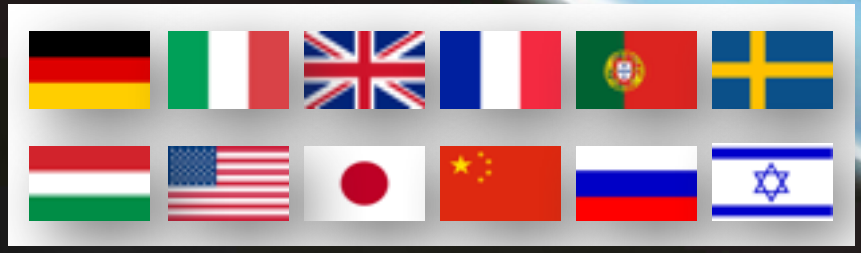
EUROPEAN
PLASMA RESEARCH
ACCELERATOR WITH
EXCELLENCE IN
APPLICATIONS

EuPRAXIA

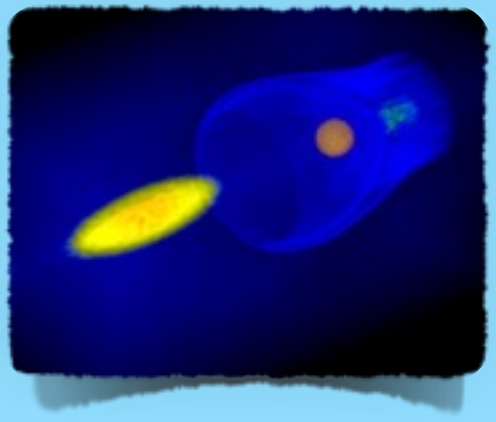
Plasma Wakefield Acceleration Configuration

Alberto Marocchino on behalf of the Sparc_Lab collaboration



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 653782.

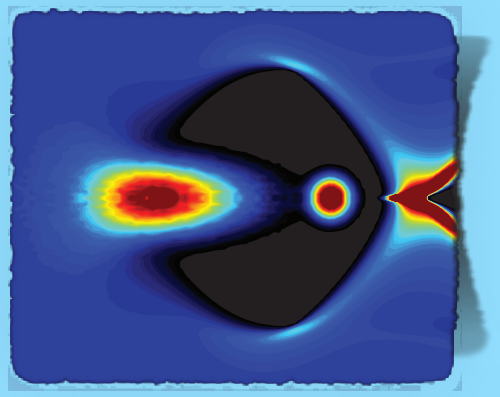
Codes



ALaDyn

full PIC Code

bunch and background
treated with macro-particles



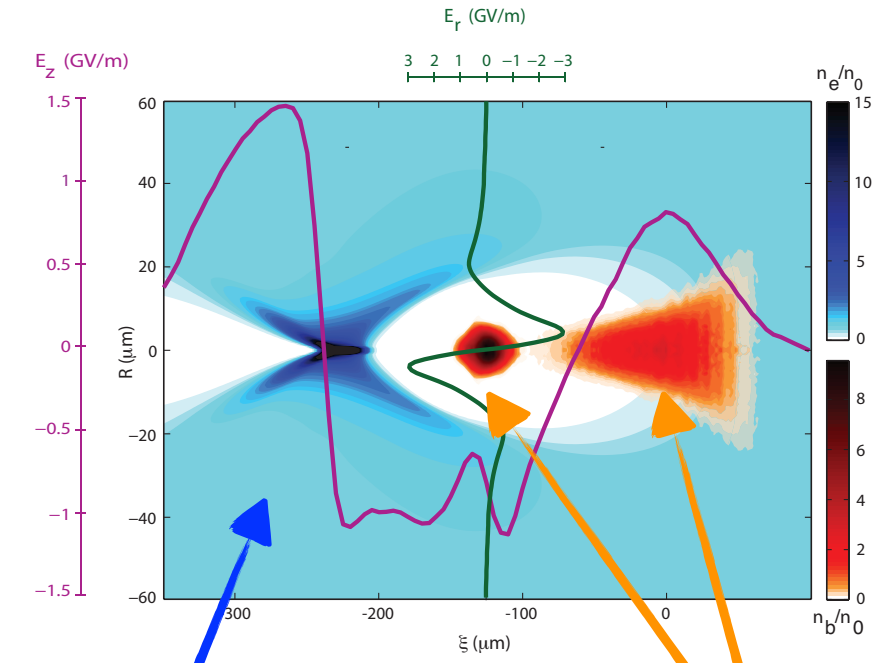
Architect

Hybrid Code

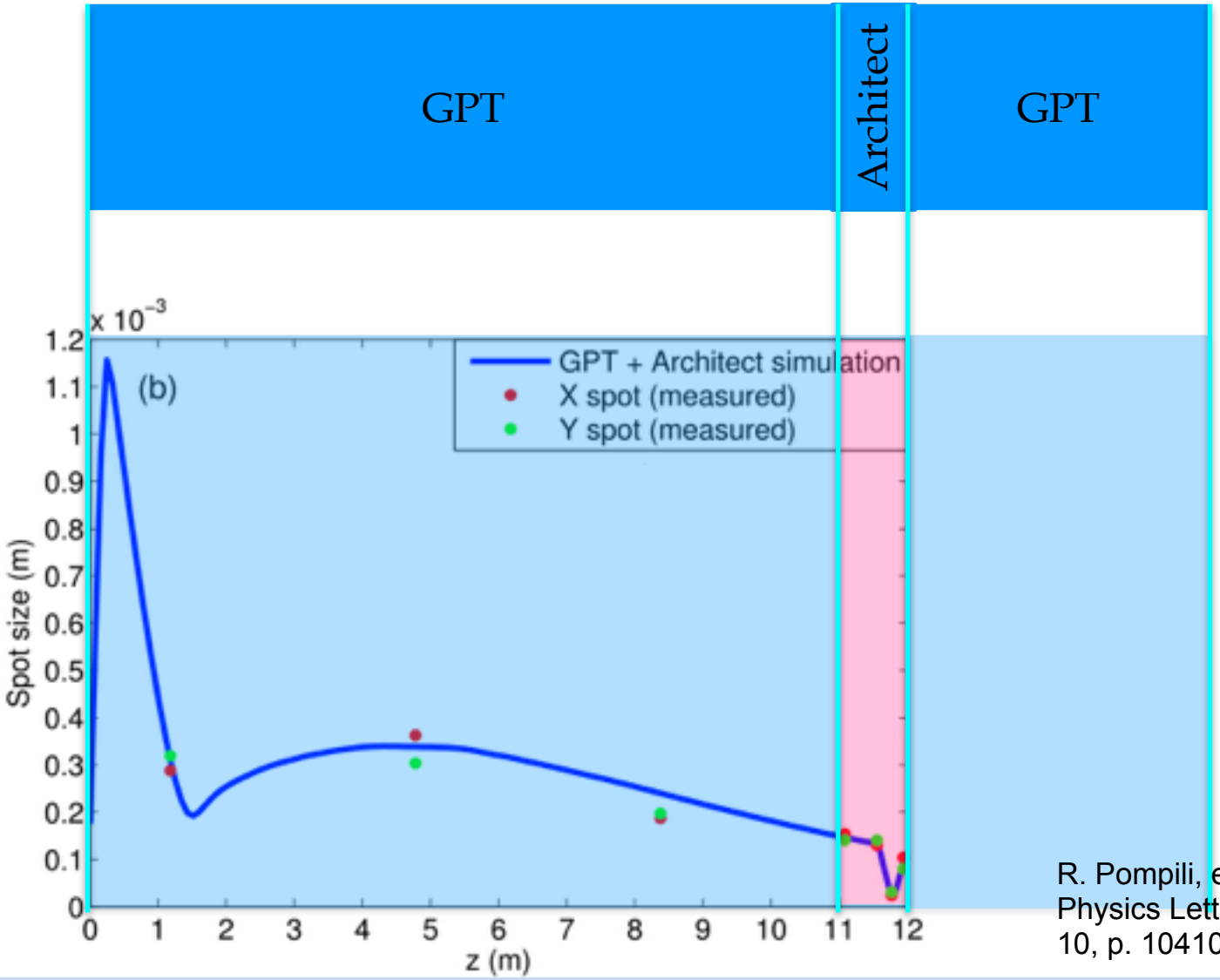
bunch as PIC
background as a fluid

Architect hybrid approach

- **Bunch**(es) are treated **kinetically**
- **background plasma as a fluid**
- systematic scan in no-time
- cylindrical symmetry assumed
- **no-Quasi Static Approximation**



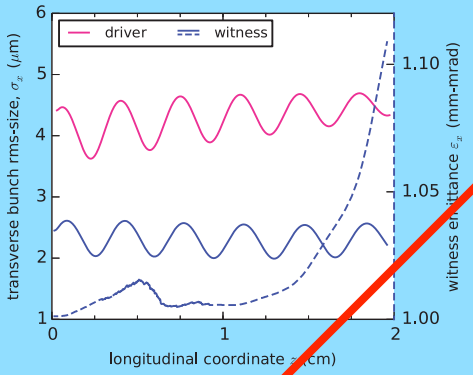
Start-to-end

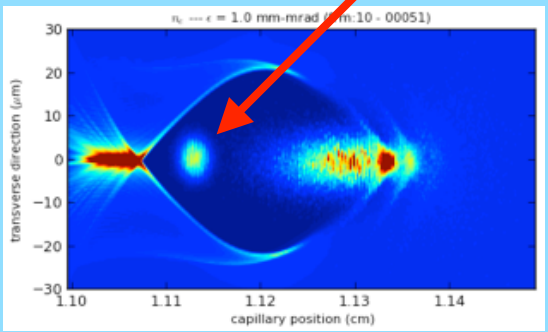


R. Pompili, et al. "Applied Physics Letters, vol. 110, no. 10, p. 104101, Mar. 2017.

Physical Problem: Beam Physics

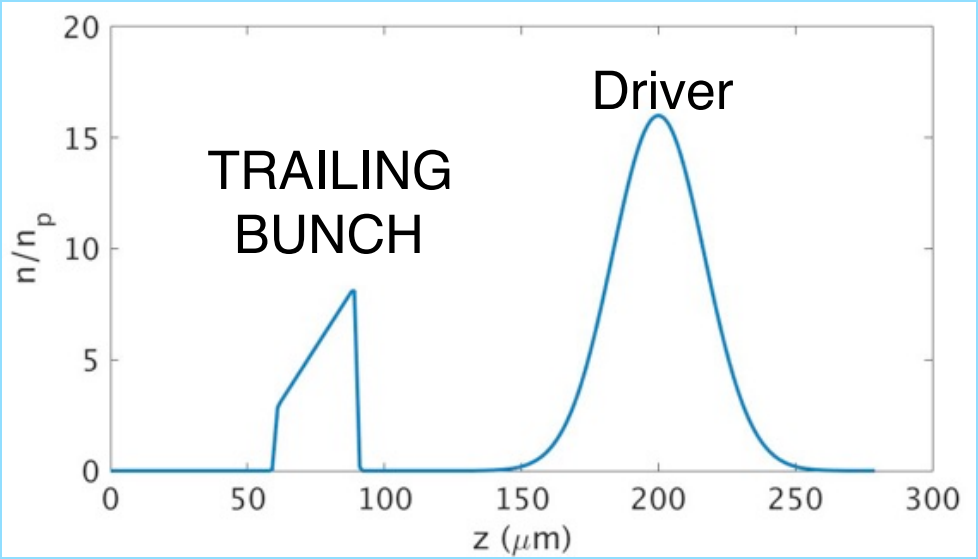
ext-injection





Physical requirement:

- longitudinal matching
- transverse matching
- low emittance at entrance
- low energy spread

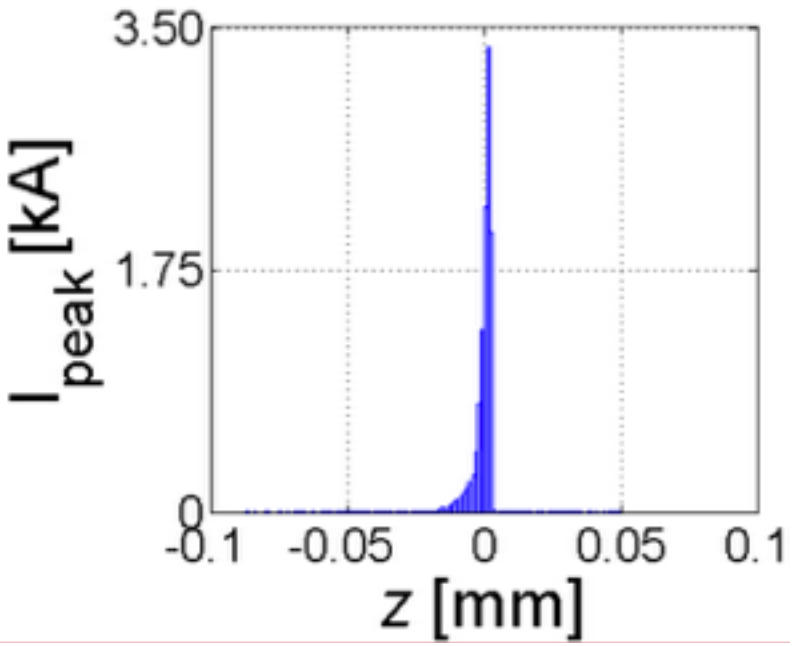


T-step from photo-cathode

T-Step :: Geometry

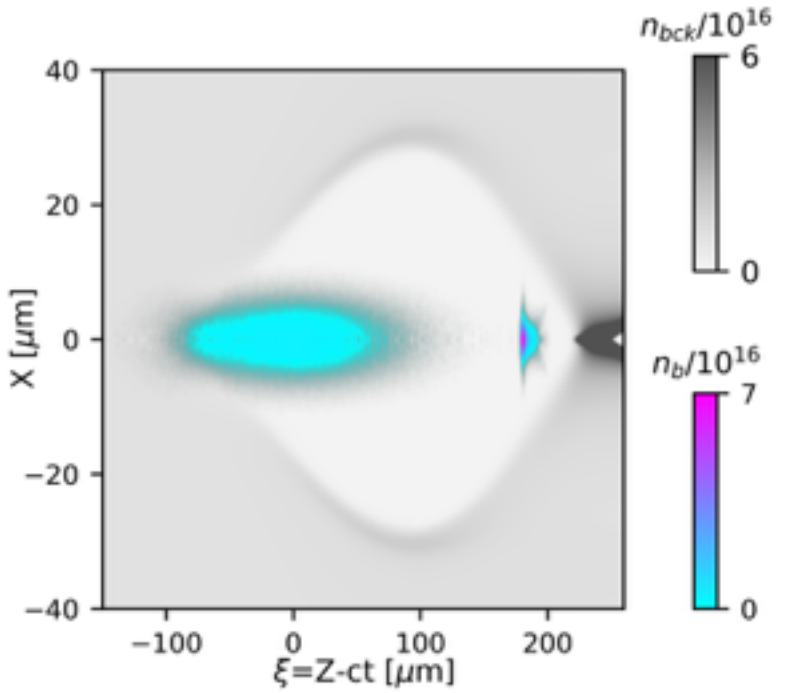
- We need a triangular shape
- Very close to the ideal condition
- Triangular bunch are feasible

T-Step :: hist

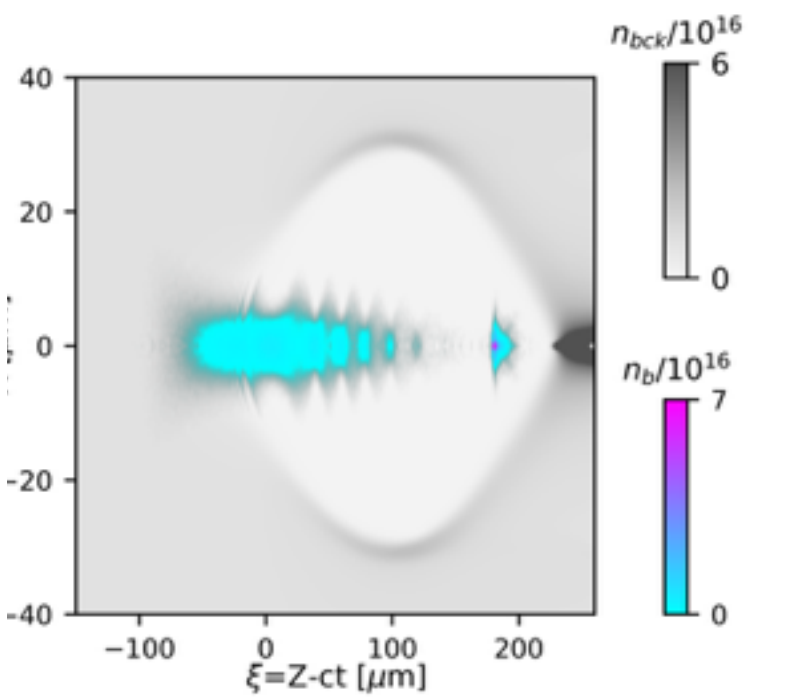


Architect sims

Architect :: entry

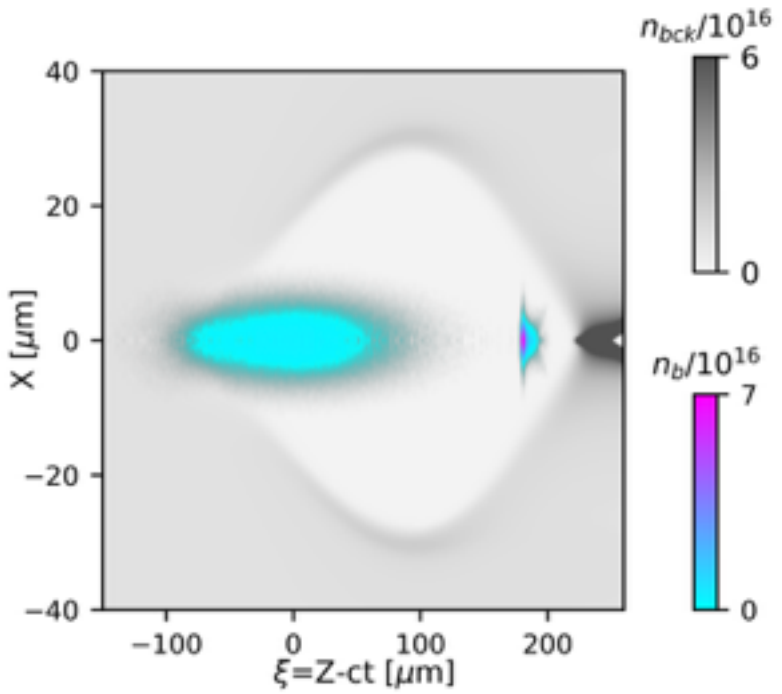


Architect :: exit



Architect sims

Architect :: entry



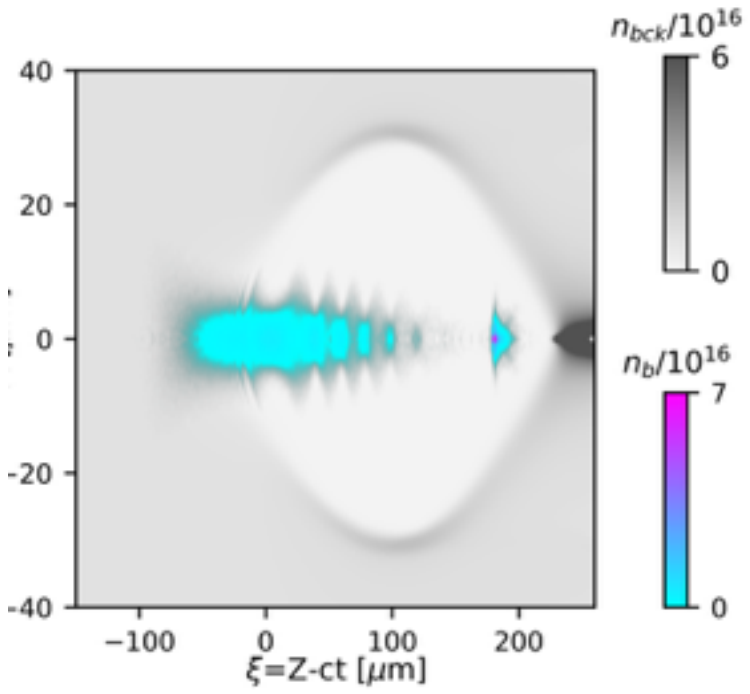
Bunch Parameters

	Driver
Q (pc)	200
σx (μm)	4
σy (μm)	4
σz (μm)	50
εx (μm)	3
εy (μm)	3
σE (%)	0.1

	Trailing Bunch
Q (pc)	29
σx (μm)	0.73
σy (μm)	1.3
σz (μm)	3.5
εx (μm)	0.4
εy (μm)	0.4
σE (%)	0.06

Architect sims

Architect :: exit



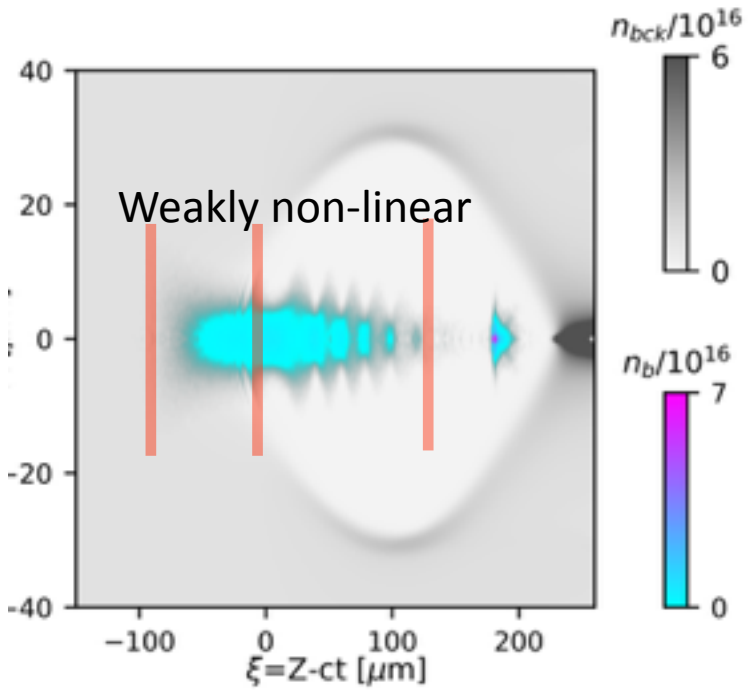
Bunch Parameters

	Driver	Driver End-Capillary
Q (pc)	200	195
σx (μm)	4	7
σy (μm)	4	7
σz (μm)	50	47
εx (μm)	3	4.9
εy (μm)	3	4.9
σE (%)	0.1	16

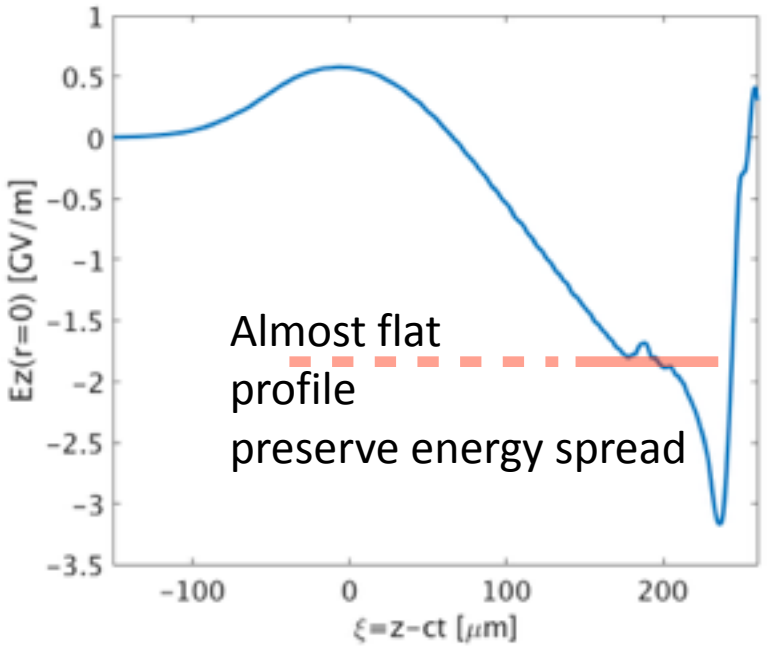
	Trailing Bunch	Trailing Bunch End-Capillary
Q (pc)	29	29
σx (μm)	0.73	1.2
σy (μm)	1.3	1.18
σz (μm)	3.5	3.3
εx (μm)	0.4	0.48
εy (μm)	0.4	0.81
σE (%)	0.06	0.73

Architect sims

Architect :: exit

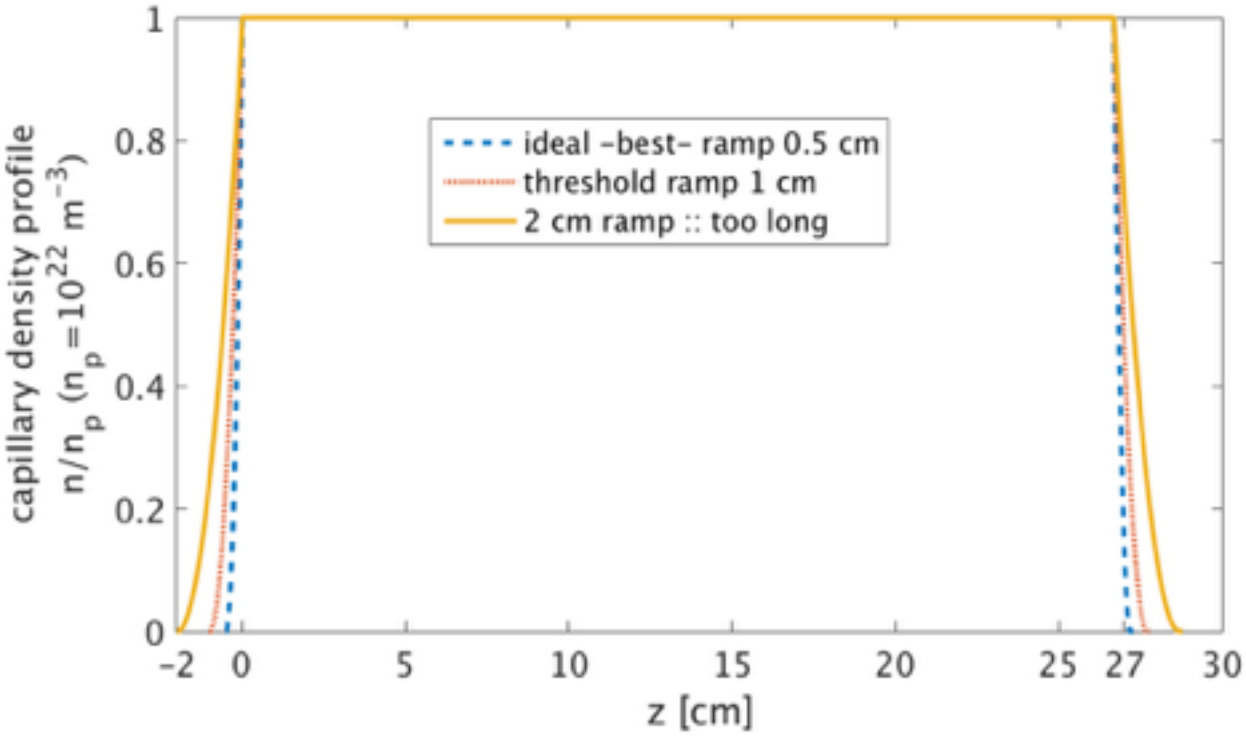


Beam Loading



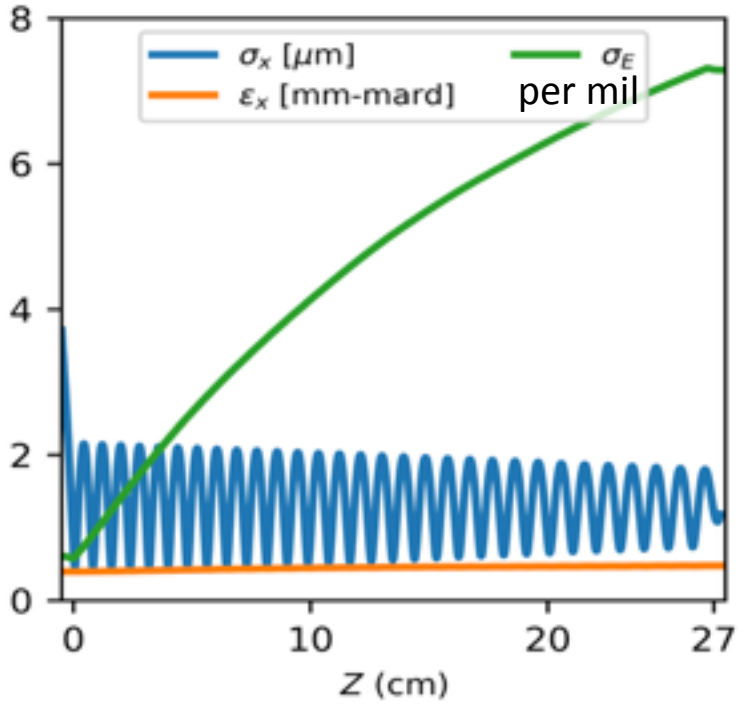
Architect sims

Background Profile



Architect sims

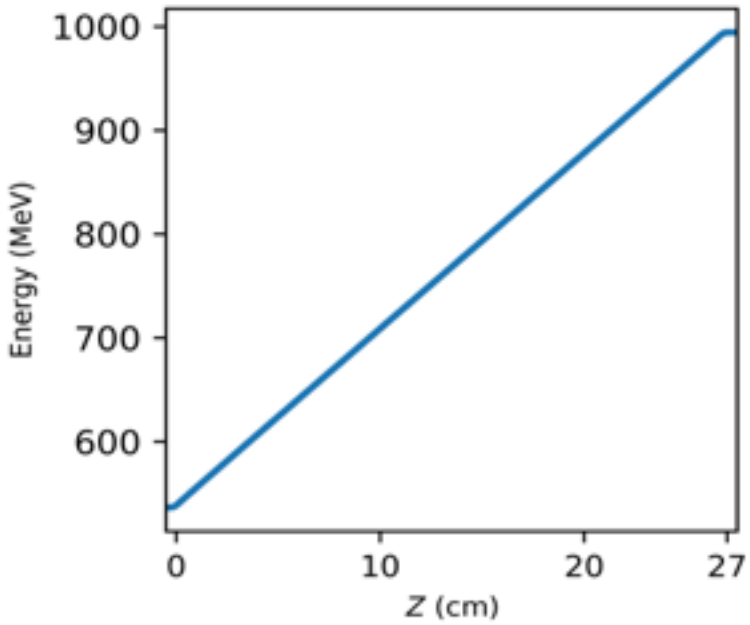
Bunch integrated parameters



- Emittance growth very slowly
- The energy spread is the most critical parameter

Architect sims

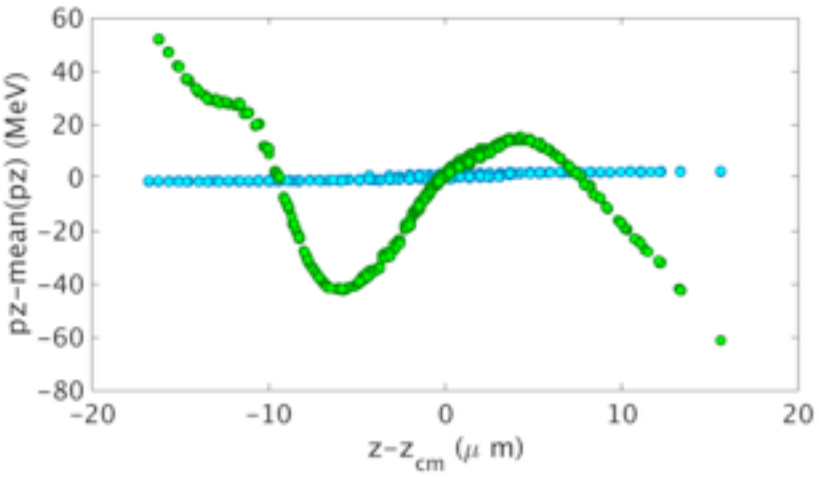
Bunch integrated parameters



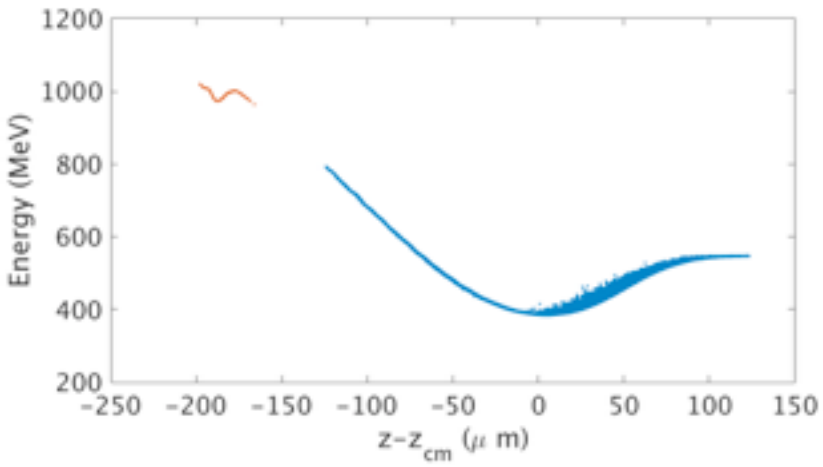
- The energy growth is very stable
- Driver :: 500 MeV -Rigid-
- Driver :: lose little energy (Stable bubble)

Architect sims

PS at exit

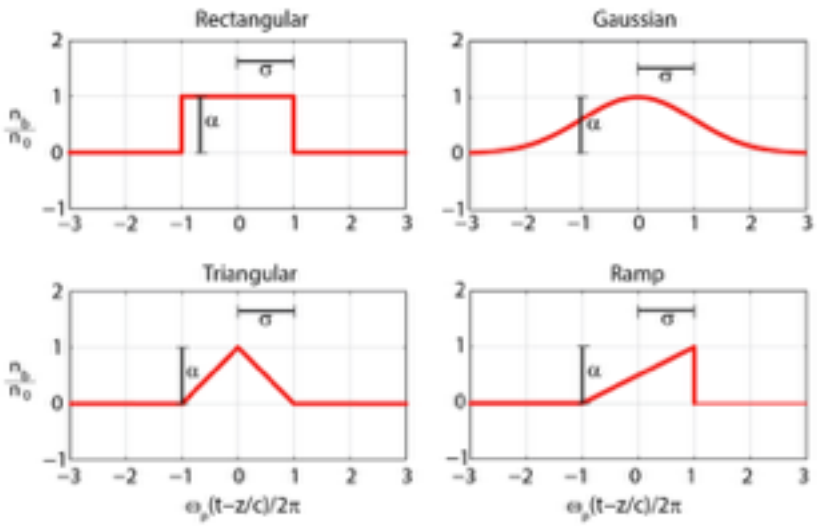


PS at exit

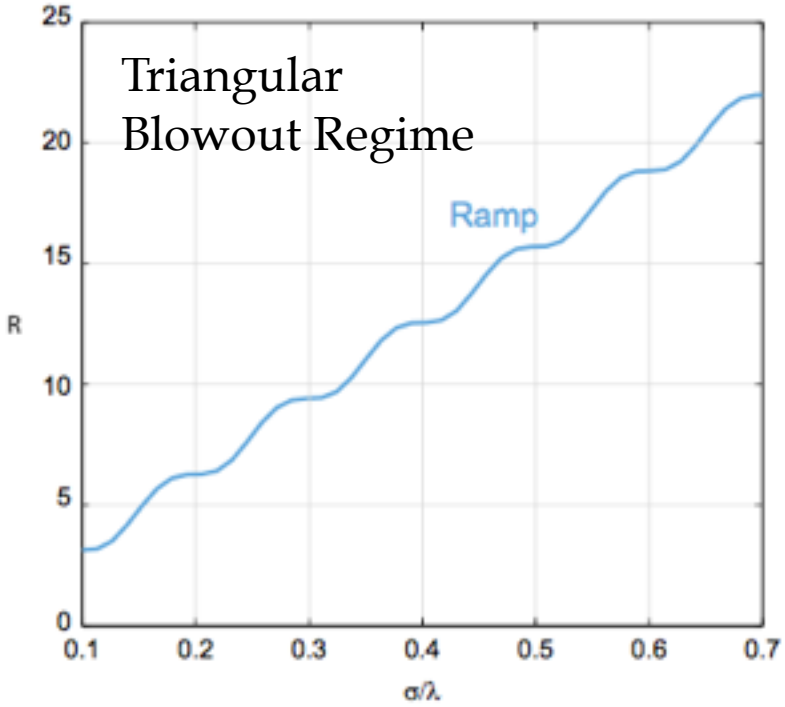


Transformer ratio

Beam Profile



Best Case Scenario



F. Massimo, A. Marocchino, et al. Nuclear Inst. and Methods in Physics Research, A, vol. 740, no. C, pp. 242–245, Mar. 2014.