RF-Gun Experience at PITZ - Longitudinal Phase Space

Collaboration meeting

9th of October 2006

Hamburg University

Juliane Rönsch

RF-Gun Experience at PITZ
Longitudinal Phase Space

Motivation

- special device to measure the longitudinal phase space at low momentum
- typical high energy diagnostics can not be used
- analysis of non-linearities of the longitudinal phase space
- prepare the beam an optimum compression in the bunch compressor

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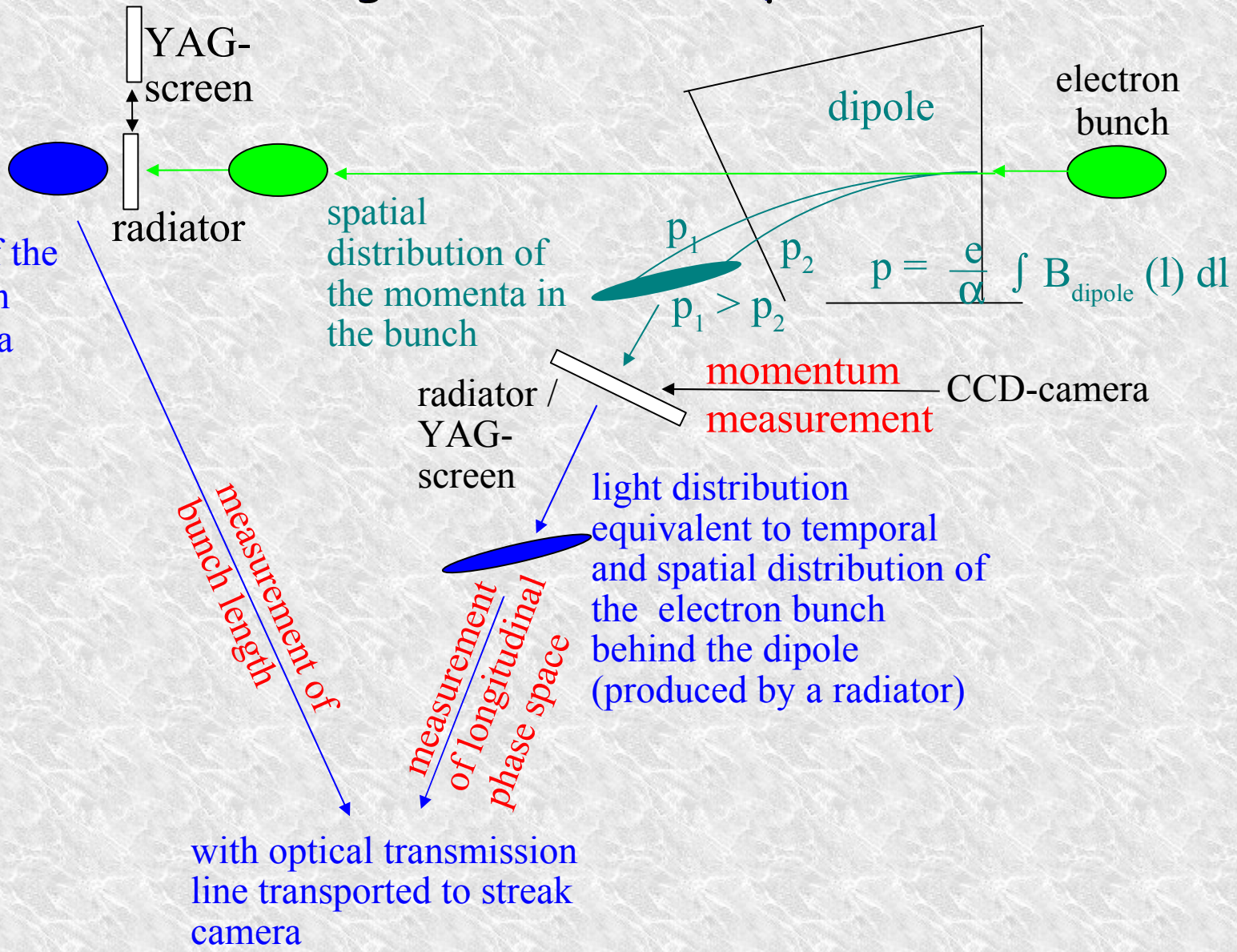
Longitudinal Phase Space



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Longitudinal Phase Space

requirements:

- high number of photons -> to make a streak measurement possible
- good temporal resolution
- small emission angle -> in order to match in the following optical system
  -> to avoid total reflection in the radiator

→ **Aerogel is made from Silicon Dioxide, the same material as ordinary Glass, only 1000 times less dense.**

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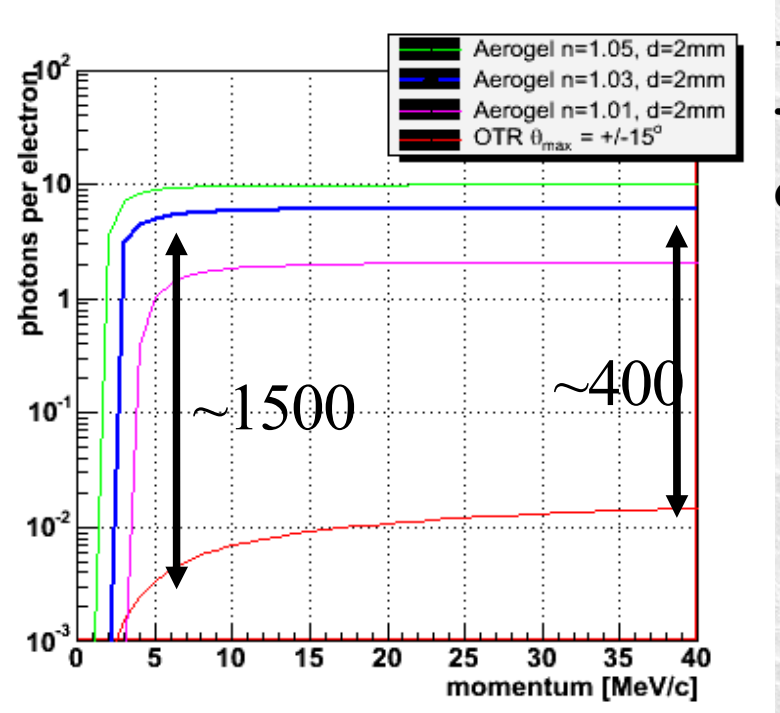

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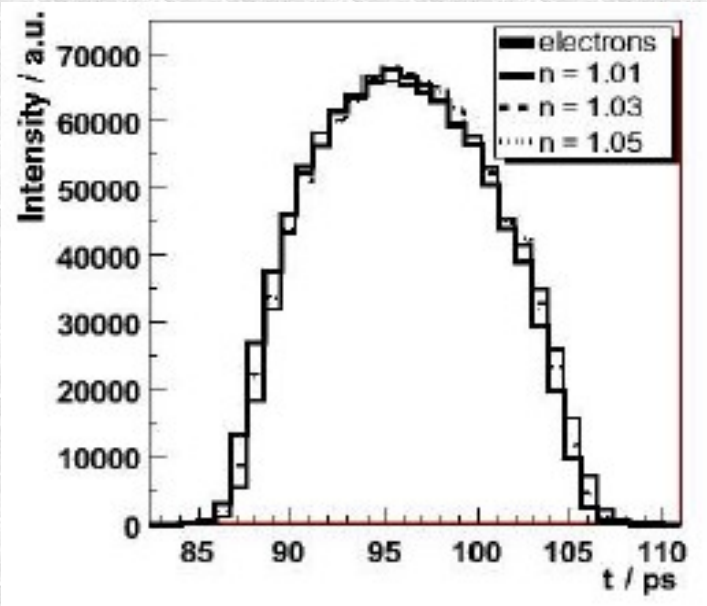

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n	l / mm	σt / ps
1,01	20	0,51
1,03	2	0,12
1,05	1	0,11

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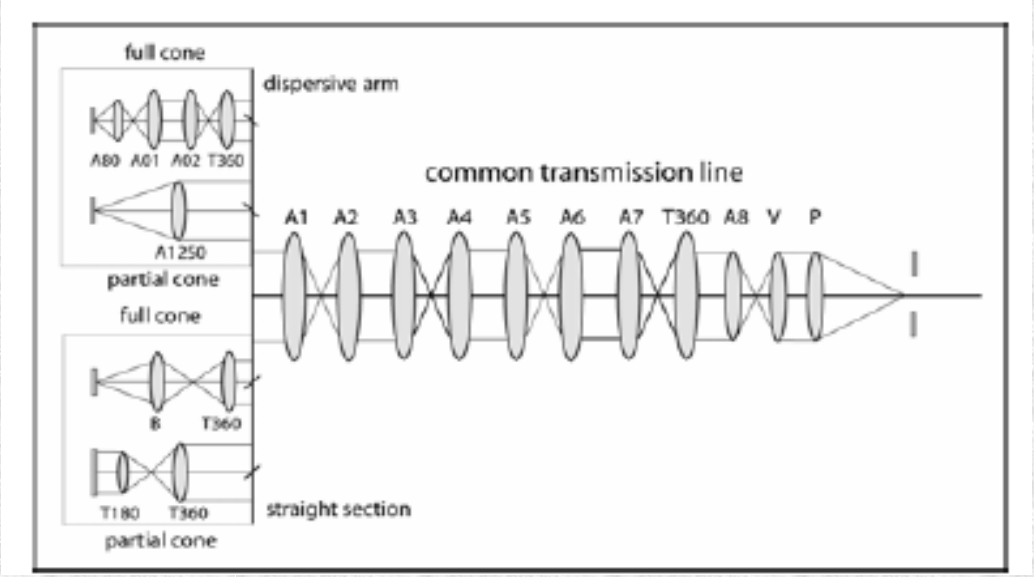
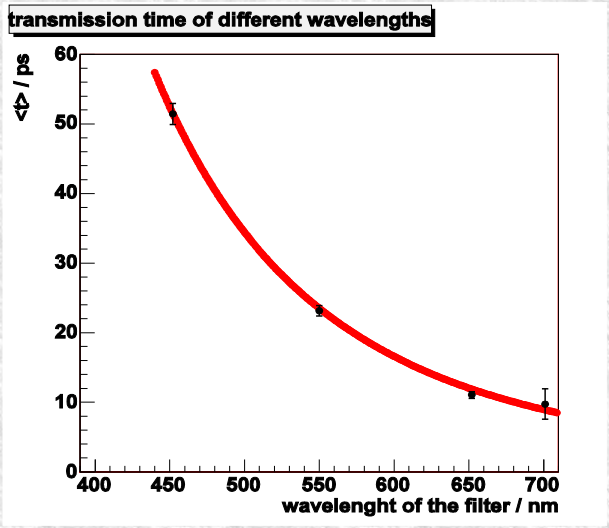
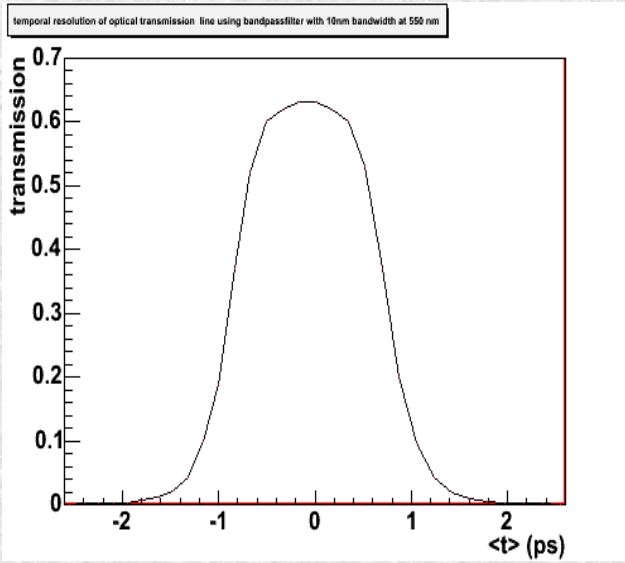
optical transmission line





-> use of a filter (550nm, 10nm bandwidth) necessary



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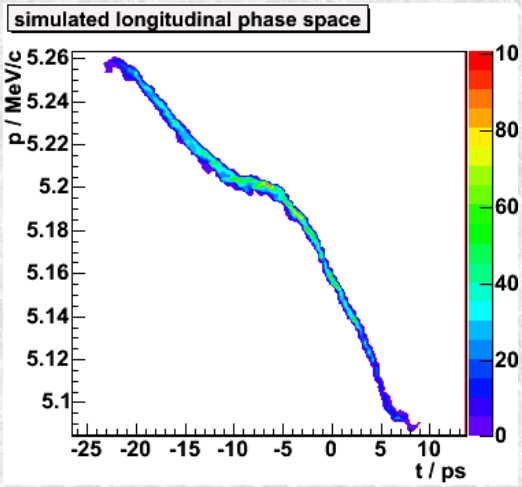
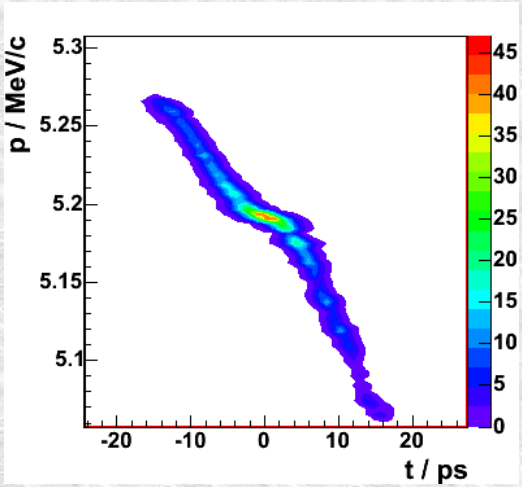
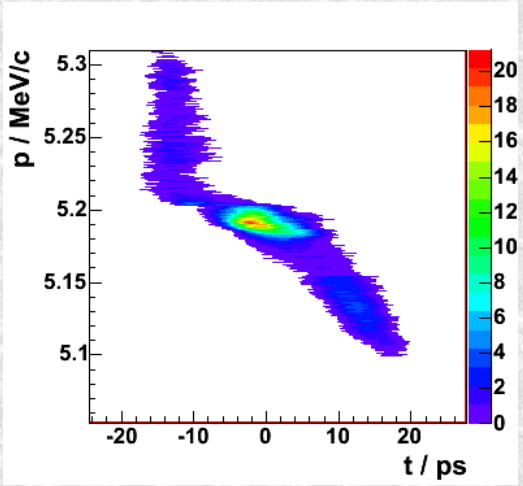
Longitudinal phase space measurements results for flat-top laser distribution (FWHM about 20 ps, rising time about 7ps), a charge of 1 nC and the launch phase with the highest momentum gain



Simulated longitudinal phase space



Simulated longitudinal phase space convoluted with the temporal resolution function of the streak camera



Measured longitudinal phase space

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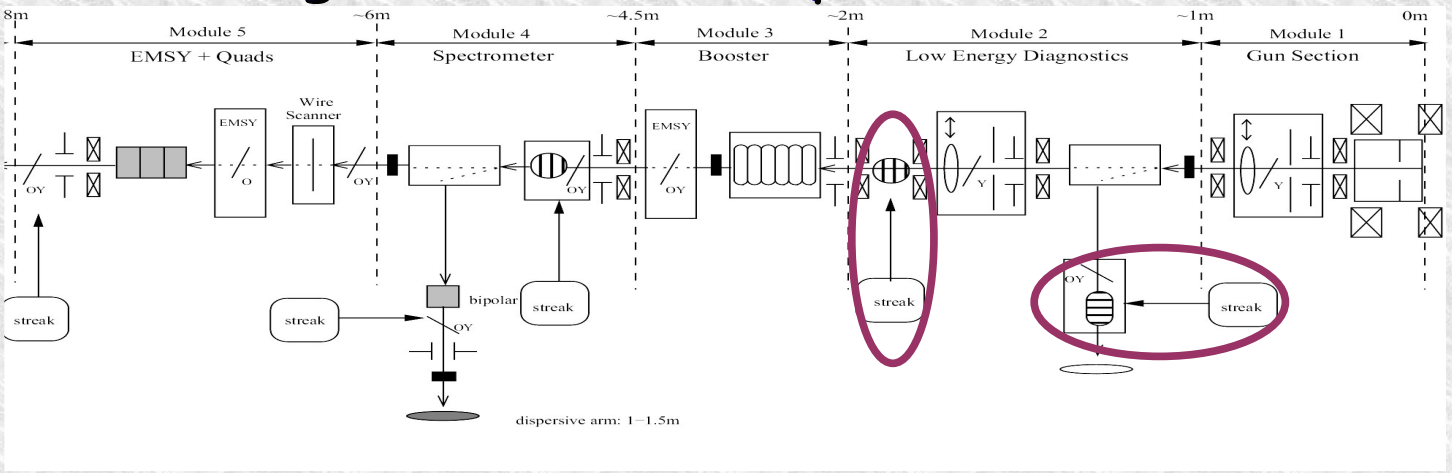
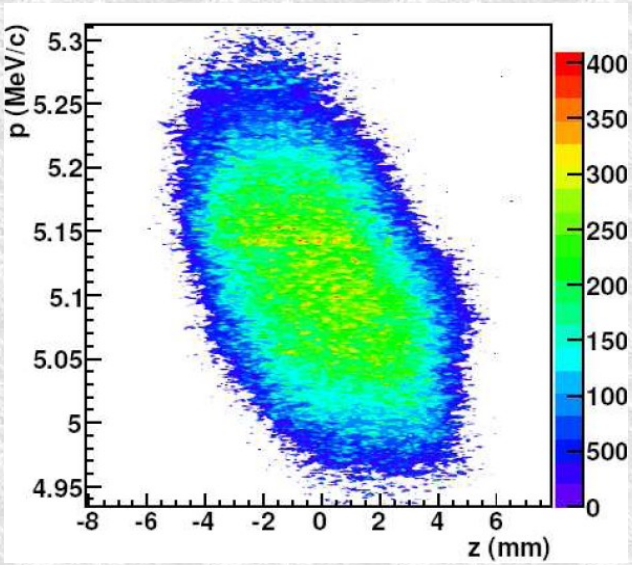
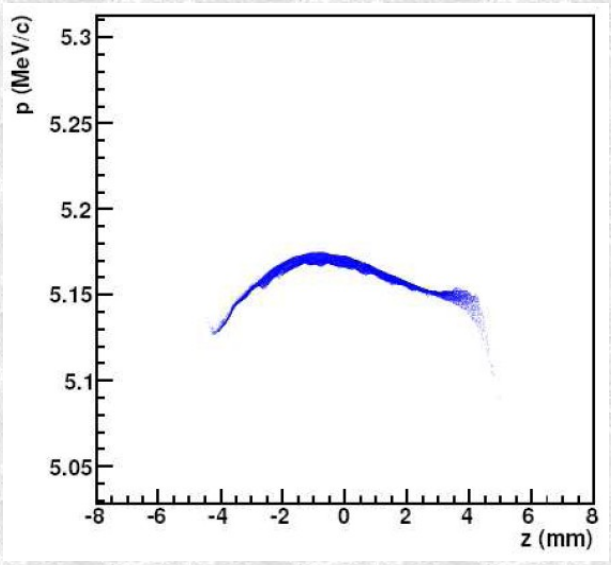
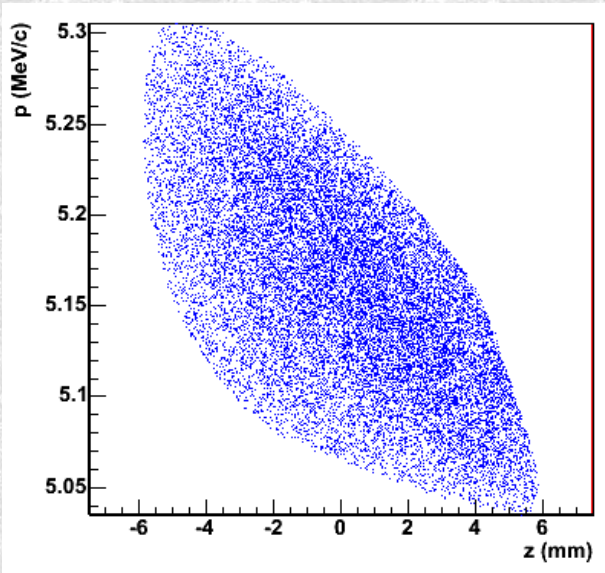
Measurement of longitudinal phase space and it projections after the gun









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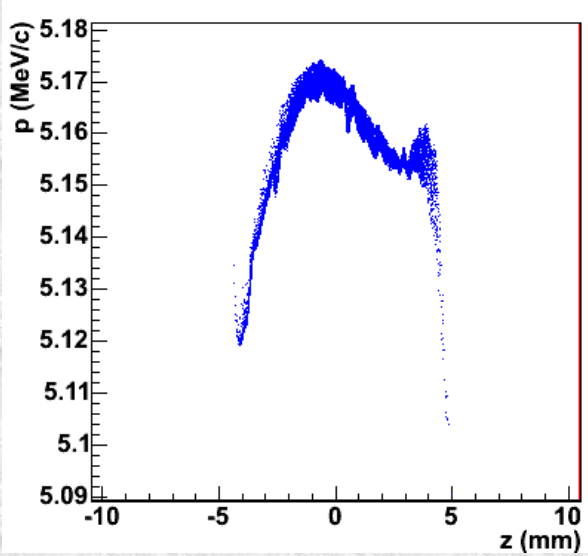
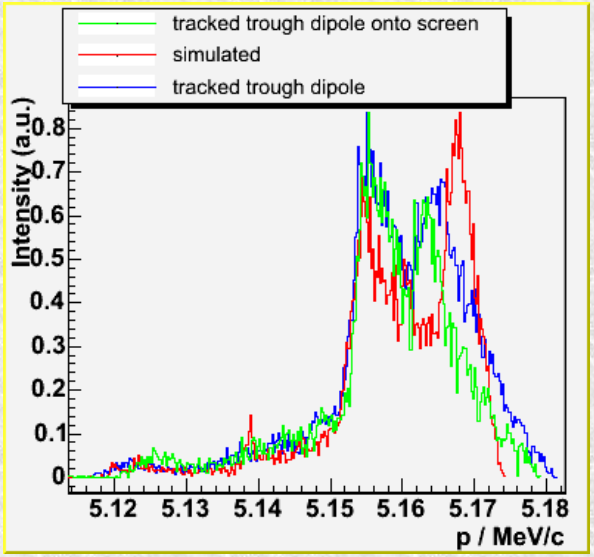
Measurement of mean momentum and momentum spread after the gun





Simulation parameters:

B_{max} (Sol) = 0.2128 T

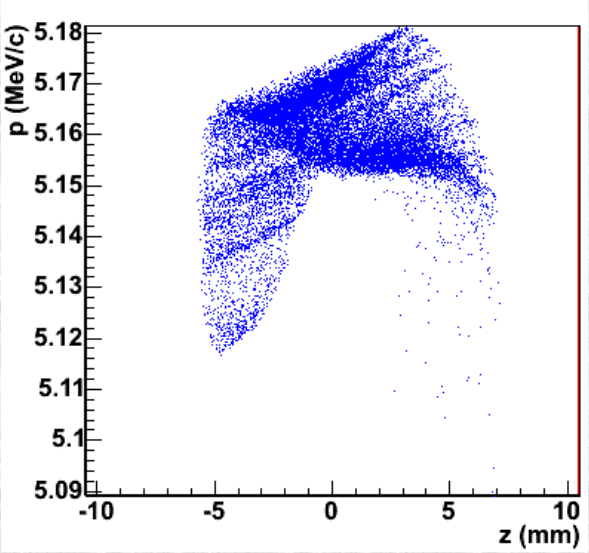
≈ 365 A

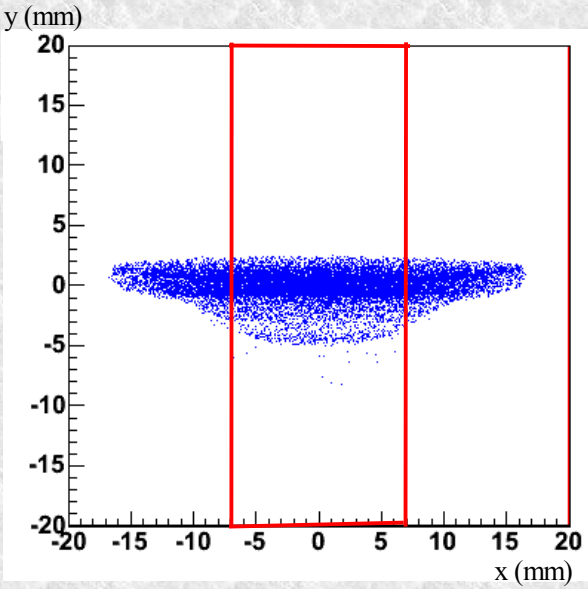
transv. laser size: 0.55mm

MaxE = 45.05 MV/m

ϕ = -10°

Fieldbalance = 1.06





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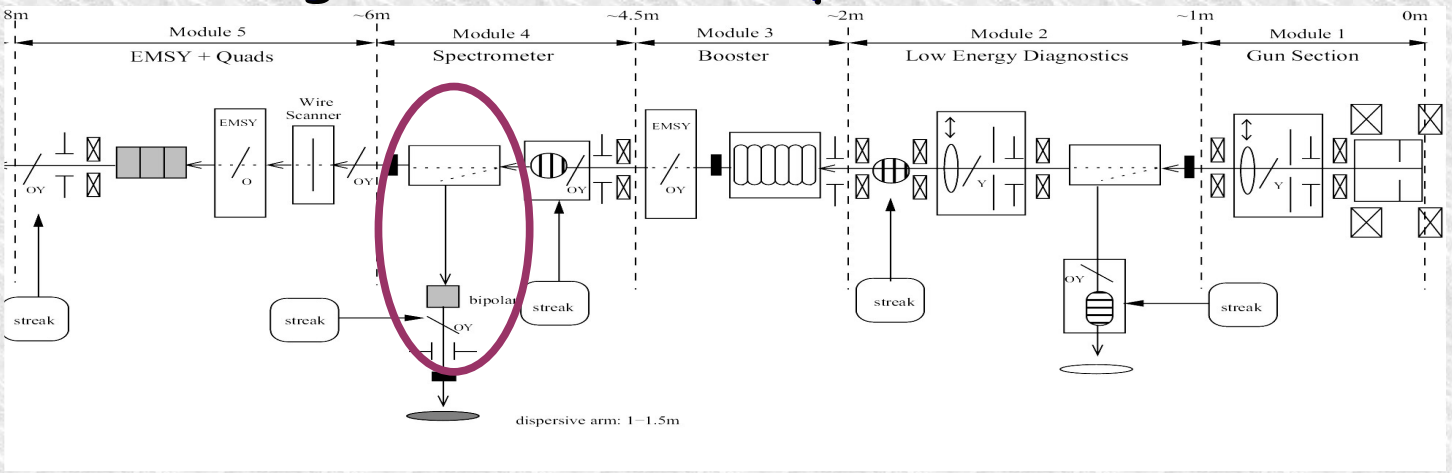
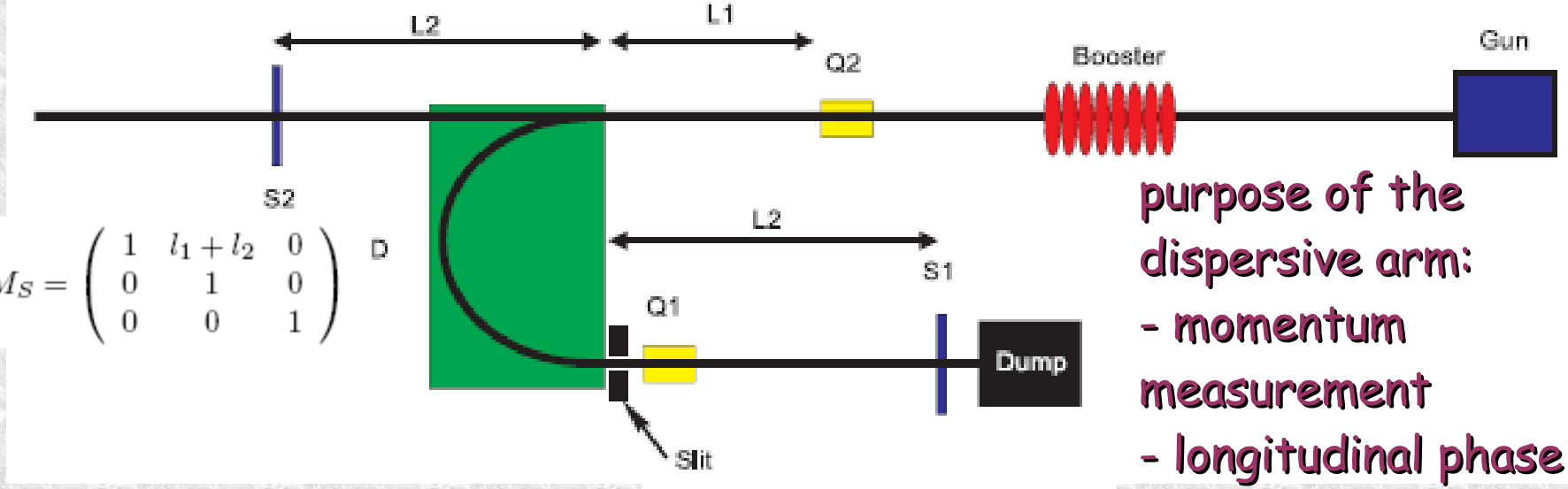
Solution for the "high energy" dispersive arm (HEDA)
5 - 40 MeV/c





$$M_S = \begin{pmatrix} 1 & l_1 + l_2 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$M_D = \begin{pmatrix} -1 & -l_1 - l_2 & 2\rho \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

purpose of the dispersive arm:
- momentum measurement
- longitudinal phase space
- slice emittance

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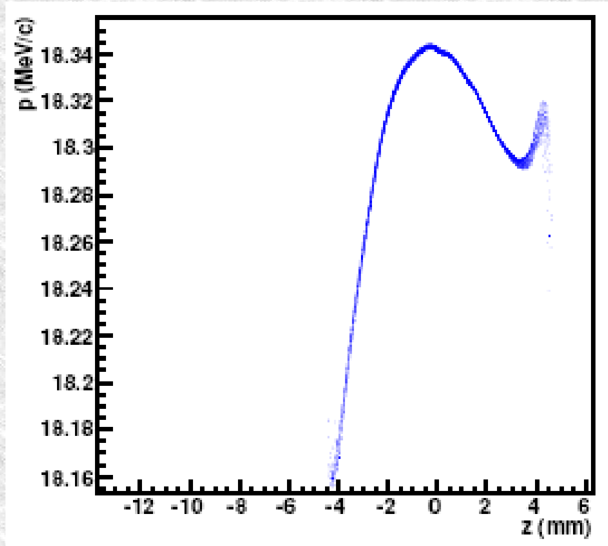
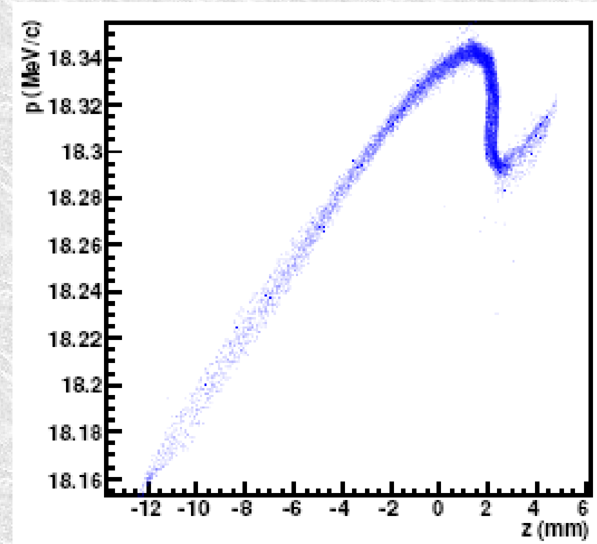
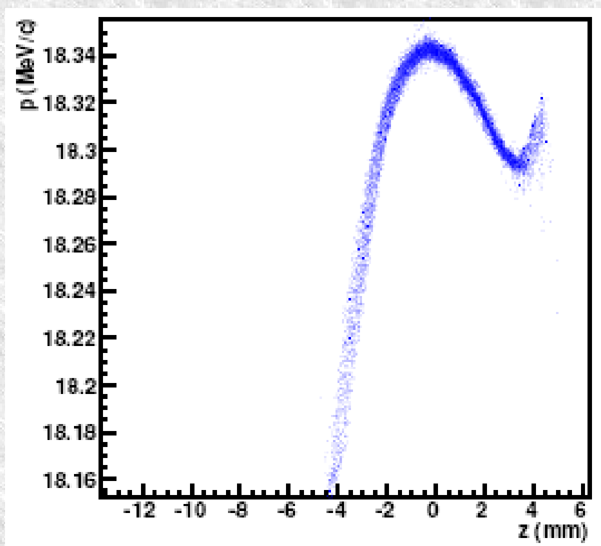
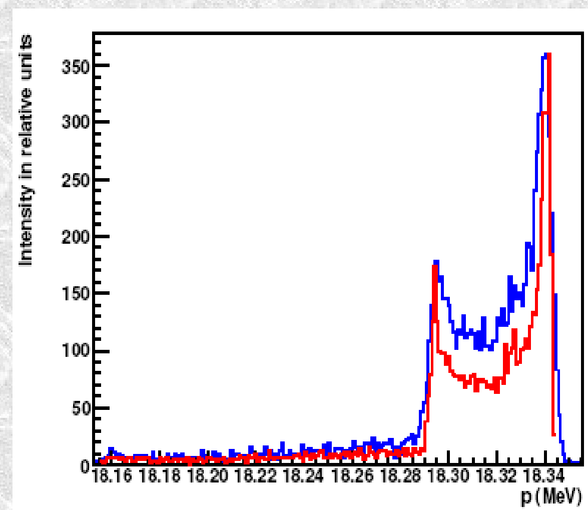
Solution for the "high energy" dispersive arm (HEDA) 5 – 40 MeV/c









Summary & outlook

- Longitudinal phase space was measured after the gun, system upgrades are ongoing in order to improve the resolution.
- Screen station for bunch length measurement after the booster will be installed in the next weeks.
- Measurements of the longitudinal phase space after the booster cavity the the 180° bend are planed for next year.

Thanks