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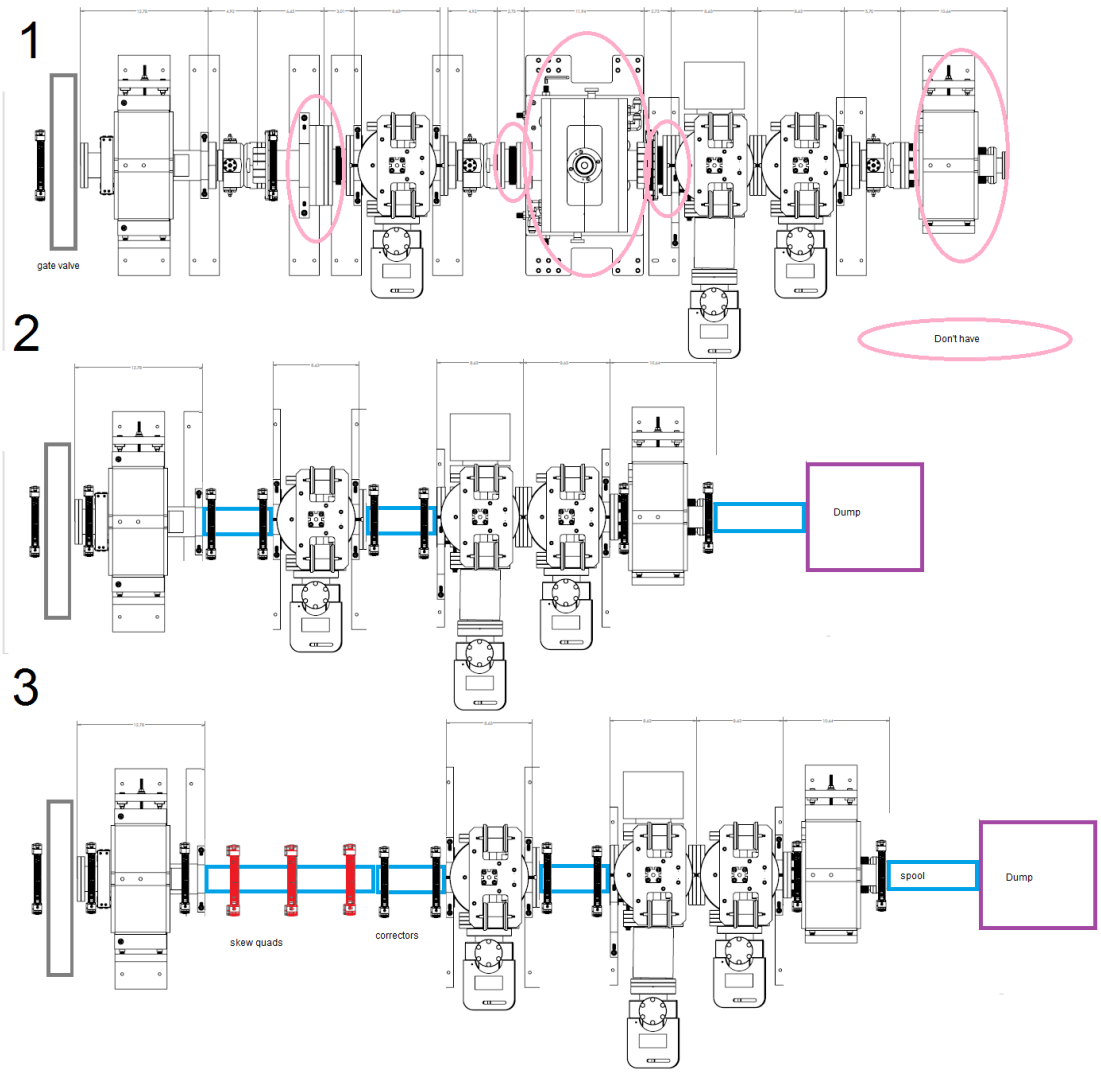
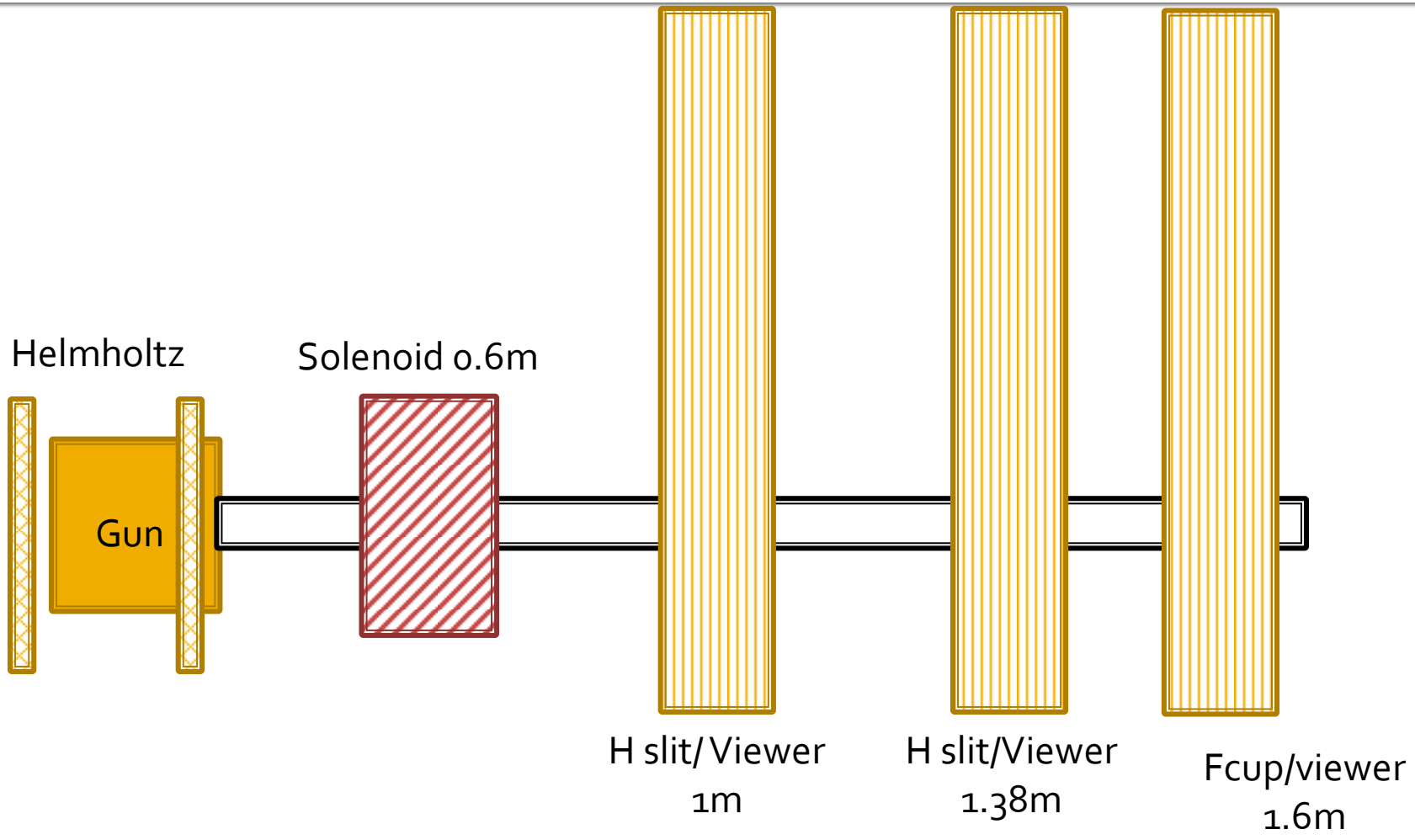
# Magnetized Beam LDRD

# Phased approach



# Phase 2 Layout



# Measurements

- Phase 1
  - Thermal emittance (solenoid scan)
- Phase2: With space charge
  - Emittance
  - Magnetization (If we can source a magnet)
- Phase 3:
  - Magnetization
  - Round to Flat transform

# A virtual experiment

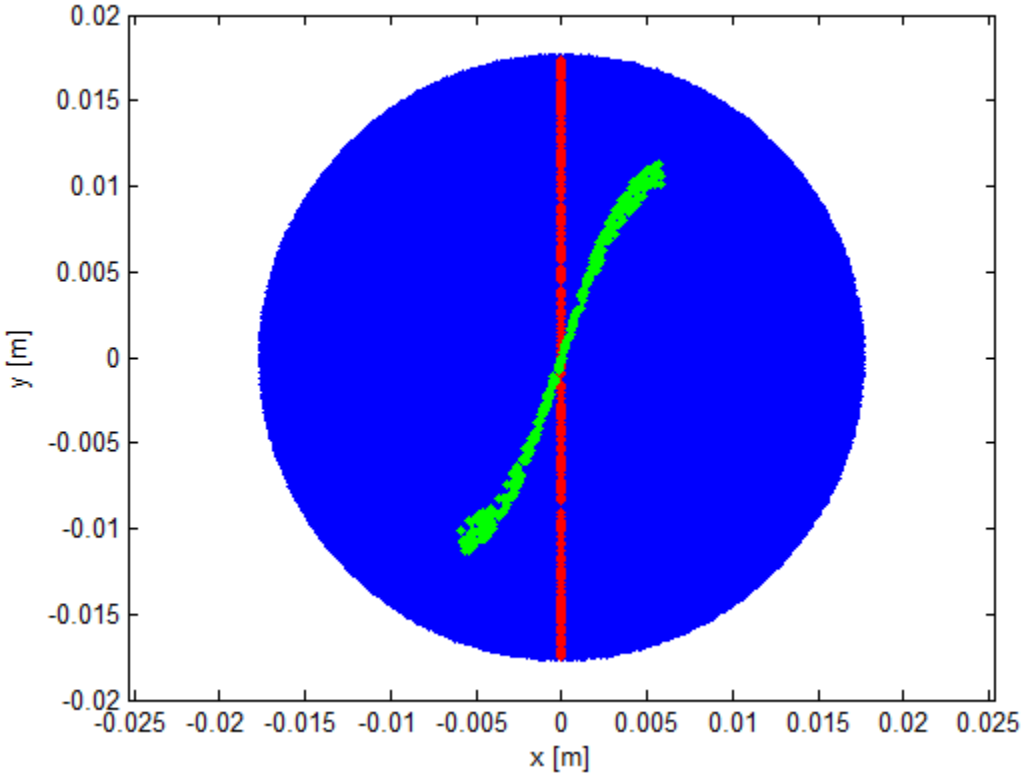
- This is a real experiment we would like to do to measure magnetization.
- Insert a slit into the beamline to select an emittance-dominated beamlet.
- Let the beamlet drift to a screen and image it.
- $< L >= \frac{2p_z\sigma_1\sigma_2 \sin\theta}{D} = B_z e {a_0}^2$

# Magnetization

Blue – beam at the slit (500k, 20um slit)
Red – particles selected by slit
Green – particles tracked to screen 0.26m away

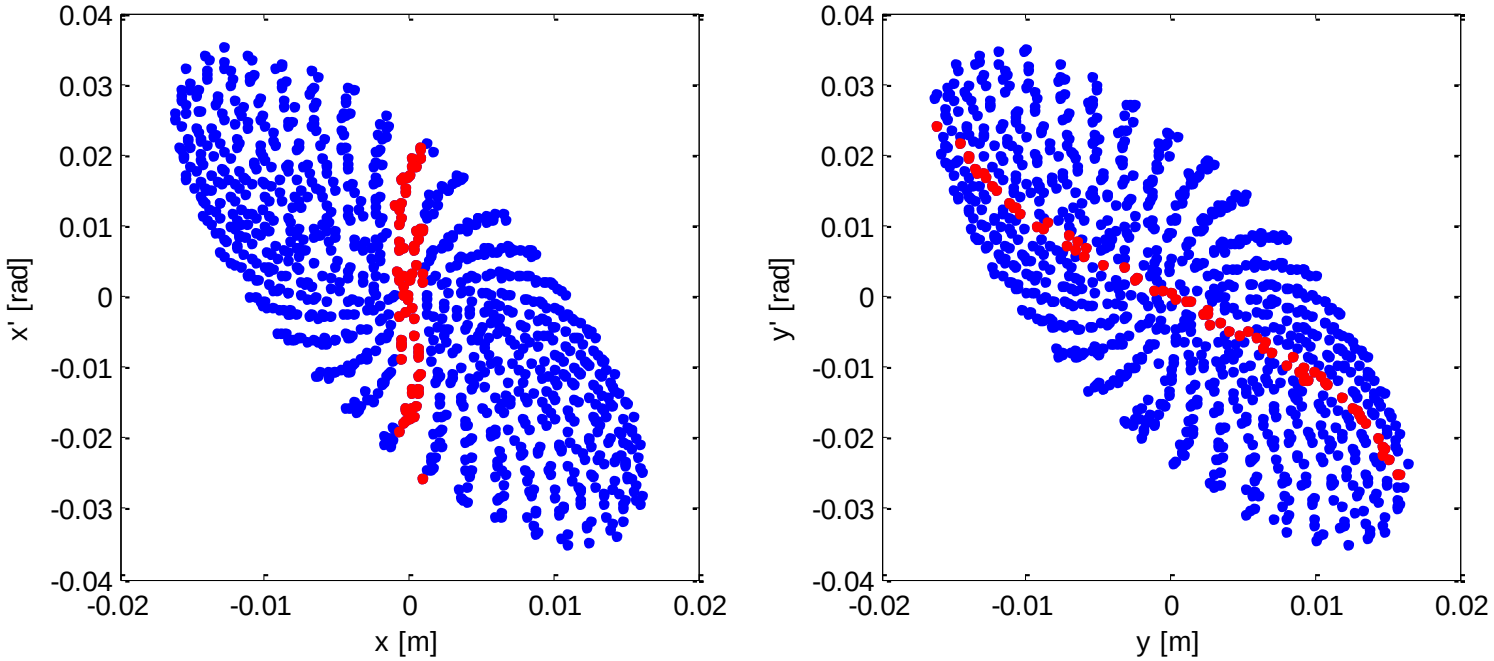
Not linear!
Assumes a solenoid at cathode with 0.2T peak
0.07% particles through slit

This isn't charge related.
Not related to 'emittance compensation' solenoid.

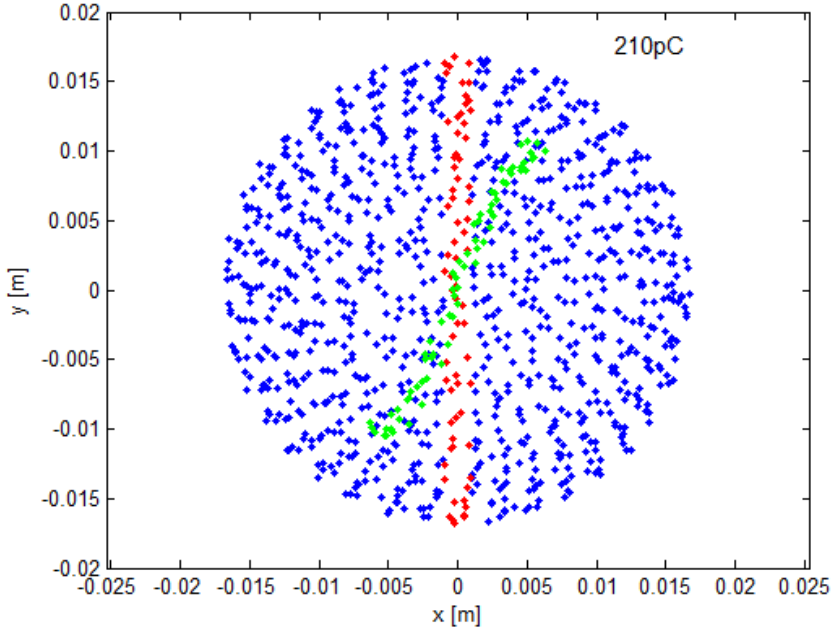


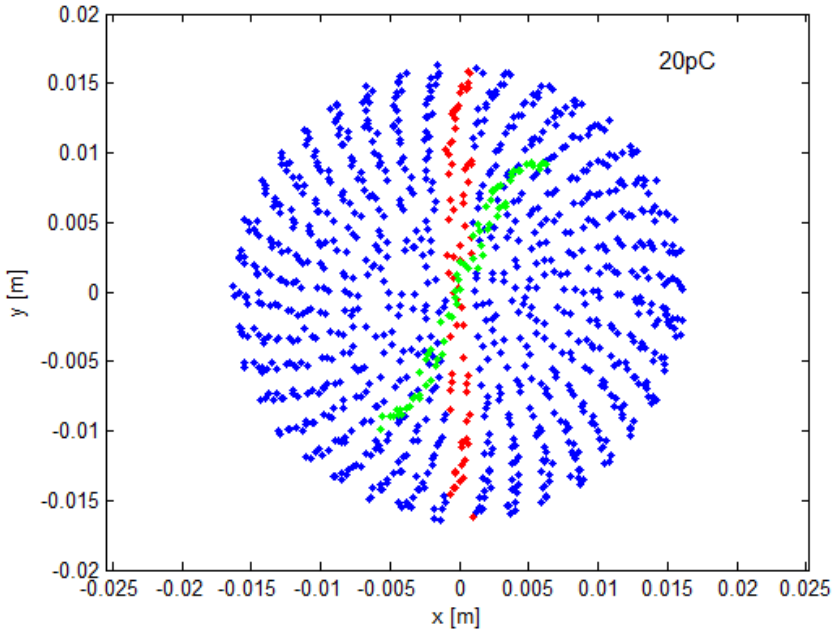

Ldrd.009.0100.001

This is what the slit cuts out in phase space – can see the curve here.



# Magnetization

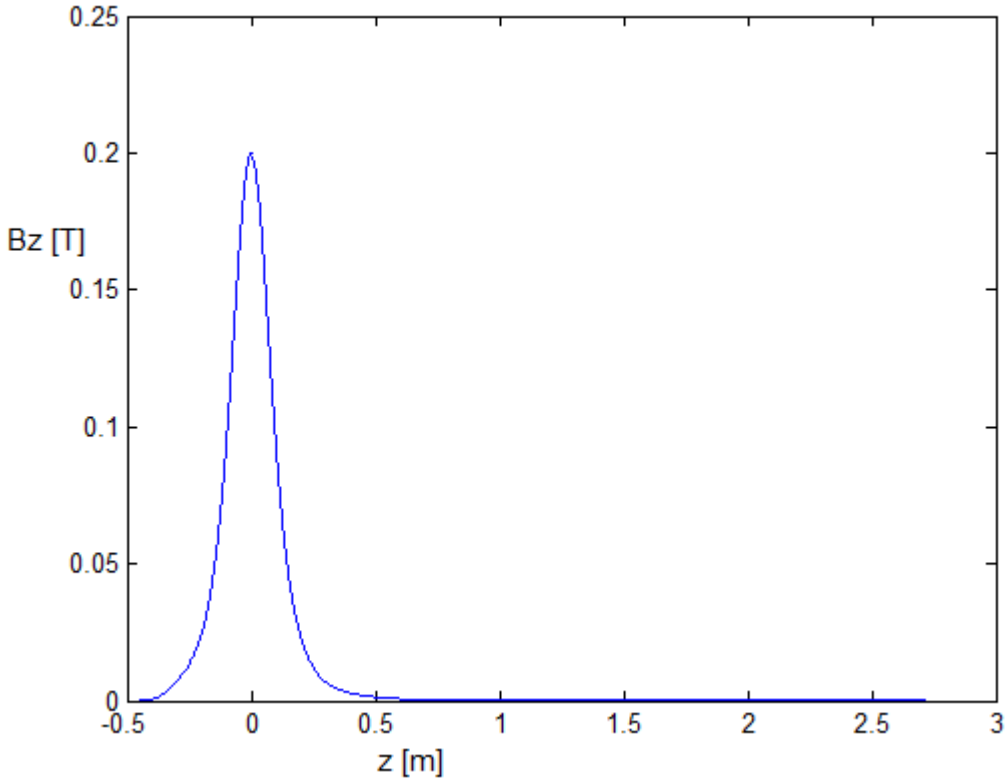



The curve is still evident at 20pC.

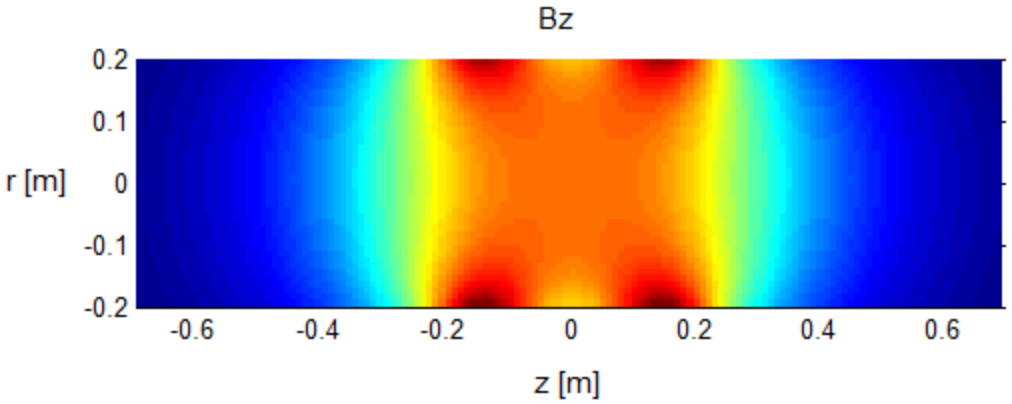
# Magnetization

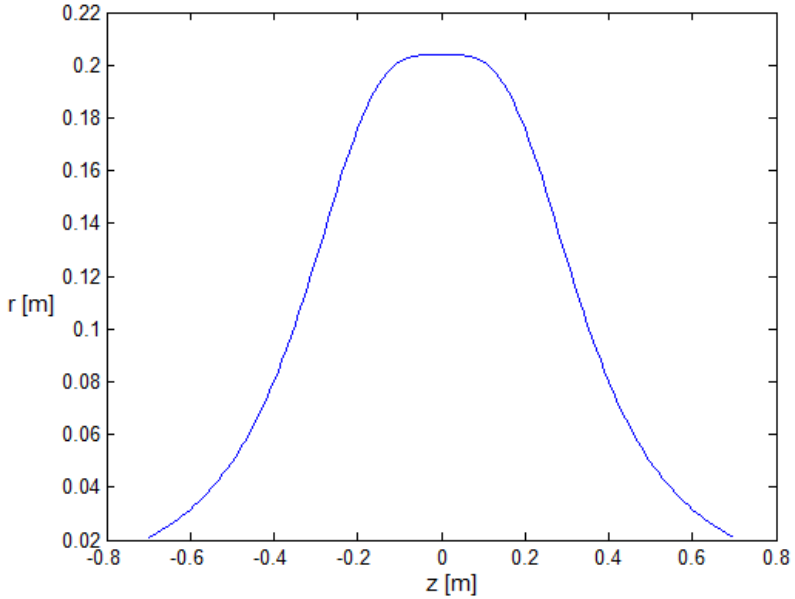
This is the solenoid field I used…



# Helmholtz coils

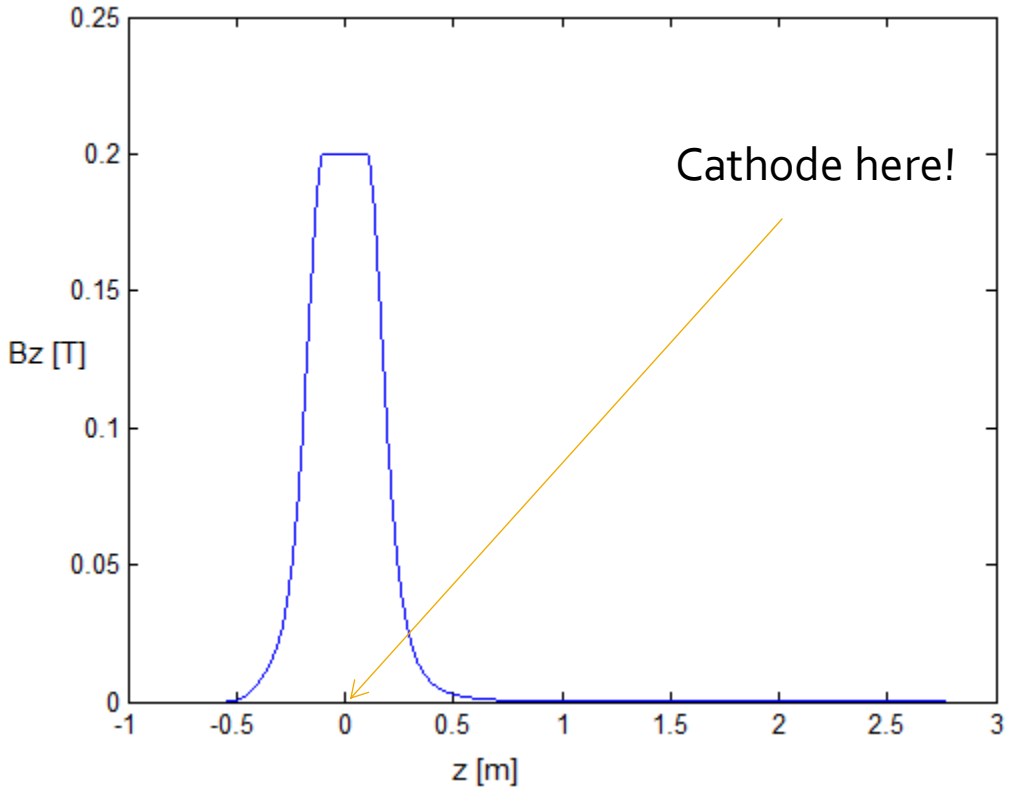
Has flat region in center
Coil radius = 0.3m
Coil separation 0.3m
On axis field 0.2T (68,000 A-turns)
-chunky



# Magnetization

Make fake field map.




Make fake helmholz pair field

# Field calculation

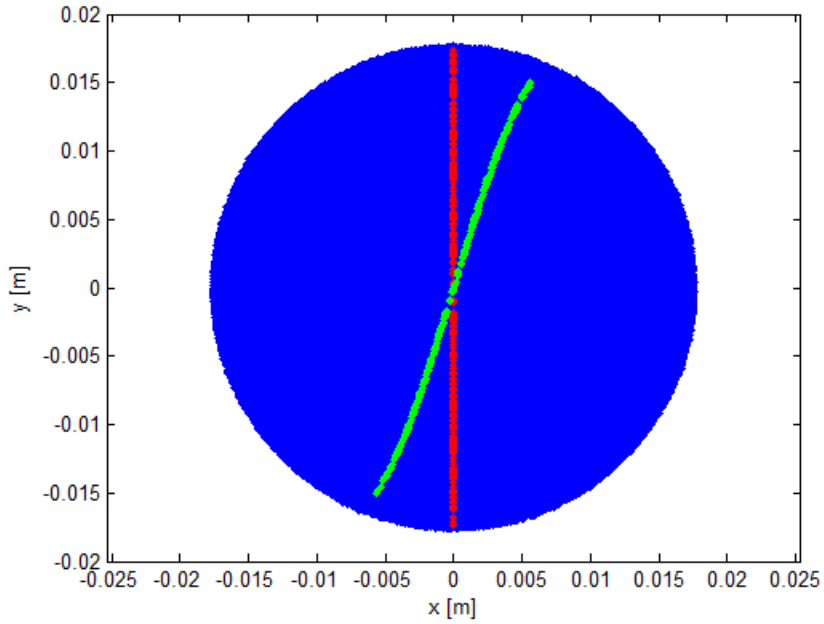
- In astra – off axis fields calculated from the on-axis field profile derivatives polynomial expansion

- Bz(r)=Bz,o-(r^2/4*Bz″)+(r^4/64*Bz″″)…etc
- Br(r)=-r/2*Bz′+(r^3/16*Bz‴)… etc

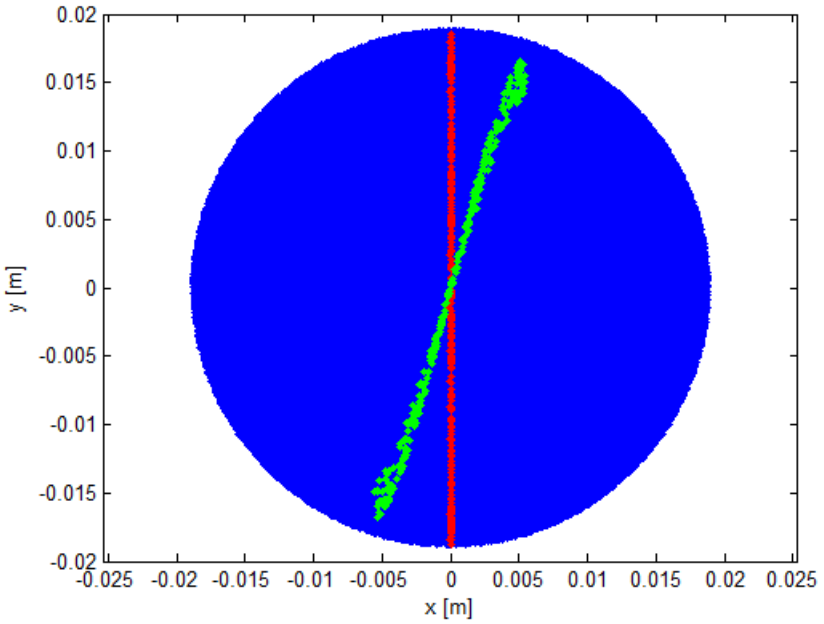
- Flatter the profile, less variation in Bz off axis.

# Magnetization

Linear




0 pC




420 pC

# Magnetization

- Important to start off with a good field on the cathode.
- Eventually can simulate 3D fields.