Energy Distribution in FCC-ee with Beamstrahlung

Dmitry Shatilov

BINP, Novosibirsk

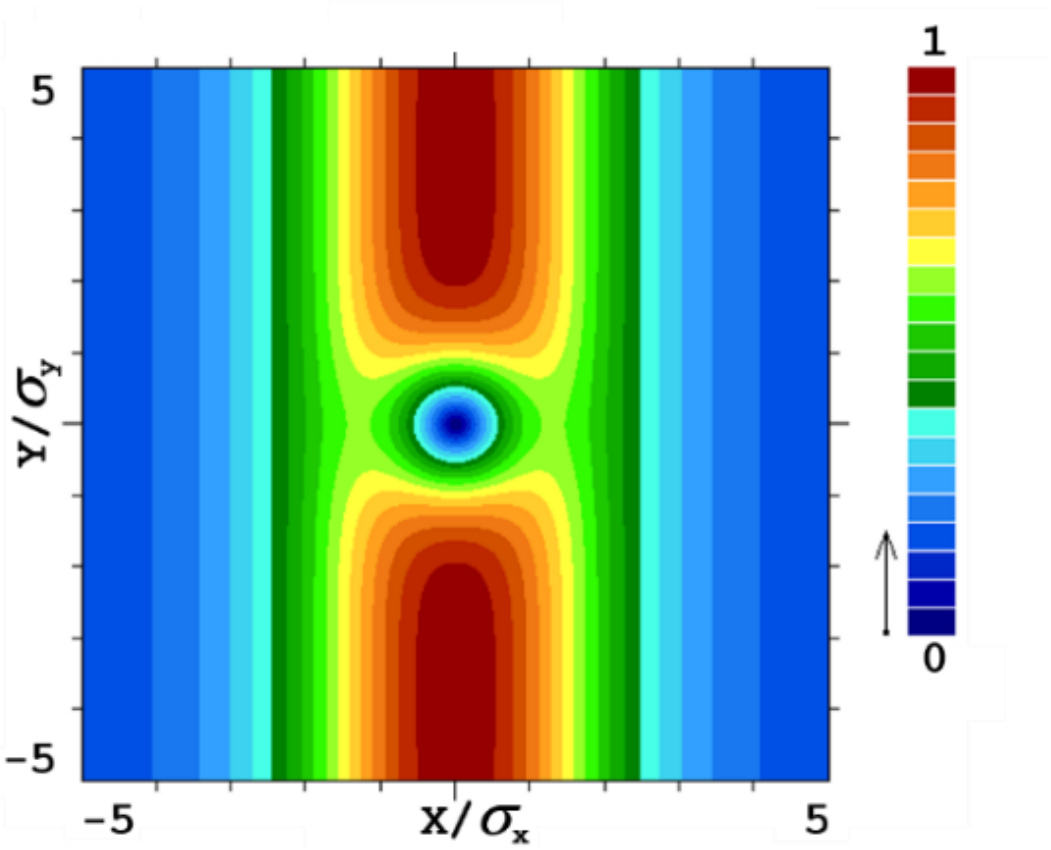
XIth FCC-ee Energy Calibration and Polarization WG meeting

30 November 2017

The Model

- Due to symmetry, “half ring” collider is considered with one IP.
- At this stage we used linear lattice with damping and Gaussian noise. No explicit energy loss in the arcs!
- IP is located symmetrically between RF sections, so we assume the energy at the IP is the “mean energy”. In fact, IR region is not symmetrical.
- There is no dispersion at the IP, thus there is no correlations between dE/E and transverse coordinates. However, correlations between σ_E and transverse coordinates appear due to beamstrahlung.
- In simulations, particles collide with the slices of the opposite bunch, not with particles. So we account only energies of the test particles.
- To find out the details of energy distribution in collision, new features were recently implemented in the tracking code. Further we will discuss the results for Z only (45.6 GeV).

Absolute Value of Transverse Force for Flat Beams



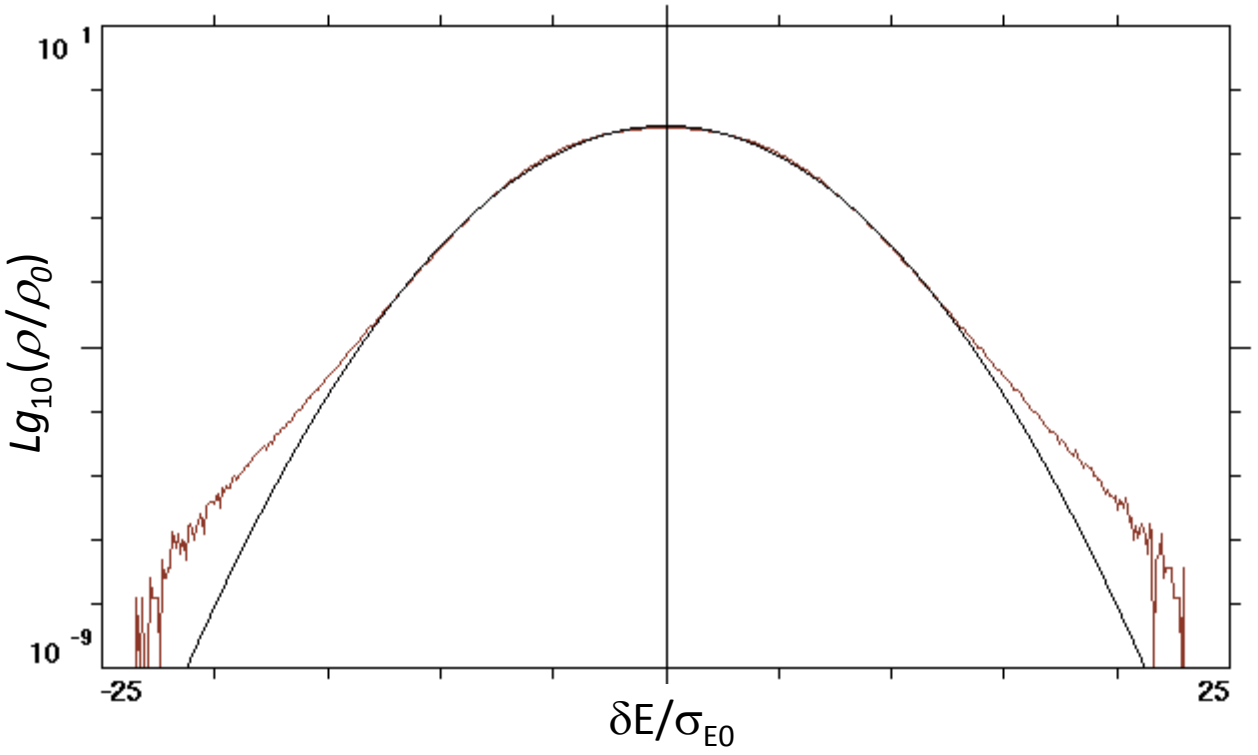
Due to the crossing angle, particles traverse the opposite bunch horizontally.

Maximum beamstrahlung: $|y| > 2\sigma_y$

Maximum luminosity: $|y| > 2\sigma_y$

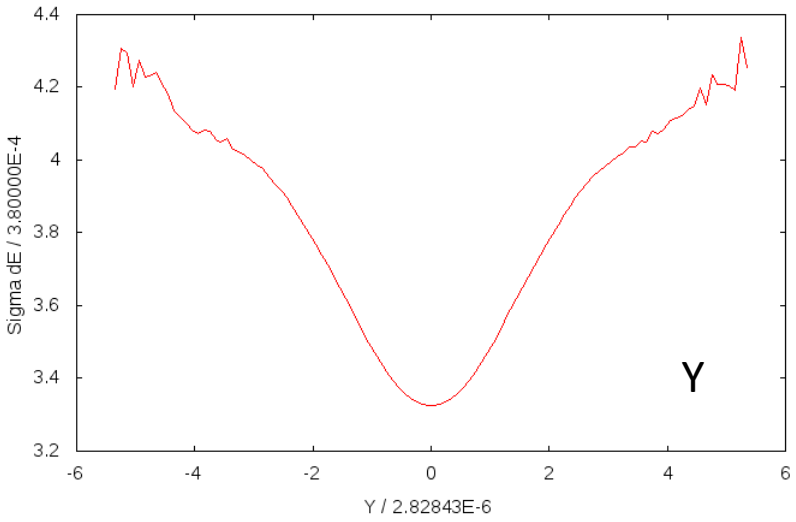
Equilibrium Energy Distribution

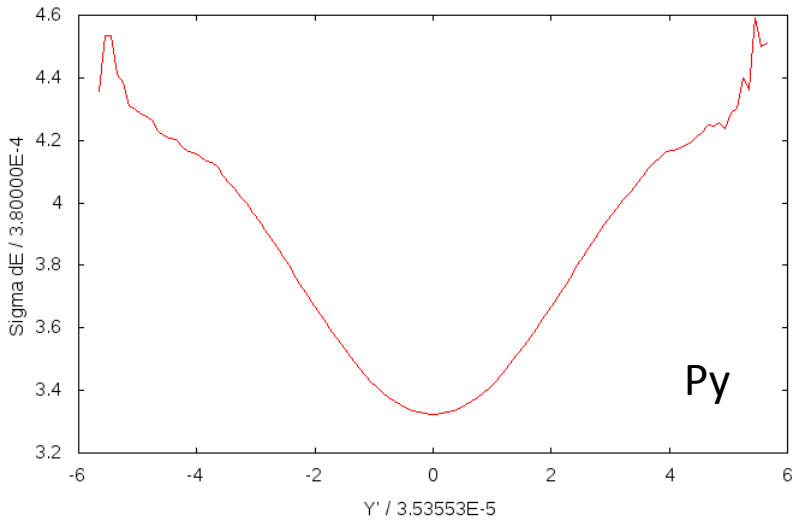
σ_{E0} = 0.00038, σ_E = 0.00132, Black line: Gauss with $\sigma_E = 3.4\ \sigma_{E0}$

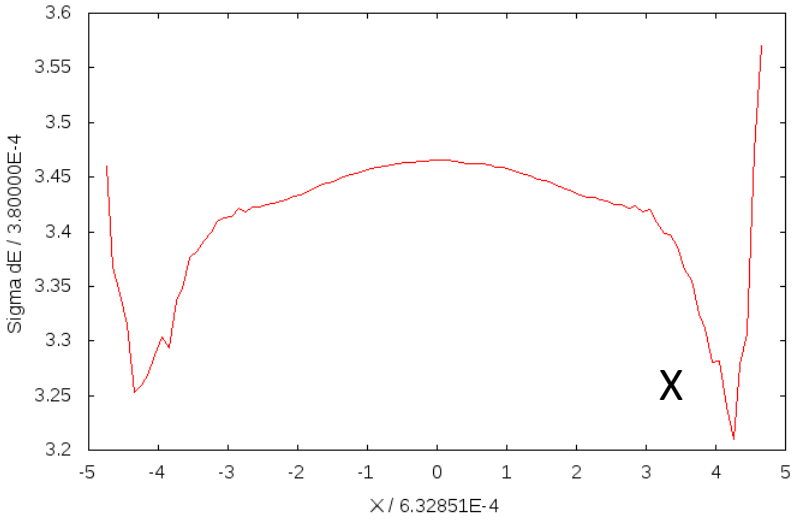


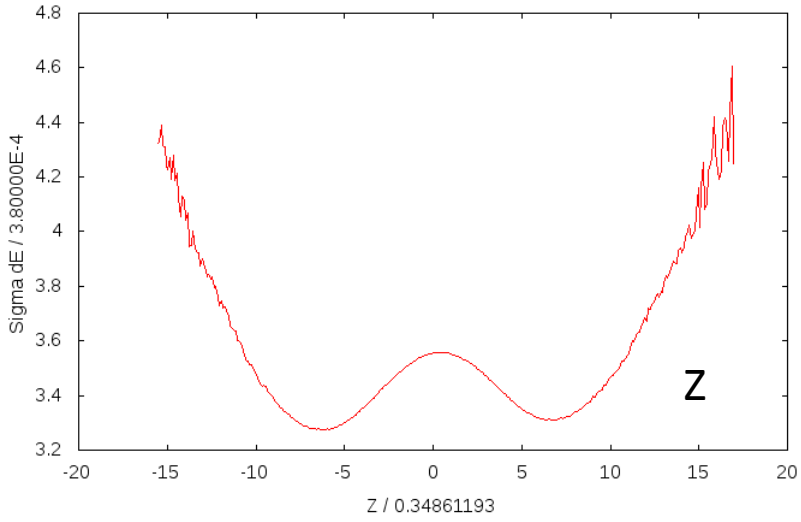
Energy acceptance: 1.3% = 34.2 σ_{E0}

Energy Spread vs. Other Coordinates

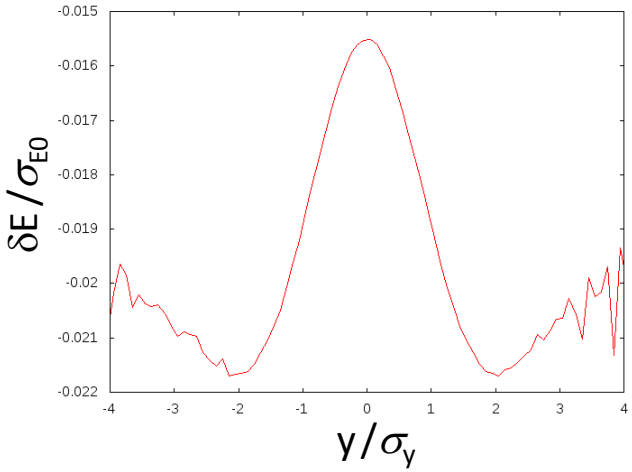


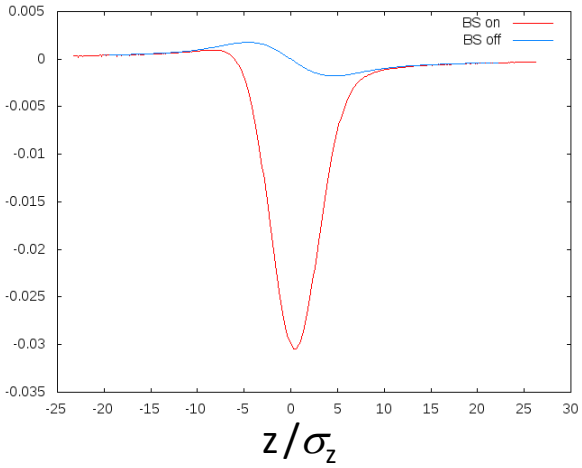


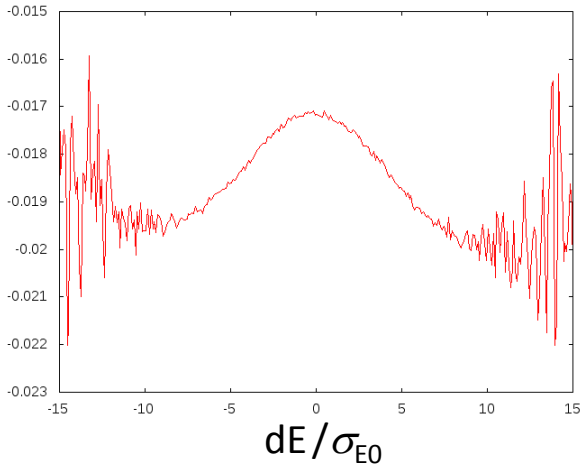


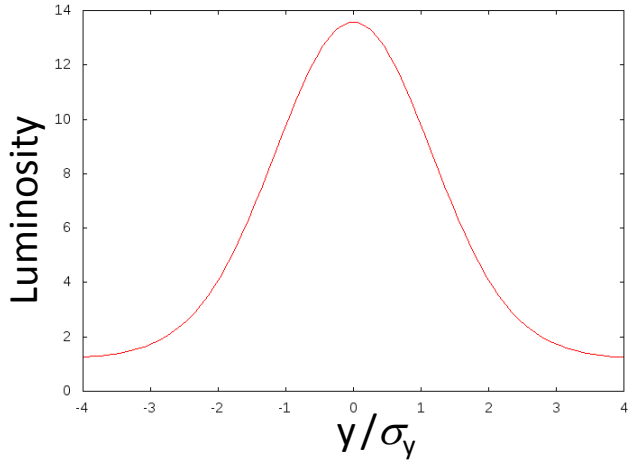


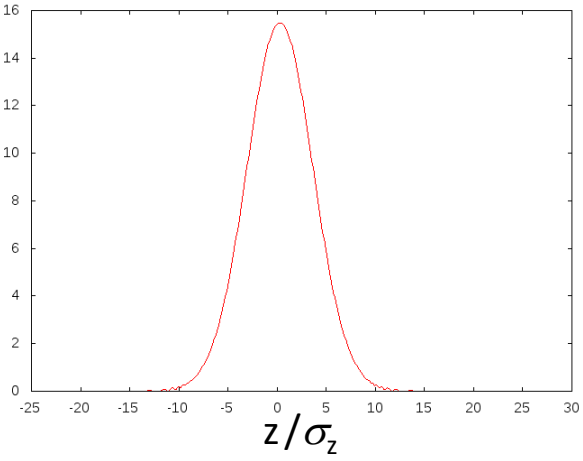
Energy Loss & Luminosity per Collision

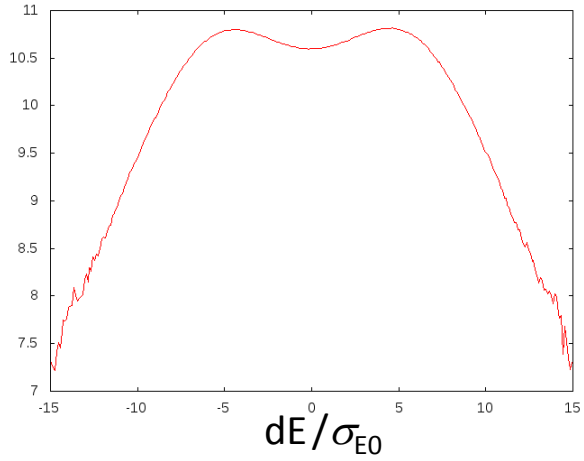




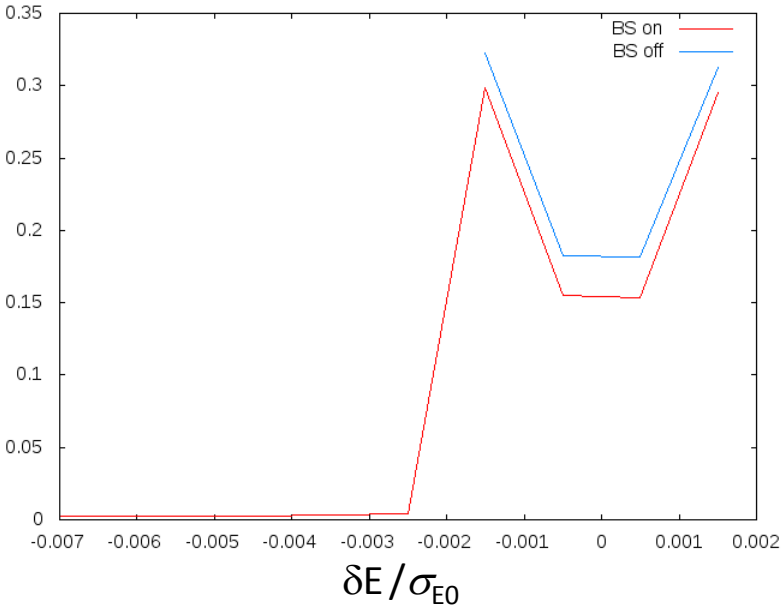


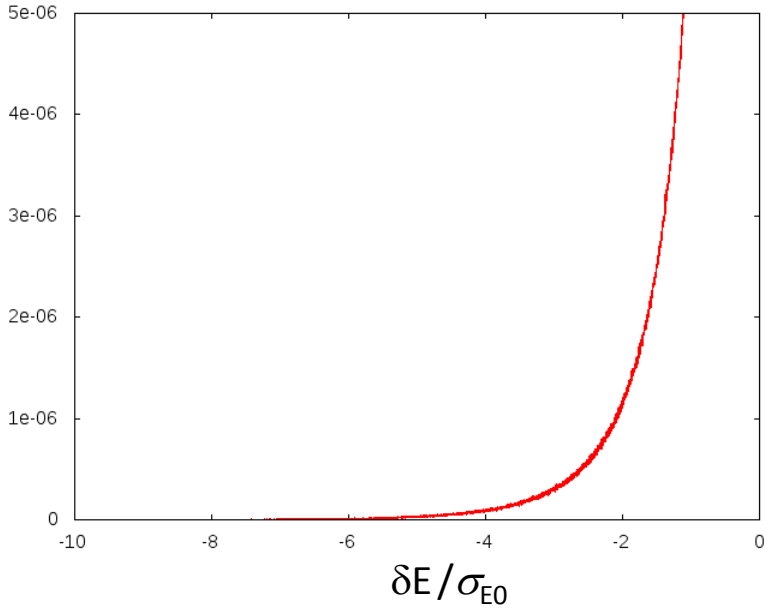






Energy Loss Distribution





Mean energy loss per collision: 6.77E-6 · E_0 = 1.78E-2 · σ_{E0} ≈ 309 KeV

Mean collision energy: (1+1.3E-6) · E_0. Without beamstrahlung – the same!

Summary

I think you got more new questions than answers to the old ones…
Let us discuss!