Update on CLIC detector forward region studies

(in collaboration with FCAL + MDI teams)

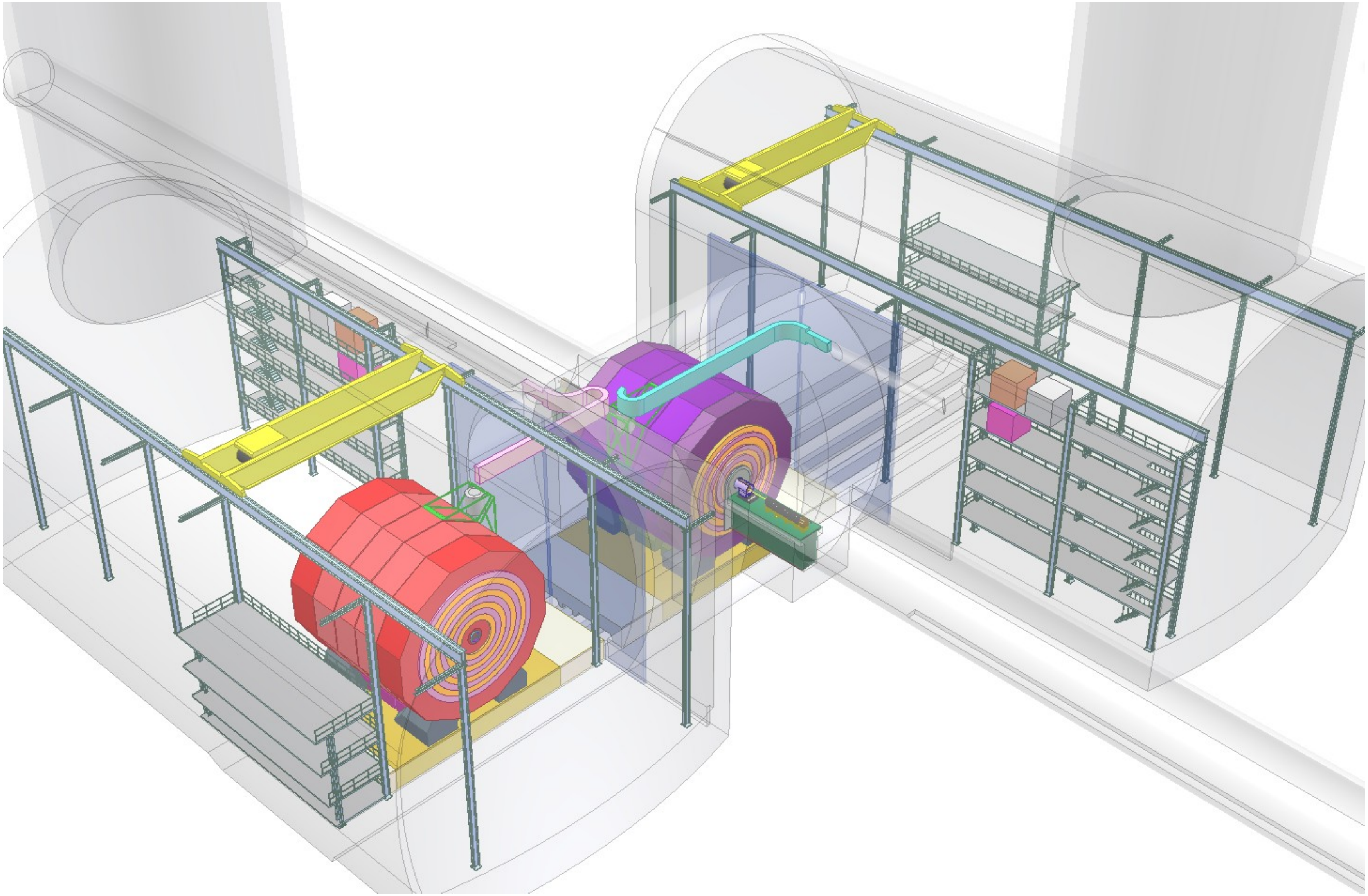
presented by Konrad Elsener (CERN),

for the CLIC detector study team

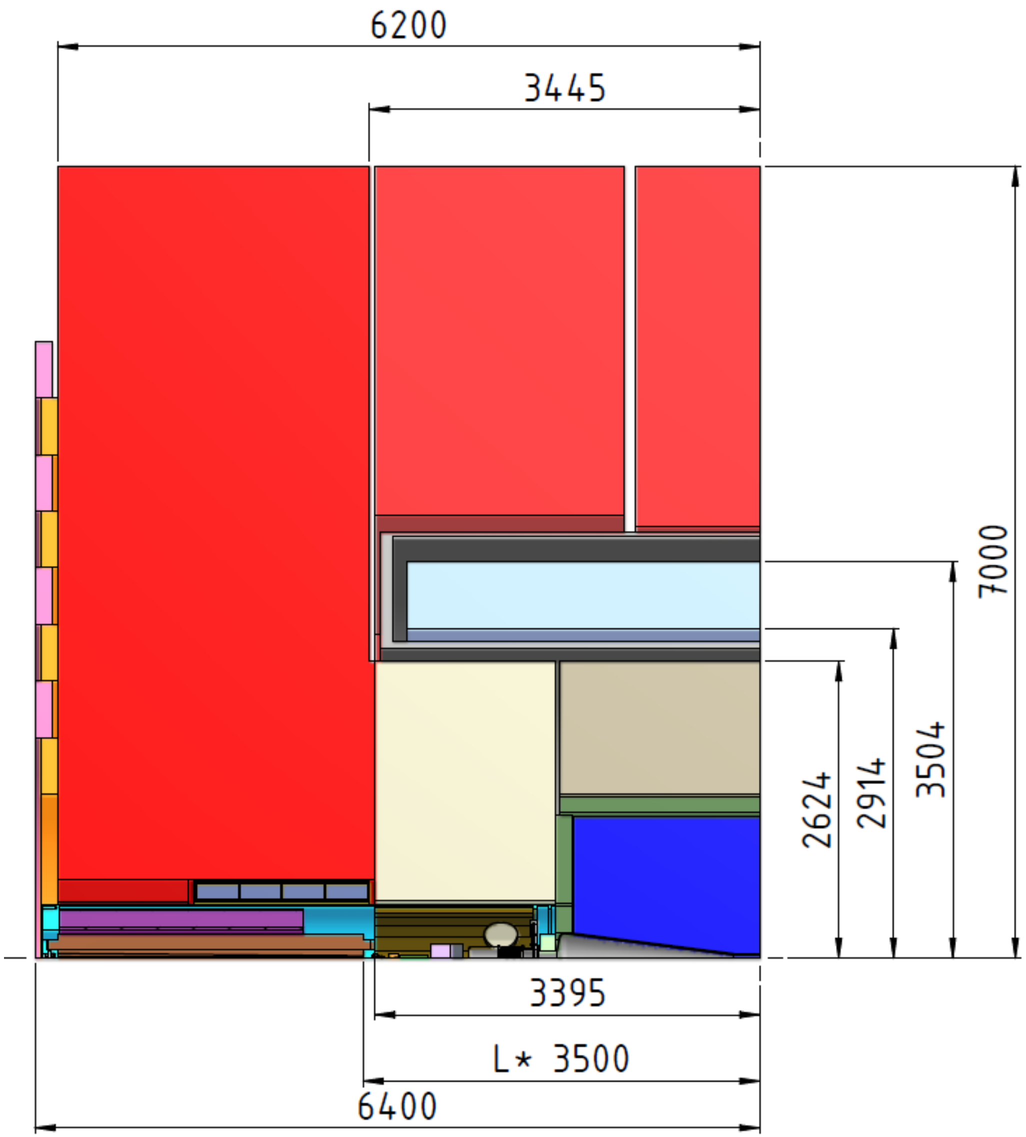
ALCPG Eugene, 20 March 2011

1) CLIC detectors for CDR: CLIC_SiD and CLIC_ILD
2) CLIC detector layout and opening scenario
3) QD0 and anti-solenoid
4) a) Radiation to QD0
   b) full beam loss on QDO
5) Pre-Isolator: update
6) Vacuum layout: update
7) Summary and outlook

1) CLIC detectors for CDR

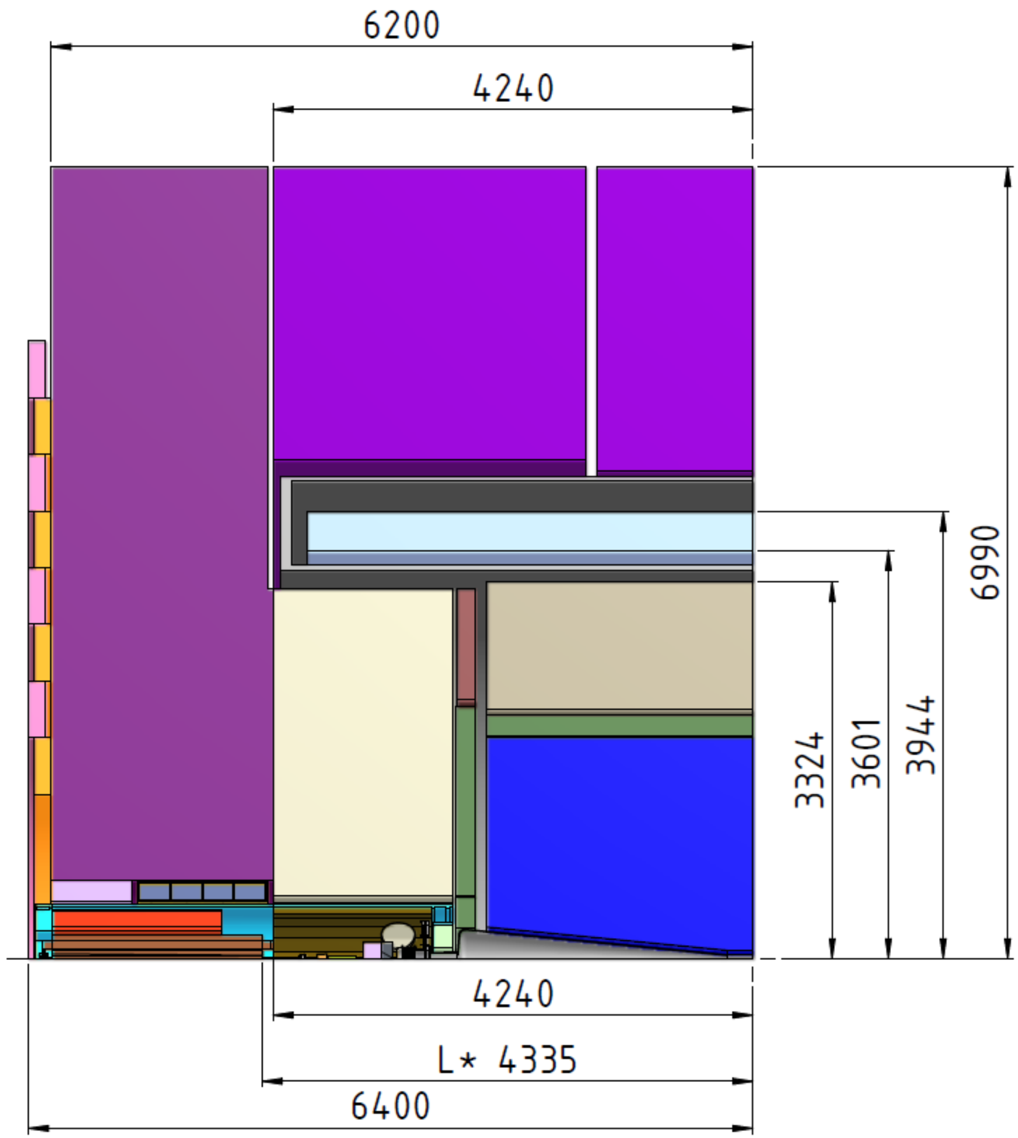


CLIC_SiD_CDR (5 T)



K. Elsener for the CLIC detector study team, ALCPG Eugene, 20 March 2011

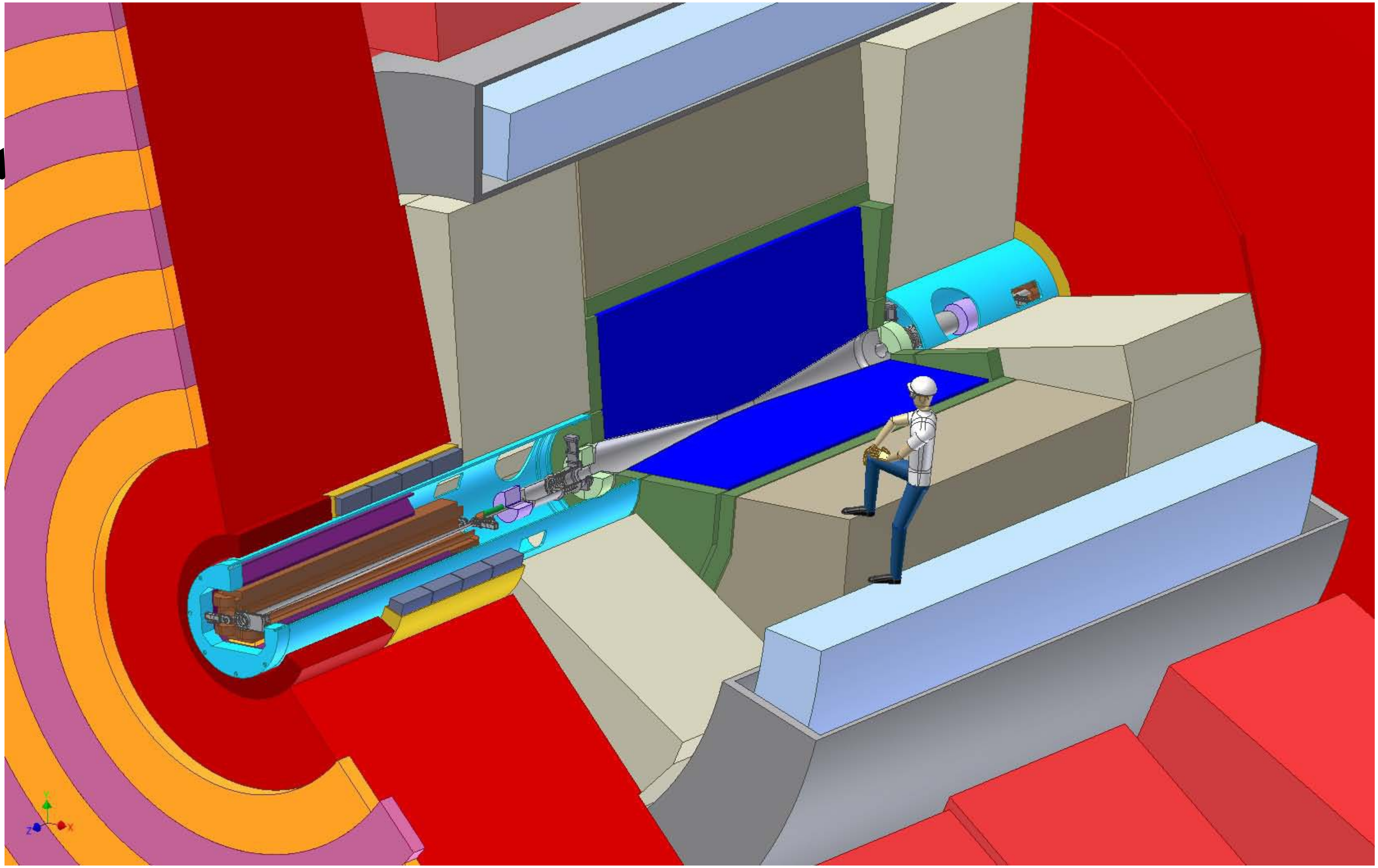
CLIC_ILD_CDR (4 T)



K. Elsener for the CLIC detector study team, ALCPG Eugene, 20 March 2011

CLIC_SiD detector for CDR – cut open

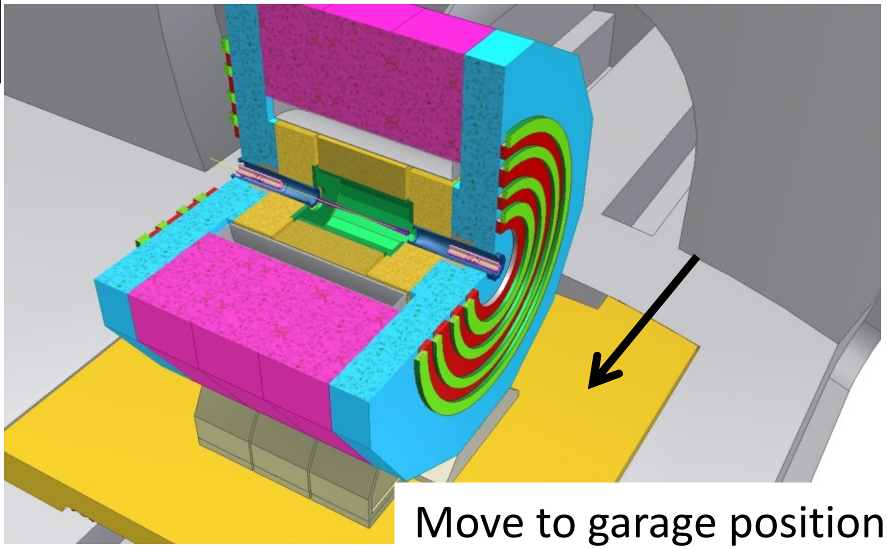
Shielding Rings



reminder: opening the detector

(caution: drawings of 2009 model)

1



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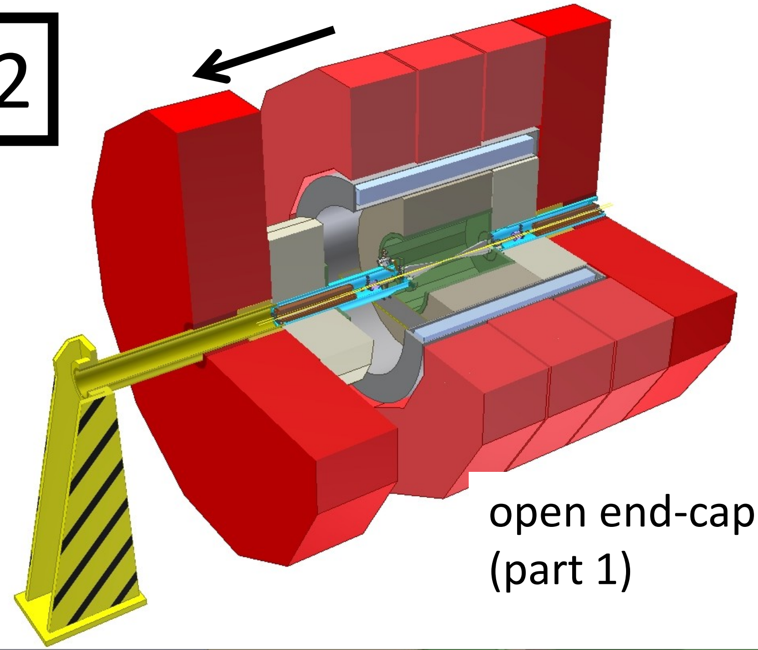

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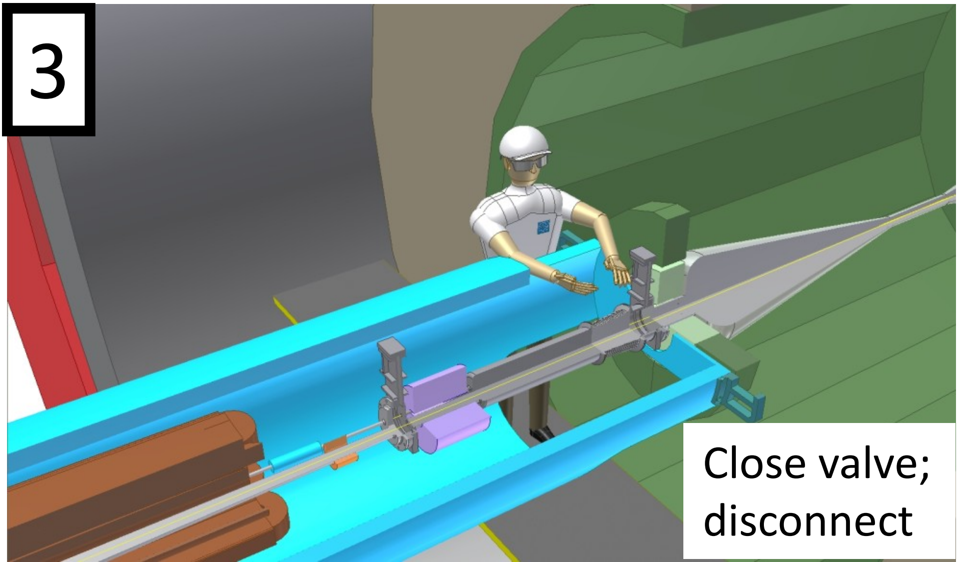

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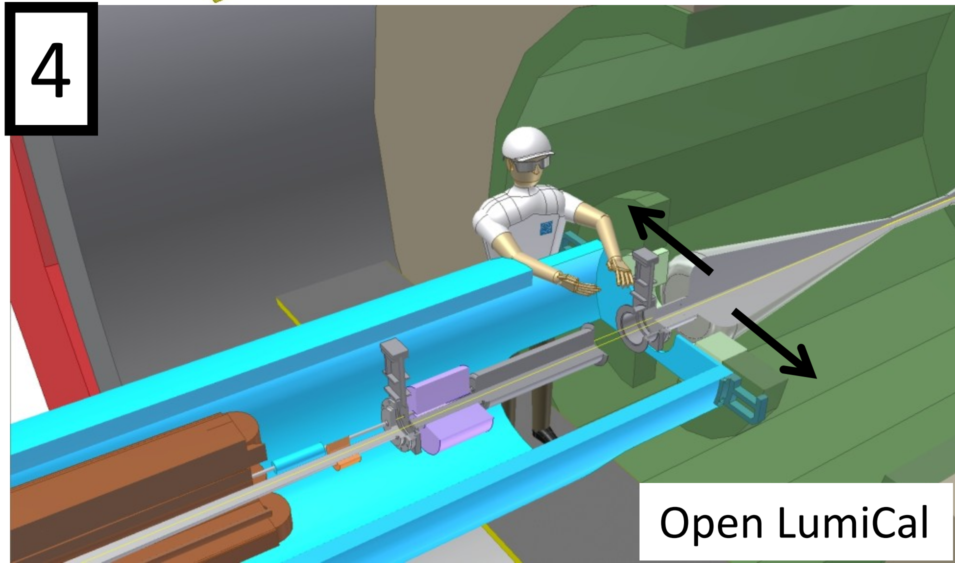
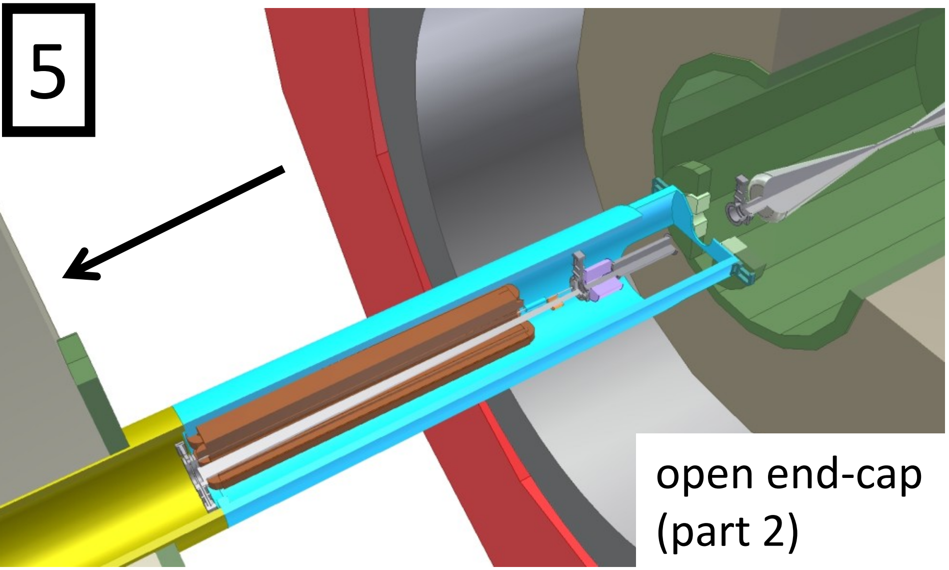


reminder: opening the detector (2)

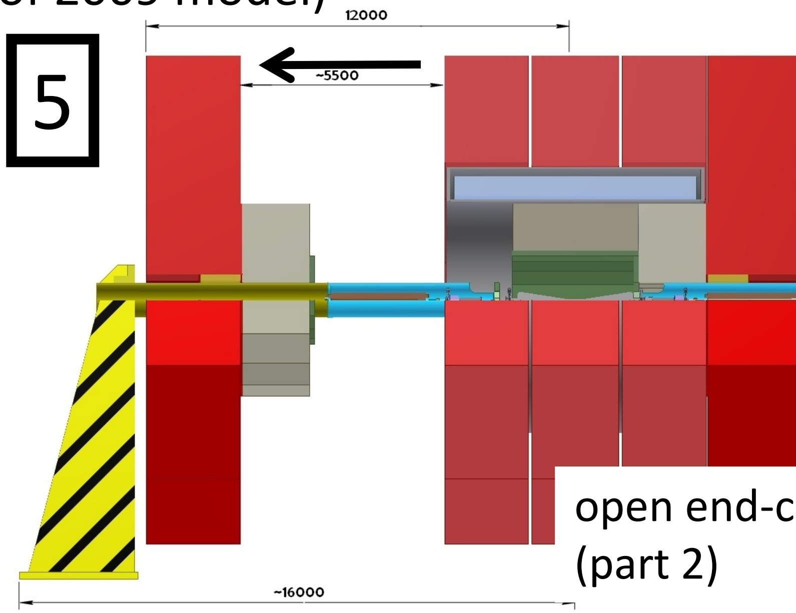
(caution: drawings of 2009 model)

5



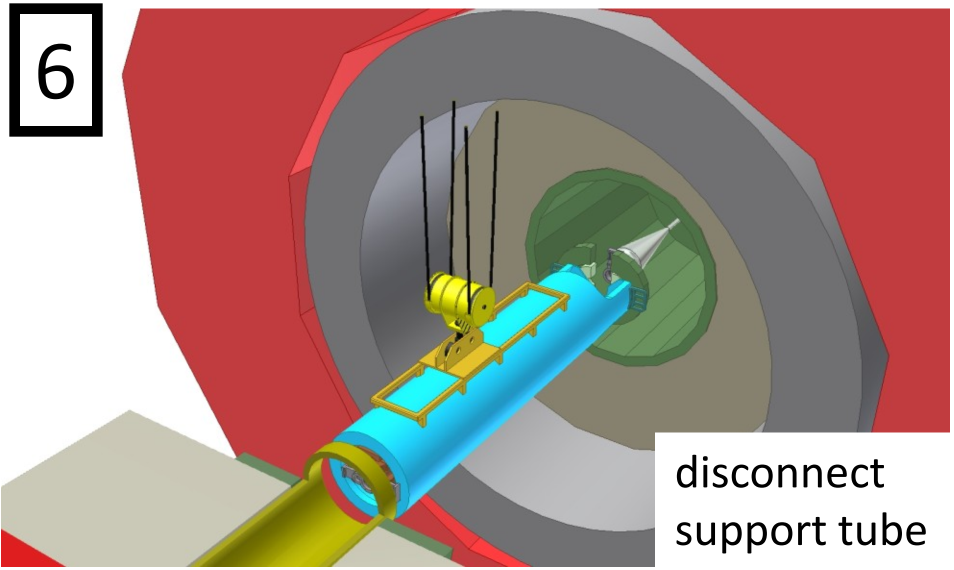
open end-cap (part 2)

5



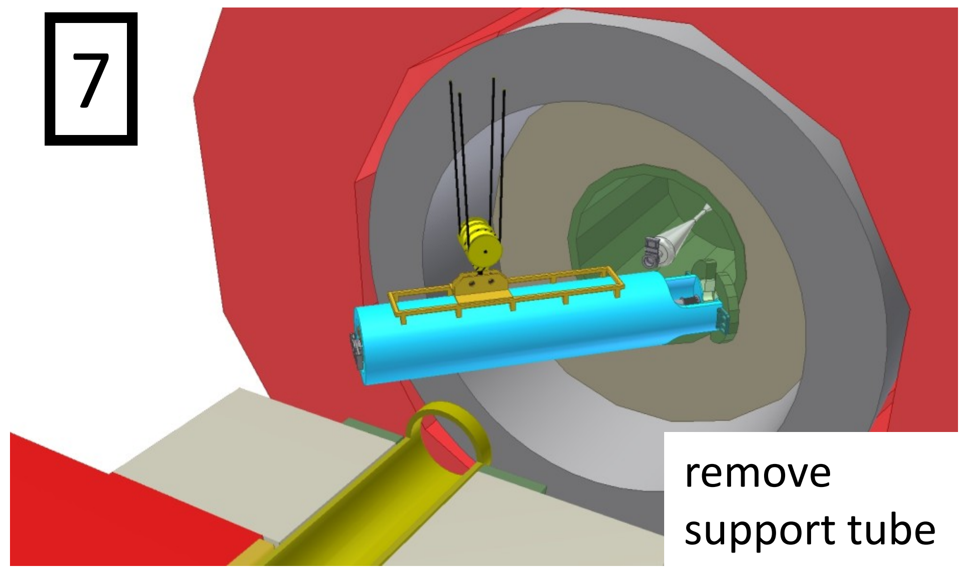
open end-cap (part 2)

6



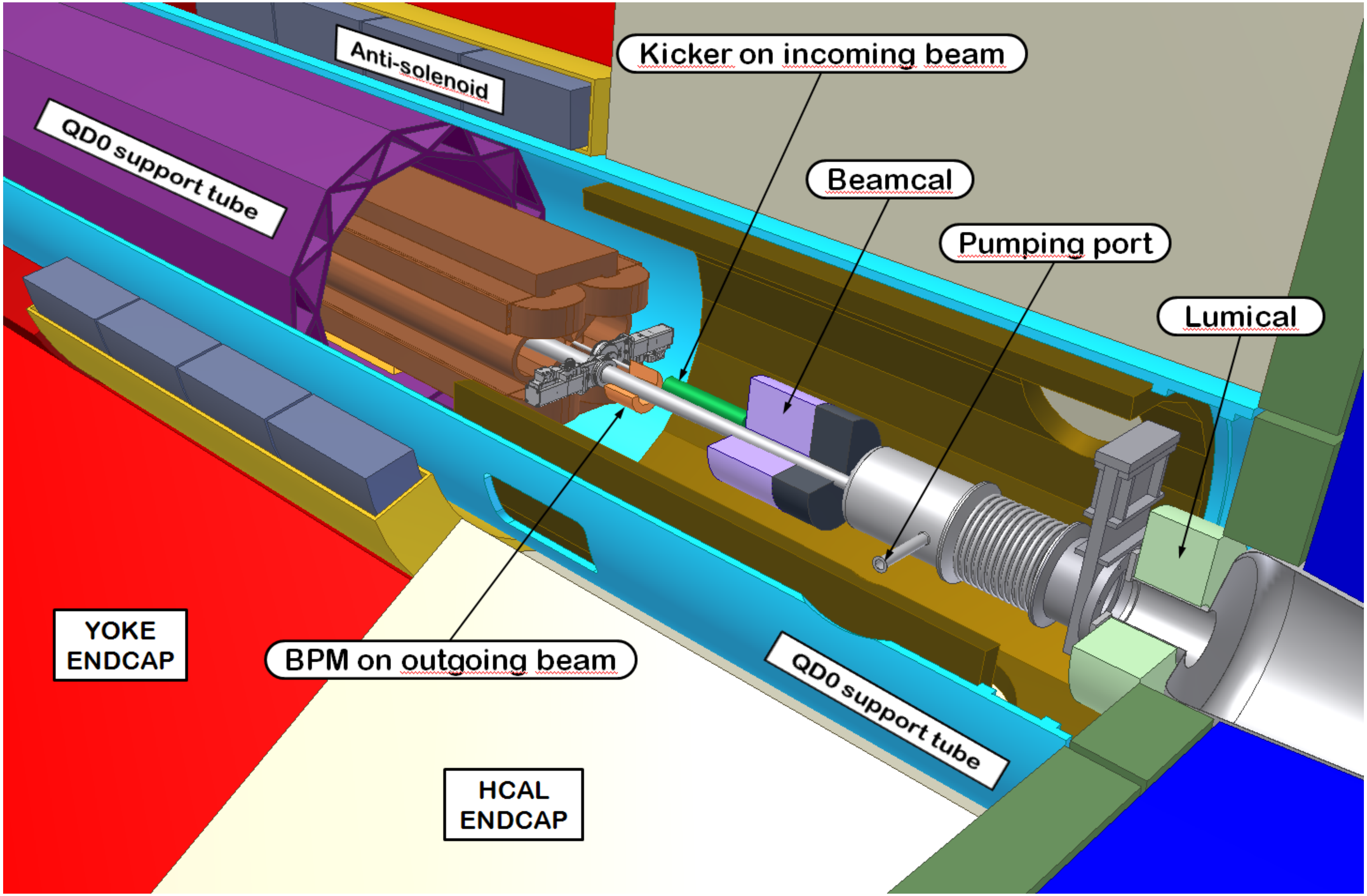
disconnect support tube

7

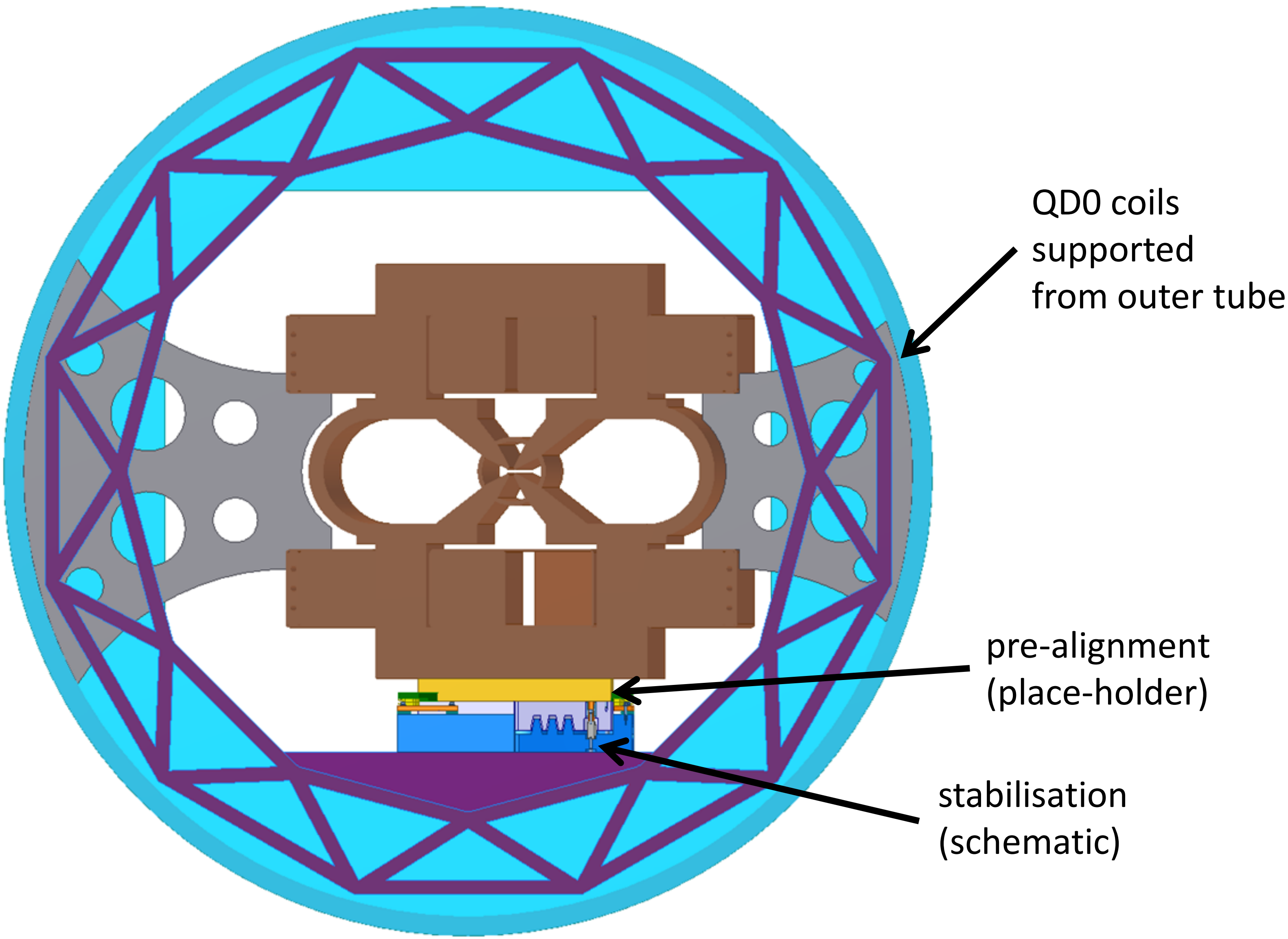


remove support tube

QD0 and Anti-Solenoid

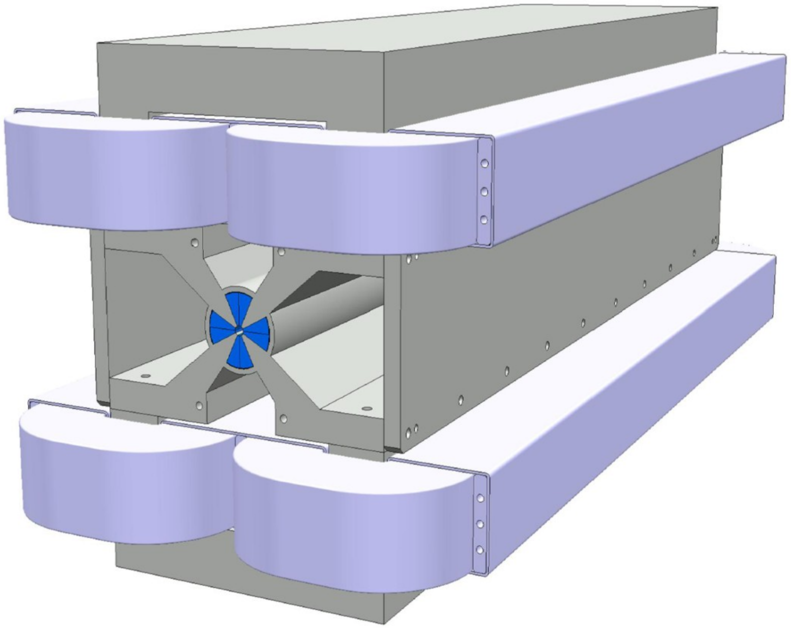


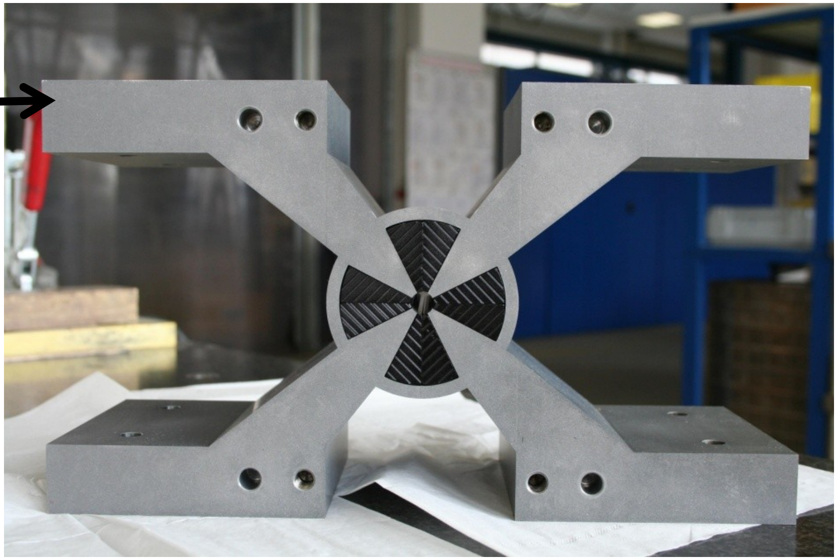
QD0 and “double-tube” for support

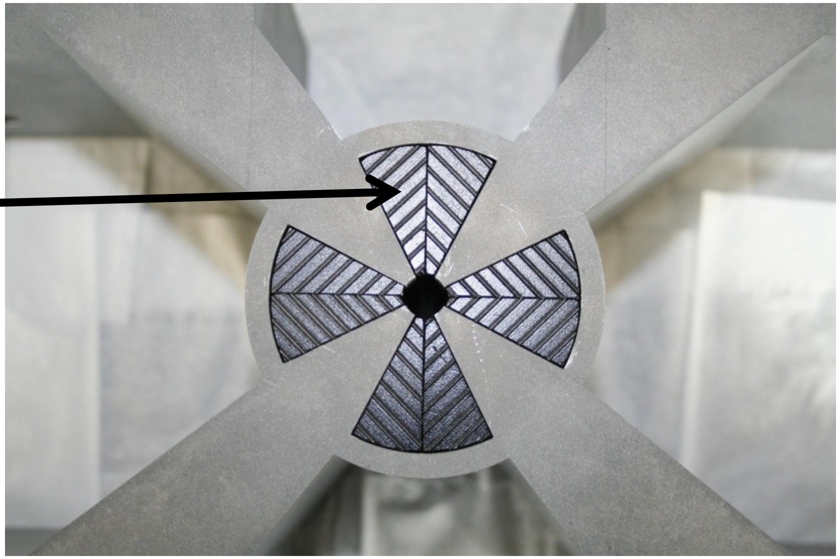


QD0 – 10 cm prototype under construction

5.75 T/m, R = 4.2 mm





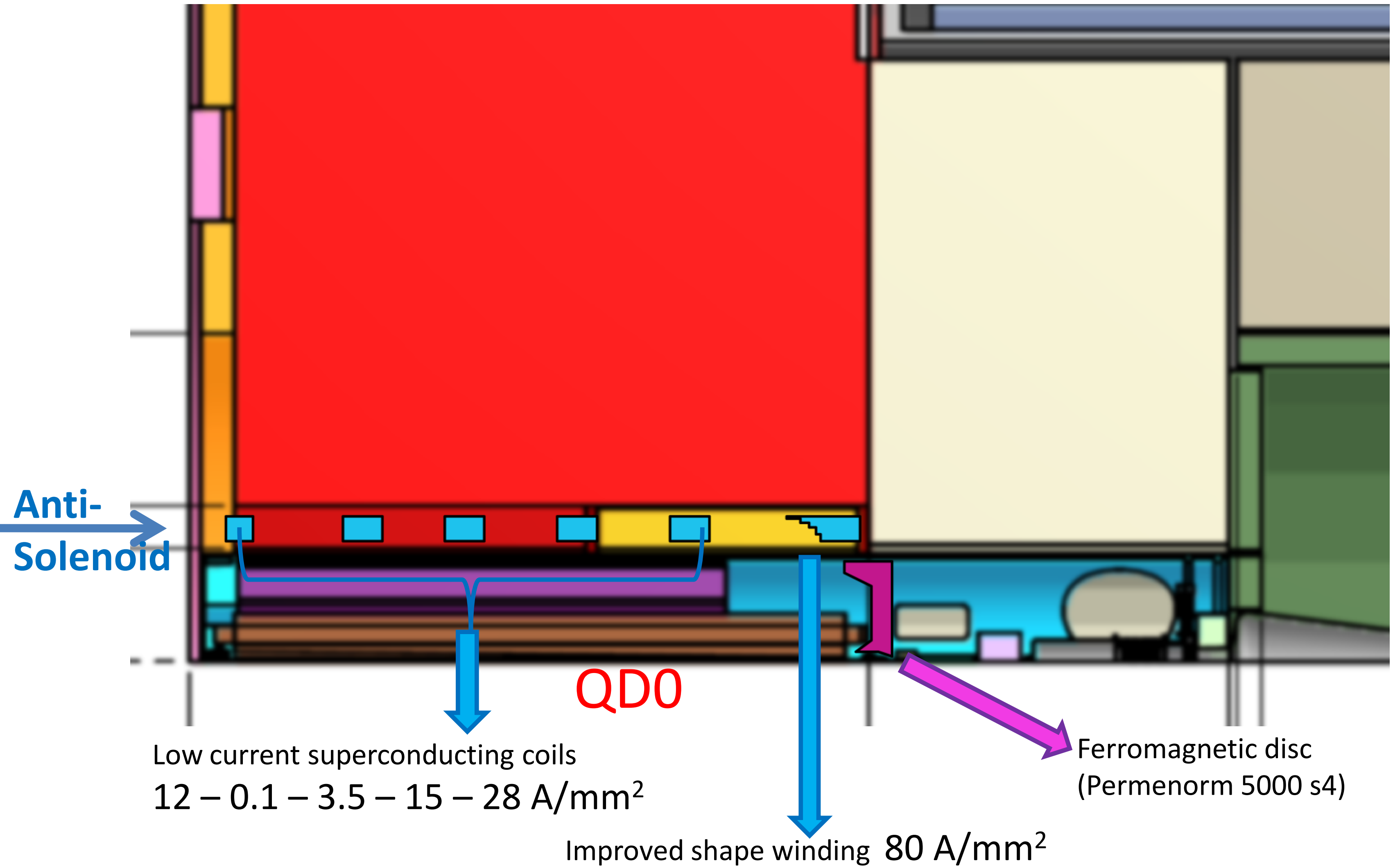


Magnet conceptual and detailed design: CERN
Manufacturing of main components (quadrupole core in Permendur by electro-erosion ; PM blocks): Vacuumschmelze (D)
Manufacturing of return yoke and coils: CERN

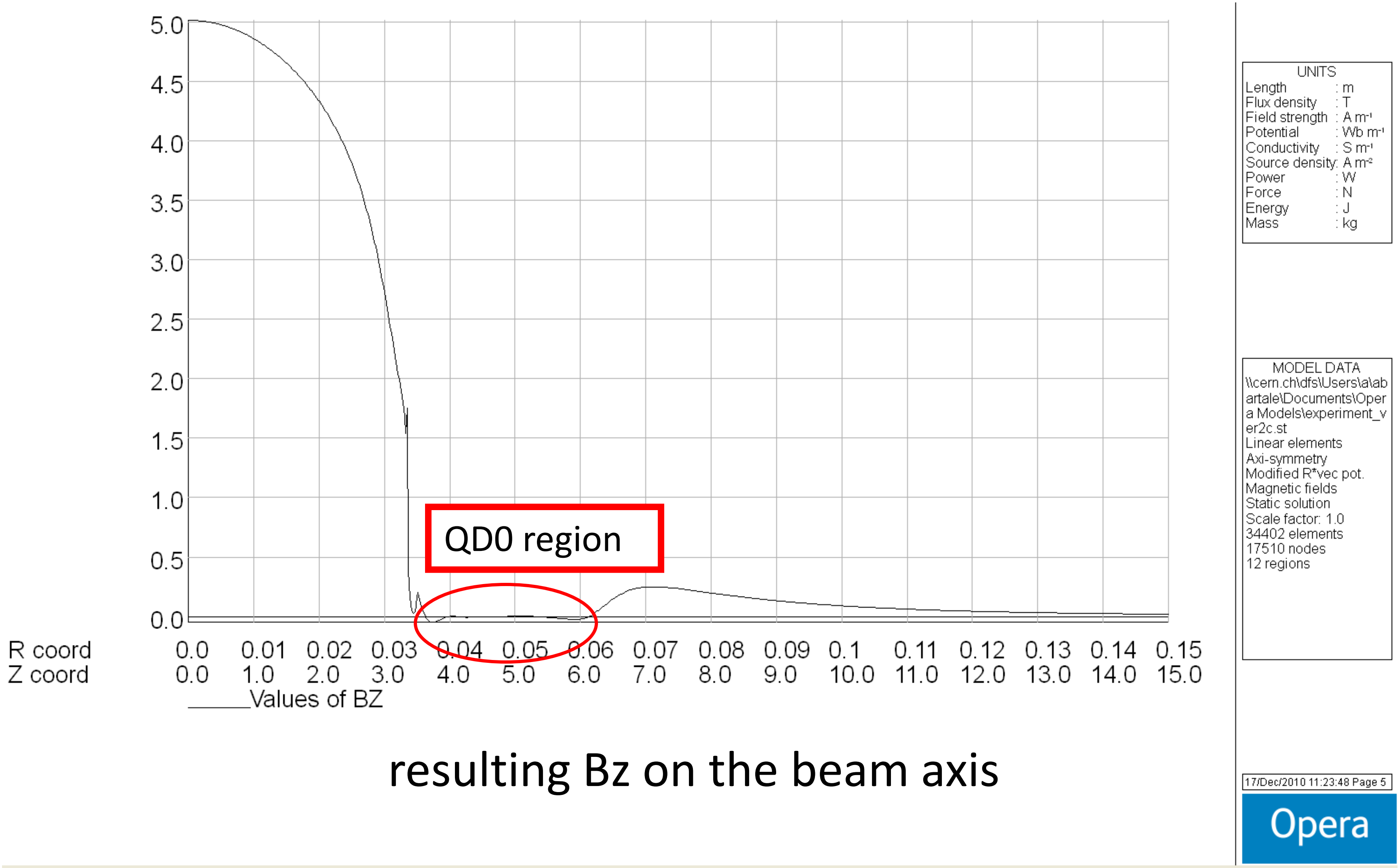
from M. Modena, 11 March 2011

QD0 and Anti-Solenoid

(reduce B-field affecting the beam)



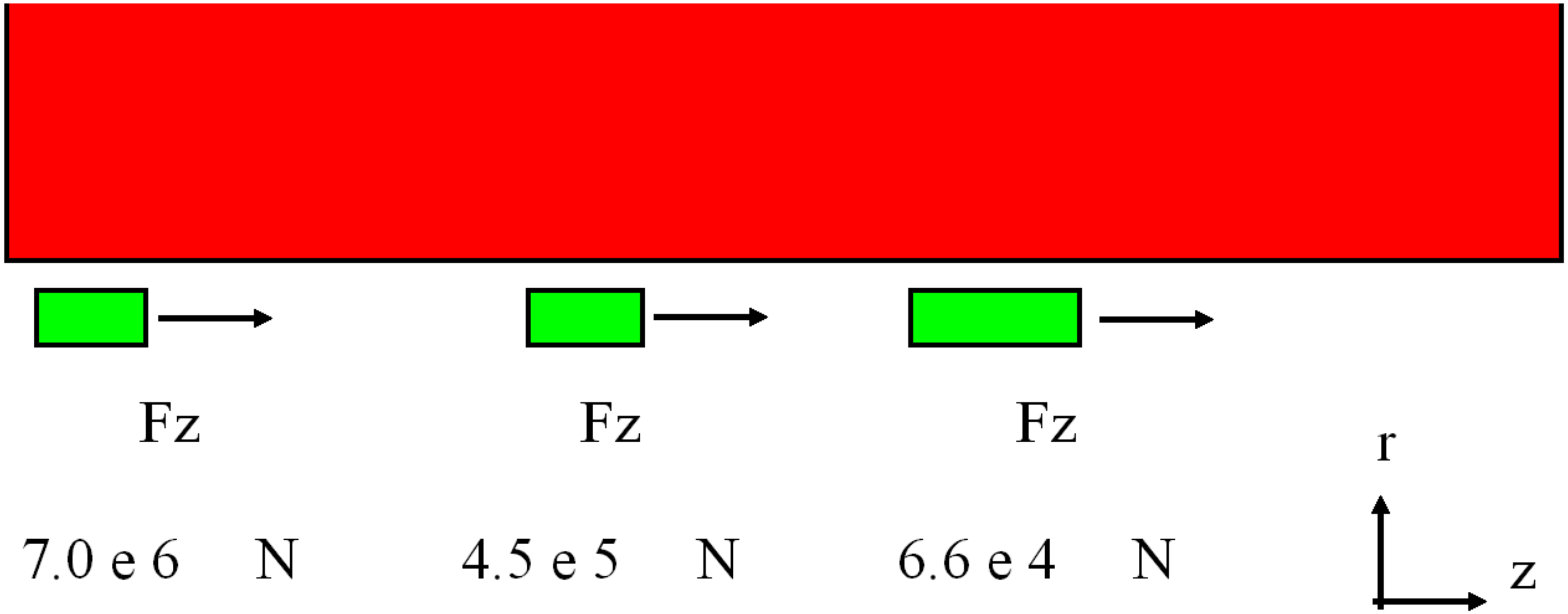
QD0 and Anti-Solenoid



resulting Bz on the beam axis

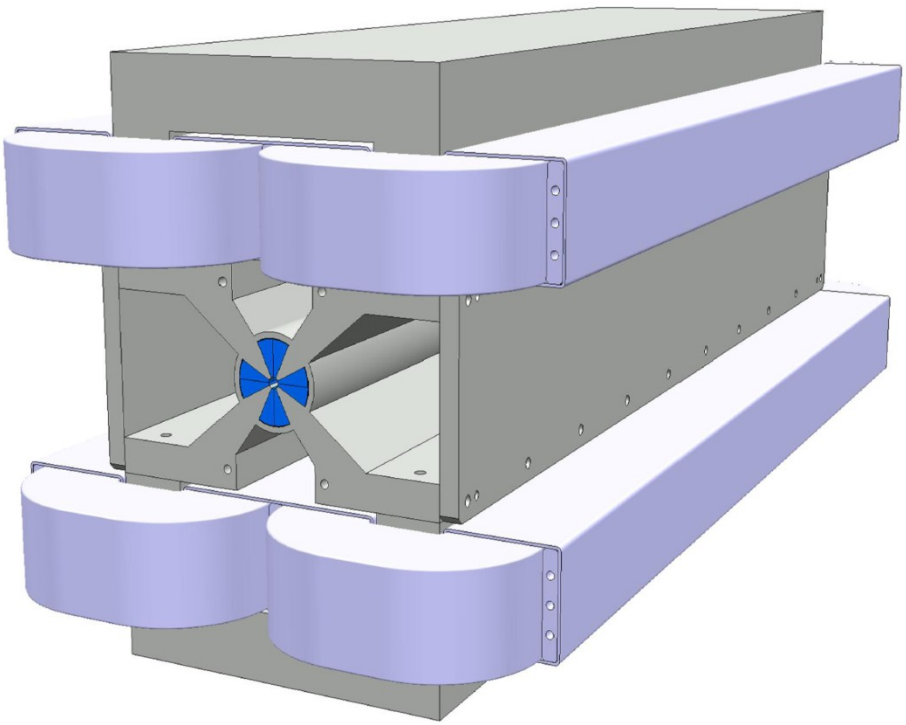
Solenoid and Anti-Solenoid

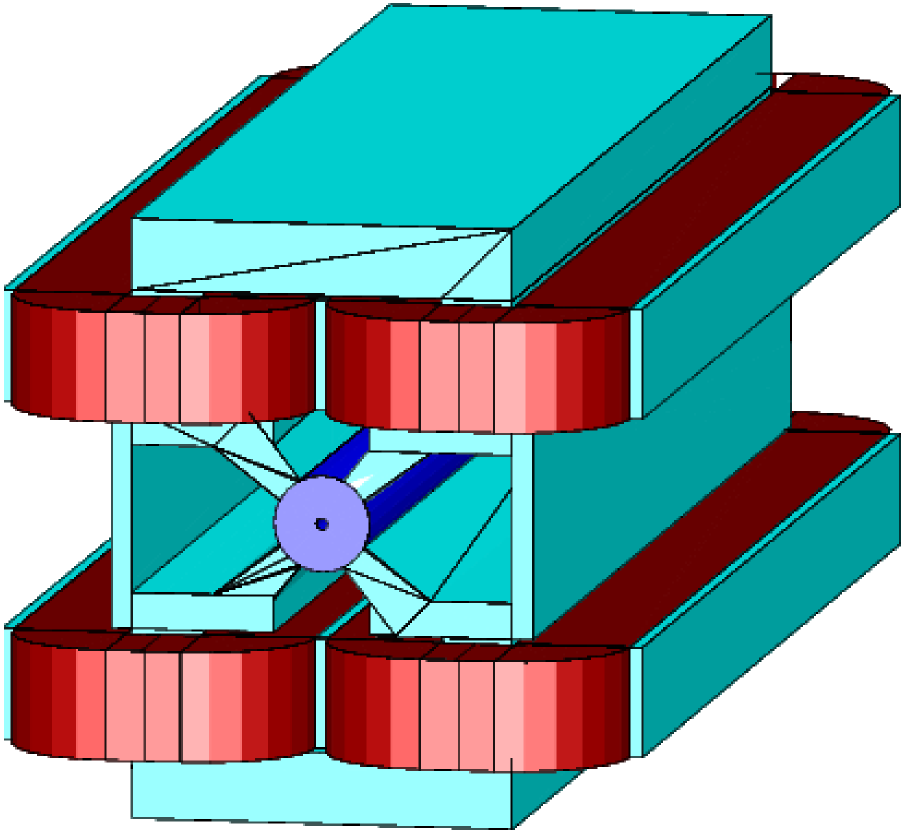
forces calculated (earlier layout):
both solenoid AND antisolenoid are energized



Resulting forces tend to push the antisolenoid **away** from the IP

Radiation to QD0 (using Mokka)



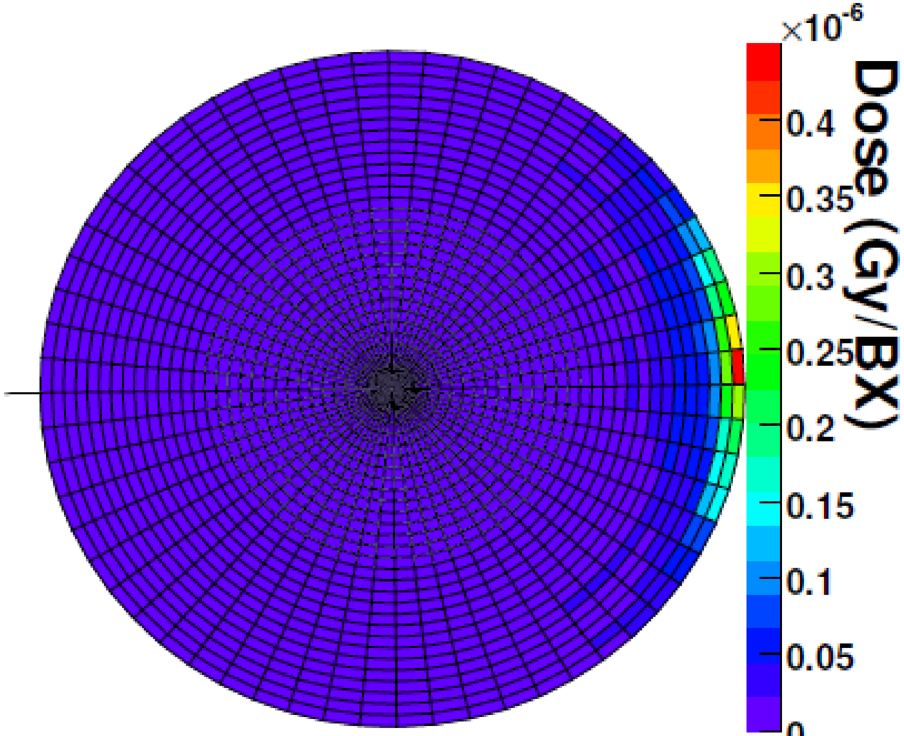


A. Sailer and E. Teodorescu, LCD Note 2010-013

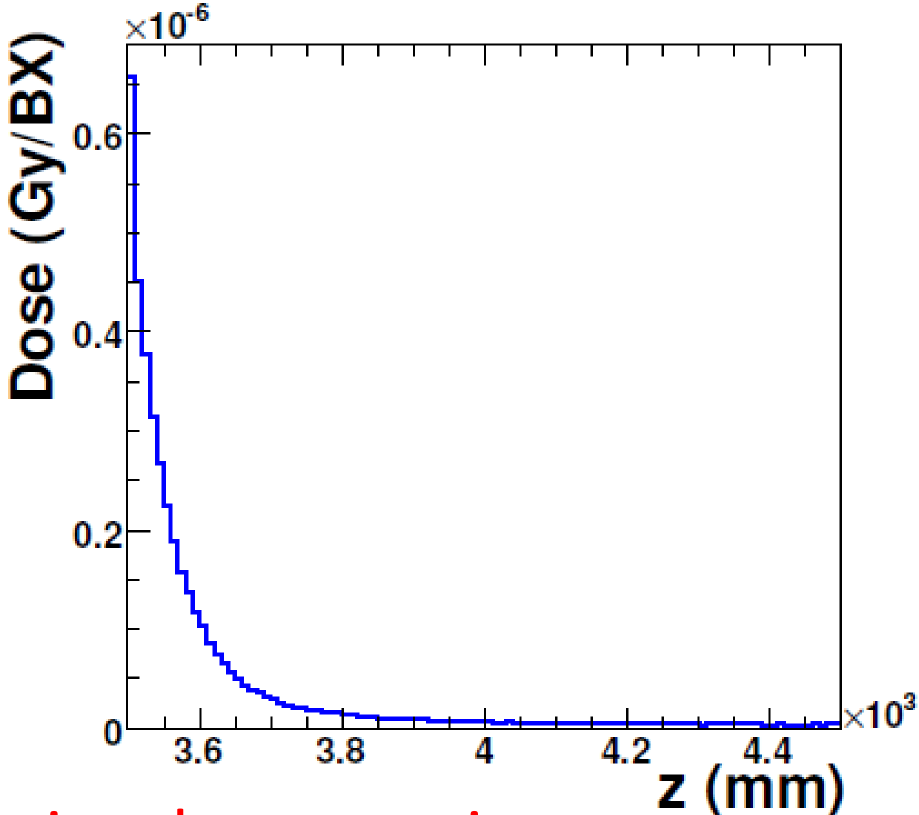
Radiation to QD0 (in Mokka)

Model contains 1 m long QD0, in CLIC_ILD detector

Cross section distribution,
dose integrated over full length



Longitudinal distrubtion,
dose integrated over full section



< 270 kGy/y from incoherent pairs

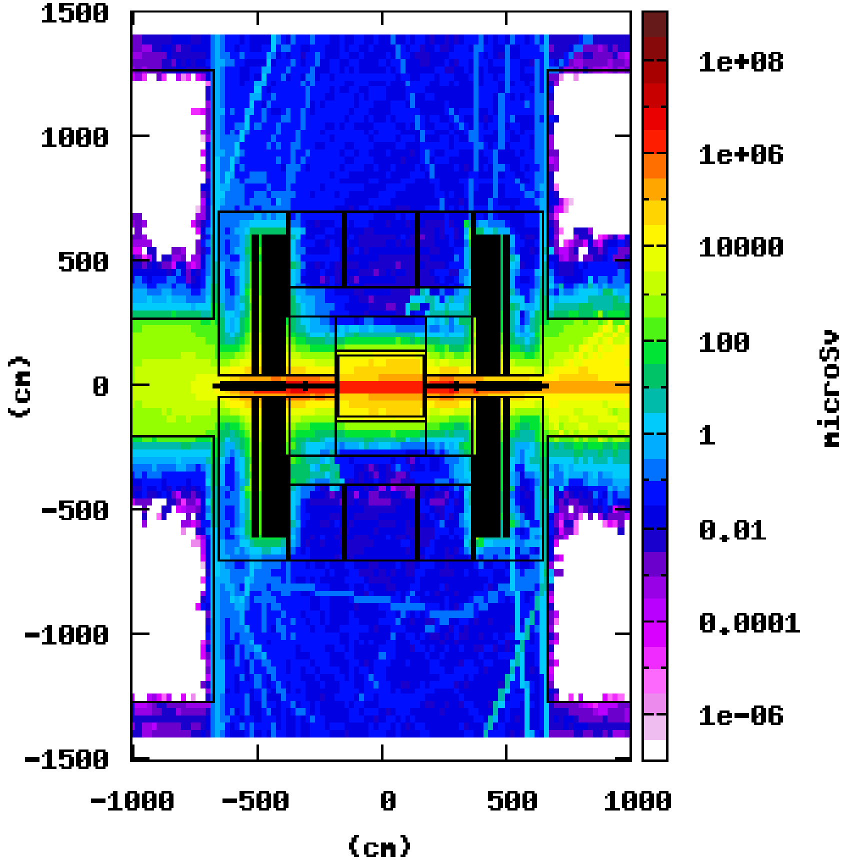
< 50 Gy/y from neutrons

A. Sailer and E. Teodorescu, LCD Note 2010-013

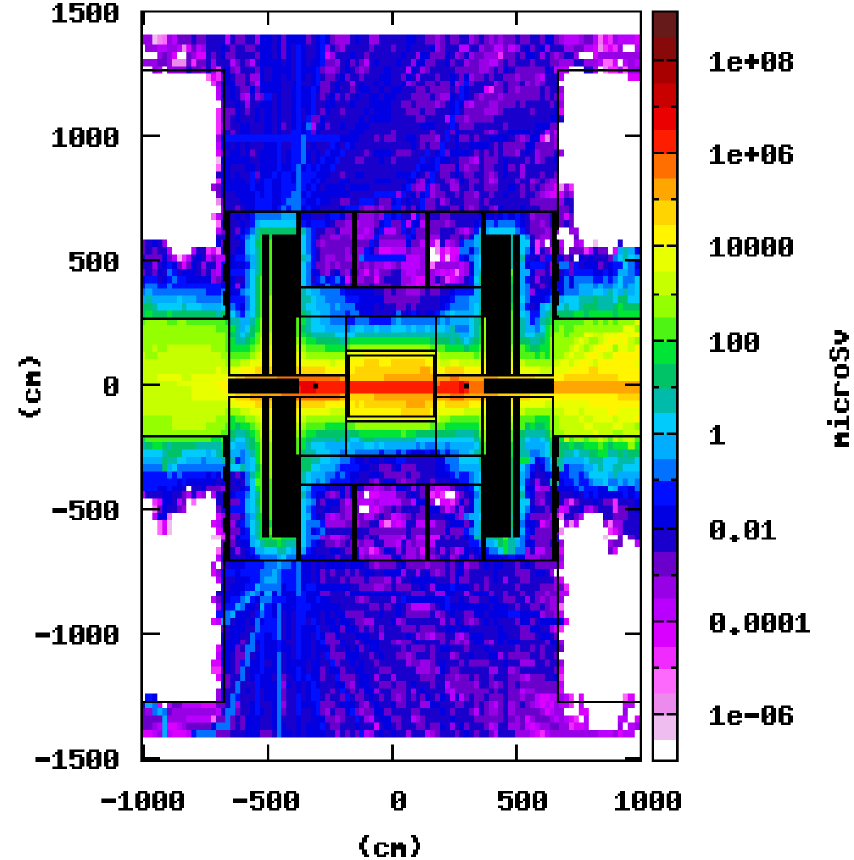
1 train - full beam loss on QD0 (FLUKA)

VERY PRELIMINARY - without magnetic field

No Shielding Rings



With Shielding Rings



For this loss scenario, prompt dose <10 μSv outside detector

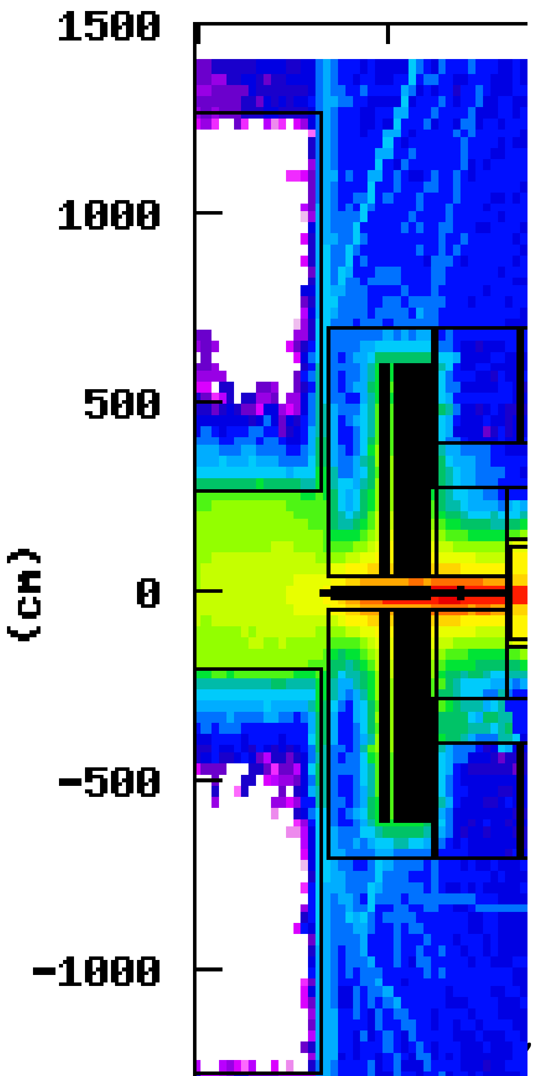
H*(10)>0.5 μSv.h^{-1} : Radiation Area

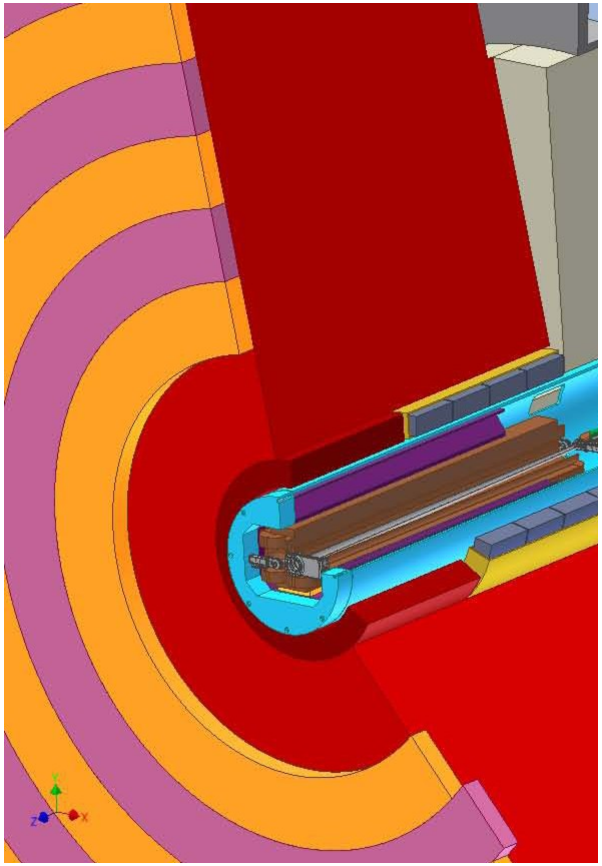
H*(10)<10 μSv.h^{-1} : Allows 'hands-on' interventions during intervention times measured in hours or days

1 train - full beam loss on QD0 (FLUKA)

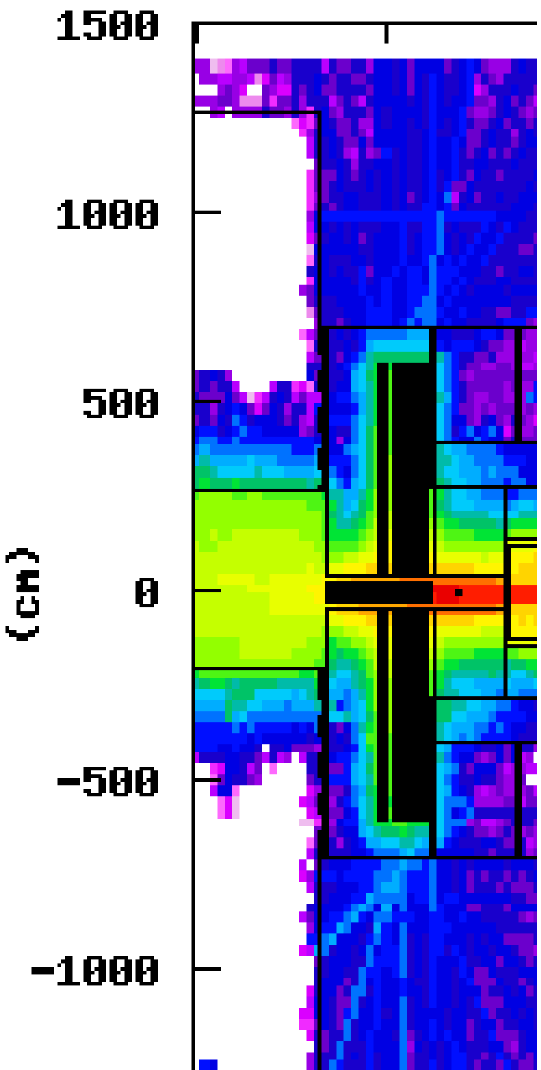
VERY PRELIMINARY - without magnetic field

No Shielding Rings





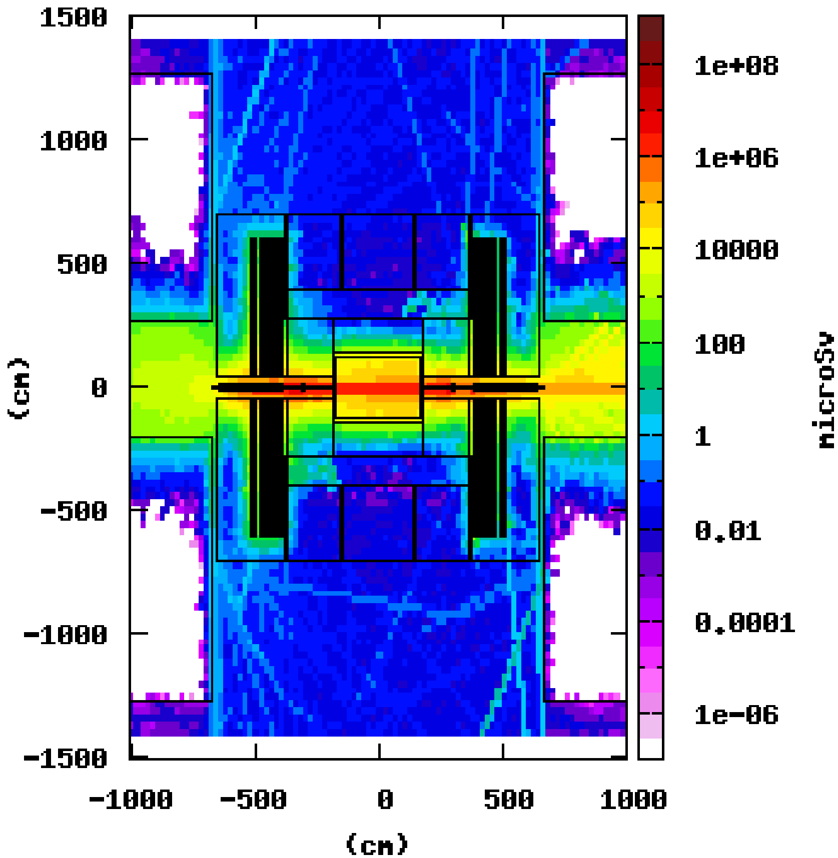
With Shielding Rings



1 train - full beam loss on QD0 (FLUKA)

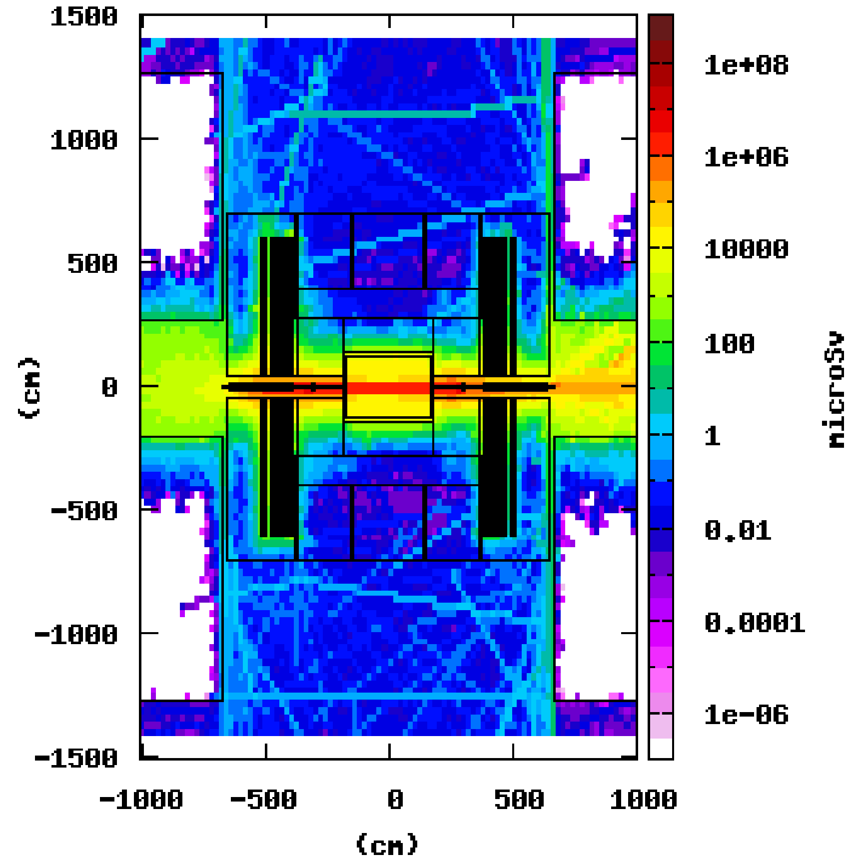
VERY PRELIMINARY - <u>without shielding rings</u>

No Field



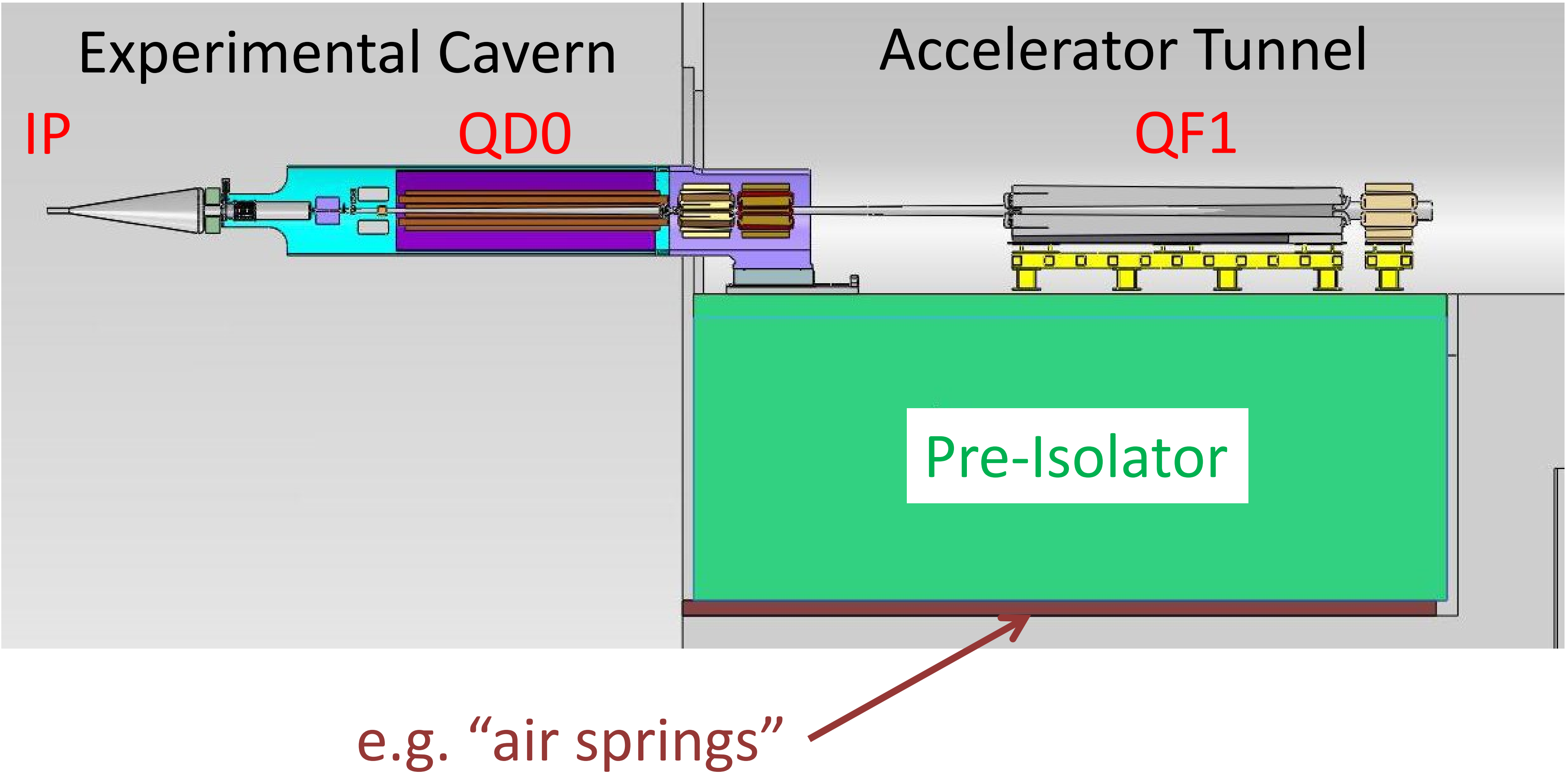
For this loss scenario,
prompt dose <10 µSv outside detector

5T Field



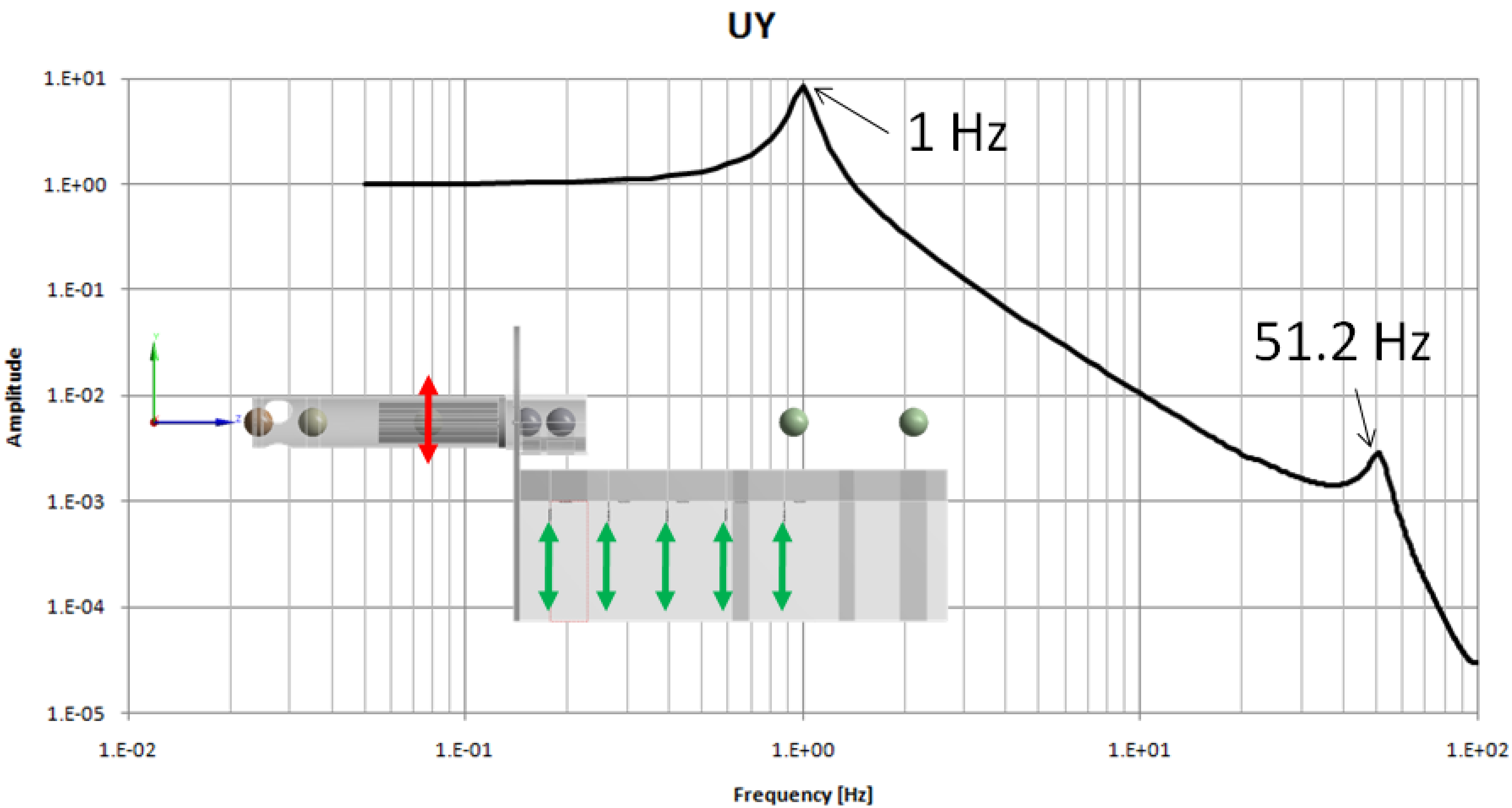
For this loss scenario,
prompt dose <50 µSv outside detector

Pre-Isolator: Update



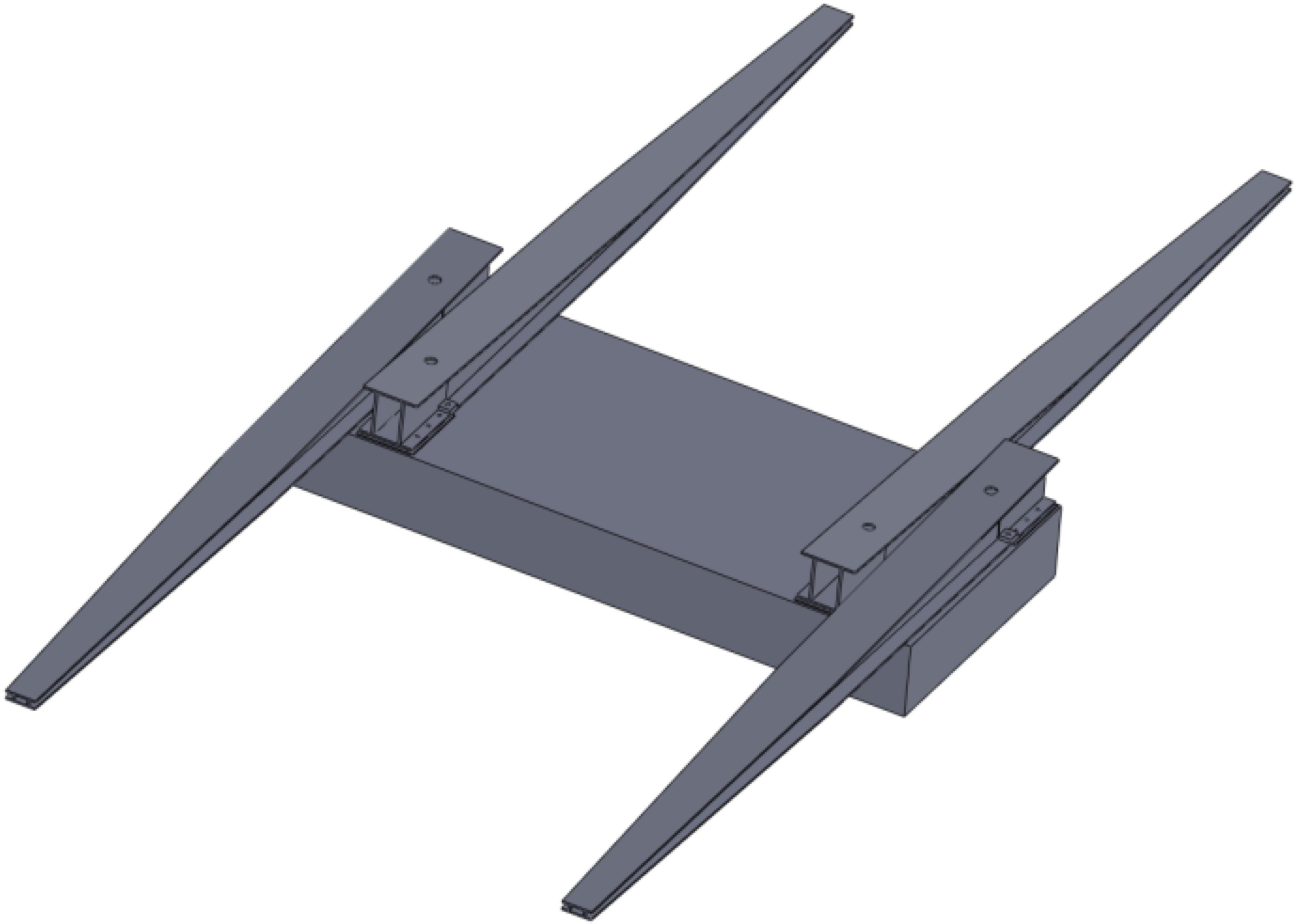
Pre-Isolator: expected performance

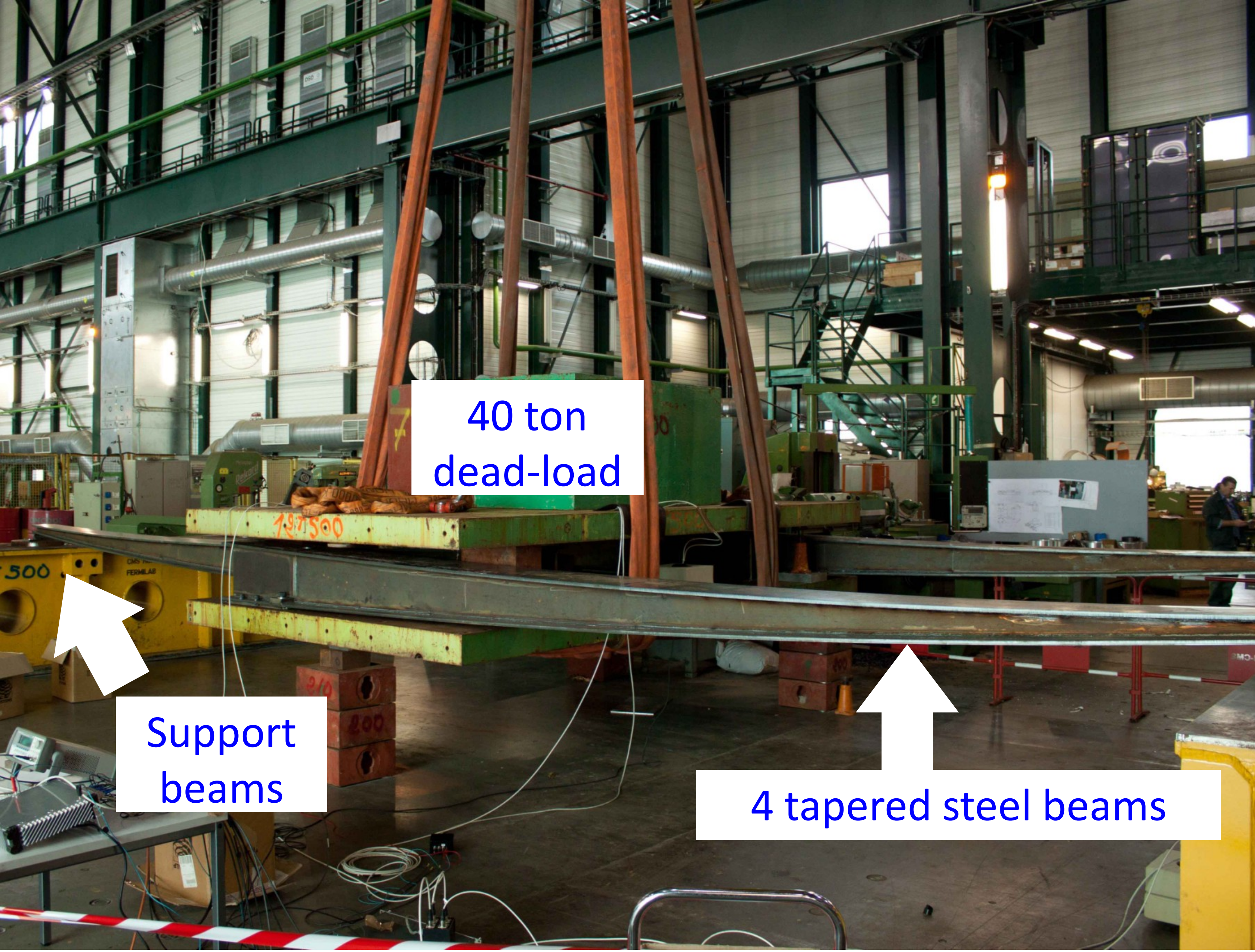
Vertical steady-state response at QD0



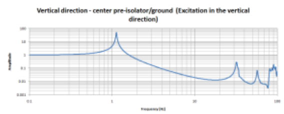
Pre-Isolator: Update – simple test set-up

(more challenging for the model calculations !)

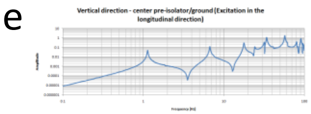



40 ton
dead-load
Support
beams
4 tapered steel beams

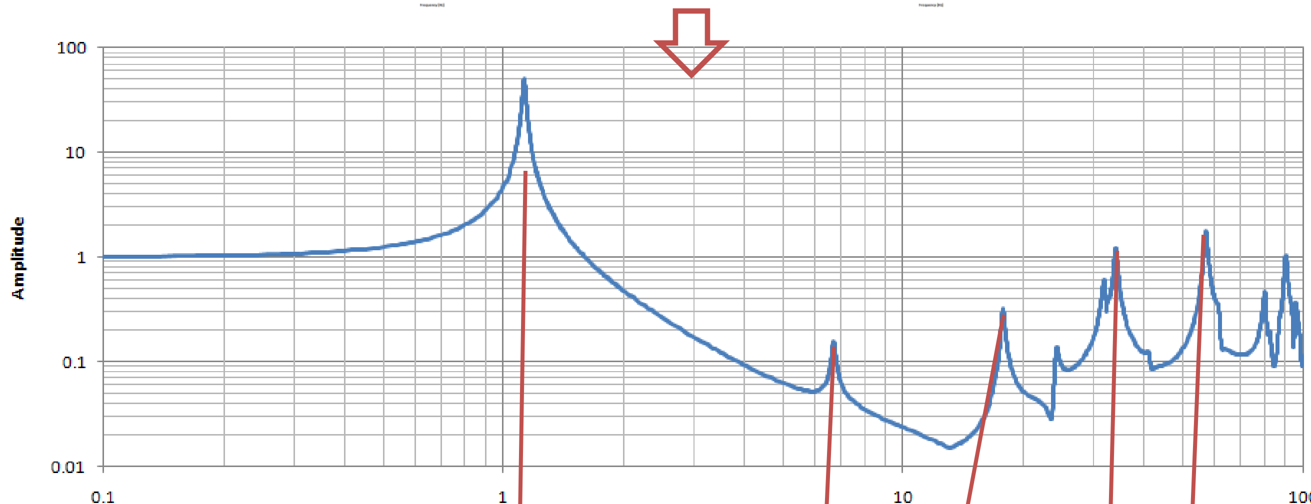
Combined harmonic response in the vertical direction



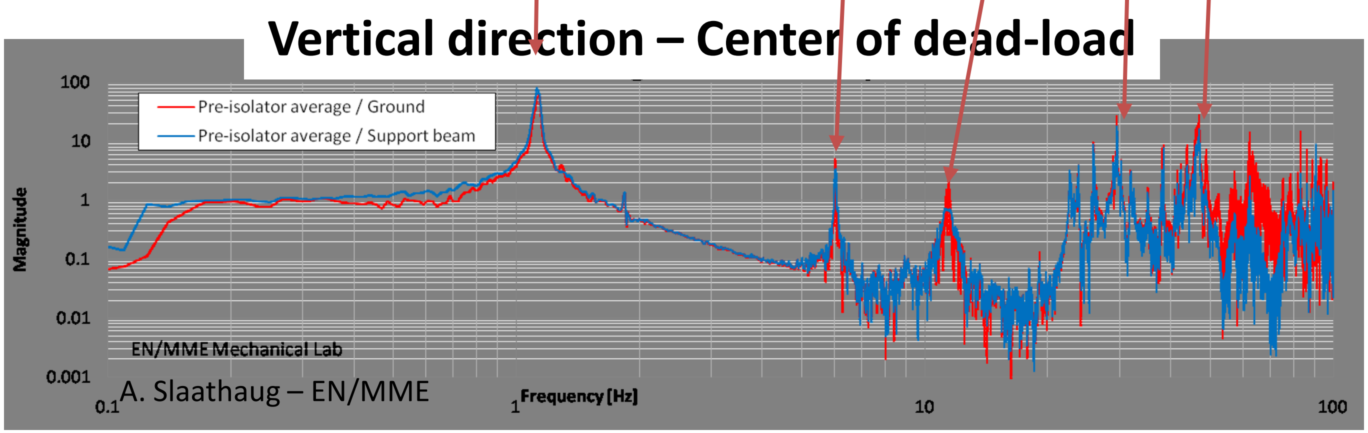
Combine +



Simulated



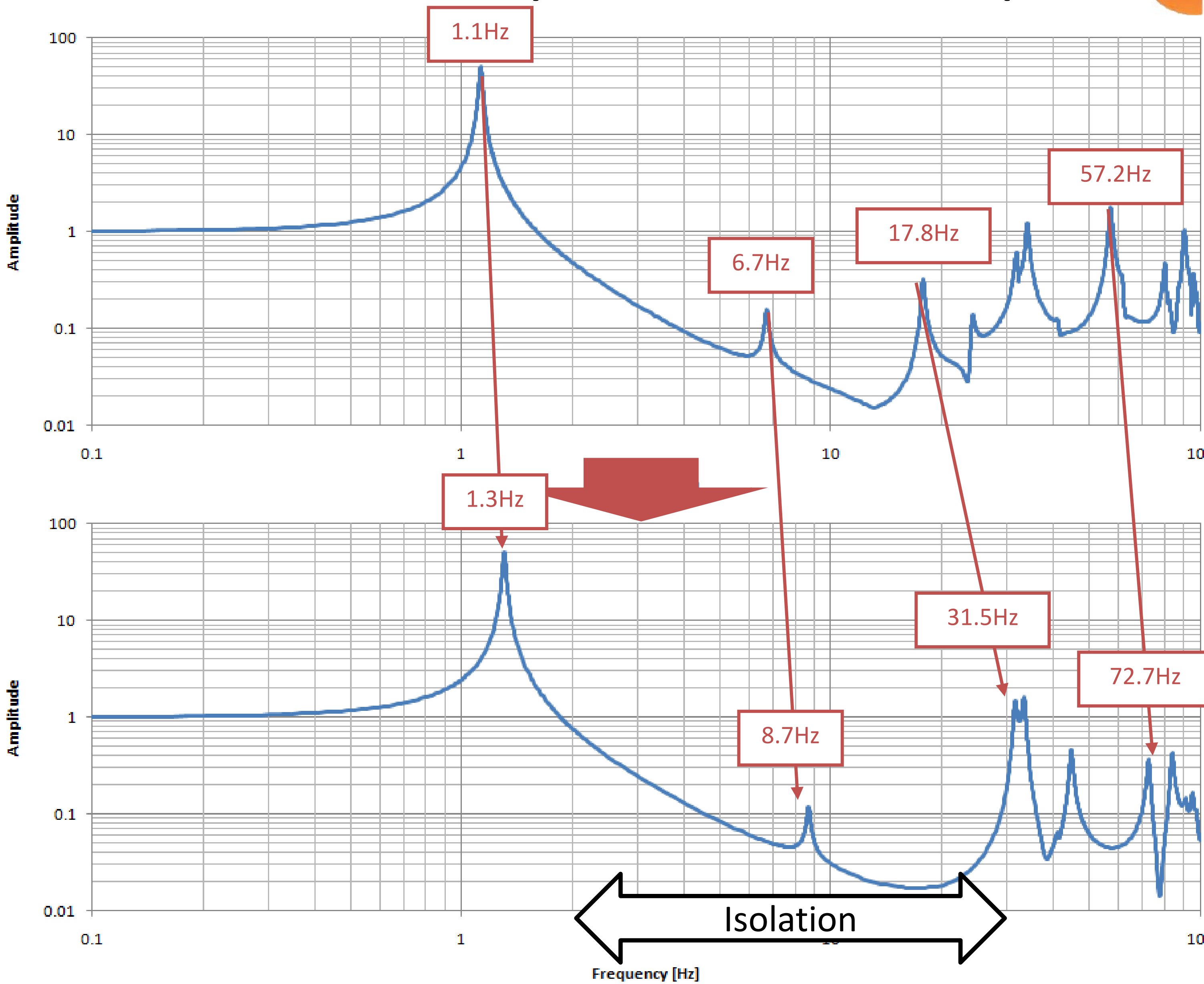
Measured



Predictions for an improved test set-up

Initial design

New design



F. Ramos, CERN MDI meeting 18 December 2010

Pre-Isolator: Status

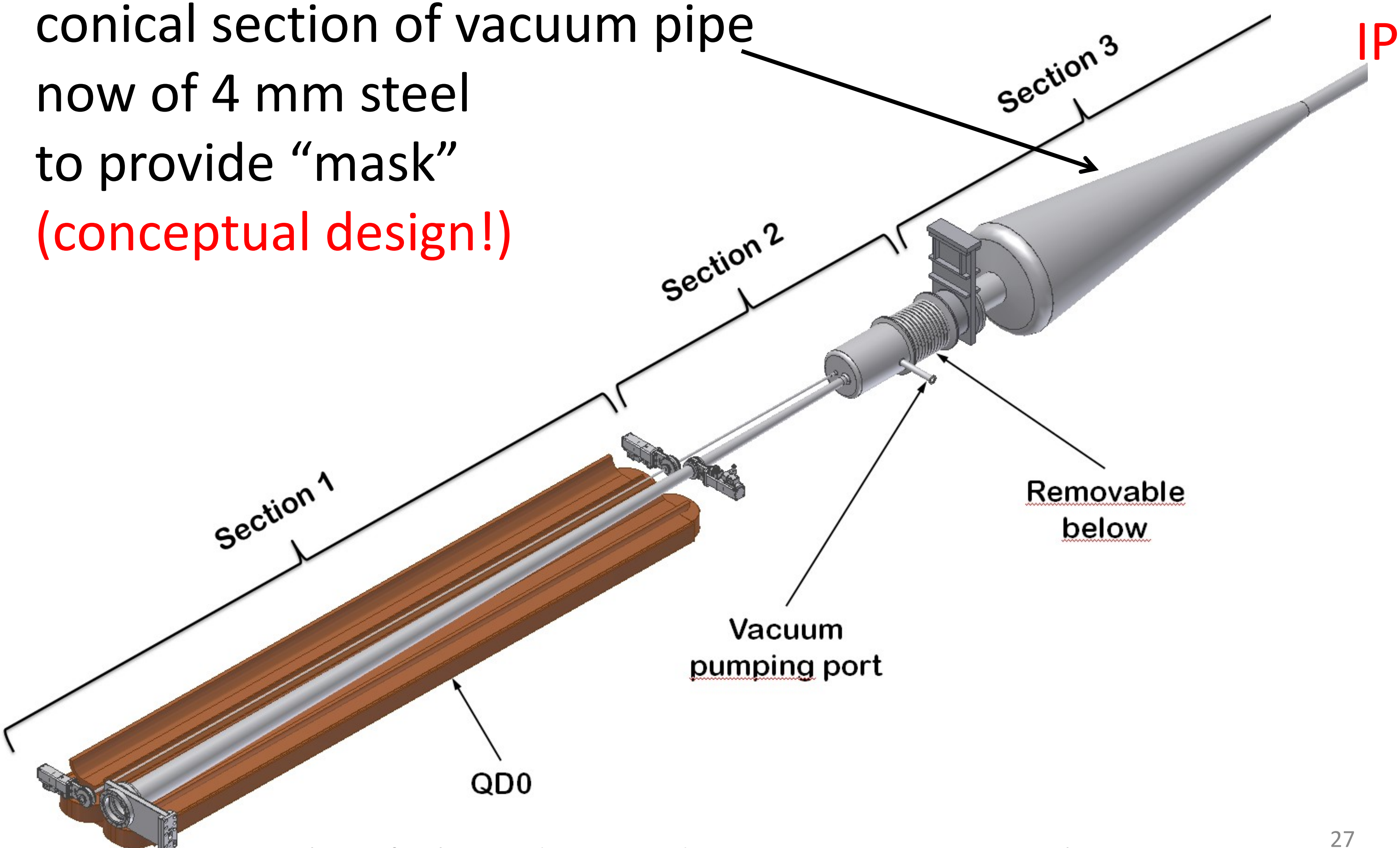
Results of measurements with the new, improved design of the test set-up have been communicated. Analysis is in progress.

Next steps: to be discussed.

In parallel, contacts with industry are on-going to check different solutions for a "final" version of the pre-isolator

Vacuum Layout: Update

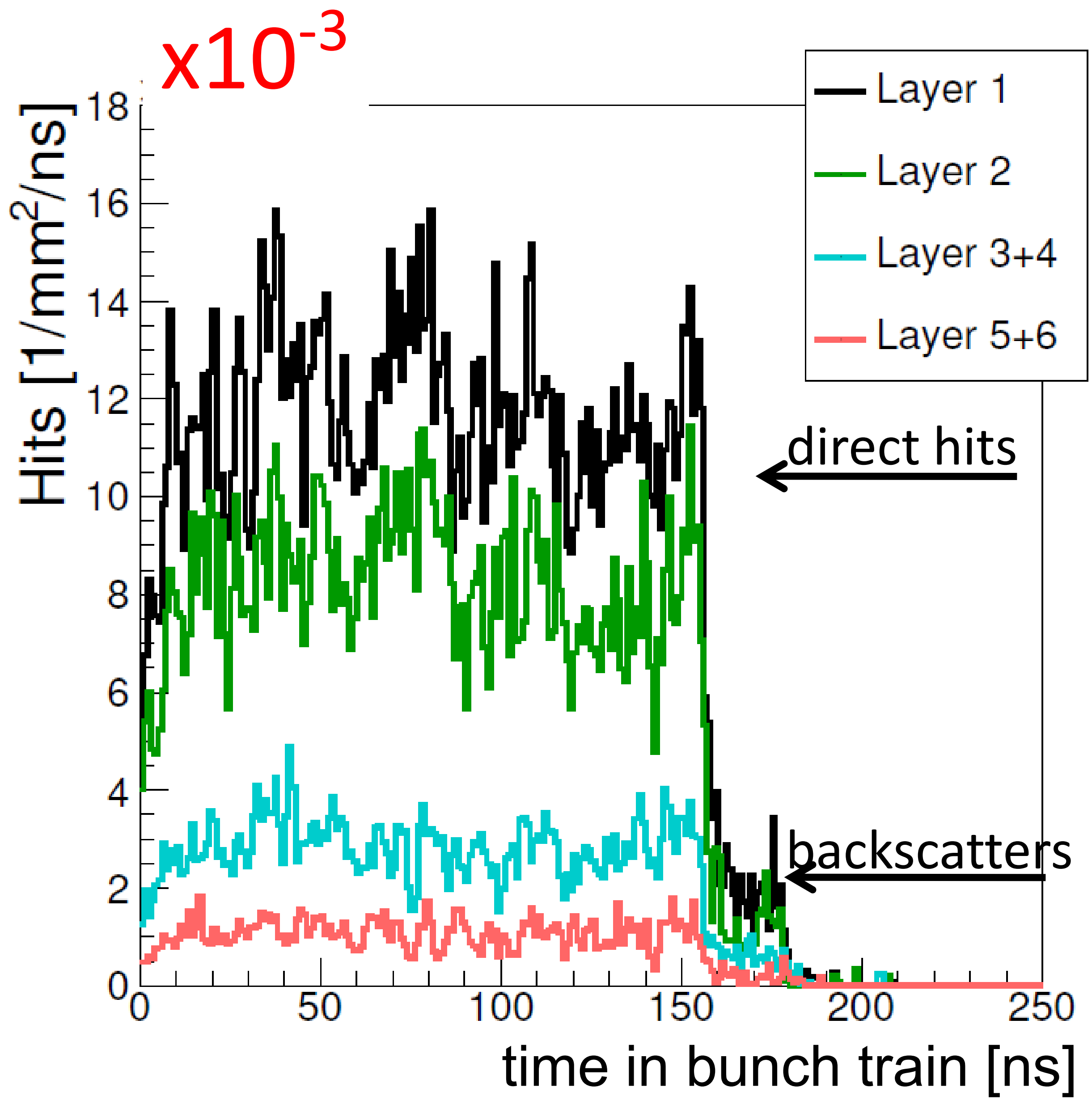
conical section of vacuum pipe
now of 4 mm steel
to provide "mask"
(conceptual design!)



Vertex detector hits from incoherent pairs

(CLIC_ILD_CDR)

"now" : direct hits are dominant



Summary

Progress is being made on a number of forward region and MDI issues around the CLIC detectors. Examples given here.
(see also Dominik Dannheim, Tuesday at 11:10
"Beam-induced backgrounds in the CLIC detector models")

The corresponding chapters for the CLIC accelerator CDR (Vol. 1) are completed in first draft form – waiting for comments from the editors.

Chapters for the Physics and Detectors CDR (Vol. 2) exist in early draft forms – on "very forward region", "magnet systems", "interaction region and detector layout" - and are due to be ready end of April.

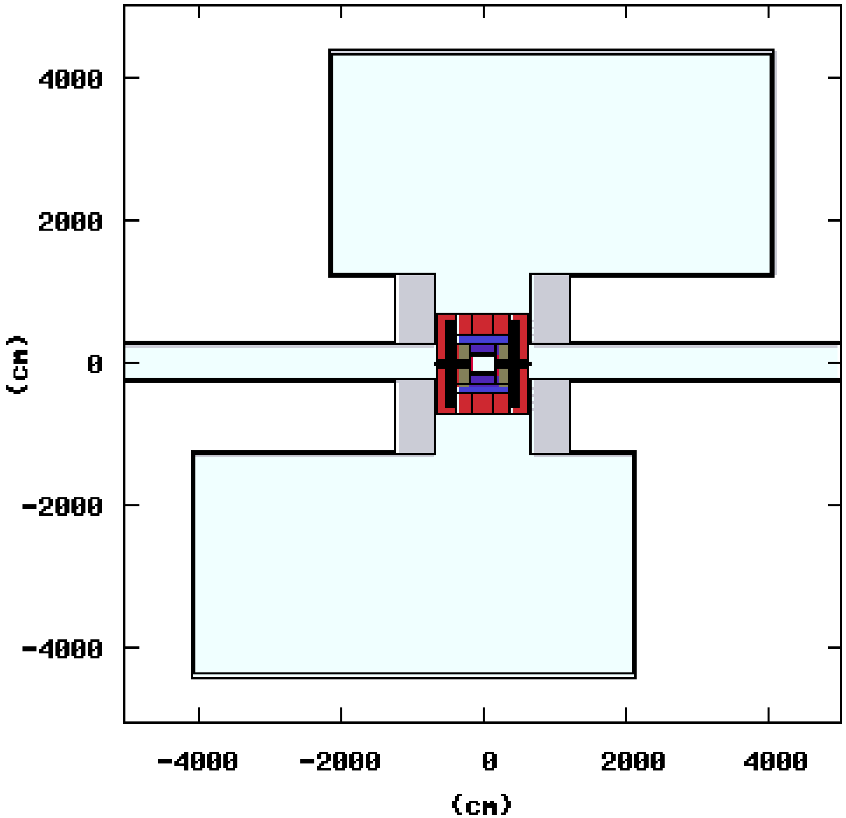
Thanks to all for helping to prepare this talk !

SPARES

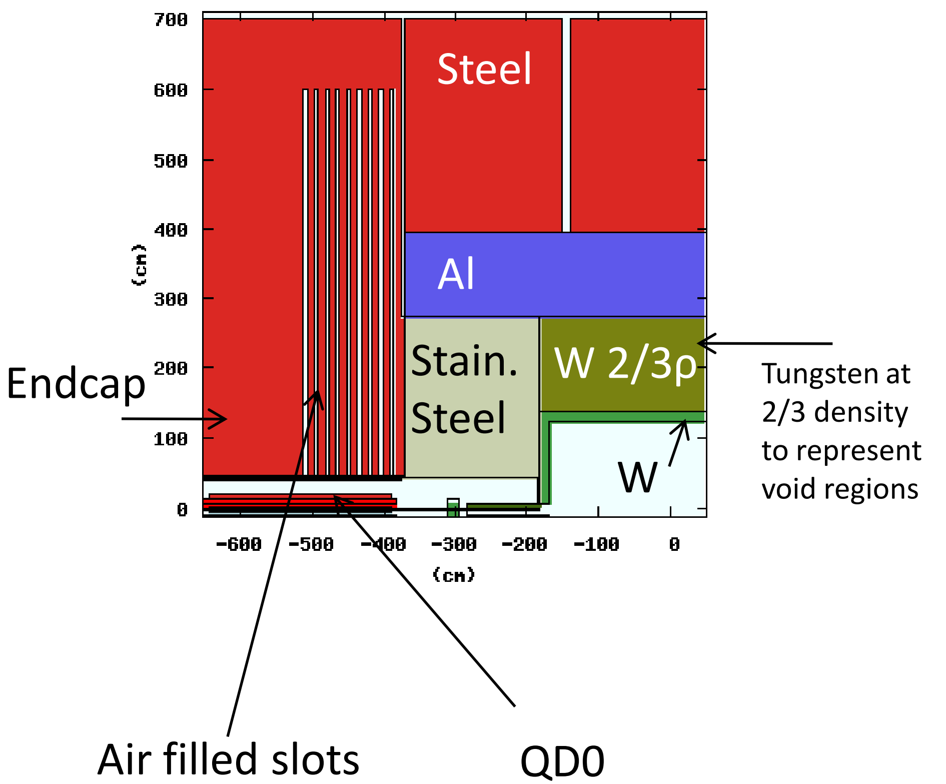
MDI Region – FLUKA Representation

- Representation of MDI Region & Detector used in FLUKA simulations

Horizontal cut through MDI Region



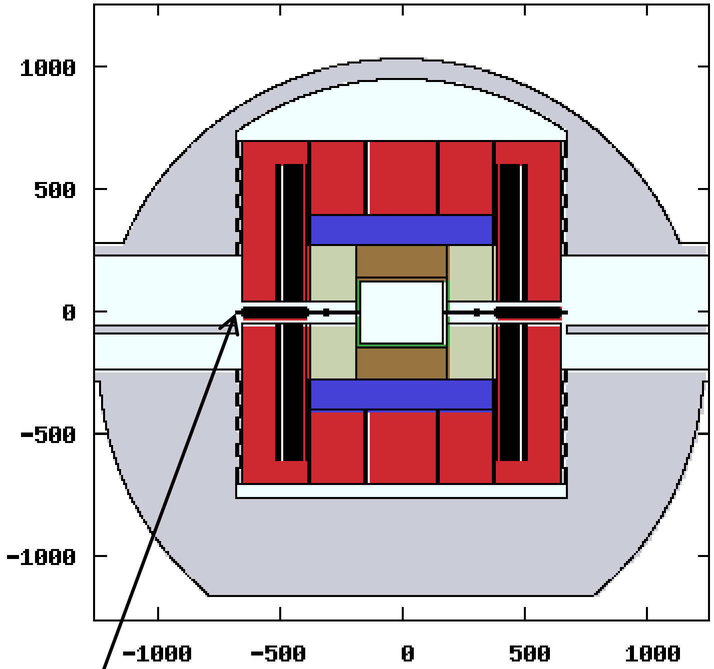
Detector Materials



MDI Region – FLUKA Representation

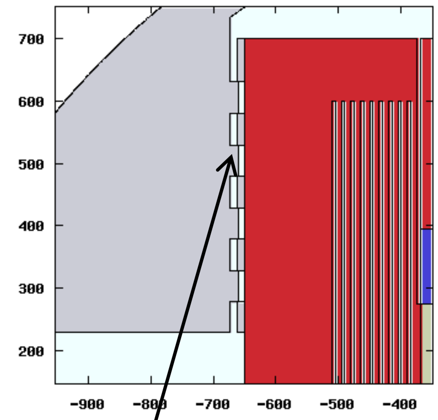
- First Simulations: Beam Loss on QDO, with & without shielding.

Vertical cut through Detector



Beam Loss represented at 'edge' of QP

Shielding Rings



Possible shielding Design. Rings (concrete?) attached to detector endcap - Contractible for maneuver of detector from side caverns to interaction region. Rings overlap by 2 cm.

Representation of Solenoid Field

Simple representation of solenoid field included in simulations