

The role of Bari physicists in gas counters development

6th RD 51 workshop

Bari-Hotel Palace

7-10 October 2010

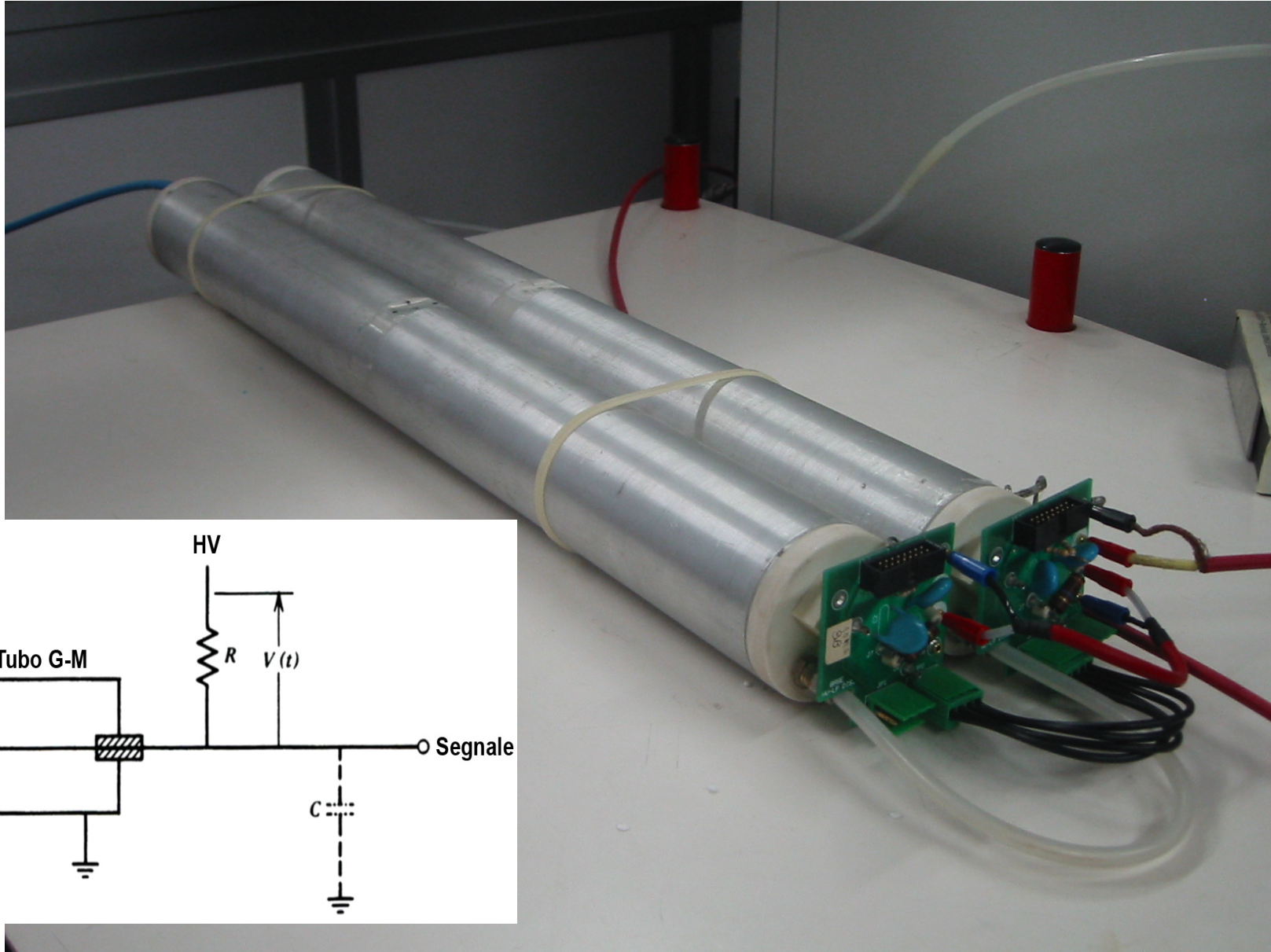
Paolo Spinelli

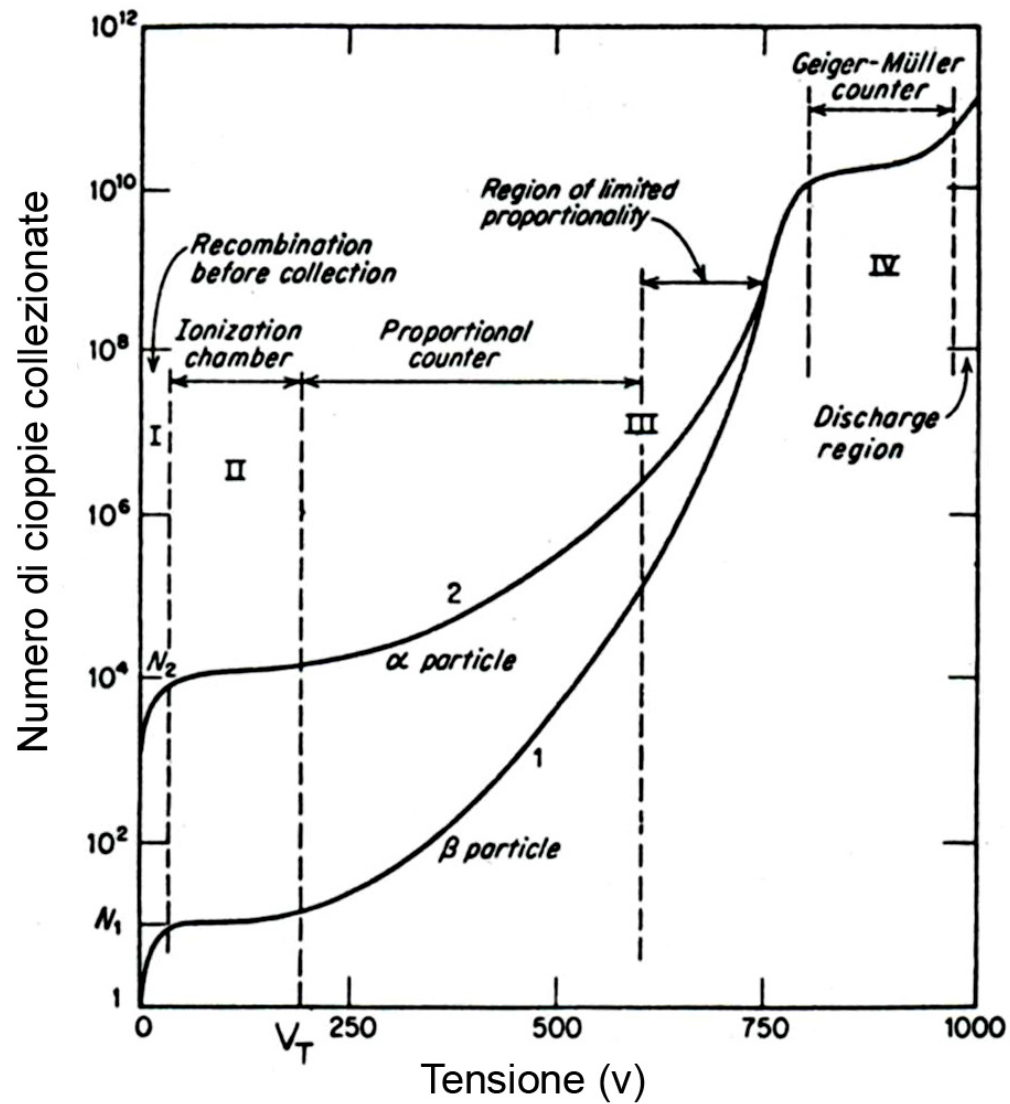
(Fermi-GLAST collab.)

Physics dep.and INFN

Bari

Like everybody else, we “started from scratch”
i.e. cylindric gas counters





we “played” with graphs like these: which gas regime? which gas gain?

end of '60 years: there were 10 phycists led by L.Guerriero
operating at Brookhaven (pion-nucleon interactions)



my thesis dealt with $\pi^- p \rightarrow \rho^0 n$ reaction

5 GeV incident energy

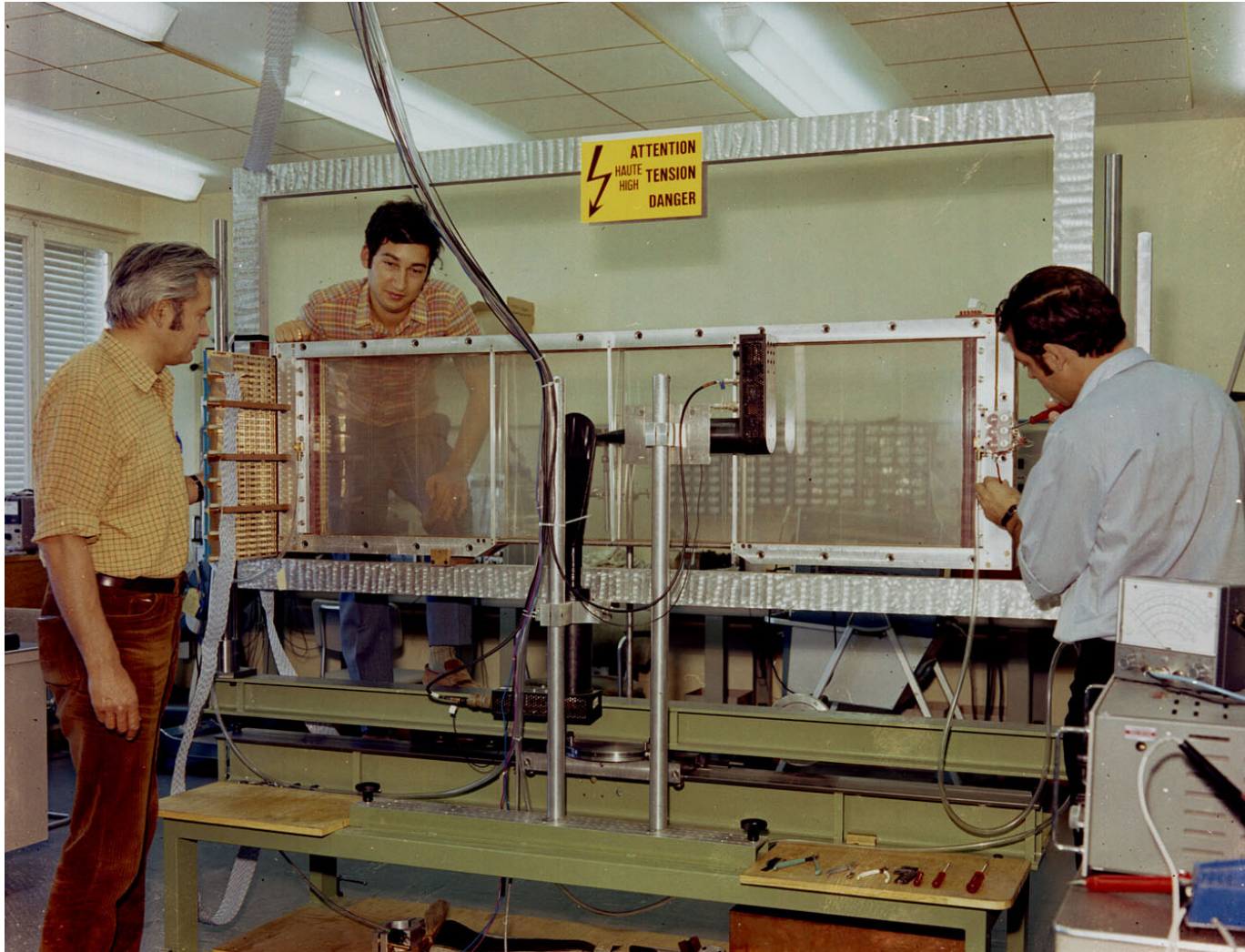
detector:

optical spark
chamber

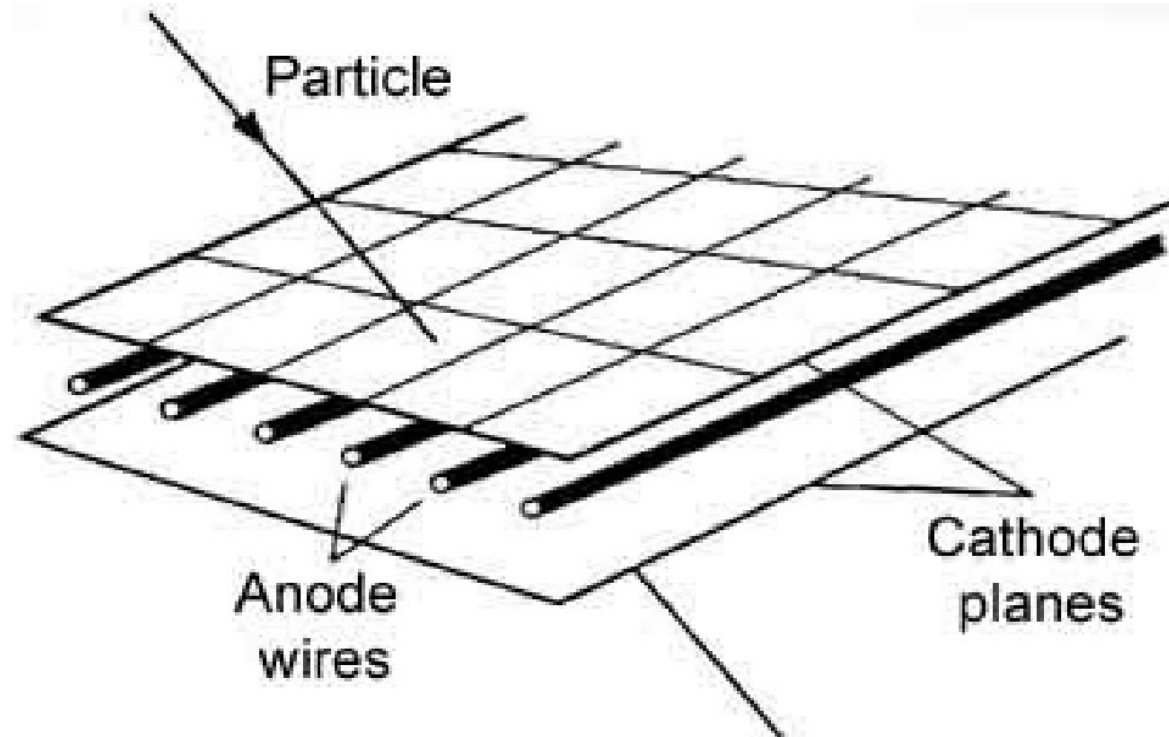
*design of prof.
L. Guerriero*



we made a real jump forward in '68 when G.
Charpak...



...developed the first multiwire proportional chamber



Charpak, Nobel Prize 2001

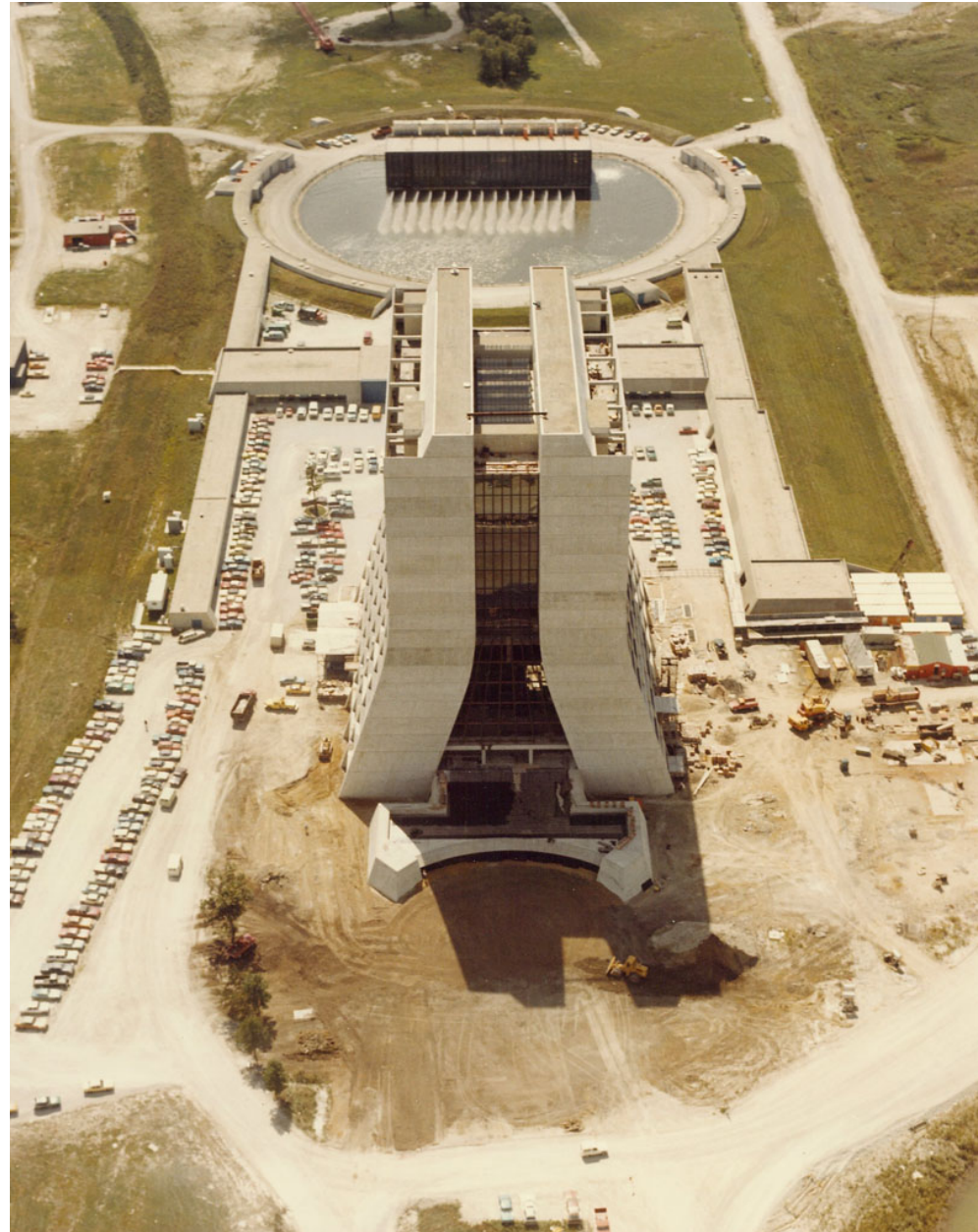


Thank you, George, for what you taught us, thank you for everything !

we moved to N.A.L.(Fermilab) in 1973



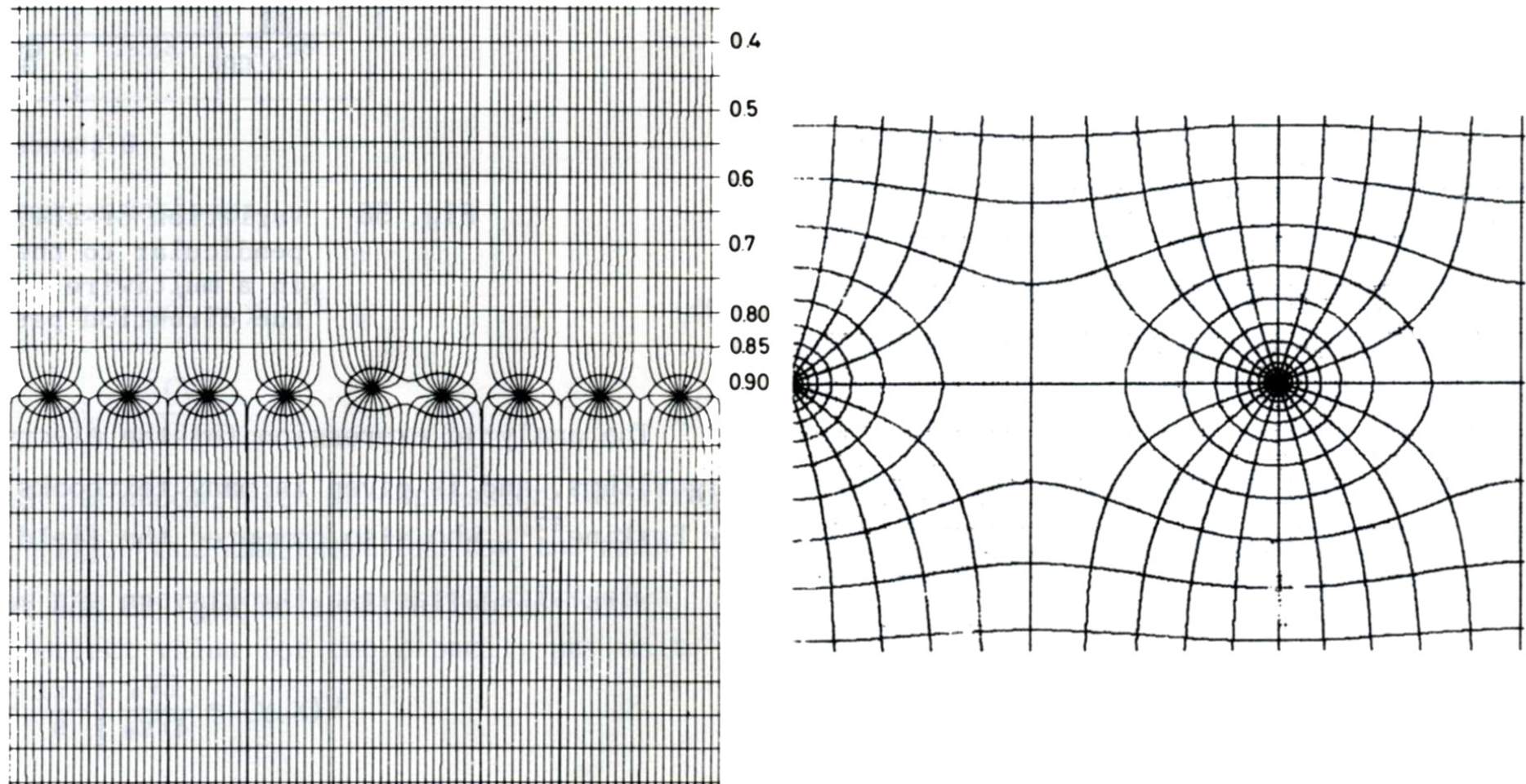
Fermilab main building (high rising)



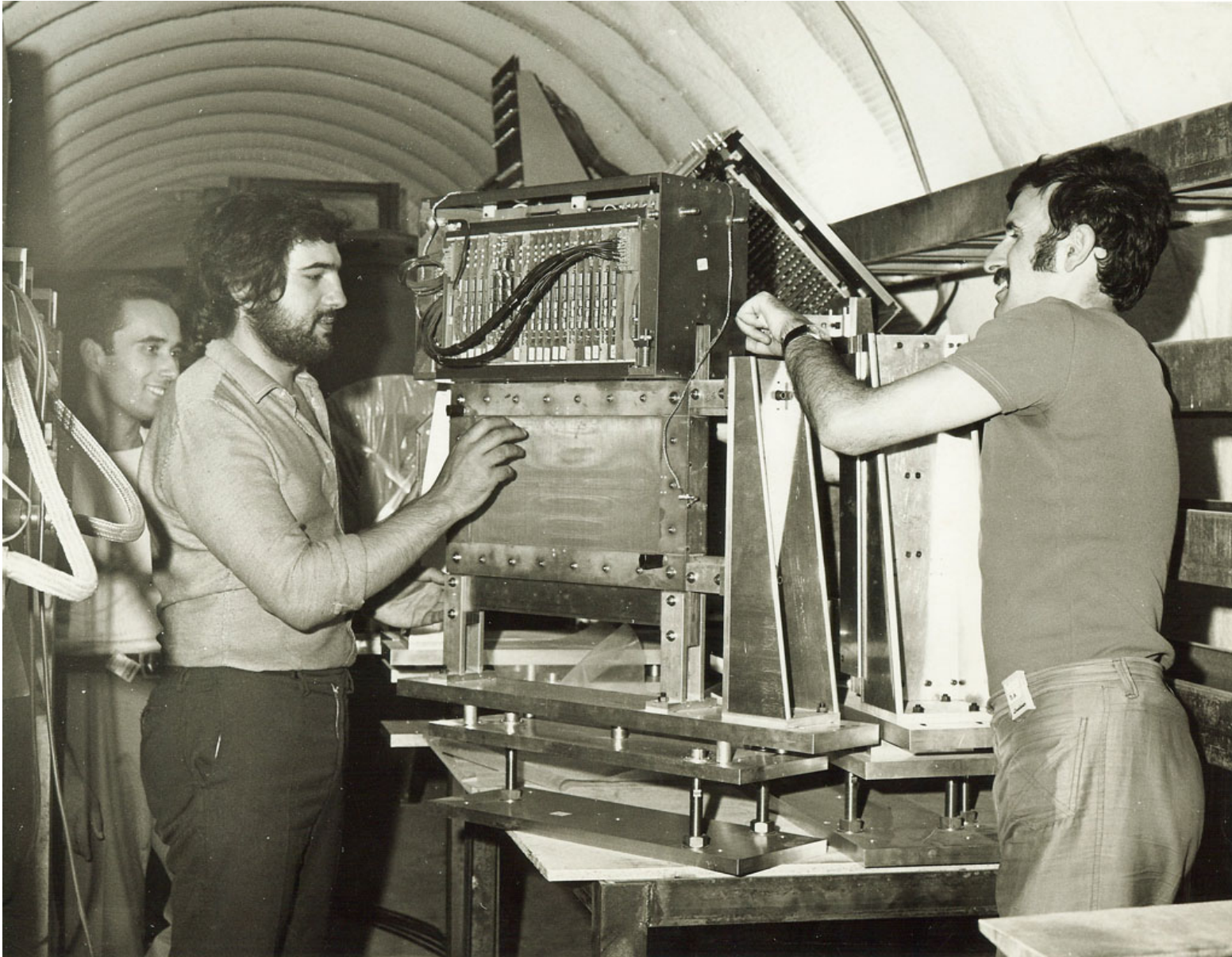
Meson Area: we worked inside the curved tunnel



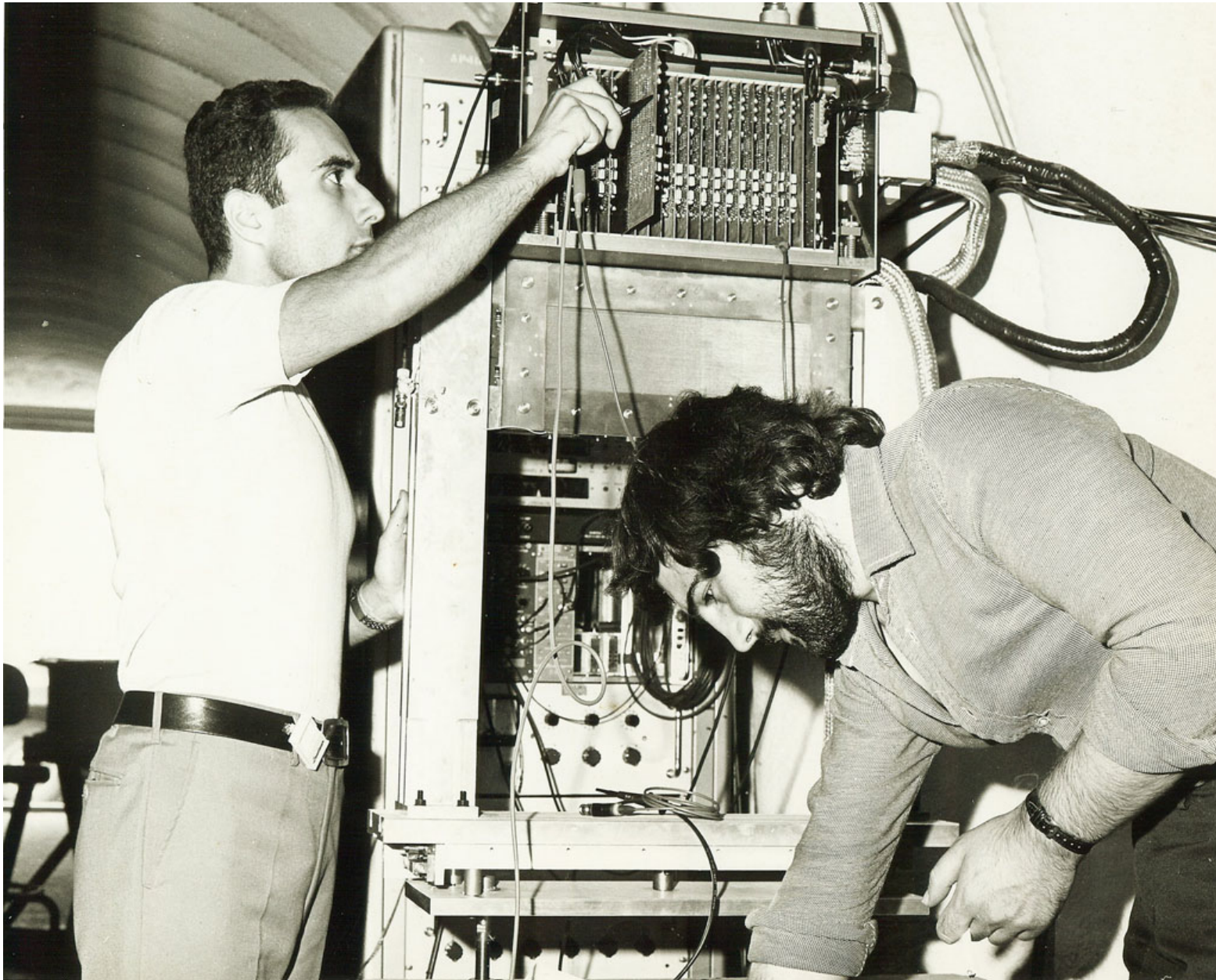
Following the prescriptions of **Charpak** and **Sauli** we became expert on wire chamber developing and manufacturing (we learnt the “**magic**” gas mixture!)



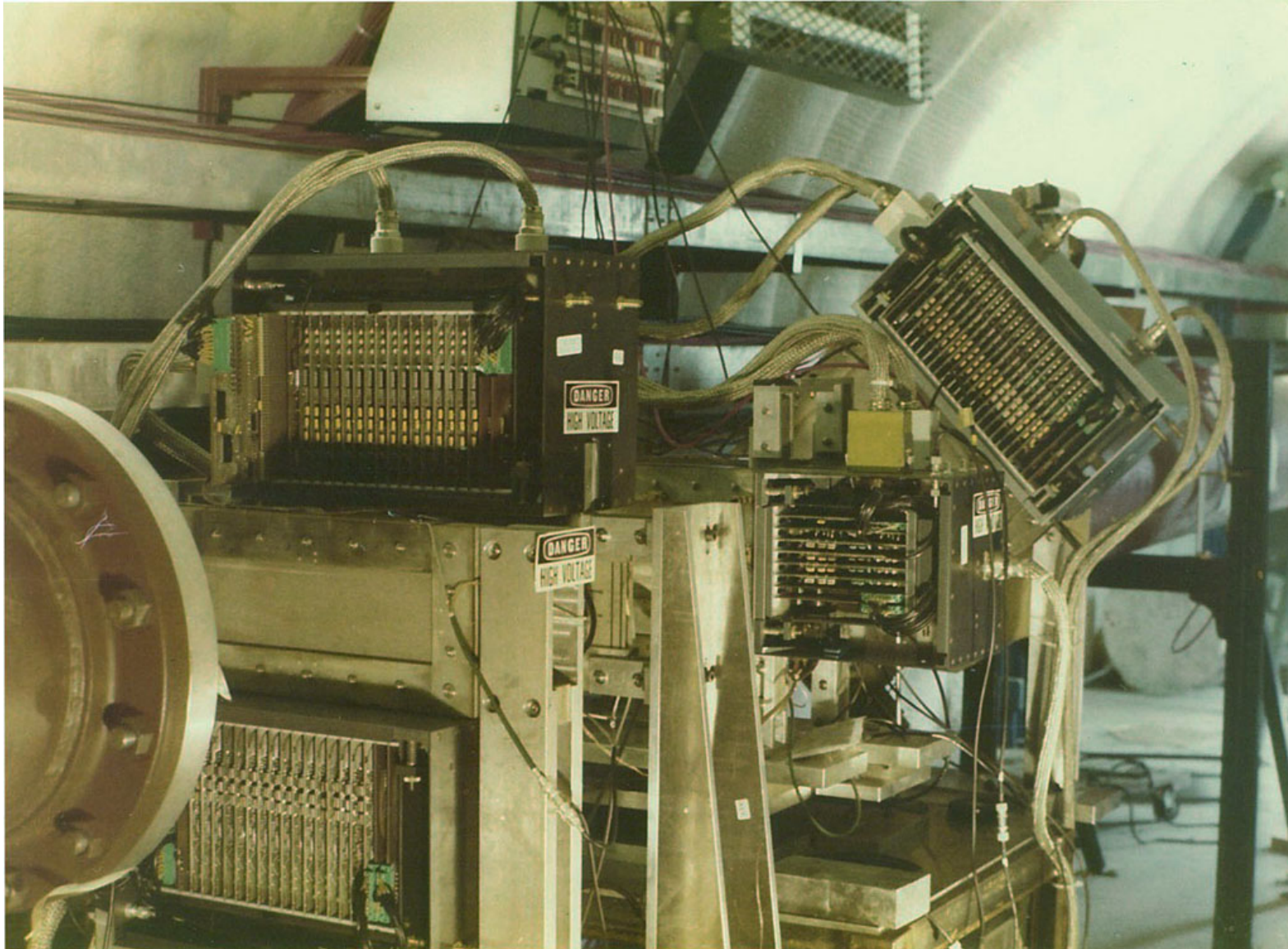
this was our first MWPC



our second MWPC



we set up a spectrometer with 10 MWPC
during summer '73 (experiment E 96)



we got a real mediatic success!

The Village Courier



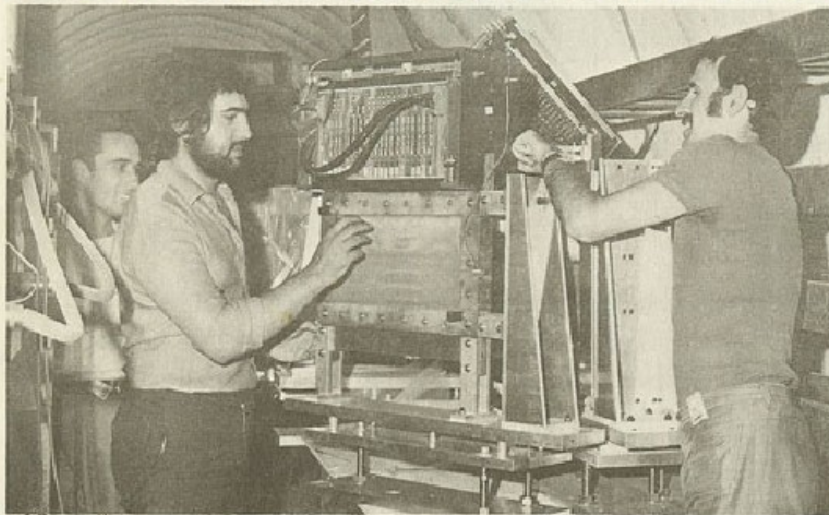
national accelerator laboratory

Operated by Universities Research Association Inc.
Under Contract with the United States Atomic Energy Commission

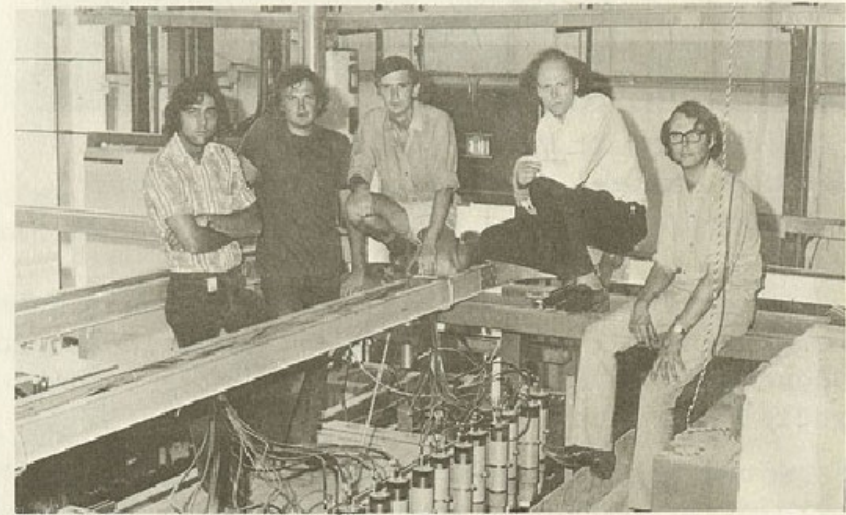
Vol. 5 No. 27

July 26, 1973

NAL'S DOORS OPEN WIDE TO INTERNATIONAL VISITORS

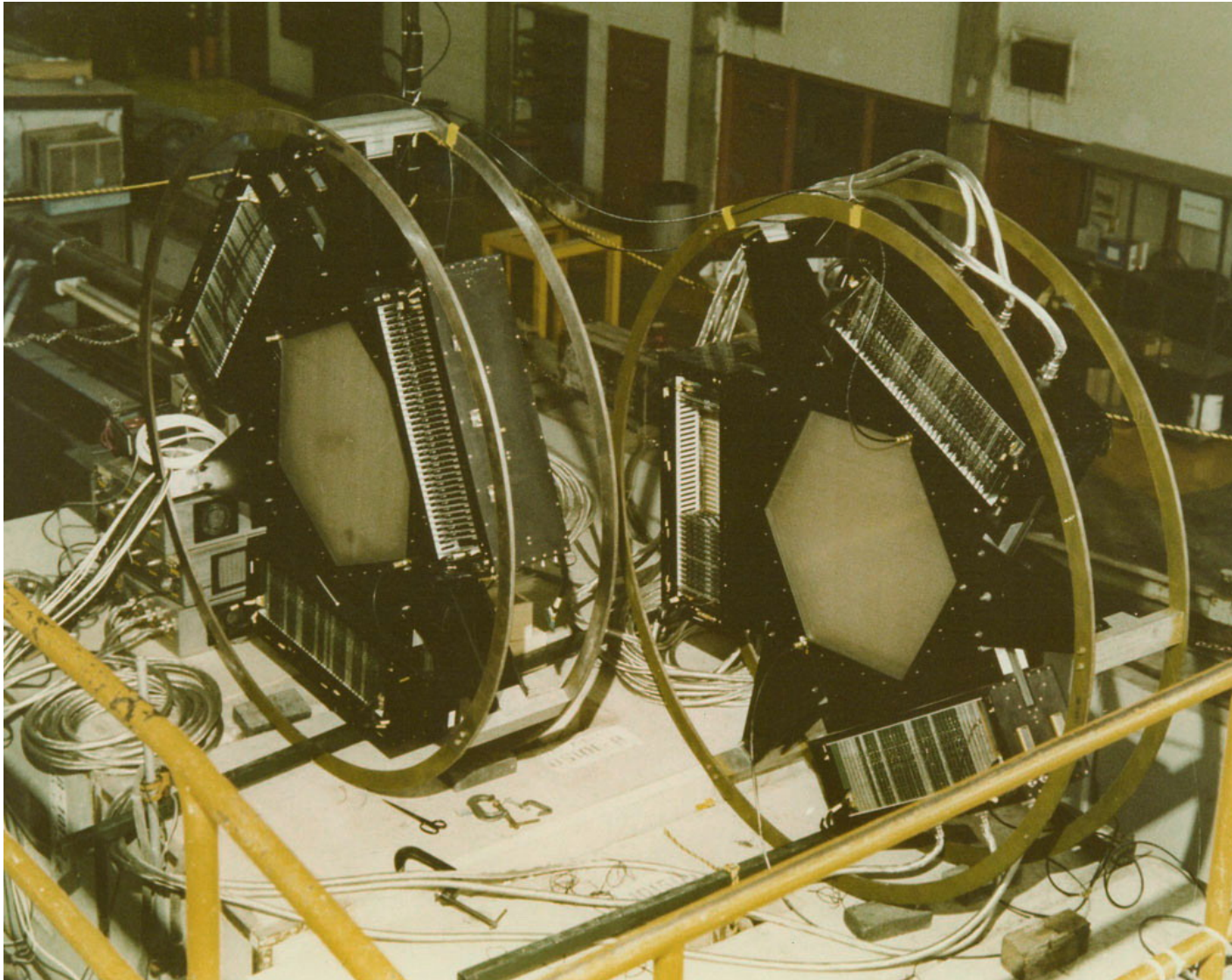


...Among NAL's International visitors, from Bari, Italy, are (L-R): Paolo Spinelli, Giorgio Maggi, and Arcangelo Distante...



...From Oxford University comes (L-R): Phil Burton, Andres Skuja, Ian Kirkbride, Bill Williams, and Tom Quirk...

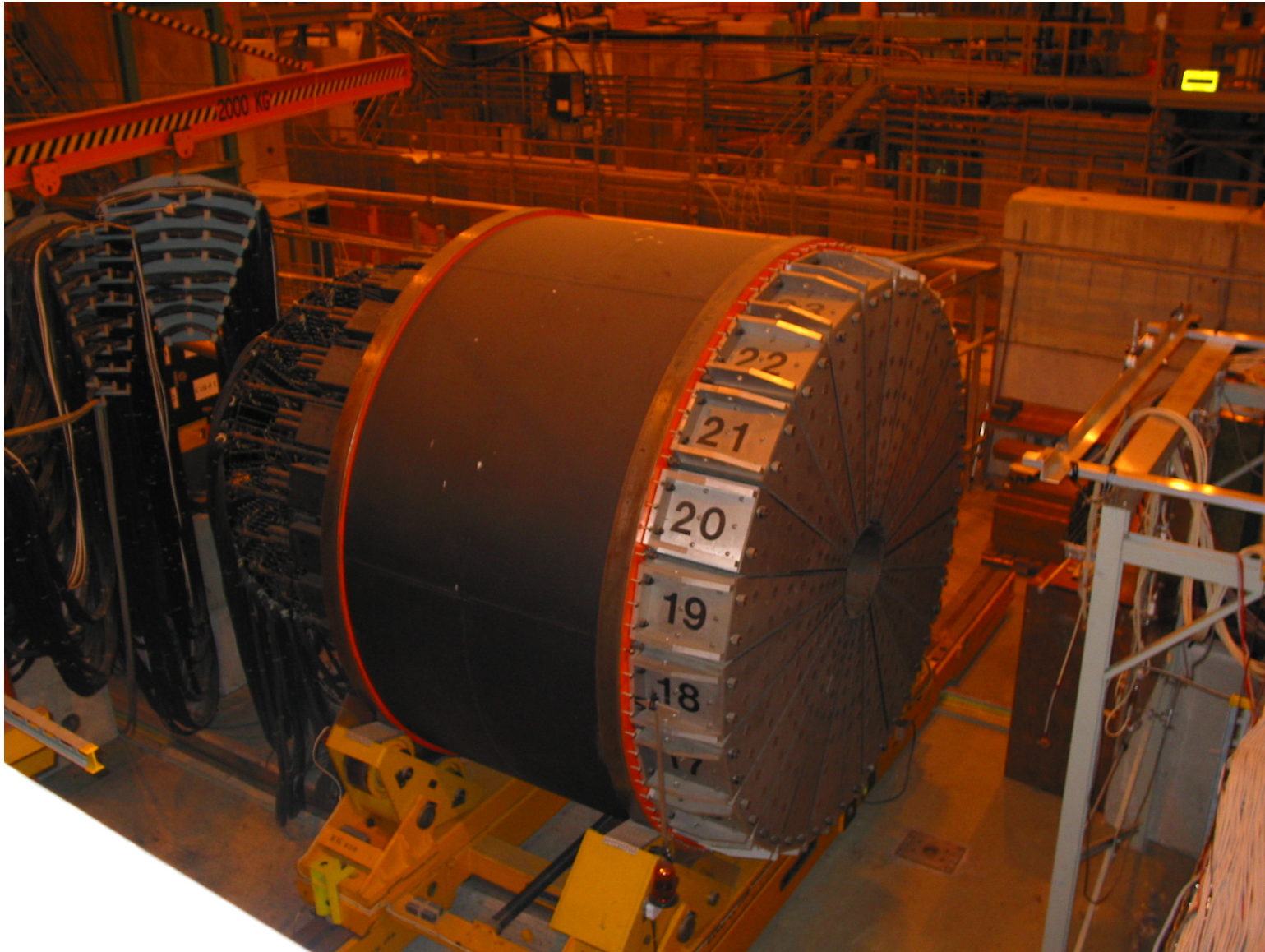
3 years later, we became clever indeed:
hexagonal triple plane MWPC ! (exp.118)



in '78 we came back to Europe: CERN-Geneva
there were 15 +15 physicists...

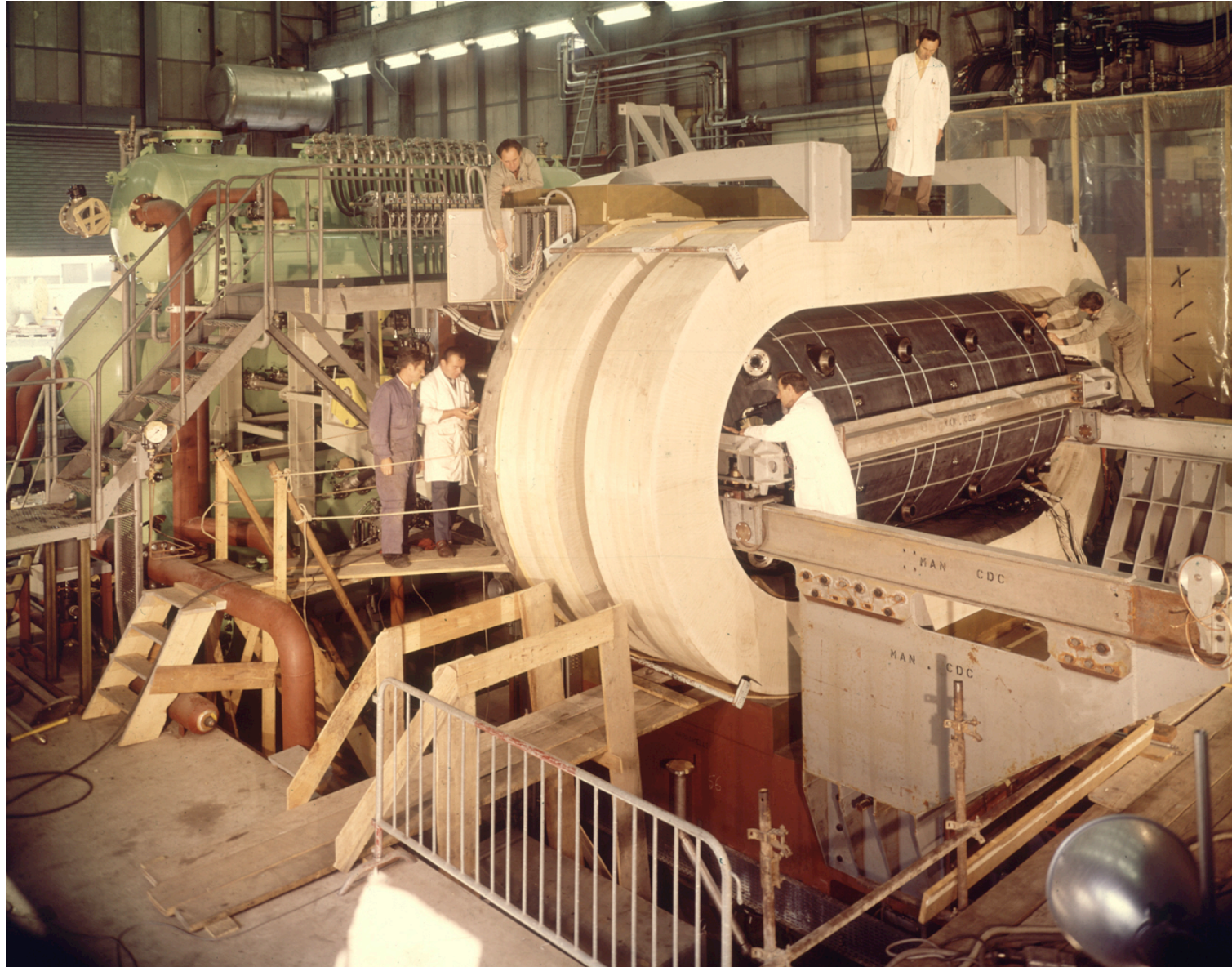


the epoch of giant detectors began!
(NA5 calorimeter) – *prof. Guerriero Group-*

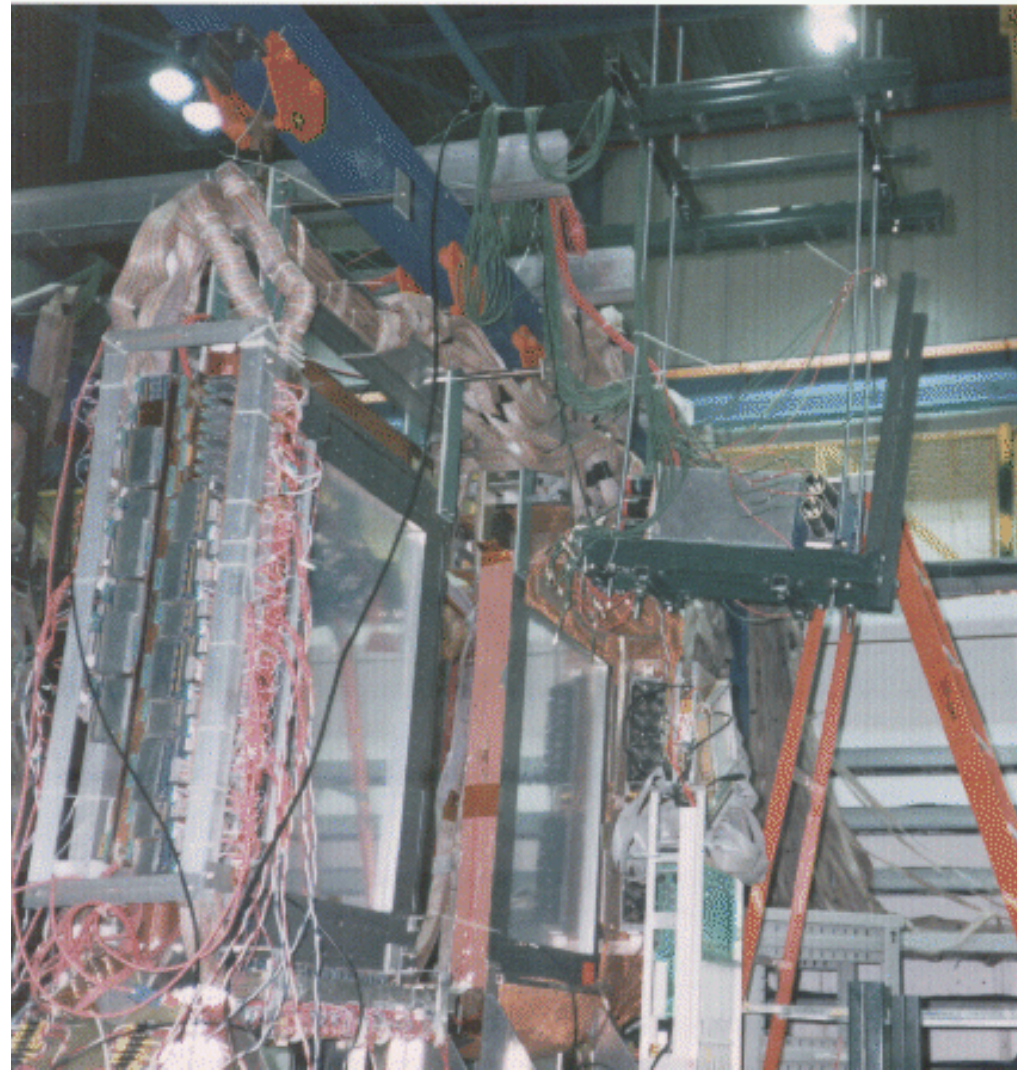
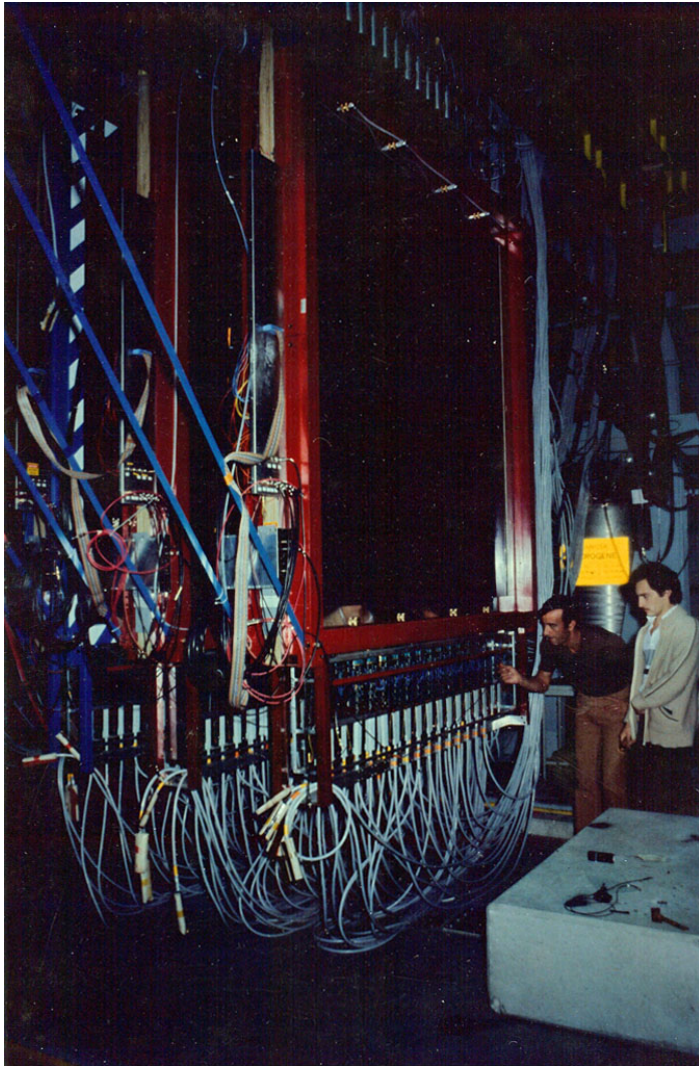


Gargamelle bubble chamber

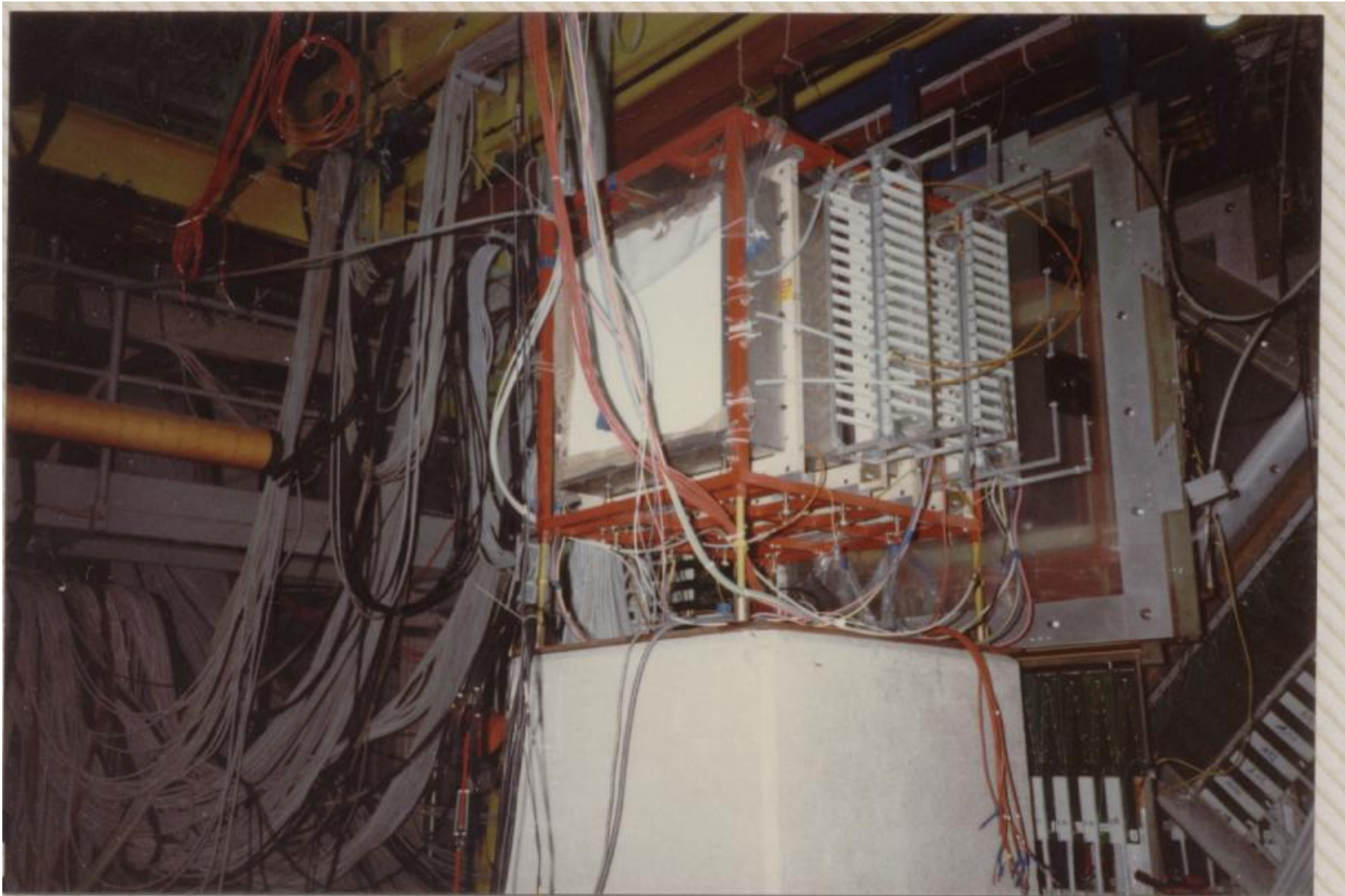
Prof. Natali Group



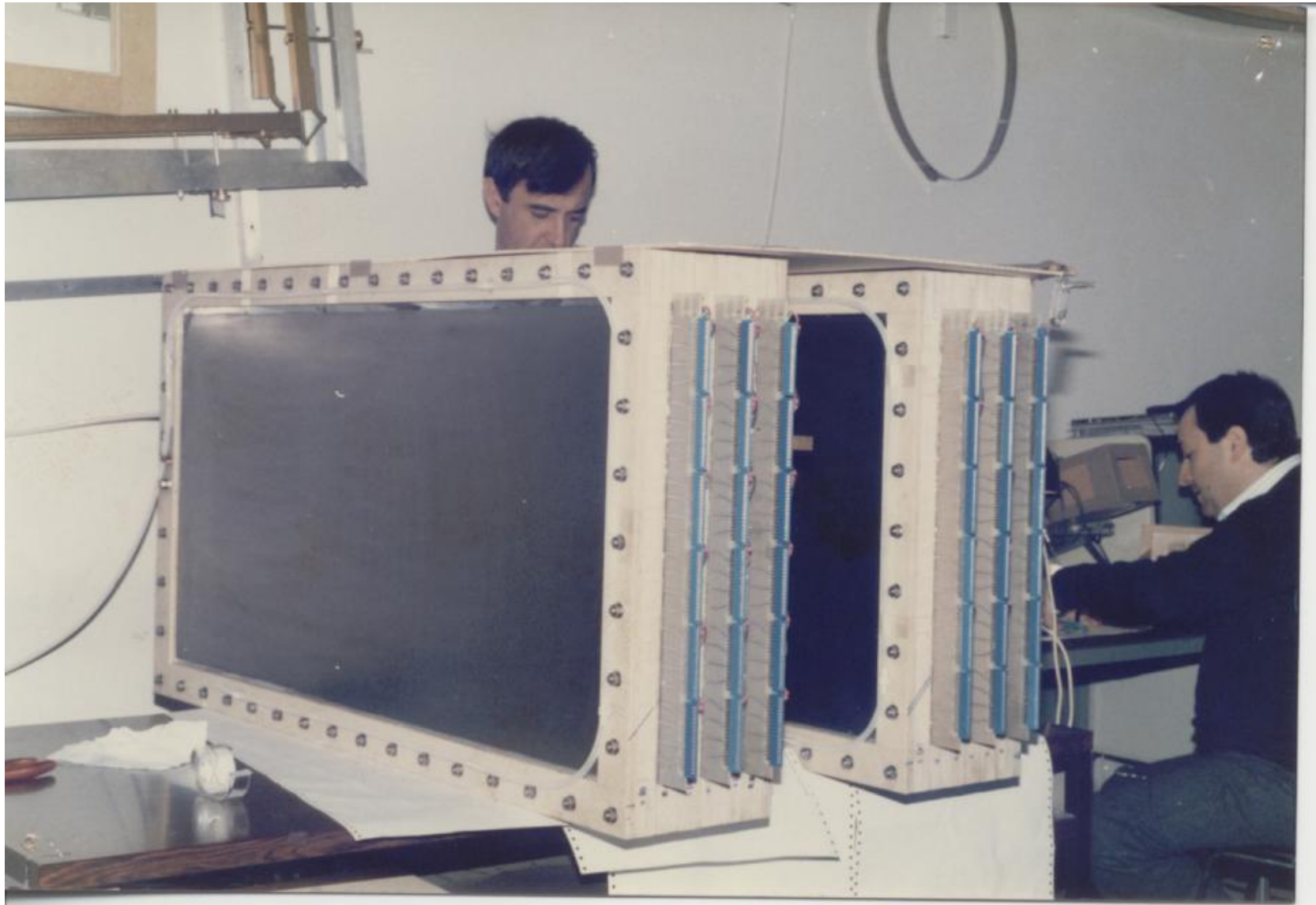
...we dealt with giant MWPCs (exp. NA24)
3 x 3 m², 3 mm spacing, triple plane (x,u,v)



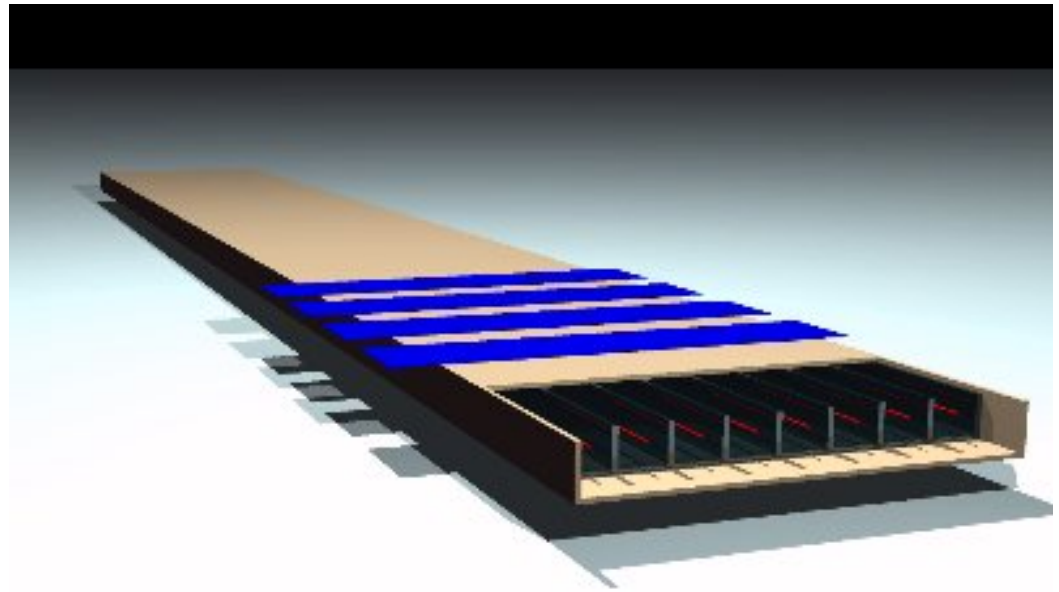
We developed also a lot of “quite proportional” MWPCs for TRDs (experiment NA24) 1985



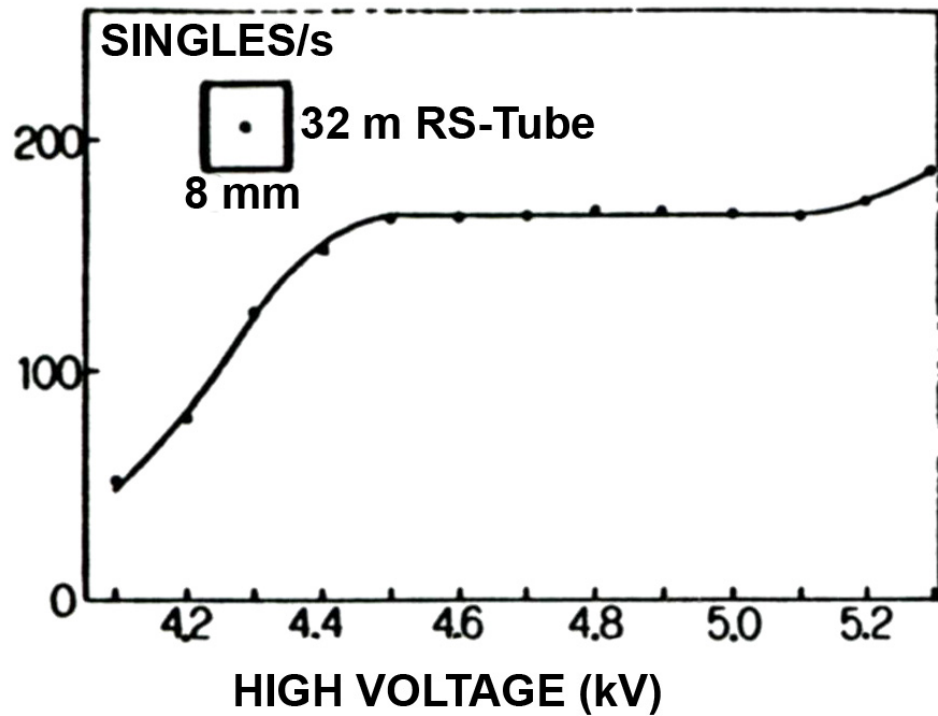
1987: 3cm gap MWPCs for a TRD (NUSEX exp.@Mt. Blanc)



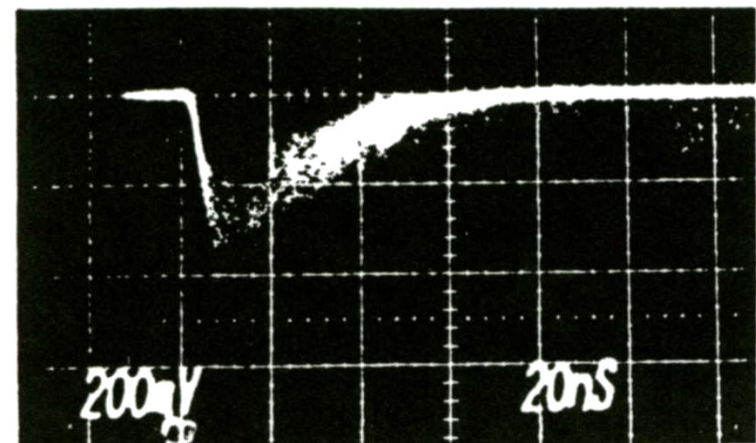
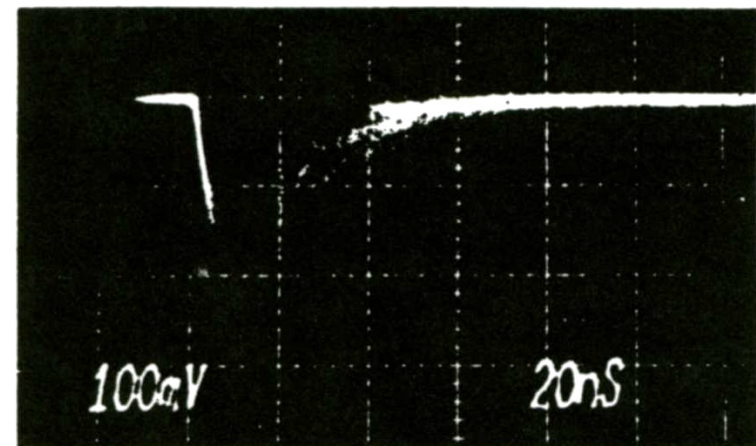
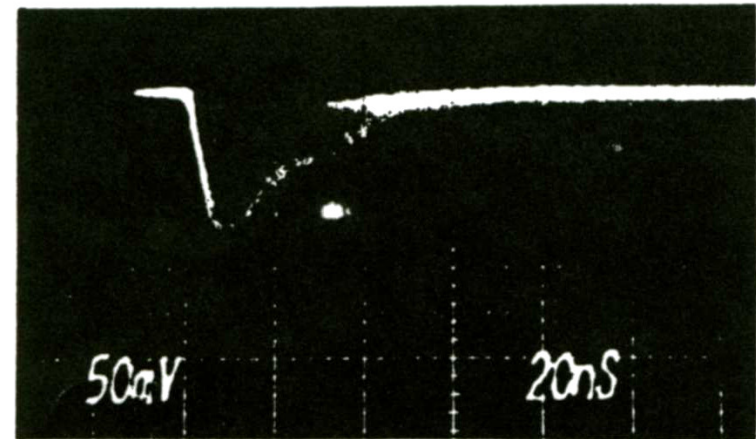
1980: the streamer tube became a **mature** technology → we **dived** into this technique



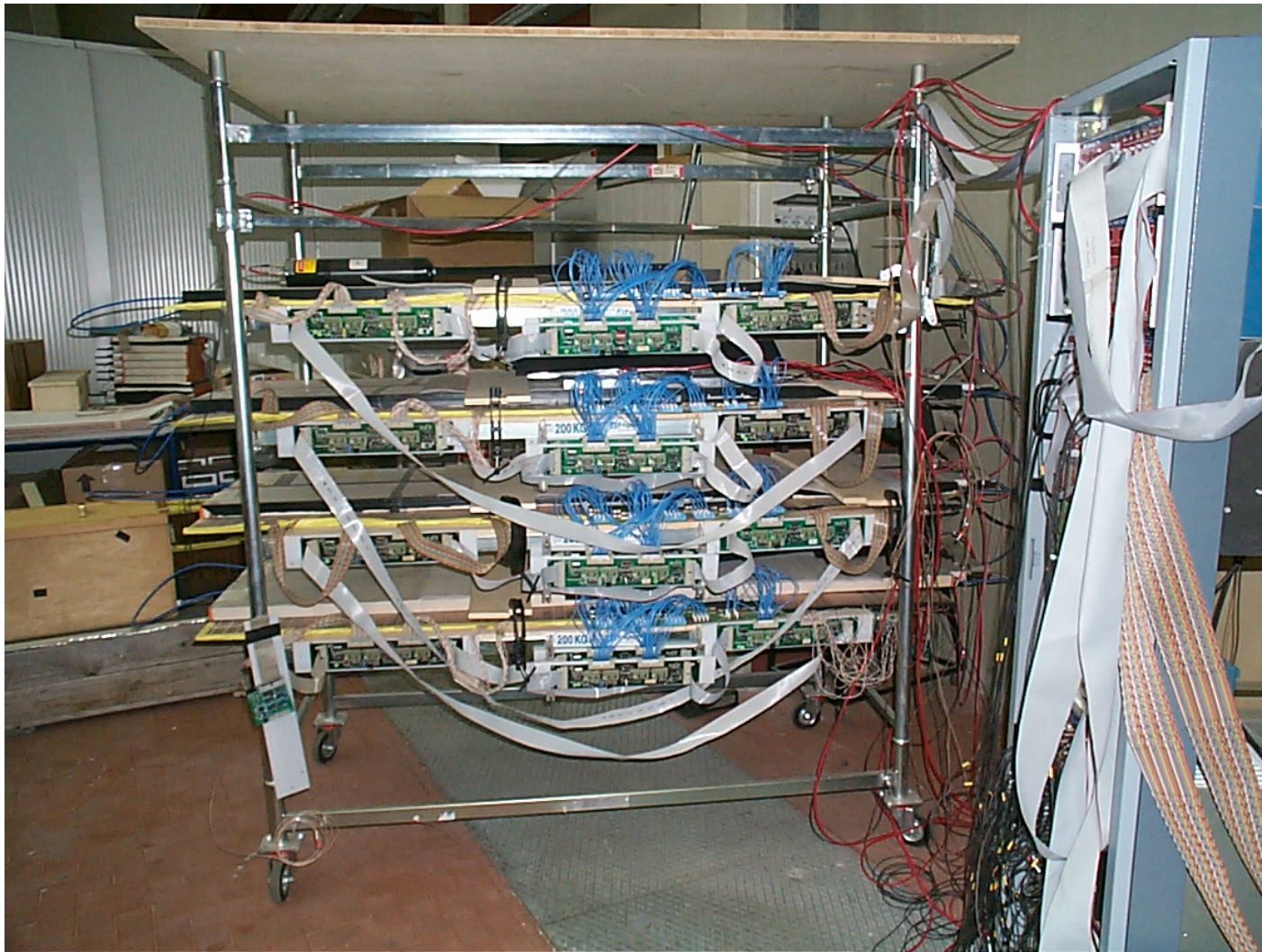
Rate di impulsi singoli vs HV per un tubo RS 0.8x0.8x320 cm³ con fili di 100 μm.



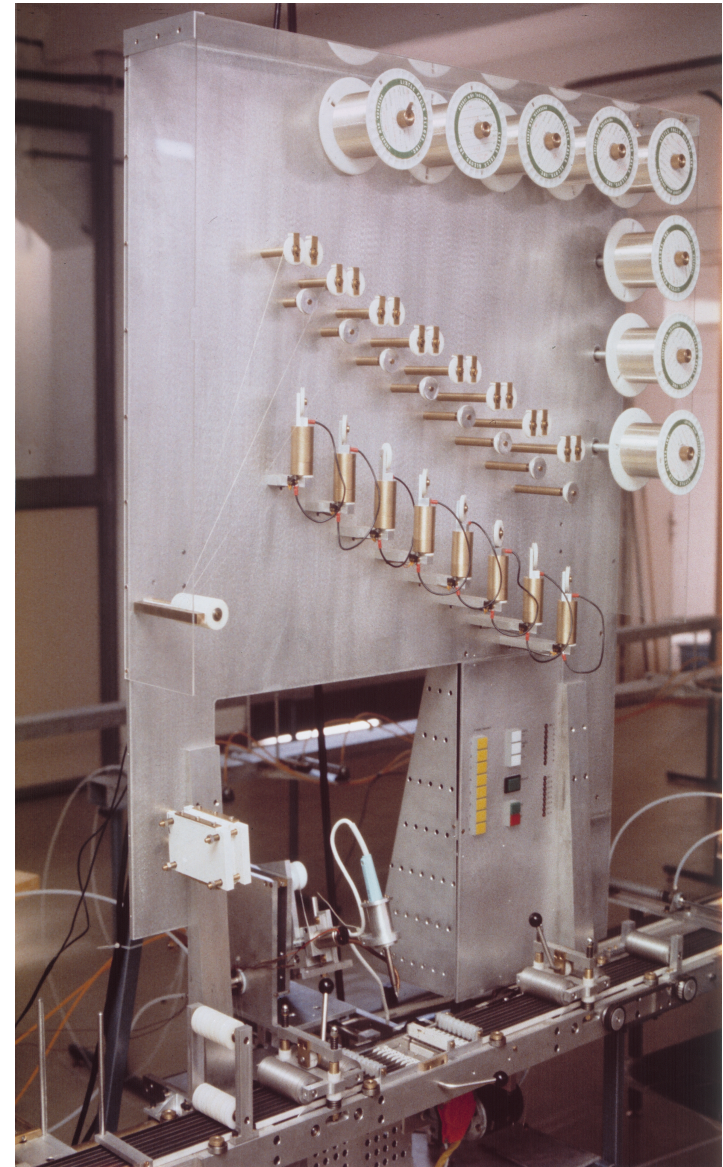
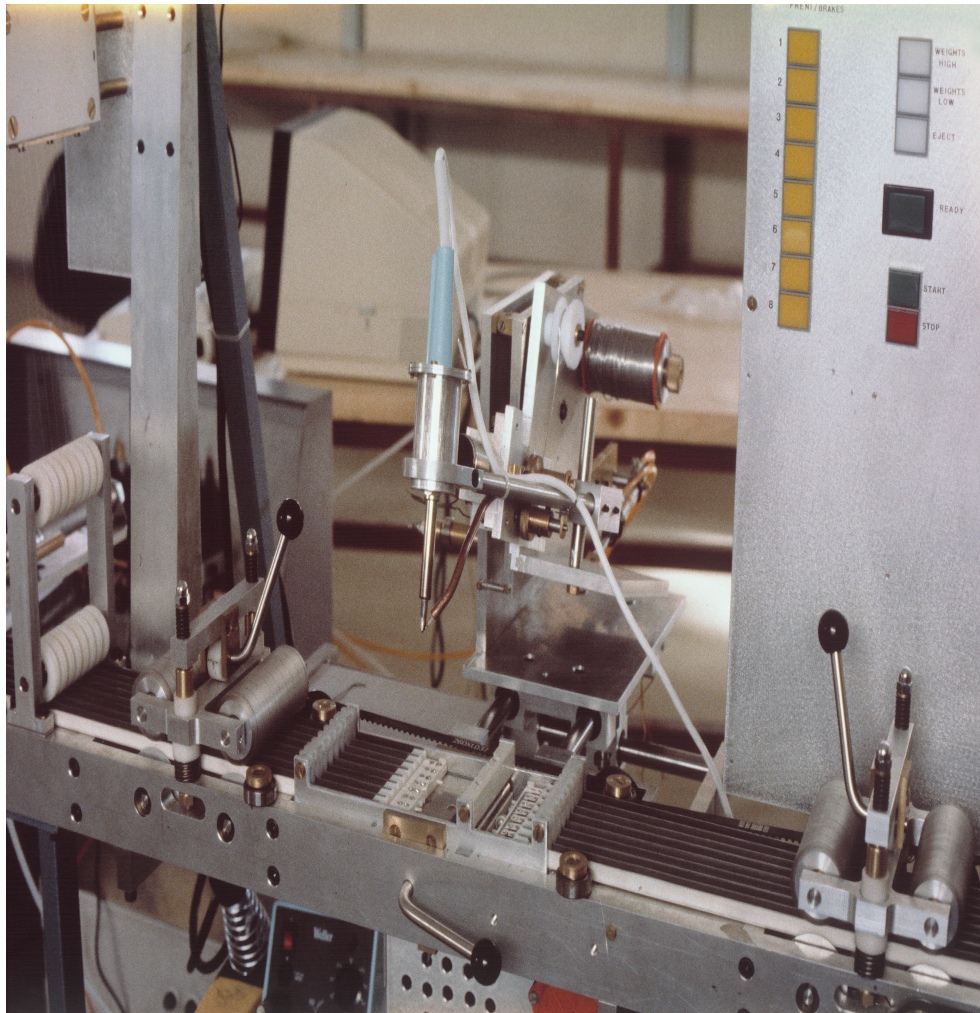
Impulsi in uscita dai fili per il tubo in figura per diversi valori di HV.



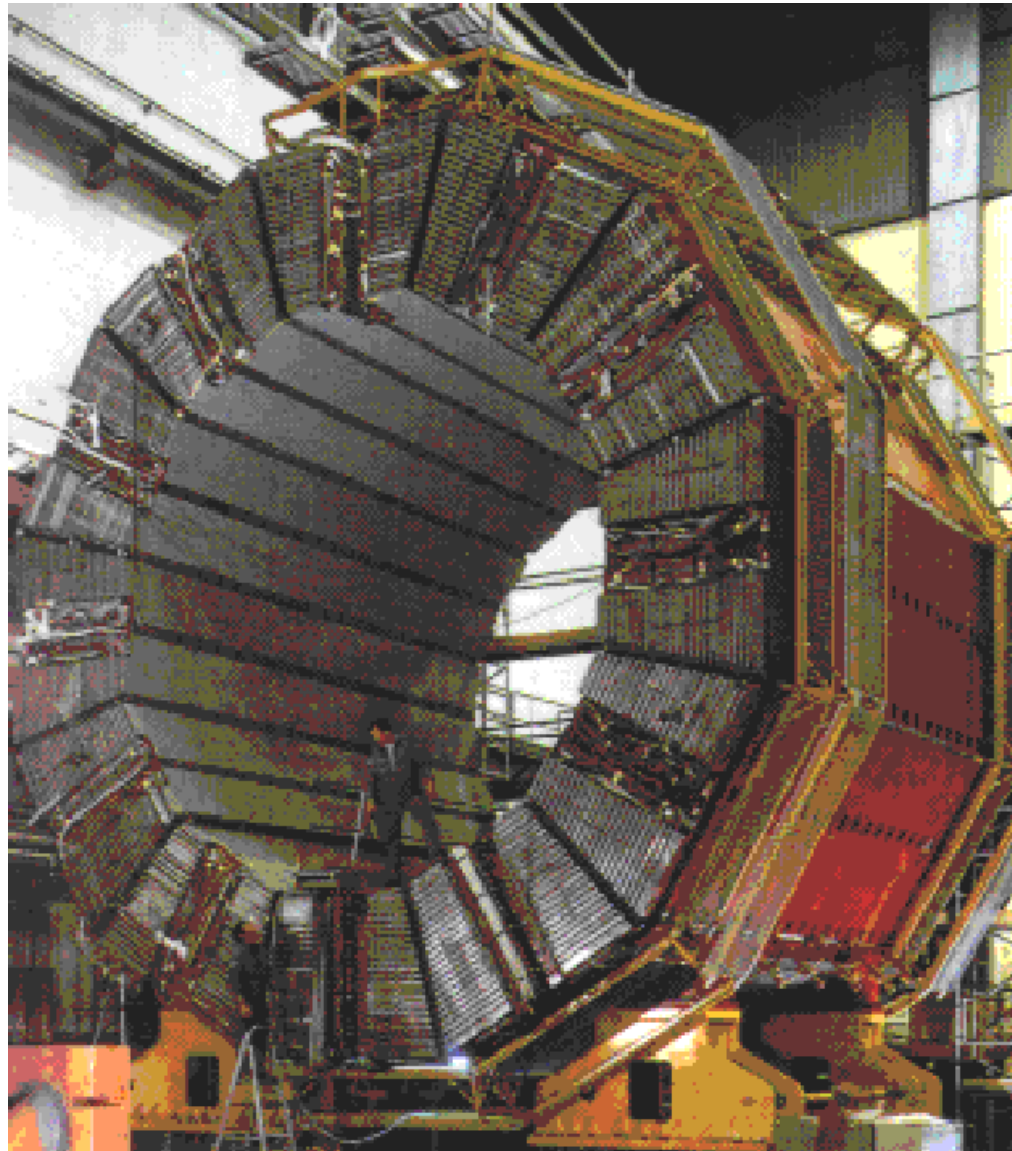
Streamer tube telescope



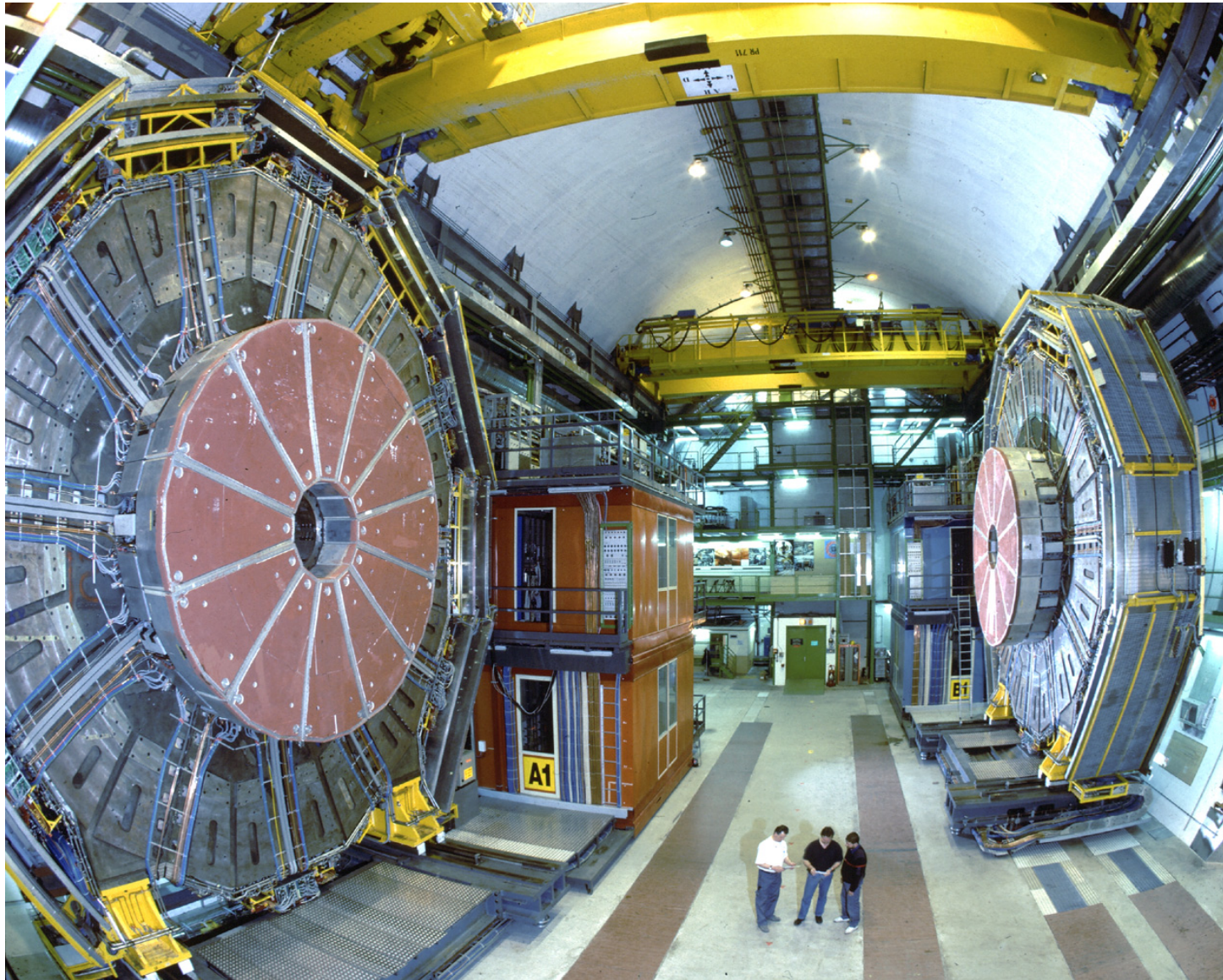
Streamer tube winding machine



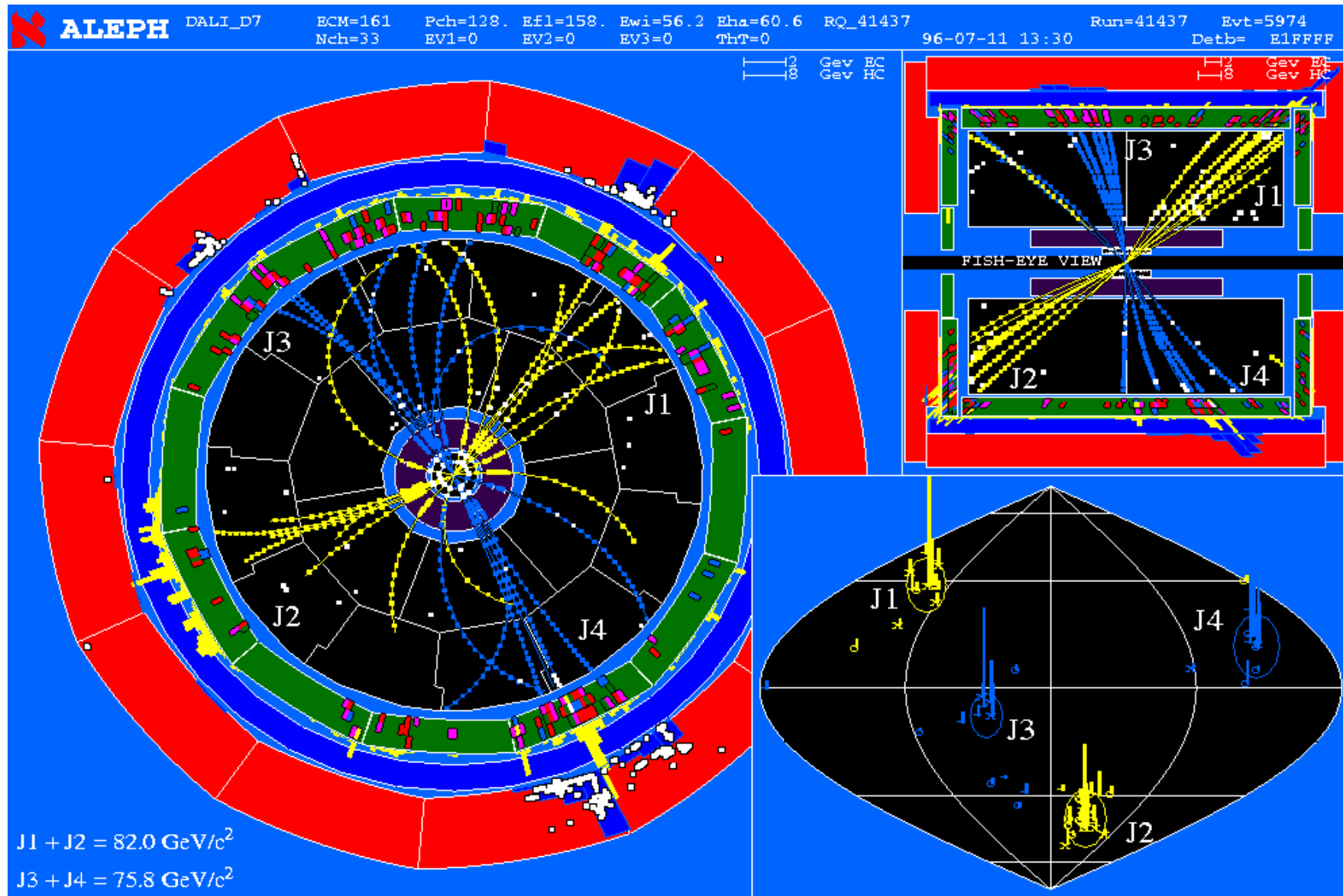
...a 1st monster like this was built by Aleph Group



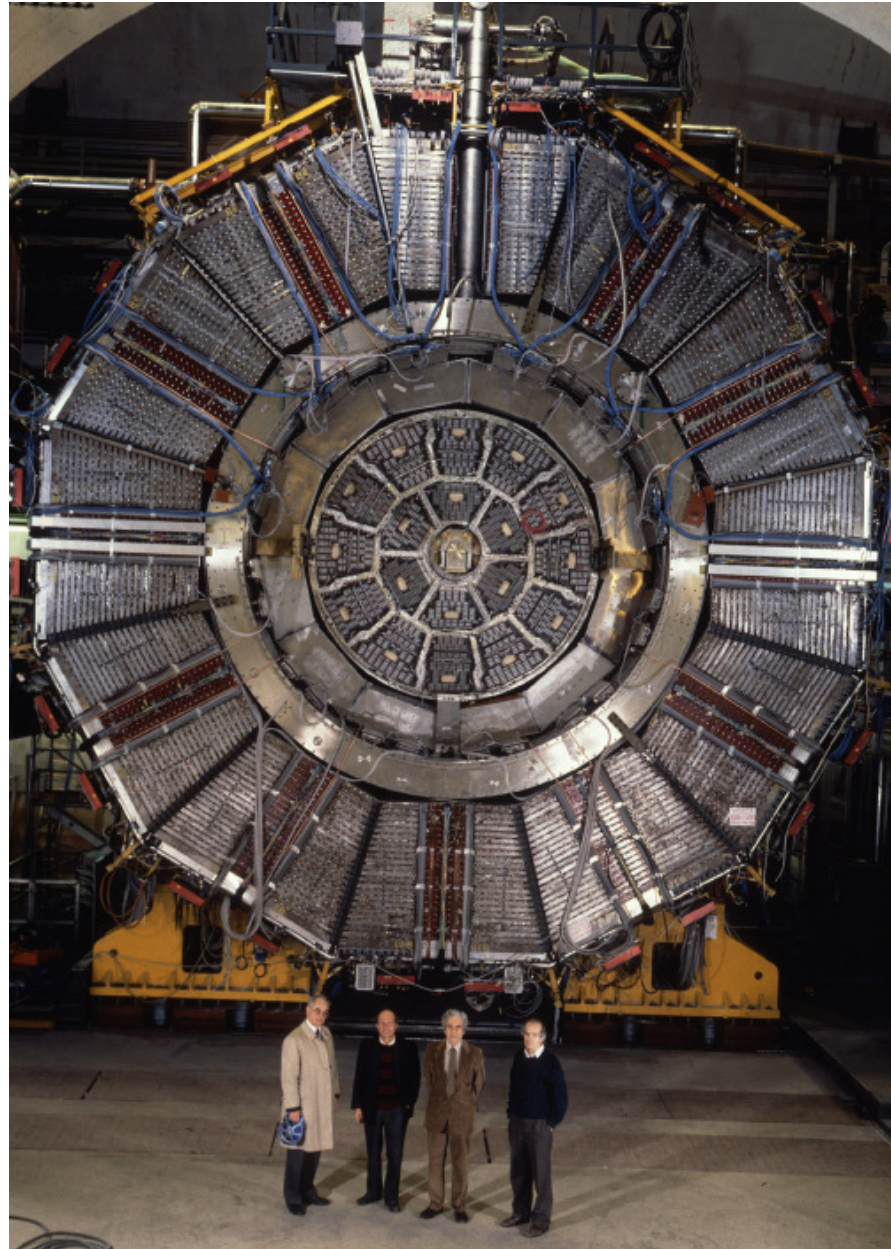
Aleph streamer tube calorimeter was really big!



Really exceptional results!



...earning the Nobel Prize for J. Steinberger



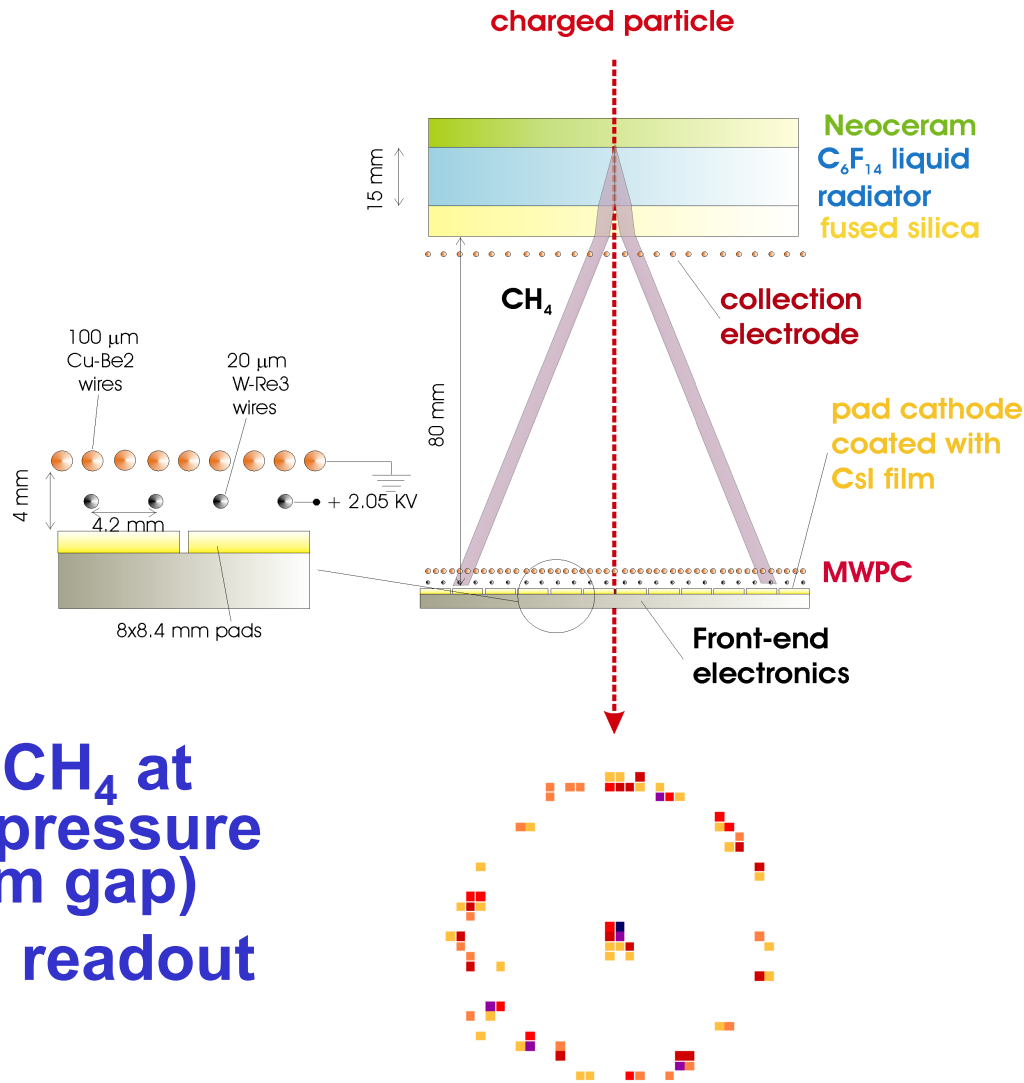
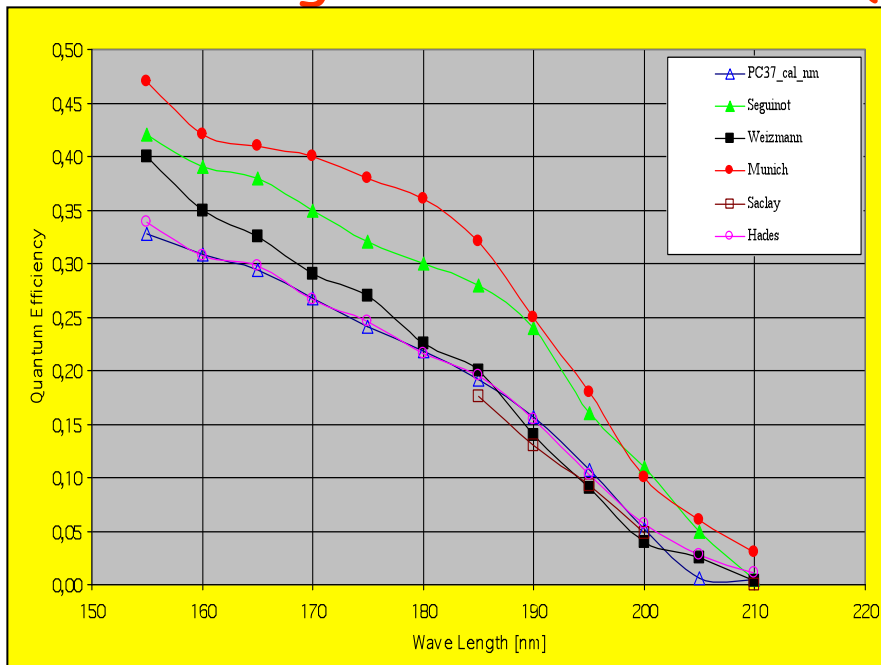
This 2nd monster was built by MACRO group at Gran Sasso (no **monopole**, no Nobel prize!)



10.000 m² area covered by streamer tubes

1993: CsI RICH detector

R&D together with CERN (E.Nappi, F. Piuz)



MWPC with CH₄ at atmospheric pressure (4 mm gap)
analogue pad readout

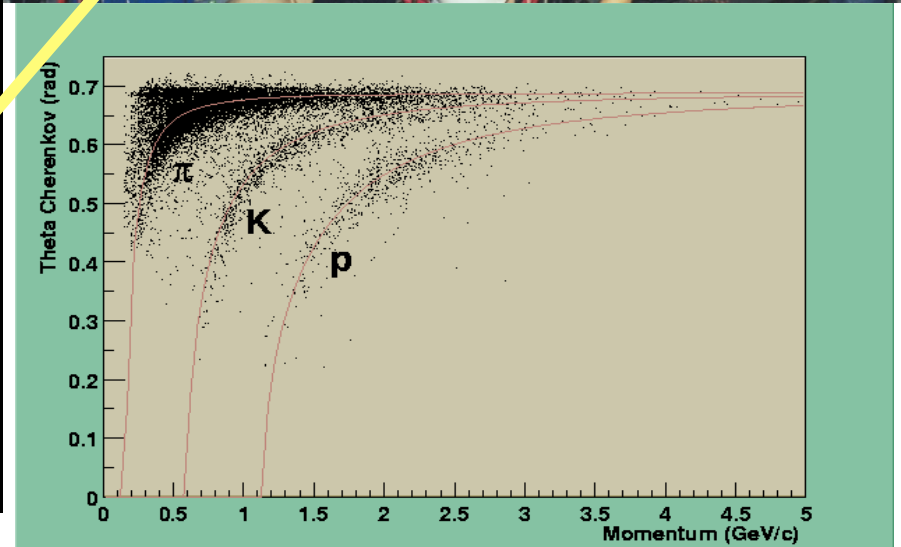
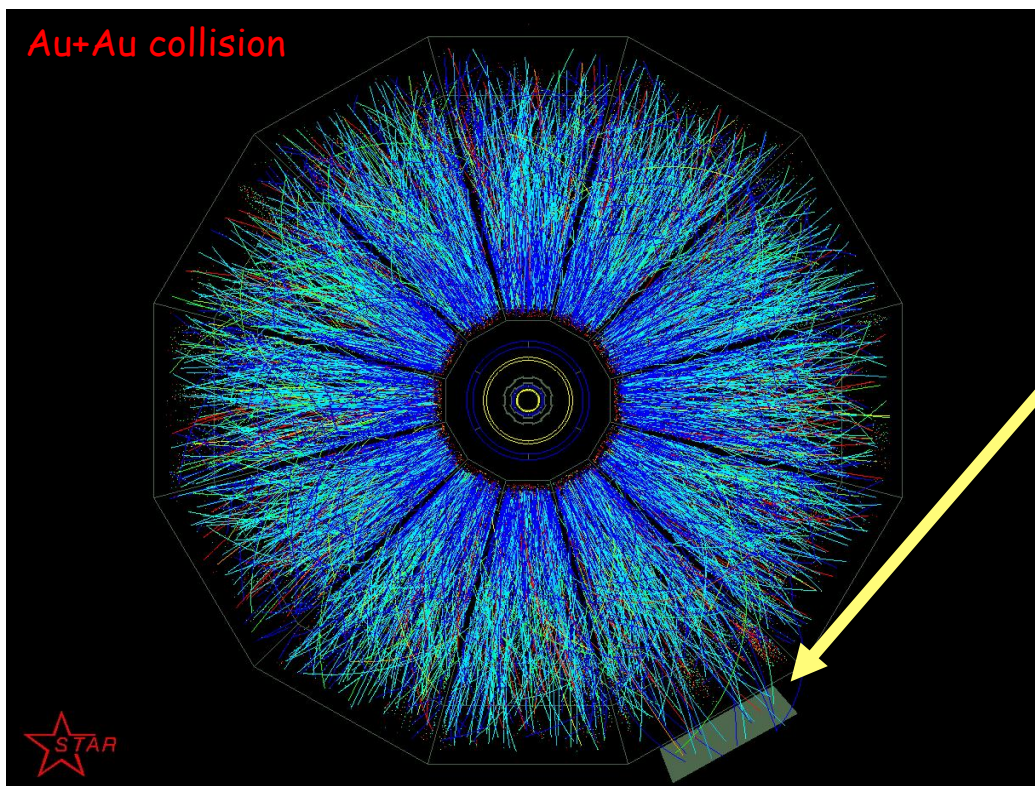
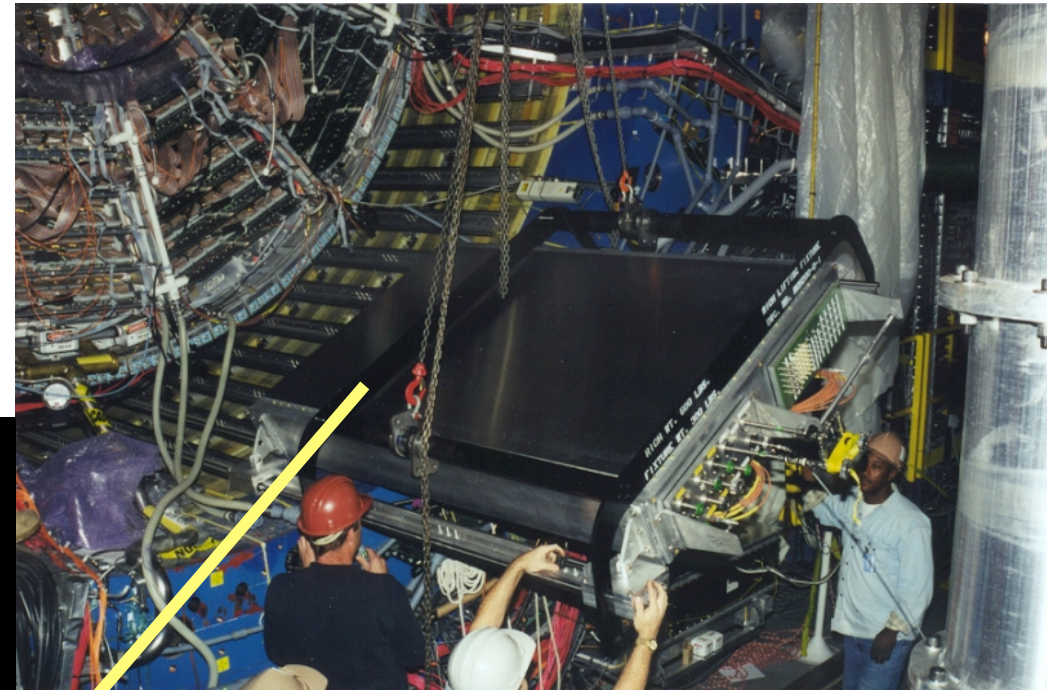
Long tradition in designing and building RICH detectors

1° Workshop on RICH detectors: Bari 2-5 June 1993

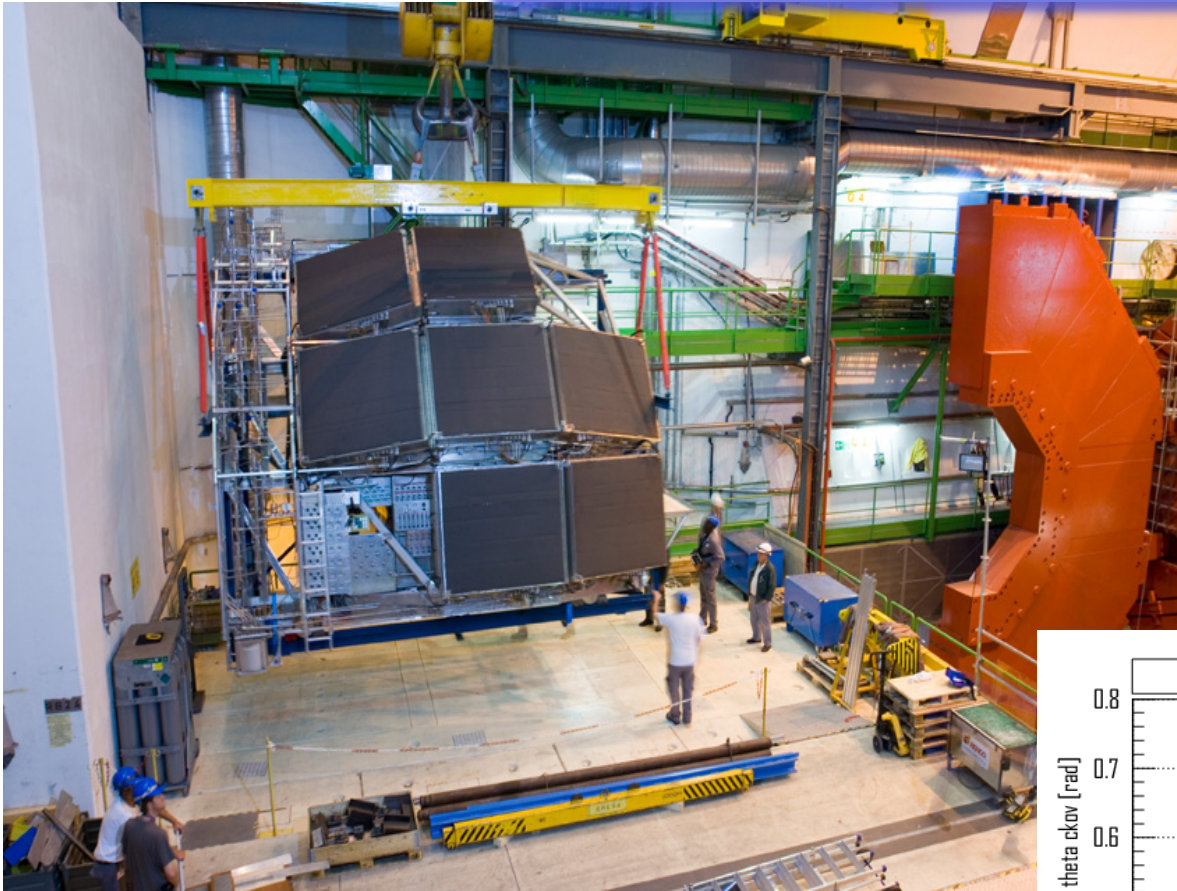


CsI RICH Detector at BNL

operated in STAR
from 1999 to
2001

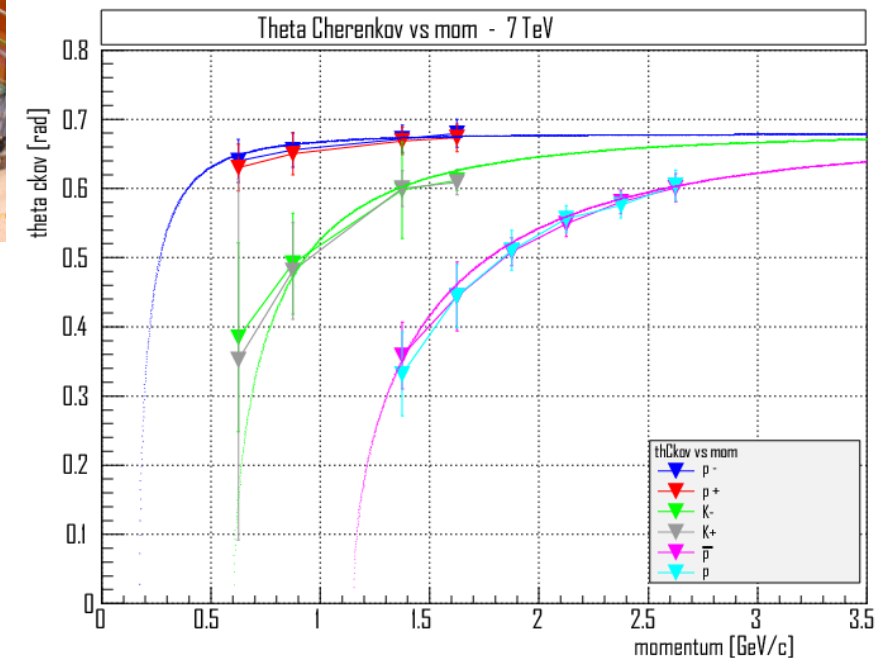


CsI RICH detector at LHC

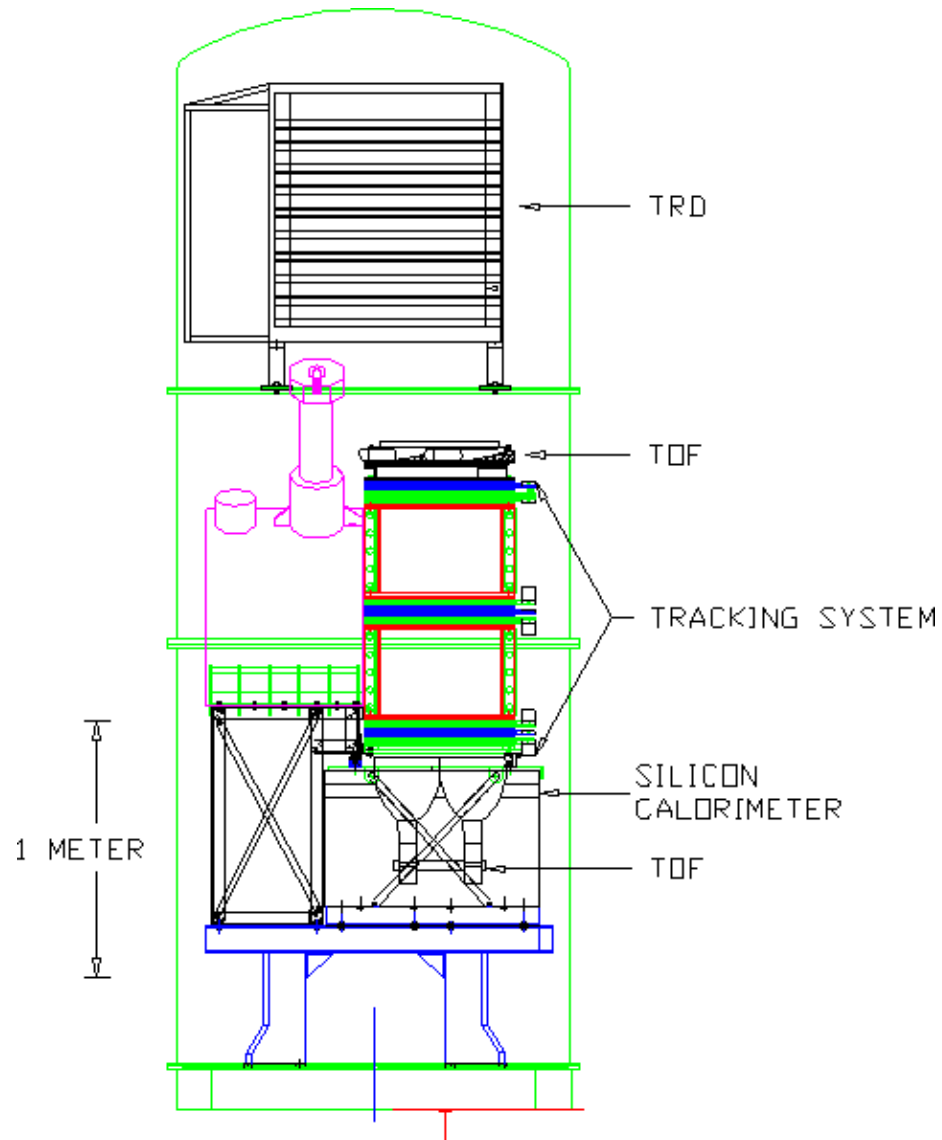


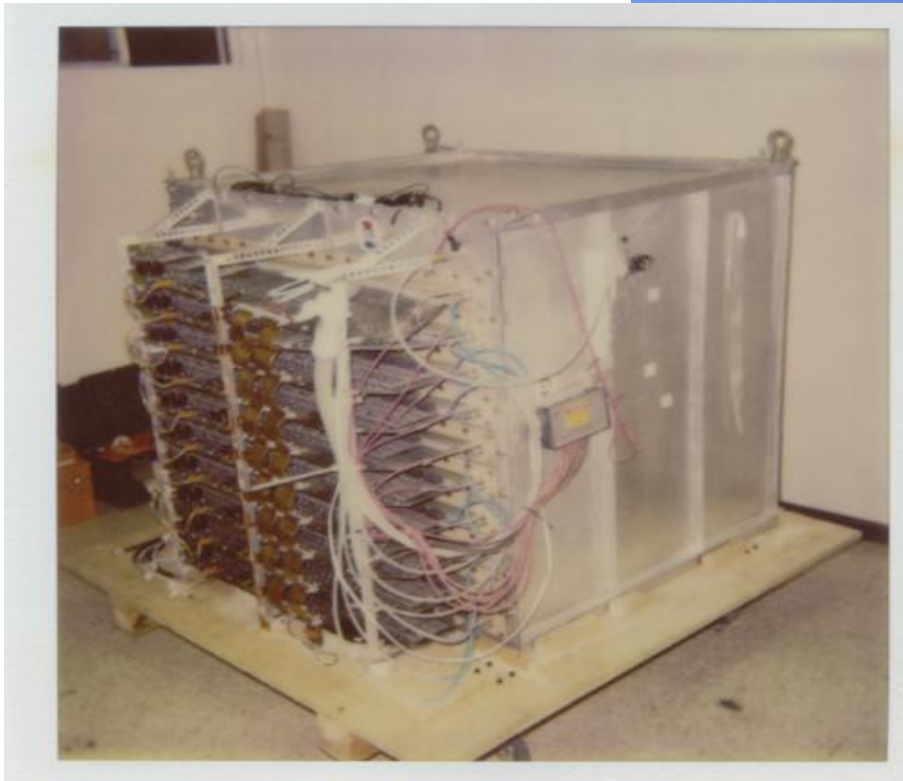
ALICE experiment
7 modules, each
 $\sim 1.5 \times 1.5 \text{ m}^2$

total CsI area $\sim 10 \text{ m}^2$
the largest CsI RICH
ever built



1993: TRD for antimatter search → standard MWPC



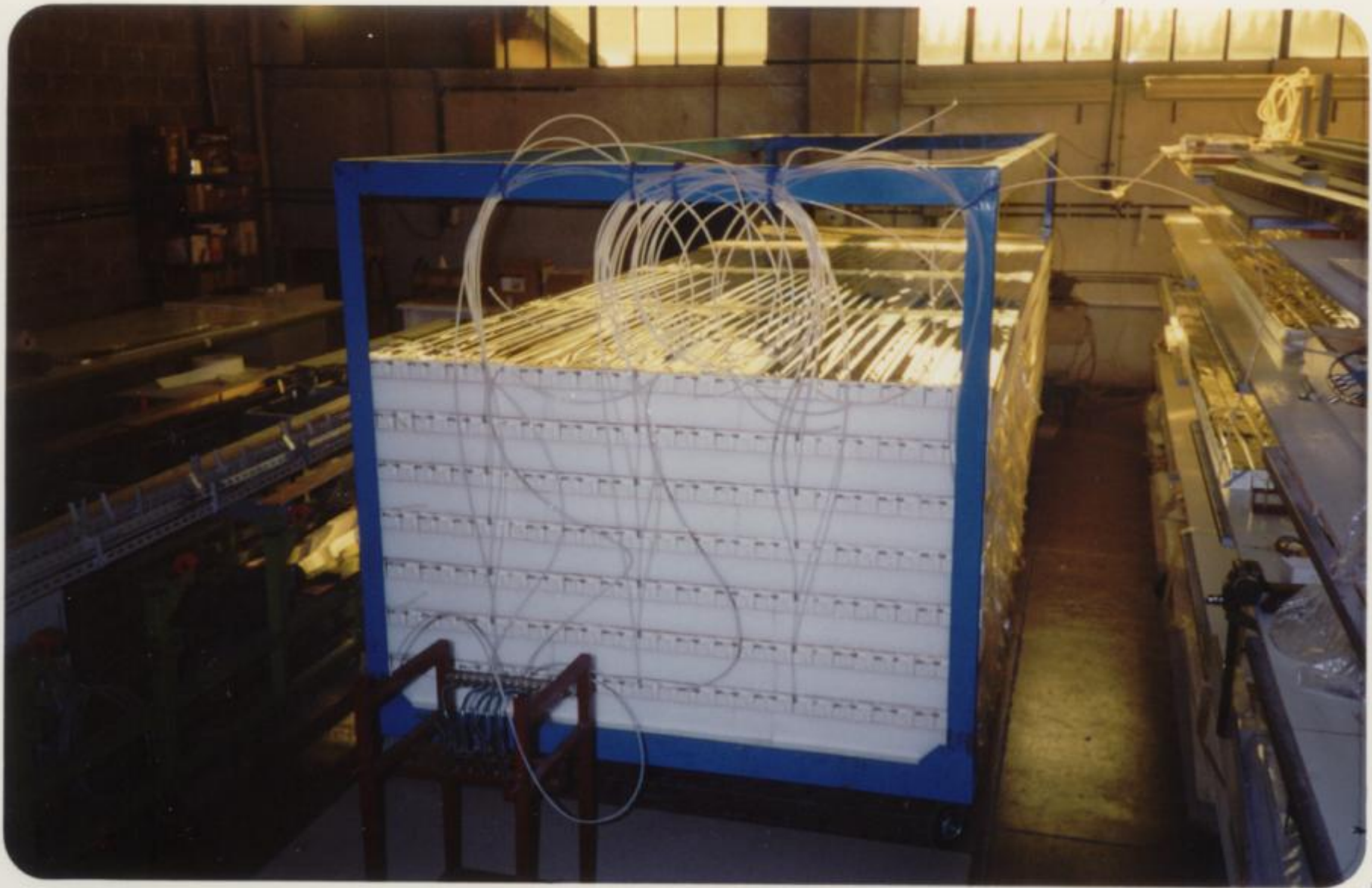


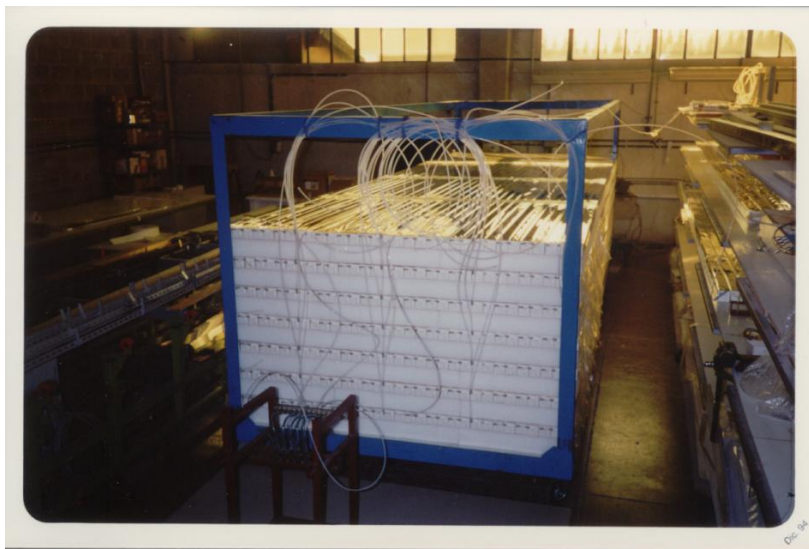
balloon launch base: New Mexico

1994: MACRO TRD proportional tube



1994: MACRO TRD module 3 x 6 x 3 m³



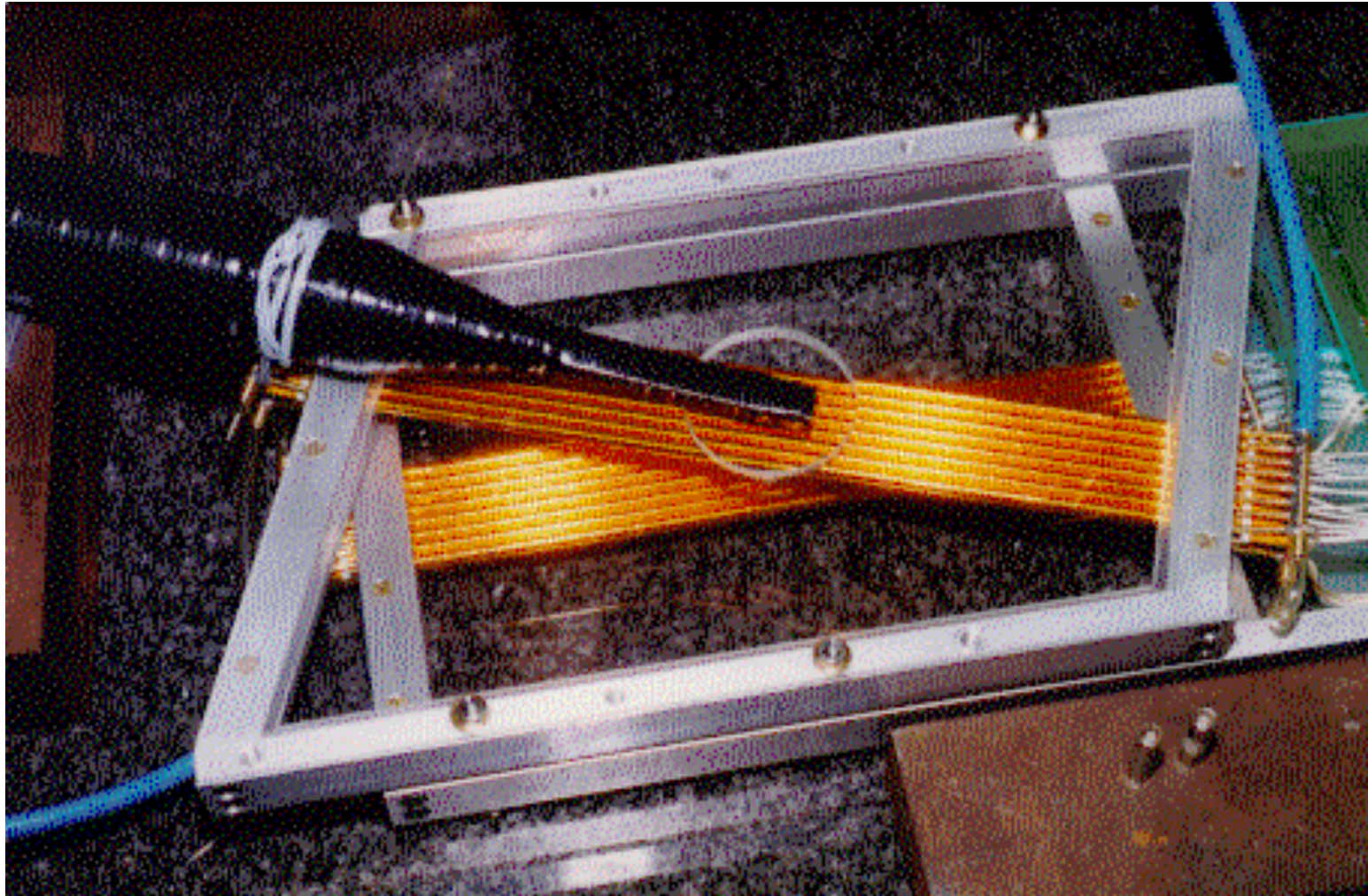


3 of these modules were
mounted on MACRO top
largest TRD in the world

Volume
 $6 \times 6 \times 3 \text{ m}^3$

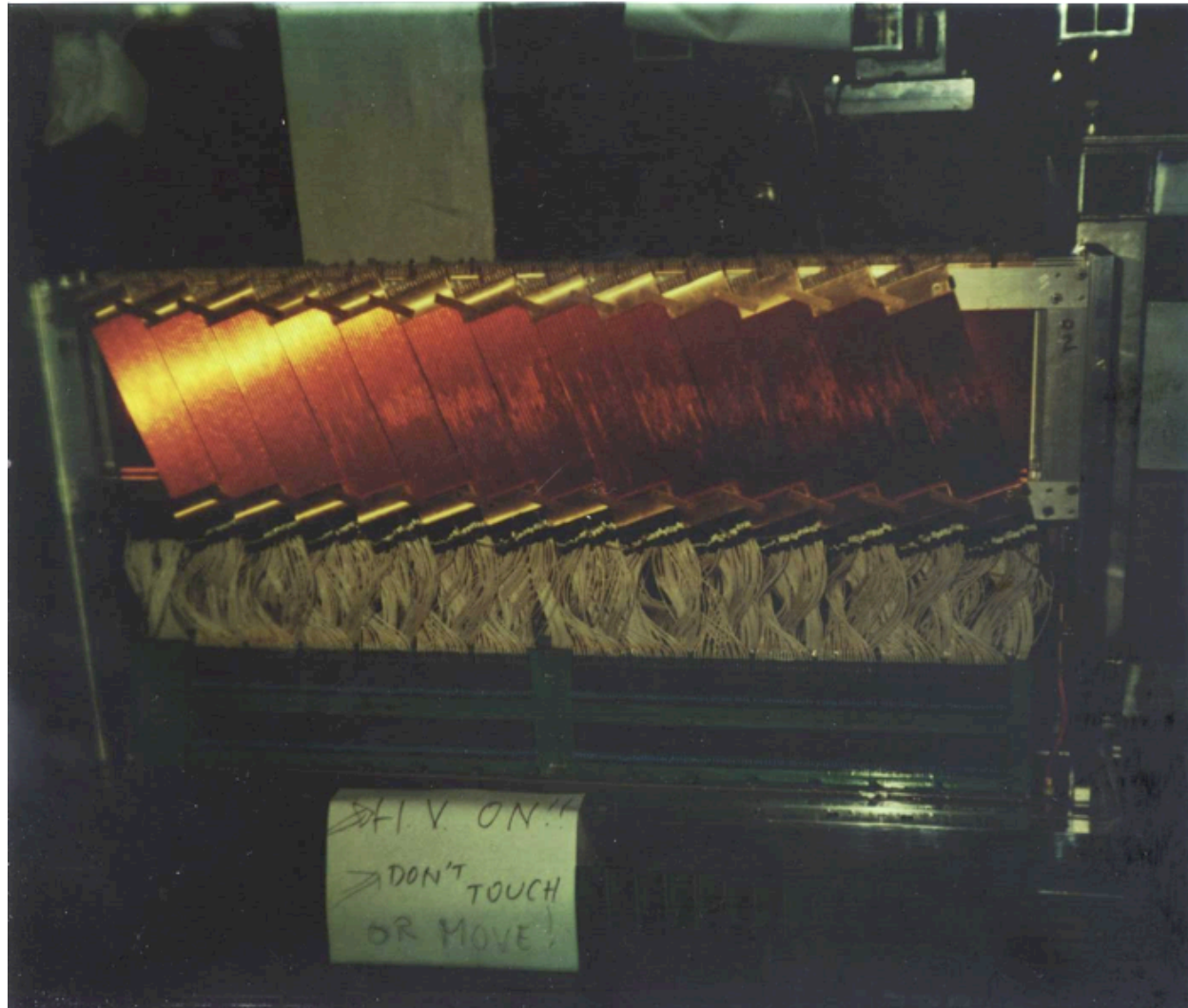


1995: straw tube detectors for experiment 864
(strange quark matter search at BNL)



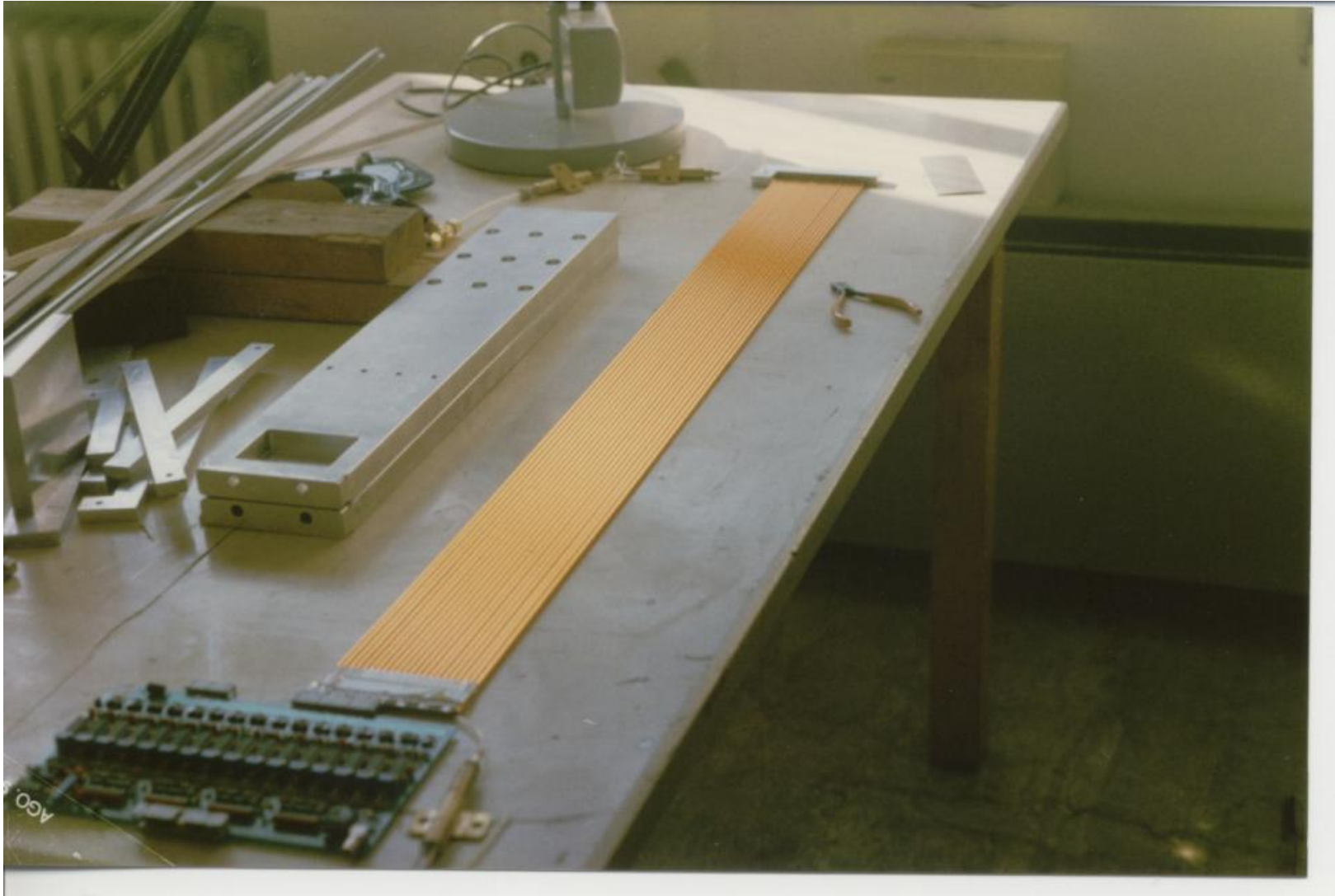
4mm straws working in vacuum in sealed mode

1995: straw tube detector for experiment 864
(strange quark matter search at BNL)



4mm straws working in vacuum in sealed mode

straw tube module → future developments

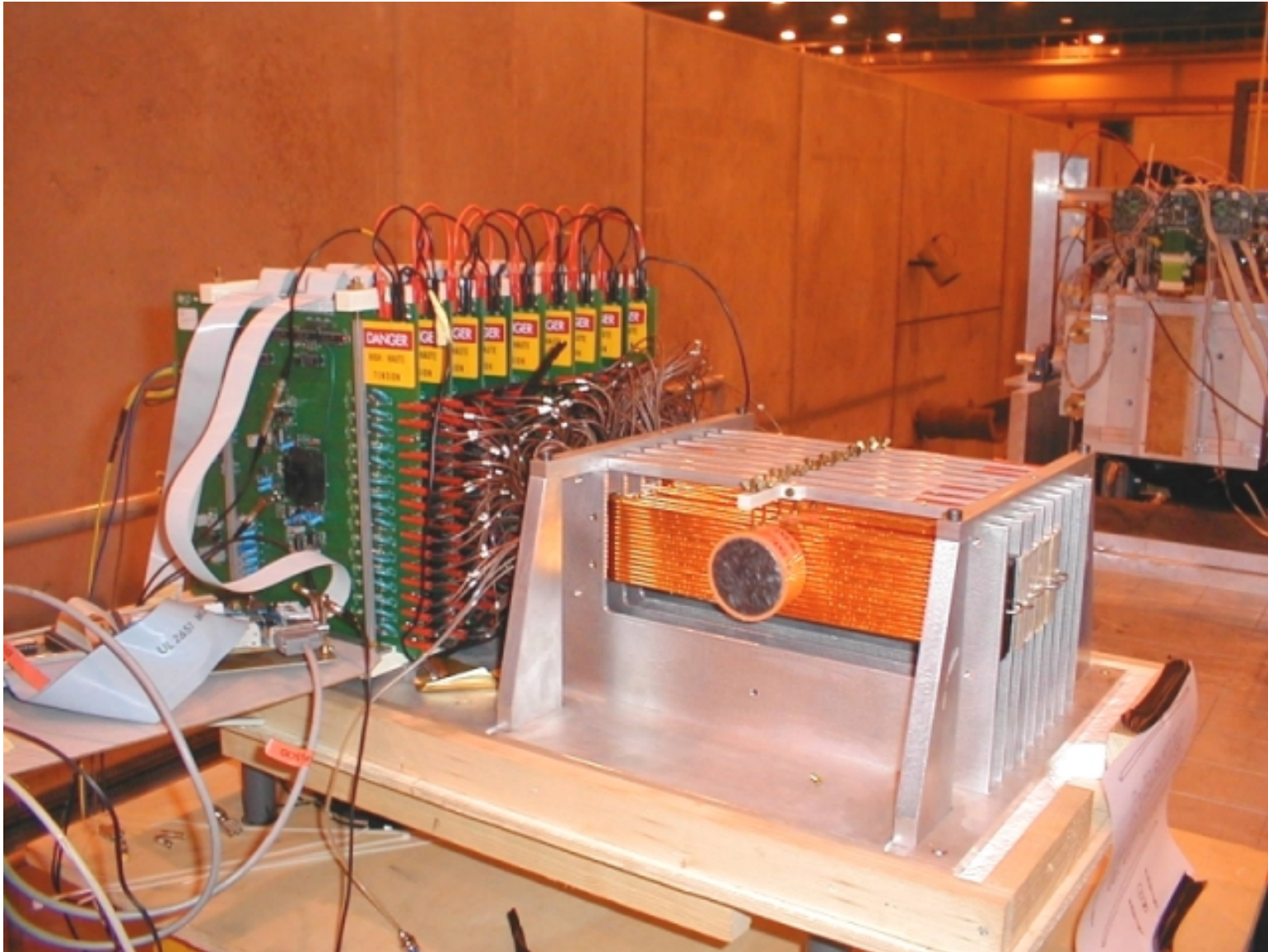


2000: TRD for fast triggering on π and k for NA49 experiment



4mm straws filled with xenon gas

TRD for PAMELA satellite experiment (2006)





1998

prop. tubes

TRD for

neutrino

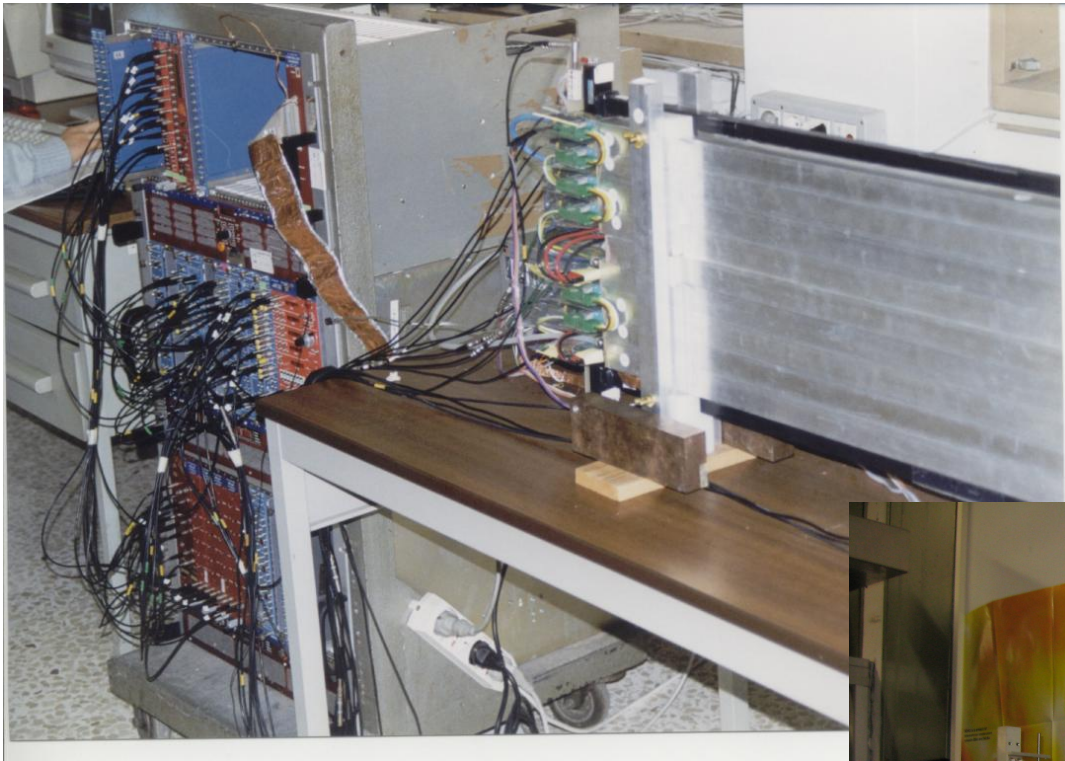
oscillations

experiment

from CERN to

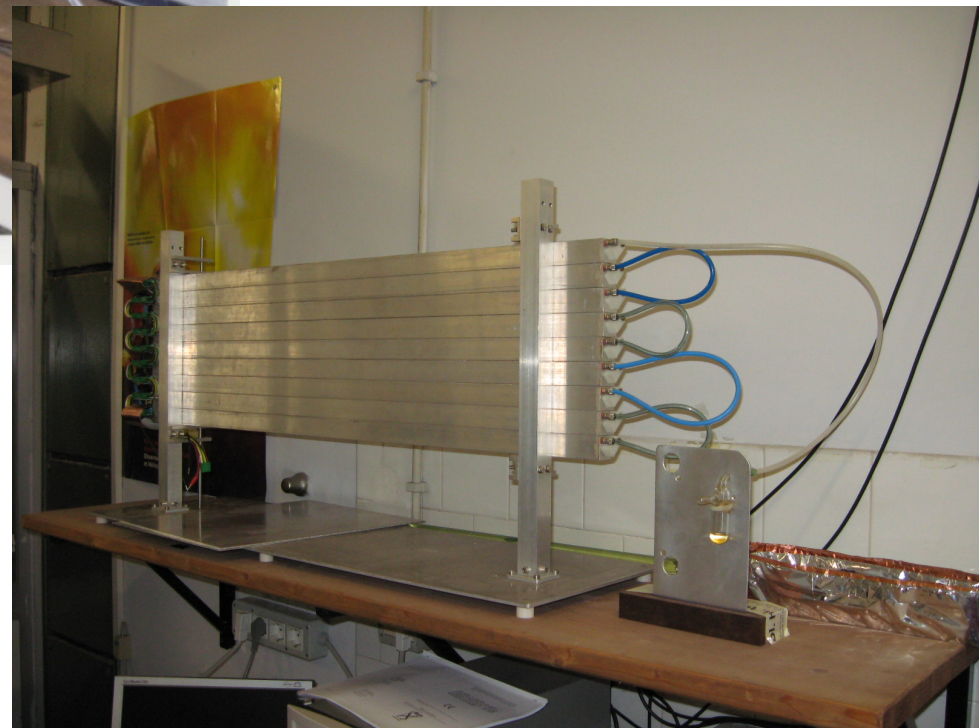
Gran Sasso

1999: square drift tubes for ICANOE test exp.



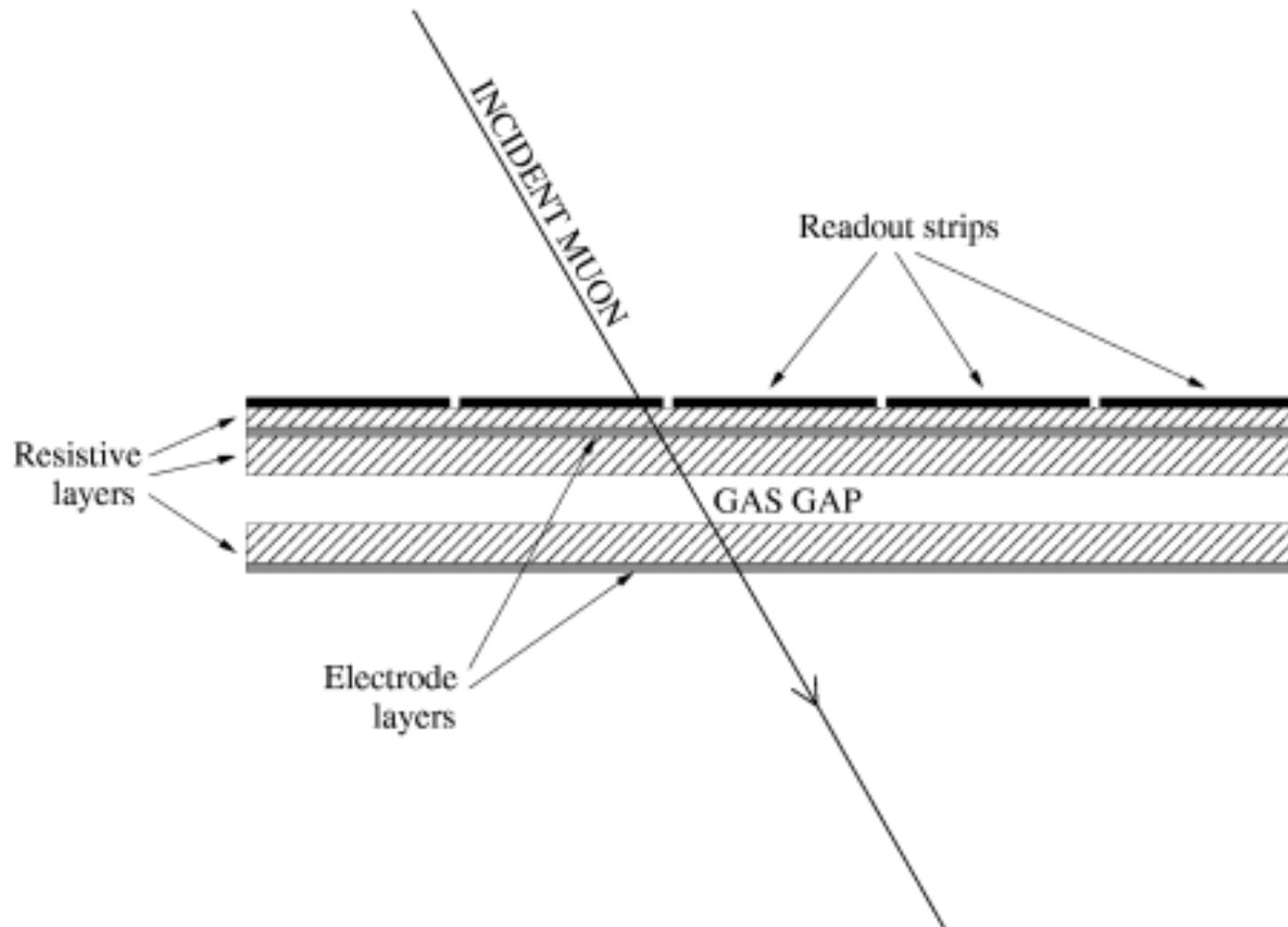
Prototype: 1m length

Spectrometer: 6 m length

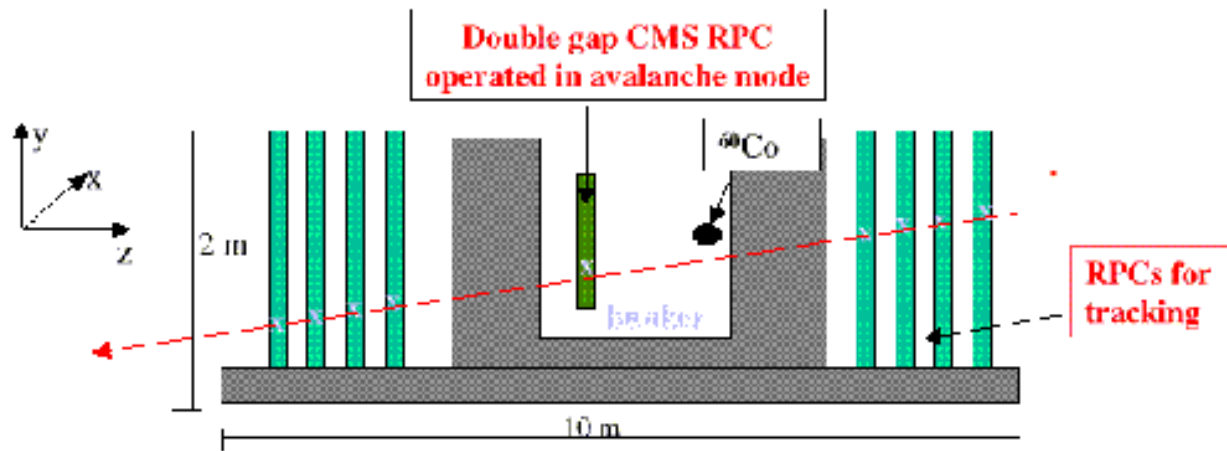


new development: resistive plane chamber (RPC)

single and double layer

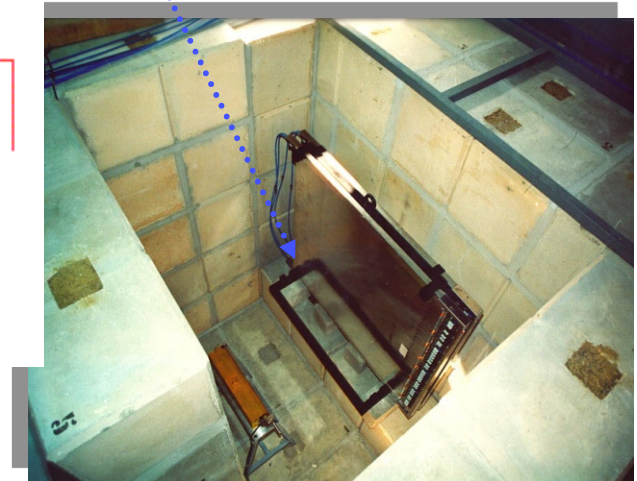
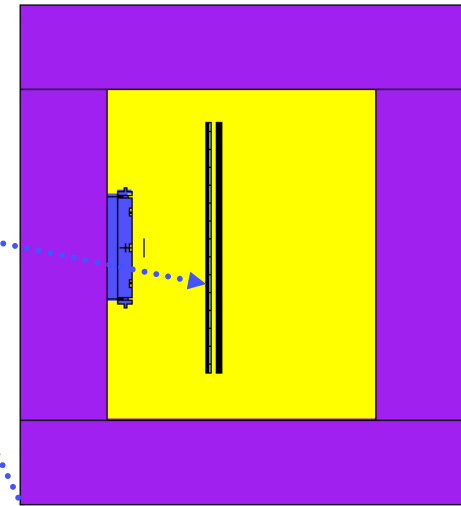


1998: aging test @ Bari



$$\sigma = 1 \text{ cm}$$

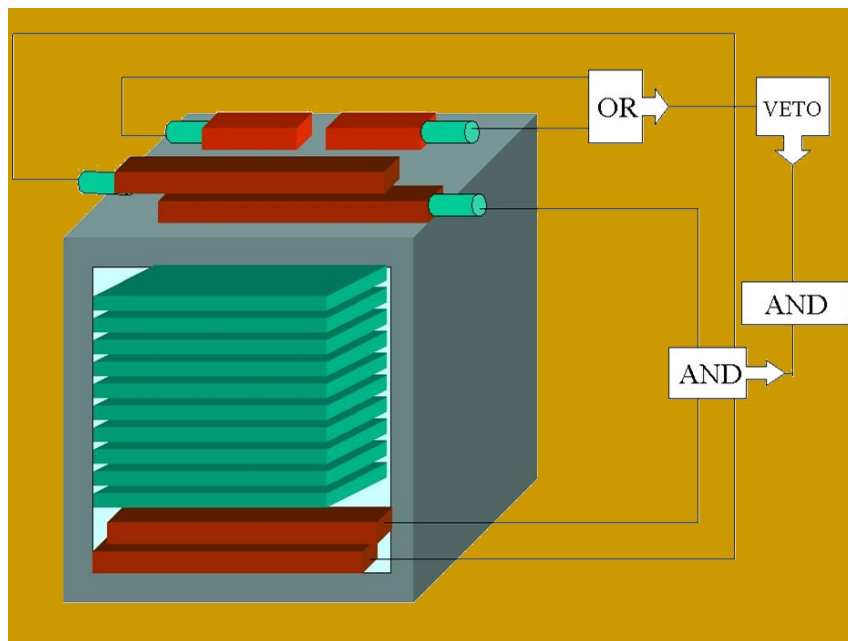
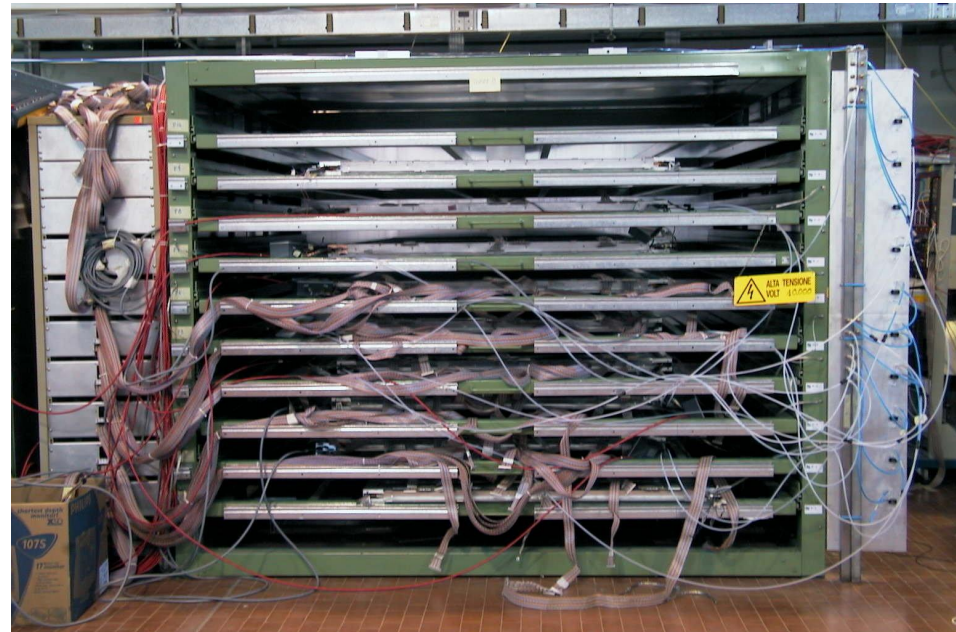
RPCs

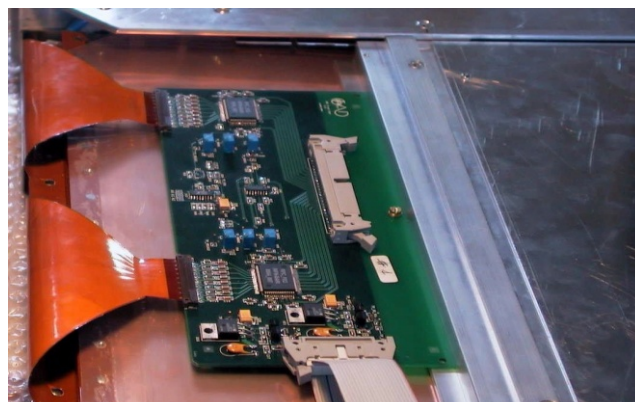


The new automatic tool for gluing the spacers

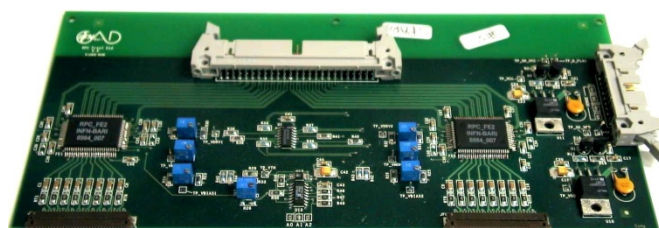


RPC telescope setting up for testing





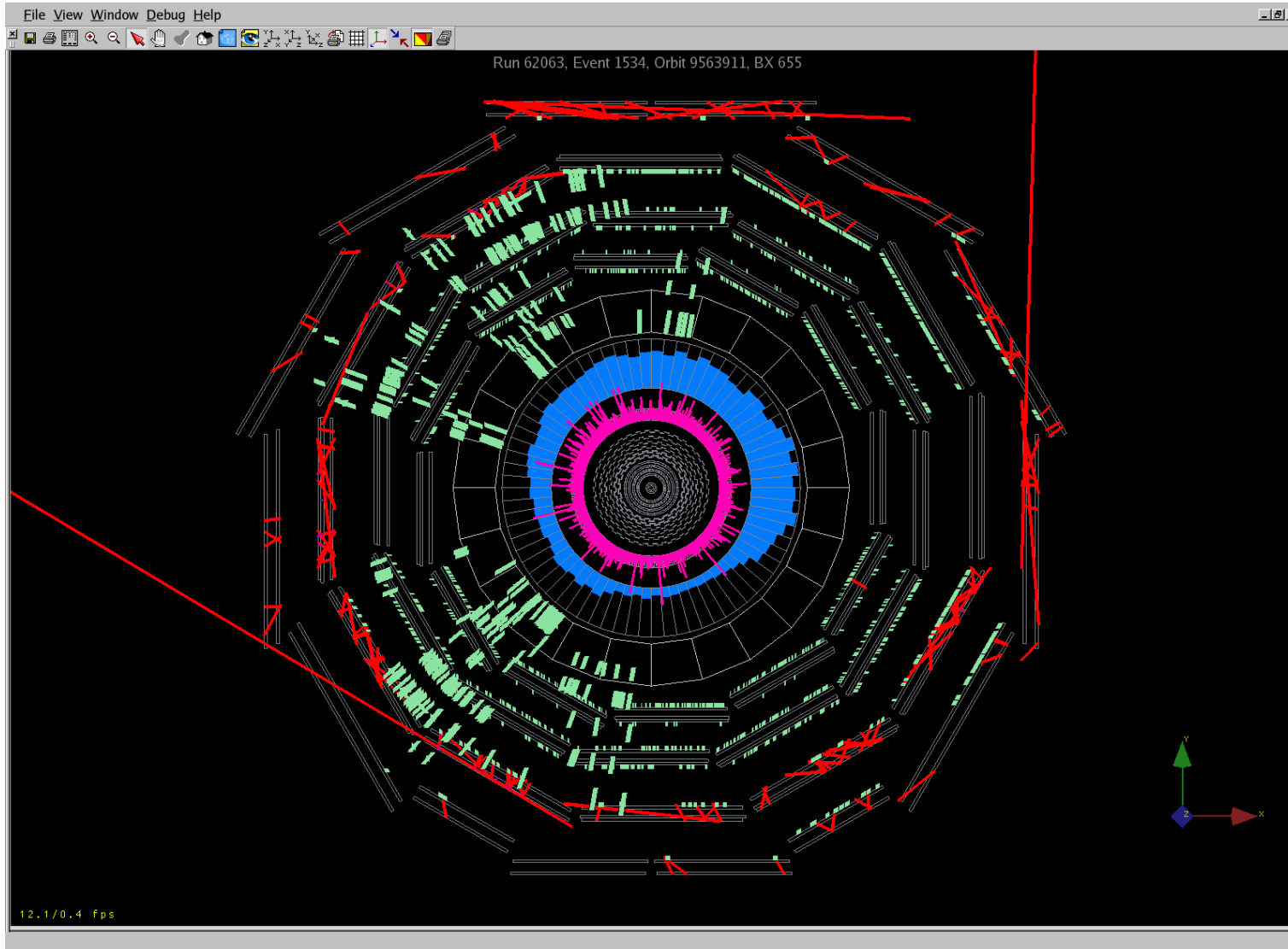
RPC chamber
assembly



CMS apparatus

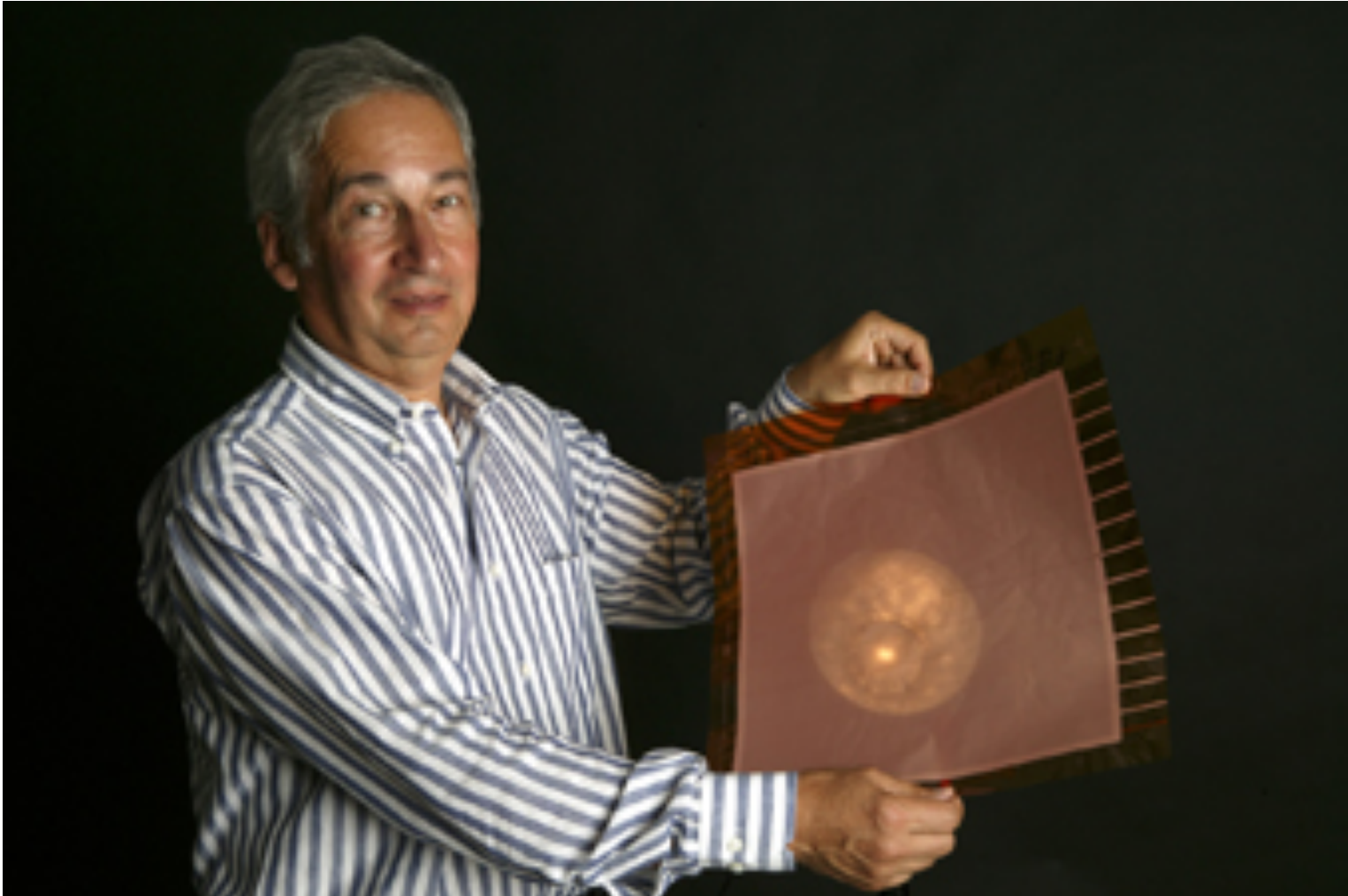


CMS event: really impressive!



recent developments:

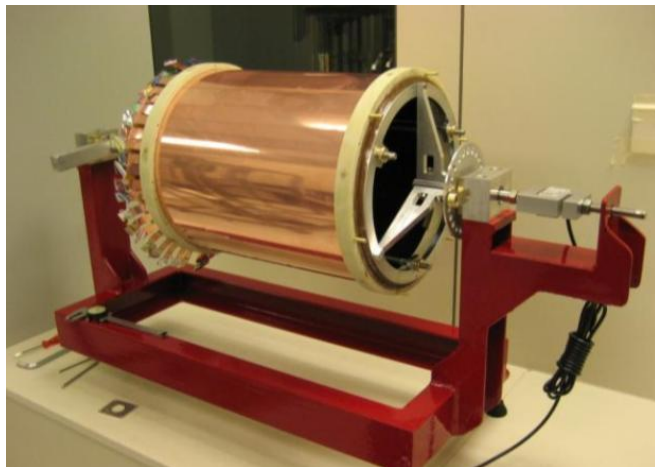
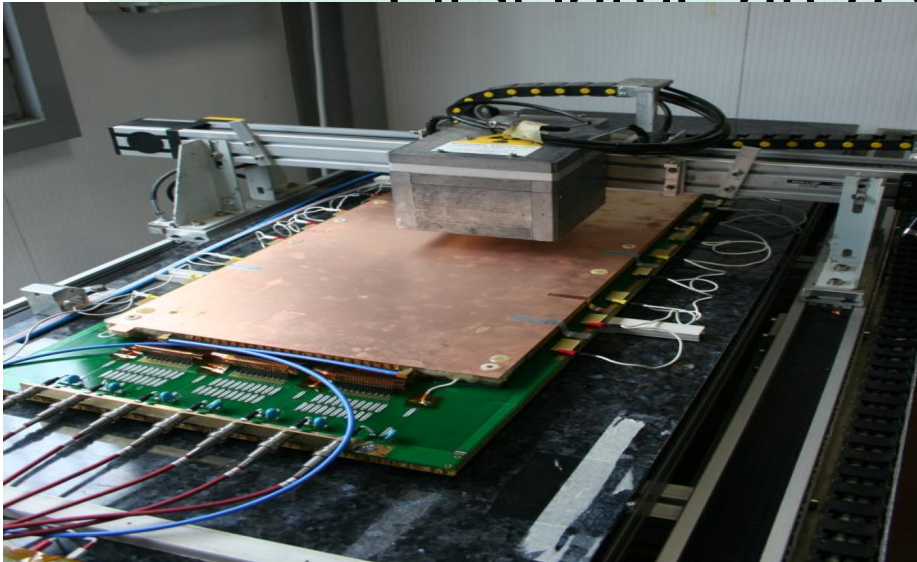
Fabio showing a GEM plane



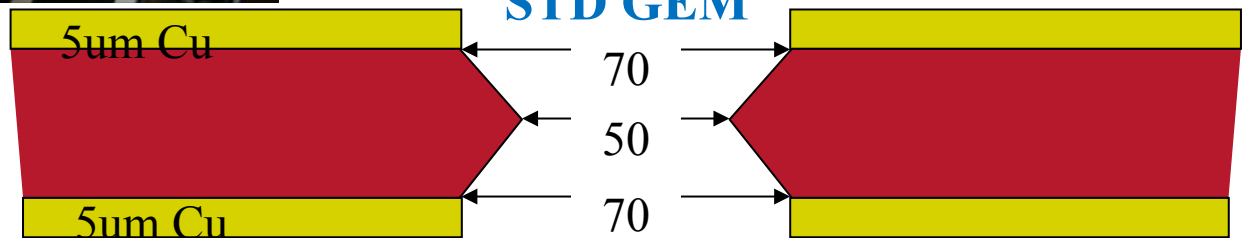
First large area GEM for KLOE2

300 x 700 cm²

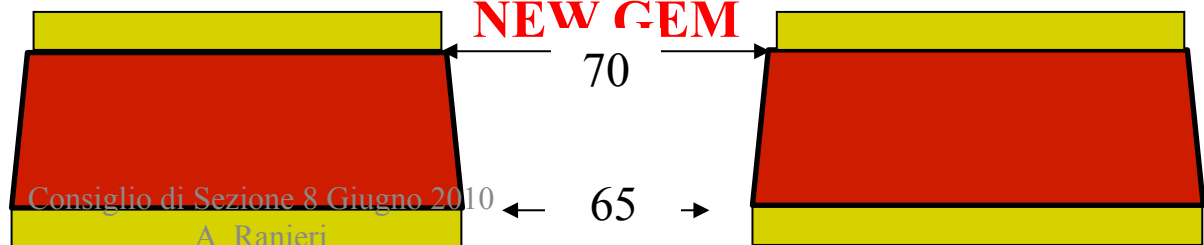
single mask technique



STD GEM



NEW GEM



Consiglio di Sezione 8 Giugno 2010

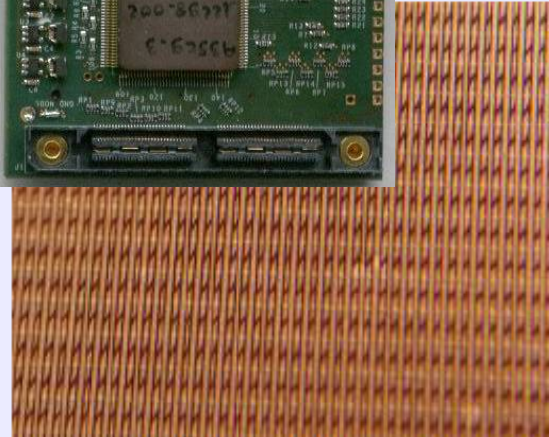
A. Ranieri

triple GEM planar chamber for KLOE2

I gerbers dei vari circuiti disegnati e discussi con il responsabile del Servizio Circuiti Stampati del CERN

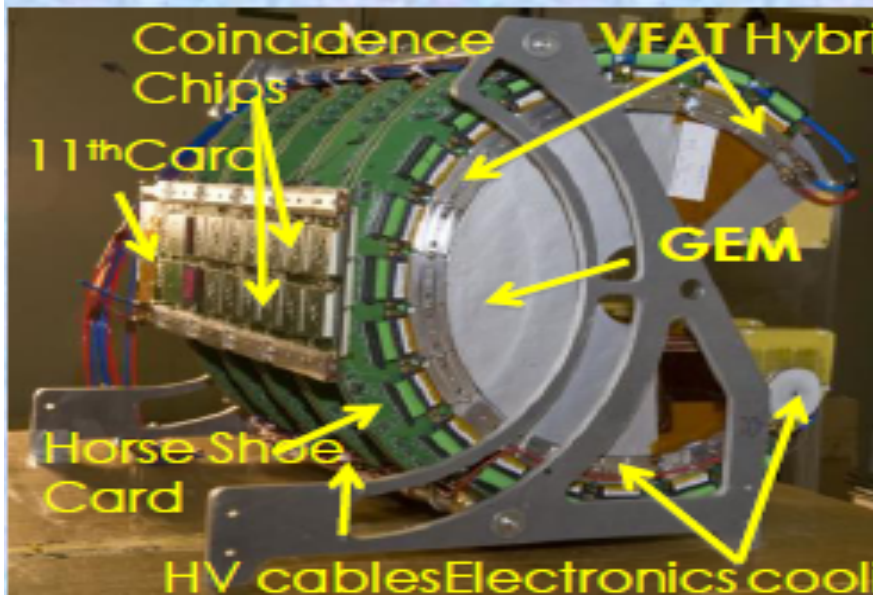
Le GEM, i cui primi sei prototipi ci sono stati consegnati a marzo, sono realizzati con la nuova tecnica di singola maschera.

Prototipo planare accoppiato con un piano di readout a strips XV pronto per essere equipaggiato con la versione del GASTONE64 finanziato dalla commissione a febbraio. Verrà letto con la catena finale e portato al fascio T9 del PS al CERN a ottobre.

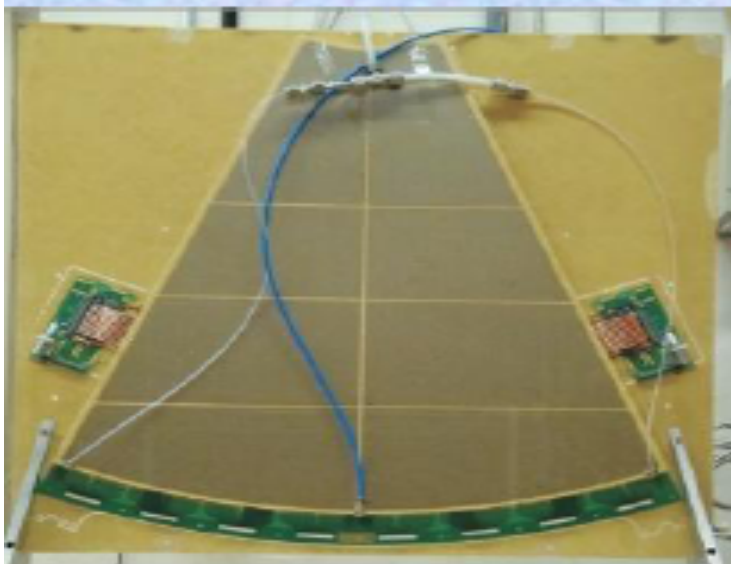
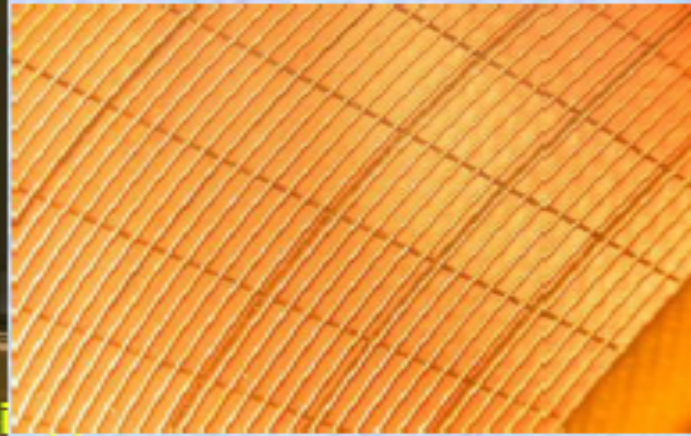


I circuiti stampati dei piani anodici, delle segmentazioni HV dei catodi e delle GEM e il FEE basato sul nuovo chip GASTONE64, sono responsabilità di Bari

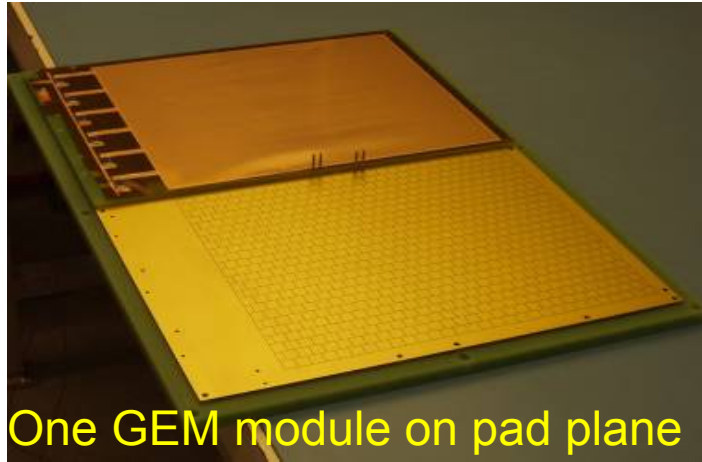
TOTEM GEMs:



**2D readout
(strips & pads)**



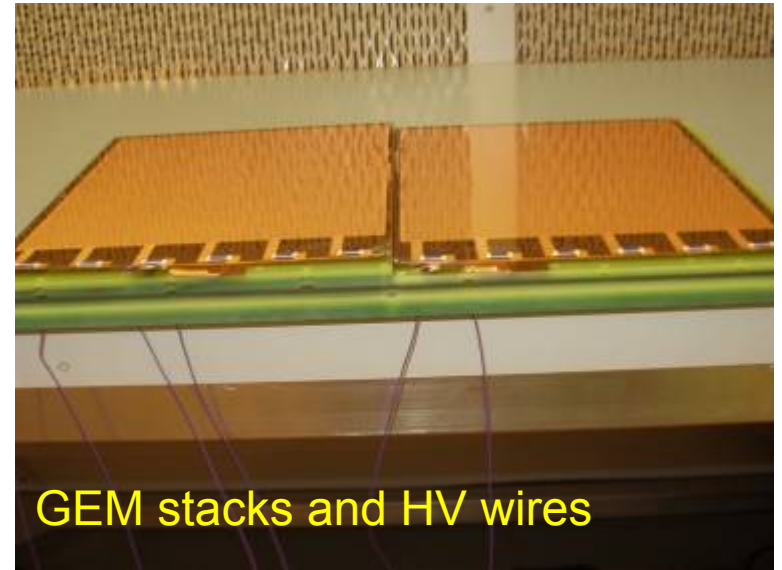
HARP first double GEM



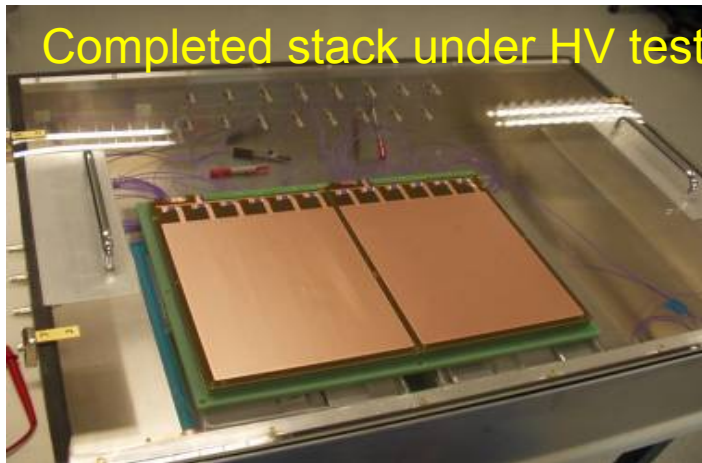
One GEM module on pad plane



GEMs being fixed with the guard ring



GEM stacks and HV wires



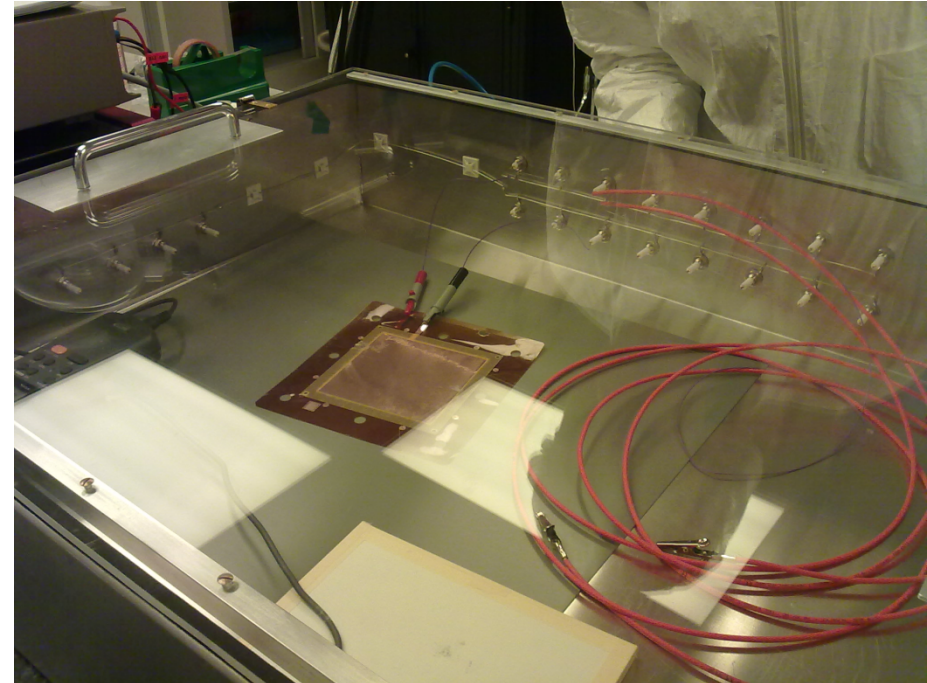
Completed stack under HV test



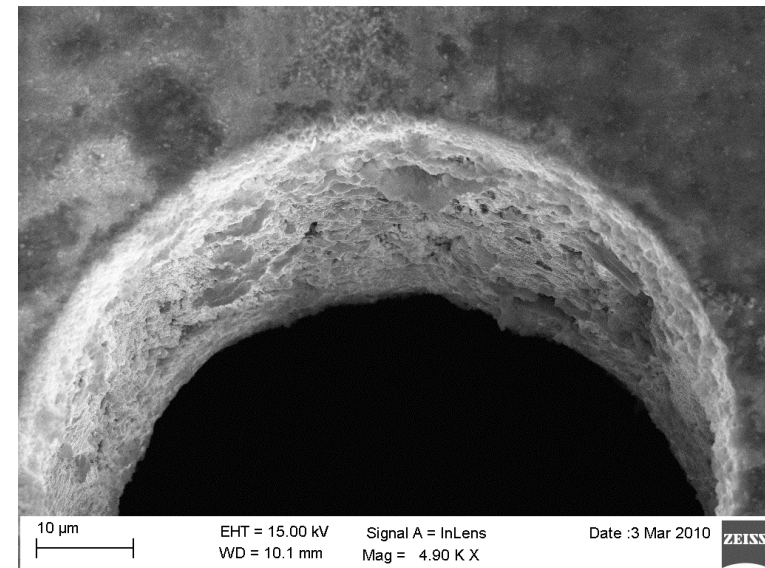
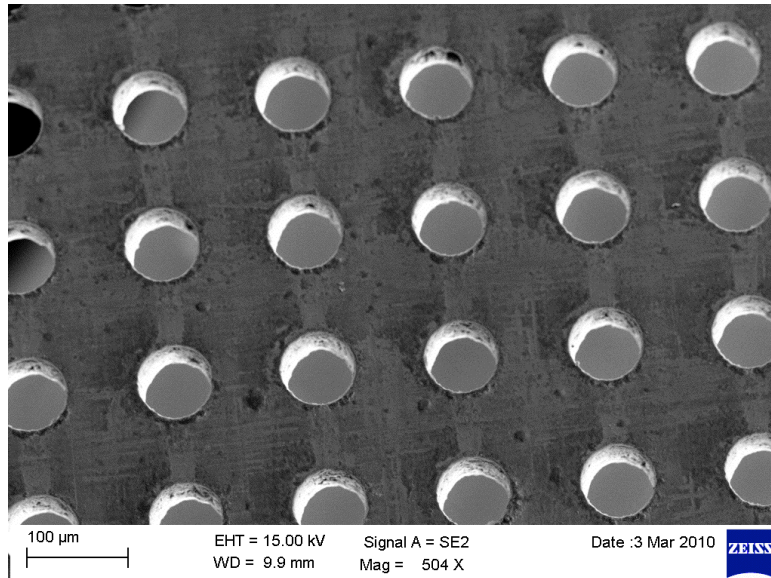
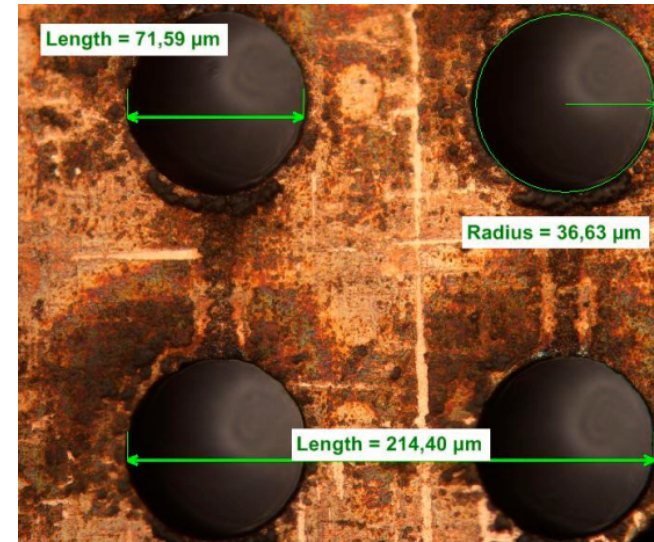
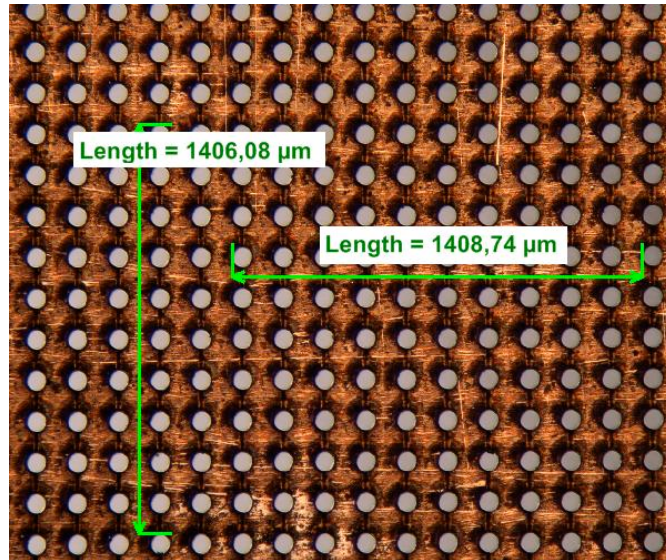
GEM Bari activity 2009-2010

lab for GEM e MM
in clean room

- gas mixture study
- prototype characterization

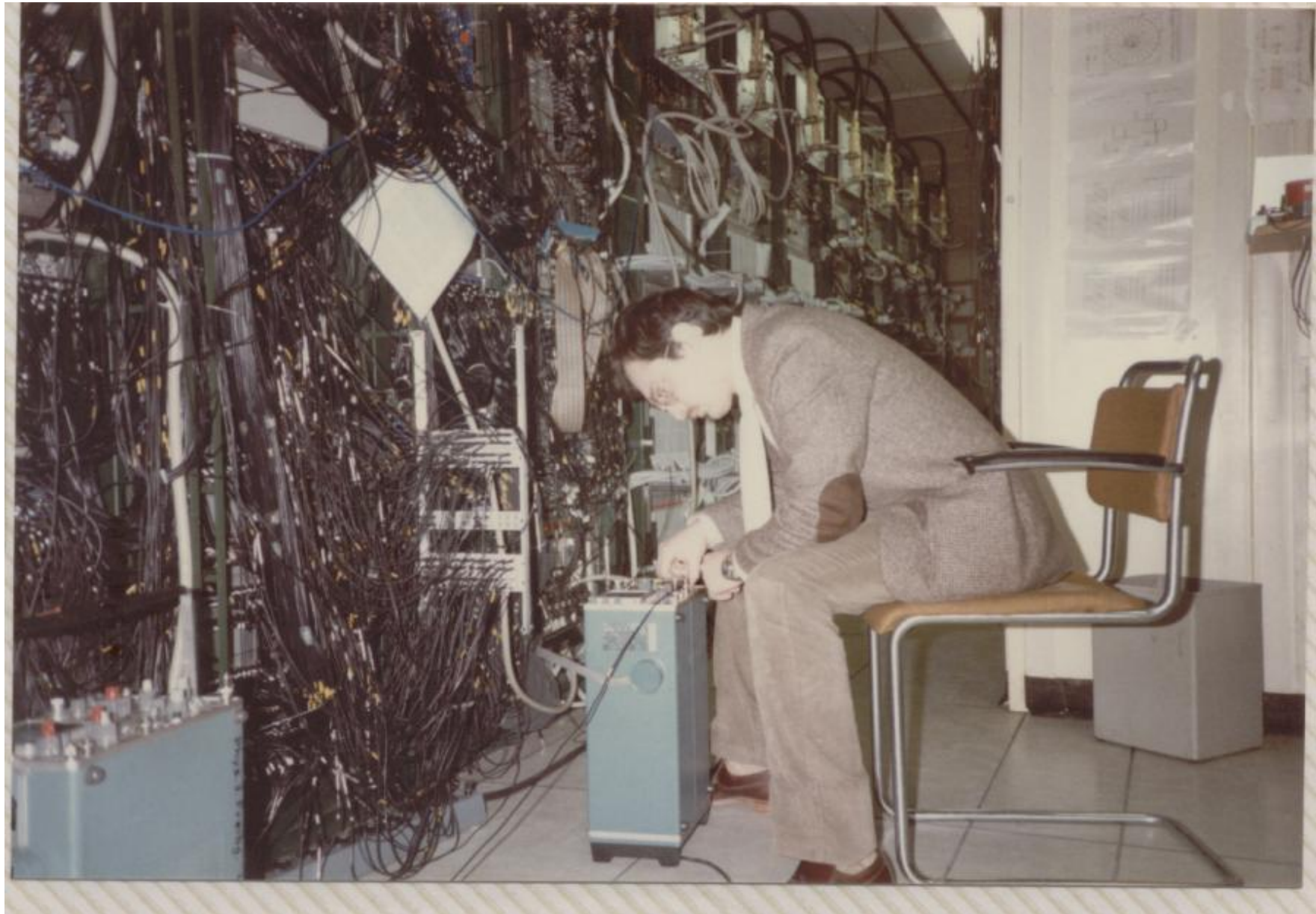


Laser technique: very good job!

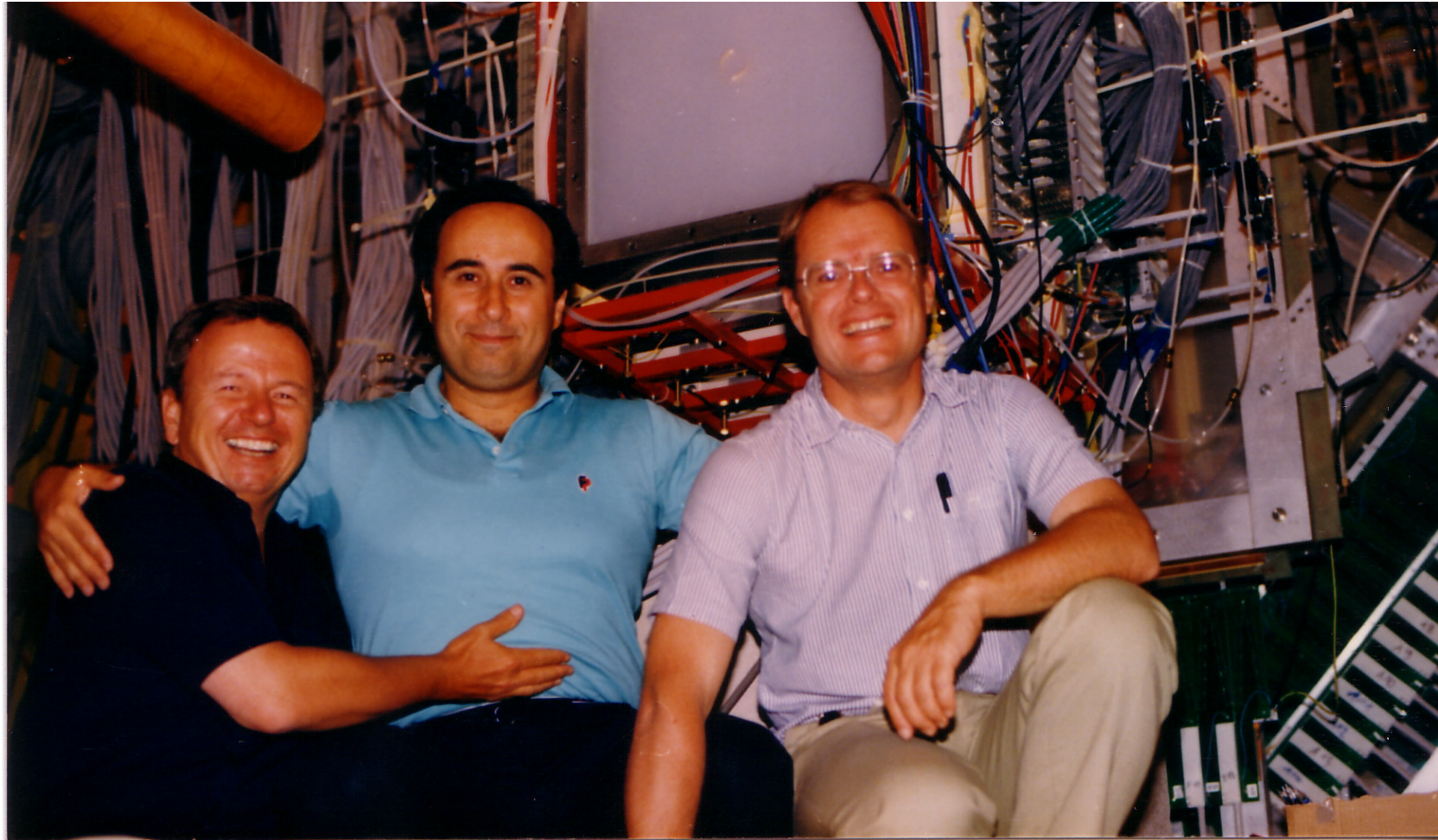


Now I must approach to the
conclusions...

The physicist's life is **not easy**, especially **in labs**, but...



...but (believe me) it keeps them in good shape!



thank you !