Georges Charpak

8.3.1924-29.9.2010

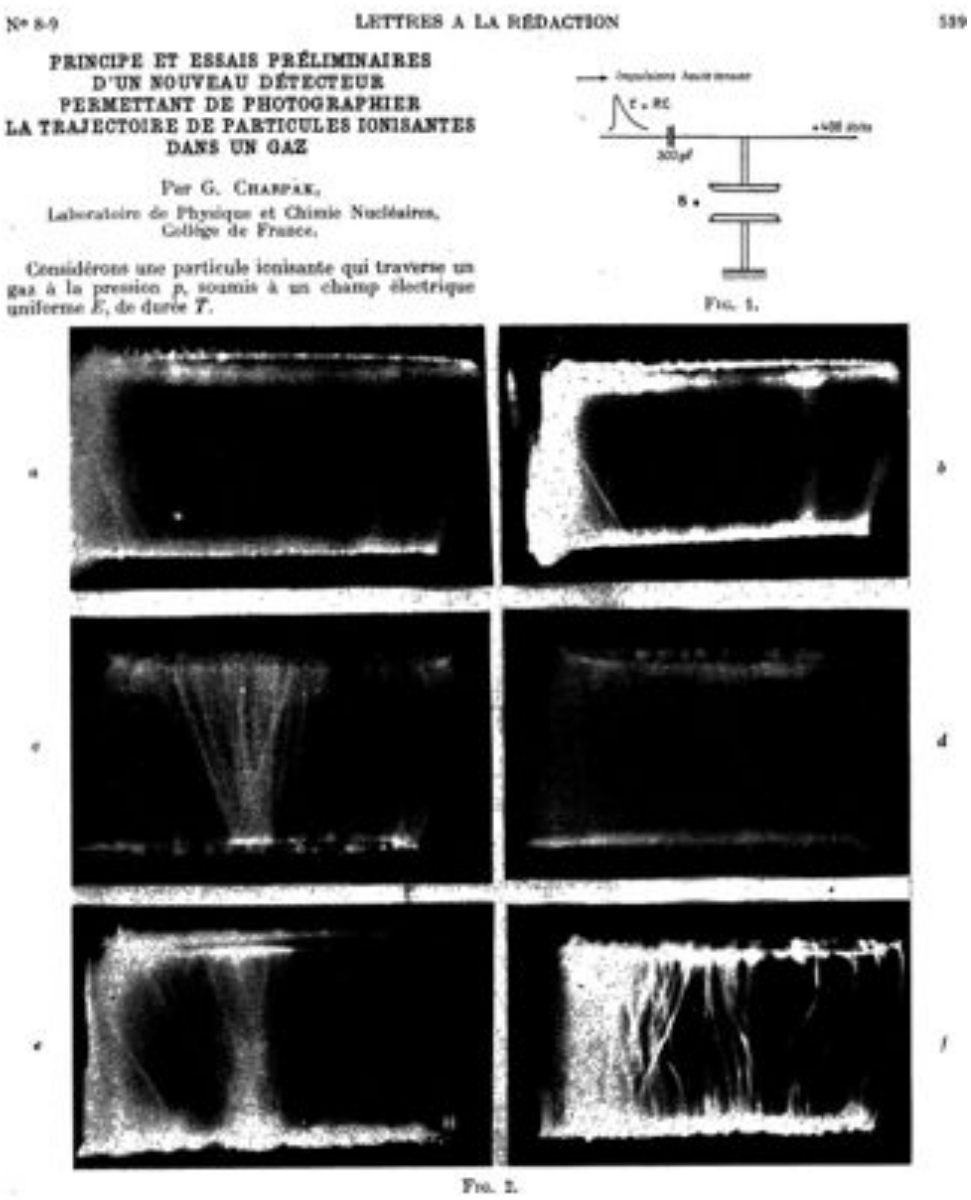
A TRIBUTE TO GEORGES CHARPAK

Fabio Sauli
TERA Foundation and CERN, Geneva, Switzerland
Editor, Nuclear Instruments and Methods Sect. A

1957: CHARPAK'S EARLY WORKS ON GAS DISCHARGES

Journal de Physique et le Radium
Lettres a la Rédaction

OPTICAL SPARK CHAMBERS:
S. Fukui and S. Myamoto, A new type of particle detector: the discharge chamber, Nuovo Cimento 11 (1959) 113.



N° 8-9 LETTRES A LA RÉDACTION 539

PRINCIPE ET ESSAIS PRÉLIMINAIRES D'UN NOUVEAU DÉTECTEUR PERMETTANT DE PHOTOGRAPHIER LA TRAJECTOIRE DE PARTICULES IONISANTES DANS UN GAZ

Par G. CHARPAK,
Laboratoire de Physique et Chimie Nucléaires, Collège de France.

Considérons une particule ionisante qui traverse un gaz à la pression p, soumis à un champ électrique uniforme E, de durée T.

FIG. 1.

FIG. 2.

1968: MULTI-WIRE PROPORTIONAL CHAMBER (MWPC)

NUCLEAR INSTRUMENTS AND METHODS 62 (1968) 262–268; © NORTH-HOLLAND PUBLISHING CO.

THE USE OF MULTIWIRE PROPORTIONAL COUNTERS TO SELECT AND LOCALIZE CHARGED PARTICLES

G. CHARPAK, R. BOUCLIER, T. BRESSANI, J. FAVIER and Č. ZUPANČIČ

CERN, Geneva, Switzerland

Received 27 February 1968

Properties of chambers made of planes of independent wires placed between two plane electrodes have been investigated. A direct voltage is applied to the wires. It has been checked that each wire works as an independent proportional counter down to separations of 0.1 cm between wires.

Counting rates of 10^6/s/cm are easily reached; time resolutions of the order of 100 nsec have been obtained in some cases; it is possible to measure the position of the tracks between the wires using the time delay of the pulses; energy resolution comparable to the one obtained with the best cylindrical chambers is observed; the chambers operate in strong magnetic fields.

1. Introduction

Proportional counters with electrodes consisting of many parallel wires connected in parallel have been used for some years, for special applications. We have investigated the properties of chambers made up of a plane of independent wires placed between two plane electrodes. Our observations show that such chambers offer properties that can make them more advantageous than wire chambers or scintillation hodoscopes for many applications.

2. Construction

Wires of stainless steel, 4×10^{-3} cm in diameter, are stretched between two planes of stainless-steel mesh, made from wires of 5×10^{-3} cm diameter, 5×10^{-1} cm apart. The distance between the mesh and the wires is 0.75 cm. We studied the properties of chambers with wire separation $a = 0.1$, 0.2, 0.3 and 1.0 cm. A strip of metal placed at 0.1 cm from the wires, at the same potential (fig. 1), plays the same role as the guard rings is cylindrical proportional chambers. It protects the wires against breakdown along the dielectrics. It is

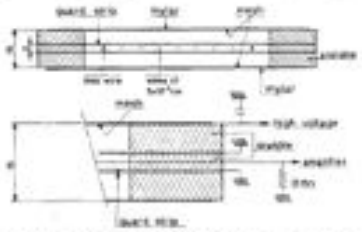


Fig. 1. Some details of the construction of the multiwire chambers.
A copper shield protects the wires at their output from the chamber and contains the solid state amplifiers.

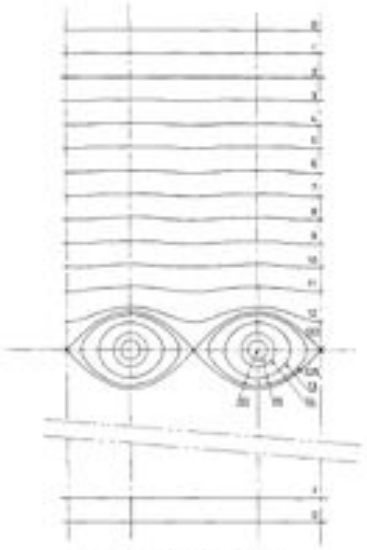
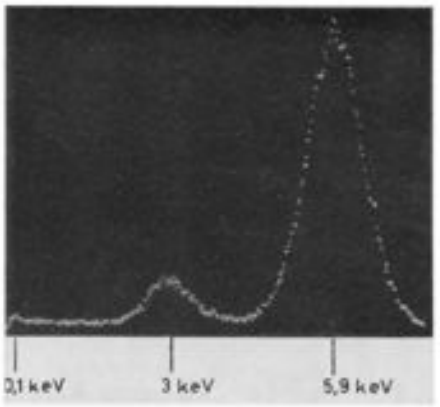
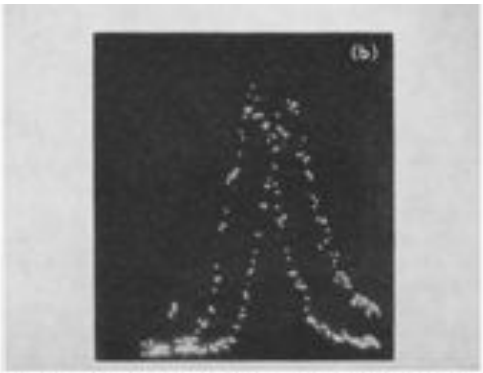


Fig. 2. Equipotentials in a chamber.
Wires of 4×10^{-3} cm diameter, 0.3 cm separation, and 1.5 cm total thickness. 20 V applied between the wires and the external mesh. Results from an analogic method.

ENERGY RESOLUTION ON 5.9 KeV



DEPENDENCE OF COLLECTION TIME FROM TRACK DISTANCE



G. Charpak,R. Bouclier, T. Bressan,J. Favier and C. Zupancic: The use of Multiwire Proportional Counters to select and localize Charged Particles, Nuc. Instr. and Meth. 62(1968)262

FIRST PUBLIC PRESENTATION OF THE MWPC

colloque international sur l'électronique nucléaire

VERSAILLES, 10-13 September 1968

*

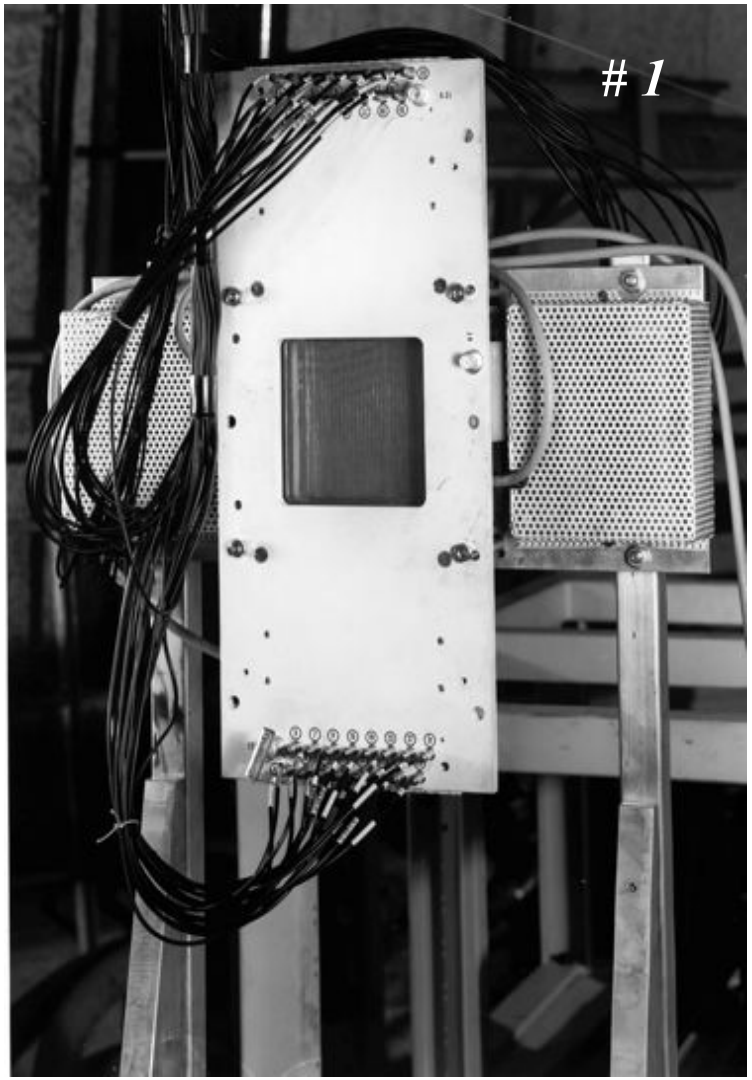
international symposium on nuclear electronics

Chambres à Etincelles

Spark chambers

Rapporteur Reporter — **M. CHARPAK** CERN - GENEVE (Suisse)

Secrétaire scientifique Scientific Secretary — **M. FEUVRAIS** Faculté des Sciences - Lyon (France)



VERSAILLES 1968: MY FIRST CONGRESS

WIRE SPARK CHAMBERS WITH MAGNETOSTRICTIVE READOUT

USE OF WIRE SPARK CHAMBERS WITH MAGNETOSTRICTIVE READ-OUT IN A SCATTERING EXPERIMENT AT THE CERN PROTON SYNCHROTRON

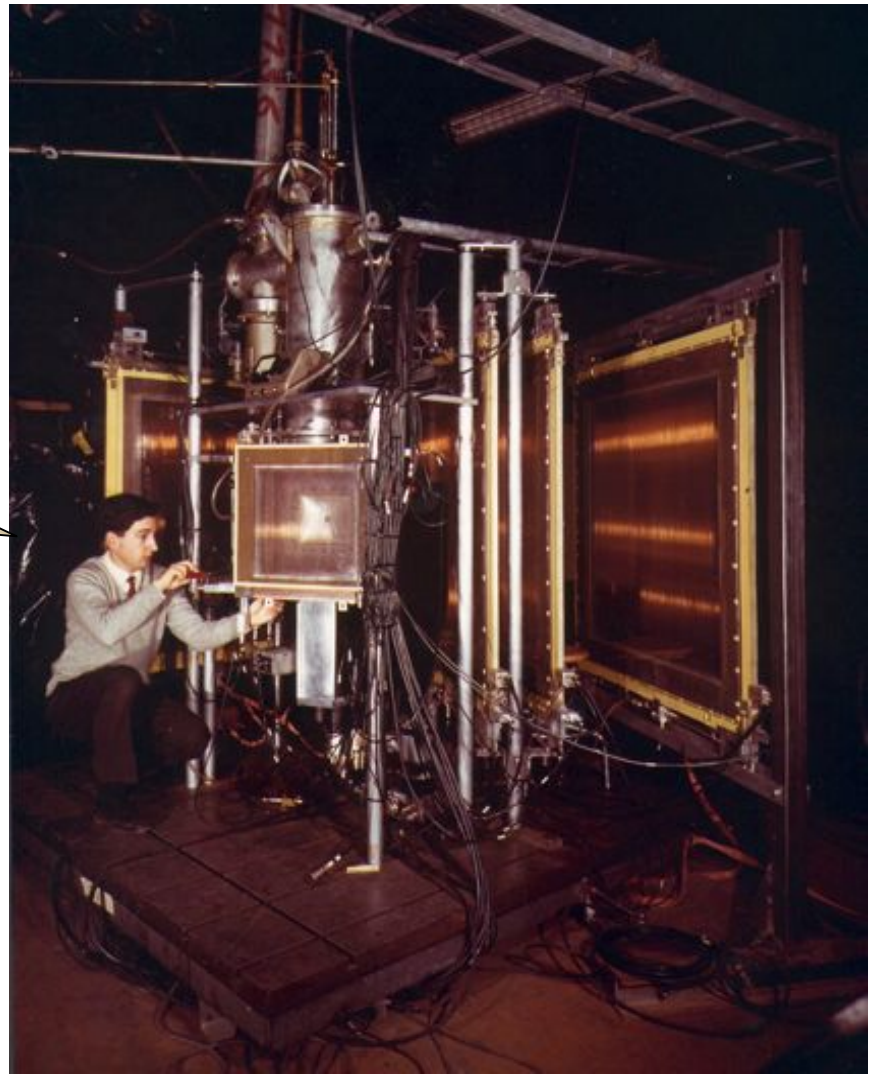
F. Bradamante, S. Conetti, G. Fidecaro,
M. Fidecaro, M. Giorgi, A. Penzo, L. Piemontese,
F. Sauli and P. Schiavon

University of Trieste High-Energy Group and CERN

(presented by F. Sauli)

SUMMARY

The main features of the experimental set-up used in the measurement of the pion-deuteron elastic scattering at large momentum transfer are described; nine wire spark chambers with magnetostrictive read-out have been used to reconstruct the geometry of each event. The recording logic was able to handle a total of 34 coordinates, coming out of the 23 reading lines used. Precision and efficiency of this system are discussed.



1971: LARGE SIZE MWPC

THE PROBLEM OF FRONT-END ELECTRONICS: SMALL SIGNALS (mV)

SYSTEMATIC GAS FILLING STUDIES

R. Bouclier, G. Charpak, Z. Dimcovski, G. Fisher, F. Sauli, G. Coignet and G. Flügge: Investigation of some properties of Multiwire Proportional Chambers, Nucl. Instr. and Meth. 88(1970)149

THE MAGIC GAS:

ADDITION OF FREON CF_3Br TO ARGON-ISOBUTANE ALLOWS TO REACH VERY LARGE, SATURATED GAINS

Increasing HV

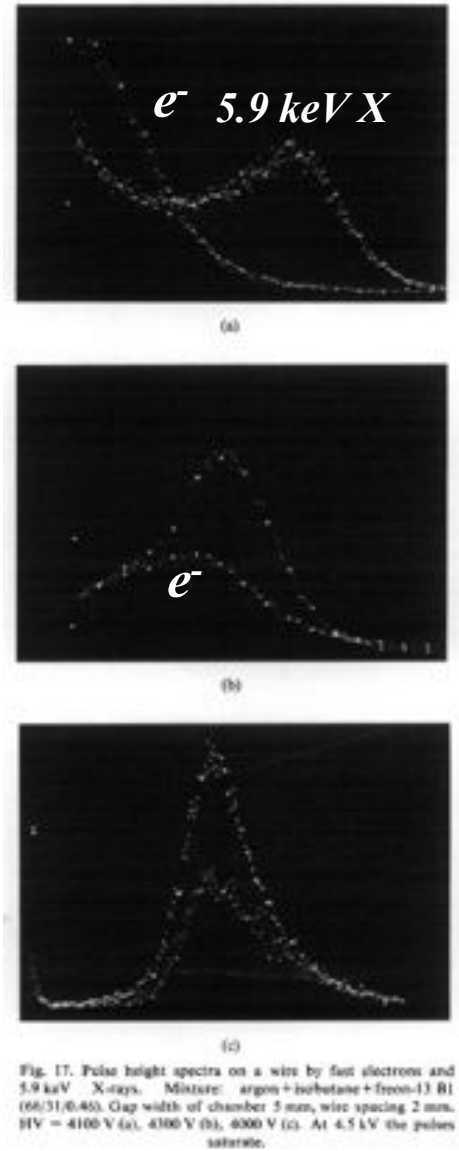
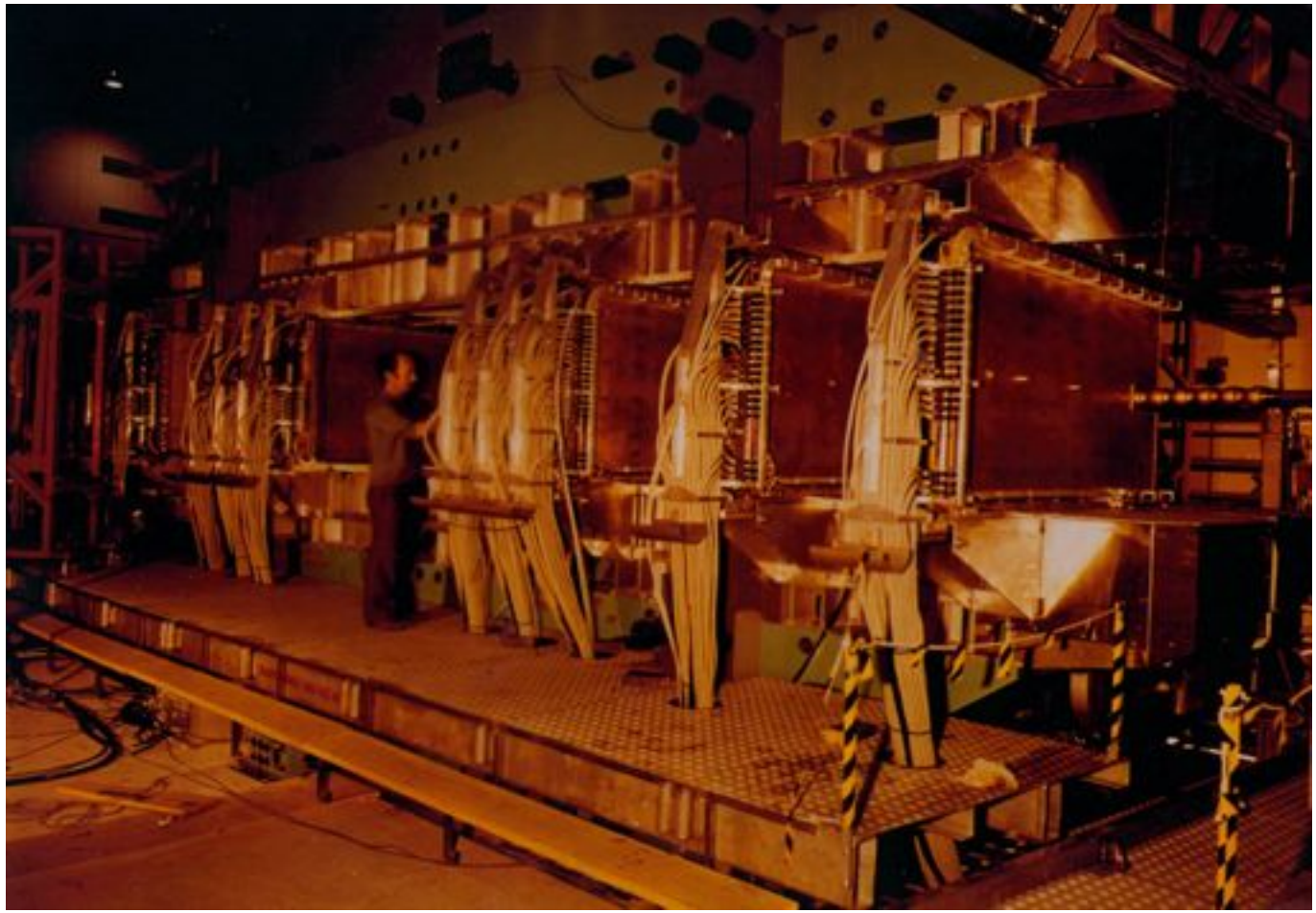
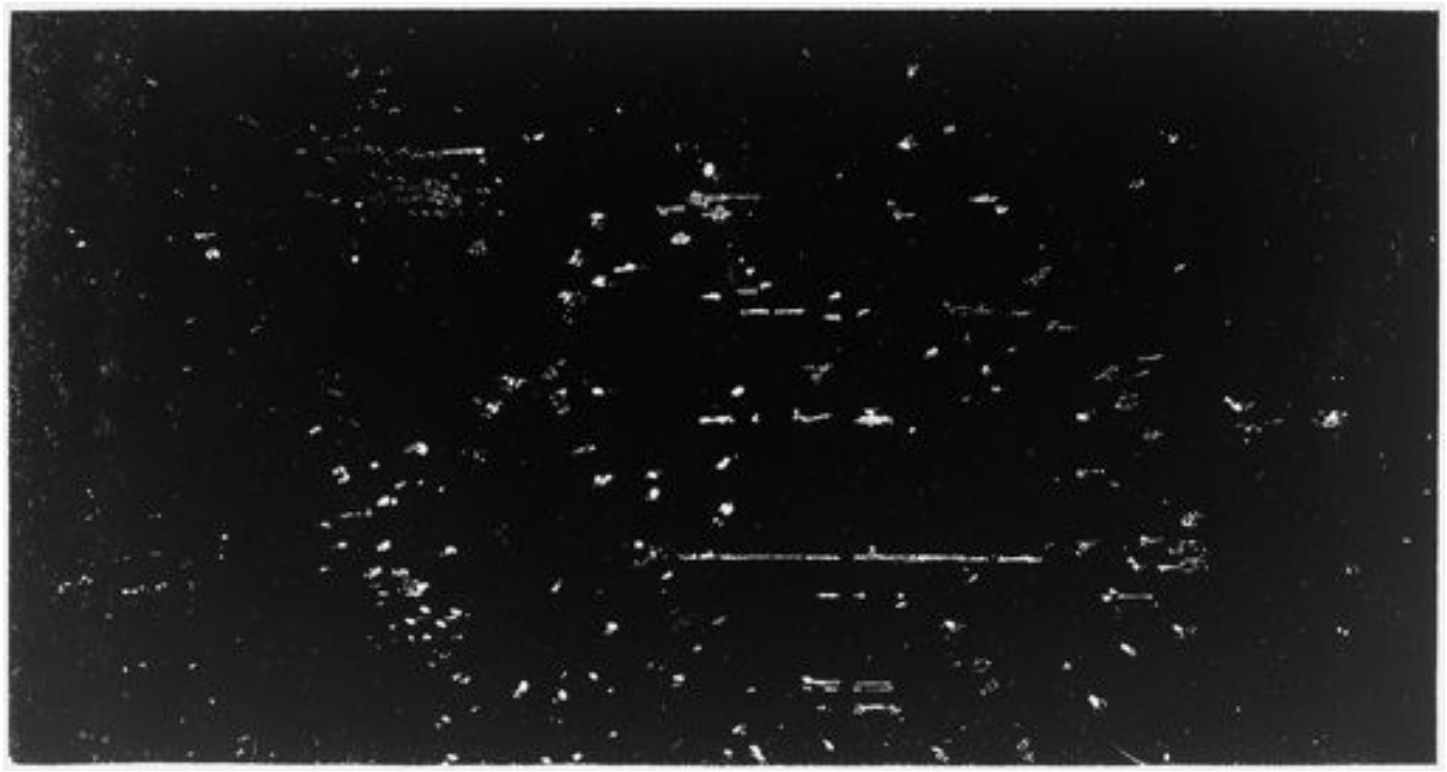


Fig. 17. Pulse height spectra on a wire by fast electrons and 5.9 keV X-rays. Mixture: argon + isobutane + freon-13 B1 (66/31/0.45). Gap width of chamber 5 mm, wire spacing 2 mm. HV = 4100 V (a), 4300 V (b), 4000 V (c). At 4.5 kV the pulses saturate.

1972-1983: SPLIT FIELD MAGNET DETECTOR
40 LARGE AREA MWPCs AT CERN ISR



UNFORTUNATE CONSEQUENCES OF LARGE GAINS: LOCALIZED DISCHARGES AND AGING



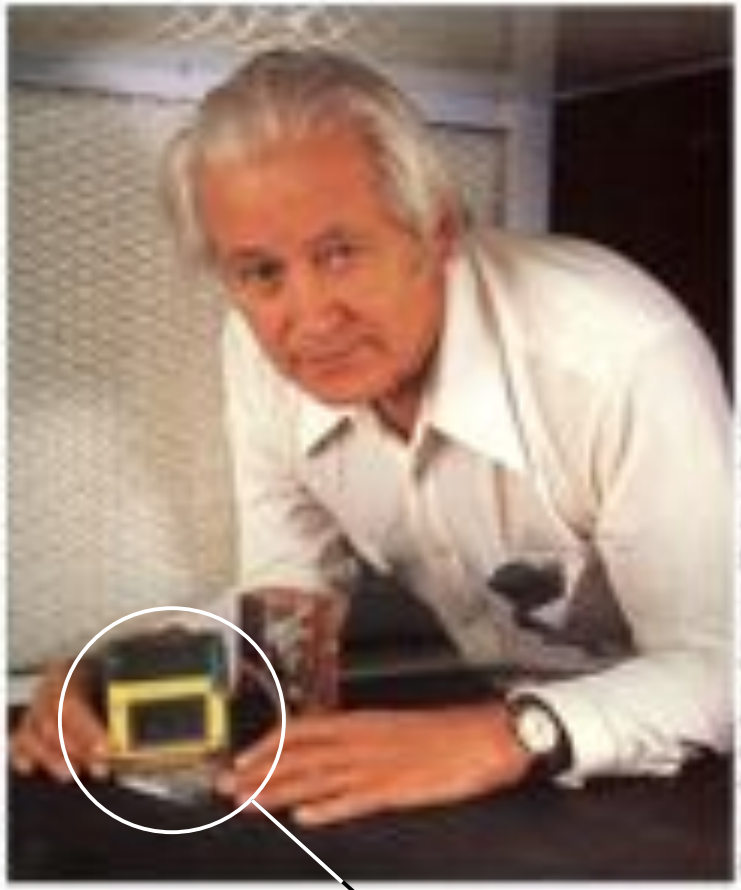
FIRST OPTICAL IMAGING PROPORTIONAL CHAMBER?

1973: GEORGES WITH A SMALL HIGH ACCURACY DRIFT CHAMBER PROTOTYPE

The Nobel Prize in Physics 1992

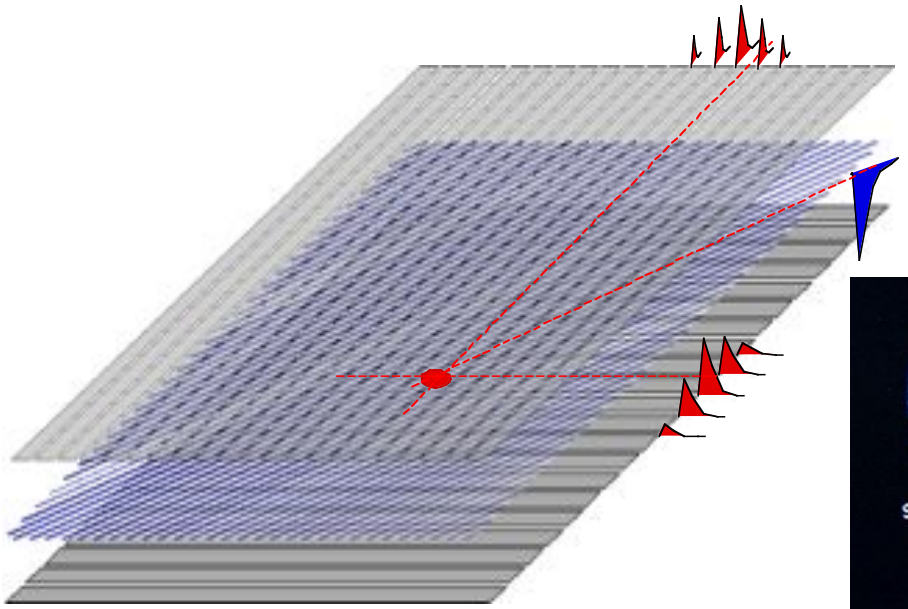
The Royal Swedish Academy of Sciences awards the 1992 Nobel Prize in Physics to **Georges Charpak** for his invention and development of particle detectors, in particular the multiwire proportional chamber.

Georges Charpak
CERN, Geneva, Switzerland

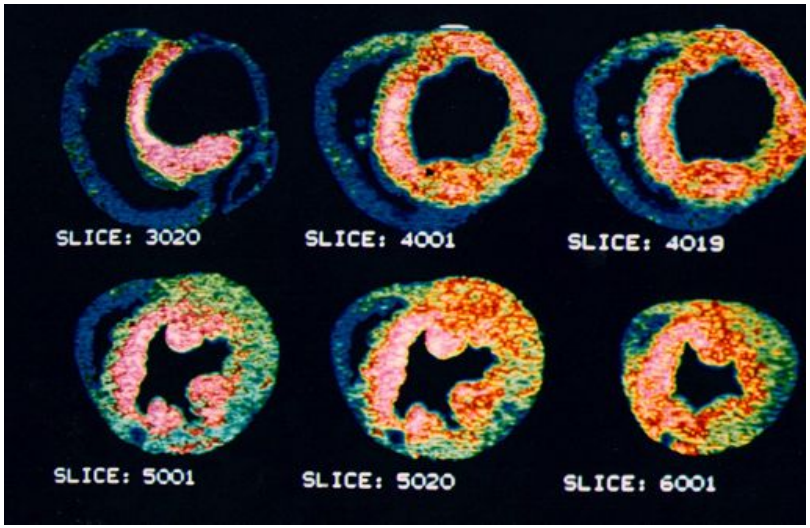


Small Prototype High Accuracy DC

1973: TWO-DIMENSIONAL MWPC READOUT CATHODE INDUCED CHARGE



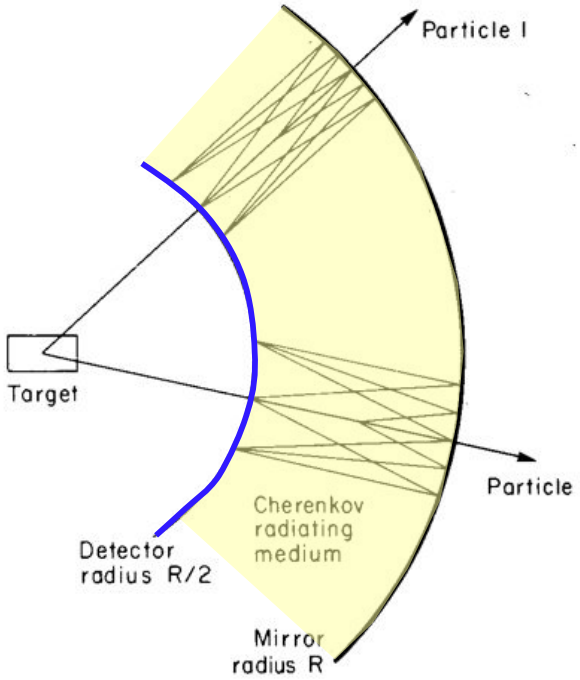
APPLICATIONS: RADIOCHROMATOGRAPHY

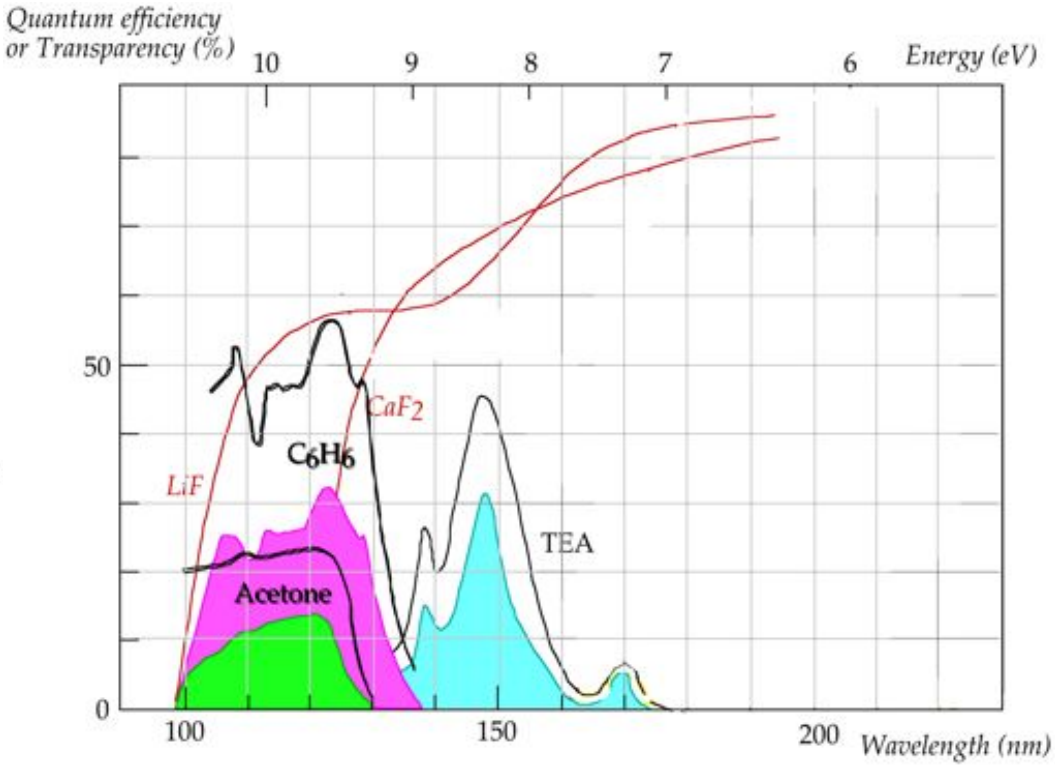


F. Angelini et al, Nucl. Instr. and Meth. A269(1988)430

G. Charpak and F. Sauli,
High-Accuracy, Two-Dimensional Readout in Multiwire Proportional Chambers
Nucl. Instr. and Meth. 113(1973)381

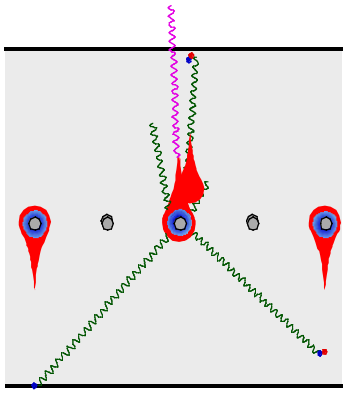
1976-77: CHERENKOV RING IMAGING FOR PARTICLE IDENTIFICATION

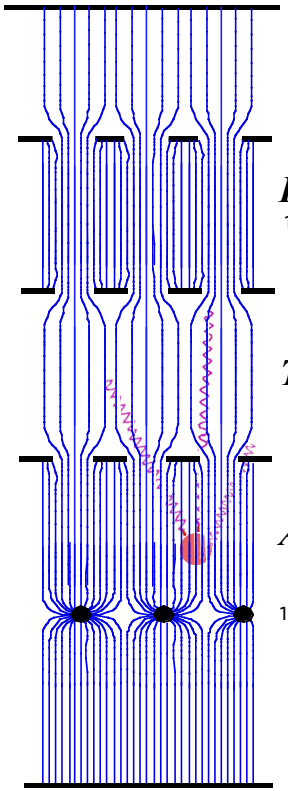




J. Seguinot and T. Ypsilantis, Photo-ionization and Cherenkov Ring Imaging, Nucl. Instr. and Meth.142 (1977) 377

THE PROBLEM OF SINGLE ELECTRON DETECTION IN PHOTOSENSITIVE GASES :





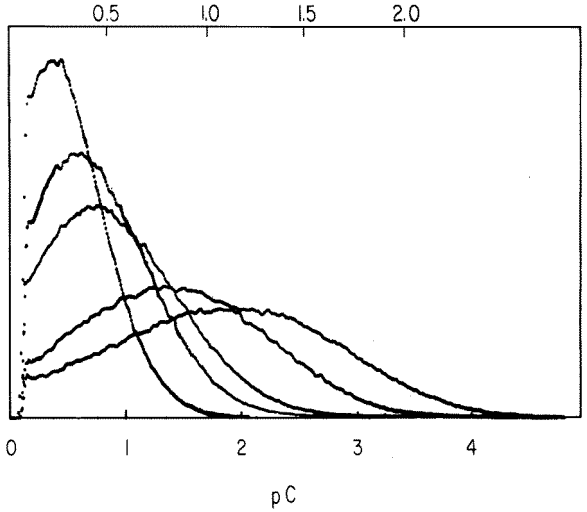
Preamplification (x 100)

Transfer (x 0.1)

Amplification (x 10^4)

TOTAL GAIN 10^5

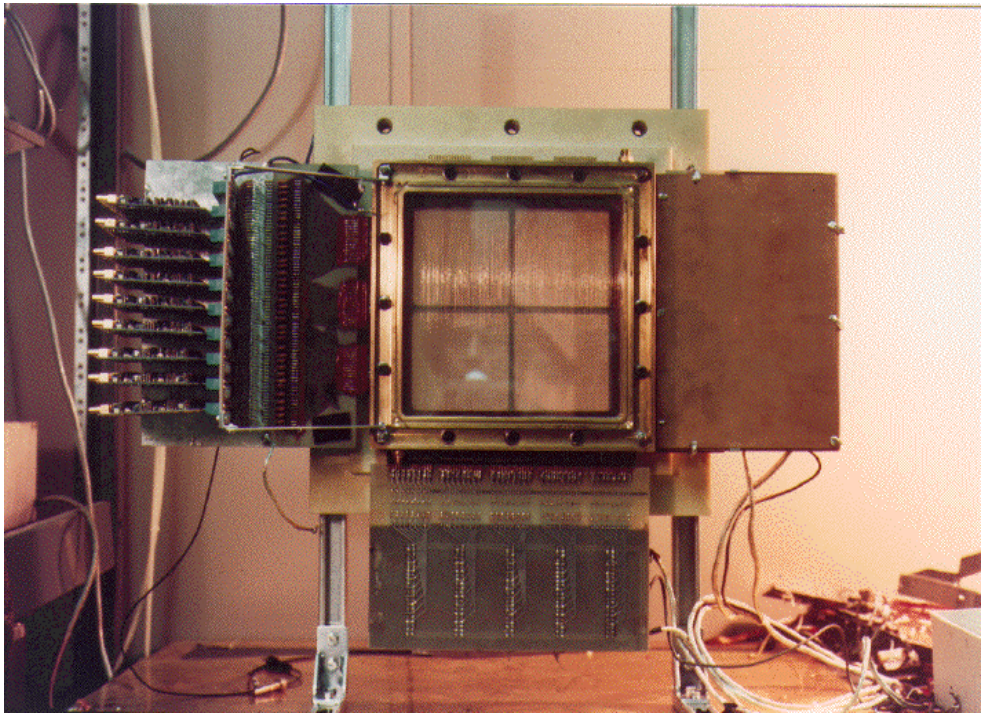
SINGLE PHOTOELECTRON PH SPECTRA:

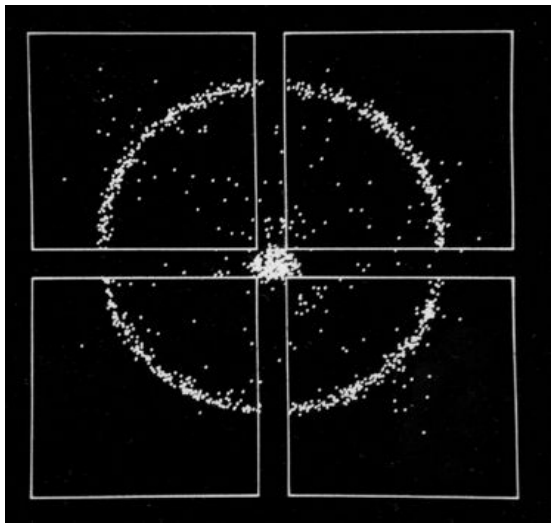


G. Charpak and F. Sauli,
The Multistep Avalanche Chamber: a new high-rate, high-accuracy gaseous detector
Phys. Letters 78B(1978)523

1979: THE FIRST GAS RICH

TRIETHILAMINE (TEA) PHOTOSENSITIVE VAPORS - CaF_2 WINDOWS - 2D MWPC



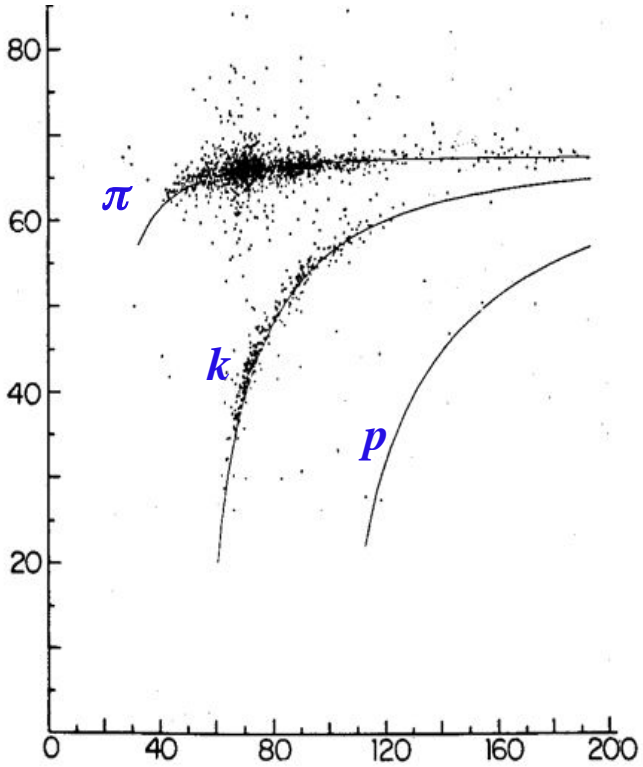


G. Charpak, S. Majewski, G. Melchart, F. Sauli and T. Ypsilantis: Detection of Far-Ultraviolet Photons with the Multistep Avalanche Chamber, Nucl. Instr. and Meth. 164(1979)419

MULTISTEP RICH CHAMBERS FOR E605

CERN-Columbia Univ.-FNAL-KEK- Saclay-SUNY -Washington University

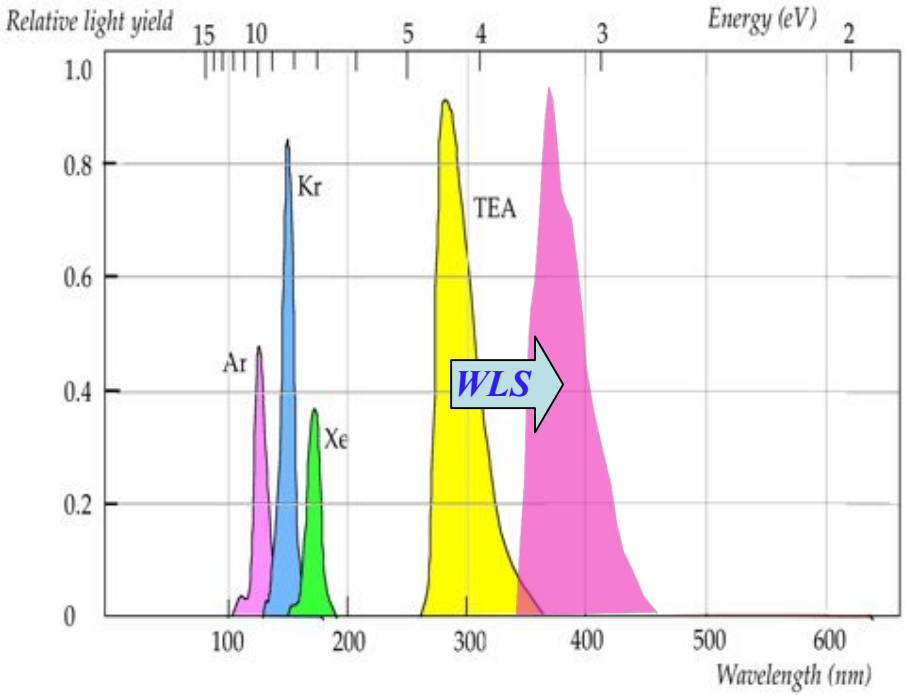
PARTICLE IDENTIFICATION:



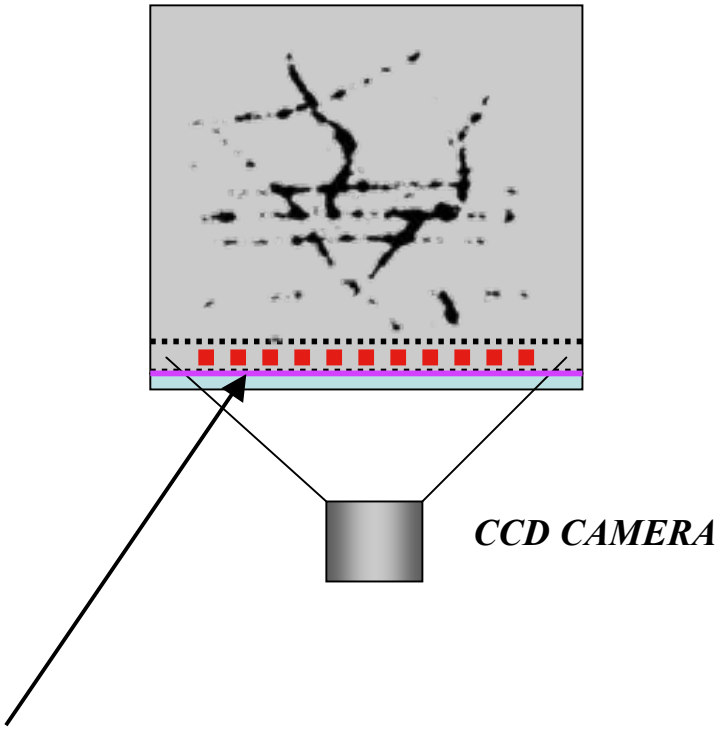
R. McCarthy, M. Adams, C. Brown, G. Coutrakon, G. Charpak, D. Finley, H. Glass, J.R. Hubbard, D. Jaffe, A. Jonckheere, H. Jöstlein, J. Kirz, Ph. Mangeot, A. Peisert, J.C. Santiard and F. Sauli: Identification of large-transverse-momentum hadrons using a ring-imaging Cherenkov counter, Nucl. Instr. and Meth. A248 (1986) 69

1987: OPTICAL TRACKS DETECTION: THE IMAGING CHAMBER

EMISSION SPECTRA OF AVALANCHES IN GASES:



MWPC OR AVALANCHE CHAMBER



THIN-FOIL WAVELENGTH SHIFTER:

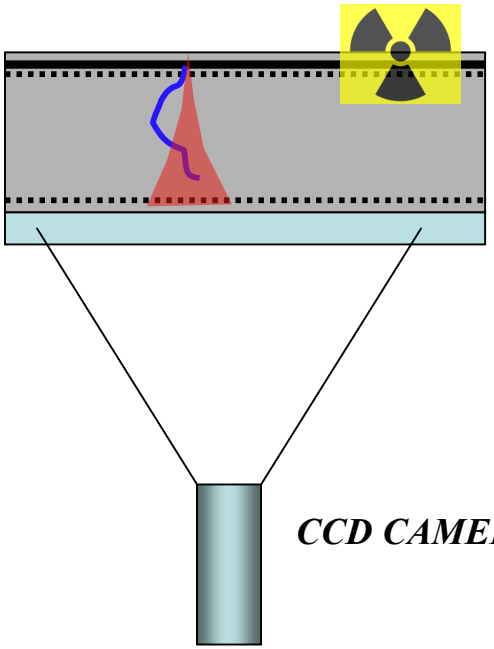
C. Aurouet, H. Blumenfeld, M. Bourdinaud, V. Jeanney, C. Lafond and C. Perrin: Recent developments in Wavelegth Shifters, Nucl. Instr. and Meth. 211(1983)309

COSMIC ACTIVITY RECORDED WITH THE OPTICAL AVALANCHE CHAMBER:

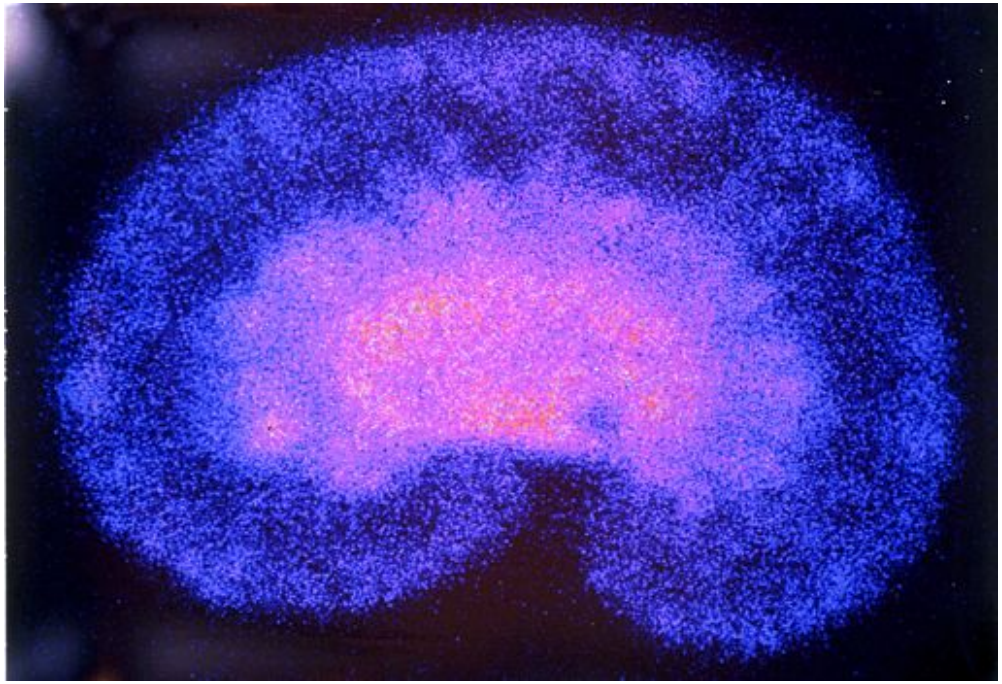
G. Charpak, J.P. Fabre, F. Sauli, M. Suzuki and W. Dominik: An optical, proprortional, continuously operating avalanche chamber, Nucl. Instr. and Meth. A258(1987) 177

1989: RADIOCHROMATOGRAPHY WIYH THE OPTICAL IMAGING CHAMBER

AVALANCHE CHAMBER



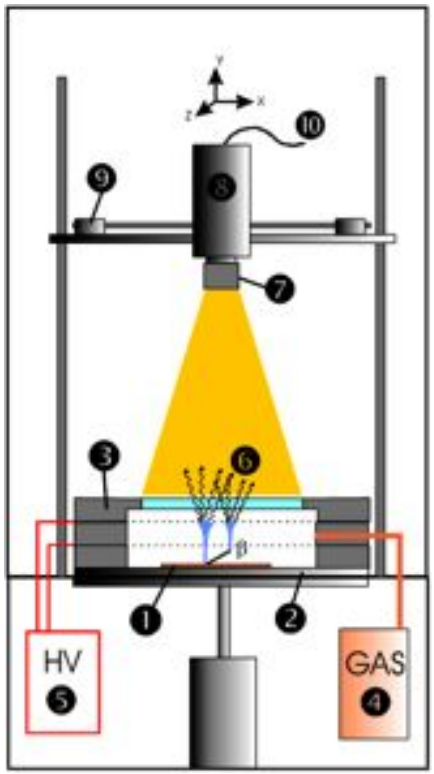
TRITIUM-LABELED RAT KIDNEY SLICE:

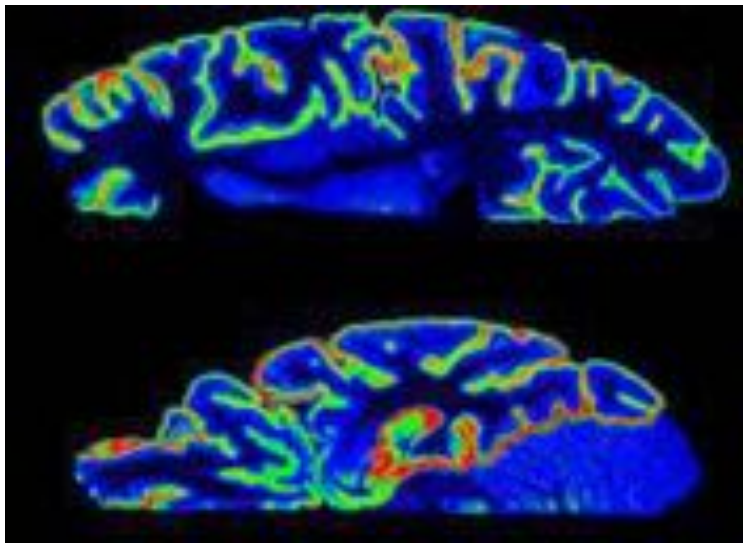


W. Dominik, N. Zaganidis, P. Astier, G. Charpak, J.C. Santiard, F. Sauli, E. Tribollet, A. Geissbüchler and D. Townsend, A gaseous detector for high-accuracy autoradiography of radioactive compounds with optical readout of avalanche positions, Nucl. Instr. and Meth. A278(1989)779

BIOSPACE

COMMERCIAL AUTORADIOGRAPHY SYSTEMS WITH GASEOUS DETECTORS



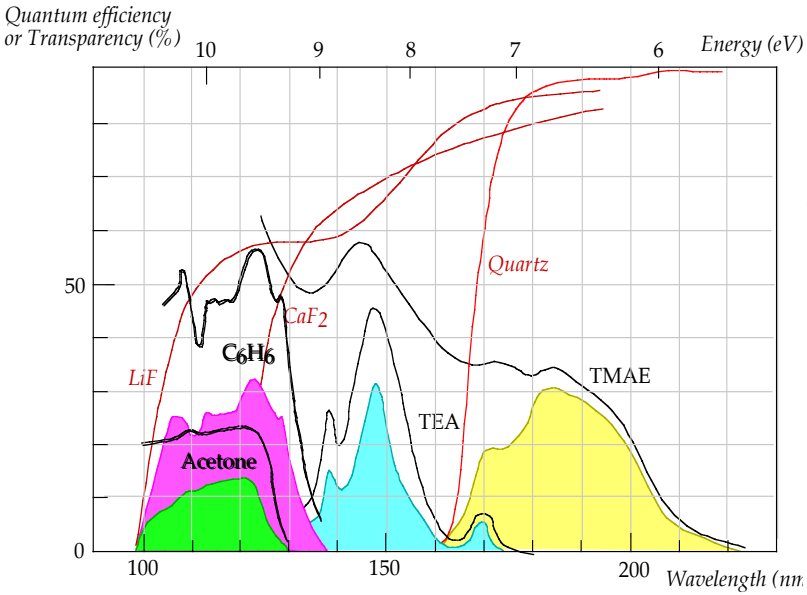


http://www.biospacelab.com

BIOSPACE: COMPANY FOUNDED IN 1989 BY CHARPAK

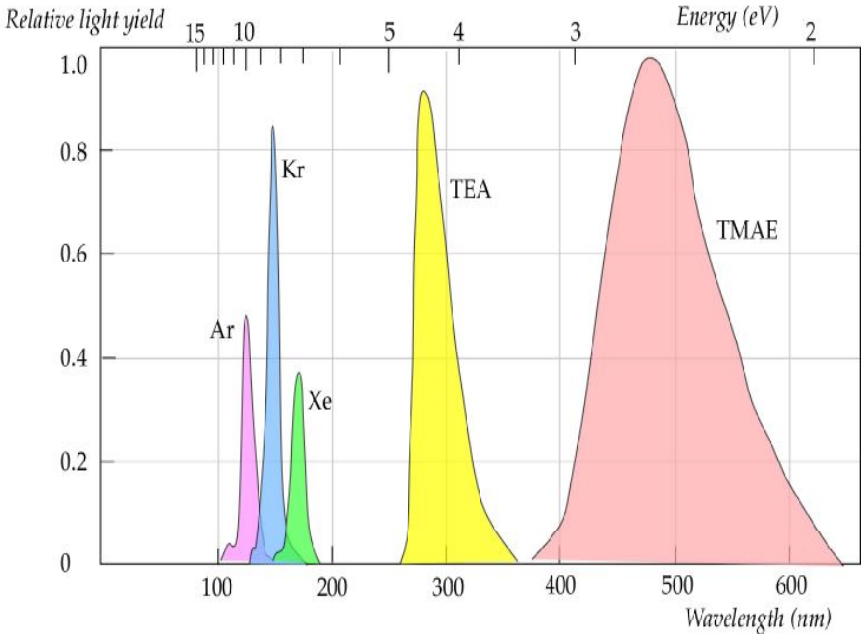
~ 2000: LOW-DOSE 3D IMAGING

1980: TMAE - ULTRALOW PHOTOIONIZATION THRESHOLD VAPOR (David Anderson)



D.F. Anderson, R. Bouclier, G. Charpak,and S. Majewski
Coupling of a BF_2 scintillator to a TMAE photocathode and a low-pressure wire chamber, Nucl. Instr. and Meth. 217(1983) 217

PHOTON EMISSION OF TMAE: VISIBLE WL!



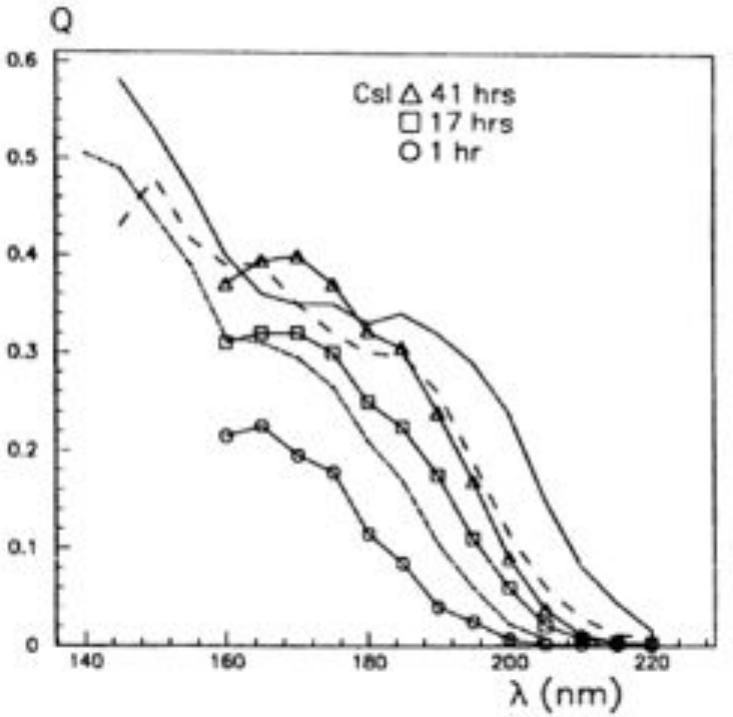
CHARPAKTRON: A CONTINUOUSLY OPERATING IMAGING CHAMBER (CERN MICROCOSM EXHIBIT)

1990 - CONDENSED AND SOLID PHOTOCATHODES

SYSTEMATIC STUDY OF PHOTOSENSITIVE THIN LAYERS:

- ***ADSORBED AND CONDENSED TMAE***
- ***ETHYL FERROCENE***
- ***CAESIUM IODIDE***

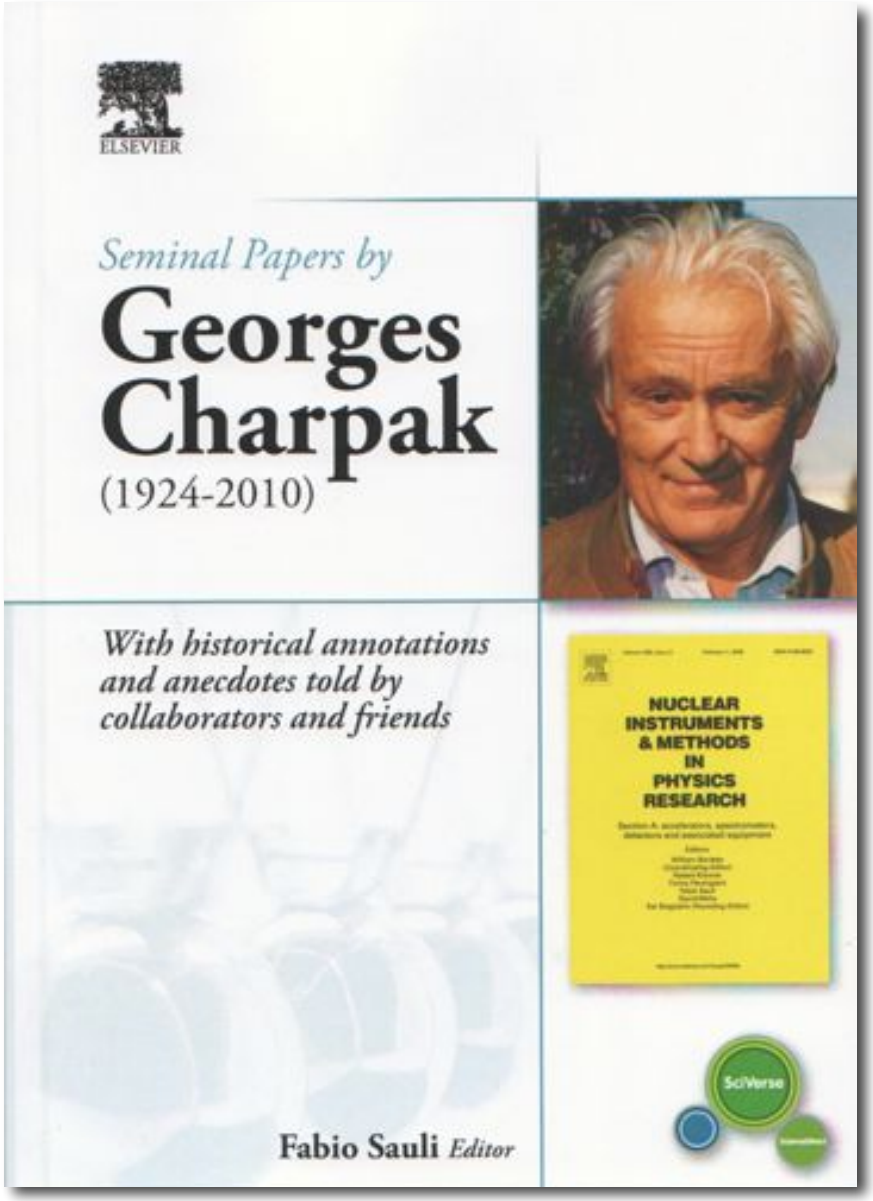
CsI QUANTUM EFFICIENCY:

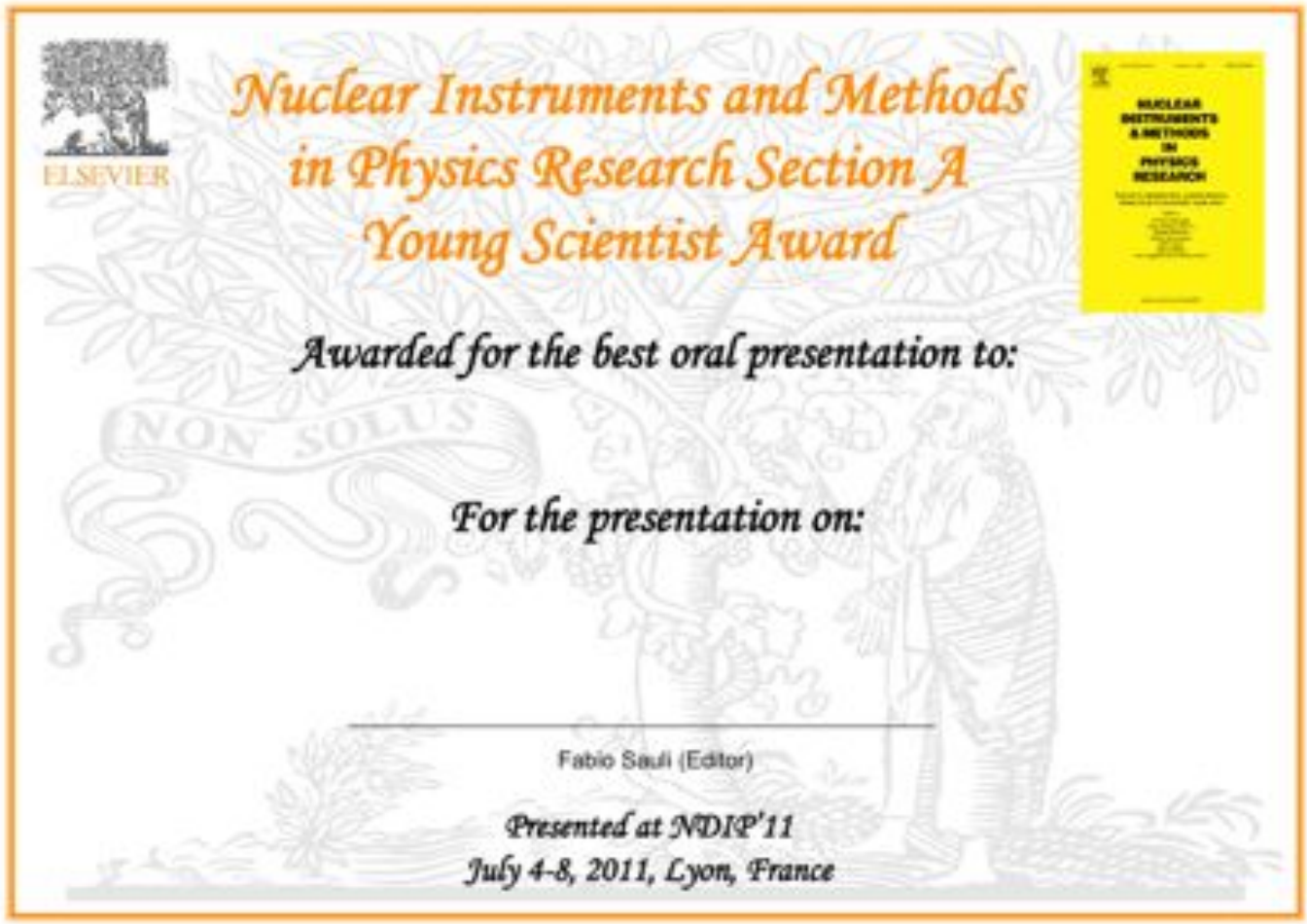


- ***BaF_2 CALORIMETRY***
- ***FAST RICH***

J. Séguinot, G. Charpak, Y. Giomataris, V. Peskov, J. Tischhauser and T. Ypsilantis:
Reflective UV photocathodes with gas-phase electron extraction: solid, liquid and adsorbed thin films,
Nucl. Instr. and Meth. A297(1990)133

GAS DETECTORS DEVELOPMENT GROUP (~1983)


ELSEVIER
Seminal Papers by
Georges Charpak
(1924-2010)
With historical annotations and anecdotes told by collaborators and friends
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH
SciVerse
Fabio Sauli Editor


ELSEVIER
Nuclear Instruments and Methods in Physics Research Section A
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For the presentation on:
Fabio Sauli (Editor)
Presented at NDIP'11
July 4-8, 2011, Lyon, France