

MAJOR EVENTS AND MINOR EPISODES

Ugo Amaldi

*Technische Universität München
and TERA Foundation*

The discovery of neutron induced radioactivity

January-March 1934

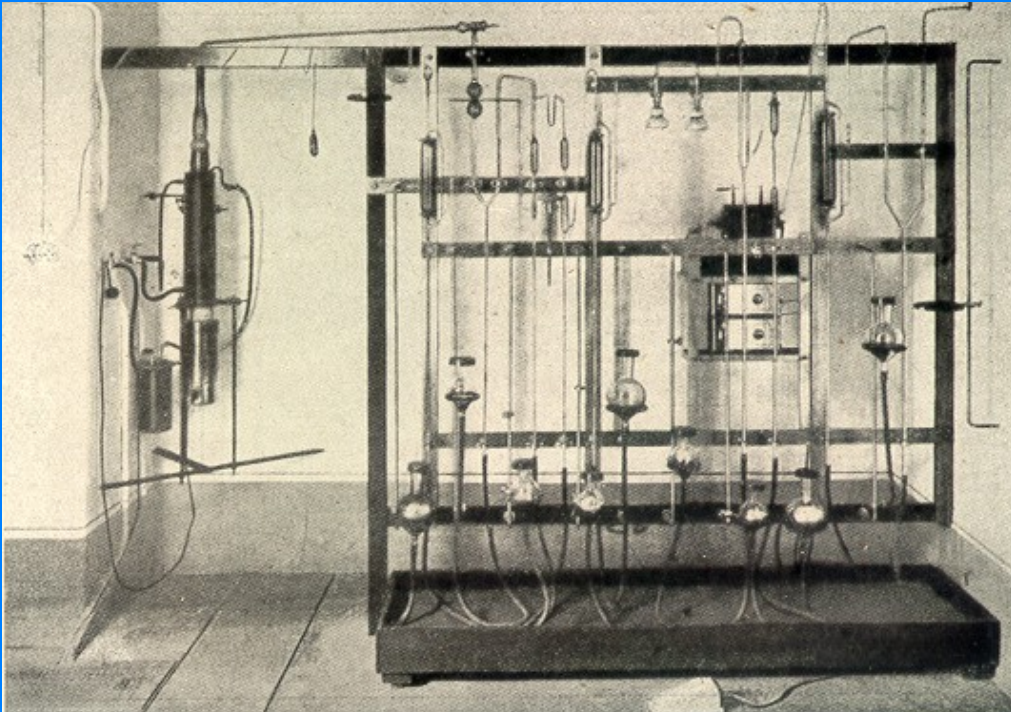
January 15: The Joliot-Curies discover artificial radioactivity induced by alfas

March 25: Enrico Fermi discovers artificial radioactivity induced by neutrons

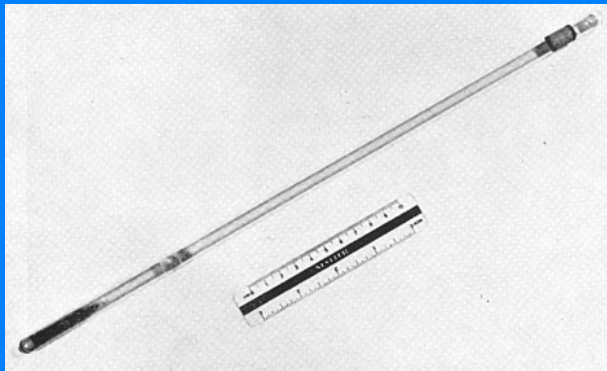


The Institute of Via Panisperna

Fermi discovery was made with a Be-Rn source. The radon was extracted at Laboratorio Fisico della Sanità Pubblica



Giulio Cesare TRABACCHI



The “Divine Providence”

*The third paper was
signed by the group*

RADIOATTIVITÀ « BETA » PROVOCATA DA BOMBARDAMENTO DI NEUTRONI. — III.

E. AMALDI, O. D'AGOSTINO, E. FERMI, F. RASETTI, E. SEGRÈ

« Ric. Scientifica », 5 (1), 452-453 (1934).

Sono state proseguite ed estese le esperienze di cui alle Note precedenti ⁽¹⁾ coi risultati che ricordiamo appresso.

Idrogeno - Carbonio - Azoto - Ossigeno. — Non danno effetto apprezzabile. Sono stati esaminati paraffina irradiata al solito modo per 15 ore

con una sorgente di uranio. *Bromo.* — Ha due periodi, uno di 30 minuti e l'altro di 6 ore. L'attività corrispondente al periodo lungo e probabilmente anche l'altra, seguono chimicamente il Br.

Fluoro. — I dati sono in accordo con quelli del precedente periodo.

Magnesio. — *Jodio.* — Periodo 30 minuti. L'attività segue chimicamente lo Jodio.

Praseodimio. — Ha due periodi. Uno di 5 minuti e l'altro più lungo.

Neodimio. — Periodo 55 minuti.

Samariumo. — Ha due periodi uno di 40 minuti e uno più lungo.

Oro. — Periodo dell'ordine di grandezza di 1 o 2 giorni.

(1) E. FERMI, « Ricerca Scientifica », 5 (1) p. 283, p. 330 (1934).

The efficacy of slow neutrons

September 1934

“In September 1934 we found a new radioisotope of Al with an half life of 2.3 minutes. But when, few days after our results were made known, I tried to repeat the experiments, I did not find anymore this new activiy.”

“The fact that we were not able to confirm our results was hurriedly communicated to Fermi who was angry and embarrassed at having presented at the London Conference on Physics an erroneous result.”



Edoardo Amaldi

September 1934

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“The fact that we were not able to confirm our results was hurriedly communicated to Fermi who was angry and embarrassed at having presented at the London Conference on Physics an erroneous result.”

“In September 1934 Fermi decided to try to construct a scale of activation in standard conditions. The work was assigned to me and Pontecorvo, one of our best students who had taken the degree (*laurea*) in July 1934 and after the summer vacation had joined the group.”

“We met, however difficulties because apparently the activation depended on the material surrounding the neutron source.”

October 20, the unexpected efficiency of “slow” neutrons

Many years later Fermi himself told Chandrasekhar how it had happened [11]. *“We were working very intensely on radioactivity induced by neutrons and the results did not make sense at all. One day while I was going to the laboratory, it occurred to me to study what would happen if I placed some lead in front of the source of neutrons. I took a long time to work the piece of lead very carefully on the lathe, which was unusual for me; I was clearly dissatisfied with something and was looking for every possible excuse for delaying the moment for putting the lead in place. At a certain point I said to myself: ‘No, I do not want a piece of lead here: what I want is a piece of paraffin.’ And that is how it was, without prior warning or conscious reasoning. I immediately took any old piece of paraffin and put it there where I should have put the piece of lead.”*

October 20, the unexpected efficiency of “slow” neutrons

Discovery: Saturday 20.10.34 (*)

First paper: Monday 22.10.34

Patent: Friday 26.10.34

(*) A. De Gregorio :
not on October 22!



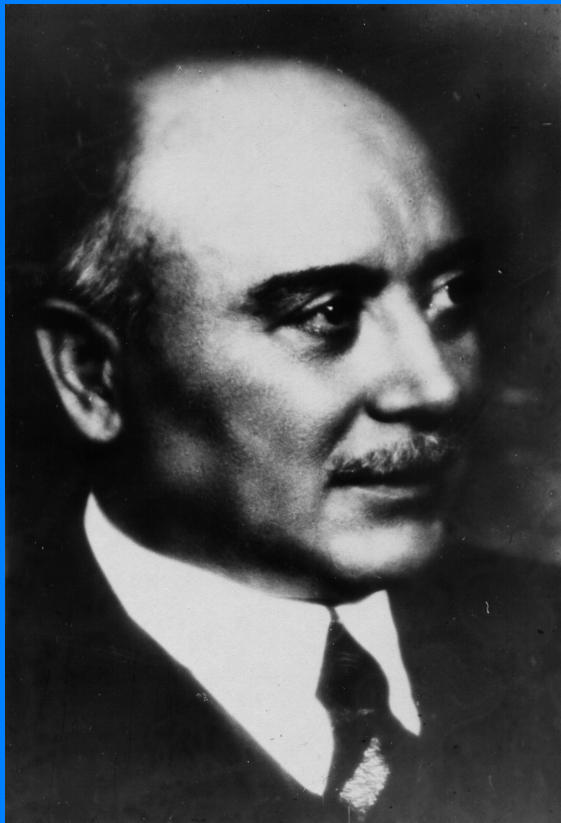
O. D'Agostino E. Segrè E. Amaldi F. Rasetti E. Fermi

+ B. Pontecorvo = The boys of Via Panisperna

The patent to "increase the production of artificial radioactivity with neutron bombardment"

Patent: Friday 26 October
because of

Orso Mario Corbino



REGNO D'ITALIA
MINISTERO DELLE CORPORAZIONI
UFFICIO DELLA PROPRIETÀ INTELLETTUALE

Attestato di Privativa Industriale
N° 324458

Nel Registro degli attestati di privativa industriale di questo Ufficio è stata regolarmente iscritta la domanda depositata, coi documenti voluti dalla legge, all'Ufficio stesso
nel giorno ventisei del mese di ottobre 1934 alle ore 12,15
da Fermi Enrico,
Amaldi Edoardo,
D'Agostino Oscar,
Pontecorvo Bruno, { a Roma
Rasetti Franco,
Segrè Emilio
e Trabacchi Giulio Cesare
per ottenere una privativa industriale per il trovato designato col titolo:

Metodo per accrescere il rendimento dei procedimenti per la produzione di radioattività artificiali mediante il bombardamento con neutroni.

Il presente attestato non garantisce che il trovato abbia i caratteri voluti dalla legge perché la privativa sia valida ed efficace, e viene rilasciato senza esame preliminare del merito e della novità di esso

Roma, li -2 FEB. 1935 Anno XIII

Il Direttore
P. Bises

Nei riferimenti al presente attestato richiamare soltanto il suindicato numero, adottando la dizione
PRIVATIVA ITALIANA N° **324458**

La Tipografia - Roma XII - Ord. 3543 - (5.000)

Fig. 1

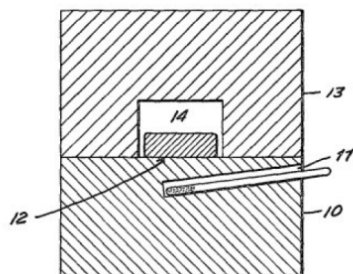
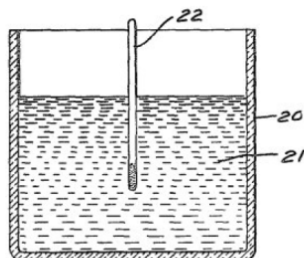


Fig. 2



INVENTORS
ENRICO FERMI, EDOARDO AMALDI,
BRUNO PONTECORVO, FRANCO RASSETTI, ENILIO SEGRE

BY
Handwritten signature
ATTORNEYS

10 The invention relates to the production of iso-
elements from other isotopes of the same
15 elements by reaction with neutrons,
specially to the production of artificial radio-
by formation of unstable isotopes.
It has been known for many years that, al-
each chemical element has always the
same atomic number or charge, it may exist in
different forms having different atomic weights.
These forms of the elements are referred to as
isotopes.

18 It has also been known that the radio-active
elements, by disintegration or break down oc-
curring in their nuclei are spontaneously con-
verted into various isotopes of other elements.
Thus, for example, the radio-active element ura-
nium may be converted into lead of atomic weight
206, while the element thorium may be converted
into a different isotope of atomic weight 208.
20 It has long been known that such spontaneous

**The American patent
was deposited on October 3, 1935**

**“To obtain radioactive
substances in quantities of
practical importance”**

ated July 2, 1940

2,206,634

Uranium is explicitly quoted

UNITED STATES PATENT OFFICE

2,206,634

PROCESS FOR THE PRODUCTION OF RADIOACTIVE SUBSTANCES

Enrico Fermi, Edoardo Amaldi, Bruno Pontecorvo, Franco Rasetti, and Emilio Segre, Rome, Italy, assignors to **G. M. Giannini & Co., Inc.**, New York, N. Y., a corporation of New York

Application October 3, 1935, Serial No. 43,463
In Italy October 26, 1934

7 Claims. (Cl. 204—31)

used which require tremendous energy to break through the potential barrier surrounding the nucleus; and that if, instead of charged particles, neutrons are used for the nuclear reactions, the greatest efficiencies are in some cases attained with low energy or "slow" neutrons, e. g., of the order of a few hundred electron volts, or even much less down to a small fraction of an electron volt.

Neutrons when produced in any ordinary manner, e. g., by the action of radon on beryllium or of polonium on beryllium or by bombardment of atomic nuclei with artificially accelerated particles, might have a very wide range of energies but high average energy. These energies range up to several million volts. It is necessary, therefore, if the greatest efficiency of reaction is to be attained, to reduce by artificial means the energy of these neutrons. We describe below a method for slowing down fast neutrons.

The American patent

American Patent:	3 October 35 2 July 40	Gabriello Giannini & Co. Granted
Request to the military patent office of ORSD	14 June 46	Giannini and L. Bernard 0.45 M\$
Request to the civil patent office of USAEC	13 October 48	Giannini and L. Bernard EF+ES 1,9 M\$

Visit to the Olivetti plants in Ivrea, Valle d'Aosta



The American patent

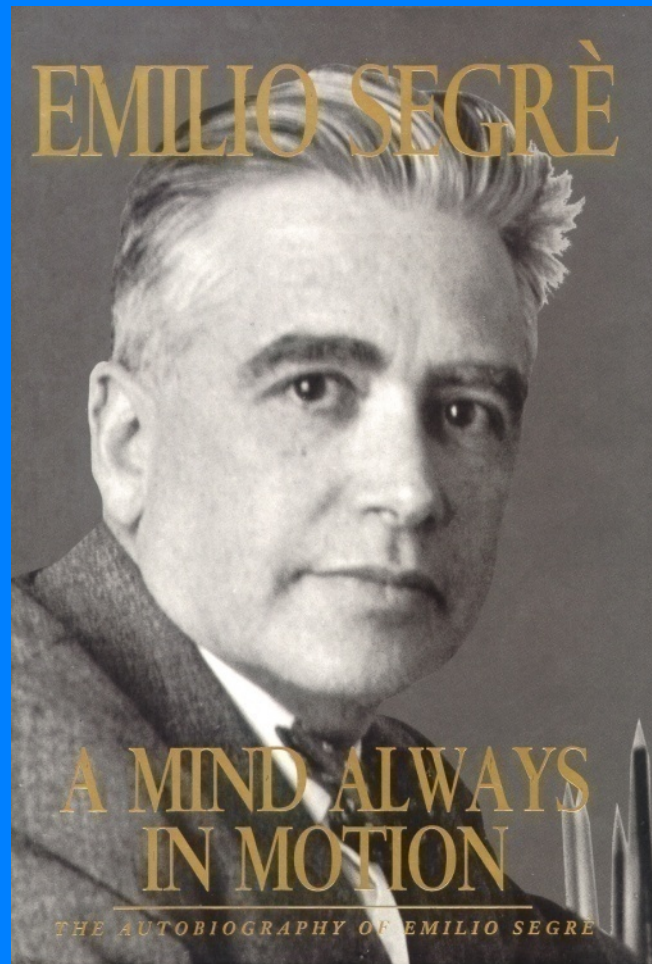
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Request to the civil patent office of USAEC	13 October 48	Giannini and L. Bernard EF+ES 1,9 M\$
Trial against the USA Government	15 August 50	Giannini and L. Bernard 10 M\$

1 September 1950: Pontecorvo disappears

November 52 : each inventor receives 28,000\$

Emilio's opinion of the patent history

“The shenanigans used by the lawyers to obstruct and minimize the “just compensation” ended by disgruntling Fermi to the extent that he declined reappointment to important government advisory boards.”



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“The treatment we received as inventors from the U.S. government reflects the mind-set of lawyers and bureaucrats, who believed that by squeezing the inventors as much as possible, they were properly serving the government.”

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“The treatment we received as inventors from the U.S. government reflects the mind-set of lawyers and bureaucrats, who believed that by squeezing the inventors as much as possible, they were properly serving the government.”

“They may have saved a few dollars, but how much did they lose in the advice a person as Fermi could have given to the government?”

“And what about the goodwill of many others?”

1978: on the occasion of Edoardo's 70th birthday

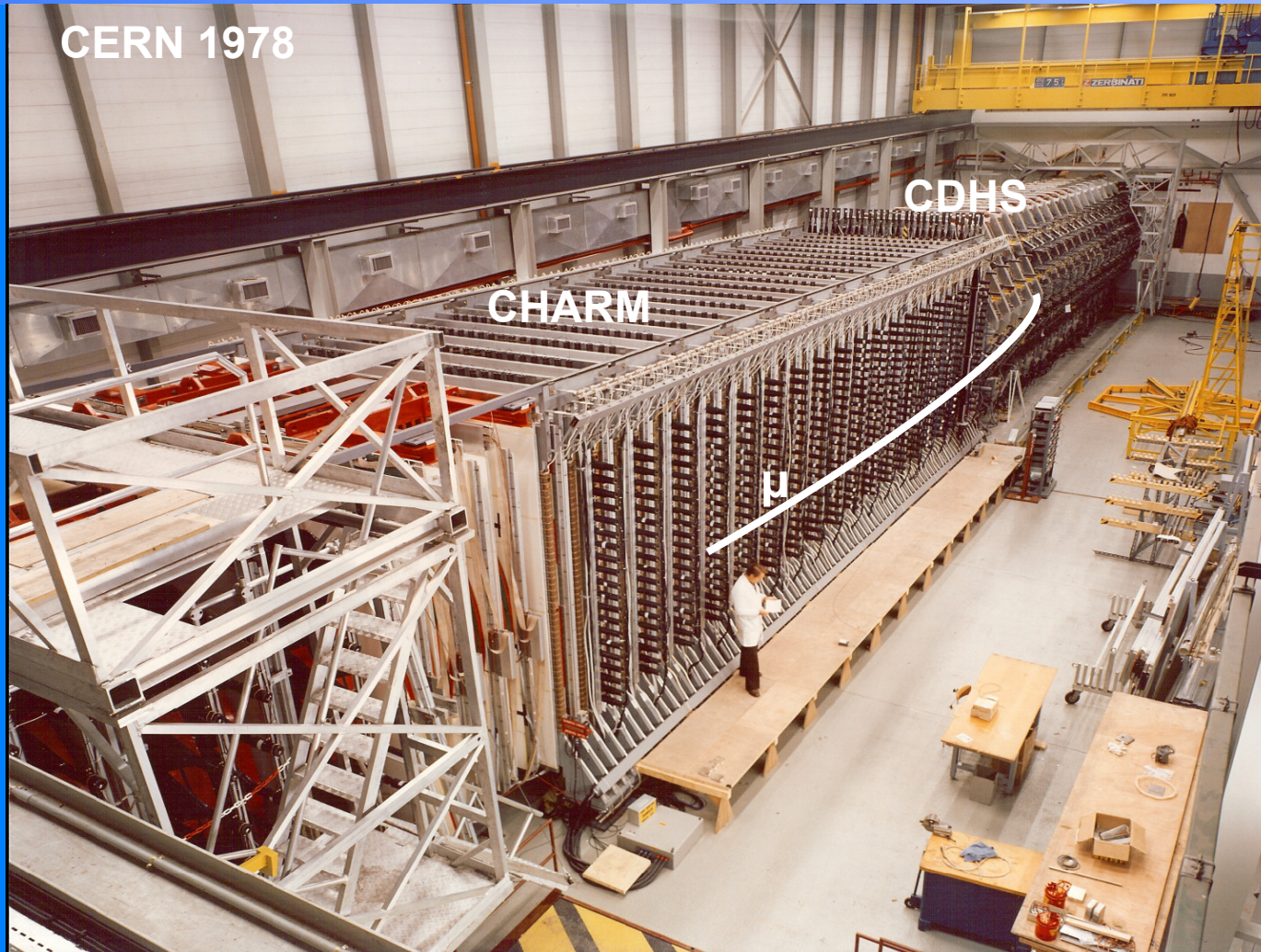


Bruno

Emilio

Edoardo

Neutrino experiment of the Cern-Hamburg- Amsterdam-Rome- Moscow collaboration



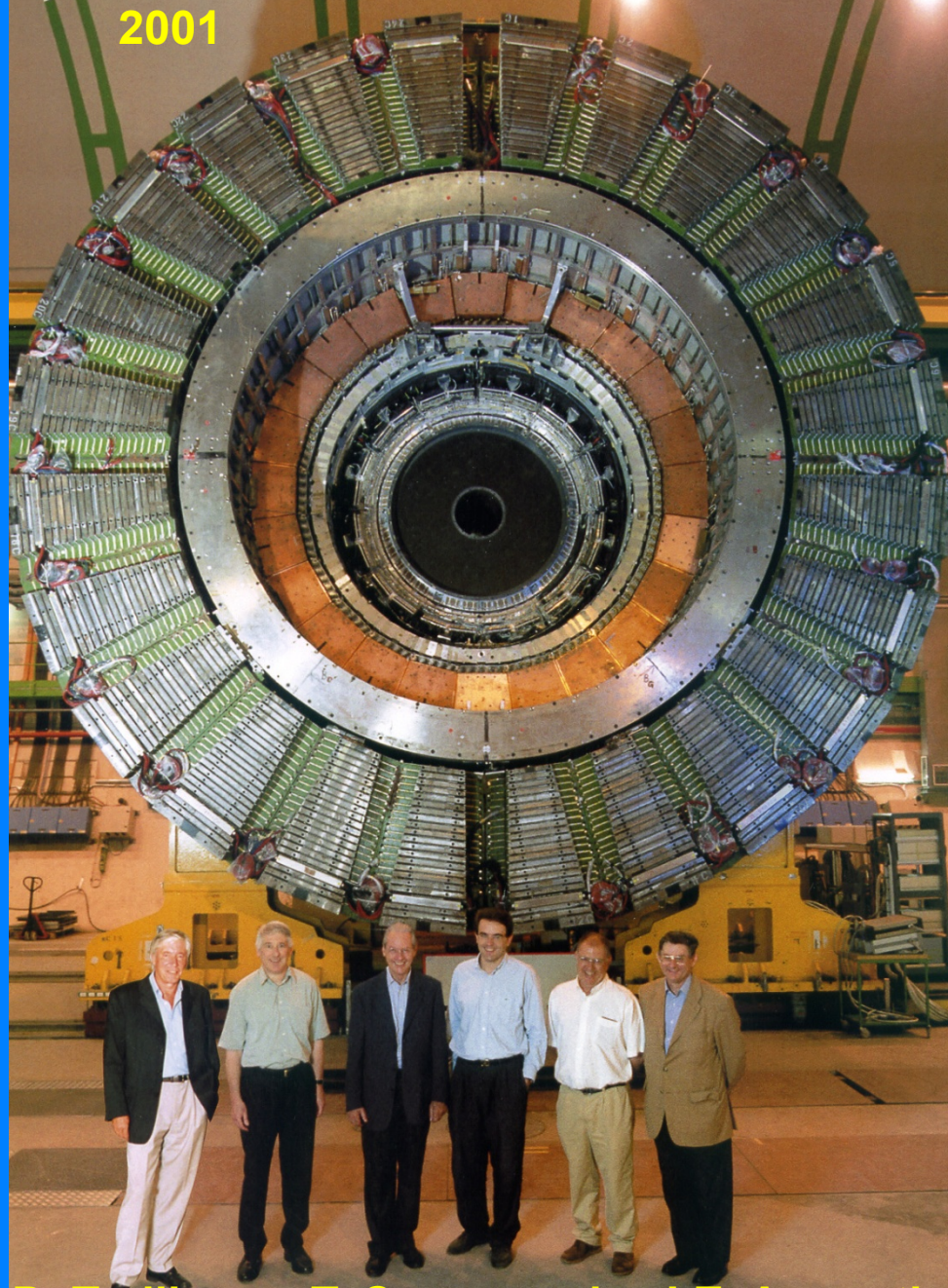
Spokesperson: Klaus Winter

Guido Barbiellini: neutrino+electron scattering

The DELPHI Collaboration at LEP

2001

DELPHI 1980-2000



D. Treille T. Camporesi J.E. Augustin
J. Timmermans W.Venus

Letter by Bruno when the Dubna group was formed



Guenakh Mitselmakher

**Giuseppe Fidecaro was Chairman of the
CERN-USSR Committee**

Letter by Bruno when the Dubna group was formed

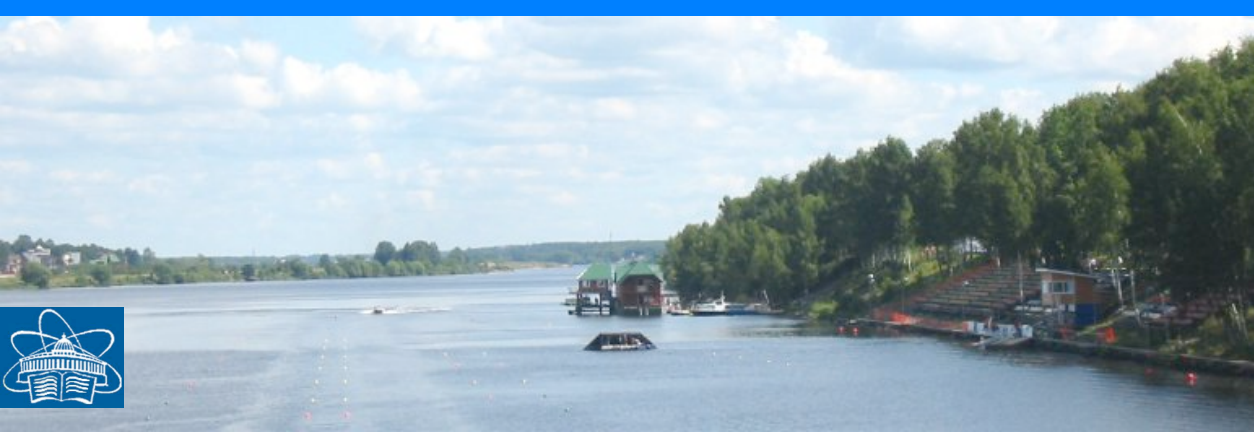


Nikolay Bogolyubov
JINR Director



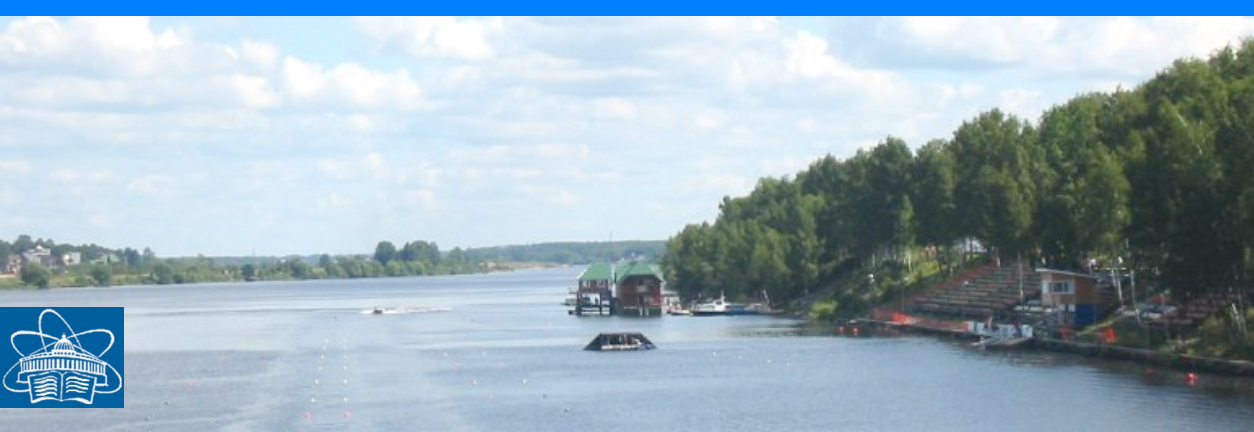
Vladimir Kadyshevsky
Leader of the DELHI-JINR group
83-85

Other minor episodes



The Dubna cottage





The Dubna cottage



EA: “Bruno è sempre stato un ingenuo”

Message by Edoardo Amaldi to the President of the Academy of Sciences of the USSR

ANDREI SAKHAROV FROM EXILE



International League for Human Rights
New York, October 1983



End of LEP pilot run: 18 August 1989

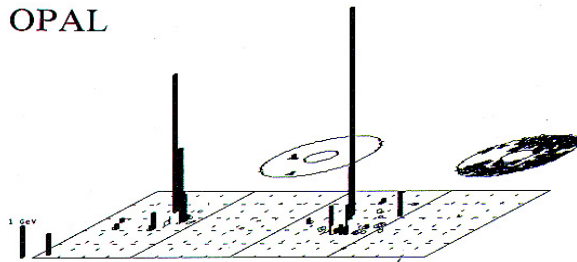


IMAGES

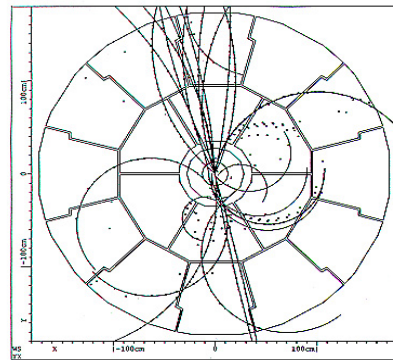
CERN European Laboratory
for Particle Physics
CH - 1211 Geneva 23
Editor: Henri-Luc Felder / AG
Tel.: 767.48.97 / 767.41.03

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OPAL



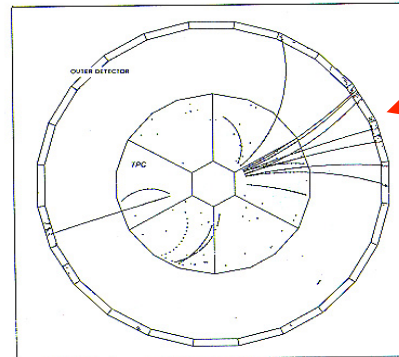
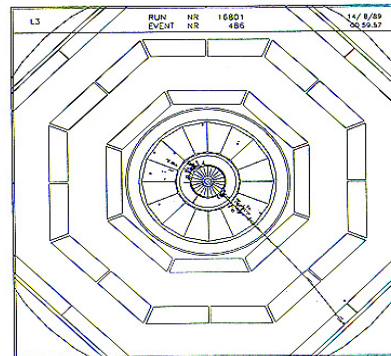
13 août: premières collisions à LEP
August: LEP's first collisions



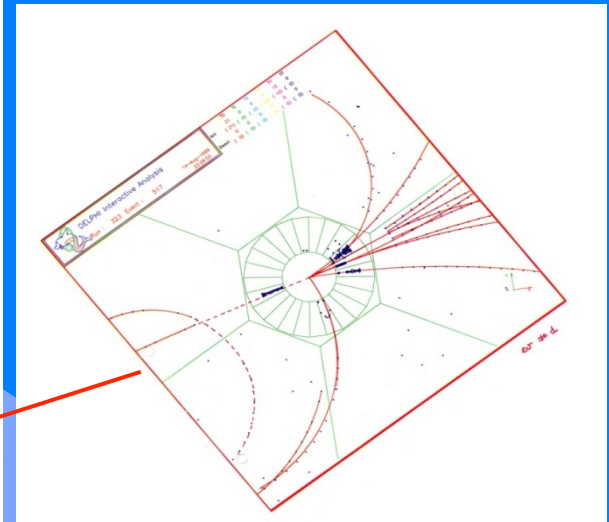
ALEPH

Des particules Z^0 dans chacun des quatre détecteurs LEP.
 Z^0 's from the four LEP detectors.

L3

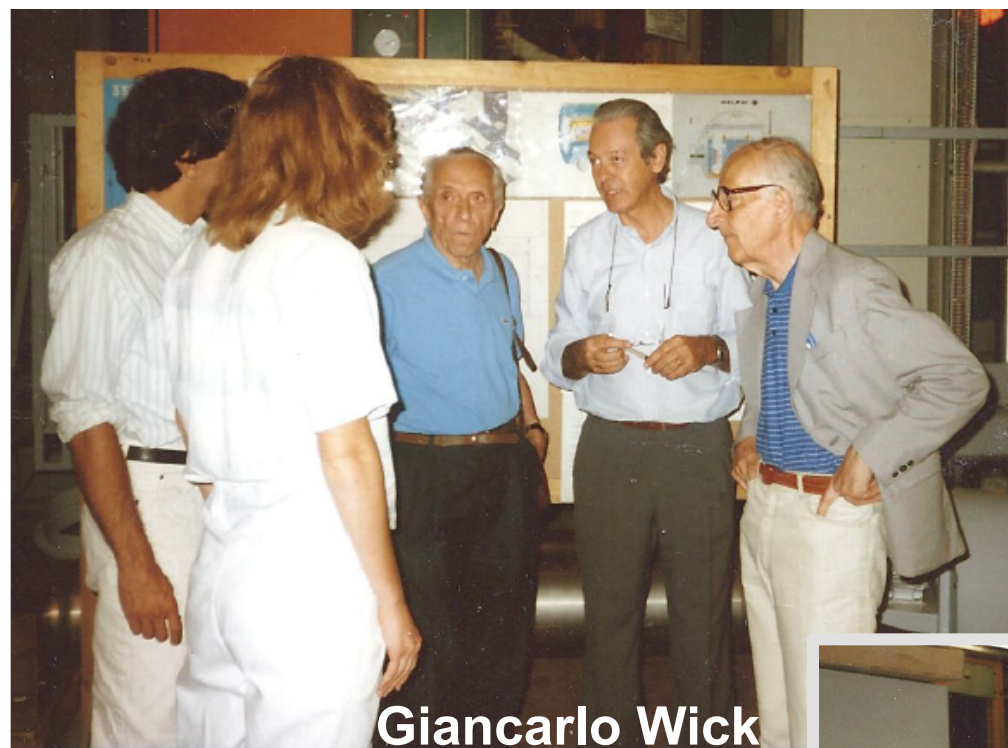


DELPHI



Visit to DELPHI

25 August 1989



Giancarlo Wick



Giuseppe Cocconi

Alan
Cocconi

Visit to DELPHI

25 August 1989

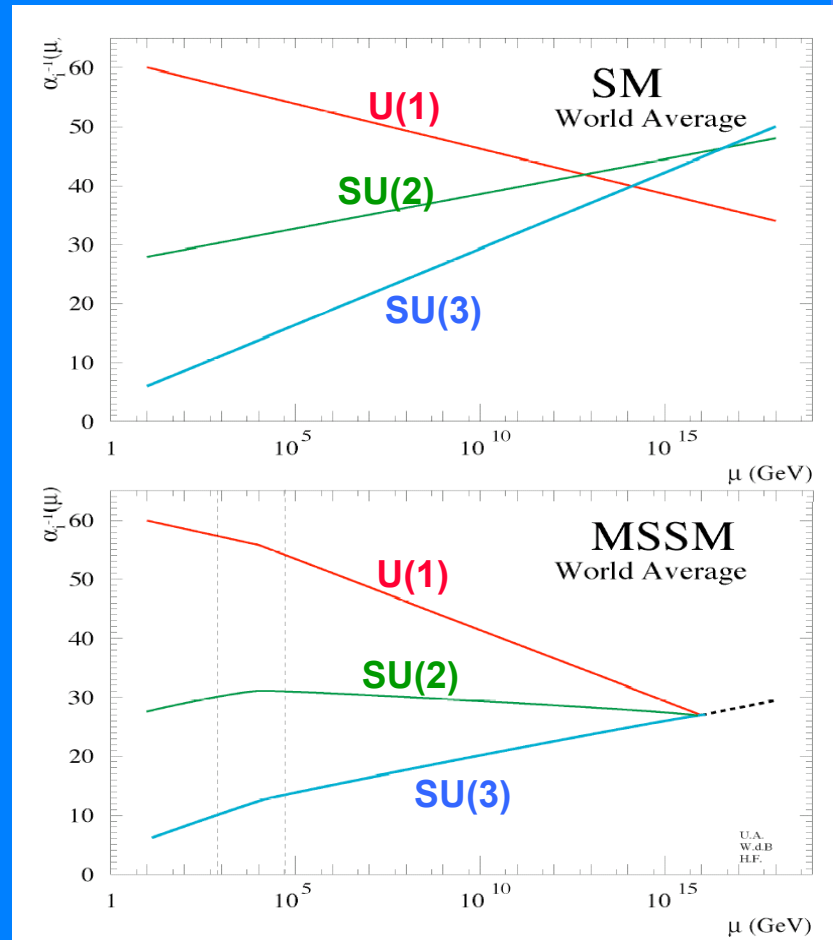






S. Bilenky

**Seminar on the results obtained by DELPHI
in the first six months**



Paper in preparation:

UA - Wim de Boer - Hermann Fürstenau

***DUBNA
Scientific
Council
January 1991***

