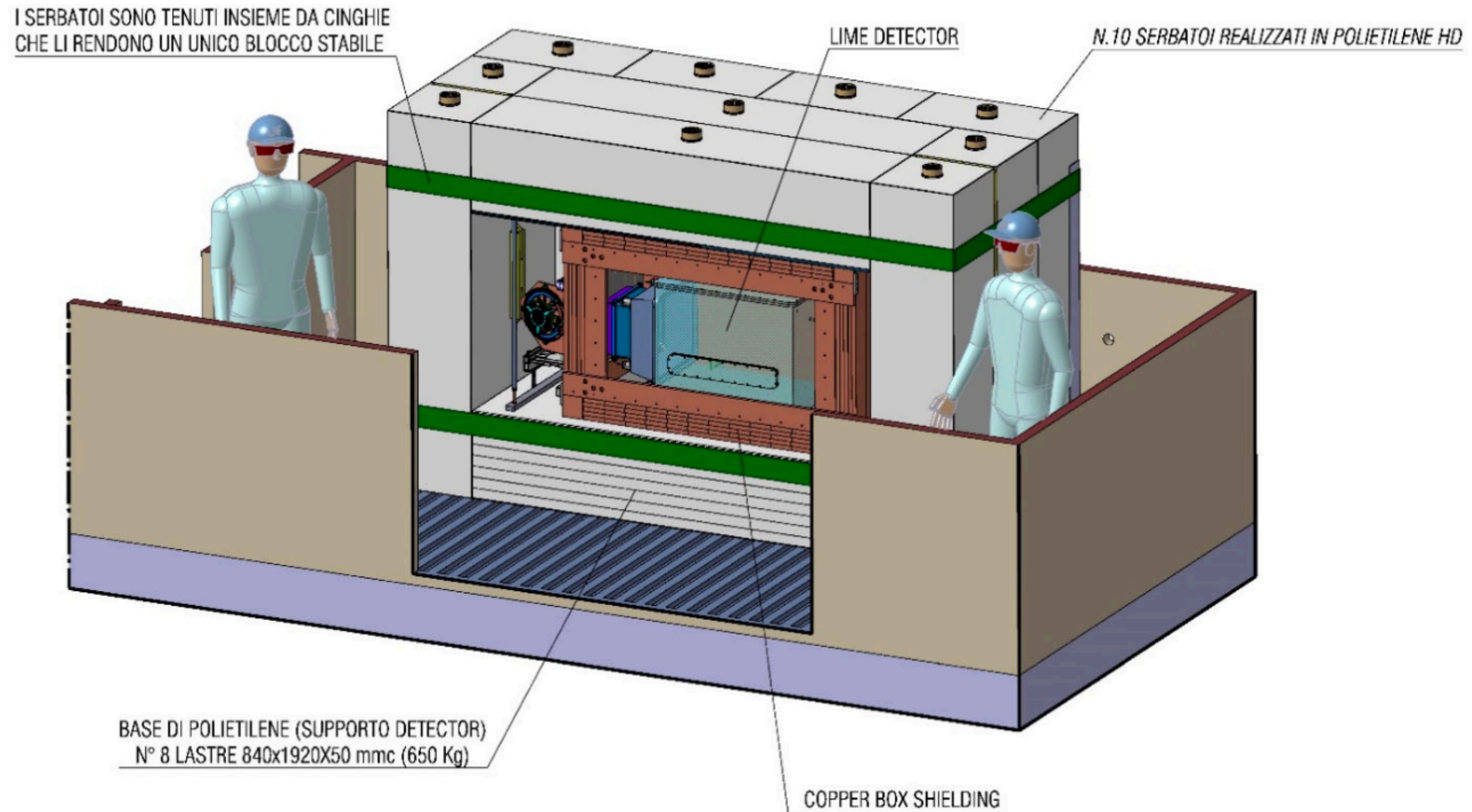


LNGS LIME site refurbishing exploiting any left space...



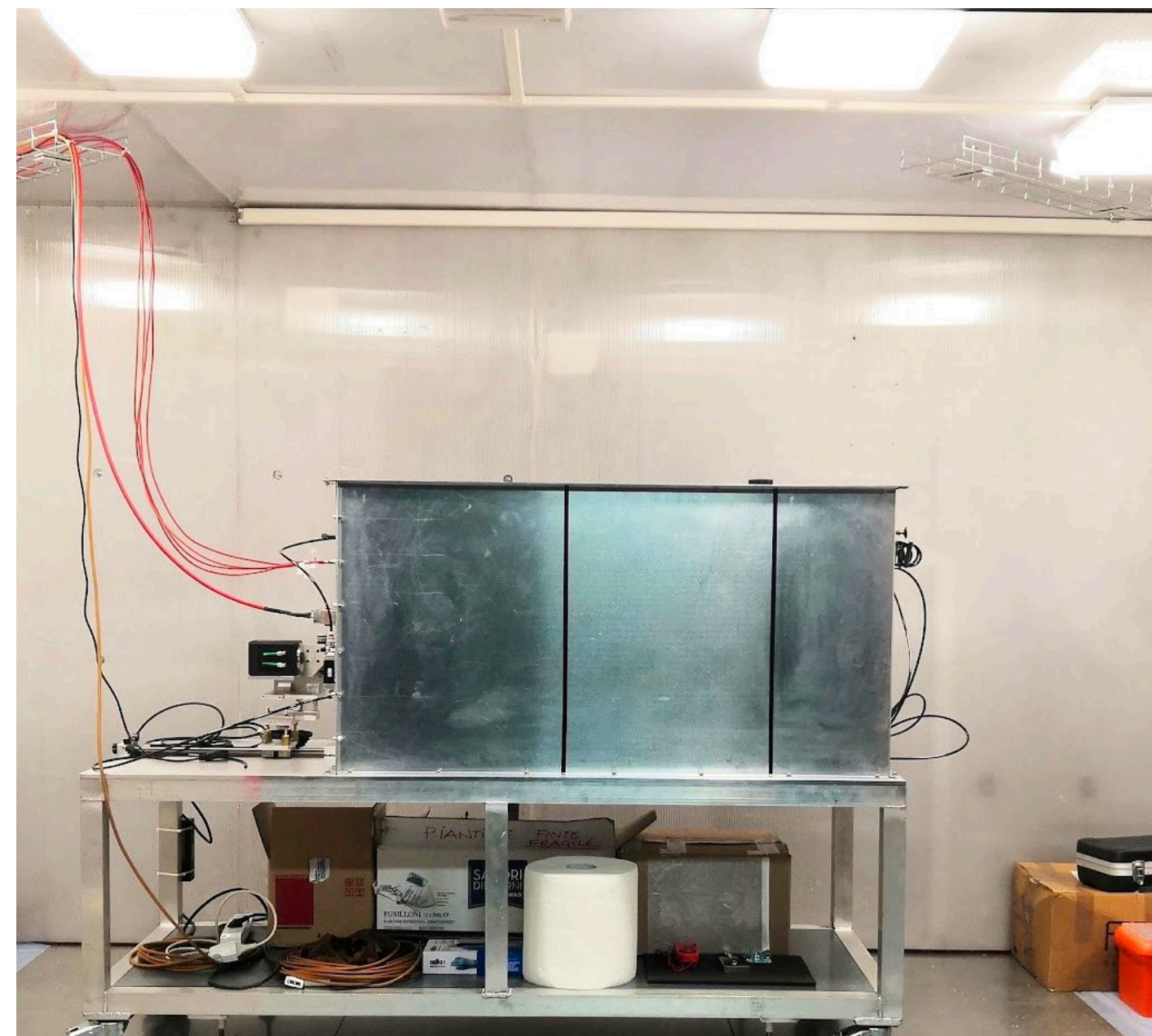
LIME detector

PHASE0 experimental setup



LIME RUN1->RUN4

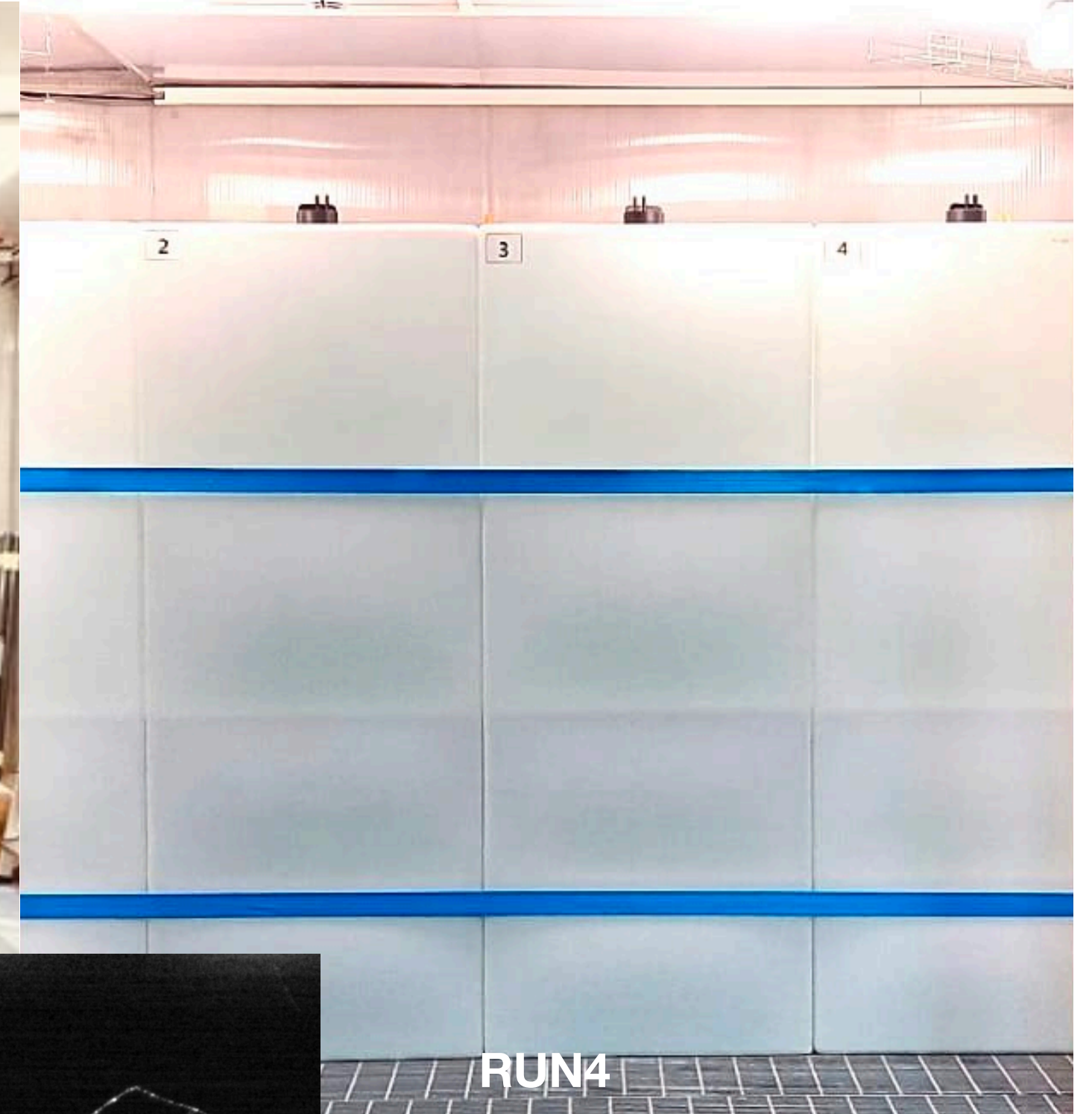
PHASE0 - M3.1 validating Montecarlo



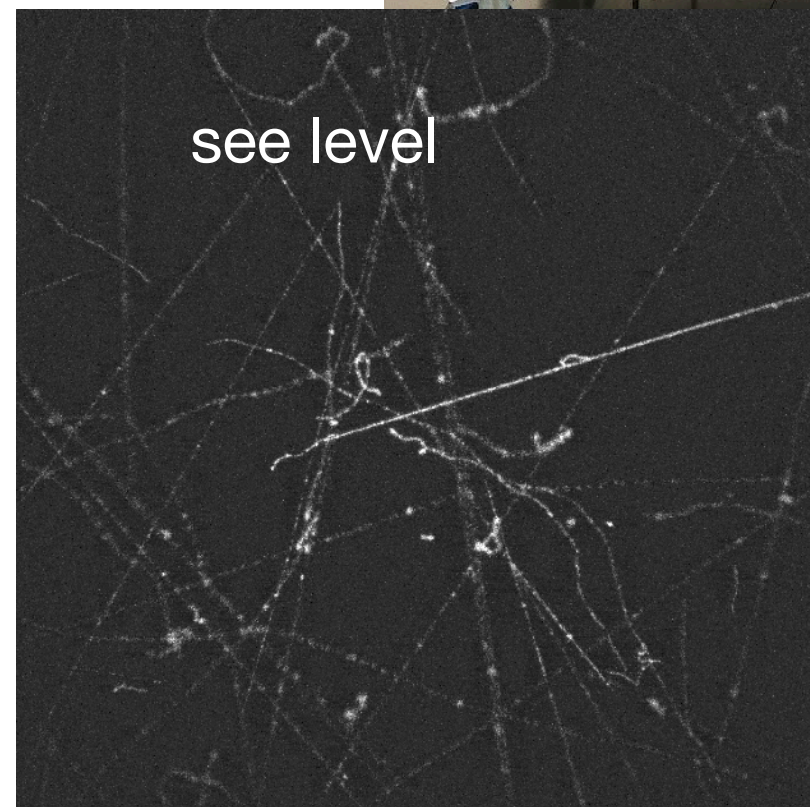
RUN1



RUN2/3



RUN4



see level



@LNGS no shield



@LNGS Cu shield

LIME RUN4 setup

last step of PHASE0



validating LIME/CYGNO-04 gas system

PHASE0/PHASE1



introduzione 2/3

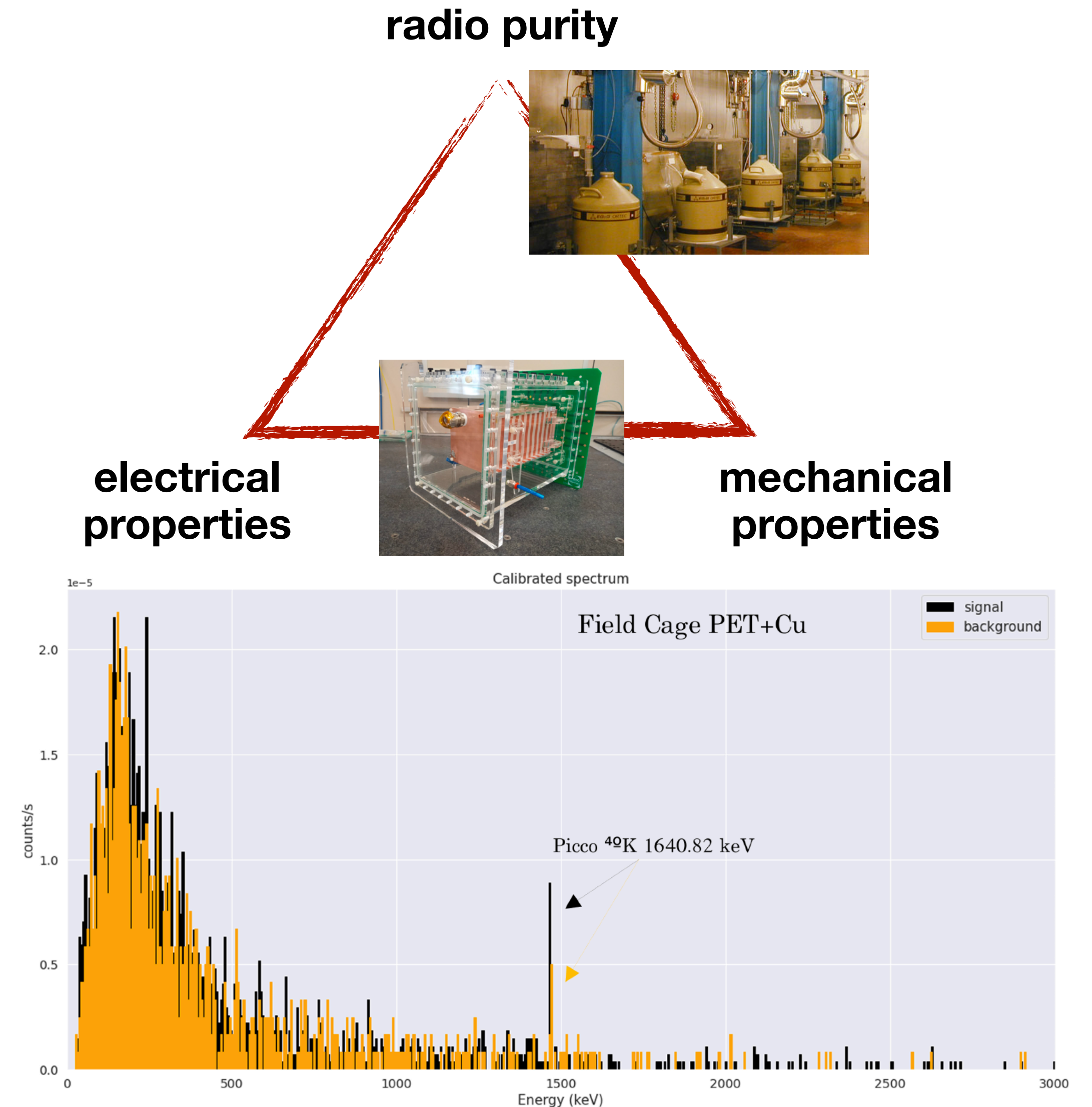
PHASE0/PHASE1

- La **PHASE0** prevedeva di far funzionare il rivelatore LIME per:
 - testare tutti i sistemi necessari per CYGNO04 (DAQ, gas system, ecc)
 - validare il Montecarlo
- **gli obiettivi sono stati raggiunti.** *Le attuali attività su LIME interferiscono con la progettazione di CYGNO04, distraendo risorse*
- nel frattempo e' cominciata **PHASE1** che prevede la **validazione e acquisto** delle componenti per CYGNO04, la **realizzazione della infrastruttura** la **progettazione esecutiva** del dimostratore e **acquisto** dei materiali necessari
- I fondi **ERC** scado a marzo 25, quindi entro **gennaio 25** tutti i materiali devono essere consegnati per poter procedere ai pagamenti, **altrimenti i core cost non saranno coperti dall'ERC**

validating materials for detector components

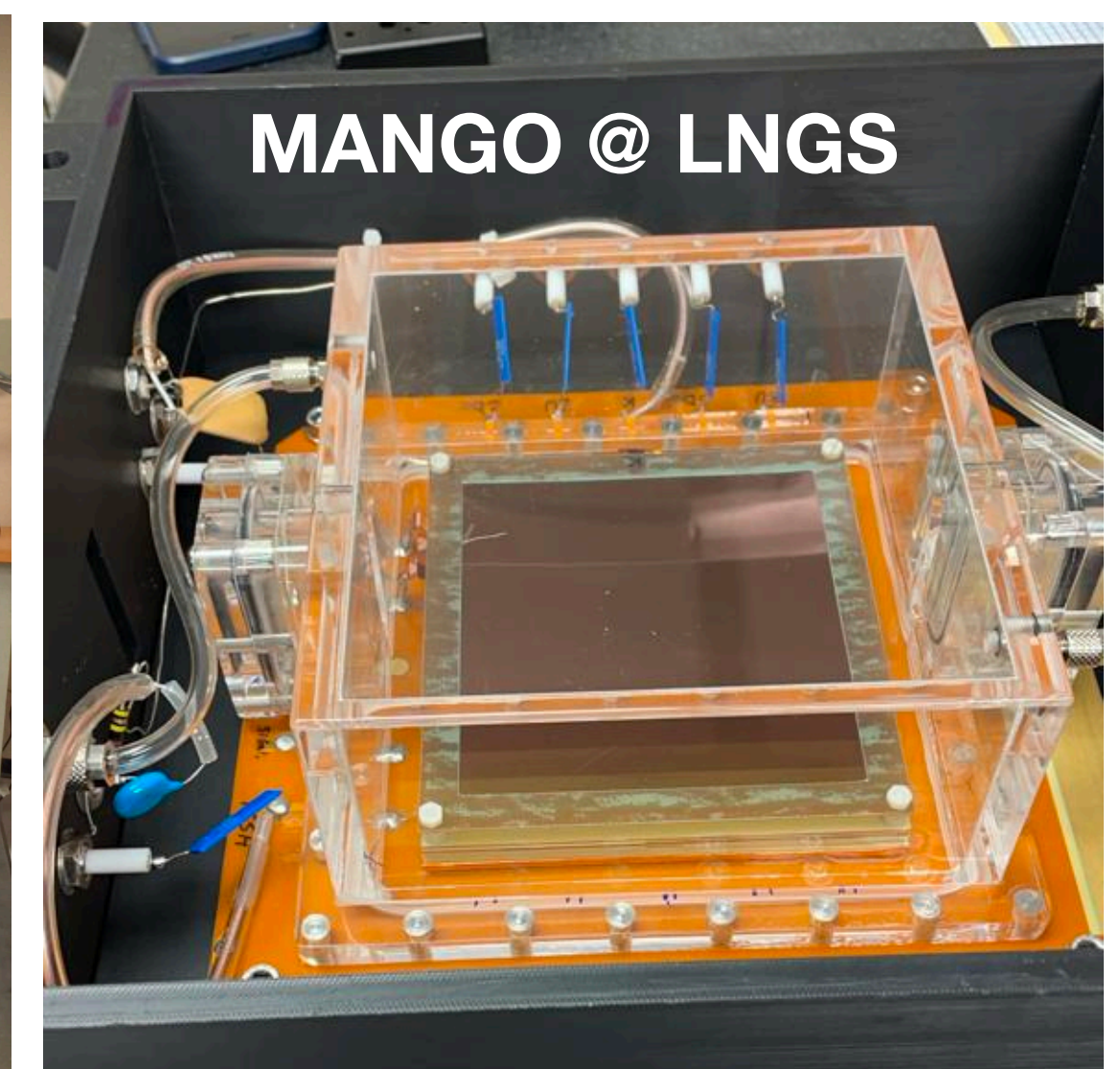
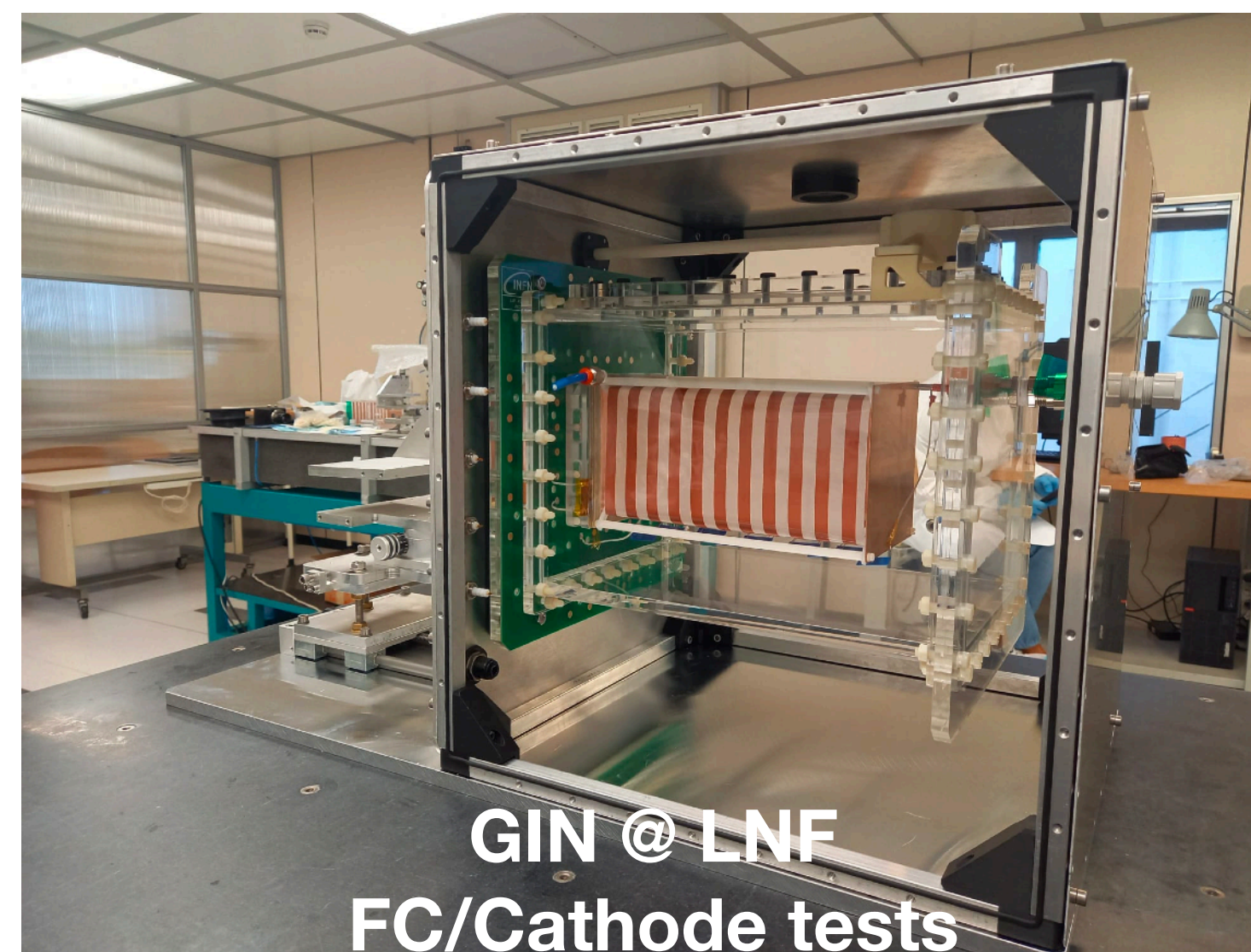
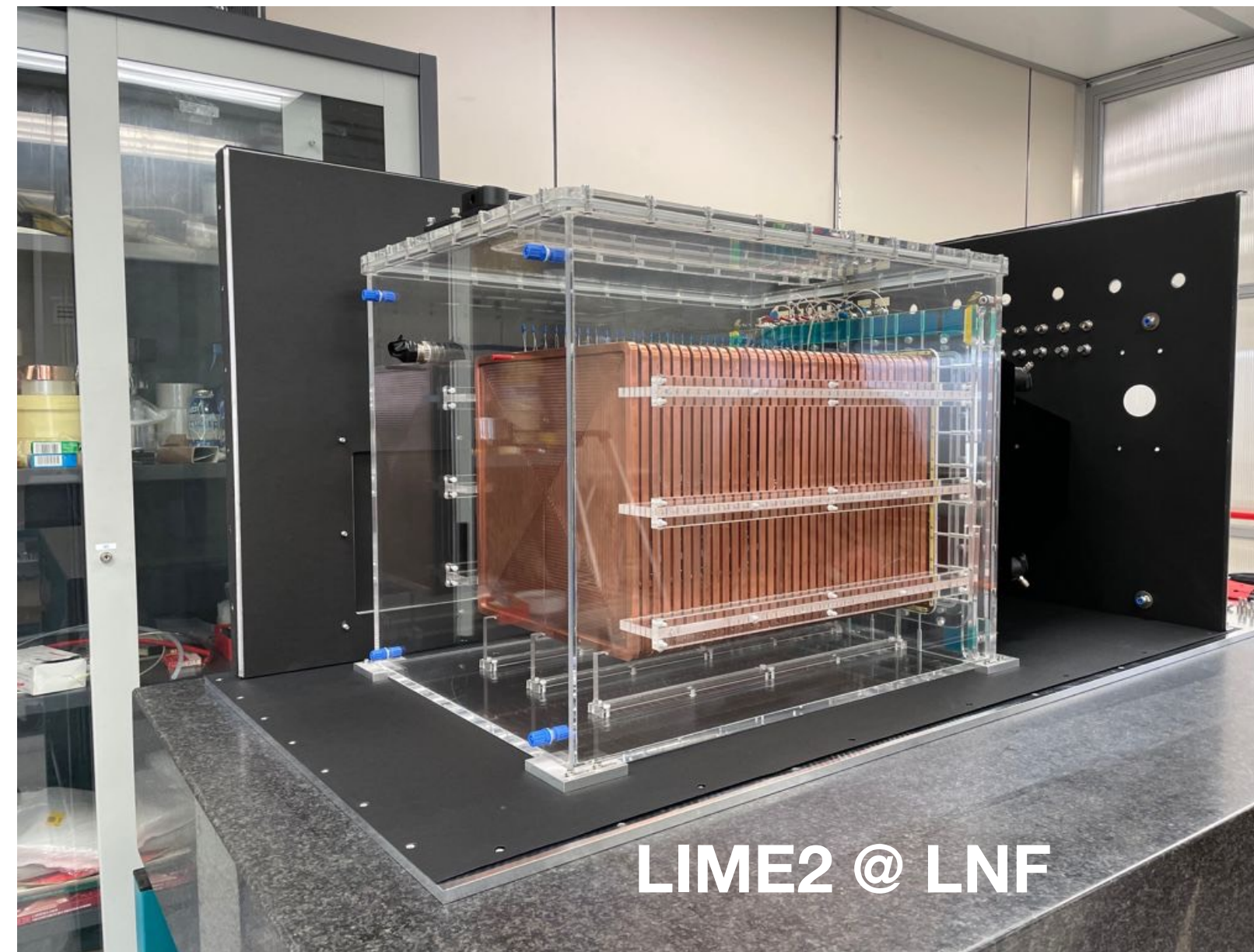
WP6 (coordinated by RM1)

- **scouting of candidate materials** is ongoing in parallel with electromechanical and gas tests
- defining of **procedure to handle materials** is on going
- a scouting of the **company that can provide** us materials started
- most of the **constraints** came from the availability of the **LNGS facility to test sample** of materials



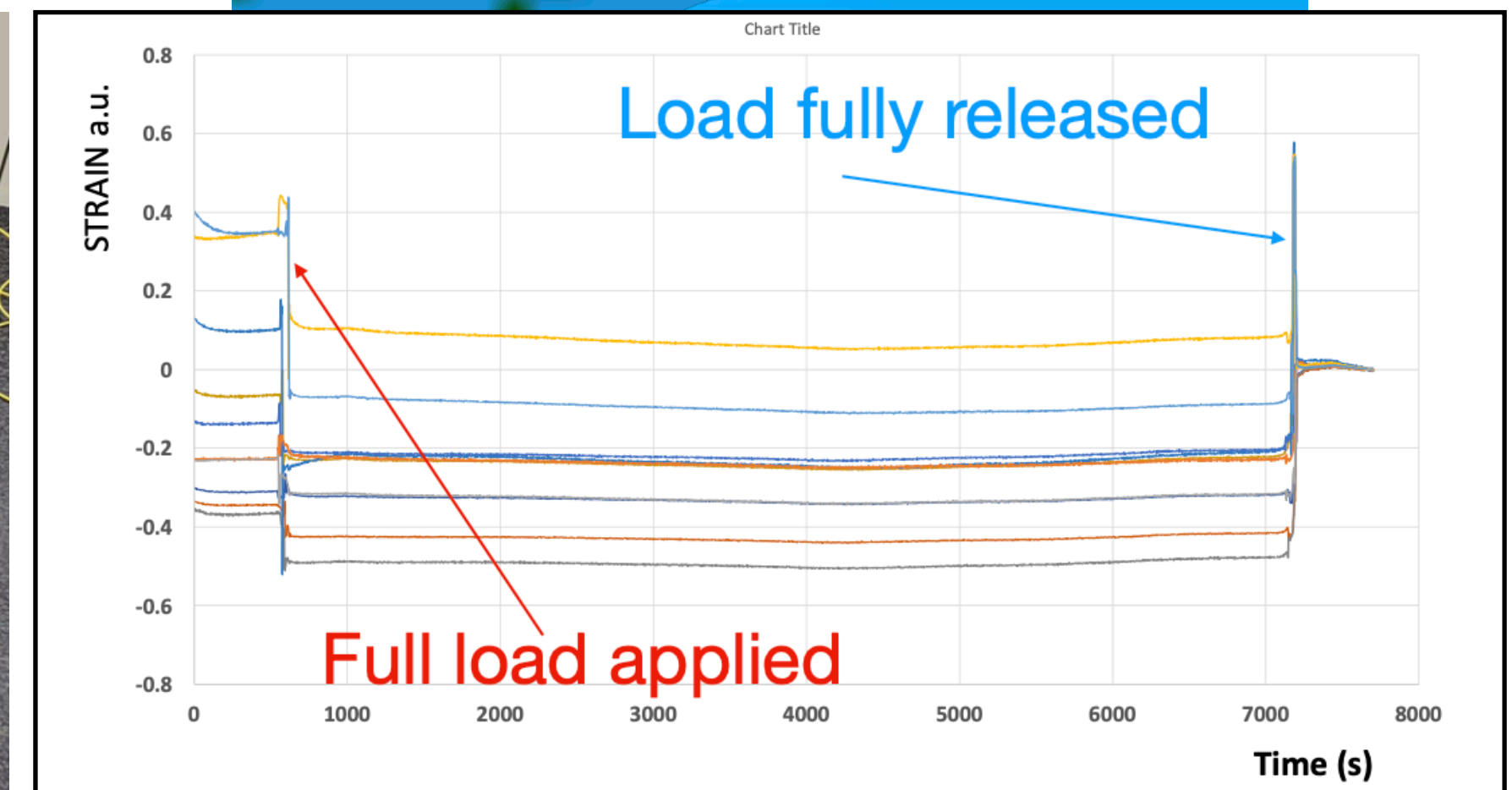
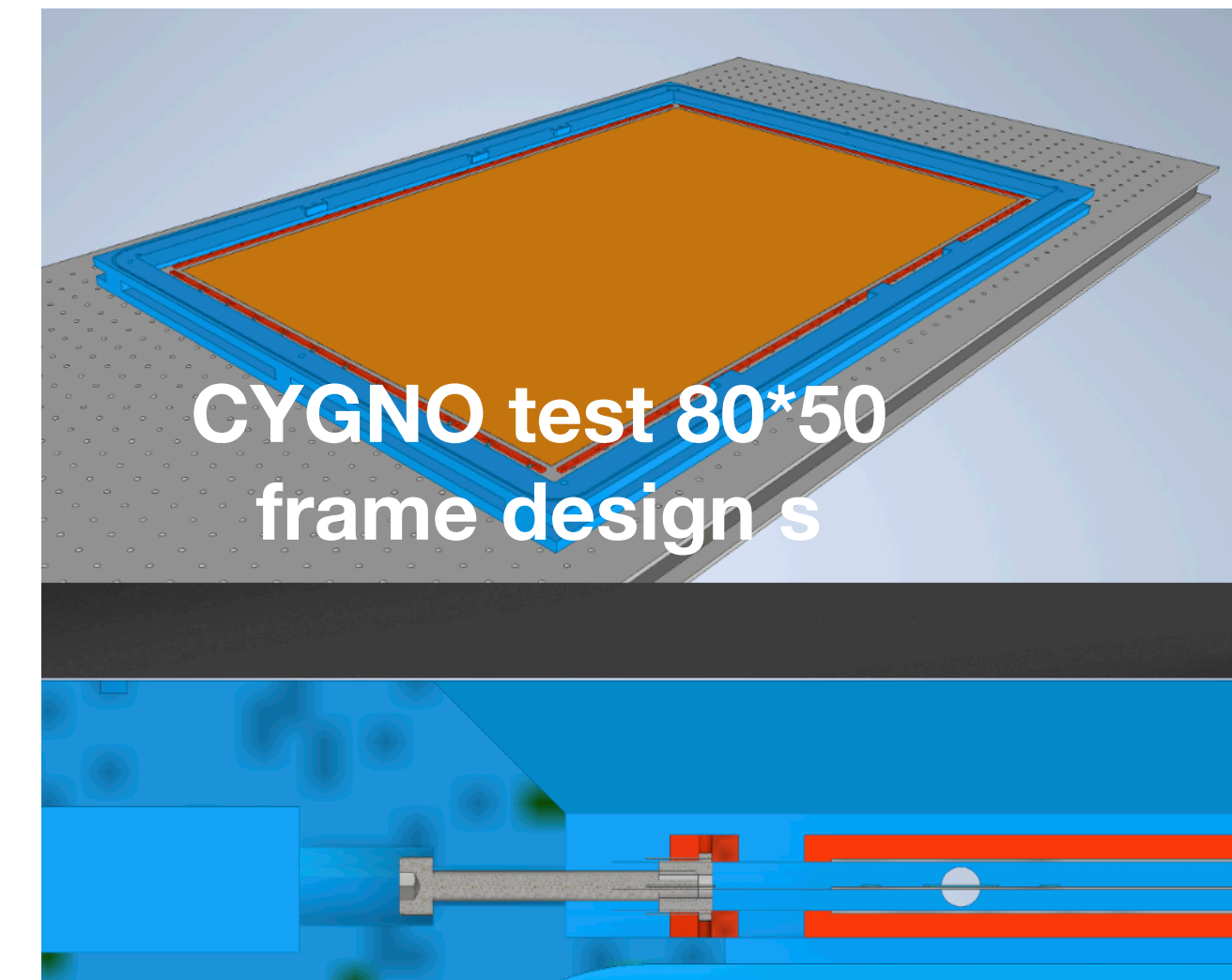
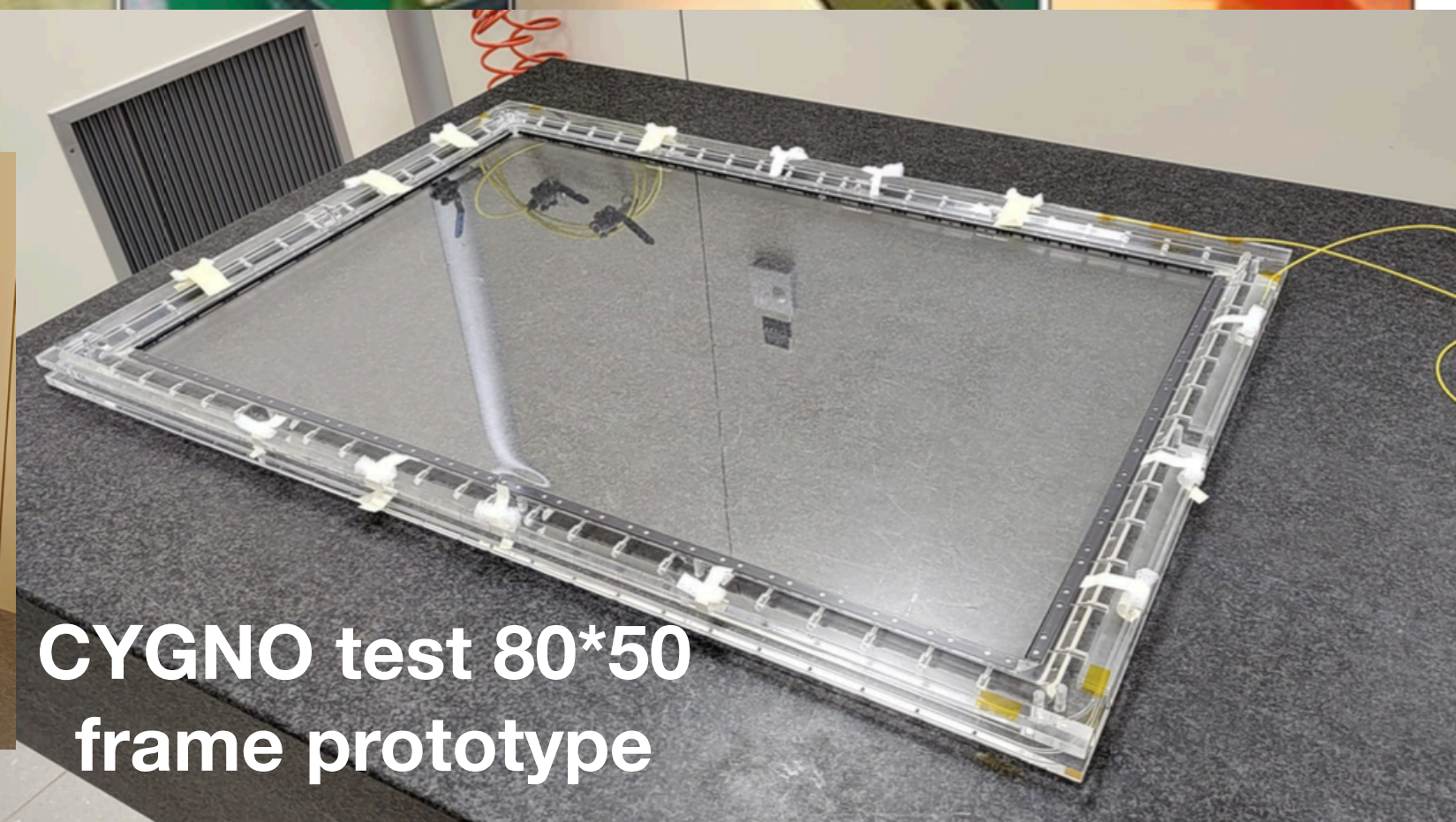
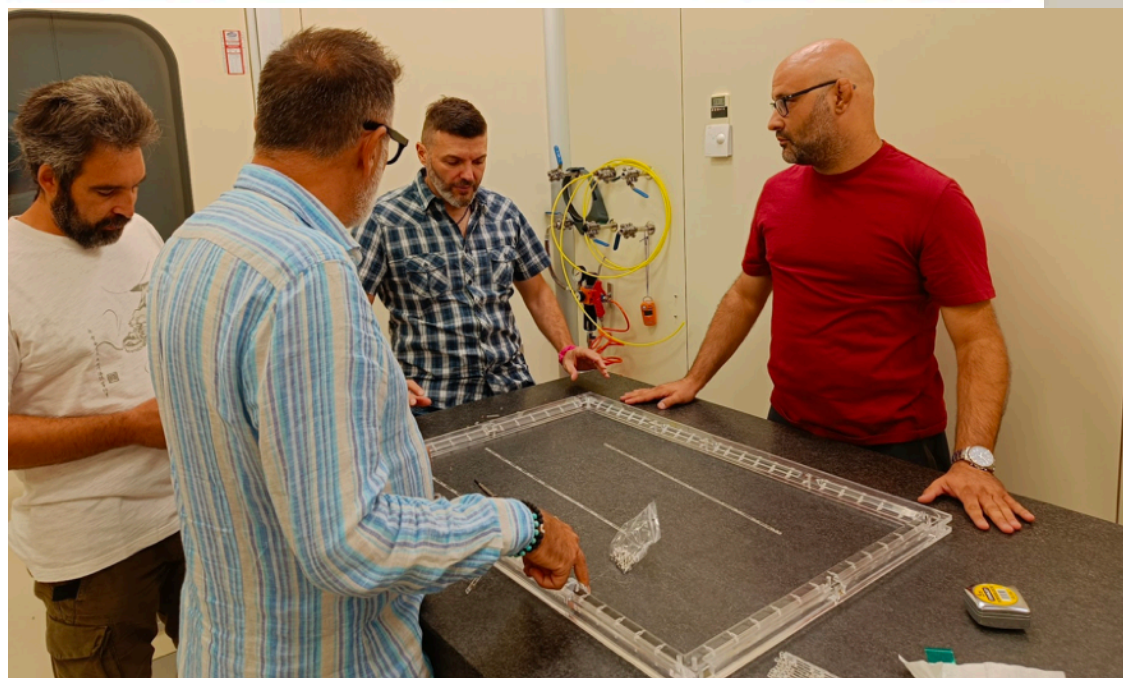
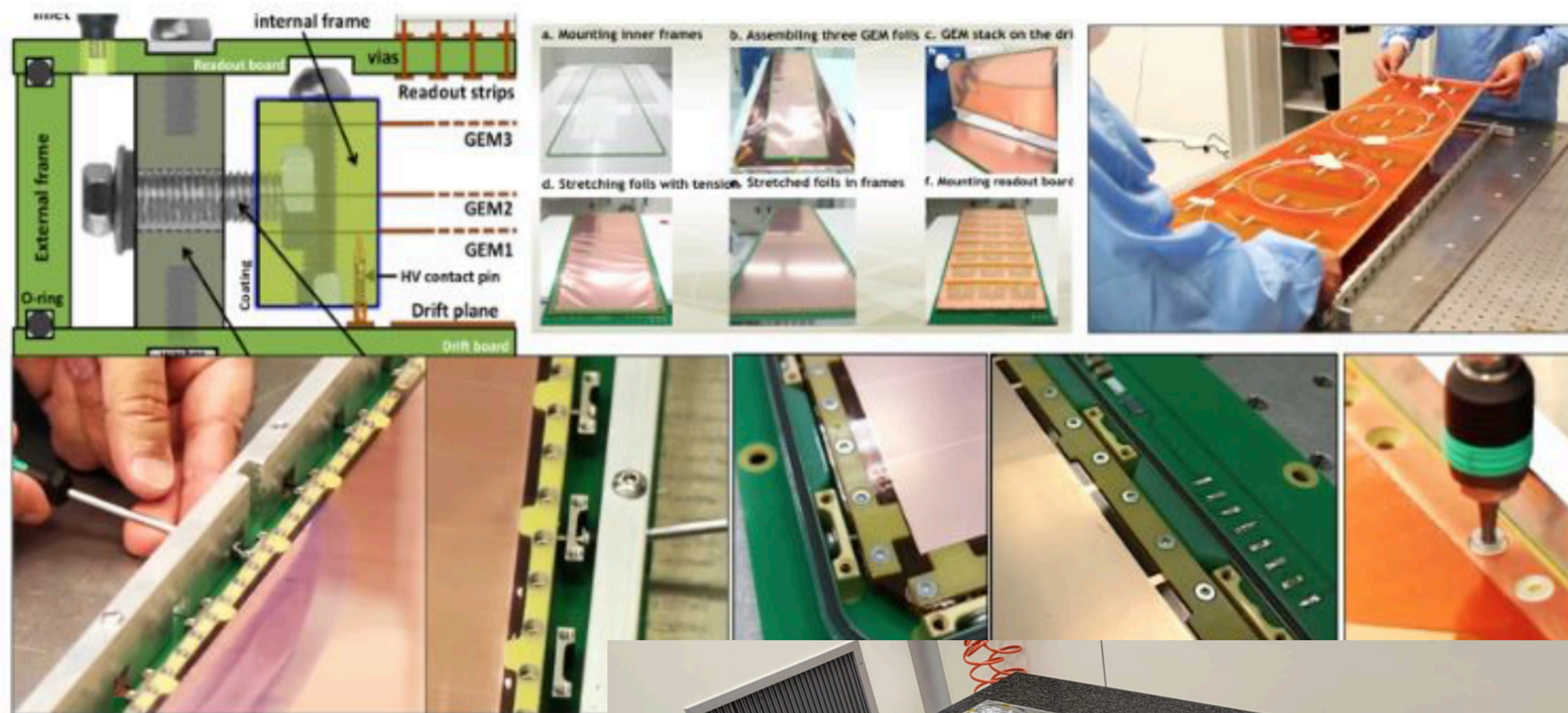
towards final R&D

- M6.1 validating large GEMs
- D6.1 validating **Field Cage** and **Cathode**
- D6.2 validating **lens and sensors**
- M6.2 validating materials for detector **components**
- D.6.2 validating **process** for handling materials to prevent radioactive contamination.



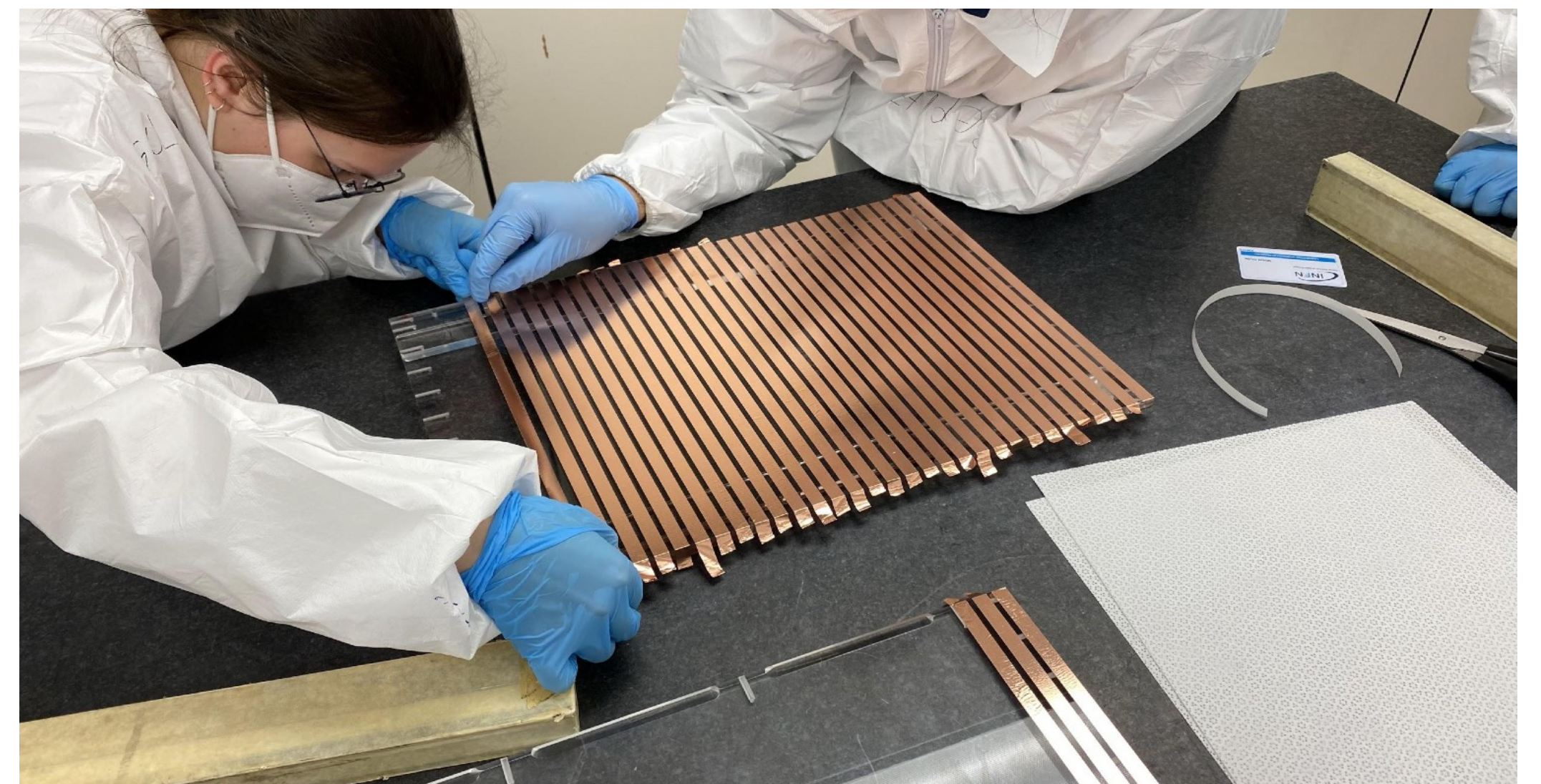
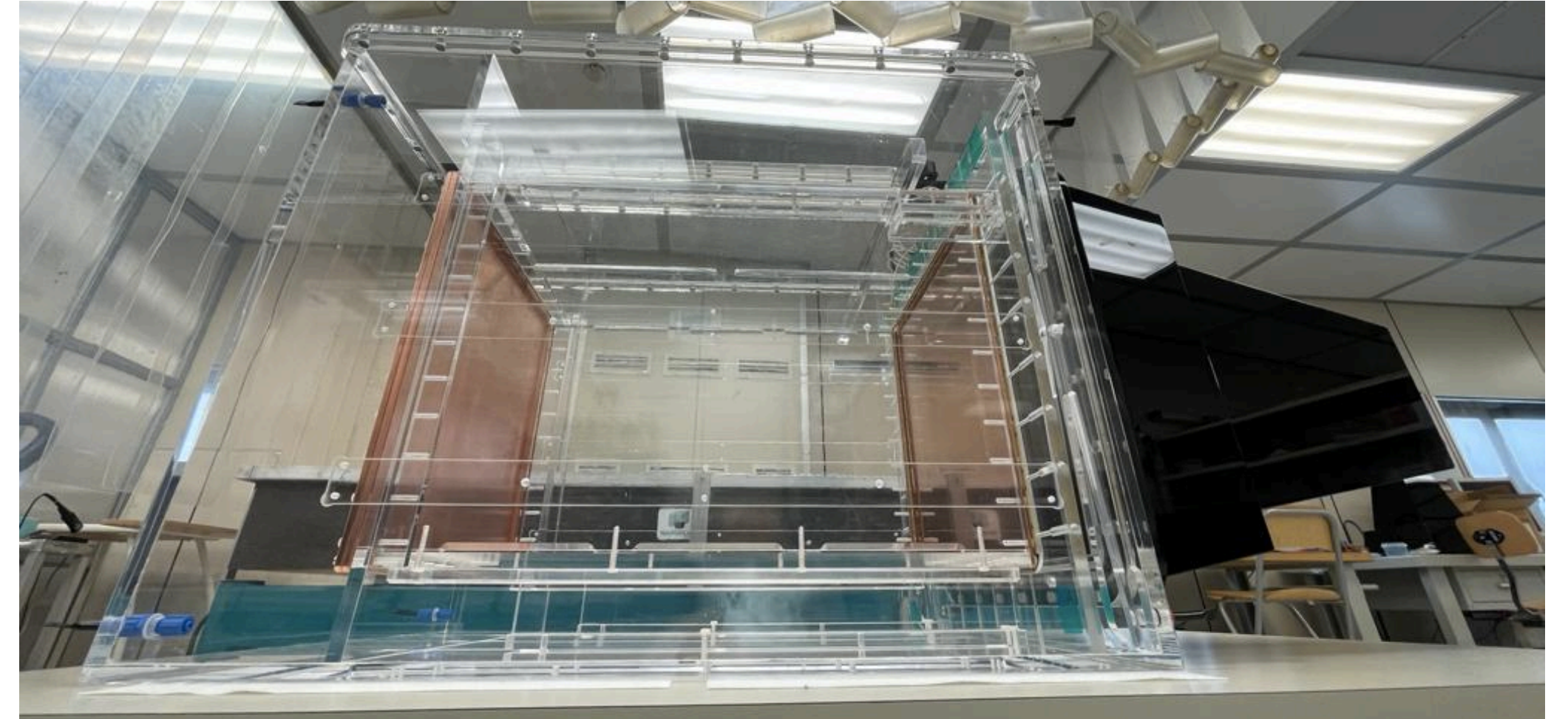
validating large GEMs

CMS stretching technology

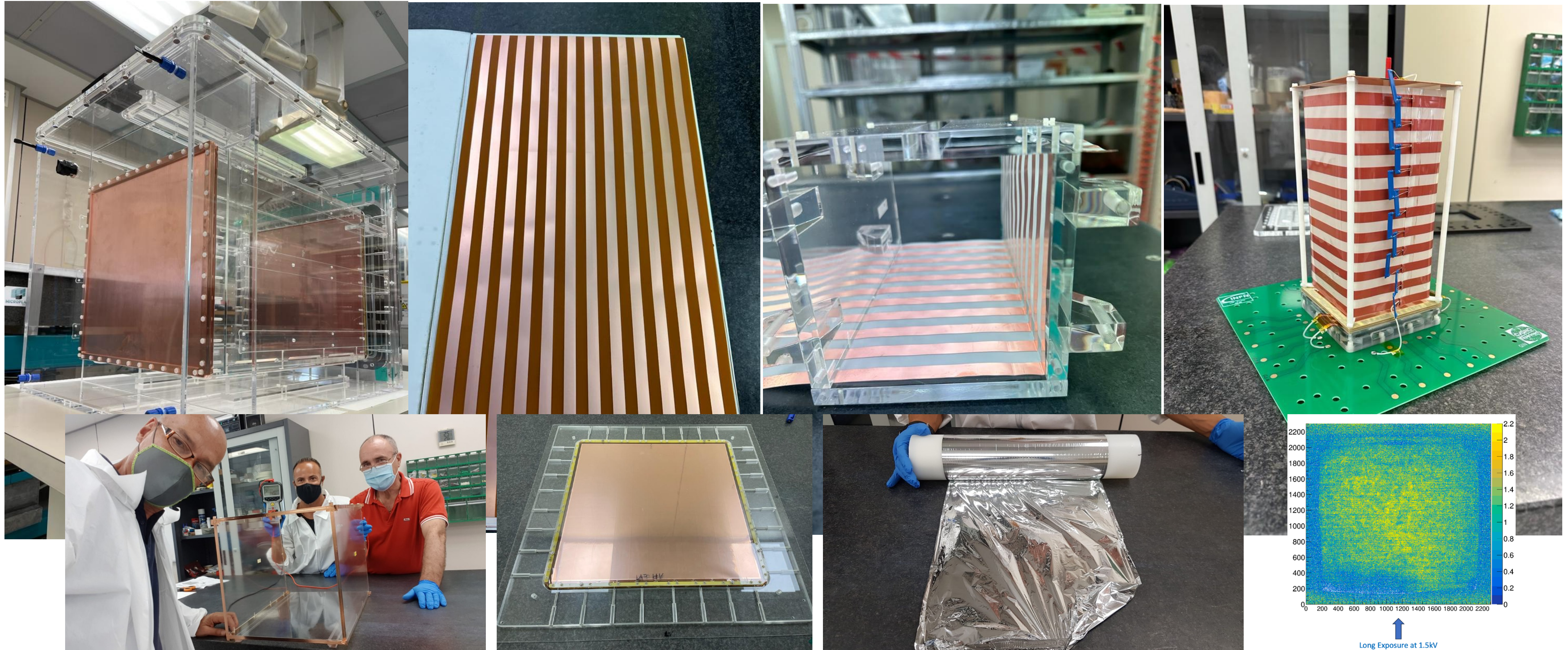


validating Field Cage and Cathode electromechanical tests

- testing on large **Kentaro FC**
- testing PMMA box with **glued strips**
- testing PMMA box FC with **printed circuit** on PVC/kapton
- testing PVC/Kapton **without mechanical support**
- testing **Loomba cathode**



validating Field Cage and Cathode electromechanical tests (con't)



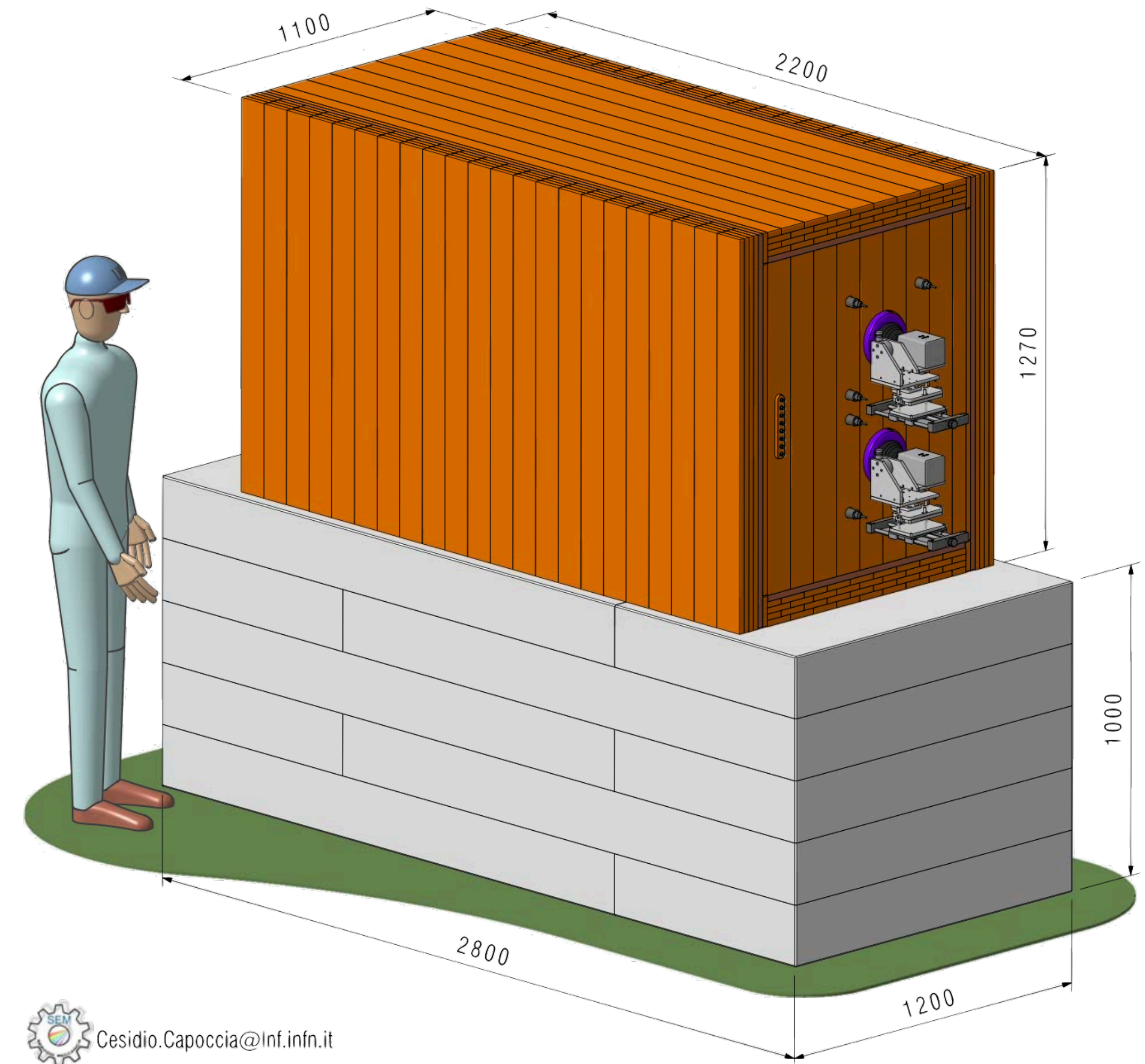
introduzione 3/3

PAHSE1

- in completa **assenza di coordinamento e di requisiti definiti dalla collaborazione**, i LNF con grandi difficoltà stanno **selezionando e validando** le componenti del detector e continuano a dare completo supporto a LIME @ LNGS
- a gennaio 23 erano pronte **PRA, VINCA** e le approvazioni necessarie della **Regione Abruzzo e vigili del fuoco** per poter procedere all'installazione
- a **novembre 23** e' stata presentato il **progetto esecutivo dell'infrastruttura**, inquadrata la ditta, avuto il via libera LNGS, realizzata una offerta preliminare che e' stata consegnata al GSSI, **ad oggi (fine luglio 24) non sappiamo se la gara sia stata assegnata.**
- in completa **assenza di requisiti definiti dalla collaborazione**, i LNF con grandi difficoltà hanno **elaborato un progetto (best effort and knowledge) nel tentativo di limitare i danni e gestire al meglio le risorse**

[illegible]

CYGNO-04



phase 1 - CYGNO-04



DocID	Rev.	Validità
INFN-PM-QA-504	1.0.1	Rilasciato
Data 29/6/2022		

Piano Qualità – CSN2

Technical Design Report - TDR CYGNO-04/INITIUM

This document identifies and describes the characteristics and technical requirements from the CYGNO-04/INITIUM Experiment related to the installation at Hall F of the Gran Sasso National Laboratories (LNGS)

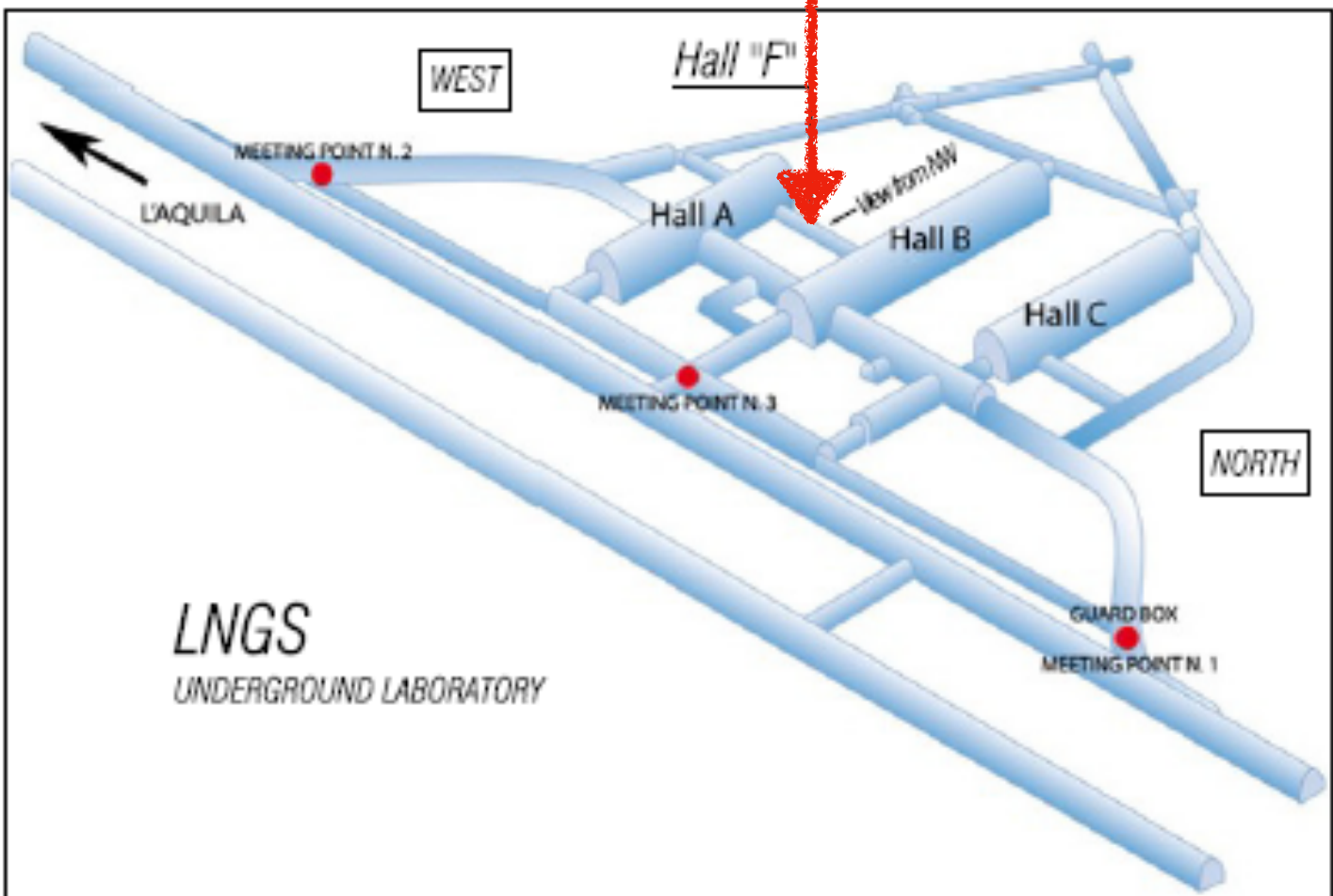
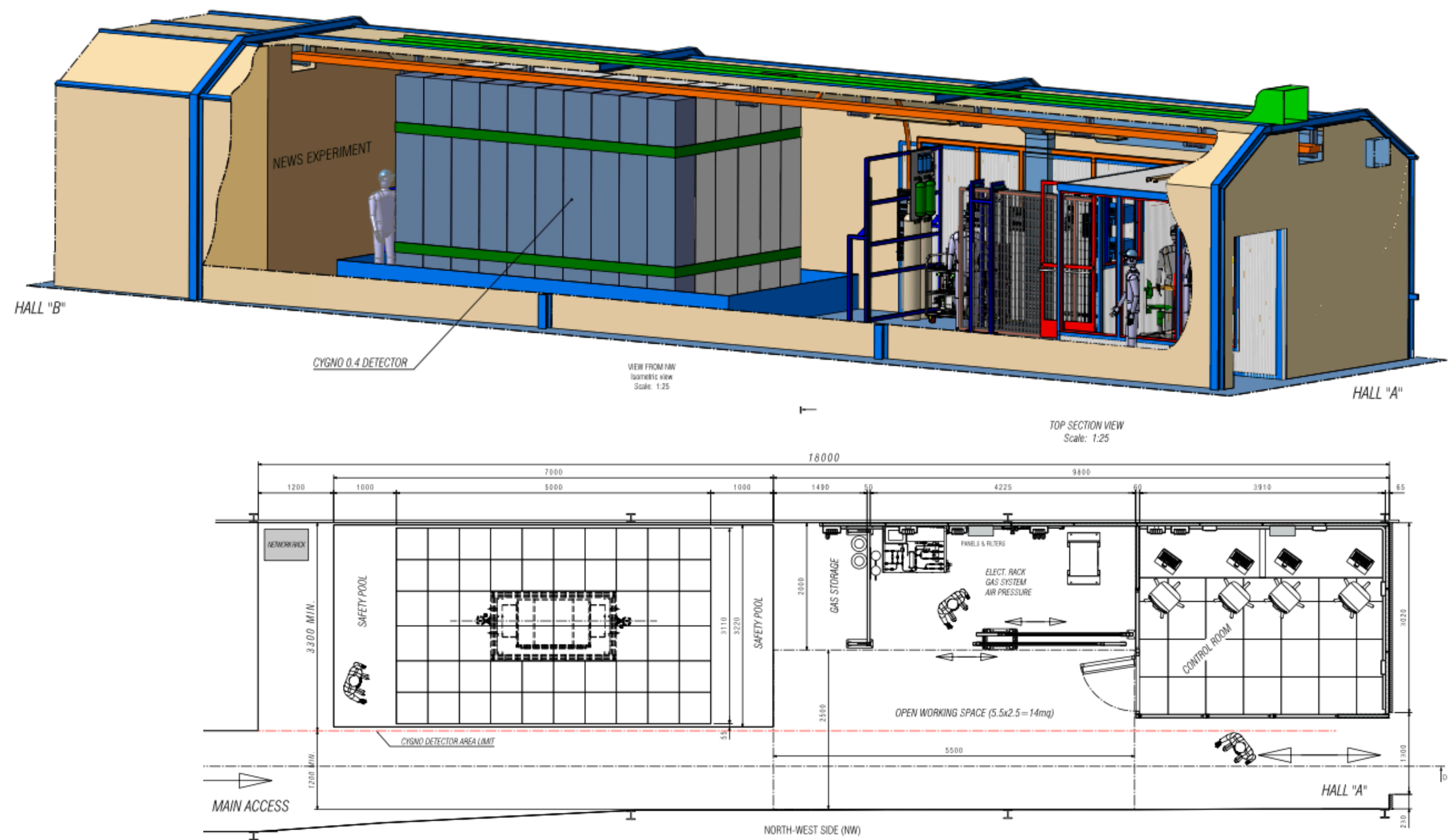
Autore	Verificato da	Approvato da
E. Baracchini C. Capoccia L. Leonzi G. Mazzitelli D. Pinci F. Rosatelli S. Tomassini		

- Distribution list:
- Commissione Scientifica Nazionale 2 (CSN2)
 - Direttore LNGS
 - Servizi LNGS
 - SCICOM LNGS

<https://doi.org/10.15161/oar.it/76967>

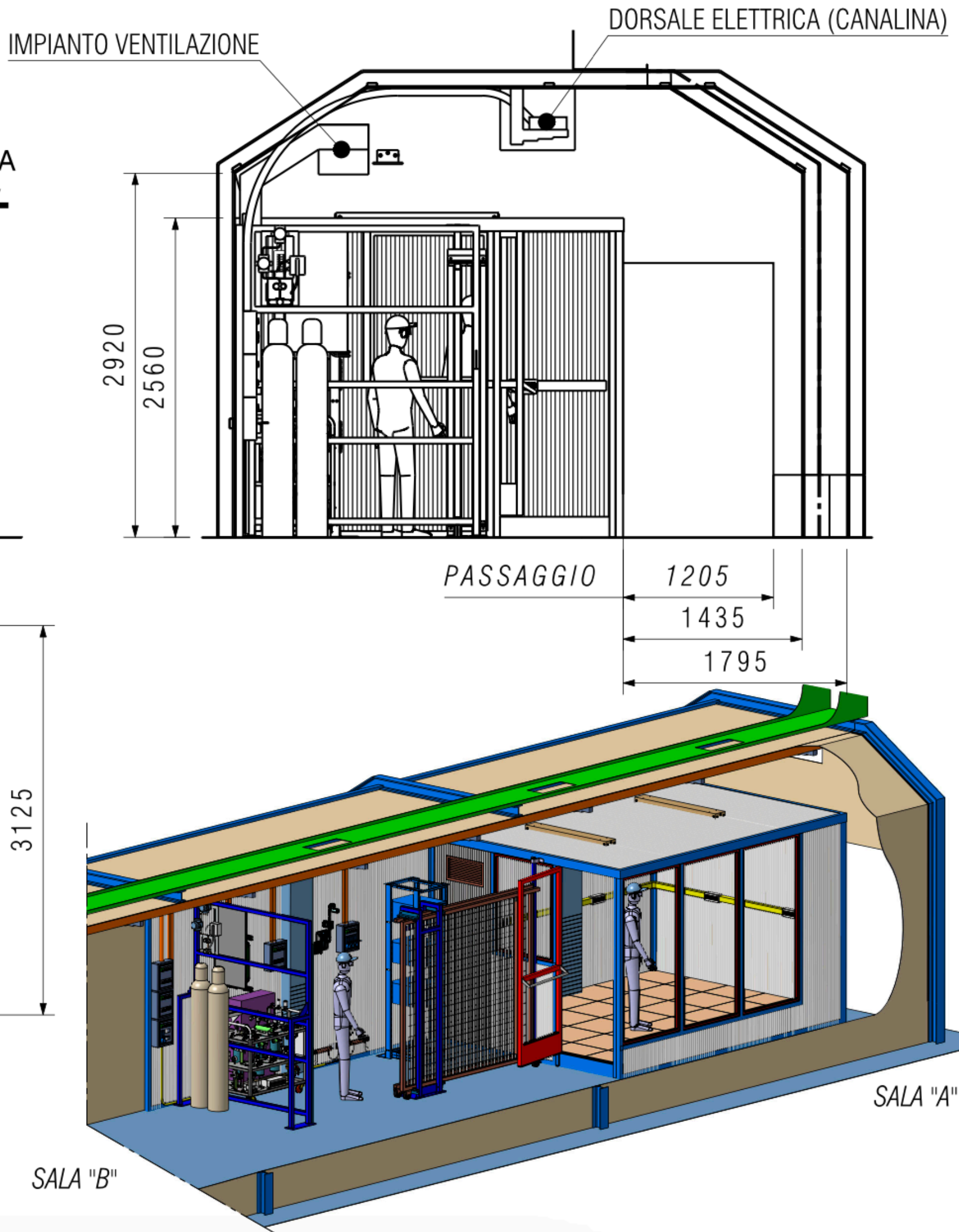
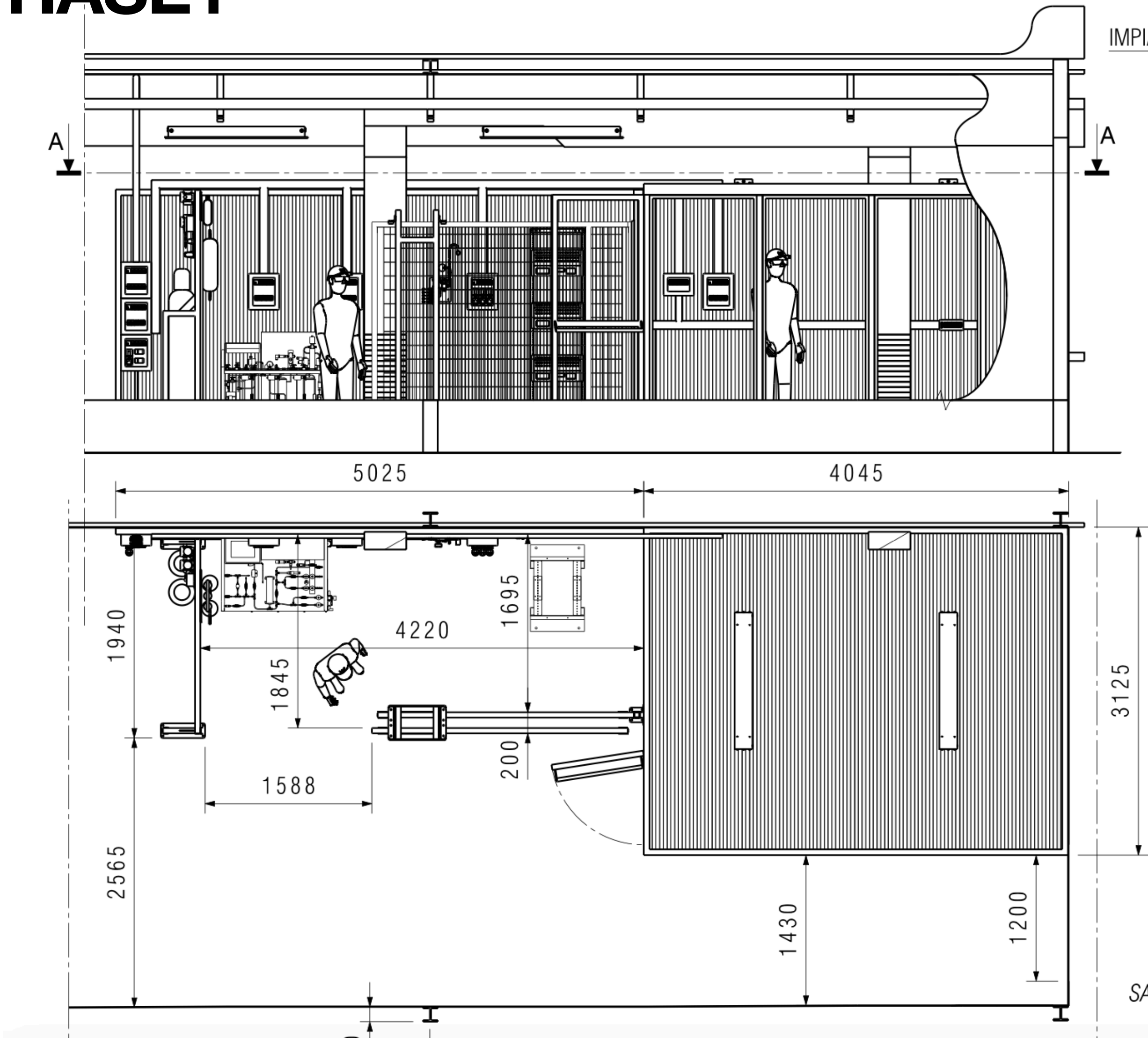
phase 1 - CYGNO-04

hall F setup



executive layout of infrastructure

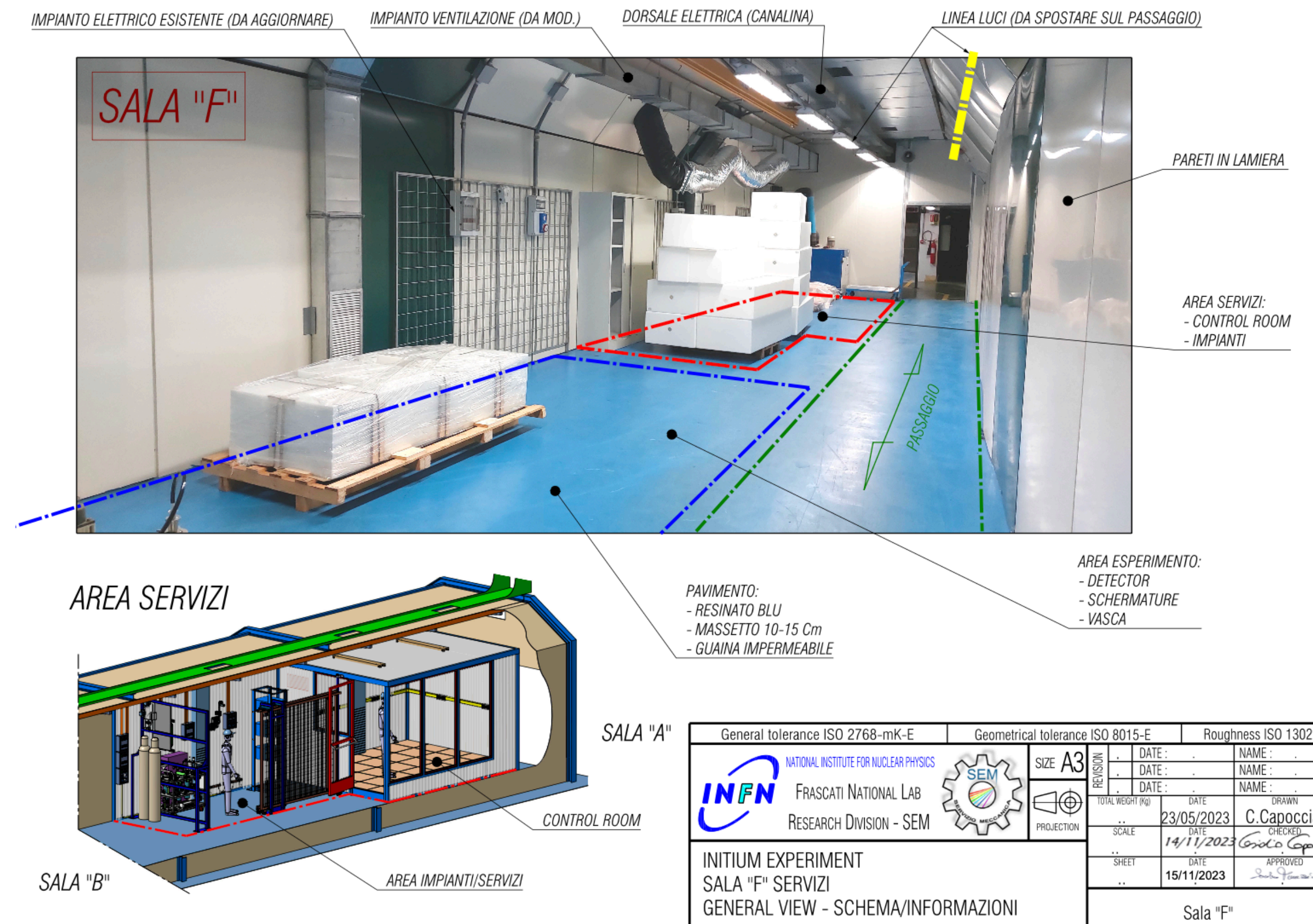
PHASE1



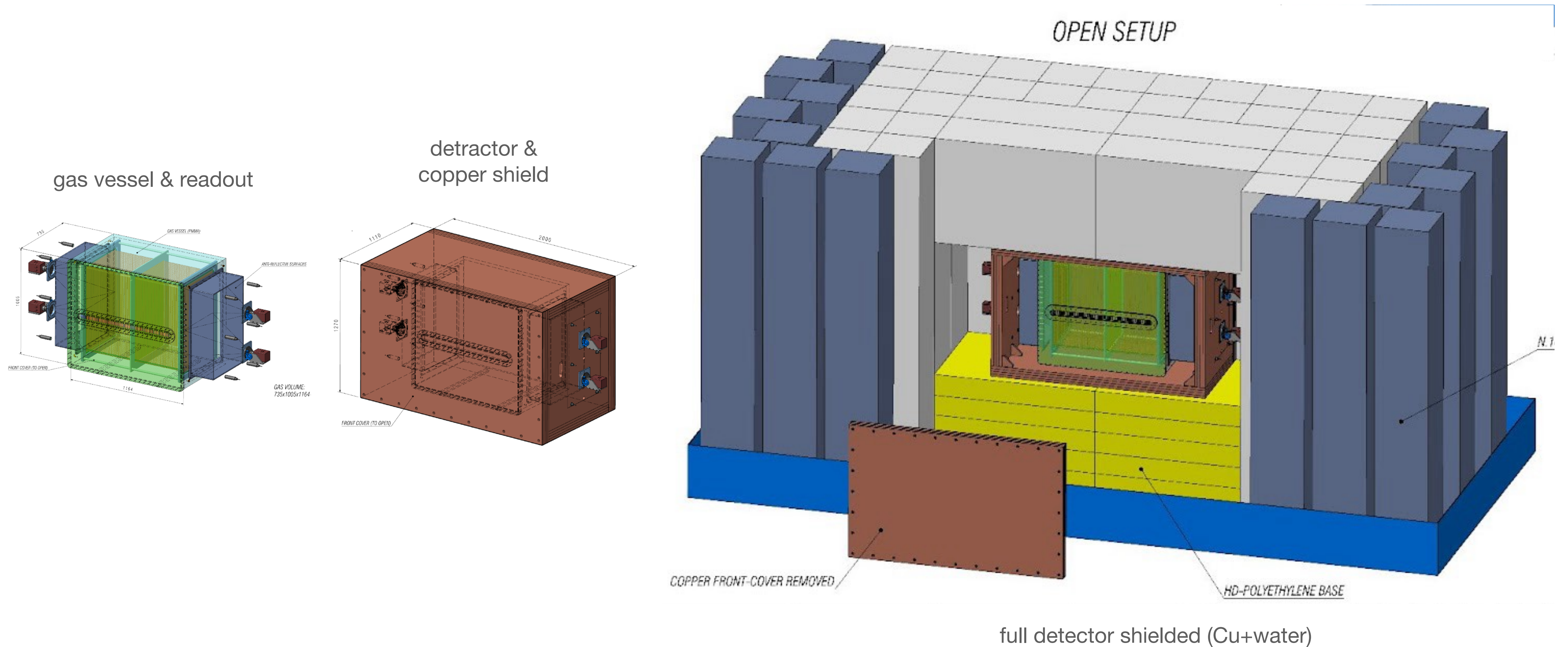
installation of the infrastructure

PHASE1

- the **tender** as been assigned we are waiting for GSSI formalisation of the procurements
- the **installation** have to be done between Gen-Feb. 24 because of critical overlap with PNRR
- the design and tender **includes** power distribution, air conditioning, compressed air, ecc. ecc. needs to host the experiment

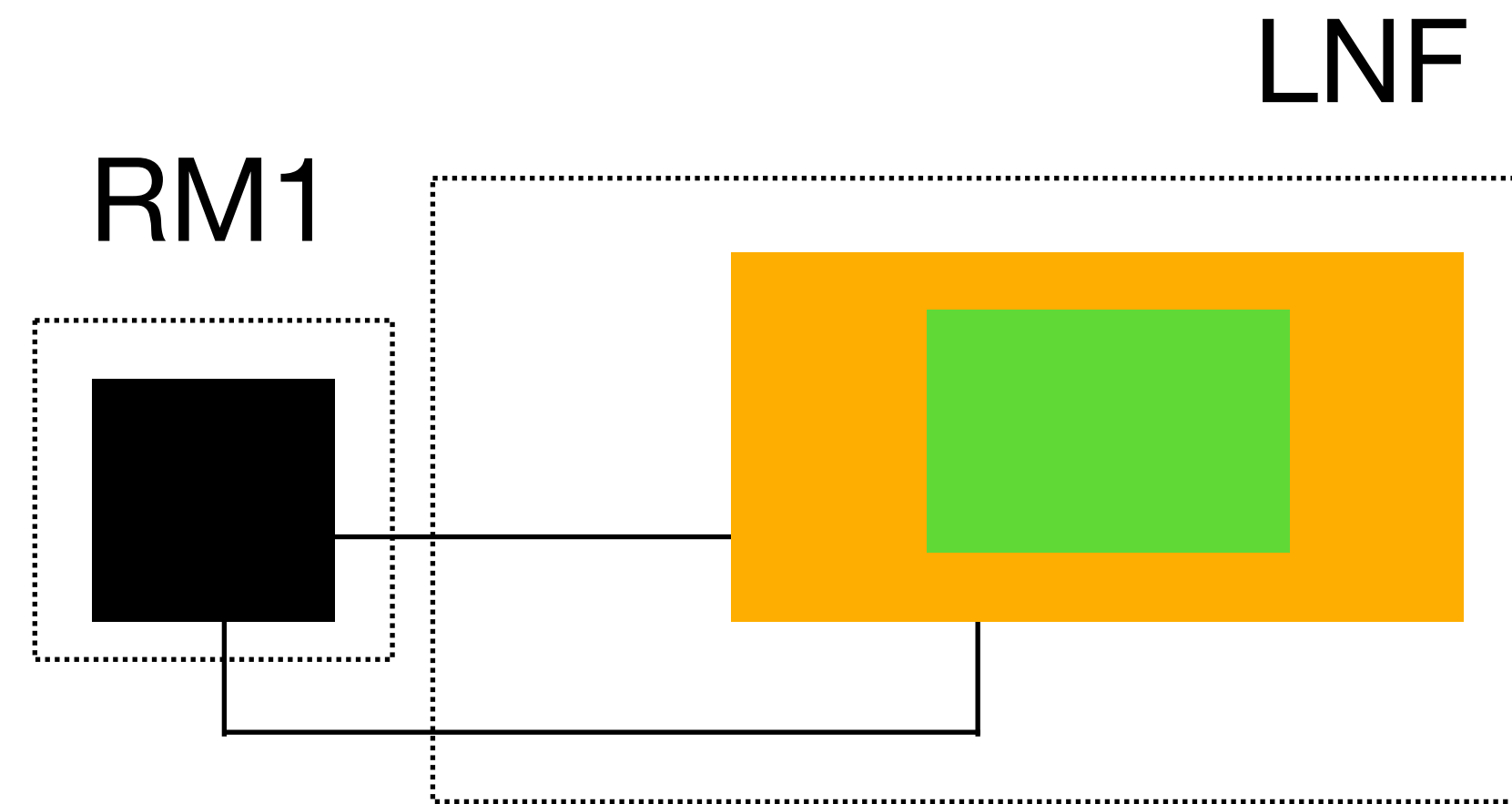


preliminary layout of the detector
PAHSE1 - best compromise with the space available



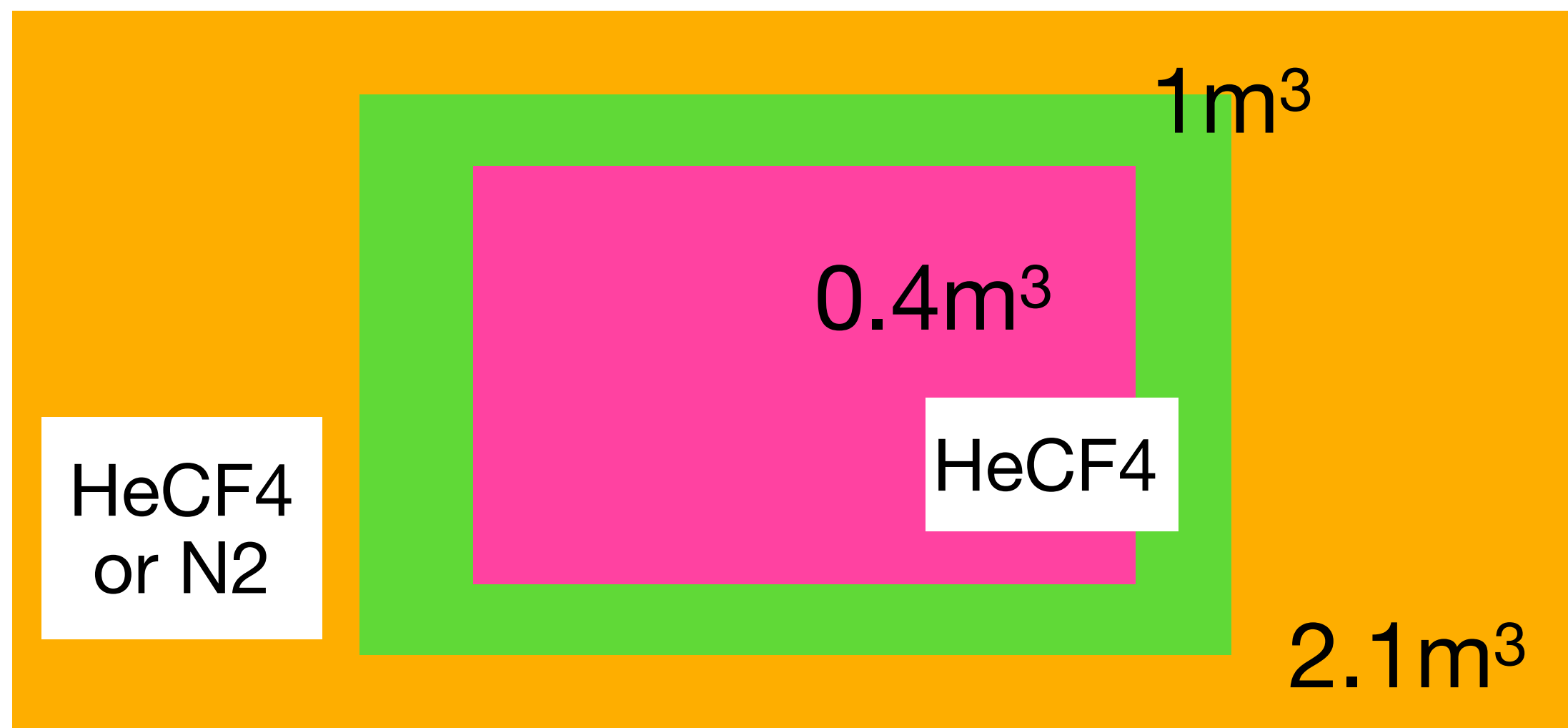
detector design strategy

double box gas tightness



technical requirements: *sufficient air tightness, mechanical and electrical capability, low radioactivity materials*

- gas system and diagnostic (RM1)
- gas pipe (requirements)
- detector tightness (requirements)
- “pass-through” connectors (requirements)
- gas consumption (requirements)



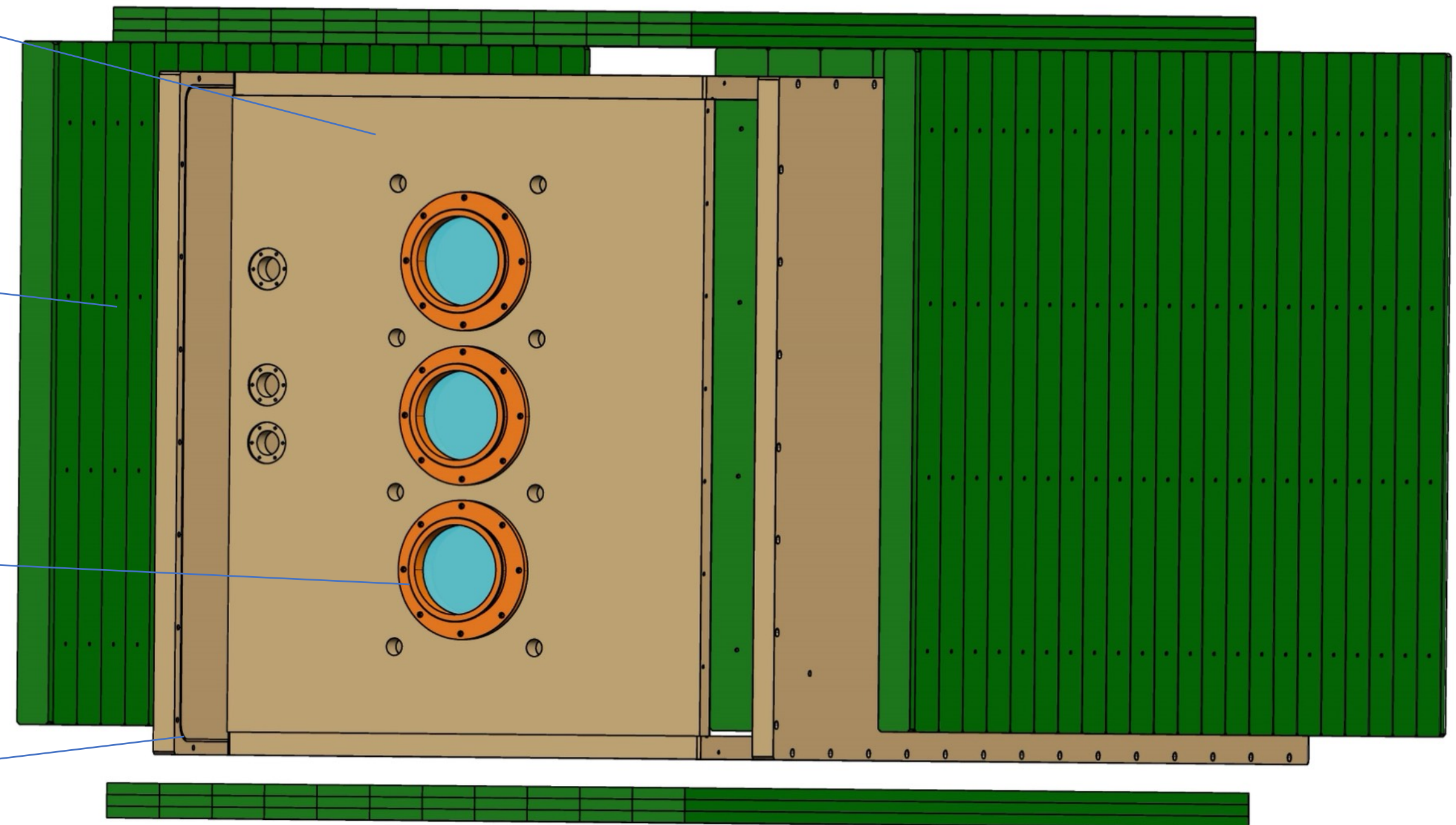
the solution optimized according to the requirements known so far is a double gas-tight container, one made of pure radio copper and one of PMMA of the smallest thickness necessary

detector design strategy



[Croce Antonio](#)

- Box clean Cu (2260x900x1100)
- Box of Cu refurbished (OPERA).
- CAMERAs pass through
- O-Ring Cu for tightness



40 mm of radiopure Cu purchased, 60 mm of “dirty” Cu recovered from OPERA

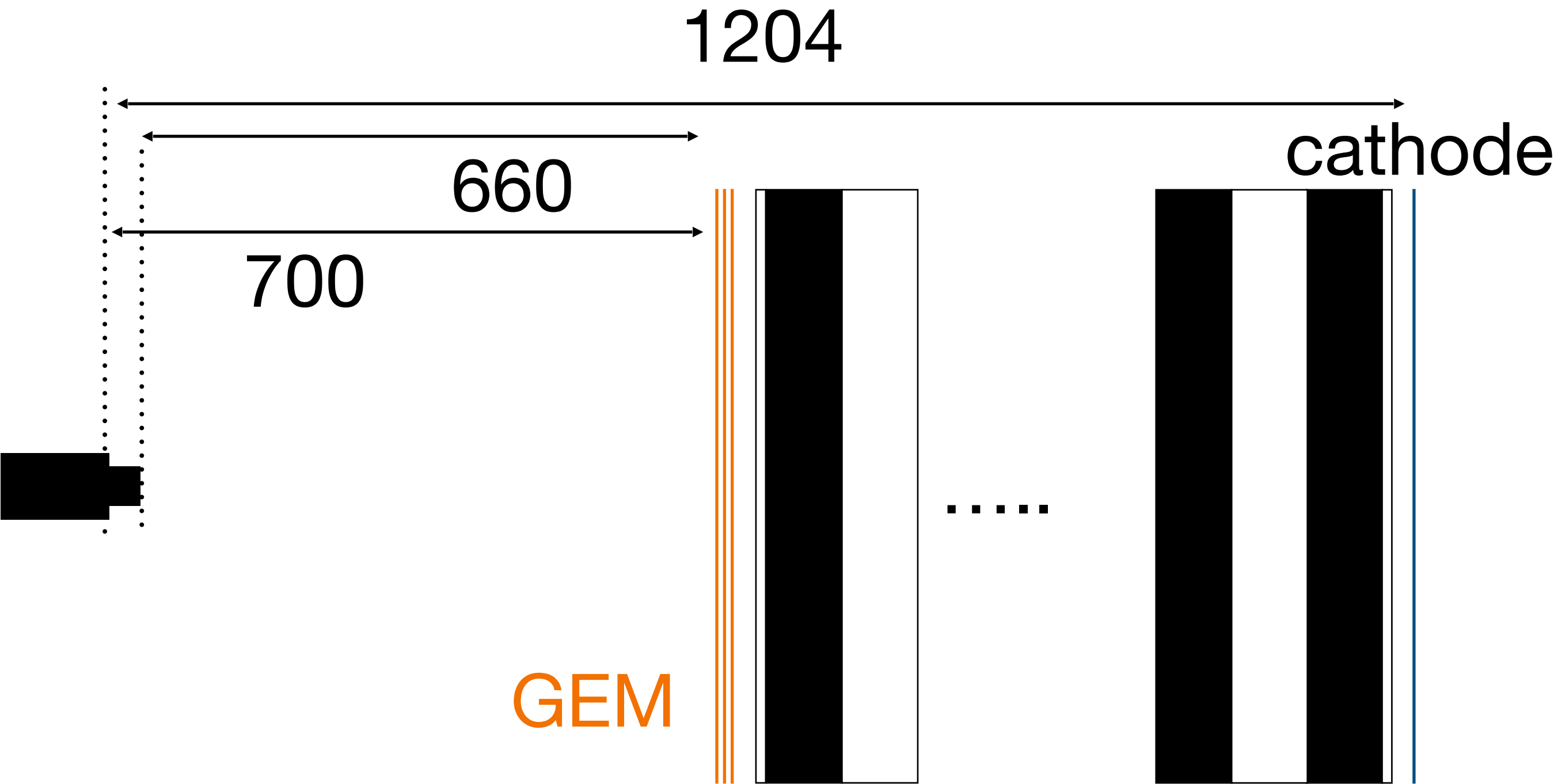
detector design strategy

esempi di missing requirements

- caratteristiche elettro-meccaniche;
- radio purezza —> (Cu/PMMA/N6 dove possibile);
- tenuta al Rn e produzione di isotopi
- tenuta gas, umidità, contaminanti, flusso, ricircolo e recupero
- compatibilità ottica: distanze ben definite, finestre ottiche (camera e PMTs)
- calibrazione: movimentazione, finestre sottili

detector layout

validating components assembly

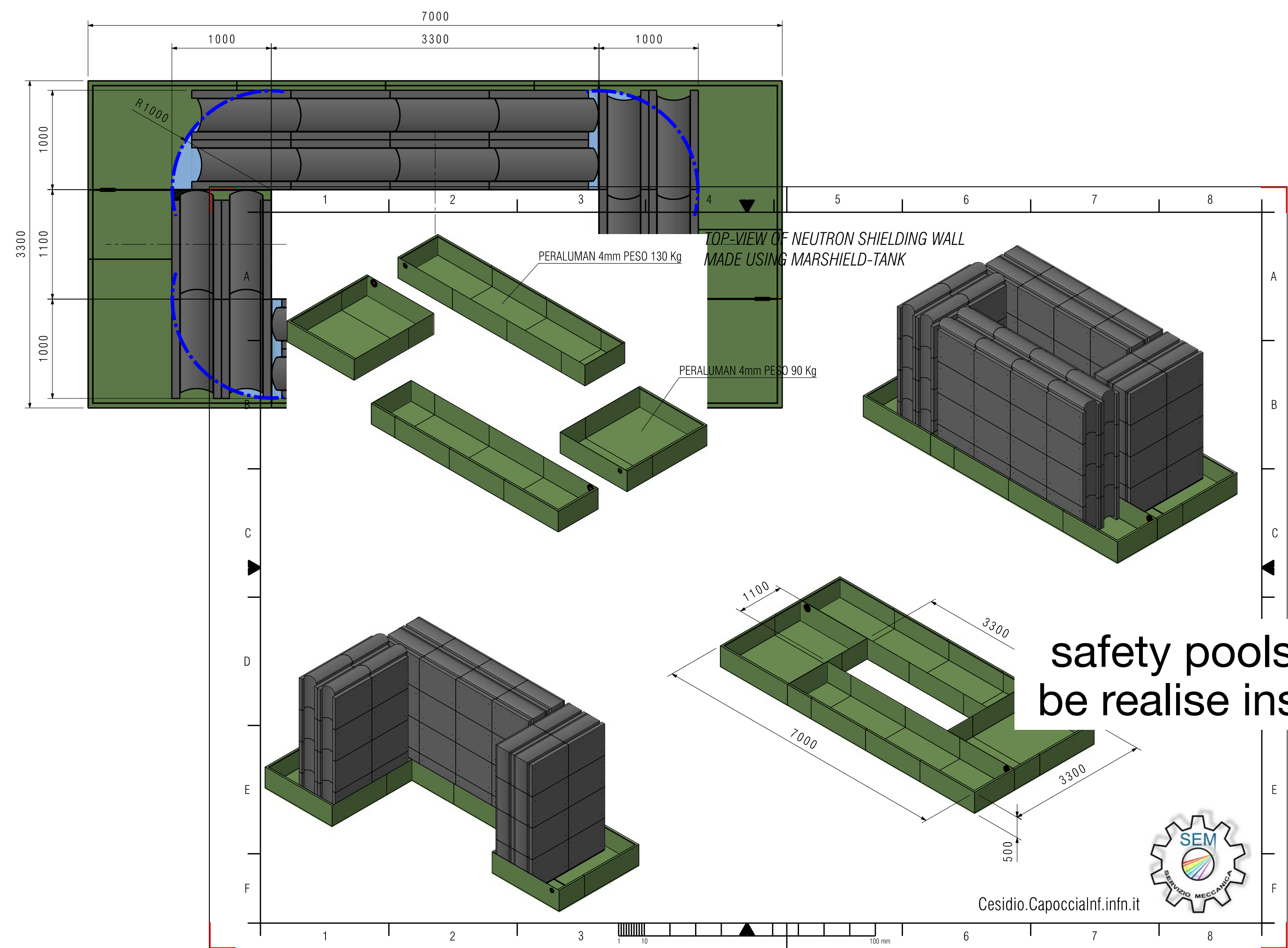


item	Relative distance (mm)	Absolute distance from cathode
cathode	0	
drift	4	5
drift FC PET	1	
drift FC Cu	10	495
drift FC PET	10	
.....*23	450	
drift FC PET	10	
drift FC Cu	10	
drift FC PET	1	500
GEM1	4	
GEM2	2	502
GEM3	2	504
OPTICS (ONYX)	660	1164
BODY	40	1204
—>		1204
total length		2408

Absolute distance of camera body is independent of lens

detector design strategy

preliminary evaluation of prêt-à-porter/custom solution



safety pools to
be realise inside



LORCA di Luca Battistutta e Francesco Nicora SNC

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PREVENTIVO

Preventivo nr. 100/2024
Data: 31/05/2024

All'attenzione di
Istituto Nazionale di Fisica Nucleare - INFN

Via Enrico Fermi, 40
00044 Frascati (RM)
Italia
CF: 84001850589

Descrizione	Prezzo	Quantità	Importo netto	IVA 22%	Importo totale
SERBATOI CUSTOM IN HDPE OFFERTA BUDGETARIA INDICATIVA PER LA FORNITURA DI N°24 SERBATOI SU MISURA CON LE SEGUENTI CARATTERISTICHE: - Realizzati in HDPE 300 Naturale atossico - Spessore pareti 15 mm - Dimensioni 700x500xH3000 - N° 1 flangiatura nella parte superiore - Paratie interne strutturali (Da definire)	€ 1.500,00	24,00	€ 36.000,00	€ 7.920,00	€ 43.920,00
				Imponibile	€ 36.000,00
				IVA 22% su € 36.000,00	€ 7.920,00
				Totale dovuto	€ 43.920,00

CONDIZIONI DI FORNITURA:

- Validità preventivo: 30 gg
- Tempi di consegna: Da concordare
- Trasporto e imballaggio: Esclusi
- Pagamento: Da concordare

WBS attempts...

CBS/PBS

WBS										File Edit View Insert Format Data Tools Extensions Help										Q Menus										100%										\$ % .0 .00 123										Default...										- 11 +										B I 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pre-quotation

Jiangsu Donchamp New Materials Technology Co. Ltd.									
Customer Name: Prof. Fabrizio Petrucci Address : Via della Vasca Navale 84, 00146 Roma - ITALY DONCHAMP® Splash block					Quotation Pl. No.: 24-CL00083 Date: 24th FEB. 2024				
Acrylic Descriptions	Length (mm)	Width (mm)	Thickness (mm)	Qty (Shts/panels)	Weight (Kg's)	Total Weight (Kg's)	Price / KG (USD)	Price (USD)/Sheet	Total Amount (USD)
Monolithic Clear Acrylic Panel -PMMA for big sphere project	2100	3100	6	1	46.48	46.48	\$12.50	\$581.02	\$581.02
Monolithic Clear Acrylic Panel -PMMA for big sphere project	2000	3030	30	1	216.34	216.34	\$17.70	\$3,829.25	\$3,829.25
Package cost and EXW price									\$200.00
PC Sum estimated shipping cost from factory to ROME (LCL)									\$500.00
Total CIF Price				2		242.82			\$5,110.27
Remark: 1. All prices offered are supplied on an Ex Works/FOB Shanghai basis. 2. All prices quoted are subject to exchange rate variation at time of order, the offer quoted is based on USD \$1.00 = 7.12 Chinese Yuan Renminbi 3. All freight quotations supplied are offered as a PC Sum – Estimate, relating to the current instability in freight offers, where confirmation can be supplied once the goods are available ex works. 4. This quotation is based on the supply of DONCHAMP® (100% virgin monomer) 5. All DONCHAMP® is cut to standard or requested dimensions. 6. DONCHAMP® is masked on two sides with pressure sensitive PE Masking. 7. DONCHAMP® has an identification label on one side. 8.Payment terms : 50% deposit 50% before shipment. 9.DONCHAMP® Splash Deflection Criteria (50 year Design Life) 1/500 3 sides supported 1/300 4 sides supported 10.Validity: 10 days from the date of this quotation. 11. Ex Works (DONCHAMP Taking) Date: 10 days after receiving deposit and confirmed drawings. 12. ETD (Estimated Time of Departure from Port): 13. ETA - approximate date (Estimated Time of Arrival into destination Port):									

Customer:
Gran Sasso Science Institute
Via F. Crispi 7
67100 L Aquila
Italy



Industriestraße 1-3, 27356
Rotenburg (Wümme) Germany

Geschäftsführer
Andreas Elsaesser
Amtsgericht Walsrode HRB 208633

Quotation

454196 Rev. 1

Date: 08.07.2024
Contact: Günter Peters
Contact: +49 4261 18907-33
Mail: sales@elsaesser.industries

Contact: Prf. ssa Elisabetta Baracchini
Phone: +39 08624280303
E-Mail: elisabetta.baracchini@gssi.it
Your Inquiry: Email dtd. 05.07.24

Thank you very much for the a.m. inquiry.
According to our standard conditions of sale to be found under www.csnmetals.de,
I have pleasure in quoting without engagement as follows:

W Delivery-Time [weeks excl. Holidays]: 16 - 18
depending on availability of raw material

Quotation: 5-Jul-2024 Cu-LME/t: \$ 9.809,00 - 1 EUR = 1,0819
Prices are valid for total quantity only.

Valid until: 22-Jul-2024

ITEM	DESCRIPTION	PCS	UNIT WEIGHT KG	TOTAL KG	KG PRICE EUR	TOTAL EUR
1	Material:E-Cu Dimension 40 x 940 x 1020 mm Extra spec.: NOSV hot rolled	2	341,33	682,67	28,88 €	19.713,16 €
2	Material:E-Cu Dimension 40 x 920 x 2300 mm Extra spec.: NOSV hot rolled	2	753,30	1506,59	29,19 €	43.973,68 €
3	Material:E-Cu Dimension 40 x 1100 x 2300 mm Extra spec.: NOSV hot rolled	2	900,68	1801,36	29,12 €	52.451,23 €
4	Material:E-Cu Dimension 40 x 500 x 1000 mm Extra spec.: NOSV hot rolled	1	178,00	178,00	29,77 €	5.298,86 €

Total Net:

121.436,92 €

PREVENTIVO

Preventivo nr. 100/2024
Data: 31/05/2024

All'attenzione di
Istituto Nazionale di Fisica Nucleare - INFN
Via Enrico Fermi, 40
00044 Frascati (RM)
Italia
CF: 84001850589



LORCA di Luca Battistutta e Francesco Nicora
SNC
Via Pitagora 32
30020 Noventa di Piave (VE)
Italia

P.IVA: 04644620272
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CELL: 3272597339
MAIL: info@lorcasolutions.com

Descrizione	Prezzo	Quantità	Importo netto	IVA 22%	Importo totale
SERBATOI CUSTOM IN HDPE OFFERTA BUDGETARIA INDICATIVA PER LA FORNITURA DI N°24 SERBATOI SU MISURA CON LE SEGUENTI CARATTERISTICHE: - Realizzati in HDPE 300 Naturale atossico - Spessore pareti 15 mm - Dimensioni 700x500xH3000 - N° 1 flangiatura nella parte superiore - Paratie interne strutturali (Da definire)	€ 1.500,00	24,00	€ 36.000,00	€ 7.920,00	€ 43.920,00
				Imponibile	€ 36.000,00
				IVA 22% su € 36.000,00	€ 7.920,00
				Totale dovuto	€ 43.920,00

CONDIZIONI DI FORNITURA:

- Validità preventivo: 30 gg
- Tempi di consegna: Da concordare
- Trasporto e imballaggio: Esclusi
- Pagamento: Da concordare

oltre a circa 250 ke di materiali ci sono le lavorazioni, l’acquisto delle telecamere (altri 200ke) e ottiche che “inchiodano” le specifiche di progetto.

conclusioni

- il progetto esecutivo che stiamo realizzando manca dei **requirement necessari per definire le specifiche finali**, questo implica dei **rischi** di progettazione e **negli acquisti** la cui ultima data possibile per molte componenti è **fine agosto '24**. Benché fossero previsti ritardi e/o mancanza di risorse nel **contingency plan non avevamo previsto la distrazione di risorse su altri scopi**.
- Abbiamo superato il **limite con il quale gestire la mancanza di requirements** e quindi si deve procedere a **minimizzare il danno** che può derivare dalla **progettazione** e successiva **implementazione** in tempi brevissimi su un progetto con **specifiche non ancora definite**.
- **L'obiettivo** di questo incontro è quindi di **condividere** lo stato dell'arte del progetto con colleghi per avere una **critica per quanto possibile obiettiva che nella estemporaneità dell'incontro** possa mettere in evidenza **rischi, mancanze** e/o **strategie** di mitigazione.

ringrazio tutti per la collaborazione