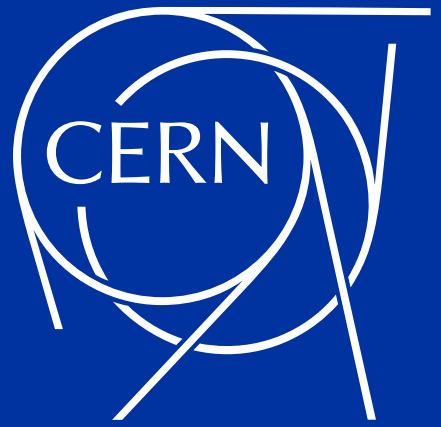


AION-100@CERN

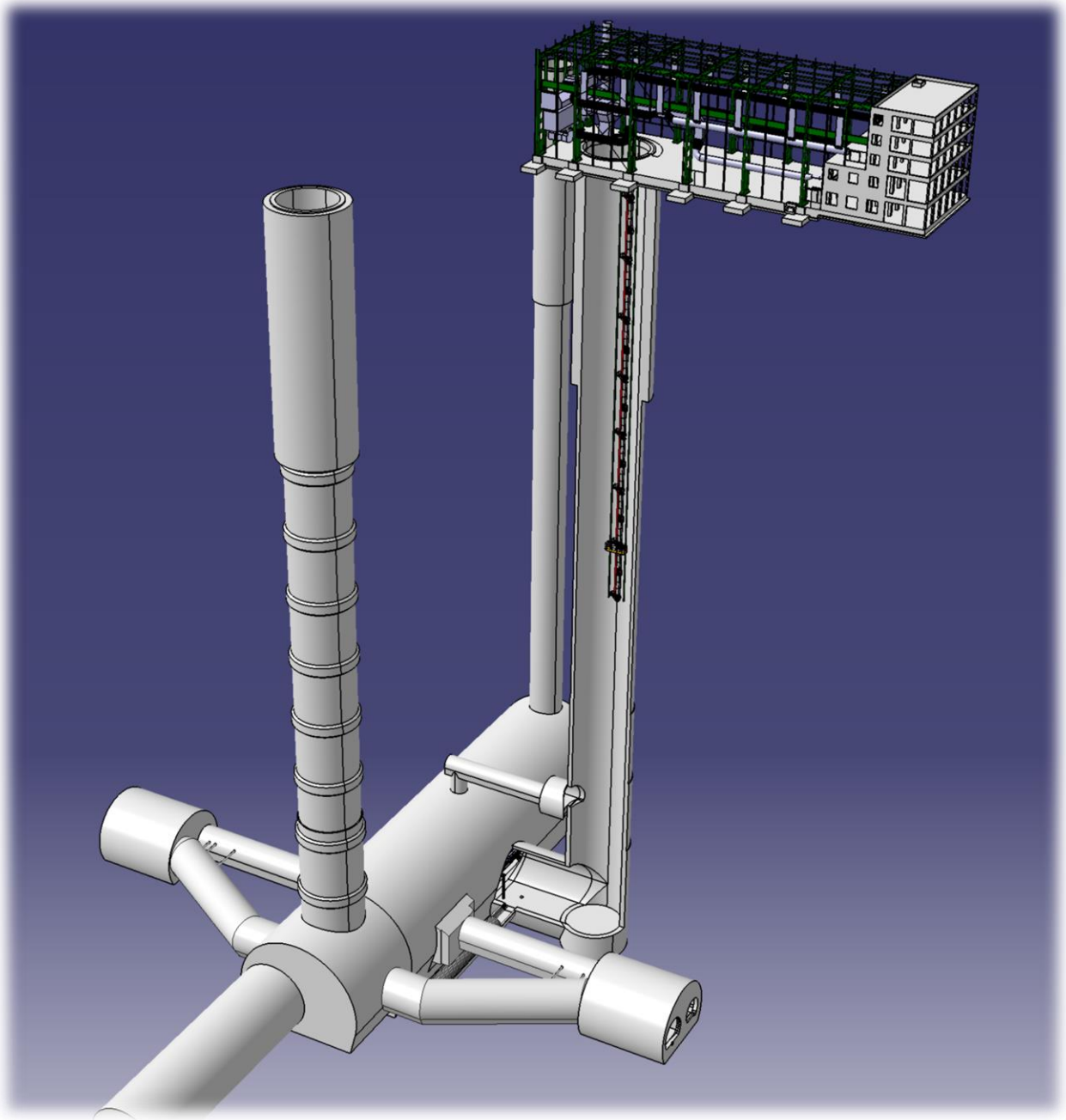
Physics Beyond Colliders General Working Group meeting, 2-3 December 2021

Kincső Balázs, John Osborne SCE-DOD-FS

02/12/2021

AION-100@CERN

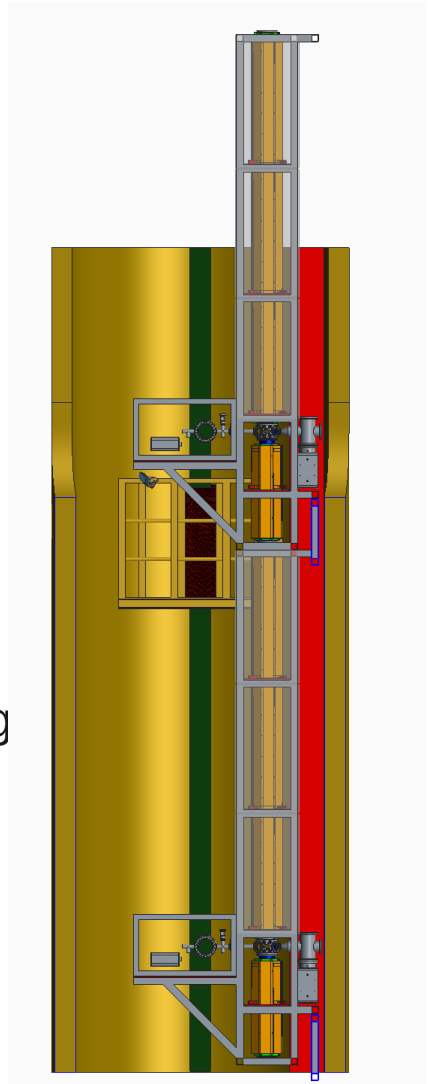
- **Introduction**
- **Aims and objectives**
- **Study Progress**
  - Radioprotection
  - Civil engineering
  - Cooling & Ventilation
  - Safety
- **Next steps**



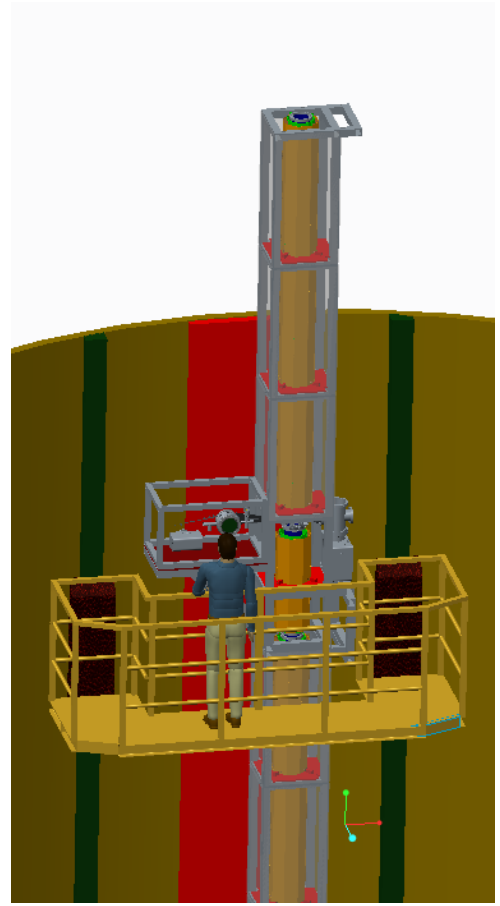
Introduction

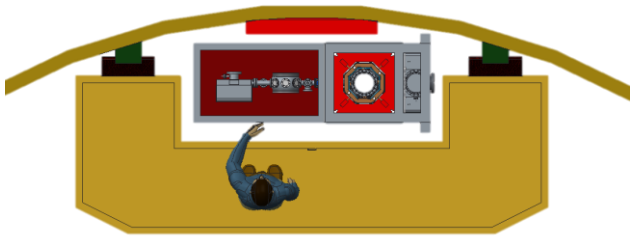
AION-100

- **100 m long Interferometer**
  - Possibly built with 5m long modules
- **Moving platform around the detector**
  - Platforms to be able to carry atom sources, ion pumps up and down etc.
  - NOT free hanging, needs rails (avoids swinging cage colliding with detector



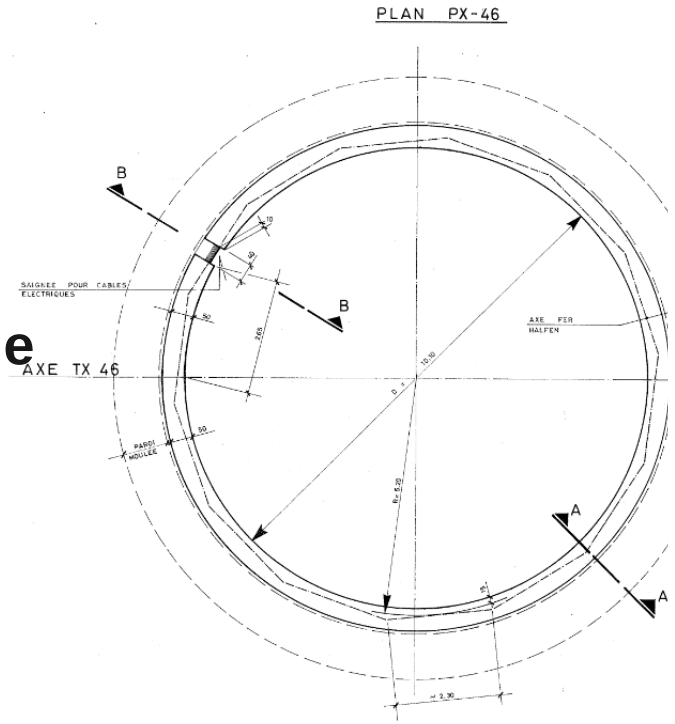
Single module of 5m

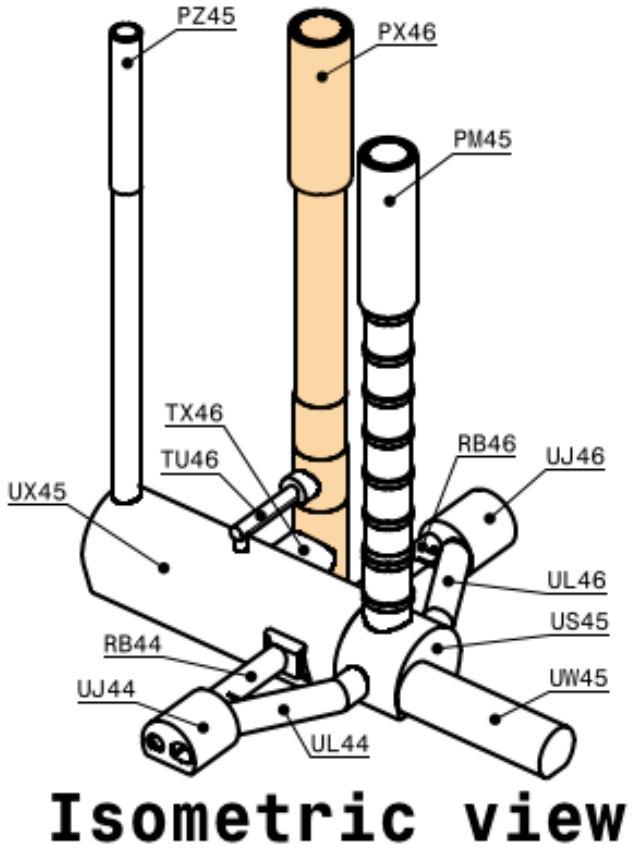




Aims and Objectives

- **Explore the possibility hosting AION-100 at CERN in one of the existing LHC access shaft**
- **Current option: PX46 shaft**
  - Internal diameter :10m
  - Internal height: 143 m
- **Determine the maximum length of the experiment that could fit in the shaft**





Isometric view

Study Progress - Radioprotection

- **Preliminary radioprotection study done in February 2021**
  - Accessibility of the experiment during LHC operation
  - Radiation levels during operation not an RP issue, however access constraints in an accidental scenario to be verified
- **No shielding is considered**
- **Accidental scenario in which the full beam is lost on one of the RF element of the LSS4**
- **Design goal: limit to max 1 mSv in accidental scenario**

Study Progress - Radioprotection

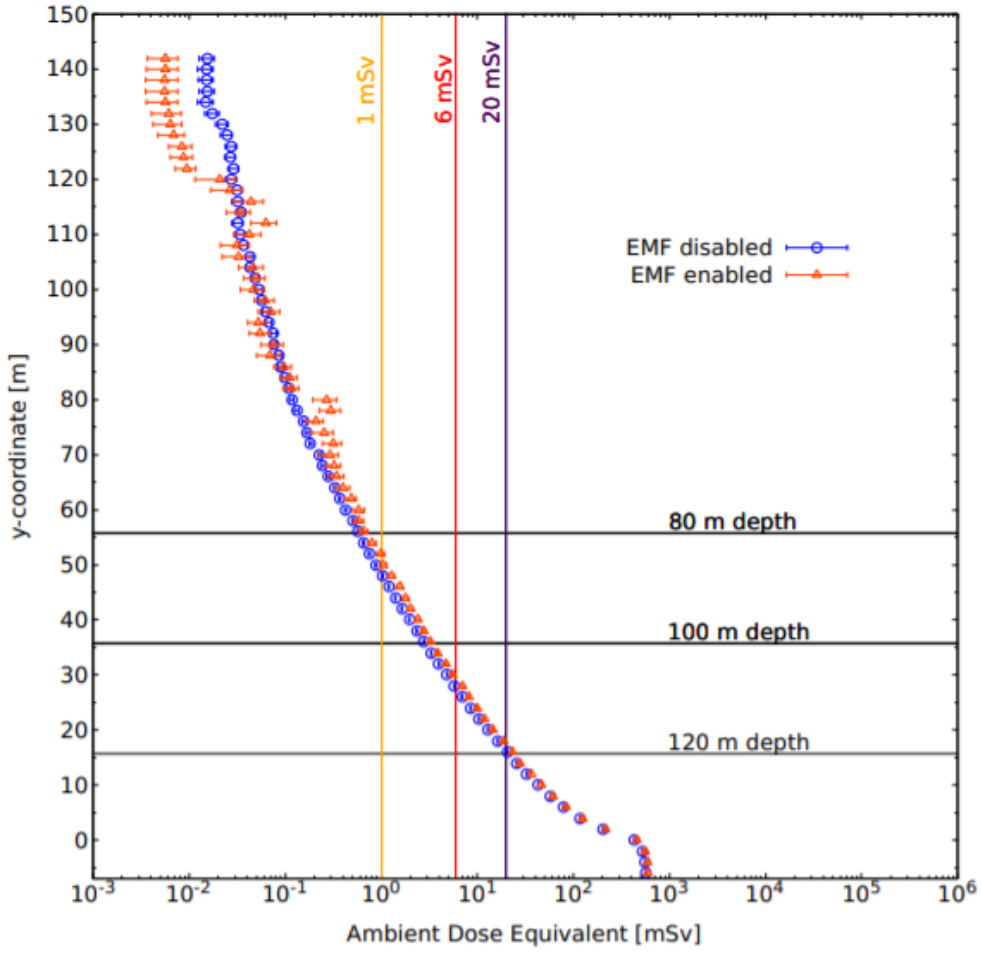
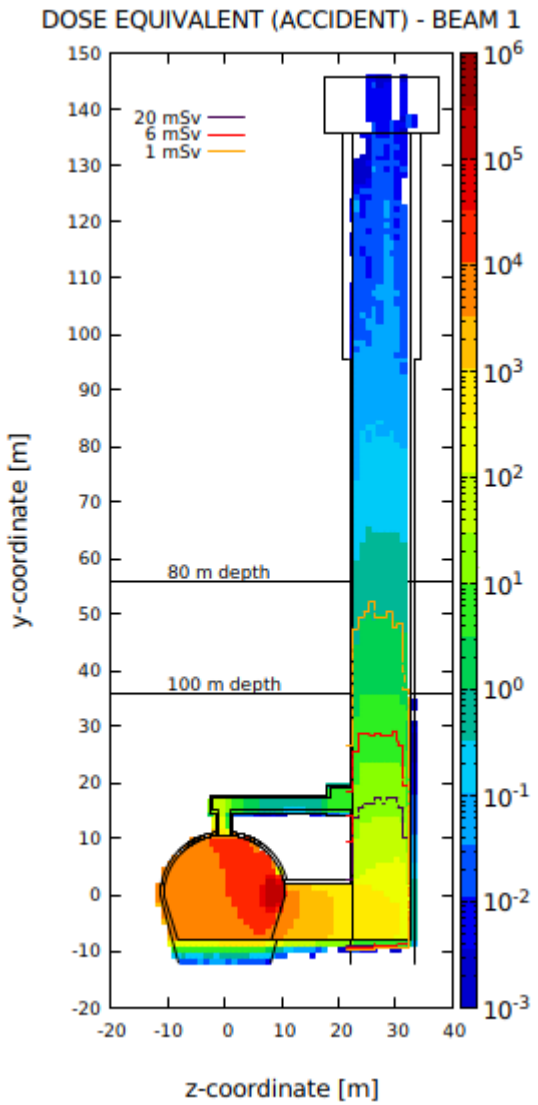
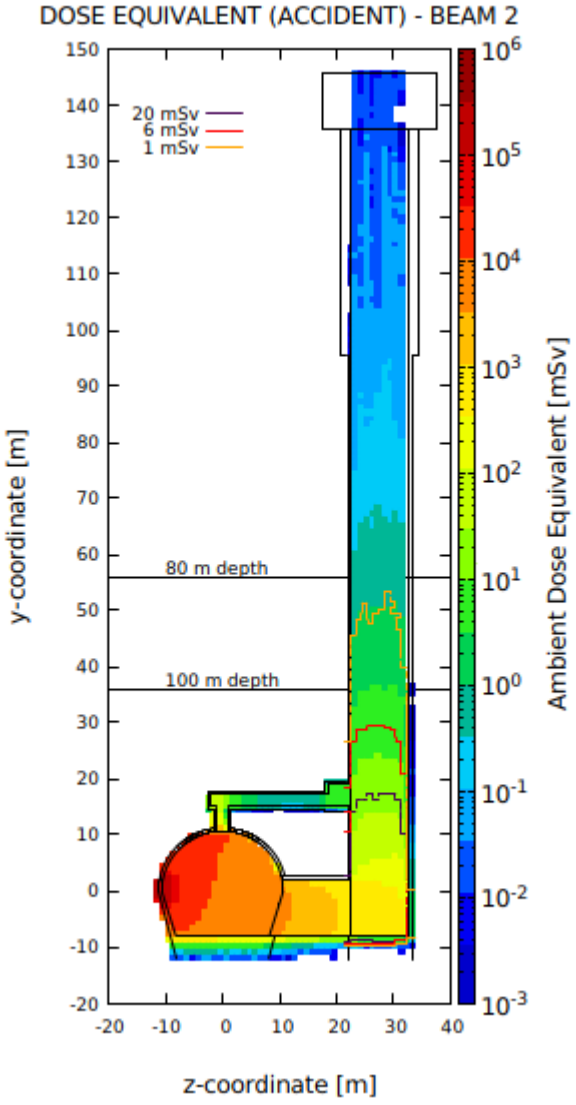


Figure 8: Ambient dose equivalent 1D profile along the PX46 shaft.





Courtesy of L. Elie and A. Infantino (HSE-RP-AS)

Study Progress - Radioprotection

Conclusions/ Recommendations:

- Experiment should have a maximum depth of 80m from the surface
- Access platform should not go beyond the maximum depth of 90 m, should not reach the bottom of the shaft
- The shaft must have a physical barrier at 90 m which does not allow the elevator and personnel to descend further down in the shaft
- Shaft will be classified as a Supervised Radiation Area
- Delimitation of the access area on the surface with a locked fence/grid.

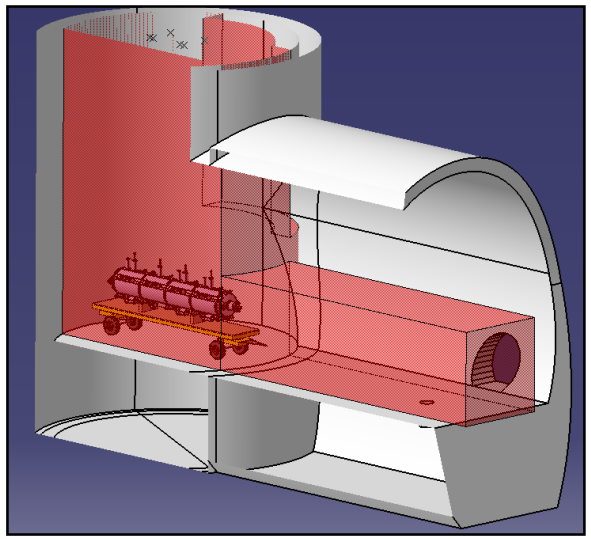
Area	Annual dose limit (year)	Ambient dose equivalent rate		Sign
		permanent occupancy	low occupancy	RADIATION
Non-designated	1 mSv	0.5 µSv/h	2.5 µSv/h	
Supervised	6 mSv	3 µSv/h	15 µSv/h	Dosimeter obligatory / Dosimètre obligatoire
Simple Controlled	20 mSv	10 µSv/h	50 µSv/h	SIMPLE CONTROLLED / CONTRÔLÉE SIMPLE; Dosimeter obligatory / Dosimètre obligatoire
Limited Stay	20 mSv	-	2 mSv/h	LIMITED STAY / SÉJOUR LIMITÉ; Dosimeters obligatory / Dosimètres obligatoires
High Radiation	20 mSv	-	100 mSv/h	HIGH RADIATION / HAUTE RADIATION; Dosimeters obligatory / Dosimètres obligatoires
Prohibited	20 mSv	-	> 100 mSv/h	NO ENTRY / DÉFENSE D'ENTRER

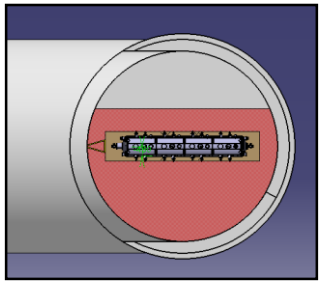
Radiation Area

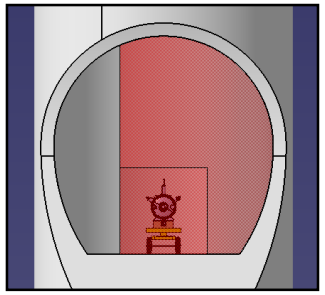
Controlled Area

Study Progress – CE / Shielding Design

- **Further study required on shielding solutions to increase the possible length of the experiment**
- **Handling Constraints**
  - Shaft used to raise/lower LHC and HL elements, PX46, TX46 need to stay open at any time

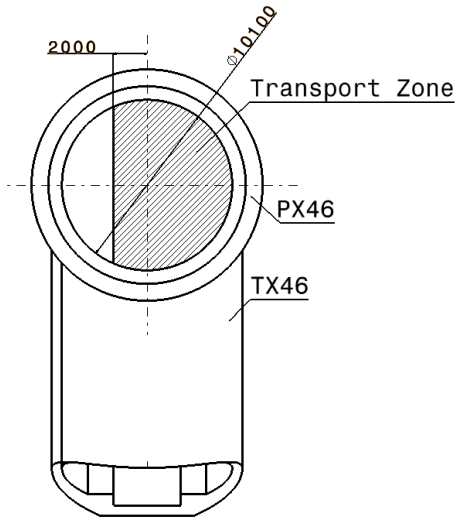


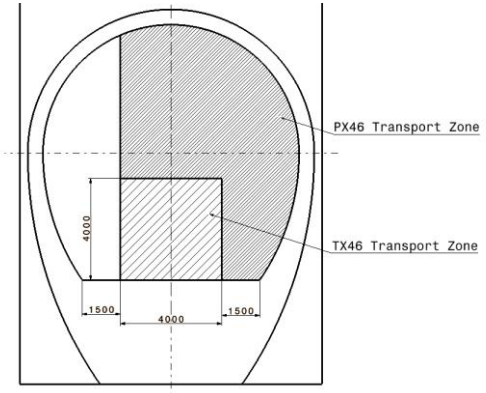




Courtesy of EN-HE-PO

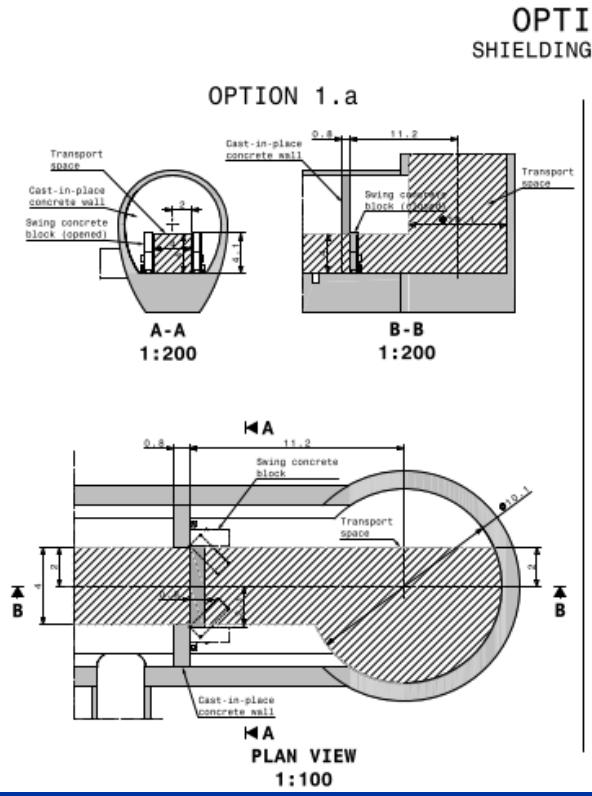
- **Transport zone required to be kept in the TX46, PX46**

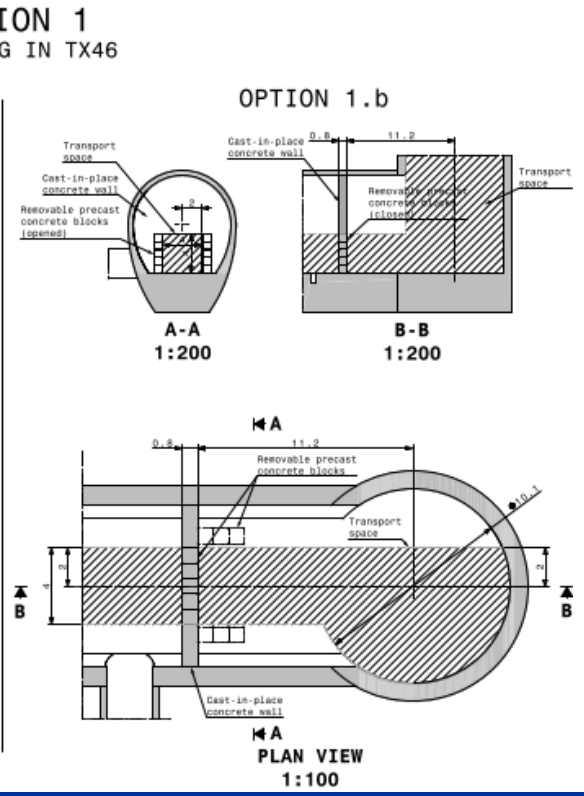


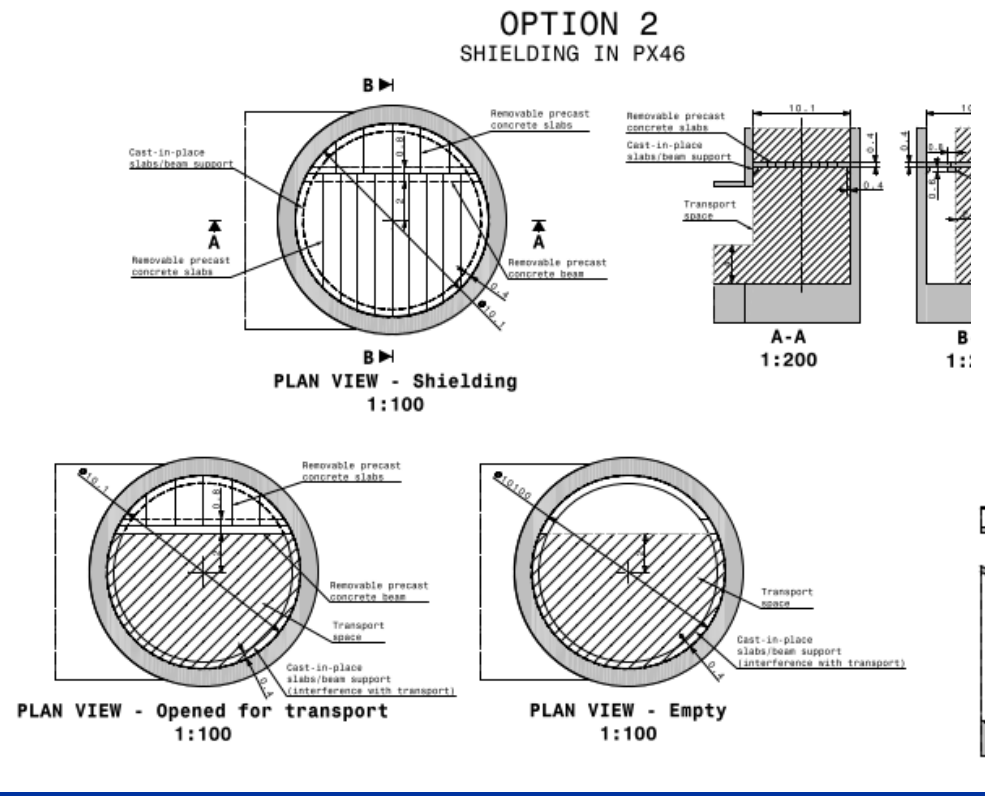


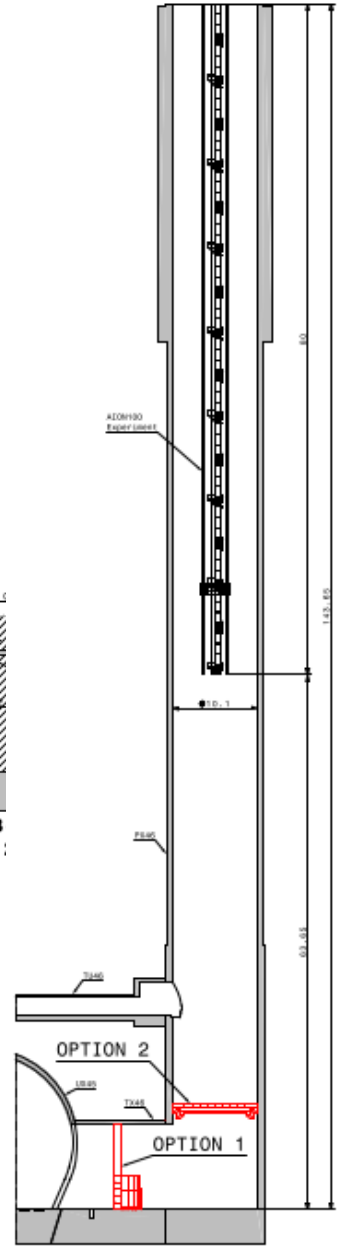
Study Progress – CE / Shielding Design

- Two solutions proposed
- Solutions with removable shielding blocks to avoid blocking the area reserved for transportation







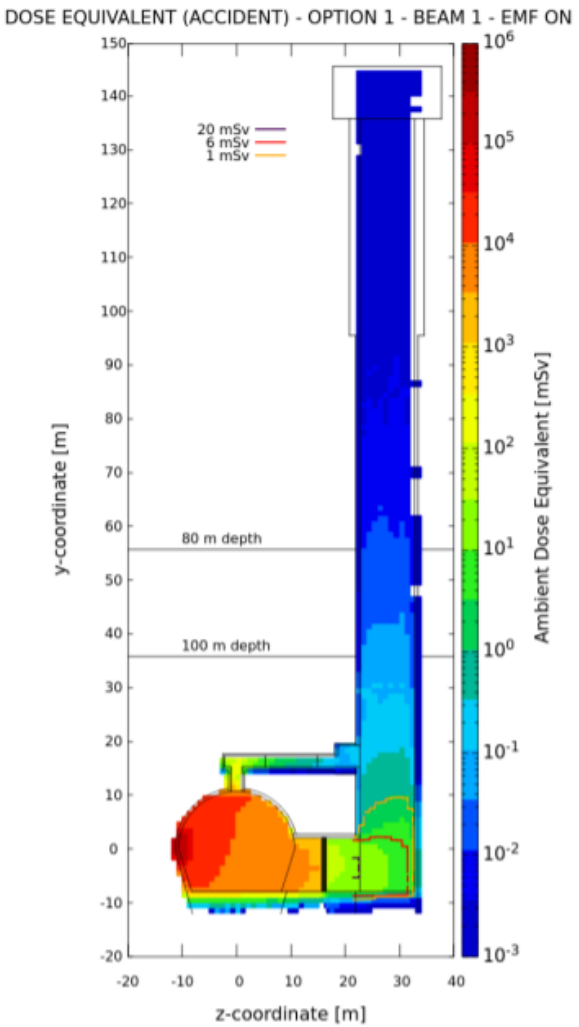


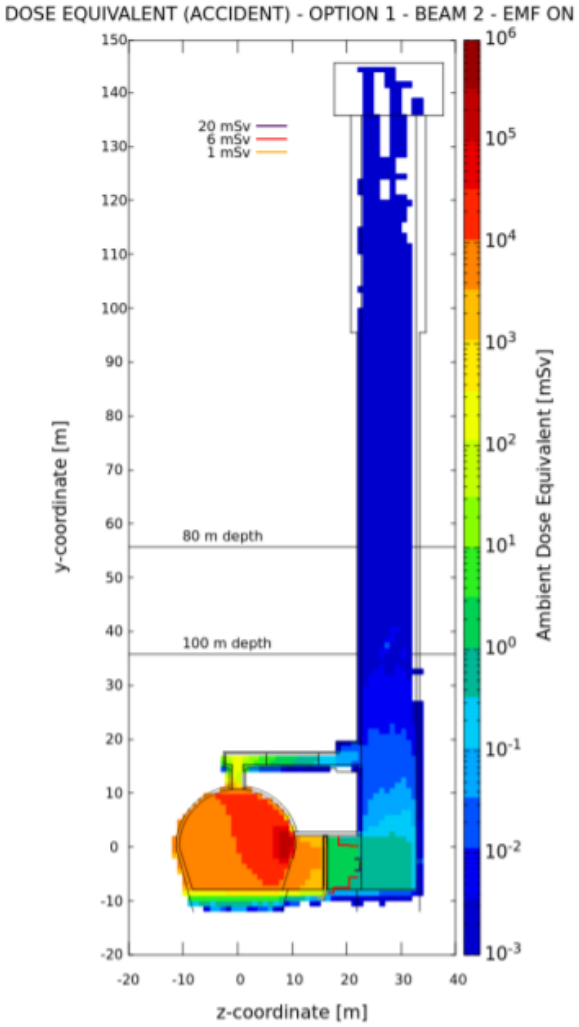
Study Progress - Radioprotection

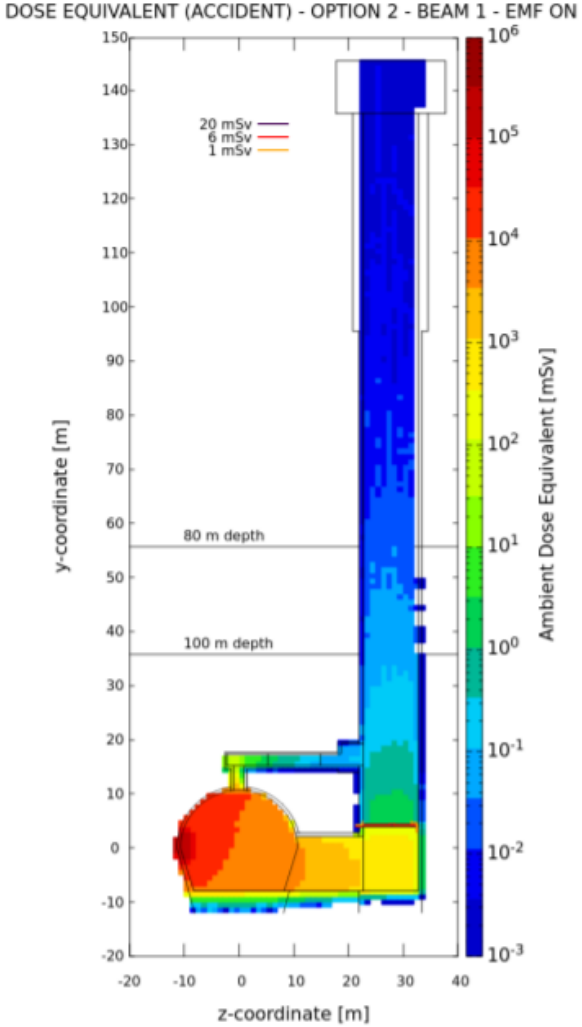
- **Second radioprotection study carried out including the proposed shielding arrangements (EDMS 2635983)**
- **Accident scenario: loss of the LHC beams**
- **Conclusions:**
  - Option 1 : possibility to use (almost) the full depth of the shaft
  - Option 2 : possibility to use up to 120 m
  - Shaft classified as Supervised Radiation Area
  - Fence/grid needed to delimit the access area on surface
  - RP monitoring required for accessing the PX46 during operation

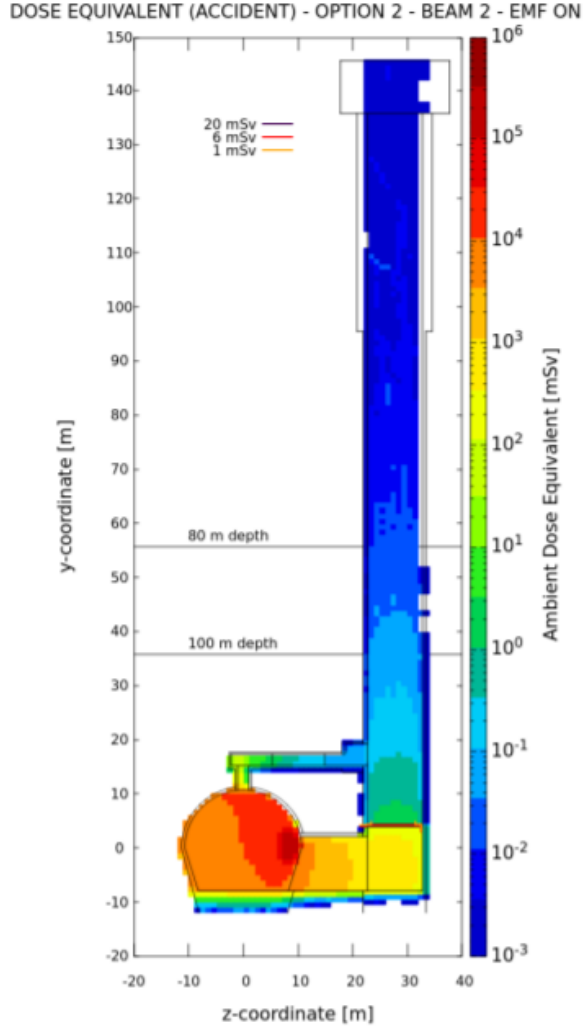
Prompt ambient dose

HL-LHC: 2748 bunches and 2.3E11 ppb





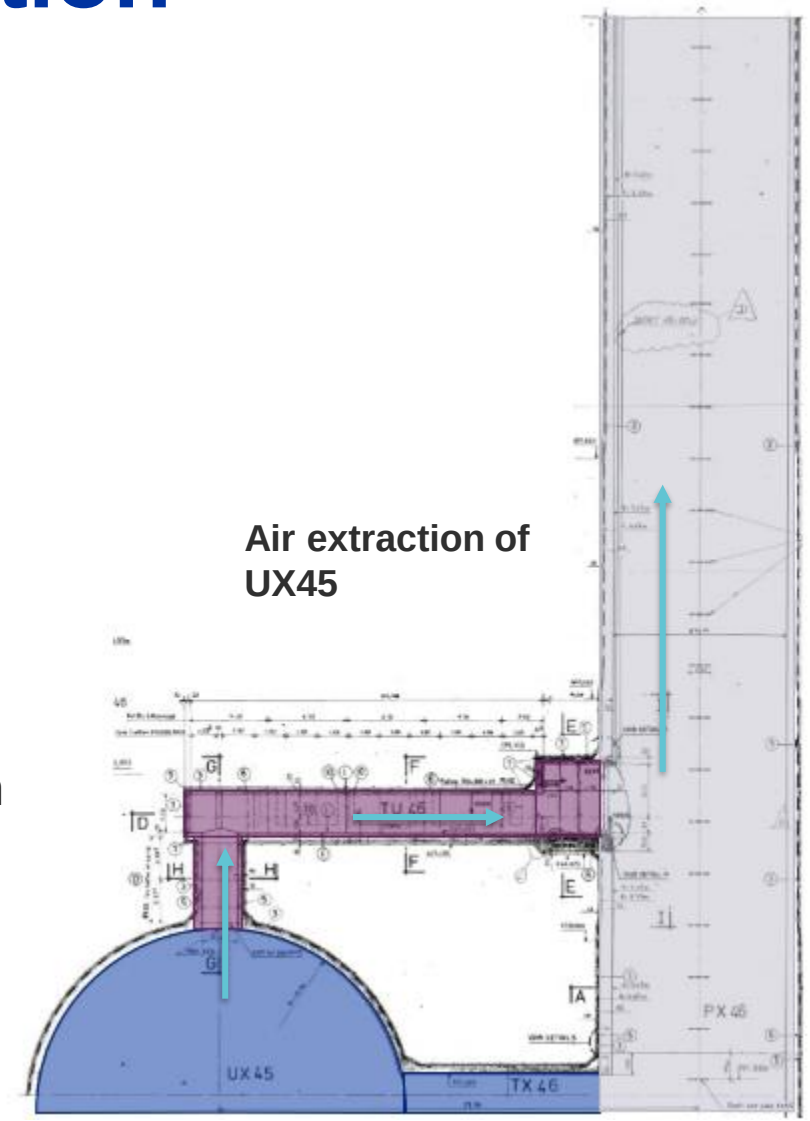




Courtesy of L. Elie and A. Infantino (HSE-RP-AS)

Study Progress – Cooling & Ventilation

- **Ventilation concept for UX45:**
  - Air extraction is done at the top of the cavern by unit located in TU46
  - Extracted air is then directly supplied in PX46 (no ducts in PX46)
  - In surface, a duct is connected to the cap to collect extracted air to main extraction unit in SX4.
- **Shielding considerations:**
  - Proposed solutions seem feasible
  - No duct through the shielding is required as per the current ventilation scheme
  - No existing duct in the shaft, one might be needed when accessing AION100 during LHC operation



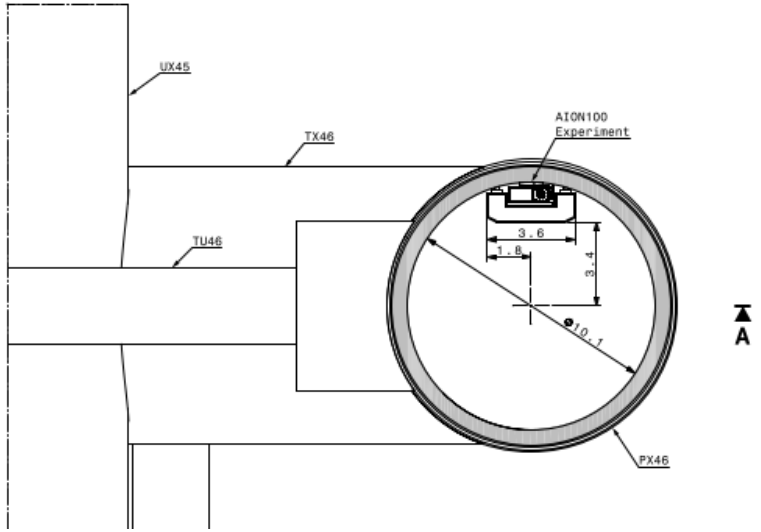
Courtesy of R. Langlois (EN-CV-LHC)

Study Progress - Safety

- **Health & Safety concerns raised during the AION-100@CERN workshop**
- **Only one exit way would be possible with the actual design**
- **Ongoing discussion regarding the feasibility of the proposed shielding arrangements**
- **Proposed solution to create a second exit way:**
  - Using TU46 as a secondary exit way
  - Having a chicane instead of the shielding wall

Study Progress - Safety

- **The handling department confirmed that**
  - Access via TU46 extremely difficult
  - Moving platform in the TU46 not openable from outside
  - Platform not on the same side as the experiment



- **Second exit through a chicane**
  - No handling constraints
  - Further study needed from RP

Next steps

- General AION-100 safety meeting
- Further input from CV, RP, RF
- Cost estimate for the shielding (CE)

Thank You!

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