A Comparison of Step 3 & Step 4

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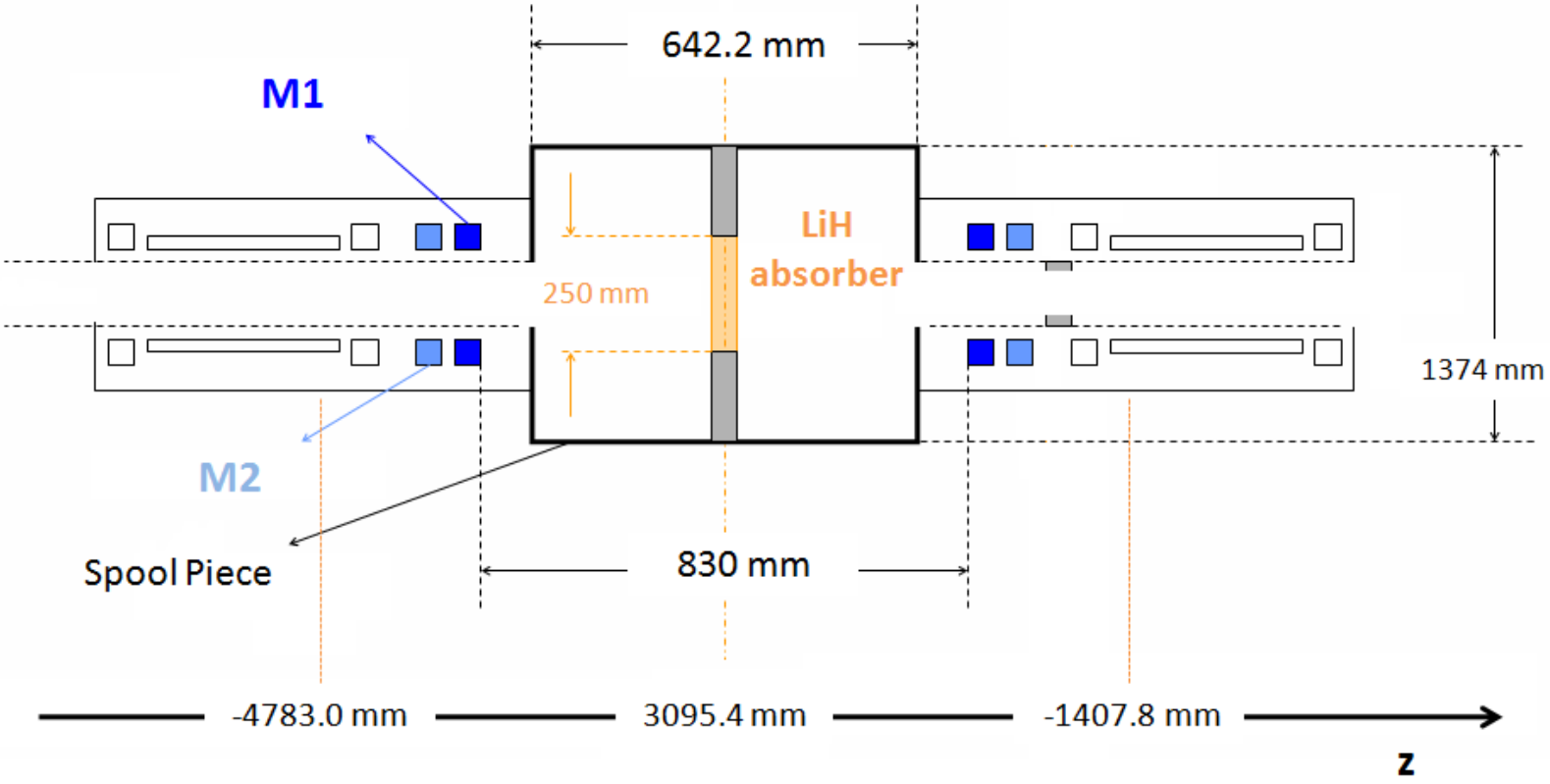
CM 28

Step 3


642.2 mm
M1
LiH
absorber
250 mm
1374 mm
M2
Spool Piece
830 mm
-4783.0 mm
3095.4 mm
-1407.8 mm
z

Matching Step 3

- Step 3 rematched for 830 mm spool piece
- Calc. B(z) & BetaFn with the following:

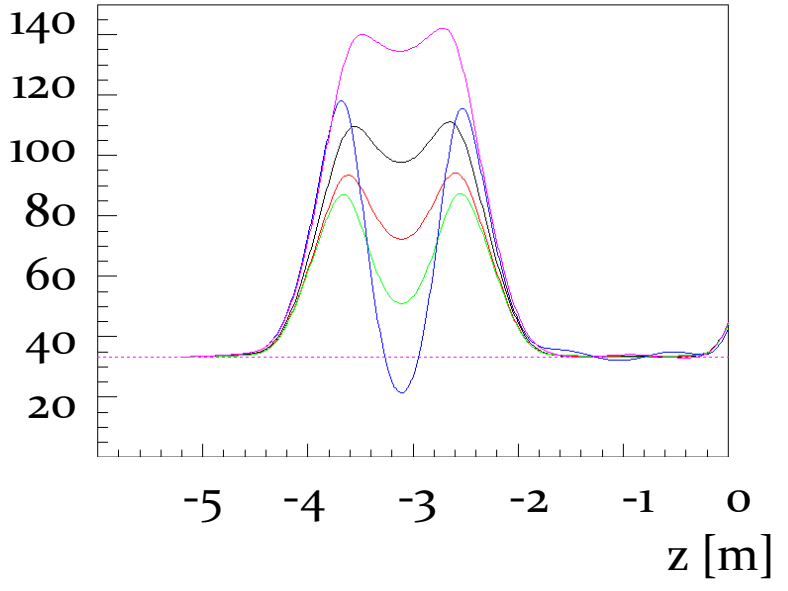
$$B_z = \frac{\mu_0 In}{2}(cos\alpha - cos\beta)$$

$$2\beta\beta'' - (\beta')^2 + 4\beta^2\kappa^2 - 4 = 0$$

- Minimize F at 1 point in a const. field region in 2nd Tracker.

$$F = 0.5*(\beta\gamma_0 - \alpha\alpha_0 + \beta_0\gamma)$$

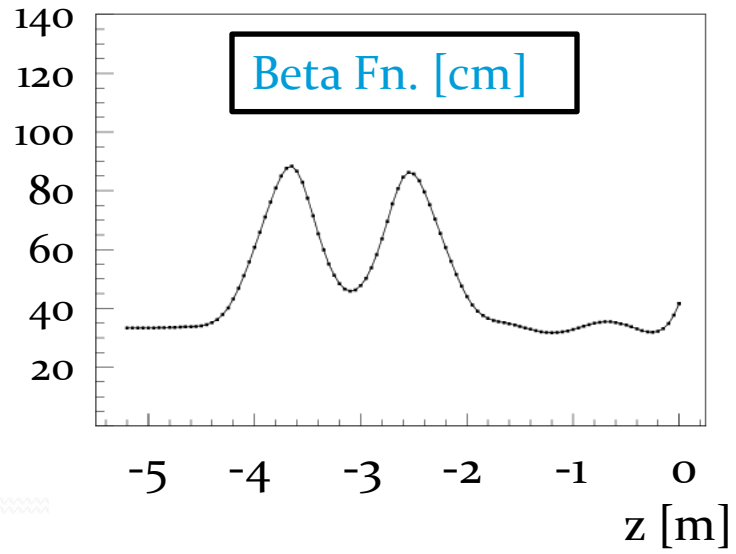
Beta Fn. [cm]

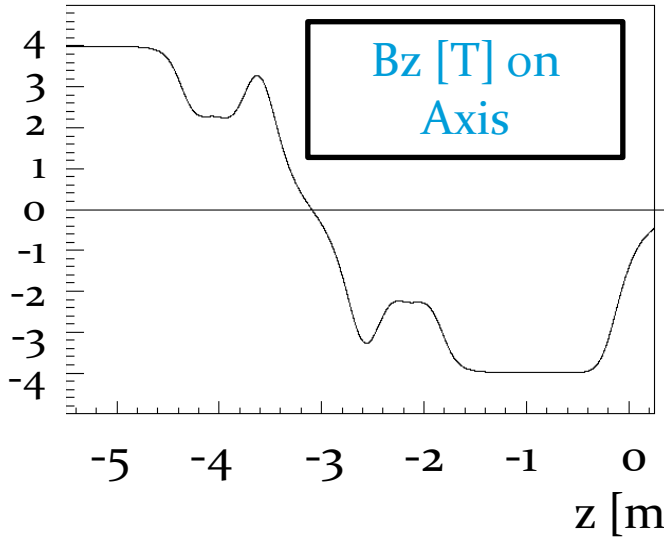


Many solutions…

Step 3 Empty: 6mm ε beam

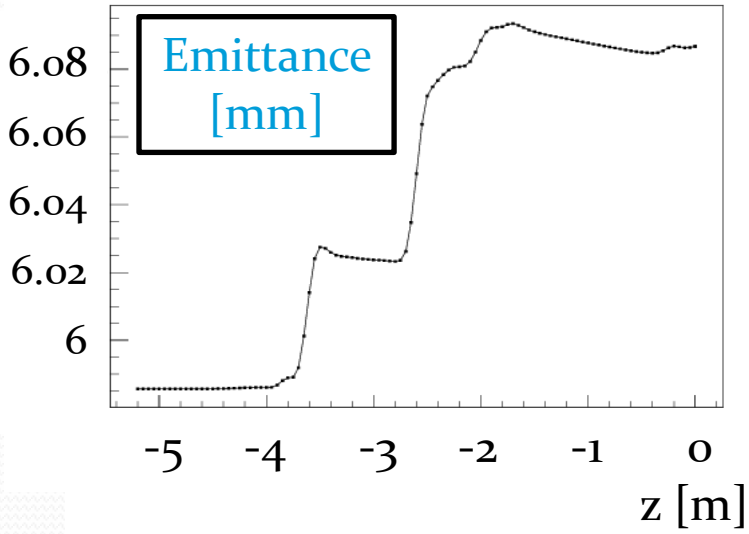
SigPz = 1 MeV/c, 100k muons

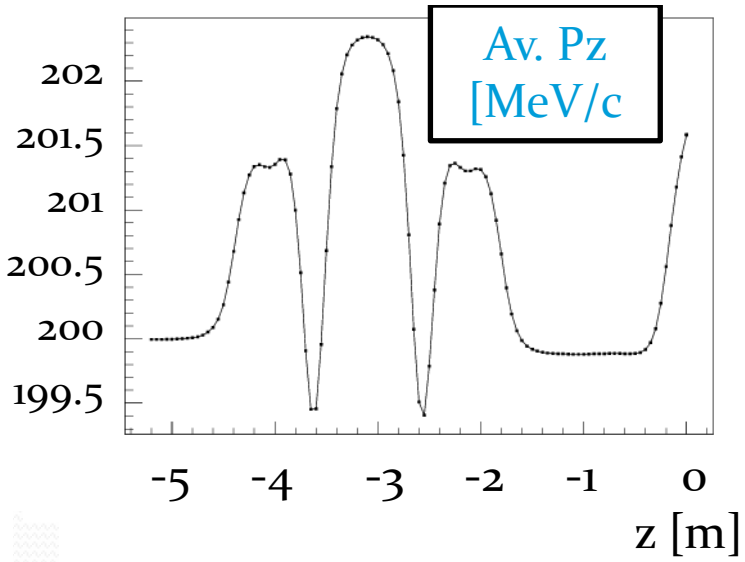




M1 = 158.9

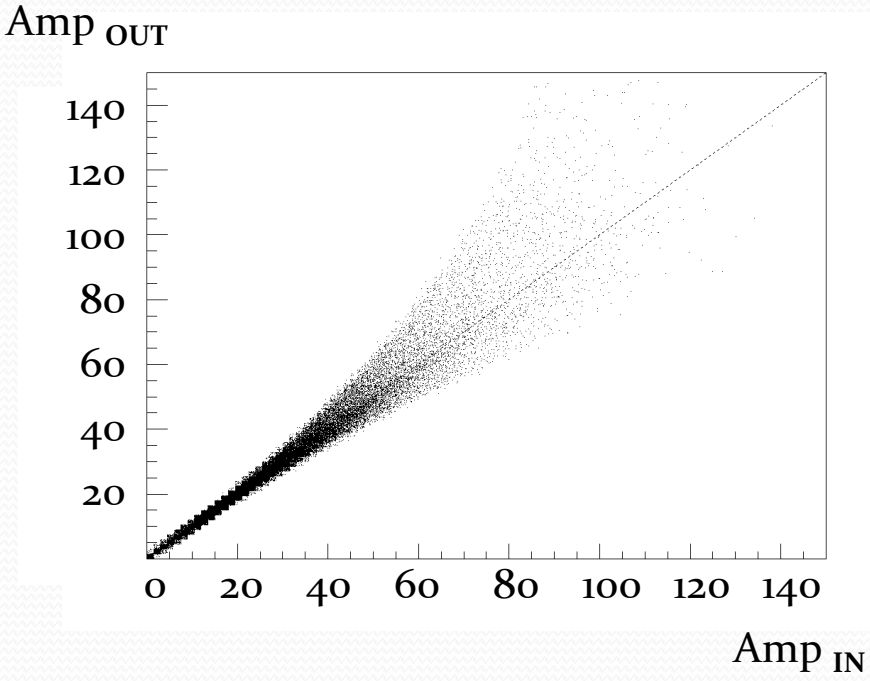
M2 = 92.4



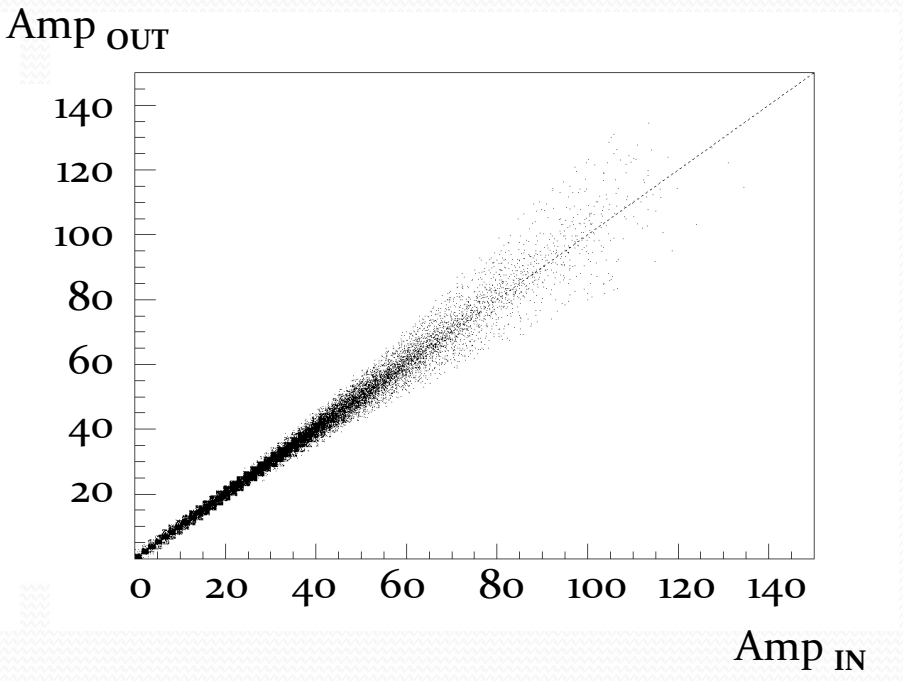


Amplitude Cooling…

Step 3 empty



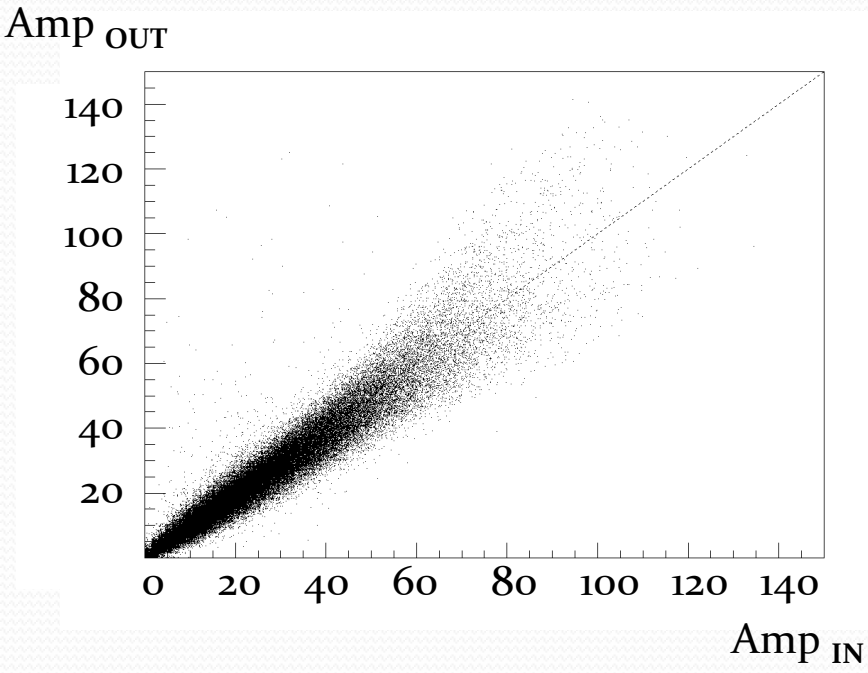
Step 4 empty



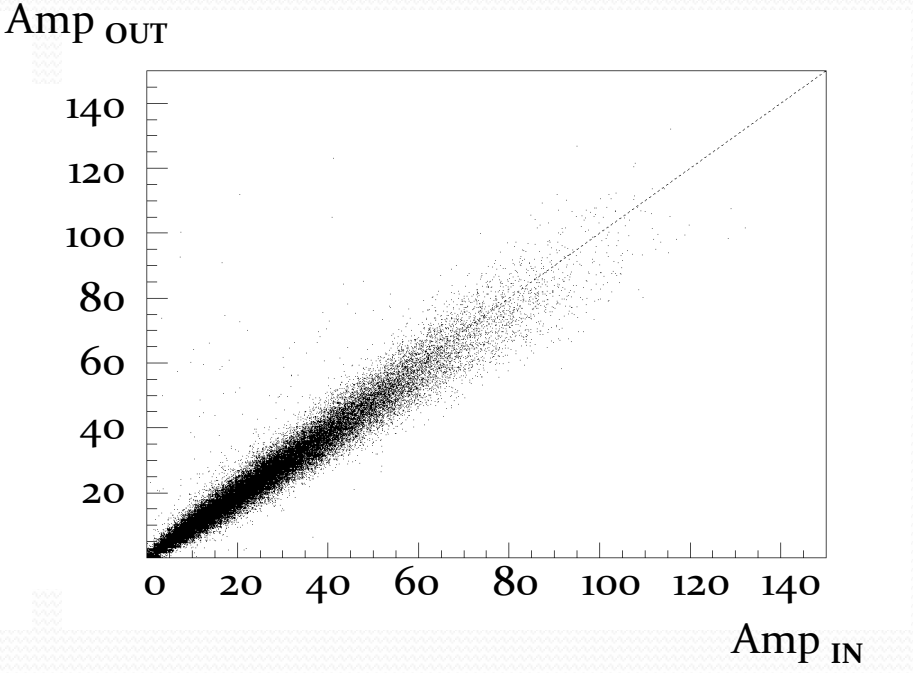
6mm beam, SigPz = 1 MeV/c, 100k muons

Amplitude Cooling…

Step 3: LiH

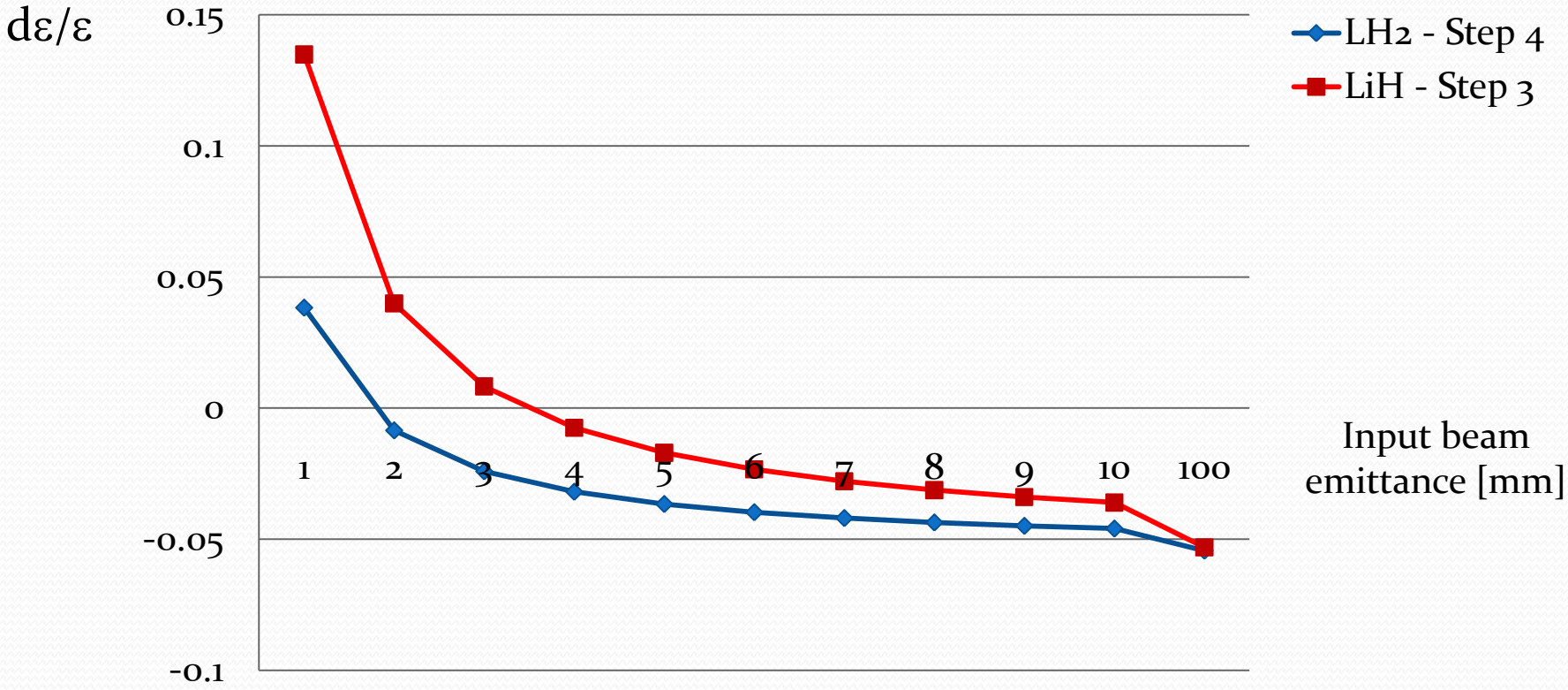


Step 4: LH2



6mm beam, SigPz = 1 MeV/c, 100k muons

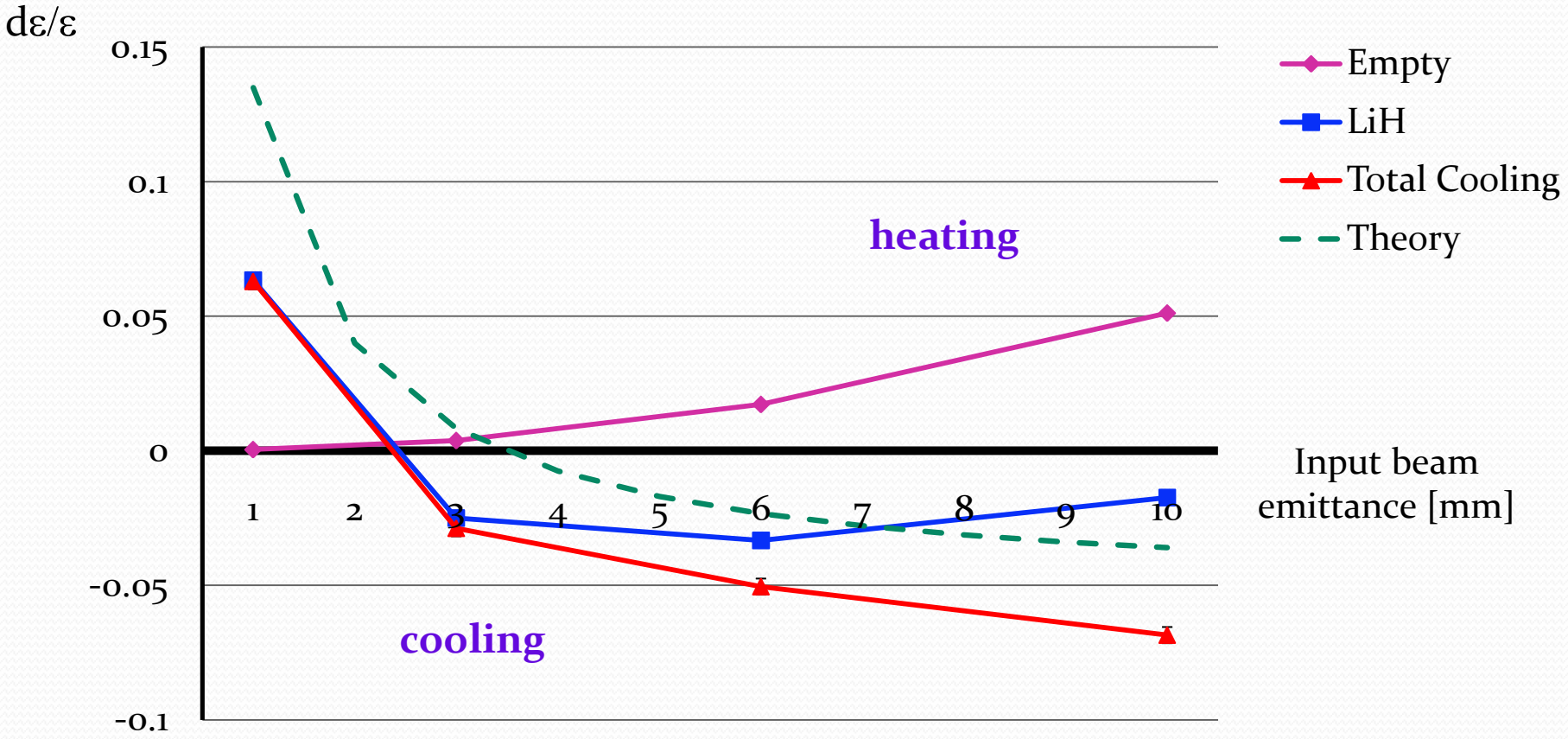
Theoretical Cooling Performance



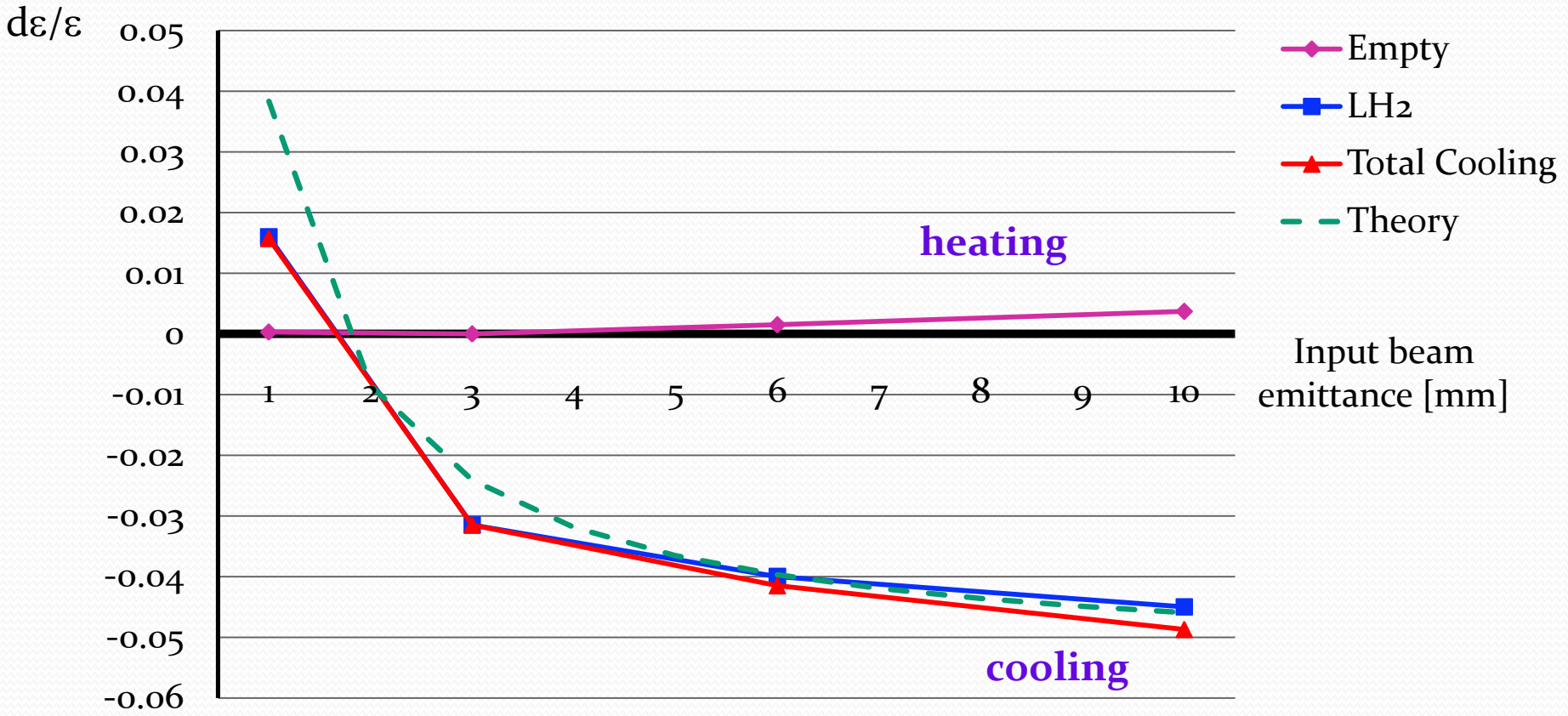
$$\frac{d\varepsilon_n}{dz} = \frac{-\varepsilon_n}{\beta^2 E}\left\langle \frac{dE}{dX} \right\rangle + \frac{\beta_t \left(0.014\ \mathrm{GeV}\right)^2}{2\beta^3 E m_\mu X_0}$$

Step 3

G4MICE : 100k mu, SigPz =1 MeV/c



Step 4


dε/ε
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
1
2
3
4
5
6
7
8
9
10
heating
cooling
Empty
LH2
Total Cooling
Theory
Input beam emittance [mm]

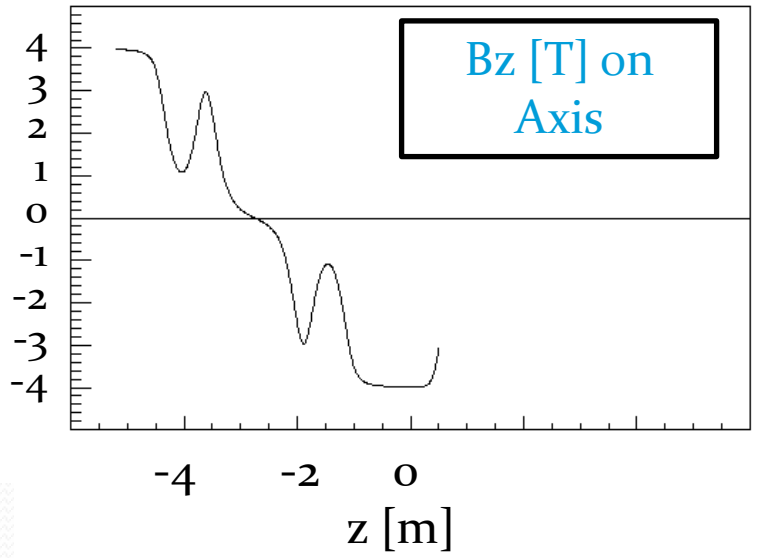
Step IV but without FC

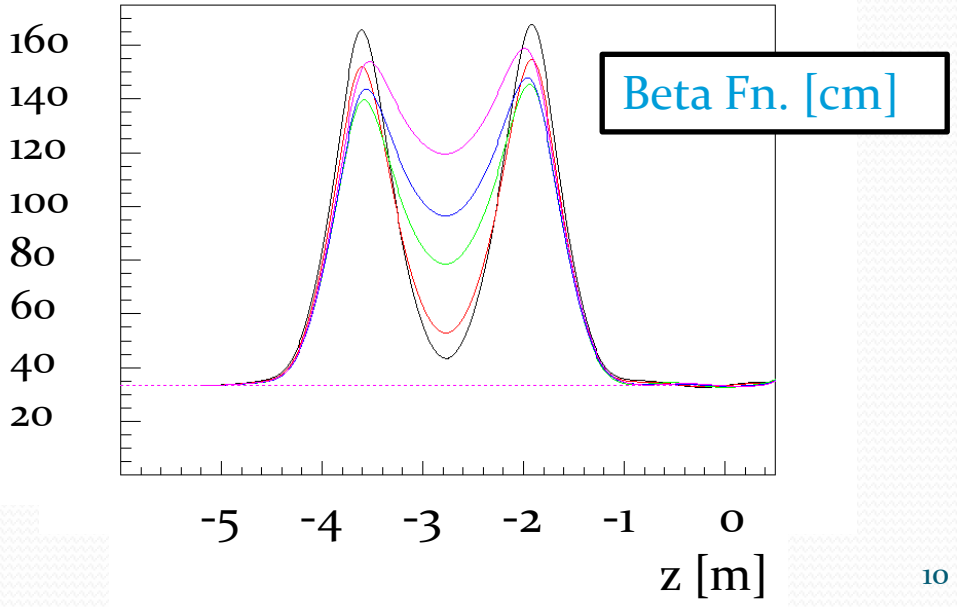
- **Focus Coil switched off**
- No LH2
- Minimized Fn at z= -0.3 m

~ centre of 2nd Tracker

$$F = 0.5*(\beta\gamma_0 - \alpha\alpha_0 + \beta_0\gamma)$$

- Range of solutions:

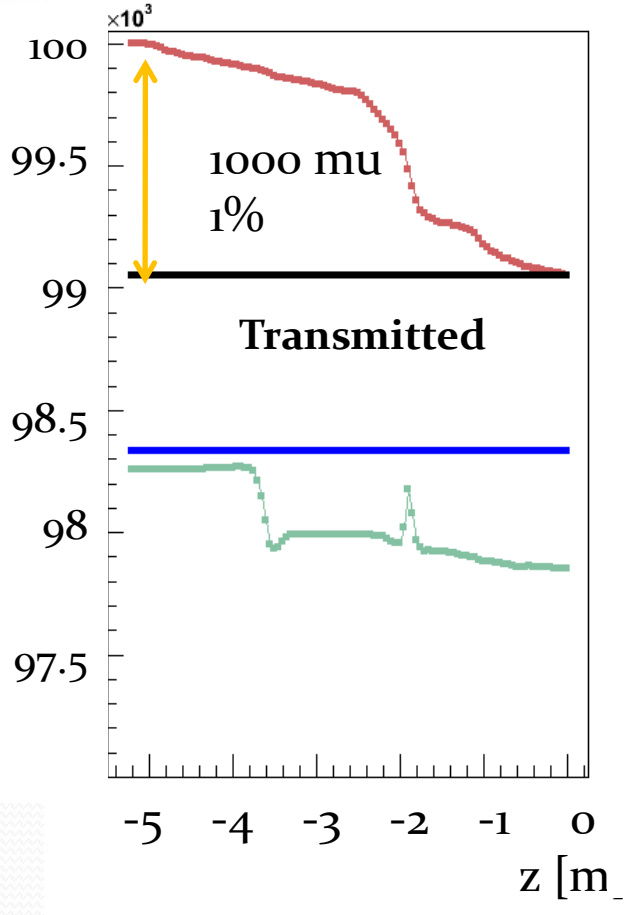




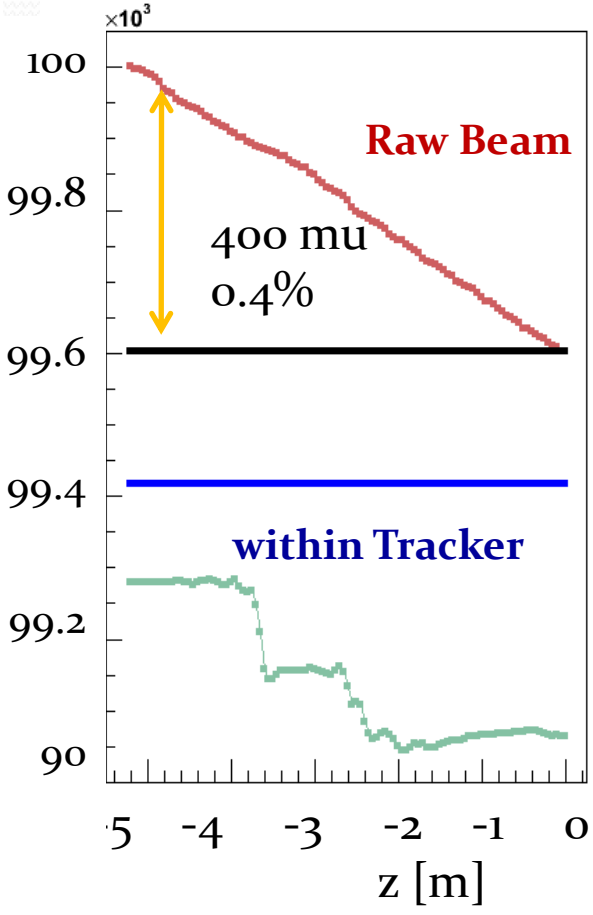
Transmission

6mm beam, SigPz = 1 MeV/c, 100k muons

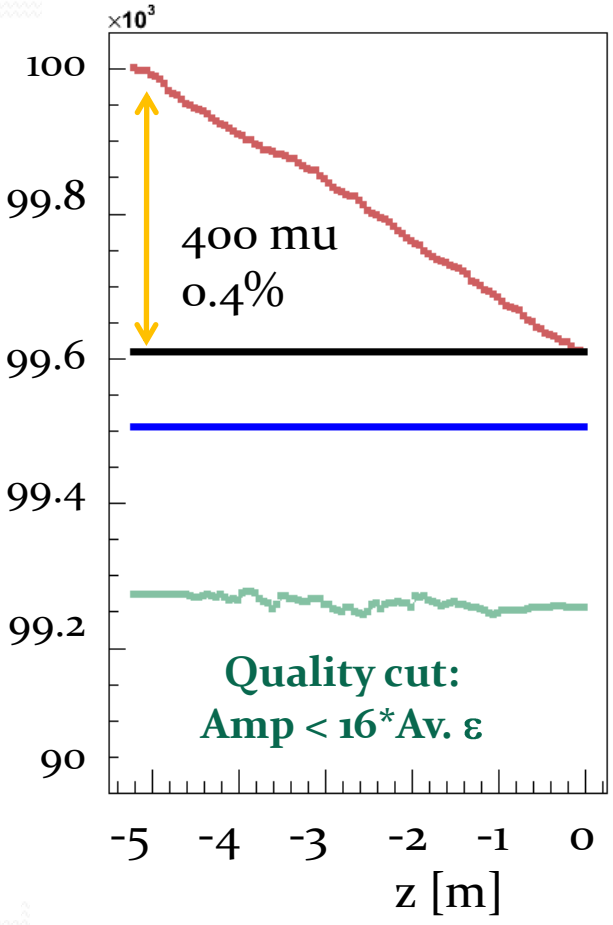
Step 4: No FC currents



Step 3: Empty



Step 4: Empty



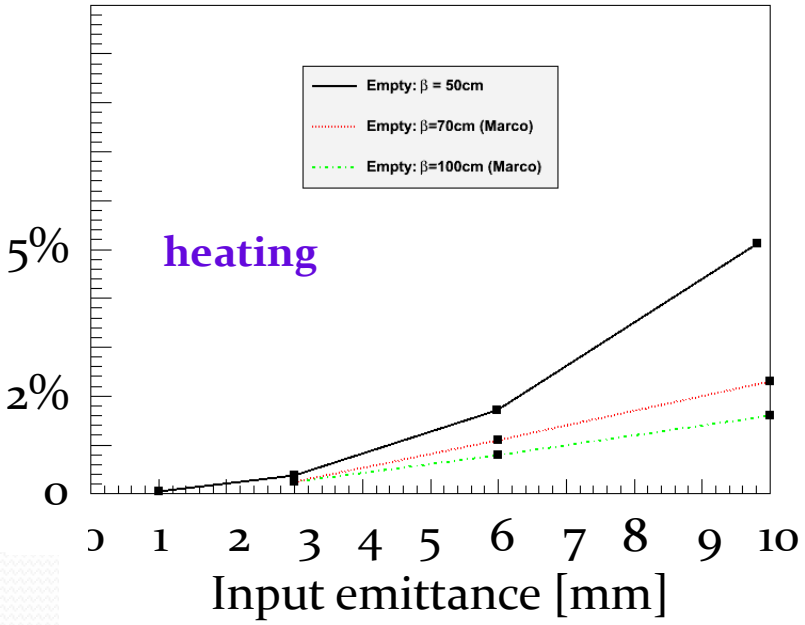
Conclusions

- Clearly more difficult to measure cooling in Step 3
  - ~10 x more heating than Step 4
- Step 3 cooling disagrees with theory
  - ε_0 < theory – don't know why (same in ICOOL)
- Need to include Tracker reconstruction…
- It appears we can run Step 4 without FC currents
  - Is this useful – Trackers?
- Can we run Step 4 with no currents in M1,M2 & FC?
  - Alignments?

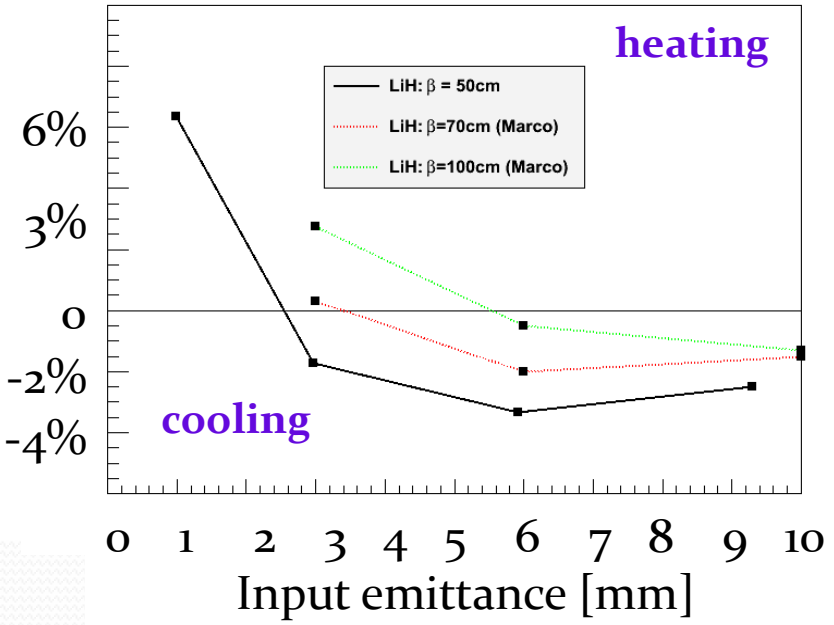
Extras...

Step 3 – comparison with existing data..

Empty Channel



LiH absorber

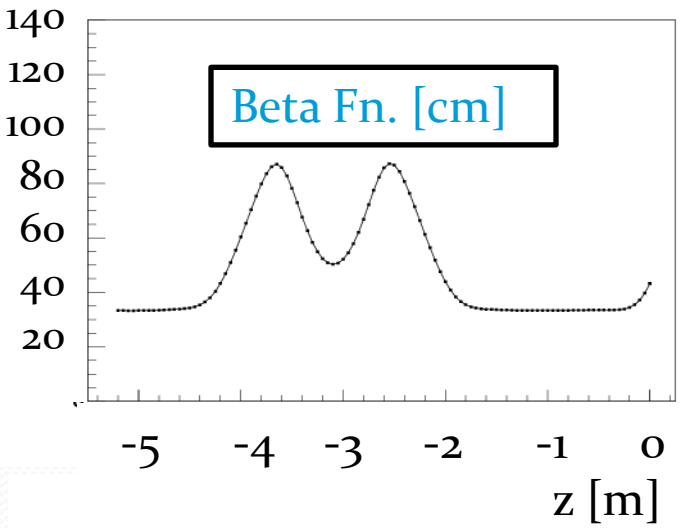


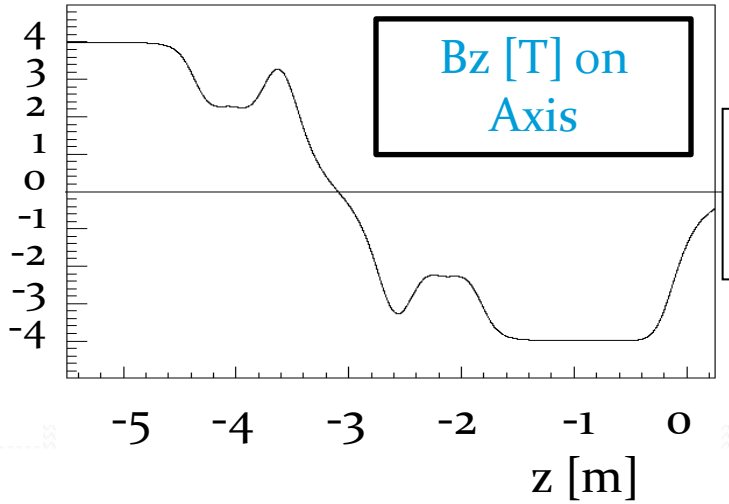
Black Data: 100k mu, SigPz =1 MeV/c, G4MICE

Marco Data: 10k mu, SigPz = big (10%), ICOOL – note 199

Step3 Empty: 1mm ε beam

SigPz = 1 MeV/c, 100k muons





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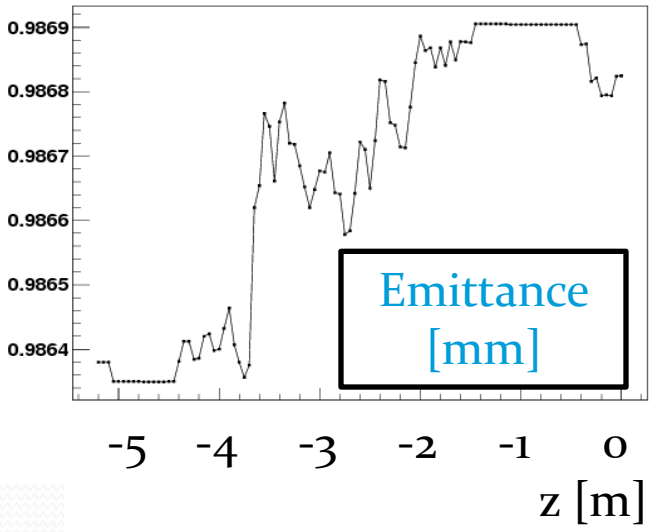
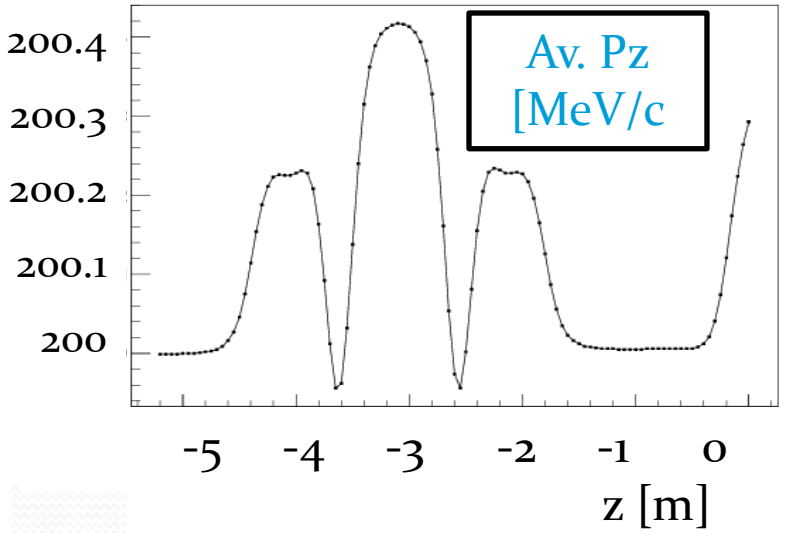
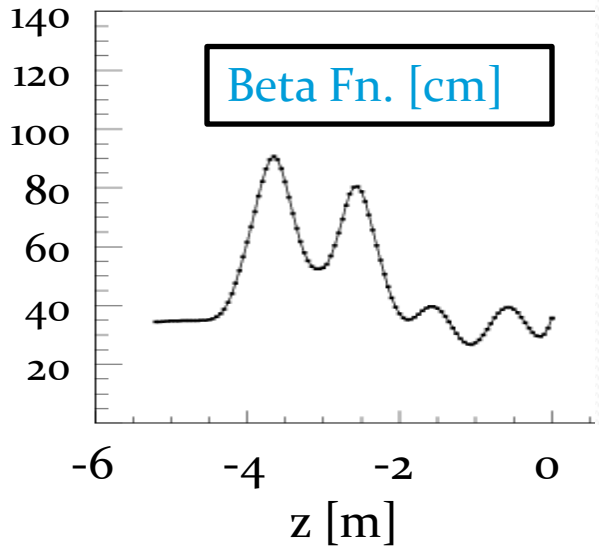
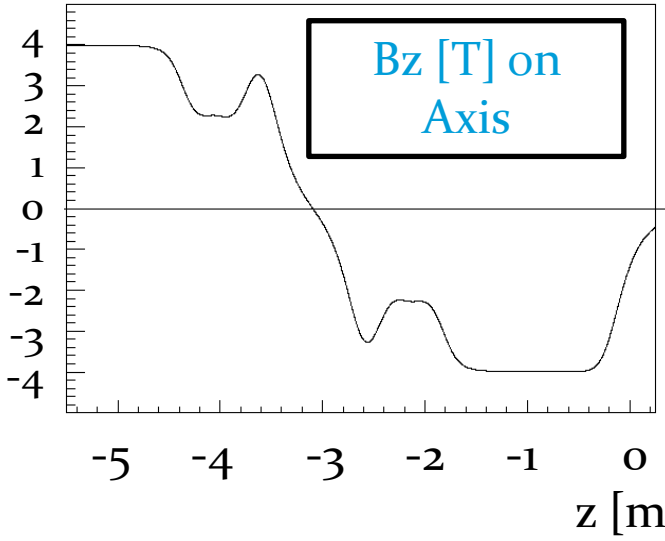




Step 3 LiH: 6mm ε beam

SigPz = 1 MeV/c, 100k muons





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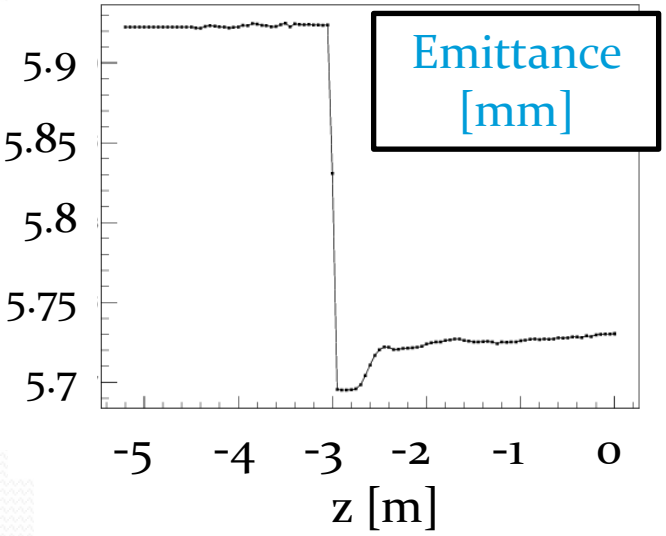
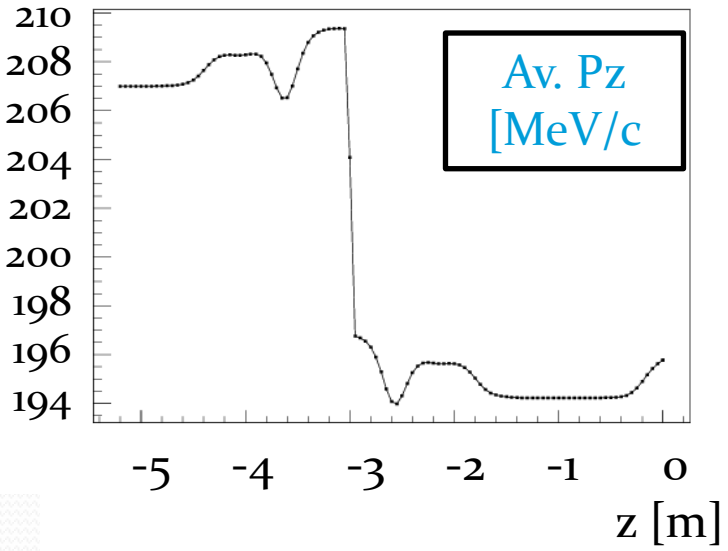
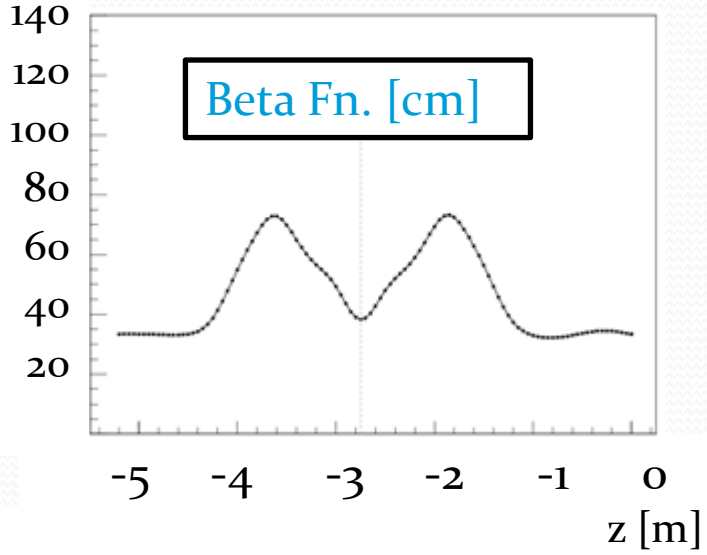
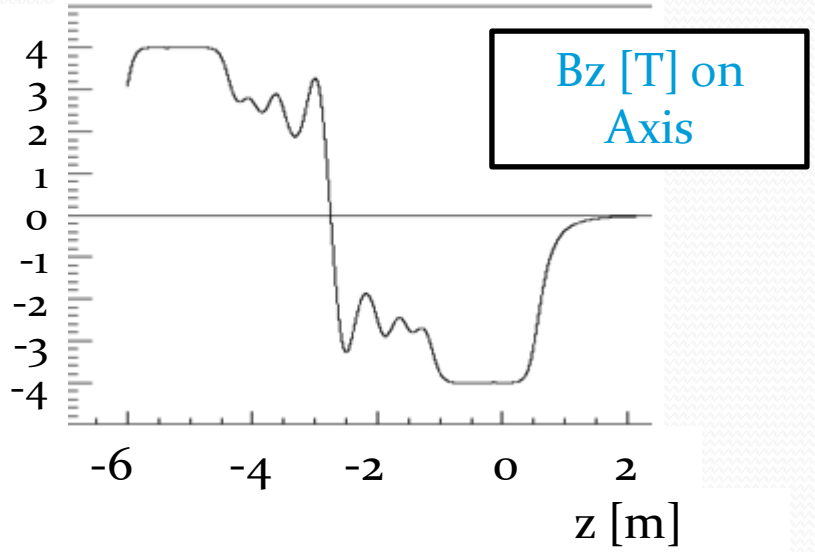


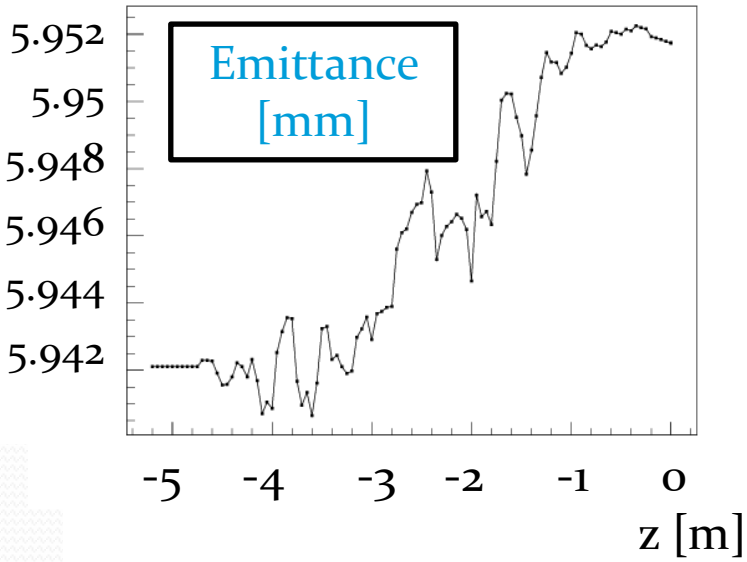


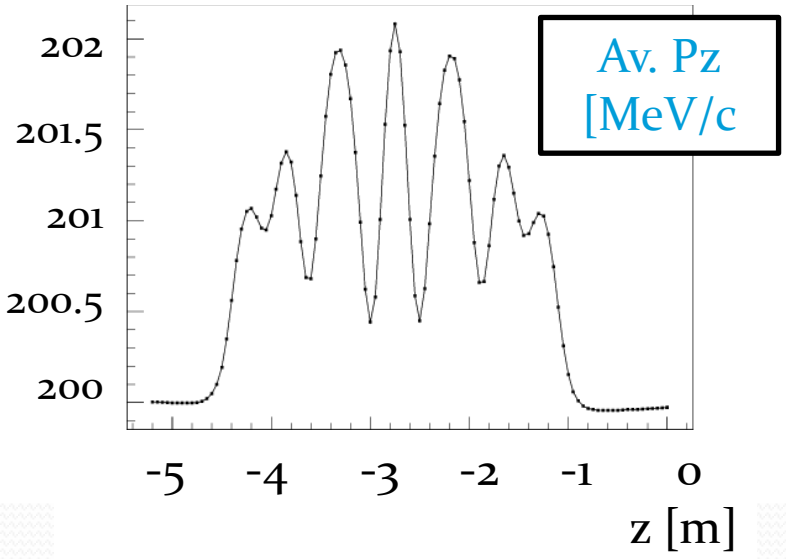
Step 4 Empty: 6mm ε beam

SigPz = 1 MeV/c, 100k muons



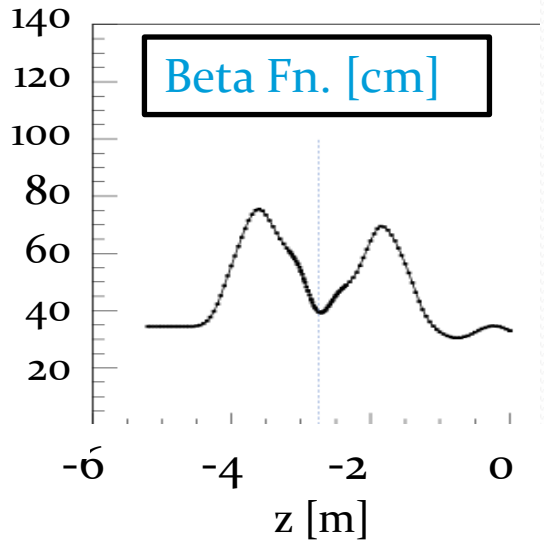


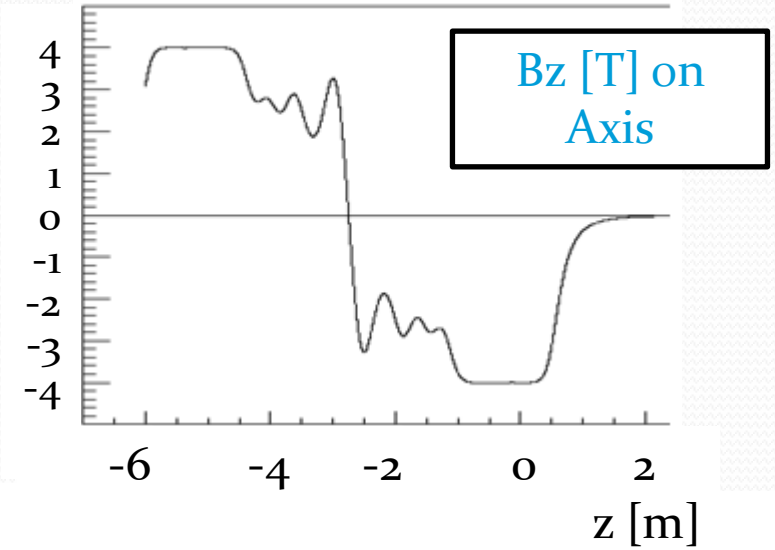


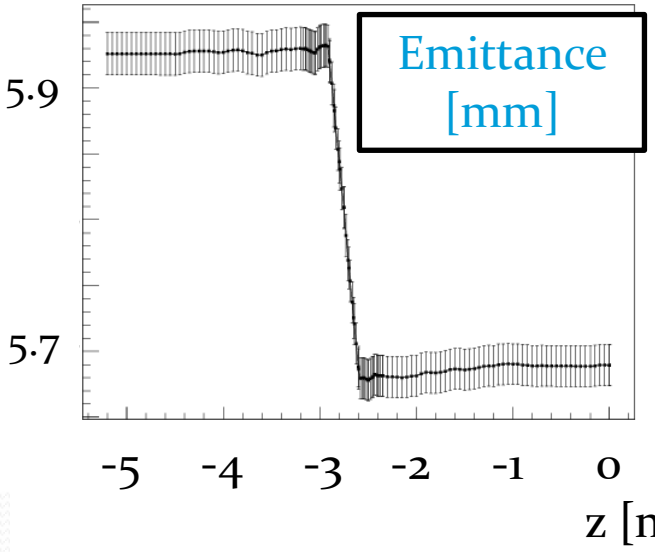


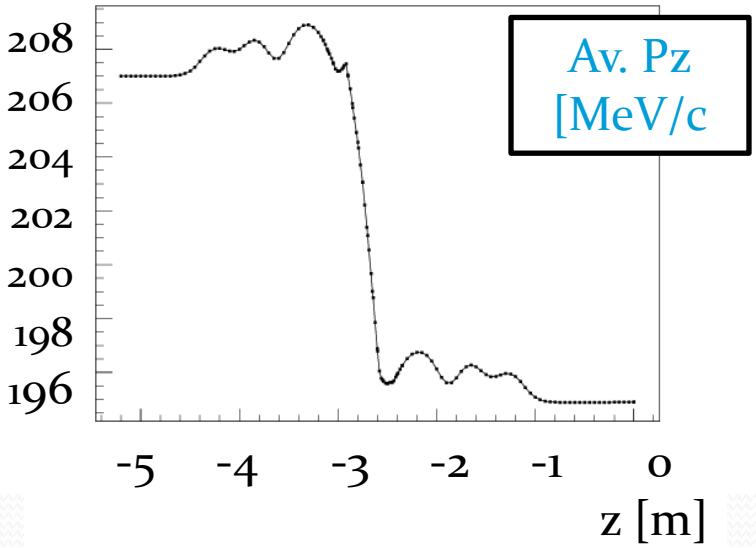
Step 4 LH2: 6mm ε beam

SigPz = 1 MeV/c, 70k muons

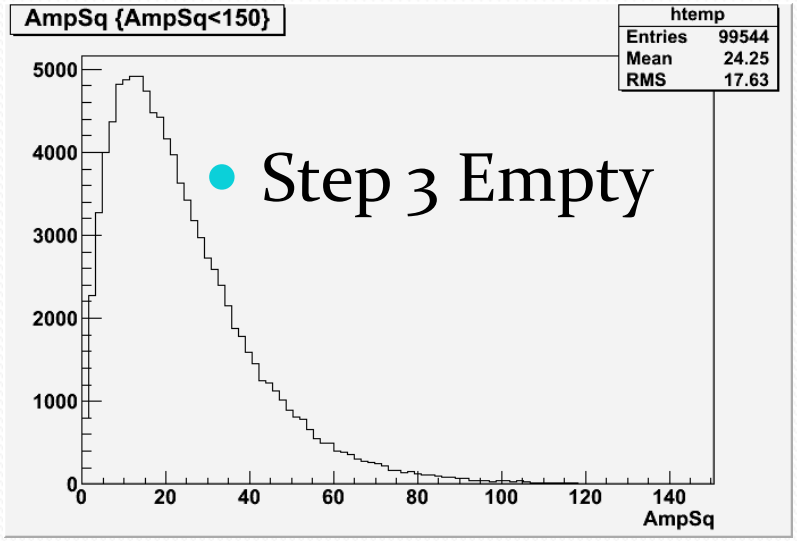




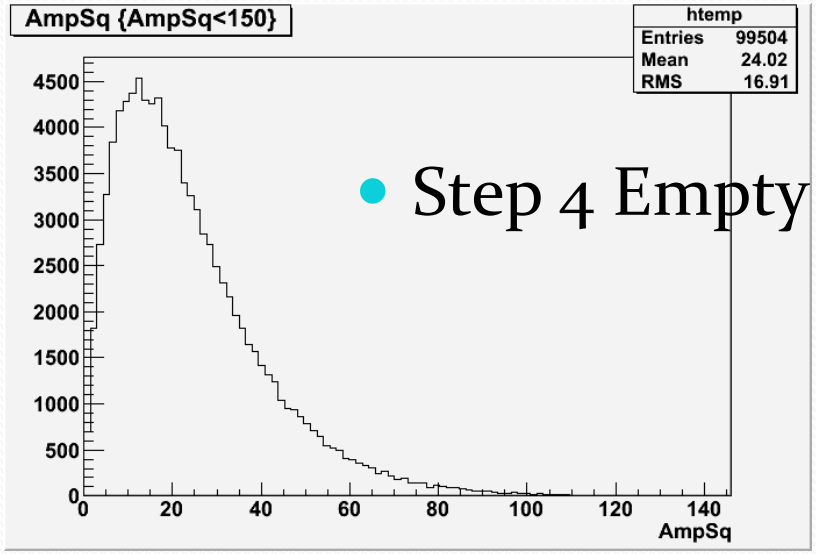




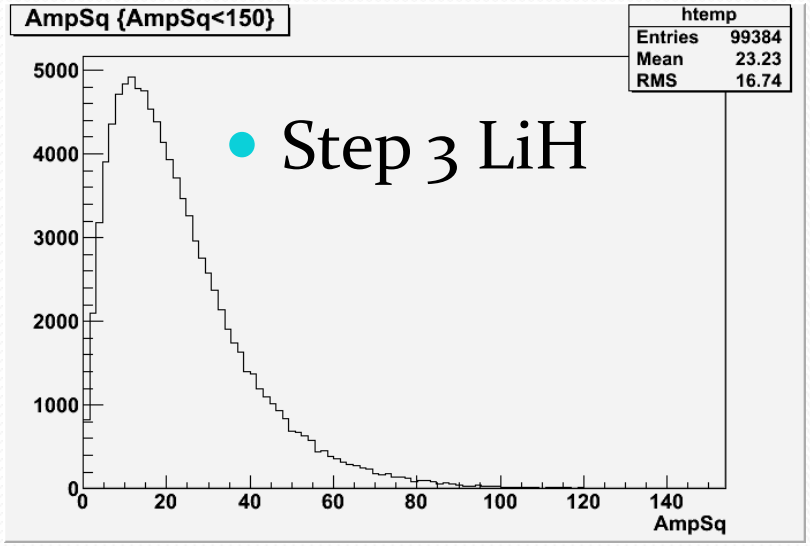
Output AmpSq



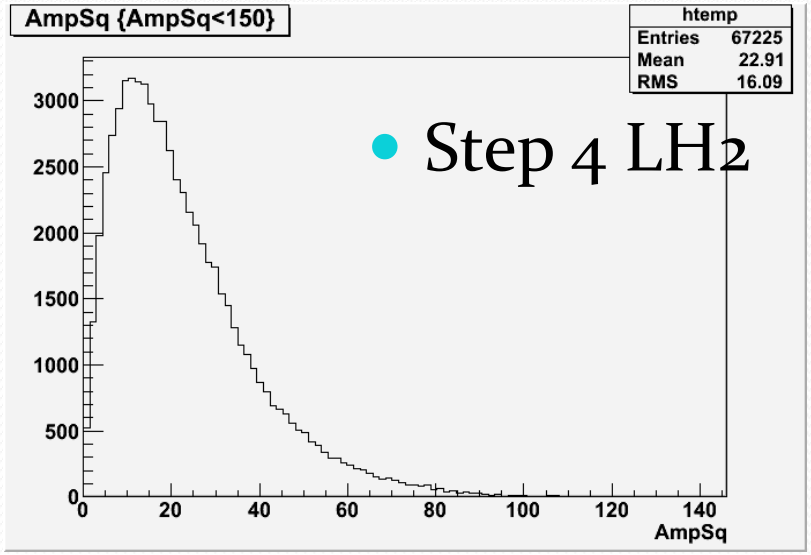
- Step 3 Empty



- Step 4 Empty



- Step 3 LiH



- Step 4 LH2