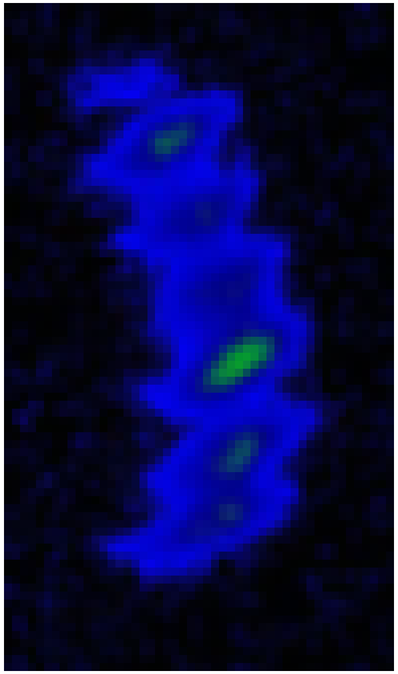
PITZ Run in 2016

Some issues of the photocathode laser pulse shaping

Measurements 28.10.2016N-29.10.2016M

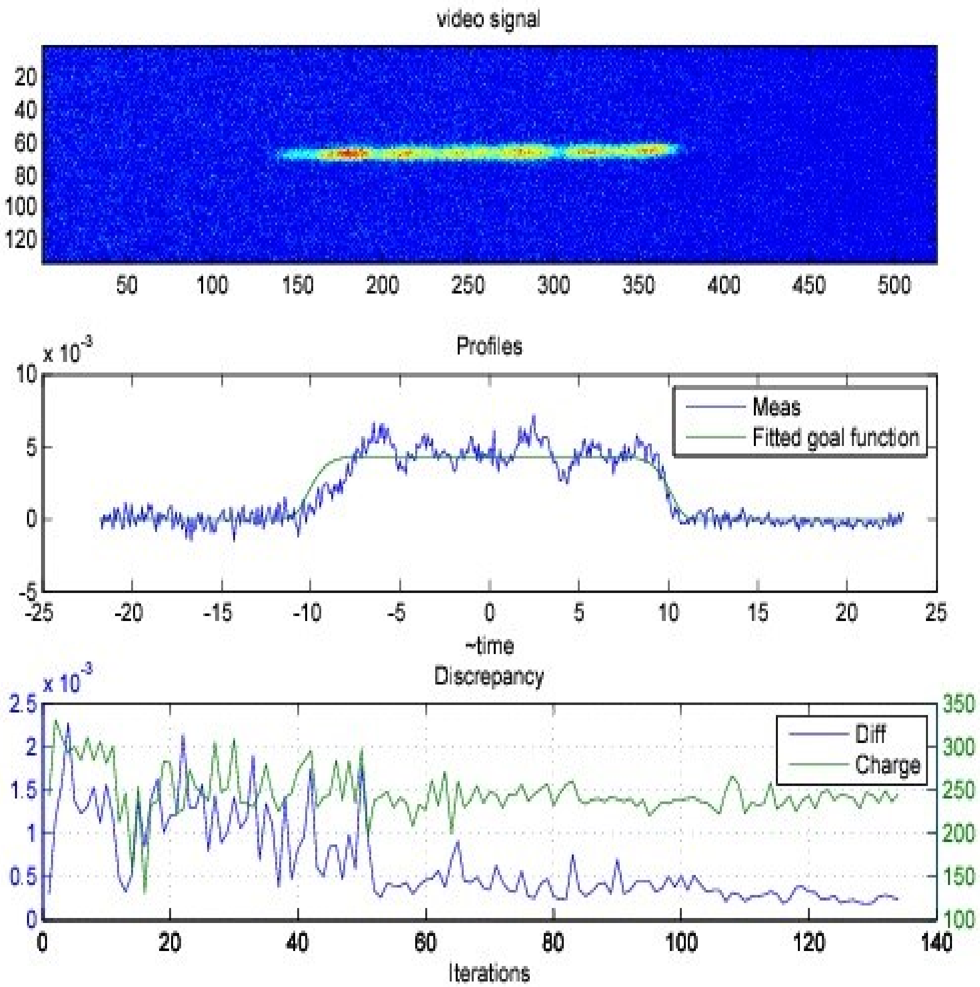


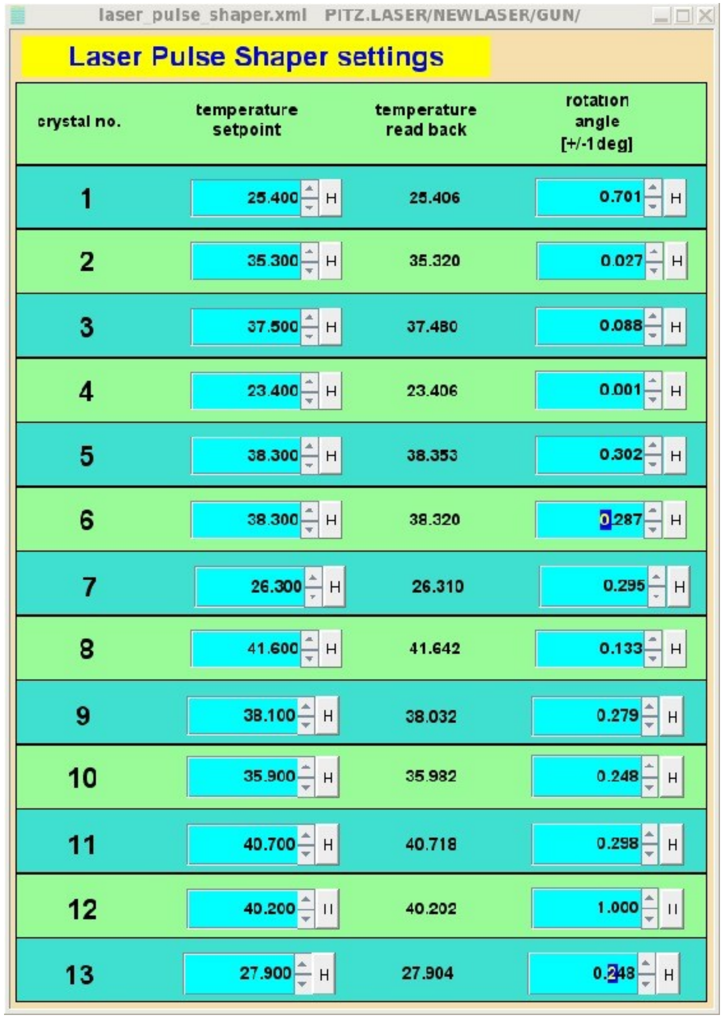
M. Krasilnikov
δE-meeting
Zeuthen, 01.12.2016

HELMHOLTZ | ASSOCIATION

DESY

Photocathode laser pulse shaping with TDS



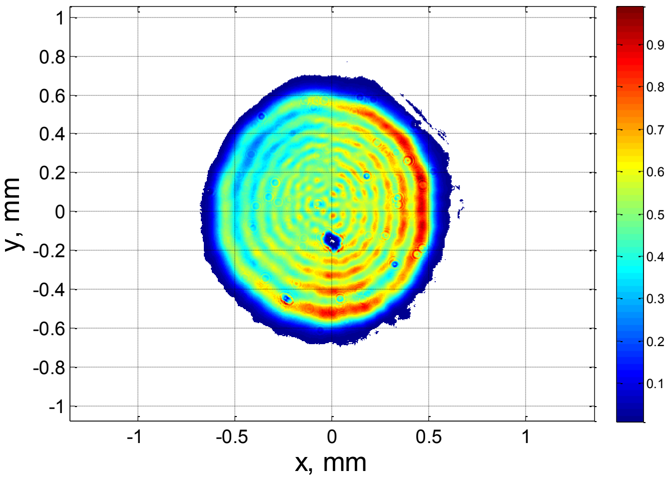

laser_pulse_shaper.xml PITZ.LASER/NEWLASER/GUN/

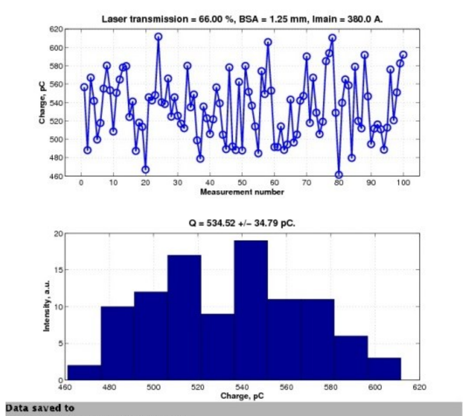
Laser Pulse Shaper settings

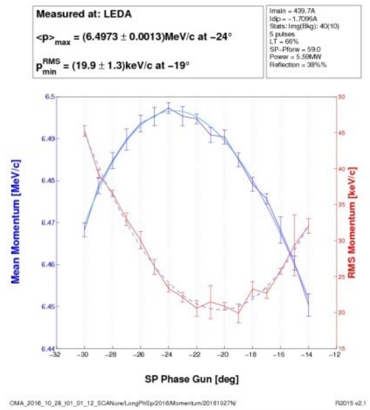
crystal no.	temperature setpoint	temperature read back	rotation angle [+/-1deg]
1	25.400	25.406	0.701
2	35.300	35.320	0.027
3	37.500	37.480	0.088
4	23.400	23.406	0.001
5	38.300	38.353	0.302
6	38.300	38.320	0.287
7	26.300	26.310	0.295
8	41.600	41.642	0.133
9	38.100	38.032	0.279
10	35.900	35.982	0.248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

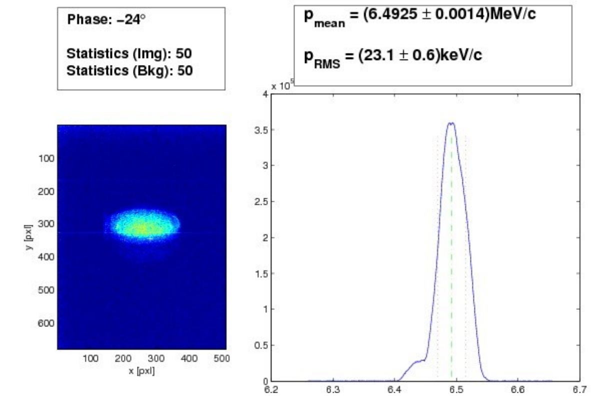
Setup emittance measurements with obtained flattop laser

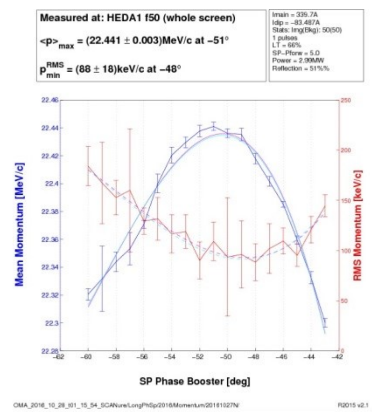
- VC2
- LEDA scan
- HEDA1 and HEDA2 scans
- Charge

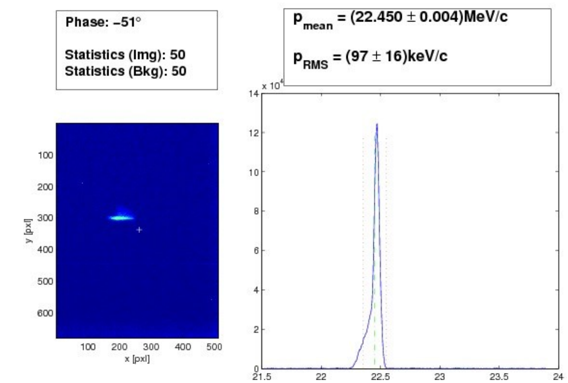


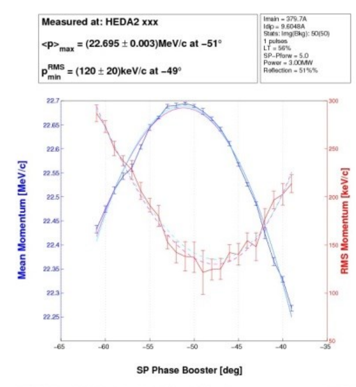


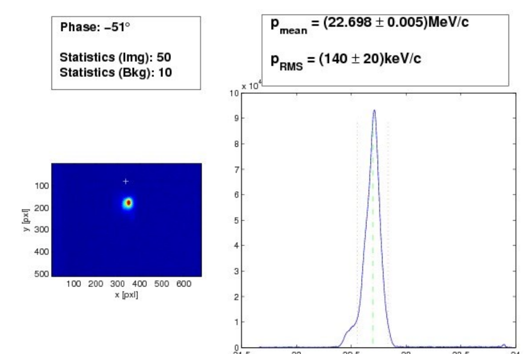






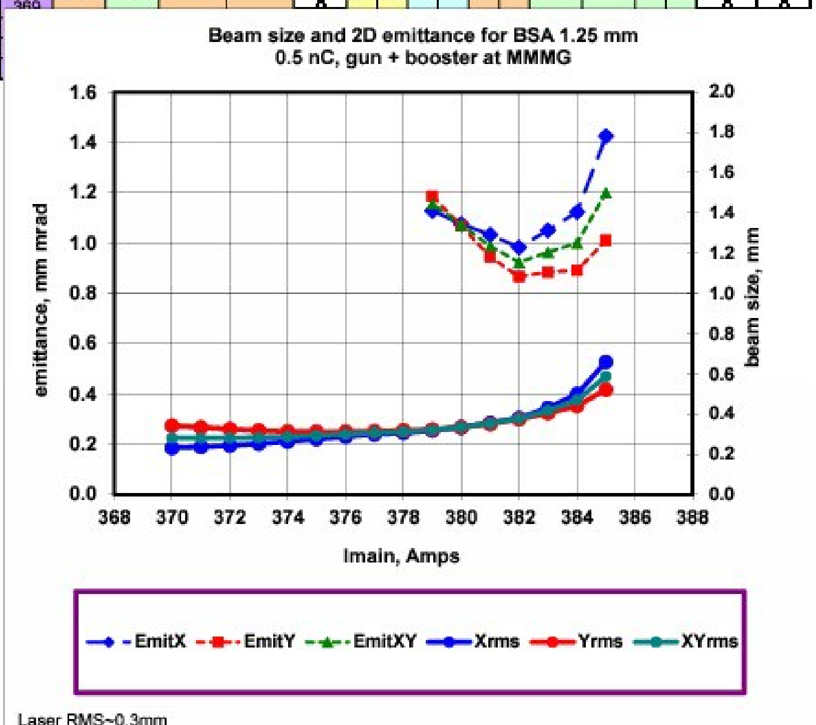




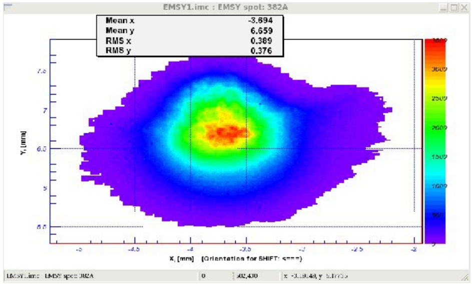


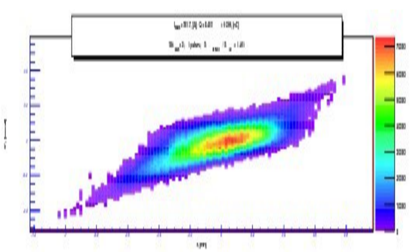
Emittance FT-500pC

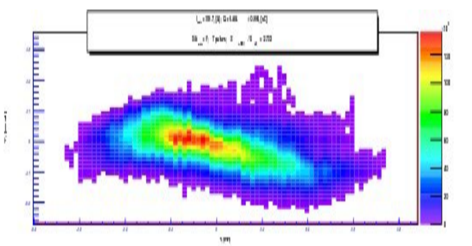
I_main (A)	Xrms, mm	Yrms, mm	EmitX_2D, mm mrad	EmitX_2D, nonscaled	XYrms, mm	EMSY1 NoP	EMSY1 Gain	MOI NoP	MOI, Gain	XBL NoP	XBL gain	EmitY_2D, mm mrad	EmitY_2D, nonscaled	YBL NoP	YBL gain	EmitXY_2D, mm.mrad	EmitXY_2D, nonscaled
Shutter speed 20 us for all BL measurements																	
385	0.659	0.522	1.425	1.049	0.687	2	18	2	23	3	22	1.011	0.802	17	22	1.2	0.817
384	0.500	0.441	1.123	0.861	0.47	1	21	2	19	2	23	0.891	0.738	12	22	1	0.797
383	0.430	0.405	1.050	0.802	0.417	1	18	1	23	2	20	0.884	0.635	9	22	0.963	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	0.923	0.6
381	0.357	0.351	1.033	0.640	0.354	1	14	1	21	1	20	0.945	0.605	7	22	0.988	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	0.646
379	0.318	0.324	1.128	0.683	0.321	1	11	1	21	1	19	1.185	0.667	7	22	1.156	0.675
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

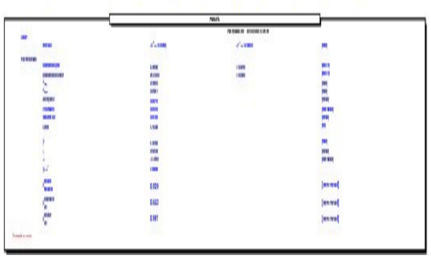


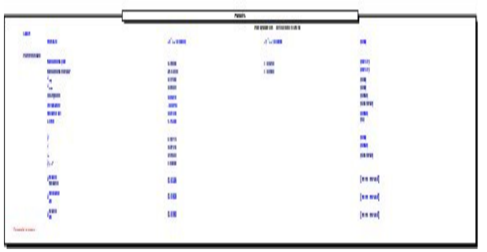
> 27.10N
Xem= 0.993 mm mrad
Yem= 0.866 mm mrad,
XYem= 0.927 mm mrad



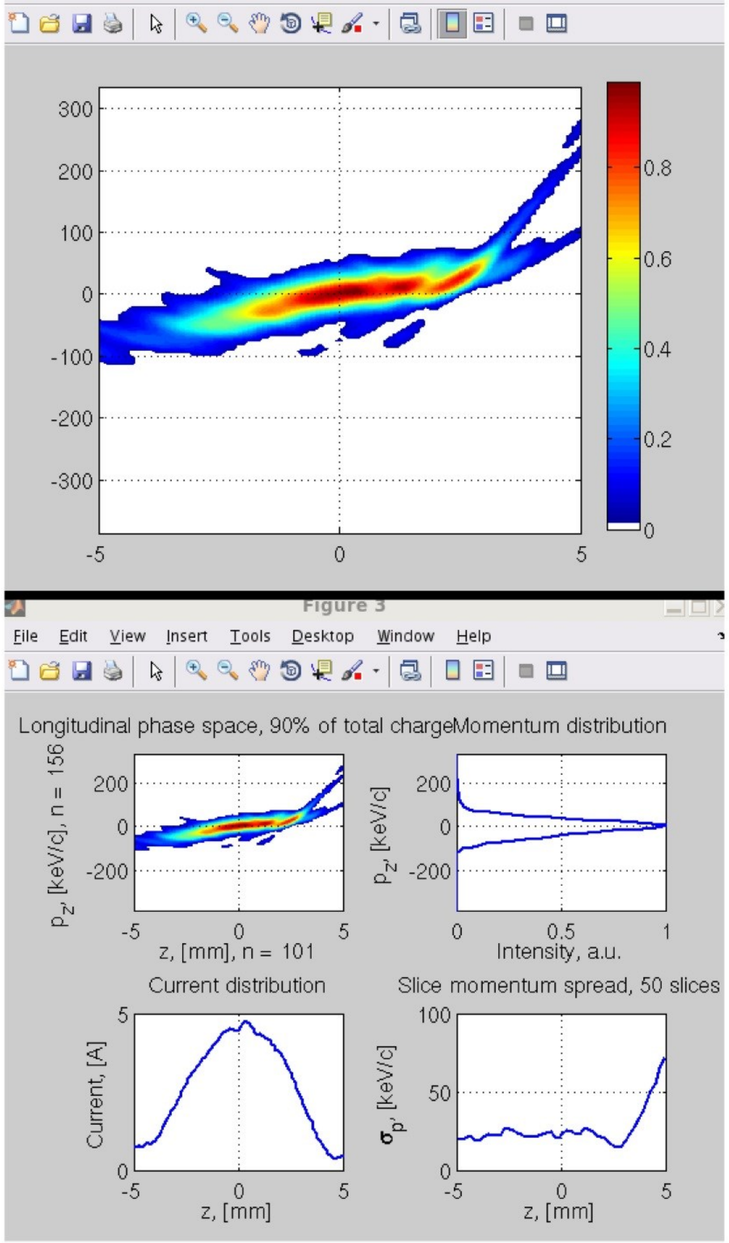








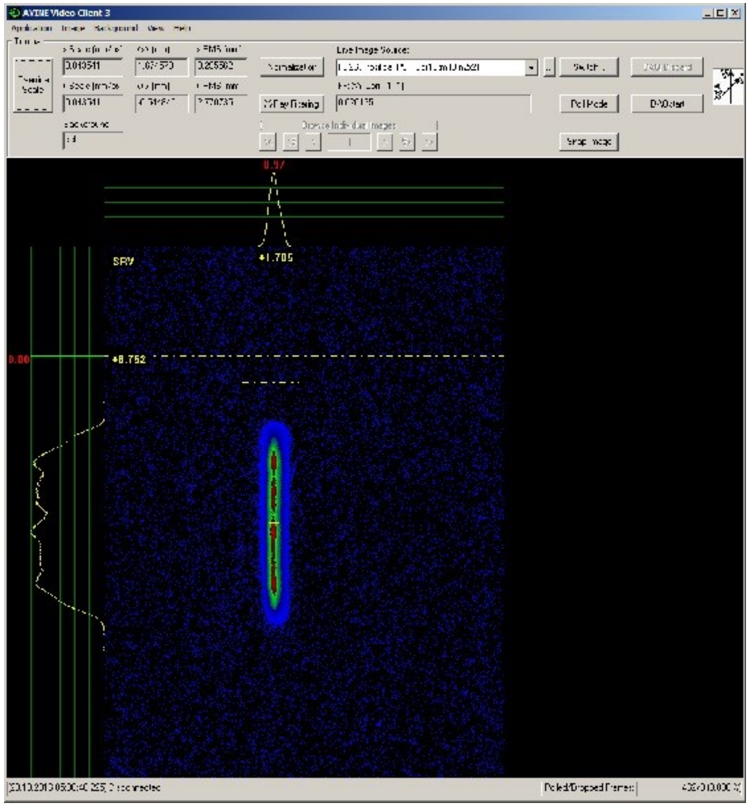
LPS tomography from HEDA1 Scan

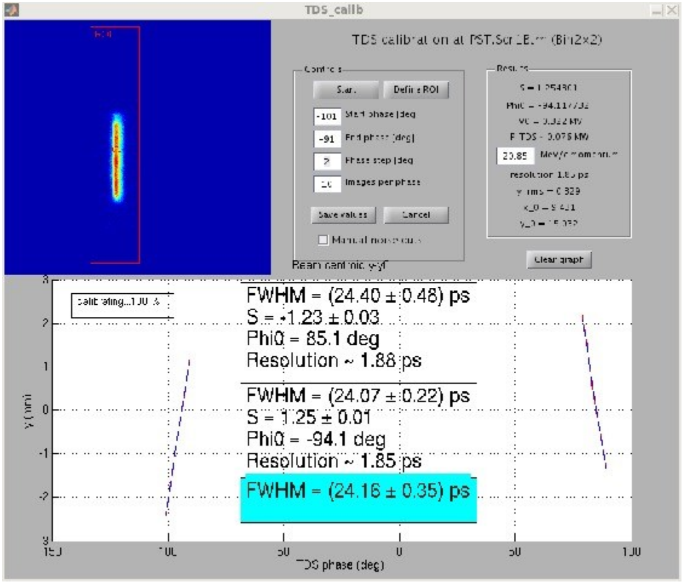


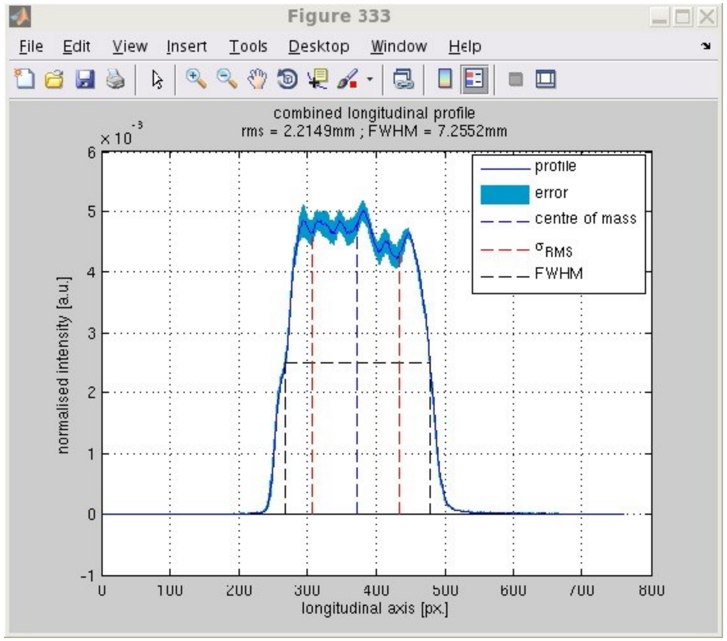
dpz = 4.657 [keV/c]
dz = 0.100 [mm]
RMS bunch length = 2.11 [mm]
RMS momentum spread = 44.06 [keV/c]
Longitudinal Emittance = 57.26 [mm*keV/c]

TDS measurements at PST.Scr1

- TDS phase scan
- Images
- Profile

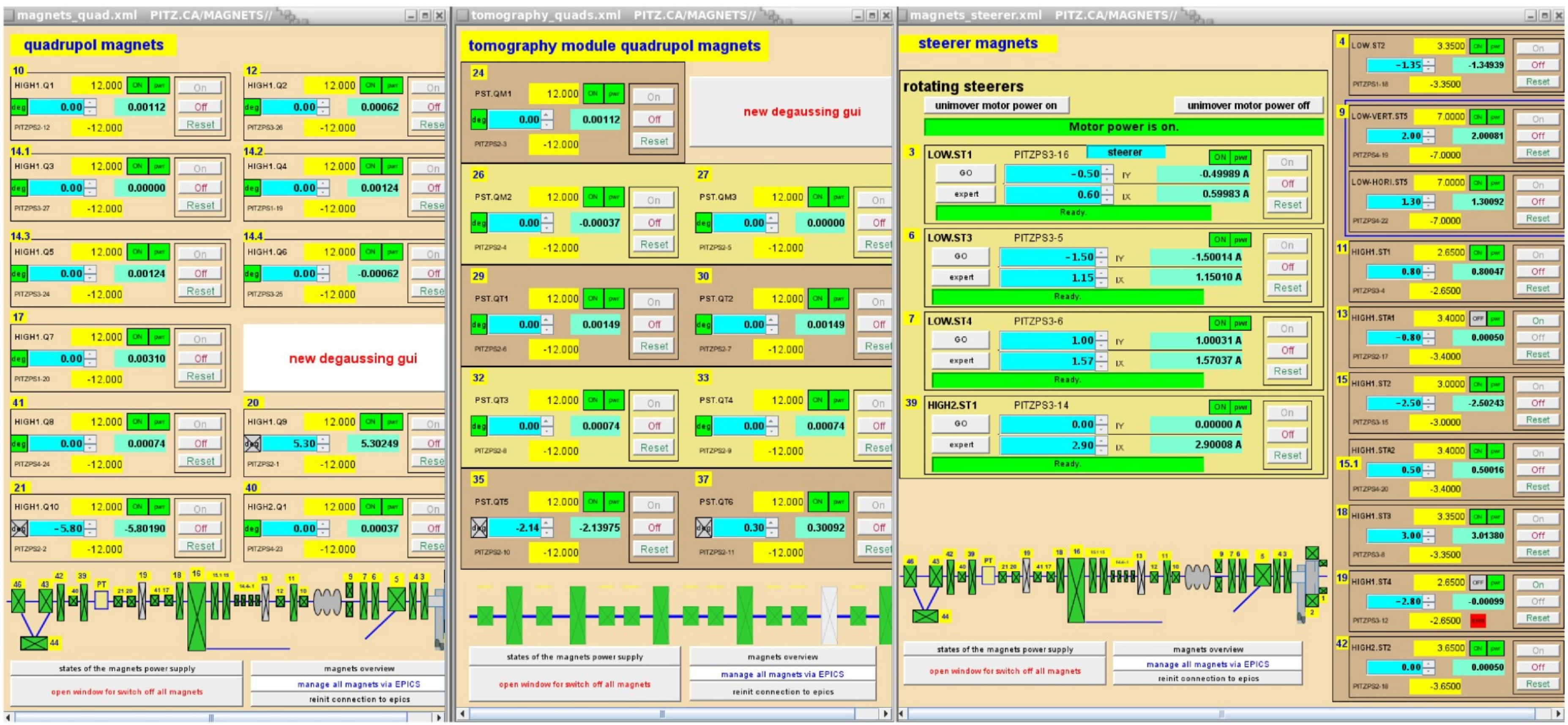






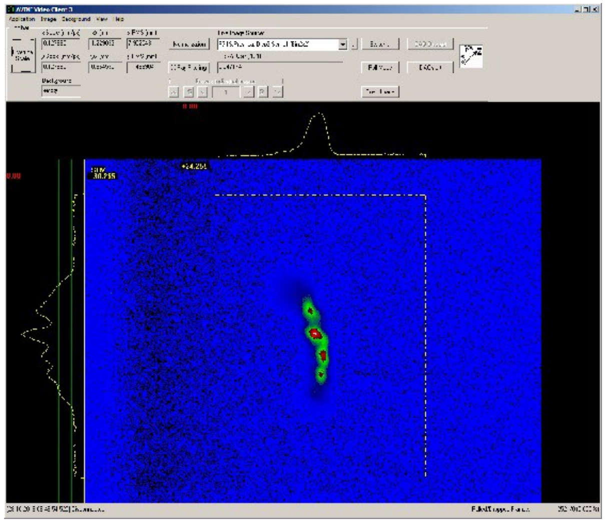
Beam transport to HEDA2

- Quads
- Steerers

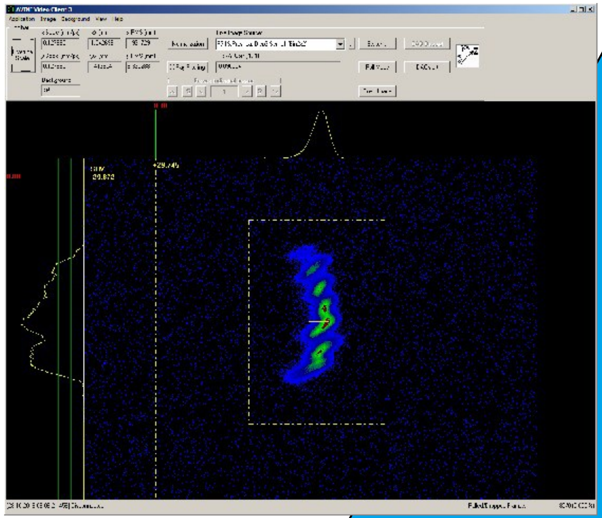


FT Longitudinal Phase Space (LPS) → PZ(horiz)-Time(vert)

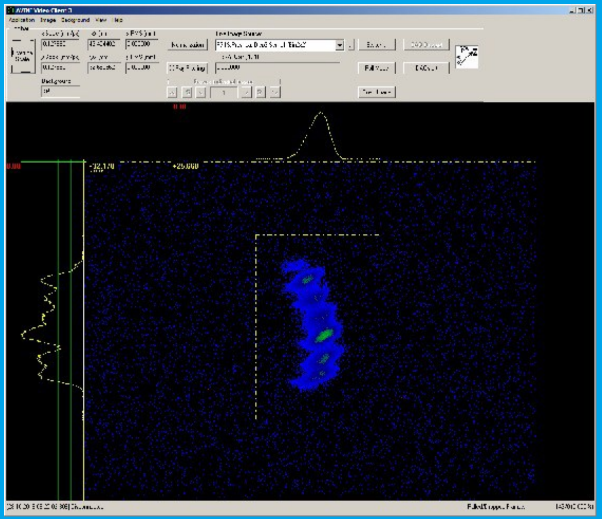
500pC

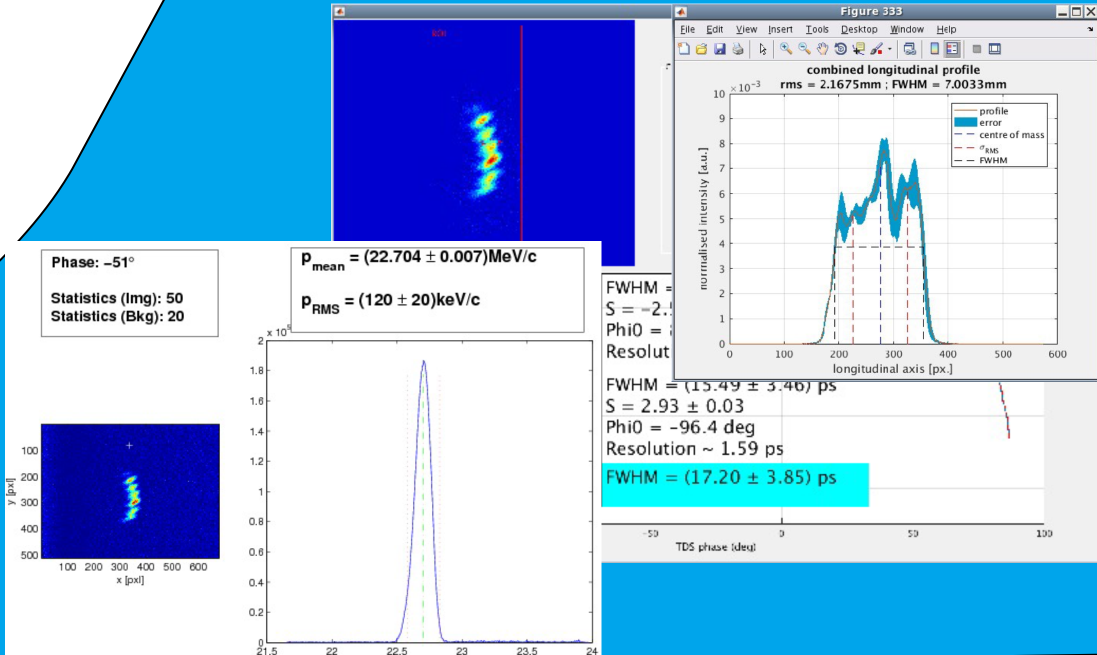


220pC

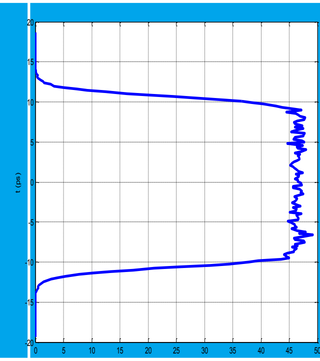
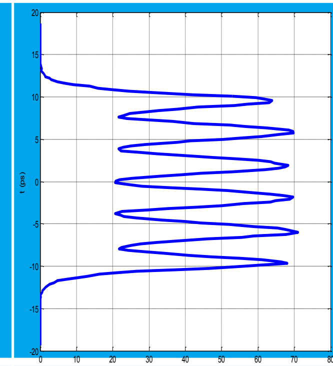
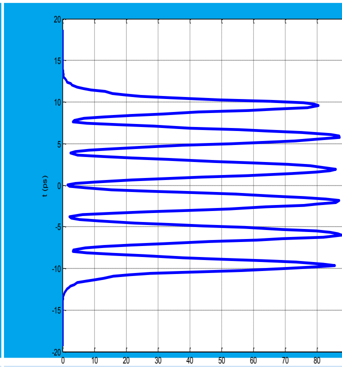
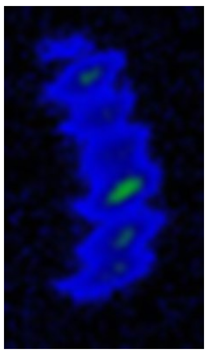
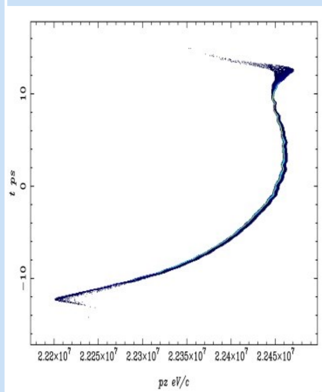
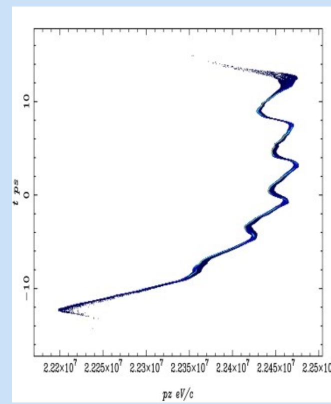
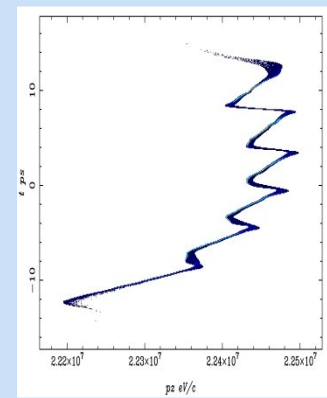
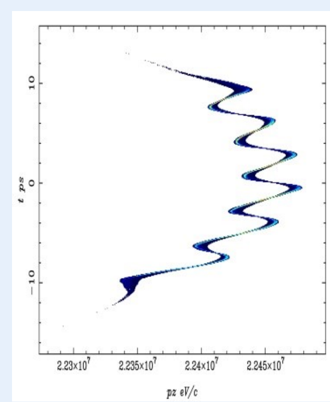
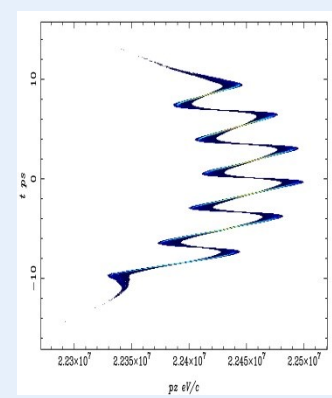


100pC





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