Beam dynamics simulations for The SMI experiment at PITZ

- **Motivation**

- **Experimental conditions**

- **First weird results**

Osip Lishilin
PITZ physics seminar
Zeuthen, 2016-12-01

HELMHOLTZ | ASSOCIATION

PITZ — Photo Injector Test Facility Zeuthen
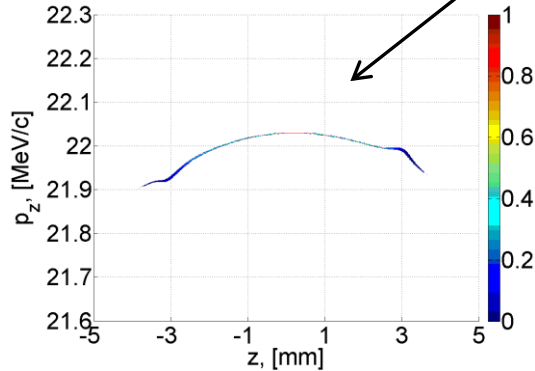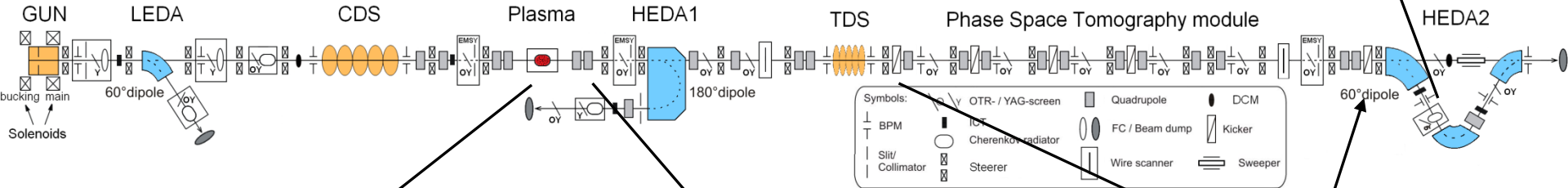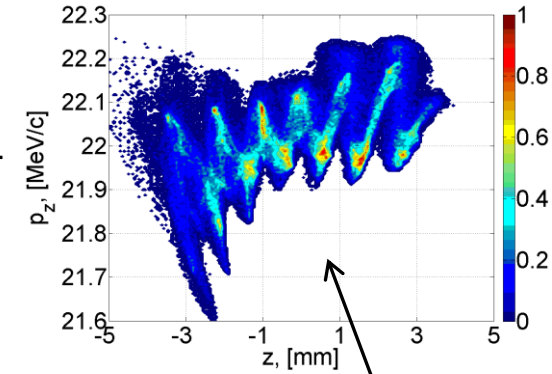
DESY

Simulated Self-modulation Experiment

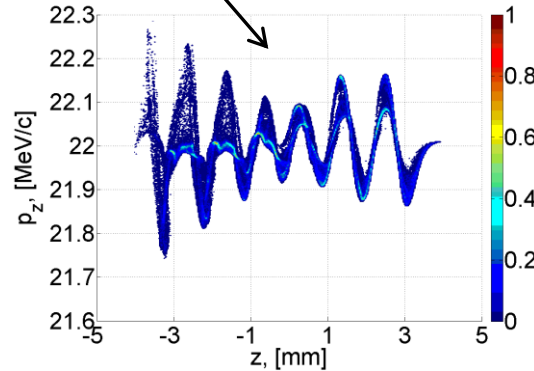**Not fully optimized**

Longitudinal Phase-space studies

Simulations:
Martin Khojoyan /
Dmitriy Malyutin

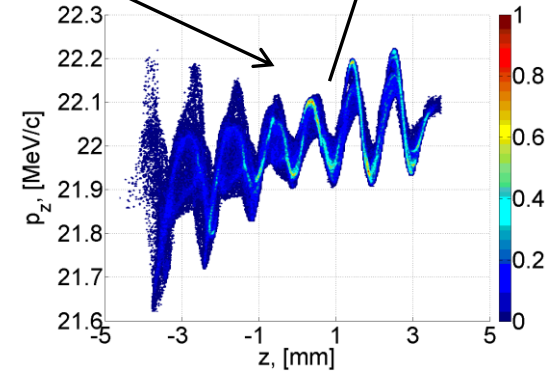Plasma density: 10^{15} cm$^{-3} \rightarrow \lambda_p \approx$ 1mm
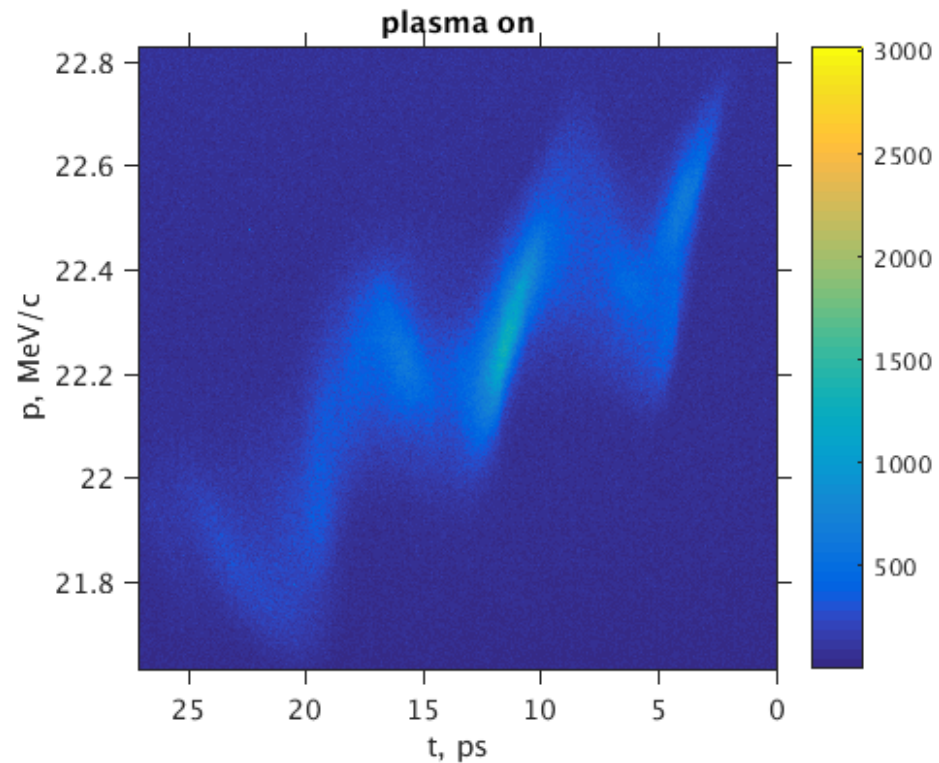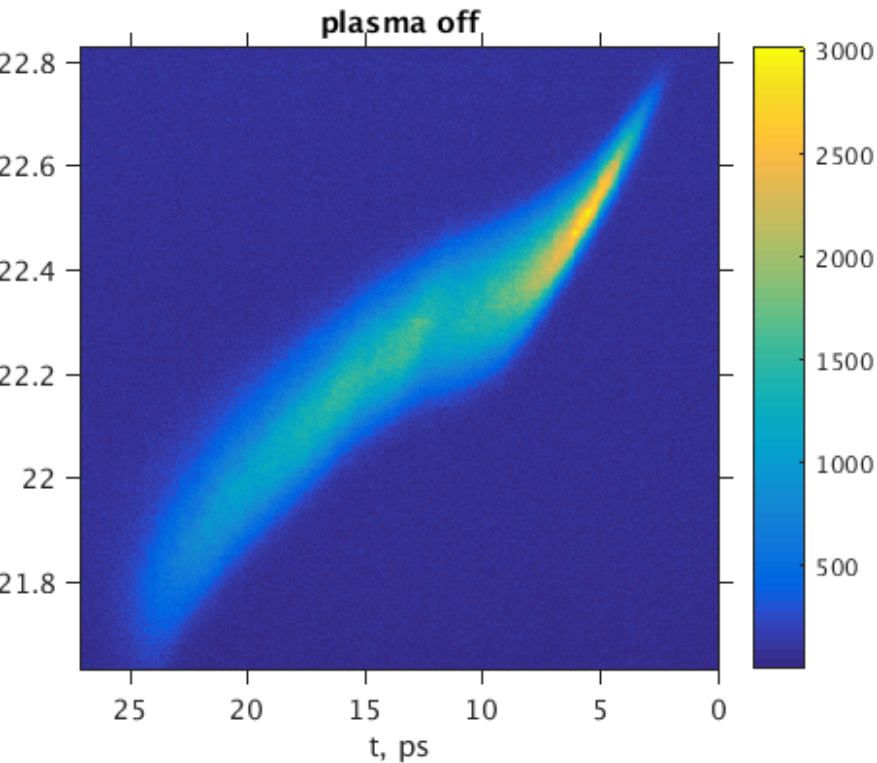
Expected phase space ←

In front of plasma cell

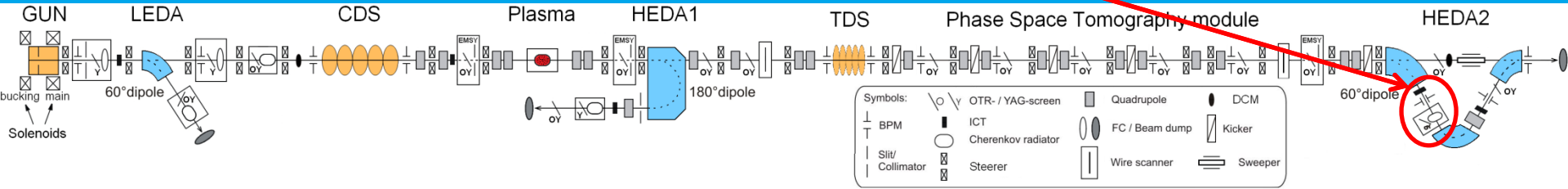After plasma cell
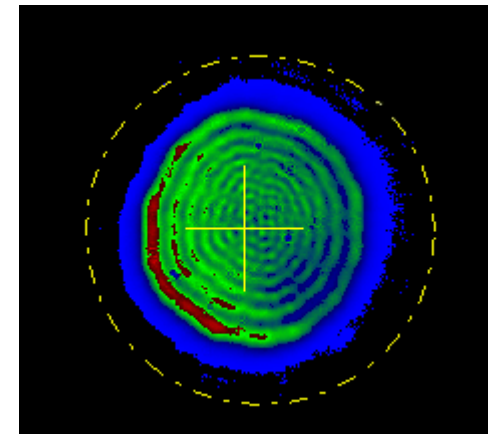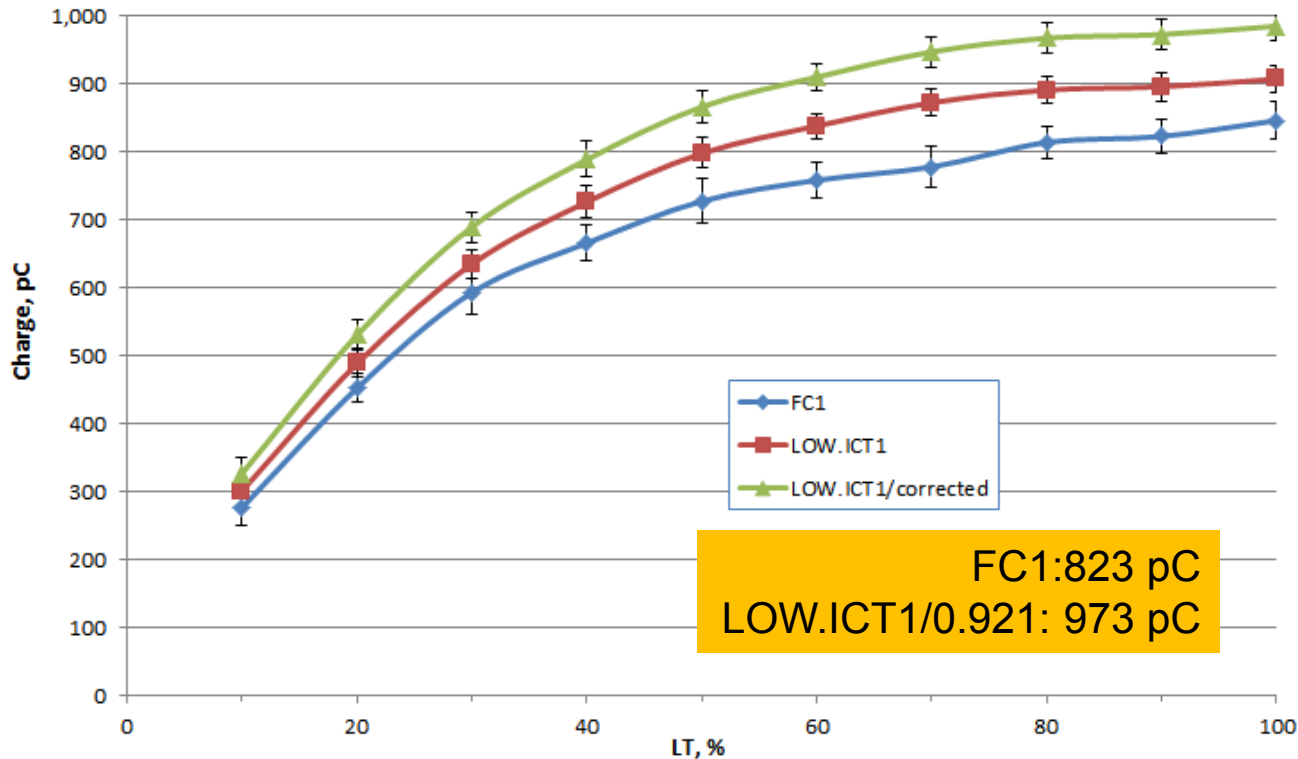(assuming zero initial energy spread)

In front of dipole

Q=0.97 nC
Plasma density: $\approx 10^{14}$ cm^{-3}

Experimental conditions

> "Flattop" laser profile, ~22 ps

> BSA=1.26 mm, XYrms=0.298 mm,

> Gun@MMMG, 6.5 MeV/c

> Booster@MMMG, 22.7 MeV/c
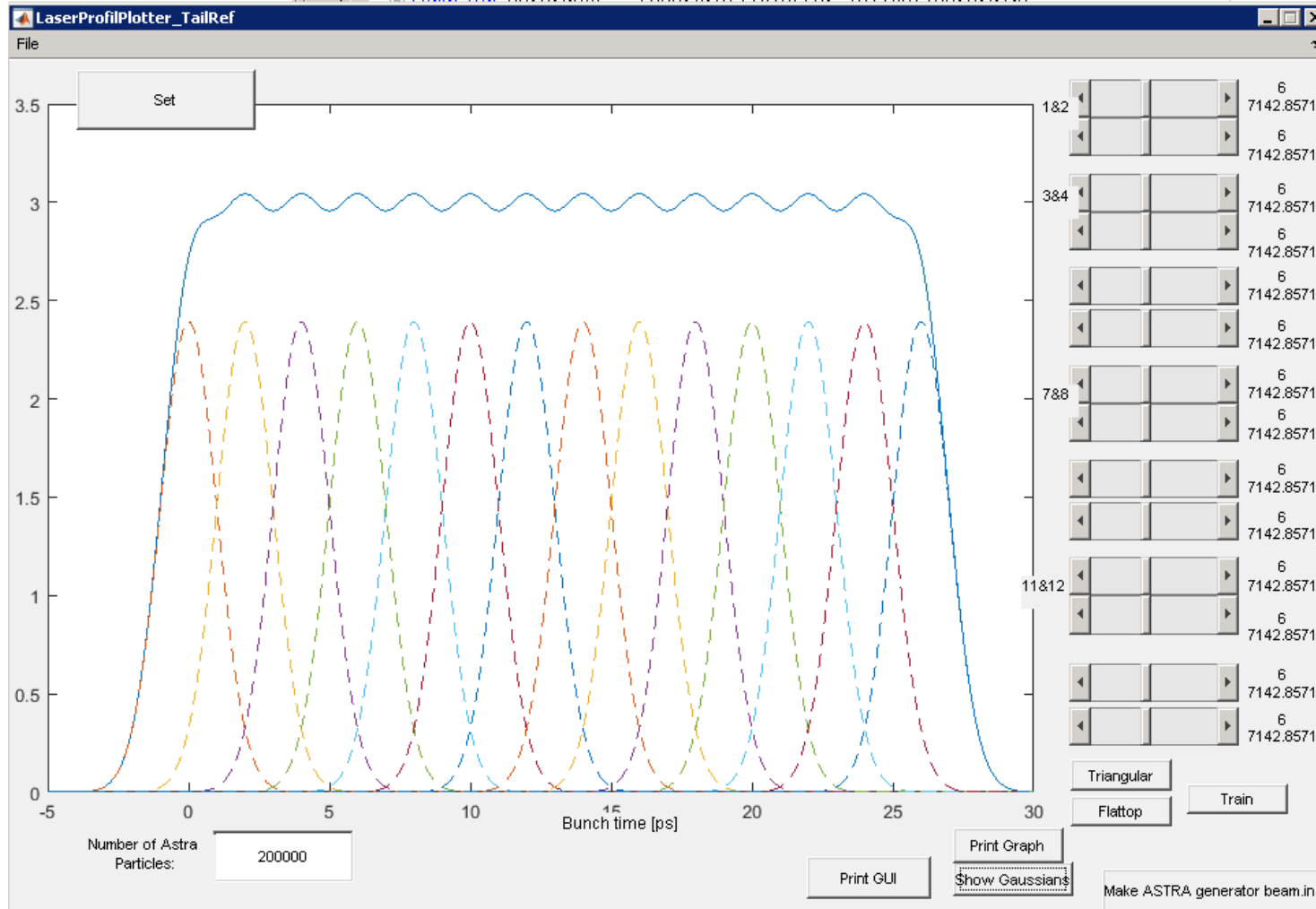

@PST.Scr
1LT=20%

Measure\Plasma\
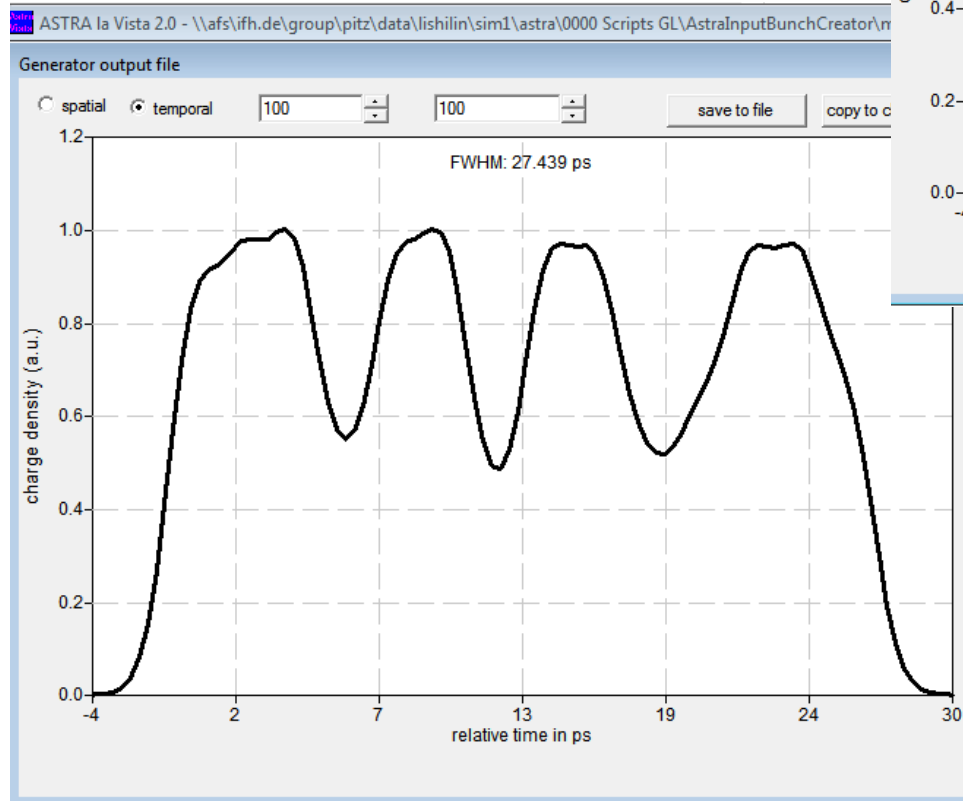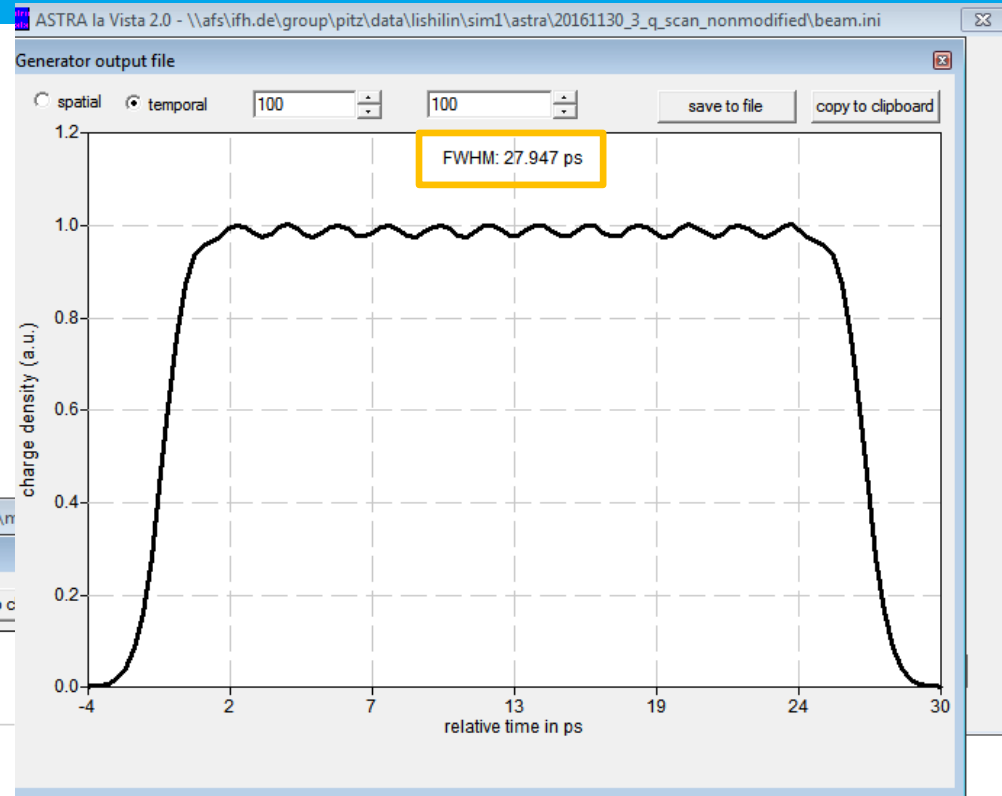\20161009M\VC2\1413

FC1:823 pC
LOW.ICT1/0.921: 973 pC

Initial distribution for ASTRA

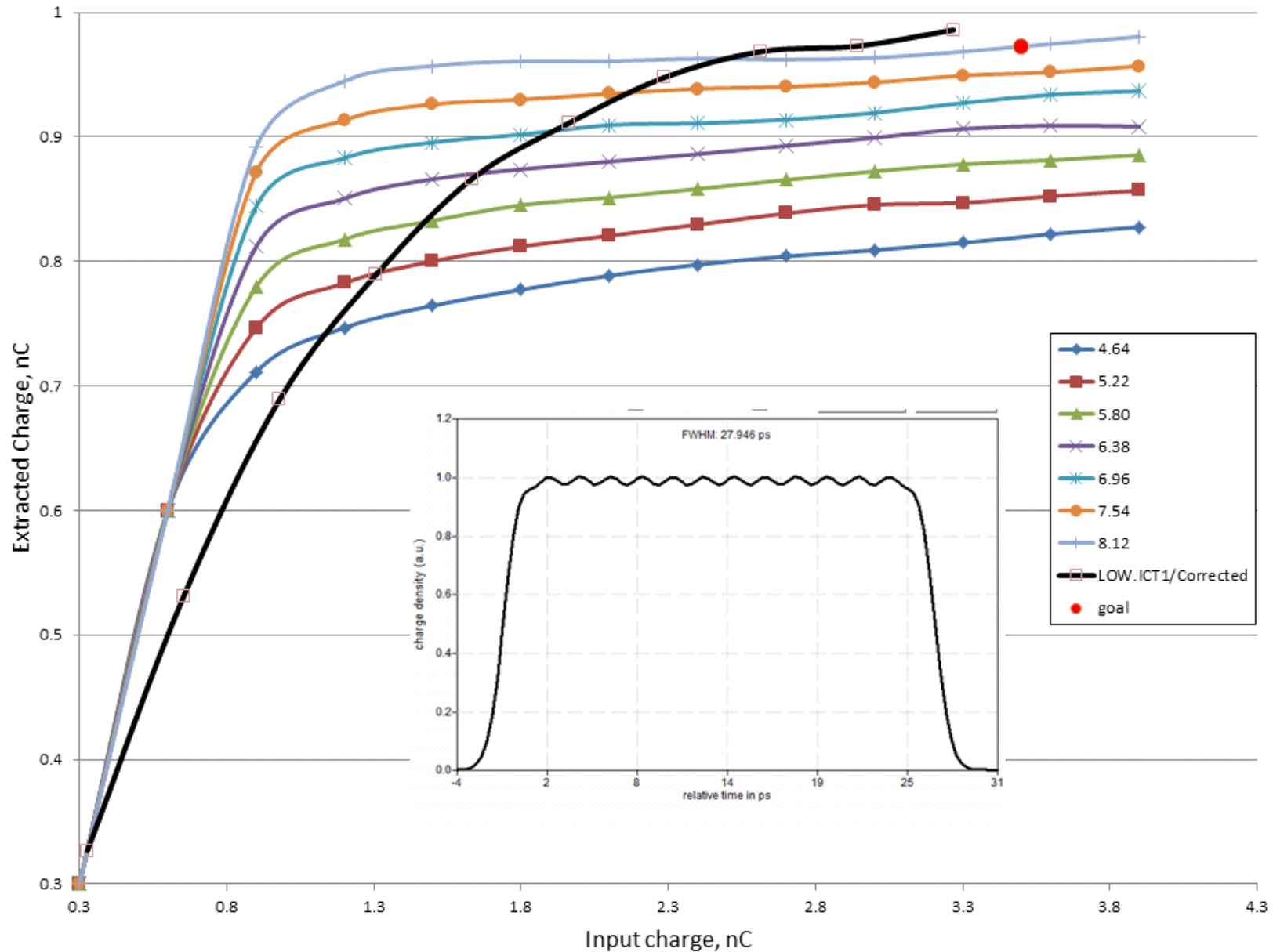> Gregor's script for laser pulse shaping=>MK_CH4.m

Initial distributions for ASTRA

> One ideal flattop

> One arbitrary modulated flattop

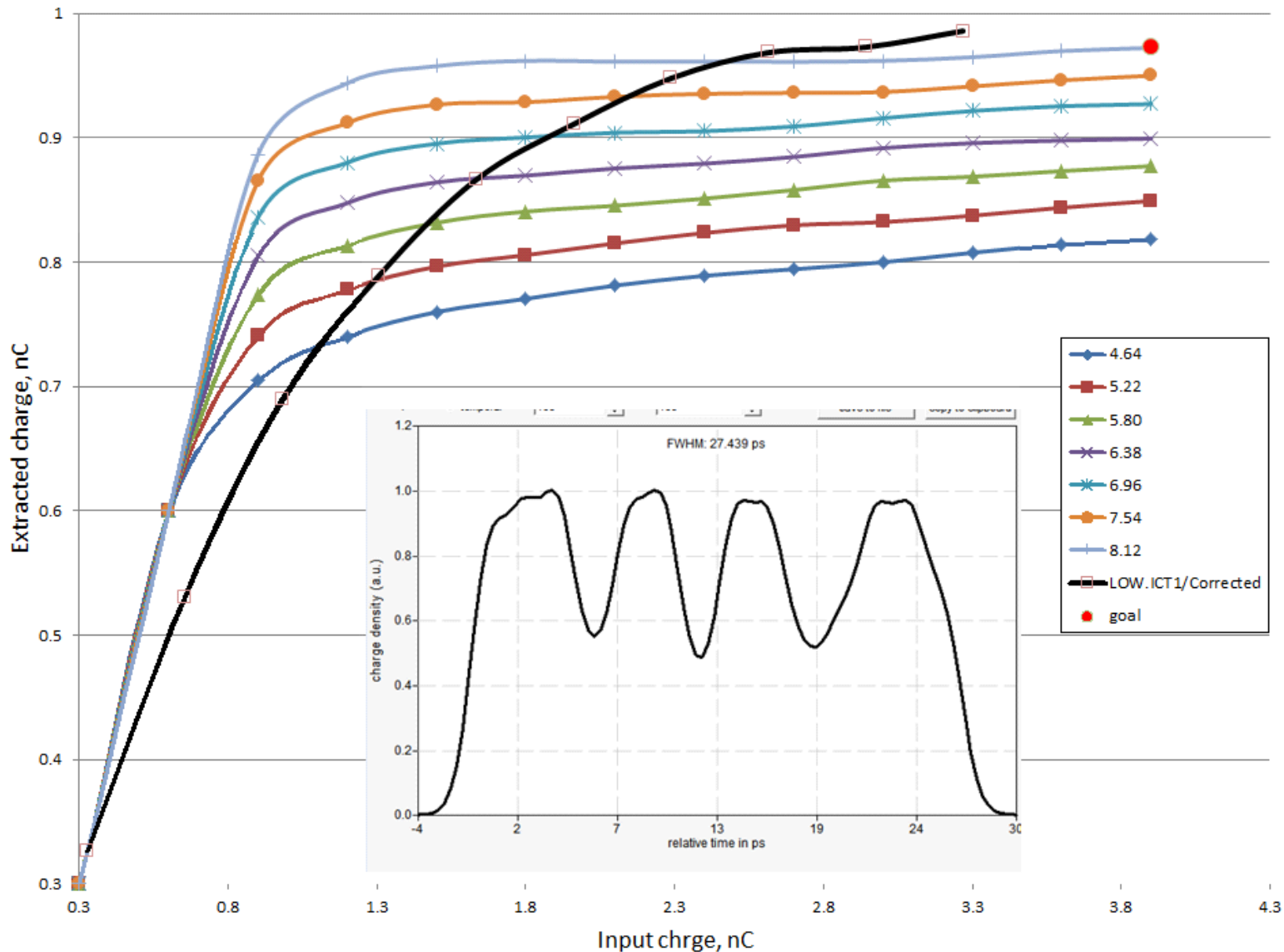> Scan emission time in ASTRA (**Trms**) in order to scale beam length

Q_extracted vs Q_input for different Trms (ps), flattop

Charge extraction, modulated flattop
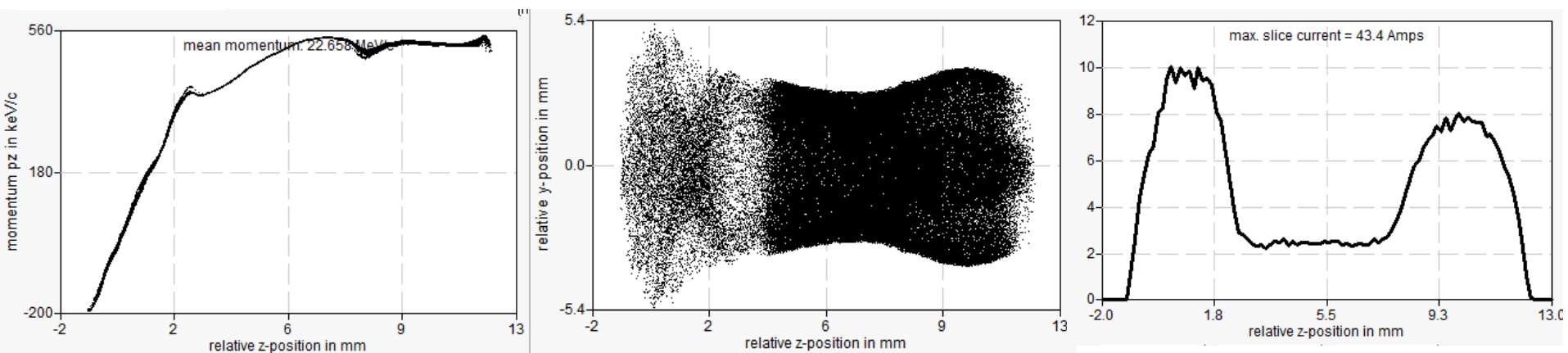

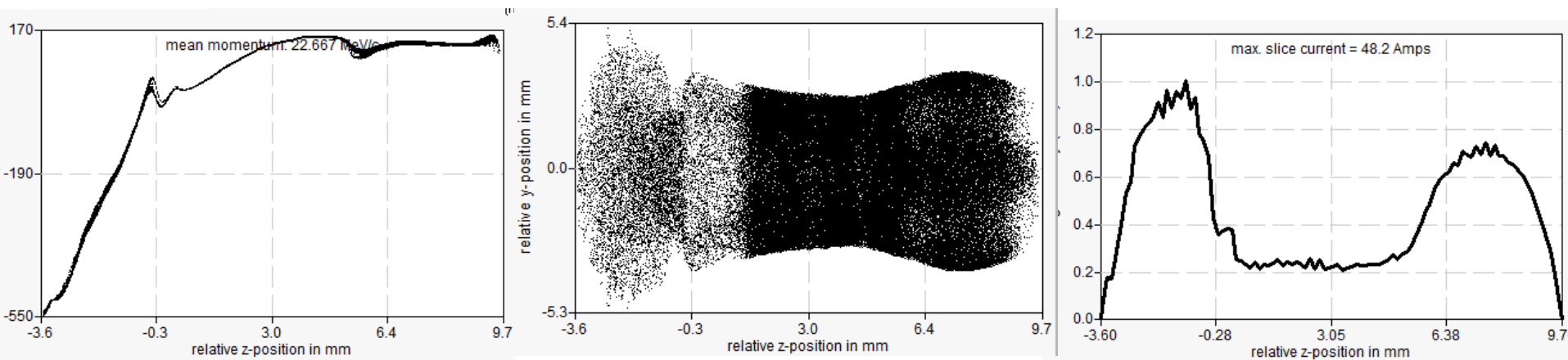Q_extracted vs Q_input for different Trms(ps), modulated flattop

LPS, X-projection and current profile at z=4.61 m
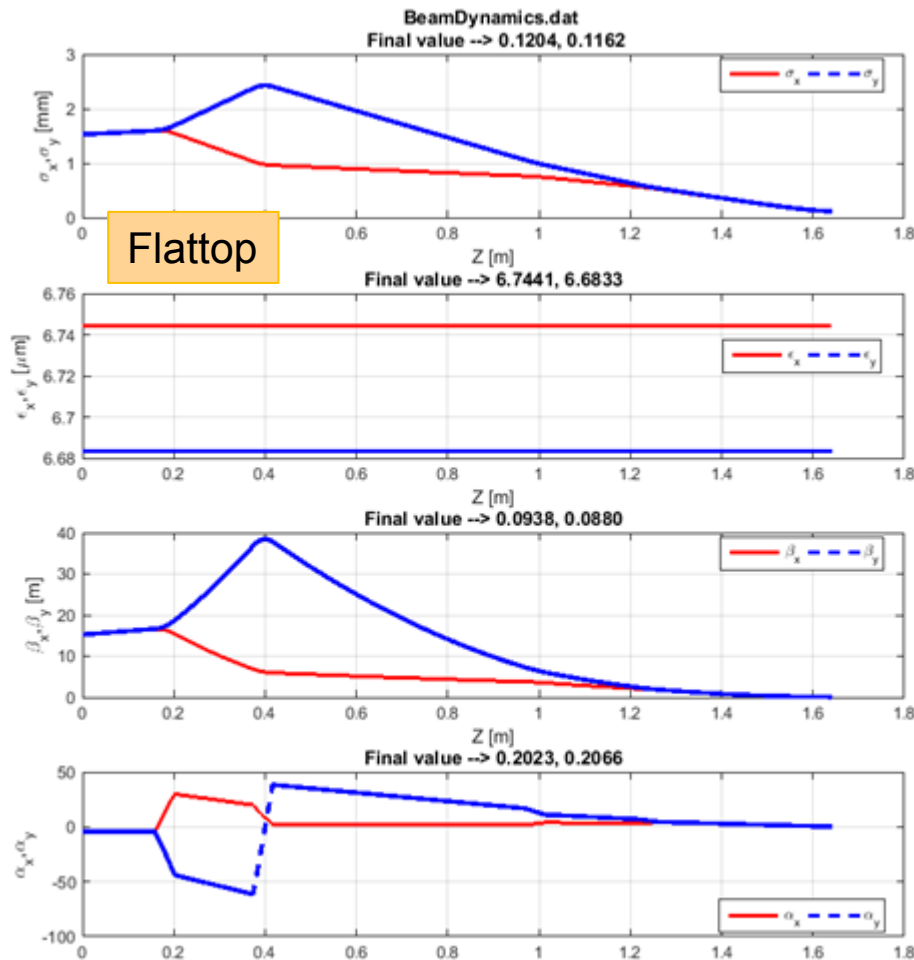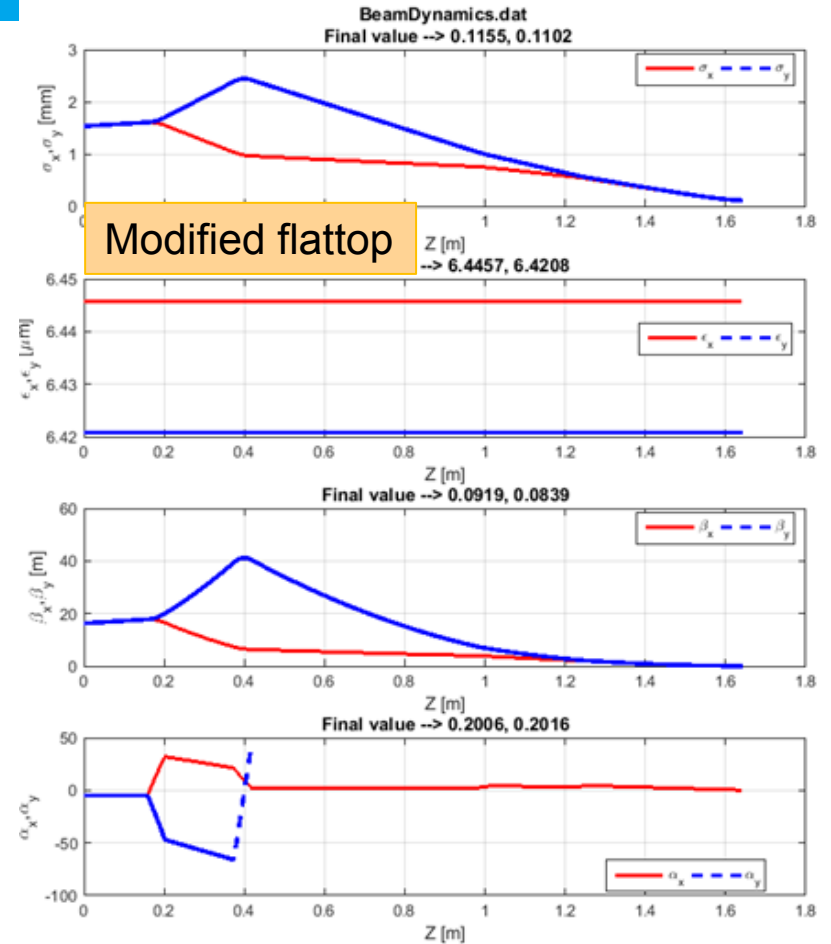
> Flattop, Q_input=3.5 nC

> Modulated flattop, Q_input=3.9 nC

Transport to plasma cell entrance with SC code

Flattop

Modified flattop
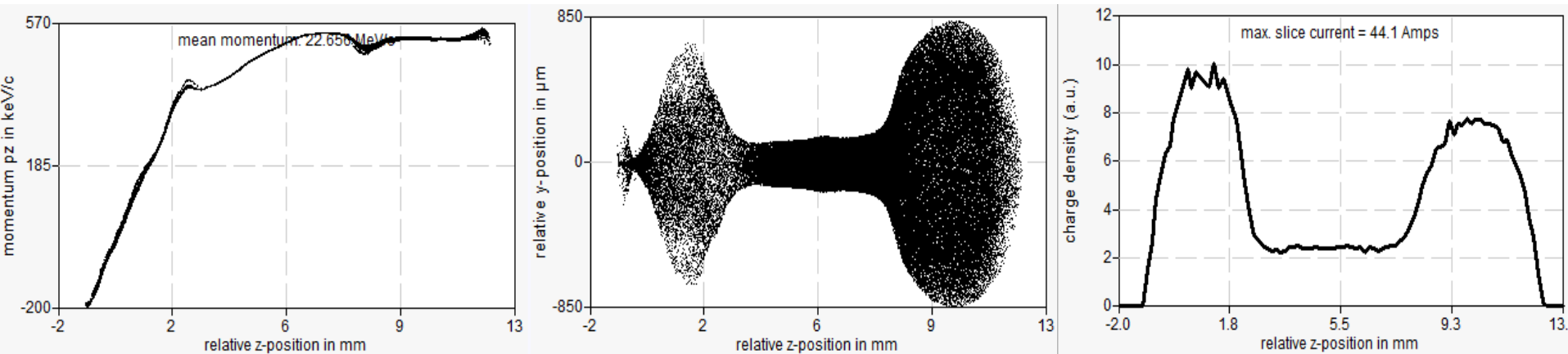
Imain=382 A
High.Q1: 3.8221 T/m
High.Q2: -4.6932 T/m
High.Q3: 1.1696 T/m
High.Q4: 1.4303 T/m

Imain=382 A
High.Q1: 3.8311 T/m
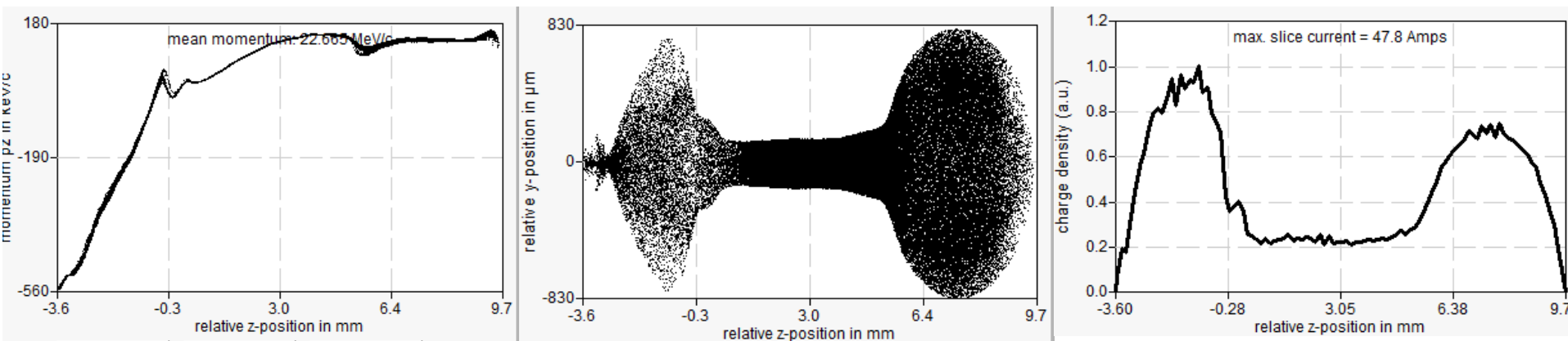High.Q2: -4.6985 T/m
High.Q3: 1.1620 T/m
High.Q4: 1.4157 T/m

> Flattop, Q_input=3.5 nC

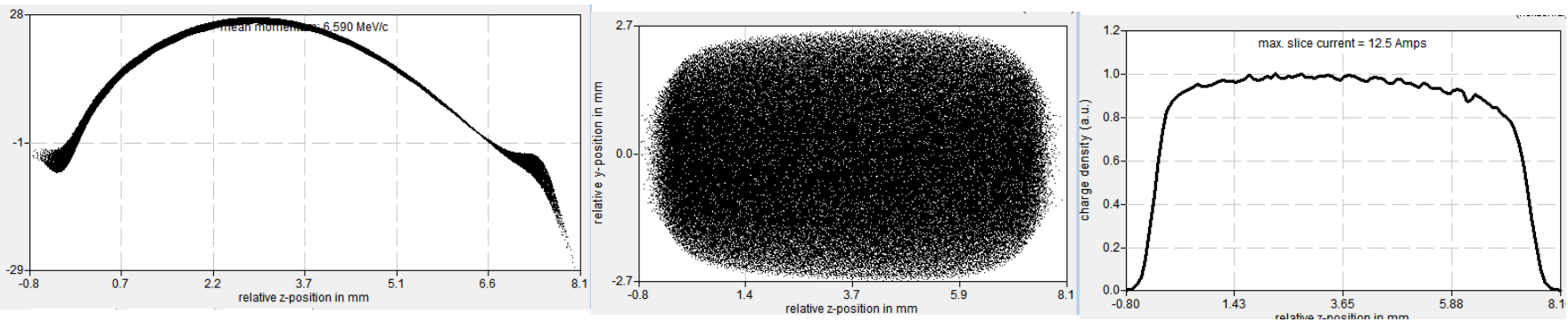

> Modulated flattop, Q_input=3.9 nC

Issues/discussion

> Not possible to reproduce the experimental LT-curve

> Due to strong space charge, beam expands enormously (~2 times longer than experimental values)

> Not really a flattop

- Checked if Core_and_halo plays a role – no big difference

- Check ASTRA built-in plateau distribution – not yet done

- Increase BSA/decrease charge in order to sit on the linear part of LT slope(?)

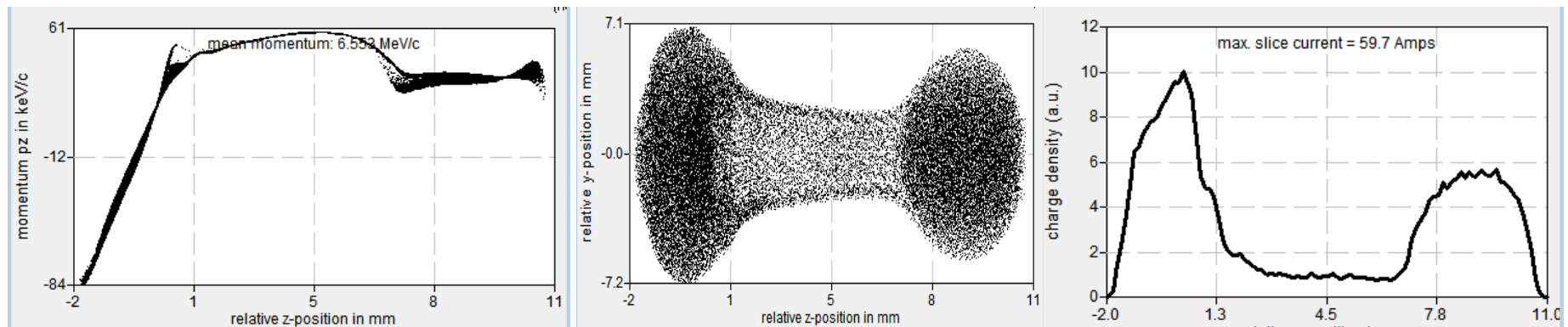- Find an initial distribution shape in order to optimize emission?
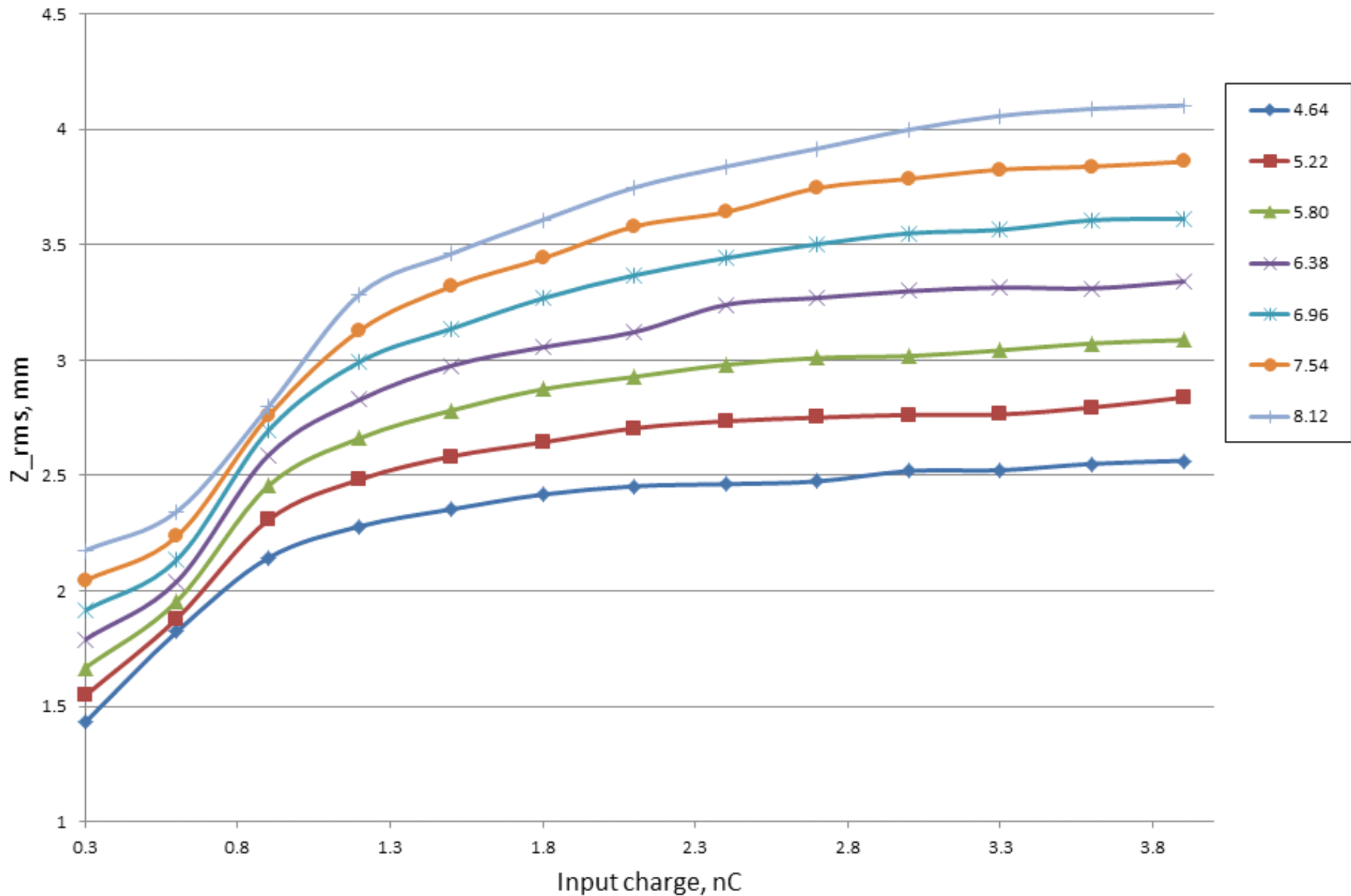
> 0.3 nC

> 3.9 nC

Electron beam length vs Q_input at z=0.2 m for different Trms (ps), flattop

Electron beam length vs Q_extracted at z=0.2 m for different Trms(ps), modulated flattop