Elegant simulations of induced energy spread

Dmitrii Samoilenko

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Elegant

- Elegant is a particle tracking code
- particles are represented by 6D coordinates: x, x’, y, y’, t, p
- beamline elements change them and pass forward
- some are easy: drift, quads
- some more complicated: LSCDRIFT, CSRCSBEND
- some are very complicated: LSRMDLTR

LSRMDLTR

- the undulator is divided into steps (100 steps per period)
- for each step we calculate undulator **B** and laser **E**, solve Lorentz equation, integrate over the step
- **B** is given by peak field B_u, full length L_u and periods N
- $\mathbb{E}$ is given by λ, peak power P, laser waist$w_0 = \sqrt{2}\sigma_x = \sqrt{2}\sigma_y$ and time profile of the pulse
- the time profile has to be prepared externally as sdds file $\rightarrow$ allows to use any filed profile, as long as you can draw it

Parameters for timing scan

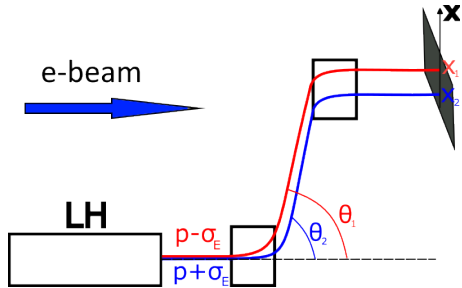
- bu=0.356
- l=0.473
- laser w0=0.7e-3
- laser wavelength=5.32e-07
- n steps=1100
- periods=11
- laser peak power=7.8e6
- time profile=gauss(sigma=4.1ps$\times\sqrt{2}$)
- time offset=2e-12

Simulations start at the entrance of ACC1, no realistic distribution from the gun, gauss($\sigma = 4.7$ps)

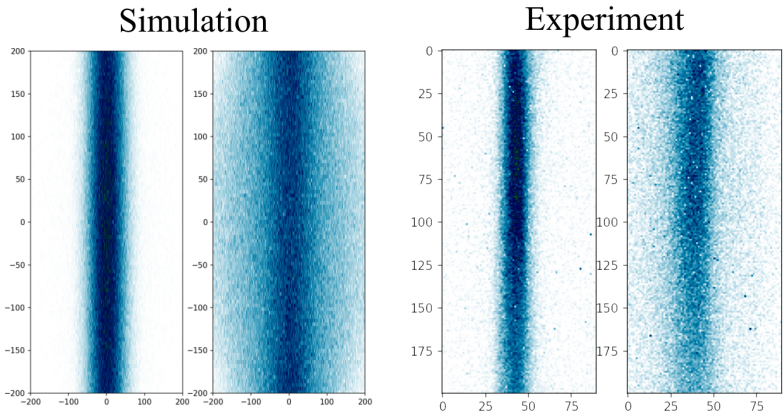
1M particles for 0.4nC $\rightarrow$ 2500 electrons in a macro-particle

Simulating the measurement

- (t, p) - polyfit(t, p) to remove correlations
- put particles in 30μm slices
- calculate the rms slice energy spread at LAHE.D
- or get (x, y) at BC1.M (pixel size, camera noise)

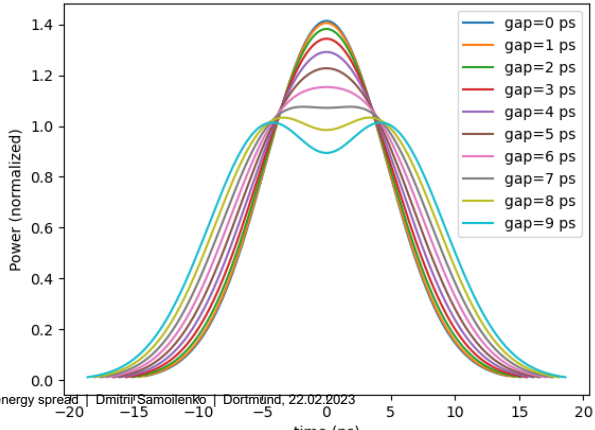


Simulating the measurement



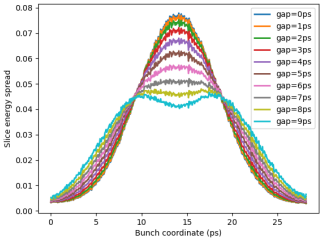
Head-tail overheating

- Seeding compression
- P = 3 MW , σ = 3.3 ps each pulse

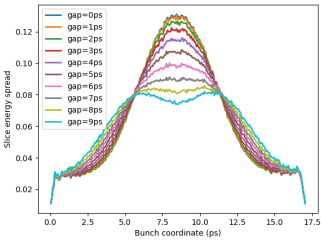


Head-tail overheating

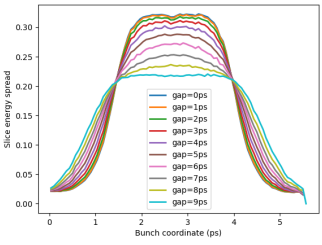
LAHE.D



BC1.M

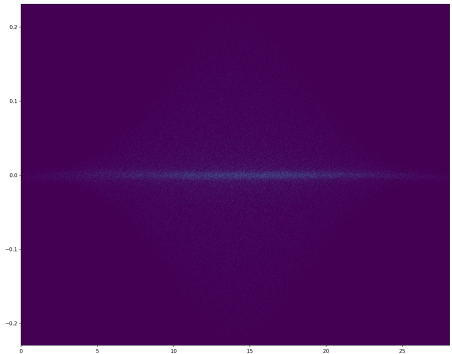


BC1.D

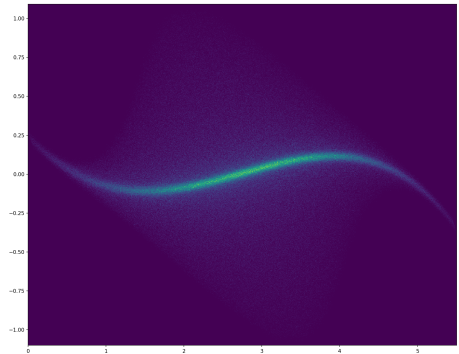


0 gap

LAHE



BC1



Thank you!

Contact

DESY. Deutsches Elektronen-Synchrotron
MPY

www.desy.de

Dmitrii Samoilenko
dmitrii.samoilenko@desy.de