

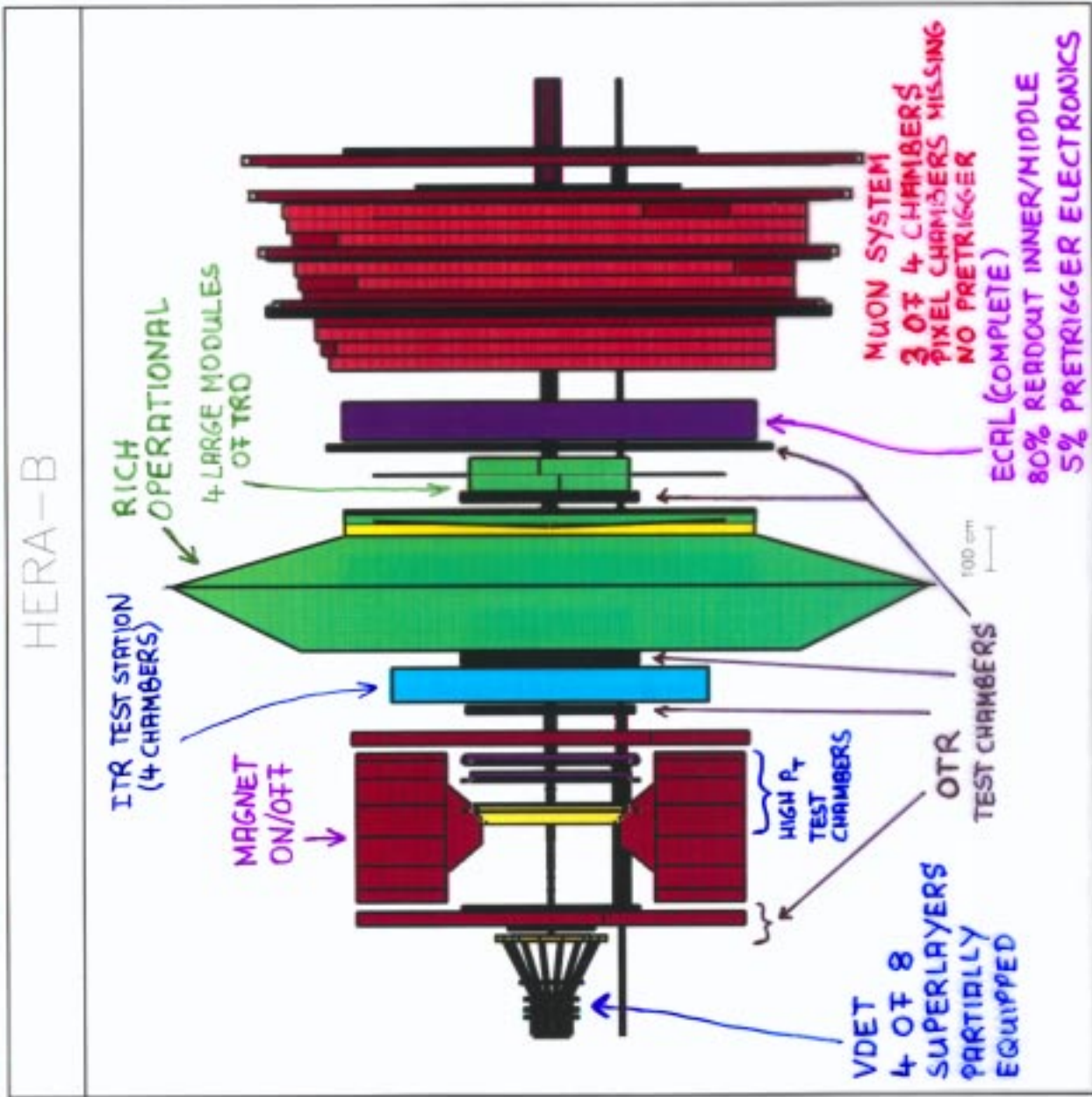
# HERA-B STATUS

PRG OPEN SESSION, June 29, 99

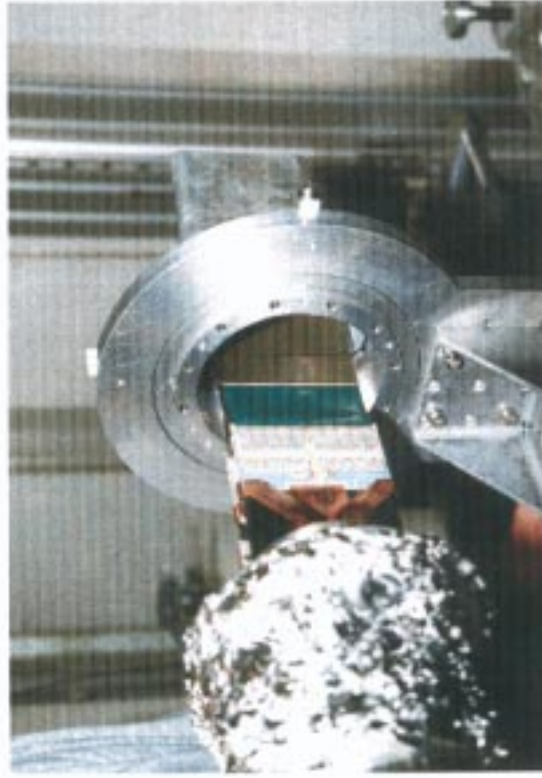
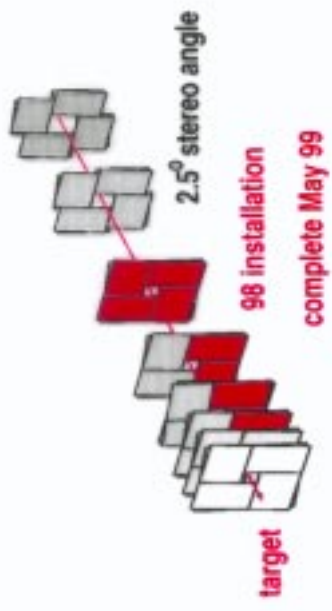
THOMAS LOHSE  
HUMBOLDT UNIVERSITY  
BERLIN

- RUNNING 1999
- DETECTOR PRODUCTION STATUS
- INSTALLATION / COMMISSIONING PLAN
- PROSPECTS FOR TRANSITION  
INTO PHYSICS RUN 2000

# RUNNING 1999



## Vertex Detector System





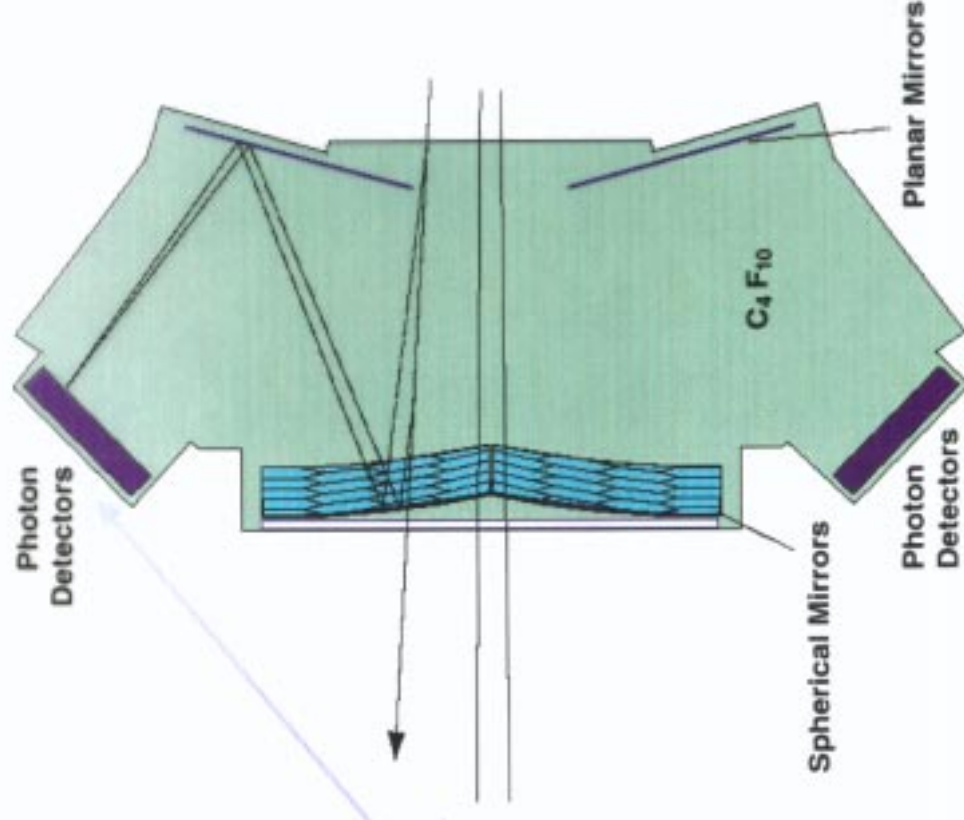
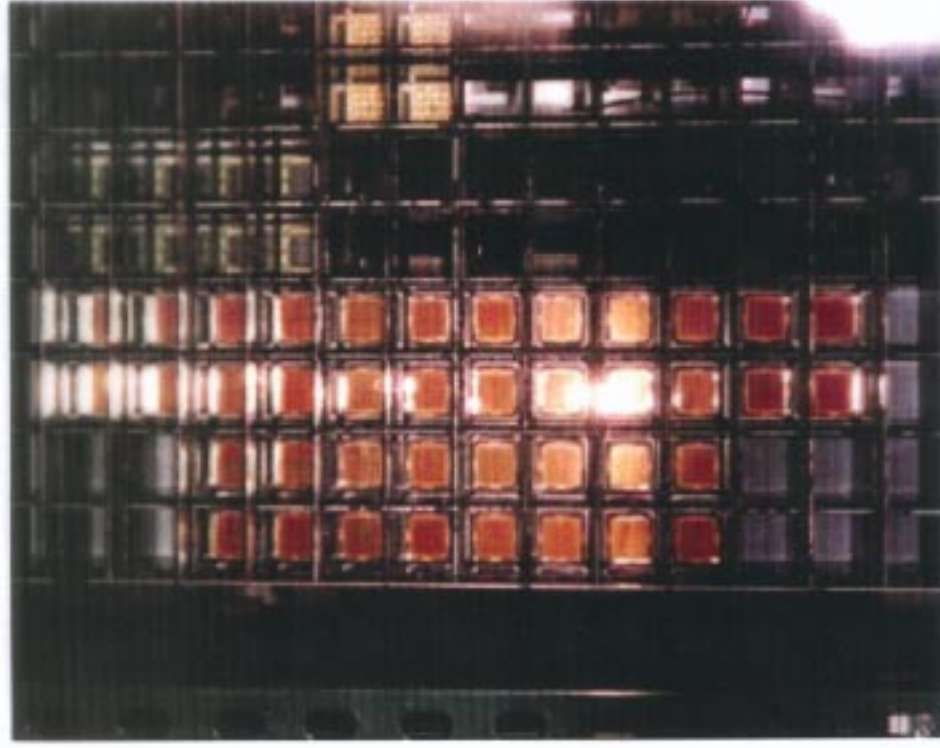


Completed MC2 chamber inside magnet

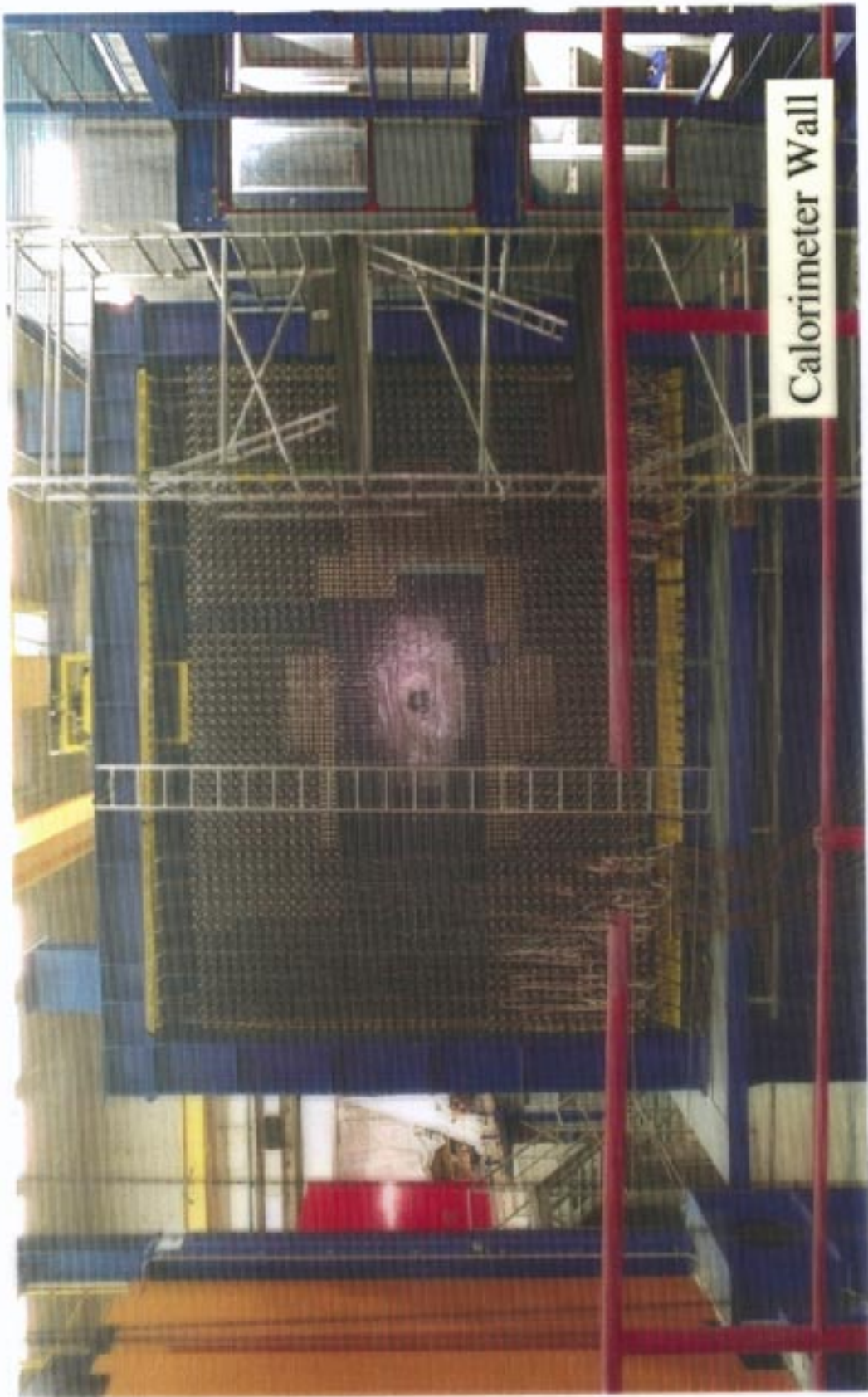
Inner Tracker Module



## Ring Imaging Cherenkov Detektor





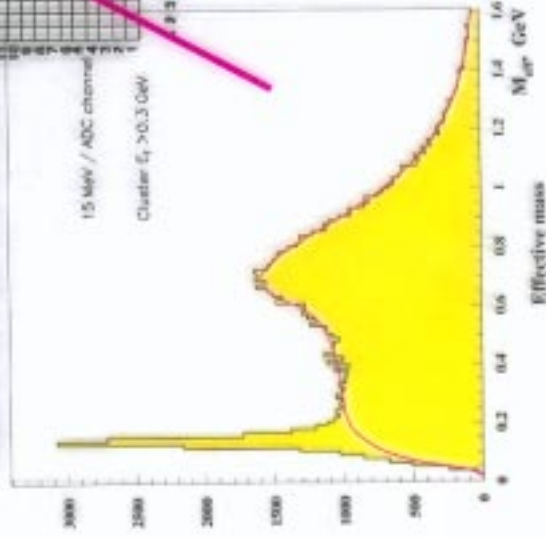


Calorimeter Wall

# Electromagnetic Calorimeter February 1999

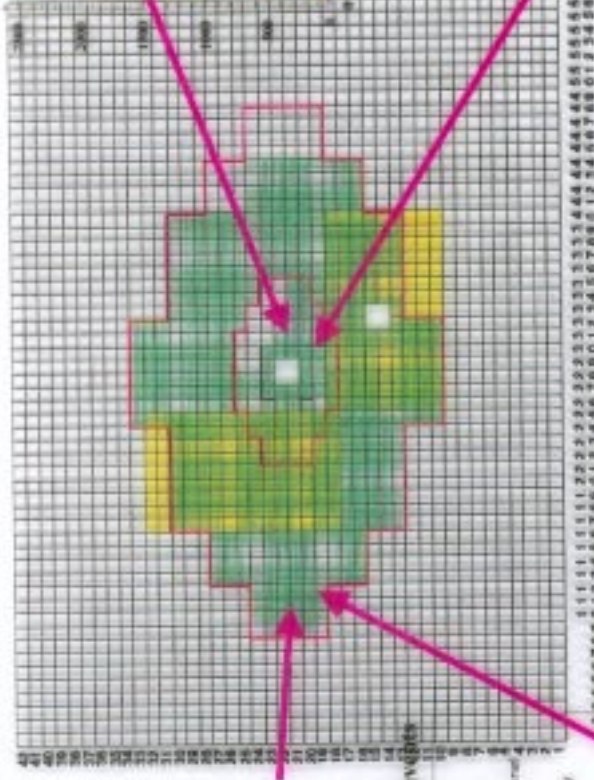
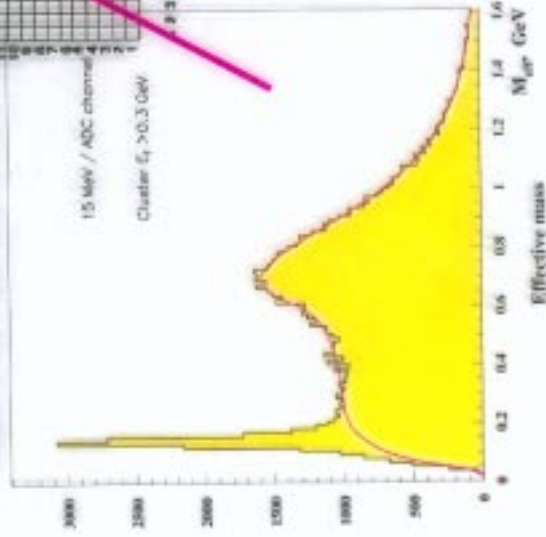
Middle Calorimeter

Middle ECAL, Run 1630, 2-cluster events



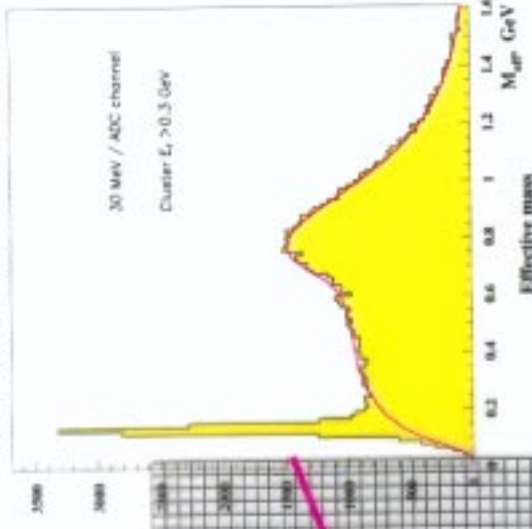
Middle Calorimeter

Middle ECAL, Run 1630, 2-cluster events



Inner Calorimeter

Inner ECAL, Run 1630, 2-cluster events



: equipped with readout boards

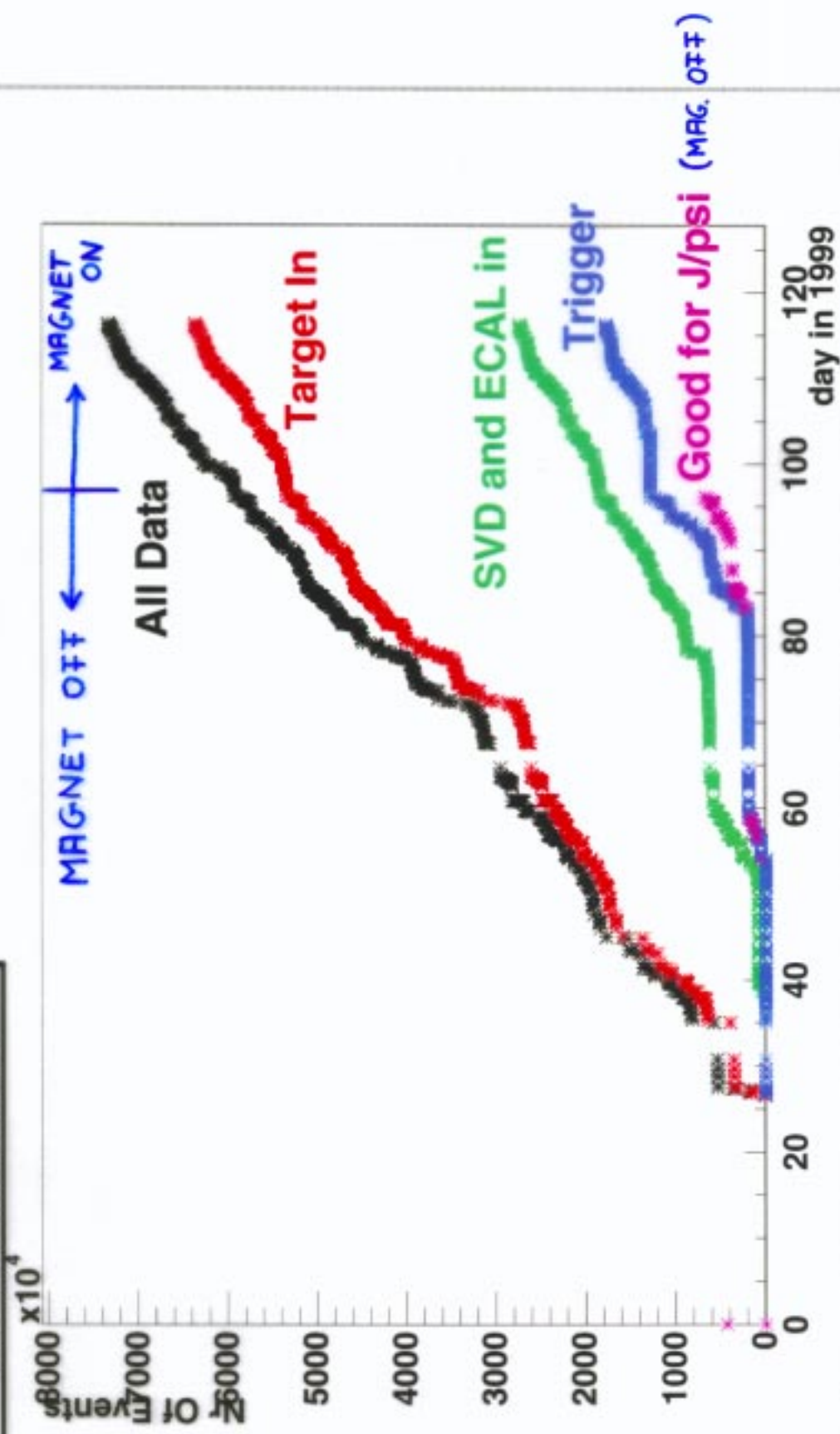
(+ up to 14 PRETRIGGER BOARDS)



: solid angle coverage of Vertex Detector

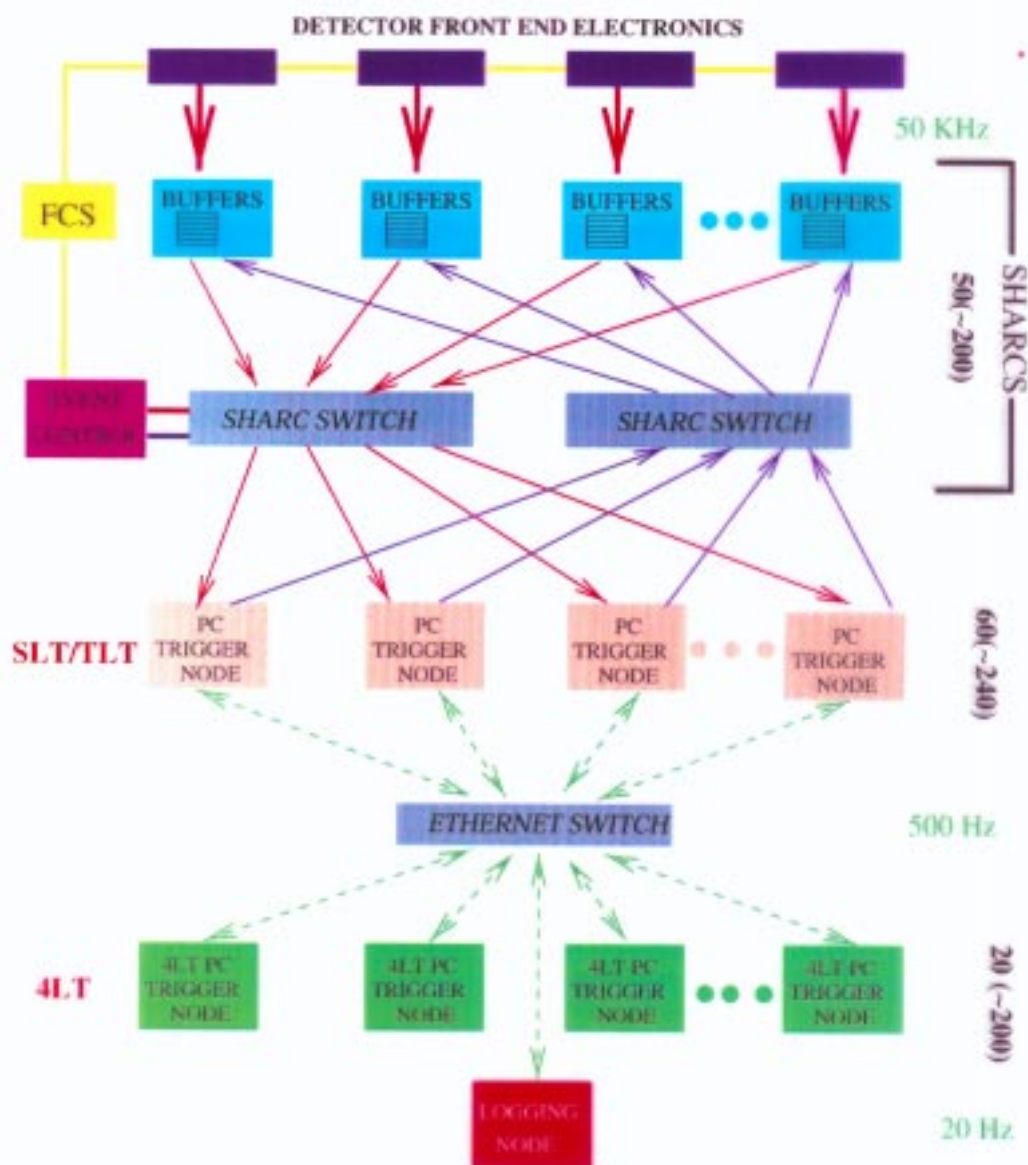


Events taken in 1999



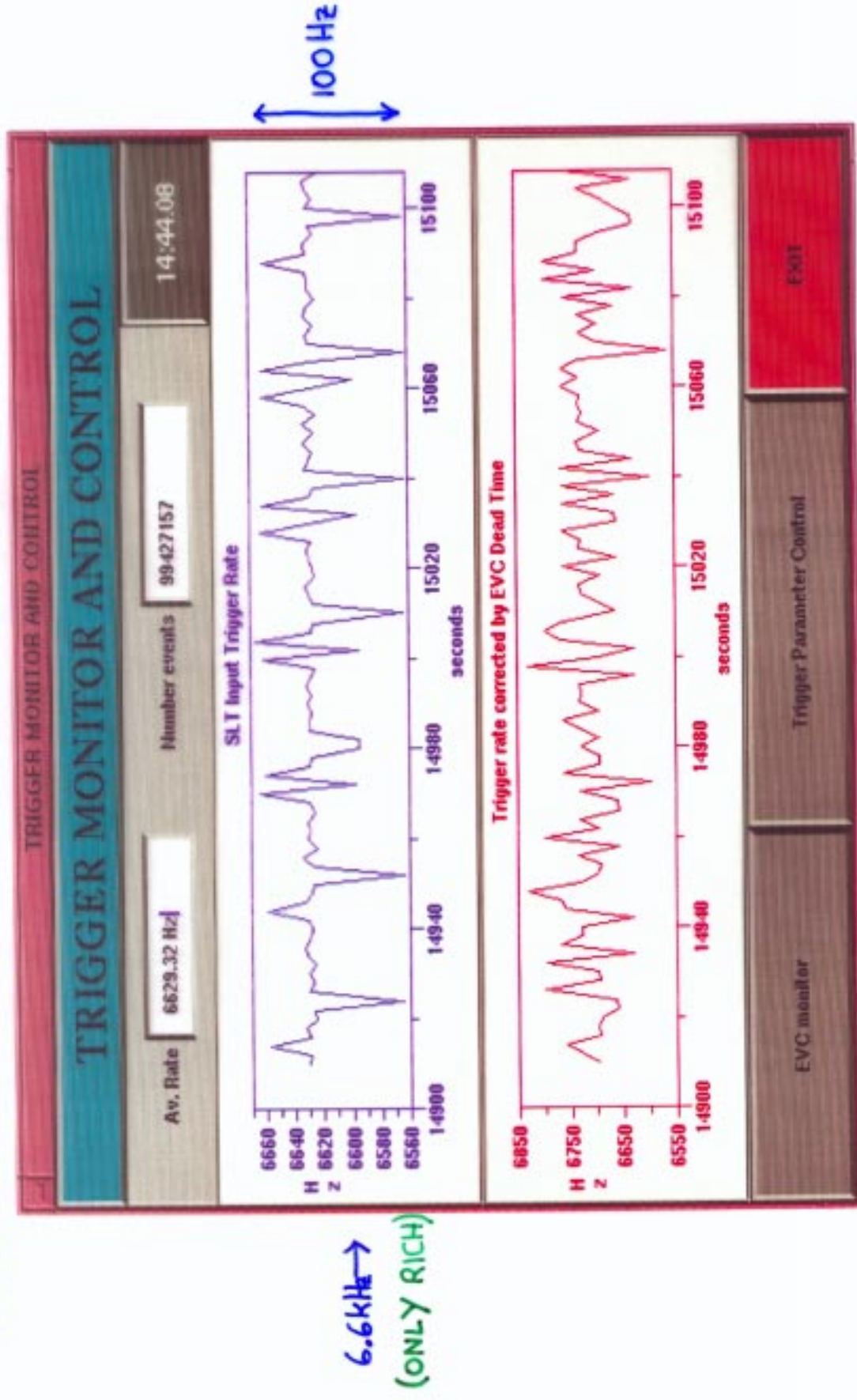
# COMMISSIONING RESULTS

## HERA-B DAQ ARCHITECTURE

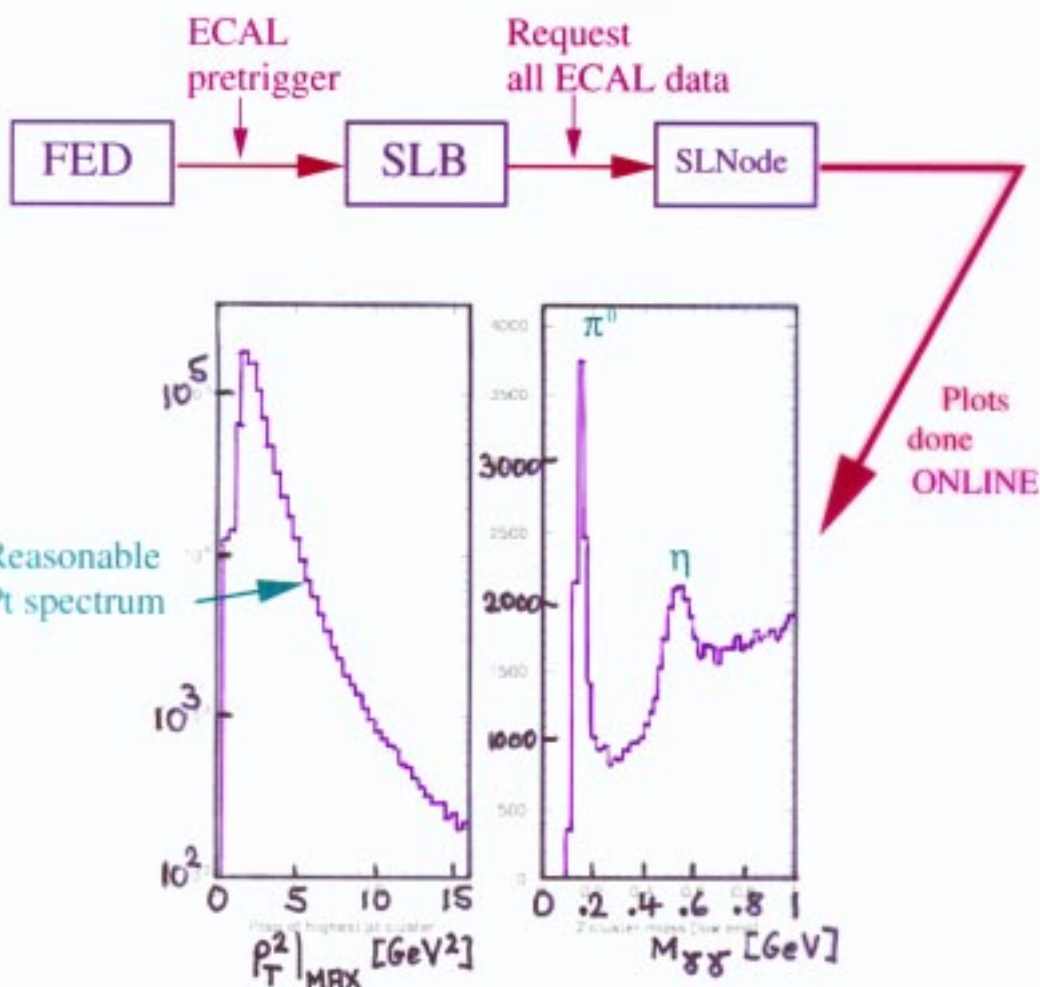




# EXAMPLE FOR RECENT READOUT TEST: 100 MILLION EVENTS @ 6.6 kHz



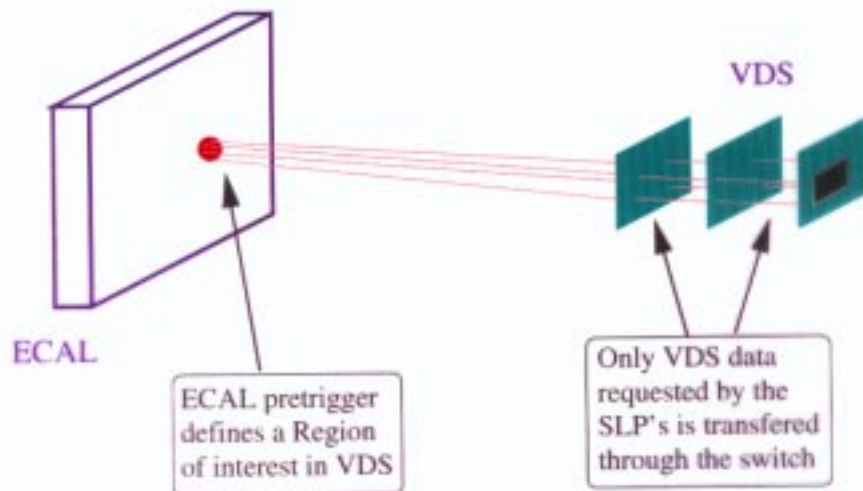
## SLT-switch



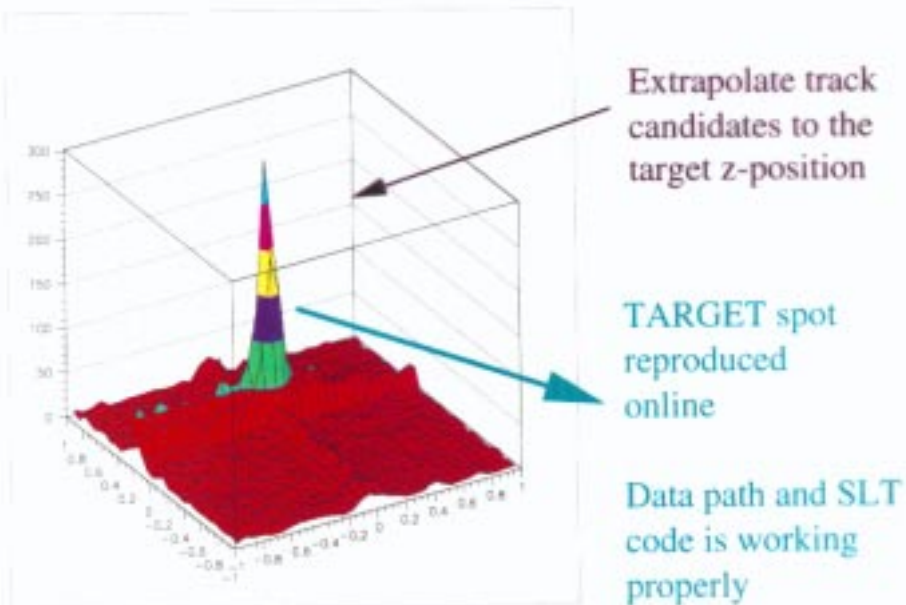
Data transfer to SLT-farm done at 10kHz  
(~30Mbytes/s)

- ➔ Able to provide data for ECAL calibration in one hour, as needed.  
( READ  $20 \cdot 10^6$  ECAL EVENTS AT  $\leq 10\text{kHz}$  )
- ➔ SWITCH SUPPORTS NECESSARY DATA RATES!  
( 50 kHz • FULL DETECTOR • ONLY R.O.I.s FROM FLT )

## SLT: data path



→ Test switch message system.  
First test of the SLT system in a  
"transfer-request" mode.

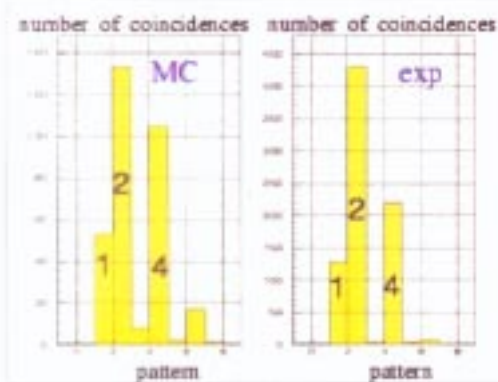
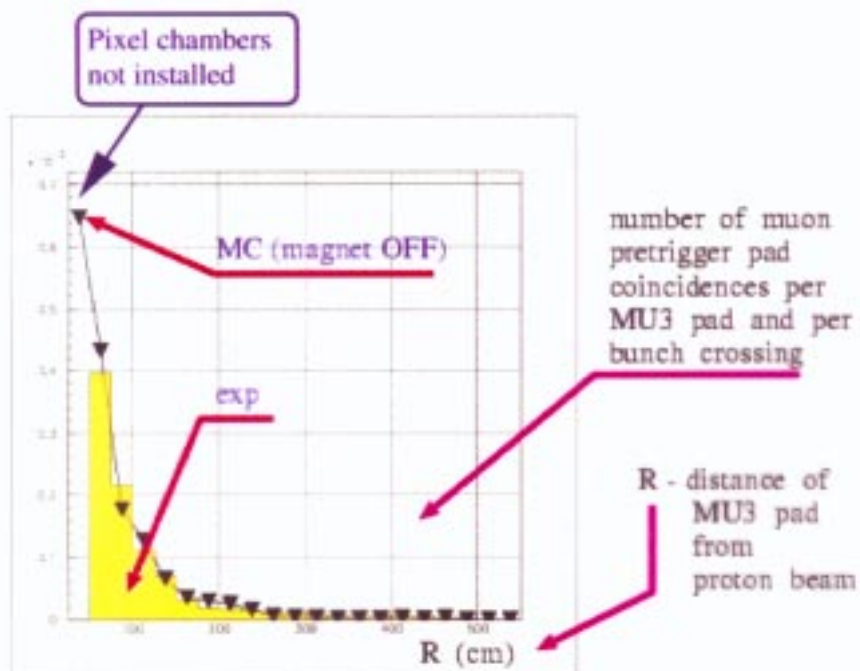


SIMILAR: TARGET SPOT FROM VDS TRACKS  
BY TLT (INDEPENDENT PATTERN  
RECOGNITION)



# MUON: Pretrigger coincidences

Simulate Muon pretrigger offline.



MU4 pattern configuration :

1 - 1 0 0  
2 - 0 1 0  
3 - 1 1 0  
4 - 0 0 1  
5 - 1 0 1  
6 - 0 1 1  
7 - 1 1 1



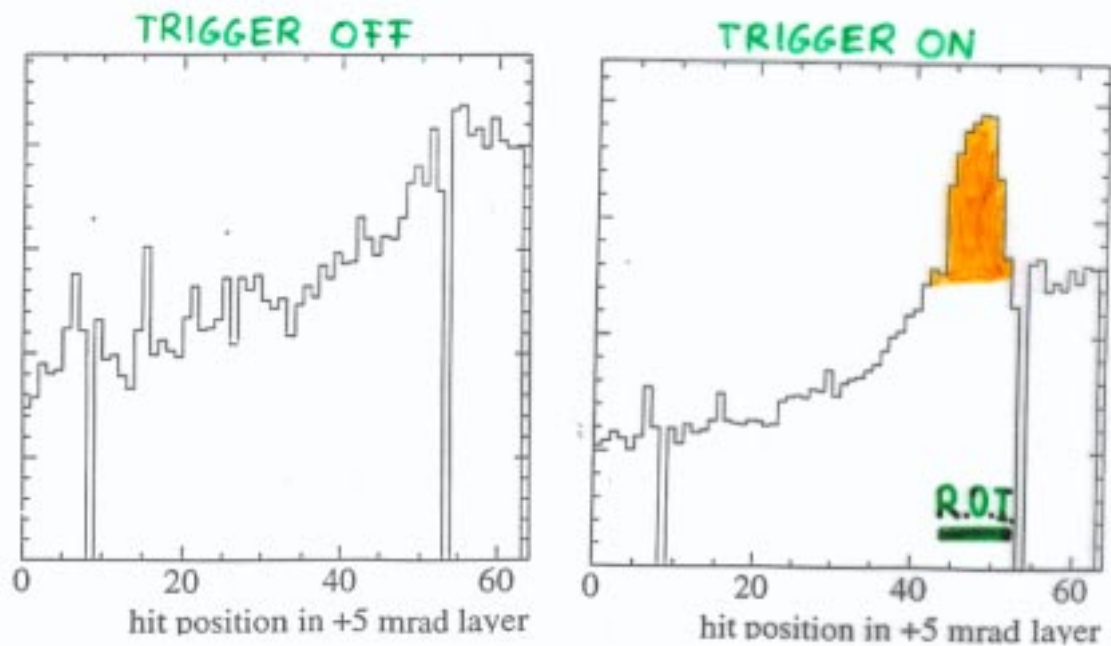
Date: February 20, 2001

Reasonable agreement between data and MC.

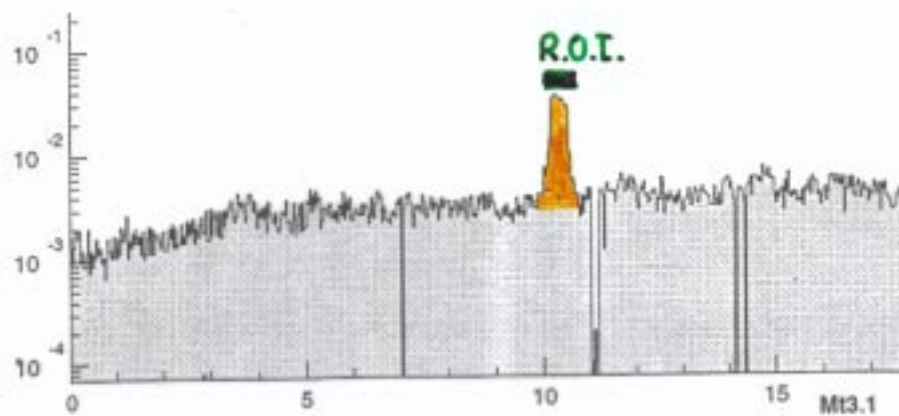
➡ Design principle of FLT looks OK.

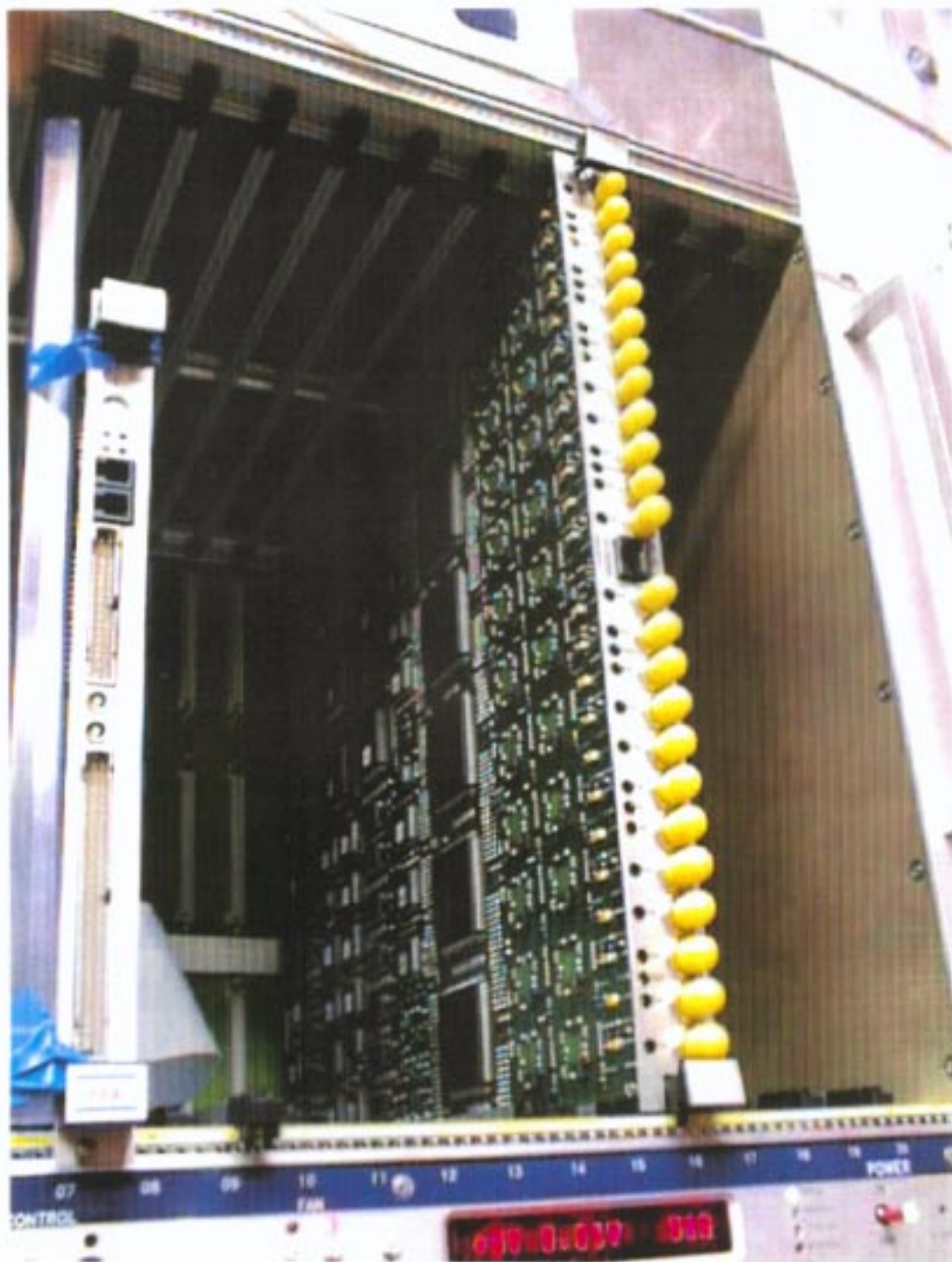
## FIRST TESTS OF LEVEL 1 TRIGGER CHAIN

### OUTER TRACKER SUPERLAYER THROUGH FLT:



### MUON CHAMBER(3) THROUGH FLT:

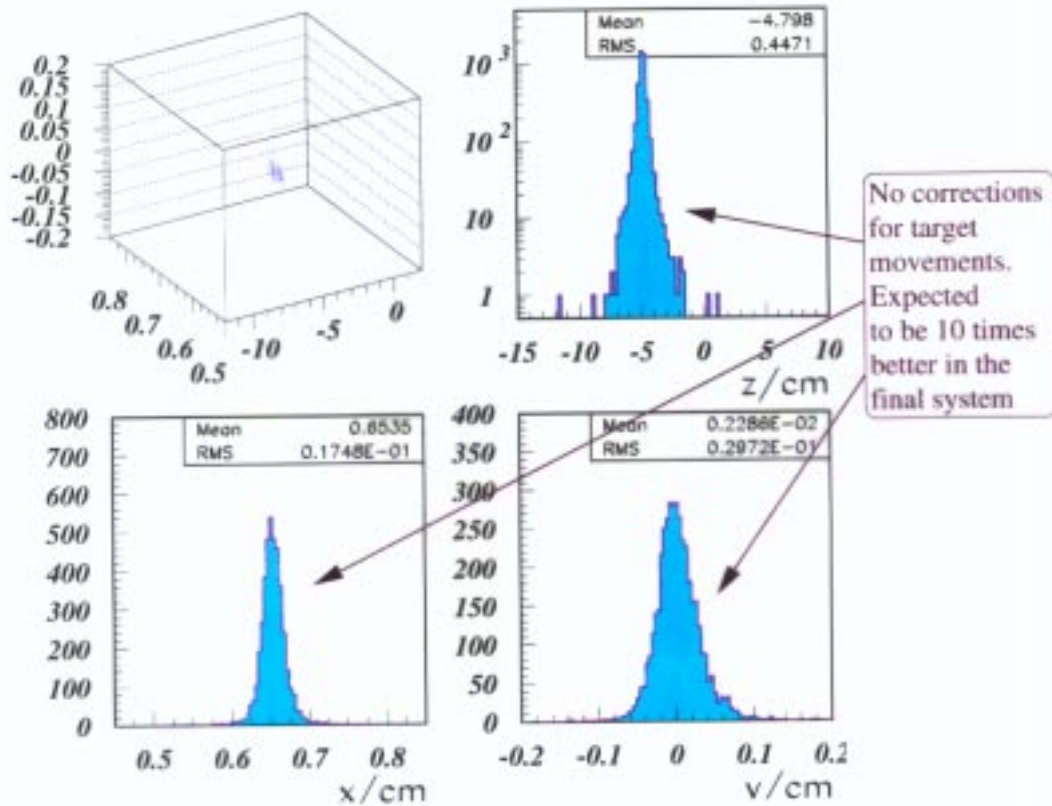




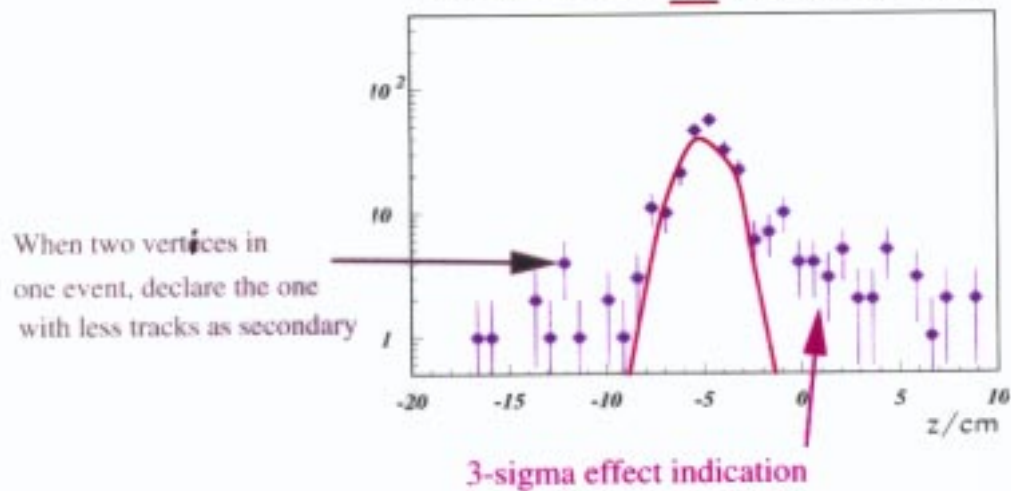


## VDS: vertex reconstruction

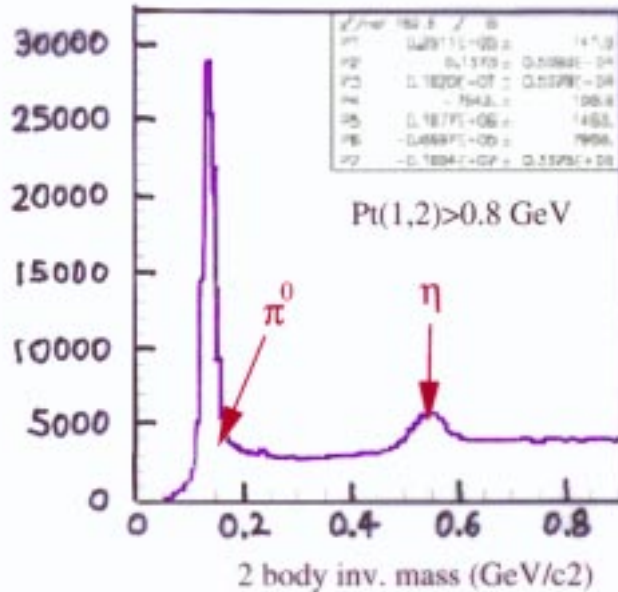
distribution of vertices with at least 3 tracks



$z$ -distribution of sec. vertex candidates

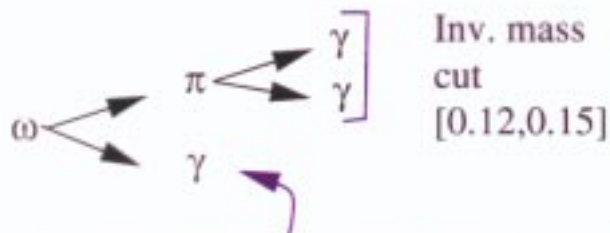


## Calorimeter calibration

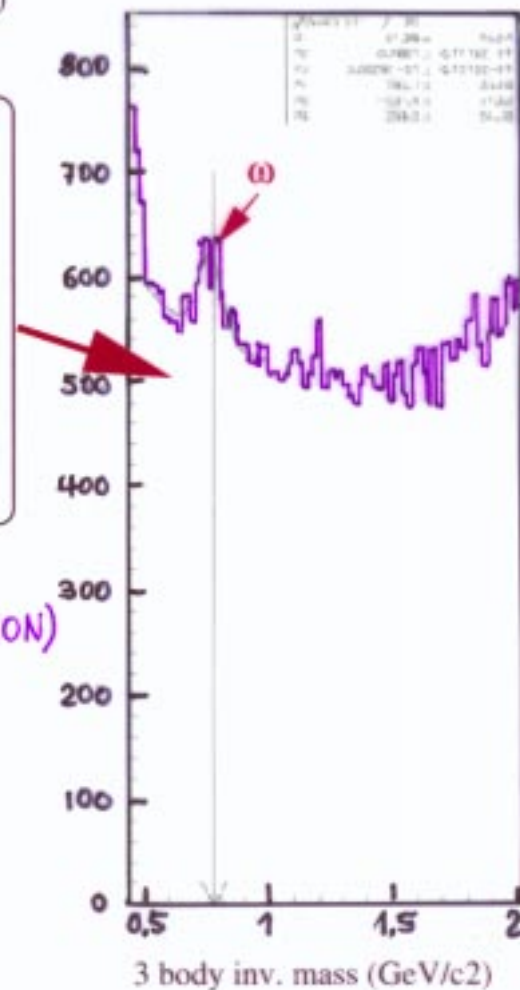


Calibration using the  $\pi^0$  signal in each tower

DAQ allows to take the needed data to have calibration one hour



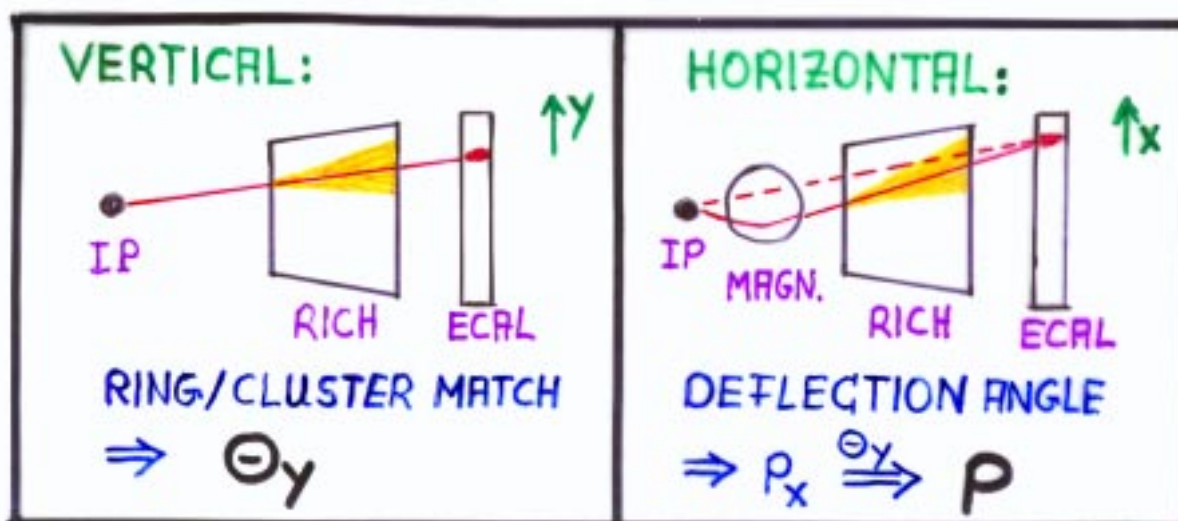
Request that no charged track closer than 2cm to the calorimeter cluster



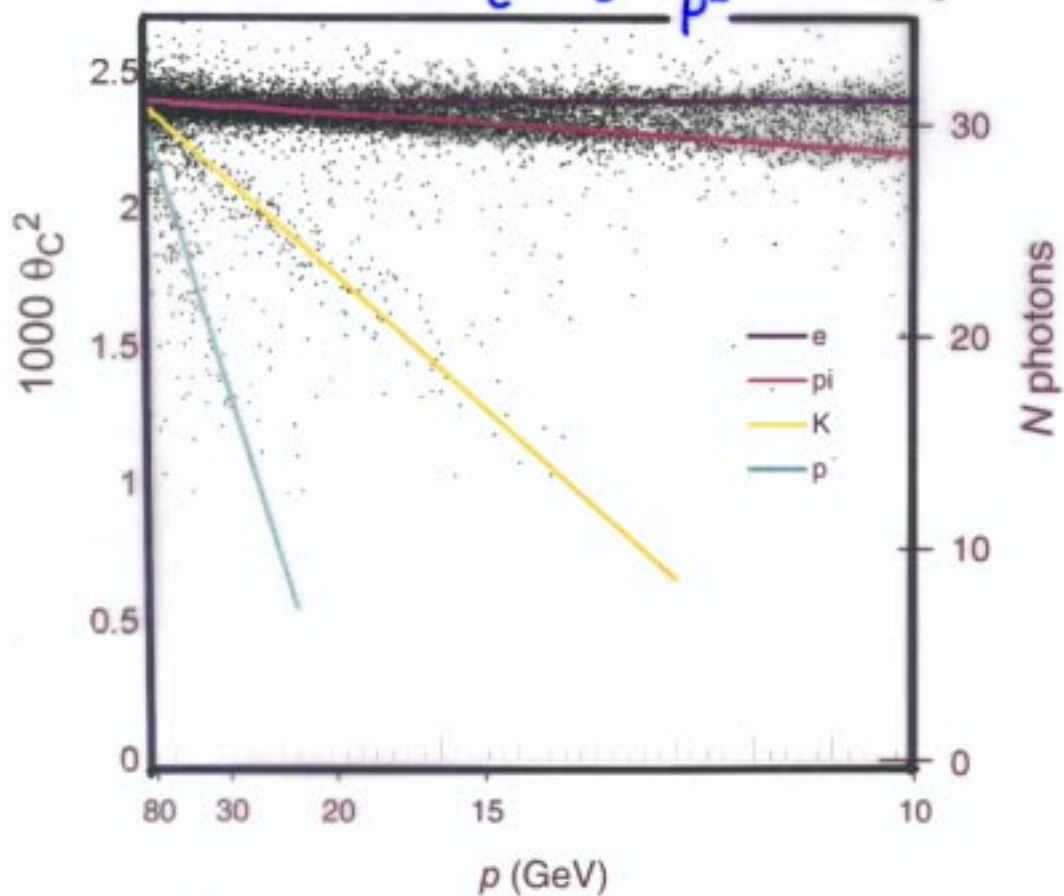
- ECAL calibrated (5% PRECISION)

- DAQ and detector synchronization working properly

# TEST : RICH PARTICLE ID

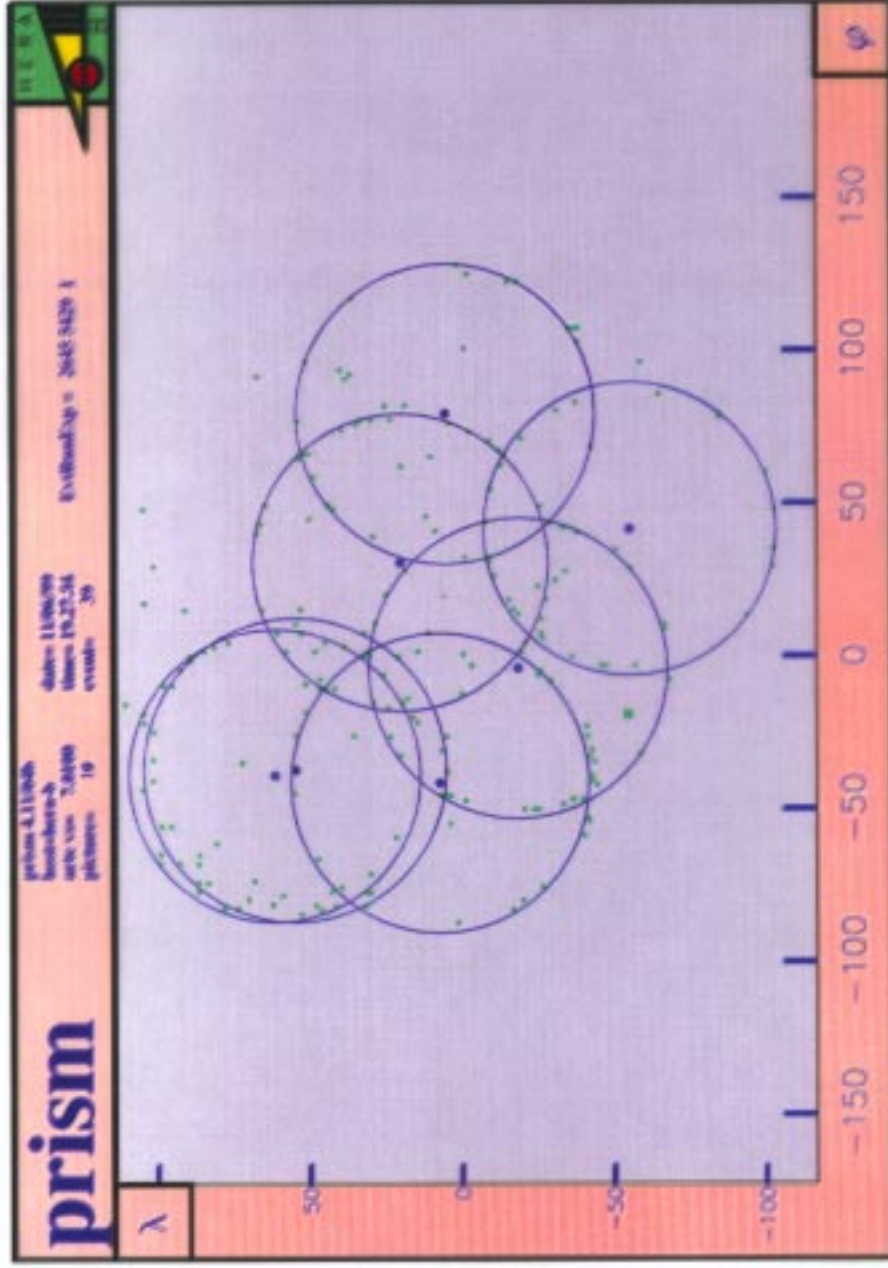


**RING RADIUS :**  $\Theta_c = \Theta_o - \frac{m^2}{p^2} \Rightarrow m$



WITH TRACKING  $\Rightarrow$  BANDS 10 TIMES NARROWER





# DETECTOR STATUS

→ HERE: THE REMAINING PROBLEMS

# TARGET AND BEAM

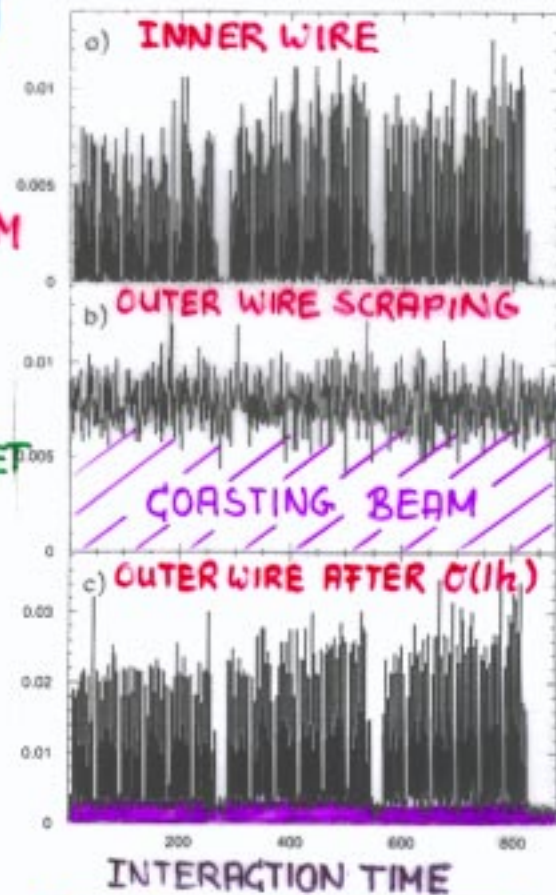
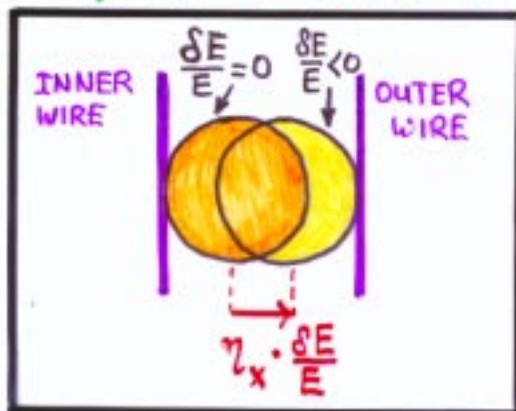
→ ROUTINE OPERATION AT HIGH RATE

→ WORRY: COASTING BEAM

- $\frac{\delta E}{E} < 0$  OUTSIDE

SEPARATRIX OF RF BUCKET

- DISPERSION AT I.P.  
⇒ ON "OUTER WIRE"



UNDER INVESTIGATION  
BY HERA + HERA-B

PATTERN RECOGNITION IN OTR RELIES ON BX-TIMING!

→ 2 OF 8 WIRES HARDLY USEABLE

⇒ LESS VERTEX SEPARATION POWER

⇒ SOME (PROBABLY SMALL) LOSS IN CP-REACH



# ITR: ANODE AGEING OF GEM-MSGCs

(NOT OBSERVED IN PROTOTYPE)

(a) Ar - DME GAS

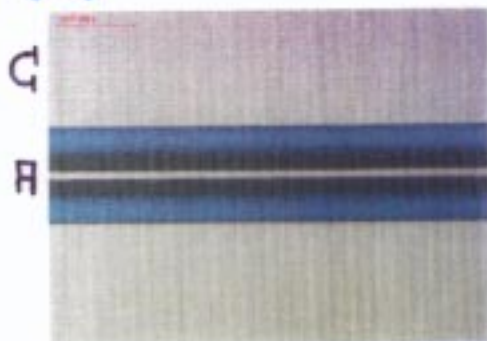
IRRAD. → C/POLYMER DEPOSITS ON ANODES → RAPID GAIN LOSS

(b) Ar - CO<sub>2</sub> GAS MIXTURES

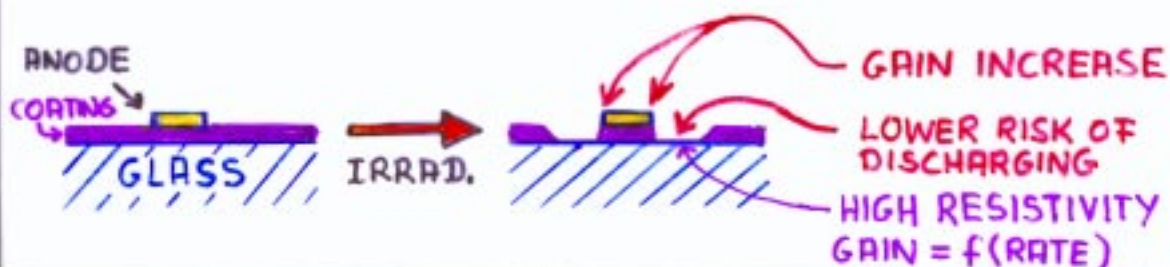
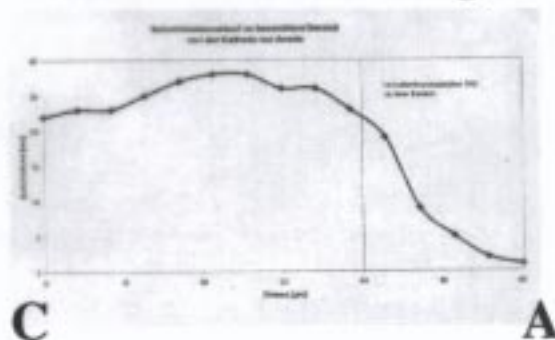
→ NO DEPOSITS ✓

→ MORE PRONE TO SPARKING (✓)  
(ACCEPTABLE, LESS SAFETY MARGIN)

(c) ETCHING OF CONDUCTIVE COATING (DIAMOND)



thickness of coating



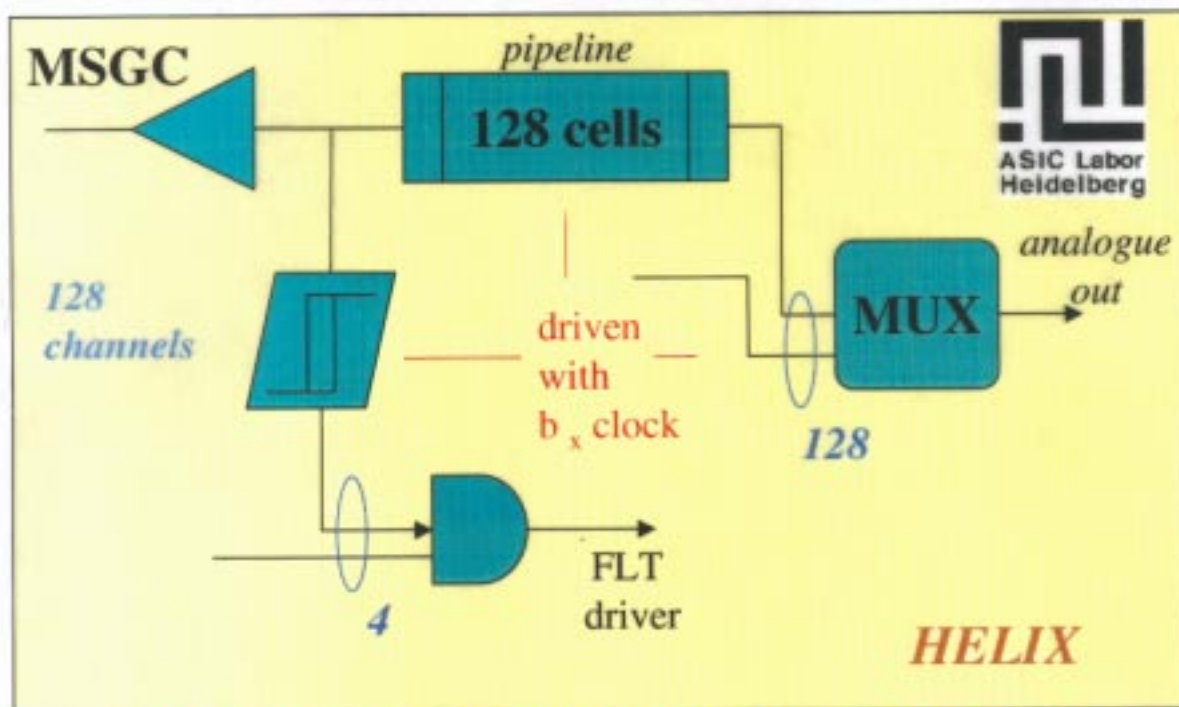
OPERATING POINT EXISTS ... BUT  
OPERATING CONDITIONS =  $f(\text{TIME, POSITION, RATE})$

THIS IS STILL A WORKING ITR CONCEPT !!!

# HELIX: READOUT CHIP (ANALOGUE/DIGITAL)

VDET:  $\nexists$  FLT  $\Rightarrow$  ONLY ANALOGUE READOUT

HELIX 2.2 OPERATIONABLE  $\nearrow$  RAD. HARDNESS OK  
 $\searrow$  S/N  $\geq 20$

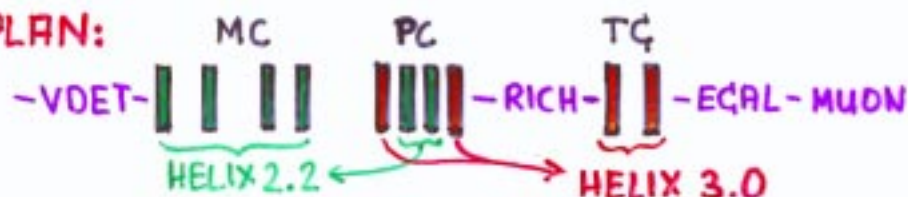


HELIX 2.2: X-TALK COMPARATOR  $\rightarrow$  ANALOGUE OUT  
 $\Rightarrow$  HIGH TRIGGER THRESHOLD, LOW EFFIC.  $\nearrow$

HELIX 3.0: • X-TALK REDUCED  $\checkmark$

- BUG  $\Rightarrow$  PIPELINE REDUCED TO 123 BX  $\nearrow$
- PCB POWER LINES  $\Rightarrow$  RESIDUAL X-TALK  $\nearrow$

PLAN:



(-X) : OLD PCB ( $\leq$  SEP. '99)  
 (+X) : NEW PCB ( $\geq$  OCT. '99)

$\Rightarrow$  REBUILD TRIGGER CHAMBERS WITH HELIX 3.1(?)  
 AND GOOD PCB IN 2000 !

# OUTER TRACKER

- ALL RUNNING/AGEING TESTS SHOW:  
SHORT + MEDIUM TERM AGEING ELIMINATED  
SEARCH FOR LONG TERM (YEAR(s)) EFFECTS ONGOING.
- WORRY: SCALING TO LARGE CHAMBERS  
... SURPRISES NOT EXCLUDED ...
- MASS PRODUCTION/ASSEMBLY AS SCHEDULED  
PRODUCTION FINISHED BY SEPT. 99
- STILL VERY TIGHT SCHEDULE FOR  
INSTALLATION + COMMISSIONING.



# FIRST LEVEL TRIGGER SYSTEM

## TRIGGER LINK BOARDS

TDC → TFCU { TECHNICAL PROBLEMS  
ARE SOLVED BUT  
TIGHT SCHEDULE  
✓  
HELIX → TFCU  
μ-PIXEL → TFCU (✓) ... SOME DELAY

## TRACK FINDING UNITS (TFUs)

- 75 NEEDED, 14 WORKING, 8 IN TEST PHASE
- MESSAGE-CHAIN-TEST NOW { SIMULATED DATA  
REAL DATA, LAST RUN
- PRODUCTION: JULY - DEC 99
- **TEST: 2 BOARDS/WEEK ⇒ VERY TIGHT SCHEDULE**

## TRACK PARAMETER UNITS (TPUs)

## TRIGGER DECISION UNIT (TDU)

✓  
(✓) ← NEEDS SOME  
DEBUGGING

## MESSAGING SYSTEM (✓)

**DESIGN UPGRADE IN SOME LOCATIONS**

## INFRASTRUCTURE (✓)

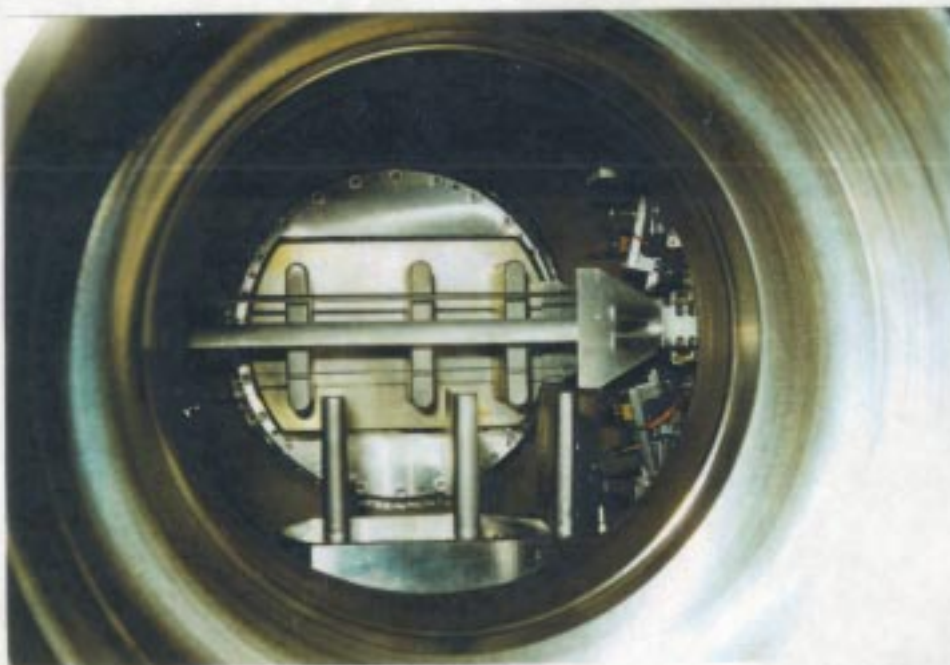
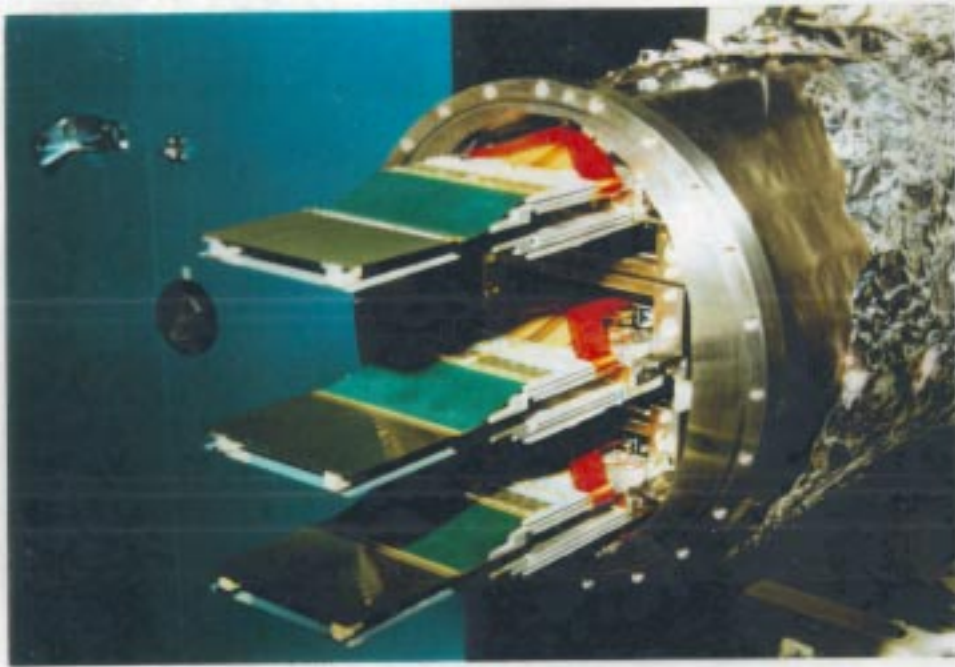
**OPTICAL TRANSMITTERS/RECEIVERS DELAYED**

## SOFTWARE (✓)

MANPOWER PROBLEMS; NOW ON THE WAY

**VERY TIGHT SCHEDULE**

# PRODUCTION AND INSTALLATION











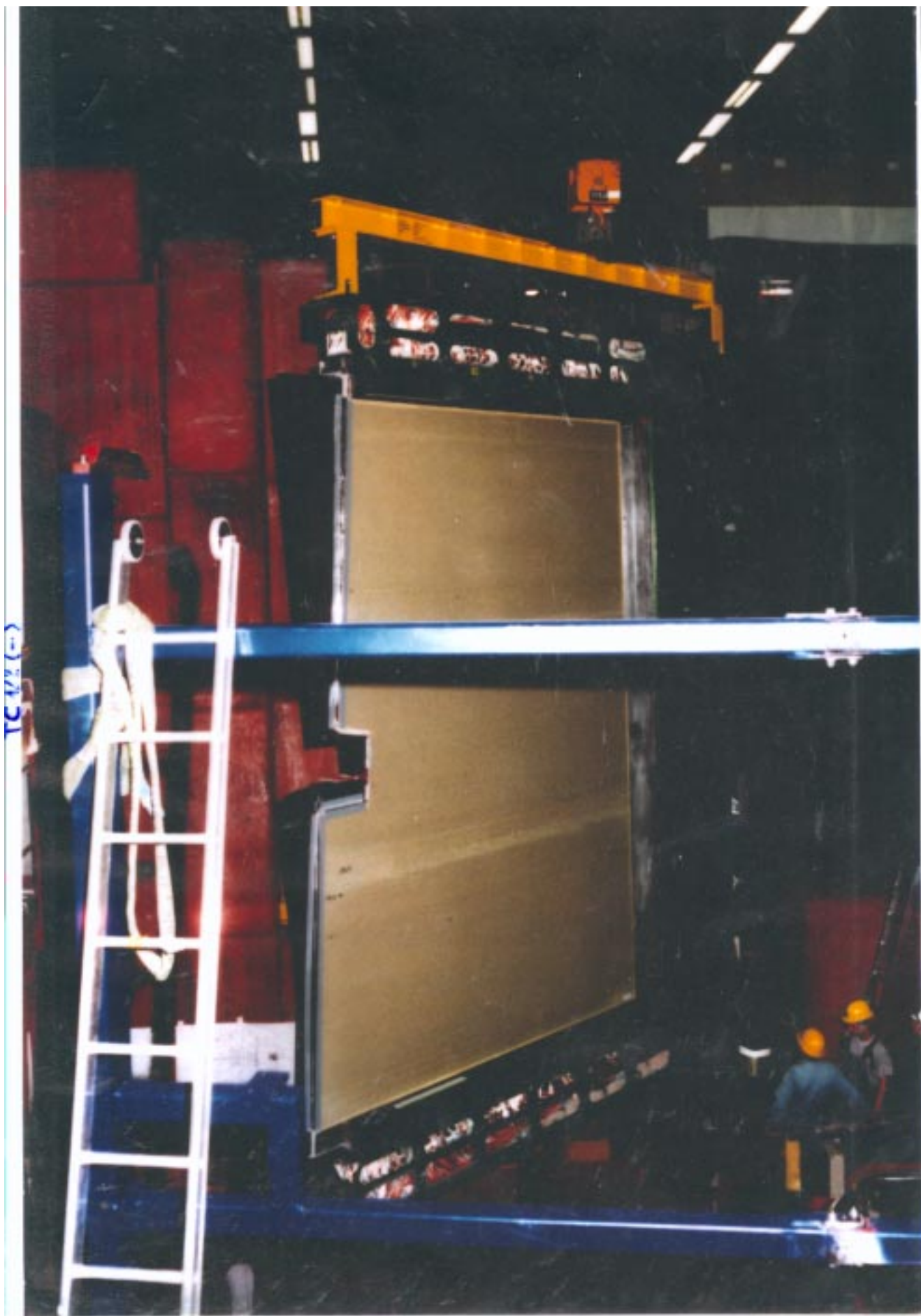
TC2(-)



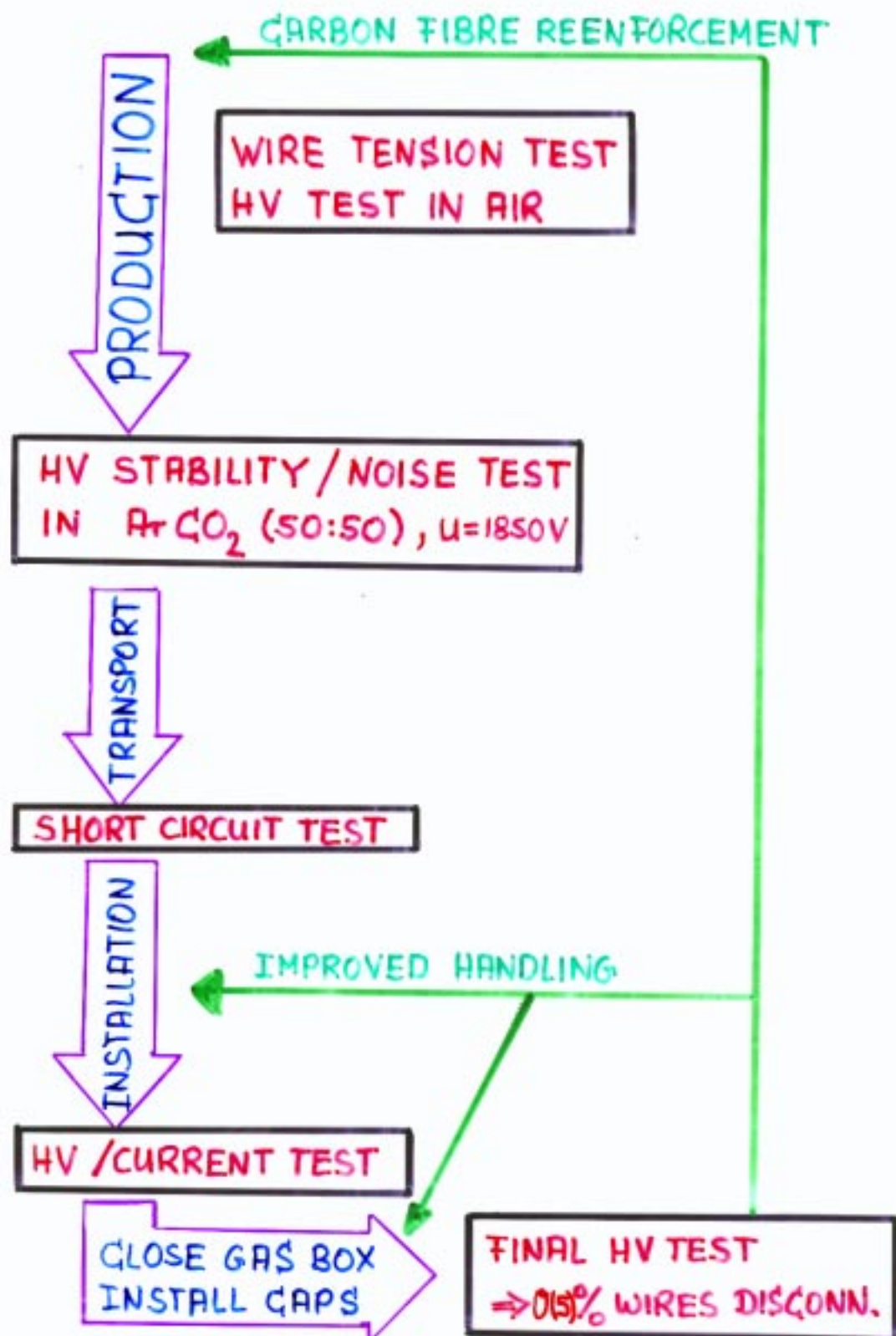


PC4 (-)



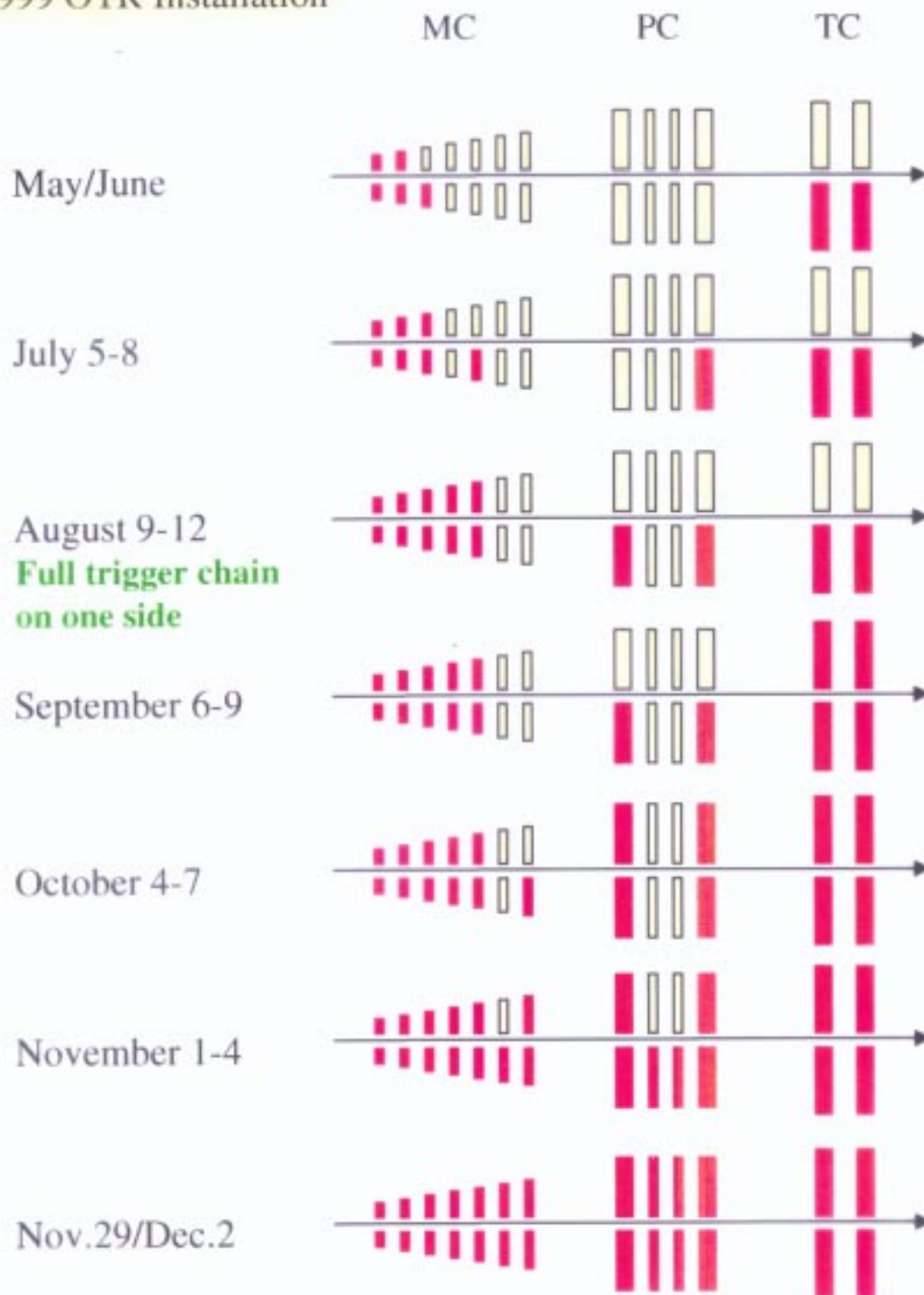


# OTR QUALITY CONTROL





## 1999 OTR Installation

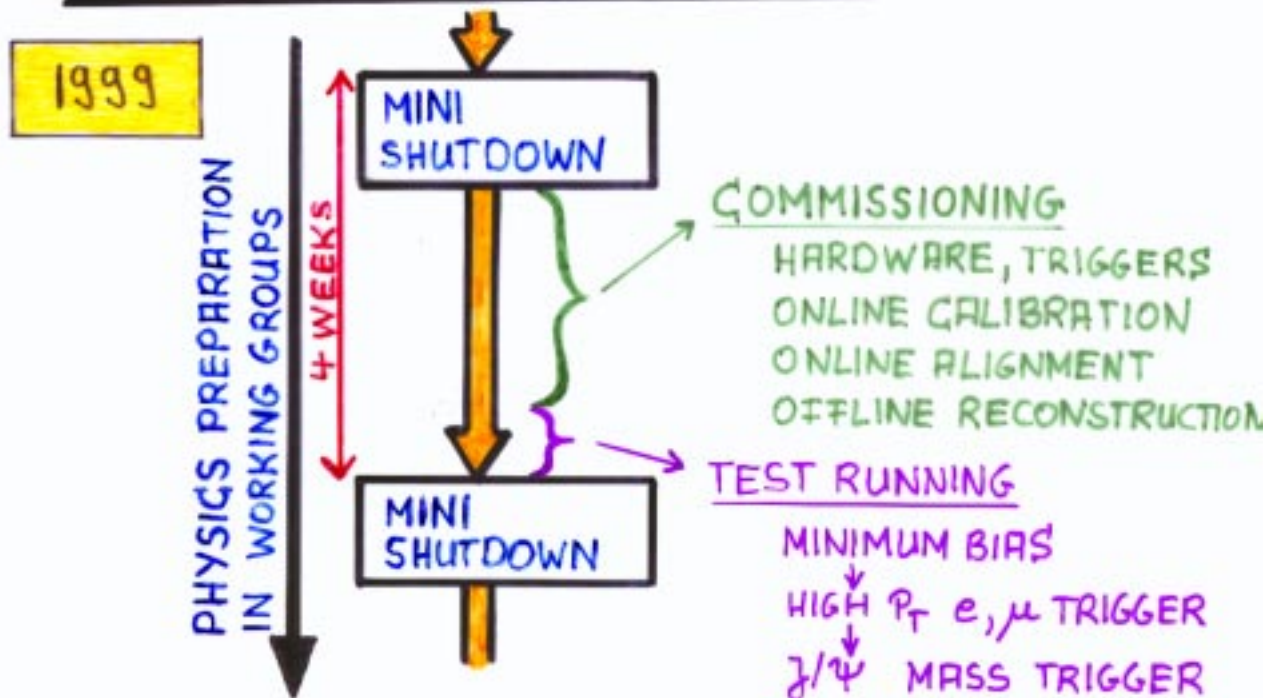




## OVERVIEW

SYSTEM	PRODUCED	INSTALLED=	STATUS
TARGET	✓	✓	✓ BUT COASTING BEAM
VDET	VESSEL: ✓ SIO8: SEP 99	VESSEL: ✓ SIO8: OCT 99	✓
ITR	NOV 99	DEC 99	REDUCED TRIGGER VERY TIGHT
OTR	SEP 99	DEC 99	VERY TIGHT
HIGH $p_T$	NOV 99	JAN 00	✓
RICH	✓	✓	✓
TRD	OCT 99	DEC 99	✓
ECAL DETECTOR READOUT PRETRIG.	✓ ✓ SEP 99	✓ AUG 99 OCT 99	✓ ✓ ✓
MUON DETECTOR PRETRIG.	JUL 99 NOV 99	SEP 99 DEC 99	✓ TIGHT
FLT	DEC 99 ?	DEC 99 ?	VERY TIGHT
FARMS, DAQ		SEP-DEC 99	✓
RECONSTRUCTION SOFTWARE	(✓)		✓
ONLINE CALIBR./ ALIGNMENT	DEC 99 ?		VERY TIGHT

# OUTLOOK '99 ... '00



**2000**

$$N(J/\psi K_S^0) \approx 400 \times$$

$$\times \frac{\sigma_{b\bar{b}}(920 \text{ GeV})}{12 \text{ nb}} \times \frac{T_{\text{RUN}}}{4 \text{ MONTHS}} \times \frac{\epsilon_{\text{LUMI}}}{30\%}$$

$\times \epsilon$  (DETECTOR ACCEPTANCE LOSS)

$\times \epsilon$  (TRIGGER ACCEPTANCE LOSS)

$\times \epsilon$  (TRIGGER EFFICIENCY LOSS)

$\times \epsilon$  (NOT YET OPTIMIZED TRIGGER/DETECTOR)

$$400 \text{ EVENTS} \Rightarrow \sigma(\sin 2\beta) \approx 0.25$$

# SUMMARY

- ENORMOUS PROGRESS
- SOME TECHNICAL PROBLEMS LEFT  
BUT NONE OF "DISASTER TYPE"
- THE MAIN PROBLEM IS THE TIGHT  
SCHEDULE FOR REMAINING INSTALLATION,  
COMMISSIONING AND CALIBRATION

THERE ARE MAJOR CHALLENGES AHEAD  
BUT HERA-B FINALLY SEEMS TO BE  
ON THE RIGHT TRACK