IP parameter optimization for low energy operation

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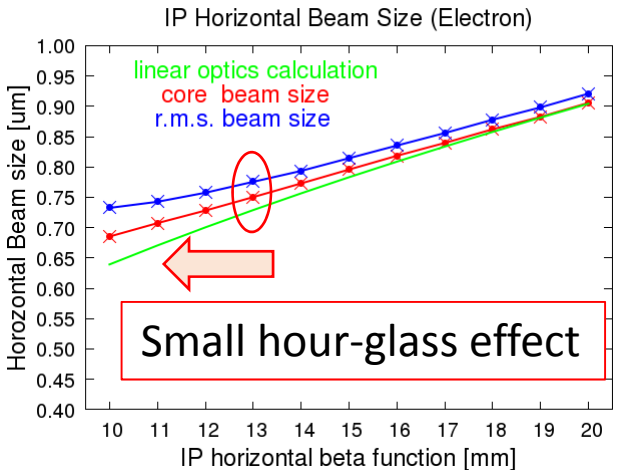
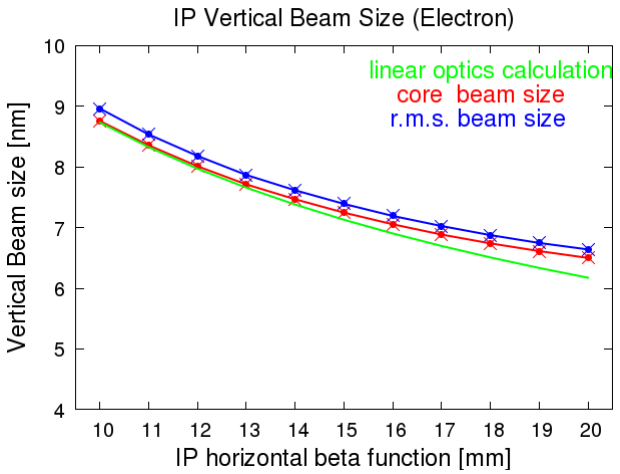
Geometrical aberration for electron beam ($\sigma_p/p = 0.188\%$)

$$\gamma\varepsilon_x = 10\ \mu\mathrm{m}\ , DY = 25$$



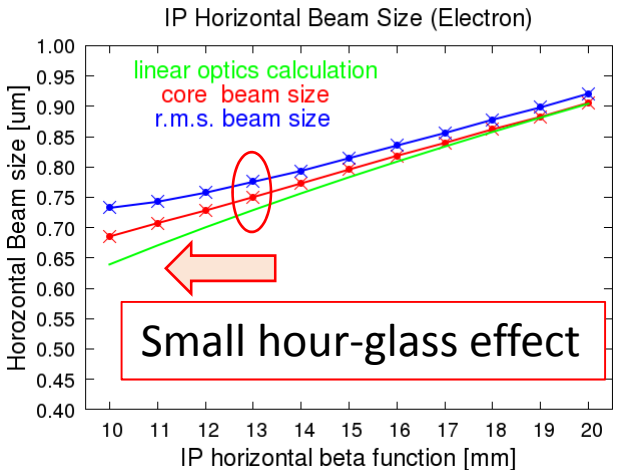


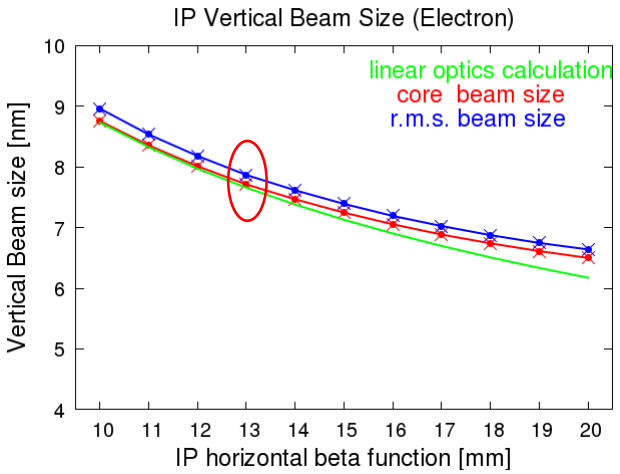
Smaller betaX*

- Small hour-glass effect
  => higher luminosity by same disruption parameter.
- Large geometrical aberration
  => Luminosity reduction, tight tolerance etc.
- Small horizontal collimation depth
  => Large detector background

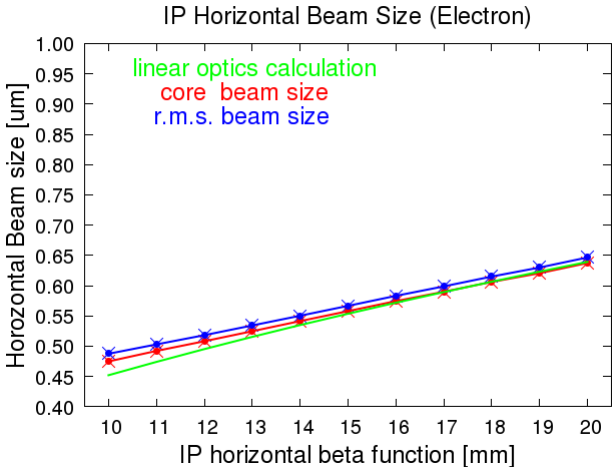
Geometrical aberration for small emittance beam

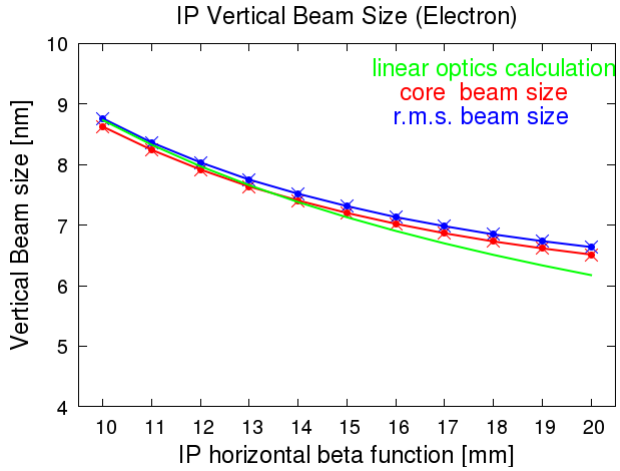
$$\gamma\varepsilon_x = 10\ \mu\mathrm{m}\,, DY = 25$$





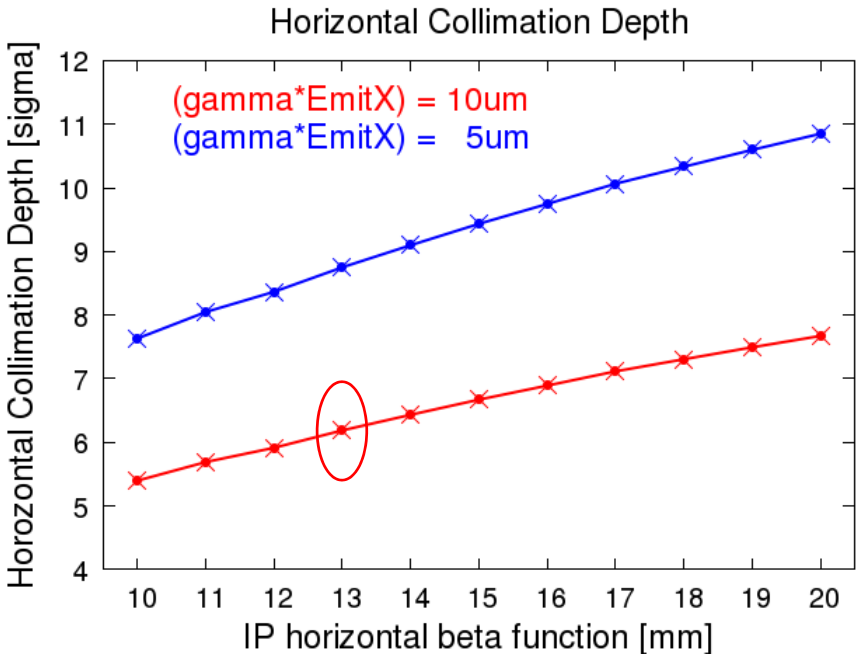
$$\gamma\varepsilon_x = 5\ \mu\mathrm{m}\,, DY = 35$$

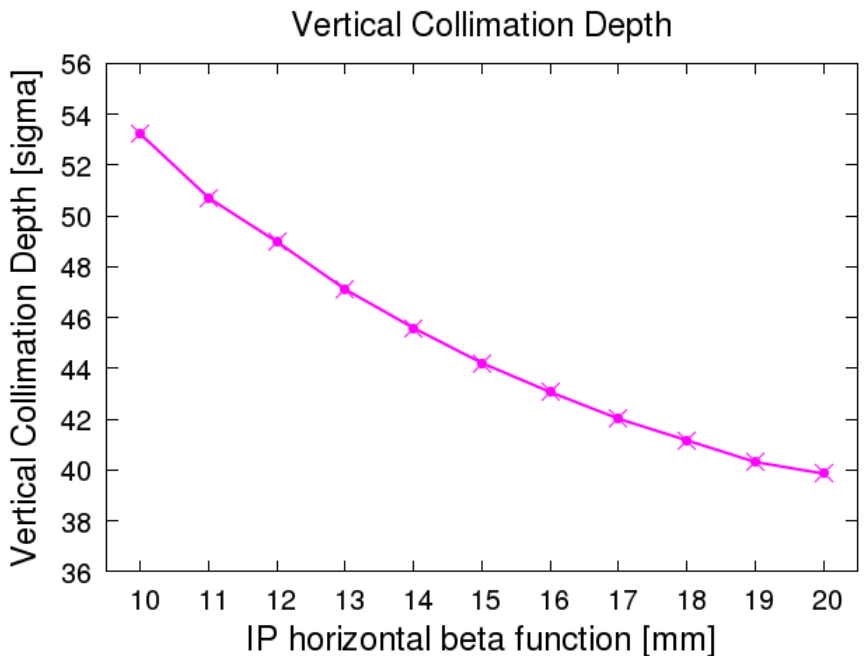




Geometrical aberration is weaker than that with large emittance beam.

Collimation Depth for 125GeV beam (ECM=250GeV operation)





When the horizontal emittance is smaller than design, the collimation depth can widen for smaller betaX.*

=> We had better to set the smaller betaX for smaller emittance.*

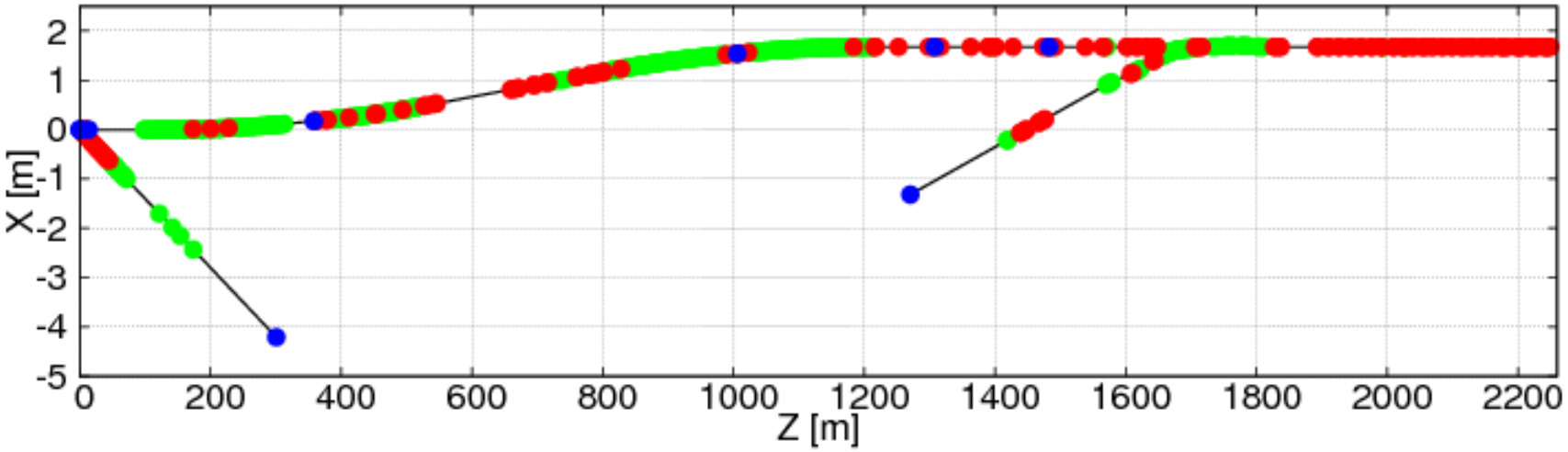
BDS optics for ECM=1TeV operation

ECM= 500GeV optics can be increased the beam energy up to 300GeV (ECM=600GeV)

The beam optics can be increased to ECM=1TeV by using same geometry.

- The most of magnets for ECM=500GeV can reuse to 1TeV optics.

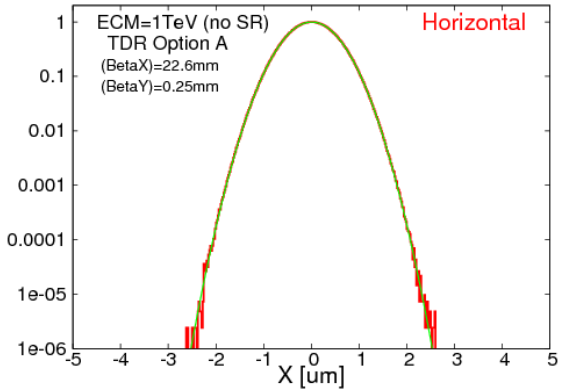
- Some new magnets should be installed to extend to ECM=1TeV.

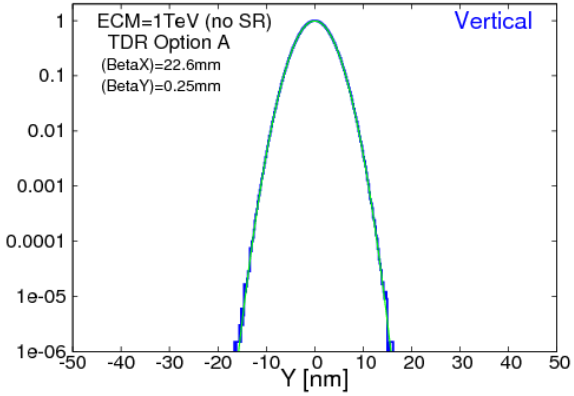


Simulation Results for ECM=1TeV optics

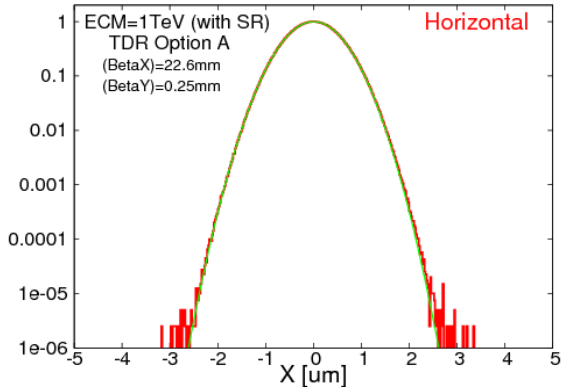
Large aberration by Synchrotron radiation

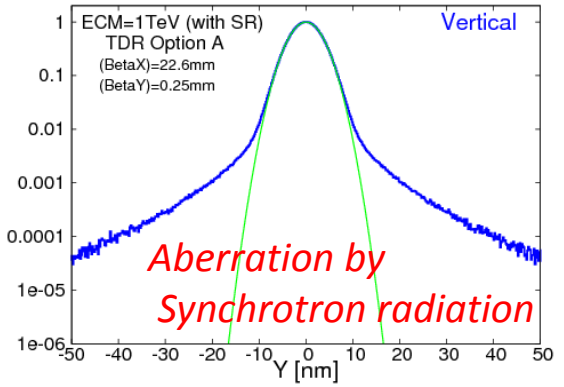
<< no SR >>





<< with SR >>





	Horizontal			Vertical			Relative
	design	rms	core	design	rms	core	Luminosity
no SR	0.481um	0.481um	0.481um	2.99nm	2.99nm	2.99nm	99.8%
with SR		0.499um	0.498um		3.71nm	3.15nm	91.7%

The geometry of BDS beamline has strong constraint for synchrotron radiation at 1TeV operation.

Synchrotron radiation for BDS at ECM=500GeV with strong bending magnet.

Electron beam ($\sigma_p/p = 0.188\%$)

Momentum Spread Growth by Synchrotron Radiation

	Collimator	FF beamline	Total
B = 1.0 x B0	0.0058%	0.0017%	0.0061%
B = 1.5 x B0	0.0059%	0.0020%	0.0062%
B = 2.0 x B0	0.0060%	0.0024%	0.0064%

Horizontal Emittance Growth by Synchrotron Radiation

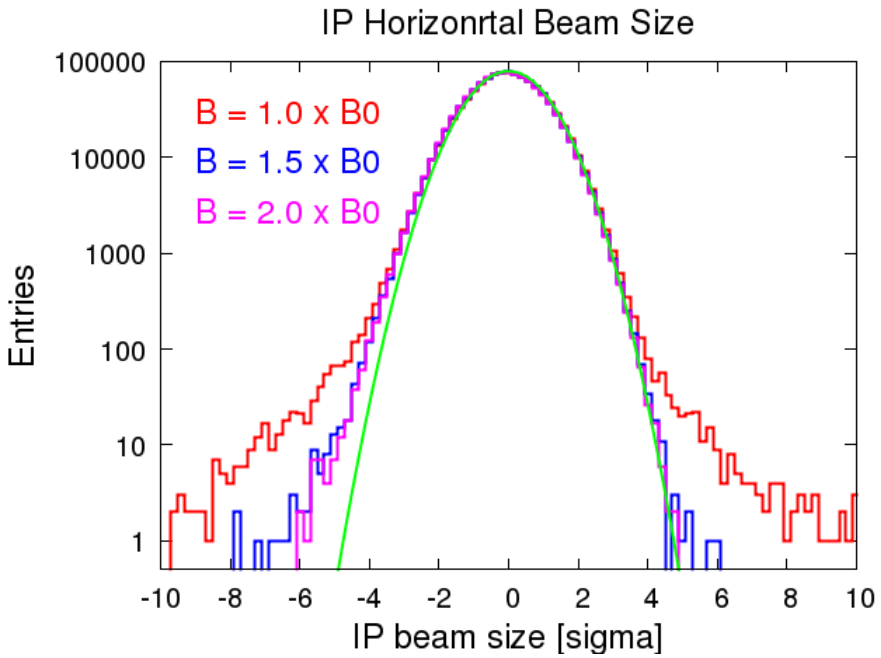
	Collimator	FF beamline	Total
B = 1.0 x B0	0.45%	0.07%	0.52%
B = 1.5 x B0	0.67%	0.49%	1.16%
B = 2.0 x B0	1.49%	2.06%	3.55%

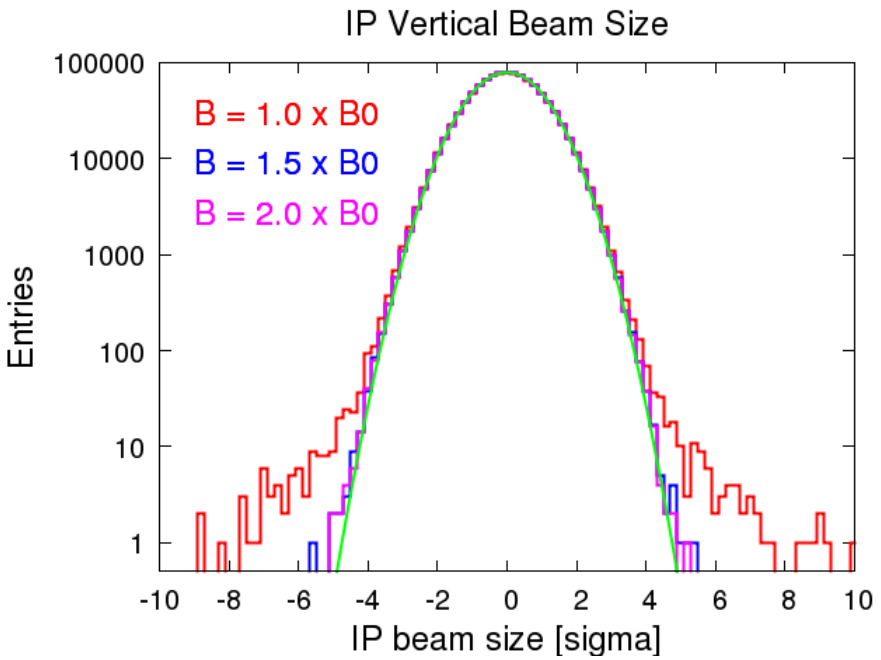
By using the strong bending magnet, the strength of sextupole magnet can be reduced.
=> Small geometrical aberration for low energy operation.

The emittance growth can be reduced by putting additional BENDs in beamline.

IP beam profile at ECM=250GeV for BDS with strong BEND

$$\sigma_p/p = 0.188\%$$
$$\beta_x^* = 0.013\ \mathrm{m}\,, \beta_y^* = 0.00041\ \mathrm{m}$$





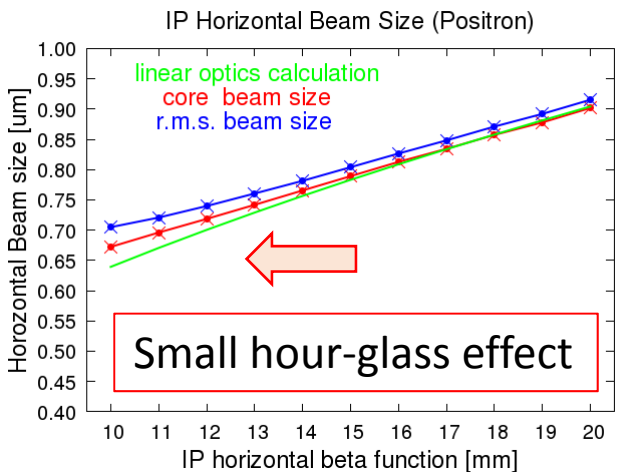
Present ILC BDS was designed to be used for ECM=250-1000GeV.
Therefore, the optics is not optimized for ECM=250GeV.

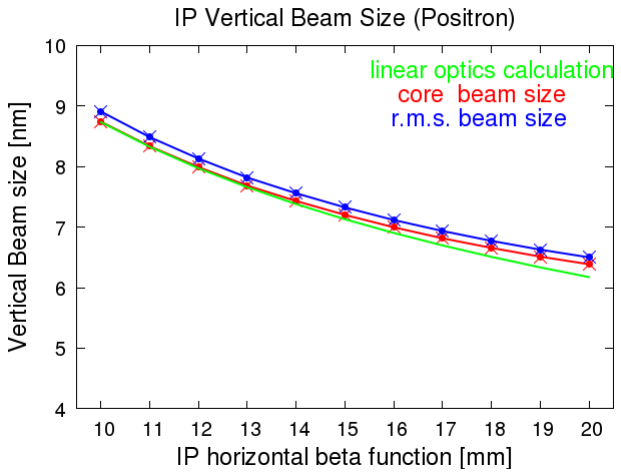
If we decide the optics will be redesigned only for ECM=250-500GeV,
we can make the optics at ECM=250GeV small aberration (and maybe compact) .

backup

Geometrical aberration for positron beam ($\sigma_p/p = 0.150\%$)

$$\gamma\varepsilon_x = 10\ \mu\mathrm{m}\,, DY = 25$$





$$\gamma\varepsilon_x = 5\ \mu\mathrm{m}\,, DY = 35$$