

dE - measurements program

Measurements with long Gaussian laser pulse

δE -Measurement program

1. Ecath=60MV/m (?additionally 45MV/m as an option)
2. Gun phase: MMMG
3. Laser temporal profile: long Gaussian of ~11ps FWHM
4. Bunch charge: 0.4 nC
5. BSA=BSA0 (interpolated optimum for each bunch charge – based on the 2015 results) and 2*BSA0 (? relaxed transverse space charge by a factor of 4). Please check the rms spot size at VC2: XYrms~BSA/4:

Meas \ charge→	0.4 nC
Laser temporal	Long Gauss
A	1.1 mm
B	2.2 mm

e.g., for measurement “0.4-A” → BSA=1.1mm

6. CDS booster: 3MW, phase scan for LPS tomography. The CDS phase for TDS measurements: min projected energy spread at HEDA2(?)
7. Expected measurements (for each of 6 setups: 0.4-A and 0.4-B – to be saved in e.g. ... \measure\LongPhSp\2016\deltaE\longG\0.4-A\...):
 - a. Laser transverse distribution at VC2 (20+20frames)
 - b. Beam momentum scan in LEDA as a function of gun SP Phase → MMMG gun phase, $\langle P_z \rangle$, PZrms
 - c. Laser attenuator scan (LT-scan) for the MMMG phase with LOW.FC1 (if it is too noisy – use LOW.FC2, also LOW.ICT1/HIGH1.ICT1), adjust the LT for the goal charge, measure the bunch charge
 - d. Beam momentum in HEDA1 as a function of the booster SP phase (very detailed – to be used for LPS reconstruction). Don't forget to adjust the e-beam at the reference screen HIGH1.Scr5 (centered and vertically focused). Booster phase MMMG (or min energy spread at HEDA1?).
 - e. Setup the e-beam trajectory; e.g. from 31.10.2016 05:18 (PITZ logbook)
 - f. E-beam projected emittance at EMSY1 vs. main solenoid current (use fastscan3), Imain* for minimum XY-emittance.
 - g. Beam transport to the PST.Scr1, TDS measurements of the bunch temporal profile (Imain to be tuned as well? Or use one delivering the best emittance).
 - h. Beam transport to HEDA2 (Imain to be tuned as well?), quad settings for the best HEDA resolution – save magnet settings and beam images at screens in the HIGH section. Check the TDS phase range at HIGH2.Scr1 – not to be cut by the beam line aperture.
 - i. Beam momentum in HEDA2 as a function of the booster SP phase → booster phase for the minimum projected momentum spread.
 - j. LPS measurements at HEDA2 with applied TDS:
 - i. TDS phase scan (calibration)
 - ii. TDS at zero phase – momentum measurements with OMA
 - iii. TDS off – momentum measurements with OMA

Short (~2ps) Gaussian

Fri Nov-11	Sat Nov-12	Sun Nov-13	Mon Nov-14
Krasilnikov Chen	Delta-E Chen	Chen	Good Yeremyan Delta-E
Lishilin Vardanyan	Lishilin Vardanyan	Lishilin Vardanyan	Rublack Chen ShortG4 THz
Loisch Melkumyan	Delta-E Melkumyan	Chen Vardanyan	Vardanyan

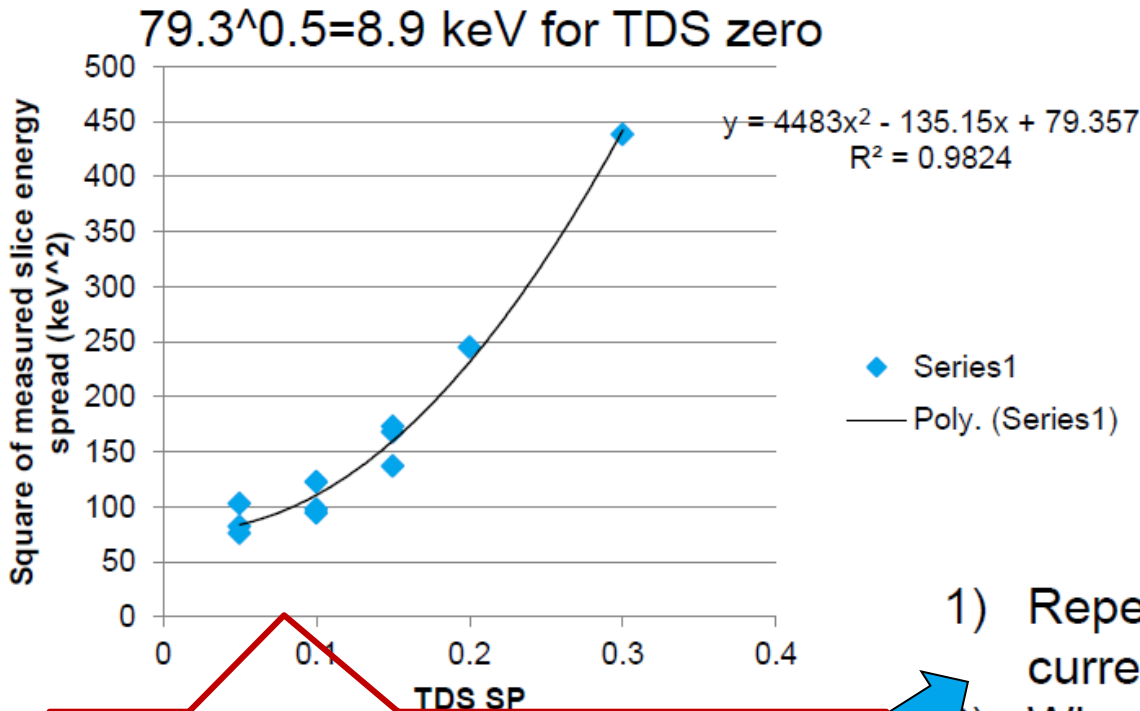
Long (~11ps) Gaussian

Thu Nov-17	Fri Nov-18	Sat Nov-19	Sun Nov-20
Slice emit Saisa-Ard	Isaev New cathode insertion New gun quad install conditioning	Isaev Zhao LG4nC	Isaev Zhao LG4nC
Slice emit Yeremyan	Saisa-Ard	Good Vardanyan	Good
LG-dE Kemer Chen	Q-Train Yeremyan	Gun Quad Rublack Qian	SLM test/3D laser Qian

Slice energy spread measurement

- Real slice energy spread
- TDS contribution
- Beta function contribution

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



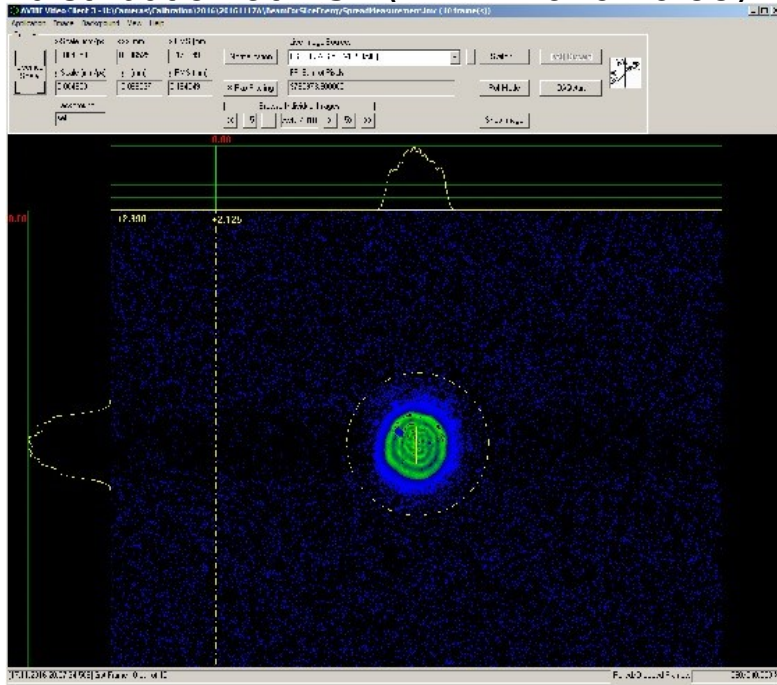
Temporal profile	FWHM
Short Gaussian	~1.8-2ps
Long Gaussian	~11-11.5ps

Measurements with **short** Gaussian taken on 20161113N with 100 pC, 0.75 mm

- Repeat this measurement with current long gaussian laser
- When optimize xrms on dipole2, turn off & degauss HEAD2, Use screen (H2.scr2) after HEDA2 as a 'ref' to min Xrms

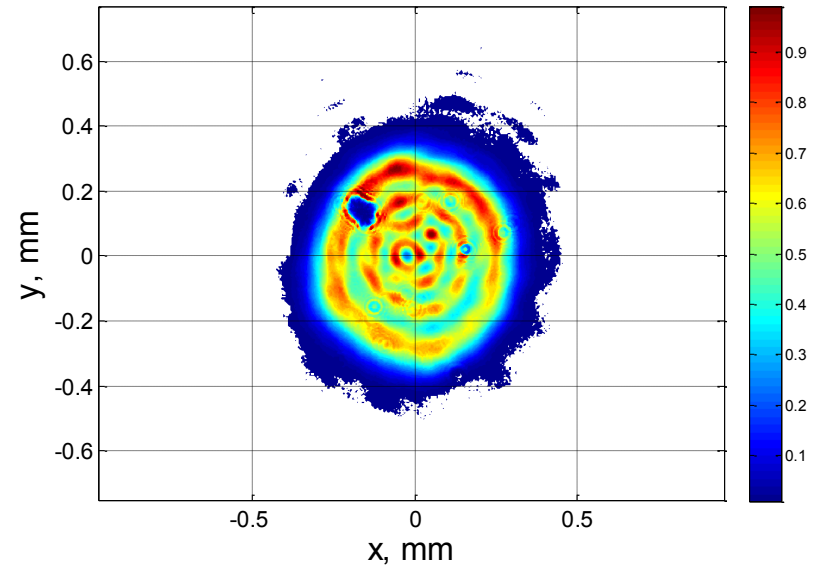
Measurements with long Gaussian on 17.11.2016A-N: VC2

➤ Photocathode laser: transverse distribution at VC2 (17.11.2016 20:58)

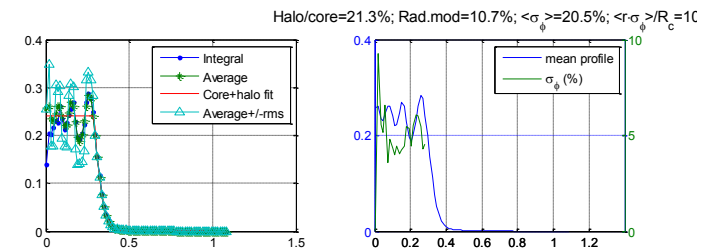
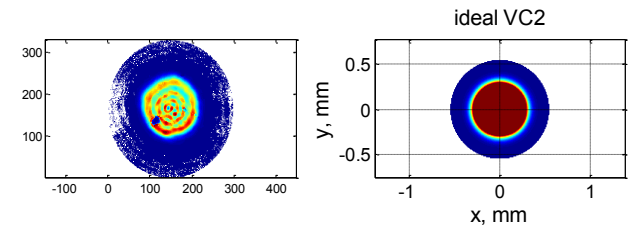
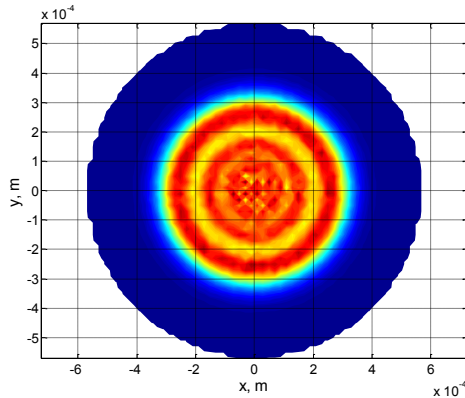


Xrms=0.179mm
Yrms=0.194mm

XYrms=0.186mm

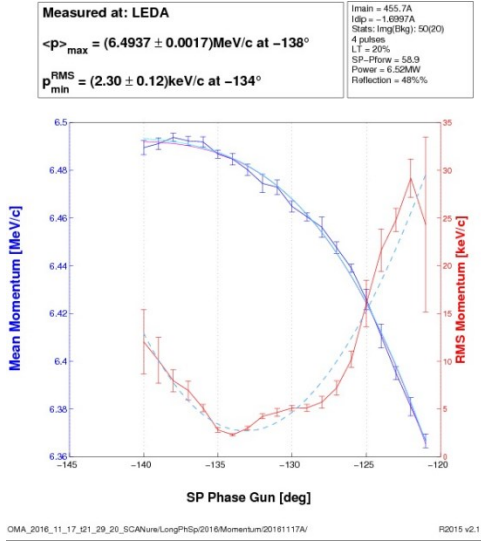


Used in ASTRA simulations
XYrms=0.186mm
Trms=4.88ps
(11.5ps FWHM)

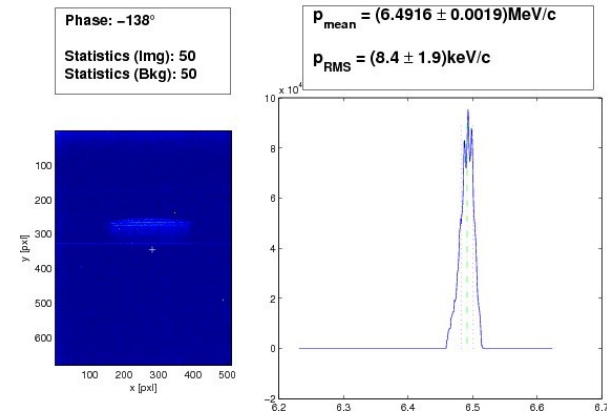


Measurements with long Gaussian on 17.11.2016A-N: Pz-gun

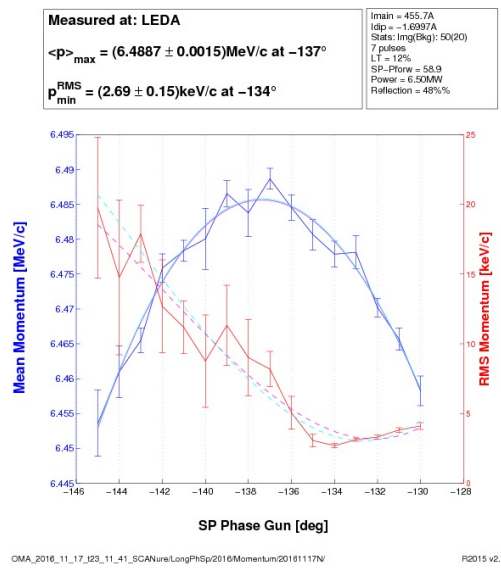
> LEDA scan (17.11.2016 21:29)



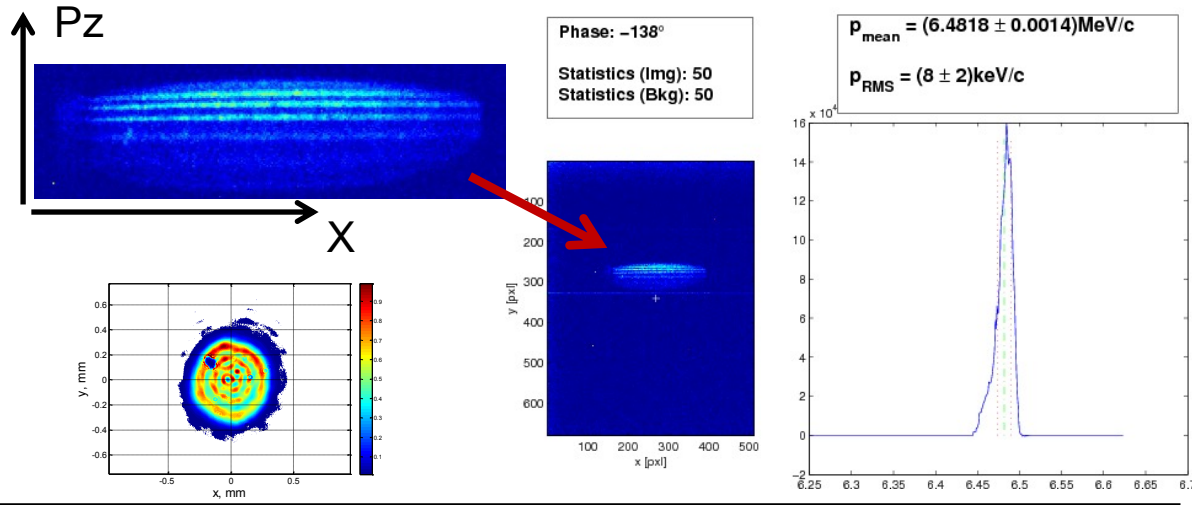
> LEDA projection at MMMG phase, -138 deg (17.11.2016 21:30)



> LEDA scan (17.11.2016 23:11)

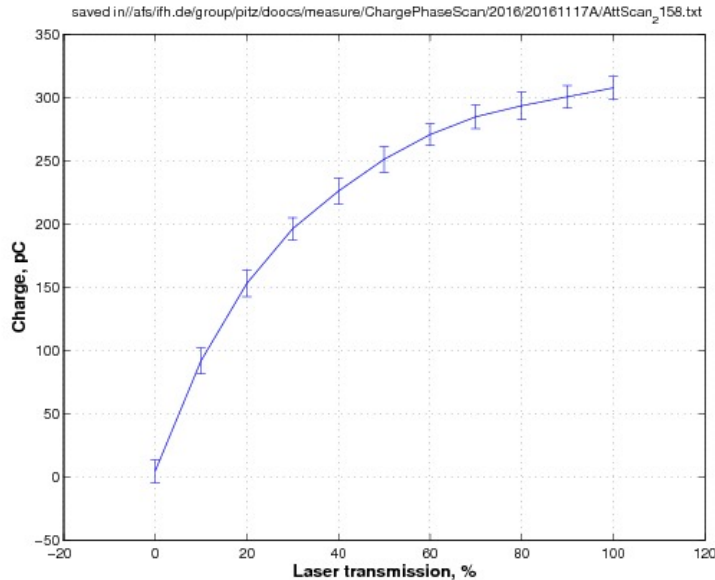


> LEDA projection at MMMG phase, -138 deg (17.11.2016 23:30)

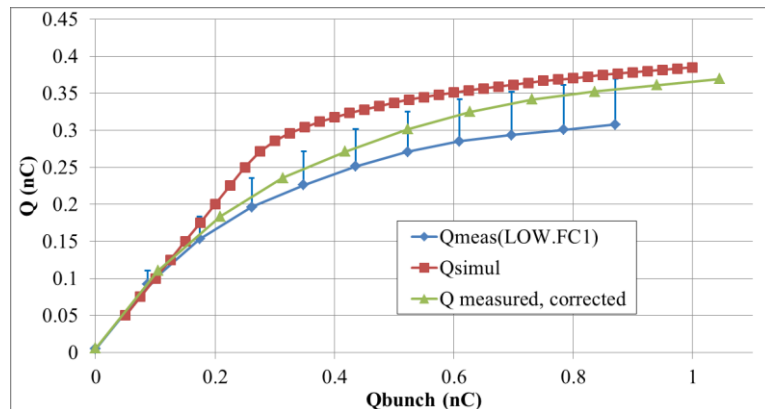


Measurements with long Gaussian on 17.11.2016A-N: Q

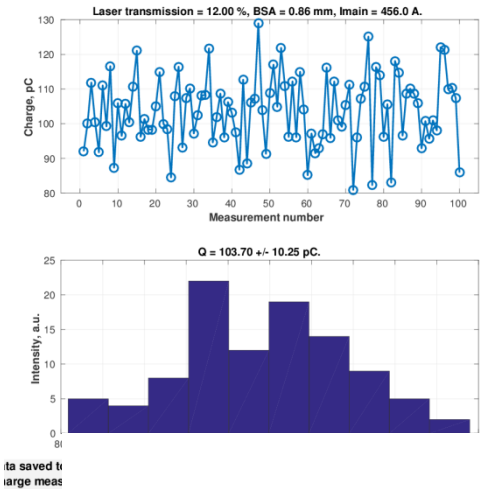
- > Attenuator scan @Low.FC1, 6.5 MW gun power, BSA 0.75 mm (17.11.2016 22:00)



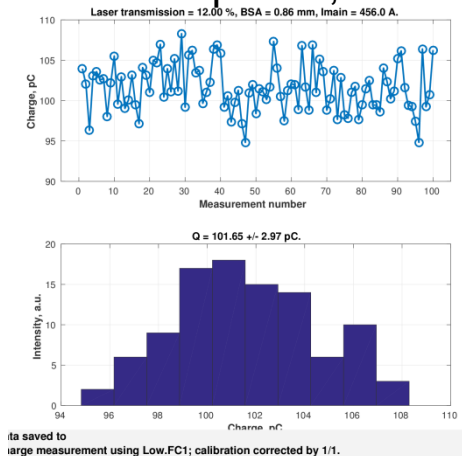
Charge measurement using Low.FC1; calibration corrected by 1/1.



- > Charge (LOW.FC1) at MMMG phase, (17.11.2016 22:04)



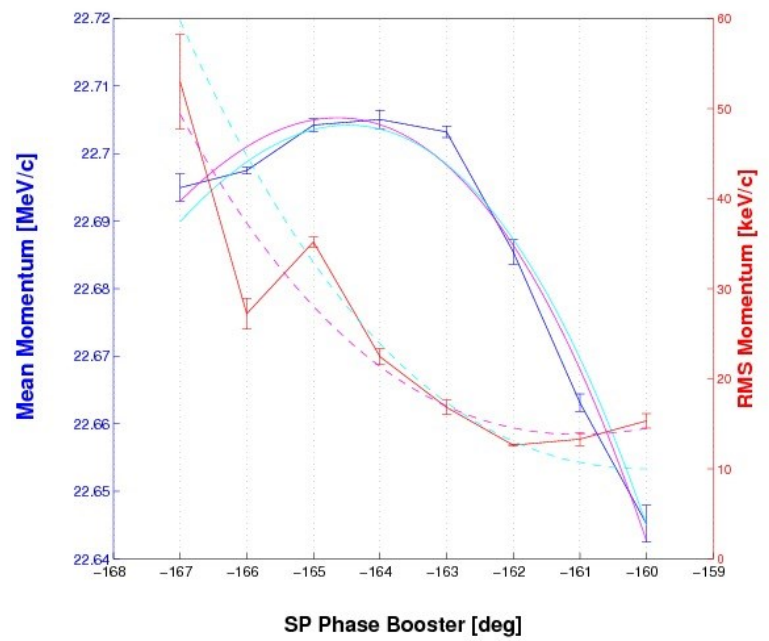
- > Charge (LOW.FC1) at MMMG phase, (17.11.2016 23:42)



Measurements with long Gaussian on 17.11.2016A-N: Pz-final

> HEDA1 scan (18.11.2016 00:28)

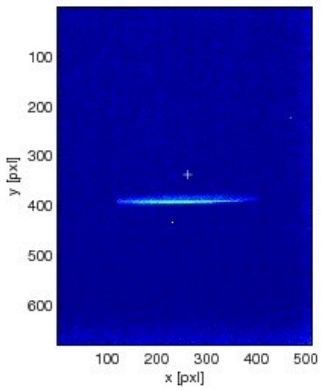
<p>Measured at: HEDA1 f50 (whole screen)</p> <p>$\langle p \rangle_{\max} = (22.7050 \pm 0.0014)\text{MeV/c at } -164^\circ$</p> <p>$p_{\min}^{\text{RMS}} = (12.62 \pm 0.11)\text{keV/c at } -162^\circ$</p>	<p>Imain = 389.7A Idip = -82.802A Stats: limg(Bkg): 10(5) 2 pulses LT = 12% SP-Pforw = 5.0 Power = 3.08MW Reflection = 48%</p>
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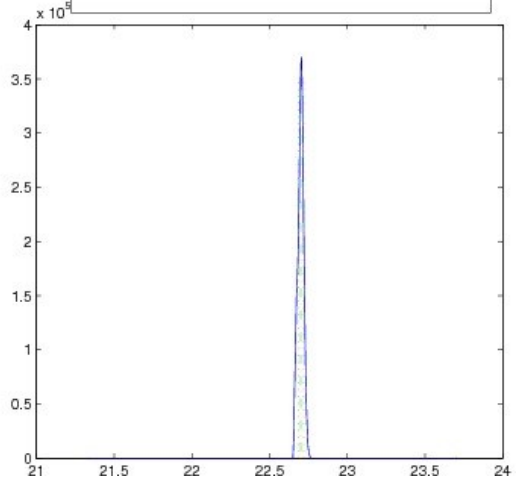
OMA_2016_11_18_100_28_42_SCANure/LongPhSp/2016/Momentum/20181117N/ R2015 v2.1

> LEDA projection at MMMG phase, -138 deg (18.11.2016 00:31)

Phase: -164°
 Statistics (limg): 100
 Statistics (Bkg): 20



$p_{\text{mean}} = (22.702 \pm 0.003)\text{MeV/c}$
 $p_{\text{RMS}} = (17.8 \pm 1.4)\text{keV/c}$



NB: HEDA1 problems are due to a temperature problem

Measurements with long Gaussian on 17.11.2016N: Transport to PST.Scr1

- > restored steering from 31.10.2016 (18.11.2016 00:37)

magnets_steerer.xml PITZ.CA/MAGNETS/HIGH1.ST1

steerer magnets

rotating steerers
 unlimover motor power on
 unlimover motor power off

Motor power is on

ID	NAME	UNIT	VALUE	UNIT	VALUE	STATUS
10	LOW.S11	PITZPS16	steerer	0.00	0.49907 A	On
13	LOW.S13	PITZPS3	steerer	1.50	1.50009 A	On
14	LOW.S14	PITZPS3	steerer	1.00	1.00021 A	On
70	HIGH2.ST1	PITZPS14	steerer	0.00	NaN A	Off

Diagram: A schematic of the magnet lattice with various magnets labeled (e.g., 10, 13, 14, 70) and their power supply connections.

- > $I_{main}=370A$, $I_{buck}=30.66A$, compensated
 → same as on 13.11.2016 (18.11.2016 00:44)

magnets_mainbuck.xml PITZ.CA/MAGNETS/MAIN/

main + bucking magnet

SMAC running into: [redacted]

POLARITY
 STATUS: **normal polarity**

magnet is in operation

MAIN/X	MAIN/Y
0.2000 mm	0.7000 mm
MAIN/ROLL	MAIN/PITCH
-0.0100 °	0.0000 °
MAIN/YAW	
0.1000 °	

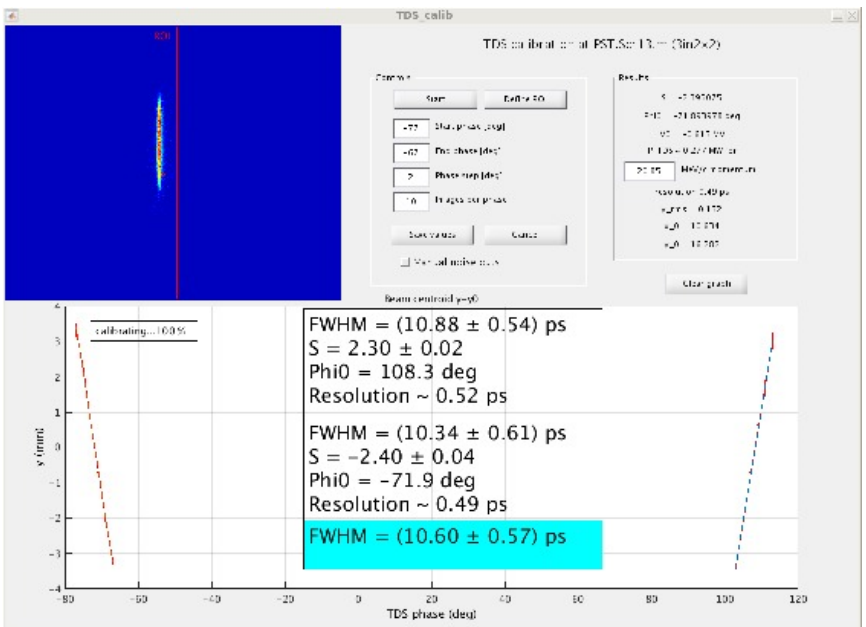
open window for moving main magnet

Parameter	Value	Unit	Status
MAN	530.000	OK	On
Current	370.00	H	369.69388
PITZPS1-1	0.000		
BUCKING	30.000	OK	On
Current	30.66		30.58678
PITZPS1-2	0.000		

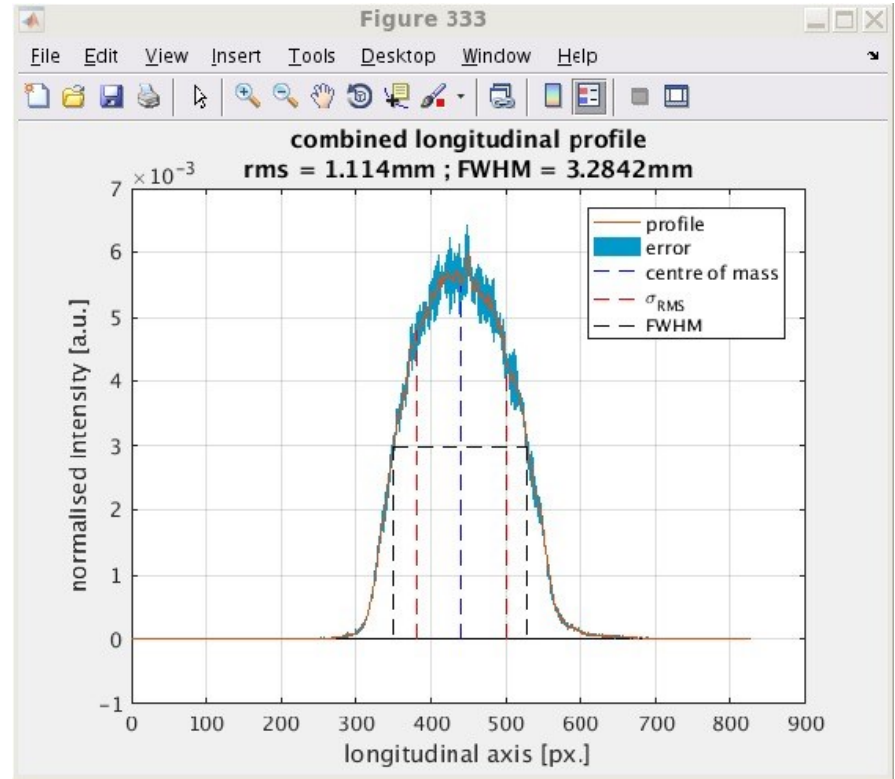
Diagram: A schematic of the magnet lattice with various magnets labeled (e.g., 76, 73, 72, 70, 34, 31, 30, 29, 28, 27, 26, 23, 22, 21, 12, 11, 10, 3, 2, 1) and their power supply connections.

Measurements with long Gaussian on 17.11.2016N: TDS

- > TDS calib,
TDS SP=0.6MV, PST.Scr1 f200
(18.11.2016 01:02)



- > longitudinal profile
(18.11.2016 01:02)



Measurements with long Gaussian on 17.11.2016N: transport to HEDA2

> Quad settings
(18.11.2016 01:40)

> Steerers
(18.11.2016 01:45)

tomography module quadrupol magnets

new degaussing gui

quadrupol magnets

Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14

new degaussing gui

quadrupol magnets

Q15 Q16 Q17 Q18 Q19 Q20 Q21 Q22 Q23 Q24 Q25 Q26 Q27 Q28 Q29 Q30 Q31 Q32 Q33 Q34 Q35 Q36 Q37 Q38 Q39 Q40 Q41 Q42 Q43 Q44 Q45 Q46 Q47 Q48 Q49 Q50 Q51 Q52 Q53 Q54 Q55 Q56 Q57 Q58 Q59 Q60 Q61 Q62 Q63 Q64 Q65 Q66 Q67 Q68 Q69 Q70 Q71 Q72 Q73 Q74 Q75 Q76 Q77 Q78 Q79 Q80 Q81 Q82 Q83 Q84 Q85 Q86 Q87 Q88 Q89 Q90 Q91 Q92 Q93 Q94 Q95 Q96 Q97 Q98 Q99 Q100

new degaussing gui

quadrupol magnets

Q101 Q102 Q103 Q104 Q105 Q106 Q107 Q108 Q109 Q110 Q111 Q112 Q113 Q114 Q115 Q116 Q117 Q118 Q119 Q120 Q121 Q122 Q123 Q124 Q125 Q126 Q127 Q128 Q129 Q130 Q131 Q132 Q133 Q134 Q135 Q136 Q137 Q138 Q139 Q140 Q141 Q142 Q143 Q144 Q145 Q146 Q147 Q148 Q149 Q150 Q151 Q152 Q153 Q154 Q155 Q156 Q157 Q158 Q159 Q160 Q161 Q162 Q163 Q164 Q165 Q166 Q167 Q168 Q169 Q170 Q171 Q172 Q173 Q174 Q175 Q176 Q177 Q178 Q179 Q180 Q181 Q182 Q183 Q184 Q185 Q186 Q187 Q188 Q189 Q190 Q191 Q192 Q193 Q194 Q195 Q196 Q197 Q198 Q199 Q200

new degaussing gui

quadrupol magnets

Q201 Q202 Q203 Q204 Q205 Q206 Q207 Q208 Q209 Q210 Q211 Q212 Q213 Q214 Q215 Q216 Q217 Q218 Q219 Q220 Q221 Q222 Q223 Q224 Q225 Q226 Q227 Q228 Q229 Q230 Q231 Q232 Q233 Q234 Q235 Q236 Q237 Q238 Q239 Q240 Q241 Q242 Q243 Q244 Q245 Q246 Q247 Q248 Q249 Q250 Q251 Q252 Q253 Q254 Q255 Q256 Q257 Q258 Q259 Q260 Q261 Q262 Q263 Q264 Q265 Q266 Q267 Q268 Q269 Q270 Q271 Q272 Q273 Q274 Q275 Q276 Q277 Q278 Q279 Q280 Q281 Q282 Q283 Q284 Q285 Q286 Q287 Q288 Q289 Q290 Q291 Q292 Q293 Q294 Q295 Q296 Q297 Q298 Q299 Q300

new degaussing gui

quadrupol magnets

Q301 Q302 Q303 Q304 Q305 Q306 Q307 Q308 Q309 Q310 Q311 Q312 Q313 Q314 Q315 Q316 Q317 Q318 Q319 Q320 Q321 Q322 Q323 Q324 Q325 Q326 Q327 Q328 Q329 Q330 Q331 Q332 Q333 Q334 Q335 Q336 Q337 Q338 Q339 Q340 Q341 Q342 Q343 Q344 Q345 Q346 Q347 Q348 Q349 Q350 Q351 Q352 Q353 Q354 Q355 Q356 Q357 Q358 Q359 Q360 Q361 Q362 Q363 Q364 Q365 Q366 Q367 Q368 Q369 Q370 Q371 Q372 Q373 Q374 Q375 Q376 Q377 Q378 Q379 Q380 Q381 Q382 Q383 Q384 Q385 Q386 Q387 Q388 Q389 Q390 Q391 Q392 Q393 Q394 Q395 Q396 Q397 Q398 Q399 Q400

new degaussing gui

quadrupol magnets

Q401 Q402 Q403 Q404 Q405 Q406 Q407 Q408 Q409 Q410 Q411 Q412 Q413 Q414 Q415 Q416 Q417 Q418 Q419 Q420 Q421 Q422 Q423 Q424 Q425 Q426 Q427 Q428 Q429 Q430 Q431 Q432 Q433 Q434 Q435 Q436 Q437 Q438 Q439 Q440 Q441 Q442 Q443 Q444 Q445 Q446 Q447 Q448 Q449 Q450 Q451 Q452 Q453 Q454 Q455 Q456 Q457 Q458 Q459 Q460 Q461 Q462 Q463 Q464 Q465 Q466 Q467 Q468 Q469 Q470 Q471 Q472 Q473 Q474 Q475 Q476 Q477 Q478 Q479 Q480 Q481 Q482 Q483 Q484 Q485 Q486 Q487 Q488 Q489 Q490 Q491 Q492 Q493 Q494 Q495 Q496 Q497 Q498 Q499 Q500

new degaussing gui

quadrupol magnets

Q499 Q500

tomography module rotating steerer magnets

rotating steerers

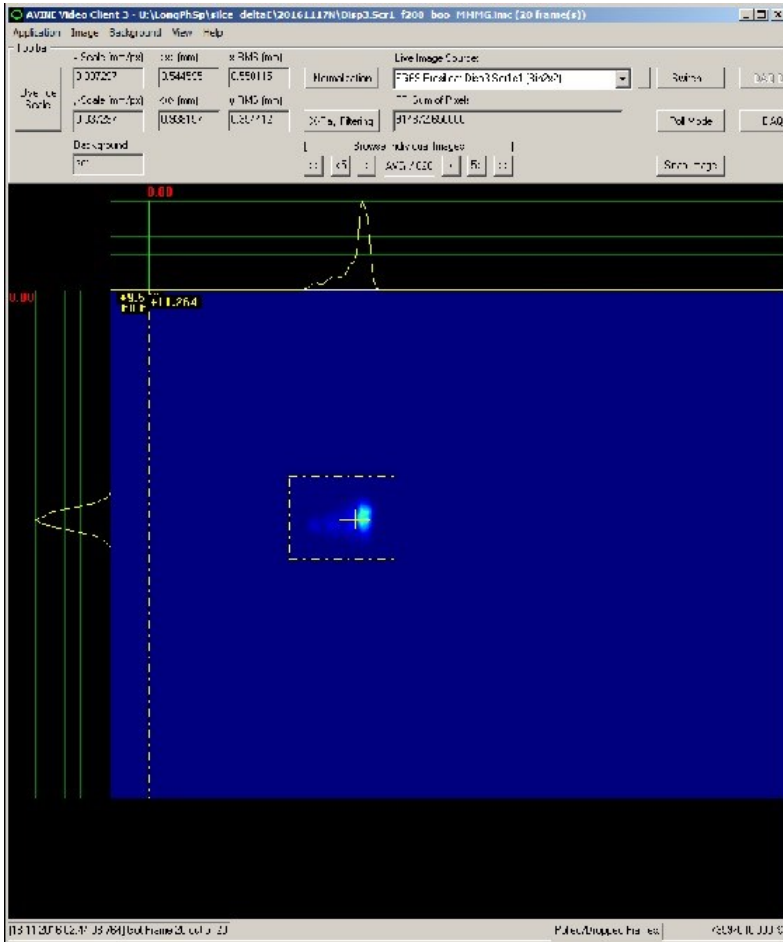
PS15-1 PS15-2 PS15-3 PS15-4 PS15-5

rotating steerers

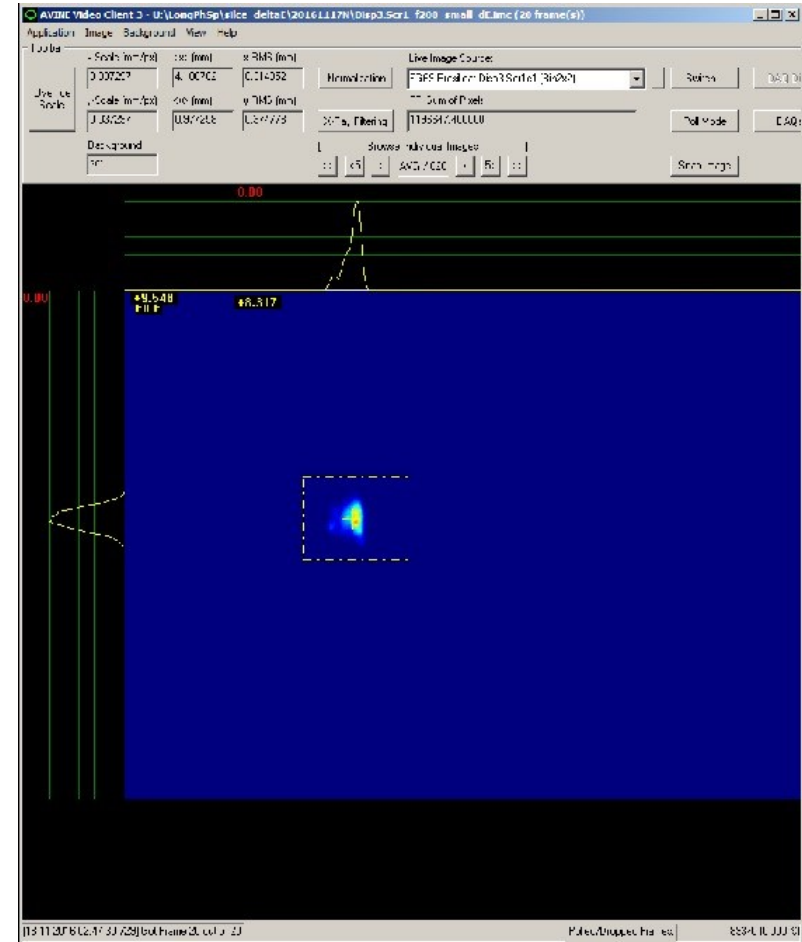
PS15-1 PS15-2 PS15-3 PS15-4 PS15-5

Measurements with long Gaussian on 17.11.2016N: HEDA2

- > beam at Disp3.Scr1 f200, booster at **MMMMG** phase 1p4g (18.11.2016 02:44)

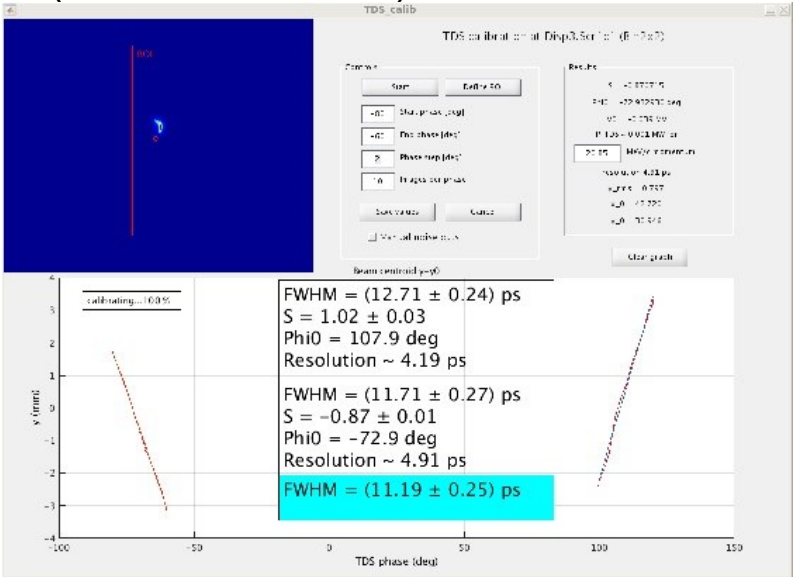


- > beam at Disp3.Scr1 f200, booster at **smallest dE** phase = -162.4 deg (18.11.2016 02:48)

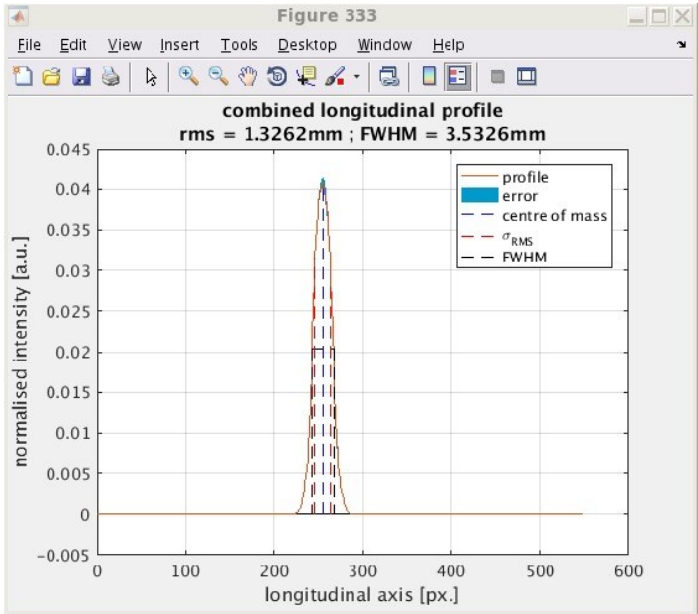


Measurements with long Gaussian on 17.11.2016N: TDS+HEDA2

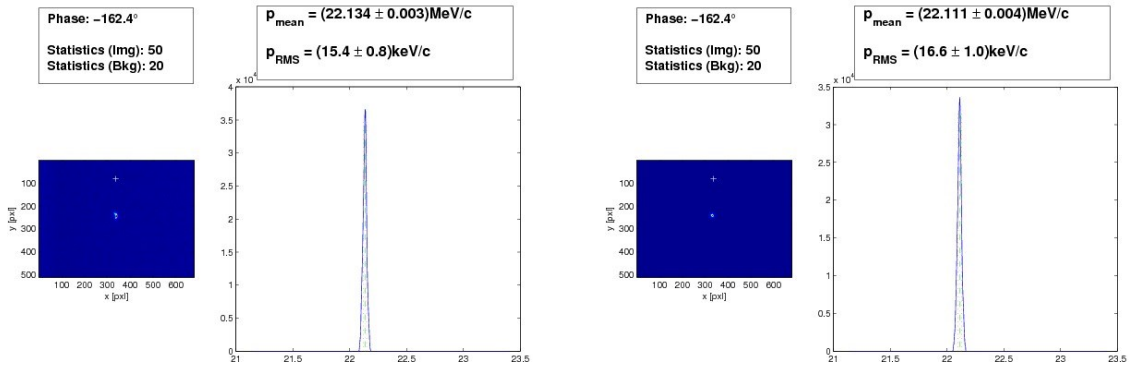
- > TDS calib,
TDS SP=**0.05MV**,
(18.11.2016 03:58)



- > longitudinal profile
(18.11.2016 03:58)

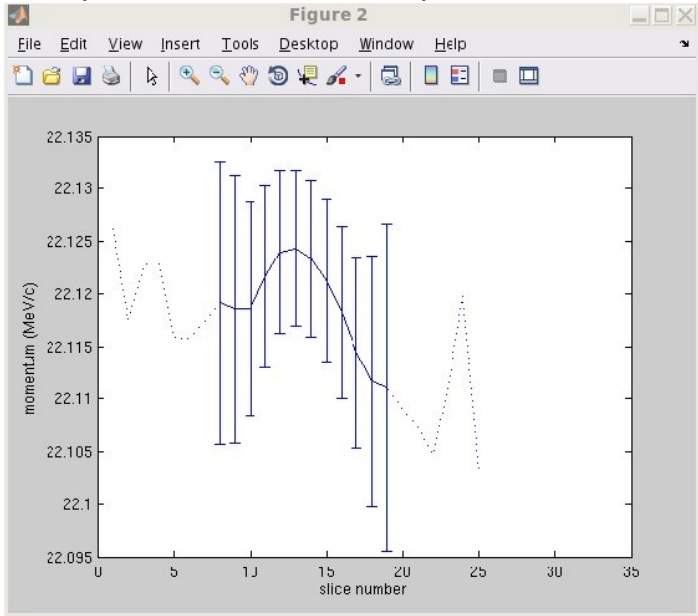


- > Pz-distributions
w/ TDS (18.11.2016 04:00) w/o TDS (18.11.2016 04:00)

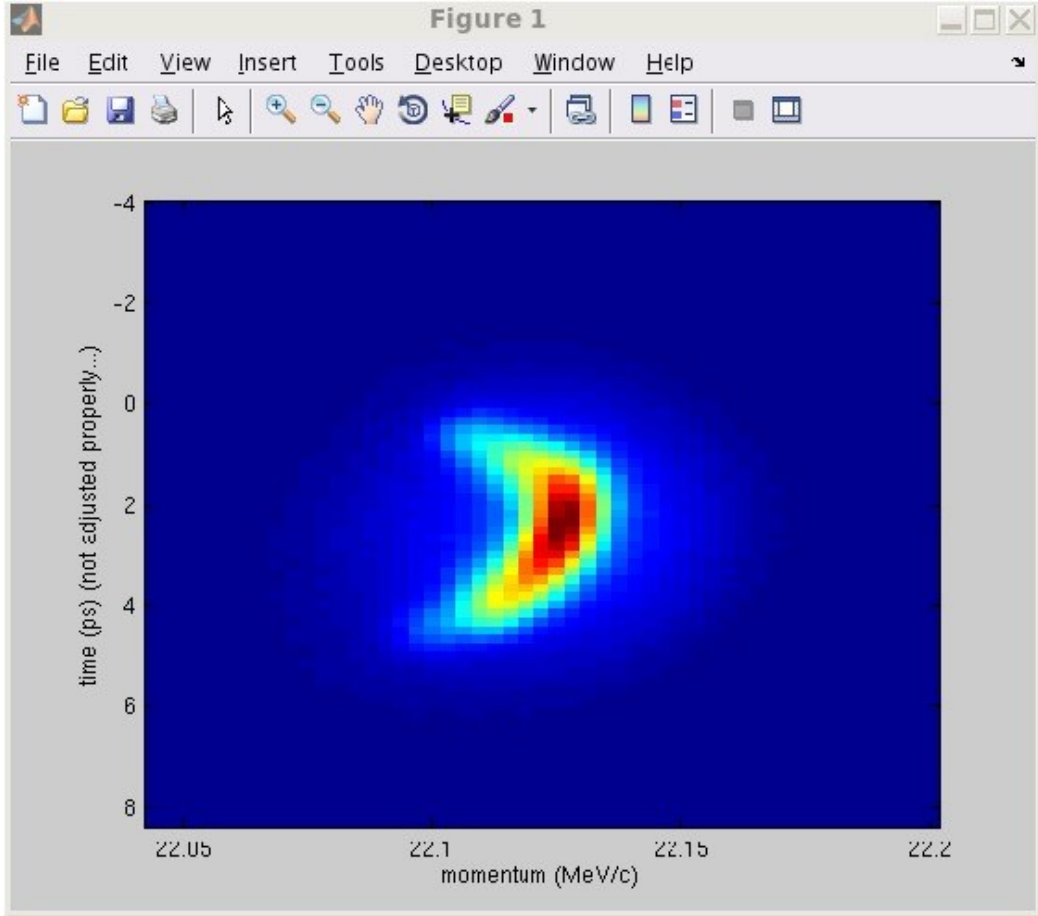


Measurements with long Gaussian on 17.11.2016N: TDS+HEDA2

> LPS, TDS SP=**0.05MV**,
(18.11.2016 04:04)



> LPS (18.11.2016 04:04)



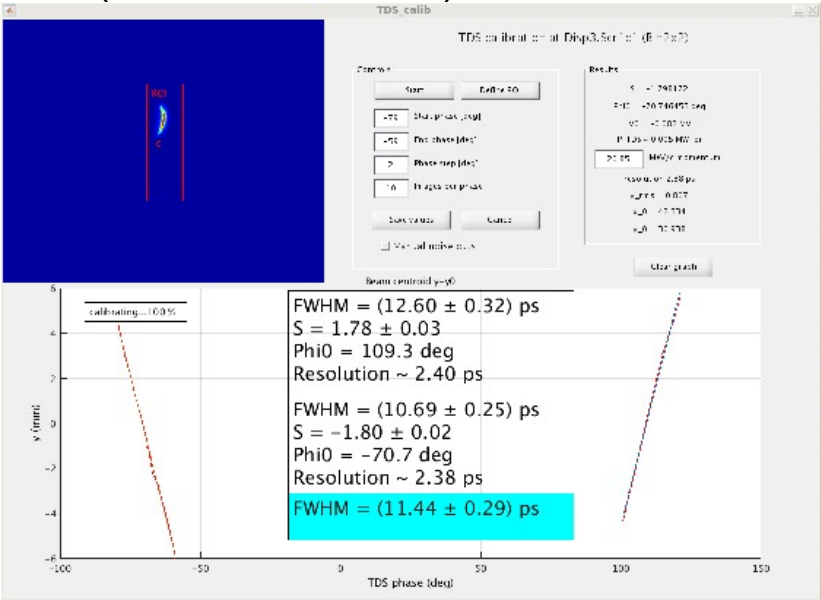
Slice energy spread was measured with
bunch charge of 112.6094 pC
solenoid current of 369.6939 A
booster power 3.0776 MW
booster phase -162.4
gun phase -138
gun power 6.5082 MW
TDS setpoint 0.05 MV
BSA setpoint 0.86 mm and readback 0.74265 mm
number of analysis slices 33
and the center slice (number 14) measured slice energy spread was 7.4495 keV/c

OK

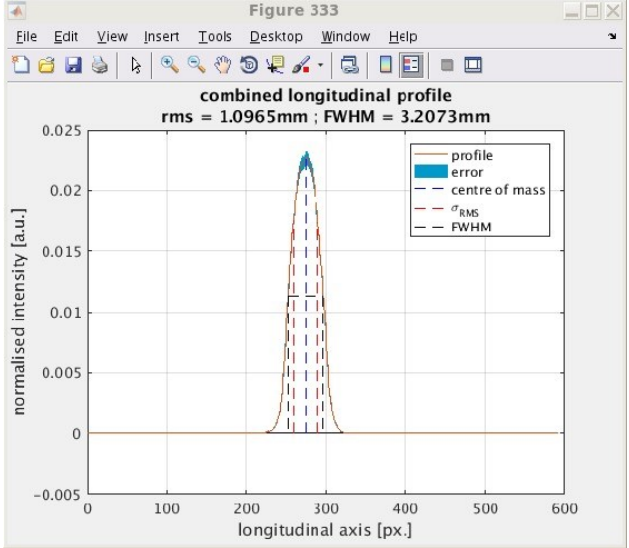
file /docs/measure/LongPhSp/2016/deltaE/shortG/2016/20161117N/sliceEspread_0403.mat

Measurements with long Gaussian on 17.11.2016N: TDS+HEDA2

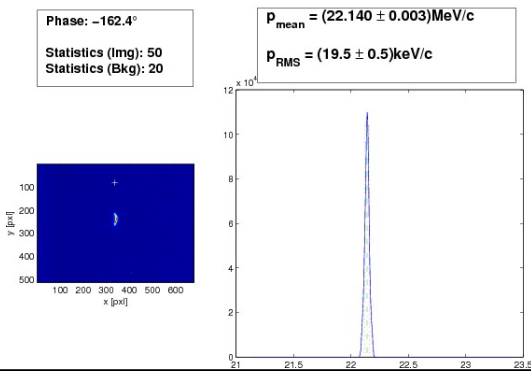
- TDS calib,
TDS SP=**0.1MV**,
(18.11.2016 03:01)



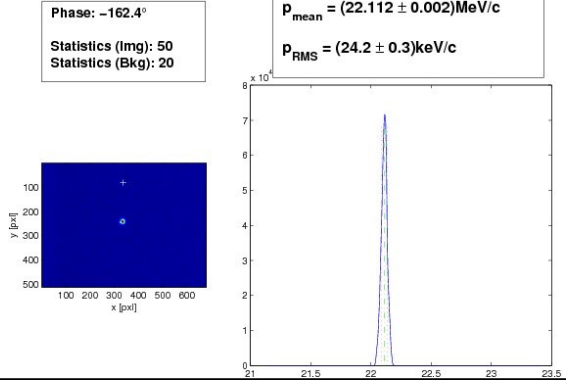
- longitudinal profile
(18.11.2016 03:01)



- Pz-distributions
w/ TDS (18.11.2016 03:07)



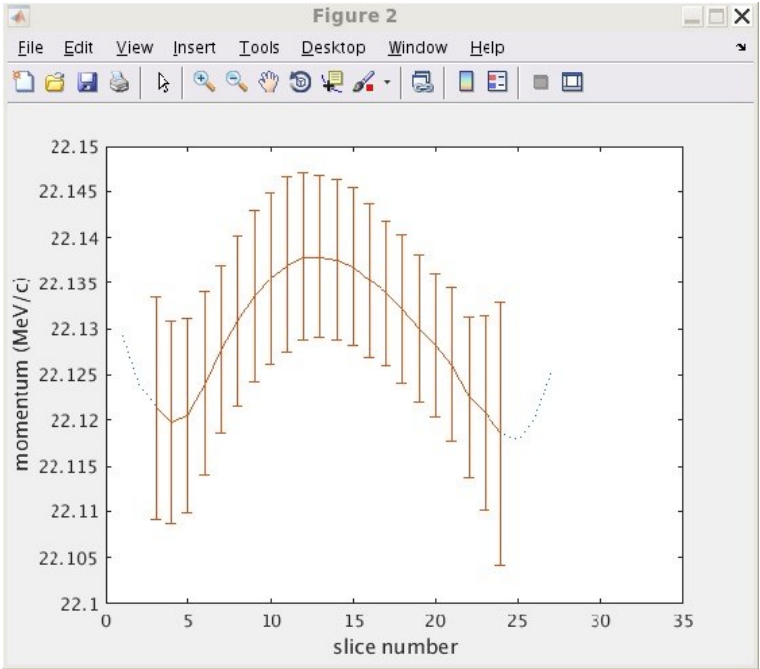
- w/o TDS (18.11.2016 03:08)



Measurements with long Gaussian on 17.11.2016N: TDS+HEDA2

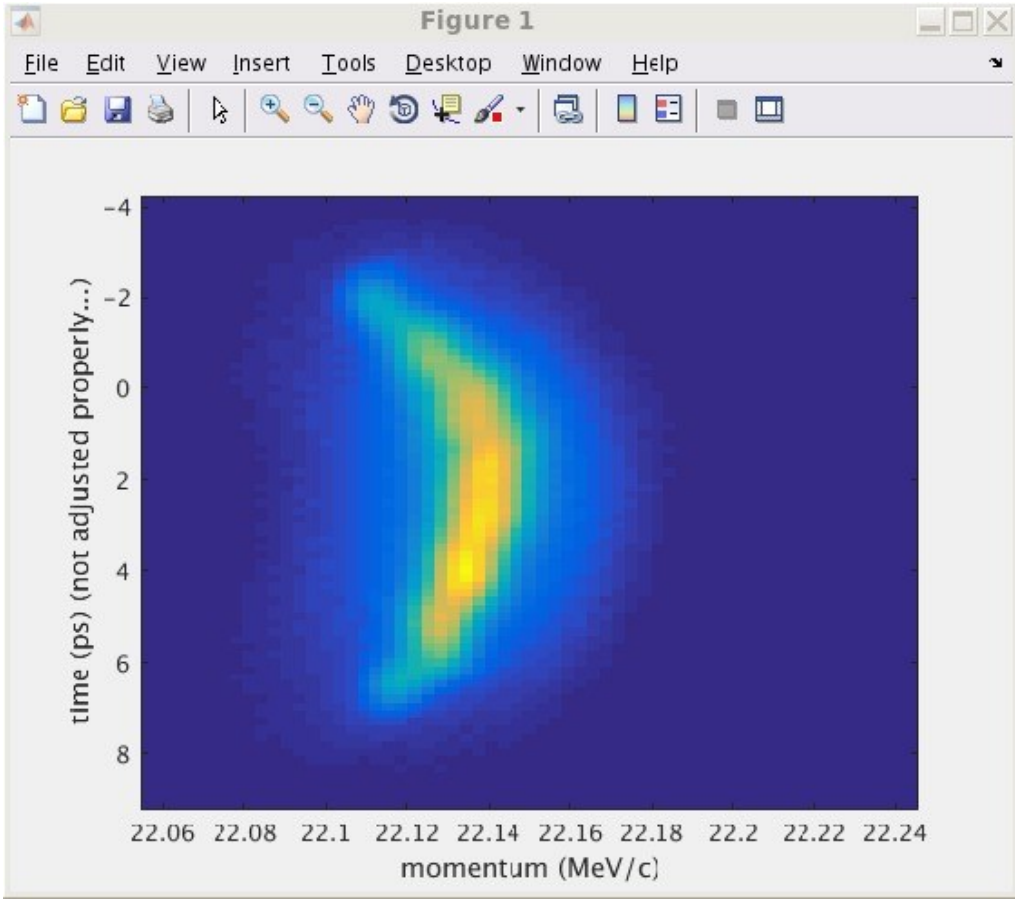
> LPS, TDS SP=0.1MV,
(18.11.2016 03:13)

> LPS (18.11.2016 03:13)



Slice energy spread was measured with
bunch charge of 112.332 pC
solenoid current of 369.6939 A
booster power 3.0745 MW
booster phase -162.4
gun phase -138
gun power 6.5106 MW
TDS setpoint 0.1 MV
BSA setpoint 0.86 mm and readback 0.74265 mm
number of analysis slices 33
and the center slice (number 14) measured slice energy spread was 8.7432 keV/c

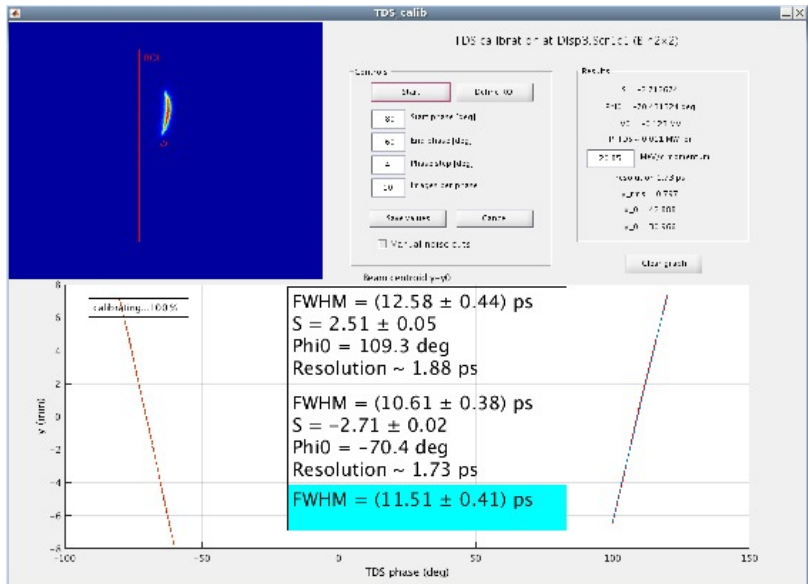
OK



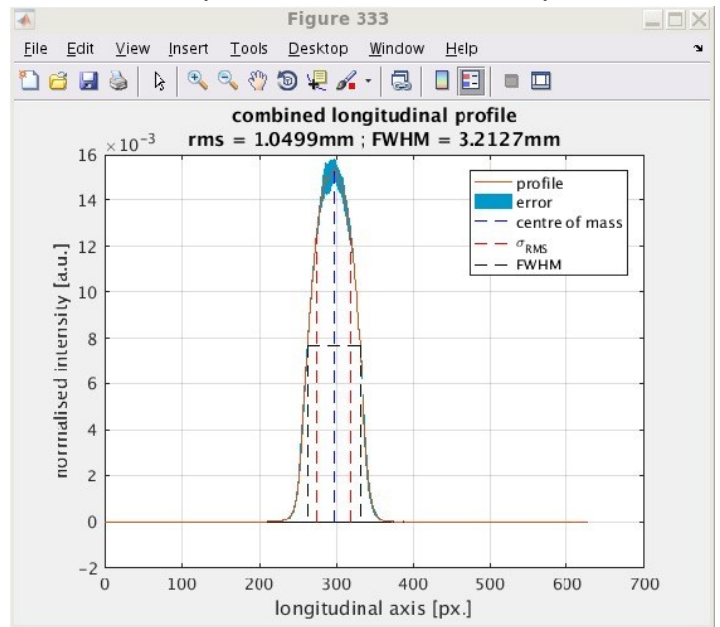
file
/docs/measure/LongPhSp/2016/deltaE/shortG/2016/20161117N/sliceEspread_0310_MMS.mat

Measurements with long Gaussian on 17.11.2016N: TDS+HEDA2

- > TDS calib,
TDS SP=**0.15MV**,
(18.11.2016 03:25)

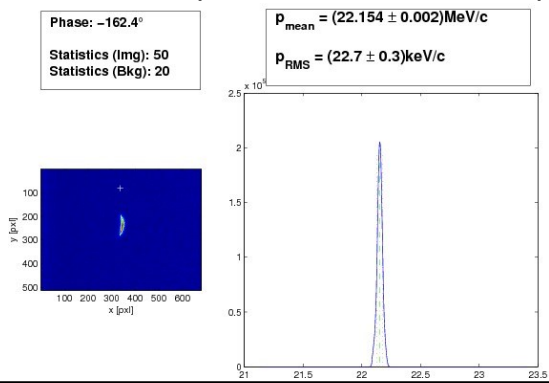


- > longitudinal profile
(18.11.2016 03:25)

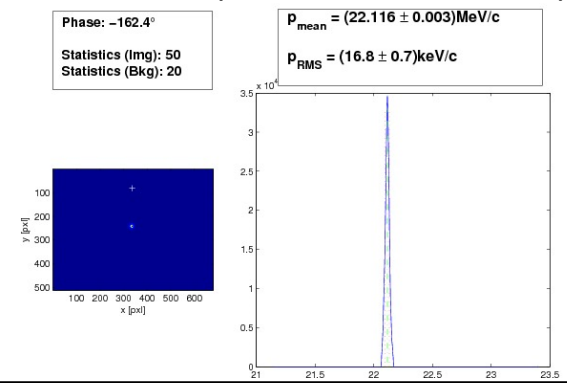


> Pz-distributions

w/ TDS (18.11.2016 03:27)

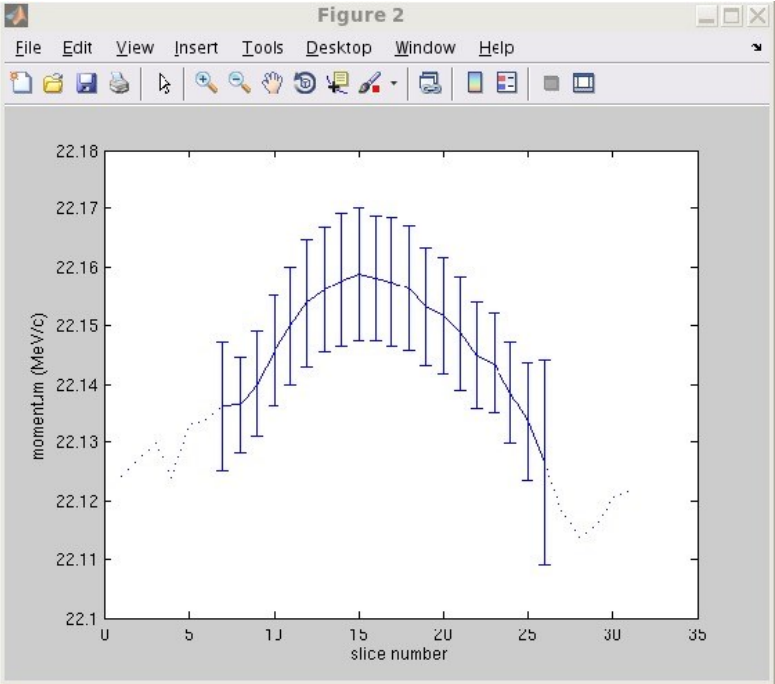


w/o TDS (18.11.2016 03:28)



Measurements with long Gaussian on 17.11.2016N: TDS+HEDA2

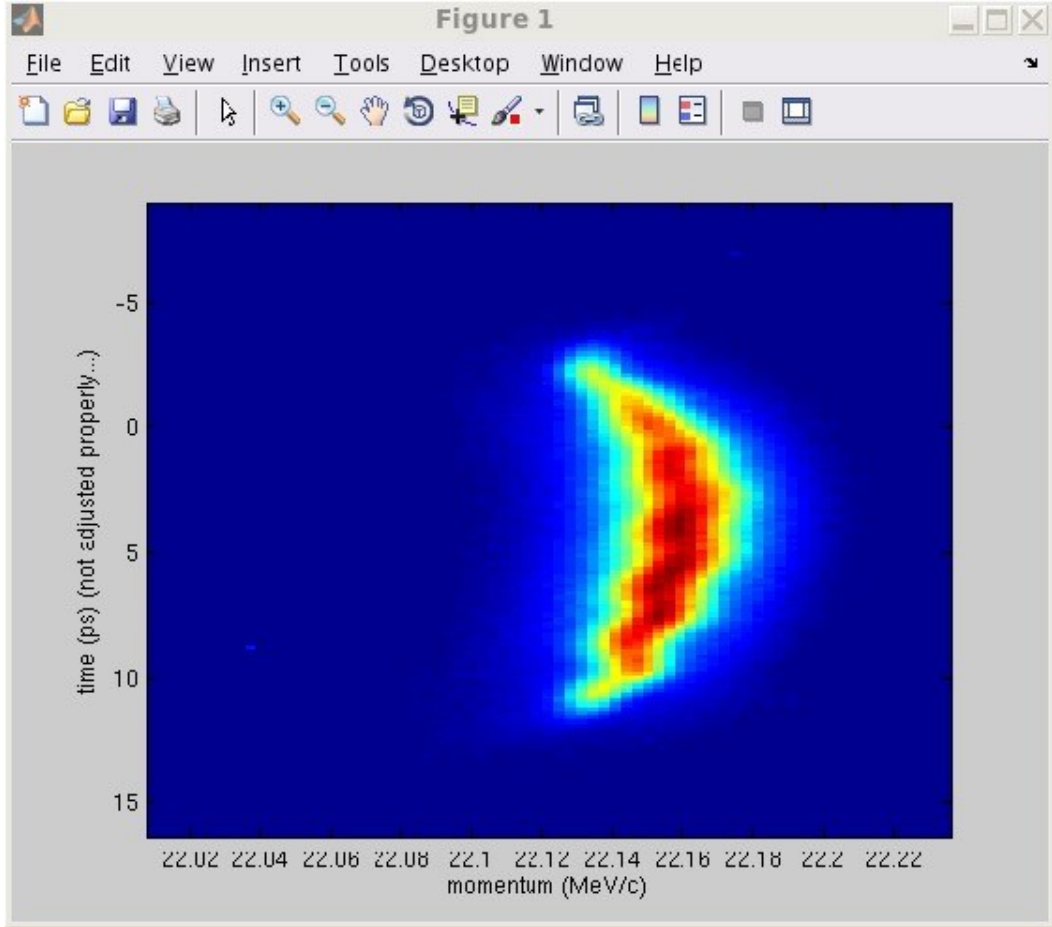
> LPS, TDS SP=**0.15MV**,
(18.11.2016 03:32)



Slice energy spread was measured with
bunch charge of 113.6085 pC
solenoid current of 369.6939 A
booster power 3.0741 MW
booster phase -162.4
gun phase -138
gun power 6.5204 MW
TDS setpoint 0.15 MV
BSA setpoint 0.86 mm and readback 0.74265 mm
number of analysis slices 33
and the center slice (number 16) measured slice energy spread was 10.6829 keV/c

OK

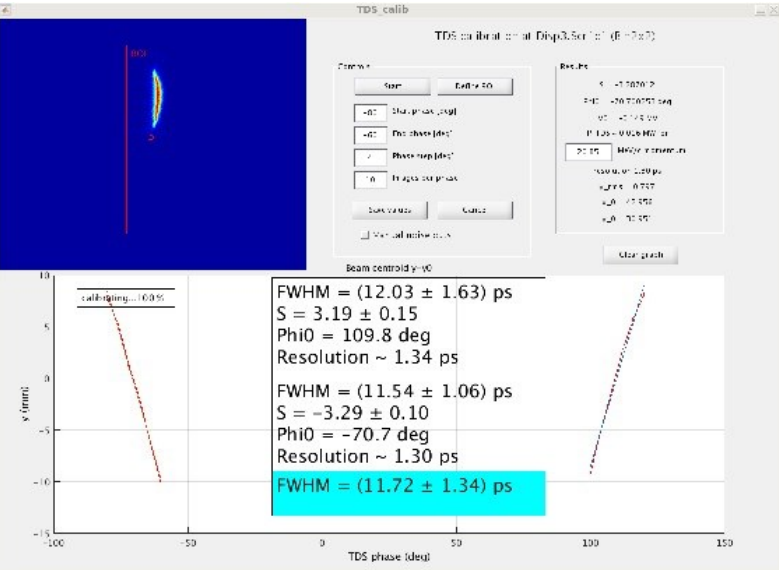
> LPS (18.11.2016 03:32)



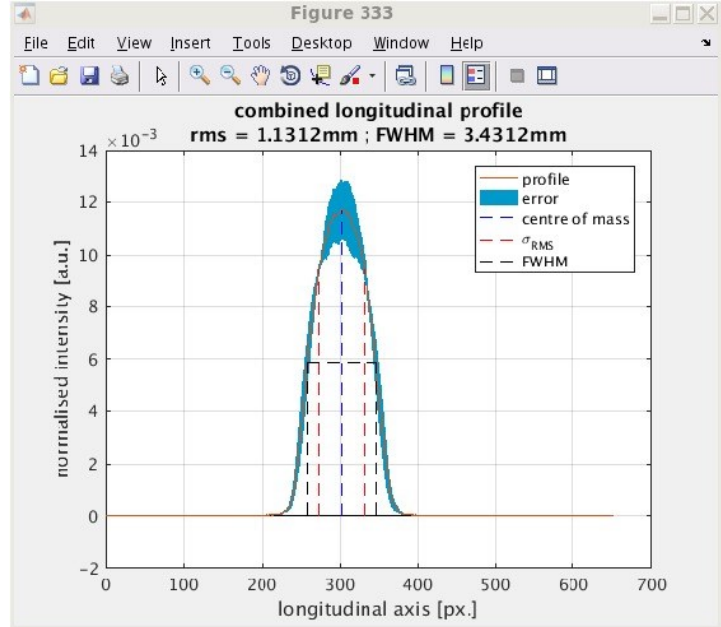
file /doocs/measure/LongPhSp/2016/deltaE/shortG/2016/20161117N/sliceEspread_0328.mat

Measurements with long Gaussian on 17.11.2016N: TDS+HEDA2

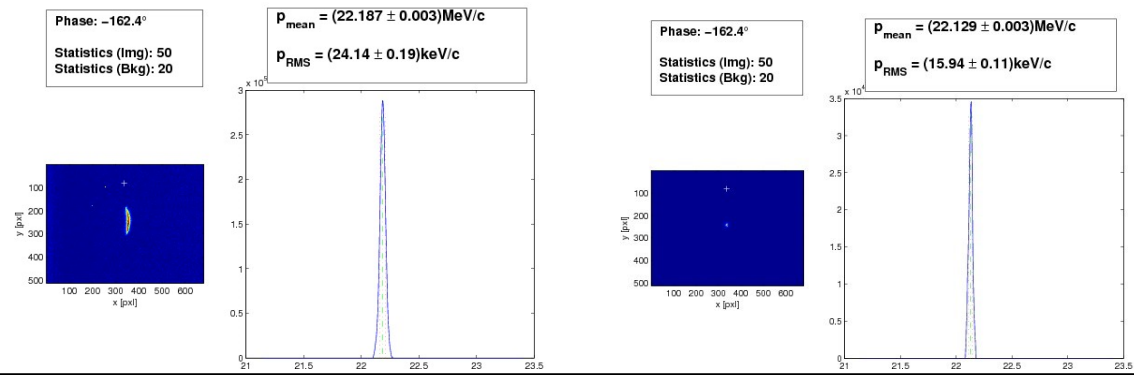
- > TDS calib,
TDS SP=**0.20MV**,
(18.11.2016 03:35)



- > longitudinal profile
(18.11.2016 03:35)

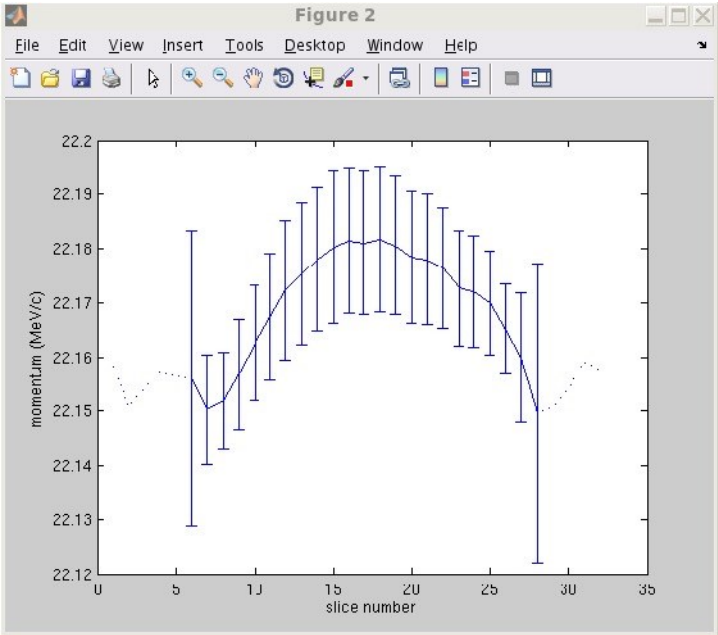


- > Pz-distributions
w/ TDS (18.11.2016 03:37) w/o TDS (18.11.2016 03:38)

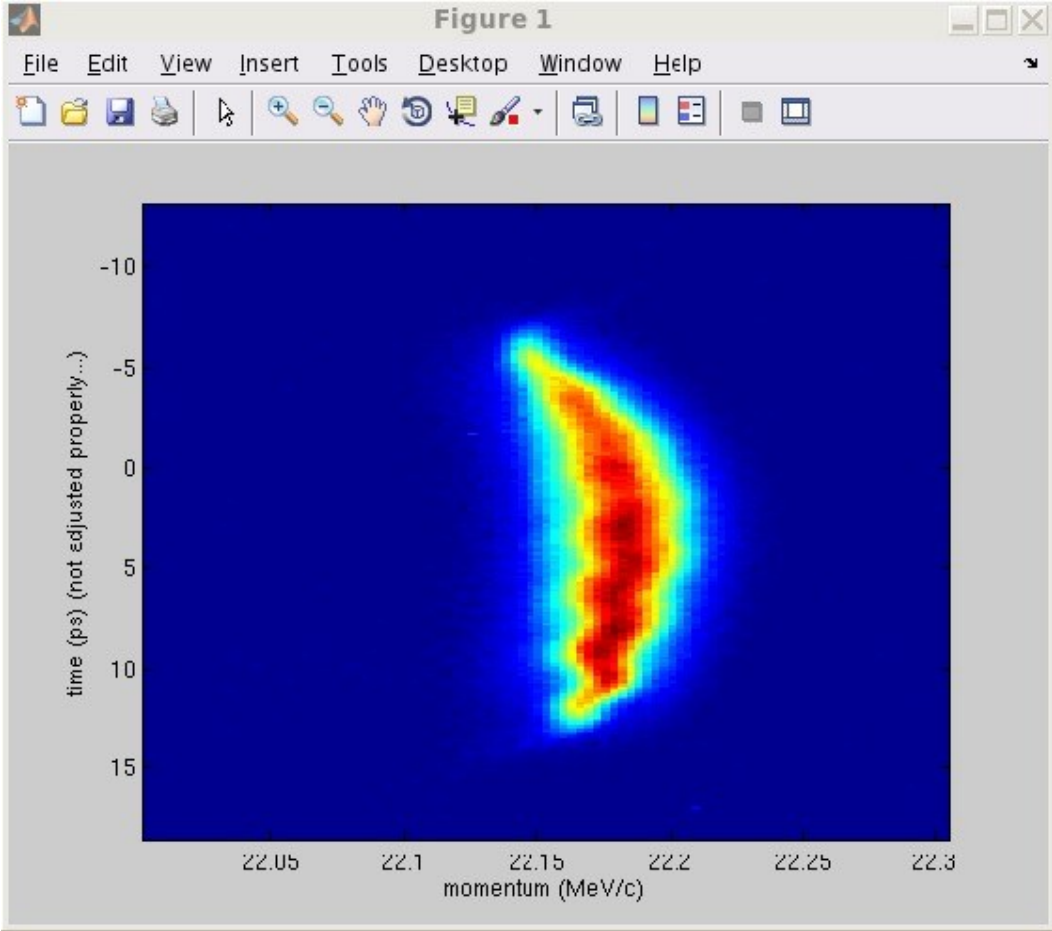


Measurements with long Gaussian on 17.11.2016N: TDS+HEDA2

> LPS, TDS SP=**0.20MV**,
(18.11.2016 03:39)



> LPS (18.11.2016 03:32)

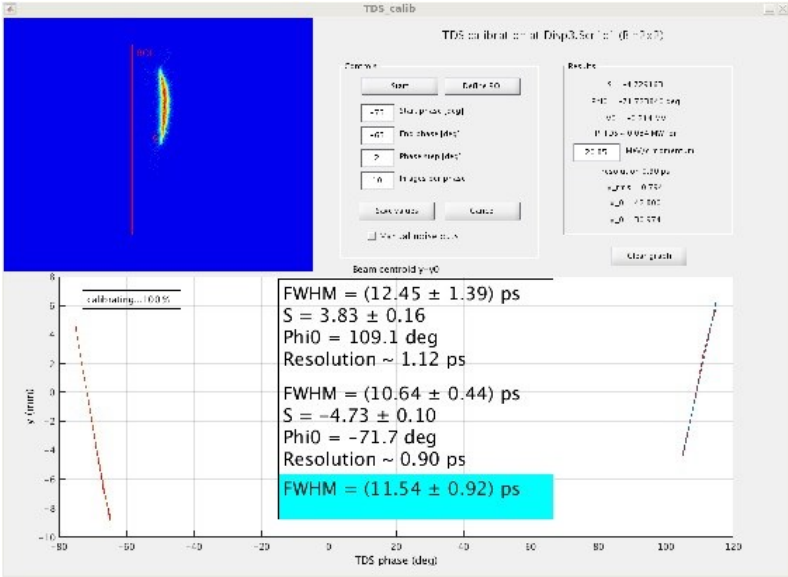


Slice energy spread was measured with
bunch charge of 112.887 pC
solenoid current of 369.6939 A
booster power 3.0828 MW
booster phase -162.4
gun phase -138
gun power 6.4941 MW
TDS setpoint 0.2 MV
BSA setpoint 0.86 mm and readback 0.72186 mm
number of analysis slices 33
and the center slice (number 17) measured slice energy spread was 13.1497 keV/c

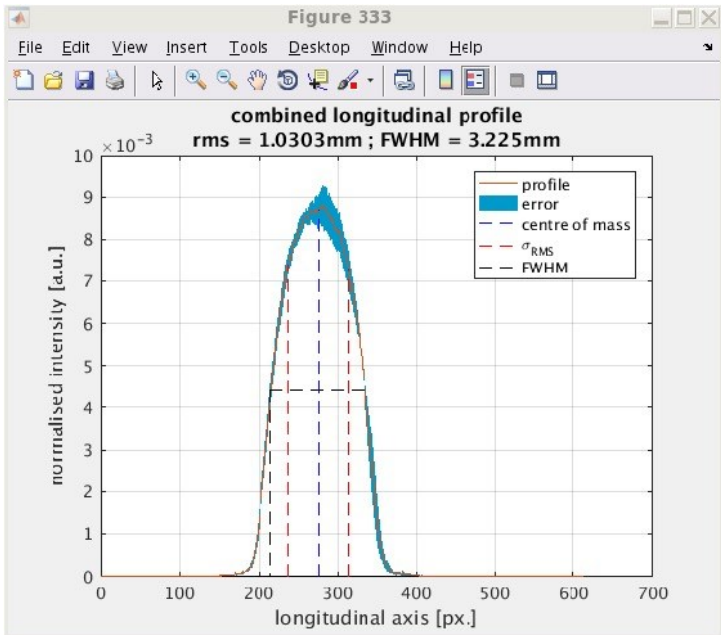
OK

Measurements with long Gaussian on 17.11.2016N: TDS+HEDA2

- > TDS calib,
TDS SP=**0.25MV**,
(18.11.2016 03:48)

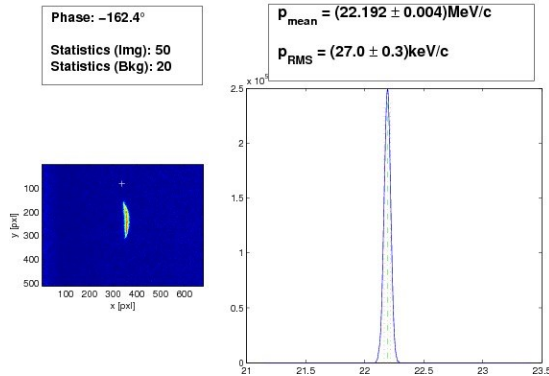


- > longitudinal profile
(18.11.2016 03:48)

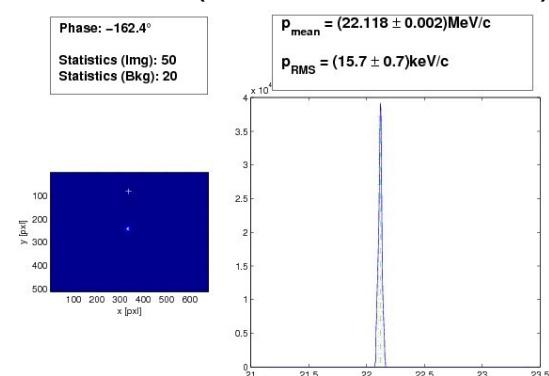


- > Pz-distributions

w/ TDS (18.11.2016 03:49)

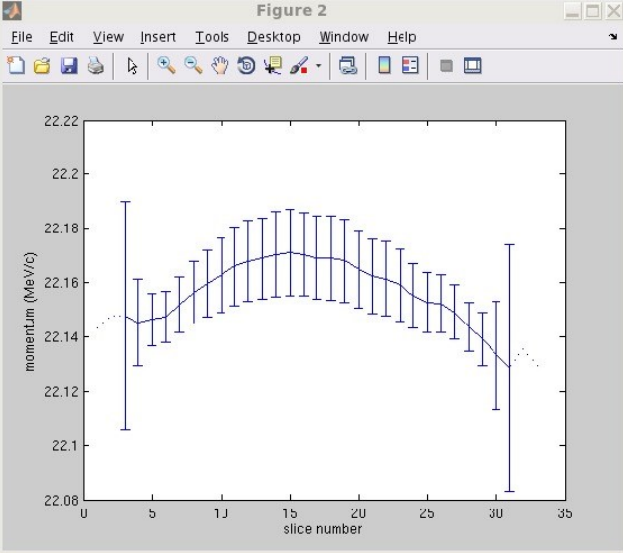


w/o TDS (18.11.2016 03:50)

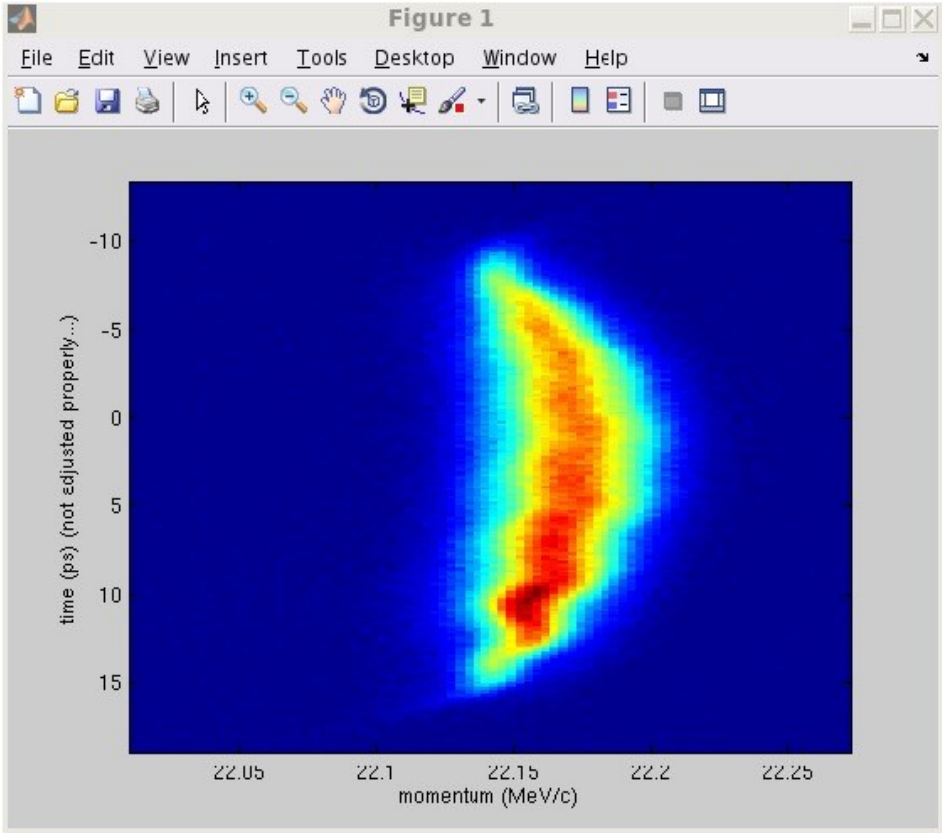


Measurements with long Gaussian on 17.11.2016N: TDS+HEDA2

> LPS, TDS SP=**0.25MV**,
(18.11.2016 03:52)



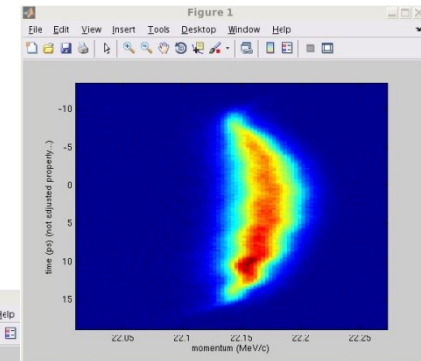
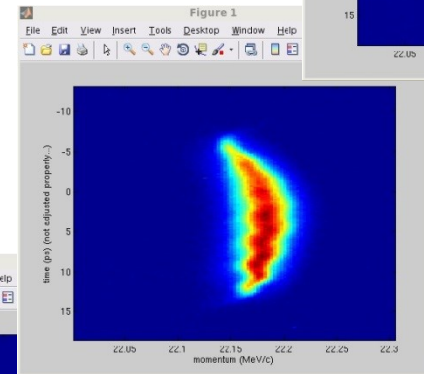
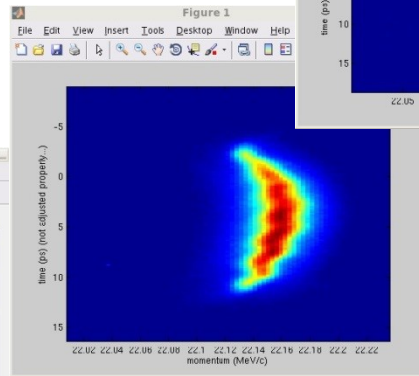
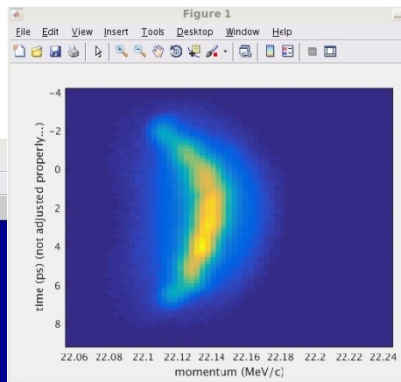
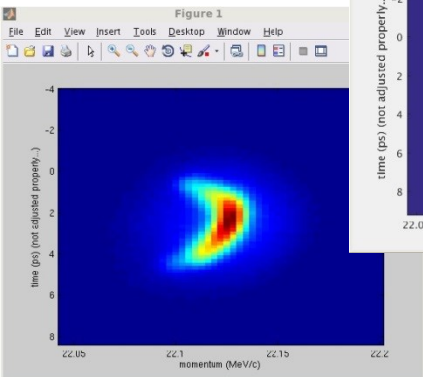
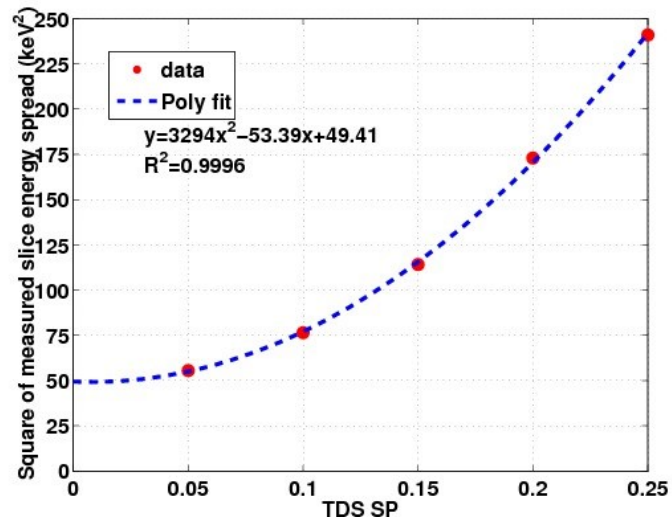
> LPS (18.11.2016 03:52)



Slice energy spread was measured with
bunch charge of 114.219 pC
solenoid current of 369.6939 A
booster power 3.0738 MW
booster phase -162.4
gun phase -138
gun power 6.5052 MW
TDS setpoint 0.25 MV
BSA setpoint 0.86 mm and readback 0.74265 mm
number of analysis slices 33
and the center slice (number 18) measured slice energy spread was 15.5226 keV/c

OK

TDS SP scan



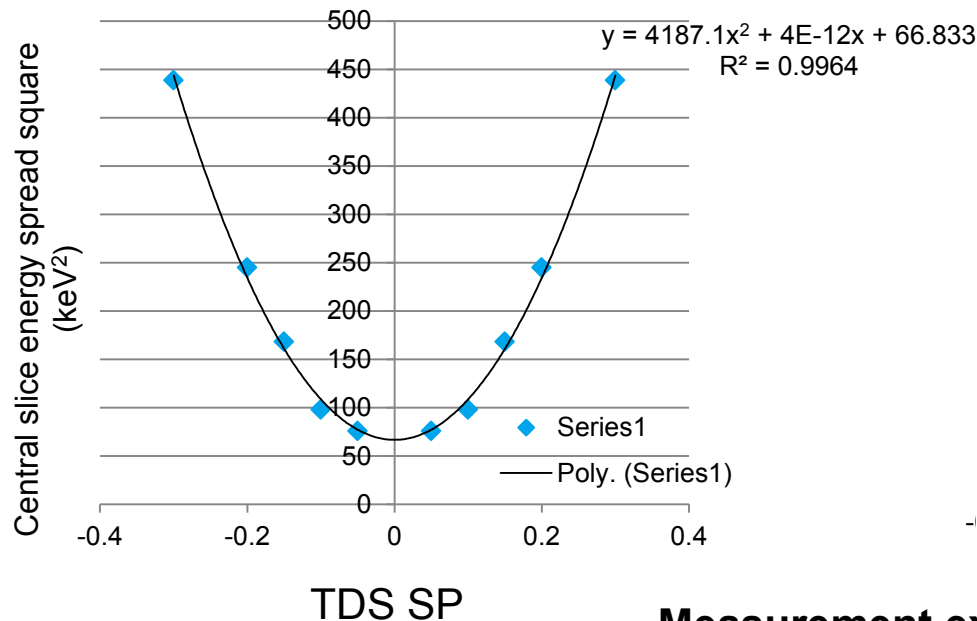
Slice energy spread with long Gaussian laser

➤ Slice energy spread measurement

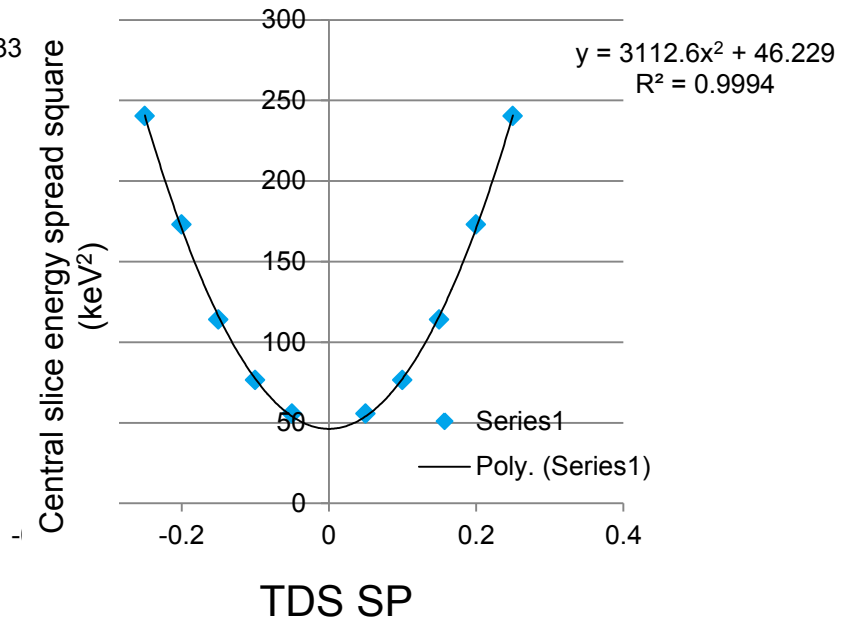
- Real slice energy spread
- TDS contribution
- Beta function contribution

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

8.2 keV for TDS zero (**Short** Gaussian)



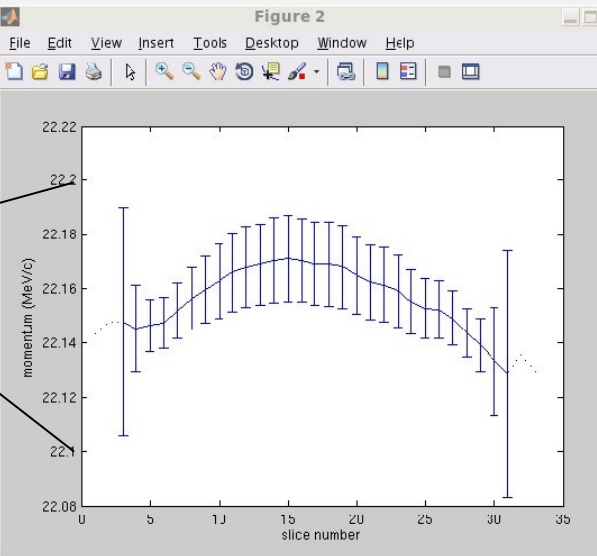
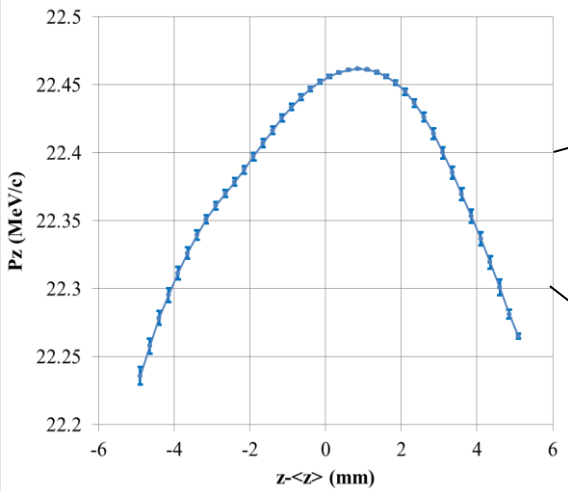
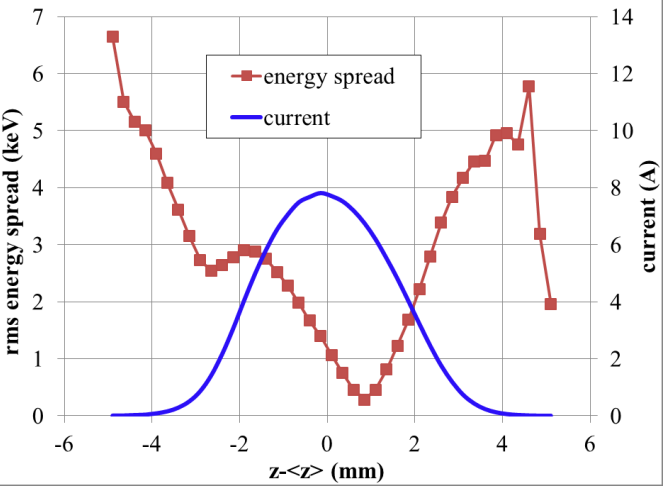
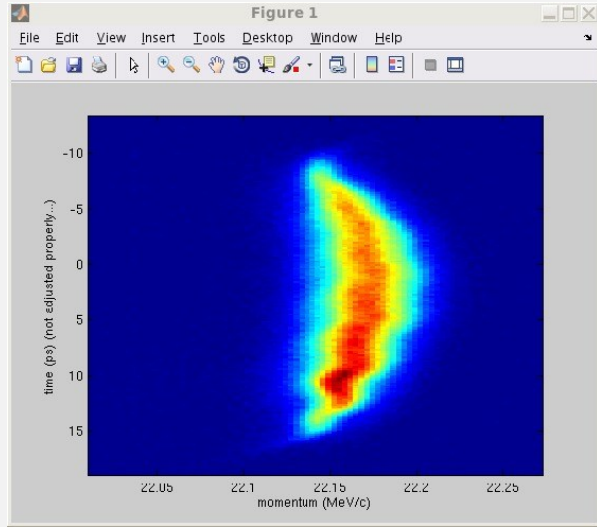
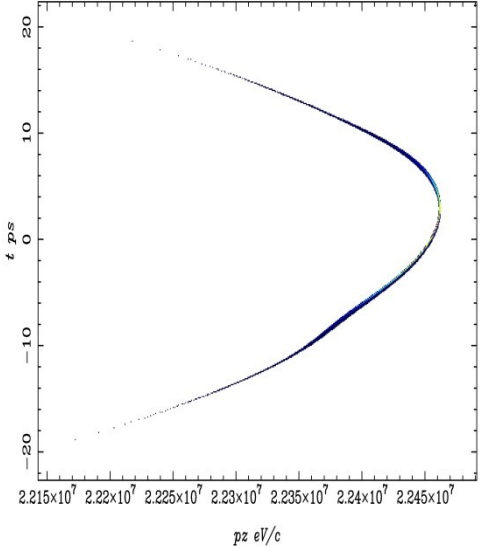
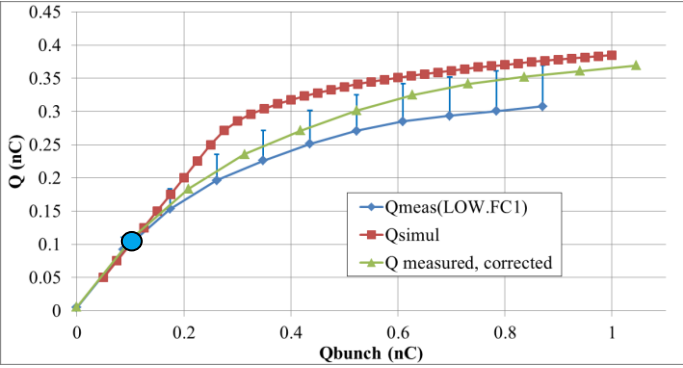
6.8 keV for TDS zero (**Long** Gaussian)



Measurement example
20161113N ↔ 20161117N
100 pC, 0.75 mm

+ASTRA simulations

Measurements SP(TDS)=0.25



Conclusions (preliminary)

- > Original measurements program with long Gaussian cathode laser pulses (0.4nC x BSA=1.1-2.2mm) was not realized due to the short time
- > But measurements with 100pC and BSA=0.75mm (eff) was done (for more consistency to measurements with short Gaussian pulses)
- > Still resolution on the slice energy spread seems to be the main limiting factor:
 - Beam transverse size in the HEDA2 dipole (beat function)
 - TDS induced energy spread (estimated $\frac{d(\delta E)}{dSP(TDS)} \sim 3 \frac{eV}{MV}$)
- > Measured longitudinal phase space (LPS) shows modulation even with long Gaussian cathode laser pulses:
 - MBI (also in LEDA)?
 - Space charge effect while transport, e.g. quad (over)focusing?
 - Measurement artifact??
- > ...

Short Gaussian pulses measurement program

δE - measurements program

1. Ecath=60MV/m (?additionally 45MV/m as an option)
2. Gun phase: MMMG
3. Laser temporal profile: short Gaussian of ~2 ps FWHM
4. Bunch charge: 0.2 nC and 0.1 nC
5. BSA=BSA0 (interpolated optimum for each bunch charge – based on the 2015 results) and 2*BSA0 (? relaxed transverse space charge by a factor of 4). Please check the rms spot size at VC2: XYrms~BSA/4:

Meas \ charge→	0.2 nC	0.1 nC
Laser temporal	Short Gauss	
A	0.85 mm	0.75 mm
B	1.7 mm	1.5 mm

e.g., for measurement “0.1-A” → BSA=0.75mm, for “0.2-B” – BSA=1.7 mm

6. CDS booster: 3MW, phase scan for LPS tomography. The CDS phase for TDS measurements: min projected energy spread at HEDA2(?)
7. Expected measurements (for each of 6 setups: 0.2-A ... 0.1-B – to be saved in e.g. ... \measure\LongPhSp\2016\deltaE\shortG\0.2-A\...):
 - a. Laser transverse distribution at VC2 (20+20frames)
 - b. Beam momentum scan in LEDA as a function of gun SP Phase → MMMG gun phase, $\langle P_z \rangle$, PZrms
 - c. Laser attenuator scan (LT-scan) for the MMMG phase with LOW.FC1 (if it is too noisy – use LOW.FC2, also LOW.ICT1/HIGH1.ICT1), adjust the LT for the goal charge, measure the bunch charge
 - d. Beam momentum in HEDA1 as a function of the booster SP phase (very detailed – to be used for LPS reconstruction). Don’t forget to adjust the e-beam at the reference screen HIGH1.Scr5 (centered and vertically focused). Booster phase MMMG (or min energy spread at HEDA1?).
 - e. Setup the e-beam trajectory; e.g. from 31.10.2016 05:18 (PITZ logbook)
 - f. E-beam size at HIGH1.Scr1 vs. main solenoid current (use fastscan3)
 - g. Beam projected emittance measurements at EMSY1: main solenoid current: focus at HIGH1.Scr1 and +1% of this value (? , rounding the Imain) over the focus.
 - h. Beam transport to the PST.Scr1, TDS measurements of the bunch temporal profile (Imain to be tuned as well? Or use one delivering the best emittance).
 - i. Beam transport to HEDA2 (Imain to be tuned as well?), quad settings for the best HEDA resolution – save magnet settings and beam images at screens in the HIGH section. Check the TDS phase range at HIGH2.Scr1 – not to be cut by the beam line aperture.
 - j. Beam momentum in HEDA2 as a function of the booster SP phase → booster phase for the minimum projected momentum spread.
 - k. LPS measurements at HEDA2 with applied TDS:
 - i. TDS phase scan (calibration)
 - ii. TDS at zero phase – momentum measurements with OMA
 - iii. TDS off – momentum measurements with OMA