

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

HISHAM KAMAL SAYED

Physics Department

BROOKHAVEN NATIONAL LABORATORY

ANALYTIC FORM FOR TAPERED SOLENOID

Inverse-Cubic Taper

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

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

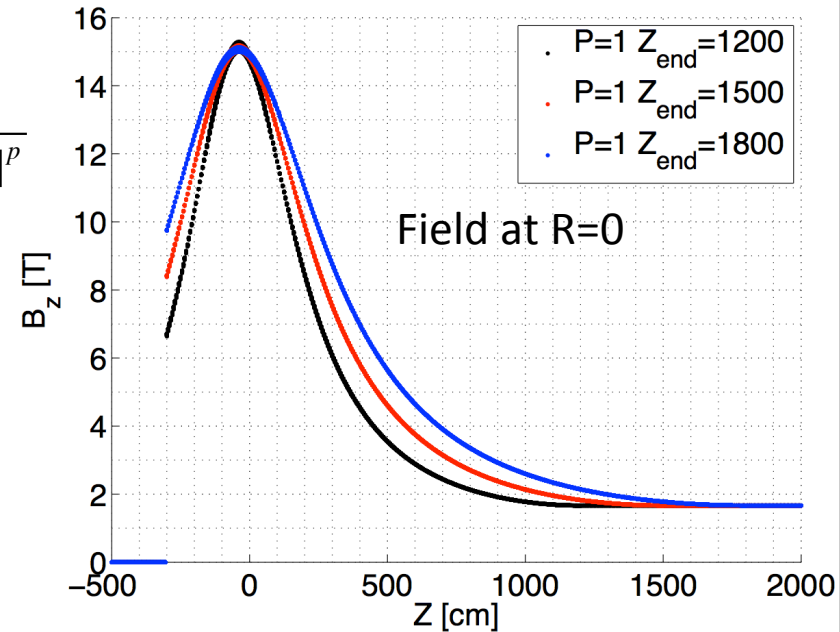
$$a_3 = -2 \frac{(B_1/B_2)^{1/p} - 1}{(z_2 - z_1)^3} + \frac{a_1}{(z_2 - z_1)^2}$$

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

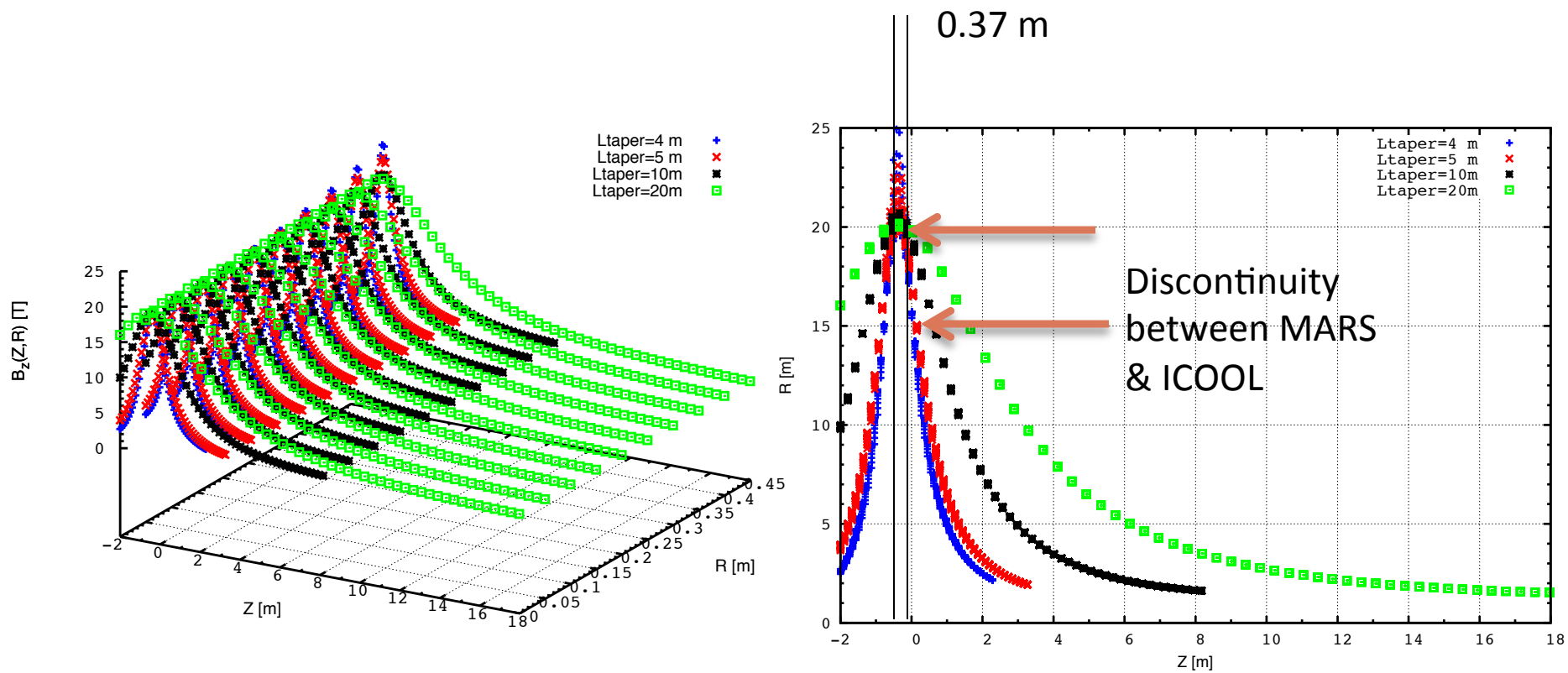
BR = BR - R**5 / 384.0 * DBZ5

! Fourth Order

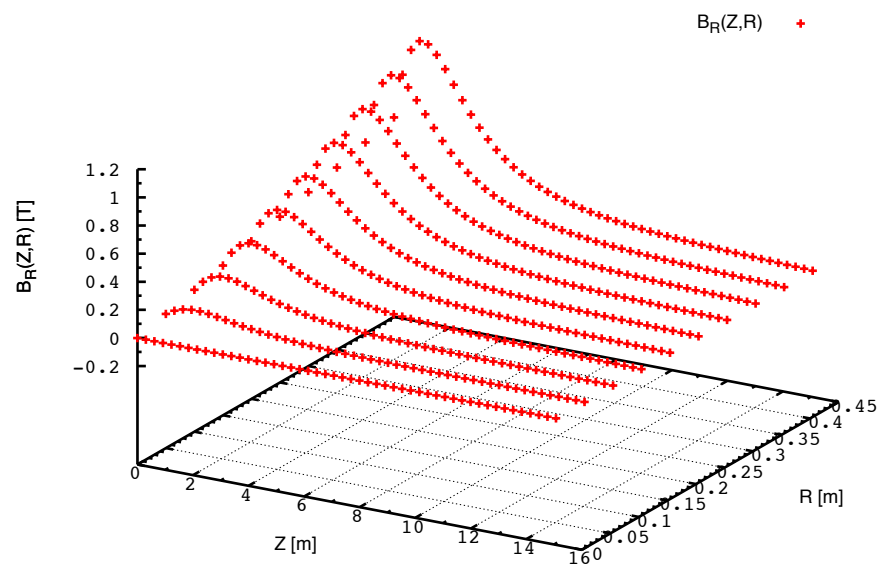
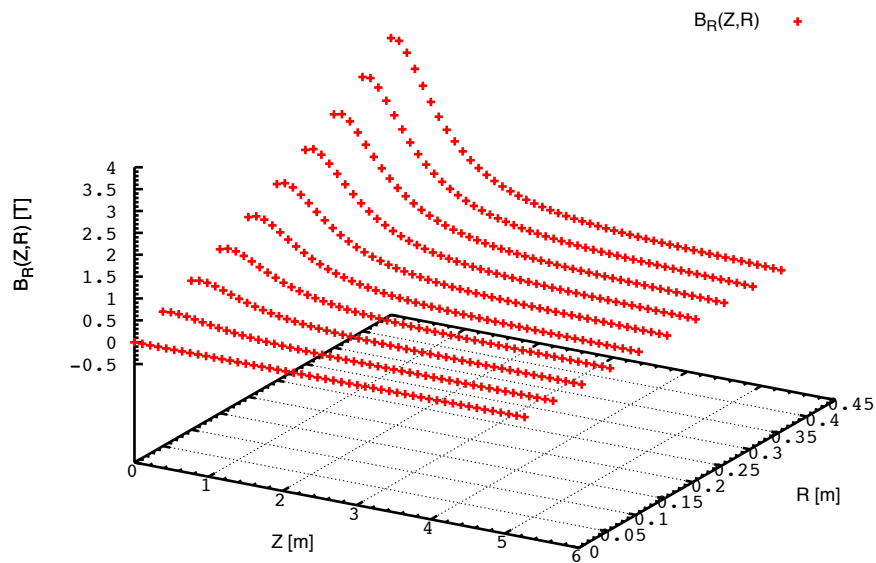
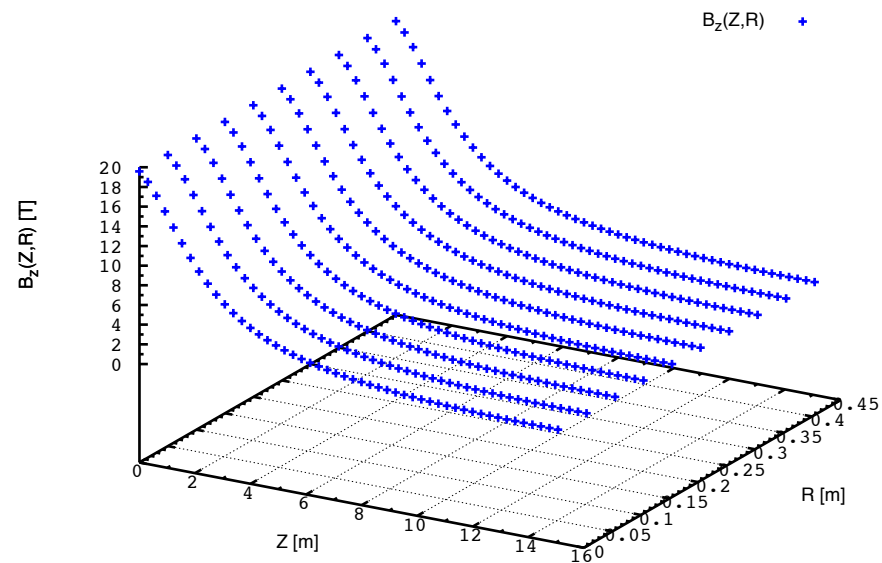
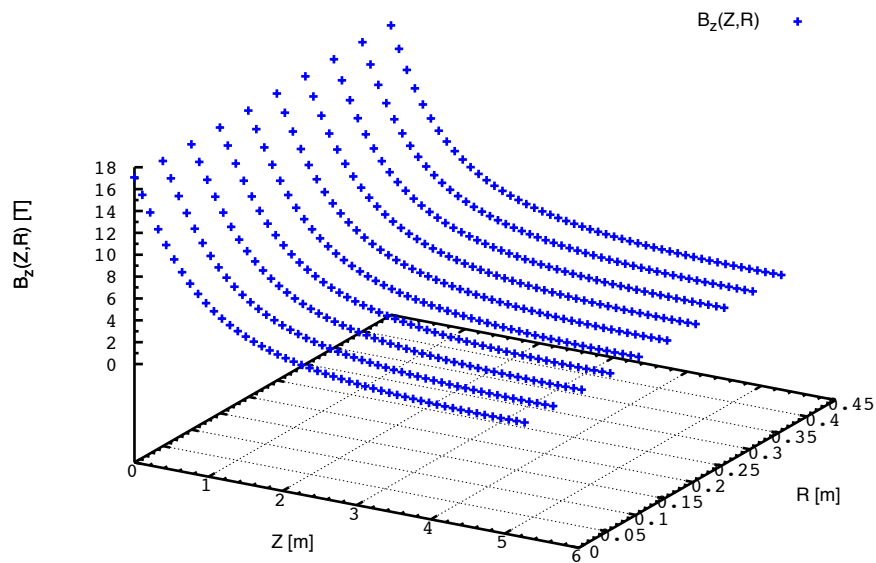
BZ = BZ - R**6 / 2304.0 * DBZ6

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

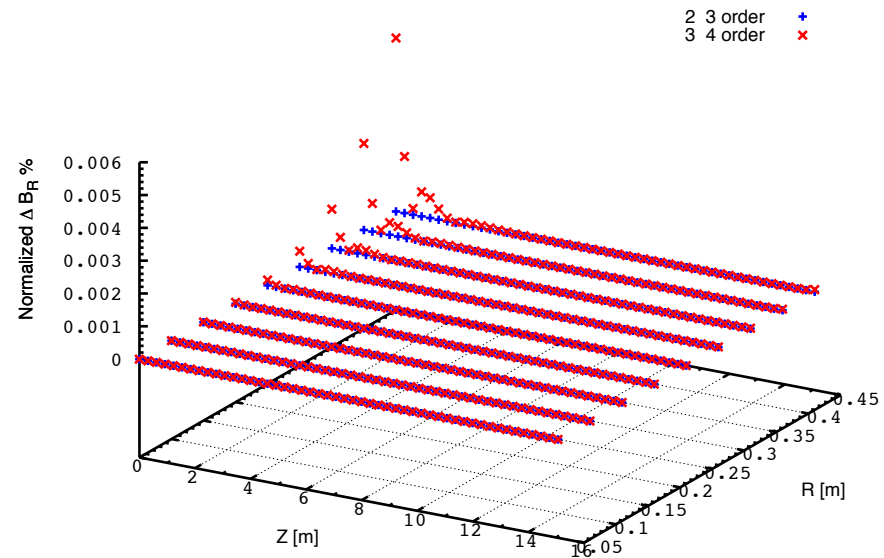
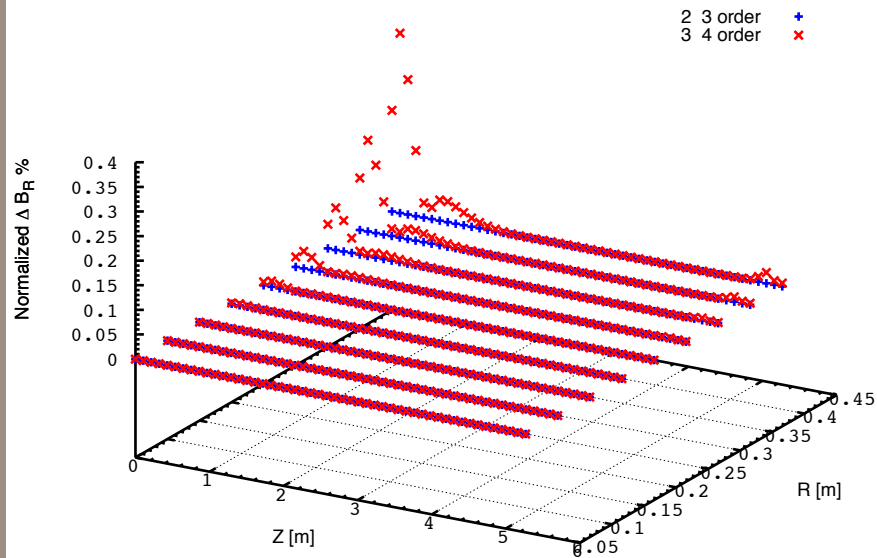
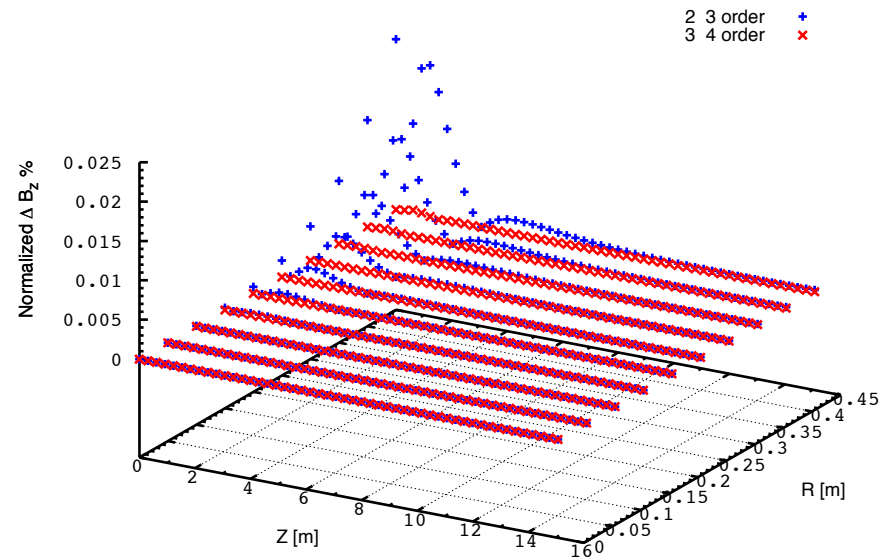
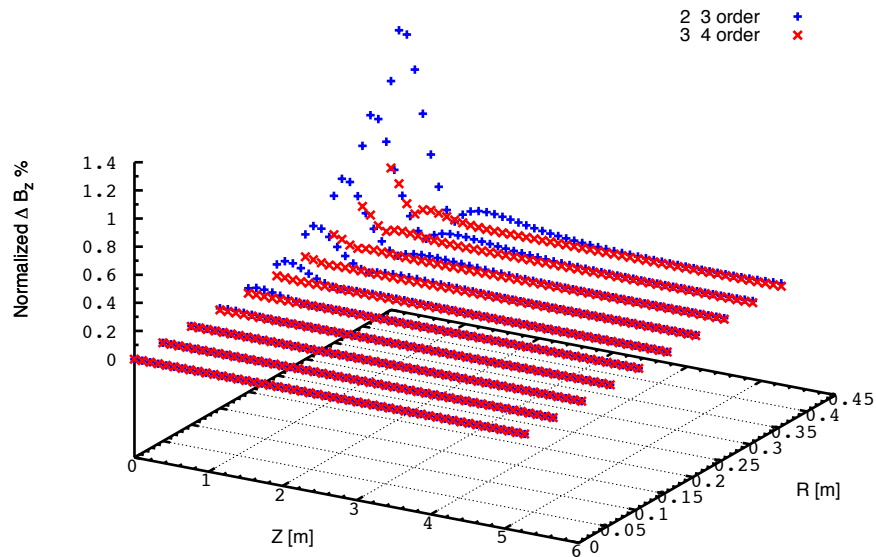
SOLENOID TAPERED FIELD



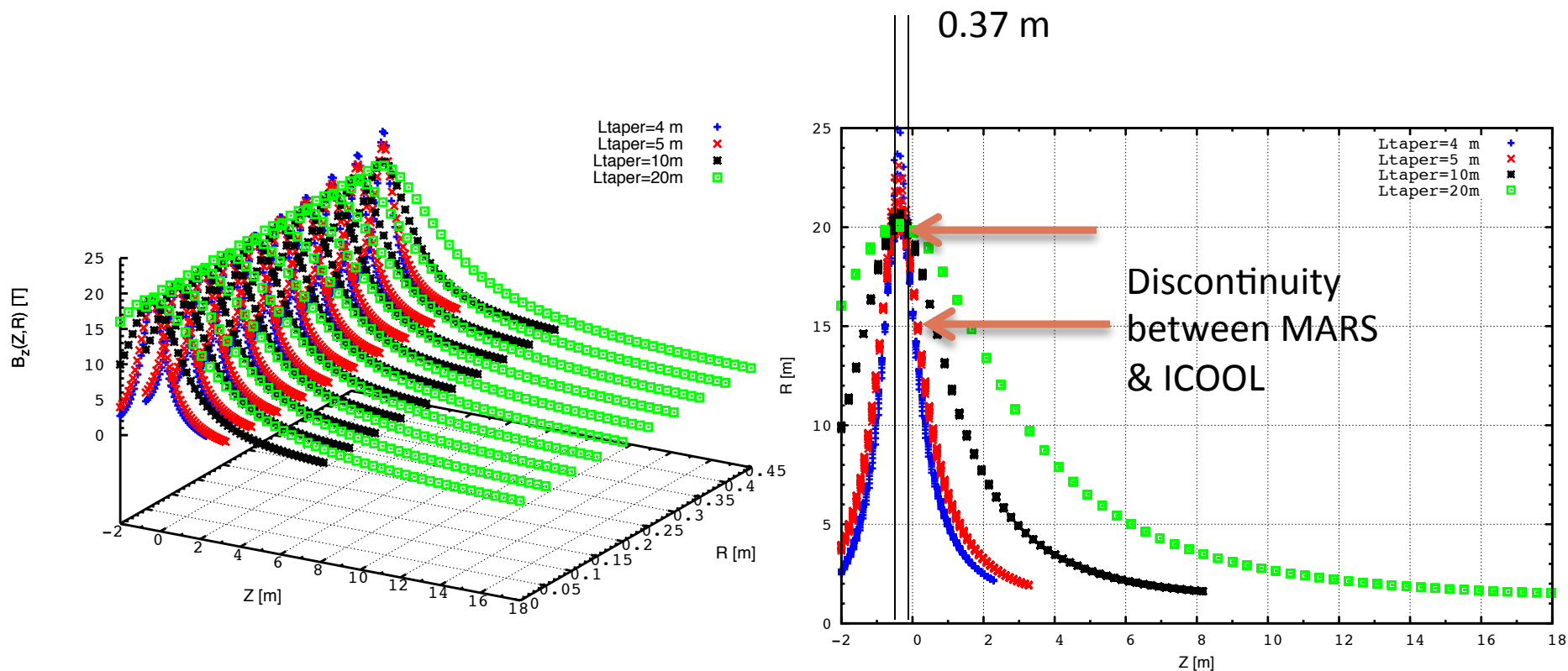
SOLENOID TAPERED FIELD



SOLENOID TAPERED FIELD



SOLENOID TAPERED FIELD



- Higher order terms more important for shorter tapers
- Field discontinuity at MARS to ICOOL hand off
- Re-run MARS for shorter Tapers
- Feed new distributions to ICOOL