Cornell University
Laboratory for Elementary-Particle Physics

Cornell Plans for RTML EDR Work

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Cornell LEPP

Cornell's role in the RTML

- The RTML presents a significant number of accelerator physics design challenges, many of which must be confronted during the ILC EDR phase, currently envisioned for the period FY08-10. In most of these areas, participation of Cornell faculty, staff and students would be of major benefit to the ILC program.
- Cornell has already been active in this area, with partial funding coming from a DOE grant. Cornell is part of the low emittance transport working group collaboration, and has made significant contributions to the study of dilution mechanisms in the main linac and beam based correction algorithms.
- We have also contributed to the design of the spin rotator in the baseline design of the RTML.
- For the work proposed here, we will continue to work in close collaboration with the ILC Beam Dynamics group at SLAC, and continue to reproduce studies at SLAC, FNAL and elsewhere as needed to establish the credibility of the modeling software.
- The work packages described here cover the FY08-09 period and have been included in the FY08-09 ART plan as of May, 2007. The funding source has not yet been established.

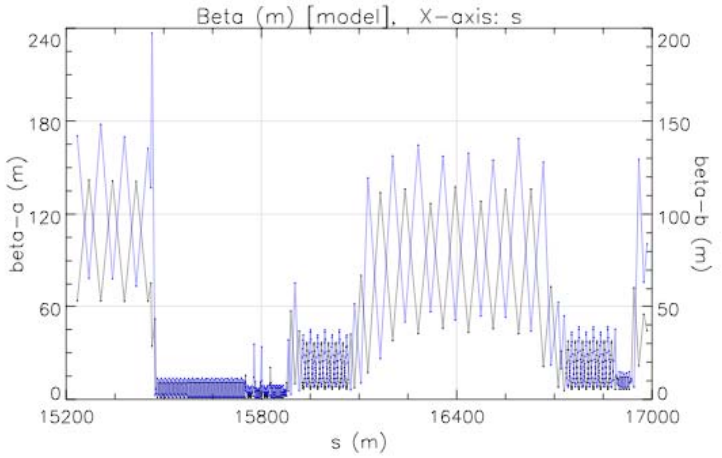
WP1: Lattice Design for EDR Geometry

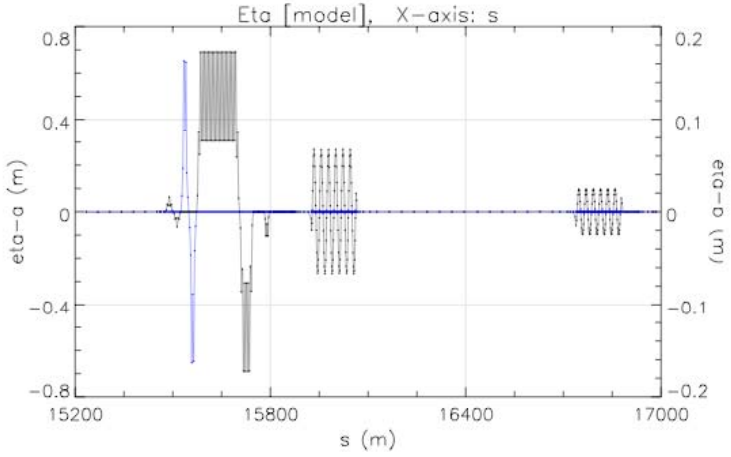
Optics design of transfer lines, arcs, doglegs, and betatron/dispersion matching necessary to match the RTML design to the site geometry chosen for the EDR. Includes beamlines from damping ring extraction, through "Escalator", Return line, and turnaround, and thence from BC2 to start of main linac, in coordination with lattice development team.

RTML lattice in Tao/Bmad

We have implemented a description of the current RTML lattice in Tao/Bmad and checked agreement with RDR design.

May 2007 RTML lattice:
Bunch compressor region lattice functions





WP 2: RTML Emittance Tuning

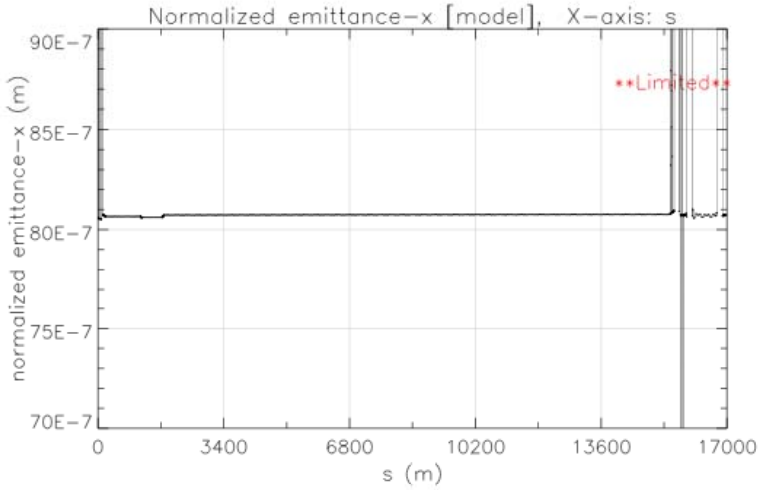
- Implement established RTML emittance tuning algorithm(s) using modeling software developed at Cornell, BMAD and TAO and compare with results of studies at SLAC, KEK, FNAL and elsewhere. Investigate and develop alternative emittance tuning strategies.
- In the second year, complete emittance preservation studies in RTML. This will include static tuning, alignment/error sensitivity studies, failure mode analysis, beam and accelerator component jitter analysis. Consider the effect of stray fields in the return lines.

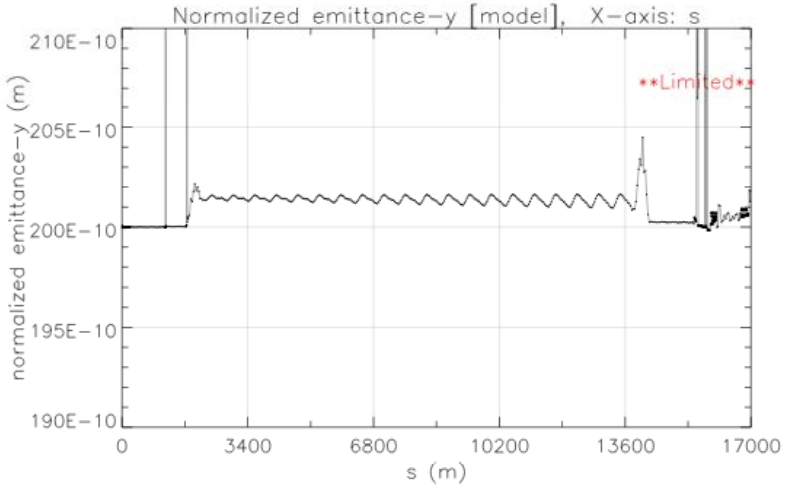
WP 2: RTML Emittance Tuning (cont.)

- This is an extension of the work already underway at Cornell to understand sources of emittance dilution in the RTML. Continue modeling of the baseline RDR design. A Bmad representation exists for all of the relevant beamline components, including spin tracking through solenoids and acceleration in 6-d phase space through RF cavities and wigglers.

RTML emittance in Tao/Bmad

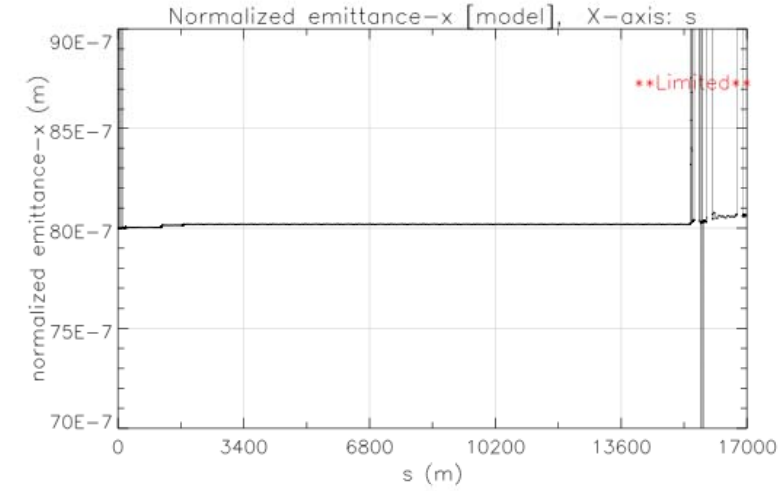
- Emittance transport in RTML (no errors)

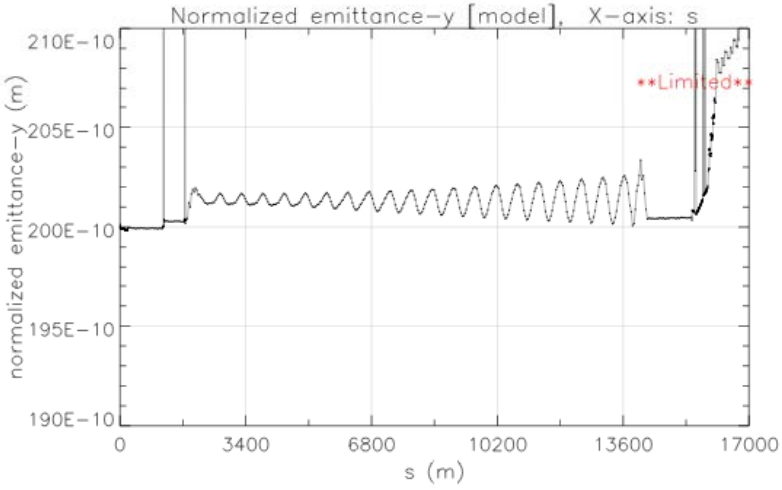




RTML emittance in Tao/Bmad

- Emittance transport in RTML (5 μm vertical offset in one QD in the return line at 4577 m)





WP 3: Ultra-Short Bunch Compressor

- An ultra-short bunch compressor can in principle deliver beams with the required parameters to the start of the linac and at somewhat lower cost than the baseline design. However, it is unclear whether or not field and alignment errors can be systematically tuned out since a configuration for orthogonal dispersion correcting knobs is not evident.
- Investigate the tunability of the optics of the ultra-short bunch compressor. Complete the design work as required and characterize sources of emittance dilution, and energy and phase errors, and then search for beam based correction algorithms that systematically yield bunch parameters consistent with design objectives. Modification of the optics and the deployment of instrumentation will be considered in the interest of attaining adequate tunability.

WP 4: Beam Tails

- Beam tails generated in the damping ring will be eliminated by collimation upstream of the main linac. Extend the tracking studies to include tails, (particles at large energy and transverse amplitudes) so that we can evaluate the effectiveness of collimators in eliminating damping ring generated halo. Effects of multiple Coulomb scattering will be included.

Resources

- Faculty: G. Dugan, D. Rubin (summer salaries)
- 1 full-time post-doc
- 1 full-time grad student
- $10K M&S
- Totals: $275K ($285K) in FY08 (FY09) includes $95K ($99K) indirect costs

Conclusion

- At Cornell, we are ready to contribute modestly to the ILC RTML EDR effort.
- Our intention is to capitalize on our strengths, by a focus on physics analysis and simulations.
- We have substantial experience in accelerator design, and we provide an opportunity to train future students in the field.