

it could work !

Summary and plans on the underground site(s) at LNGS



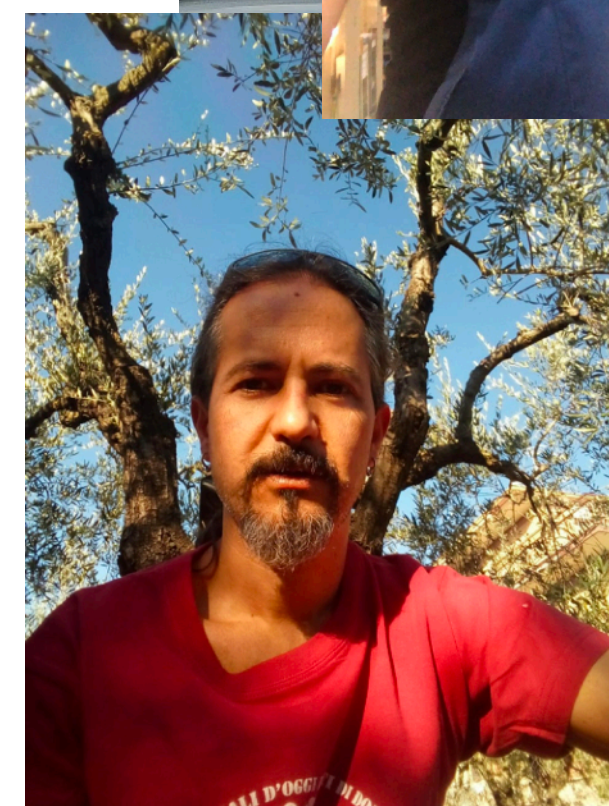
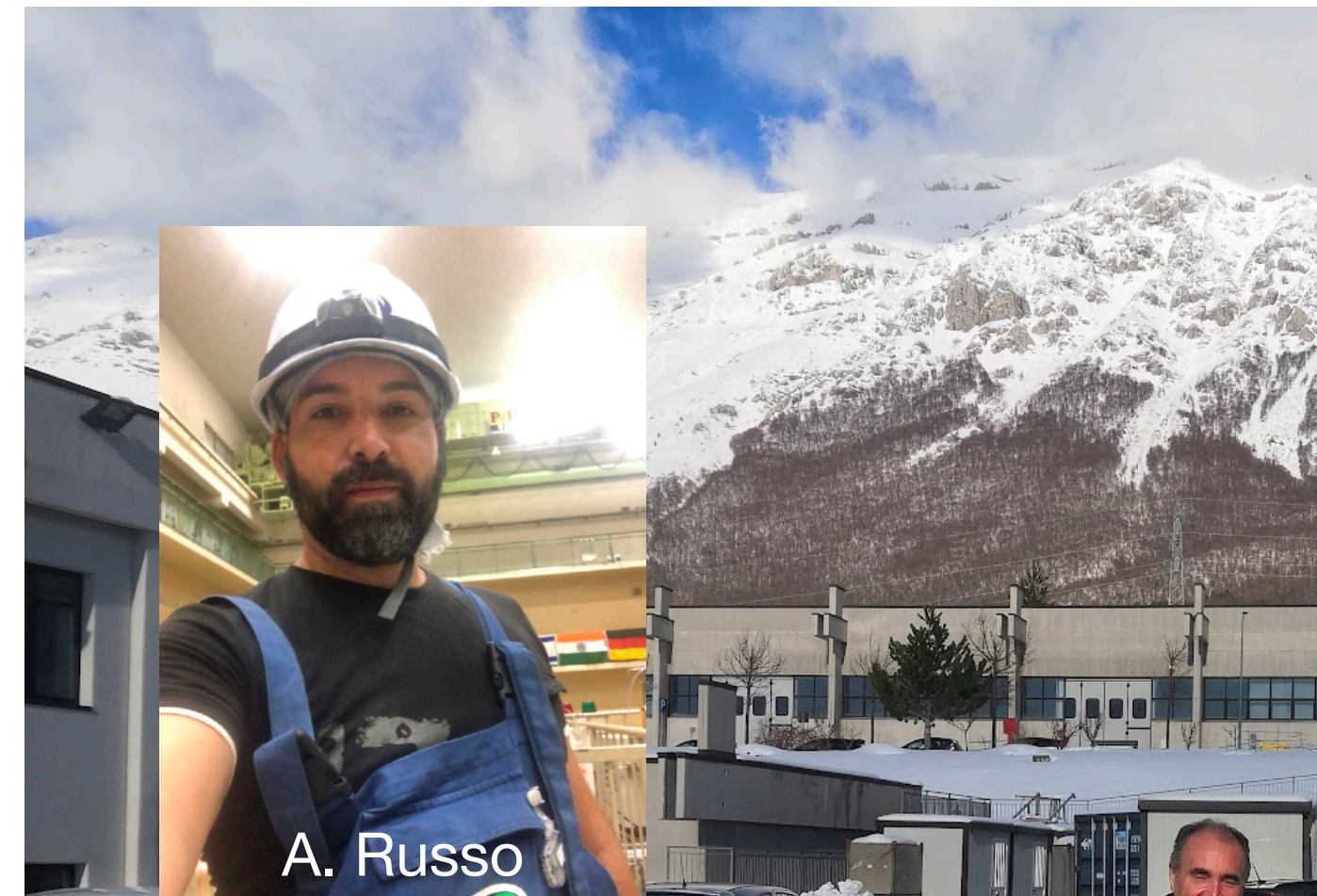
20/12/21 G. Mazzitelli on behalf of

**C. Capoccia, E. Paoletti, L. Passamonti, D. Pierluigi, A. Rodano, F. Rosatelli, A. Russo, R. Tesauero, S. Tomassini.
L. Leonzi and the staff of LNGS's services**

summary

It could work!

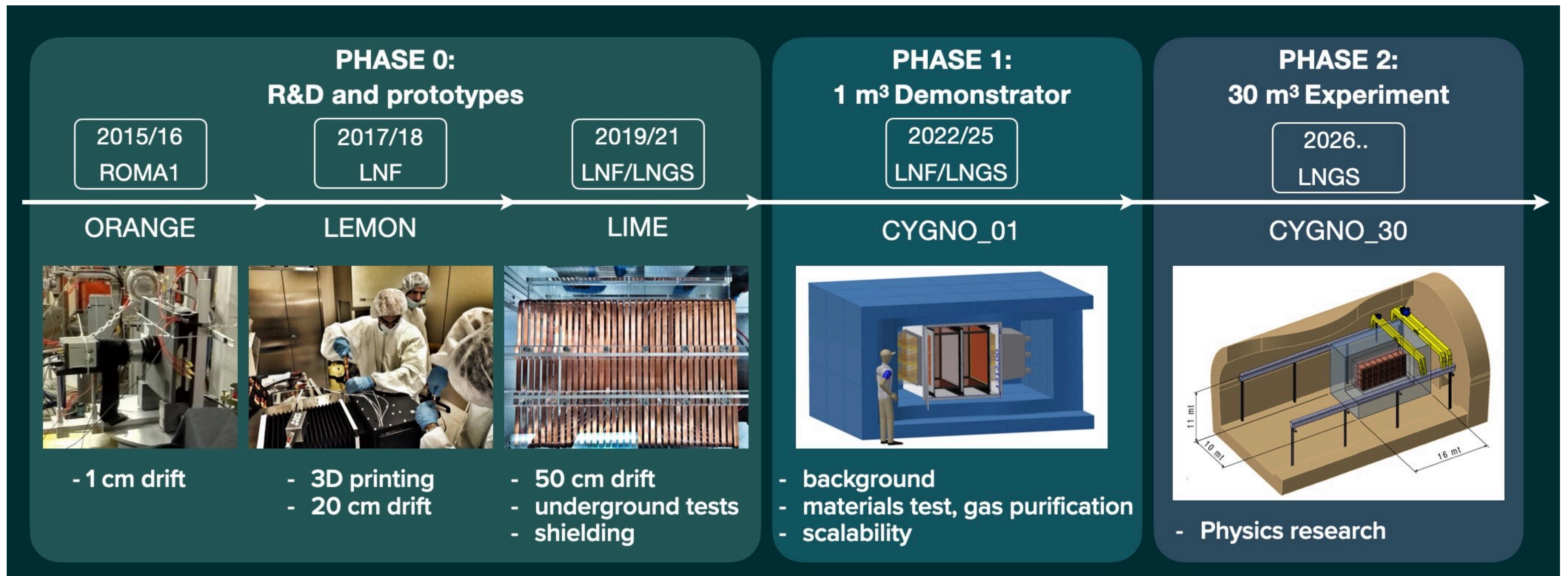
- Status of LIME installation ad LNGS
- LIME open issues and what next...
- CYGNO where we are and ...
- TDR and deadlines



The LNF staff is also supporting the design, construction and maintenance of prototype under study at LNGS (not reported in this talk)

from “!” to “?”: it could work?

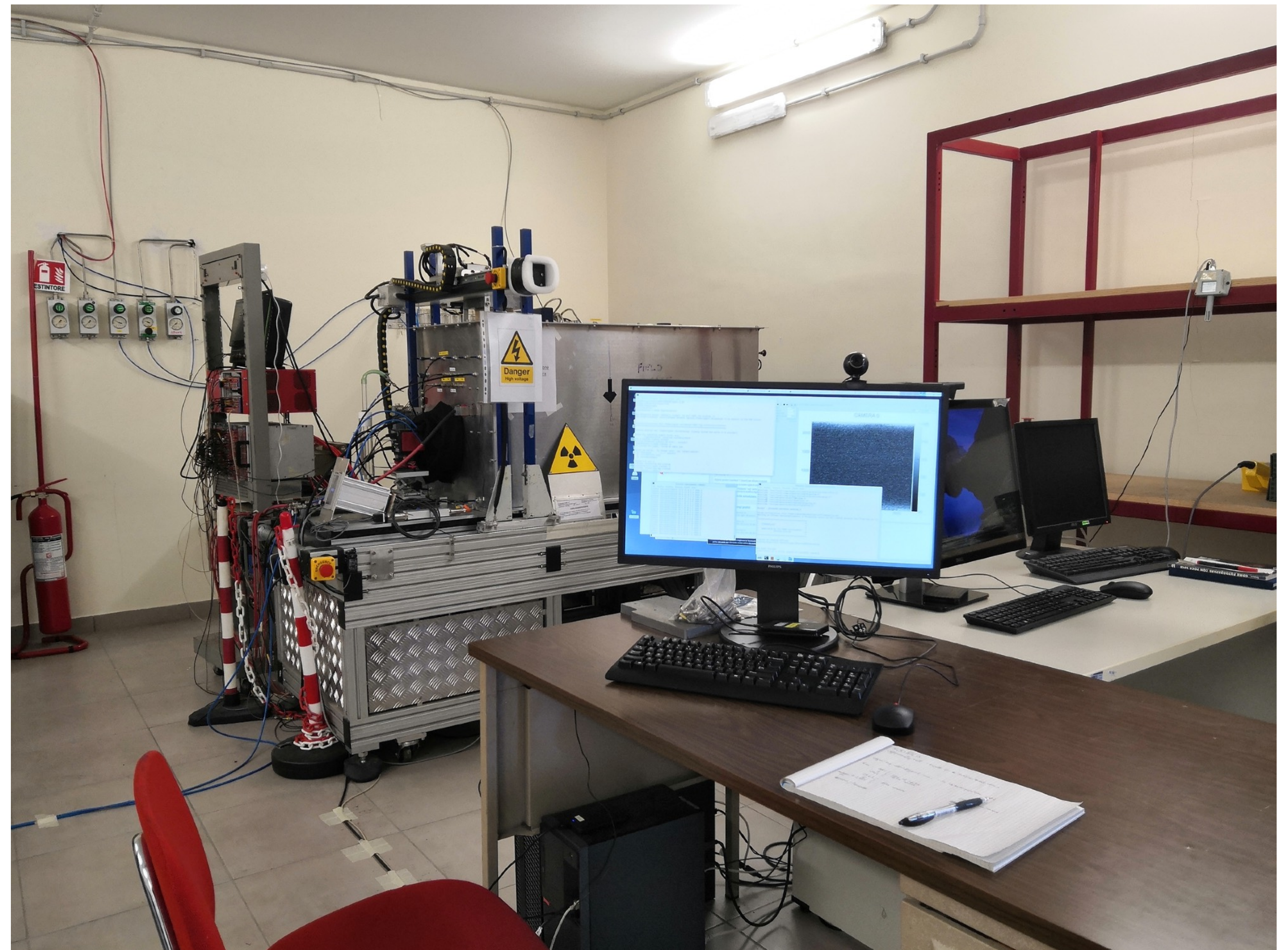
from the idea to the realisation...



LIME at LNF

Calibration and long term stability test

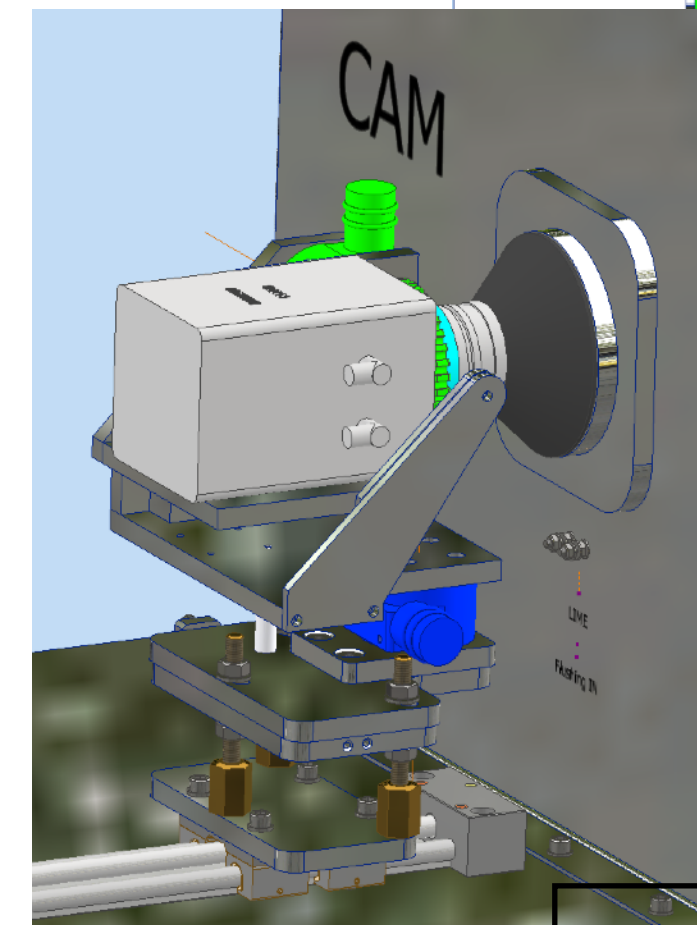
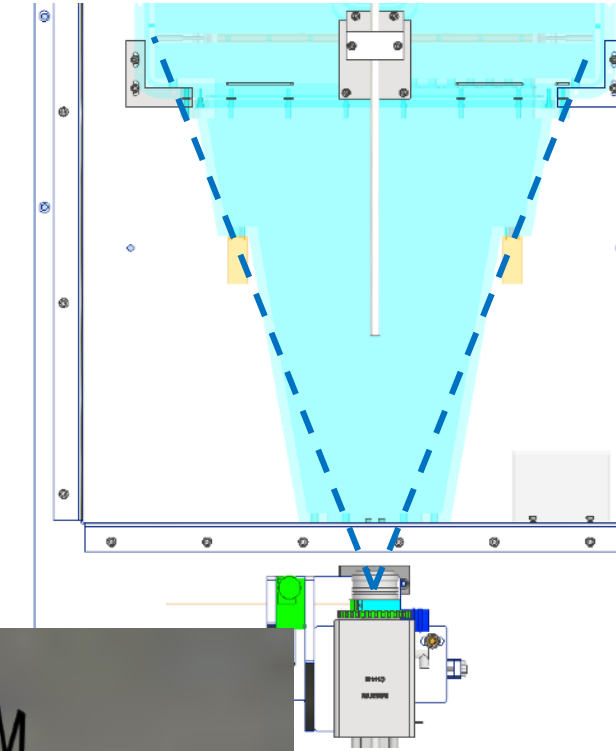
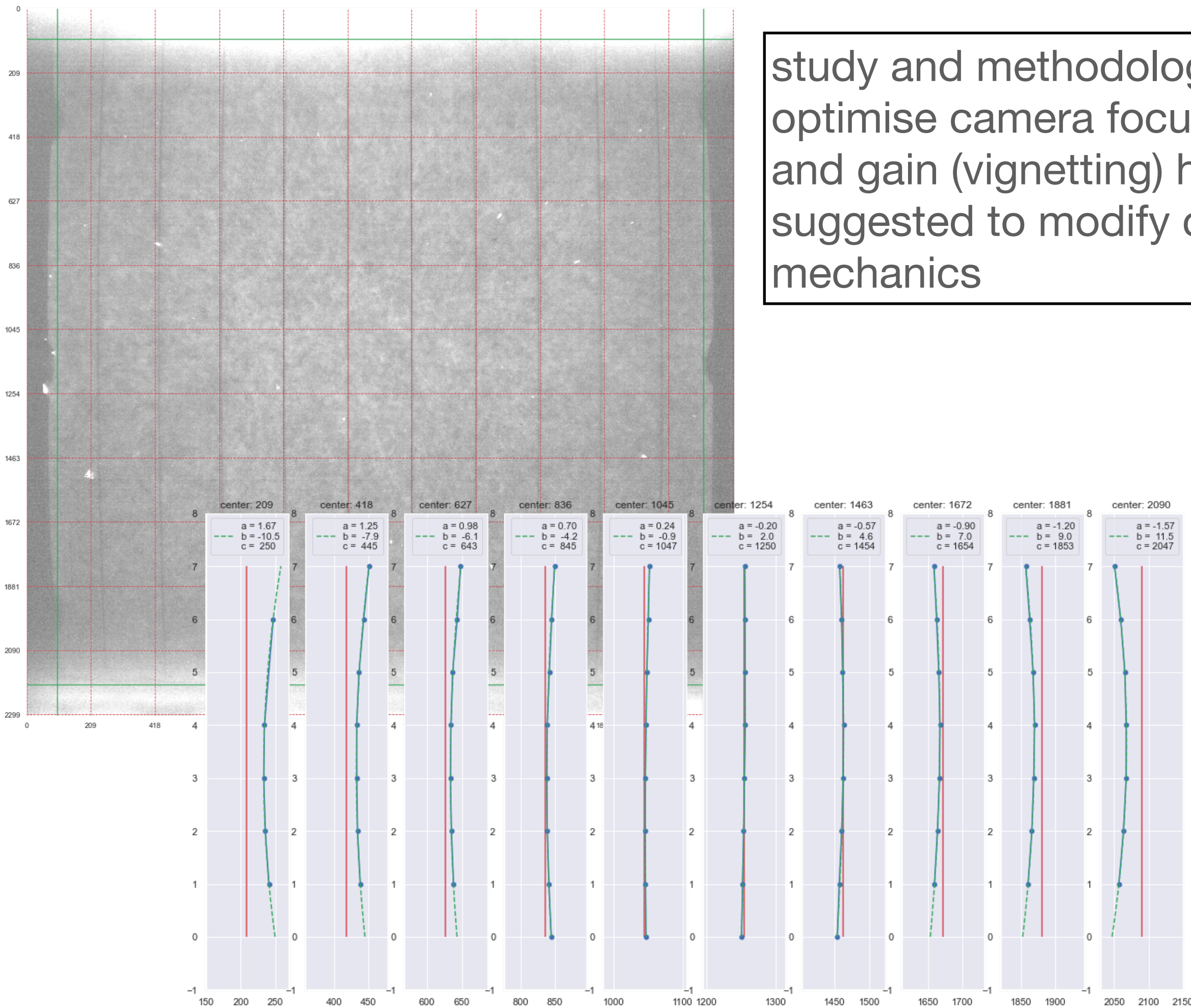
- read-out test, gas flow optimisation, PMTs characterisation and calibration, light and electromagnet shielding test, camera holding and tuning test (see Pinci talk)
- DAQ test, data storage, data shearing, online DB, etc. (see Messina talk)
- camera focus and alignment procedure, auxiliary channels and slow controls implementation, quasi online analysis and data qualifications (see Antonietti talk)



final camera mechanics

installation and test ongoing

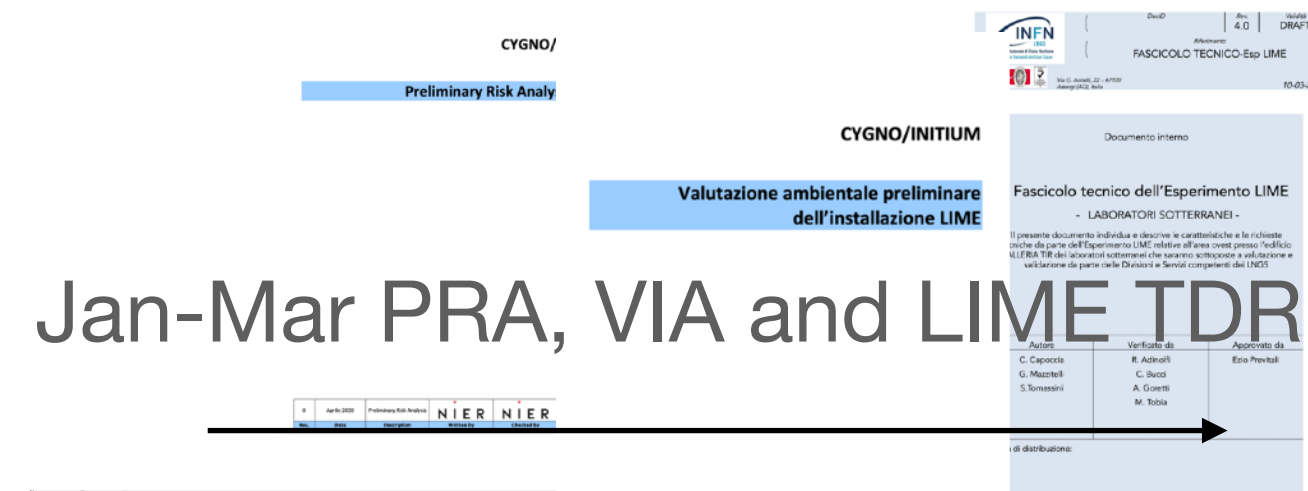
study and methodology to optimise camera focus, alignment and gain (vignetting) have suggested to modify camera mechanics



- new bellow (more elastic) and new micro-metric movements are under installation and test @LNF
- it's still missing a good method for a uniform illumination of the image

LIME @ LNGS

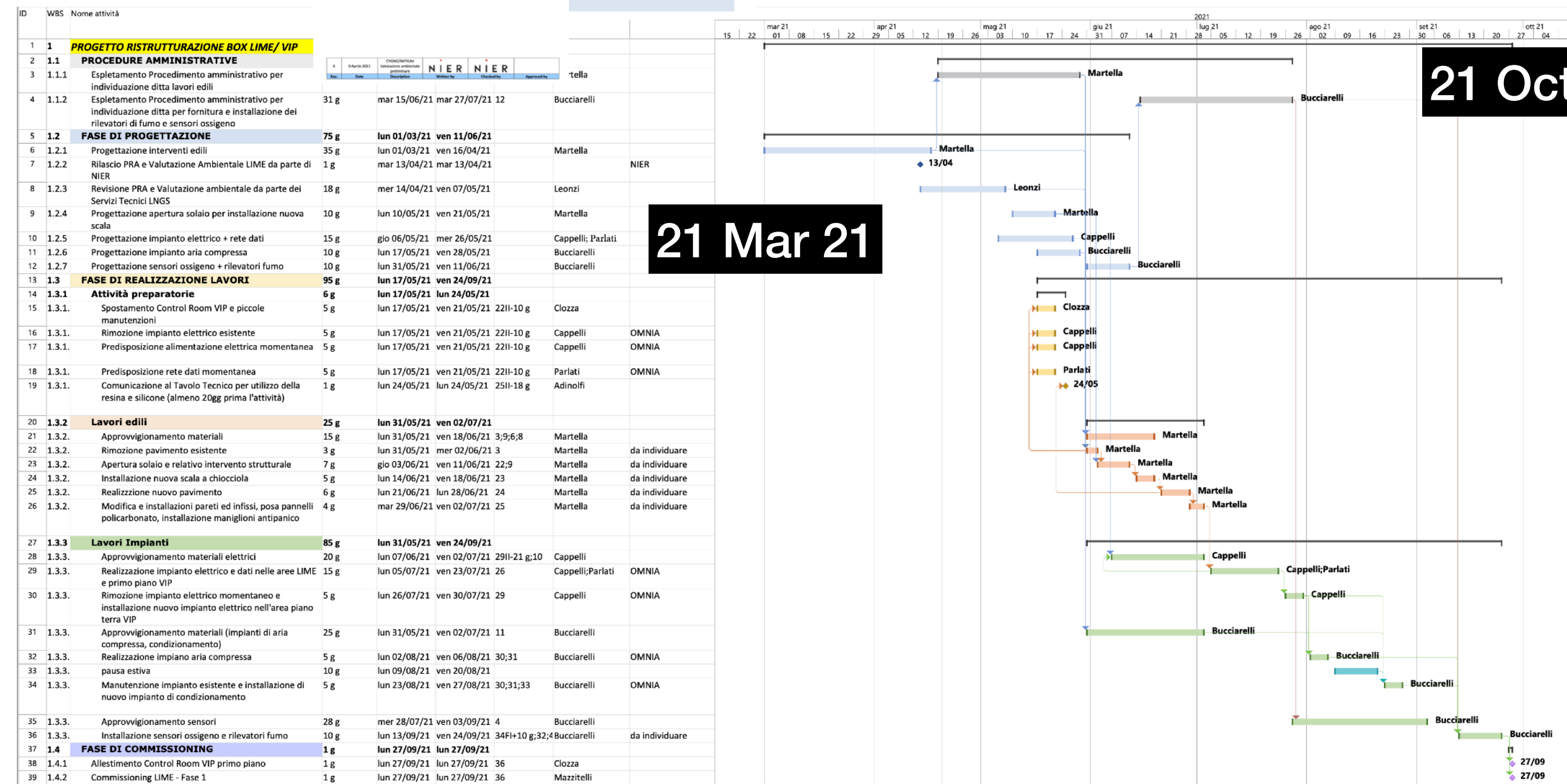
It could work?



Jan-Mar PRA, VIA and LIME TDR

“baracca” refurbishing, power, air condition ecc.

14 Jan 22,
and more...



actually, we are 2/3 month in late for electrical power, 3/4 month late for air conditioning we do no when monitoring system will be installed

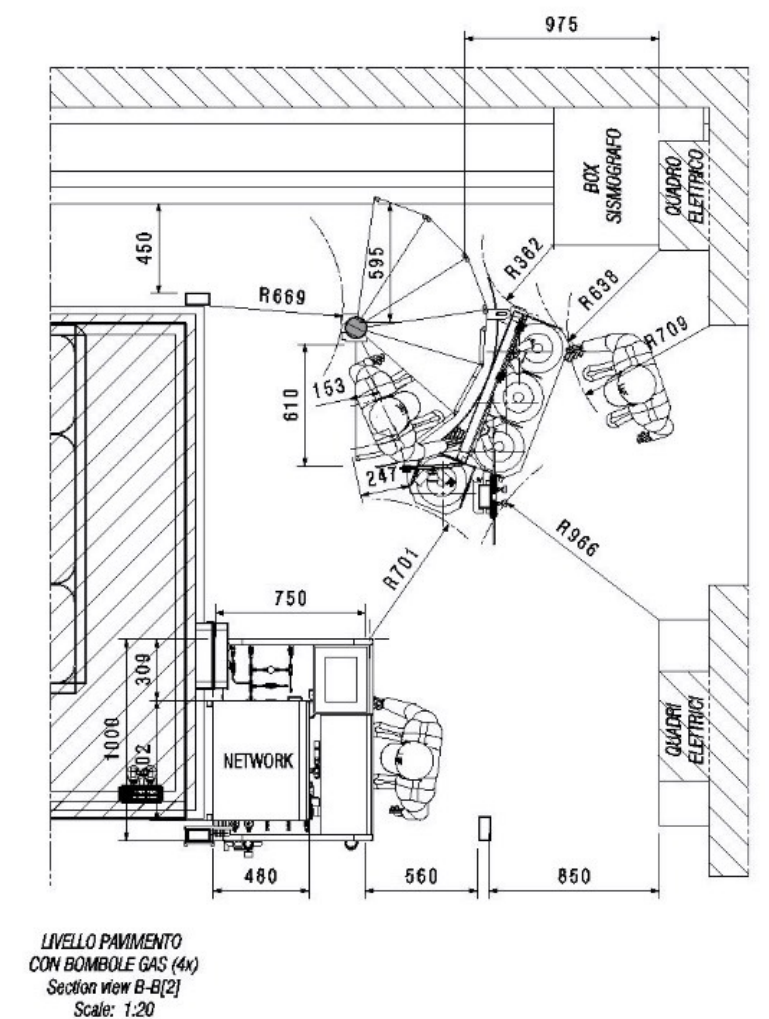
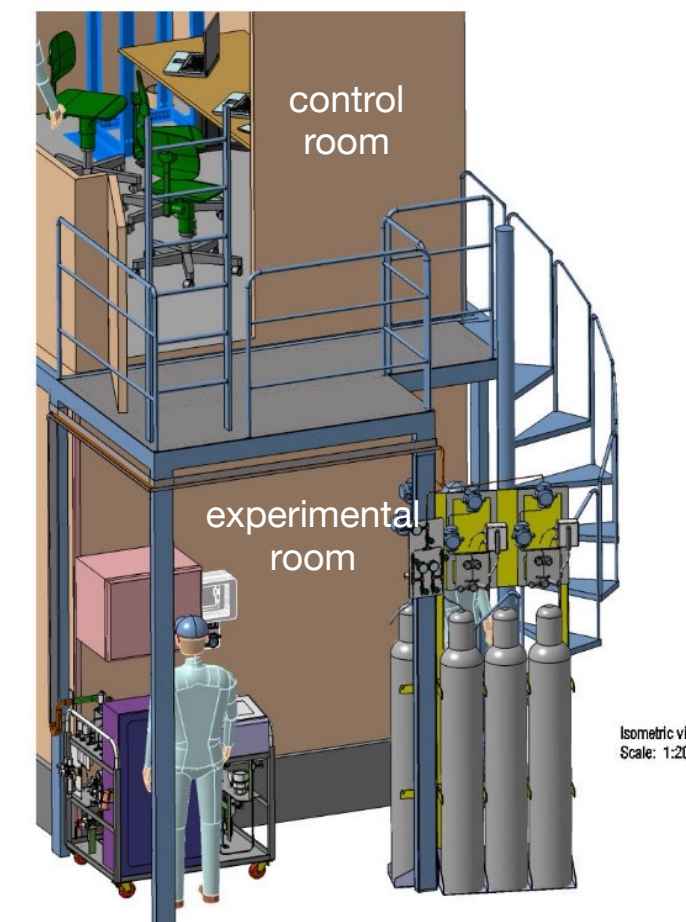
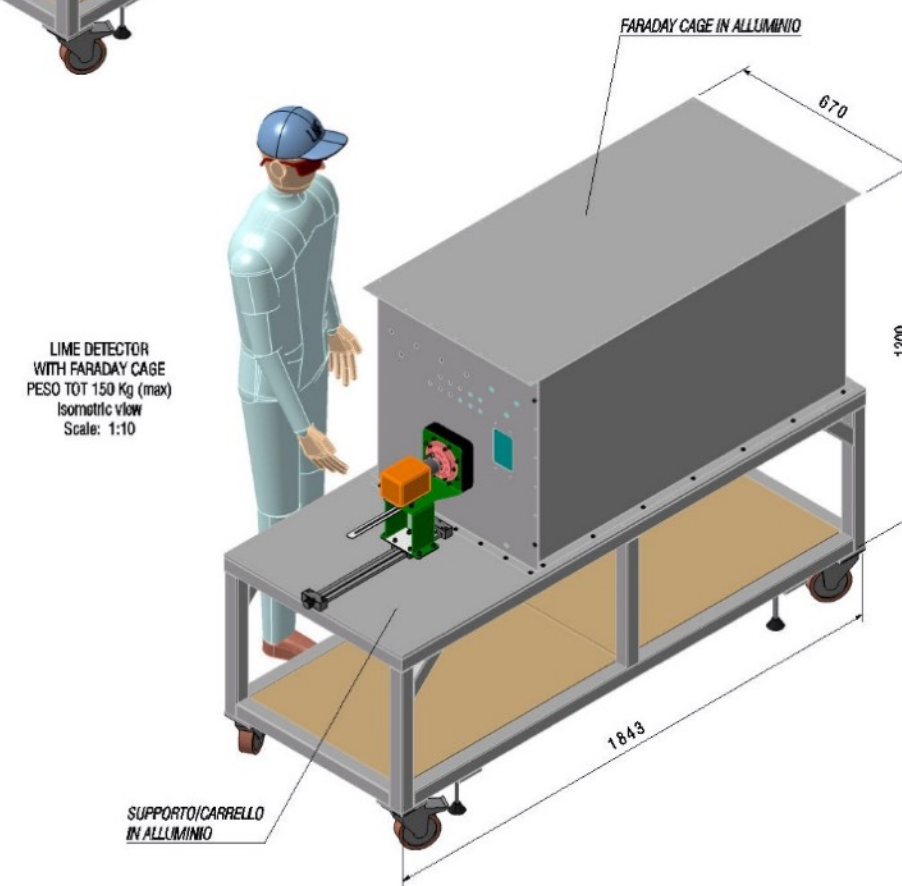
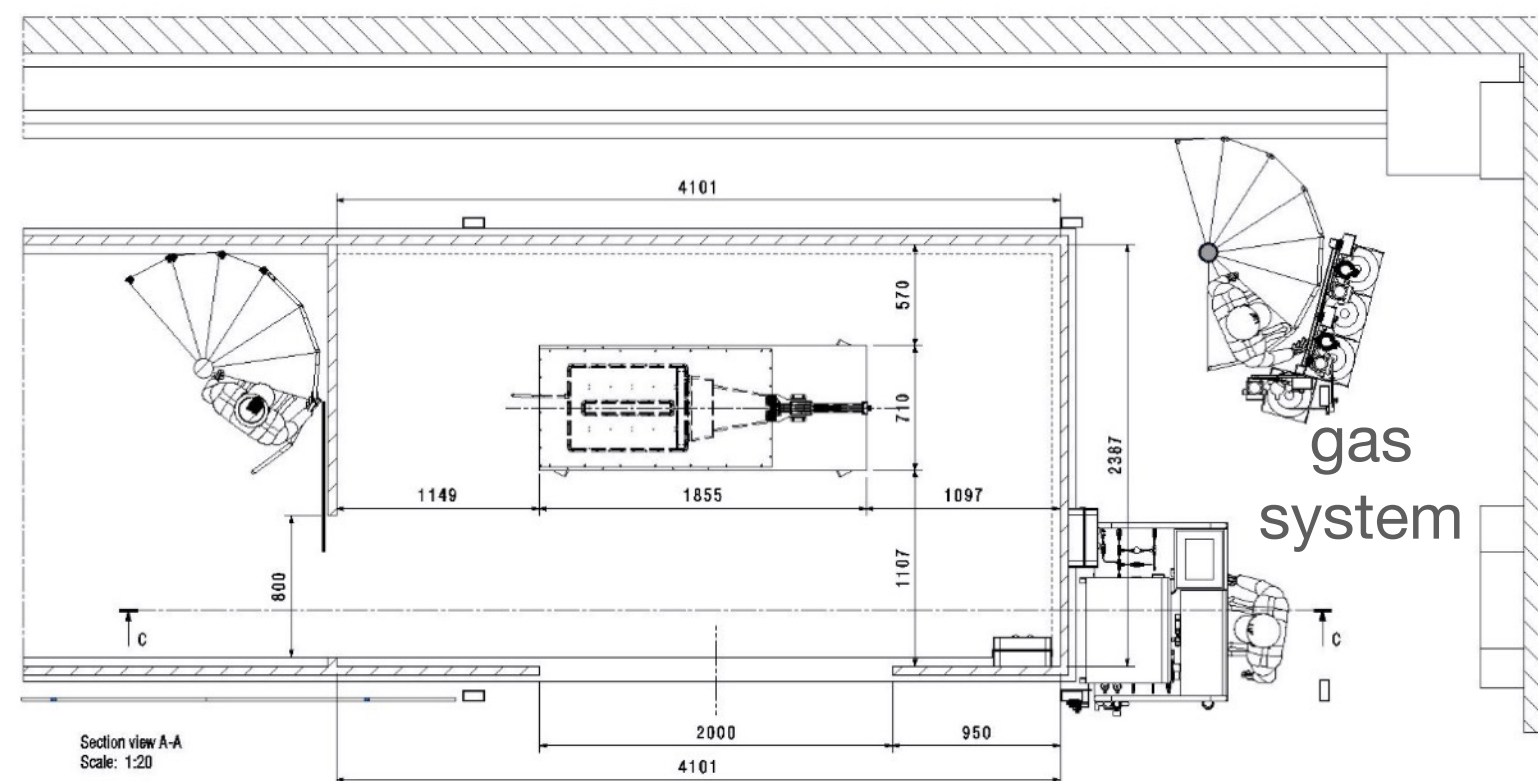
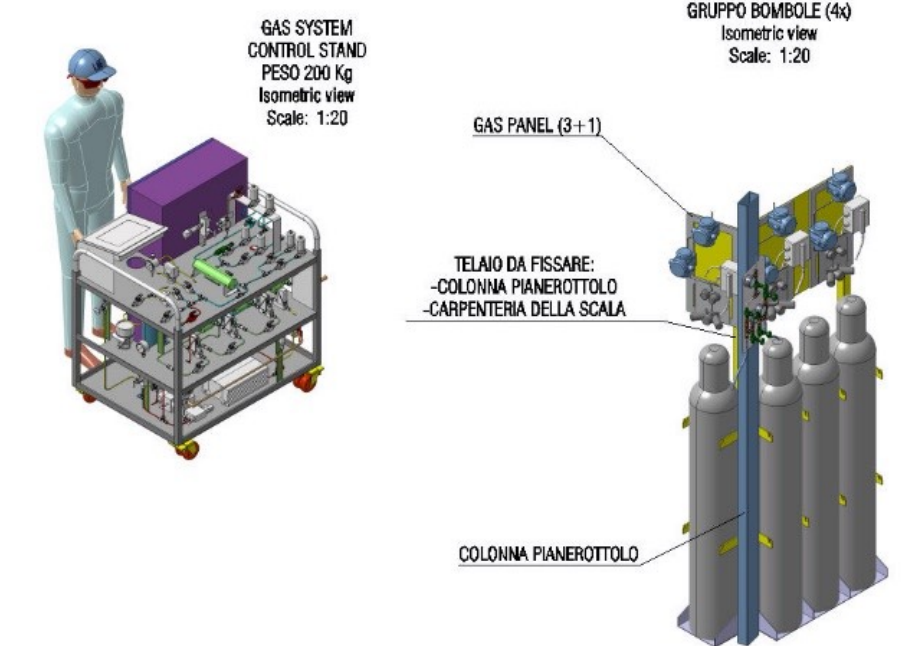
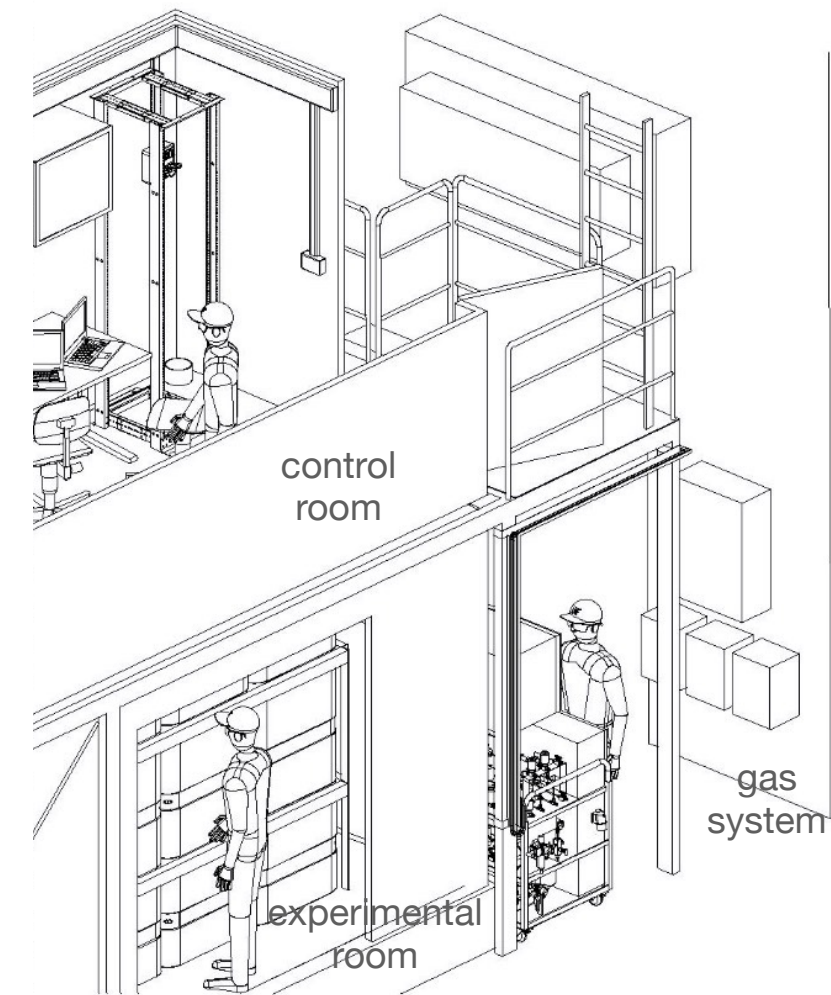
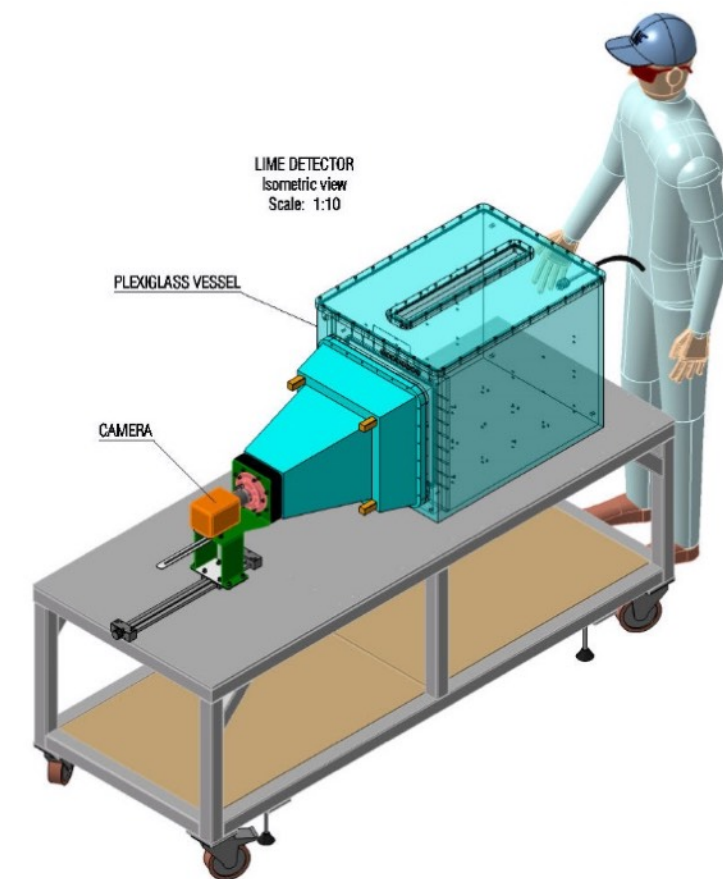
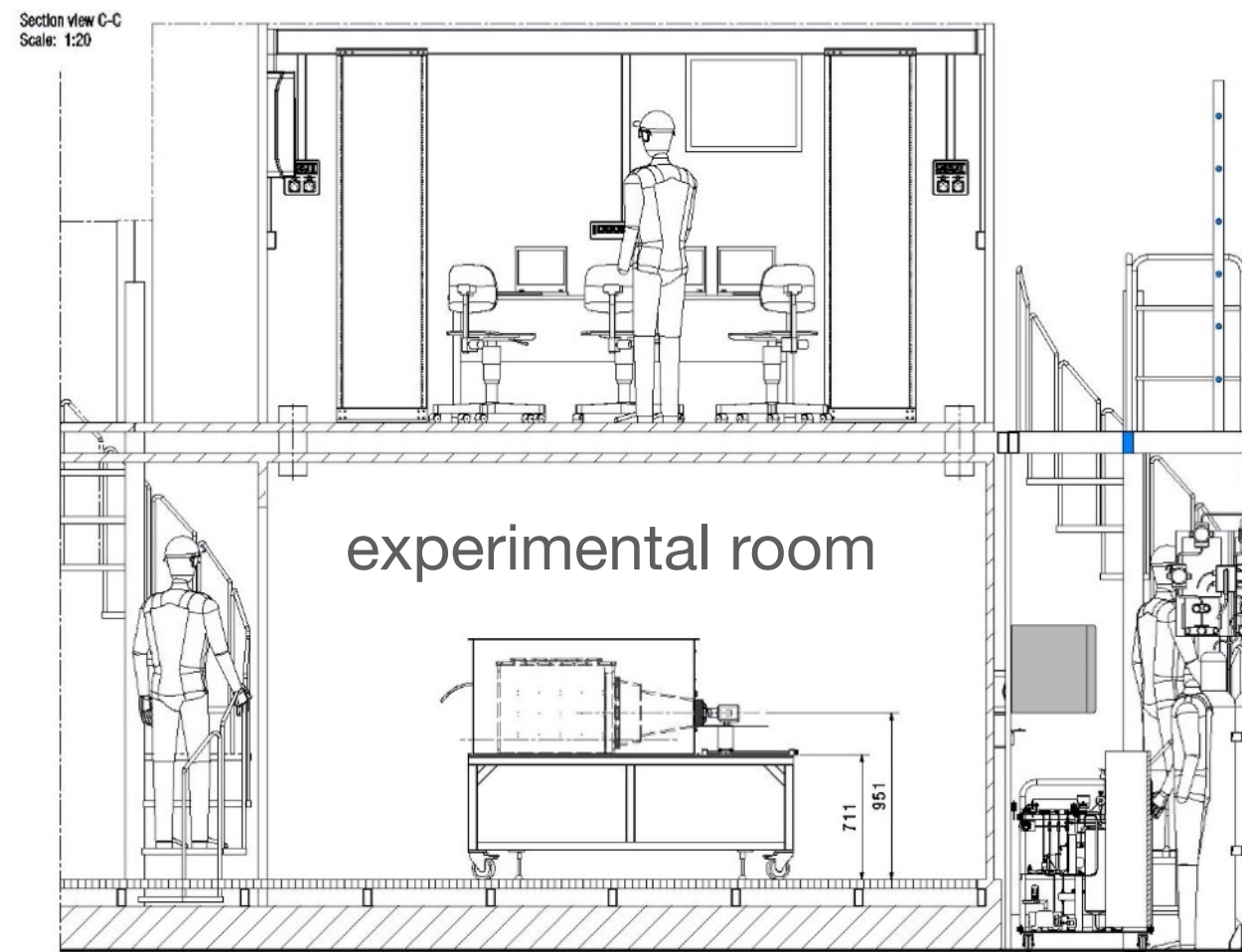


LIME underground first phase

unshielded

gas system installation layout

control room



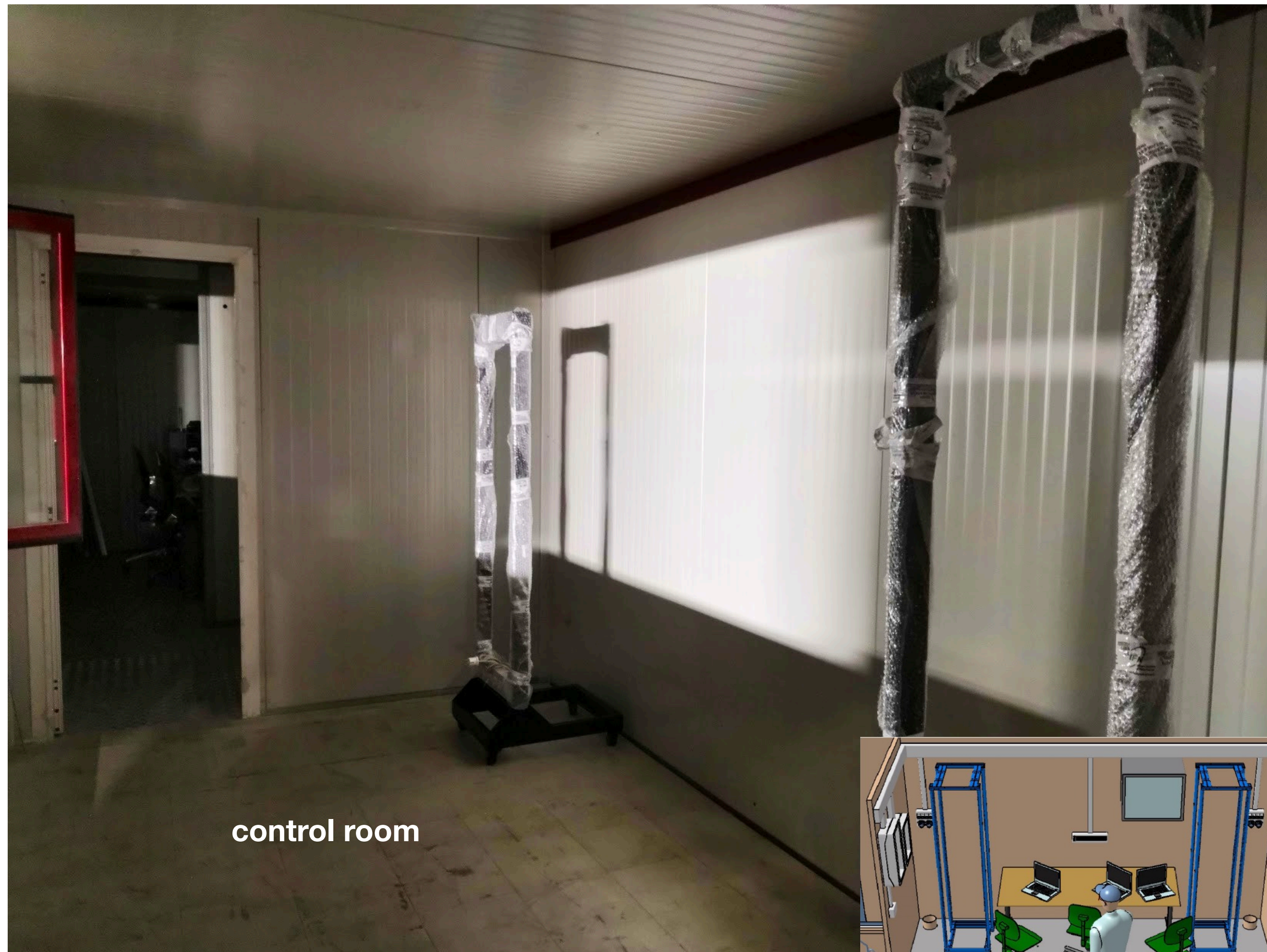
LIME site

“baracca” refurbishing

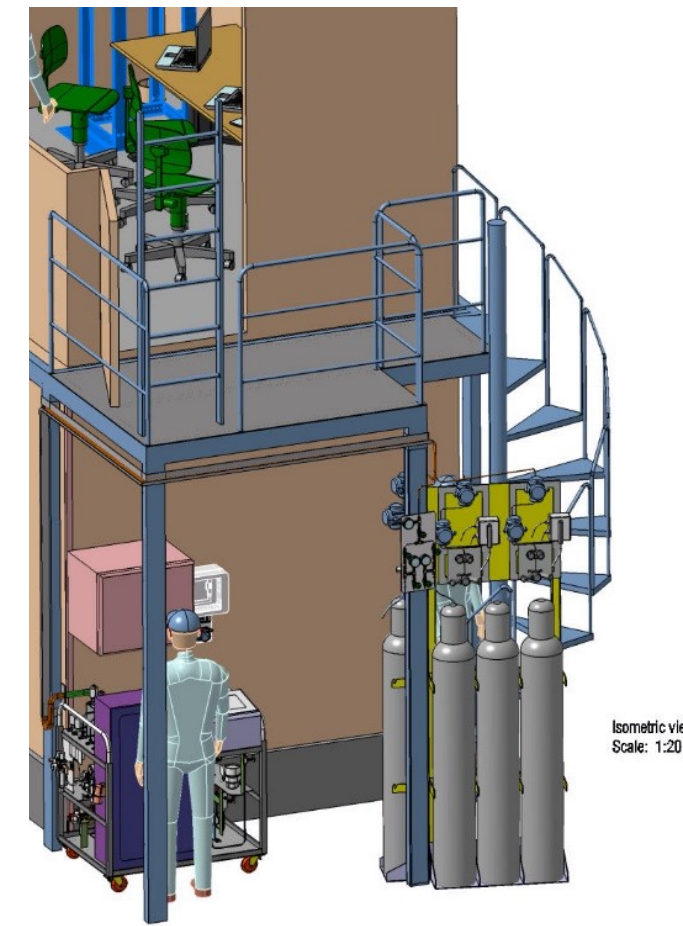


LIME site

“baracca” refurbishing



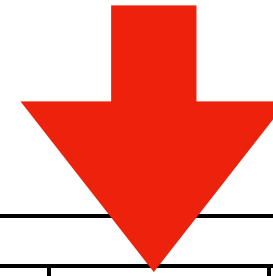
control room



updated LNGS schedule

“baracca” refurbishing

Schedula prossime attività VIP-LIME:



Tempi	Responsabile attività	DITTA	2021	2022							
			20-22 dic.	10-14 gen.	17-21 gen	24-28 gen	31-04 feb	07-11 feb	14-18 feb		
Definizione posizione quadri UPS degli esperimenti VIP-LIME	3 gg	Cappelli	LIME-VIP	█							
Realizzazione impianto elettrico + rete dati LIME	3 gg	Cappelli/Parlati	OMNIA		█						
Spostamento materiali VIP dal primo piano	1 gg	Clozza	FACCHINAGGIO		█						
Realizzazione impianto elettrico + rete dati VIP	3 gg	Cappelli/Parlati	OMNIA		█						
Spostamento fan coil primo piano VIP e manutenzione condizionatore piano terra LIME	2 gg	Bucciarelli	OMNIA			█					
Sistemazione materiali VIP primo piano	1 gg	Clozza	FACCHINAGGIO				█				
Impegno fondi LIME per attività condizionatori + aria compressa	2 gg	Mazzitelli			█						
Approvvigionamento materiali per attività condizionatori + aria compressa	20 gg	Bucciarelli	OMNIA			█	█	█			
Installazione condizionatori primo piano LIME e ventilatore con filtro HEPA al piano terra	5 gg	Bucciarelli	OMNIA						█		
Installazione linea + pannello aria compressa LIME	3 gg	Bucciarelli	OMNIA							█	
Progettazione sensori ossigeno e rilevatori fumo	20 gg	Bucciarelli				█	█	█			
Installazione sensori + rilevatori fumo		Bucciarelli	da individuare							marzo-aprile 2022	

ATTIVITA'	Resp. Attività	STIMA COSTI	COPERTURA FONDI
IVA inclusa			
Lavori edili per la ristrutturazione e adeguamento del box	Martella	24.650,00 €	LIME
Lavori per l'installazione dell'impianto elettrico e rete dati	Cappelli/Parlati	30.000,00 €	LNGS Direzione
Installazione di nuovi impianti (aria compressa, condizionamento) e manutenzione impianti esistenti	Bucciarelli	2.646,41 €	LIME
Installazione di sensori (ossigeno e rilevatore fumo)	Bucciarelli	15.860,00 €	LIME
TOTALE		73.156,41 €	

the total core cost of LIME detector will be about 250ke

LIME site

“baracca” equipment and final step



Dettagli tecnici:

- Portata d'aria max. (senza filtro): 750 m³/h
- Portata d'aria max. (Filtro G4): 680 m³/h
- Portata d'aria max. (Filtro G4 & H13): 290 m³/h
- Depressione max.: 720 Pa
- Classe di polvere (secondo DIN EN 60335-2-69): H
- Regolazione variabile della portata d'aria
- Potenza del motore: 120 Watt
- Tensione di connessione: 230 V / 50-60 Hz
- Consumo di corrente: 1,0 A
- Cavo di alimentazione / Collegamento: CEE 7/7 / H05RN-F
- Livello sonoro max. (a 1 m di distanza): 77 dB (A)
- Dimensioni (Largh x lungh x alt): 315 x 430 x 430 mm
- Peso (vuoto/pieno): 6,0 / 7,5 kg
- Mobilità: trasportabile



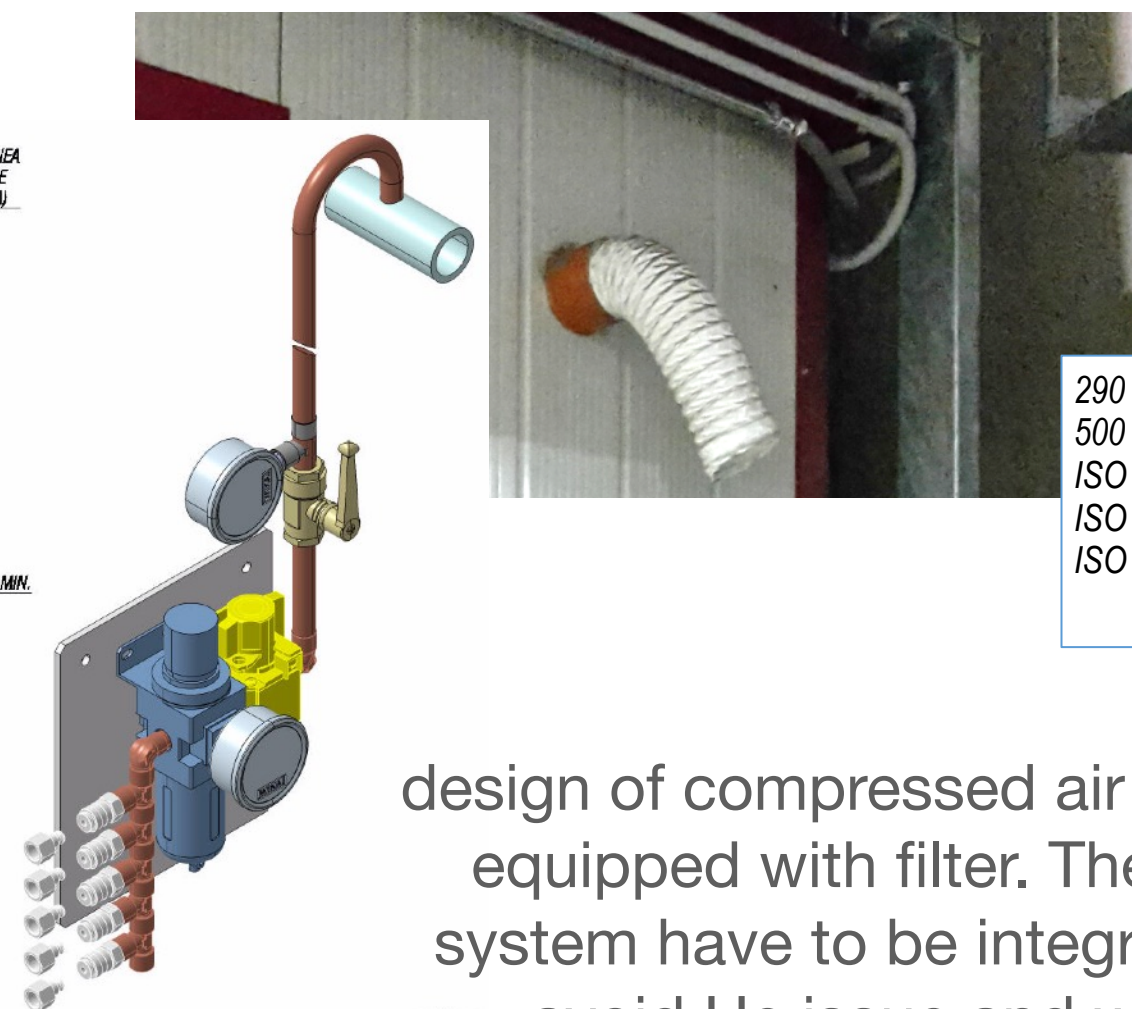
Purificatore d'aria TAC 750 E -
Pacchetto con filtro HEPA
688,08 €
Incluso iva



Purificatore d'aria TAC 1500
1.213,90 €
Incluso iva



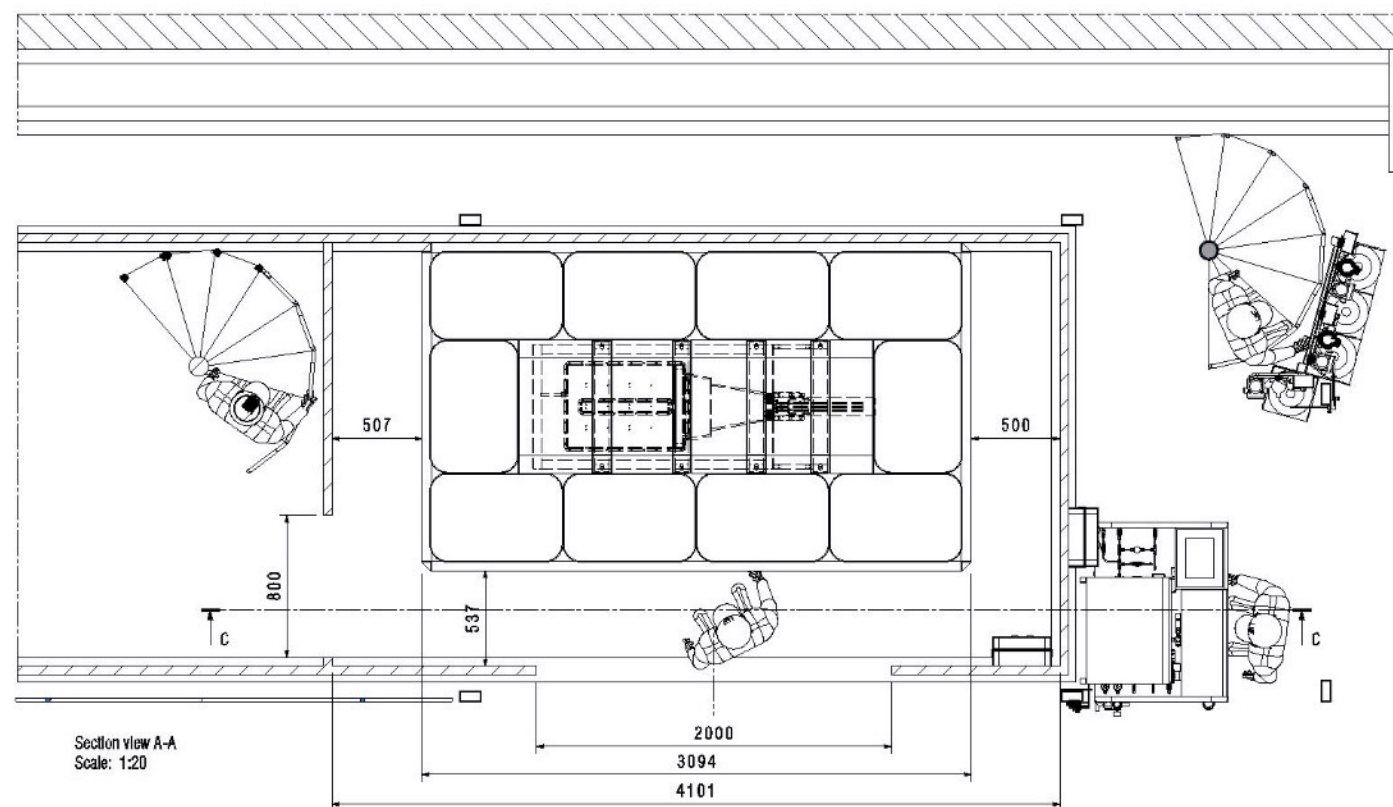
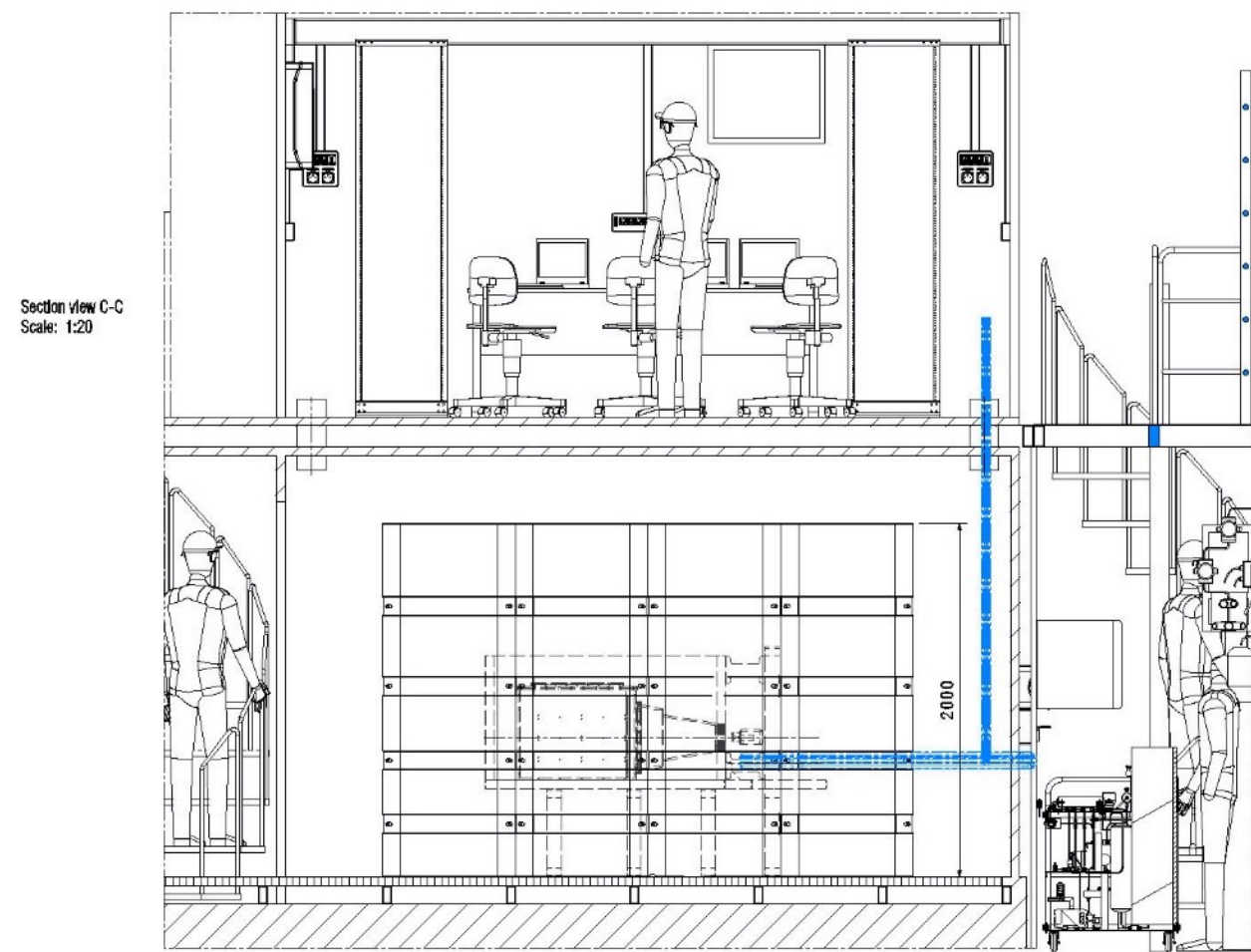
290 (mc/h) / 22 mc = 13 (ISO 9)
500 (mc/h) / 22 mc = 23 (ISO 8)
ISO 9 -> 1,000,000 (fino a 15 vol/h)
ISO 8 -> 100,000 (15 - 25 vol/h)
ISO 7 -> 10,000 (30 - 60 vol/h)



design of compressed air distribution system equipped with filter. The air compressed system have to be integrated with PMTs to avoid He issue and with gas system

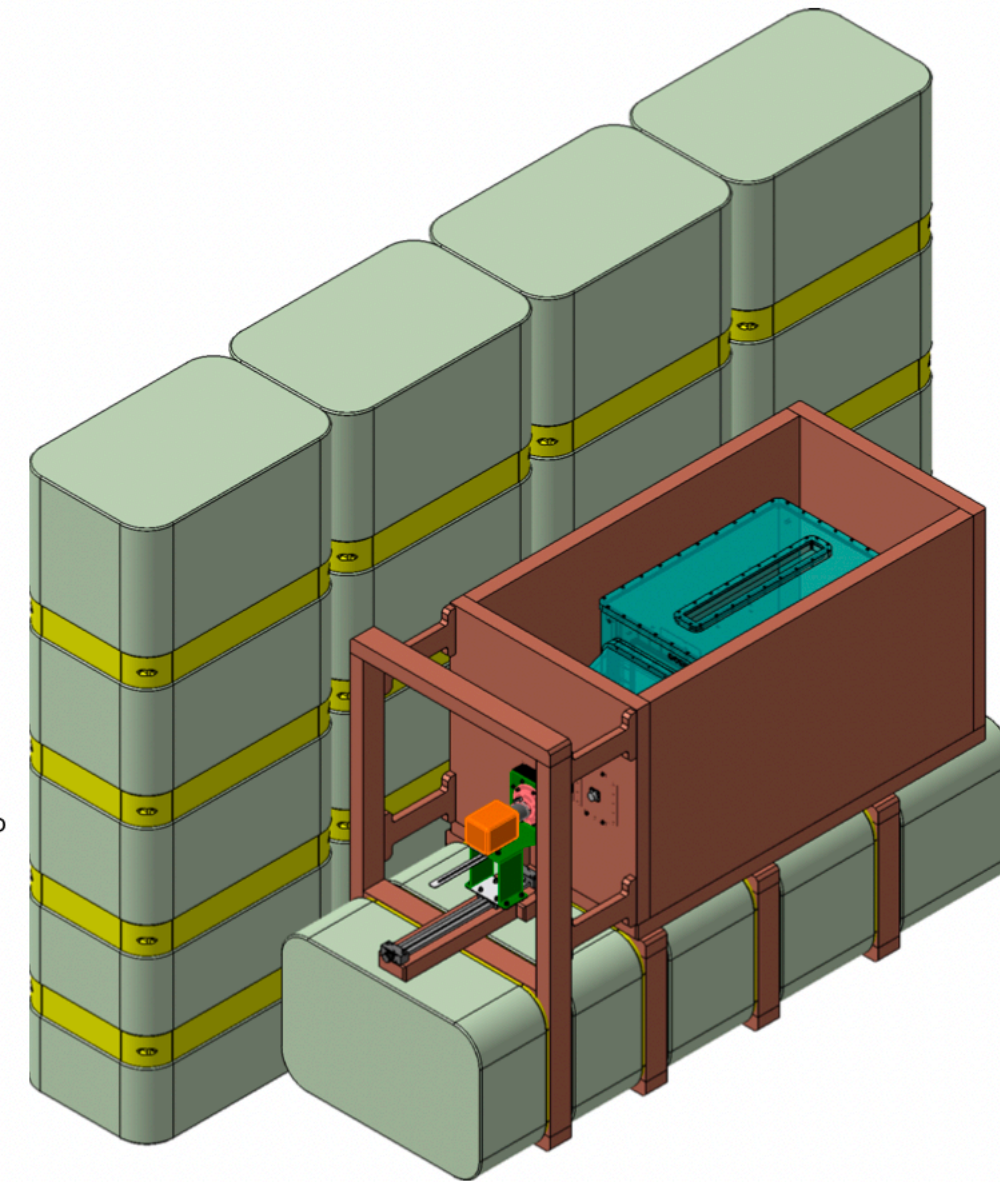
- before Christmas ensured power line will be connected to baracca
- plugs and electrical panels are now available (wrong respect the foreseen one) and in the week 10/01/22 will be installed
- in the week of 17/01/22 we can foreseen LIME transportation at LNGS
- the order ready for air conditioning and compress air distribution system, and as soon as administration re-open work can be executed (made inside LNGS maintenance contract service)
- fire system, O2 monitor, etc is delayed and we do not have any scheduled time for installation (but is not a constraint to start)
- we still have the to decide how recycle/dispose the exhausted He/CF4 mixture (see Renga talk)

LIME underground second phase shielded



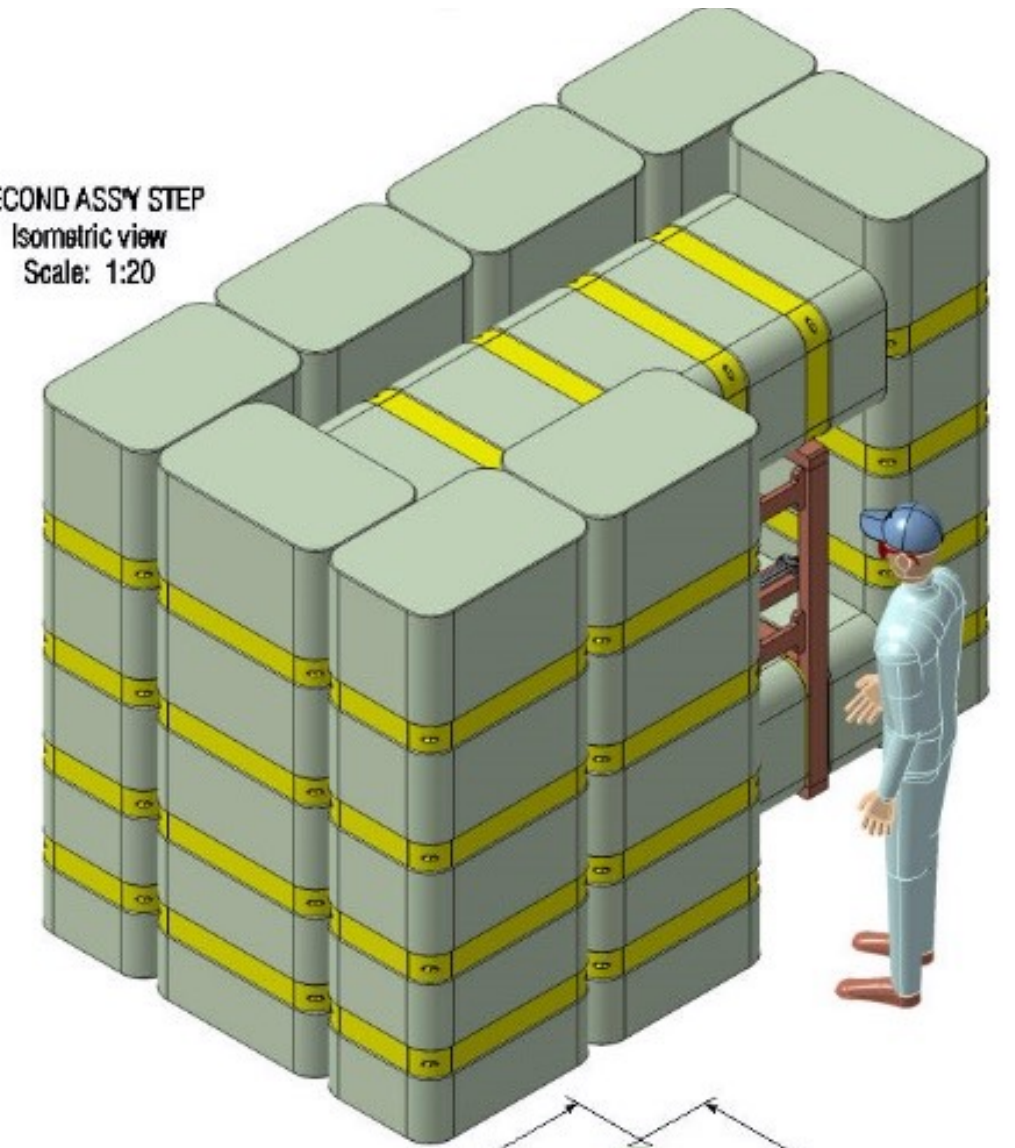
WATER SHIELDING
 N.12 Serbatoi
 Capacità 750 lt cad
 Peso serbatoi vuoti 65 Kg cad
 Peso serbatoi pieni 815 Kg cad
 Peso totale 10 ton di cui:
 - Acqua deminer. = 9 ton
 - Polietilene HD = 1.2 ton

FIRST ASSY STEP
 Isometric view
 Scale: 1:20

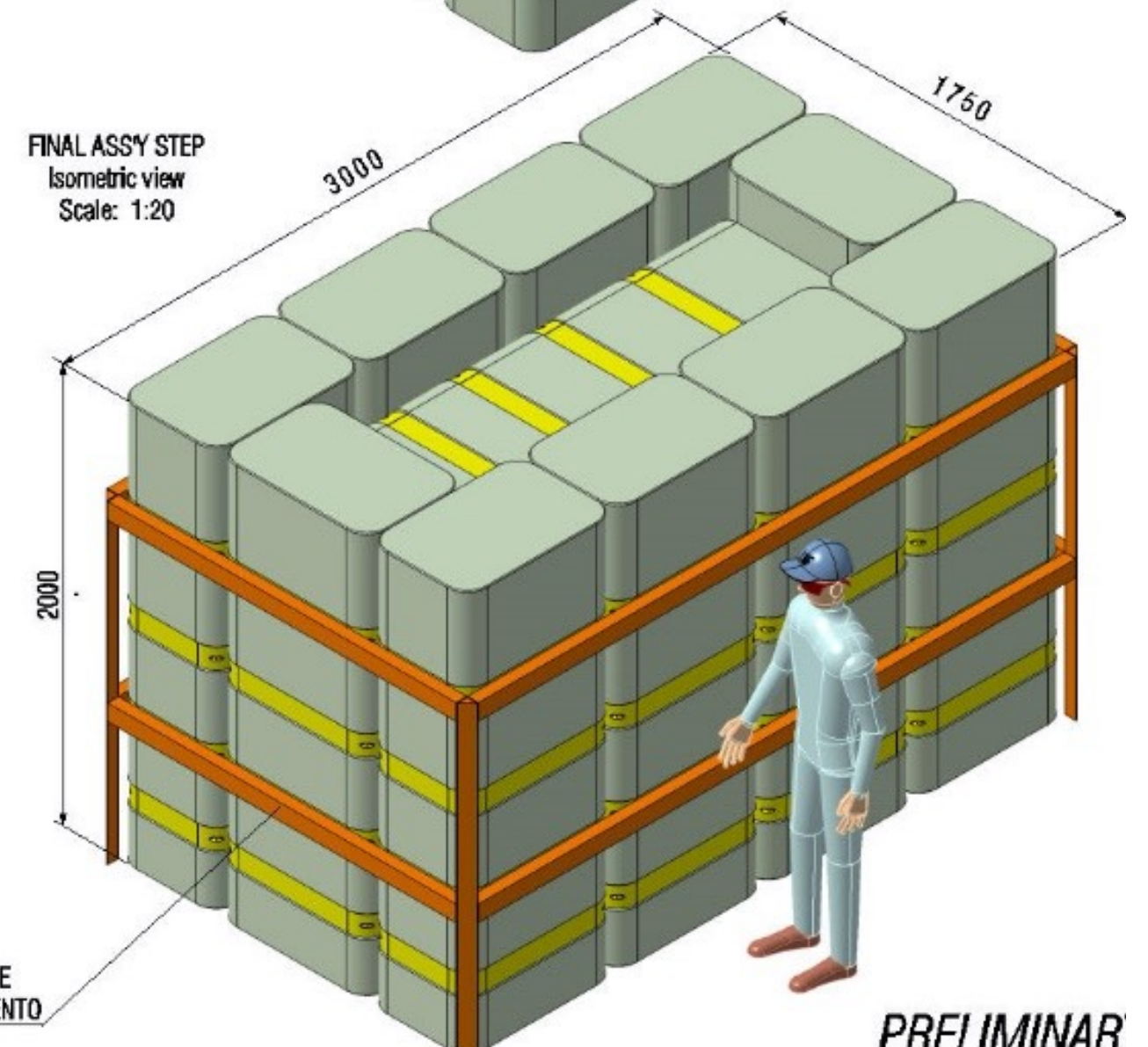


COLLETTI DI RINFORZO (4x) POLIETILENE
 Peso tot = 35 Kg
 Isometric view
 Scale: 1:20

SECOND ASSY STEP
 Isometric view
 Scale: 1:20



FINAL ASSY STEP
 Isometric view
 Scale: 1:20



PRELIMINAR

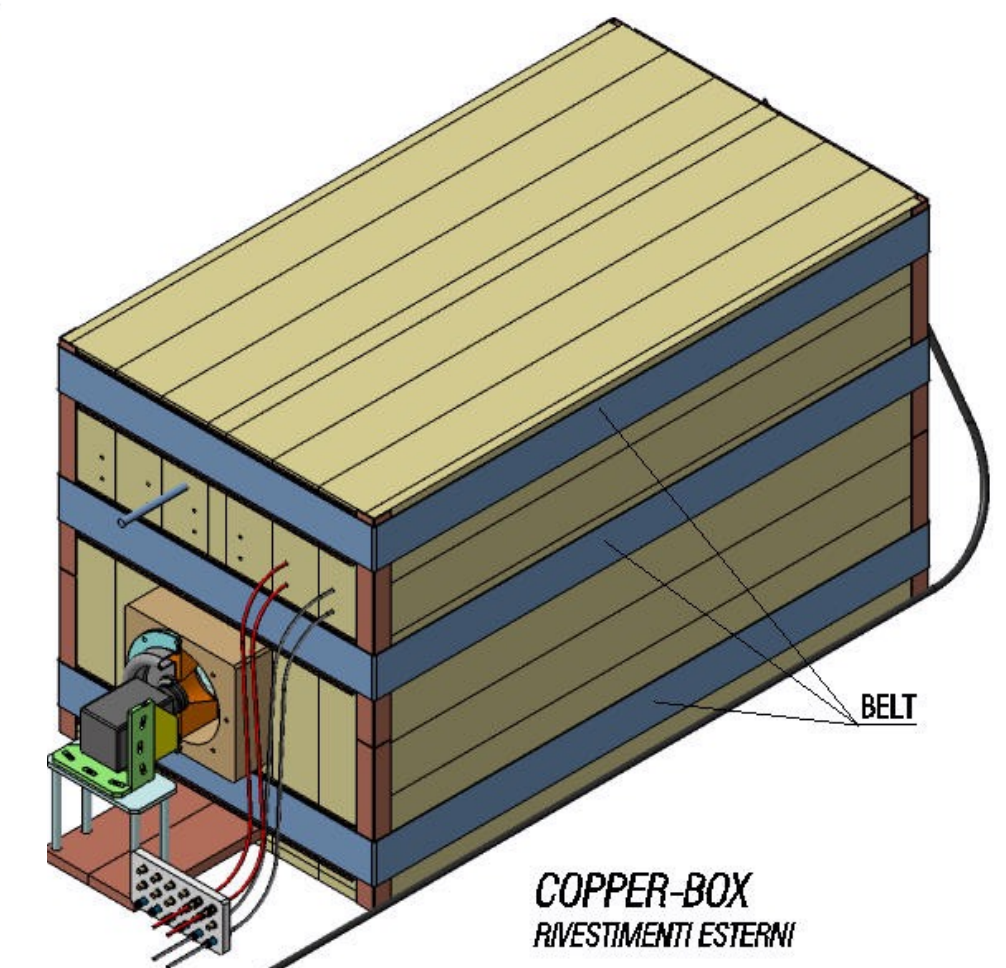
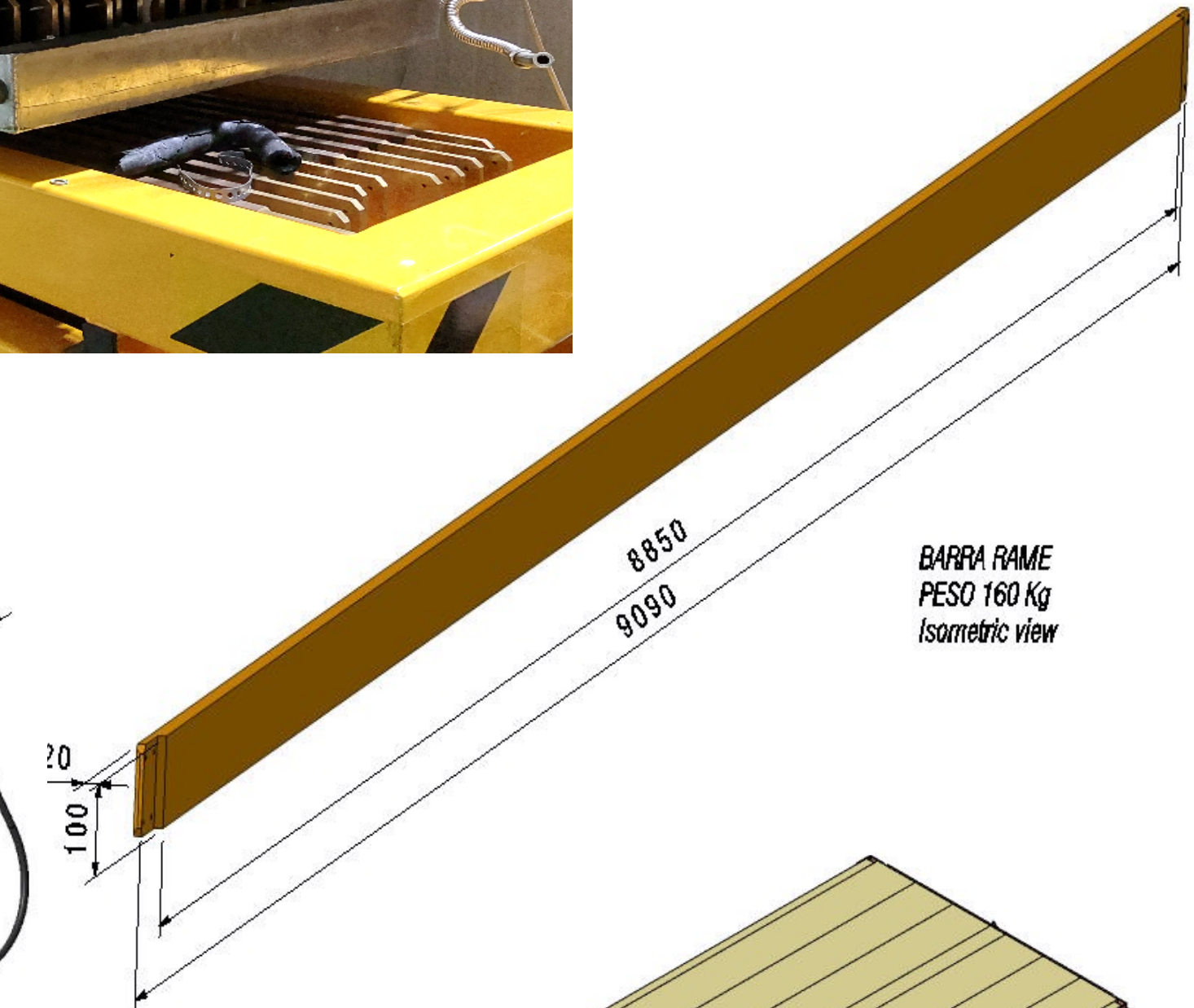
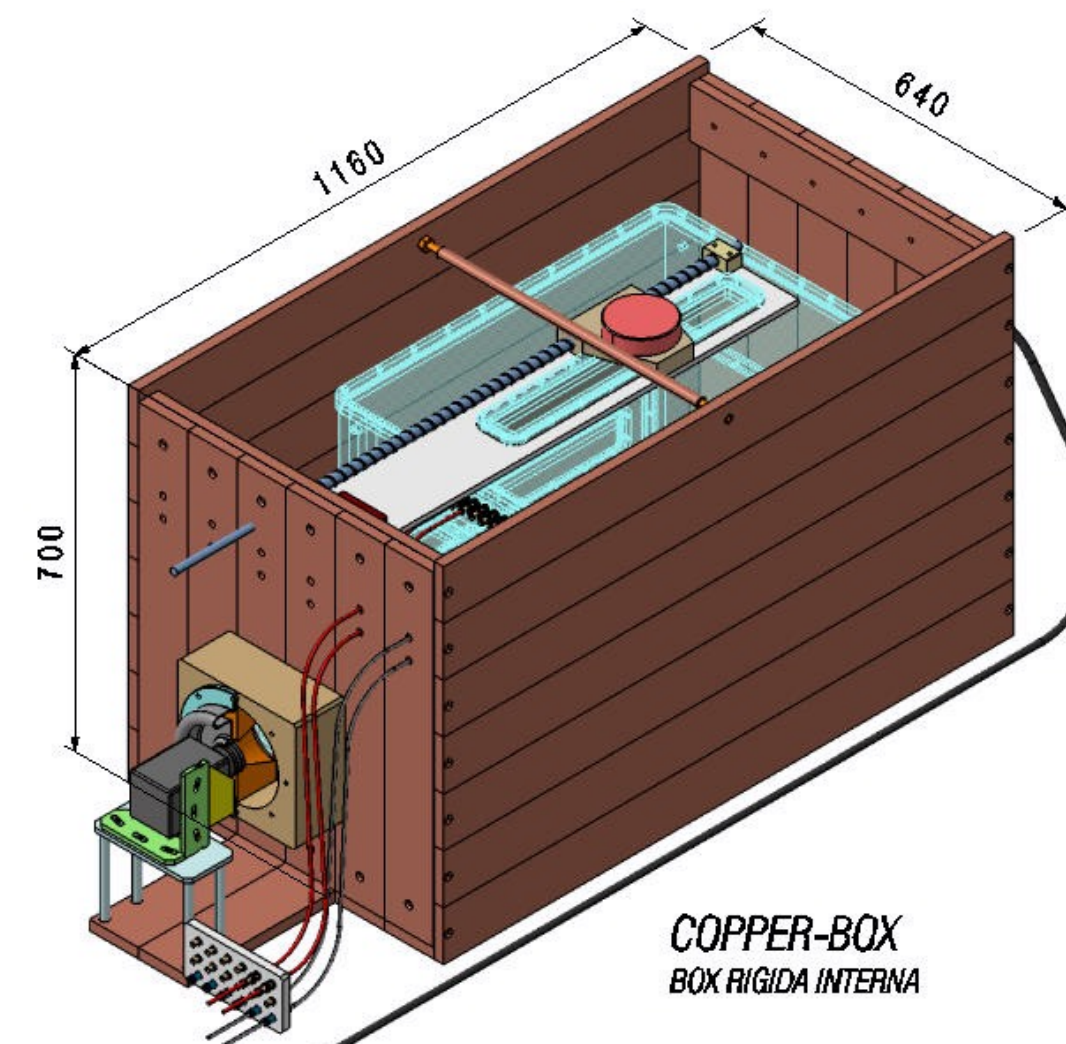
LIME shielding

OPERA Cu bars

- bars have to be cut, drill, clean (citric or nitric acid and ultrasonic) and package to lower oxidation
- the works could be done underground (very difficult) or outside but in less than 5 week (then cosmic start to activate the Cu)
 - rent a TIR (Pinci/Baracchini who drive?)
 - raw cut underground and make a standard transportation.
- the work outside could be done in a company or many companies (complicated)
- the work can be done in the LNGS workshop by us and the support of external effort and tolls (OMNIA)
- we are working to understand the better solution, evaluate cost and anyway this work have to be formalised soon with a specific TR to submit @ LNGS.



LIME → COPPER BOX
COPPER – SHIELDING
60 BARRE → 10 Ton

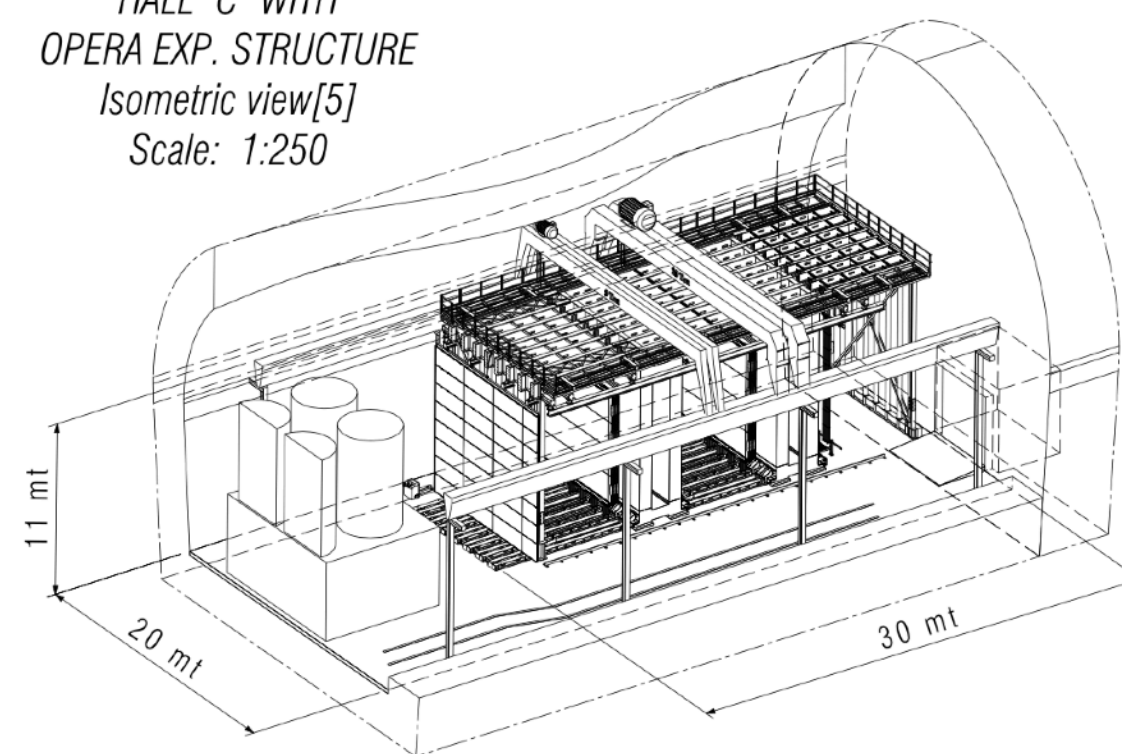


CYGNO (tech goal) to CYGNO 30 (physic goal)

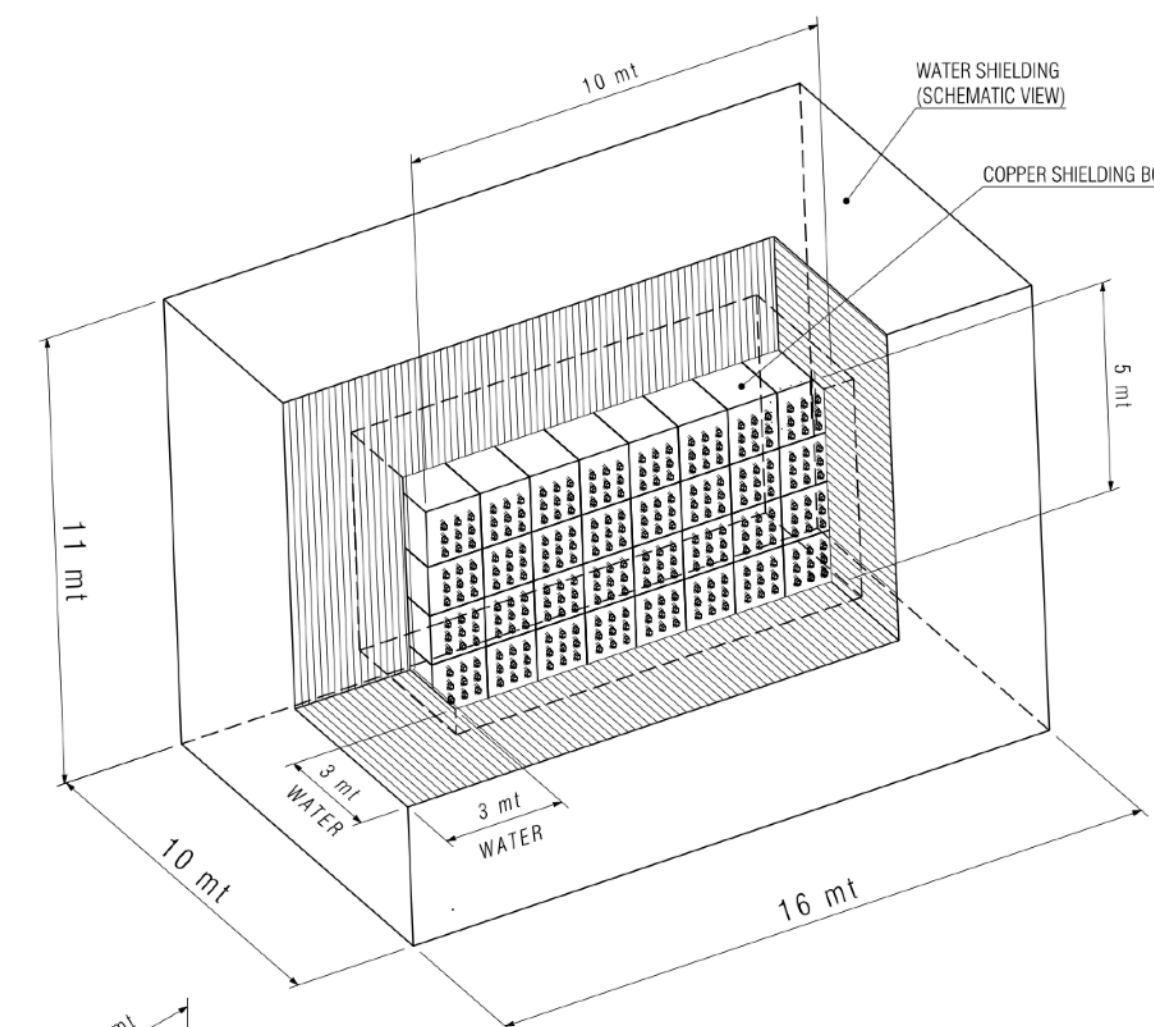
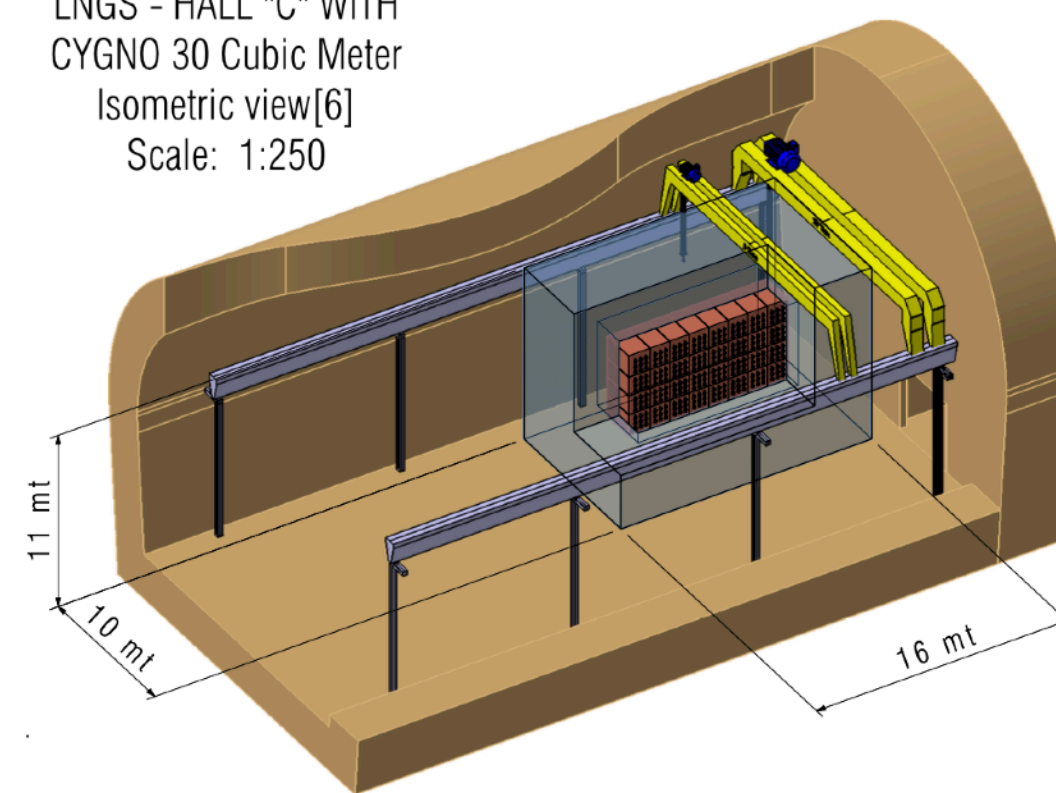
It could work?

- the objective of CYGNO is to **demonstrate** that we are able to build a real detector based on gaseous **TPC** equipped with **OPTICAL** read-out at atmospheric pressure.
- this means to demonstrate the **scalability** of the readout and been able to reach the lower possible **background** by means of optimal choice of materials in order to **justify the investment of O(Meuro)** in 30m³ detector, beyond any physical motivation (see competitor well ahead in the same energy range).
- CYGNO30-100 could work, but...

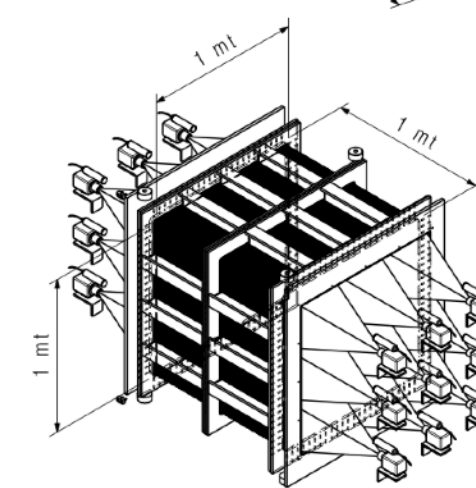
HALL "C" WITH OPERA EXP. STRUCTURE
Isometric view[5]
Scale: 1:250




LNGS - HALL "C" WITH CYGNO 30 Cubic Meter
Isometric view[6]
Scale: 1:250



Cygnos of 30 cubic meters made by an array of 4x8=32 Cigno modules of 1 cubic meter. The setup is completed by a copper (100 mm thick) and water (3m thick) shielding



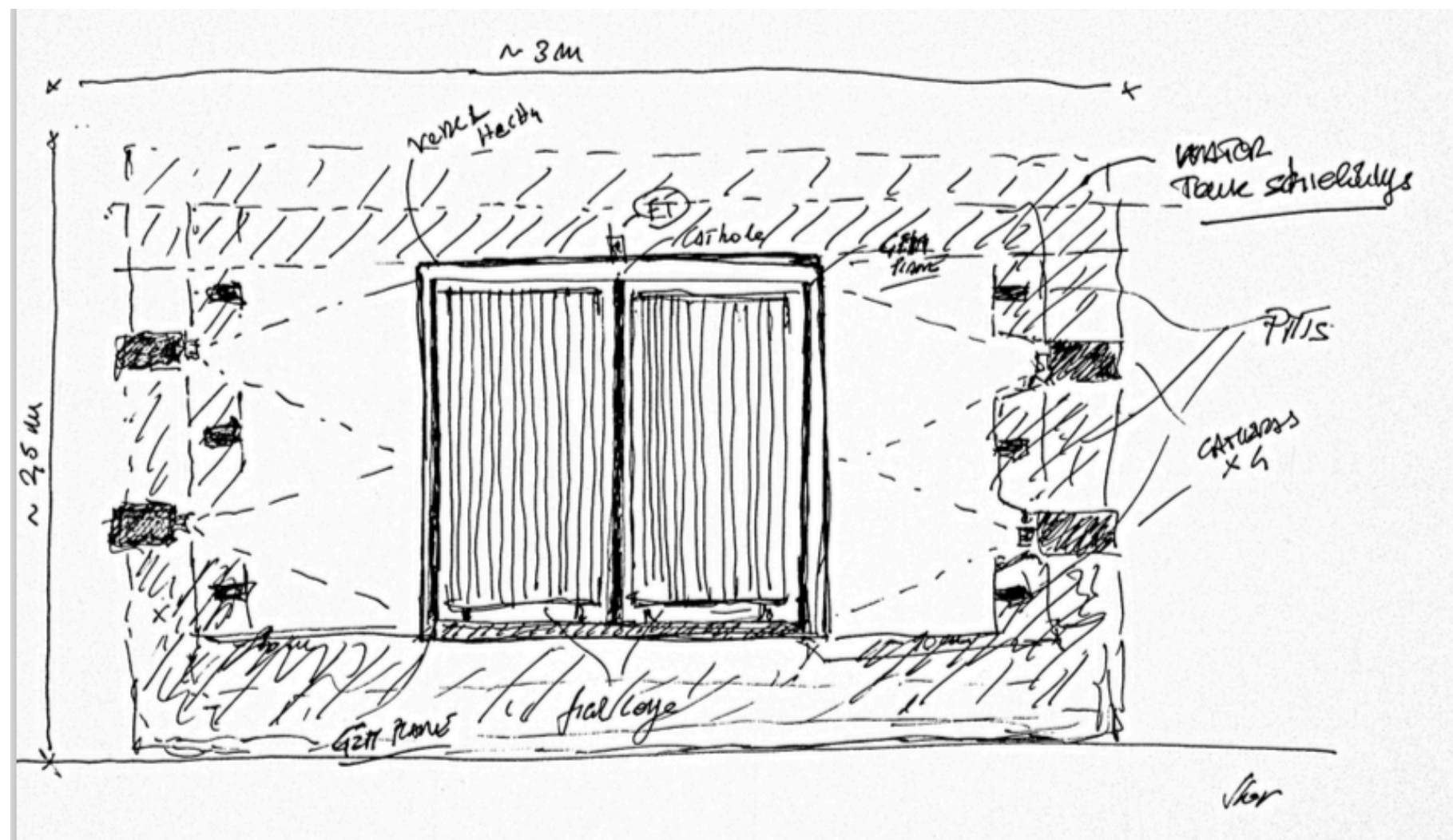
CYGNO 1 Cubic Meter

General tolerance ISO 2768-mK-E		Geometrical tolerance ISO 8015-E		Roughness ISO 1302	
 NATIONAL INSTITUTE FOR NUCLEAR PHYSICS FRASCATI NATIONAL LAB RESEARCH DIVISION - SEM		SIZE A2 PROJECTION	DATE DATE DATE	NAME NAME NAME	DRAWN CHECKED APPROVED
CYGNO EXPERIMENT CYGNO 30 Mc @ LNGS-U SETUP FIRST EVALUATION OF SETUP-ENVELOPPE		SCALE 1:1	DATE 23/11/2020	NAME C.Capoccia	APPROVED
					CYGNO 30 Mc

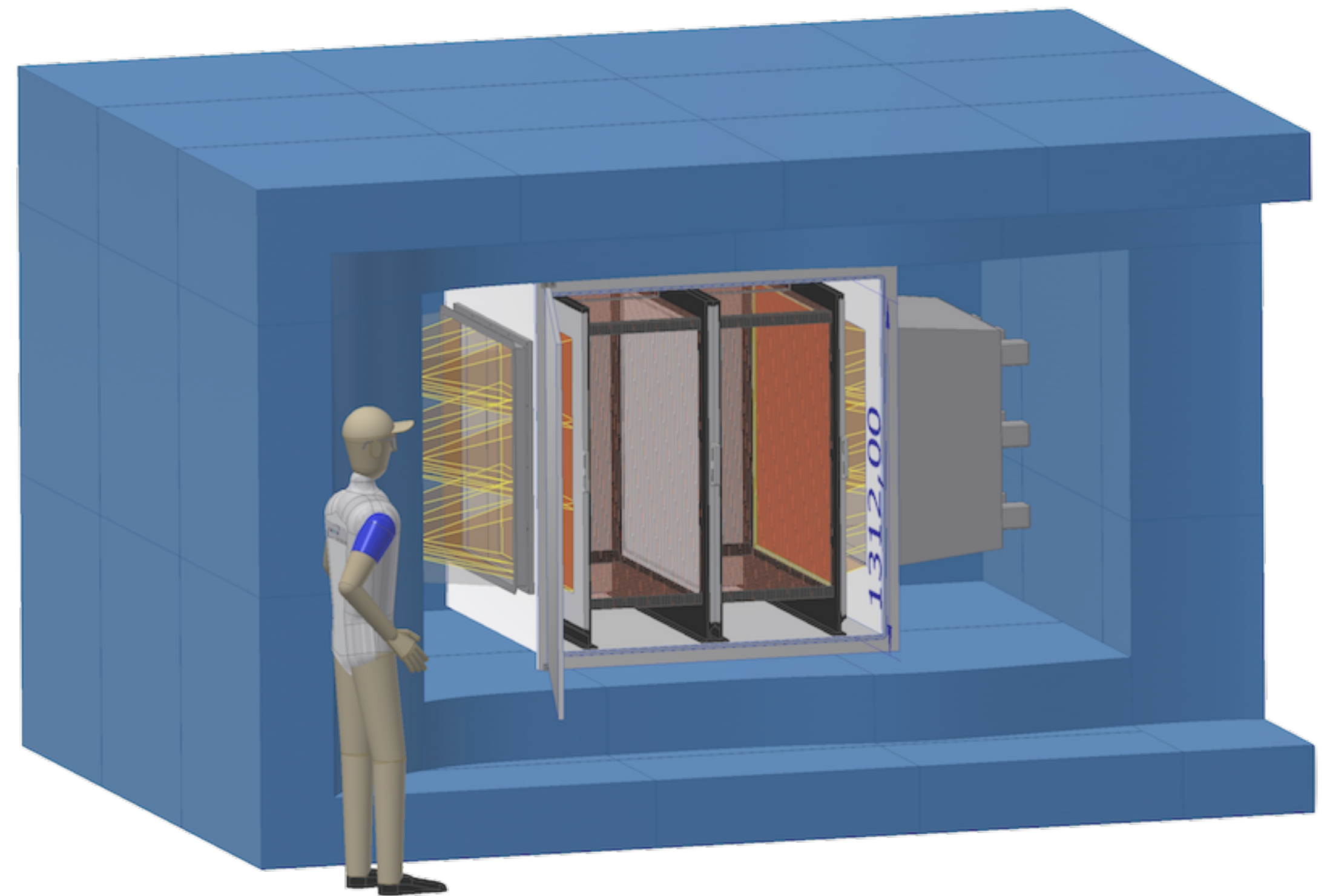
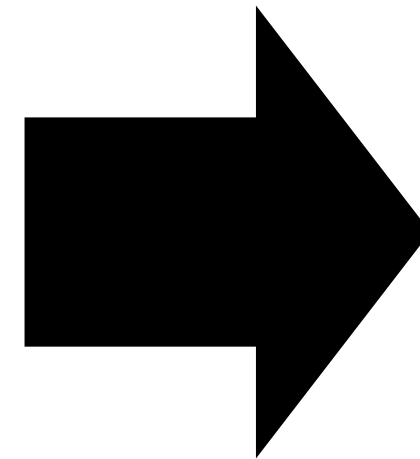
PRELIMINARY

CYGNO

It could work?



Draft by G.Mazzitelli after the visit at Boulby visit in May 2018

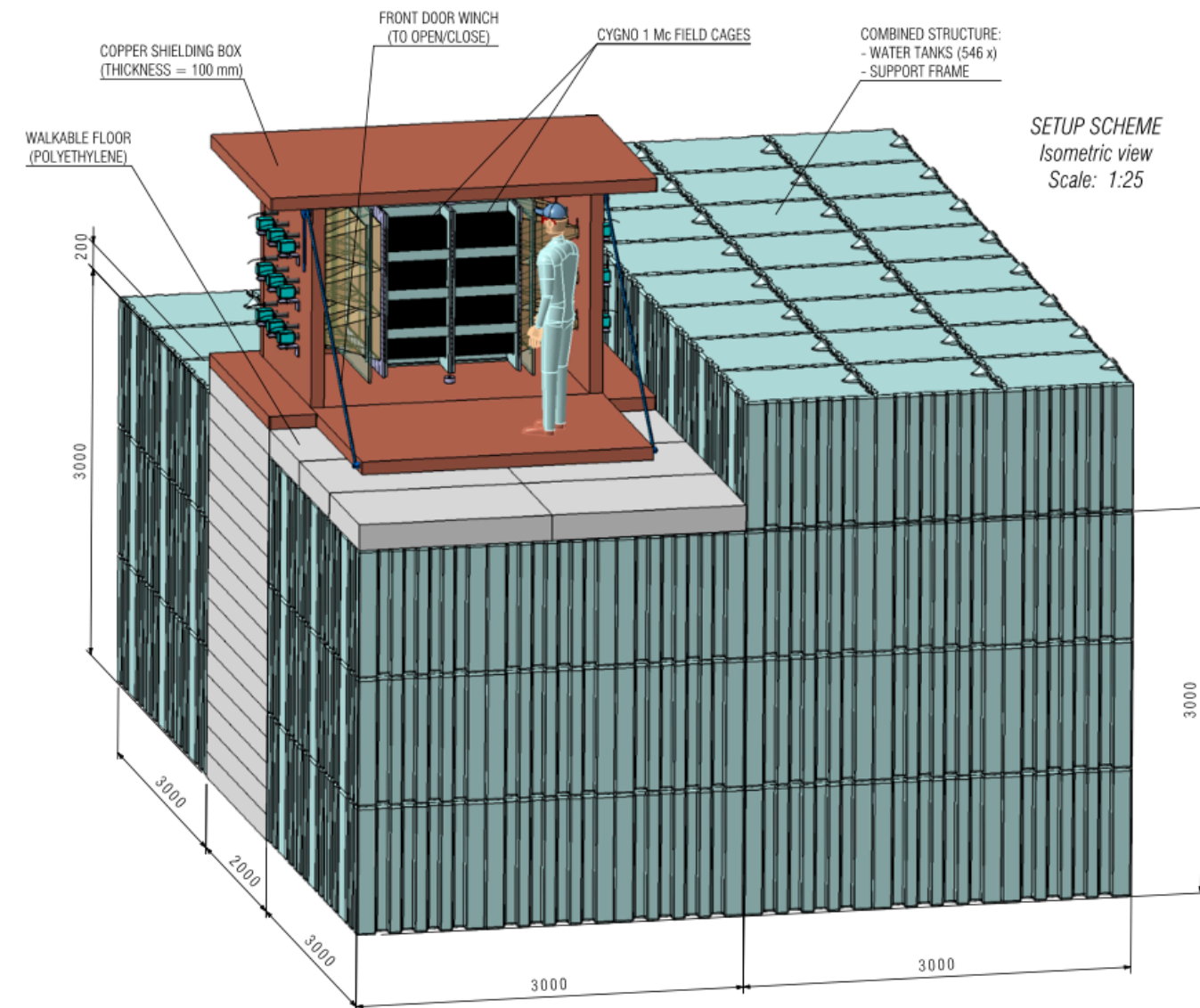
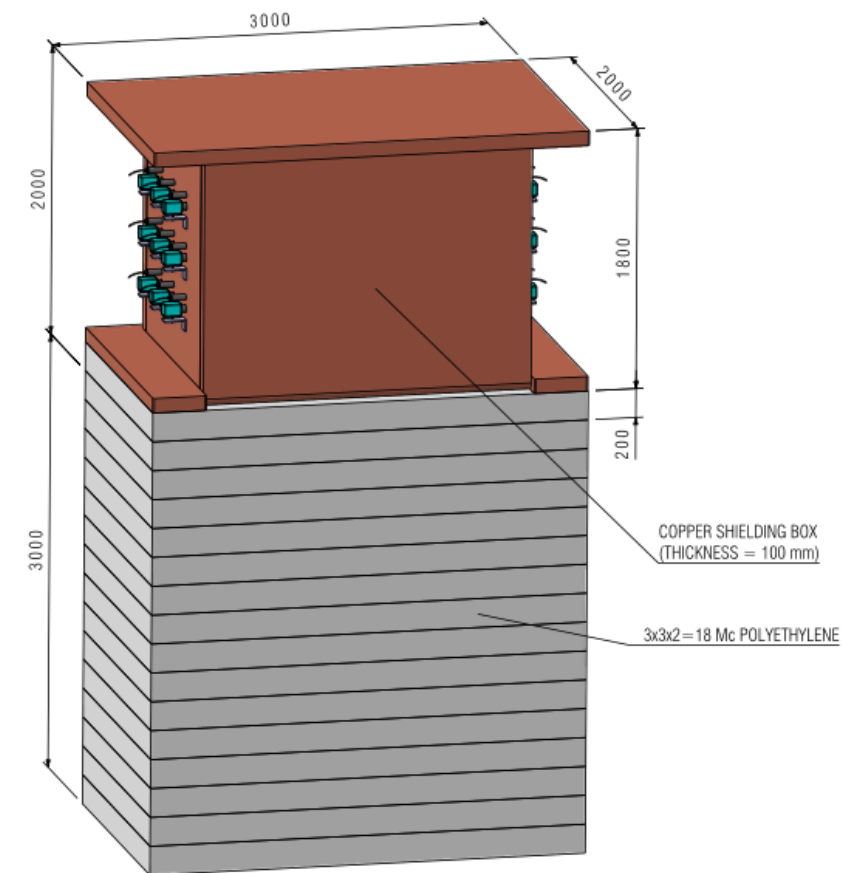


CYGNO Conceptual Design Report
S. Tomassini 2019

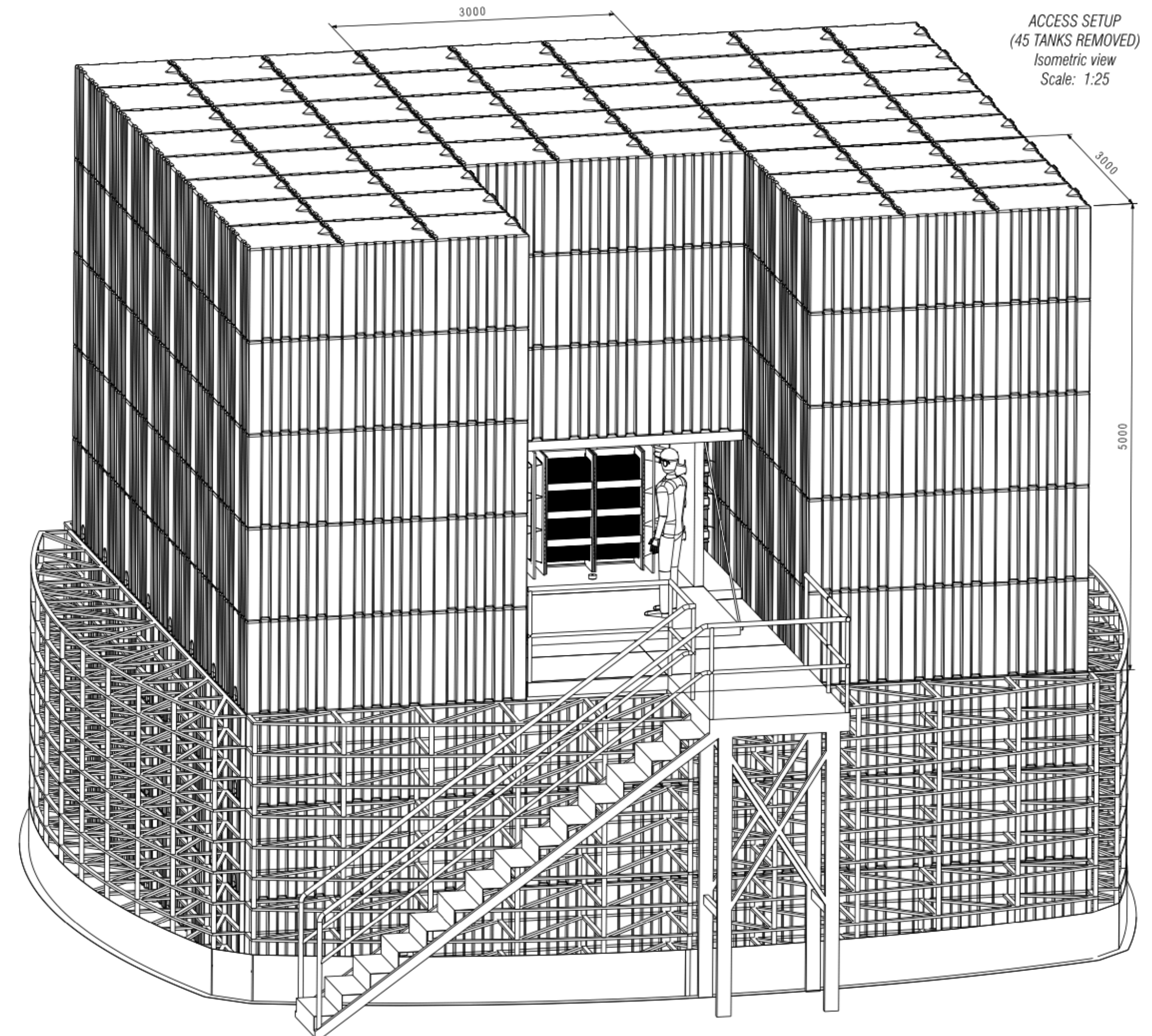
CYGNO

It could work?

CYGNO 1 Mc
Isometric view
Scale: 1:25



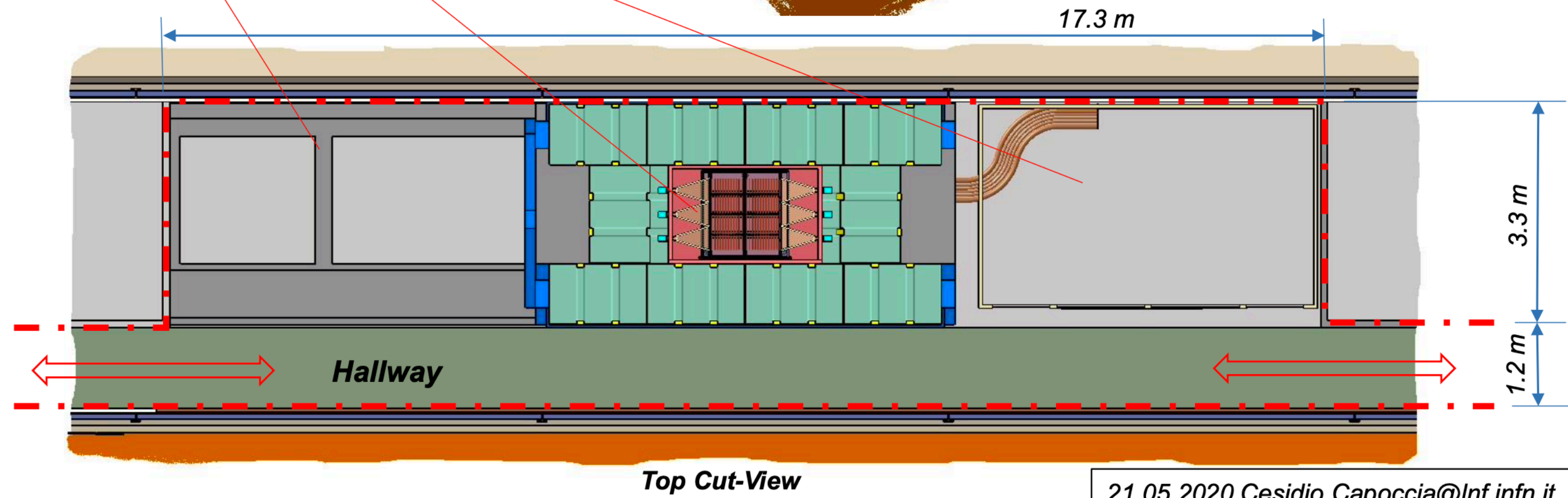
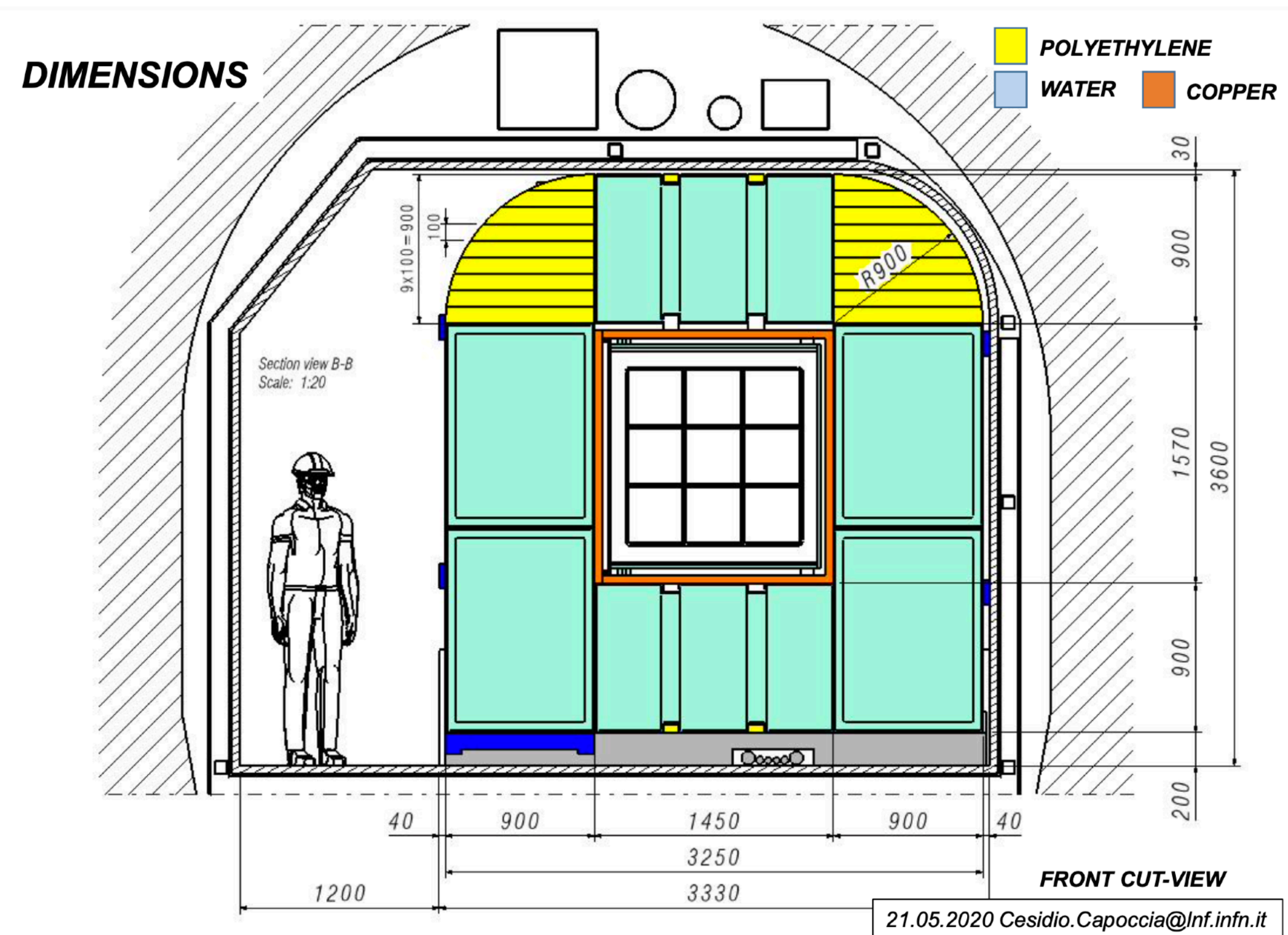
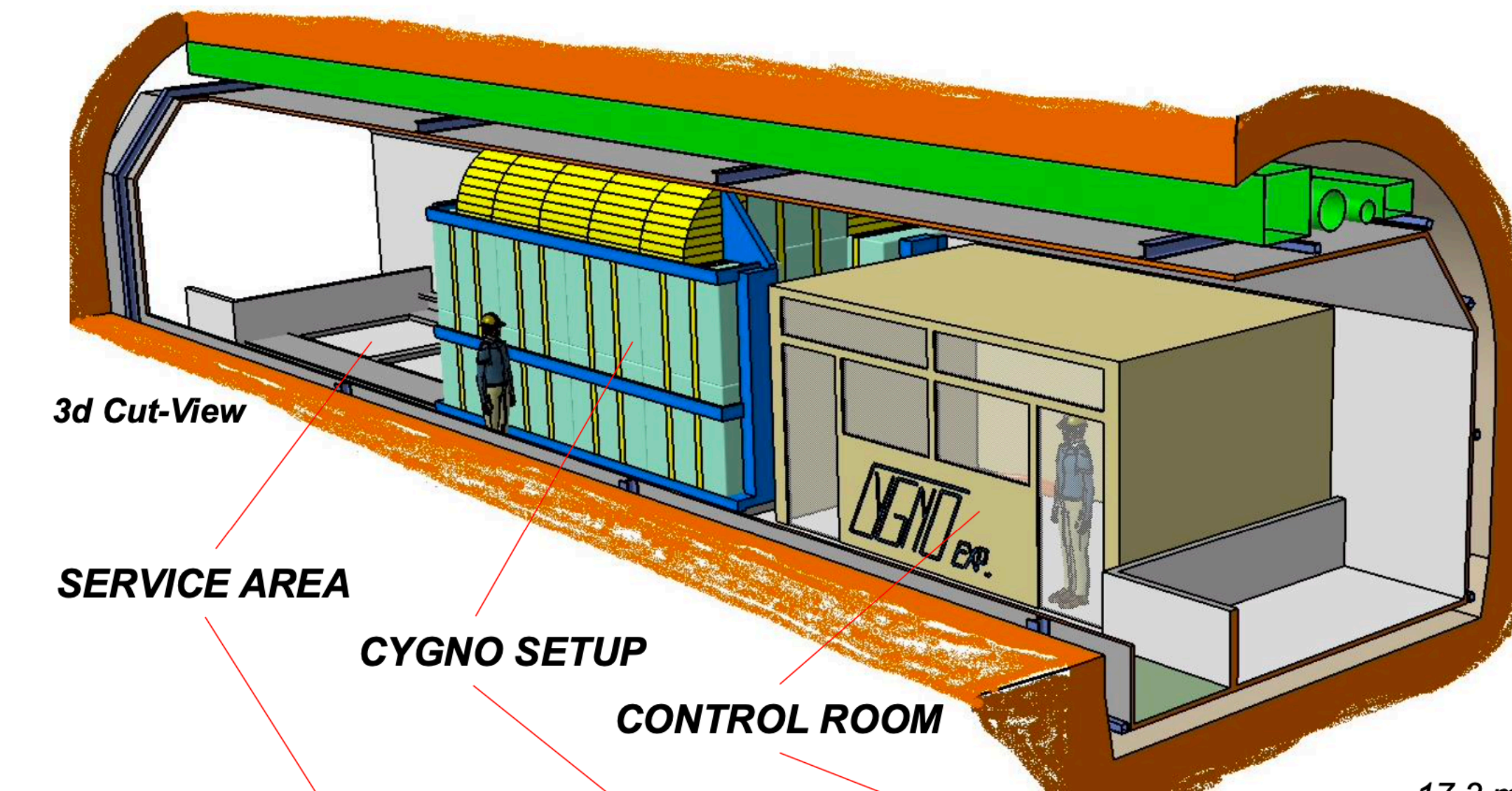
ACCESS SETUP
(45 TANKS REMOVED)
Isometric view
Scale: 1:25



How CYGNO should be to demonstrate ONLY the technological objectives in 2020/21 (+ control room+ auxiliary system + VIA + PRA, etc)

CYGNO vs CHINOTTO

It could work?



CHINOTTO can demonstrate with similar performance respect to CYGNO technological issue, but is limited of physics performance.
 (easy VIA + PRA (!?)
 control room+ auxiliary system +, etc)

WBS/WBC

It could work?

1	WBS NUMBER							I	J	QUANTITY AT WBS LEVEL							TOTAL	COMPONENT COST AT WBS LEVEL							
	Ref.	1	2	3	4	5	6			7	1	2	3	4	5	6		7	(kEuro)	Unit Cost	7	6	5	4	3
4	GM	1							EACH	1															729.26
5	GM	1	1						EACH		1														573.26
6	GM	1	1	1					EACH			1										280.60			
7	GM	1	1	1	1				EACH				1									35.00			
8	ST	1	1	1	1	1			EACH					1			15.00				15.00				
9	ST	1	1	1	1	1	2		EACH						8		2.00				16.00				
10	ST	1	1	1	1	1	3		EACH						2		2.00				4.00				
11	DP	1	1	1	2				EACH						8						169.60				
12	LB	1	1	1	2	1			EACH							3	0.50		1.50						
13	CC	1	1	1	2	2			EACH							3	0.20		0.60						
14	LB	1	1	1	2	3			EACH							3	0.20		0.60						
15	LB	1	1	1	2	4			SET							3	0.20		0.60						
16	DP	1	1	1	2	5			EACH							1	9.00		9.00						
17	DP	1	1	1	2	6			SET							1	2.20		2.20						
18	RO	1	1	1	2	7			SET							1	3.00		3.00						
19	DP	1	1	1	2	9			EACH							4	0.80		3.20						
20	DP	1	1	1	2	10			SET							1	0.50		0.50						
21		1	1	1	3				EACH				1								30.00				
22		1	1	1	3	1			SET					1			10.00		10.00						
23	CC	1	1	1	3	2			SET							1	10.00		10.00						
24		1	1	1	3	3			SET							1	10.00		10.00						
25		1	1	1	4				EACH				1								31.00				
26	CC	1	1	1	4	1			EACH					100			0.20		20.00						
27		1	1	1	4	2			EACH					100			0.01		1.00						
28	CC	1	1	1	4	3			EACH							1	10.00		10.00						
29	RO	1	1	1	5				EACH							1					15.00				
30		1	1	1	5	1			EACH							1	5.00		5.00						
31	RO	1	1	1	5	2			EACH							1	5.00		5.00						
32	RO	1	1	1	5	3			SET							1	5.00		5.00						
33		1	1	2					EACH				1								129.16				
34	CC	1	1	2	1				SET					3475			0.025		86.88						
35	CC	1	1	2	2				SET					23			0.700		16.10						
36	CC	1	1	2	3				SET					1650			0.011		18.15						
37	CC	1	1	2	4				SET					2009			0.004		8.04						
38		1	1	3					EACH				1								118.00				
39																									
40	Ref.	1	2	3	4	5	6	7	QUANTITY AT WBS LEVEL							TOTAL	COMPONENT COST AT WBS LEVEL								
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	(kEuro)	Unit Cost	7	6	5	4	3	2	1	
	GM	1							EACH	1															1122.94
	GM	1	1						EACH		1														966.94
	GM	1	1	1					EACH			1										512.60			
	GM	1	1	1	1				EACH				1									55.00			
	ST	1	1	1	1	1			EACH					1			15.00				15.00				
	ST	1	1	1	1	2			EACH					10			2.00				20.00				

- a more **realistic** cost estimation after the experience of LIME bring up **700-800ke** the cost of **CHINOTTO** and 1.2Me the cost of CYGNO

- we have the economical **resources** (ERC + PRIN + CSN2) to realise CHINOTTO and this project seems to be able to answer to all the **technological open issue**

Gantt (when and who)

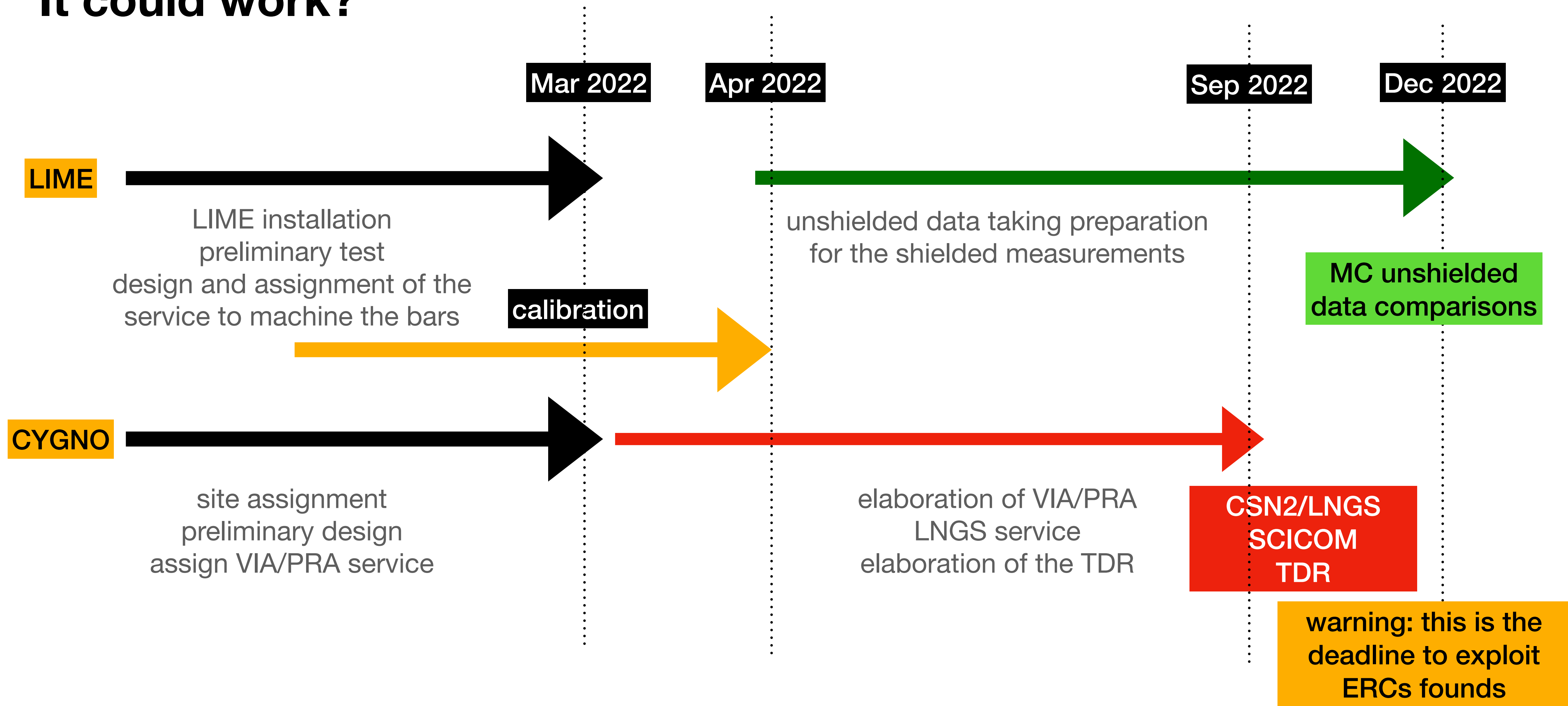
It could work?

any effort to schedule our activity up to now fails because of us, not fully focused, because of external interference (covid included), because of an R&D project can not realistically scheduled.

- **starting from the 10 Jan 22 we have to:**
 - purchasing of gas bottles of He CF4 for LIME (LNGS)
 - purchasing of empty gas bottle for gas recycling/disposal (LNGS)
 - assigning service for gas recycling/disposal (RM1)
 - transporting and install LIME (LNF)
 - installing PS, cabling, DAQ, auxiliary device, etc (RM1/LNF)
 - finalising LIME shielding design (LNF)
 - assigning the service to machine Cu bars (LNF)
 - finalising CYGNO/CHINOTTO simulation (RM1)
 - drafting preliminary design of CYGNO (LNF)
 - assigning the service for PRA/VIA (LNF)
 - starting unshelled data taking shifts (all)
- **starting from Mar 22 we have to:**
 - shifts on unshielded data taking (All)
 - LIME data qualification (RM1/RM3/LNF)
 - LIME data analysis (RM1/RM3/GSSI)
 - LIME MC data comparison (RM1/GSSI)
 - purchasing water tank for LIME (LNF)
 - finalising the CYGNO/CHINOTTO design (LNF)
 - elaborating PRA/VIA (LNF)
 - drafting the TDR (all)

Gantt

It could work?



conclusion (1/2)

it could work? but...

- **warning** (prevision): **administrative issue** are really very strong and not ease to foreseen and handle
- **realism** (objectives): we have to be aware of the **constraints** that any site will be assigned imply for the detector design, construction and installation
- **sustainability** (money): we have to carefully **estimate** the project cost (CYGNO/CHINOTTO or what ever it is), because of next steps requires we demonstrate that the project can be realised.
- **deadline** (next steps): we have to be ready for **Sep 22** (CSN2/LNGS SCICOM) with a TDR (site allocation —> preliminary design —> VIA/PRA—> final design) that is +/- our last deadline to be able to exploit the resources we have.
- **effort** (people): this will probably requires a strong effort in parallel with LIME that it's not clear to me if we are able to handle...

conclusion (2/2)

but... it could work!

- **LIME:** we will have soon LIME running, and many nice information and results could come;
- **site allocation:** very, very preliminary and not official communication...
- **resources:** the evaluation of the economical resources we have ensure that CHINOTTO can be realise;
- will be not easy at all, but... it could work!



https://www.youtube.com/watch?v=4An1BrG2u_4