

Update on the MoEDAL-MAPP Experiment



TREX Meeting 15th October 2021

*James L. Pinfold
For the MoEDAL Collaboration*



Menu Rapide

- MoEDAL Reinstallation around IP8.
- MAPP Installation in UA83



MoEDAL-Reinstallation

- Version 2 of the MoEDAL Reinstallation Plan was presented on the 30th of September 2021



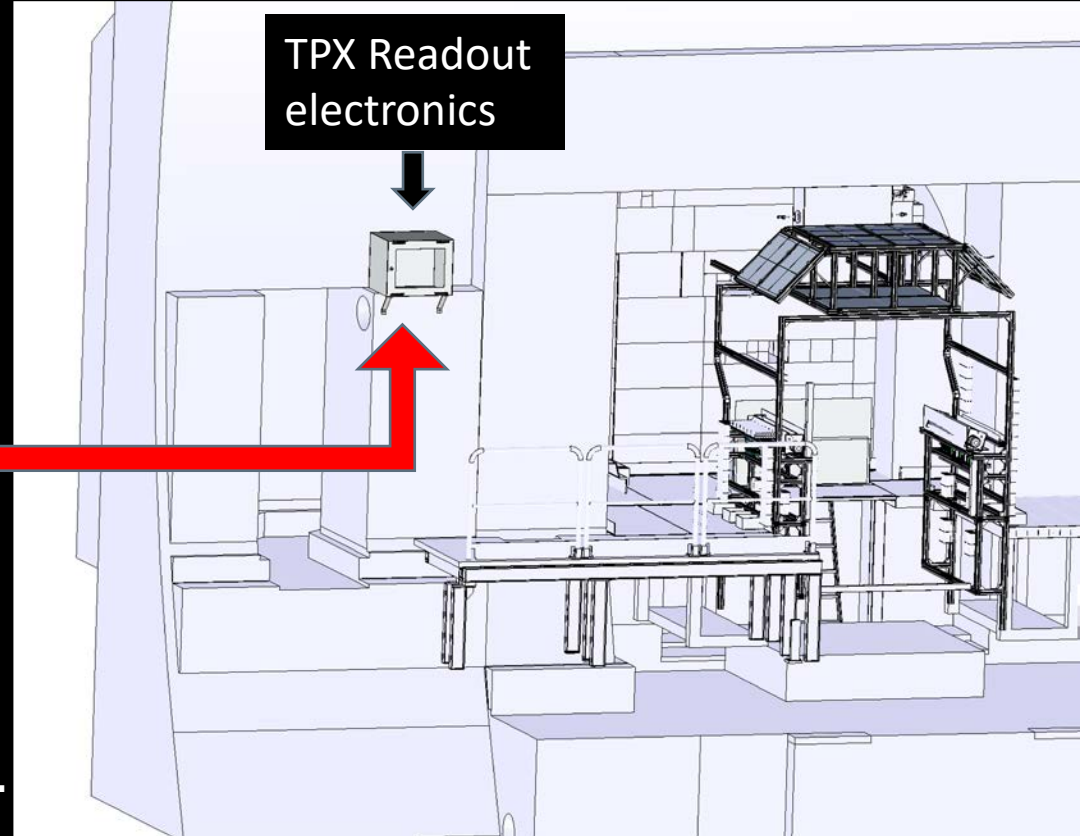
- *“The latest document is clear a step forward. The installation of cable trays and cabling shall proceed as time is running short. Installation of the MoEDAL electronics and detector will get the green light once they are stored in CAD models and have received the acceptance by the TC and by the responsible for the detectors in the vicinity of MoEDAL.”* Rolf Lindner



MoEDAL- Next Steps

- *“Due to the tight installation planning of LHCb and the delay in several areas compared to last years schedule, the installation of MoEDAL will have to be delayed accordingly. The detectors close to MoEDAL will probably not be in place before February. Therefore, the installation of MoEDAL will most probably take place in February 2022, and under the assumption that the remaining drawings of MoEDAL equipment are stored in CATIA.” Rolf Lindner*
- *Last issue relevant to TRES (?) is the installation of the fibre-optic cable carrying the LHC clock signal*
- *A ticket has been created for the laying of the fibre-optic cable - “Ticket No: RQF1801156, Opened: 18-05- 2021 21:42:19, Short description: Fiber Optics installation: LHC Experiments - LS2.”*
 - *The installation to be handled by Jorge Rodriguez Fernandez*
 - *The fibre optic cable will be routed around the the VELO cavern*
 - *Work is scheduled for weeks 48 - 49 (permission needed to route to TPX)*

MoEDAL TPX Fibre-optic Receiver



Rack CYFIB01 in the UA83 gallery.

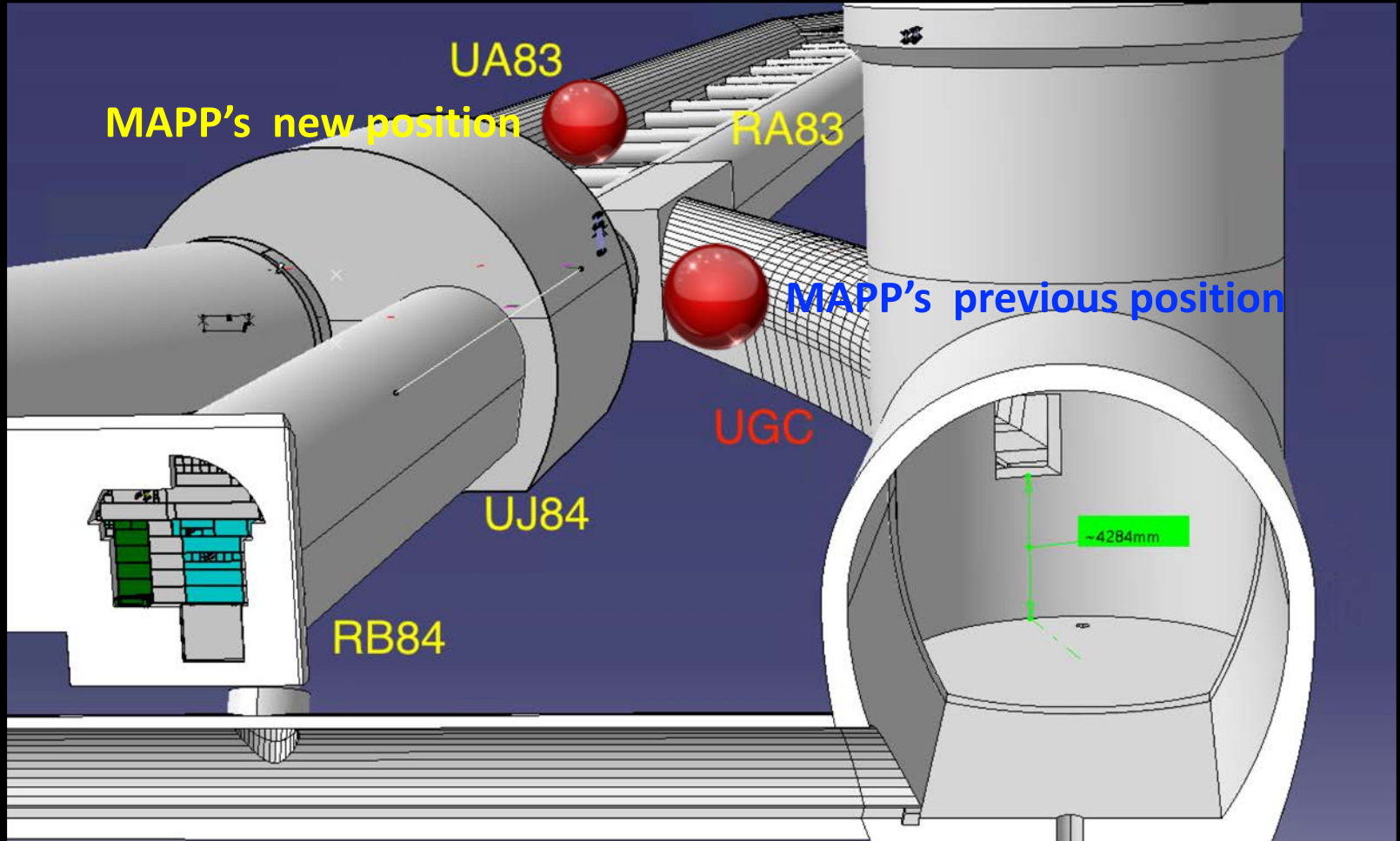
Ticket No: [RQF1801156](#), Opened: 18-05-2021 21:42:19

Short description: Fiber Optics installation: LHC Experiments - LS2 - Quote request

Message from Francois Butin:

Reply from: Francois.Butin@cern.ch

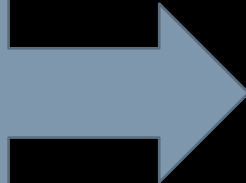
MAPP – Status





MoEDAL-MAPP ECR


Mike will sign on
the production of
an accepted TP -
A week or two
away



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P.O. Box
1211 Geneva 23 - Switzerland

EDMS NO. **2617044** REV. **0.2** VALIDITY **DRAFT**

REFERENCE
LHC-X8MAPP-EC-0001

 **LHC**

Date: 2021-09-20

ENGINEERING CHANGE REQUEST

MoEDAL MAPP-mQP Detector in UA83

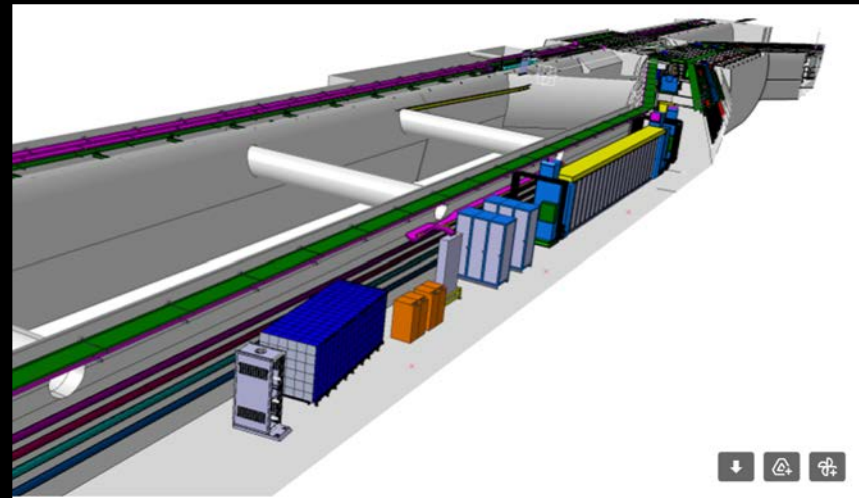
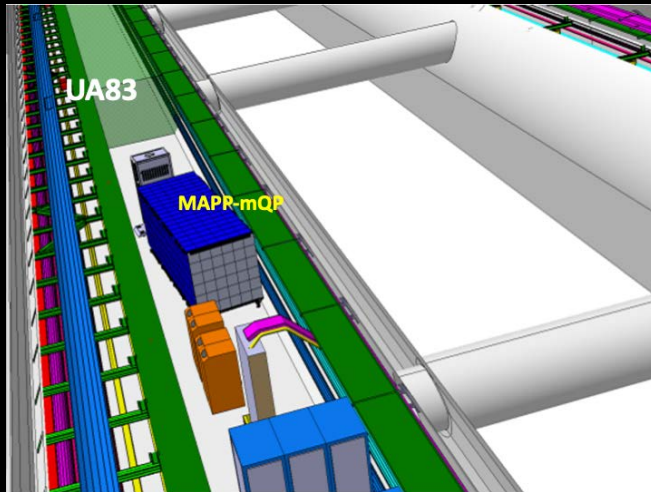
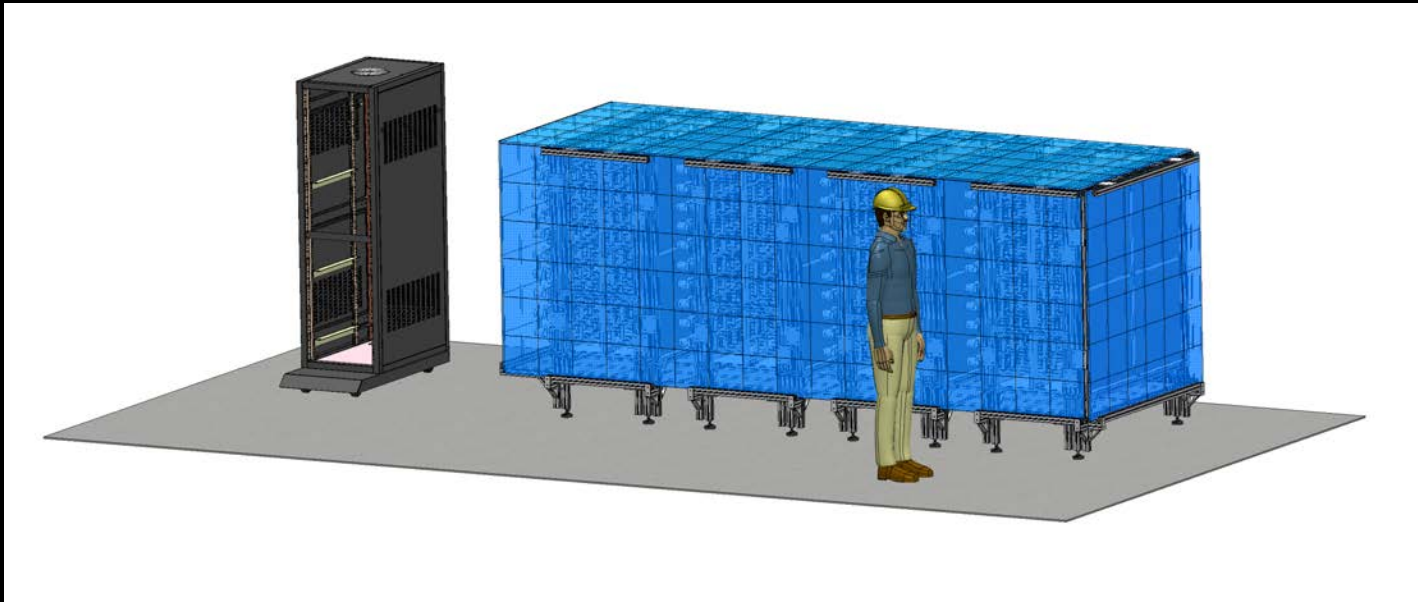
BRIEF DESCRIPTION OF THE PROPOSED CHANGE(S):
The MoEDAL collaboration proposes to install a new detector MAPP-mQP in the UA83 gallery at Point 8 of the LHC.
This document describes the changes required to accommodate the new project.

DOCUMENT PREPARED BY: F. Butic, BE-EA E. Dho, EP-DI J. Devine EP-DI	DOCUMENT TO BE CHECKED BY: M. Barberan, O. Beltramello, N. Bellegarde, C. Bernard, M. Bernardini, M. Brugger, G. Canale, N. Charitonidis, S. Cherault, A. Ciccotelli, J.-P. Corso, J. F. Fuchs, C. Gaignant, R. Garcia Alia, G. Girardot, A. Infantino, R. Jones, J. Kuczynska, H. Mainaud Durand, Y. Muttoni, T. Otto, L. Pereira, J. Pinfeld, D. Ricci, F. Sanchez Galan, M. Solfaroli, R. Soluk, R. Steerenberg, K. Weiss, J. Wenninger	DOCUMENT TO BE APPROVED BY: M. Lamont (on behalf of the LMC)
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DOCUMENT SENT FOR INFORMATION TO:
C. Bertone, J. Blanc, G. Canale, M. Pirozzi, K. Buffet,
ATS groups' leaders

SUMMARY OF THE ACTIONS TO BE UNDERTAKEN:

The Detector and it's Location





Radiation Field

Radiation studies in UA83 MAPP MoEDAL experiment

Alessia Ciccotelli, Francesco Cerutti



ENGINEERING
DEPARTMENT



Safety Derogation Request



HSE
Occupational Health & Safety
and Environmental Protection Unit

Safety Derogation Request Form

Date	Requested by	Dpt/Group
27 août 2021	<u>MoEDAL</u> - MAPP Experiment EP Safety Office	EP

DESCRIPTION OF THE REQUEST

Location / Project :

UA83

Regulation related to the derogation:

Plastic materials needed for the MoEDAL Detector are not conforming to CERN IS41, and specifically needed due to their physical properties.

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Regulation related to the derogation:

.....Accepted!

SPECIALIST OPINION

Specialist:

Fabio CORSANEGO HSE-OHS-IB Jonathan Gulley HSE-OHS-PE

Specialist opinion:

Acceptable with the conditions agreed here below

Compensatory measures defined in collaboration with the requestor:

safeguards: hardware/software interlocks

power supplies are low voltage (24V), are current and temperature limited (turn off when current or temperature goes out of range) and provide an alarm signal when current or voltage moves out of some predefined *operating window*.

handover of alarms generated by the system

Three types of warning/alarm information will be provided to the CCC:

- 1) The current/voltage and temperature readings/alarms from the power supplies,
- 2) The hermetic metal flame shield is monitored by temperature sensors placed on the outside of the shield. The output of these temperature sensors will also be provided to the CCC,
- 3) There is a plan (not yet confirmed) to monitor the detectors + electronics with an IR camera whose output is provided to the CCC.

Other safeguards:

- 1) The power supplies, readout electronics and other non MoEDAL live equipment present in UA83 are separated by a distance of 1.5 m from the detector,
- 2) The only entities that use power in the detector volume are PMT bases. Power supplied to the bases is LV and only stopped up in the base,
- 3) The detector volume is completely encased in a hermetic (sealed to exclude air movement) flame shield. Cables enter the volume via a patch panel. Metal planes separate each of the four compartments of the detector. A strong metal plate forms the base of the scintillator bar compartments.



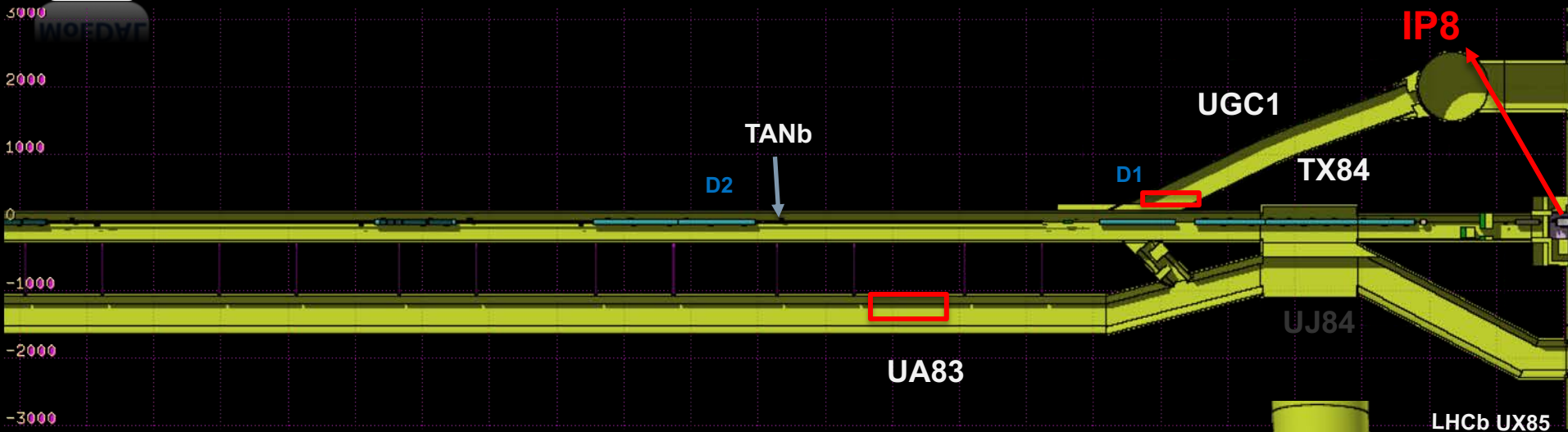
Temporary MAPP Storage Area



20 m² of surface space in SD8 building (2855). The zone will be cleared and fenced with mobile barriers kindly installed by Kevin, and will be made available to the collaboration as of week 46.

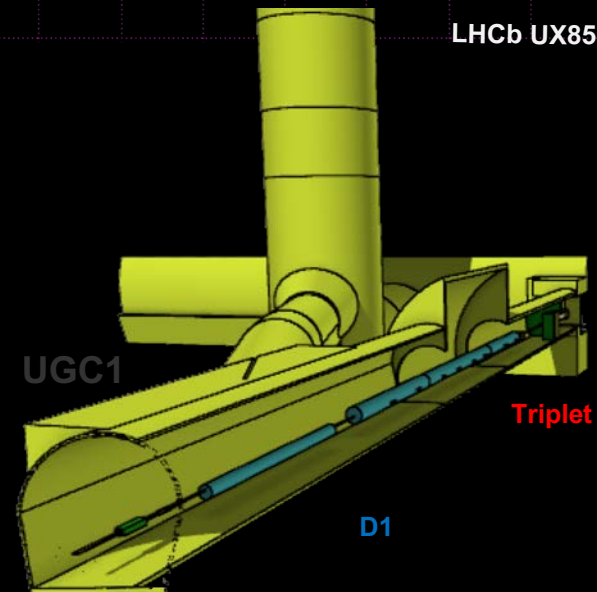


FLUKA model of IR8



Assumption: ducts empty

Normalization: Annual luminosity = 10 fb^{-1}
Instantaneous luminosity = $2 \cdot 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$

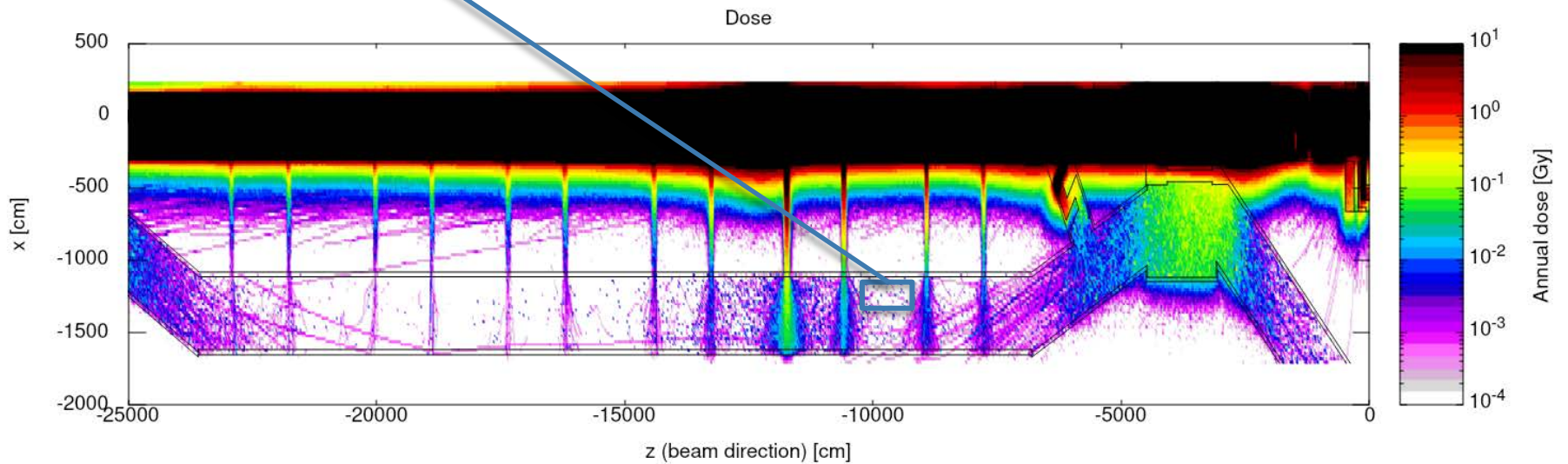
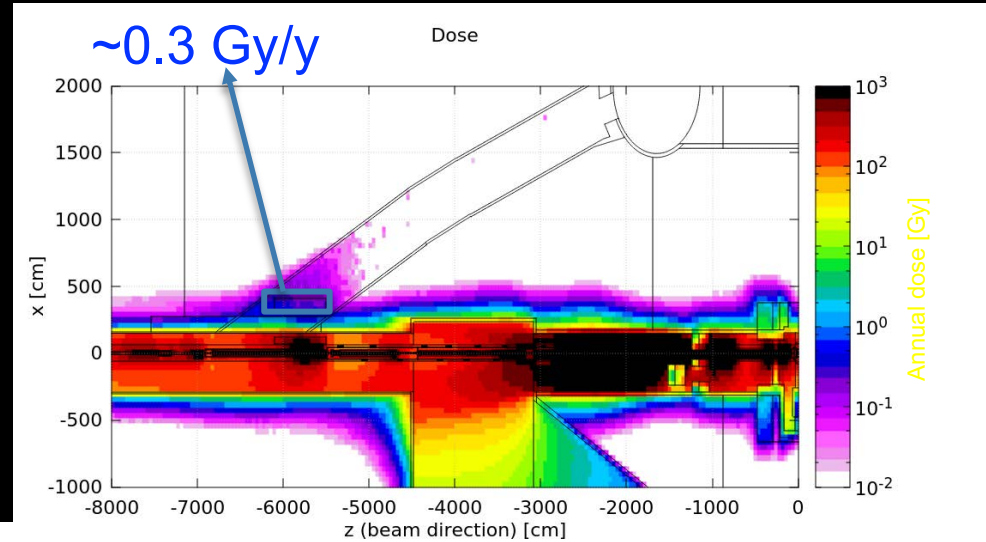




Dose

Annual luminosity 10 fb^{-1}

Below 1 mGy/y

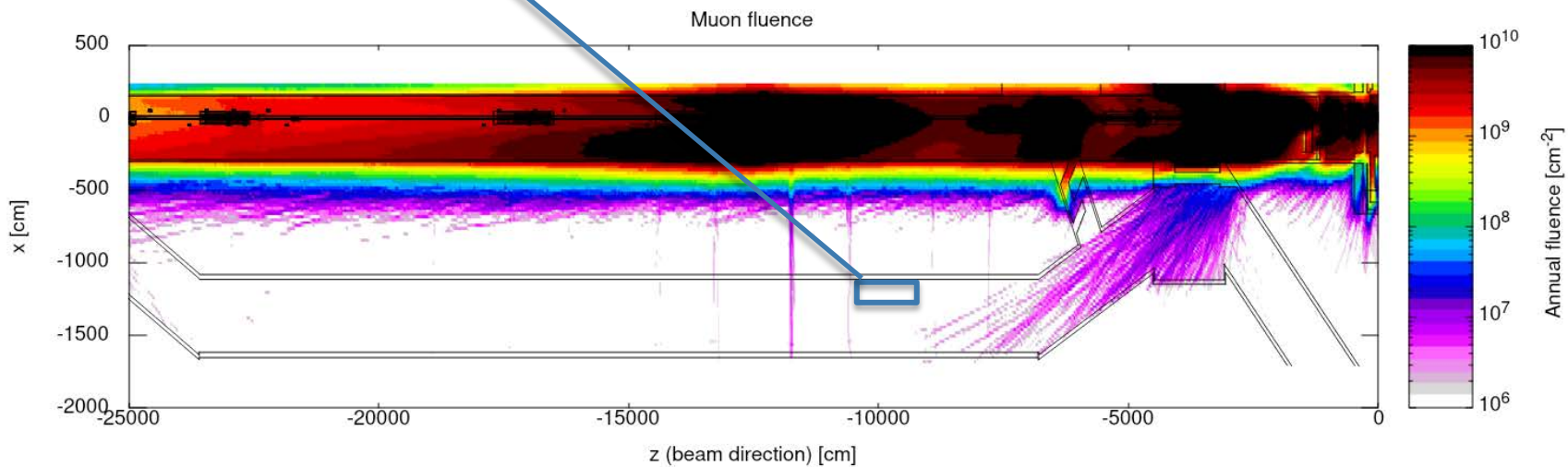
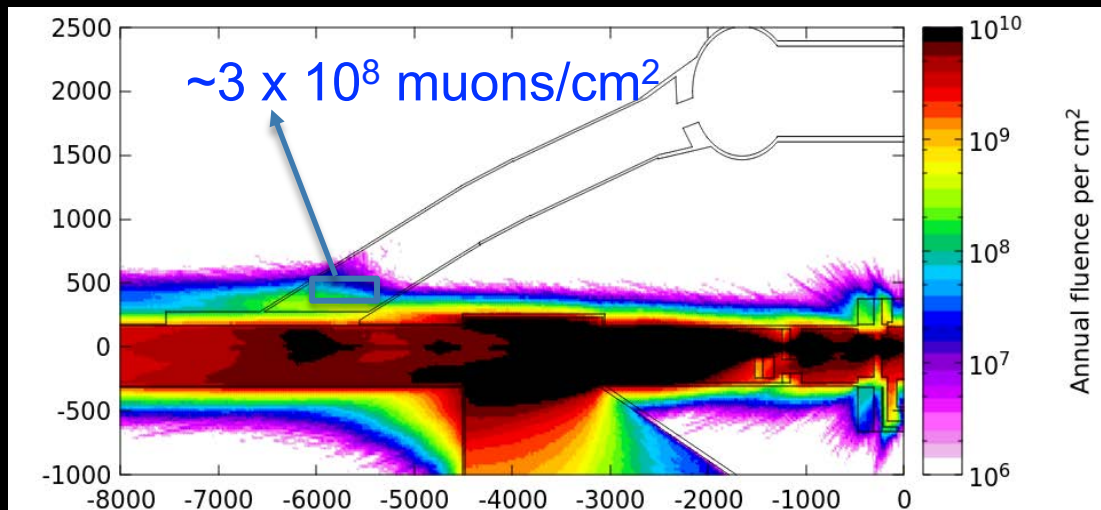




Muon fluence

Annual luminosity
 10 fb^{-1}

Muons: $< 10^6 \text{ cm}^{-2}$



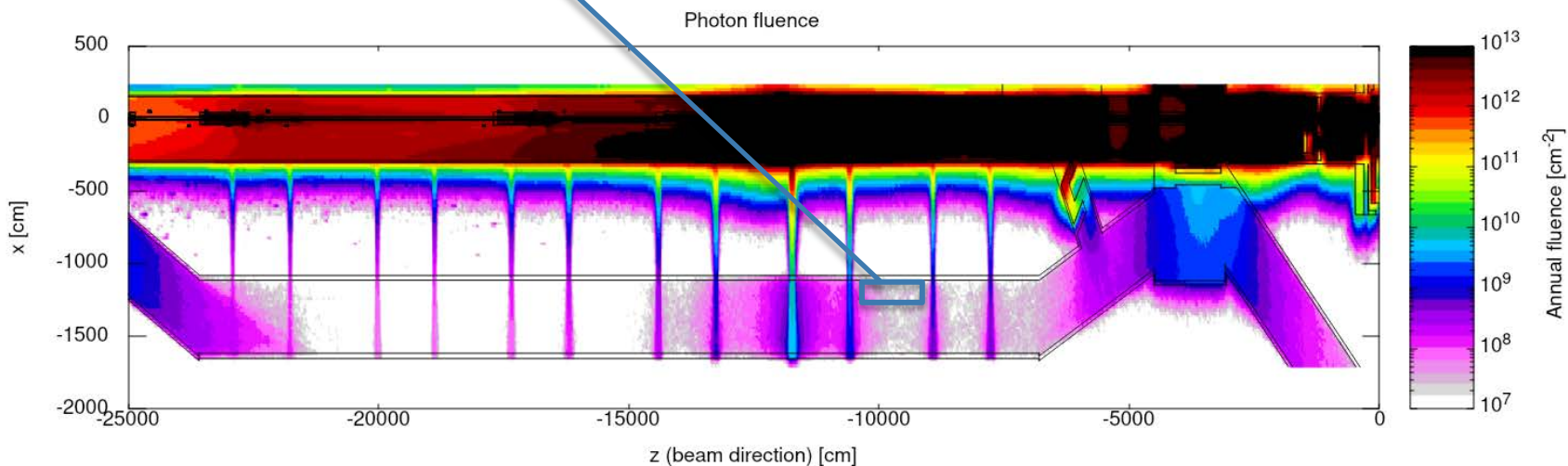
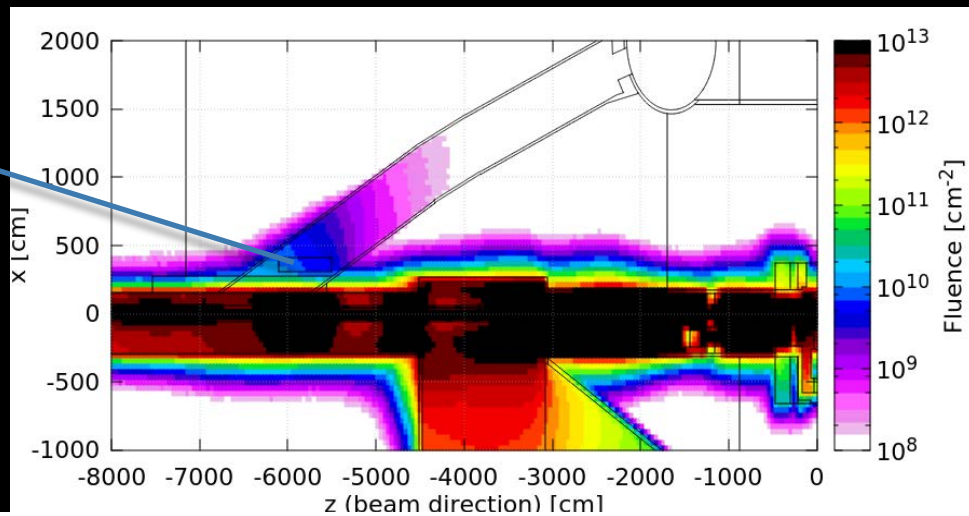


Photon fluence

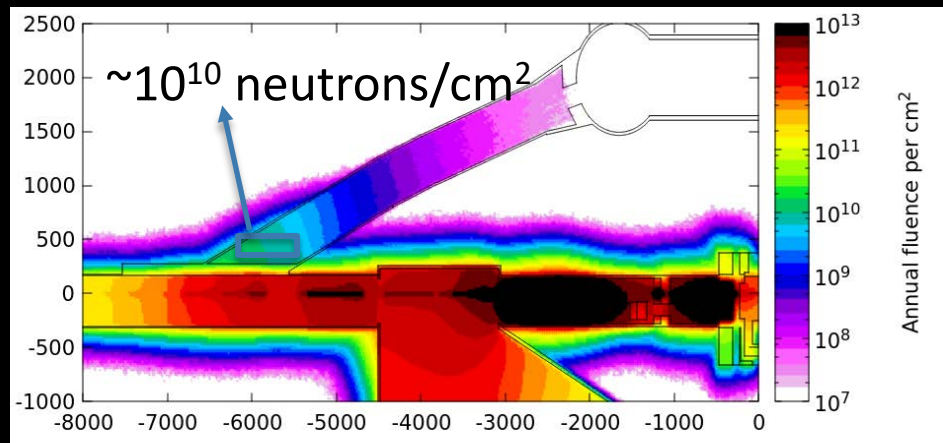
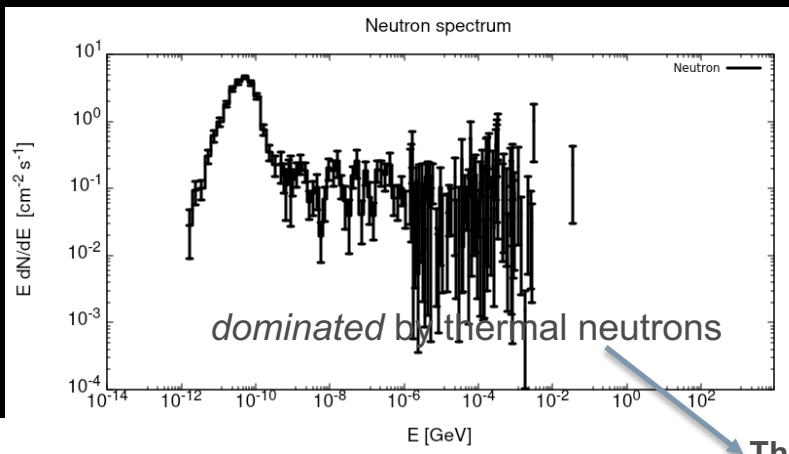
Annual luminosity 10 fb^{-1}

$\sim 8 \times 10^9 \text{ photons [cm}^{-2}\text{]}$

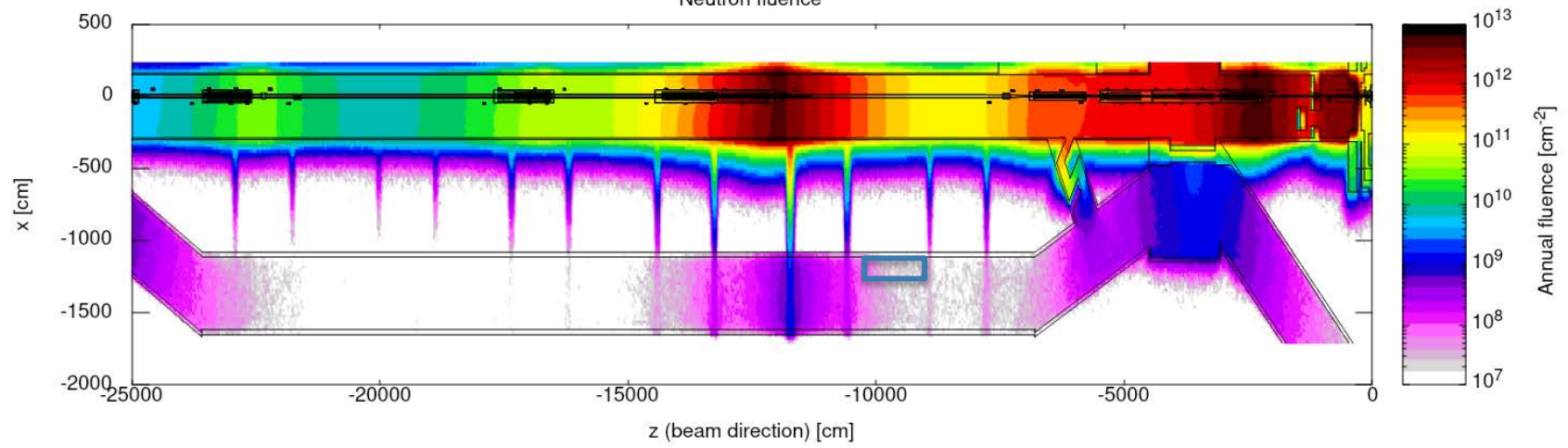
Photons: $\sim 10^8 \text{ cm}^{-2}$



Neutron fluence



Thermal neutron equivalent fluence
Neutron fluence

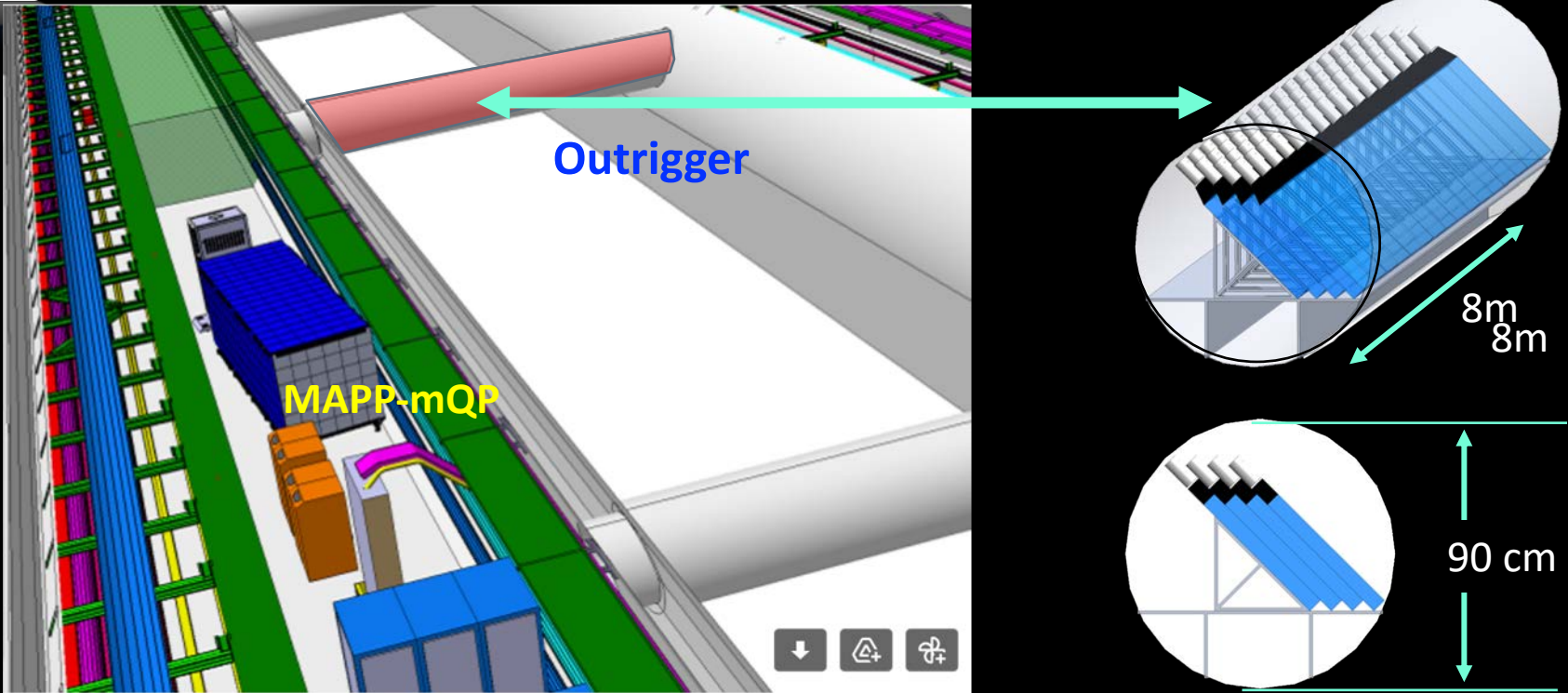


Average neutron fluence in the volume of interest integrated over the whole energy range is $\sim 5 \cdot 10^7 \text{ cm}^{-2}/\text{y}$



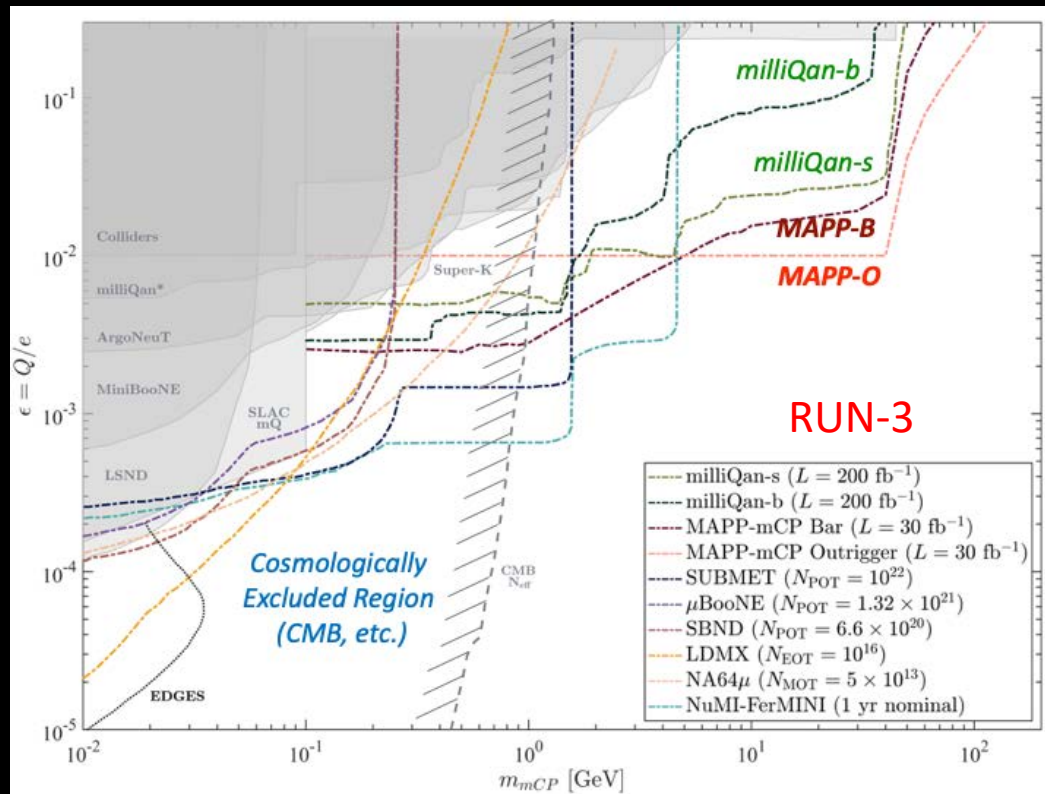
Not part of the current ECR/TP per se but being planned as an addendum to the current ECR/TP

The Outrigger Detector



- *The contribution of scintillator slabs from the EXO-200 experiment has enabled us to complete our plans for an outrigger detector for the MAPP-mQP to improve its sensitivity at high mass*
- *The basic unit of the outrigger is a 50 cm x 50 cm x 5 cm plate readout by a PMT on a light guide. These basic units are combined in 4 layer, 8m long, 64 detector array that fill the pipe joining UA83 and the beam-line tunnel*

Physics Impact of Move to UA83

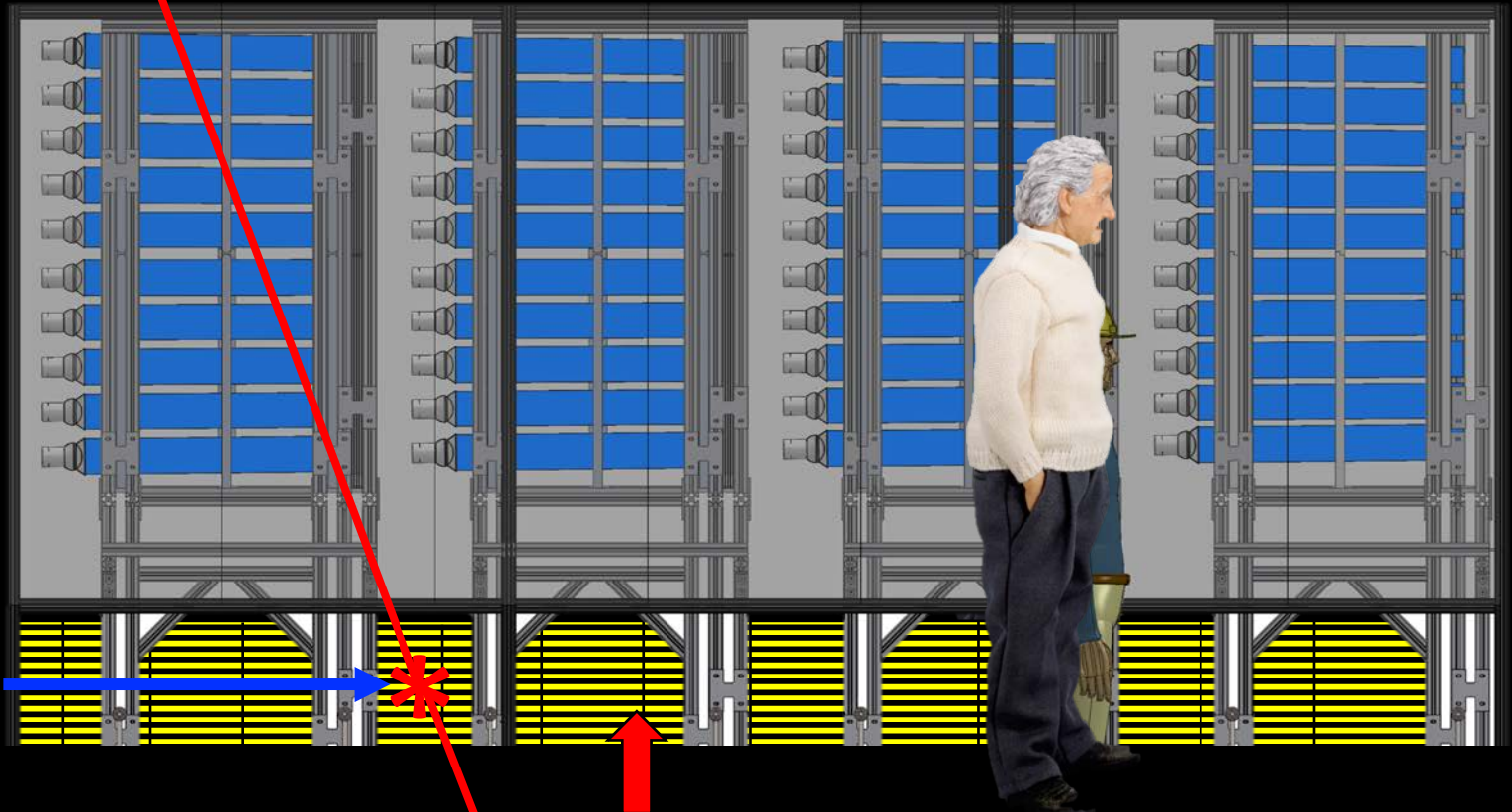


- The MAPP-mQP (Bar) & (Outrigger) detector is on track to provide the best limits on higher mass millicharged particle production during Run-3
- The MAPP results at present assume 100% detector efficiency and no backgrounds – a full simulation is in progress.
- The MAPP sensitivity will improve when we include resonance production



Using MAPP as MALL

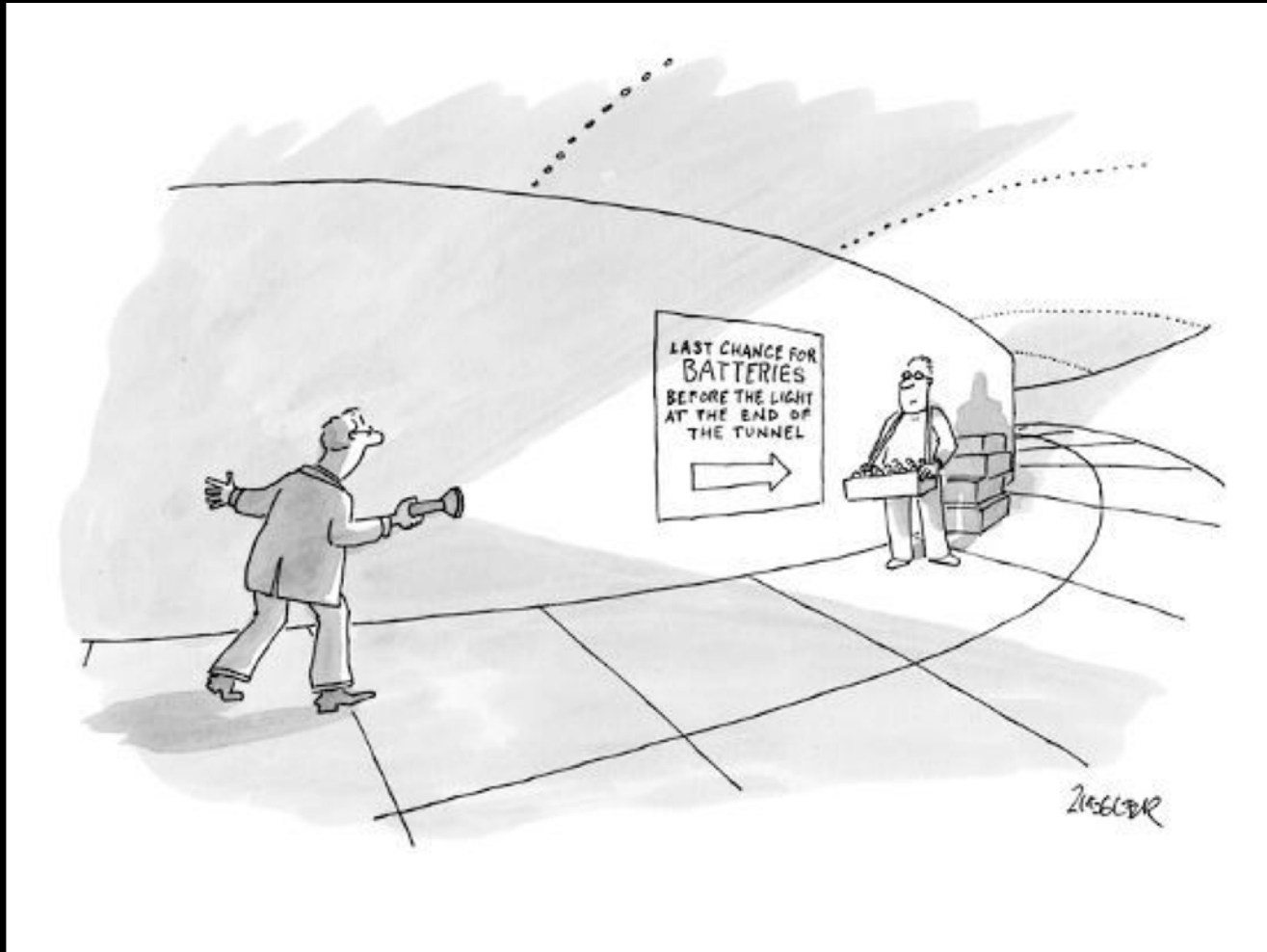
We can use the MAPP-mCP detector to monitor MoEDAL trapping detector to monitor for the decays of captured very long lived trapped massive charged particles. This obviates the need for the MoEDAL-MALL detector.



Decay of Long-lived particles

MoEDAL MMT Trapping Volumes

Last words



I think we can see light at the need of the tunnel for installation of both detectors, MoEDAL and MAPP, for Run-3.