ILCv – mat-LIAR DFS Cross-Checking

Accelerator Physics Phone / Video Meeting

The Problem

- Why don't ILCv (Cornell) and mat-LIAR (SLAC) get the same DFS performance?
  - To a casual observer, algorithms are the same
  - Results are different
    - Mat-LIAR $\gamma \ \varepsilon$ vs S plot has "spikes" in the upstream areas
    - Final emittances aren't quite the same

What we Did

- **Tracking Exercises**

  – Look directly at the codes

  – Found and fixed a minor bug in ILCv

    - Wakefields of misaligned cavities misapplied

    - Excellent agreement for Exercise 2

- **Eliminate all sources of randomness**

  – Use same 100 misaligned linacs in both codes

  – Set BPM resolution to 0 μ m

What we did (2)

- Jeff and PT DFS use different approaches to changes in the incoming orbit from on- to off-energy
  - PT: Perform global fit with change in orbit and desired corrector settings as parameters
  - Jeff: resteer incoming orbit before taking off-energy orbit
  - Made both codes use Jeff's method

What we did (3)

- Both Jeff and PT use 20% or 18 GeV ΔE, whichever is less

  – There are many ways to achieve this energy change!

    - Carefully examined Jeff's algorithm for selecting cavities to switch off

    - It systematically uses cavities further upstream than PT's algorithm

    - Made both codes use Jeff's method

Convergence!

3 Jeff DFS Implementations, 100 mat-LIAR seeds

Everything except cavity selection agrees: mat-LIAR still gets spikes

Emittance growth agrees to ~7%, absolute emittance to ~1%

mat-LIAR new
ILCv
mat-LIAR old

$\gamma\varepsilon_y$ [nm]

BPM #