BDS, Start to End Simulation, Simulation Codes Summary

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Presentations

- Deepa Angal-Kalinin: Beam dynamics issues in BDS
- Peter Tenenbaum: Possible migration to Accelerator Makeup Language
- Glen White: BDS tuning simulation
- Andrea Latina: Static and Dynamic Alignment of the CLIC BDS
- Javier Resta Lopez: Start to End simulations with intra-train feedback
- Tony Hartin: Luminosity performance with multiple feedbacks
- Peter Tenenbaum: Lucretia status and plans
- Andrea Latina: PLACET : New features and plans
- Paul Lebrun: CHEF status and plan
- Roger Barlow: Issues in Simulating the Effects of Wakefields
- Steve Malton: Interfacing BDSIM with PLACET, wakefield calculations of collimator
- Isabell Melzer-Pellmann: Lumi scans with wakefields in Merlin

BDS tasks related to LET (1)

- BDS has the most different styles of magnets; standardize the magnets and reduce the styles
- Magnets on strings
  - **Additional correctors/PSs**
  - **How will it affect the tuning + beam based alignment**
  - **How will it affect the performance after push-pull**
- Temperature requirements in the tunnel and its effect on beam stability
- Stability requirements for push-pull
- Angle feedback and integration of other feedbacks?
- Effect of wakes from pumping ports, vacuum chamber misalignments, resistive wall, IR wakes, HOM heating, wake fields from crab, spoilers, other transitions….

BDS tasks related to LET (2)

Laser wire

- Define requirements on emittance measurement (absolute/relative) of train (or bunch) every ? second? → beam tuning procedure
- The present design of laser wire assumes 300 scans per train, which drives the requirements of the laser
- Do we need any beam spotsize diagnostics between collimation region and IP (somewhere in the final focus?)

Crab system

  - **To understand and verify requirements on the crab cavity mode damping from beam dynamics point of view. e.g. 10E+4 for SOM is difficult from RF design, but may be relaxed with intra-train feedback?**
  - **The alignment of crab cavity and effects of the orbit offset in sextupoles may be perhaps fixed with some small vertical crab cavity nearby the main one.**
- Low energy parameters
- Work plan is being developed
- Lattices to be frozen in autum

BDS Alignment

- 100nm BPM resolution needed in sextupoles
- Quad shunting+DFS
  - Is the systematic error important?
- Multi-knobs, also high order needed
- Studies using one beam and it's mirror yield 90% at better than 110% luminosity
  - Independent beams yield 90% at better than75%
  - slower convergence
- 1e-3 magnet error significantly impacts convergence
- Intra-pulse beam-beam offset feedback kick limited by sextupole
- 200nm stability requirement for quadrupoles
- Main goal is to have a verification by another study

ATF2

- ATF2 is an important test
- Can take advantage of flight simulators
- Need to fully study alignment and tuning
  - E.g. losses can be a problem
- Simulation of ATF2
  - Spot size measurement is slow (1 minute)
  - Convergence speed crucial
  - Spot size growth 1nm/hour

CLIC BDS Alignment

- Few-to-few and DFS used
- DFS problematic since response to energy deviation not linear
- Collimations system alignment works
- FFS alone does not work
- Full optimisation (brute force) with simplex works on 50% of the cases
  - No solution yet
- Could still be starting point for ILC second BDS alignment study

CLIC BDS Dynamic Effects

- Choice of orbit feedback gain
  - Ground motion requires yields gain>0.01 to correct orbit
  - BPM resolution requires gain<0.3
- Very tight quadrupole stability requirements
  - Fractions of nm for final doublet
  - Nanometer for other magnets
  - Need to use stabilisation
- Should also run this for ILC

Integrated Feedback Studies

- Continuation of studies started by Glen
- From linac to IP
  - Including fast IP feedback
  - Bunch compressor should come soon
- Multi-bunch tracking
  - Realistic main linac, undulator not used
- Ground motion C or K yield 85% of target luminosity
- Smoother luminosity increase during feedback than before
  - Banana effect is less important
- Crab cavities and collimator wakefields to be included

Feedback Optimisation

- Basic idea is to exploit luminosity information to speed up beam-beam offset feedback convergence
- Based on Javier’s integrated simulation
- Luminosity based on pair signal
- Optimise gain for minimum luminosity loss
- Looks an interesting approach

Beam-Beam Scans

- Translate emittance growth into luminosity loss
- Try to optimise collision in presence of imperfection along the machine
- Banana effect is reduced compared to TESLA

Wakefield Models

- Linear wakefields seem OK for main studies
- Need something better for loss studies
- Uncertainties still exist
  - Comparison between formulae
    - Check proper implementation
  - Benchmarking with experiments
    - Experiments are not easy

BDSIM-PLACET Interface

- BDSIM is a vital code for BDS studies
  - Halo and background studies
  - But not aimed at alignment and tuning studies
- Geometry information
  - Currently: Halo tracking in BDSIM, core in PLACET
  - General lattice information
  - Imperfections

Deck Format

- Current deck format is based on XSIF
  - Parser is available and can be added to programs
- Slow transition to AML is planned
  - Until 2010 both formats (XSIF+AML) will be supported
  - AML is similar to XML
  - An AML parser is available and can be used
    - Can also read and write SIF
    - Has been tied to PLACET
    - Plans exist to tie it to SAD, LUCRETIA and MERLIN

LUCRETIA

- MATLAB based toolkit
  - Performs tracking
  - Correction and tuning is user supplied
- LIAR and DIMAD are no longer supported
- Mass production runs using MATLAB compiler
- Used for ATF2
- To be included
  - Undulator
  - IR solenoid
  - Better cavity wakes
- Reference documentation available
  - Tutorial to come
- Way cool with it’s own cult

PLACET

- tcl/tk and OCTAVE interface
  - Dynamic libraries
- AML interface+some more available
- Coherent/incoherent synchrotron radiation
- Collimator wakes, also from GdfidL
- Misalignment, correction and tuning routines are included
  - Can use your own ones, if you like
- Preliminary MPI version exists
- Halo and tail generation module
- Some reference manual available
  - Tutorials on the web
  - Online help
- Used for ATF2

CHEF

- A library
  - Contains tracking
  - Correction and tuning left to the user
- Wakefields are to be improved
- Significant modifications
- XSIF interface rewritten
- Some concerns about status of AML

Conclusion

- Integrated simulations move forward
- Confirmation of BDS alignment is needed
- Interesting ideas on feedback improvements
- Several codes are being developed
  - Way cool, way hot...
- More work to be done