

Experiments with an Electric Deflector

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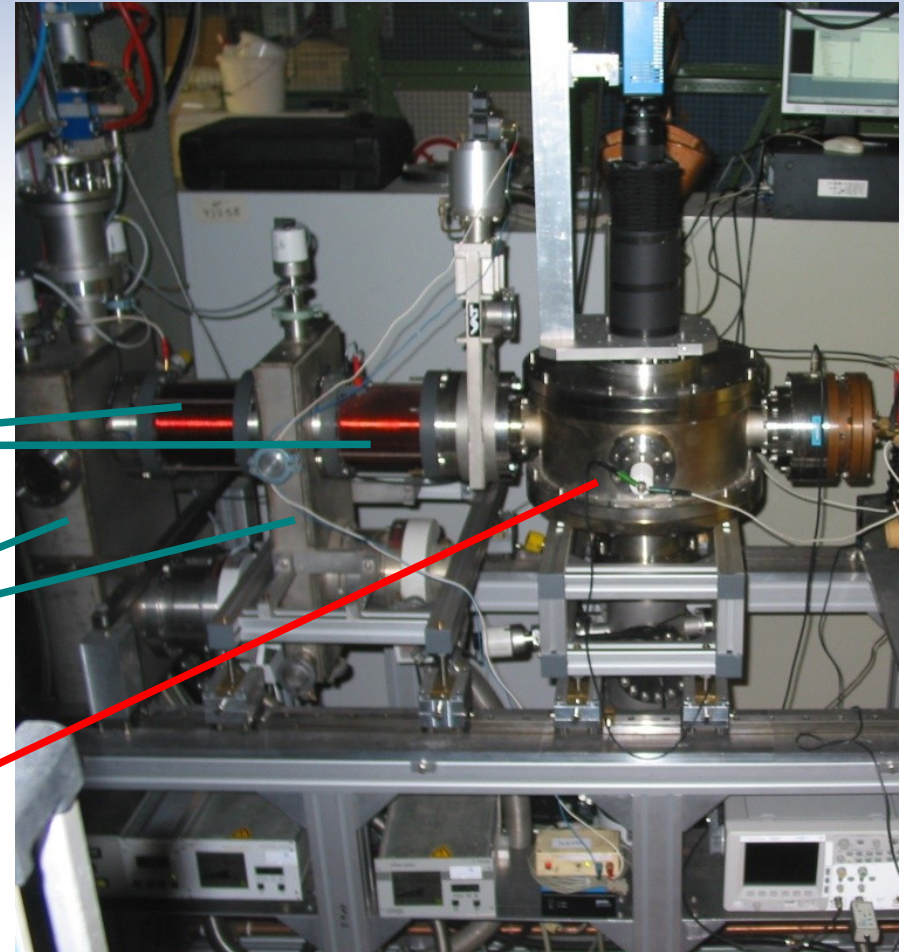
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 - Static (Voltage / Angle Dependence)
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Motivation

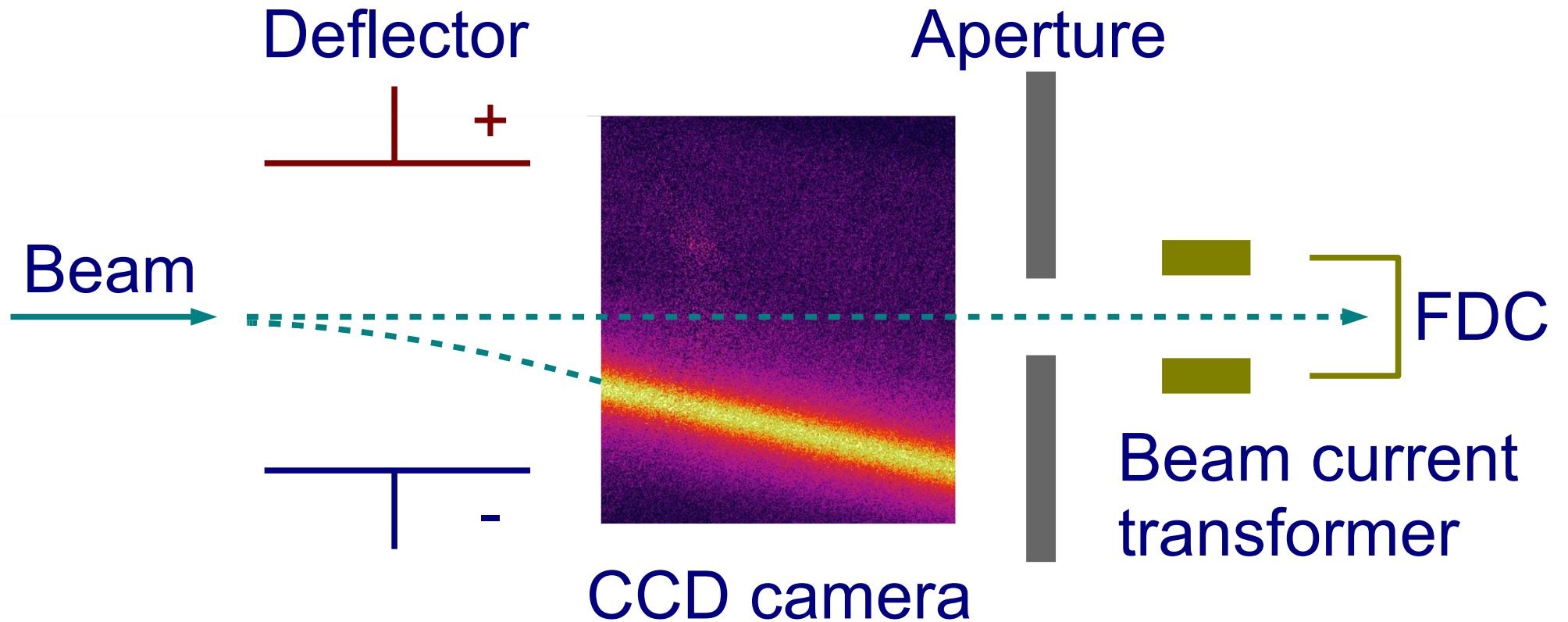
- Test stand for deflection system
- FRANZ Chopper parameters
 - Electric field: 11 kV with 3 cm gap → 300 kV/m
 - Pulse repetition rate: 250 kHz (4 μ s period)
 - Pulse width: ~ 600 ns with 100 ns flat top
- Similar application: F8SR (ExB Kicker)
 - Electric field: MV/m
 - Pulses: μ s

Test Stand Layout

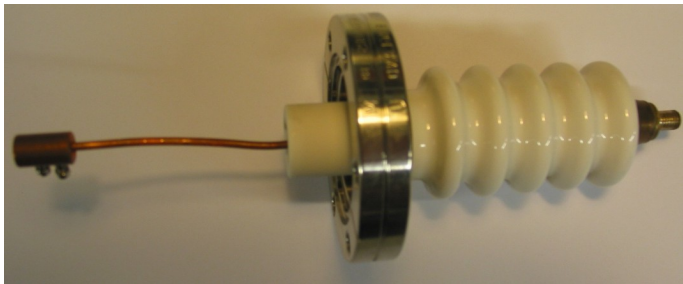
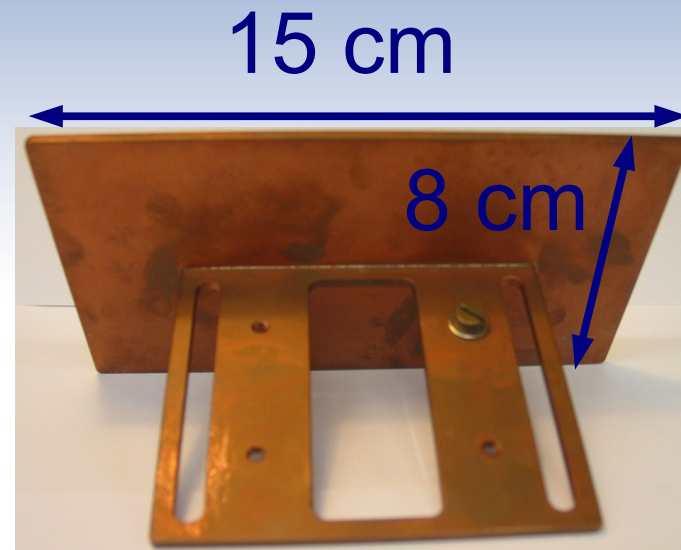
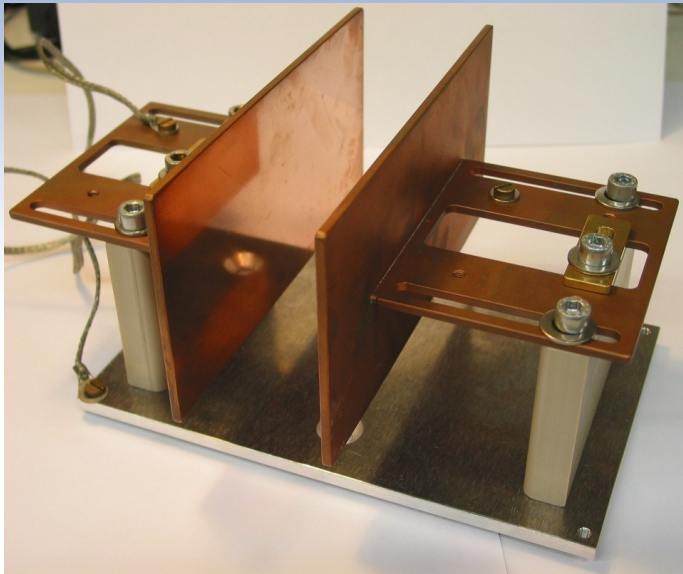
- Volume ion source
 - Pentode extraction
 - 65 keV, 8.5 mA (He)
- Beam forming
 - Gabor Lenses
- Diagnostics and pumping
- Deflection tank



Experimental Setup

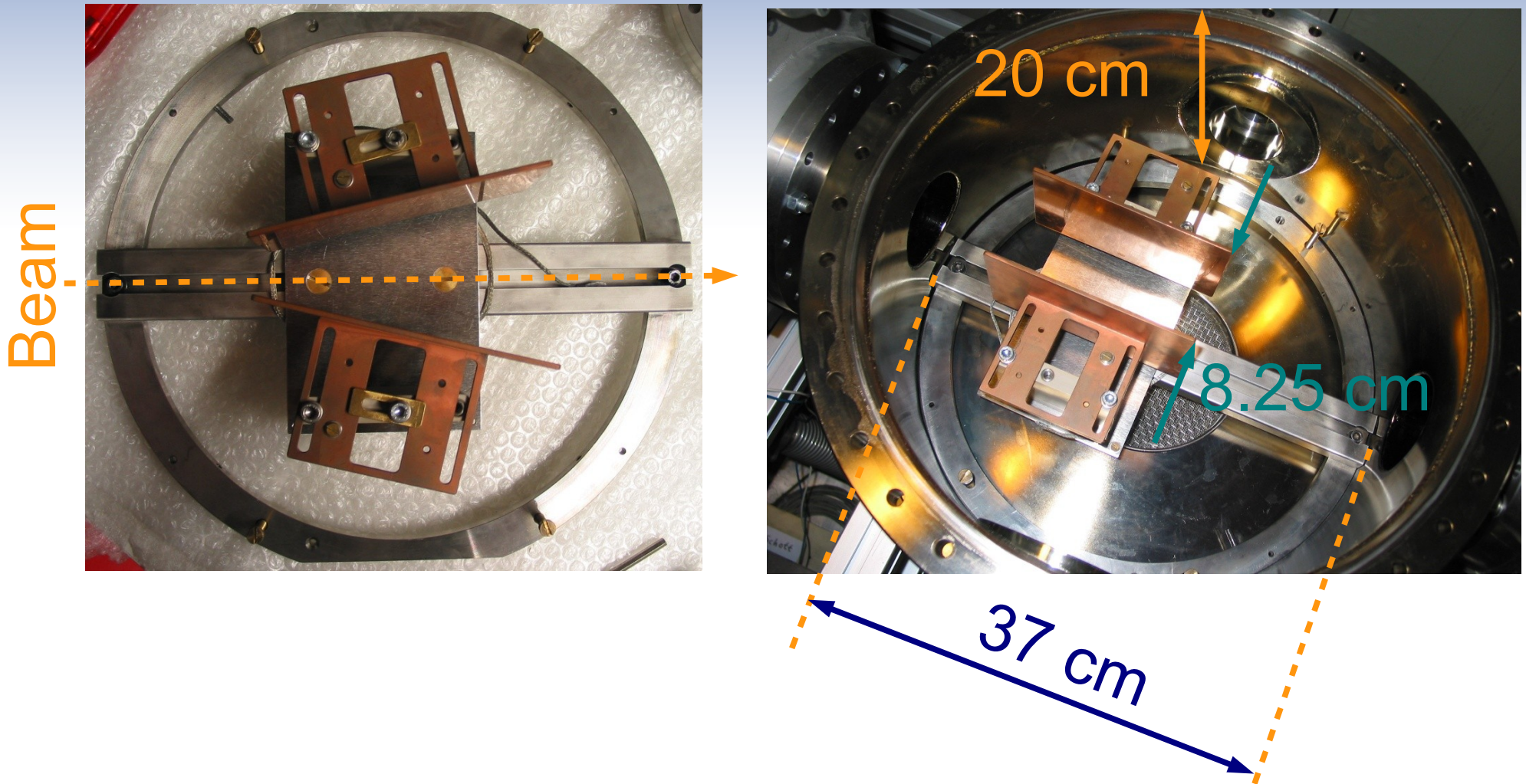


Deflection Plates

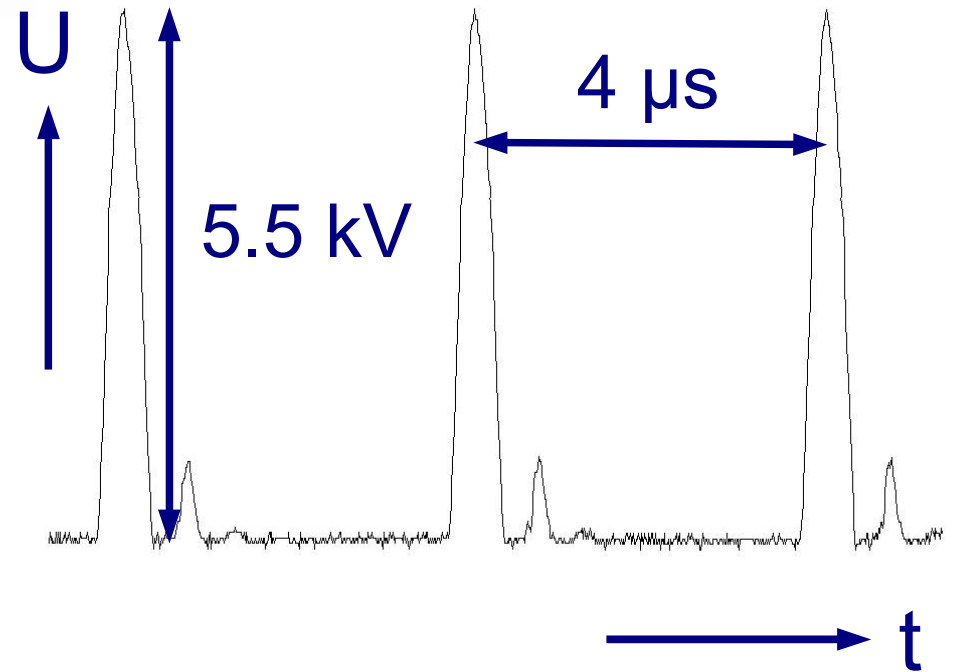
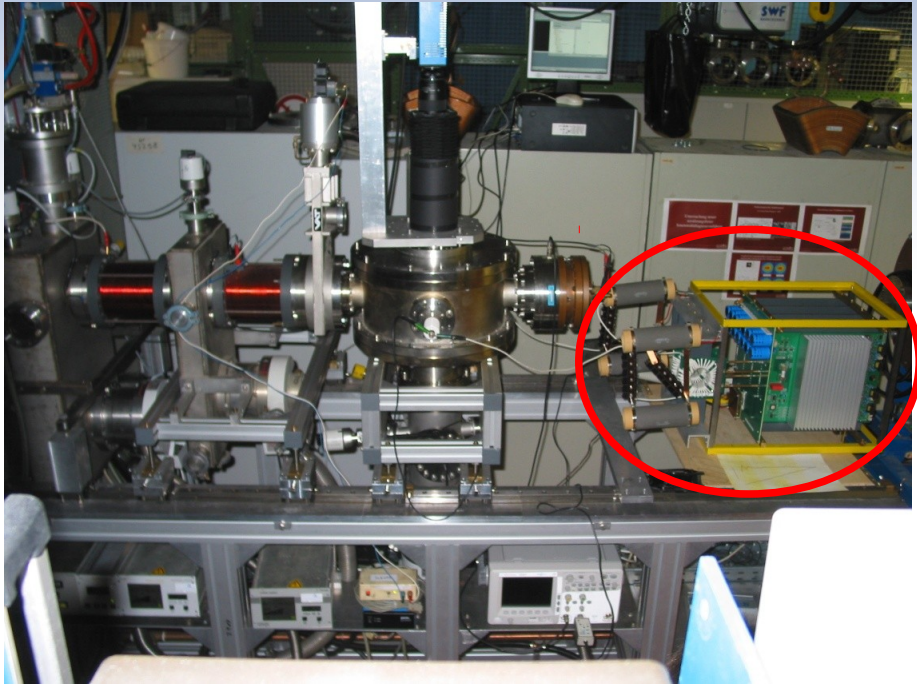


- Voltage (static) up to 25 kV
- HF limitations from vacuum feedthroughs?

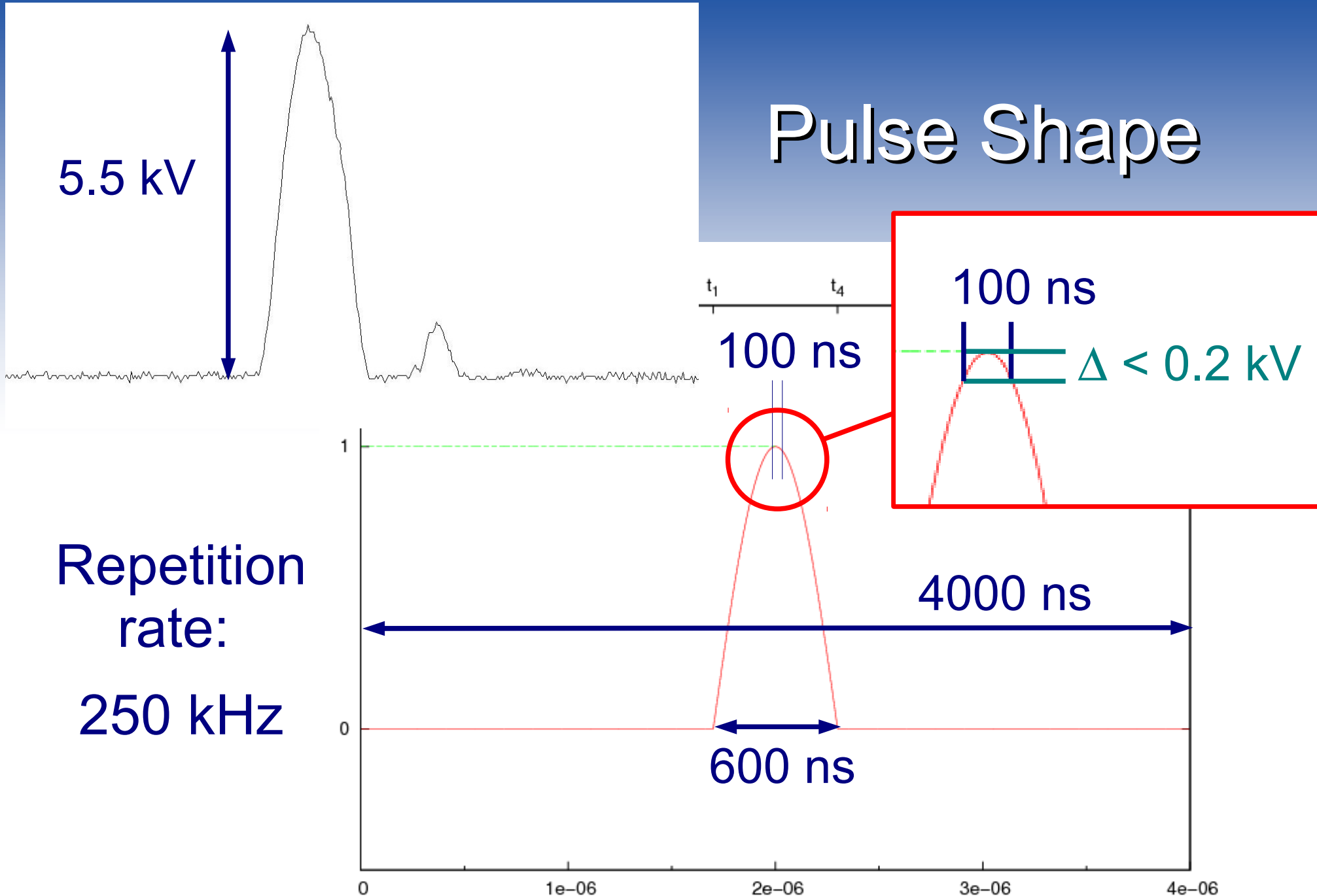
Deflection Tank



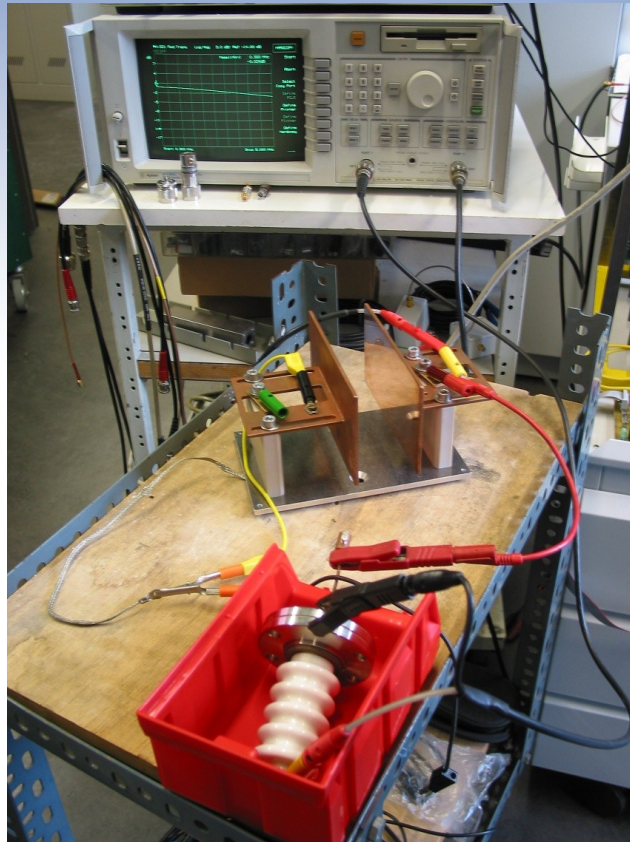
Pulse Generator



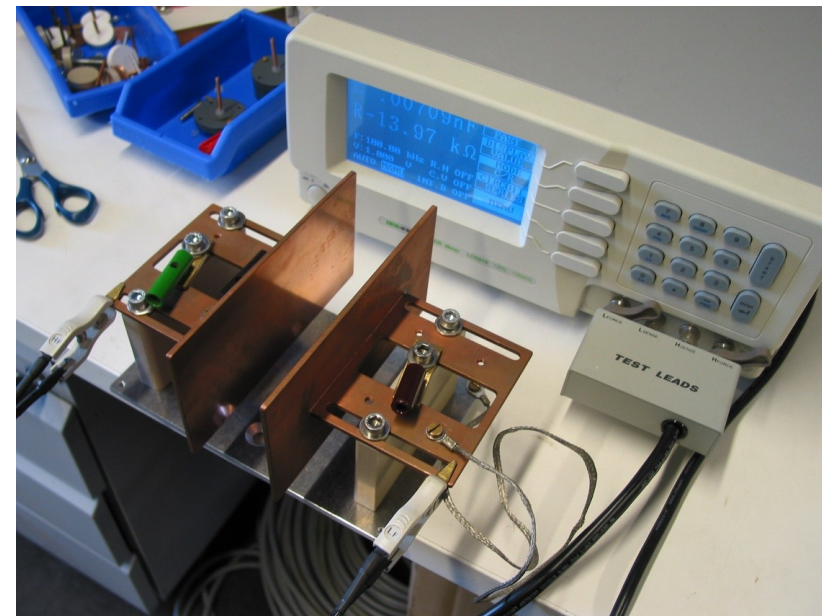
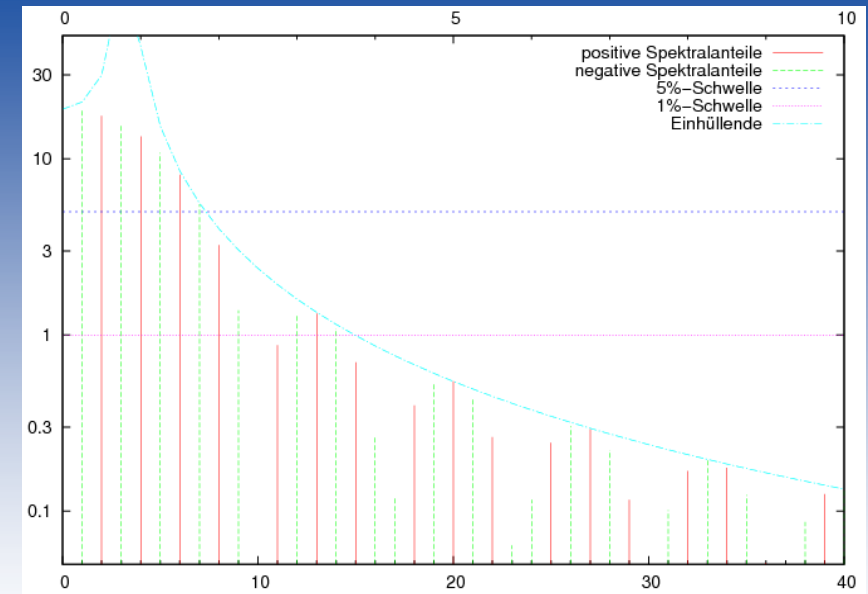
Pulse Shape



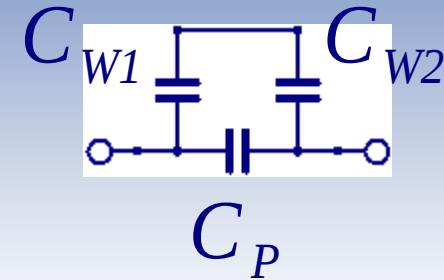
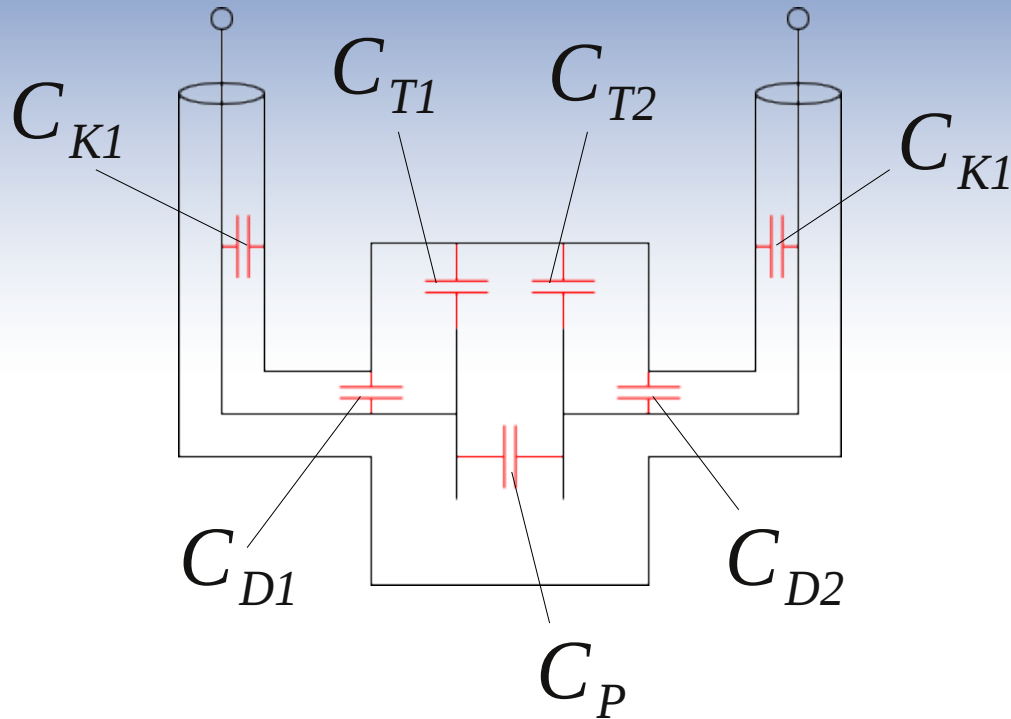
Pulse Spectrum



HF measurement
of complete system



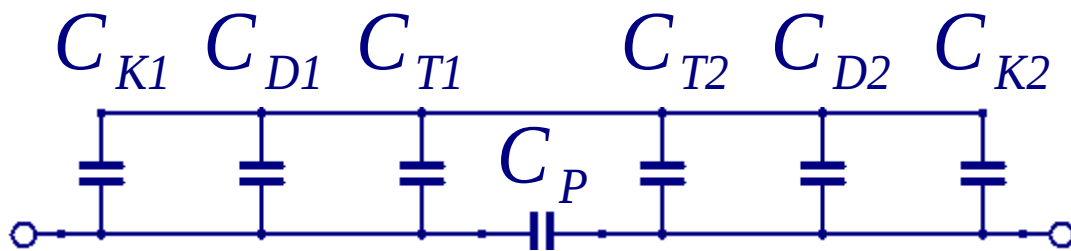
Capacitances (Model)



$$C_{ges} = C_P + \frac{1}{\frac{1}{C_{W1}} + \frac{1}{C_{W2}}}$$

with $C_{W1} = C_{W2}$

$$C_{ges} = \frac{1}{2} C_W + C_P$$

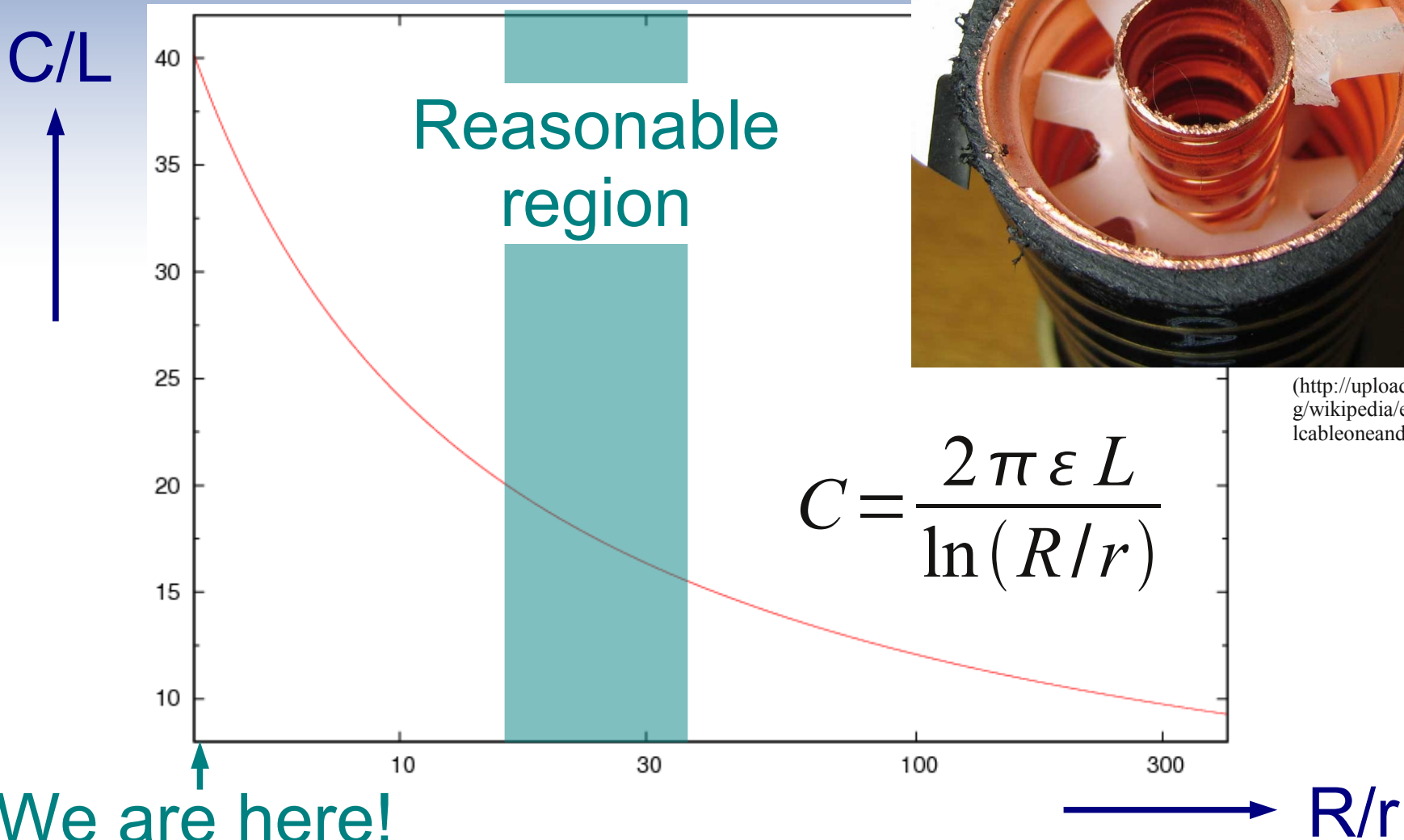
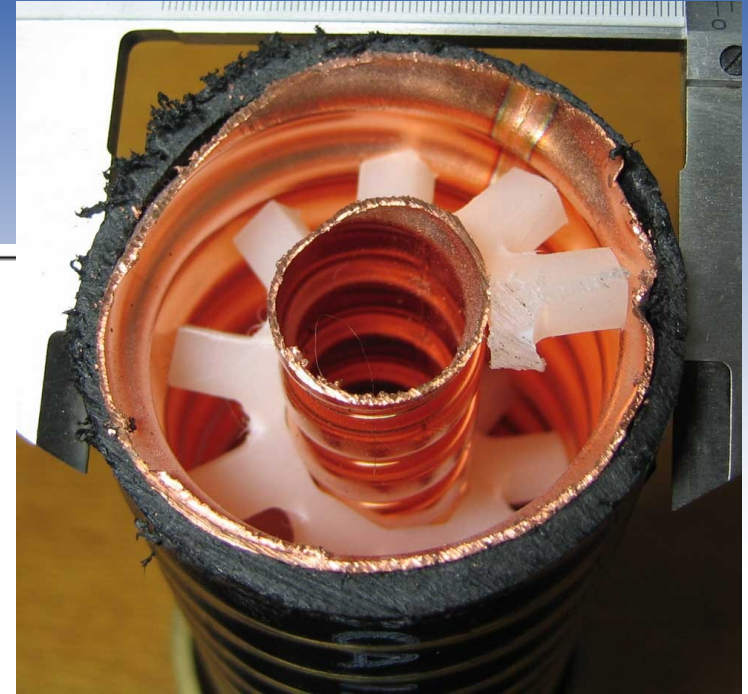


Comparison of Capacitances

	Analytical	Simulation*	Measurement
C_K	(40 pF)	(40 pF)	40 pF
C_D	2 pF	(2 pF)	3 pF
C_T	3.7 pF	3 pF	4 pF
C_P	1.3 pF	2 pF	1 pF
C_W	45.7 pF	45 pF	47 pF
C_{ges}	24.2 pF	24.5 pF	24.5 pF

*Simulations done with CST EM Studio

Cable Capacitance



(<http://upload.wikimedia.org/wikipedia/en/c/cb/Coaxialcableoneandfifthofan.jpg>)

Beam Diagnostics

CCD camera

Beam shutter

Deflection plates

Pressure control

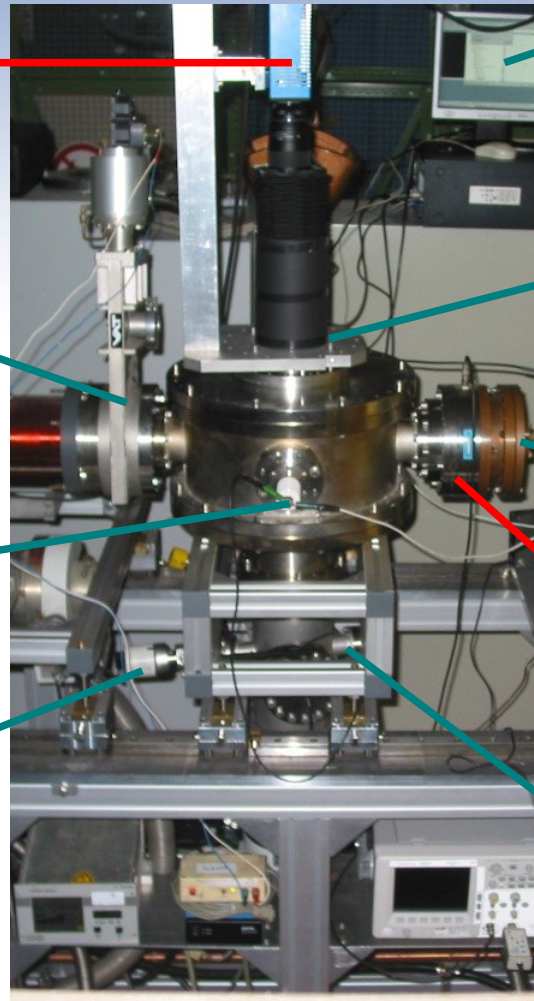
Camera control and readout

Optical spectrometer

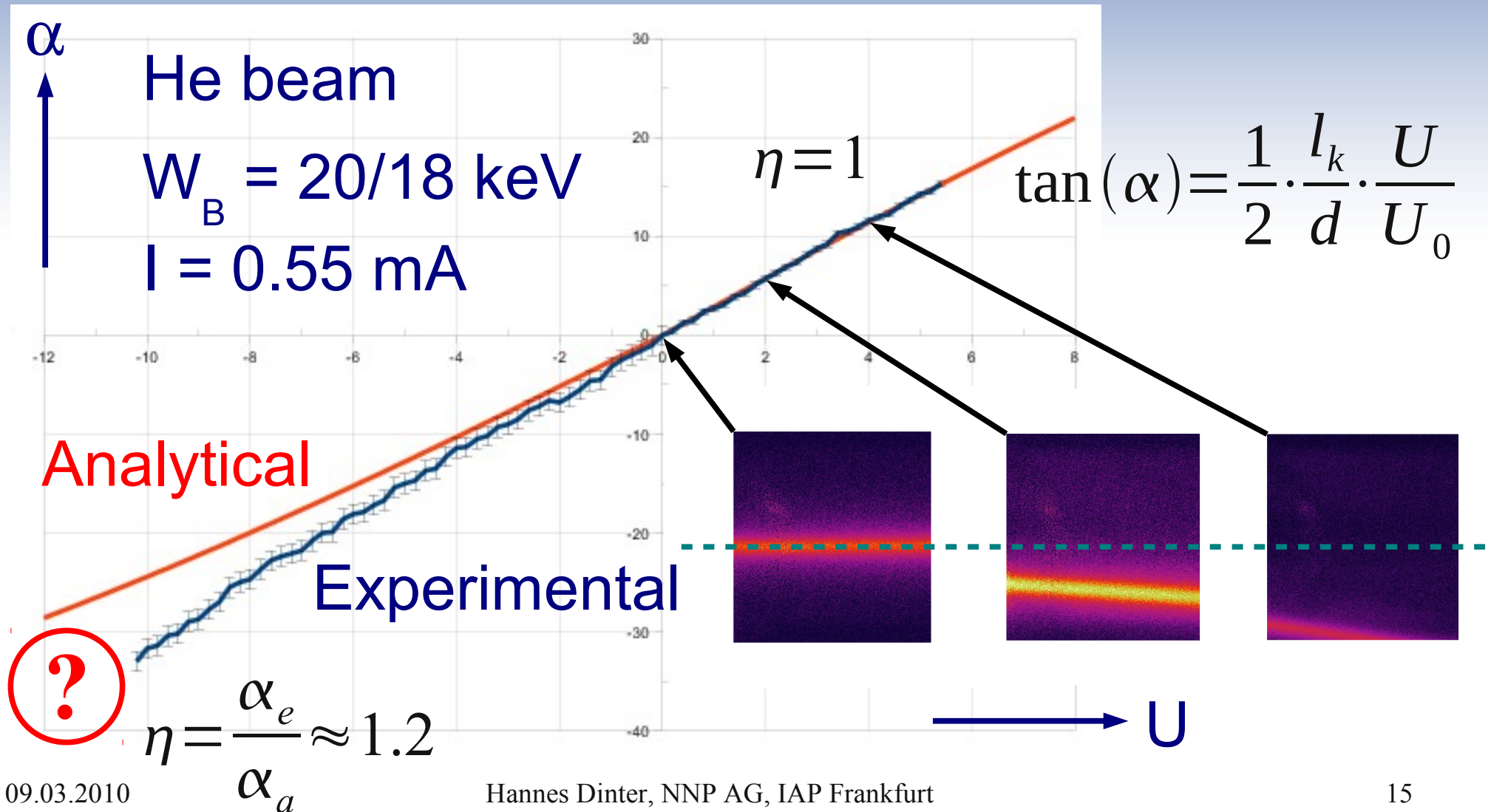
Beam dump

Beam current transformer

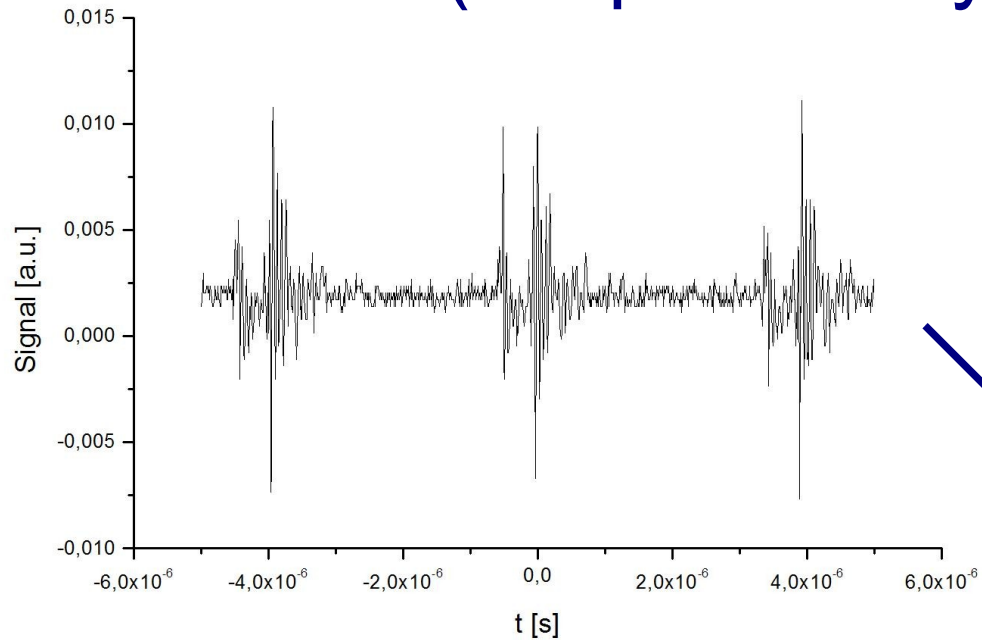
Mass spectrometer



Voltage / Angle Dependence

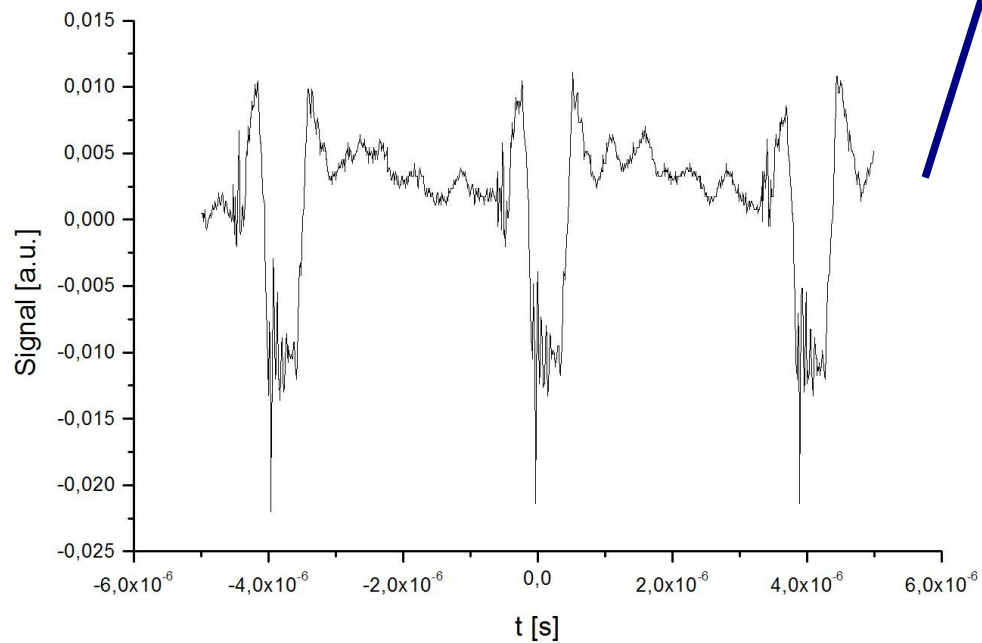


No beam (HF pulse only)

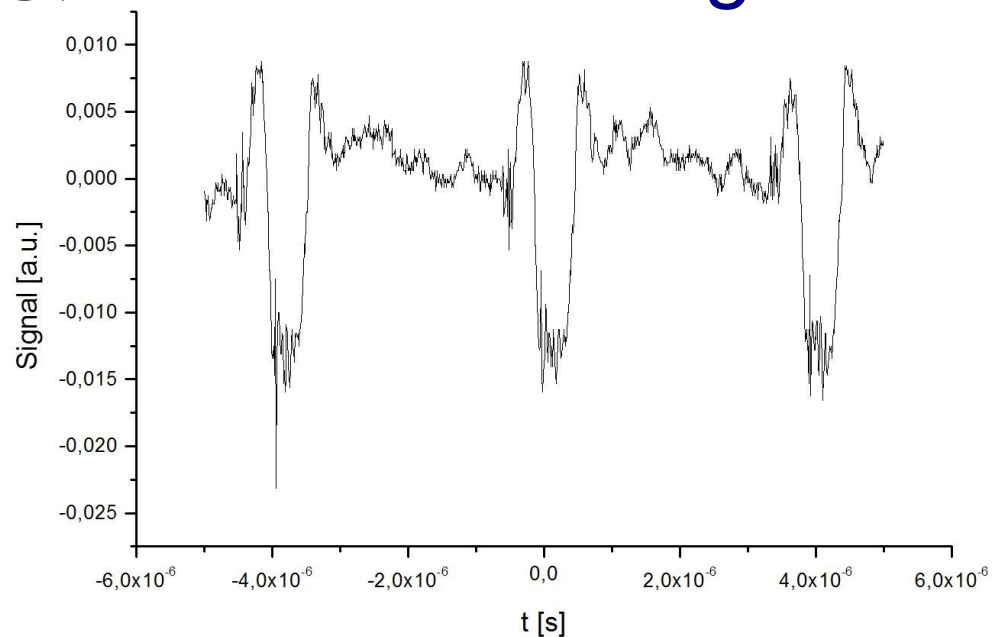


Beam Current Signal

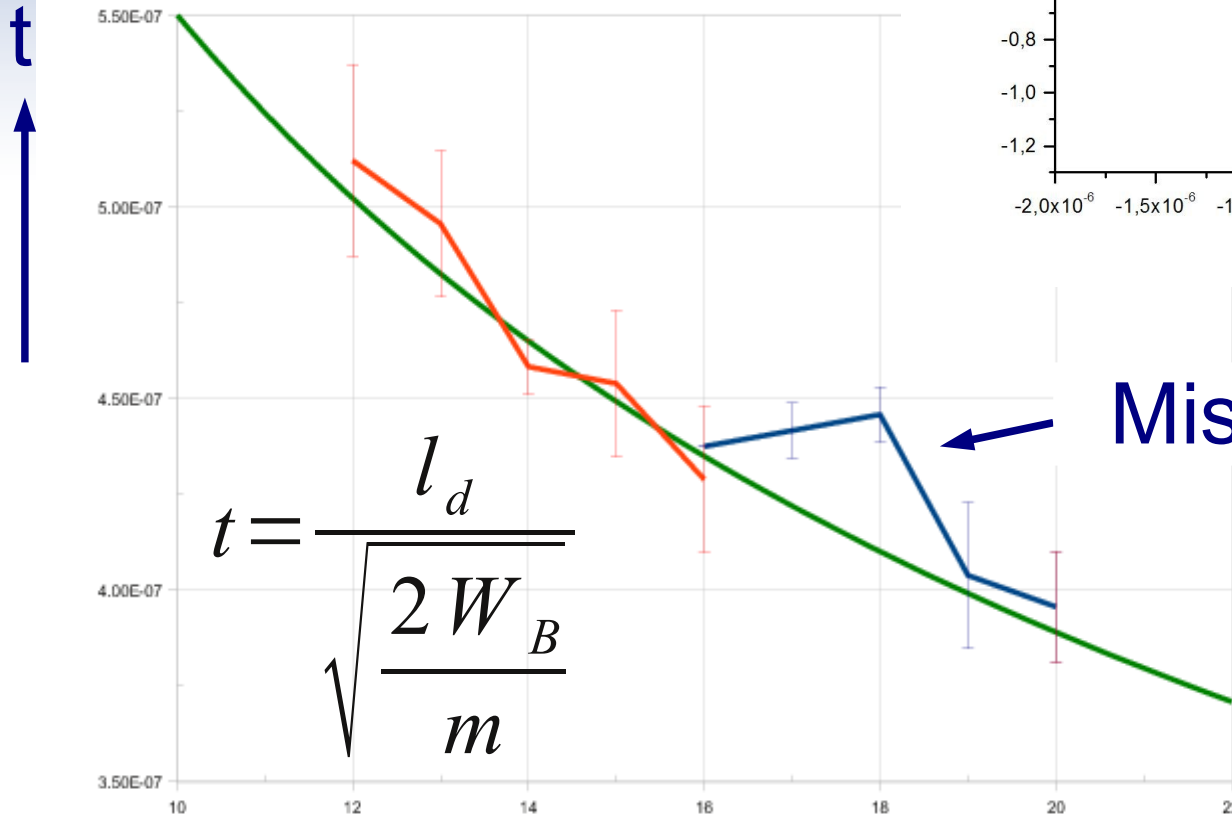
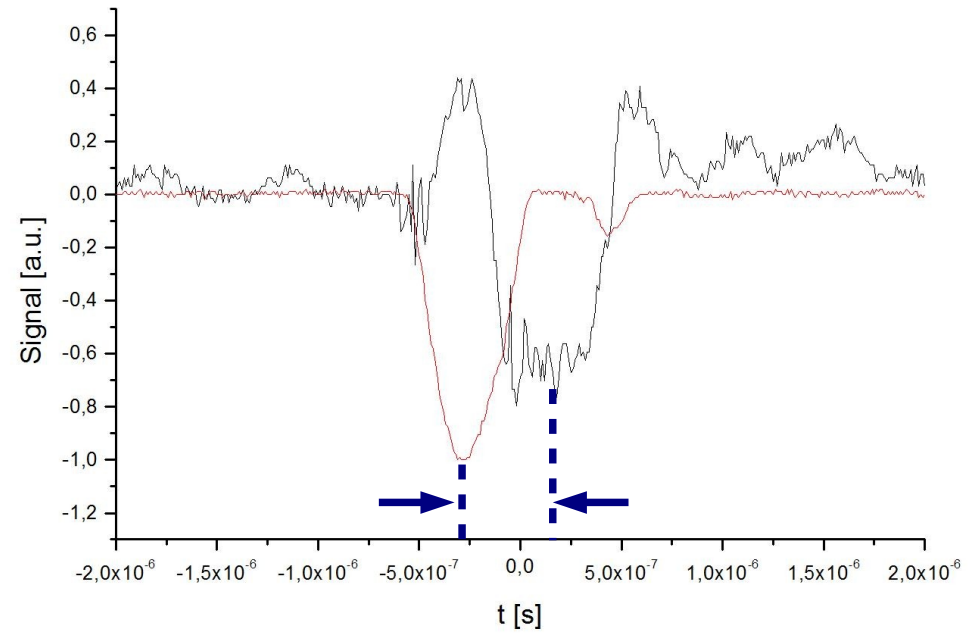
With 1.1 mA He beam



— Difference signal



TOF Measurements



$$t = \frac{l_d}{\sqrt{\frac{2W_B}{m}}}$$

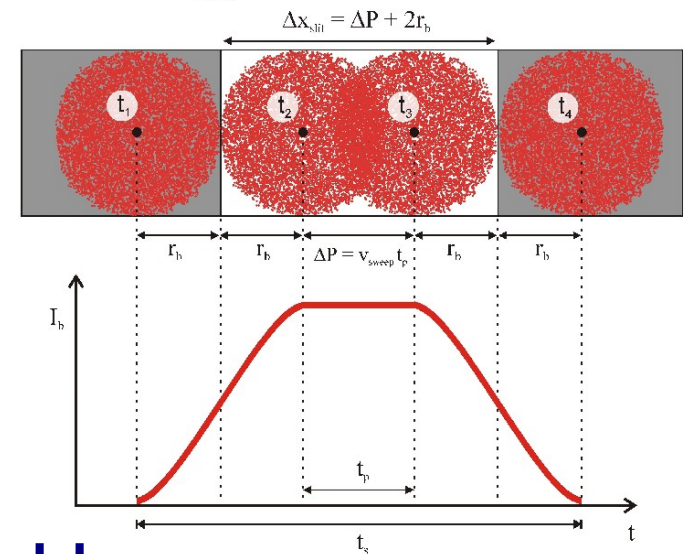
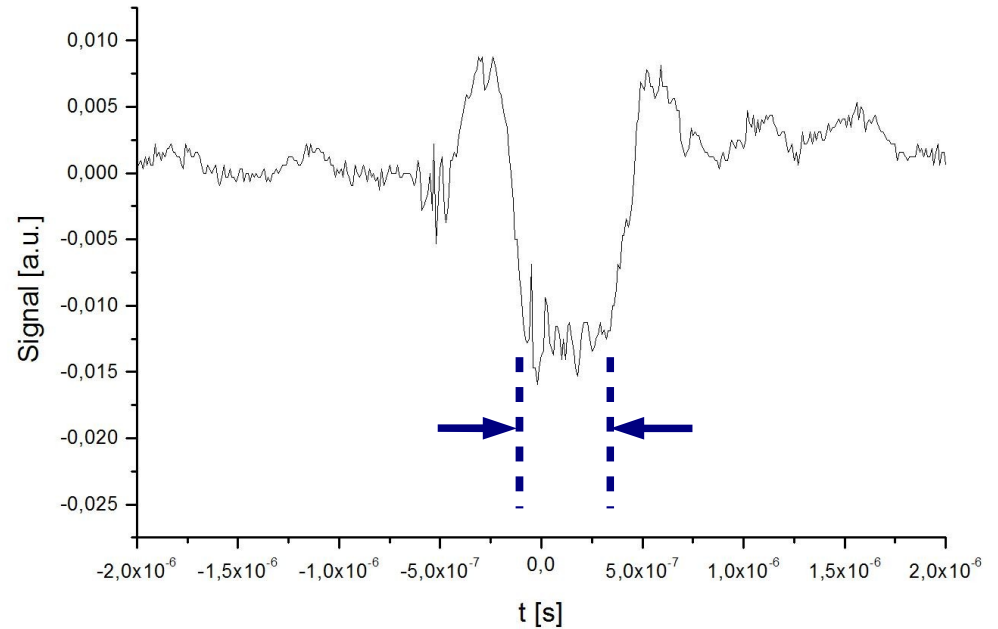
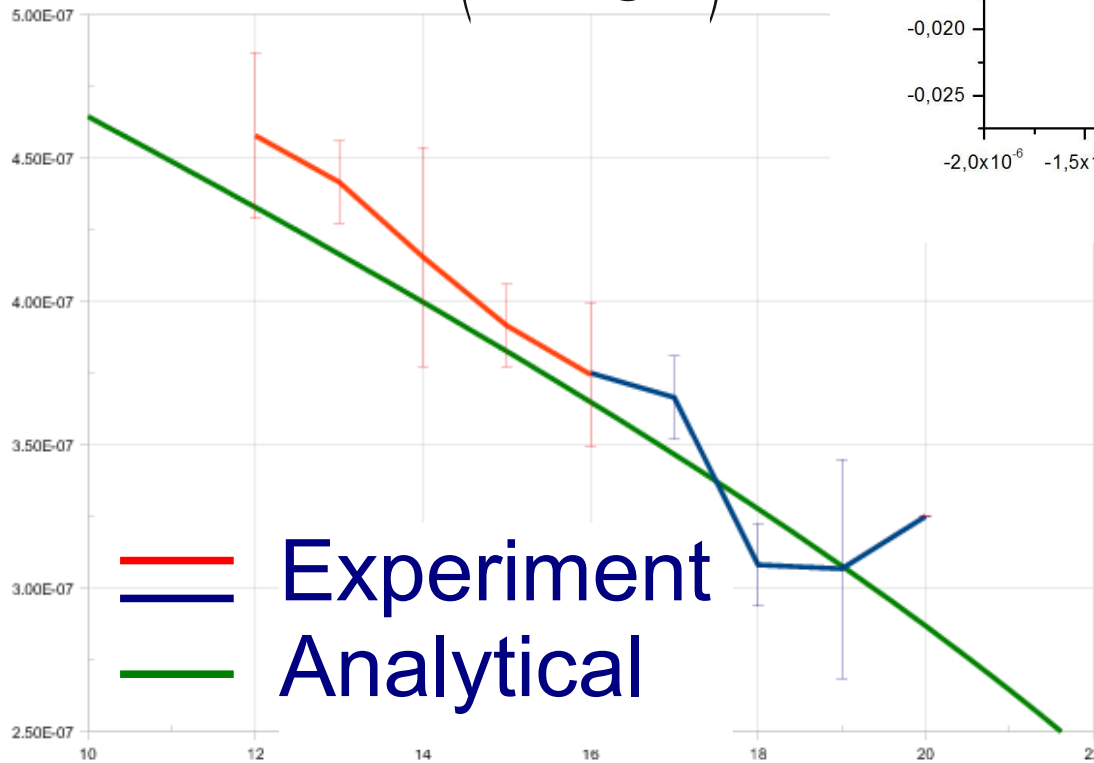
Mismatch of ion optics

— Experimental
— Analytical

Plateau Length

$$t = \frac{1}{\Omega} \arcsin \left(G \cdot \frac{U_B}{\hat{U}} \right)$$

t ↑



U_B

(C. Wiesner)

Conclusion

- Deflection system was successfully tested
 - Deflection plates, pulse generator, pulse transmission and diagnostics
- He beams up to 20 keV, 1.1 mA were successfully deflected with 250 kHz, ± 4 kV

Outlook

- Adaptation to FRANZ chopper parameters
 - Geometry, material, mounting and cooling of deflection plates and tank design
- Reduction of cable capacitances
- Further beam experiments