

Benchmarking the LCLS-II Photoinjector

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With thanks to: M. Gibbs, S. Gilevich,
A. Saad, J. Shtalenkova, S. Vetter,
C. Zimmer, F. Zhou, and the whole EIC
team.

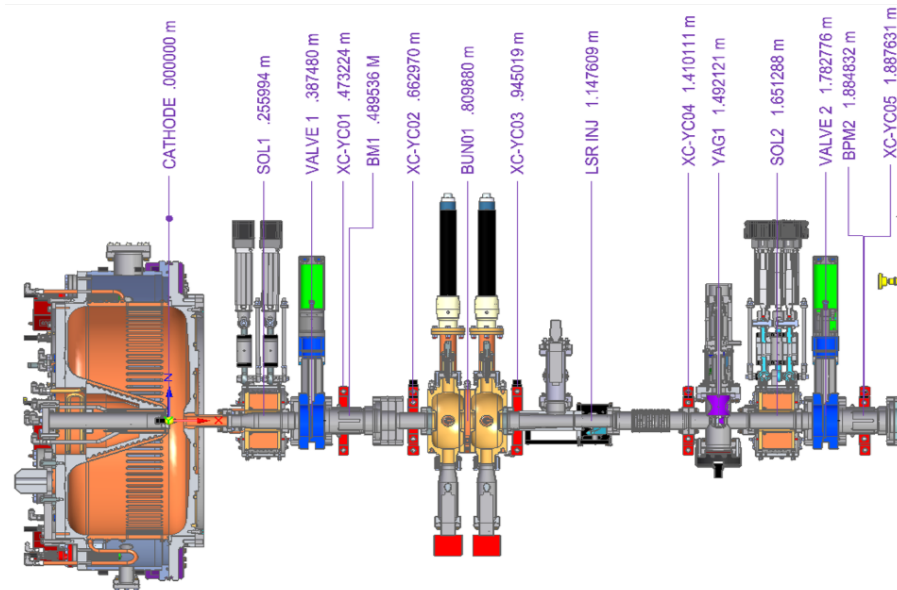


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- Early Injector Commissioning (EIC) layout
- Code comparison
- Laser profile
 - Using VCC images
- Measurements
 - Beam size
 - Emittance (on the schedule)
- Future work



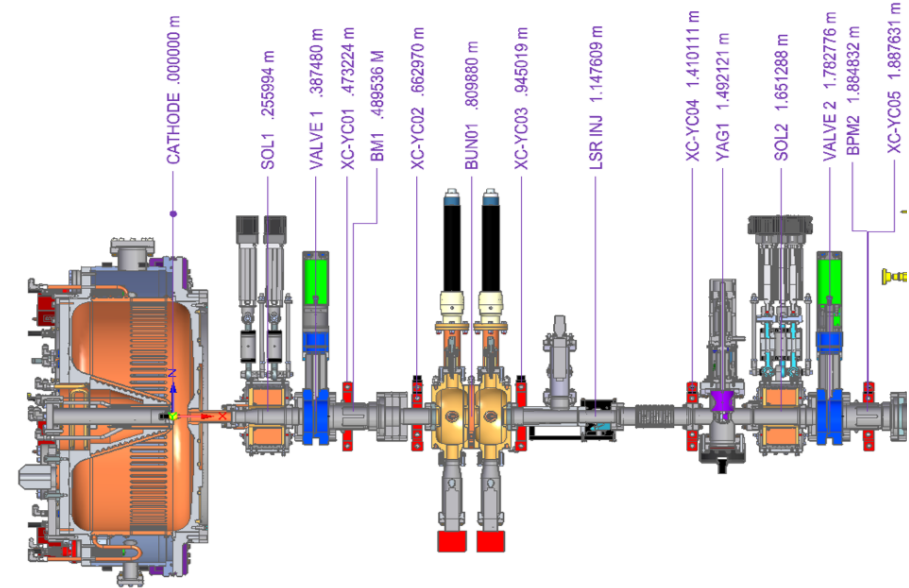
Early Injector Commissioning (EIC) layout

Based on APEX* gun:

- 187 MHz quarter cell gun
- 1.3 GHz buncher
- Two solenoids
- Correctors, BPM's
- Toroid, Faraday

EIC Goals:

- QE studies
- beam alignment
- Timing & rf control checks
- radiation safety checks, etc....

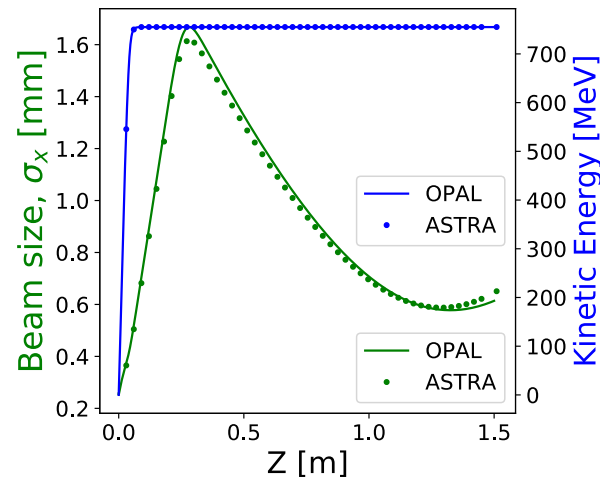
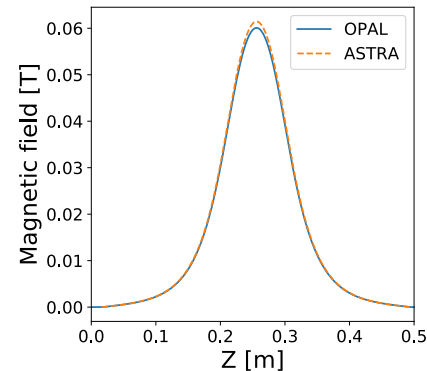
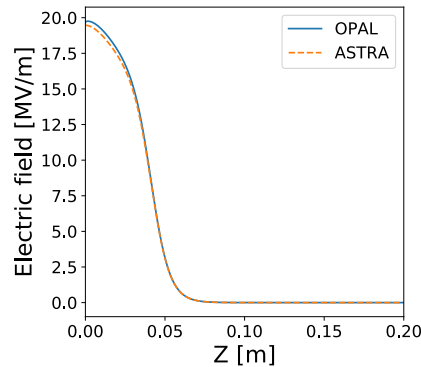


*APEX: Phys. Rev. ST Accel. Beams, vol. 15, p. 103501, Oct 2012

Code Comparison

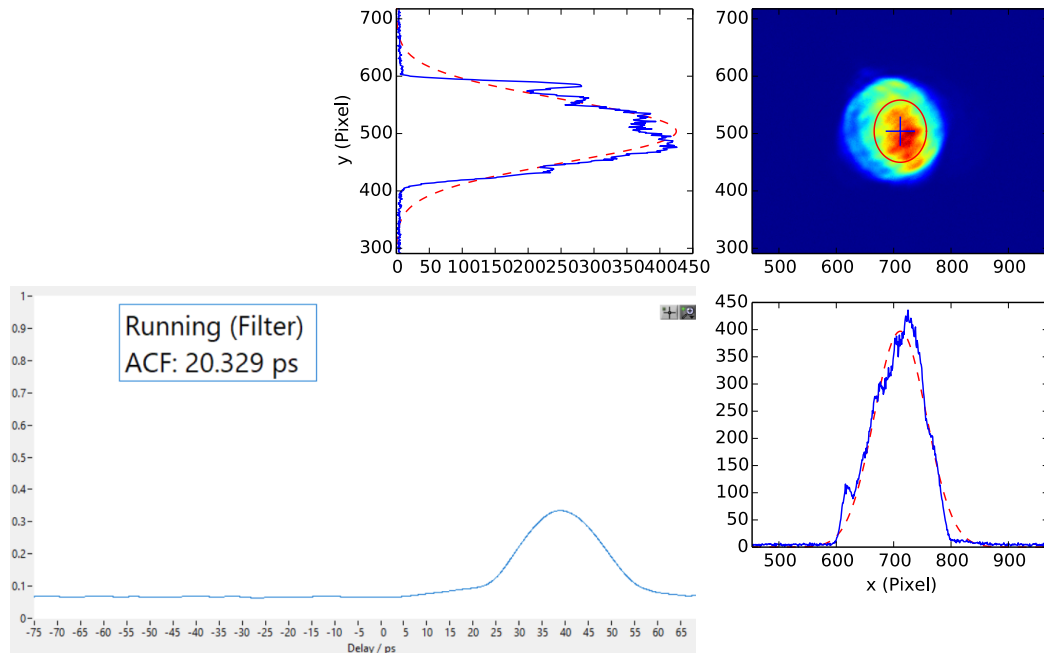
- Quick verification that layout is being simulated correctly.
- Working on adding IMPACT-T

Parameter	Value
Charge	20 pC
Laser radius	0.5 mm
Laser FWHM	20 ps
Gun phase	Max energy gain
Field on cathode	20 MV/m
Buncher	off
Solenoid strength	0.06 T



Laser Profile

- Gaussian in the longitudinal
 - ~20ps FWHM
 - measured by cross-correlator in the laser room
- Virtual Cathode Camera (VCC)
 - Imaged at the same distance as the cathode.
 - Transverse profile is non-uniform
 - What is the effect on the beam?

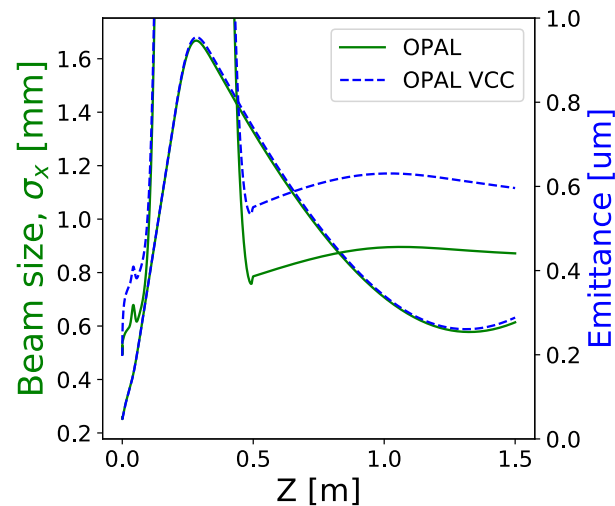


Thanks to S. Gilevich, A. Miahnahri, and S. Droste for laser work.

Using VCC images

- Loaded laser image into OPAL
 - Generated transverse distribution based on VCC image
 - Radius is set in input file.
- Beam size roughly the same
- Emittance increase observed
- Further systematic study will be done,
 - Various charge and laser radii
 - Compare to data

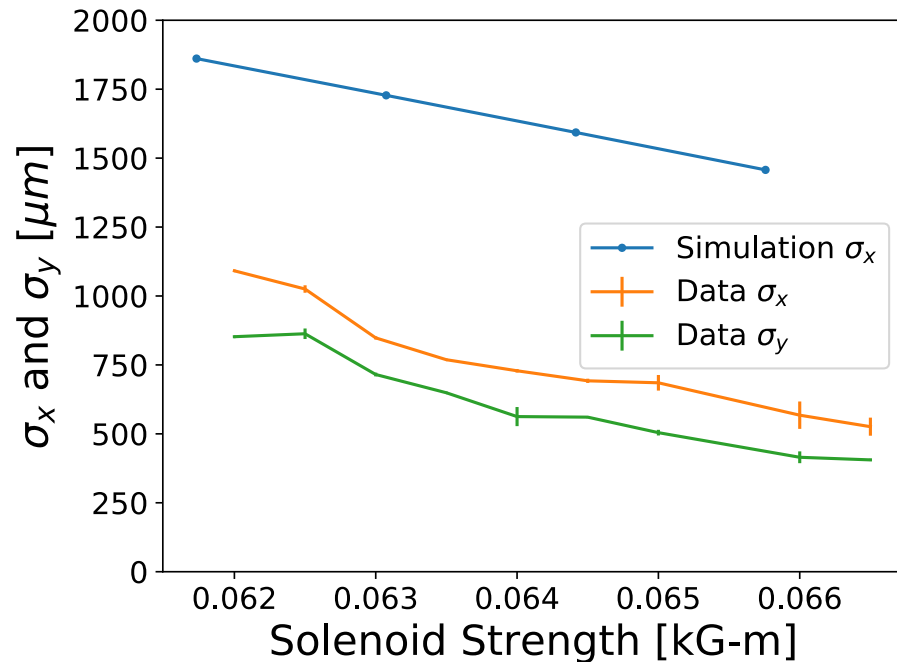
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Measurements: Beam size

Possible sources of error being investigated (typical culprits):

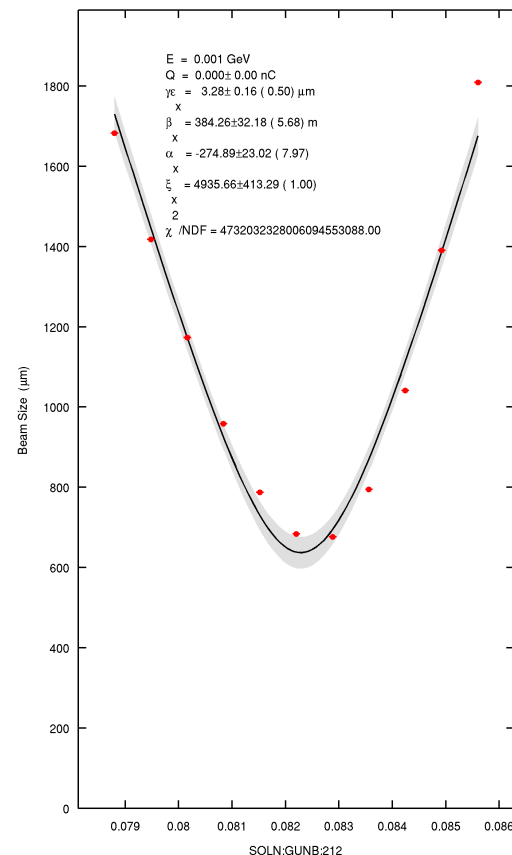
- Alignment in the solenoid
- Laser transverse profile
- Phase, energy



Measurements: Emittance

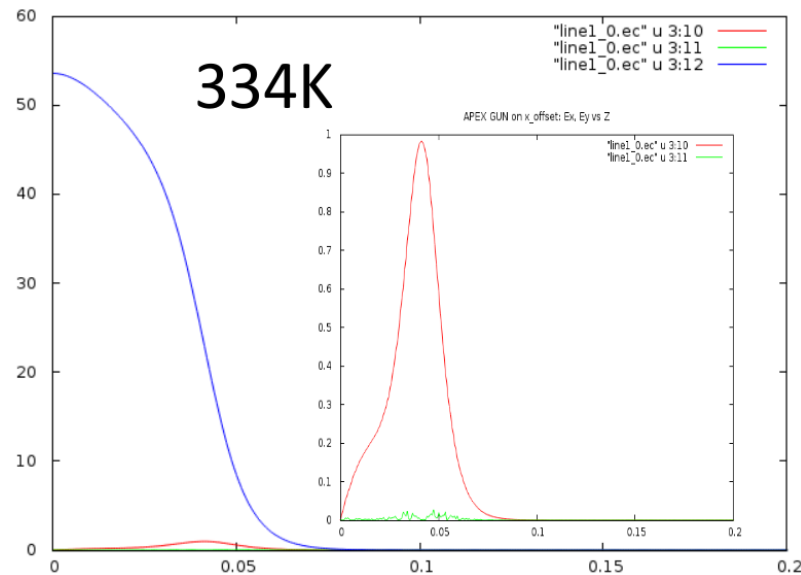
Emittance measurement GUI:

- Updated physics calculations
 - Removed ultra-relativistic assumptions
- Gun kinetic energy is much lower than LCLS
 - ~750 keV vs. 6 MeV
- Example GUI scan
 - Scanned solenoid in ASTRA simulations
 - Plugged beam sizes into GUI
- Emittance measurements scheduled for this/next week



Future work

- Systematic VCC study
 - Charge, radius scans
 - Quantify jitter over time
 - Compare to data
- Compare with 3D field maps
 - From ACE3P
- Continue experimental measurements/comparison:
 - Emittance, beam size, energy



Plot courtesy L. Xiao

Thank you for your attention!

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