

Beam Dynamics Simulations for PITZ Bunch Compressor

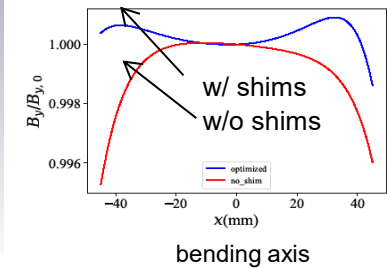
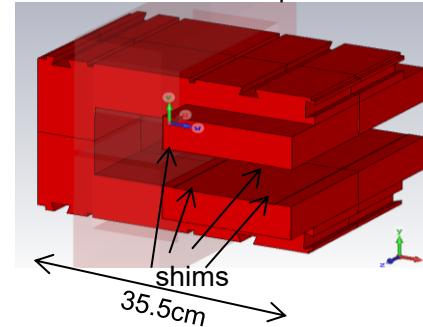
Motivation and Start-to-end Simulations

Propose of our bunch compressor and various specs

- To optimize for **SASE FEL**
 - 2-5ps flattop, 200-400A (overcompressed)
- To support tuning **seeded FEL**
(by Photocathode laser pulse modulation, slit technique)
- To optimize for **superradiant**
 - <1ps fwhm, low charge <400pC
- To optimize for low-Q sub-ps high-repetition application (~1pC)

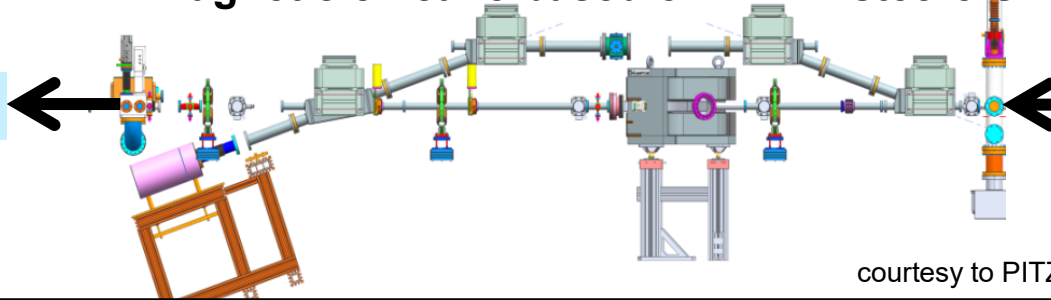
use of old HERA magnet (steerer) with new pole shoe

CST EM-Studio optimizer



Magnetic chicane based on HERA steerers

Undulator



Gun&Booster
6-22MeV/c

courtesy to PITZ and engineering team

- Study with S2E optimizer
 - Gun and booster: ASTRA
 - Bunch compressor: IMPACT-T and OCELOT
- Optimize gun phase
 - Uncorrelated energy spread
- Optimize booster phase
 - Full compression, under- or over-compression

ASTRA supporting data and tools by X.-K. Li
reference

ASTRA: K. Flottmann, "Astra", DESY, Hamburg, www.desy.de/~mpyflo, (2000).

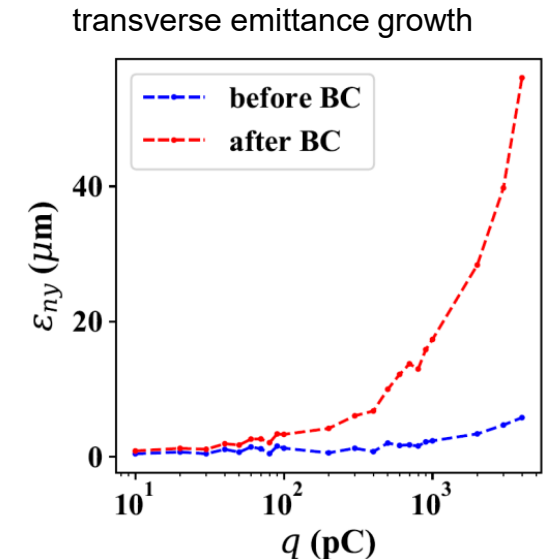
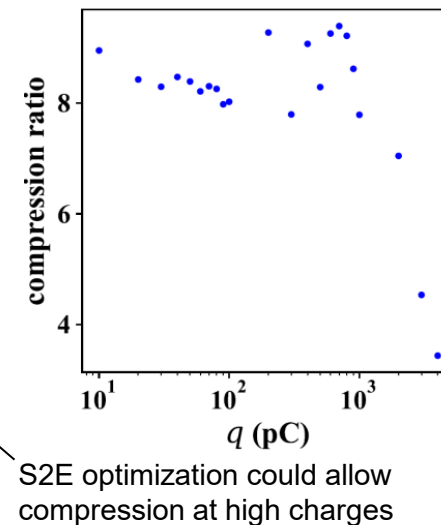
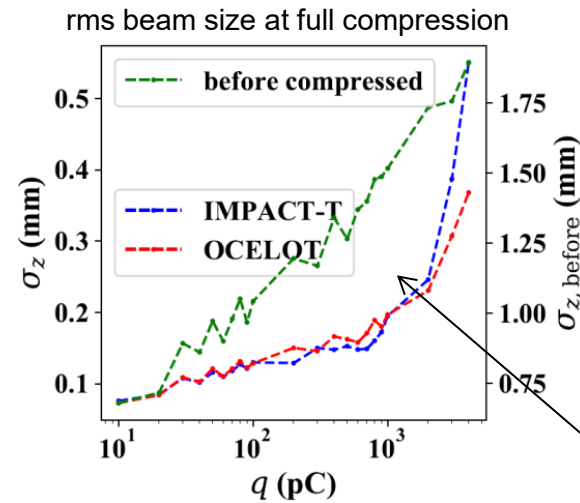
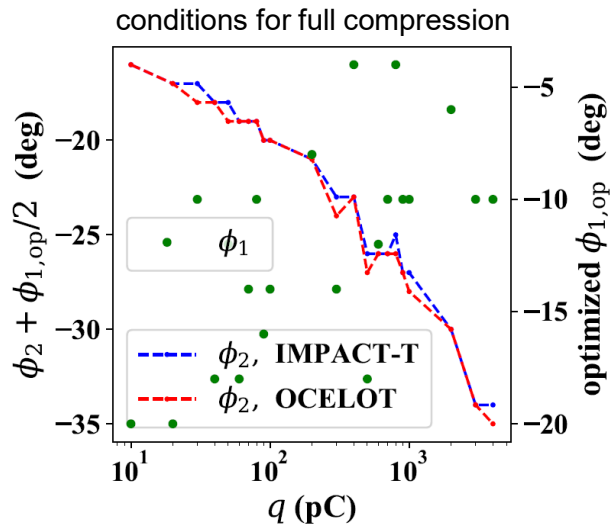
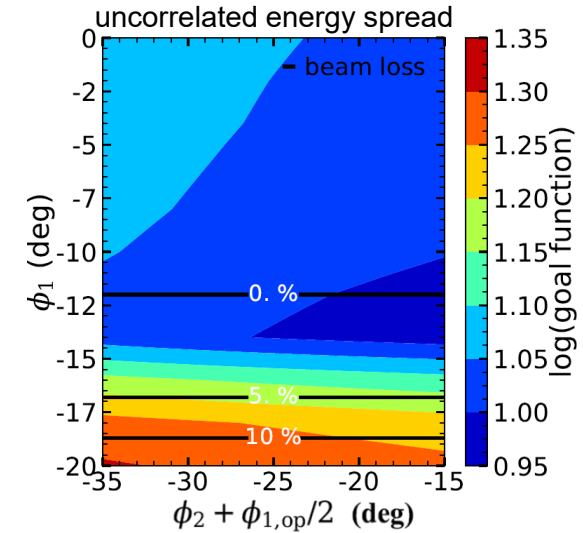
IMPACT-T: J. Qiang, et al, "Three-dimensional quasistatic model for high brightness beam dynamics simulation," Physical Review Special Topics: Accelerators and Beams **9**, 044204 (2006).

OCELOT: S. Tomin, et al, OCELOT as a framework for beam dynamics simulations of X-Ray sources, in: Proc. of IPAC'17, Copenhagen, Denmark, (2017), pp. 2642-2645.

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Simulation Results

- This optimizer method performs
 - optimized gun phase for each charges
 - conditions and rms beam size for full compression
 - compression ratio starts to drop after 2nC
- IMPACT-T results are benchmarked with OCELOT



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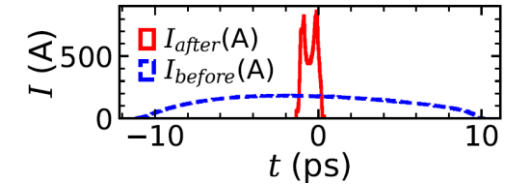
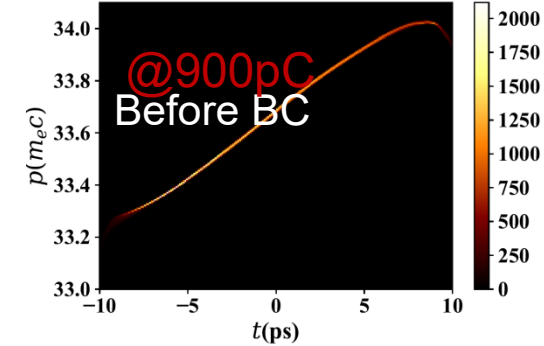
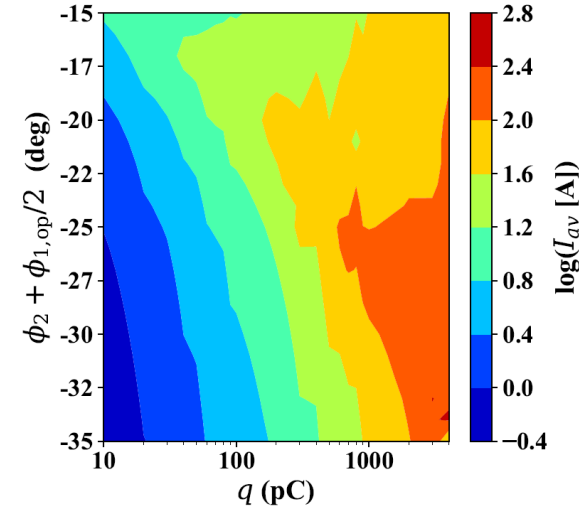
Conclusions and Outlook

- We find conditions for desired average current and rms beam size
 - according to further applications
- We will test on these conditions in experiments

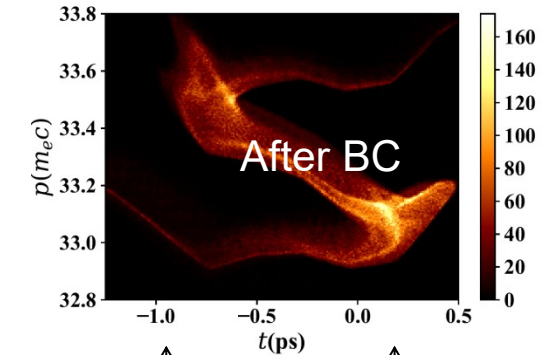
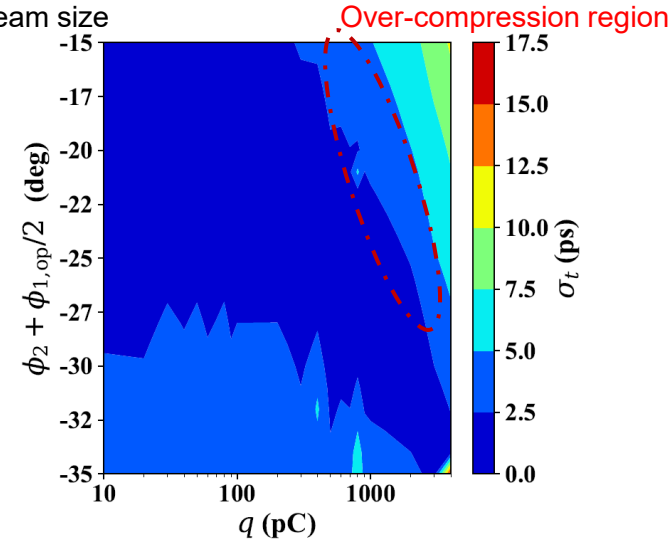
Conclusions

- S2E optimization of gun and booster phase has been developed for flexibility in tuning bunch length, current profile, etc.
- Optimized gun phase linearizes energy chirp, thereby compression ratio.
- Ocelot and ImpactT results are benchmarked.

average current



rms beam size



↑
head

↑
tail

Question

- Thank you for your attentions