

# **Lumi-monitor update and IR geometry**

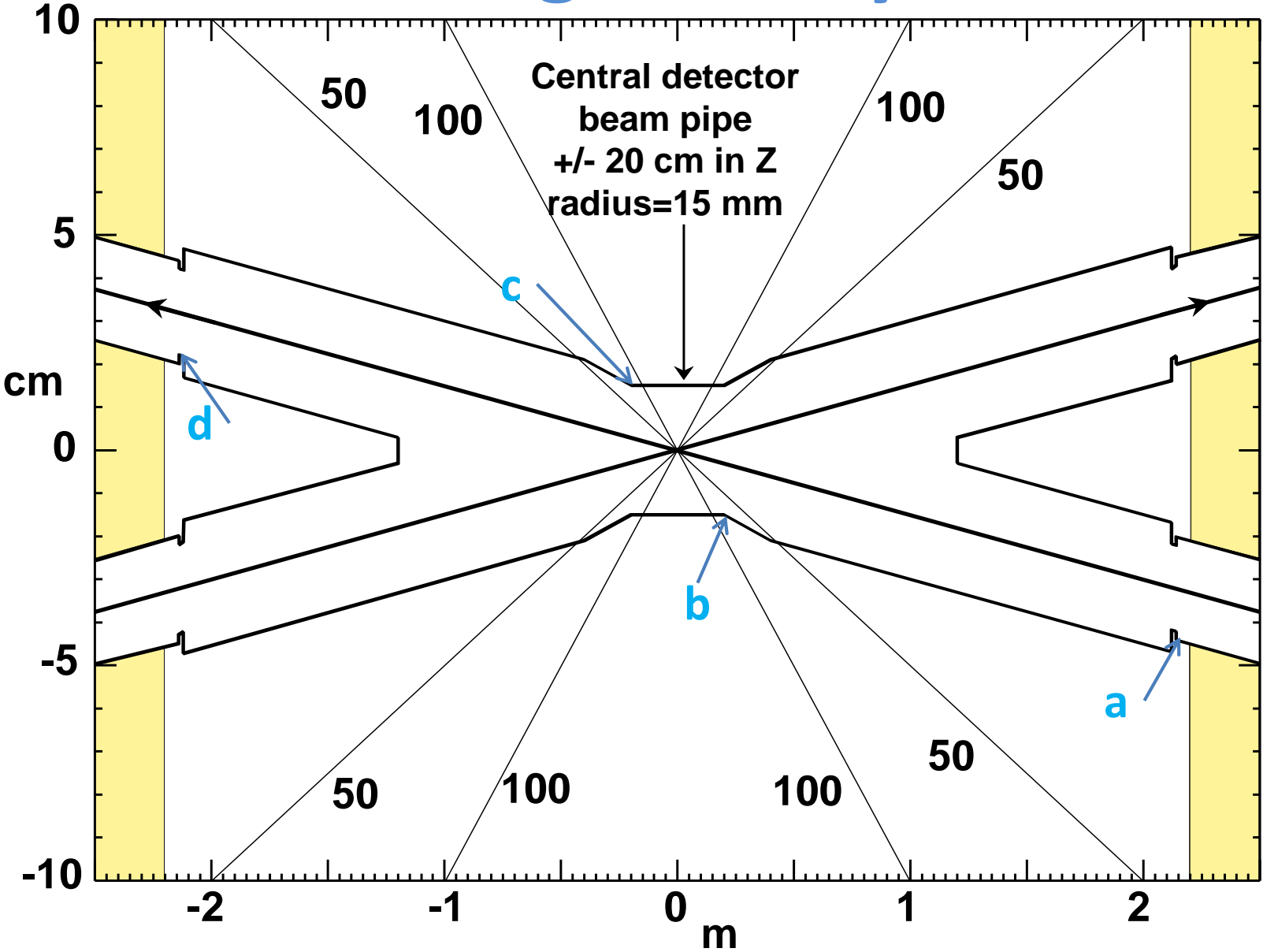
**M. Sullivan for M. Dam**

**Jan 26, 2017**

# Outline

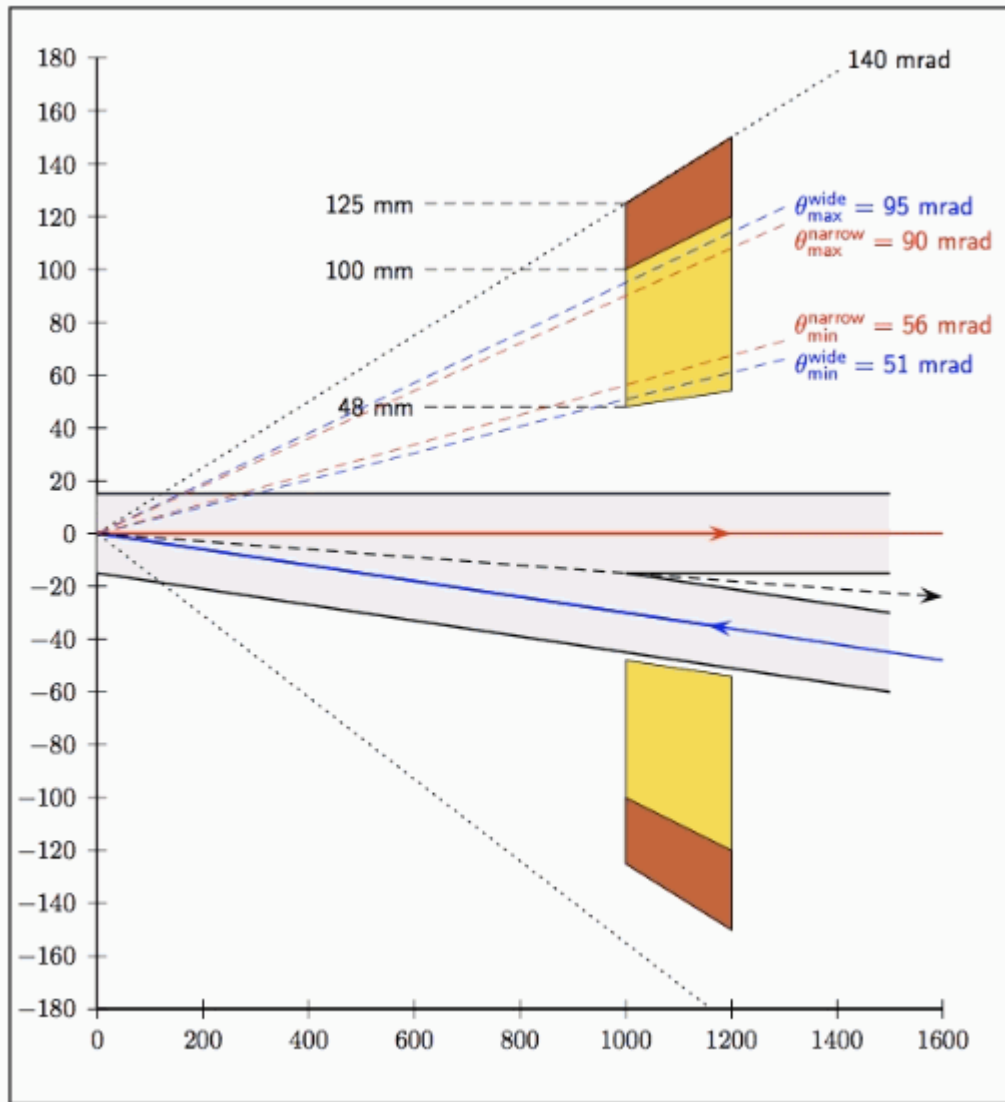
- IR layout at start of workshop
- Some evolution
- Current layout
  - How Lumi-monitor fits in
- Next steps
- Summary

# 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

# LumiCal at 1-1.2 m



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

Note minimum angle of 50 mrad

Cross section:  $\sigma = 24 \text{ nb}$   
Geometric precision needed for absolute normalization to  $10^{-4}$

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

Courtesy Mogens

- **Mogens was asked how much radiation length of material can he stand in front of his detector and still function**
  - 10% of RL
- **Armed with this information went back to the drawing board**

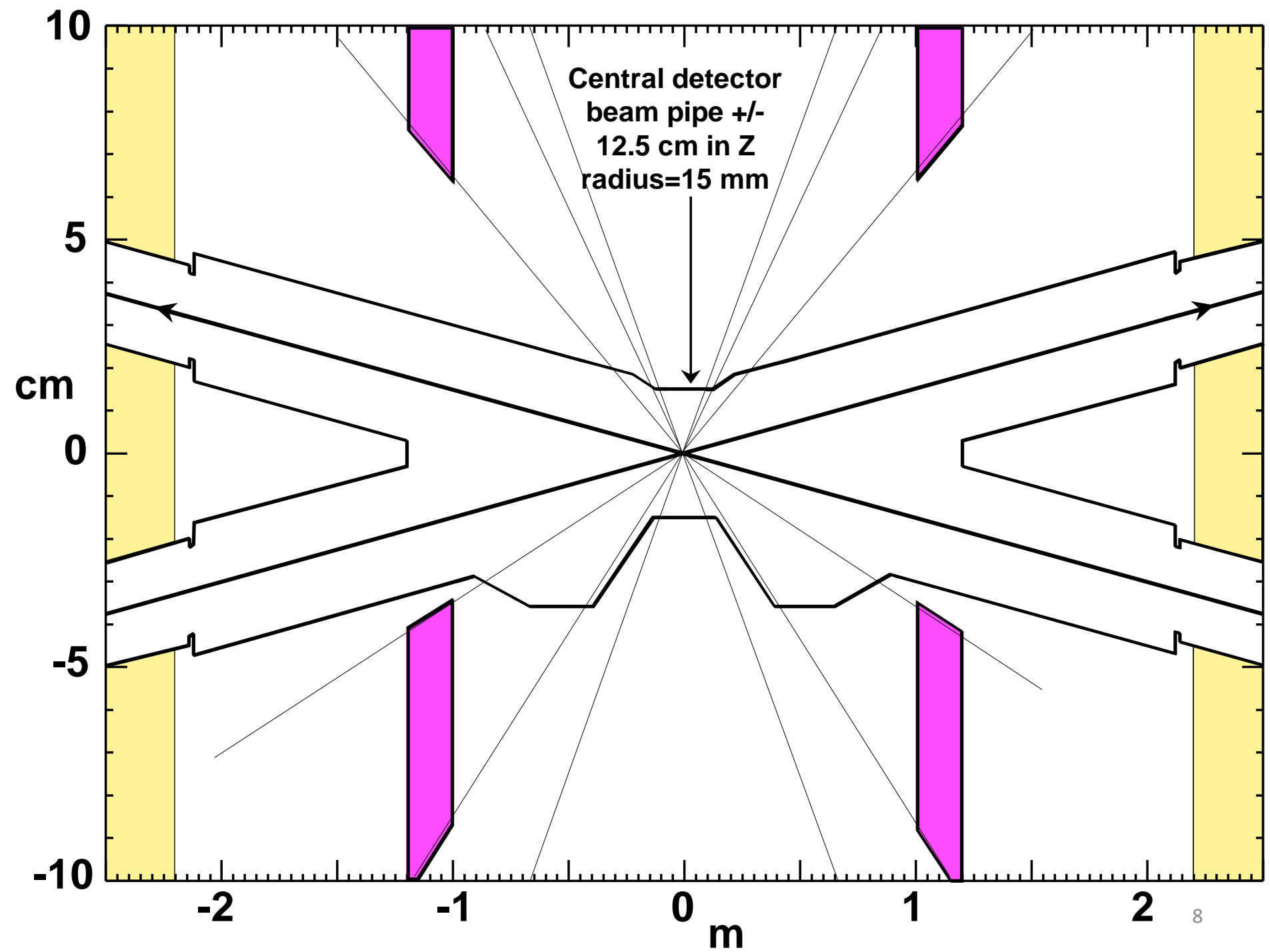
- And first made a table of RL vs angle of incidence

		$X_0$ mm			wall= 0.005								
					Be		Al		Thick Au (5 $\mu$ m)				
Be	Al	Au				$x/X_0$	% $x/X_0$	$x/X_0$	% $x/X_0$	actual	$x/X_0$	% $x/X_0$	
		Incident angle			Thickness								
		deg	mrad	rad	wall	actual	$x/X_0$	% $x/X_0$	$x/X_0$	% $x/X_0$	actual	$x/X_0$	% $x/X_0$
		651.9			1	114.59	0.1758	17.6	0.4773	47.7	0.573	0.0089	0.9
		240.1			1	57.30	0.0879	8.8	0.2386	23.9	0.286	0.0044	0.4
		64.6			1	38.20	0.0586	5.9	0.1591	15.9	0.191	0.0030	0.3
					1	28.65	0.0440	4.4	0.1193	11.9	0.143	0.0022	0.2
					1	22.93	0.0352	3.5	0.0955	9.5	0.115	0.0018	0.2
					1	19.11	0.0293	2.9	0.0796	8.0	0.096	0.0015	0.1
					1	14.34	0.0220	2.2	0.0597	6.0	0.072	0.0011	0.1
					1	11.47	0.0176	1.8	0.0478	4.8	0.057	0.0009	0.1
					1	9.57	0.0147	1.5	0.0398	4.0	0.048	0.0007	0.1
					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
2	34.91	0.034907	0.5	14.33	0.0220	2.2	0.0597	6.0
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 .....

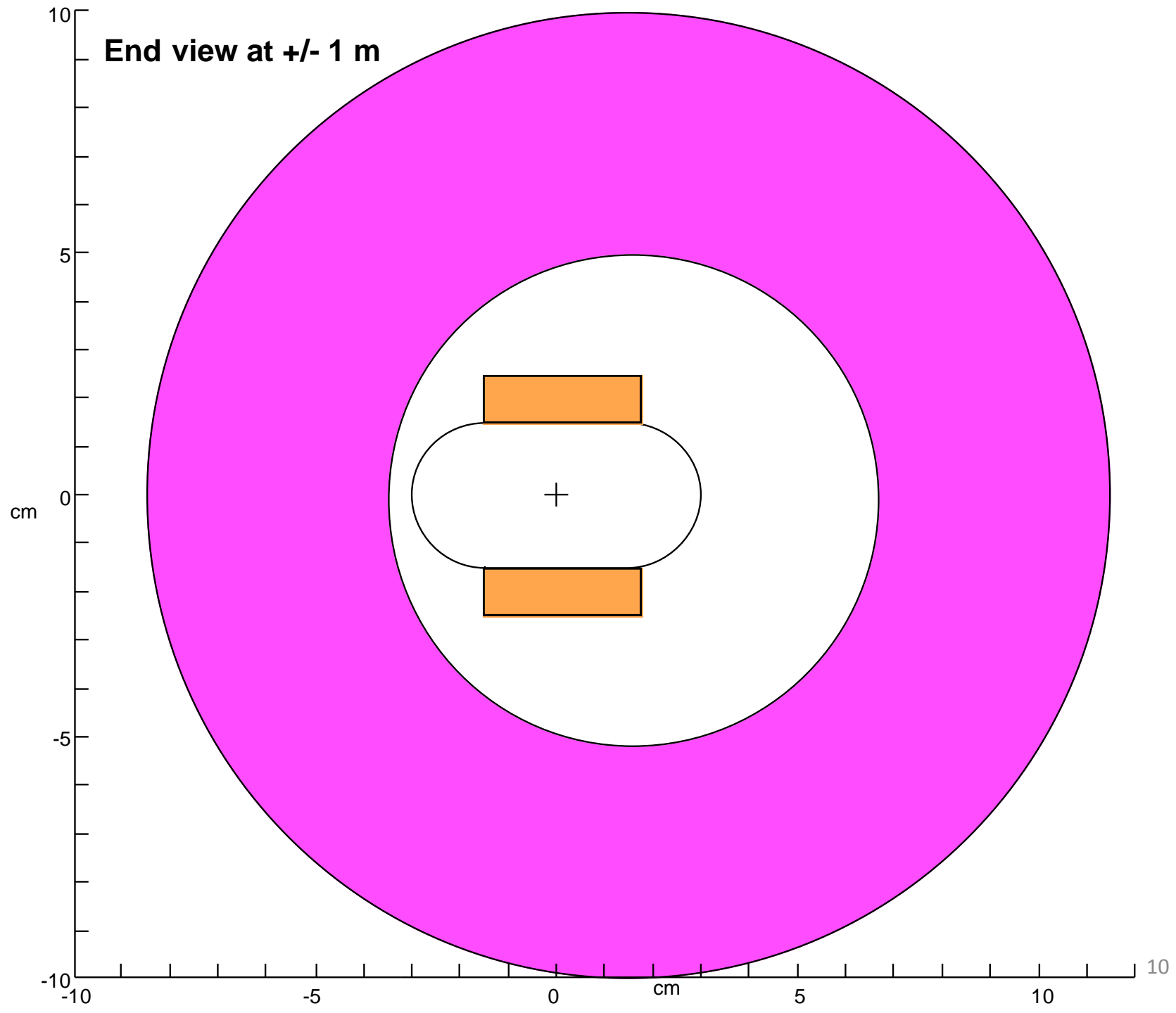




# HOMs

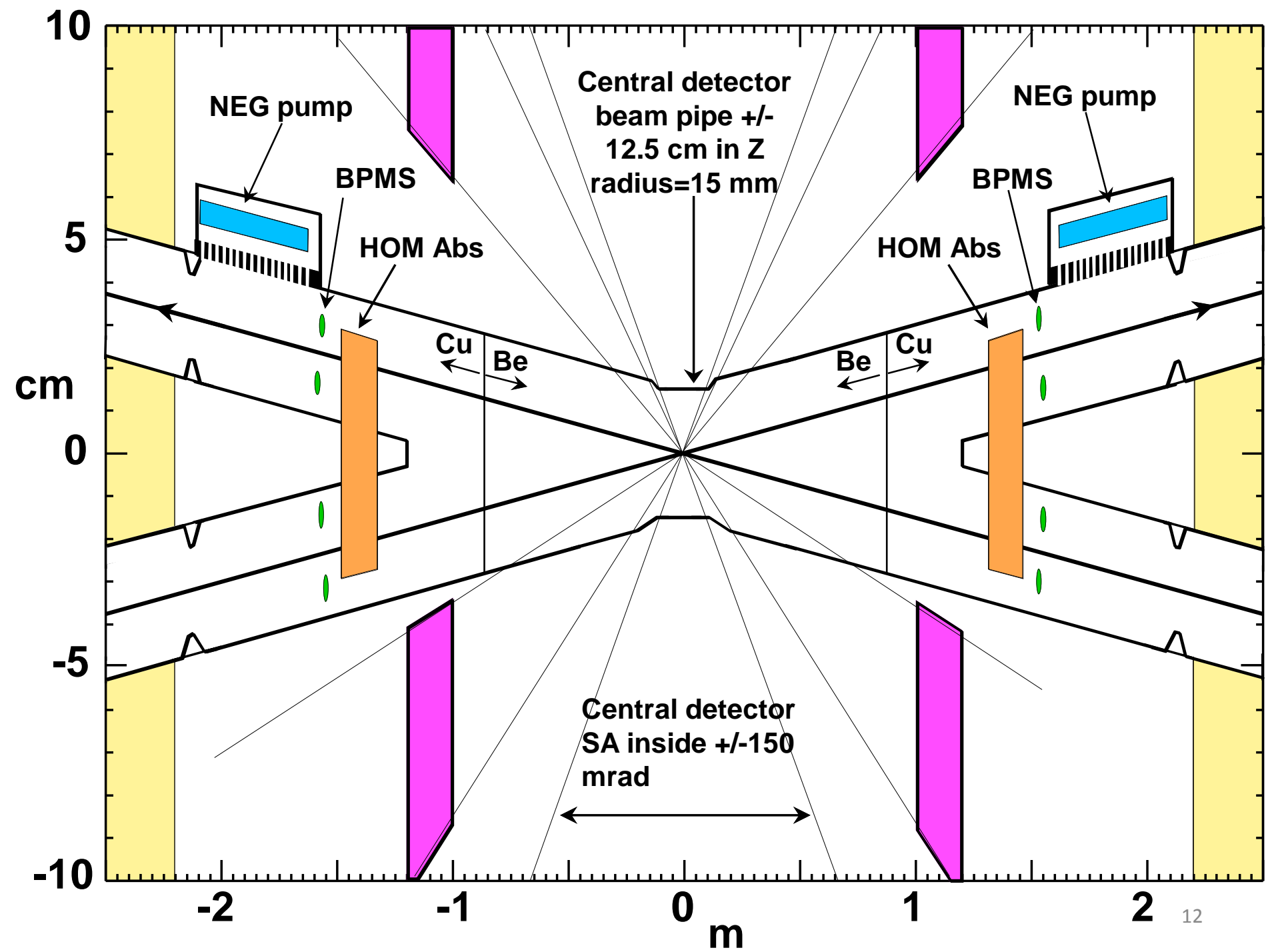
- **Attempt to make minimum angle of incidence 3 deg (50 mrad)**
  - Then chamber could be Al
- **Showed this to Sasha and it was not well received**
  - This makes the cavity larger and adds more HOM power to the region
  - Also the beam pipe bulge is only needed at the part of phi that is close to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

**End view at +/- 1 m**



# How about Be?

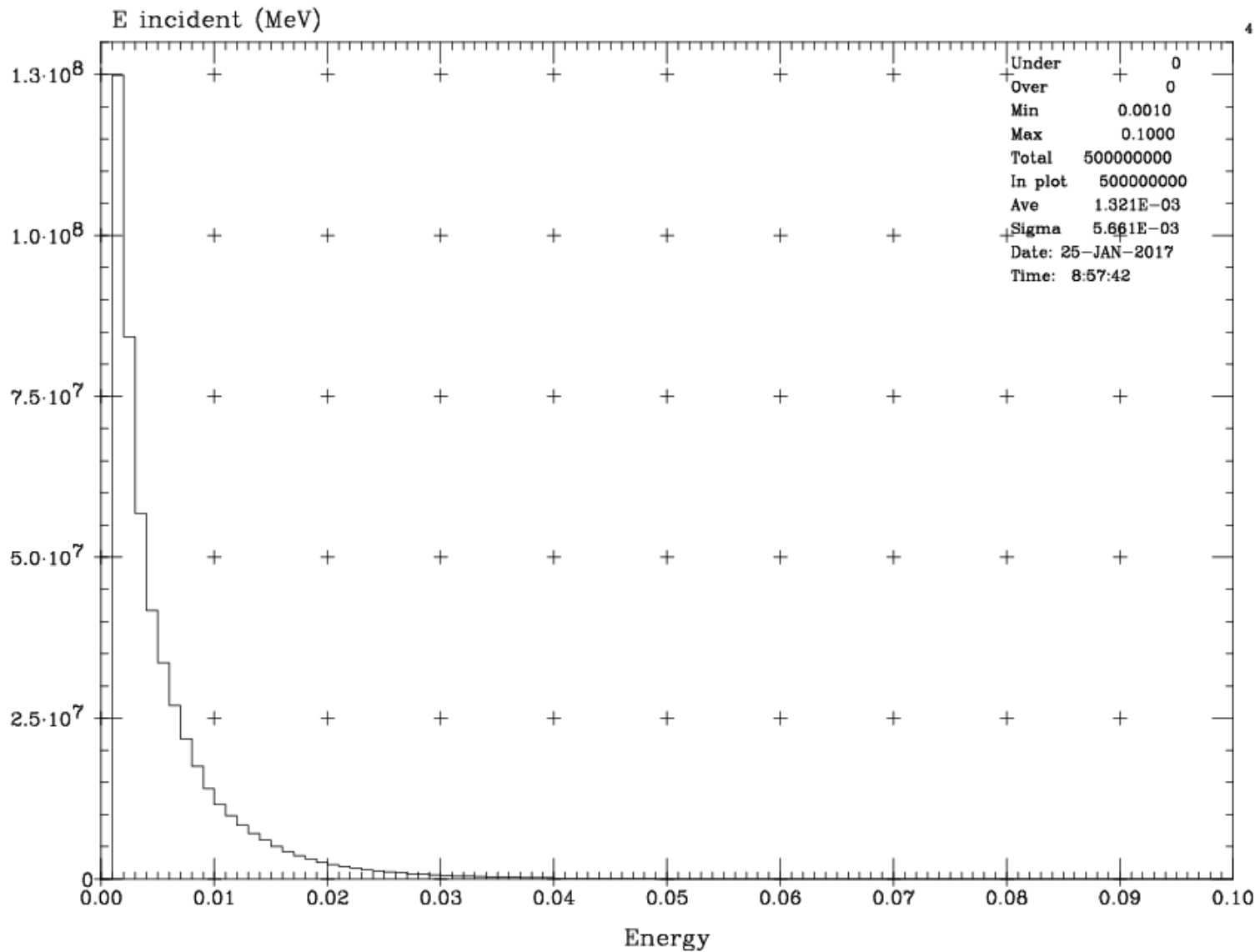
- **So went back to RL table and decided to be more aggressive and ask for Be**
  - Then we can go down to 1 deg of incident angle and still be below 9% of a RL. This is for a 1 mm thick beam pipe wall
  - Perhaps we can use a thinner wall?
- **Using Be then gets us to this design**



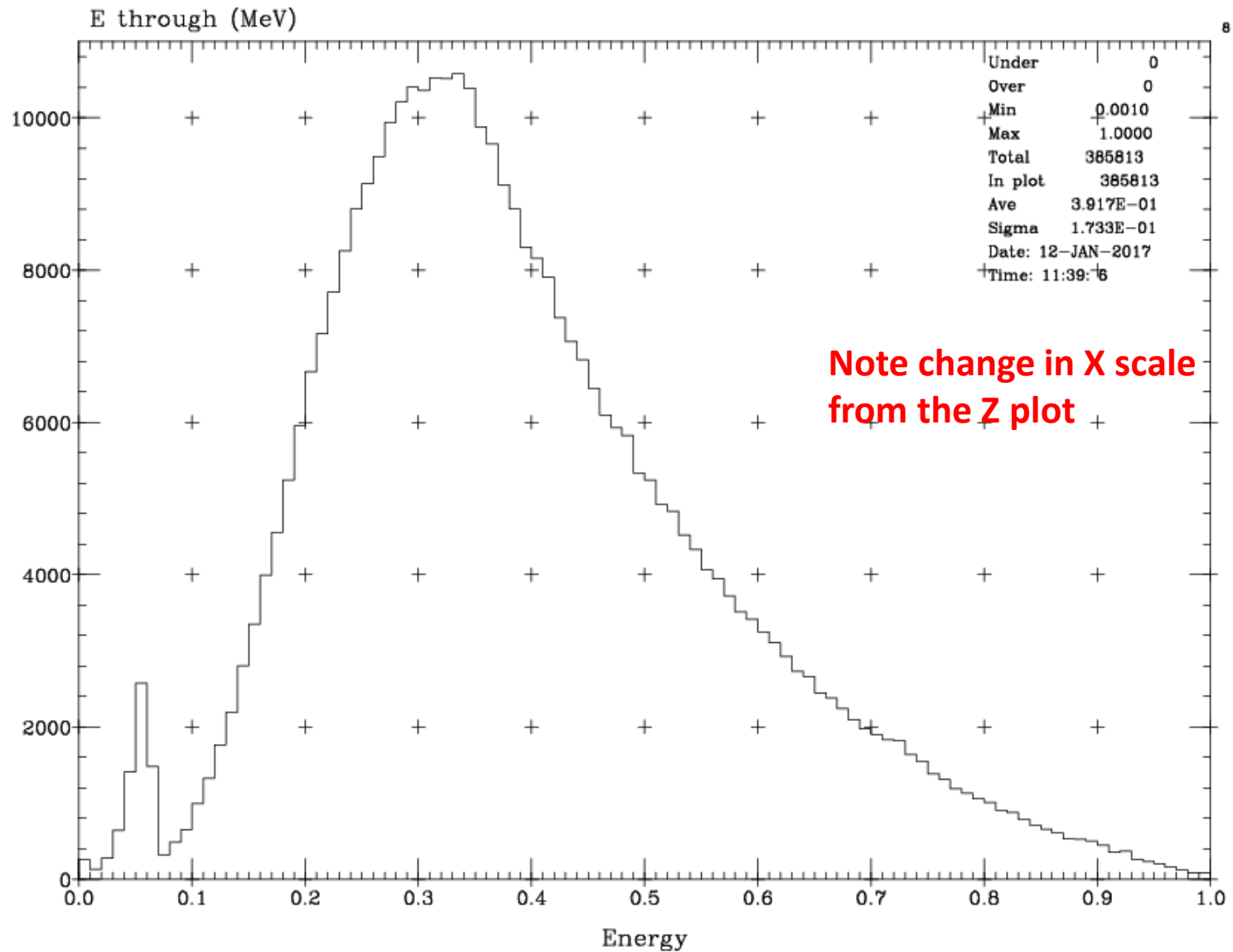
# Shielding

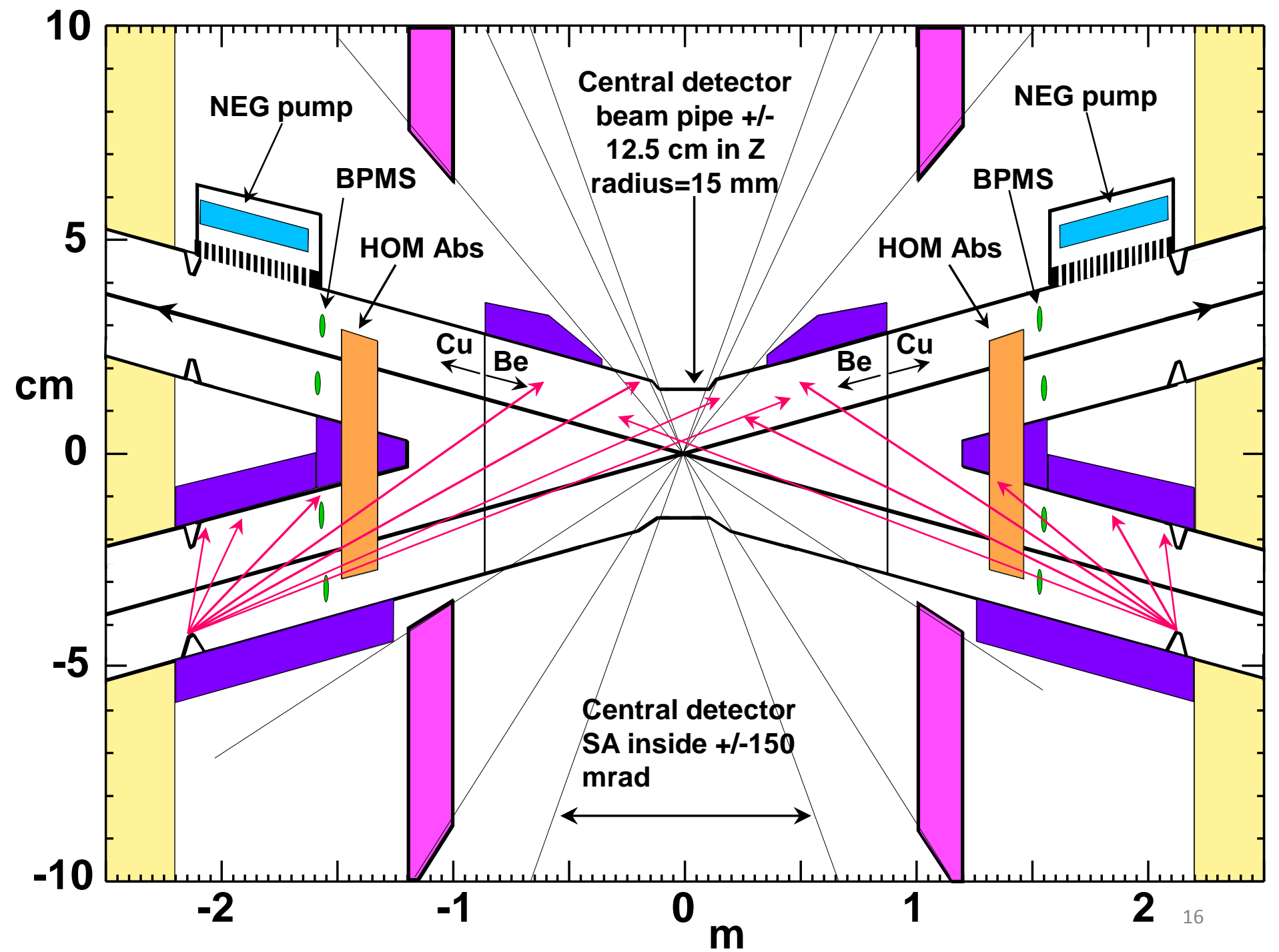
- The question now arises about shielding the central detector from SR from the last bend magnet
- The LumiCal needs a window in the beam pipe where we can no longer put shielding
- For the Z running this may not be a big issue
  - The photon energies are lower (Ave scattered=1.3 keV)
- But for the Top 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







# What about the Higgs?

- **Scattered SR photon energies will increase**
- **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