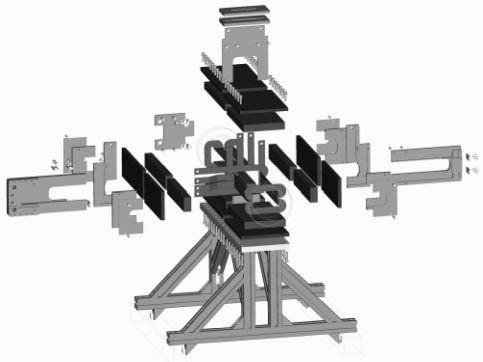
BESSY

Berliner Elektronenspeicherring-Gesellschaft
für Synchrotronstrahlung m.b.H.



A Diagnostic Kicker System as a Versatile Tool for Storage Ring Characterisations

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Leibniz Gemeinschaft

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Motivation

- Beam excitation in **any transverse direction**
- Deflection up to **aperture limits**
- Excitation **amplitude** - precisely defined and **reproducible**

Challenge

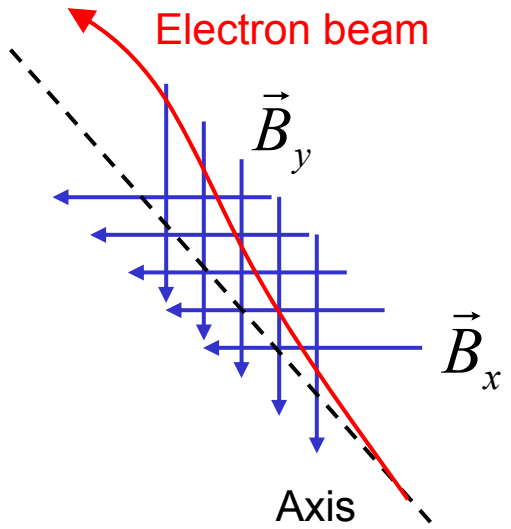
- **Simultaneous pulsing** of both systems
- High **amplitude stability** up to **10Hz** repetition rate
- **Timing** stability by **pulse synchronisation**

Requirements

- **Two** separate diagnostic **kicker systems**

Related Machine Parameters

Description	Parameter
Momentum	up to 1.9 GeV / c
Machine length	240 m
Revolution time	800 ns
Physical aperture (hor. x ver.)	27 mm x 6 mm



Pinger System Design Parameters

Description	Horizontal	Vertical
Deflection angle	5.3 mrad	2.1 mrad
Kick strength	19.3 mTm	13.2 mTm
Pulse length	1.5 µs	1.5 µs
Magnet aperture	93 mm x 50 mm	85 mm x 52 mm
Magnet length	240 mm	300 mm

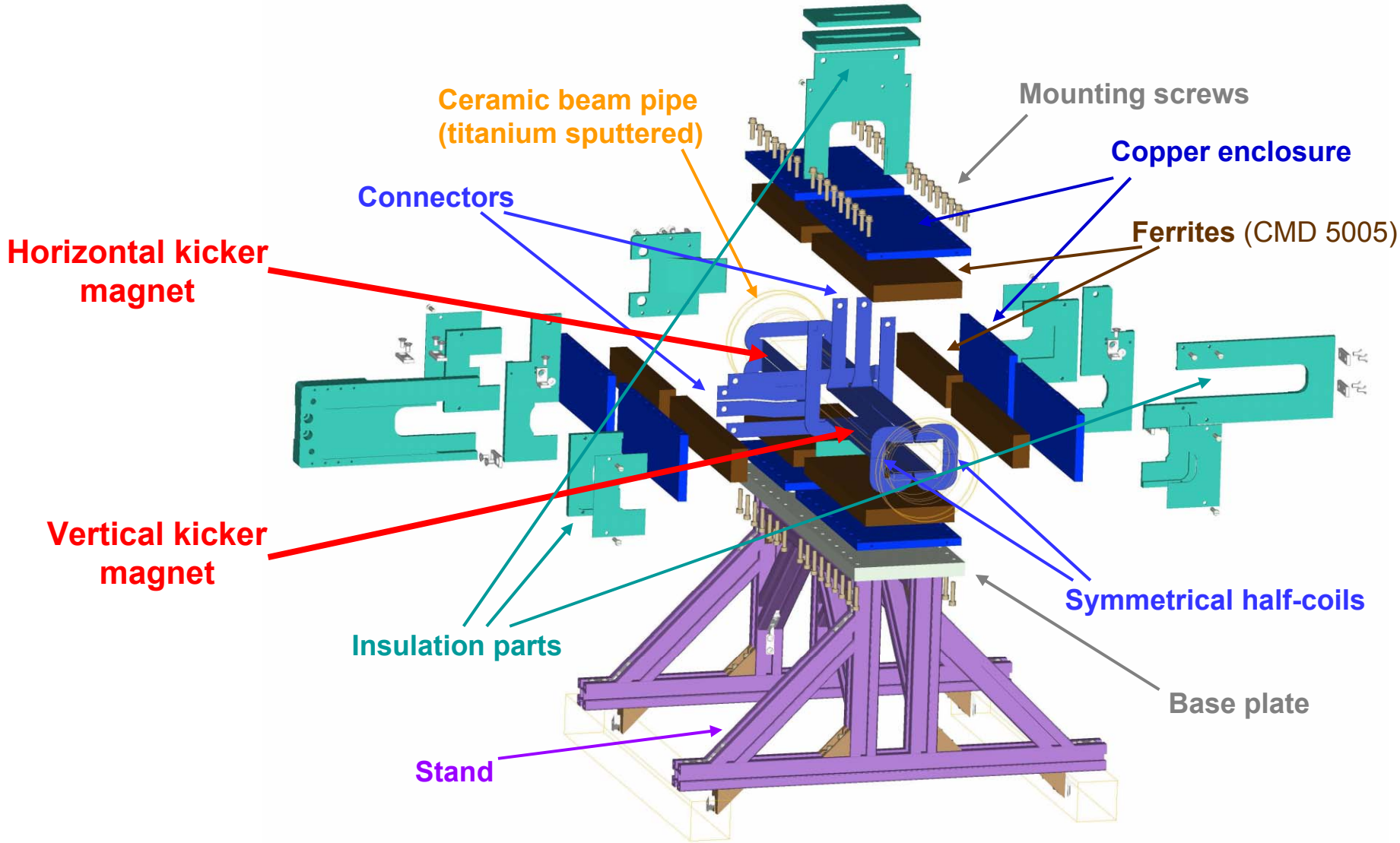
Constrains for the Mech. Design were:

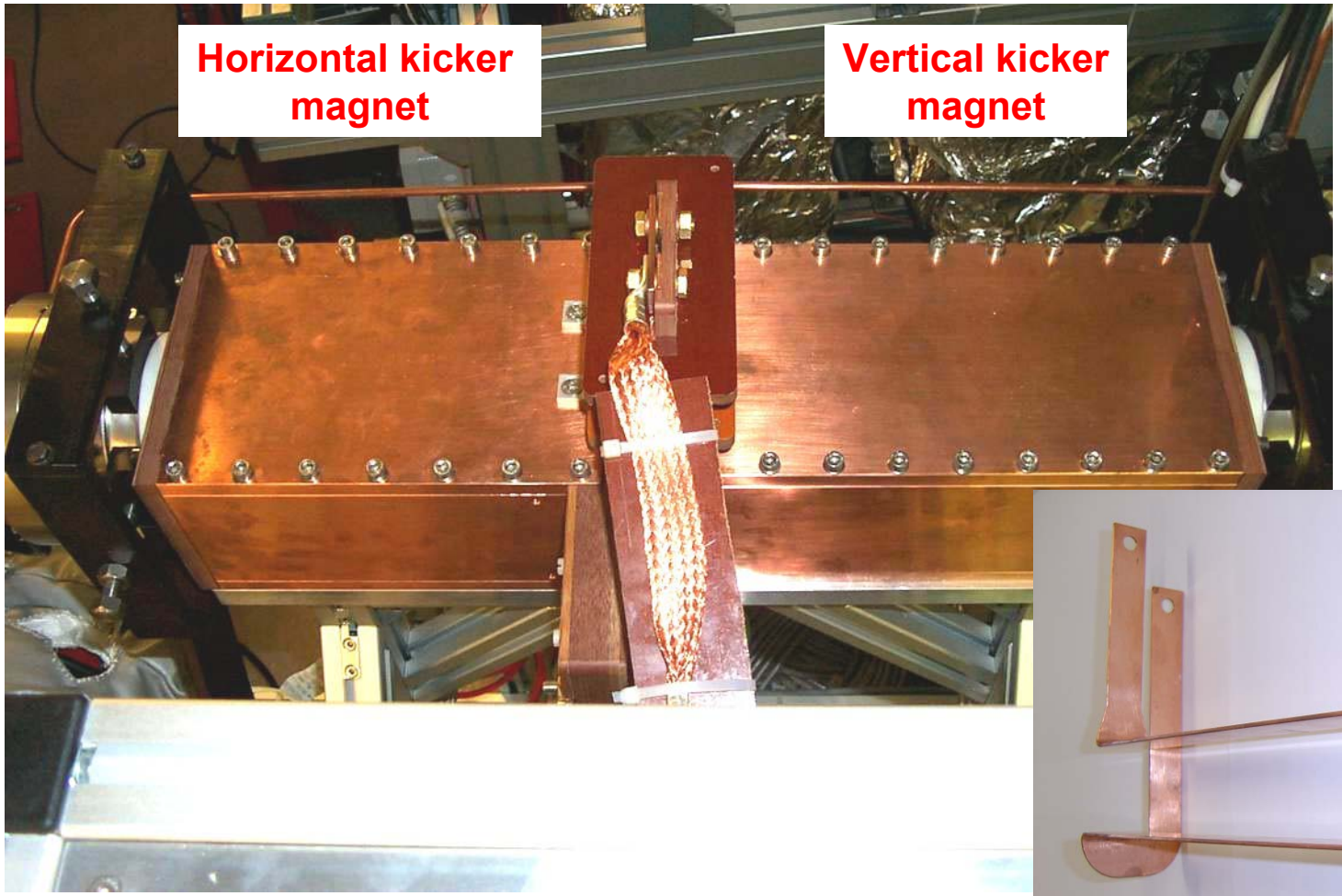
- Available **mechanical length** of 690 mm
- High magnetic **flux density**
- Integration into the storage ring with **least interference** to **continuous user operation**.

Technical Realisation of the two Diagnostic Kicker Systems

- Two **lumped inductance** magnets, designed as **ferrite window frame** magnets
- Magnets around a **ceramic beam pipe**
  - Titanium sputtered with **5 µm** thickness, **No considerable field reduction**
- Pulser circuits directly attached
- **Half-sinusoidal** pulse shape with **max. pulse length** of **1.5 µs**

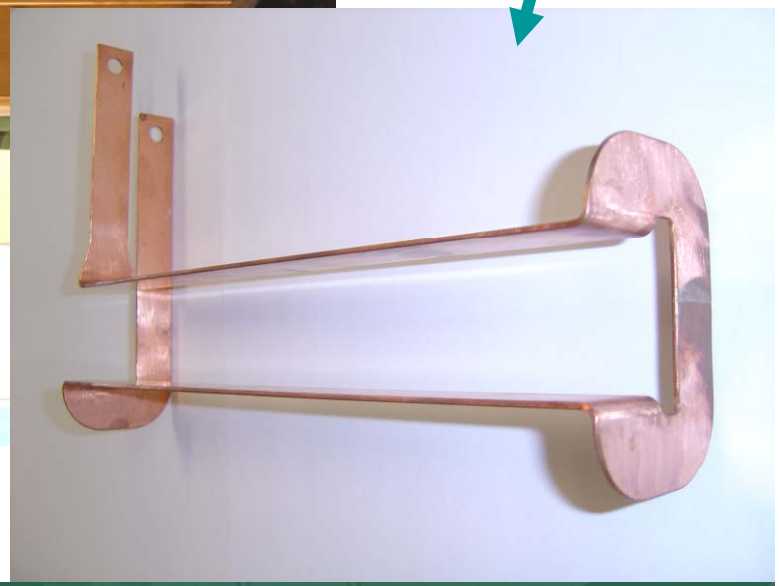
Exploded View of the Kicker Magnet Assembly



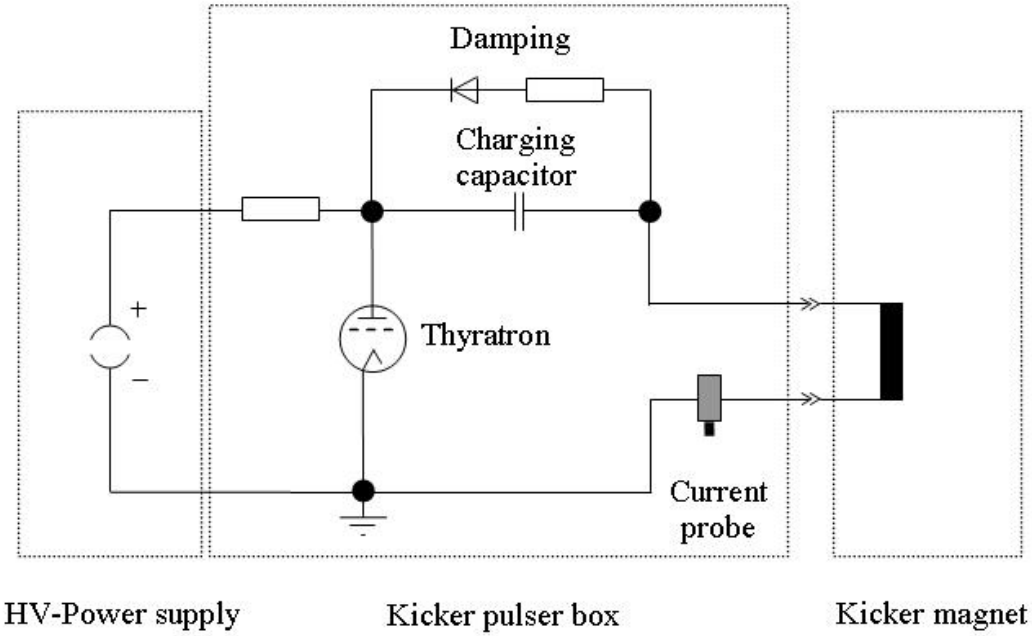


Picture of the assembled magnets from above

Half-coil of vertical kicker magnet

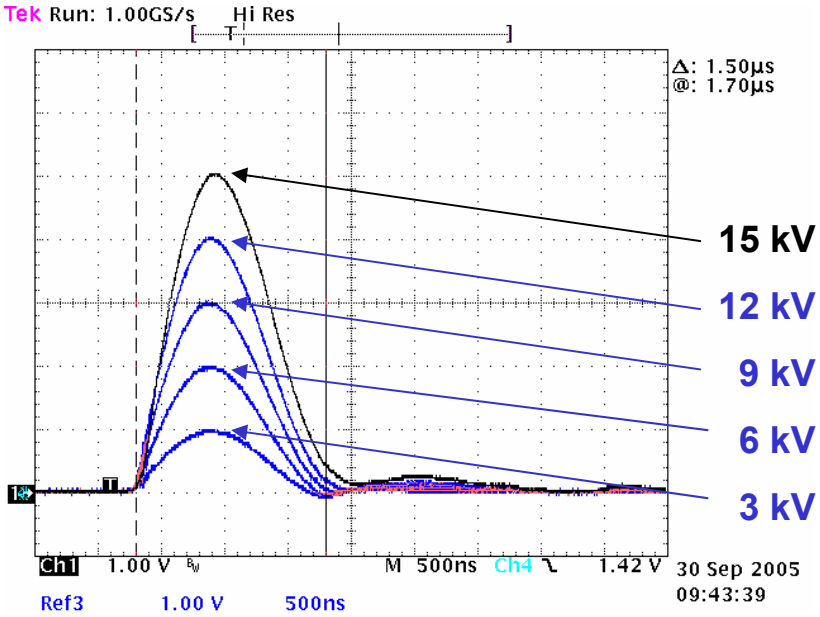


Design of Pulser Circuit

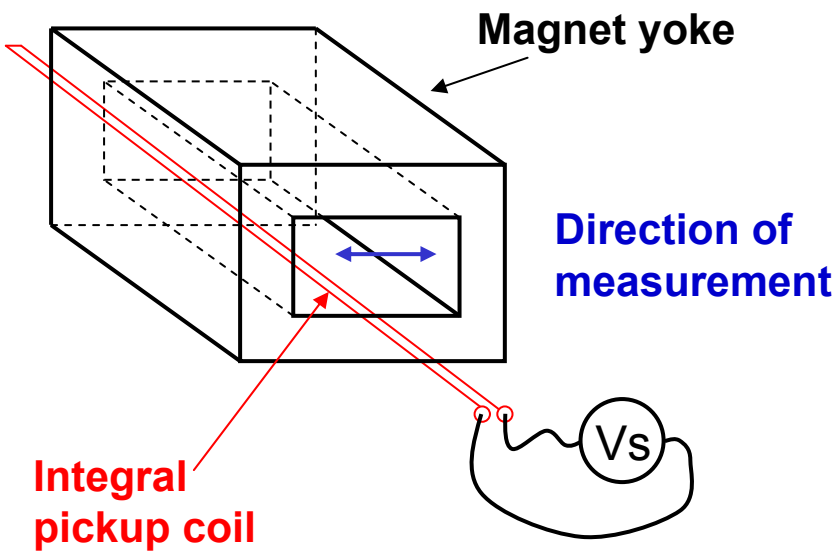


- **Low shift** of ignition **timing vs. trigger**
  → **Thyratron** as main switch
- Realisation in-house by utilising **commercially** available **components**
- Pulser boxes **adjacent to** the **magnets**
  → **Low inductance**
- Charging power supply with **high stability** (2×10^{-4})
- Three dimensional layout
  → **High voltage prove** and **low inner inductance**
- **Wrap connections**
  → **Interchangeable polarity**

Pulse Current on Horizontal Magnet from 3 to 15 kV

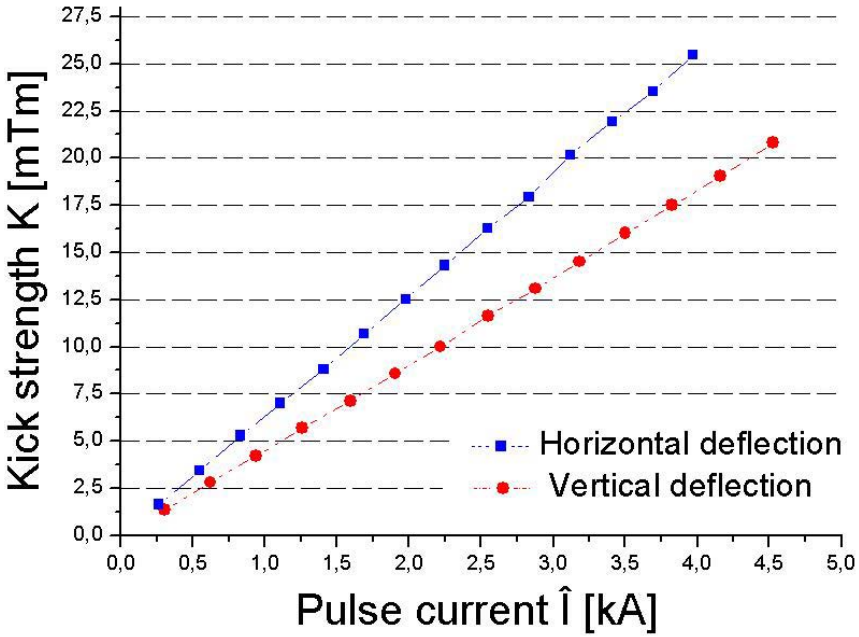


Integral Magnetic Field Measurement



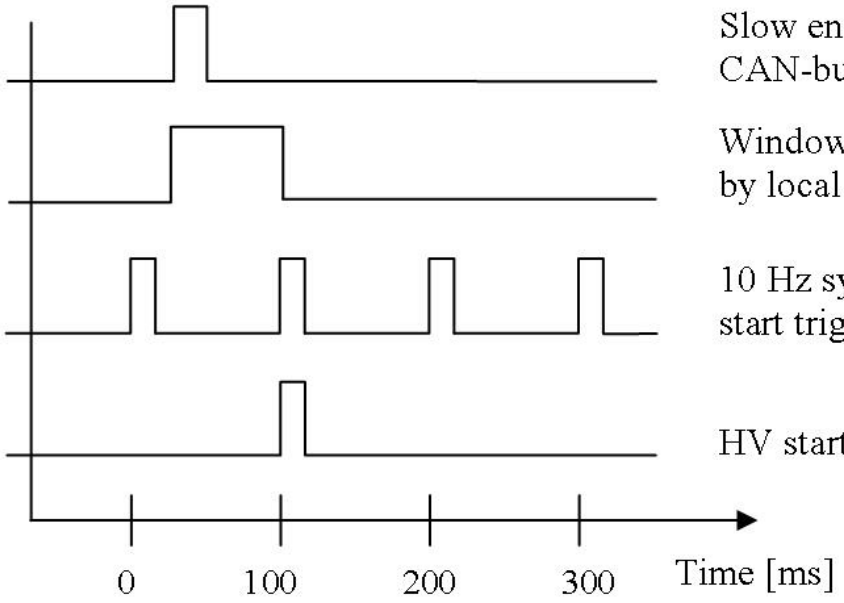
Measured Integral Field vs. Pulse Current

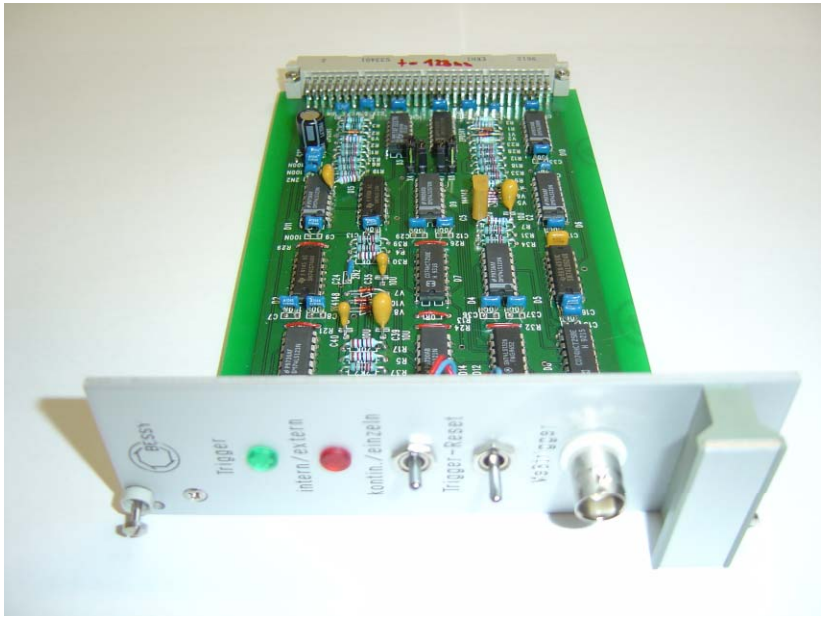
- **Linearity** over the **whole range**
  → **No saturation** of the core was observed!



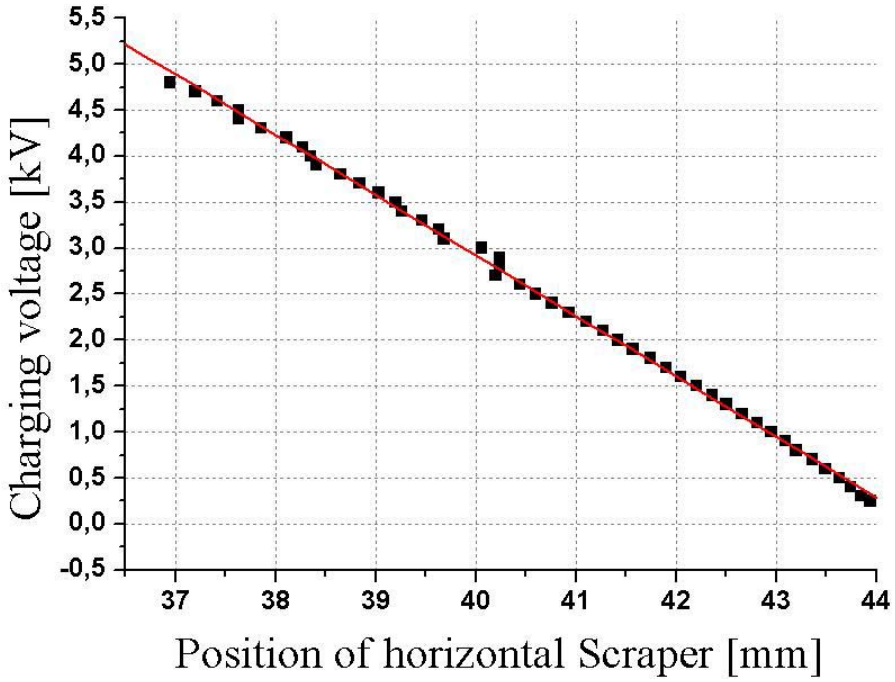
Measurements with current amplitudes up to **4.5 kA** vertical and **3.9 kA** horizontal

- Both systems can be run **simultaneously** and **synchronized** in:
- **Continuous operation mode** with 10 Hz repetition rate
- **Single shot mode** where a gate signal is given by CAN-bus for **synchronous start trigger**
- **Synchronized** with the **1.25 MHz revolution frequency** and **50 Hz line beat** for **coincident** beam excitation and measurement





Charging Voltage on Horizontal Kicker vs. Horizontal Beam Deflection

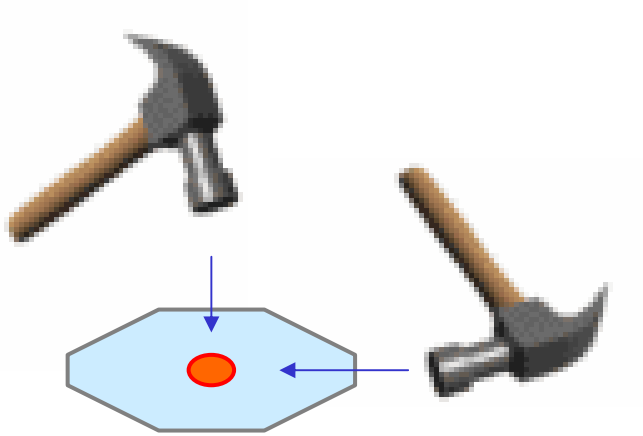


Methodology

- The system is **continuously pinging** horizontally at **10 Hz**.
- Determination of the excitation amplitude by a **moveable aperture limit** - a horizontal scraper.
- **Increasing excitation** of the circulating electron beam up to **nearly zero lifetime**.
- Measurement identifies the **linearity** between **charging voltage** vs. **deflection amplitude**.

Conclusion

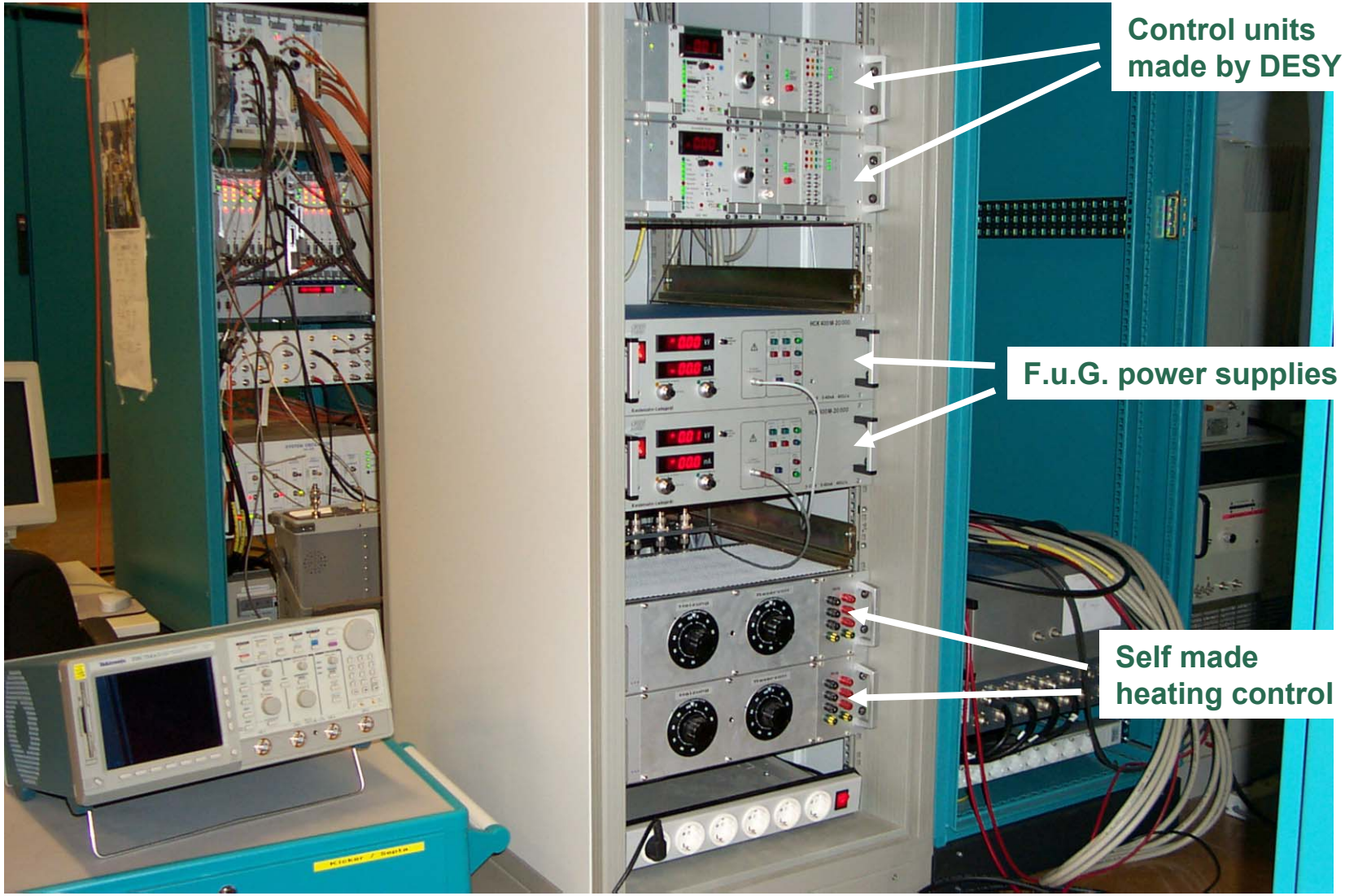
- This Diagnostic Kicker System was integrated into the BESSY II storage ring 6 years ago.
- Since then a variety of measurements have been successfully performed, e.g.:
  Frequency map measurements, dynamic aperture measurements, …
- Very reliable equipment with only little maintenance.



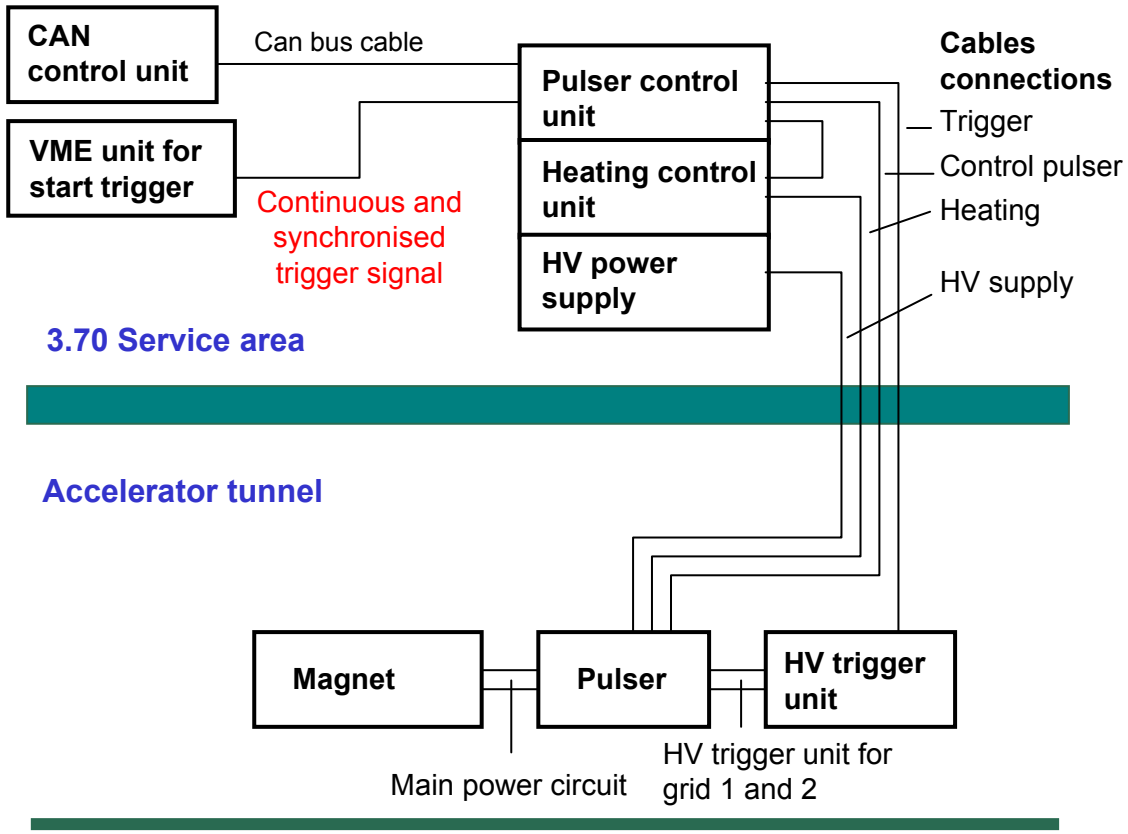
Acknowledgements

- To the excellent cooperation of different work groups at BESSY
- Especially to Peter Kuske, who established the system by his frequency map measurements
- Continuous support and guidance of Jens-Olaf Kuszynski for the Labview control programs

Control Rack with Local Control Electronics



General Survey



Labview program – front panel and flow diagram for frequency map acquisition