Fermilab GDE Simulation Kickoff meeting: Information for Simulations

Wakefields

Roger Barlow

Who and what

Wakefields in Collimators

(Contact persons: Bane, Stupakov, Barlow)

Wakefields in Cavities

(Contact persons Bane, Stupakov, Jones)

My colleagues (Bane, Stupakov and Jones) are much more expert than me. So I will do the running around while they do the important stuff.

Wakefields in collimators

In the ILC the bunch core passes very close to the collimators, and wakefields **may** be large enough to reduce luminosity.

High order modes (not just the usual dipole) are large near the boundaries and **may** be important.

What do we have?

- Assorted analytic formulae
- EM simulators (MAFIA, ECHO, GdfidL…)
- Two tracking codes
  - Merlin, Placet
- Experimental results from SLAC, past and present
- Simulations of ILC and CLIC

General comment

- The formulae and simulations and measurements show rather poor agreement.
- This is because we don't understand them properly. Yet.
- The ILC will push parameters to a realm beyond current work. We have to be able to trust our results, and we are not in that situation.

Simulations

4 (or more) approaches

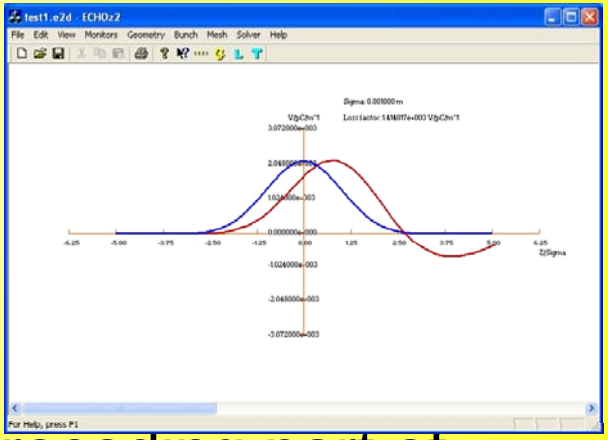
0) Calculate wakefield due to standard bunch using EM simulation program and apply it. Good (only) for core/halo studies as wakefields distort bunch

1) single bunch kick factor

$$\Delta y' = f(a,b,..)\ \Delta y$$

Assumes Gaussian bunch

2) kick on particle as proportional to charge density



3) kick on particle from integral over preceding part of bunch

Analytic Formulae

1) Kick factor formulae from Bane, Stupakov, Yokoya, etc. for geometric and resistive wakefields in circular and rectangular collimators in various regimes
2) Same formulae can be used slice by slice
3) Limited number of formulae for all modes full wake function (Raimondi)

Numerical interpolation

- Possible in principle to take EM simulations and decompose into wake potentials suitable for tracking codes

What can we do (1)

- Compile list of formulae (Bane, Stupakov, Yokoya, Chao, Raimondi…)
- Understand their regions of applicability and limits of validity
- Compare with EM simulators and understand any differences.
- Identify missing formulae that we need

Work in progress:
http://www.hep.man.ac.uk/u/adina/

What can we do (2)

- Put formulae in Merlin and Placet

Merlin is more easy to adapt/expand

Placet has a BDSIM interface

- Build Library of EM simulations of standard cavities:

0) Simulate bunch in aperture and dump field map

4) Deconvolute bunch to get single particle wake function

Outcomes to work for

1: Compendium of formulae – soon

2: Compendium of formulae, annotated and tested - ongoing

3: Interfaces of formulae to Merlin (soon) and Placet (later)

4: Library of EM simulations of ILC collimator designs – could start soon

5: Interface of these to Merlin (soon) and Placet (later)

Wakefields in cavities

- Not really my field, but makes sense to work together, given overlap of contract people
- Much bigger issue, as cavities are designed to resonate and long-range wakes have been known to kill the beam
- For available results - Ask Roger Jones
- Ideal wakefields and wakefields with random errors available

Where next?

- Meeting of 4 contact people to discuss points above, plus anything else raised at this meeting.