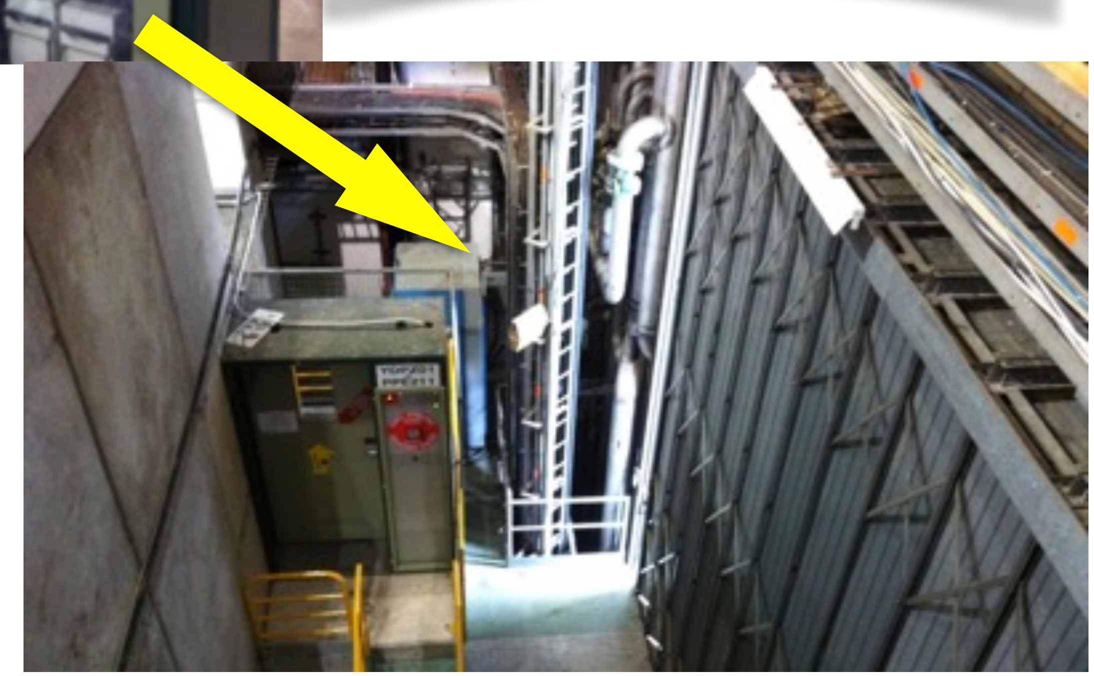
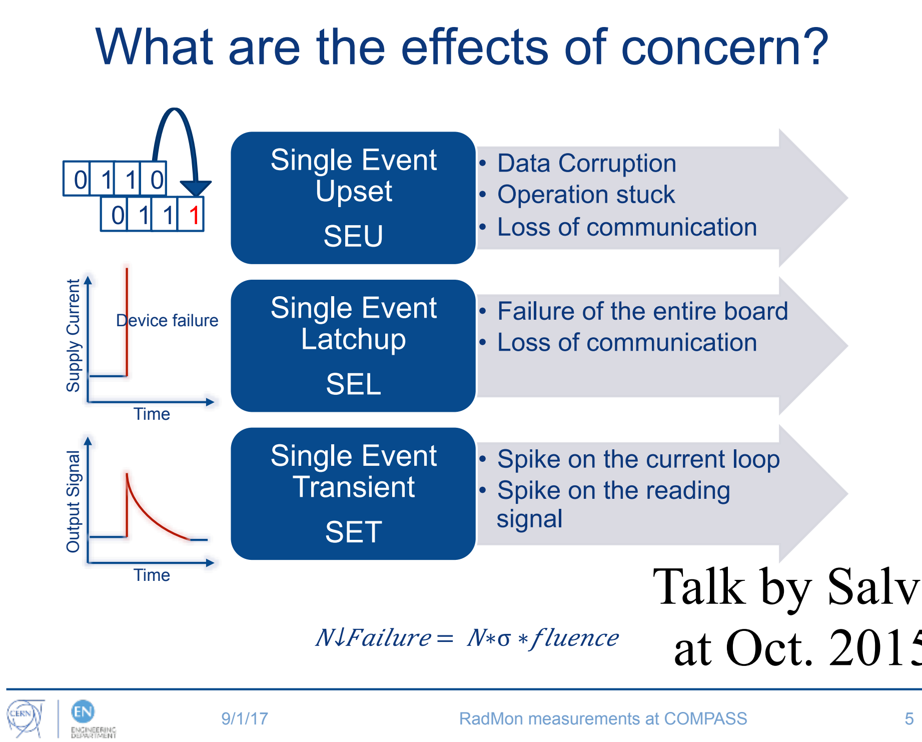
2018: modifications of setup wrt 2015

- PLC shielding
- Beam Telescope
- Vertex detector
- Nuclear targets
- Li6 absorber

2018: improved shielding of He coldbox PLC

- PLC units will be moved from upstairs Jura side to ground level behind concrete wall to reduce radiation & Single Event Effects (SSE).

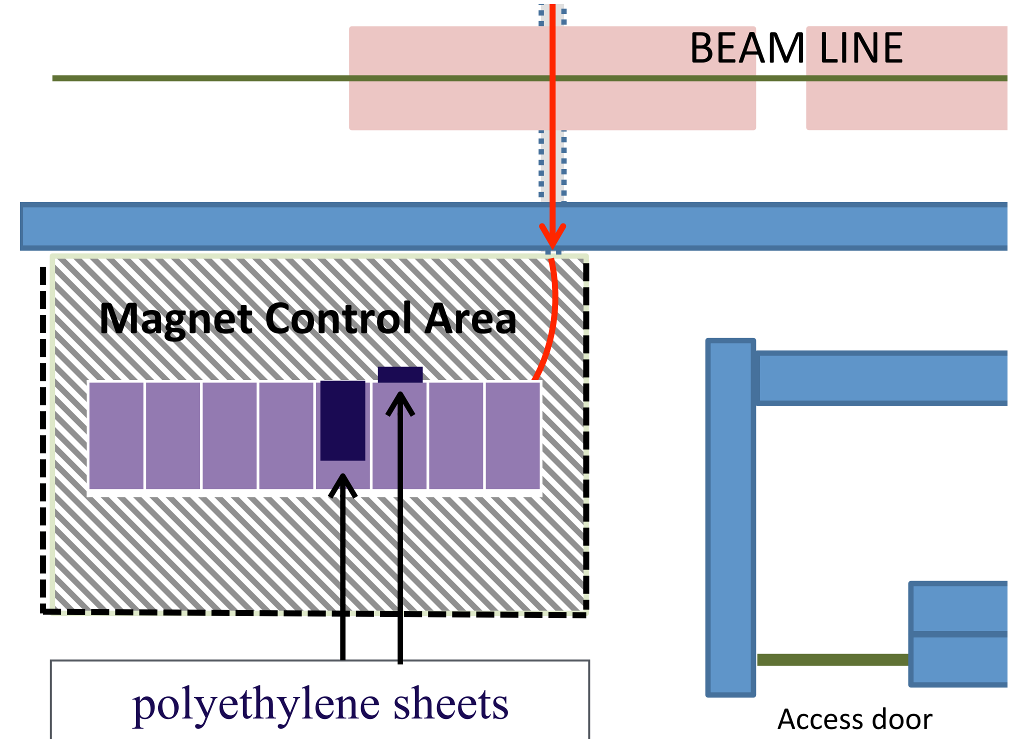




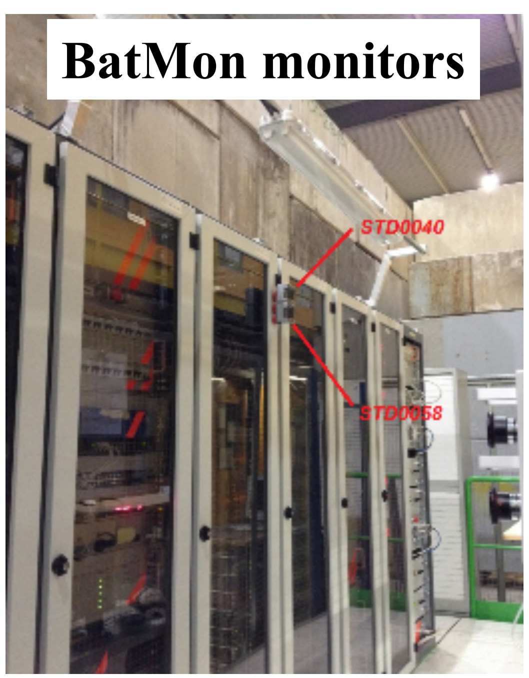
Talk by Salvatore Danzeca at Oct. 2015 TB meeting

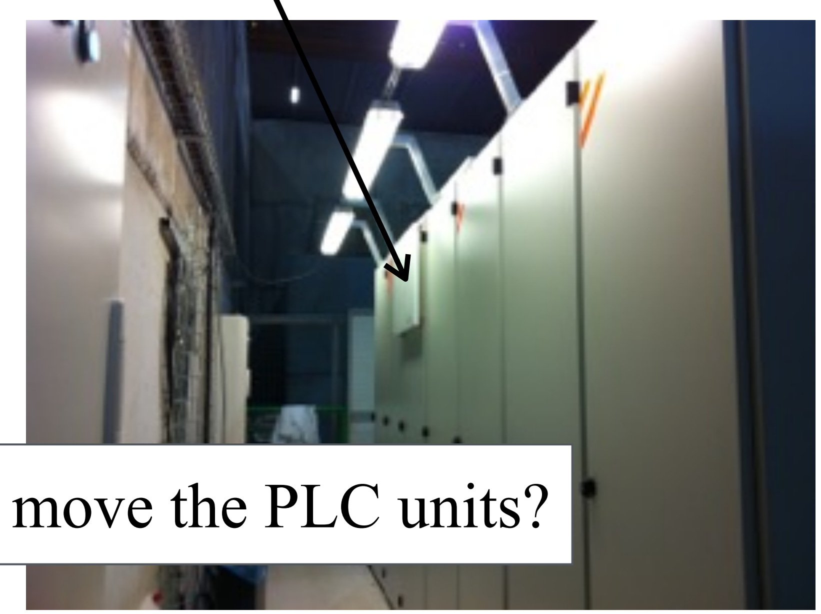
2018: improved shielding for magnet PLCs?

- **Multiple SEEs during 2015 magnet operation.**
- **BatMon monitors** installed August 2015.
- PLCs were shielded in October 2015 with sheets of polyethylene. Failures still present afterwards.
- Instead of adding more shielding, the preferred solution seems to be **to move the PLCs (up to 100m),** across the street in clean area or BA82 or…
- Angelo's FLUKA geometry file does not include PLC area (only experimental area, starting from end of beam line). In principle this geometry could be extended but secondary beams and halo very difficult to simulate.



polyethylene sheets 600mm x 500mm x 25mm





Should we go ahead and move the PLC units?

2018: improve redundancy in Beam Telescope

- 2015: 8 SciFi planes were installed, FI01 (X,Y), FI15 (X,Y,U), FI03 (X,Y,U).
- 2015: $\langle BT/event \rangle$=2.1 ($\geq$5 hits required). If 1 plane is lost: $\langle BT/event \rangle$=1.7
- **Move FI04** to beam telescope (from downstream of absorber), z=-675
  - FI04 does not contribute to 2015 tracking (Catarina's simulation)
  - Recent MC simulation (Vincent) shows that this option has a significant impact on the redundancy of beam track reconstruction in the BT.
- Alternatively: build additional U-layer for FI01.

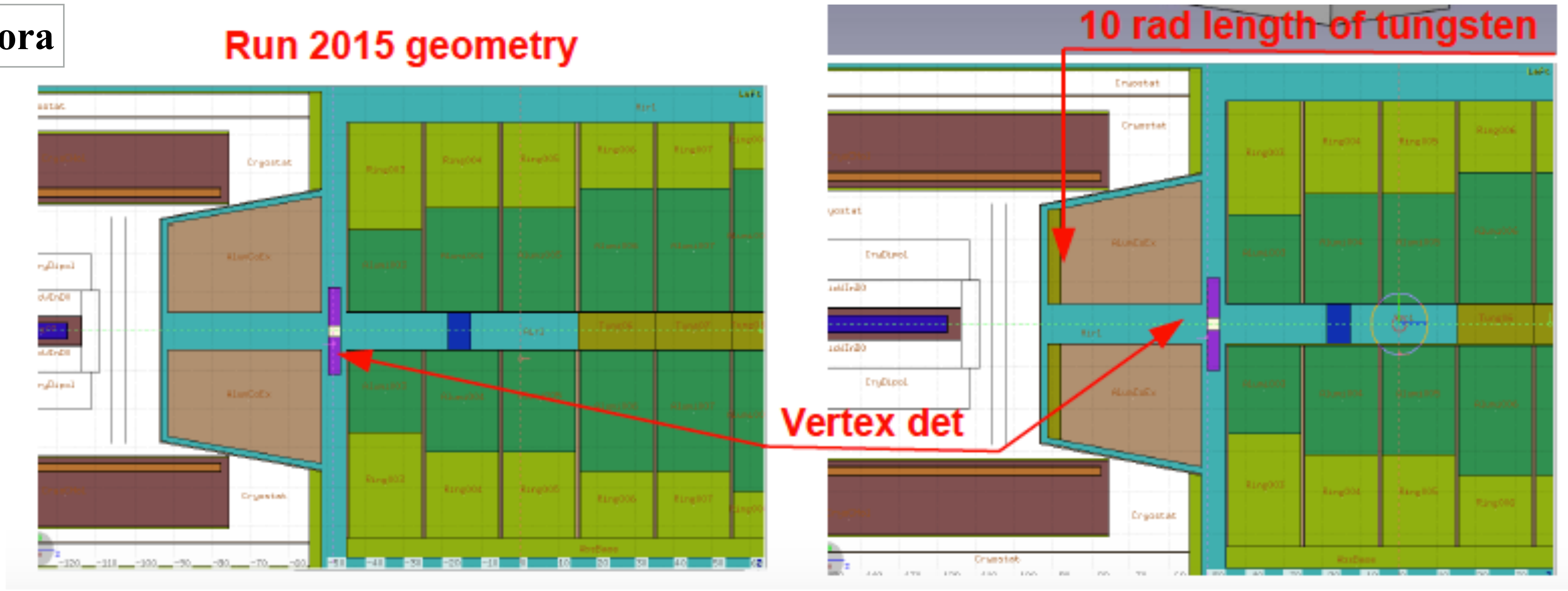
2018: move Vertex Detector (FI35)?

- 2015: FI35 suffers from high multiplicity, being illuminated by showers from the hadron absorber. Its hits are not included in the track reconstruction.
- **Move FI35** to downstream of hadron absorber (from upstream of hadron absorber) = FI04 position of 2015?
- In addition, rotate by 90º to allow access to FEE.
- The simulation (Vincent) shows that:
  - 30% of events have ≥1 hit in FI35 (at new position), which is certainly more than what FI04 saw.

  But: what is the overall impact on track reconstruction?
    - $\chi 2$ only marginally improved
    - sigma of track time slightly improved
- One selling argument of the original FI35 position was to have a point upstream of the absorber, for better target pointing, to avoid multiple scattering in the absorber.
- Is it worth the effort? Rainer will need ~ 1 manpower month for the movement.
- Mounting has yet to be discussed with Vladimir and the Saclay group.

2018: better protection of FI35 from γ radiation?

Angelo Maggiora



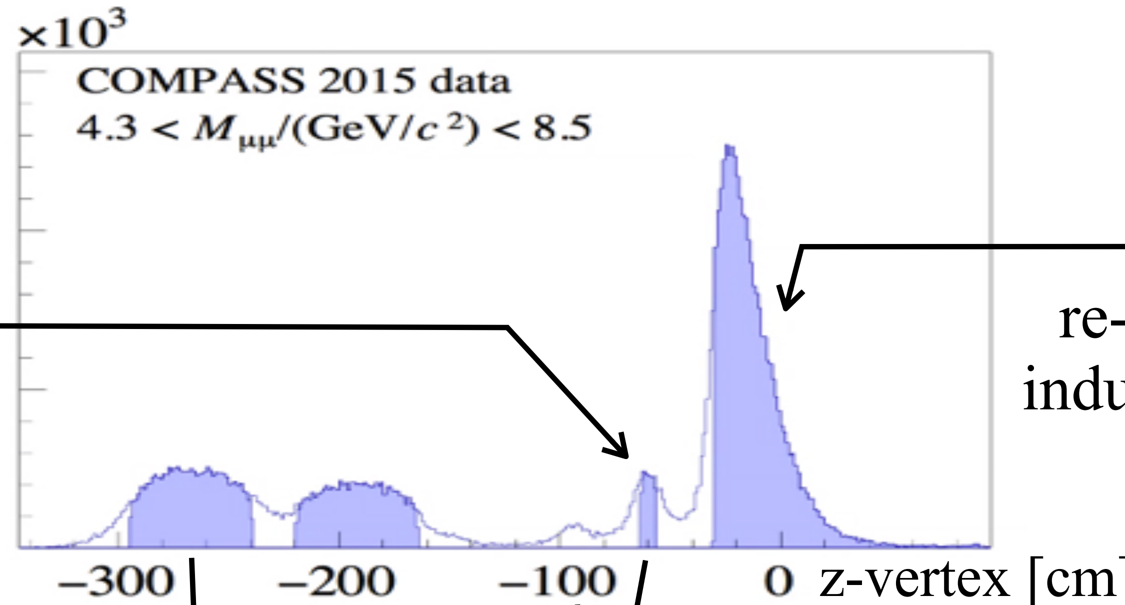
name	Cone geometry	Charged part	Photons
VTX01-ntg-01	Alu cone, 2015 configuration	21.2 part/pr	193.3 part/pr
VTX01-ntg-02	10 rad length of W, 3.5 cm	12.6 part/pr	117.9 part/pr

Warning

- **Vertex resolution, to be studied with comgeant**
- **Cradle equilibrium: the change the center of gravity of the cradle, risk of cone falling on the solenoid closing cap**
- **Check the cone activatoion level before machining**
- **Feasibility study with TB**

2015 nuclear targets

Al target:
poor statistics,
shadowed by W plug



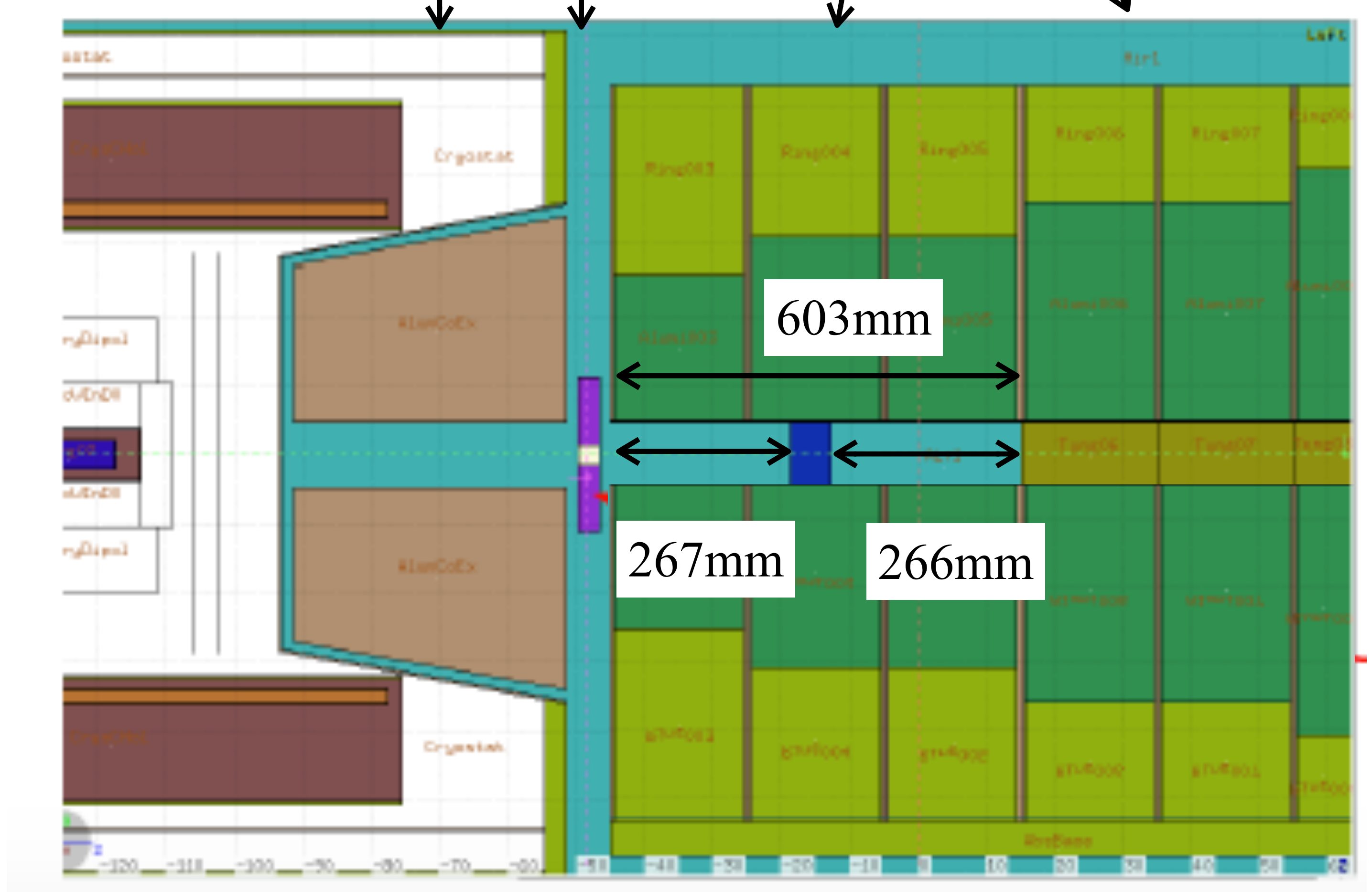
W target (plug):
re-interactions (DY events induced by secondary pions),
z-resolution

NH3

nose

FI35

After removal of FI35: gain more freedom to position Al target



70mm

95mm

2018: improvement of nuclear targets?

Idea 1: Replace Al target by W target, to improve W statistics,
& move ~6cm upstream, to avoid tail of events from W plug,
& add 6cm disk of aluminum, to minimize escaping radiation
(with a hole in the center to let beam pass)

→ Angelo's study August 2017

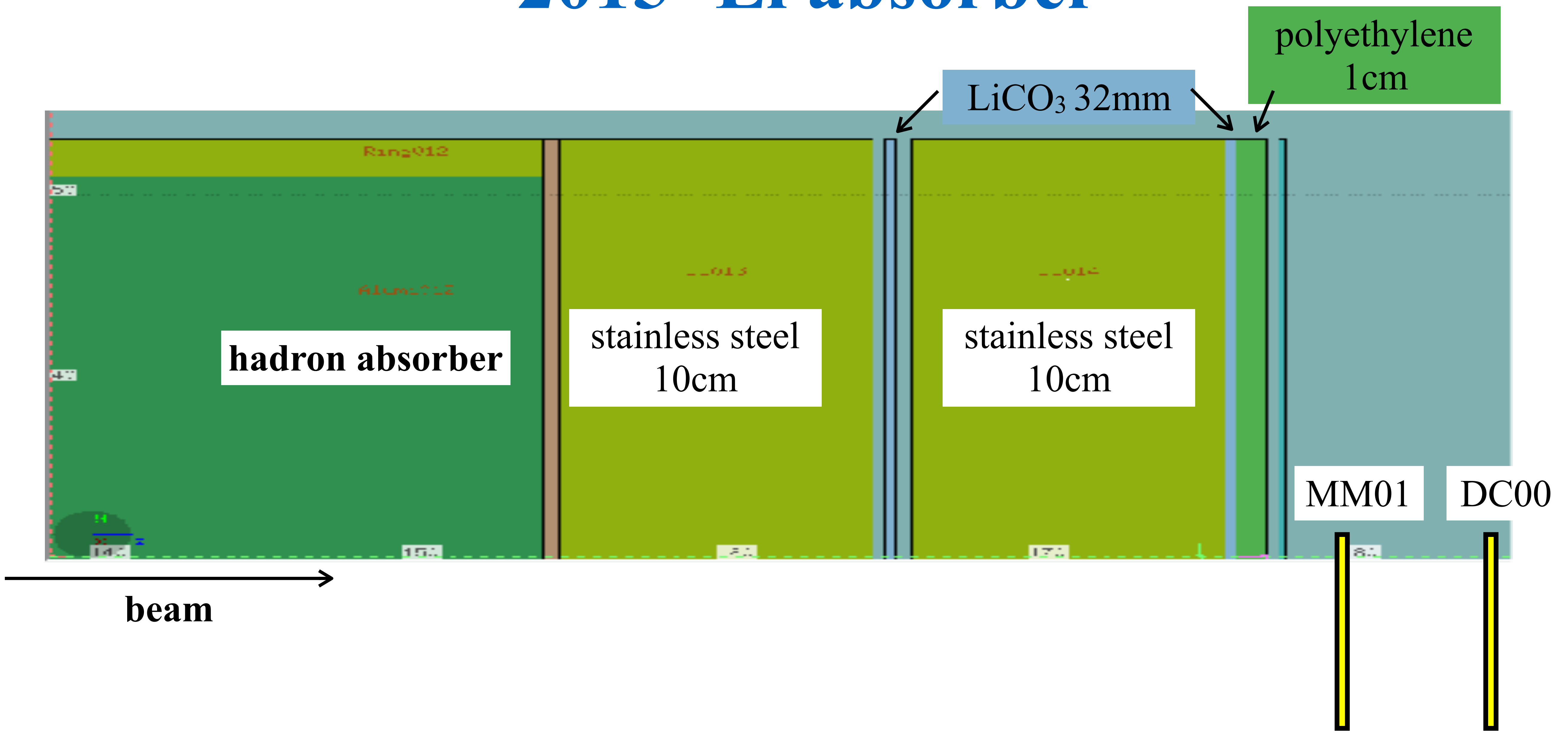
configuration	Mean dose in control room (μSv/h)	Dose Increment	note
Final-04	4,08	0%	configuration of 2015 run
Final-09	4,12	1%	Final-04 + alu target
Final-10	4,53	11%	Final-06 + w target

- Angelo: Disk will not decrease radiation in the environment around the absorber.
- Can reduce a little bit the backward scattering but not in the polarized target. The radiation in the target must be minimized to avoid loss of polarization.
- Main problem is radiation orthogonal to the W plug (side radiation).
- ~10% increase of radiation, while we must reduce the radiation!

Discussion at DY meeting August 31:
Idea 2a: Move Al target as much as possible upstream, make it thicker.
Idea 2b: as 2a, but make it Ca, Ni, Fe target.

For the sake of the nuclear Drell-Yan effect!

2015 ^{6}Li absorber

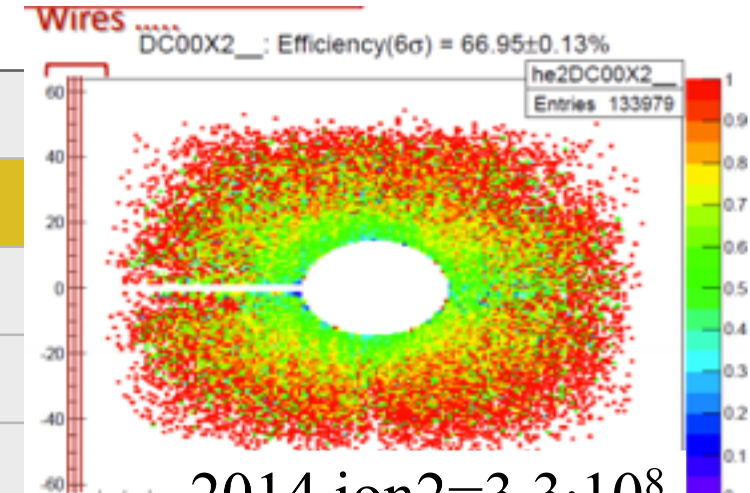


- Purpose: absorption of neutrons, which might be captured and emit $\gamma \rightarrow e^+e^-$
- Installed after 2014 DY run because of suffering efficiency in DC0.

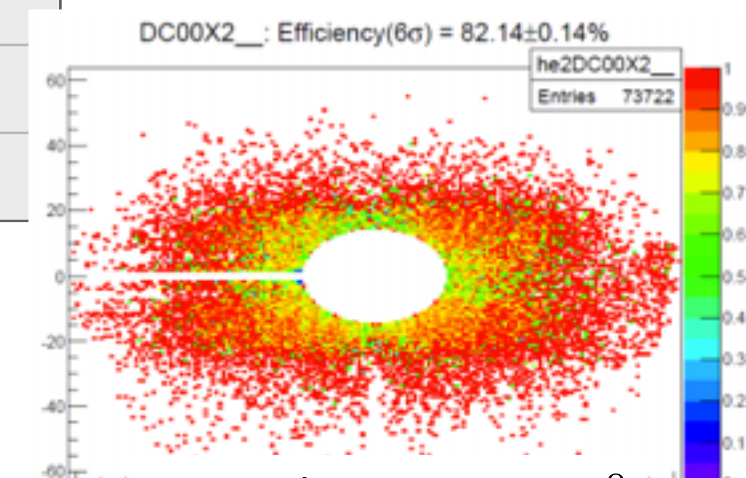
DC0 efficiency & MM rates 2014 vs. 2015

	no ^{6}Li	2 ^{6}Li sheets		
DC0-eff [%]	2014	2015	2015	2015
ion2 [10^8]	3.3	3.4	4.8	1.8
X1	83.0	91.5	89	92.3
X2	**66.9**	84.6	**82**	91.5
Y1	83.0	90.1		
Y2	83.3	90.6		
U1	74.7	84.6		
U2	72.1	84.1		

efficiency numbers based on one example run.



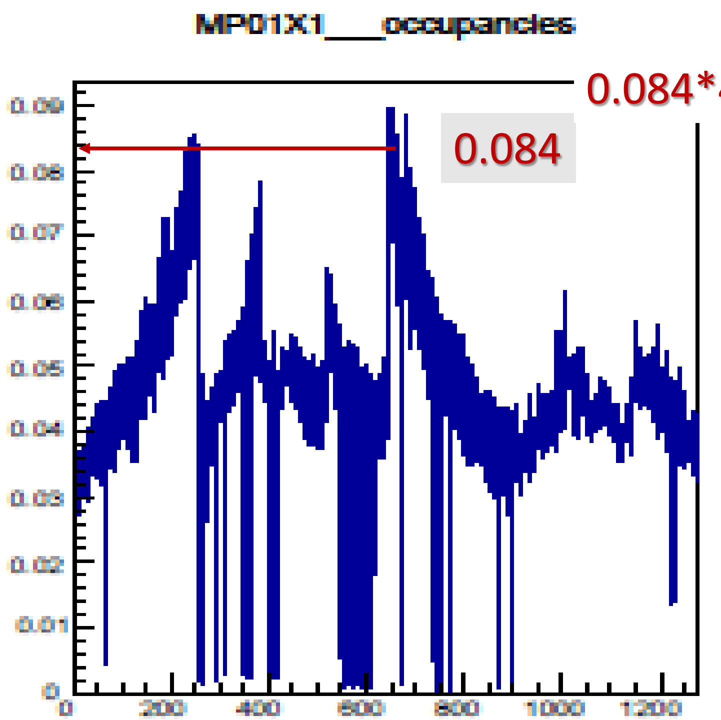
2014 ion2=$3.3 \cdot 10^8$



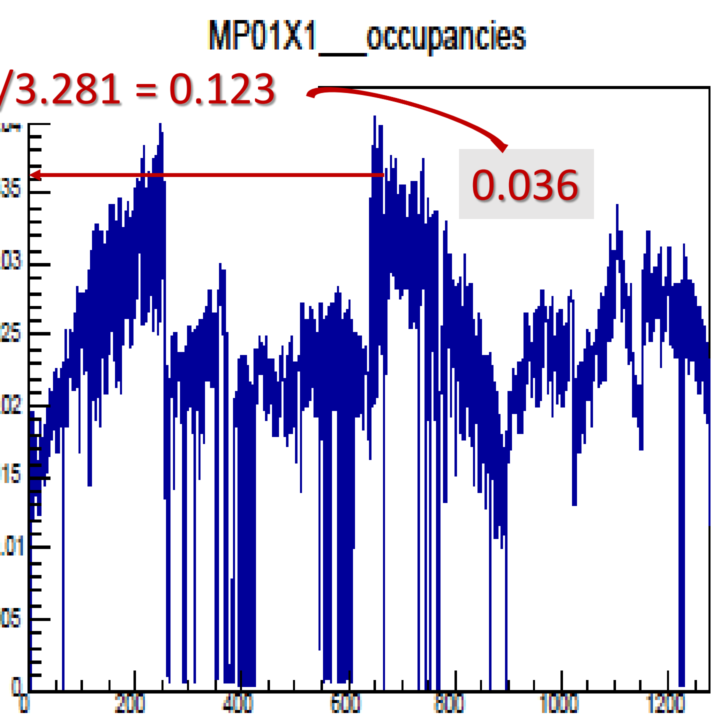
2015 ion2=$4.8 \cdot 10^8$

plots from Alain

DY 2014
Run 255039 μ_IonCh = $3.281 \cdot 10^8$



DY 2015
Run 258283 μ_IonCh= $4.800 \cdot 10^8$

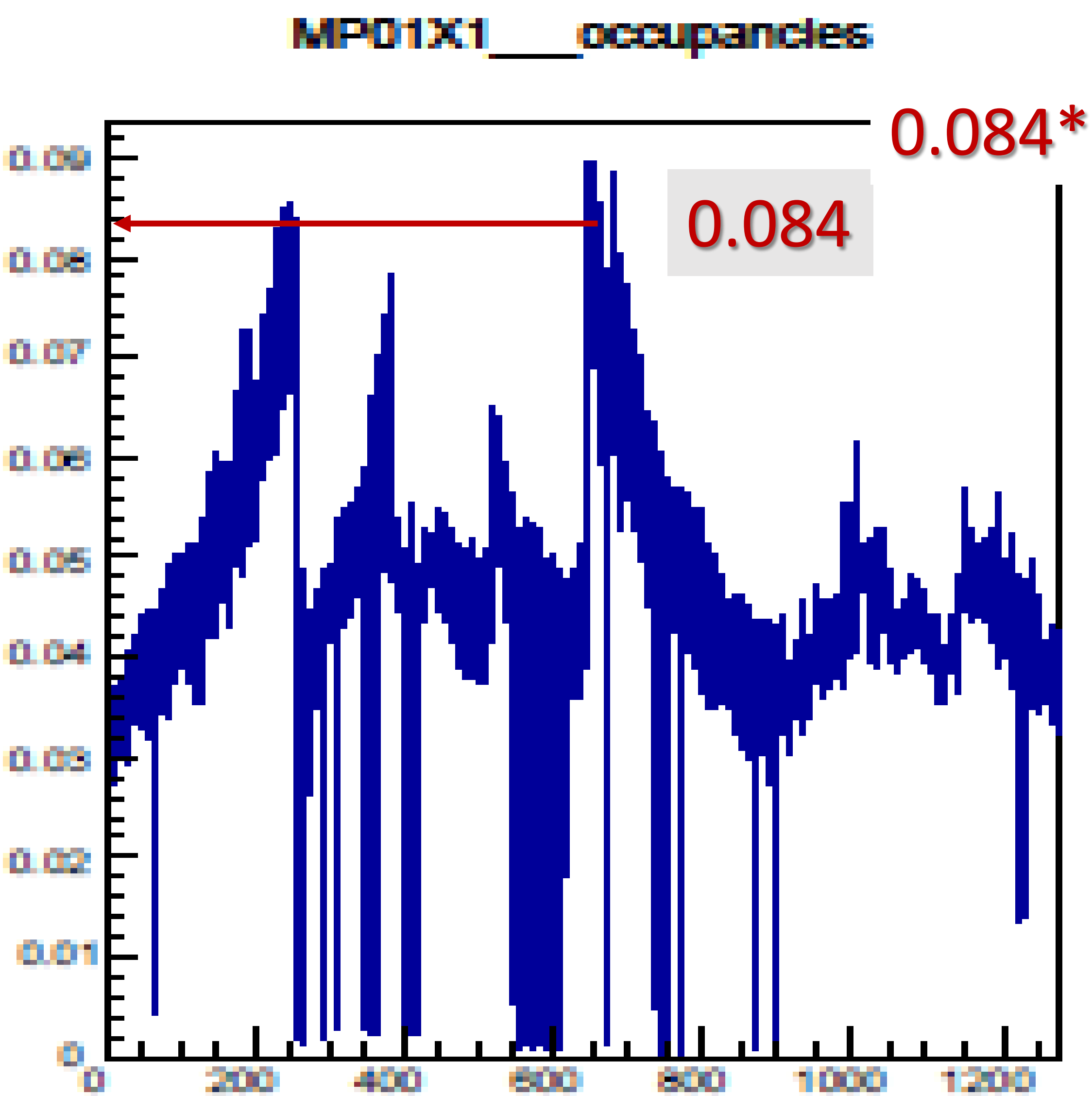


Might be difficult to judge because also protection resistors of DC0 were exchanged - before or at the beginning of the 2015 run (?).
But: MM rates! (left)

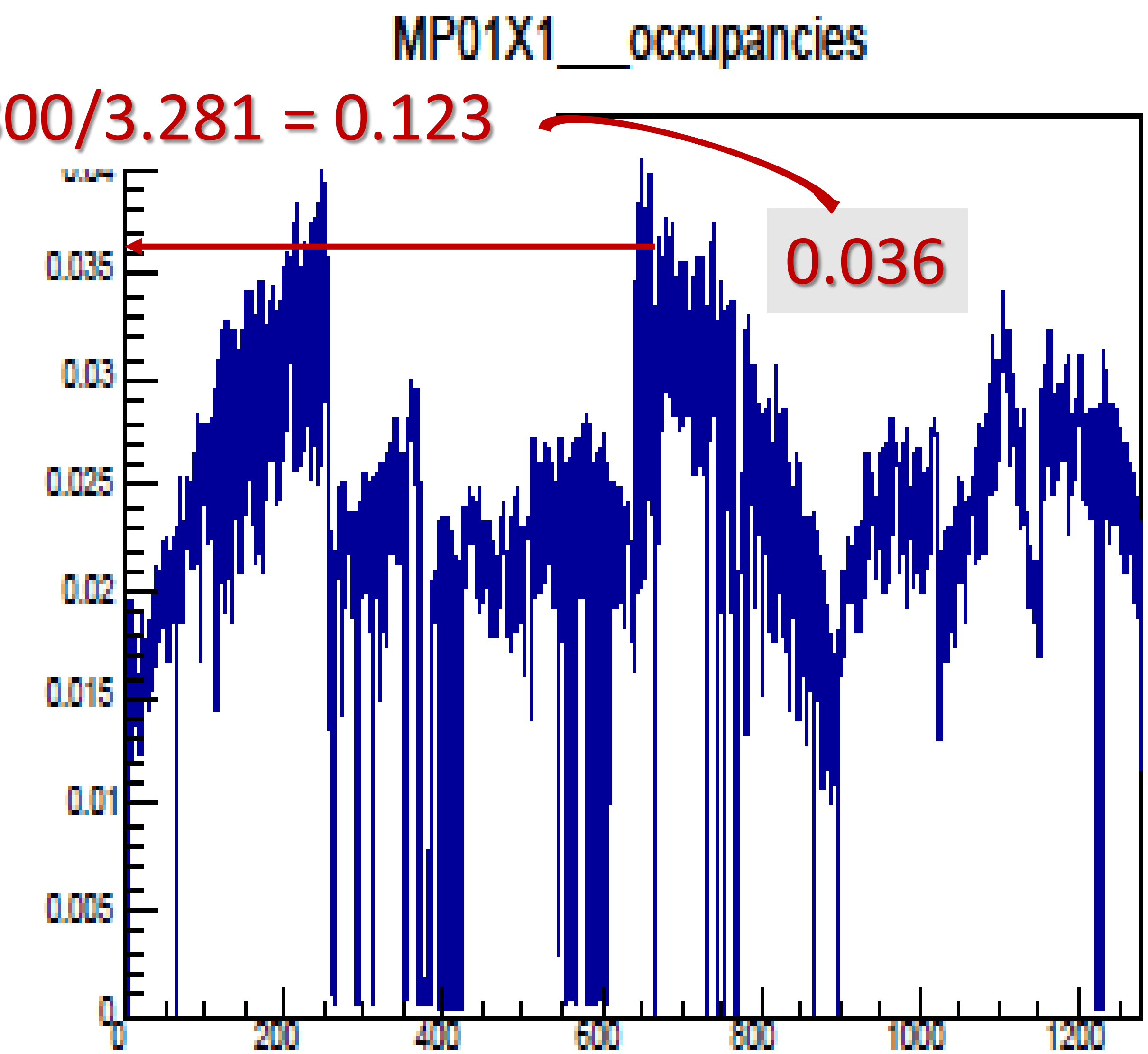
Rates in micromega with / without Li6

courtesy Alain

DY 2014	DY 2015
Run 255039 μ_IonCh = 3.281*10^8	Run 258283 μ_IonCh= 4.800*10^8



0.084*4.800/3.281 = 0.123



FLUKA simulations for neutron absorbers

Angelo Maggiora, presented at DY meeting July 13, 2017

simulation	Additional sheet	Thickness [cm]	phot/Pr	neutron/Pr	e^-/Pr/cm^2	charg/Pr
MM01-ntg-10	Air (run 2015)	0.32+0.32+1	2.145	1.762	0.109	0.219
MM01-ntg-11	Carbonated Lithium + polyethylene (run 2015)	0.32+0.32+1	2.259	1,600	0.119	0.230
MM01-ntg-12	Borated polyethylene (B = 30%)	0.32+0.32+1	2.383	1.328	0.108	0.230
MM01-ntg-13	Gadolinum+ polyethylene	0.32 + 1.32	2.411	1.616	0,127	0.234

Neutral = neutrons + photons + other

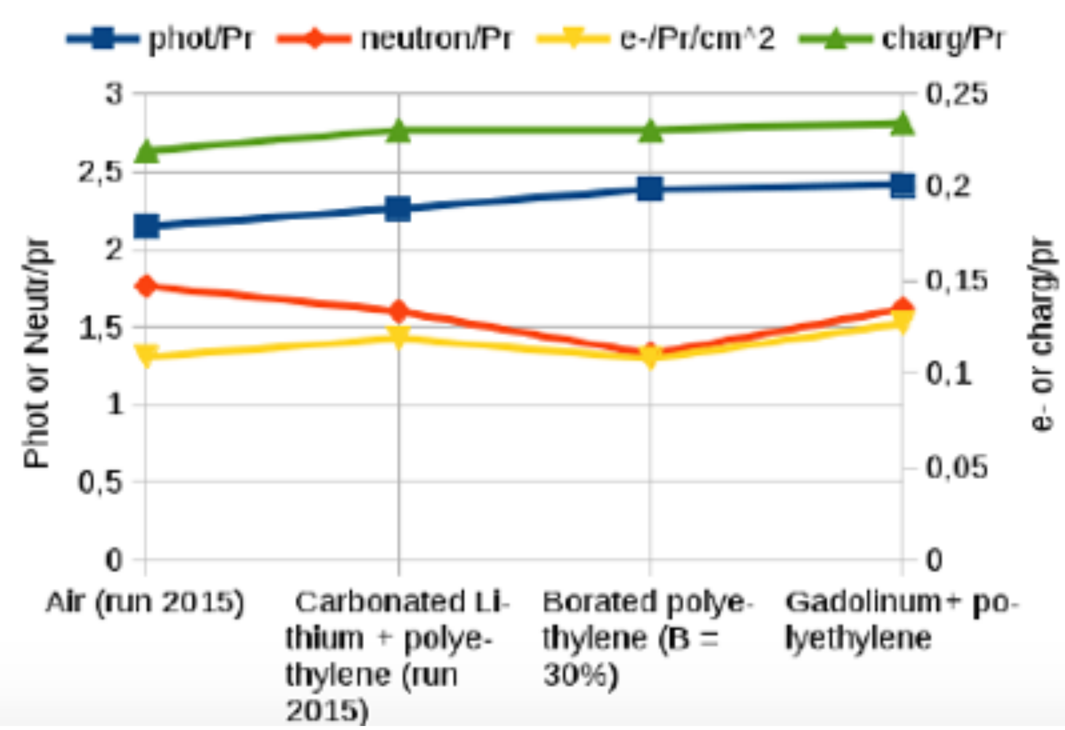
Check with standard flka scoring

Neutrons crossing MM1

- Lithium -9%
- Borated polyethylene -25%

Photons crossing MM1

- Lithium +5%
- Borated polyethylene +11%



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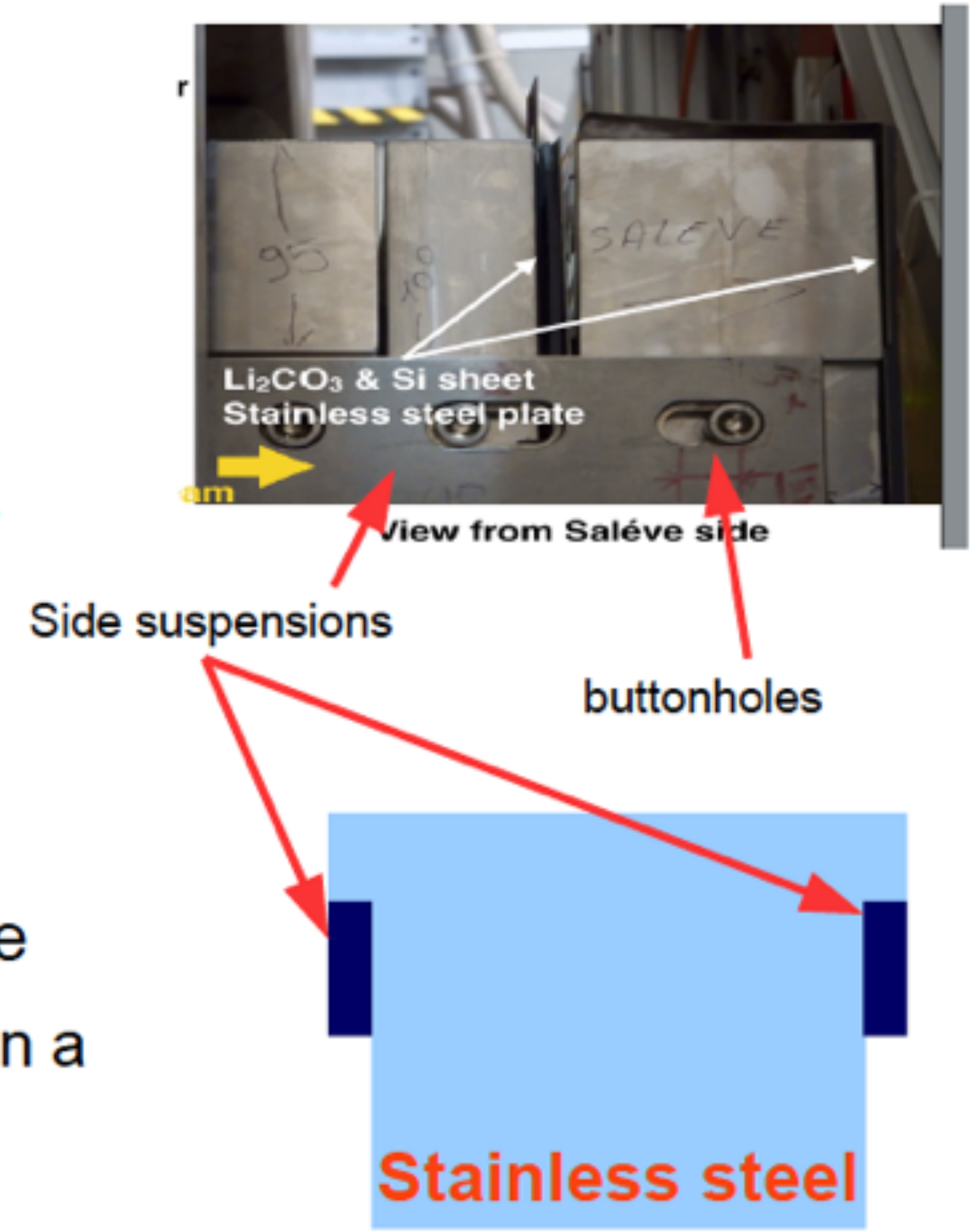
Suggestions
from cheap to expensive

- Reshouffle the downstream stainless steel layers
  - Motivation: leave more material in the neutron source direction
    - Now: 5cm + 5cm + airgap + 10cm
    - Reshouffled: 10cm + 5cm + airgap + 5cm
  - Check the side bar suspensions and its buttonholes
- Remove the downstream Li layer and polyethylene
  - Simply wrong: always, put the moderator first and then a neutron absorber
- Replace the side suspensions with longer one
  - Leave more air gap between the last two layers
- Use natural borated polyethylene instead of Li



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conclusions

- No impressive neutrons reduction even with the best neutrons absorbers (in theory)
- No relevant difference in XY distribution
- For neutrons flux reduction, borated polyhethylene is better than carbonated lithium sheet
- For photons flux reduction, carbonated lithium is better tha borathed polyethylene
- Check of vertex, momentum resolution etc, must be done using the standard Compass simulations tools.

But the basic question is:
The high rates is due to neutrons or photons interaction?

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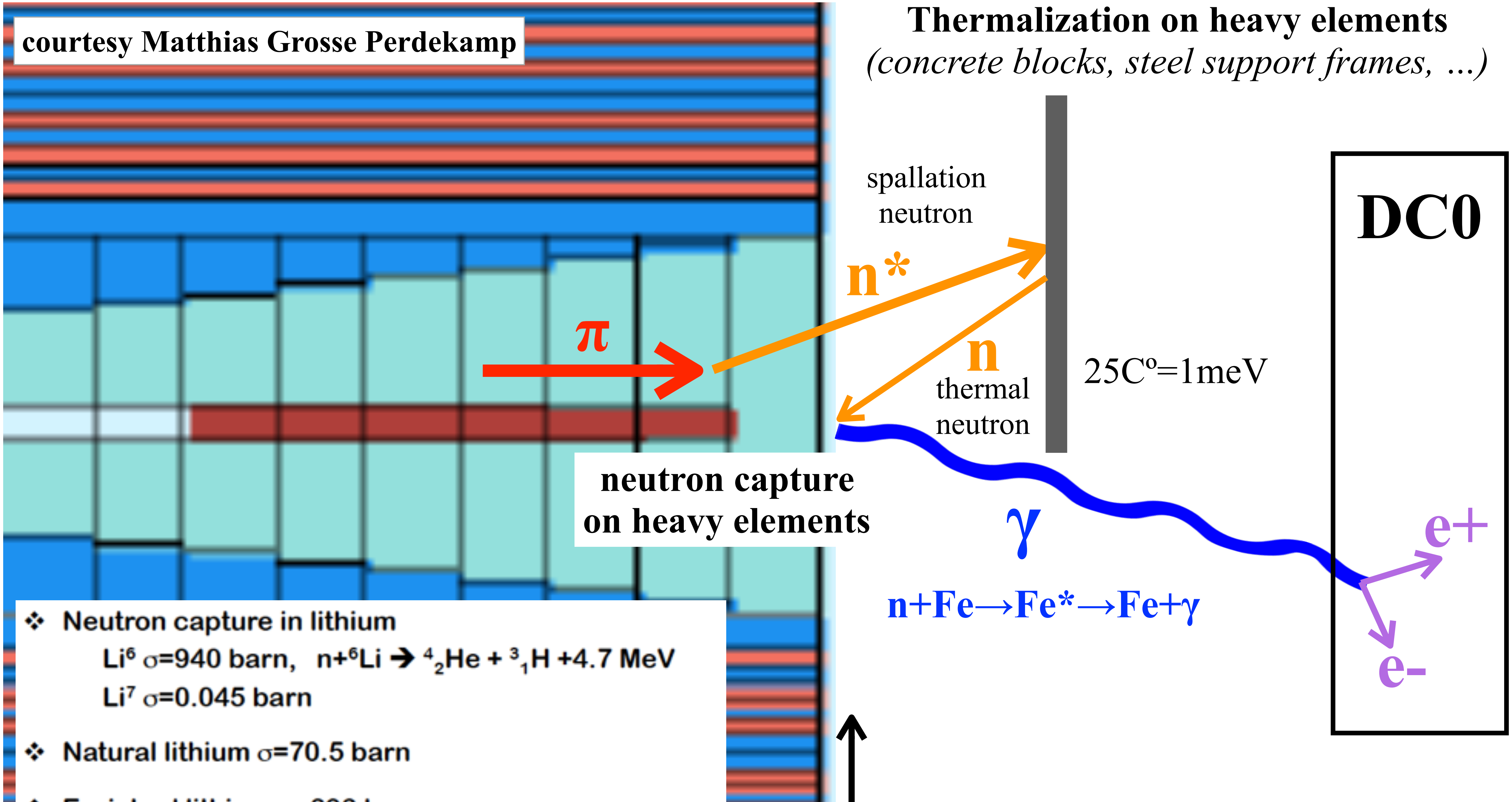
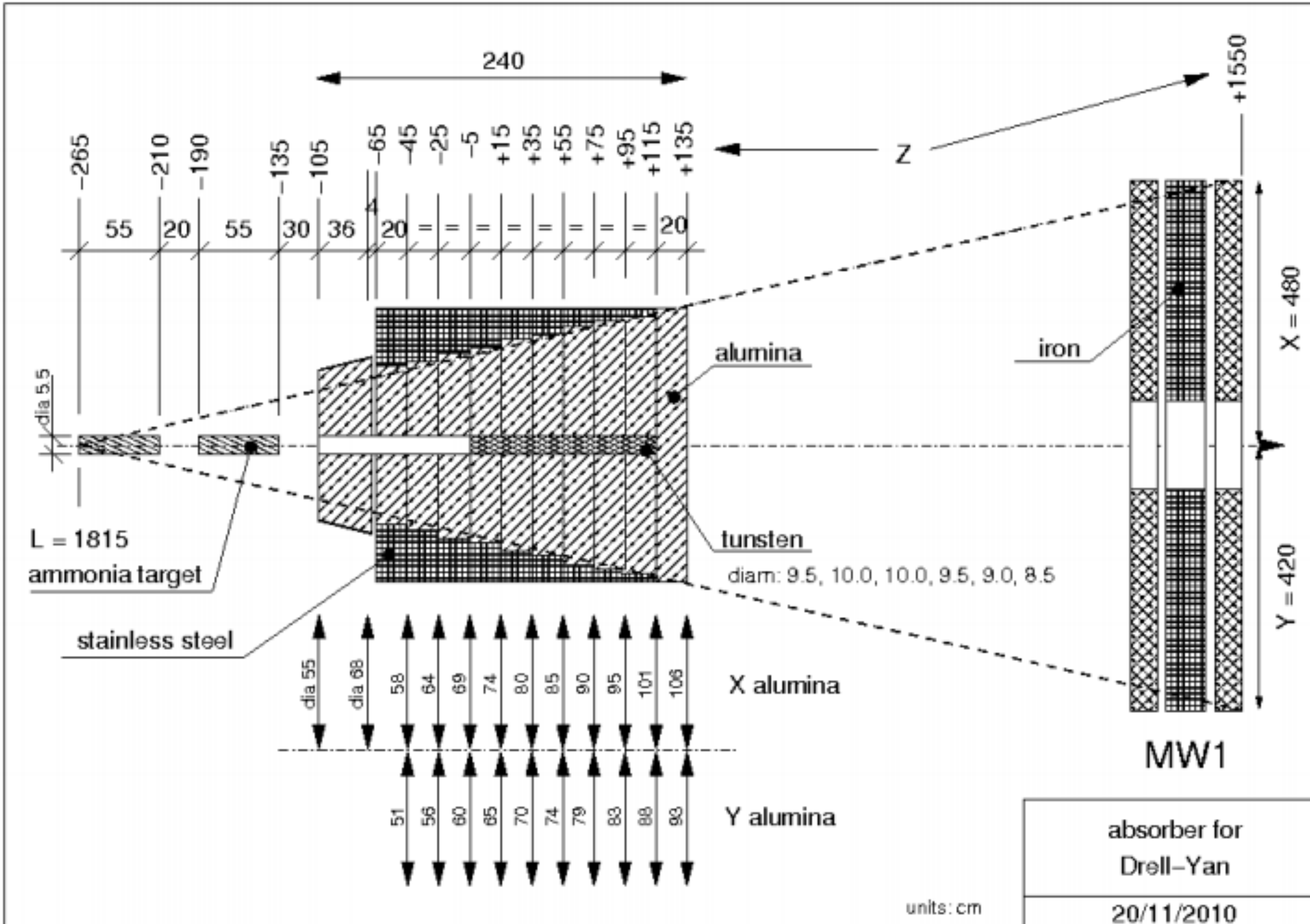
$^6LiCO_3$: principle



- Neutron capture in lithium
  - Li^6 σ=940 barn, $n+^6Li \rightarrow {}^4_2He + {}^3_1H$ +4.7 MeV
  - Li^7 σ=0.045 barn
- Natural lithium σ=70.5 barn
- Enriched lithium σ=893 barn
- Absorption length
  - Enriched d=1.5 mm reduce th. neutron flux to 1%
  - Natural λ=20mm reduce th. neutron flux to 1%

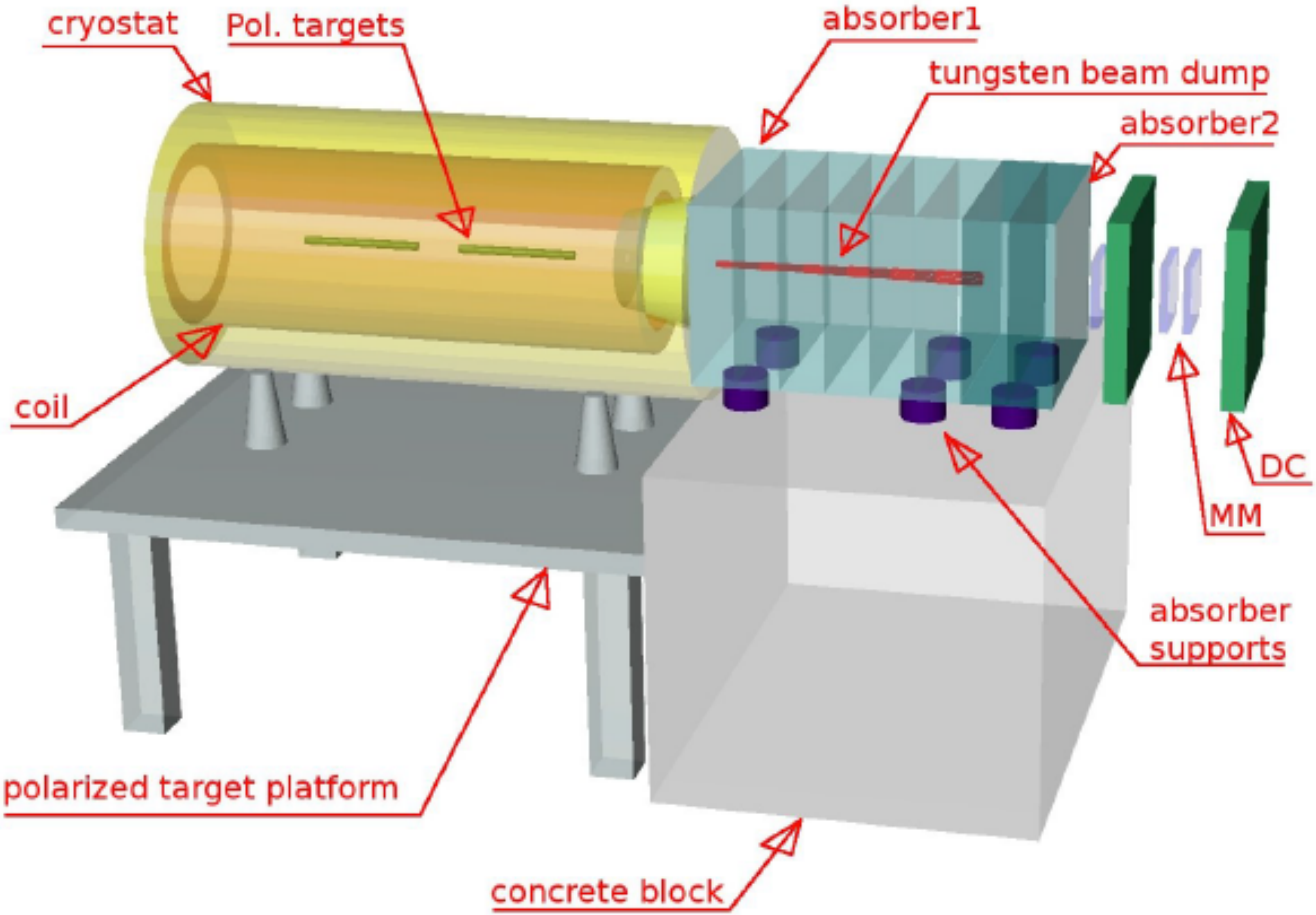
Insert neutron absorber here:
- Both Li and Bo are good in absorbing low-E neutrons
- $n + {}^6Li \rightarrow {}^3H + {}^4He$: *stop in air, do not reach DC0*
- n + B → B* → B + γ_500 keV : *reaches DC0*

Extra slides



240
Z
-265
-210
-190
-135
-105
-65
-45
-25
-5
+15
+35
+55
+75
+95
+115
+135
+1550
55
20
55
30
36
4
20
20
dia 5.5
alumina
iron
X = 480
Y = 420
L = 1815
ammonia target
tunsten
diam: 9.5, 10.0, 10.0, 9.5, 9.0, 8.5
stainless steel
dia 55
dia 68
58 64 69 74 80 85 90 95 101 106
X alumina
51 56 60 65 70 74 79 83 88 93
Y alumina
MW1
absorber for Drell–Yan
units: cm
20/11/2010

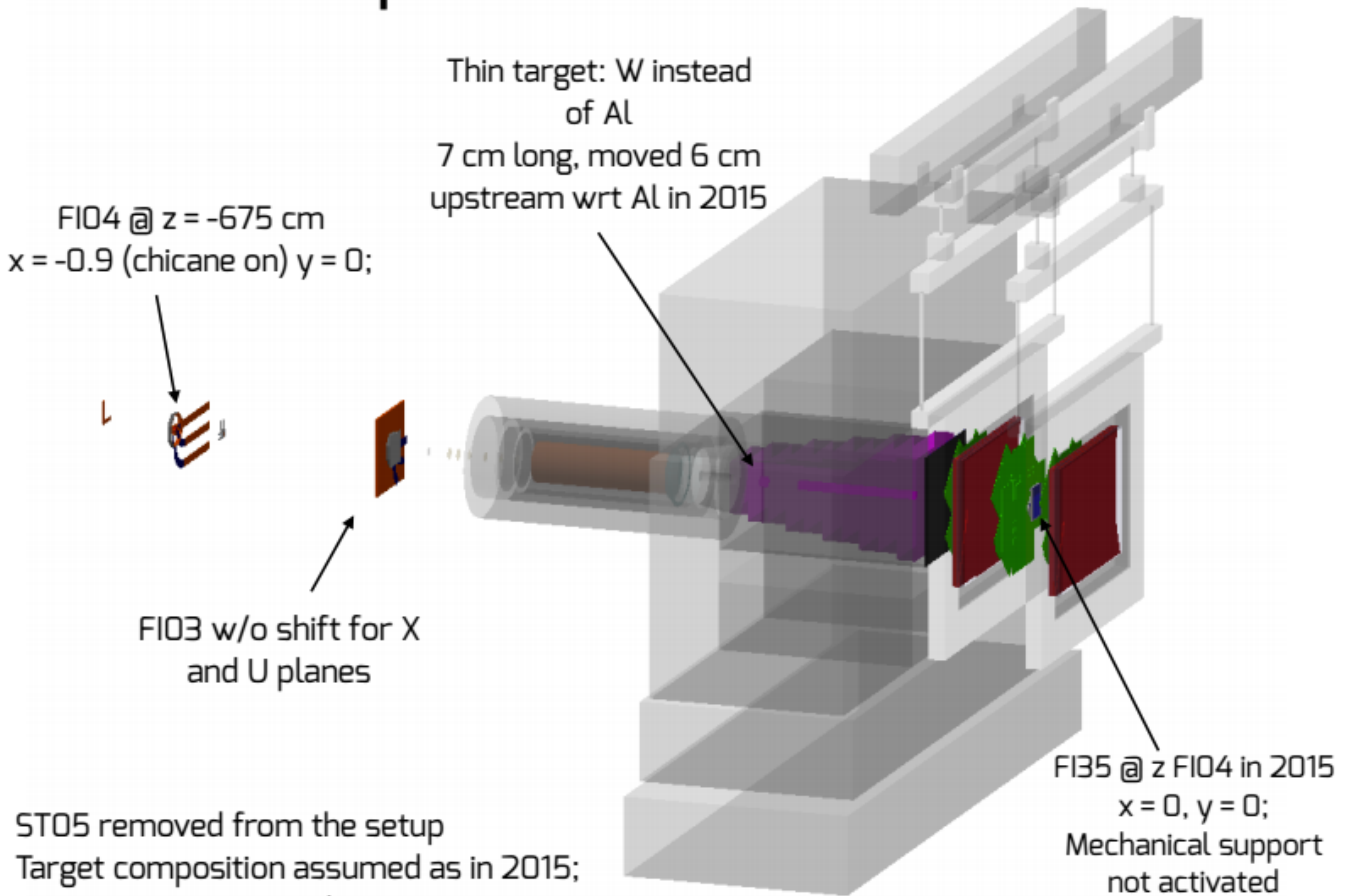
2015 setup (Al target missing)



2018: proposed modifications

courtesy Riccardo Longo

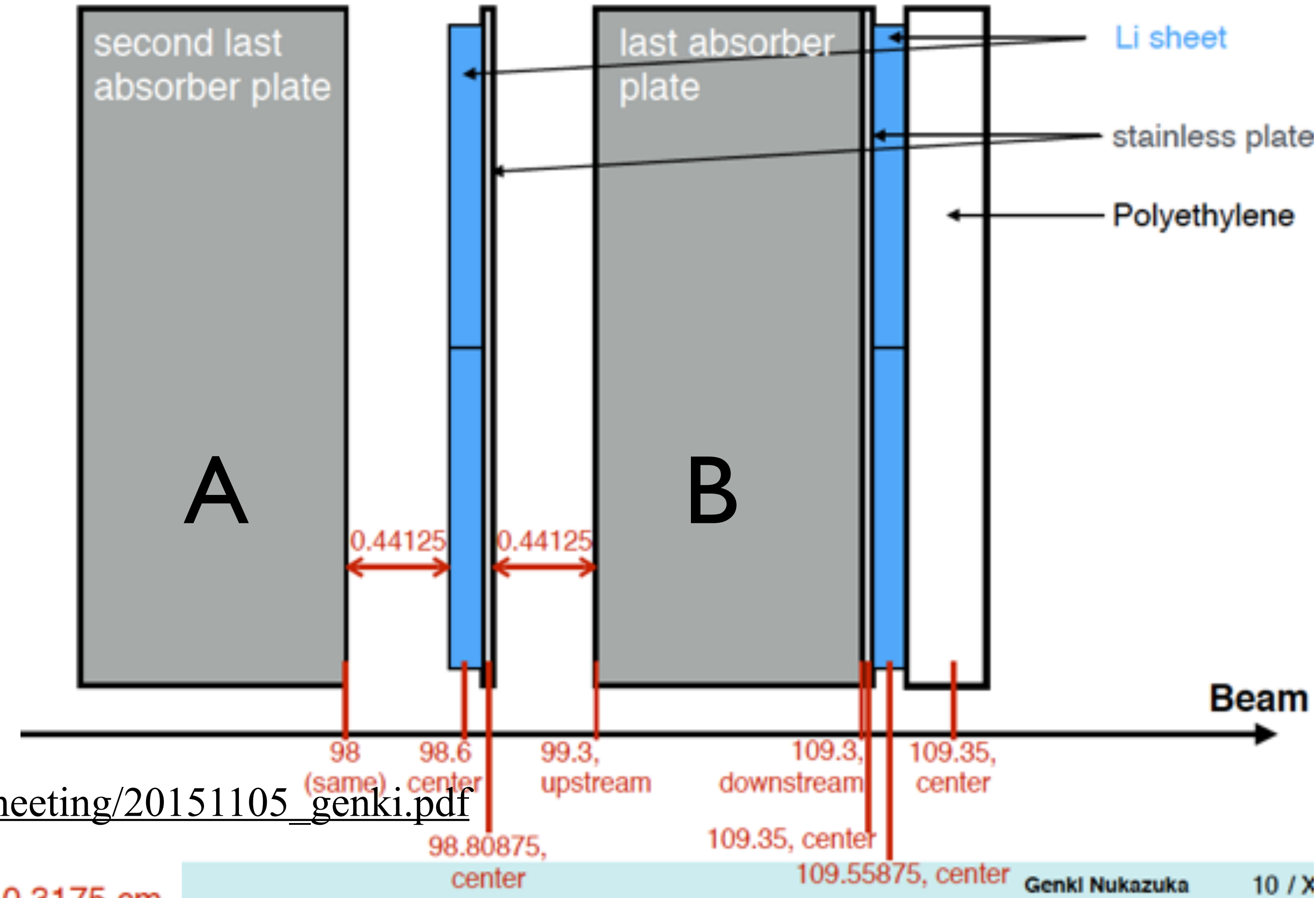
DY-2018: first implementation in TGeant



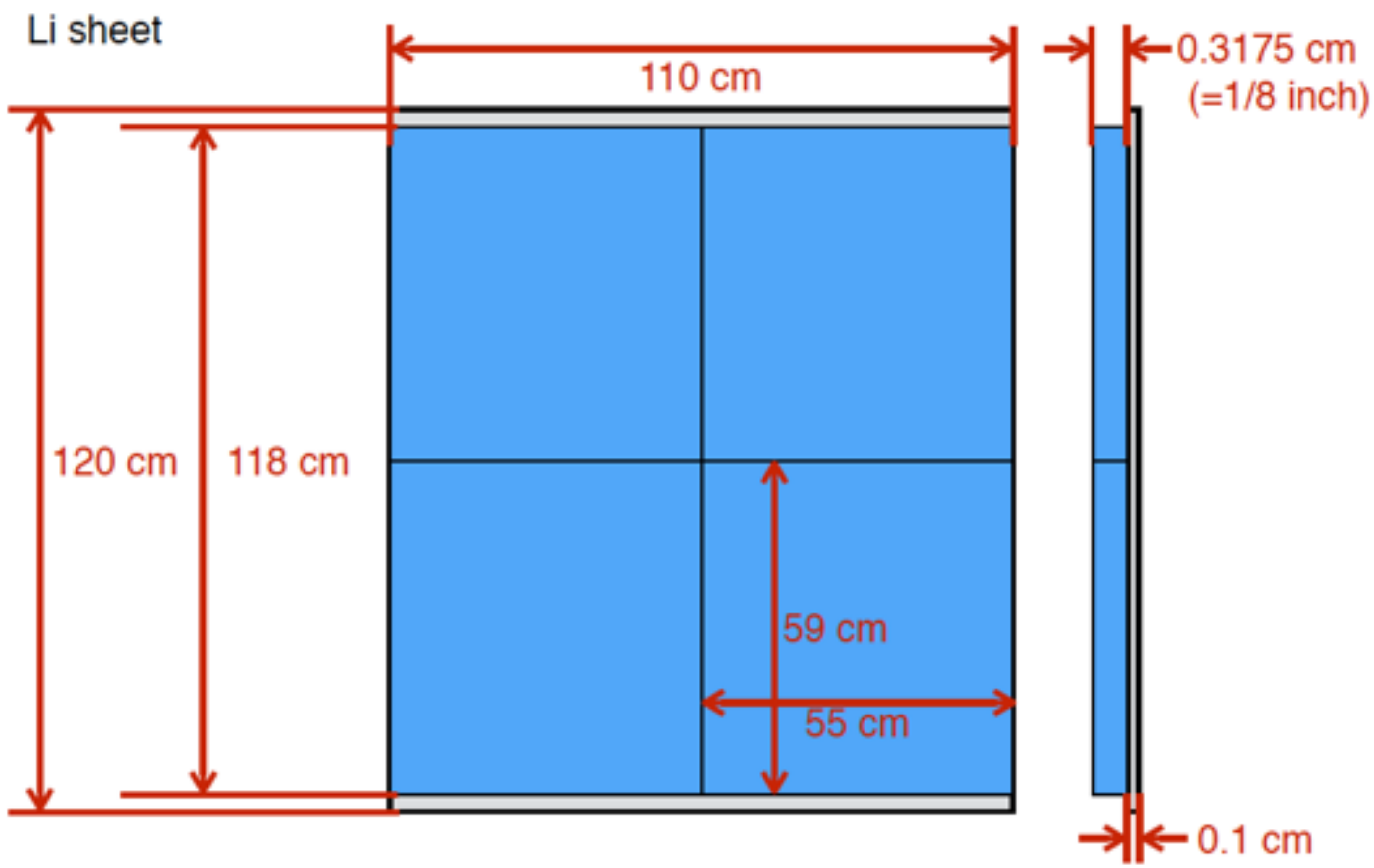
ST05 removed from the setup
Target composition assumed as in 2015;
Trigger Logic assumed as in 2015;

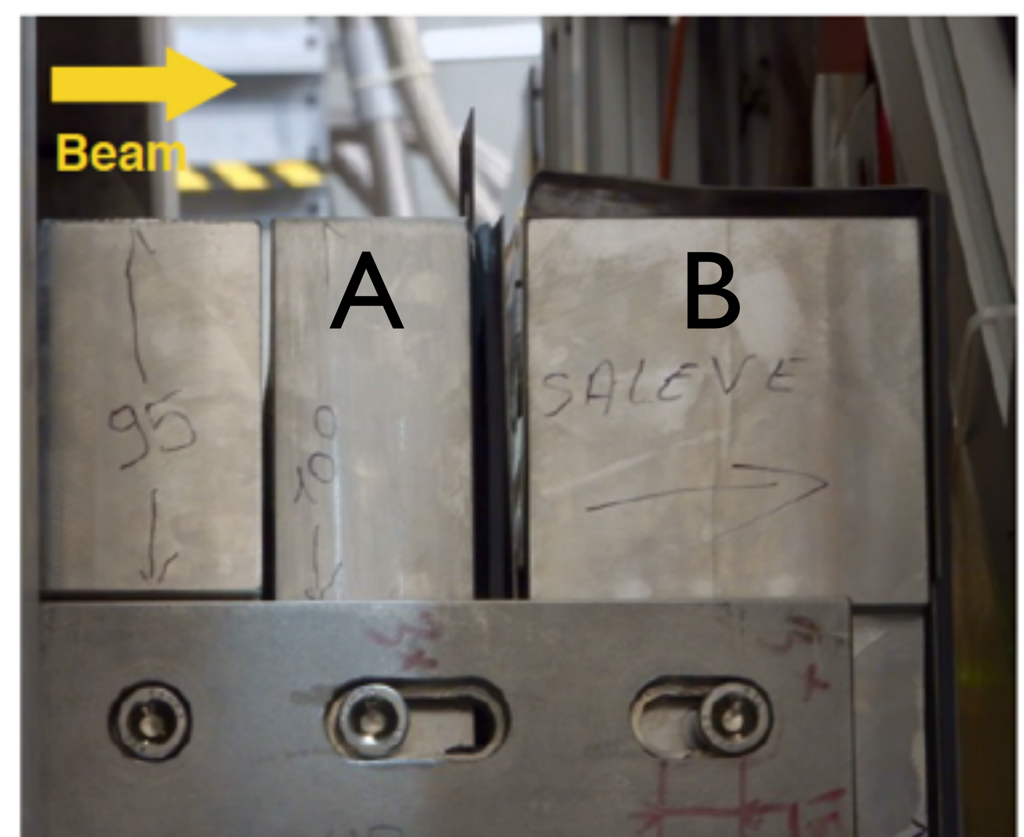
^{6}Li absorber 2015

photos & sketch courtesy Genki Nukazuka



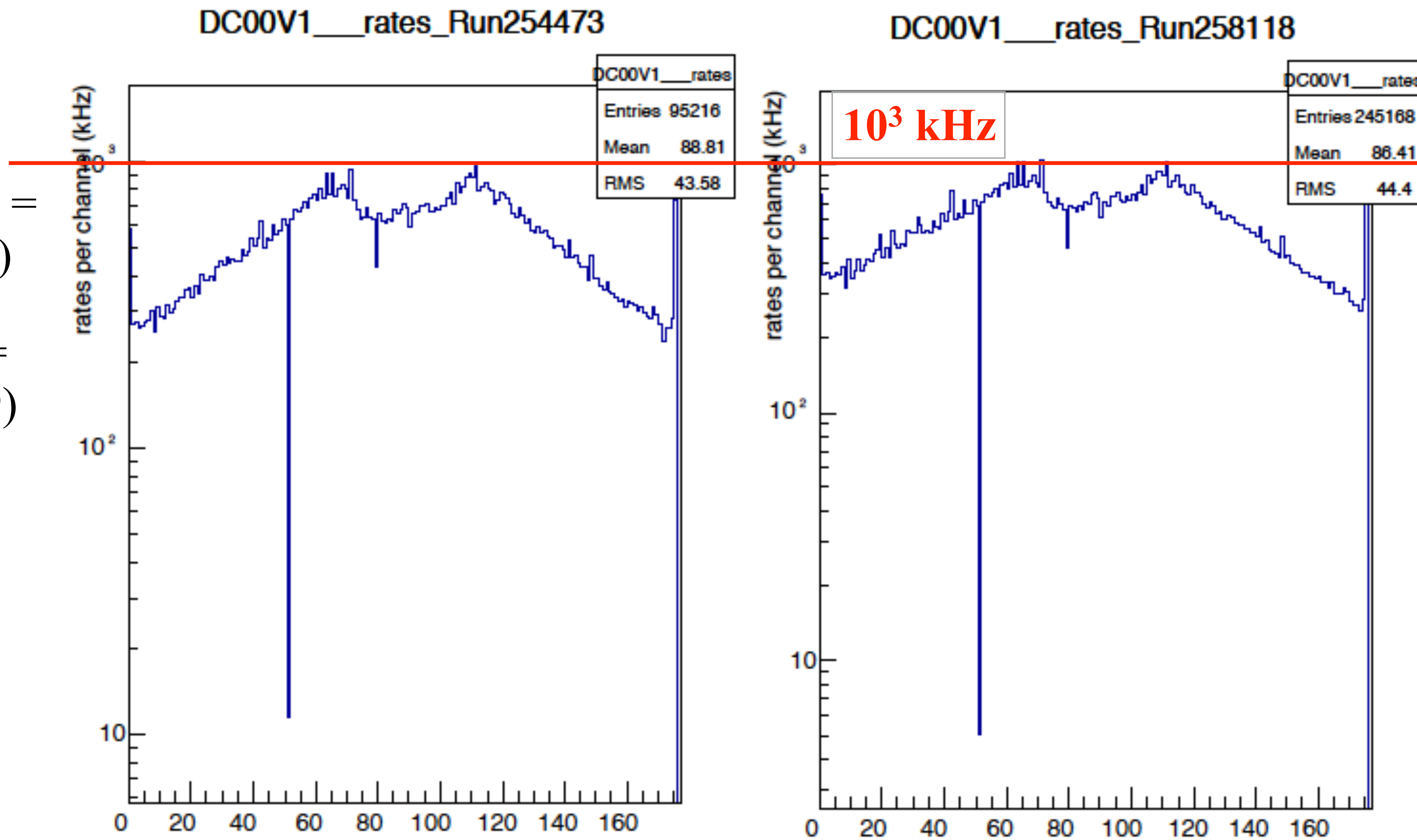
https://twiki.cern.ch/twiki/pub/Compass/Drell_Yan/Subgroupmeeting/20151105_genki.pdf





Reference runs before / after 6Li installation

- Before: 254473, ion2 = $3.93 \cdot 10^8$ (2014-11-29)
- After: 258118, ion2 = $4.10 \cdot 10^8$ (2015-06-09)



Bibliography: talks by AM, Stephane or Genki in spring & summer 2015

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https://espace.cern.ch/na58-mgt-tb/Technical%20Board/Lists/Agenda/Attachments/653/DCs_Saclay_tb_150204.pdf
https://espace.cern.ch/na58-mgt-tb/Technical%20Board/Lists/Agenda/Attachments/662/Platchkov-TB-150401_1.pdf
https://espace.cern.ch/na58-mgt-tb/Technical%20Board/Lists/Agenda/Attachments/679/DC00_01_04_tb_150708.pdf
https://twiki.cern.ch/twiki/pub/Compass/Drell_Yan/Subgroupmeeting/Genki_Efficiency_vs_Hit_rate_DC00.pdf

After removal of 2nd layer of Li sheet (June 10, 2015)