LAUDATIO

for

Carlo Rubbia and Samuel Ting

1992: Carlo Rubbia, Samuel Ting, George Charpak

Carlo Rubbia

1934 born in Gorizia,Italy

1958 PhD in Pisa

1970 Professor at Harvard

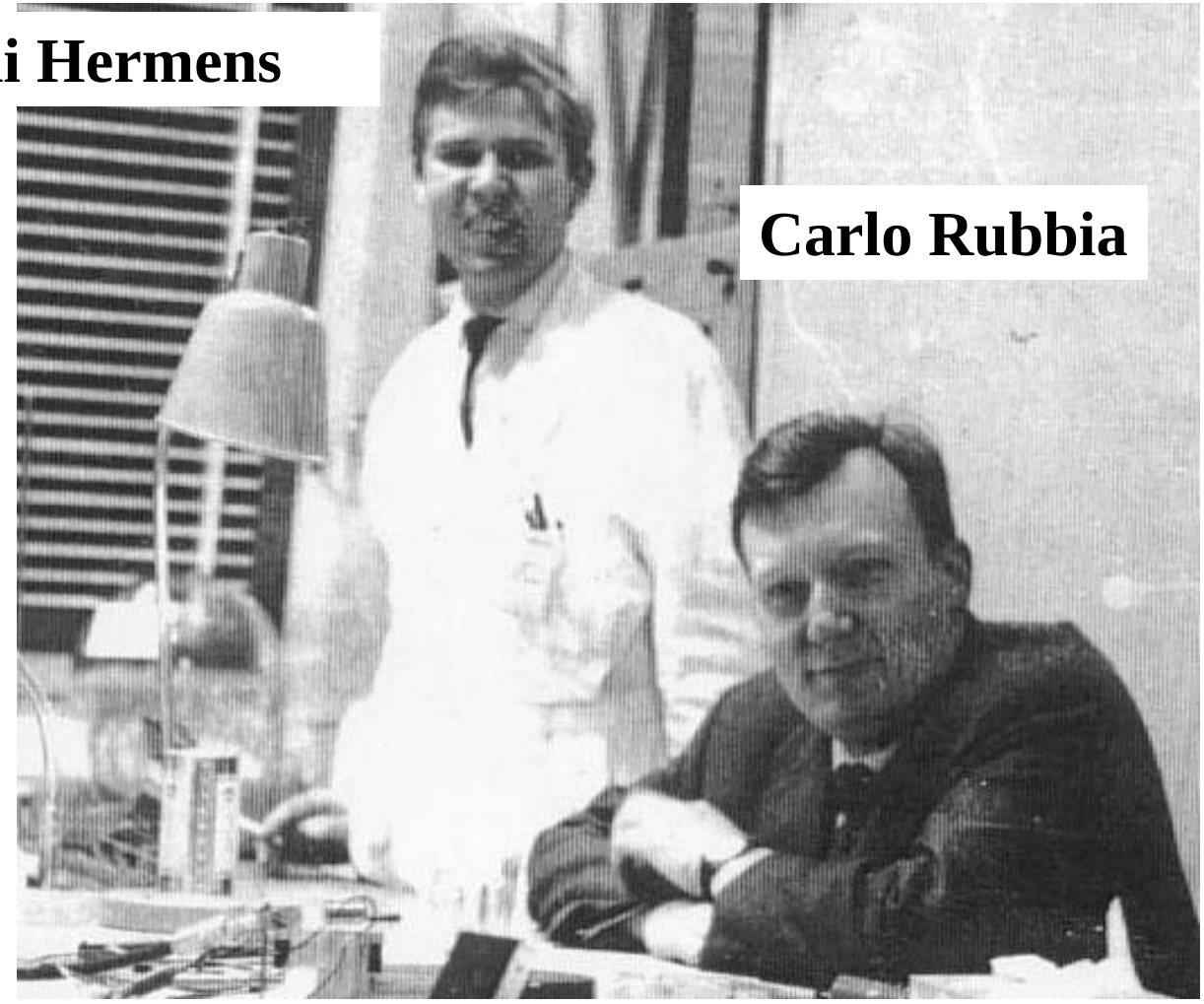
Samuel Ting

1936 born in Ann Arbor,Michigan grown up in China and USA

1962 PhD in Michigan

1969 Professor at MIT

Kaon decay experiment at CERN 1968



Standard Model of Particle Physics

Matter:

Leptons

$$\begin{pmatrix} \nu_e \\ e \end{pmatrix} \quad \begin{pmatrix} \nu_\mu \\ \mu \end{pmatrix}$$

Quarks

$$\begin{pmatrix} u \\ d \end{pmatrix} \quad \begin{pmatrix} s \end{pmatrix}$$

Interactions:

electroweak

Photon	γ	massless

strong

Experimental Observation of a Heavy Particle J†

J. J. Aubert, U. Becker, P. J. Biggs, J. Burger, M. Chen, G. Everhart, P. Goldhagen, J. Leong, T. McCorriston, T. G. Rhoades, M. Rohde, Samuel C. C. Ting, and Sau Lan Wu
Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139

and

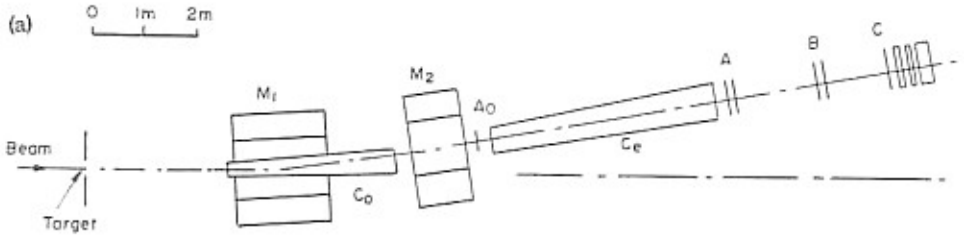
Y. Y. Lee
Brookhaven National Laboratory, Upton, New York 11973
(Received 12 November 1974)

We report the observation of a heavy particle J, with mass $m = 3.1$ GeV and width approximately zero. The observation was made from the reaction $p + \mathrm{Be} \rightarrow e^+ + e^- + x$ by measuring the e^+e^- mass spectrum with a precise pair spectrometer at the Brookhaven National Laboratory's 30-GeV alternating-gradient synchrotron.

This experiment is part of a large program to study the behavior of timelike photons in $p + p \rightarrow e^+ + e^- + x$ reactions[1] and to search for new particles which decay into e^+e^- and $\mu^+\mu^-$ pairs.

We use a slow extracted beam from the Brookhaven National Laboratory's alternating-gradient synchrotron. The beam intensity varies from 10^{10} to 2×10^{12} p/pulse. The beam is guided onto an extended target, normally nine pieces of 70-mil Be, to enable us to reject the pair accidentals by requiring the two tracks to come from the same origin. The beam intensity is monitored with a secondary emission counter, calibrated daily with a thin Al foil. The beam spot size is 3×6 mm^2, and is monitored with closed-circuit television. Figure 1(a) shows the simplified side view of one arm of the spectrometer. The two arms are placed at 14.6° with respect to the incident beam; bending (by $M1$, $M2$) is done vertically to decouple the angle (θ) and the momentum (p) of the particle.

The Cherenkov counter C_0 is filled with one atmosphere and C_e with 0.8 atmosphere of H_2. The counters C_0 and C_e are decoupled by magnets $M1$ and $M2$. This enables us to reject knock-on electrons from C_0. Extensive and repeated calibra-



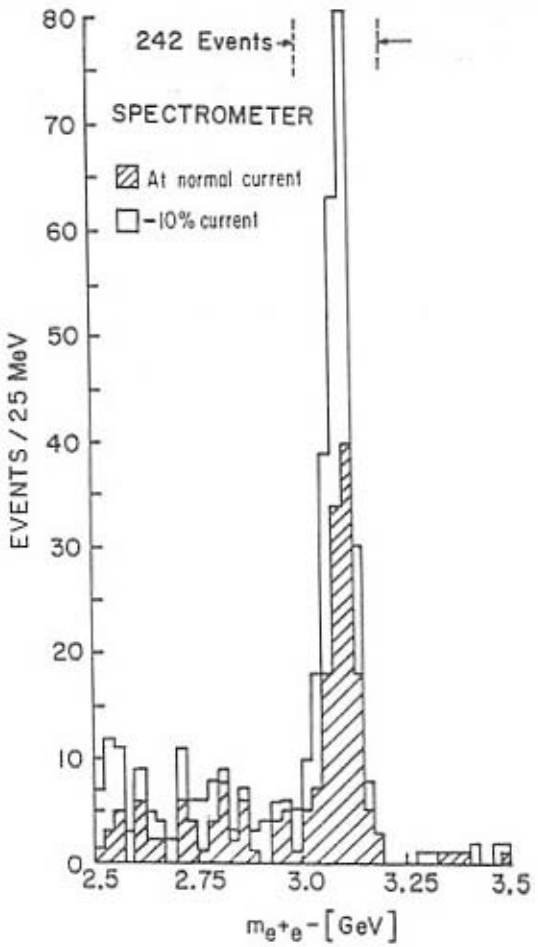
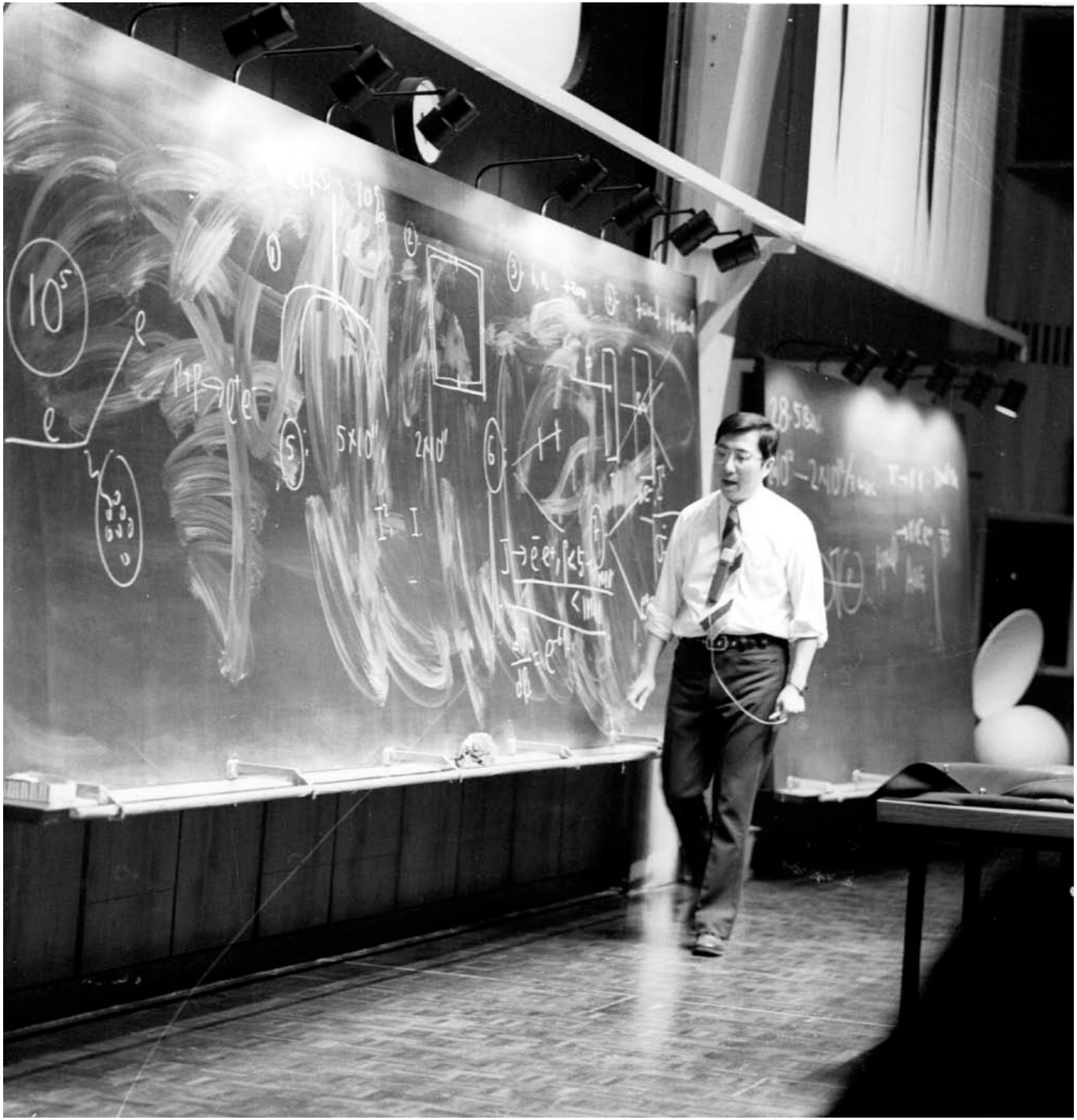


FIG. 2. Mass spectrum showing the existence of J. Results from two spectrometer settings are plotted showing that the peak is independent of spectrometer currents. The run at reduced current was taken two months later than the normal run.



Standard Model of Particle Physics

Matter:

Leptons

$$\begin{pmatrix} \nu_e \\ e \end{pmatrix} \quad \begin{pmatrix} \nu_\mu \\ \mu \end{pmatrix}$$

Quarks

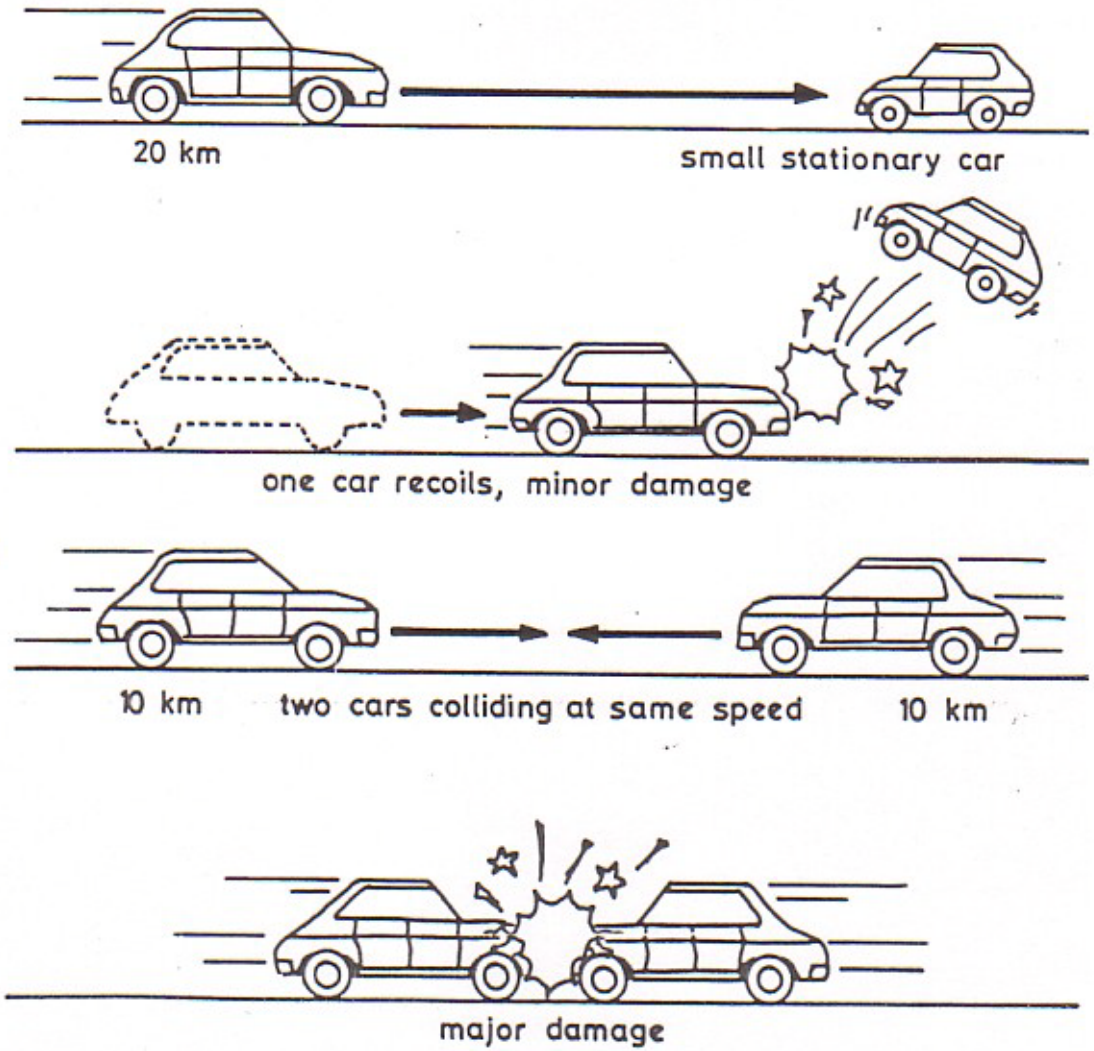
$$\begin{pmatrix} u \\ d \end{pmatrix} \quad \begin{pmatrix} c \\ s \end{pmatrix}$$

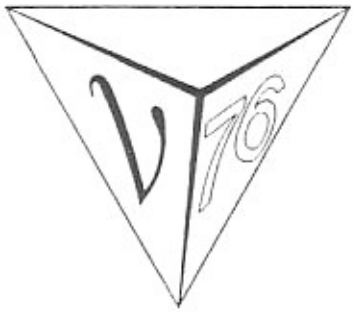
Interactions:

electroweak

Photon	γ	massless

strong


20 km
small stationary car
one car recoils, minor damage
10 km
two cars colliding at same speed
10 km
major damage



NEUTRINO CONFERENCE

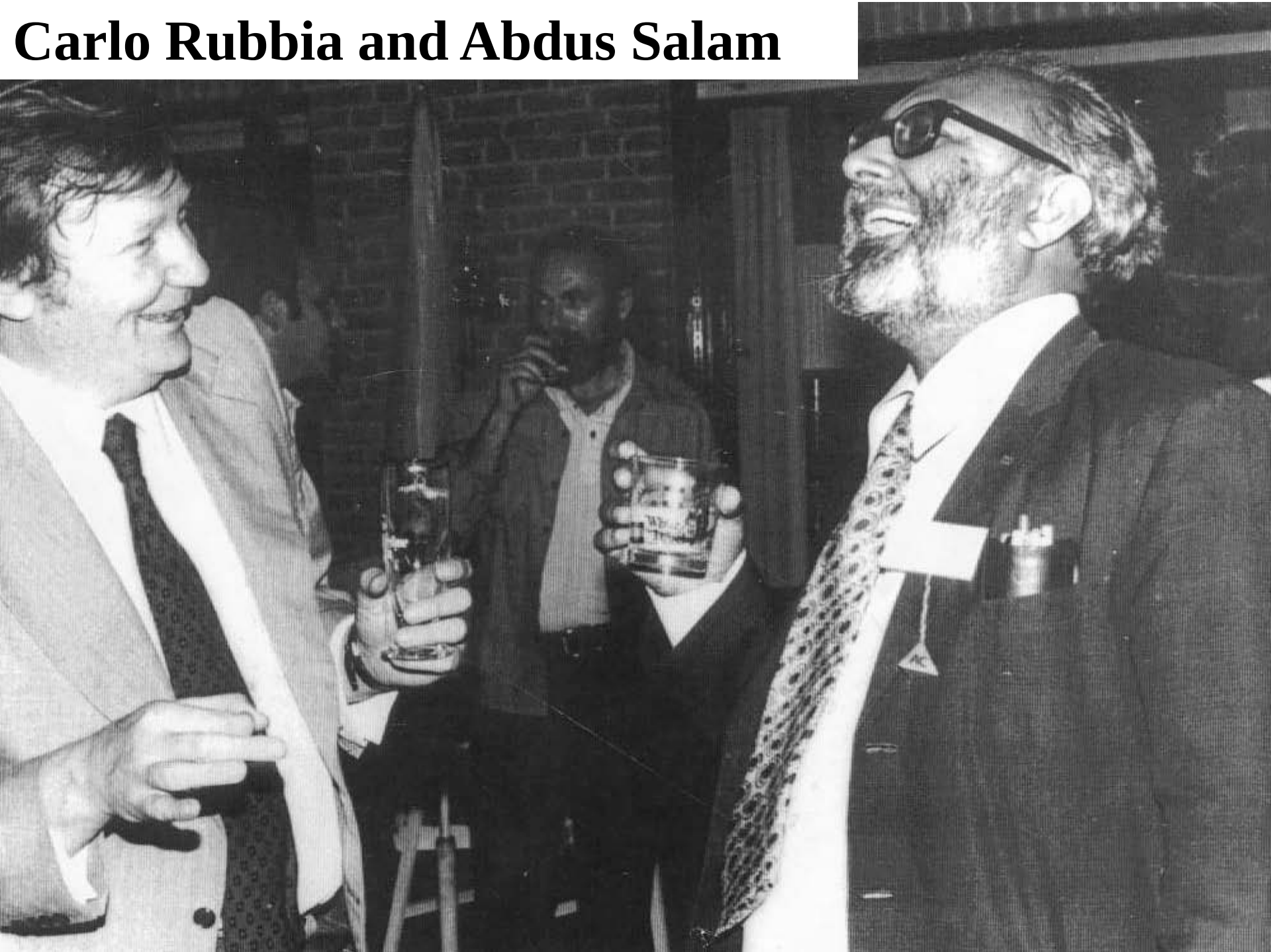
AACHEN, GERMANY, JUNE 8-12, 1976

The Conference will deal with recent developments in neutrino physics: new particle phenomena, neutral currents, and conventional weak interactions. The experimental contributions will be supplemented by review talks on related electromagnetic and strong processes. Theoretical review talks and a panel discussion will concentrate on the phenomenology of these processes and fundamental questions.

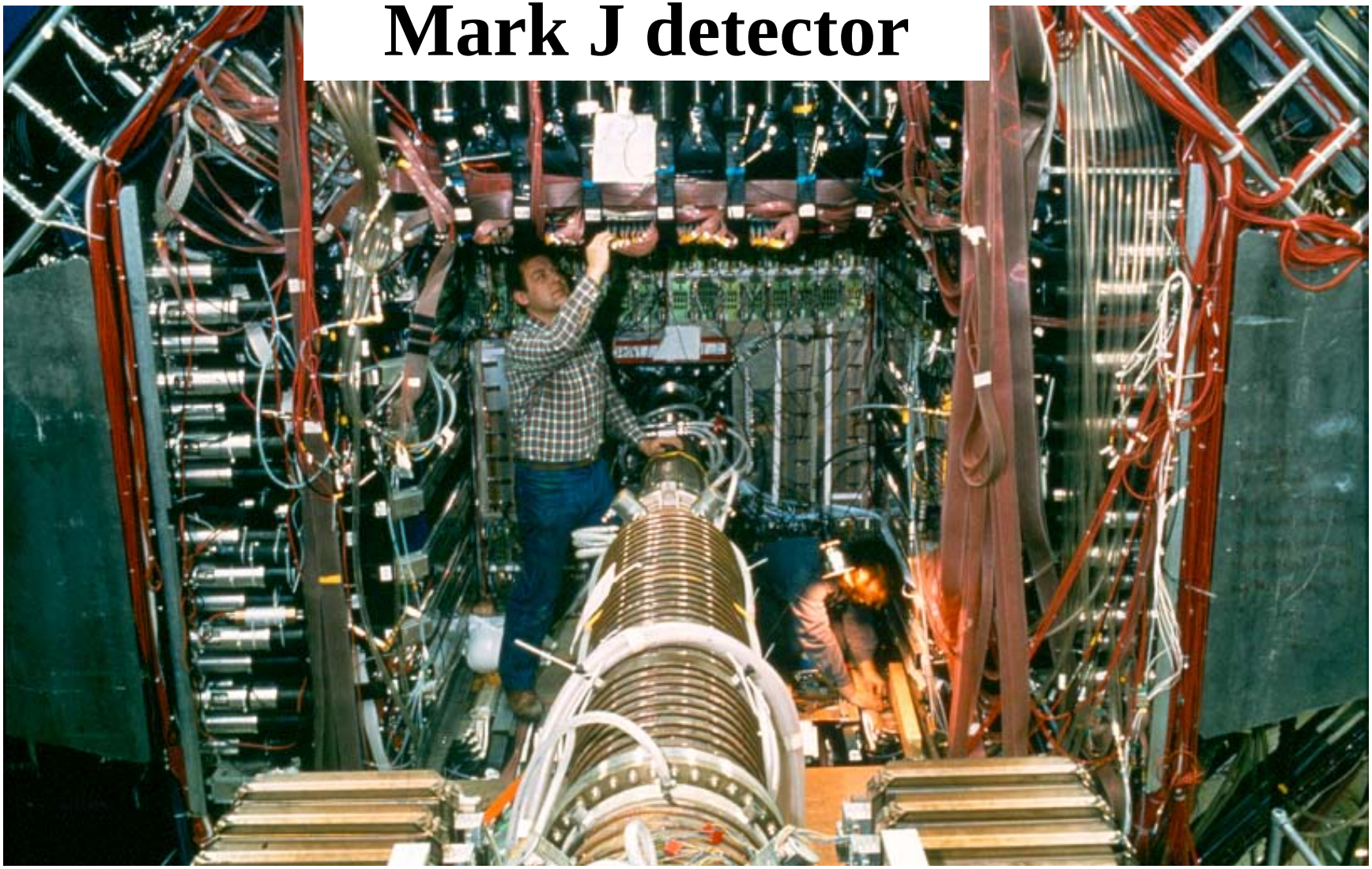
ORIGINAL EXPERIMENTAL CONTRIBUTIONS

B. C. Barish, F. Bobisut, M. Derrick, T. Hansl, J. von Krogh, W. Y. Lee, A. K. Mann, R. B. Palmer, F. Reines, H. Reithler, C. Rubbia, P. Schreiner, L. Sulak and representatives of Gargamelle and other collaborations.

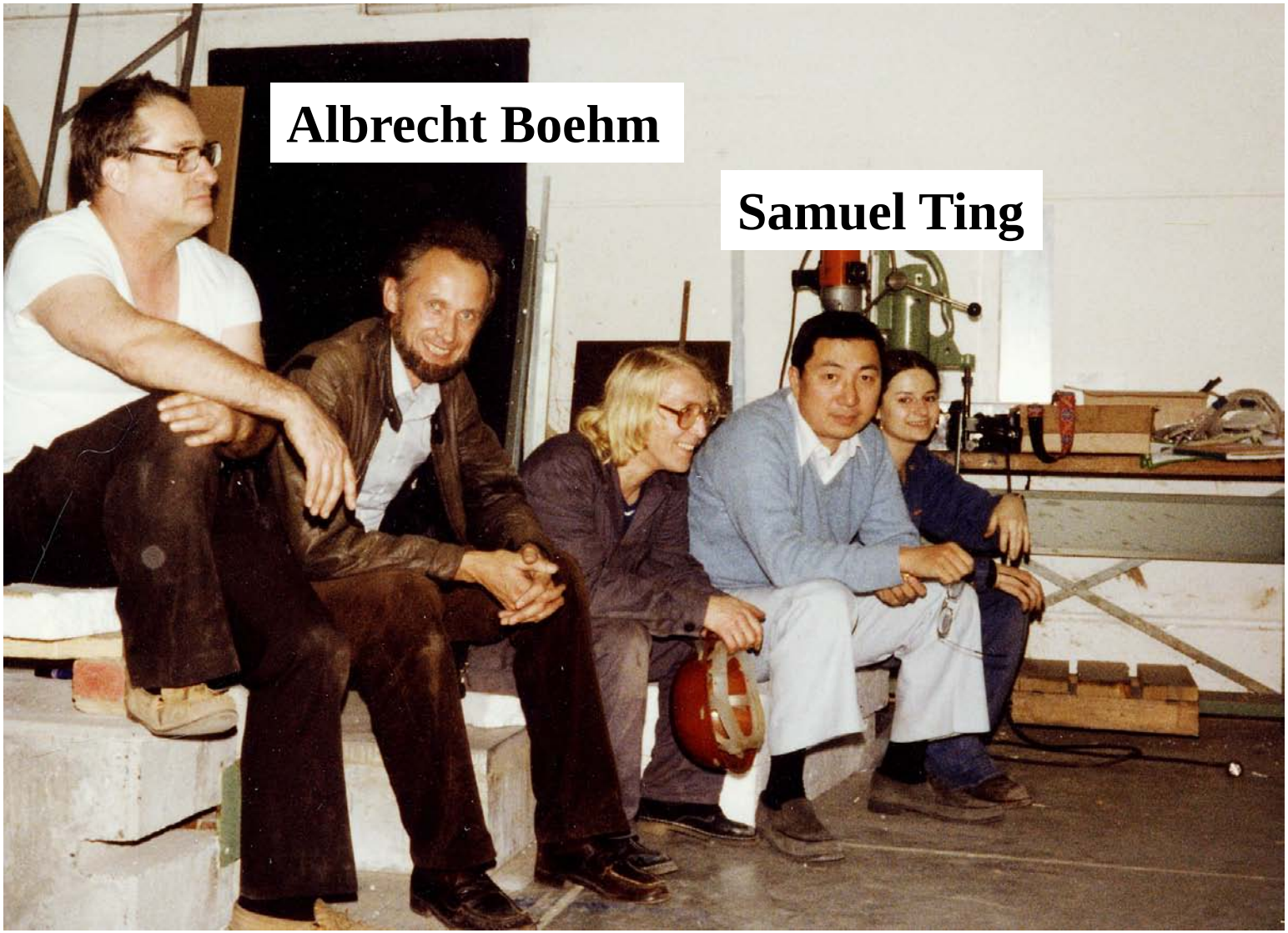
Carlo Rubbia and Abdus Salam

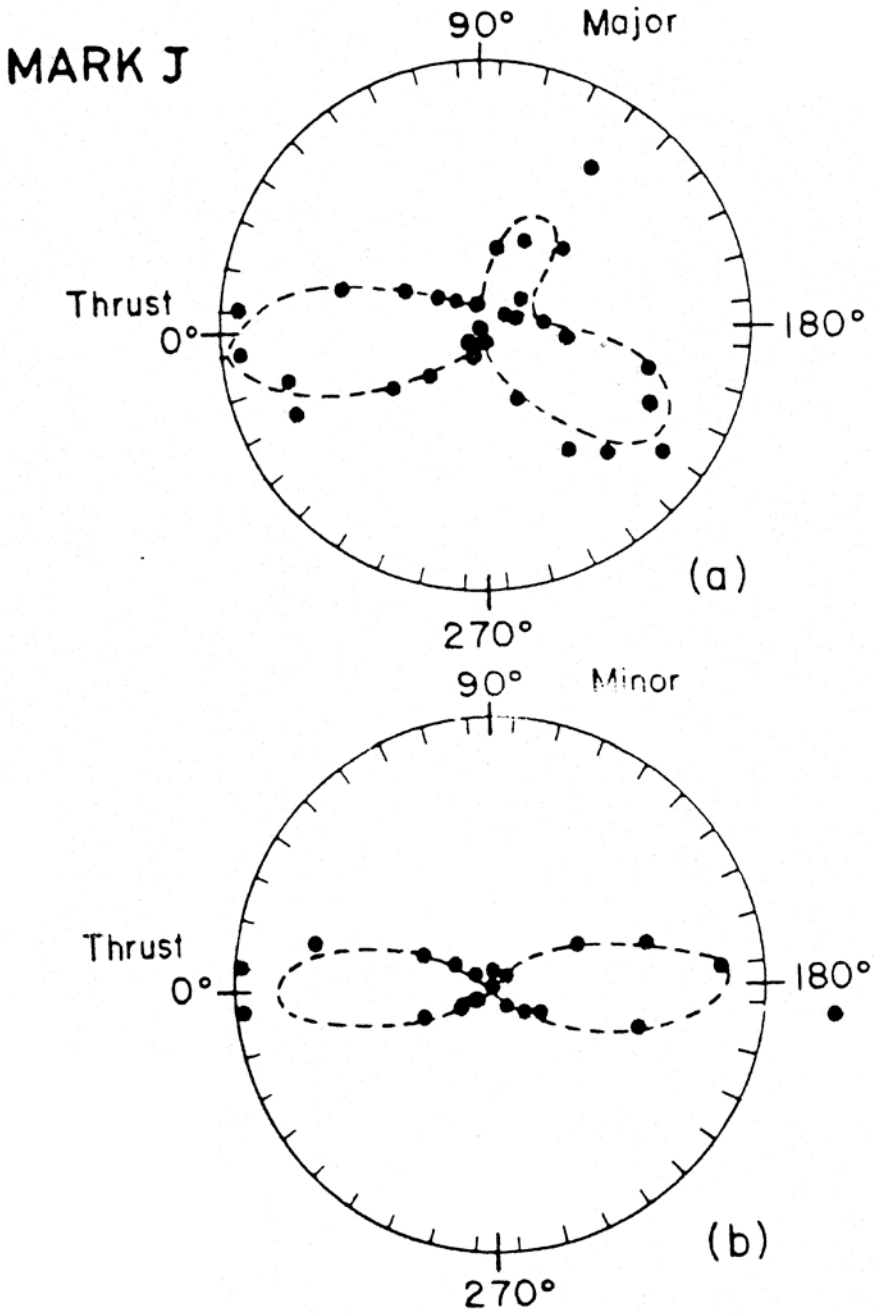


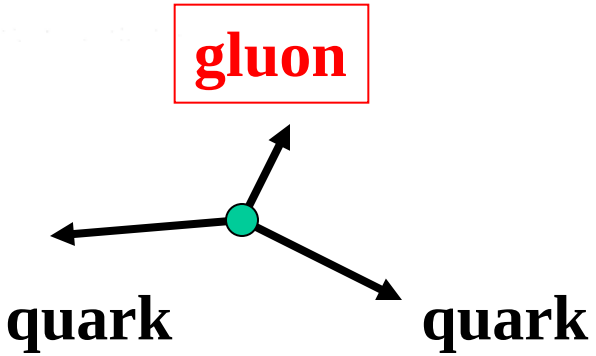
Mark J detector



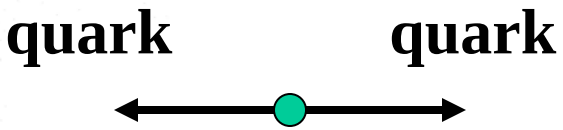
1978: preparing the MarkJ experiment at DESY







Diploma thesis
Gregor Herten
from Aachen



Standard Model of Particle Physics

Matter:

Leptons

$$\begin{pmatrix} \nu_e \\ e \end{pmatrix} \quad \begin{pmatrix} \nu_\mu \\ \mu \end{pmatrix} \quad \begin{pmatrix} \nu_\tau \\ \tau \end{pmatrix}$$

Quarks

$$\begin{pmatrix} u \\ d \end{pmatrix} \quad \begin{pmatrix} c \\ s \end{pmatrix} \quad \begin{pmatrix} t \\ b \end{pmatrix}$$

Interactions:

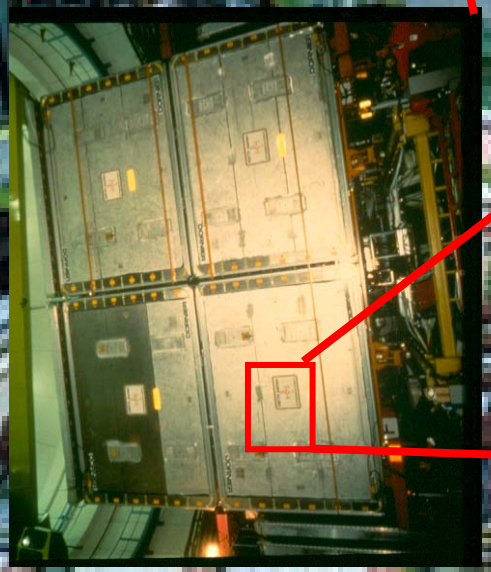
electroweak

Photon	γ	massless

strong

Gluon	g	massless

UA1 detector



EXPERIMENTAL OBSERVATION OF ISOLATED LARGE TRANSVERSE ENERGY ELECTRONS WITH ASSOCIATED MISSING ENERGY AT $\sqrt{s}$ = 540 GeV

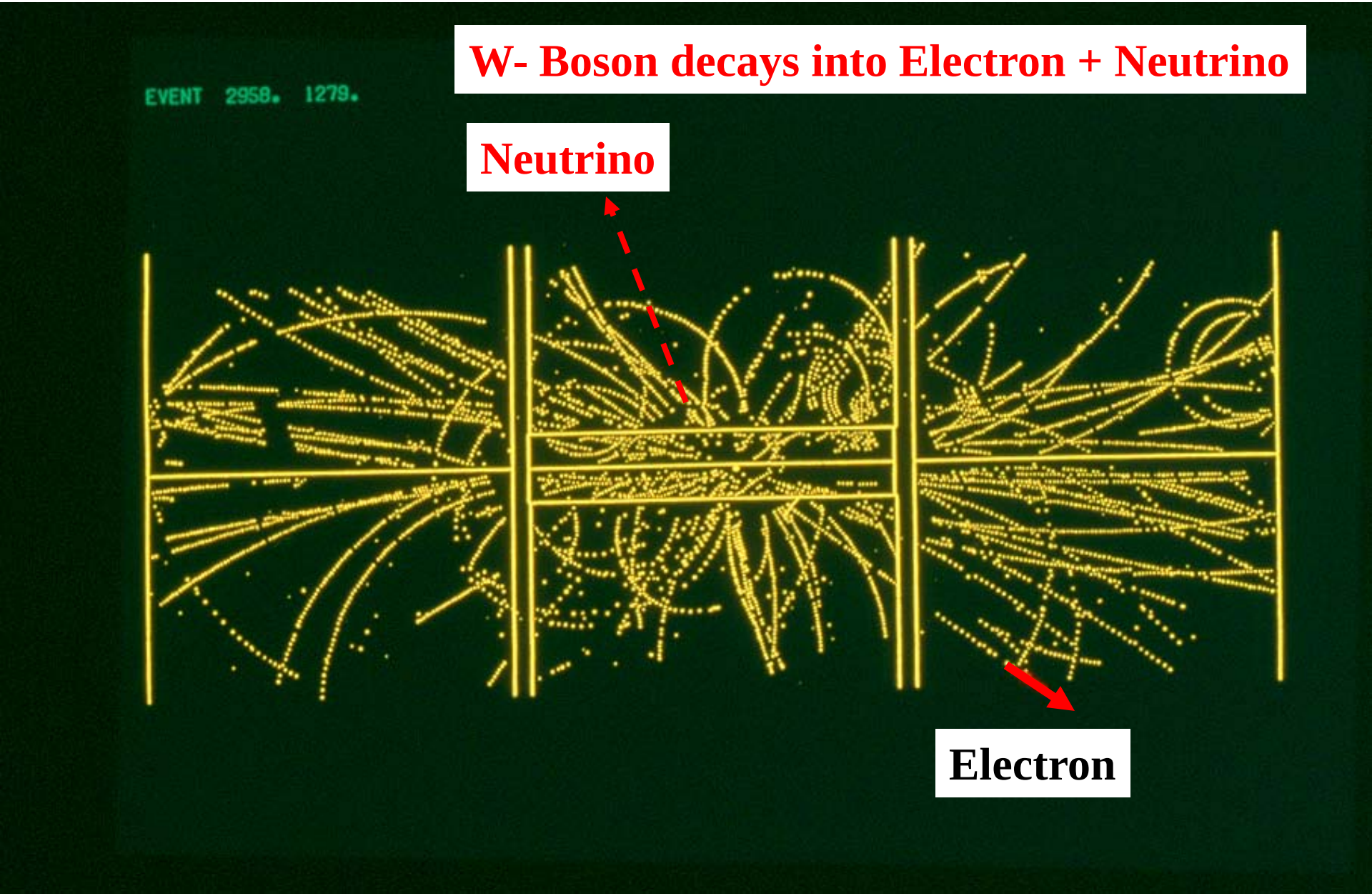
UA1 Collaboration, CERN, Geneva, Switzerland

G. ARNISON [j], A. ASTBURY [j], B. AUBERT [b], C. BACCI [i], G. BAUER [l], A. BÉZAGUET [d], R. BÖCK [d], T.J.V. BOWCOCK [f], M. CALVETTI [d], T. CARROLL [d], P. CATZ [b], P. CENNINI [d], S. CENTRO [d], F. CERADINI [d], S. CITTOLIN [d], D. CLINE [l], C. COCHET [k], J. COLAS [b], M. CORDEN [c], D. DALLMAN [d], M. DeBEER [k], M. DELLA NEGRA [b], M. DEMOULIN [d], D. DENEGRI [k], A. Di CIACCIO [i], D. DiBITONTO [d], L. DOBRZYNSKI [g], J.D. DOWELL [c], M. EDWARDS [c], K. EGGERT [a], E. EISENHANDLER [f], N. ELLIS [d], P. ERHARD [a], H. FAISSNER [a], G. FONTAINE [g], R. FREY [h], R. FRÜHWIRTH [l], J. GARVEY [c], S. GEER [g], C. GHESQUIÈRE [g], P. GHEZ [b], K.L. GIBONI [a], W.R. GIBSON [f], Y. GIRAUD-HÉRAUD [g], A. GIVERNAUD [k], A. GONIDEC [b], G. GRAYER [j], P. GUTIERREZ [h], T. HANSL-KOZANECKA [a], W.J. HAYNES [j], L.O. HERTZBERGER [2], C. HODGES [h], D. HOFFMANN [a], H. HOFFMANN [d], D.J. HOLTHUIZEN [2], R.J. HOMER [c], A. HONMA [f], W. JANK [d], G. JORAT [d], P.I.P. KALMUS [f], V. KARIMÄKI [e], R. KEELER [f], I. KENYON [c], A. KERNAN [h], R. KINNUNEN [e], H. KOWALSKI [d], W. KOZANECKI [h], D. KRYN [d], F. LACAVA [d], J.-P. LAUGIER [k], J.-P. LEES [b], H. LEHMANN [a], K. LEUCHS [a], A. LÉVÊQUE [k], D. LINGLIN [b], E. LOCCI [k], M. LORET [k], J.-J. MALOSSE [k], T. MARKIEWICZ [d], G. MAURIN [d], T. McMAHON [c], J.-P. MENDIBURU [g], M.-N. MINARD [b], M. MORICCA [i], H. MUIRHEAD [d], F. MULLER [d], A.K. NANDI [j], L. NAUMANN [d], A. NORTON [d], A. ORKIN-LECOURTOIS [g], L. PAOLUZI [i], G. PETRUCCI [d], G. PIANO MORTARI [i], M. PIMIÄ [e], A. PLACCI [d], E. RADERMACHER [a], J. RANSDELL [h], H. REITHLER [a], J.-P. REVOL [d], J. RICH [k], M. RIJSSENBEEK [d], C. ROBERTS [j], J. ROHLF [d], P. ROSSI [d], C. RUBBIA [d], B. SADOULET [d], G. SAJOT [g], G. SALVI [f], G. SALVINI [i], J. SASS [k], J. SAUDRAIX [k], A. SAVOY-NAVARRO [k], D. SCHINZEL [f], W. SCOTT [j], T.P. SHAH [j], M. SPIRO [k], J. STRAUSS [l], K. SUMOROK [c], F. SZONCSO [l], D. SMITH [h], C. TAO [d], G. THOMPSON [f], J. TIMMER [d], E. TSCHESLOG [a], J. TUOMINIEMI [e], S. Van der MEER [d], J.-P. VIALLE [d], J. VRANA [g], V. VUILLEMIN [d], H.D. WAHL [l], P. WATKINS [c], J. WILSON [c], Y.G. XIE [d], M. YVERT [b] and E. ZURFLUH [d]

Aachen [a] *–Annecy (LAPP)* [b] *–Birmingham* [c] *–CERN* [d] *–Helsinki* [e] *–Queen Mary College, London* [f] *–Paris (Coll. de France)* [g] *–Riverside* [h] *–Rome* [i] *–Rutherford Appleton Lab.* [j] *–Saclay (CEN)* [k] *–Vienna* [l] *Collaboration*

Received 23 January 1983

W- Boson decays into Electron + Neutrino




Simon van der Meer
Carlo Rubbia

Die Physikpreisträger 1985 (von links nach rechts): Traudl Hansl-Kozanecka, Ernst Radermacher, Karsten Eggert und Hans Hoffmann (Photo: W. Brüchle).

Standard Model of Particle Physics

Matter:

Leptons

$$\begin{pmatrix} \nu_e \\ e \end{pmatrix} \quad \begin{pmatrix} \nu_\mu \\ \mu \end{pmatrix} \quad \begin{pmatrix} \nu_\tau \\ \tau \end{pmatrix}$$

Quarks

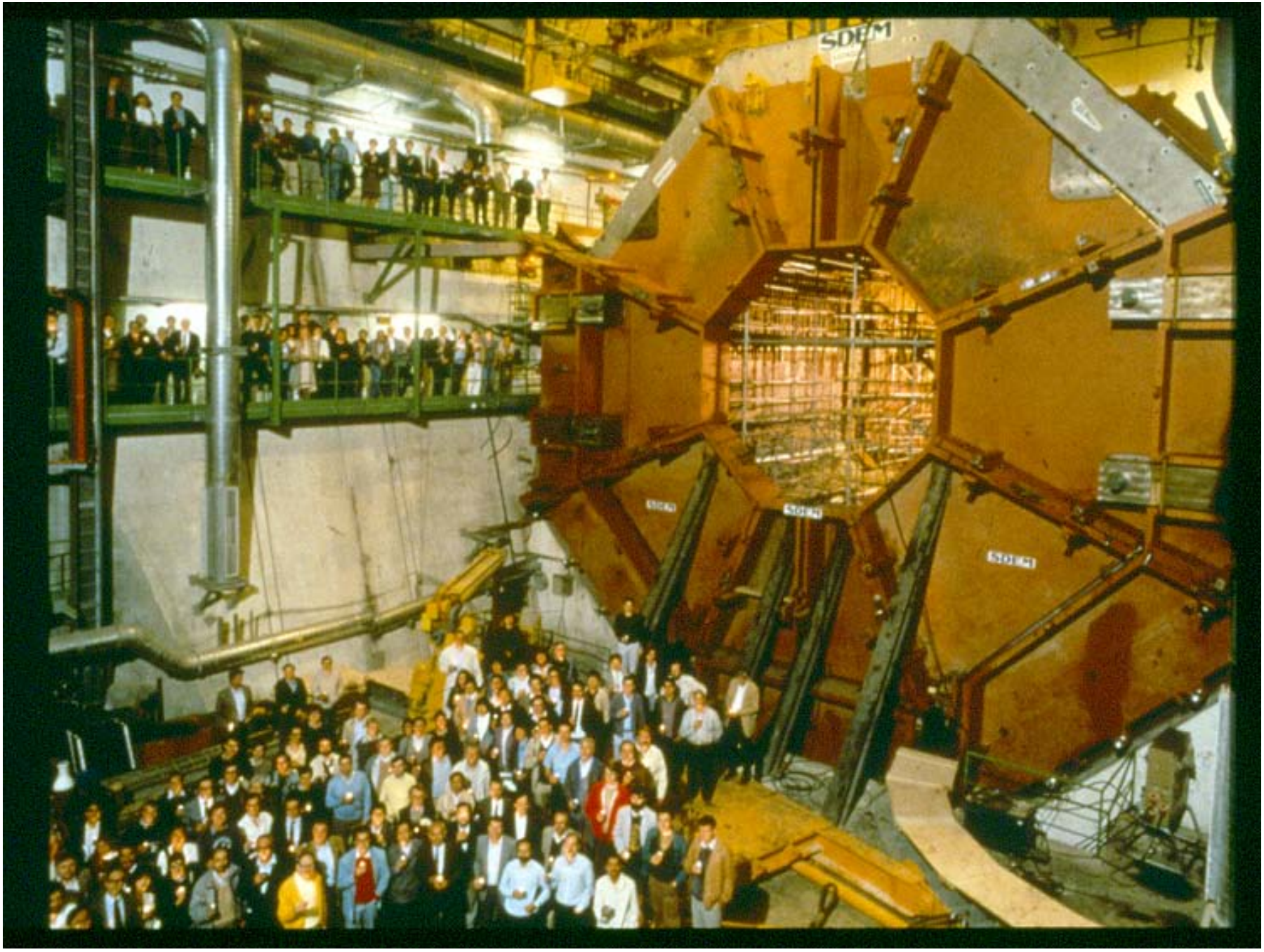
$$\begin{pmatrix} u \\ d \end{pmatrix} \quad \begin{pmatrix} c \\ s \end{pmatrix} \quad \begin{pmatrix} t \\ b \end{pmatrix}$$

Interactions:

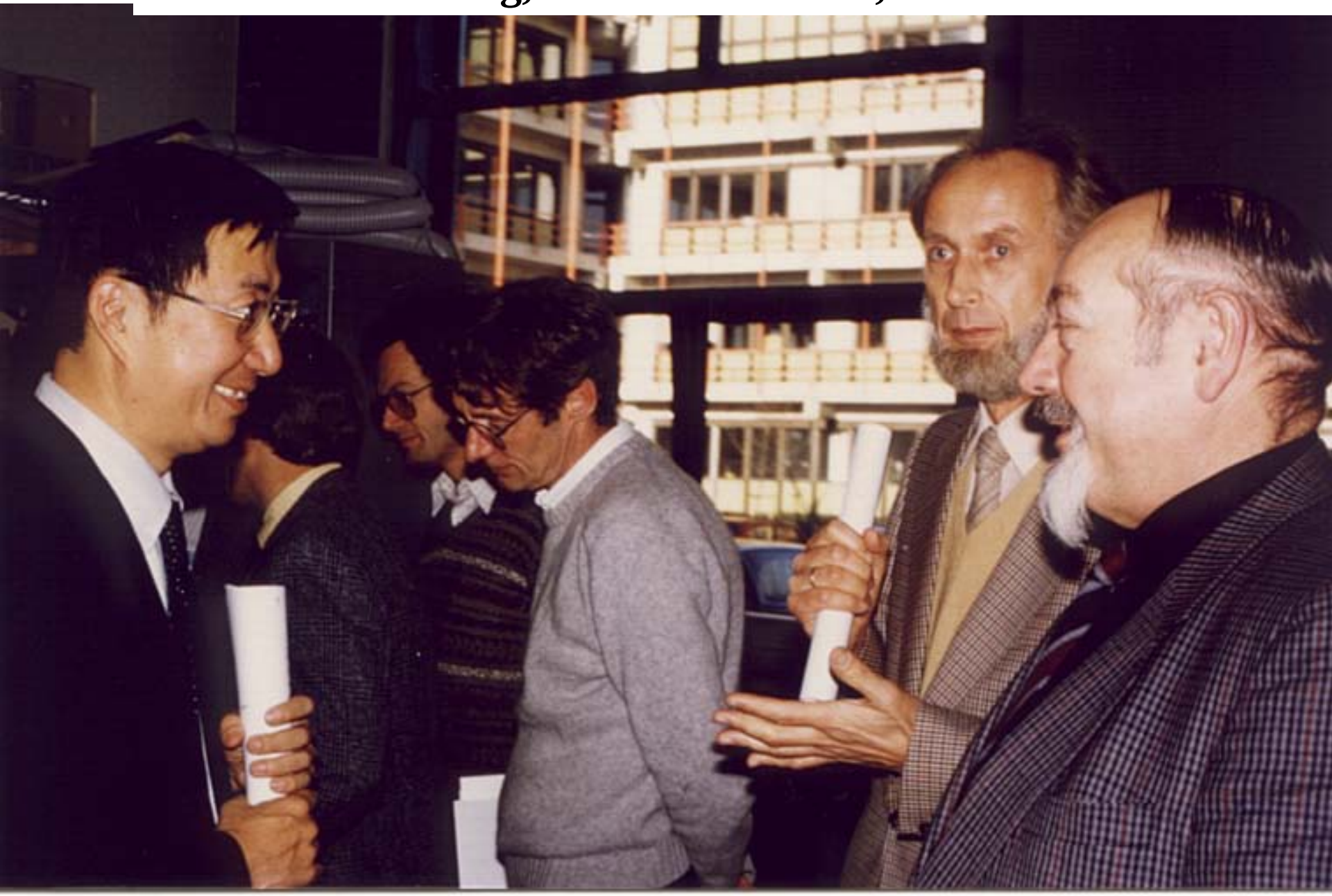
electroweak

strong

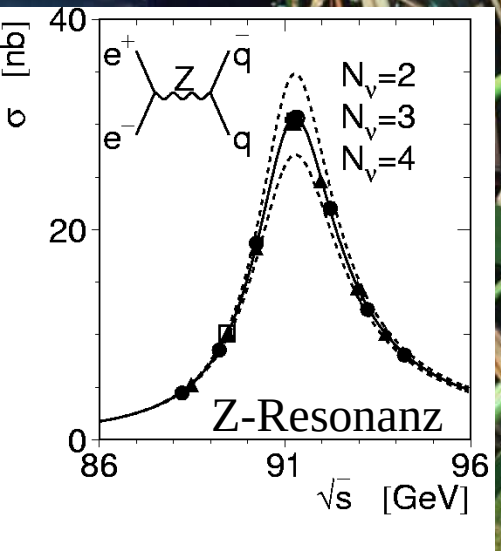
Photon	γ	massless
Z-Boson	Z	91 GeV
W-Boson	W^+ W^-	80 GeV
Gluon	g	massless


SDEM

1983: Samuel Ting, Albrecht Boehm, Helmut Faissner



LEP detector L3



Standard Model of Particle Physics

Matter:

Leptons

$$\begin{pmatrix} \nu_e \\ e \end{pmatrix} \quad \begin{pmatrix} \nu_\mu \\ \mu \end{pmatrix} \quad \begin{pmatrix} \nu_\tau \\ \tau \end{pmatrix}$$

Quarks

$$\begin{pmatrix} u \\ d \end{pmatrix} \quad \begin{pmatrix} c \\ s \end{pmatrix} \quad \begin{pmatrix} t \\ b \end{pmatrix}$$

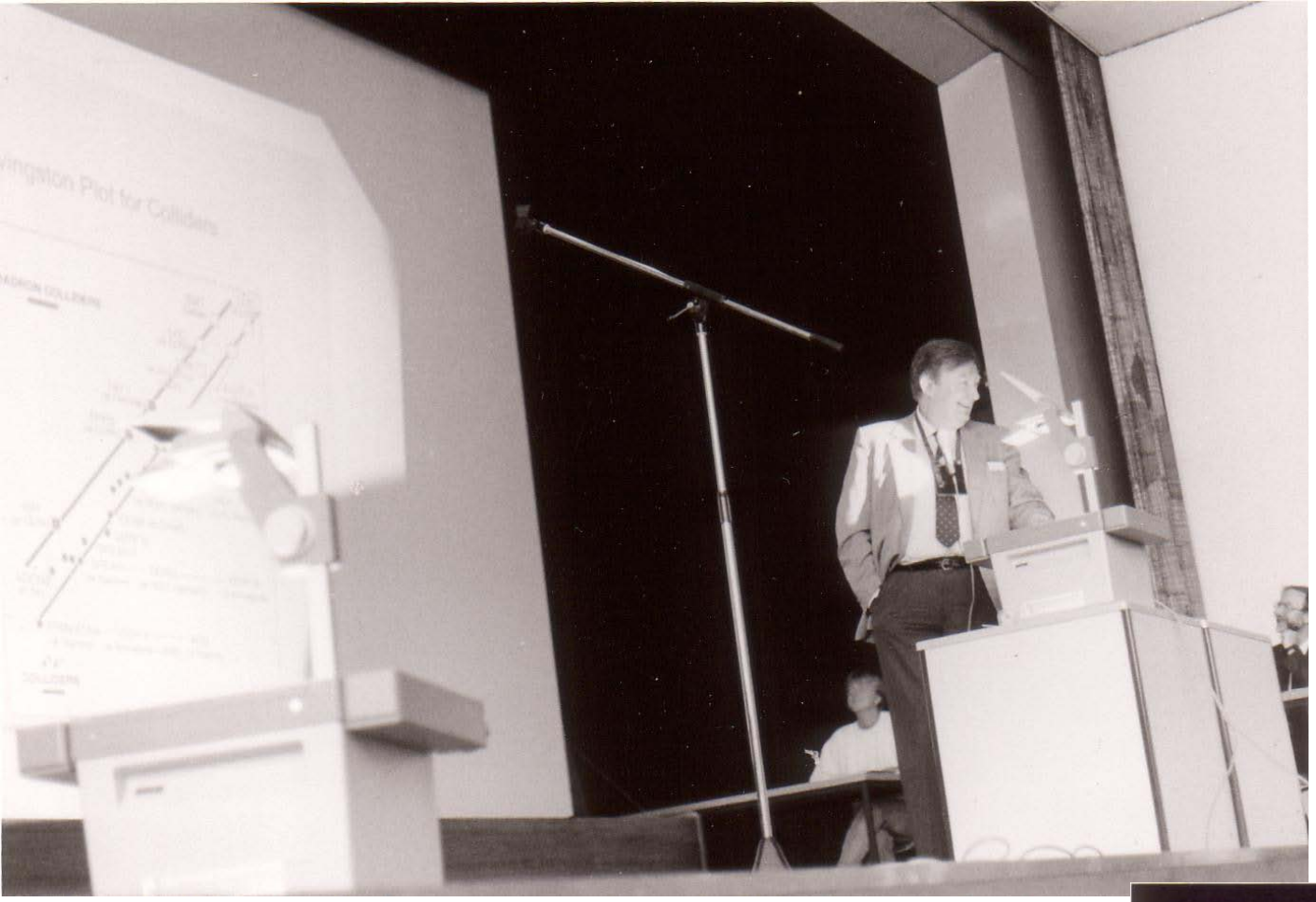
Interactions:

electroweak

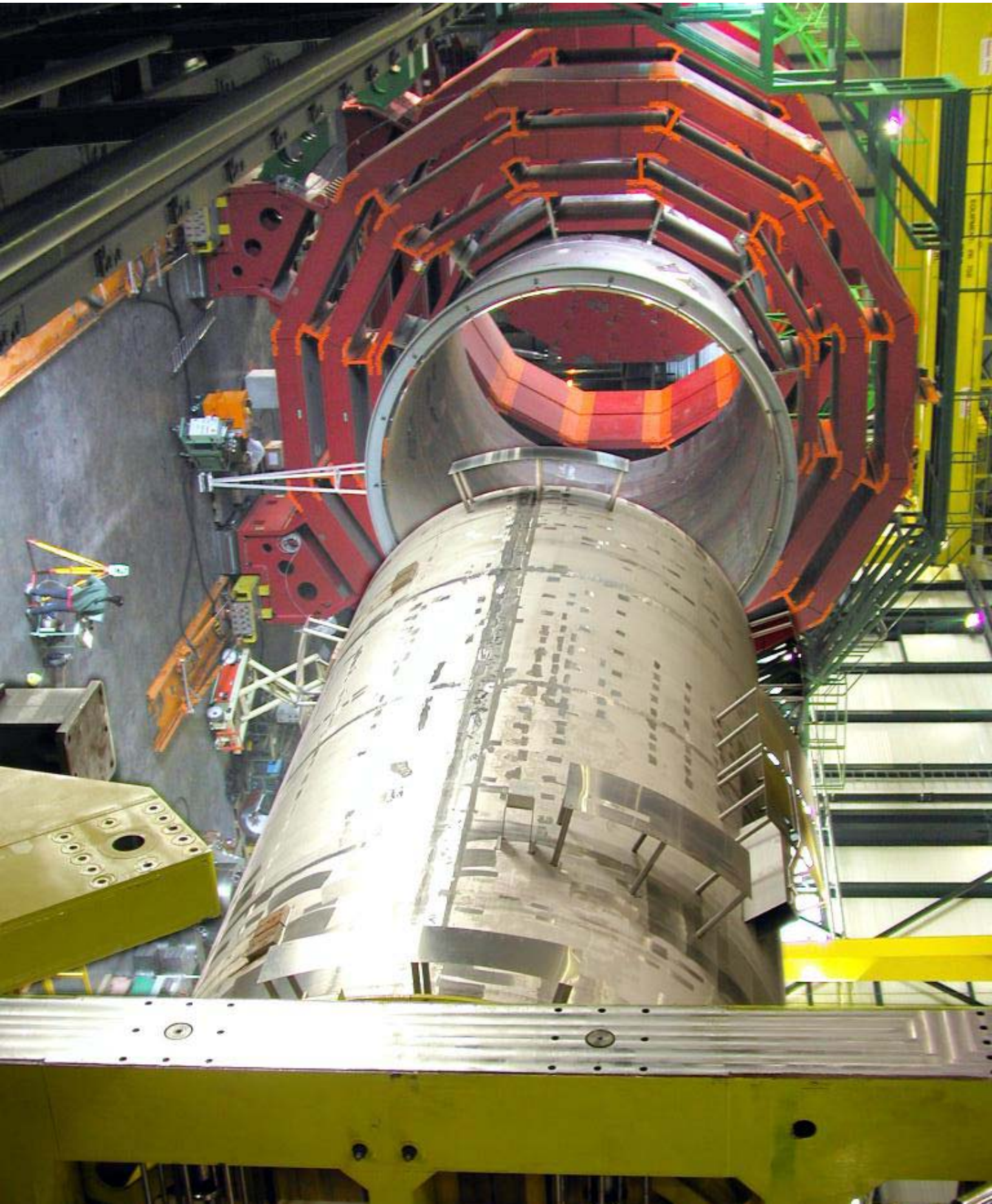
strong

Photon	γ	massless
Z-Boson	Z	91 GeV
W-Boson	W^+ W^-	80 GeV
Gluon	g	massless


rge Hadron C
Workshop
4-9 October 1990



CMS detector at LHC



AMS on the ISS