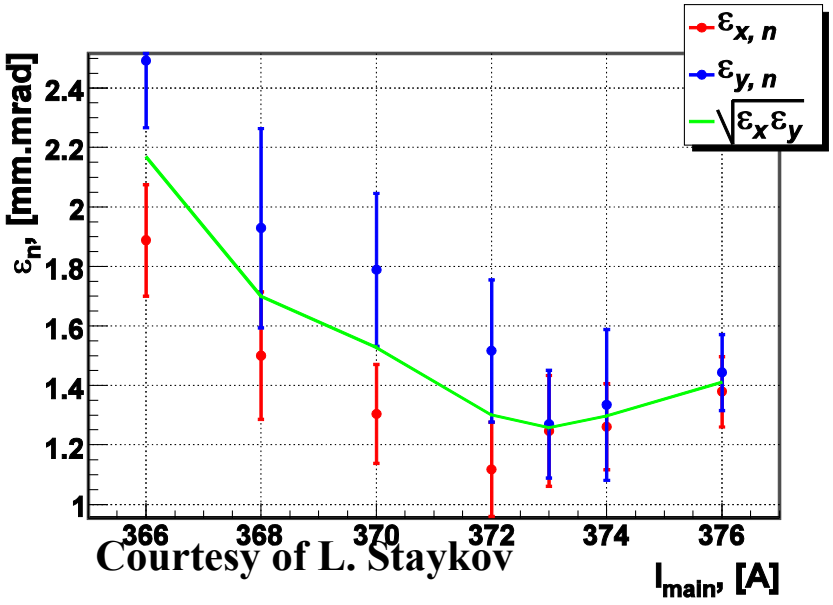
Comparisons of measurements and simulations for bunch temporal profiles and longitudinal phase space at PITZ

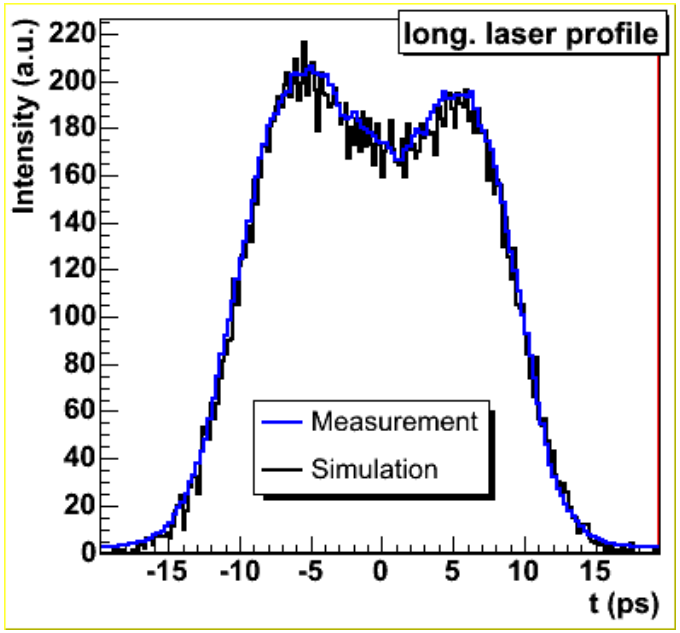
Measurements with Gun3.2

Longitudinal phase space at PITZ

Want to analyse the longitudinal conditions of the electron bunch for the case of smallest emittance



Courtesy of L. Staykov

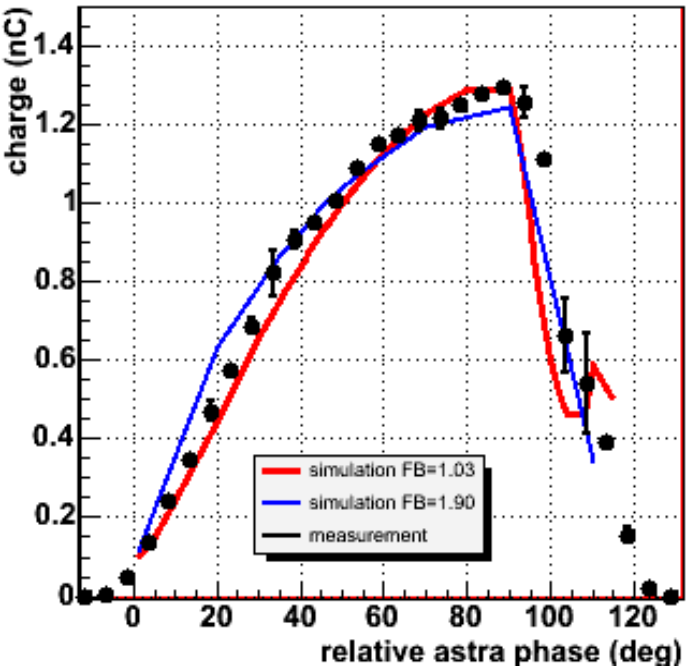


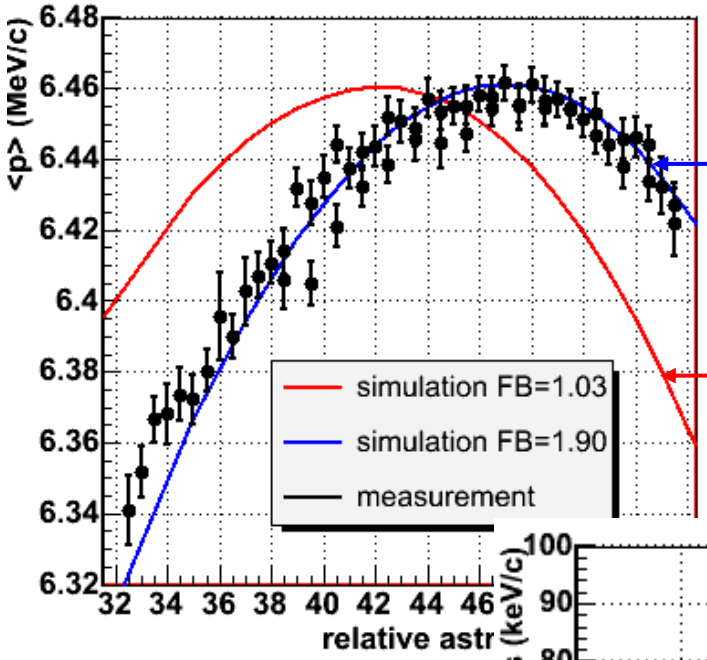
Gun3.2
Gun phase: max. momentum gain
Booster phase: max. momentum gain

temporal laser properties
FWHM = 21.08 ps
risetime = 6.73 ps
falltime = 6.47 ps
modulation = 5.12%

transverse laser beam size:
Ø = 1.2mm, σ = 0.35mm

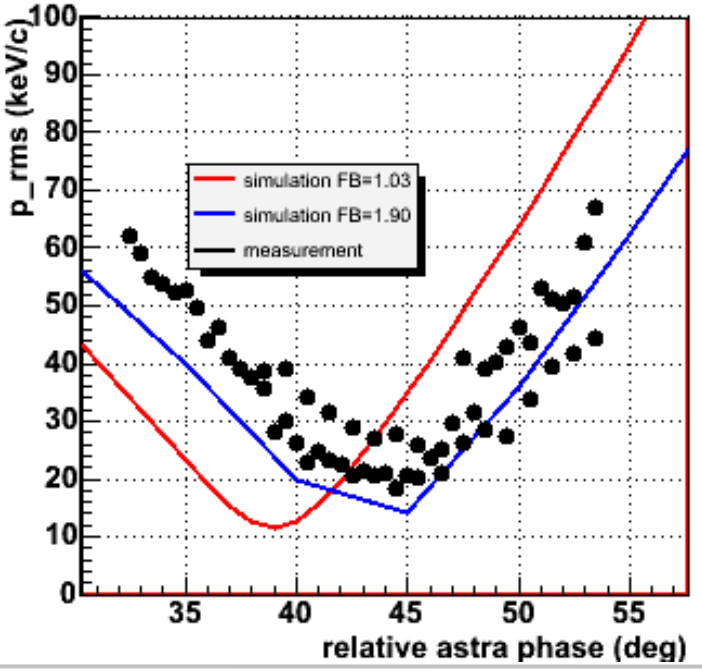
Longitudinal phase space at PITZ





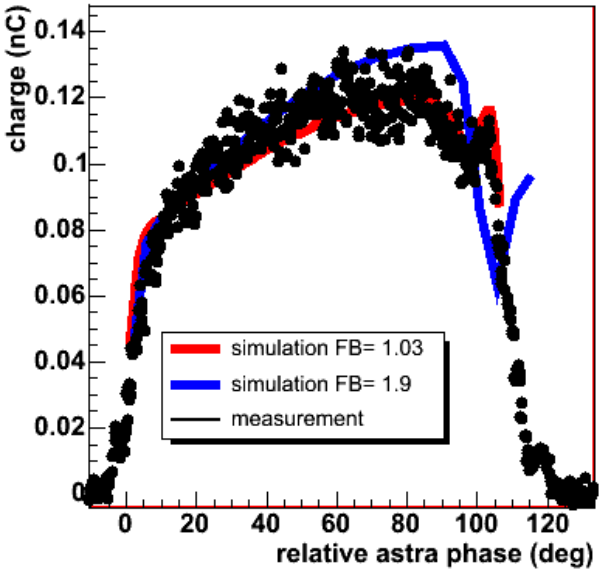
FB =1.9
~80 MV/m

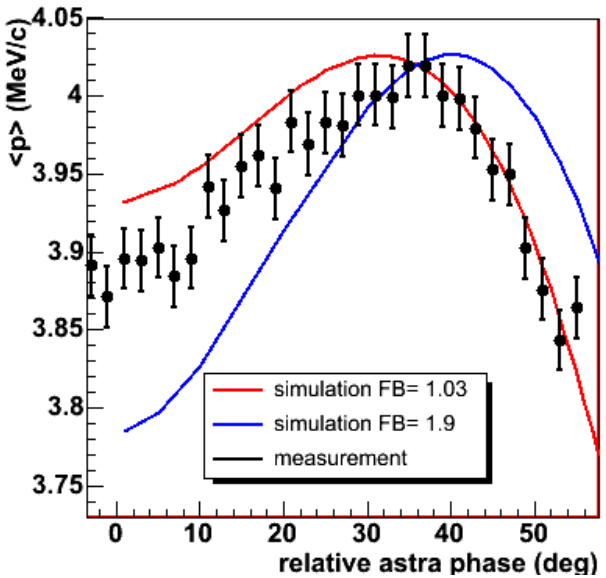
FB=1.03
~55 MV/m

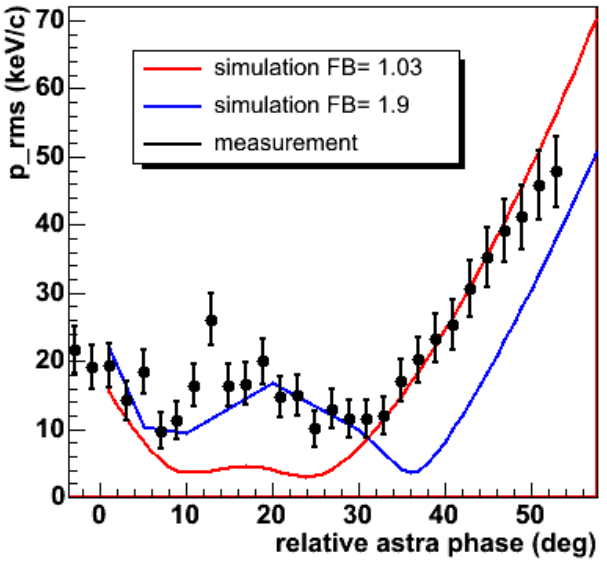


Measurement on
17th / 18th of August 2007

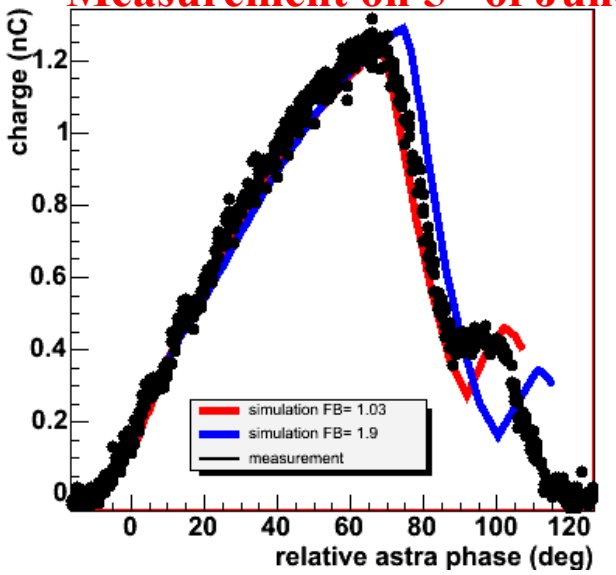
Longitudinal phase space at PITZ

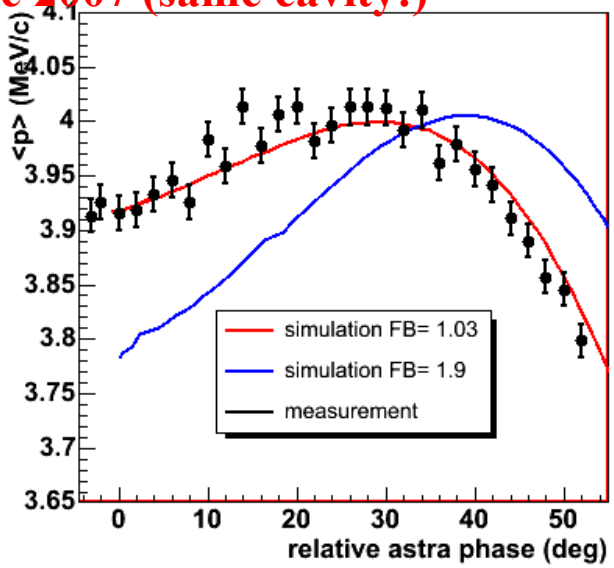


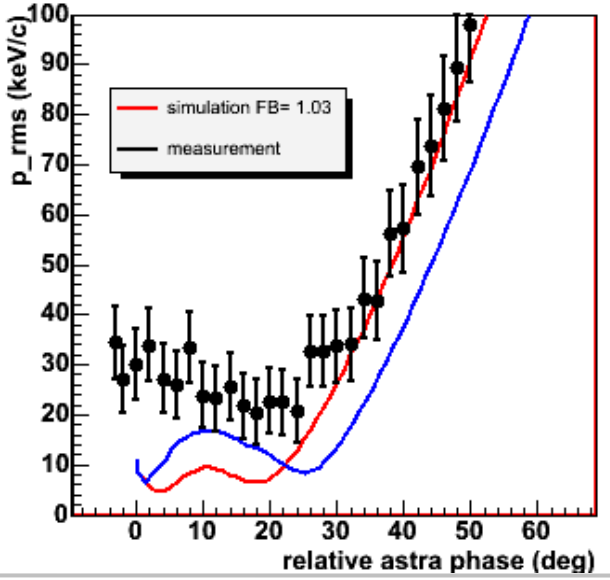




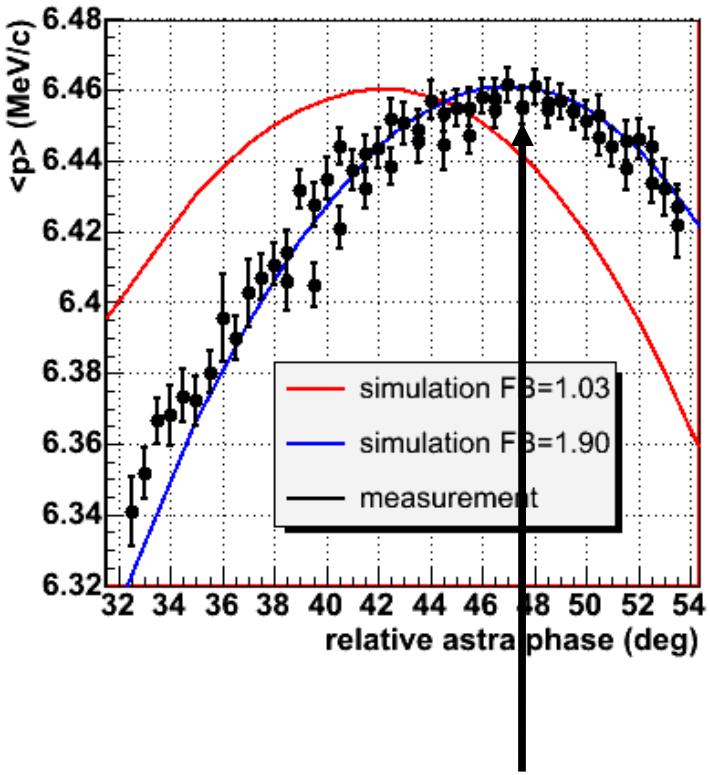
Measurement on 5th of June 2007 (same cavity!)



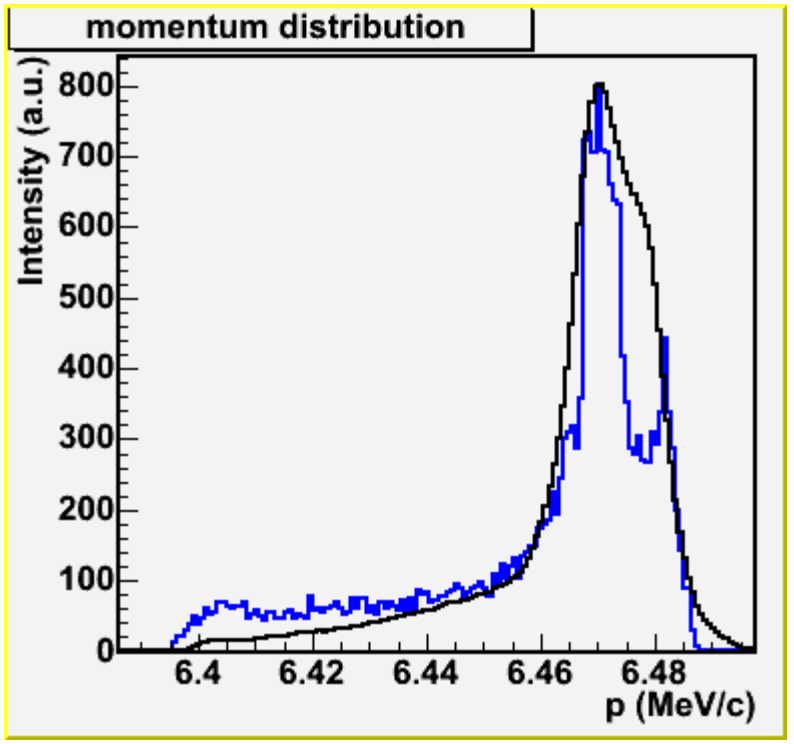




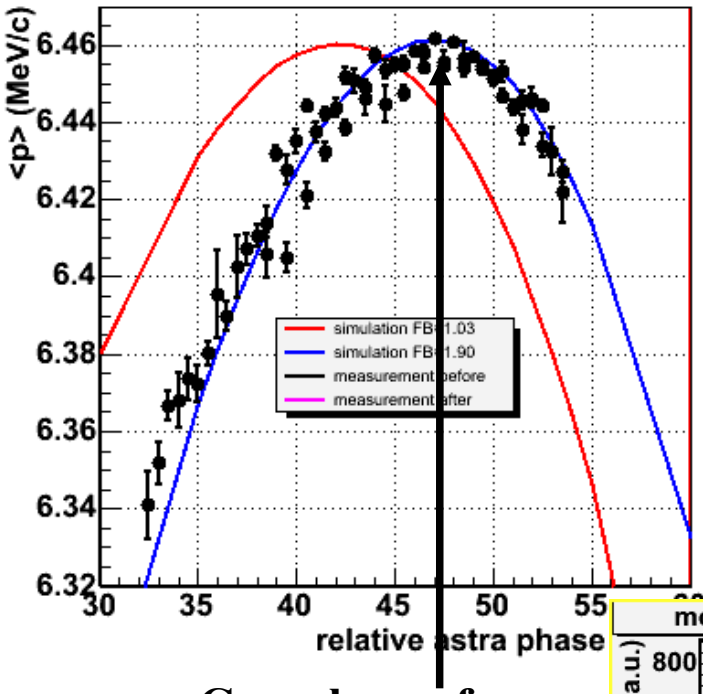
Longitudinal phase space at PITZ



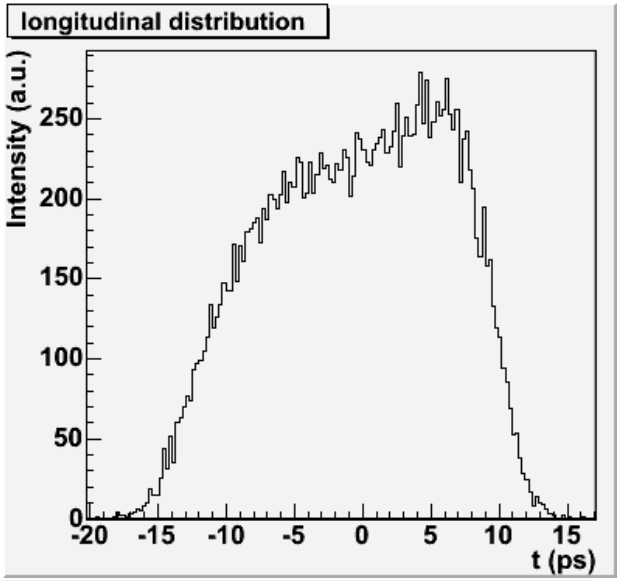
Gun phase of max. momentum gain

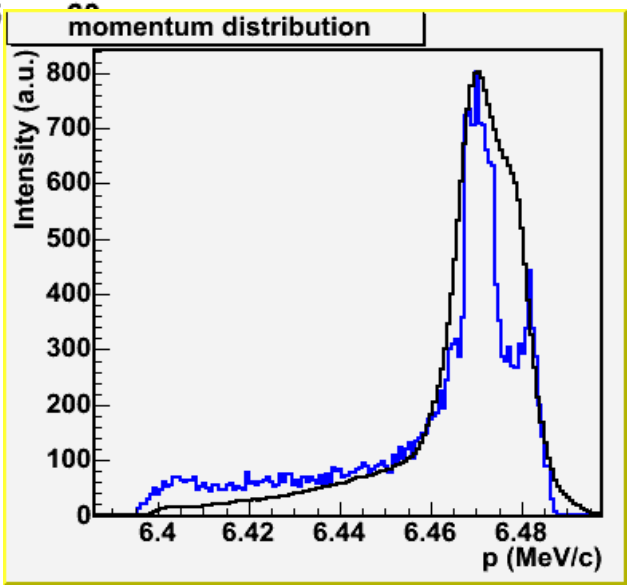


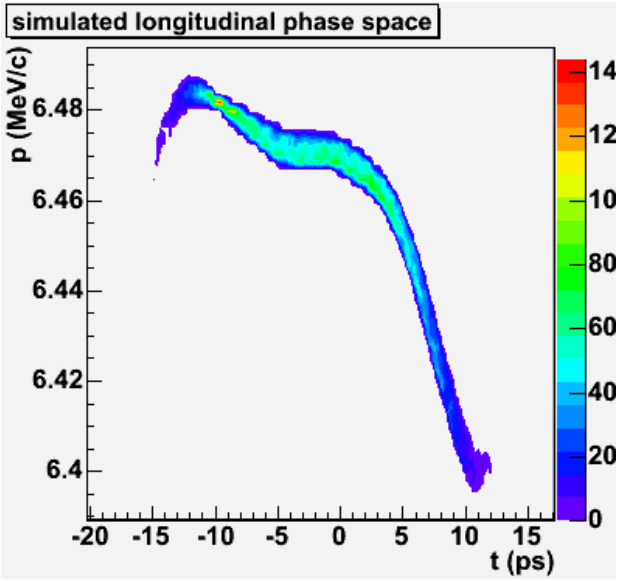
Longitudinal phase space at PITZ



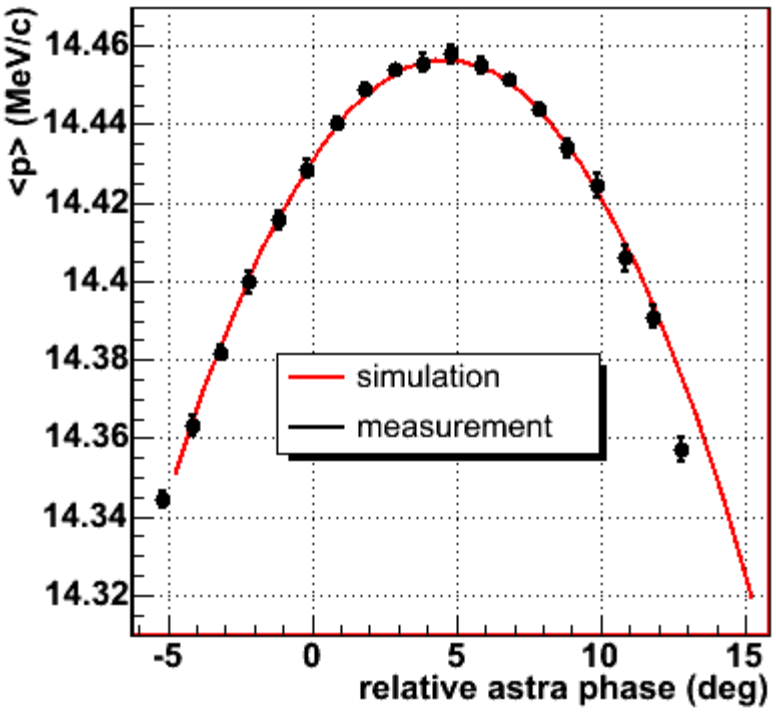
Gun phase of max. momentum gain

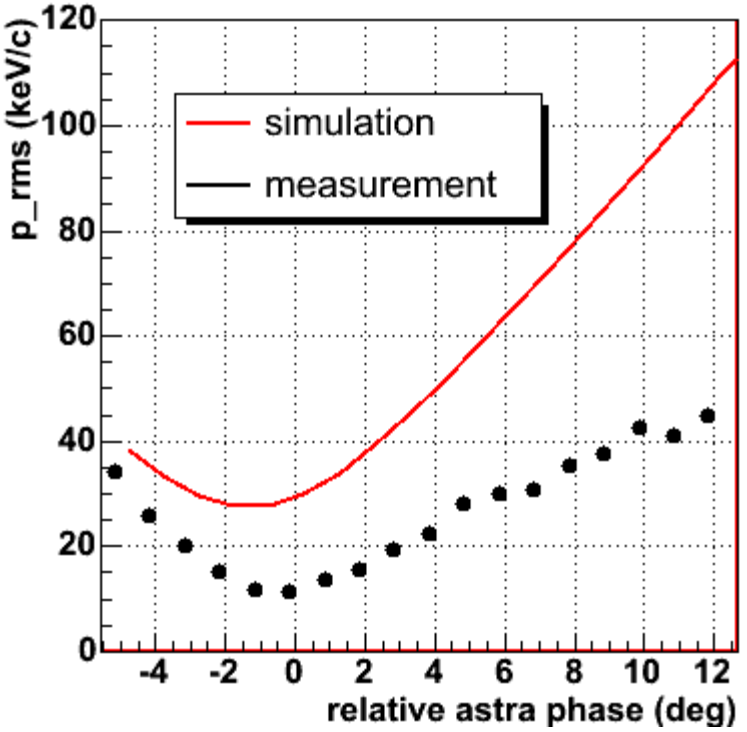


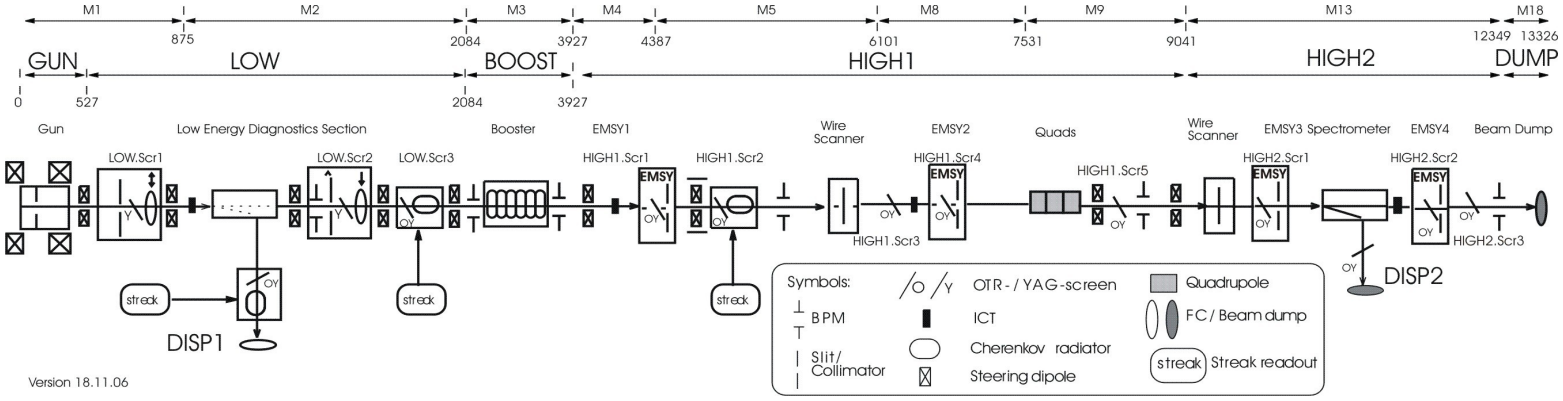




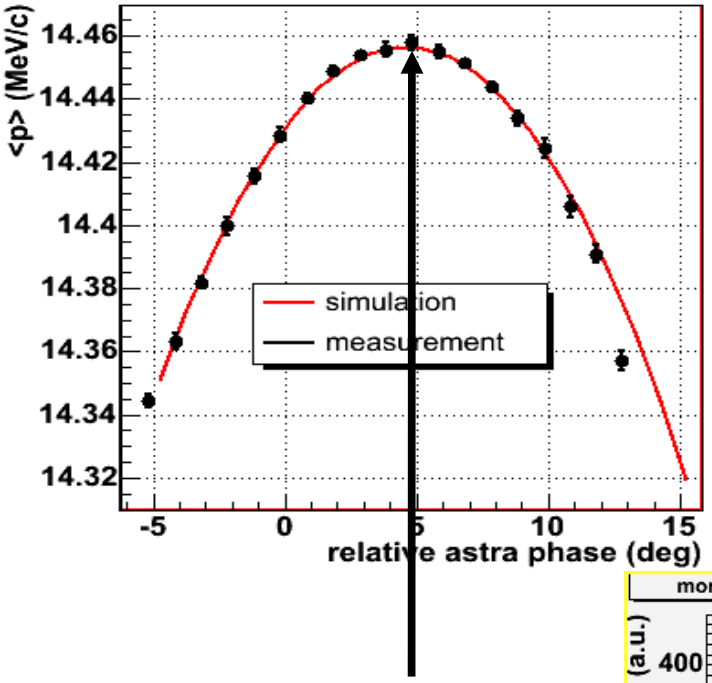
Longitudinal phase space at PITZ

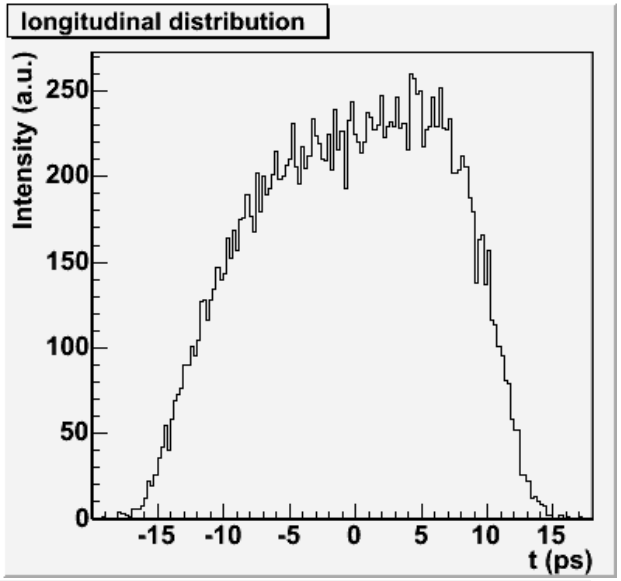




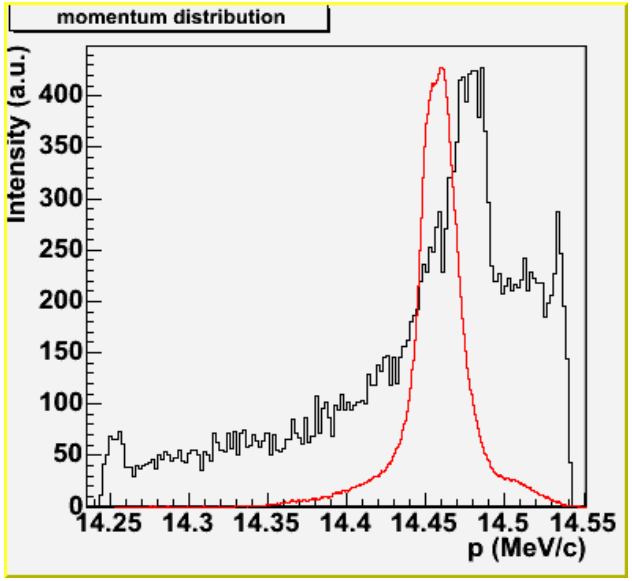


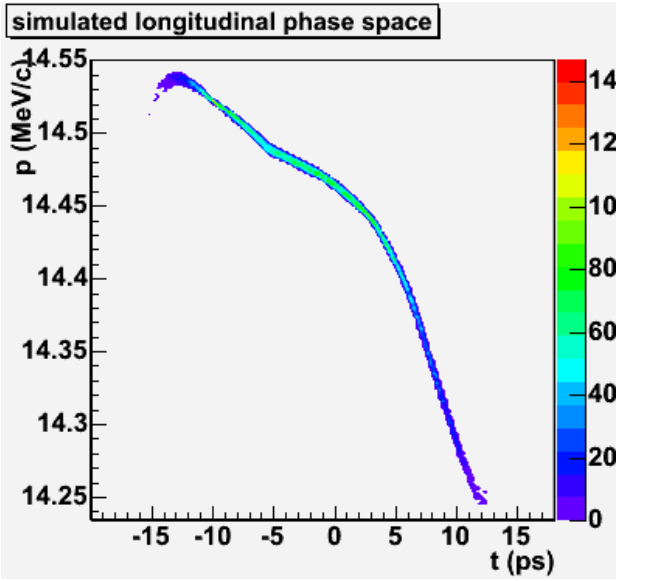
Longitudinal phase space at PITZ



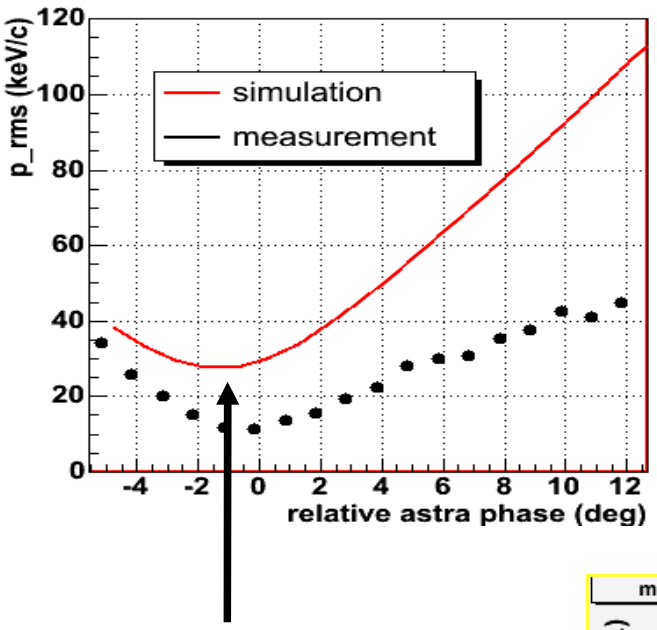


booster phase of max. momentum gain

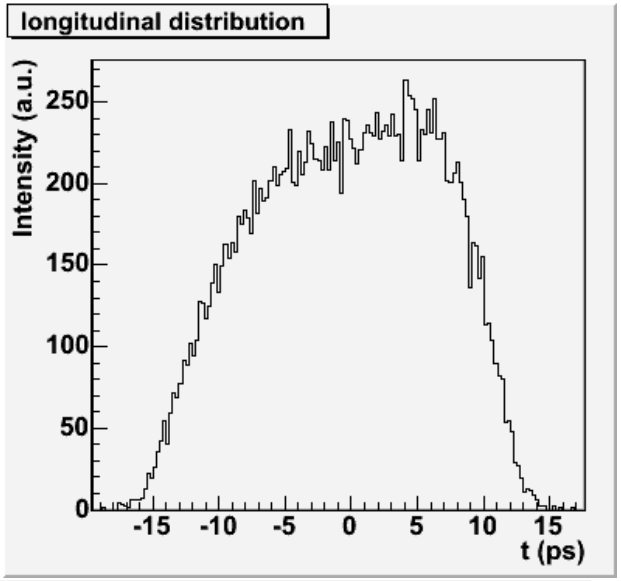


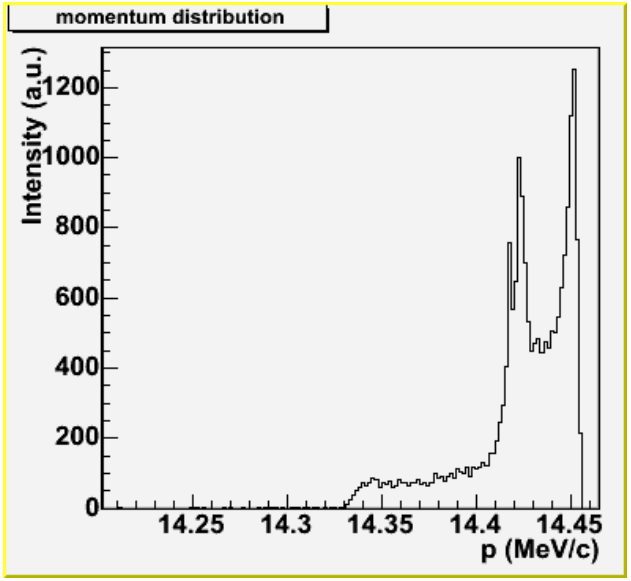


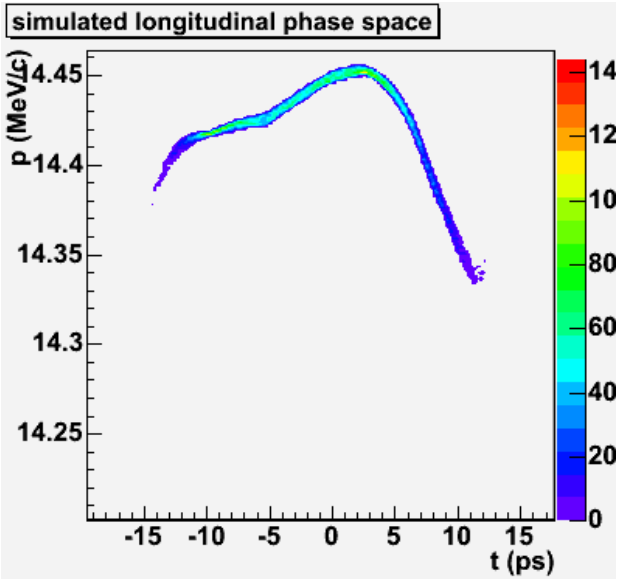
Longitudinal phase space at PITZ



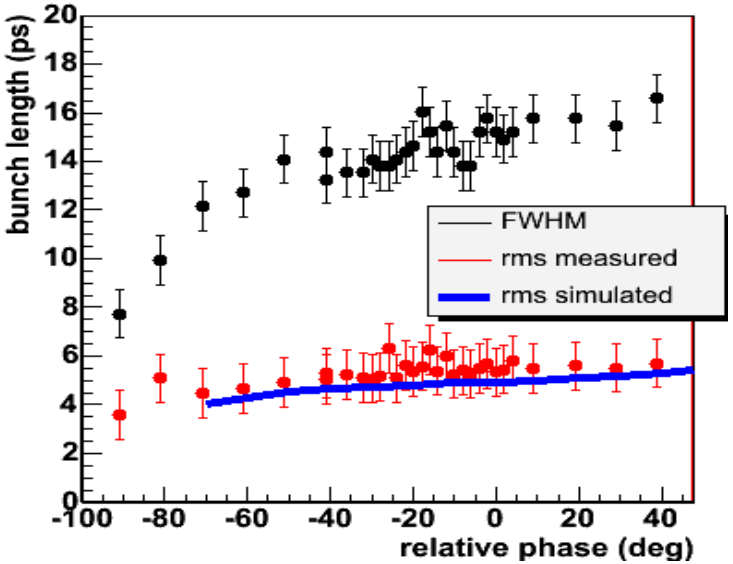
booster phase of min. momentum spread

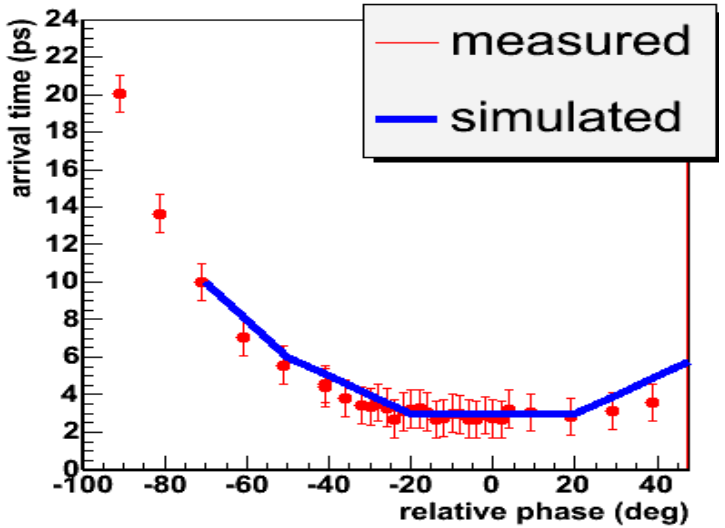






Longitudinal phase space at PITZ

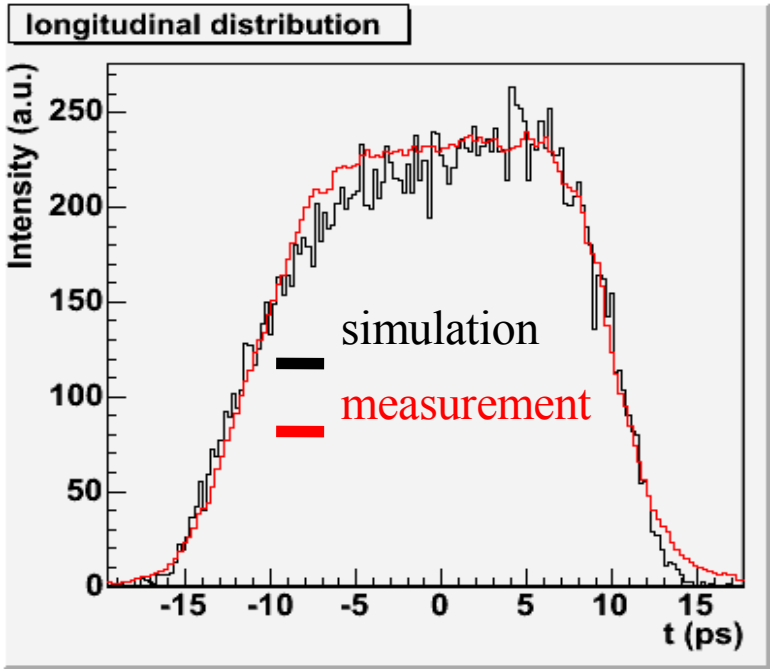




Bunch length and arrival time as a function of `the booster phase

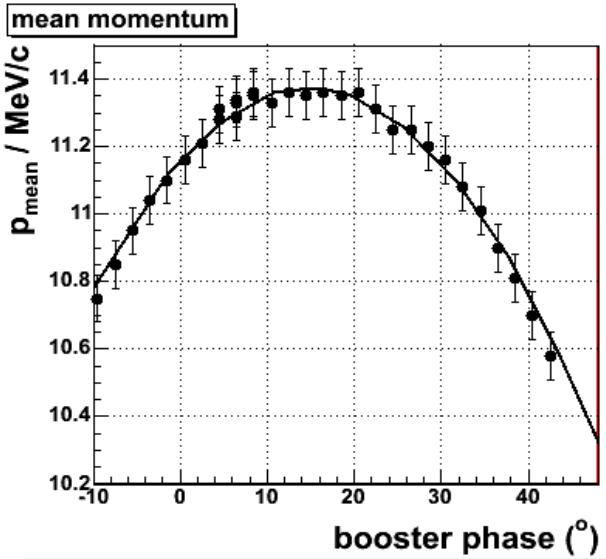
- 1 nC
- transv. laser diameter = 1.5mm
- Flat-top laser
- opt. gun phase

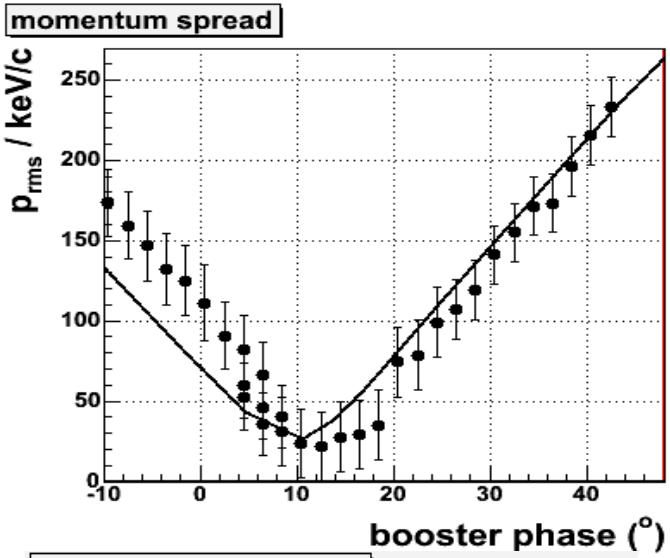
•Beam density distribution for: opt. booster phase

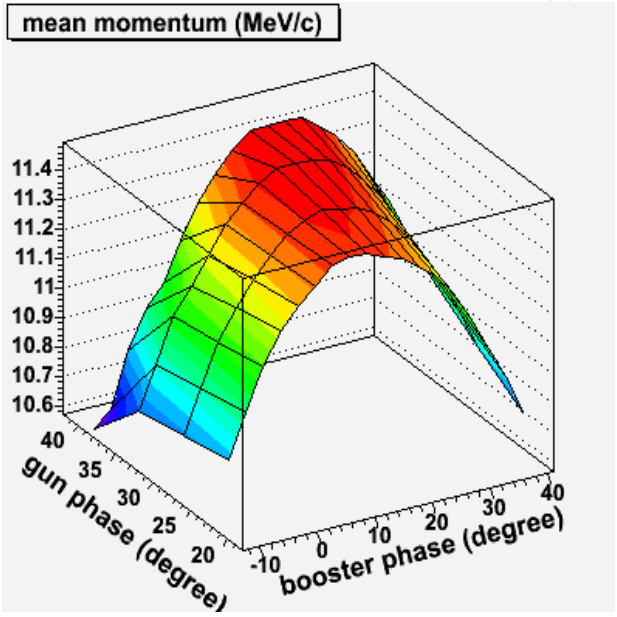


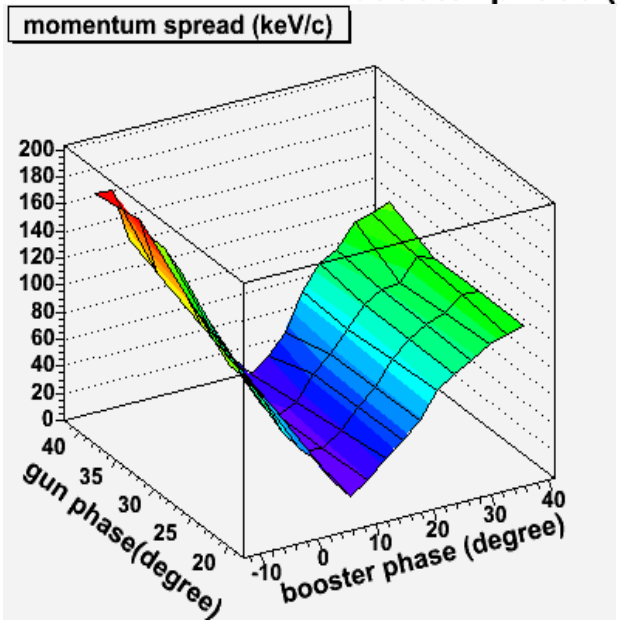
Measurements with previous Gun cavities

Longitudinal phase space at PITZ

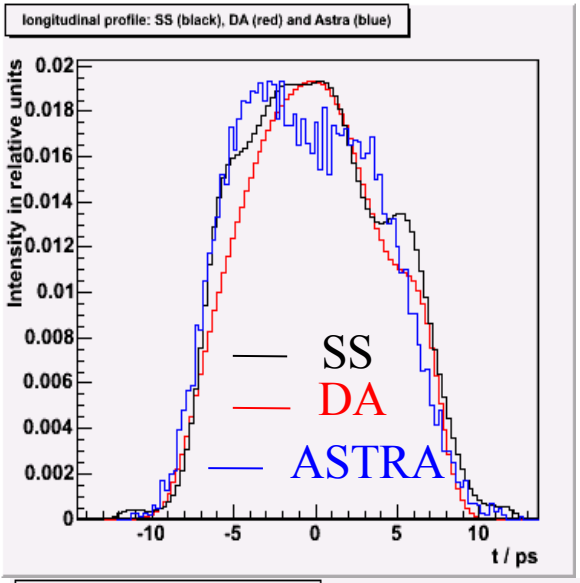




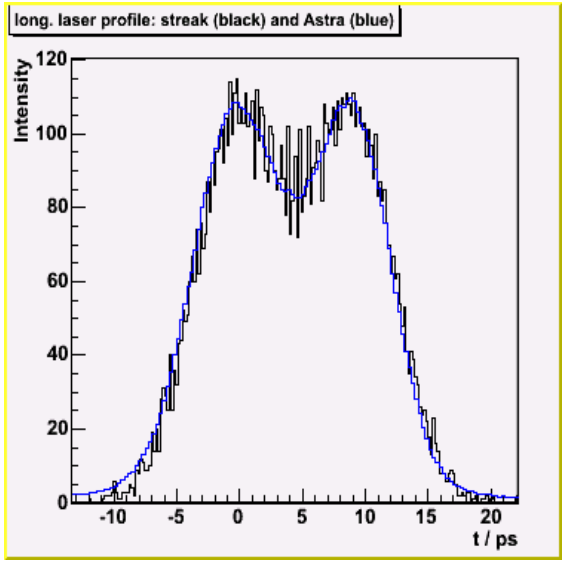


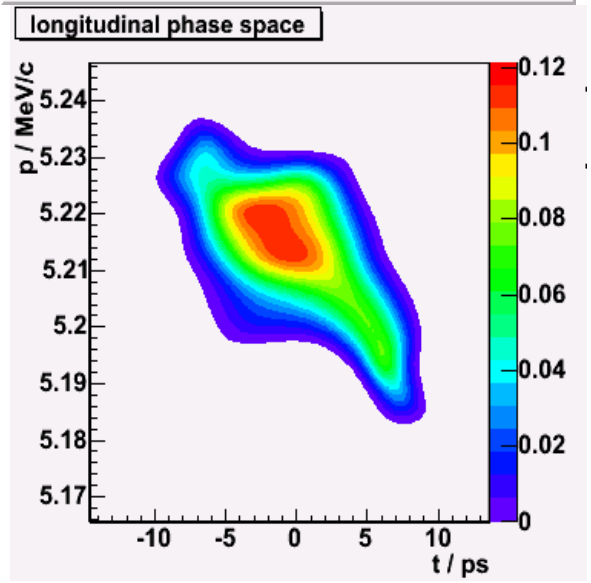


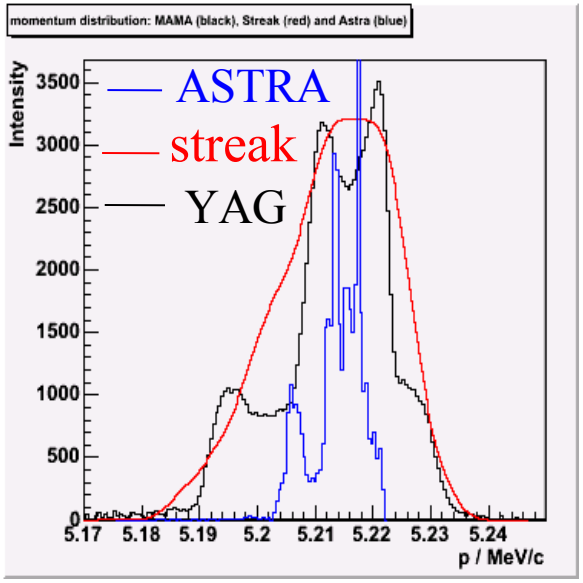
Longitudinal phase space at PITZ

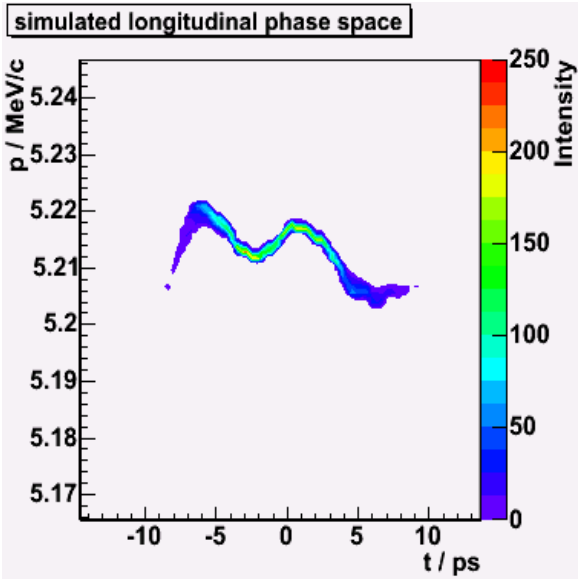


optimum phase,
30 pC,
flat-top laser
distribution



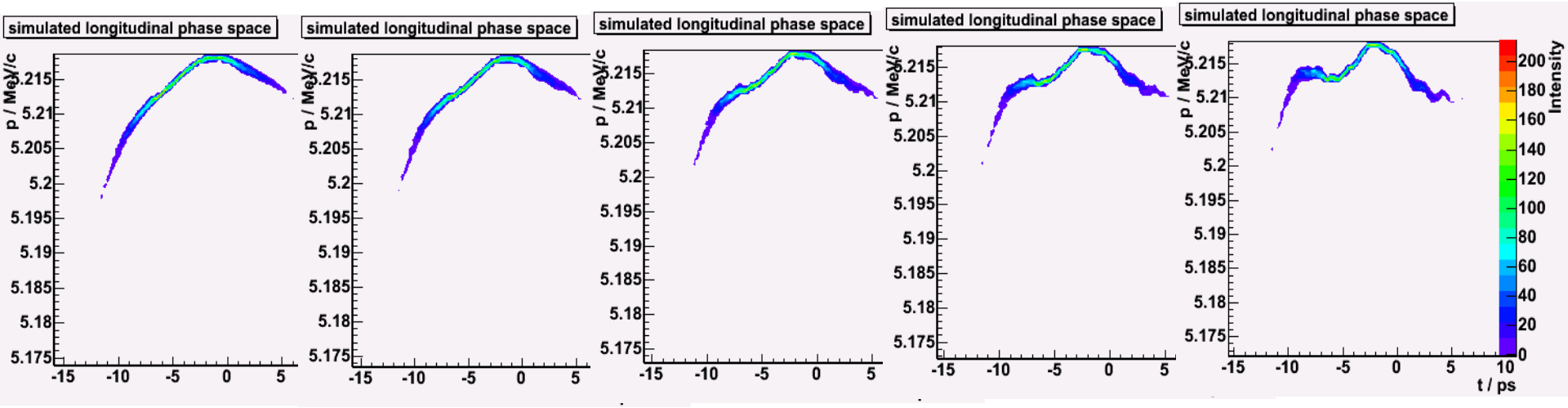




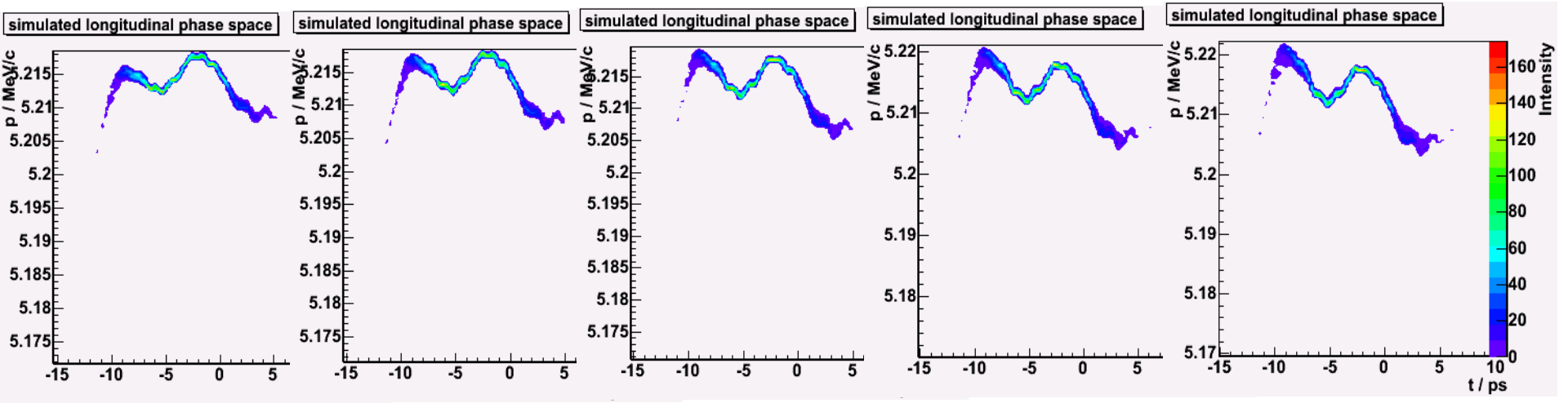


Longitudinal phase space at PITZ

optimum phase, 30 pC, flat-top laser distribution



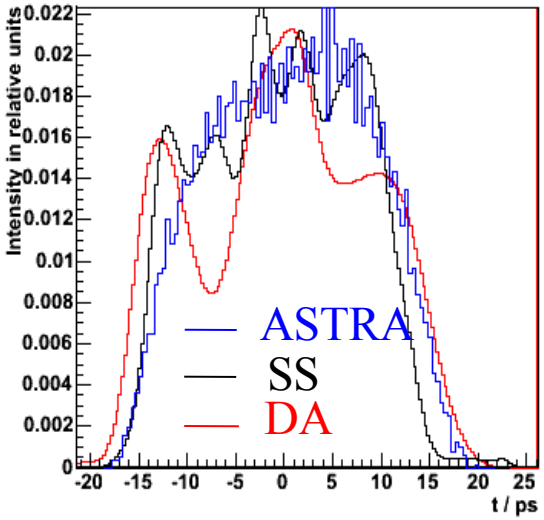
0.31 m 0.66m 1.01m 1.36m 1.71m



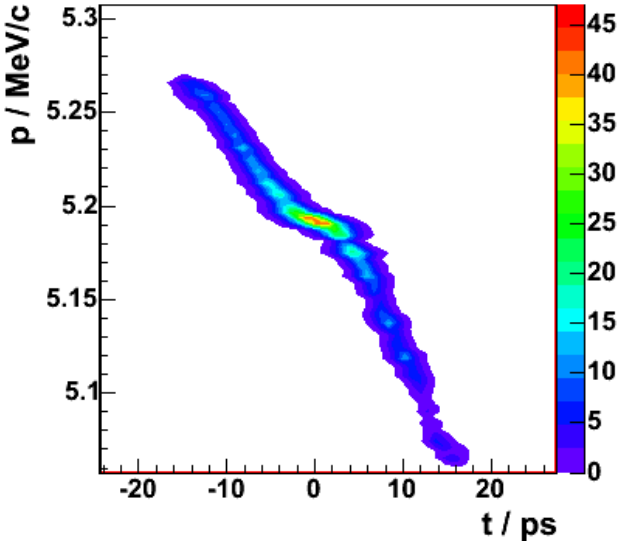
2.05 m 2.40m 2.75m 3.10m 3.45m

Longitudinal phase space at PITZ

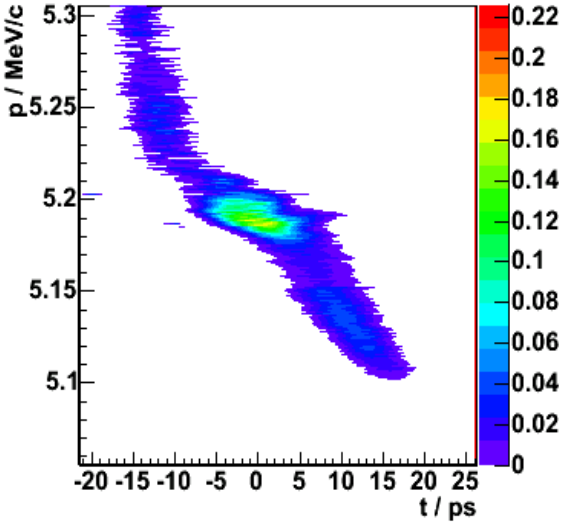
longitudinal distribution



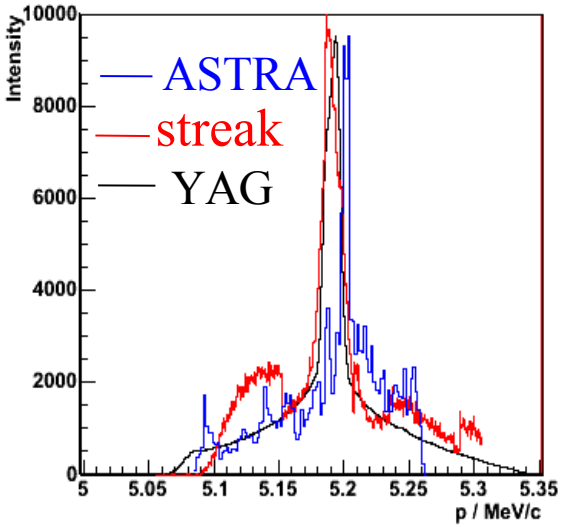
optimum phase,
1 nC,
flat-top laser
distribution



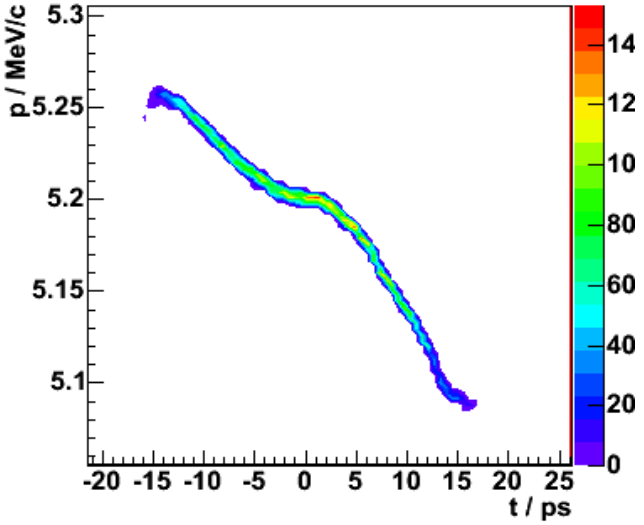
measured longitudinal phase space



momentum distribution

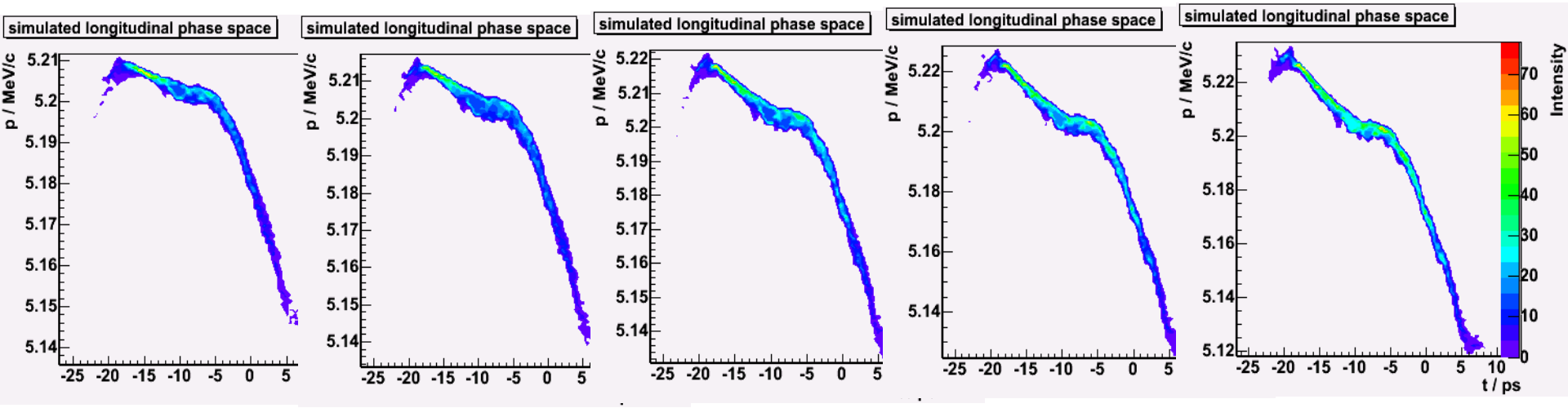


simulated longitudinal phase space

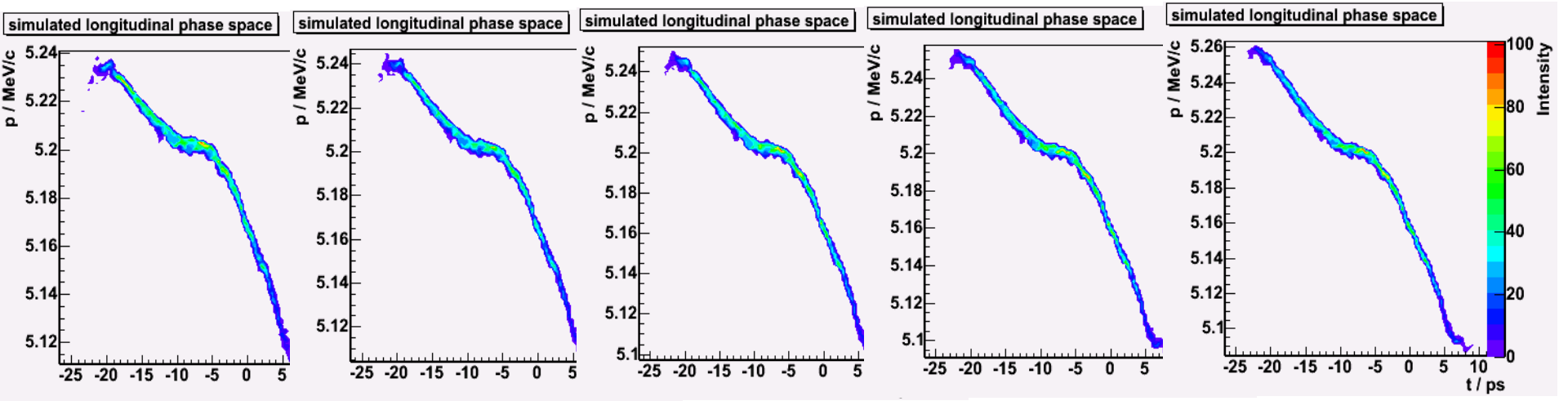


Longitudinal phase space at PITZ

optimum phase, 1 nC, flat-top laser distribution



0.31 m 0.66m 1.01m 1.36m 1.71m



2.05 m 2.40m 2.75m 3.10m 3.45m

Longitudinal phase space at PITZ

Summary

- It is of major interest to measure transverse and longitudinal properties of a bunch under the same conditions.
- Only a complete set of data allows an understanding of the beam dynamics.
- A good agreement between measurements and simulations could be archived for most of the measurements.
- But some measurements are dominated by systematic errors, which have to be analysed and reduced