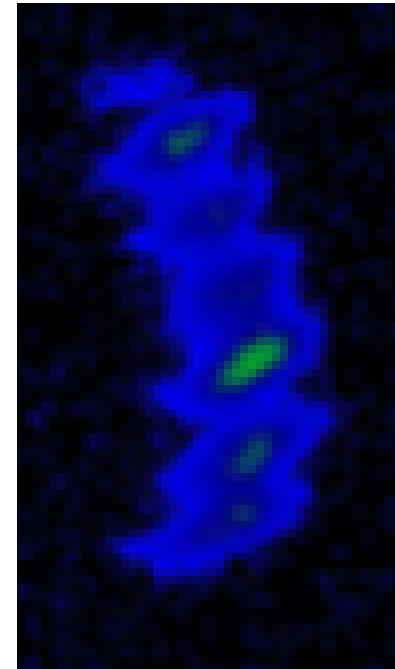


PITZ Run in 2016

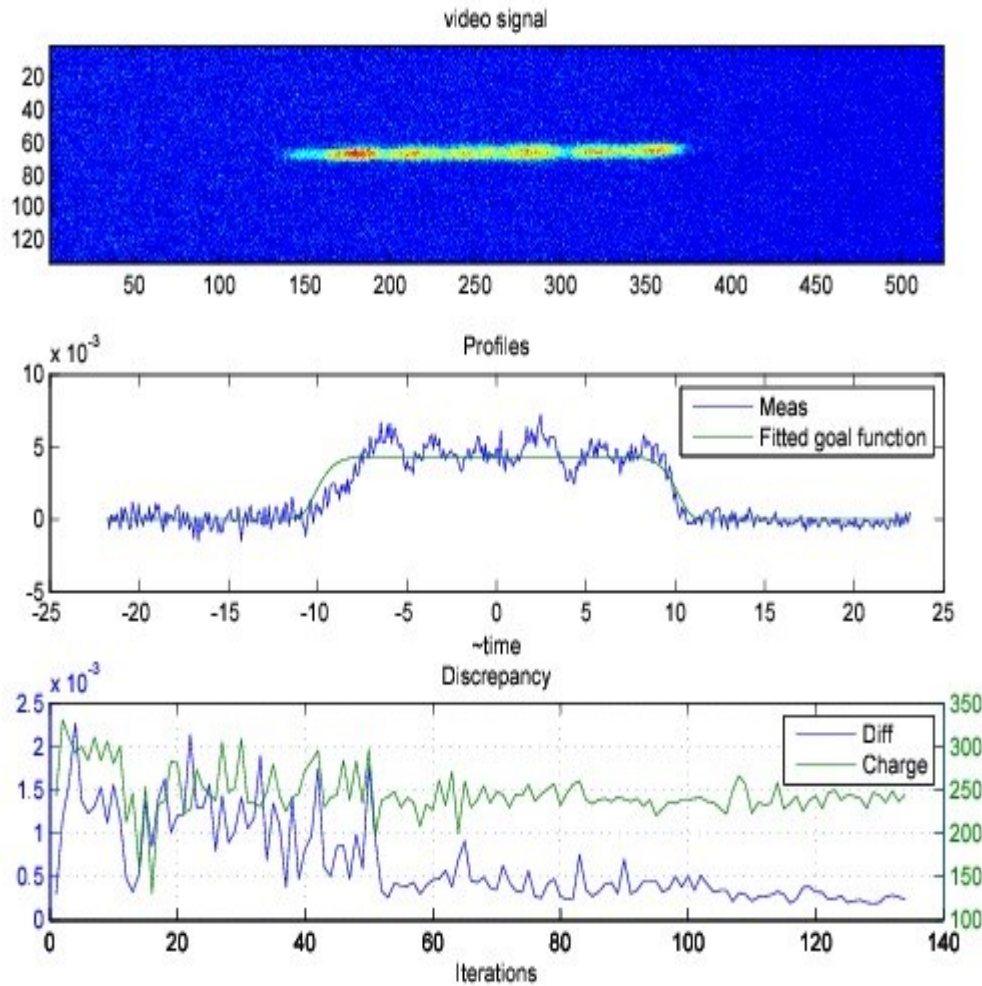
Some issues of the photocathode laser pulse shaping

Measurements 28.10.2016N-29.10.2016M

M. Krasilnikov
 δE -meeting
Zeuthen, 01.12.2016



Photocathode laser pulse shaping with TDS



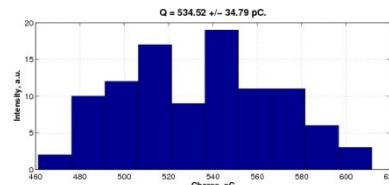
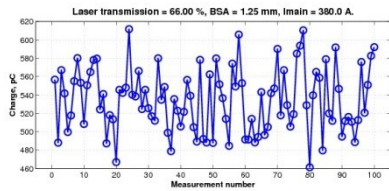
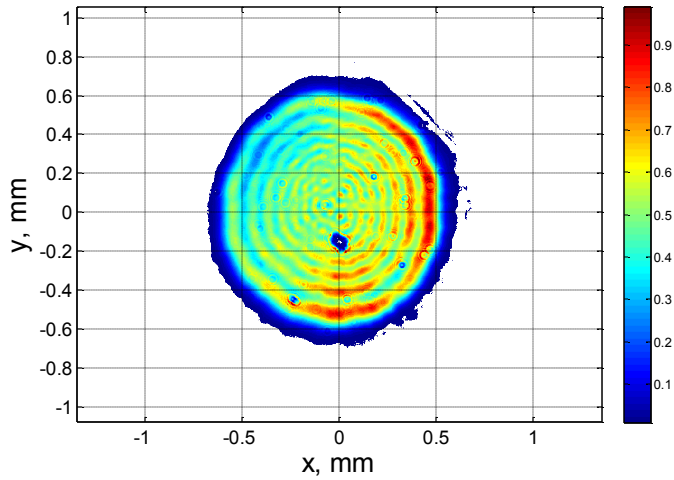
laser_pulse_shaper.xml PITZ.LASER/NEWLASER/GUN/

Laser Pulse Shaper settings

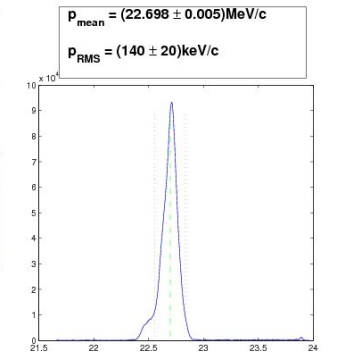
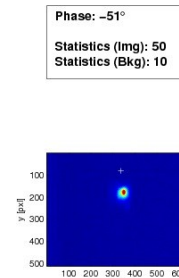
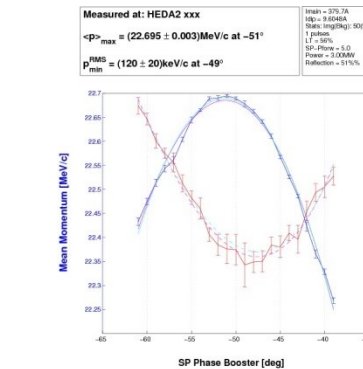
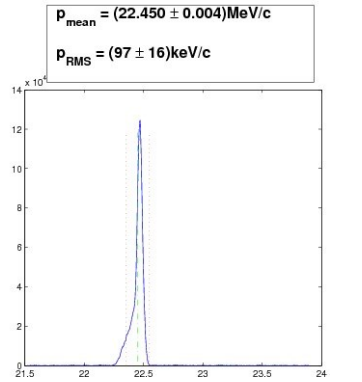
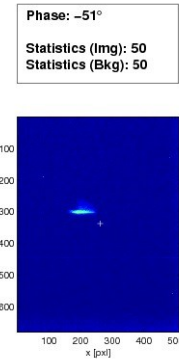
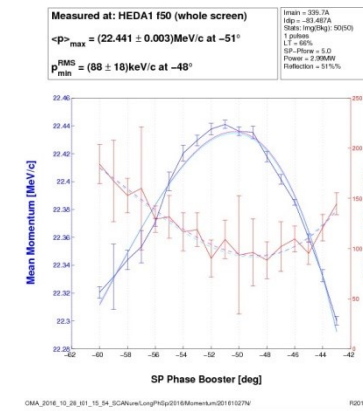
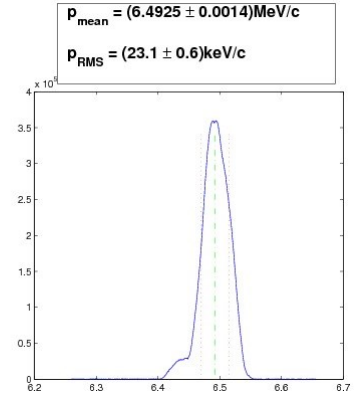
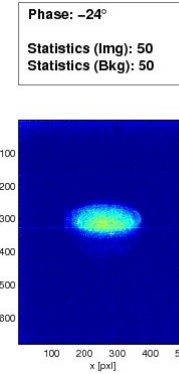
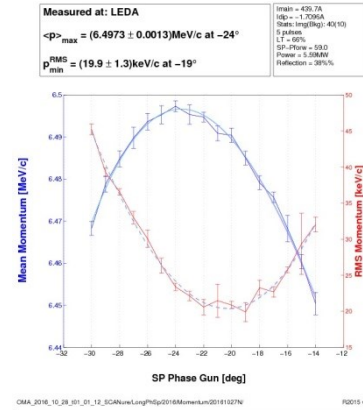
crystal no.	temperature setpoint	temperature read back	rotation angle [±1 deg]
1	25.400	25.406	0.701
2	35.300	35.320	0.027
3	37.500	37.480	0.088
4	23.400	23.406	0.001
5	38.300	38.353	0.302
6	38.300	38.320	0.287
7	26.300	26.310	0.295
8	41.600	41.642	0.133
9	38.100	38.032	0.279
10	35.900	35.982	0.248
11	40.700	40.718	0.298
12	40.200	40.202	1.000
13	27.900	27.904	0.248

Setup emittance measurements with obtained flattop laser

- VC2
- LEDA scan
- HEDA1 and HEDA2 scans
- Charge



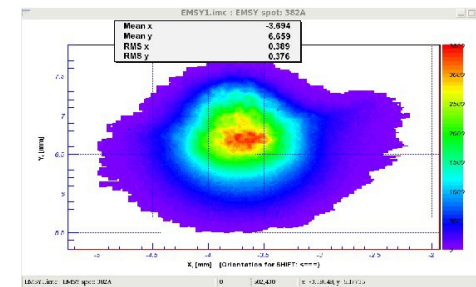
Data saved to Charge measurement using LowICT1.



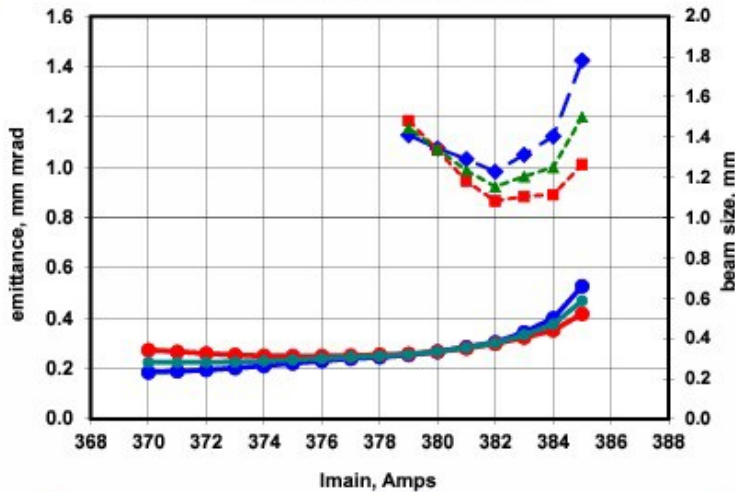
Emittance FT-500pC

I _{main} (A)	Xrms, mm	Yrms, mm	EmitX_2D, mm mrad	EmitY_2D, non-scaled	XYrms, mm	EMSY1 NoP	EMSY1 Gain	MOI NoP	MOI Gain	XBL NoP	XBL gain	EmitY_2D, mm mrad	EmitY_2D, non-scaled	YBL NoP	YBL gain	EmitXY_2D, mm mrad	EmitXY_2D, non-scaled	
Shutter speed 20 us for all measurements																		
385	0.659	0.522	1.425	1.049	0.667	2	18	2	23	3	22	1.011	0.802	17	22	1.2	0.917	
384	0.500	0.441	1.123	0.861	0.47	1	21	2	19	2	20	0.891	0.738	12	22	1	0.767	
383	0.430	0.405	1.050	0.802	0.417	1	18	1	23	2	20	0.884	0.635	9	22	0.993	0.714	
382	0.381	0.374	0.983	0.617	0.377	1	16	1	19	1	23	0.866	0.583	7	23	0.823	0.6	
381	0.357	0.351	1.033	0.640	0.364	1	14	1	21	1	20	0.945	0.605	7	22	0.898	0.622	
380	0.334	0.335	1.076	0.658	0.334	1	12	1	21	1	19	1.069	0.635	7	22	1.072	0.649	
379	0.318	0.324	1.128	0.683	0.321	1	11	1	21	1	19	1.185	0.667	7	22	1.188	0.676	
378	0.307	0.319			0.313	1	10	1	20							0	0	
377	0.300	0.315			0.307	1	9	1	18							0	0	
376	0.289	0.313			0.301	1	9	1	18							0	0	
375	0.277	0.313			0.294	1	9	1	16							0	0	
374	0.264	0.314			0.288	1	8	1	16							0	0	
373	0.253	0.318			0.284	1	8	1	16							0	0	
372	0.244	0.326			0.282	1	8									0	0	
371	0.237	0.334			0.281	1	9									0	0	
370	0.232	0.343			0.282	1	9									0	0	
369					0											0	0	

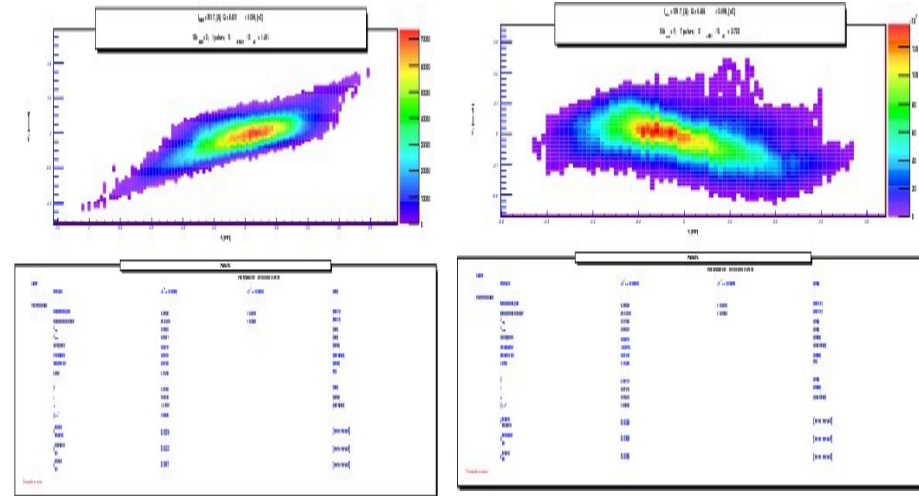
➤ 27.10N
 X_{em} = 0.993 mm mrad
 Y_{em} = 0.866 mm mrad,
 XY_{em} = 0.927 mm mrad



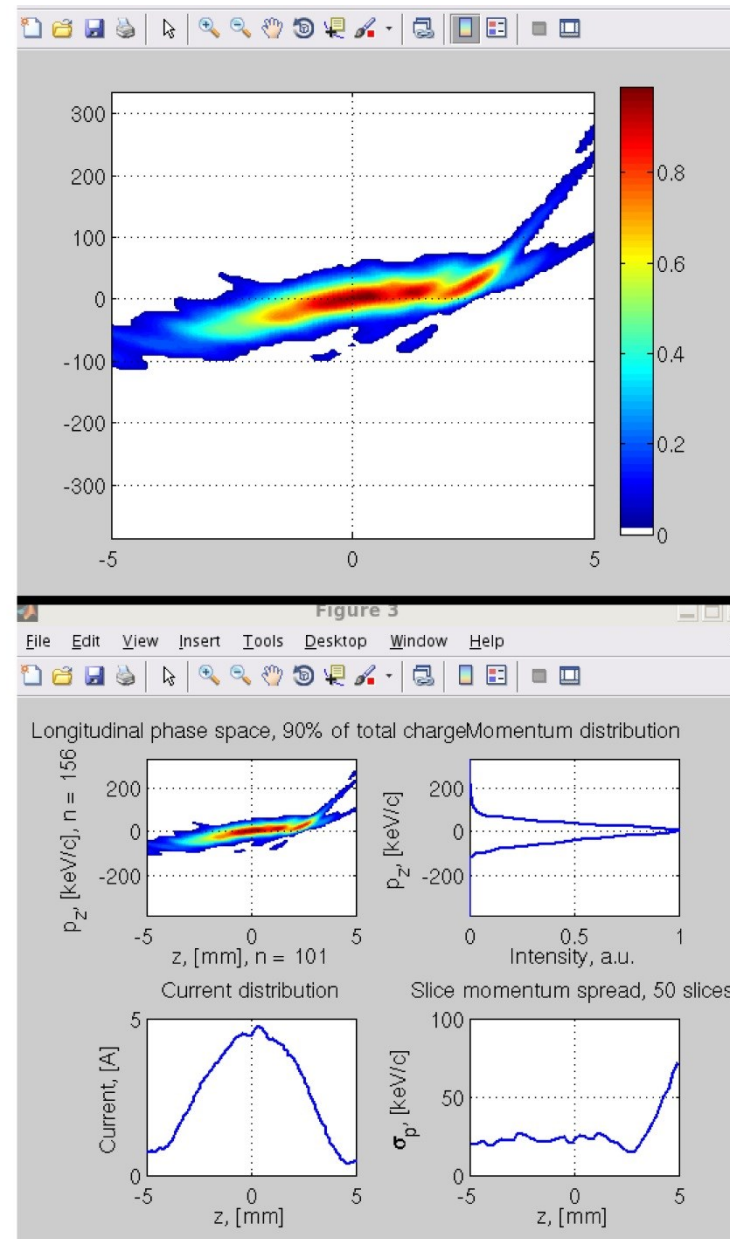
Beam size and 2D emittance for BSA 1.25 mm 0.5 nC, gun + booster at MMMG



Legend: EmitX (blue diamonds), EmitY (red squares), EmitXY (green triangles), Xrms (blue circles), Yrms (red circles), XYrms (green circles)



LPS tomography from HEDA1 Scan



$dp_z = 4.657$ [keV/c]

$dz = 0.100$ [mm]

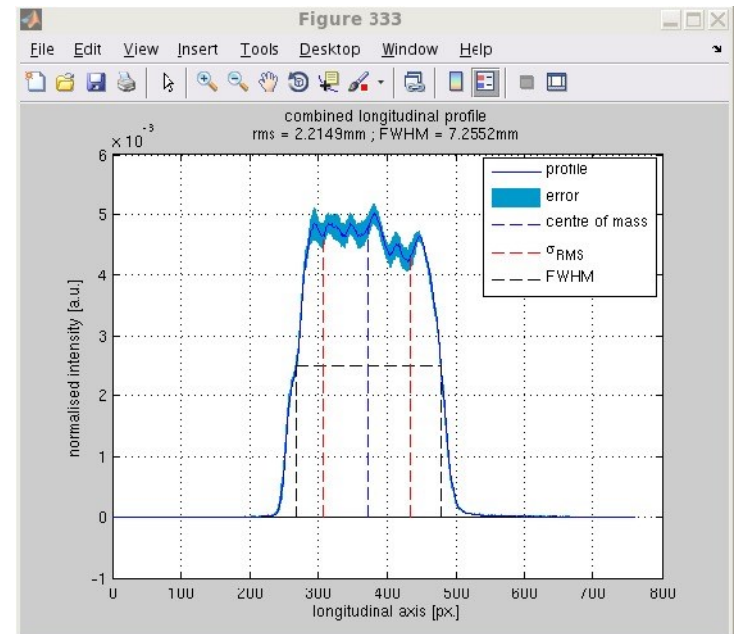
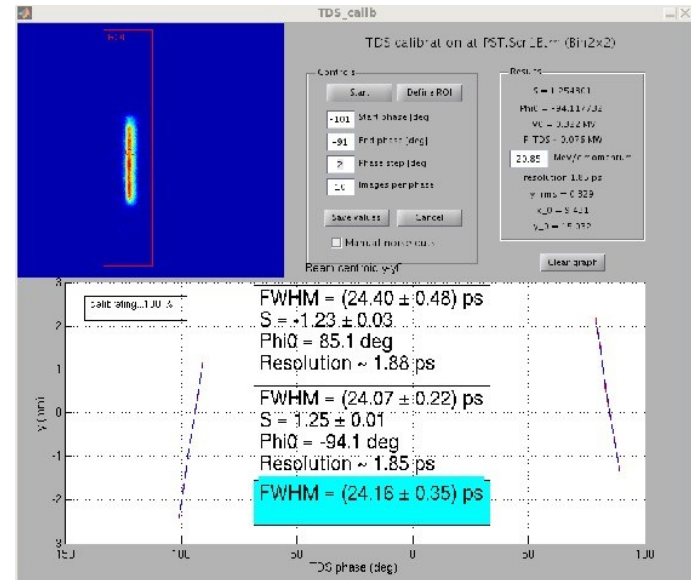
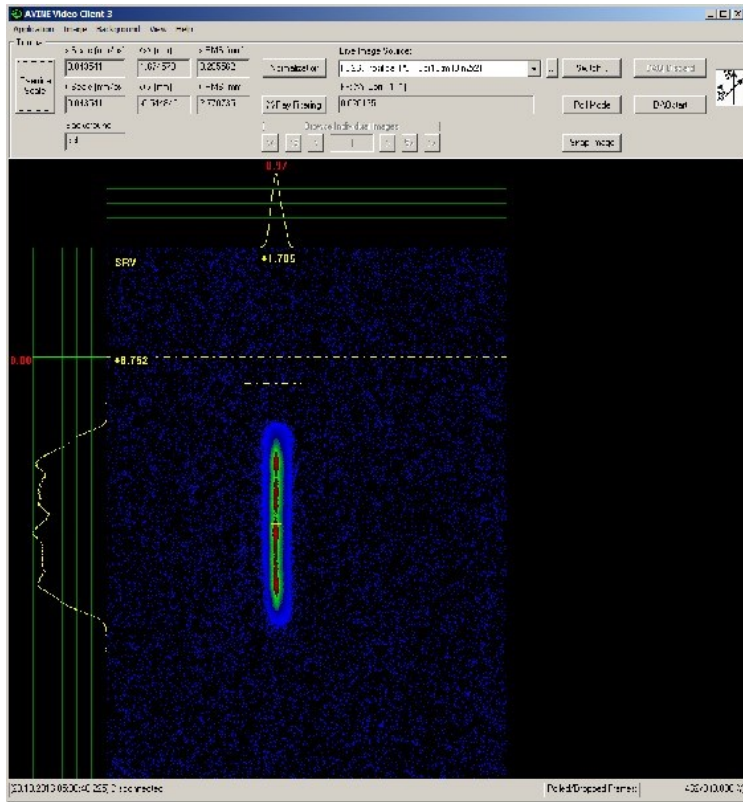
RMS bunch length = 2.11 [mm]

RMS momentum spread = 44.06 [keV/c]

Longitudinal Emittance = 57.26 [mm*keV/c]

TDS measurements at PST.Scr1

- TDS phase scan
- Images
- Profile



Beam transport to HEDA2

- Quads
- Steerers

The image displays three EPICS control panels for magnet systems, arranged horizontally. Each panel contains a grid of magnet control elements and a schematic diagram at the bottom.

- magnets_quad.xml (Left Panel):** Titled "quadrupol magnets", it shows 20 individual magnet controls (HIGH1.Q1 to HIGH2.Q1) with fields for current (e.g., 12.000 A) and steering (e.g., 0.00112 A). A "new degaussing gui" is visible in the center.
- tomography_quads.xml (Middle Panel):** Titled "tomography module quadrupol magnets", it shows 12 magnet controls (PST.QM1 to PST.QT6) with similar current and steering fields. A "new degaussing gui" is also present.
- magnets_steerer.xml (Right Panel):** Titled "steerer magnets", it shows 10 rotating steerer controls (LOW.ST1 to HIGH2.ST2) with fields for current (e.g., -0.49989 A) and steering (e.g., 1.30092 A). A "Motor power is on" indicator is visible.

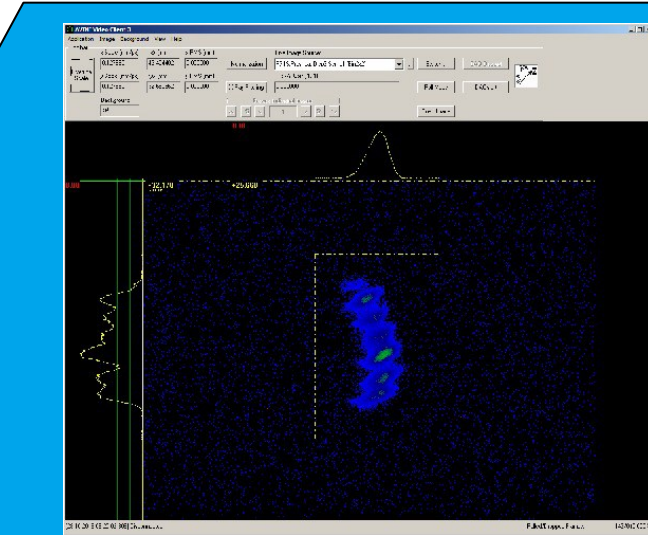
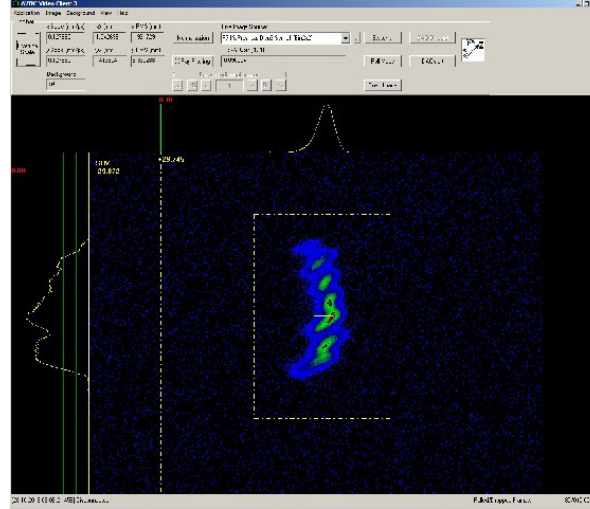
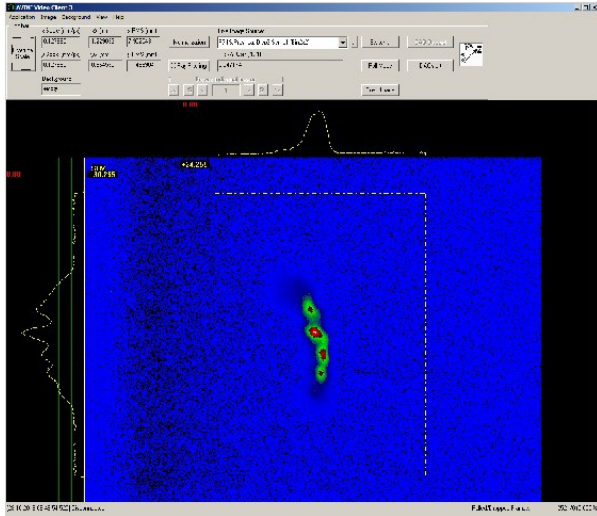
Each panel includes a schematic diagram at the bottom showing the physical layout of the magnets along a beamline. The diagrams are labeled "states of the magnets power supply" and "magnets overview".

FT Longitudinal Phase Space (LPS) → PZ(horiz)-Time(vert)

500pC

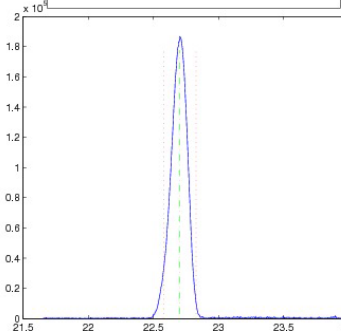
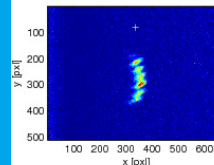
220pC

100pC



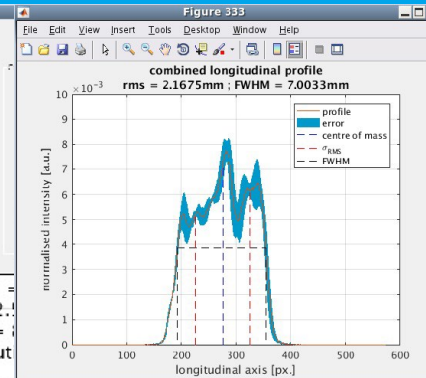
Phase: -51°
 Statistics (img): 50
 Statistics (Bkg): 20

$p_{\text{mean}} = (22.704 \pm 0.007)\text{MeV}/c$
 $p_{\text{RMS}} = (120 \pm 20)\text{keV}/c$



FWHM = $(15.49 \pm 3.46)\text{ps}$
 $S = -2.1$
 $\text{Phi}0 = -96.4\text{deg}$
 Resolut

FWHM = $(17.20 \pm 3.85)\text{ps}$

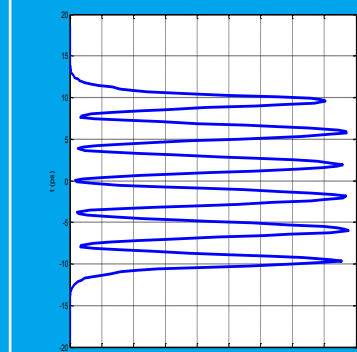
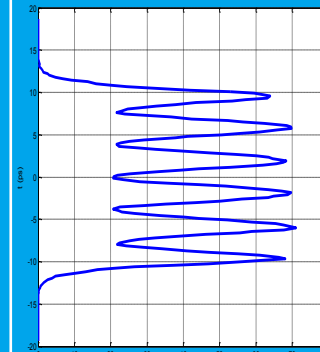
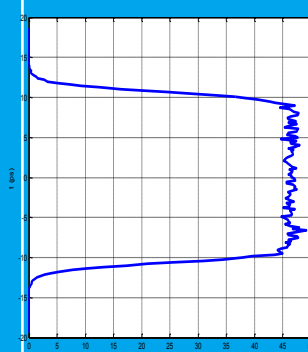


FWHM = $(15.49 \pm 3.46)\text{ps}$
 $S = 2.93 \pm 0.03$
 $\text{Phi}0 = -96.4\text{deg}$
 Resolution $\sim 1.59\text{ps}$

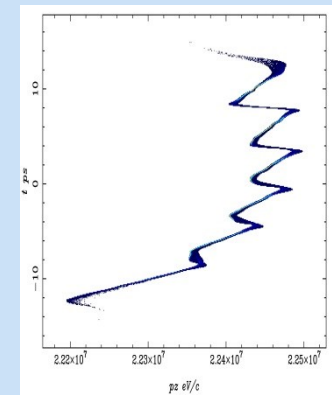
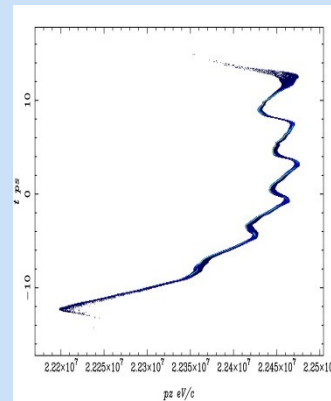
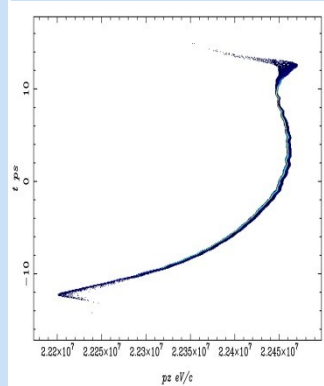
TDS phase (deu)

ASTRA simulations

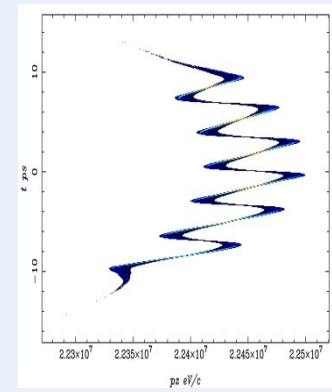
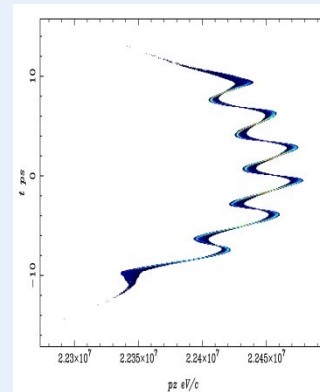
Cathode laser temporal profile →



LPS(Q=0.5nC) →



LPS(Q=0.1nC) →



Conclusions

- > Photocathode laser pulse shaping:
 - No OSS so far
 - Using TDS is tricky, but possible
- > TDS + PST.Scr1:
 - Higher charges are better for S2N reasons
 - Charge reduction → increase of the temporal modulations
- > TDS + HEDA2 = Longitudinal Phase Space (LPS):
 - LPS is strongly modulated and consists of several (up to 7) bunchlets
 - Chirps of bunchlets \perp to the overall beam chirp
- > Explanation:
 - MB Instability?
 - Beam transport?
 - Systematic limitation of the pulse shaper?
- > ...

LPS based laser pulse shaper optimization

