CHANGE REVIEW PANEL REPORT ON ILC-CR-0016: LUMINOSITY IMPROVEMENT AT 250GEV CM	EDMS No: **D*01xxxx5**

DRAFT, 26.10.2017
To be finalized with CRP members

Summary of the CRP Review

Change Request ILC-CR-0016 "Luminosity improvement at 250GeV CM" (EDMS ID D*1159725) was submitted to the TCMB on 25.9.2017.

The TCMB formed a Change Review Panel with these members:

- Benno List, DESY (chair)
- Tom Markiewicz, SLAC
- David Rubin, Cornell
- Nikolay Solyak, FNAL
- Glen White, SLAC

The CRP held a phone meeting on 20.10.2017 with BL, TM, DR, NS attending.

The CRP findings and recommendations are as follows:

Overall, the CRP agrees that the change request is reasonable.

The CR addresses four distinct changes:

1. A change of the damping ring (DR) lattice that leads to a reduction of the horizontal emittance at the DR extraction from about 6µm to 4µm.
2. A revised estimate of the horizontal emittance increase between DR extraction and IP at 125GeV beam energy, leading to a reduction from 10µm to 5µm at the IP.
3. A change to the BDS final focus setup, keeping the beta functions the same, but with reduced requirements on collimation depths and higher beam stability tolerances.
4. A revised beam size at the IP, leading to a luminosity increase by 65% at 125GeV beam energy, and new values for the beamstrahlung, pair backgrounds, and disruption parameter.

In the following, first general comments are made, then these topics are discussed separately.

1. General

Finding: We find that the CR is well motivated and clearly beneficial.

Finding: We find the estimate of the cost impact of the CR to be sufficient to judge the CR; we consider the CR to be cost neutral.

Request: We request that the ILC top parameter table (D*0925325) be updated as part of the implementation process.

2. Change of the Damping Ring lattice and re-evaluation of the horizontal emittance

Finding: We find it credible that the proposed change of the DR lattice (using the adjacent drift sections around the bending dipoles in the arcs to make the bends longer) lead to the emittance reduction described in the DR.

Finding: We find it credible that the proposed change in the DR lattice can be implemented without significant increase of costs, performance or technical risk.

Fig. 1 shows a view of a CAD model (D*01207043) with the original dipoles, which indicates that there is sufficient space to accommodate longer bending dipoles as proposed in the CR.

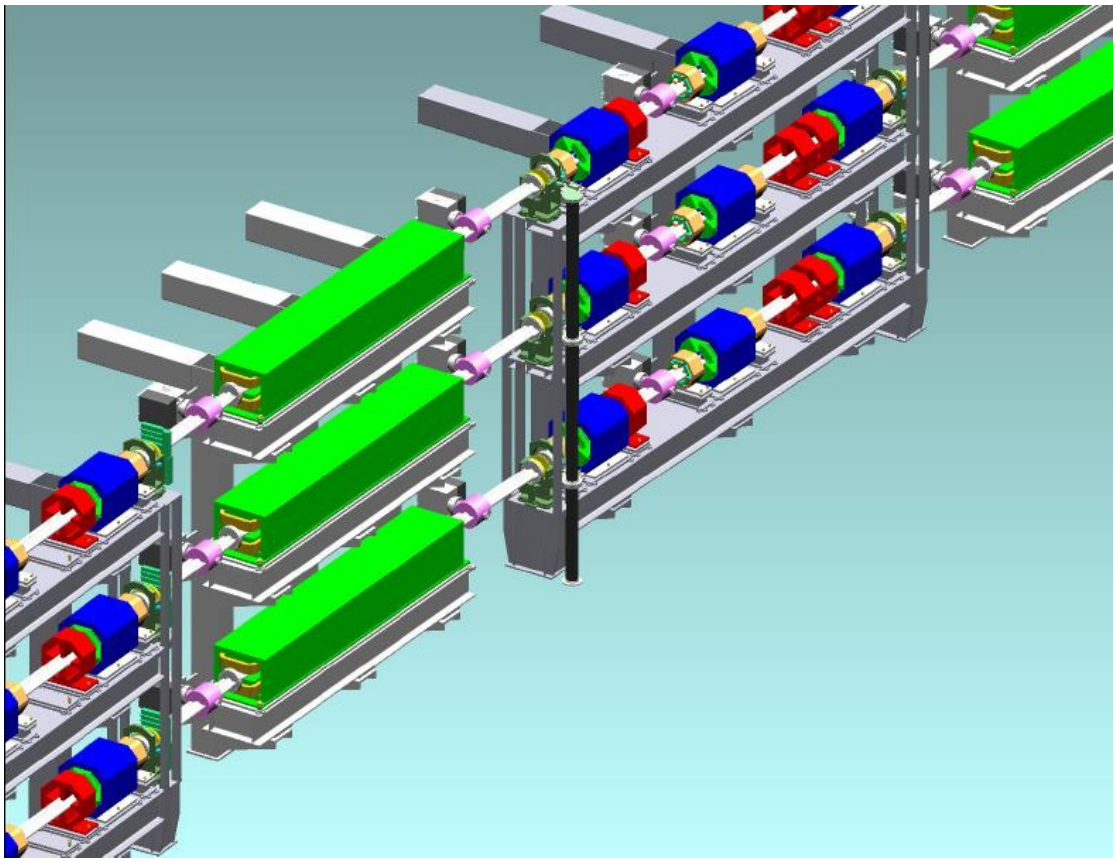

Figure 1: Damping Ring arc cell in TDR configuration. Bending dipoles are shown in green.

Finding: We find that the studies by K. Kubo presented at AWLC2017 (D*01160075) show that the dynamic aperture of the new lattice is sufficiently large.
Recommendation: We recommend performing an error analysis for the new lattice, demonstrating that the lattice's performance is stable against random misalignments of the components within the specified alignment tolerances.

Recommendation: We recommend conducting a study that evaluates the impact of the changed bending magnet length on the mechanical layout of the DR arc cell.

Request: We request that the new lattice be provided in XSIF format (suitable for MAD8) so that other groups can cross check the results.

Request: We request that as part of the implementation, the DR parameter table (D*0960955) be updated with all relevant parameters.

Request: We request that as part of the implementation, updated specifications of the arc dipoles (D0993475) are given.

3. Emittance growth from beam transport to IP

Finding: We find that the reduced estimate for the horizontal emittance growth due to the beam transport from DR extraction to the IP is not unrealistic, but needs further checking. A cursory first check by one of us (G. White) indicates that the emittance increase in the BDS may be as large as 0.6μm, larger than allowed for in the Change Request.

Recommendation: We recommend that the horizontal emittance increase is evaluated based one a simulation of the RTML, ML and BDS lattices, in a similar fashion as the vertical emittance increase.

4. Revised BDS requirements

Finding: We find that the reduced horizontal emittance overall offers a better performance, which can be used to either run at the same beam size and luminosity as in the TDR, with reduced photon backgrounds and loser requirements on collimation settings, or at increased luminosity and increased pair backgrounds, or a combination.

Finding: We find that the high disruption regime constitutes a significant challenge for the feedback and feed-forward systems and imposes tight tolerances on bunch-to-bunch jitter.

Request: We request that in the implementation stage the requirements on bunch-to-bunch jitter and performance of the feed-back and feed-forward systems are evaluated and checked for their feasibility.

Add something about collimation depths.

5. Revised Luminosity and Background Estimate

Finding: We find the proposal to adopt the "set A" configuration, which keeps the horizontal beta function β_x^* at the IP the same, reasonable.

T. Markiewicz reported on behalf of SiD that SiD studies (Anne Schütz, to be presented at LCWS17) indicate:

- The pair background does increase considerably, as indicated in the CR and the presentation of D. Jeans at AWLC2017 (D*01160115).
- The envelope of the pair background at a B field of 4T and at 80cm away from the IP increases by about 2mm.

Finding: We find that the increased backgrounds that come together with the increased luminosity are not prohibitive for the experiments. The experiments can make use of this luminosity increase.

Finding: We find that if background conditions should turn out to be too challenging for the experiments, or if certain dedicated measurements should require running at lower background levels, it is easy to increase the horizontal beam size and go fully or partially back towards TDR parameters, at no risk.
Finding: We find that, as laid out in the CR, it is probably possible to run the accelerator at even higher luminosities by reducing β_x^*, with or without a concurrent increase of β_y^* (sets "B" and "C" in the CR).

Recommendation: We recommend providing full parameter sets (disruption parameters, n_γ etc) for sets "B" and "C" mentioned in the CR.

Recommendation: We recommend that the designs of the beam pipe and innermost trackers be reviewed in view of the changed parameter sets.

6. Final recommendation:

We recommend accepting the Change Request in its entirety.

Benno List, 25.10.2017, for the CRP