XSEN

Logistics For Installation And Running in 2021

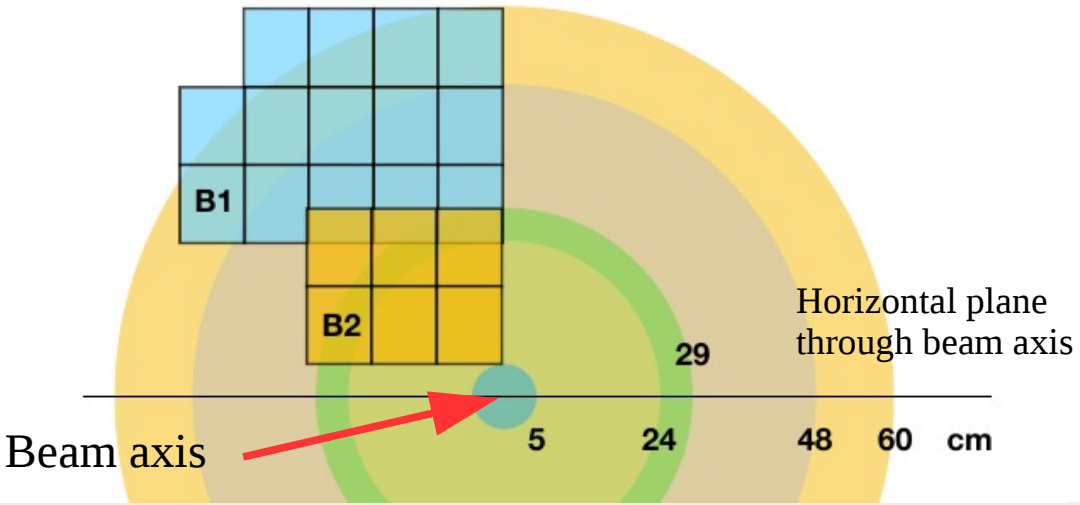
2019.10.17

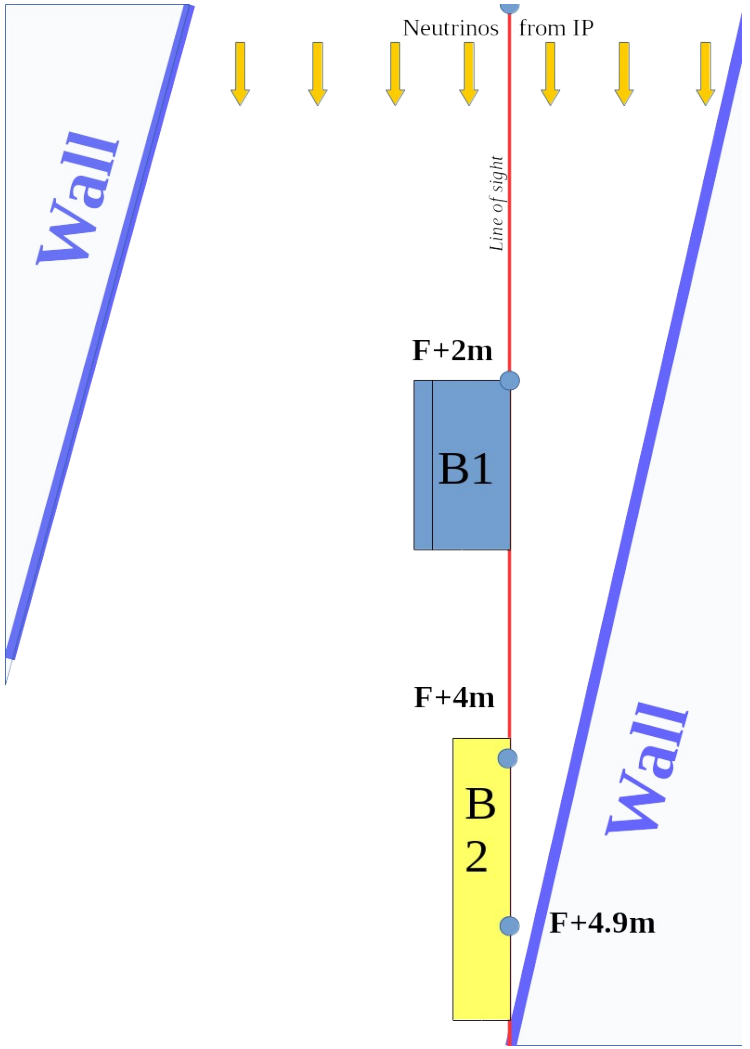
Important aspects:

- The detector is completely passive and does not require any services!
- The detector is modular and easy to transport, install and remove in few hours!
- Modularity of the detector allows it to be transported in (2-3) carts and delivered to TI18 by passing it under the cryo and beam lines.
- Passage of the people over the beam line is already possible over an existing platform.
- The detector does not require any modification of the existing structures or services in the tunnel, except for a couple of holes in the floor of TI18 to fix the support structure.

The baseline design consists of two sections covering two ranges of pseudorapidity. This allows staging of the experiment and simplification of the mechanical support structure.

LHCC encouraged us to prepare a detailed proposal on how to install and operate the Phase 1 detector, shown here as B2.

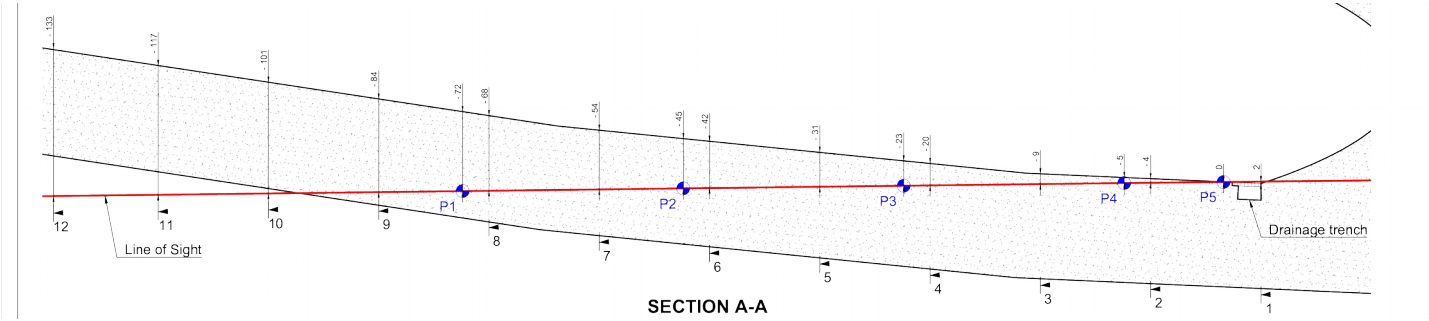


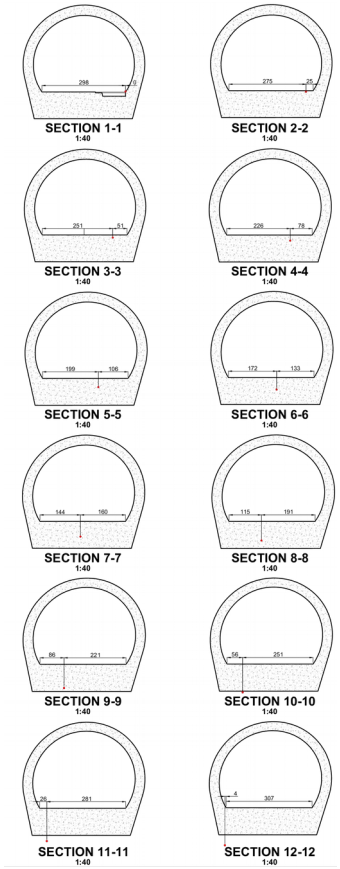


TI18

Detector footprint

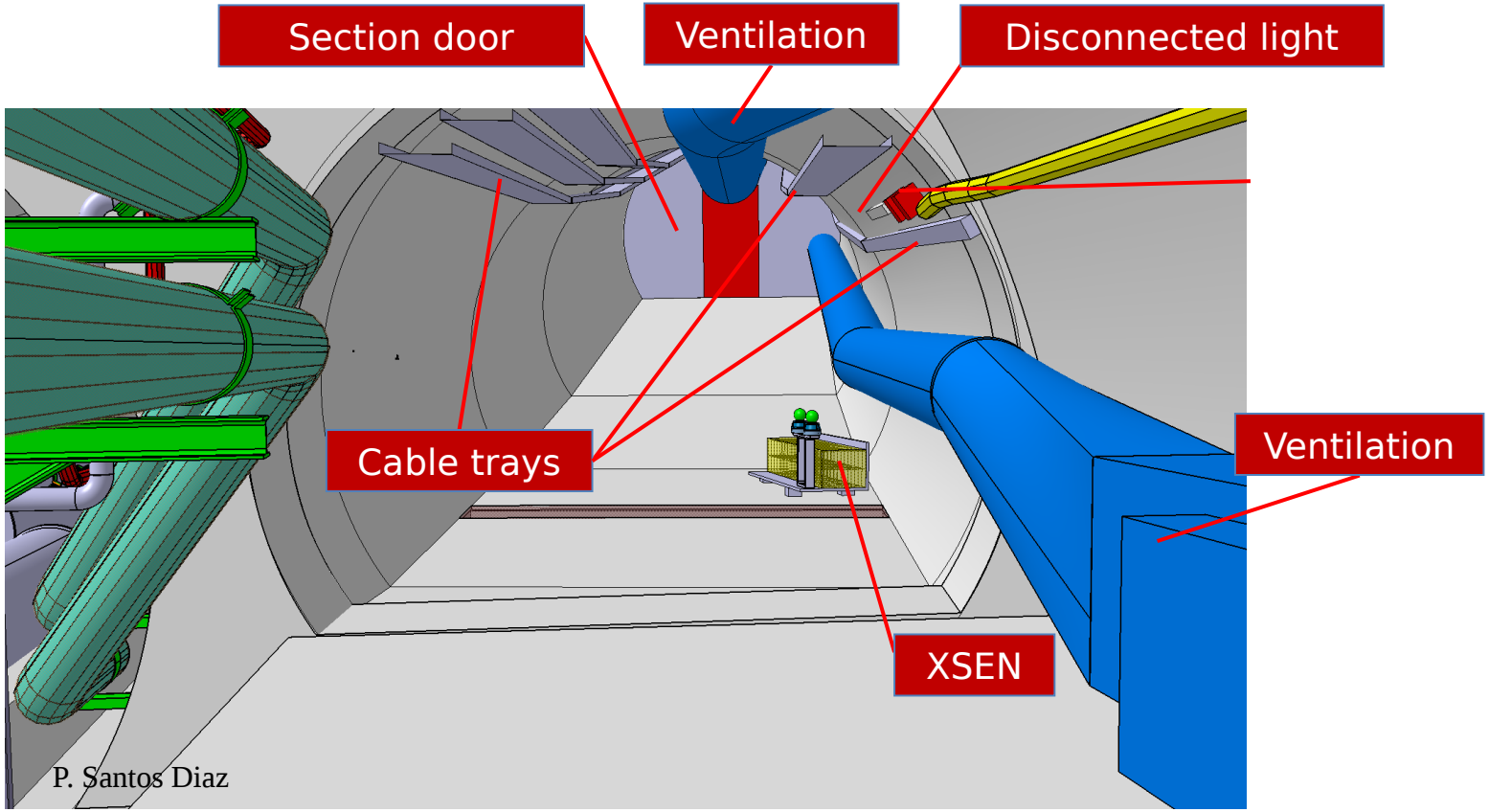
TI18 is surveyed and 3D modelled thanks to our colleagues from EN (P. Valentin) and SMB (J. Gall) Departments!

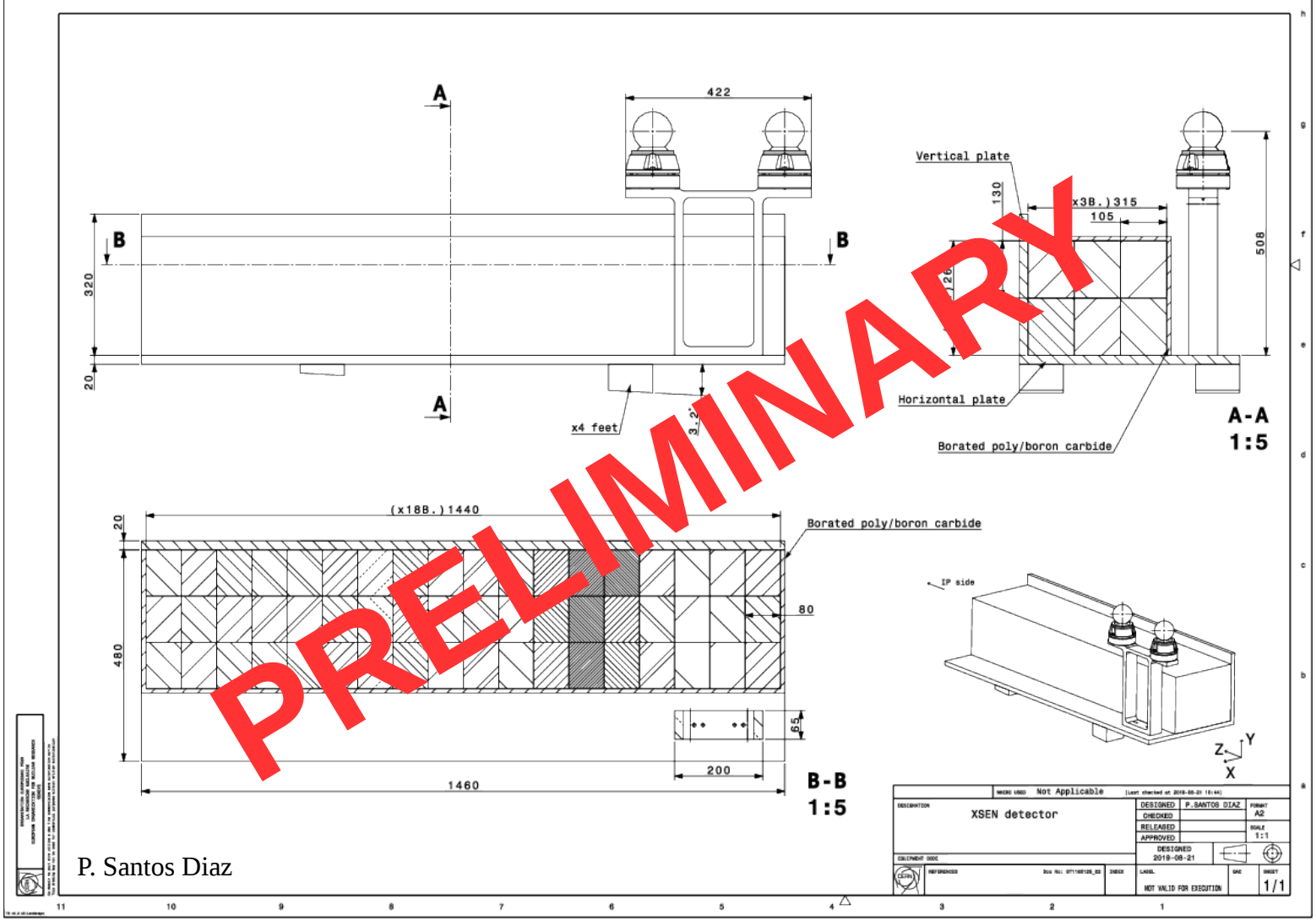




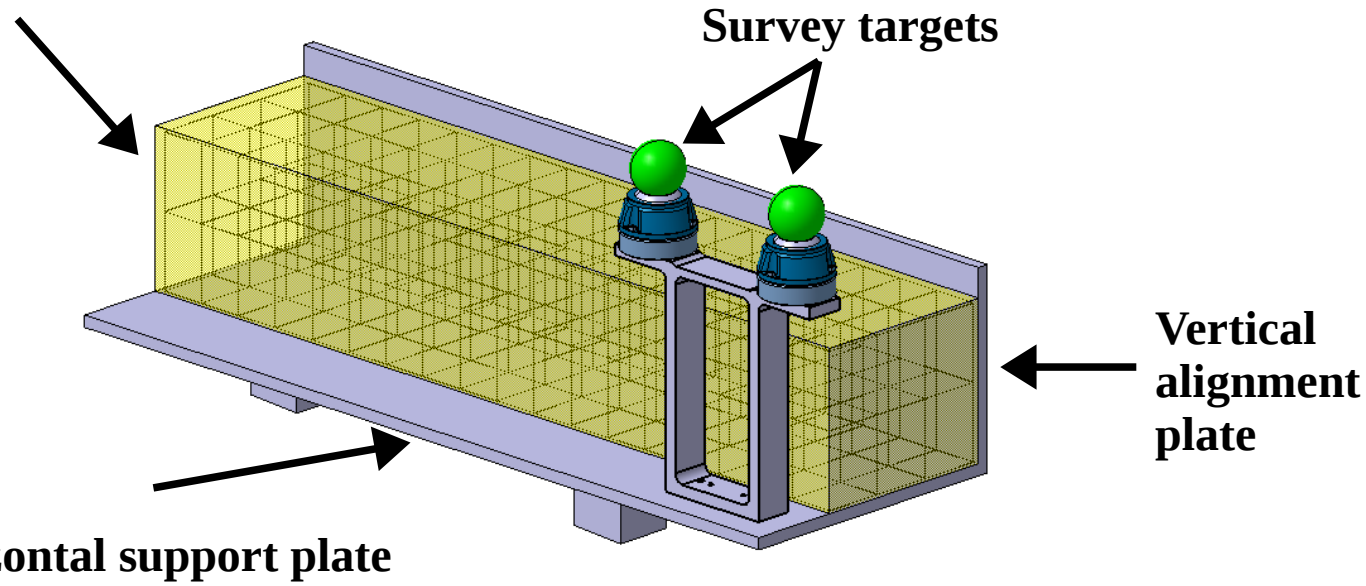
Point	Type	CCS coordinates (m)						Height above ground (m)
		THEORICAL (computed)			REAL (measured)			
		X beam	Y beam	Z beam	X ground	Y ground	Z ground	
P1	FASER - 2 m	1761.399	2525.885	2364.947	1761.399	2525.884	2365.671	-0.724
P2	FASER center	1759.554	2525.112	2364.972	1759.554	2525.112	2365.425	-0.453
P3	FASER + 2 m	1757.710	2524.339	2364.997	1757.710	2524.339	2365.220	-0.223
P4	FASER + 4 m	1755.866	2523.566	2365.022	1755.865	2523.565	2365.070	-0.048
P5	FASER + 4.9 m	1755.035	2523.218	2365.032	1755.040	2523.215	2365.031	0.002

Placement of the detector B2 in TI 18




PRELIMINARY
A
B
422
320
20
x4 feet
3.2
Vertical plate
130
(x3B.)315
105
126
508
Horizontal plate
Borated poly/boron carbide
A-A
1:5
(x18B.)1440
Borated poly/boron carbide
80
480
65
200
1460
B-B
1:5
IP side
Z
Y
X
Not Applicable
XSEN detector
DESIGNED
P.SANTOS DIAZ
CHECKED
RELEASED
APPROVED
A2
1:1
DESIGNED
2019-08-21
NOT VALID FOR EXECUTION
1/1
P. Santos Diaz

Stack of emulsion bricks



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Support structure:

CERN surveyors have already drawn a trace on the floor of TI18, so a more precise placement of the holes for bolting the support feet into the concrete can be very quickly done. *As a precaution before drilling the holes we will check what is hidden under the floor with Ground Penetrating Radar (undocumented electric cables, cooling pipes etc.)*

The support and alignment plates can be unbolted for the transport and bolted together once they are delivered to the final destination. The same procedure will be applied to the alignment targets to reduce the height of the transported equipment.

The installation of the support structure can be done well before the installation of the emulsion bricks. It would be reasonable to do it before LHC sector 12 is filled with helium, currently foreseen for August 2020.

The whole operation *(defining the precise hole positions, checking the floor, drilling holes, bolting the feet and installing plates and survey targets)* can be done in one day. Given that it involves people from several services it may be prudent to plan on two or even three half-days.

Important detail:
there is a direct line of sight from TI 18 to the nearest survey targets of the accelerator.

Emulsions:

We are considering putting together “OPERA” bricks into groups of three and enclosing them into 3d-printed boxes. The weight of such a super-brick will be around 25 kg, still within the range of manual handling.

Current design foresees a total of 36 such super-bricks; even with an exceptionally careful handling **installation of the whole B2 detector can be done in three to four hours!**

That allows to plan the installation of the emulsions at a rather late date, few days before the start of the sector powering tests. We prefer to keep the emulsions in a cold storage as long as possible to reduce fading.

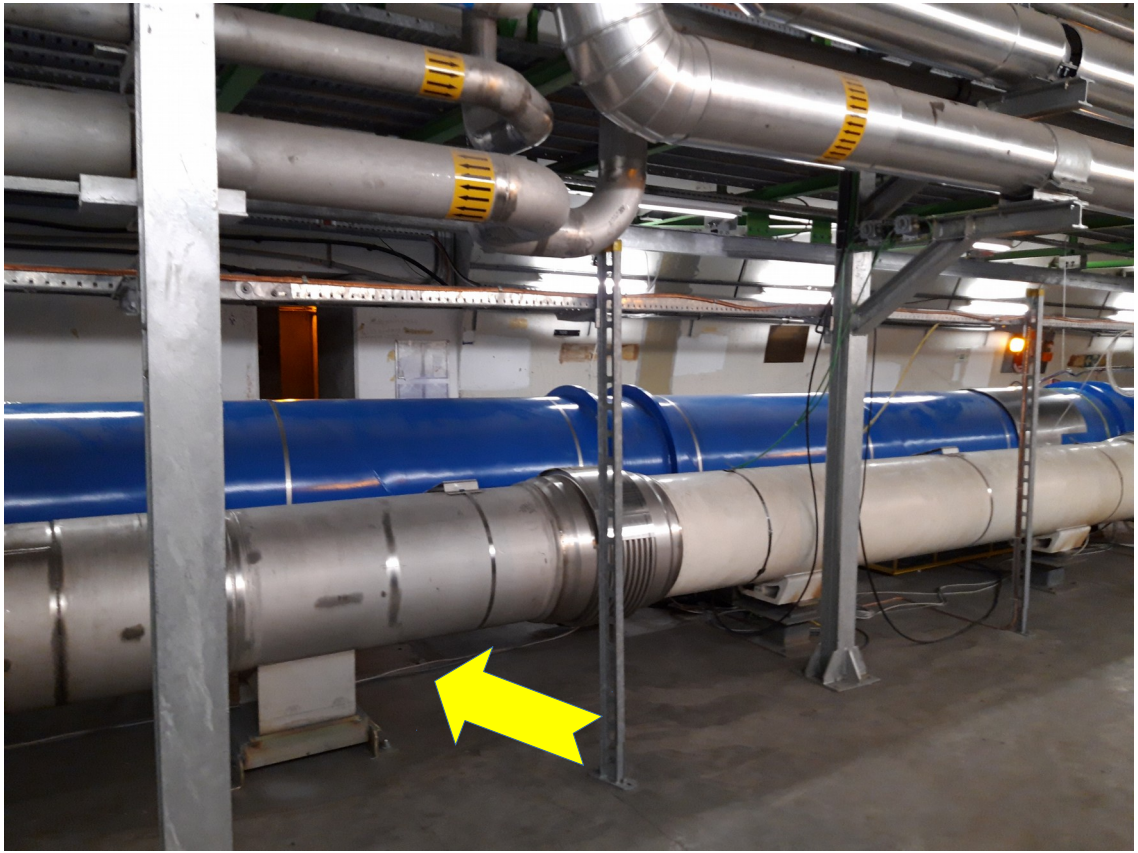
Replacement of the emulsions:

Delivery can be done in batches whose size (100 or 200 kg) will be determined in collaboration with CERN Transport that will handle the load. The preferred path is from PM15 (lift capacity is 3000 kg), making the whole trip ~500 m long. The passages are clear of any obstacles, so one-way trip surface – TI18 can be made in 15-20 minutes.

We should try to minimize exposure of emulsions to an increased (room!) temperature, so a good collaboration with CERN Transport is required. Another important detail is a potential delay while Radioprotection checks the exposed emulsions for activation. A protocol for coordinated activities between CERN Transport and CERN Radioprotection teams is under preparation.

Even with all these considerations it seems quite possible to achieve ***an installation of the full set of emulsions for B2 in half of a working day and a replacement of the whole complement of emulsions in less than a working day.***

This allows to foresee replacement of emulsions during LHC Technical Stops – a necessary step in 2022 and 2023!



Once the material is delivered near TI18, it still has be transferred to the other side of the beam line. We have an agreement from Cryo Safety to do it by passing the load under the beam line – there is 34 cm clearance. Of course, we will avoid passing under bellows or next to quench heaters.

There is nearby (~20 m) a small bridge that can be used by people to cross to the TI18 side of the tunnel.

Details, but…

There is no light or ventilation in TI18. B2 is quite near the beginning of the tunnel, so it can be worked on without additional lamps.

However, for the installation of B1 we may need more light. EN-EL group was contacted and there is no problem *(except schedule and budget code)* to extend the power or computer network into TI18.

One more thing…

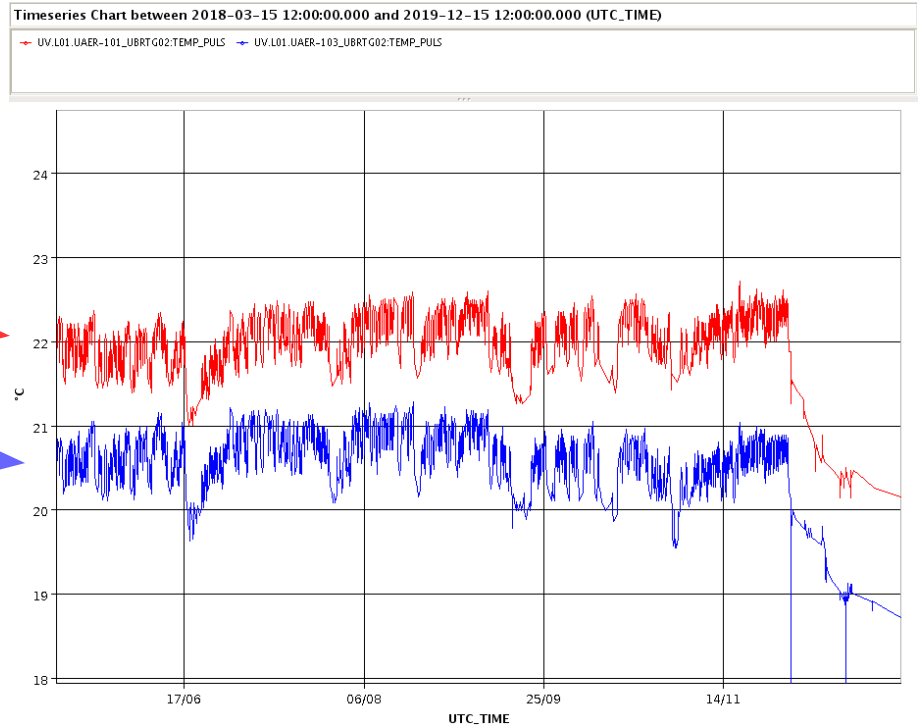
We plan to insert between XSEN bricks several light-tight envelopes with emulsions that can be extracted after predefined intervals to check fading and / or background levels. Given that removal of such an envelope does not require transport it can be done in less than an hour. Such short accesses are occasionally possible even outside Technical Stops, for example after a magnet quench.

What about fading?

An important parameter for the conservation of latent tracks is the temperature of the emulsions. In OPERA the whole cavern was kept at 15 C, however LHC tunnel is not so cool.

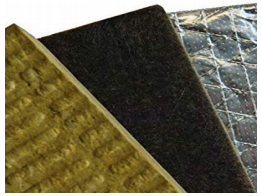
Temperature or the air extracted from S18

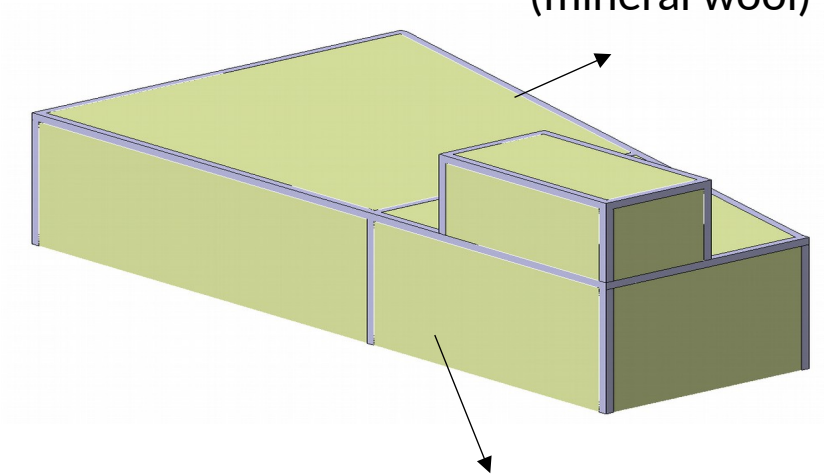
Temperature or the air extracted from S12



We plan to study fading as a function of temperature for the candidate emulsions. In case the deterioration of the track quality at 21^0 C is prohibitive, we can insulate and cool the setup.

Insulation panels
(mineral wool)

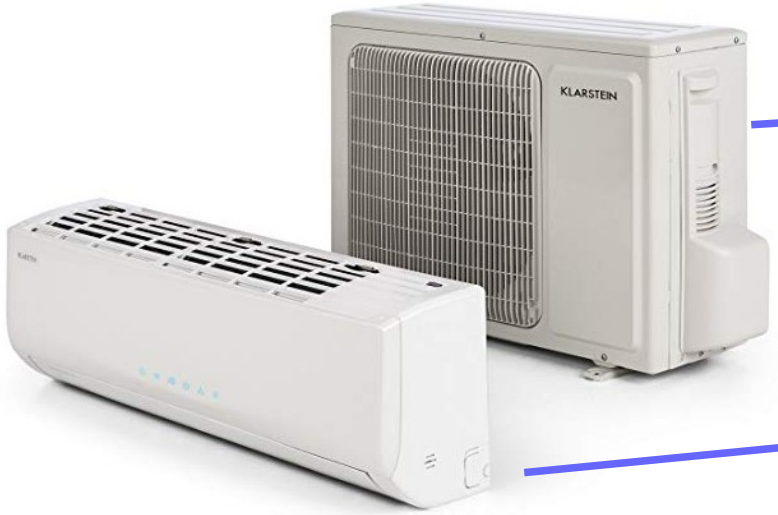


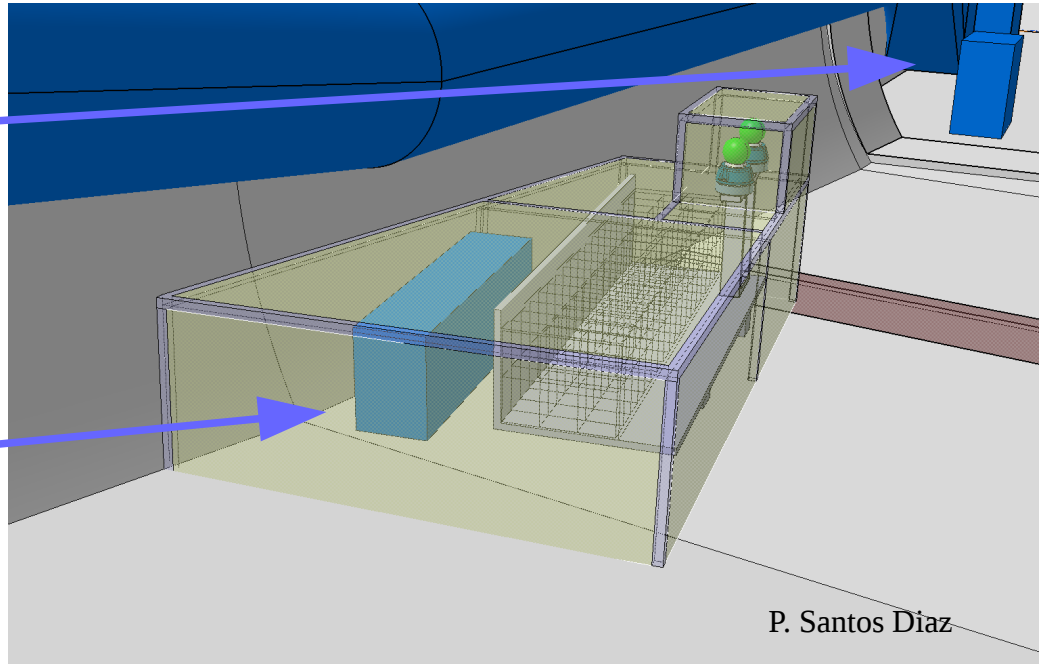


Simple aluminium profiles
(Bosch Rexroth -> standard and
plenty of accessories)

P. Santos Diaz

Given that the temperature difference is not very big, we can easily achieve this with a “home made” fridge!





Next steps:

- Contact CERN Survey
- Contact Radioprotection
- Finalize Technical Proposal
- Define services for the next phase
- Study new emulsions
- ...