Electron Column Update

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Goal

- Record beam distribution (x, p_x, y, p_y, t, p_z) immediately after Electron Column
- Load distribution into Synergia and run through IOTA lattice for one revolution

Beam Emittance

- Emittance = Geometric Emittance = $\epsilon_x = \frac{A_x}{\pi}$
- RMS Emittance = $\epsilon_{x,RMS} = \epsilon_{RMS} = \frac{\epsilon_x}{4} = \left(\bar{x^2}\,\bar{x'^2} - \left(\bar{x}\,\bar{x'}\right)^2\right)^{1/2}$ $\qquad x' = \frac{dx}{dz} \approx \frac{p_x}{p_z}$
- Normalized RMS Emittance = $\epsilon_{N,RMS} = \beta\gamma\epsilon_{RMS}$
- According to Sasha Romanov, emittance of proton beam for Electron Lens ≈ 10 mm mrad
  - RMS emittance = 2.5 mm mrad
  - Beam with K-V distribution and above emittance input to EC

Electron Column Output

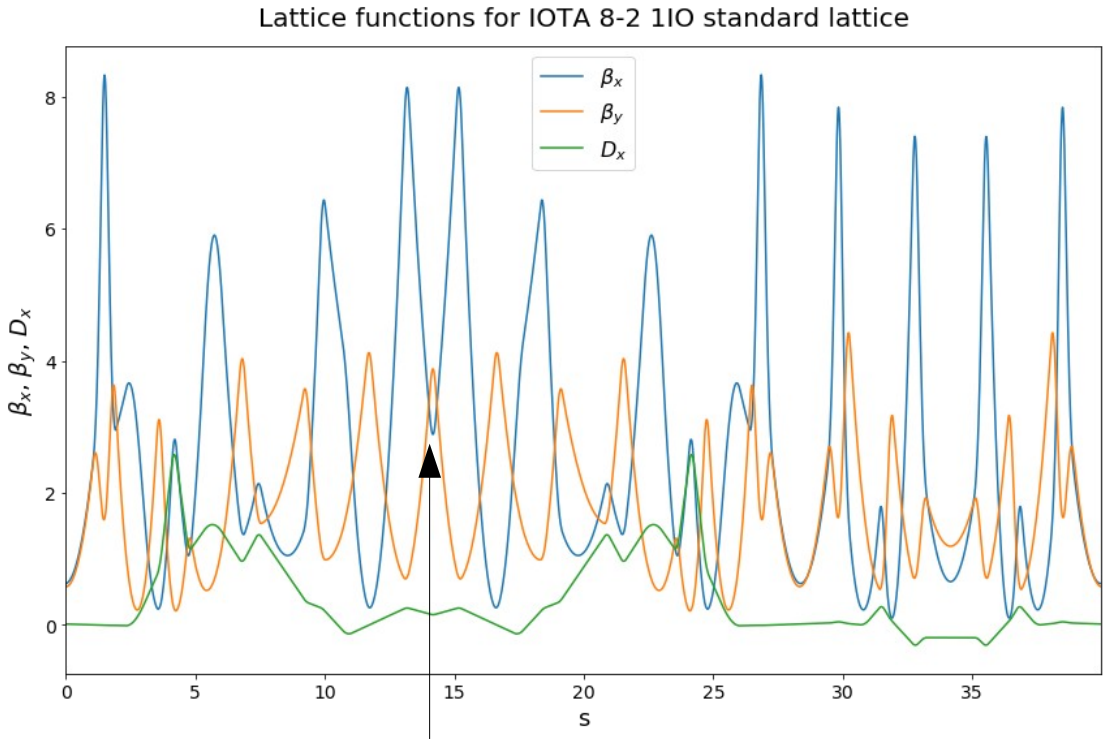
- Virtual detector placed at end of EC, recording x, p_x, y, p_y, t, p_z for all beam particles that crossed it
- ≈ 12.6 M macroparticles recorded at end of EC
- 18% emittance growth in both planes (ε_{RMS} = 2.95 mm mrad)

Synergia Simulation

- I have modified and ran the example iPython notebook ‘rssynergia-linear-8-2-IOTA-SC’ on RadiaSoft’s Jupyter Hub
- I used the madx lattice ‘t1_1IO_82_dQ_1, indicating version 8.2 lattice adjusted for dQ = -0.1
- Space-charge was turned on
- $Q_x = 0.398$, $Q_y = 0.399$

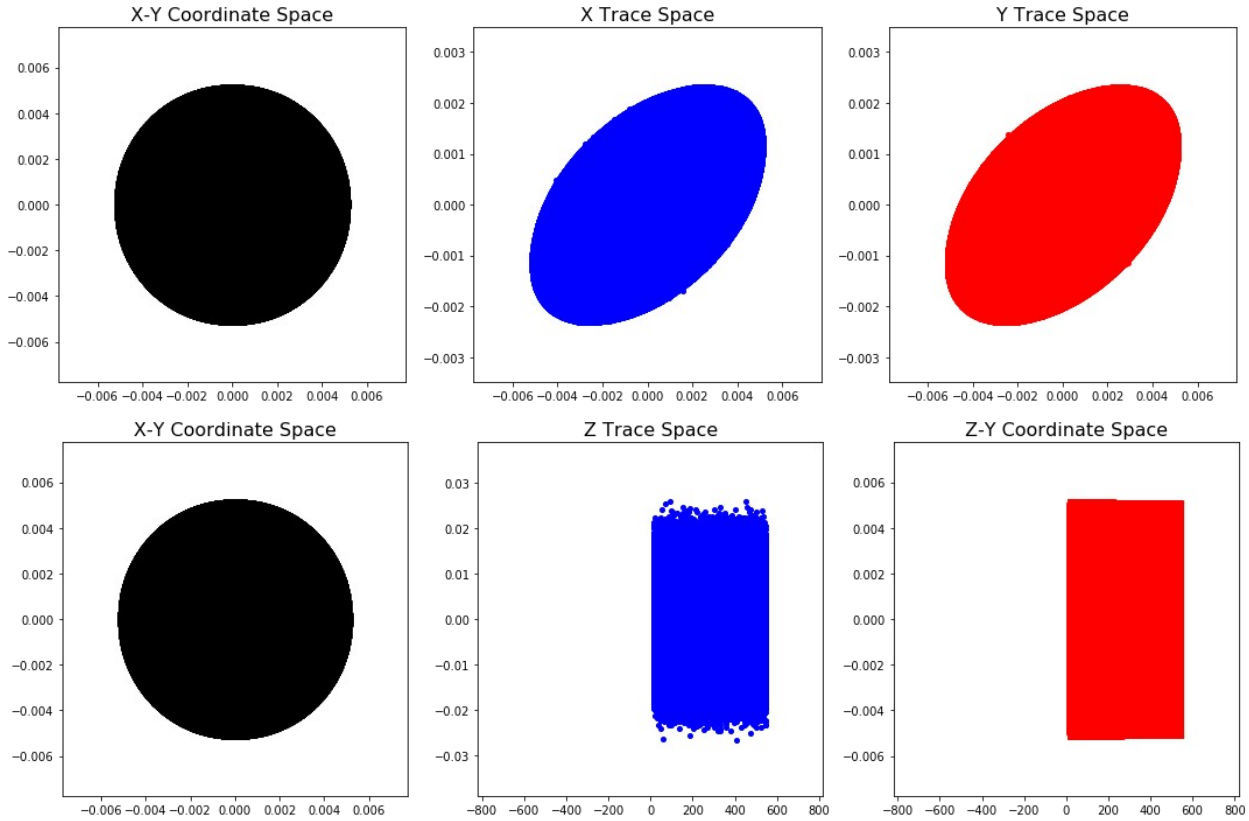
Lattice

- The lattice contains a 70 cm long EC solenoid of 0 field
- Centered on nonlinear magnet
- I ran into problems when trying to adjust the madx file to be centered on EC



Phase Space Plots

- Synergia uses c*dt and dp/p instead of t and p_z
  - To return to longitudinal position, multiply z by beta (results in 1-39 m)



Status

- Simulation of 1 turn ongoing
  - 3+ hours runtime

Issues / To-Do

- What is the best IOTA lattice to use?
- How to center madx file on Electron Column?
  - Beam is being created and recorded at center of nonlinear magnet
- Look at Synergia output after 1 turn
- Load beam distribution into Warp for second turn