CMS FSC – ECR
plans for YETS & TS1

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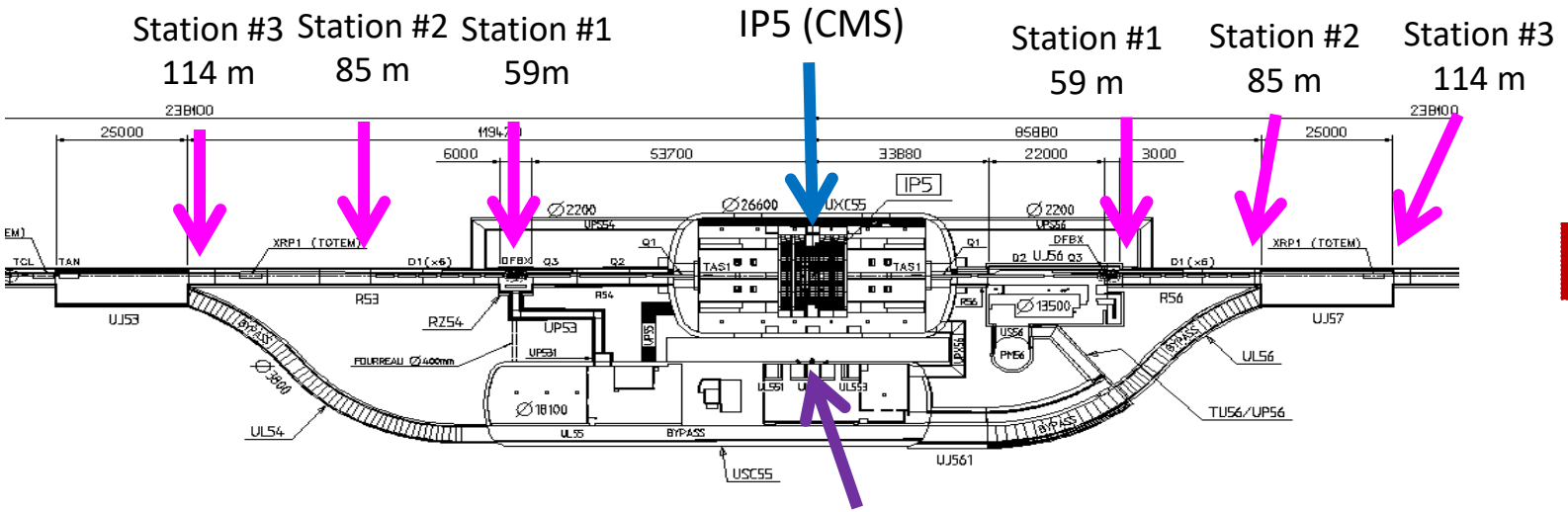
Outline

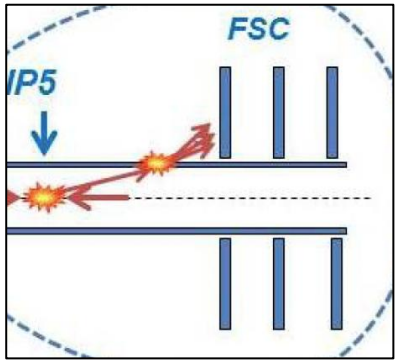
- Introduction and motivation for FSC (re)installation
- Overview of the proposed setup and its status
- Tasks for YETS 2024-2025
- Tasks for TS1 2025
- Discussion

Introduction

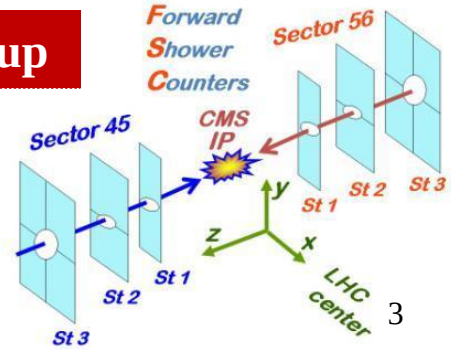
The CMS Forward Scintillator Counters (FSC):

- Detectors located in the vicinity of the beampipe and measure showers originating from very forward primary particles interacting with the beampipe
- FSC can tag low mass diffractive processes at the LHC *JINST* **4** (2009) P10001
- Proposed in Run 1 by the CMS collaboration: CMS-NOTE-2010-015





Run 1 setup



FSC in Run 1

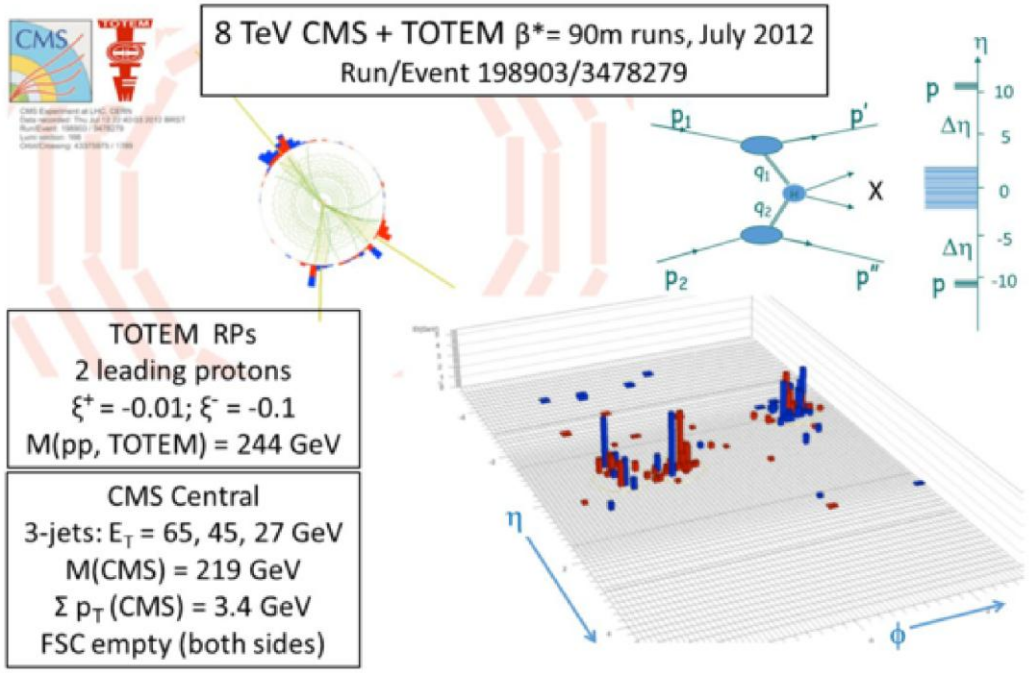
2012 data taking with FSC:

- FSC was successfully operated in 2012 during high-β*, pPb and PbPb collisions.

Example of a clean pp→p+(3-jet)+p event with rapidity gap tagged with (empty) FSC

FSC empty during the collision
=
Event with a large rapidity gap

Can be operated during very low instantaneous luminosity



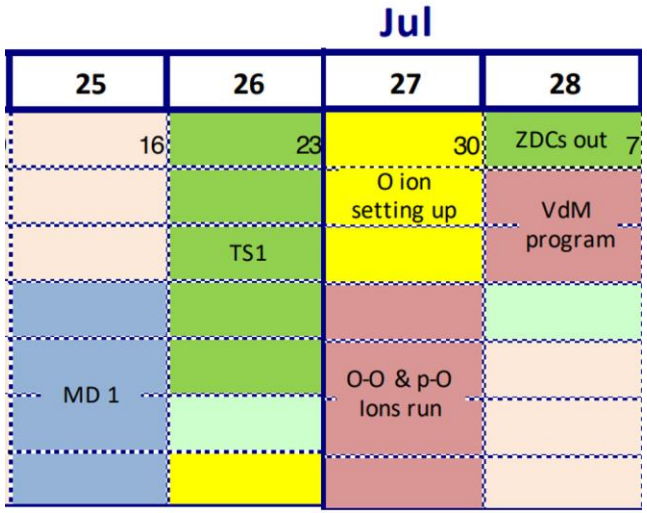
Sep 2011, courtesy of M. Albrow and S. Popescu

A. Penzo, et al., Nucl.Part.Phys.Proc. 282-284 (2017) 15-19

Revival of CMS-FSC

Goal: Operating FSC in the oxygen run

- Scheduled to week 27 in 2025
- CMS aims to utilize most of its forward detectors, including the CMS FSC sub-system



CMS feedback for oxygen run (last LPC on Feb 10th link)

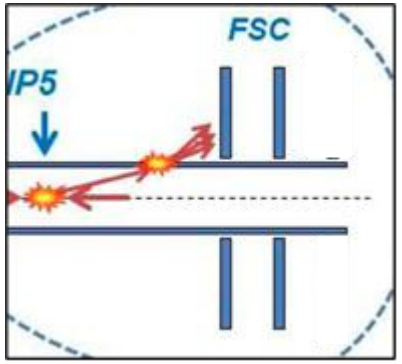
- **ZDC** will be included in the pO, OO and NeNe run
- CMS requests to include **PPS** in the pO run (physics case approved)
  - Running at 0 crossing angle is acceptable (no need for extra crossing plane studies)
  - Some beam-based alignment needed
  - **PPS** planned to be included "p" side ("O" side still under discussion)
  - Possibly also in the OO and NeNe runs (TBD)

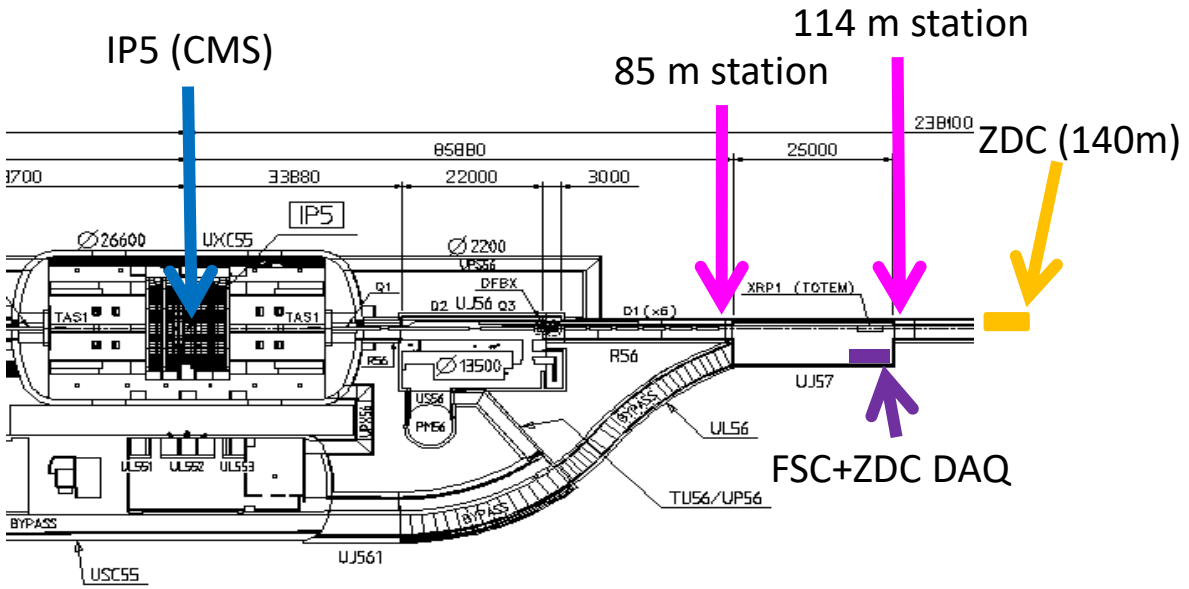
FSC will enhance the physics reach to study diffractive pO interactions

Experimental setup

The CMS Forward Scintillator Counters (FSC):

- A minimal FSC setup is proposed to be revived for the upcoming pO run
- Will be located downstream of the proton beam, at 85 and 114 m from the IP5





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Based on template: EDMS 1271880

Date: 2025-02-20

ENGINEERING CHANGE REQUEST

Re-installation of the CMS Forward Shower Counters in Point 5

BRIEF DESCRIPTION OF THE PROPOSED CHANGE(S):
Proposal for re-install during the TS1 2025 the CMS Forward Shower Counters (CMS FSC) in point 5. These are scintillation counters read out by standard photomultipliers. Original installation describes in ECR LHC-X5FC-EC-0001 - https://edms.cern.ch/document/1139168/1.0

DOCUMENT PREPARED BY:	DOCUMENT TO BE CHECKED BY:	DOCUMENT TO BE APPROVED BY:
Michael Pitt (EP/CMG)	G. Arduini, M. Barberan, S. Bally, M. Bernardini, O. Beltramello, M. Brugger, O. Boetcher, J. Blanc, J. Bernhard, C. Bertone, G. Canale, J-P. Corso, C. Colloca, J. Coupard, D. Delikaris, J. De Voght, J. Etheridge, J-F. Fuchs, J-M. Fernandez, C. Gaignant, G. Georgiev, G. Girardot, S. Grillot, A. Infantino, R. Jones, D-L. Lazic, D. Letant-Delrieux, M. Loffredo, M. Marjanovic, S. Pelletier, E. Paulat, H. Mainaud Durand, M. Mulders, S. Roesler, R. Steerenberg, P. Sphicas, C. Tromel, H. Vincke, J. Wenninger, M. Wolf, M. Yougil.	Mike Lamont (On behalf of the LMC) F. Sanchez-Galan (On behalf of the TREX)

DOCUMENT SENT FOR INFORMATION TO:
R2E, ATS Group Leaders.

SUMMARY OF THE ACTIONS TO BE UNDERTAKEN:
- Install signal cables during EYETS 24-25 (EN-EL).
- Dry test of the setup during the EYETS 24-25 (CMS).
- Install the detectors on stations 2 and 3 during TS1 (CMS).
- Removal of the counters will take place after the OO run during the one day allocated for the CMS ZDC removal (July 2025).
- The signal cables to be removed during LS3 (EN-EL).

Note: When approved, an Engineering Change Request becomes an Engineering Change Order.
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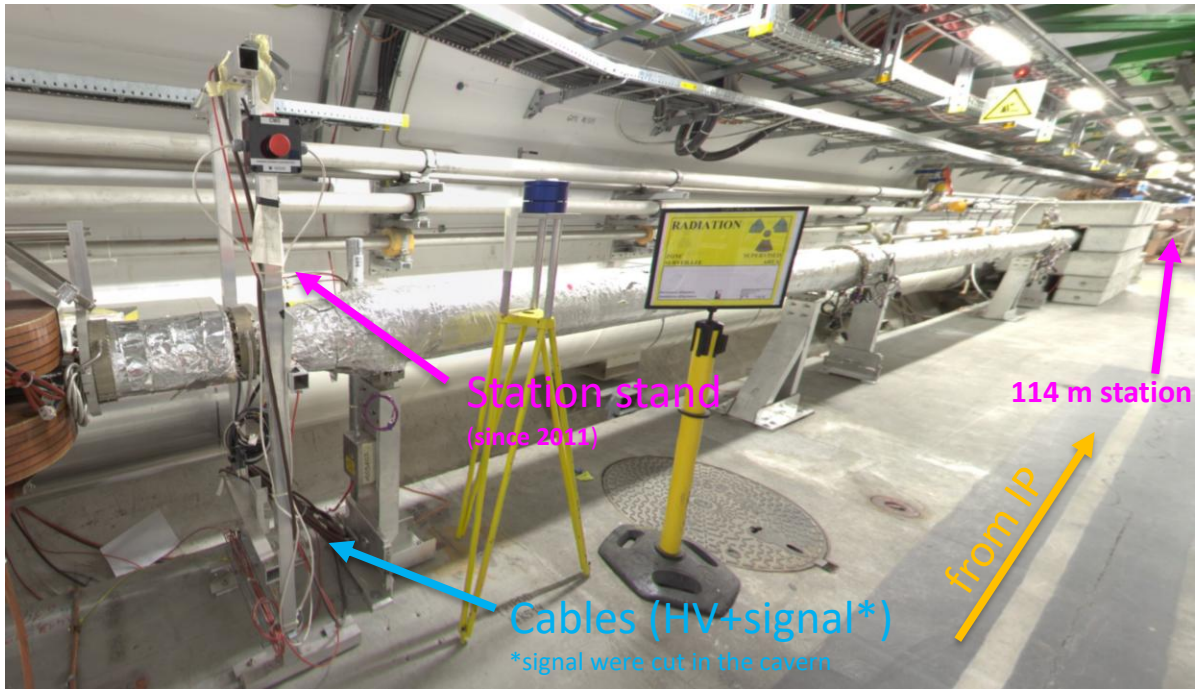
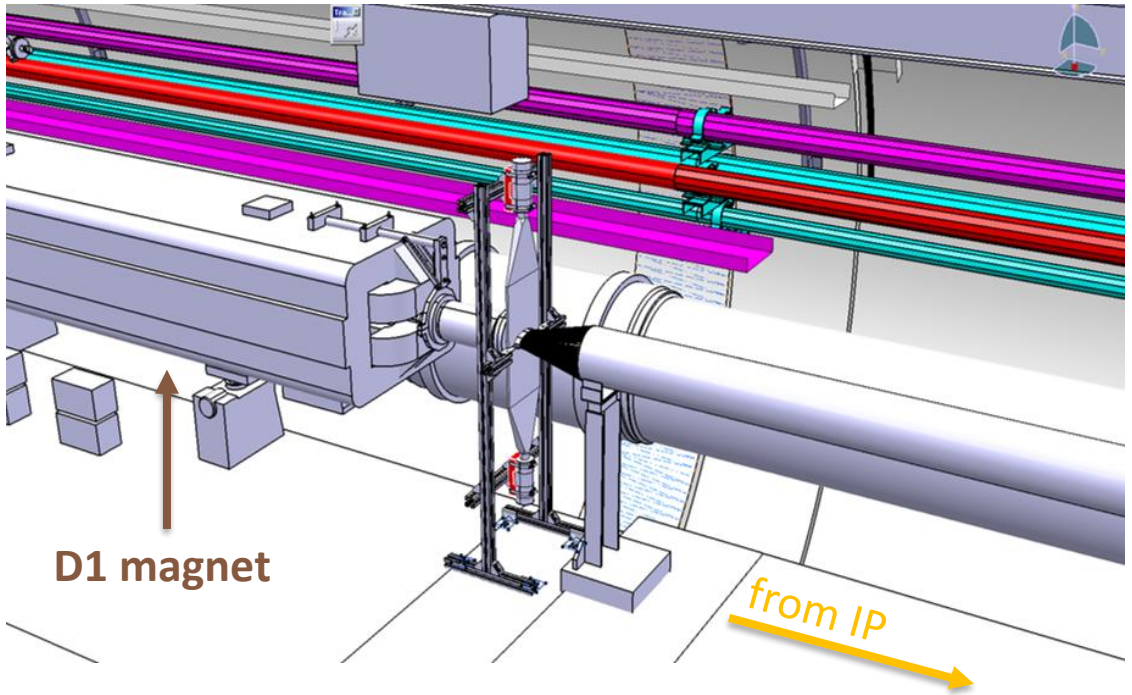
Sketch with CMS cavern, FSC locations, and "ZDC bunker" (ZDC DAQ)

Experimental setup

FSC status in the tunnel: 89 m station



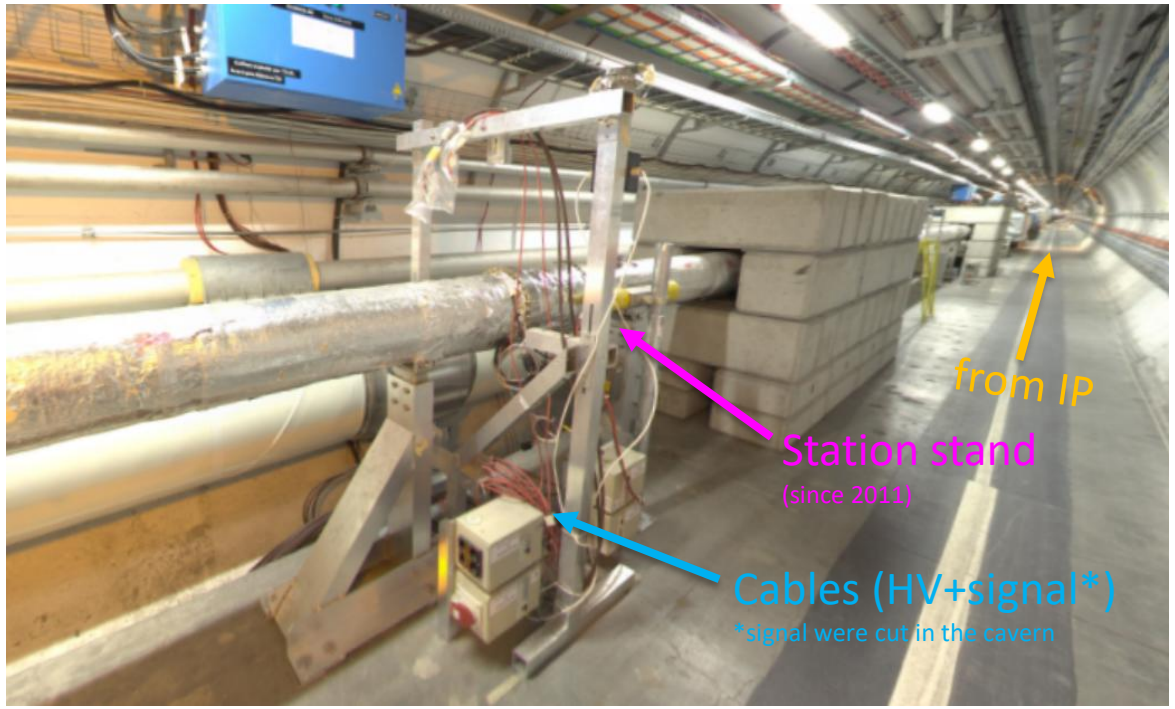
LHC-UJ56/C-04R5 captured on 2021-01-12 by EN-ACE-CL



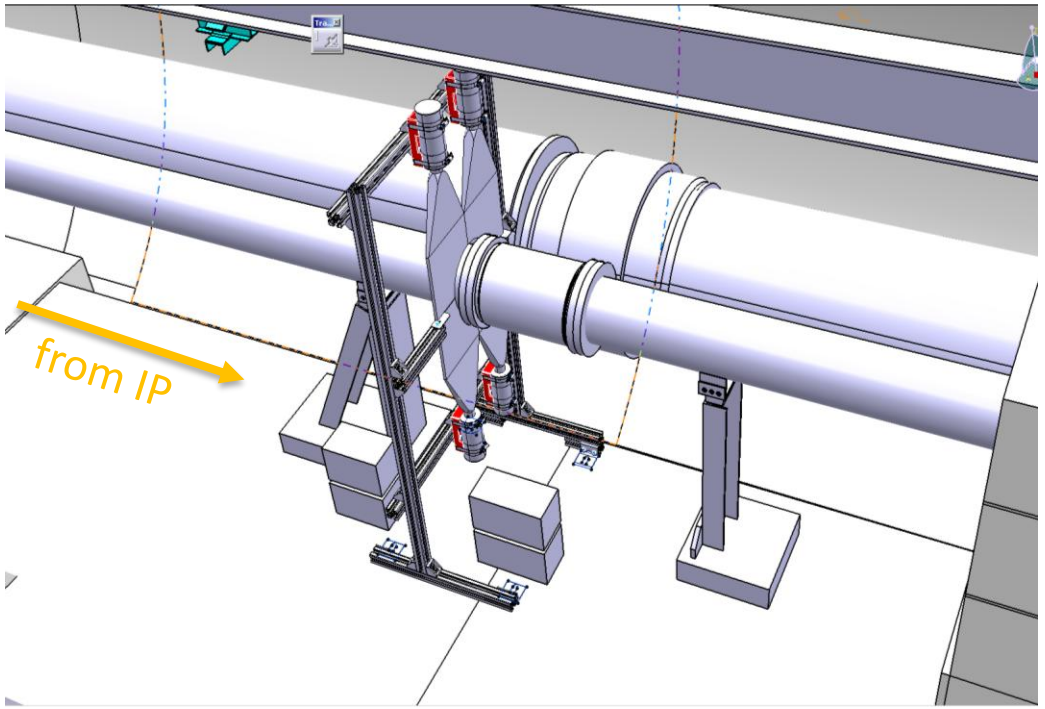
The 3D integration of the stations (performed by EN-ACE-INT)

Experimental setup

FSC status in the tunnel: 114 m station



LHC-UJ56/C-04R5 captured on 2021-01-12 by EN-ACE-CL



The 3D integration of the stations (performed by EN-ACE-INT)

Infrastructure

Detectors – using old ones

- Counters were released from RP and tested, the best 2+4 will be installed.

Stands (since run 1)

- Aluminium rails, bolted into the floor, designed so that the upper counters cannot fall and touch the beam pipe
- Can accommodate heater jacket (TBC)

HV cables (since run 1)

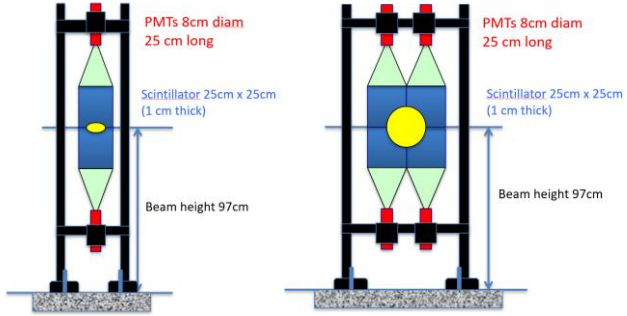
- Available since run 1, tested last week

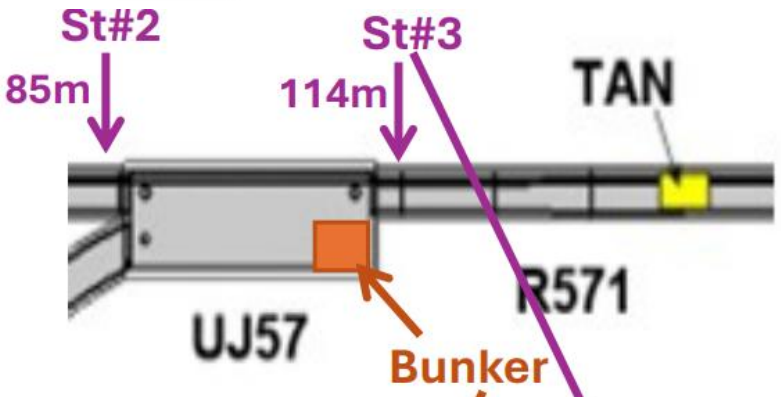
Signal cables

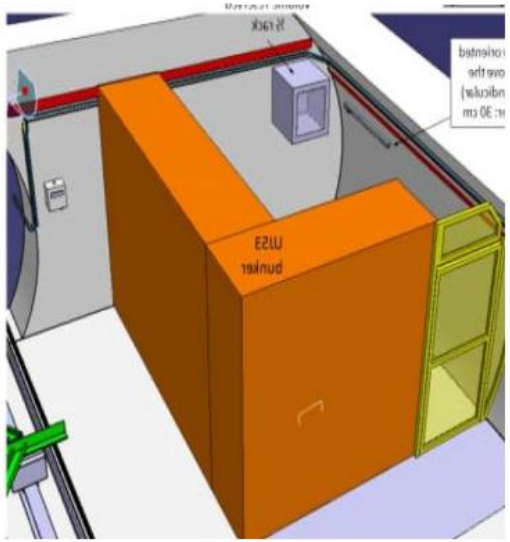
Old were cut ☹.

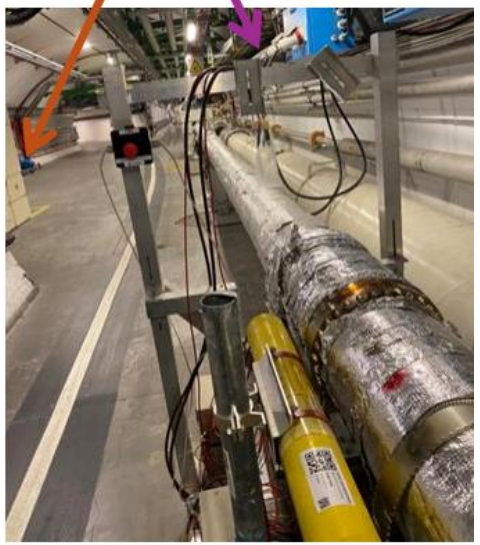
Luckily, the FSC is located just near the ZDC bunker.

New signal cables to connect FSC to the ZDC bunker are needed





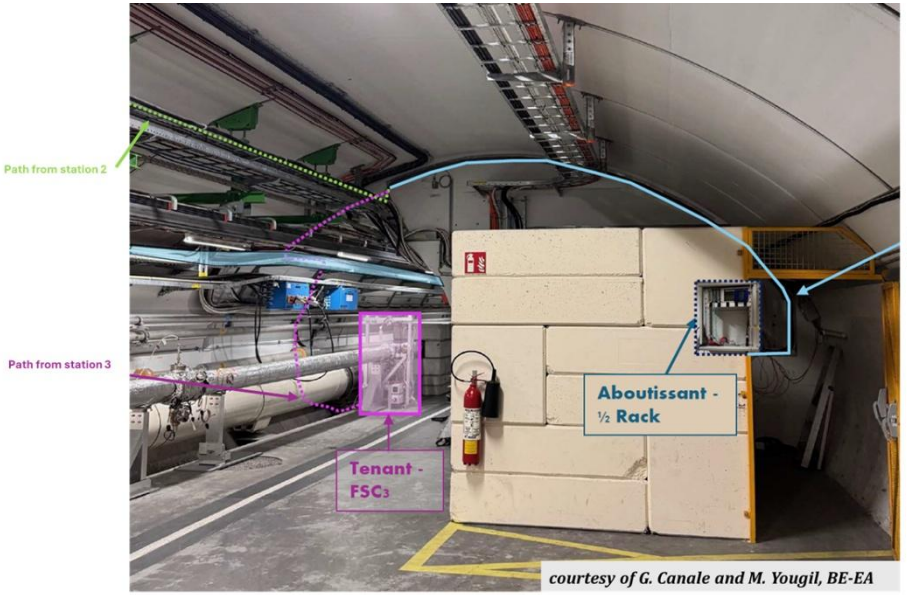


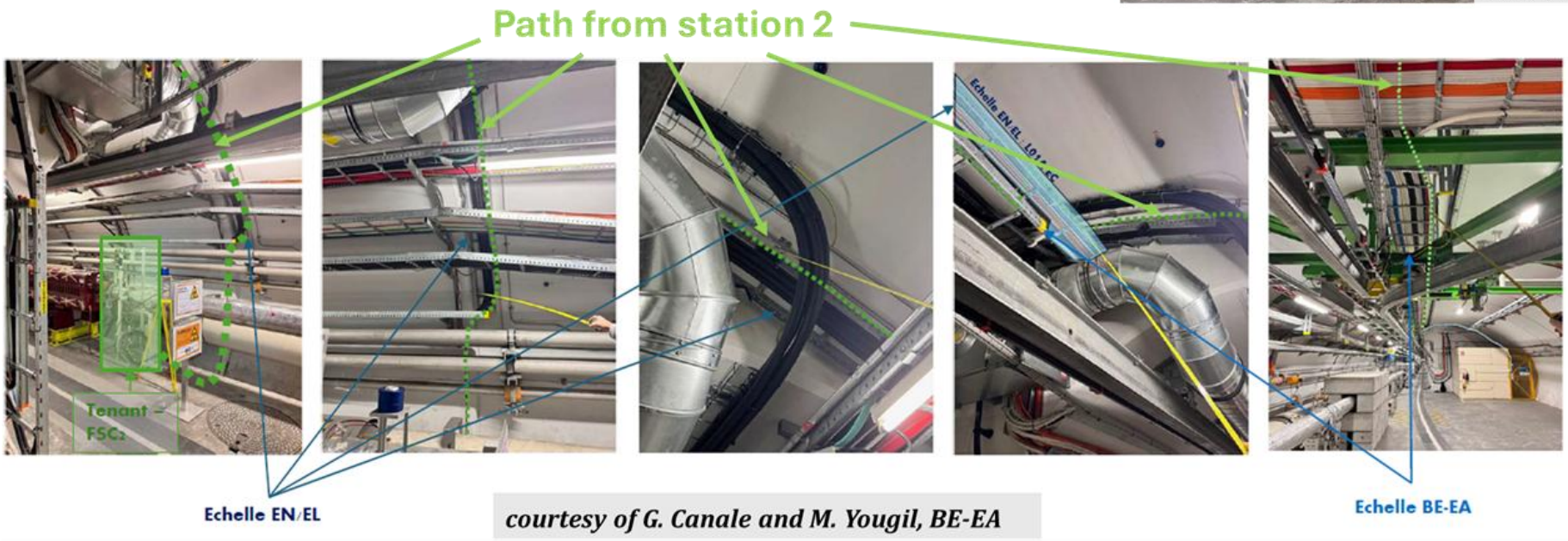


Plans for YETS 2024-2025

Cabling (week 10, March 05 the latest)

- Task assessed during VIC on 14 Feb (impact 248338)
- New cable layout: 2x50m (St#2) 6x27m (St#3)
- Order for new cables + installation was made
- Can be only performed in YETS (unlikely during TS1)
- Exceptional authorisation: EDMS-3235026





Plans for YETS 2024-2025

Dry tests (week 10)

Impact (draft) 248925, duration 2 days (to be scheduled)

- Exercise the installation and removal of the counters

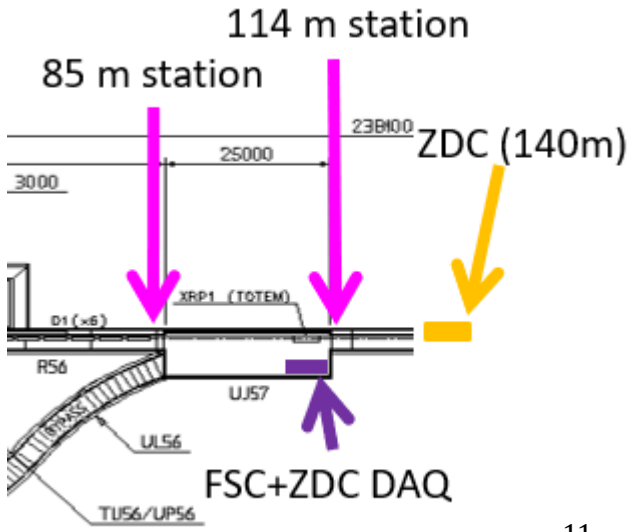
Participation is mandatory for the team responsible for the installation during TS1 2025.

- Safety tests of the assembly (followed by a technician)
- Noise tests (grounding, …)
- Synchronization with ZDC readout

Signal arrival at FS2(85m), FS3(114m), ZDC(140m) – signal propagation to the bunker (50m, 27m, 60m respectively)

DIMR to be created with the following estimates:

- 50 µSv for individual dose
- 250 person.µSv for collective dose



Plans for TS1 2025

FSC installation (week 27)

Work Dose Planning prepared (4325/1):

- Safe zones assigned
- Limited time of work near the D1 magnet
- The Pb shield can be for FSC team disposal
- RP technician will follow up the installation

Jul

25	26	27	28
16	23	30	ZDCs out 7
		O ion setting up	VdM program
	TS1		
MD 1		O-O & p-O Ions run	

Installation:

- Performed by two teams, each team comprise of 2 members
- Following the installation noise tests to be performed from the bunker
- The installation work will be done in coordination with the CMS ZDC team

Discussion

- As the cabling work can be performed, the CMS-FSC can be prepared for the oxygen run (urgent).
- A few days of testing during the YETS 2024-2025 will be required to prepare the setup for the installation during TS1.
- CMS-FSC to be installed during TS1 for the pO/OO runs and will be removed afterward.

Backup