

Summary of the dE experiment with the short Gaussian laser

01.12.2016

Working points for short Gaussian laser pulse

Gun gradient (MV/m)	60	
Gun phase	MMMG	
Laser temporal profile	~ 2 ps FWHM	
Booster phase	Make an upright phase-space on the screen	
Charge (pC)	200	100
BSA (mm)	0.85	0.75
	1.70	1.70

Motivation of the four working points:

We were not sure what we could measure because of the resolution (~2 keV without binning, 4~5 keV with 2x2 binning), these working points were proposed in order to see distinguishable measurement results!

TDS scan to find the best TDS set point (0.2 nC, BSA 0.85 mm)

- Laser transverse distribution at VC2
- MMMG gun phase
- Laser attenuator scan - bunch charge
- Beam momentum at HEDA1 with booster phase scan
- Main solenoid current scan - beam size at HIGH1.Scr1
- **Emittance at EMSY1 (increase the solenoid current with the best focus by 1%)**
 - 2.2 μm , 375 A**
- **Gregor wrote a nice script to quickly analyze the slice energy spread at HEDA2**
- **Main solenoid current changed to get a nice phase-space on the screen**
- **Slice energy spread measurement**
- **Re-measured the emittance**
 - 3.8 μm , 386 A, MMMG**
- Bunch length measurement
 - 10.66 \pm 0.41 ps (2.59/2.64 ps **FWHM** size of unstreaked beam)**

Summary of the typical results

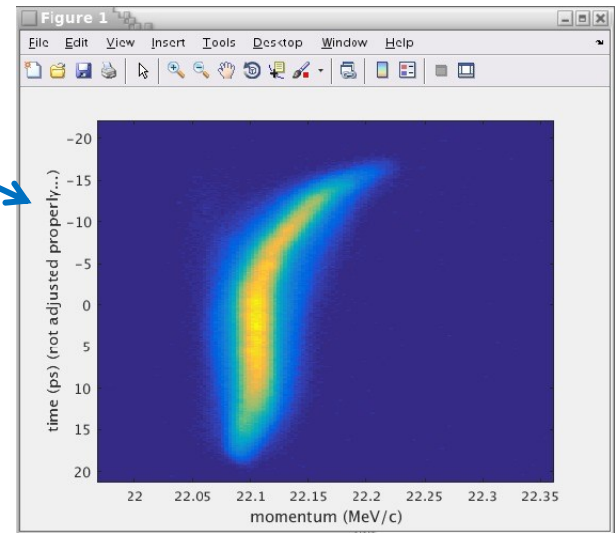
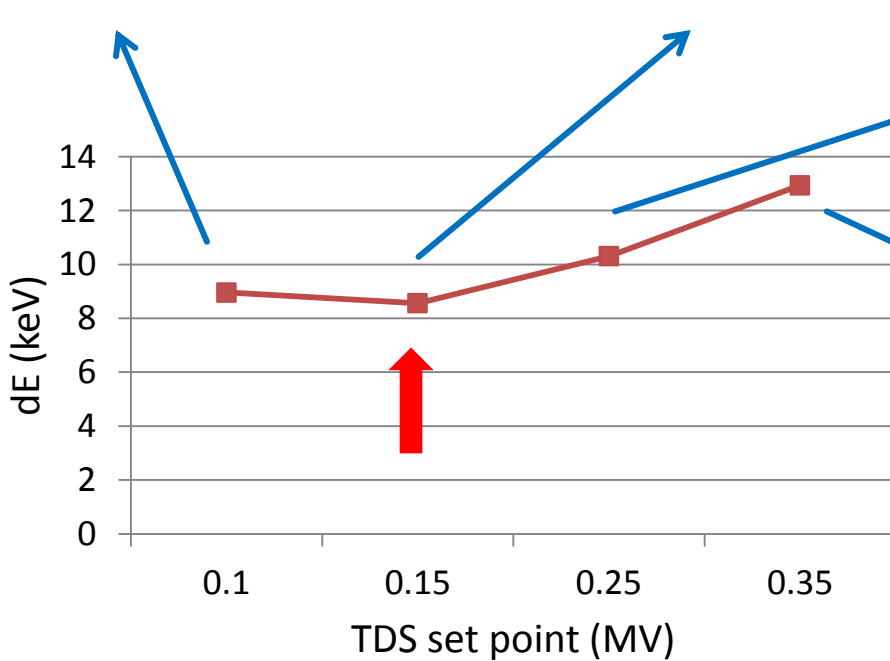
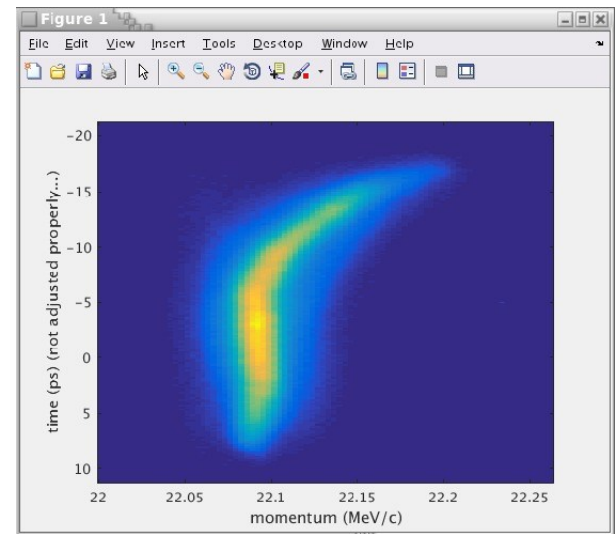
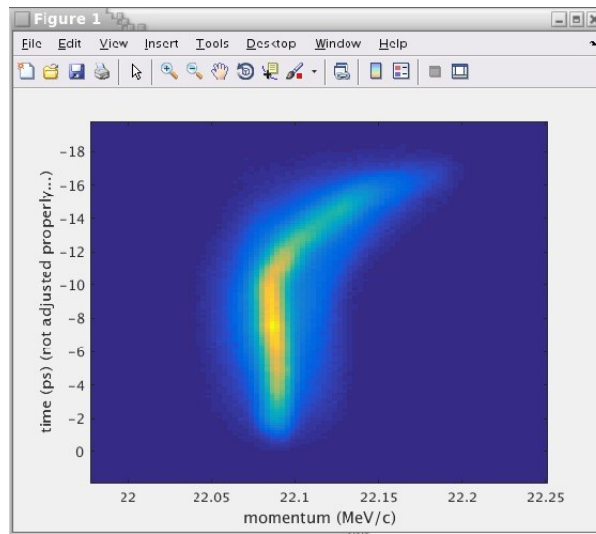
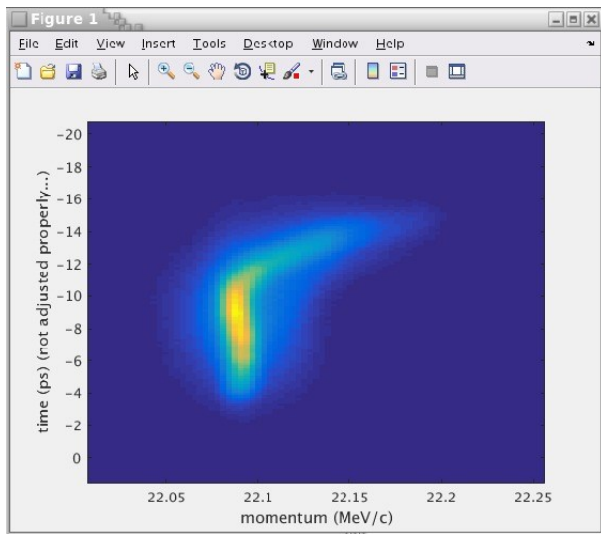
Bunch charge (pC)	RMS laser spot (mm)	I_{main} (A)	Emittance ¹ (μm)	Bunch length (ps)	min δ_u^2 (keV)
100	0.182/0.195	387	3.5	7.00 ± 0.15	7.0
	0.369/0.375	371	1.9	4.20 ± 0.18	8.2
200	0.201/0.214	386	3.8	10.66 ± 0.41	8.6
	0.423/0.428	371	2.1	5.80 ± 0.16	9.4

[1] At MMMG phase

[2] Central slice picked up by hand

$$\delta_E^{\text{measured}} \approx \sqrt{(\delta_E^{\text{real}})^2 + (\delta_E^\beta)^2 + (\delta_E^{\text{TDS}})^2}$$

TDS scan to find the best TDS set point (200 pC, BSA 0.85 mm)

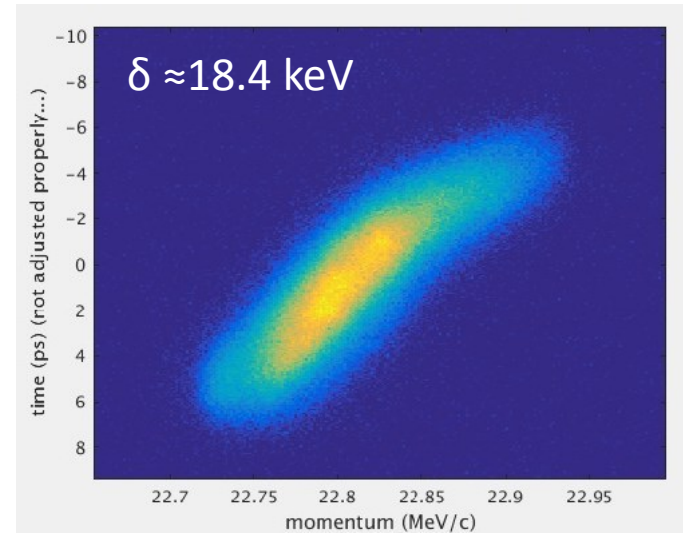
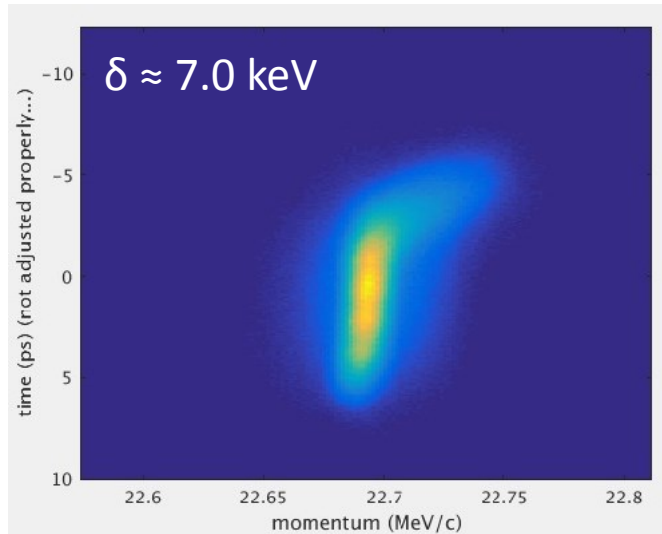


Comparison between the MMS and MMMG phases (100 pC, BSA 0.85 mm)

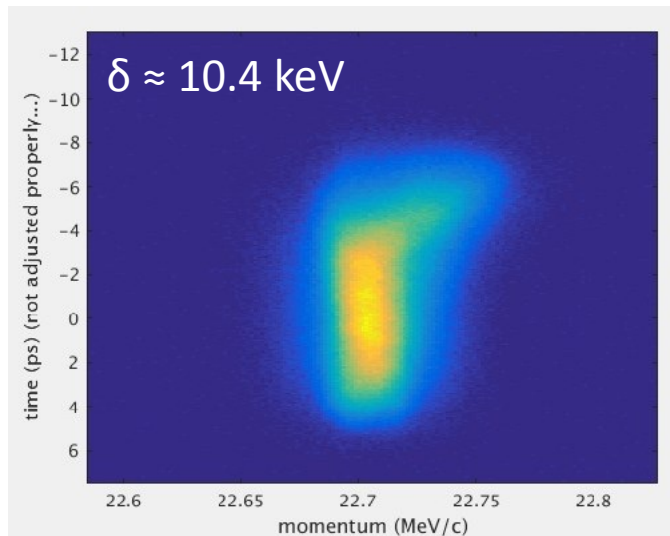
MMS phase

MMMG phase

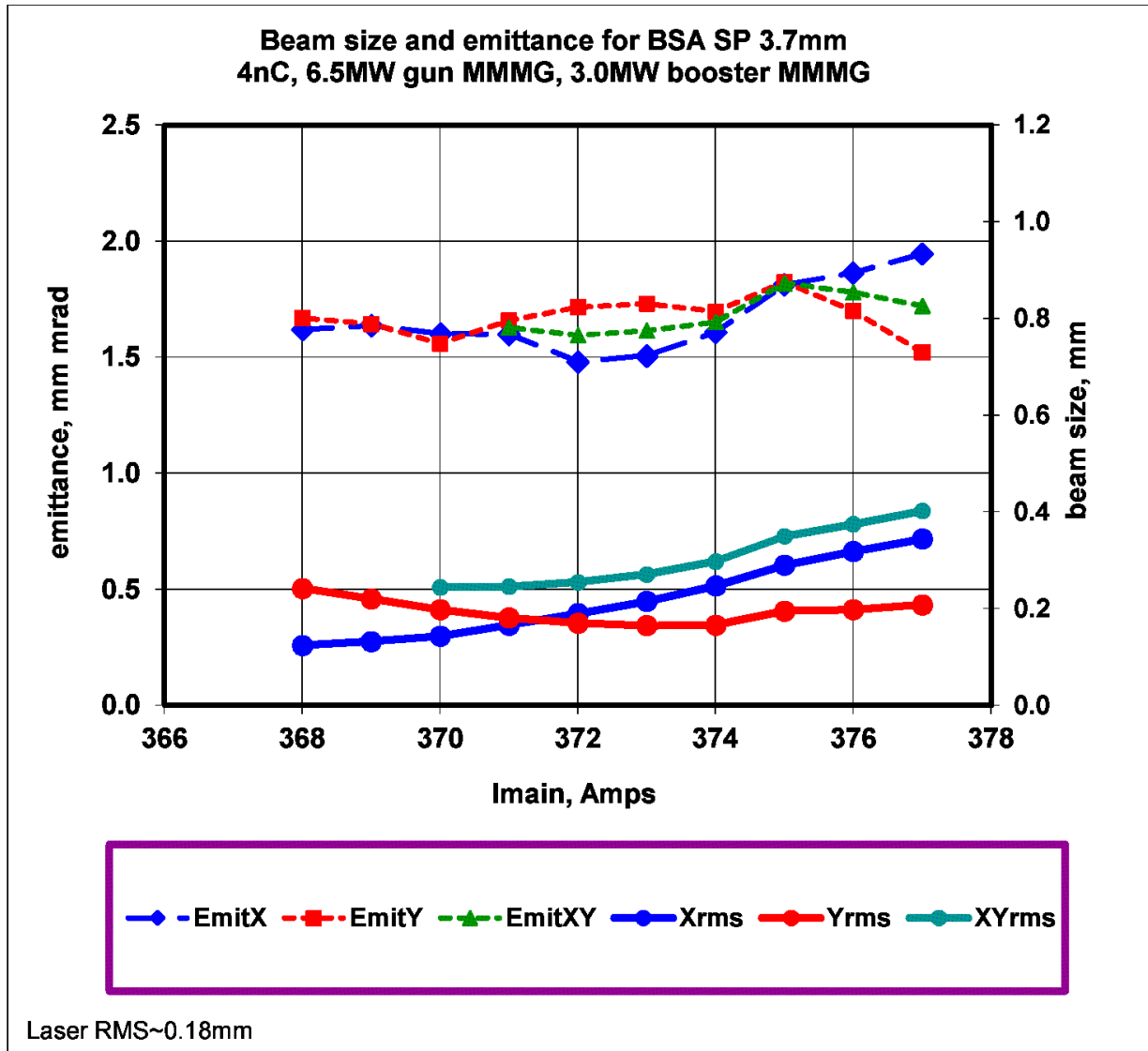
386.7 A



376.7 A



We confirmed that we were using the better main solenoid and booster phase setup.



Emittance scan (200 pC, rms laser spot 0.203/0.216 mm)

