

**ALTERNATIVE CAPTURE SOLENOID STUDY  
FOR THE MUON COLLIDER TARGET**

**HISHAM KAMAL SAYED**

**Physics Department**

**BROOKHAVEN NATIONAL LABORATORY**

Nov. 1, 2012

# ANALYTIC FORM FOR TAPERED SOLENOID

Inverse-Cubic Taper

$$B_z(0, z_i < z < z_f) = \frac{B_1}{[1 + a_1(z - z_1) + a_2(z - z_1)^2 + a_3(z - z_1)^3]^p}$$

$$a_1 = -\frac{B_1'}{pB_1} \quad a_2 = 3 \frac{(B_1/B_2)^{1/p} - 1}{(z_2 - z_1)^2} - \frac{2a_1}{z_2 - z_1}$$

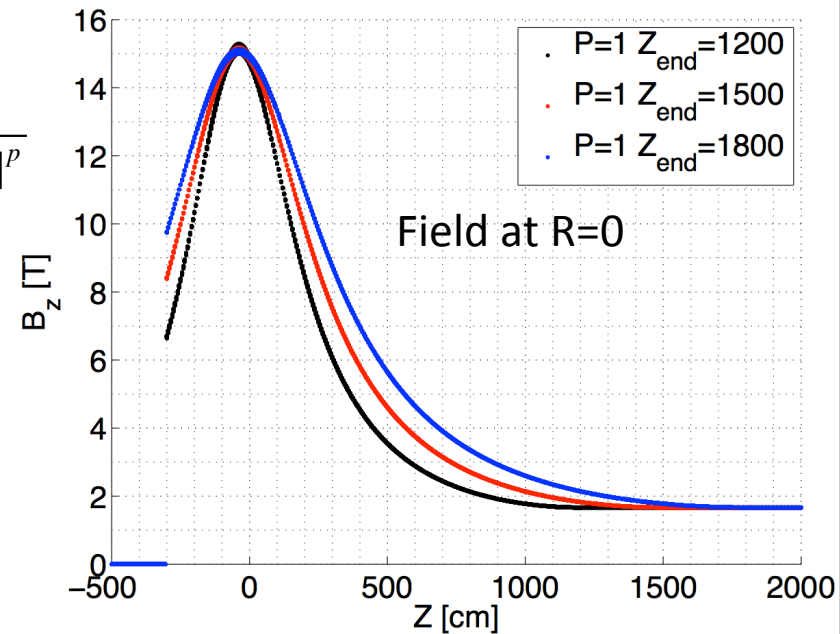
$$a_3 = -2 \frac{(B_1/B_2)^{1/p} - 1}{(z_2 - z_1)^3} + \frac{a_1}{(z_2 - z_1)^2}$$

Off-axis field approximation

$$B_z(r, z) = \sum_n (-1)^n \frac{a_0^{(2n)}(z)}{(n!)^2} \left(\frac{r}{2}\right)^{2n}$$

$$B_r(r, z) = \sum_n (-1)^{n+1} \frac{a_0^{(2n+1)}(z)}{(n+1)(n!)^2} \left(\frac{r}{2}\right)^{2n+1}$$

$$a_0^{(n)} = \frac{d^n a_0}{dz^n} = \frac{d^n B_z(0, z)}{dz^n}$$



! First Order

BZ = B1 / CUBIC\*\*POW

BR = -R / 2. \* DBZ1

! Second Order

BZ = BZ - R\*\*2 / 4. \* DBZ2

BR = BR + R\*\*3 / 16. \* DBZ3

! Third Order

BZ = BZ + R\*\*4 / 64.0 \* DBZ4

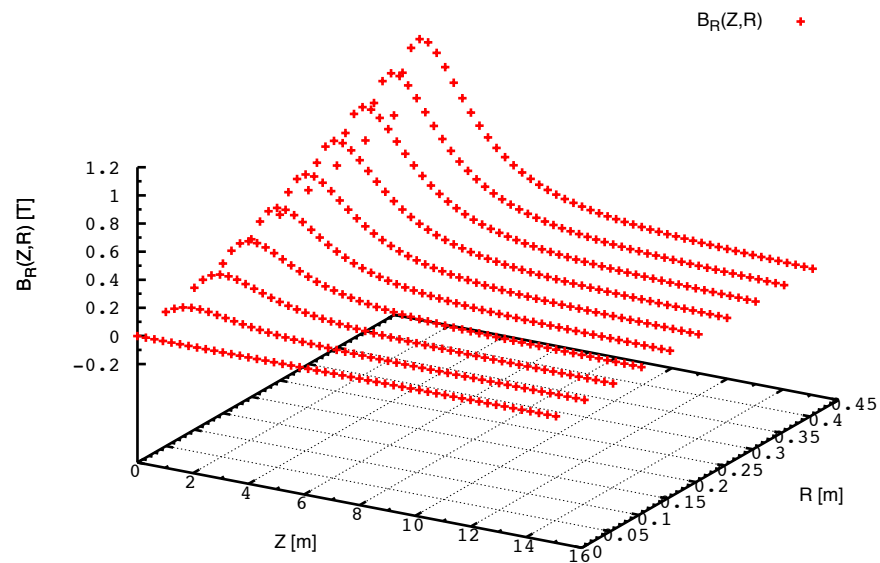
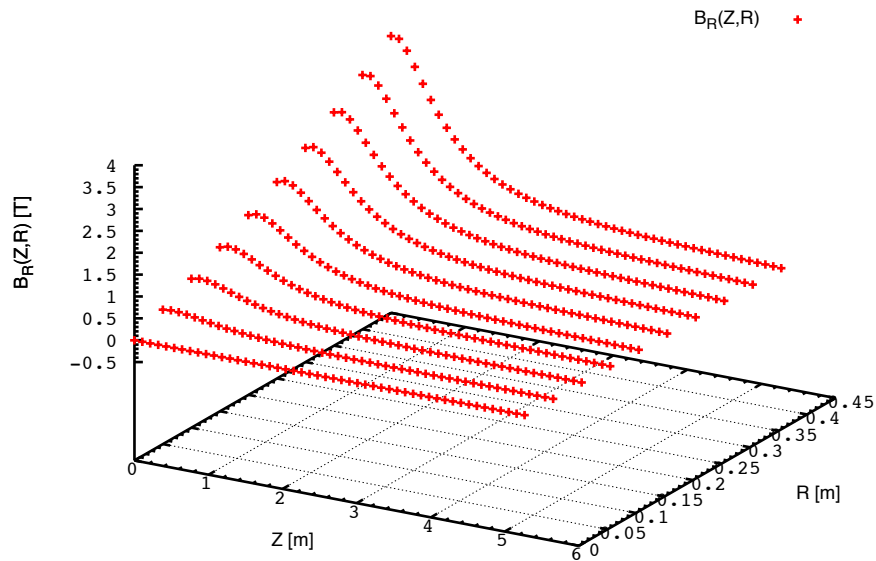
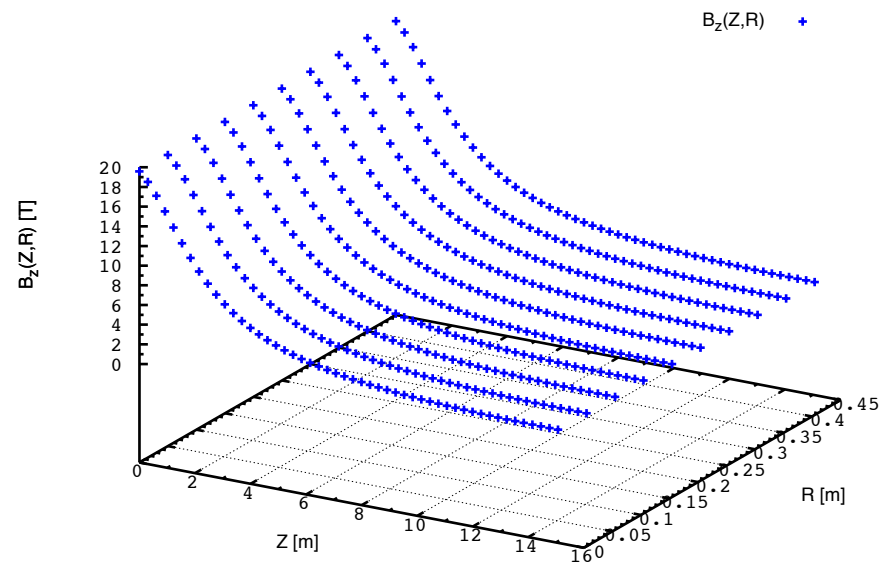
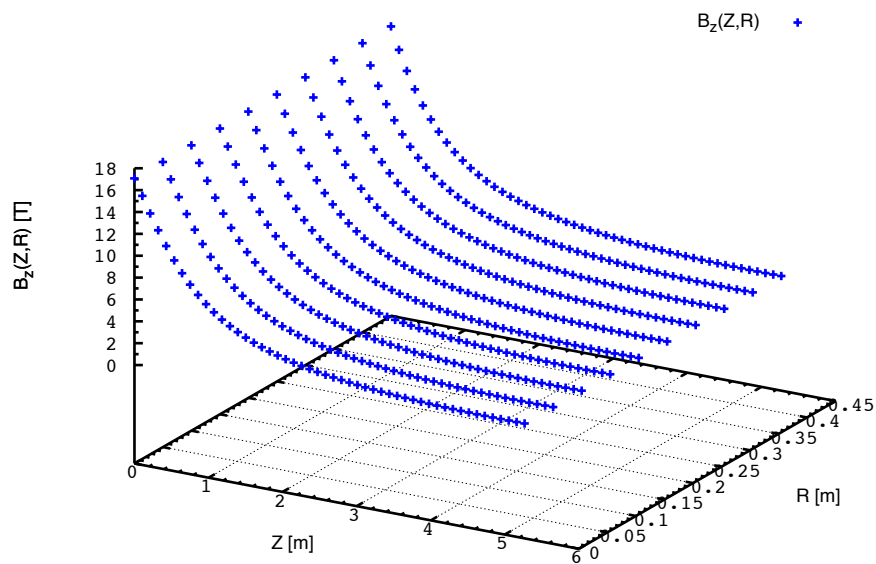
BR = BR - R\*\*5 / 384.0 \* DBZ5

! Fourth Order

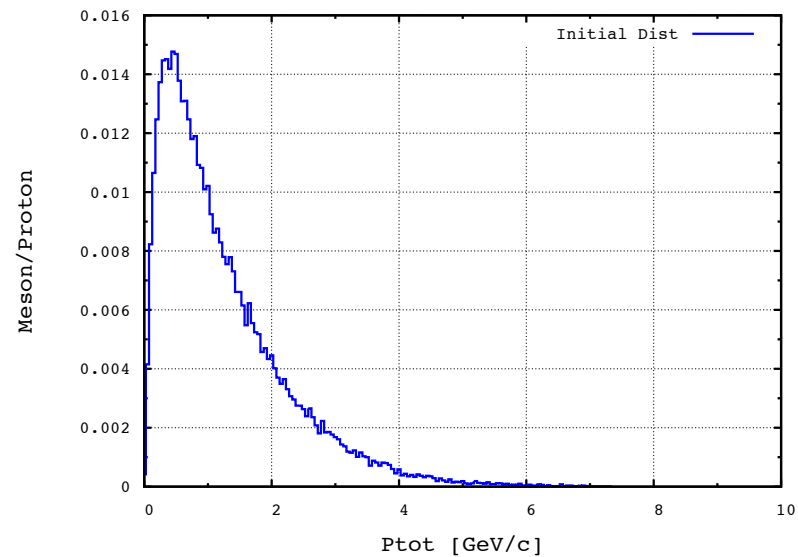
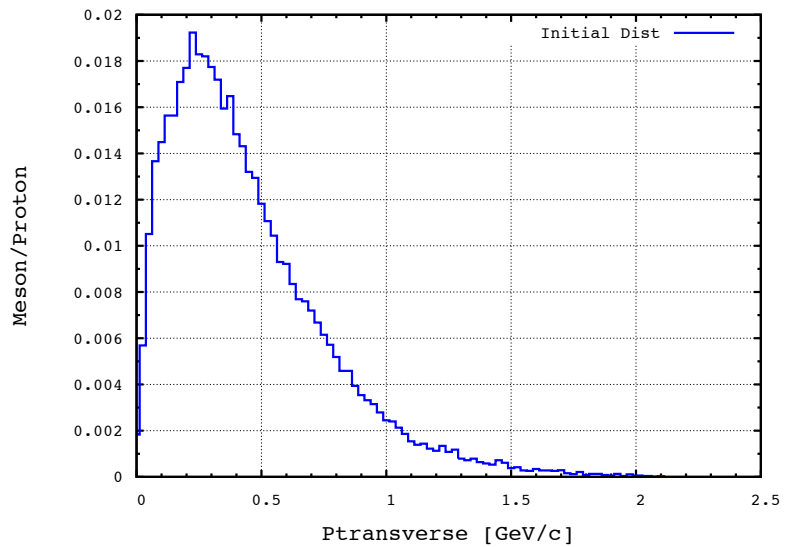
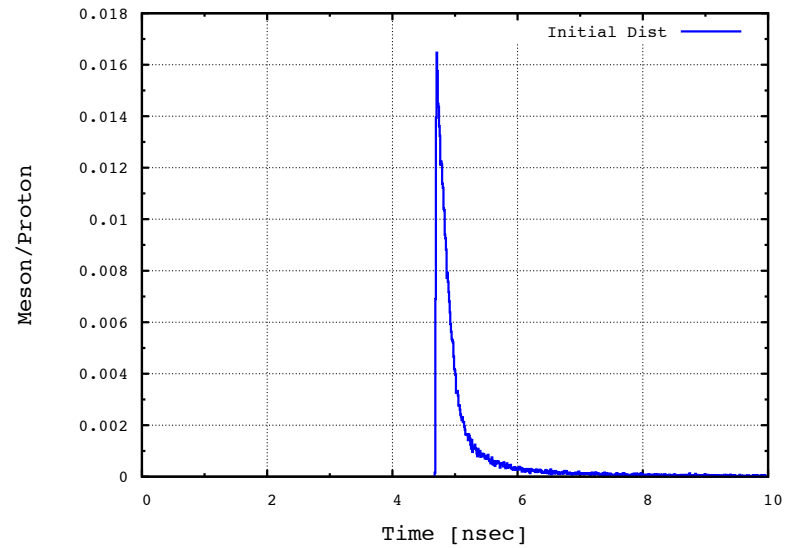
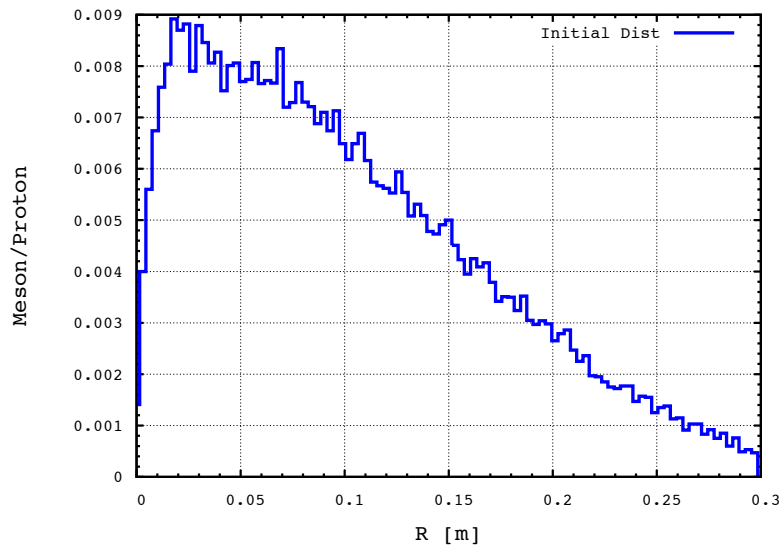
BZ = BZ - R\*\*6 / 2304.0 \* DBZ6

BR = BR + R\*\*7 / 18432.0 \* DBZ7

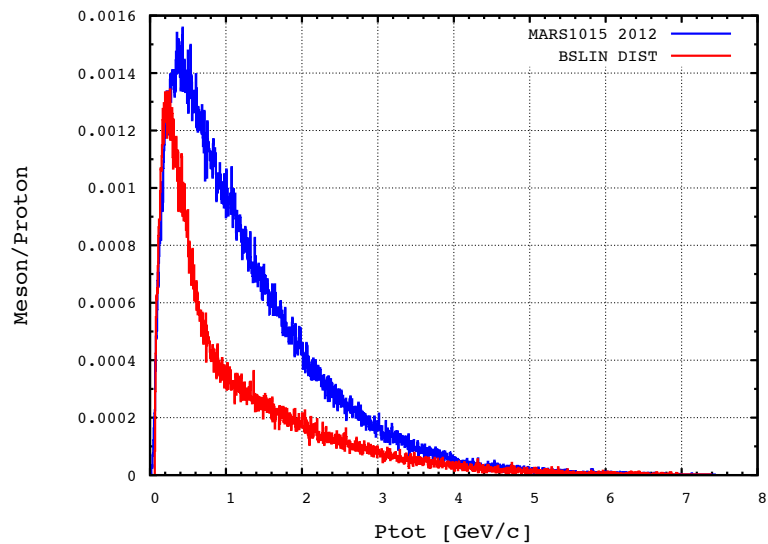
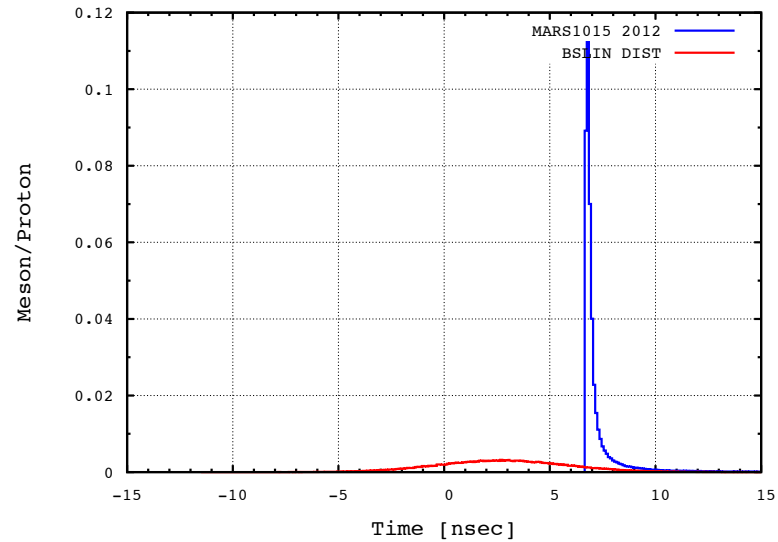
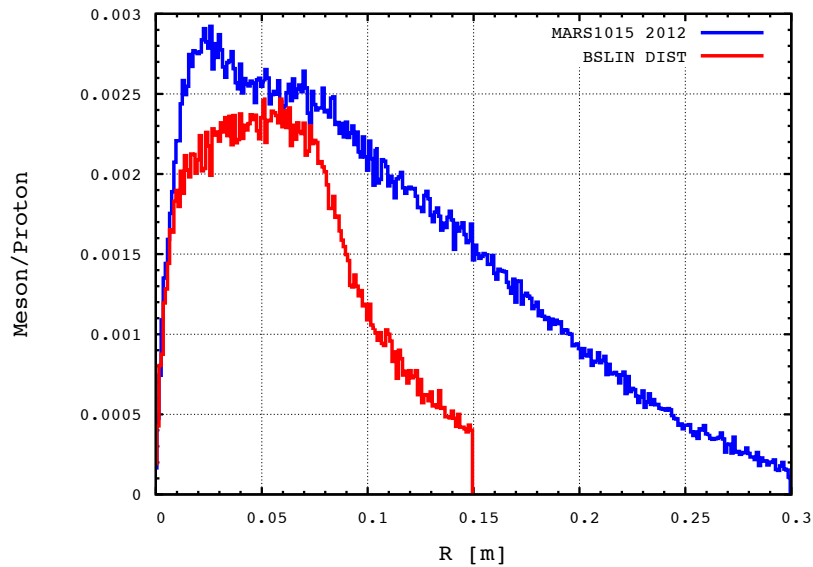
# SOLENOID TAPERED FIELD



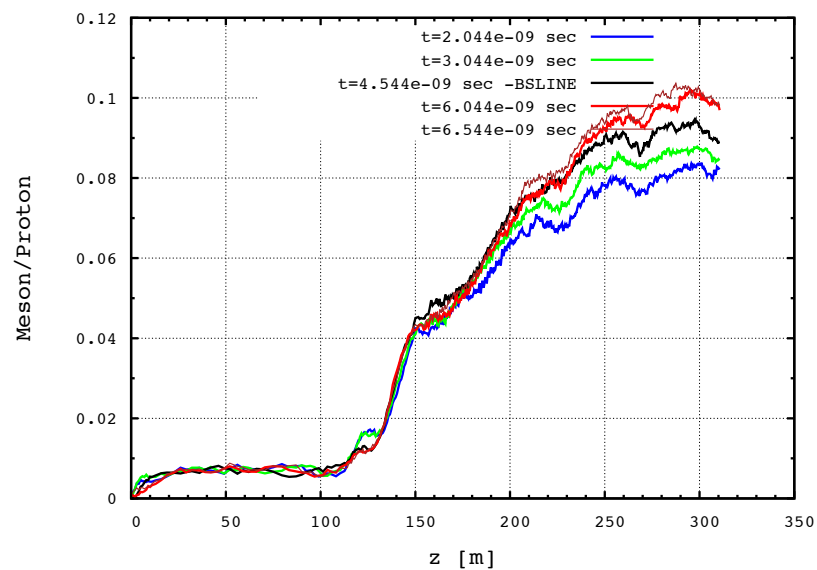
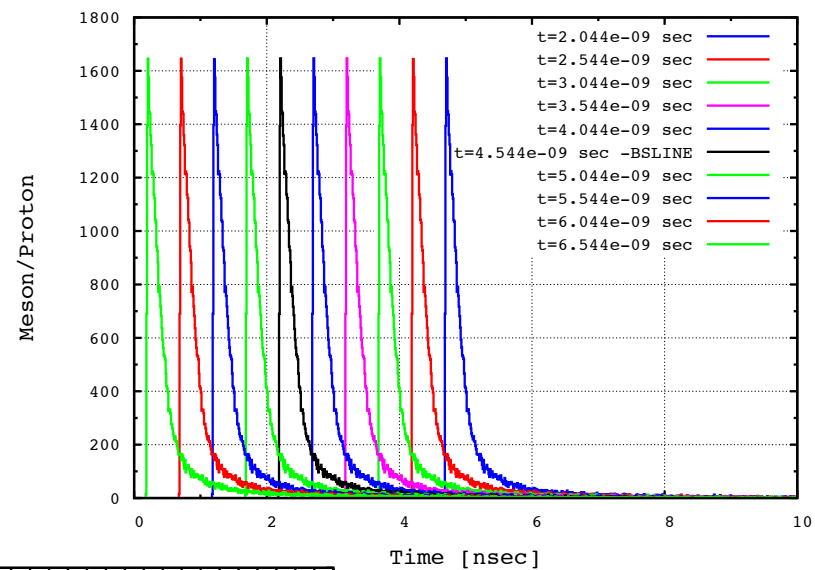
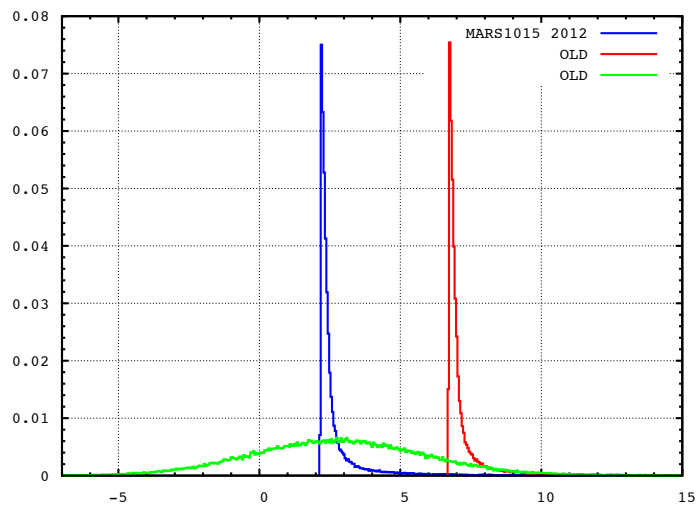
## INITIAL PARTICLE DISTRIBUTIONS



# INITIAL PARTICLE DISTRIBUTIONS (CURRENT & BASELINE)

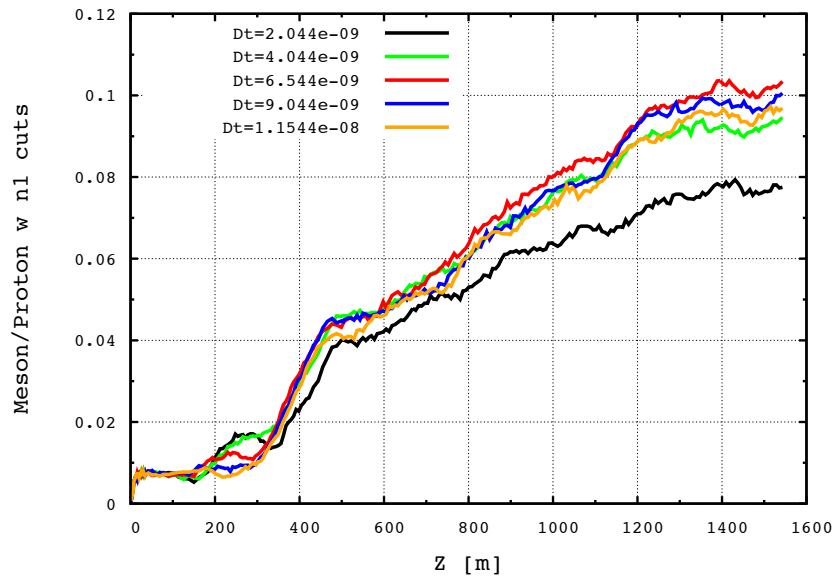


# FIXING TIME OF ARRIVAL

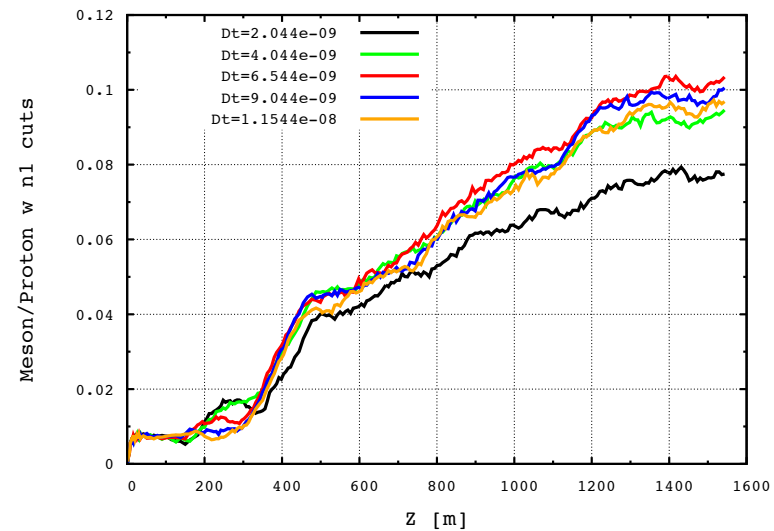


# TIME OF ARRIVAL SCAN

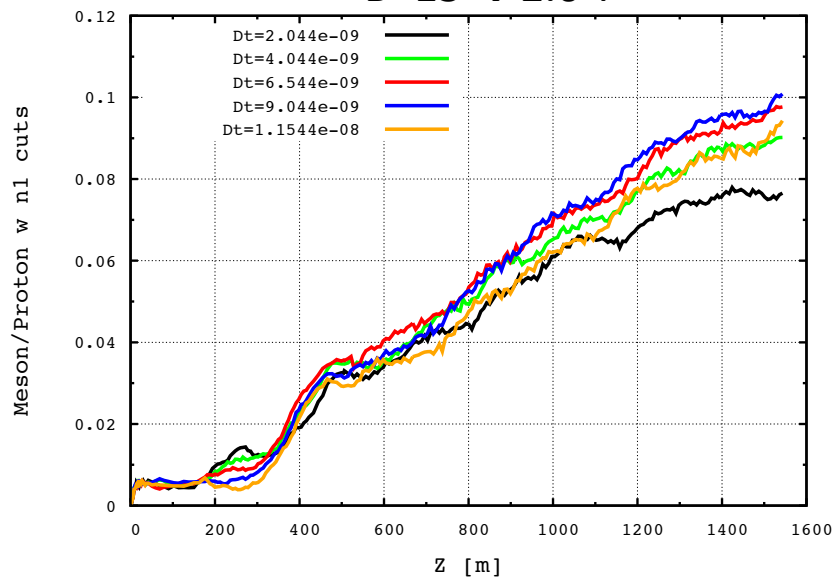
B=20 → 1.5 T



B=15 → 1.5 T



B=15 → 2.0 T

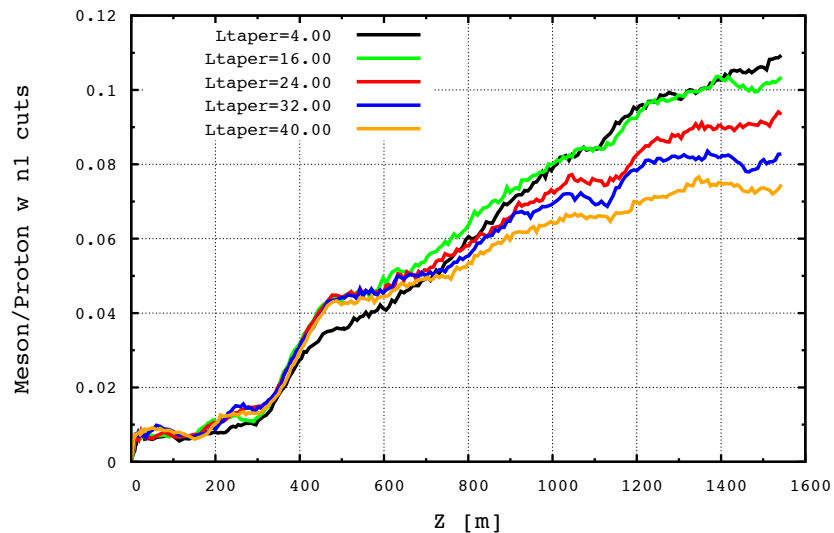


Ltaper=16 m

# TAPER SCAN

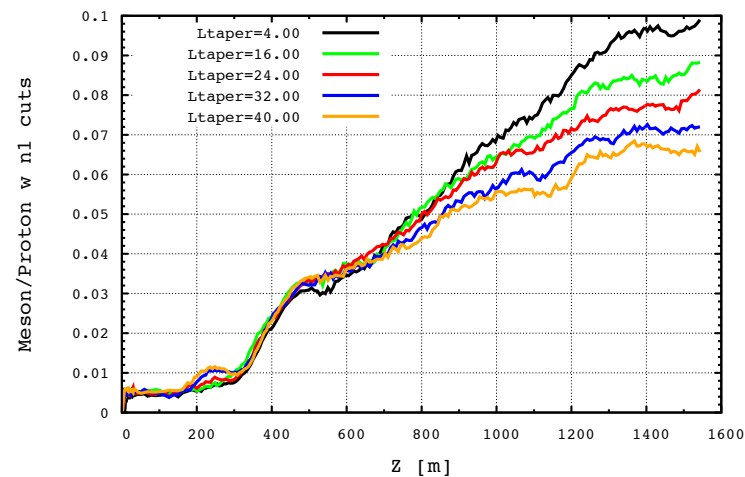
**B=20 → 1.5 T**

Bz=20→1.5T - Dt=6.5 nsec



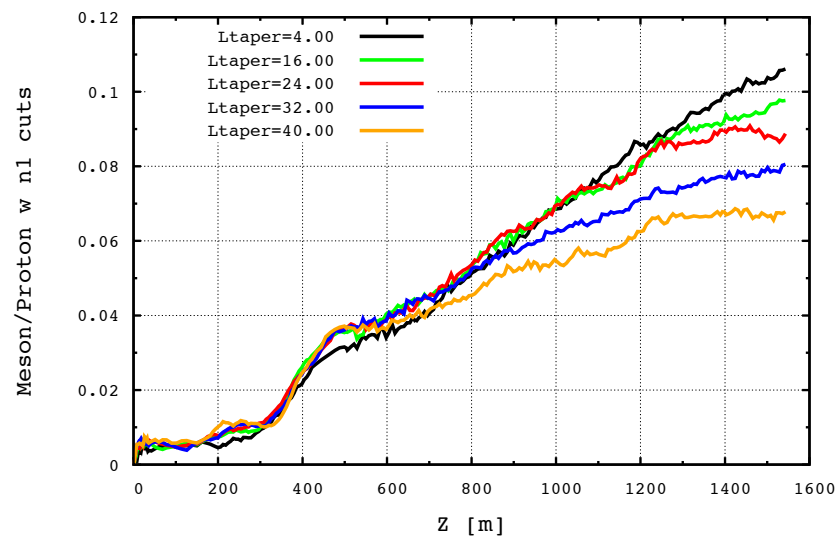
**B=15 → 1.5 T**

Bz=15→1.5T - Dt=6.5 nsec



**B=15 → 2.0 T**

Bz=15→2.0T - Dt=6.5 nsec

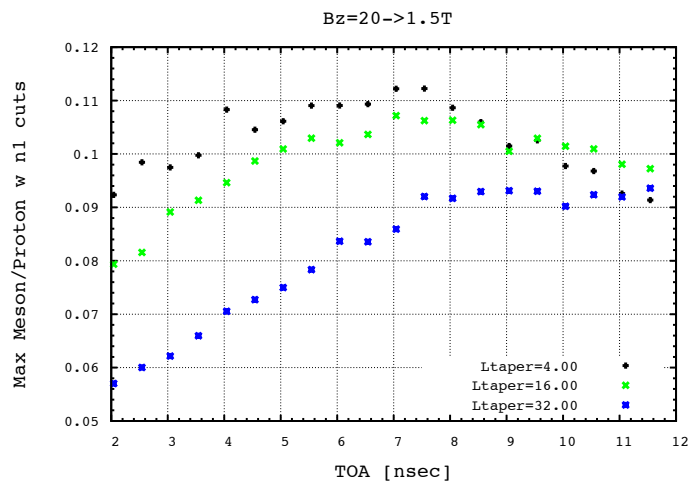


TOA=6.5 nsec

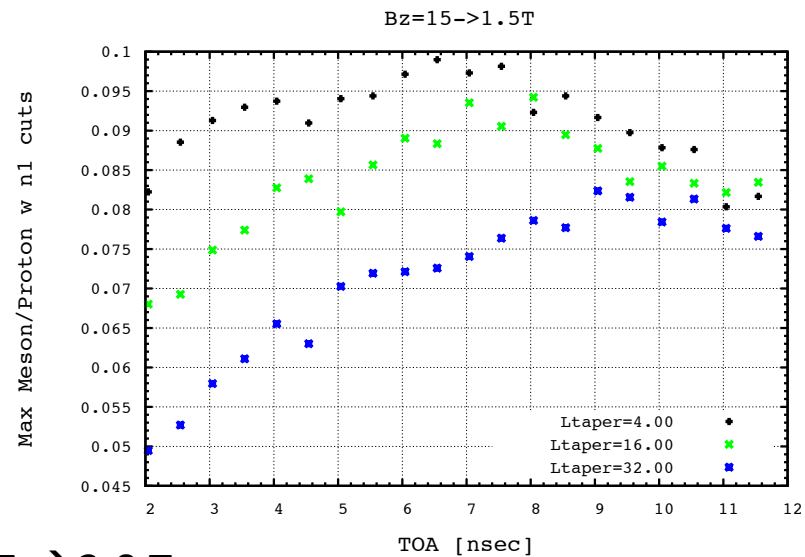


# TIME & TAPER LENGTH SCAN

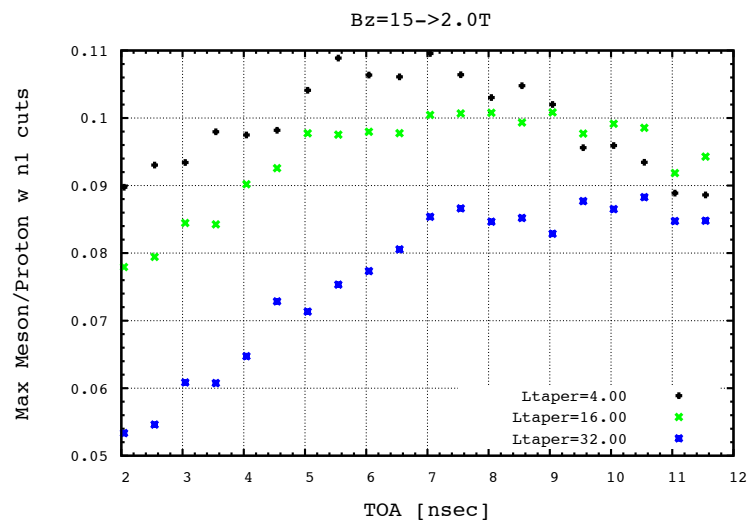
B=20  $\rightarrow$  1.5 T



B=15  $\rightarrow$  1.5 T



B=15  $\rightarrow$  2.0 T



## TIME &amp; TAPER LENGTH SCAN

