

Modelling the Laser-hybrid Accelerator for Radiobiological Applications (LhARA)



Octupole

AIM: FLAT DOSE DISTRIBUTION AT END STATION

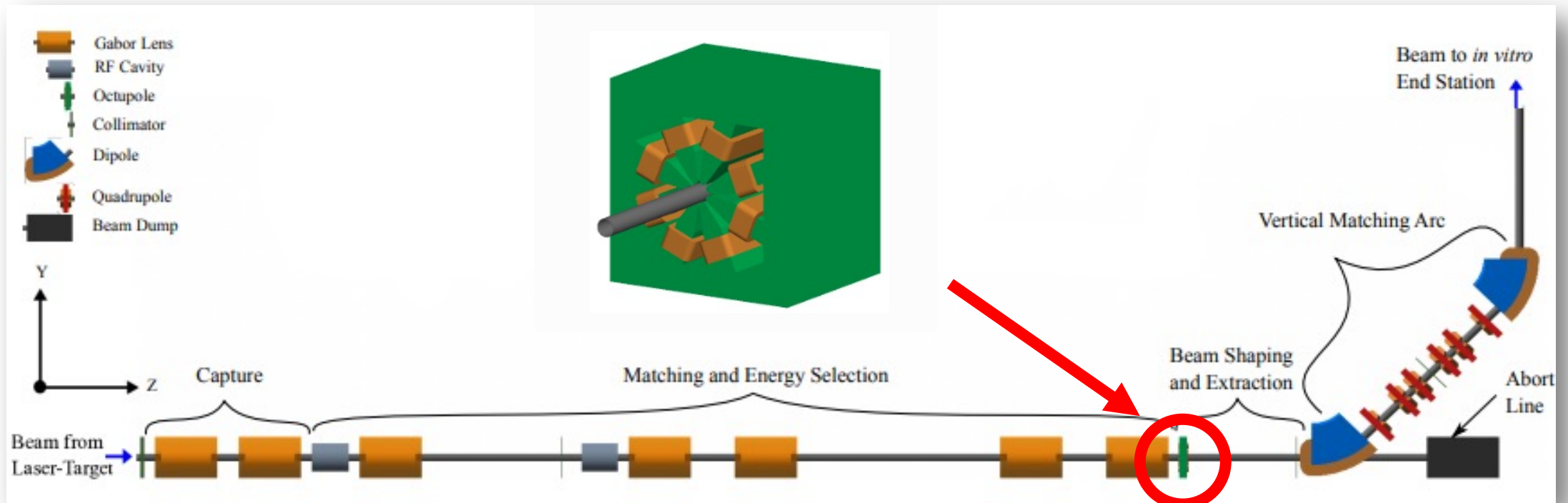
Is this the best positioning for it?

Does it have long enough to have a strong enough effect on End Station 1

What strength does it need to be

Is this strength feasible?

$$k_3 = \frac{1}{B\rho} \frac{d^3 B_y}{dx^3} [m^{-4}]$$



Running simulations

- Using BDSIM to run simulations with varying different K3 (octupole strength) values

$$k_3 = \frac{1}{B\rho} \frac{d^3 B_y}{dx^3} [m^{-4}]$$

K3 value	Outcomes
0	CONTROL
6,000	TOO LOW?
8,000	TOO LOW?
10,000	
15,000	
20,000	
30,000	
50,000	
100,000	TOO HIGH?



Range of 10,000 – 50,000 seems the best currently between the un-optimised and optimised beam.

Currently refining this.

Running simulations

	UN-OPTIMISED BEAM	OPTIMISED BEAM
DRIFT 30 – END STATION	<i>Various K3 values</i>	
DRIFT 29 – END OF VERTICAL ARC (drift 30 –2m)		

Un-optimised beam

Starts from beginning of LhARA simulation

Optimised beam

Will optimised this, begins just before octupole

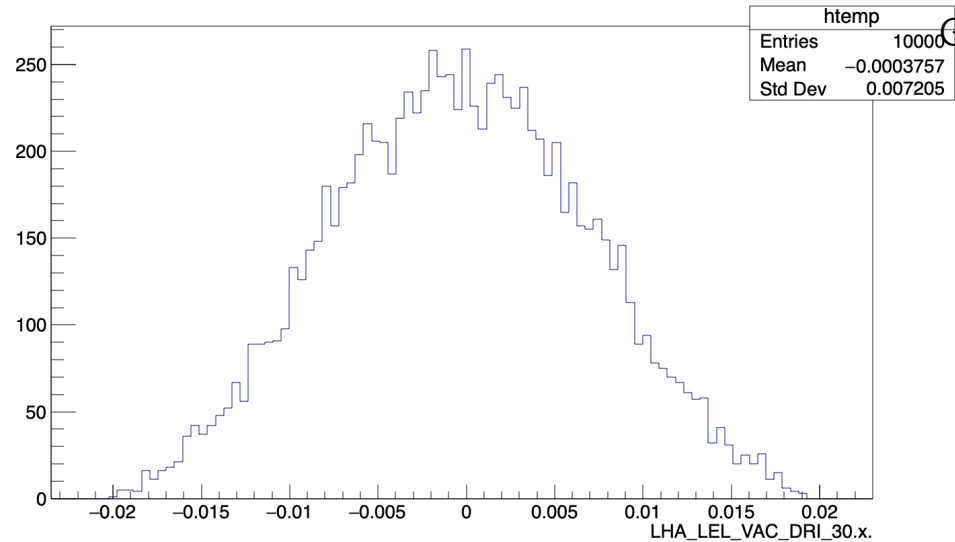
K3=0

P=10,000

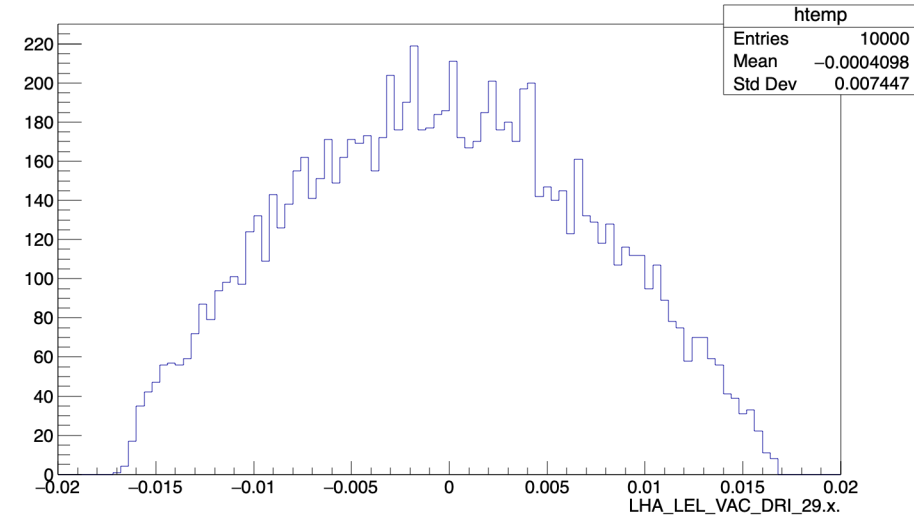
Un-optimised beam

Graphs recorded at drift 30 and 29

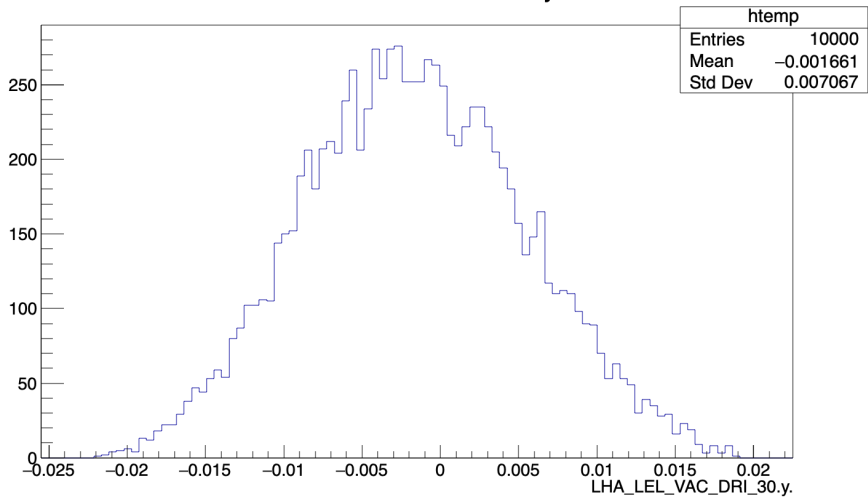
LHA_LEL_VAC_DRI_30.x.



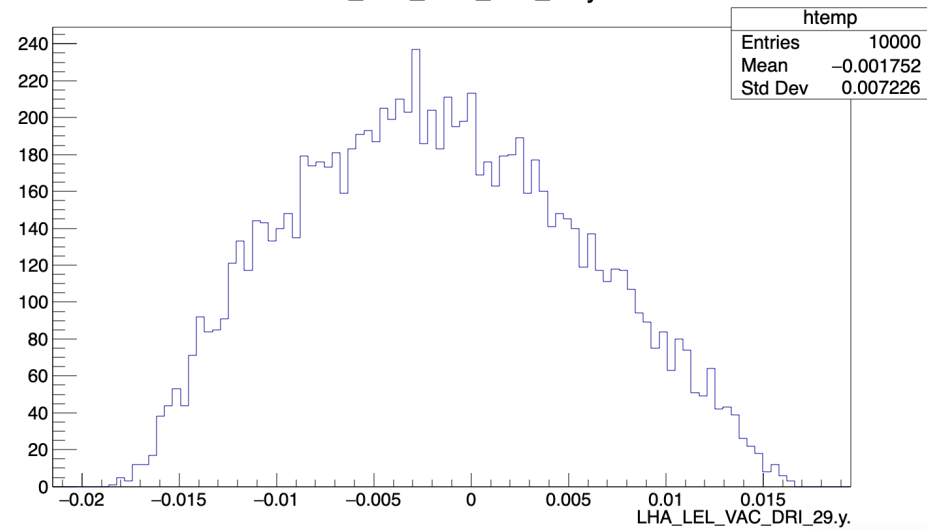
LHA_LEL_VAC_DRI_29.x.



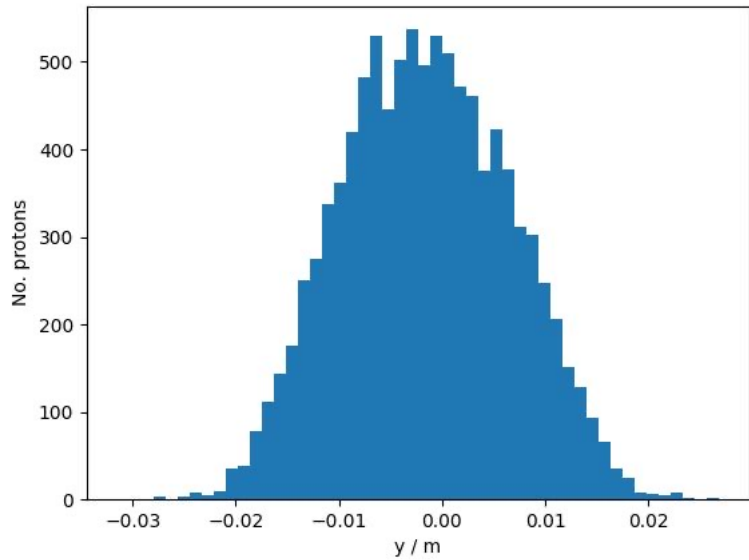
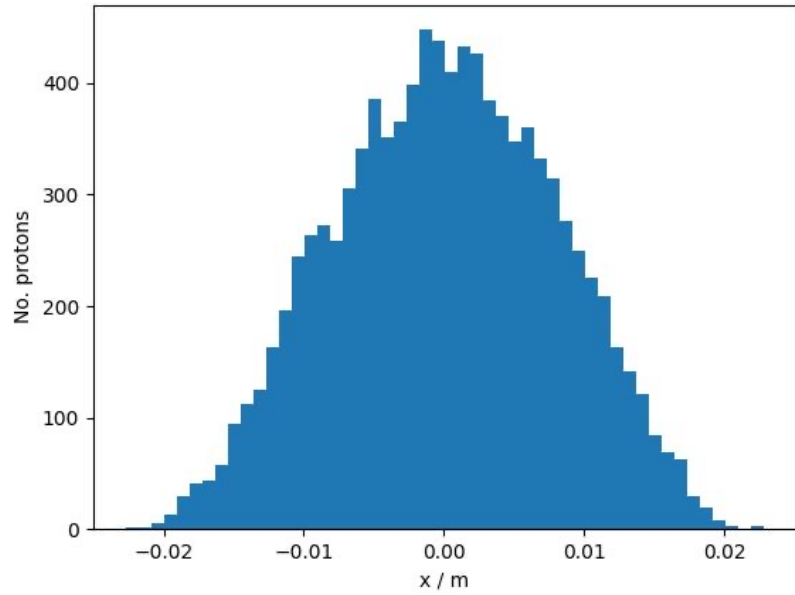
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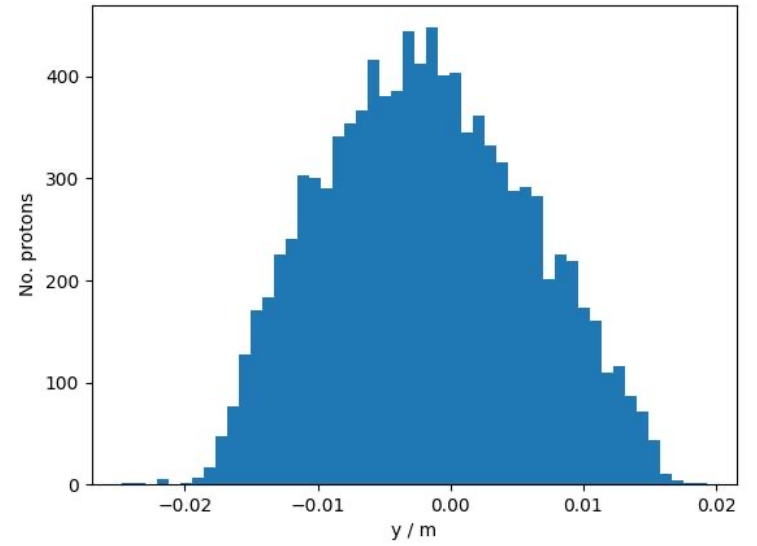
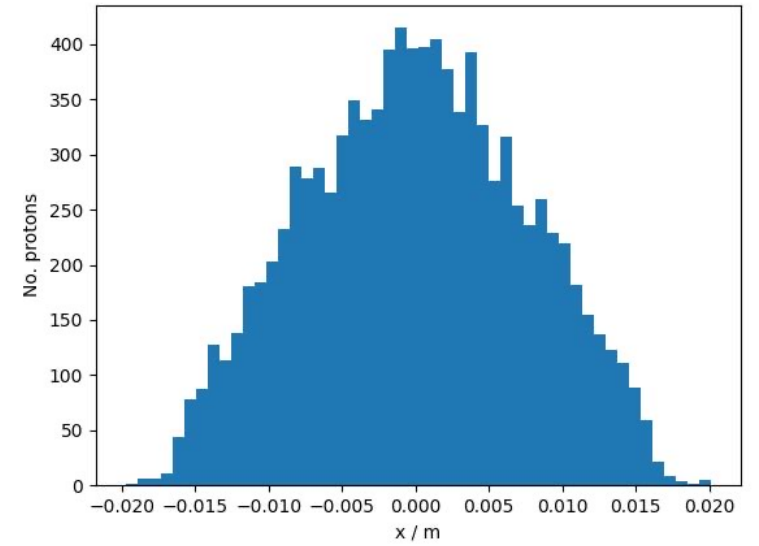
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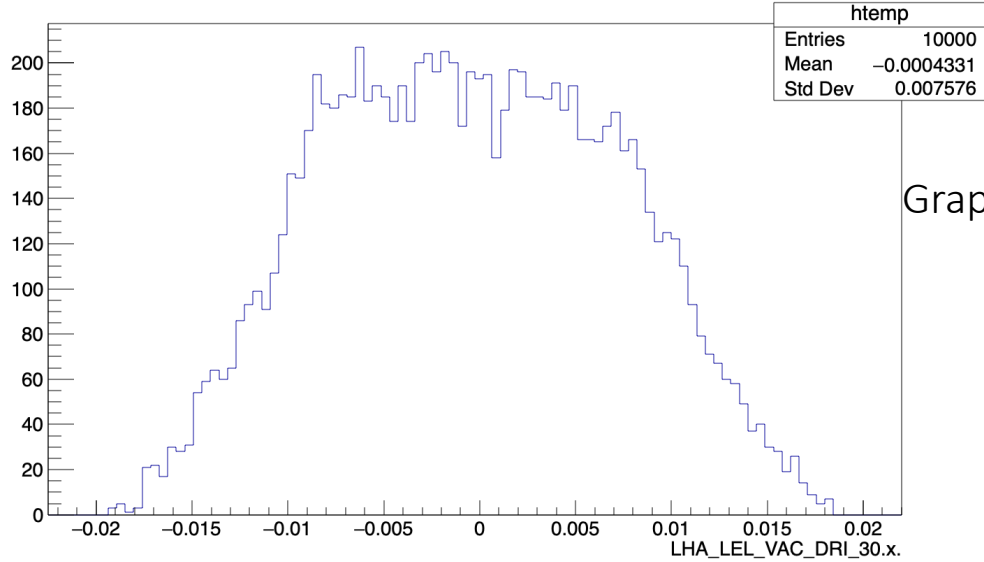
K3=0
P=10,000
Optimised beam



Drift 29



LHA_LEL_VAC_DRI_30.x.

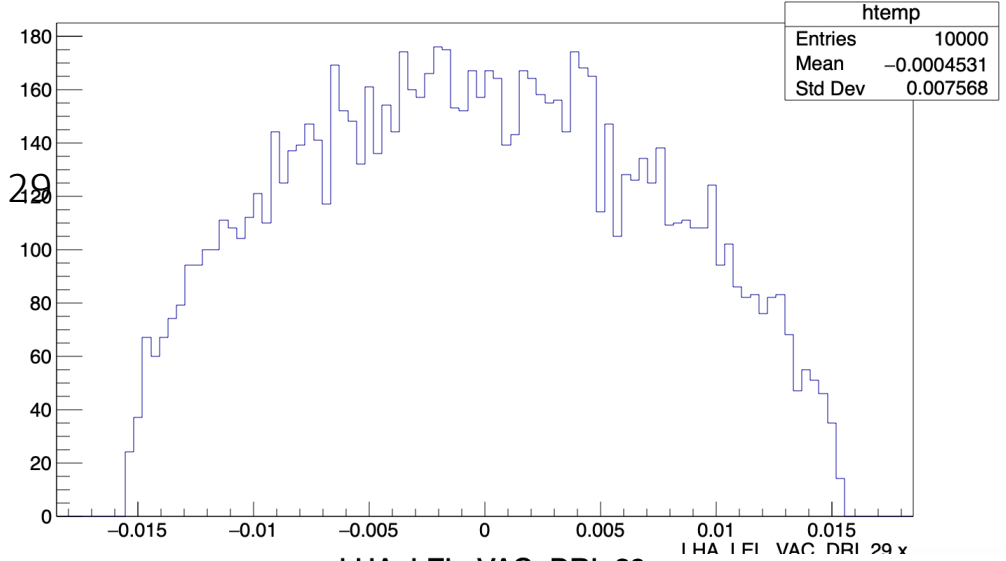


K3=10,000

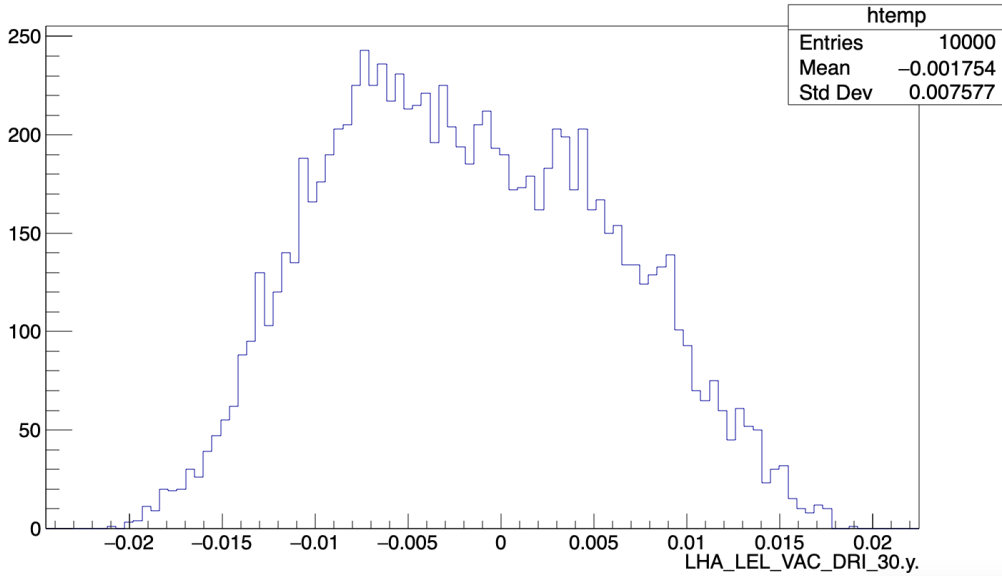
P=10,000

Un-optimised beam
Graphs recorded at drift 30 and 29

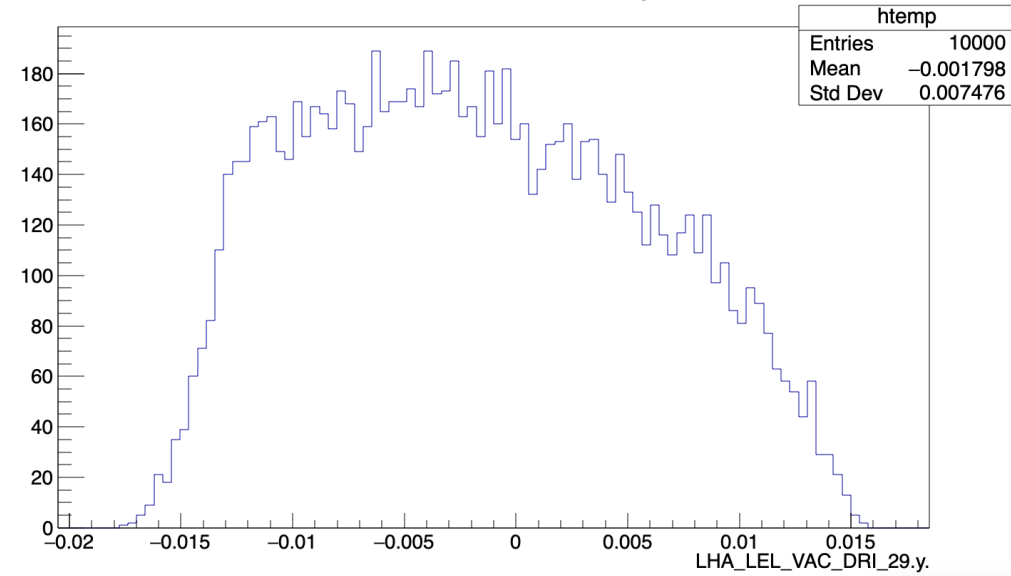
LHA_LEL_VAC_DRI_29.x.



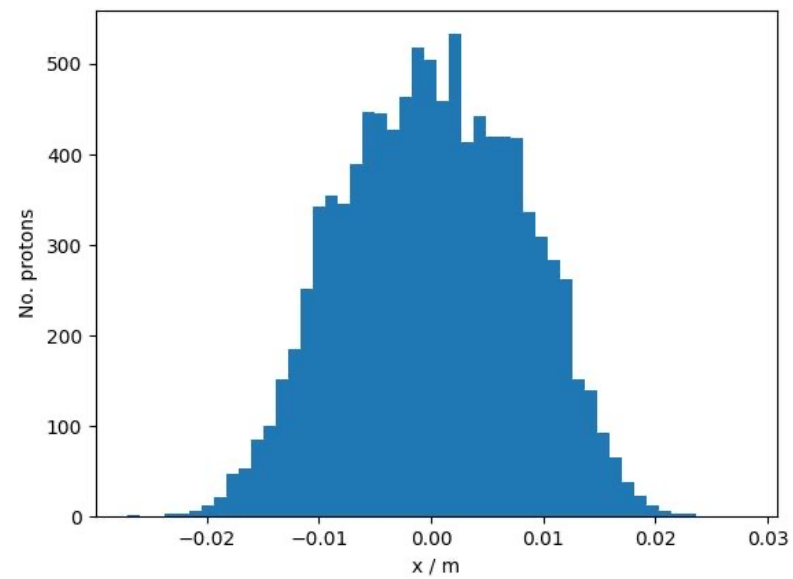
LHA_LEL_VAC_DRI_30.y.



LHA_LEL_VAC_DRI_29.y.

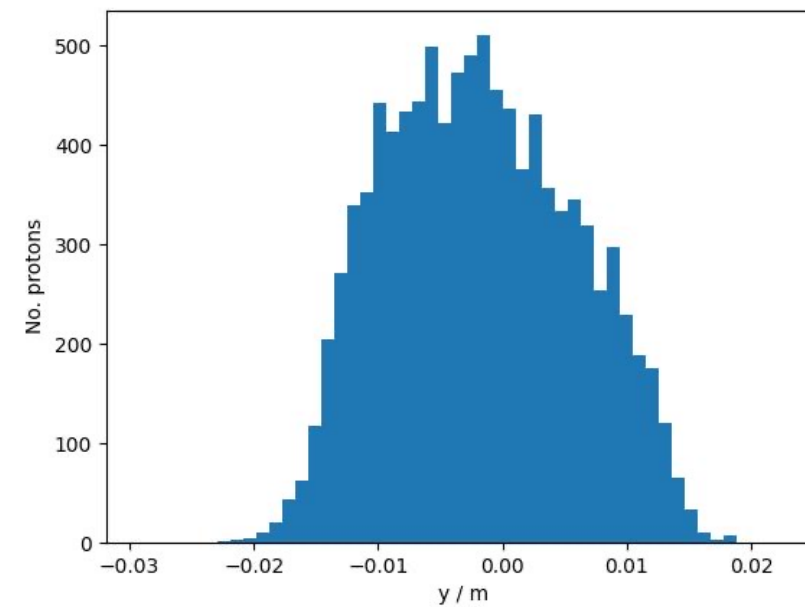
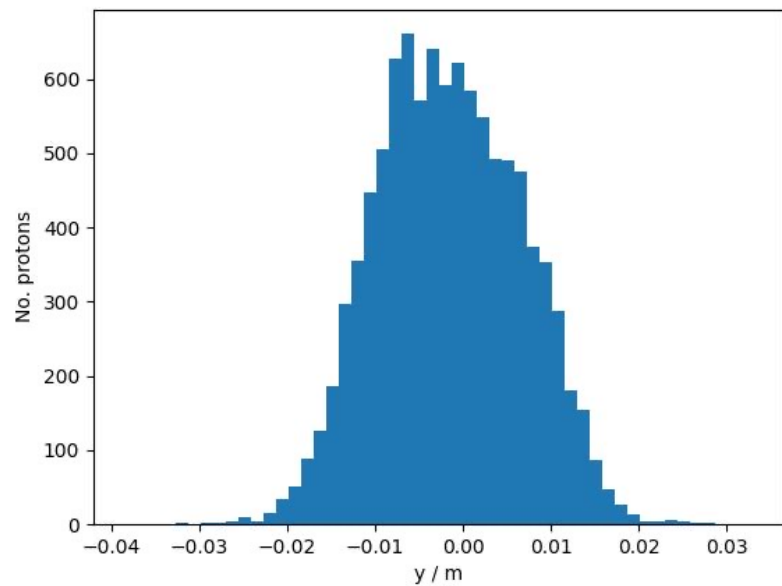
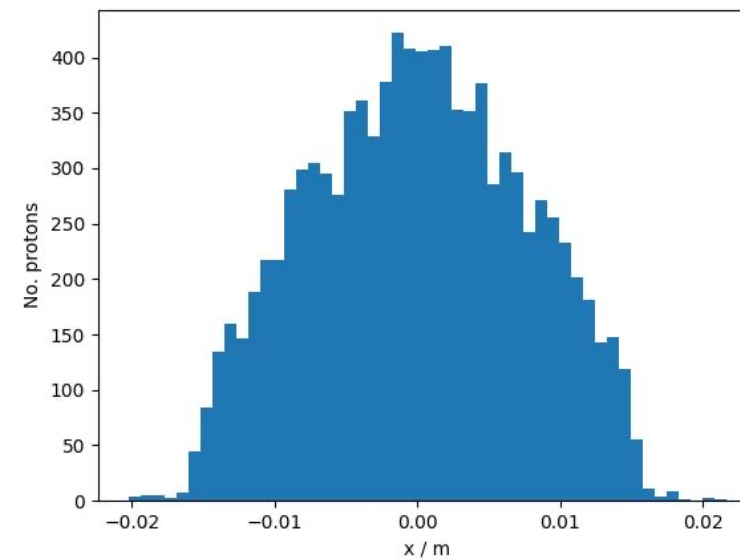


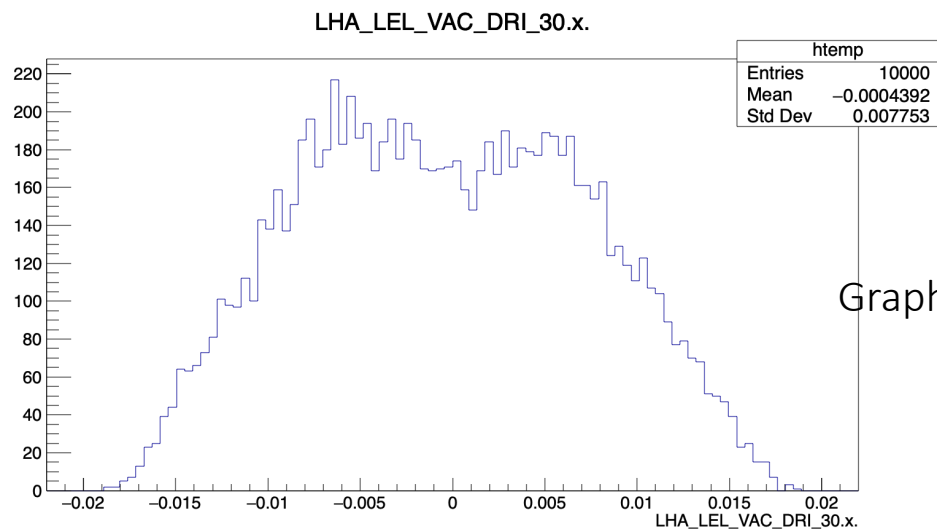
Drift 30



K3=10,000
P=10,000
Optimised beam

Drift 29

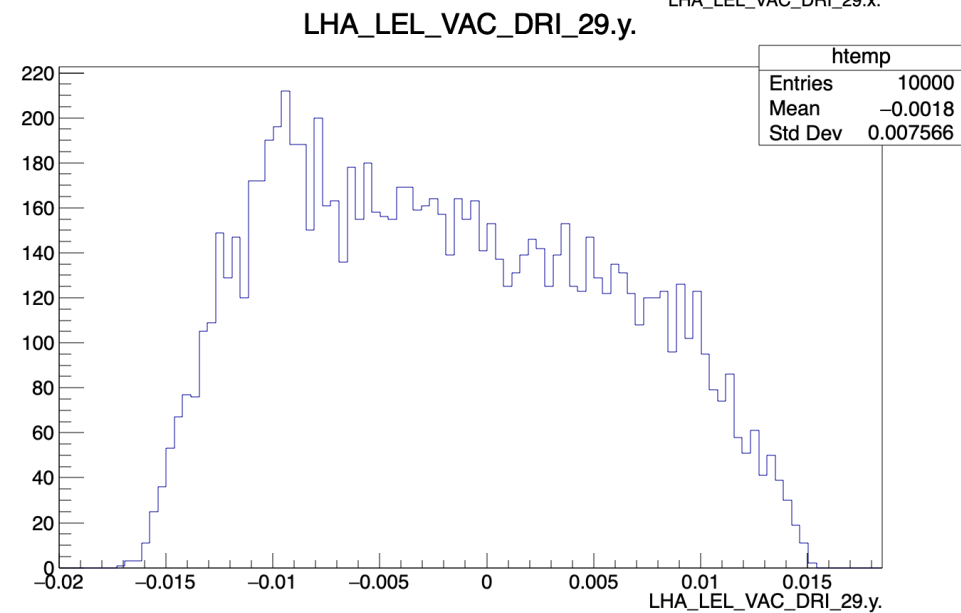
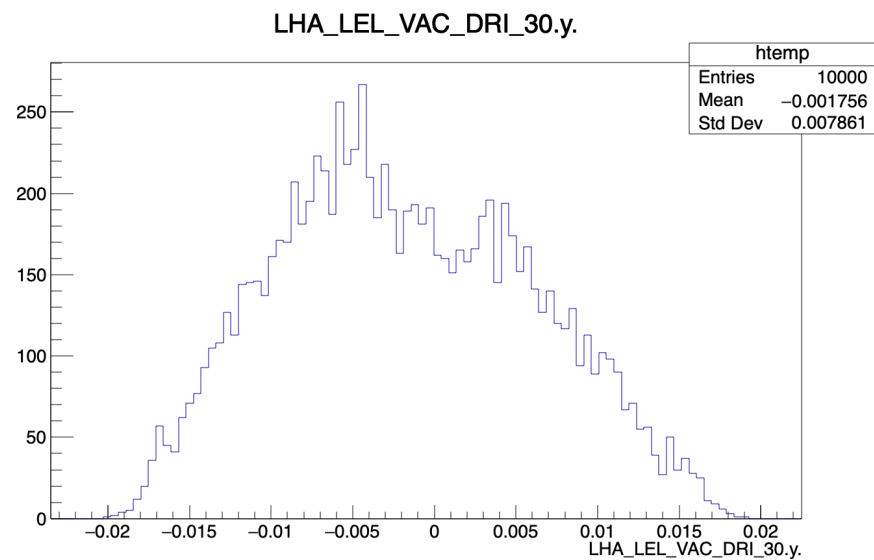
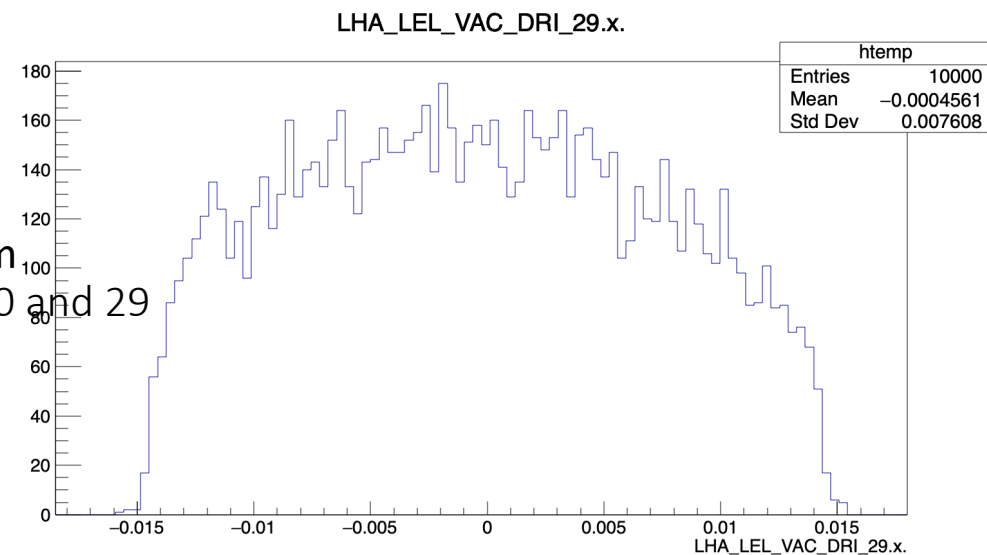




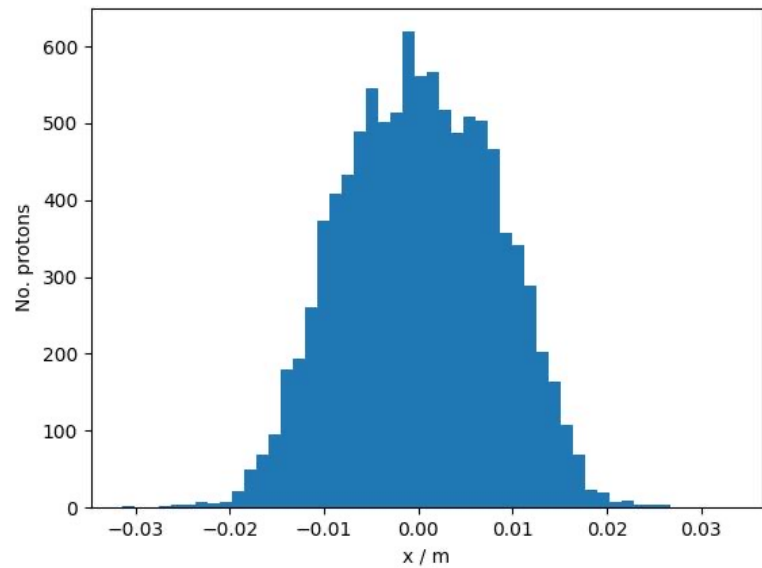
K3=20,000

P=10,000

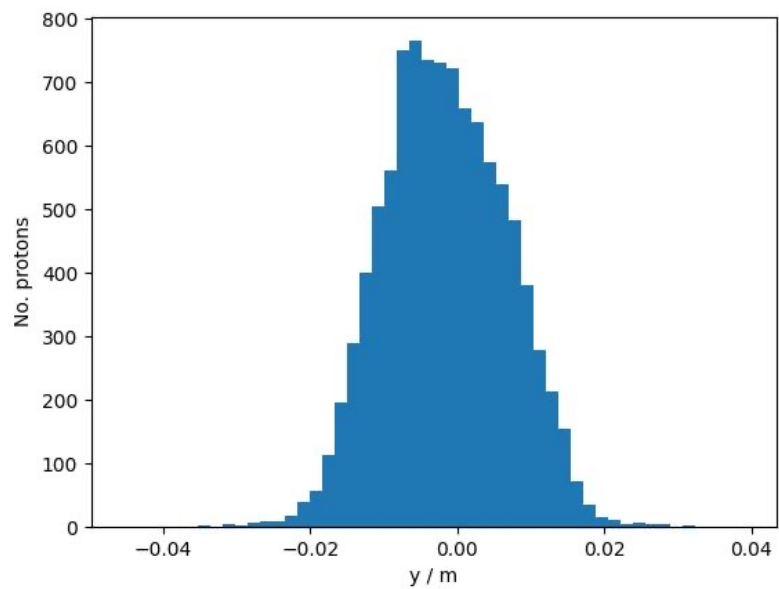
Un-optimised beam
Graphs recorded at drift 30 and 29



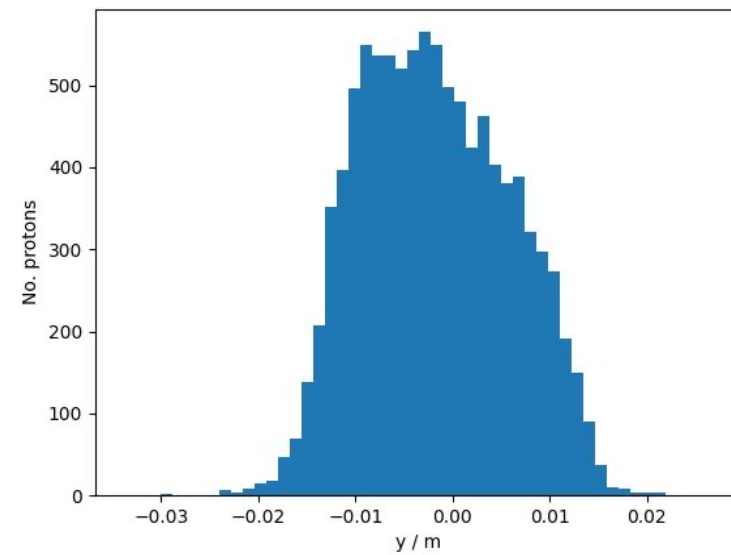
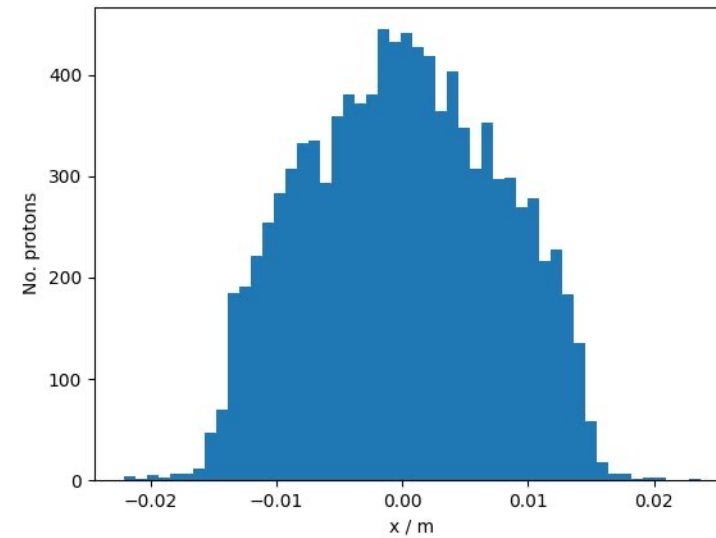
Drift 30



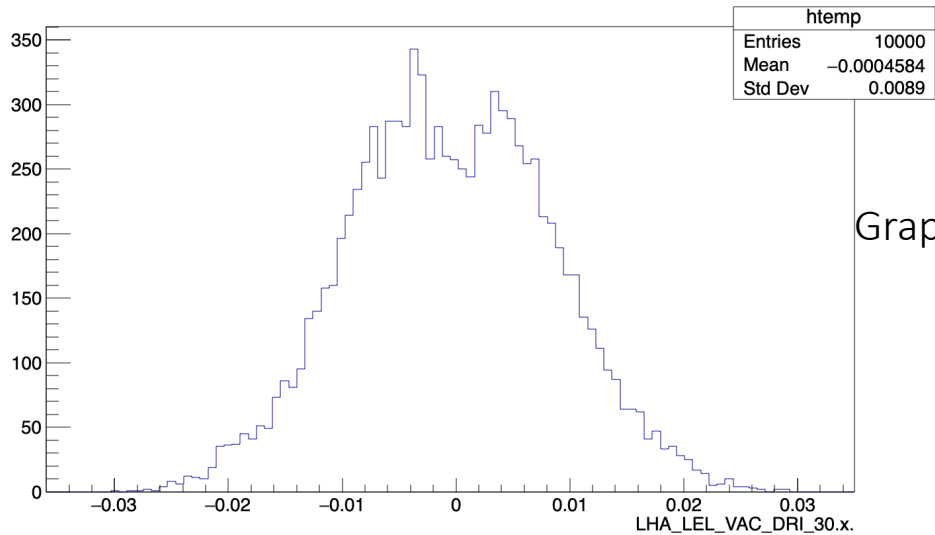
K3=20,000
P=10,000
Optimised beam



Drift 29



LHA_LEL_VAC_DRI_30.x.



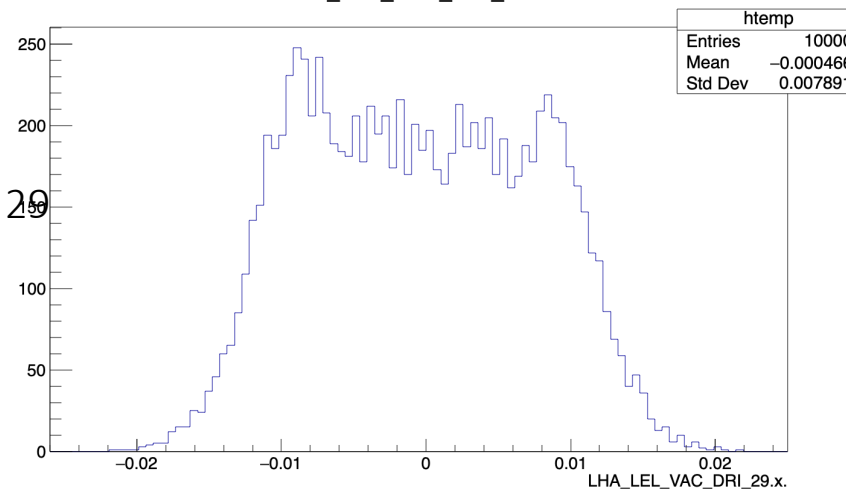
K3=50,000

P=10,000

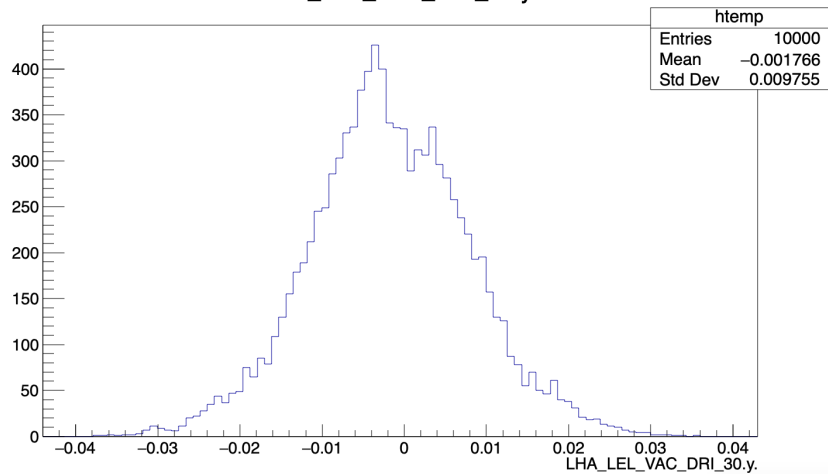
Old beam

Graphs recorded at drift 30 and 29

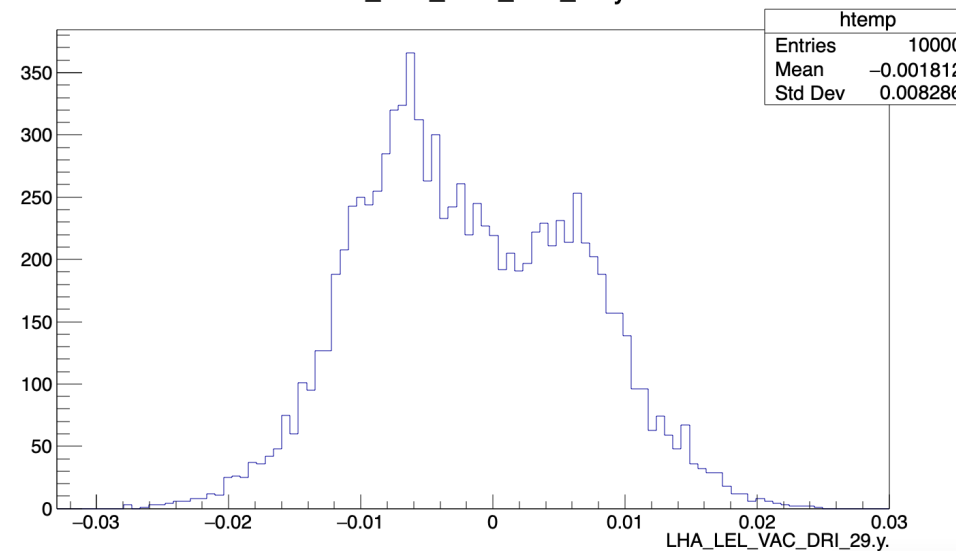
LHA_LEL_VAC_DRI_29.x.



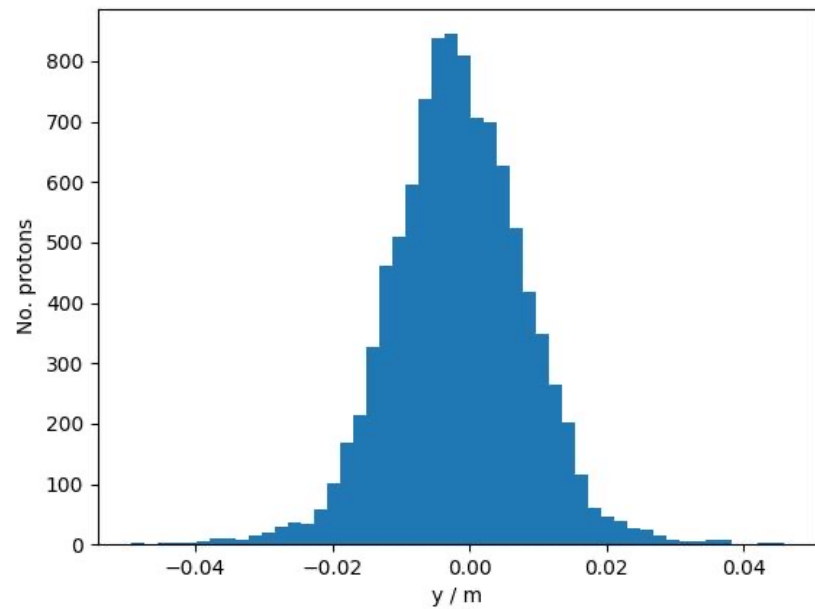
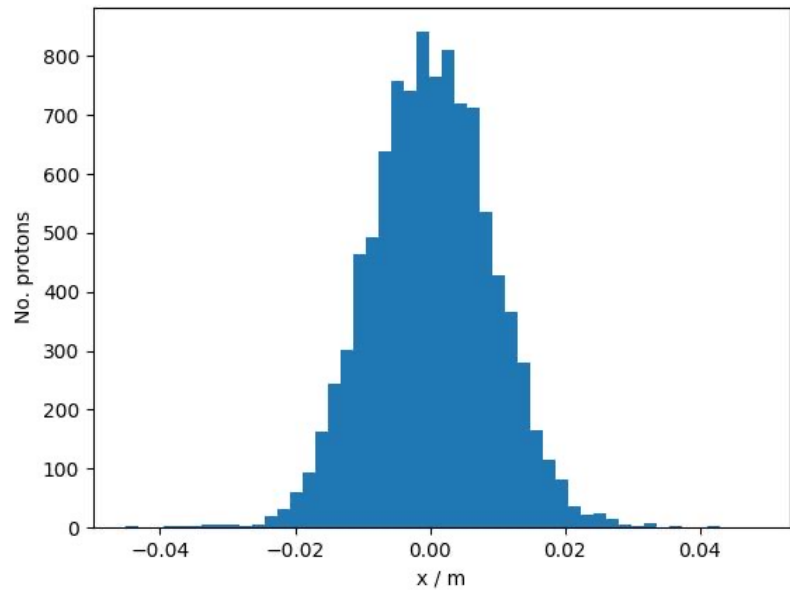
LHA_LEL_VAC_DRI_30.y.



LHA_LEL_VAC_DRI_29.y.

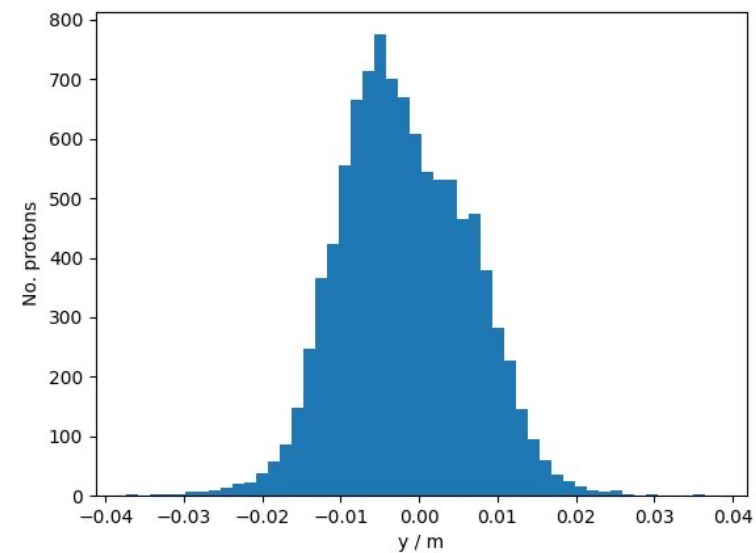
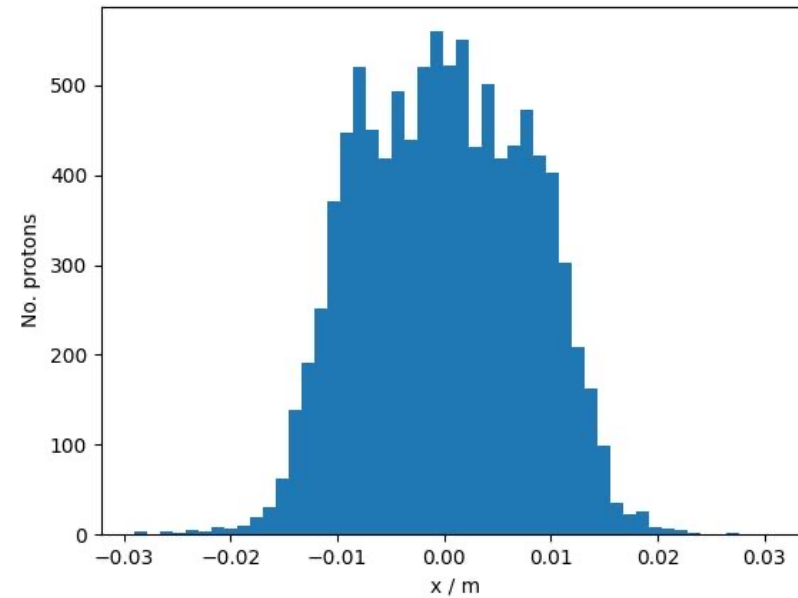


Drift 30



K3=50,000
P=10,000
Optimised beam

Drift 29



Calculating field strength

Calculations got us +0.2... T and -0.2... T for the x and y components of the B field. For $K_3 = 20,000$ with the un-optimised beam

This means that if we need to increase B according to new calculations with optimised beam this could still be feasible

$$B_x = C_3(3x^2y - y^3)$$

$$B_y = -C_3(3xy^2 - x^3),$$

[untitled \(aps.org\)](#)

$$k_3 = \frac{1}{B\rho} \frac{d^3 B_y}{dx^3} [m^{-4}]$$

General K_3
equation

Moving forward

- There is significant consistent asymmetry in y
 - X, or just all graphs in general, are not as uniform with the new optimised beam
 - Still potential uncertainty as beam size is still 10,000 particles
-
- Attempt to run beam with larger amount of particles – Will has given me a beam with around 68,000 particles
 - We can see that results seem to vary with very small changes so this needs to be considered moving forward – distribution is sensitive to beam conditions

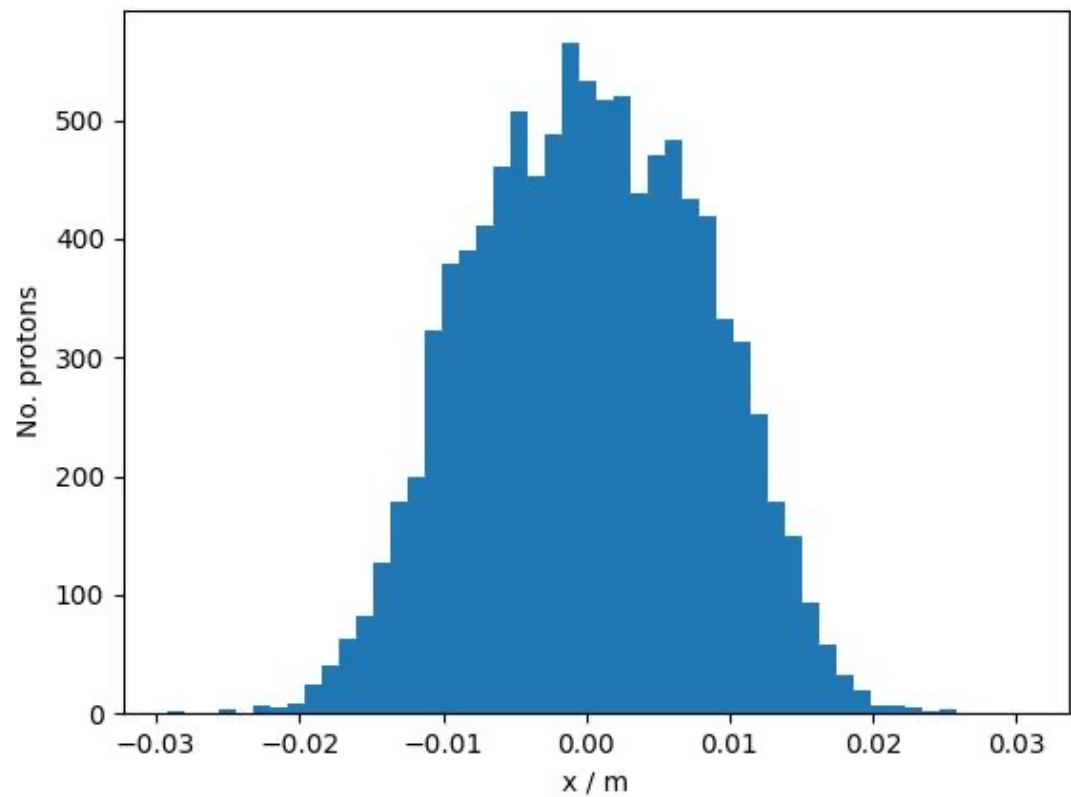
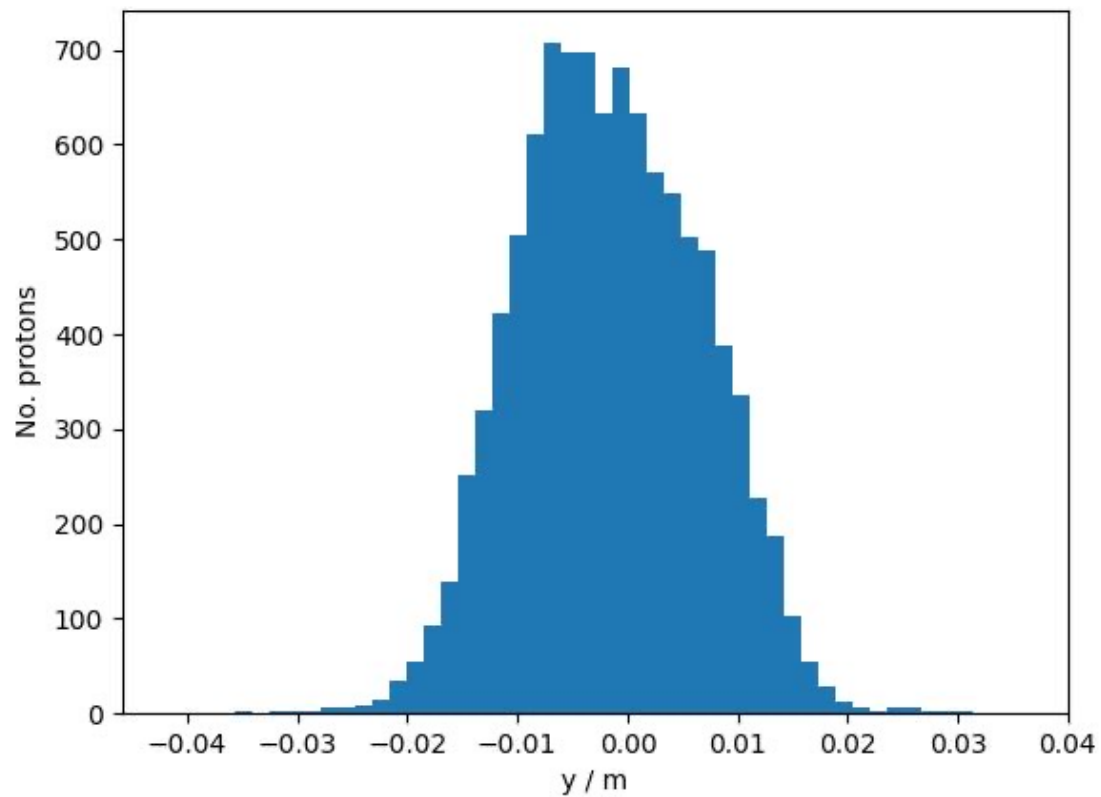


K3=15,000

P=10,000

Optimised beam

Graphs recorded at drift 30



K3=15,000

P=10,000

Optimised beam

Graphs recorded at drift 29

