BDS optics and minimal machine study

Deepa Angal-Kalinin
ASTeC & The Cockcroft Institute
Daresbury Laboratory

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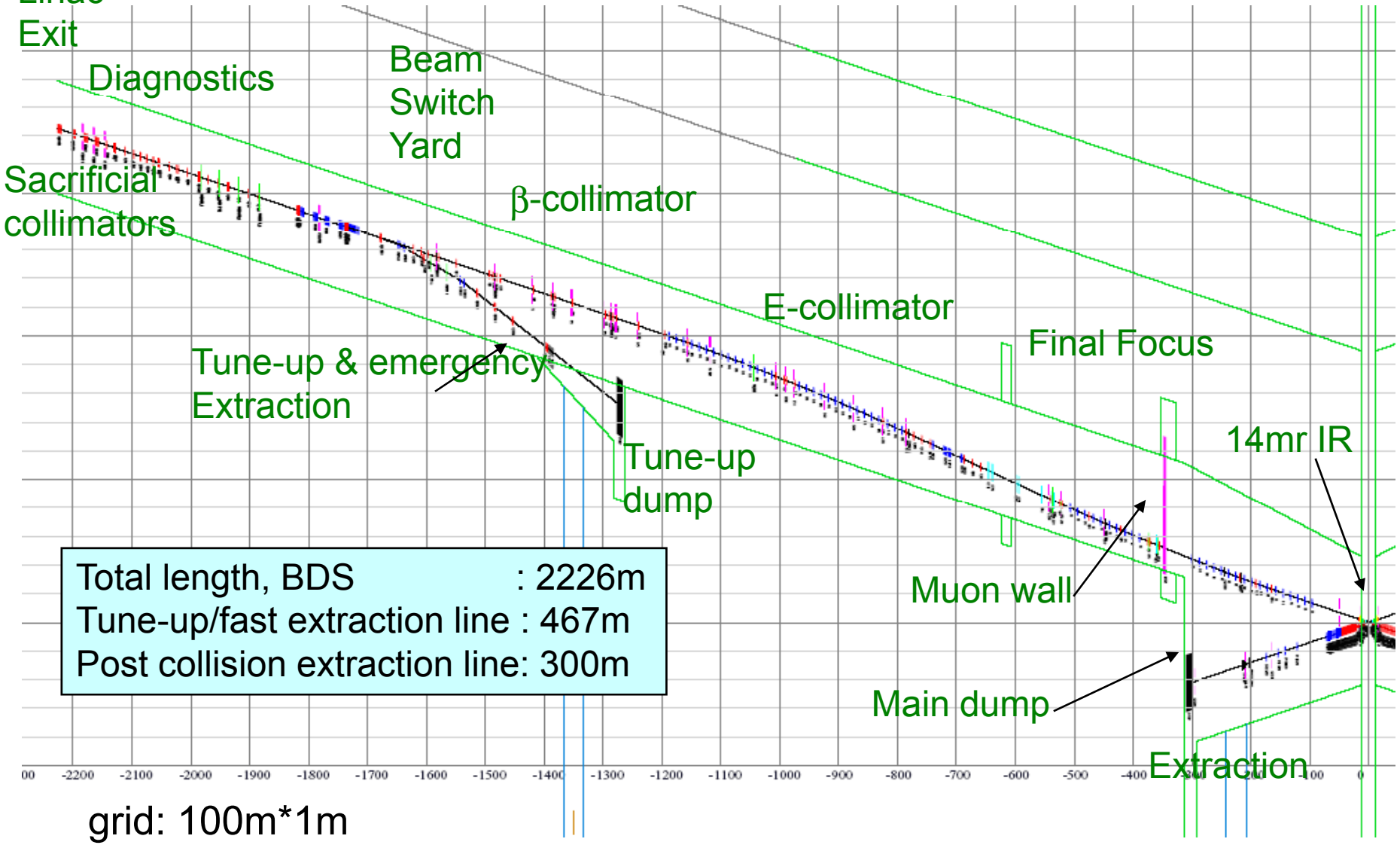
RDR BDS Design



Total length, BDS : 2226m
Tune-up/fast extraction line : 467m
Post collision extraction line: 300m

grid: 100m*1m

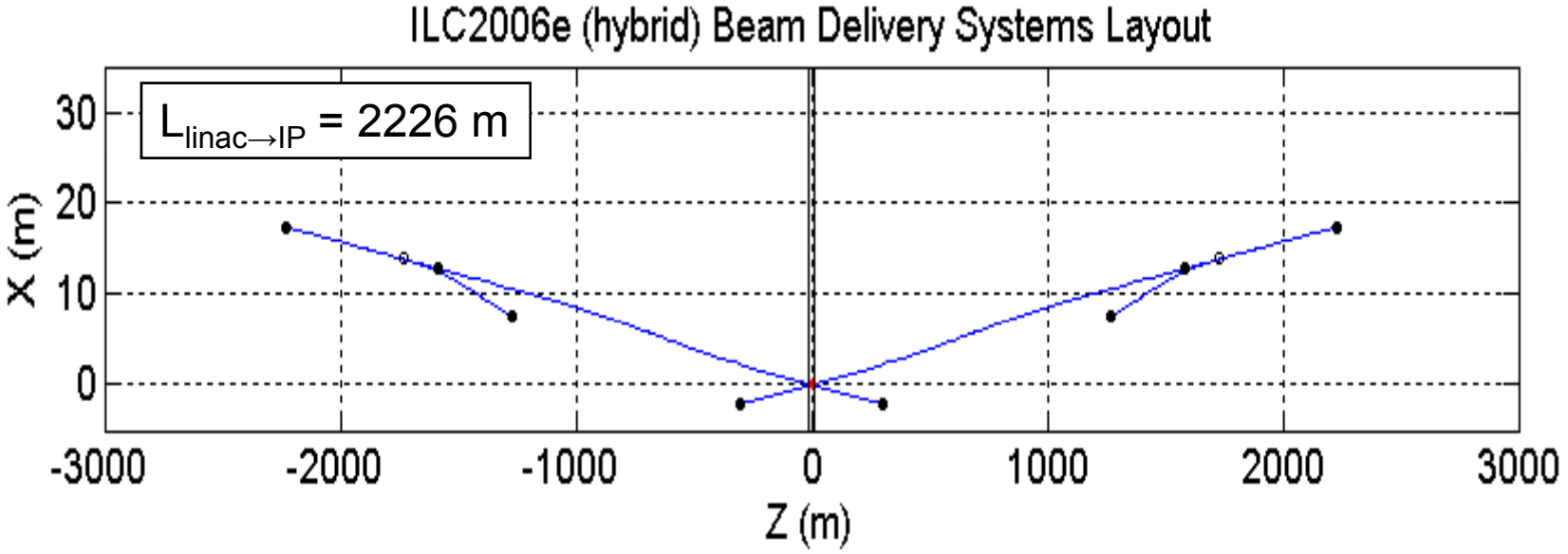
BDS RDR Design Criterion

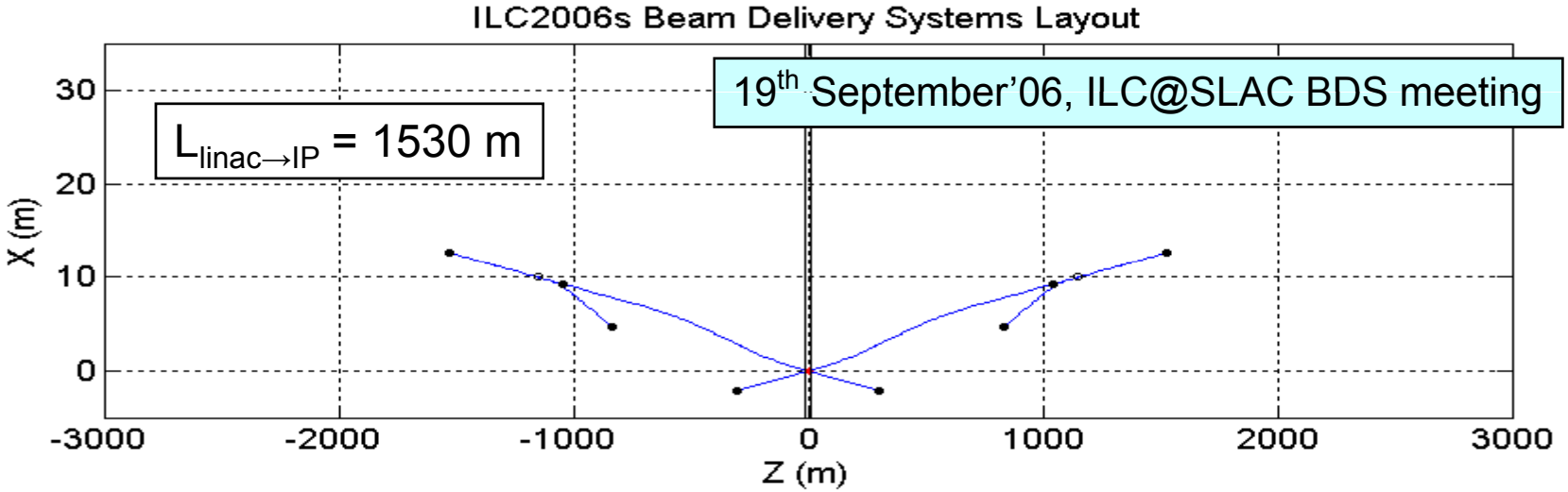
- Initial operation at (up to) 250 GeV; upgrade to 500 GeV by adding magnets only
  - **no layout/geometry changes (beam dumps locations fixed)**
- Decimate dipoles : reduce ∫Bdl for 250 GeV operation by reducing lengths (i.e. number of dipoles); reserve space for additional dipoles to keep layout fixed
- Quadrupoles & sextupoles unchanged
  - **reduce ∫Gdl for 250 GeV operation by reducing strengths**
  - **Final Doublet magnets will have to be replaced for 500 GeV**
- Final Focus: 12 m "soft" bends divided into 5 × 2.4 m pieces
  - **start with center piece only at each location**
  - **space reserved for remaining 4 pieces at each location for 500 GeV**
- Synchrotron Radiation Emittance Growth (DIMAD tracking; SYNC option 2)

  @ 250 GeV, emit/emit0 = 1.0036
  @ 500 GeV, emit/emit0 = 1.0078

http://www.slac.stanford.edu/~mdw/ILC/2006e/doc/BDS2006e.ppt

Hybrid & Minimal (250 GeV) layouts





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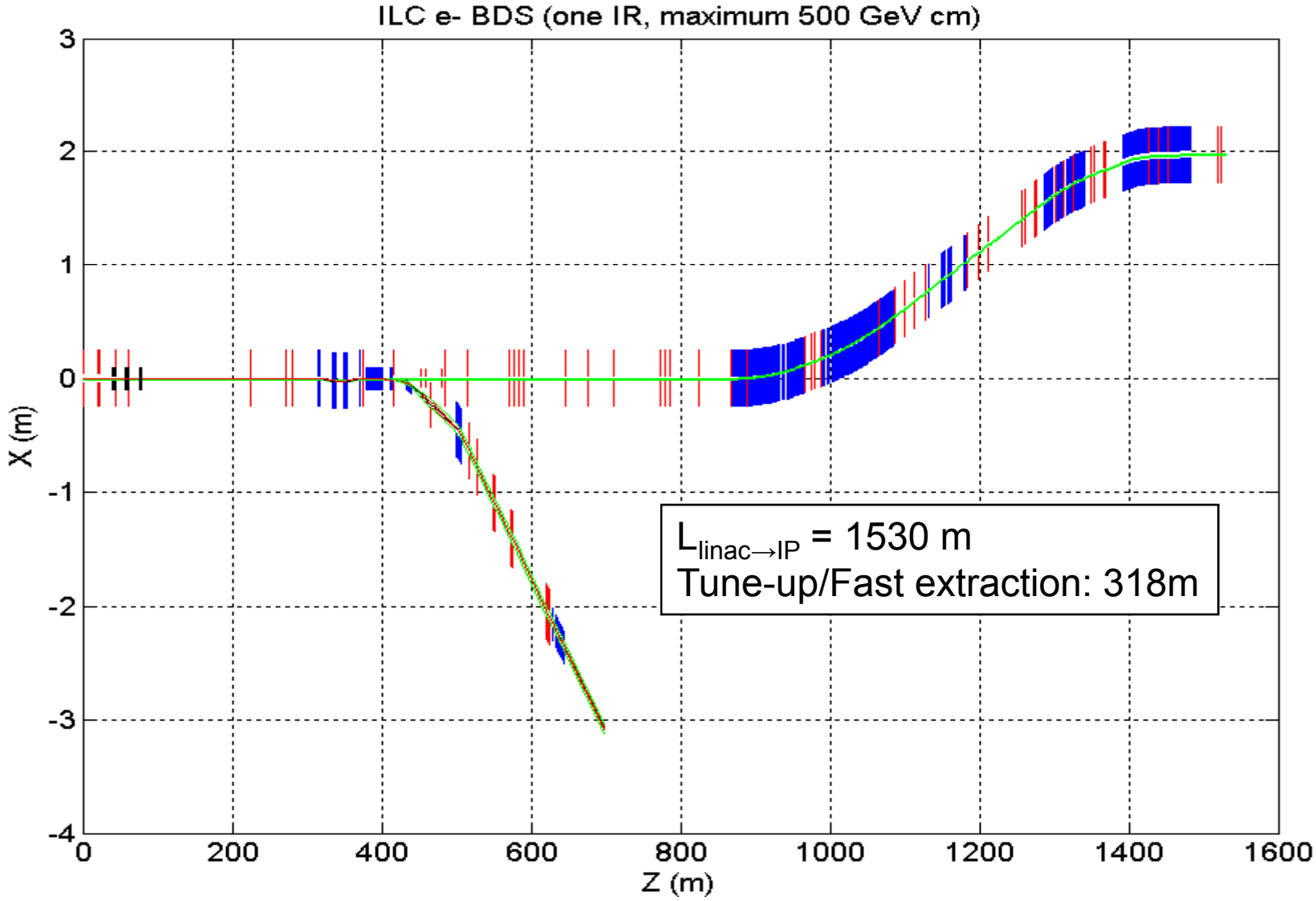
ILC2006s : Lattice details



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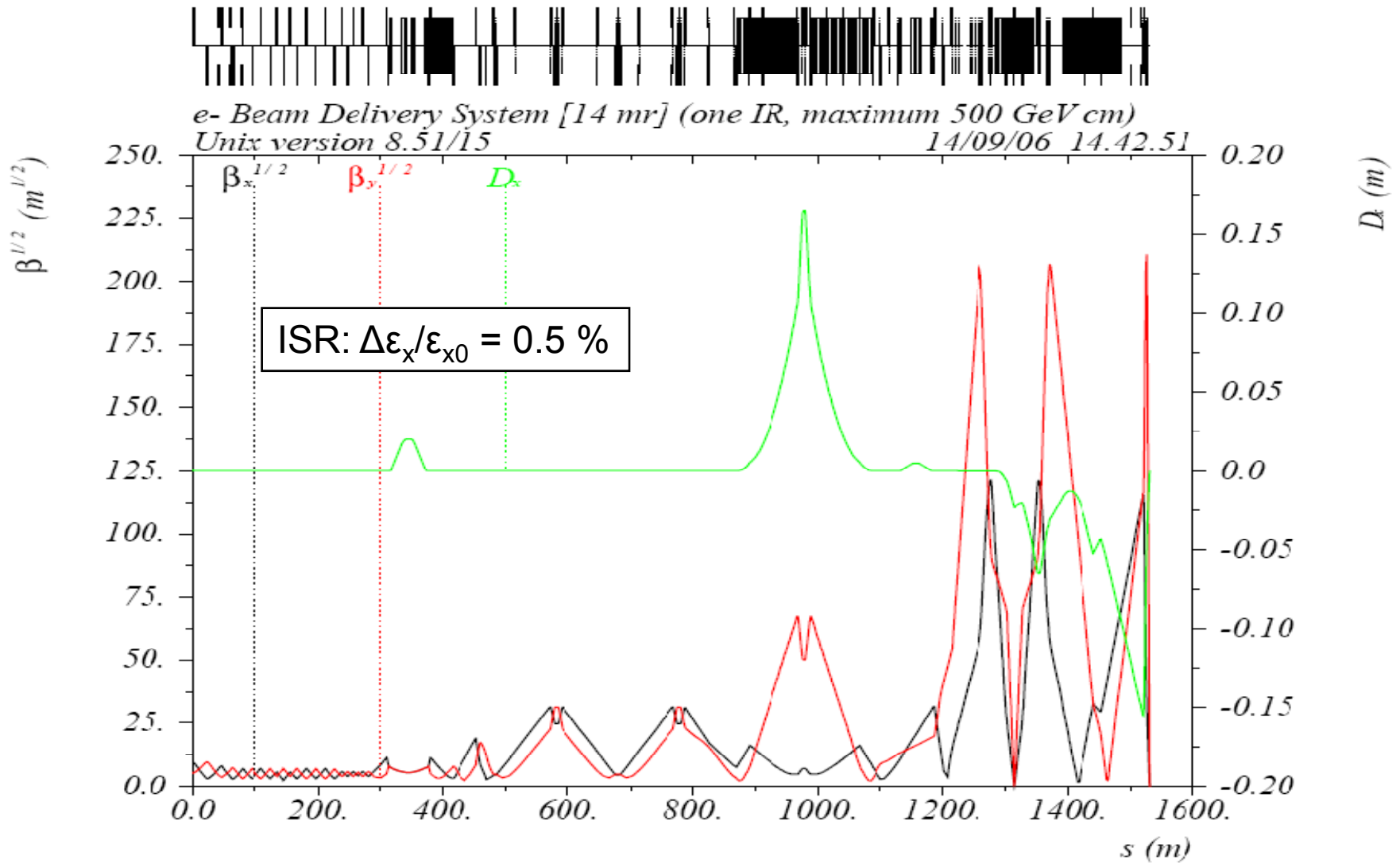
ILC2006s : Optics



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Central Region Integration

- Undulator-based positron source moved to end of linac (250 GeV point)

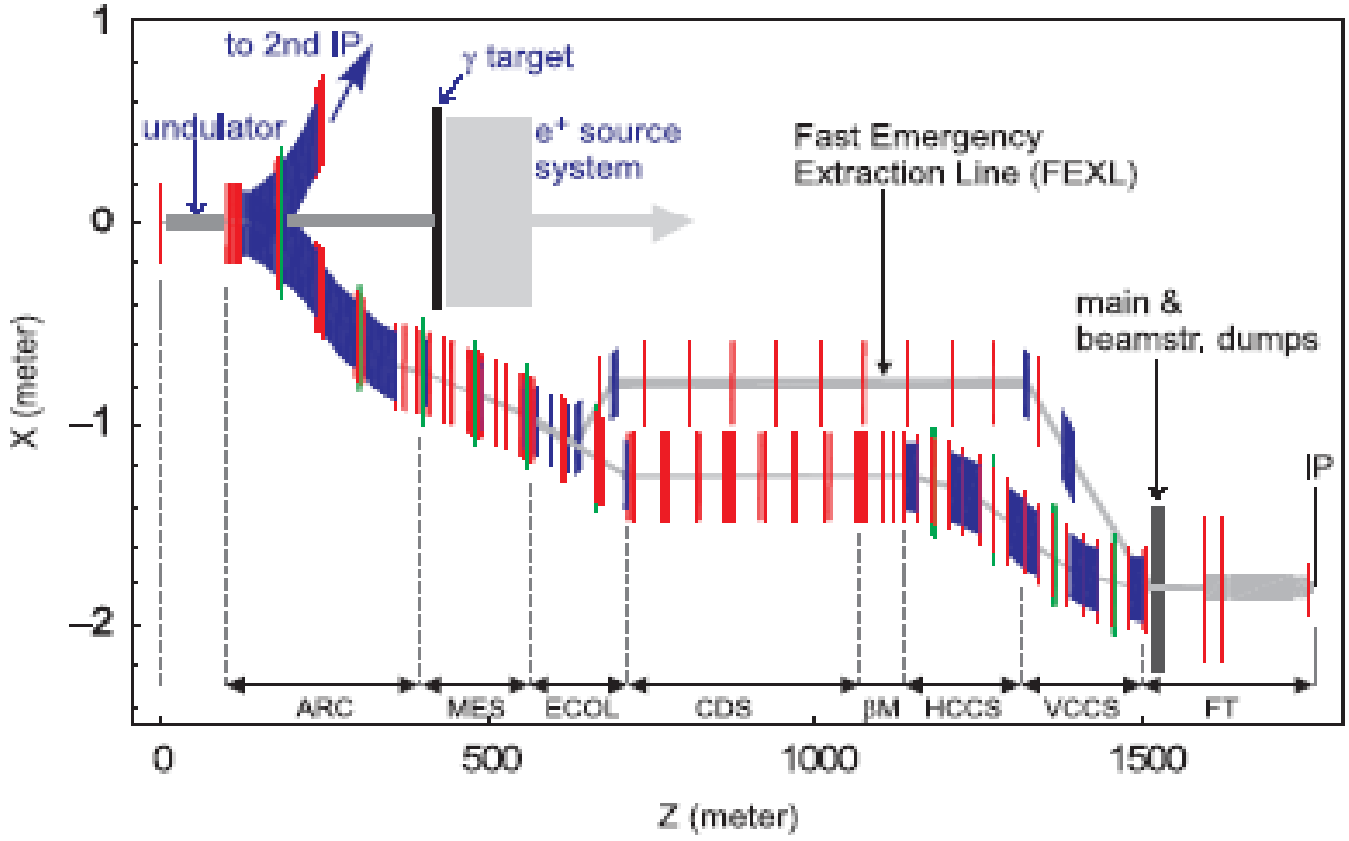
- e+ and e- sources share same tunnel as BDS
- upstream BDS (optimised integration)
- Including 5GeV injector linacs

- Removal of RDR “Keep Alive Source”
- replace by few % ‘auxiliary’ source using main (photon) target
- 500 MV warm linac, also in same tunnel

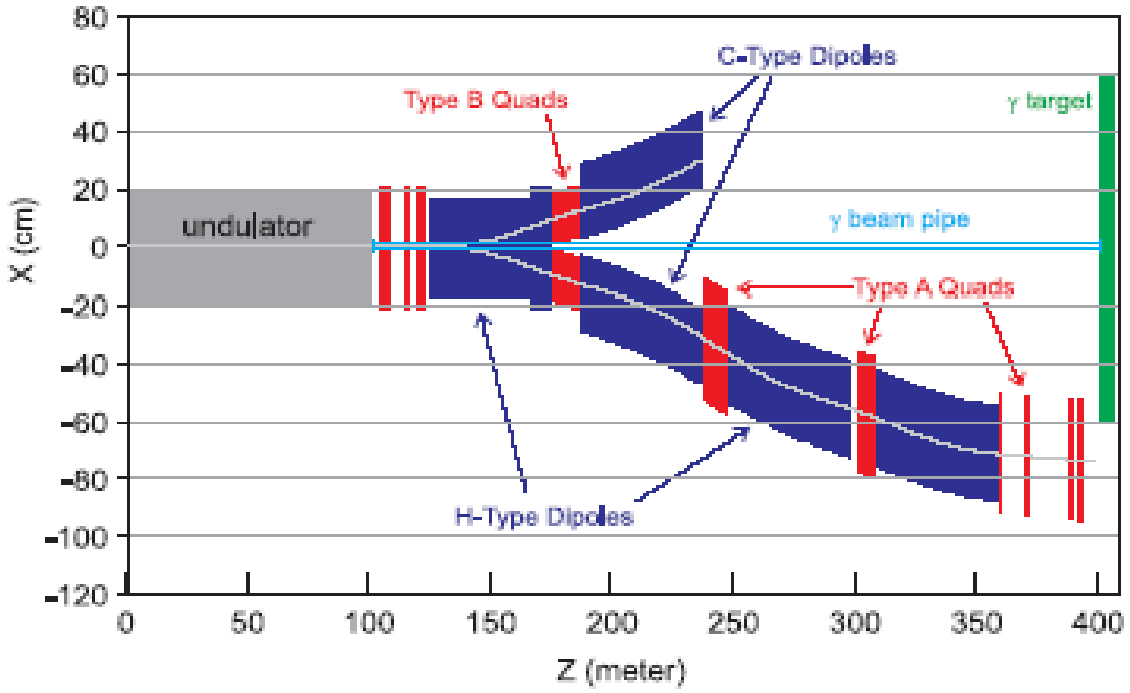
- Damping Rings
- in BDS plane but horizontally displaced to avoid IR Hall
- Injection/Ejection in same straight section
- Circumference
- 6.4 km (current RDR baseline)
- 3.2 km (possible low-P option)

Undulator location

- Changes in BDS layout to accommodate this
  - **Dogleg to provide clearance for the e+ photon target**
- TESLA design : switchyard to allow photons to the target as well as beam to second IR.

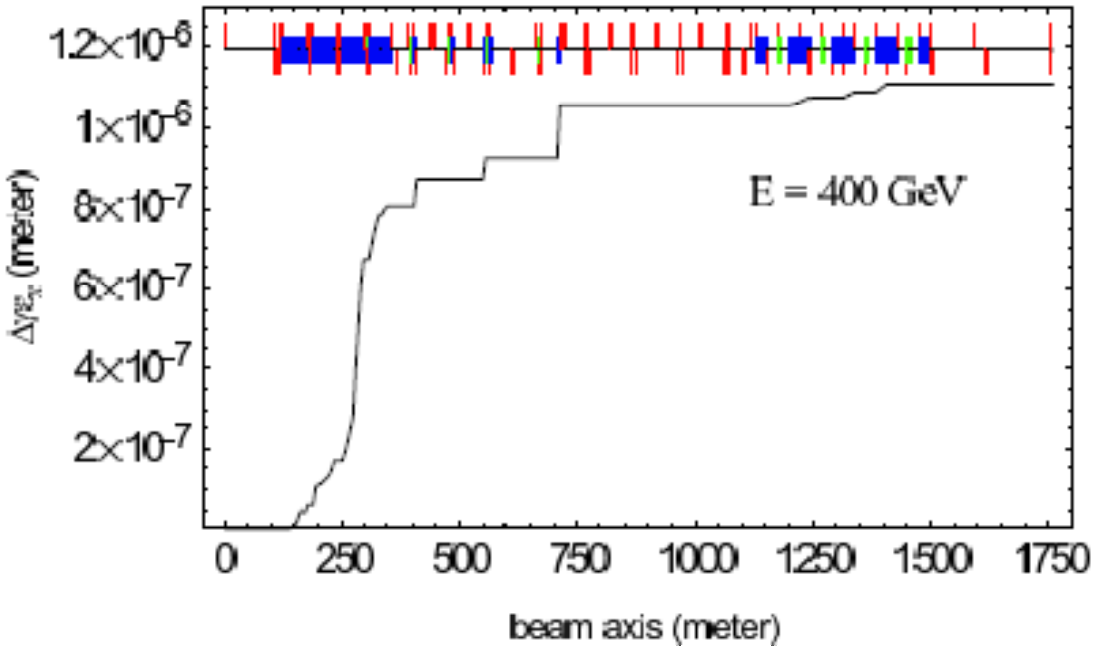


Dogleg : TESLA



- 100 m for undulator + 300 m photon beam line (proposed 400m for ILC to reduce the offset of dogleg)
- TESLA Transverse clearance at target (60cm)
  Need more for ILC ? (remote control, 1m transverse concrete shielding).
  ~100cm (need exact number).
- Beam pipe can pass through this shielding but without any component

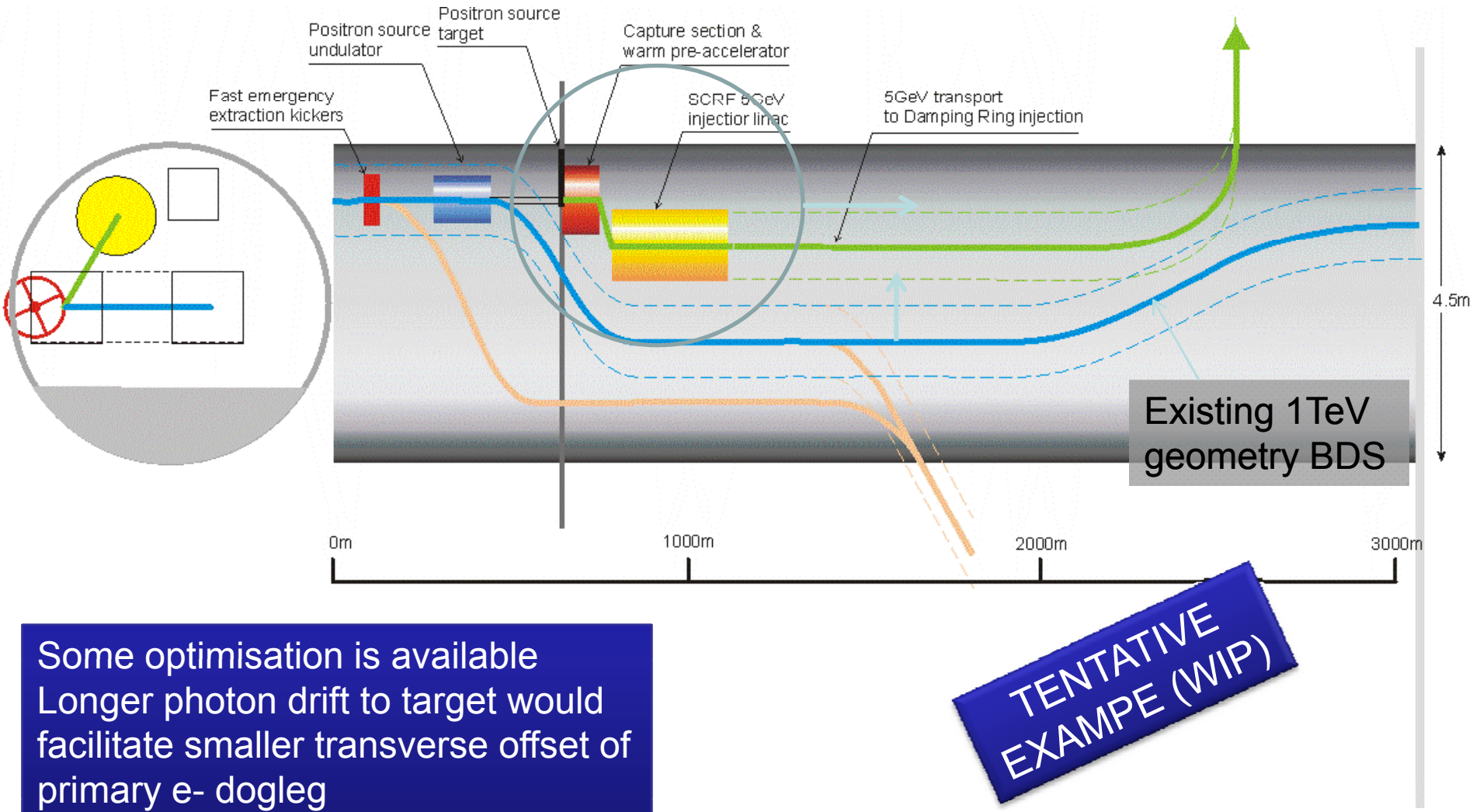
TESLA : emittance growth



Horizontal emittance growth for the entire BDS, and a beam energy of 400 GeV (design emittance $\gamma\varepsilon_x = 8 \times 10^{-6}$ m).

14% emittance growth was considered to be acceptable.

Positron Source & BDS integration



Some optimisation is available
Longer photon drift to target would facilitate smaller transverse offset of primary e- dogleg

N. Walker, Positron Source Workshop 29/10/08

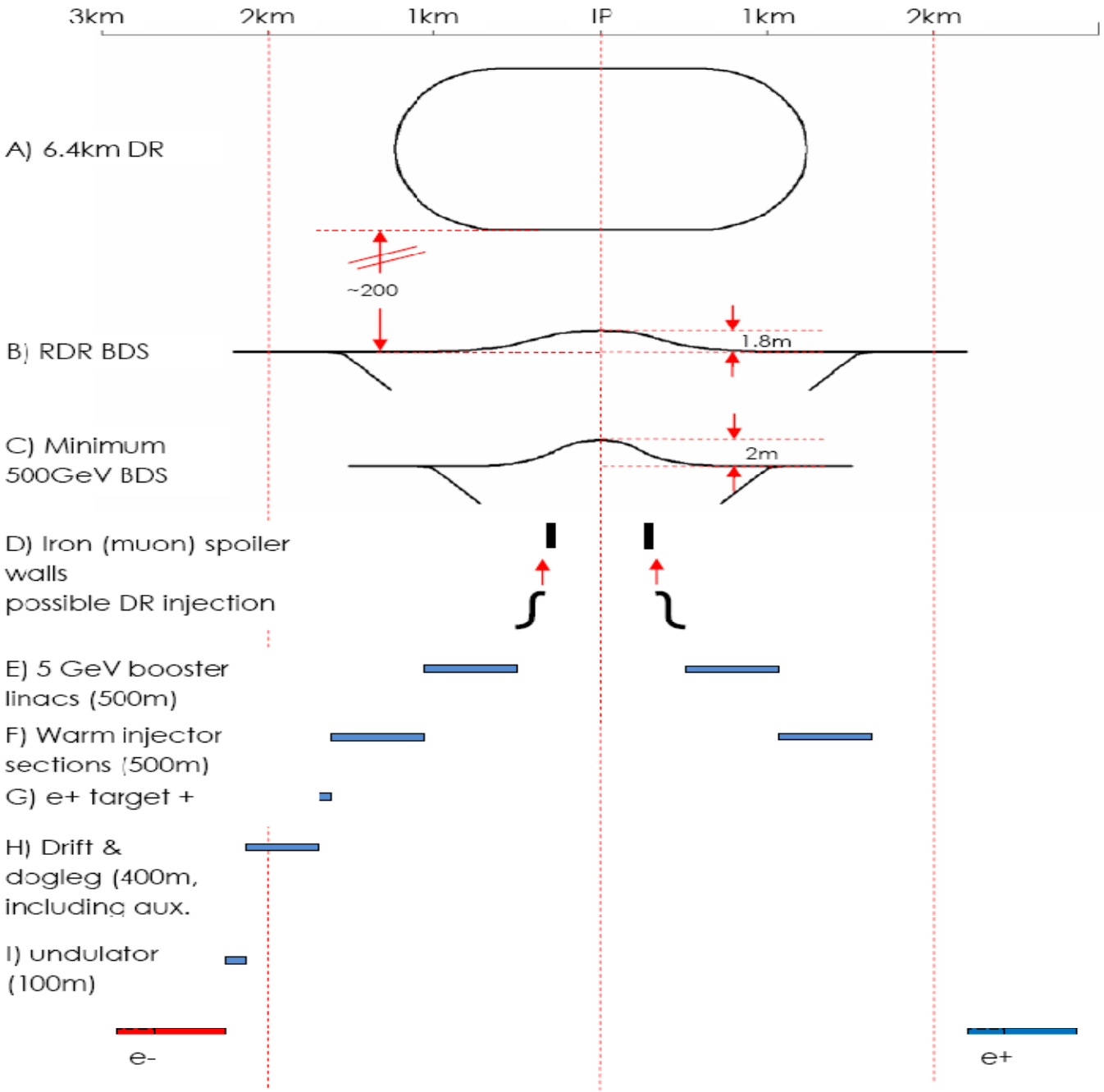


Figure 1: Approximate lengths and locations of source components and damping rings compared to both the RDR BDS and the proposed minimum 500 GeV BDS.

Layout possibilities

- Fast extraction/tuning before undulator? This will protect the small aperture of the undulator.
- Beam diagnostics (coupling correction and emittance measurement section) before the undulator?
  - **before dogleg – no bends and tune-up dump**
  - **laser wire photon detection?**
- Polarisation measurement – probably better after the undulator?
  - **Will need dedicated chicane for fast extraction : will add to the overall length.**

Design Criterion

- Dogleg : design criterion
  - **How much emittance dilution is acceptable?**
  - **ISR emittance growth for ILC2006s (no dogleg) is 0.5% (criterion?)**
- Can dogleg be combined with energy collimation?
- Order of collimation will be energy, betatron => collimation performance
- Location of muon wall (possible DR injection)
- Can we change the spoiler survival criterion to 1 bunch at 250 GeV?
- Locations of energy and polarisation measurements

Upgrade path

- Beam dump locations cannot be changed
  - **Consider if having only one beam dump for tuning + post collision will save cost.**
- To extend the BDS backwards will not be possible due to undulator location?
- To discuss…