Simulations with core+halo laser distribution of emittance data measured in 2011

Main focus of PITZ group:

**production of electron bunches with extremely small transverse emittance.**

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DESY, Zeuthen, 7 August 2015

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Introduction

> One of the main parameter that influences the transverse emittance is LASER TRANSVERSE DISTRIBUTION!

> In core+halo distribution we have a laser transverse radial profile comprised of a flat-top core with Gaussian-like decaying halo.

> In order to optimize the parameter setups we are conducting simulations with ASTRA code.

> Simulation with core+halo distribution is in a good agreement with measurements.

> My task is re-simulation of the emittance data measured in 2011. At that time machine was operated at nominal European XFEL conditions and the world record emittance was obtained.
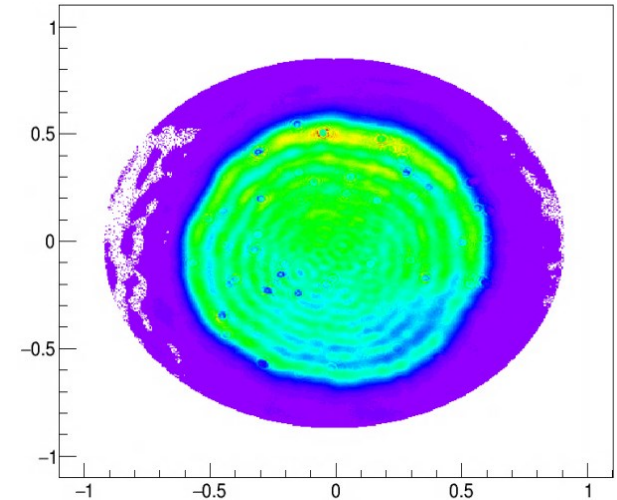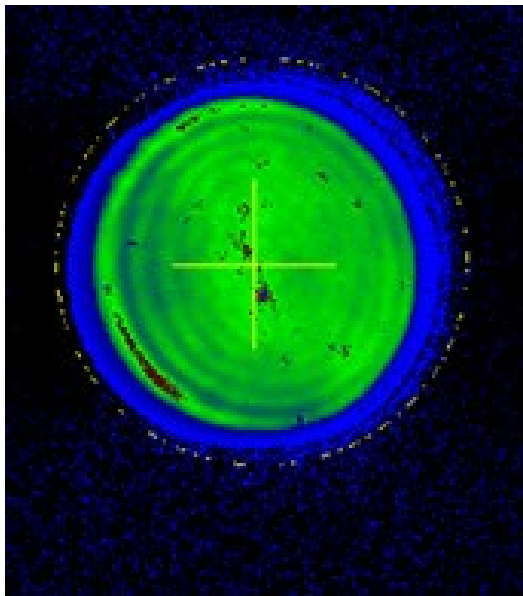

Schematic diagram of the 2011 PITZ electron beam line including electron gun and CDS booster cavity
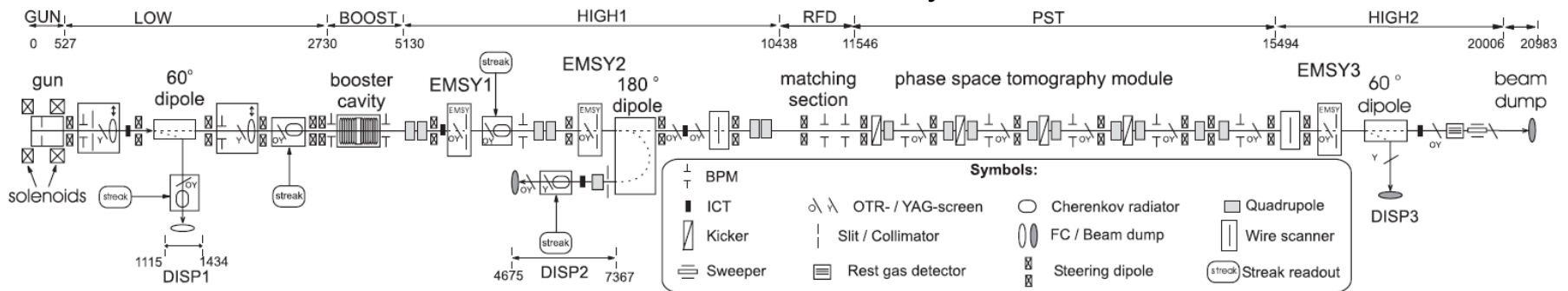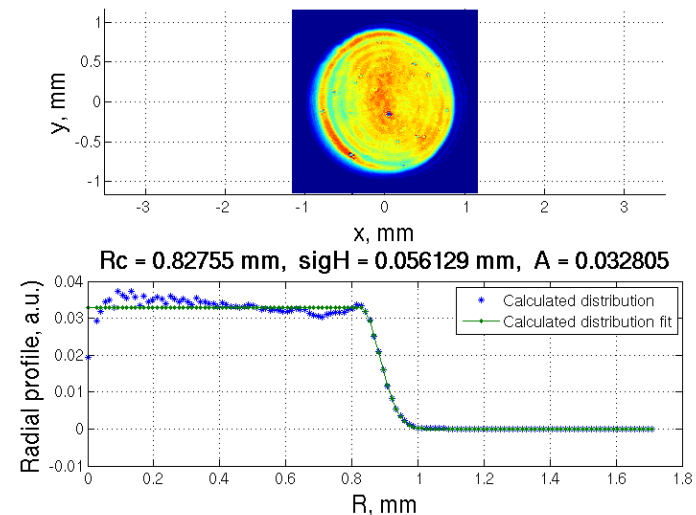
First steps of the simulations

BSA	Date	Shift	Gun phase	Gun mom	Gun mom sim	Booster mom	B mom sim	Charge	Delta charge	Egun	E booster
1.8 mm	12.02. 2011	A	MMMG	6.69 MeV/c	???	24.87 MeV/c	???	982.3	34.6	???	???

✓ laser profile from 12.02.2011 afternoon shift


✓ laser profile reproduced in MatLab

First steps of the simulations

	Measured	Simulated
BSA, mm	1.8	-
Gun momentum, MeV/c	6.69	6.68
Gun phase, deg	MMMG	MMMG
Gun gradient, MV/m	-	60.5
Booster momentum, MeV/c	24.87	24.77
Booster phase, deg	MMMG	MMMG
Booster gradient, MV/m	-	20.75
Charge, nC	0.98	1

✓ checking of ASTRA distribution

$Rc = 0.83545$ mm, $sigH = 0.056512$ mm, $A = 0.0120$

Further steps:

➢ Emittance simulations for various charges
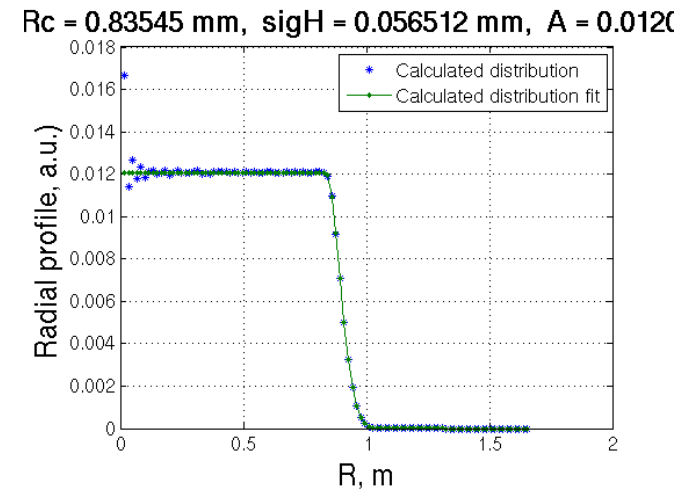
References:

> "A procedure to generate core + halo input distributions for ASTRA based on actual laser transverse distribution", Carlos Hernandez-Garcia & Mikhail Krasilnikov, edited after optimization by G. Vashchenko;

> "Experimentally minimized beam emittance from an L-band photoinjector", M. Krasilnikov, F. Stephan, G. Asova, H.-J. Grabosch, M. Groß, L. Hakobyan, I. Isaev, Y. Ivanisenko, L. Jachmann, M. Khojoyan, G. Klemz, W. Ko¨hler, M. Mahgoub, D. Malyutin, M. Nozdrin,§ A. Oppelt, M. Otevrel, B. Petrosyan, S. Rimjaem, A. Shapovalov, G. Vashchenko, S. Weidinger, and R. Wenndorff