e^- FINAL-FOCUS SYSTEM FOR LHeC

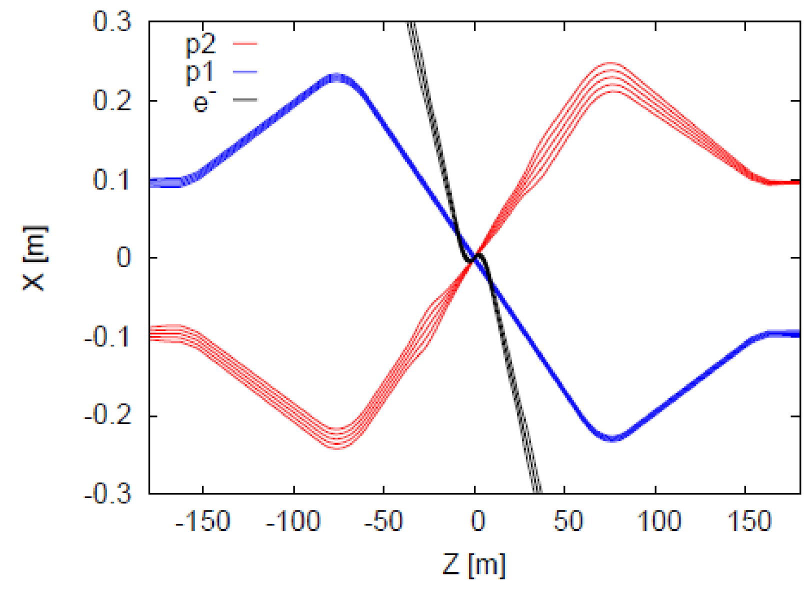
J.Abelleira[1,2], R. Tomas[1], F. Zimmermann[1]

[1]CERN, Geneva, Switzerland; [2]EPFL, Lausanne, Switzerland

ABSTRACT

One of the options considered by the design study for a Large Hadron electron Collider (LHeC) is adding a recirculating energy-recovery linac tangential to the LHC. In order to obtain the required luminosity with an electron beam from a linac, reaching the smallest possible proton beam size is essential. At the collision point the electron beam should be of the same size as the protons. For this purpose a local chromatic correction scheme is proposed, based on the novel compact Final Focus scheme for future linear colliders, first proposed by P. Raimondi and A. Seryi. The procedure for developing this final focus optics and the achieved performance are described.

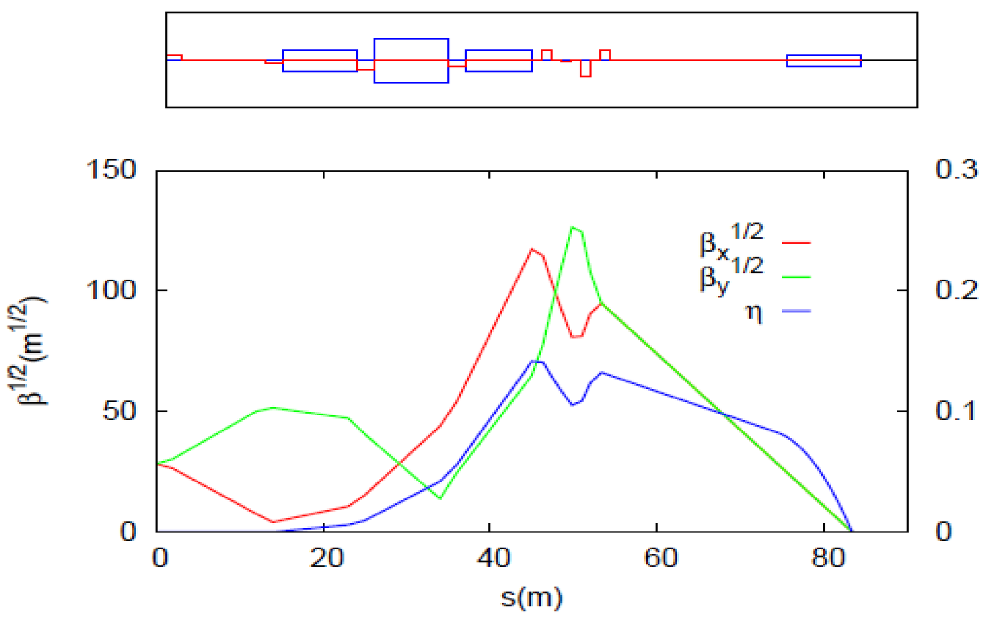
LAYOUT



- LHeC interaction region displaying the two p^+ beams and the e^- beam trajectories
- Injection of e- parallel to beam 1, collision with beam 2.
- Crossing angle of 6 mrad between the non-colliding proton beams.

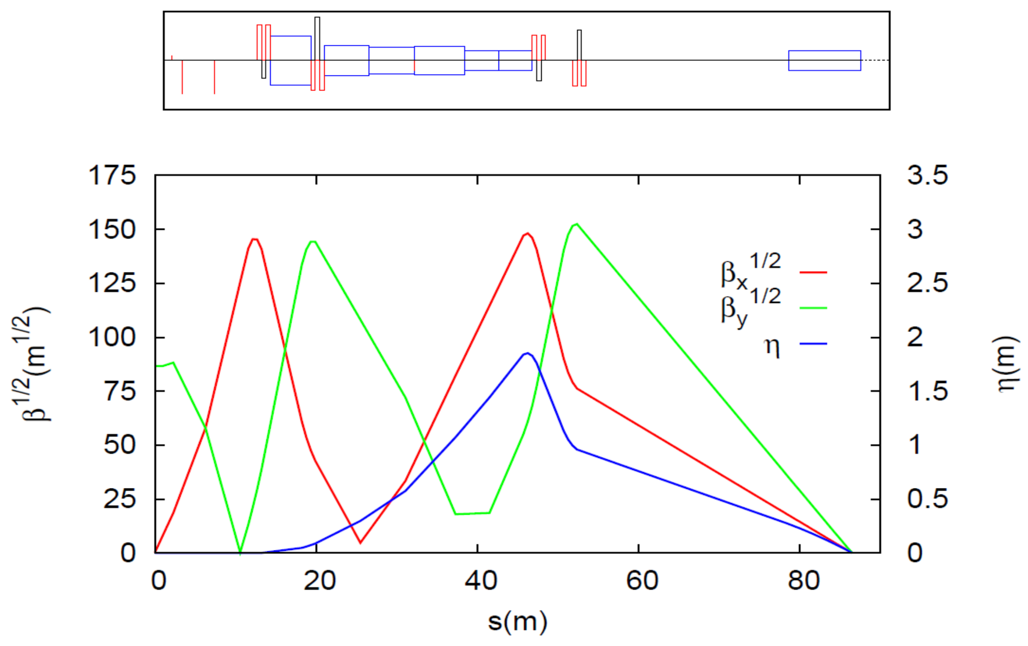
FINAL-FOCUS WITH TRIPLET

- Triplet design.
- Round beam $\beta^*_{x,y} = 0.1$ m.
- SR power: 25 kW
- Not possible to implement a local chromatic correction

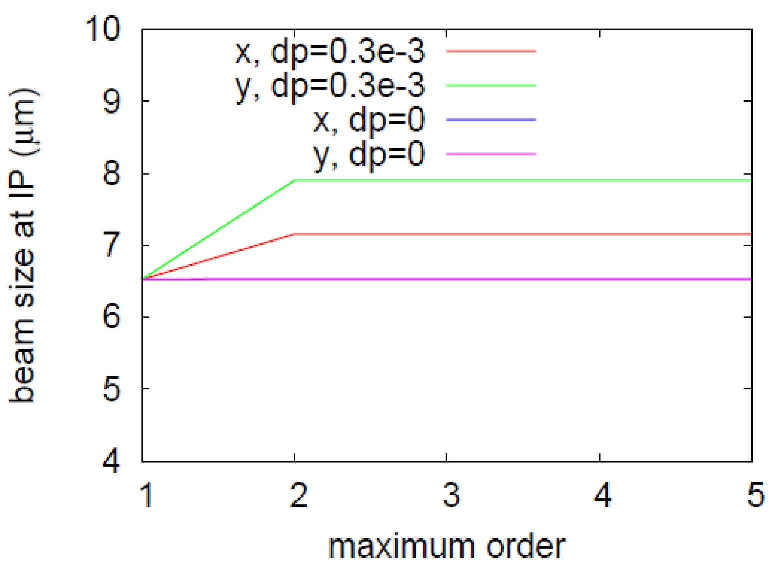


FINAL-FOCUS WITH DOBLET

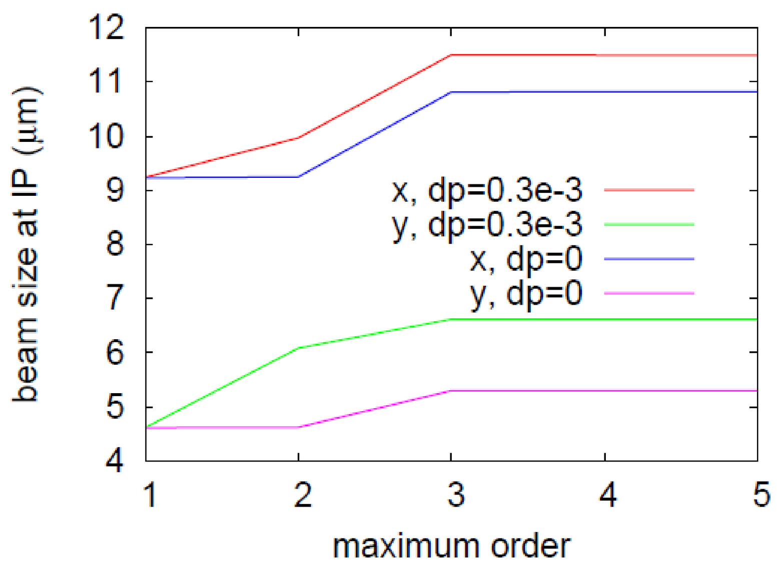
- Doublet design.
- Flat beam $\beta^*_x = 0.2$ m, $\beta^*_y = 0.05$ m.
- Local chromatic correction
- Limiting factors: high L^* and high dispersion
- The maximum quadrupole gradient is 40 T/m.
- Total SR power is 0.5MW. Too high.
- Too strong dipole magnets



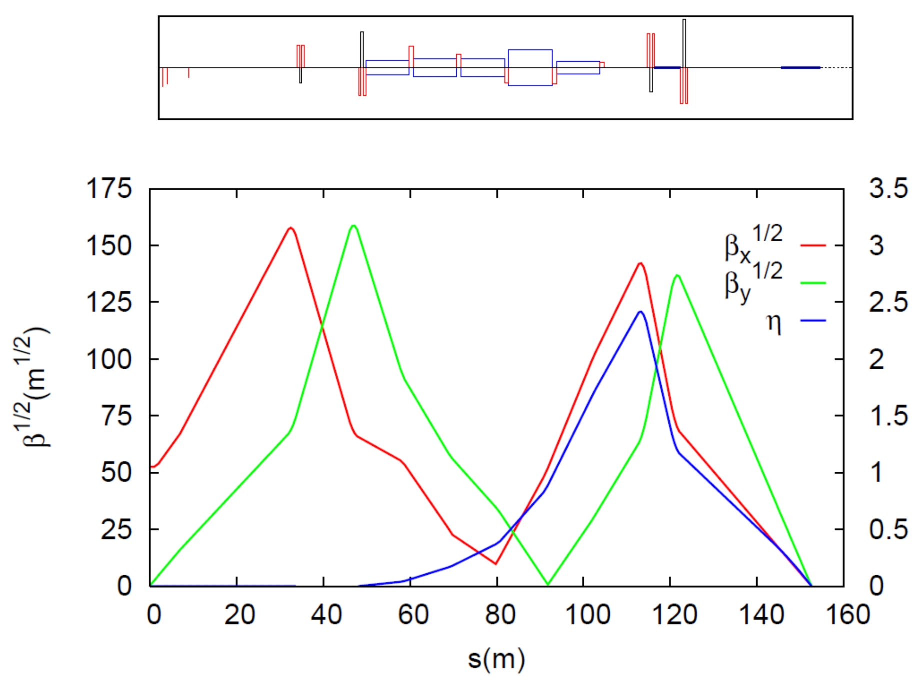
ABERRATIONS COMPARATIVE



FF with triplet



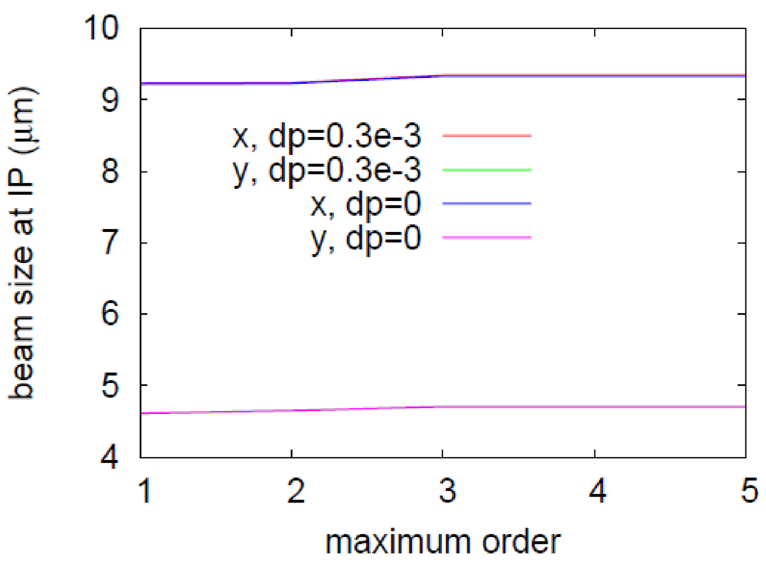
FF with doublet



Extended system

- More dispersion created with weaker dipole magnets
- Much longer system
- 200 m between IP and linac. Limit!
- Total SR power reduced to 83 kW.
- Maximum quadrupole gradient reduced to 15 T/m.

- Beam size determined by MAPCLASS code.
- Compromise in the FF doublet between correcting the chromatic and the geometric aberrations.
- If the system is long enough, both aberrations can be perfectly cancelled.

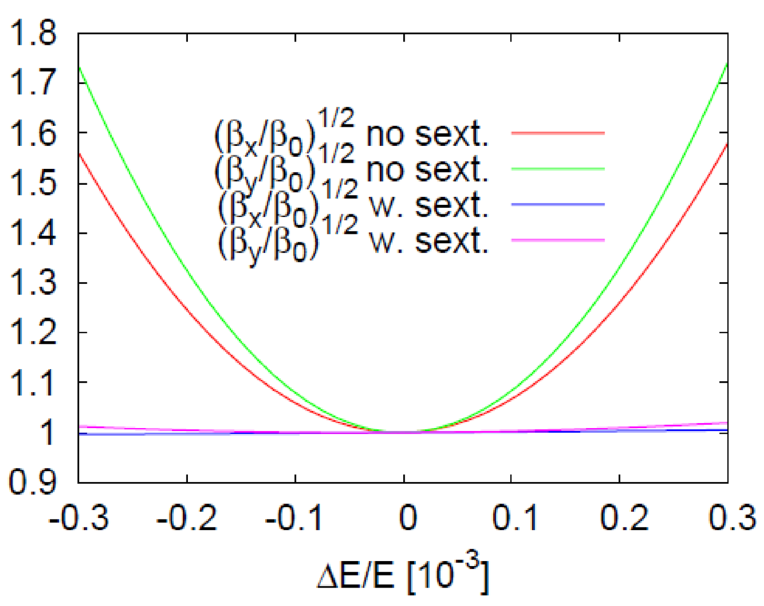


Extended FF with doublet

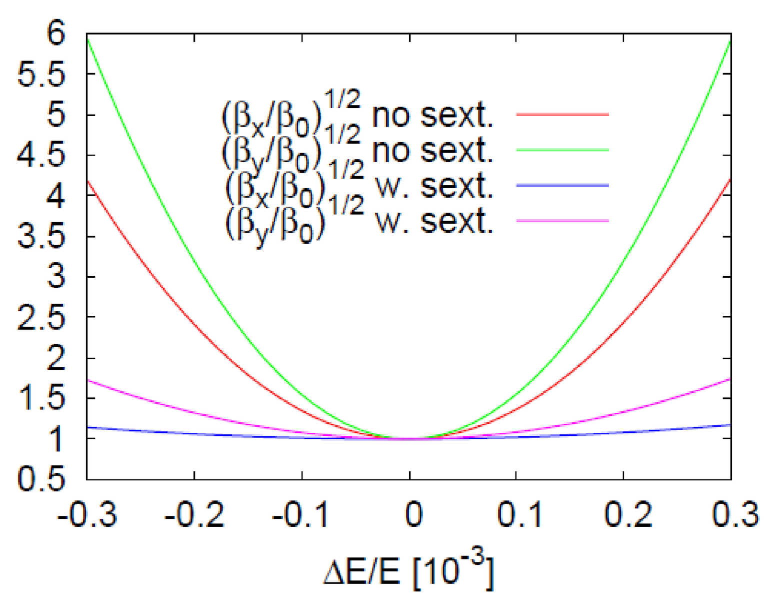
Relative IP e− beam-size increase, determined by tracking with respect to $\sigma_{0,x,y} = (\varepsilon_{x,y}\beta_{x,y})^{1/2}$ for a Gaussian beam with $\delta_{rms} = 3\times10^{-4}$., taking into account the contribution of the energy loss by synchrotron radiation (SR)

	FF triplet	FF doublet w. sext	Extended FF doublet w sext.
$\Delta\sigma_x/\sigma_{x,0}$ NO SR	10%	25%	2%
$\Delta\sigma_y/\sigma_{y,0}$ NO SR	21%	43%	3%
$\Delta\sigma_x/\sigma_{x,0}$ SR	10%	34%	3%
$\Delta\sigma_y/\sigma_{y,0}$ SR	21%	47%	4%

BANDWITH COMPARATIVE

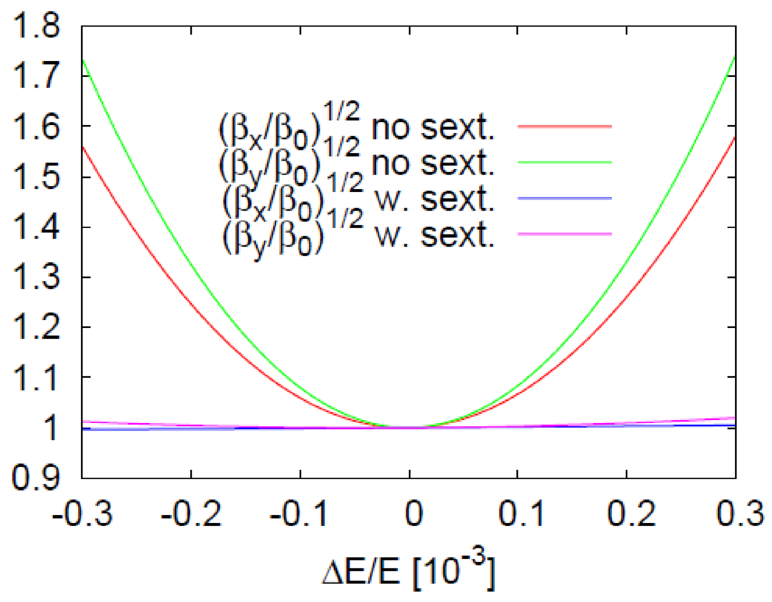


FF with triplet



FF with doublet

The bandwidth is considerably enlarged with a local chromatic correction.



Extended FF with doublet

CONCLUSIONS

Three e^- final-focus optics have been studied. For a local chromatic correction, a final doublet must be used, placing sextupoles next to the quadrupoles. A perfect cancelation of aberrations is possible if there is enough space to place long weak dipole magnets.

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