H1 SILICON DETECTORS

PRESENT STATUS

By Wolfgang Lange, DESY Zeuthen

OUTLINE

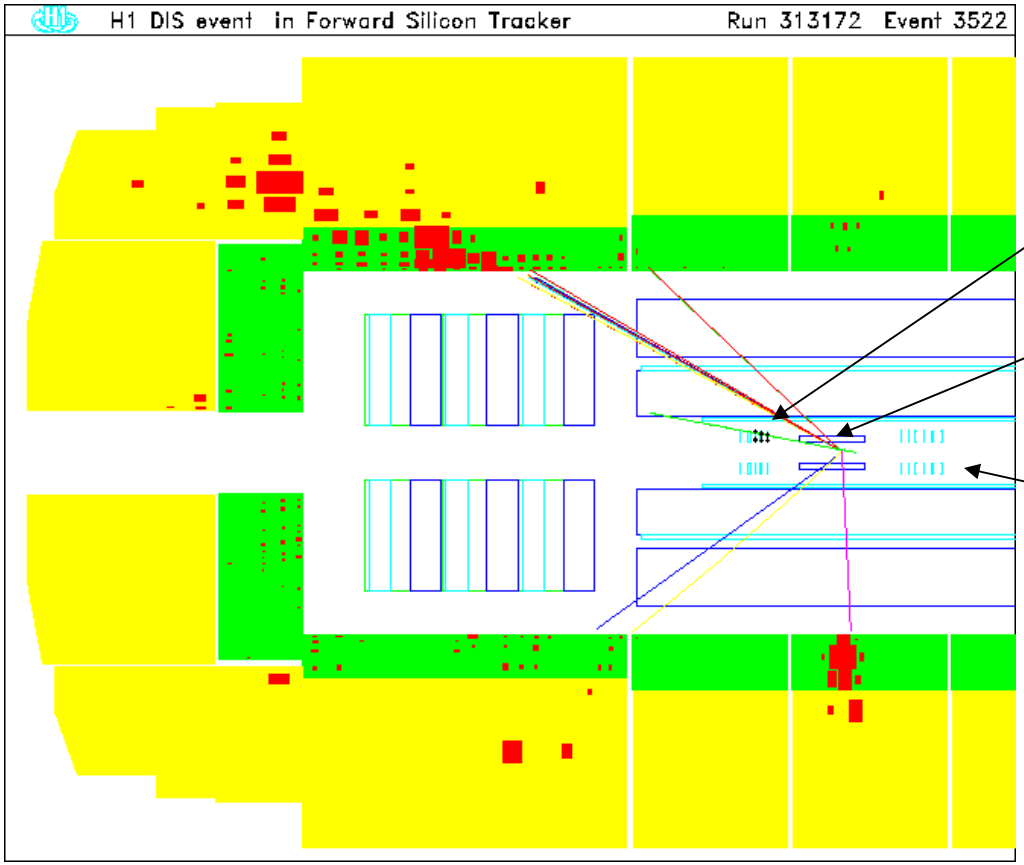
- Silicon Detectors in H1 (BST, CST, FST, BST-PAD)

  Backward Silicon Tracker [1], Forward Silicon Tracker [1],
  Central Silicon Tracker [2]
  Backward Pad Detector (part of BST) [1]
- Hardware configuration
- Current status
- Results
- Look into the future

[1] DESY Zeuthen, Acad. of Sc. and Charles Univ. Praha, Rutherford Lab, PSI Villigen

[2] ETH Zürich , PSI Villigen, Rutherford Lab

\+ for all subdetectors DESY/H1 technical infrastructure

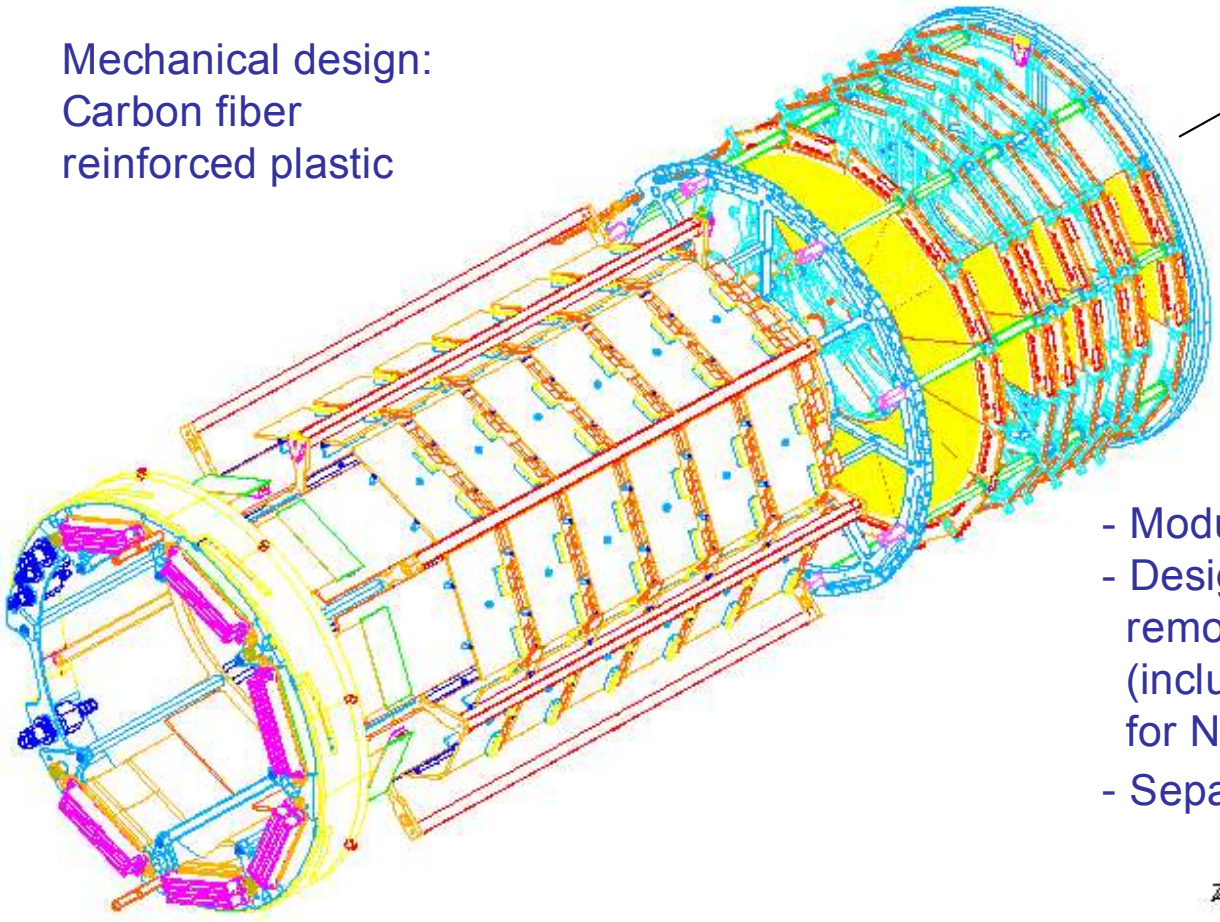


electron beam

proton beam

proton direction = forward direction

Mechanical design:
Carbon fiber
reinforced plastic

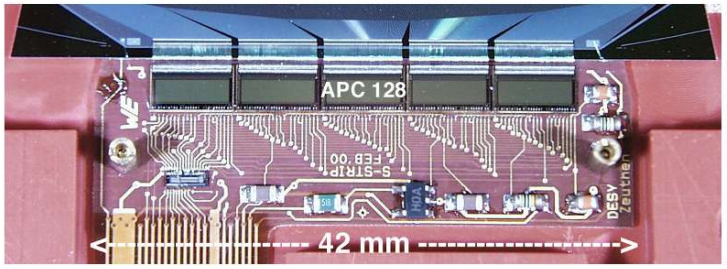


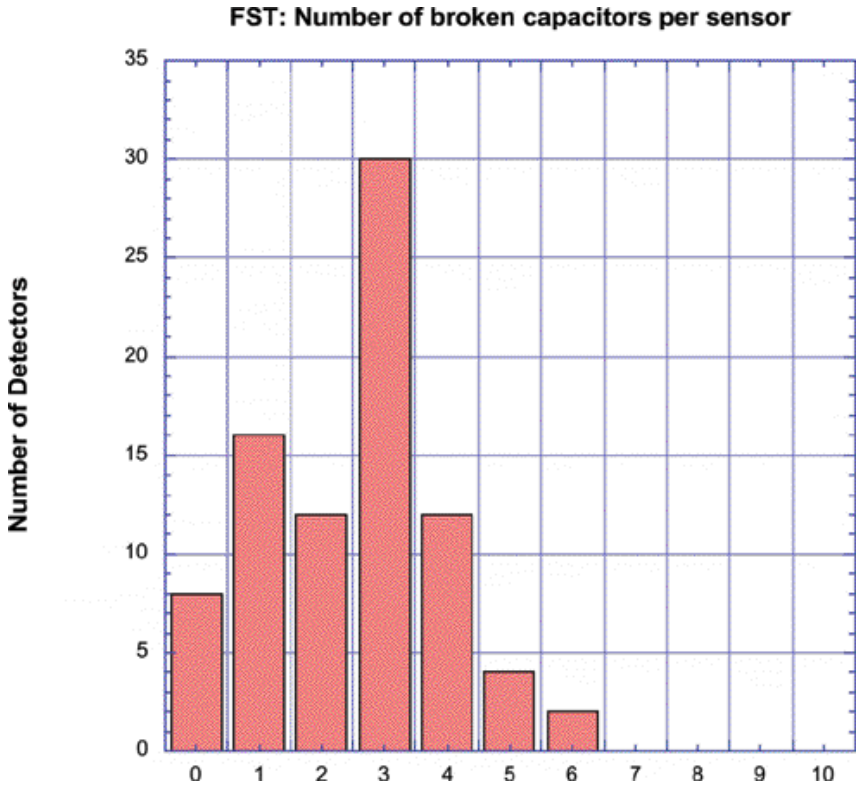
- Modular design of all components
- Design as a “plug in” device with remotely operated contact ring (including all media connections for N_2 and H_2O)
- Separate inner and outer shielding

Cable- and media connections are pre-installed to the contact ring

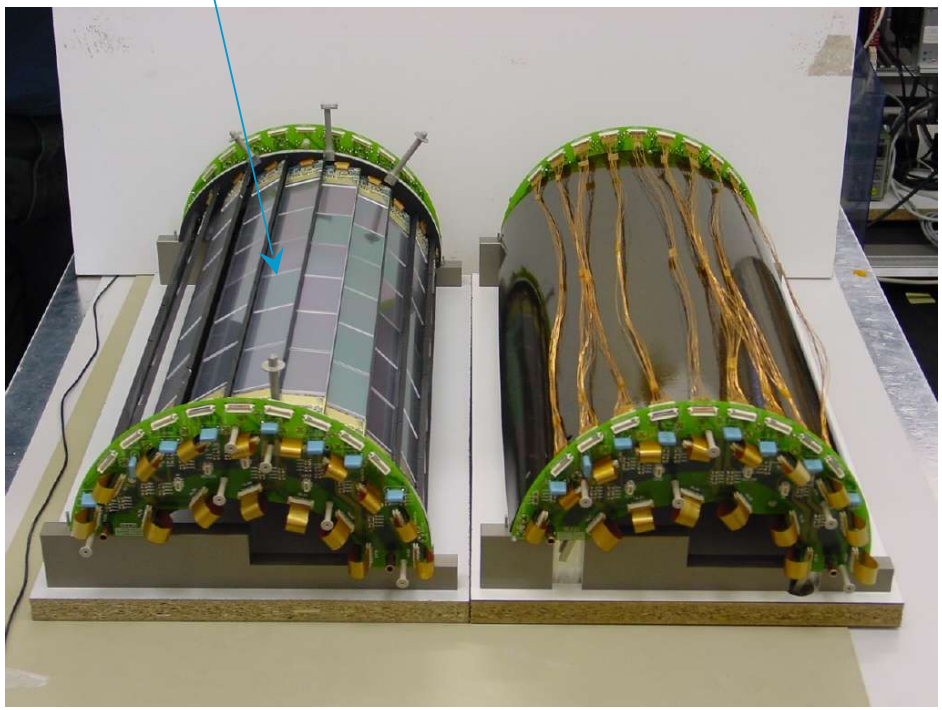
S(tandard) - DETECTOR MODULE

- universal detector module
  for front and back side
- low cost design with included strip line
  and heat distributing Al bottom layer
- standard circuitry (using APC 128 /decoder)
  optimized for low common mode and
  low noise (including ground plane)
- 220 modules (spares included) produced for
  both FST and BST





one ladder

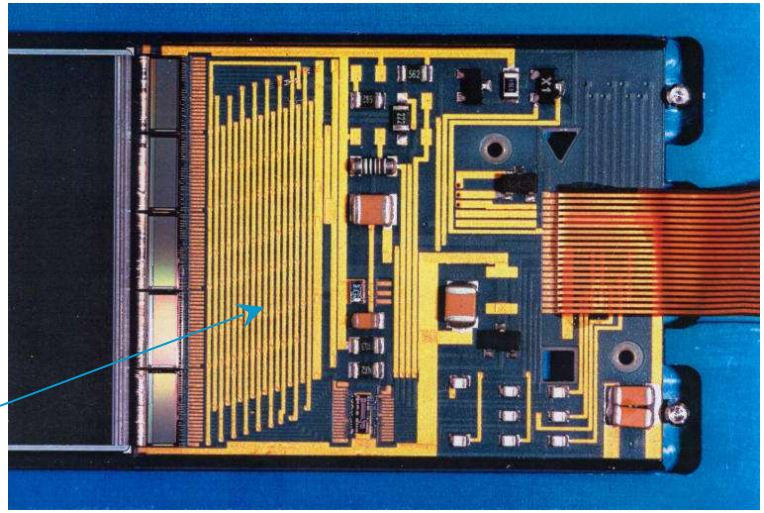


- CST barrel consists of two layers completely covering the beam pipe

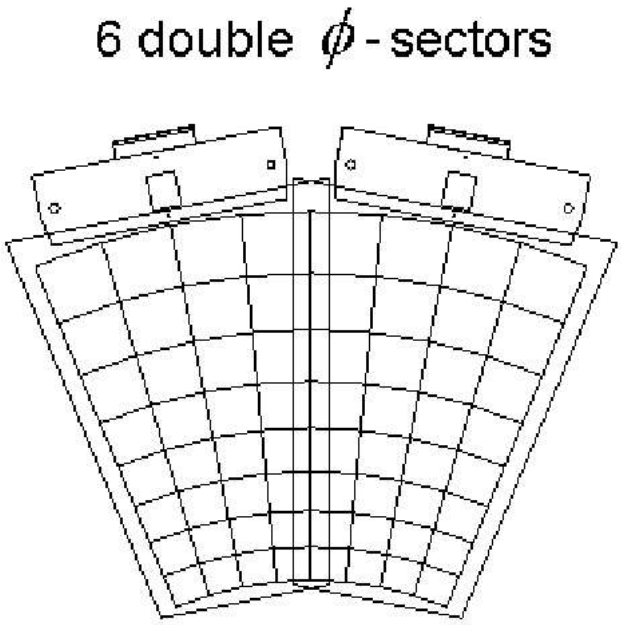
- Ladders consist of 6 double sided sensors with hybrids on both sides

- hybrids are equipped with radhard readout chips APC128 (DMILL)

CST hybrid



BST PAD DETECTOR



- For the measurement of deep inelastic scattering one needs to trigger on such events (vertex pointing)

- Background suppression for SPACAL hits (photon background)

- Four planes (disks) with pad detectors which are read out by the trigger system of H1 (trigger level 1)

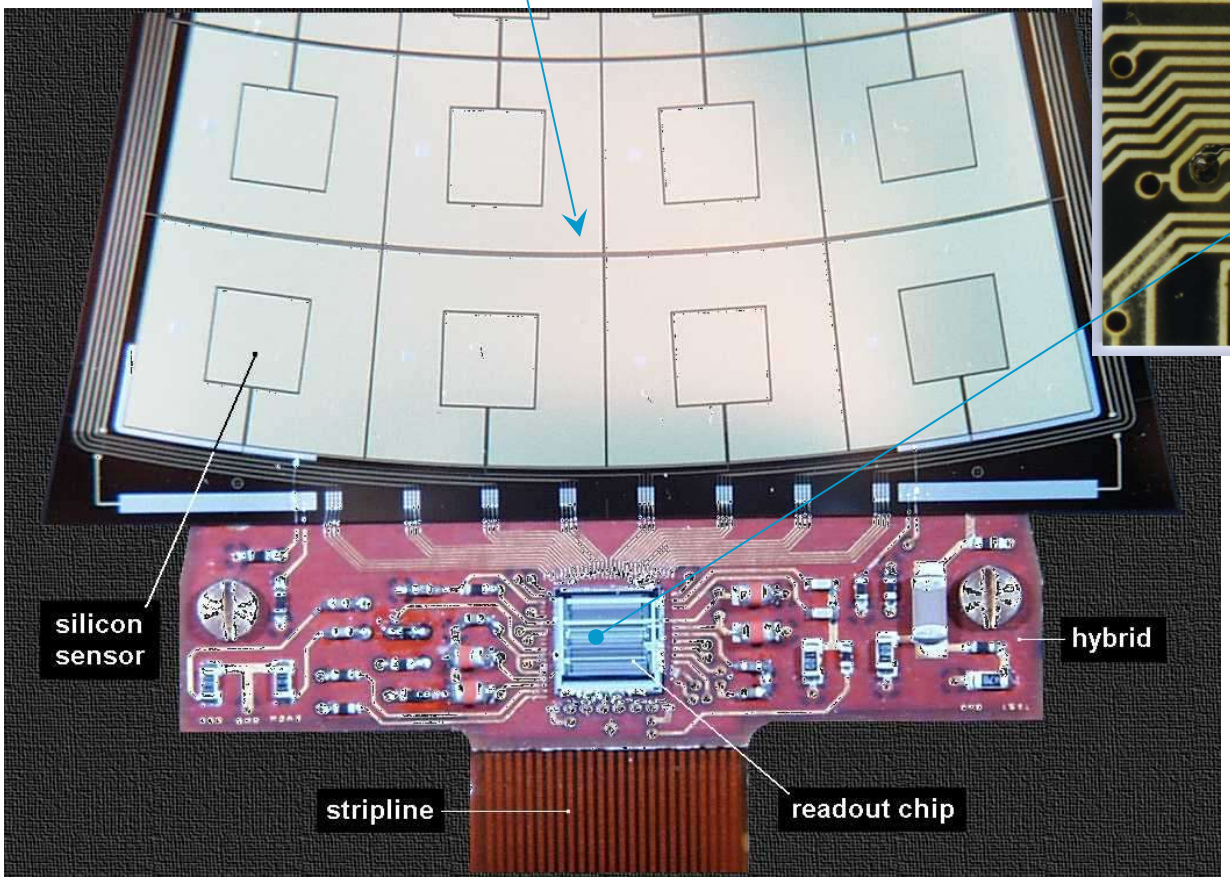
- Pad detector supplies trigger patterns (“masks” or classified tracks, L1) as well as hit patterns (level 3)

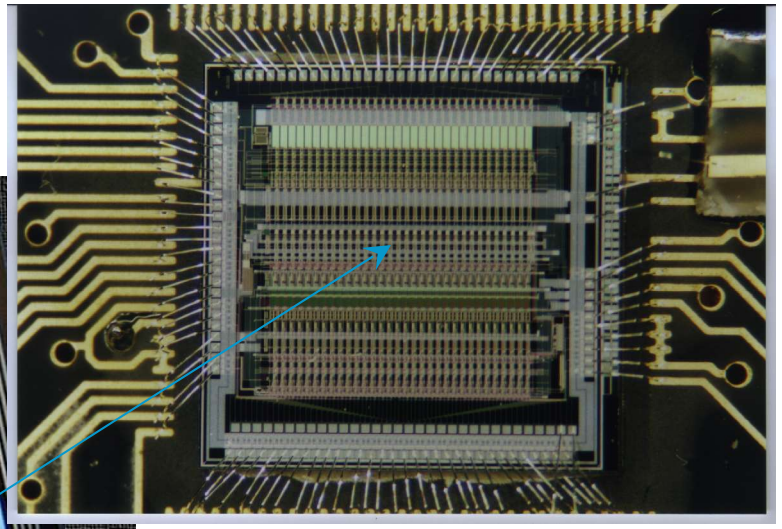
- Measurement of normalized counting rates per area allows the use as “radiation monitor”

Readout chain: sensor -> detector module -> repeater (pre-processing) -> H1 readout

BST PAD DETECTOR MODULE

AC coupled sensors with 32 (4 * 8) pads

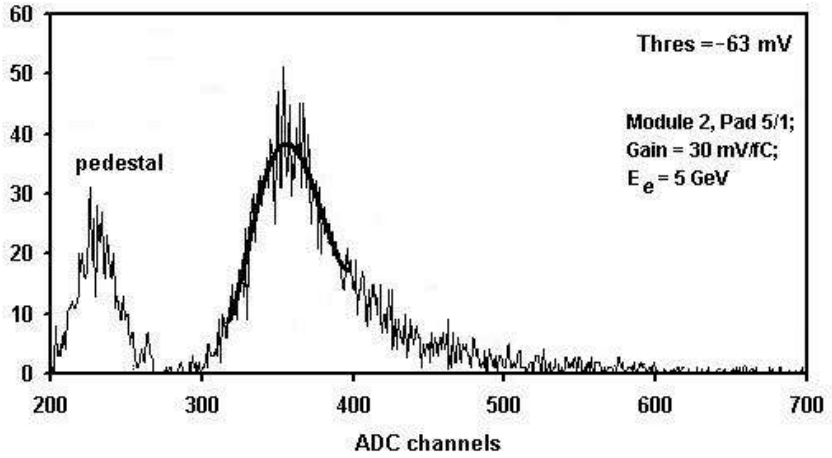




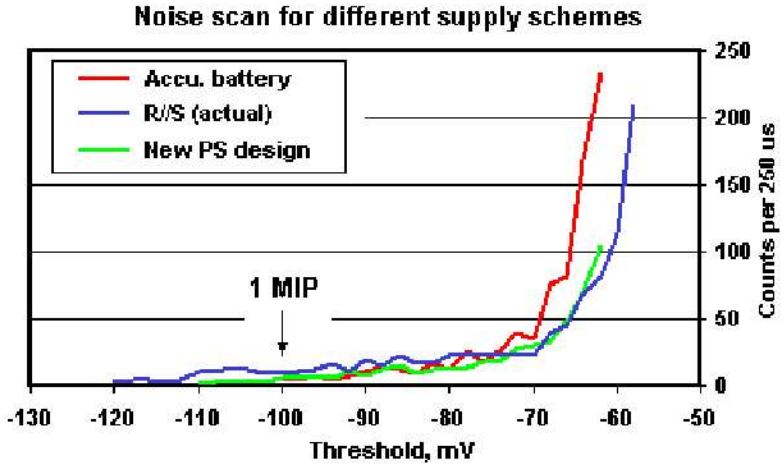
ASIC “PRO/A”:

- 32 channels
- preamp / shaper / discriminator
- adjustable gain (four steps)
- subtraction of neighboring channels possible
- output ‘monostable’ or ‘time over threshold’
- input current compensation optional
- over all test feature

- Tuning of all modules under HERA conditions with no beam -> ‘noise counts’
- Threshold scale calibrated with MIPs in a test beam
- Most critical part **after** design: depletion voltage of sensor
  -> careful decoupling and grounding mandatory
- nearly 100% trigger efficiency with tuned system
  -> tracks defined already with two hits in two planes

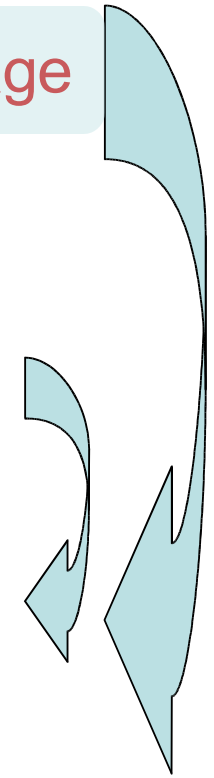


“self triggered” spectrum of MIPs
(pedestal added with external trigger)



Threshold scans for different
depletion voltage supplies

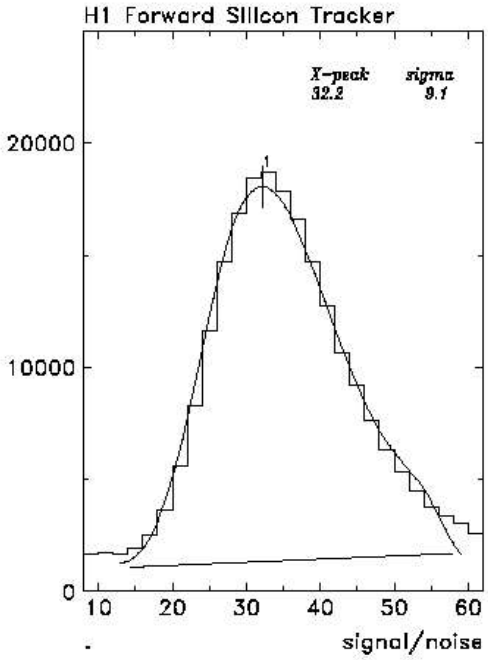
FST is fully operational and aligned
CST is operational, needs fine tuning of adjustments (luminosity required)
BST is partly operational, suffers from radiation damage (problematic and painful start-up of HERA after luminosity upgrade)
Pad system operational with excellent performance, but unfortunately two sectors damaged by radiation

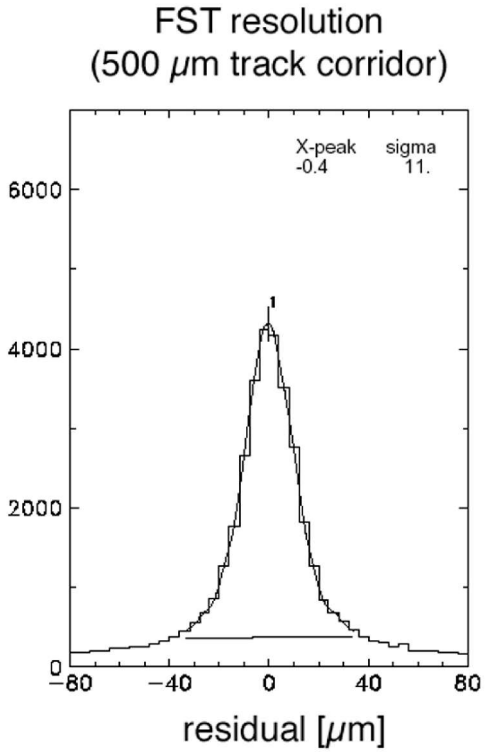


Components affected: slow control (CAN bus, SLIO) and line drivers / receivers

Excellent performance of strip modules

(S-hybrid equipped with sensors from CIS Erfurt):



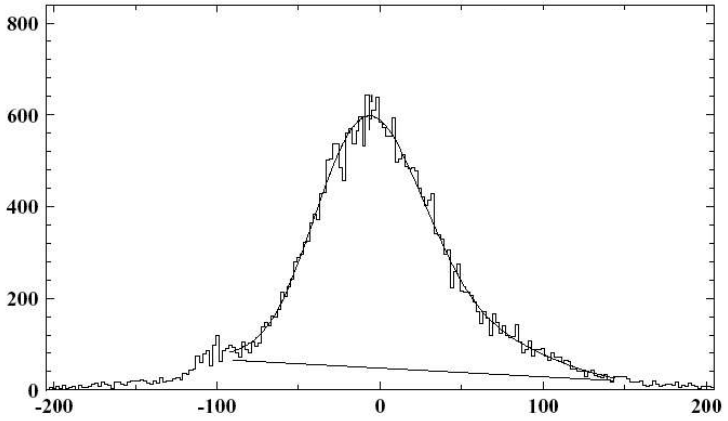


S/N ≥ 30

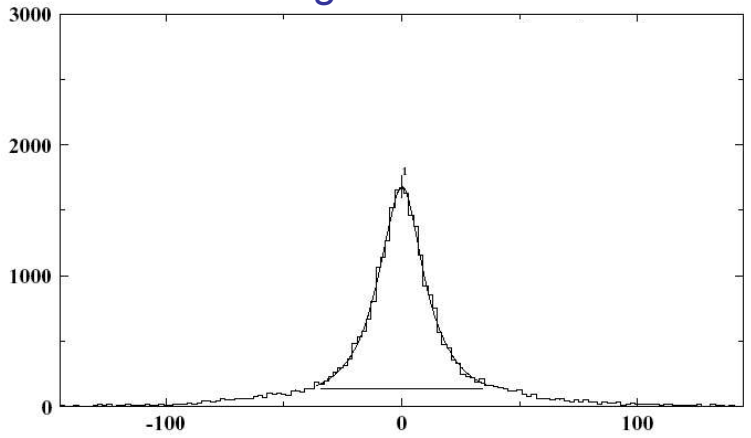
spatial resolution ≤ 12 μm

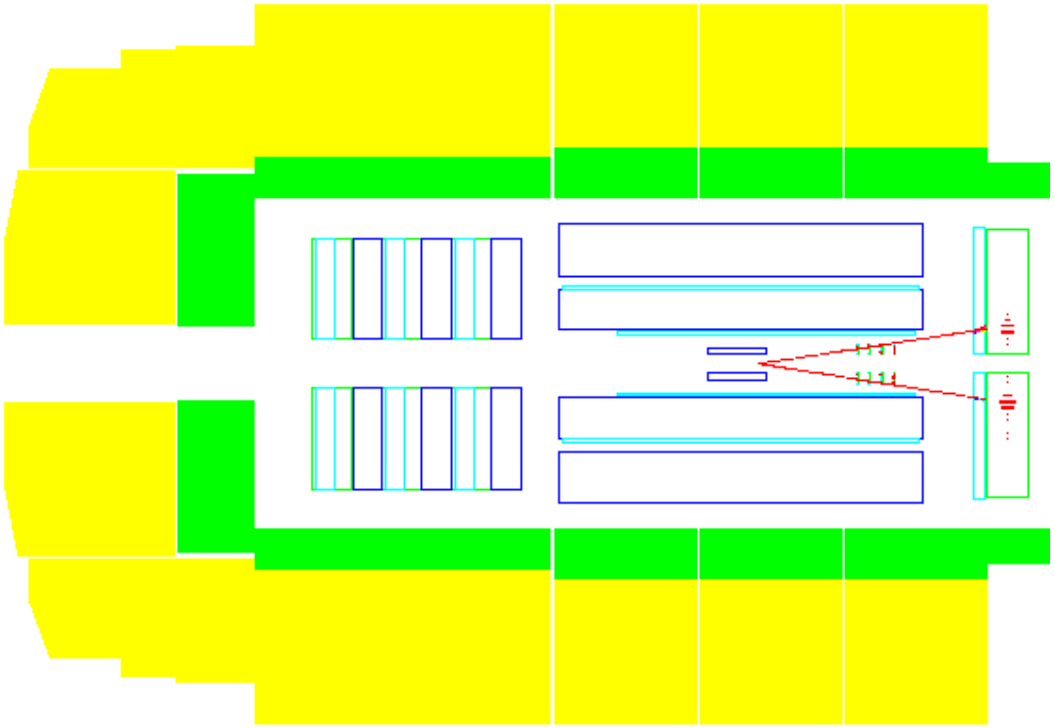
FST with preliminary alignment

before alignment

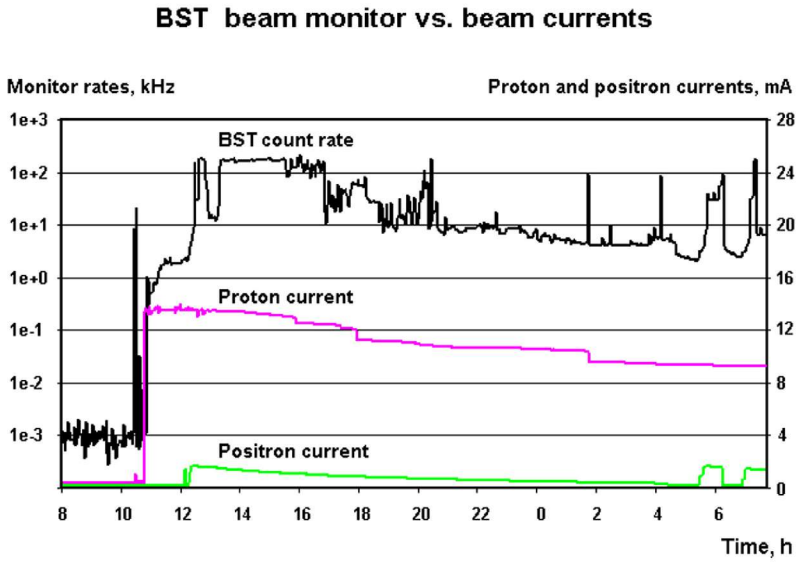


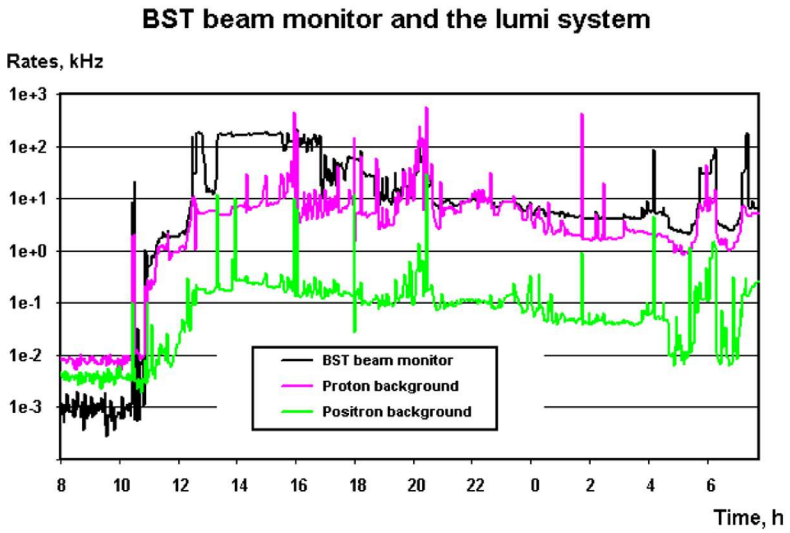
after alignment





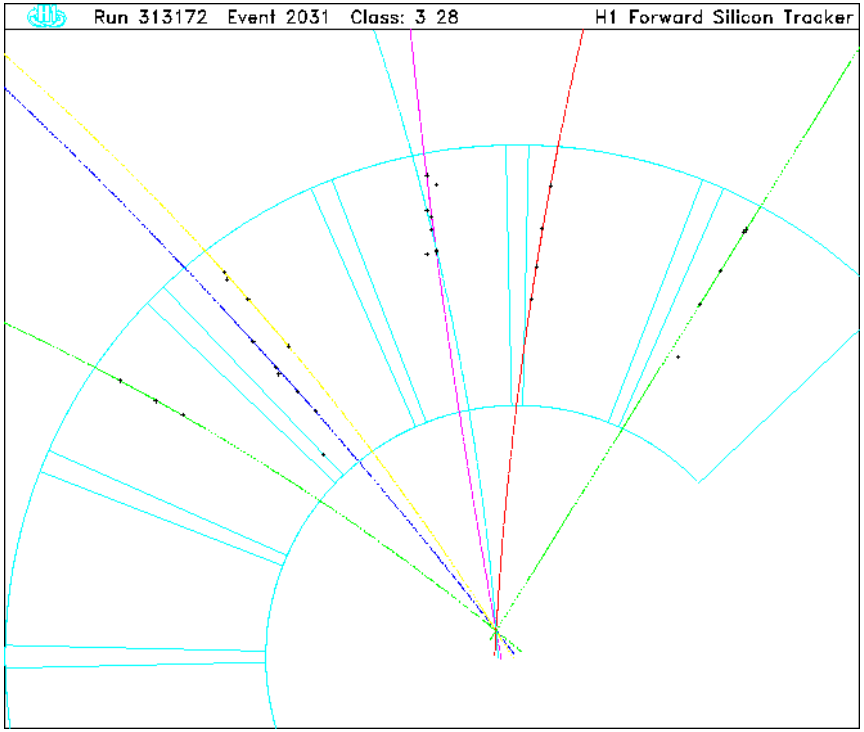
- J/Psi decay: this type of event can only be separated from the
  photon background by the charged tracks in the BST

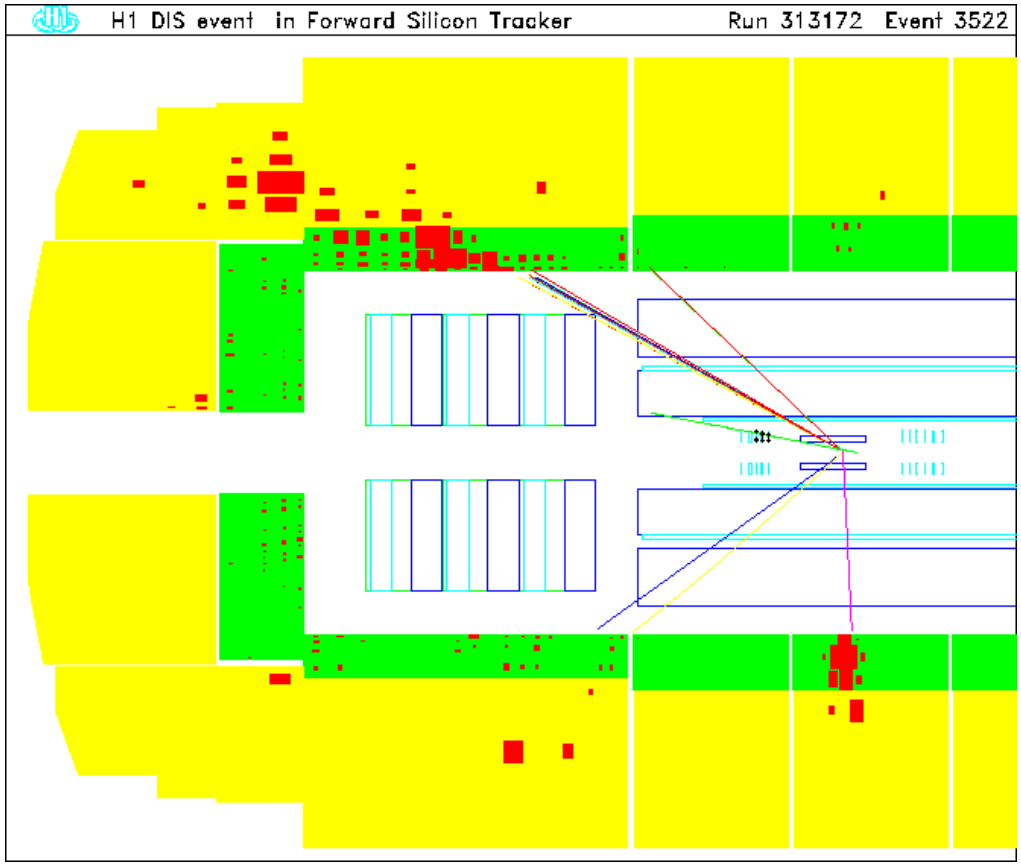




-The counting rate of the pad detector follows the beam currents as well as the background rates

RESULTS (continued) - FST event





Two different events are shown (left polar projection, right x/y-z projection).

- Hardware
  - FST: fine
  - BST: needs repair during spring 2003 shutdown
  - BST Pad: needs repair during spring 2003 shutdown
  - CST: needs fine tuning and alignment

- Physics
  - FST ready for taking luminosity data until spring 2003 (planned: 10 nB^{-1} for extension of proton structure function F_2 to lower x)
  - Charm Physics with BST/FST