ILC – Accelerator Simulation Plans

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Scope & Motivation

- Support & develop accelerator simulation packages to understand the beam physics and control issues of the ILC
- Motivation: Learn enough Beam Physics via simulations to obtain “real” (or just “reasonable”?) confidence such that our design will work and can be accurately costed.
- Focus is on the Main Linac (as suggested by S. Mishra)..with caveats..

ILC Challenges & Simulation

- Low Emittance Transport (LET)
  - Emittance preservation is critical for Luminosity
  - A formal Working Group at ILC workshops.
  - Requires extensive simulations of the static & dynamical machine.
- Machine Protection.
  - Related to emittance preservation!. and....
- Both topics requires exquisite control systems.

Controls & Simulation

- Control system cheap with respect to other hardware, so why bother ?
- Because it is an indirect cost driver!
  - ILC is a “flying brick”, need sophisticated feedbacks & controls.
  - If components can not be controlled accurately or reliably, more hardware (i.e., tunnel stubs, turn-around (DR -> BC)) is needed. -> cost.

Where Simulations are needed...

- From http://www.linearcollider.org/cms/?pid=1000095
  - 2 **- Beam and luminosity parameters**
  - 3 - Main Linac Starting Gradient, Upgrade Gradient and Upgrade Path
  - 4 - **Straight or vertically curved tunnel Straight or earth's curvature - Incline Limit, Cryogenic Standpoint**
  - 6 - **1 vs 2 tunnels**
  - 7 - Damping ring size and layout
  - 8 - Positron Source Type
  - 10 - Damping ring location
  - 12 - How much is a 1% change in average luminosity worth?
  - 13 - Maximum AC power the site can use?

Plans, Summary

- Infrastructure
  - Software: Packages, Tool-kits, libraries.
  - Hardware: Do we have enough gear?
- Beam Physics and Algorithms
  - Towards the dynamical machine.
- People
  - Yes, we need more.

Plans/Software

- Many efforts across ILC collaboration. Many interesting packages.. Probably too many!...
- Personal opinion: None of them strong enough (now!) to support a complete simulation of the entire LET complex, in dynamical mode (including controls & anticipated failure modes)
- Consensus among pro's : Tool kit approach more sensible than rigid executable.. Yet, from an architecture stand points, many of these packages pre-date the concept of tool-Kits, especially OO ones..
- Package merging, re-modeling, or re-designing overall strategy a bit unclear at this stage.
- ==> More studies of the existing suite is needed.
- ==> More prototyping of extensions to these software.

Plans/Software, Benchmarking...

- Informal and more formal benchmarking will play a very constructive role.
  - We have (almost!) a common input for the static description of the lattice, via “MAD” or “SIF” or “XSIF” ASCII data files.
  - Discussions, and a project (AML-Cornell) to extend the machine description based on XML
  - To incorporate Alignment data (Queen's Mary College)
- Standard mis-alignments and steering (correction and control) algorithm...
  - No agreed upon programming language.. (TCL, Matlab, C++, F95..)
  - A serious handicap in reaching “end-to-end, integrated & dynamical simulation of LET” : many algorithms have to be re-implemented in many of these packages.
- Leveling of existing other projects, e.g. SciDAC (e.g. Synergia)

Software, short term plans

- Keep learning/investigating existing packages:
  - Lucretia/Matlab on ilcsim:
    - need to document “1 to 1” steering for Quad 1-D misalignment (works too well, I suspect)
  - Learning Placet via benchmarking
  - Same for Merlin
- Keep up with informal discussion in LET group
- Meet and discuss with Nick Walker (and/or Daniel Schulte) this week.
- Next LET workshop?

Man Power.

- Currently, technical man power <~ (bureaucracy + management)
- Real need of
  - Accelerator physicists
    - PostDocs or Application Physicists
  - Software engineering
- Most important, and difficult, budgeting issue.