CPS Magnet

2/09/2024

J. Ballard

Requirements

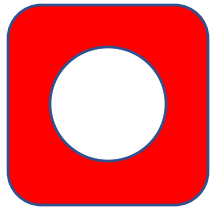
- Dipole field with a nominal field B_x=0.67 T (x-axis goes beam-left).
  - Uniformity is not important for CPS.
- Gap size 1.4 cm (x from -0.7mm to +0.7mm). Can be larger.
- Length of poles along Z=60cm to provide flat B_x between z=-30cm and z=+30cm.
- Closest coil point to the center in XY projection is 11cm to avoid high radiation exposure.
- The size limit in XY plane is 64cm in X and 48cm in Y. Defined by the shielding in FLUKA.
- The limit on total length of the magnet in Z is 80cm, including the coil return parts. Defined by the shielding in FLUKA.
- Pole height approximately $\Delta y \approx 8$cm. This is not very critical.
- The radiation dose in the magnet coils is expected to be on the order of 3×10^4 Gy. We need to have a factor of x10 or more overhead with the radiation hardness in the design of these coils.
  - I used bedstead coils instead of racetrack coils to avoid coils close to the beam.
- We need to be able to double the magnetic field without overheating coils or saturating the return yoke.
  - This is for potential JLAB upgrade in a distant future.
  - We may need to buy a new power supply if we upgrade.
  - The way CPS is designed, the magnet is replaceable without completely removing the shielding of CPS.

Basic Specs

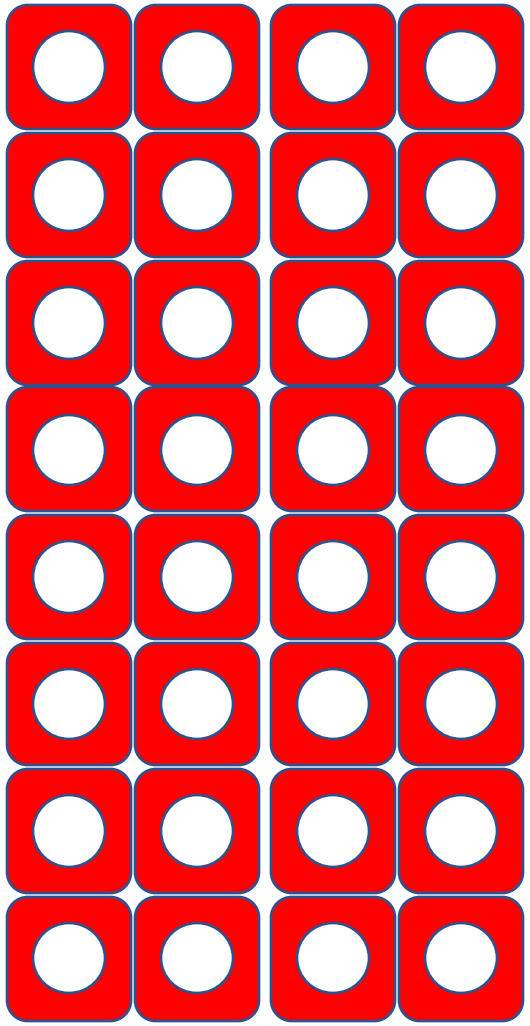
- B = 1.32 T (field)
- g = 0.014 m (gap)
- μ_0 = 1.26e-6 (permeability)

- NI = 14706 A (total amp-turns, both coils)
- N = 96 Turns (total, both coils)
- I = 153 A (power supply current)
- N_{coil} = 48 Turns
- V = 35.4 V (power supply voltage)
- L = 47 mH

- Luvata 8204 Conductor
  - ~7.9 A/mm^2 at 153 A

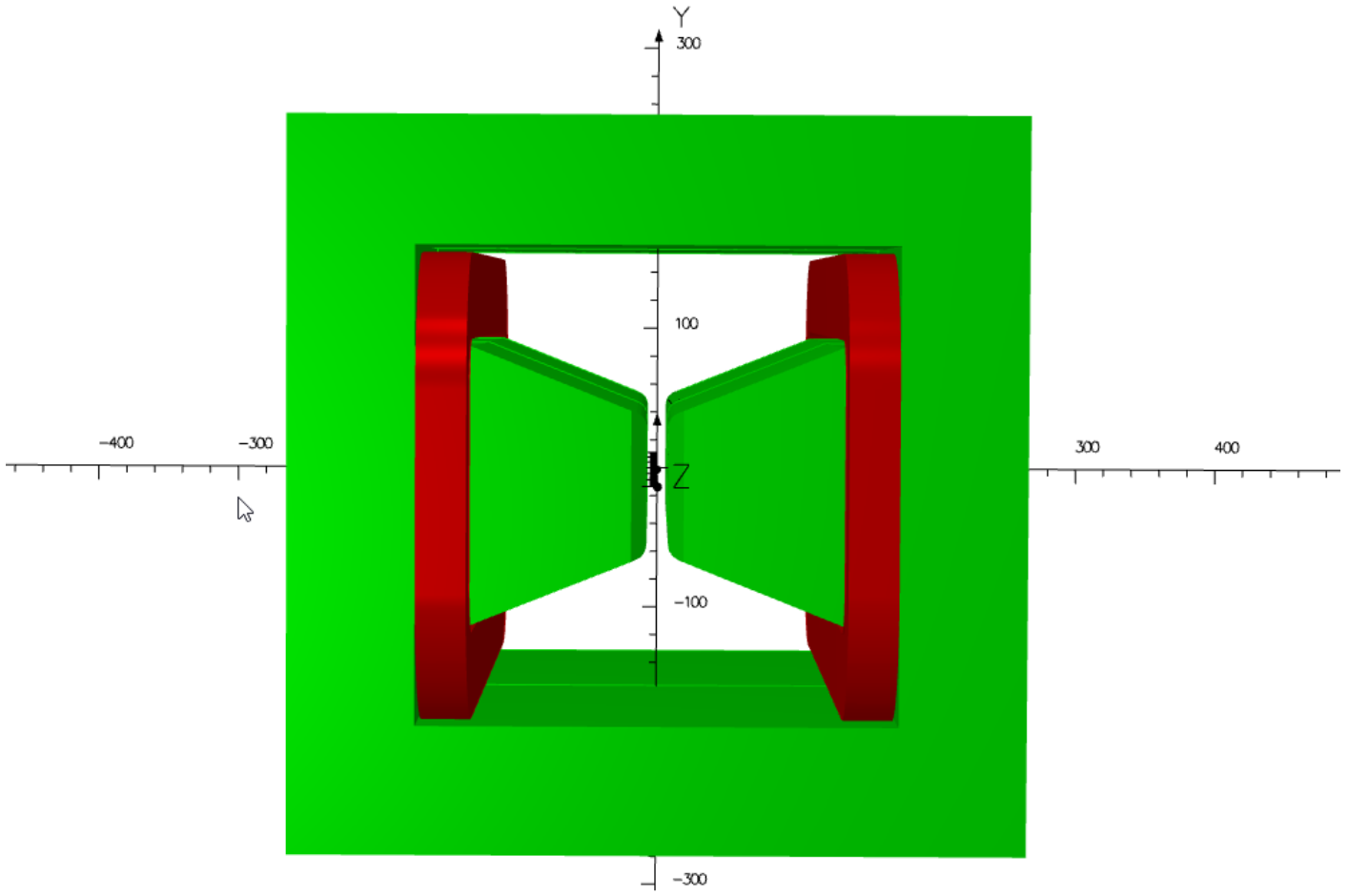


Conductor:
6 mm x 6 mm
4.5 mm hole



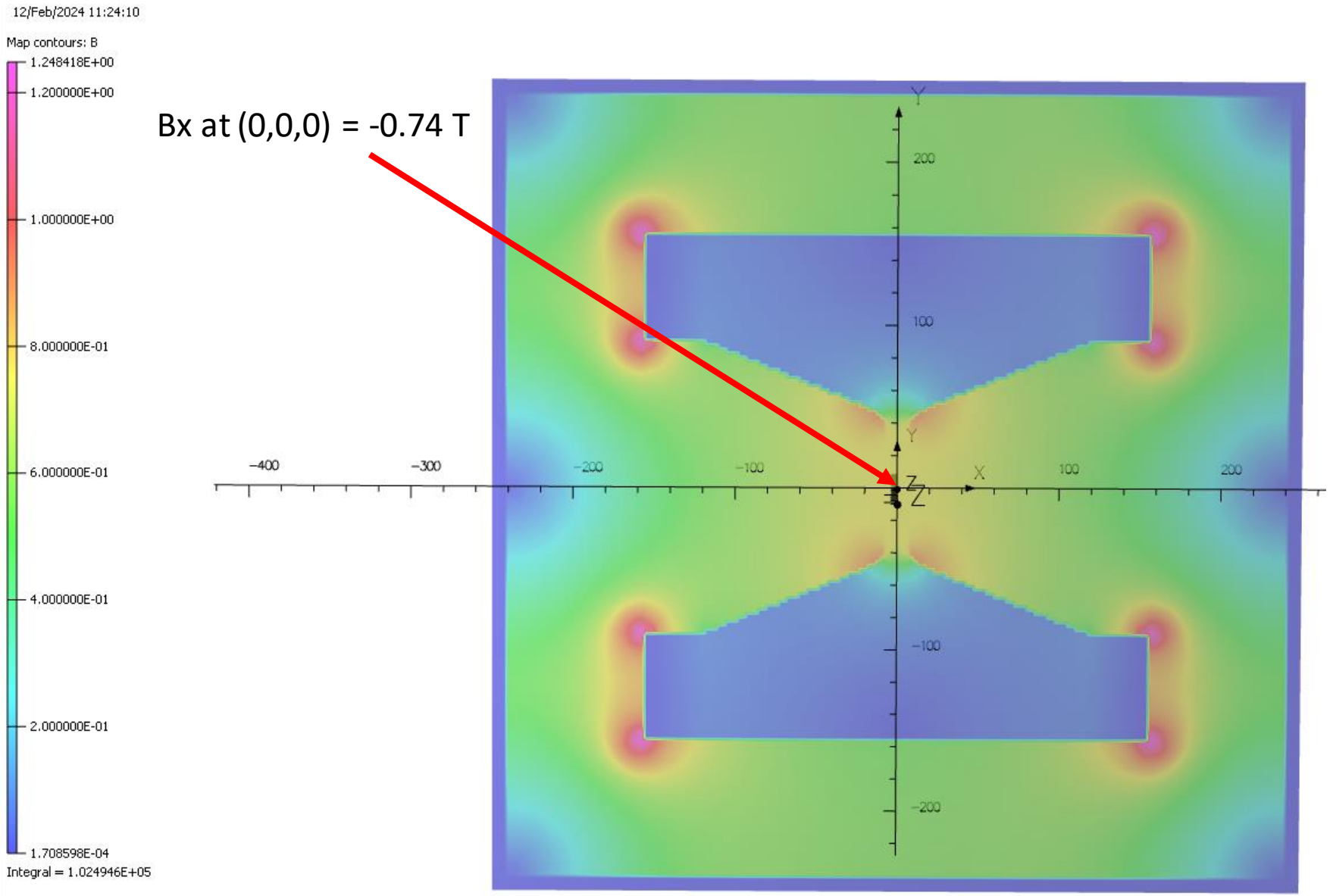
2 pancakes
Each 2 layers x 8 turns

Geometry

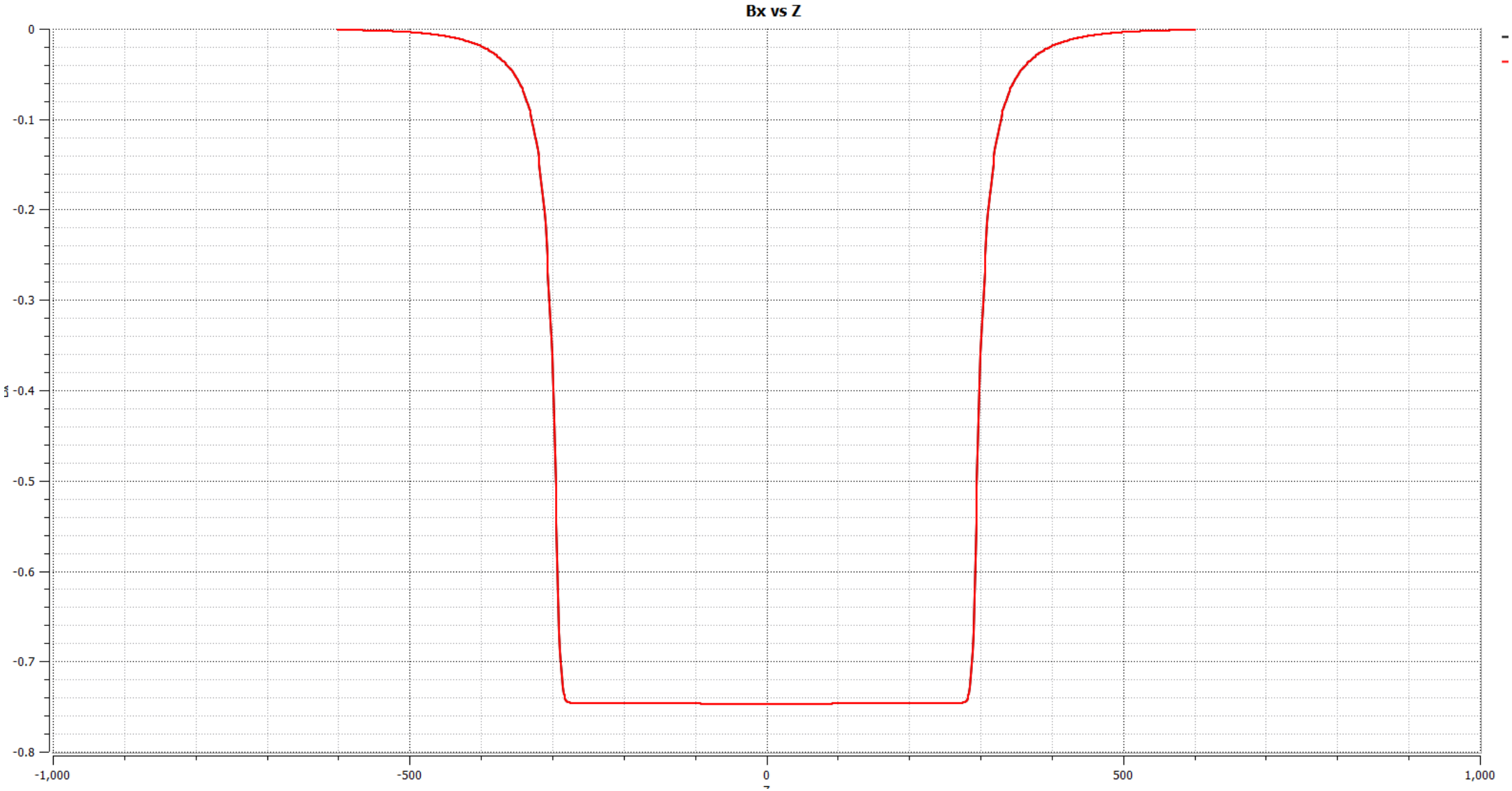


Yoke Outer Dimensions: 24 cm x 24 cm x 60 cm
Pole Face ~7.6 cm

Results at Nominal Field + 10%

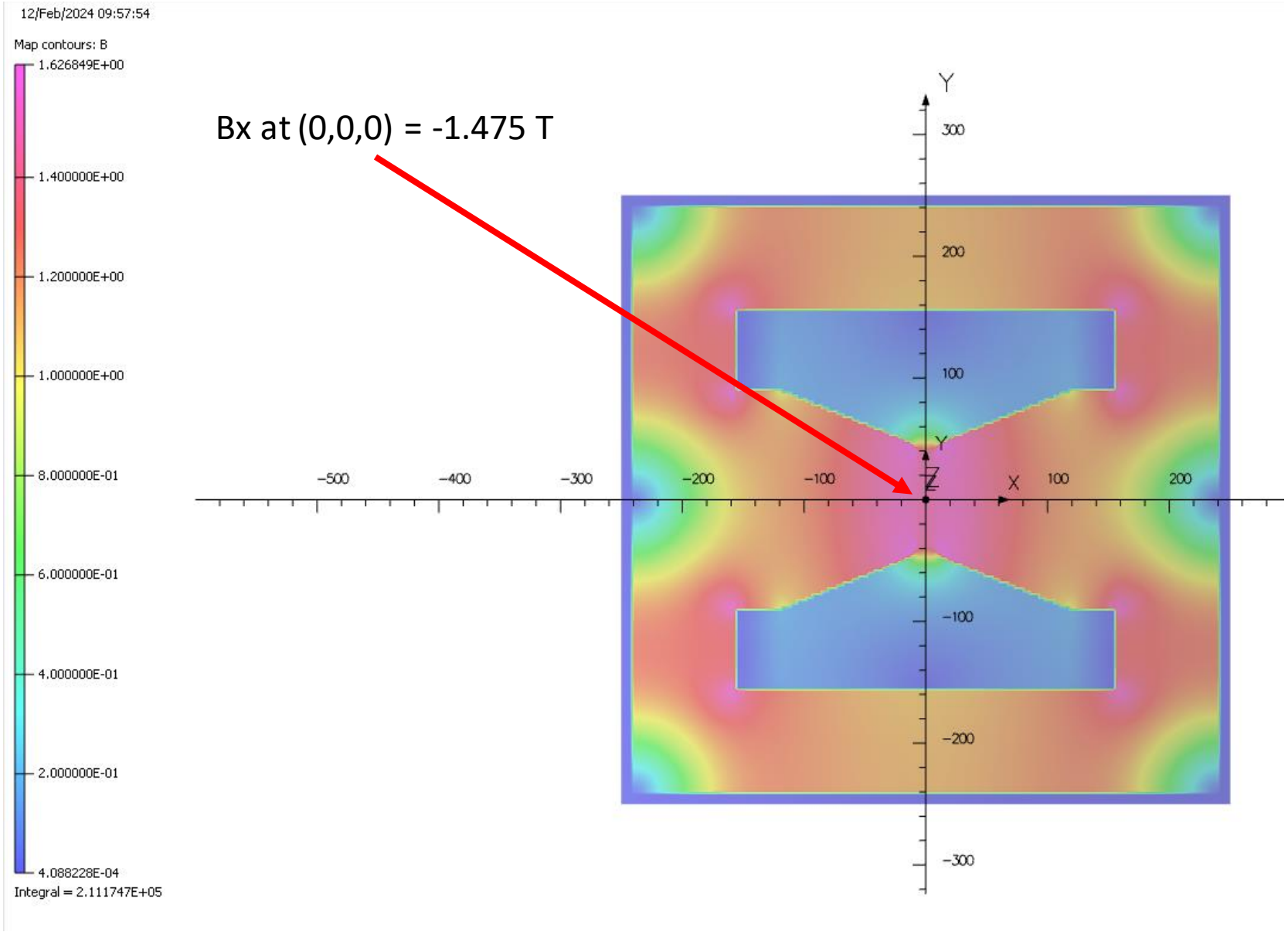


Results at Nominal Field + 10%

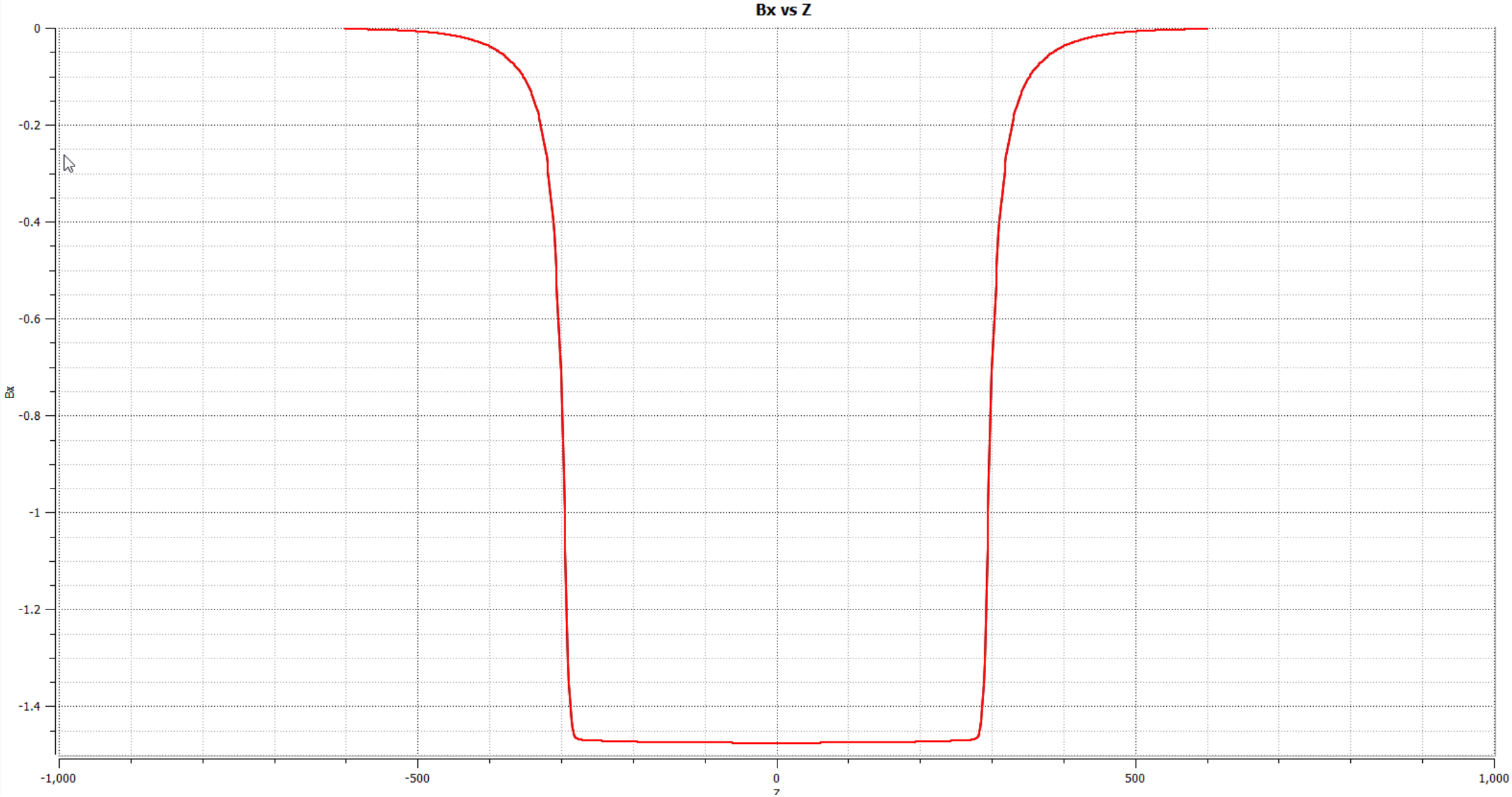


Bx*dL = 0.462 T*m

Results at Double Field + 10%



Results at Double Field + 10%



Bx*dL = 0.913 T*m