Optics for Compton Spectrometer

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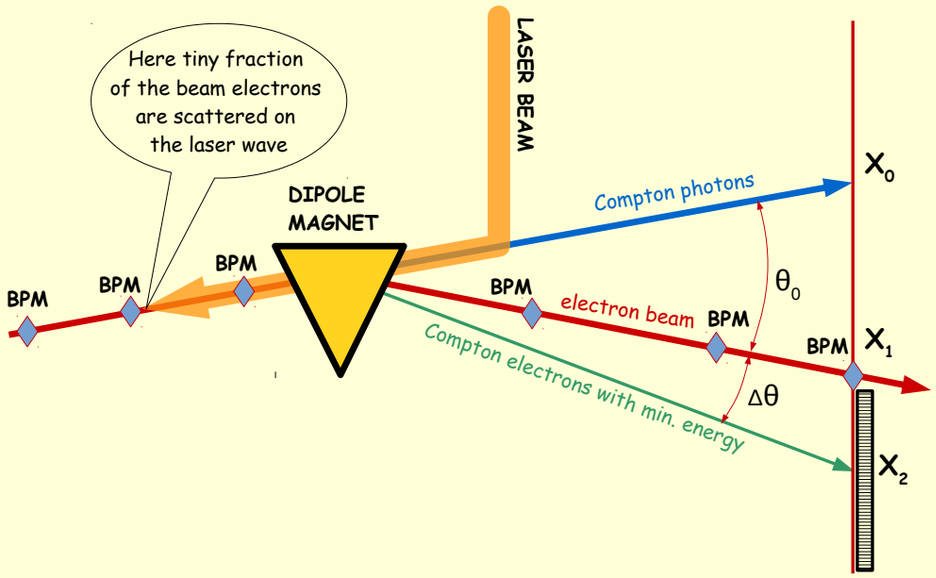
30 Nov. 2017

XIth FCC-ee Energy Calibration and Polarization WG meeting

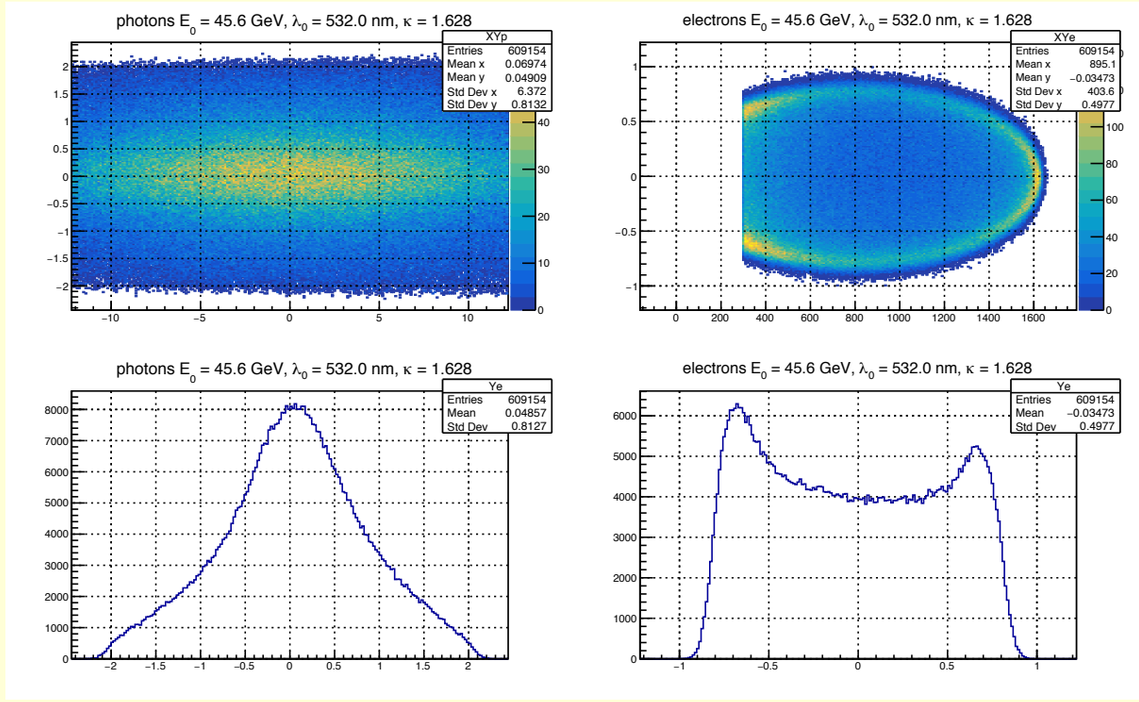
Inverse Compton Spectrometer for energy calibration

Spectrometer with laser calibration



Access to the beam energy: $E_0 = \frac{\Delta\theta}{\theta} \times \frac{(mc^2)^2}{4\omega_0}$

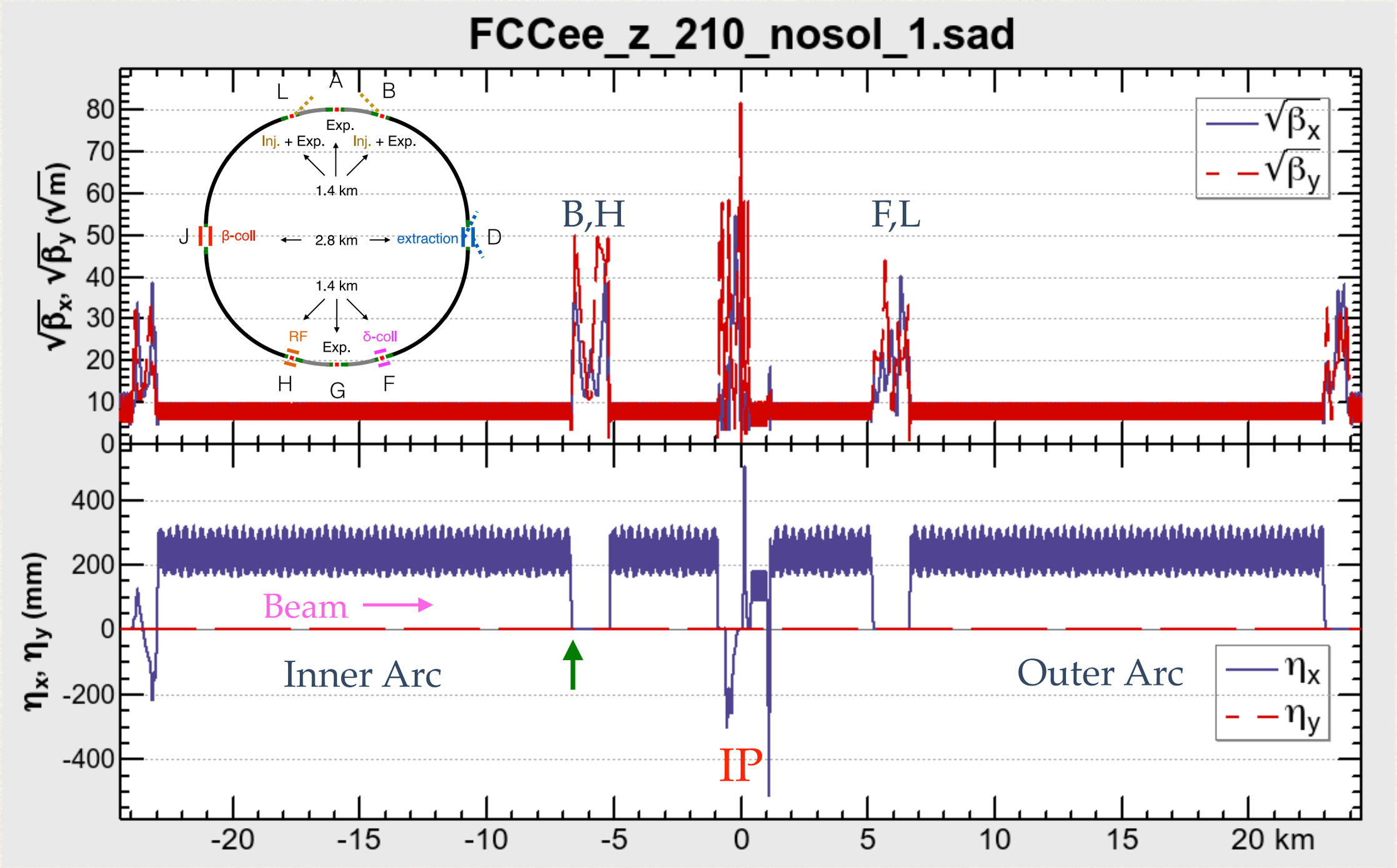
FCC-ee, 45.6 GeV, 2.33 eV, $P_\perp = 0.4$

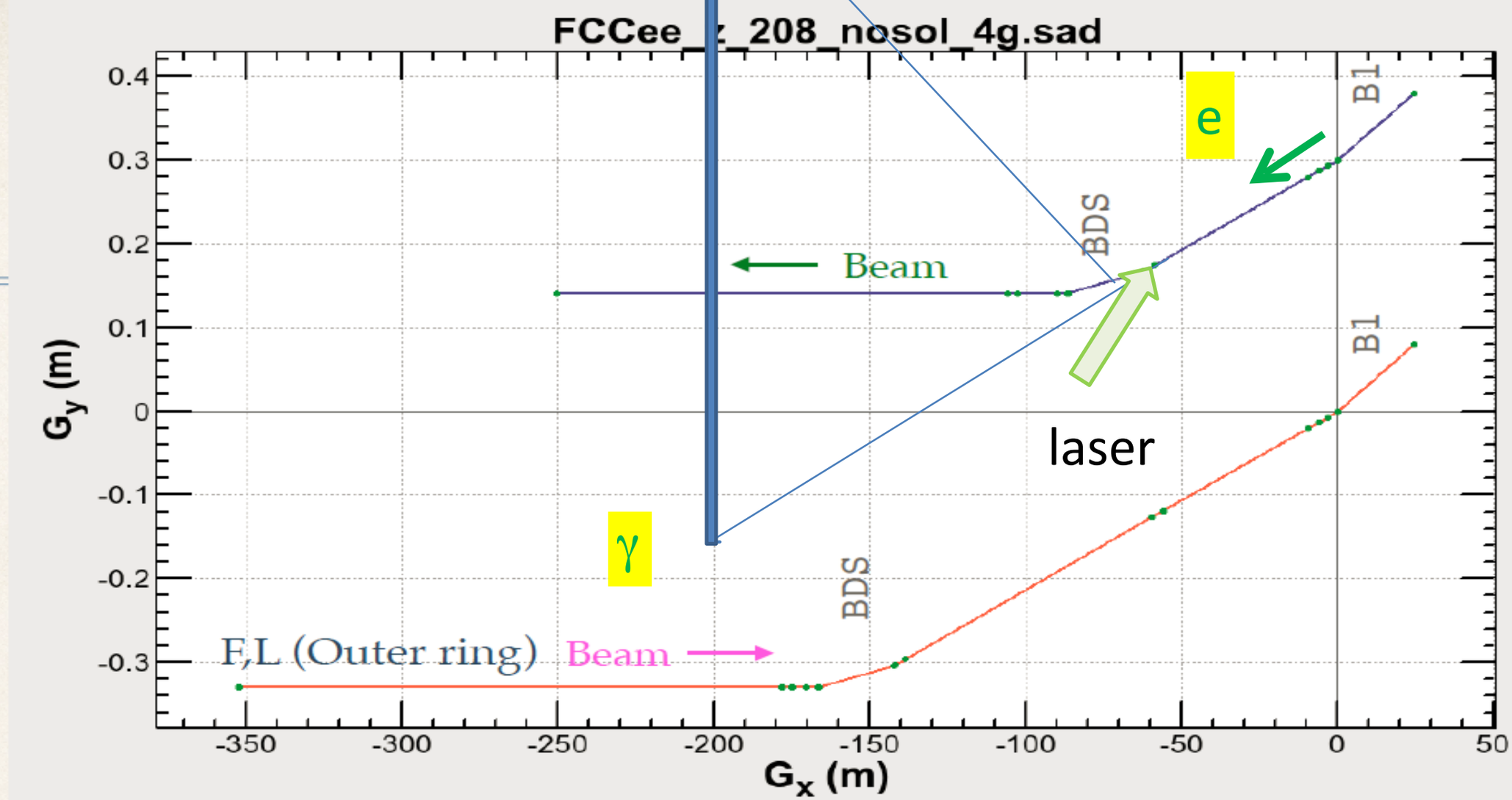


- The scattering parameters are estimated from the 2D distributions of the scattered photons and electrons.
- Does not relay on the BPM readings.
- Quadrupoles after the dipole are unfavorable.

Nickolai Muchnoi

Possible Location for the spectrometer

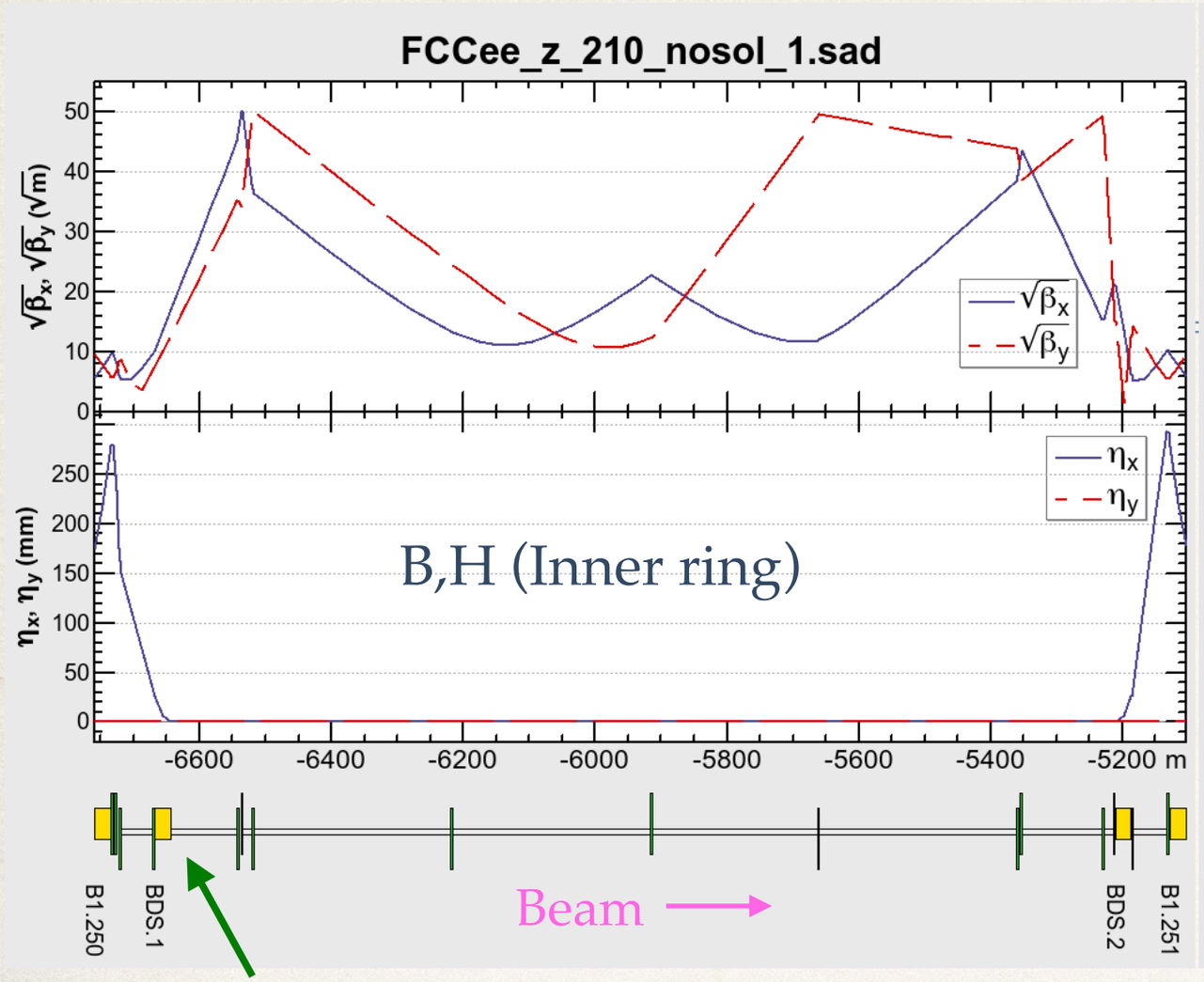


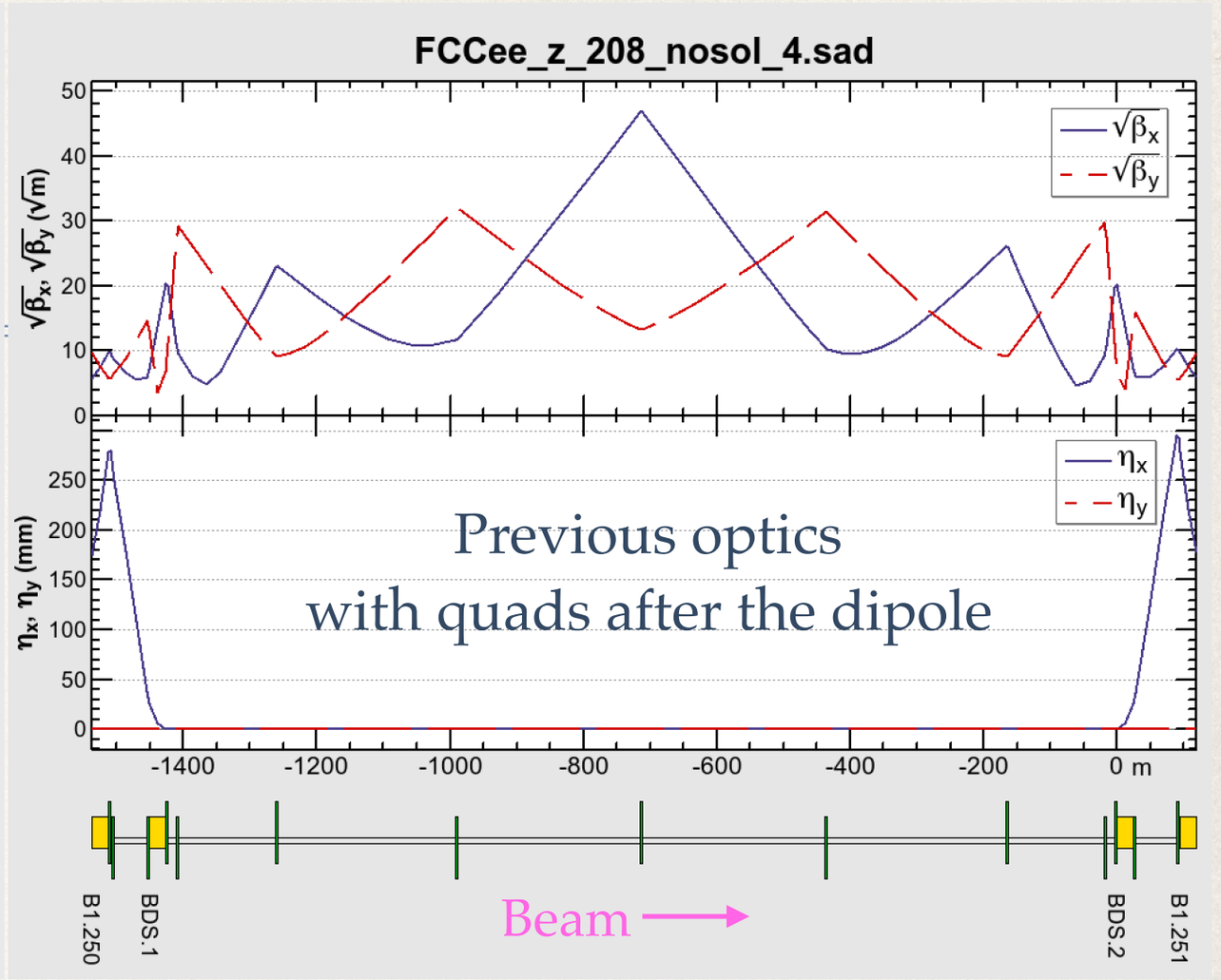


Require that there is no quadrpole on the traje
of the outgoing electrons of the lowest energy

The dispersion suppressor dipole (BDS):

```
;
 BEND    BDS      =(L =24.119925292770883  ANGLE =.002134100603580931    E1 =.5    E2 =.5 )
;
```

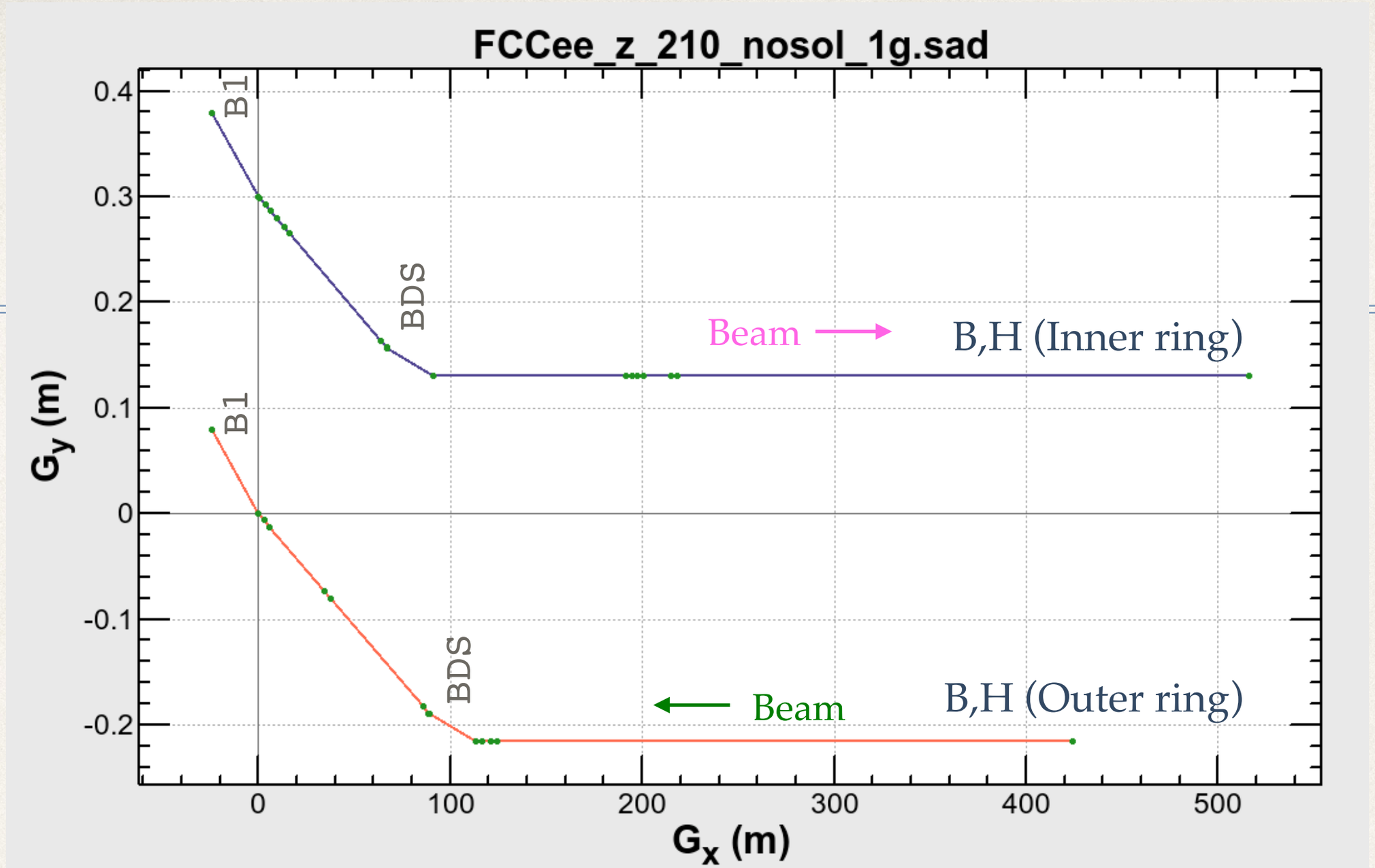




No quads after the dipole for 100 m.

The dispersion suppressor dipole (BDS):

```
;
 BEND    BDS      =(L =24.119925292770883  ANGLE =.0021341006035809 31    E1 =.5    E2 =.5 )
;
```



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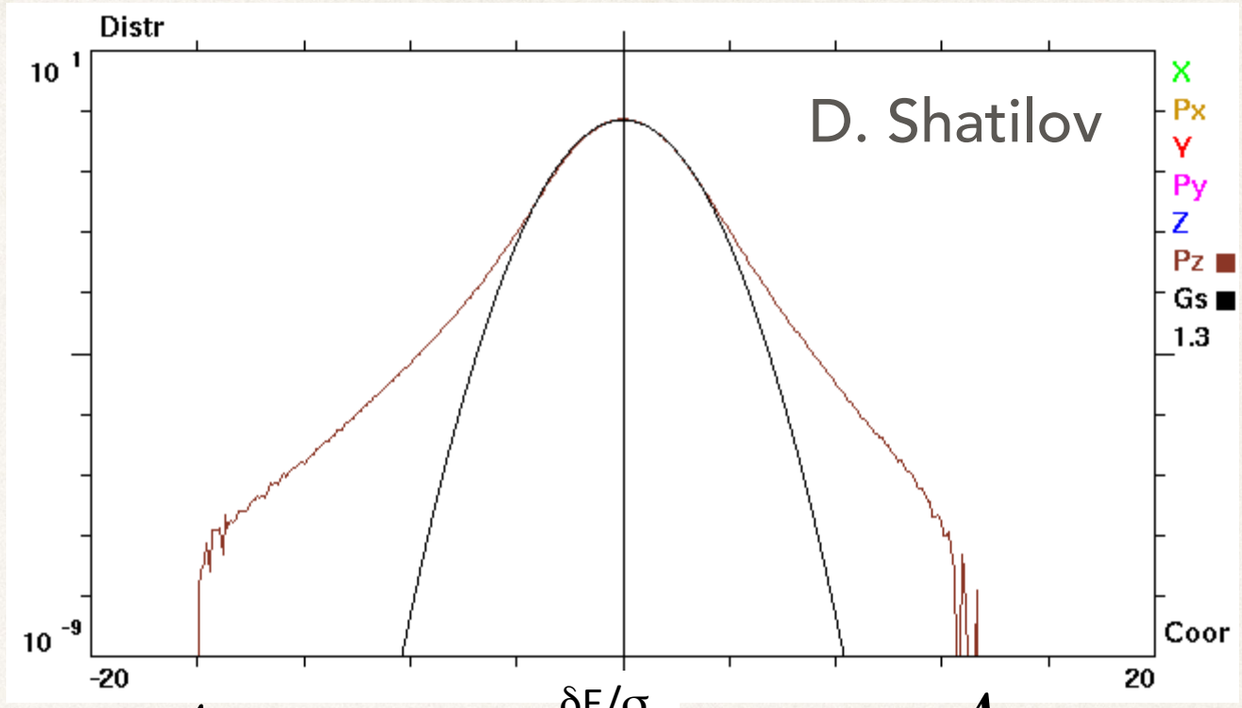
```

Asymmetric acceptance (ttbar)

E = 182.5 GeV

σ_{E0} = 0.00153, σ_E = 0.00193,
Black line: Gauss with $\sigma_E = 1.3\ \sigma_{E0}$

Energy acceptance: 2.5% = 16.3 σ_{E0}

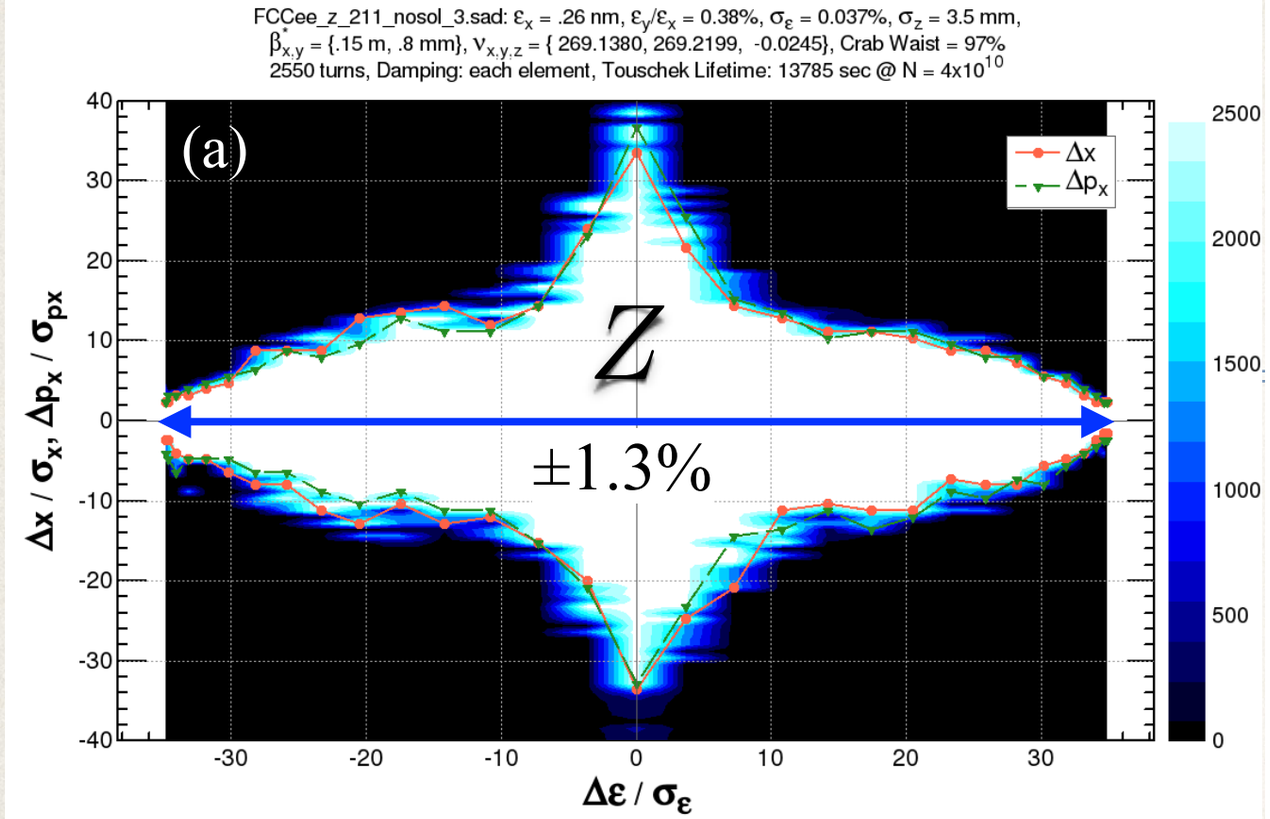


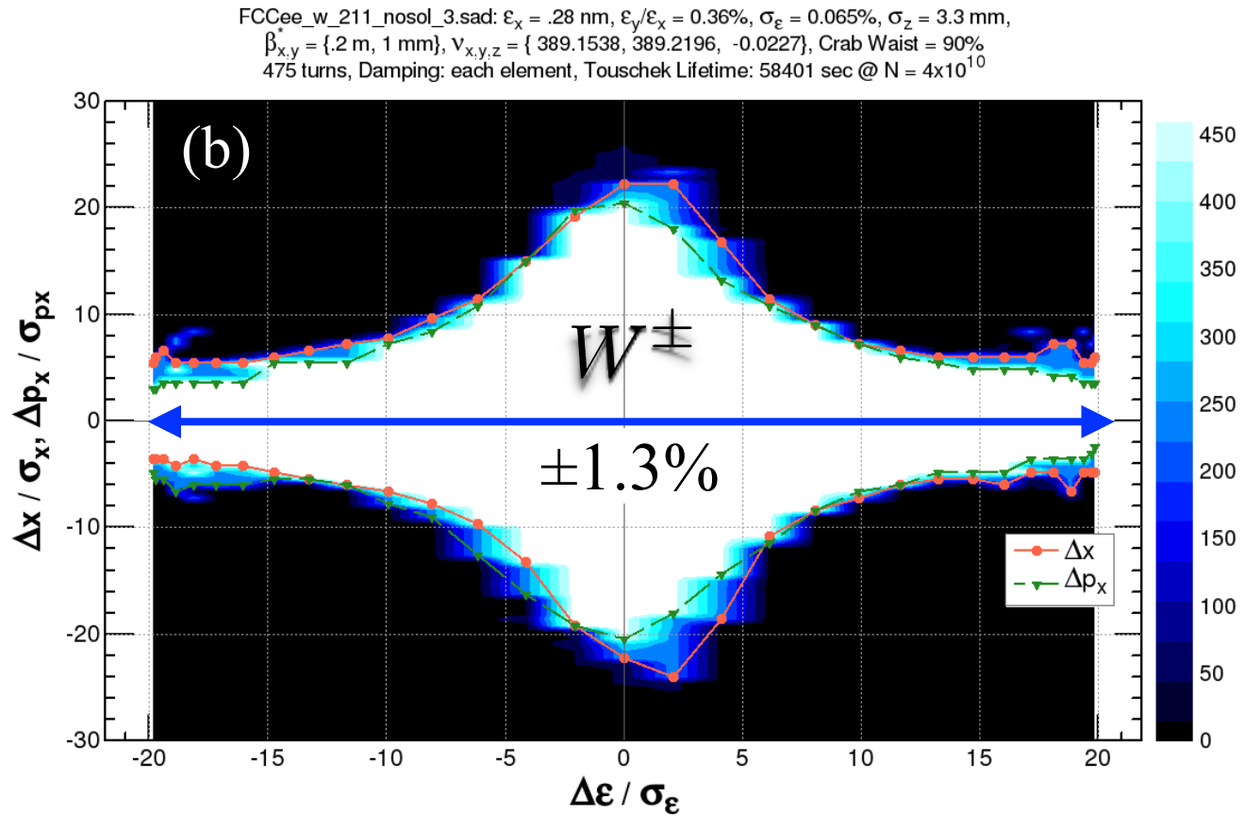
- The expected energy distribution of the beam has asymmetric tail due to beamstrahlung (D. Shatilov, as above).
- Thus the required momentum acceptance should be asymmetric: Wider aperture in the negative side.
- The aperture of the positive side can be expressed as the summation of damping and diffusion terms in a half synchrotron period:

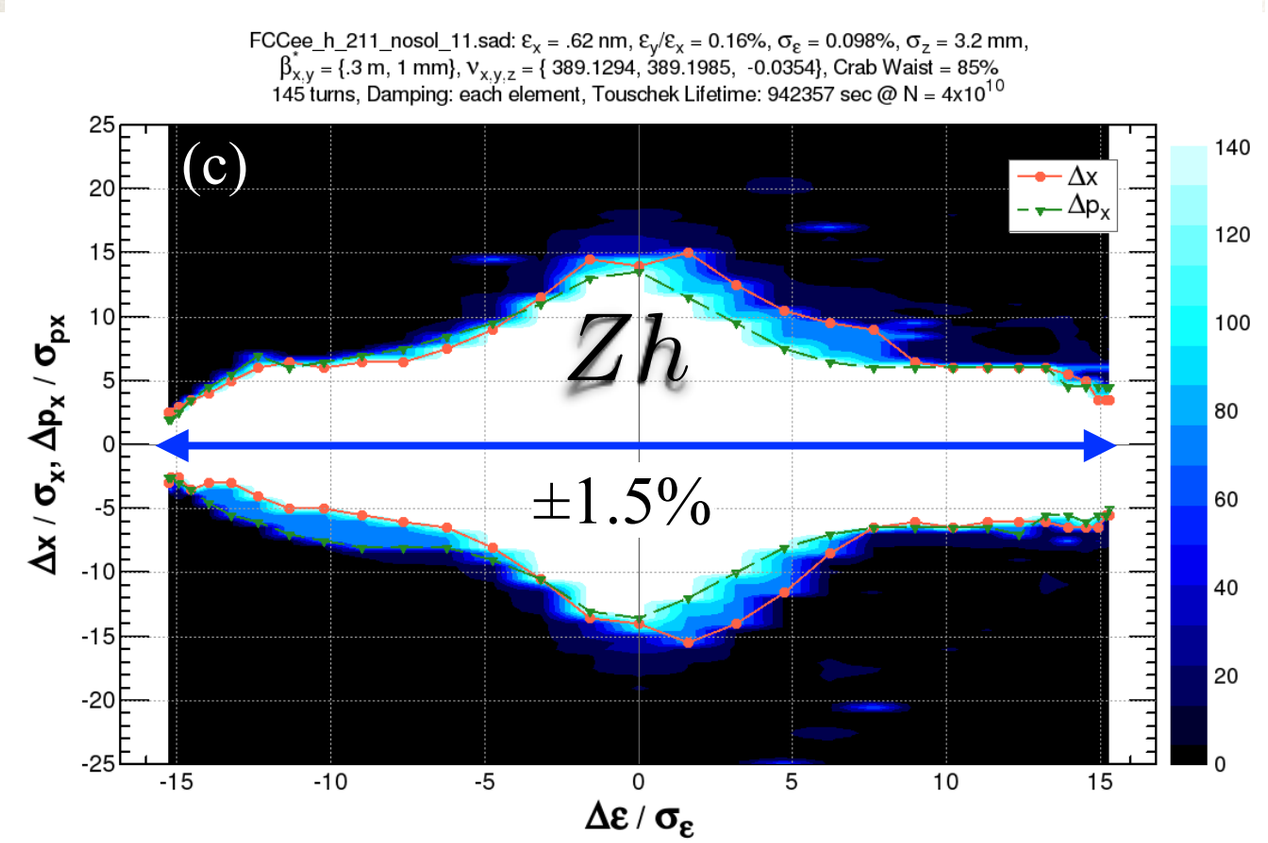
$$A_+ \approx -A_- \exp(-\alpha_z/2\nu_s) + 3\sigma_{\delta,\mathrm{BS}}\sqrt{1-\exp(-\alpha_z/\nu_s)}$$

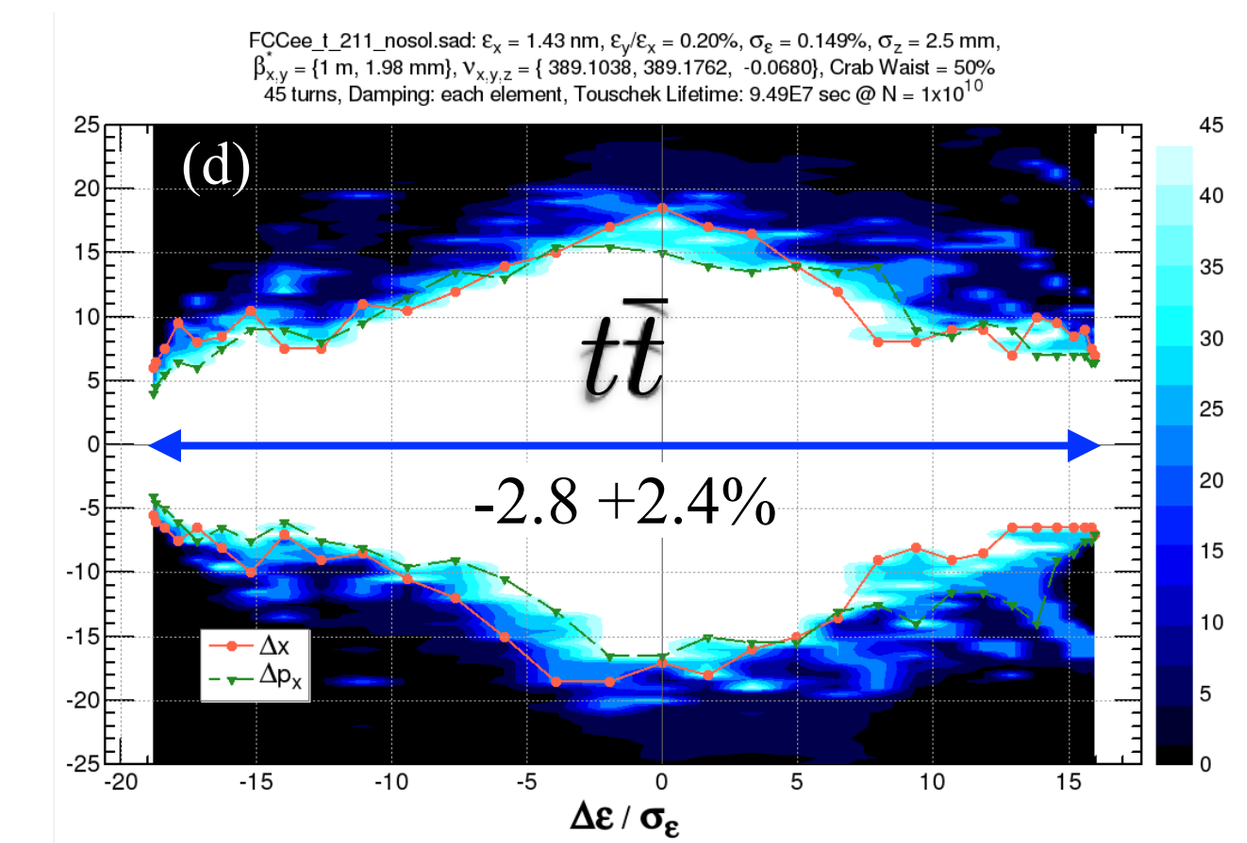
with the longitudinal damping rate α_z .

Dynamic Aperture — looks OK for all energies









Summary

- The optics of the inner ring of the short straight section B, H are modified to install the Compton spectrometer.

- Quadrupoles are removed after the dispersion suppressor dipole (BDS) for 100 m.

- Dynamic aperture looks OK at ttbar, and in progress for other energies.

- An optimization of DA with asymmetric momentum acceptance has been tried fo ttbar.