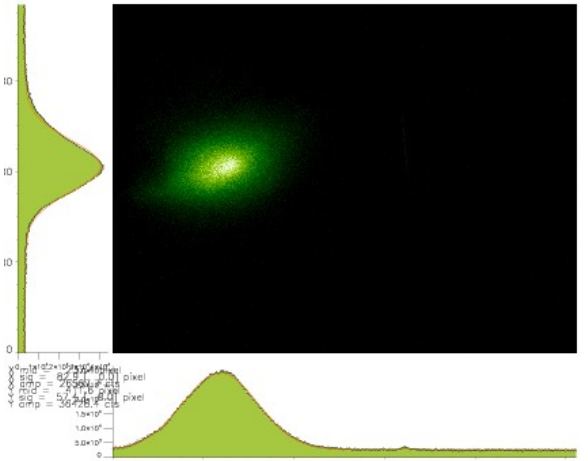
Status of OBLA Measurements

Thomas Schietinger

FELSI Meeting, 29 January 2008

Measurement campaign so far

- Before Christmas: first beam observed, but parts of the diagnostics not yet working, large timing jitter.
- First two weeks of January mainly devoted to hardware fixes (timing problem, diagnostics)
- Observe (?) charge-up of UHV mirror
  - go from 2.5 mm to 5 mm distance from beam
- Solenoids have strong effect on beam position
  - Realignment requested (done last Friday)



Emittance monitor;
200 kV / 12 mm gap

- First attempt to estimate emittance: solenoid scan on 24 Jan., using first solenoid (MSL10=SP1, bolted to pulser, has counter coil)

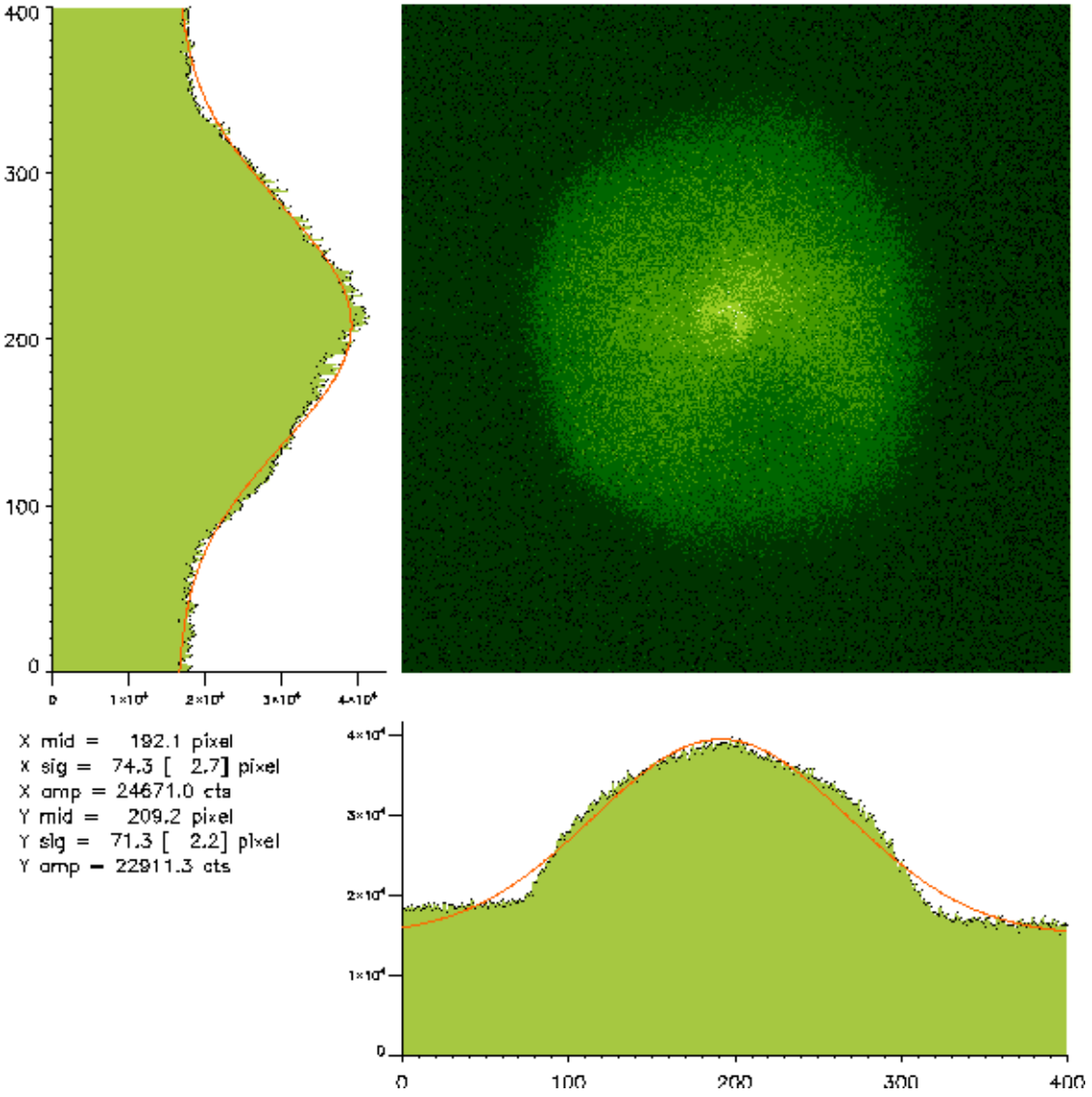
Solenoid Scan with MSL10

- MSL10 has counter coil. Exact field map depends on ratio main/counter coil!
  - MSL10 not very well suited for solenoid scan
- To cancel B field on cathode at 12 mm gap, counter coil current must be –2.37% of main coil
  - This value is different for each gap!
- For main coil current around 30–40 A, no current on counter coil:
  - field integral $\int (B/I)^2 dz = 28.182\ kT^2m/A^2$,
  - effective length $l_{eff} = \int (B/B_{max})^2 dz = 33.70$ mm
- Use these values for preliminary emittance evaluation

Solenoid Scan, 24 Jan. 2008

Å. Andersson, Y. Kim

- Cathode-anode gap: 12 mm
- Pulser voltage: ~315 kV
- Laser $\sigma_{x,y}$: 130 µm
- Laser σ_t: 16.5 ps
- Pixel size: 25.8 µm
- Distance solenoid-screen: 429.5 mm



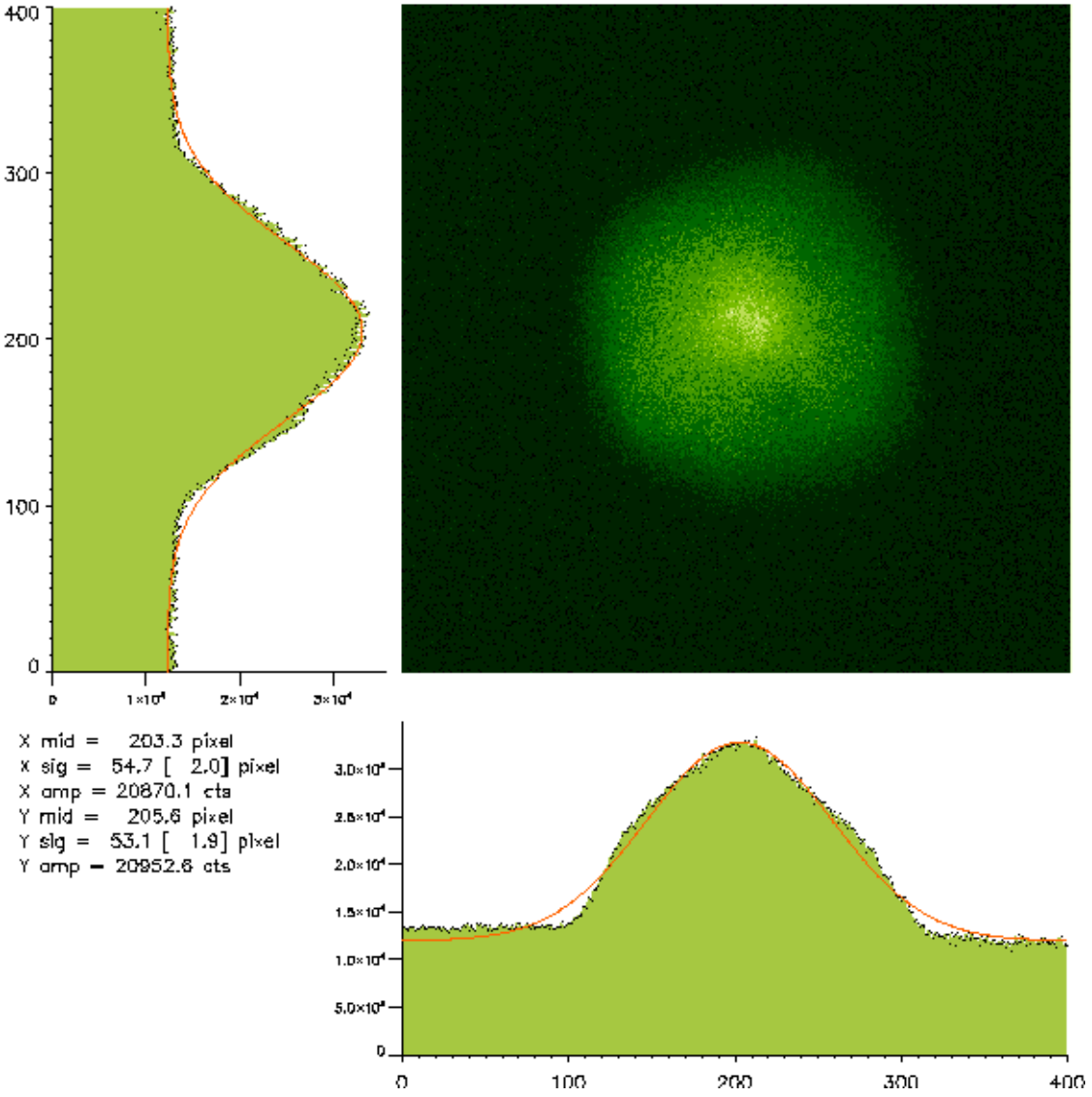
I(main coil): 31 A

I(counter coil): 2 A

Solenoid Scan, 24 Jan. 2008

Å. Andersson, Y. Kim

- Cathode-anode gap: 12 mm
- Pulser voltage: ~315 kV
- Laser $\sigma_{x,y}$: 130 µm
- Laser σ_t: 16.5 ps
- Pixel size: 25.8 µm
- Distance solenoid-screen: 429.5 mm



I(main coil): 32 A

I(counter coil): 2 A

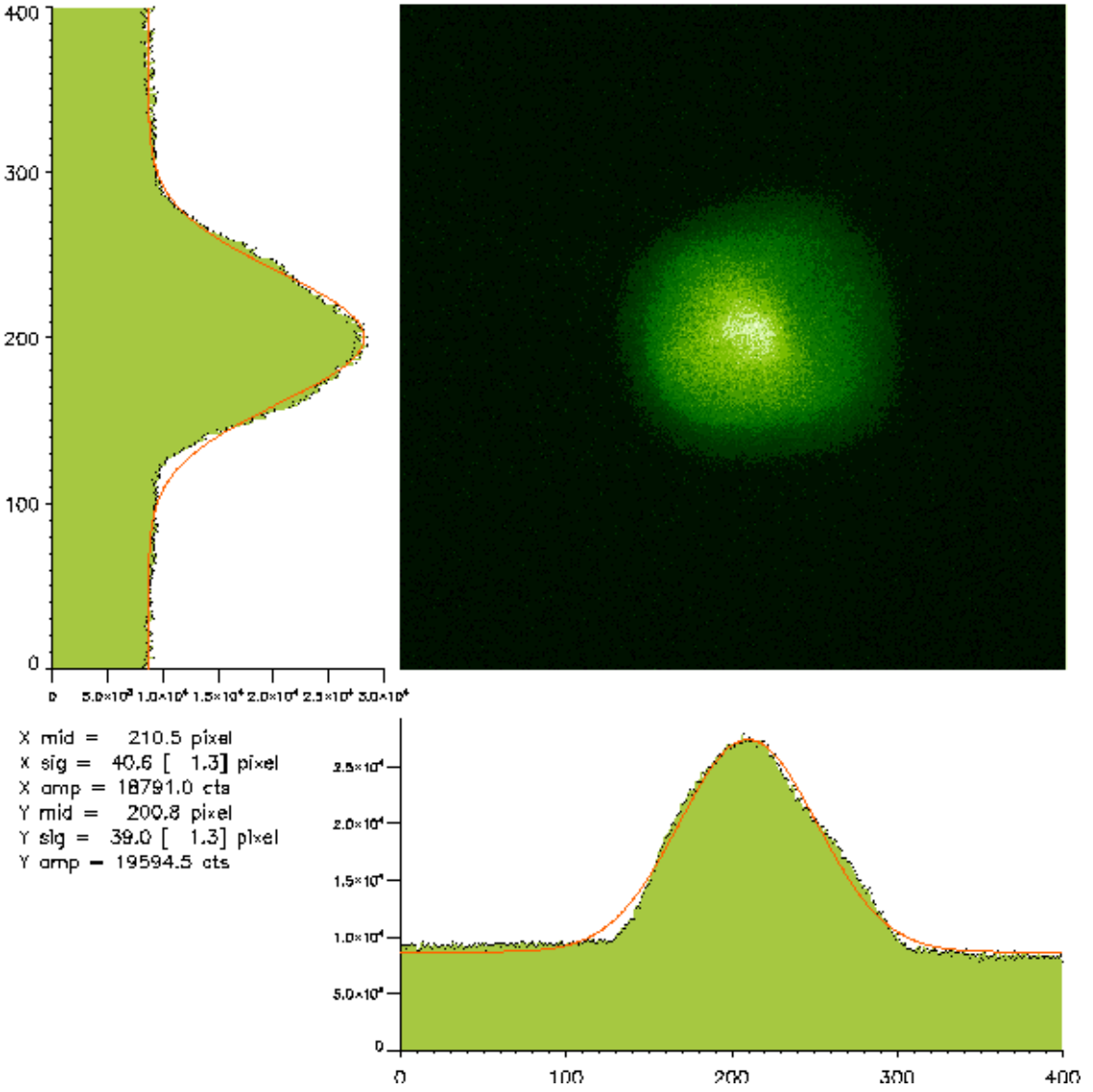
Solenoid Scan, 24 Jan. 2008

Å. Andersson, Y. Kim

- Cathode-anode gap: 12 mm
- Pulser voltage: ~315 kV
- Laser $\sigma_{x,y}$: 130 µm
- Laser σ_t: 16.5 ps
- Pixel size: 25.8 µm
- Distance solenoid-screen: 429.5 mm

I(main coil): 33 A

I(counter coil): 2 A



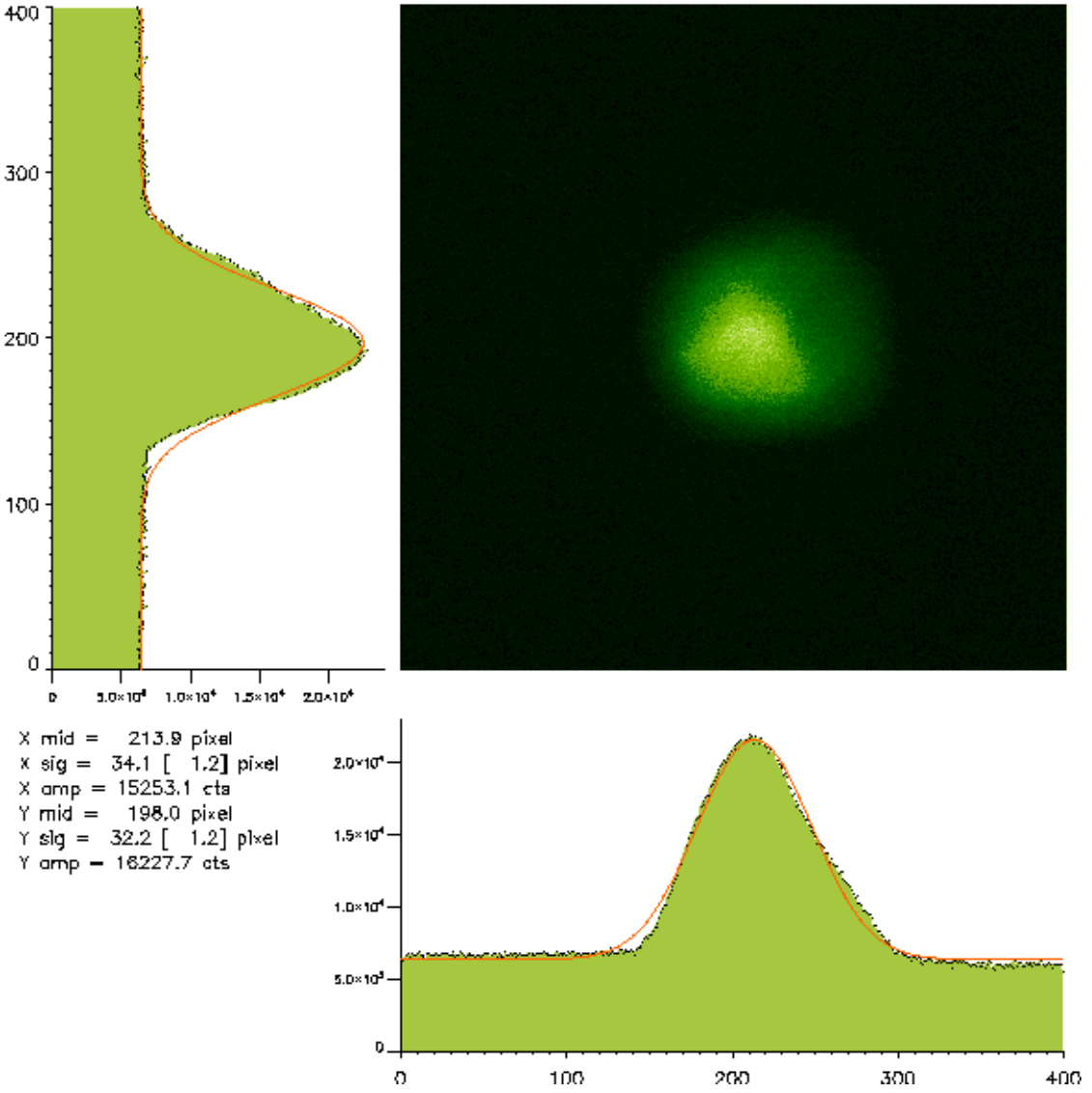
Solenoid Scan, 24 Jan. 2008

Å. Andersson, Y. Kim

- Cathode-anode gap: 12 mm
- Pulser voltage: ~315 kV
- Laser $\sigma_{x,y}$: 130 µm
- Laser σ_t: 16.5 ps
- Pixel size: 25.8 µm
- Distance solenoid-screen: 429.5 mm

I(main coil): 33.5 A

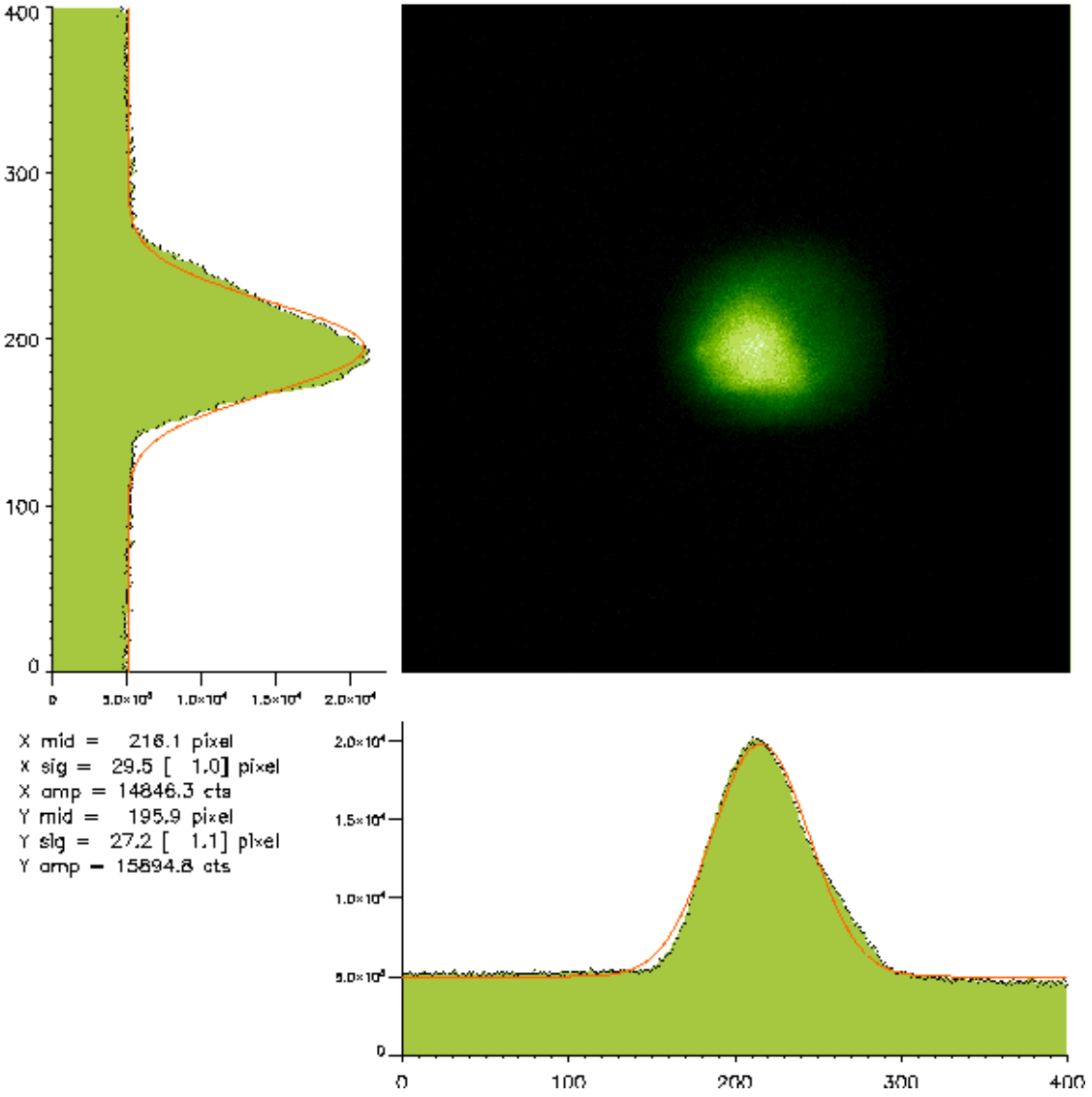
I(counter coil): 2 A



Solenoid Scan, 24 Jan. 2008

Å. Andersson, Y. Kim

- Cathode-anode gap: 12 mm
- Pulser voltage: ~315 kV
- Laser $\sigma_{x,y}$: 130 µm
- Laser σ_t: 16.5 ps
- Pixel size: 25.8 µm
- Distance solenoid-screen: 429.5 mm



I(main coil): 34 A

I(counter coil): 2 A

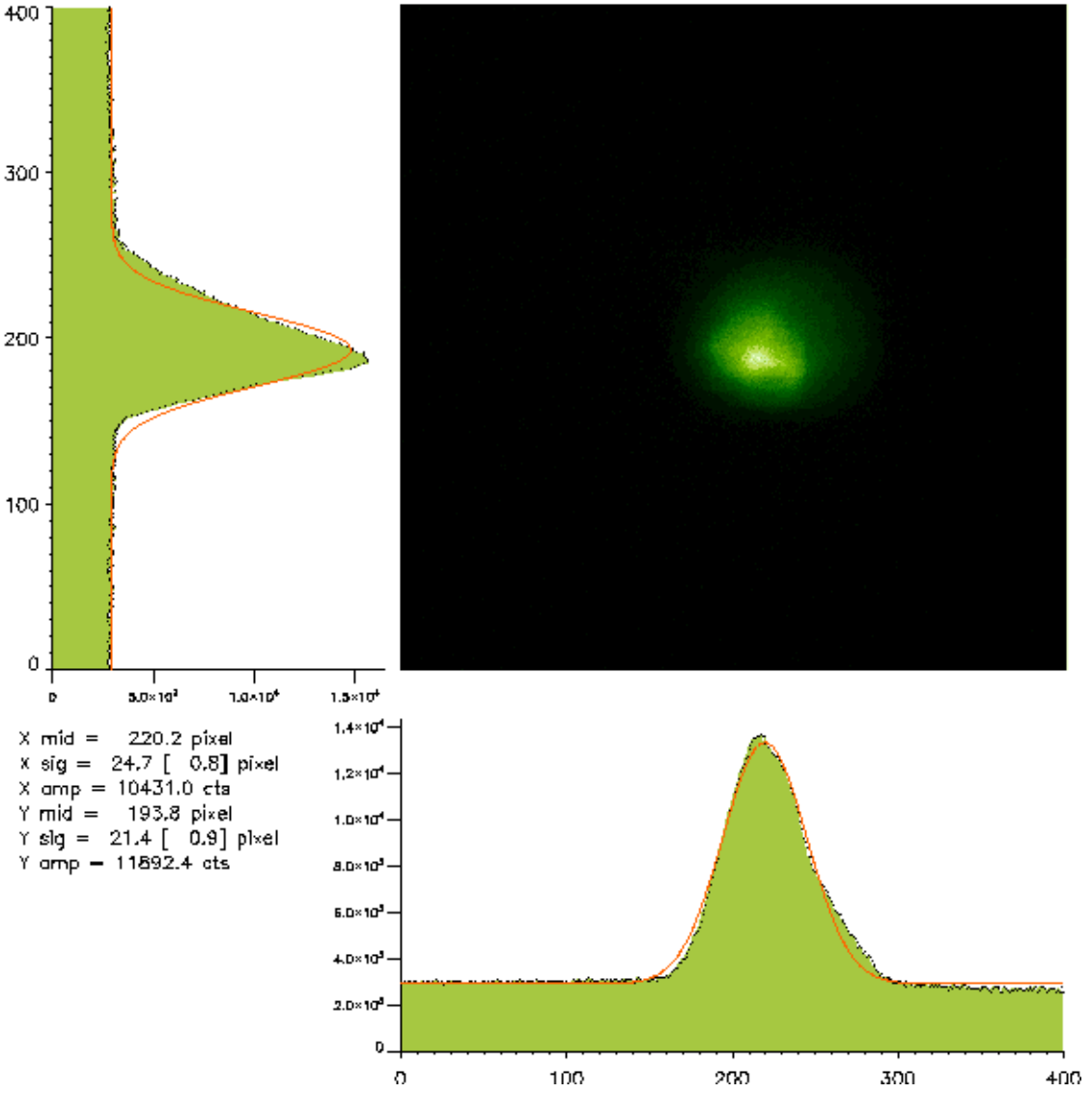
Solenoid Scan, 24 Jan. 2008

Å. Andersson, Y. Kim

- Cathode-anode gap: 12 mm
- Pulser voltage: ~315 kV
- Laser $\sigma_{x,y}$: 130 µm
- Laser σ_t: 16.5 ps
- Pixel size: 25.8 µm
- Distance solenoid-screen: 429.5 mm

I(main coil): 34.5 A

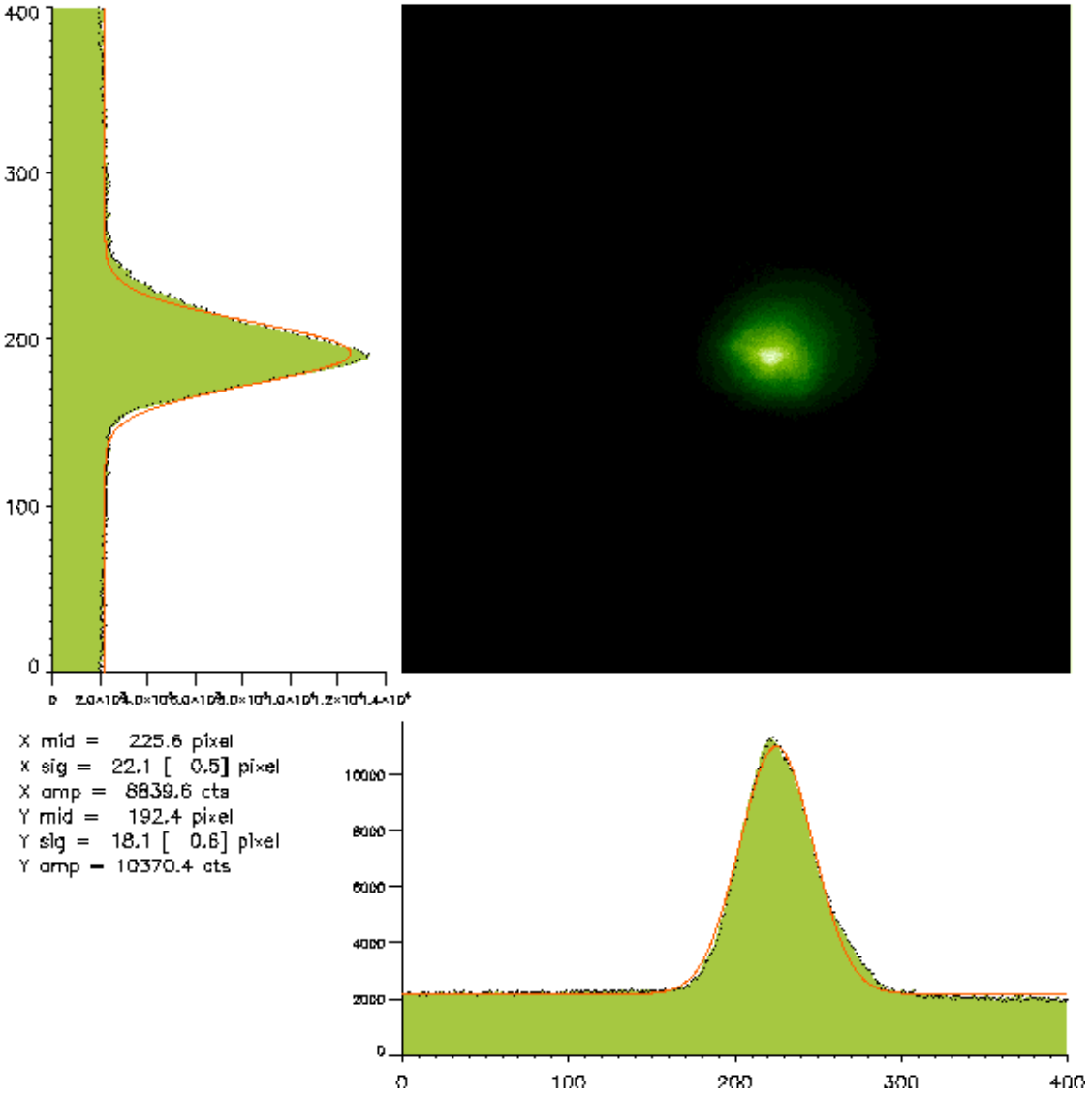
I(counter coil): 2 A



Solenoid Scan, 24 Jan. 2008

Å. Andersson, Y. Kim

- Cathode-anode gap: 12 mm
- Pulser voltage: ~315 kV
- Laser $\sigma_{x,y}$: 130 µm
- Laser σ_t: 16.5 ps
- Pixel size: 25.8 µm
- Distance solenoid-screen: 429.5 mm



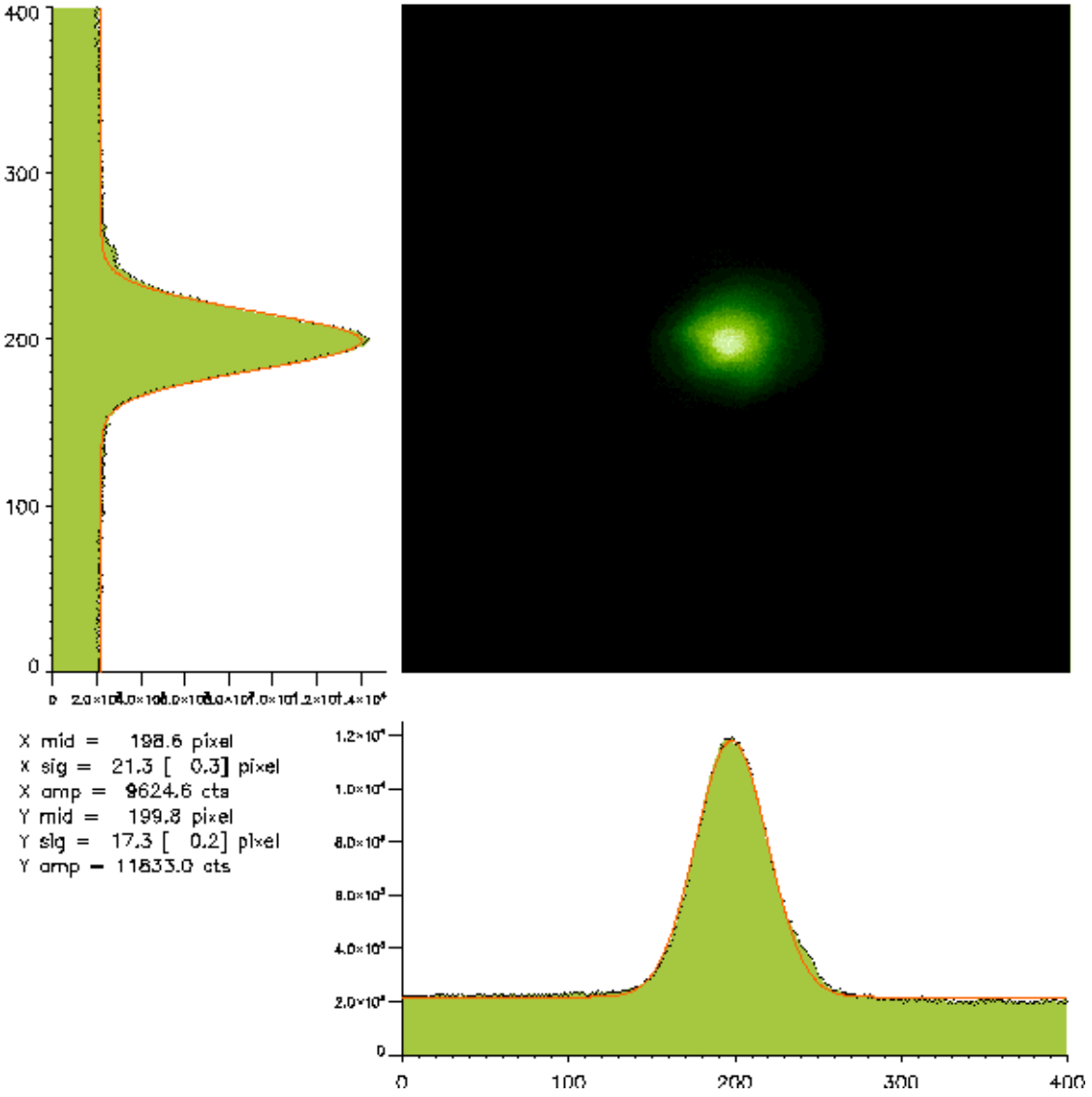
I(main coil): 35 A

I(counter coil): 2 A

Solenoid Scan, 24 Jan. 2008

Å. Andersson, Y. Kim

- Cathode-anode gap: 12 mm
- Pulser voltage: ~315 kV
- Laser $\sigma_{x,y}$: 130 µm
- Laser σ_t: 16.5 ps
- Pixel size: 25.8 µm
- Distance solenoid-screen: 429.5 mm



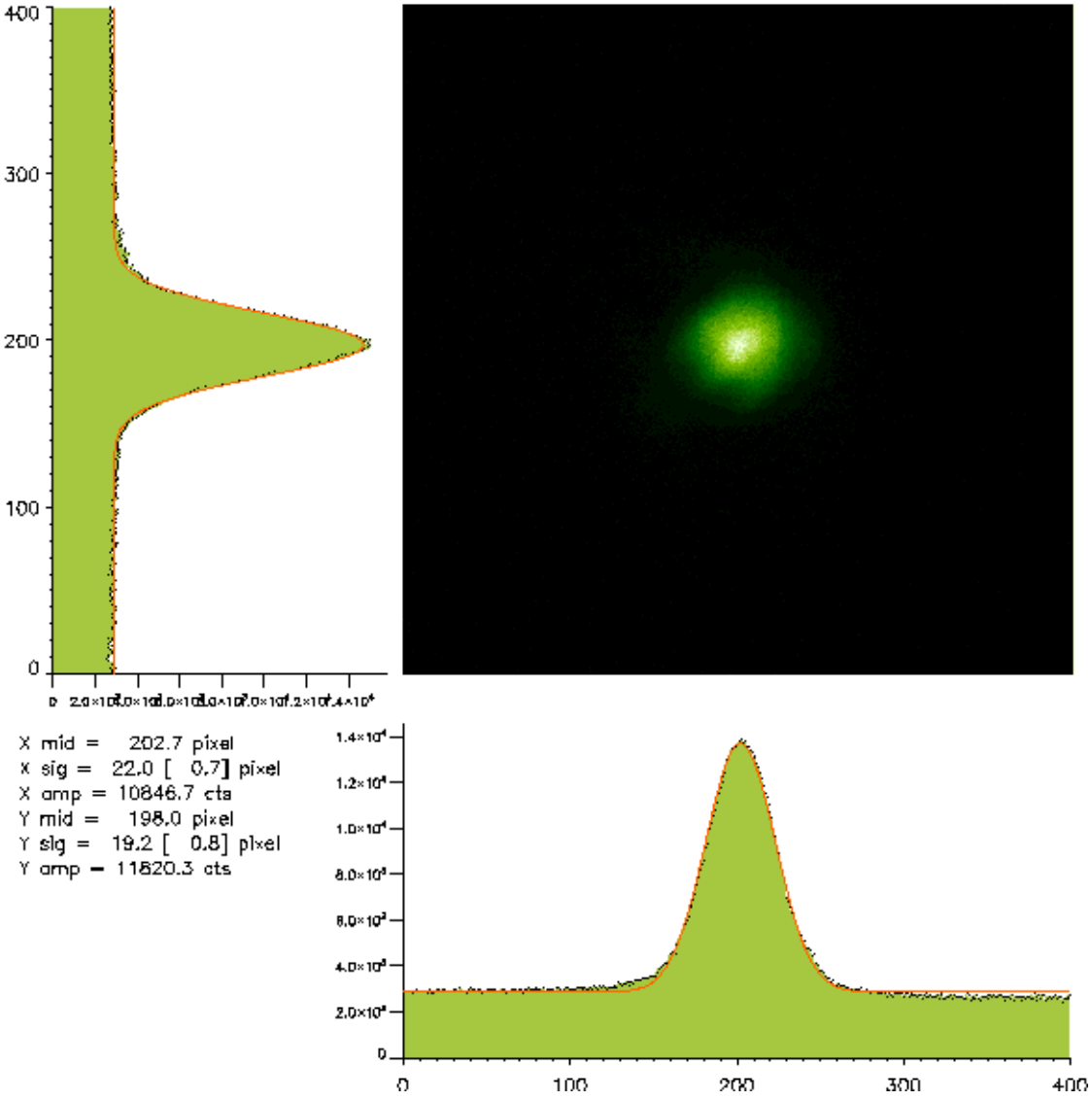
I(main coil): 35.5 A

I(counter coil): 2 A

Solenoid Scan, 24 Jan. 2008

Å. Andersson, Y. Kim

- Cathode-anode gap: 12 mm
- Pulser voltage: ~315 kV
- Laser $\sigma_{x,y}$: 130 µm
- Laser σ_t: 16.5 ps
- Pixel size: 25.8 µm
- Distance solenoid-screen: 429.5 mm



I(main coil): 36 A

I(counter coil): 2 A

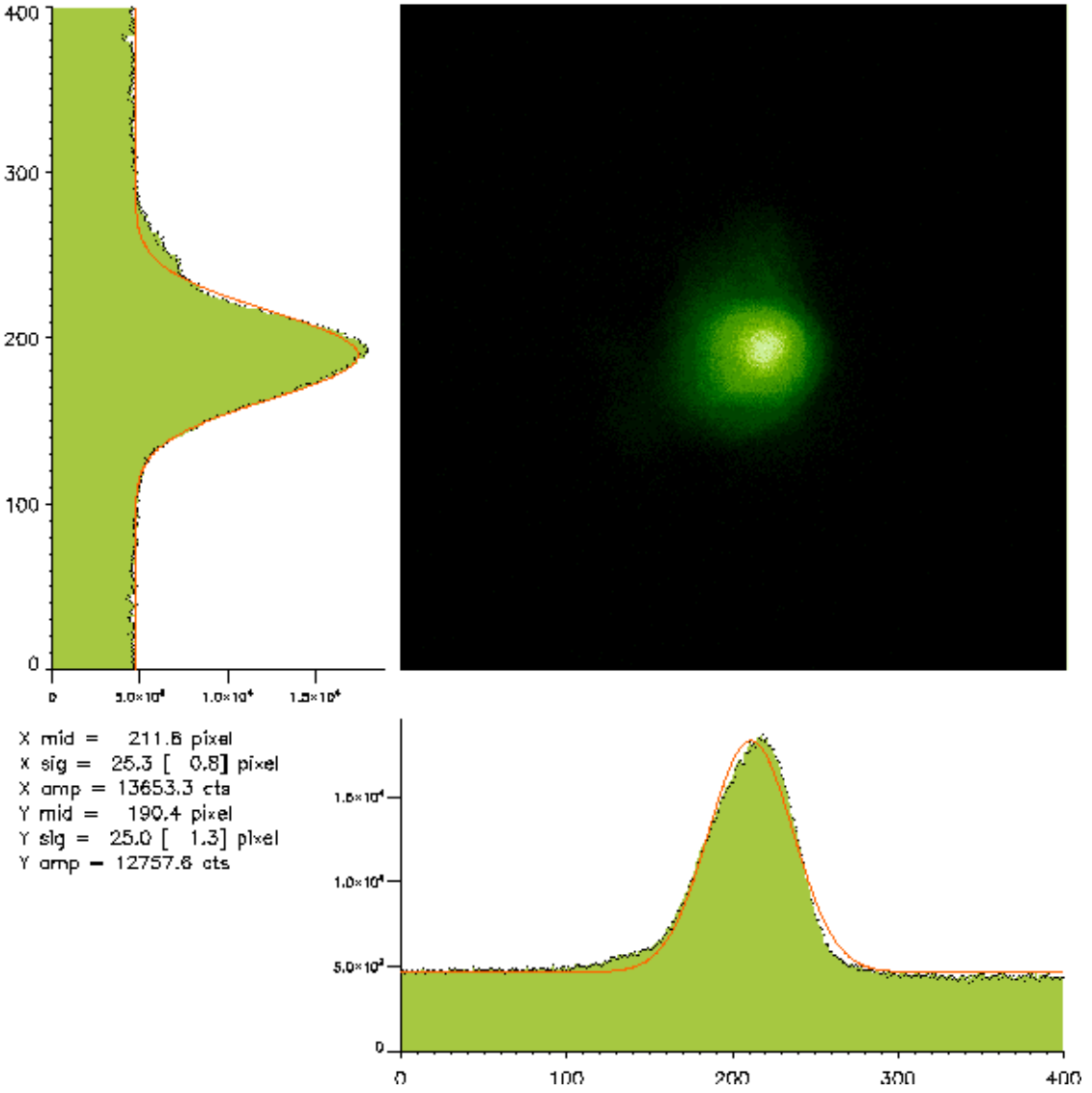
Solenoid Scan, 24 Jan. 2008

Å. Andersson, Y. Kim

- Cathode-anode gap: 12 mm
- Pulser voltage: ~315 kV
- Laser $\sigma_{x,y}$: 130 µm
- Laser σ_t: 16.5 ps
- Pixel size: 25.8 µm
- Distance solenoid-screen: 429.5 mm

I(main coil): 36.5 A

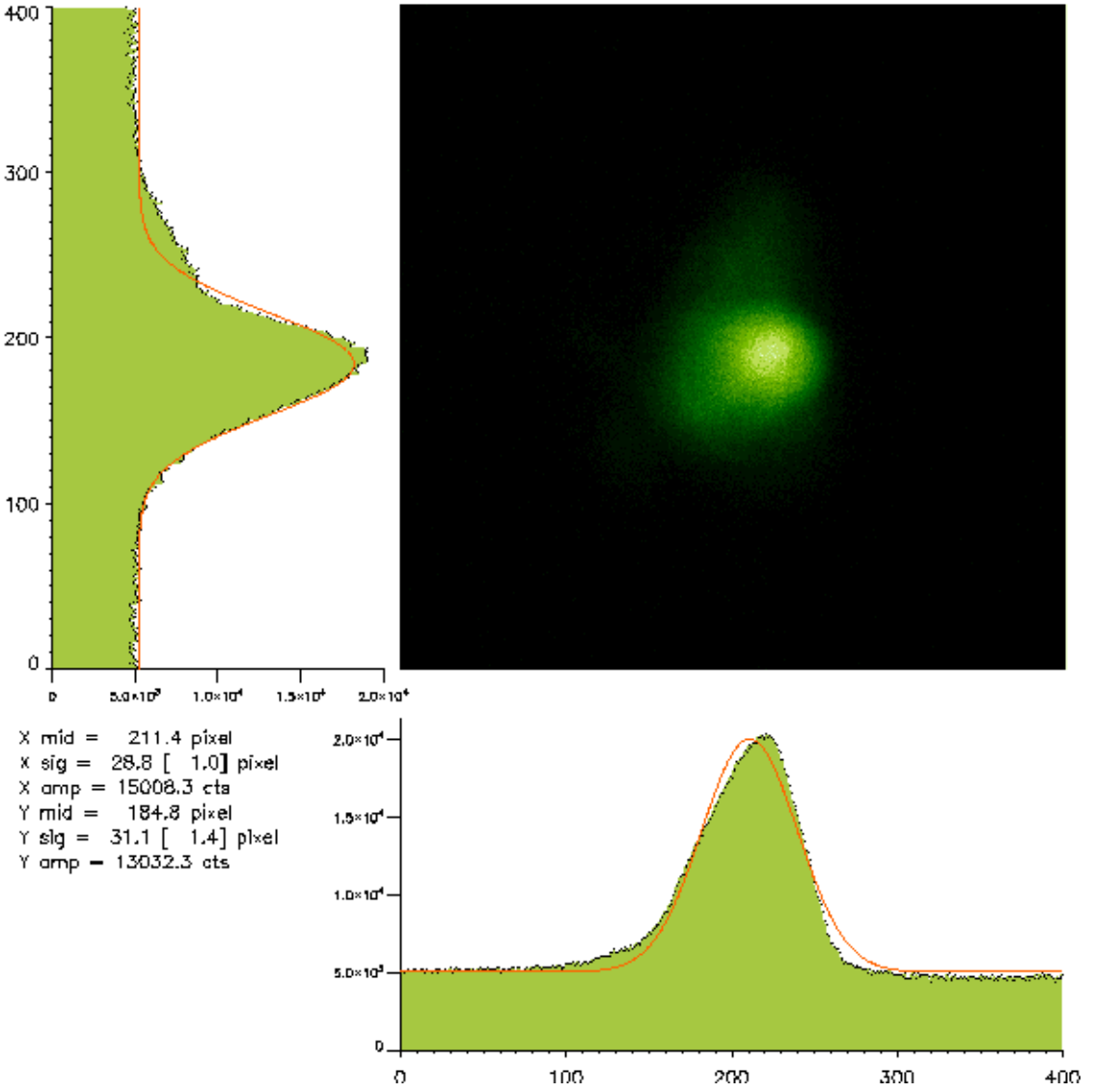
I(counter coil): 2 A



Solenoid Scan, 24 Jan. 2008

Å. Andersson, Y. Kim

- Cathode-anode gap: 12 mm
- Pulser voltage: ~315 kV
- Laser $\sigma_{x,y}$: 130 µm
- Laser σ_t: 16.5 ps
- Pixel size: 25.8 µm
- Distance solenoid-screen: 429.5 mm



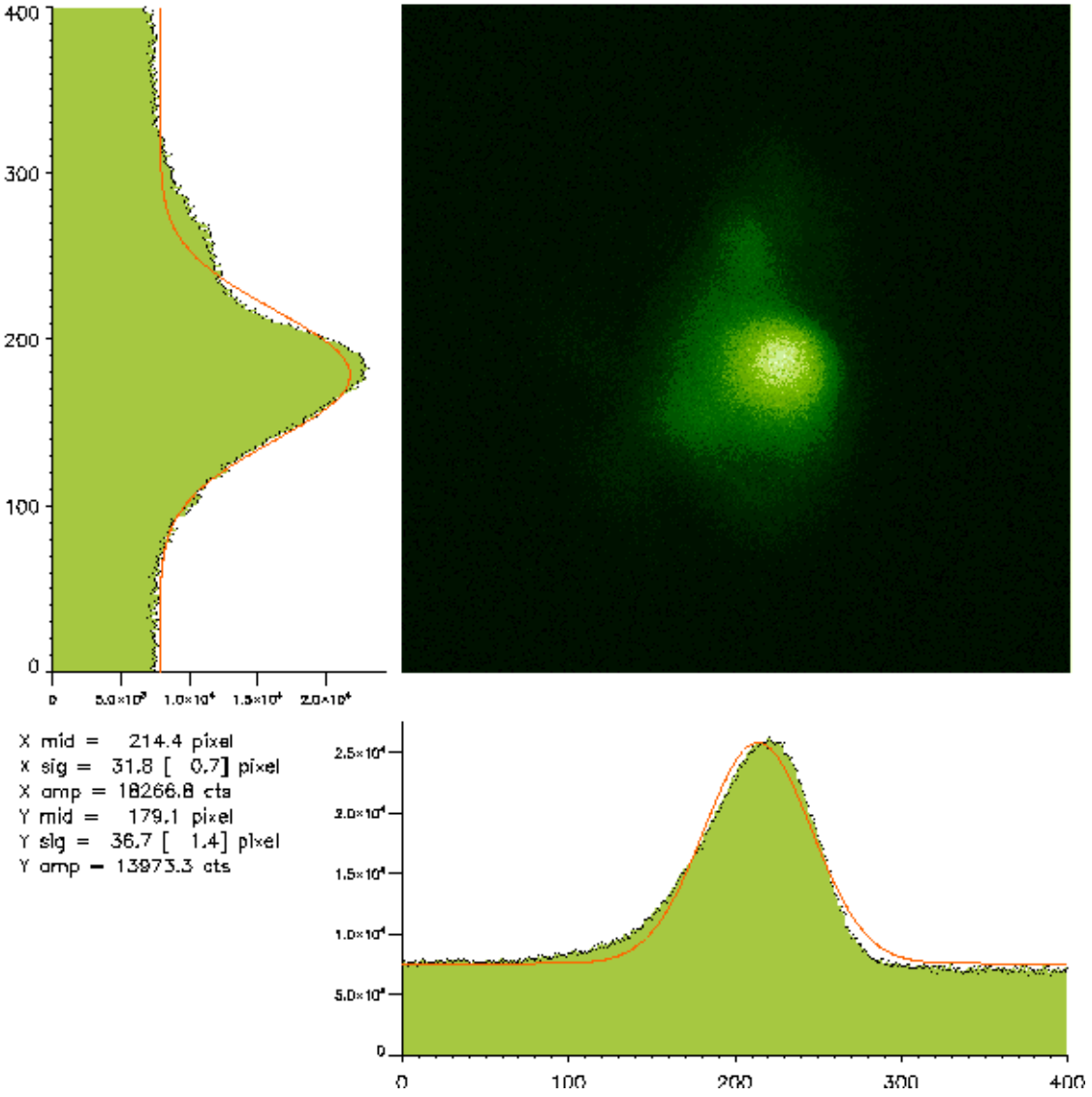
I(main coil): 37 A

I(counter coil): 2 A

Solenoid Scan, 24 Jan. 2008

Å. Andersson, Y. Kim

- Cathode-anode gap: 12 mm
- Pulser voltage: ~315 kV
- Laser $\sigma_{x,y}$: 130 µm
- Laser σ_t: 16.5 ps
- Pixel size: 25.8 µm
- Distance solenoid-screen: 429.5 mm



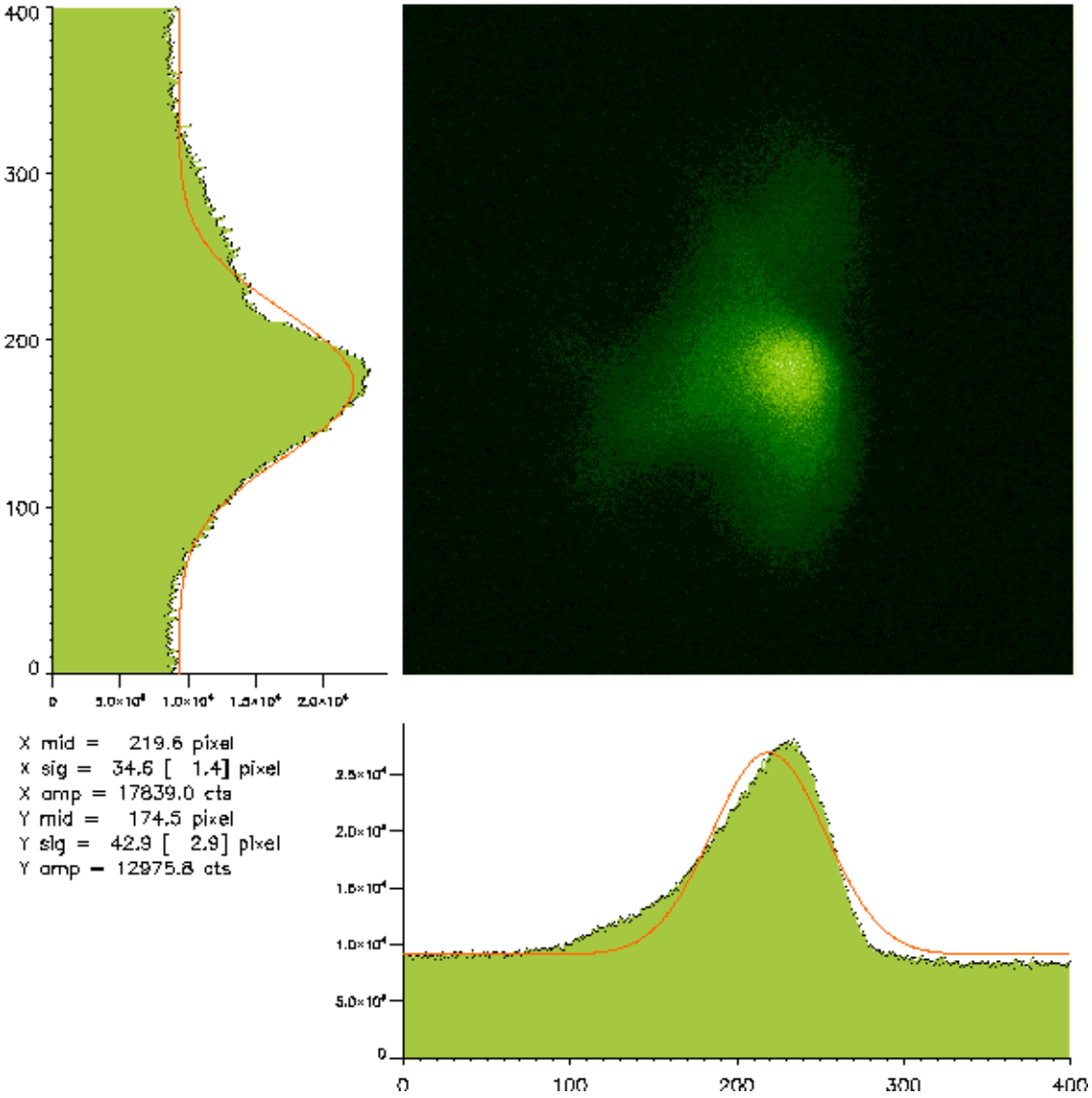
I(main coil): 37.5 A

I(counter coil): 2 A

Solenoid Scan, 24 Jan. 2008

Å. Andersson, Y. Kim

- Cathode-anode gap: 12 mm
- Pulser voltage: ~315 kV
- Laser $\sigma_{x,y}$: 130 µm
- Laser σ_t: 16.5 ps
- Pixel size: 25.8 µm
- Distance solenoid-screen: 429.5 mm



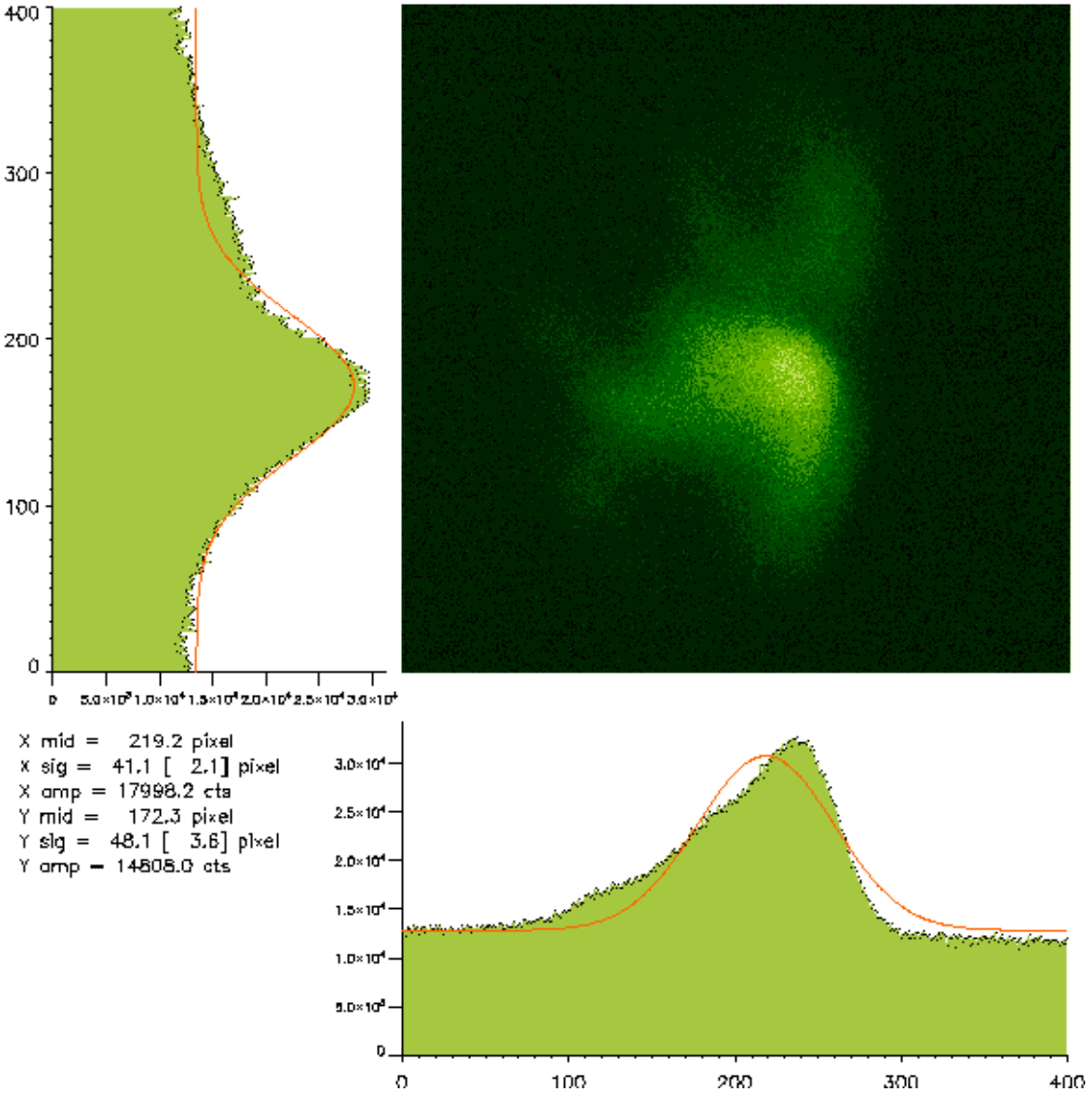
I(main coil): 38 A

I(counter coil): 2 A

Solenoid Scan, 24 Jan. 2008

Å. Andersson, Y. Kim

- Cathode-anode gap: 12 mm
- Pulser voltage: ~315 kV
- Laser $\sigma_{x,y}$: 130 µm
- Laser σ_t: 16.5 ps
- Pixel size: 25.8 µm
- Distance solenoid-screen: 429.5 mm



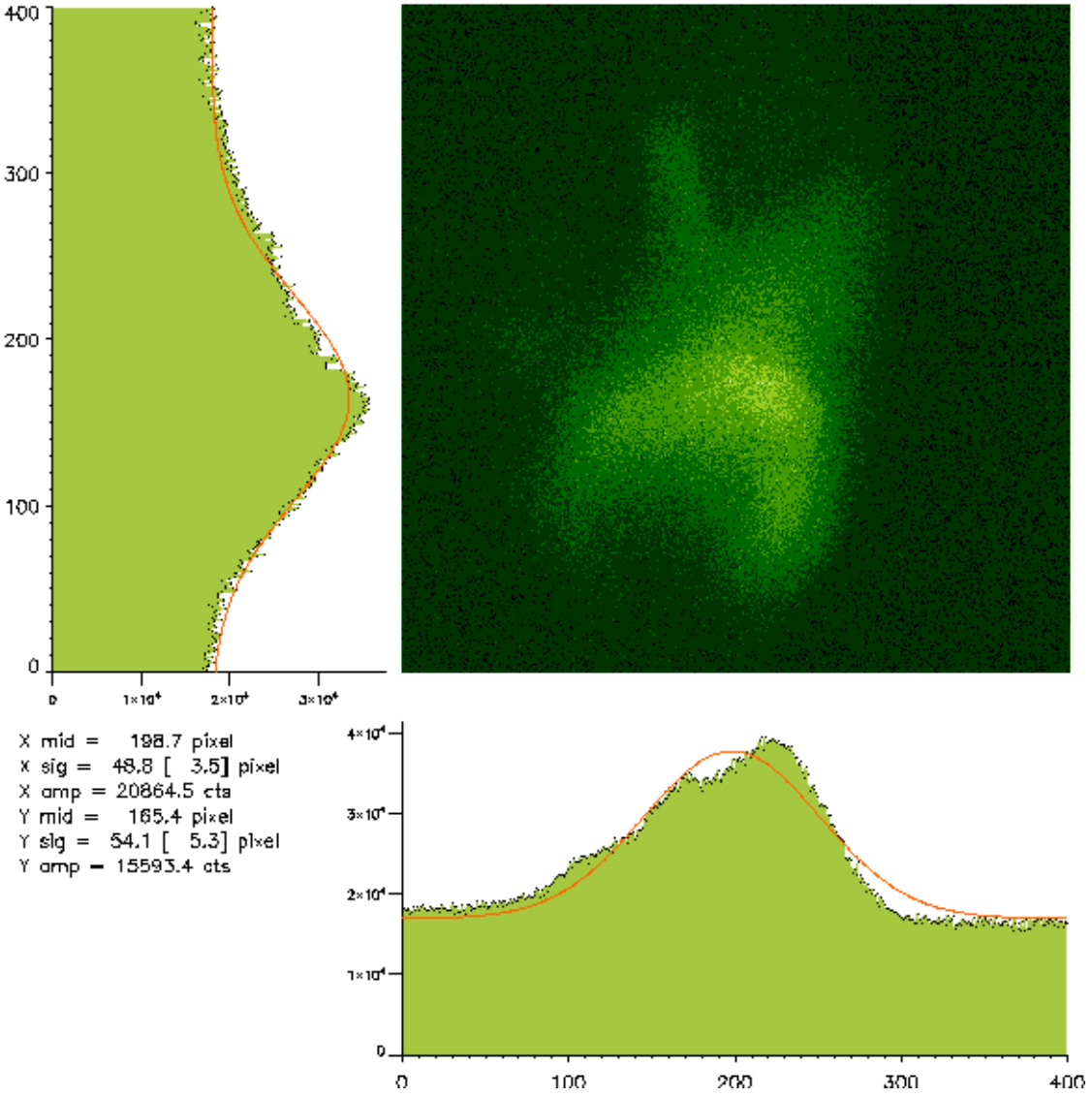
I(main coil): 38.5 A

I(counter coil): 2 A

Solenoid Scan, 24 Jan. 2008

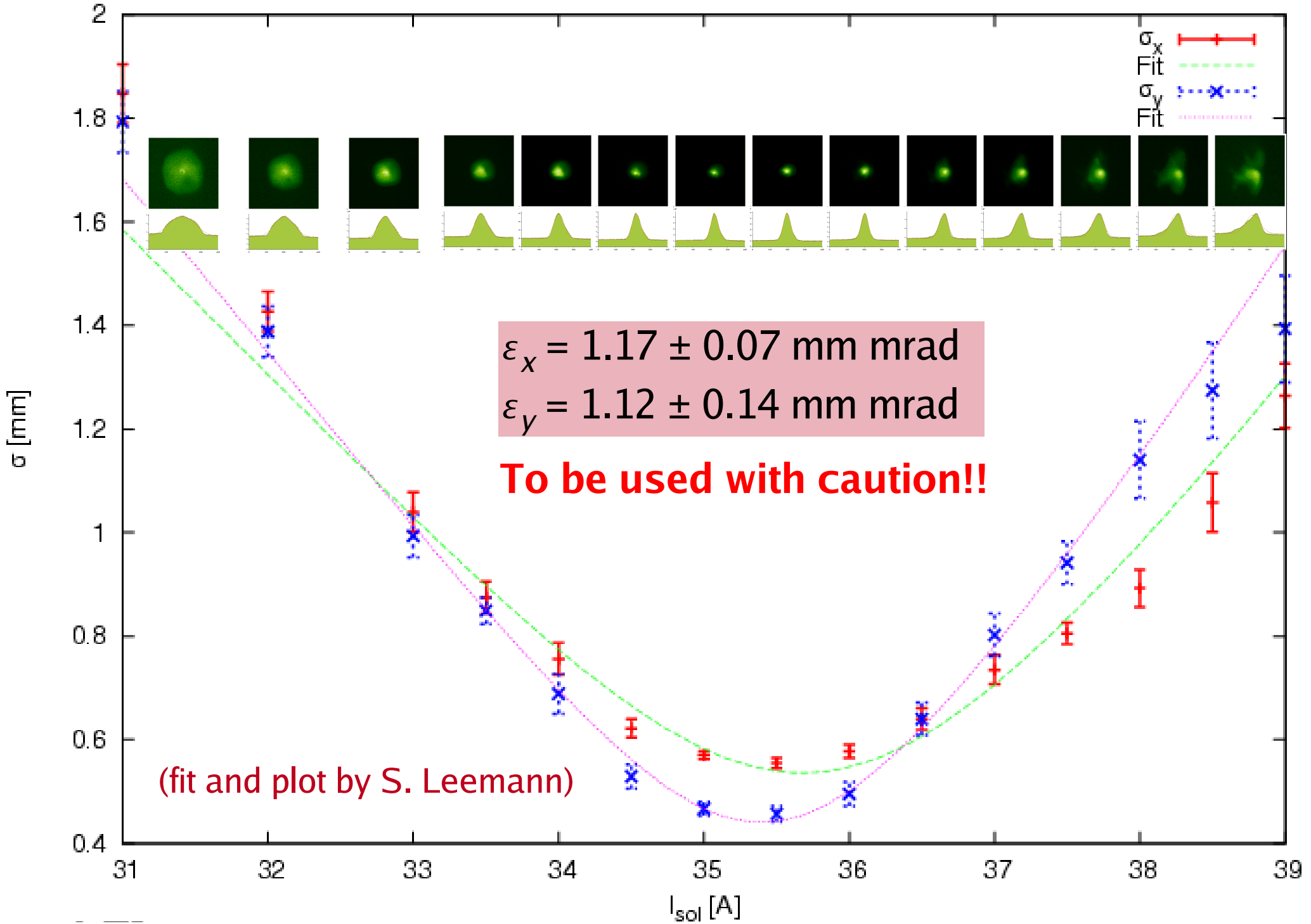
Å. Andersson, Y. Kim

- Cathode-anode gap: 12 mm
- Pulser voltage: ~315 kV
- Laser $\sigma_{x,y}$: 130 µm
- Laser σ_t: 16.5 ps
- Pixel size: 25.8 µm
- Distance solenoid-screen: 429.5 mm



I(main coil): 39 A

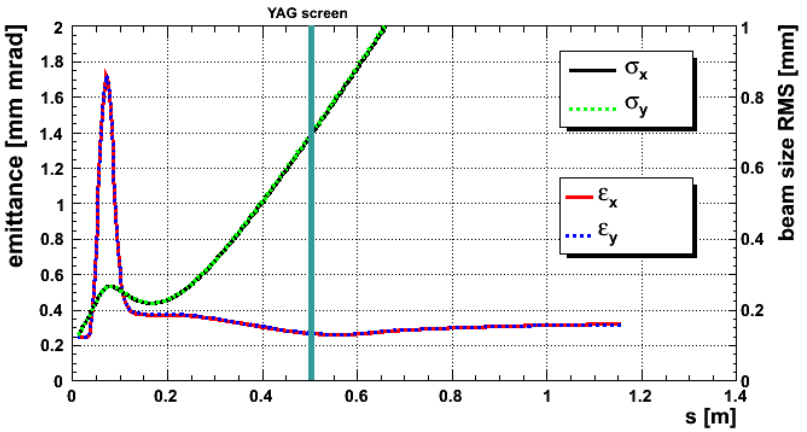
I(counter coil): 2 A


σx
Fit
σy
Fit
σ [mm]
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
31
32
33
34
35
36
37
38
39
Isol [A]
εx = 1.17 ± 0.07 mm mrad
εy = 1.12 ± 0.14 mm mrad
To be used with caution!!
(fit and plot by S. Leemann)

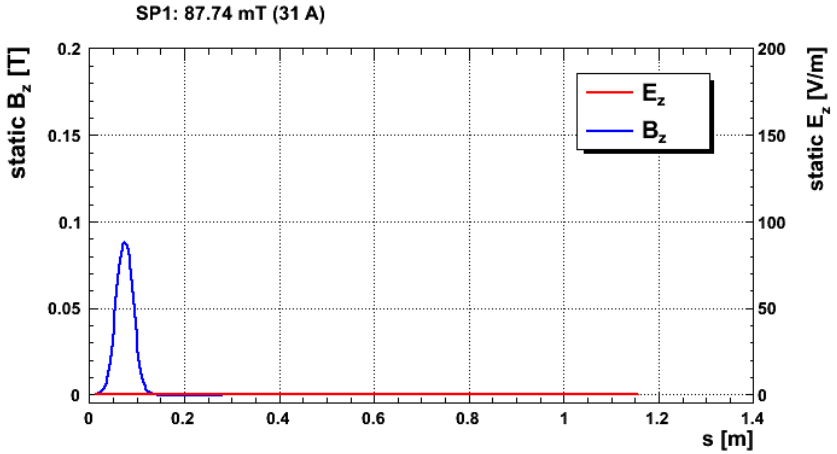
Charge: 7.6 pC
mesh: 32 × 32 × 32
macroparticles: 100k
time step: 0.1 ps (gun),
1 ps (after)
σ_t: 16.5 ps; $r_{x,y}$: 225 µm

Simulation (Impact-t)

OBLA, phase-I, 12 mm gap, 315 kV



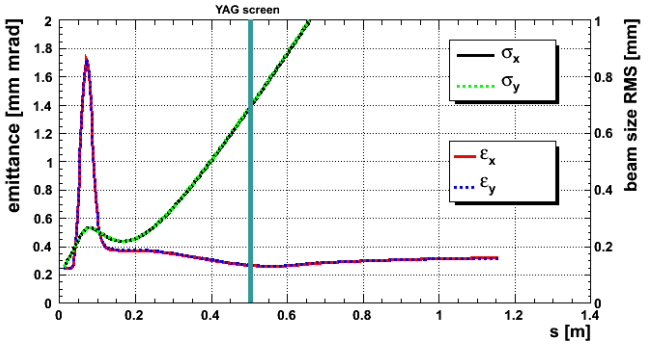
I_{tot} = 31 A



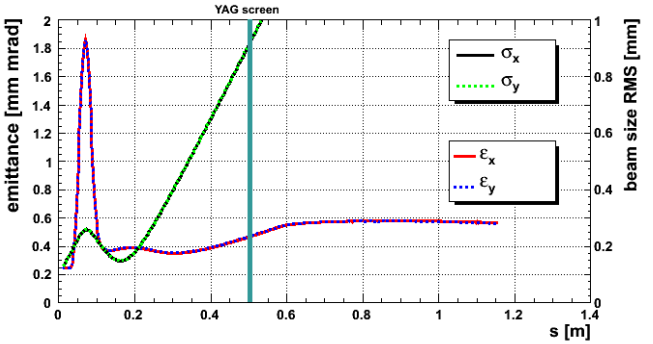
IMPACT-T Tue Jan 29 13:05:05 2008

OBLA, phase-I, 12 mm gap, 315 kV

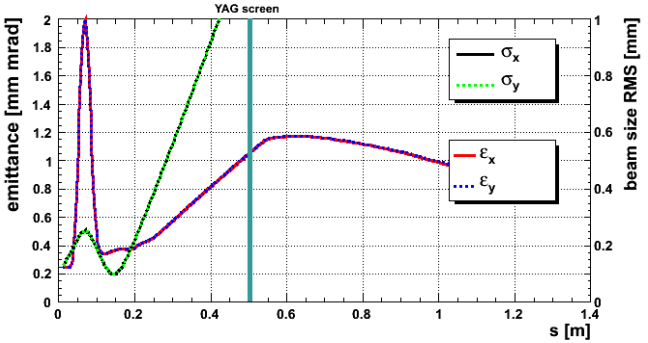
I_{tot} = 31 A



I_{tot} = 35 A



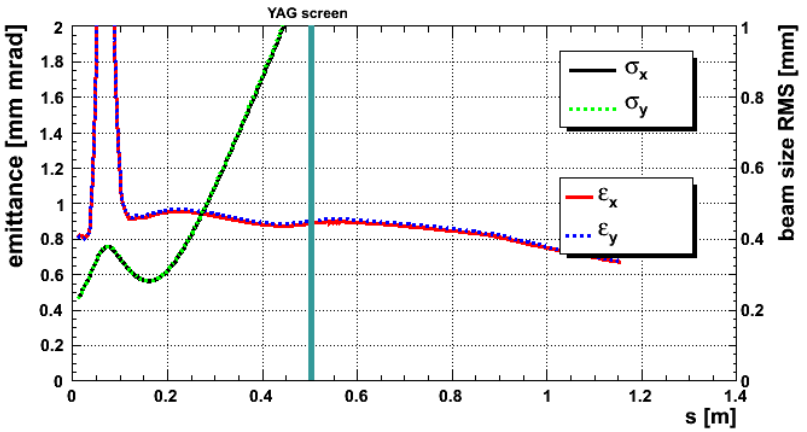
I_{tot} = 39 A



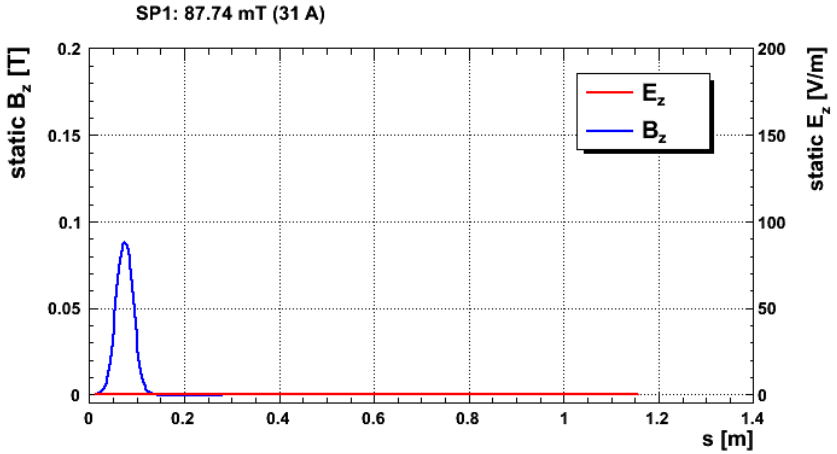
Charge: 7.6 pC
mesh: 32 × 32 × 32
macroparticles: 100k
time step: 0.1 ps (gun),
1 ps (after)
σ_t: 16.5 ps; $r_{x,y}$: **450 µm**

Simulation (Impact-t)

OBLA, phase-I, 12 mm gap, 315 kV



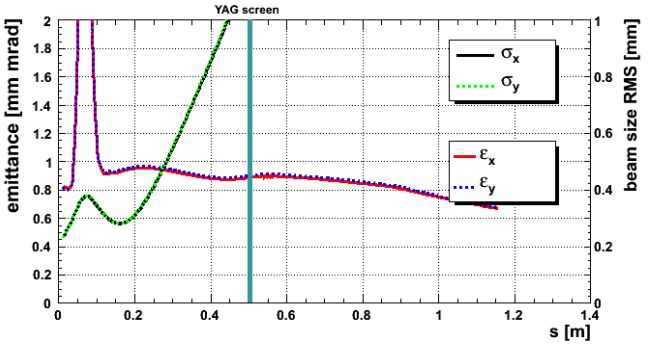
I_{tot} = 31 A



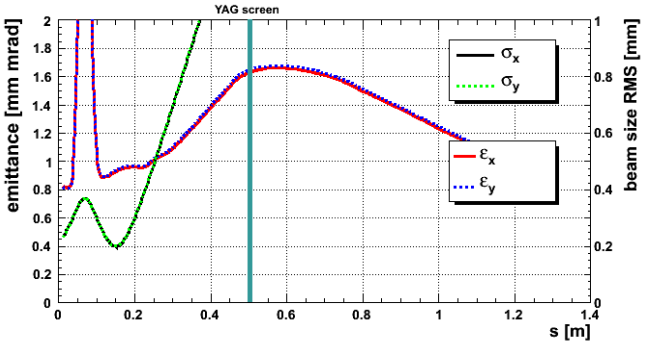
IMPACT-T Tue Jan 29 13:18:12 2008

OBLA, phase-I, 12 mm gap, 315 kV

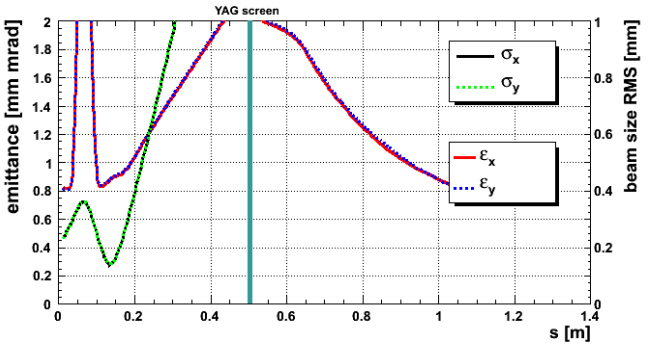
I_{tot} = 31 A



I_{tot} = 35 A



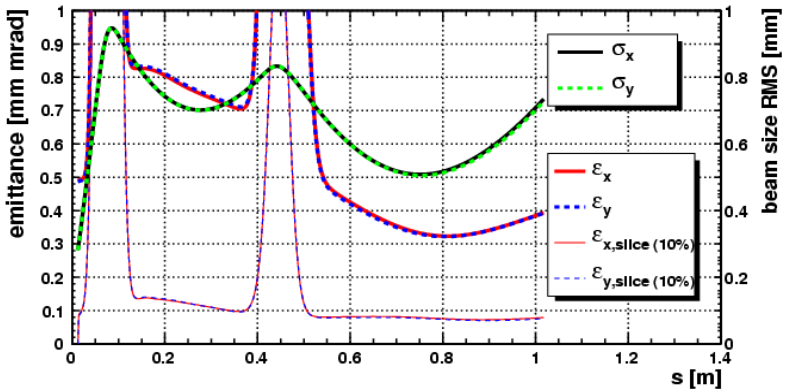
I_{tot} = 39 A

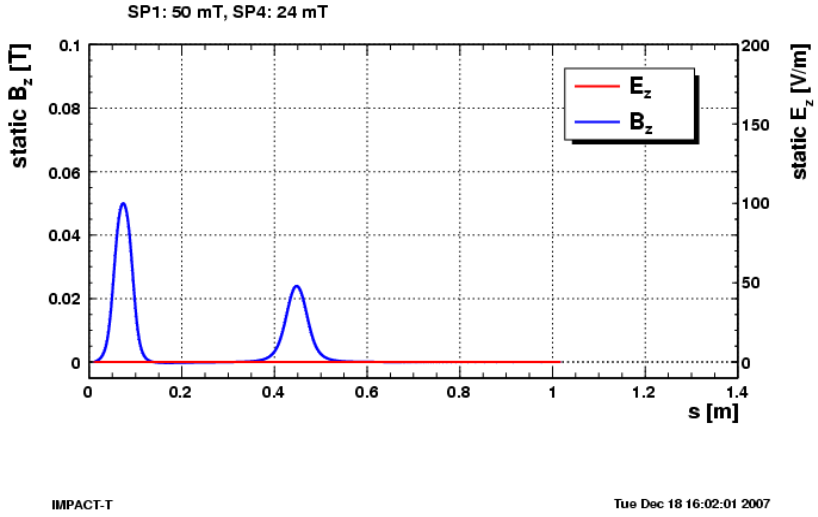


Charge: 6 pC
mesh: 32 × 32 × 32
macroparticles: 100k
time step: 0.1 ps (gun),
1 ps (after)
σ_t: 6.5 ps; $r_{x,y}$: 300 µm

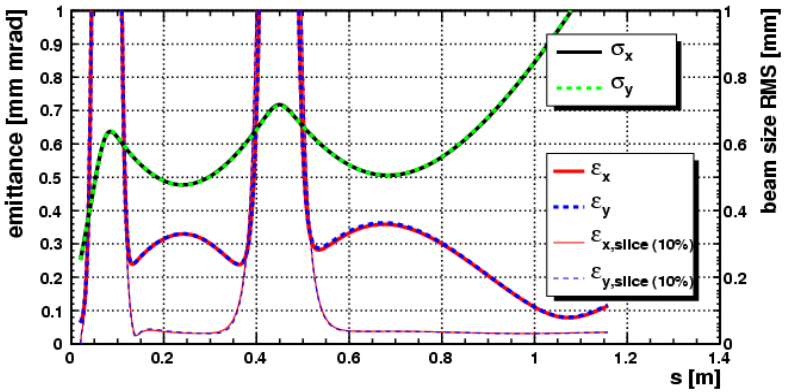
Older simulations (Impact-t)

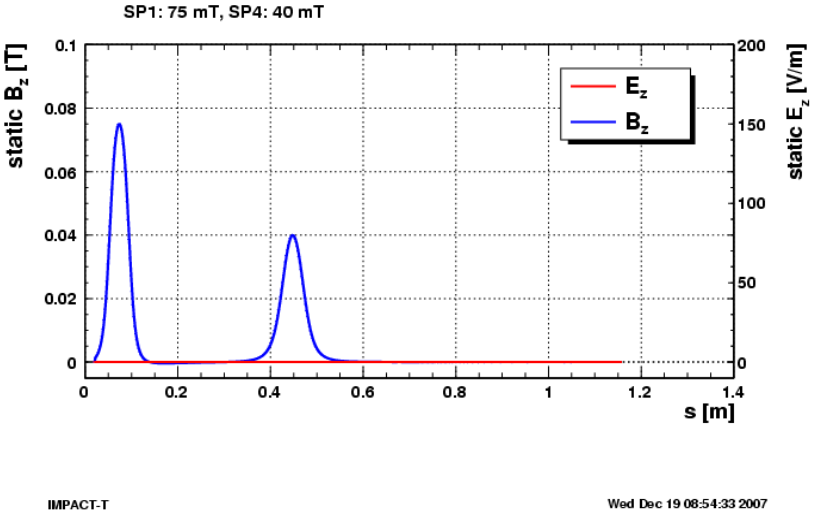
OBLA, phase-I, 12 mm gap, 100 kV





OBLA, phase-I, 12 mm gap, 200 kV

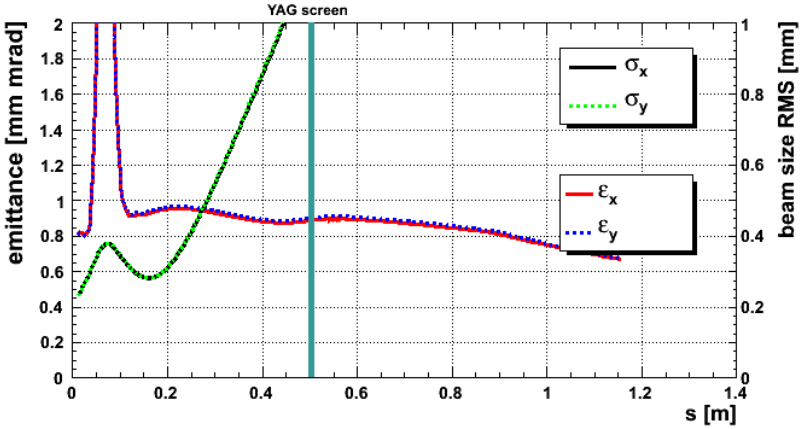




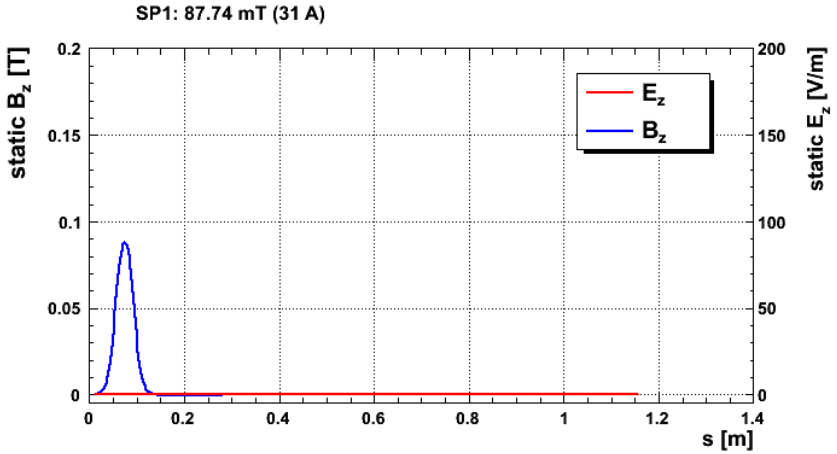
Simulation (Impact-t)

Charge: 7.6 pC
mesh: 32 × 32 × 32
macroparticles: 100k
time step: 0.1 ps (gun),
1 ps (after)
σ_t: 16.5 ps
$r_{x,y}$: **450 µm**

OBLA, phase-I, 12 mm gap, 315 kV



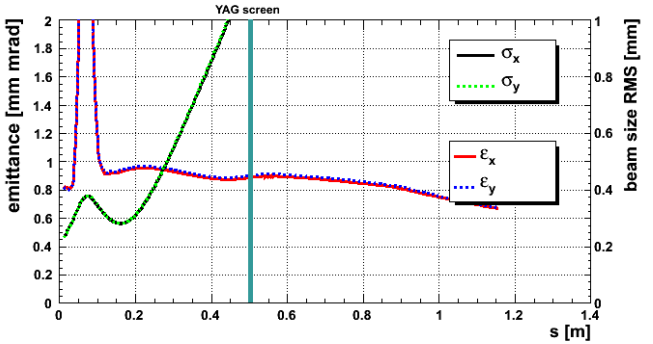
I_{tot} = 31 A



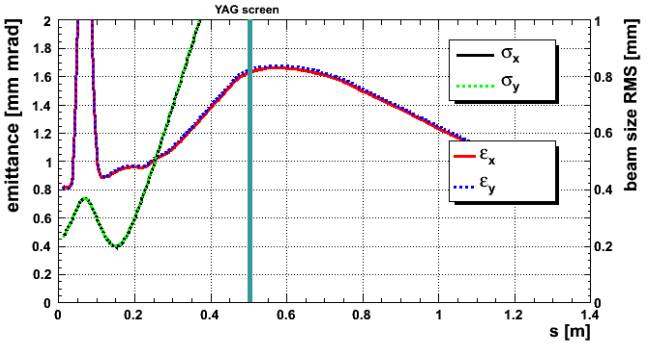
IMPACT-T Tue Jan 29 13:18:12 2008

OBLA, phase-I, 12 mm gap, 315 kV

I_{tot} = 31 A



I_{tot} = 35 A



I_{tot} = 39 A