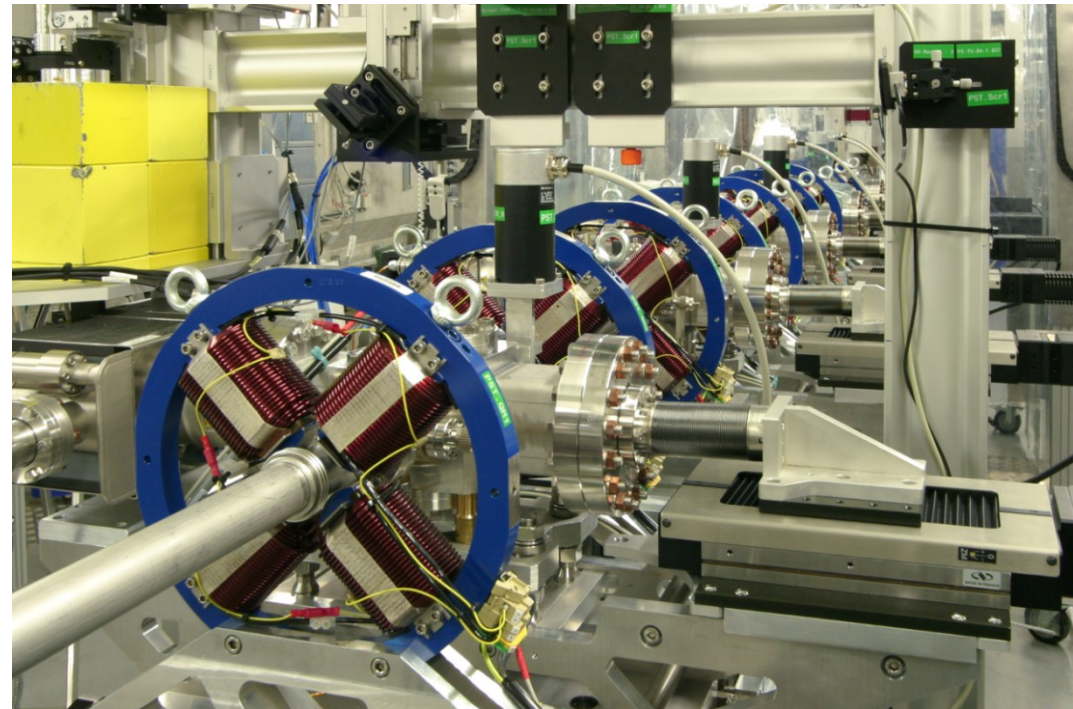


Space-charge matching studies at PITZ.

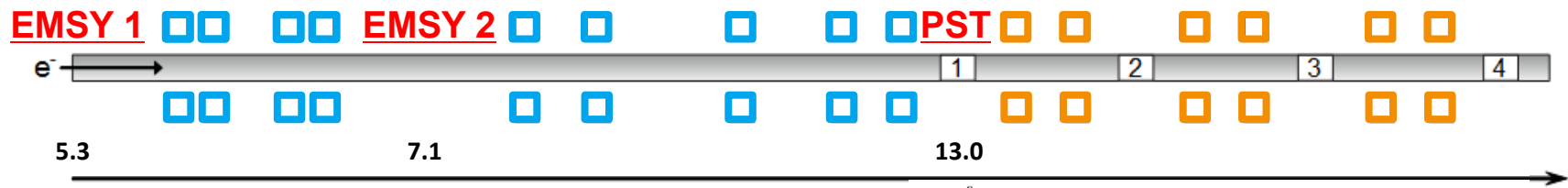
- Motivation and specifications of the measurement
- SC matching and comparison with ASTRA
- Measured values and comparison with simulation
- Conclusions

Georgios Kourkafas
PPS Seminar
07.05.2015

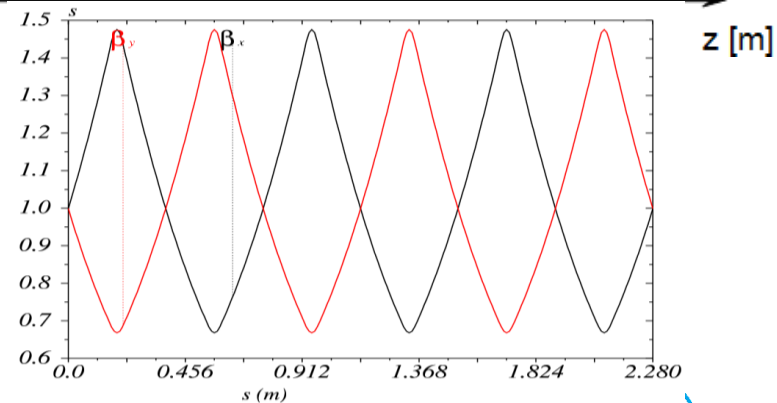


- > Motivation: Apply space-charge matching and evaluate its performance at EMSY 2 and PST section
- > Laser specs: 12 ps (?) FWHM gaussian, BSA 1.6mm diameter
- > Beam specs: 500 pC, 21 MeV/c (5MW in the gun), MMMG phase, 357A sol.
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- > Beamline specs (PITZ 2.5):

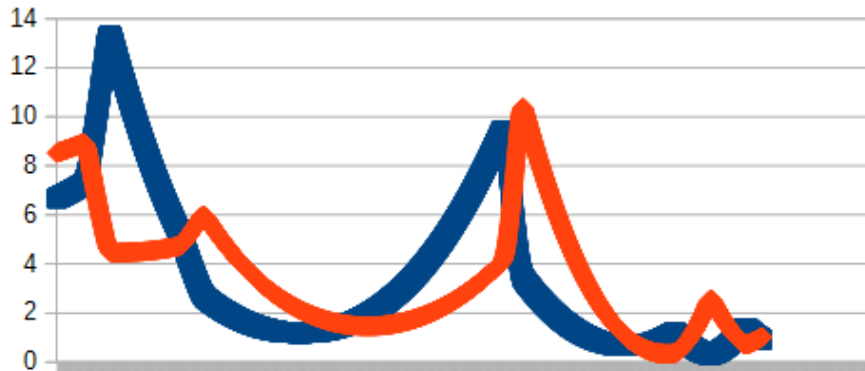


- > Matching requirements :
Twiss parameters @ PST.Scr2 screen →
 $\beta_{x,y} = 1.0 \text{ m}$, $\alpha_{x,y} = \pm 1.1$
- > Saved data: 20150418A\m2a_full (PST),
201504\20150419M \19MEMSY2m2 (EMSY 2),
201504\17NEMSY1_BSA16 (EMSY 1)

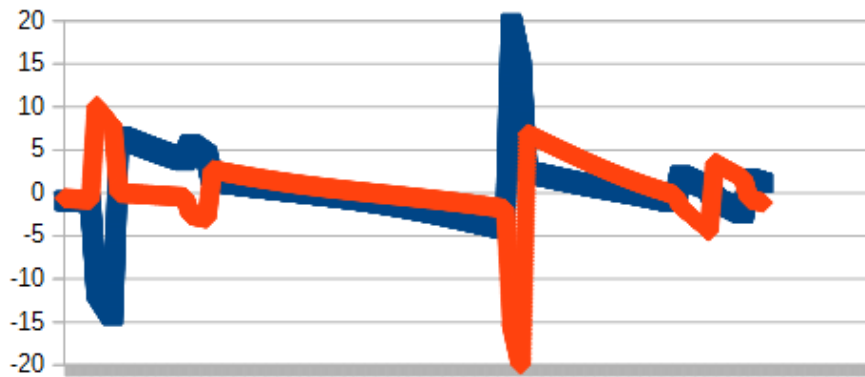


SC matching and comparison with ASTRA

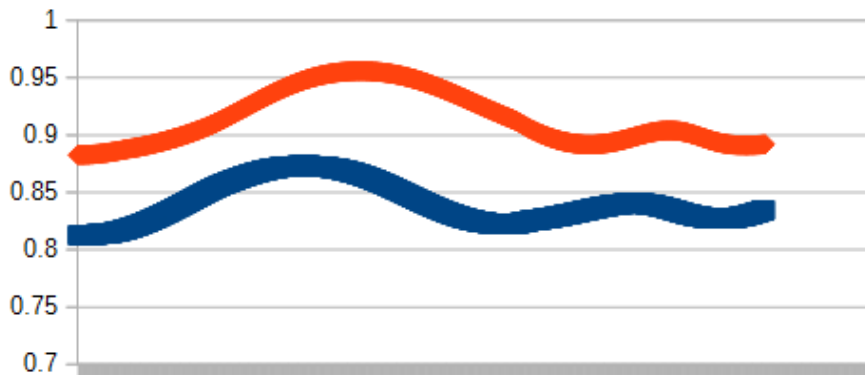
Beta SC [m]



Alpha SC

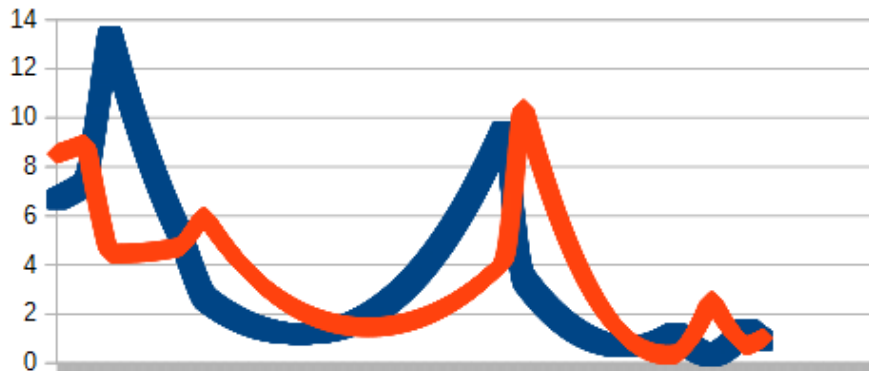


Emittance SC [mm*mrad]

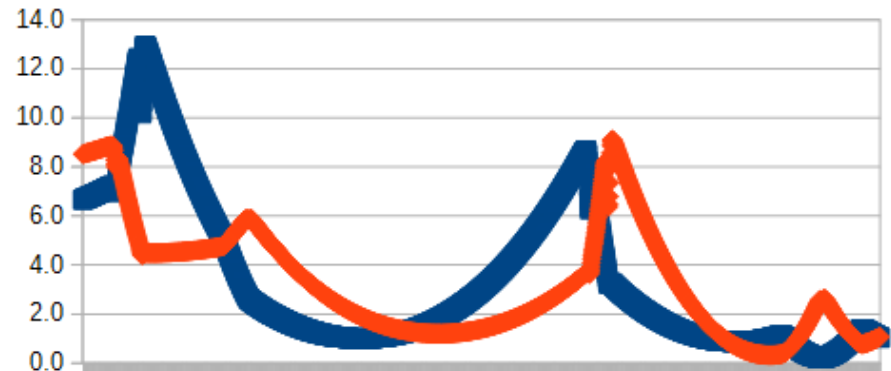


SC matching and comparison with ASTRA

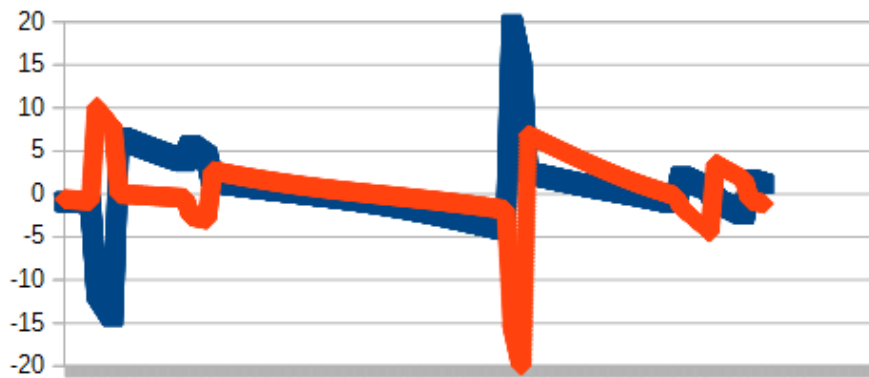
Beta SC [m]



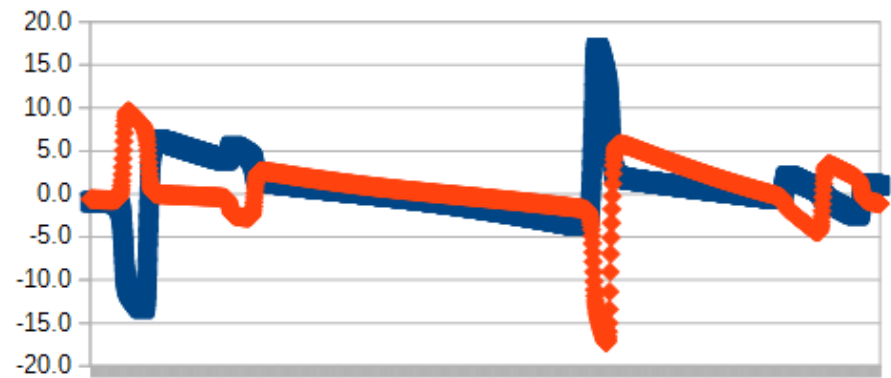
Beta ASTRA [m]



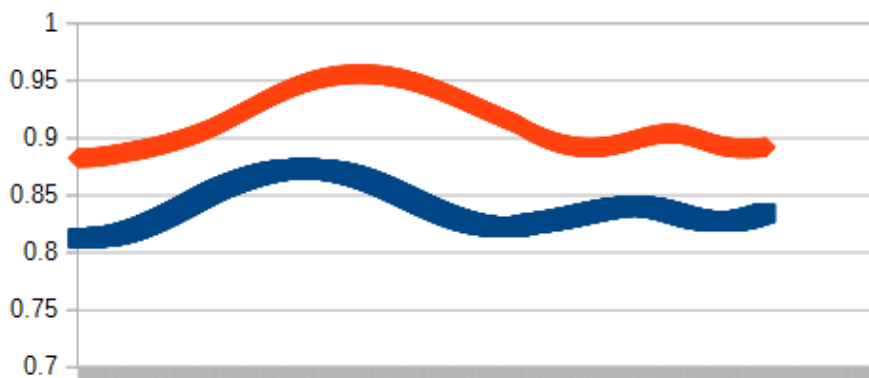
Alpha SC



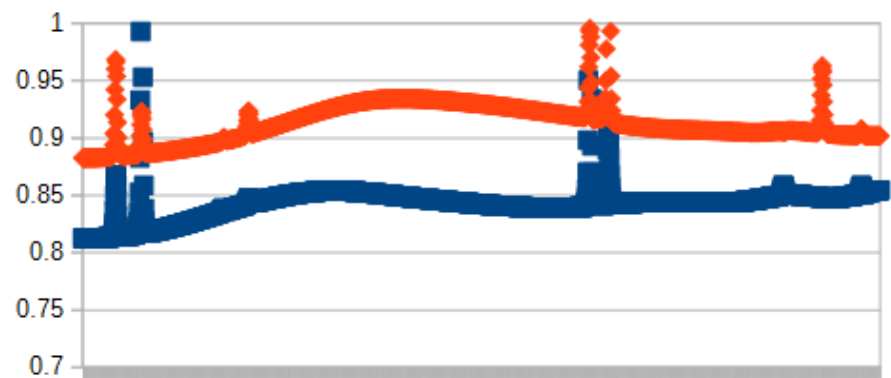
Alpha ASTRA



Emittance SC [mm*mrad]



Emittance ASTRA [mm*mrad]



EMSY 2 (1.8 m downstream)

	SC	ASTRA	Measured
ϵ_x [mm·mrad]	0.86	0.85	0.94 ± 0.04
β_x [m]	2.08	1.99	2.83 ± 0.11
α_x	1.09	1.16	1.42 ± 0.10
ϵ_y [mm·mrad]	0.92	0.91	1.25 ± 0.07
β_y [m]	4.83	4.80	5.51 ± 0.37
α_y	2.29	2.39	3.13 ± 0.14

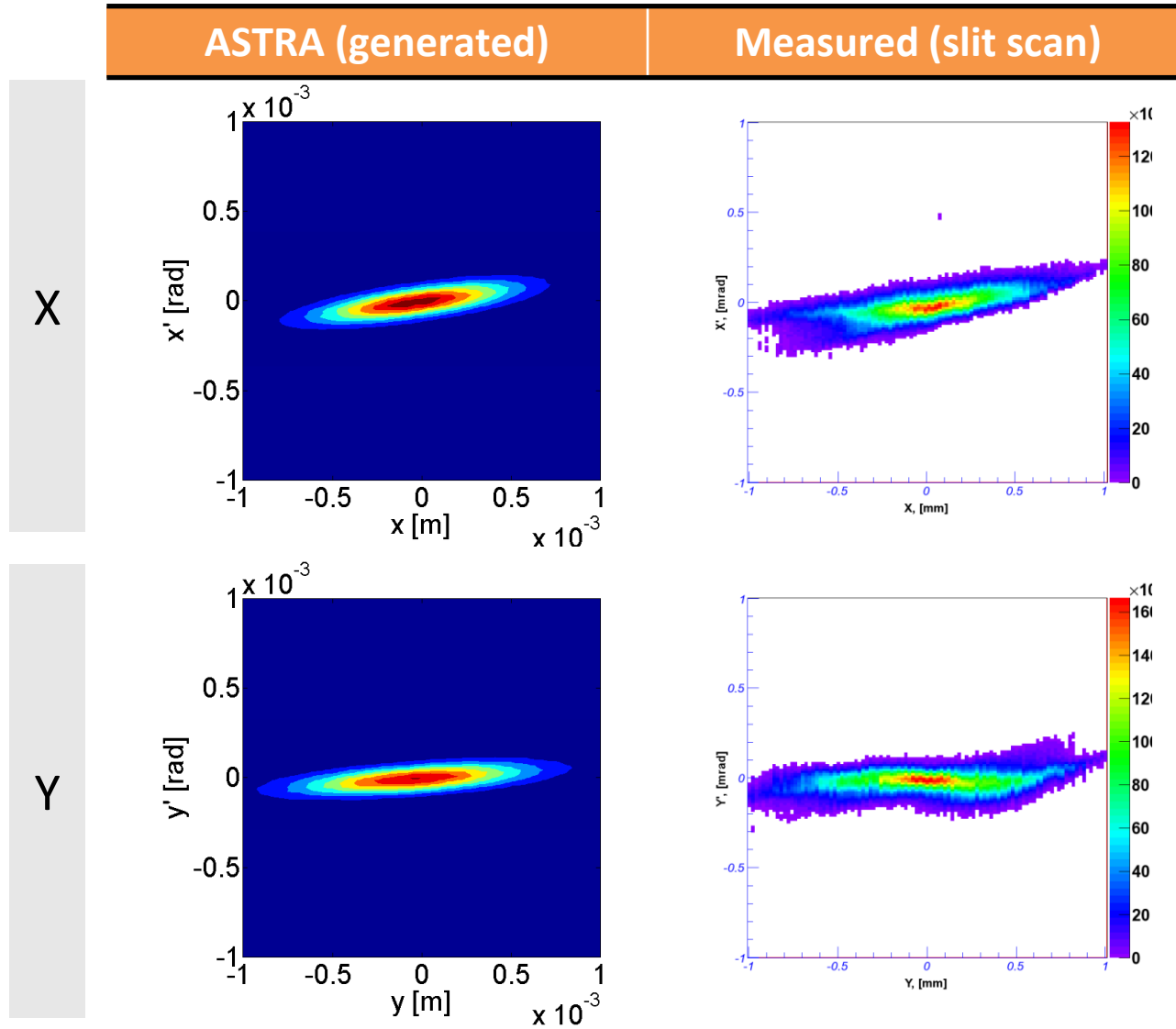
	EMSY 2 (1.8 m downstream)			PST (7.8 m downstream)		
	SC	ASTRA	Measured	SC	ASTRA	Measured
ϵ_x [mm·mrad]	0.86	0.85	0.94 ± 0.04	0.83	0.85	1.96 ± 0.03
β_x [m]	2.08	1.99	2.83 ± 0.11	0.91	1.01	0.78 ± 0.02
α_x	1.09	1.16	1.42 ± 0.10	1.13	0.96	0.70 ± 0.02
ϵ_y [mm·mrad]	0.92	0.91	1.25 ± 0.07	0.89	0.90	1.44 ± 0.02
β_y [m]	4.83	4.80	5.51 ± 0.37	1.03	1.10	1.07 ± 0.01
α_y	2.29	2.39	3.13 ± 0.14	-1.12	-1.15	-1.09 ± 0.02

> Increased emittance due to measurement imperfections?

1. machine instabilities (water cooling system, beam jitter)
2. non optimized operation settings (transverse laser profile with halo, BBAs)
3. uncertainty in the description of the input beam at EMSY 1
4. non-linear fields, transverse coupling, etc ...

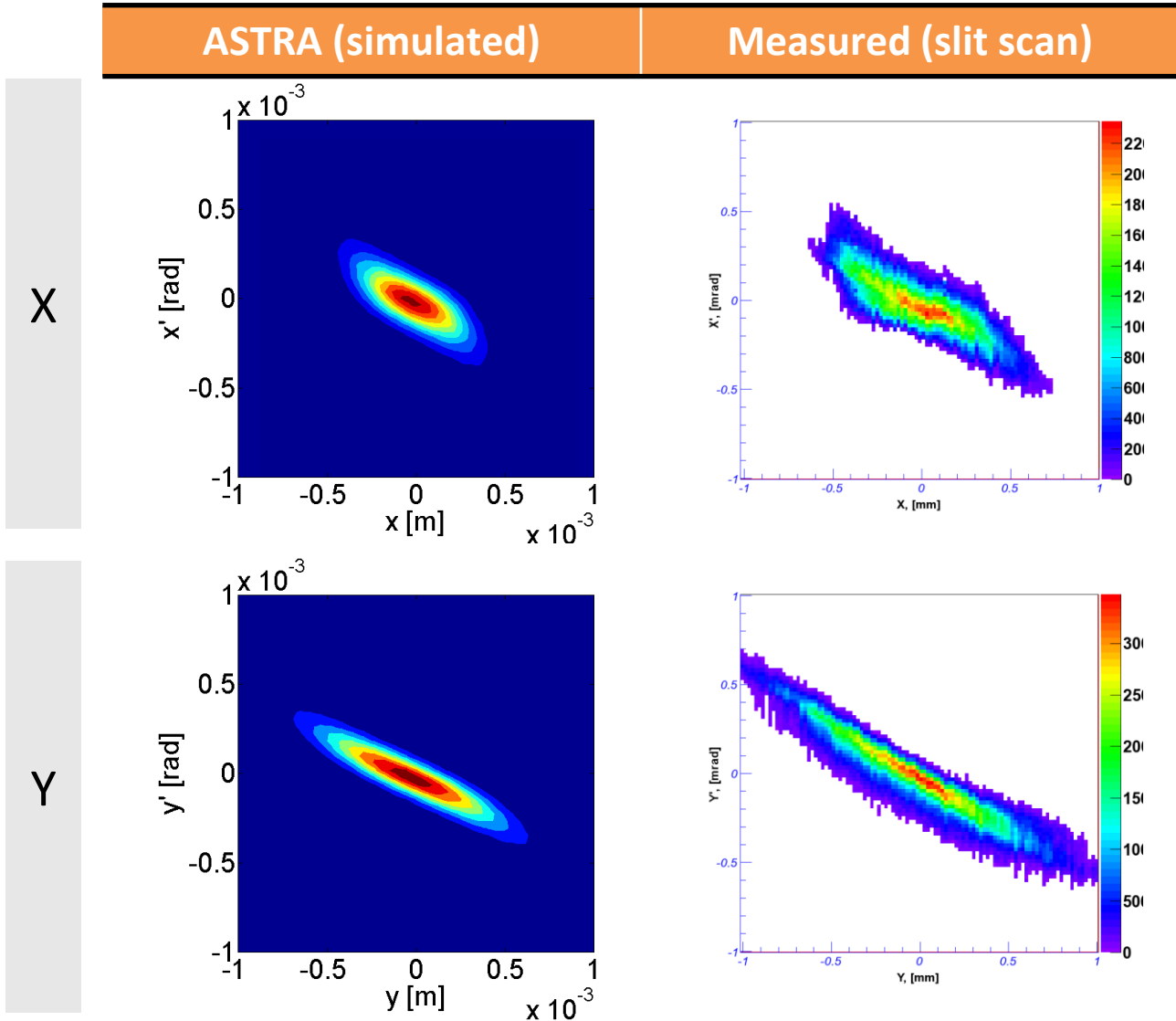
Measured values and comparison with simulation

EMSY 1 (beginning of matching)



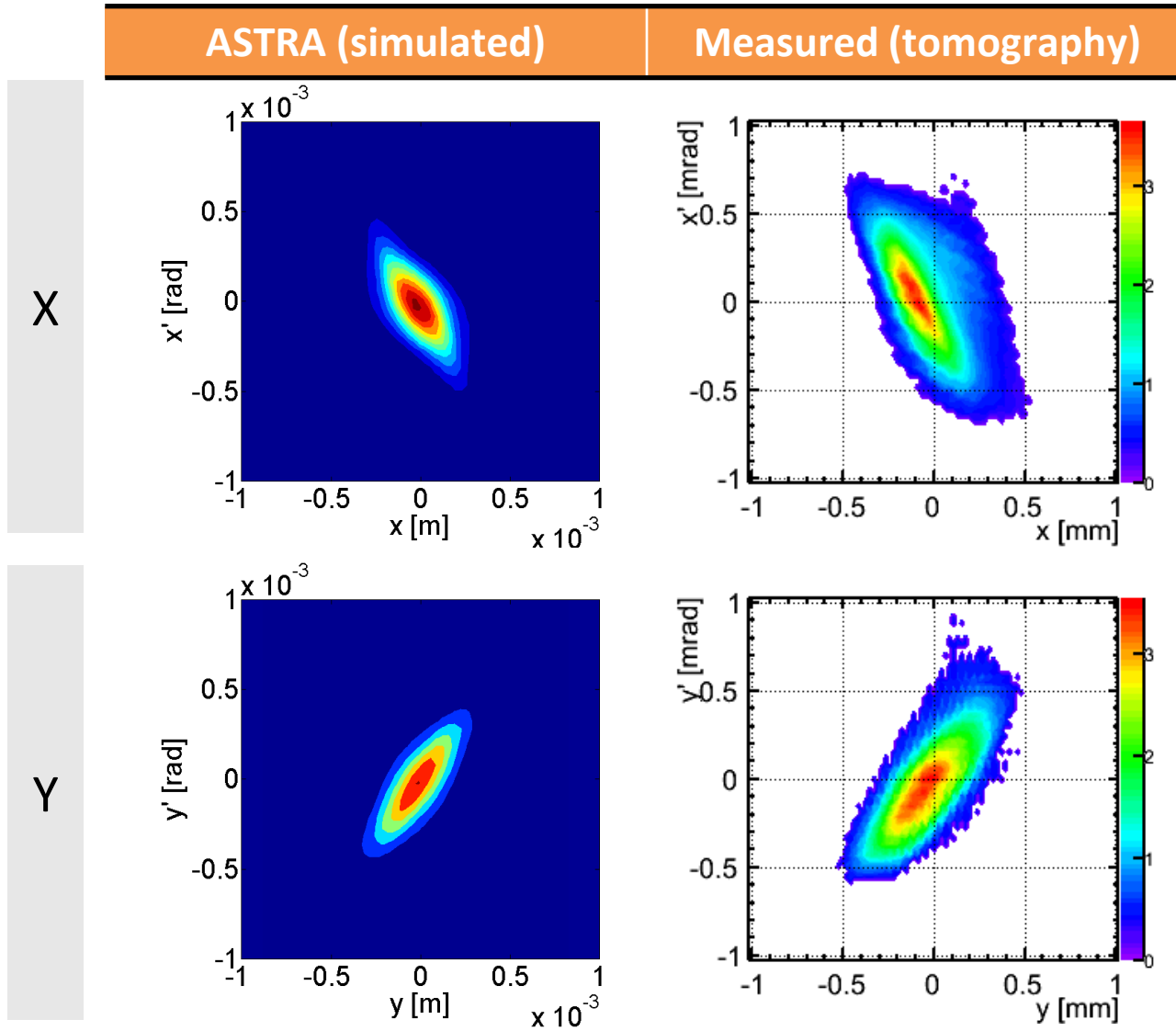
Measured values and comparison with simulation

EMSY 2 (1.8 m downstream, 4 quads in between)



Measured values and comparison with simulation

PST (7.8 m downstream, 9 quads in between)



- The **space-charge matching** of the transverse phase space at PITZ provides **fast** and **reliable** results (Twiss parameters in accordance with ASTRA)
- According to previous studies, the mismatch when space charge is neglected reaches up to several hundreds per cent.
- Excessive emittance growth observed, the reason has to be clarified

A big thank you to the shift crew and the PITZ group!!

THANK YOU.



Backup Slides

Laser profile during the measurement

$X_{rms}=0.399$ mm

$Y_{rms}=0.383$ mm

