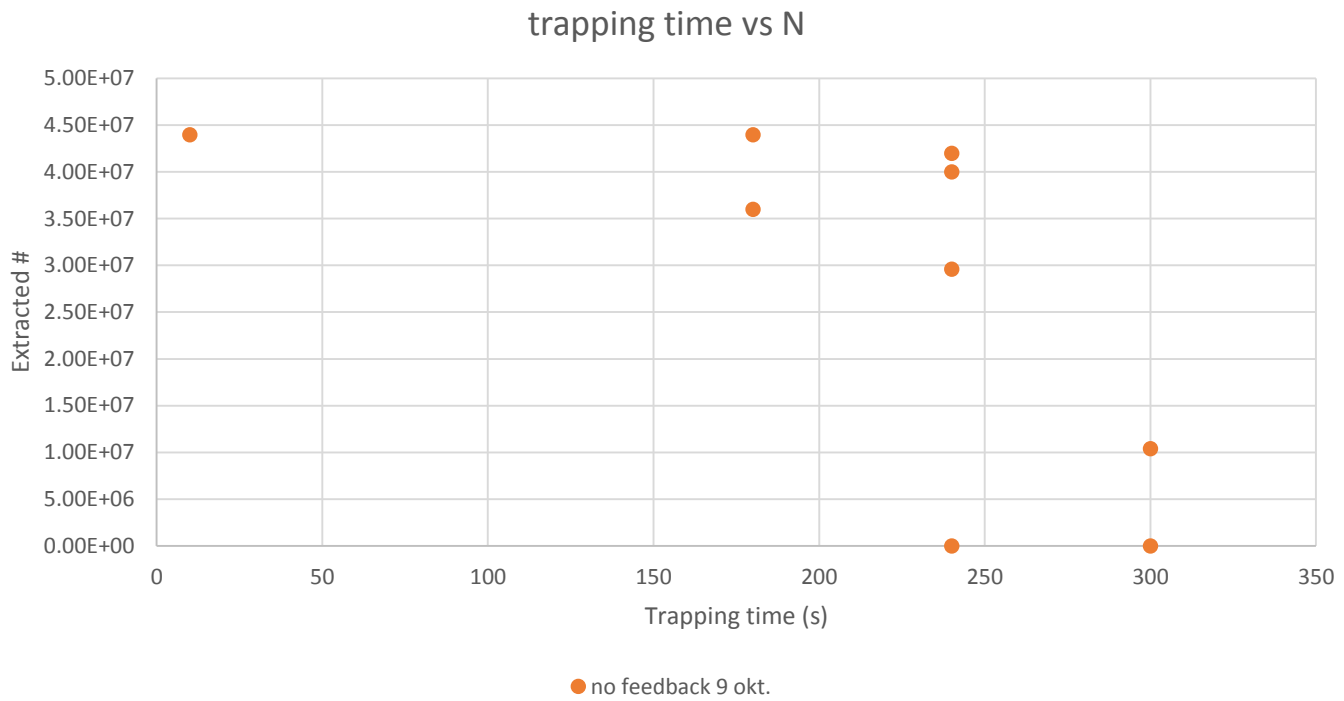
CUSP magnetic field alignment

Simon Van Gorp

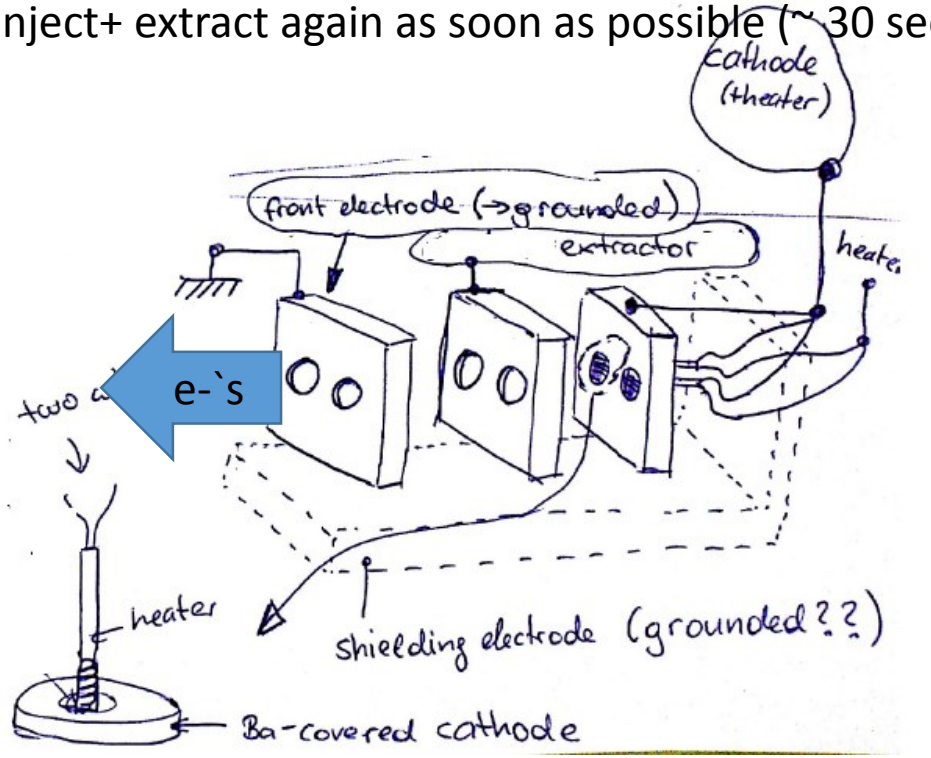
Situation before alignment: limited lifetime of electrons stored in the CUSP.

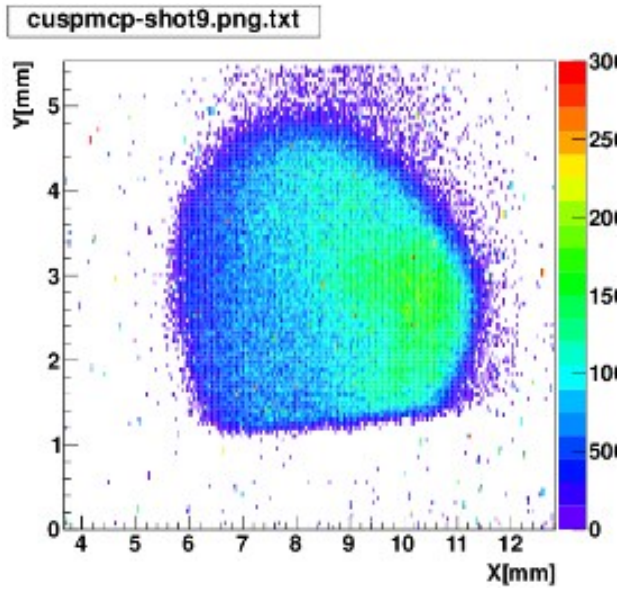


Trapping times of maximum 4 minutes could be achieved… although quite unstable

Getting a " feel" of the misalignment:

Inject+ extract again as soon as possible (~ 30 seconds later)

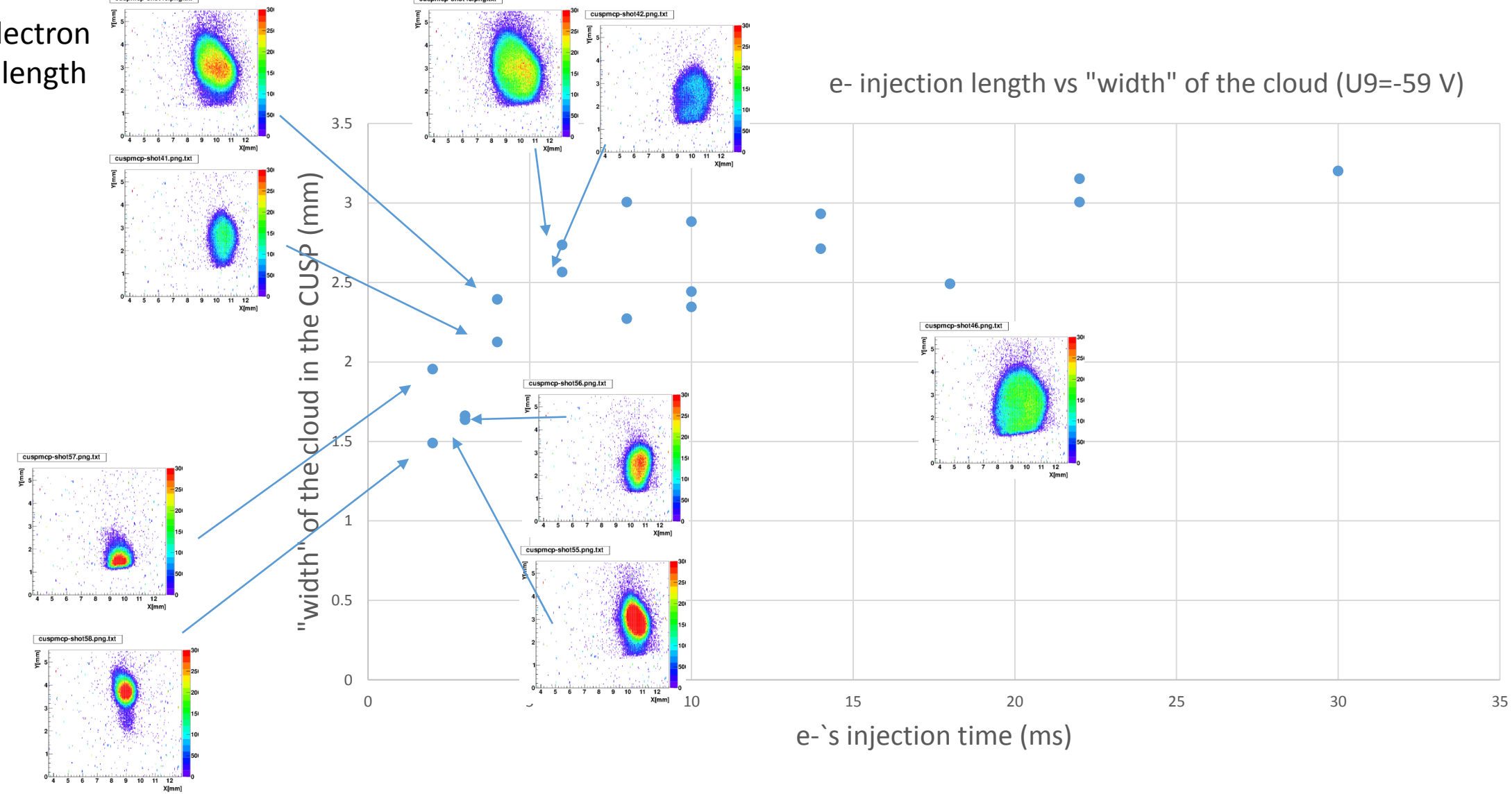




Size of the e-cloud in the CUSP trap.

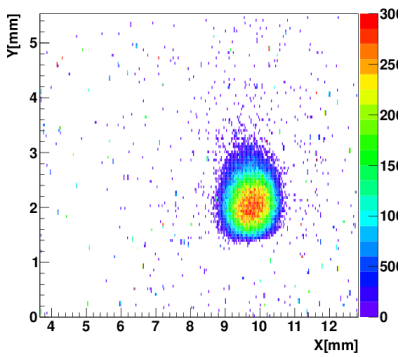
e- cloud size much larger than expected:
Rough estimate: e-gun hole size is 2 mm -> Bfieldratio of 100 -> 2/sqrt(100) = 0.2 mm inside the CUSP trap
Why ?? 1) electron gun doesn`t focus the cloud in the magnetic field (due to electrode configuration of e-gun)
2) Misaligned Bfield allows radial transport of the particles in the cloud causing the cloud`s radius to increase

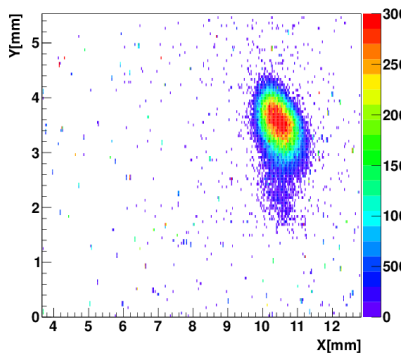
Varying the electron gun injection length

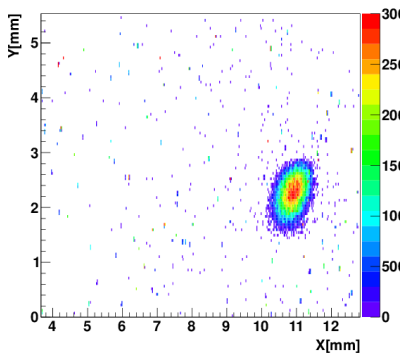


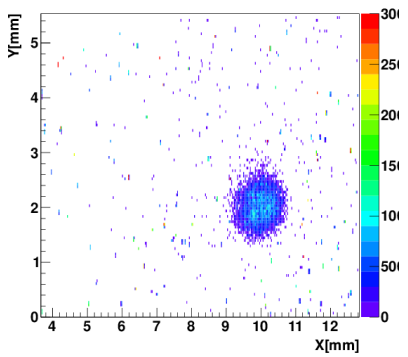
Varying the injection time allows to vary the spotsize of the cloud.

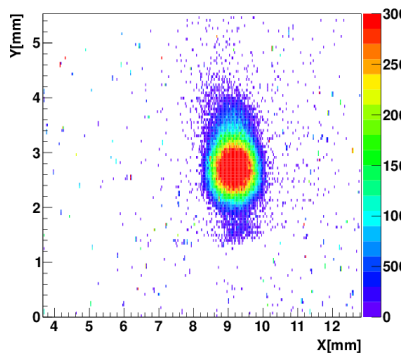
Small spot size @ 2 ms but highly unstable due to Diocotron motion.





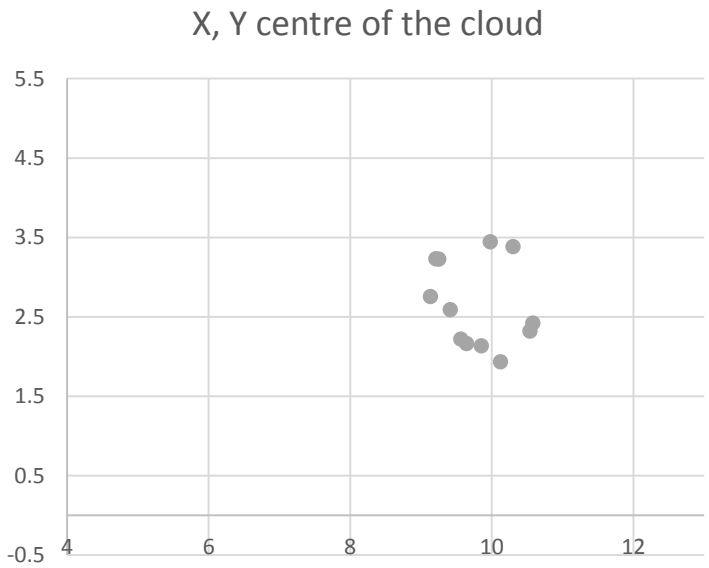






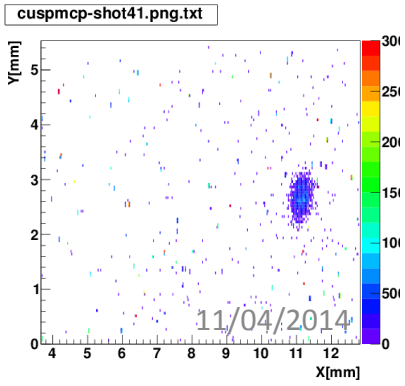
Friday (21st March)

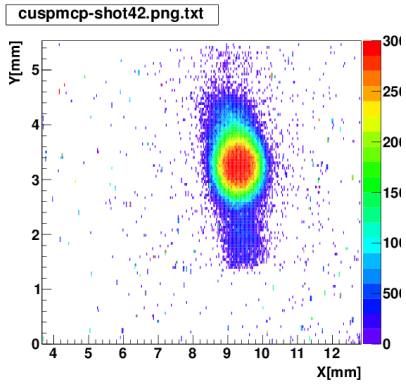
After optimizing 2 directions of the magnet support

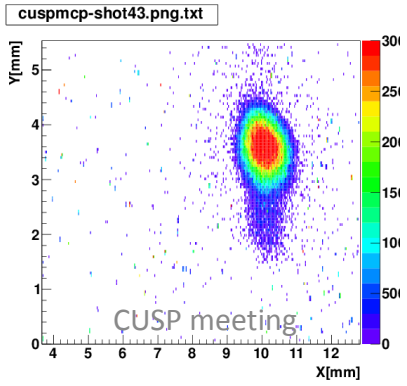


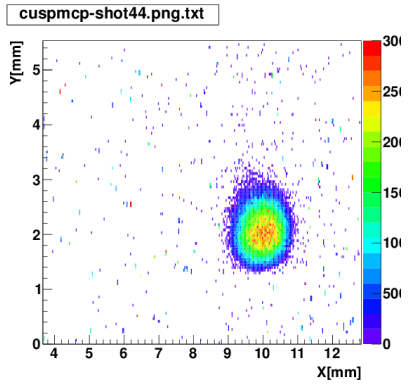
Misalignment between B and mechanical axis exerts torque on the plasma causing it to shift radially (← Maybe Higaki has a comment?)

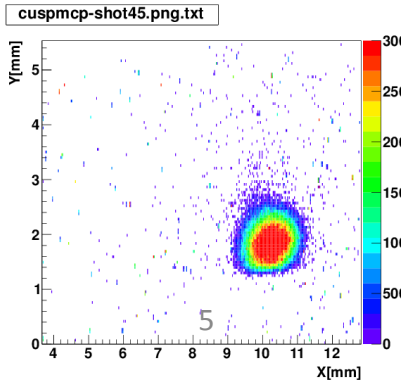
Idea: move the magnet support structure and do the same measurements.
3 directions of the magnet support structure == patience is needed
After optimizing the magnet, optimize the e-gun position, optimize the magnet again, optimize the e-gun position, …

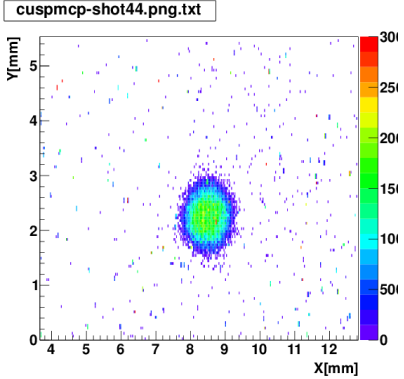


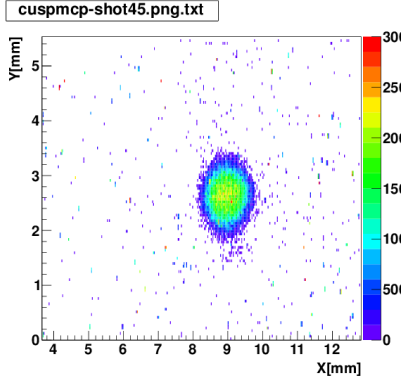


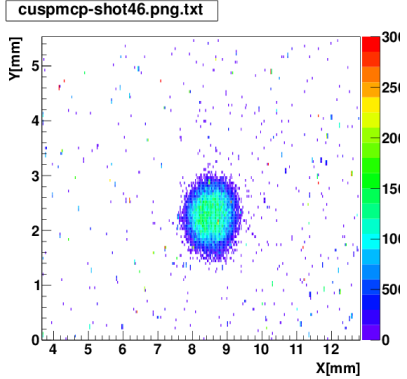


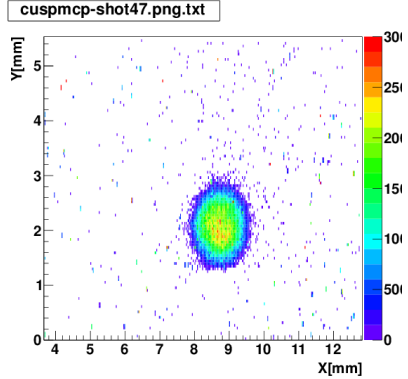


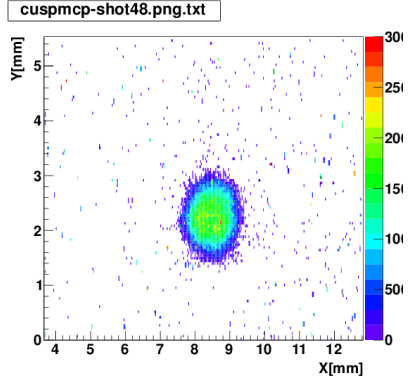






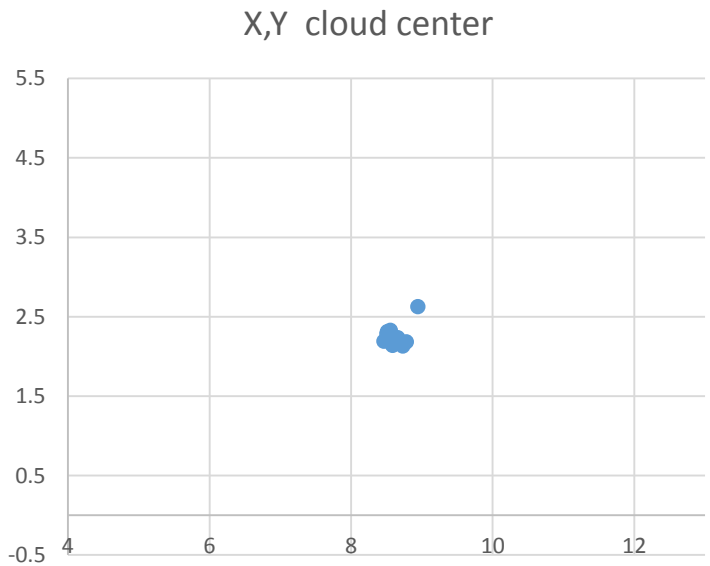


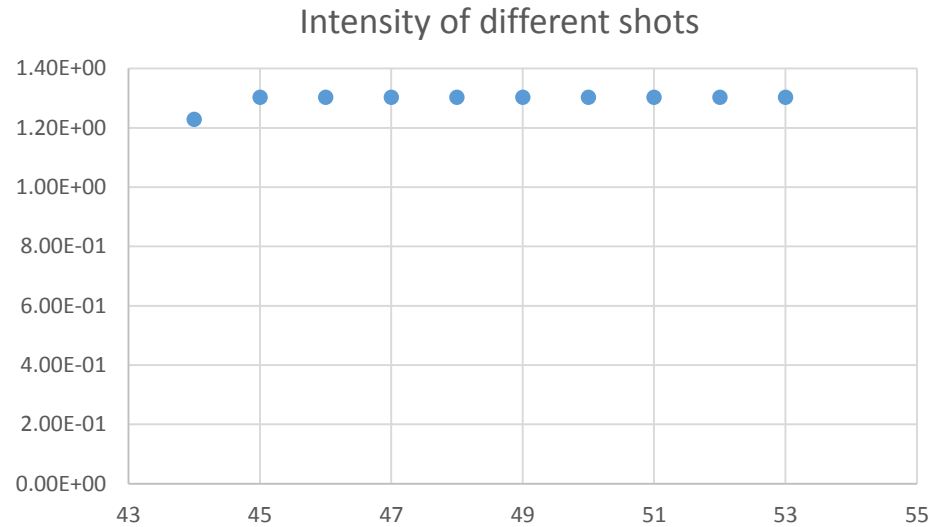


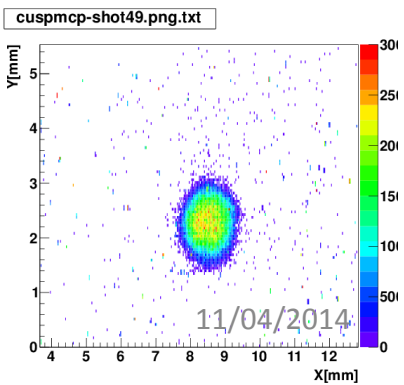


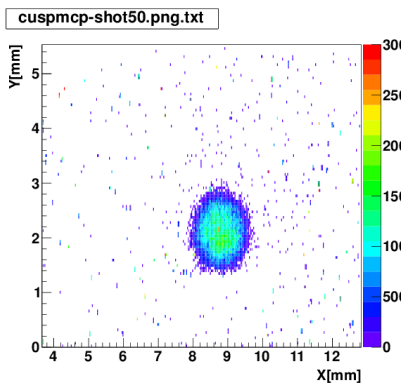
(31st March) all the directions of the magnet support Structure are optimized

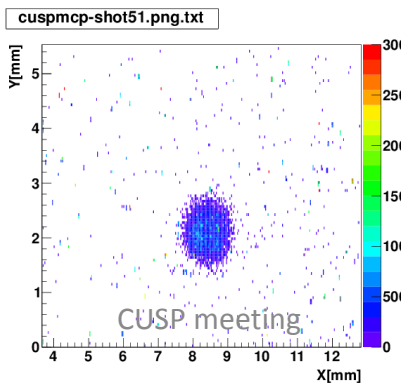
Spread X: 0.14 mm
Spread Y: 0.13 mm

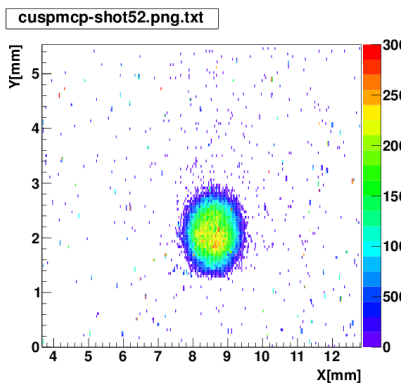


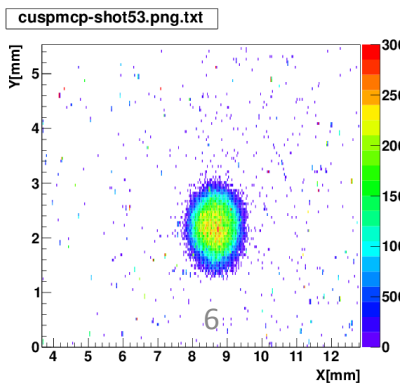






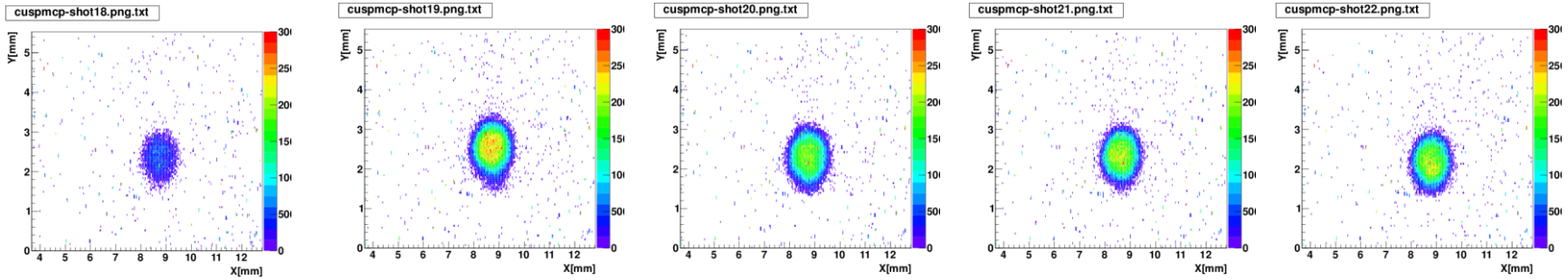




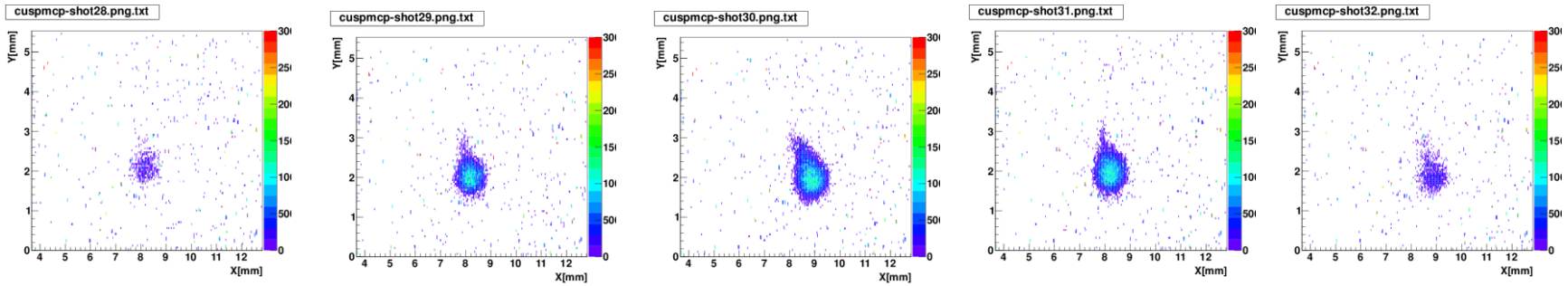


Go to lower field (0.5 T) to optimize further since cloud expansion time scales as~ B^2 [Driscoll, Malmberg 1983]

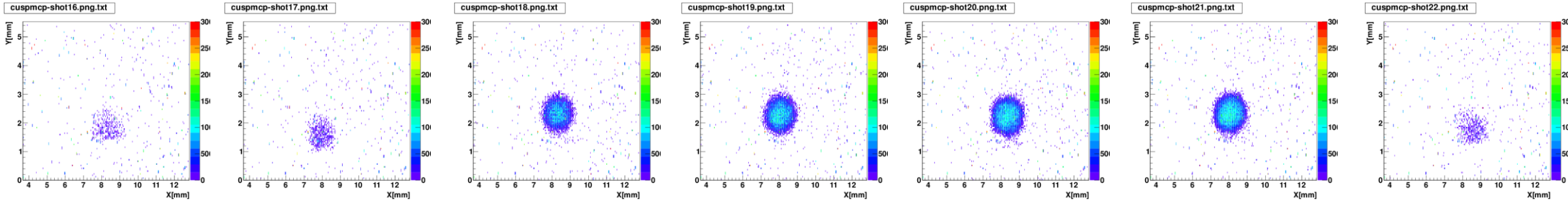
2.7 T



0.67 T



After optimizing the e-gun position + again the support position: at 0.5 T and with 2 minutes additional waiting time…

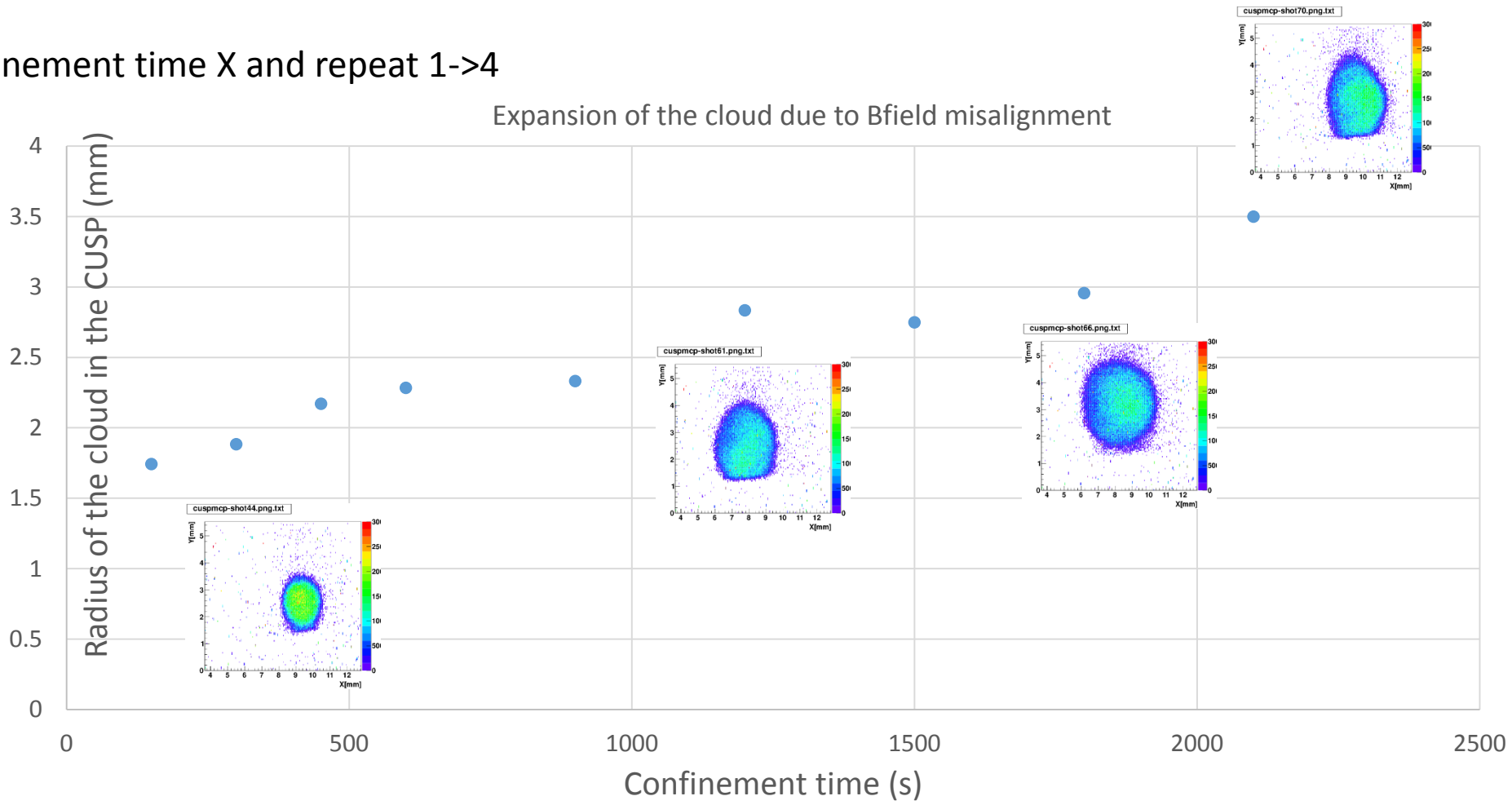


Experiment:

1) Inject e-`s in the CUSP trap
2) RW (60s, 7 MHz, 10 Vpp)
3) confine X seconds
4) Extract e-`s and look at MCP image

5) Change confinement time X and repeat 1->4

April 7th



Note: @ t=2100 s the cloud center is not on-axis anymore (Diocotron), the radius is estimated for this point

Conclusion

1) obtained a (relatively fast) method to align the CUSP field.
2) Why was the magnet so much misaligned in the first place ?
3) magnet was shifted 2 mm(!) (ALPHA side) + tilted 1 mm (upstream part of magnet is lower in height than downstream part).

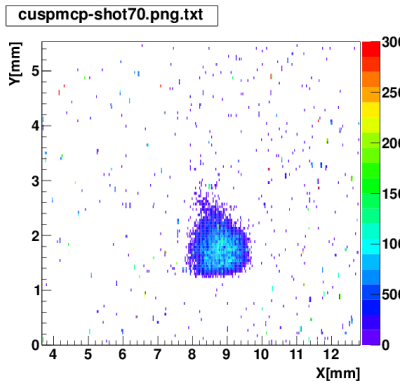
→ surprised that this is so significant…

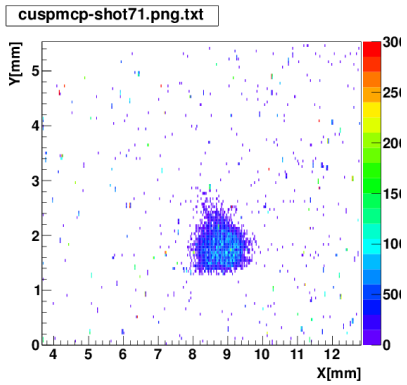
Magnet positions	original		After tuning
A	51.85		53.85
B	52.55		54.5
C	51.75		51
D	51.5		49.7
1	20.1		19.2
2	22.1		22.1
3	22.3		22.3
4	19.2		18.35

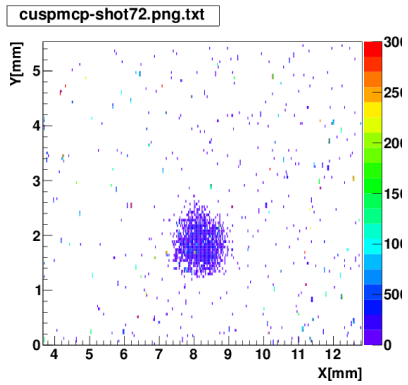
This is work in progress as recent measurements the past days show that it is not possible to reproduce the lifetime plot. To be investigated(!)

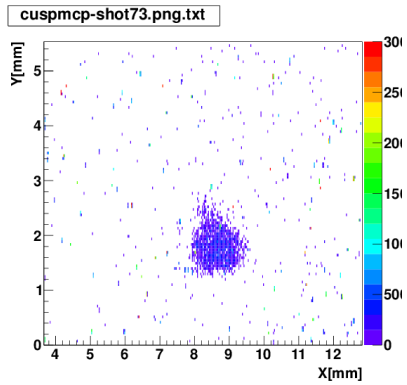
effect of e+ magnet on CUSP field of 0.5 T

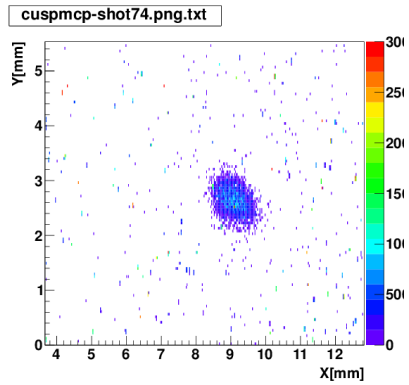
e+ field
0.15 T



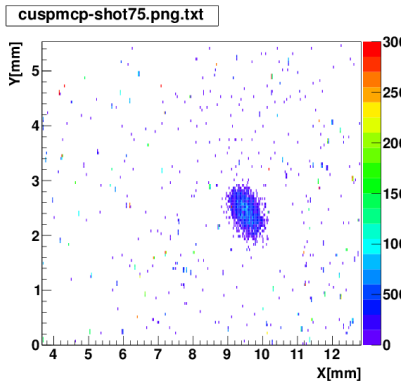


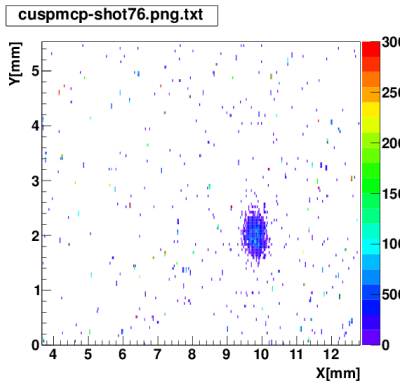


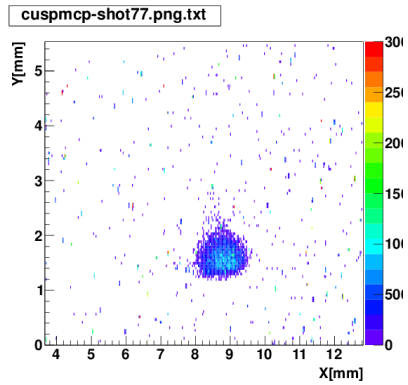


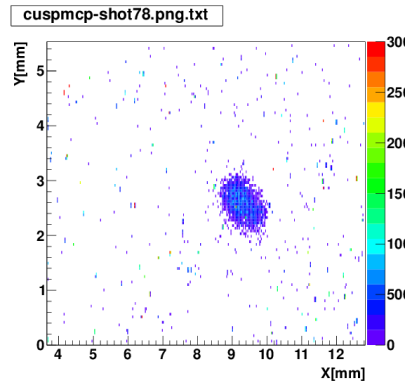


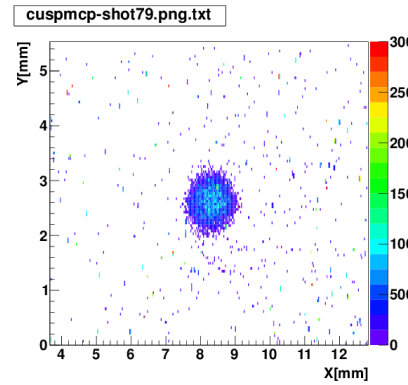
E+ field
0.5 T

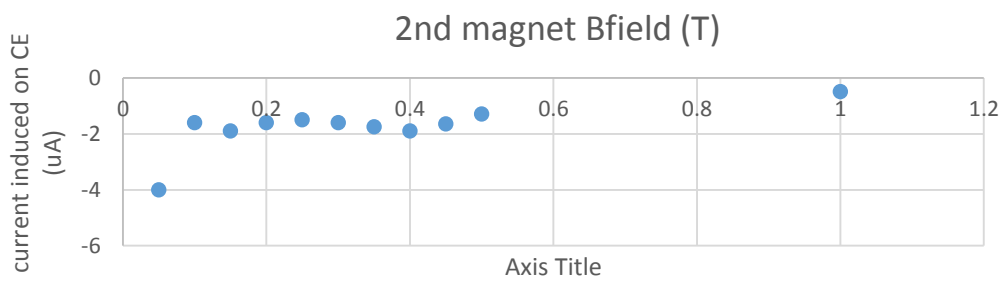


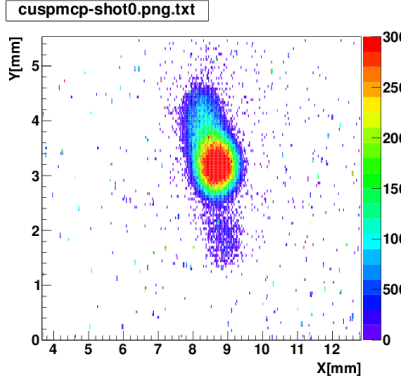


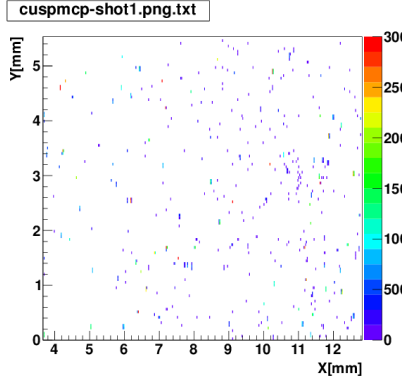


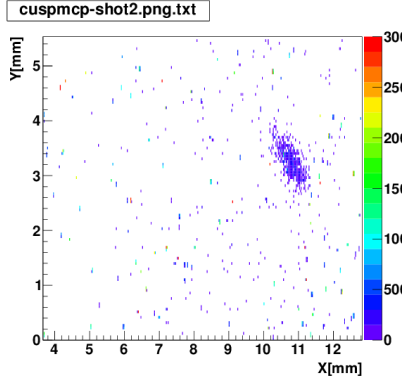


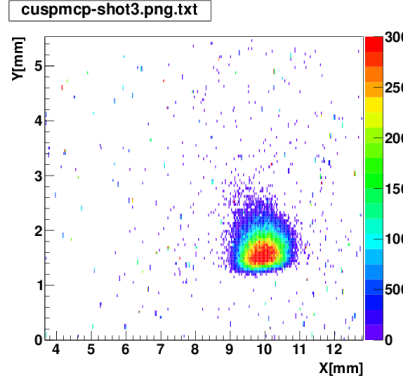


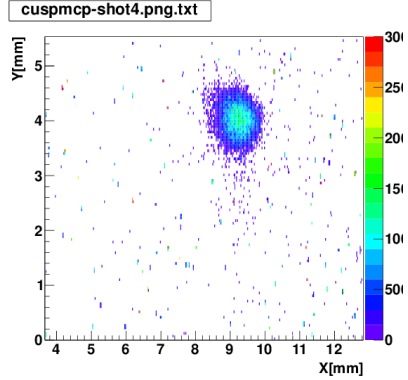


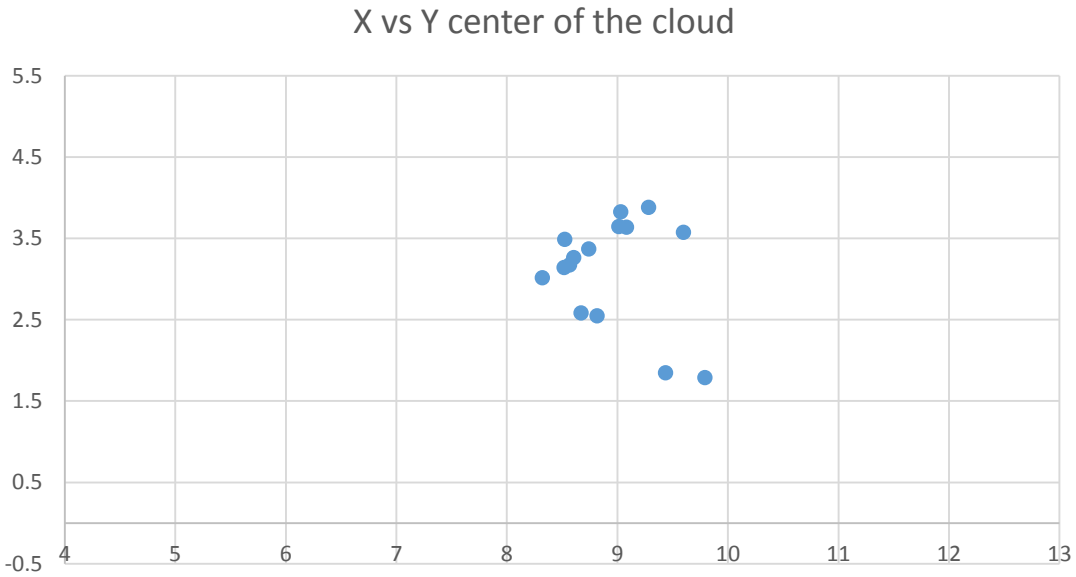












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After optimizing the magnet, optimize the e-gun position, optize the magnet again, optimize the e-gun position, …