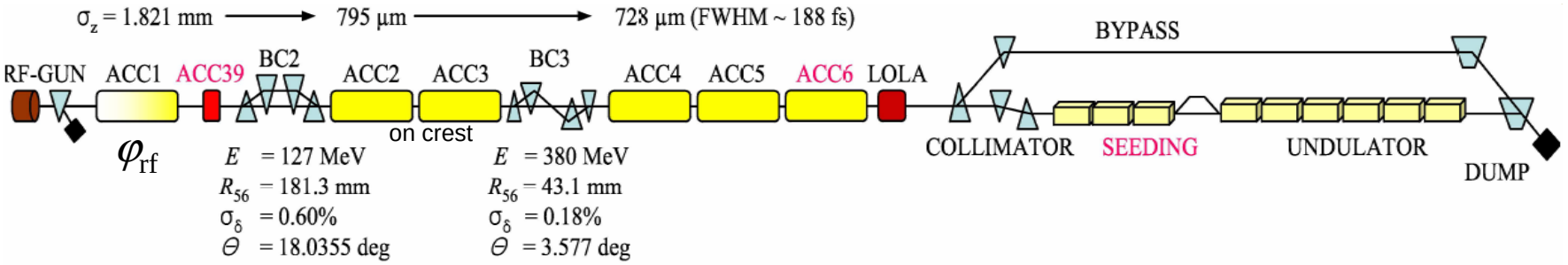
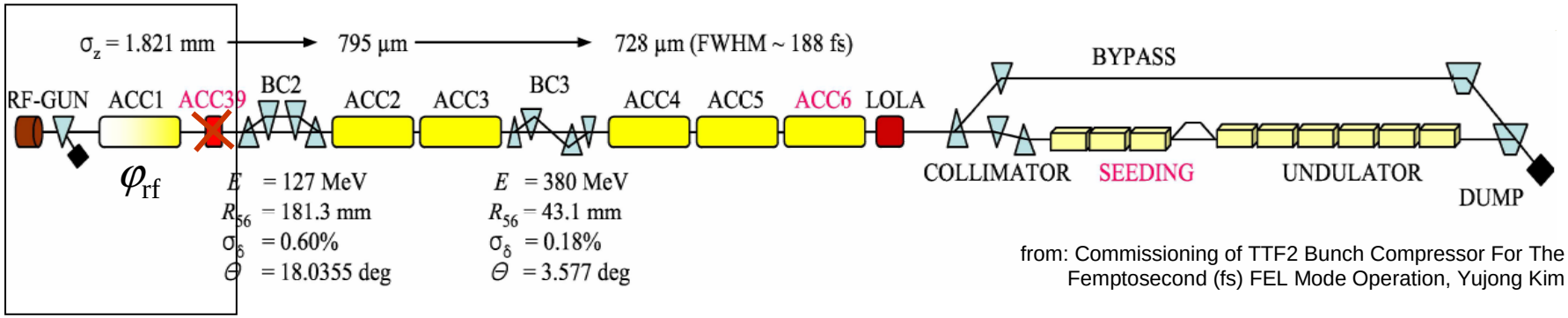
CSR Calculation for TTF2, update



1. different: bunch shape, BC3 geometry
2. CSR “projected”, optics = option 1, φ_{rf} = 7,9 (o1&o2),11,14 deg
3. phase scan: current after BC3
4. conclusion / remarks

1. different: bunch shape



from: Commissioning of TTF2 Bunch Compressor For The Femptosecond (fs) FEL Mode Operation, Yujong Kim

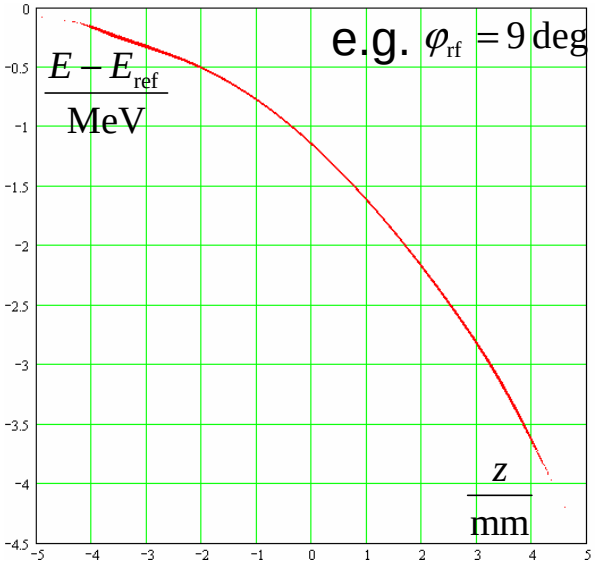
distribution (“parabola shape”)
1nC, 200000 particles

1) ASTRA calculation with different phases in ACC1 (6 .. 15 deg);
tracking to 13.5m (after last cavity, before 1st quadrupole)

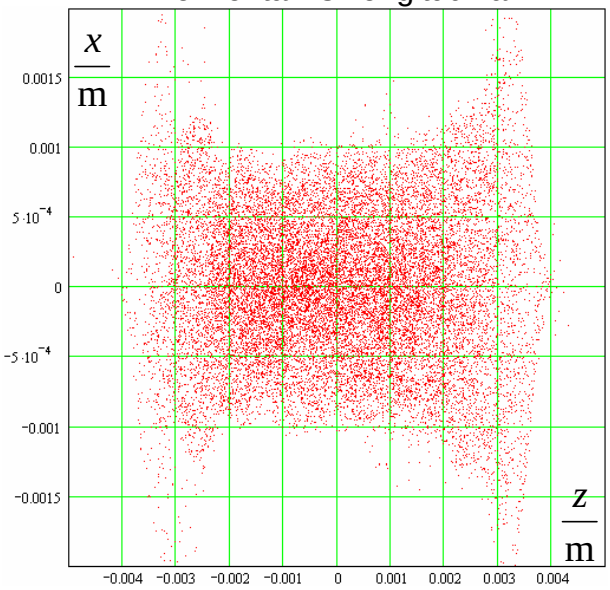
2) calculate Twiss parameters from core of bunch (particles between ±2mm)
use transport matrix for matching to required values at entrance of BC2
(Nina Golubeva)

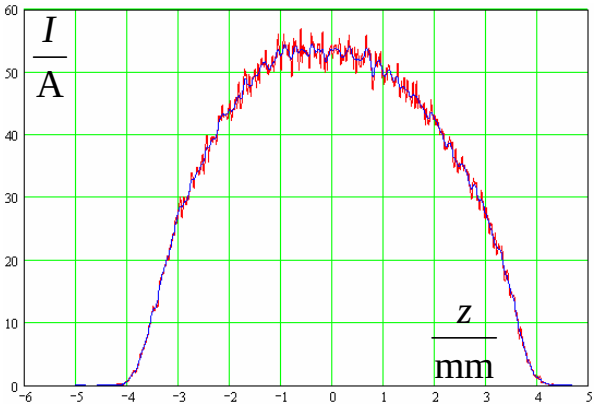
$$\alpha_x = 4.619 \quad \beta_x = 20.174\,\mathrm{m}$$
$$\alpha_y = -0.012 \quad \beta_y = 2.809\,\mathrm{m}$$

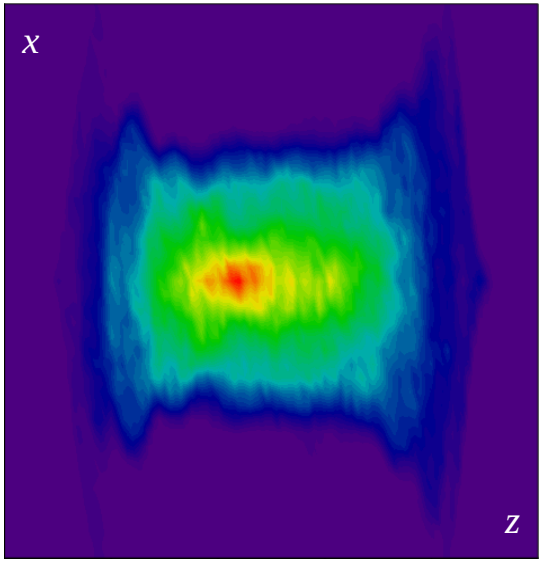
particles at at 13.5m (in ACC1)



horizontal vs. longitudinal

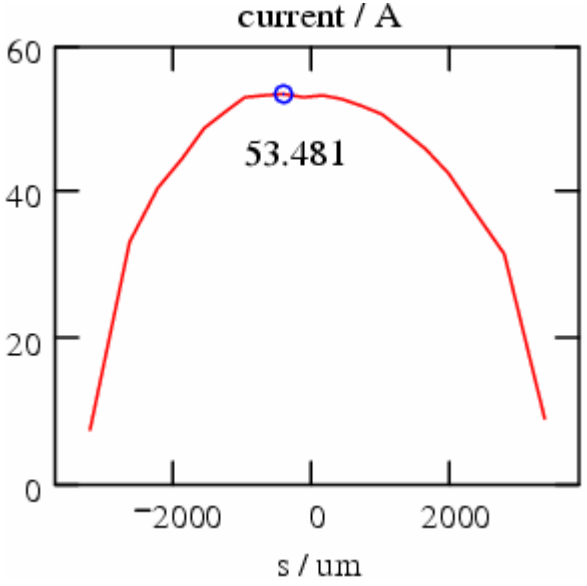


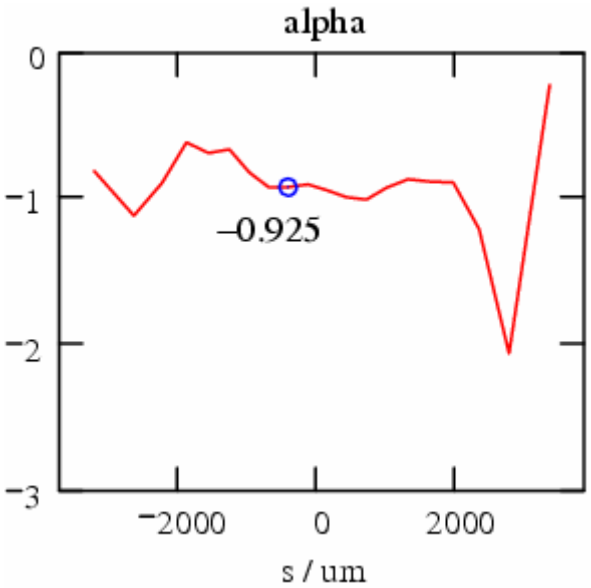


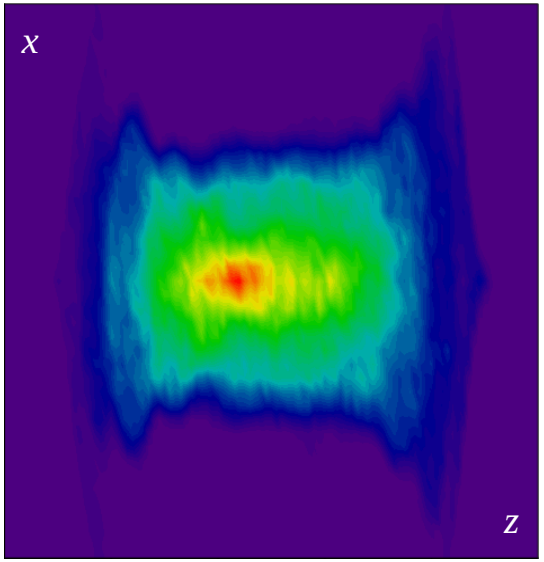


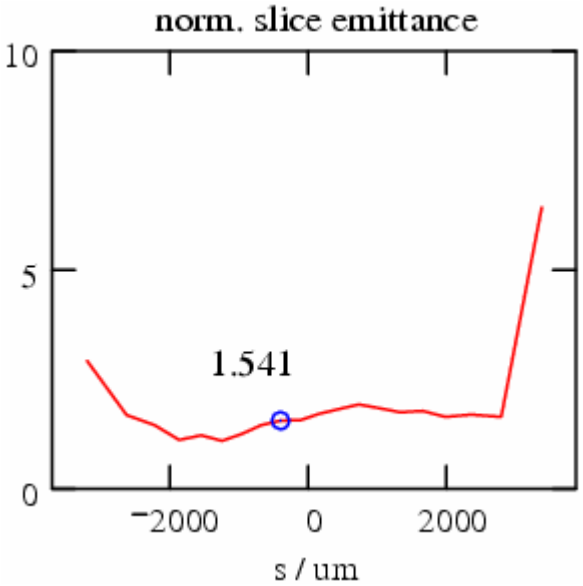
particles at at 13.5m (in ACC1)

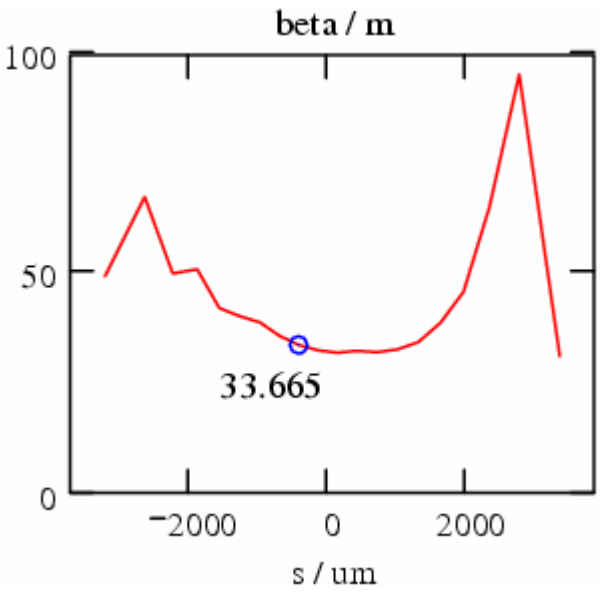
(“slices” with 5000 particles)

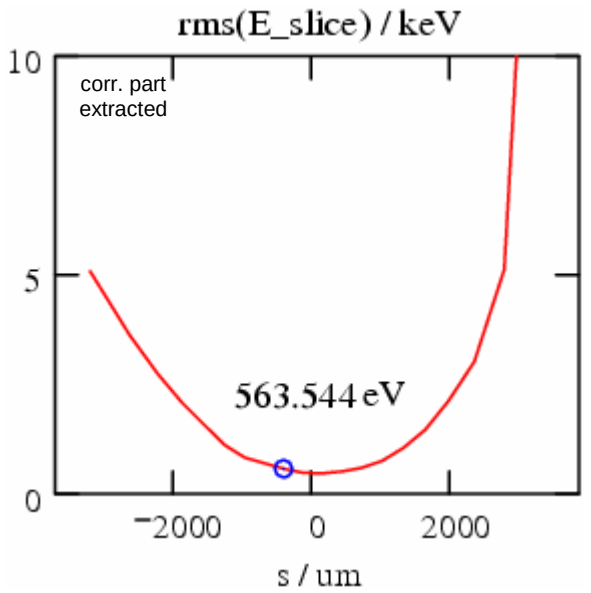






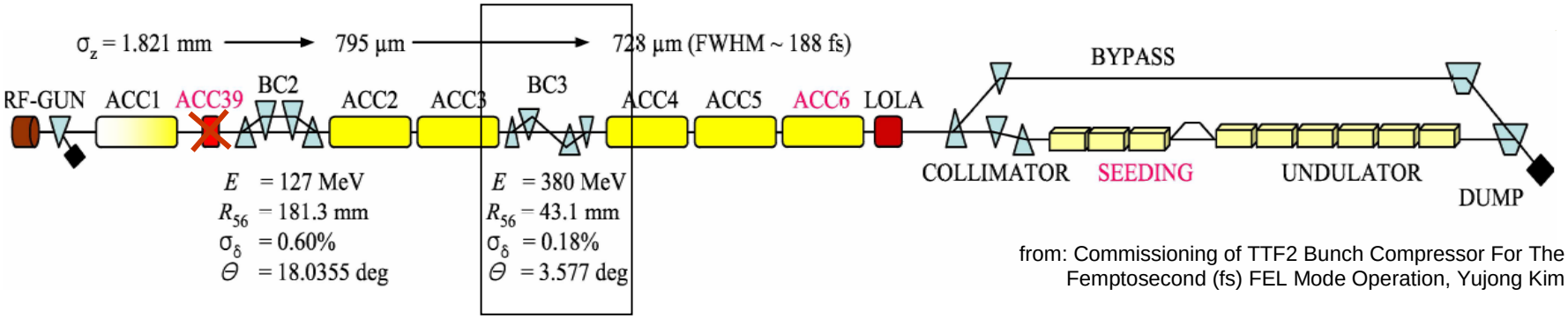






1. different: BC3 geometry

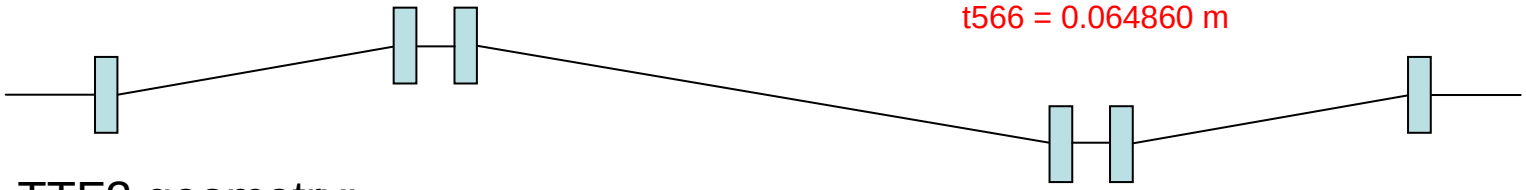
my best wishes to Frank Stulle in Swizerland



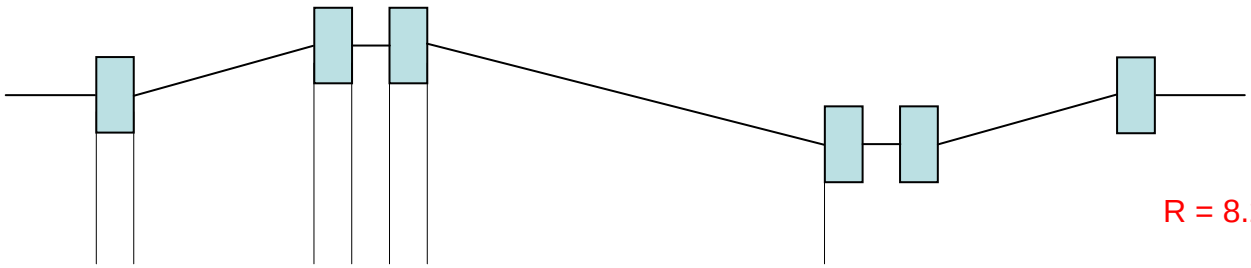
from: Commissioning of TTF2 Bunch Compressor For The Femptosecond (fs) FEL Mode Operation, Yujong Kim

wrong geometry:

R = 5.695 m r56 = -0.041226 m t566 = 0.064860 m



TTF2 geometry:



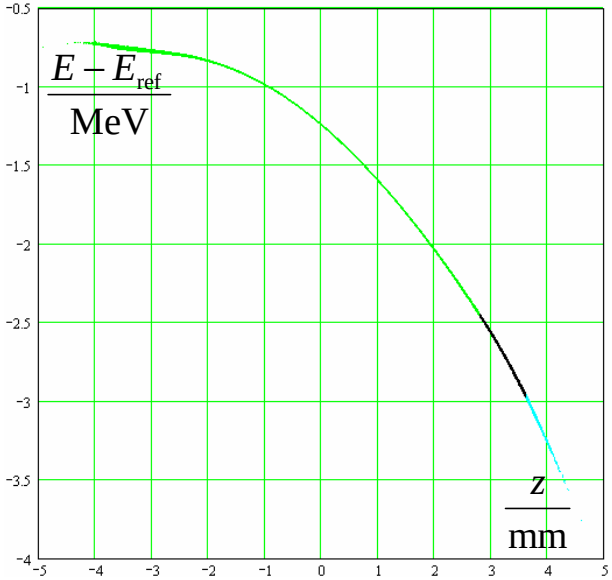
R = 8.2 m r56 = -0.041218 m t566 = 0.062049 m

0.5 2.38 0.5 5.259

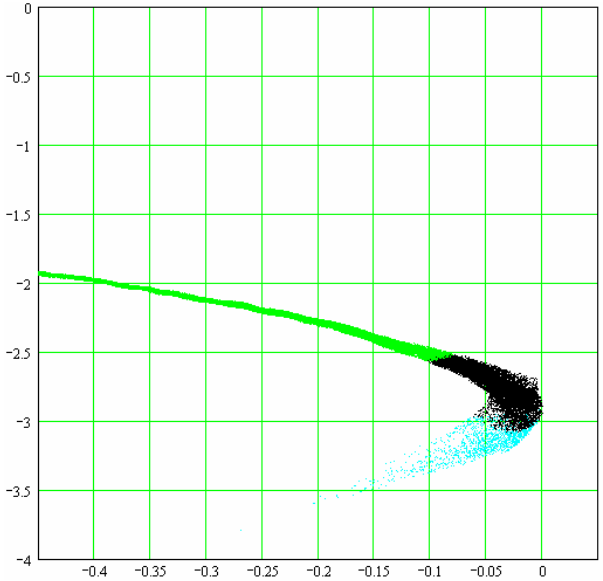
update

2. CSR "projected" optics = option 1 $\varphi_{rf} = 7\,\mathrm{deg}$

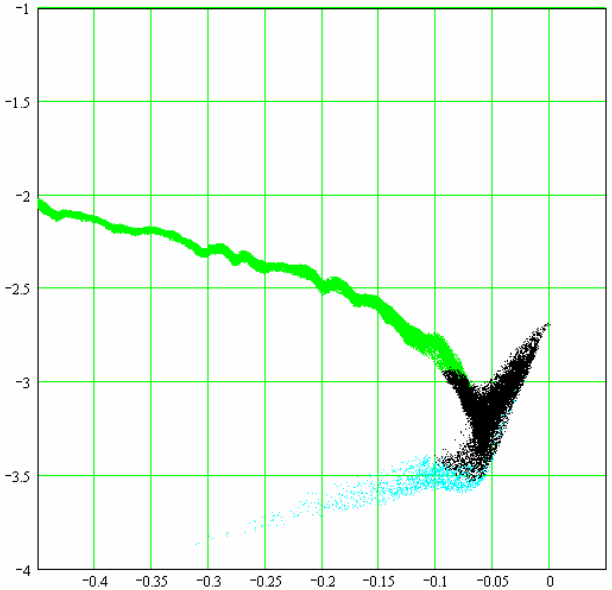
before BC2

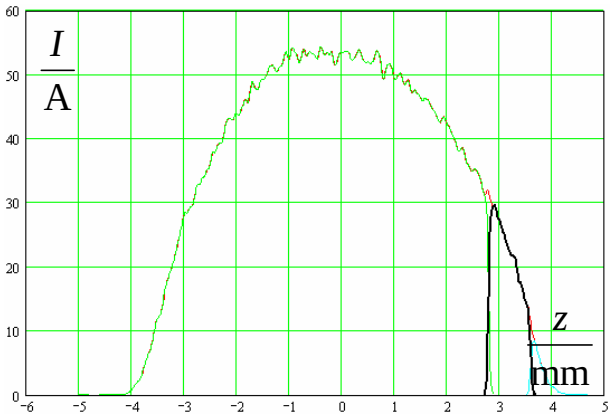


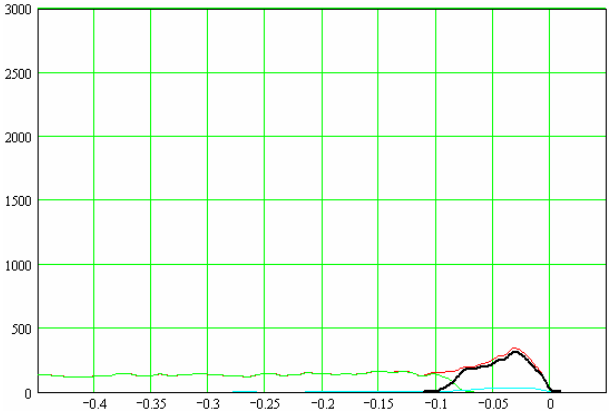
1m after BC2

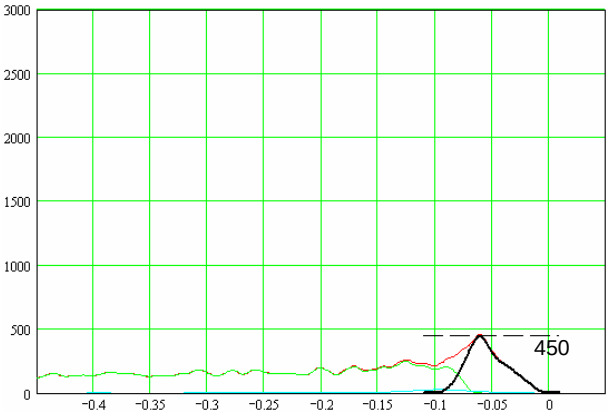


1m after BC3





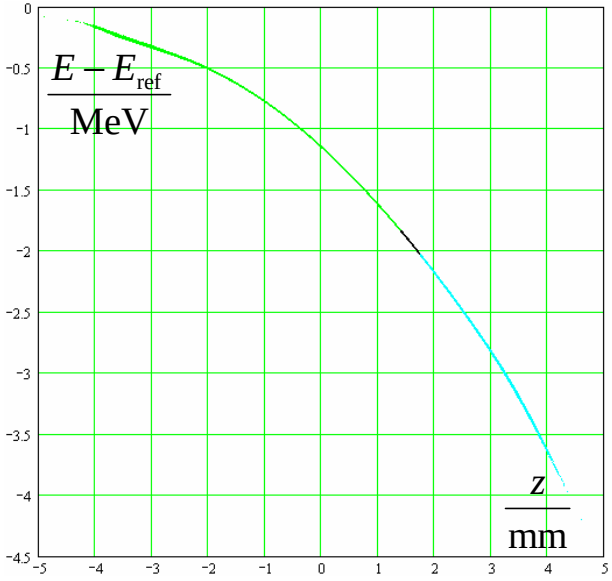




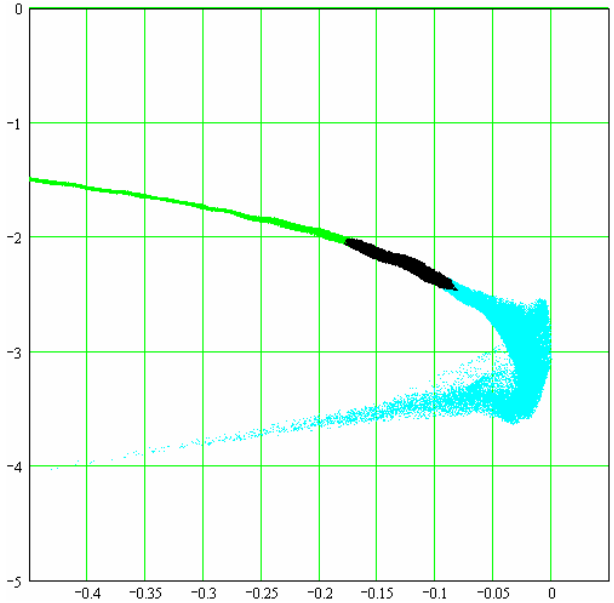
update

CSR “projected” optics = option 1 $\varphi_{rf} = 9\,\mathrm{deg}$

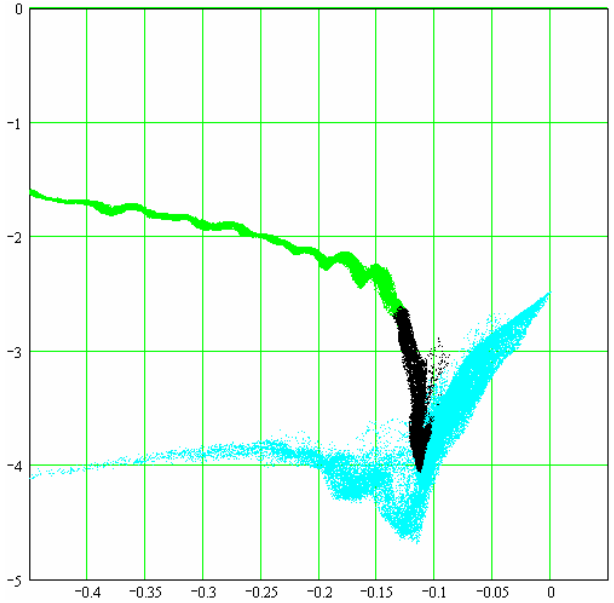
before BC2

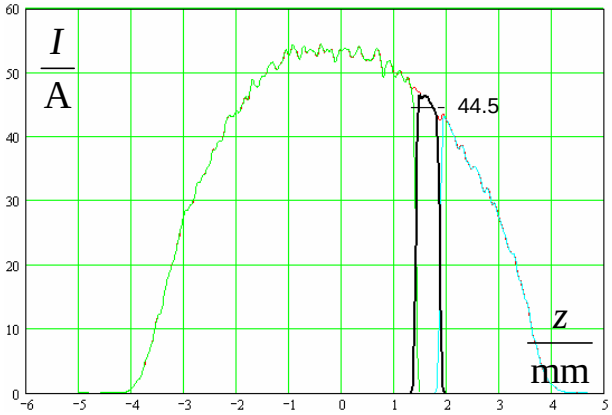


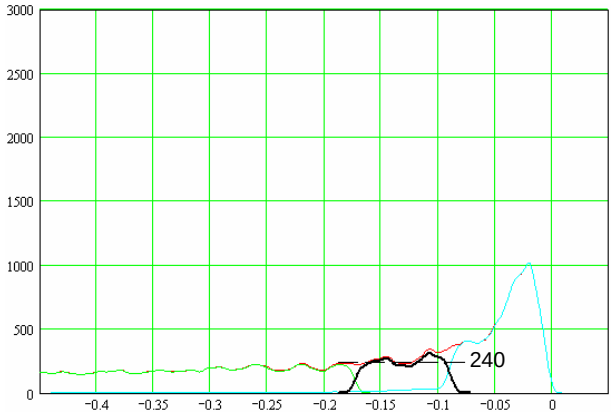
1m after BC2

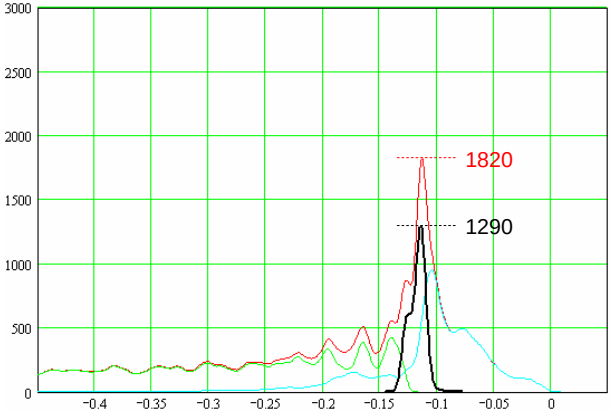


1m after BC3





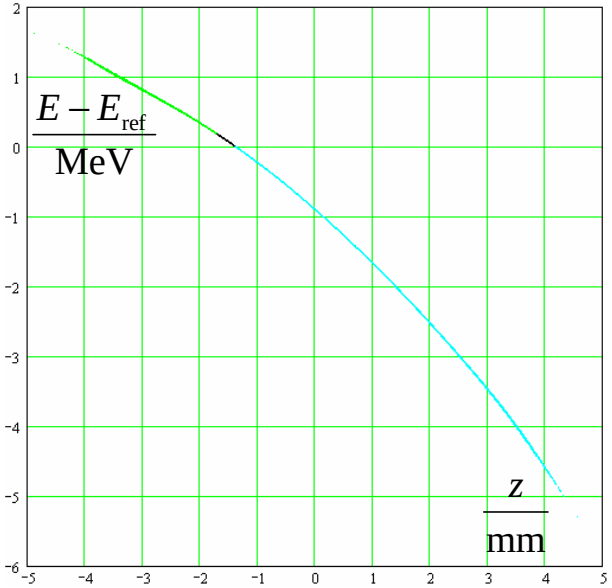




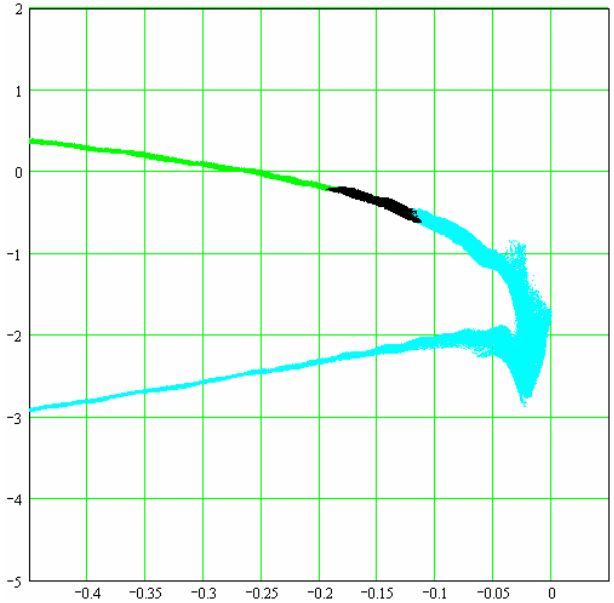
update

CSR “projected” optics = option 1 $\varphi_{rf} = 14\,\mathrm{deg}$

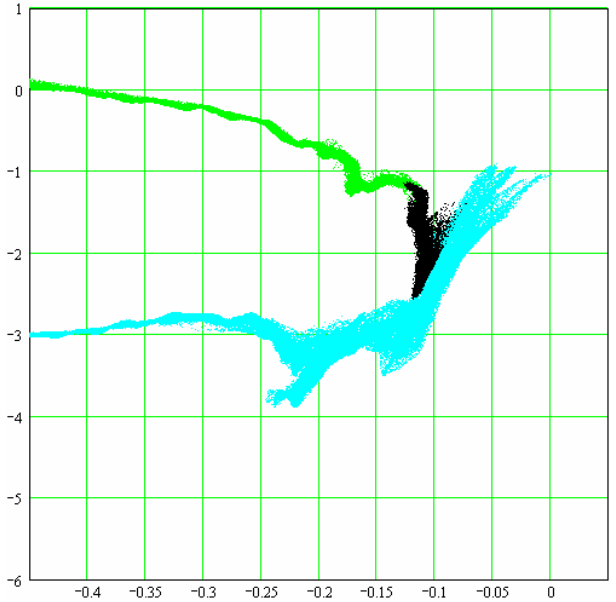
before BC2

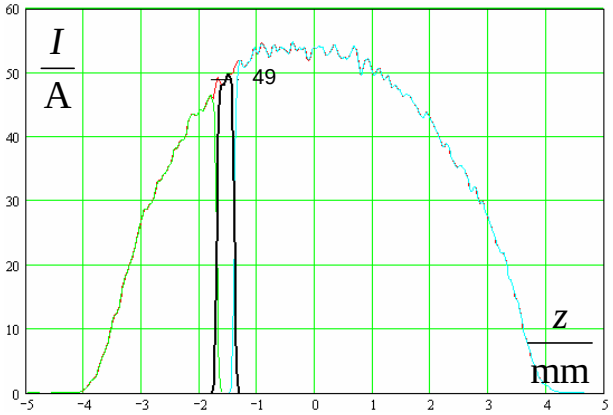


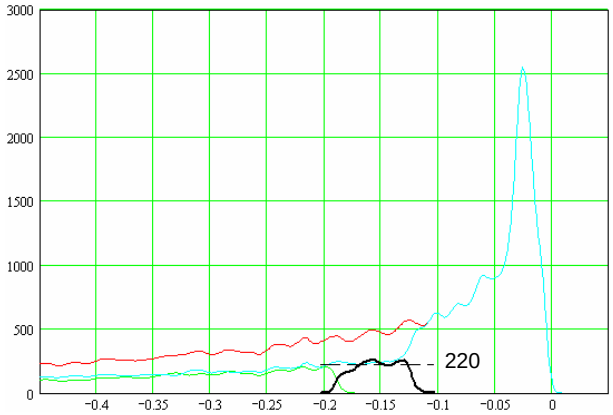
1m after BC2

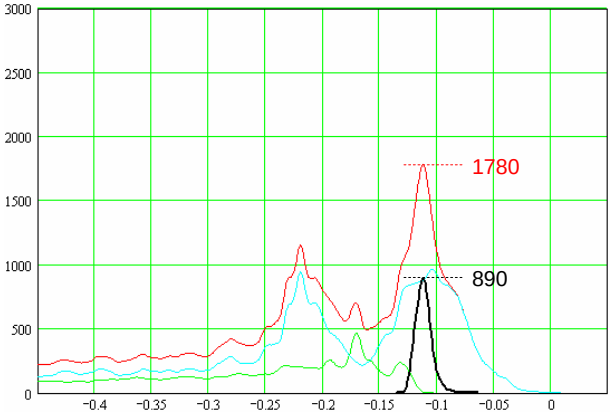


1m after BC3





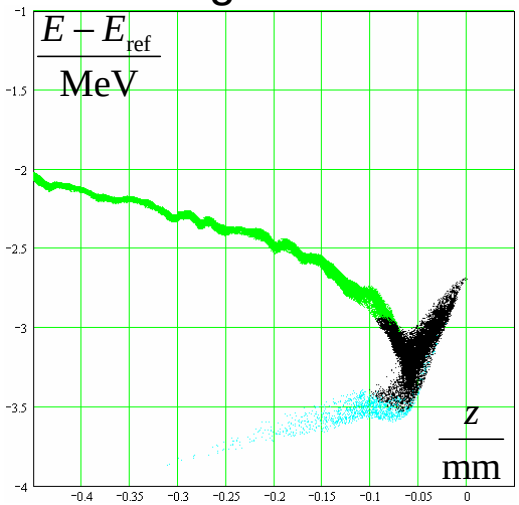




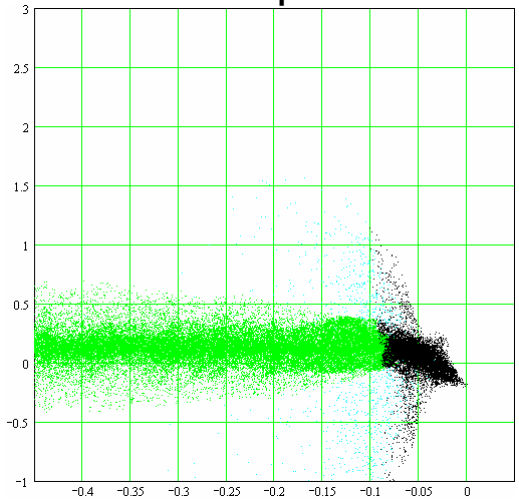
update

CSR “projected” optics = option 1 $\varphi_{rf} = 7\ \mathrm{deg}$

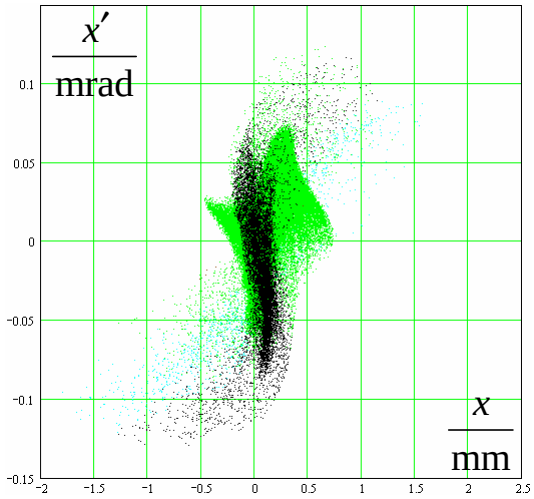
longitudinal

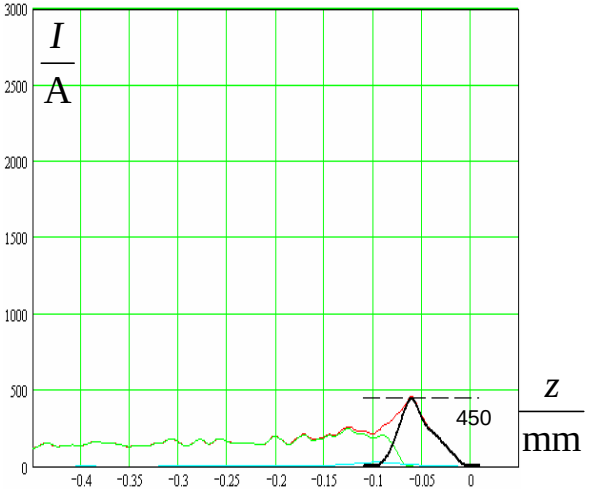


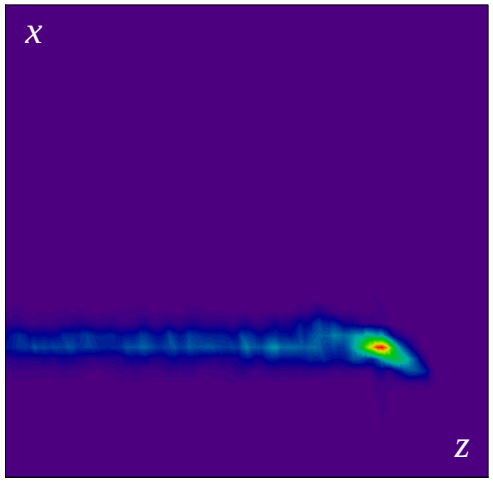
“top”



horizontal







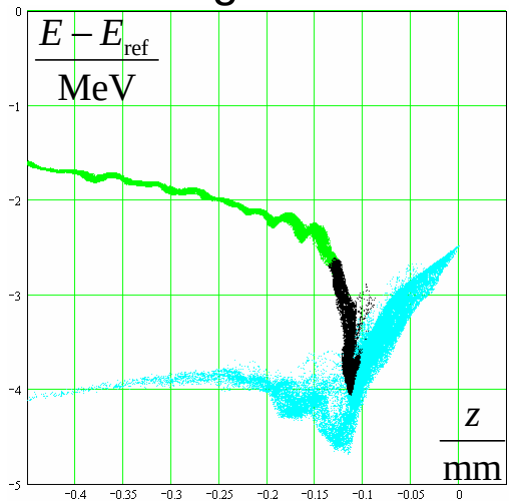
all particles:
emittance/um = 2.4
rms-length/um = 1030
rms-energy spread/keV = 535

“black” particles:
emittance/um = 4.7
rms-length/um = 17.4
rms-energy spread/keV = 145

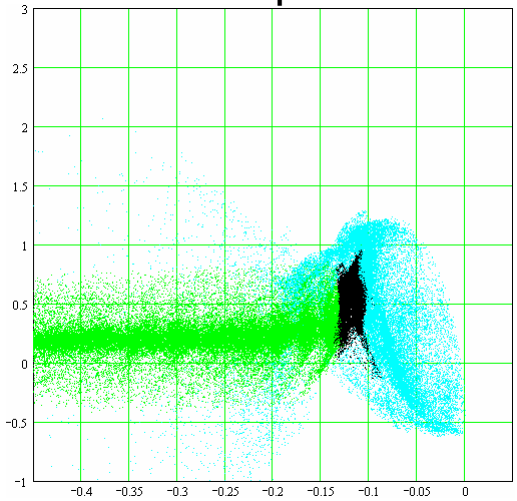
update

CSR “projected” optics = option 1 $\varphi_{rf} = 9\,\mathrm{deg}$

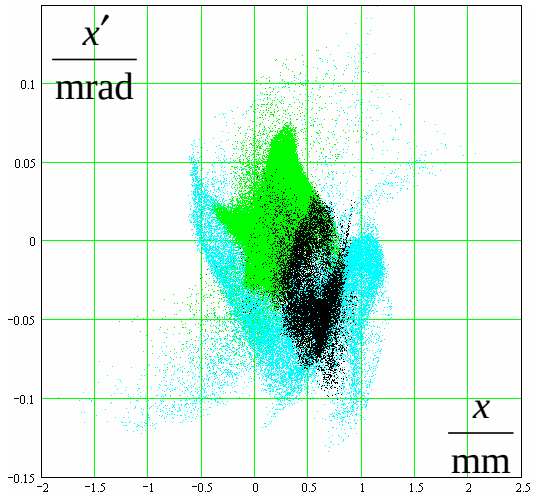
longitudinal

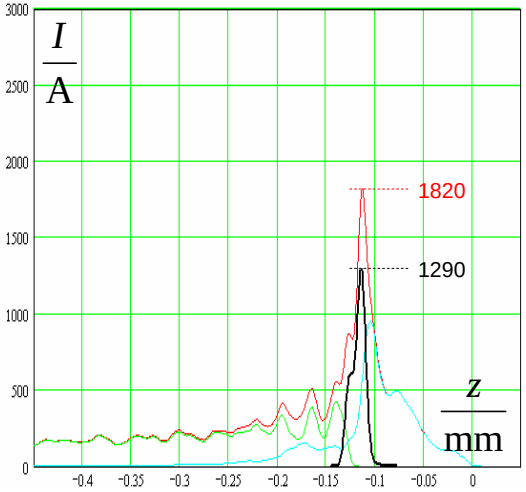


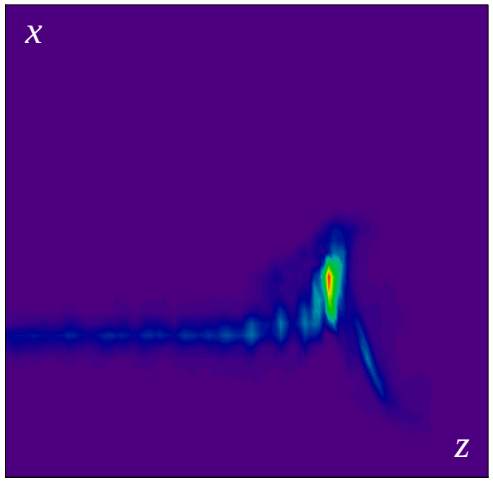
“top”



horizontal







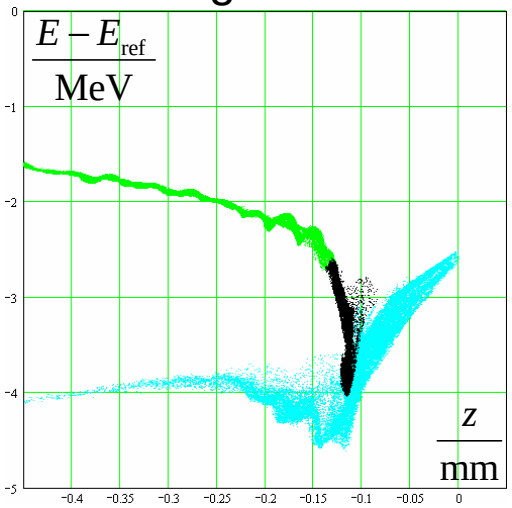
all particles:
emittance/um = 6.3
rms-length/um = 693
rms-energy spread/keV = 1030

“black” particles:
emittance/um = 3.1
rms-length/um = 6.7
rms-energy spread/keV = 412

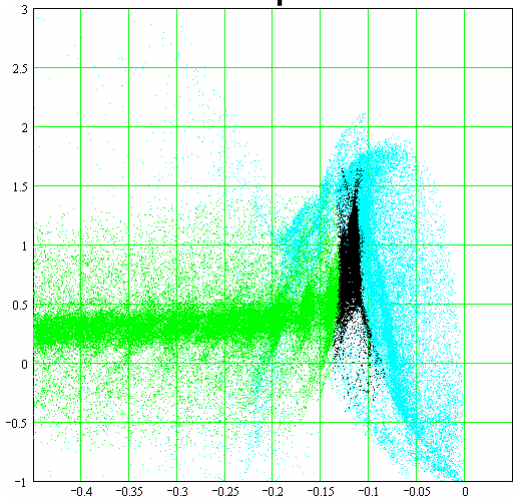
update

CSR “projected” optics = option 2 $\varphi_{rf} = 9\,\mathrm{deg}$

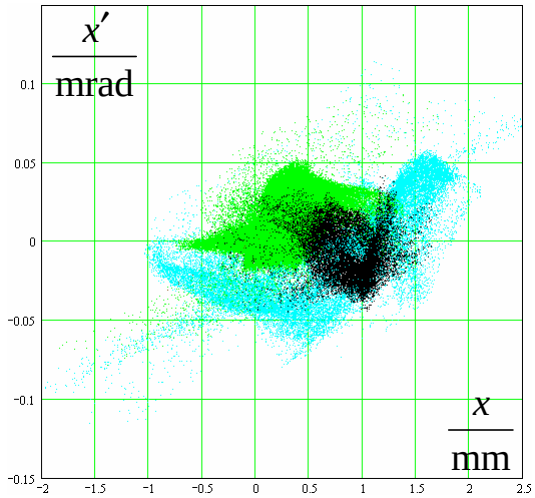
longitudinal

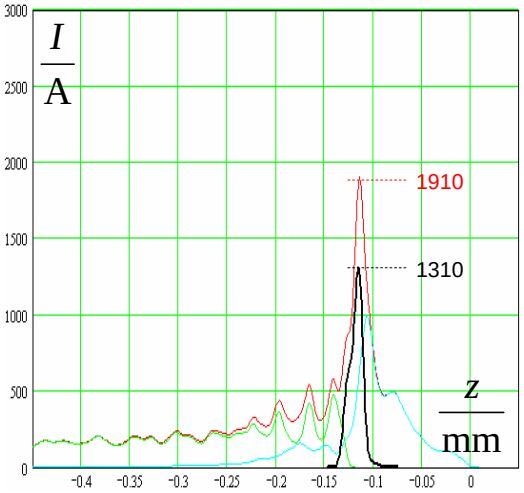


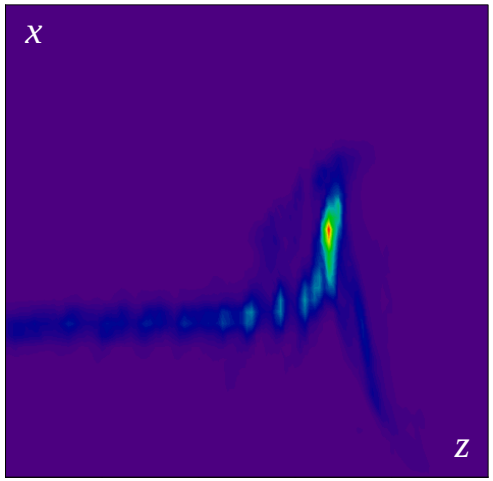
“top”



horizontal







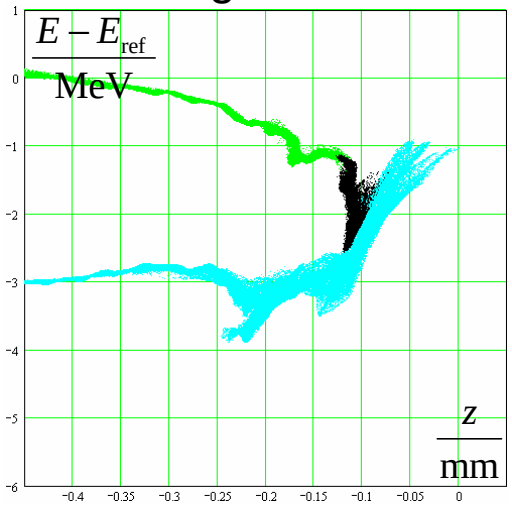
all particles:
emittance/um = 6.2
rms-length/um = 693
rms-energy spread/keV = 1020

“black” particles:
emittance/um = 3.1
rms-length/um = 6.5
rms-energy spread/keV = 415

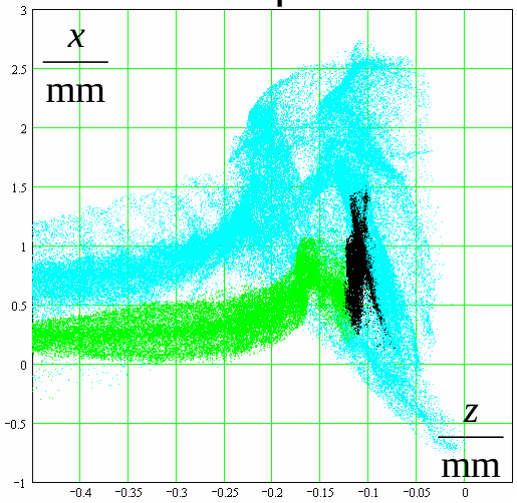
update

CSR “projected” optics = option 1 $\varphi_{rf} = 14\,\mathrm{deg}$

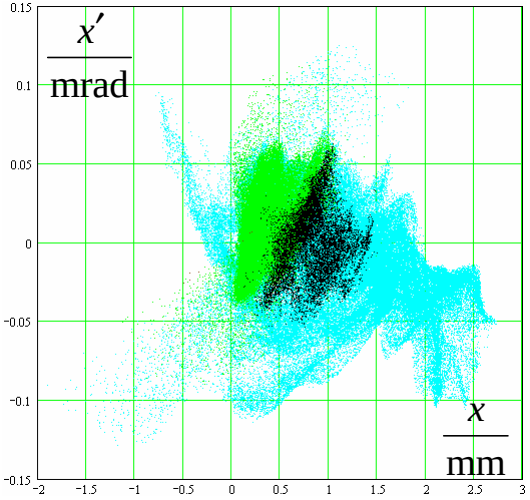
longitudinal

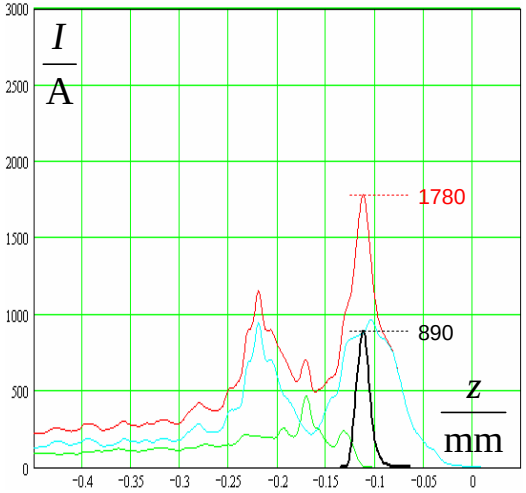


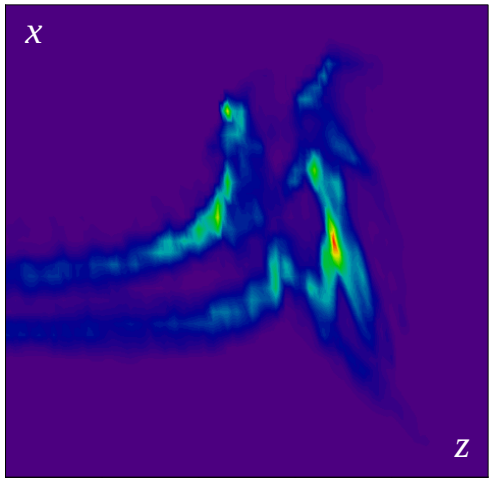
“top”



horizontal





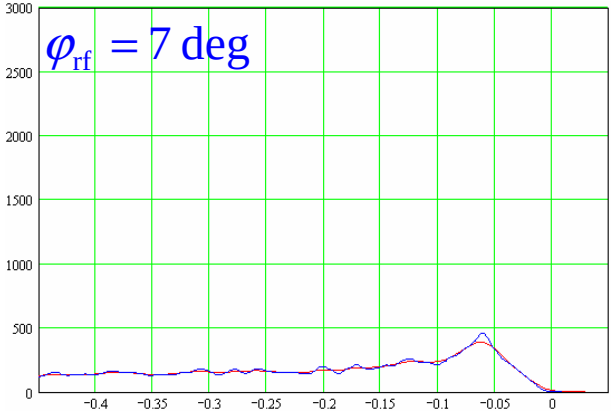


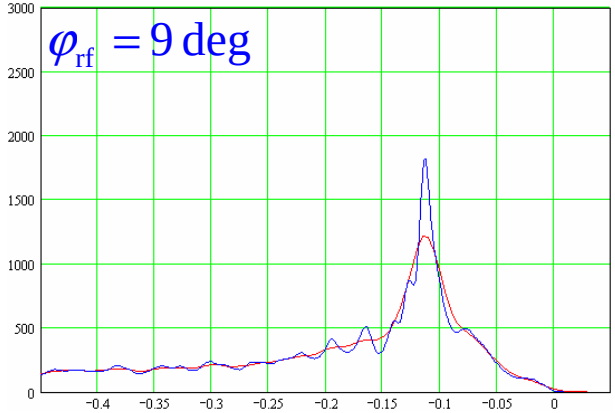
all particles:
emittance/um = 13.8
rms-length/um = 326
rms-energy spread/keV = 1230

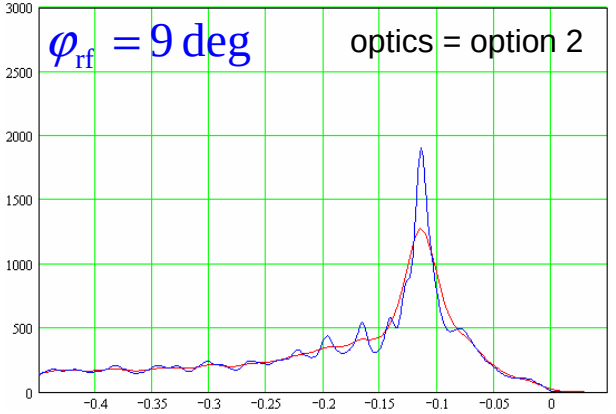
“black” particles:
emittance/um = 3.6
rms-length/um = 6.6
rms-energy spread/keV = 345

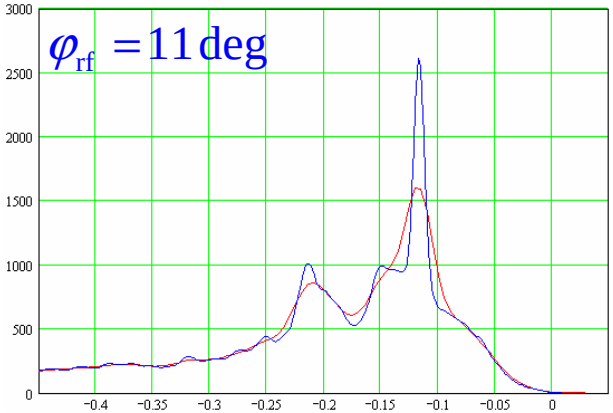
update

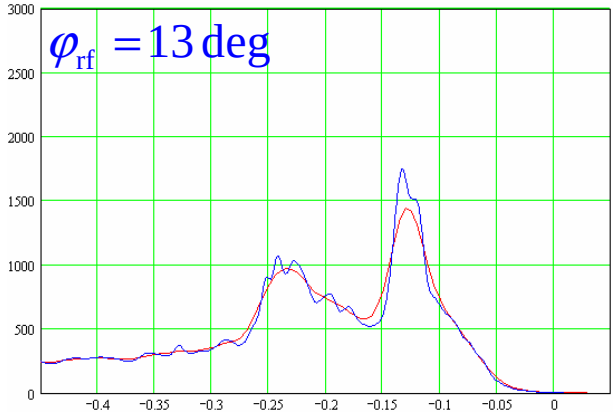
3. phase scan: current after BC3

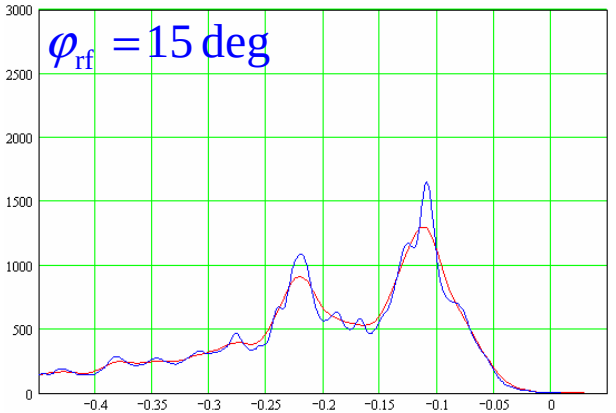












update

4. conclusion / remarks

	$\varphi_{rf} = 7\,\mathrm{deg}$	$\varphi_{rf} = 9\,\mathrm{deg}$ option 1	$\varphi_{rf} = 9\,\mathrm{deg}$ option 2	$\varphi_{rf} = 14\,\mathrm{deg}$
all particles:				
peak current /A	= 450	1820	1910	1780
emittance/um	= 2.4	6.3	6.2	13.8
rms-length/um	= 1030	693	693	326
rms-energy spread/keV	= 535	1030	1020	1230
“black” particles:				
peak current /A	= 450	1290	1310	890
emittance/um	= 4.7	3.1	3.1	3.6
rms-length/um	= 17.4	6.7	6.5	6.6
rms-energy spread/keV	= 145	412	415	345

1. calculation for 1nC parabolic shape and correct BC3 geometry
2. different: similar behavior for both optic options for φ_{rf} = 9deg

- ASTRA space charge calculations in preparation
- improved current filter needed (sc-instability !!)

update