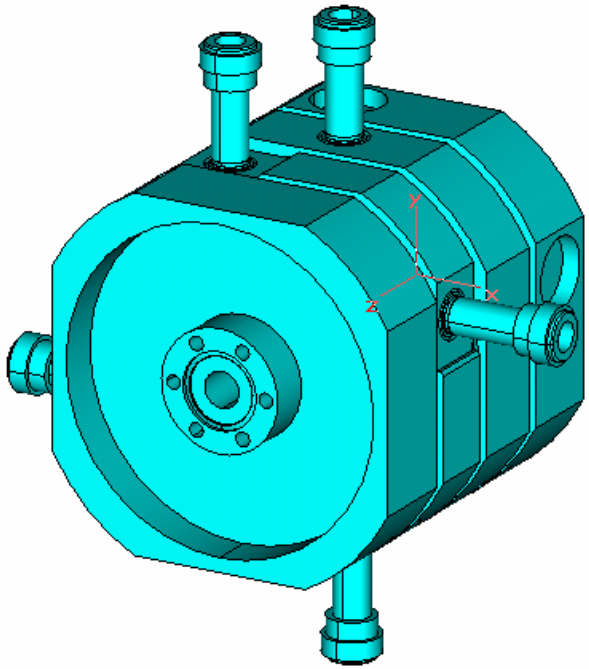
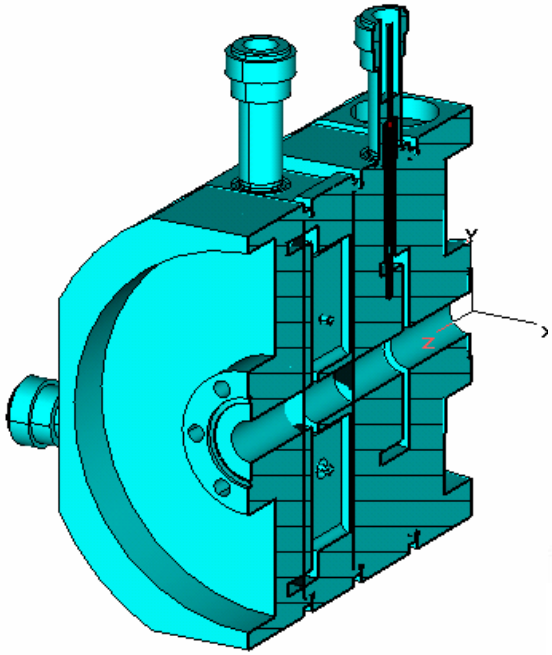
Dipole field Impact on Beam axis caused by BPM Magnetic feedthrough

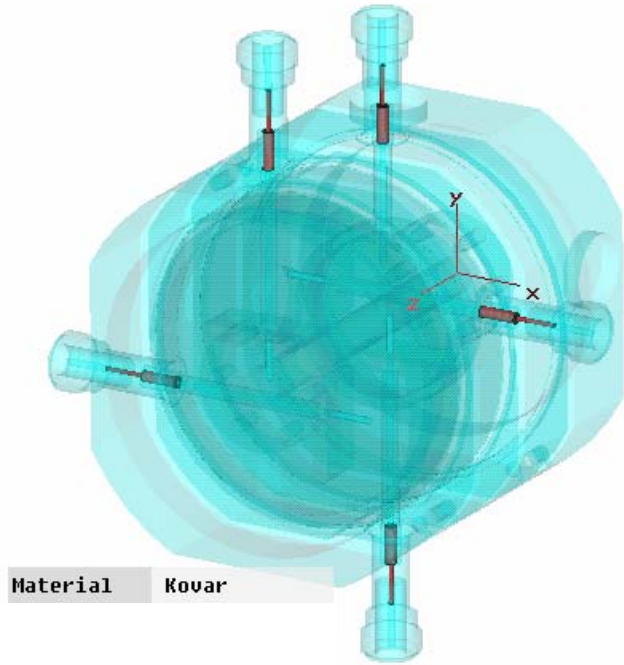
1. Problem with Setup
2. Orientation of Feedthrough to produce highest dipole field in *x* direction
3. Orientation to produce highest dipole field in *y* direction
4. Summary

Cavity BPM with Feedthrough





Cross section

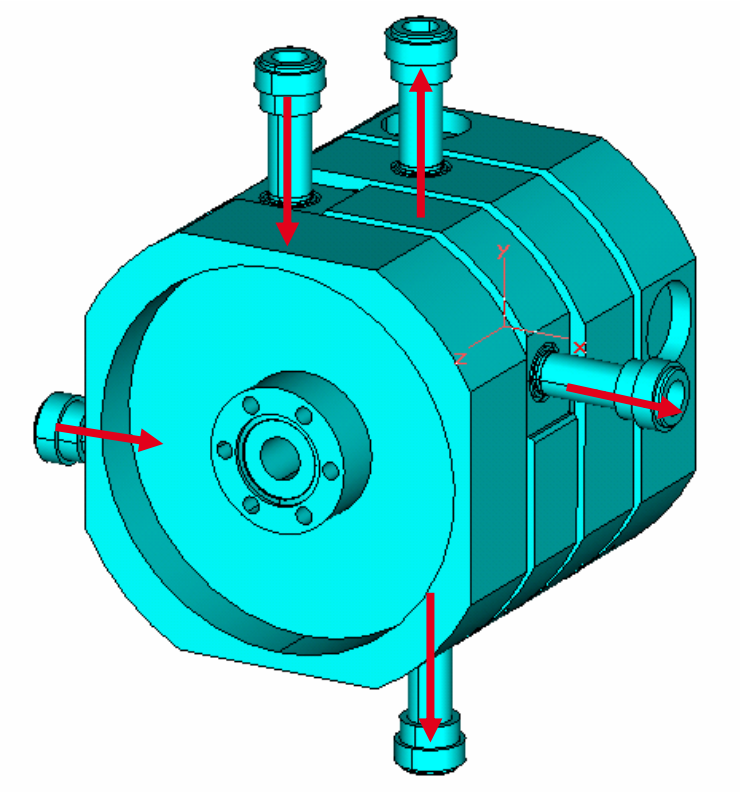


Inner pin of feedthrough consists of Kovar: maximum remanence of 1.2 T

Cavity BPM body consists of Stainless Steel

BPM is one component between two undulators for XFEL

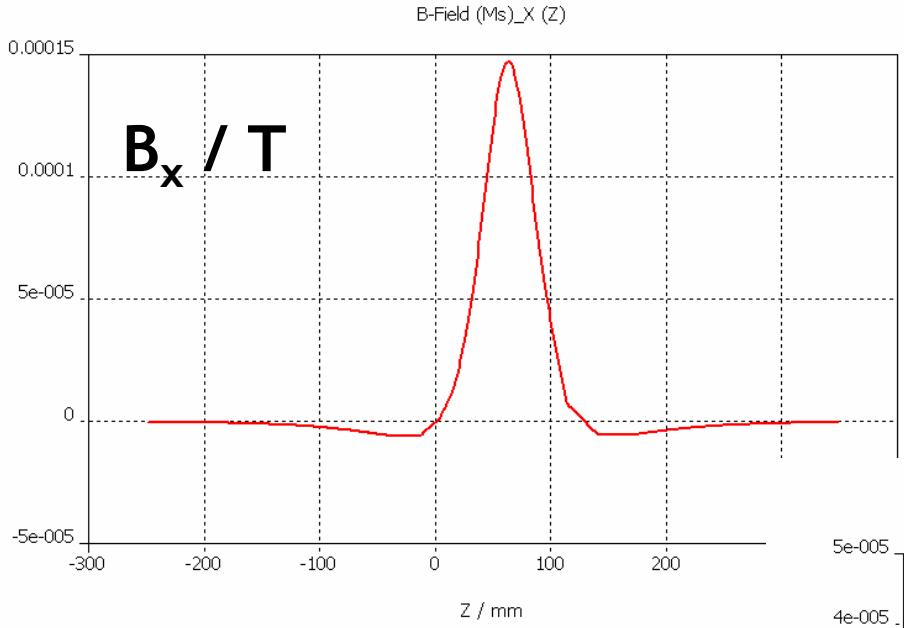
Configuration for highest *x* magnetic dipole field



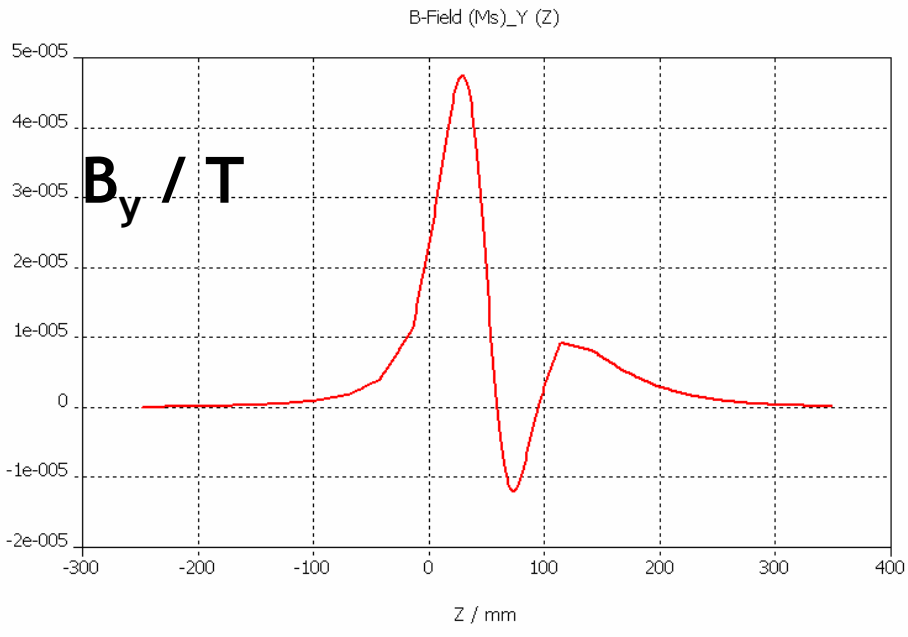
This orientation produces highest $\int B_{dipole}\, dz$ at *x* direction

Remanence of 1.2 T is used: worst case

Dipole field strength along *z*

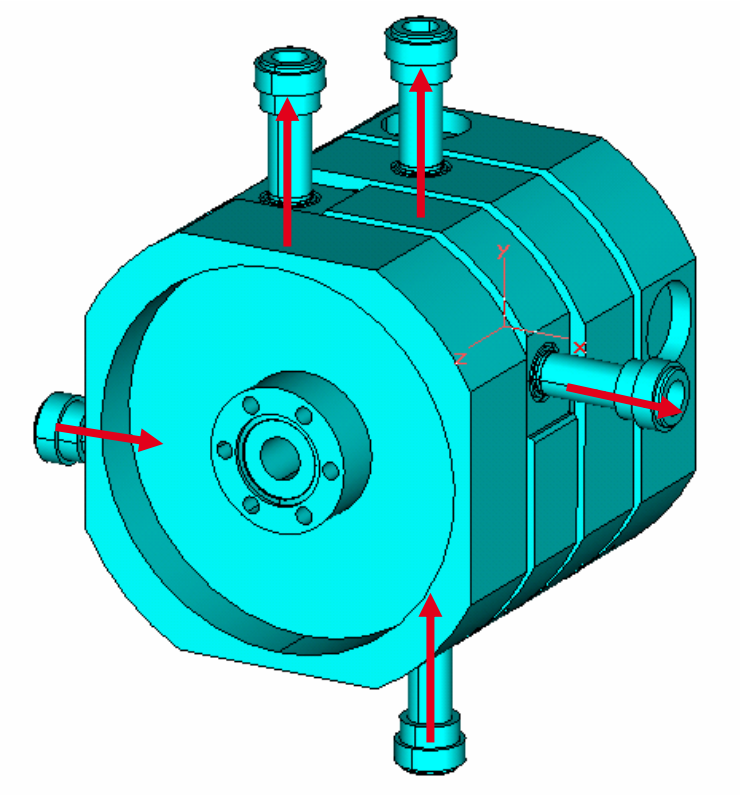


$$\int B_{x,dipole}\, dz = 0.070\ \text{Gm}$$



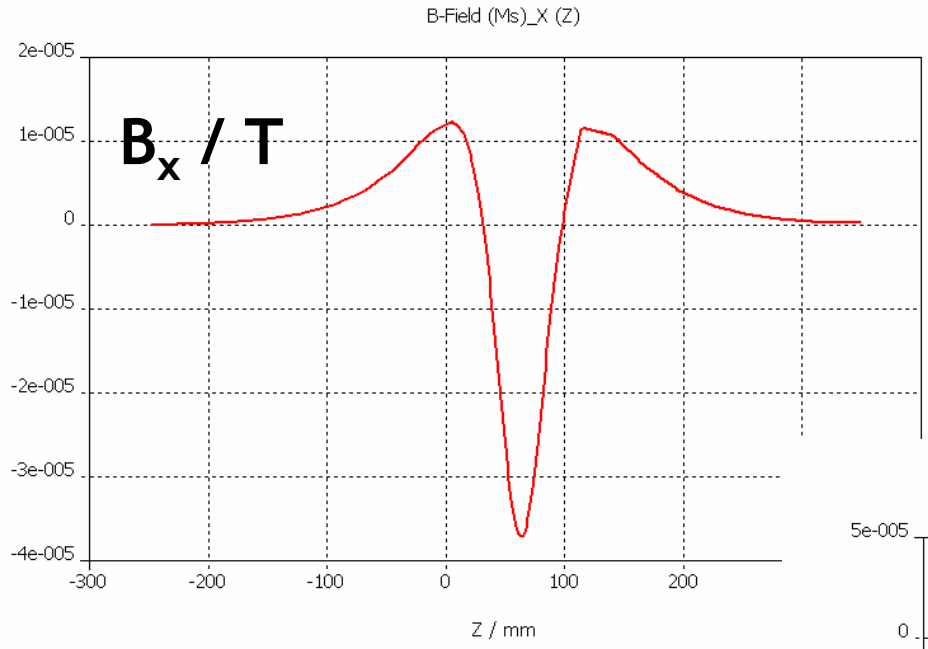
$$\int B_{y,dipole}\, dz = 0.031\ \text{Gm}$$

Configuration for highest *y* magnetic dipole field

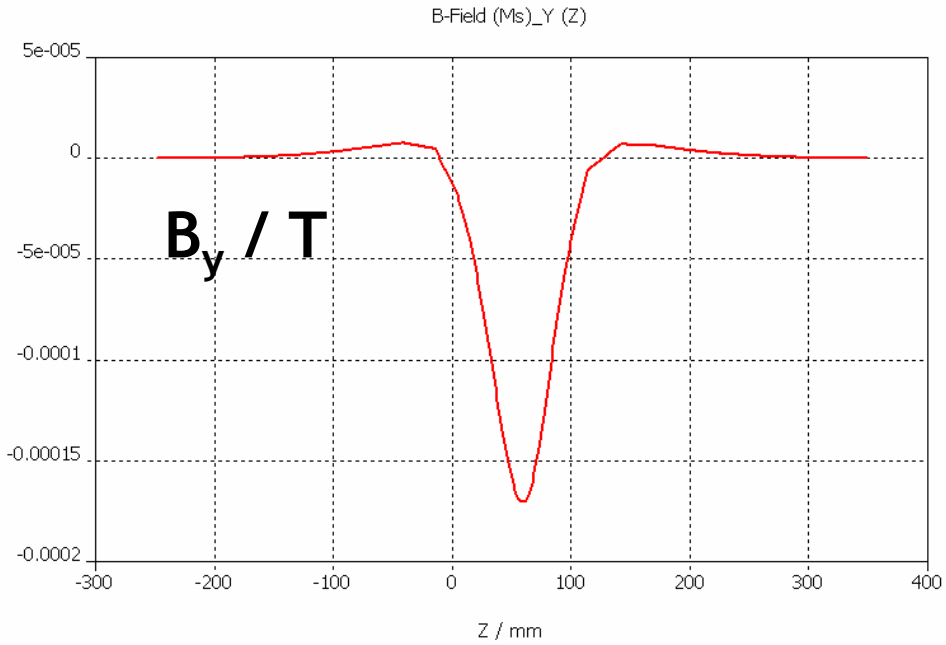


This orientation produces highest $\int B_{dipole}\, dz$ at *y* direction

Dipole Field strength along *z*



$\int B_{x,dipole}\, dz = 0.007$ Gm



$\int B_{y,dipole}\, dz = 0.091$ Gm

0.09 Gm - Is this big?

- **Earth field ≈ 0.3 G**

  1.8 Gm over one undulator section

- **Quad misalignment**

  typical gradient 50 T/m * 0.1 m * 1μm

  0.05 Gm for one intersection

- **Kick to the beam of 0.1 σ**

  x' = 0.1*√(4e-11/30) ≈ 0.1 μrad

  corresponds to 0.06 Gm

Specification for maximum on axis field in undulator section (from PIII field measurements and BBA studies at FLASH): 1 G

Available corrector strength (air coils) in undulator: 12 Gm

Summary

- Highest dipole field integral observed in *y* direction with 0.091 Gm for highest remanence field of Kovar
- Magnetic budget is 6 Gm per Undulator section
- Cavity BPM is one component per section: 1.5% of budget is caused by BPM