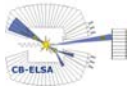
R&D at the Electron-Stretcher Accelerator

Status 03/2011

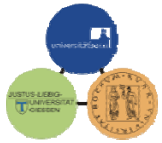
Wolfgang Hillert

Physikalisches Institut der universitätbonn

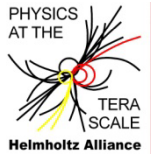
"Clients":



Funding:



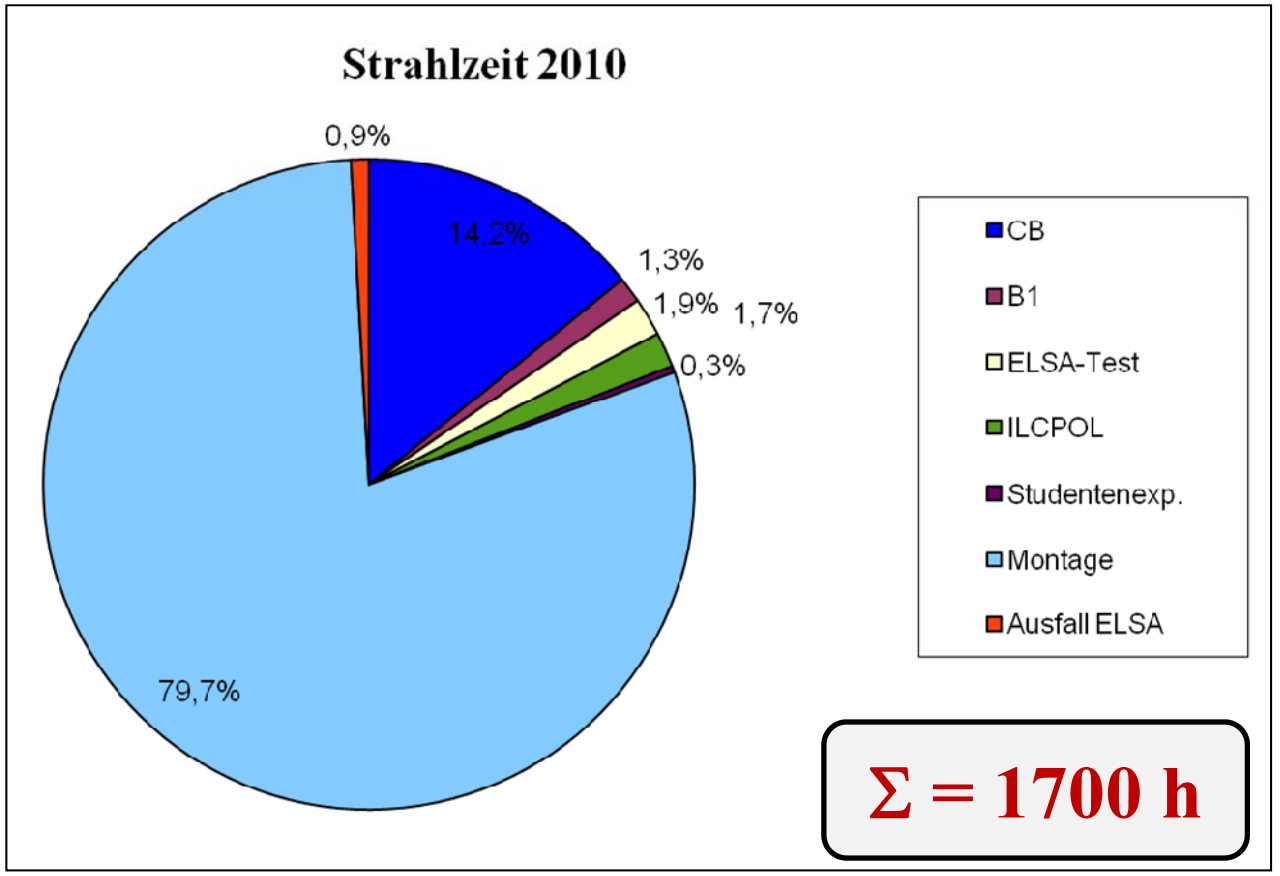
DFG-SFB/TR16



Bundesministerium für Bildung und Forschung
Spindynamik in Leptonen-Beschleunigern

ELSA - Statistics:

- CB: May: 85h
  Σ=1243 Jun: 44h
  Jul: 332h
  Oct: 289h
  Nov: 493h
- B1: Jan: 60h
  Σ=111 Feb: 13h
  Apr: 33h
  Sep: 5h
- Ilcpol: Feb: **151h**
- Stud: Sep: **28h**
- ELSA: **Σ=166h**



2010

- Improvements

- Thermionic gun uptime of 100% (no vacuum bursts)
- Stabilized tunes on the fast energy ramp
- Online meas. of beam position @ tagging target
- LINAC I available for irradiation purpose
- Beam loss monitor system commissioned
- Improved CO vertical correction in ELSA
- Bunch by bunch feedback operational

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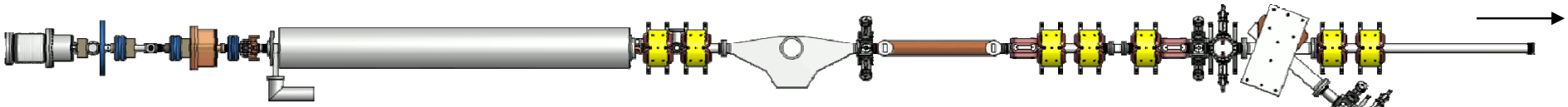
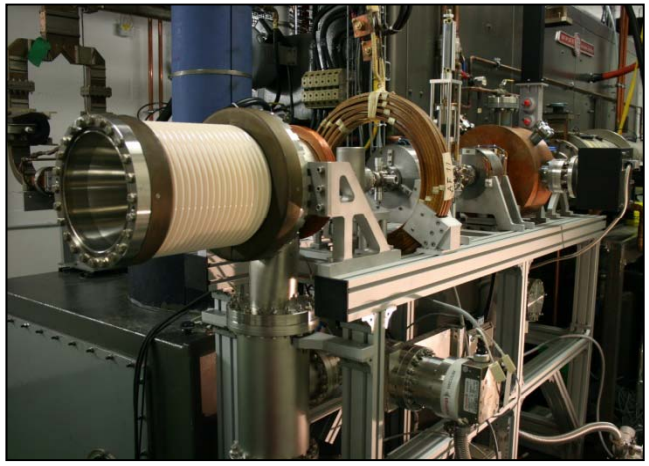
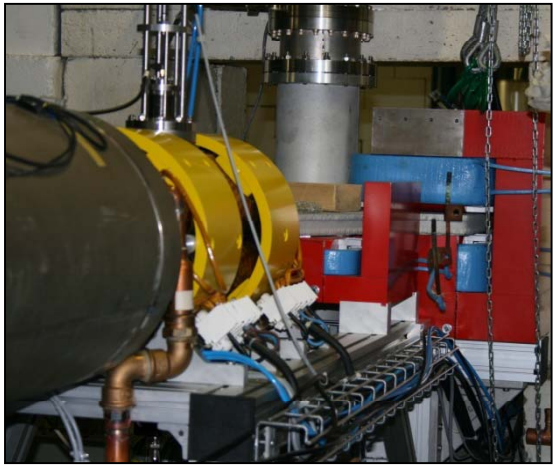
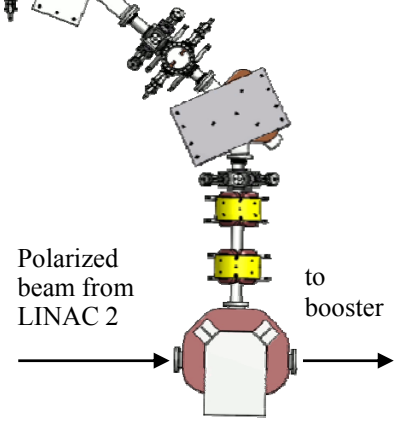
Injector LINAC 1 Transfer line Irradiation chamber









LINAC I:

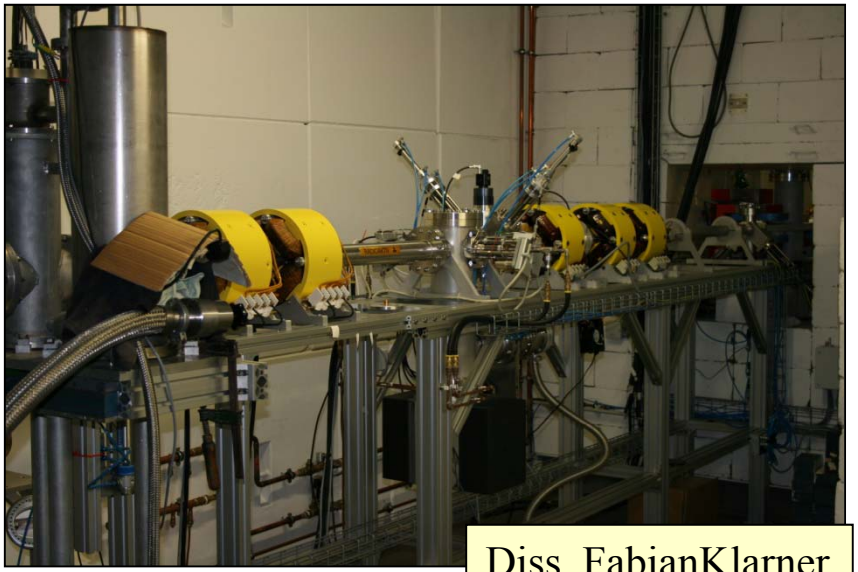
Commissioned in 12/2010

Dedicated beam time in 2011 for:

- irradiation of target material (COMPASS)
- irradiation of detector electronics (ATLAS)

Operation parallel to CB/ELSA run!

Regular COMPASS irradiation finished,
now preparing 1-2 extra samples



Diss. FabianKlarner

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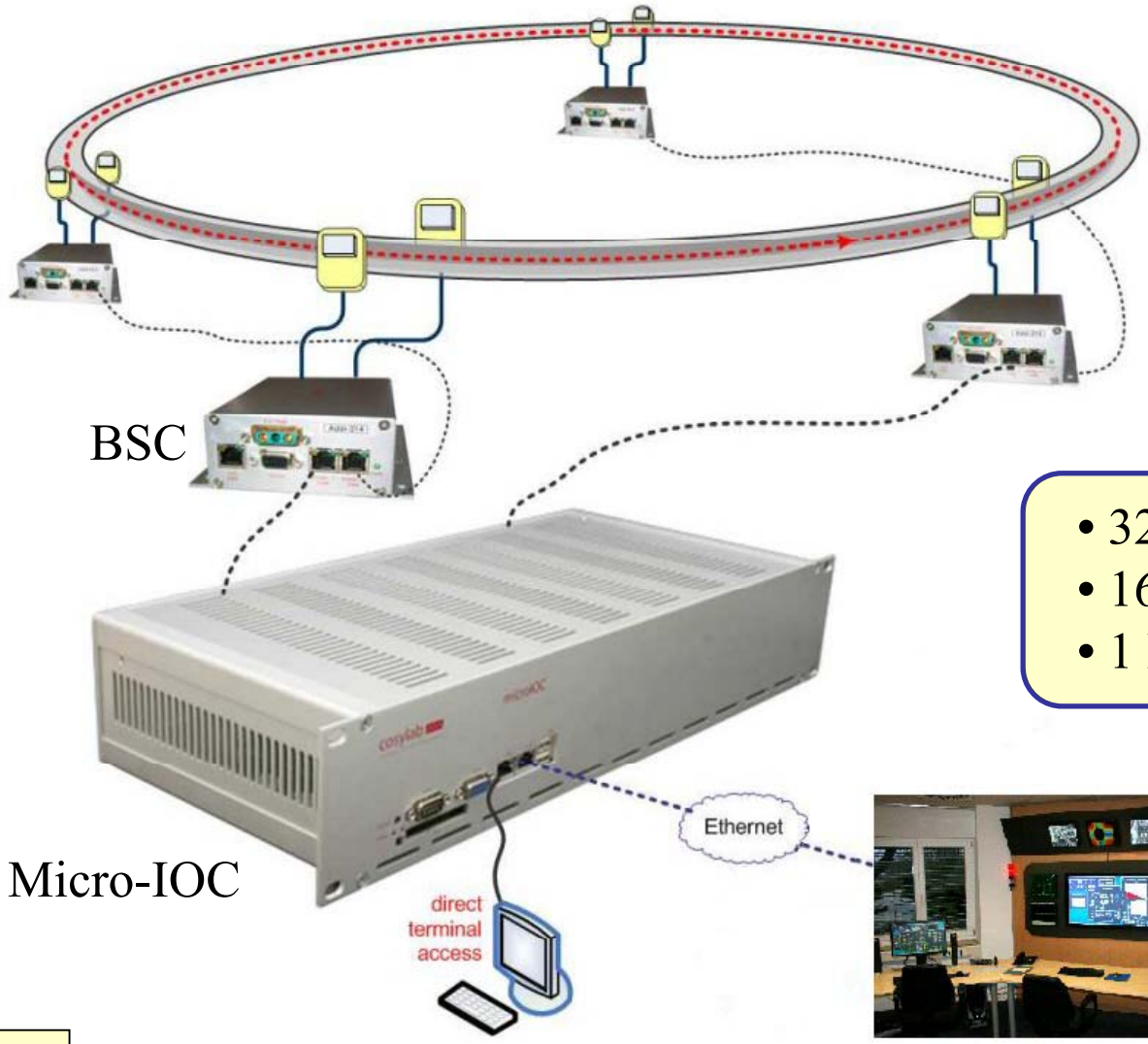
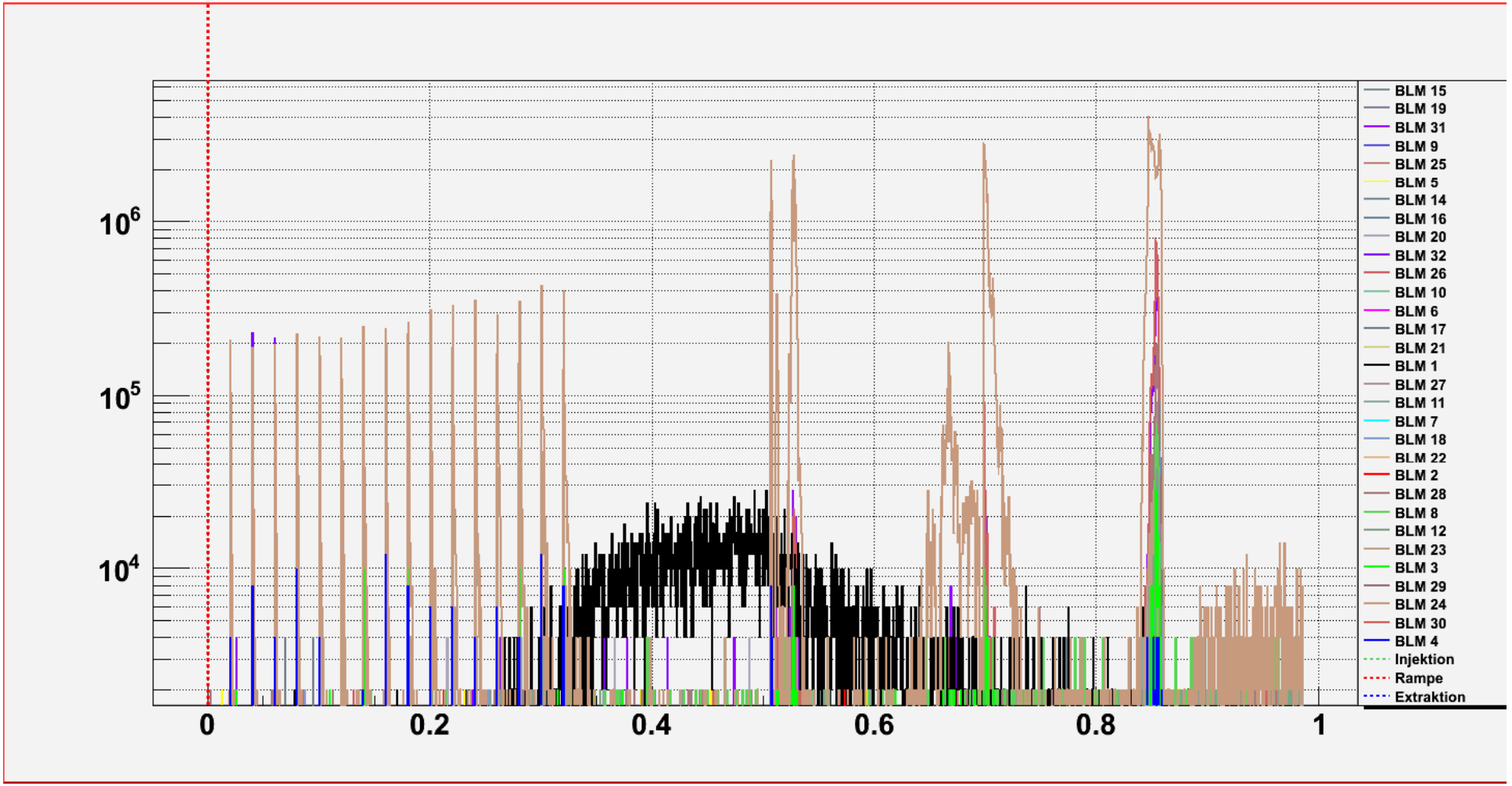
Beam-Loss-Monitor System



- 32 Detectors
- 16 BSC's
- 1 Micro-IOC

Dipl. Dennis Proft

First measurements



Dipl. Dennis Proft

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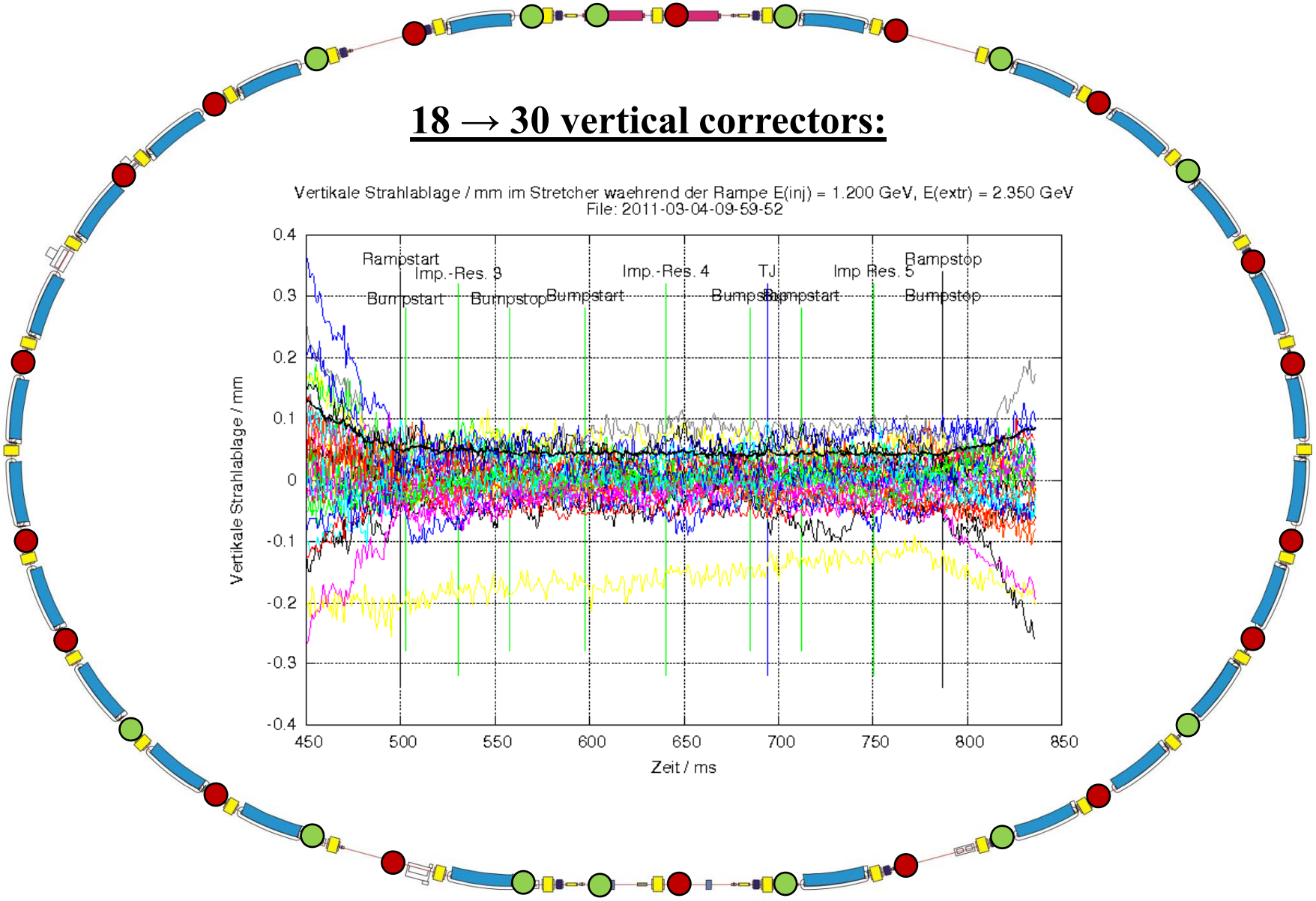
CO-Correction in ELSA:

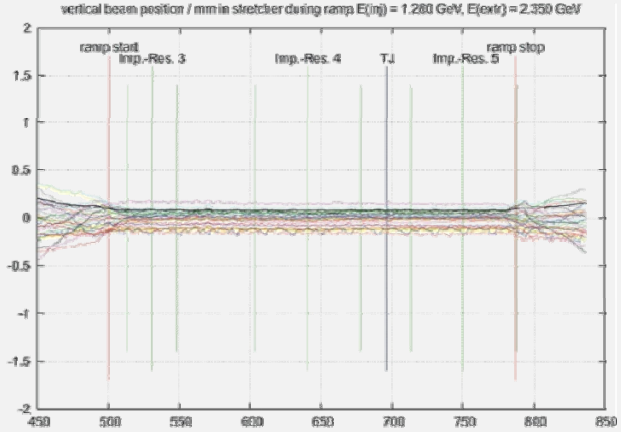
18 → 30 vertical correctors:



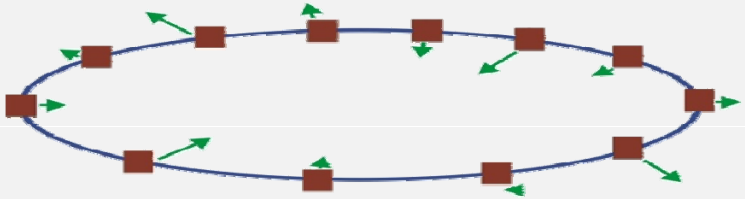
Correction Menu for pol. e^-:

Imperfection Resonances

- Magnet alignment
- Correction of field errors
- Closed orbit correction:

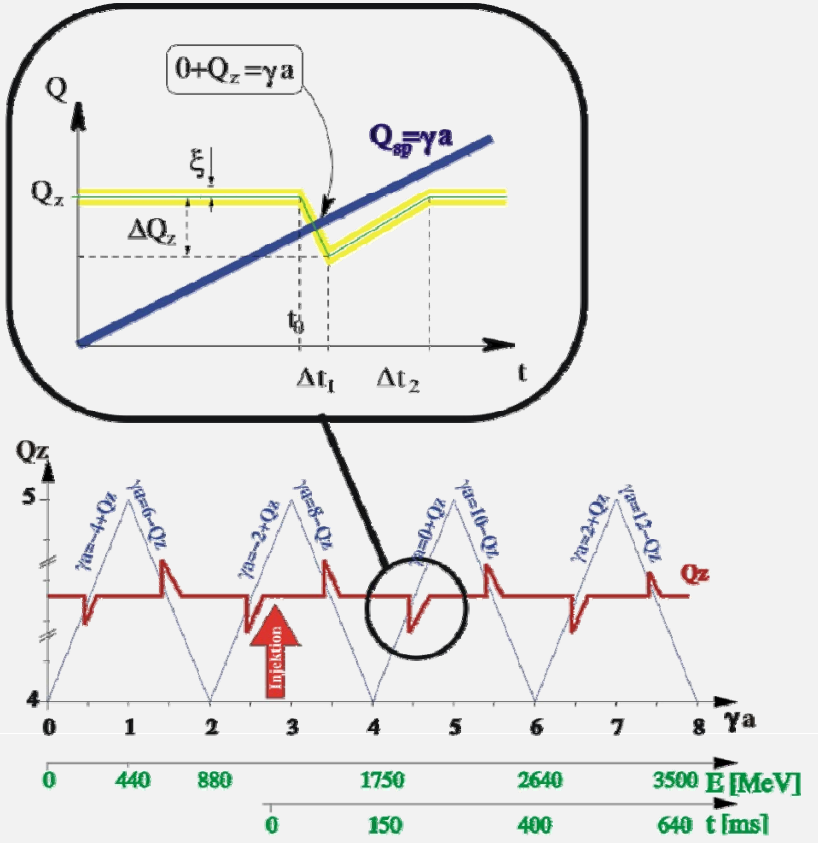


- Harmonic correction:



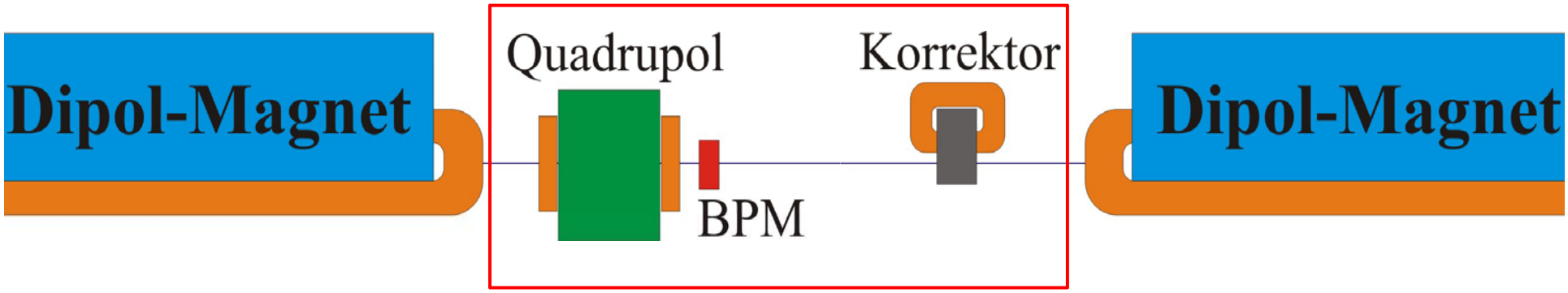
Intrinsic Resonances

- Small coupling
- Tune jumping:



Improved Correction

Harmonic distribution of combined B-fields in straights:



Calculation of corrector currents from matrix inversion

$$\vec{b}_{\mathrm{harm}} = \mathbf{M} \cdot (\mathbf{I} + \mathbf{g} \cdot \mathbf{R}) \cdot \vec{b}_{\mathrm{cor}}$$

by using the SVD technique.

Operational!

Diss. Oliver Boldt

Harmonic Correction

December 2009:

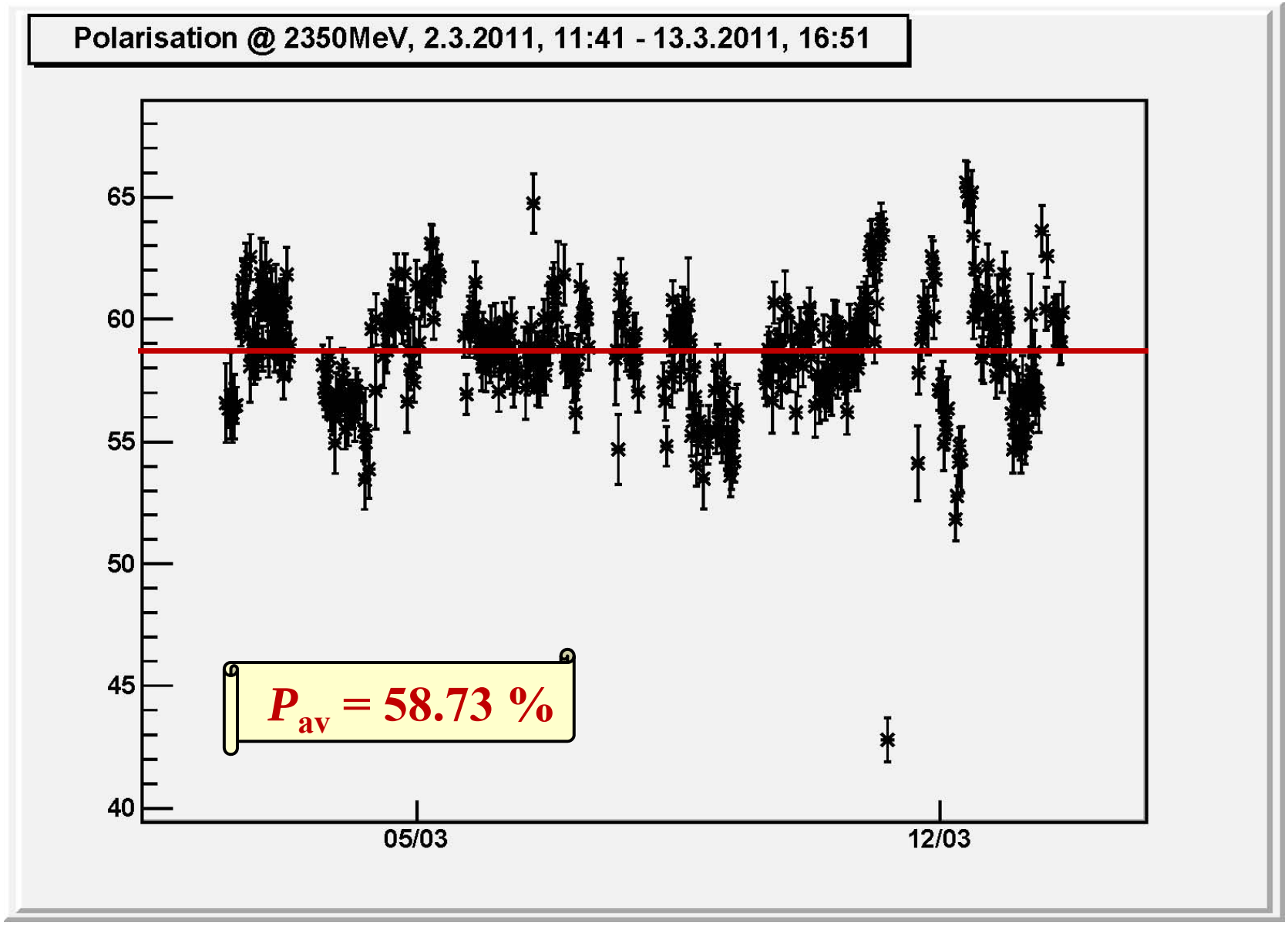
cos3 = 0.000
sin3 = 0.024
cos4 = -0.006
sin4 = 0.001
cos5 = -0.002
sin5 = 0.007

March 2011:

cos3 = 0.015
sin3 = 0.017
cos4 = -0.006
sin4 = 0.005
cos5 = 0.009
sin5 = -0.004

Slightly different due to readjustments and add. correctors

CB/ELSA-Run with pol. d:



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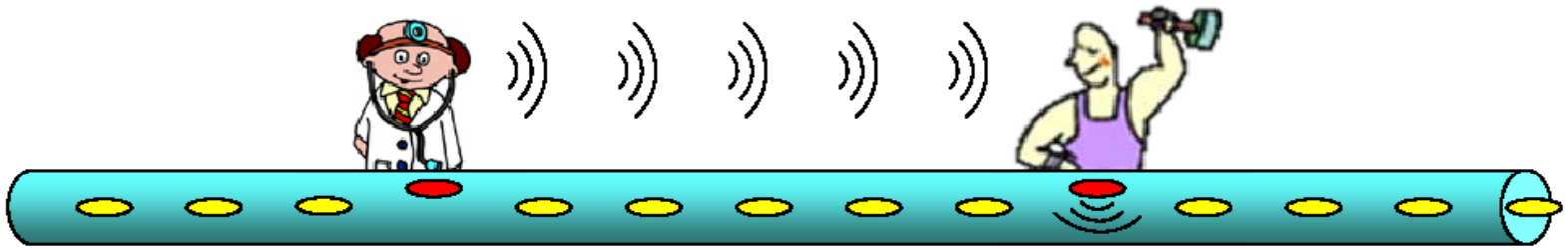
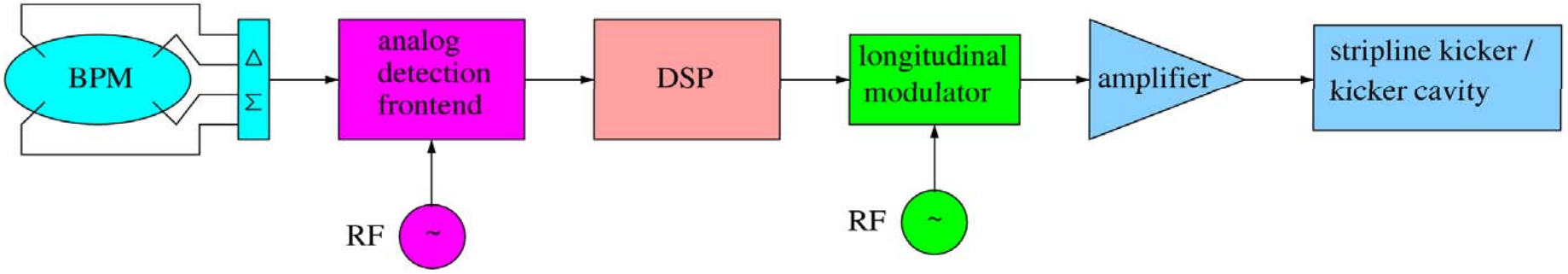
Bunch by Bunch Feedback

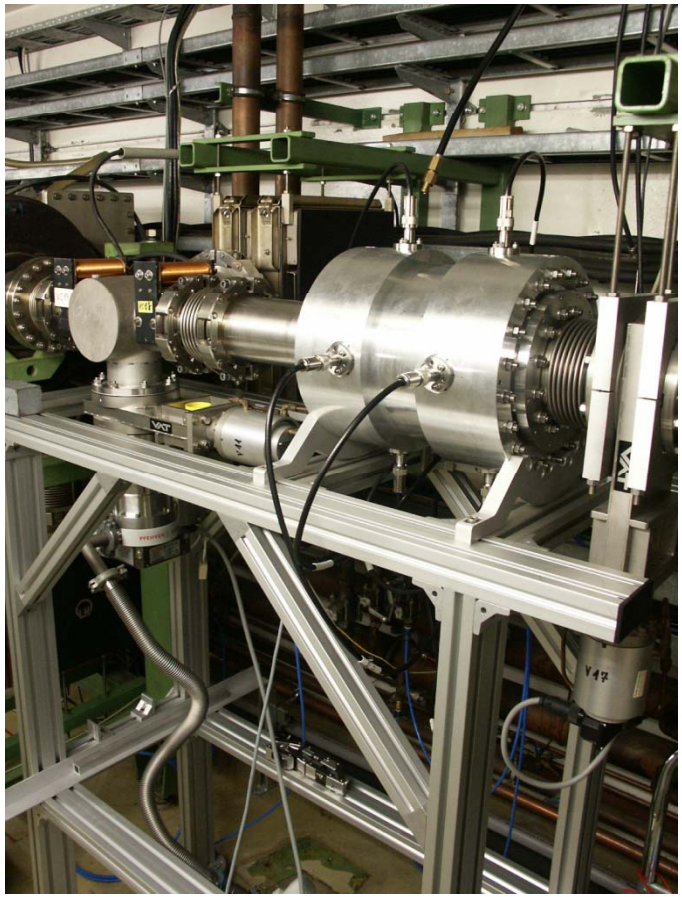


Δt = 2 ns, BW = 250 MHz



Bunch by Bunch Feedback (FB)

installation of prototype longitudinal kicker cavity



Ma.Sc. Nikolas Heurich

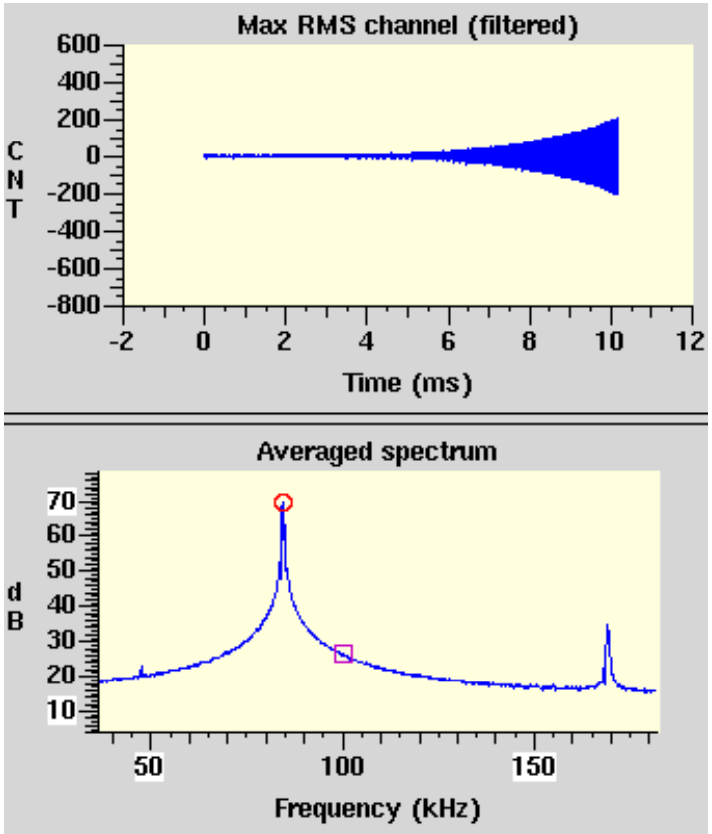
frontend electronics, 3 digital signal processors, amplifiers

Diss.André Roth

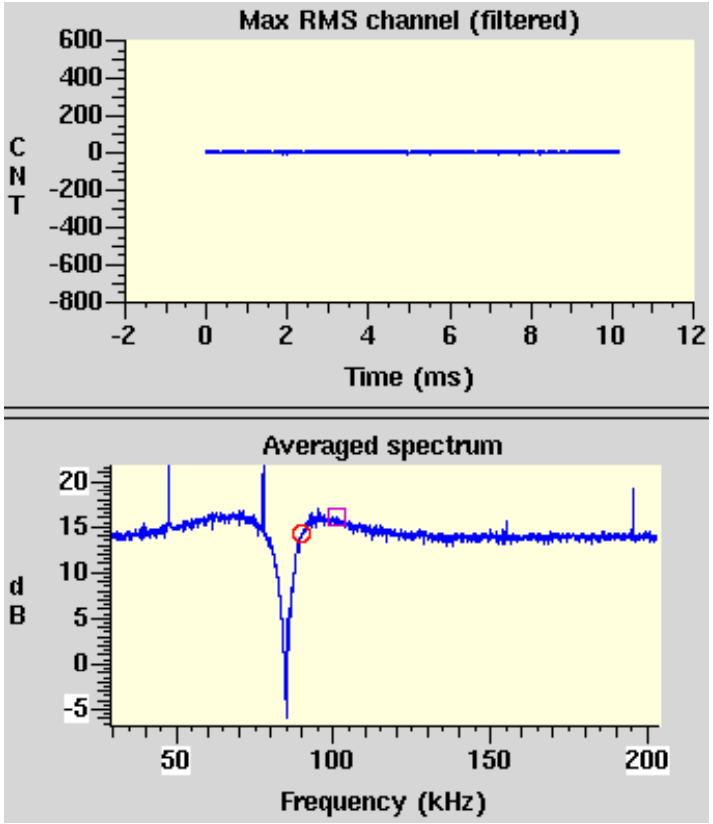
Booster mode: 17 mA at 2.35 GeV

- longitudinal FB loop closed: better injection efficiency at 1.2 GeV
- at 10 mA coherent longitudinal beam instabilities
- synchrotron oscillation (85 kHz) of bunches damped successfully
- rf ramp: stabilization of longitudinal tune & low beam loss with FB

Feedback: off



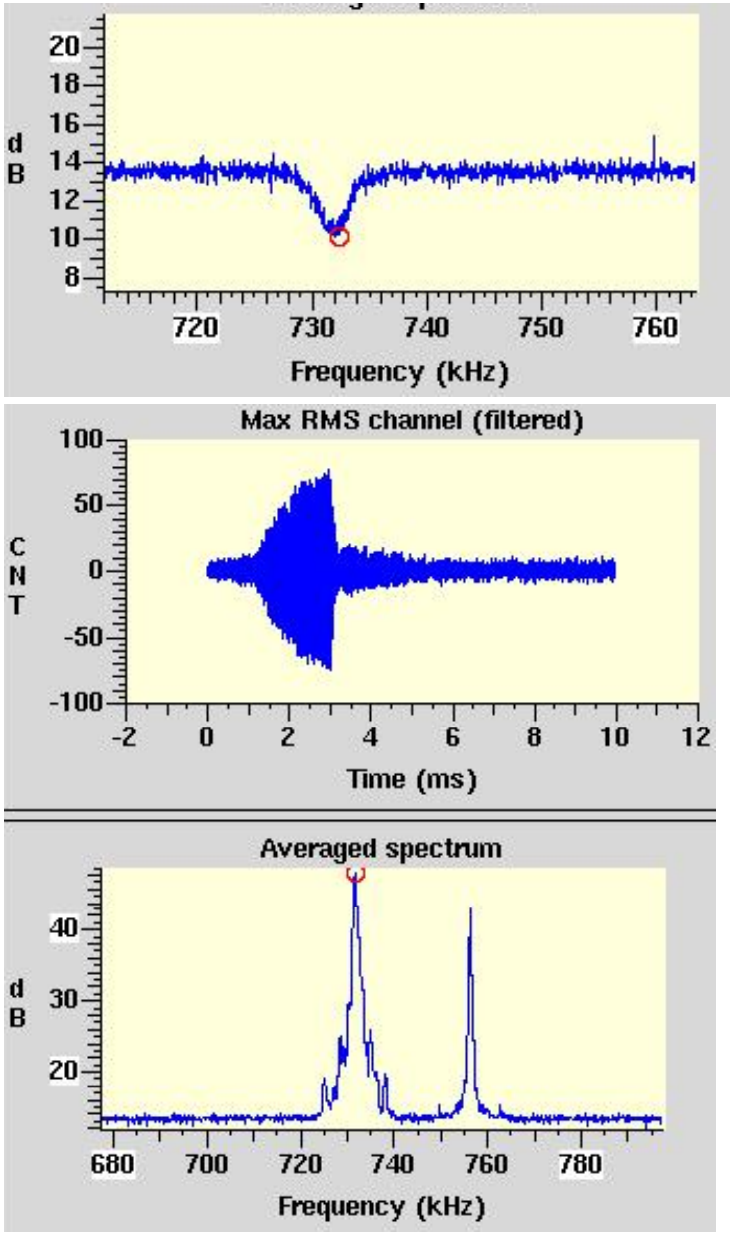
Feedback: on



Storage ring mode: up to 100 mA at 2.35 GeV

- if longitudinal FB is active, beam also becomes transverse instable !
- horizontal FB loop closed: betatron oscillations of bunches at 732 kHz damped successfully
- horizontal drive-damp investigations at 50 mA: FB shows good damping performance
- but: beam also starts to oscillate vertical (at 756 kHz) !

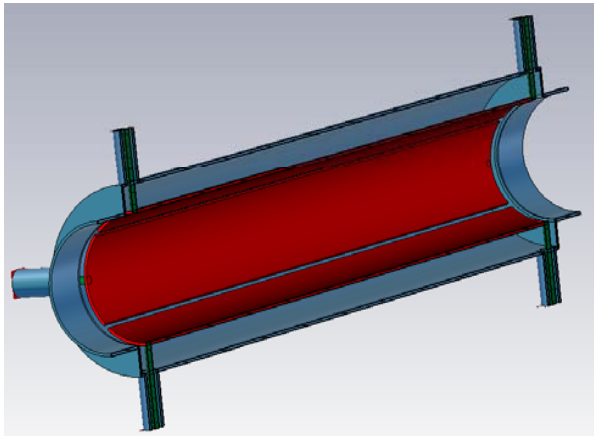
Second wide-band amplifier ordered, 3D-feedback will be available in summer



Next Steps / Outlook

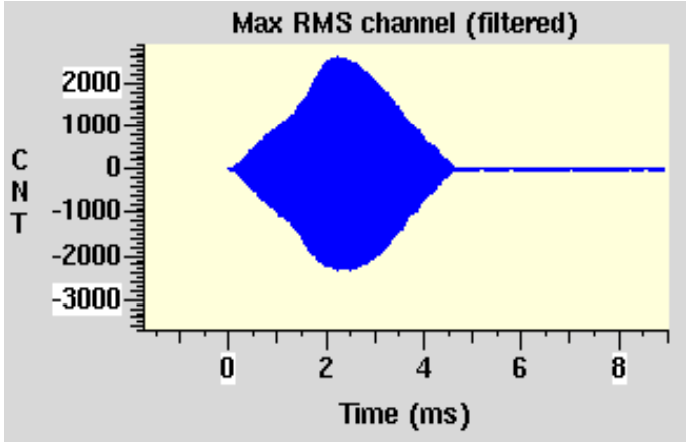
- use better injection efficiency with longit. FB to store higher currents (20-25 mA) for booster mode (at same injection time)

- for higher currents transverse feedback loop must be also closed: new transverse stripline kicker (larger BW) & amplifier for vertical FB



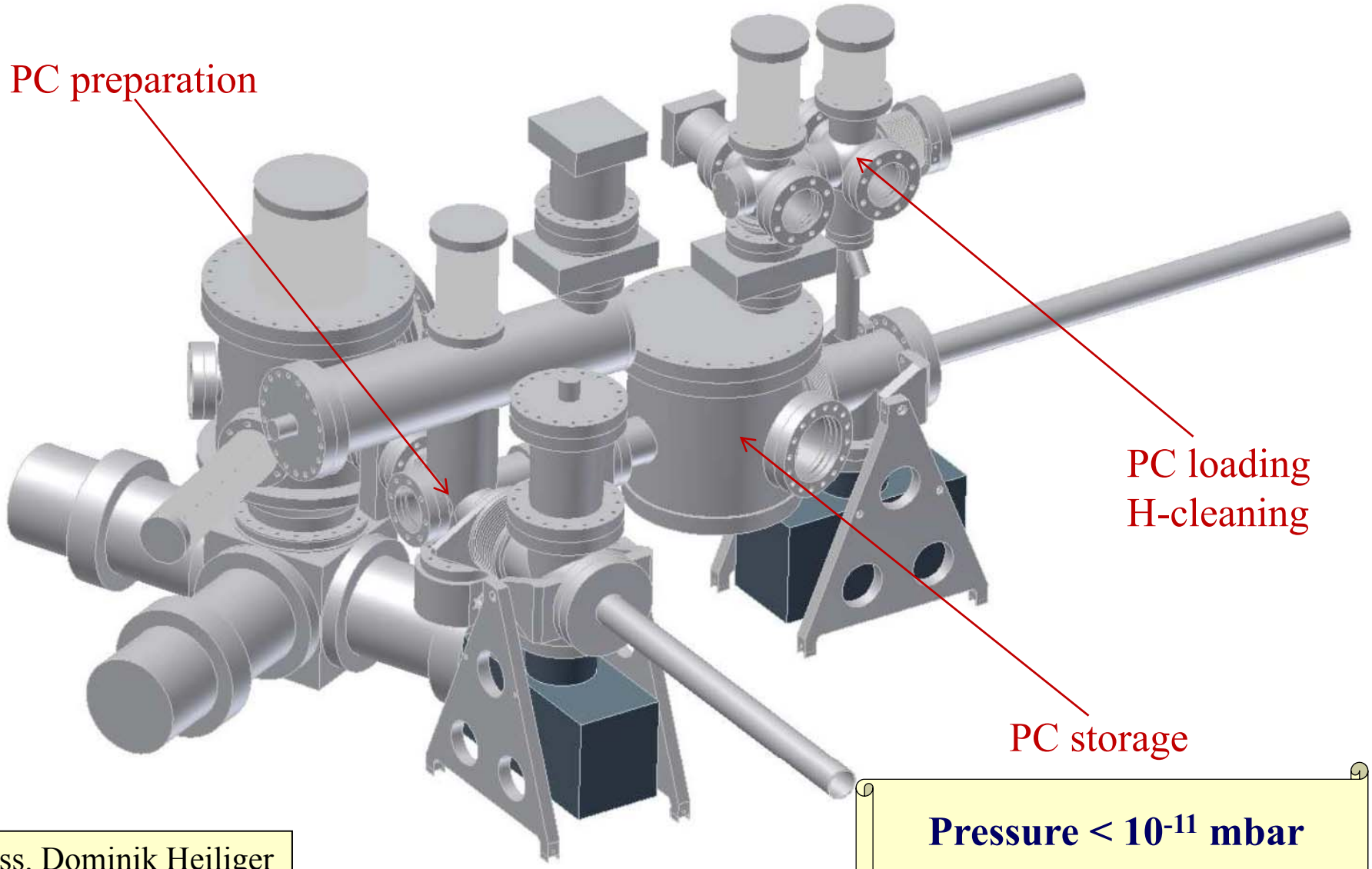
- tranverse bunch cleaning: single bunch in ELSA possible !?

- studies of instabilities modes: analyse drive-damp transitions



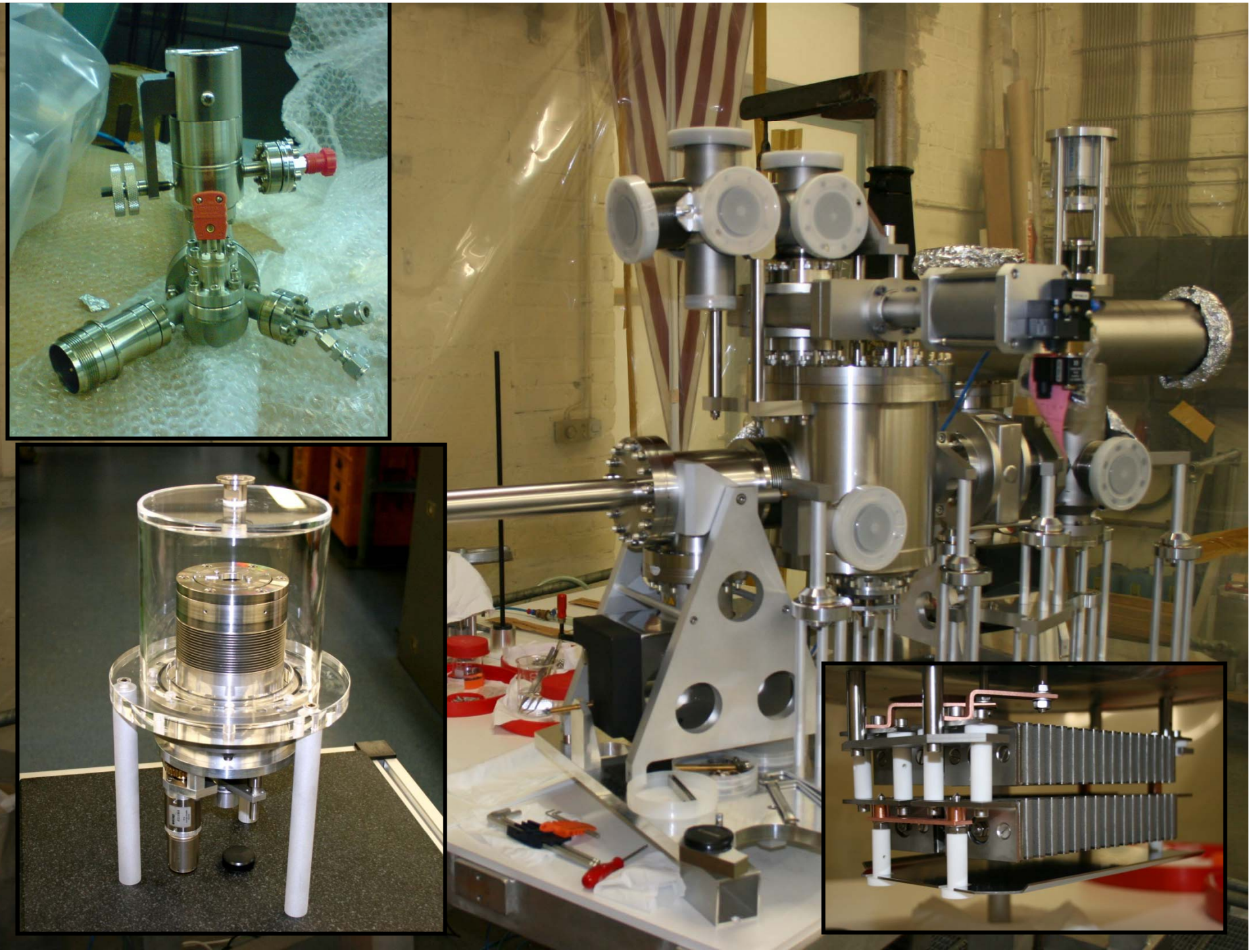
Ma.Sc. Manuel Schedler

New Load-Lock: coming 2011



Diss. Dominik Heiliger

Pressure < 10^{-11} mbar



ELSA - Status:

ELSA is operational for experiments using:

- **lin. polarized photons $E_e < 3.3$ GeV**
- **circ. polarized photons $E_e < 2.4$ GeV, $P_e = 60 - 65\%$**

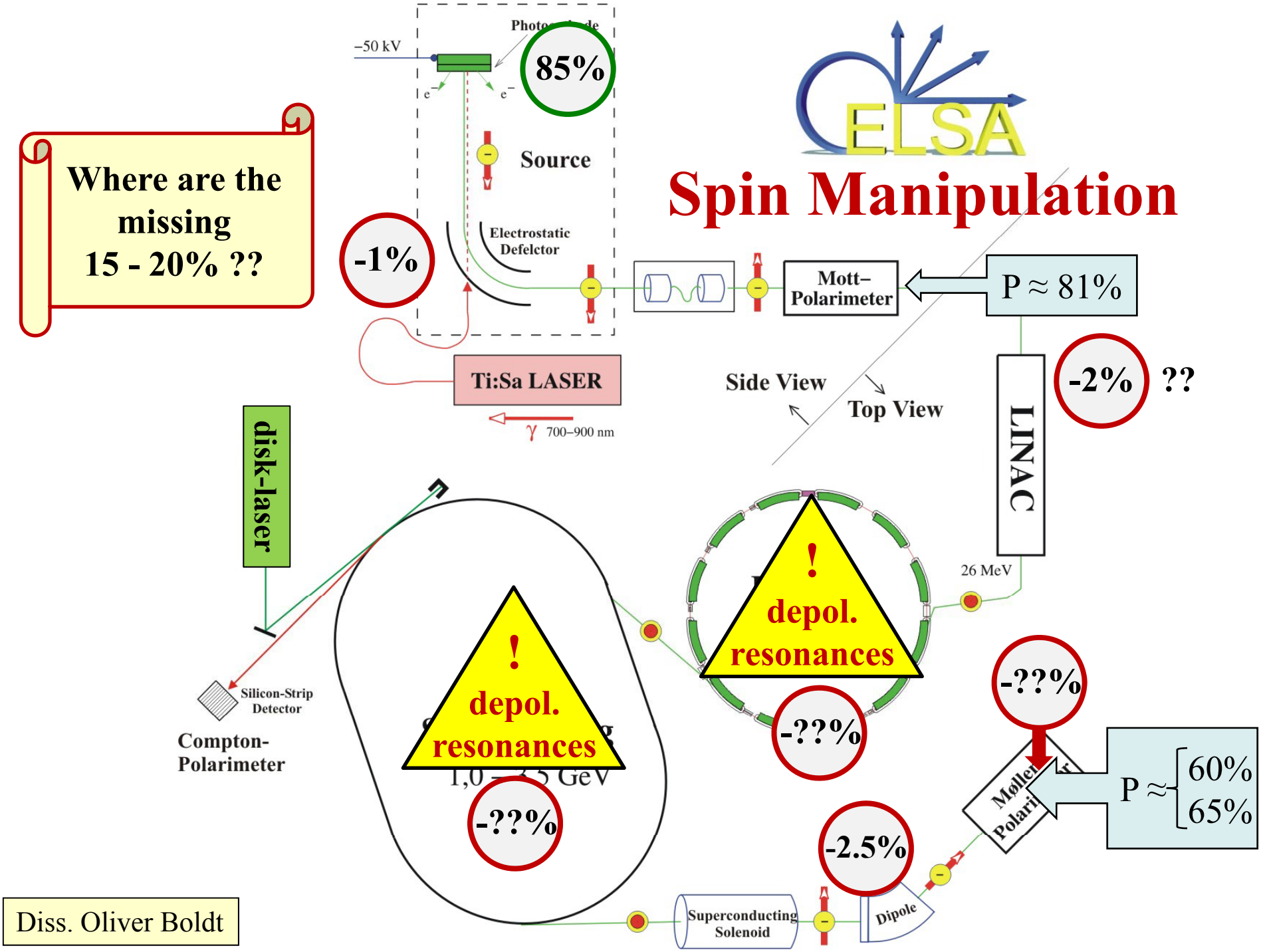
offering stabilized:

- **beam intensity** (feedback on tag-or)
- **beam polarization** ($\Delta P < 5\%$)
- **beam position and pointing** ($\Delta x,z < 0.5$mm)

~~**External beam current is limited to $I < 0.5$nA**~~

ELSA cannot be operated reliably at $T >> 30°C$!!

Spin Manipulation

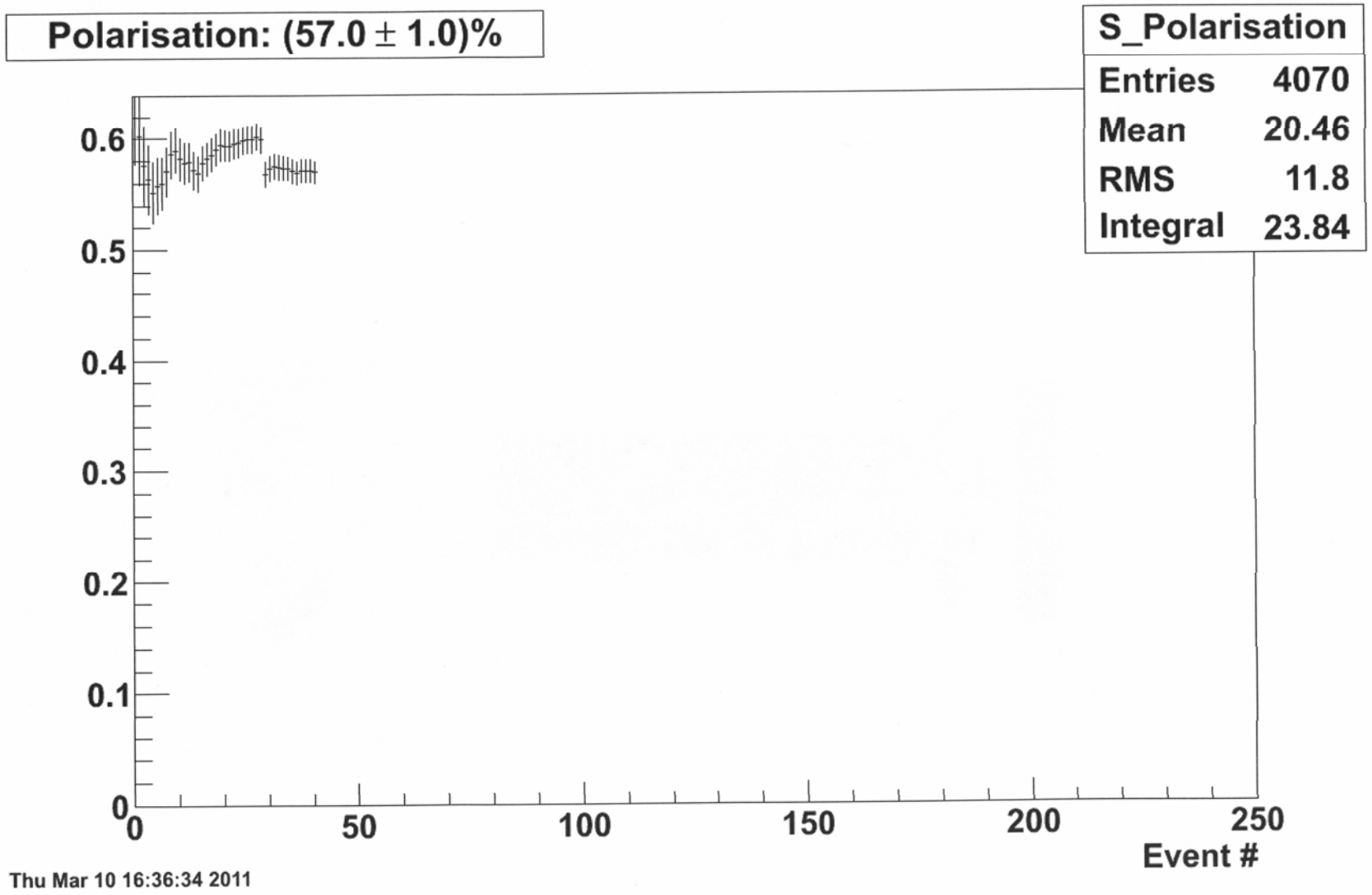


pol. e^- in ELSA

Staged Approach:

- **comm. and online control of 64 new PS in the acc. tunnel**
- **hor. CO correction using suppl. dipole correction windings**
- **using existing correctors for vert. correction (# 18 → 30!)**
- **install. of a vertical correction system in the synchrotron (before second half of polarized d run)**
- **replacement of existing by new vertical corrector magnets**

Extended shutdown period of ELSA is needed for the installation of the load-lock system pol. source!


Polarisation: (57.0 ± 1.0)%
S_Polarisation
Entries 4070
Mean 20.46
RMS 11.8
Integral 23.84
0.6
0.5
0.4
0.3
0.2
0.1
0
0
50
100
150
200
250
Event #
Thu Mar 10 16:36:34 2011