AD & I : BDS Lattice Design Changes

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ALCPG09 & GDE Meeting, Albuquerque

29th September'09 – 3rd October'09

AD & I : Central Integration
Changes to RDR BDS Lattice Design

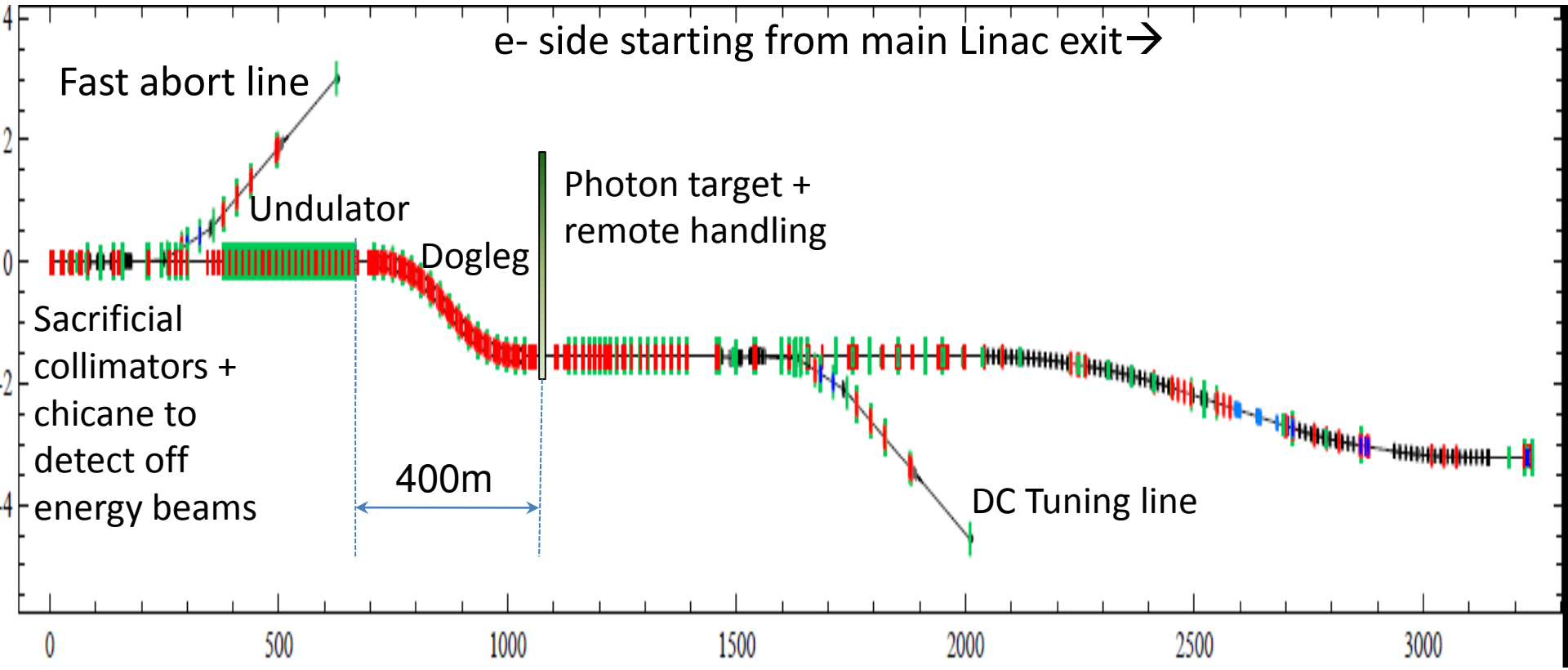
- Undulator moves to the end of the e- main Linac.

- Need dogleg after the undulator to send the photons to the target located at ~400m from the undulator exit.

- Dogleg needs to provide 1.5m transverse offset at the target location at ~400m from the end of the undulator and ~40m drift near target area for remote handling. Design to keep the emittance dilution at 500 GeV beam energy to reasonable level.

- Due to small aperture of undulator, need to move the sacrificial collimation section and the fast abort line in the beginning of the RDR BDS lattice before the undulator.

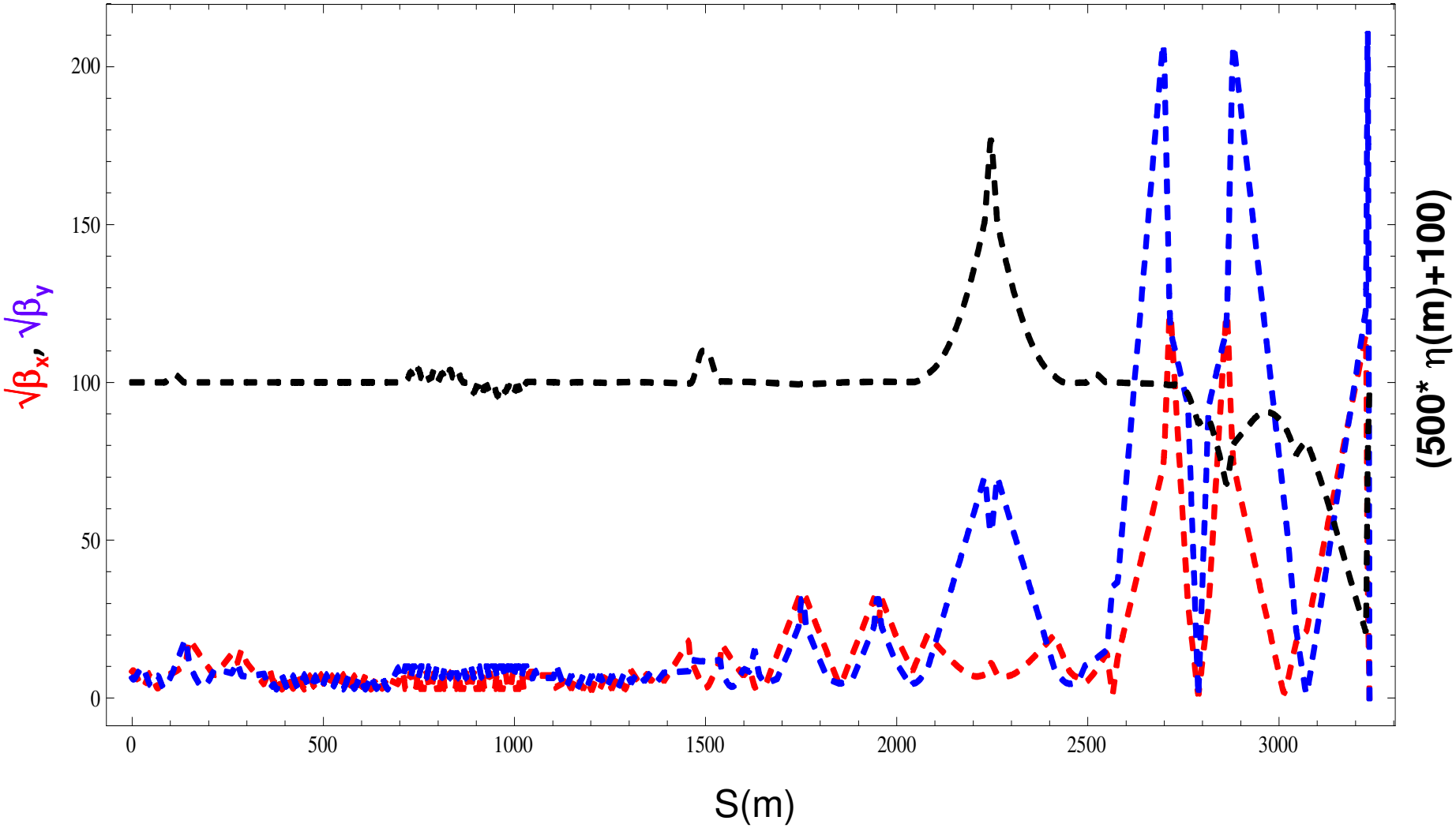
AD & I : BDS lattice design on e- side



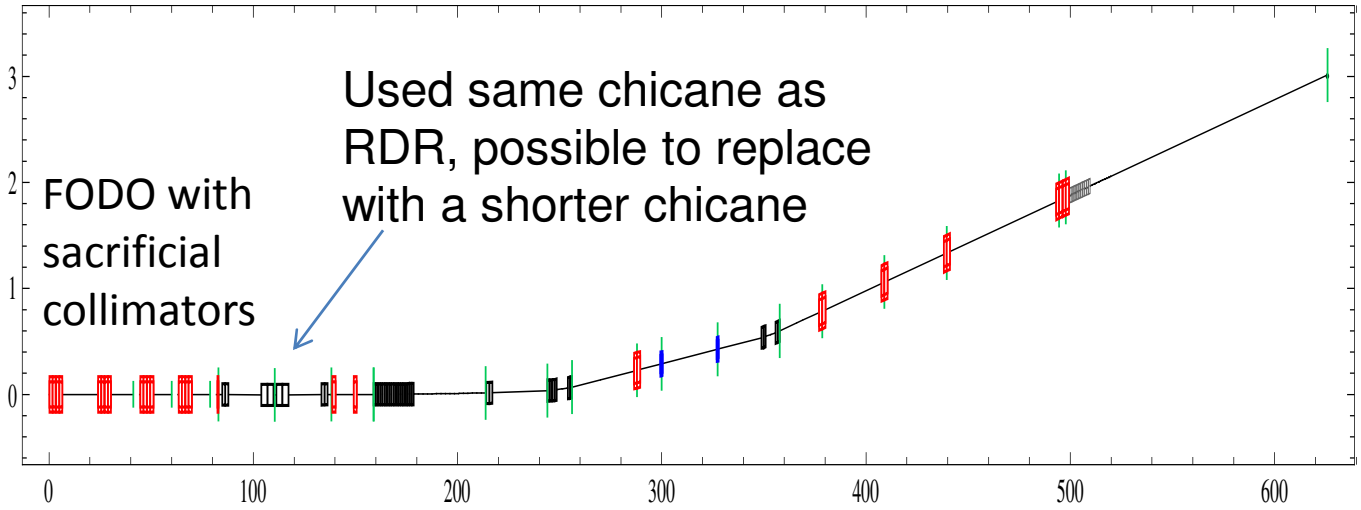
Polarisation chicane + laser wire photon detection are still in the same chicane. Can either use degraded electrons for LW or include additional chicane for LW photon detection.

Positron side BDS need to change for separate functionalities of this chicane as agreed.

Optics of e- BDS from exit of Linac to IP

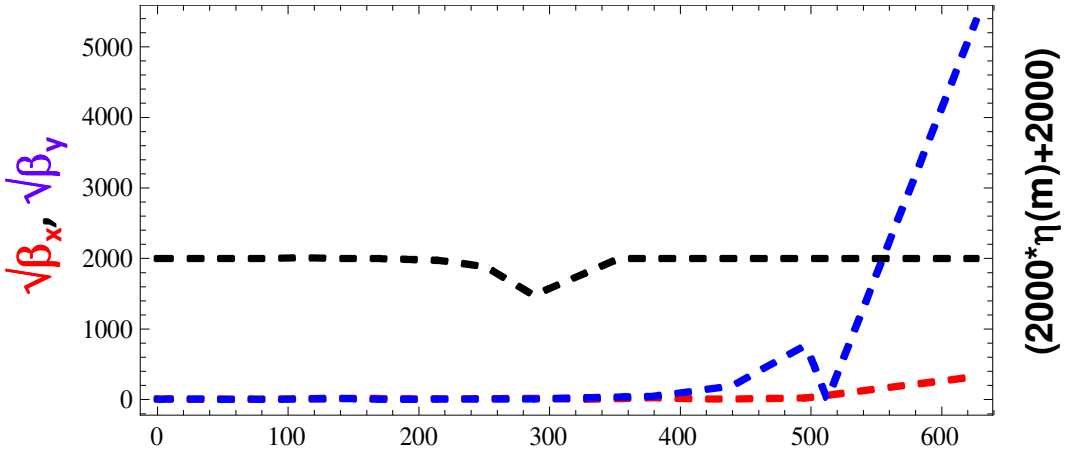


Sacrificial collimation & fast extraction/abort line

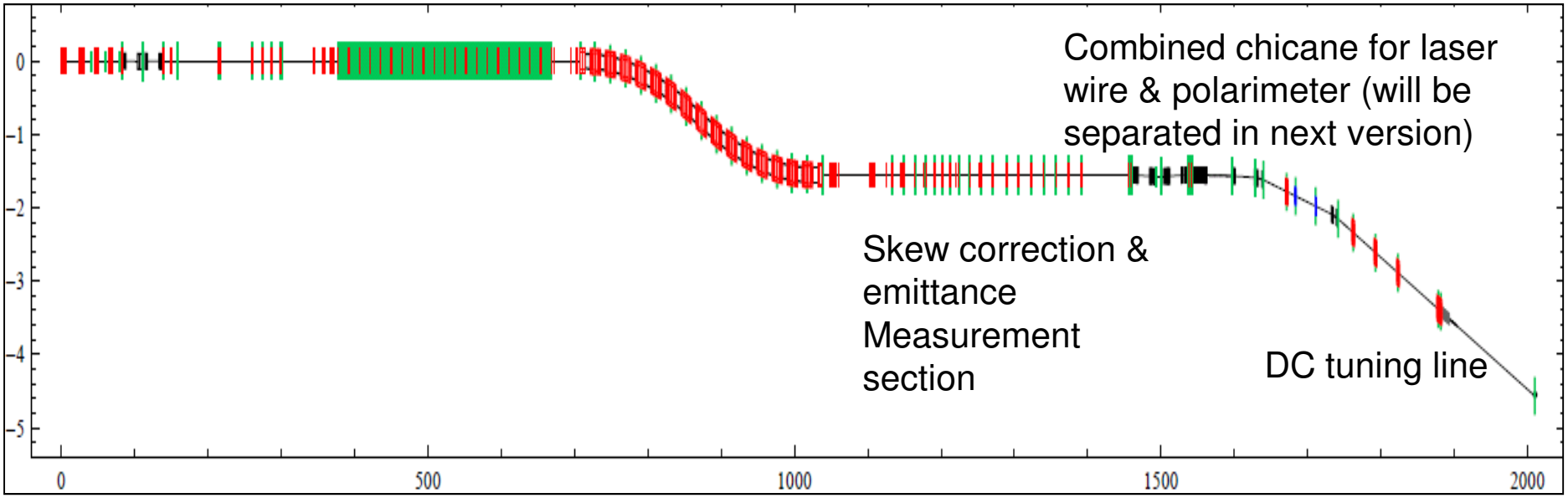


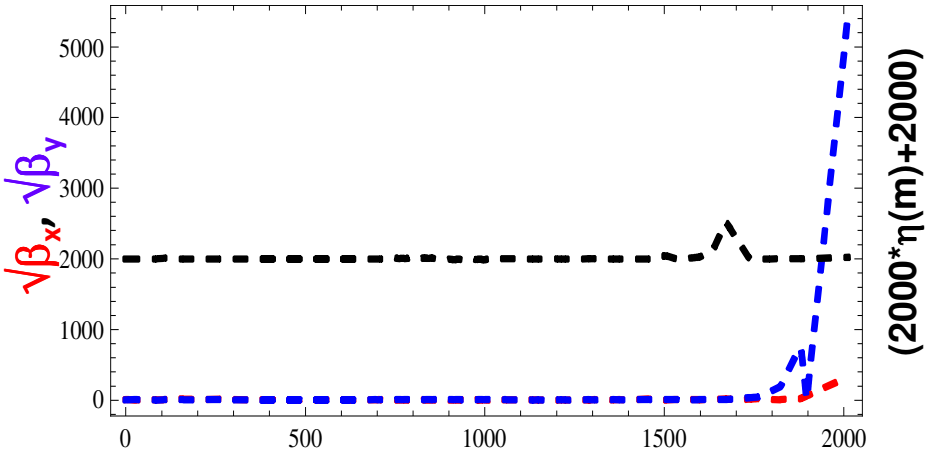
Fast abort dump power can be reduced (TBD)

May be extraction line length can be reduced? Presently same as RDR. The acceptance of the line needs to be +1% to -15-20% .



Tuning line





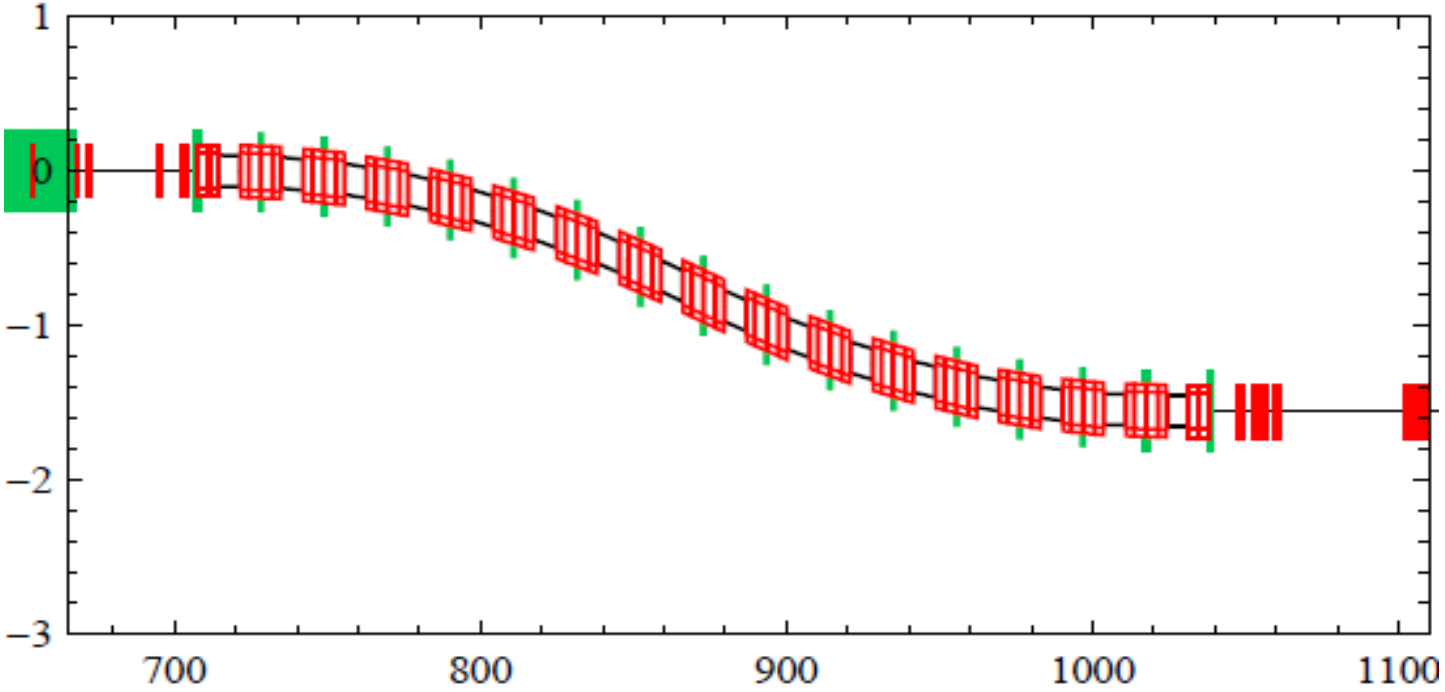
DC tuning line, now need much less acceptance.

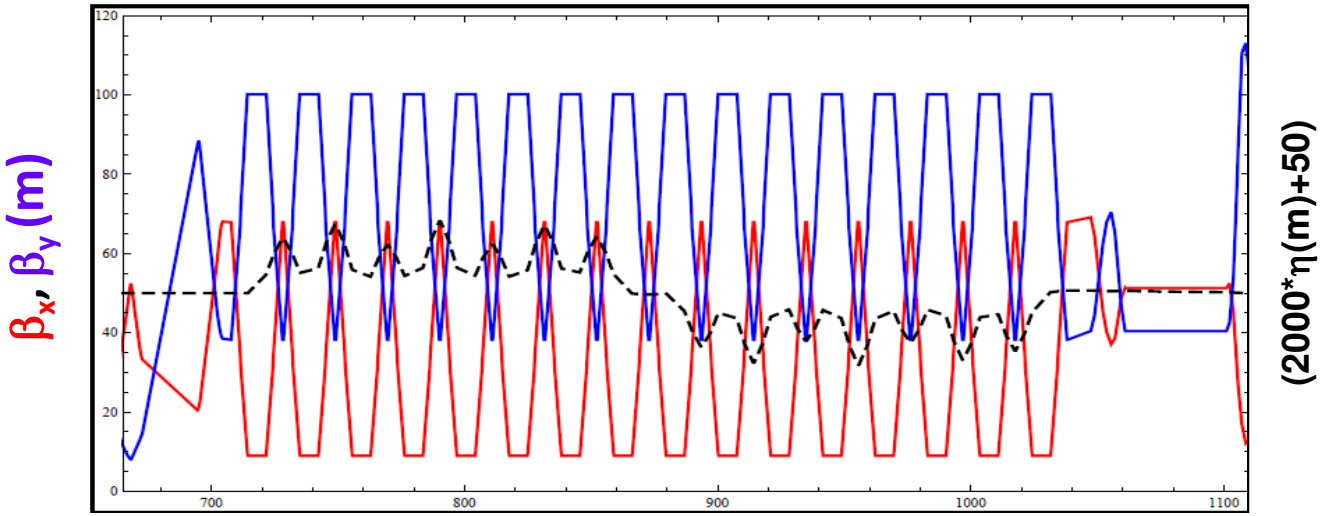
Can be shortened by using DC dipoles instead of kickers. Presently same as RDR.

Power of beam dump for new low power parameters? Cost of beam dump scales weakly with power but will have implications to required shielding.

It was suggested at recent AD&I meeting at Daresbury to look at possible combining this dump with the main beam dump (few sketches later).

Dogleg Design : Theoretical Minimum Emittance Lattice





Dogleg Design Parameters

$\gamma\varepsilon_{x0} = 10^4$ nm

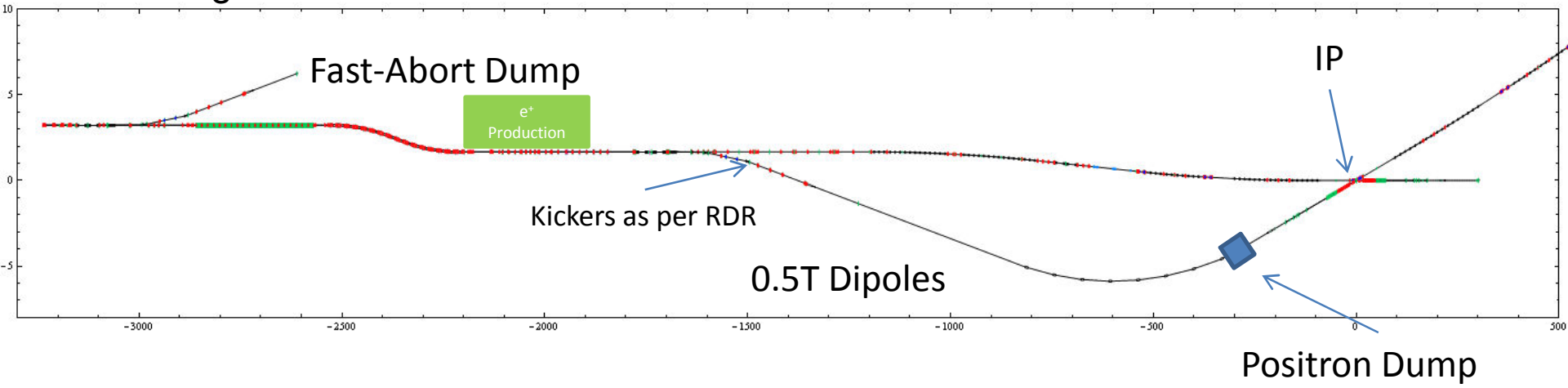
Element	40Tm Design	60Tm Design	*80Tm Design*
Bend Angle L	1.1mrad 2.0 m	1.02mrad 2.06 m	*1.35mrad* *7.08 m*
Focus. Quad L	5.64m	4.83m	*3.52m*
Defocus. Quad L	3.66m	3.2m	*2.57m*
Smallest Drift L	0.4m	0.4m	*0.2m*
Cell Length	24.44m	20.84m	*20.665*
No. Cells	12	14	*12*
Number of Elements	64 Quads / 16 Dipoles	72 Quads / 18 Dipoles	*64 Quads/ 16 Dipoles*
Emittance Growth (250/500GeV)	5.77nm / **367nm**	5.54nm / **336nm**	*5.92nm/**378nm***
Undulator-to-Target distance	**~480m**	**~440m**	***~400m***

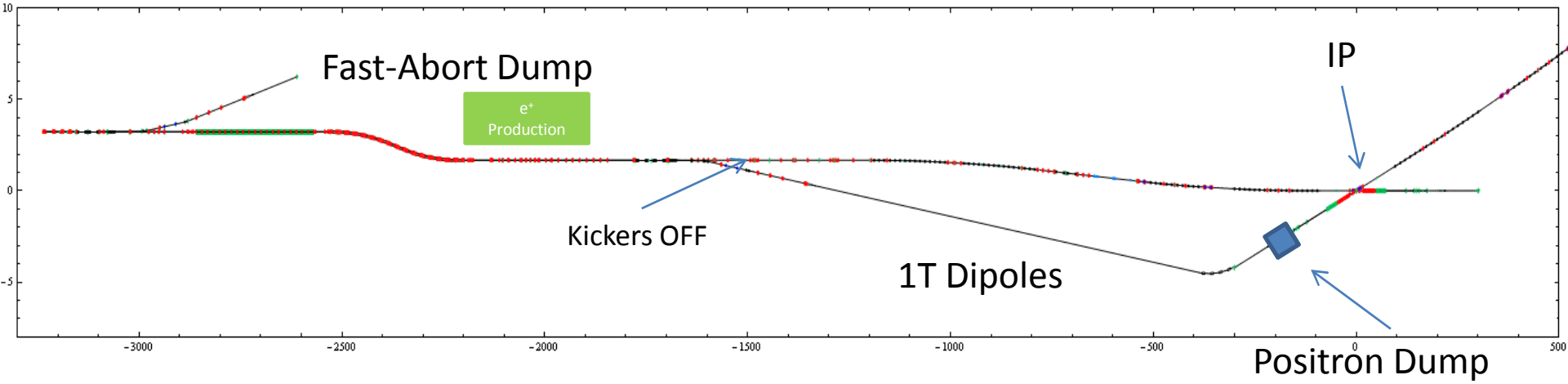
Reduced Quadrupole field leads to longer arc length, as well as longer quadrupoles. This raises the required dipole field. Included 80Tm design in the design.

Emittance dilution compared to other lattices

Lattice	Transverse off-set	Normalised Emittance growth due to dogleg	Number of magnets
TESLA TDR	0.7 m	681nm@400GeV ~8.5% 2544nm@500 GeV ~25%	Dipoles 96 Quads 16
Big Bend like (20 mrad and 2 mrad configuration)	1.5 m	493nm@400 GeV 1927nm@500 GeV (~19%)	Dipoles 160 Quads 34
80Tm TME	**1.5 m**	**5.92 nm / 378 nm**	***64 Quads/ 16 Dipoles***

Possible layouts for combining the tuning beam dump with the main beam dump. Main beam dump similar to TESLA (with windows on both sides). Design assumes perpendicular impact on the beam dump window. One with weaker dipoles (0.5T) more spread out, and one with a long transfer line then a “turn-around”. Effect of SR and backgrounds need to be evaluated.





Plans

- Decide power of fast abort dump and changes to this extraction line. Acceptance of fast abort line (-15-20% to +1%)?
- Design of DC tuning line, how strong dipoles can be used for this line? Specify tuning dump power. Study the possibility of merging with the main beam dump. Details of SR deposition in the tunnel and radiation effects need to be studied.
- Timing issues with e+ and e- BDS being discussed with AD & I team.
- Separate functionalities of polarimeter + laser wire chicane (MPS on positron BDS side)
- Have not shorten the RDR deck yet, the FFS including the energy collimation lattice can be shortened by ~100-200m allowing more emittance growth at 1 TeV CM.
- Dogleg – space between magnets, tolerances, decimation of dipoles?
- Check how much tunnel length can be saved if we shorten the chicanes (including polarisation, energy) allowing more emittance dilution.
- Support for travelling wave and low power beam dynamics simulations including collimation depth changes.
- Crossing angle layout: Changes in configuration for gamma-gamma?