Beam dynamics optimization for 100pC

Parameters for optimization

Optimization results

Summary

Grygorii Vashchenko
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HELMHOLTZ GEMEINSCHAFT

DESY

Parameters for optimization

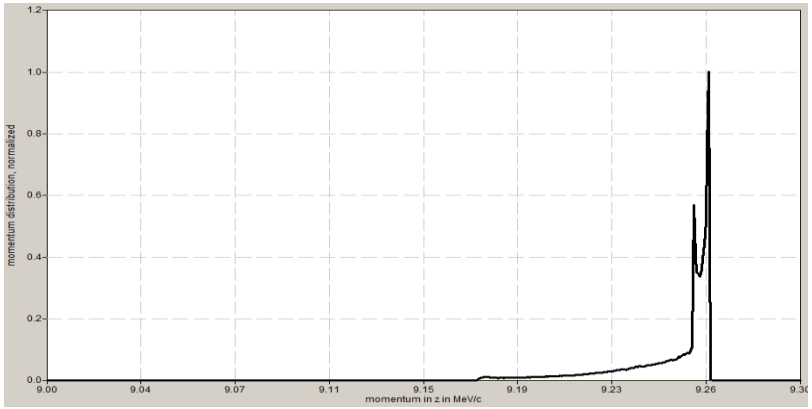
Parameter	Value	Unit
Bunch charge	0.1	nC
Flat top laser temporal profile, FWHM	21.5	ps
Flat top laser temporal profile, rt/ft	2	ps
Uniform laser transverse profile, rms	[0.08;0.01;0.21]	mm
Gun launching phase w.r.t. MMMG phase	[-8;0.5;11.5]	deg
Main solenoid current	[368;1;384]	A
Booster accelerating gradient	[0;1;30]	MV/m
Booster launching phase w.r.t. MMMG phase	0	deg

Best emittance value for 100 pC charge

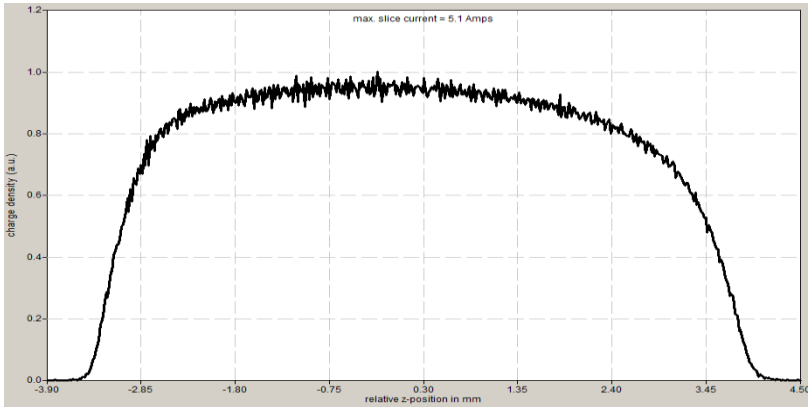
Parameter	Value	Unit
Bunch charge	0.1	nC
Flat top laser temporal profile, FWHM	21.5	ps
Flat top laser temporal profile, rt/ft	2	ps
Uniform laser transverse profile, rms	0.1	mm
Gun launching phase w.r.t. MMMG phase	2	deg
Main solenoid current	379	A
Booster on-axis peak field	3	MV/m
MMMG booster phase from auto phasing	0	deg
Emittance	0.128	mm mrad

Beam distributions

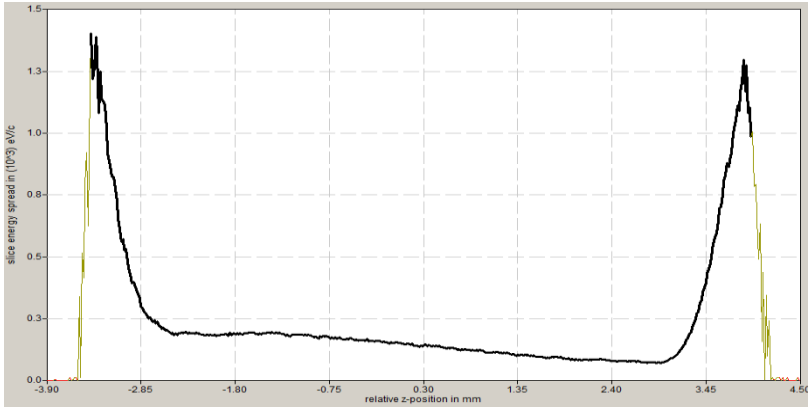
Momentum distribution



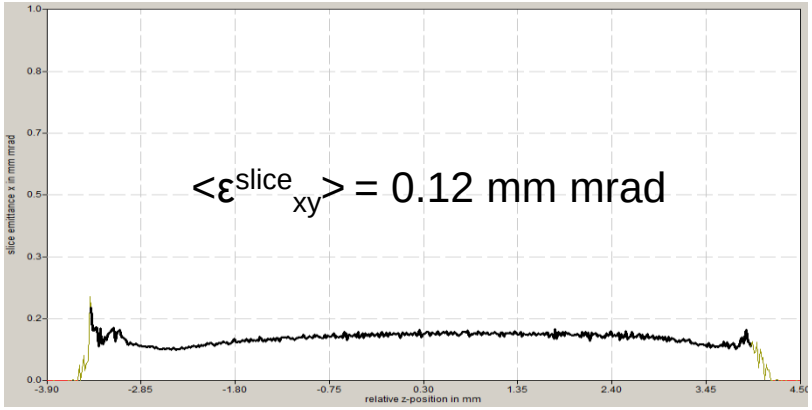
Current profile



Slice energy spread



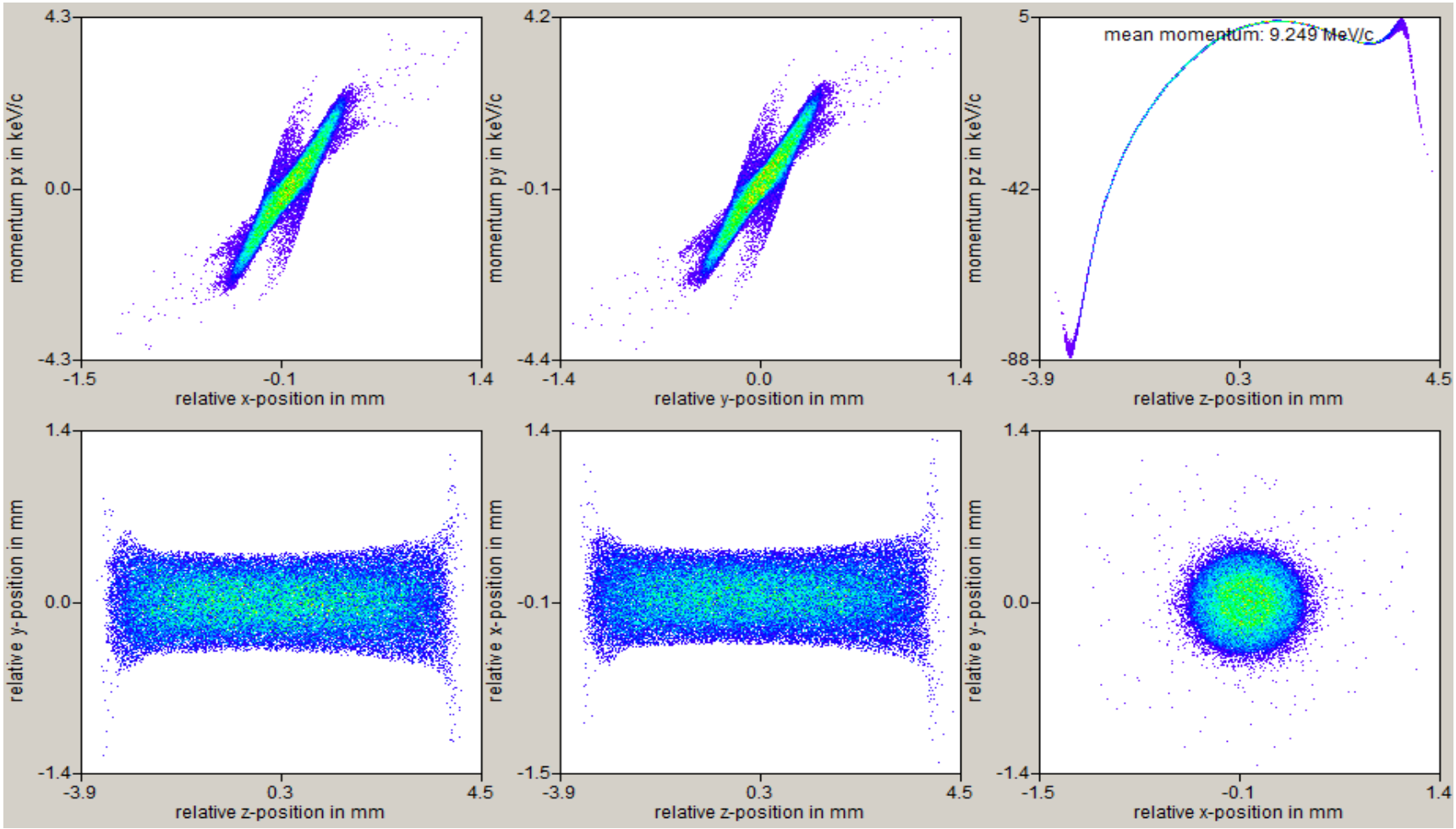
Slice emittance



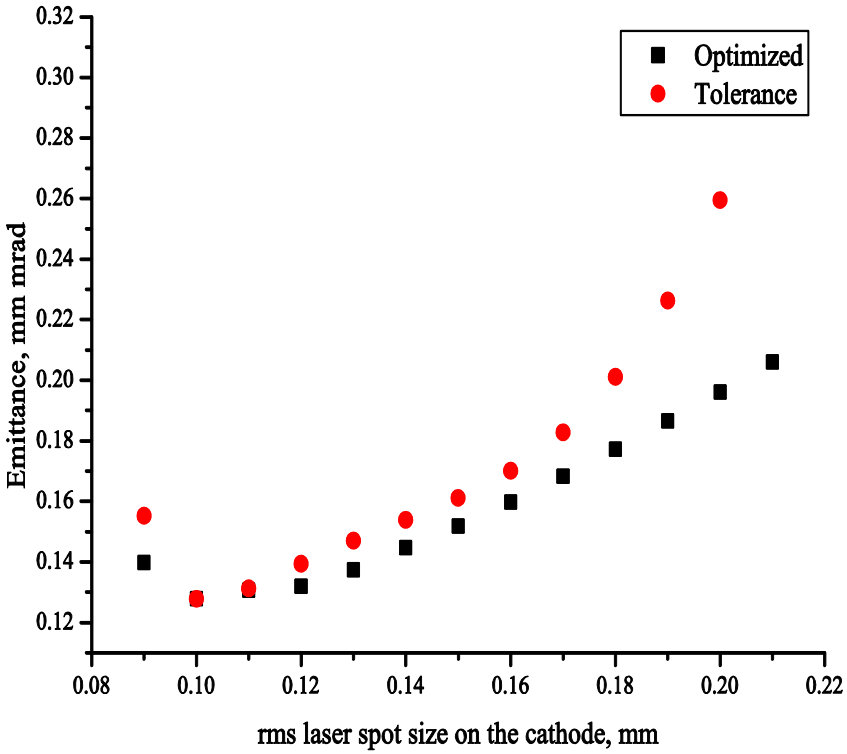
$\langle \varepsilon^{slice}_{xy} \rangle = 0.12$ mm mrad

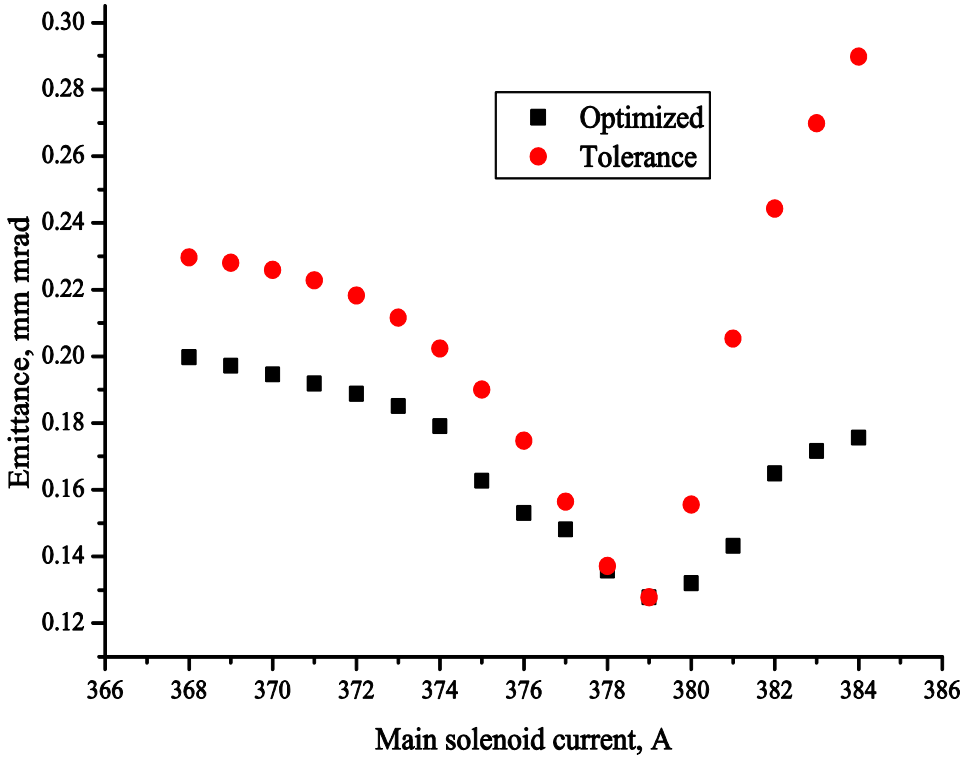
Beam distributions

Phase spaces and beam distributions, $\varepsilon^{projected}_{xy}$ = 0.13 mm mrad

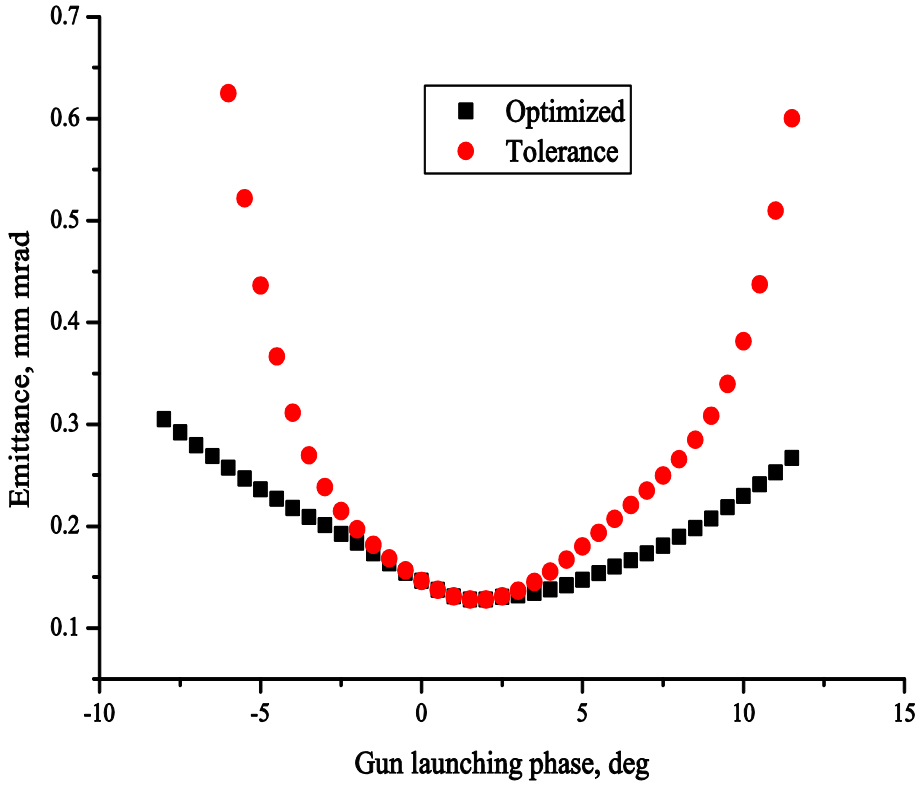


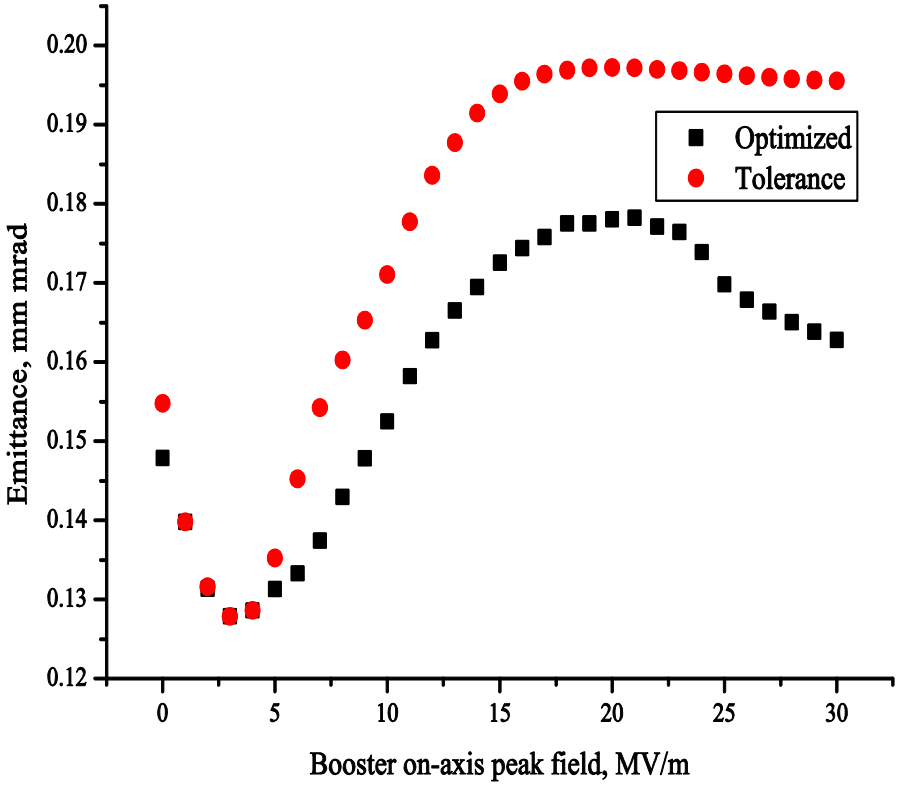
Emittance dependencies on the rms laser spot size on the cathode and main solenoid current





Emittance dependencies on the gun launching phase and booster on-axis peak field





Summary

- Minimum emittance value for 100 pC bunch charge, flat-top temporal laser profile with FWHM = 21.5 ps, 2 ps rise/fall time, gun accelerating gradient of 60.5 MV/m was found for the following conditions:
  - rms laser spot size on the cathode: 0.1mm
  - Booster accelerating gradient: 3MV/m
  - Main solenoid current: 379 A
  - Gun launching phase w.r.t. MMMG phase: 2 deg
- $\varepsilon^{projected}_{xy} = 0.13$ mm mrad
- $<\varepsilon^{slice}_{xy}> = 0.12$ mm mrad
- $\varepsilon^{thermal}_{xy} = 0.085$ mm mrad
- $\varepsilon^{thermal}_{xy} / \varepsilon^{projected}_{xy} = 0.65$

Best emittance value, 100 pC