Minimal Machine : BDS Design

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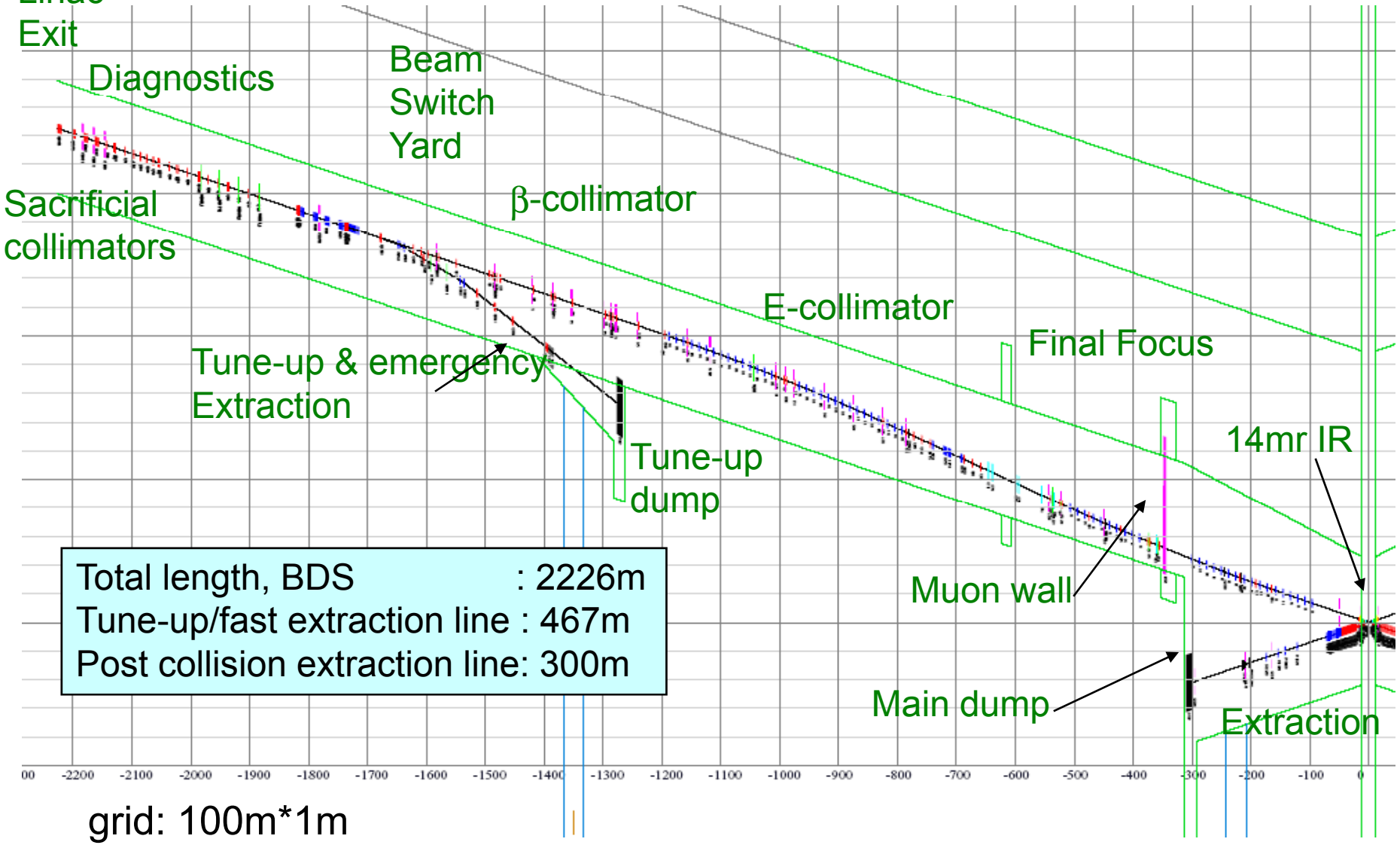
Contents

- RDR BDS Design
- Minimal machine
  - **Central region integration**
  - **Implications to the BDS lattice design**
  - **Layout possibilities & Design criteria**
- BDS design - Next steps

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
- 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**
- Quadrupoles & sextupoles unchanged
  - **reduce ∫Gdl for 250 GeV operation by reducing strengths**
  - **Final Doublet magnets will have to be replaced for 500 GeV**
- Synchrotron Radiation Emittance Growth at 1 TeV CM <1%

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

RDR Design Discussion

- RDR design
  - **Concerns about combined functionality of MPS collimator, laser wire detector and upstream polarimeter measurements.**
    - These issues were discussed in details at the Energy Polarization workshop in Zeuthen, April 2008 and highlighted again at LCWS08/ILC08 sessions.
    - The recommendation is to separate these functionalities for precise polarisation measurements.
  - **Allow more emittance growth due to synchrotron radiation at 1 TeV CM to shorten the BDS.**

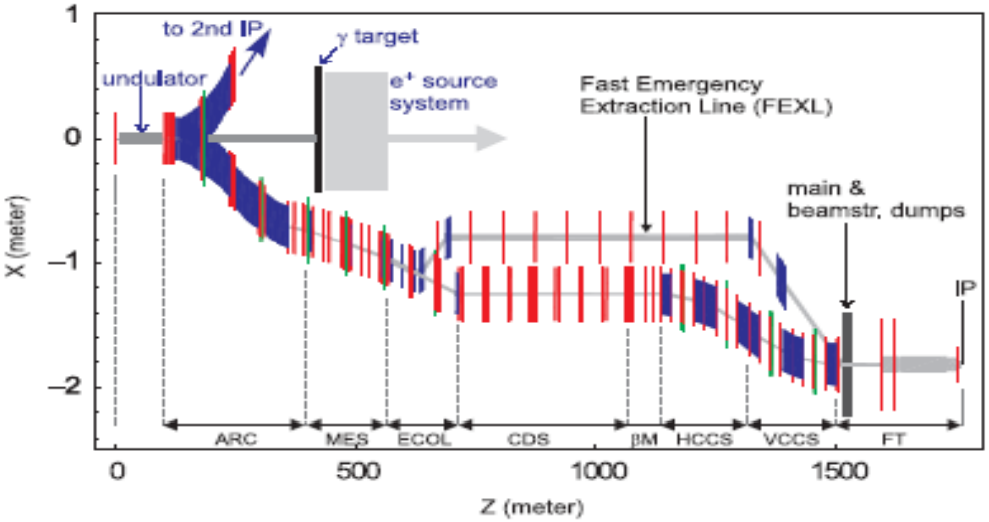
Minimum Machine : Central Region Integration

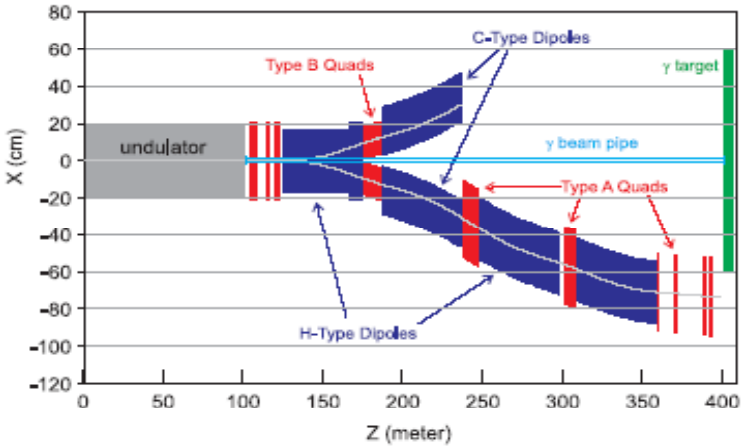
- Undulator-based positron source moved to end of linac (250 GeV point)
- e+ and e- sources share same tunnel as BDS
  - **upstream BDS (optimised integration)**
  - **Including 5GeV injector linacs**
- Removal of RDR “Keep Alive Source”
  - **replace by few % ‘auxiliary’ source using main (photon) target**
  - **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)**

Following the discussions during LCWS08/ILC08, it has been agreed that the BDS stays as missing magnet design as proposed in the RDR to keep the upgrade path to 1 TeV CM easier, as the locations of the undulator and the beam dumps will be impossible to move.

Undulator location

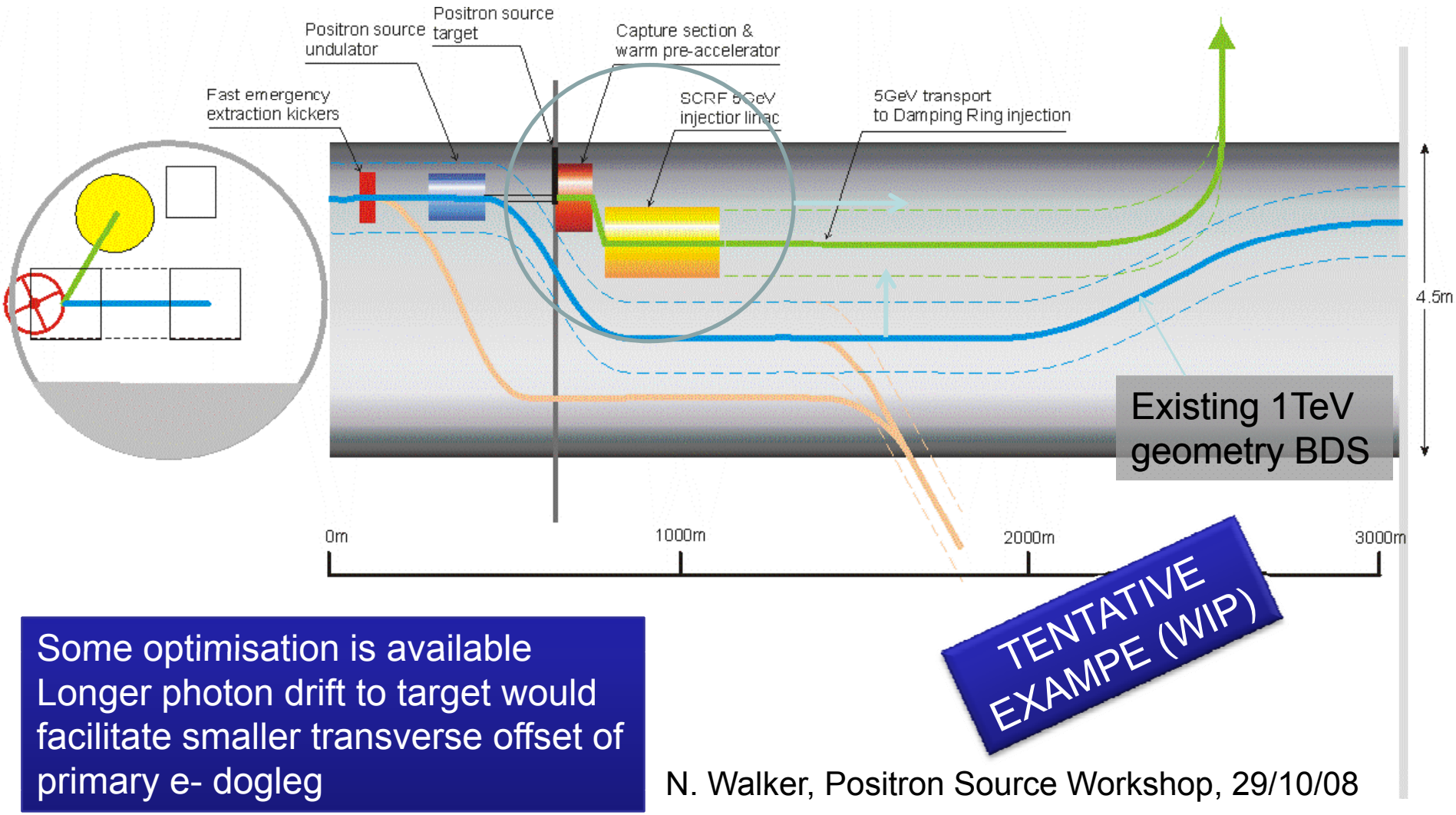
- Changes in BDS layout to accommodate undulator at the end of main linac
  - **Dogleg to provide clearance for the e+ photon target**
- TESLA design : switchyard to allow photons to the target as well as beam to second IR.





• 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).
• Beam pipe can pass through this shielding but without any component.
• 14% emittance growth at 800 GeV CM in TESLA including the dogleg.

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

Other possibilities and ideas will be explored.

Layout possibilities & Design Criterion

- Fast extraction before undulator
- Beam diagnostics - coupling correction and emittance measurement section – after the dogleg
- Fast extraction and tuning line (+possible main extraction line through micro-tunnelling) share a common beam dump
- Upstream polarisation measurement
  - Preferred location after the undulator?
  - Additional chicane for fast extraction and new location of polarimeter chicane on positron side.
- Emittance growth due to SR
  - Allow upto ~10% emittance dilution due to ISR at 1 TeV CM including dogleg.
  - need to consider energy loss and SR power deposition through the BDS
- Location of muon wall (possible DR injection)
- Could study some other options like
  - Can dogleg be combined with energy collimation?

BDS design for Minimal Machine – next steps

The issues with central region integration, which are relevant for BDS design, include

- evaluation of necessary transverse separation and allowed emittance growth in the dogleg that offsets BDS beamline and the undulator
- re-evaluation of the upstream polarimeter location (before or after the undulator)
- considerations of use of common beam dump for several beamlines
- if the positron source undulator chicane is placed on one side only, need to understand the implications for
  - layout and IP positions
  - upgrades or modifications
  - location of fast extraction, beam diagnostics and polarimeter
- implications to installation, commissioning and running due to complexity of the central integration region

- Evaluation of new low P parameter set (need tighter focusing at the IP)
  - methods to create travelling focus
  - collimation requirements and wakefield dilution
  - effect of aberrations and field quality requirements
  - backgrounds for low P parameters
  - extraction line