

Slice emittance temporal Gaussian case

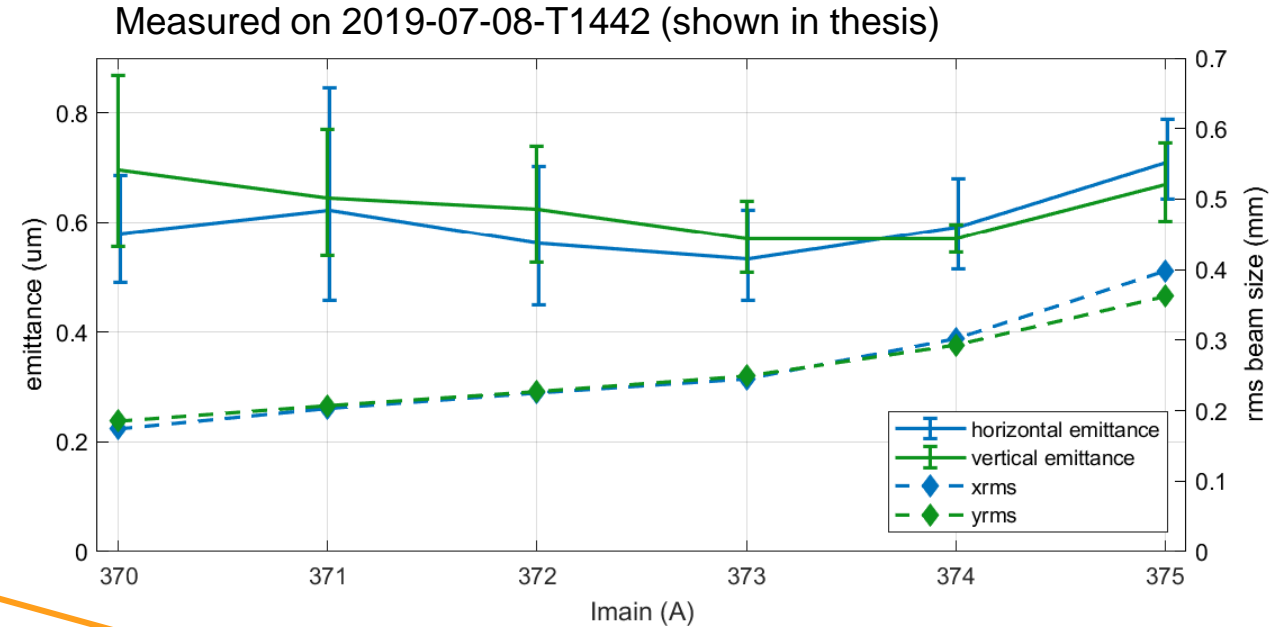
Analysis of data and simulation comparison

Raffael Niemczyk
Zeuthen, 10.06.2021

General setting

Temporal Gaussian, transverse flattop

- Temporal Gauss. 6 ps (FWHM) laser pulse
- 250 pC beam, transverse Flattop (BSA = 1.0 mm)
- Proj. emittance: $\text{Emit}_{XY} = (0.58 \pm 0.04) \mu\text{m}$ @ $I_{\text{main}} = 373 \text{ A}$
 - Measured on 2021-05-19T1229
 - EMSY rms X = 0.205 mm
 - EMSY rms Y = 0.200 mm



EMSY beam sizes (still) different

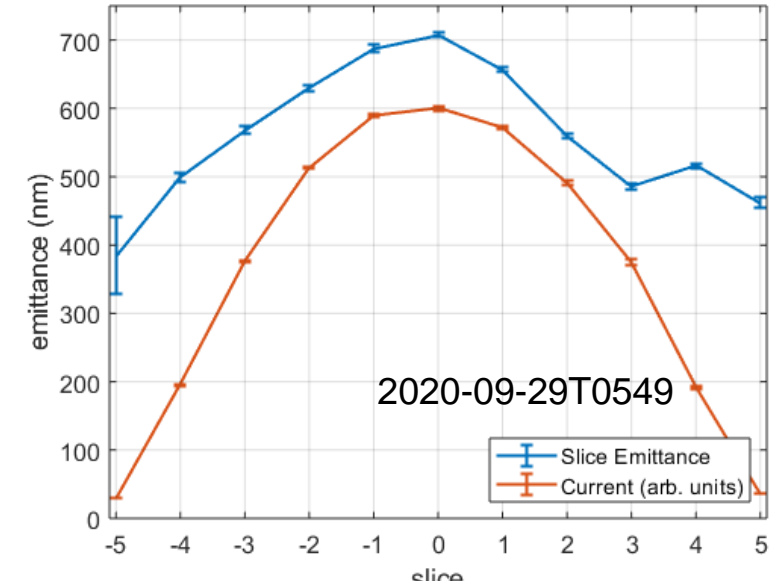
Optimum I_{main} : 373A
 $\text{Emit}_{XY} = (0.55 \pm 0.08) \mu\text{m}$
EMSY rms X = 0.245 mm
EMSY rms Y = 0.249 mm

Measurements

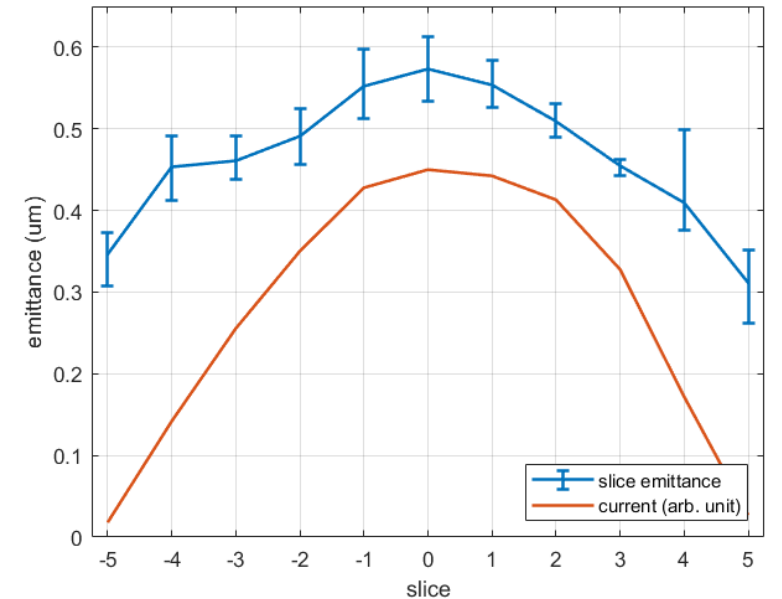
Three measurements in total

- > 90% truncation \approx flattop: 2019-12-20T0643
 - > Considered in thesis
 - > Centre slice emittance $\sim 0.67 \text{ } \mu\text{m}$
- > Transv. Flattop: 2020-09-20T0536
 - > Rejected from thesis
 - > High centre slice emittance ($\sim 0.71 \text{ } \mu\text{m}$)
- > Latest measurement: 2021-05-19T1332
 - > Centre slice emittance (0.57 ± 0.04) μm (P2P error)

Temporal Gaussian case



2021-05-19T1330



Astra simulation

VC2 image and projected emittance

> VC2 image taken on 2021-05-19T0814

> $X_{rms} = 0.243$ mm

> $Y_{rms} = 0.245$ mm

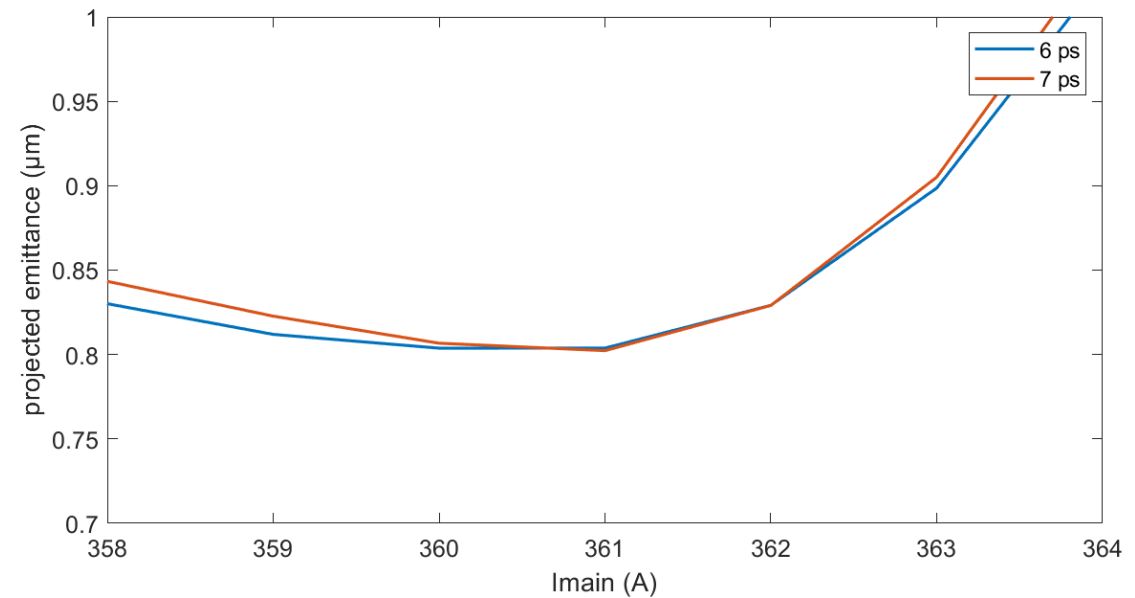
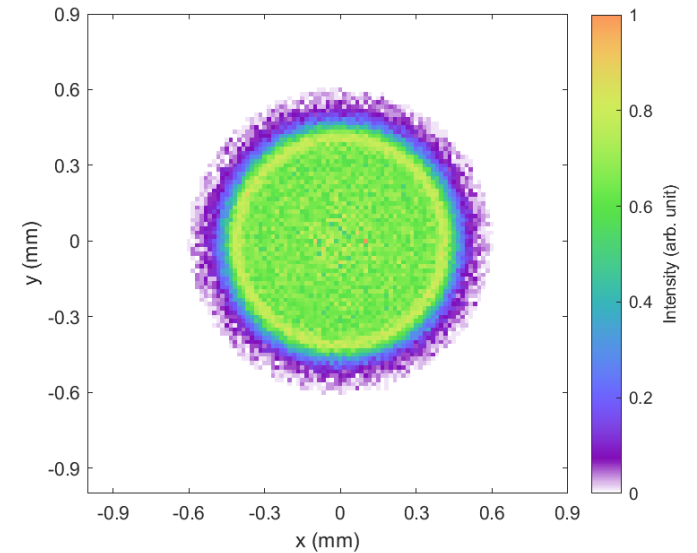
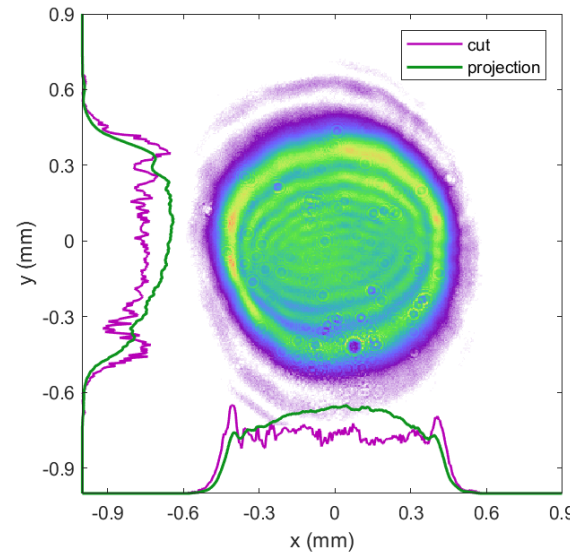
> In simulation $X_{rms} = Y_{rms} = 0.242$ mm

> @EMSY1

> $I_{main} = 361$ A

> $X_{rms} = 0.44$ mm

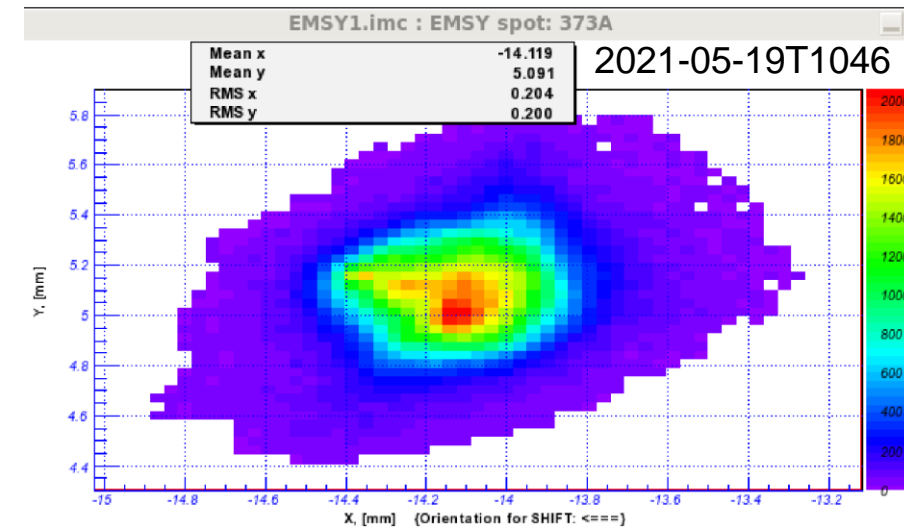
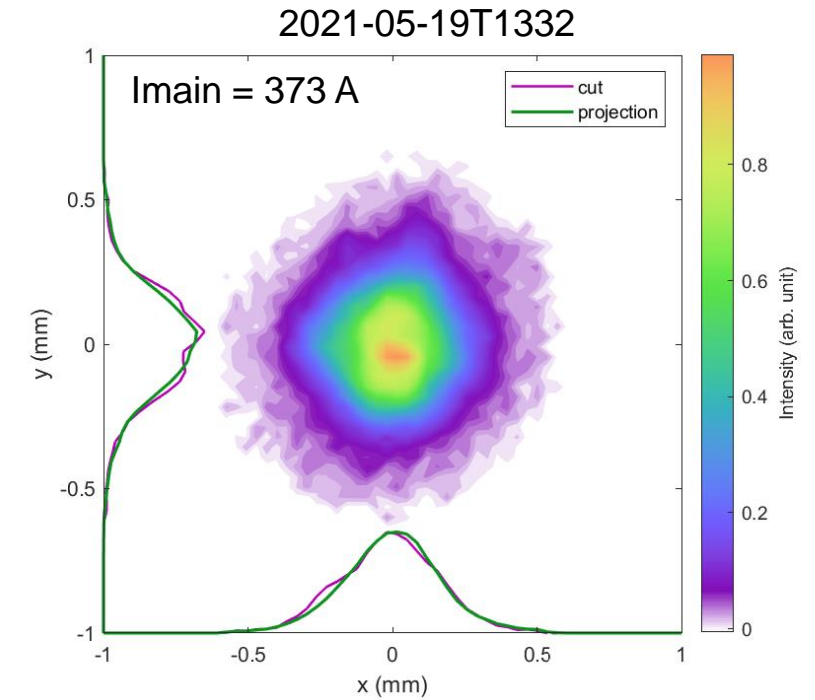
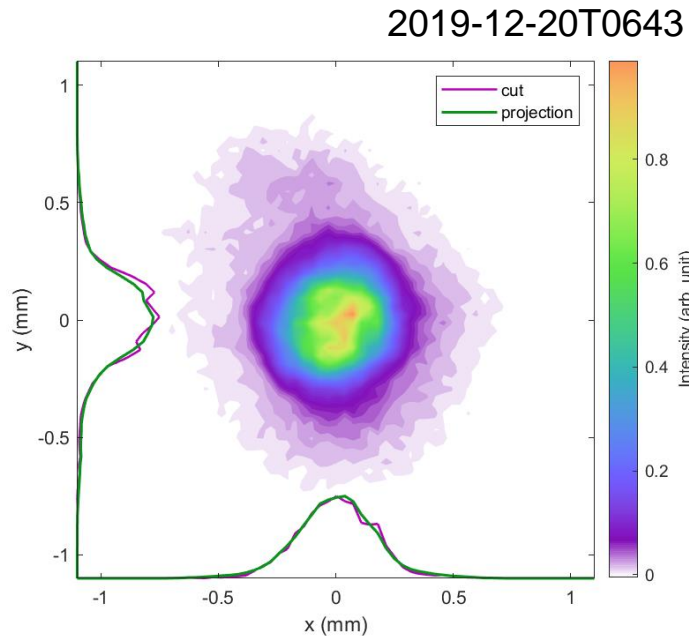
> $EmitX = 0.81$ μm



EMSY spots

Comparison of fastscan and slitscanner

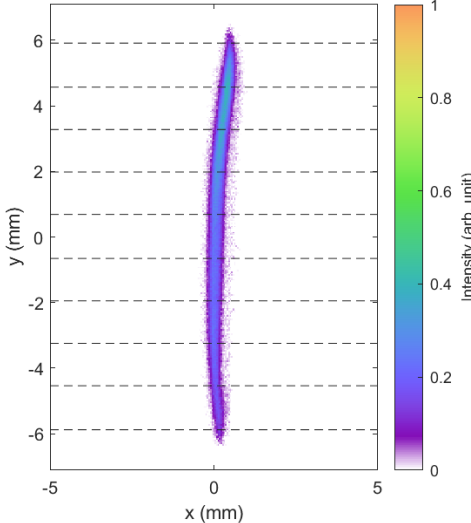
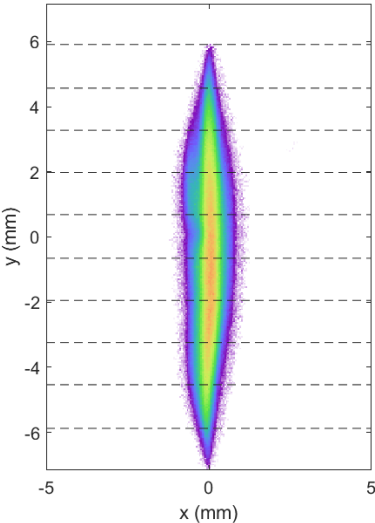
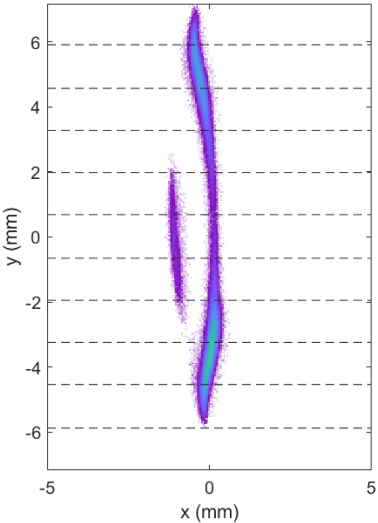
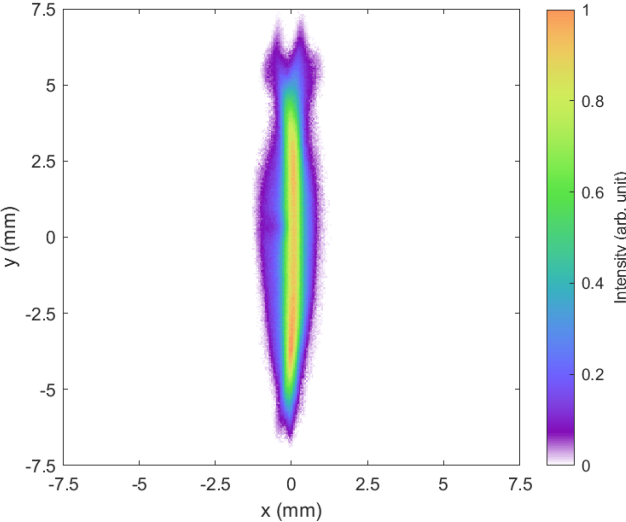
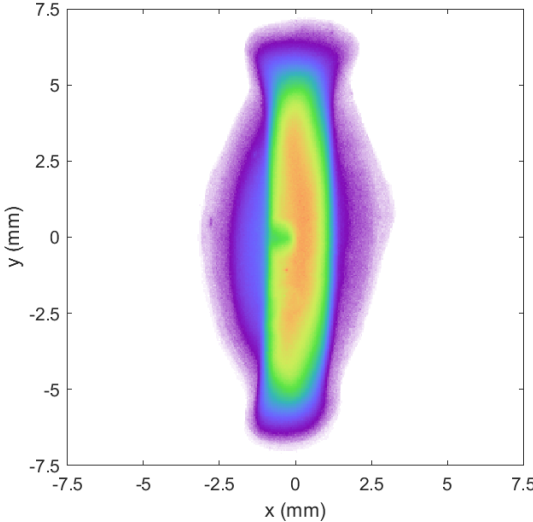
- > 2021-05-19T1332
 - > Xrms = 0.171 mm (SlitScanner.m)
 - > Yrms = 0.182 mm
- > 2021-05-19T1046 (fastscan)
 - > Xrms = 0.204 mm
 - > Yrms = 0.200 mm
- > 90% truncation \approx flattop: 2019-12-20T0643
 - > Xrms = 0.174 mm
 - > Yrms = 0.202 mm



MOI and Beamlets

Of the latest measurement – temporal Gaussian

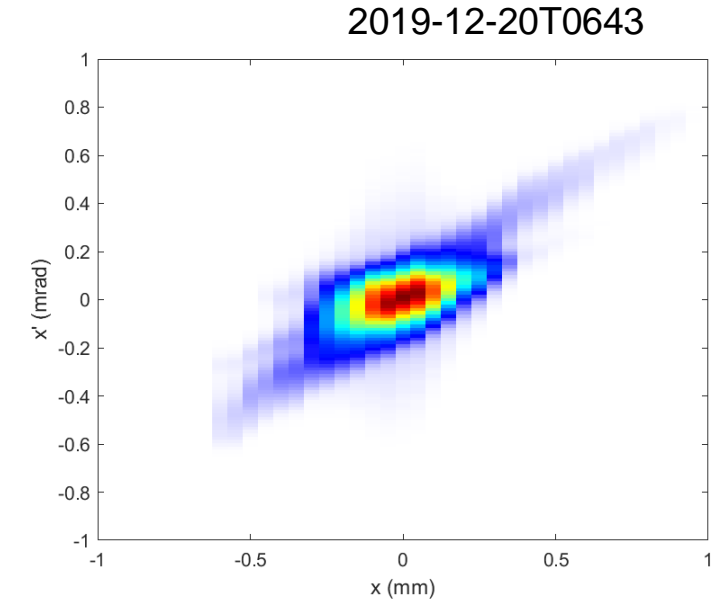
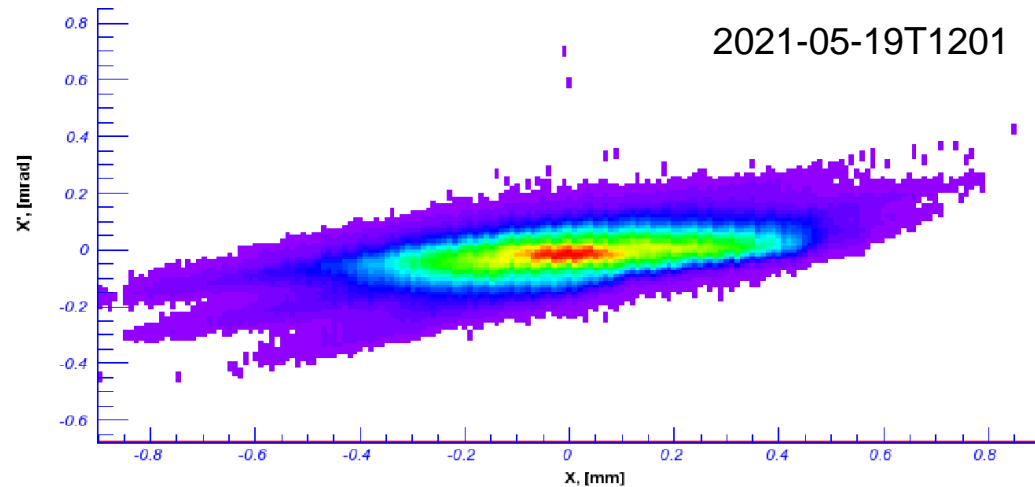
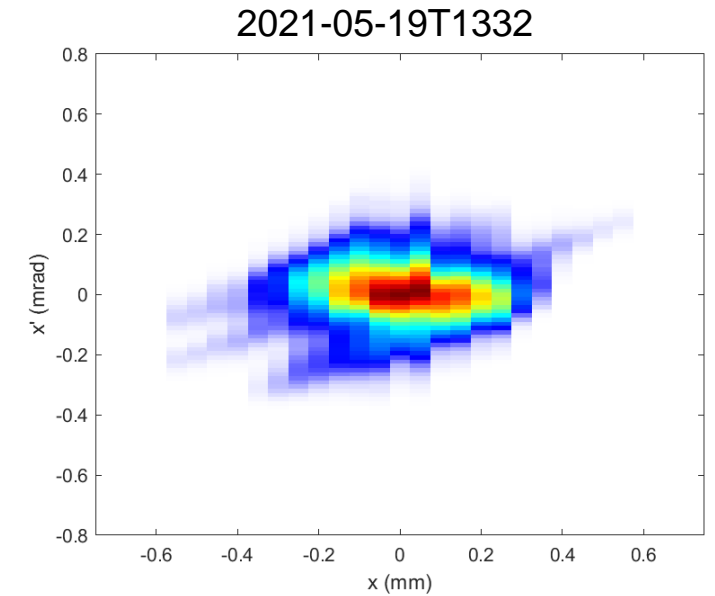
> Latest measurement: 2021-05-19T1332



Projected phase space

Comparisons of the three measurements

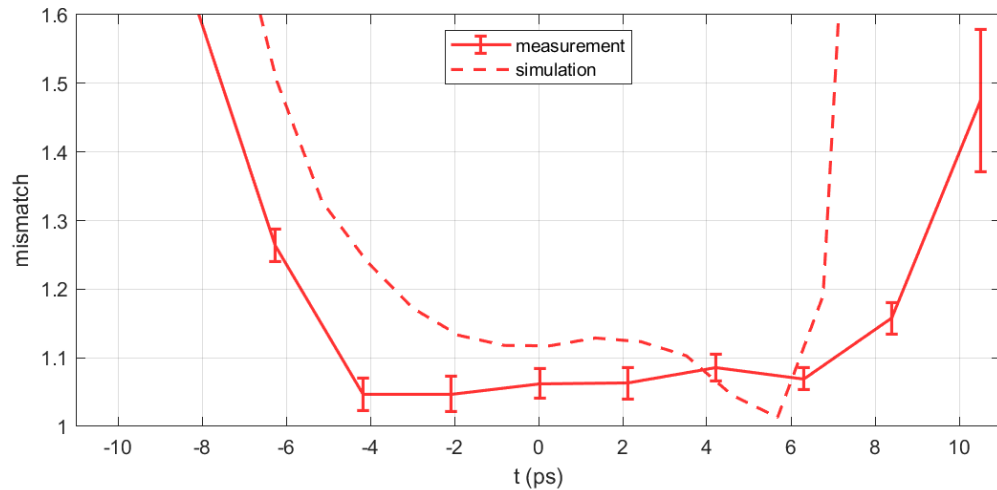
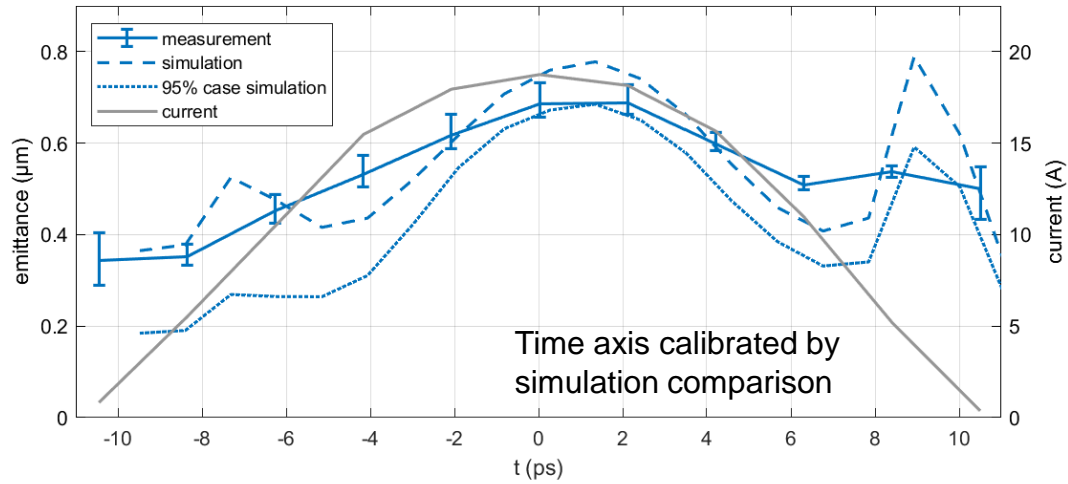
- > 90% truncation \approx flattop: 2019-12-20T0643
 - > Considered in thesis
 - > Centre slice emittance $\sim 0.67 \text{ } \mu\text{m}$
- > Latest measurement: 2021-05-19T1332
 - > Centre slice emittance $(0.57 \pm 0.04) \text{ } \mu\text{m}$ (P2P error)



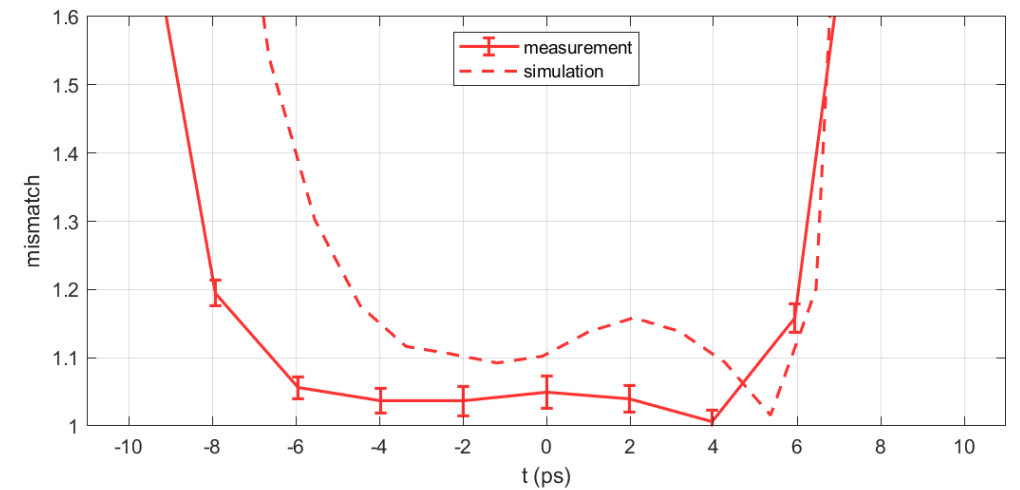
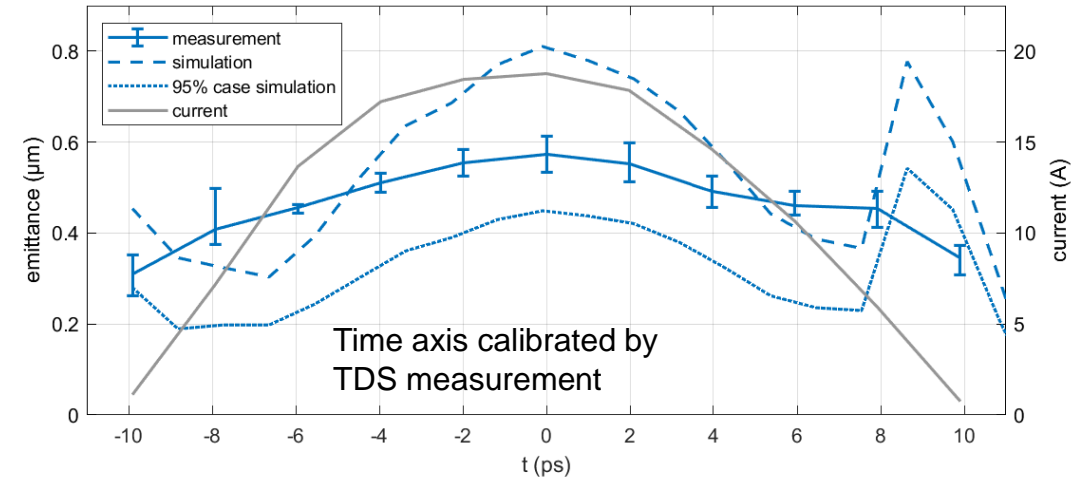
Slice emittance

Comparison of both curves

2019-12-20T0643



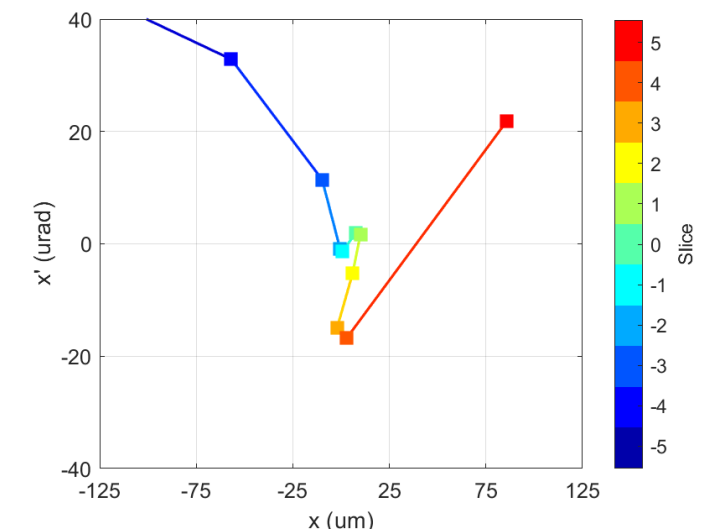
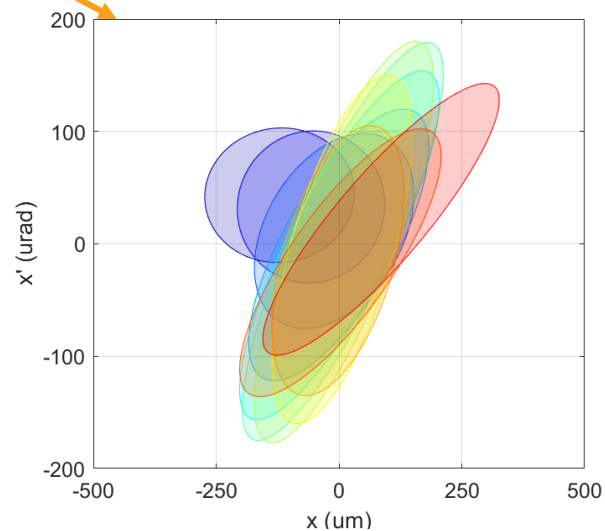
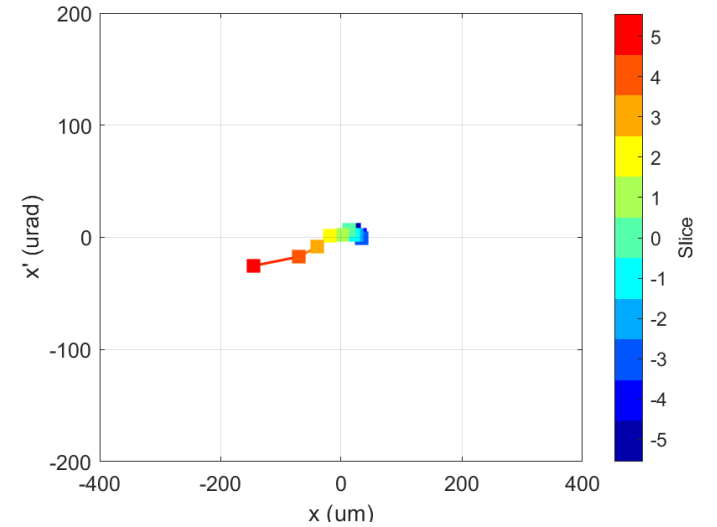
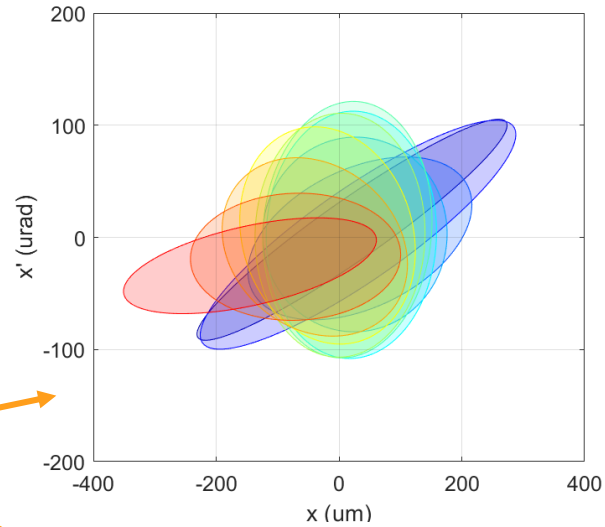
2021-05-19T1332



Emittance decomposition

Comparison between both temporal Gaussian measurements

- > Top: New measurement (2021-05-19T1332)
- > Bottom: 90% truncation \approx flattop: 2019-12-20T0643
- > From thesis



	New meas.	Temp. Gaussian
Projected emittance	0.60 μm	0.69 μm
Slice emittance	0.53 μm	0.62 μm
Mismatch emittance	0.25 μm	0.28 μm
Linear misalignment emittance	0.12 μm	0.14 μm
Nonlinear misalignment emittance	< 0.01 μm	< 0.01 μm

Summary

Repetition of slice emittance measurements

- Temporal Gauss. 6 ps (FWHM) laser pulse, 250 pC
- Slice emittance reduction: 0.62 μm \rightarrow 0.53 μm
- Centre slice emittance reduction: (0.69 ± 0.05) μm \rightarrow (0.57 ± 0.04) μm
- Also: Shear parameter calibrated at newer measurements
 - Not done before due to broken RF5 klystron

Comparison of EMSY spots

Comparing emcalc analysis with SlitScanner.m

- > 2021-05-19T1046 (fastscan)
 - > Xrms = 0.204 mm
 - > Yrms = 0.200 mm
- > Fastscan data analysed with SlitScanner.m
 - > Xrms = 0.197 mm
 - > Yrms = 0.196 mm

