STATUS OF THE OUTER TRACKER FOR THE HERA-B EXPERIMENT

Mar Capeáns

for the Hera-B Outer Tracker Collaboration

DESY - HAMBURG

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TRACKER FUNCTION

Reconstruction of tracks to

i) measure momentum with a precision $\Delta p/p=10^{-4}$

ii) provide fast trigger signals for the FLT

DETECTOR REQUIREMENTS AT HERA-B

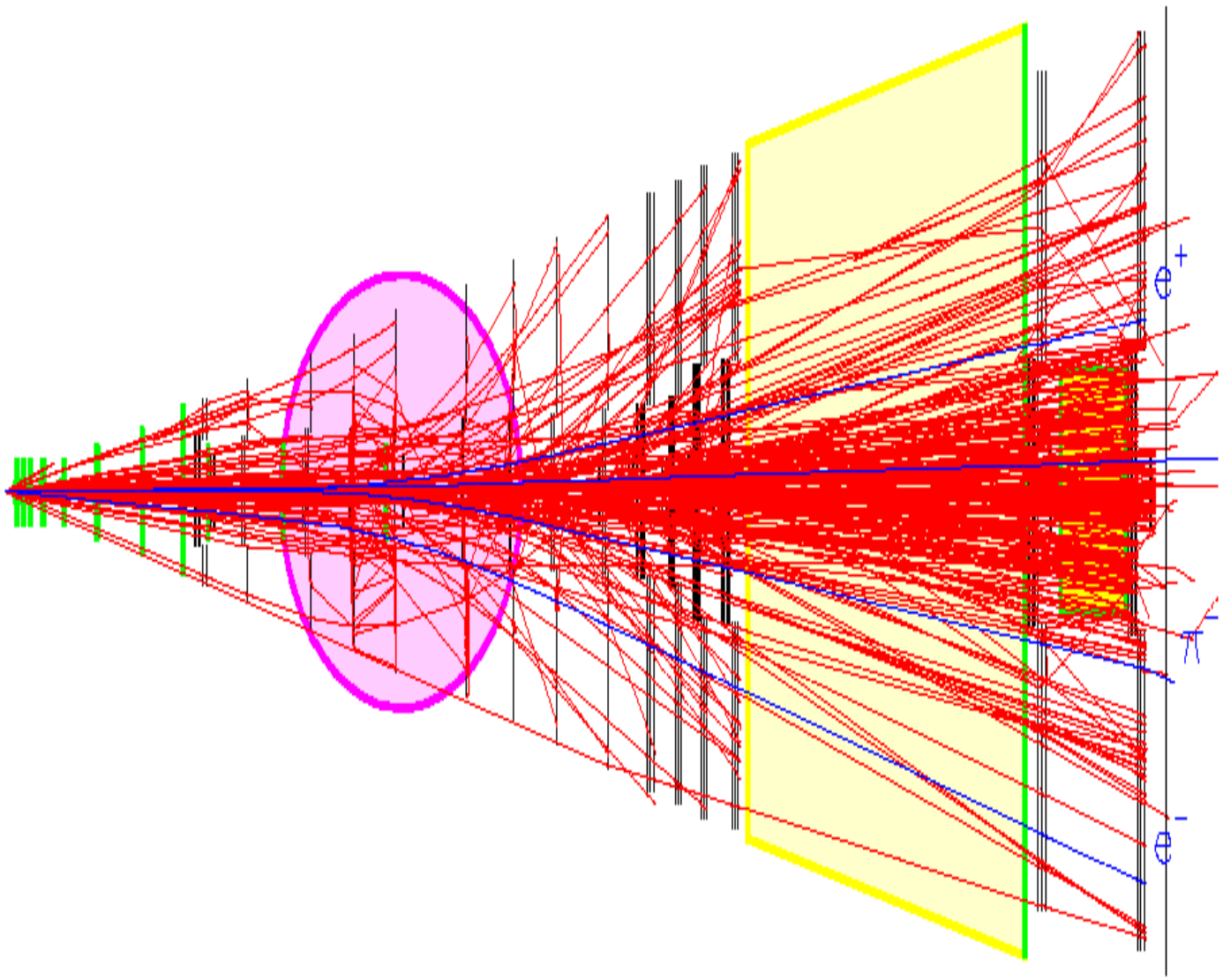
Acceptance angle +/- 100 to 250 mrad (bending plane)	**Large detector size** **~ 1000 m^2**
Occupancy Up to 30%	**Defines granularity**
Rate Max. of $2x10^3$ mips mm^2/s 0.5 C/cm·year accumulated charge	**OTR enters in the range of new, high rate trackers**
Efficiency 98% hit finding efficiency (to guarantee good FLT track finding) **Resolution** (in bending plane) ~ 200 μm (stereoangles) **Fast signal collection** bunch crossing = 96 ns	**Gas selection** **Geometry** **Electronics** **Etc…**
Minimum of material	**Self-supporting chamber**

GASEOUS DETECTOR
WITH HONEYCOMB STRUCTURE

Typical event … each 96 ns !!!

interactions/BX	3-5
charged particles per BX	60-200

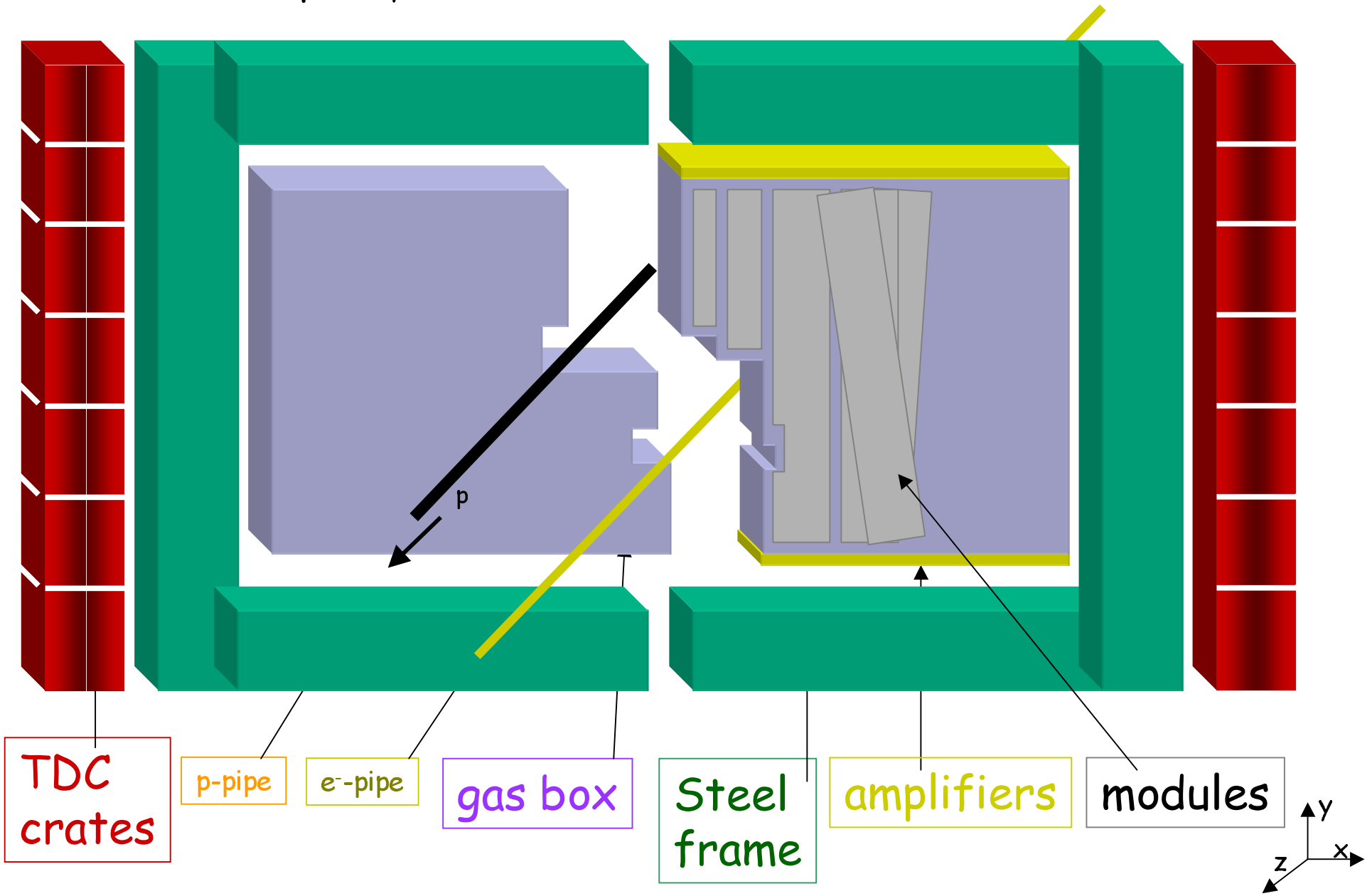
particle flux/year/area $2 \times 10^{14}/R^2[cm^2]$



M. Capeáns

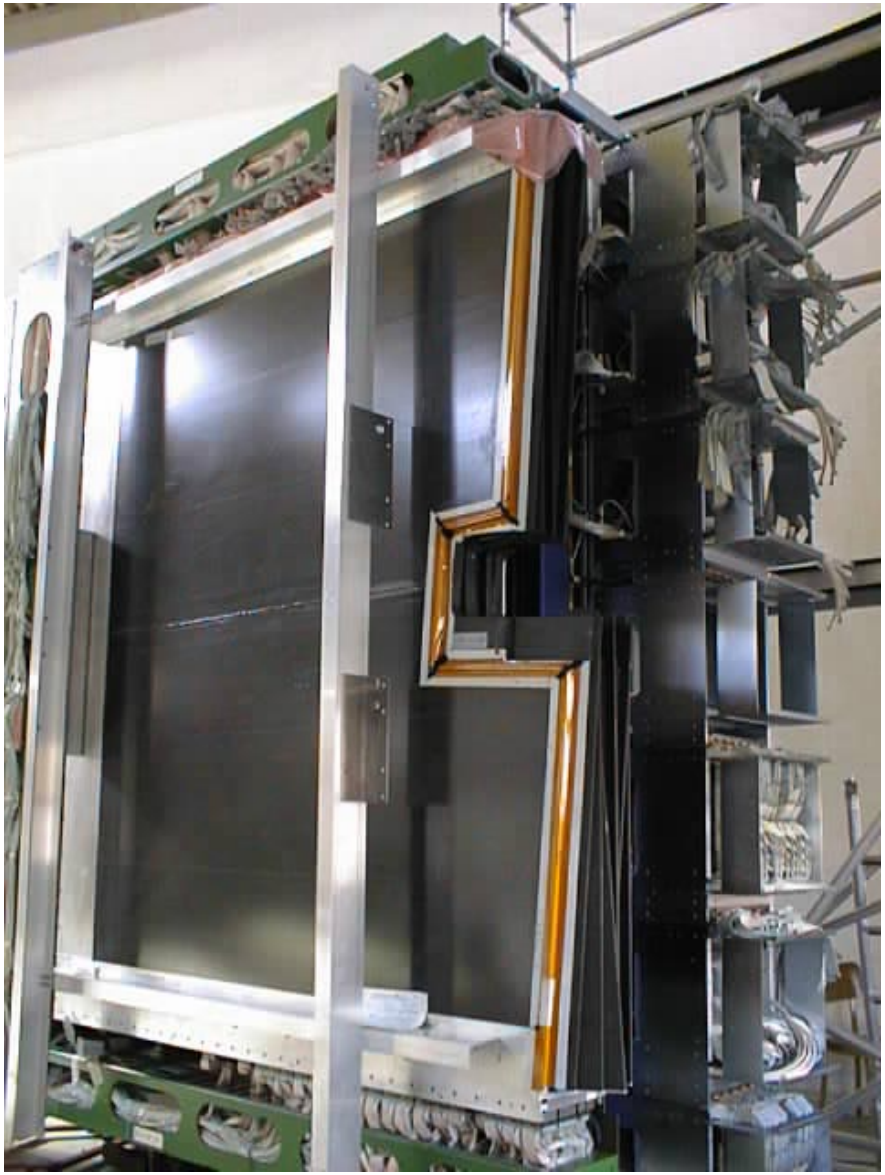
Typical OTR station

Superlayer size: from 0.9 x 0.6 m^2 to 6.5 x 4.6 m^2

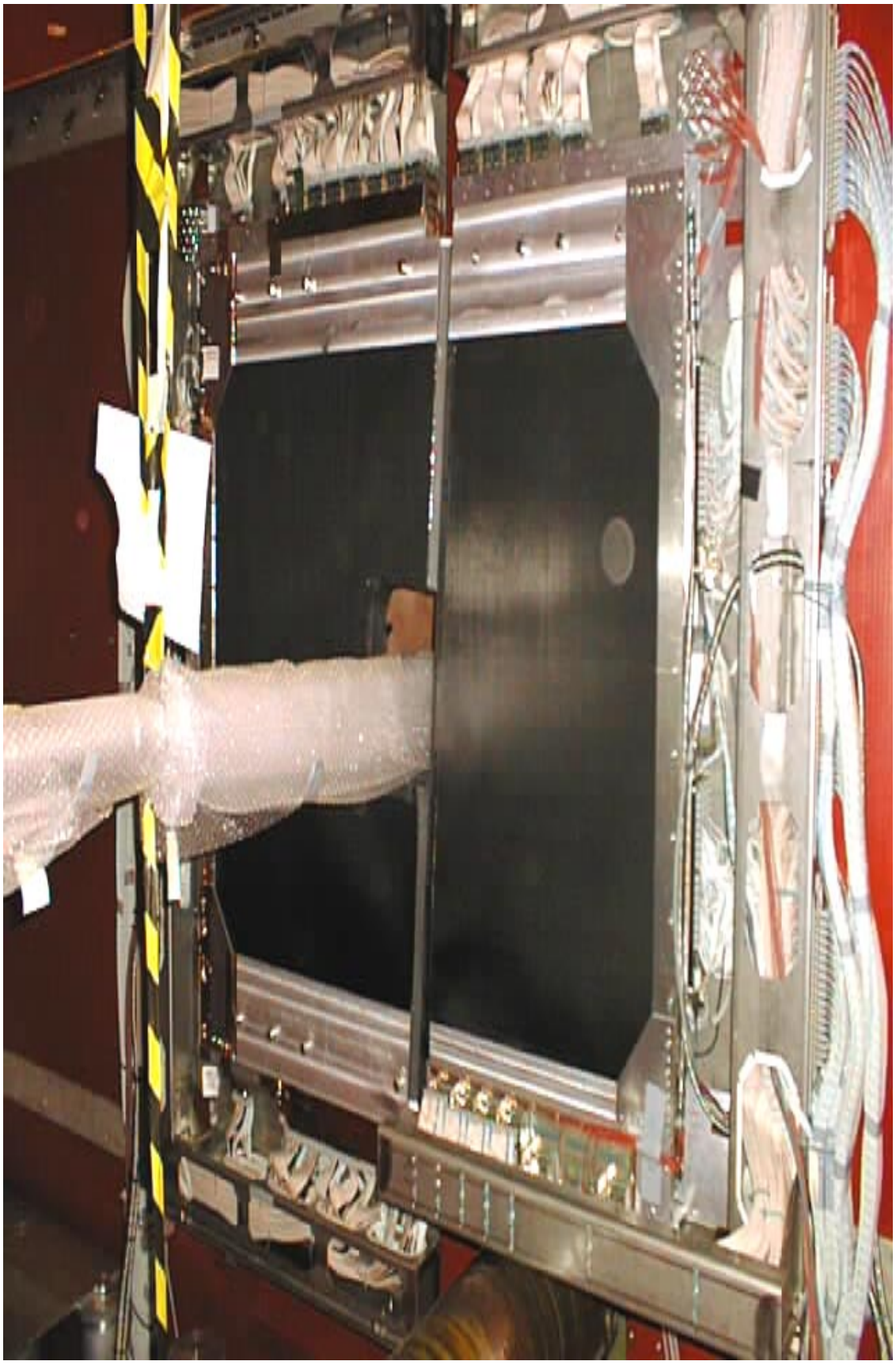


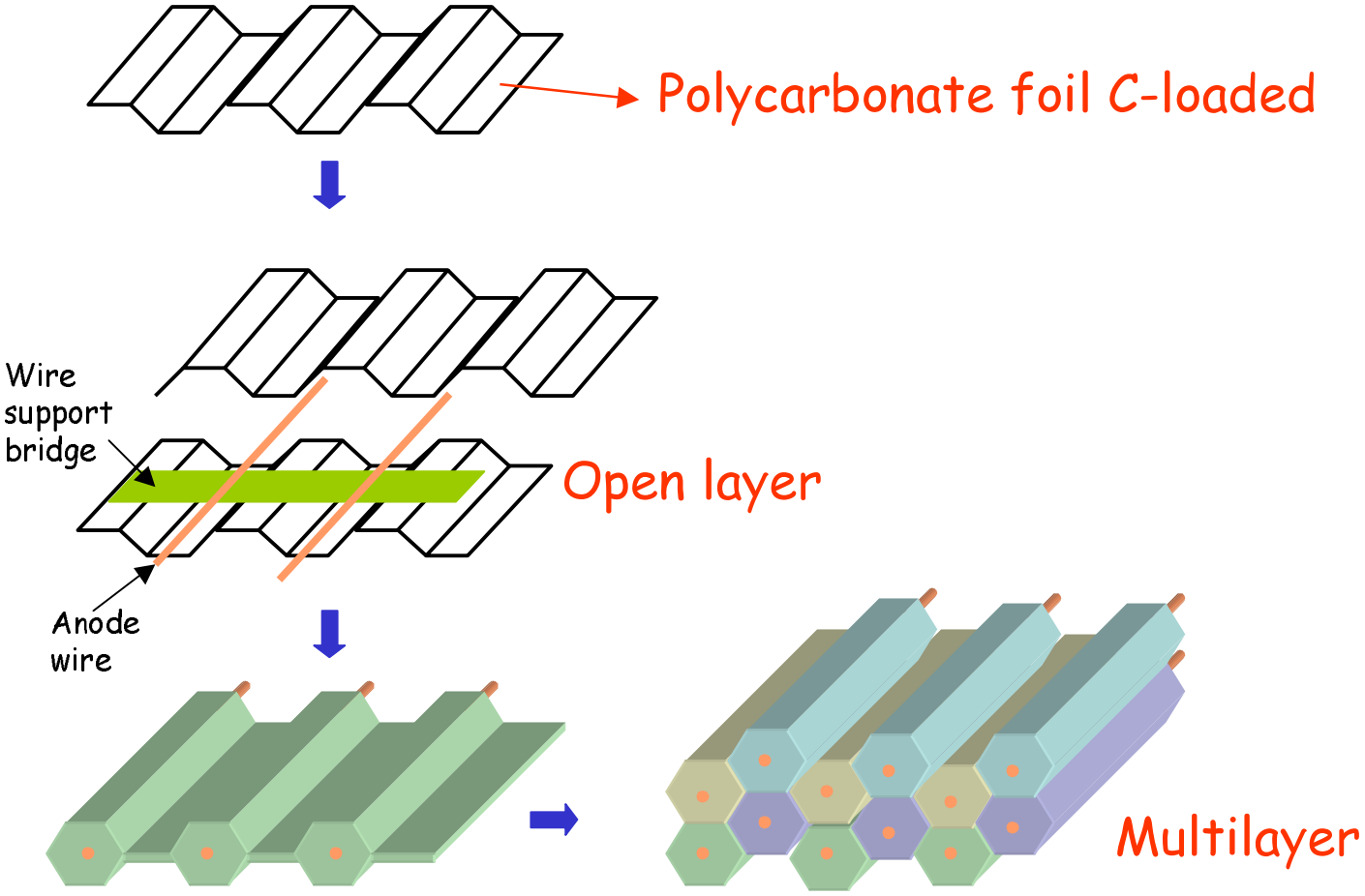
Modules in half superlayer

Superlayer completed, ready for transportation



Completed MC2 chamber inside magnet





Open geometry
EASY WIRING !!!

Limitation in width,
due to manufacturing

Soft structure
in terms of overpressure

↓

external gas volume,
so called, GAS BOX

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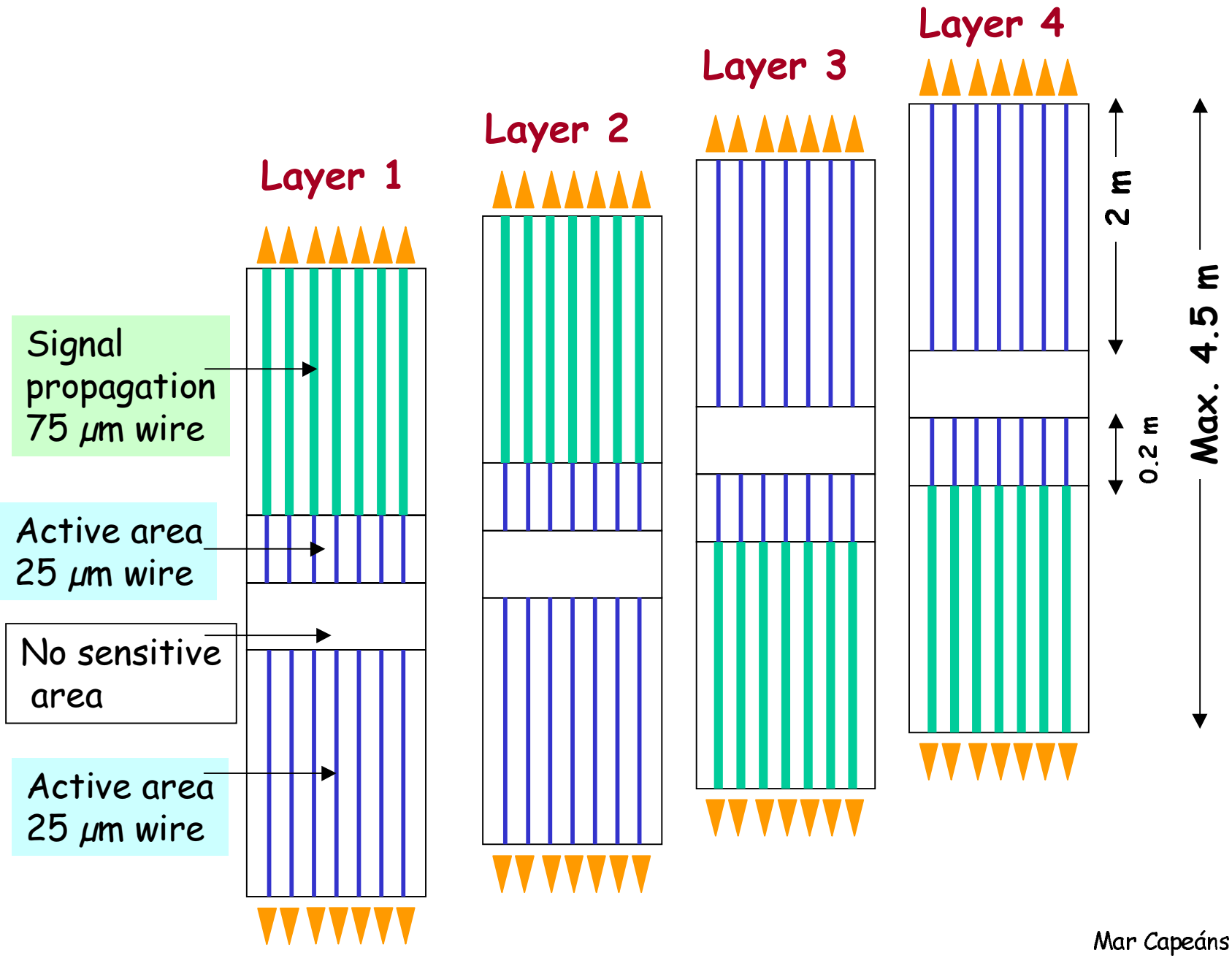
TYPICAL OTR MODULE



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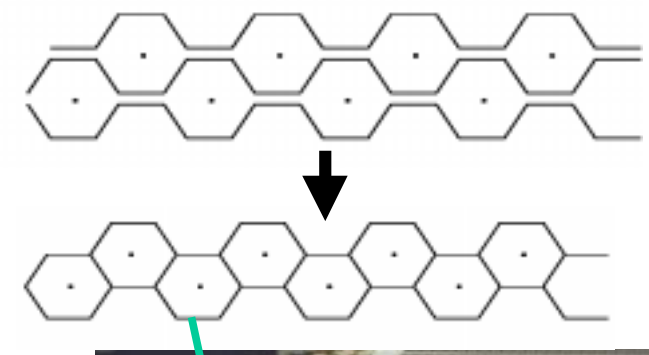
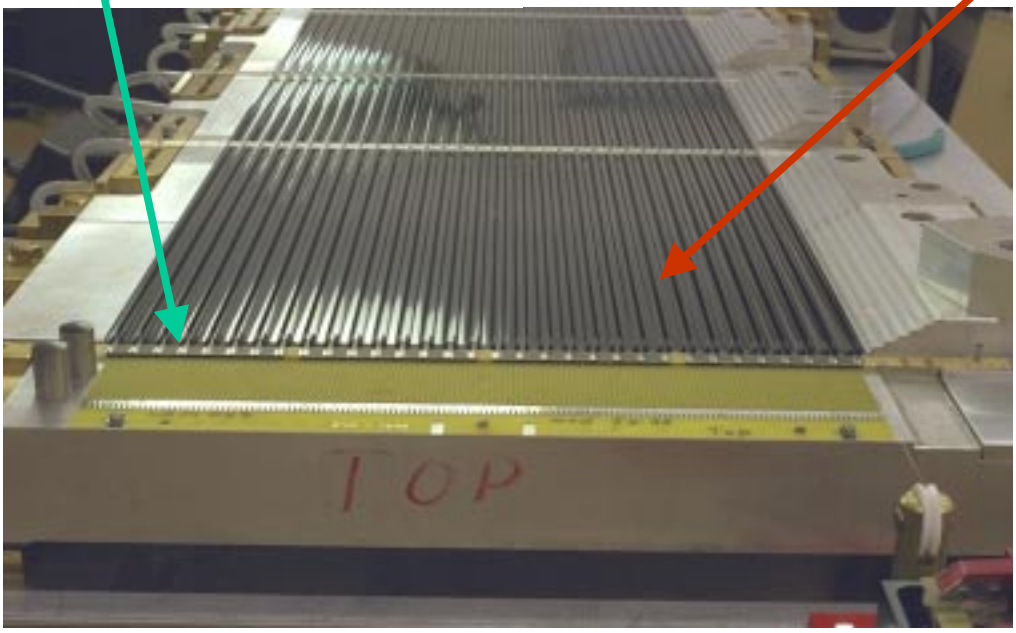
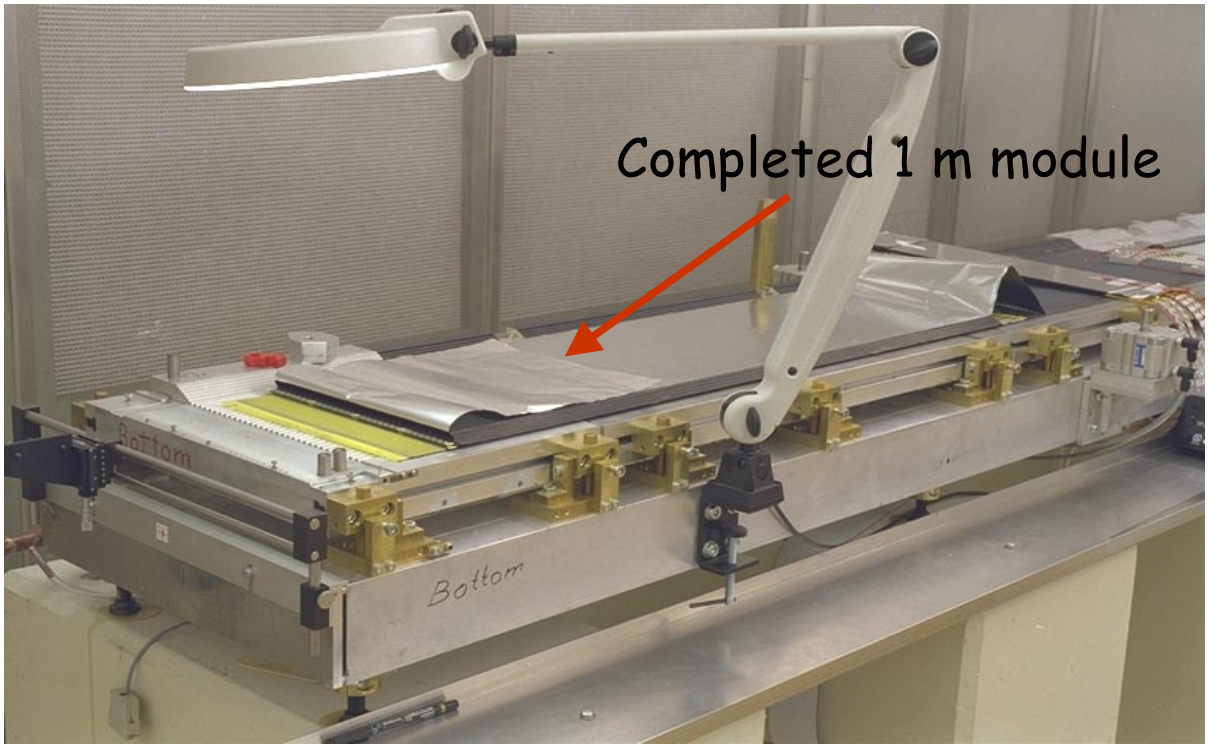
folded layers of Pokalon foil



Pokalon foil in template





R & D

- Gas ageing (~2.5 C/cm.5 years; gain ~2.5 x 10^4)
- Radiation hardness

- Gas system → gas exchange
  → recirculation + purification

Ar-CF_4-CO_2 (65-30-5)

- Design
- Production methods
- Tools

R & D

PROBLEMS OBSERVED		SOLUTIONS
Gas ageing	Ar-CH_4-CF_4	Change of gas: $CH_4 \rightarrow CO_2$
	Araldit	New glues
Malter effect	Cathode surface (related to conductivity)	Gold-plating of cathode surface

Chambers would not operate in Hera-B longer than 10 hours

Stable gain for more than 2 Hera-B years

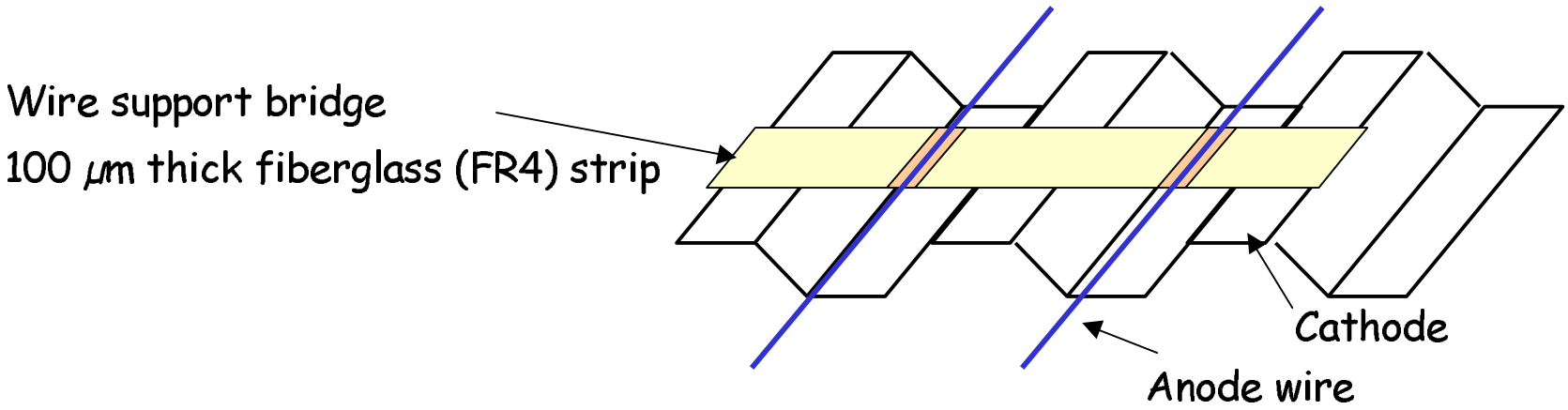
And more R & D

1

Irradiation of the detector in presence of water (0.1% level) leads to HV instabilities *(rest currents)*

Only solution: control water content in the detector

? ? ? ? ?



2

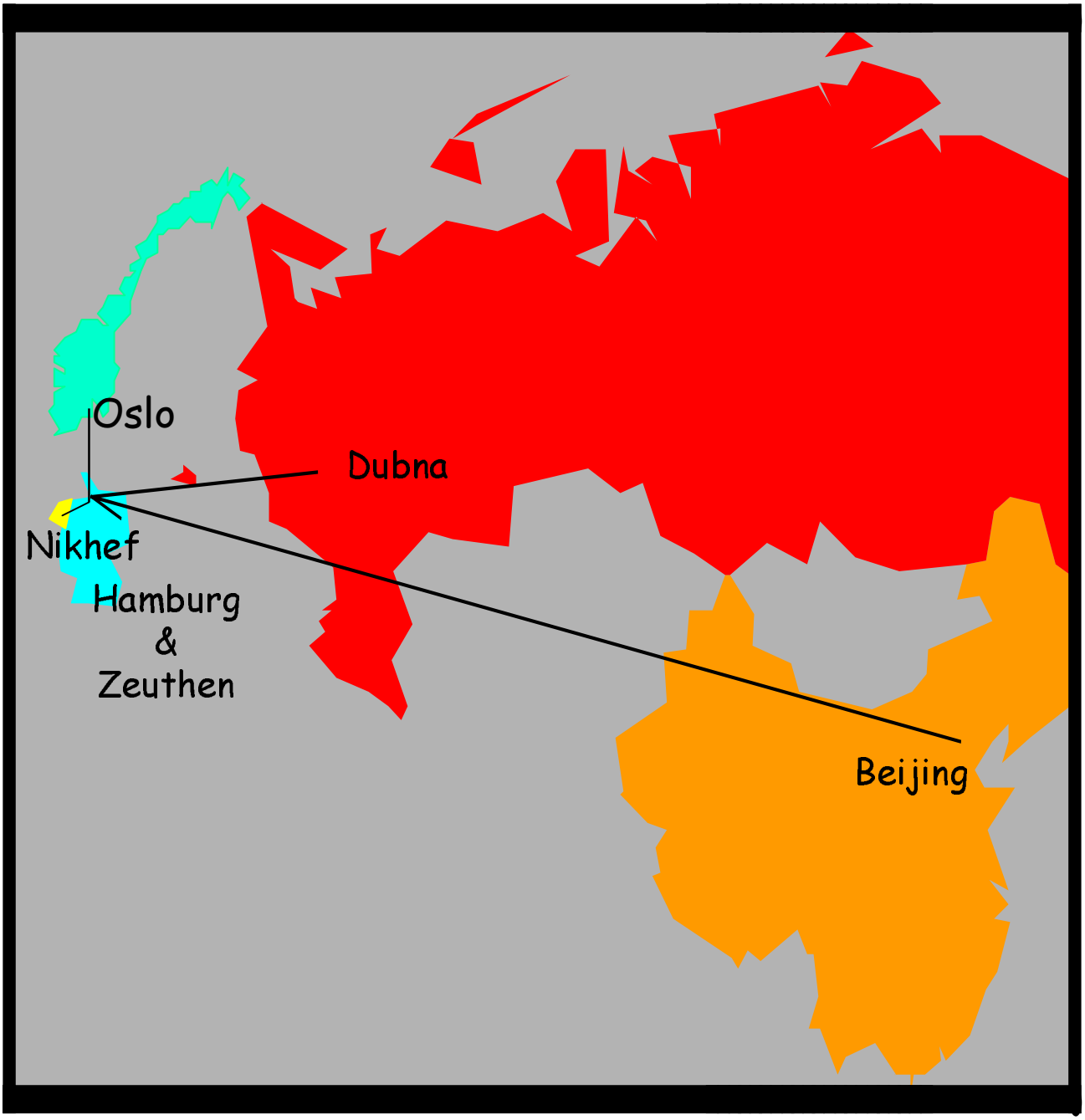
Wire etching

It appears as a function of accumulated charge

OTR PRODUCTION

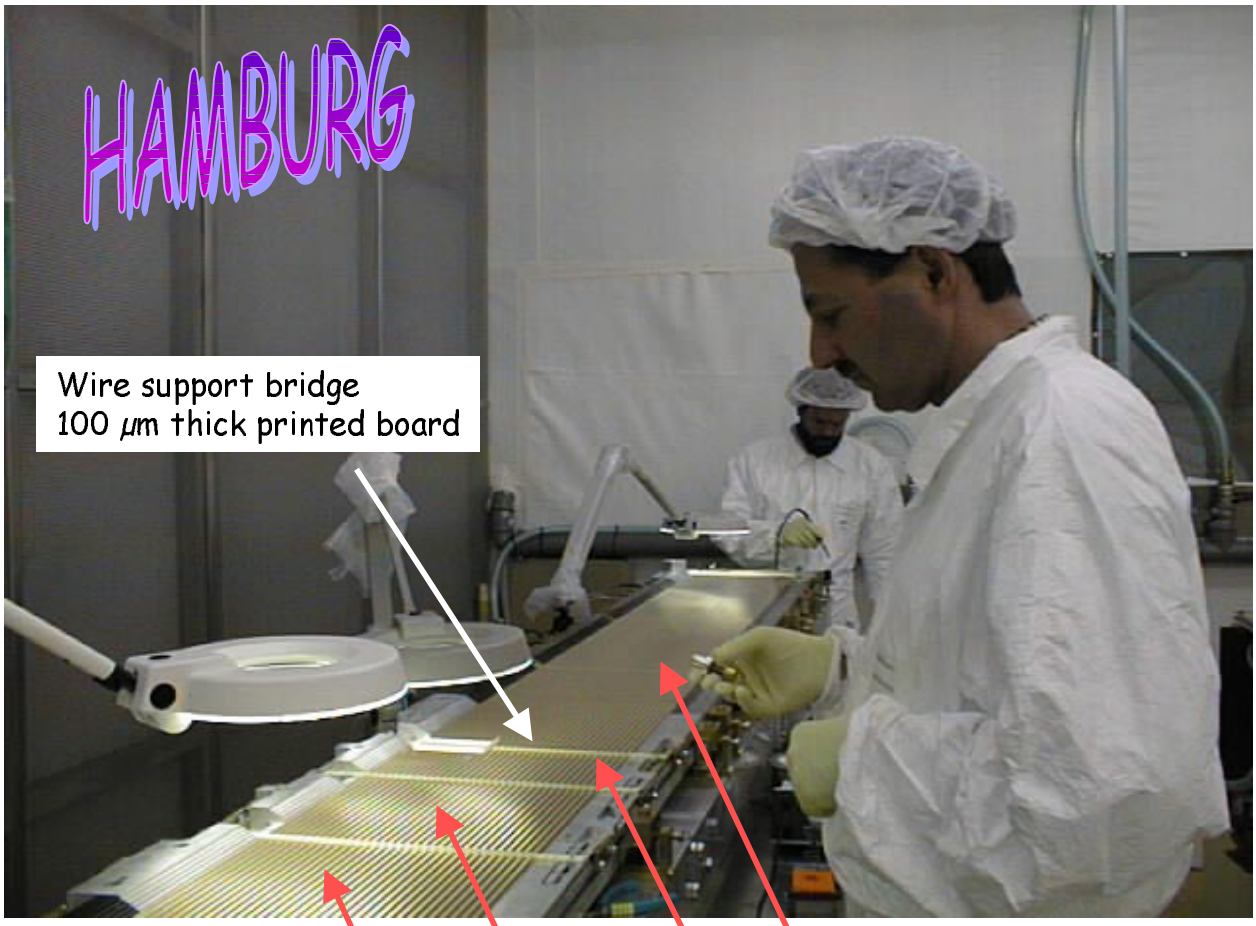
OTR ~ 1000 m^2; 120000 channels

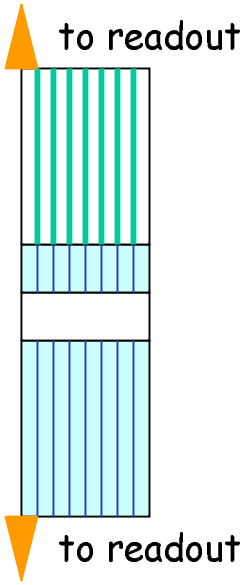
Share of work



MODULE CONSTRUCTION

Clean room conditions





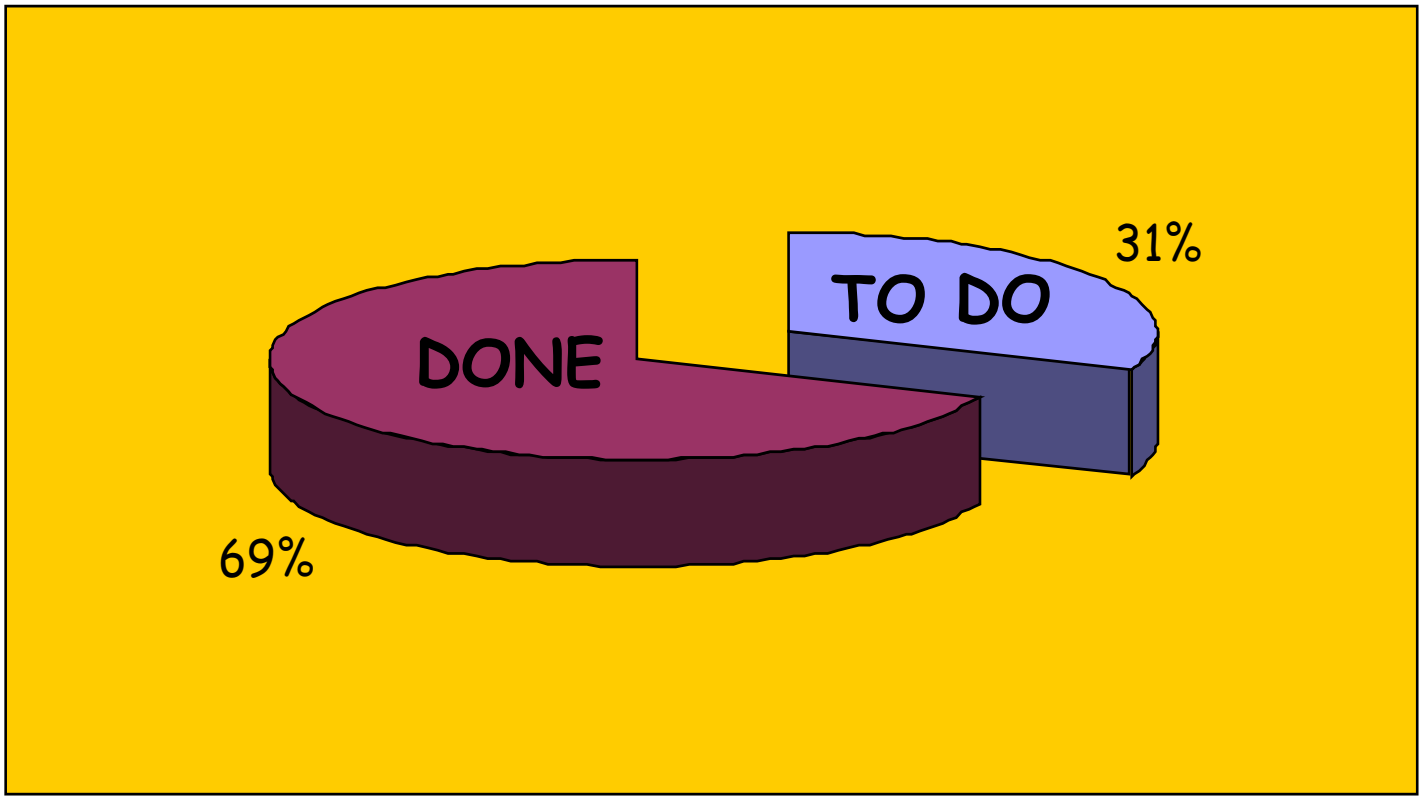
Sector A: thick wire

Sector B: sense wire

Sector C: empty

Sector D: sense wire

PRODUCTION STATUS @ June'99



MODULE QUALITY:
failure rate ~ 1.3% of channels

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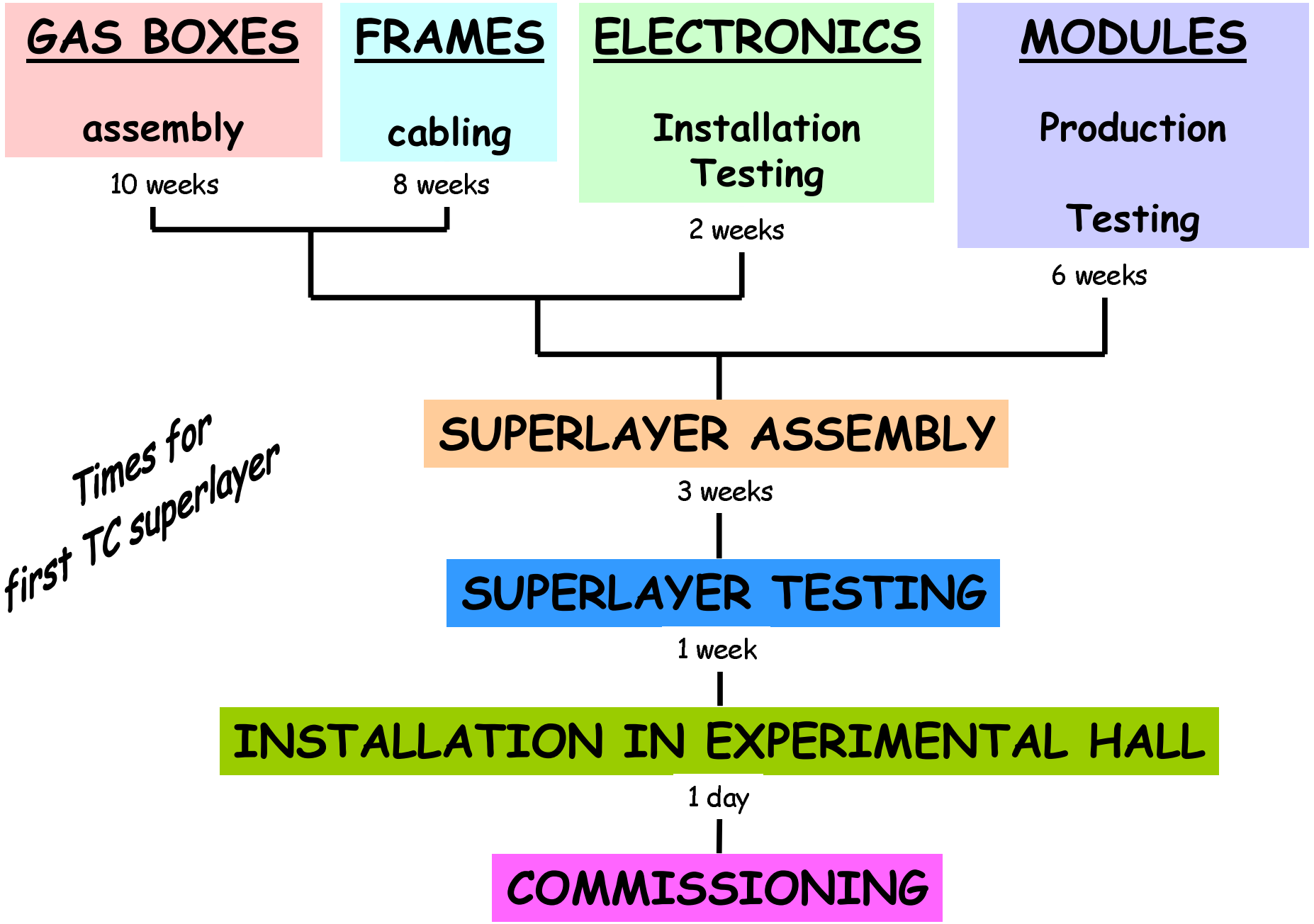
GAS BOXES
assembly
10 weeks
FRAMES
cabling
8 weeks
ELECTRONICS
Installation
Testing
2 weeks
MODULES
Production
Testing
6 weeks
SUPERLAYER ASSEMBLY
3 weeks
SUPERLAYER TESTING
1 week
INSTALLATION IN EXPERIMENTAL HALL
1 day
COMMISSIONING
Times for
first TC superlayer

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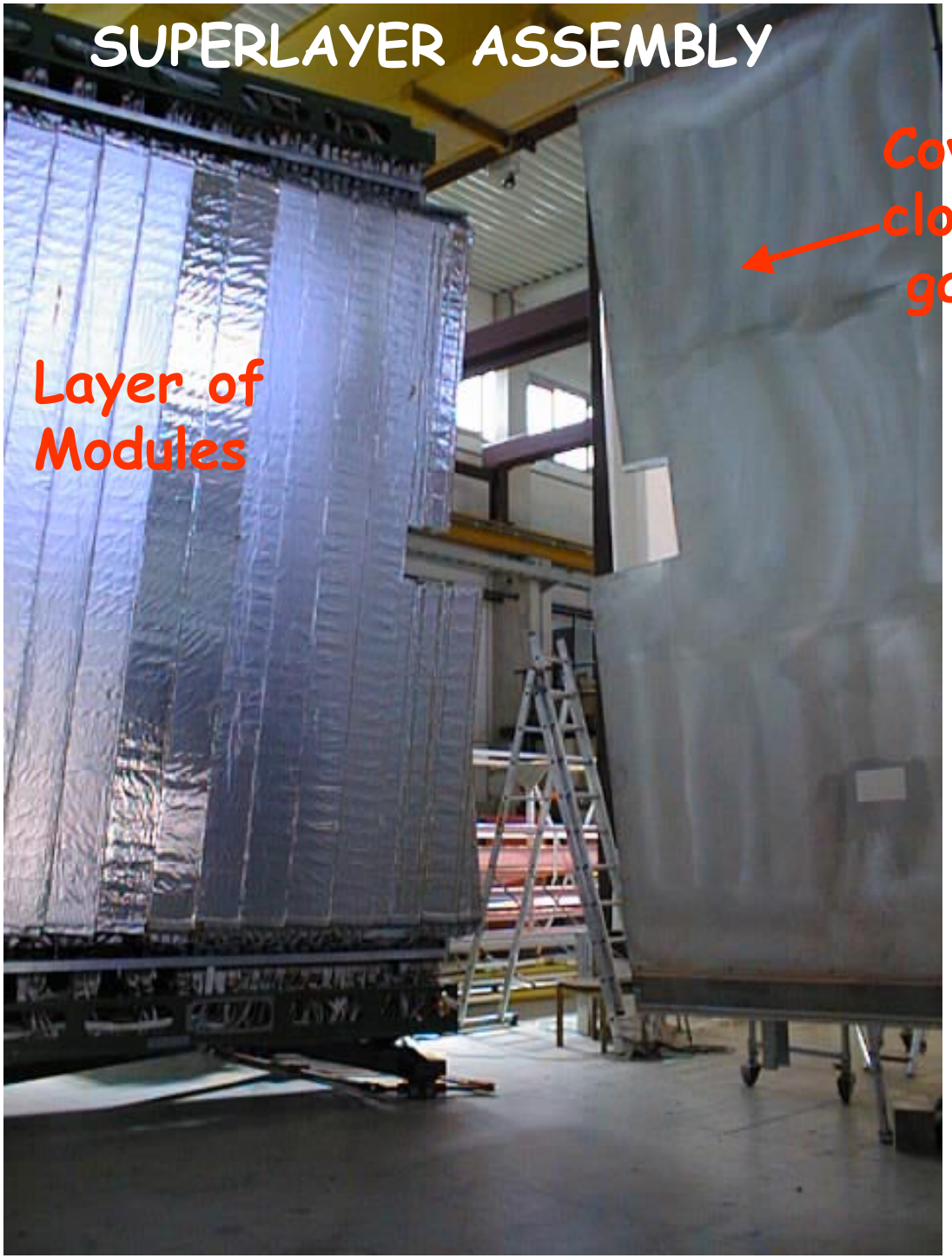
SUPERLAYER ASSEMBLY



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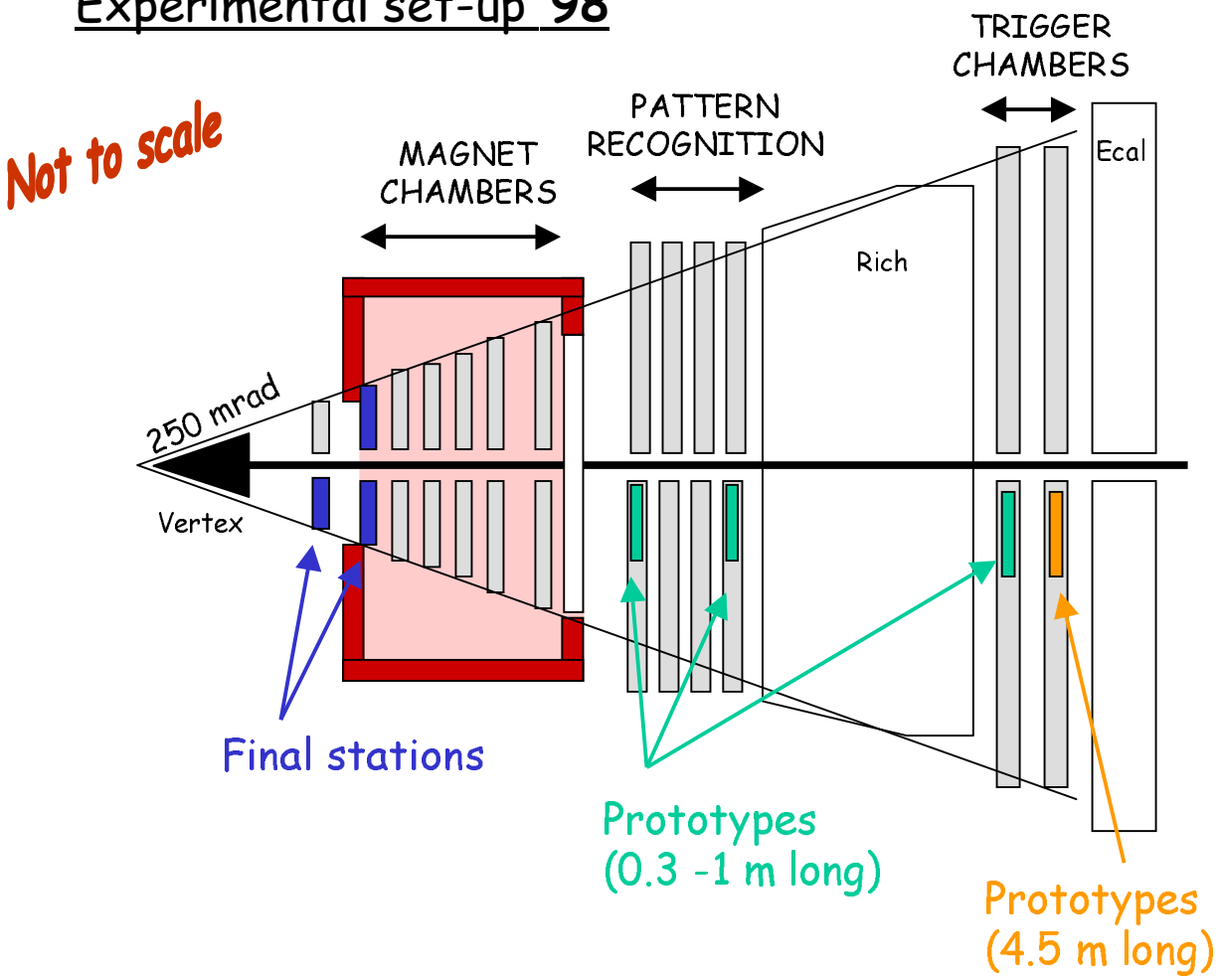
RUNNING IN HERA-B

Experimental set-up '98



1. Operation under full target rate
2. Spectra, efficiency, etc
3. System studies:
   - i) Tracking
   - ii) Integration in common system
   - iii) First Level Trigger studies

Long-term operation in Hera-B

August 98 - May 99

> 400 hours equivalent 40 MHz

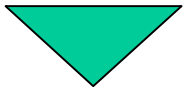
14% of 1 Hera-B year

Detector operated by shift crew

Expert on call NEVER called !!!

VERY ROBUST DETECTOR

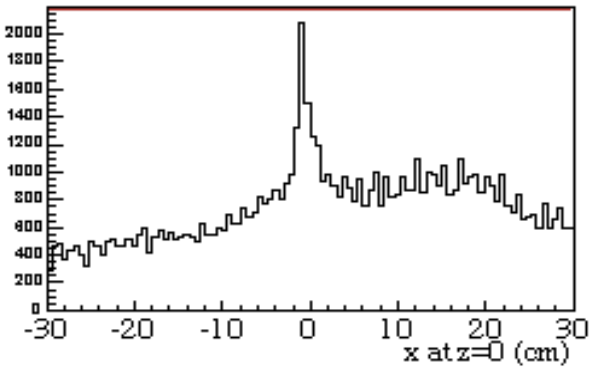
Space points in different super layers

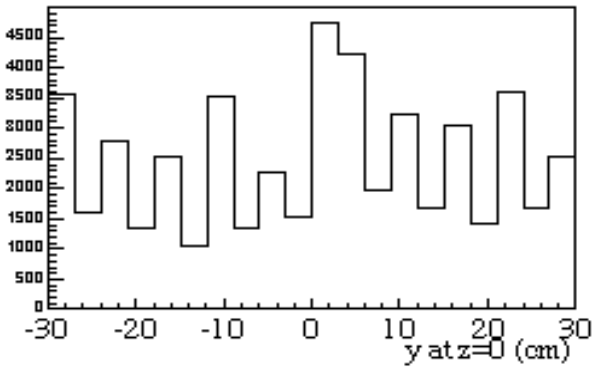


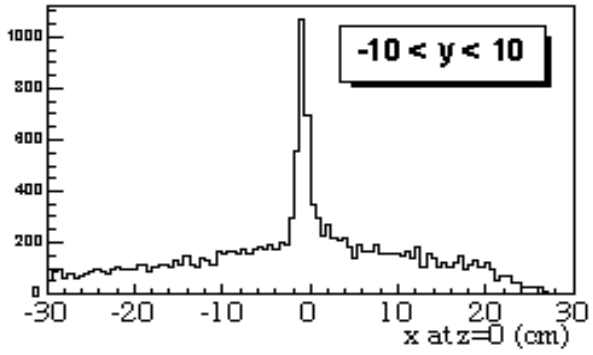
tracks

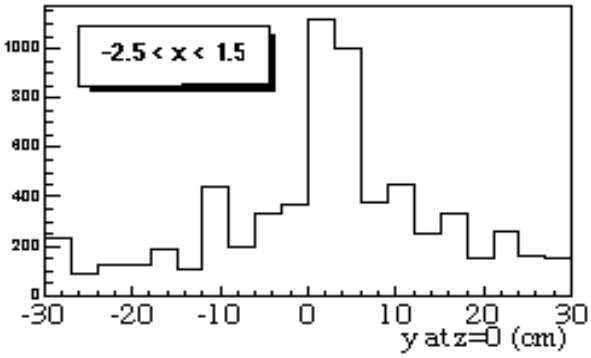
Reconstructed Target Spot

track determined by 2 space points, extrapolation to z=0 (vertex)









X **Y**

10 MHz target rate

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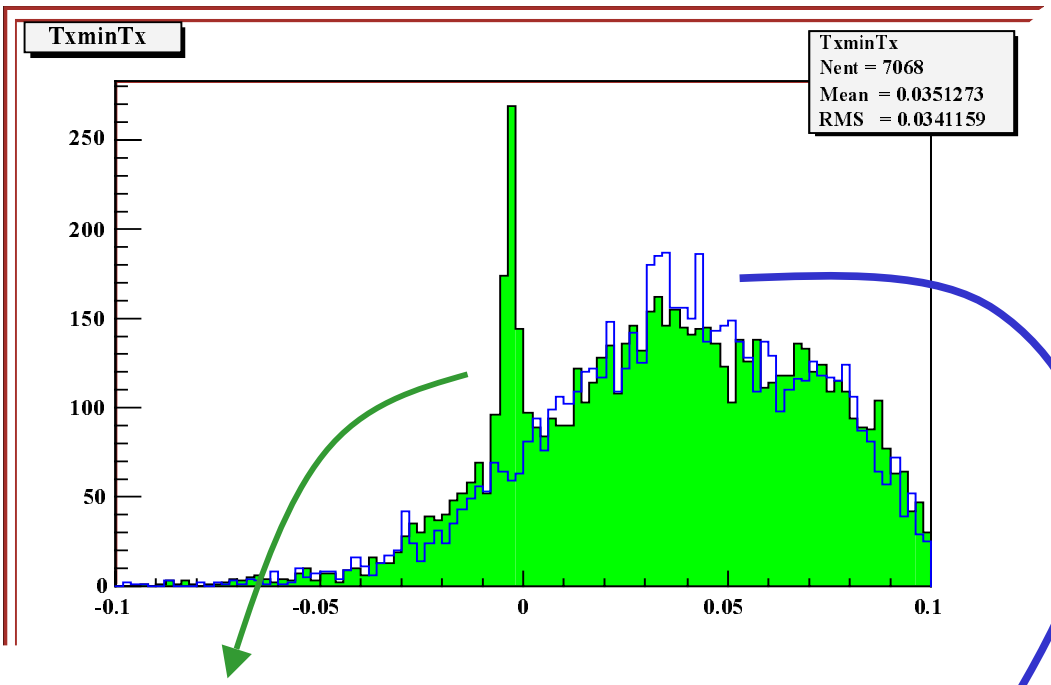
Track correlation

OUTER TRACKER (OTR) & VERTEX DETECTOR (VDS)



Tracks in OTR and VDS
for the same events

Tracks in OTR and VDS
for different events

Common run at 10 MHz target rate

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SUMMARY

The Outer Tracker of Hera-B
is a challenging detector

R&D phase prolonged considerably
Working solution found

The installation of the OTR
will be completed at the end of 1999

Running in Hera-B:

i) no operational problems at full target rate (40 MHz) and exceeding design values

ii) integration in common DAQ and common slow control ongoing

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