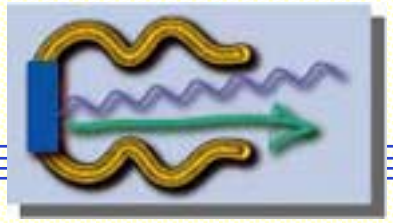

Advantages of the superconducting 3 ½ cell SRF gun in Rossendorf

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FLS 2006 @ DESY, Hamburg, May 15 – 19, 2006

outline

1. Rossendorf SRF gun parameters (gaussian laser profile)
2. design of the Rossendorf 3½ cell SRF gun and E-field profile
3. transverse emittance with a flat top laser profile (ASTRA simulation)
4. transverse emittance with a gaussian laser profile (ASTRA simulation)
5. conclusion

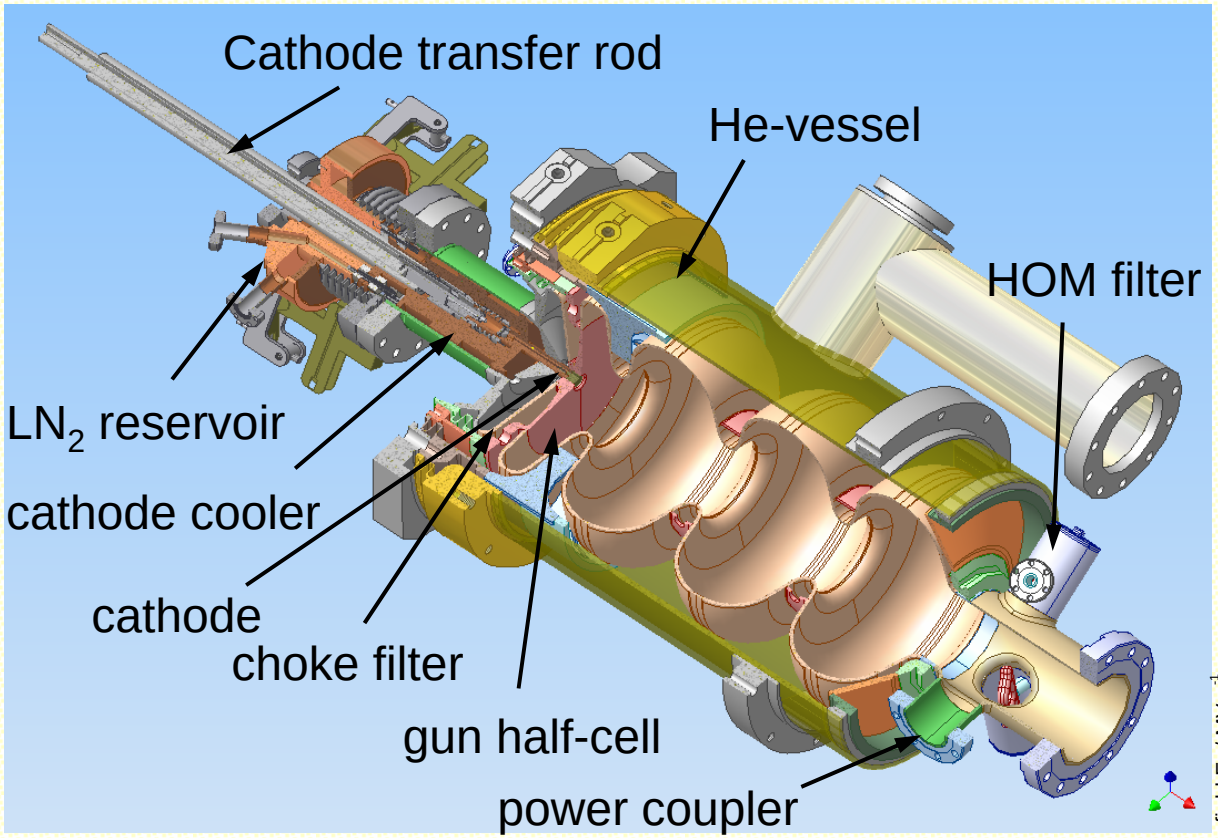
Rossendorf SRF gun parameters (gaussian laser profile)

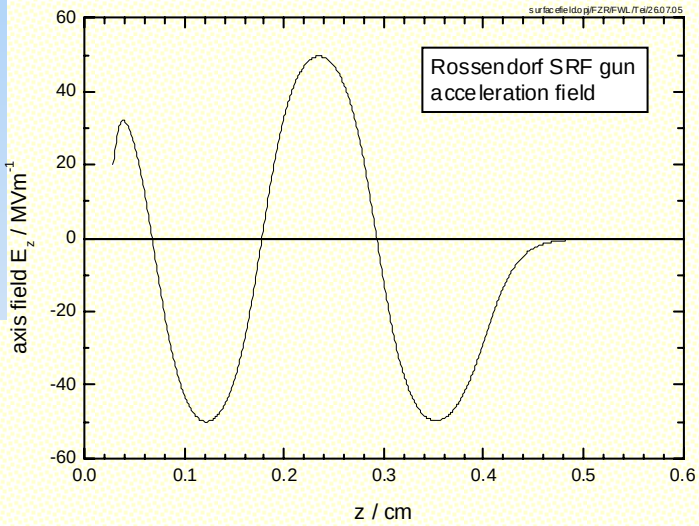
low RF power losses + cw operation

Planned Operation Modes and Beam Parameters

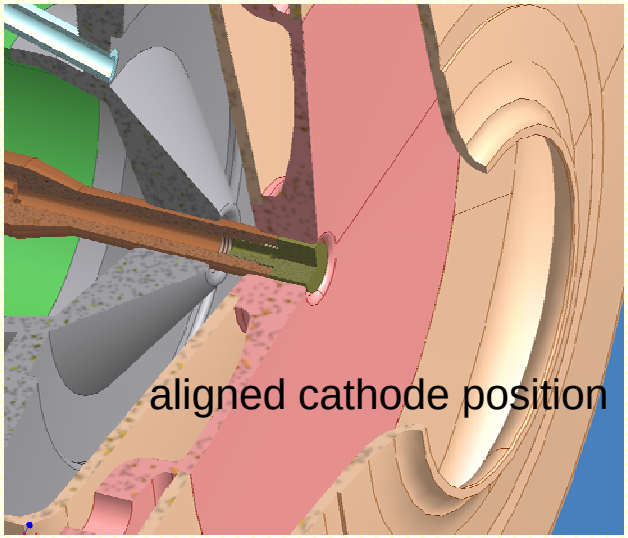
	ELBE	High Charge	BESSY-FEL
Pulse Frequency	13 MHz	≤1 MHz	1 kHz
Bunch Charge	77 pC	1 nC	2.5 nC
Bunch Length (FWHM)	5 ps	20 ps	50 ps
Peak Current	15.4 A	50 A	125 A
Average Current	1.0 mA	≤1 mA	2.5 µA
Norm trans. Emittance$_N$ (rms)	1.5 µm **OK**	2.5 µm **??**	3 µm **??**

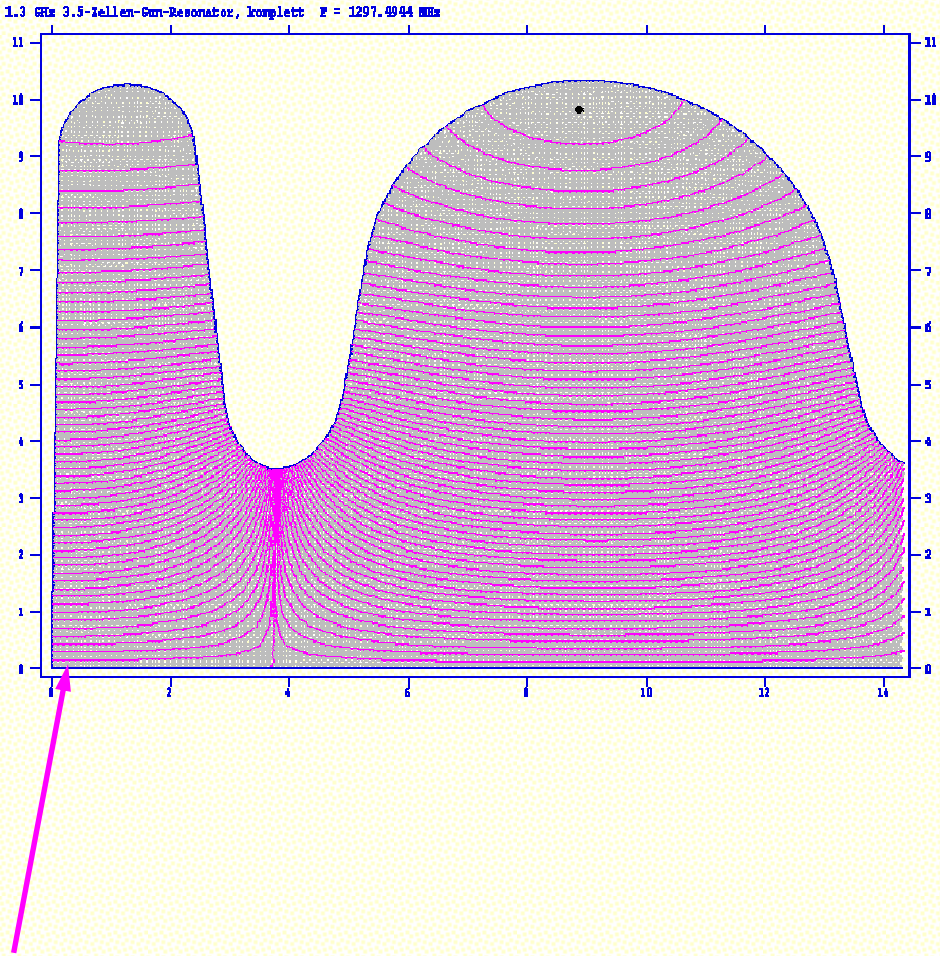
Rossendorf 3½ cell SRF gun





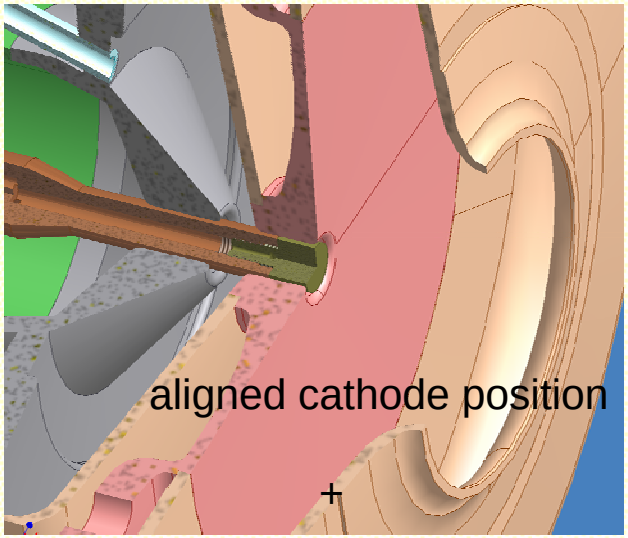
transverse emittance with a flat top laser profile (ASTRA simulation)

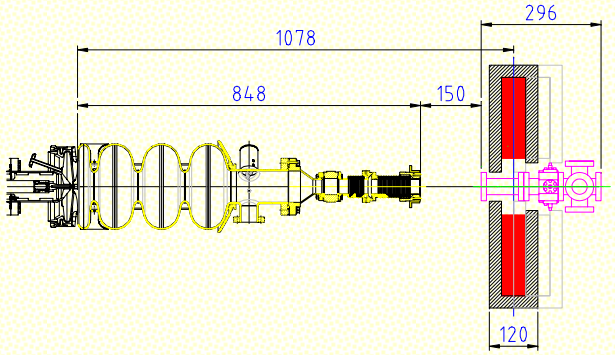




starting with an aligned cathode position ⇒ horizontal force lines

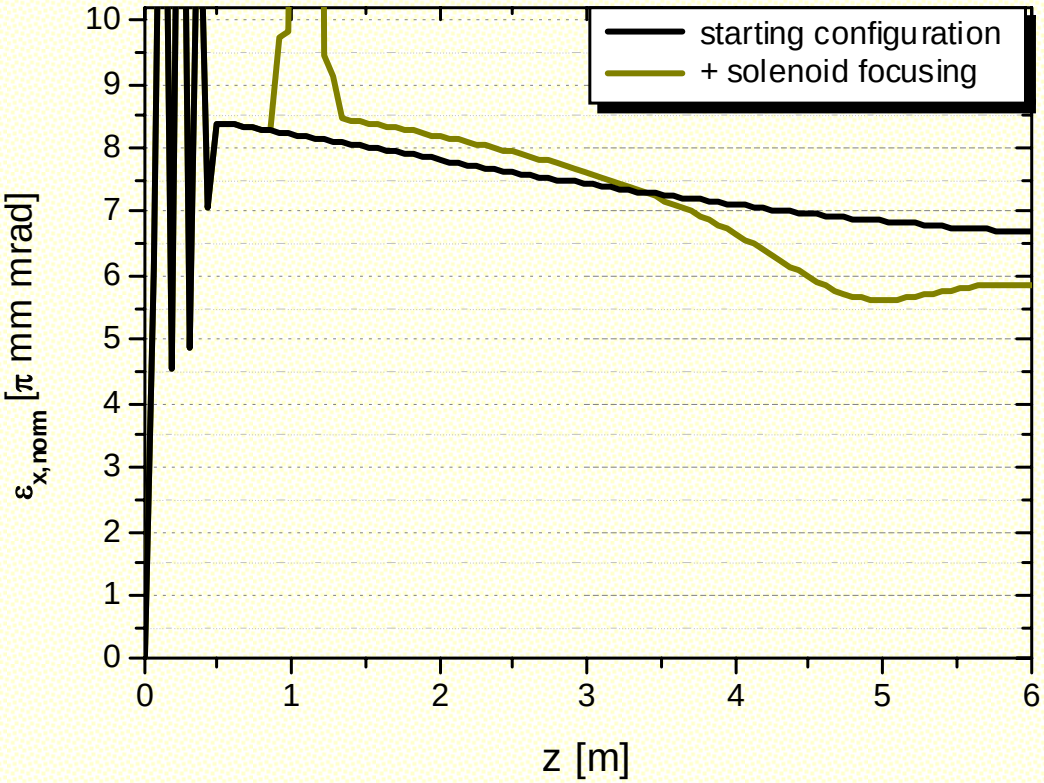
transverse emittance with a flat top laser profile (ASTRA simulation)



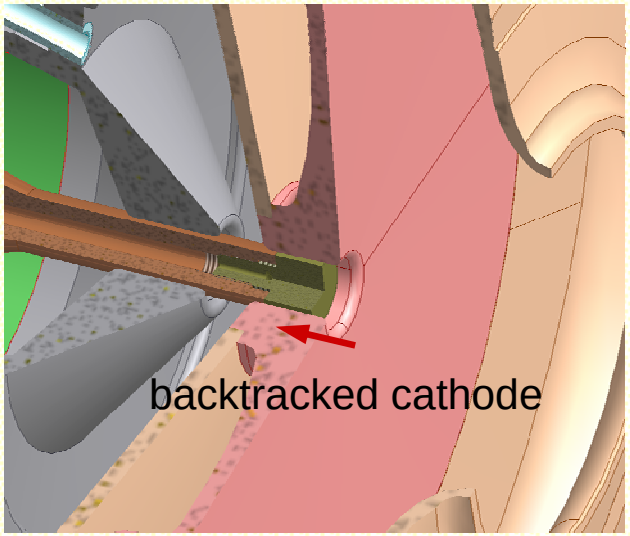


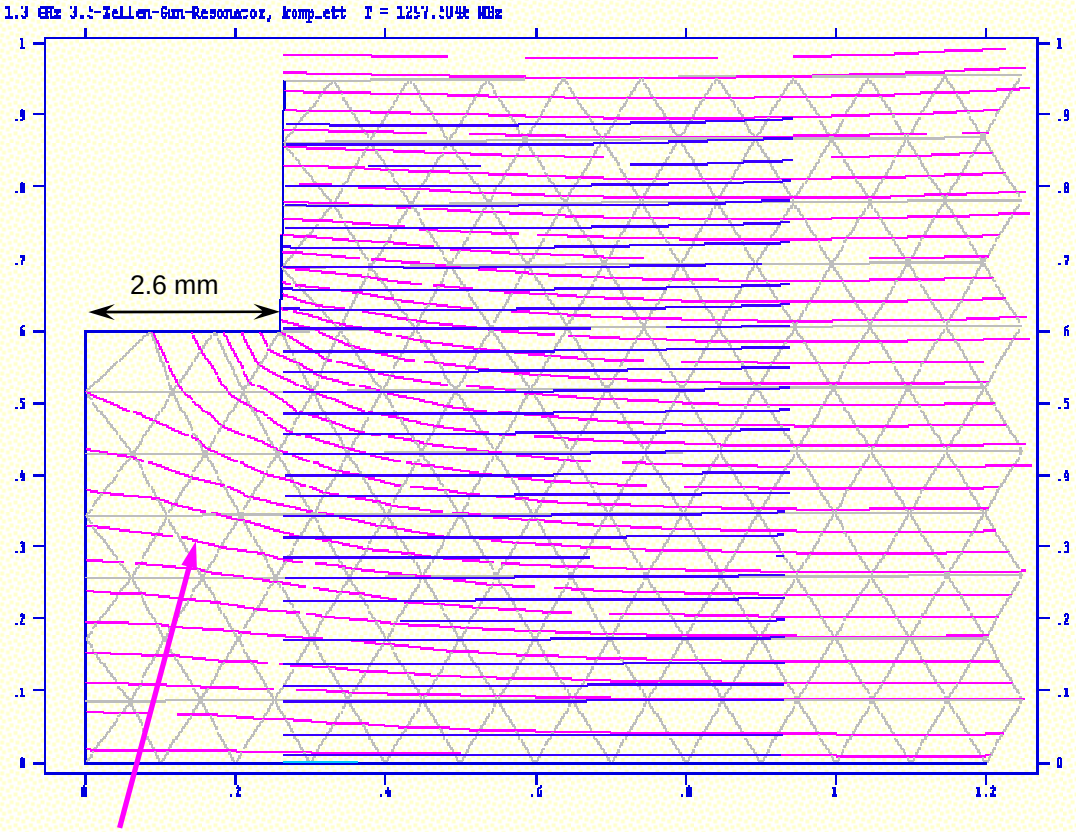
bunch charge : 1 nC
bunch length : 20 ps
σ_x : 1.5 mm

long. emittance :
≈ 40 π keV mm



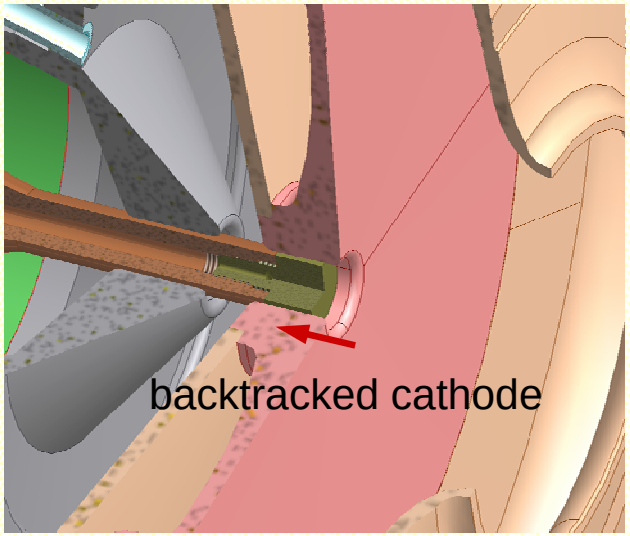
transverse emittance with a flat top laser profile (ASTRA simulation)





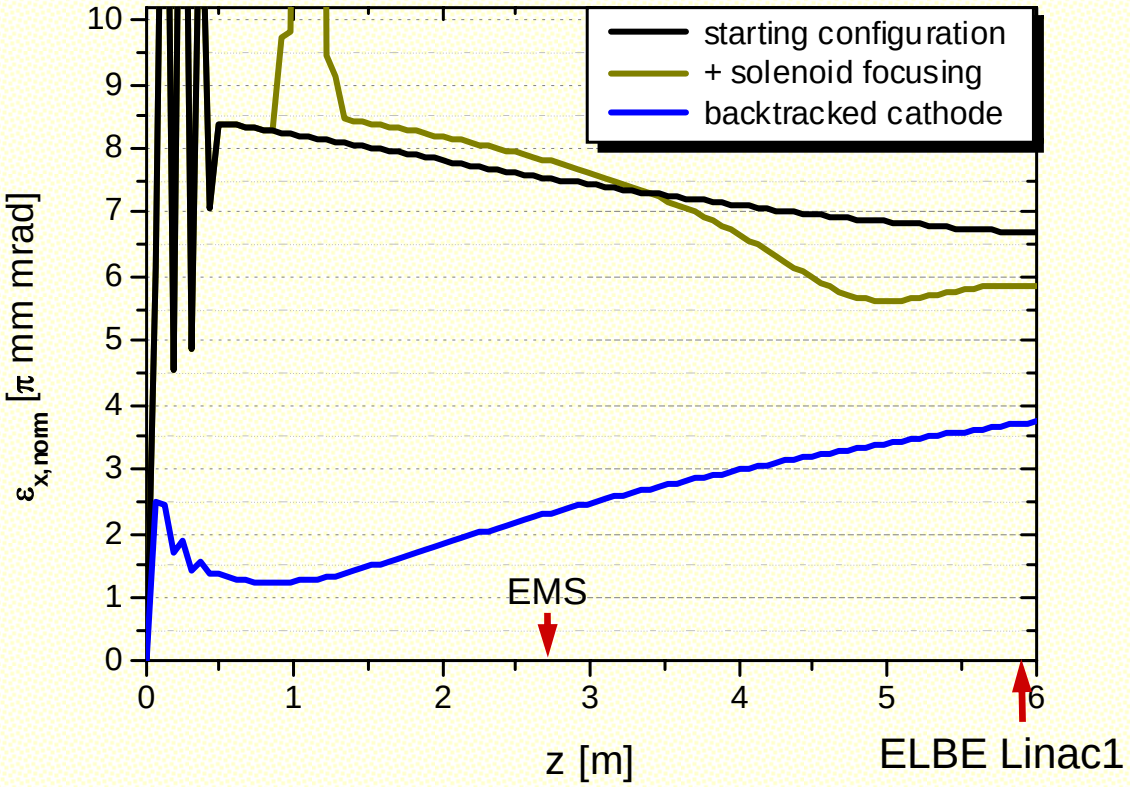
curved field lines ⇒ focusing force

transverse emittance with a flat top laser profile (ASTRA simulation)

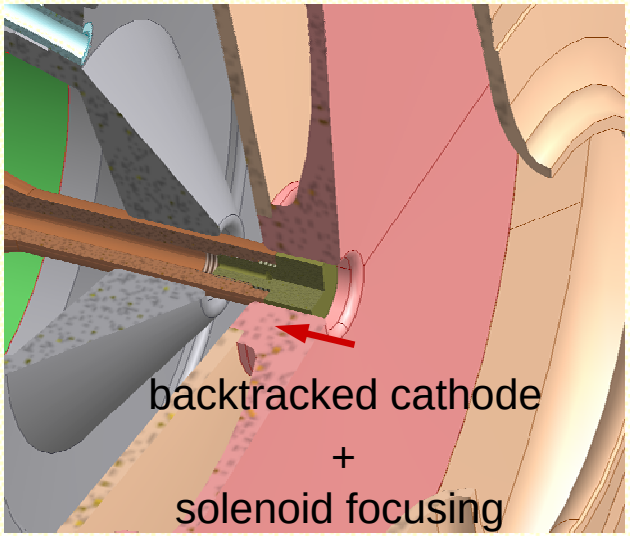


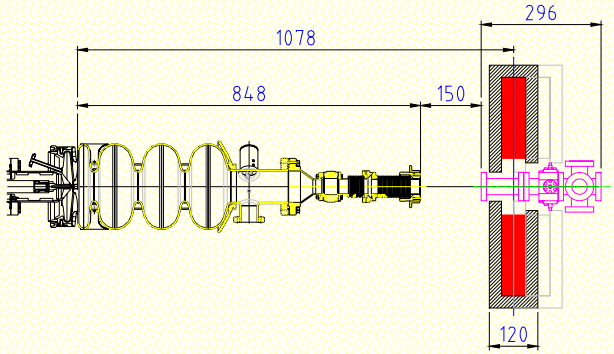
bunch charge : 1 nC
bunch length : 20 ps
σ_x : 1.5 mm

long. emittance :
≈ 70 π keV mm



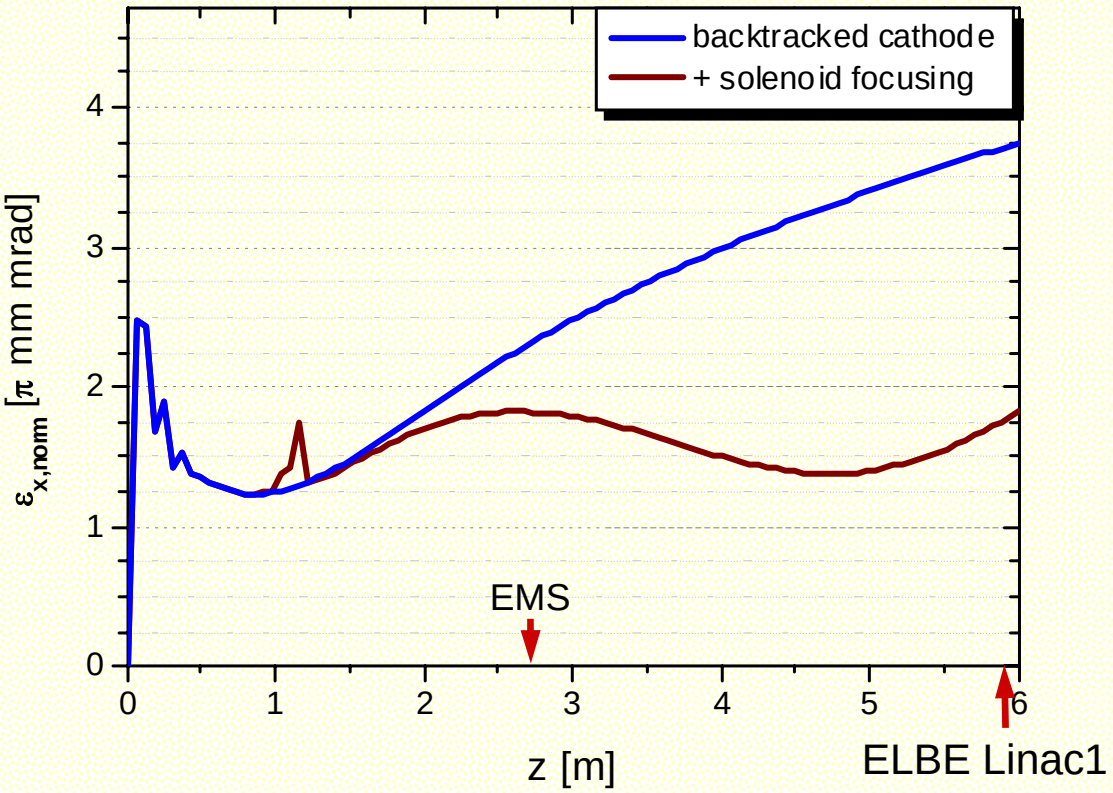
transverse emittance with a flat top laser profile (ASTRA simulation)



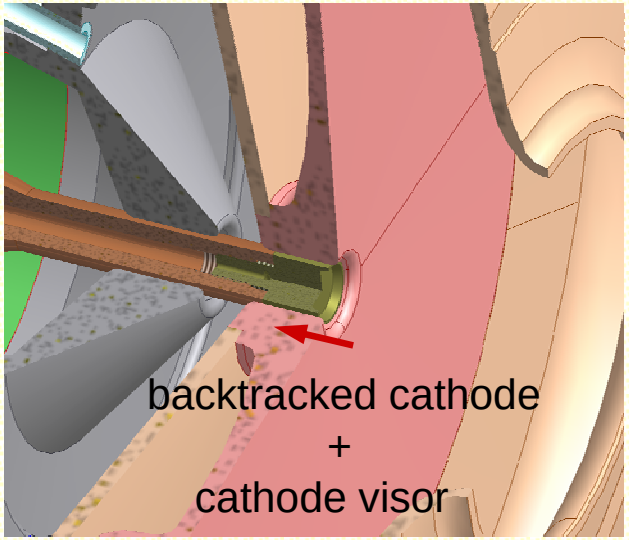


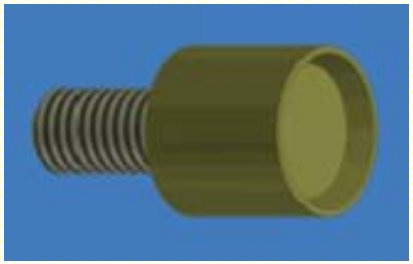
bunch charge : 1 nC
bunch length : 20 ps
σ_x : 1.5 mm

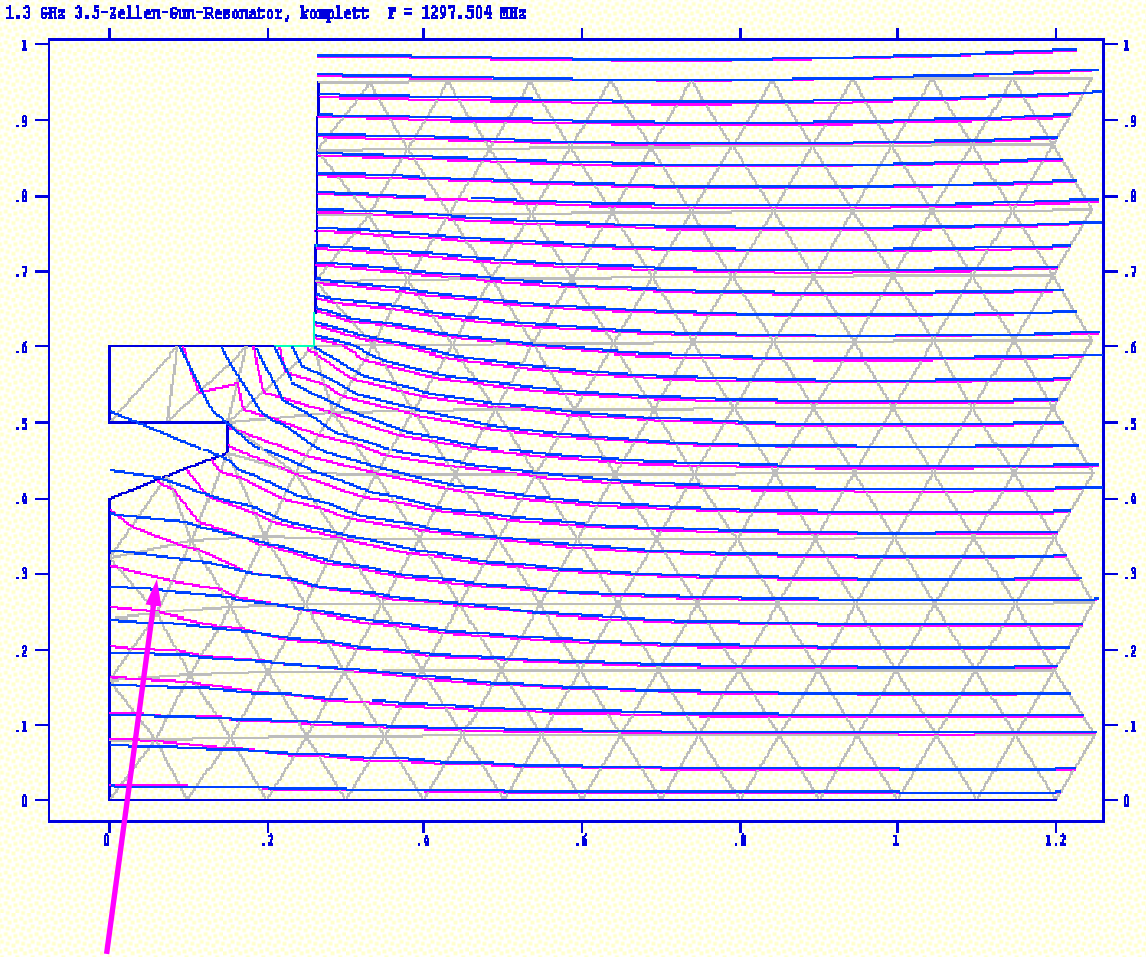
long. emittance :
≈ 70 π keV mm



transverse emittance with a flat top laser profile (ASTRA simulation)

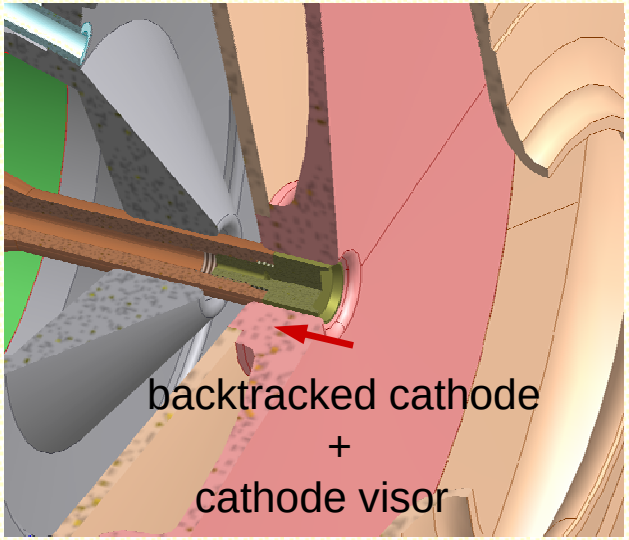






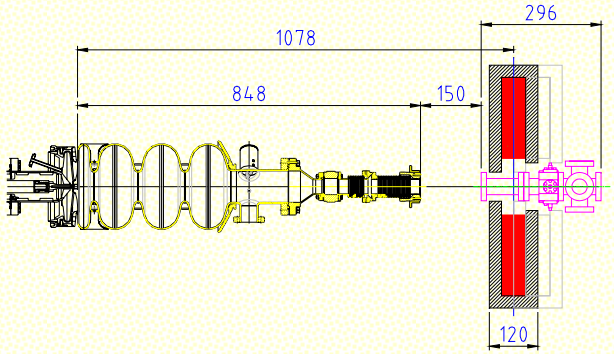
optimized curved field lines ⇒ optimal focusing force

transverse emittance with a flat top laser profile (ASTRA simulation)



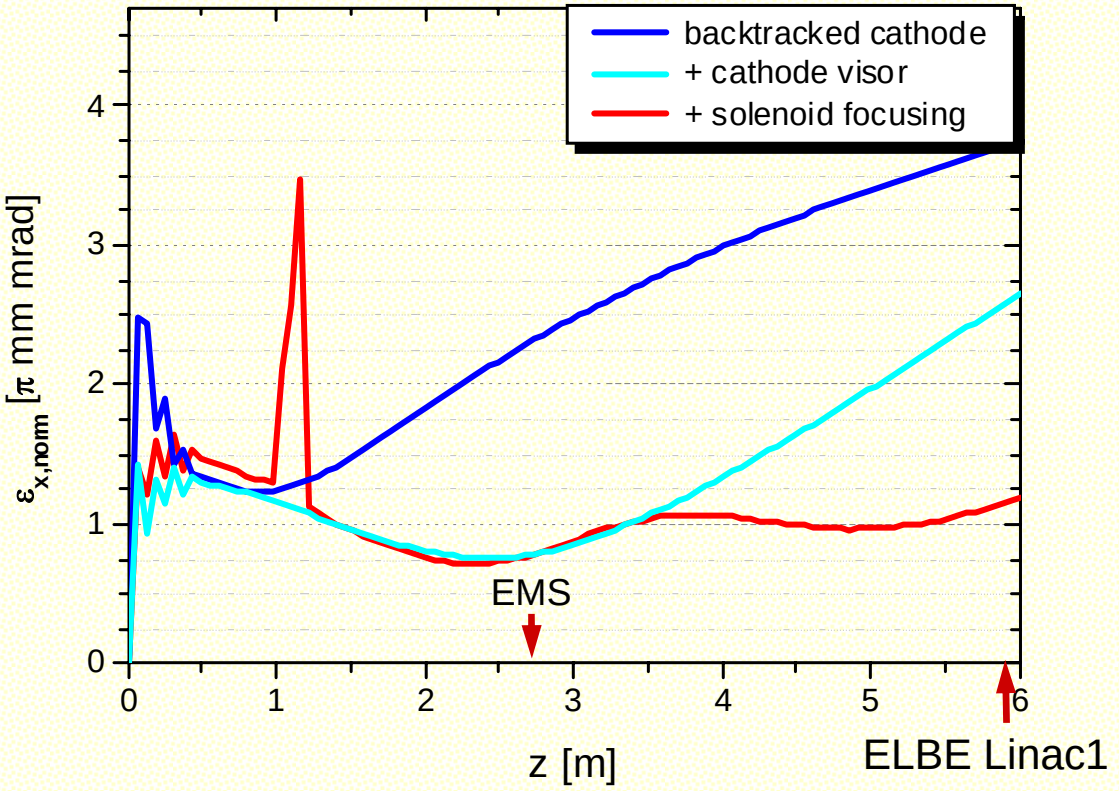
+

solenoid focusing

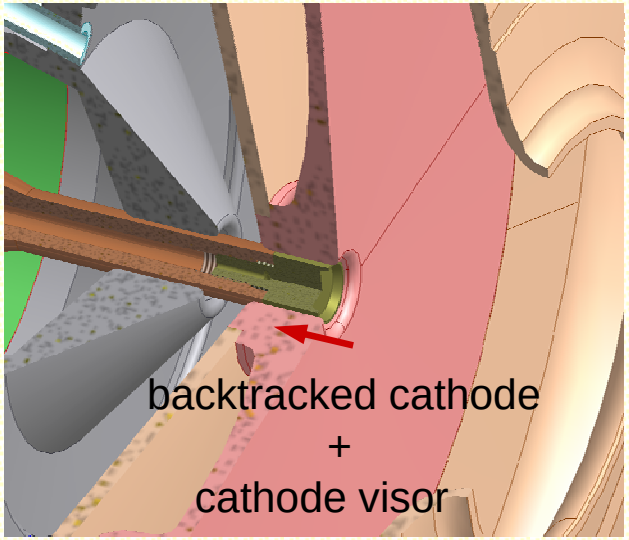


bunch charge : 1 nC
bunch length : 20 ps
σ_x : 1.5 mm

long. emittance :
≈ 70 π keV mm



transverse emittance for high charge operation mode (ASTRA simulation)



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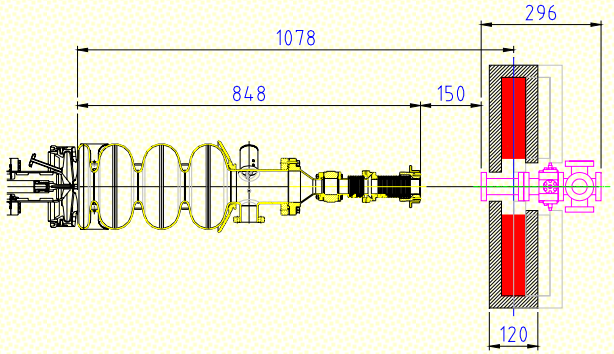
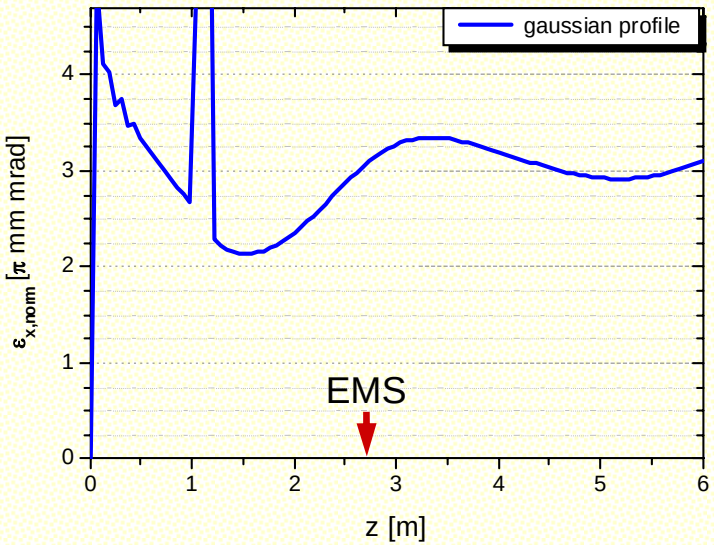
solenoid focusing

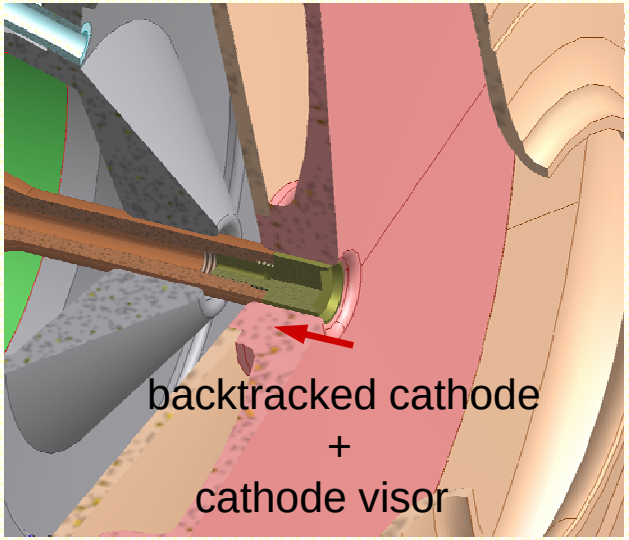


gaussian profile	High Charge
Pulse Frequency	1 MHz
Bunch Charge	1.0 nC
Bunch Length (FWHM)	20 ps
Peak Current	50 A
Average Current	1 mA
Norm trans. Emittance$_N$ (rms)	2.5 µm



long. emittance :
≈ 110 π keV mm

transverse emittance for BESSY-FEL operation mode (ASTRA simulation)



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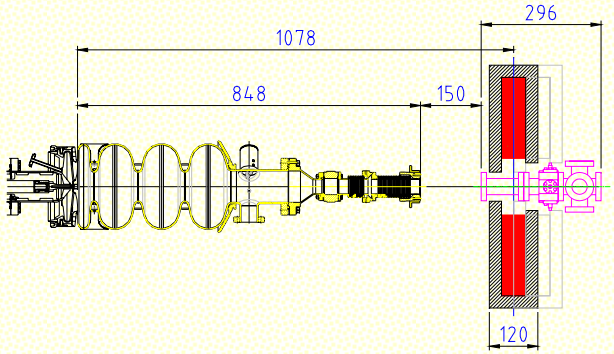
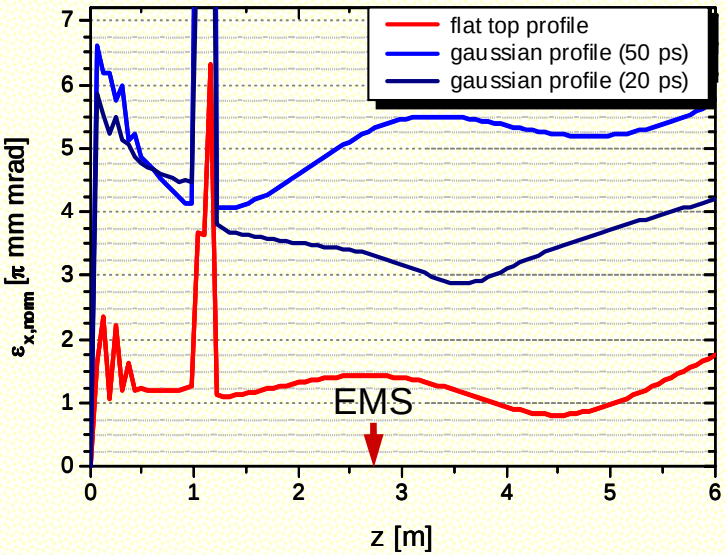
solenoid focusing



gaussian profile	BESSY-FEL
Pulse Frequency	1 kHz
Bunch Charge	2.5 nC
Bunch Length (FWHM)	50 ps
Peak Current	125 A
Average Current	2.5 µA
Norm trans. Emittance$_N$ (rms)	3 µm



long. emittance :
≈ 600 π keV mm (flat top, 50ps)

≈ 2000 π keV mm (gaussian, 50ps)

≈ 300 π keV mm (gaussian, 20ps)

Planned Operation Modes and Beam Parameters

	High Charge	BESSY-FEL
Pulse Frequency	≤1 MHz	1 kHz
Bunch Charge	1 nC	2.5 nC
Bunch Length (FWHM)	20 ps	50/20 ps
Peak Current	50 A	125 A
Average Current	≤1 mA	2.5 µA
Norm trans. Emittance$_N$ (rms)	2.5 µm	3 µm
Flat top Laser Profile	**OK**	**OK** **(50 ps)**
Gaussian Laser Profile	**nearly**	**nearly** **(20 ps)**