Compact dog-leg design for 125 GeV electron beam

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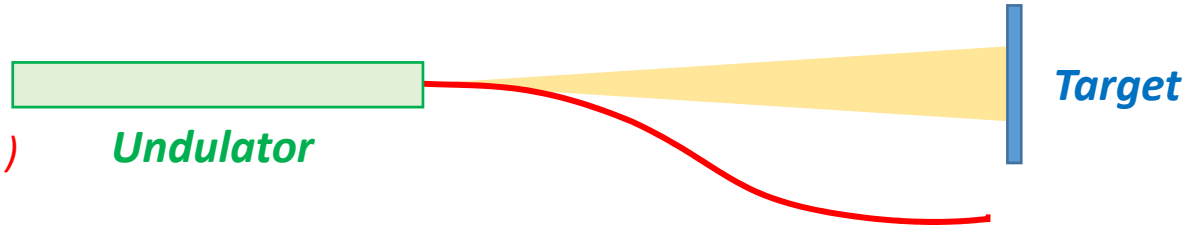
ILC cost reduction WG1 meeting

Motivation

The target heating for 125GeV beam is large for present design.
One of the main reason is the large photon spot size at target for their large divergence, and the capture efficiency is not good for 125 GeV beam.

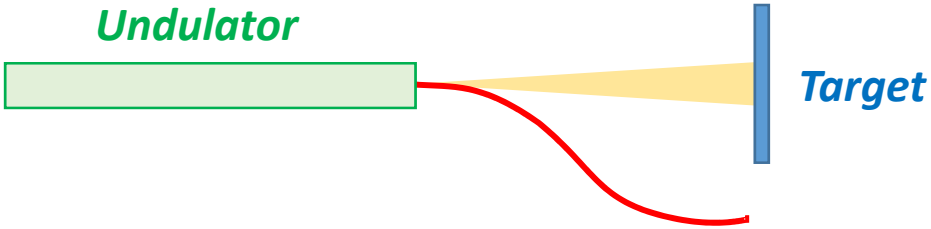
TDR dogleg

Compatible to ECM=1TeV
(limited by emittance growth by SR)



Compact dogleg

Only for ECM=250GeV



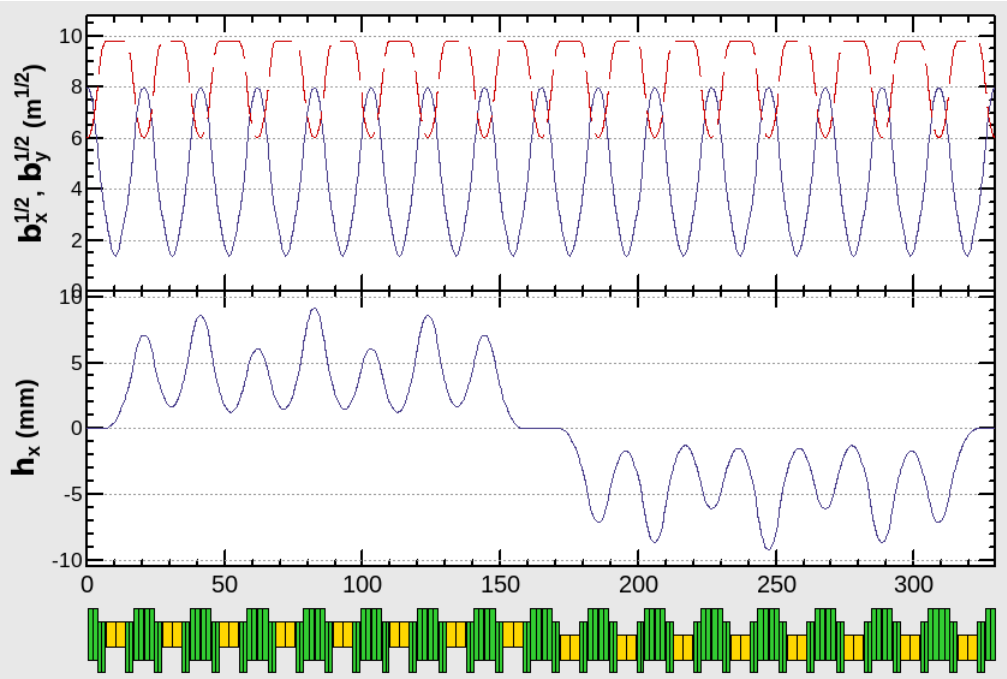
By using compact dog-leg only for 125 GeV electron beam (1st stage), we can make the distance between undulator and target close.

=> Photon spot size at target will be able to be small.
=> The capture efficiency can be improved (??).
=> Undulator length can be shortened (??).
=> The target heating will be relaxed for 125 GeV beam (??).

Furthermore, the 125 GeV beam has a problem of FC heating for their large spot size.
The heating problem of FC also can be relaxed by using the compact dog-leg (??).

Dog-leg for Undulator positron source

Dog-leg was designed to minimize the horizontal emittance growth by SR for 500GeV beam.



Beam Energy	Bending Field	Horizontal Emittance Growth	SR power to chamber
500 GeV	0.3217 T	4.0 %	62.48 kW
125 GeV	0.0804 T	0.001%	0.24 kW

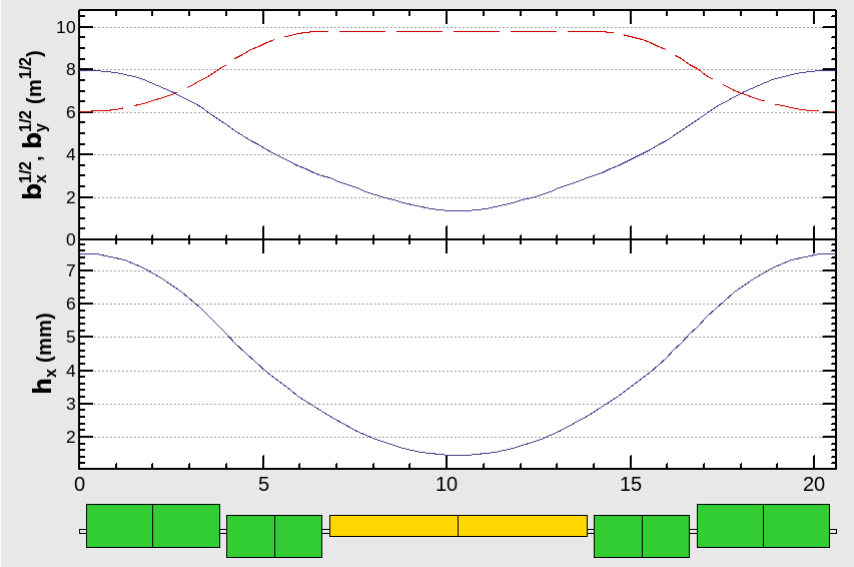
Over-spec for 125GeV beam

=> We can make compact design only for 125GeV beam.

=> The distance between undulator and target shorten.

Dog-leg Cell design

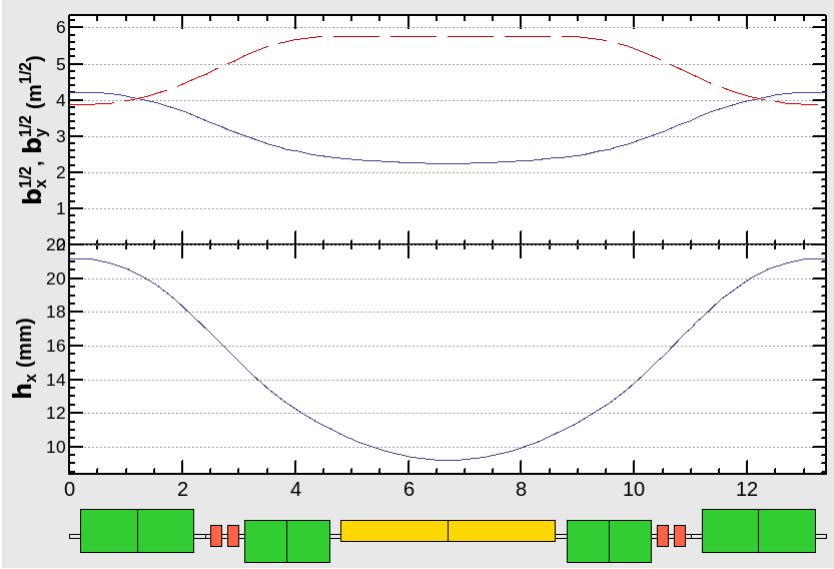
Original Dog-leg cell



The dog-leg consist of
TME (Theoretical Minimum Emittance) lattices

- 3.6m-long QF magnet
- 2.6m-long QD magnet
- 7.0m-long Bending magnet
- no space to put steering magnets

Dog-leg cell for 125GeV beam



The dog-leg also consist of
TME (Theoretical Minimum Emittance) lattices

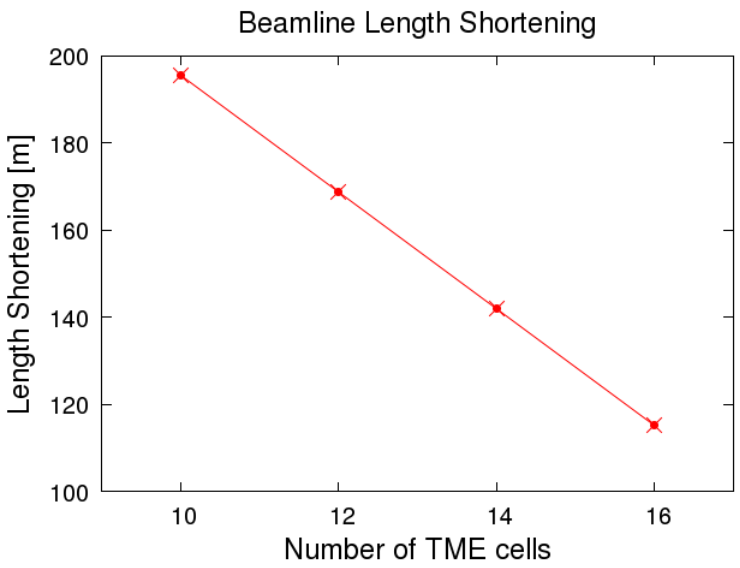
- 2.0m-long QF magnet
- 1.5m-long QD magnet
- 3.8m-long Bending magnet
- Steering magnets were put for orbit tuning.

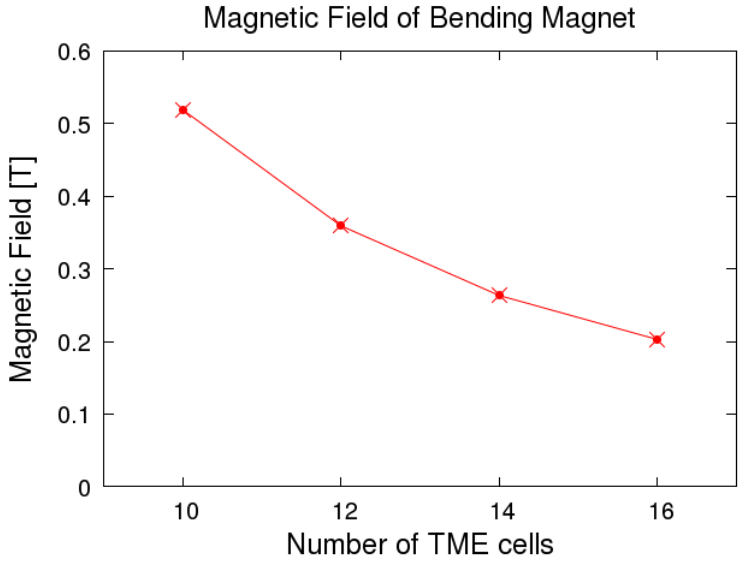
Maximum field gradients for quadrupoles were designed to be less than 60 T/m.

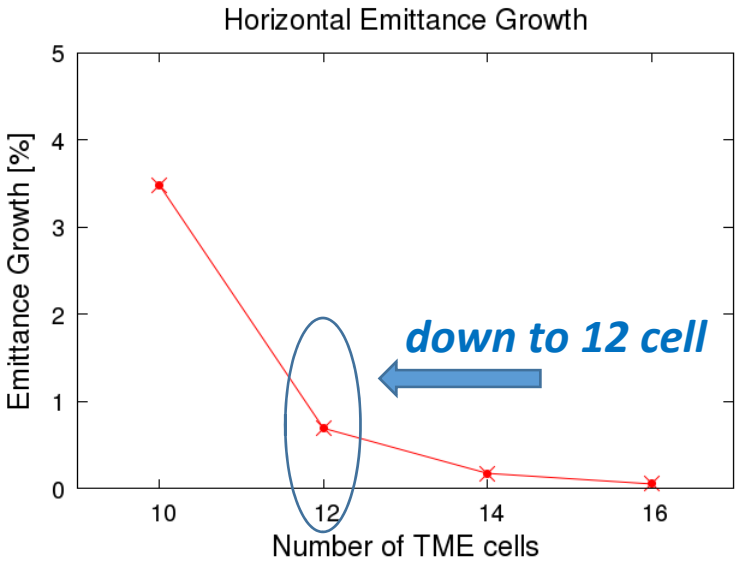
Same length of bending magnets were assumed to other BDS section.

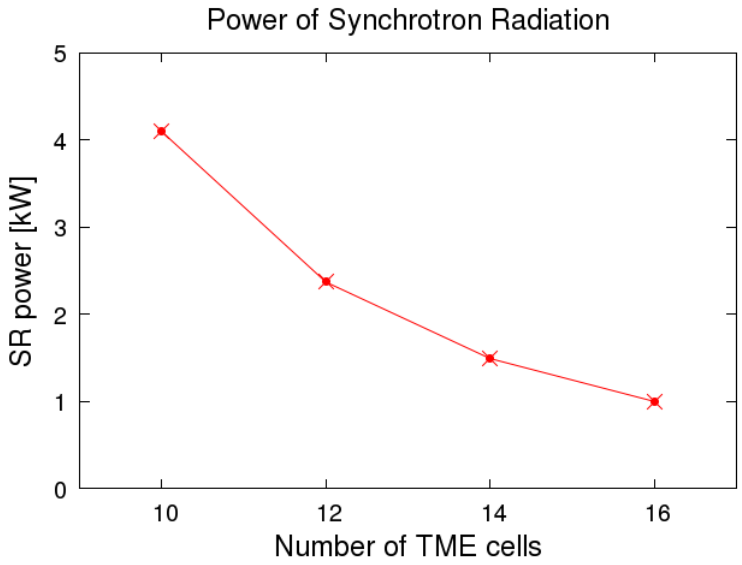
Optimization of number of cells

Number of cells were changed by keeping the horizontal offset to be 1.555m



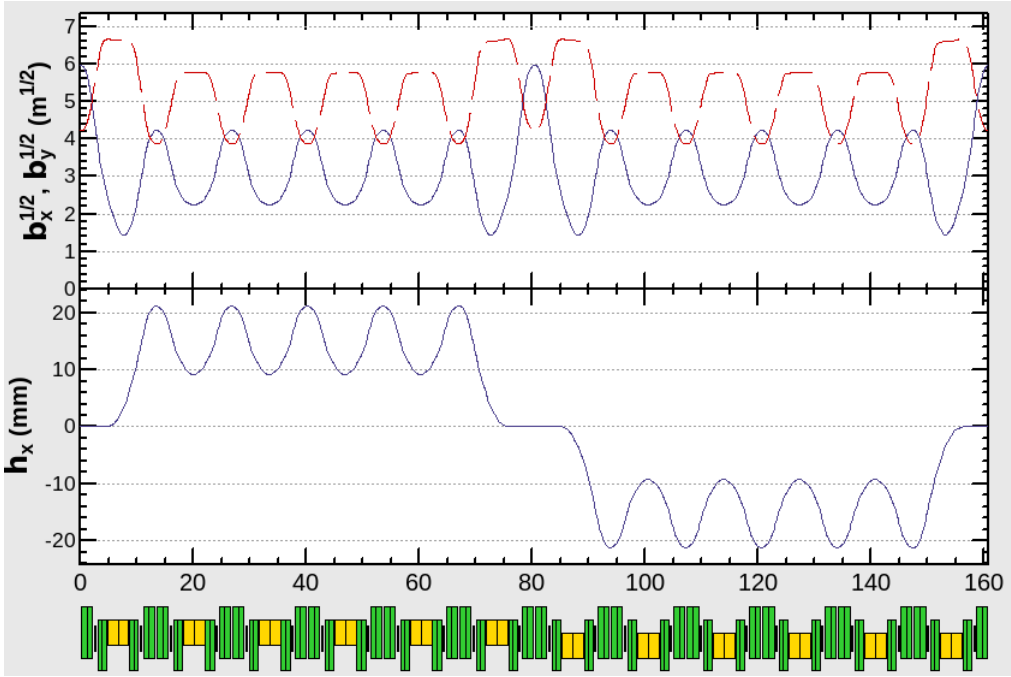




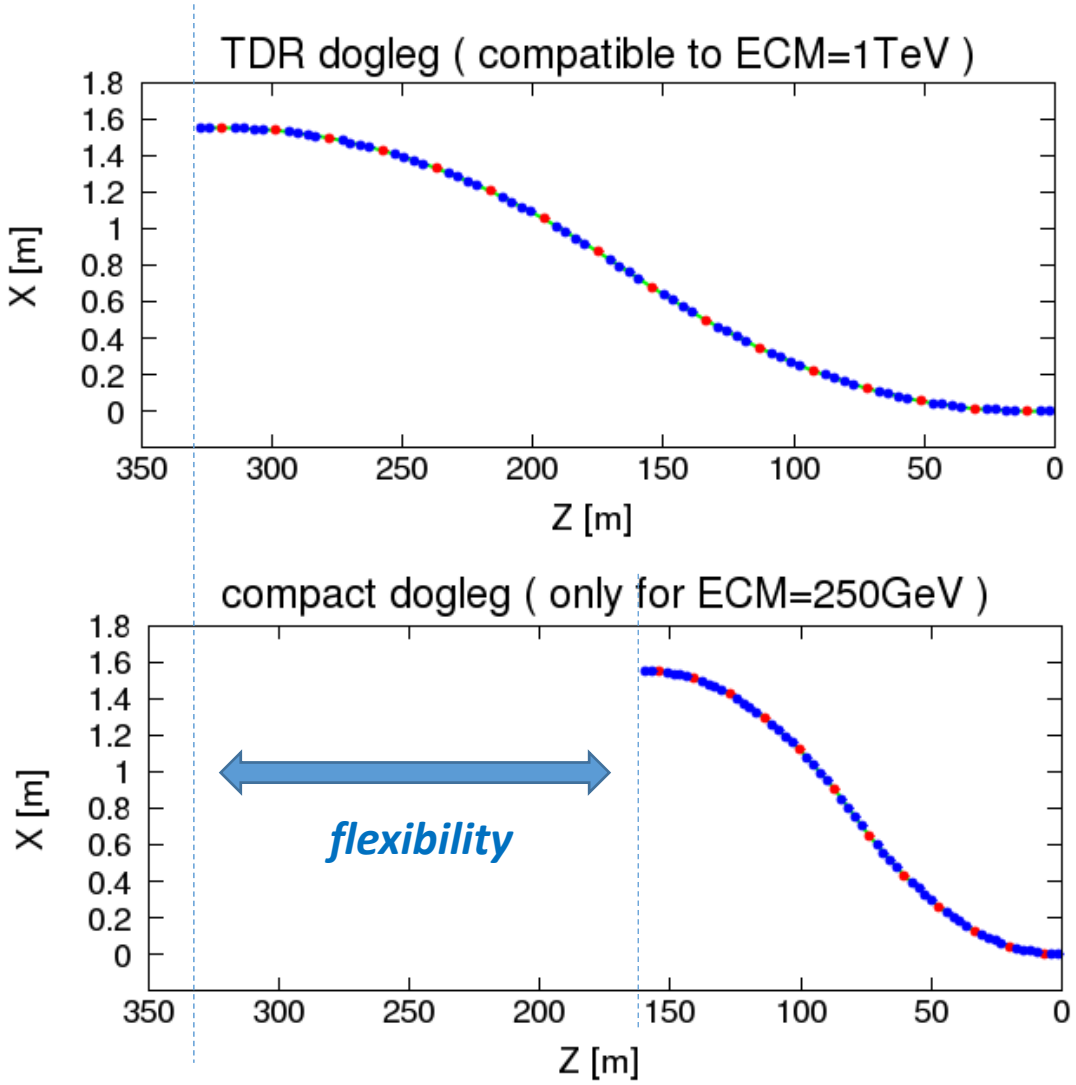


Dog-leg design for 125GeV electron beam

12 cell (8 normal cells and 4 dispersion suppressor cells)



- *The distance between undulator to target can be shortened by 168.8 m.*
- *The horizontal offset is kept to 1.555 m.*
- *Horizontal emittance growth for 125 GeV beam is 0.7 %.*
- *Maximum field gradients for quads are less than 60 T/m.*
- *Put steering magnets for orbit correction.*



We can shorten the length of dogleg to optimize the undulator position source by (0 – 168.8 m) for 125GeV electron beam.