Magnet Error Model

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Introduction

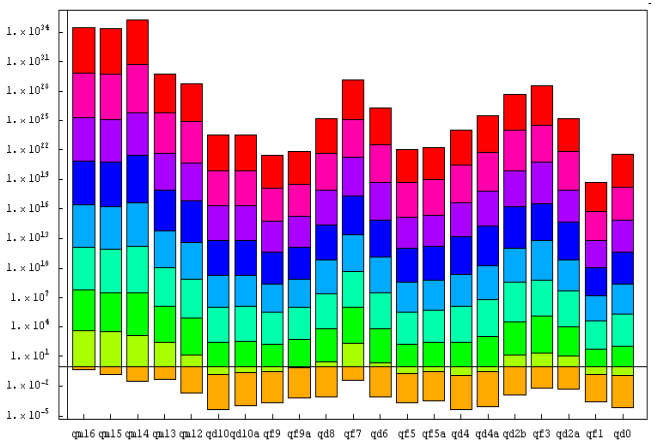
- Too many different magnets to develop analysis of magnet errors through EM codes.
- Determination of errors should proceed along several parallel axis:
  1. Review of existing facilities magnet errors
     - LCLS, SLC, X-FEL, SR Light Sources
  2. Tolerance Calculations based on tracking studies
  3. Simplified model based on few-point parameterisation of the field quality
- Analysis through EM modelling should be prioritised towards the most exotic magnets
  - Final doublet, BC magnets etc

Review of (existing) facilities

- It should be expected that tolerances for existing facilities will provide a reasonable expectation value for a cost-optimised set of errors.
- However, it is probable (possible?) that tolerances can be expected to improve over previous designs simply due to advances in technology and the sheer size of the ILC magnet procurement requirements.
- Magnets should be grouped into “families” and then compared to existing closest-fit designs
- This can also be used as the input to a simple field error parameterisation.

Tolerance Studies

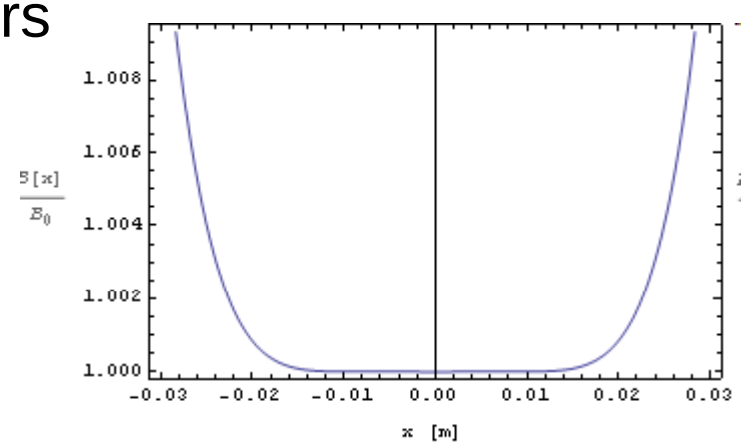
- Analysis of tolerances via particle tracking is quick and relatively simple to perform.
- However, provides no realistic numbers on expected magnet errors.
- Provides no analysis of the interplay for the magnet harmonics.
- Analysis of this sort was performed for the ATF2, which may provide some insights into BDS tolerances.
- Tolerances need to be performed at timescales of feedback systems (certainly for lower order errors)



Simplified Parameterisation Model

- For the simulation of random field errors, we can simply parameterise the expansion of the field quality.
- This allows us to take an existing magnet harmonic content and create new harmonic content in a systematic way.
- Creating the “allowed” field components is trivial.
- “disallowed” components also presents few problems.
- Including the effects of manufacturing errors (i.e. skew quad fields, octupole fields) is more tricky, but we can rely on previous experience for these numbers

$$B_0 + \frac{B_2}{B_0} x^2 + \frac{B_4}{B_0} x^4 + \frac{B_6}{B_0} x^6 + \ldots$$



Next Steps

- First steps are to perform literature search on other machines.
- From this I can generate a set of “magnet families” based on current lattice designs for RTML to the BDS.
- Use this to provide some parameterised models of field errors for each family.
- Combine this with tolerance specifications to provide a list of field error sets:
  - “ideal” = tolerances
  - “realistic” = parameterised models
- As and when magnet designs are produced, provide improved parameterised models.