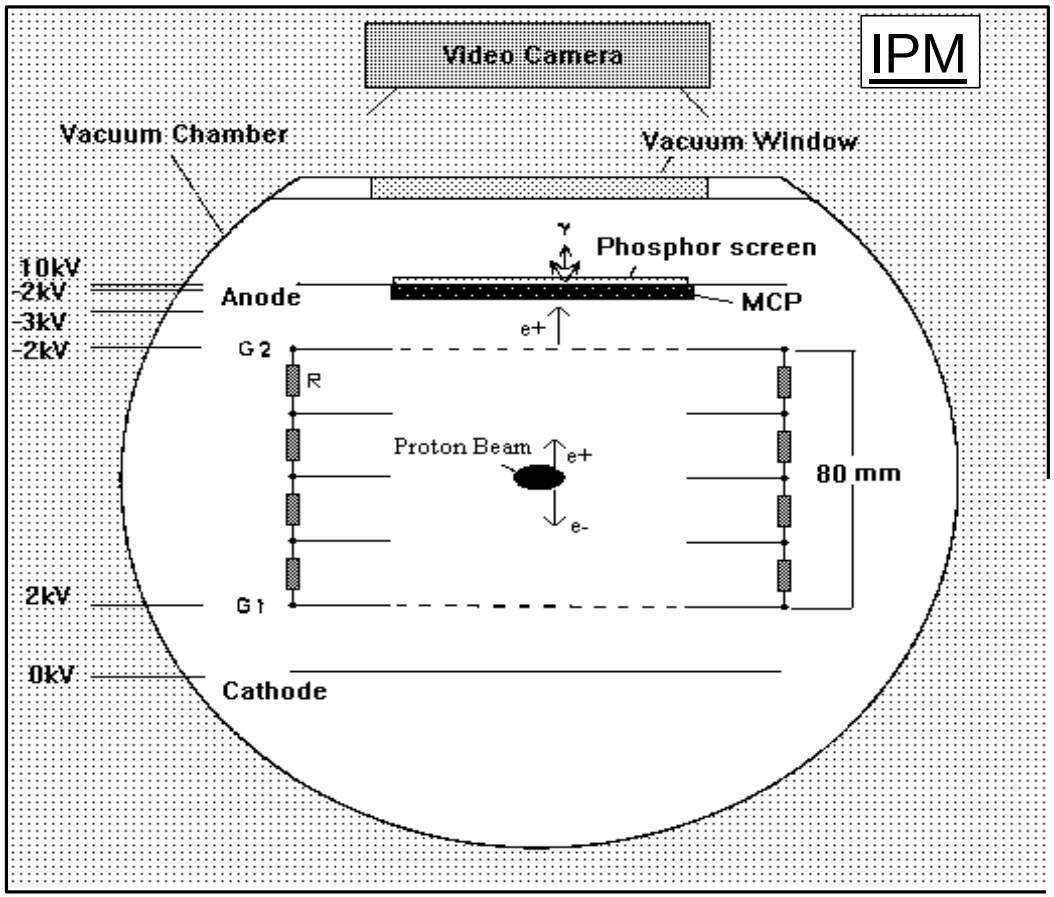
Present Status of Instrumentation at DESY

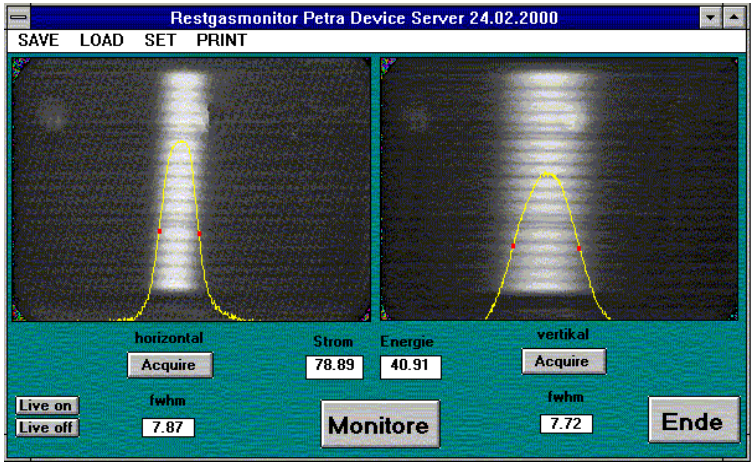
by K. Wittenburg, DESY

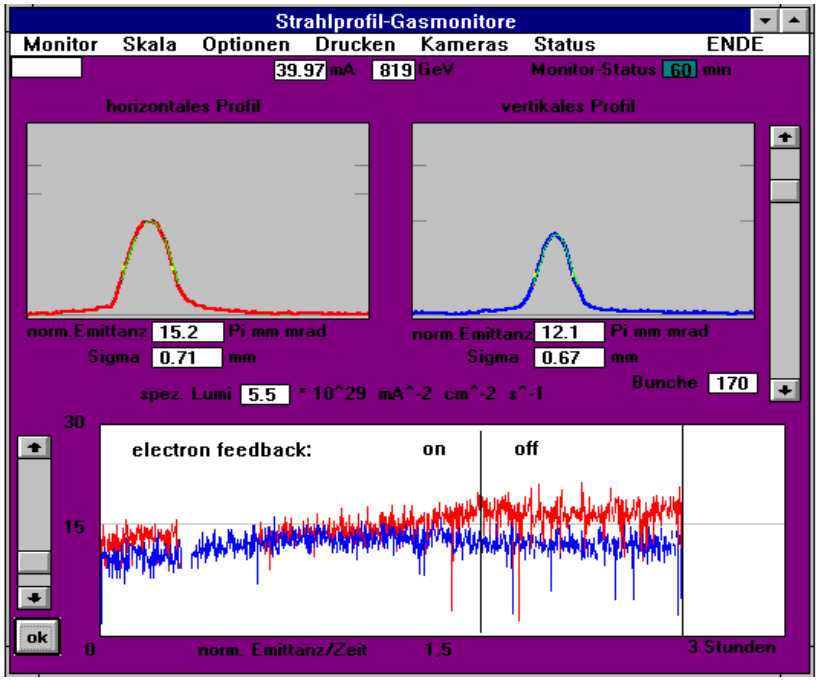
Quantity:	Profile	BPM	Beam Loss	Current	Misc
DESYIII	fast[5] wire scanners (up to 220 mA) IPM[1] (first prototype was tested many years ago)	inductive pick-up[7]	Scintillator[8]	Toroid[10]	"stepping wire" (in preparation)[2] 3 resistive wall monitors[13]
PETRAp	fast[5] wire (up to 160mA) IPM[1] (sensitive, correct beam width at small bunch currents only)	capacitive pickup (button) (for e and p)[12]	Long segmented Ion Chamber (planed)[14]	Toroid[9,10,11]	"stepping wire" (in preparation)[2] 2 resistive wall monitors[13]
HERAp	OTR Screen (proposed, for injection[6]) IPM[1] (sensitive, correct beam width at small bunch currents only) fast[5] wire (up to 160mA)	Directional coupler Pickup (Stripline)[12]	PIN diode BLMs (counting mode)[3]	Toroid[9,10,11]	BLMs at scrapers[2,4] "stepping wire" (in preparation)[2] fast wall current pick-up for bunch length measurement[15]

Notes: (see also figures)

1) gas ionization monitor system
2) For tail measurements, see talk
3) 10 MHz response, counting mode
4) PMTs and PIN diodes
5) up to 1 m/s, upgrade planed
6) for max. 10 bunches only, to measure the quadrupole moment
7) 30 kHz-250 MHz Bandwidth
8) Photomultiplier, > 10 MHz response.
9) DCCT slow current transformer typ PCT or M-PCT, 0-200 mA, res: 0.5 μA, CD - 100kHz
10) AC Fast current transformer, 30 kHz - 20 MHz, Cal: 10^{11} p/V, res: <<10μA, meas. precise transport efficiency
11) difference of 9) and 10) = coasting beam
12) Broadband readout (<96 ns)
13) for bunch length, timing and feedback; 2 MHz - 1 GHz bandwidth
14)
15) 200 kHz - 3 GHz, Linnecar type







»Vacuum 10-9 mbar
»1 - 60 - 210 Bunches => << 0.1 - 160 mA
»7.5 - 40 - 820 GeV/c
»beam width << 1 mm, length 30 - 3 cm

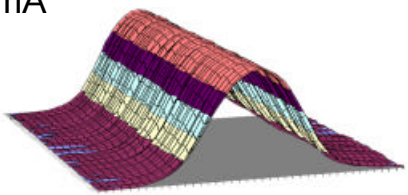
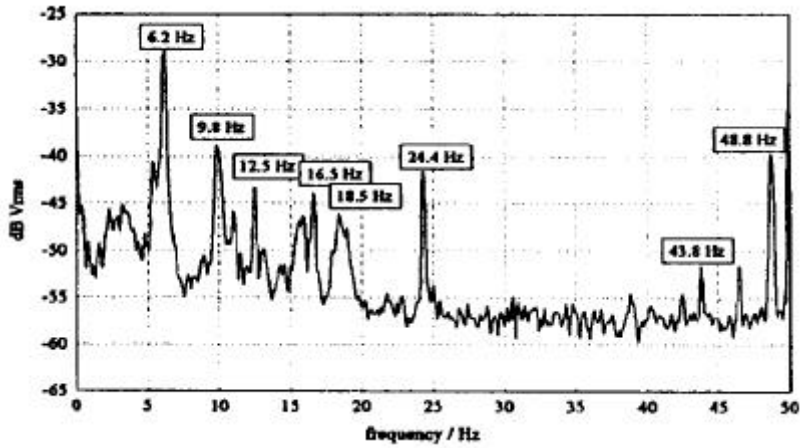


Fig. 1

BLMs at HERAp

Ground Motion



Proton Diffusion

The diffusion parameters at different tune modulation settings are measured by retracting a scraper from the beam tail and observing the adjacent loss rate decrease and slow increase afterwards.

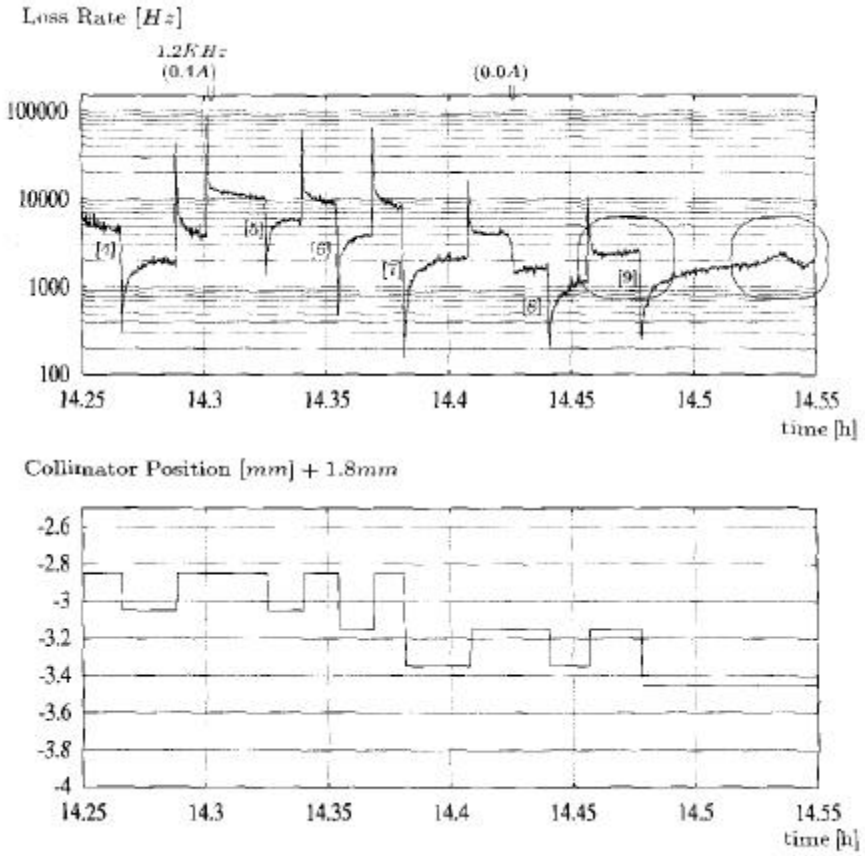
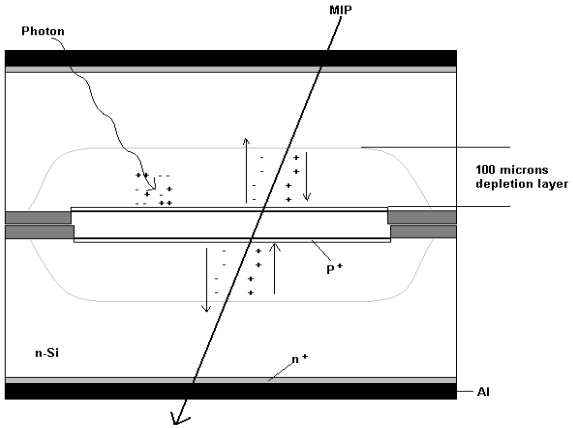


Fig. 2

BLMs at HERA

Sensitive and fast amplifier with low noise and with a fast coincidence following

- Efficiency to charged particles: 30%
- TTL output for counting
- Very low noise:
- Dark count rate < 0.01 Hz
- max. count rate > 10.4 MHz
- Very high dynamic range: >109
- Insensitive to synchrotron radiation:
- Efficiency to γ: 3.5 · 10-5
- Coincidence + lead: 1Hz at 1.5 Gy/h (e- ring at max.)



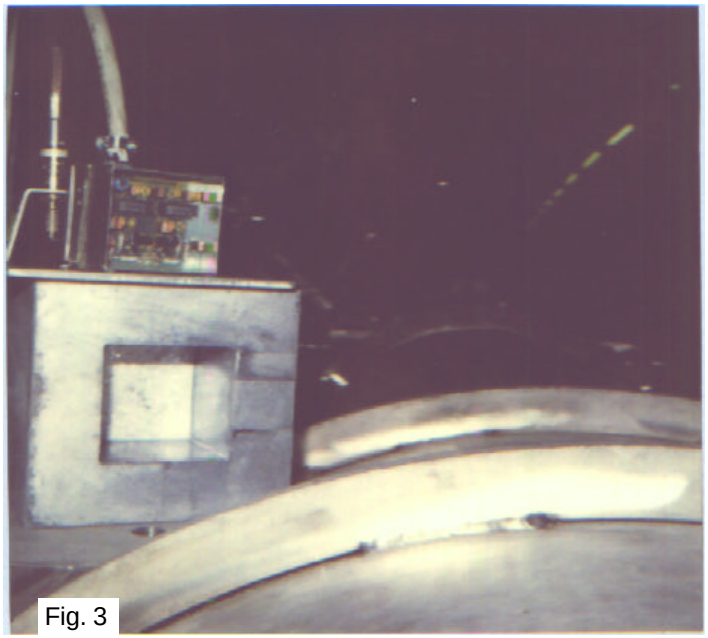
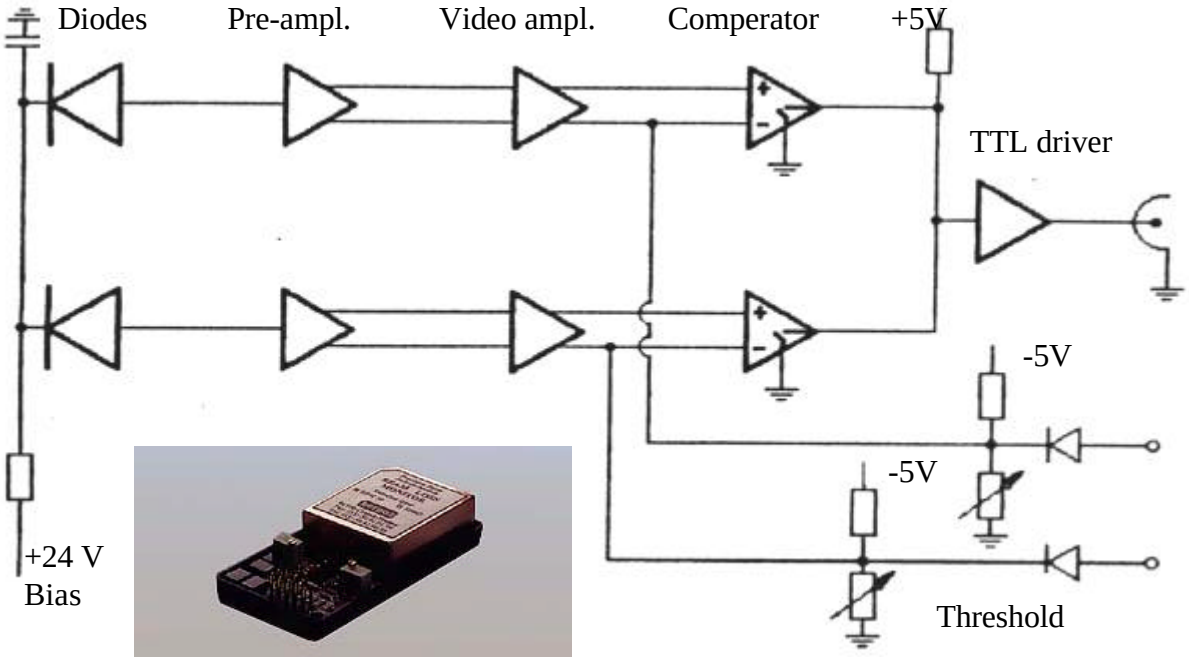
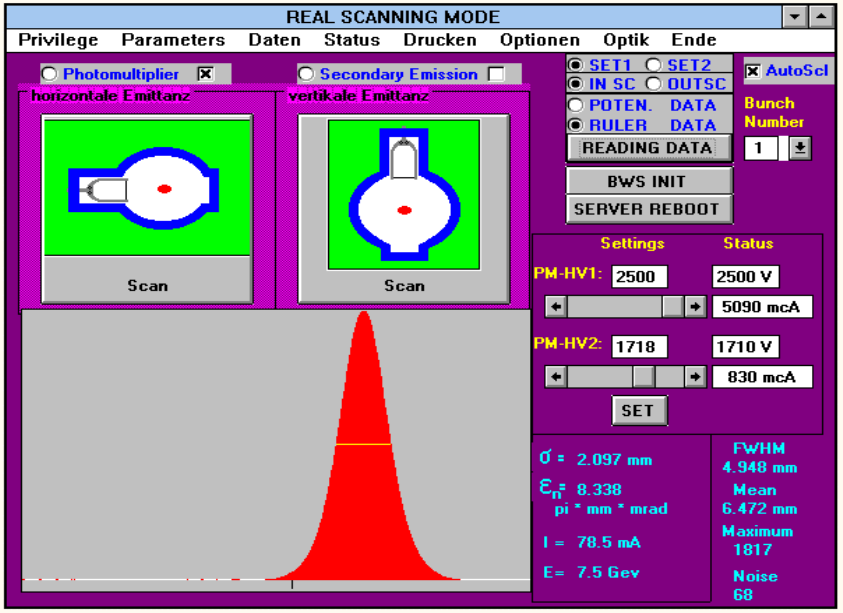


Fig. 3



Wire scanners in all circular accel. at DESY



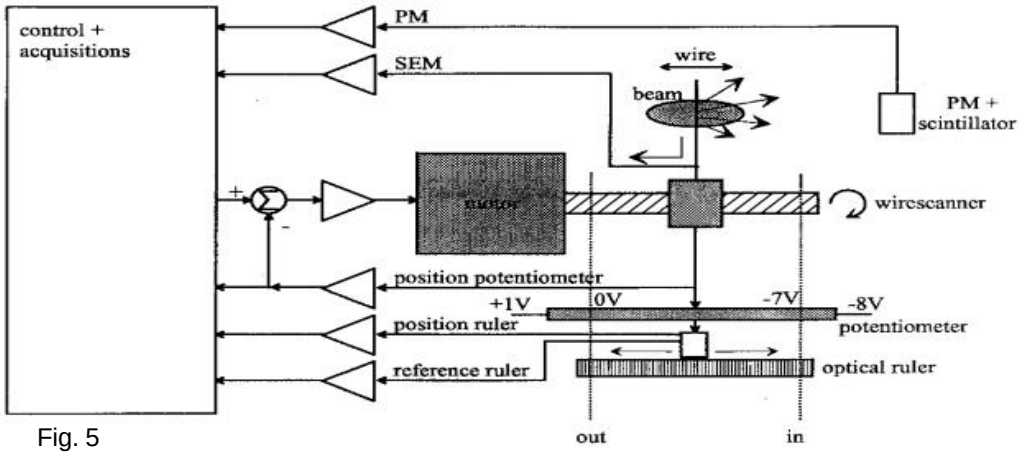
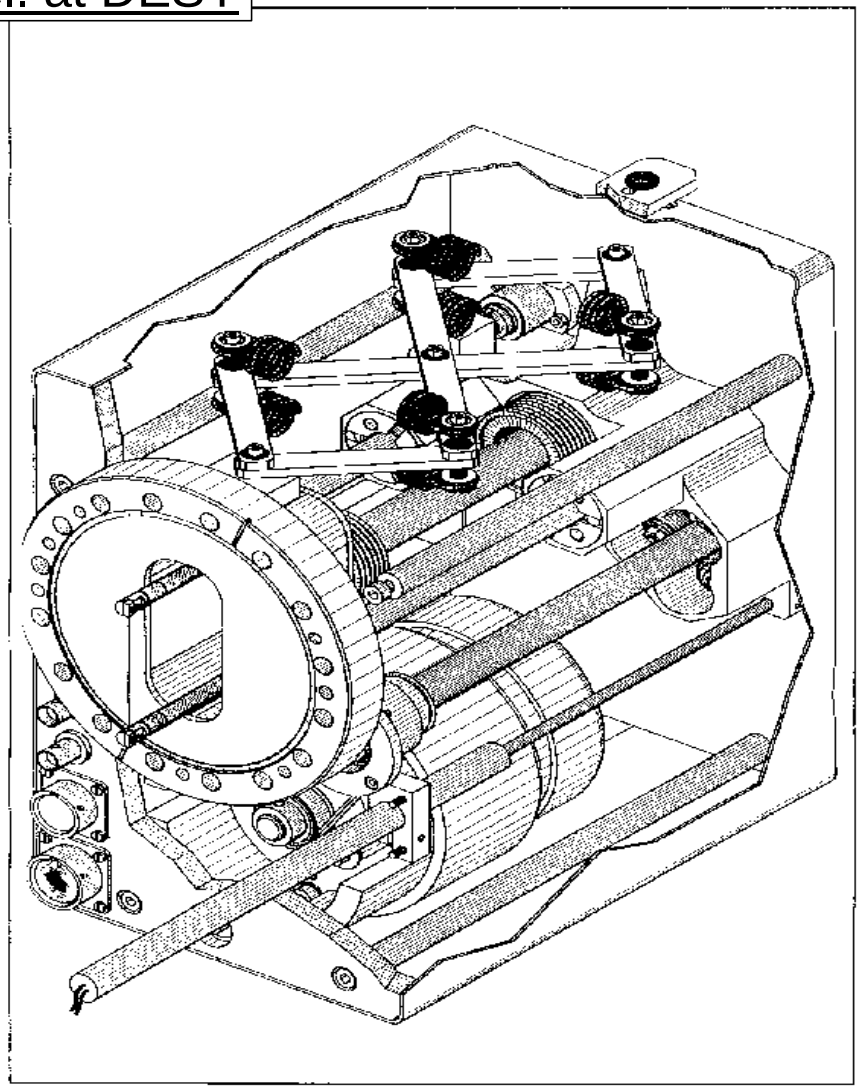
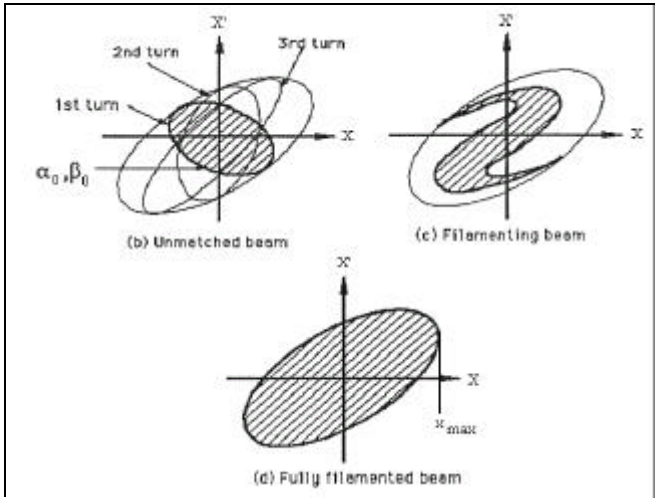
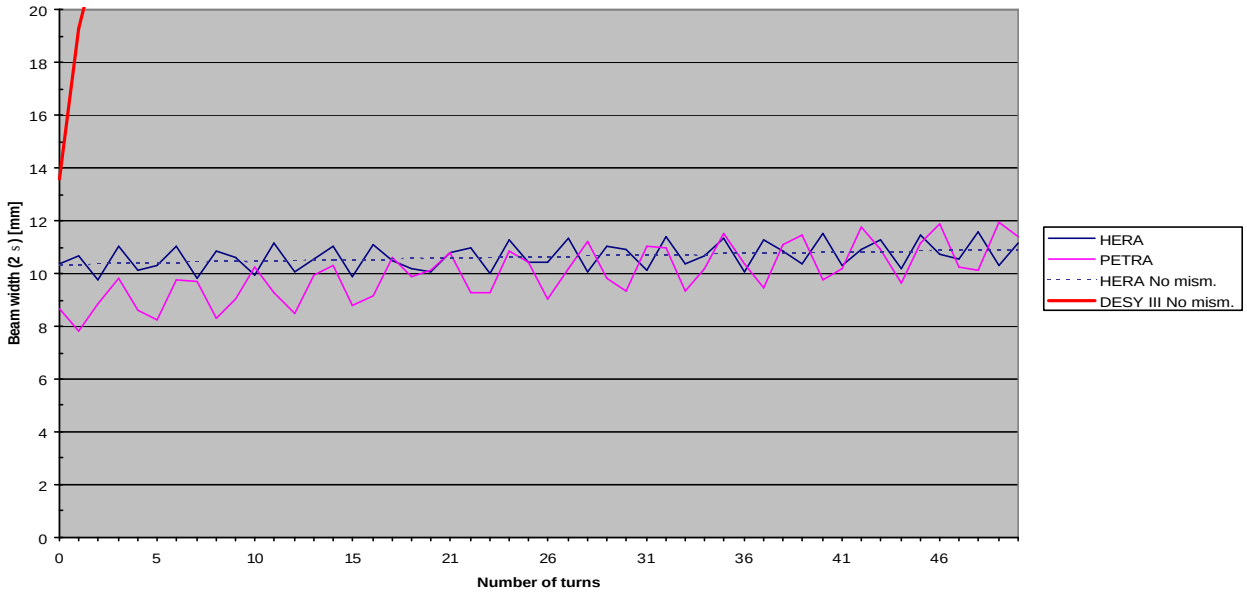


Fig. 5

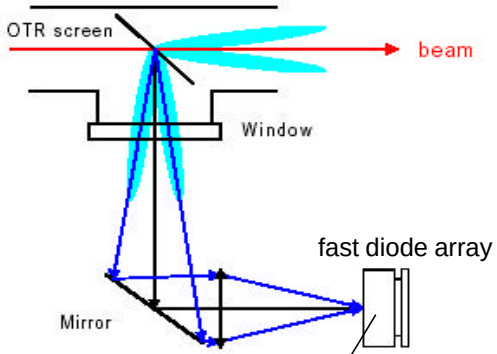


Quadrupole oscillation monitor; OTR screen

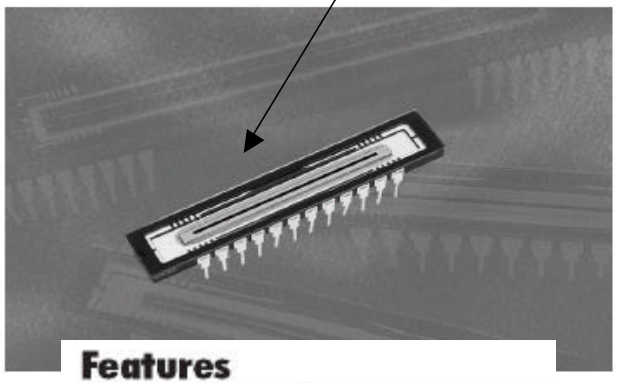




The following fig. 2 shows a simulation for the first 10 turns in HERA. A 10% β- or α– mismatch lead to a shape oscillation of up to 2 mm (2 σ).



: Matching monitor set-up in the SPS



Features

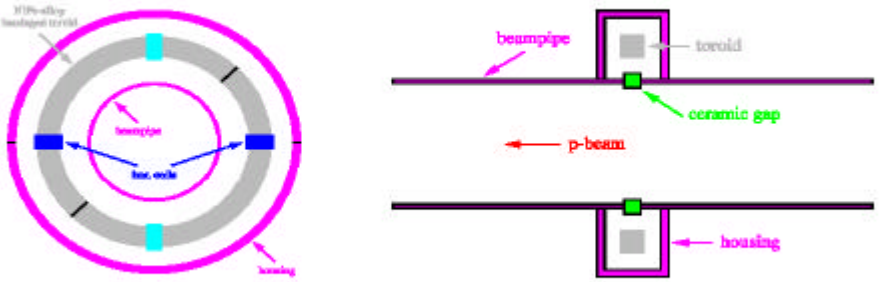
- Single output, up to 15MHz data rate
- 13µm (H) x 500µm (V) pixel size
- Photodiode photoelements
- 2048 elements
- Antiblooming and exposure control

Overview

Physical Characteristics	IL-C6
Pixel dimensions	13µm x 500µm
Aperture	26.6mm x 0.5mm
Active pixels	2048
Isolation pixels per line	5
Light-shielded pixels per line	4

Fig. 6

Inductive Beam-Position Pickup

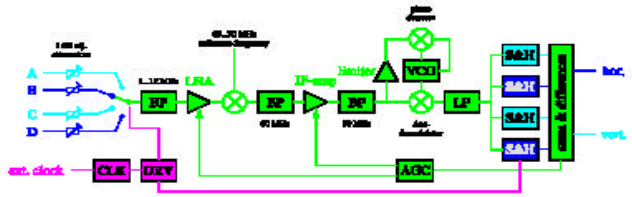


Schematic of the inductive beam-position pickup.

- Circular beampipe of 84 mm diameter aperture.
- 10 mm wide ceramic gap.
- 134 mm diameter NiFe-alloy bandaged toroid transformer with 4 orthogonally arranged single-loops (electrode-coils).
- Normalized sensitivity $\Delta/\Sigma \approx 1.2\%/\text{mm}$ with a high linearity over the full aperture.
- Typical signal levels range between some 10 mV at flat-bottom and several volts at flat-top energy (peak-peak amplitudes, 50 Ω termination).
- 30 kHz...250 MHz (-3 dB) bandwidth.

DESY III BPMs

Electronics Hardware



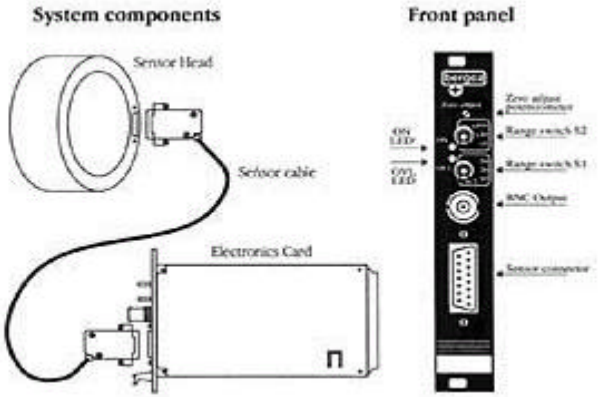
Schematic of the modified analogue *BERGOZ* BPM-electronics.

Wherever possible, commercial subsystems and modules were used for electronics hardware of the BOM/BPM-system:

- A modified *BERGOZ* BPM-electronics for the analogue signal processing:
  - Input frequency range ≈ 3...10 MHz, to guarantee the detection of any number of bunches in the ring.
  - IF center frequency of 60 MHz, 500 kHz bandwidth.
  - External LO input, driven from the rf-synchronous DESY-III low-level rf-synthesizer (≈ 63...70 MHz).
  - Changes on the internal clock frequency and AGC loops.
- Two C-size VXI digitizer-boards (*VXI-Technologies VM2616*) with 64 independent 16-bit ADC's sharing 512kWord of total memory.
- A PC plug-in delay generator (*Stanford DG135*), which delivers the ADC trigger.
- Usual PC-hardware, including a IEEE1394 "Firewire"-link to the VXI-crate.

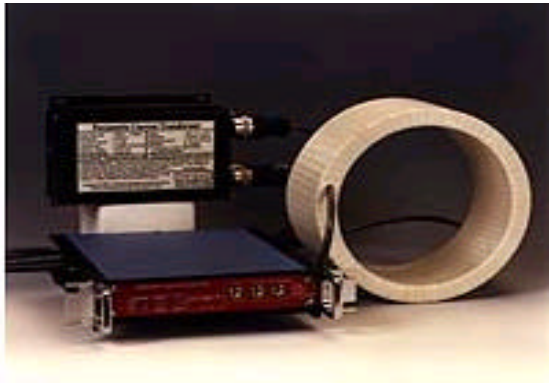
Fig. 7

MPCT Modular Parametric Current Transformer



see Bergoz homepage

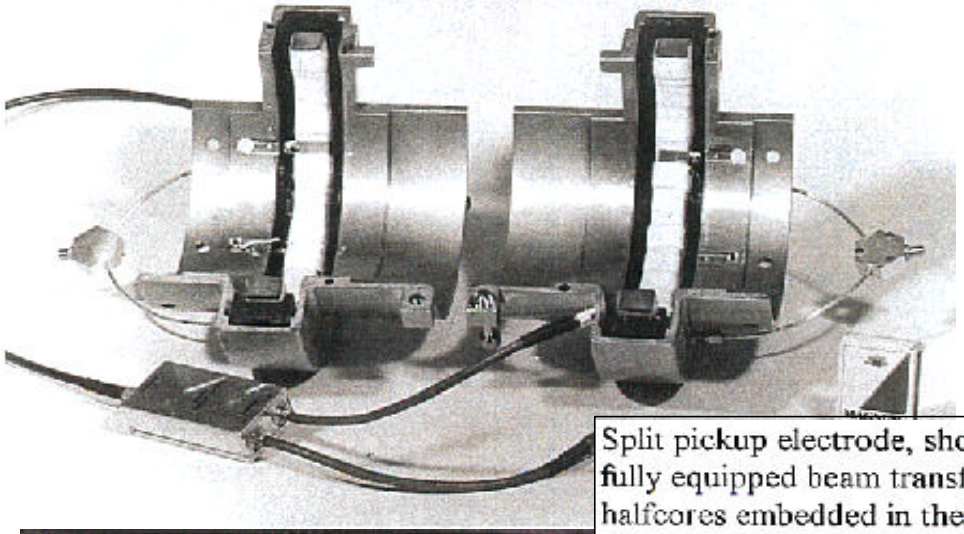
PCT Parametric Current Transformer



The PCT is used on most particle accelerators in the world to measure the average beam current. It is an essential instrument for machine tuning and commissioning. It is often the only truly calibrated beam instrument in an accelerator. It serves as a reference to calibrate other beam diagnostics.The PCT is used on most particle accelerators in the world to measure the average beam current. It is an essential instrument for machine tuning and commissioning. It is often the only truly calibrated beam instrument in an accelerator. It serves as a reference to calibrate other beam diagnostics.

Fig. 9

Fast AC bunch current monitor



Split pickup electrode, showing fully equipped beam transformer-halfcores embedded in their halfcovers

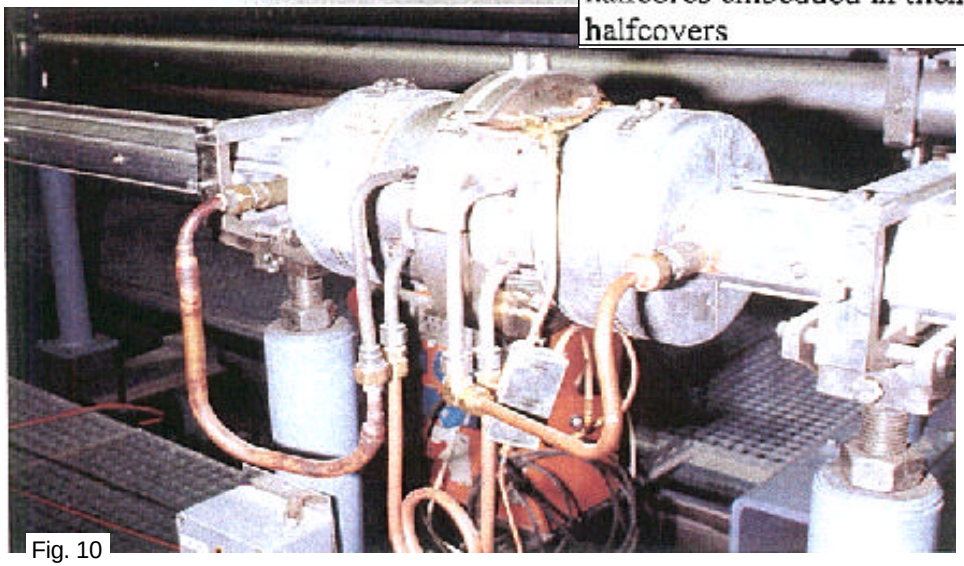


Fig. 10

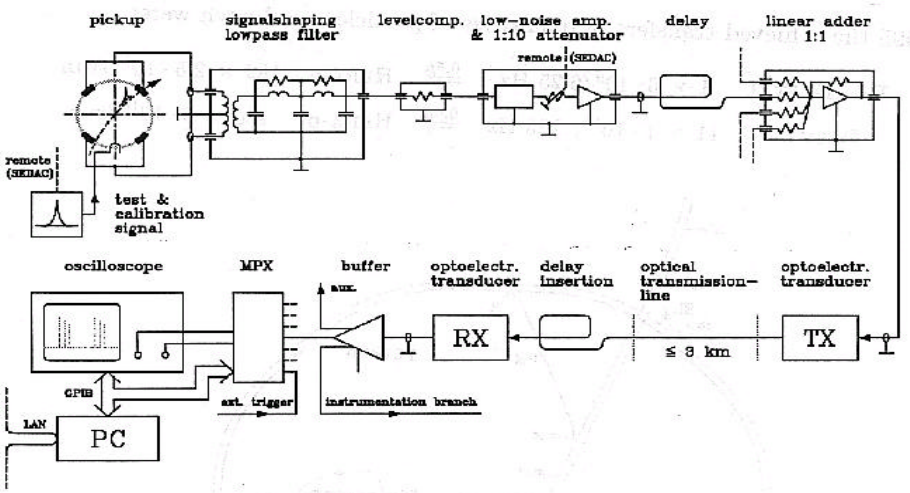


Figure. 3. Overview of a transmission monitoring setup

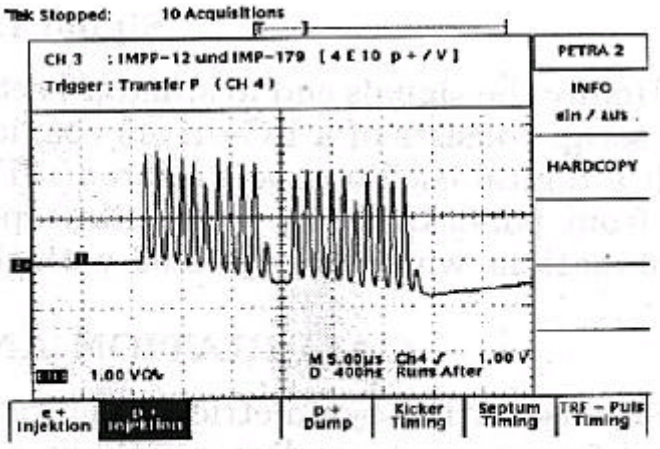
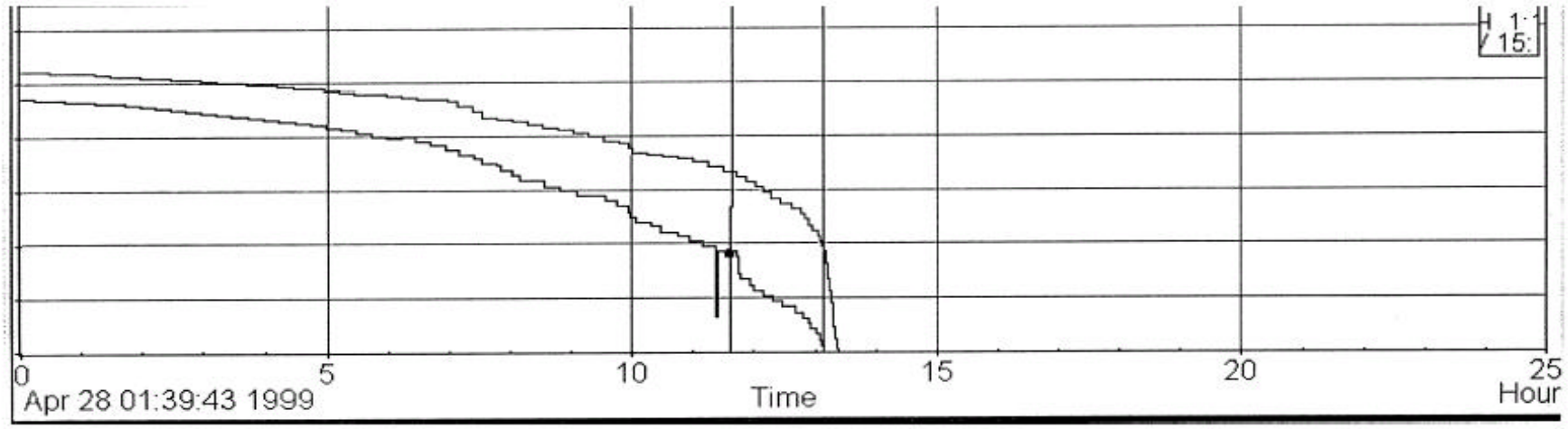


Figure. 5. Proton transfer (P. -line)
DESY III – PETRA II

coasting beam in HERA



Total DC current (upper) and total bunch current (lower)

Fig. 11

Button pickups in PETRA (protons and electrons) and HERA (electrons)

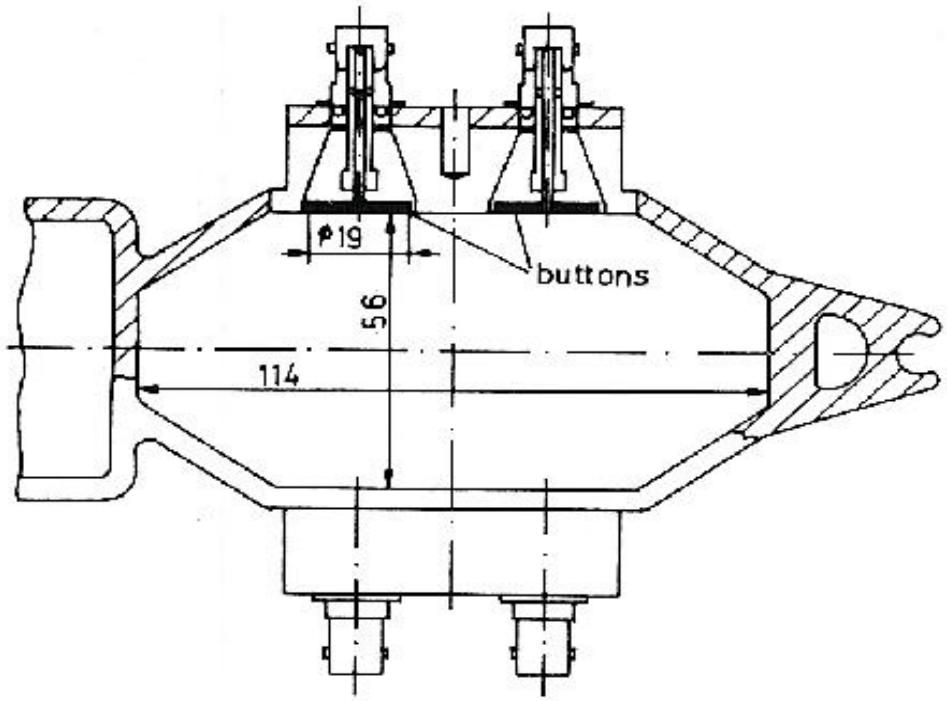


Figure 1: The PETRA button pick-up

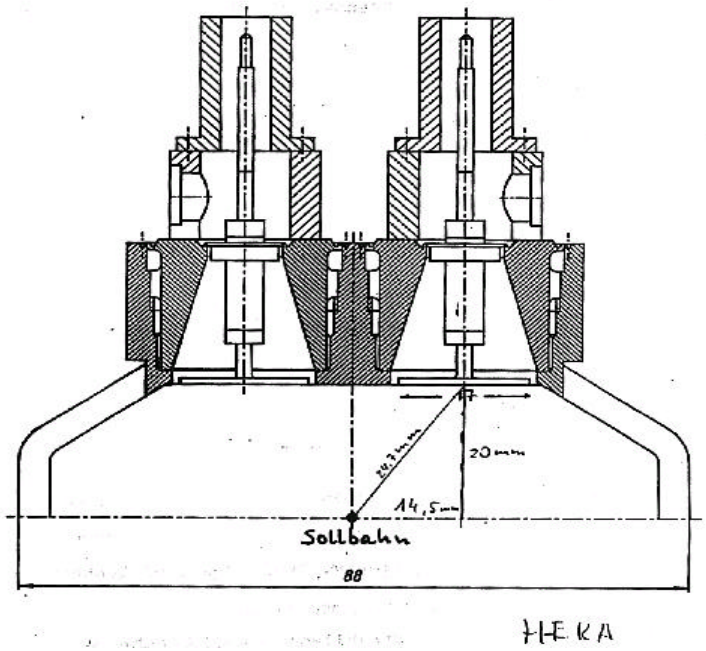


Fig. 12a

Stripline BPM in HERA (protons)

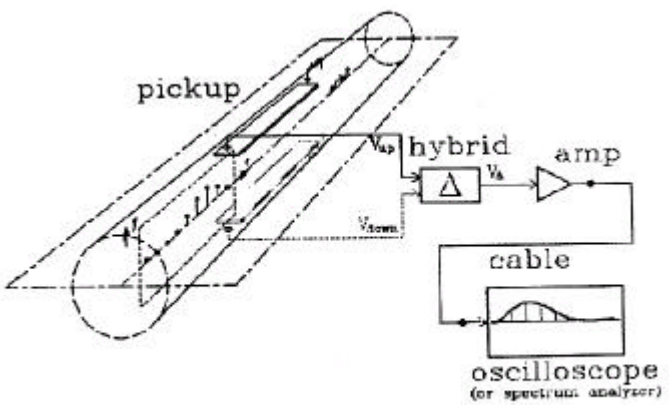


Figure. 1. Transverse beam monitor setup

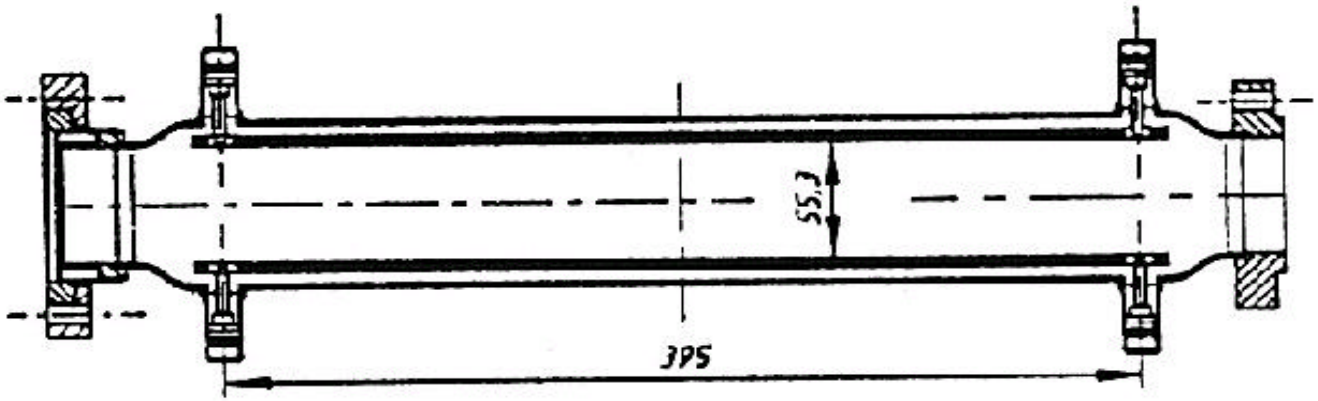


Figure 3: Technical drawing of the HERA beam position pick-up (longitudinal section)

Fig. 12b

Longitudinales Multibunch-Feedback (DESY 3)

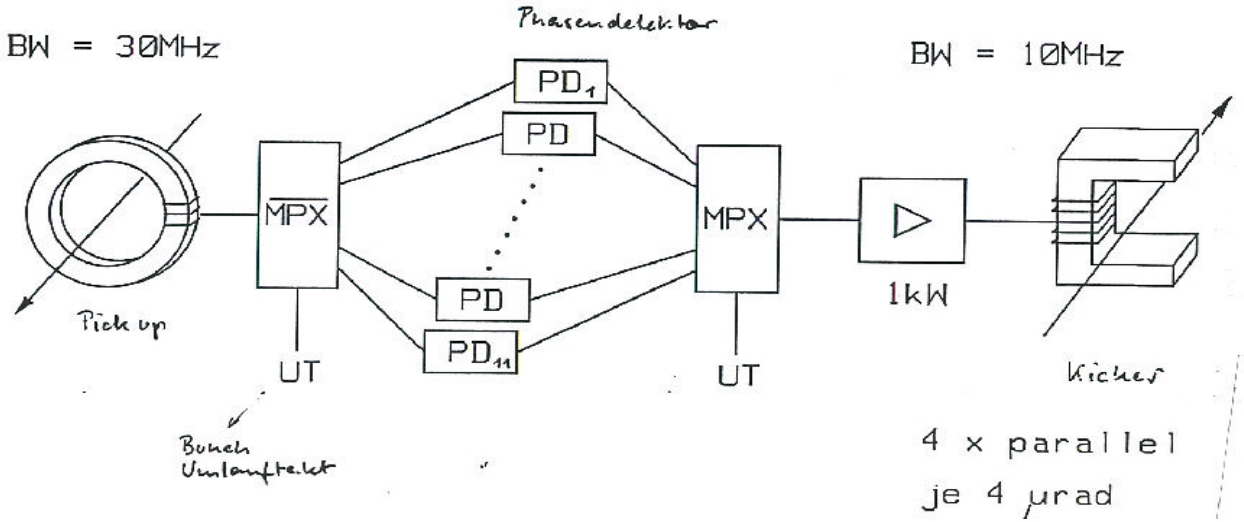
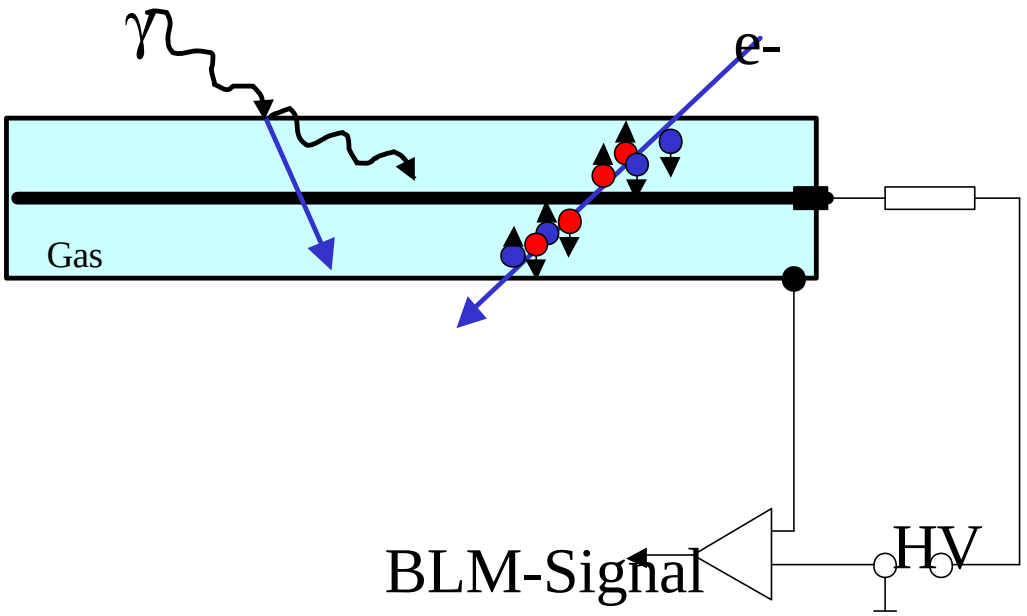


Fig. 13



Segmented long coax cable as a BLM for PETRAp (planned)

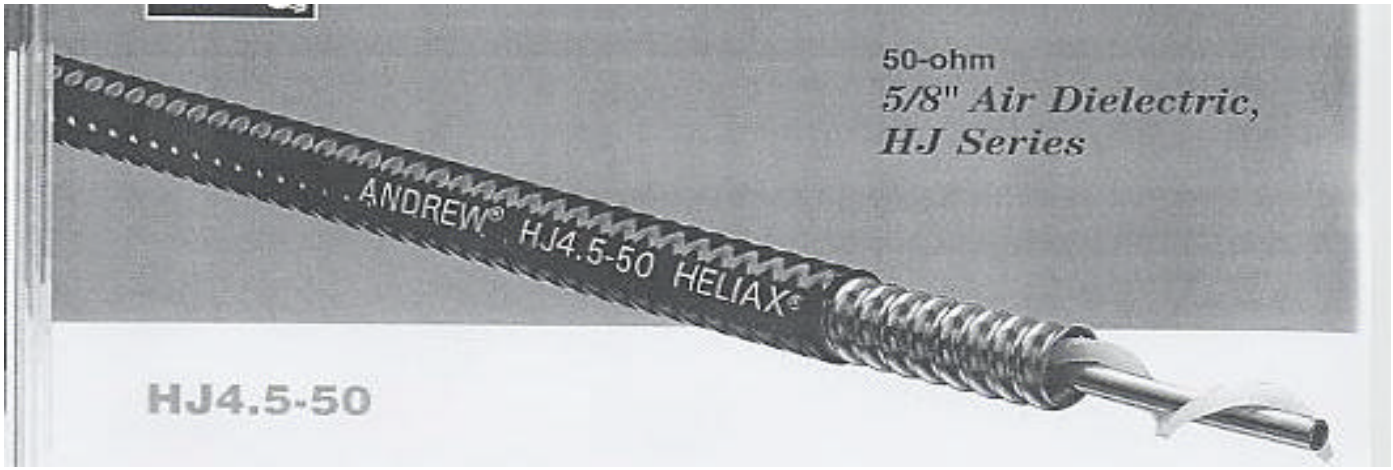


Fig. 14

Fast wall-current monitor in HERAp

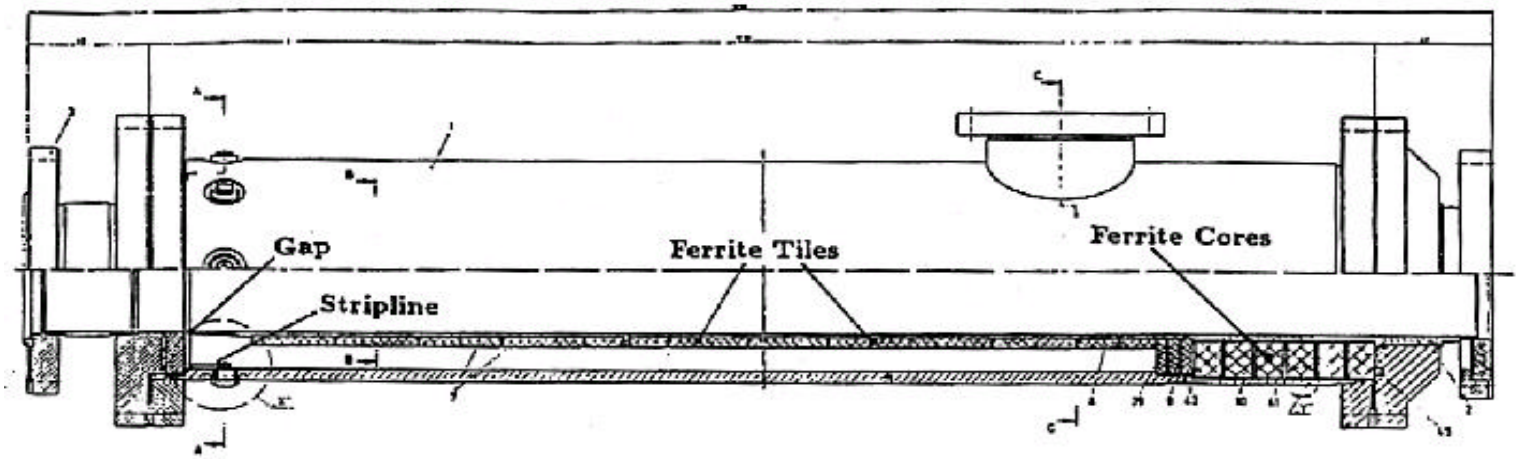


Figure 1: Wall Current Pick-up

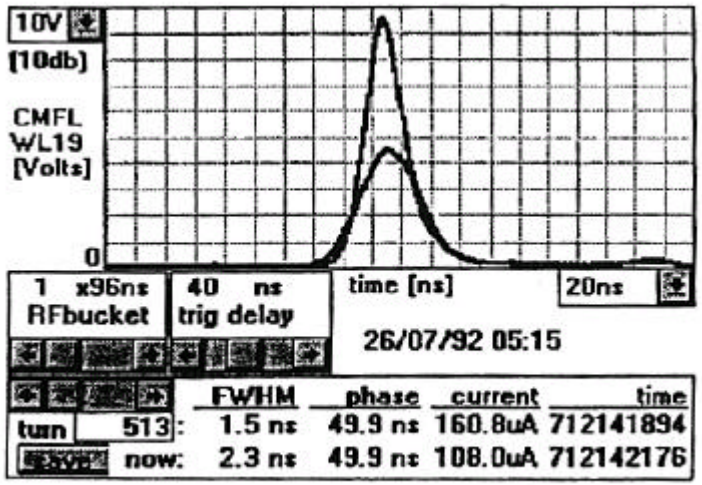


Figure 2: Injected Bunch Momentum Matched

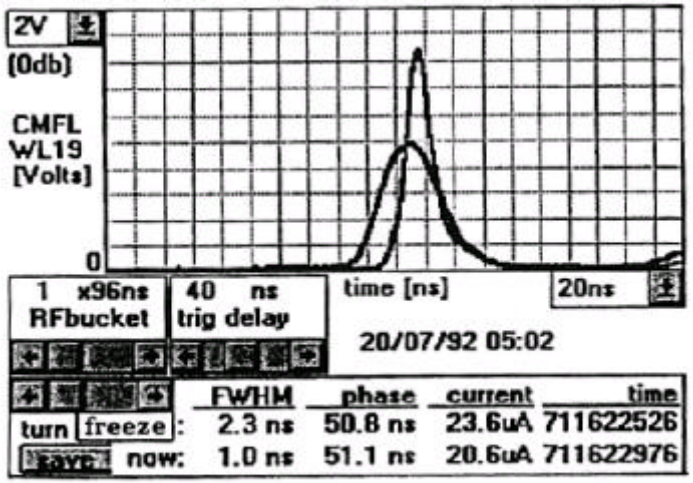


Figure 3: Bunch Compression Test At 820GeV/c

Fig. 15

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