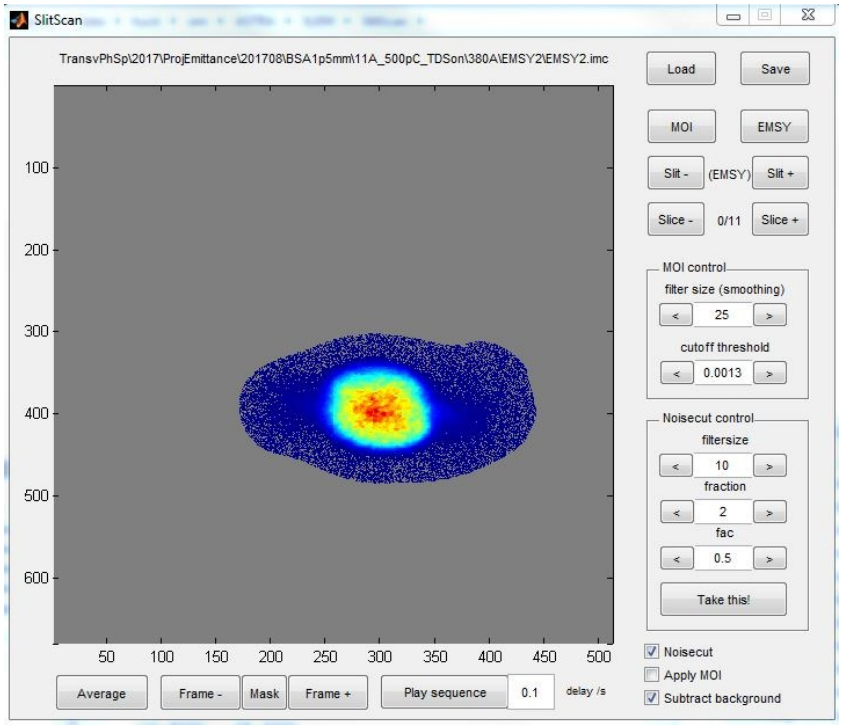
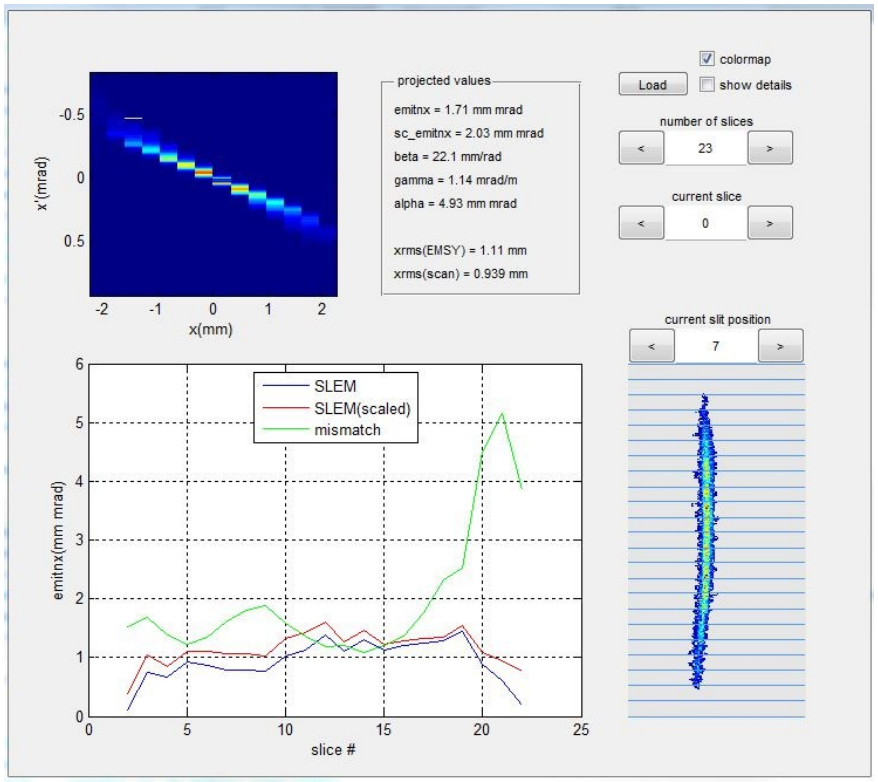
Slit scan + TDS @PITZ, first results

- Setup: EMSY2 slit, 5 m drift length to PST.Scr1 with TDS inbetween
- Manual slit scan in order to average 10 images at each slit position for higher signal-to-noise ratio (LYSO n/a yet)
- Matlab tools written for offline image filtering and analysis
  - Main idea: cut beamlet images in vertical slices and analyse those separately
- 4 scans done so far: 500 pC@BSA12 and BSA15, 1nC@BSA15
  - 11-14 slit positions, 50 µm slit
- Also fastscans w/o TDS done

Two new Matlab tools





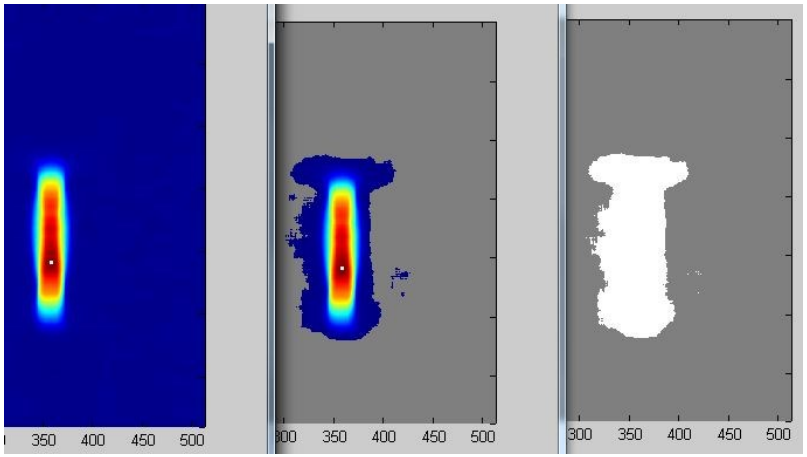
„Semi-manual“ image filtering

Filter settings, thresholds and noisecut options can and should be adjusted for each (averaged) image

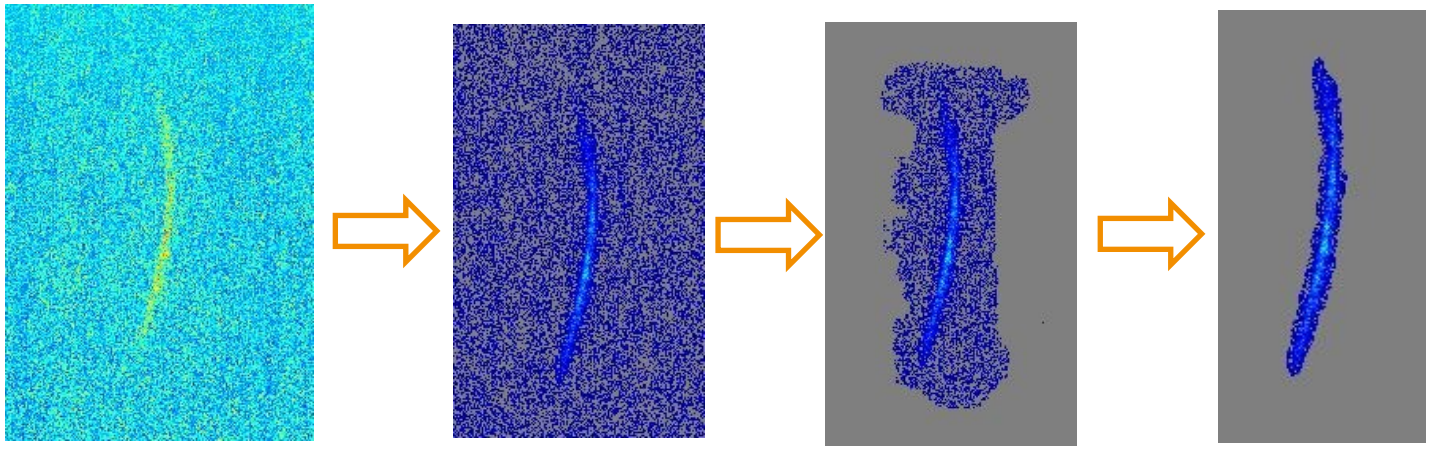
Phase space construction & SLEM analysis

GUI shows phase space, SLEM & mismatch parameter, and the filtered images

Image filtering

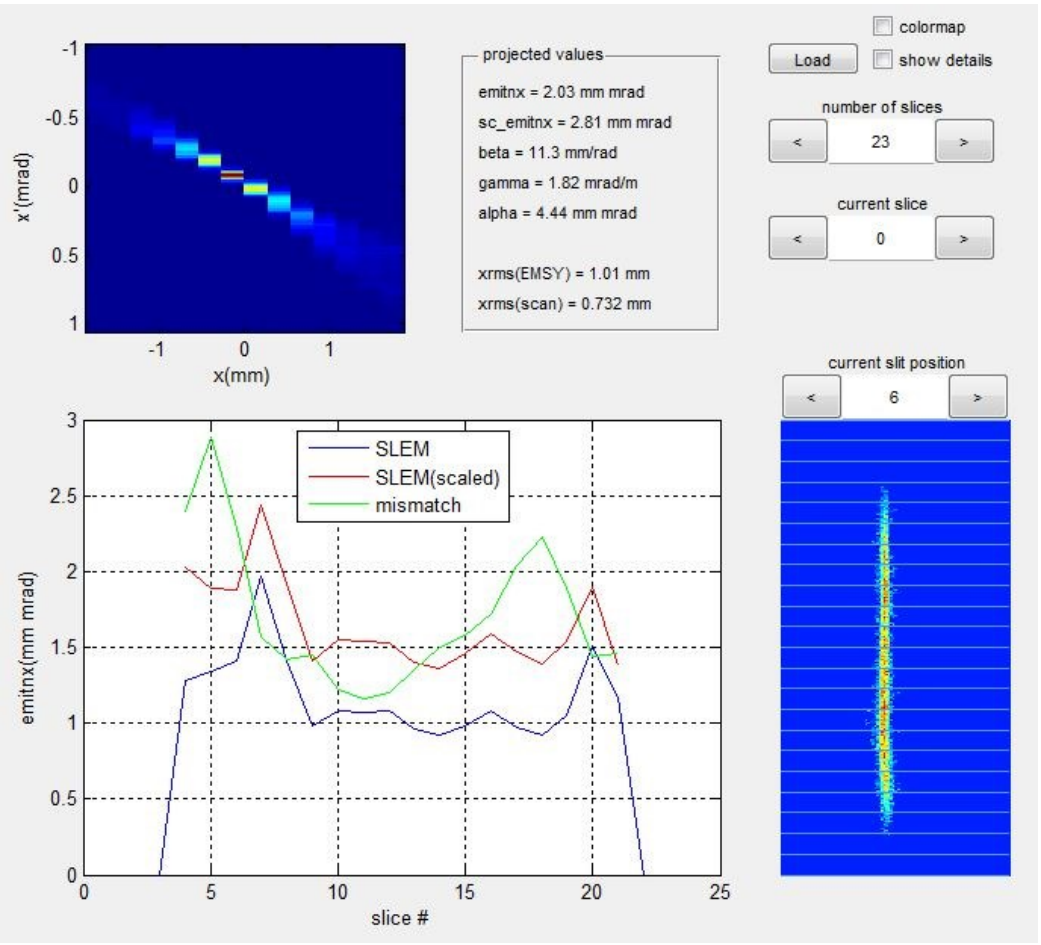


Creating MOI

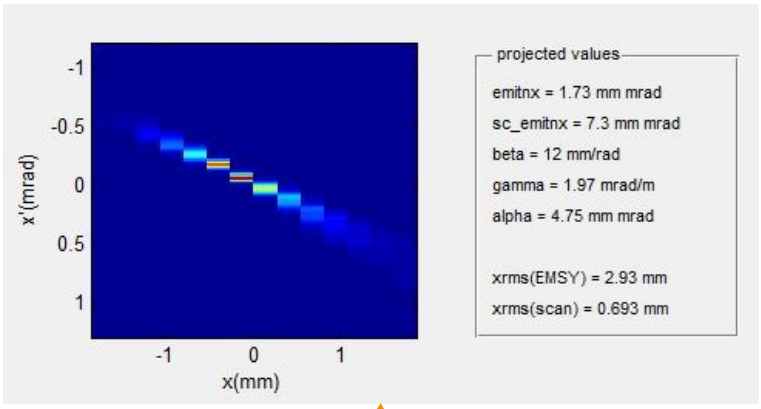


averaging > applying MOI > noisecut

Results (500 pC, BSA1.2, July)



Manual scan with TDS on

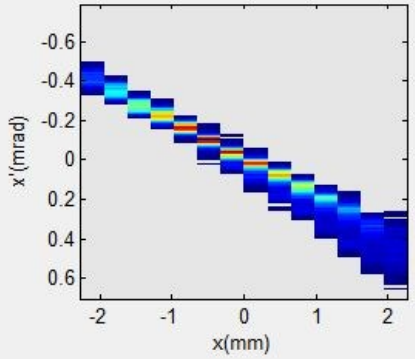


TDS off (manual and fastscan)

Momentum gun	6.51900
Momentum booster	21.94500
σ_{xsq}	2.73880
σ_{scan}	0.48394
divergence	0.26801
covariance	-0.12761
sheared div	0.02321
LDrift	3.64300
β	10.08927
γ	3.09441
α	5.49730
$\beta\gamma-\alpha^2$	1.00000
$\varepsilon^{scaled}_{sheared}$	5.348
$\varepsilon^{noscaled}_{2D}$	0.997
$\varepsilon^{scaled}_{2D}$	5.642

?

Results (500 pC, BSA1.2, Aug-11)

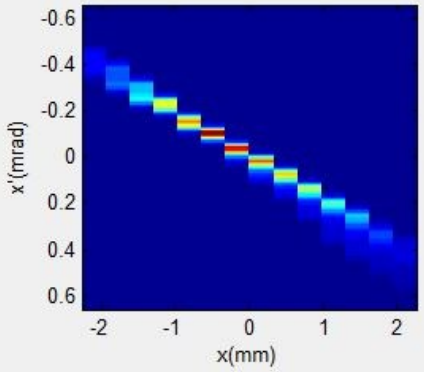


projected values

emitnx = 1.93 mm mrad
sc_emitnx = 3.1 mm mrad
beta = 24.5 mm/rad
gamma = 1.2 mrad/m
alpha = 5.34 mm mrad

xrms(EMSY) = 1.69 mm
xrms(scan) = 1.05 mm

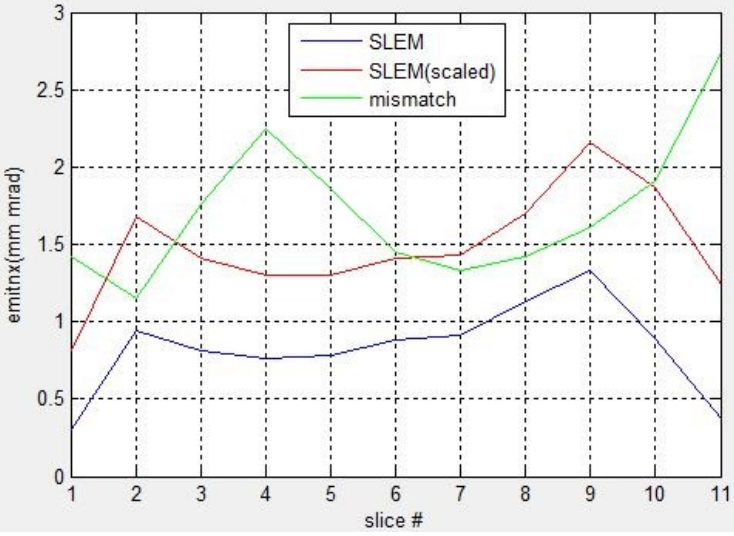
colormap
Load
show details
number of slices
11
current slice
0



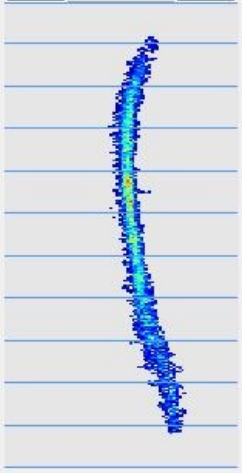
projected values

emitnx = 1.73 mm mrad
sc_emitnx = 2.27 mm mrad
beta = 26.5 mm/rad
gamma = 1.26 mrad/m
alpha = 5.68 mm mrad

xrms(EMSY) = 1.35 mm
xrms(scan) = 1.03 mm

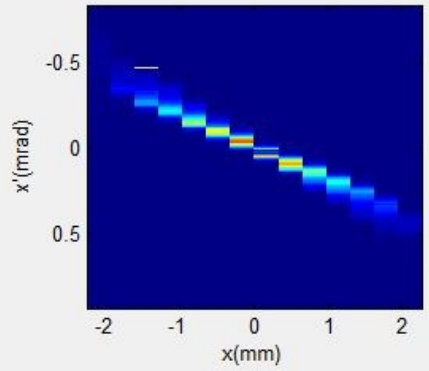


current slit position
10



Momentum gun	6.40700
Momentum booster	21.93700
σ_{yag}	1.32830
σ_{scan}	1.09299
divergence	0.23041
covariance	-0.24791
sheared div	0.04426
LDrift	5.00000
β	26.99027
γ	1.19941
α	5.60111
$\beta\gamma-\alpha^2$	1.00000
$\varepsilon^{scaled}_{sheared}$	2.209
$\varepsilon^{noscaled}_{2D}$	1.900
$\varepsilon^{scaled}_{2D}$	2.309

Results (500 pC, BSA1.5)



projected values

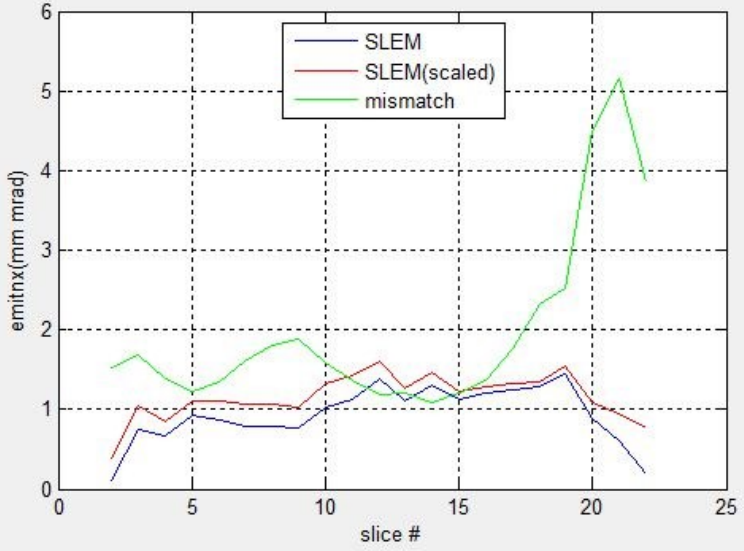
emitnx = 1.71 mm mrad
sc_emitnx = 2.03 mm mrad
beta = 22.1 mm/rad
gamma = 1.14 mrad/m
alpha = 4.93 mm mrad

xrms(EMSY) = 1.11 mm
xrms(scan) = 0.939 mm

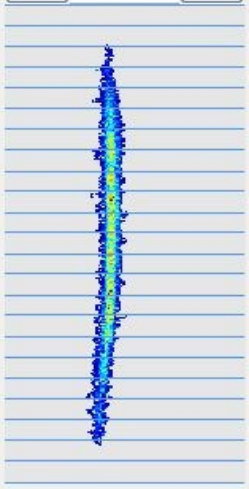
colormap
Load
show details

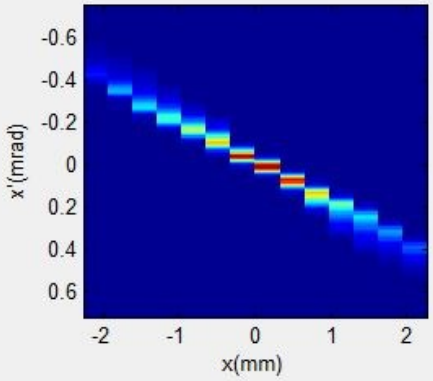
number of slices
< 23 >

current slice
< 0 >



current slit position
< 7 >





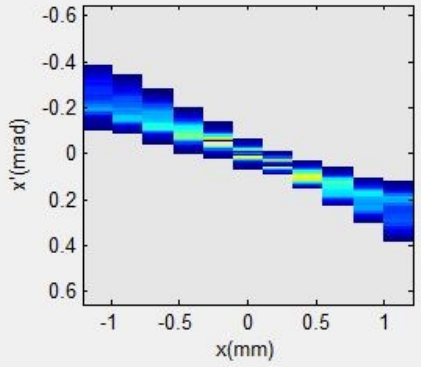
projected values

emitnx = 1.8 mm mrad
sc_emitnx = 1.98 mm mrad
beta = 25.2 mm/rad
gamma = 1.25 mrad/m
alpha = 5.52 mm mrad

xrms(EMSY) = 1.13 mm
xrms(scan) = 1.03 mm

Momentum gun	6.40700
Momentum booster	21.93700
σ_{yag}	1.05300
σ_{scan}	1.02956
divergence	0.23517
covariance	-0.23963
sheared div	0.03470
LDrift	5.00000
β	30.55113
γ	1.59404
α	6.90650
$\beta\gamma-\alpha^2$	1.00000
$\varepsilon^{scaled}_{sheared}$	1.437
$\varepsilon^{noscaled}_{2D}$	1.489
$\varepsilon^{scaled}_{2D}$	1.523

Results (1 nC, BSA1.5)



projected values

emitnx = 1.02 mm mrad
sc_emitnx = 3.37 mm mrad
beta = 16.4 mm/rad
gamma = 1.04 mrad/m
alpha = 4.02 mm mrad

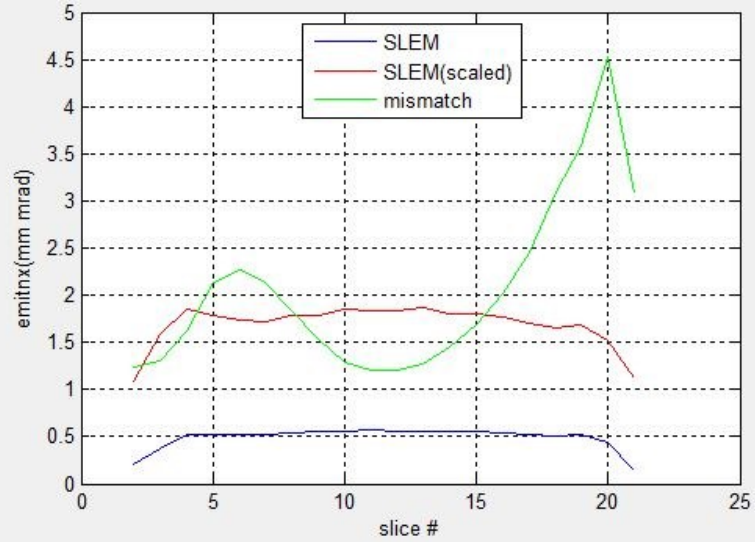
xrms(EMSY) = 2.06 mm
xrms(scan) = 0.625 mm

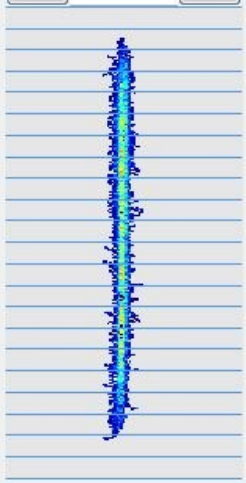
colormap
Load
show details

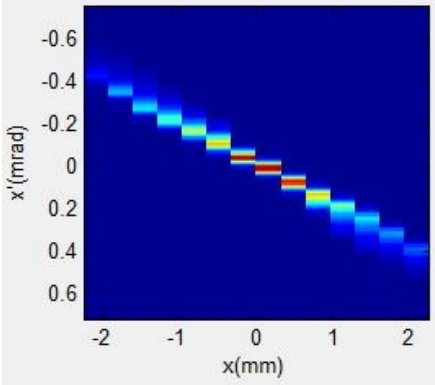
number of slices
< 22 >

current slice
< 0 >

current slit position
< 6 >





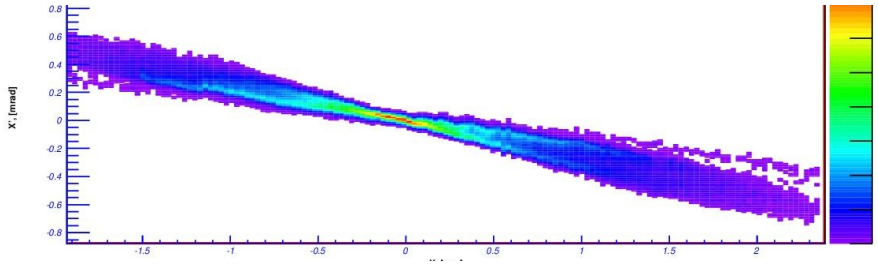


projected values

emitnx = 1.8 mm mrad
sc_emitnx = 1.98 mm mrad
beta = 25.2 mm/rad
gamma = 1.25 mrad/m
alpha = 5.52 mm mrad

xrms(EMSY) = 1.13 mm
xrms(scan) = 1.03 mm

Momentum gun	6.40700
Momentum booster	21.93700
σ_{yag}	1.63620
σ_{scan}	0.92823
divergence	0.23996
covariance	-0.21656
sheared div	0.05209
LDrift	5.00000
β	16.53947
γ	1.10530
α	4.15704
$\beta\gamma-\alpha^2$	1.00000
$\varepsilon^{scaled}_{sheared}$	3.866
$\varepsilon^{noscaled}_{2D}$	2.236
$\varepsilon^{scaled}_{2D}$	3.942



Summary

		emitnx	scaled	alpha	beta	gamma	core SLEM
500pC(July)	fastscan	1	5,64	5,5	10,1	3,1	
	TDS off	1,73	7,3	4,8	12	2	
	TDS on	2,03	2,81	4,4	11,3	1,8	1
500pC BSA12	fastscan	1,9	2,3	5,6	27	1,2	
	TDS off	1,7	2,3	5,7	26,5	1,26	
	TDS on	1,9	3,1	5,3	24,5	1,2	0,8
500pC BSA15	fastscan	1,49	1,52	6,9	30,6	1,6	
	TDS off	1,8	1,98	5,5	25,2	1,3	
	TDS on	1,71	2,03	4,9	22,1	1,1	1
1 nC BSA15	fastscan	2,2	3,9	4,2	16,5	1,1	
	TDS off	1,8	1,98	5,5	25,2	1,3	
	TDS on	1	3,37	4	16,4	1	0,6

- „scaled“: emitnx scaled by xrms(EMSY)/xrms(phasespace)
- SLEM is not scaled
- Emittances are in [mm mrad], other parameters in SI units
- (side note: TWISS units in emcalc screenshots are wrong)
- Red circles are hard-to-believe numbers…probably sth. went wrong

Summary

- **First results look very promising**, despite occasionally large discrepancies
- SLEM largely independent of number of slices (10-30)
- Projected phase space and αβγ-values are pretty similar to fastscan results for almost every measurement
- Emittance values show some larger discrepancies, partly because of EMSY-scaling
  - EMSY-scaling is known to jitter on the order of 10%
  - In one case (1nC), EMSY analysis by fastscan gave 20% difference when switching on TDS (should be zero)
  - In one case, EMSY analysis by fastscan yielded 1.3 mm while both manual analysis of the same file and the VC analysis said 1.7 mm
- Other important systematic issues:
  - Significant smaller scan range in manual scans (see p.7)
  - Lower intensity with TDS on
  - Large slit size, not taken into account by the analysis
  - Only ~10 different slit positions