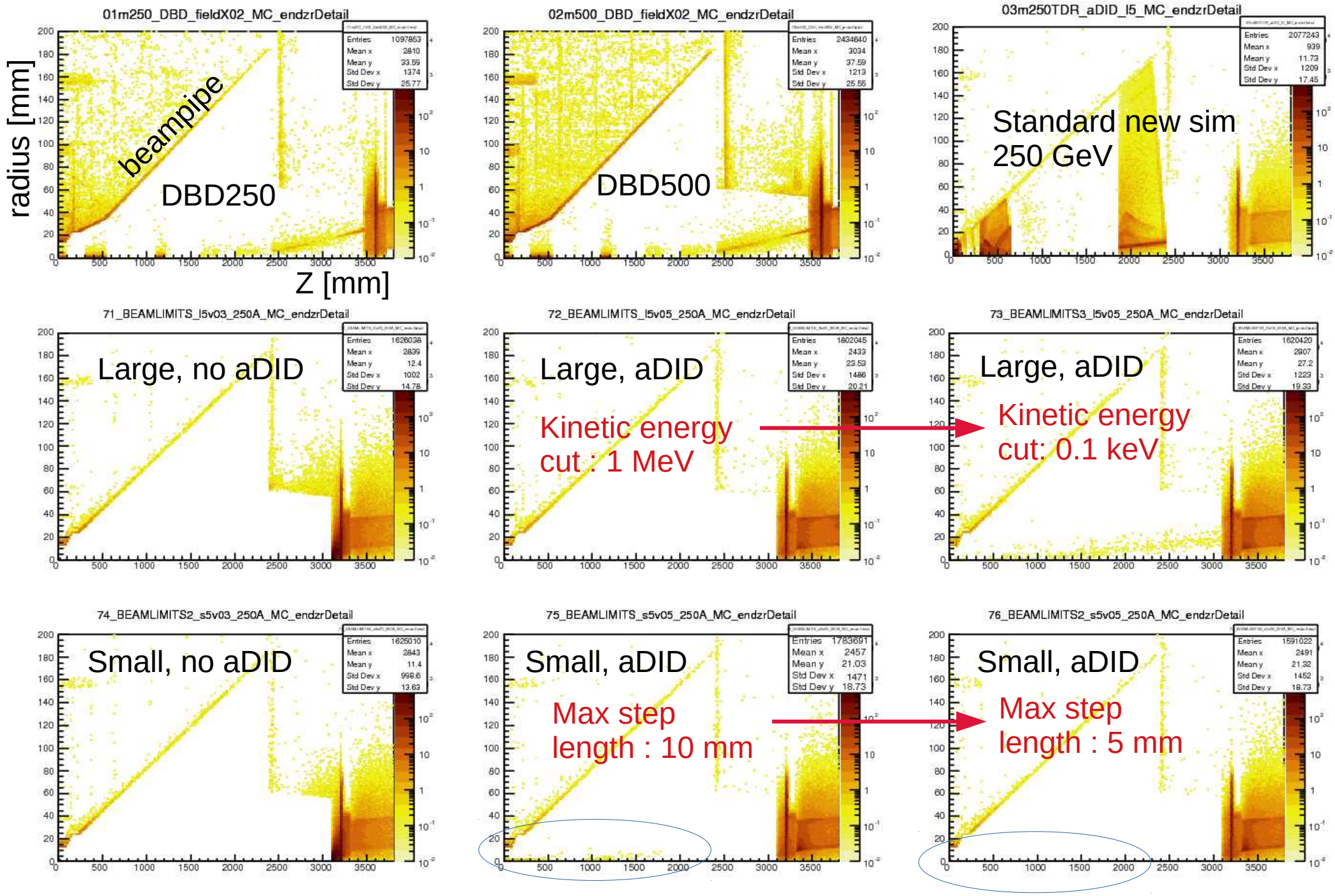
Update on pair backgrounds, ILD sw-ana, 5 Dec 2018

Simulating pair backgrounds from Guinea-Pig in ILD models

→ extra “noise” hits: realistic tracking
→ potentially large # hits : DAQ/computing

Daniel & Akiya, KEK

MC particle endpoints: z vs. r



Vertex detector hits per BX

VXD hits/BX	L1, 2		L3, 4		L5, 6	
	Early	Late	Early	Late	Early	Late
DBD						
250_DBD_fieldX02	98.8	5.1	0.7	0.4	0.1	0.1
500_DBD_fieldX02	194.7	15.9	1.3	0.5	0.1	0.7
NEW SIMULATIONS with new 250 GeV beam params						
LARGE, no anti-DID						
BEAMLIMITS_l5v03_250A	255.	185.6	4.6	19.6	0.6	6.6
LARGE, anti-DID						
BEAMLIMITS_l5v05_250A	261.	61.9	2.0	4.3	0.5	1.4
LARGE, anti-DID, lower momentum threshold						
BEAMLIMITS3_l5v05_250A	257.	65.2	2.6	5.4	0.4	2.1
SMALL, no anti-DID, smaller maximum step length						
BEAMLIMITS2_s5v03_250A	204.	192.	2.3	22.0	0.1	5.5
SMALL, anti-DID, smaller maximum step length						
BEAMLIMITS2_s5v05_250A	191.	77.3	2.1	5.5	0.2	4.0
SMALL, anti-DID, new 250 GeV params						
BEAMLIMITS_s5v05_250A	200.	71.1	1.4	6.4	0.1	3.5
LARGE, anti-DID, intermediate result, for illustration, 500 GeV						
akiya_l5_500TDR	312.	115.	2.3	9.7	0.3	4.2

Early hits (<15ns): Particles coming directly from IP

Late hits (>15 ns): Particles reflected from forward region

VXD hits/BX	L1, 2 Early	L1, 2 Late	L3, 4 Early	L3, 4 Late	L5, 6 Early	L5, 6 Late
DBD						
250_DBD_fieldX02	98.8	5.1	0.7	0.4	0.1	0.1
500_DBD_fieldX02	194.7	15.9	1.3	0.5	0.1	0.7
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LARGE model has more early VXD hits than SMALL → B field effect

VXD hits/BX	L1, 2 Early	L1, 2 Late	L3, 4 Early	L3, 4 Late	L5, 6 Early	L5, 6 Late
DBD						
250_DBD_fieldX02	98.8	5.1	0.7	0.4	0.1	0.1
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no-antiDID model has similar number of early VXD hits than antiDID → expected

VXD hits/BX	L1, 2 Early	L1, 2 Late	L3, 4 Early	L3, 4 Late	L5, 6 Early	L5, 6 Late
DBD						
250_DBD_fieldX02	98.8	5.1	0.7	0.4	0.1	0.1
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no-antiDID model has several times more late VXD hits than antiDID
→ less pairs hit FCAL

VXD hits/BX	L1, 2		L3, 4		L5, 6	
	Early	Late	Early	Late	Early	Late
DBD						
250_DBD_fieldX02	98.8	5.1	0.7	0.4	0.1	0.1
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akiya_l5_500TDR	312.	115.	2.3	9.7	0.3	4.2

Number of <u>late</u> VXD hits no longer depends strongly on modest G4 parameter variations
→ stable configuration

VXD hits/BX	L1, 2		L3, 4		L5, 6	
	Early	Late	Early	Late	Early	Late
DBD						
250_DBD_fieldX02	98.8	5.1	0.7	0.4	0.1	0.1
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New simulations predict several times more early VXD hits than DBD-era:
→ new beam parameters

VXD hits/BX	L1, 2		L3, 4		L5, 6	
	Early	Late	Early	Late	Early	Late
DBD						
250_DBD_fieldX02	98.8	5.1	0.7	0.4	0.1	0.1
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BEAMLIMITS_s5v05_250A	200.	71.1	1.4	6.4	0.1	3.5
LARGE, anti-DID, intermediate result, for illustration, 500 GeV						
akiya_l5_500TDR	312.	115.	2.3	9.7	0.3	4.2

New simulations predict order of magnitude more late VXD hits than DBD-era estimates

VXD hits/BX	L1, 2		L3, 4		L5, 6	
	Early	Late	Early	Late	Early	Late
DBD						
250_DBD_fieldX02	98.8	5.1	0.7	0.4	0.1	0.1
500_DBD_fieldX02	194.7	15.9	1.3	0.5	0.1	0.7
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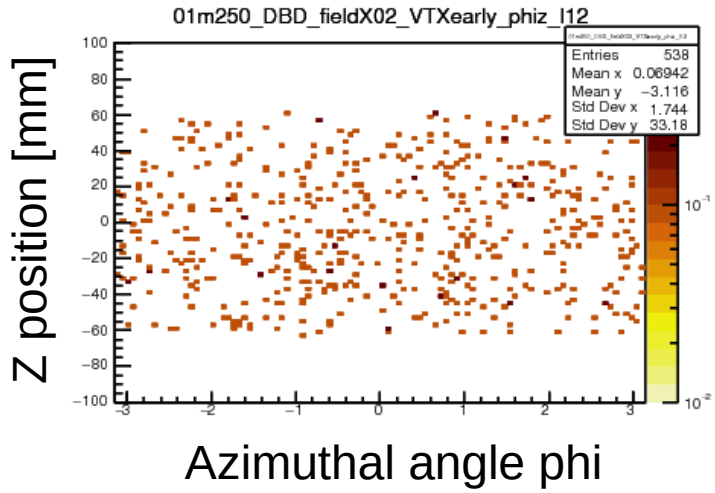
BEAMLIMITS_s5v05_250A	200.	71.1	1.4	6.4	0.1	3.5
LARGE, anti-DID, intermediate result, for illustration, 500 GeV						
akiya_l5_500TDR	312.	115.	2.3	9.7	0.3	4.2

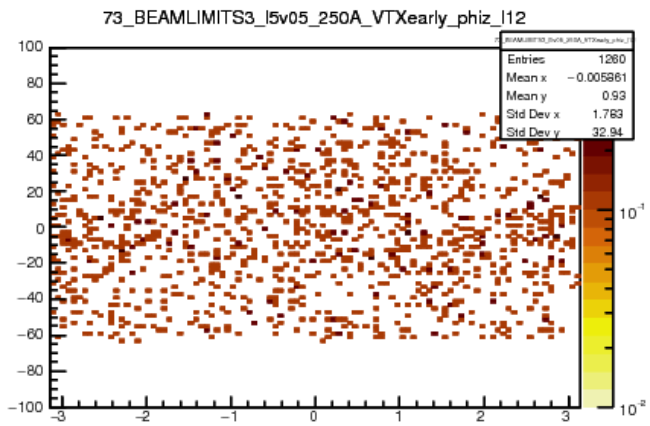
New 250 GeV simulations, in total:
3 times more VXD hits than DBD-250
50% more VXD hits than DBD-500

[normalisation/BX]

Early Hits in VXD L1,2

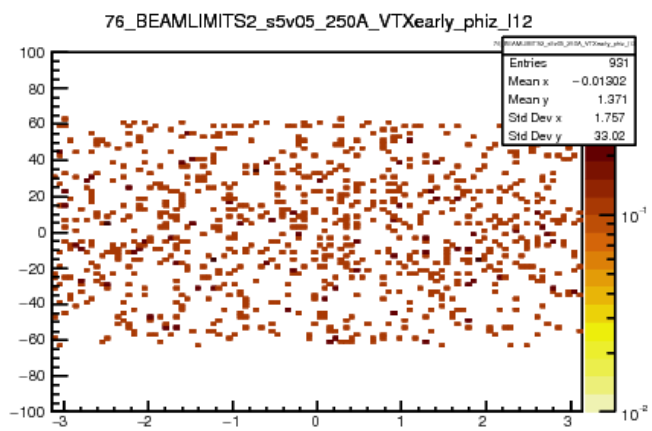


DBD 250
[sim & beam params]



New beam params,
new sim [aDID]

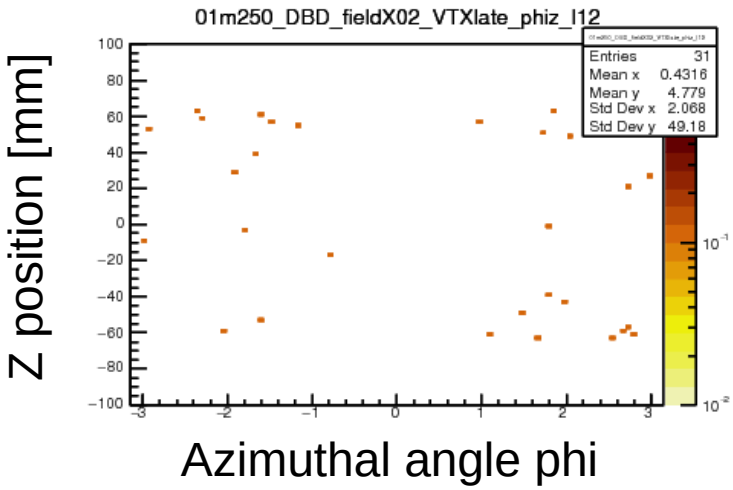
Large detector



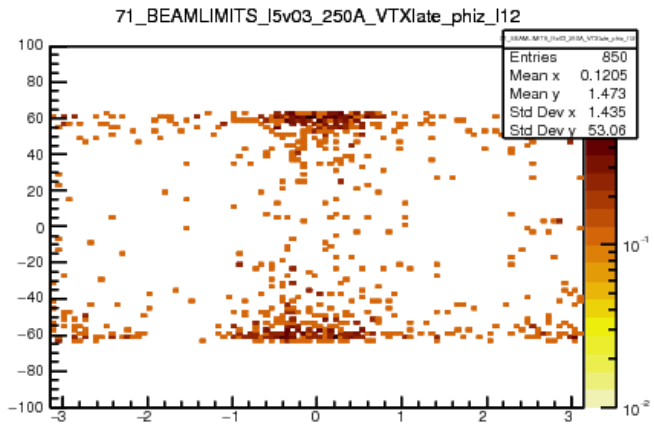
Small detector

[normalisation/BX]

Late Hits in VXD L1,2

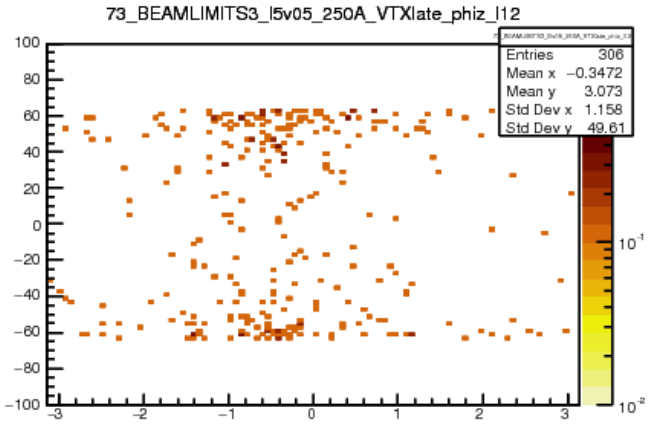


DBD 250
[sim & beam params]



New beam params,
new sim

No a-DID



a-DID

Use code from Strahinja to convert to hits/area in various systems

Large, 250 new params, anti-DID

[I believe: (mean #hits/BX +/- bunch-by-bunch variation)

```
-----------------------------------------
Subsystem : VXD
  Layer 1: 7292 hits.  hitsperBX = (810.2 +- 339.) hits/BX.  (5.89 +- 2.471) hits/cm^2/BX.
  Layer 2: 4215 hits.  hitsperBX = (468.3 +- 204.) hits/BX.  (3.40 +- 1.488) hits/cm^2/BX.
  Layer 3: 906 hits.   hitsperBX = (100.6 +- 57.4) hits/BX.  (0.16 +- 0.094) hits/cm^2/BX.
  Layer 4: 746 hits.   hitsperBX = (82.88 +- 47.2) hits/BX.  (0.13 +- 0.078) hits/cm^2/BX.
  Layer 5: 279 hits.   hitsperBX = (31    +- 17.1) hits/BX.  (0.03 +- 0.018) hits/cm^2/BX.
  Layer 6: 266 hits.   hitsperBX = (29.56 +- 16.6) hits/BX.  (0.03 +- 0.017) hits/cm^2/BX.
-----------------------------------------
Subsystem : FTD
  Layer 1: 357 hits.   hitsperBX = (39.6 +- 22.8) hits/BX.   (0.045 +- 0.026) hits/cm^2/BX.
  Layer 2: 214 hits.   hitsperBX = (23.7 +- 16.3) hits/BX.   (0.028 +- 0.019) hits/cm^2/BX.
  Layer 3: 357 hits.   hitsperBX = (39.6 +- 22.3) hits/BX.   (0.014 +- 0.008) hits/cm^2/BX.
  Layer 4: 244 hits.   hitsperBX = (27.1 +- 14.1) hits/BX.   (0.010 +- 0.005) hits/cm^2/BX.
  Layer 5: 169 hits.   hitsperBX = (18.7 +- 7.42) hits/BX.   (0.007 +- 0.003) hits/cm^2/BX.
  Layer 6: 88 hits.    hitsperBX = (9.77 +- 3.99) hits/BX.   (0.004 +- 0.001) hits/cm^2/BX.
  Layer 7: 50 hits.    hitsperBX = (5.55 +- 3.62) hits/BX.   (0.002 +- 0.001) hits/cm^2/BX.
-----------------------------------------
Subsystem : SIT
  Layer 1: 205 hits.   hitsperBX = (22.7 +- 10.6) hits/BX.   (0.0031 +- 0.0014) hits/cm^2/BX.
  Layer 2: 190 hits.   hitsperBX = (21.1 +- 13.3) hits/BX.   (0.0028 +- 0.0018) hits/cm^2/BX.
  Layer 3: 314 hits.   hitsperBX = (34.8 +- 17.5) hits/BX.   (0.0014 +- 0.0007) hits/cm^2/BX.
  Layer 4: 282 hits.   hitsperBX = (31.3 +- 12.4) hits/BX.   (0.0012 +- 0.0005) hits/cm^2/BX.
-----------------------------------------
Subsystem : TPC
  Reporting total hits in the detector element:
  Layer 1: 709 hits.   hitsperBX = (78.8 +- 103.8) hits/BX.
-----------------------------------------
Subsystem : SET
  Layer 1: 140 hits.   hitsperBX = (15.5 +- 8.0) hits/BX.   (3.02e-05 +- 1.56e-05) hits/cm^2/BX.
  Layer 2: 146 hits.   hitsperBX = (16.2 +- 7.1) hits/BX.   (3.14e-05 +- 1.39e-05) hits/cm^2/BX.
```

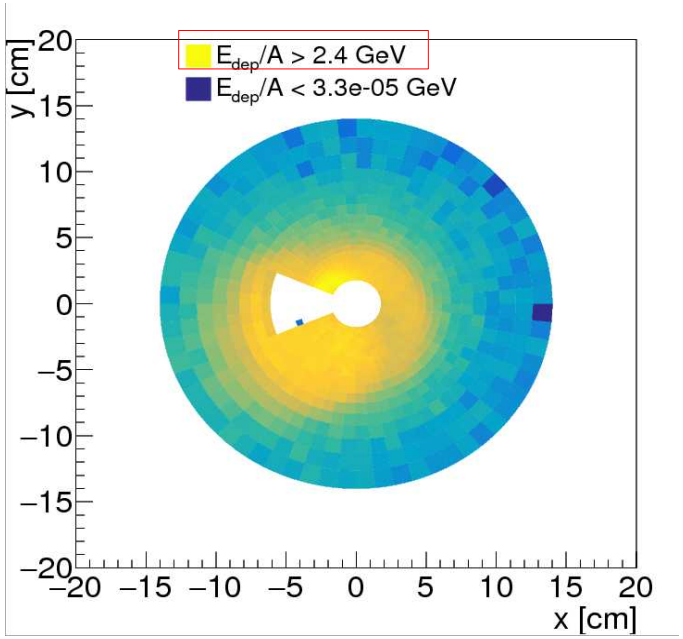
Code from Strahinja to make beam-cal energy maps

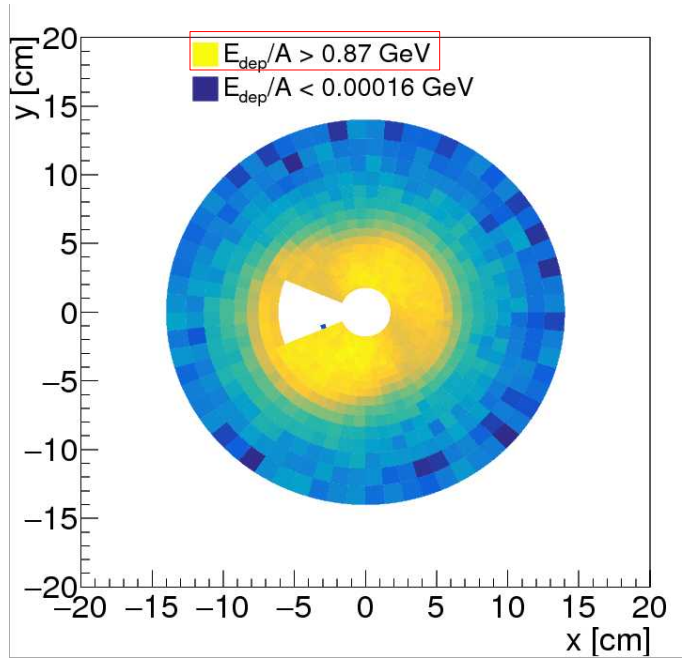
→ WARNING: color scale changes between plots !!!

No anti-DID

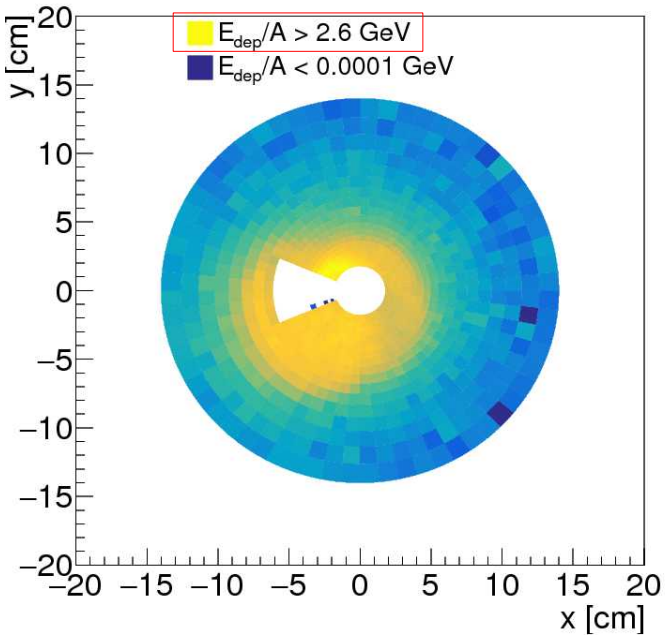
With anti-DID

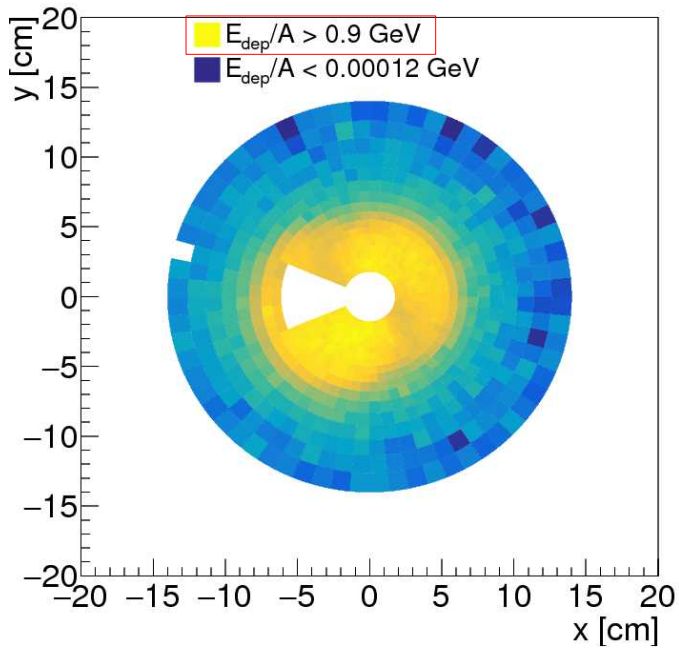
LARGE





SMALL





Looks somewhat reasonable:

- More centred

- Smaller max. energy deposit with aDID

Conclusion

I think we're getting there !

If you want more detailed studies, numbers, plots for your favourite subdetector,
please make them yourselves

I will soon put O(10) simulated bunch crossings in various configurations somewhere accessible,
you are welcome to make use of them.