

Background Study

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Types of Background runs

- We have many different types of background runs (no gas in target), most of them are taken just after the 1.1 GeV production runs began
 - (Type 1) No gas in chamber, target is out of position: indicated by **low** gas flow rate, **low** chamber pressure, target motor position at **large** y value
 - Run 1122, 1125, 1342
 - Can be used to study background from beam line
 - (Type 2) Gas in the chamber, target is out of position: indicated by **high** gas flow rate, **high** chamber pressure, target motor position at **large** y value
 - Run 1123, 1126
 - Can be used to study background from residual gas
 - (Type 3) No gas in chamber, target at beam position: indicated by **low** gas flow rate, **low** chamber pressure, target motor position at **small** y value
 - Run 1127, 1129, 1153, 1163, 1197, 1417 and probably 1318 (no target pos info)
 - Can be used to study background generated by target cell
 - (Type 4) Gas in the chamber, target at beam position, indicated by **high** gas flow rate, **high** chamber pressure, target motor position at **small** y value
 - Majority of the background runs are this type, should be used for background subtraction

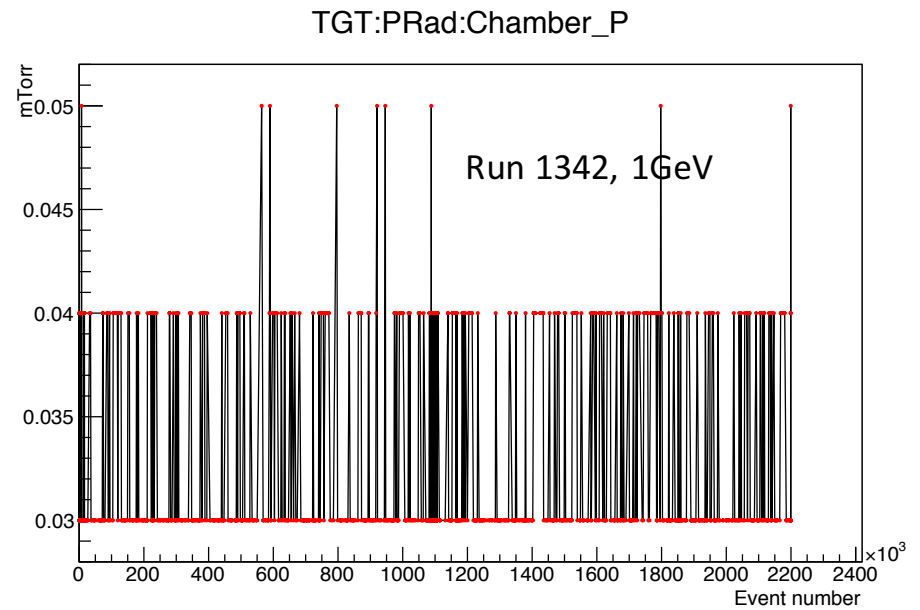
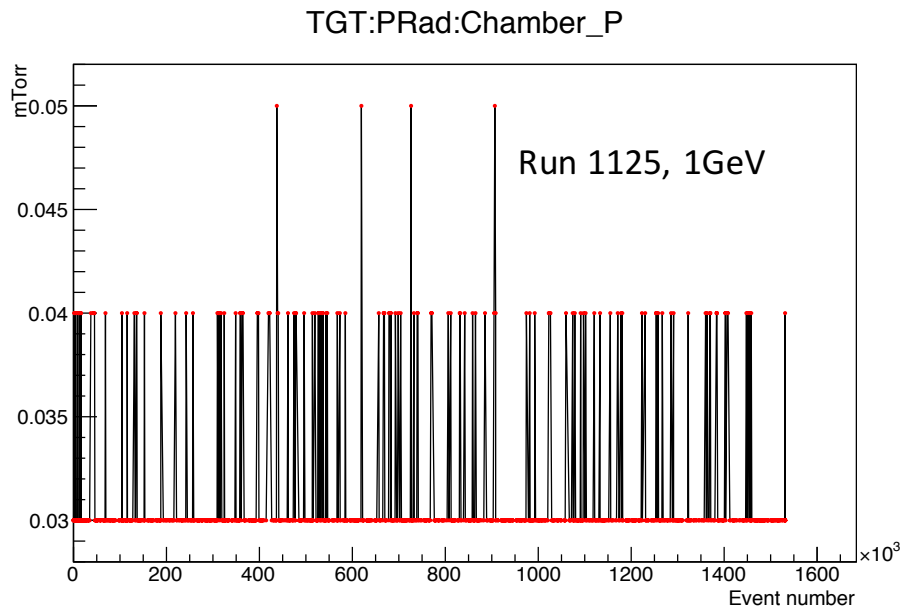
Types of Background runs

- Most of the runs from the first 3 types have not been calibrated, so small shifts for the ep and ee peak are expected if they are analyzed with the current calibration constants
- At 2 GeV, there is no run belongs to the **Type 2** and only one run belongs to **Type 3**
- In this study, I will compared the four types of runs, and try to identify the major background source
- I will proceed this study as follows:
 - Show the characteristics of the EPICS values for these four types of Runs
 - Show characteristics of beam line pressure for these four types of runs
 - Look at cluster E vs theta identify the major background source

EPCIS for background run Type 1

- No gas in the chamber, target cell out of position: characterized by **low** chamber pressure, **low** gas flow rate, **large** value for target y position

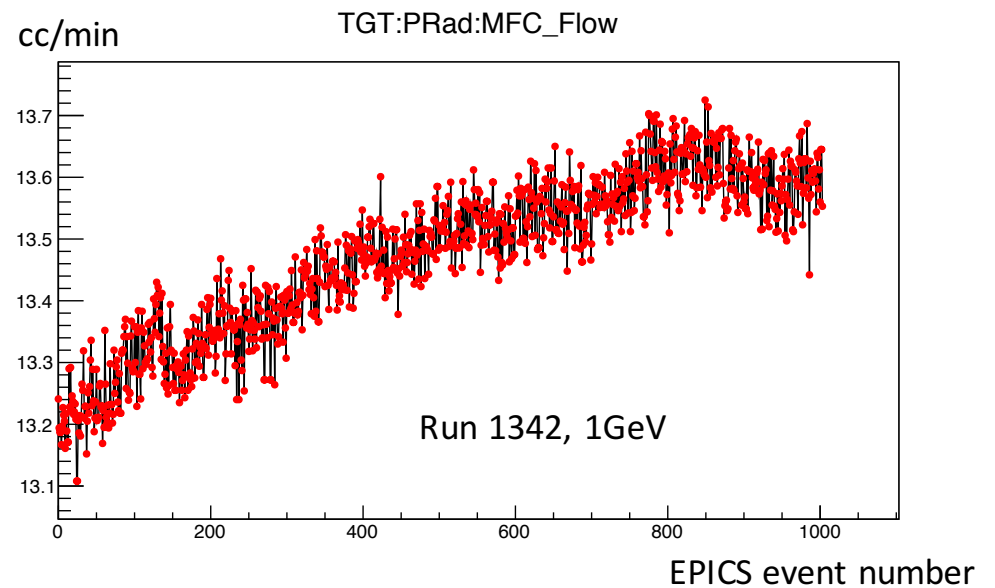
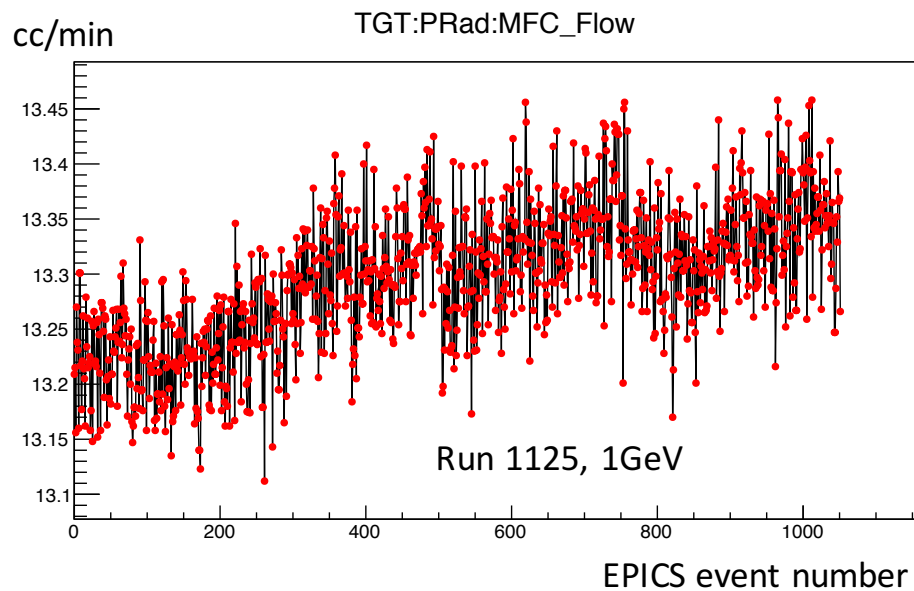
If filling gas into the chamber, chamber pressure should be around 2.9 mTorr



EPCIS for background run Type 1

- No gas in the chamber, target cell out of position: characterized by **low** chamber pressure, **low** gas flow rate, **large** value for target y position

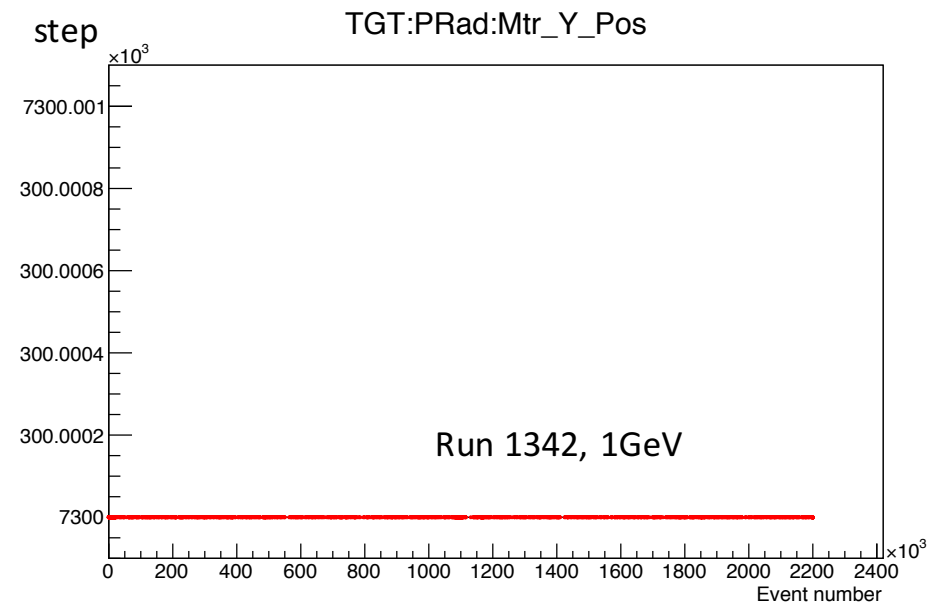
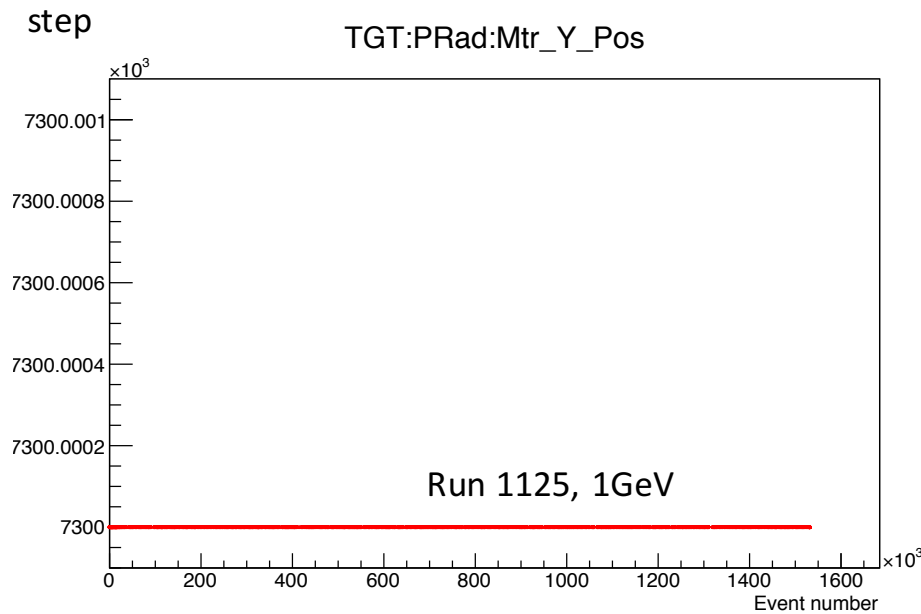
If filling gas, either in chamber or in cell, nominal value for the target flow rate is 600cc / min



EPCIS for background run Type 1

- No gas in the chamber, target cell out of position: characterized by **low** chamber pressure, **low** gas flow rate, **large** value for target y position

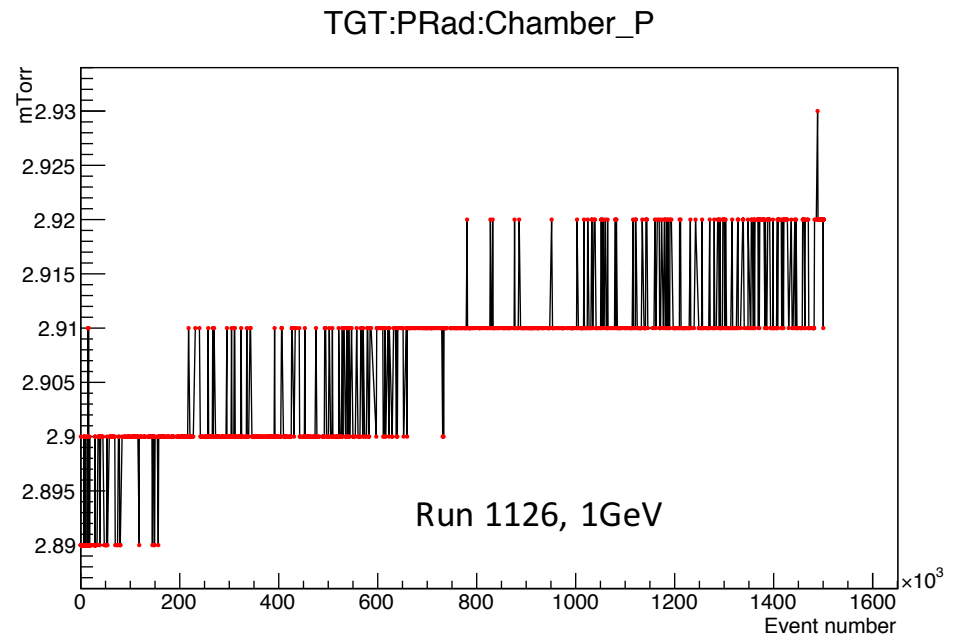
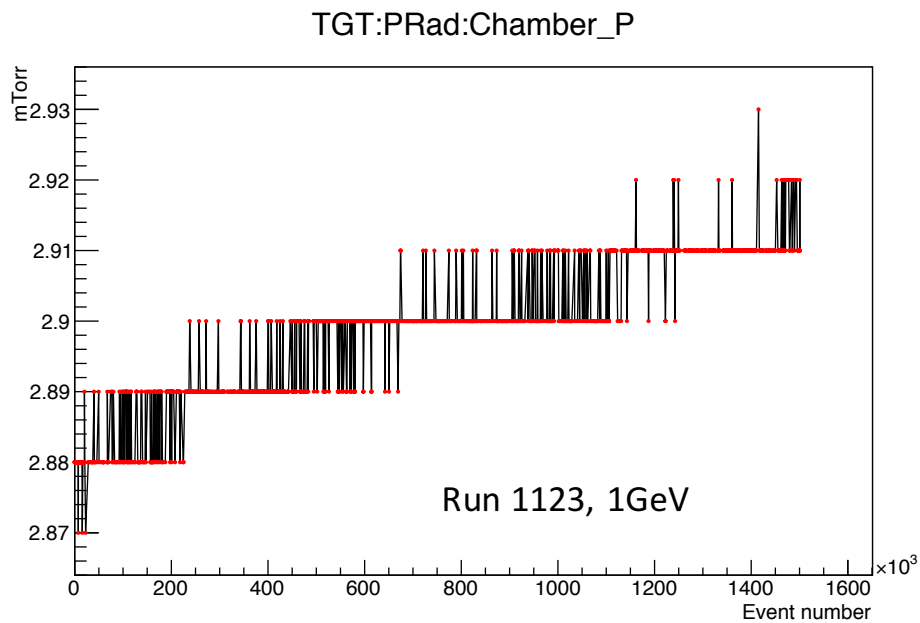
If target is out of position, target motor y always at 7.3e6 steps



EPCIS for background run Type 2

- Gas in the chamber, target in out position: **high** gas flow rate, **high** chamber pressure, target motor position at **large** y value

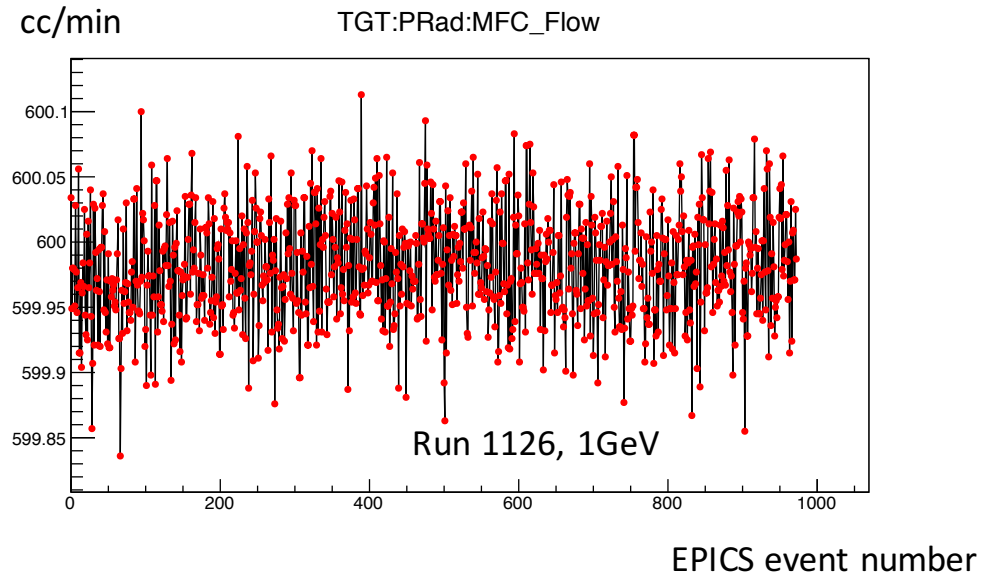
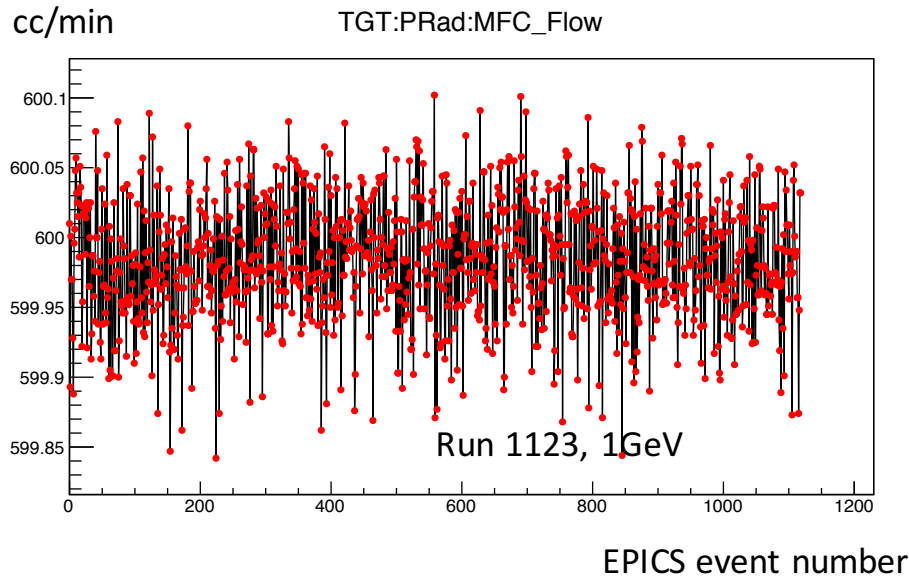
If not filling gas, chamber pressure should be around 0.035 mTorr



EPCIS for background run Type 2

- Gas in the chamber, target in out position: **high** gas flow rate, **high** chamber pressure, target motor position at **large** y value

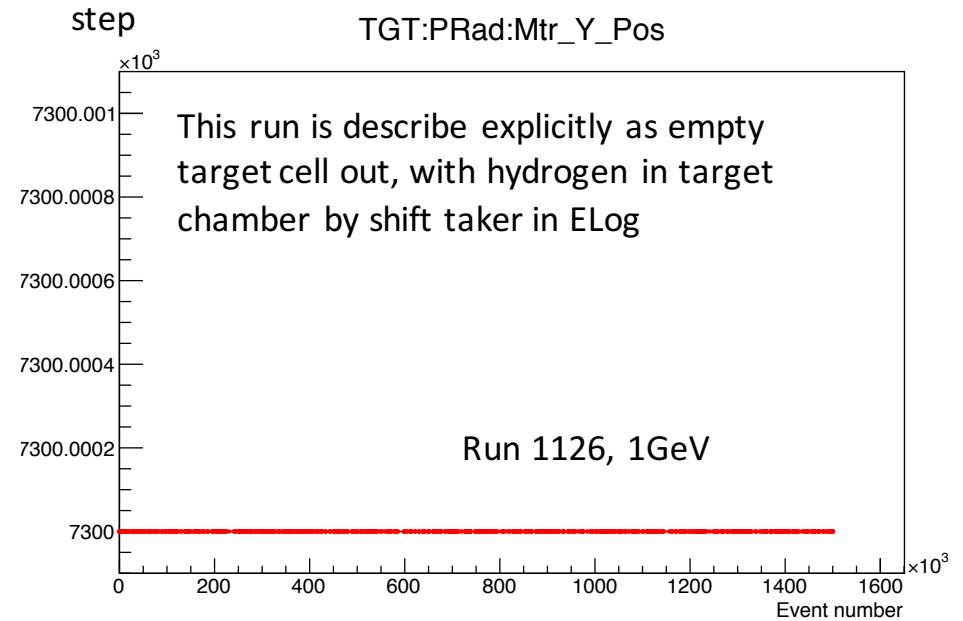
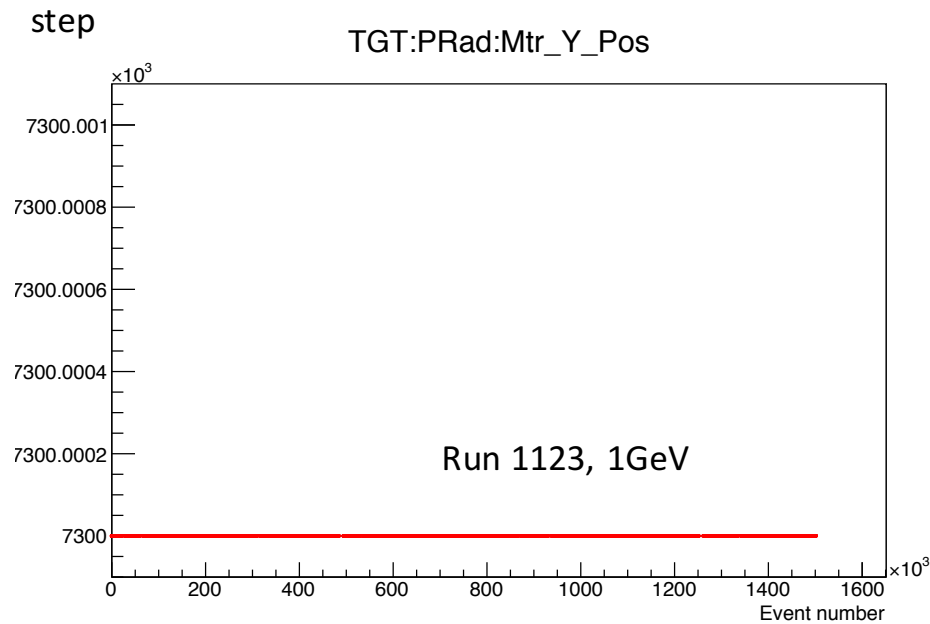
Gas flow rate at nominal value 600cc/min, same as all production runs



EPCIS for background run Type 2

- Gas in the chamber, target in out position: **high** gas flow rate, **high** chamber pressure, target motor position at **large** y value

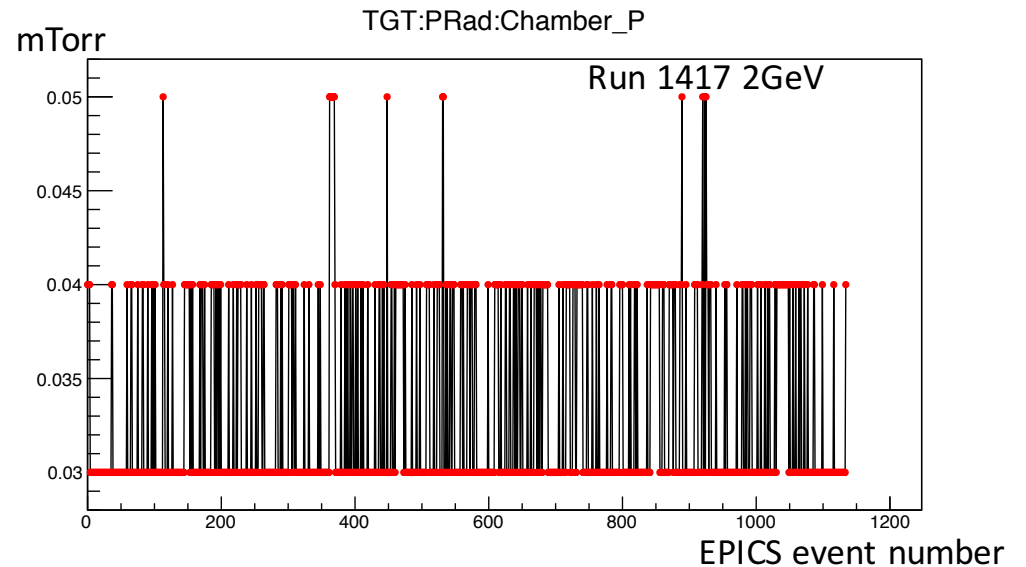
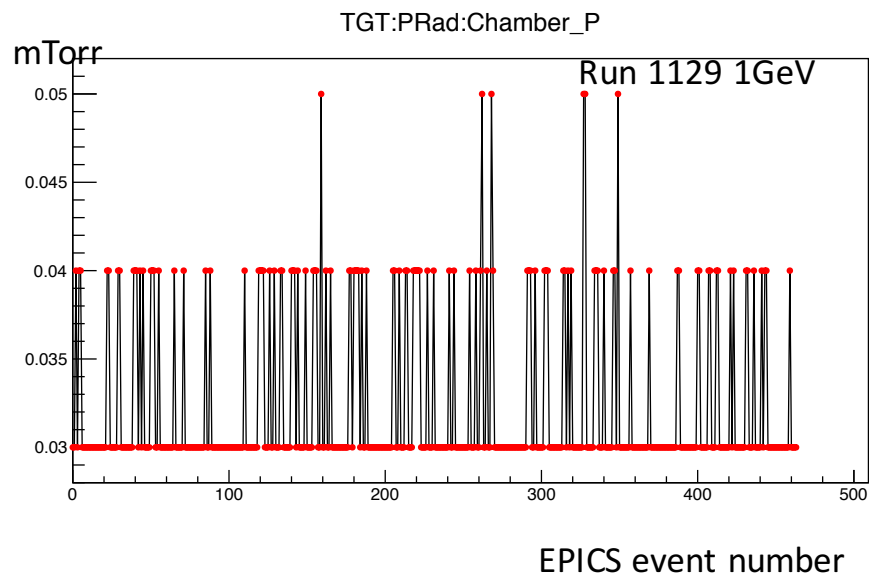
If target is out of position, target motor y always at 7.3e6 steps



EPCIS for background run Type 3

- No gas in chamber, target at beam position: indicated by **low** gas flow rate, **low** chamber pressure, target motor position at **small** y value

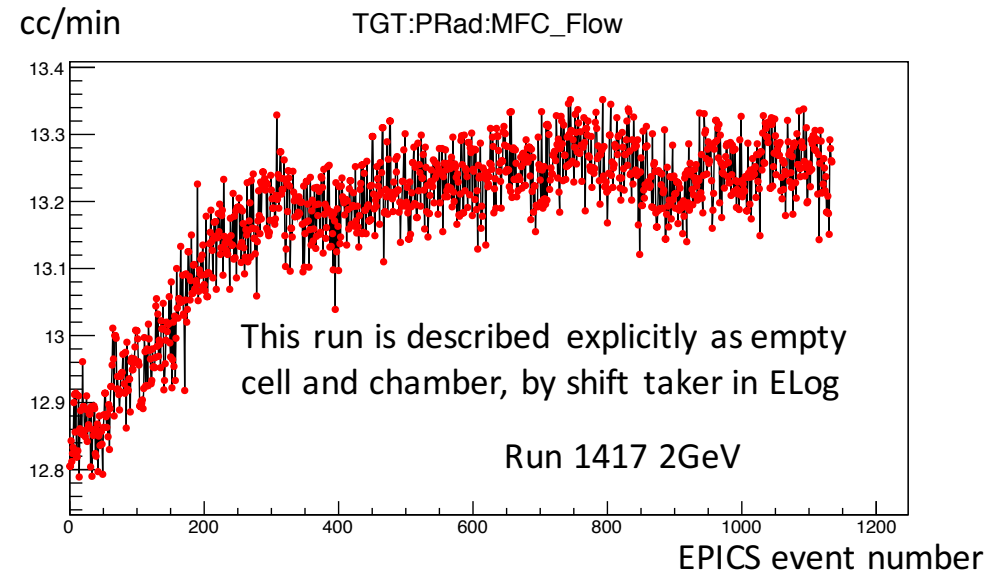
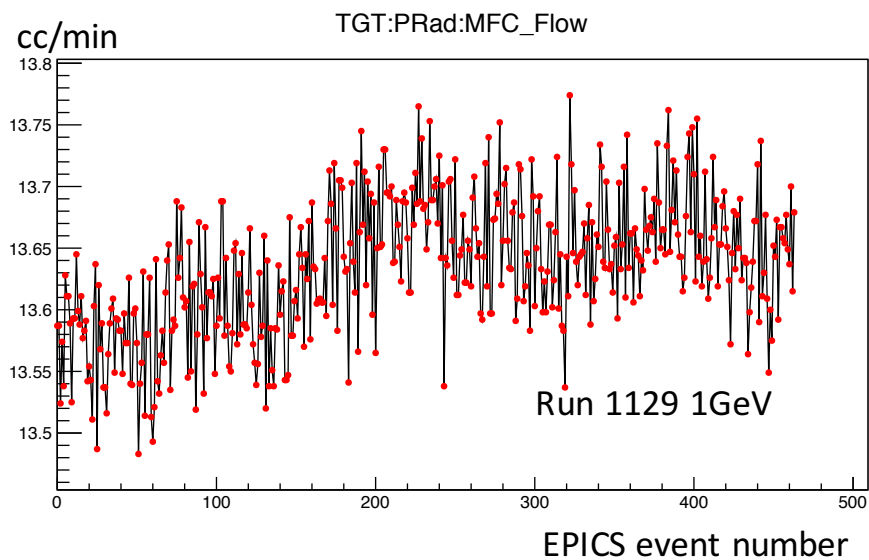
If filling gas into the chamber, chamber pressure should be around 2.9 mTorr



EPCIS for background run Type 3

- No gas in chamber, target at beam position: indicated by **low** gas flow rate, **low** chamber pressure, target motor position at **small** y value

If filling gas, nominal gas flow rate is 600 cc/min

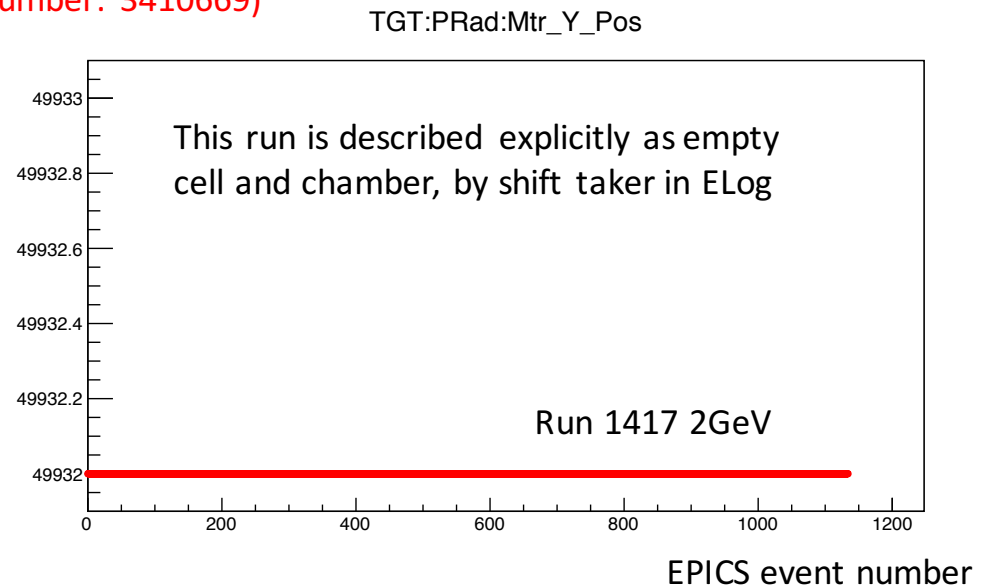
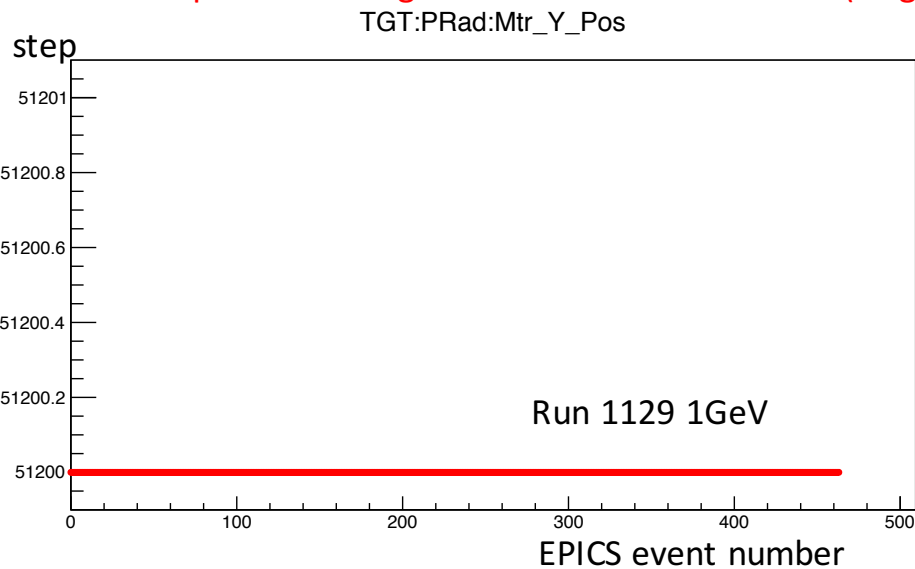


EPCIS for background run Type 3

- No gas in chamber, target at beam position: indicated by **low** gas flow rate, **low** chamber pressure, target motor position at **small** y value

If target is out of position, the motor y position should show $7.3e6$. If it is in beam position, this value is much smaller. But this value changed for a few times during the experiment:

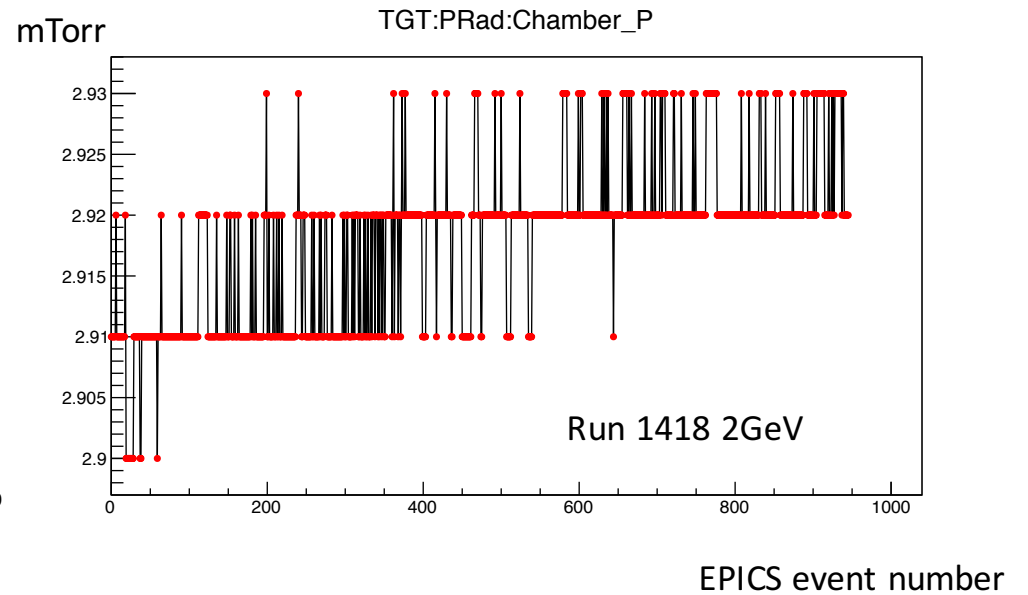
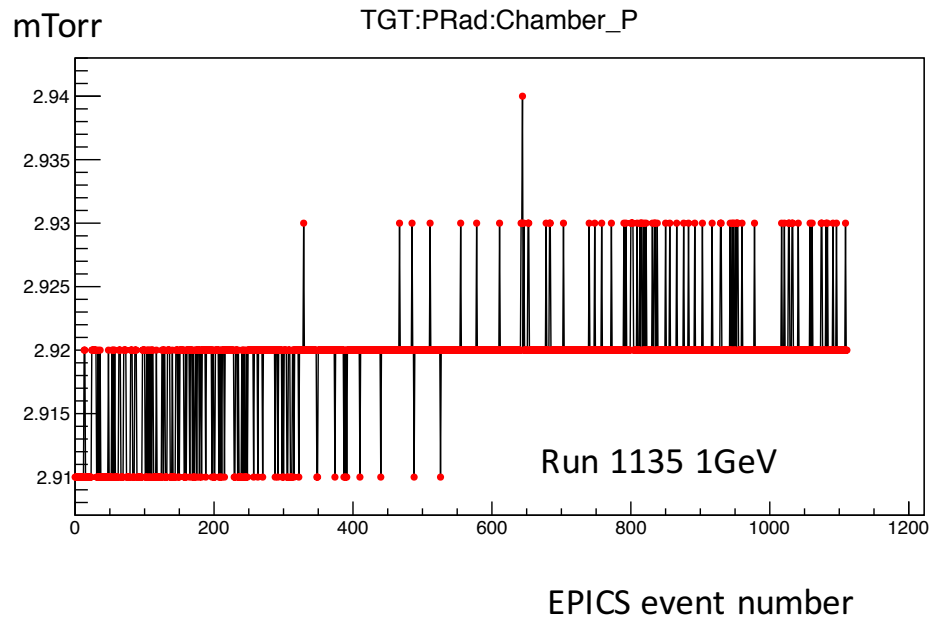
- Y position changed from 51200 to 38000 after run 1147 (Elog number: 3409008)
- Y position changed to 49932 after run 1387 (Elog number: 3410669)



EPCIS for background run Type 4

- Gas in the chamber, target at beam position, indicated by **high** gas flow rate, **high** chamber pressure, target motor position at **small** y value

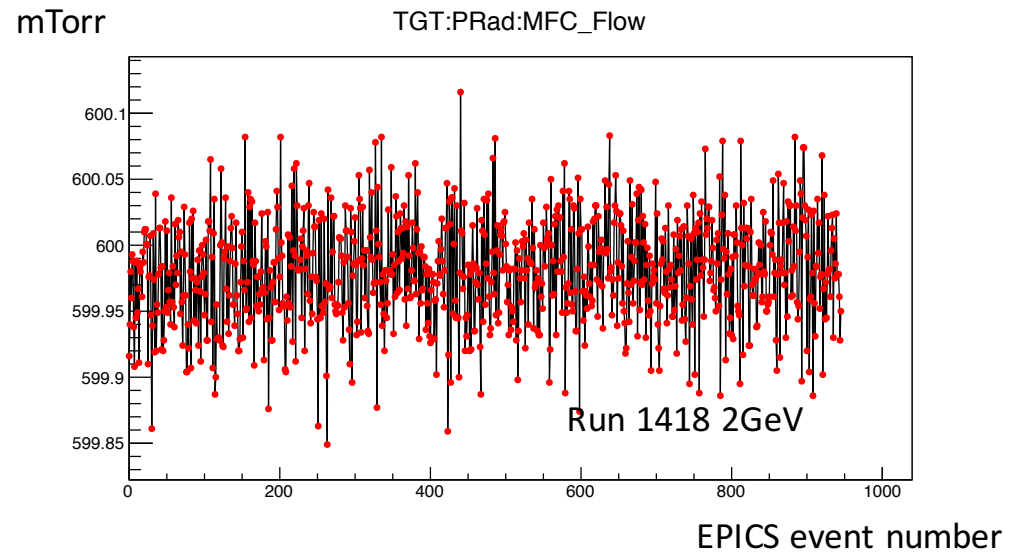
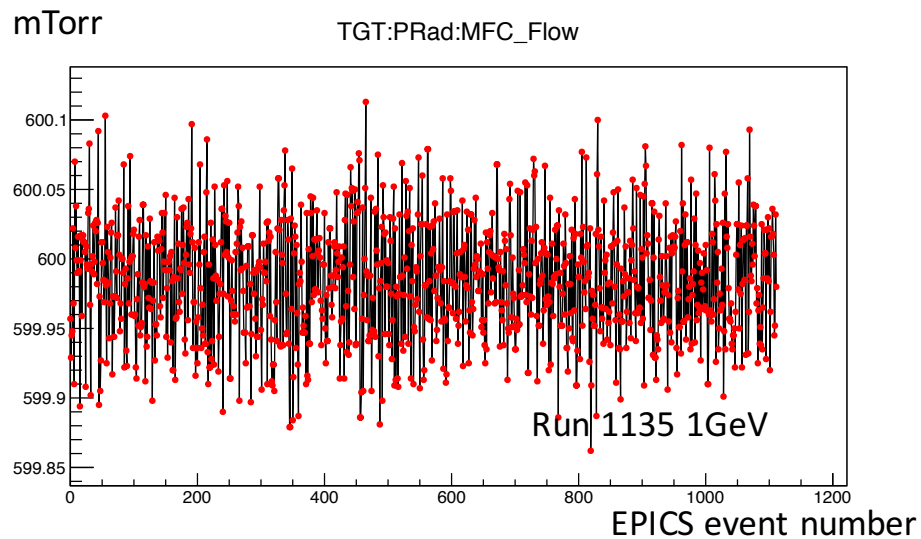
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EPCIS for background run Type 4

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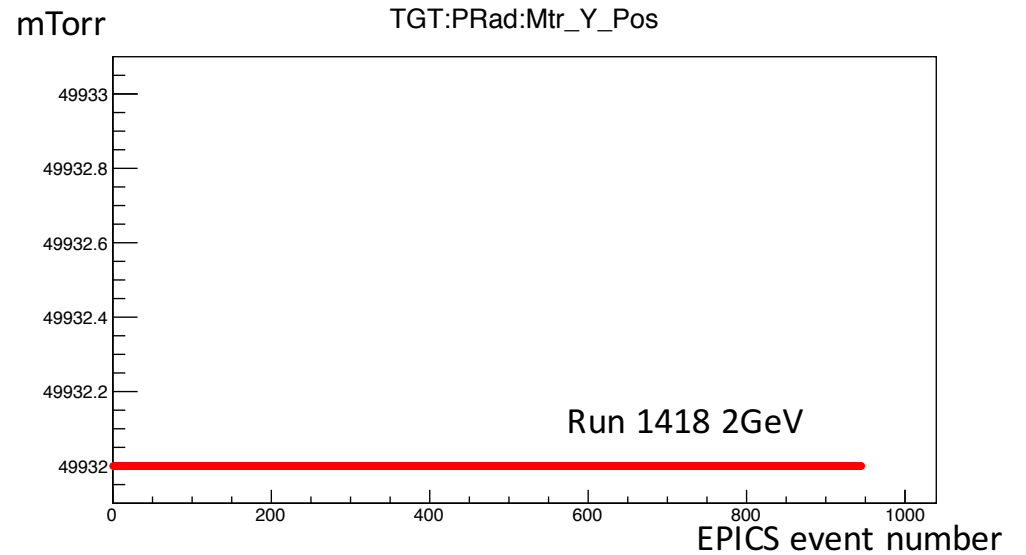
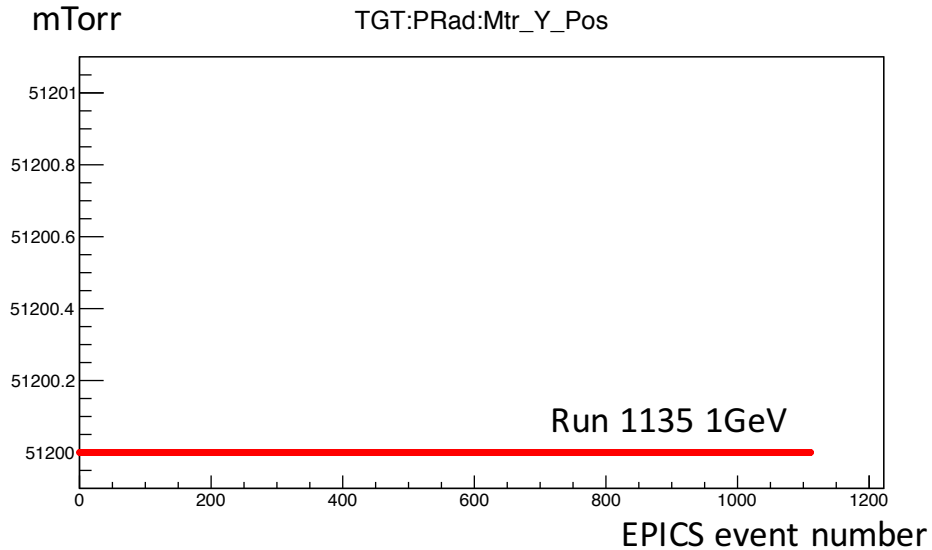
Gas flow rate at nominal value 600cc/min, same as all production runs



EPCIS for background run Type 4

- Gas in the chamber, target at beam position, indicated by **high** gas flow rate, **high** chamber pressure, target motor position at **small** y value

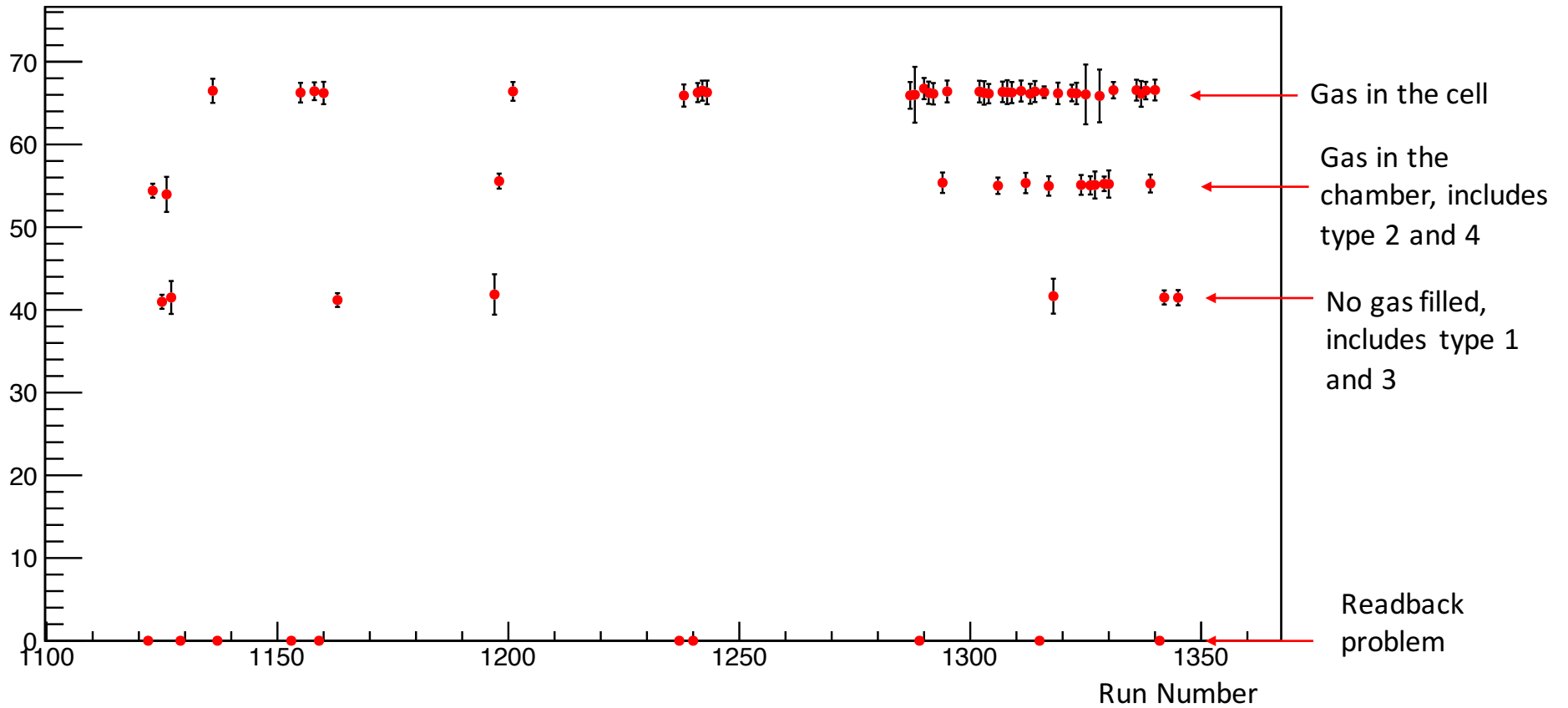
Values agree with the input from ELog



Beam line pressure

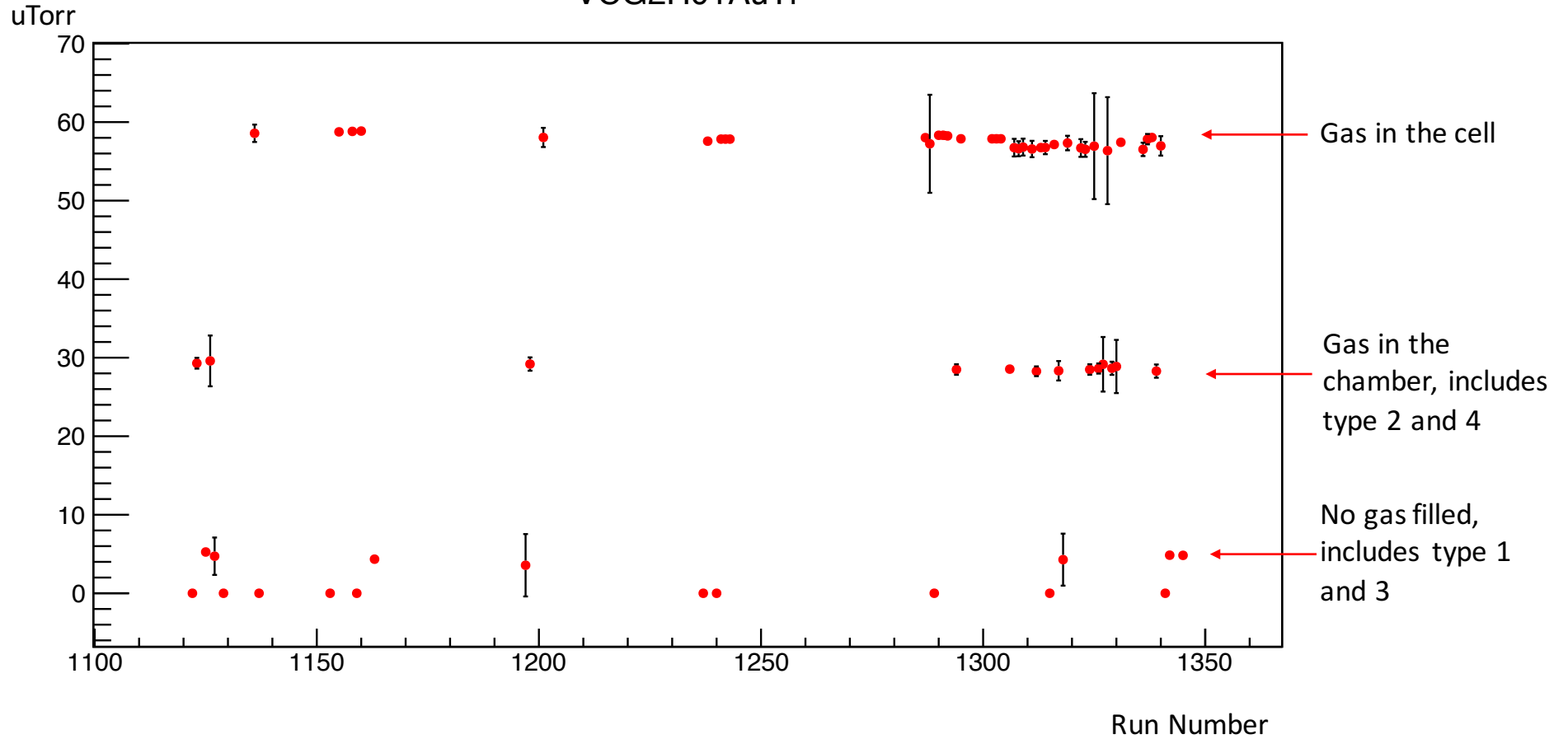
VCG2H00AuTr

uTorr



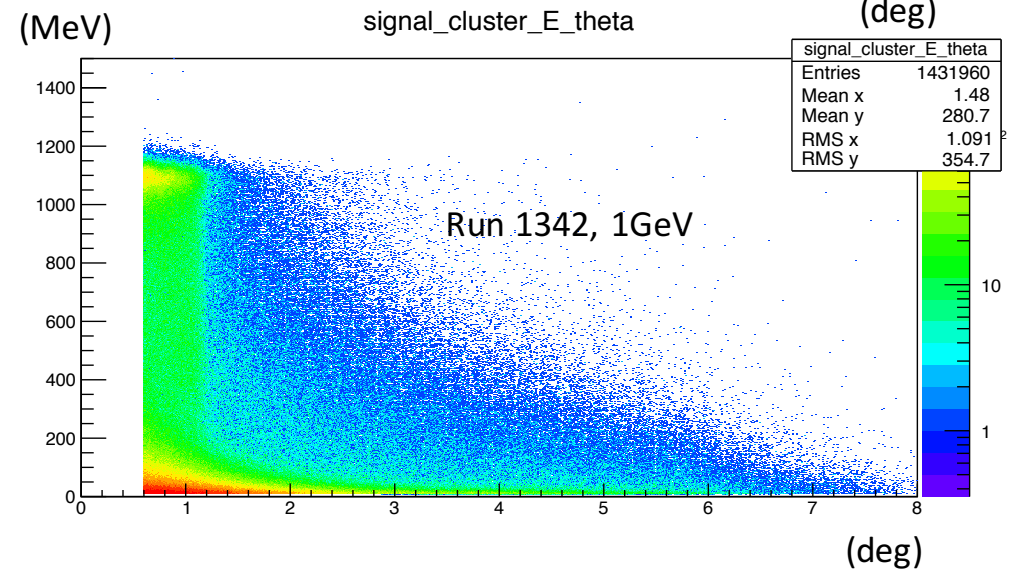
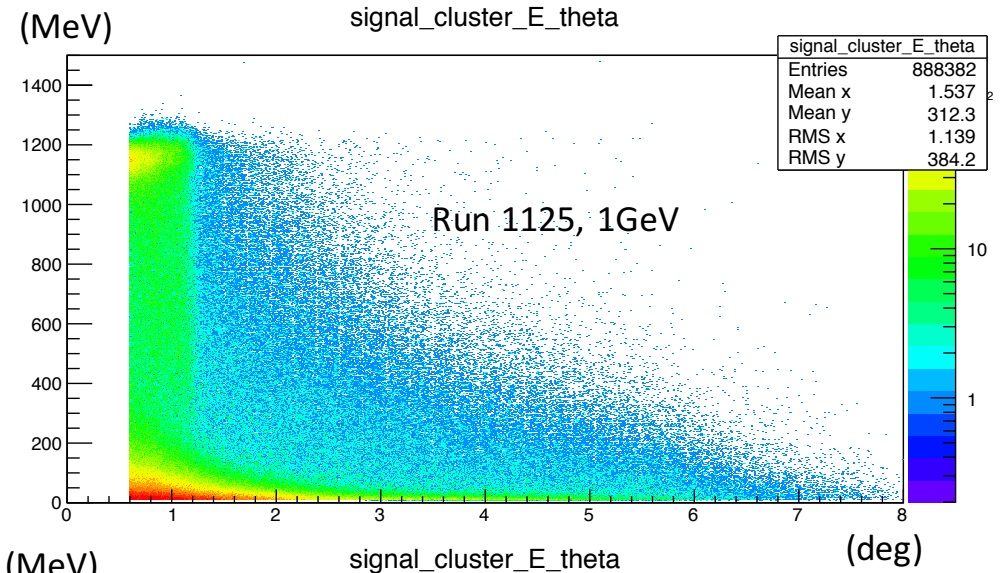
Beam line pressure

VCG2H01AuTr



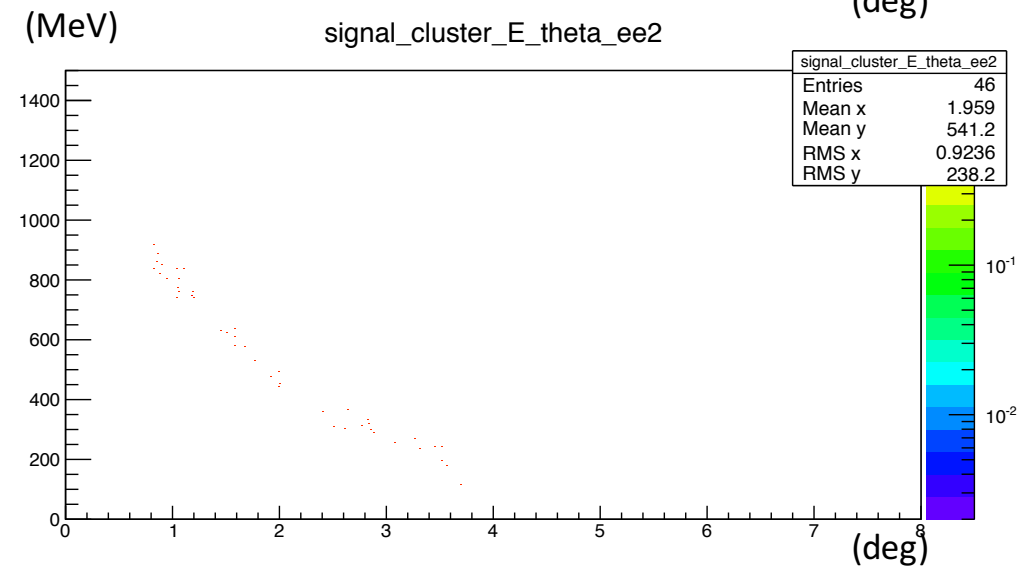
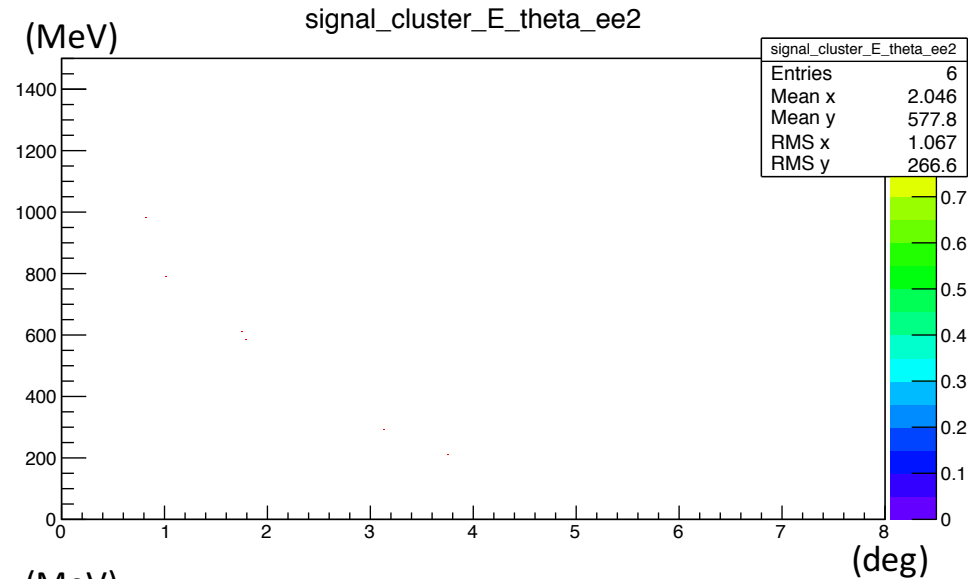
Cluster E vs theta for type 1

- No gas in the chamber, target cell out
- No obvious ep and ee peak can be observed



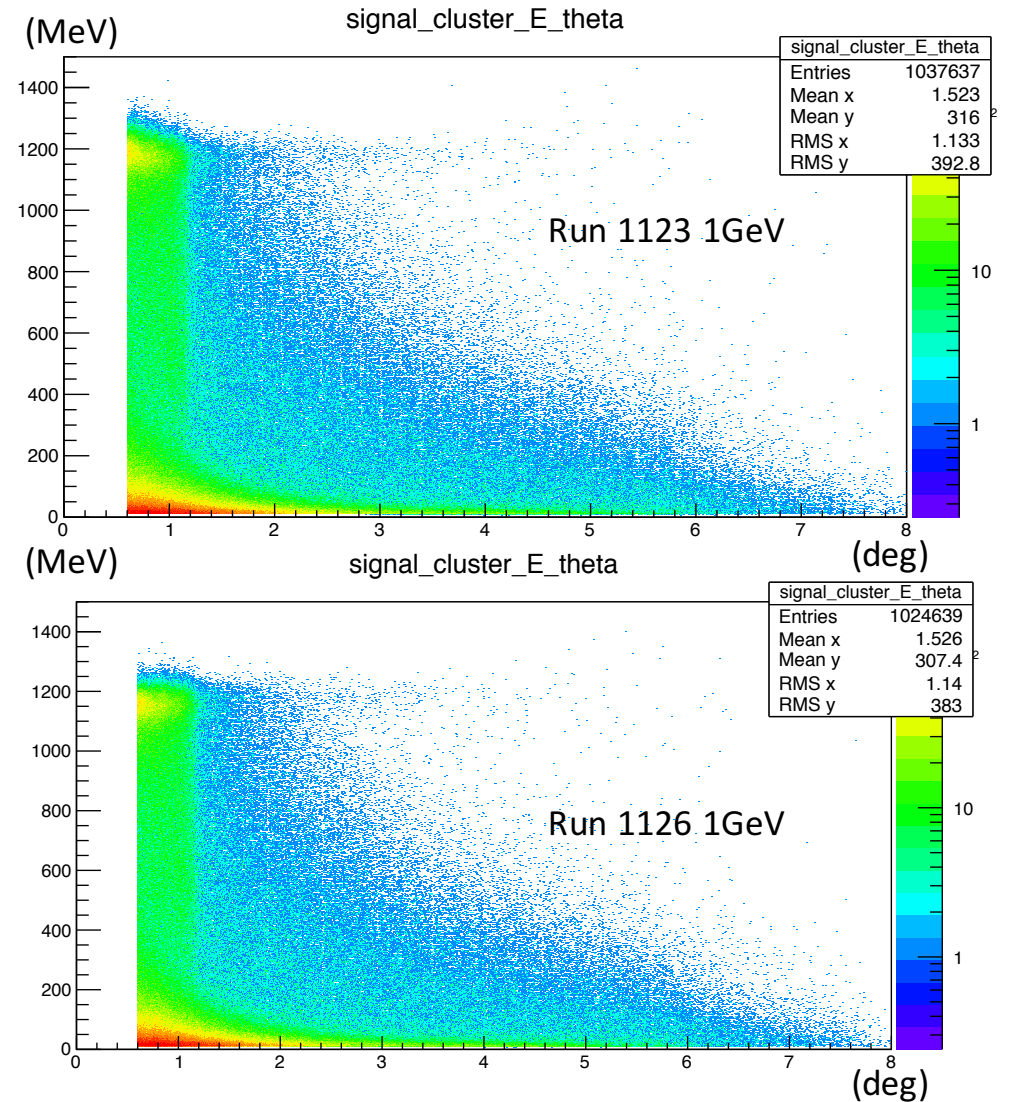
Cluster E vs theta for type 1

- No gas in the chamber, target cell out
- No obvious ep and ee peak can be observed
- After applying double arm Moller selection method, almost no event survive



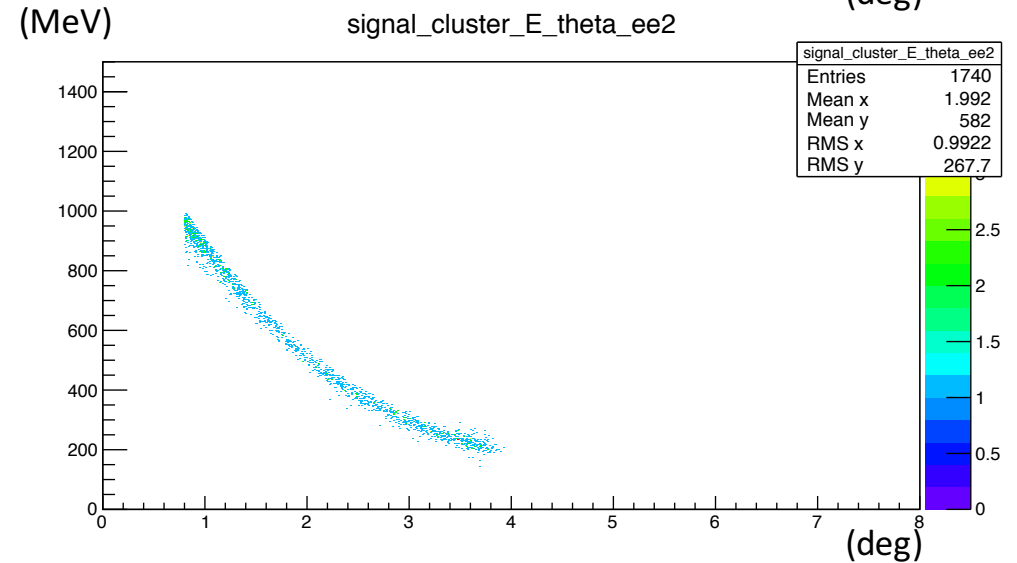
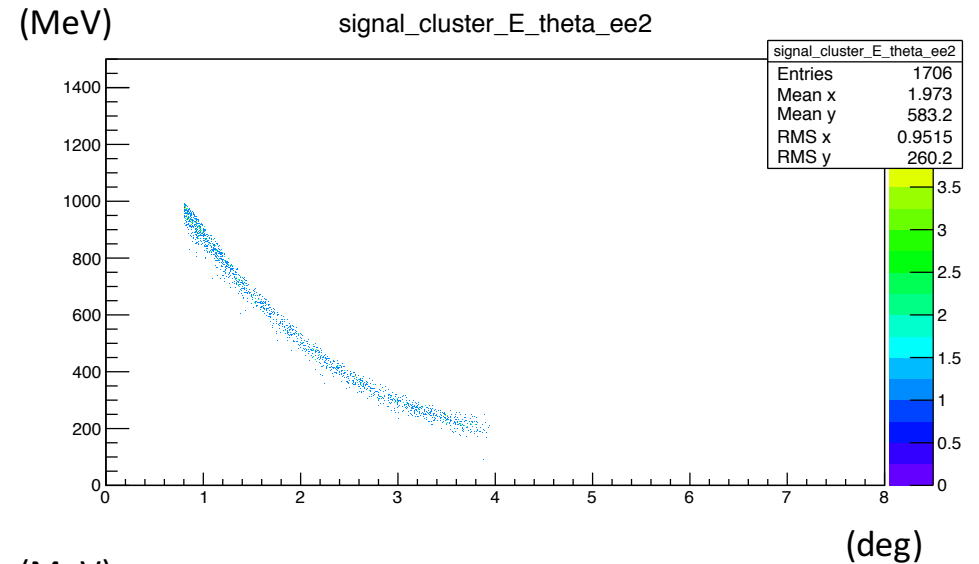
Cluster E vs theta for type 2

- Gas in the chamber, target cell out
- very vague ep and ee signals
- After applying double arm Moller selection method, we can see that there are many Moller compared to type 1 runs



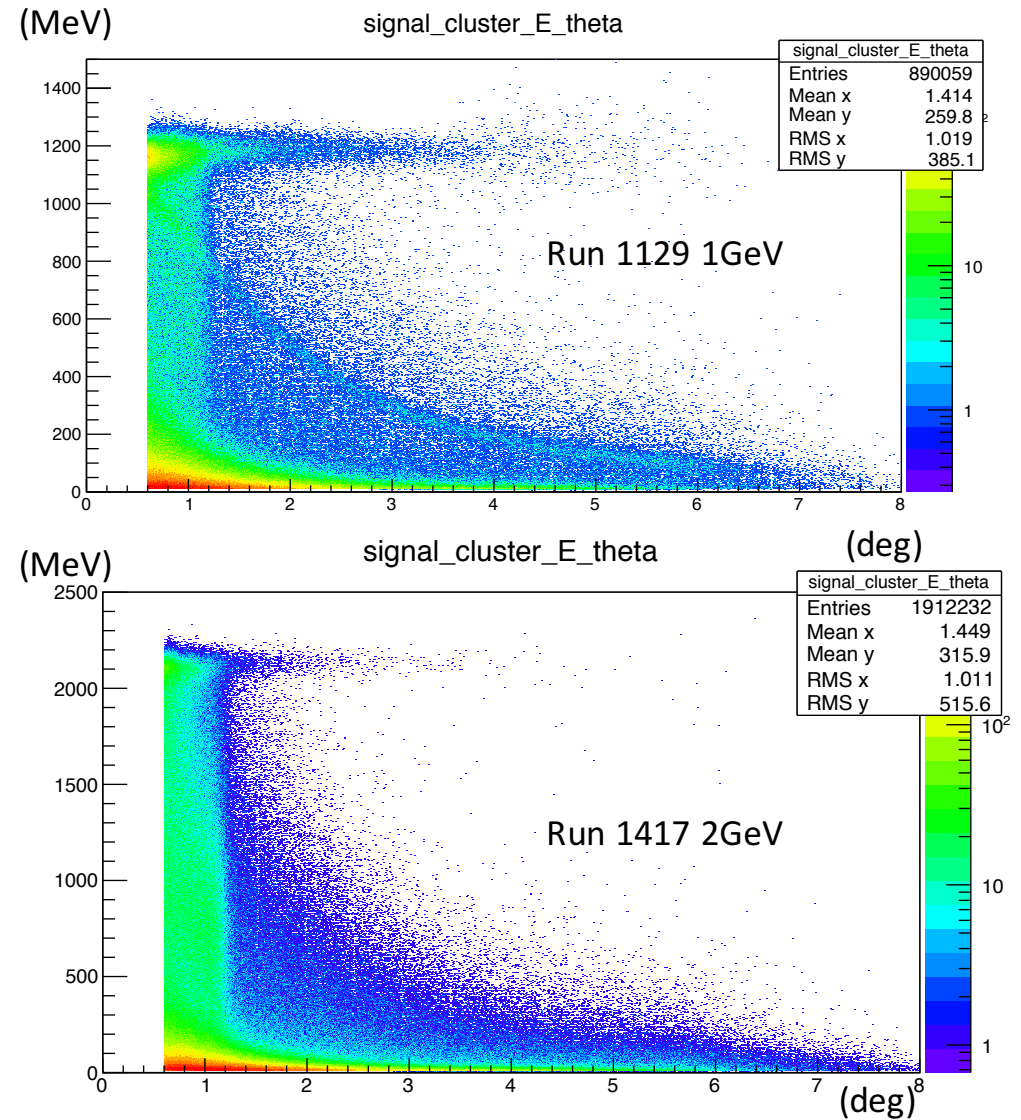
Cluster E vs theta for type 2

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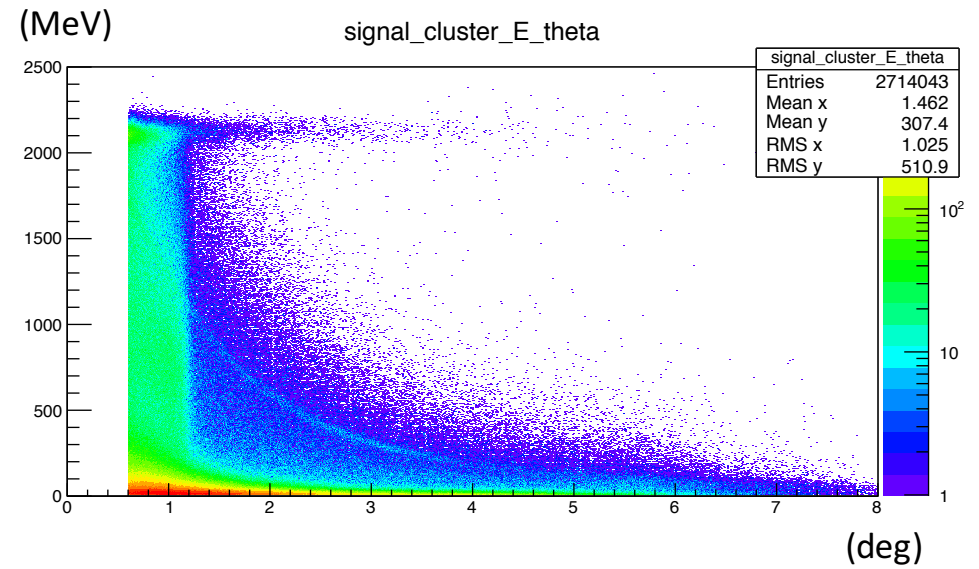
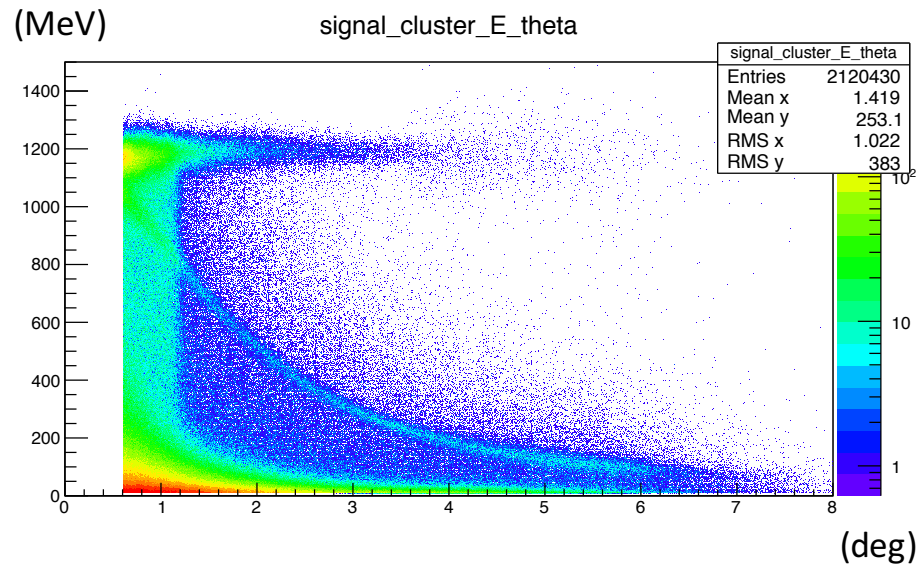
Cluster E vs theta for type 3

- No Gas in the chamber, target cell in
- very obvious ep and ee signals for 1GeV
- Still a clear signal for 2GeV ep, much less obvious for 2GeV ee
 - 2GeV ee from empty target run is only sub-percentage compared from production run



Cluster E vs theta for type 4

- Gas in the chamber, target cell in



Conclusion

- Based on these four different type of background run, the ep and ee signal depend strongly on the target position
- Background generated from target seems to dominate over background from residual gas for 1GeV (maybe even at 2GeV)
 - Most possible reason would be beam halo hitting the cell window
- This may explain why we always have much more ep background than Moller
 - Mott scattering scales with the square of target nuclei charge
- It may also be the reason why EPICS cannot explain the large fluctuations in the background at all