Spin Dynamics and Main Linac

Always acknowledge a fault. This will throw those in authority off their guard and give you an opportunity to commit more mistakes

(Mark Twain, 1853, 1910)

Paul Lebrun

Fermilab

Spin Dynamics

- Tony Hartin gave us a compelling overview of polarisation losses through the entire LET system, on behalf of collaboration from Cockroft Inst, Oxford, Desy and IPPP, Durham.
  - Review of many processes, spin direction change either because of quasi continuous precession, or radiation.
  - Confirming and improving the precision of the calculations
  - PolarisationLosses are small IP 0.1%, BDS, .06 %...
  - But! Requirement challenging: "**Precision physics requires uncertainty ≤0.1% on luminosity-weighted polarisation.**" I presume this can be achieve via fast cycling of spin direction => dynamic effects needs to be studied..

Main Linac

- 6 Talks, from Chris Adolphsen, Kiyoshi Kubo, Andrea Latina, Freddy Poirier, Nikolay Solyak and Valentin Ivanov
  - And a Joint session Wake Field and Coupler wakes
- Overall remark:
  - Many talks discussed dynamic effects => progress ! (we are (slowly) doing what we said we would be doing ~ a year ago...

Main Linac, Requirements (Chris A.)

- LET advocate are participating to ~3 out 4 main work package.
- Some “first cut” (and in some cases, fairly evolved..) answers to Chris A. on requirement for;
  - energy stability (jitter < 1.5%)
  - Alignment tolerances and set of surveyor reference marks
    - *No longer using a perfect, mystical line on which the machine is layed out.*
  - Quad motions... 100 nm to 500 nm... Need refinement, but difficult
- But no (or not much) analytical studies.. *Do we rely too much on our codes?*

Revisiting Previous calculations (Kiyoshi K.)

- Based on a new alignment model.
  - Performance is a bit worse. In the static case, we no longer have a safety margin, without “global correction” (bumps of various kind).
  - DFS tuning: improved precision, revealing disagreement between Kirti's work and current calculation.. ? (*not sure what to add..? Do we try to resolve this?*)
- Some dynamic effects..

Main Linac Simulation (Andrea)

- ⇒ Static alignment strategies for a laser-straight and a curved layout
  - use of BC to align the ML
  - weight scan for DFS with two test beams
  - emittance tuning bump
  - impact of BPM calibration errors
- ⇒ Dynamic effects
  - quadrupole jitter during alignment
  - ripples of the RF gradien
  - luminosity loss due to quadrupole jitter
  - MICADO in the main linac

WakeField and Coupler Kicks

- We got a “fix-it” plan..
  - See summary talk this morning
  - Work to be done to incorporate sophisticated wakes and kicks in our code.
    - Does this requires 6D tracking codes? Or “quasi 6D” ?

SVD Analysis (Andrea L., Nikolay S.)

- Orthogonal bumps studied in details leads
  - Better understanding of the system
  - Better performance
  - Exploit this technique in more complex cases, such as curved Linac, BDS,....
- Question:
  - Aren't these “good knob combinations” just an other facet of the suppression of the quasi-null space of SVD ?(If so, this technique routinely used at Argonne and FNAL to re-align machines...)

DFS with Dynamic Effects

- Started about 6 month ago, Desy and FNAL. Published at PAC07. (Freddy and myself).
- Conclusion (Freddy Poirier's talk..)
  - With the simple CL model, 200um/600m no significant impact on the corrected emittance.
  - Though the impact of a random-walk-like correlation could be non negligible if alignment was worse. The results are highly dependent on the values of the alignments (need to be precise on what we mean)
  - Here the choice of a wrong weight for the DMS could make things worse (scanning the weight would resolve the problem).

Wake-up people: Joint session Wake Field/LET

- But making summary of summary is difficult...
- Complexities...
  - Design details... Multiple cavity... manufactoring imperfection(s)..
- Awaiting for the summary sheet from Wake Field experts, such that this info can be transferred to our codes.
- Can't be ignored.

The next challenges

- Documentation (for future generations..)
- Pursue Dynamic Studies
- Integrated **all** known effects when tuning and maintaining performance. Document performance
- Interface with “Start to End” simulation.