Collimation Simulations and Optimisation

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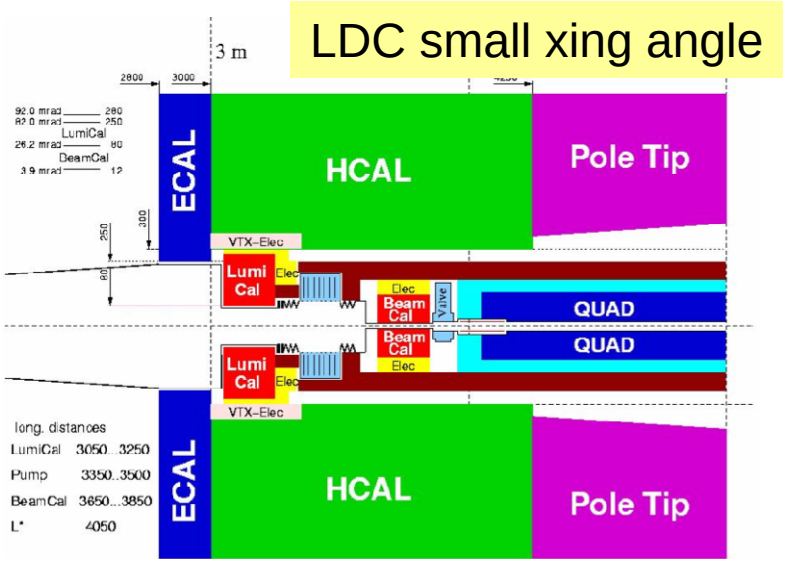
Contents

- Collimation design mature, lead by SLAC/FERMILAB
- My areas of input – collimation depths and collimation optimisation.
- Collimation Depths
  - Analytical solution for current BDS “2006e”.
  - BDSIM cross check (off energy halo)
- Collimation Optimisation and Halo Tracking
  - Method and History
  - Latest results 2006e

Collimation Depths Overview

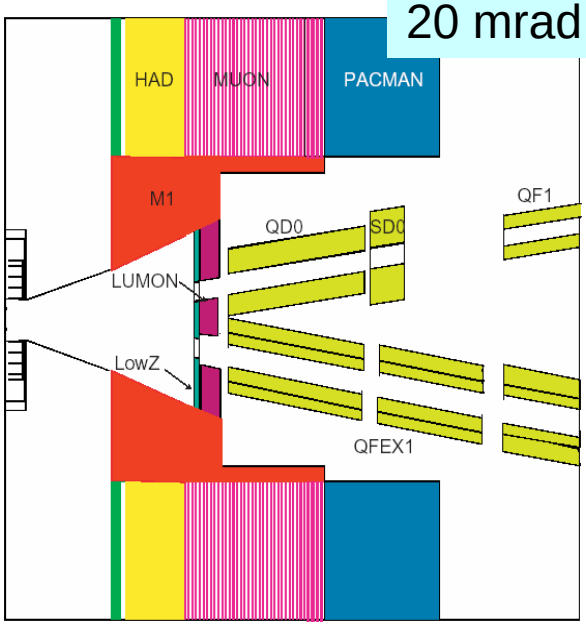
- Criteria, clean passage of halo SR through IR apertures
- Beamcal and extraction quads are limiting apertures
- Many complicating factors
  - Multiple crossing angle 20,14,2,0 mrad
  - Multiple detector designs, L*
  - IP Parameter Sets (Nominal only here, as in BDS design)



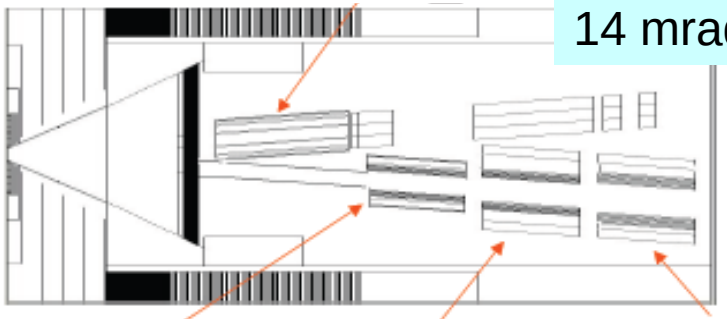
New BDS for RDR

- 2 x 14 mrad approved after Vancouver
- Single 14 mrad as baseline “approval recommended”
- Identical FD to 20 mrad but different IR design

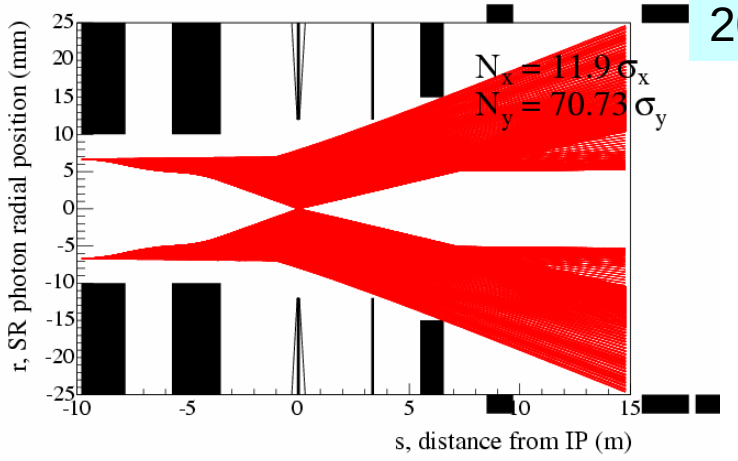
20 mrad



14 mrad



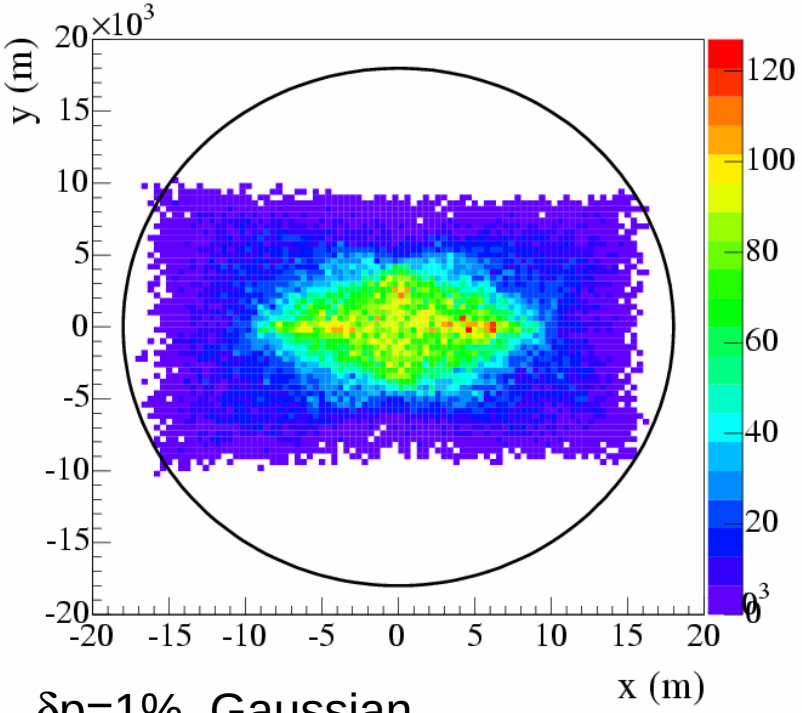
2006”e”



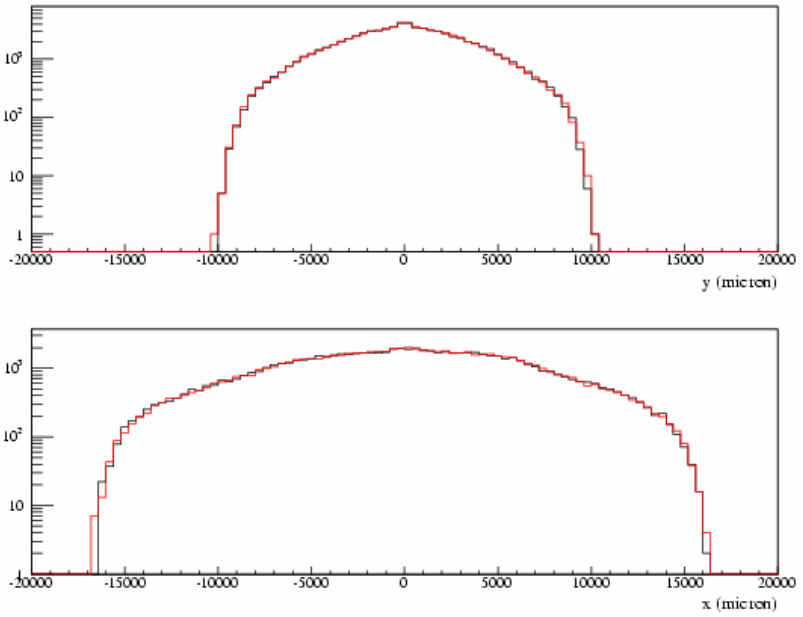
BDSIM cross check of collimation depths

- DBLT is linear on-energy envelope tracking
- BDSIM can track off-energy halo through FD

SR profile at 1st Extraction Quad (r=18mm)



δp=1%, Gaussian



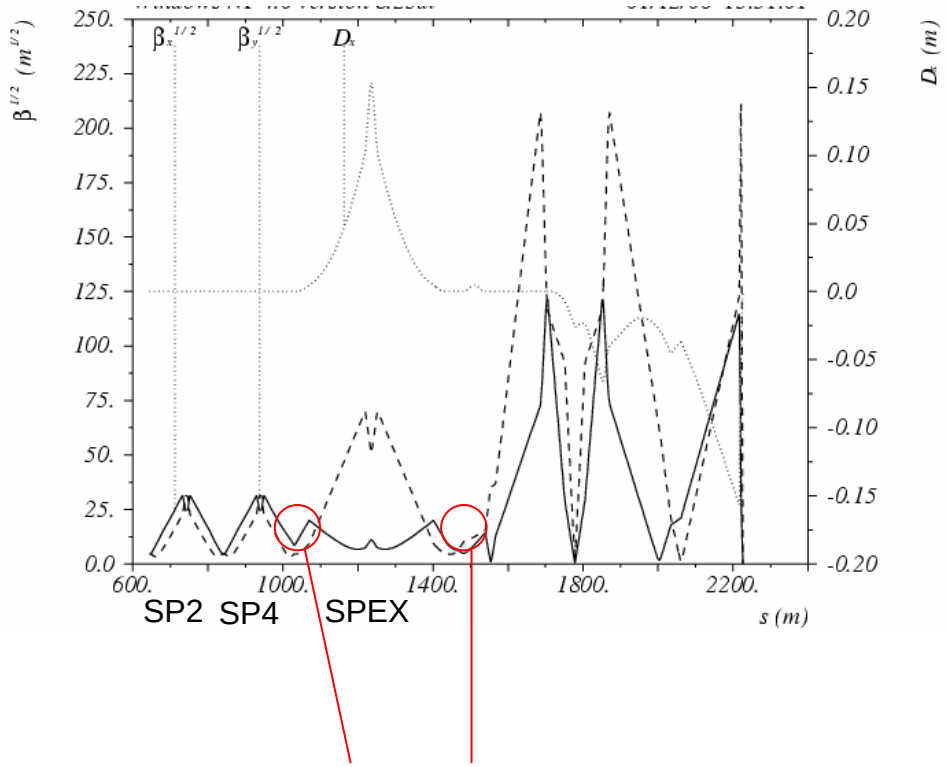
On-energy, δp=1% Gaussian

Collimation Optimisation

- ILC BDS evolution
  - NLC BDS adapted for cold ILC linac
  - ILC survivable betatron spoiler optics
- Collimation performance evolution
  - NLC rather good collimation efficiency
  - ILC collimation performance poorer. Tighter apertures in y. SPEX as secondary betatron spoiler.
- Can we tweak ILC lattice to restore NLC performance?

More History and Basic Design

- ILC BDS evolution not specifically addressed collimation optimisation
- Latest 2006e deck is for minimised length/cost
- PHASE ADVANCES not perfect for any design
- BANDWIDTH through final doublet not well controlled for any design
- Restore phase advances
- Search solution space for optimum bandwidth

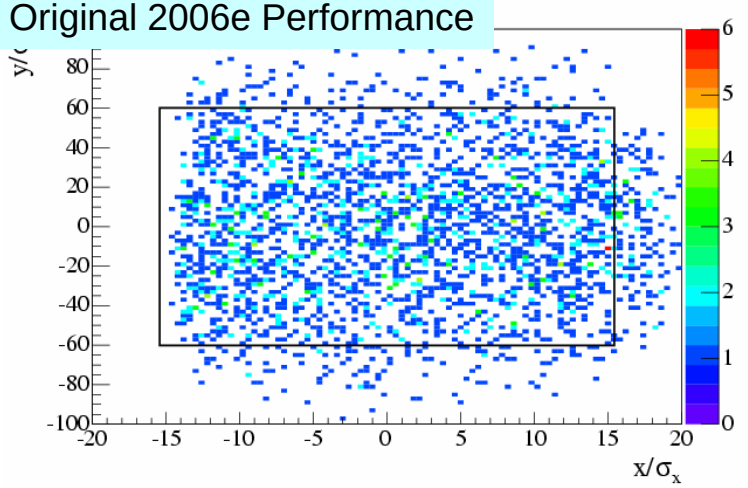


Matching quads restore phase advances

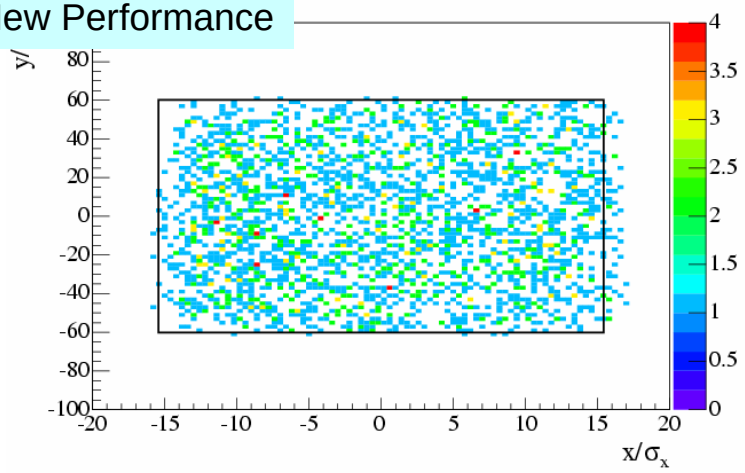
2006e Optimised Performance Tracking Results

- MERLIN BDS halo tracking, “black” spoilers set at nominal collimation depth
- Optimisation gives improved performance, sugges no longer need vertical SPEX collimator

Original 2006e Performance



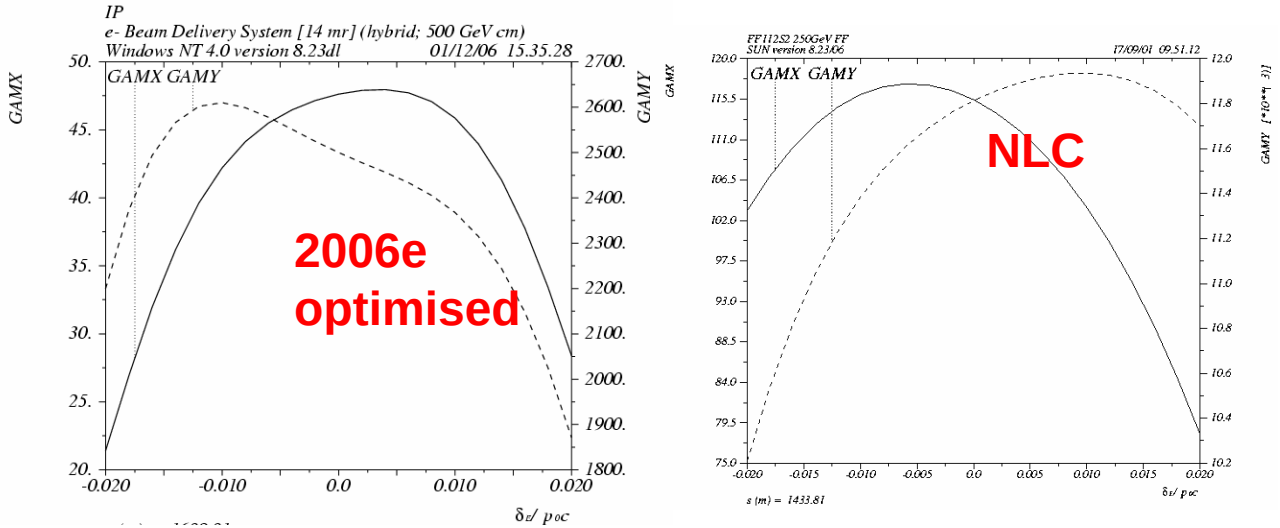
New Performance



Same population in both halos at FD

2006e Optimised Features

- Bandwidth

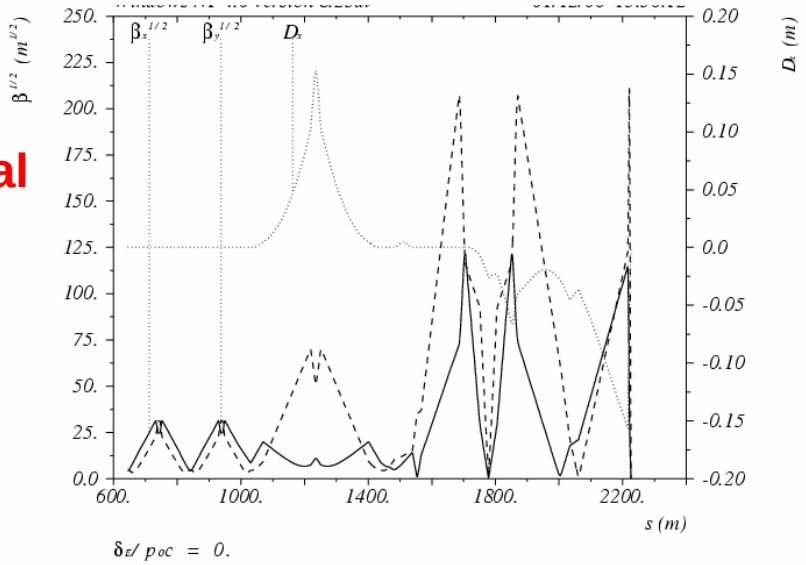


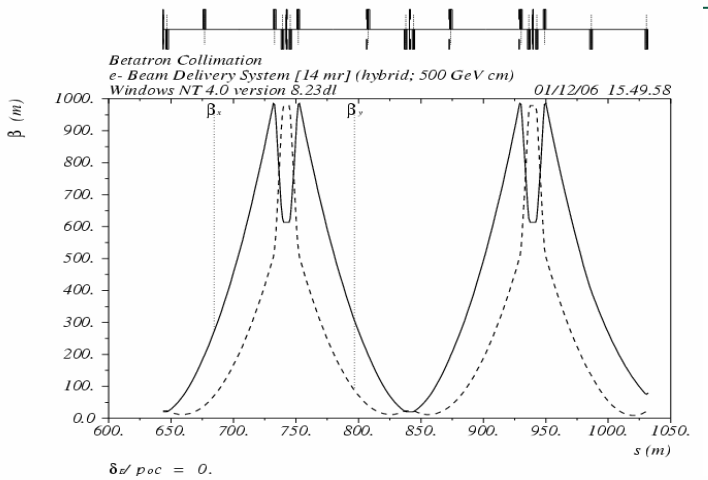
- Phase advances

	2006e	2006e optimised
SP4-SPEX	x: 0.38 y: 0.59	x: 0.5 y: 1.0
SP4-IP	x: 2.76 y: 2.34	x: 2.75 y: 3.25

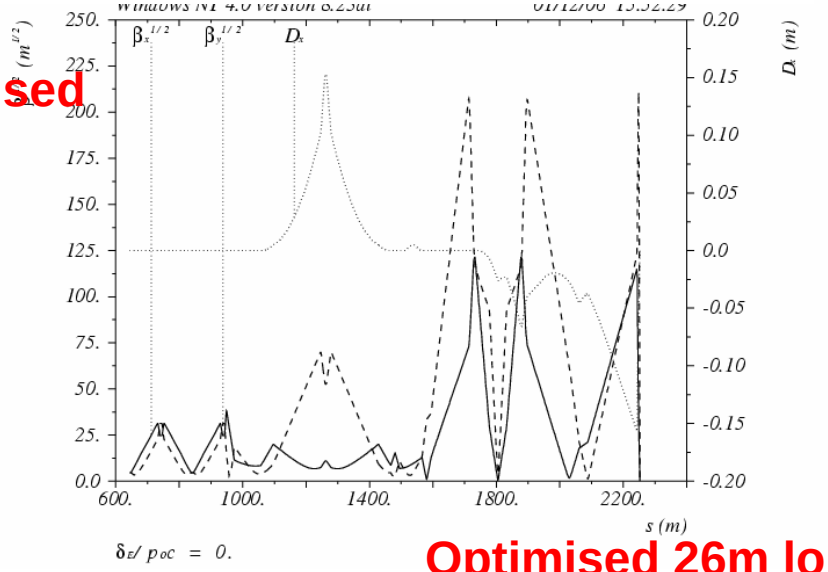
2006e Optics

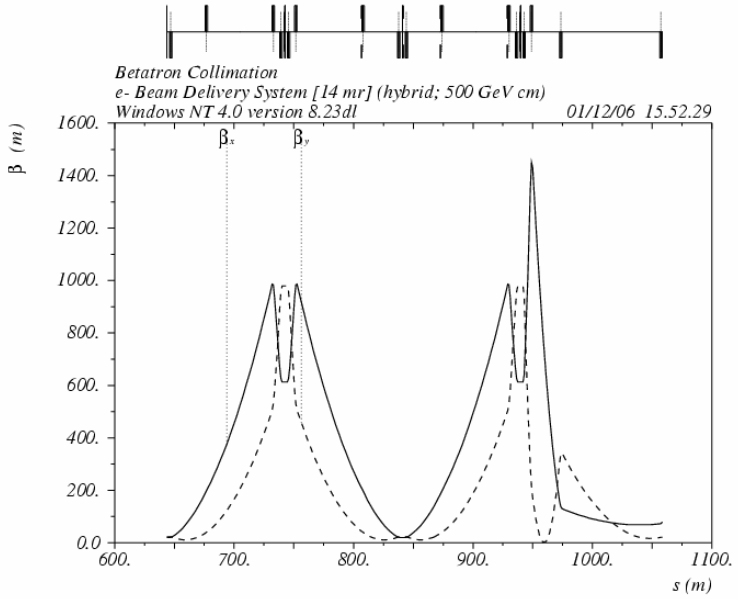
Original





Optimised





Optimised 26m longer (single BDS)

Conclusions

- Optimised lattice performance *seems* much improved for primary halo tracking
- Full simulation (secondaries) and losses along line needed
  - BDSIM/STRUCT
- Lattice longer/costlier so ultimately this optimisation may not be feasible.
  - Additional quads rather than longer length?