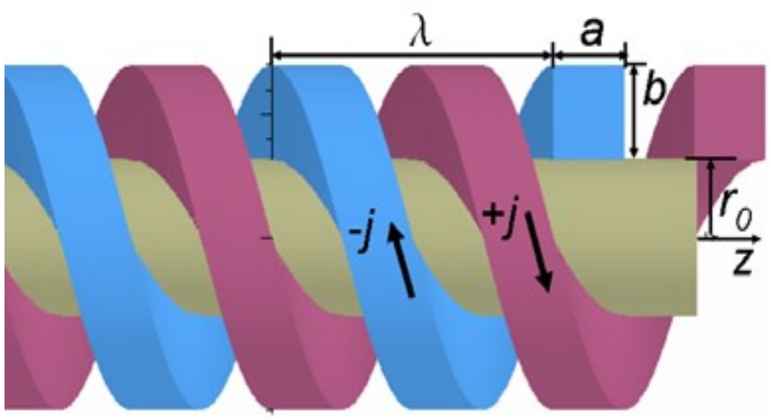
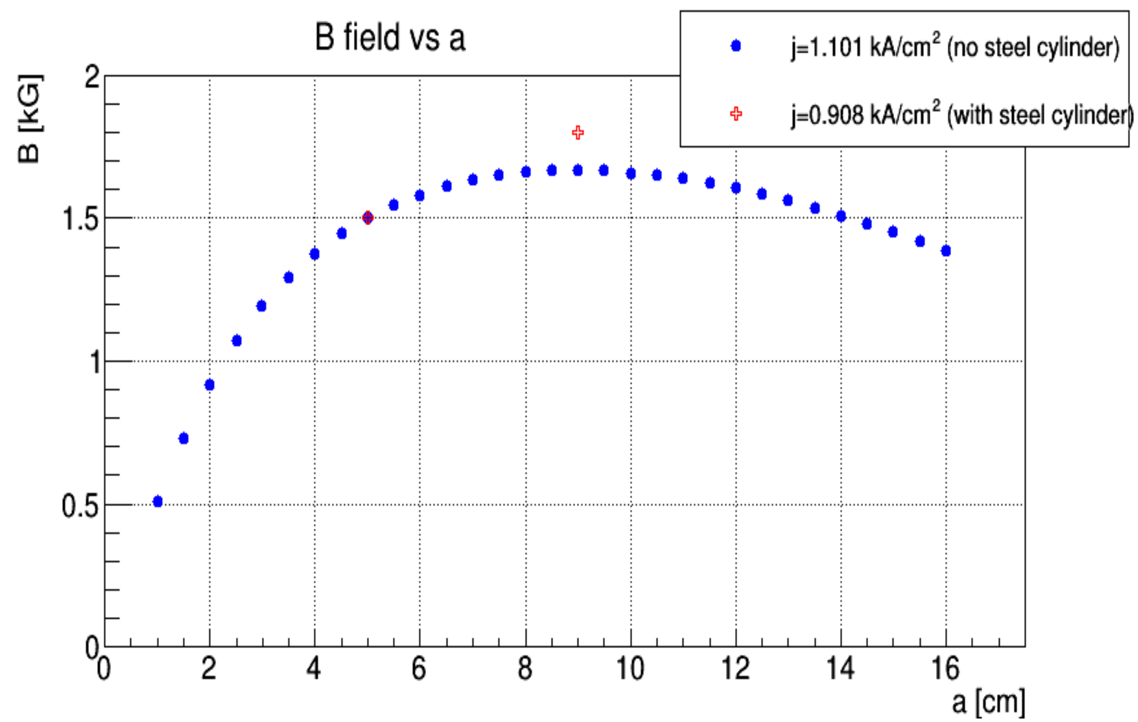
Helical Undulator Magnetic Field Optimization

Magnetic field vs conductor geometry



$b \times a = 25\ cm^2$, assuming the same number of conductors



Previously was chosen

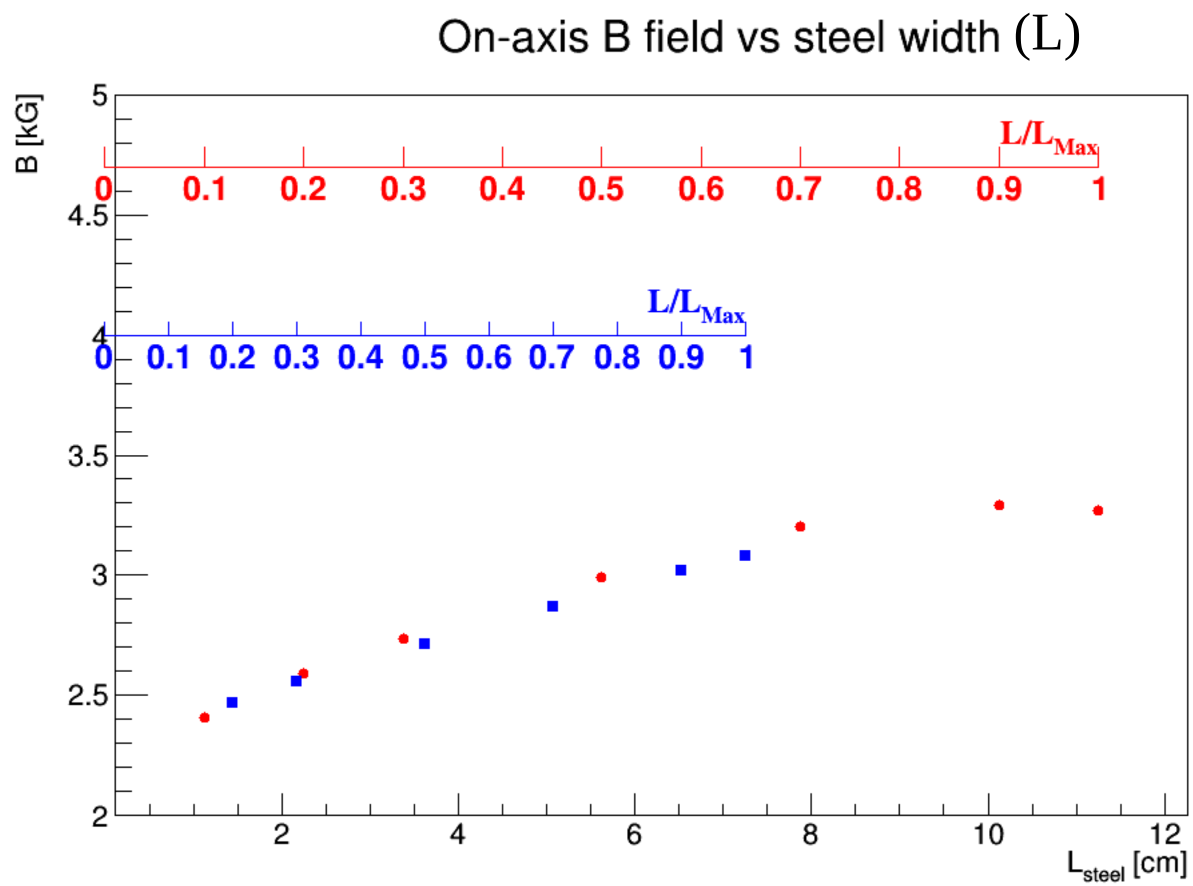
a=5 cm,
b=5 cm

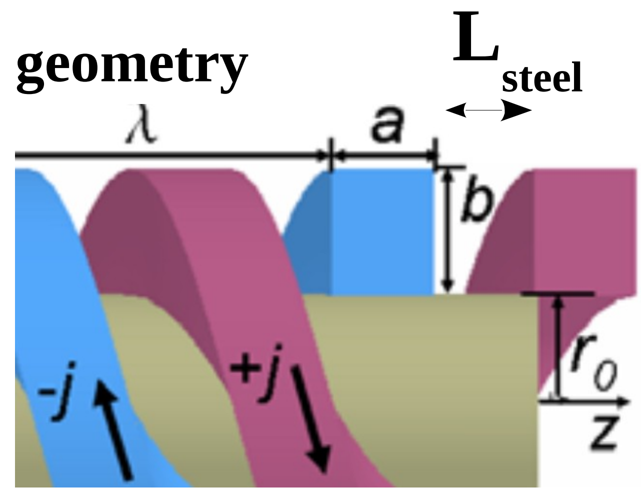
and used corresponding current density to get 1.5 kG on-axis field.
With

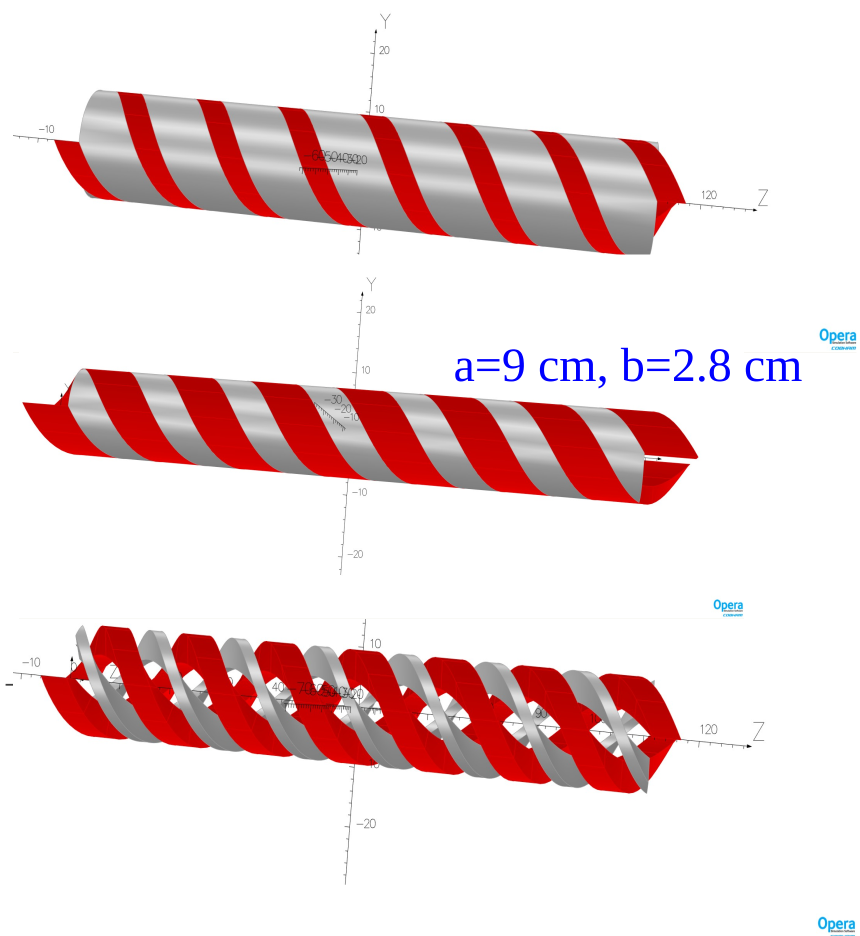
a=9 cm,
b=2.8 cm

we get about 20% higher on-axix field

Magnetic field vs steel-spiral geometry





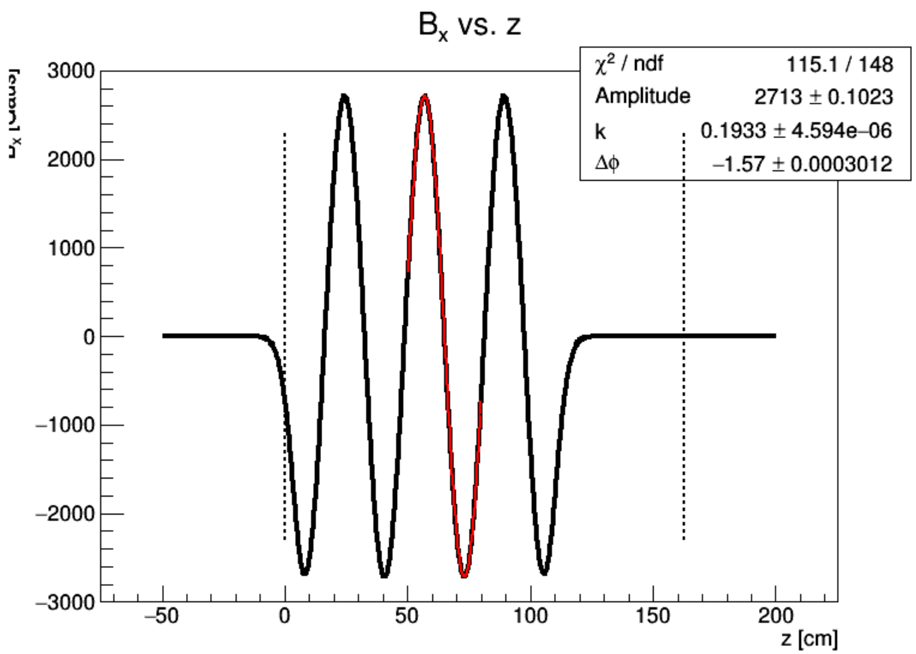


a=5 cm, b=5 cm

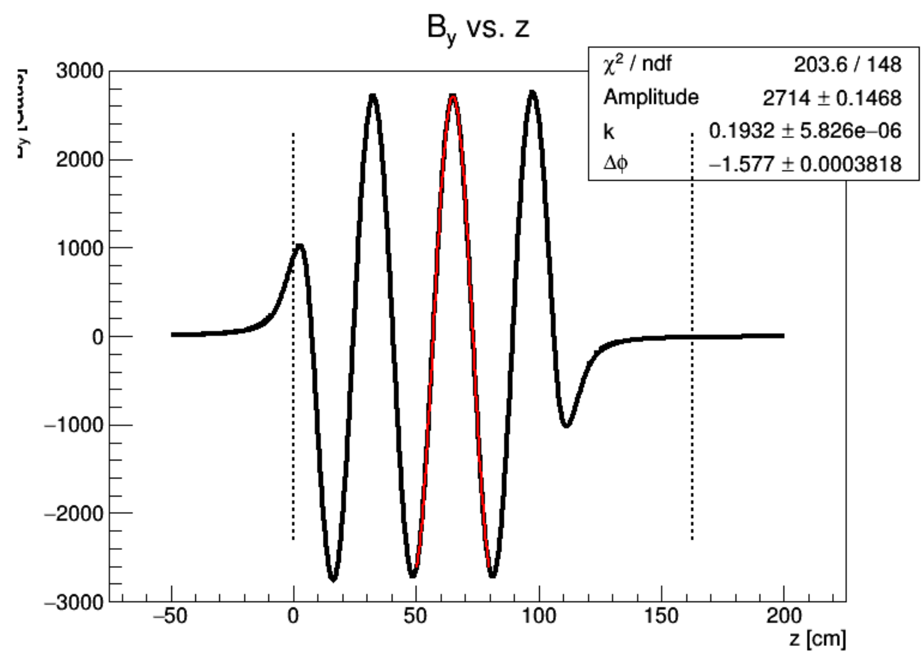
a=9 cm, b=2.8 cm

Magnetic field profile

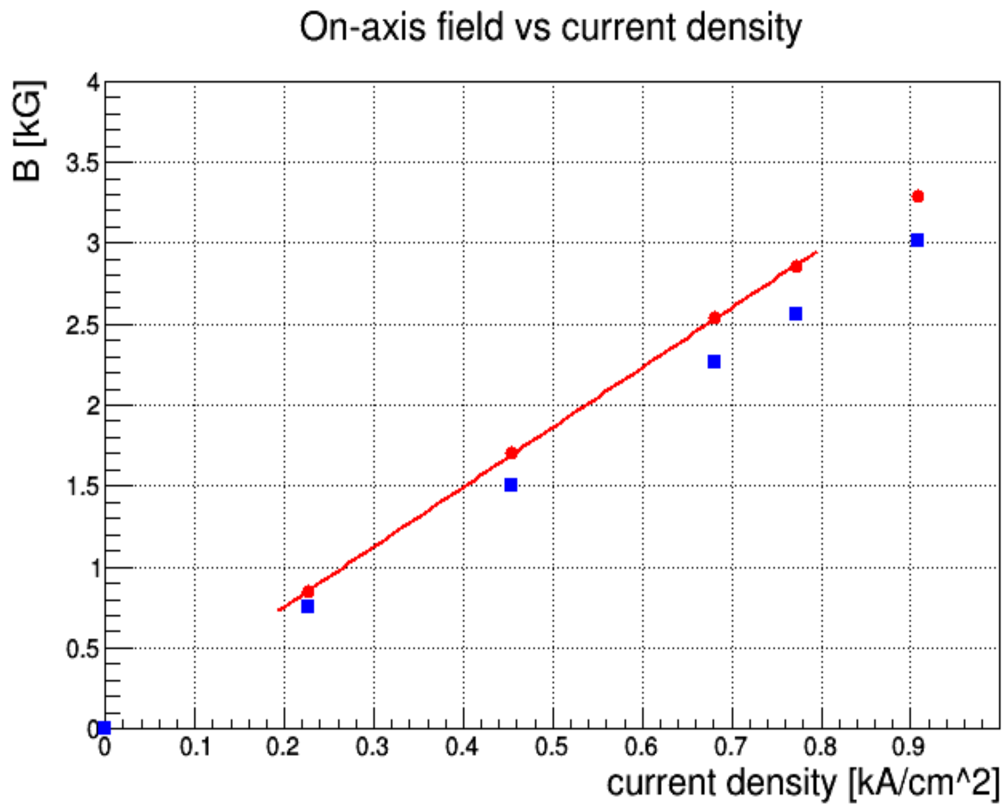
$Bx(z)=Amp*\sin(kz+\Delta\phi)$

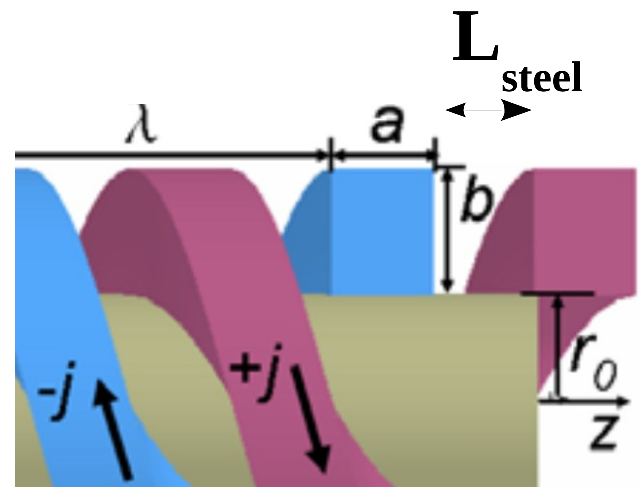


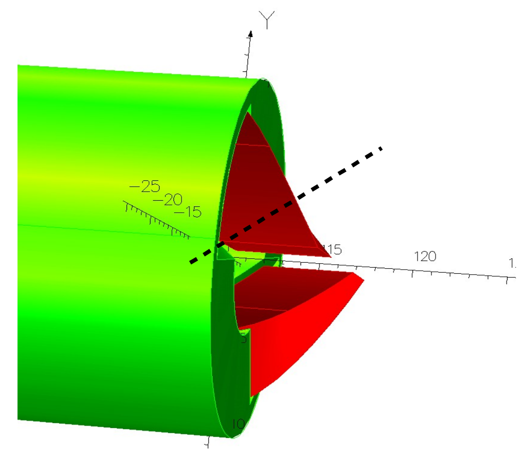
$Bx(z)=Amp*\cos(kz+\Delta\phi)$



Magnetic field vs current density







a=5 cm,
b=5 cm,
L_{steel} = 10 cm, steel (90% of available space)

J_{real} = 1.24*J_{OPERA} **for B_0=1.5 kG J=0.508 kA/cm^2**

a=9 cm,
b=2.8 cm,
L_{steel}=6.5 cm, steel (90% of available space)

J_{real} = 1.32*J_{OPERA} **for B_0=1.5 kG J=0.59 kA/cm^2**

Summary

- **Adding spiral-steel material we can reduce the current density about twice**
- **On-axis transverse magnetic field still has Sin-Cos profile**