PITZ Run Coordination Meeting 15.05.2012

Tasks for week 19

1. RF1 probably needs conditioning –done?
2. Gun long-term tests (RF only?) –done?
3. Trajectory studies for best beam shape (emittance) , E-beam size at various screens (asymmetry investigations)
4. Emittance measurements 1nC: BSA=1.2mm; gun SP phase 0;-6deg (then BSA=1.6 ?) - now with correct solenoid polarity
5. HEDA2 commissioning?
6. AOM tests?
7. Streak measurements at LOW.Scr3
8. Momentum measurements (gun, booster) – phase scans in LEDA/HEDA for various power levels

Week 19	Mon May-07	Tue May-08	Wed May-09	Thu May-10	Fri May-11	Sat May-12	Sun May-13
Morn. 7:00 to 15:30	ss letti	Gross Marchetti			Gross Marchetti	Khojoyan Marchetti	Khojoyan Marchetti
Late 15:00 to 23:30	enko alov	Vashchenko Shapovalov			Shapovalov	Kourkafas	Vashchenko Kourkafas
Night 23:00 to 7:30	Kusoljari			oljariyakul	Kusoljariyakul	Kusoljariyakul	Kusoljariyakul

AOM tests

RF1 commissioning
RF2 long-term tests

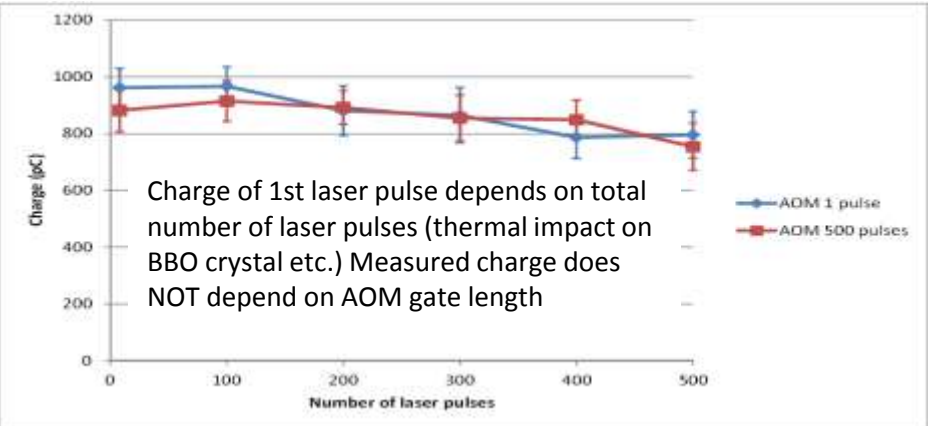
emittance

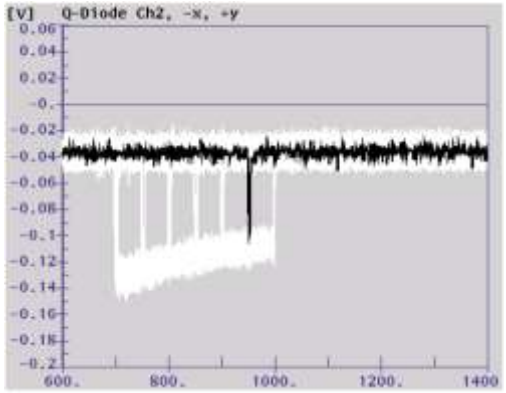
HEDA2 commissioning (cross-check with HEDA1?)

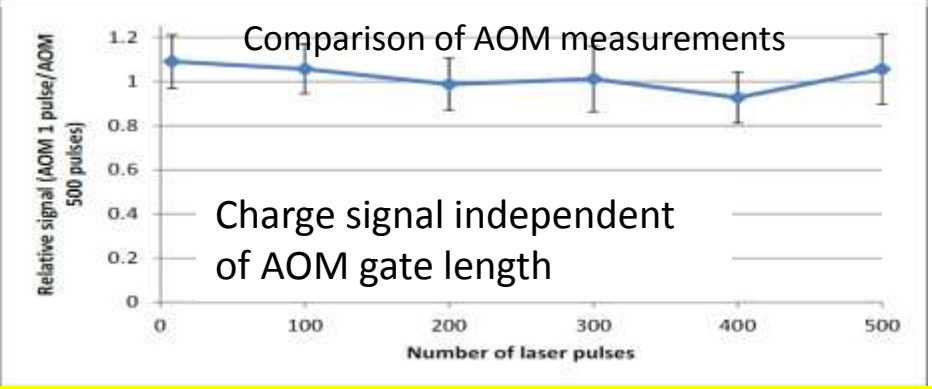
Momentum measurements

Week 19: problems and achievements

- AOM



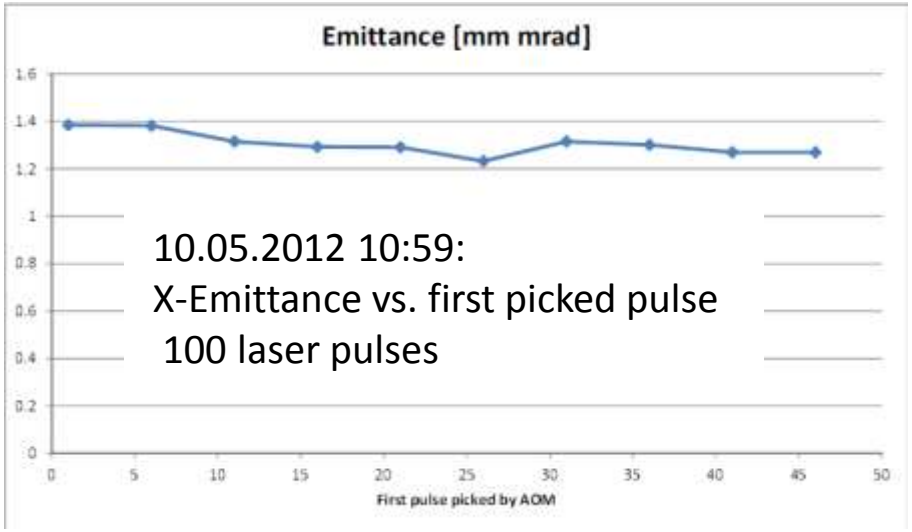




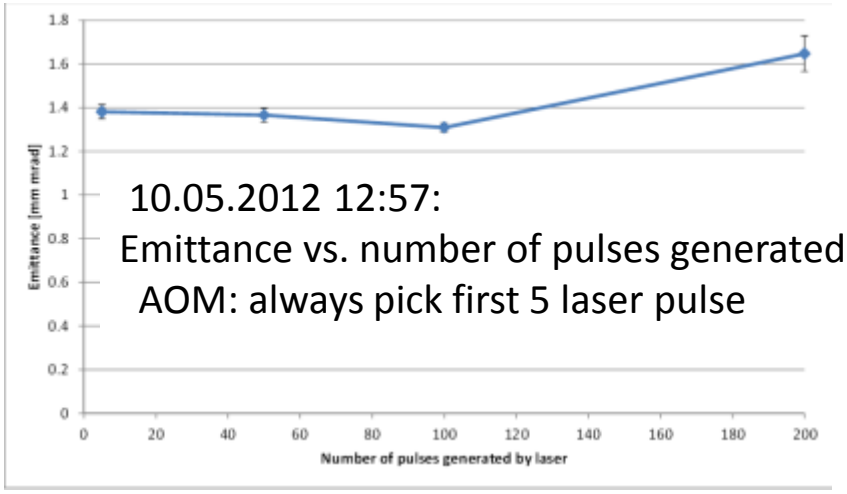
- Charge measurements with AOM: Charge of 1st pulse in train does not depend on length of AOM gate (no heating effects visible)
- Momentum measurements with LEDA for two gun power settings (4MW and 5.5MW): No influence of AOM visible
- Tests with Q-diode: By transmitting only 5 laser pulses at a time with the AOM the pulse amplitude still traces the envelope of the 300 laser pulse train.
  Ergo: The amplitude variation is caused by the laser (in front of the AOM). Everything behind (BSA etc.) is not affecting the amplitude

Week 19: problems and achievements

- AOM➔ emittance



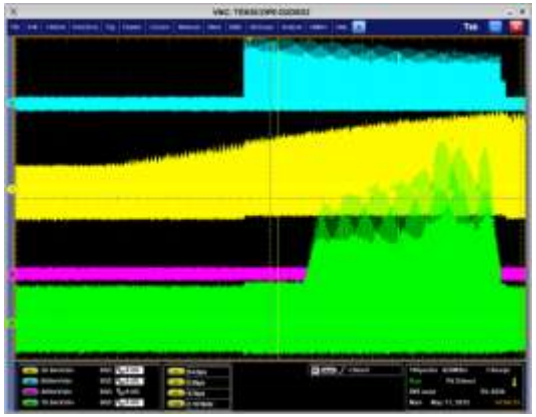
10.05.2012 10:59:
X-Emittance vs. first picked pulse
100 laser pulses



10.05.2012 12:57:
Emittance vs. number of pulses generated by laser
AOM: always pick first 5 laser pulse

Week 19: problems and achievements

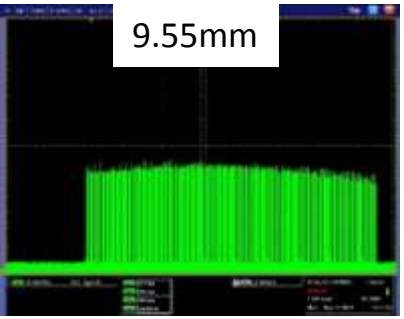
- AOM➔ ?problems

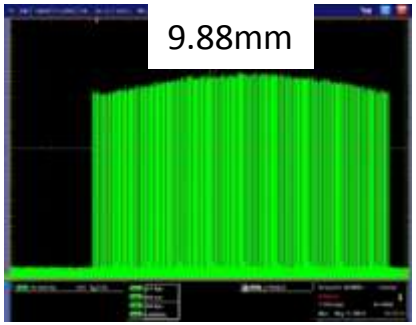


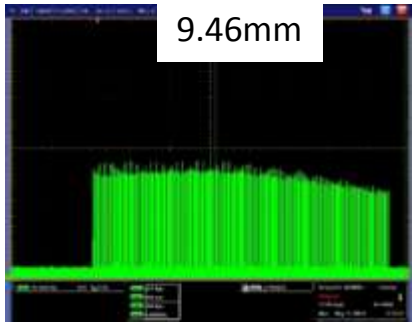
10.05.2012 20:13:

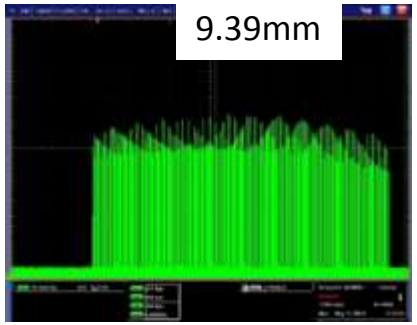
- the disturbance in the temporal shape of the UV laser pulse train was not caused by the laser itself. It was caused by the Acousto-optic pulse picker (AOM).
- It turned out that the presence of the disturbance depends on the position of the laser beam on the AOM. The **distance between the transducer (source of the sound wave) and the laser beam** was varied using the screw that adjust the vertical position of the AOM. The amplitude of the picked pulse train growths with decreasing distance to the transducer. In between there is one broad range or several locations where the envelope of the pulse is disturbed.

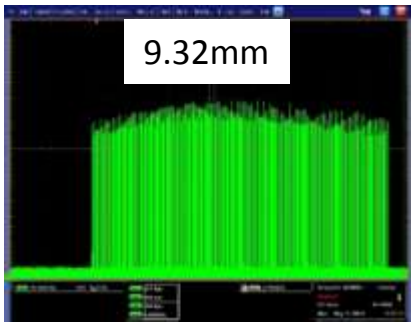
The oscillogram of this entry and the following ones show series of different location of the UV beam on the AOM:

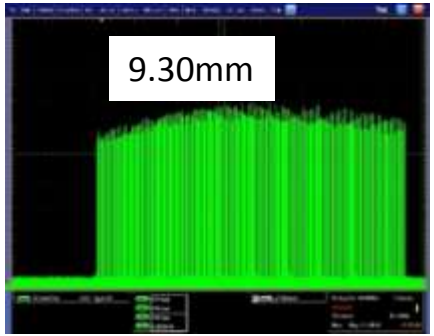


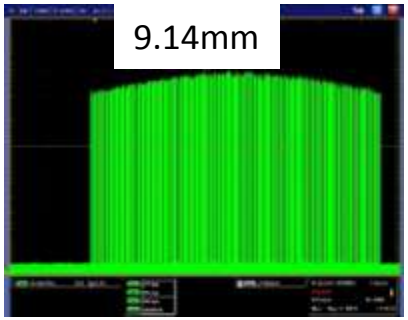


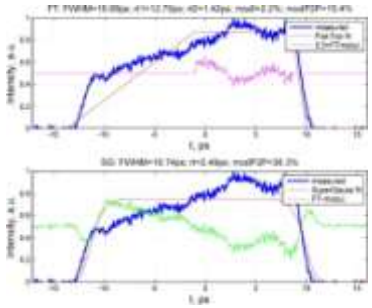






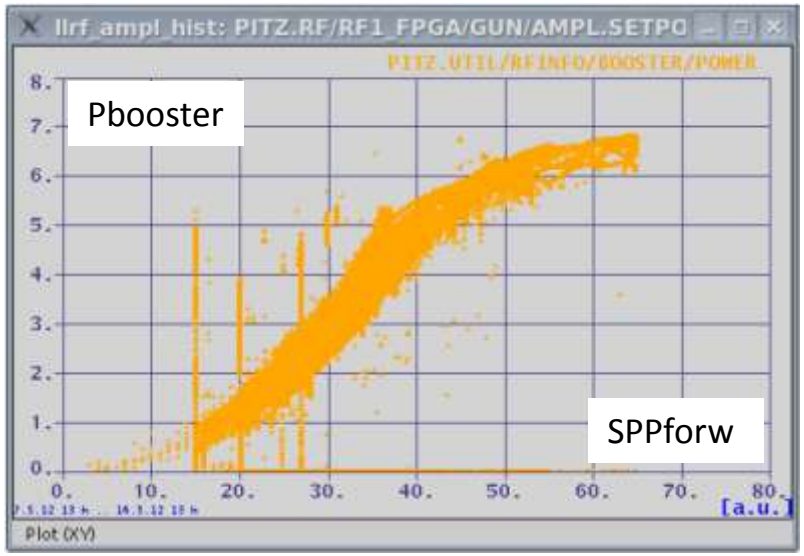


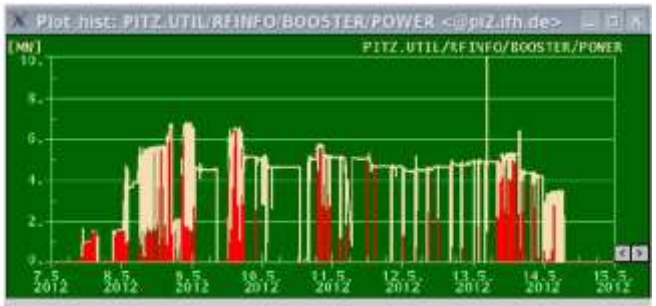


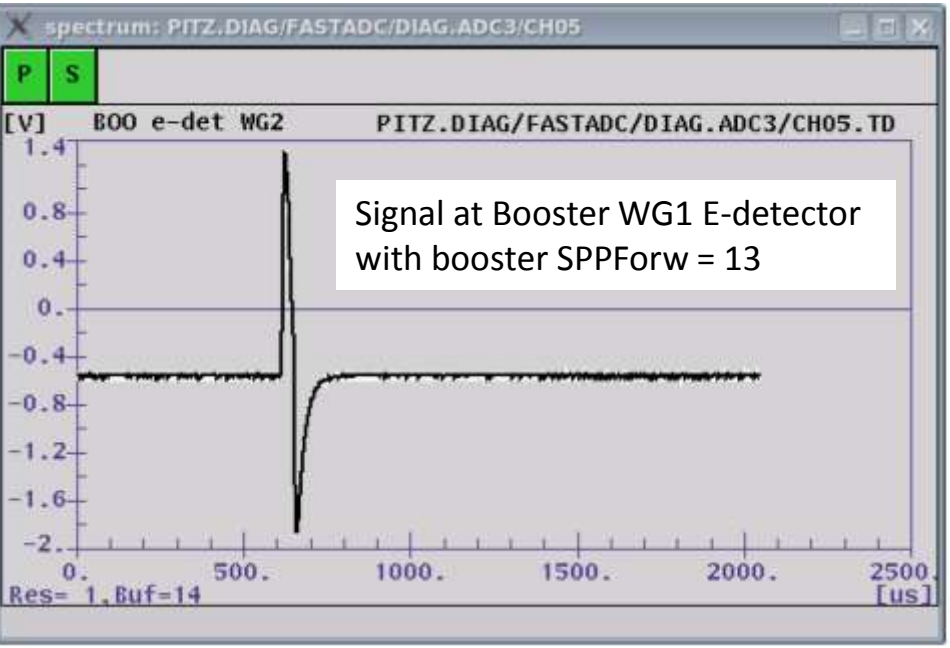


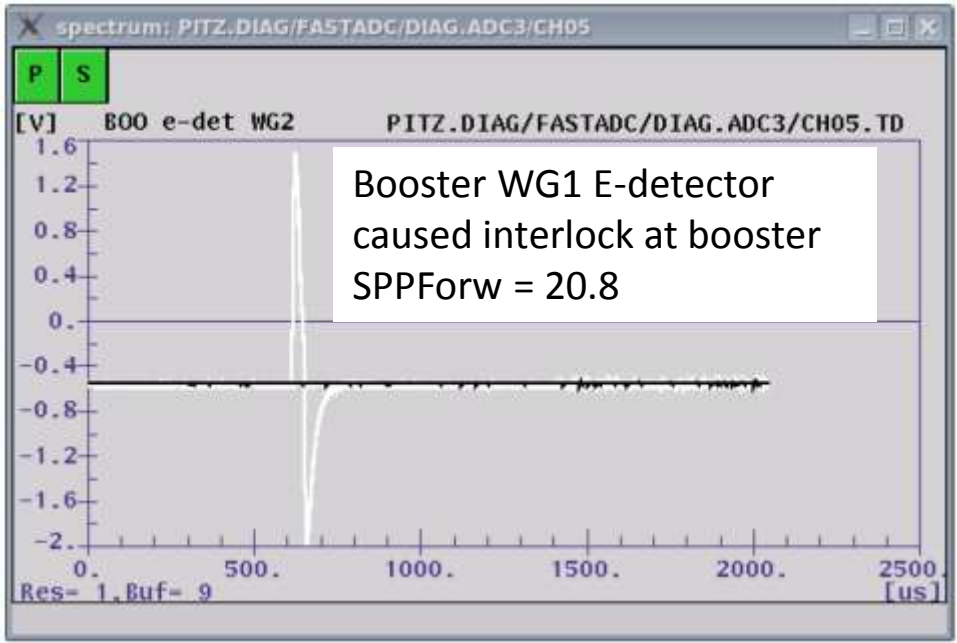
Week 19: problems and achievements

- Booster







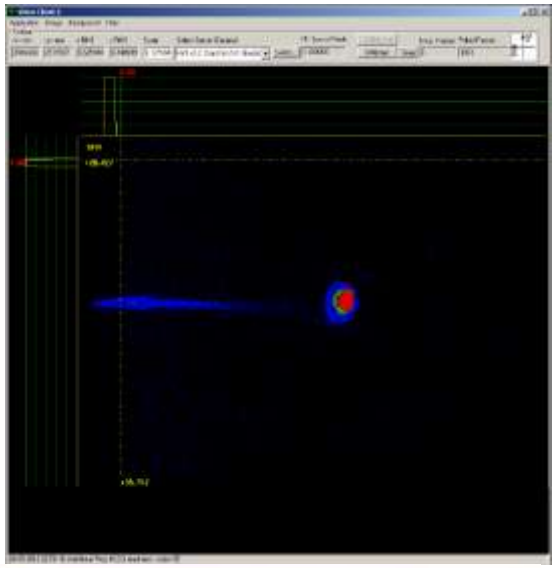


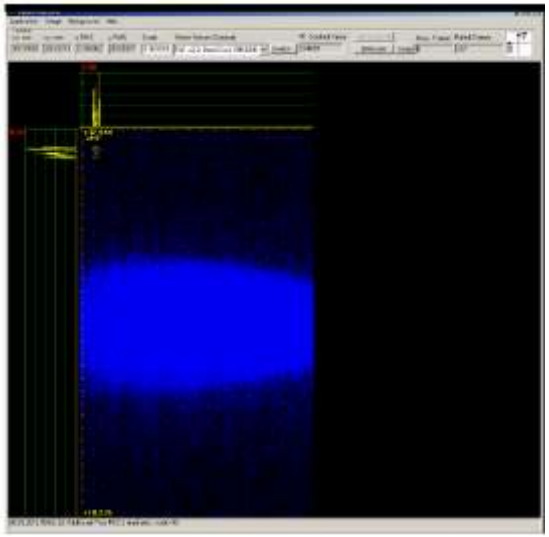
Week 19: problems and achievements

- HEDA2

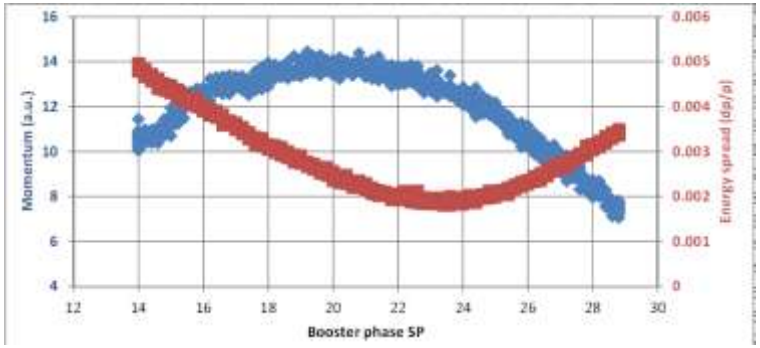
First beam in the HEDA2

Camera should be rotated by 90 degrees

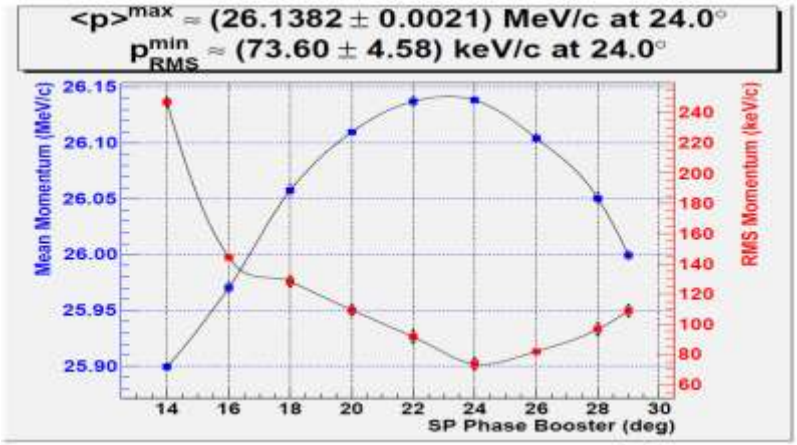




HEDA2 Momentum scan, not calibrated



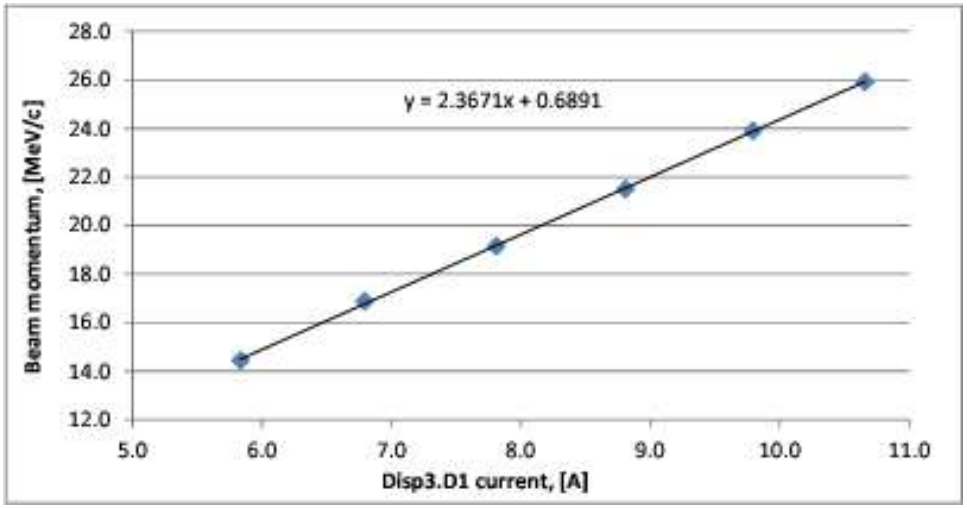
HEDA1 Momentum scan

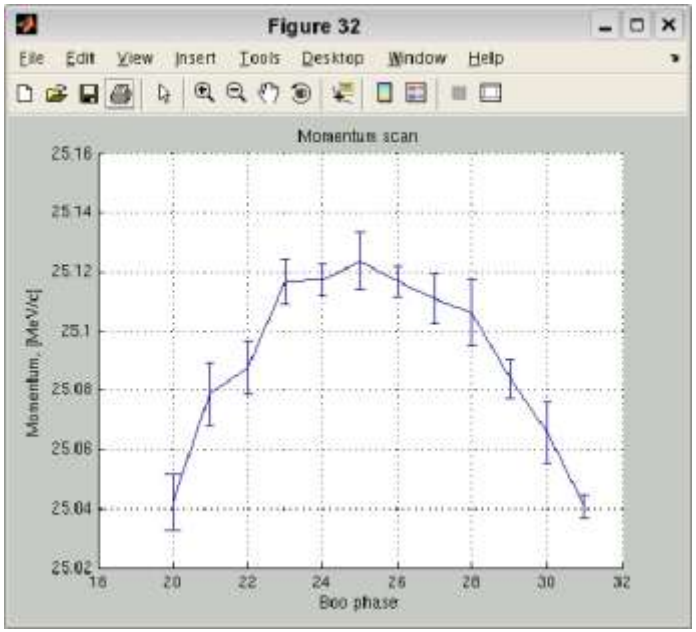


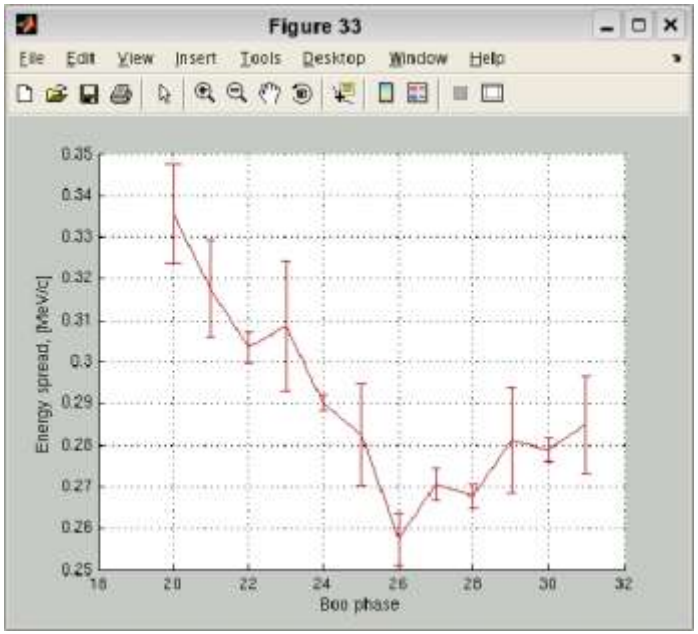
Week 19: problems and achievements

- HEDA2

11.05.2012 N
Calibration for Disp3.D1
Momentum on the Disp3.Scr1 horizontal center as function of the Disp3.D1 current. Calibration done based on momentum measurement with the High1.D1.





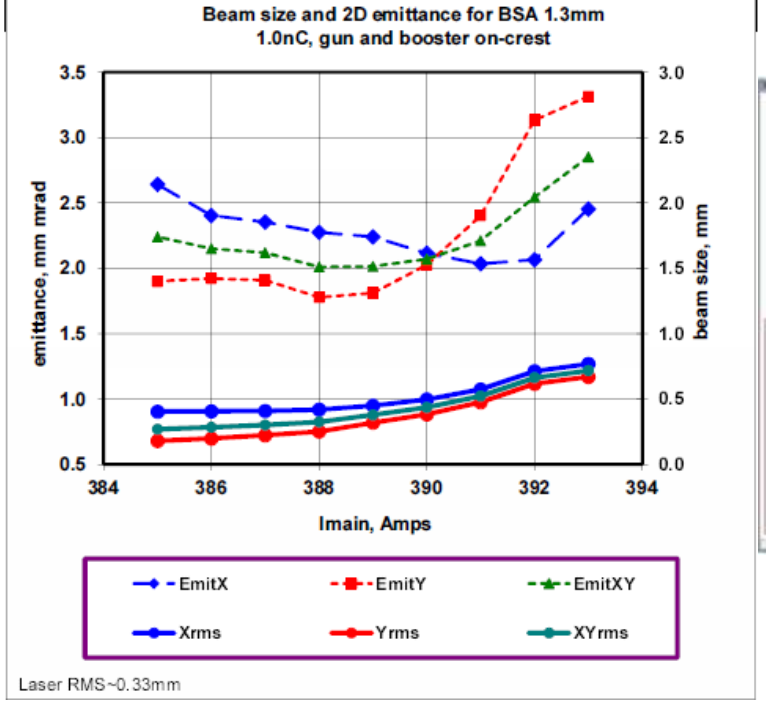


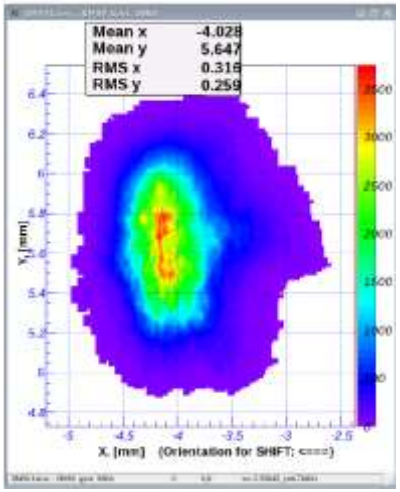
Week 19: problems and achievements

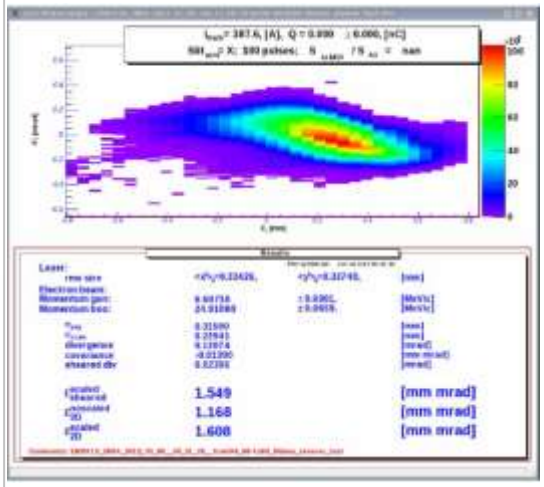
- Emittance

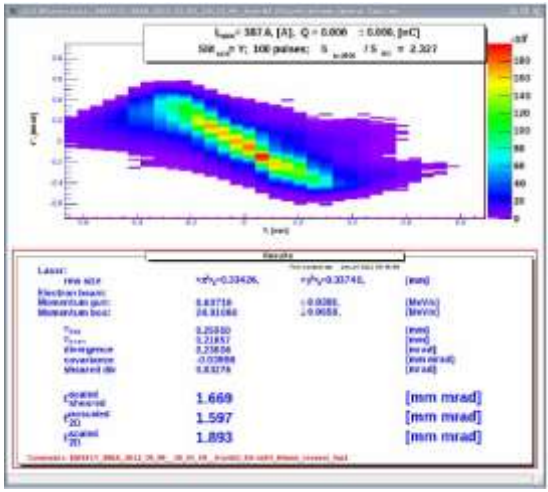
08.05.2012N

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 us for all BL measurements																	
393	0.769	0.670	2.454	2.345	0.718	2	20	2	22	25	18	3.313	3.236	7	18	2.851	2.755
392	0.713	0.617	2.066	1.690	0.663	2	18	2	16	13	18	3.133	2.556	6	18	2.544	2.078
391	0.574	0.476	2.034	1.636	0.523	2	16	2	14	12	18	2.403	2.208	4	18	2.211	1.901
390	0.497	0.383	2.115	1.625	0.436	2	12	2	10	10	18	2.026	1.965	3	18	2.070	1.787
389	0.449	0.319	2.241	1.718	0.378	1	16	1	14	7	18	1.811	1.602	2	18	2.015	1.659
388	0.419	0.252	2.275	1.929	0.325	1	15	1	14	10	18	1.778	1.569	2	18	2.011	1.740
387	0.409	0.223	2.354	2.076	0.302	1	14	1	14	13	18	1.909	1.552	3	18	2.120	1.795
386	0.407	0.198	2.404	2.179	0.284	1	13	1	16		18	1.923	1.572	4	18	2.150	1.851
385	0.404	0.180	2.642	2.338	0.270	1	13	1	16		18	1.900	1.611	5	18	2.240	1.941





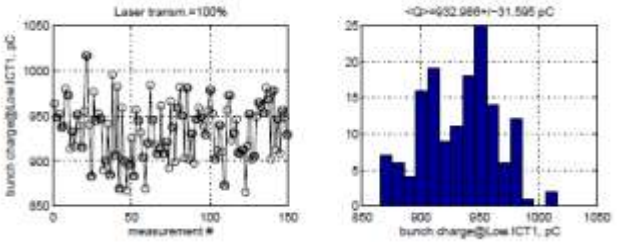




Week 19: problems and achievements

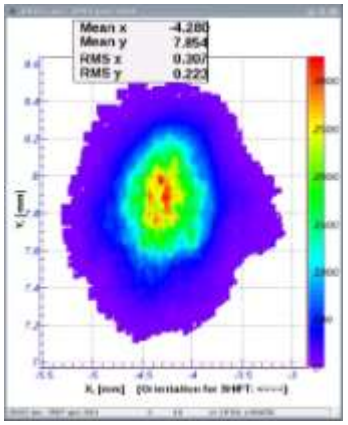
- Emittance

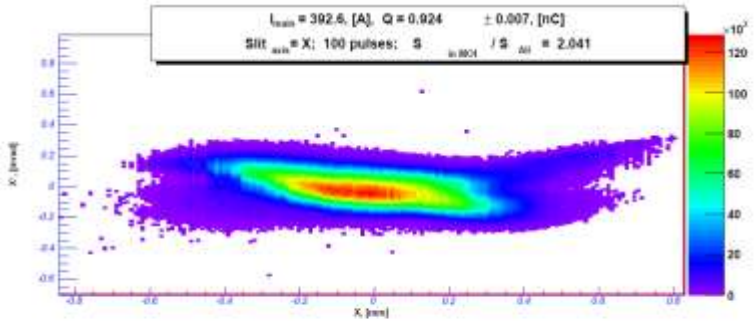
09.05.2012N → <1nC@100%

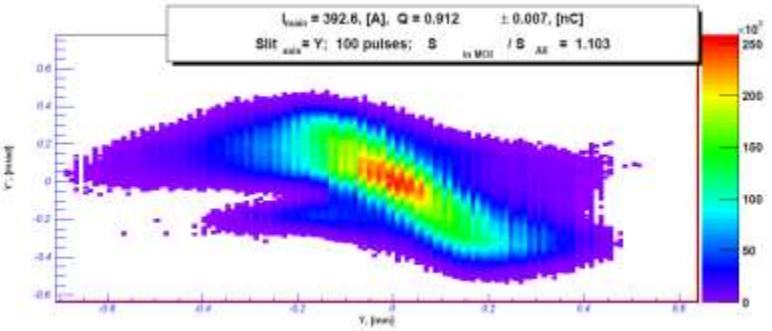


Emittance measurement for Imain = 393A
(1.2mm BSA, 0.9nC bunch charge).

* Xemit = 1.397
* Yemit = 1.564







Results

Laser:			
rms size	$\langle x^2\rangle_x$=0.33426,	$\langle y^2\rangle_y$=0.33749,	[mm]
Electron beam:			
Momentum gun:	6.60710	± 0.0301,	[MeV/c]
Momentum boo:	24.91080	± 0.0659,	[MeV/c]
σ_{rms}	0.30709		[mm]
σ_{scan}	0.22595		[mm]
divergence	0.09765		[mrad]
covariance	-0.03645		[mm mrad]
sheared div	0.02110		[mrad]
$\varepsilon^{scaled}_{sheared}$	1.289		[mm mrad]
$\varepsilon^{noscaled}_{2D}$	1.029		[mm mrad]
$\varepsilon^{scaled}_{2D}$	1.397		[mm mrad]

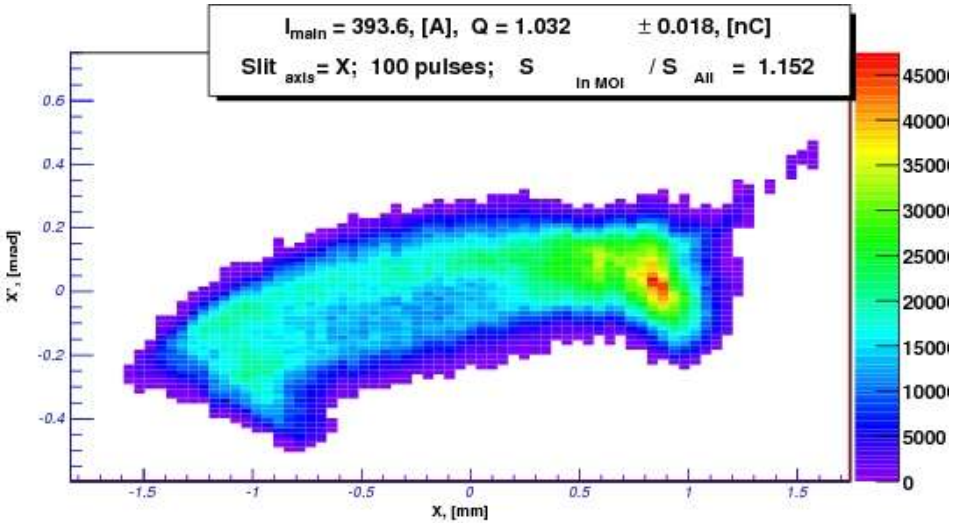
Results

Laser:			
rms size	$\langle x^2\rangle_x$=0.33426,	$\langle y^2\rangle_y$=0.33749,	[mm]
Electron beam:			
Momentum gun:	6.60710	± 0.0301,	[MeV/c]
Momentum boo:	24.91080	± 0.0659,	[MeV/c]
σ_{rms}	0.22280		[mm]
σ_{scan}	0.16650		[mm]
divergence	0.19457		[mrad]
covariance	-0.02178		[mm mrad]
sheared div	0.02598		[mrad]
$\varepsilon^{scaled}_{sheared}$	1.447		[mm mrad]
$\varepsilon^{noscaled}_{2D}$	1.169		[mm mrad]
$\varepsilon^{scaled}_{2D}$	1.564		[mm mrad]

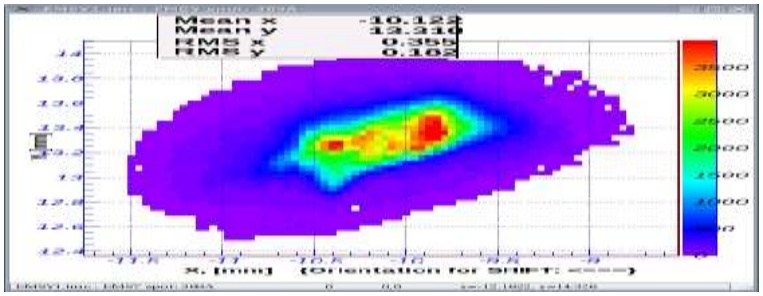
Week 19: problems and achievements

- Emittance

11.05.2012M ➔ Strange phase space shape



~ “flat” beam Xrms/Yrms~2



Results

Plot system ver. Jan 14 2012 05:46:48

Laser:			
rms size	$<x^2>_0$=0.30400,	$<y^2>_0$=0.31200,	[mm]
Electron beam:			
Momentum gun:	6.73200	± 0.0201,	[MeV/c]
Momentum boo:	24.94900	± 0.0734,	[MeV/c]
σ_{yag}	0.42000		[mm]
σ_{scan}	0.71772		[mm]
divergence	0.14346		[mrad]
covariance	0.05659		[mm mrad]
sheared div	0.08602		[mrad]
$\varepsilon^{scaled}_{sheared}$	2.225		[mm mrad]
$\varepsilon^{noscaled}_{2D}$	4.200		[mm mrad]
$\varepsilon^{scaled}_{2D}$	2.458		[mm mrad]

Comments: EMSY1X_394A_2012_05_11__14_36_02__from89_20-to93_00_fast

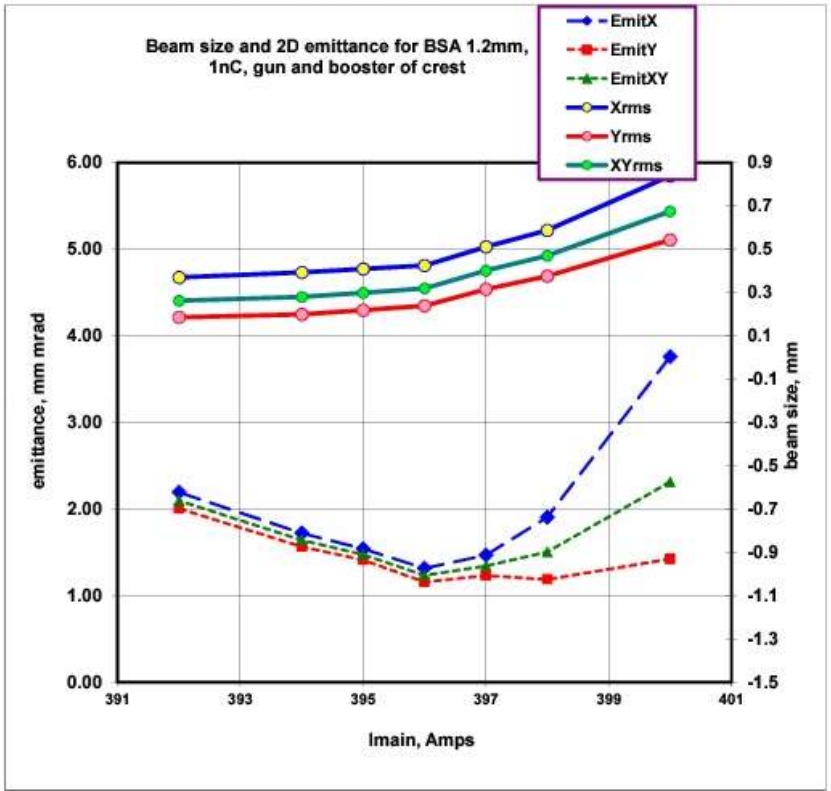
The reason for these strange phase spaces was found - low.st2 was moved accidently

Week 19: problems and achievements

- Emittance

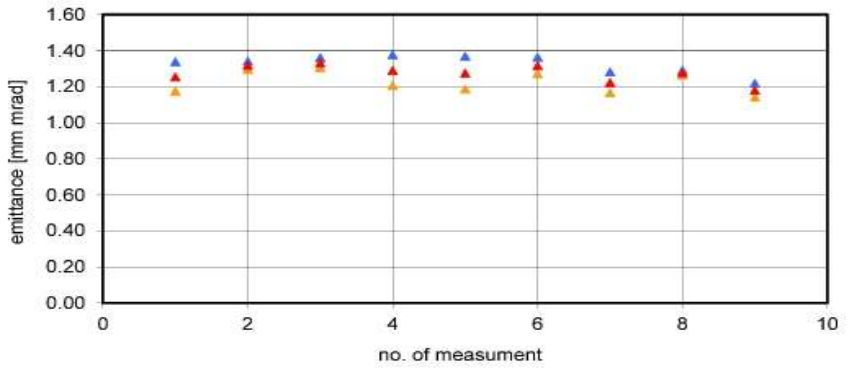
11.05.2012A ➔
From the solenoid scan: xy-emit = 1.231 mm mrad

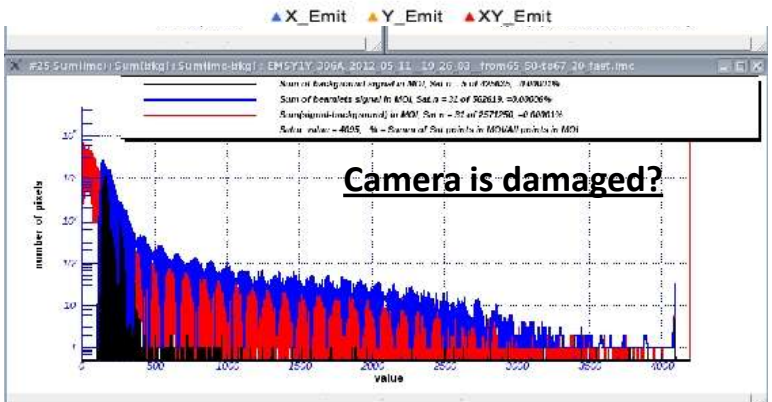
I_main (A)	Xrms, mm	Yrms, mm	EmitX_2D, mm mrad	EmitX_2D, nonscaled	XYrms, mm	EMSY1 NoP	EMSY1 Gain	MOI NoP	MOI, Gain	XBL_NoP	XBL gain	EmitY_2D, mm mrad	EmitY_2D, nonscaled	YBL NoP	YBL gain	EmitXY_2D, mm.mrad	EmitXY_2D, nonscaled	X-scale factor	Y-scale factor
all EMSY pictures are saturated for 393A to 383A => overestimation in the beam sizes																			
For all measurements f160 lenses and 2x2 binning were used																			
400	0.838	0.542	3.756	2.821	0.674	1	15	1	15	10	22	1.421	1.443	15	22	2.310	2.018	1.3	1.1
398	0.587	0.375	1.903	0.973	0.469	1	6	1	9	2	18	1.185	0.956	6	22	1.502	0.964	2.0	1.6
397	0.510	0.314	1.464	0.669	0.400	1	2	1	6	1	22	1.228	0.882	5	22	1.341	0.768	2.2	1.7
396	0.424	0.238	1.313	0.596	0.318	1	1	1	4	1	20	1.155	0.959	5	21	1.231	0.756	2.2	1.6
395	0.408	0.217	1.537	0.748	0.298	1	0	1	3	2	18	1.408	1.078	5	22	1.471	0.898	2.1	1.6
394	0.392	0.198	1.719	0.823	0.279	1	0	1	2	2	20	1.562	1.032	5	22	1.639	0.922	2.1	1.8
392	0.369	0.184	2.191	1.166	0.261	1	0	1	2	3	22	2.002	1.268	6	22	2.094	1.216	1.9	1.7



3x3 statistics :
Xemit=1.327+/-0.053 mm mrad
Yemit=1.223+/-0.060 mm mrad
XYemit=1.274+/-0.040 mm mrad

meas	beam size @ EMSY			X-emittance		Y-emittance		XYemit, scaled	XYemit, nonscaled
	X	Y	XY	scaled	nonscaled	scaled	nonscaled		
1	0.463	0.288	0.365	1.338	0.658	1.175	0.883	1.254	0.762
2	0.463	0.288	0.365	1.342	0.614	1.294	0.907	1.318	0.746
3	0.463	0.288	0.365	1.361	0.601	1.304	0.938	1.332	0.751
4	0.475	0.298	0.376	1.377	0.600	1.207	0.871	1.289	0.723
5	0.475	0.298	0.376	1.369	0.601	1.186	0.871	1.274	0.724
6	0.475	0.298	0.376	1.363	0.624	1.271	0.920	1.316	0.758
7	0.434	0.281	0.349	1.281	0.618	1.167	0.887	1.223	0.740
8	0.434	0.281	0.349	1.290	0.607	1.264	0.952	1.277	0.760
9	0.434	0.281	0.349	1.219	0.605	1.142	0.841	1.180	0.713
Mean	0.457	0.289	0.364	1.327	0.614	1.223	0.897	1.274	0.742
Std	0.018	0.007	0.012	0.053	0.018	0.060	0.036	0.049	0.018





Week 19: problems and achievements

- Emittance

Statistics taken by the night shift 11.05.2012N **:**

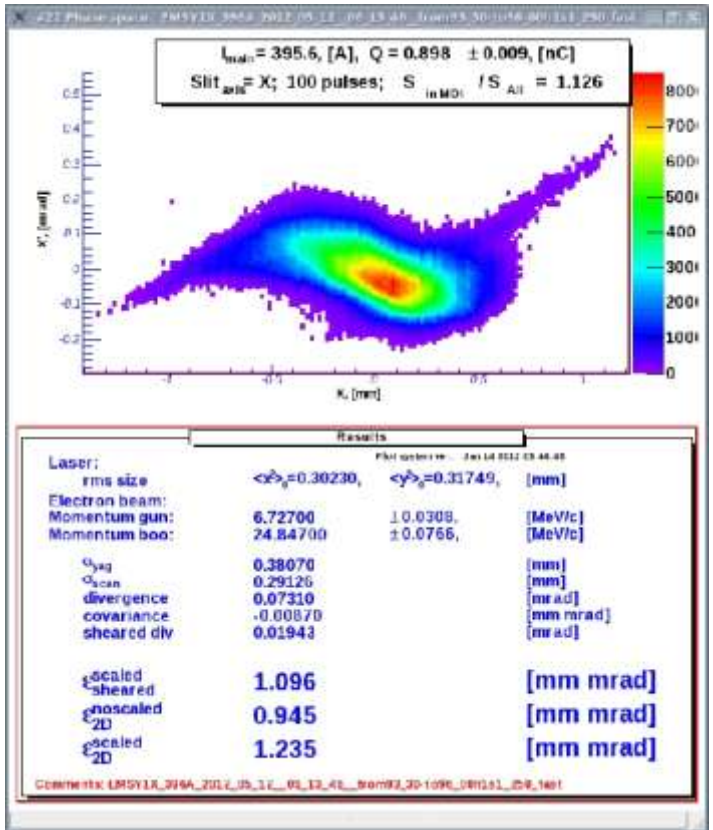
• Emittance measurement x3 with f250 at h1.scr4 and f160 on High1.Scr1 for Imain=396A done:

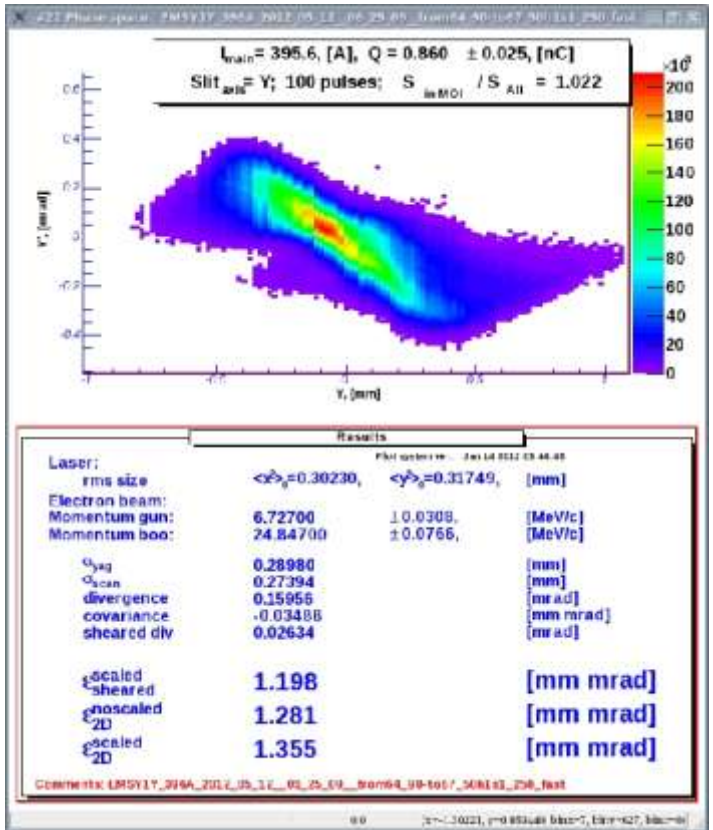
* Xemit = 1.412
* Yemit = 1.589

•Emittance measurement x3 with f250 at h1.scr4 and f250 on High1.Scr1 for Imain=396A done:

* Xemit = 1.231
* Yemit = 1.415

meas	beam size @ EMSY			X-emittance		Y-emittance		XYemit, scaled	XYemit, nonscaled	speed	comment
	X	Y	XY	scaled	nonscaled	scaled	nonscaled				
1	0.408	0.315	0.358	1.380	0.944	1.632	1.370	1.501	1.137	0.100	H1.S4 250, H1.S1 160
2	0.408	0.315	0.358	1.400	1.000	1.484	1.248	1.432	1.117	0.200	H1.S4 250, H1.S1 160
3	0.408	0.315	0.358	1.455	0.960	1.670	1.430	1.559	1.172	0.200	H1.S4 250, H1.S1 160
Mean	0.408	0.315	0.358	1.412	0.968	1.589	1.349	1.497	1.142		
Std	0.000	0.000	0.000	0.039	0.029	0.110	0.093	0.064	0.028		
1	0.381	0.290	0.332	1.285	0.957	1.508	1.343	1.392	1.134	0.200	H1.S4 250, H1.S1 250
2	0.381	0.290	0.332	1.235	0.945	1.355	1.281	1.294	1.100	0.200	H1.S4 250, H1.S1 250
6	0.381	0.290	0.332	1.172	0.889	1.381	1.302	1.272	1.076	0.200	H1.S4 250, H1.S1 250
Mean	0.381	0.290	0.332	1.231	0.930	1.415	1.309	1.319	1.103		
Std	0.000	0.000	0.000	0.057	0.036	0.082	0.032	0.064	0.029		





Week 19: problems and achievements

- Emittance by 12.05.2012M

Emittance measured for BSA 1.2mm, charge of ~800pC, at gun phase of -9 deg w.r.t. MMG phase and f=250 for EMSY1 and High1.Scr4 (1x3)

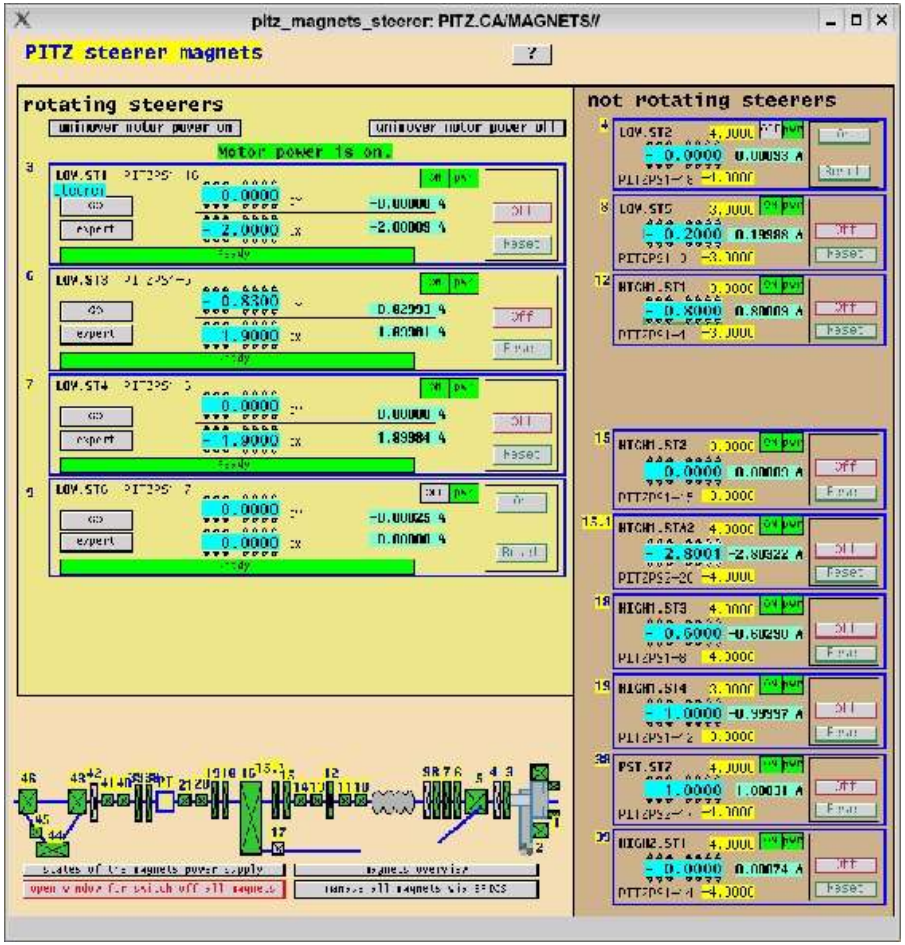
* Emitx=1.557 mm mrad
* Emity=2.083 mm mrad
* Emitx=1.801 mm mrad

Difficulties:

* Two times simultaneous modulator errors for RF1 and RF2
* Gun PMT and PD ILs
* Booster PMT and e-detector ILs
* Charge is lower and lower..
* Beam momentum is lower than 6.7 MeV/c for the modified beam transport ?
* Steering is not reproducible !!

Week 19: problems and achievements

- Emittance by 12.05.2012N (new steering from the late shift)



The ideas behind: Move the beam as far as possible from the vacuum mirror with low.st1Switch off low.st2 as it makes significant changes in the beam shape which any other steerer not (even low.st1 which is upstream)Switch off low.st6 as it works unstable (problem with angle determination appears from time to time - settings may be not reproducible). Use as small as possible kicks from the rest steerers

For f160 for high1.scr4 solenoid scan and statistics for the best point done:

* Xemit = 1.287
* Yemit = 1.757
* For f250 for high1.scr4 statistics for the best point done:
* Xemit = 1.603
* Yemit = 1.675

Q~0.6nC!, gun → -3deg

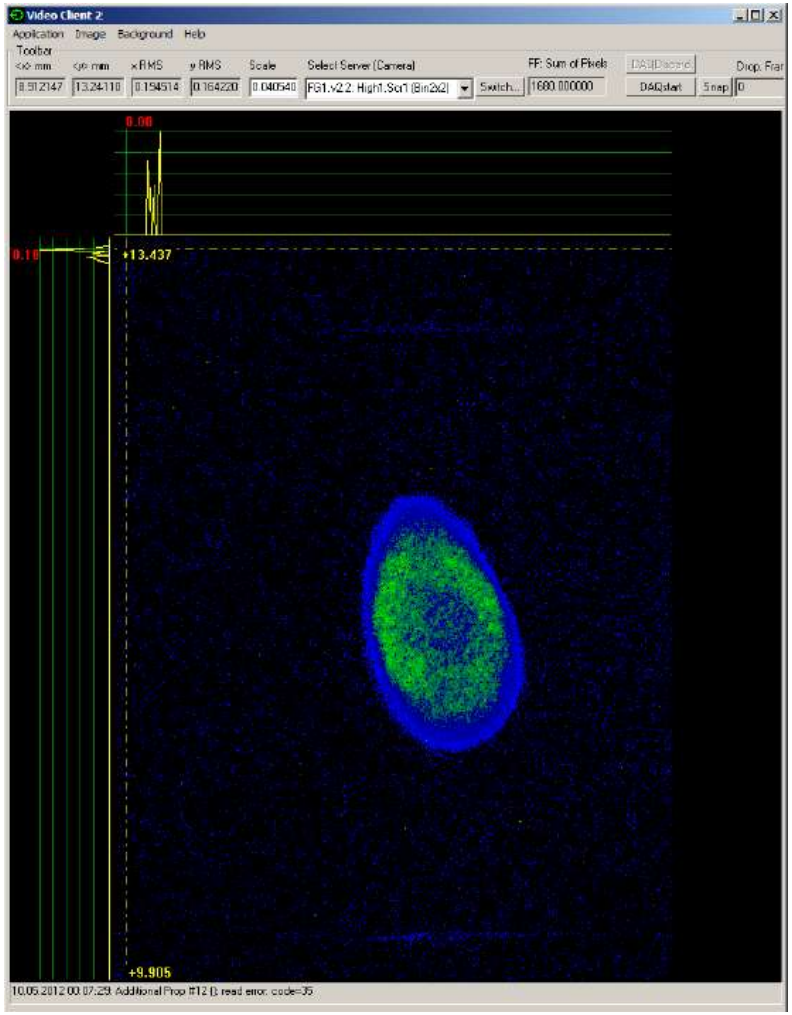
Week 19: problems and achievements

- Emittance

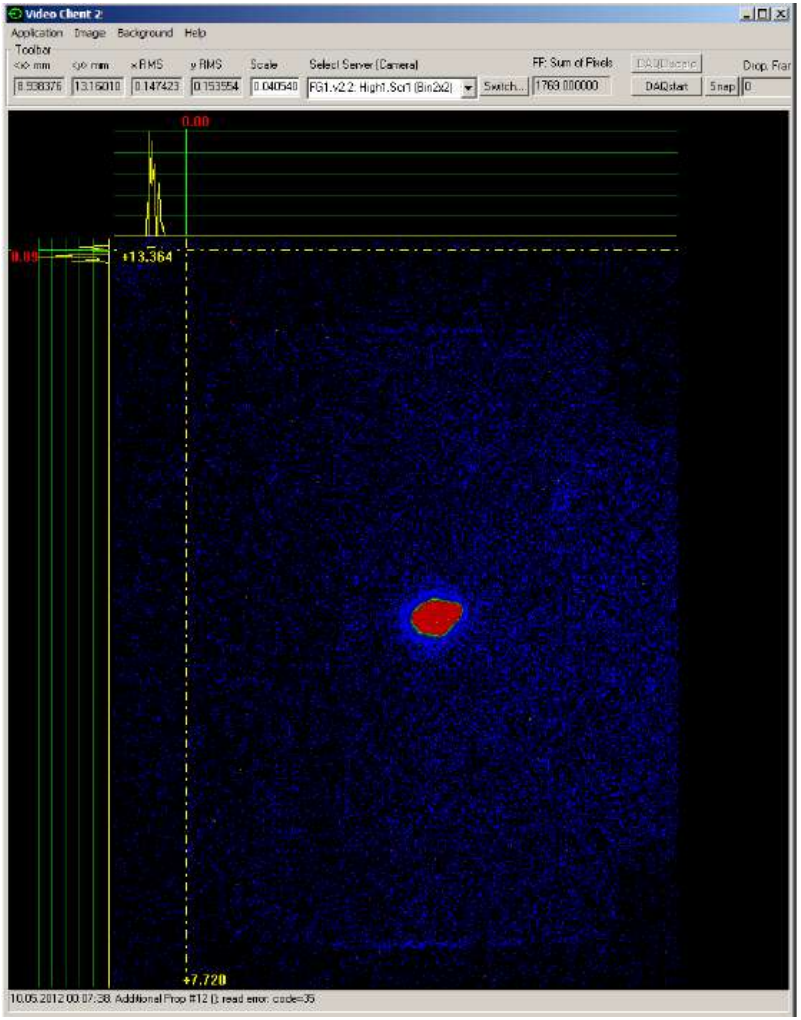
13.05.2012M
Emittance measured (at last) for gun phase = -3 deg off-crest, charge about 800pC, booster on-crest, BSA 1.2mm, steering #2, f=160 for EMSY1 and High1.scr4:
* Emitx=0.973 mm mrad at Imain=395A
* Emity=1.142 mm mrad at Imain=397A
* Emitxy=1.126 mm mrad at Imain=396A
* Statistics (1x3) for 396A done --> strangely emittance values are smaller:
* Emitx=0.895 mm mrad at Imain=396A
* Emity=0.917 mm mrad at Imain=396A
* Emitxy=0.905 mm mrad at Imain=396A

E-beam

10.05.2012 00:07 Electron beam at the High1.Scr1, No booster

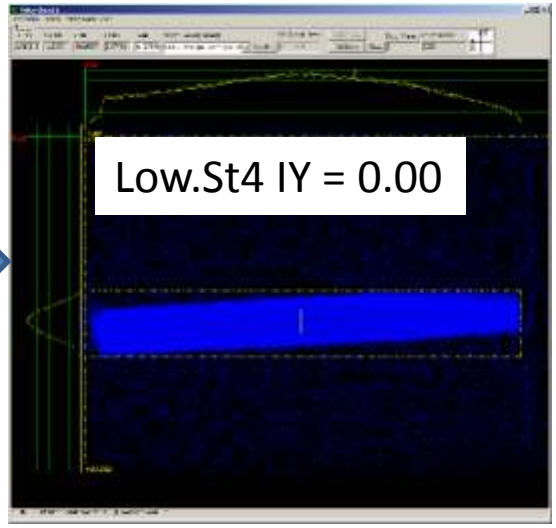


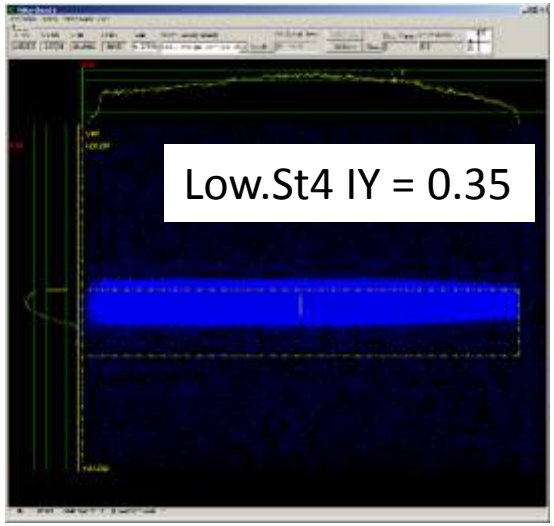
10.05.2012 00:07 Electron beam at the High1.Scr1, With booster

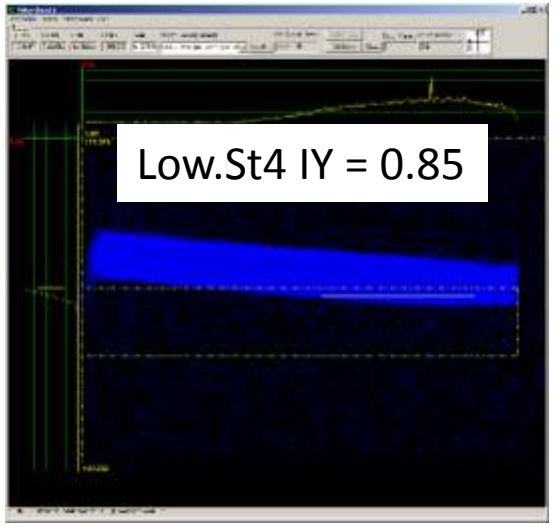


E-beam at HEDA1,2, booster -40deg off crest

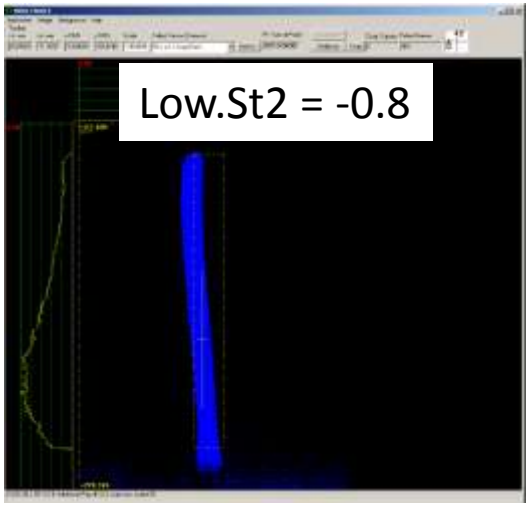
Disp3.Scr1

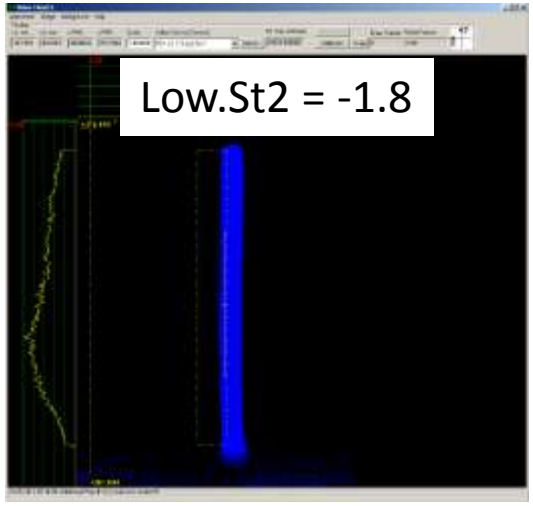


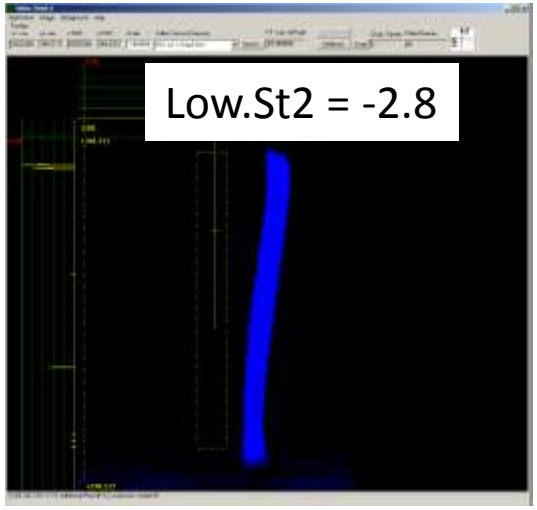




Disp2.Scr1

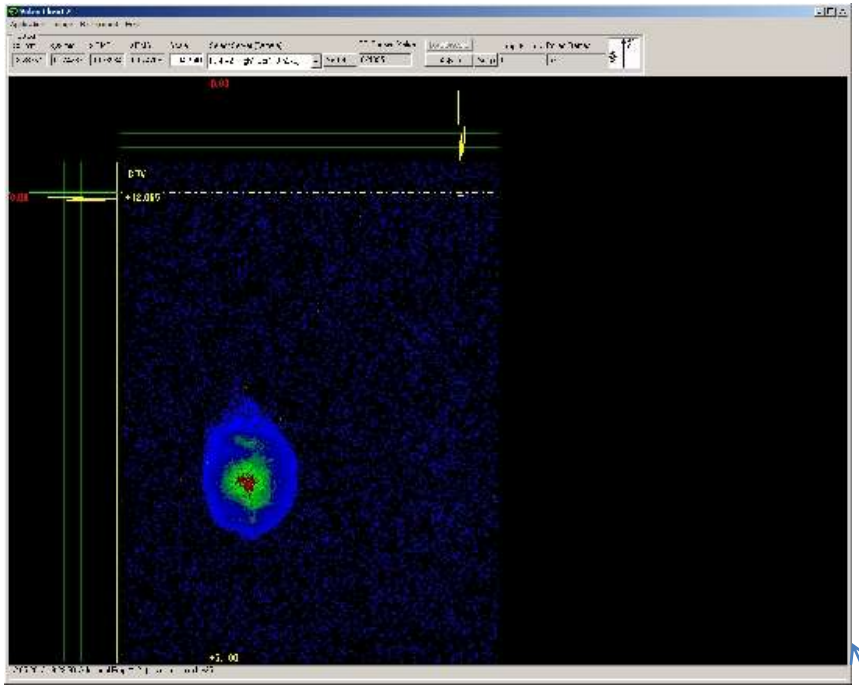




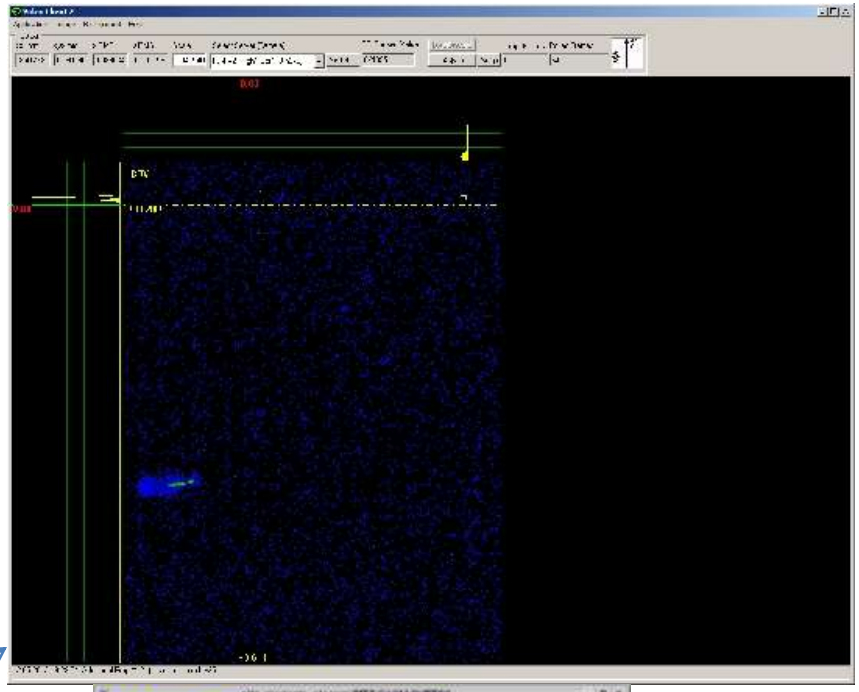


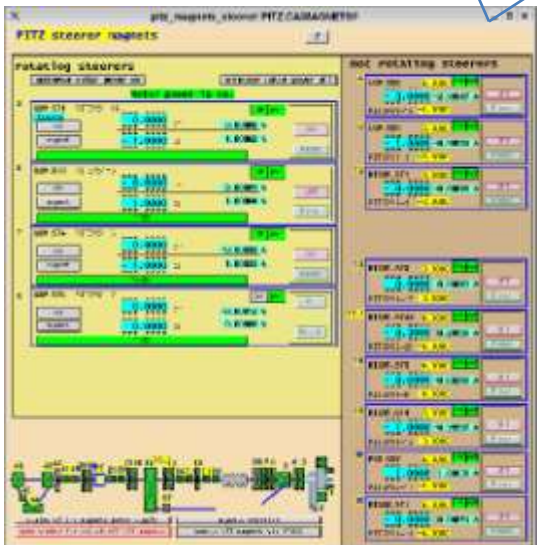
E-beam: 2beams observed on 12.05.2012A

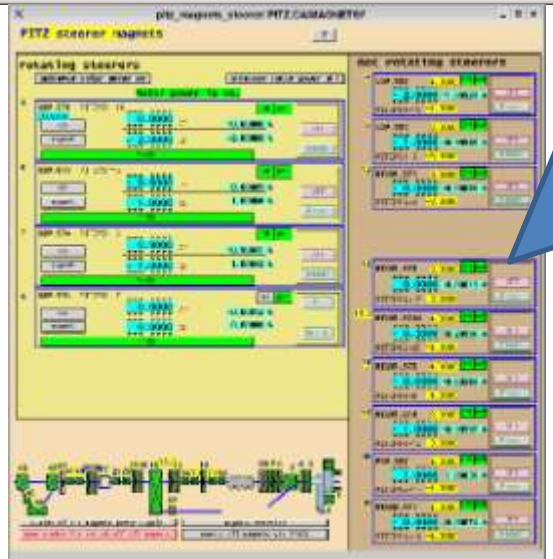
Beam on High1.Scr1 at Imain = 410 A



Beam on High1.Scr1 at Imain = 380 A





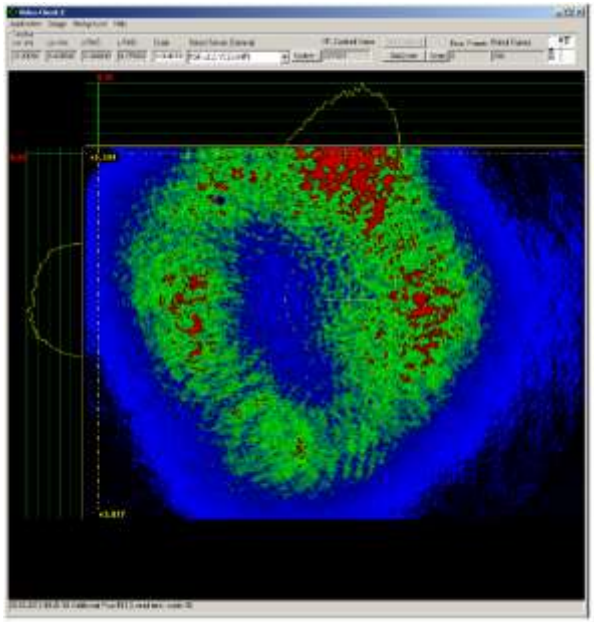


At this steering setting we can not observe 2 beams -> most probably they are overlapped on the screen

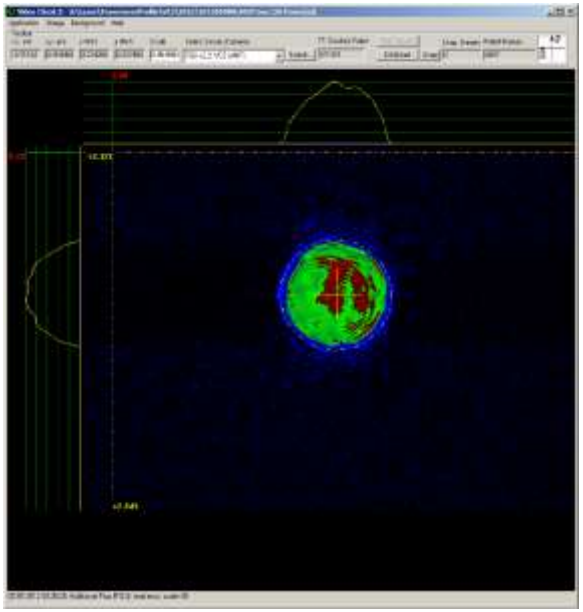
Week 19: problems and achievements

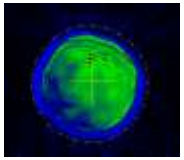
- Laser

09.05.2012 00:25 Laser beam on VC2, aperture is open

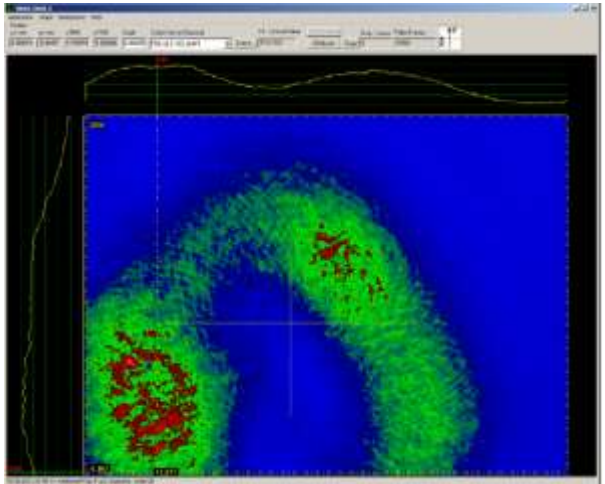


09.05.2012 00:38 Laser beam on VC2, BSA~1.3mm

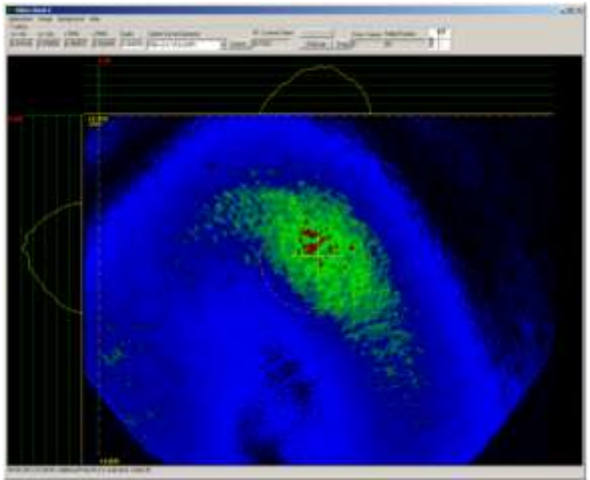




09.05.2012 20:48

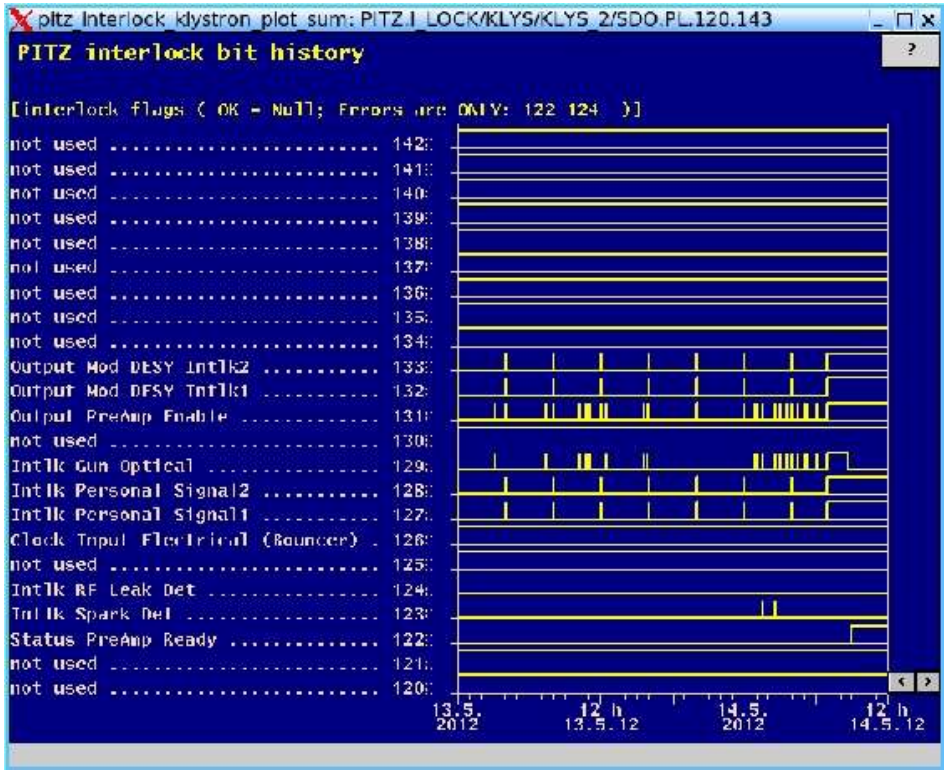


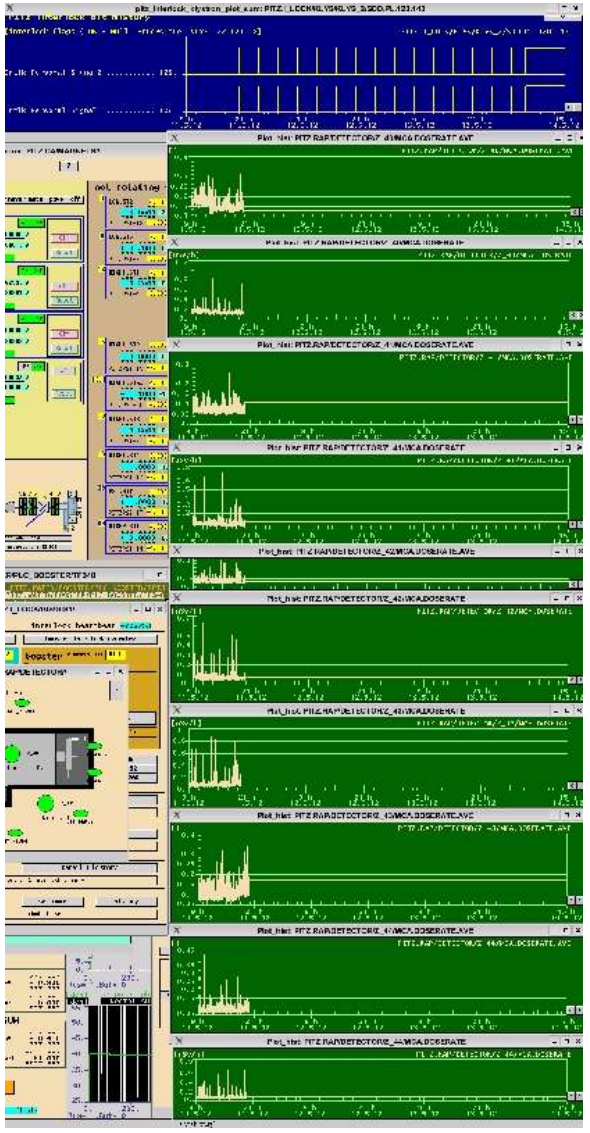
09.05.2012 23:38



Week 19: problems

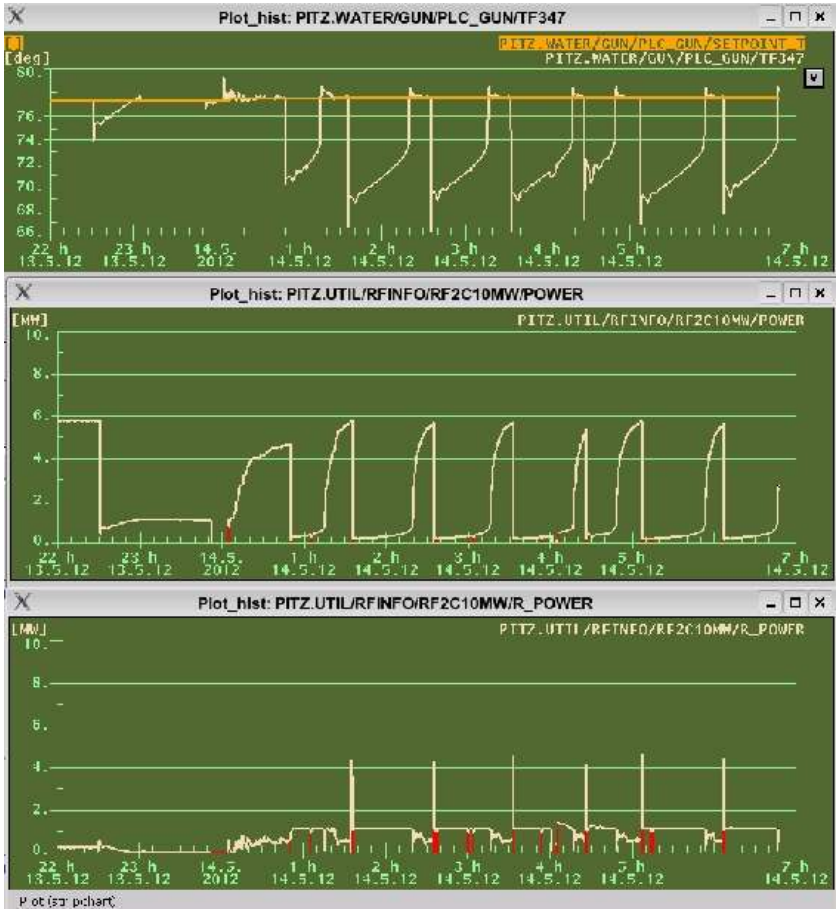
- Modulator errors → ? personal IL faked by Pandora server (severe consequences→ one power module in the modulator is damaged)

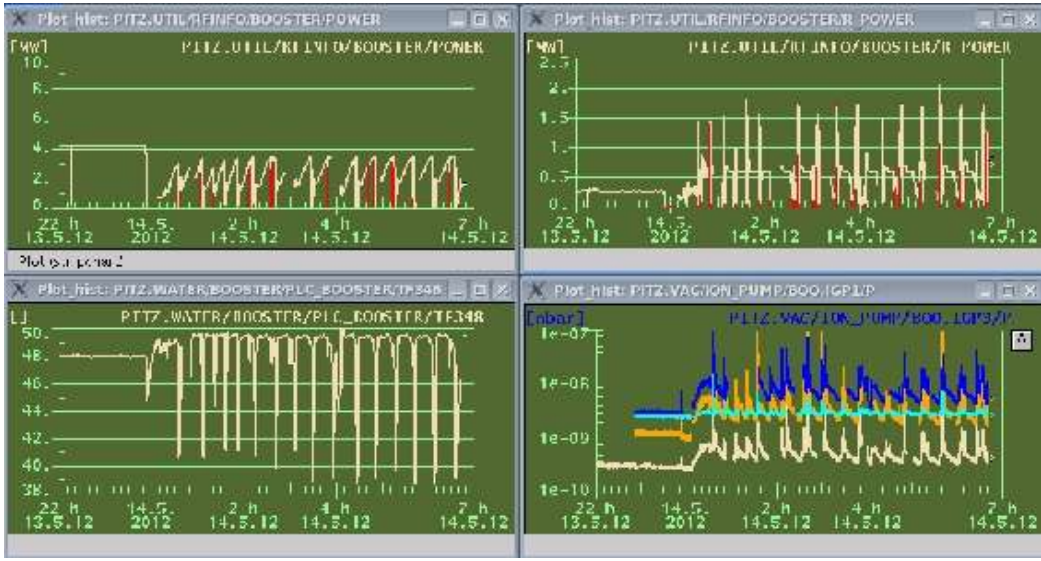




Week 19: problems and achievements

- Modulator errors → ??
- RF conditioning (gun+boostre) for 750us RF pulse duration (13.05N)

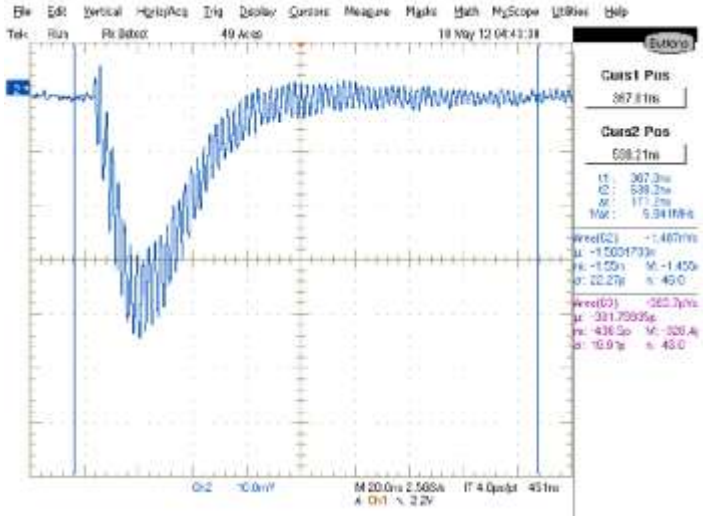


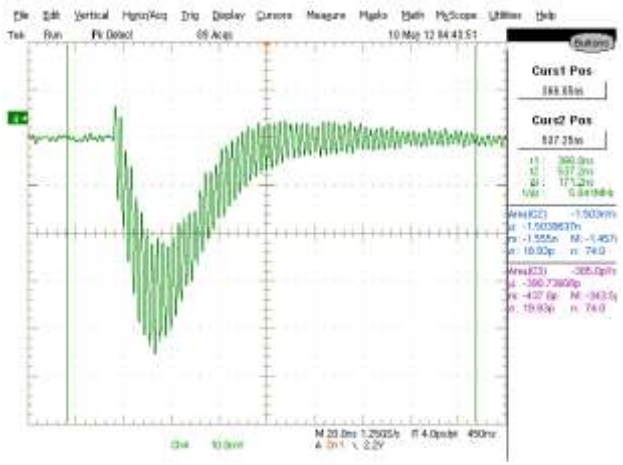


Week 19: problems

- Other problems
  - Degaussing GUI Problem

  - Phase shifters software problems → solved
  - No signal at the IBPC (Low.ICT1) → fixed on 9.05A
  - Noisy signals from DISP3.ICT1,2





  - Radiation warning Z_43 (10.05M 08:37)
  - Main solenoid fuse problem
  - Water compressor faults

Planning next run week

- AOM problems!!!
- Laser stability (Te-, Tr- profiles + 1nC at BSA=1.2mm!)
- Steering reproducibility (LOW.St2 – replace? – MO+, LOW.St6 – MO+MW)
- Steerer PS stability (if not corrected in shutdown?) - using e-beam position jitter - Morning shift should start!
- Beam (phase space) shape vs. steering – check
- Doubled beam investigations? - Morning shift should start!
- Beam size at HIGH1.Scr1 vs (Nop, Gain, f160/f250)
- Emittance measurements 1nC:
  - BSA=1.2mm; gun SP phase=0 deg
  - BSA=1.2mm; gun SP phase=-6deg
  - BSA=1.6mm; gun SP phase=0 deg
  - BSA=1.6mm; gun SP phase=-6deg
- Check BPM analog signals, calibration for available (MK)

Week 21	Mon May-21	Tue May-22	Wed May-23	Thu May-24	Fri May-25	Sat May-26	Sun May-27
Morn. 7:00 to 15:30			Khojoyan Kalantaryan	Khojoyan Kalantaryan	Khojoyan Kalantaryan	Khojoyan Kalantaryan	Khojoyan Kalantaryan
Late 15:00 to 23:30			Rimjaem Kusoljariyakul	Rimjaem Kusoljariyakul	Rimjaem Kusoljariyakul	Rimjaem Kusoljariyakul	Rimjaem Kusoljariyakul
Night 23:00 to 7:30			Krasilnikov Marchetti	Krasilnikov Marchetti	Krasilnikov Marchetti	Krasilnikov Marchetti	Krasilnikov Marchetti

#	Prio	item	measurements	coordinator	remarks	Status
1		Min emittance for 0.02; 0.1; 0.25;1;2 and 3nC (new)	Slit scan at EMSY1, optimization BSA, gun phase, Imain	MK, GV	Laser flat-top ~22ps	
1a		Min emittance for various charge optimizing also the laser pulse length	Slit scan at EMSY1, optimization laser pulse length and BSA, gun phase, Imain	MK, GV	Laser pulse length variation = outer loop	
2		Emittance vs. booster gradient	Slit scan at EMSY1	GV	Check low gradient predictions from BDS	
3	+	E-beam temporal profiles with TDS	For different bunch charges, BSAs, laser profiles	DM	TDS has to be commissioned	
4	+	Emission studies	Schottky scans for various BSAs, LT, (+short Gaussian laser pulses?)	MK, BM, JL, M.Rehders ?	Benchmarking for simulations	2 data sets taken
5		Gun and booster stability check	RF and beam based measurements of the phase and amplitude stability	Igl	Resonance accurate check, methods for the amplitude stability ?	
6		Emittance vs. laser rt	Emittance optimization at EMSY1	MG, MKh		
7		Emittance vs. temporal Gaussian laser	Emittance optimization at EMSY1	MG, MKh		
8		E-beam trajectory studies	For the symmetric e-beam and best emittance	MO	?BPMs to be re-commissioned (MK)	
9		Emittance at Ecath=45MV/m	Emittance optimization at EMSY1	GV, Igl		
10	+/-	Emittance along the beam line and tomography	Emittance at EMSY1-3 + cross-check with tomo	GeK, BM, JL	Tomography module re-commissioning (week 3, +GA)	
11		Laser and solenoid BBA	Methodic for XFEL	MK	Solenoid hysteresis!	
12		Slice emittance with HEDA1	Systematic comparison of slit and quad scans for various charges	Yel		
13		Slice emittance with TDS	Commissioning and first measurements	DM, BM		
14	+/-	Longitudinal phase space with TDS	LPS measurements with TDS+HEDA2	DM, KeK		
15		Longitudinal phase space in LOW (HIGH1) section	LPS measurements with aerogel in the LOW (HIG1) section + streak readout	MM	Streak beam line alignment before (MM+MG)	
16	+	Slice emittance with HEDA2	Using DISP3.Scr2	KeK		
17		Cathode studies	QE, QE maps	MO, RM		done
18		AOM tests	With e-beam	MG		First tests
19		Long bunch train operation	Stability and reliability long term check			2,5 tests