E-beam transverse focusing for beam plasma interaction studies

- **Transverse focusing of 22 MeV electron beam using 3 quadrupoles in high section**
- **Summary**

Martin Khojoyan
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HELMHOLTZ ASSOCIATION

DESY

Goal and parameters for ASTRA simulations

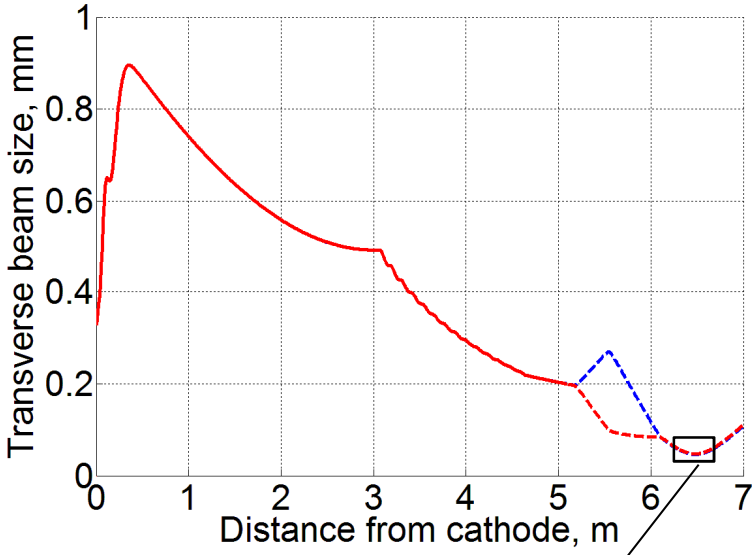
Requirements for an electron beam with 100pC charge:

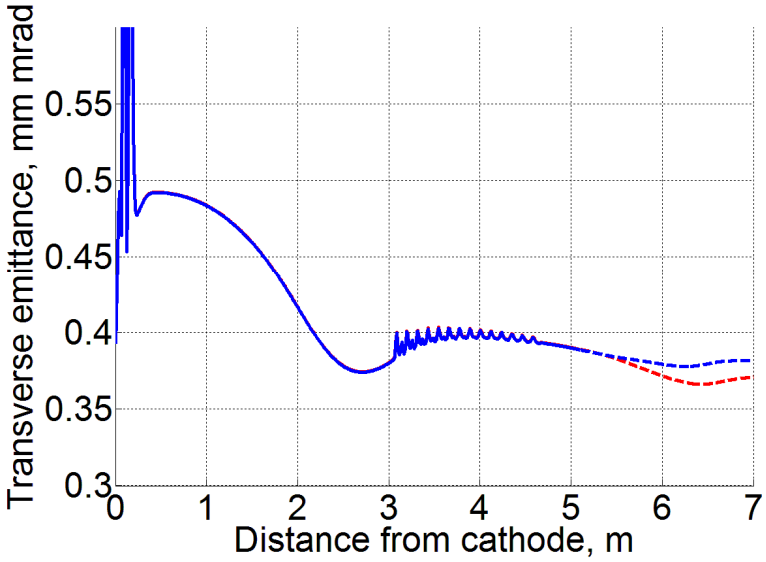
- Smooth beam transverse focusing at the entrance / middle of plasma cell (z = [6.45-6.55] m)
- Transverse beam rms size → $\sigma_{xy} = \sqrt{\sigma_x \cdot \sigma_y} \sim 50 \mu m$

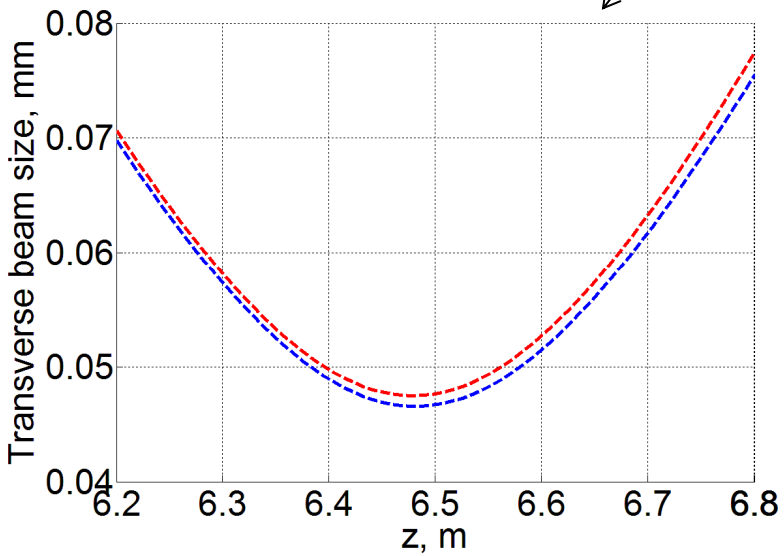
Setup for beam simulations

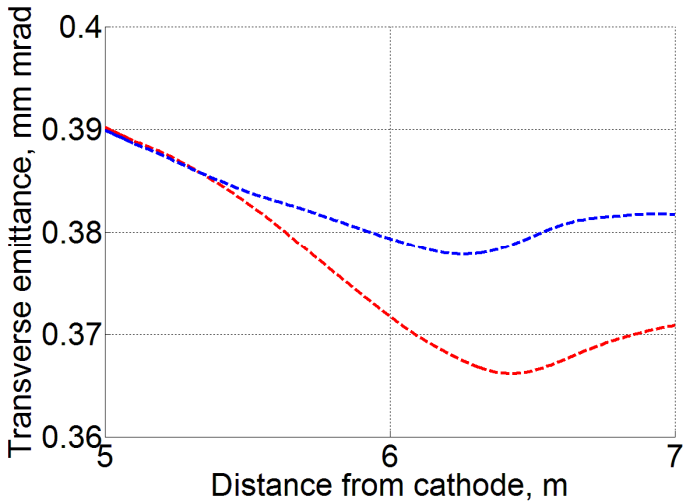
- Laser: Longitudinally flat-top → 2/22\2 ps. Transverse rms spot size on the cathode → 0.3mm
- Gun: Gradient of 61 MV/m (6.73 MeV/c after gun at on-crest phase), phase fixed to on-crest
- Booster: Gradient of 17.5 MV/m (22 MeV/c final beam momentum for gun and booster on-crest phases), phase fixed to on-crest
- Solenoid scan for e-beam focus on EMSY1 (optimum B(T) = 0.215 T)
- 3 quadrupoles are used for further beam transverse focusing:
- High1.Q1 → position 5.19m, focusing gradient: g(T/m)=-1.911
- High1.Q2 → position 5.55m, focusing gradient: g(T/m)=3.233
- High1.Q3 → position 6.1m, focusing gradient: g(T/m)=-3.086
- 100pC charge

Beam transverse properties along the PITZ linac

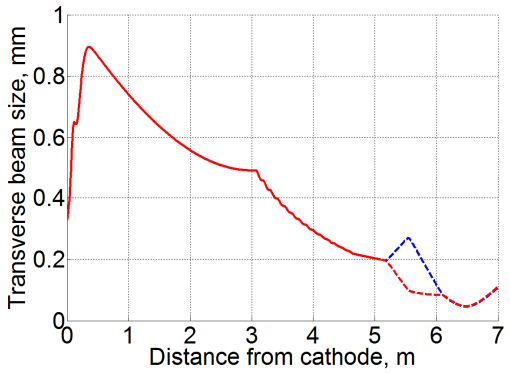


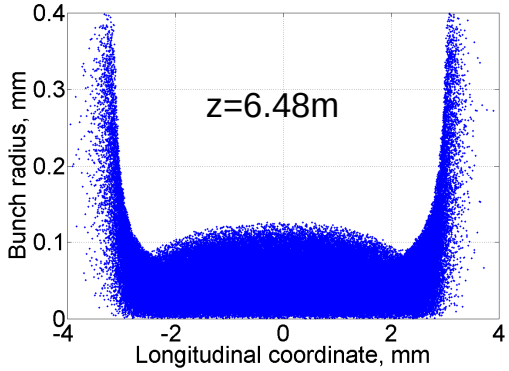


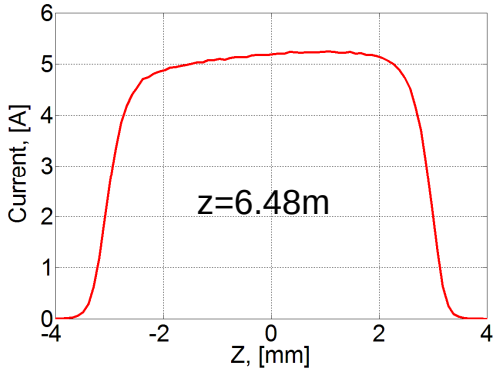


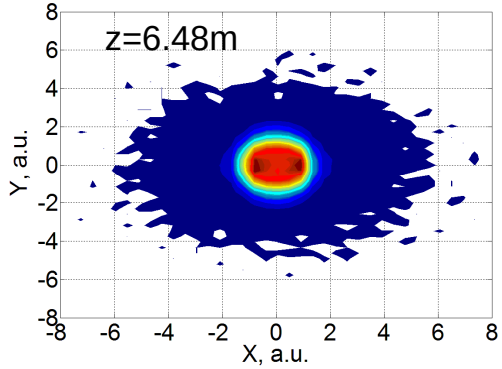


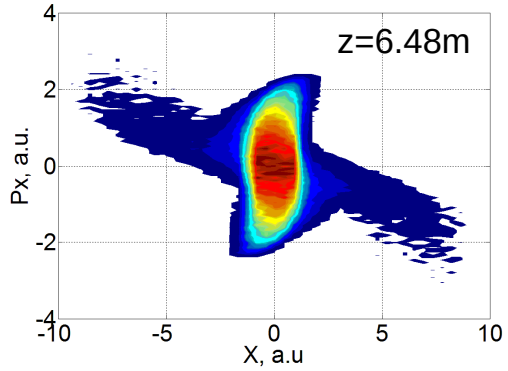
Beam properties at 6.48m after the cathode

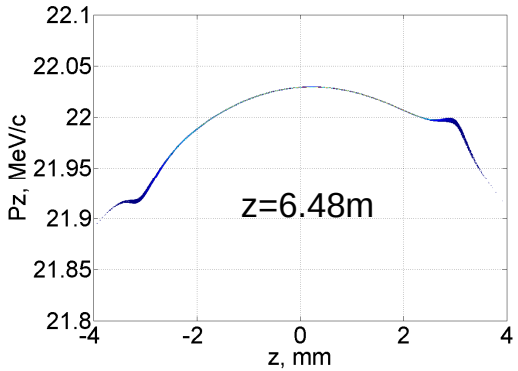












Beam parameters	Value
Final beam momentum, MeV/c	22
Total charge, pC	100
Longitudinal beam position, m	6.48
Horizontal beam rms size, um	46.5
Vertical beam rms size, mm	47.5
Bunch length in FWHM, mm	5.93
Final beam energy, MeV	17.6
Peak slice current, A	5.3
Horizontal beam emittance, mm mrad	0.37
Vertical beam emittance, mm mrad	0.38
Gradient of High1.Q1, T/m	-1.911
Gradient of High1.Q2, T/m	3.233
Gradient of High1.Q3, T/m	-3.086