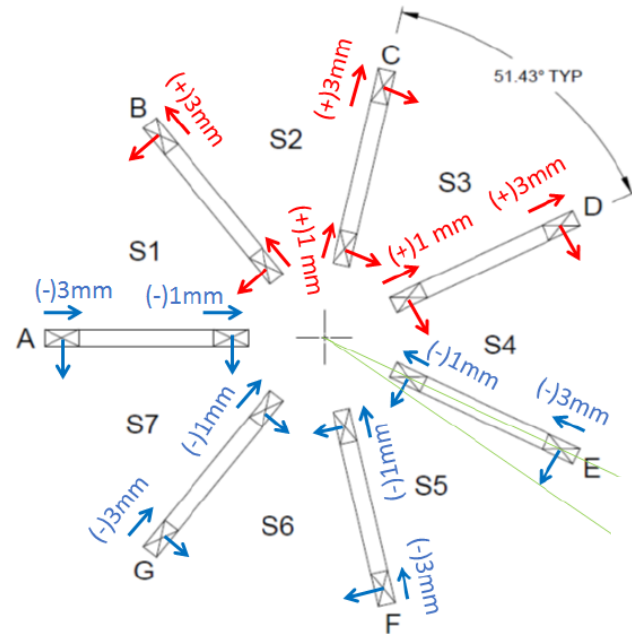
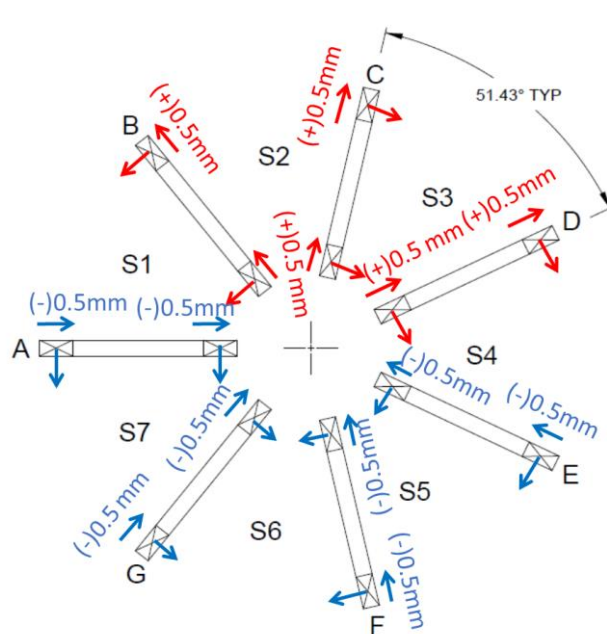


Alignment Tolerance Cases



CASE 1



CASE 2 and 3

Physics worst case

- All coils offset in same direction (without us knowing)
- Least likely (survey, tracking)

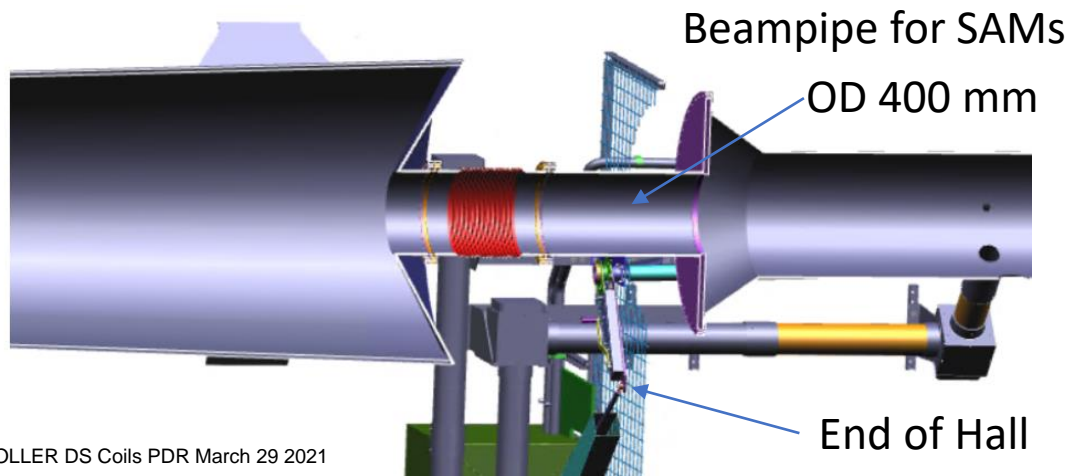
BEAM worst case is coils aligned in a “conspiratorial” way within tolerances

→ induces dipole

- affects beamline shielding (dose on coils)
- backgrounds from end of hall apertures
- Irradiation

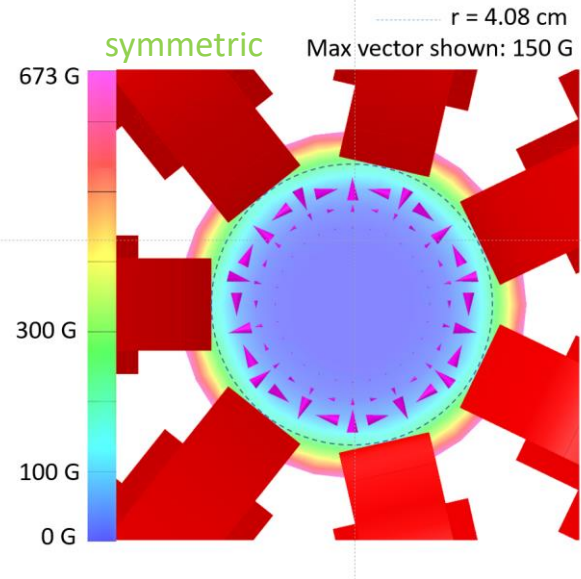
Several offset cases considered:

1. All sub-coils offset to induce maximum dipole within allowed tolerances
2. All subcoils offset without deformation and to ± 0.5 mm
3. Same as case 2, but dipole field has different orientations in each subcoil

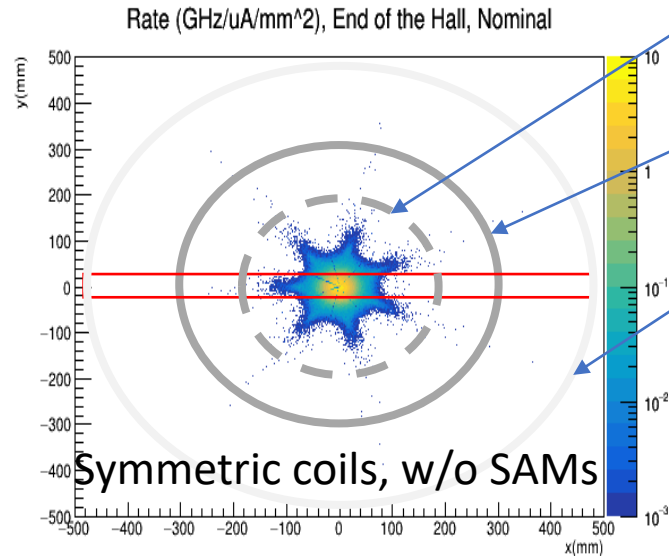


Nominal (symmetric) case – clean transport to dump

Looking downstream



Looking upstream

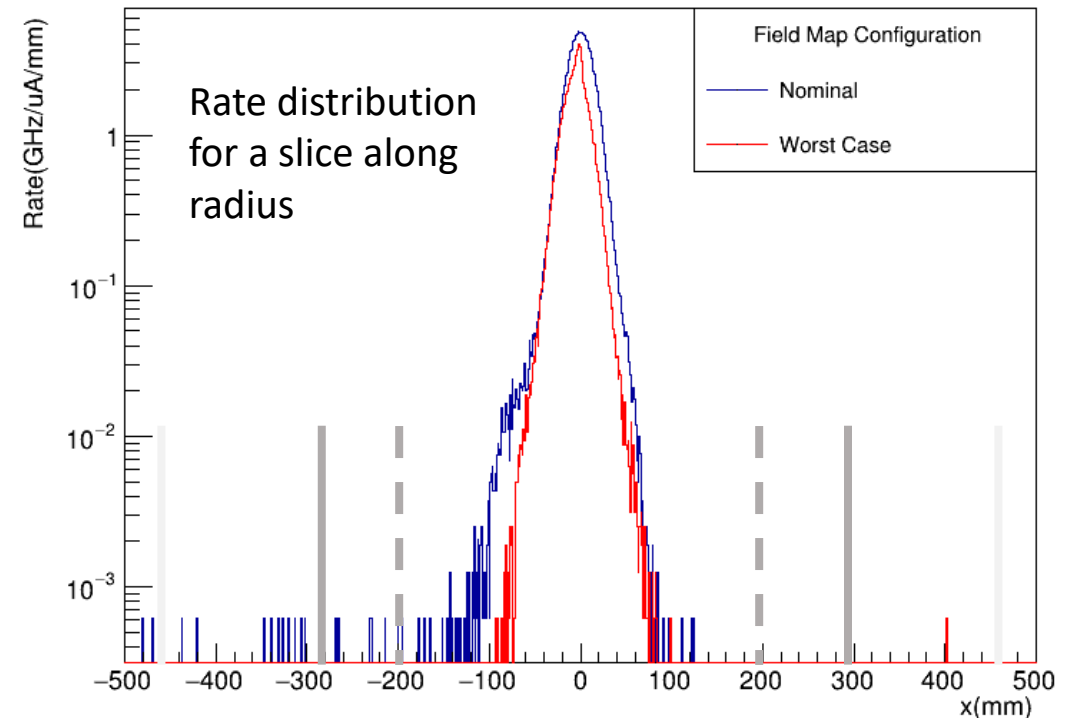


Beampipe intrusion for the SAMs
(~0.5m upstream)

Limiting aperture in dump tunnel
(~0.5 m downstream)

Dump entrance flange
(same z location as plots)

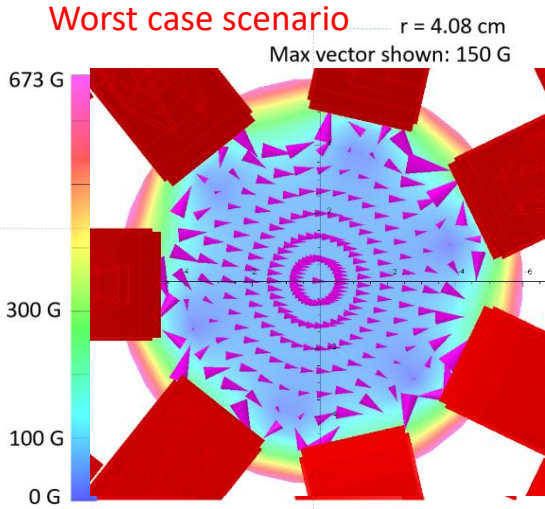
End of the Hall Plane, Septant 1, $-0.5 \leq y \leq 0.5$ mm



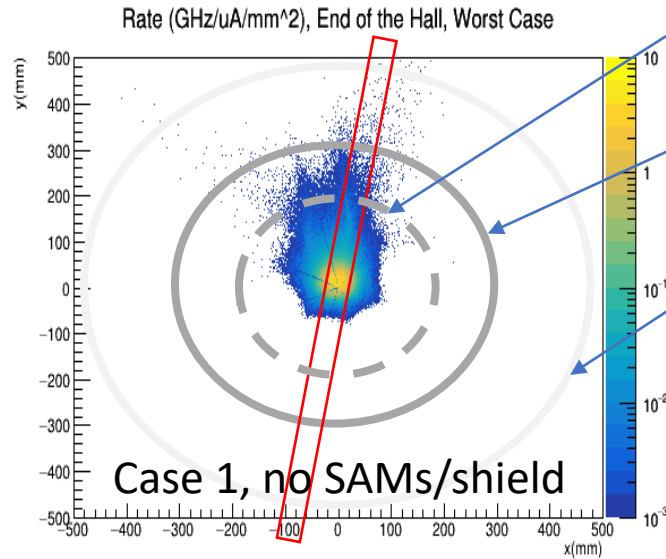
- In the top left plot you see a picture of the ds coils at a particular z location with the magnetic field contours and vectors
- Middle top plot is a 2D rate distribution at the entrance to the dump tunnel
- To the right is a 1D distribution of the rate in horizontal septant (1); the vertical lines indicate the radius of various apertures

Worst case – clean transport to dump

Looking downstream



Looking upstream

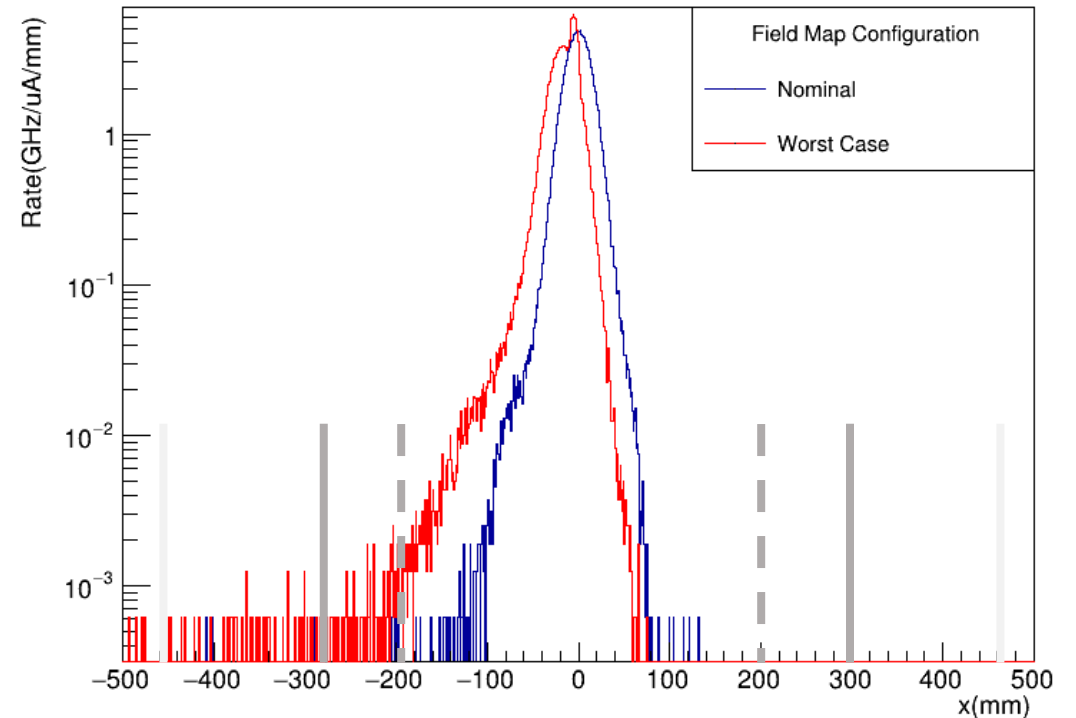


Beampipe intrusion for the SAMs
(~0.5m upstream)

Limiting aperture in dump tunnel
(~0.5 m downstream)

Dump entrance flange
(same z location as plots)

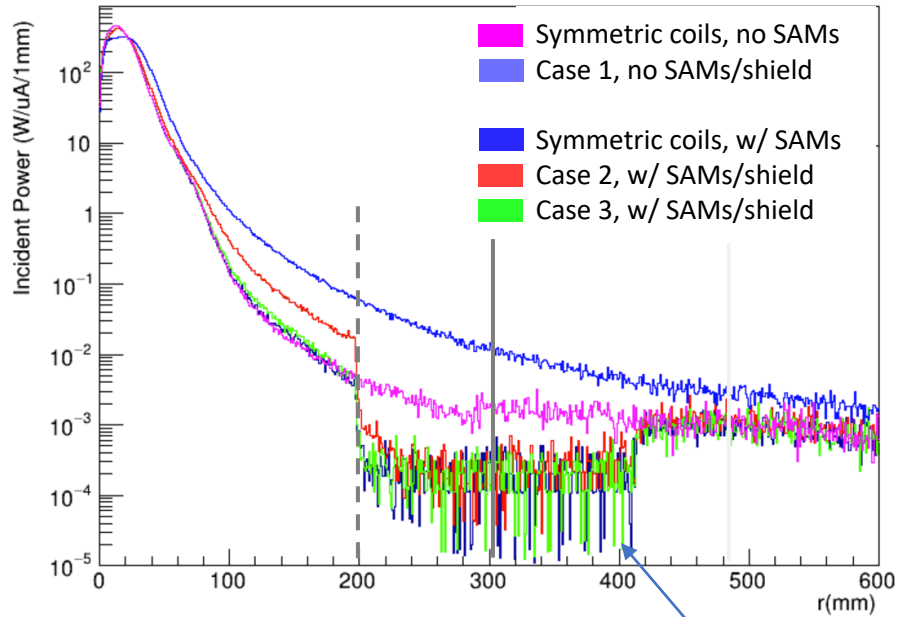
End of the Hall Plane, Septant 2, $-0.5 \leq y \leq 0.5$ mm



- In the top left plot in the worst case scenario there is an induced dipole field > 100 G over most of the area inside the coils
- In this particular orientation, the electrons are bent upward into septant 2
- To the right is a 1D distribution of the rate in the worst septant (2); even in the worst-case scenario the beam is mostly clearing

Comparison of cases – clean transport to the dump

Radial Distribution End of the Hall Plane



Total Beam Power 715 kW

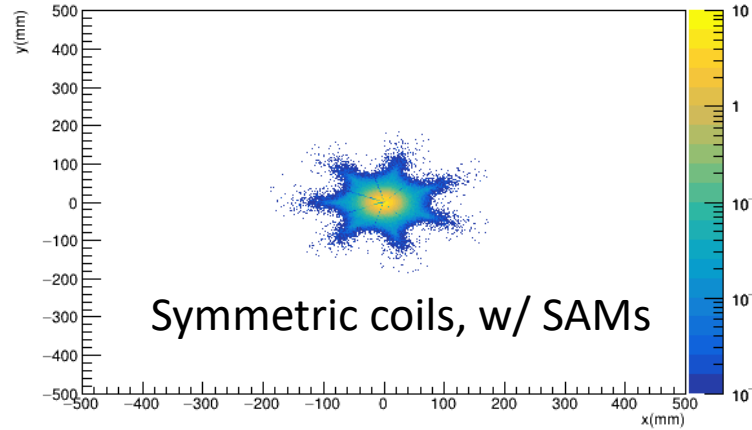
Integrated Power from
200 mm < r < 600 mm

Symmetric coils, no SAMs	38.1 W
Case 1, no SAMs/shield	260 W
Symmetric coils, w/ SAMs	13.4 W
Case 2, w/ SAMs/shield	17.8 W
Case 3, w/ SAMs/shield	14.2 W

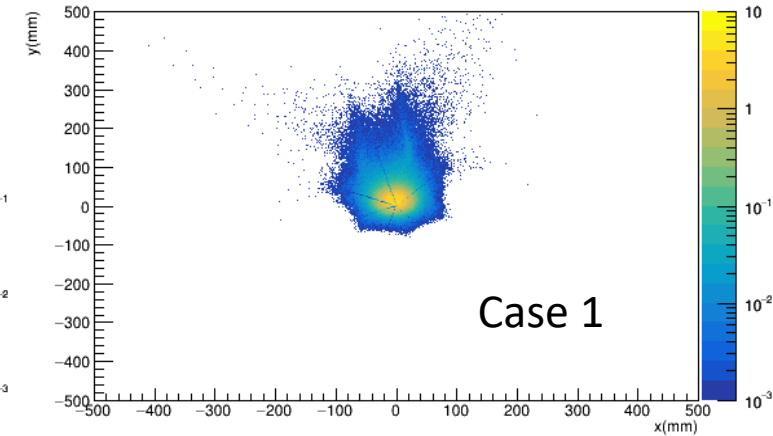
Most likely

worst case is 10^{-4} of total beam power
order of magnitude lower for most likely case

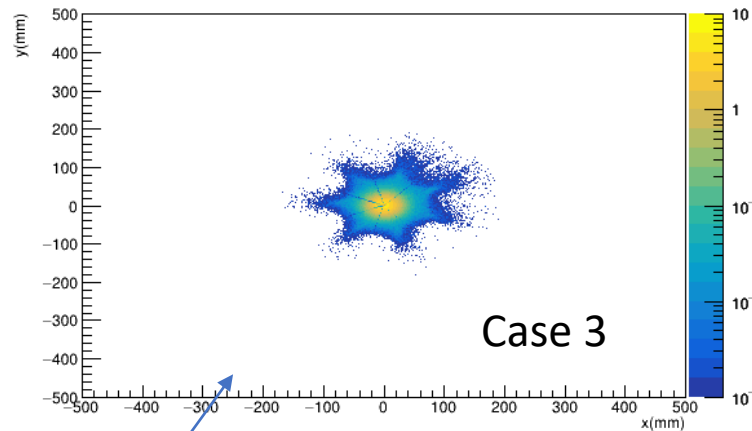
Rate (GHz/uA/mm²), End of the Hall, Nominal



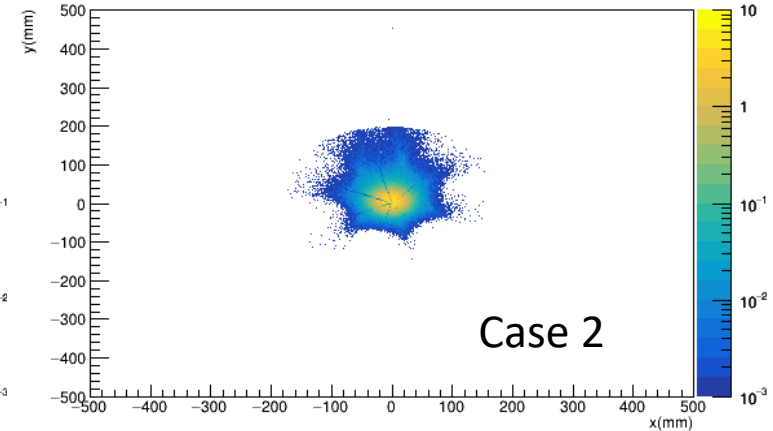
Rate (GHz/uA/mm²), End of the Hall



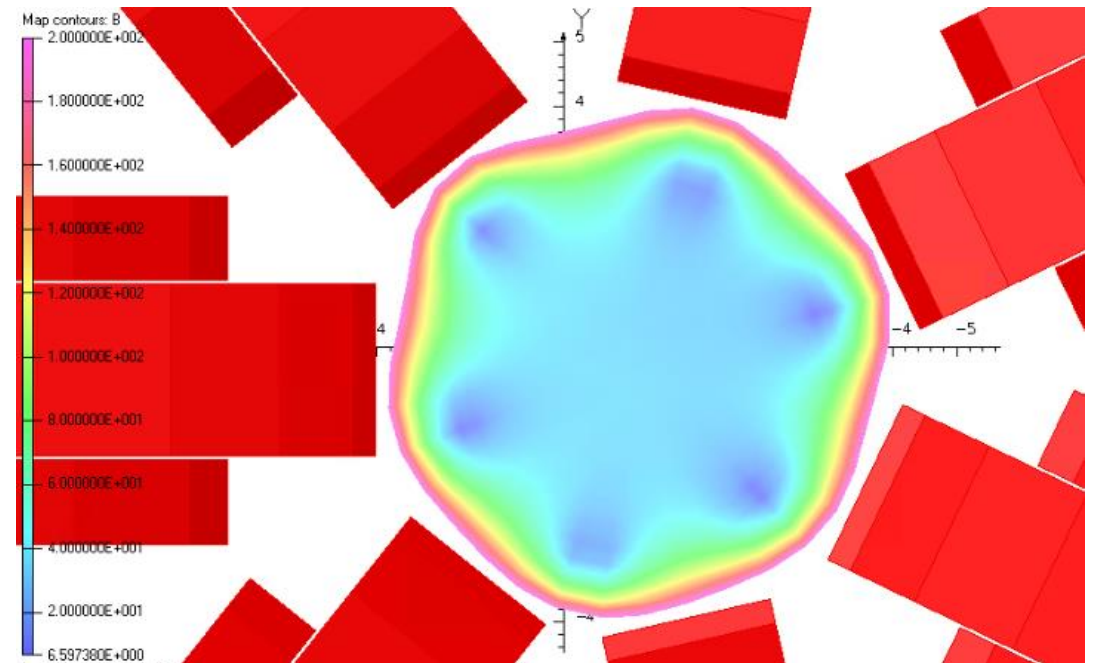
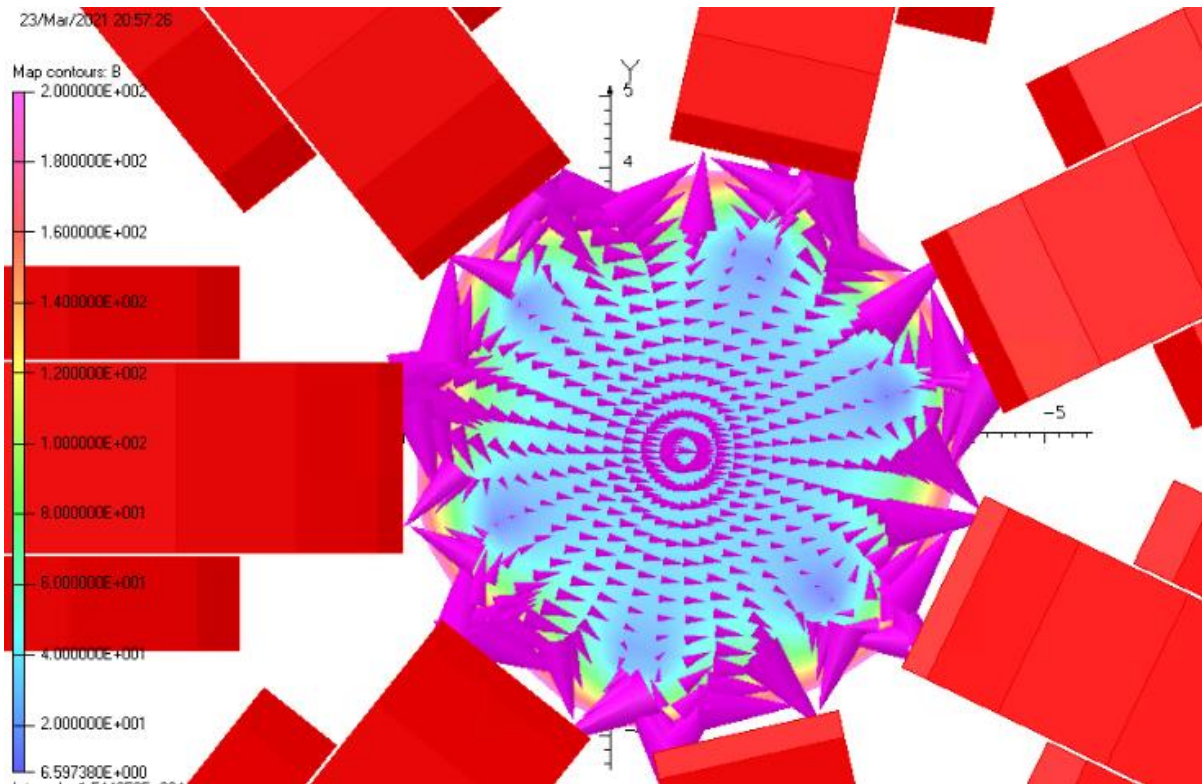
Rate (GHz/uA/mm²), End of the Hall



Rate (GHz/uA/mm²), End of the Hall

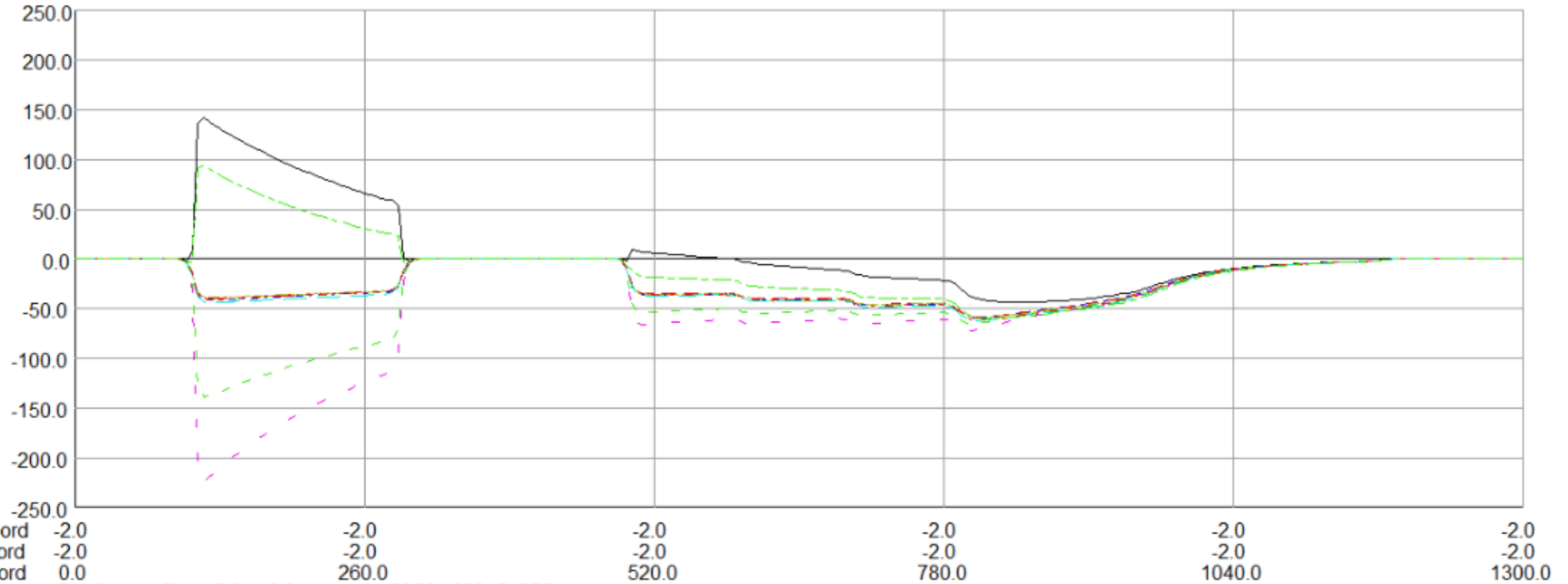


Dipole fields – worst case

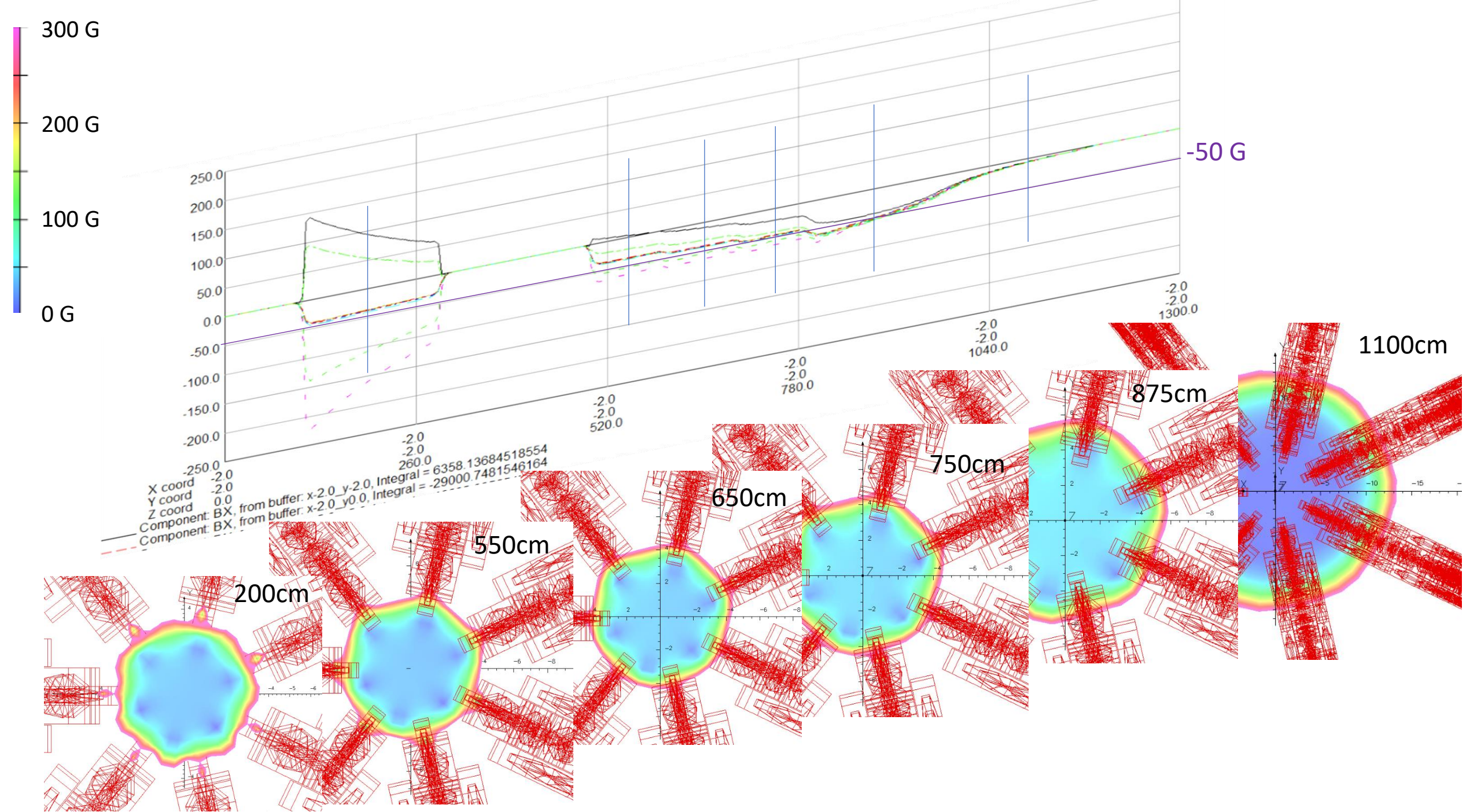


Use 75 G

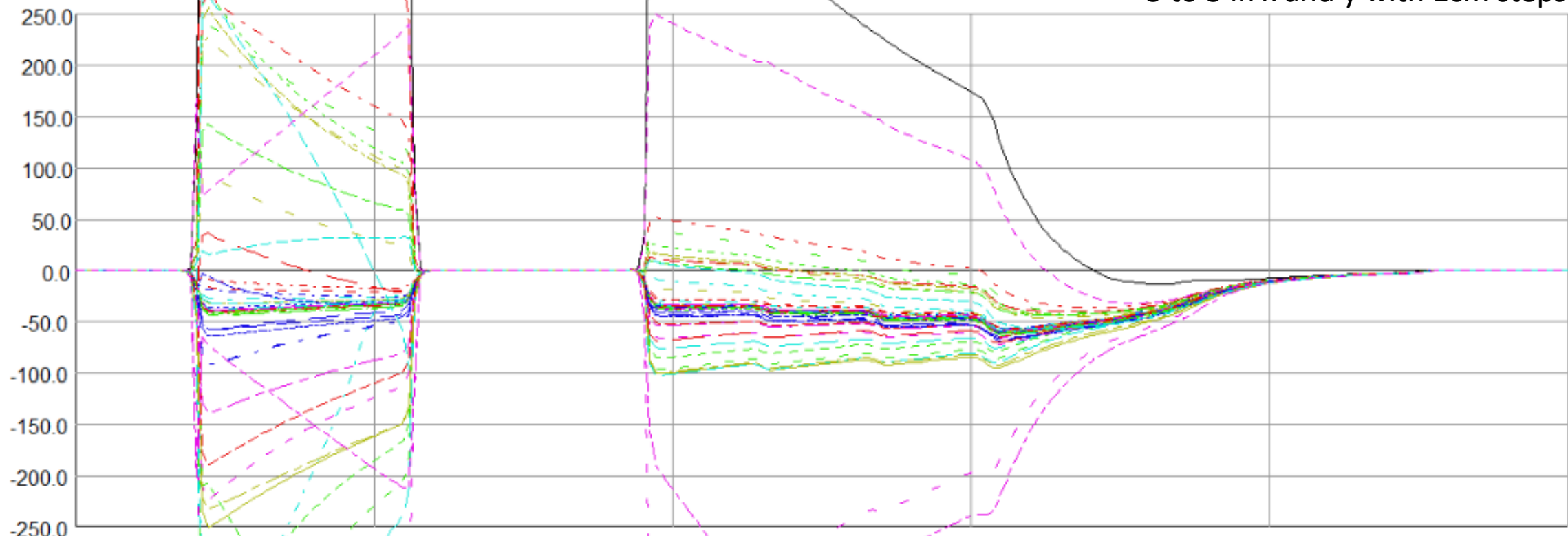
-2 to 2 in x and y with 2cm steps



Component: BX, from buffer: x-2.0_y-2.0, Integral = 6358.13684518554
Component: BX, from buffer: x-2.0_y0.0, Integral = -29000.7481546164

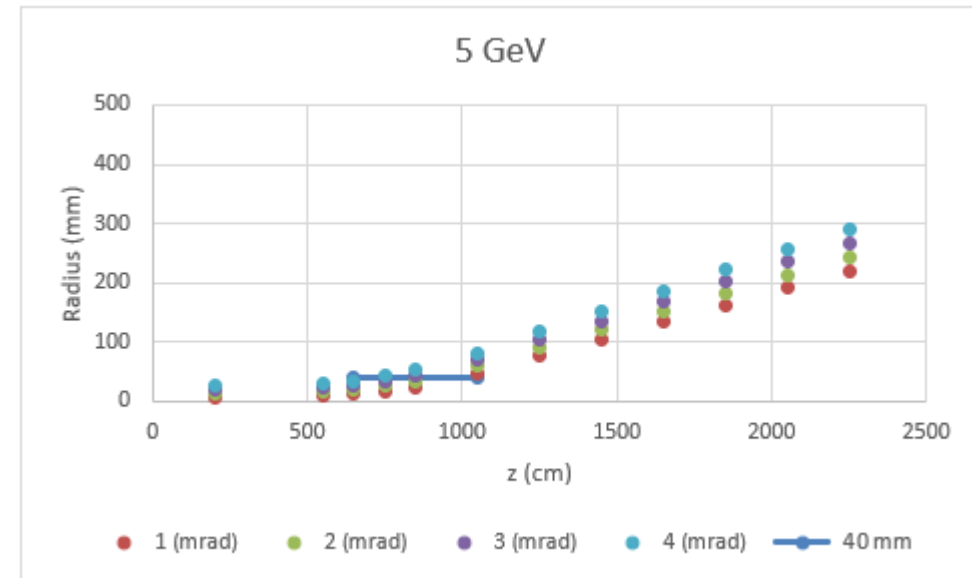
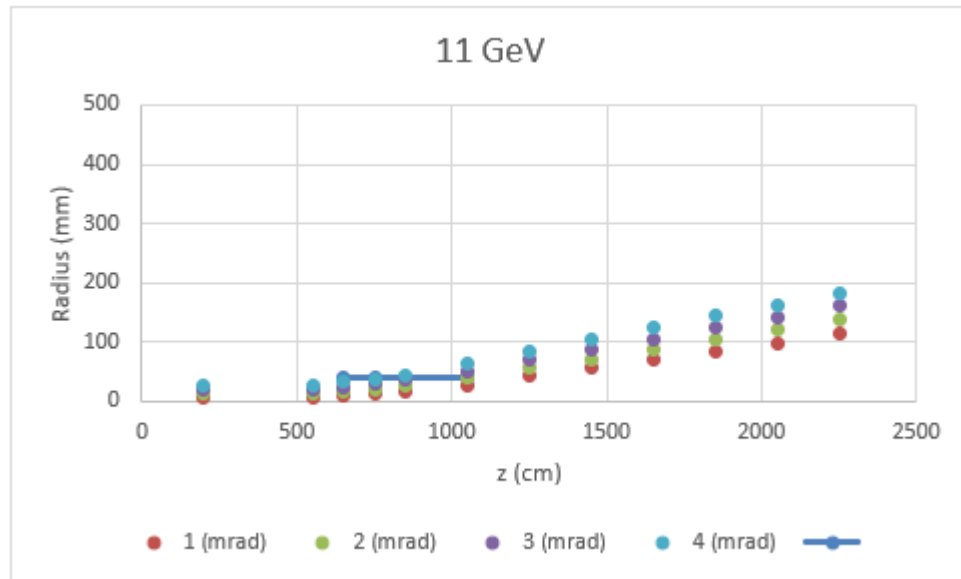


-3 to 3 in x and y with 1cm steps



X coord -3.0 -3.0 -3.0 -3.0 -3.0
Y coord -3.0 -3.0 -3.0 -3.0 -3.0
Z coord 0.0 260.0 520.0 780.0 1040.0 1300.0
Component: BX, from buffer: x-3.0_y-3.0, Integral = 184351.236244245
Component: BY, from buffer: x-3.0_y-3.0, Integral = 71628.7327810238

Back of envelope tracks

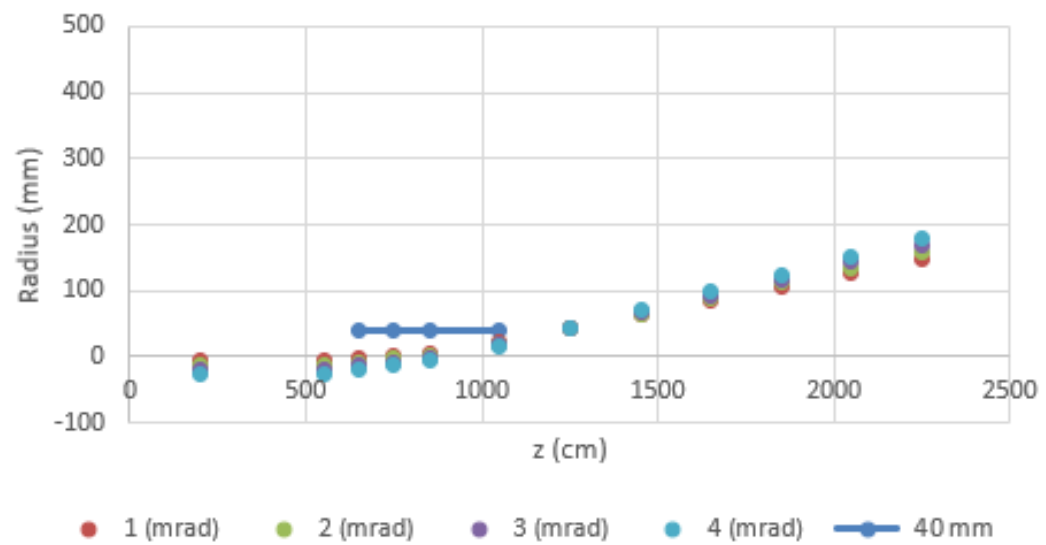


How to use these back of envelope calculations to determine the shielding needed from symmetric to worst case?

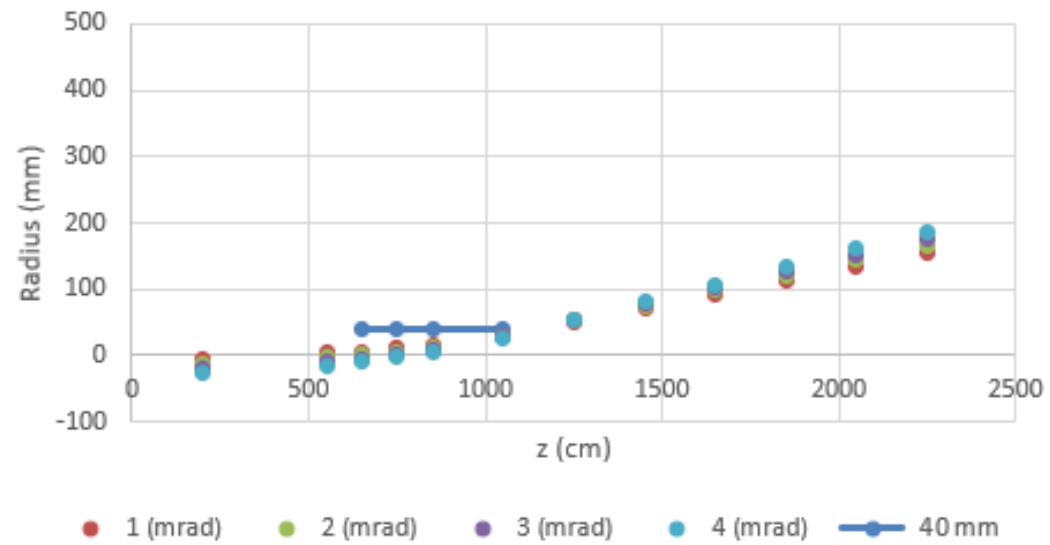
Lower energies or higher angles swept away faster and so don't clear the beamline shielding

A lower field means that less gets swept into the beamline shielding, but also has lower angle at end.

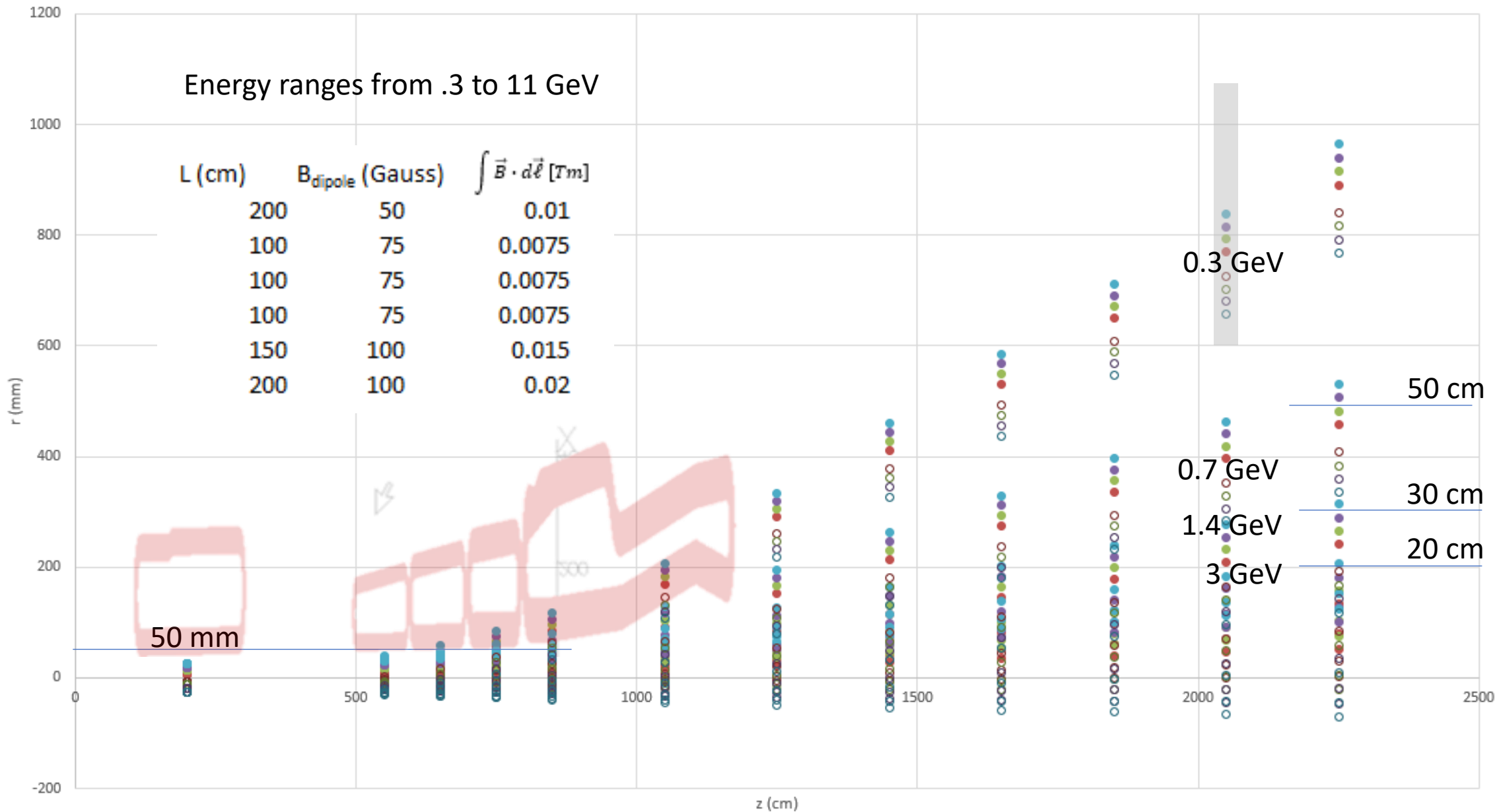
11 GeV, opposite side



1 GeV, opposite side

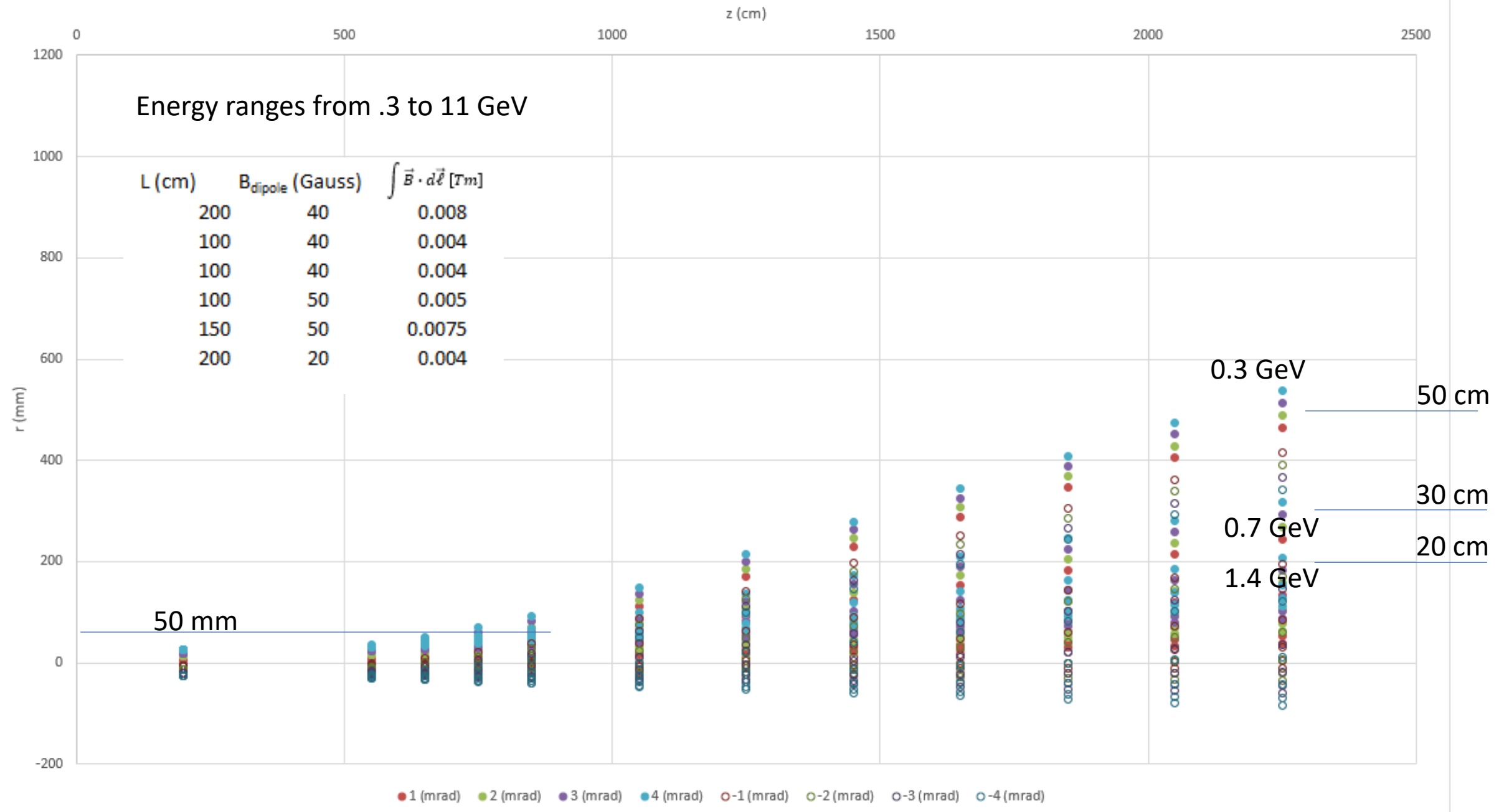


Tracks for different angles and energies

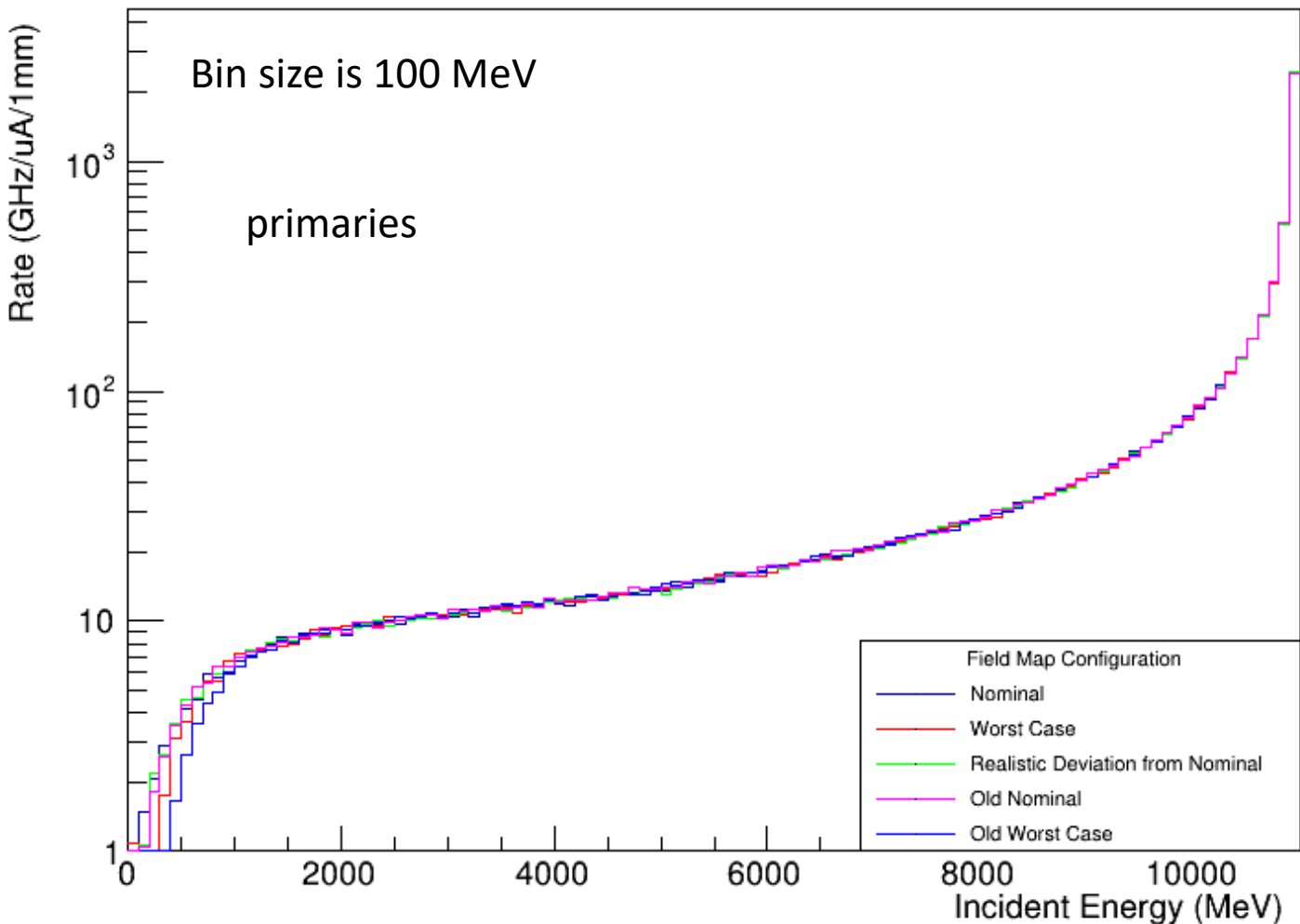


● 1 (mrad) ● 2 (mrad) ● 3 (mrad) ● 4 (mrad) ○ -1 (mrad) ○ -2 (mrad) ○ -3 (mrad) ○ -4 (mrad)

Tracks for different angles and energies



Radial Distribution End of the Hall Plane



10 (GHz/uA/100MeV) *

Radial Distribution End of the Hall Plane

