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

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 $\int B_{\text{dipole}} \, dz$ at x direction

Remanence of 1.2 T is used: worst case
Dipole field strength along $z$

\[ \int B_x,_{\text{dipole}} \, dz = 0.070 \text{ Gm} \]

\[ \int B_y,_{\text{dipole}} \, dz = 0.031 \text{ Gm} \]
Configuration for highest $y$ magnetic dipole field

This orientation produces highest $\int B_{\text{dipole}} \, dz$ at $y$ direction.
Dipole Field strength along $z$

\[
\int B_{x,\text{dipole}} \, dz = 0.007 \text{ Gm}
\]

\[
\int B_{y,\text{dipole}} \, dz = 0.091 \text{ Gm}
\]
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 * 1 μm
  - 0.05 Gm for one intersection
- Kick to the beam of 0.1 σ
  - \( x' = 0.1 \sqrt{(4\times10^{-11}/30)} \approx 0.1 \, \mu \text{rad} \)
  - 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