Q=1.0 nC

e-beam

RF-GUN ACC1 ACC2 ACC3 ACC4 ACC39 BC1 BC2

20 MV/m
-2.773 deg

13.65 MV/m
22.22 MV/m
-25.0 deg

20.22 MV/m
-24.3 deg

32.5 MV/m
160.6 deg

$E = 511$ MeV
$\sigma_\delta \sim 1.88\%$
$R_{56} = 100.7$ mm
$\theta = 4.25$ deg

$E = 511$ MeV
$\sigma_\delta \sim 1.87\%$
$R_{56} = 4.8$ mm
$\theta = 0.93$ deg

ASTRA
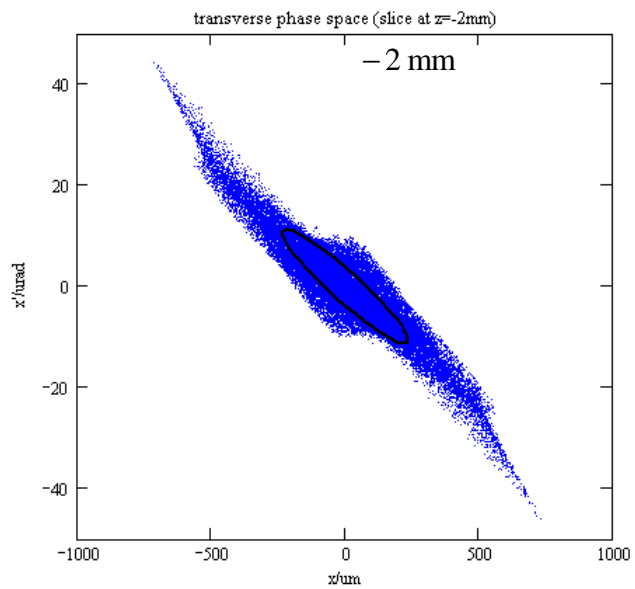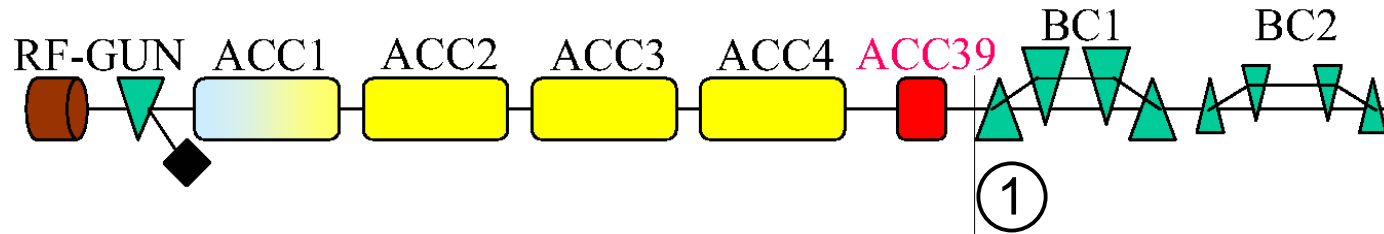(space charge)

ELEGANT
(geom. Wakes, CSR)

CSR-Track

① ② ③ ④

1 entrance of BC1 ASTRA/ELEGANT calculation with 200000 particles by Y.Kim
2 exit of BC 1
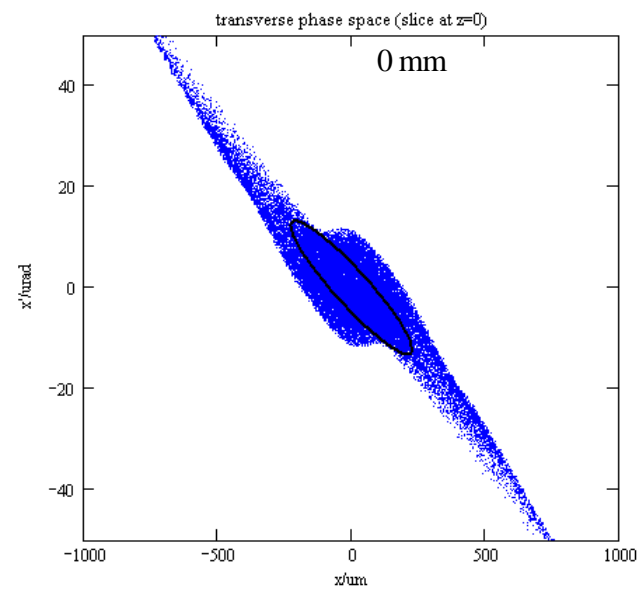3 entrance of BC2 ASTRA/ELEGANT calculation with 200000 particles by Y.Kim
4 exit of BC2

Martin Dohlus   double bc jan 2004

RF-GUN ACC1 ACC2 ACC3 ACC4 ACC39 BC1 BC2

①

transverse phase space (slice at z=-2mm)

$-2\,\mathrm{mm}$

x'/hrad
x/um

transverse phase space (slice at z=0)

$0\,\mathrm{mm}$

x'/hrad
x/um

transverse phase space (slice at z=2mm)

$2\,\mathrm{mm}$

x'/hrad
x/um

$\gamma_E \varepsilon = 0.94 \cdot 10^{-6}\ \mathrm{m \cdot rad}$

$\alpha = 2.73\ \mathrm{m^{-1}}$

$\beta = 60.37\ \mathrm{m}$

$\gamma = 0.139$

$\gamma_E \varepsilon = 1.12 \cdot 10^{-6}\ \mathrm{m \cdot rad}$

$\alpha = 2.5\ \mathrm{m^{-1}}$

$\beta = 46.6\ \mathrm{m}$

$\gamma = 0.156$
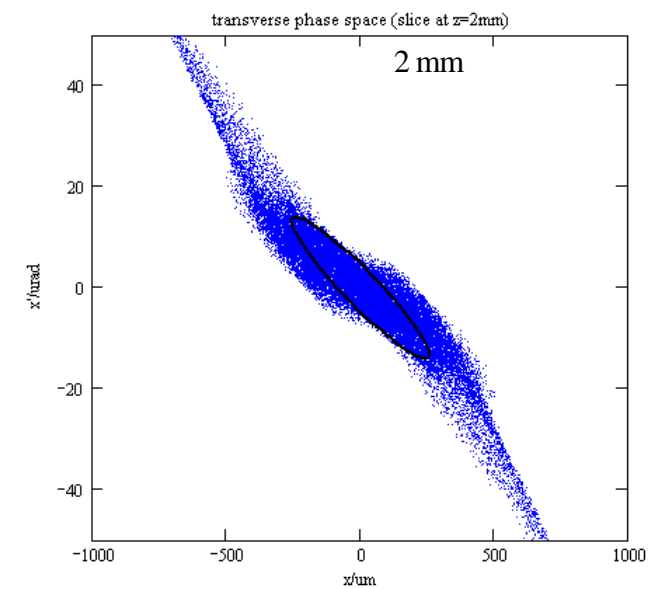
$\gamma_E \varepsilon = 1.26 \cdot 10^{-6}\ \mathrm{m \cdot rad}$

$\alpha = 2.66\ \mathrm{m^{-1}}$

$\beta = 52.53\ \mathrm{m}$

$\gamma = 0.154$

Martin Dohlus   double bc jan 2004

emittance * 10E9 — BC1 entrance

alpha * m — BC1 entrance

beta / m — BC1 entrance

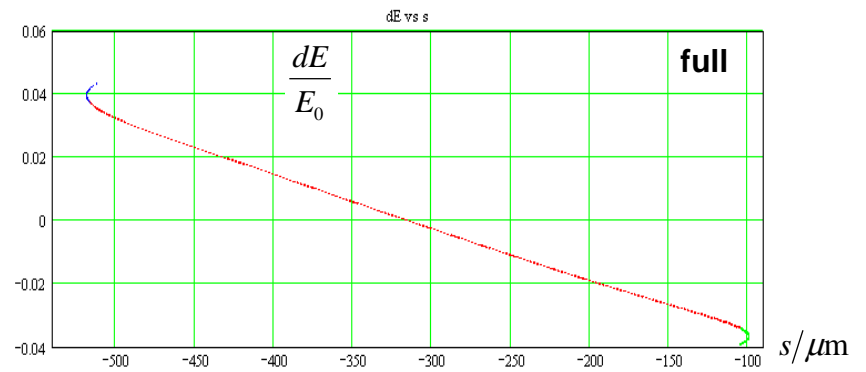$$\frac{\langle dE \rangle_z}{E_0}$$

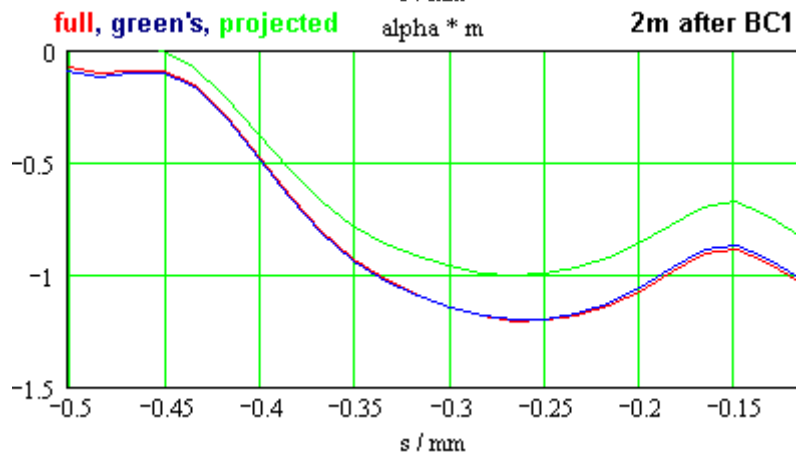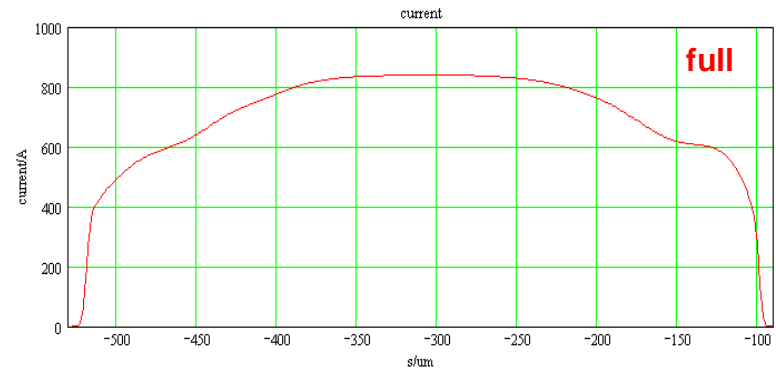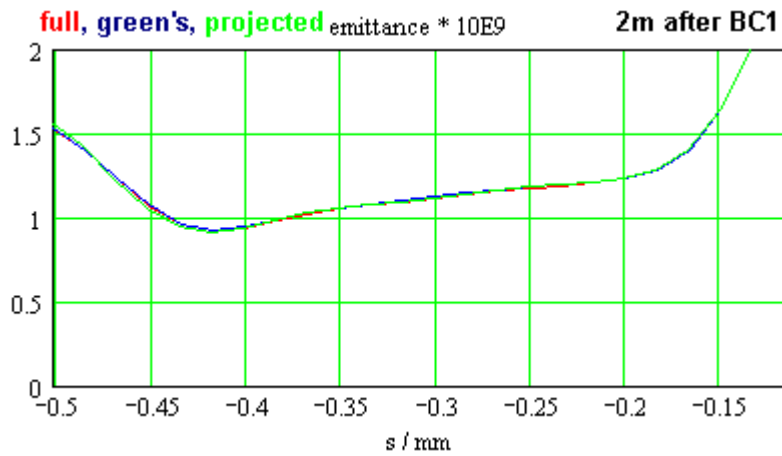**Martin Dohlus double bc** jan 2004
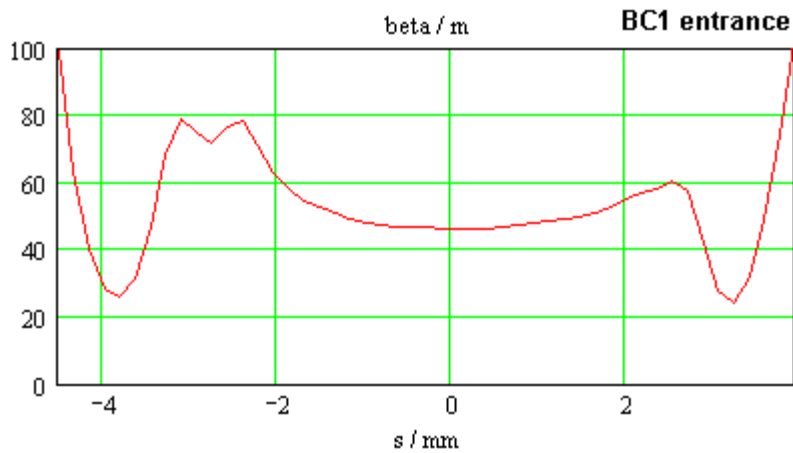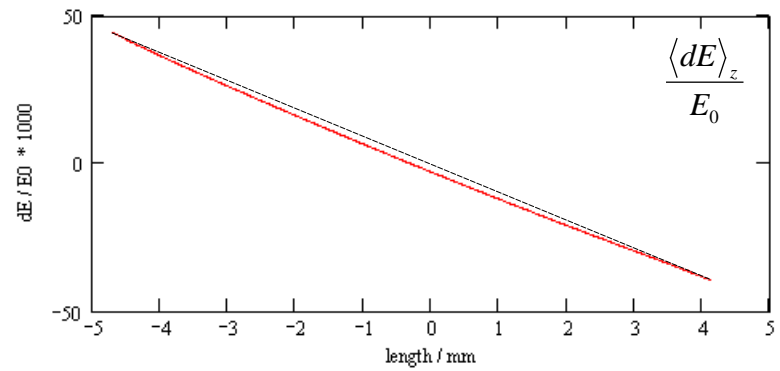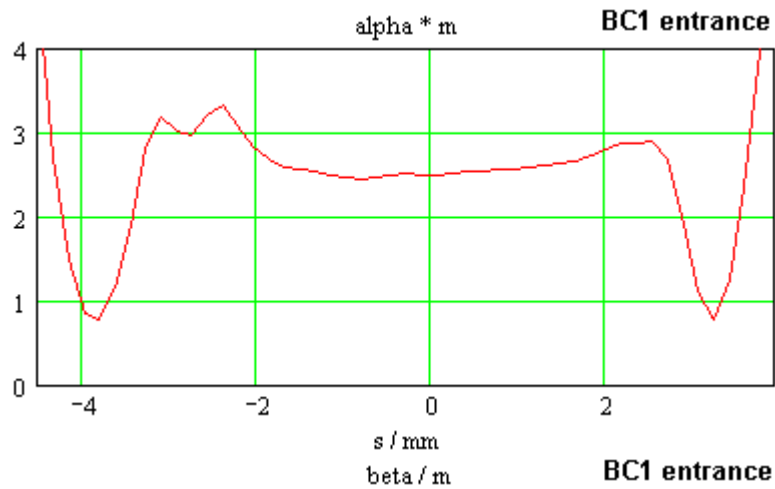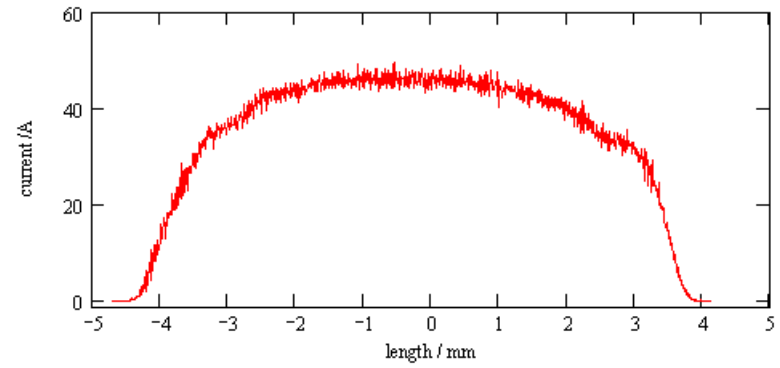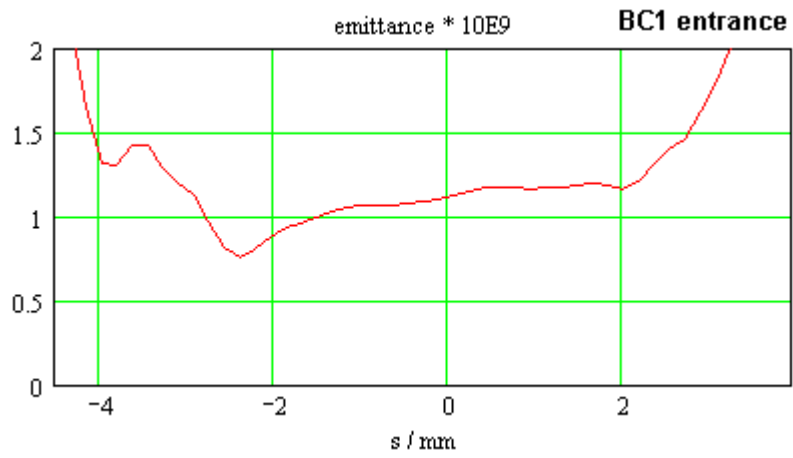
BC1: ELEGANT-distribution → CSRTrack-distribution

a) longitudinal, equidistant z-mesh, **no uncorrelated energy spread !**
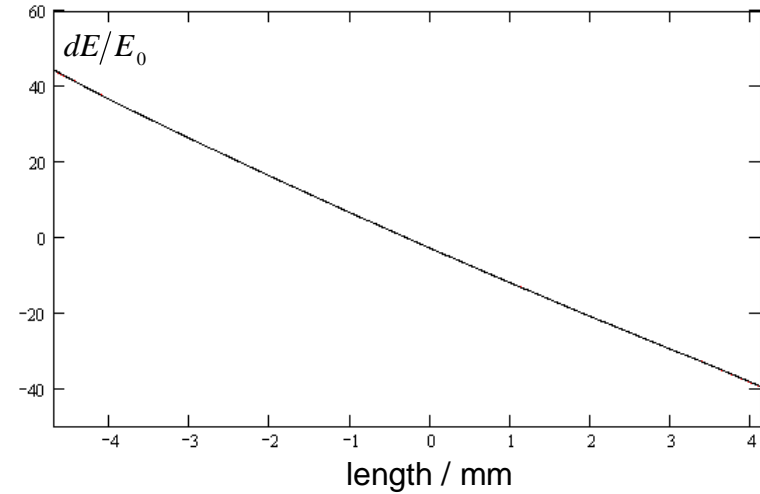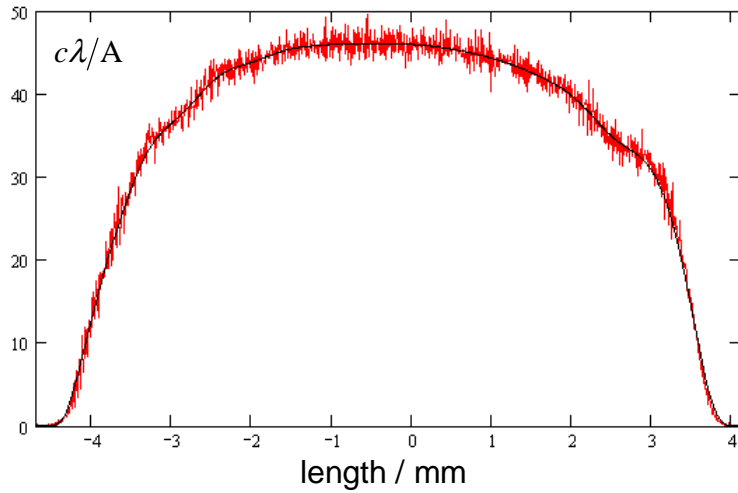
b) transverse, gaussian, equidistant mesh
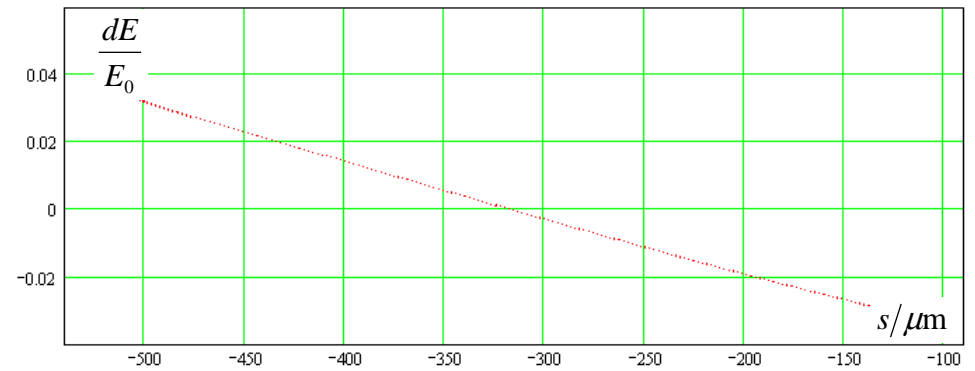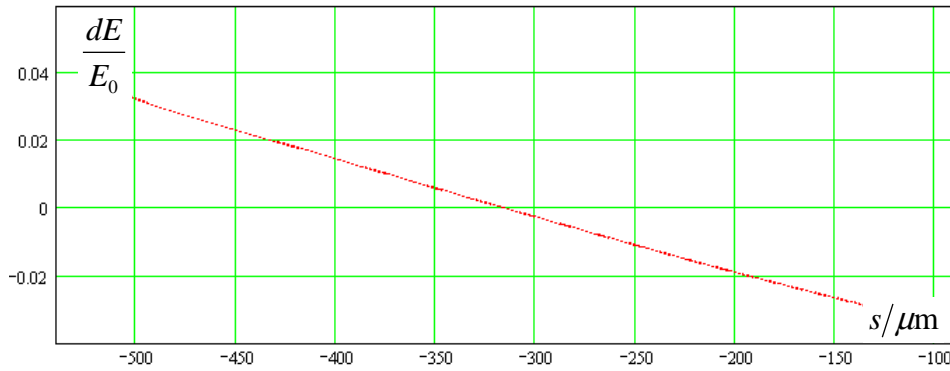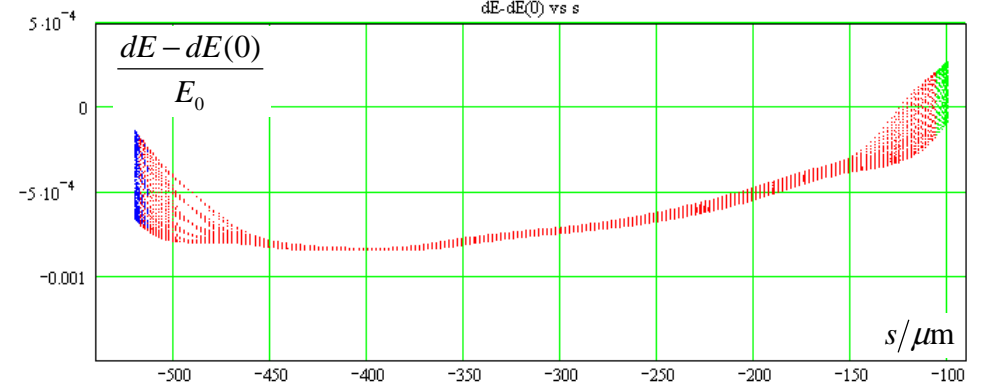   37 particles/slice, 219 slices
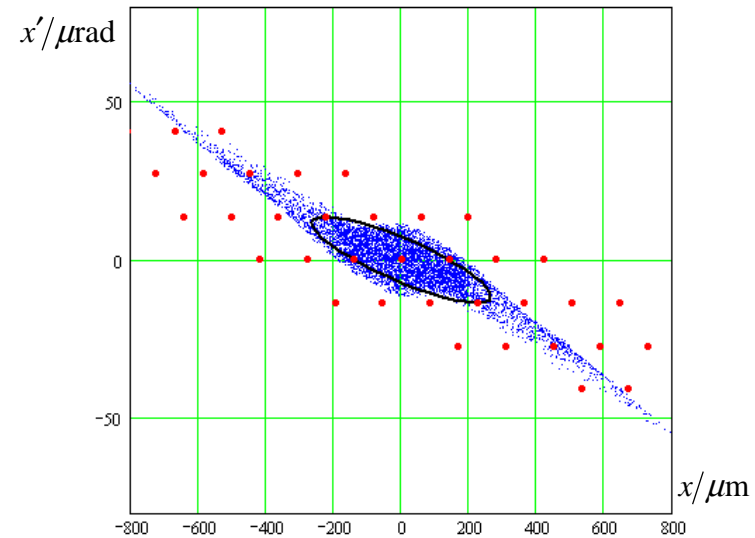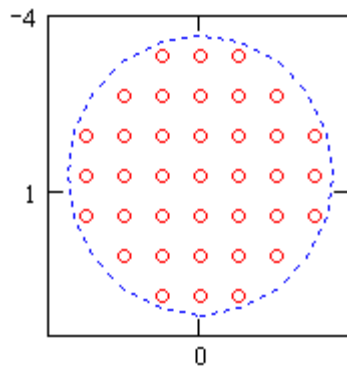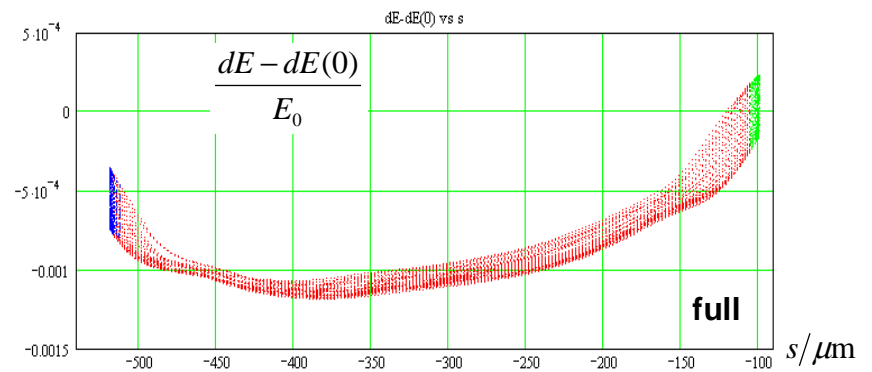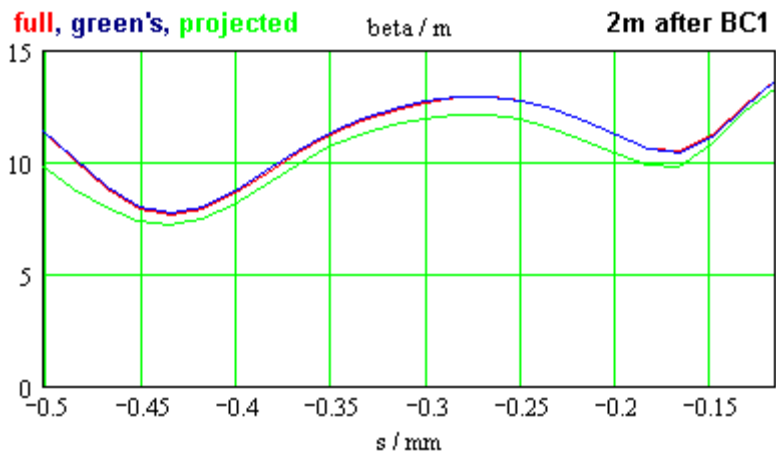
Martin Dohlus   double bc jan 2004

full, green's, projected emittance * 10E9   2m after BC1

current — **full**

full, green's, projected alpha * m   2m after BC1

$$\frac{dE}{E_0}$$ **full**

full, green's, projected beta / m   2m after BC1

$$\frac{dE - dE(0)}{E_0}$$ **full**

Martin Dohlus double bc jan 2004

2m after BC1

full

dE vs s

$$\frac{dE}{E_0}$$

s/μm

dE-dE(0) vs s

$$\frac{dE - dE(0)}{E_0}$$

s/μm

rms(dE-E0) vs s

$$\frac{\text{rms}\{dE - dE(0)\}}{E_0}$$

s/μm

projected

dE vs s

$$\frac{dE}{E_0}$$

s/μm

dE-dE(0) vs s

$$\frac{dE - dE(0)}{E_0}$$

s/μm

rms(dE-E0) vs s

$$\frac{\text{rms}\{dE - dE(0)\}}{E_0}$$

s/μm

Martin Dohlus   double bc jan 2004
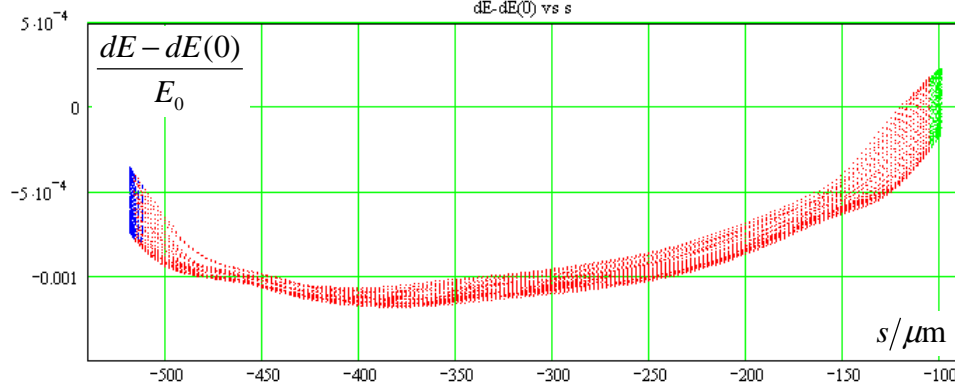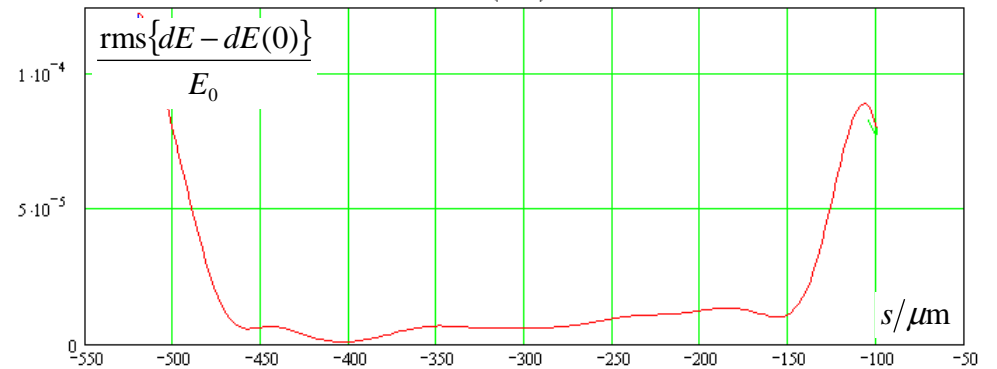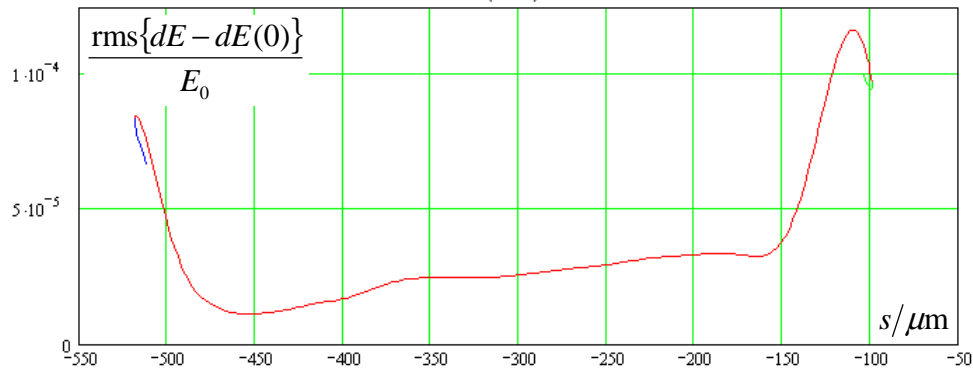
2m after BC1, analysis of "initial" slices

═══ full   - - - - projected

current / A

≈ 370 μm

alpha * m

emittance

beta / m

Martin Dohlus   double bc jan 2004

RF-GUN ACC1 ACC2 ACC3 ACC4 ACC39 BC1 BC2

③

transverse phase space (z=-0.57mm)

-0.57 mm

transverse phase space (z=-0.47mm)

-0.47 mm

transverse phase space (z=-0.37mm)

-0.37 mm
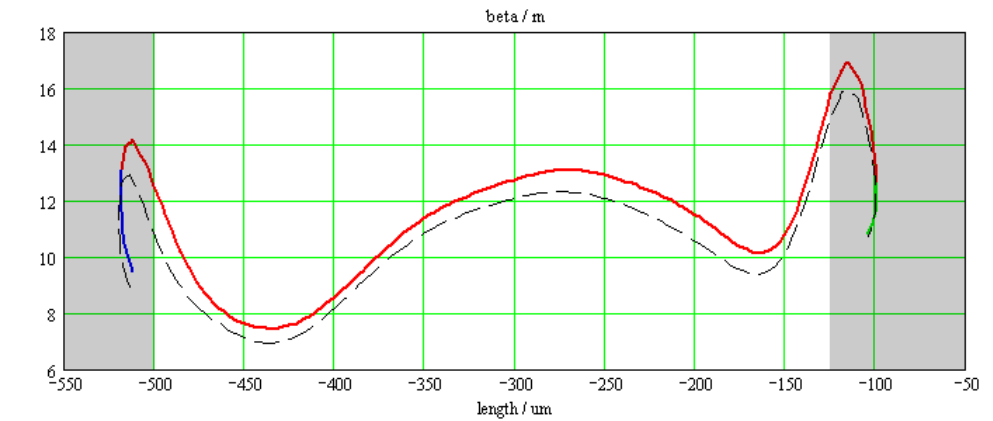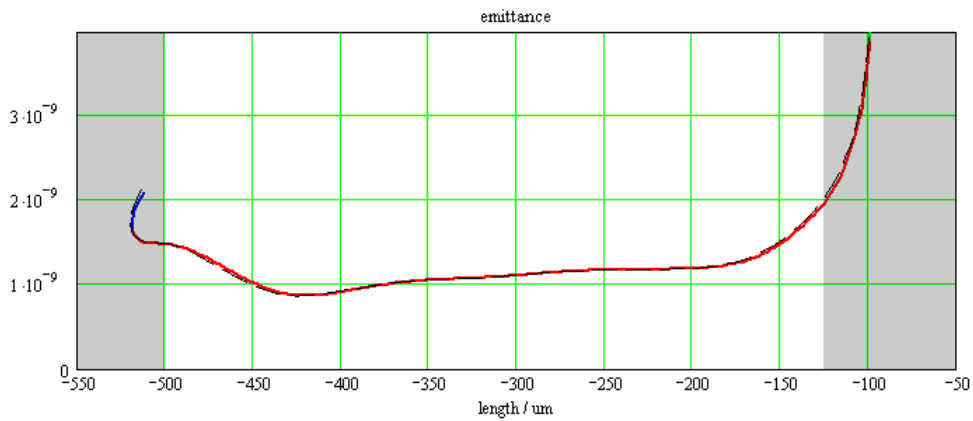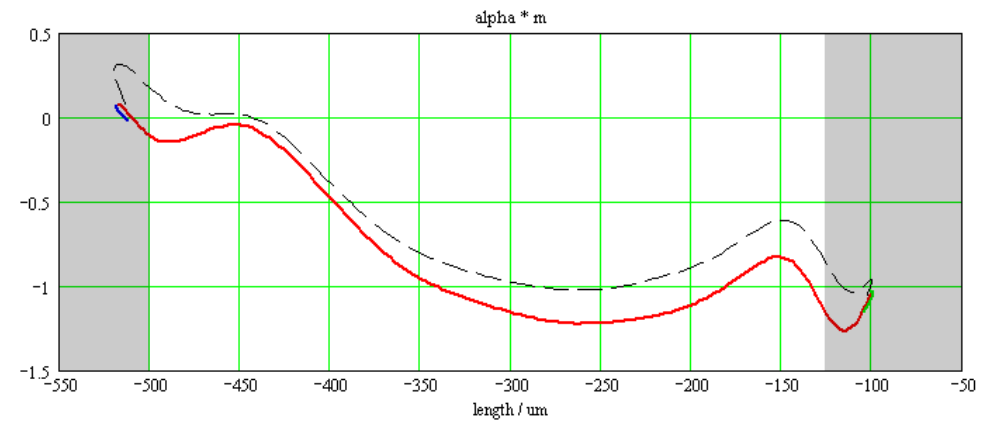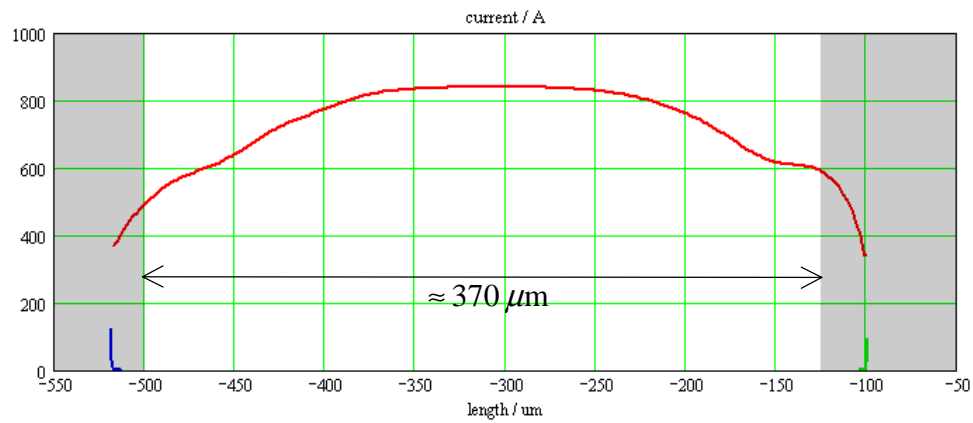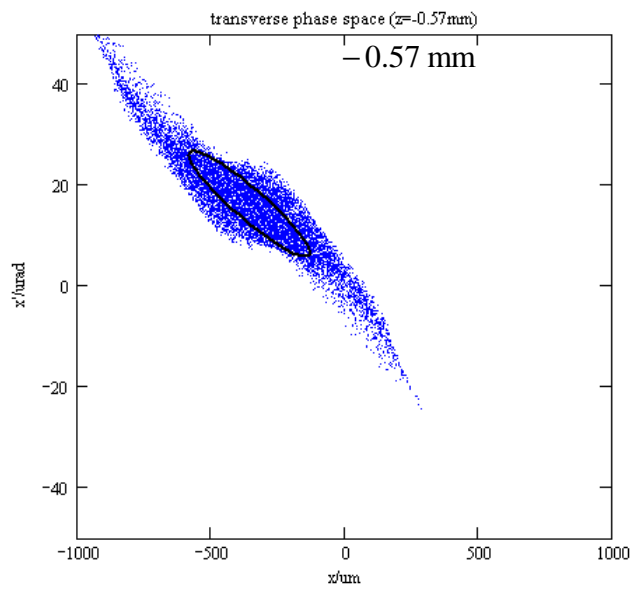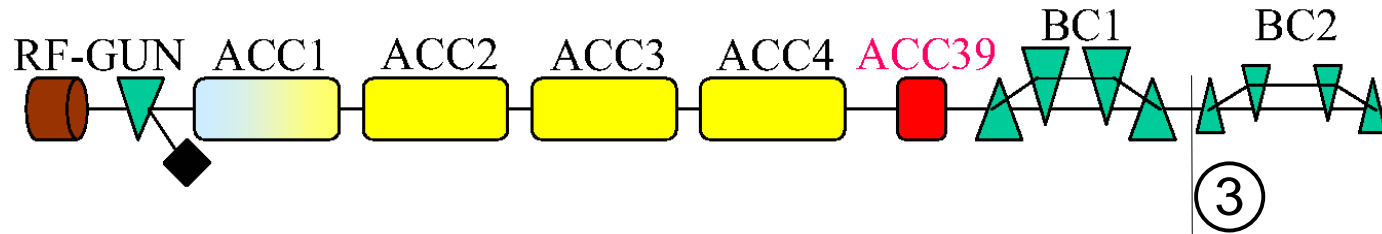
$\gamma_E \varepsilon = 0.88 \cdot 10^{-6}$ m·rad

$\alpha = 2.47$ m^{-1}

$\beta = 57.73$ m

$\gamma = 0.123$
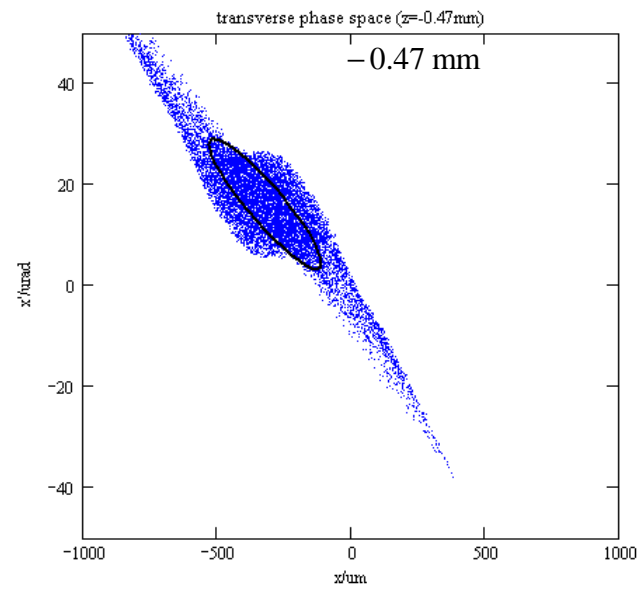
$\gamma_E \varepsilon = 1.10 \cdot 10^{-6}$ m·rad

$\alpha = 2.25$ m^{-1}

$\beta = 40.19$ m

$\gamma = 0.151$
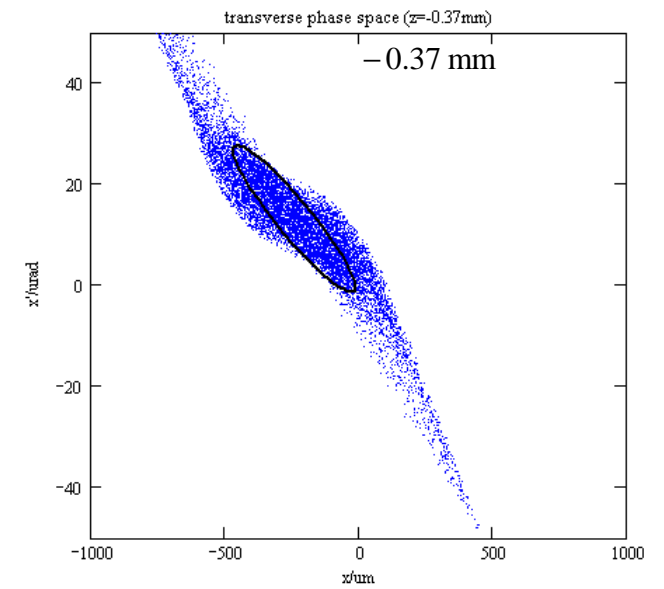
$\gamma_E \varepsilon = 1.20 \cdot 10^{-6}$ m·rad

$\alpha = 2.58$ m^{-1}

$\beta = 43.40$ m

$\gamma = 0.177$

Martin Dohlus   double bc jan 2004

emittance * 10E9   BC2 entrance

s / mm

alpha * m   BC2 entrance

s / mm

beta / m   BC2 entrance

s / mm

current /A

length / mm

dE / E0 * 1000

$$\frac{\langle dE\rangle_z}{E_0}$$

length / mm

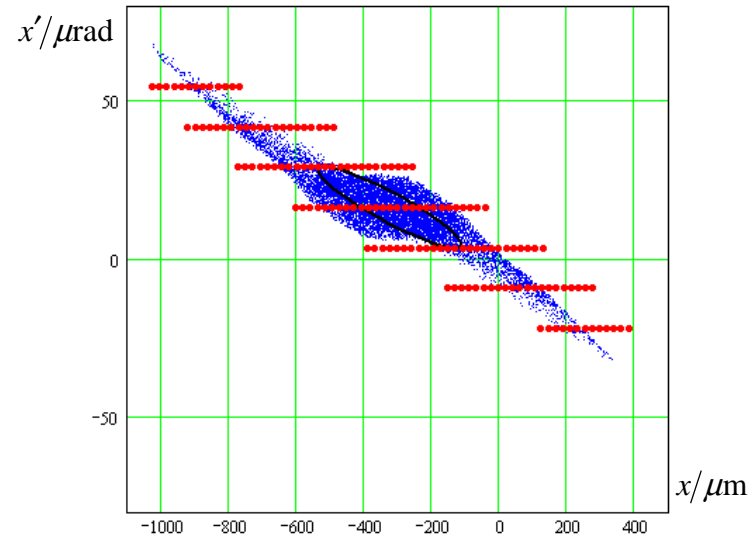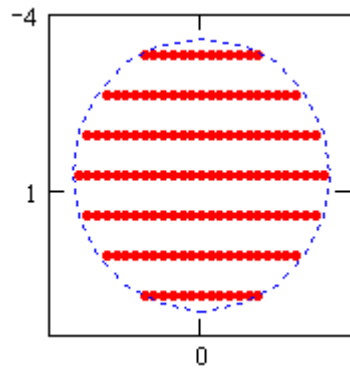**Martin Dohlus   double bc** jan 2004
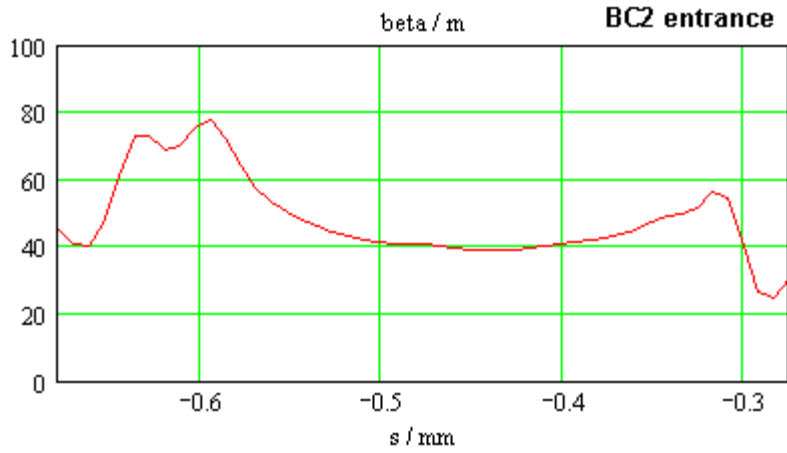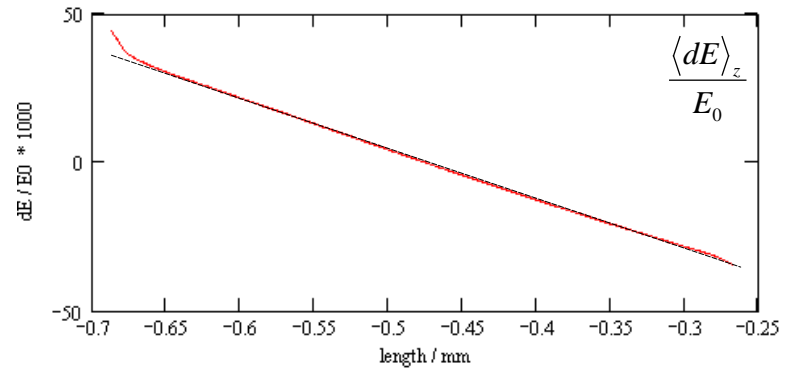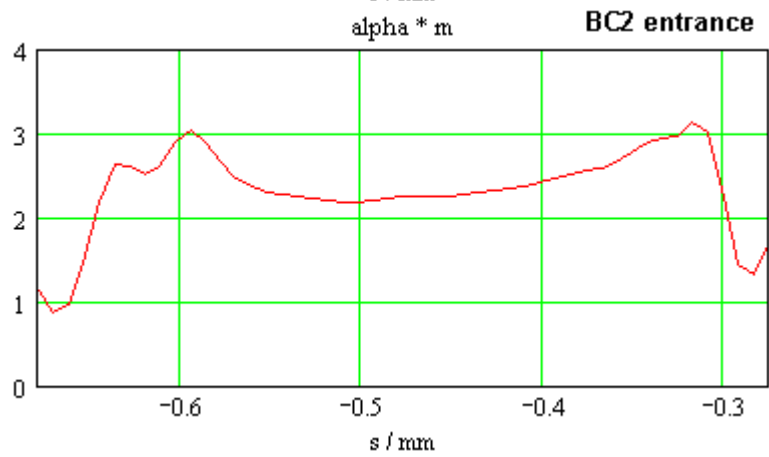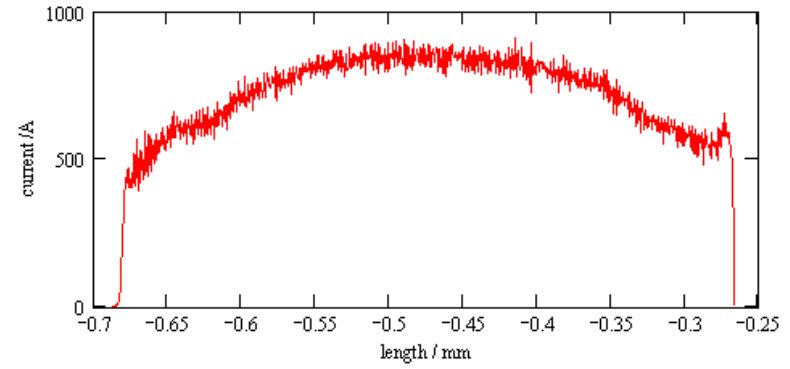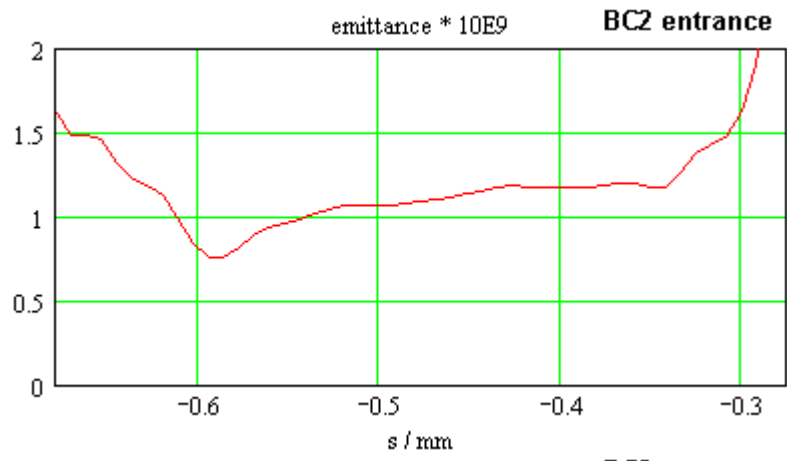
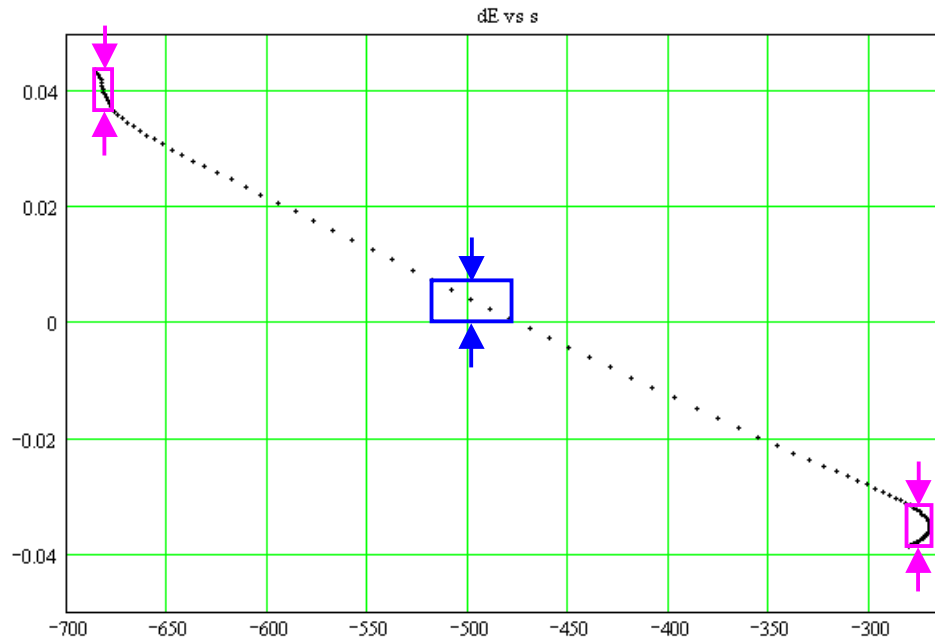# BC2: ELEGANT-distribution → CSRTrack-distribution

a) longitudinal, dE-mesh (not equidistant), no uncorrelated energy spread !
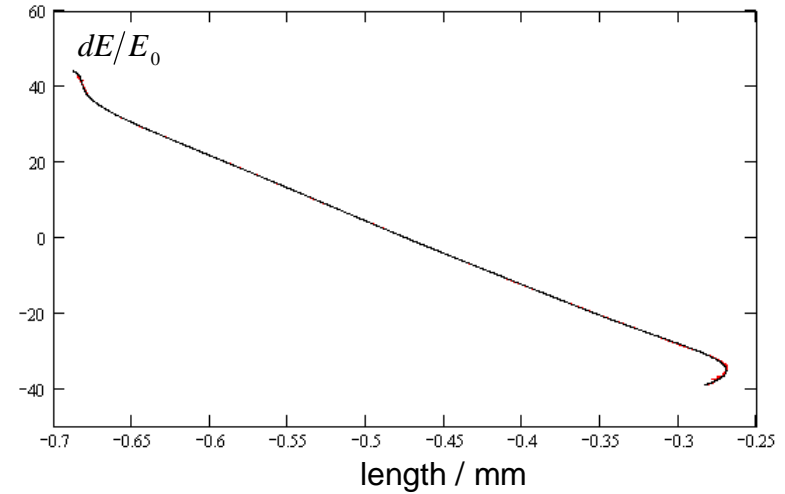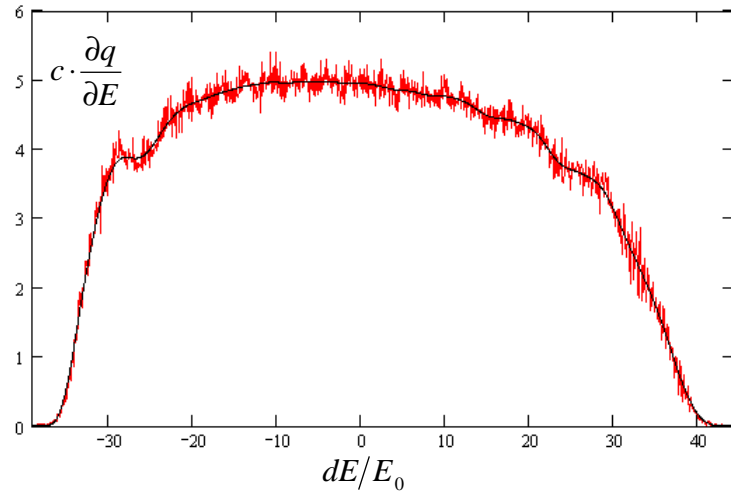
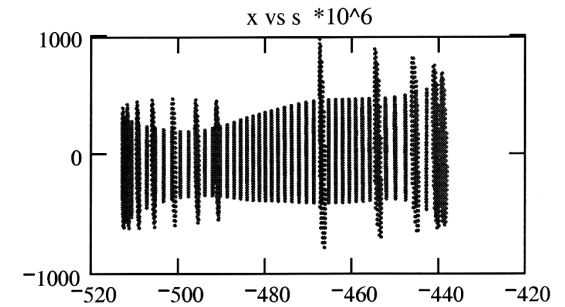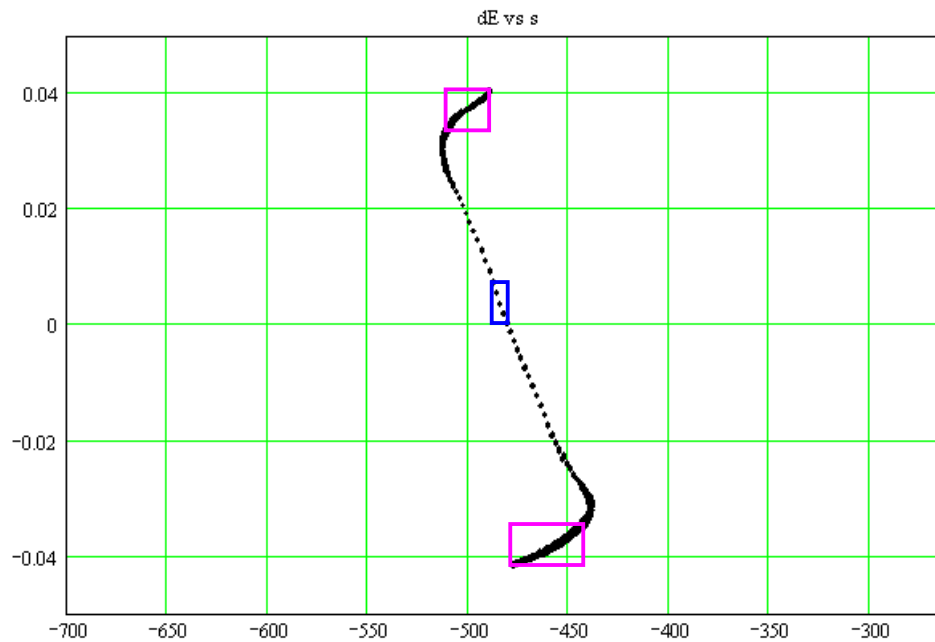**b) transverse, gaussian, equidistant mesh**
101 particles/slice, 100 slices

BC2 entrance
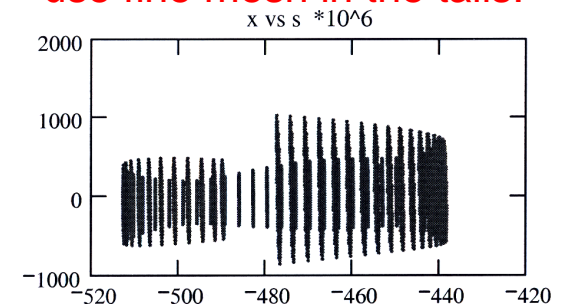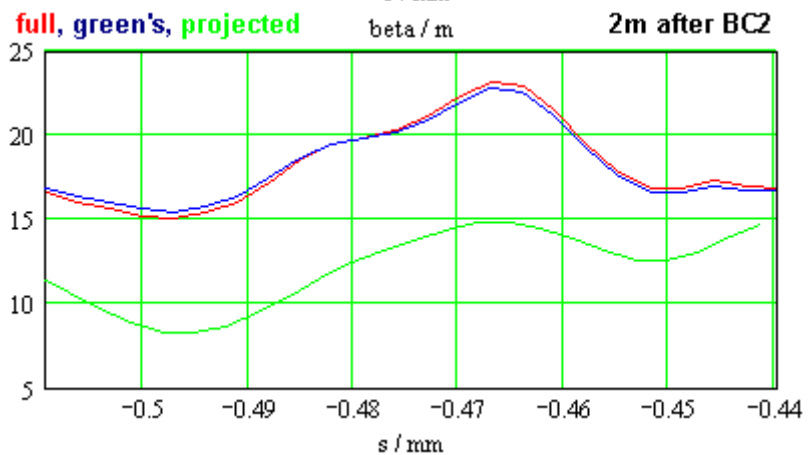

dE vs s

equidistant *E*-mesh

$$\Delta E = \Delta E$$

$\Downarrow$
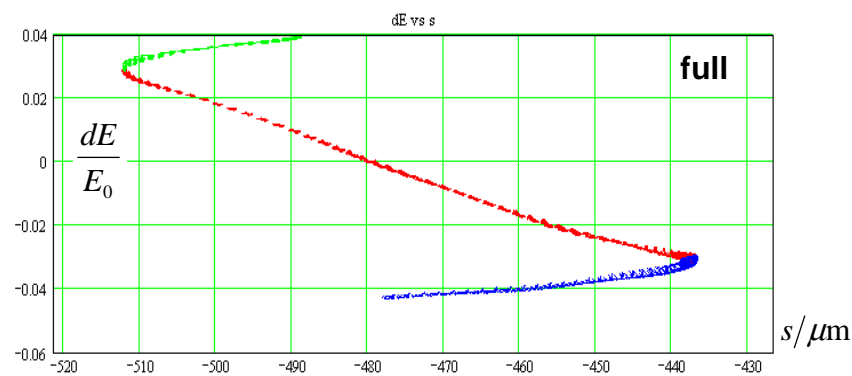
distance between
tail slices is
increased

BC2 exit

dE vs s

x vs s *10^6

use fine mesh in the tails:

x vs s *10^6

Martin Dohlus   double bc jan 2004

full, green's, projected emittance * 10E9   2m after BC2

current   full

full, green's, projected   alpha * m   2m after BC2

dE vs s   full

$$\frac{dE}{E_0}$$

$s/\mu m$

full, green's, projected   beta / m   2m after BC2

dE-dE(0) vs s

$$\frac{dE - dE(0)}{E_0}$$

full $s/\mu m$

Martin Dohlus   double bc jan 2004

2m after BC2

full

dE vs s

$$\frac{dE}{E_0}$$

$s/\mu\text{m}$

dE-dE(0) vs s

$$\frac{dE - dE(0)}{E_0}$$

$s/\mu\text{m}$

rms(dE-E0) vs s

$$\frac{\text{rms}\{dE - dE(0)\}}{E_0}$$

$s/\mu\text{m}$

projected

dE vs s

$$\frac{dE}{E_0}$$

$s/\mu\text{m}$

dE-dE(0) vs s

$$\frac{dE - dE(0)}{E_0}$$

$s/\mu\text{m}$

rms(dE-E0) vs s

$$\frac{\text{rms}\{dE - dE(0)\}}{E_0}$$

$s/\mu\text{m}$

Martin Dohlus   double bc jan 2004

2m after BC2, analysis of "initial" slices

═══ full ----- projected

current / A

≈ 35 μm

≈ 50 μm

length / um

alpha * m

length / um

emittance

length / um

beta / m

length / um

Martin Dohlus   double bc jan 2004