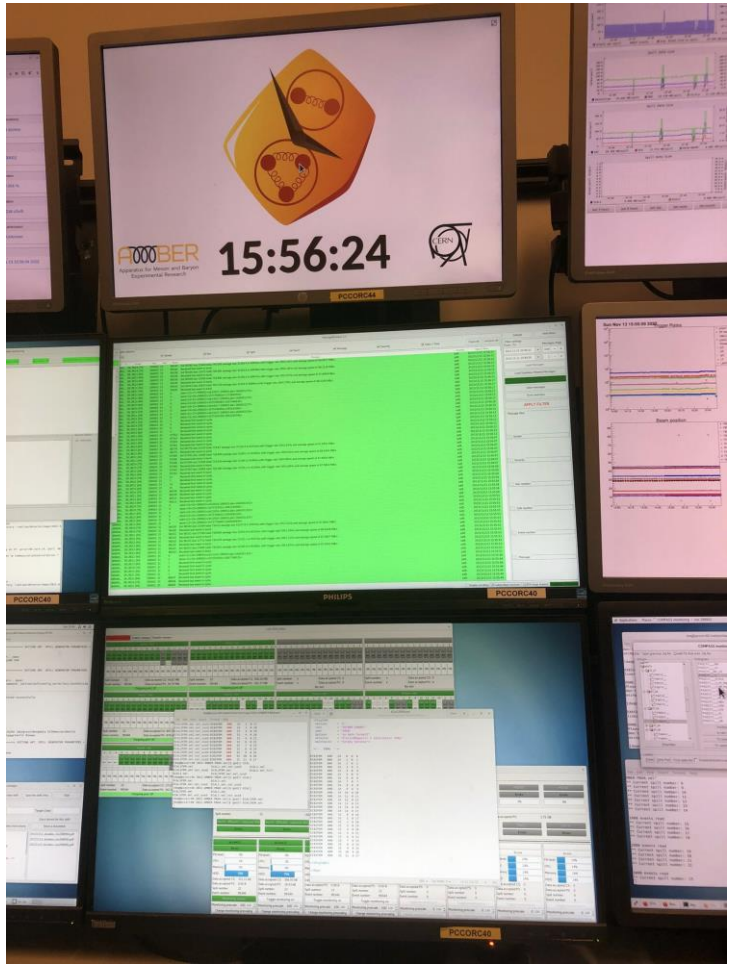
EHN2 working group
23/02/2023

Apparatus for Meson and Baryon Experimental Research

AMBER – plans for 2023

Outlook

1. AMBER APX:
   - 2023 preparations
2. PRM
   - 2023 set-up

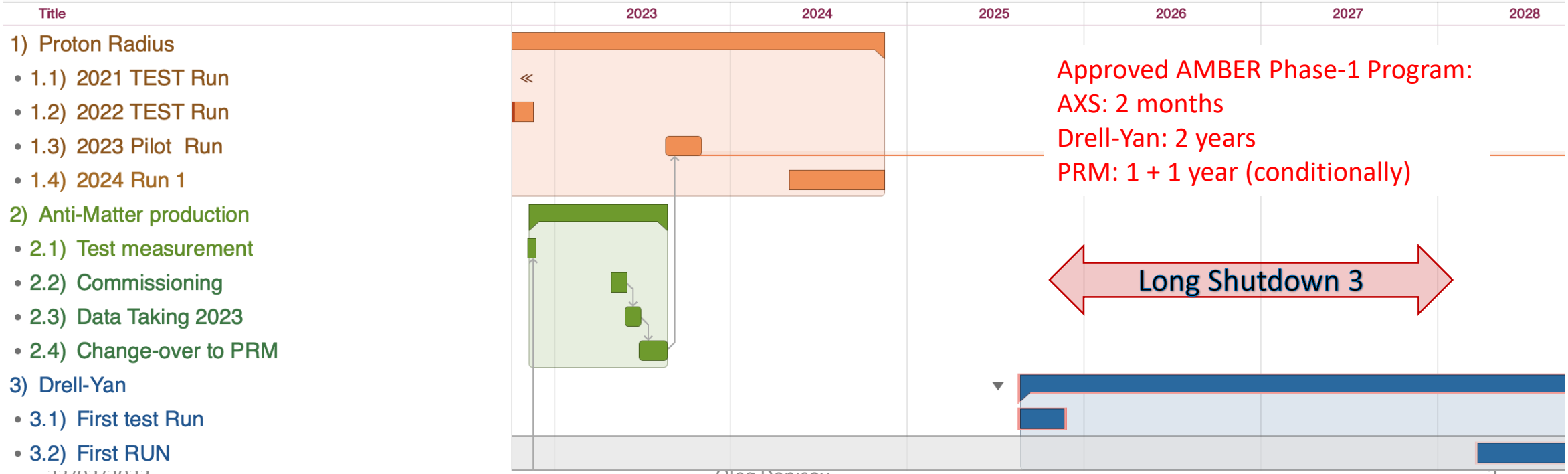


AMBER Phase-1 running plan

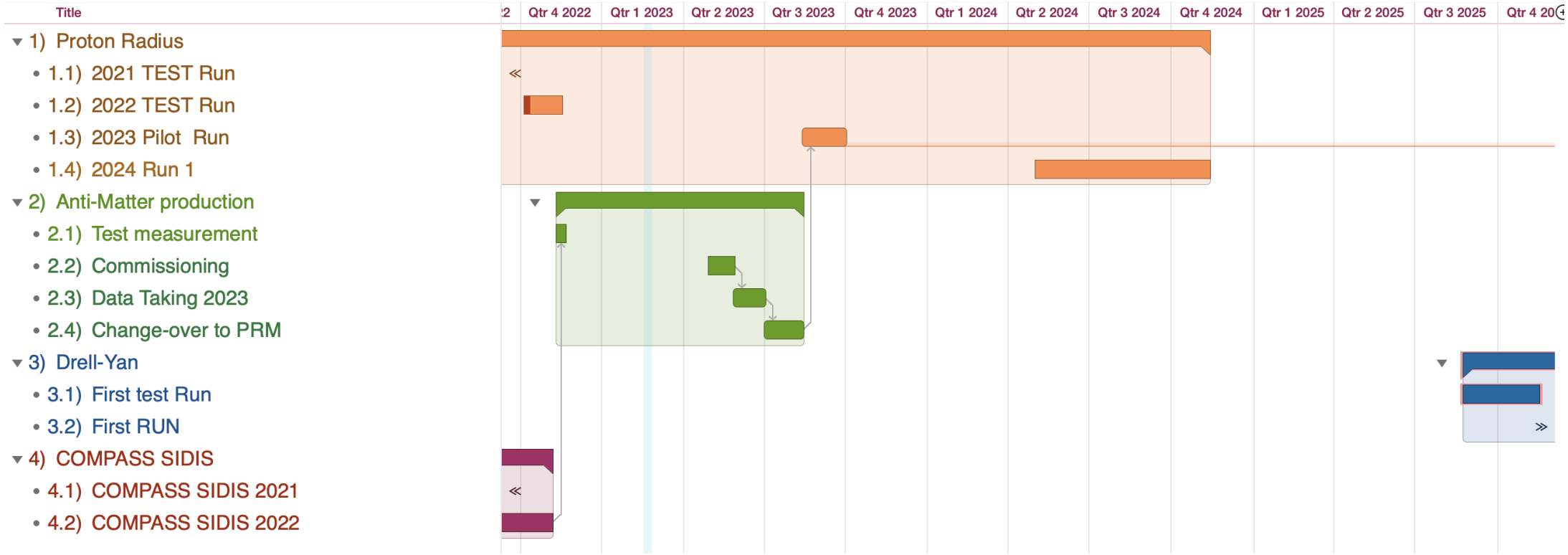
Apparatus for Meson and Baryon Experimental Research

Milestones:

1. May 1st 2023 – Antimatter production Run (Std. DAQ)
2. Sep. 1st 2023 – PRM pilot (FreeDAQ, very limited setup)
3. May 1st 2024 – PRM Run (FreeDAQ, limited setup)
4. Sep. 1st 2025 – DY Pilot (FreeDAQ, all trackers + mu id)
5. May 1st 2028 – DY Run (Full Spectr. Ex. RICH, Calorimeters)



AMBER Running Plan



1. AMBER APX: 1st May – 30th June 2023
2. Changeover APX ➔ PRM : 30th June – 15th/30th August
3. PRT Pilot Run: 15th/30th August – 28th September

Spectrometer composition 2023

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BeamLine:
[X] Cedar (CE01,02)
Not available for the test run
Working for installation of: one CEDAR West (
lower momentum coverage) + one CEDAR North for 2023

BeamTelescope:
[X] Cold Silicons (SI01,02,03)
[X] SciFis (Fi01,15,02)
[X] Vetos (VI1,VI2,Vbl,Vout)

Large Angle Spectrometer (LAS):
[X] MicroMegas (PM01,02,03)
[X] GEMs (GM01,02,03,04,05,06)
[X] SciFis (Fi03,04,05, 55)
[X] Small DCs (DC0,1)
[X] Big DCs (DC4,5)
[X] MWPCs (PS01, PA01,02)
[X] Straw (ST03)
[X] Rich
[X] RichWall (RW01)
[] ECAL1
[] HCAL2
[X] MuonWall1 (MW11,12)
[] Hodoscopes (HG01/02)

Small Angle Spectrometer (SAS):
[X] GEMs (GP03,GM07,08,09,10,11)
[X] MWPCs
(PA03,04,05,06,11,PB01,02,03,04,05,06)
[] Hodoscopes (HO03/04, HM04/05, HL04/05, HI05)
[X] SciFis (Fi07,08)
[X] W45 (DW01/02/03/04/05/06)
[] ECAL2
[] HCAL2
[X] MuonWall2 (MW21,22,23,24,25,26)

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General plan

- April detector commissioning – beam commissioning
- May 1st: AMBER pbarXS official start of data taking
- Allocated beam time 2 months (May and June 9 weeks)
- Current plans is to divide this period in 4 sub periods
  - May 1 - 15 Commissioning of AMBER pbarXS and beam settings
  - May 16- June 4 Measurement at 190,100 and 250 GeV
  - June 7-15 Measurement at 60 GeV
  - June 15-30 Contingency

Plan for beam PID in the AMBER pbarXS

- For beam energies 100,190,250 GeV use 2 CEDAR – N
- Test CEDAR-N with beam at 60 GeV.

- Use a pair Threshold Cherenkov Counters for beam energy 60 GeV
  - Investigate how to integrate these info into AMBER data flowc

CEDARs studies

Apparatus for Meson and Baryon Experimental Research

- Limitation of CEDAR N to tag p at lower momenta
- Dipanwita: commissioning of CEDAR N at 60 GeV/c in April
- If not successful we will use 2 CEDAR N and add two Cherenkov counters for the last part of the run

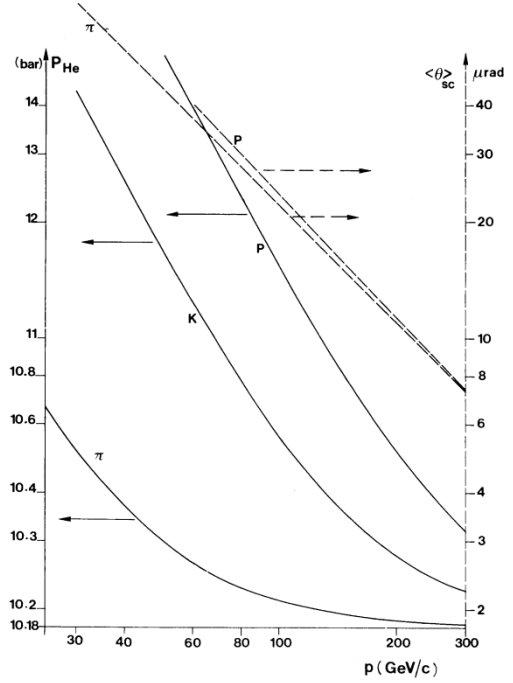
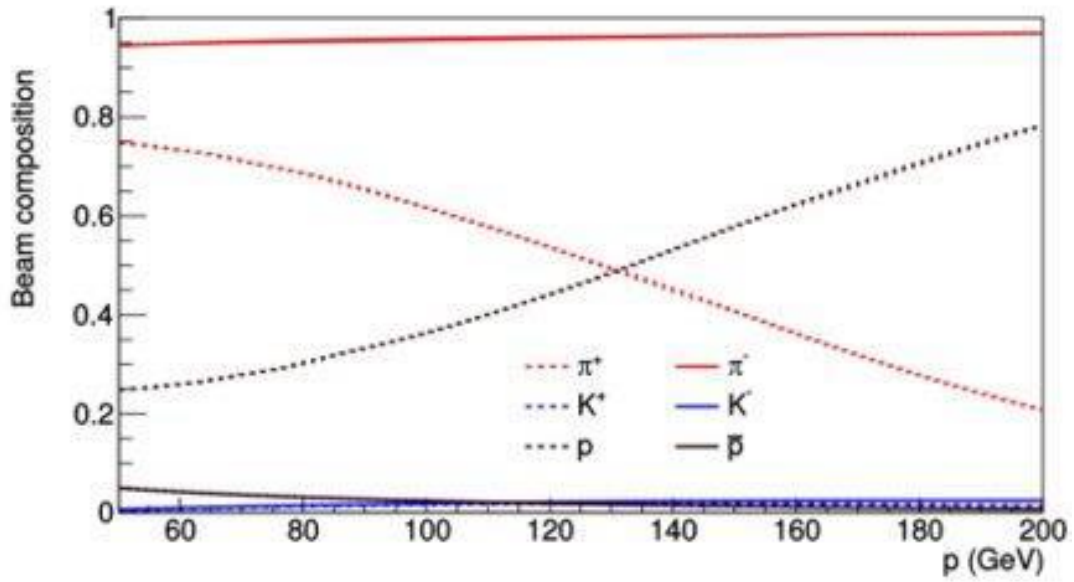


Fig. 7 Working pressure and multiple scattering for CEDAR-N (gas: He)



Second test run Nov. 2022

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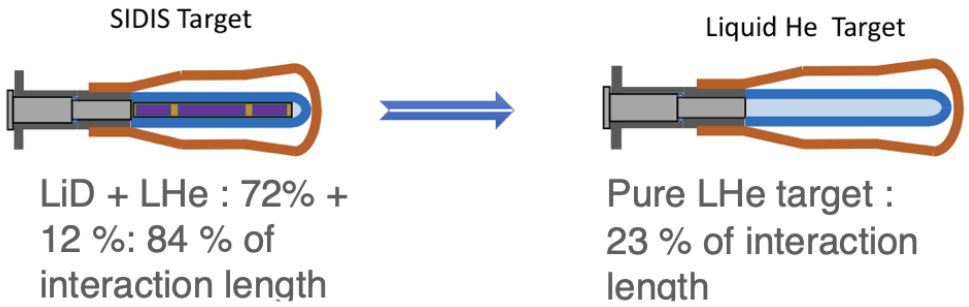
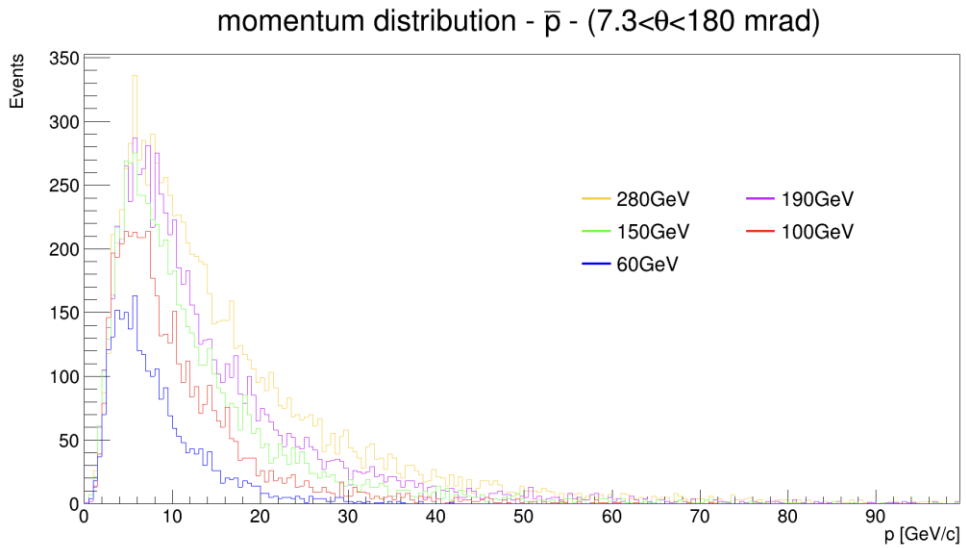
Test performed with the COMPASS SIDIS 2022 LiD Target
the difference in the trigger rate between LiD target and Liquid He Target is ~ factor 3 —> pre-scale the trigger/decrease beam intensity



Data taking at different beam momentum:
250 GeV/c, 190 GeV/c, 100 GeV/c, 60 GeV/c



Minimum bias trigger:
1. beam trigger + hodoscope veto —> ensures that the particle reaches the experiment within the geometrical target acceptance
2. beam killer —> remove non-interacting beam particles

Changeover to APX + UTS

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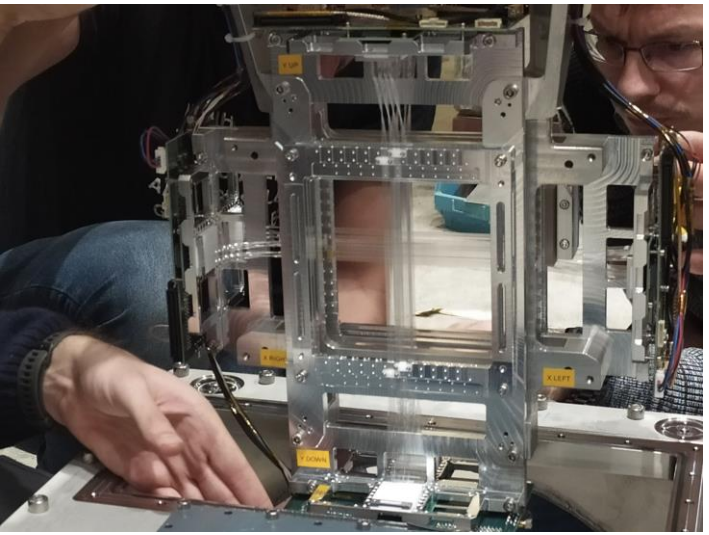
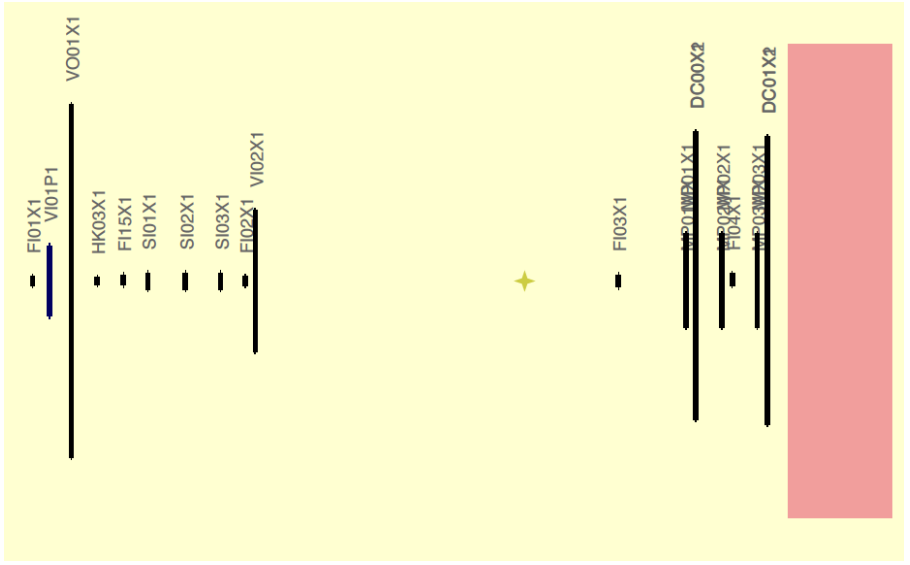
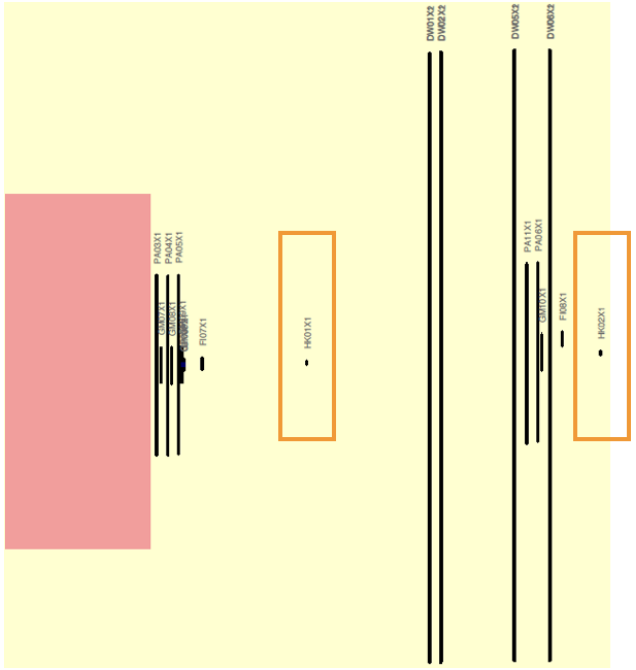


Change over from SIDIS to APX setup:

- Target dipole OFF, SOLENOID MODE, polarisation measurement, switch off magnet to destroy polarisation, restart solenoid and do test. Switch on magnets and do some measurements
- Survey of SCIFI1, SCIFI15 —> movement —> survey of the new position (SCIFI1, SCIFI15, Veto)
- Chicane was removed
- Beam Killers installed and surveyed





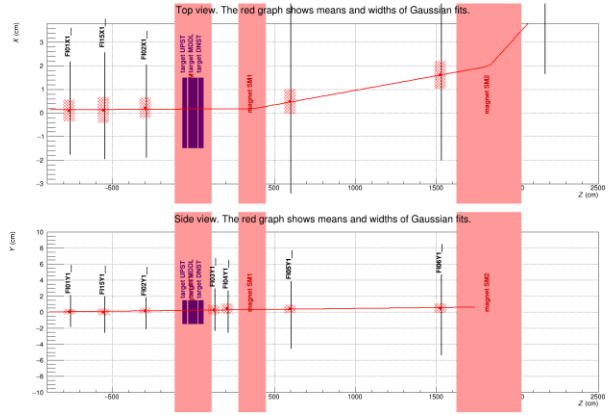
APX

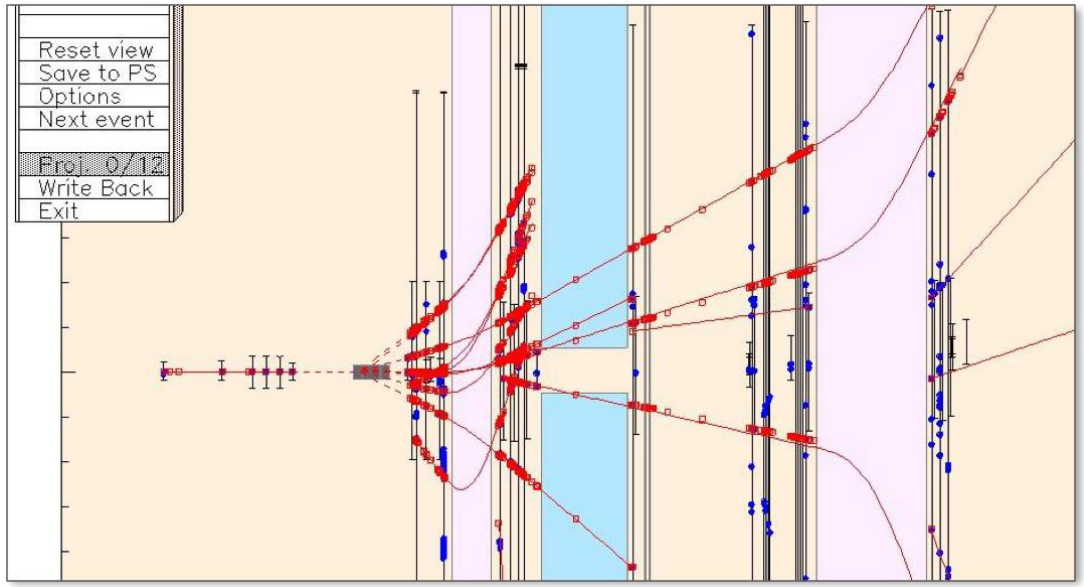
positive hadron beam
T6 intensity 70.0e+11 p/spill
Symmetry 99%
Ion chamber 2: about 5e+05/spill

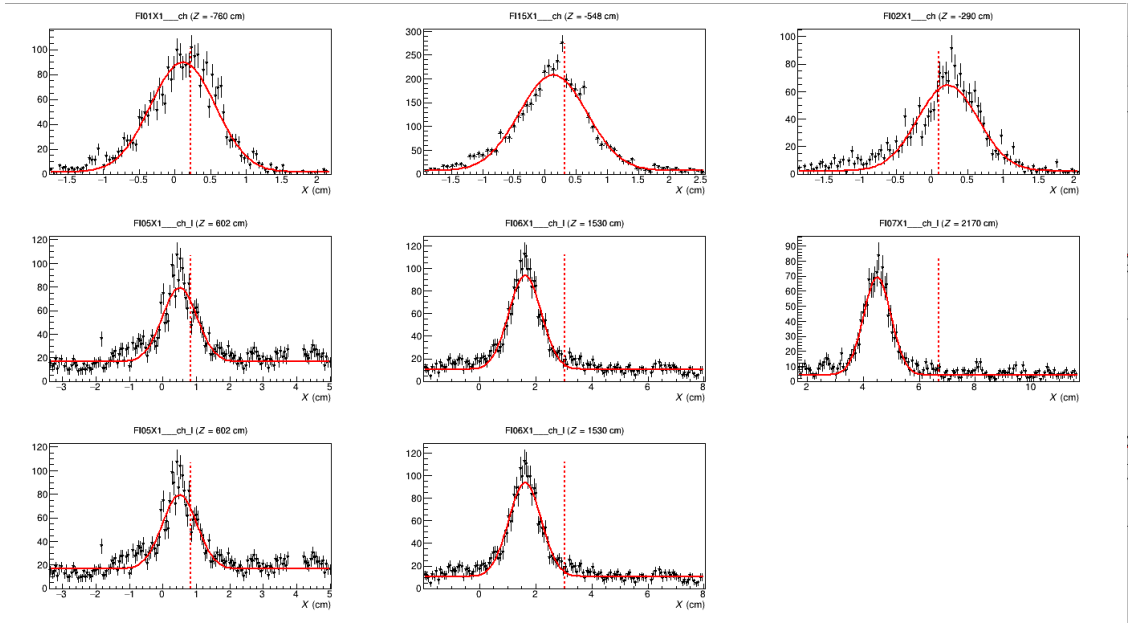
Apparatus for Meson and Baryon Experimental Research

Energy [GeV/c]	SM1 [A]	SM2 [A]	BK1_x [mm]	BK1_y [mm]	BK2_x [mm]	BK2_y [mm]	n. spills (~)
60	936	1500	102	6	180	5	1700
60	2500	0	103	7.5	139	5	1000
60	936,6	0	45	7.7	59	5	1900
100	1562	2500	107	6	188	5	1000 + 550
190	2500	4800	85	0	155	0	2400 + 1200
250	2500	4800	67	11	118	11	1200

Beam tuning done with Dipanwita:
M2A.AMBER.000 2022 AMBER 60 GeV/c
M2A.AMBER.001 2022 AMBER 250 GeV/c
M2A.AMBER.002 2022 AMBER 100 GeV/c
M2A.AMBER.003 2022 AMBER 100 GeV/c







2023 – Preliminary PRM set-up

We intend to be ready with PRM set-up in the period 15-30/08 in order to collect 1 month of useful data in Sep. 2023

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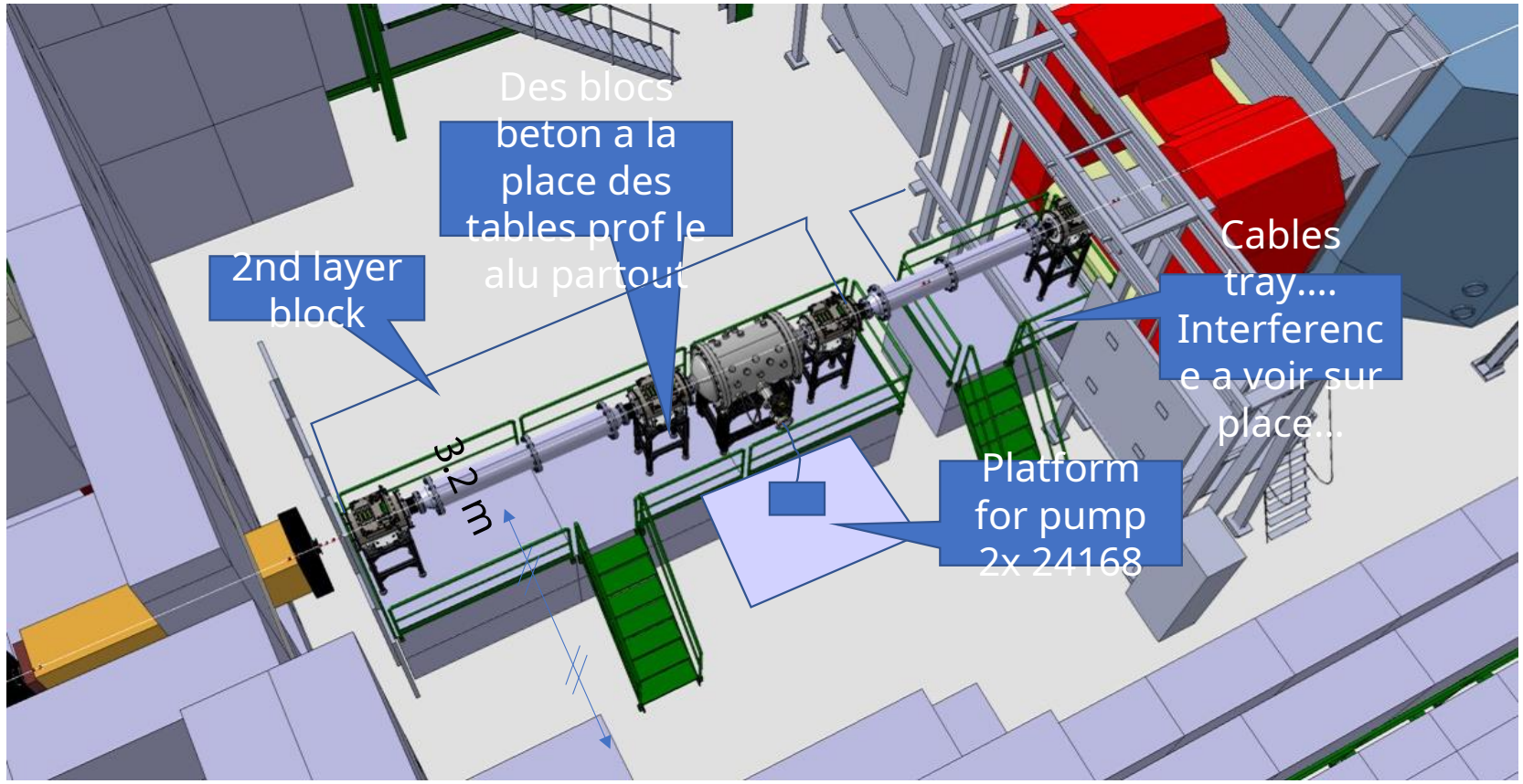
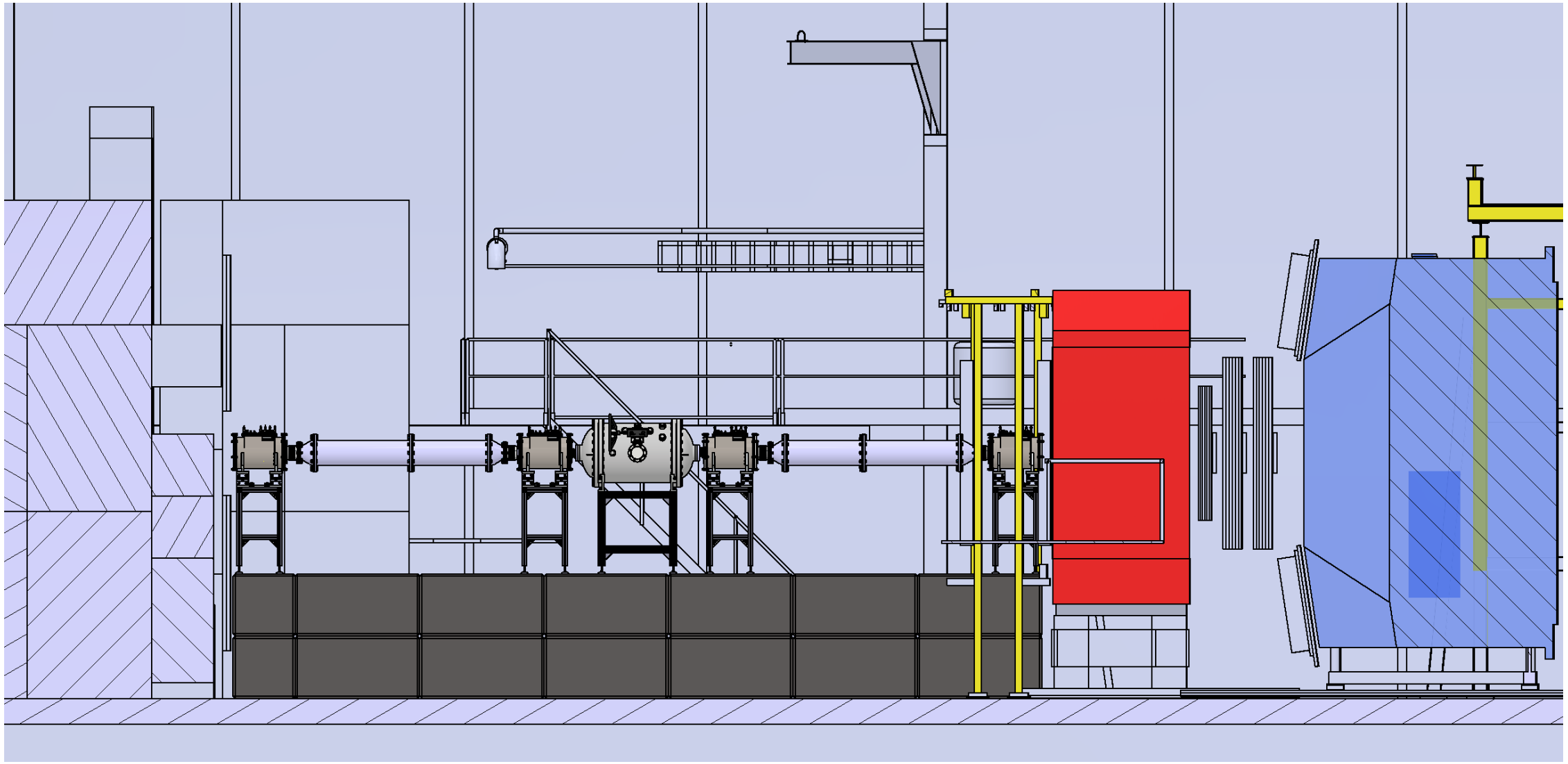


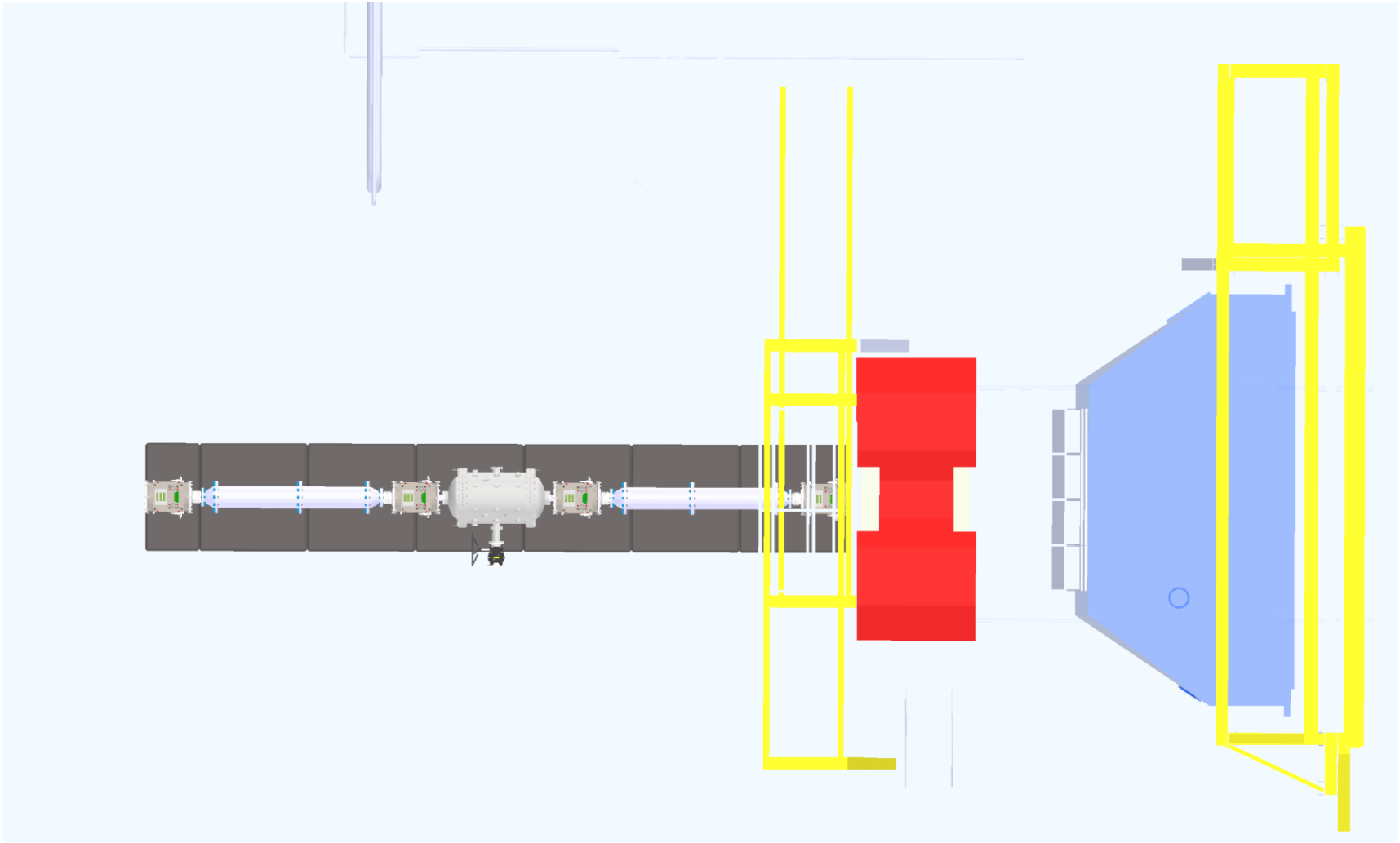
2023 – Preliminary PRM set-up

Apparatus for Meson and Baryon Experimental Research



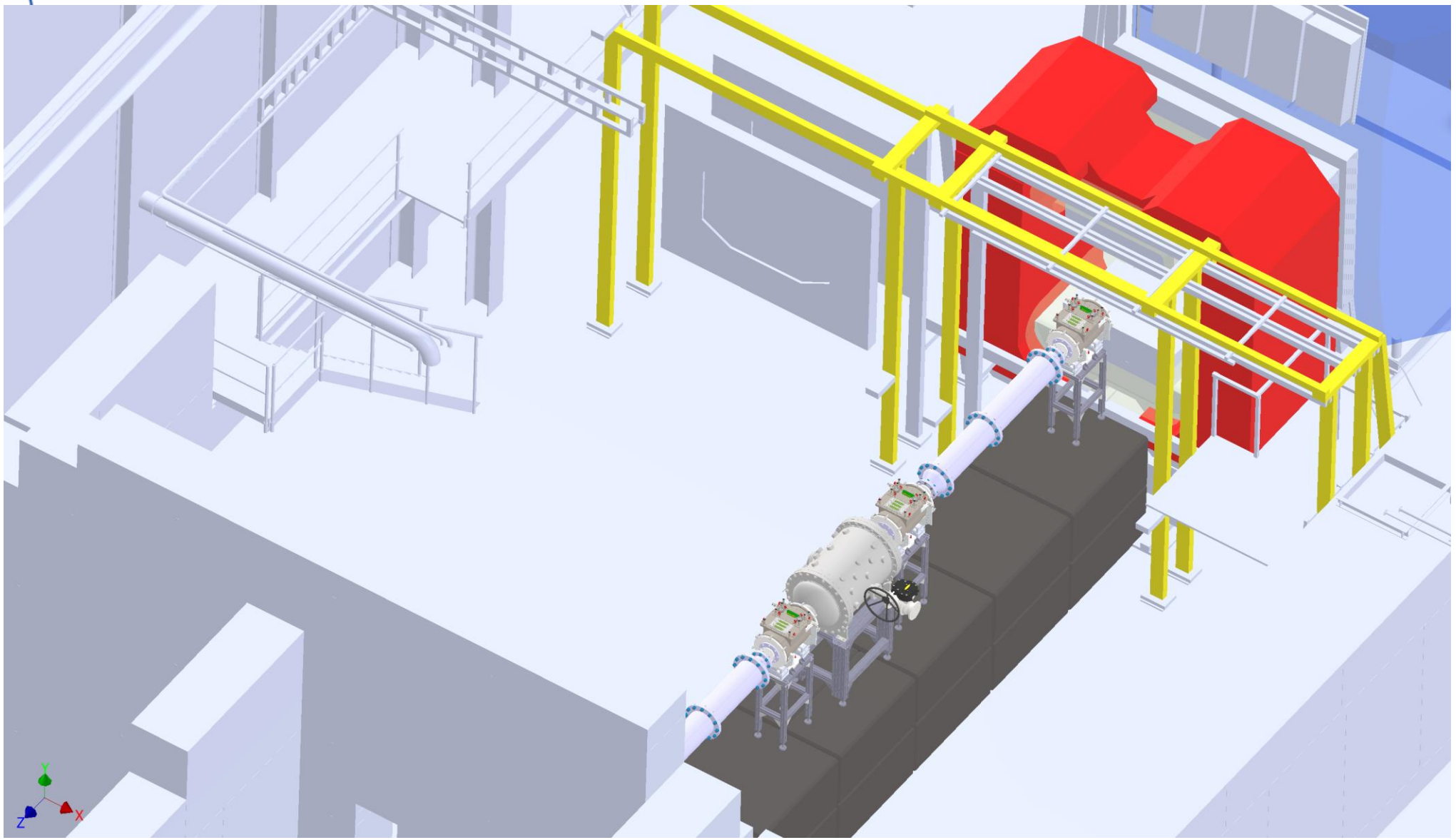
2023 – Preliminary PRM set-up

Apparatus for Meson and Baryon Experimental Research

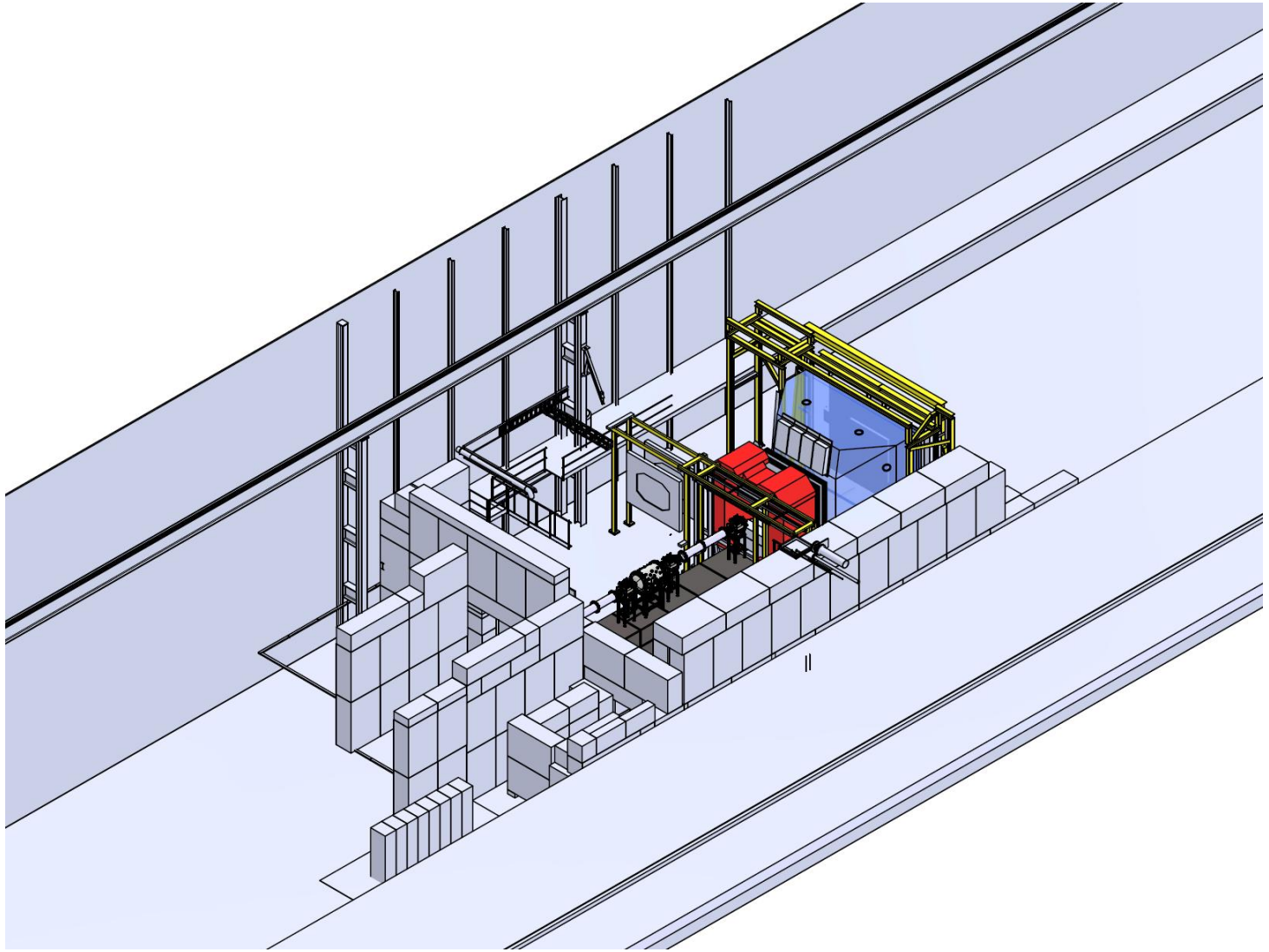


2023 – Preliminary PRM set-up

Apparatus for Meson and Baryon Experimental Research



2023 – Preliminary PRM set-up



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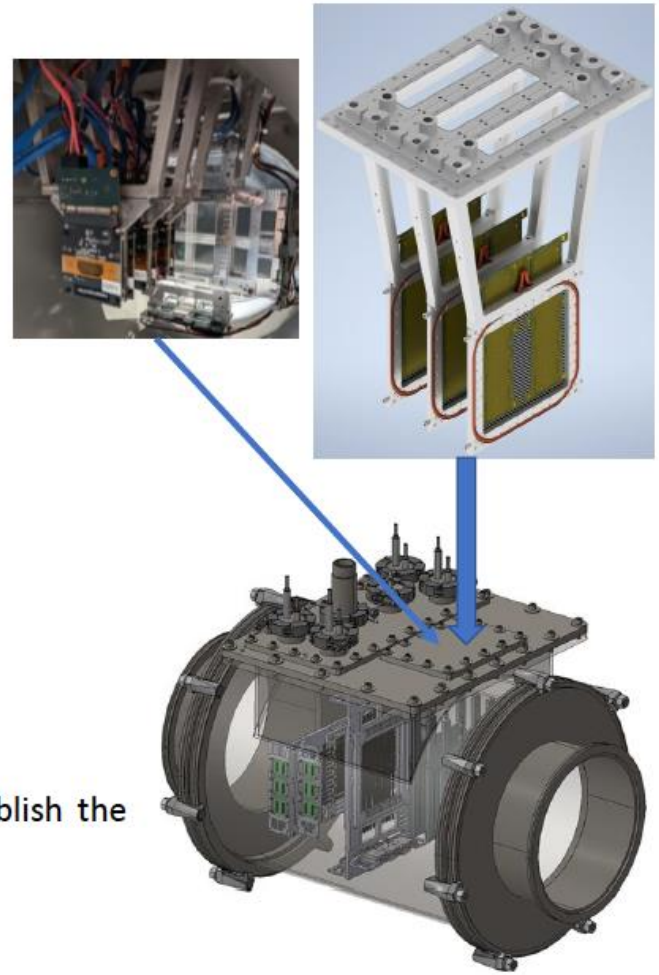
Apparatus for Meson and Baryon Experimental Research

Possible preparation plan for the ALPIDE tracker



January – February 2023

- ❑ CMUX based RO development and tests with ALPIDE
- ❑ Test of a Flex PCB assembly with the modification of the tools (if needed)
- ❑ Decision of the possible production chain and on the needed the manpower
- ❑ Start of the production of the carbon plates (to be agreed in January)
- ❑ Production of additional Flex PCBs to equip the 4 UTS stations

March - July

- ❑ Production of the mechanics for the 4 UTS stations
- ❑ Assembly of the 9 – 12 tracking planes (probably more time will be needed)
- ❑ Parasitic running of the UTS@AMBER to test/debug the RO and the establish the operation protocol

September RUN

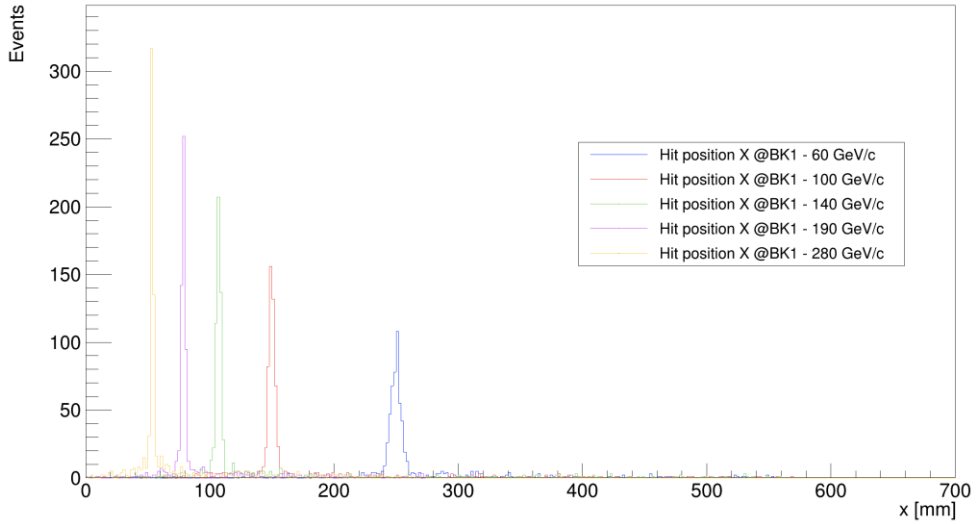
Spares

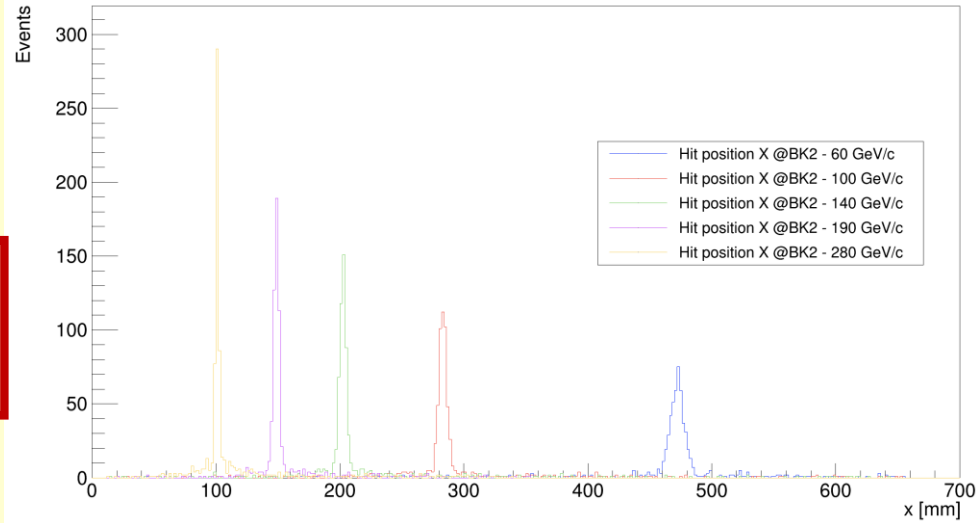
Attivita di Analisi e MC (AXS I) (TO)
Trigger elements & beam

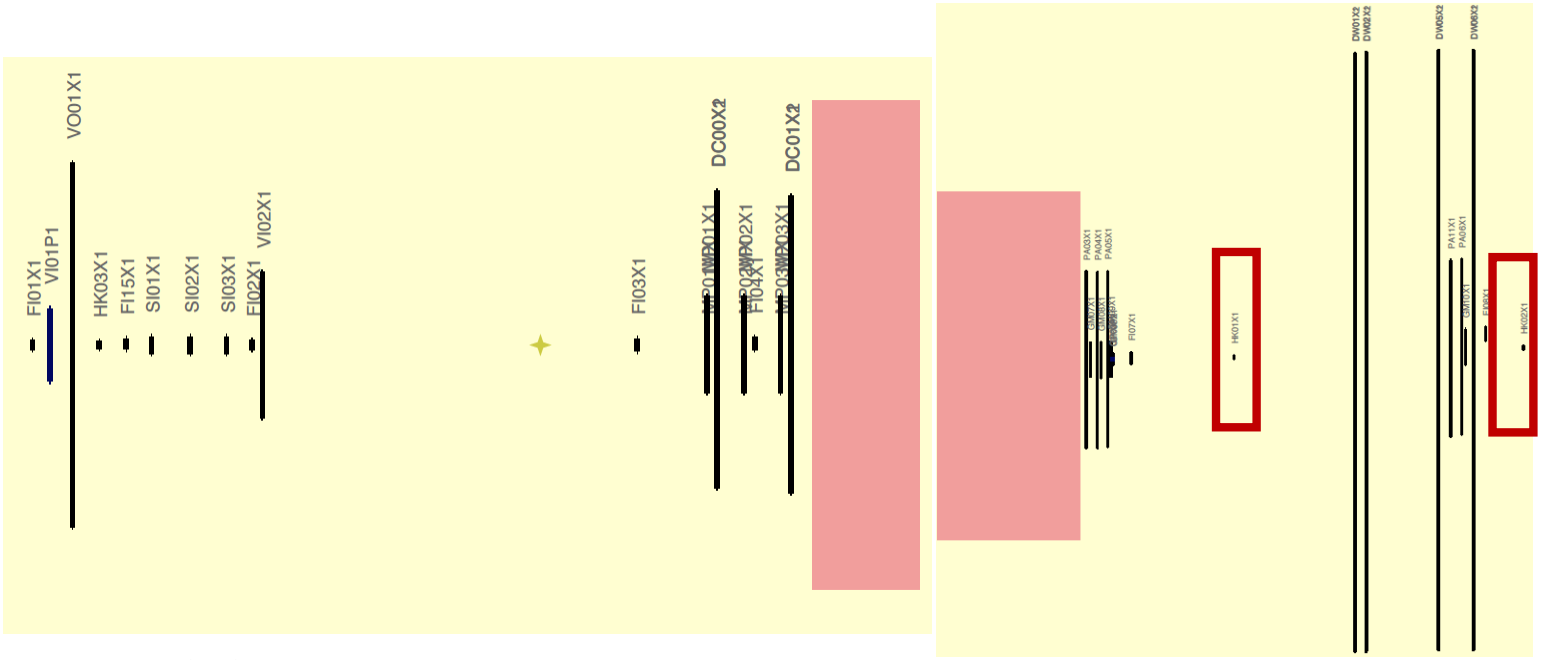
Apparatus for Meson and Baryon Experimental Research

How to do the measurement:

- beam trigger + hodoscope veto —> ensures that the particle reaches the experiment within the geometrical target acceptance
- beam killers —> remove non-interacting beam particles
- Need to scale the magnet current at low beam momenta



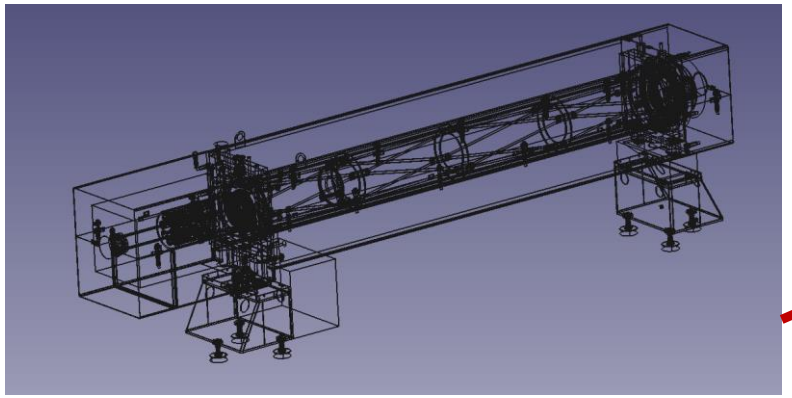


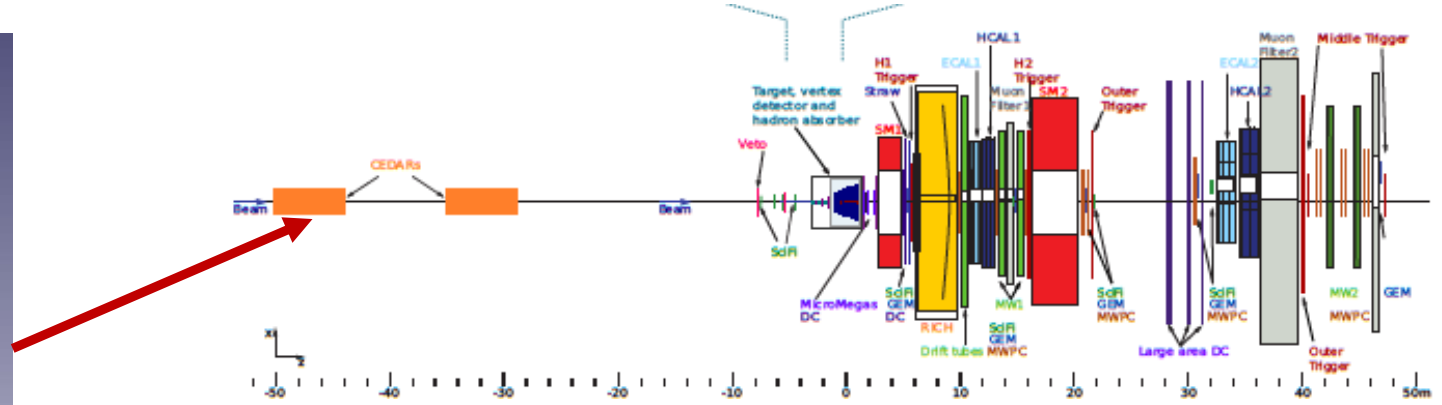


Optimal position of the beam killer
For the different beam momentum
All MC results confirmed in May 2022 test

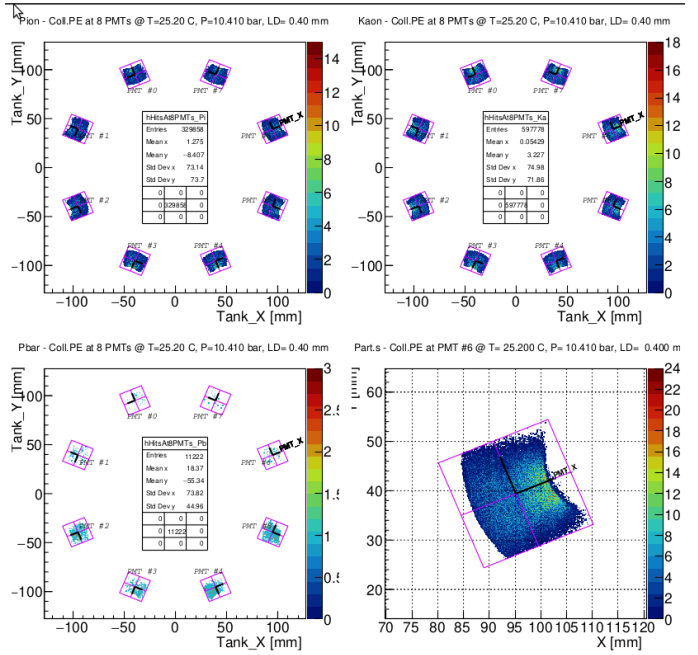
Attivita di Analisi e MC (AXS & DY)
CEDARs implementation in Tgeant (TO)

Apparatus for Meson and Baryon Experimental Research



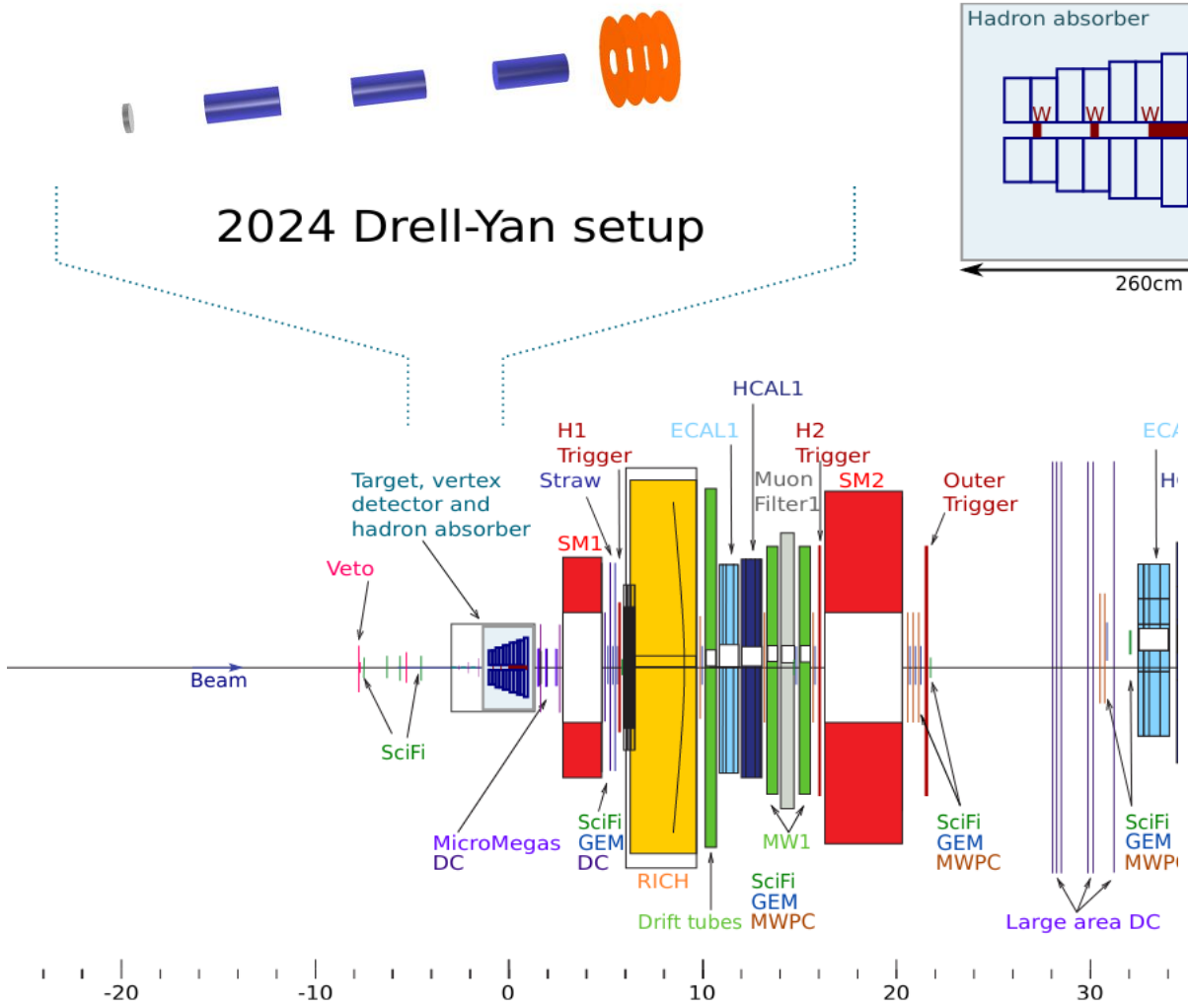


CEDARs (Cherenkov Differential counter with Achromatic Ring Focus) is an essential part of the beam PID in the AMBER Experiment (AXS and DY programs).
Recently CEDAR CAD description imported in TGEANT software.
Production and transport of Cherenkov photons in CEDAR is simulated in a separate code (Flavio Tosello (TO)). This code in encapsulated now in the TGEANT.
It is extremely useful tool for AXS and DY MC and analysis.
Code validation is nearly finished



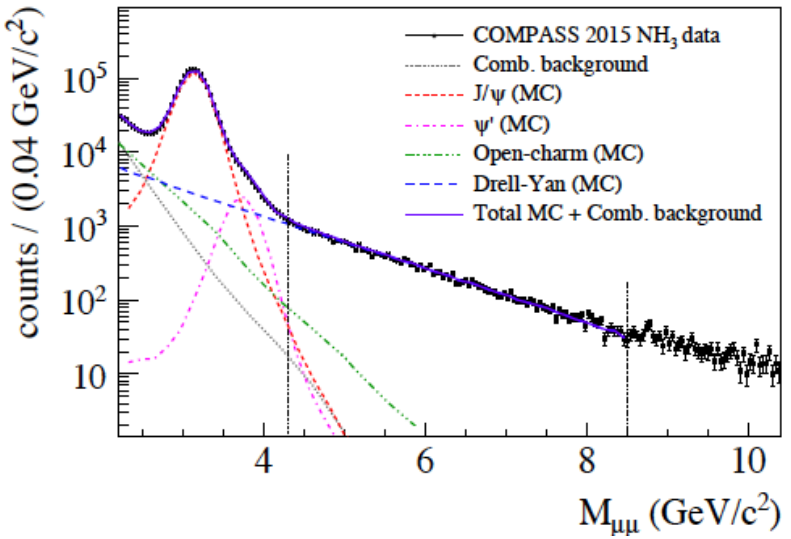
Drell-Yan experiment preparation I

Apparatus for Meson and Baryon Experimental Research



Drell-Yan process is a low cross-section process:

- High intensity hadron beam
- Hadron absorber to protect Spectrometer from a very high secondary flux
- Vertex Detector to compensate loses in resolution because of the absorber in order to improve mass and space resolution



Drell-Yan experiment preparation
Toward doubling of the incoming beam intensity (TO)

Apparatus for Meson and Baryon Experimental Research

Study and optimisation of the shielding to:

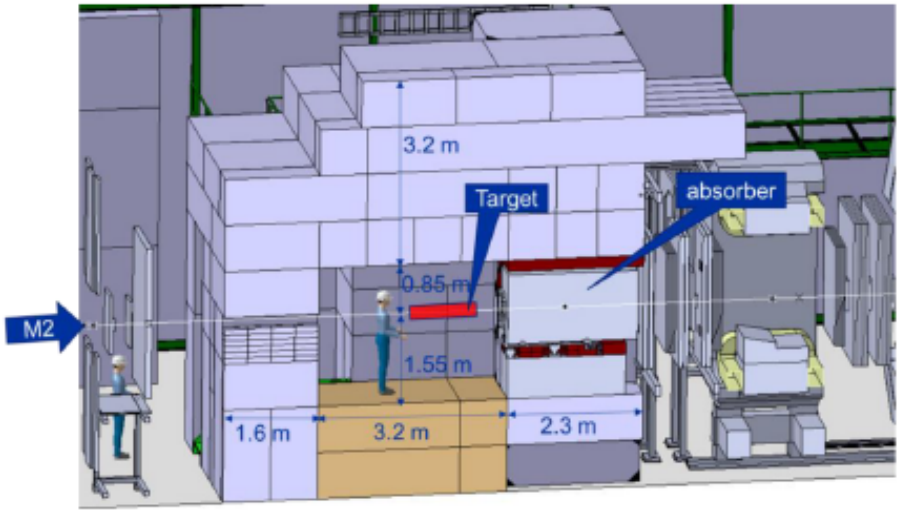
- Contain the radiation
- Minimise the environmental impact
- Comply with regulations

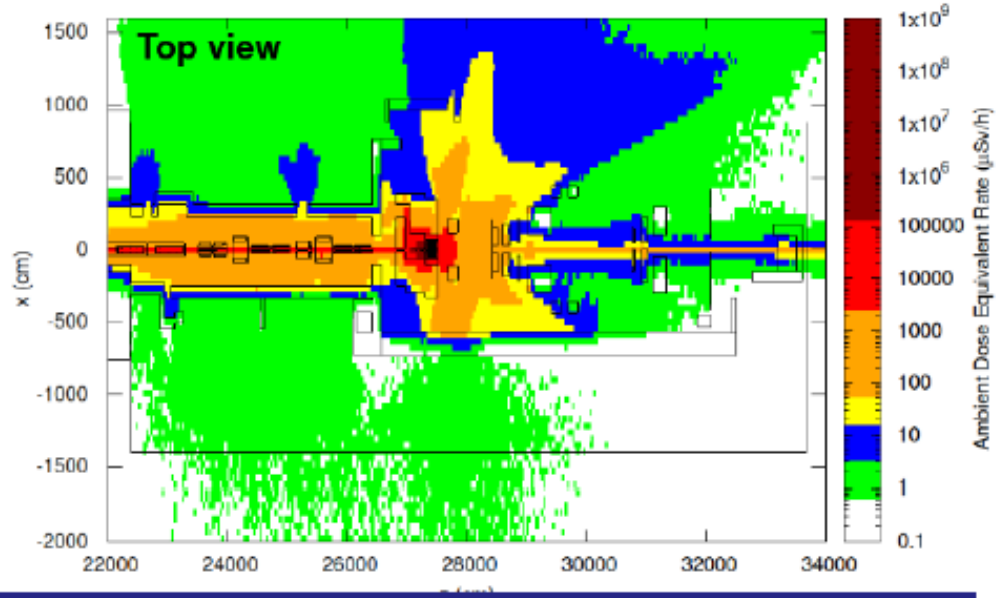
⇒ Compatible with 2×current Intensities

⇒ ECR to be submitted

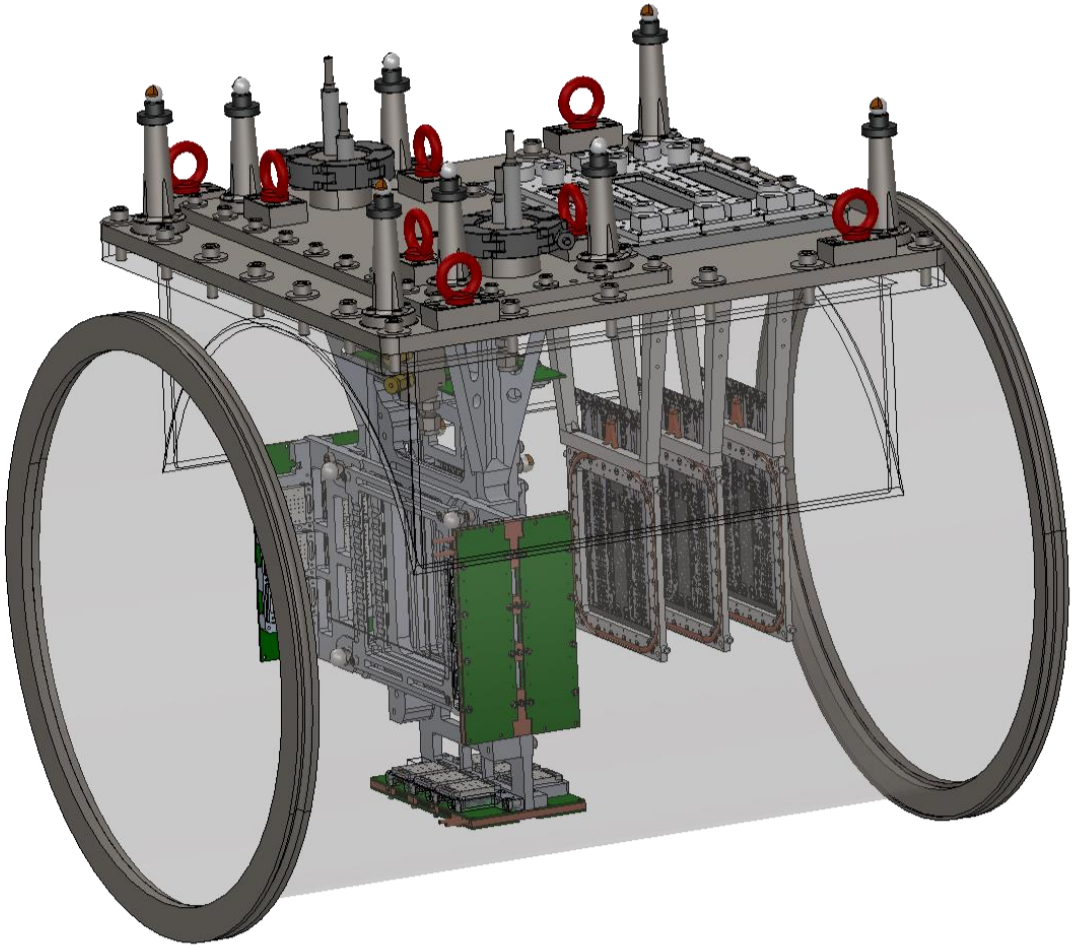
Area	Annual dose limit (year)	Ambient dose equivalent rate		Sign
		permanent occupancy	low occupancy	
Non-designated	1 mSv	0.5 µSv/h	2.5 µSv/h	
Supervised	6 mSv	3 µSv/h	15 µSv/h	
Simple Controlled	20 mSv	10 µSv/h	50 µSv/h	
Limited Stay	20 mSv	-	2 mSv/h	
High Radiation	20 mSv	-	100 mSv/h	
Prohibited	20 mSv	-	> 100 mSv/h	

Radiation Area / Controlled Area





Unified Tracking Station



PRM test run 2022 (interleaved with last period of the COMPASS data taking)

- COMPASS could take data with a test setup installed upstream of the target region
- Possible schedule: last double-week period before AMBER AP week, i.e. end October
- Installation of UTS during MD 19. October
- Data taking during last repolarization phase ~ end October