Progress in 2006 of ELAN-BDYN and INSTR

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Remarks

- Quite some progress for instrumentation and beam dynamics for ILC and CLIC
- A lion share of the European progress has been made in EUROTeV
- ELAN supported important meetings
  - LET meeting at CERN (focused on ILC)
  - With a CLIC day before
  - GDE meeting in Bangalore
  - Will support ILC school in Japan

ILC Accelerator Physics Page

- http://www.linearcollider.org/wiki/doku.php?id=rdr:rdr_ts:accelerator_physics
- Contains information about tasks
- Answers to the main linac area group
- Information about benchmarking

LET Workshop for ILC

- About 30 participants from all regions
- 17 presentations
- 1 video session
- Left enough time for discussion
  - Many discussions
- Homework done during workshop
  - New main linac lattice
  - Benchmarking started
- A CLIC day before

Programme

- Lattice Design
- Main linac studies
- Beam delivery alignment
- Ring to main linac alignment and tuning
- Beam delivery system tuning
- RDR preparation
- Polarization issues
- Instrumentation requirements
- Summary

Lattice Design

- RTML
  - The ring to main linac lattice had not been finished at the time of the workshop
  - Is ready by now
- Main linac
  - No common lattice prior to workshop
  - Beam dynamics lattice as been developed during workshop (P. Eliasson, P. Tenenbaum)
  - Detailed lattice left to N. Solyak
  - If we find a difference design would need to be reconsidered
- BDS
  - Ready, some modifications since workshop

RTML

- Presented by P. Tenenbaum (SLAC)
- Complicated system with many different sub-systems
- Not ready at time of workshop
  - Available but not yet tested by us
- Bunch compressor can probably be used in beam-based main linac alignment

Main Linac

- Main problems are
  - Tunnel that follows the earth curvature
  - Alignment of first part of the linac
  - Reliability of performance simulations (beam based alignment)
  - Effectiveness of tuning bumps
  - Long range wakes
  - Dynamic effects during correction
- Different alignment techniques exist
  - Dispersion steering
  - Ballistic alignment
  - Quad shunting
  - Kick minimisation
- Main focus is on dispersion steering

Tunnel Curvature

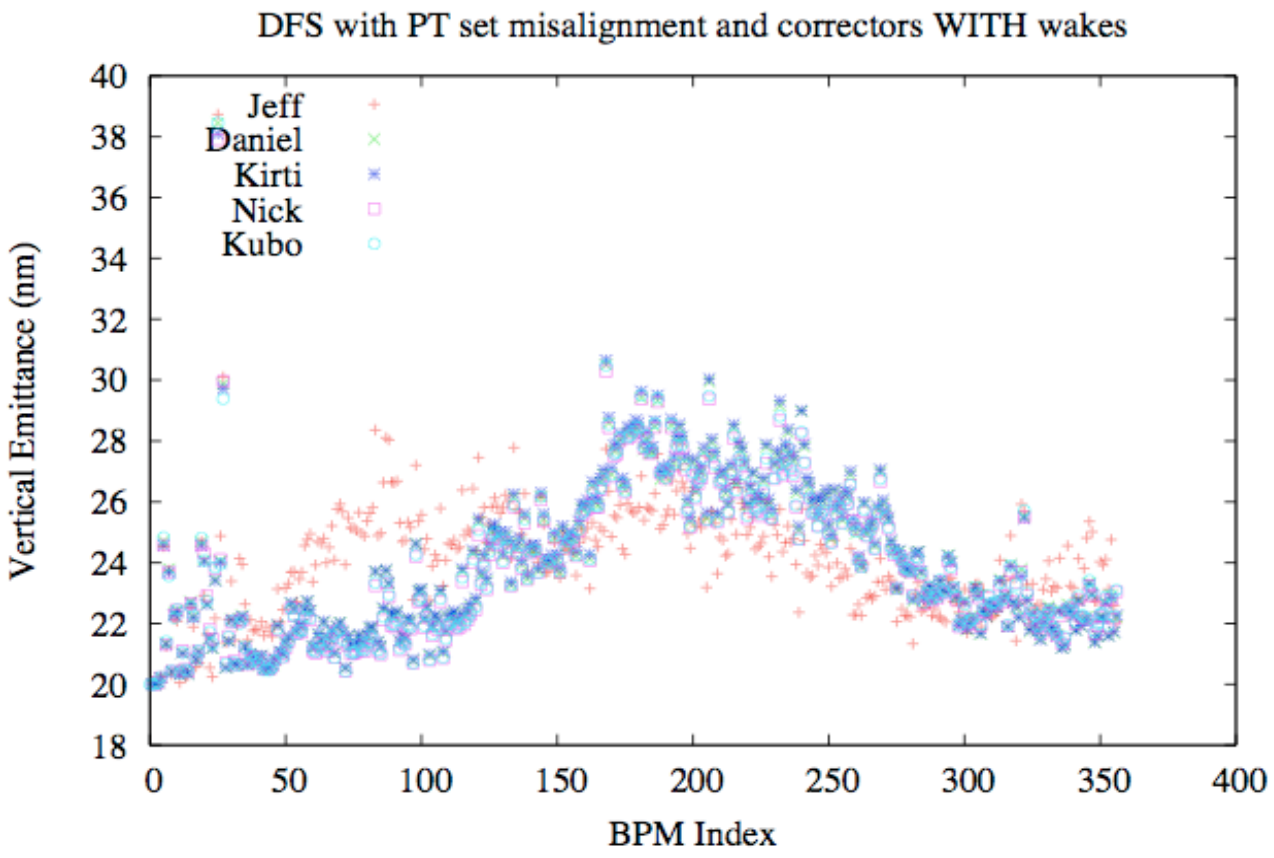
- Simulations performed at F. Poirier, K. Kubo and D.S.
  - For the usual errors performance of the curved linac is the same as for laser straight if carefully matched
- Synchrotron radiation seems acceptable (D.S.)
- Power supply stability requirement is acceptable provided intra-pulse feedback is used after the linac (K. Kubo, D.S.)
- Main problem is BPM scale error (F. Poirier, D.S.)
  - Scale error has a similar effect as BPM resolution but scales differently with the alignment method
  - A 10% BPM scale error is significant for emittance
  - For very good BPM resolution (1 micron) the scale error can play significant role
  - But still seems acceptable
  - Tuning bumps should help (P. Eliasson)

Alignment of the Linac

- The dispersion steering relies on different beam energies
- Difficult to achieve at start of the linac
- Idea is to use bunch compressor
  - Varying the compressor phase, one changes the beam energy and phase at the linac entrance
  - Results are very encouraging (A. Latina, CERN)
- Benchmarking is crucial (all)
- Tuning bumps are efficient (P. Eliasson)
  - With simple one-to-one almost sufficient
  - More details to be added
- Dynamic simulations started (D.S.)

Benchmarking

- Benchmarking started at ELAN workshop
- Compared misaligned and corrected machines
  - Subtraction of large numbers
- Need to compare aligment simulations next



Long Range Wakes

- R. Jones pointed out that rotating long-range modes are a potential problem
  - Damping is not the same in all directions
  - An couple horizontal beam jitter in vertical kicks
- Mitigation is to split the tune of the lattice
  - Rogers simulations support this
  - To split the lattice tune had already been foreseen in Snowmass
  - Cross check of results planned

BDS

- The lattice is quite final
- The beam-based alignment and tuning is crucial
- Very detailed simulation of static tuning by G. White (Oxford)
  - Magnet alignment and knob tuning at IP
  - Achieving 80% of expected geometric luminosity seems “straightforward”
  - Reclaiming the last 20% seems somewhat tough
    - Some proposals for solutions have been discussed
    - Required tuning steps subtle?
- Quite a variety of signals available for final tuning
  - Beam-beam deflections, pairs, beamstrahlung…
  - All have their benefits and drawbacks

Polarisation

- Important to take into account now to not create problems later
- J. Smith
  - Polarisation added to BMAD
  - Tracking studies in the different sub-systems
- I. Bailey (Liverpool/Cockroft)
  - heLiCal collaboration
  - Development of tools for all sub-systems
- P. Schmid (DESY)
  - Designed and evaluated a spin rotator

Instrumentation Requirements

- M. Ross informed about the instrumentation foreseen and the cost of some of these items
- Can find information via the ILC wiki

Main Linac Issues from Area Group

- Quadrupole design issues
  - Could answer for field strength
  - Tolerances on field quality are likely not tight
    - Could be given by background issues rather than luminosity
  - Stability requirement is known
  - Some alignment methods require fast field changes with certain precision requirements
  - How often do we trim the quadrupoles?
    - Need to discuss with main linac area group
- Corrector Issues
  - Range, tolerances, speed, stability
  - We want small steps

Main Linac Issues 2

- Feedback
  - No intra-pulse feedback foreseen in the main linac
- BPMs
  - Proposed 300nm resolution bunch-to-bunch
  - Good enough
- Methods to keep quadrupoles matched to beam energy and regulate beam energy at the linac end
  - To be discussed with the operation experts

RDR Preparation

- Extensive discussion on what we want to achieve
- Top priority: sufficiently complete static tuning studies to credibly support luminosity promises
  - Or refute them!
  - Understand costs – “We can make 2e34, but the tolerances on the alignment must be tightened by X%”
- Mapped out the tasks and (in general) who will do them
  - In some cases we only know the institution, in other cases an actual name
    - Dangerous! Harder to hold a lab’s feet over the fire than a person’s!
  - Caution – we’ve had ample time in the past to do everything we now want to do in the future
    - LET work generally requires serious time commitment
    - Easy to get chewed up by hundreds of small, short-term crises

Work Distribution

- From GDE meeting
- Static Performance Study
  - Bunch Compressor
    - PT (develop method); DESY, (CERN), J.Smith(testing), Eun-San Kim(testing +?)
  - Main Linac
    - D.Schulte; J.Smith, Fermilab, K.Kubo, CERN, X.Zhu, DESY
    - DFS, BA, Kick Minimization, Quad Shunting, Bumps
    - Benchmarking
  - BDS
    - G.White (develop method); DESY (check method), (CERN, check method), KEK (S.Kuroda and T.Okugi, check method, compare with ATF2)
- Dynamic Performance Study
  - Ground motion/luminosity decay with time
    - DESY will provide RF models
    - DESY, G.White, CERN, (KEK: Kuroda, Okugi, Kubo)

ELAN-INSTR I

Database of Instrumentation:
http://www.pp.rhul.ac.uk/~blair/ELAN/INSTR/ELAN_INSTR_home.htm

Set of links to EU instrumentation projects:

- The UK Linear Collider LC-ABD Collaboration
- Laser based beam diagnostics (mainly laser-wire and laser R&D)
- Confocal Resonator Beam Position Monitor at Uppsala/CERN
- Energy Spectrometry at UCL, Cambridge and RHUL
- The LAL Pulsed Laser Injected Cavity Experiment
- Precision Time and Phsae Monitoring and Wide Band Current Monitor at CERN

ELAN-INSTR III

Also links to the GDE Instrumentation wiki:

http://www.linearcollider.org/wiki/doku.php?id=bcd:instrumentation_and_controls:instrumentation_and_controls_home

The ELAN database will now be centred in the GDE Instrumentation and control structures.

Note: emerging list of ILC R&D priorities can be found at:

http://www.linearcollider.org/wiki/lib/exe/fetch.php?cache=cache&media=rdb%3Ardb_external%3Ard_master20060407.xls

ELAN-INSTR II

Further links to:

- Fast Luminosity Monitoring based on low angle calorimeters
- The CARE-HHH-ABI network.
- The DESY MDI group
- The DESY-Zeuthen beam diagnostics studies
- The EUROTeV Diagnostics Work Package

And links to the XFEL diagnostics:

- Standard Beam Diagnostics
- Special Beam Diagnostics

Conclusion

- The organisation for ILC has been taken over by GDE
  - Large amount of work is being done in EUROTeV
- CLIC is largely covered in EUROTeV
- ELAN instrumentation and beam dynamics workpackages can focus on
  - Communication
  - Knowledge dissemination
  - Preparation of future bids