Simulations
- Beam dynamics in low emittance transport (LET: From the exit of Damping Ring)

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Past works of low emittance transport simulations

- In early stage, a lot of works on Main Linac
  - Mostly (not all) on static errors.
  - Results were satisfactory, except for some small issues to be studied more (see later)
  - Many Codes were developed and bench marking was performed. successfully.
  - In 2006 summer at Vancouver meeting, we agreed to “move” to other areas (BDS, RTML) and dynamic errors.
- BDS, luminosity performance studies
  - By 2007, tuning procedures and feedbacks in BDS were simulated, showing good luminosity performance.
- RTML low emittance preservation
  - Started relatively late, but by 2007, all beam lines had been simulated.
  - Results are promising, though not satisfactory. (see later)

We performed beam dynamics simulations for all LET beam lines. Results are promising. No serious problem is expected.

Man power

- We lost some active persons since Dec. 2007. (They are moved or assigned to other projects.)
- To make clear commitments is difficult for many people who can work for ILC only part time.
- It is hard to assign responsible people to every “possible issue”. Assign to only “known important issues”.
- Collaboration with CLIC may help us.

Remaining LET Beam Dynamics Issues

Need to find solutions

- Survey alignment modeling
- Main linac BPM scale error.

Need to be checked

- Emittance preservation in Bunch Compressors (Ref. Solyak's talk)
- Stray fields in long transport from DR (Ref. Solyak's talk)
- Emittance preservation in e- linac including undulators

Not much have been done yet

- "Start to end" simulations - effects of various jitters and possible cross talks between different feedbacks

Long-range alignment modeling

Present status of survey/alignment simulations

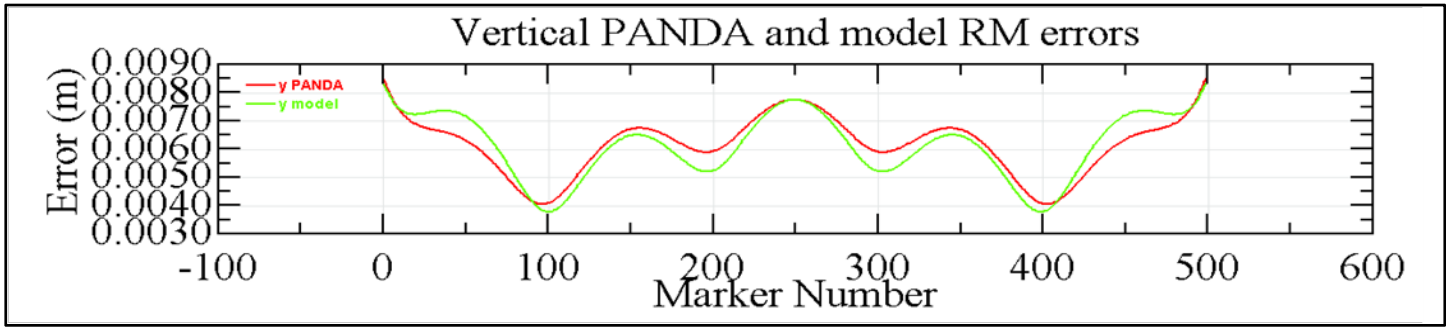
- We use simple, tentative models, which has not been checked by survey/alignment engineers.
- We have not provided survey/alignment spec which can be translated to engineering requirements.

We need to work closely with alignment experts but we do not have responsible people in ILC-GDE.

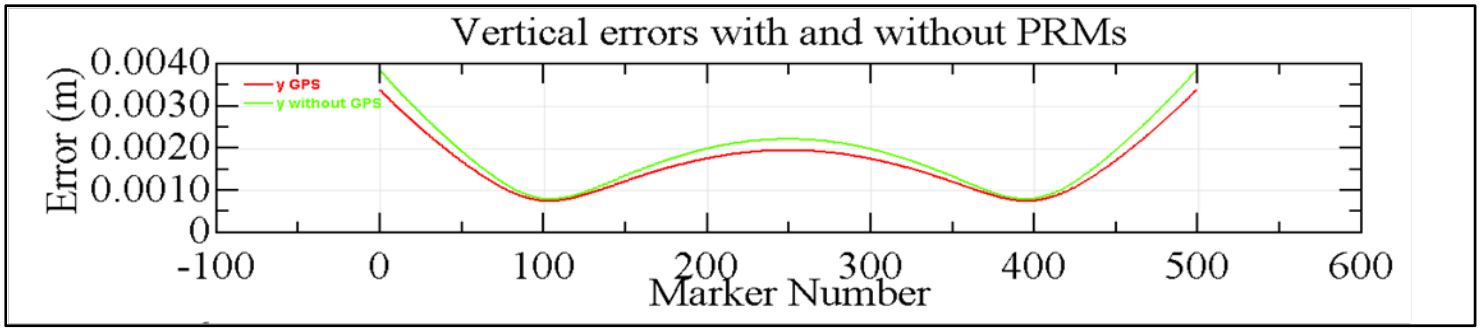
There are some past works (DESY and KEK, in beam dynamics) and present activities (Daresbury, survey and beam dynamics).

Example of survey simulations

Model for representing Laser Tracker network,
compared with results of a commercial software package "PANDA"



Model for representing LiCAS RTRS

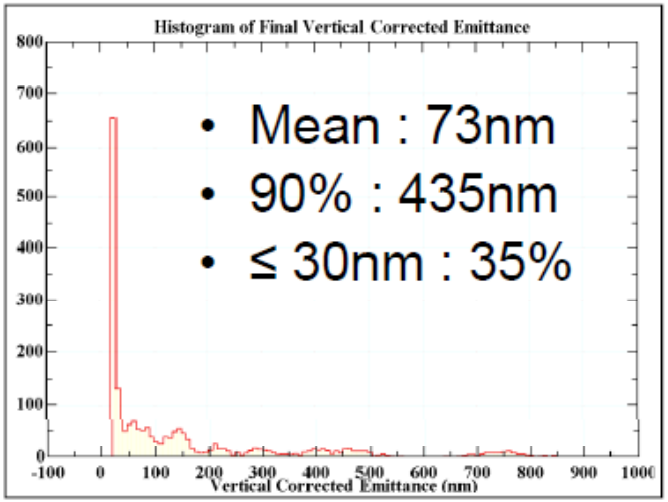


John Dale, LET Beam Dynamics Simulation Meeting, 19 March 2009

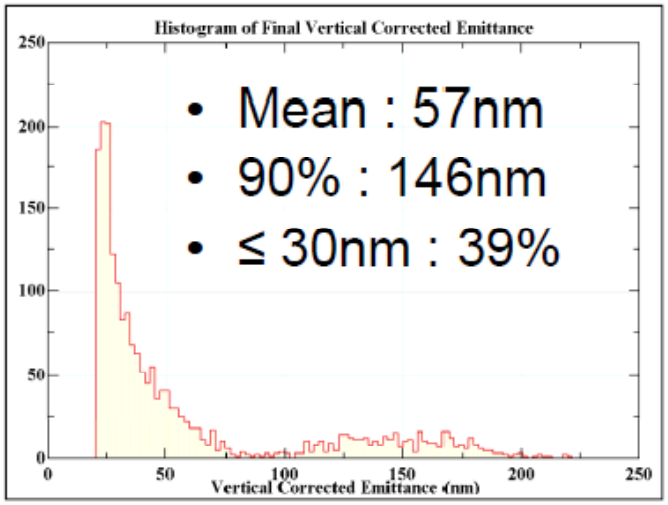
DMS (Dispersion Matching Steering) Simulations (emittance distribution)

Laser trackers

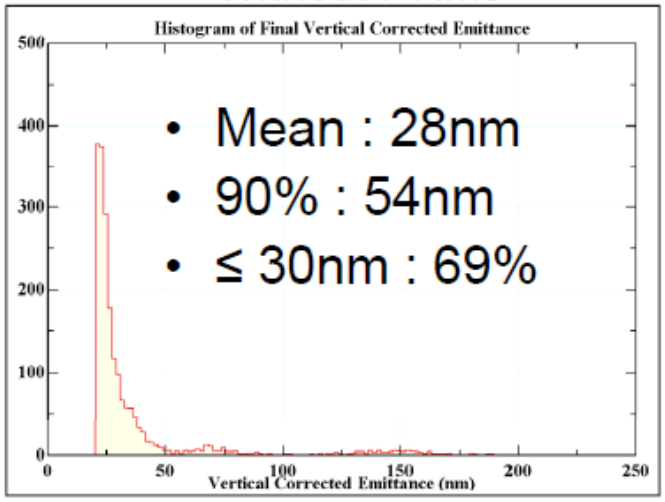
Model



PANDA



LiCAS RTRS



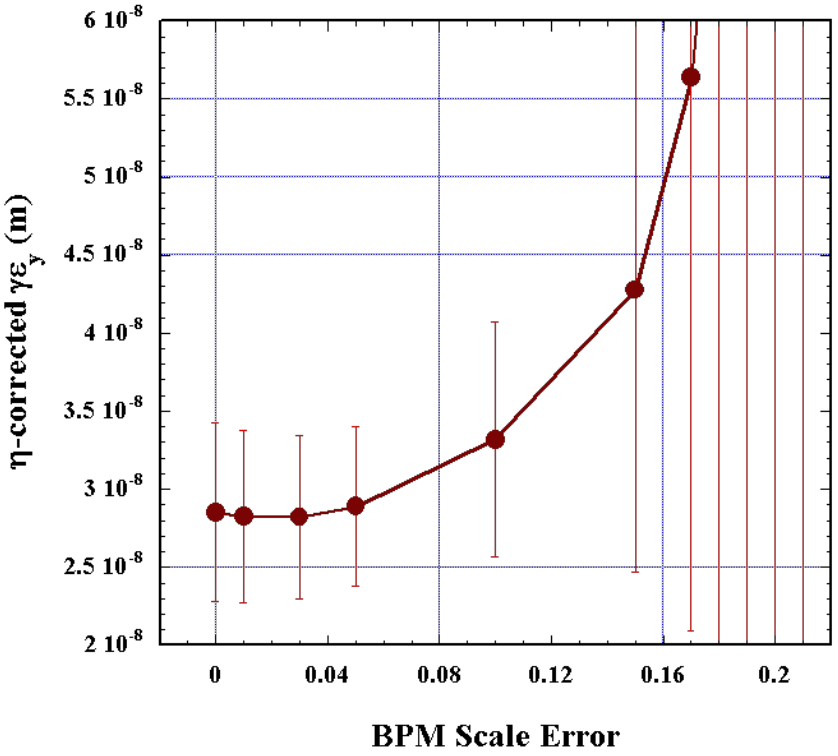
John Dale, LET Beam Dynamics Simulation Meeting, 19 March 2009

Main linac BPM scale error

- BPM scale error affects performance of Dispersion Matching Steering. (DMS is adjusting dispersion at every BPM, which is designed to be non-zero because the linac is curved following the earth.) Tolerance is a few %.
- This issue is related to beam energy error and magnet strength error
  - Knowing beam energy and magnet strengths (ratio of them) accurately, BPM scale can be calibrated.
  - Calibration procedure should be considered, then simulated.
    - Note that beam energy will be measured before and after the main linac, not in the linac.

Emittance vs. BPM scale error in ML with standard errors

Average of 40 random seeds.
Error bars indicate standard deviations



from K. Kubo, Report in ILC LET Beam Dynamics Workshop, SLAC 2007
http://ilcagenda.linearcollider.org/conferenceDisplay.py?confId=2364

Emittance preservation in Bunch Compressors

Simulations so far shows emittance increase in Bunch Compressor about 6 nm, while emittance budget in RTML is 4 nm.

(The budget probably can be increased by factor 2, reducing the budget for ML.)

- Dispersion Free Steering (DFS) is not effective at the very beginning, because beam energy can not be changed there.
- Effect of cavity tilt (pitch) and correction should be studied more.
  - In DFS, RF phase or amplitude is changed. It also changes transverse kick due to cavity tilt, which affects DFS.
- Correction methods other than DFS should be checked
  - Preliminary study of pitch adjustment (movers of cryomodules) showed good results.
  - E.g., Corrections based on direct measurement of transverse kicks by cavities.

(See Sloyak's report.)

Emittance preservation in e- linac including undulators

Two possible problems

- Emittance dilution in the undulator section
  - Some studies showing no serious problems. But need more systematic studies and cross checks.
- Problems from small momentum acceptance of the undulator section
  - May Prevent DMS correction in e- linac
  - It has not really studied.
  - Bypass line may be necessary.
  - This problem is solved by moving the undulator to the end of the linac as proposed in the MM document.

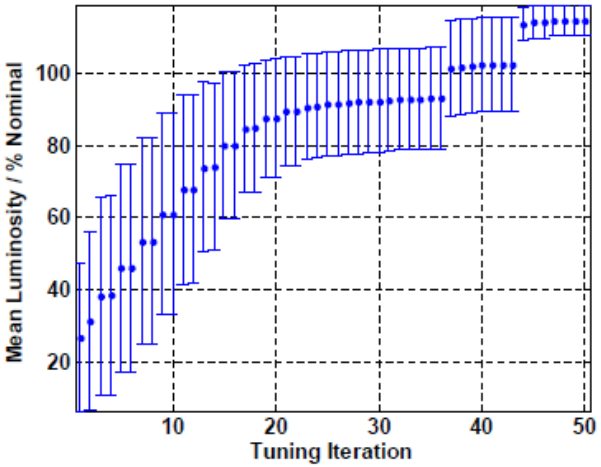
BDS - Luminosity tuning

- Studied very well, though some remained issues.
  - Two beam luminosity tuning (Most studies simulated only one beam.)
  - Modeling of error of magnet strength error
  - Wakefield effects (collimator wakes)
- Comparison with experiments of the final focus system - ATF2

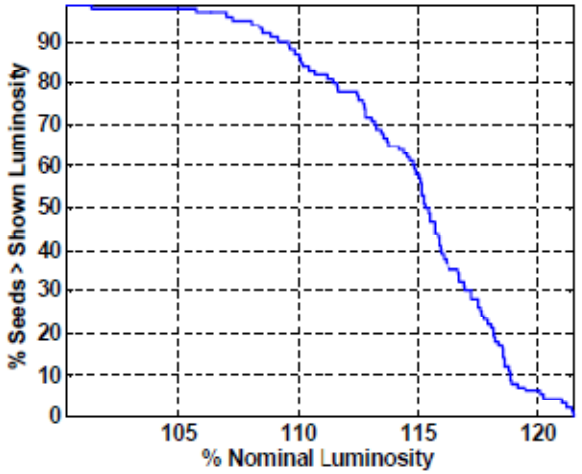
Results of Luminosity Tuning Simulations

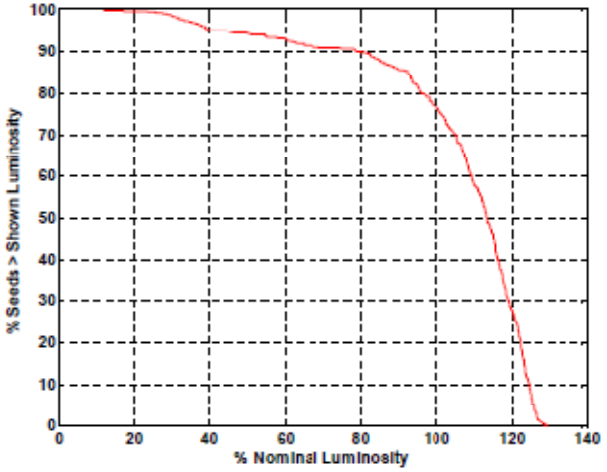
Glen white, report in ILC-LET Workshop, SLAC, 2007

Luminosity vs. tuning iterations (single sided simulation)



Achieved luminosity. Single and two sided simulations





Integration of studies of all LET beam lines

- Many common issues, tools and persons
- Communications between different “areas” are critically important
  - These are why our group exists.
- Start (DR) to End (IP or Dump) simulations
  - Set realistic initial condition of each beam line section from upstream simulations
  - Include various jitters and drifts from Damping ring to IP
  - Check possible cross talks between different feedbacks.
  - The goal will be time dependent luminosity with jitters and drifts
  - This has not really been started yet.

SUMMARY

- We performed beam dynamics simulations for all LET beam lines.
- Results are promising.
- There are some remained issues.
  - Any of them are not considered to be serious.
- We will concentrate on important issues.
  - It is difficult to cover all possible issues due to limited man power.
  - Communication and integration of studies of all LET beam lines is important