2011 Damping Rings Lattice Evaluation

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March 20, 2011

Outline

- Goals for today's lattice evaluation process
- Evaluation criteria
- Ranking methodology
- Post-ALCPG11 process and plans

Goals for the Lattice Evaluation I

- Select a new baseline lattice consistent with the new ILC central region design
  - **Reduced circumference**
  - **New operating requirements**
  - **Preserve key design features of existing baseline (DCO4)**
- Be ready to begin the process of integrating this design into the final ILC Technical Design
  - **Detailed description**
  - **Costing**
  - **Performance Evaluation**

Goals for the Lattice Evaluation II

- However, we are certainly not comparing "final" designs today
  - **There have been insufficient resources to fully evaluate some issues**
    - For instance, no complete and systematic studies of instabilities is available for the current designs
    - We rely on the general observations obtained during the original baseline design process (2005-2007)
    - Where particular concerns exist, we hope to complete narrowly focused follow-up studies during the conclusion of the Technical Design Phase
  - **Our goal for today is to finalize a single path to pursue**
  - **Will need to "complete" the design in time for a DR "Baseline Technical Review" in early July**

Key Design Modifications

- Reduction in circumference – 6.4km ⇨ 3.2km
  - **“Low power” operation with 1300 vs 2600 bunches (new baseline)**
  - **Maintain beam current and bunch structure ⇨ minimal impact on performance with respect to collective effects**
- Pursue lower momentum compaction design
  - **Less conservative design with respect to collective effects**
  - **Smaller RF requirements for 6mm bunch length**
- Updated Specification for Straights
  - **Minimize length consistent with 3.2km design requirements**
  - **Maintain injection/extraction layout**
  - **Minimize phase adjustment trombone**
  - **Adjust circumference chicane**
  - **Space in RF & wiggler sections for all design options (low & high power, 10Hz ops)**
  - **Added space in wiggler section for photon absorbers**
  - **Preserve CFS interface**
- Energy Acceptance Specification
  - **Injection ±0.5%**
  - **For quantum lifetime desire at least ±0.75% ⇨ lattice evaluations at ±1%**

Ranking System

- Will utilize the same system as previously used in 2008
- All criteria are evaluated on a scale of 1 to 5
- See next slides for descriptions…

Ranking Criteria I

5 Item has been addressed in the lattice design and fully meets the DR specifications. In cases where lattice flexibility is required, the range of parameters has been thoroughly explored and meets the DR specifications for the entire parameter range. In cases where technical systems impact is being evaluated, the lattice design results in a technically feasible design with minimum cost.

4 Item has been addressed in the lattice design but some refinement is still required to meet the DR specifications. In cases where lattice flexibility is desired, work remains to ensure that the DR specifications can be met for the entire parameter range. In cases where technical systems impact is being evaluated, the lattice design results in a technically feasible design, but technical issues remain and/or cost is not the minimum. In all cases, there is a high expectation that a successful design can be completed

Ranking Criteria II

3 Item has only been partially addressed. Significant work remains in order to meet the DR specifications. In cases where technical systems impact is being evaluated, significant technical issues remain and/or significant cost optimization is required. In all cases, there is a reasonable expectation that a successful design can be completed.

2 Item has not been directly addressed in the lattice design. There is a reasonable expectation that a successful design can be achieved which meets DR specifications. In cases where technical systems impact is being evaluated, there is a reasonable expectation that technical and/or cost issues can be successfully addressed.

1 Item has not been directly addressed in the lattice design. Significant questions exist about achieving a successful design which meets DR specifications. In cases where technical systems impact is being evaluated, there are significant uncertainties that technical and/or cost issues can be successfully addressed.

Ranking Criteria Clarifications

For questions where relative rankings are required, the ranking of the *best* lattice will be calibrated with the above absolute rating scale. For cases where insufficient information exists to make an evaluation, an entry of "Ins." (insufficient) will be recorded.

Within each major evaluation item, a weighted average of the rankings for each sub-item will be used to generate the overall ranking for that item. Setting the weights of each sub-item was carried out as part of the TILC08 evaluation process and we propose to maintain the same weights for the present evaluation. In order to obtain an overall score for each lattice, each of the overall item rankings will be summed.

2011 Evaluation Criteria

1. Lattice Design and Dynamical Properties
2. Magnets, Supports and Power Supplies
3. Vacuum System and Radiation Handling
4. RF System
5. Space for Instrumentation and Diagnostics

Lattice Evaluation – Item 1

- **Lattice Design and Dynamical Properties**

a) Is the design complete? Does it include all necessary systems, such as injection/extraction optics, RF, wiggler, circumference chicane, tune trombone, etc?

b) Is there sufficient margin in general dynamical parameters (damping times, equilibrium emittance and energy spread, etc.)?

c) Does the momentum compaction factor provide a good compromise between RF requirements, at 6 mm bunch length, and instability thresholds?

d) How does the lattice compare with others in terms of sensitivity to collective effects (such as impedance-driven instabilities, intrabeam scattering, space charge, ion effects, and electron cloud)?

e) How much flexibility is there in tuning the momentum compaction factor?

f) Is the dynamic aperture sufficient?

g) Are there any particular benefits or concerns with the dynamics, specific to the lattice?

Lattice Design and Dynamical Properties

Evaluation Item	Weight	DMC3	DSB3	Other	----
1. Lattice design and dynamical properties.					
Completeness	1.0				
Margin - general parameters	1.0				
α_p choice	1.0				
Compare lattice sensitivities to collective effects	1.0				
α_p flexibility	1.0				
Dynamic aperture	1.0				
Particular benefits/concerns	1.0				
Overall					

Lattice Evaluation – Item 2

- **Magnets, Supports and Power Supplies**

a) How does the number of magnets, and the number of different styles of magnet, compare with the other lattices?

b) Are the magnet parameters (length, field strength or gradient, spacing) reasonable?

c) Compare the degree of magnet optimization required for the various lattices?

d) How do the alignment and stability sensitivities compare with other lattices? In particular, what is the sensitivity of emittance dilution due to these effects.

e) How do the numbers and types of supports required for the magnets compare with other lattices?

f) How do the numbers and types of individually powered magnets compare with the other lattice options?

g) Are there any particular benefits or concerns with the magnets, supports and power supplies, specific to the lattice?

Magnets, Supports and Power Supplies

Evaluation Item	Weight	DMC3	DSB3	Other	----
2. Magnets, supports and power supplies.					
Compare magnet counts and types	1.0				
Reasonableness of magnet parameters	1.0				
Compare degree of optimization needed	1.0				
Compare alignment & stability sensitivities	1.0				
Compare support counts and types	1.0				
Compare individual PS counts and types	1.0				
Particular benefits/concerns	1.0				
Overall					

Lattice Evaluation Criteria – Item 3

- **Vacuum System and Radiation Handling**

a) How do the aperture requirements compare with other lattice designs?

b) How does the difficulty of handling the radiation from the dipoles and wigglers compare with other lattice designs?

c) Are there any particular benefits or concerns with the vacuum system, specific to the lattice?

Vacuum System & Radiation Handling

Evaluation Item	Weight	DMC3	DSB3	Other	----
3. Vacuum system and radiation handling.					
Compare aperture requirements	1.0				
Compare radiation load issues (dipole/wiggler regions)	1.0				
Particular benefits/concerns	1.0				
Overall					

Lattice Evaluation – Item 4

- **RF System**

a) How feasible is the RF voltage required, for the targeted momentum compaction factor, to provide a bunch length of 6 mm?

b) Is there sufficient space in the lattice for all required RF cavities (allowing some margin for klystron failure)?

RF System

Evaluation Item	Weight	DMC3	DSB3	Other	----
4. RF system.					
RF voltage requirements	1.0				
Space in lattice for RF cavities	1.0				
Overall					

Lattice Evaluation – Item 5

- **Space for Instrumentation and Diagnostics**

a) Can the BPMs and other instrumentation and diagnostics be readily accommodated?

Instrumentation and Diagnostics

Evaluation Item	Weight	DMC3	DSB3	Other	----
5. Instrumentation and diagnostics.					
Accommodation of diagnostics	1.0				
Overall					

ALCPG11 Deliverables

- Goal for this meeting is to pick a basic lattice design
  - **Given the present state of development, we expect that the choice may not be "complete"**
  - **Required adjustments to the chosen design will need to be clearly identified and a timeline for implementing the changes will be developed**
  - **Will need to pursue any final modifications to the design as quickly as possible**
- We expect to announce the key elements of a 3.2km baseline design during the closeout on Wednesday

Post-ALCPG11 Process

- After ALCPG11, we will want to review final design adjustments as rapidly as possible
  - **Expect monthly WebEx meetings until this process is complete**
  - **We are anticipating a major review of the damping rings by the GDE PM team in early July**
    - The review will include a detailed systems review
    - We expect that detailed change control procedures will be implemented for the design at that point
    - The detailed lattice design will need to be complete in advance of this meeting – by mid-June at the latest!
- A full-featured design will need to be available by mid-year in order to support key activities for the remainder of the TDP
  - **Evaluation of collective effects**
  - **System conceptual design and final specifications**
  - **Costing**

Today's Agenda

8:30 - 9:00	This Talk	
9:00 - 9:30	Damping Ring Specifications	S. Guiducci
9:30 - 10:00	DSB3 Lattice Update	S. Guiducci
10:00 - 10:30	Coffee Break	
10:30 - 11:00	DMC3 Lattice Update	J. Gao/D. Wang
11:00 - 11:30	Lattice Studies and Straight Specification	D. Rubin
11:30 - 12:00	Dynamic Aperture Studies	Y. Sun
12:00 - 13:30	Lunch	
13:30 - 15:30	Lattice Evaluation/Ranking	All