Status of ILC BDS Design

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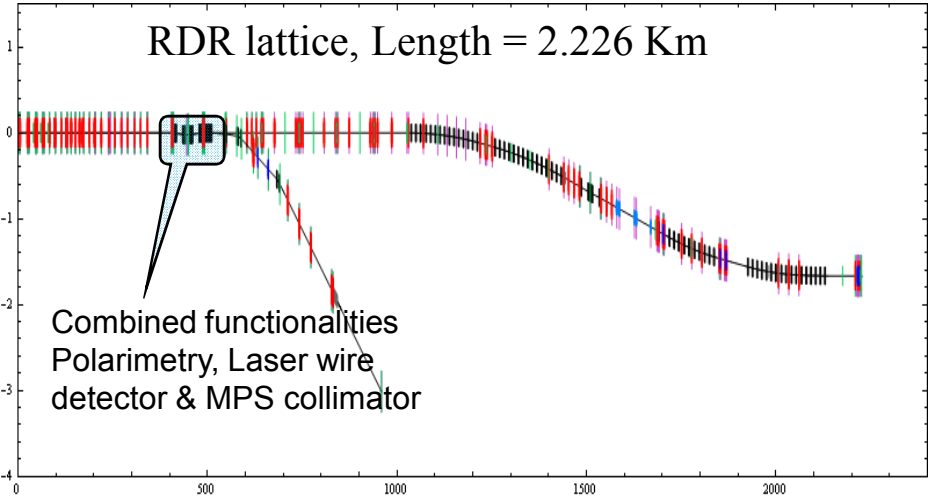
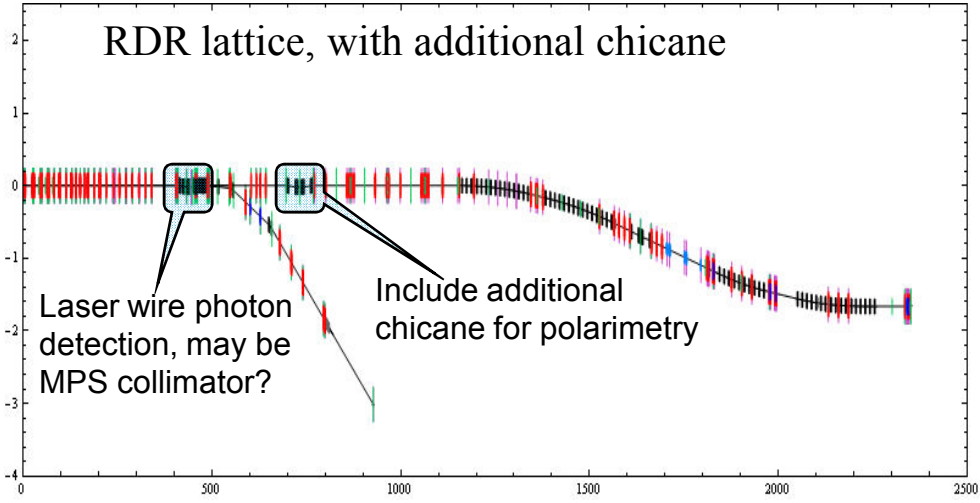
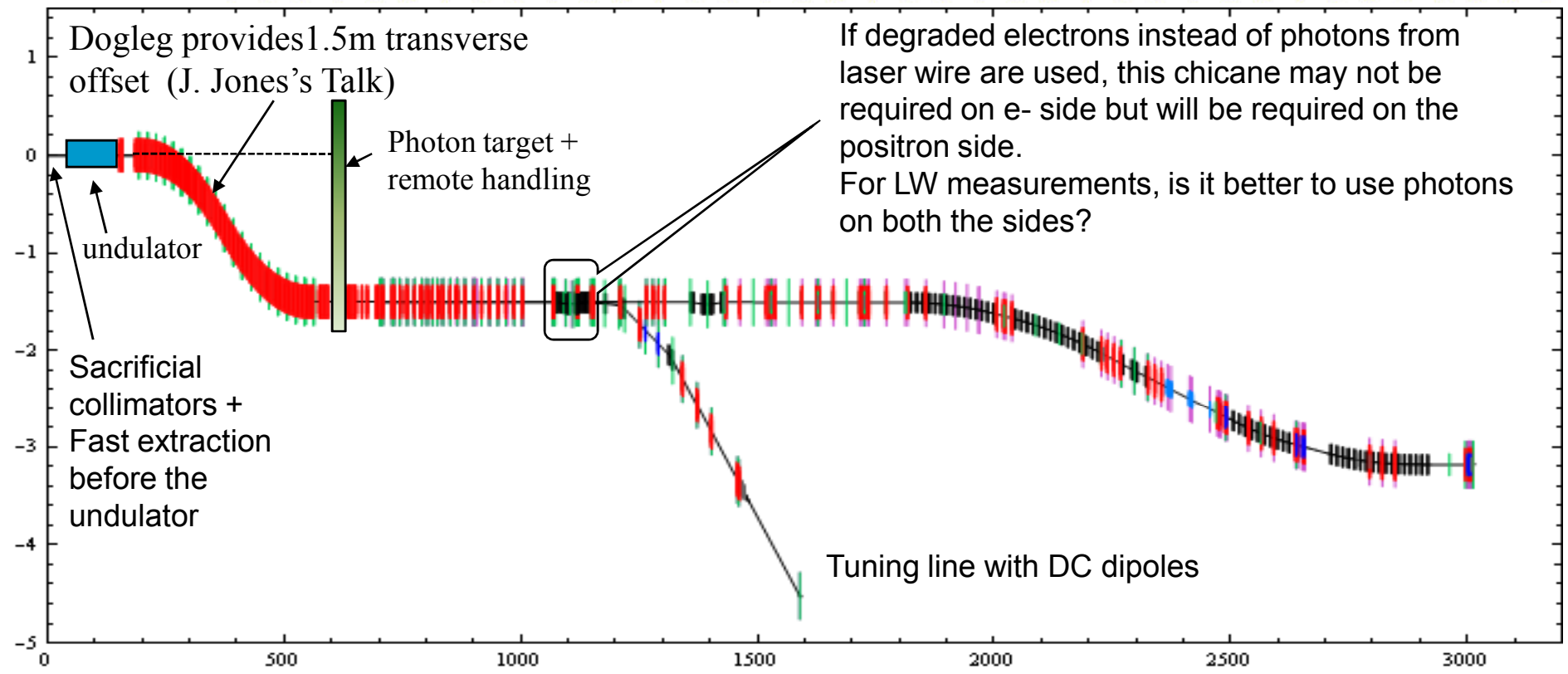
Status of compact BDS lattice design

- Proposed changes to ILC Reference Design Report (RDR) lattice
  - Separate functionality of upstream polarimeter, MPS and laser wire photon detection
  - Central integration of positron source & BDS : dogleg on e- side
  - Shortening of BDS : allowing more emittance growth @1TeV CM (including dogleg for e-)
  - New low power parameter set with longer bunch than RDR, need travelling focus to get L~2 x 10^{34} with n_b= 1312
  - Implications to BDS design including support for travelling focus





Central Integration : BDS Design Changes



Positron side will be similar to the RDR (modified as necessary).
Fast Extraction before the undulator.
Photon target @400m from the undulator. Target + remote handling need ~1.5m transverse separation from the BDS axis. Dogleg design to provide this offset without any component in the BDS through the remote shielding area, presently ~40m.

Reduction in RDR FFS length

- Emittance growth <1% @1TeV CM for RDR. Final focus length Total=1582m (betatron coll=388m, energy coll=407m, beta match=245m, FT=540m)
- For shortening the length, use analytical dependence on the length

$$\frac{\Delta\sigma_y^2}{\sigma_y^2} \propto \frac{\gamma^5}{L^2}\,\eta_B'^3 \propto (\gamma\varepsilon_y)^{3/2} L^{*3}\left(\frac{\eta_{IP}'^2}{\varepsilon_x}\right)^{3/2}\left(\frac{\varepsilon_x}{\varepsilon_y}\right)^{3/2}\frac{\gamma^{7/2}}{L^5}$$

$$\frac{\Delta\sigma^2}{\sigma^2} \propto \left(\frac{\Delta\sigma^2}{\sigma^2}\right)_0 /(1-dL/L_0)^5$$

dL is shortening of length (Lo is initial length of FF)

- Expect ~100 m reduction in FFS and additional similar length reduction from the E-collimation (but there will be some increase in the length due to additional chicane for the polarimeter chicane!).
- Complete re-fitting of the FFS will be required, beam sizes on the E-collimator and phases advances of betatron collimators w.r.t. FD.

Low Power option

A. Seryi, PAC09, WE6PFP082

- Motivation: reduction of beam power => potential cost reduction; reduced cryo system; smaller diameter damping rings, single stage BC etc.
- The RDR "low power" option may be a machine "cost saving" set but it is not a favorite set for detectors.
- Improved Low P may require tighter IP focusing, and use of "travelling focus" [V. Balakin, 1990]
  - Travelling focus allows to lengthen the bunch (From RDR Low-P bunch length of 200μ to 300μ) => beamstrahlung energy spread is reduced.
  - Focusing during collision is aided by focusing of the opposite bunch.
  - High sensitivity to any beam offset => operation of the intra-train feedback and intra-train luminosity optimization will be more challenging.
- Travelling focus can be created in two different ways:

1. Small uncompensated chromaticity and coherent E-z energy shift dE/dz along the bunch.
2. Use a transverse deflecting cavity giving a z-x correlation in one of the FF sextupoles and thus provide z-correlated focusing.

Option 2 seems easier to implement. Tracking studies and possibly mitigation of higher order aberrations are needed for both the schemes.

Plans

- ILC BDS RDR design will be modified to
  - separate functionalities for upstream polarimeter chicane, laser wire detection and machine protection.
  - Reduce length of BDS by allowing more emittance increase at 1 TeV CM
- Central integration and new Low power parameter options are being evaluated as cost saving options.
  - Undulator based positron source moves to the end of linac and thus needs dogleg chicane in the beginning of e- BDS.
  - TME dogleg design gives reasonably small emittance growth @1 TeV CM (James Jones); implications to beam based alignment ?
  - Request help from LET colleagues to evaluate the low P parameter option with travelling focus.
- Lattice changes to BDS design are planned to be done by end of July'09 so that 3D drawings for the central region integration can be discussed at the ALCPG09, Albuquerque, (29 September'09- 3 October'09) for re-baseline discussion for the TDP phase.