

# SS Field Model

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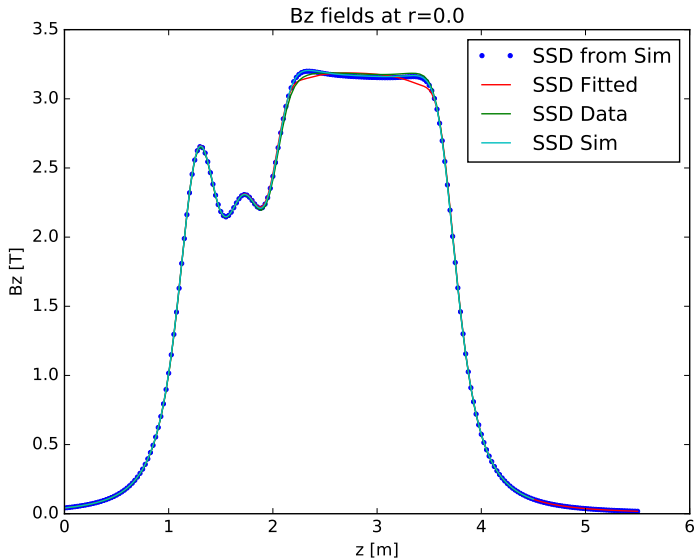
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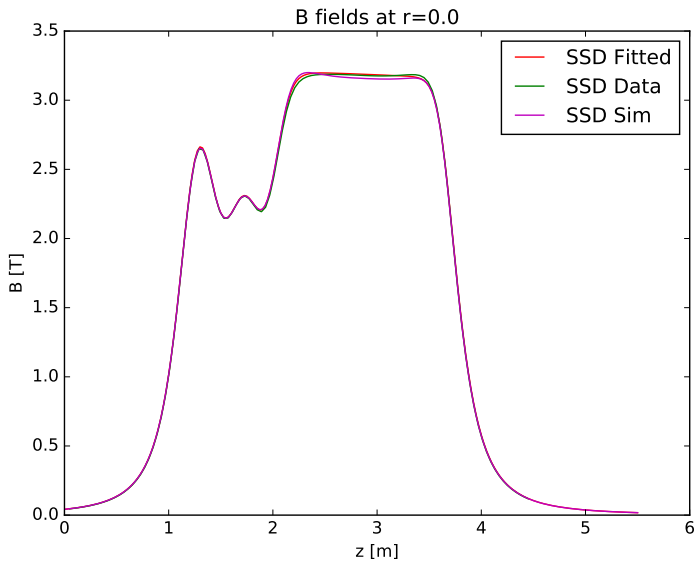
## *Applying Fitting Routine to SSD*

- Fitting routine has been applied to all of SSD's coils
- Also data exists where the CC is powered 'individually'
- Fitting routine has been slightly improved

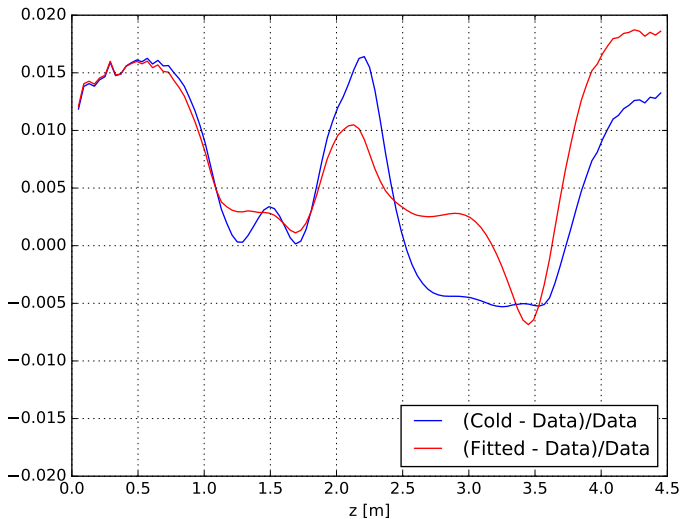
Last time at analysis meeting...



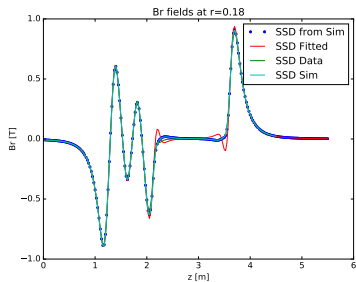
And now...



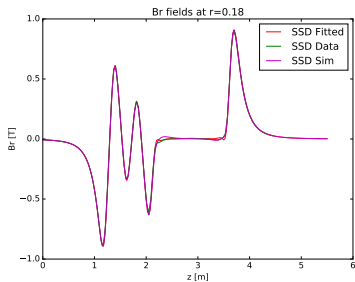
In terms of fractional difference.



And it looks better for  $B_r$  too.

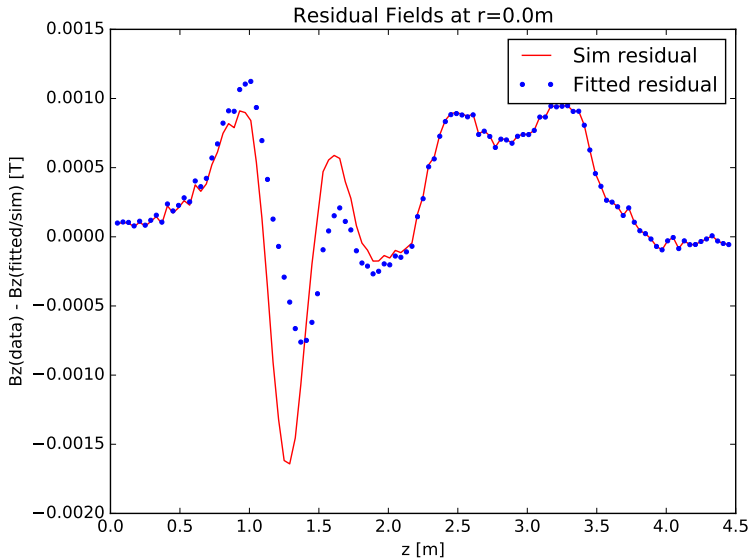


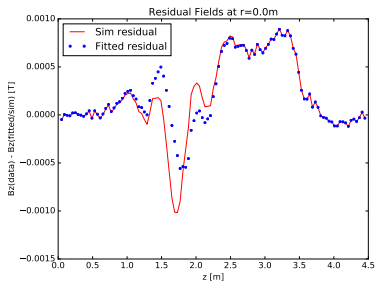
(a) Before improvements



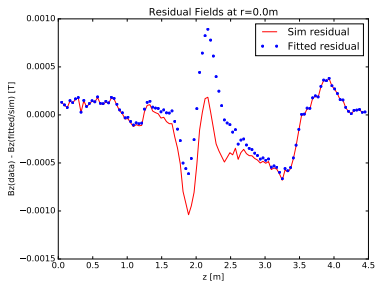
(b) After improvements

Also last time people noticed an excess in the residual field.





(c) M2 Residuals

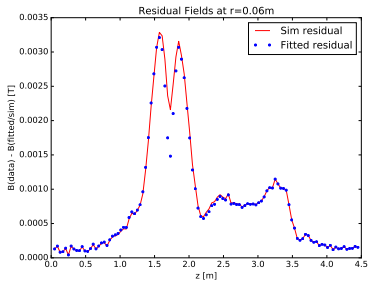


(d) E1 Residuals

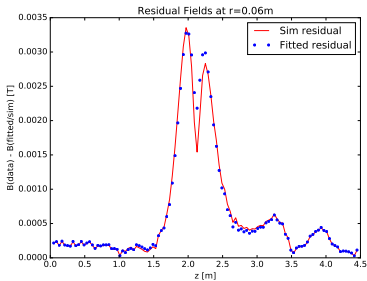
Excess residual field can be seen in the region where the Centre Coil exists.

The residual can also be seen in the same plot for E2 although it's less obvious.





(a) M2 Residuals



(b) E1 Residuals

Still shows at different  $r, \phi$ .

Work has begun on the Fourier-Bessel Model!

For  $|z| \leq z_0$  (Inside the solenoid)

$$B_z = J\mu_0 \tilde{S}_{10}(r) - \frac{1}{2} J\mu_0 [S_{10}(r, z - z_0) + S_{10}(r, z_0 + z)]$$

$$B_r = \frac{1}{2} J\mu_0 [S_{11}(r, z_0 - z) - S_{11}(r, z_0 + z)]$$

For  $|z| > z_0$  (Outside the solenoid):

$$B_z = \frac{1}{2} J\mu_0 [S_{10}(r, |z| - z_0) - S_{10}(r, |z| + z_0)]$$

$$\frac{1}{2} J\mu_0 \operatorname{sgn}(z) [S_{11}(r, |z| - z_0) - S_{11}(r, |z| + z_0)]$$

Using the solenoid parameters used in the paper<sup>1</sup> I tested whether my implementation was working. (Coordinates are in cm.) The coil is 5cm long and has  $R_1 = 2.5\text{cm}$  and  $R_2 = 16.0\text{cm}$ .

(r,z)	My $B_z$ (T)	Paper's $B_z$ (T)
(0,0)	6.83722	6.83722
(2.5, 5.0)	3.738944	3.570410
(5.0,7.5)	2.391758	2.017130
(16, 22.5)	0.362767	0.1373990

For a first pass I'm pretty happy! Lots of improvements that I already know I need to do... Like the 40 term expansion they use that I truncate *a lot*.

I did make the  $B_r$  code today after lunch... But I think I've made an error somewhere as it is giving me very weird numbers so I'll have a look at it again.

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<sup>1</sup>A Fourier Bessel Transform Method for Efficiently Calculating the Magnetic Field of Solenoids. J. Nachamkin and C. J. Maggiore. (1979)