HERA-B status report

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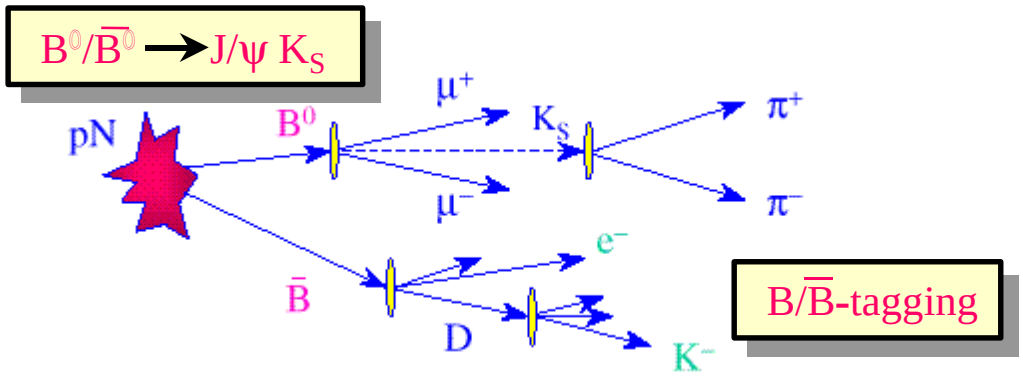
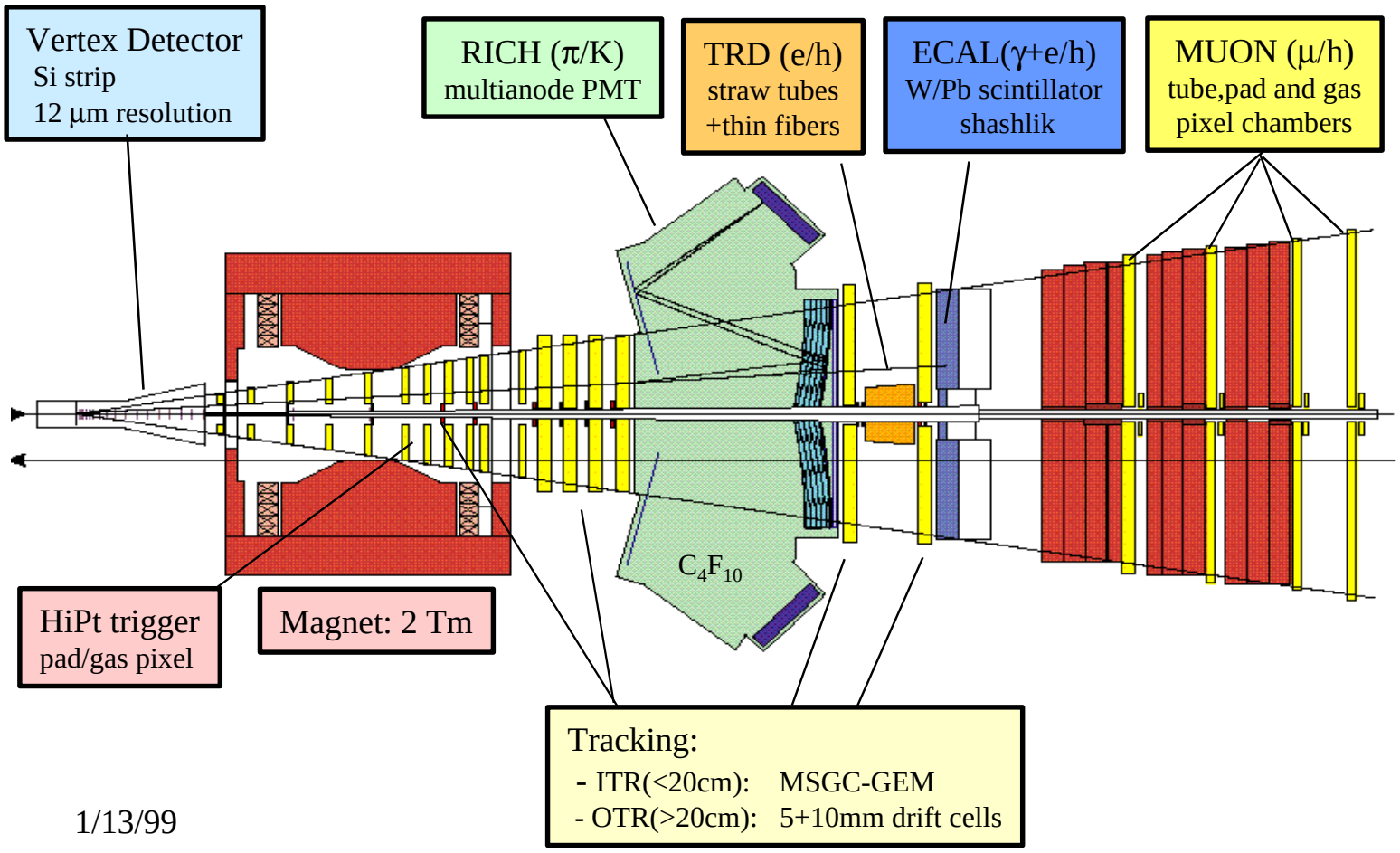
for
The HERA-B Collaboration

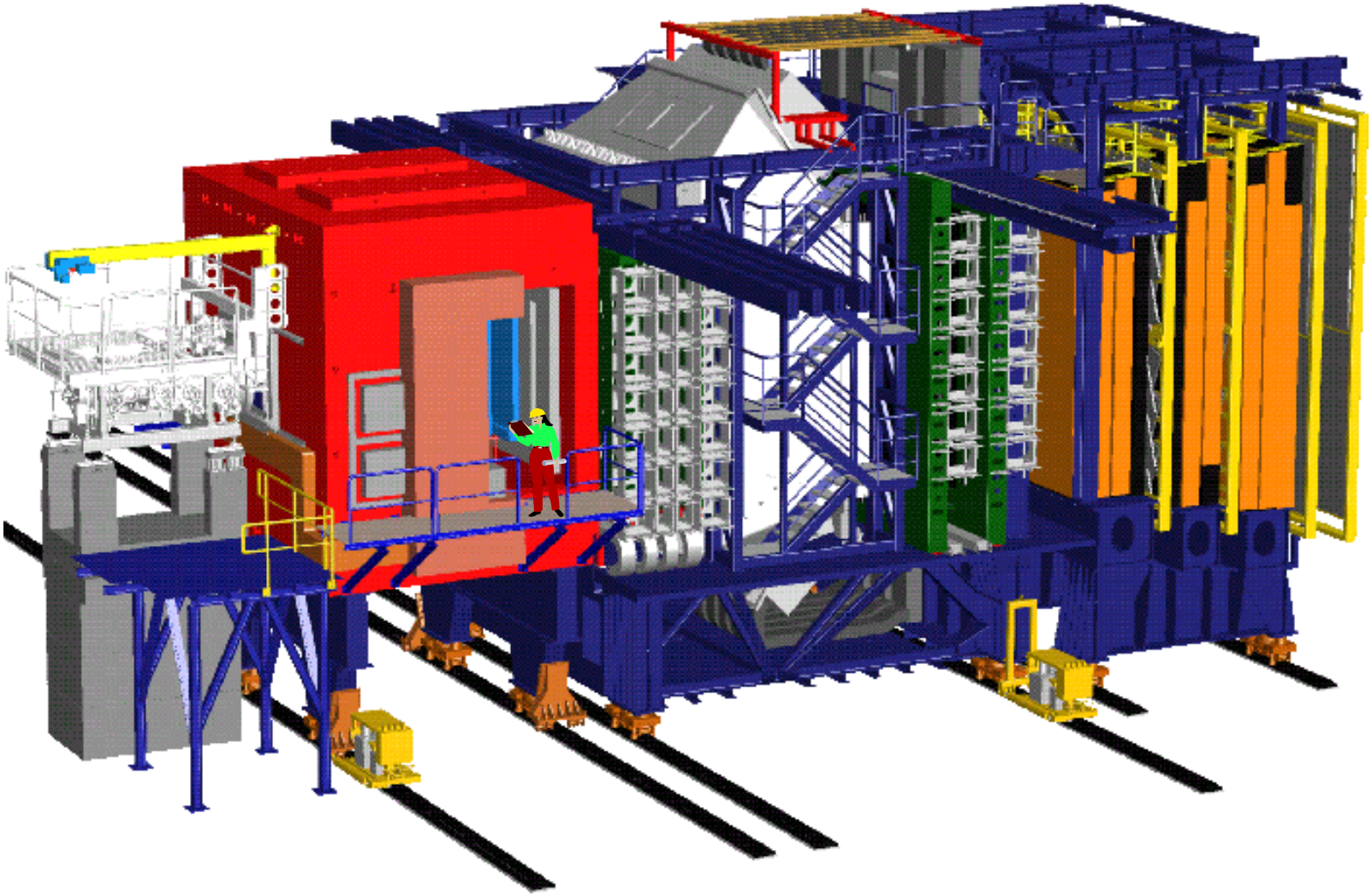
contents

I. overview of the subdetector installations
II. tracking chambers
III. electronic
IV. DAQ and results of the 98 run
V. plans and summary

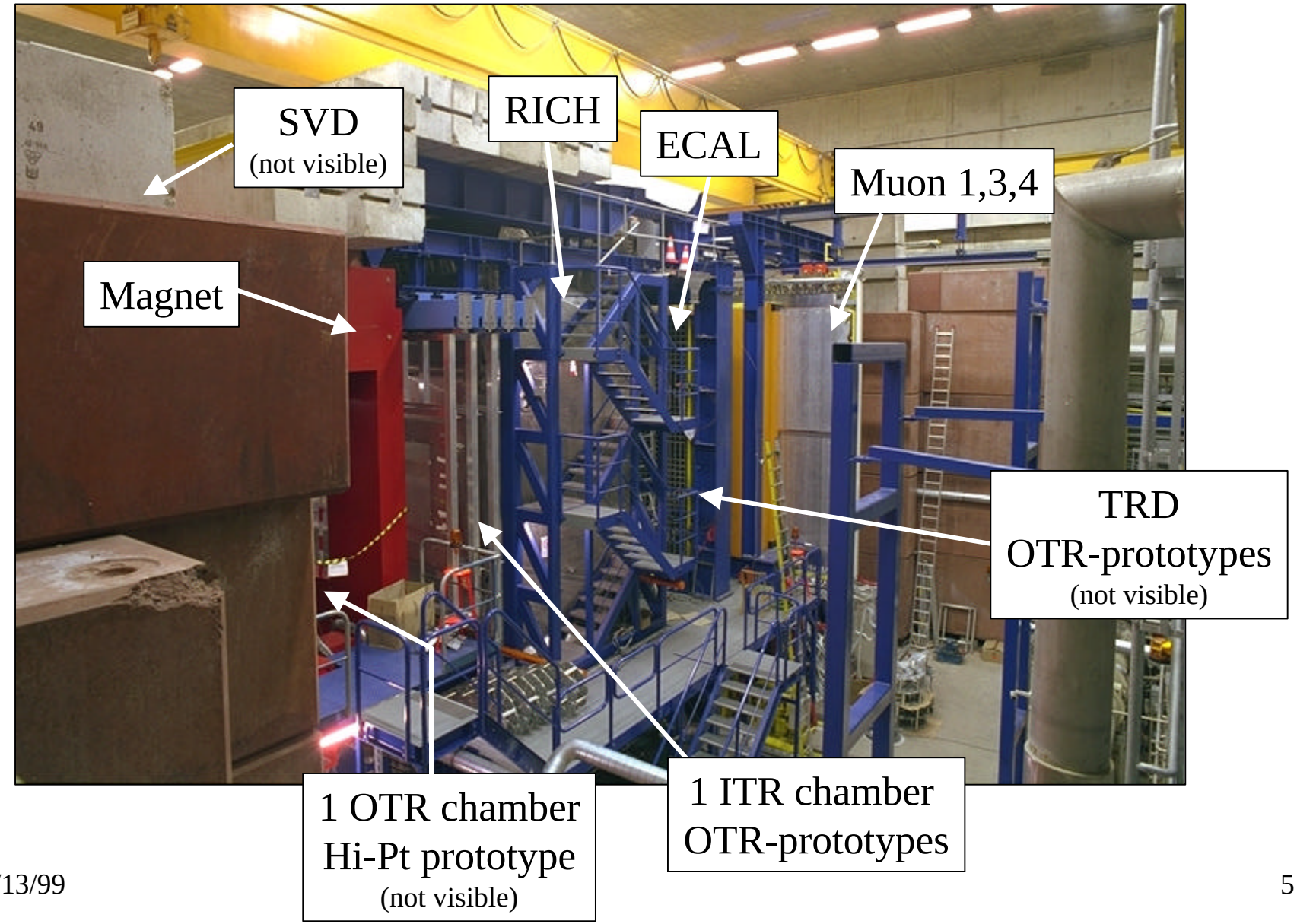
HERA-B Experiment



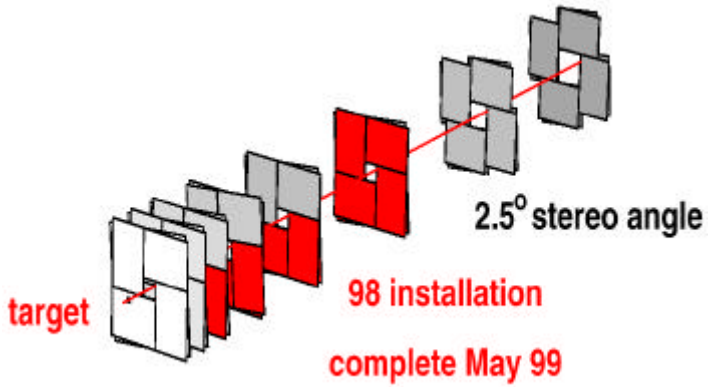


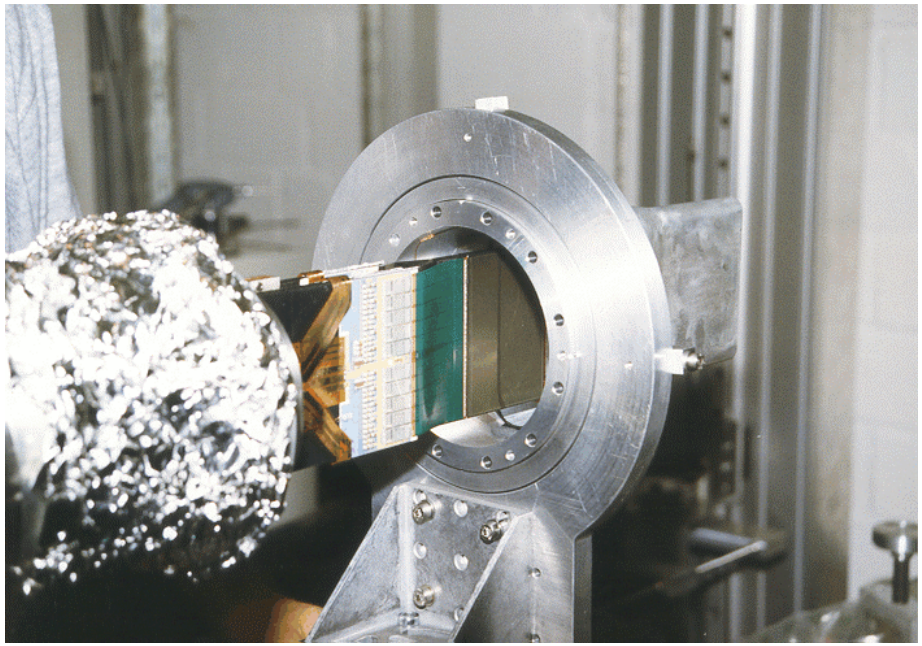


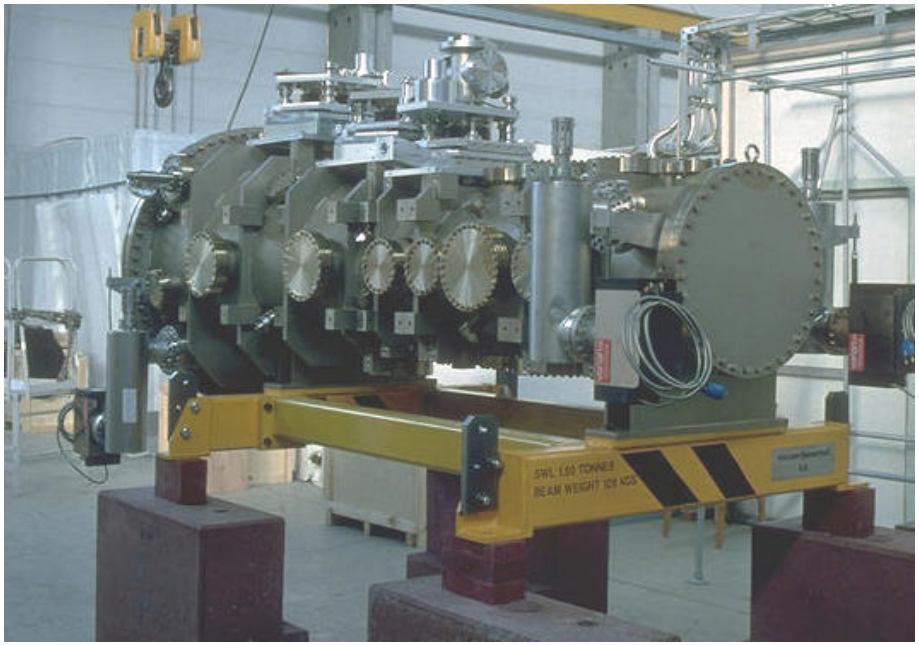
present status



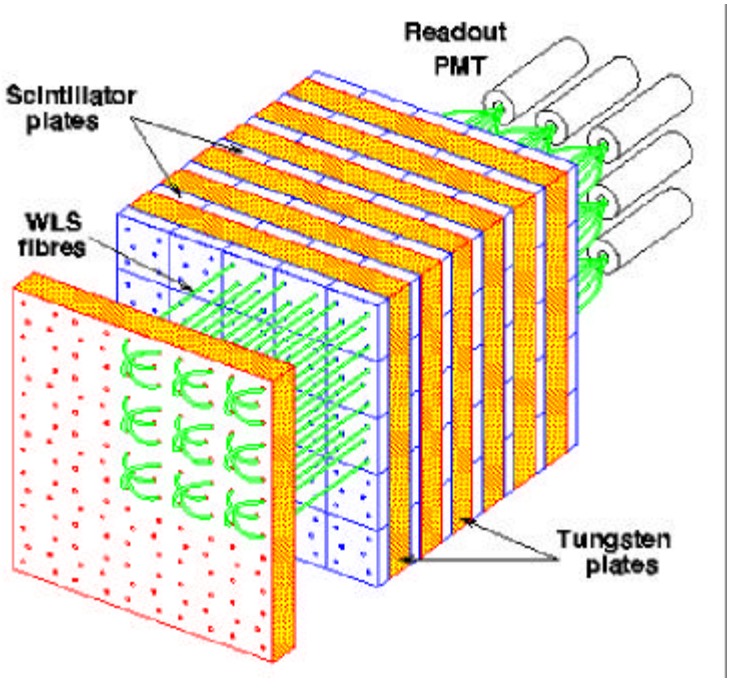
Vertex Detector System

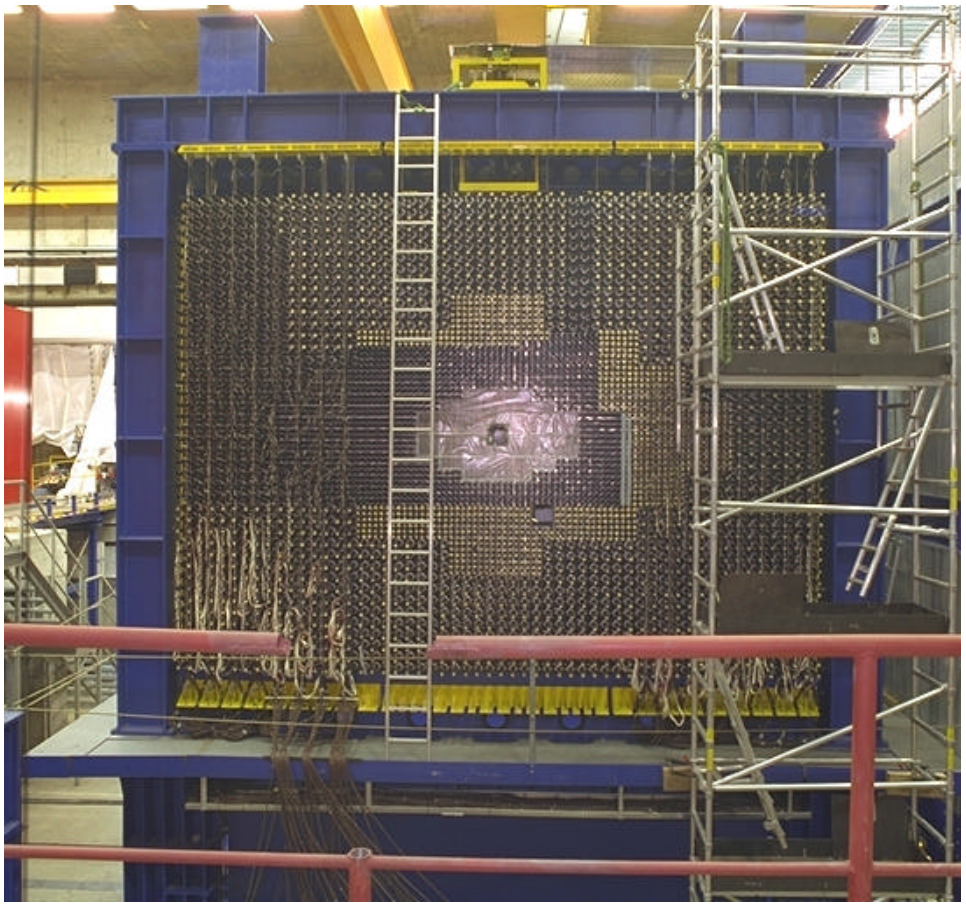






Electromagnetic Calorimeter

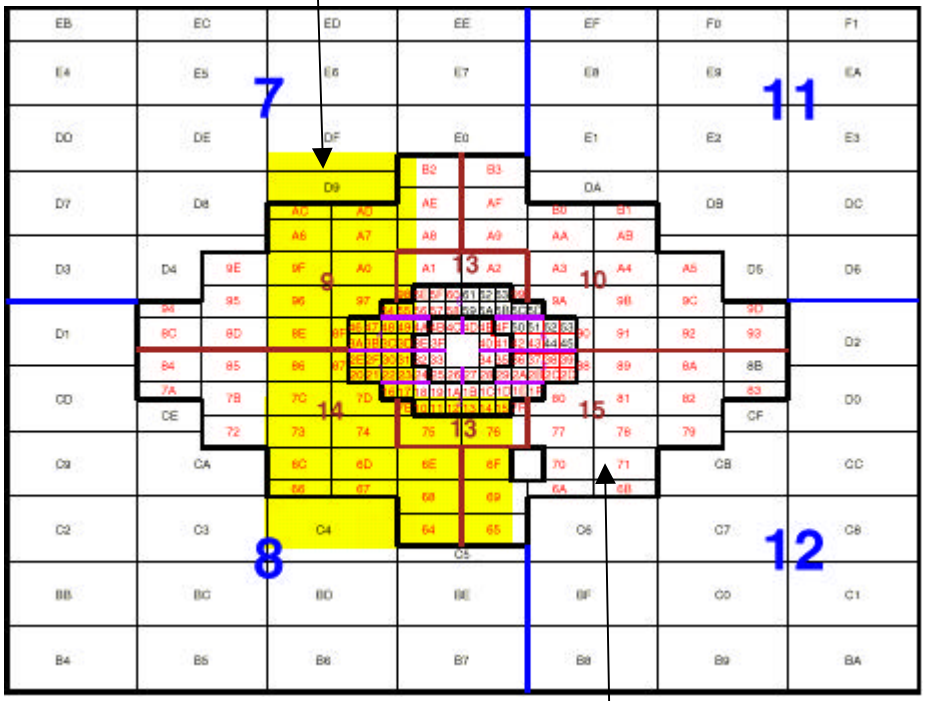




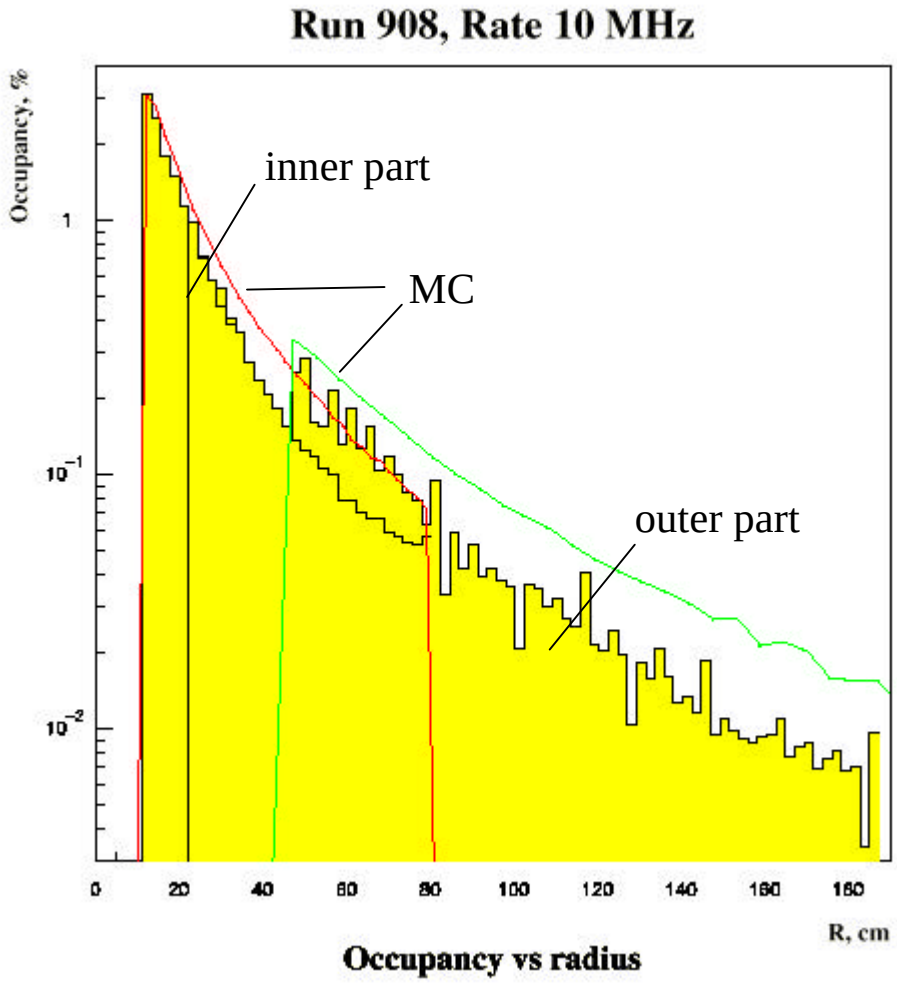
PMT installation finished in last shutdown

calorimeter occupancy

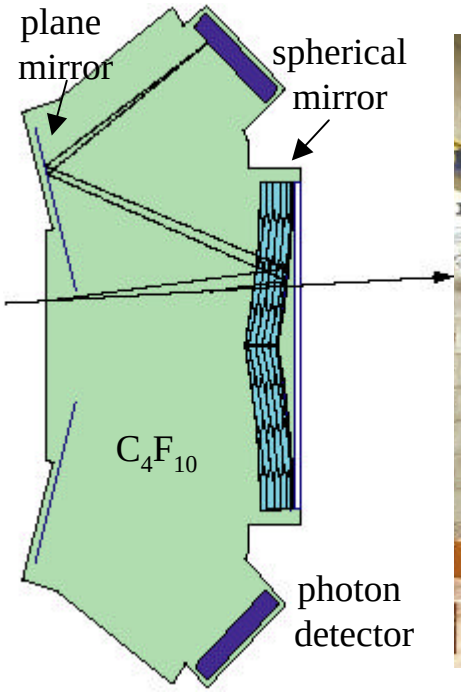
overlap with vertex detector

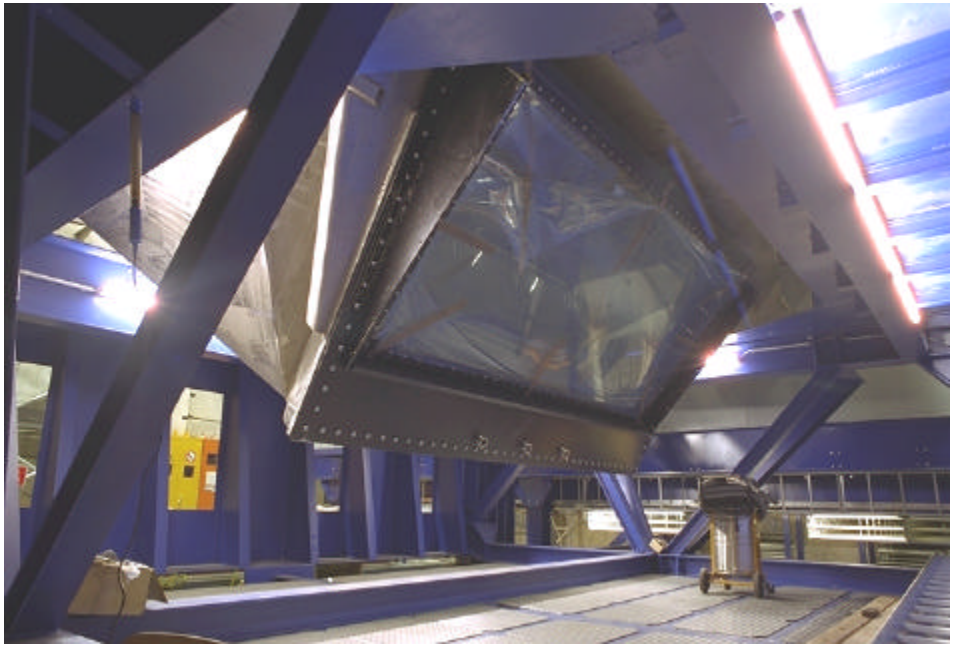


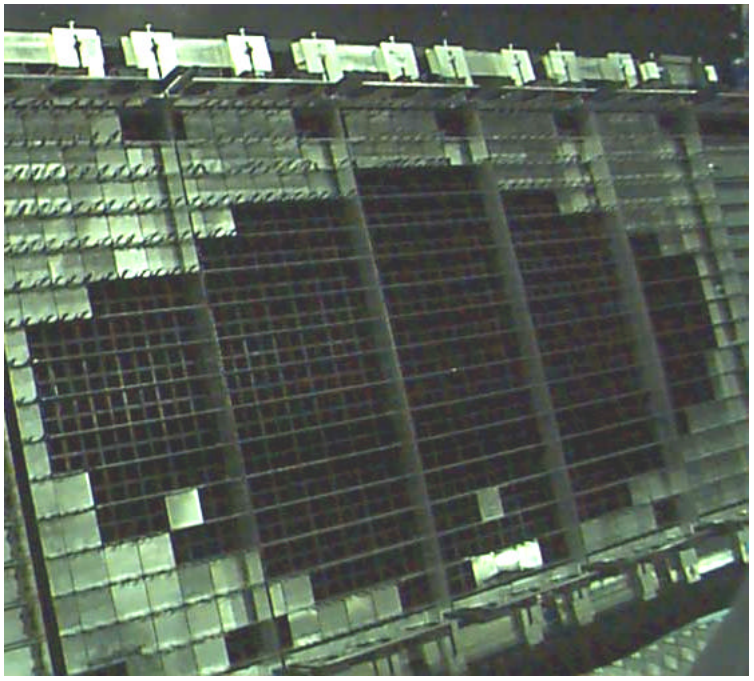
red: readout available for
most of inner and middle region



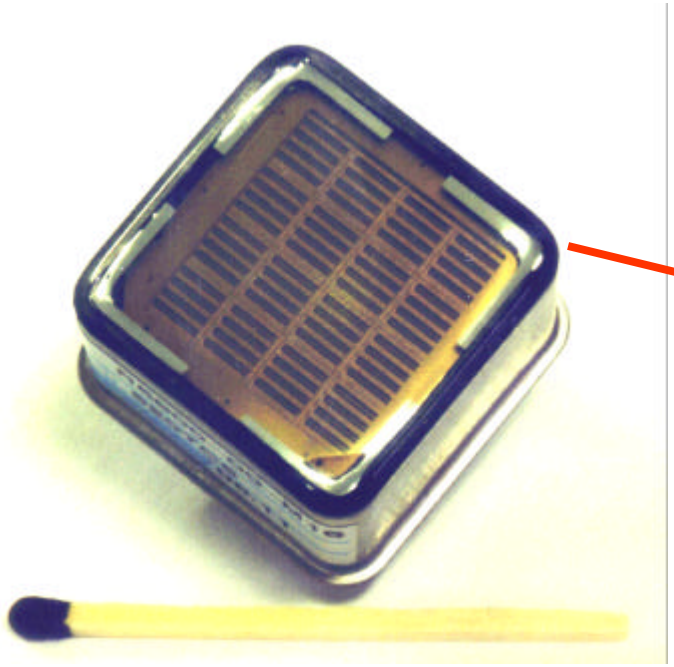
RICH-Counter



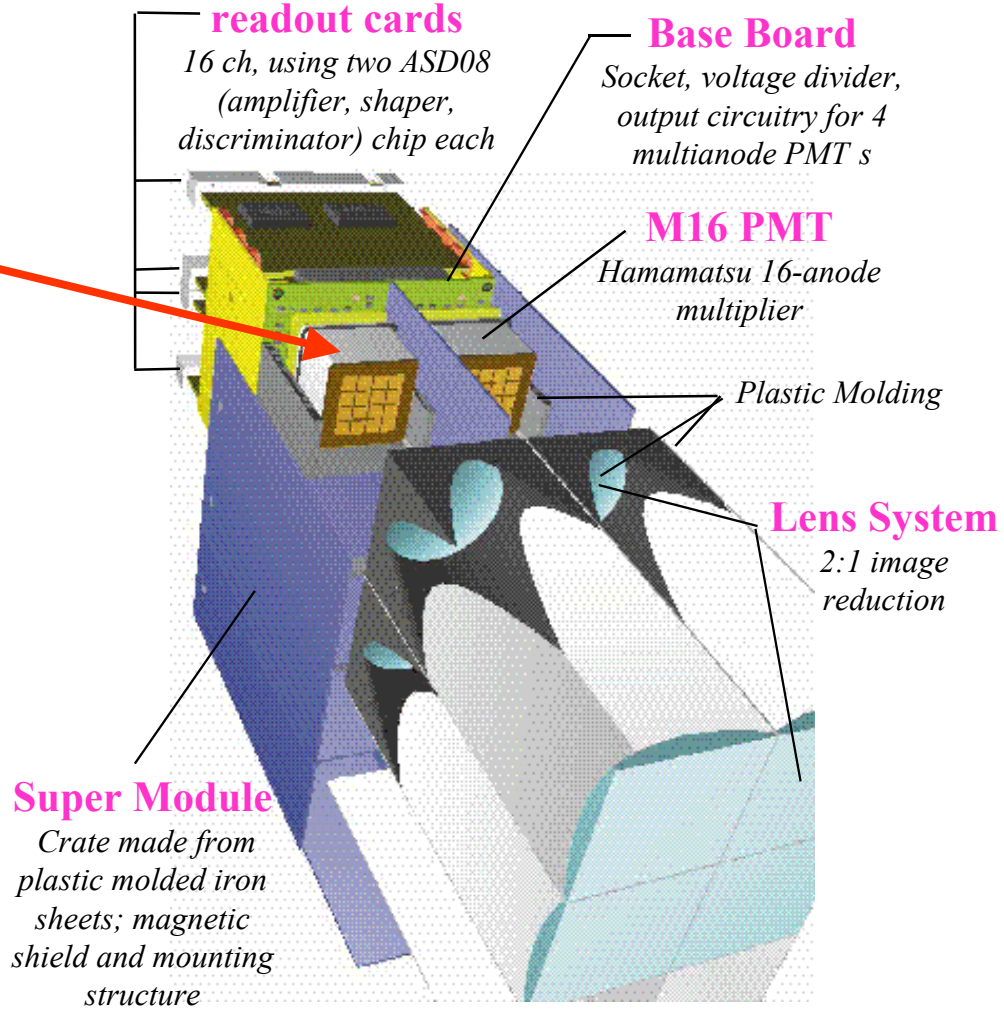


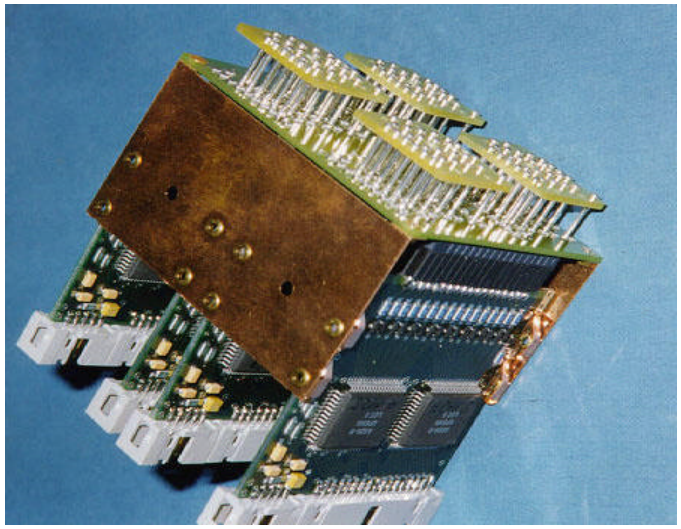


Hamamatsu 1-anode photomultiplier

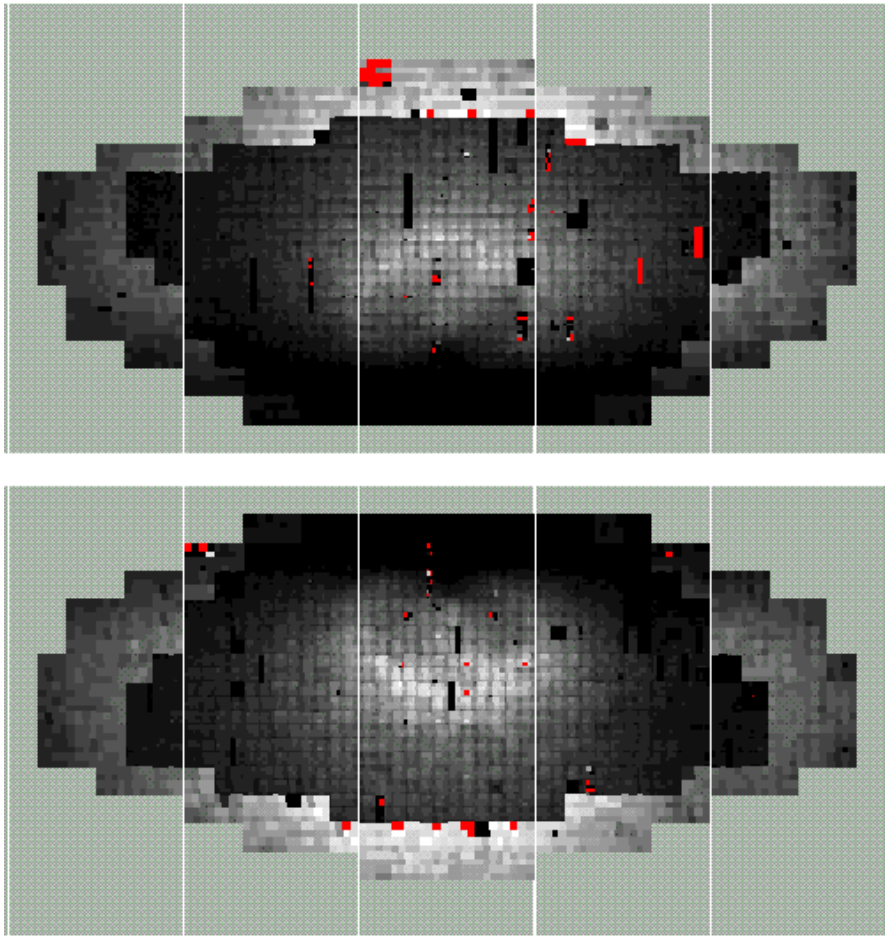


RICH detector module





Occupancy map



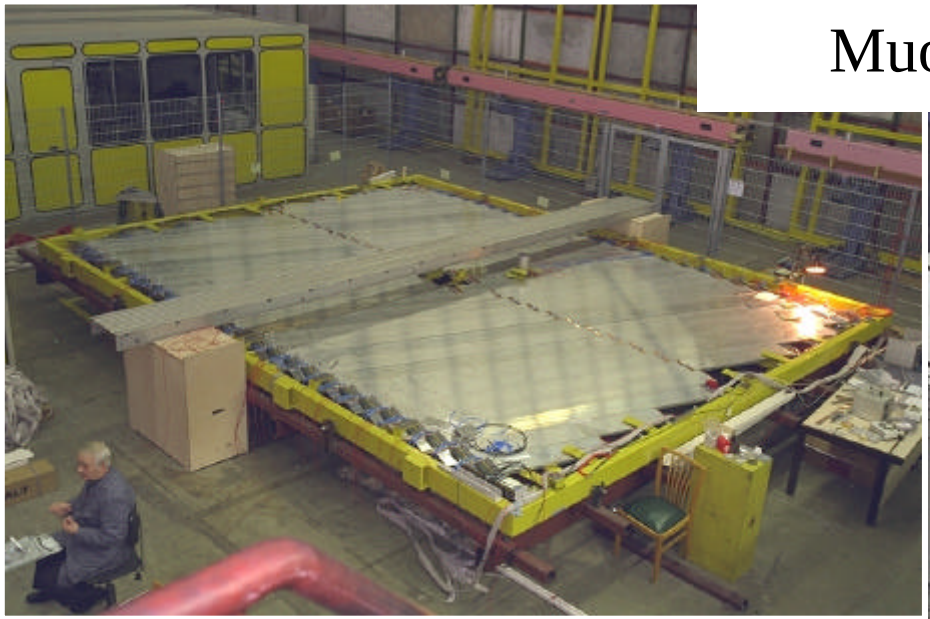
black-white: normal occupancy variation
red: occupancy above threshold
- on M4/M16 boundary
- hot channels

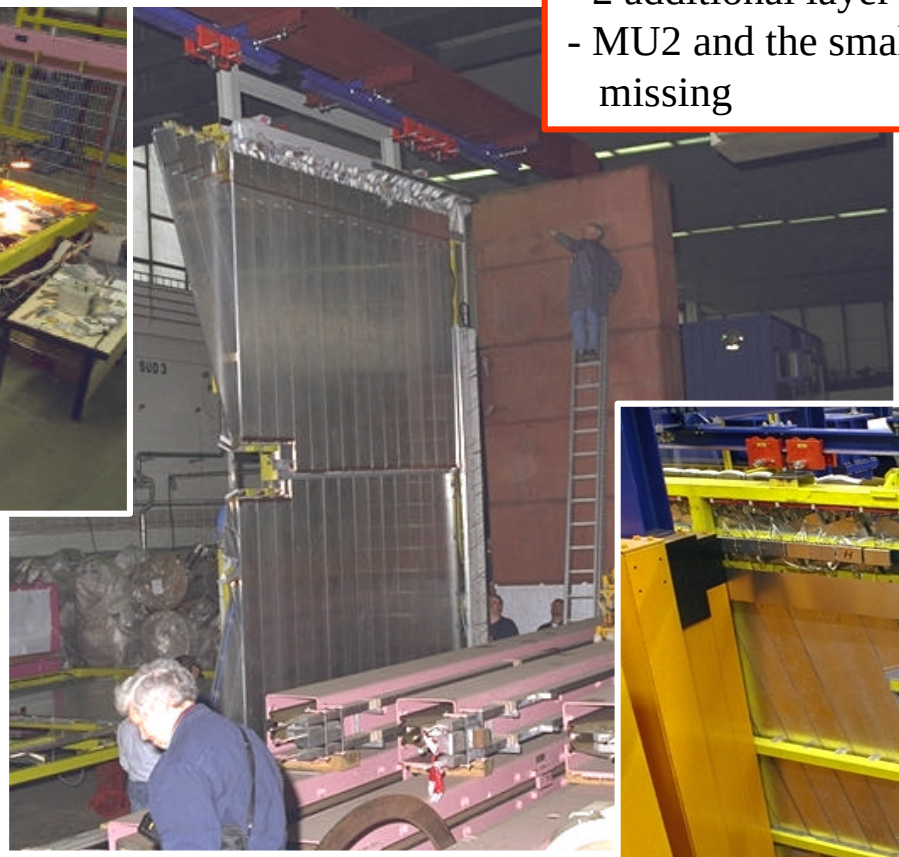
black islands: not working channels
- missing pmt's
- bad ASD-cards

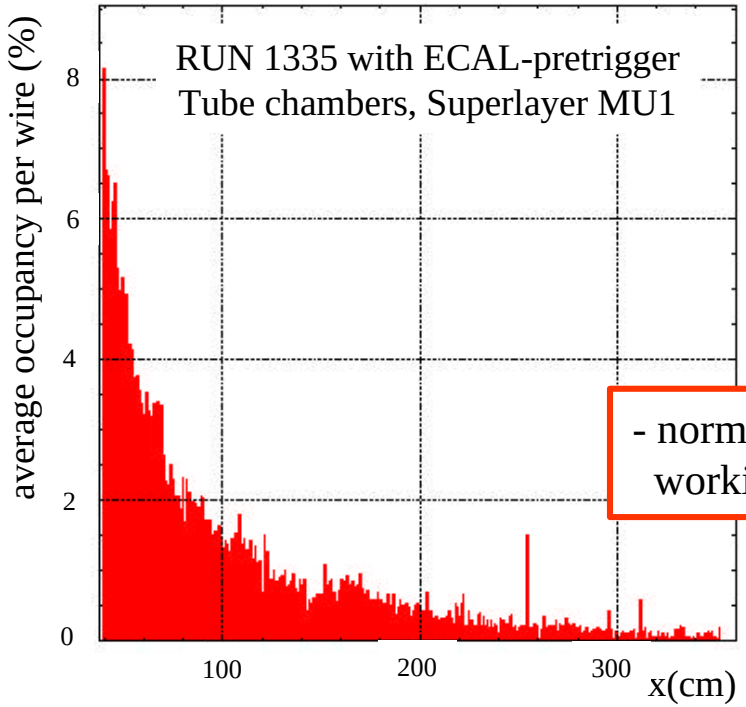
~ 95% of the channel work properly

Muon chamber

- 2 additional layer's installed
- MU2 and the small pixel chamber missing

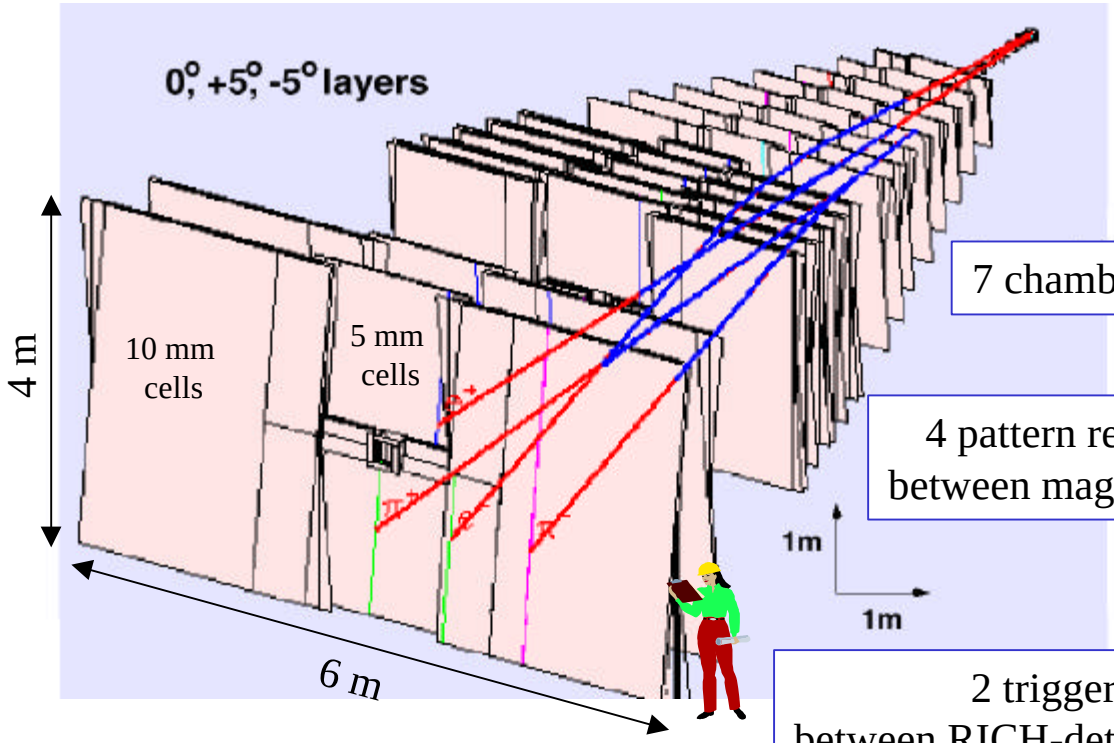






- normally >95% of the channels are working properly

Honeycomb Outer Tracker

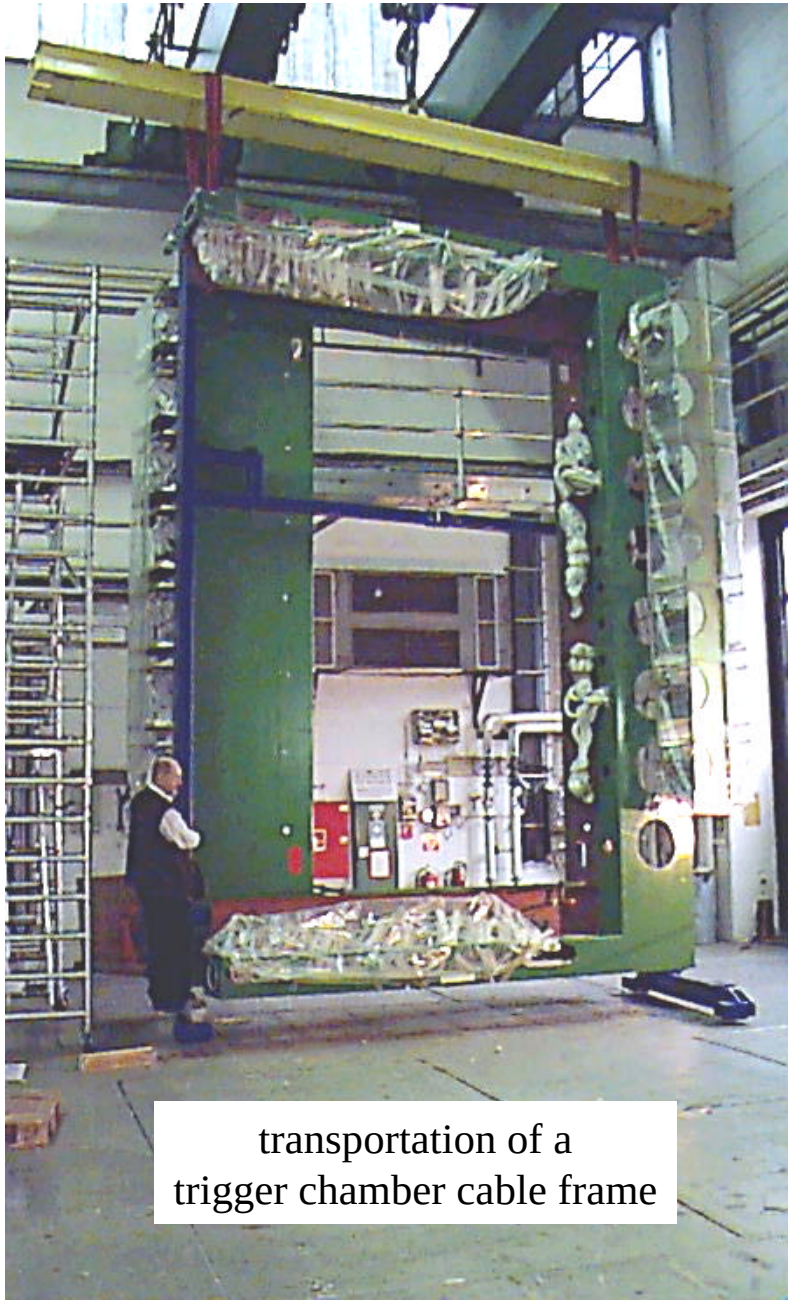


7 chambers in the magnet

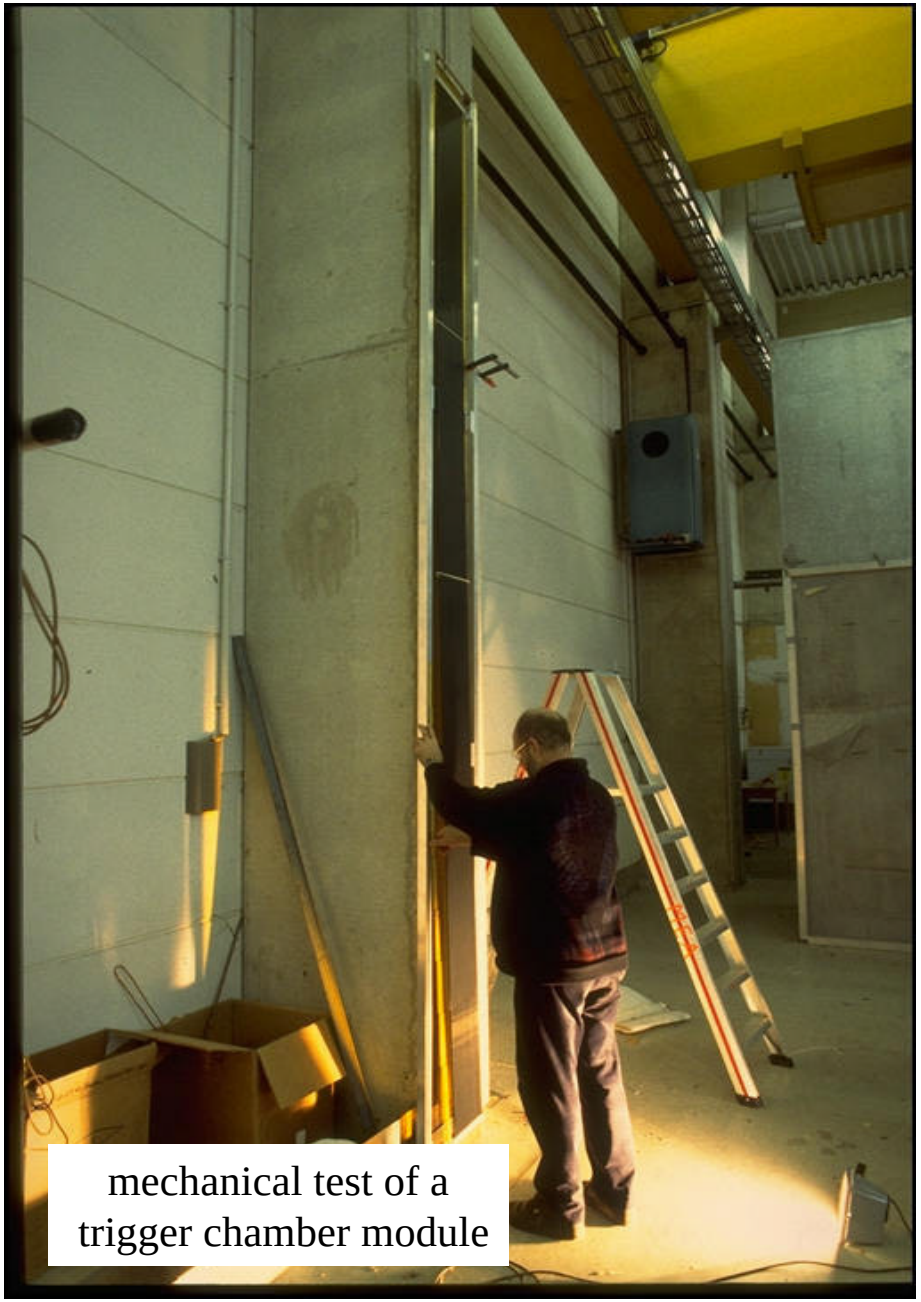
4 pattern recognition chambers between magnet and RICH-detector

2 trigger chambers between RICH-detector and calorimeter

- large area
- many channels (120,000 channels)
- strong irradiation:
  -integrated charge up to 400 mC/cm/year



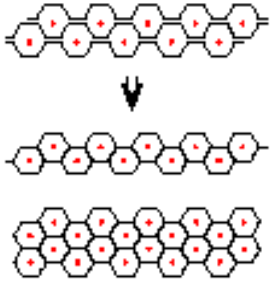
transportation of a
trigger chamber cable frame

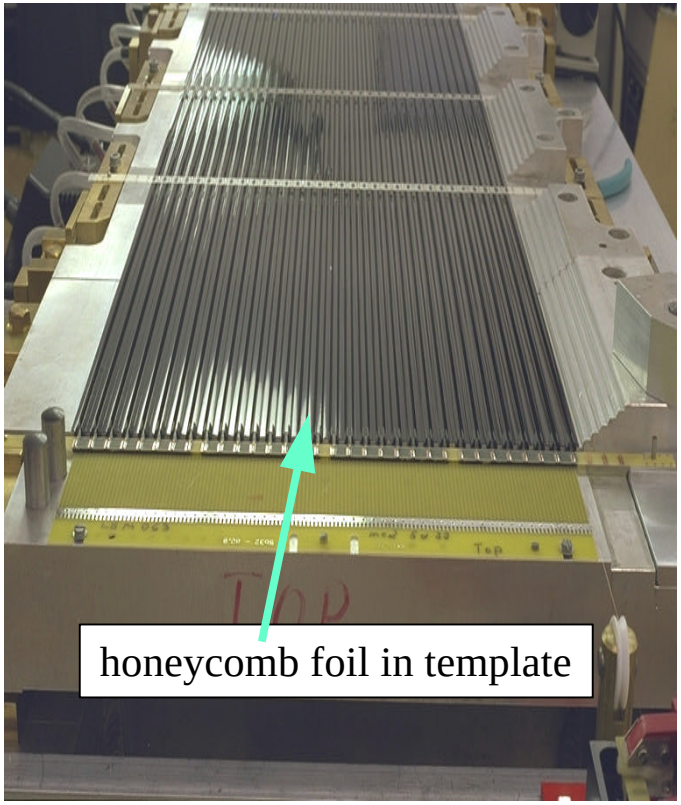


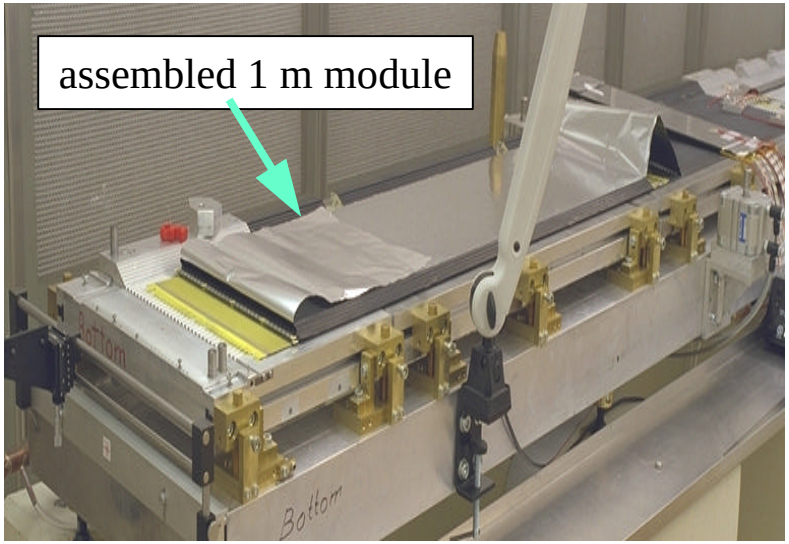
mechanical test of a
trigger chamber module

module production

modules with hexagonal cells formed by gluing layers of honeycomb foil

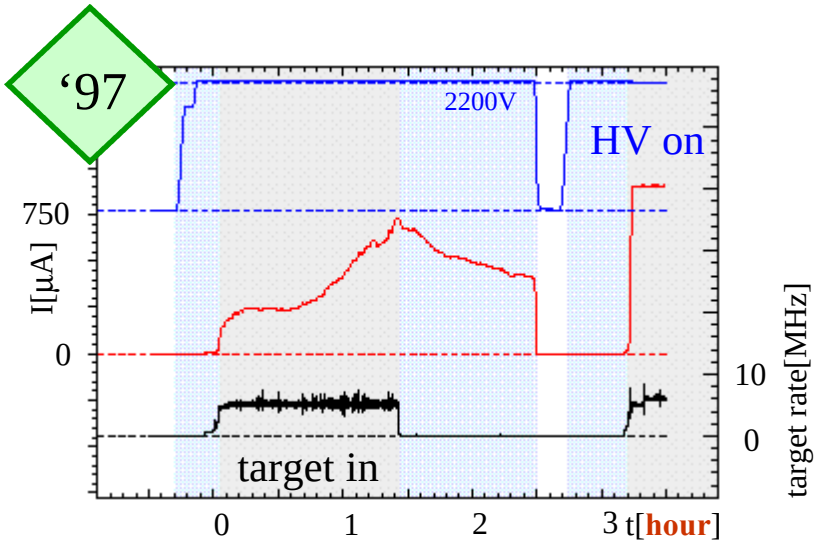






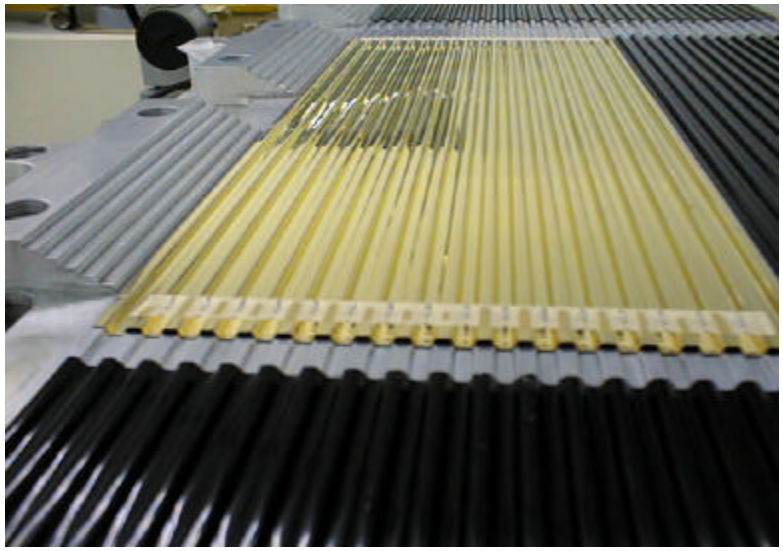
OTR radiation damage

1997: Malter like effect observed in HERA
damaga after hours*(~O(mC/cm))*



- runaway currents during irradiation
- decaying dark current afterwards
- turning off HV restores chamber

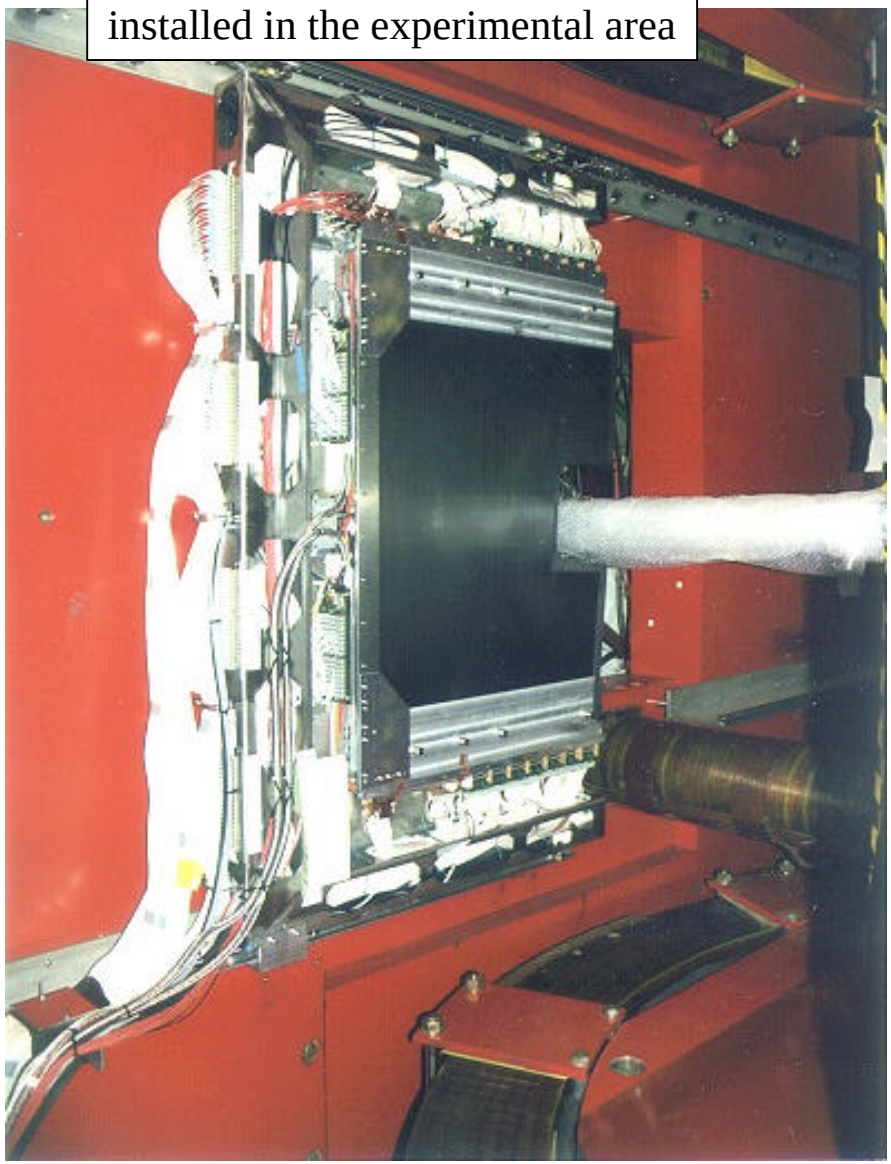
changes:
- gas: Ar:CF_4:CO_2 (65:30:5)
  - CO_2 instead of CH_4
- Cu/Au coating
- non outgasing glue
- gas flow



mass production is restarted

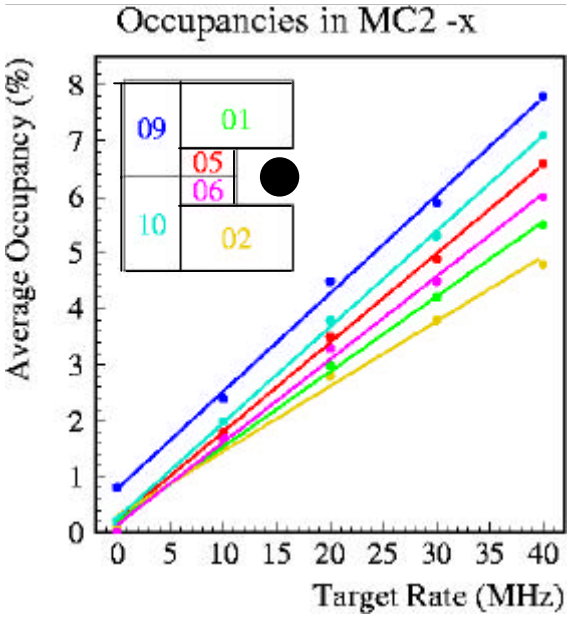
time

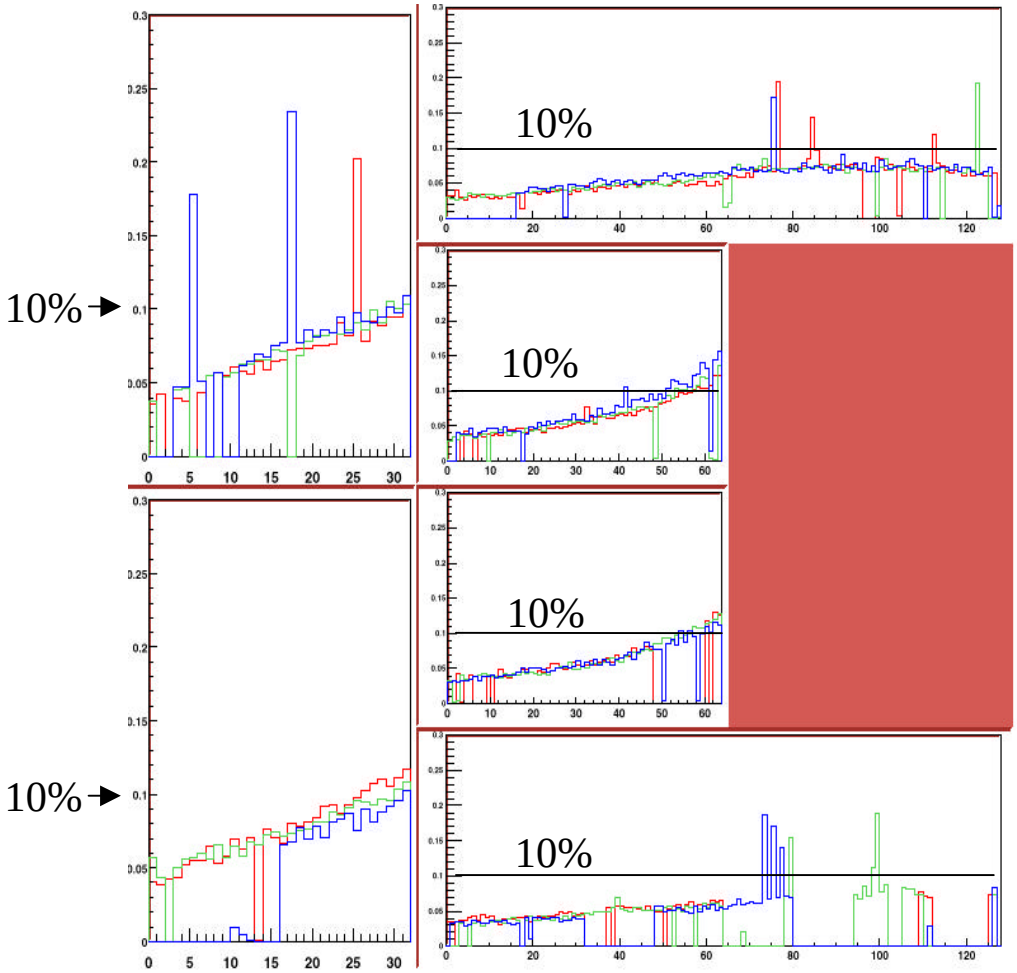
Outer tracker magnet chamber with final mechanical design installed in the experimental area



performance of MC2-

occupancy, 40 MHz interaction rate,
different sectors, 3 stereo angles





Inner tracker

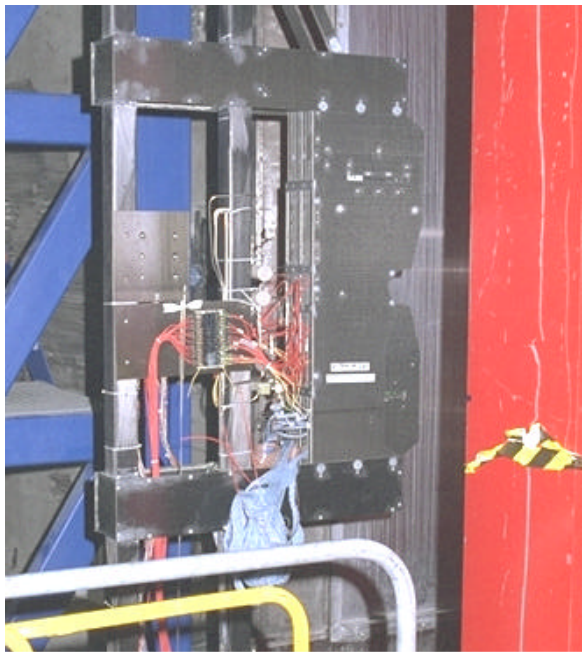
- mass production of the MSGC-GEM chambers and the electronics is running and well on schedule (HELIX excluded)

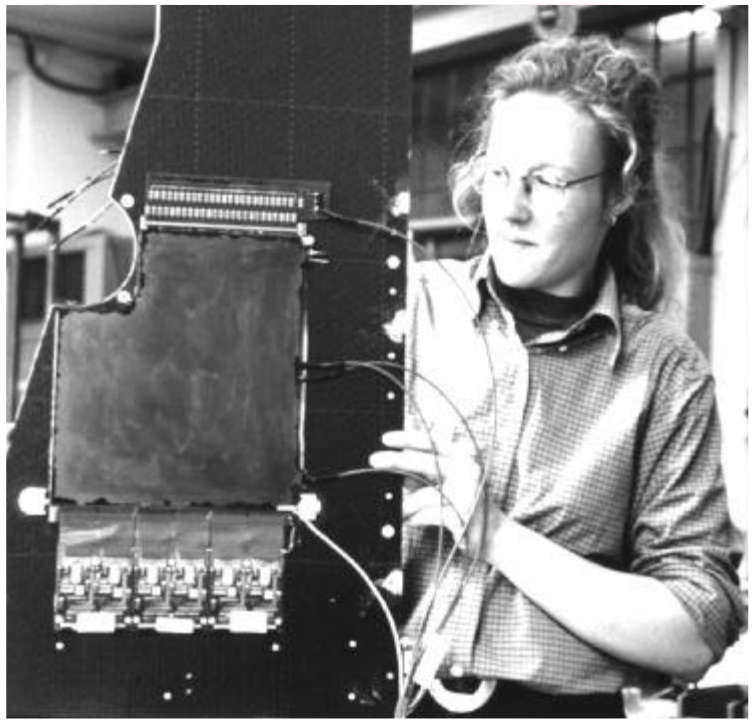
- prototype chamber with HELIX 2.2 installed in HERA-B
  analog part of HELIX 2.2 works satisfactory

- full readout chain for analog readout successfully tested
  (in HERA-B area up to know only without beam)

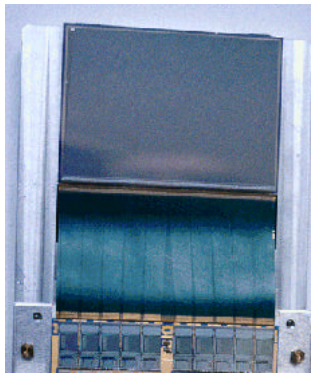
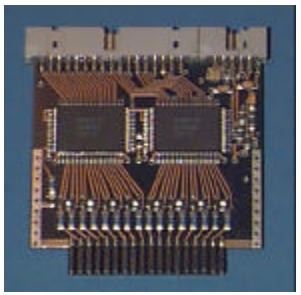
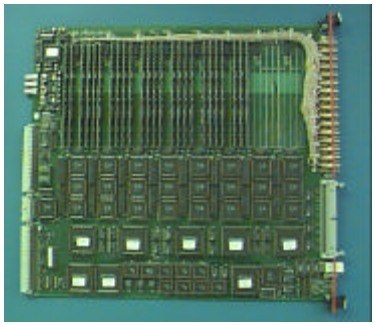
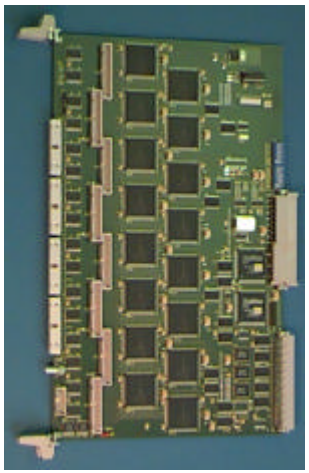
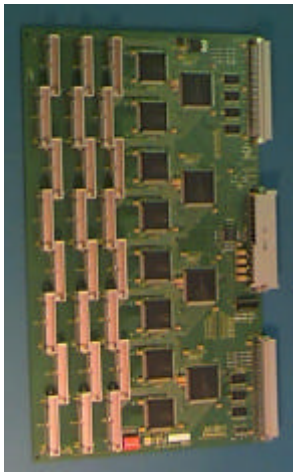
- HELIX:
  - Version 2.2 is not able to provide trigger signals at reasonable threshold
  - switching of the trigger output generates a power spike, which couples into the analog input. This generates new triggers and the system starts ringing
  - in the next Version 3.0 this coupling should be suppressed by a factor of ~5
  - HELIX3.0 will be not available for the May/June shutdown

- gas aging (deposits) observed unexpected
  - no design changes
  - same materials, but different batch from same companies
  - bad gas bottles ?
  - reason not yet known





detector specific readout electronic

SVD/ITR	OTR/TRD RICH/MUON HiPt	ECAL
Helix (amplifier,shaper, analog pipeline, trigger logic) 	ASD8/ASD-BLR based FE (amplifier,shaper,discriminator) 	(amplifier,ADC,pipeline) 
	  TDC-board HIT-board common trigger link board	

- readout electronic operates stable and reliable
  - 96 ns BX, deadtime free
  - pipelining for FLT latency (128 BX)
  - 0.5 ns time resolution
- OTR/RICH/Muon electronic is completed
- 160/226 ECAL readout boards available
- Helix 2.2 satisfies SVD needs, available

first level trigger

- calorimeter pretrigger system
  - 20/128 boards available showing production problems
  - 5 installed in the experiment
  - 3 were used as the FLT-system in the ‘98 run

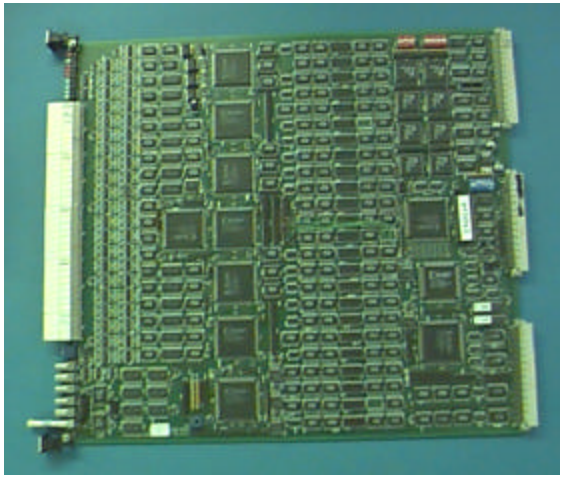
- muon pretrigger system
  - prototype system tested, minor problems

- high-pt pretrigger
  - prototype system available, will be tested soon

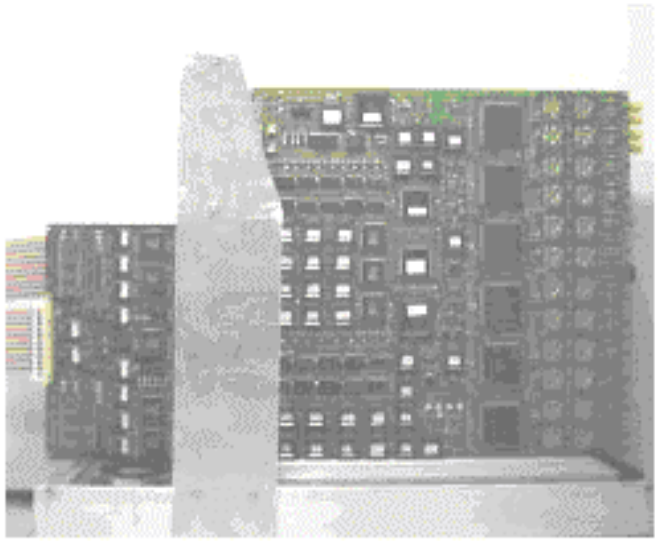
- Outer tracker/Muon data link to TFU
  - prototypes tested with one outer tracker prototype
  - test will be extended to 4 link boards and 2 chambers

- TFU (track finding unit)
  - 10/80 TFU applicable for half of the tracking system
  - modification for other chambers finished
  - production test series ahead

- trigger decision system (TPU,TDU)
  - a prototype TPU was used in the ‘98 run



ECAL-pretrigger board



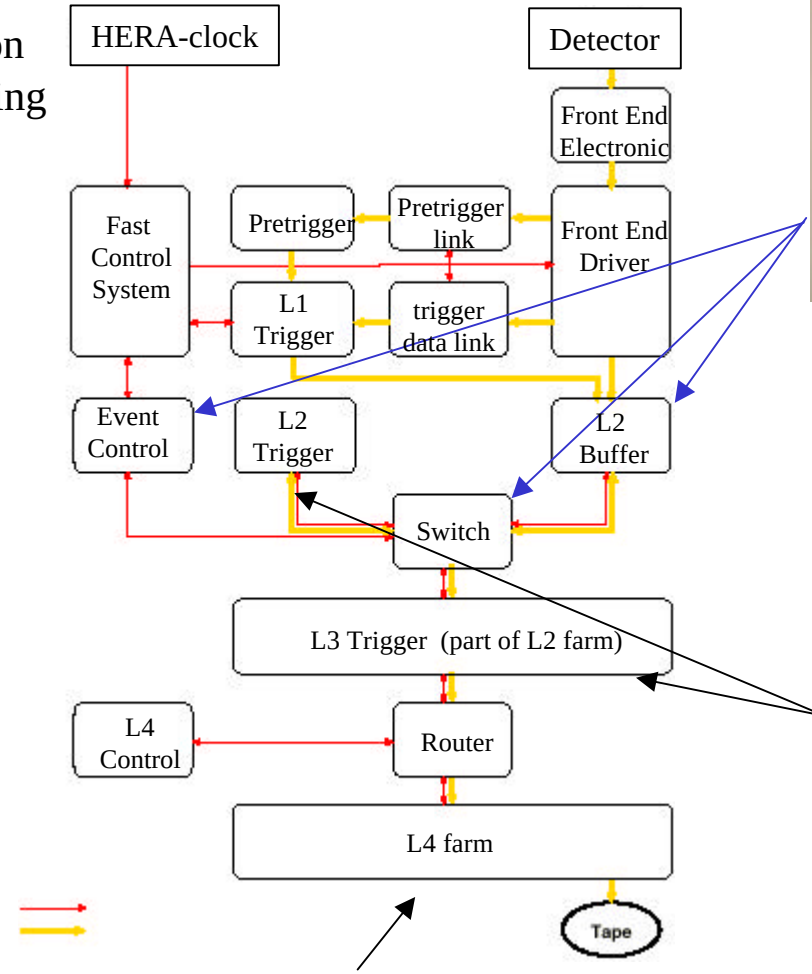
TFU

HERA-B DAQ

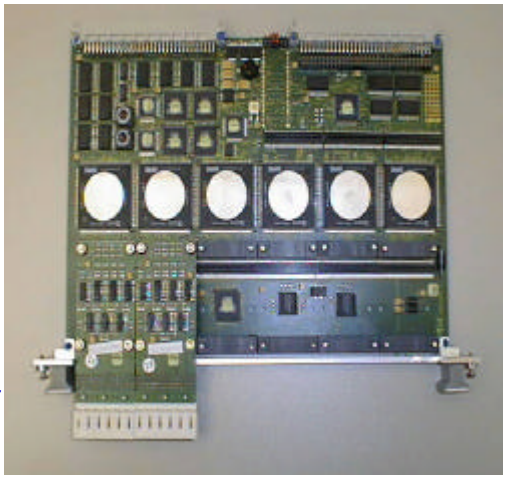
-1/3 of the full system is in operation
-full DAQ chain is set up and working

Trigger (pretrigger+TPU)
Fast Control System
Event Controller
Second Level Trigger
Fourth Level Farm
Computer Center
Tape

- several errors have been fixed
  in the Fast Control System
- FLT-rates up to 2 kHz
- 2.5 Mbytes/sec data rate
  factor 2 larger as design
- stable and reliable operation



4LT-farm
- 20 PC installed



SHARC-board
-75% produced, 50% used

L2-farm:
-100/240 PC installed

Run'98

- goals for the '98 run:
  - commissioning of the final DAQ system ✓
  - common running of:

    Vertex detector, Outer tracker, RICH, Calorimeter and Muon-system ✓
  - commissioning and calibration of the subdetectors was successful
  - at least two weeks of physics running (direct J/Ψ-production) failed:
    trigger acceptance sill very low

- 13 million events were recorded in total
- 250k events were taken with ECAL trigger:

- analyzed up to now: run 1335 (3.5h duration)
  - trigger condition:

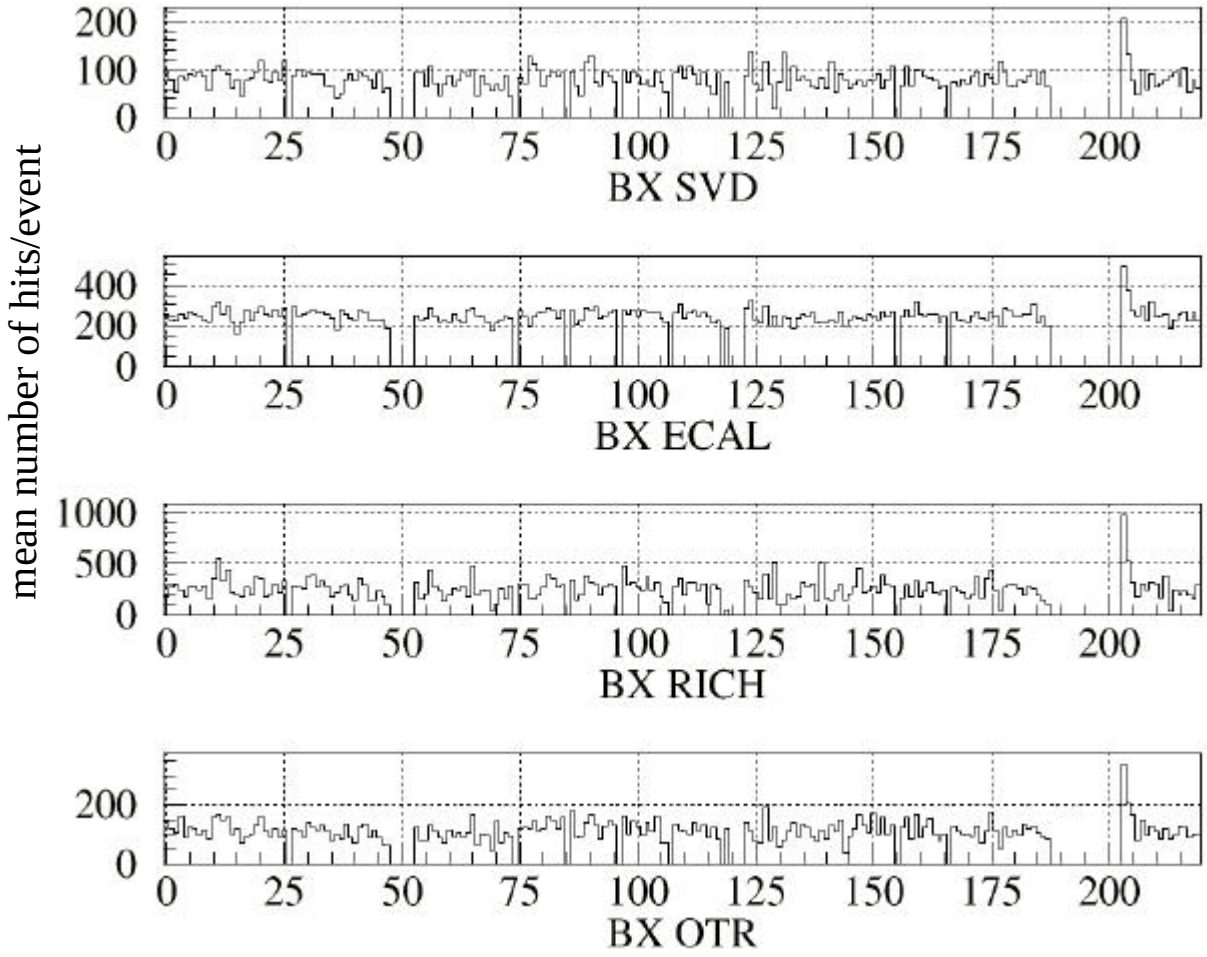
    L1: one calorimeter hit with p_t>1.1 GeV
    L2: a second cluster with p_t>0.75 GeV and two cluster mass > 2 GeV

  - 6×10^9 events seen (factor ten L2-input rate reduction,FCS problem)
  - 4×10^4 events written to tape

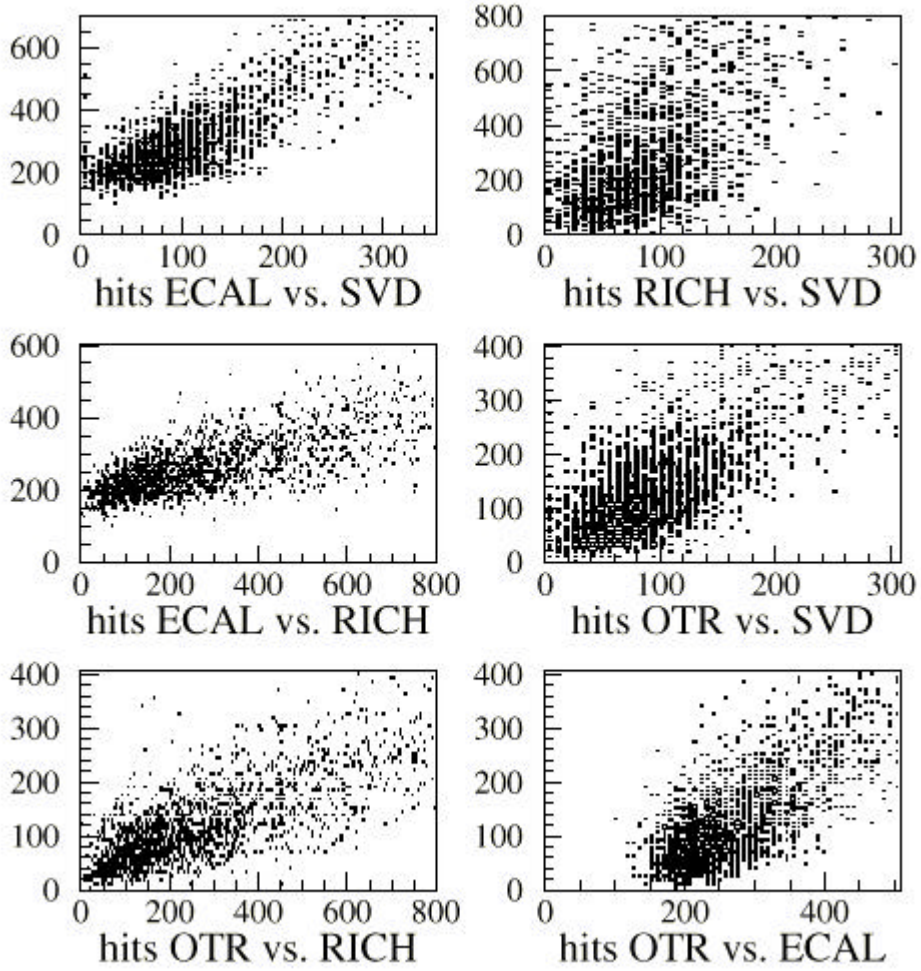
- rate reduction 1.7×10^5 : L1+L2 suppression successfully tested

online monitor: synchronisation

use bunch structure for time correlation

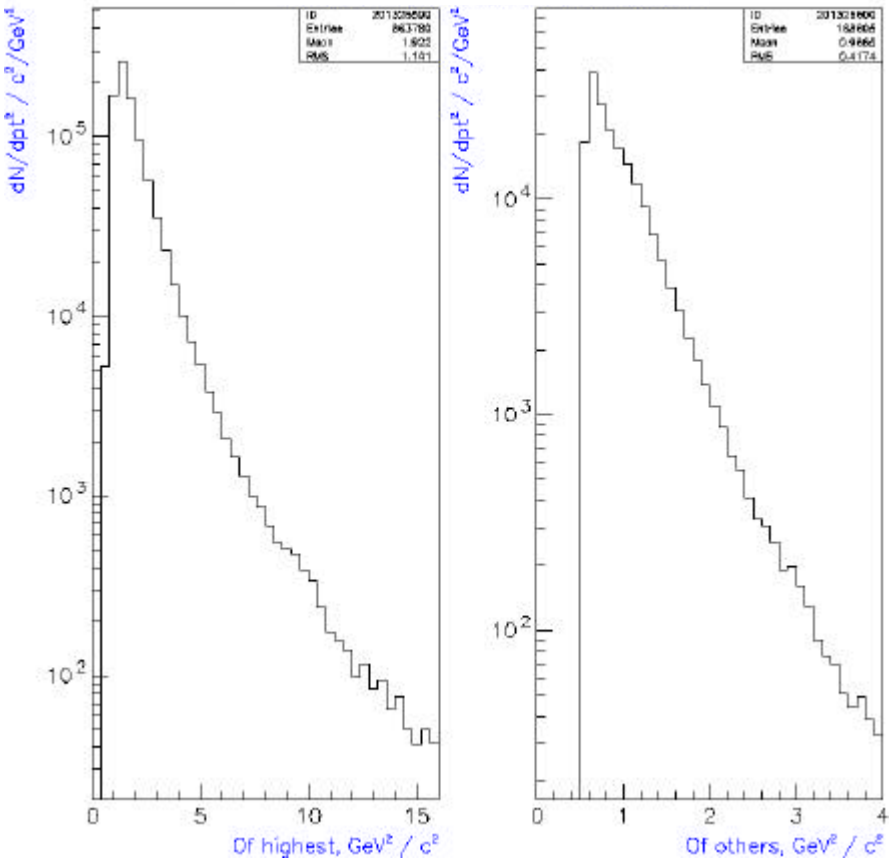


online monitors: hit correlations

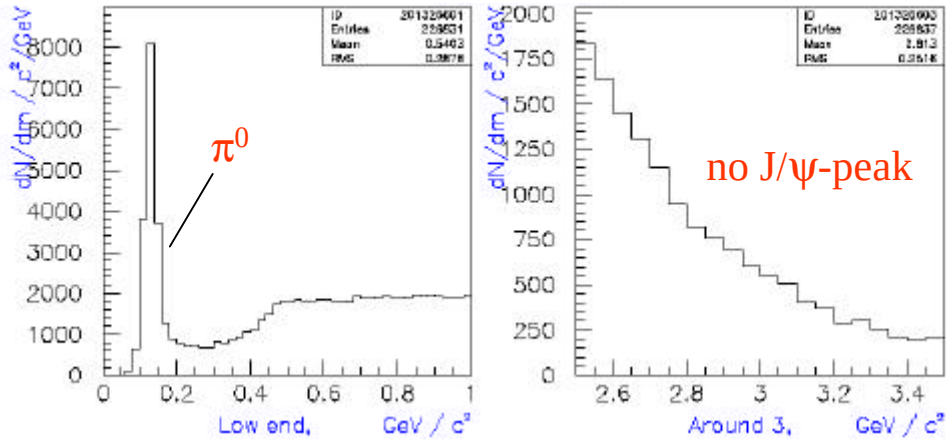


online monitor: p_t and mass spectra

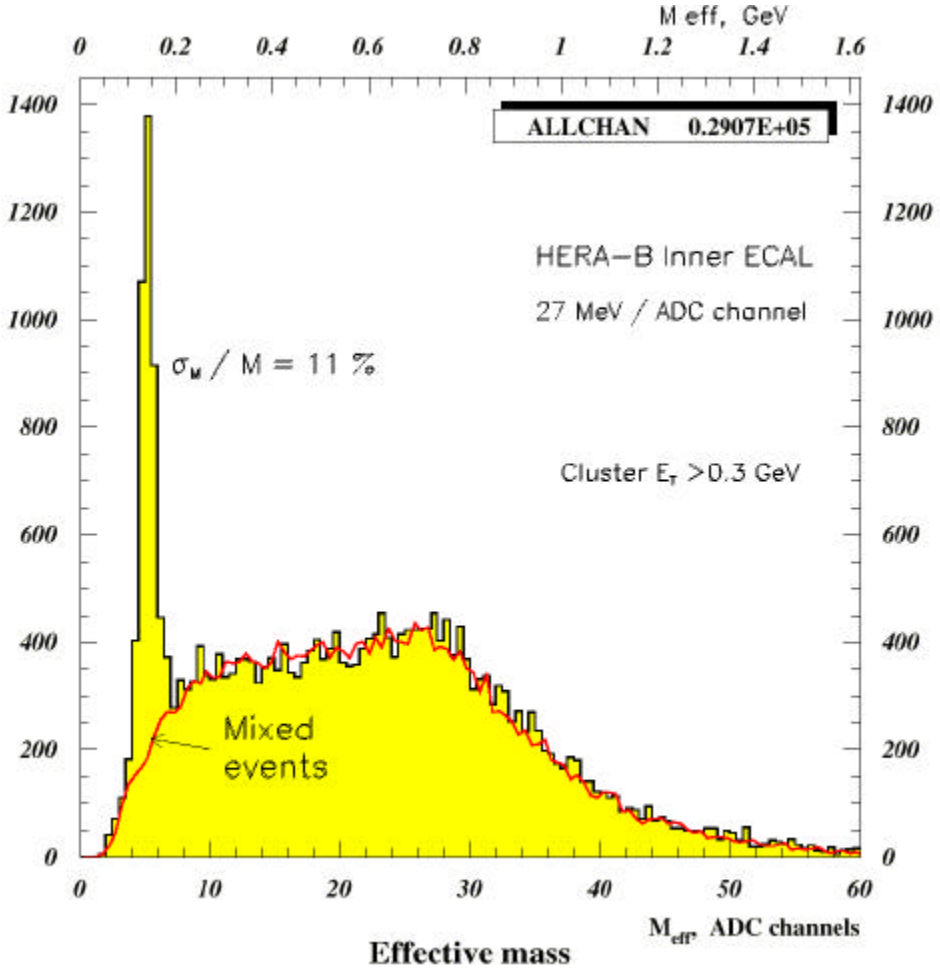
pt^2 of clusters



two cluster mass



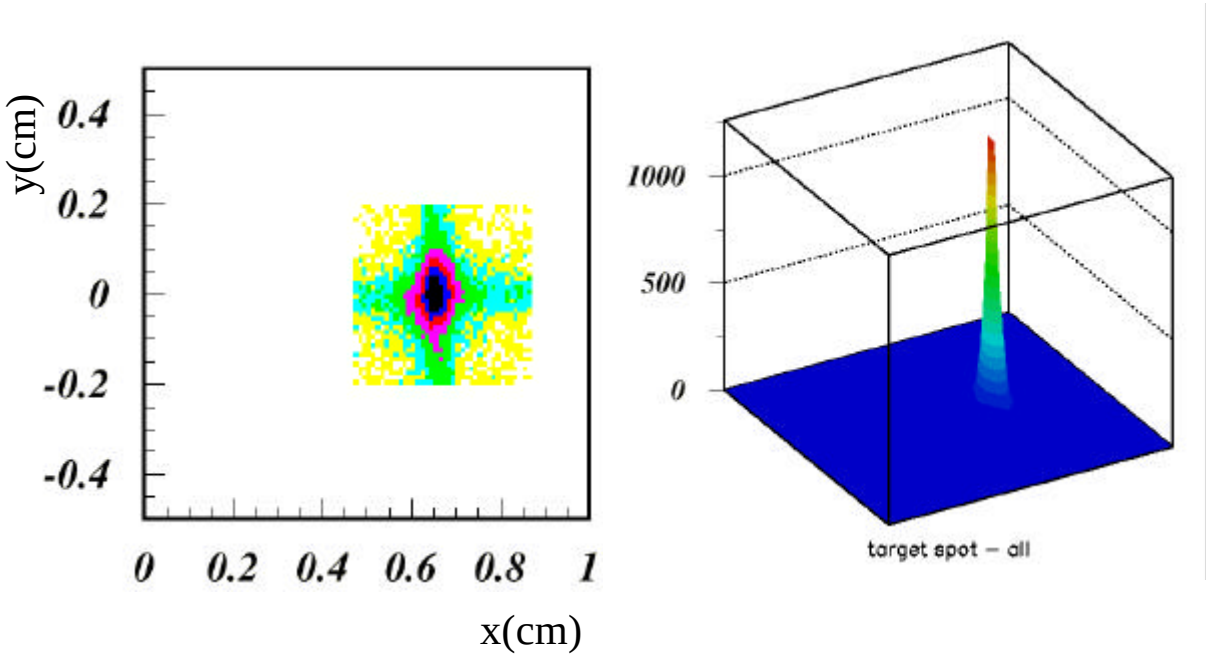
ECAL calibration



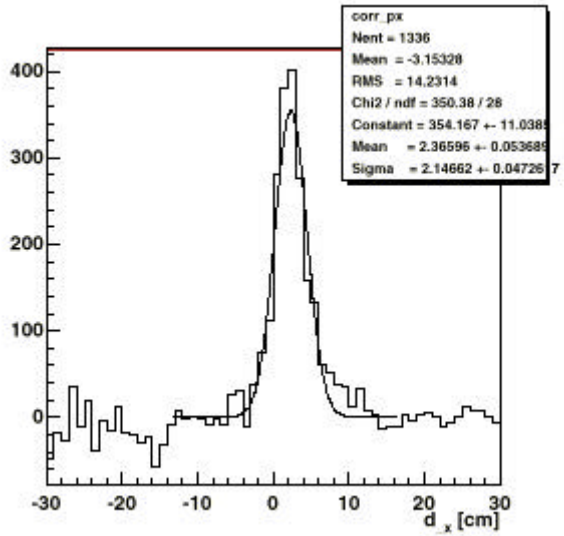
- calibration:
  equalize integrated energy at fixed radius (Magnet off !)
- accuracy ~ 10%

track candidates

target seen with the silicon vertex detector



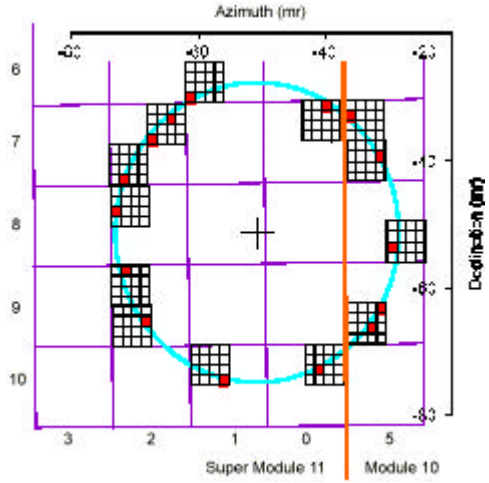
extrapolated vertex detector track segments combined with calorimeter hit



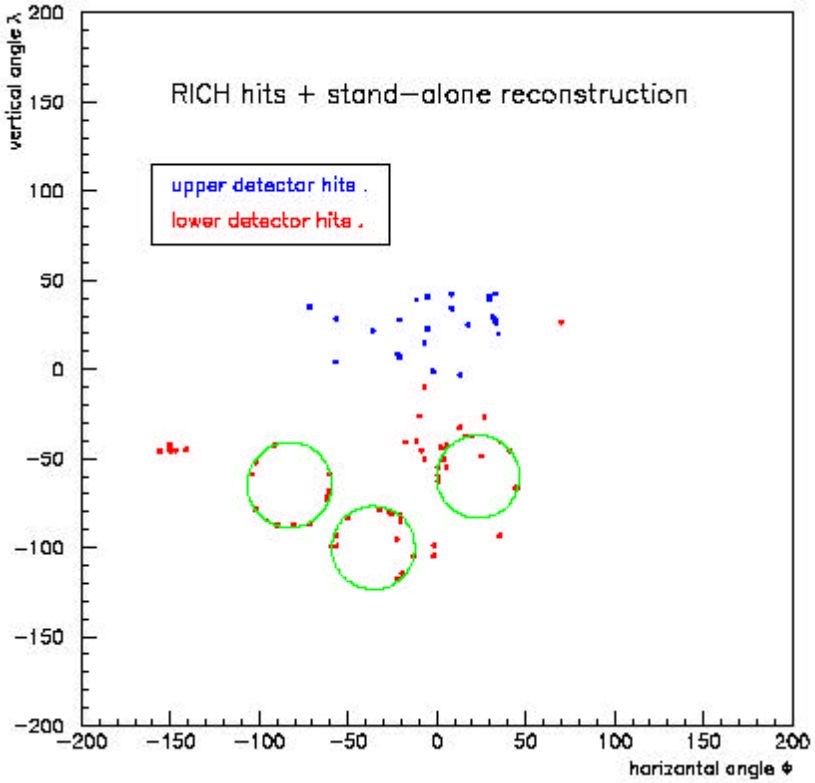
distance[cm]

common RICH-Calorimeter track

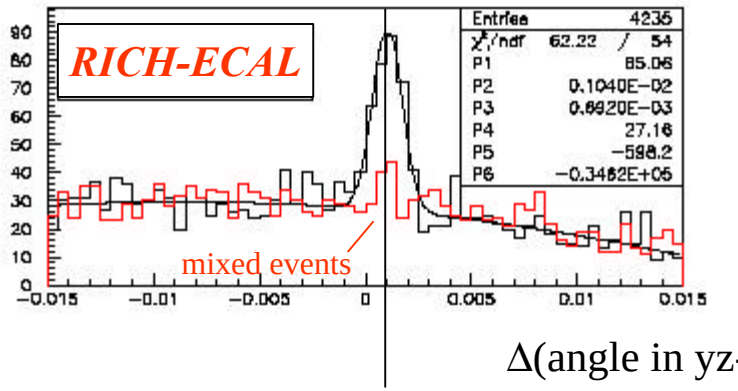
- the spherical mirror of the RICH maps
  incoming parallel light approx. to a point
- each space point on detector plane represents a direction
- RICH-rings are mapped in angle space
- ring center=track direction



14 hits: probably converted photon



- radiator air: 7 photon/β=1-track
- a significant number of photons only
  from converted photons: (two β=1-tracks)
- required 12 photons, correlation with ECAL only



Δ(angle in yz-plane)

misalignment: 1 mrad: Δy ~ 1.2 cm
σ=0.7 mrad

plans

Installation:
- May shutdown:
  - complete the vertex detector
  - complete Muon-system
  - install 1/3 outer tracker for trigger
  - install 1/3 inner tracker
- finish outer/inner tracker installation in 3 days mini breaks

Commissioning:
- online J/Ψ-peak: enlarge trigger rates
- online reconstruction
- detector studies, calibration+alignment
- FLT-studies (starting summer '99)

critical path:
- outer tracker chamber production:
  - is being started now
  - very tight schedule
- inner tracker chamber production:
  - HELIX-trigger capability
- availability of trigger hardware

Goal:
- B-physics RUN I: Jan-May 2000

in case of a success: 4×10^6 sec ⇨ 700 events @ 17 nb ⇨ $\Delta\sin 2\beta \sim 0.18$

summary

- large fraction of the HERA-B Detector is installed
- routinely readout with ECAL+SLT-trigger is established
- main tracking system still missing
- OTR:
  new gas mixture and foil coating solves the OTR aging problems
  OTR chamber production is being started
- ITR:
  chamber production is well progressed, but there are still open issues