Beam loading compensation with beam monitor signal

talk given by E. Vogel,
work performed in collaboration with
W. Koprek, P. Pucyk, T. Traber, D. Nölle,
H. Schlarb, C. Gerth, F. Löhl, …

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# Beam loading compensation with beam monitor signal

Problem:

- adaptive feed-forward algorithms require low pass filters

- beam loading transients are filtered, too

- this leads to overshoots while 'switching on' the beam

Countermeasures:

- prediction of beam current and derivation of compensation

- measurement of beam current in real time and applying appropriate compensation

Scheme implemented for ACC1 at FLASH:
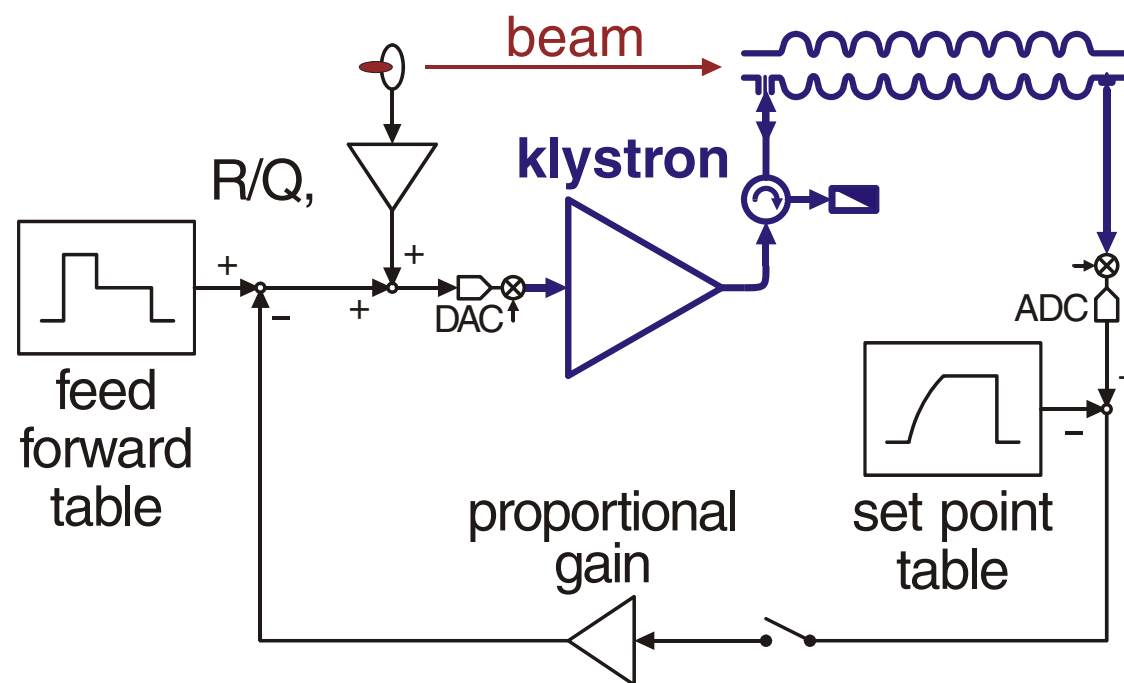
Charge proportional signal from toroid monitor

- **taking several samples** (5) **per bunch** from analogue monitor signal

- **sum of samples**

- **offset correction** using samples at times without beam
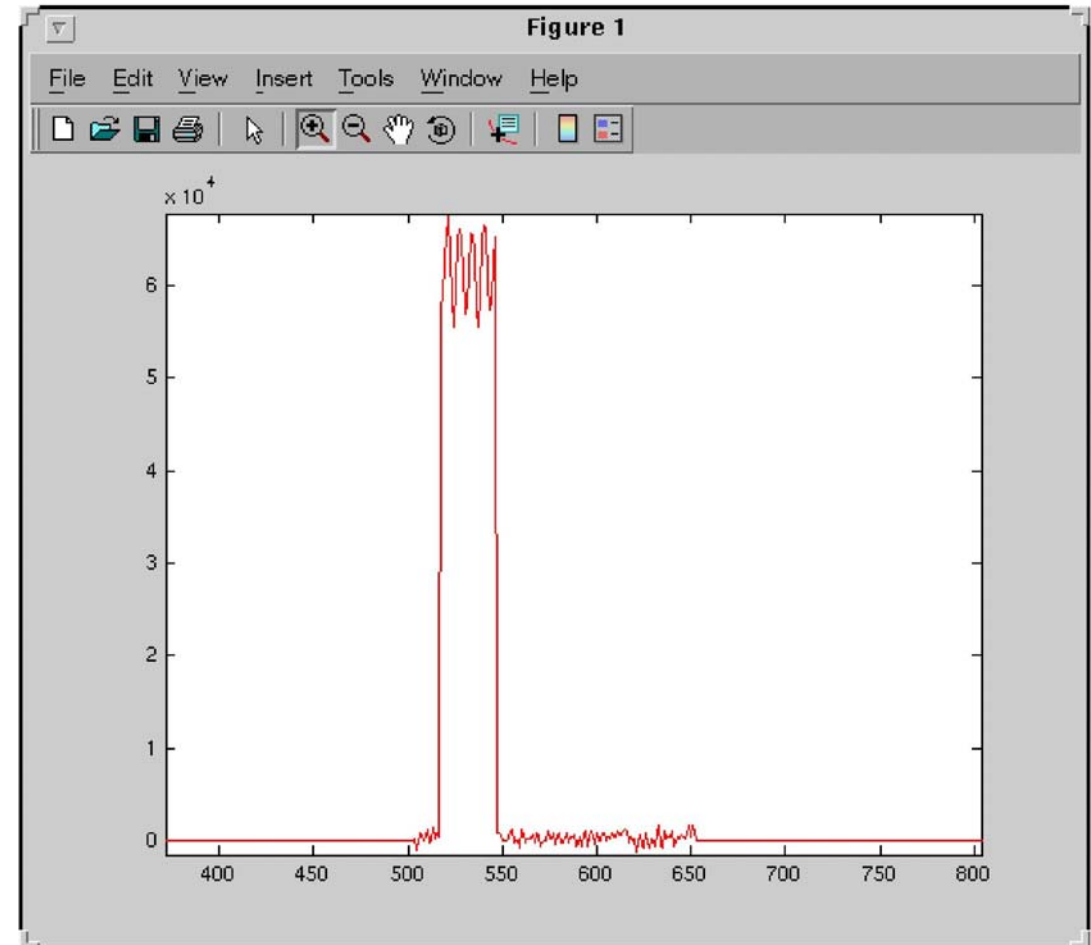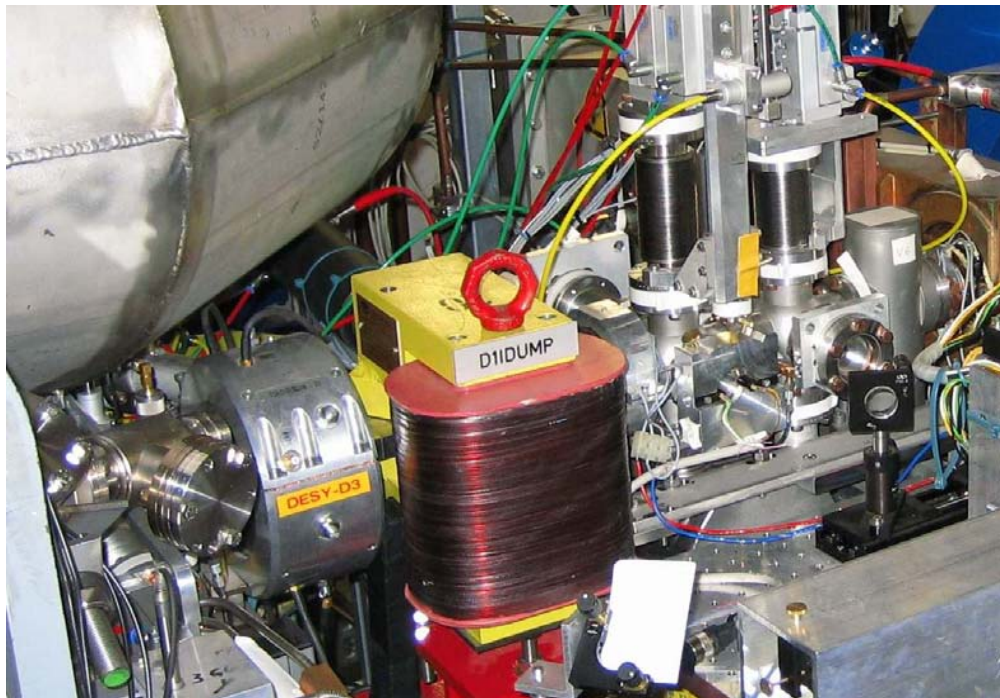
# Calibration of compensation signal with phase scan

Method:

- rf feedback off

- identical signal without beam and with beam and compensation

- for correct amplitude I and Q cross zero at same phase value (-20°)
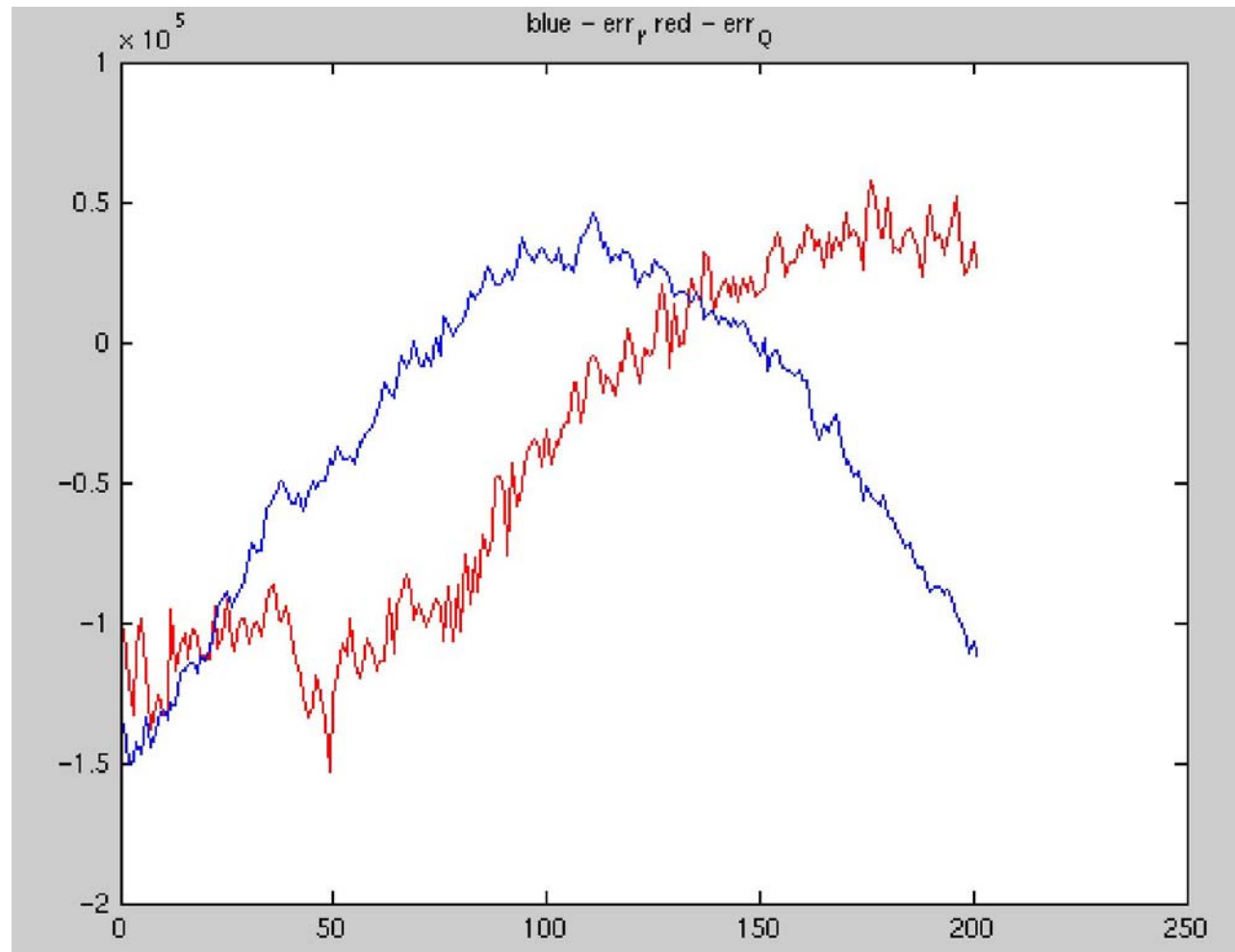
Beam loading compensation obtained...
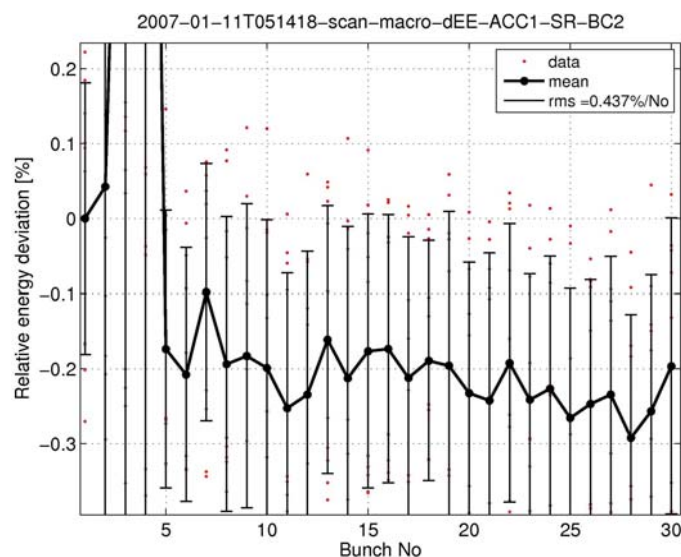
Color:

- **green line:** without beam and wothout compensation

- **black line:** with beam and without compensation

- **blue line:** with beam and with compensation
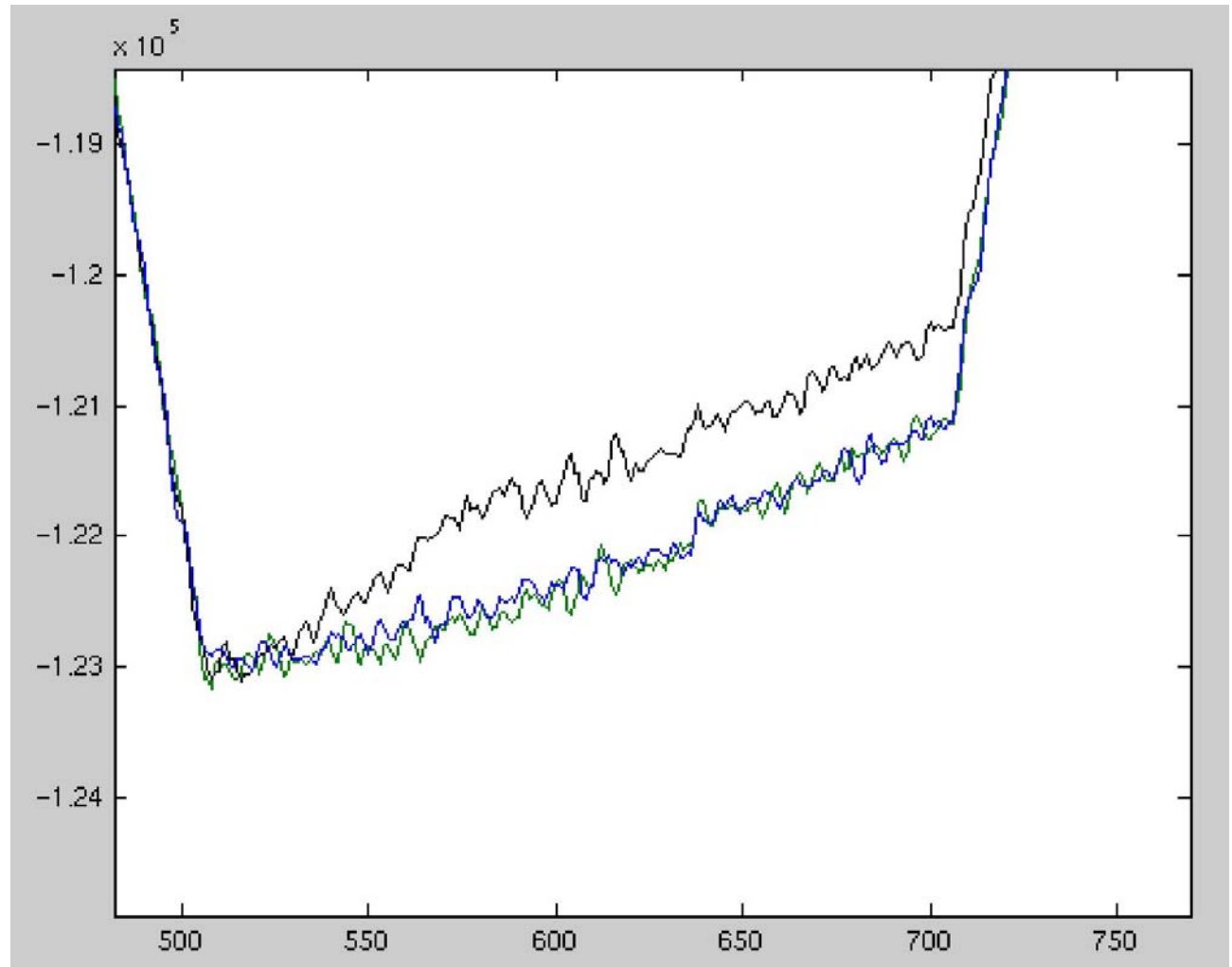
First (very preliminary) beam based qualification...

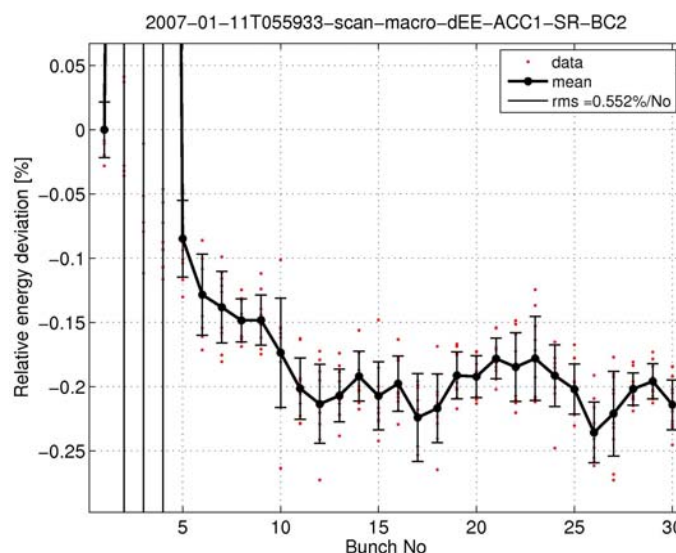with synchrotron light monitor at BC2, setup by H. Schlarb, C. Gerth, F. Löhl, …

w/o FB, AFF, BLC	with FB, w/o AFF, BLC	with BLC, w/o FB, AFF

'Error' bars: 0.4%	'Error' bars: 0.05%	'Error' bars: 0.4%
'Slope': 0.1% / 30 µs	'Slope': 0.1% / 30 µs	'Slope': vanished?
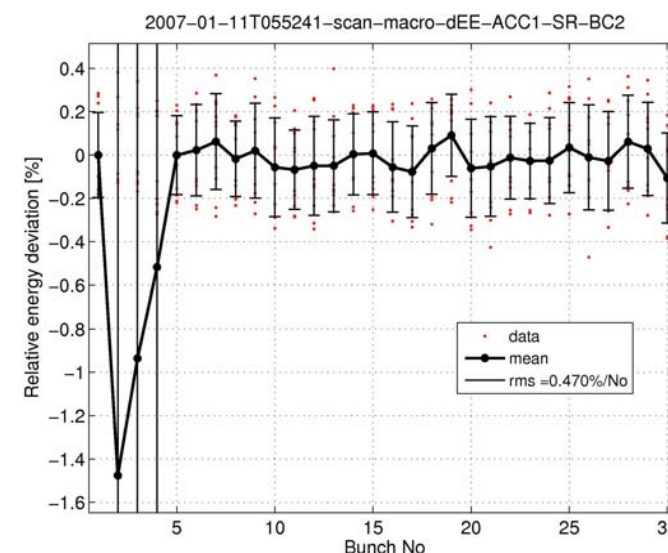
FB = feed back, AFF = adaptive feed forward, BLC = beam loading compensation

To be investigated:

measurement resolution, arrival time jitter, 'missing' bunches at the beginning

Back up solution implemented:

In case of missing toroid monitor signal the settings of the rf gun laser server are taken to predict the beam loading compensation signal.

First 'final test':

SASE with 800 (600) bunches in August 2006.

Next steps:

Further qualification of method by measuring energy stability of beam in BC2.