Lumi-monitor update and IR geometry

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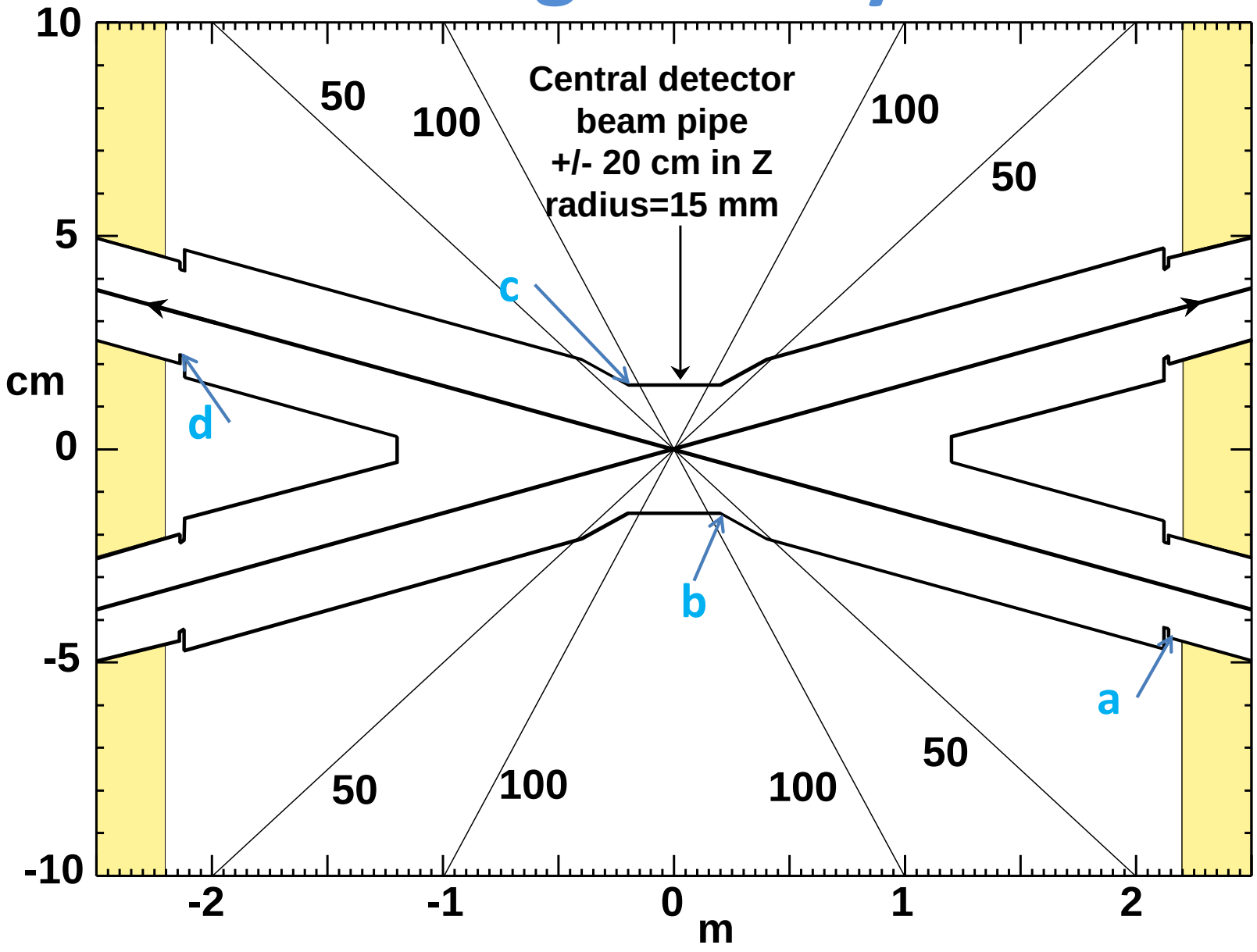
Outline

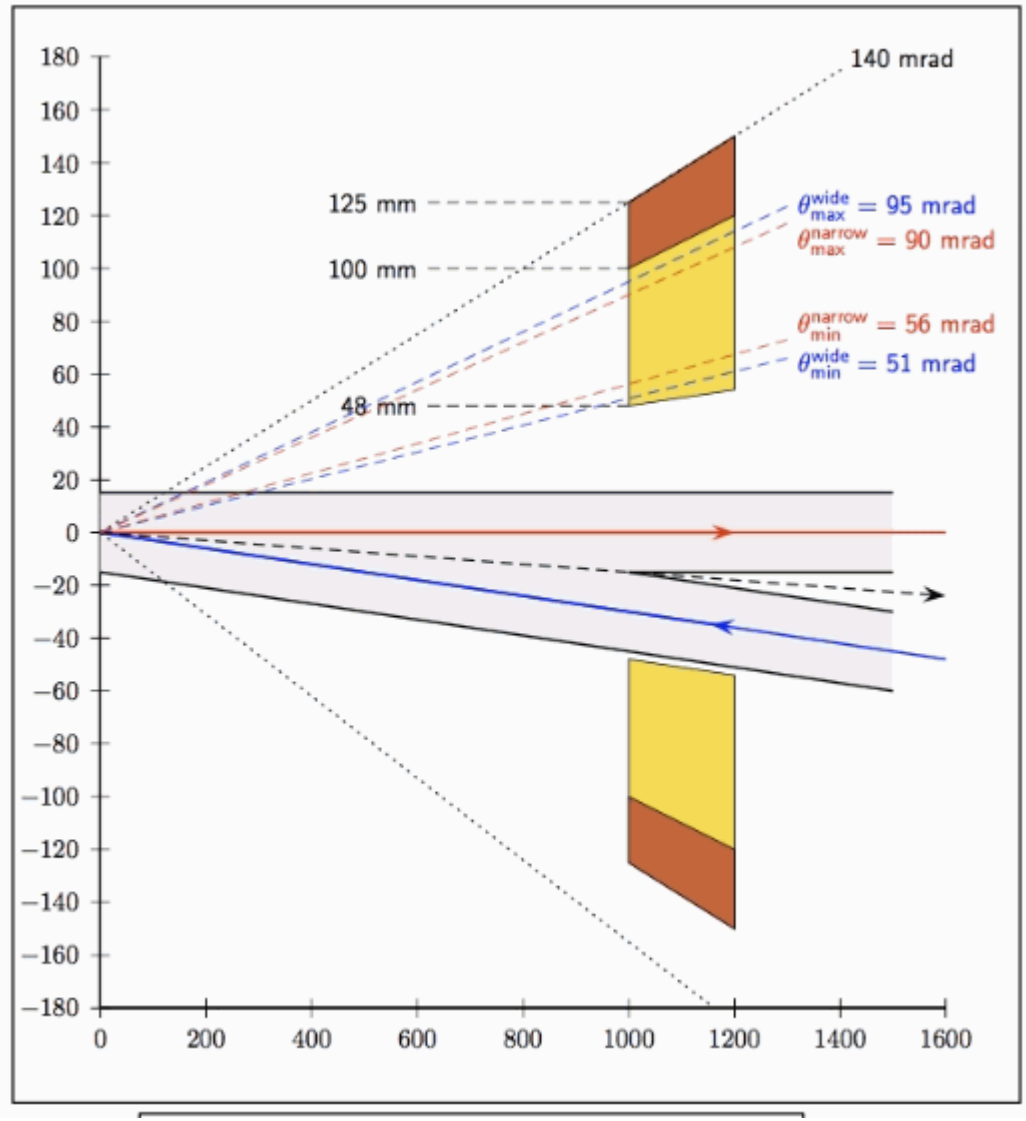
- **IR layout at start of workshop**
- **Some evolution**
- **Current layout**
  - How Lumi-monitor fits in
- **Next steps**
- **Summary**

Detector geometry view



- **Central chamber now 30 mm diameter but…**
  - Lumi-monitor not shown
  - Tagging angles for LumiCal incorrect
  - Beam pipe not optimized for LumiCal
- **After Mogens presented the LumiCal and Mike Koratzinos presented the latest on the solenoid compensation**
  - Settled on putting the LumiCal at 1.0-1.2 m from the IP
- **We also settled on making the beam pipe warm and 30 mm diameter inside the QC1**
- **The diameter of the beam pipe in QC2 (second FF magnet) is probably even larger (~40 mm)**

LumiCal at 1-1.2 m (Mogens case ‘b’)



Services are squeezed into 100-140 mrad cone to maximize SA acceptance

Note minimum angle of 50 mrad

Cross section: σ = 24 nb
Geometric precision needed for absolute normalization to 10^{-4}

- $\delta z = 53\ \mu m$
- $\delta r_{min} = 1.7\ \mu m$
- $\delta r_{max} = 7.0\ \mu m$

Courtesy Mogens

- **Mogens was asked how much radiation length of material can he stand in front of his detector and it can still function**
  - 10% of RL

- **Armed with this information went back to the drawing board**

- **And first made a table of RL vs angle of incidence**

	X_0 mm
Be	651.9
Al	240.1
Au	64.6

wall= 0.005

Incident angle			Thickness		Be		Al		Thick	Au (5 um)	
deg	mrad	rad	wall	actual	x/X_0	% x/X_0	x/X_0	% x/X_0	actual	x/X_0	% x/X_0
0.5	8.73	0.008727	1	114.59	0.1758	17.6	0.4773	47.7	0.573	0.0089	0.9
1	17.45	0.017453	1	57.30	0.0879	8.8	0.2386	23.9	0.286	0.0044	0.4
1.5	26.18	0.02618	1	38.20	0.0586	5.9	0.1591	15.9	0.191	0.0030	0.3
2	34.91	0.034907	1	28.65	0.0440	4.4	0.1193	11.9	0.143	0.0022	0.2
2.5	43.63	0.043633	1	22.93	0.0352	3.5	0.0955	9.5	0.115	0.0018	0.2
3	52.36	0.05236	1	19.11	0.0293	2.9	0.0796	8.0	0.096	0.0015	0.1
4	69.81	0.069813	1	14.34	0.0220	2.2	0.0597	6.0	0.072	0.0011	0.1
5	87.27	0.087266	1	11.47	0.0176	1.8	0.0478	4.8	0.057	0.0009	0.1
6	104.72	0.10472	1	9.57	0.0147	1.5	0.0398	4.0	0.048	0.0007	0.1
10	174.53	0.174533	1	5.76	0.0088	0.9	0.0240	2.4	0.029	0.0004	0.0

Tried this first

Incident angle			Thickness		Be		Al	
deg	mrad	rad	wall	actual	x/X_0	% x/X_0	x/X_0	% x/X_0
0.5	8.73	0.008727	0.5	57.30	0.0879	8.8	0.2386	23.9
1	17.45	0.017453	0.5	28.65	0.0439	4.4	0.1193	11.9
1.5	26.18	0.02618	0.5	19.10	0.0293	2.9	0.0796	8.0
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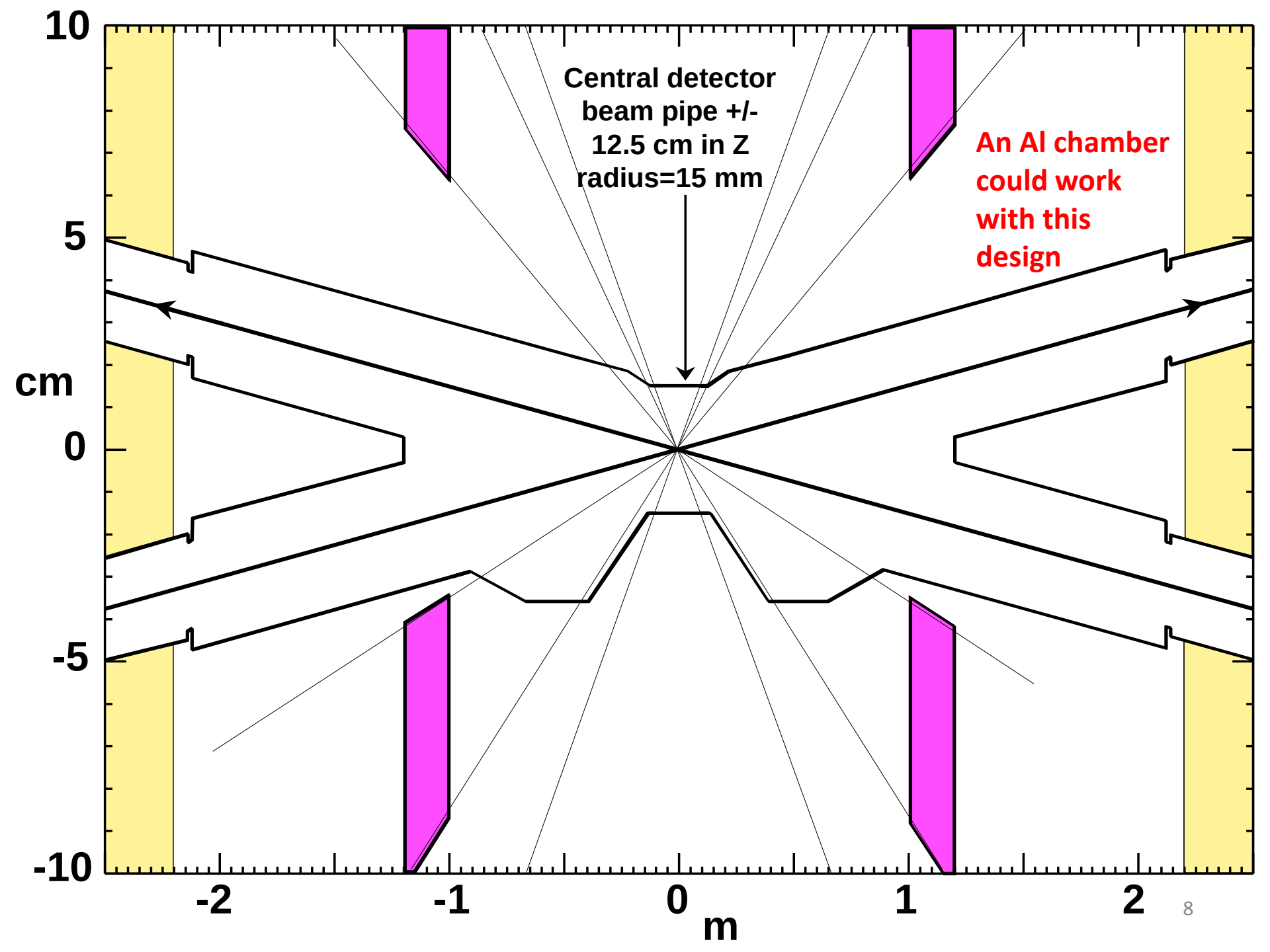
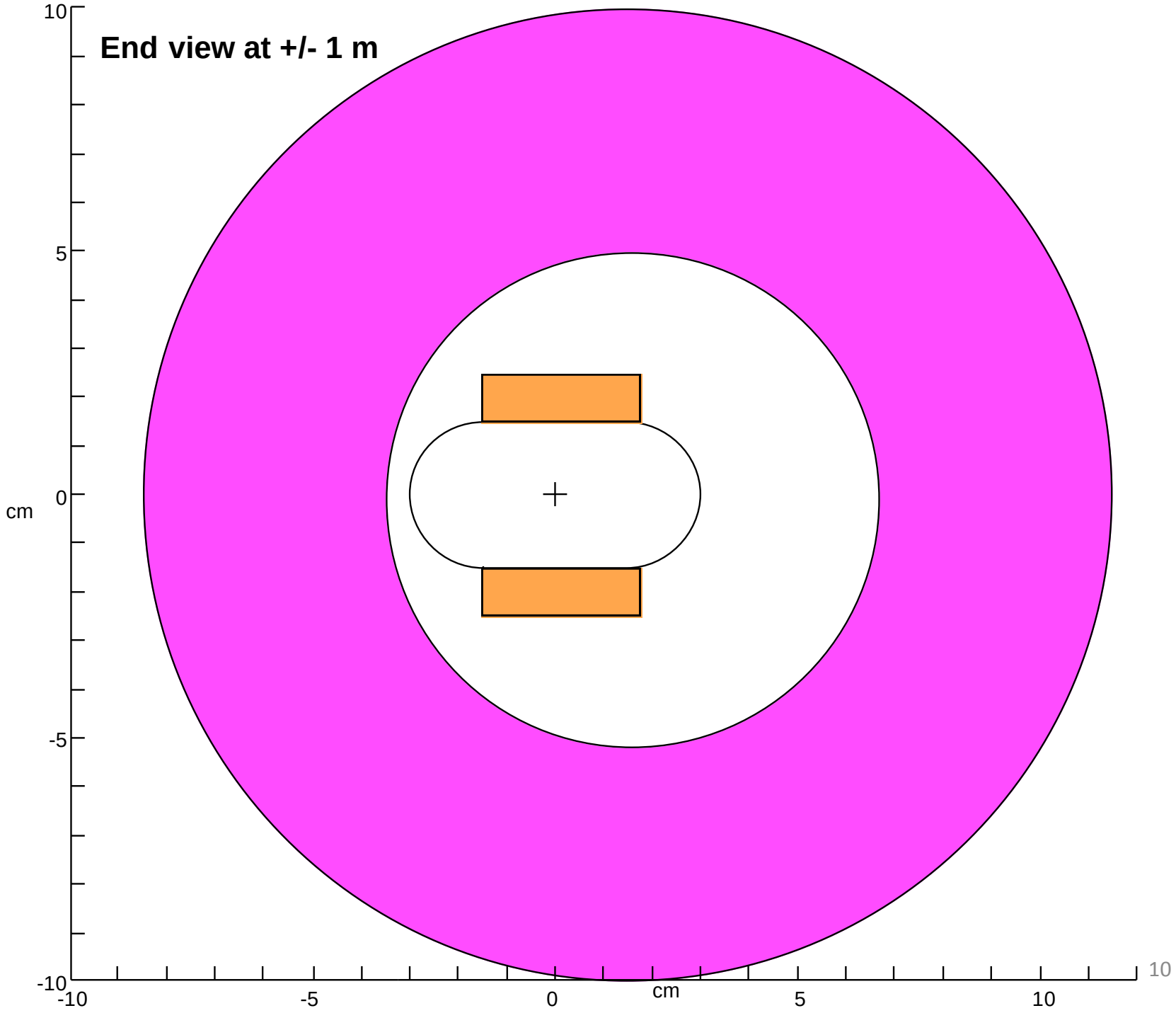
2.5	43.63	0.043633	0.5	11.46	0.0176	1.8	0.0477	4.8
3	52.36	0.05236	0.5	9.55	0.0147	1.5	0.0398	4.0
4	69.81	0.069813	0.5	7.17	0.0110	1.1	0.0299	3.0
5	87.27	0.087266	0.5	5.74	0.0088	0.9	0.0239	2.4
6	104.72	0.10472	0.5	4.78	0.0073	0.7	0.0199	2.0
10	174.53	0.174533	0.5	2.88	0.0044	0.4	0.0120	1.2

- **Which led to …..**


Central detector
beam pipe +/-
12.5 cm in Z
radius=15 mm
An Al chamber
could work
with this
design
10
5
0
-5
-10
cm
-2
-1
0
1
2
m

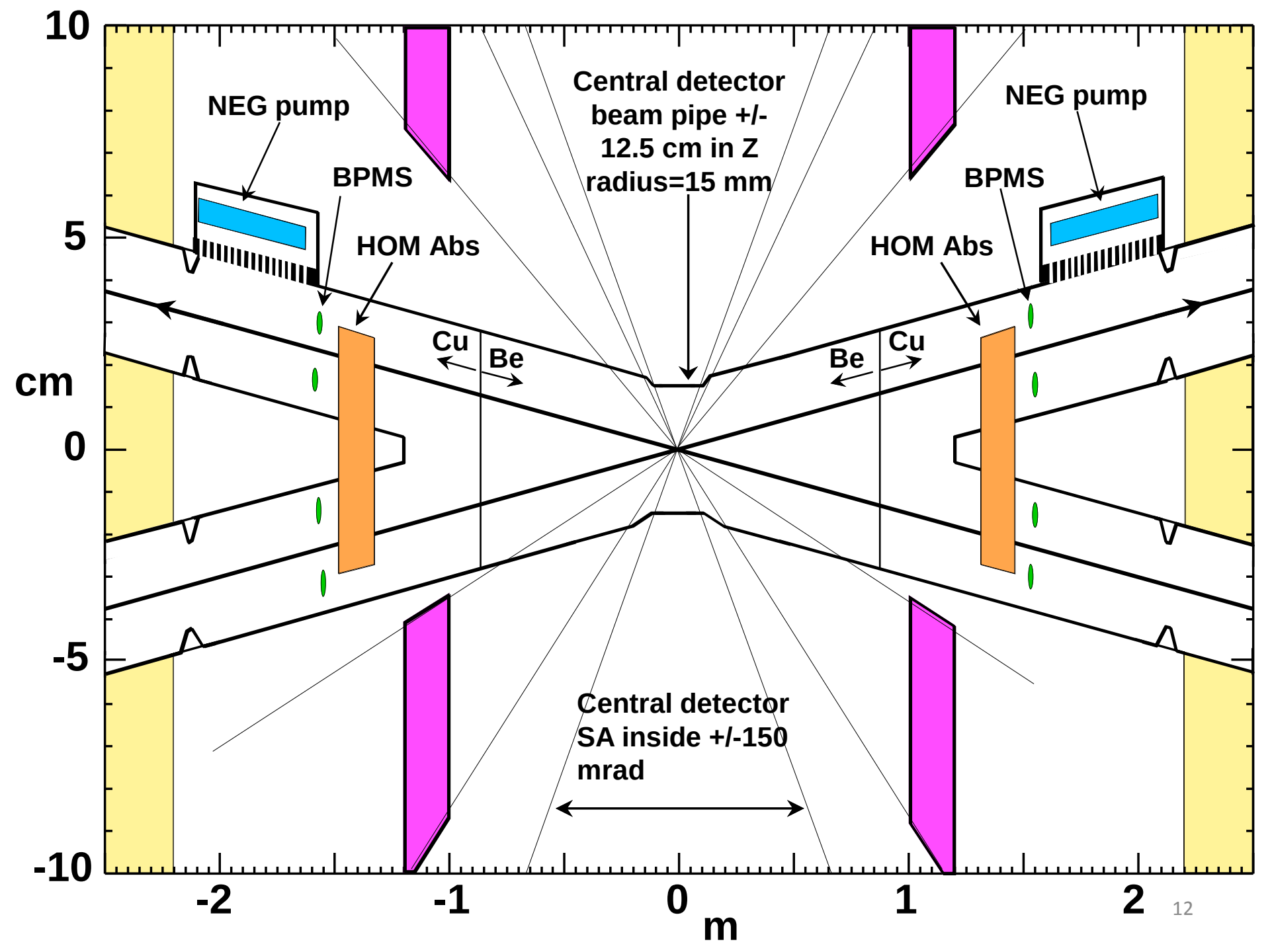
HOMs

- **Attempt to make minimum angle of incidence 3 deg (50 mrad)**
  - Then chamber could be Al
- **Showed this to Sasha and it was not well received**
  - This makes the cavity larger and adds more HOM power to the region
  - Also the beam pipe bulge is only needed at the part of phi that is close to the other beam pipe


End view at +/- 1 m
10
5
0
-5
-10
cm
-10
-5
0
5
10
cm

How about Be?

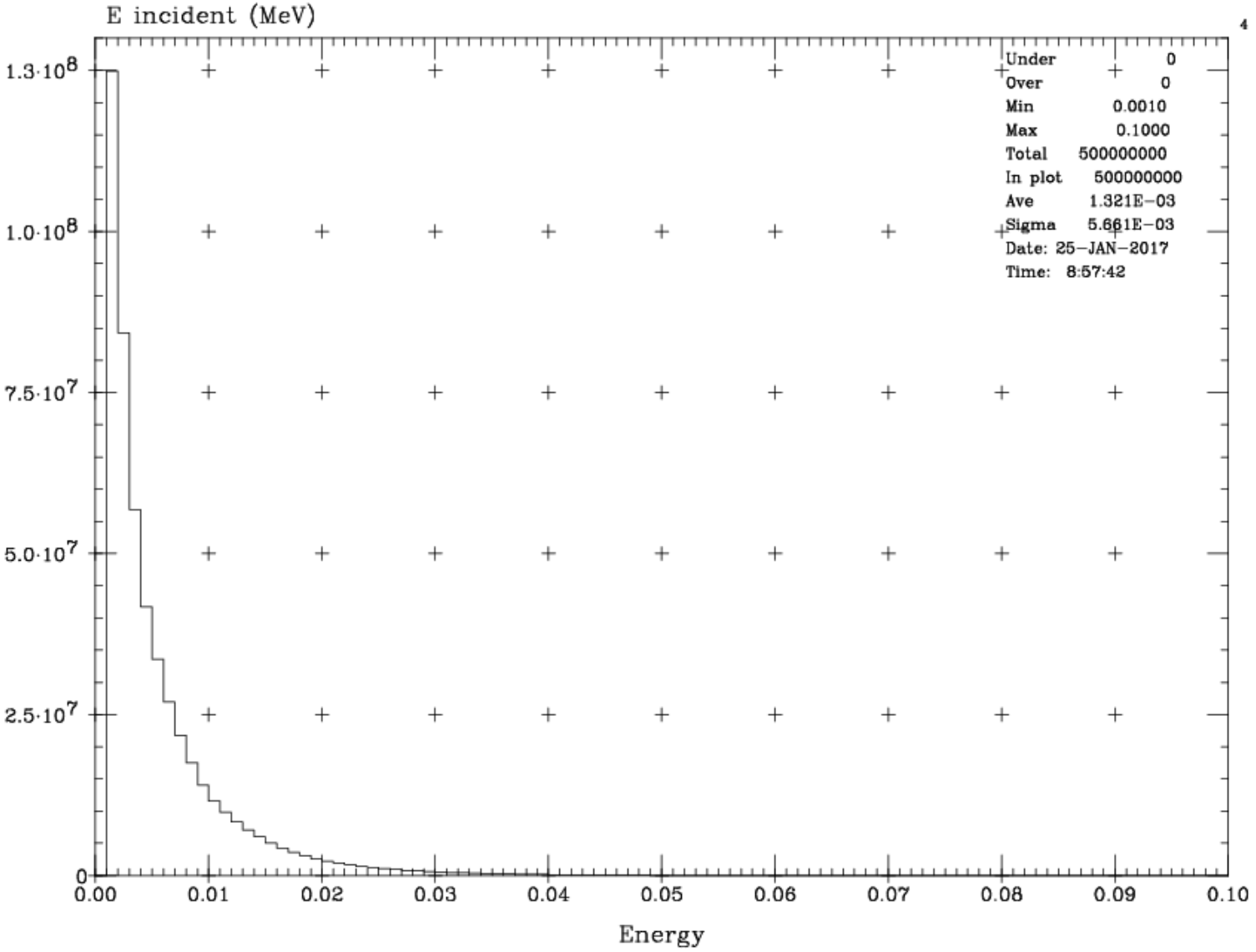
- **So went back to RL table and decided to be more aggressive and ask for Be**
  - Then we can go down to 1 deg of incident angle and still be below 9% of a RL. This is for a 1 mm thick beam pipe wall
  - Perhaps we can use a thinner wall?
- **Using Be then gets us to this design**


10
5
0
-5
-10
cm
-2
-1
0
1
2
m
NEG pump
BPMS
HOM Abs
Cu
Be
Central detector
beam pipe +/-
12.5 cm in Z
radius=15 mm
NEG pump
BPMS
HOM Abs
Be
Cu
Central detector
SA inside +/-150
mrad

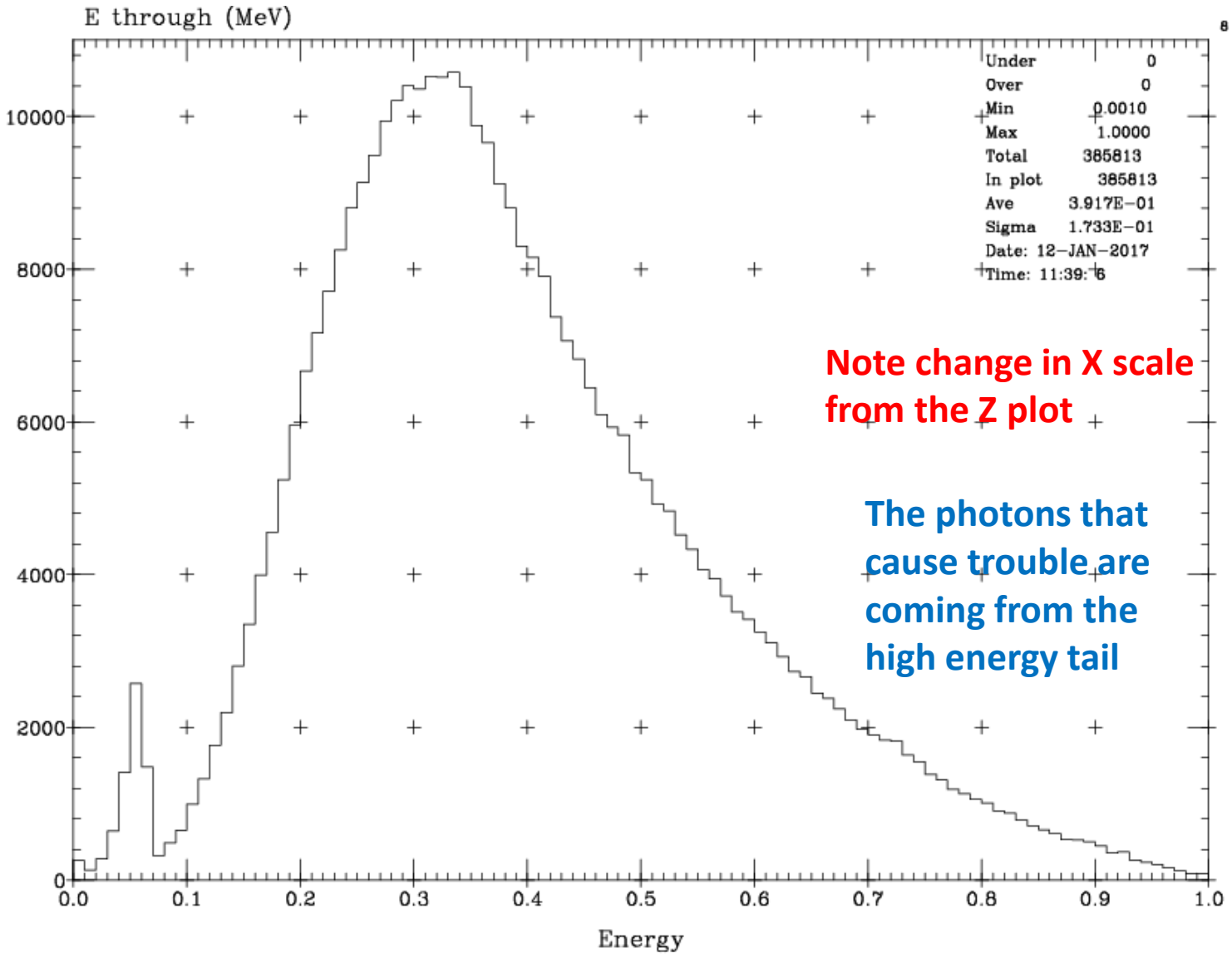
Shielding

- **The question now arises about shielding the central detector from SR from the last bend magnet**
- **The LumiCal needs a window in the beam pipe where we can no longer put shielding**
- **For the Z running this may not be a big issue**
  - The photon energies are lower (Ave scattered=1.3 keV)
- **But for the Top running this becomes an issue**
  - Ave scattered is 390 keV
  - Effectively the central part of the beam pipe increases from +/-12.5 cm to +/-50 cm
  - This will increase the number of photons going into the central chamber (factor of 10? More?)
  - Simulation comparison will tell us the answer

Z scattered photon energy spectrum

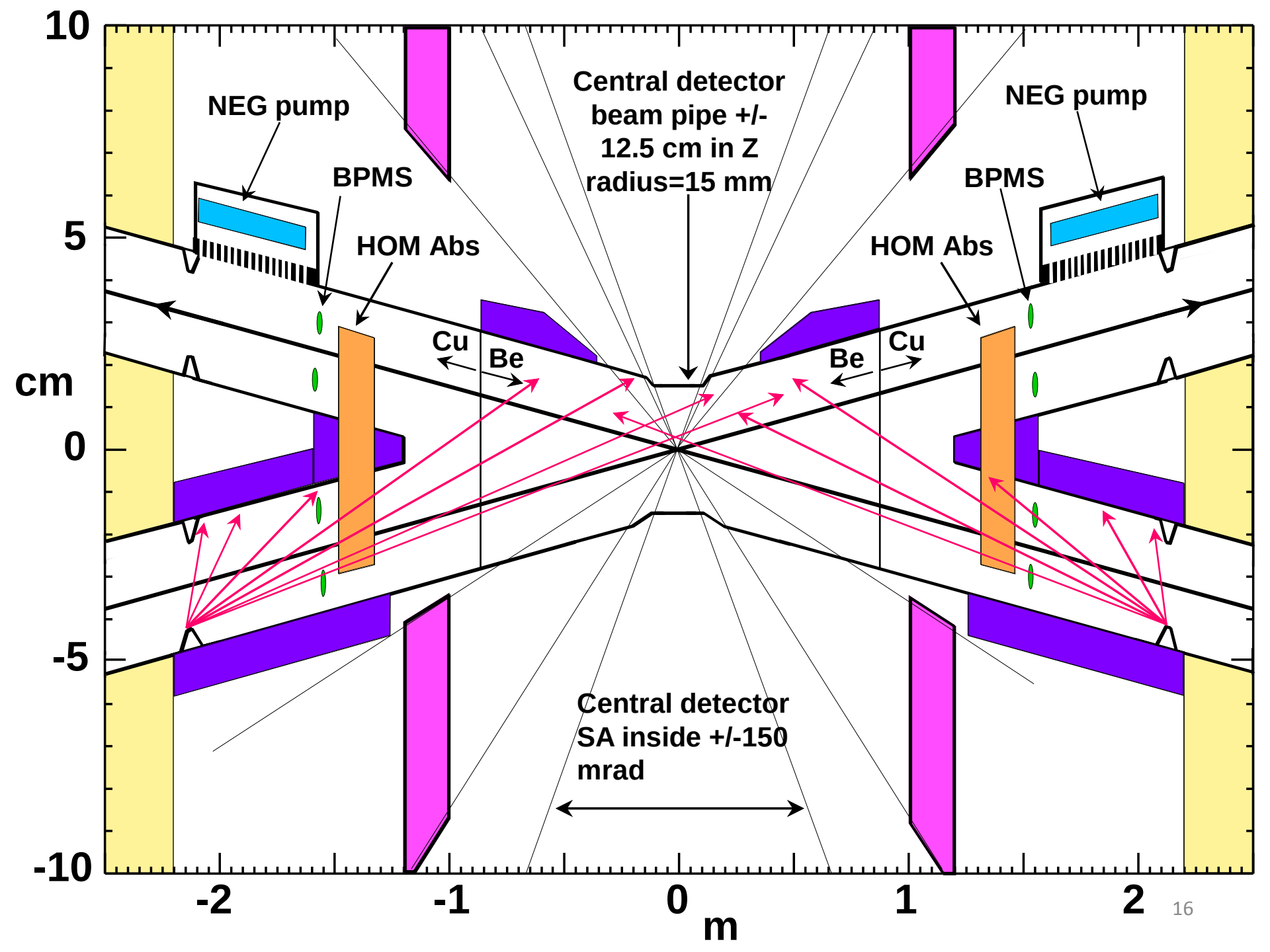


Top scattered photon energy spectrum



Note change in X scale from the Z plot

The photons that cause trouble are coming from the high energy tail


NEG pump
BPMS
HOM Abs
Central detector
beam pipe +/-
12.5 cm in Z
radius=15 mm
NEG pump
BPMS
HOM Abs
Cu
Be
Be
Cu
Central detector
SA inside +/-150
mrad
10
5
0
-5
-10
cm
-2
-1
0
1
2
m

For the Top running

- 1.9×10^9 photons incident on the mask tip every beam bunch
- 3.87% scatter through the mask tip
- About 1% can scatter through 2 cm of Ta
- This means about 700,000 photons go into the central detector region every beam crossing – too many
- We will need to add as much shielding as we can in order to cut this rate down

What about the Higgs?

- **Scattered SR photon energies will increase**
  - The critical energy of the last soft bend magnet
  - For the Top – 100 keV
  - For the Higgs – 40 keV
  - For the Z – 1.7 keV
- **Needs to be looked at as a separate case**
- **More simulation runs with the GEANT4 model of the beam pipe**
- **Do we want/need the LumiCal for the Higgs?**
- **Stay tuned……**

Summary

- The LumiCal looks OK at the Z running
- We need a Be beam pipe for the LumiCal window in order to minimize the RL to the LumiCal and to minimize the HOM power in this region
- The LumiCal window will cause central detector SR backgrounds to increase at the Top running because of the high energy of the scattered photons

Conclusions

- A great deal of progress has been made in deciding on baseline parameters and general layout of the IR
- SR at the Z does not seem to be a big concern due to the very low photon energies
- SR backgrounds at the Higgs and Top will be more of an issue. The photon energies will significantly increase.