



Injection, Extraction and Abort Line Optics

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Cornell ILC Damping Ring Workshop, September 26-28 2006



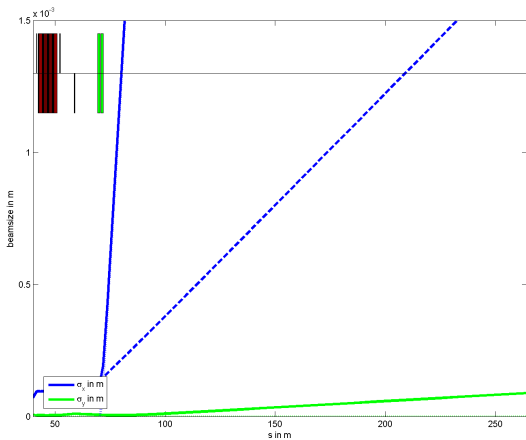
Introduction

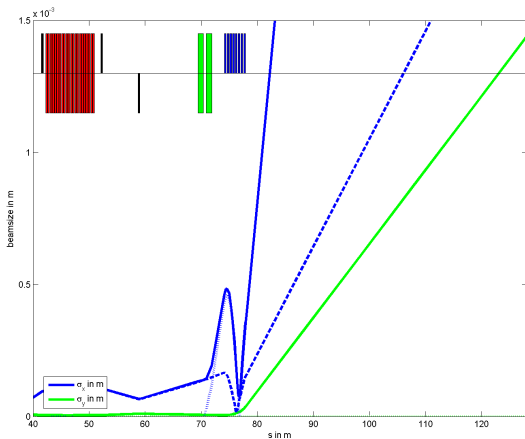


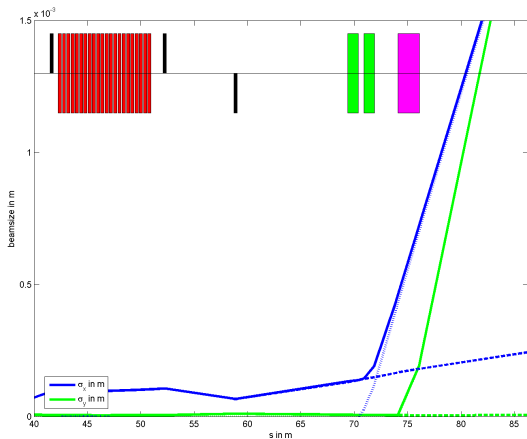
- ▶ Lattice up to and including septa done by Aimin Xiao (ANL).
- ▶ Use damping ring quadrupoles and RTML bending magnets (RTML6-type, 2 m long, up to 193 mrad bending angle).
- ▶ Current design has injection and extraction in same long straight, abort line in opposite long straight.



- ▶ To avoid damaging dump, beamsizes at dump needs to be $\mathcal{O}(1 \text{ mm})$, i.e. much larger than beamsizes of damped beam ($\varepsilon_x = 500 \text{ pm}$, $\varepsilon_y = 2 \text{ pm}$, and $\frac{\Delta E}{E} = 1.3 \times 10^{-3}$).
- ▶ For a simple estimate use extraction (horizontal plane).
- ▶ If it takes too long for beam to grow, add magnets.









Summary for Abort Line



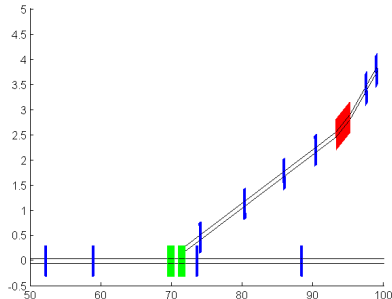
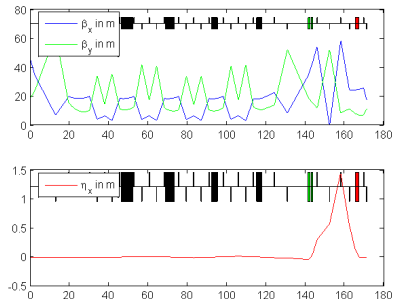
- ▶ Without extra magnets, abort line is too long.
- ▶ With quadrupoles (DR type), lots of them are needed and the line is still long.
- ▶ With one vertical bending magnet (RTML6-type, 2 m long, 150 mrad bending angle), the abort line would be $\mathcal{O}(10\text{ m})$ long.
- ▶ Haven't looked at coupling using skew quads but that likely requires $\mathcal{O}(4)$ quadrupole magnets (two skew, two normal).



Injection Line



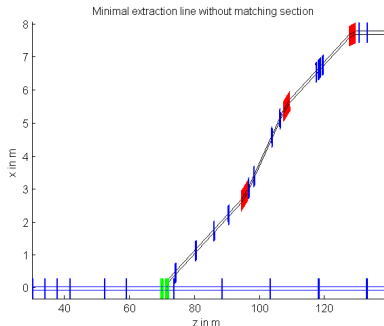
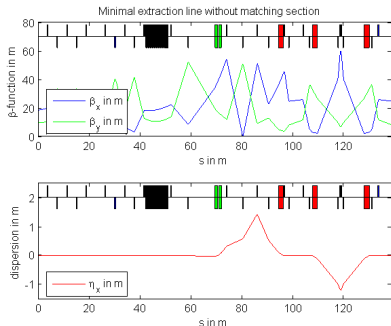
- ▶ Only need to cancel dispersion from septa and kickers, rest is done by source beamline.



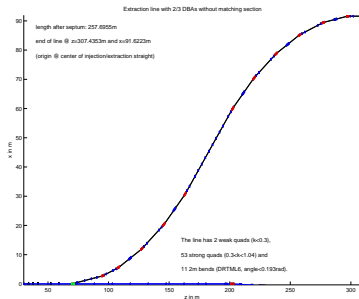
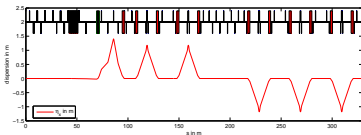
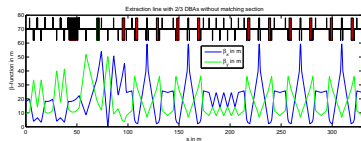


- ▶ As tunnels are laid out, the layout keeps changing.
- ▶ Modular design to respond to layout changes.
- ▶ All modules have same Twiss parameters at entrance and exit.
- ▶ Four modules:
 1. Dispersion cancellation section
 2. Double Bend Achromat (DBA)
 3. FODO section
 4. Matching section
- ▶ Modules can be put together to meet layout needs; for final layout it might be necessary to stretch or squeeze one or more FODO cells.

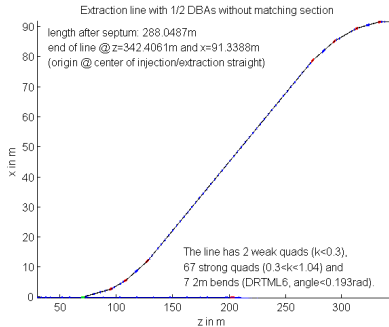
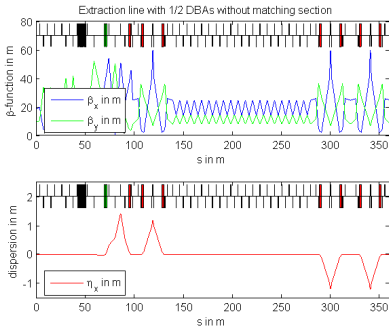
Two DR tunnels, new RTML layout
or
single DR tunnel, original DR straight



Two DR tunnels, original RTML layout, 2/3 DBAs



Two DR tunnels, original RTML layout, 1/2 DBAs





Summary of Extraction Line



- ▶ Modular design useful to quickly adapt to changing layout.
- ▶ Layout has not yet settled down.
- ▶ No studies of beam dynamics yet.
- ▶ New suggestion to invert order of injection and extraction.