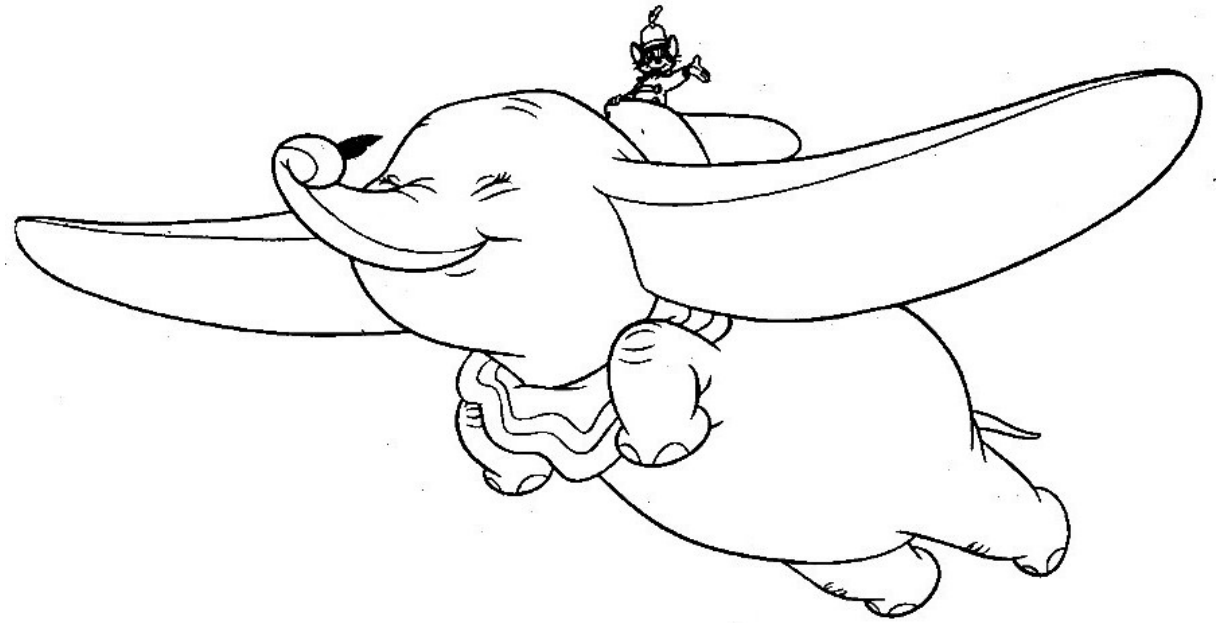
The discovery of the antihyperon $\overline{\Sigma}^{+}$
A Roman story at the particle zoo

Adele La Rana

University of Macerata & INFN Rome 1 &

Italian Society for the History of Physics and Astronomy

***The Rise of Particle Physics* - Rome, 23-24 September 2024**



Consulted archives:

- Archive Edoardo Amaldi, Sapienza (Rome)
- Rectorate Archives, Sapienza (Rome)
- Nobel Prize Archive, Swedish Academy (Stockholm)
- Emilio Segrè Papers, Bancroft Library (Berkeley)
- Owen Chamberlain Papers, Bancroft Library (Berkeley)
- Gerson Goldhaber Papers, Bancroft Library (Berkeley)

The $\overline{\Sigma}^{+}$ team in Rome

Edoardo Amaldi

Lina Galtieri

Giustina Baroni

Carlo Castagnoli

Max Ferro-Luzzi

Augusta Manfredini

IL NUOVO CIMENTO Vol. XVI, N. 2 16 Aprile 1960

Production and Decay of an $\overline{\Sigma}^{+}$.

E. Amaldi, A. Barbaro-Galtieri, G. Baroni, C. Castagnoli,
M. Ferro-Luzzi, A. Manfredini, M. Muchnik, V. Rossi and M. Severi

Istituto Nazionale di Fisica Nucleare - Sezione di Roma
Istituto di Fisica dell'Università - Roma

Mario Muchnik

V. Rossi

Marco Severi

The zoo or… jungle of particle physics in 1960

1937: **mesotron**, later called **muon** (thought to be a particle predicted in 1935, turned to be unpredicted in 1946)
1947: **pion** (predicted in 1935)
1947-1953: V-particles (characteristic forked tracks), gradually distinguished in **kaon or K meson, lambda barion Λ, sigma barion Σ, xi barion Ξ** (all *strange particles*, unpredicted)
1955: **antiproton** (predicted)
1956: **neutrino** (predicted since 1930)
1958: anti-lambda barion (predicted)
1960: anti-sigma minus (predicted) and **anti-sigma-plus** (predicted)

Table of known particle in Ginestra Amaldi's popular book

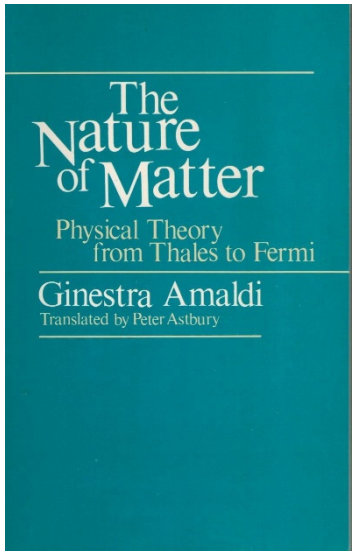
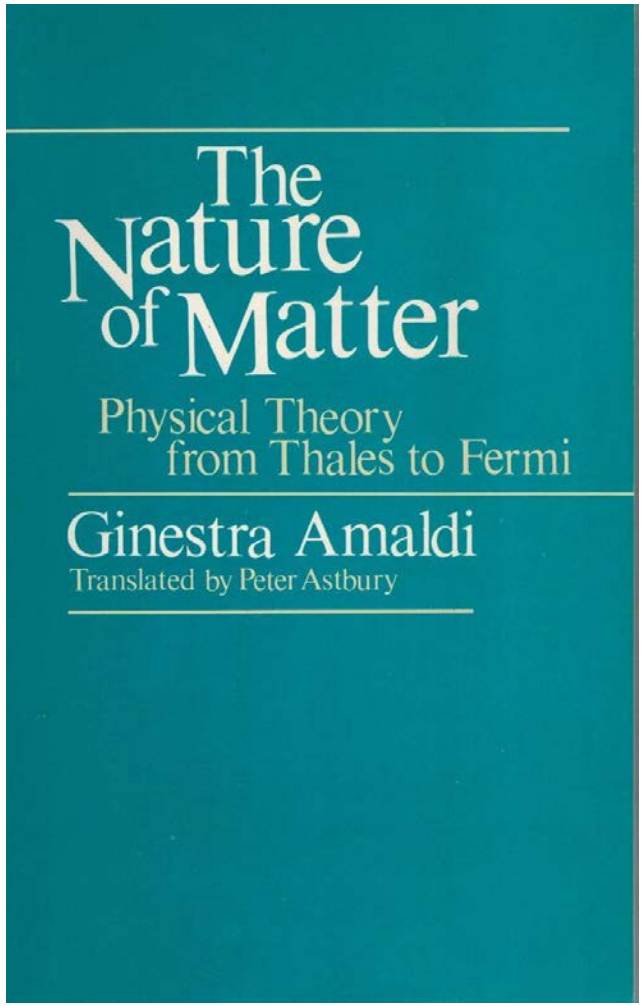


TABLE III

I	II	III	IV	V	VI	Particles		Spin
p^+ n°	p^+ n° $\bar{n}^\circ$ $\bar{p}^-$	p^+ n° $\bar{n}^\circ$ $\bar{p}^-$	p^+ n° $\bar{n}^\circ$ $\bar{p}^-$	p^+ n° $\bar{n}^\circ$ $\bar{p}^-$	Ξ° Ξ^- $\bar{\Xi}^+$ $\bar{\Xi}^\circ$ Σ^- Σ° Σ^+ $\bar{\Sigma}^-$ $\bar{\Sigma}^\circ$ $\bar{\Sigma}^+$ λ° $\bar{\lambda}^\circ$ p^+ n° $\bar{n}^\circ$ $\bar{p}^-$	XI Sigma Lambda Nucleon (proton, neuton)	Barions	$\frac{1}{2}$
		π^- π° π^+	π^- π° π^+	π^- π° π^+	K^+ K° $\bar{K}^\circ$ $\bar{K}^-$ K_1° K_2° $\bar{K}_1^\circ$ $\bar{K}_2^\circ$ π^- π° π^+	K Pion	Mesons	0
e^-	e^- e^+	e^- e^+	e^- e^+ ν° $\bar{\nu}^\circ$	μ^- μ^+ e^- e^+ ν° $\bar{\nu}^\circ$	μ^- μ^+ e^- e^+ ν° $\bar{\nu}^\circ$	Muon Electron Neutrino	Leptons	$\frac{1}{2}$
γ	γ	γ	γ	γ	γ	Photon		1

Matter and Anti-matter, a 1961 book by Ginestra Amaldi

Italian edition -1961



English edition -1966

Ginestra Giovene (1913-1994) graduated in physics at Sapienza University in 1931 and married Edoardo Amaldi in 1933

Roman search for antihyperons begins

A FEW REMARKS ABOUT THE PLANNING OF AN EXPERIMENT DEVOTED TO THE DETECTION OF ANTIHYPERONS ($\bar{\Lambda}^0, \bar{\Sigma}^+, \bar{\Sigma}^-$) PRODUCED BY ANTIPROTON REACTIONS.-

Emulsions Group - Roma - January 1959

By exposing a stack of 175 emulsions of 600 μ x 25 cm x 15 cm to a beam of 2500 $\bar{p}$ of $T_{\bar{p}}$ = 1000 MeV kinetic energy, one expects to find between $\sim$ 5 and $\sim$ 30 $\bar{\Sigma}^+$. The total number of incident $\bar{p}$ could be increased provided the background due to minimum ionization tracks were kept below 10^6 tracks/ cm^2.

1. Production of antihyperons — Page 1
2. Kinematics of production — 2
3. Kinematics of decay — 3
4. Estimate of cross section
   4.1 Target free and at rest — 4
   4.2 Effect of binding energy — 5
5. Scheme for experiment with emulsions — 8

Bibliography

(1) C.O. Beasley and W.G. Holladay Suppl.N.Cim. 7, 77 (1958)

(2) Baldo-Ceolin and Prowse N.Cimento 4, 635 (1958)

(3) E.Fermi, Progr.Theor.Phys., 5, 570 (1950)

(4) Antiproton col. Exp. - Phys.Rev. 105, 1037 (1957)

(5) M.Gell-Mann, Phys.Rev., 106, 1296 (1957)

(6) E.Segré, Antiprotons Annual Rev.Nuclear Science

(7) Emulsions group - Rome - Congress of the Italian Physical Society - Palermo, Nov.1958.

(8) J.R.Fulco - Private com.

(9) J.M.Wilcoxand B.J. Moyer, Phys.Rev., 99, 875 (1955)

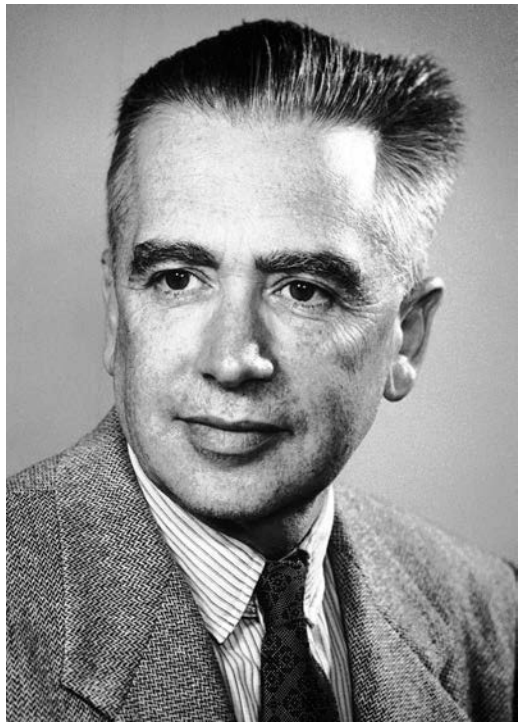
(10) E.Amaldi, Internal Report, December 1955

(11) Cork, Bruce, Lambertson, Piccioni, Wenzel - Phys.Rev. 107, 248 (1957)

Amaldi Archive

Two friends and an antihyperon

Edoardo Amaldi (1950s)



Emilio Segrè (1950s)

Amaldi to Owen Chamberlain in Berkeley, Feb. 6th 1959

Dear Owen,

In connection to the letter sent by Emilio to Gerson and to you some days ago, we should be glad to know from you the transversal dimensions of the beam of antiprotons.

Here in Rome life is going quite well. The synchrotron has given 300 MeV before Christmas with the single cavity. The second cavity is now mounted and we hope to have the full energy in a reasonable time.

Emilio is leaving for Scandinavia for a few seminars and he will be away a few weeks.

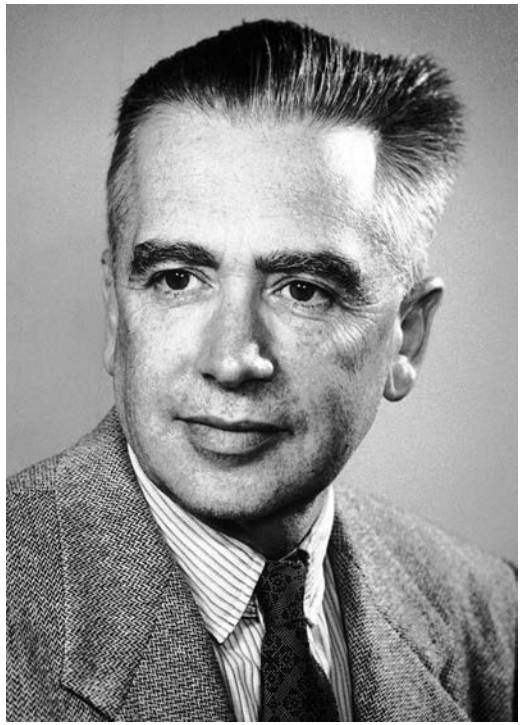
We should be very pleased if the irradiation for the production of antihyperons would be possible. We should be glad to know as soon as possible if the irradiation is made and when, since we have to write to Ilford in advance for preparation of emulsion stacks to be sent to Berkeley.

Best wishes to you and your family.

Sincerely,

Two friends and an antihyperon

Edoardo Amaldi (1950s)



Emilio Segrè (1950s)

Amaldi to Gerson Goldhaberin Berkeley, Feb. 10th 1959

Dear Gerson,

I thank you very much for your very extensive letter on the use of punched cards for antiprotons events. We will use them according to your instructions.

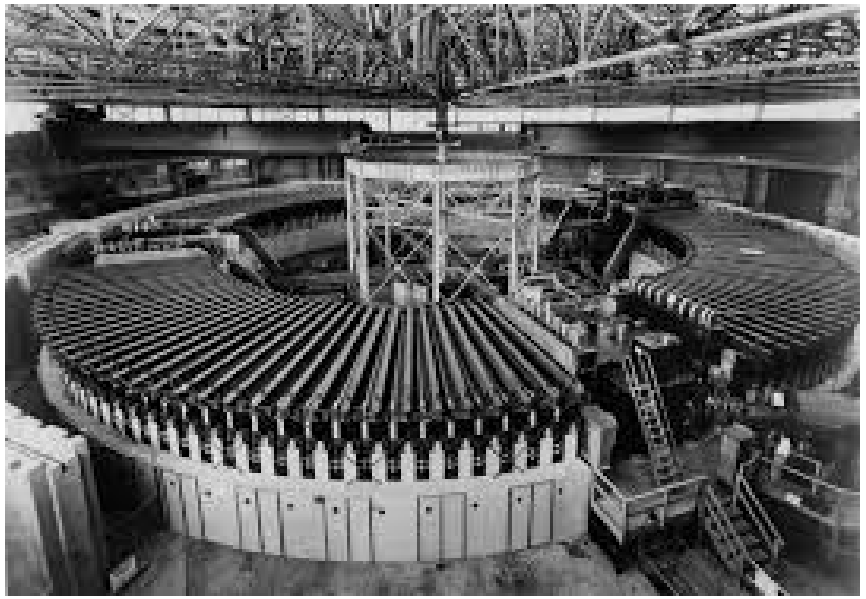
In our stack we have found almost 700 antiprotons stars and we have finished investigating primaries. The investigation of stars will continue for two more months. In the investigation of primaries we have constructed the small angle scattering from 1.5° on. It agrees very well with the one published by you and Sandweiss. In order to make the comparison with a similar hystogram we have obtained with protons of 140 MeV, we would like to separate out of all the data on antiprotons those referring to an energy interval extending from 140 to 140 MeV and from 140 to 170 MeV. Therefore we should be very grateful to you if you would send to us your data referring to the above mentioned energy interval, starting from 1.5° projected angle (in you paper you gave only the data from 2° on).

At the beginning of February Emilio has sent to Owen Chamberlain and to you a few considerations that we made on the research of antihyperons.

With best wishes to you and Sula.

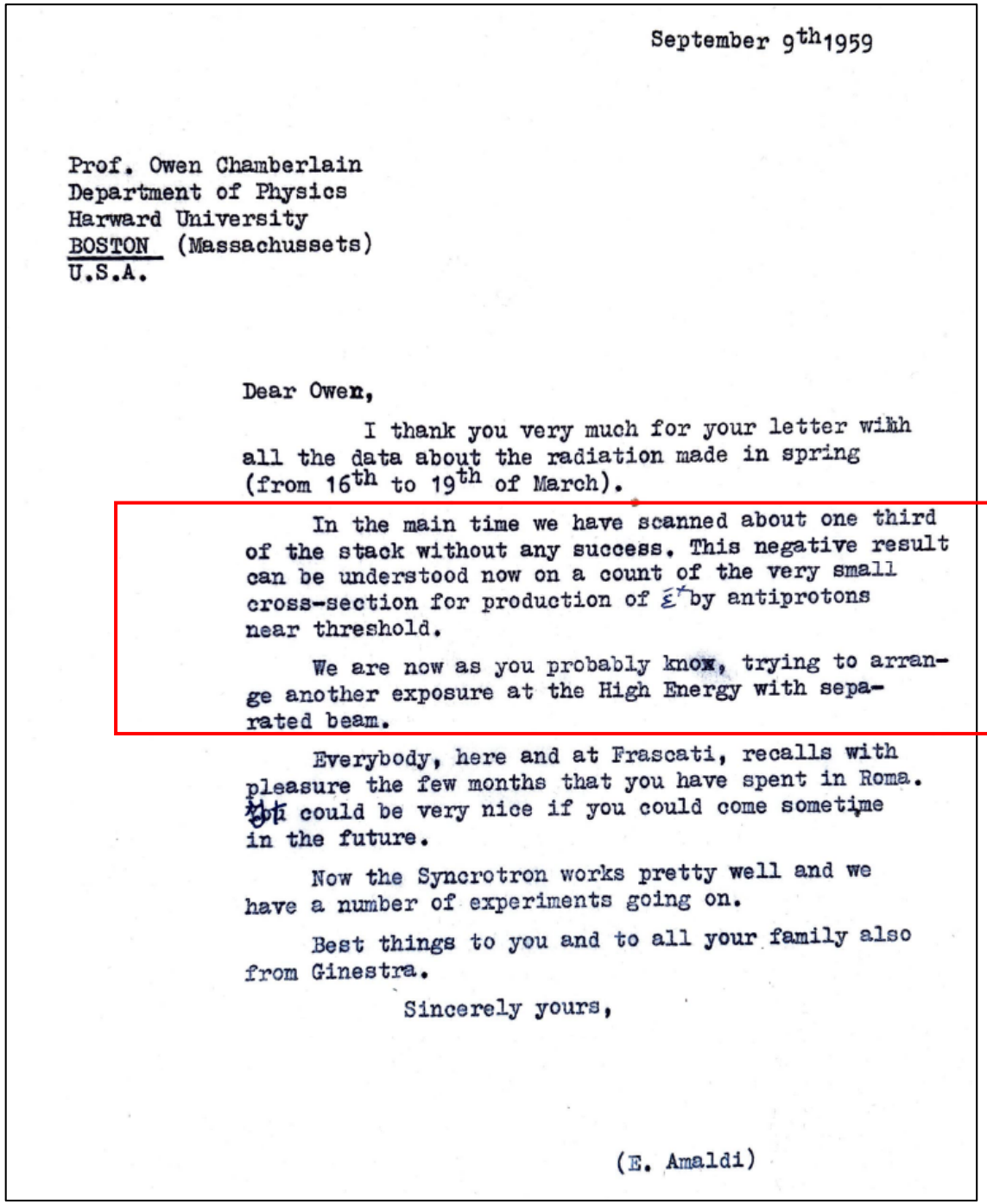
Sincerely yours,

A timeline of the search for $\overline{\Sigma}^{+}$ by Amaldi's team



Bevatron at the Lawrence Berkeley National Laboratory

- **March 16-19, 1959:** emulsion stack exposed in high energy antiproton beam and then sent from Berkeley to Rome. Momentum of the beam: **1.65 GeV/c**.
- **Late April 1959:** the scans of the emulsion started.
- **Early September 1959:** about one third of the stack scanned "without much success". The main inconvenience is very high background. Amaldi writes to Goldhaber on Sept. 2, saying that their current experience showed that "the background should not exceed 10^5 cm^2". So they arranging another stack exposure to a more powerful antiproton beam.
- **October 1959:** a new emulsion stack is exposed to a purified antiproton beam. With momentum of **2.05 GeV/c** .
- **April 11, 1960**: seminar held by Castagnoli and Manfredini at Sapienza, presenting the evidence for antisigma discovery
- **April 15, 1960**: the discovery paper is submitted as a "letter to the editor" to Il Nuovo Cimento



September 9th 1959

Prof. Owen Chamberlain
Department of Physics
Harward University
BOSTON (Massachussets)
U.S.A.

Dear Owen,

I thank you very much for your letter with all the data about the radiation made in spring (from 16th to 19th of March).

In the main time we have scanned about one third of the stack without any success. This negative result can be understood now on a count of the very small cross-section for production of $\bar{\Sigma}^+$ by antiprotons near threshold.

We are now as you probably know, trying to arrange another exposure at the High Energy with separated beam.

Everybody, here and at Frascati, recalls with pleasure the few months that you have spent in Roma. It could be very nice if you could come sometime in the future.

Now the Syncrotron works pretty well and we have a number of experiments going on.

Best things to you and to all your family also from Ginestra.

Sincerely yours,

(E. Amaldi)

Amaldi to Chamberlain September 9, 1959:

«In the main time **we have scanned about one third of the stack without any success**. This negative result can be understood now on a count of the **very small cross-section for production of $\bar{\Sigma}^+$ by antiprotons near treshold**.
We are now as you probably know, trying to **arrange another exposure at the High Energy** with separated beam.»

Amaldi Archive

UNIVERSITY OF CALIFORNIA

RADIATION LABORATORY
BERKELEY 4, CALIFORNIA

June 8, 1959

Prof. E. Amaldi
Istituto di Fisica "Guglielmo Marconi"
Piazzale delle Scienze, 5
Roma, ITALIA

Dear Prof. Amaldi,

In reply to your letter of May 27, we have two separated antiproton beams scheduled for the near future. An experiment by our group is about to begin and will continue until about July 1. At 1.7 Bev/c the separation will be modest, no more than a factor of 10, but the flux will be high. Since it is not so long until this run ends, it would be difficult to acquire the emulsions in time. I have inquired of Goldhaber and Barkas for emulsions; but there don't seem to be any spares around.

Another suggestion, made by Prof. McMillan, is that you wait until the $\bar{p}$ beam for the 72" chamber is set up. This experiment will begin about July 1 and run for two months. The beam should be very pure. If this beam proves successful, emulsions can be exposed some time in August or early September. This will allow time for arrangements after we know how good the beam is. Gerson Goldhaber has offered to look after an exposure for you.

Sincerely yours,

W. A. Wenzel

cc: E. J. Lofgren
E. M. McMillan
G. Goldhaber

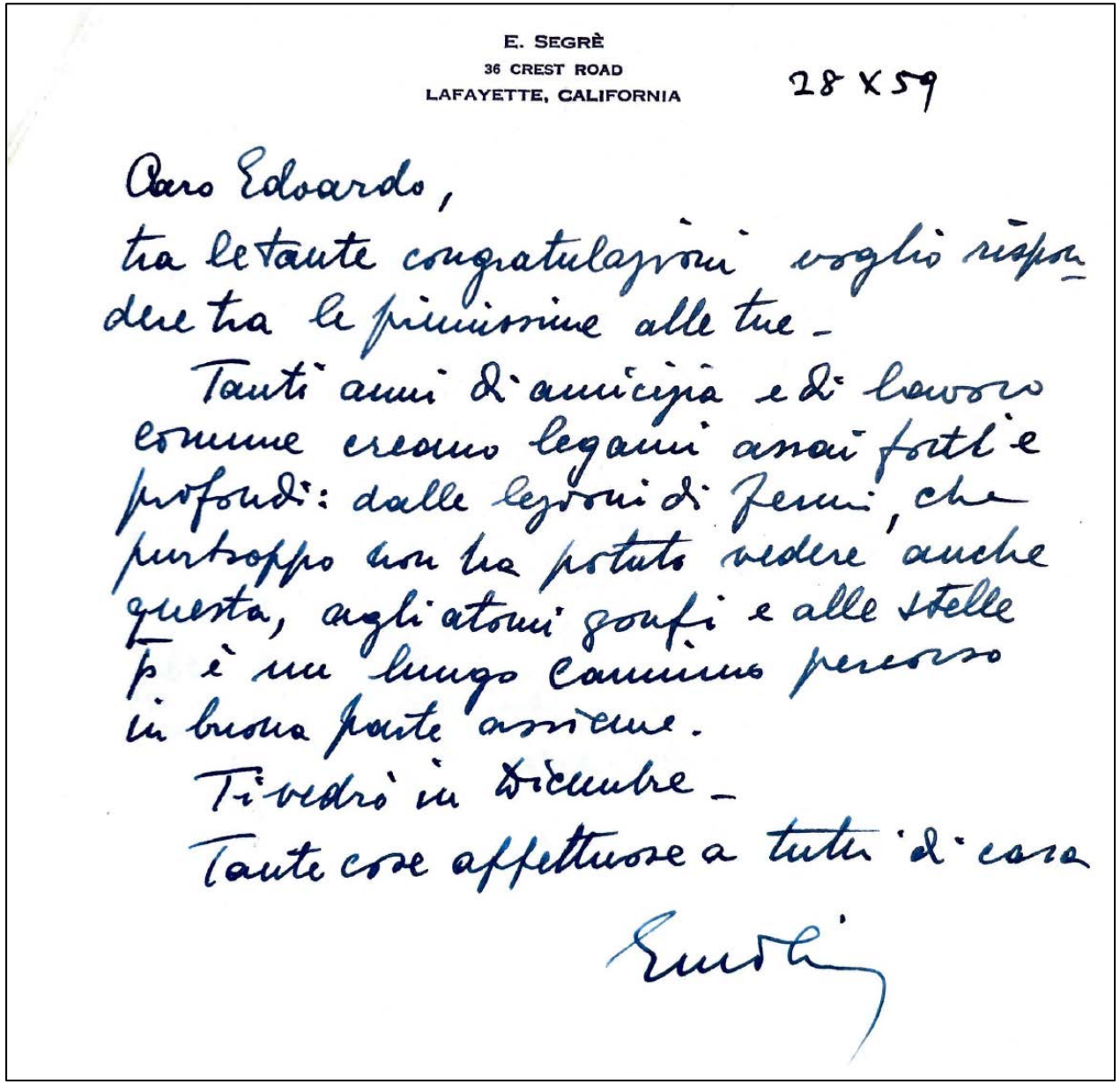
Two alternatives for the second exposure of the emulsion stack to a «separated beam»:

1) **June- early July 1959: antiproton beam of momentum 1.7 BeV/c, modest separation but high flux**

2) **Later in 1959: purified antiproton beam in preparation for the 72 inch liquid hydrogen bubble chamber (suggestion by McMillan) «*The beam should be very pure. If this beam proves successful, emulsions can be exposed some time in August or early September.*»**

Amaldi Archive

In the meantime… the Nobel Prize to Segrè and Chamberlain is announced



E. SEGRÈ
36 CREST ROAD
LAFAYETTE, CALIFORNIA

28 X 59

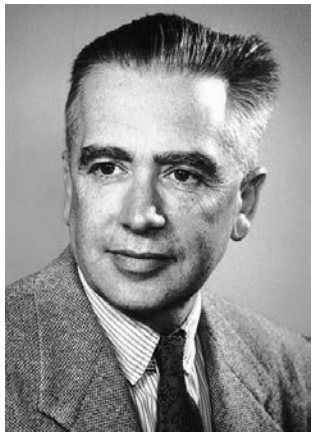
Caro Edoardo,
tra le tante congratulazioni voglio rispondere tra le primissime alle tue -

Tanti anni di amicizia e di lavoro comune creano legami assai forti e profondi: dalle lezioni di Fermi, che purtroppo non ha potuto vedere anche questa, agli atomi gonfi e alle stelle p è un lungo cammino percorso in buona parte assieme.

Ti vedrò in dicembre -

Tante cose affettuose a tutti di casa

Emilio



October 28, 1959

Dear Edoardo,
among the many congratulations I wish to respond to yours among the very first. Many years of friendship and shared work create very strong and deep bonds: **from Fermi's lectures, who unfortunately could not see this event, to swollen atoms and antiproton stars, it is a long journey traveled largely together.**
I'll see you in December.
Many loving things to everyone at home.

Amaldi Archive

April 11, 1960: a seminar at the Physics Intitute at Sapienza

EDOARDO AMALDI

Istituto nazionale di fisica nucleare

Sezione di Roma

Attività svolta durante l'anno 1959-1960

ROMA
CONSIGLIO NAZIONALE DELLE RICERCHE
1962

A report of the **activities at the Institute in Rome since July 1, 1959 to June 30, 1960**. Among the **main research activities**, the first listed is:

Emulsioni nucleari. (E. AMALDI, A. BARBARO-GALTIERI, G. BARONI, G. BELLETTINI, C. CASTAGNOLI, M. FERRO-LUZZI, A. MANFREDINI, M. MUCHNIK, V. ROSSI, M. SEVERI)

Il gruppo che studia le emulsioni nucleari ha continuato l'analisi delle lastre esposte a Berkeley ad un fascio di antiprotoni di 2.05 GeV/c contenente circa un $\bar{p}$ per ogni 4 particelle di fondo. Sulle 2400 stelle studiate è stato trovato un evento che presenta tutte le caratteristiche di un antisigma più.

The **list of seminars** shows the one devoted to presenting the evidence of the production and decay of anti-sigma +:

(27)	5 aprile	»	– Prof. M. JEAN (Orsay): L'interprétation collective des premiers niveaux excités des noyaux pair-pair.
(28)	11	»	» – Prof. C. CASTAGNOLI, Prof. A. MANFREDINI (Roma): Evidenza per la produzione e il decadimento dell'anti-sigma+.
(29)	12	»	» – Ing. G. B. GERACE (Pisa): Una unità di controllo veloce per calcolatrici elettroniche.

The discovery paper of the anti-hyperon $\overline{\Sigma}^+$

IL NUOVO CIMENTO VOL. XVI, N. 2 16 Aprile 1960

Production and Decay of an $\overline{\Sigma^+}$.

E. AMALDI, A. BARBARO-GALTIERI, G. BARONI, C. CASTAGNOLI, M. FERRO-LUZZI, A. MANFREDINI, M. MUCHNIK, V. ROSSI and M. SEVERI

Istituto Nazionale di Fisica Nucleare - Sezione di Roma
Istituto di Fisica dell'Università - Roma

(ricevuto il 17 Aprile 1960)

1. – About one year ago we started a search for $\overline{\Sigma^+}$ by exposing emulsion stacks to antiproton beams of the Bevatron of the Radiation Laboratory in Berkeley. A first exposure, in March 1959, to a beam of 1.65 GeV/c momentum (1), did not give any positive result. A second exposure was made in October 1959 to the 2.05 GeV/c purified $\overline{p}$ beam (2). In the course of the scanning of this stack (175 G-5 emulsions 600 μm thick) we observed the event shown schematically in Fig. 1.

Track 1 belongs to the beam of negative incident particles, the composition of which corresponds, very roughly, to 1 antiproton for every 2 pions and 1 muon. The angle of dip of the incident particle is 1°; the center of star A is in emulsion No. 69, point C in emulsion No. 67 and the center of star B in emulsion No. 66.

TABLE I.

Track no.	Angle	Observed range (cm)	$p\beta$ (MeV/c)	w_0/w	n/n_0	β	Mass (MeV)	Identification
2	5° 10′	1.79	1 430±210	1.12±.04	1.09±.03	.76±.03	1 600±300	$\overline{\Sigma^+}$
3	2° 27′	0.85	685±100	1.18±.04	1.12±.03	.71±.03	970±190	$\overline{p}$

w_0 and n_0 correspond to measurements on tracks of the incident antiprotons.

Table I shows the $p\beta$ – derived from scattering measurements –, the mean gap-length w and the number of blobs n for tracks 2 and 3; it contains also the values of the corresponding masses, deduced by combining the $p\beta$ with the β

(1) T. ELIOFF, L. AGNEW, O. CHAMBERLAIN H. STEINER, C. WIEGAND and T. YPSILANTIS: *Phys. Rev. Lett.*, 3, 285 (1959).

(2) Our stack was exposed to the purified $\overline{p}$ beam prepared for the 72 inch Hydrogen Bubble Chamber of the Alvarez Group.

Search for $\overline{\Sigma}^+$ by exposing emulsion stacks to antiproton beam of Bevatron

1° exposure in March 1959, antiproton beam **1.65 GeV/c** : **No positive result**

2° exposure in October 1959, purified antiproton beam **2.05 GeV/c** (prepared for the 72 inch Hydrogen Bubble Chamber of the Alvarez Group).

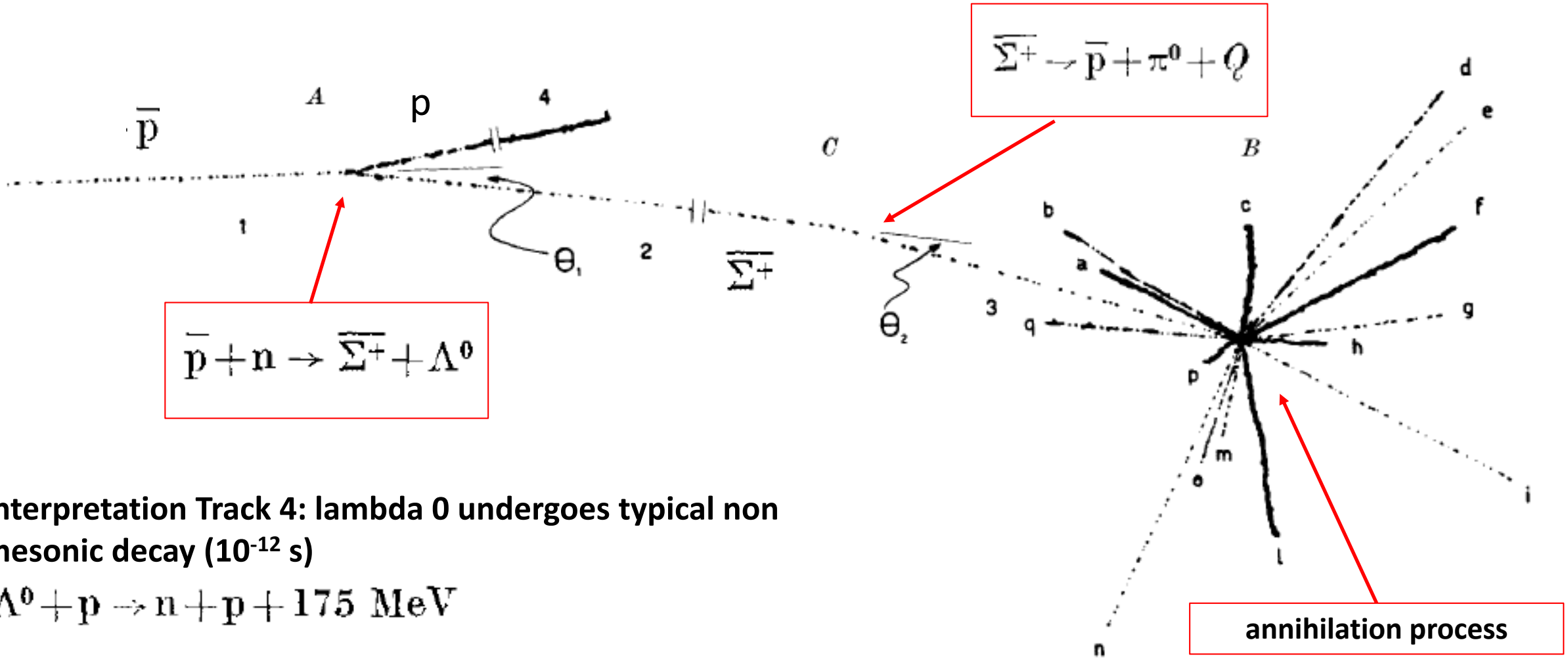
Beam: 1 antiproton for every 2 pions and 1 muon
175 G-5 emulsions 600 μm thick

About 2400 stars analysed: **1 good candidate event**

"We express our gratitude to **Dr. Wenzel** and the Bevatron staff, to **Prof. L. Alvarez** and his group, to **Prof. O. Chamberlain** and colleagues and to **Prof. G. Goldhaber** for their precious assistance in arranging and carrying out the exposures of the stacks."

E. Amaldi, A. Barbaro-Galtieri, G. Baroni, C. Castagnoli, M. Ferro-Luzzi, A. Manfredini, M. Muchnik, V. Rossi, M. Severi, *Production and decay of an* $\overline{\Sigma}^+$, Il Nuovo Cimento Vol. 16(2), 392-395 (**April 16, 1960**). **Received on April 17**.

The discovery paper of the anti-hyperon $\overline{\Sigma}^{+}$



Interpretation Track 4: lambda 0 undergoes typical non mesonic decay (10^{-12} s)

$$\Lambda^0 + p \rightarrow n + p + 175\ \text{MeV}$$

The discovery of the of the antihyperon $\overline{\Sigma}^{+}$ on Italian newspapers

Nel supplemento: IL RACCONTO COMPLETO DI G. TOMASI DI LAMPEDUSA

Anno XII - Numero 92 - L. 30

Ultimissima della notte

PAESE SERA

SENSAZIONALE SCOPERTA

DI TRE FISICI A ROMA

AMALDI, CASTAGNOLI e MANFREDINI hanno individuato una nuova particella atomica che si chiama ANTI-SIGMA PIU'

IN 2ª PAGINA:

Le consultazioni per il centro-sinistra

FANFANI: "Sono soddisfatto,,

IN 3ª PAGINA:

I risultati dell'inchiesta in Sicilia

LE ACCUSE DI SANTALCO NON SONO STATE PROVATE

Esclusiva di "Paese Sera,,

IN 13ª PAGINA:

La caccia ai rapitori di Eric Peugeot

Paese Sera, **Sunday April 17, 1960:**

Sensational Discovery of Three Physicists from Rome. Amaldi, Castagnoli and Manfredini identified a new atomic particle called anti-sigma plus»

The discovery of the of the antihyperon $\overline{\Sigma}^{+}$ on Italian newspapers

AMALDI, CASTAGNOLI e MANFREDINI hanno individuato una nuova particella atomica che si chiama ANTI-SIGMA PIU'

I tre fisici che hanno individuato l'«Anti-Sigma più» (da sinistra): Il prof. Amaldi, il prof. Castagnoli e la prof. Manfredini. Con i proff. Franzinetti e Cortini avevano scoperto l'Antiprotone

Un gruppo di fisici dell'Università di Roma ha scoperto l'esistenza di una nuova particella atomica, denominata « Anti Sigma più ». Si tratta di una scoperta di tale importanza da porre l'Italia allo stesso livello dei Paesi più avanzati in campo nucleare come gli Stati Uniti e l'Unione Sovietica, dato il suo eccezionale interesse agli effetti della conoscenza della struttura del nucleo atomico e delle forze ancora misteriose che ne tengono unite le parti. La scoperta è stata effettuata in questi giorni all'Istituto di Fisica di Roma dal gruppo composto dei professori Edoardo Amaldi (direttore dell'Istituto), Carlo Castagnoli e Augusta Manfredini. Questi stessi fisici nucleari facevano parte del gruppo che scoprì nel 1954 l'esistenza dell'antiprotone nei raggi cosmici (insieme con i professori Cortini e Franzinetti). L'antiprotone fu poi prodotto un'anno dopo con il Bevatrone dell'Università di California da Emilio Segrè e dai suoi colleghi. Per questo Segrè è stato insignito del Premio Nobel, ma ciò non toglie che la priorità della scoperta dell'antiprotone rimane italiana.

(Continua in 6. pagina)

ANGELO COEN

NEI PROSSIMI GIORNI
Un giornalista d'eccezione
CESARE ZAVATTINI
in un reportage d'eccezione
CUBA

IN 2ª PAGINA:
Le consultazioni per il centro-sinistra
FANFANI: "Sono soddisfatto,,

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LE ACCUSE DI SANTALCO NON SONO STATE PROVATE
Esclusiva di "Paese Sera,,

IN 13ª PAGINA:
La caccia ai rapitori di Eric Peugeot

Il piccolo Eric Peugeot fra le braccia della madre

Alla vigilia della santa Pasqua vorremmo veramente immaginarci un'Italia paradisiaca, popolata da uomini tutti buoni, ingenui e generosi come il

UN UOMO E UN GIORNO

Un paio di bravi ragazzi, che non erano neppure caporali, rischiarono la vita per salvarla. Non restava che trasportarla in ospedale. Ma i colonnelli, con tutti i loro gradi, le loro

VENTIQUATTRO ORE

Malgrado gli sforzi del

ARIA COMPRESSA

tutto il

The discovery of the of the antihyperon $\bar{\Sigma}^+$ on Italian newspapers

AMALDI, CASTAGNOLI, MANFREDINI: TRE NOMI ILLUSTRI DELLA FISICA MODERNA

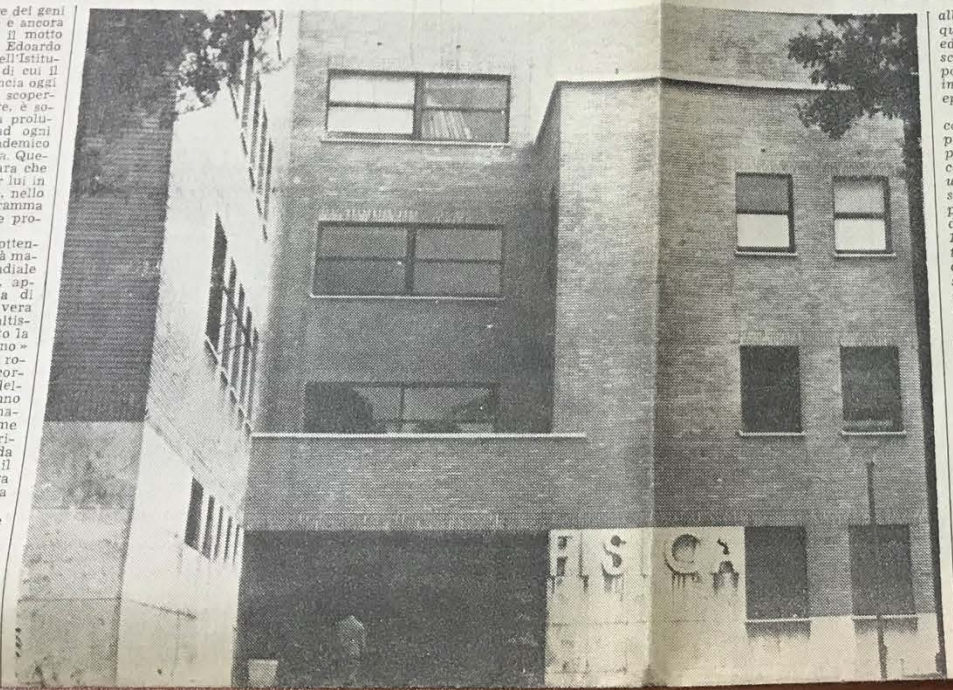
Chi sono gli scopritori dell'"Anti-sigma più,,

Nel 1954, con Franzinetti e Cortini, avevano individuato per la prima volta l'Antiprotone nei raggi cosmici - Il prof. Amaldi, già collaboratore di Enrico Fermi, (con Pontecorvo e Segrè), dirige l'Istituto di Fisica dell'Università di Roma - "Non occorre essere geni ma bisogna studiare,, Il prof. Carlo Castagnoli un lavoratore accanito - La prof. Augusta Manfredini è la prima donna affermatasi in Italia nel campo della fisica

Non occorre essere dei geni ma bisogna studiare e ancora studiare »: è questo il motto con il quale il prof. Edoardo Amaldi, Direttore dell'Istituto romano di Fisica di cui il nostro giornale annuncia oggi la nuova importante scoperta nel campo nucleare, è solito concludere la sua prolusione agli studenti ad ogni apertura di anno accademico dell'Università di Roma. Questa frase gli è tanto cara che pare essersi mutata per lui in una sorta di tradizione, nello emblema di un programma costante, in una vera e propria regola di vita.

Edoardo Amaldi, che ottenne fin dalle soglie dell'età matura una notorietà mondiale nell'ambiente scientifico, appartiene a una famiglia di fisici e matematici, a una vera dinastia di studiosi ad altissimo livello; « ha succhiato la scienza col latte materno » direbbe baroccamente un romanzo popolare. Basta ricordare i due anelli estremi della catena familiare: il nonno Ugo Amaldi, celebre matematico le cui dispense, insieme con quelle del prof. D'Enriquez, sono state sfogliate da generazioni di allievi: e il giovane figlio Ugo, che lavora anch'egli all'Istituto di Fisica dell'Ateneo romano.

Per una consuetudine come quella della famiglia Amaldi, fin cui lo studio e l'analisi sono un abito mentale ormai innato, era naturale che la figura del prof. Edoardo si ponesse in così netta contraddizione con l'idea romantica melensa che di solito ci si fa del « genio », inteso come un talentaccio stravagante, trasandato, svagato,



alla fissione dell'uranio e, quindi, alla pila atomica ed alla bomba atomica, che sconvolsero i rapporti di potenza tra le nazioni ed inaugurarono una nuova epoca.

L'« Anti Sigma più » è, come dice la parola, l'antiparticella della « Sigma più ». Quest'ultima è un così detto « iperone », cioè una particella avente massa superiore a quella del protone. Difatti, la massa del protone equivale a 1836 volte quella dell'elettrone, mentre la massa dell'« Anti Sigma più » ora scoperta, supera di 2300 volte la massa dell'elettrone.

Malgrado il suo nome, l'« Anti Sigma più », non ha carica elettrica positiva, ma negativa. Difatti, essendo l'antiparticella della « Sigma più », positiva, la sua carica elettrica è opposta a quest'ultima. Viceversa, l'« Anti Sigma meno », scoperta dai sovietici, ha carica elettrica positiva.

La scoperta italiana e quella sovietica sono state fatte con procedimenti completamente diversi. Difatti l'« Anti Sigma meno » sovietico è stato prodotto usando come proiettili un fascio di mesoni « pi greco » (particelle più leggere del protone), dotati della

prodotta usando come proiettili antiparticelle.

A tale scopo fu inviato negli Stati Uniti alcuni mesi fa il giovane fisico italiano dell'Istituto di Roma, Muchnik, il quale sottopose le emulsioni fotografiche al fascio di antiprotoni prodotto dal grande Bevatrone di Berkeley. Le emulsioni furono poi riportate a Roma ed analizzate. Siamo di fronte ad un encomiabile esempio di collaborazione internazionale.

Si deve però sottolineare il fatto che l'aiuto americano fu puramente strumentale, e consistette nella semplice messa a disposizione del Bevatrone. Ma la scoperta è interamente italiana. Non siamo cioè di fronte ad un caso di collaborazione scientifica italo-americana come avvenne per la scoperta dell'antiprotone. Nel caso presente invece l'esperimento fu interamente progettato dai soli italiani Amaldi, Castagnoli e Manfredini; fu materialmente eseguito dall'italiano Muchnik, ed i suoi risultati furono completamente analizzati in Italia, senza il minimo intervento di nessuno scienziato americano.

La possibile esistenza dell'eccezionale evento nucleare fu segnalata, come

numerici per individuare se le masse, le velocità, le cariche, delle particelle denunciate dalle tracce corrispondevano a quelle che dovevano essere le caratteristiche dell'evento sperato. Naturalmente la ansia della ricerca e l'entusiasmo per la possibile grande scoperta fecero sì che non venissero misurati né il tempo né le energie.

Il trionfo è stato completo. Oggi non esiste la minima incertezza sulla eventualità che l'evento registrato sia quello così a lungo perseguito, e che la particella individuale sia proprio l'« Anti Sigma più ».

Quali sono le caratteristiche del nuovo fenomeno? Come si è detto, la emulsione fotografica è stata esposta ad un fascio di antiprotoni (dell'intensità di circa un centinaio all'ora) ed aventi l'energia di circa un miliardo e mezzo di elettronvolts. Uno di questi antiprotoni ha urtato contro un nucleo di bromuro d'argento della gelatina fotografica, provocando quella che si può chiamare una « catastrofe nucleare ».

Dal punto colpito si è sprigionato il tanto agognato « anti sigma più », mentre, contemporaneamente, si produceva una altra particella, l'iperone

zero ». Siamo di fronte per la prima volta, a parte la grande importanza della scoperta, ad un fatto molto notevole ed assai singolare: l'« anti sigma più », che è stato prodotto da un antiprotone, ha dato origine di nuovo, dopo la sua morte, ad un nuovo antiprotone.

Quest'ultimo antiprotone, nato dalle « spoglie mortali » dell'« anti sigma più », è vissuto a sua volta circa altrettanto, cioè un decimo di miliardesimo di secondo. Ma ciò è dipeso da circostanze accidentali, perché un antiprotone può vivere a lungo, finché non avvenga il suo incontro con un protone, nel qual caso si annullano reciprocamente.

La scoperta di questa nuova particella avvicina i fisici alla formulazione di una teoria completa della struttura del nucleo e delle leggi che ne determinano le trasformazioni. Una tale teoria completa avrebbe senza dubbio effetti incalcolabili nel campo delle applicazioni pratiche della fisica nucleare.

ANGELO COEN

Pietre sulla ferrovia

VOGHERA, 16 — Un atto

The discovery of the of the antihyperon $\overline{\Sigma}^{+}$ on Italian newspapers

EDIZIONE DEL MATTINO

DIREZIONE, REDAZIONE E AMMINISTRAZIONE: Via del Tritone, 152 Palazzo de «Il Messaggero» - Centralino: 44.141, 44.144, 489.841/2/3/4/5

ABBONAMENTI

	ITALIA 6 num.	ITALIA 7 num.	ESTERO 6 num.	ESTERO 7 num.	6 num.	7 num.
Anno	7.500	8.700	13.700	15.900	16.800	19.550
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UN NUMERO L. 30 — ARRETRATO L. 40 — C. C. POSTALE 1/2596

SOCIETA' EDITRICE «IL MESSAGGERO» PROPRIETARIA — ROMA

Il Messaggero di Roma

TV ELETTRODOMESTICI
LAVATRICI FRIGORIFERI CUCINE GAS MOBILI CUCINA DISCOTECA
SCONTI FINO AL 30% A RATE SENZA ANTICIPI
ORECCHIA
VIA SOLFERINO e P.zza S. GIOVANNI

Anno 82 — N. 112 * S. Anselmo vescovo — Giovedì 21 aprile 1960 — IL GIORNALE DEL MATTINO — Giovedì 21 aprile 1960 — Un numero £ 30 - Arretrato £ 40 * Spedizione in abbonamento postale

GLI SVILUPPI DELLA CRISI MINISTERIALE

Oggi la direzione d.c. deciderà sulla formula di centro-sinistra

Il Presidente del Consiglio designato ha riconfermato la disponibilità del PSDI e del PRI per un governo tripartito costituito su una base programmatica che soddisfi ai cinque punti approvati dalla DC il 27 febbraio scorso Le relazioni di Gui e Piccioni e gli interventi di Malfatti, Sarti e Lucifredi - Nella mattinata Fanfani aveva avuto un colloquio con Segni e con i parlamentari valdostani Chabod e Caveri - La riunione della direzione del P.D.I.

DECISIONI DA PRENDERE

La Direzione della Democrazia Cristiana, dopo aver ascoltato la relazione dell'on. Fanfani sull'attività da lui svolta in questi giorni, quale presidente designato, e dopo gli interventi di alcuni membri del Direttivo, data l'ora tarda, ha interrotto i suoi lavori per riprenderli e concluderli oggi. Essa si è riunita per discutere la formula, il programma e la maggioranza del governo che l'on. Fanfani intende formare e per definire l'atteggiamento politico che la Democrazia Cristiana dovrà, in conseguenza, adottare.

La Direzione della Democrazia Cristiana si dovrà, dunque, esprimere sullo stesso argomento, già discusso dai direttivi dei due gruppi parlamentari del partito, ma con

proposto una maggioranza concordata fra democratici cristiani, liberali e demo-italiani.

I rappresentanti del PSI — ha proseguito Fanfani — hanno manifestato il proposito di prendere una posizione di attesa, astenendosi nei confronti di un eventuale governo tripartito (DC-PSDI-PRI). E' su questo punto che si sono polarizzate le discussioni in seno ai direttivi dei gruppi d.c.: alcuni parlamentari hanno sostenuto che dell'astensione dei socialisti si possa prendere atto come di un fatto che non menoma i principi della DC e che può avviare il tanto auspicato distacco del PSI dal PCI; altri hanno sostenuto che, dalla promessa dei socialisti, la DC debba trarre motivo per aprire trattative dirette con il PSI al fine di accertarne la posizione nei confronti del PCI.

Invito a scegliere

L'on. Fanfani ha concluso invitando la DC a scegliere. Sulla base di tale scelta egli, non reputandosi idoneo per tutte le soluzioni, potrà o meno sciogliere la riserva con la quale ha accettato l'incarico di formare il nuovo governo e, se necessario, chiedere

DOPO LA SCOPERTA

La prima fotografia dell'«antisigma-più»

Visita all'Istituto di Fisica di Roma dove lavorano gli scienziati che si dedicano alle ricerche nel campo nucleare - I laboratori del plasma, dei raggi cosmici e quello per le indagini microscopiche sulle lastre - La massima importanza viene data alla « fisica delle particelle » - E' necessario pianificare il finanziamento perchè si possa pianificare la ricerca

April 21, 1960

Questa è la prima fotografia resa pubblica dell'«Antisigma più»: è stata ricavata direttamente dalla lastra rivelatrice e vi sono stati aggiunti i numeri e le lettere per maggiore chiarezza. In «1» si vede la traccia di un antiprotone che in «A» si biforca in un protone («C») e in un «Antisigma più». Le due traiettorie formano fra loro l'angolo theta 1. L'«Antisigma più» continua la sua traiettoria e in «C» si scinde in un antiprotone e un mesone (pi greco), che sulla lastra non si vede perchè neutro. Fra le due traiettorie vi è l'angolo theta 2. L'antiprotone prosegue la sua corsa fino alla stella, che ne mostra l'annichilazione in seguito all'incontro con un protone, cioè con la materia. Nell'annichilazione vengono prodotti mesoni e altre particelle

Ill^mo Prof. Amaldi,

Abbiamo letto sul giornale, e sentito per radio, della loro sensazionale scoperta atomica, che mette l'Italia in posizione da gareggiare con la Russia e l'America.

Io ho scritto a Lei Prof. Amaldi, sapendo che è il presidente delle ricerche, e l'artefice principale della grande scoperta, ma intendo congratularmi anche con la Prof. Augusta Manfredini, e col Prof. Carlo Castagnoli, per la meravigliosa scoperta chiamata «anti - sigma più».

Io mi voglio anche compiacere con loro, gente silenziosa e studiosa, e ringraziarli per il contributo che danno alla Scienza e al bene comune.

Tanti saluti rispettosi

e auguri per l'avvenire

Giuseppe Botta e compagni

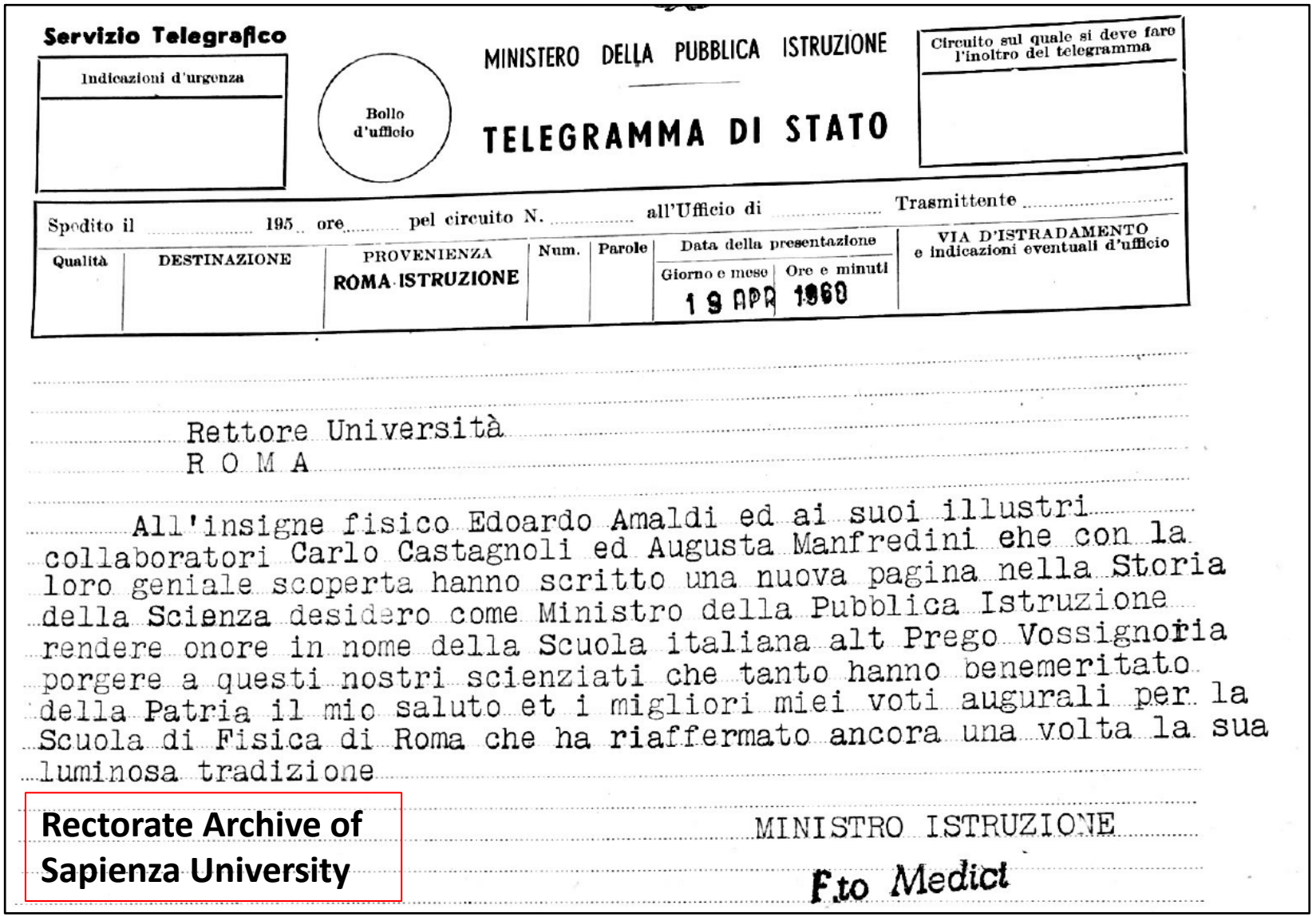
di scuola.

Ternengo

(Vercelli)

April, 1960

Congratulations from the Minister of Education for the discovery of $\overline{\Sigma}^+$



Servizio Telegrafico

Indicazioni d'urgenza

Bollo d'ufficio

MINISTERO DELLA PUBBLICA ISTRUZIONE

TELEGRAMMA DI STATO

Circuito sul quale si deve fare l'inoltro del telegramma

Spedito il ... 195 .. ore ... pel circuito N. ... all'Ufficio di ... Trasmittente ...

Qualità	DESTINAZIONE	PROVENIENZA	Num.	Parole	Data della presentazione		VIA D'ISTRADAMENTO e indicazioni eventuali d'ufficio
		ROMA ISTRUZIONE			Giorno e mese	Ore e minuti	
					19 APR	1960	

Rettore Università
R O M A

All'insigne fisico Edoardo Amaldi ed ai suoi illustri collaboratori Carlo Castagnoli ed Augusta Manfredini ehe con la loro geniale scoperta hanno scritto una nuova pagina nella Storia della Scienza desidero come Ministro della Pubblica Istruzione rendere onore in nome della Scuola italiana alt Prego Vossignoria porgere a questi nostri scienziati che tanto hanno benemeritato della Patria il mio saluto et i migliori miei voti augurali per la Scuola di Fisica di Roma che ha riaffermato ancora una volta la sua luminosa tradizione

MINISTRO ISTRUZIONE

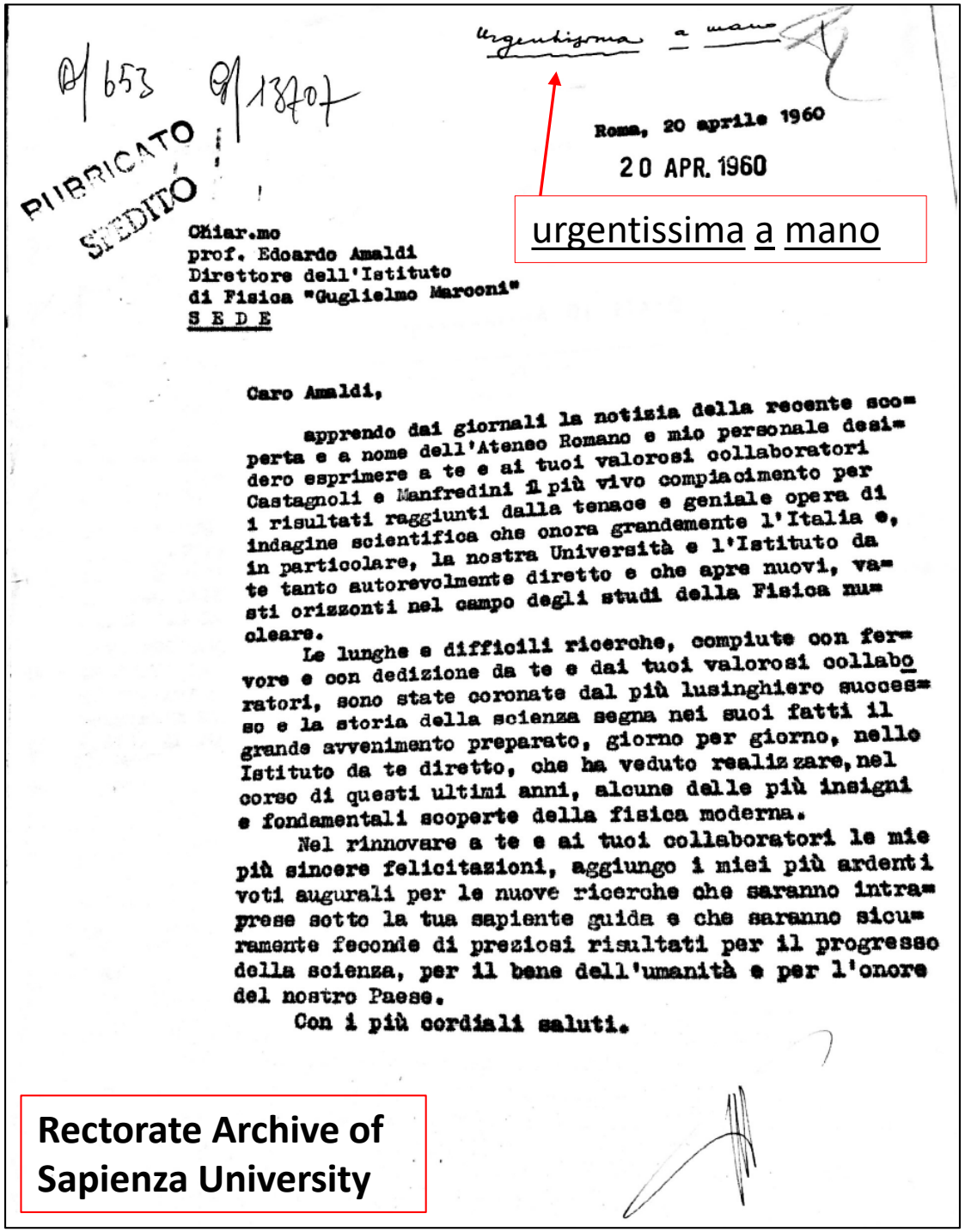
F.to Medici

Rectorate Archive of Sapienza University

April 19, 1960

***To the distinguished physicist Edoardo Amaldi and his illustrious collaborators Carlo Castagnoli and Augusta Manfredini, who with their ingenious discovery have written a new page in the history of science**, I, as Minister of Public Instruction, wish to pay homage on behalf of the Italian schools. I ask Your Excellency to convey to these scientists, who have so well deserved of the nation, my greetings and **my best wishes for the physics school of Rome, which has once again reaffirmed its brilliant tradition**.*

Giuseppe Medici



Urgentissima a mano

Roma, 20 aprile 1960

20 APR. 1960

PUBBLICATO

SPEDITO

Chiar.mo
prof. Edoardo Amaldi
Direttore dell'Istituto
di Fisica "Guglielmo Marconi"
S E D E

Caro Amaldi,

apprendo dai giornali la notizia della recente sco-
perta e a nome dell'Ateneo Romano e mio personale desi-
dero esprimere a te e ai tuoi valorosi collaboratori
Castagnoli e Manfredini il più vivo compiacimento per
i risultati raggiunti dalla tenace e geniale opera di
indagine scientifica che onora grandemente l'Italia e,
in particolare, la nostra Università e l'Istituto da
te tanto autorevolmente diretto e che apre nuovi, va-
sti orizzonti nel campo degli studi della Fisica nu-
cleare.

Le lunghe e difficili ricerche, compiute con fer-
vore e con dedizione da te e dai tuoi valorosi collabo
ratori, sono state coronate dal più lusinghiero succes-
so e la storia della scienza segna nei suoi fatti il
grande avvenimento preparato, giorno per giorno, nello
Istituto da te diretto, che ha veduto realizzare, nel
corso di questi ultimi anni, alcune delle più insigni
e fondamentali scoperte della fisica moderna.

Nel rinnovare a te e ai tuoi collaboratori le mie
più sincere felicitazioni, aggiungo i miei più ardenti
voti augurali per le nuove ricerche che saranno intra-
prese sotto la tua sapiente guida e che saranno sicu-
ramente feconde di preziosi risultati per il progresso
della scienza, per il bene dell'umanità e per l'onore
del nostro Paese.

Con i più cordiali saluti.

urgentissima a mano

Rectorate Archive of Sapienza University

Congratulations from the Dean of Sapienza

April 20, 1960

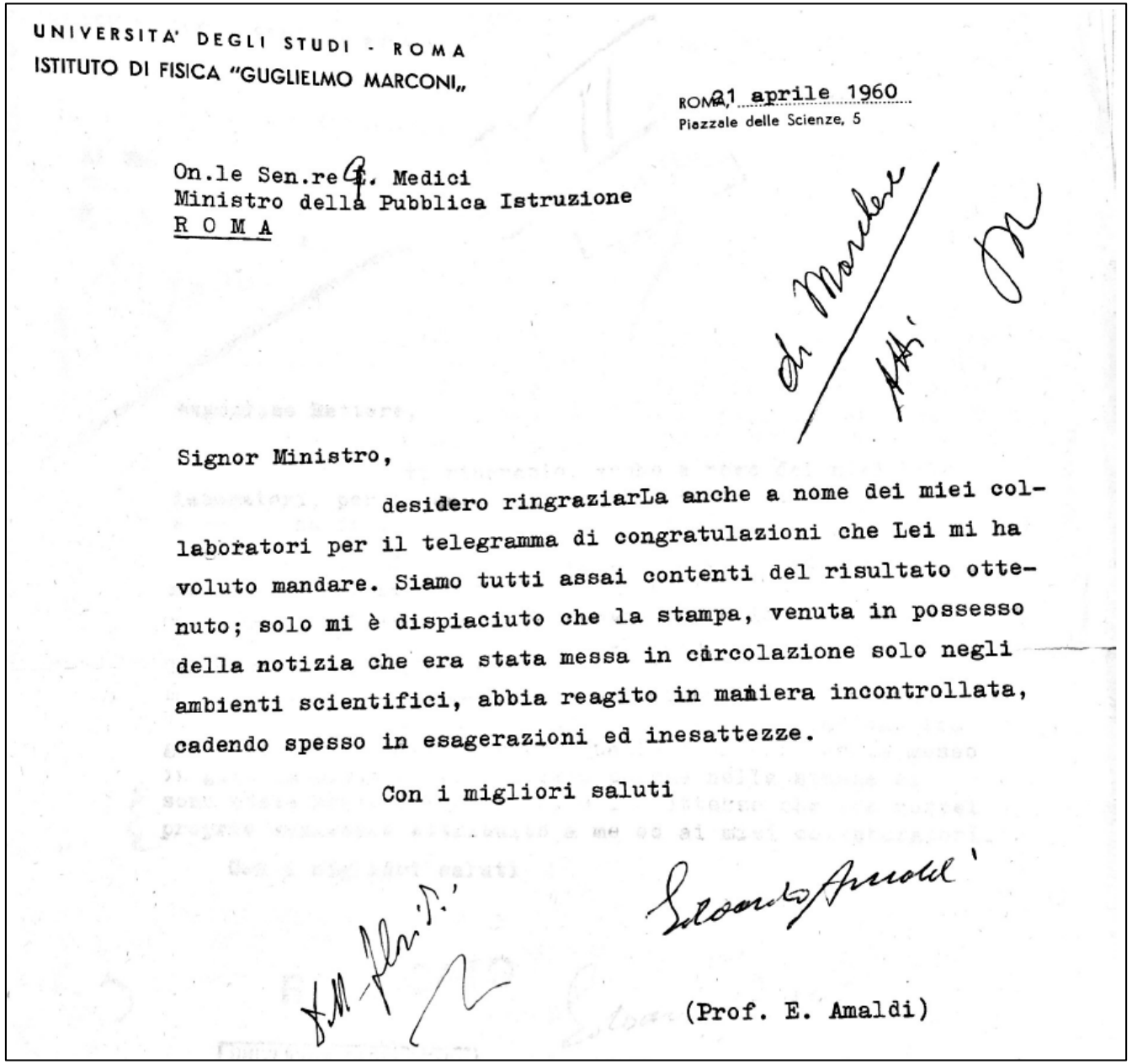
Dear Amaldi,

I have learned from the newspapers of your recent discovery and on behalf of the Roman university and myself, I wish to express to you and your valiant collaborators Castagnoli and Manfredini my warmest congratulations *for the results achieved through your tenacious and ingenious scientific research, which greatly honors Italy and, in particular, our University and the Institute so authoritatively directed by you, and which opens up new, vast horizons in the field of nuclear physics studies. […]*

The long, difficult research, carried out with fervor and dedication by you and your valiant collaborators, has been crowned with the most flattering success, and ***the history of science marks in its events the great success prepared, day by day, in the Institute directed by you, which has seen the realization, in recent years, of some of the most significant fundamental discoveries of modern physics****. […]*

With the warmest regards. ***Ugo Papi***

Amaldi's replies to the congratulatory messages



UNIVERSITA' DEGLI STUDI - ROMA
ISTITUTO DI FISICA "GUGLIELMO MARCONI"

ROMA, 21 aprile 1960
Piazzale delle Scienze, 5

On.le Sen.re G. Medici
Ministro della Pubblica Istruzione
R O M A

Signor Ministro,

desidero ringraziarLa anche a nome dei miei collaboratori per il telegramma di congratulazioni che Lei mi ha voluto mandare. Siamo tutti assai contenti del risultato ottenuto; solo mi è dispiaciuto che la stampa, venuta in possesso della notizia che era stata messa in circolazione solo negli ambienti scientifici, abbia reagito in maniera incontrollata, cadendo spesso in esagerazioni ed inesattezze.

Con i migliori saluti

Edoardo Amaldi

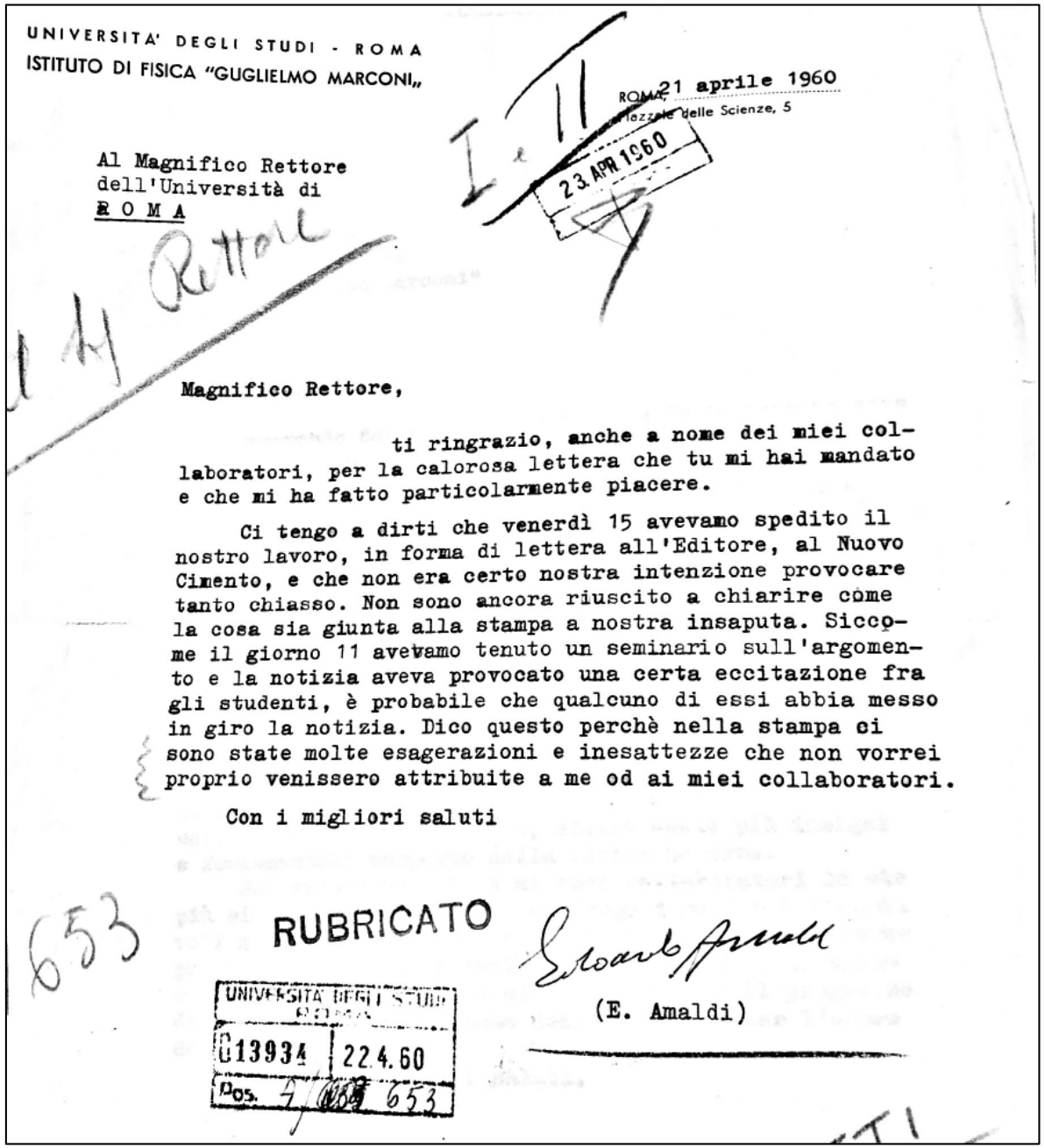
(Prof. E. Amaldi)

April 21, 1960

Mr. Minister,
I wish to thank you, also on behalf of my collaborators, for the congratulatory telegram that you sent me. ***We are all very happy with the result obtained; only I am sorry that the press, having come into possession of the news that was only circulated in scientific circles, has reacted in an uncontrolled manner, often falling into exaggerations and inaccuracies.***

With best regards,
Edoardo Amaldi

Amaldi's replies to the congratulatory messages



UNIVERSITA' DEGLI STUDI - ROMA
ISTITUTO DI FISICA "GUGLIELMO MARCONI"

ROMA, 21 aprile 1960
Piazzale delle Scienze, 5

23 APR 1960

Al Magnifico Rettore
dell'Università di
ROMA

Magnifico Rettore,

ti ringrazio, anche a nome dei miei collaboratori, per la calorosa lettera che tu mi hai mandato e che mi ha fatto particolarmente piacere.

Ci tengo a dirti che venerdì 15 avevamo spedito il nostro lavoro, in forma di lettera all'Editore, al Nuovo Cimento, e che non era certo nostra intenzione provocare tanto chiasso. Non sono ancora riuscito a chiarire come la cosa sia giunta alla stampa a nostra insaputa. Siccome il giorno 11 avevamo tenuto un seminario sull'argomento e la notizia aveva provocato una certa eccitazione fra gli studenti, è probabile che qualcuno di essi abbia messo in giro la notizia. Dico questo perchè nella stampa ci sono state molte esagerazioni e inesattezze che non vorrei proprio venissero attribuite a me od ai miei collaboratori.

Con i migliori saluti

RUBRICATO

(E. Amaldi)

UNIVERSITA DEGLI STUDI ROMA
C 13934 22.4.60
Pos. 4 653

April 21, 1960

Magnificent Rector,
I thank you, also on behalf of my collaborators, for the warm letter you sent me, which gave me particular pleasure.
I want to tell you ***that on Friday the 15th we had sent our work, in the form of a letter to the editor, to Il Nuovo Cimento, and that it was certainly not our intention to cause such a stir.*** ***I have not yet been able to clarify how the matter came to the press without our knowledge. Since on the 11th we had held a seminar on the subject and the news had caused some excitement among the students, it is likely that one of them spread the news.*** *I say this because there have been* ***many exaggerations and inaccuracies in the press*** *that I would not like to be attributed to me or my collaborators.*
With best regards,
Edoardo Amaldi

Letters between Amaldi and Segrè

11 aprile 1960

Prof. E. Segrè
Radiation Laboratory
The University
BERKELEY-4, Cal. (USA)

April 11, 1960
Amaldi to Segrè

Caro Emilio,

ti mando una bozza di descrizione di un evento trovato nel pacco esposto a Berkeley in ottobre, e che a noi sembra molto interessante.

Ti saremo grati per le critiche che ci vorrai fare.

Cordialmente,

5441/A2

UNIVERSITY OF CALIFORNIA

RADIATION LABORATORY
BERKELEY 4, CALIFORNIA

16 Aprile 60

Caro Edoardo,
la United Press mi ha telefonato per domandarmi di un articolo apparso nel Paese Sera in cui si dice che tu, Castagnoli e la Mamfredini avete trovato un antievento.
Io ho dovuto dire loro che non ne sapevo nulla.
Sono curioso di che si tratta. Penso sia un evento trovato nelle lastre irradiate coi p del nostro esperimento del '59.

April 16, 1960
Segrè to Amaldi

Letters between Amaldi and Segrè

Amaldi to Segrè April 11, 1960

Dear Emilio,

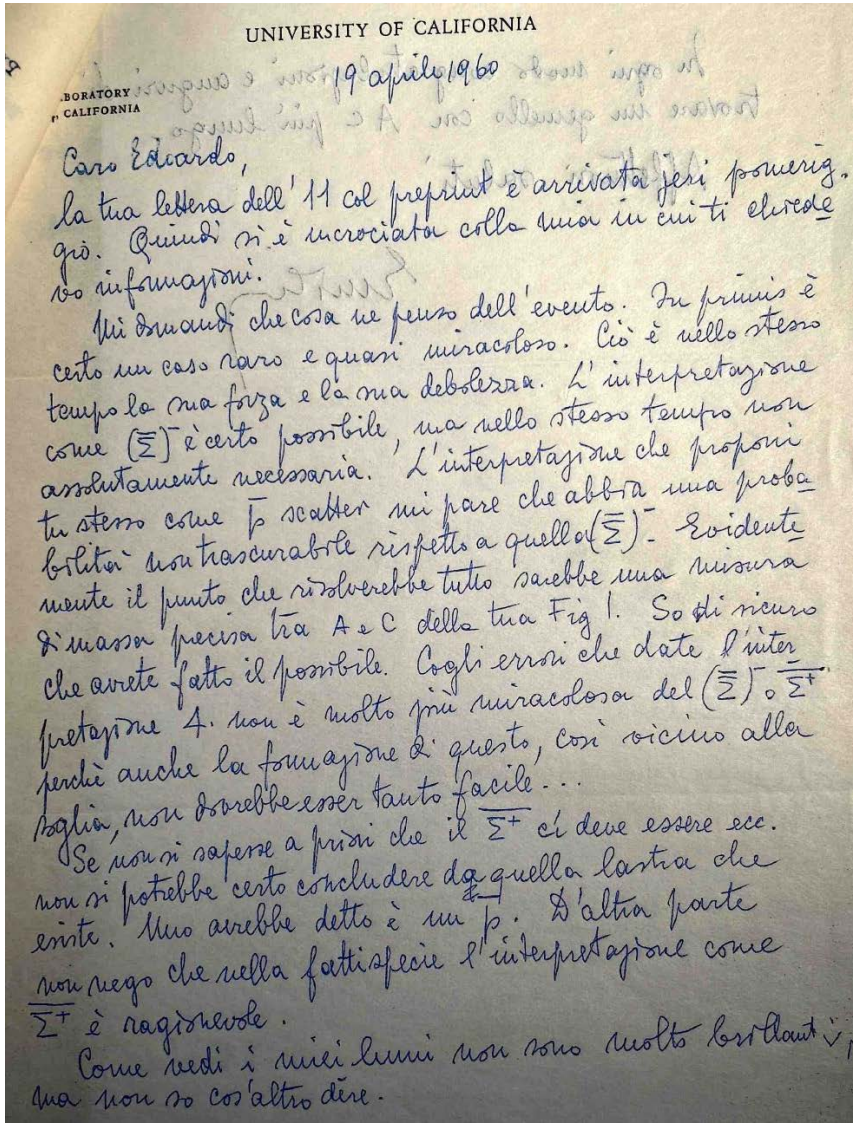
I'm sending you a draft description of an event found in the package exposed in Berkeley in October, which seems very interesting to us. We would be grateful for any criticisms you might have.

Sincerely,
Edoardo

Segrè to Amaldi April 16, 1960

Dear Edoardo,
The United Press called me asking about an article in *Paese Sera* that says you, Castagnoli, and Manfredini have found an anti-sigma.
I had to tell them I knew nothing about it. I'm curious to know what it's about. I think it's an event found in the plates irradiated with antiprotons in our 1959 experiment. If you can give me some authentic news, I'd be pleased.
Affectionately, Emilio

Letters between Amaldi and Segrè



UNIVERSITY OF CALIFORNIA

LABORATORY
of CALIFORNIA

19 aprile 1960

Caro Edoardo,
la tua lettera dell'11 col preprint è arrivata ieri pomerig. giò. Quindi si è incrociata colla mia in cui ti chiedevo informazioni.

Mi domandi che cosa ne penso dell'evento. In primis è certo un caso raro e quasi miracoloso. Ciò è nello stesso tempo la sua forza e la sua debolezza. L'interpretazione come $\bar{\Sigma}^-$ è certo possibile, ma nello stesso tempo non assolutamente necessaria. L'interpretazione che proponi tu stesso come $\bar{p}$ scatter mi pare che abbia una probabilità non trascurabile rispetto a quella di $\bar{\Sigma}^-$. Evidentemente il punto che risolverebbe tutto sarebbe una misura di massa precisa tra A e C della tua Fig 1. So di sicuro che avete fatto il possibile. Cogli errori che date l'interpretazione 4. non è molto più miracolosa del $\bar{\Sigma}^-$ o $\bar{\Sigma}^+$ perchè anche la formazione di questo, così vicino alla soglia, non dovrebbe esser tanto facile...

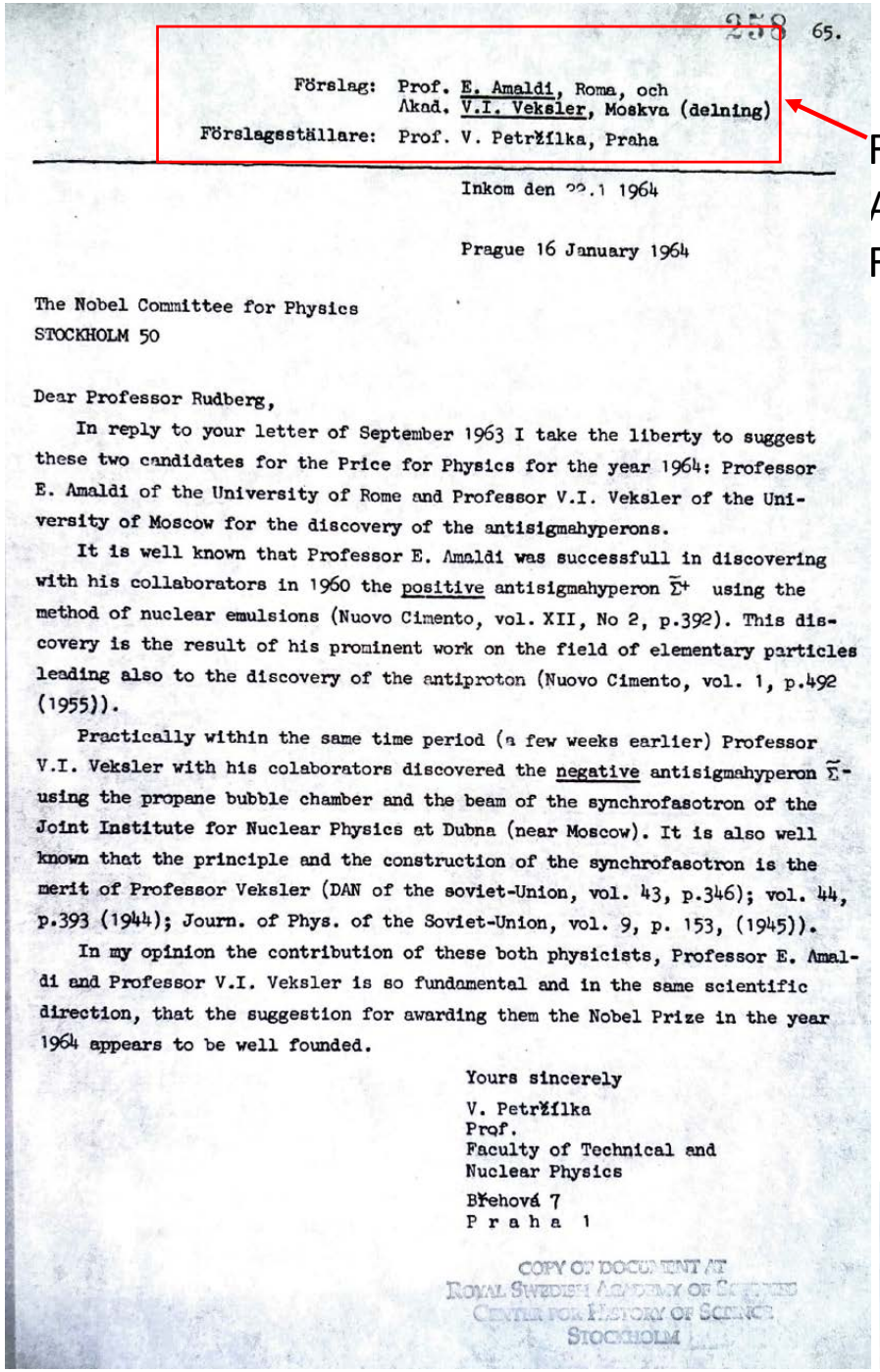
Se non si sapesse a priori che il $\bar{\Sigma}^+$ ci deve essere ecc. non si potrebbe certo concludere da quella lastra che esiste. Uno avrebbe detto è un π^+. D'altra parte non nego che nella fattispecie l'interpretazione come $\bar{\Sigma}^+$ è ragionevole.

Come vedi i miei lumi non sono molto brillanti, ma non so cos'altro dire.

April 19, 1960

Dear Edoardo,
Your letter of the 11th with the preprint arrived yesterday afternoon. So it crossed with mine where I was asking you for information.
You ask me what I think of the event. Firstly, it is certainly a rare and almost miraculous case. This is both its strength and its weakness. The interpretation as $\bar{\Sigma}^-$ is certainly possible, but at the same time not absolutely necessary. The interpretation that you yourself propose as a $\bar{p}$ scatter seems to me to have a non-negligible probability compared to that of $\bar{\Sigma}^-$.
Evidently, the point that would resolve everything would be a precise mass measurement between A and C in your Figure 1. I know for sure that you will have done everything possible. With the errors you give, interpretation 4 is not much more miraculous than $\bar{\Sigma}^-$ or $\bar{\Sigma}^+$, because even the formation of this, so close to the threshold, should not be so easy...
If one did not know a priori that the $\bar{\Sigma}^+$ must exist, etc., one certainly could not conclude from that plate that it exists. One would have said it is an antiproton. **On the other hand, I do not deny that in this specific case the interpretation as $\bar{\Sigma}^+$ is reasonable.**
As you can see, my insights are not very brilliant, but I don't know what else to say.
In any case, congratulations and **best wishes for finding a twin with a longer AC.**
Affectionately, Emilio

A Nobel Nomination in 1964



258 65.

Förslag: Prof. E. Amaldi, Roma, och
Akad. V.I. Veksler, Moskva (delning)
Förslagsställare: Prof. V. Petržílka, Praha

Inkom den 22.1 1964

Prague 16 January 1964

The Nobel Committee for Physics
STOCKHOLM 50

Dear Professor Rudberg,

In reply to your letter of September 1963 I take the liberty to suggest these two candidates for the Price for Physics for the year 1964: Professor E. Amaldi of the University of Rome and Professor V.I. Veksler of the University of Moscow for the discovery of the antisigmahyperons.

It is well known that Professor E. Amaldi was successfull in discovering with his collaborators in 1960 the positive antisigmahyperon $\bar{\Sigma}^+$ using the method of nuclear emulsions (Nuovo Cimento, vol. XII, No 2, p.392). This discovery is the result of his prominent work on the field of elementary particles leading also to the discovery of the antiproton (Nuovo Cimento, vol. 1, p.492 (1955)).

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Yours sincerely

V. Petržílka
Prof.
Faculty of Technical and
Nuclear Physics

Břehová 7
P r a h a 1

COPY OF DOCUMENT AT
ROYAL SWEDISH ACADEMY OF SCIENCES
CENTER FOR HISTORY OF SCIENCE
STOCKHOLM

Förslag: Prof. E. Amaldi, Roma, och
Akad. V. T. Veksler, Moskva (delning)
Förlagsställare: Prof. V. Petržílka, Praha

Suggestion: Prof. E. Amaldi, Rome, and
Acad. V. T. Veksler, Moscow (sharing)
Proposer: Prof. V. Petržílka, Prague

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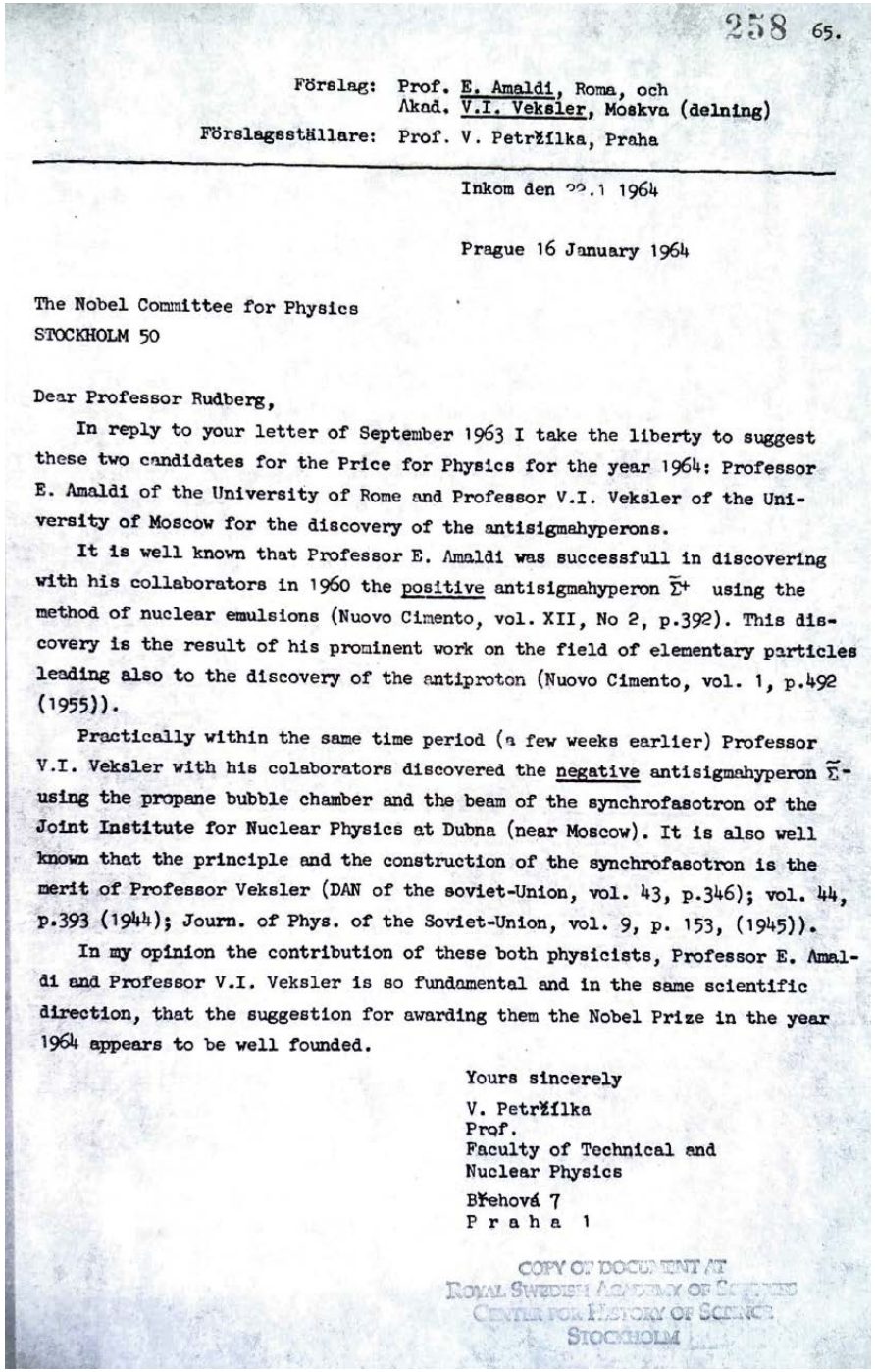
KUNGL. VETENSKAPS-AKADEMIEN
THE ROYAL SWEDISH ACADEMY OF SCIENCES

Václav Petržílka (1905-1976)



258 65.

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Akad. V.I. Veksler, Moskva (delning)

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Inkom den 22.1 1964

Prague 16 January 1964

The Nobel Committee for Physics
STOCKHOLM 50

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Břehová 7
P r a h a 1

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CENTER FOR HISTORY OF SCIENCE
STOCKHOLM

A Nobel Nomination in 1964

«**It is well known that Professor E. Amaldi was successful in discovering with his collaborators in 1960 the positive antisigmahyperon $\bar{\Sigma}^+$ using the method of nuclear emulsions** […]. This discovery is the result of his **prominent work on the field of elementary particles leading also to the discovery of the antiproton** […].

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Sincerely yours,

V. Petržílka – Fac. Of Technical and Nuclear Physics Praha»

Nobel Prize for Physics in 1964

Photo from the Nobel Foundation archive.

Charles Hard Townes

Prize share: 1/2

Photo from the Nobel Foundation archive.

Nicolay Gennadiyevich Basov

Prize share: 1/4

Photo from the Nobel Foundation archive.

Aleksandr Mikhailovich Prokhorov

Prize share: 1/4

"**…***for fundamental work in the field of quantum electronics, which has led to the construction of oscillators and amplifiers based on the maser-laser principle***"**

The discovery of the of the antihyperon $\bar{\Sigma}^-$

第16卷 第7期 物 理 学 报 Vol. 16, No. 7
1960 年 7 月 ACTA PHYSICA SINICA July, 1960

8.3 Бэв/с 的負 π 介子所产生的 $\bar{\Sigma}^-$ 超子

王淦昌 王祝翔 維克斯勒 維遼索夫 烏兰拉 丁大釗
金辛仁 克拉尼茲卡婭 庫茲涅佐夫 米 胡
阮丁賜 尼基丁 索洛維也夫

从用动量为 8.3 Бэв/с 的 π^- 介子束照射放置在磁場強度为 13700 奥斯特的丙烷气泡室所获得的 40000 张照片中找到了一个 $\bar{\Sigma}^-$ 的产生和衰变的事例。图 1 是这事例的照片，图 2 是它的示意图。

π^- 介子(径迹 1)在 0 点产生了一个星，这星包括四个高能粒子(径迹 2，6，7，16)，二个 K^0 介子(径迹 4,5,14,15)和一个小能量粒子(短径迹 17)。一个正粒子的径迹 2 在 A 点发生了轉折。离轉折点 7.7 毫米处有一个六枝的星。在测量的誤差范围(47′)内，星的中心位于径迹 2 和 3 所决定的平面上。粒子 2 在 A 点衰变为粒子 3 和一个沿 AB 方向的中性粒子 N 非常好地符合 Σ 衰变的运动学(参看表 1)。径迹 3 是一个 π^+ 介子的径迹。

表 1 在 A 点的运动学

径迹編号	电荷的符号	P 的测量值 Мэв/с	P 的計算值 Мэв/с	粒子	角度
2	+	1104±600	1798±100	$\bar{\Sigma}^-$	
3	+	244±10		π^+	$\varphi_{2,3} = 39°38′ \pm 20′$
AB	0		1628±100	$\bar{n}$	$\varphi_{2,AB} = 5°29′ \pm 20′$

粒子 N 的动量是由在 A 点粒子 3 和 N 的垂直分动量相等决定的。

假設衰变是按照 $\Sigma \to \pi^+ + n$ 的方式，我們得到 $M_2 = 1182 \pm 14$ Мэв。

在 B 点的能量和动量的平衡列于表 2。B 星具有 5 个正粒子(径迹 8,9,11, 12, 13)和一个负粒子(径迹 10)。负粒子是 π 介子。径迹 9,11, 12, 13 都終止在气泡室中，我們認为它們都是質子径迹。粒子 8 具有大动量同时跑出了气泡室。根据电离[1] 和动量的测量的結果，径迹 8 是 π 介子径迹。

Paper China-USSR, published in Russian in April 1960 (*Soviet Physics JETP*) and in Chinese in July (*Acta Physics Sinica*), translated in English in October (*Soviet Physics JETP*)

Fermi energy $E_0^H \simeq 2.5\times10^{-14}$ erg ($E_0^H/k \simeq 180°K$); effective mass in the plane perpendicular to the trigonal axis $m_1^H = m_2^H = 0.05\, m_0$ (m_0 is the free electron mass) and in the direction of the trigonal axis $m_3^H = 0.7\, m_0$.

The magnitude of the anisotropy of the hole surface and the value of the effective masses are in good agreement with recently published work on cyclotron resonance[3] in Bi ($m_1^H = m_2^H = 0.068\, m_0$ and $m_3^H = 0.92\, m_0$) and on the anomalous skin effect[4] ($m_3^H/m_1^H = 12.8$). In these works, and also in Reneker's, this group of holes has been described by the anomalously small value of bounding energy ($E_0^H = 0.18 \times 10^{-14}$ erg, $E_0^H/k = 13°K$) which was suggested by Heine[6] and by Strelkov and Kalinkina[7] to explain the appreciable electronic specific heat of Bi.

We should point out that n^H in one ellipsoid of revolution is 0.34×10^{18} cm^{-3}, and is practically equal to the concentration of electrons in Shoenberg's three-ellipsoid model, $n^e = 0.39 \times 10^{-18}$ cm^{-3}. These two groups of 'light' electrons and holes must evidently be responsible for the galvanomagnetic properties of Bi. The difference between the mean effective masses of the electrons in Shoenberg's three-ellipsoid model,

$$\bar{m}^e = [m_1(m_2m_3 - m_4^2)]^{1/2} = 0.053m_0$$

PRODUCTION OF A Σ HYPERON BY 8.3 Bev/c NEGATIVE π MESONS

WANG KANG-CHANG, WANG CHU-CHIEN, V. I. VEKSLER, N. M. VIRYASOV, I. VRANA, TING TA-CHAO, KIM HU IN, E. N. KLADNITSKAYA, A. A. KUZNETSOV, A. MIKHUL, NGUYEN DIN TU, A. V. NIKITIN, and M. I. SOLOV'EV

Joint Institute for Nuclear Research

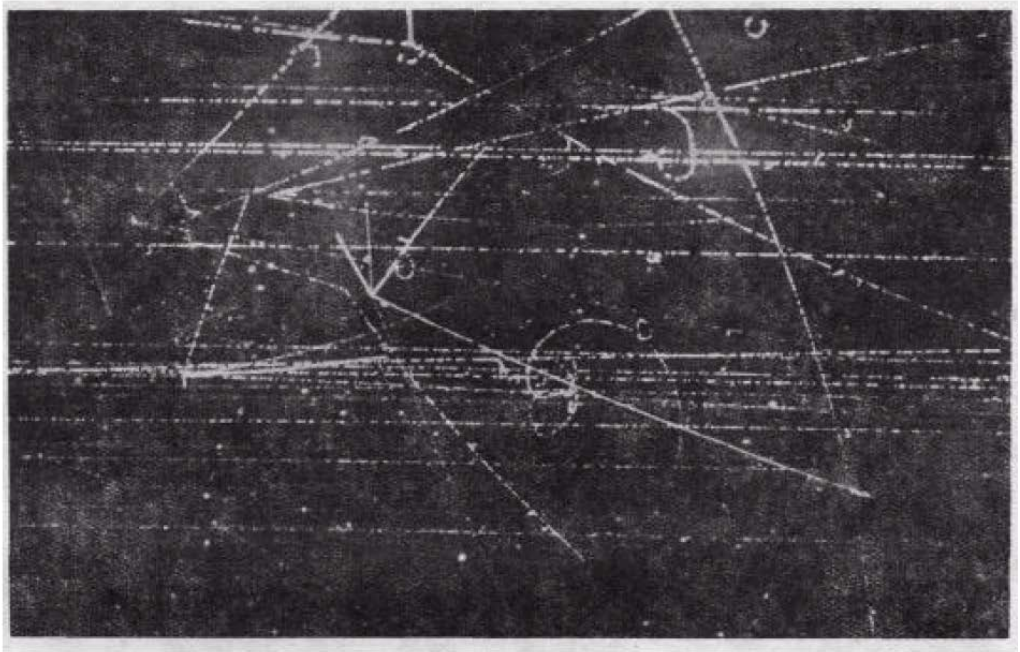
Submitted to JETP editor March 24, 1960

J. Exptl. Theoret. Phys. (U.S.S.R.) **38**, 1356-1359 (April, 1960)

ONE event of production and decay of a $\bar{\Sigma}^-$ hyperon was found out of 40,000 pictures obtained by a beam of negative 8.3 ± 0.6 Bev/c pions in a propane bubble chamber[1] with a constant magnetic field of 13,700 oe. A photograph and diagram of this event are shown. A π^- meson (track 1) gives a star at point O, from which emerge four charged particles of high energy (tracks 2, 6, 7, 16), two K^0 mesons (tracks 4, 5, 14, 15), and one particle of low energy (short track 17). The track of the positively charged particle 2 is deflected at point A. At a distance of 7.7 mm from the point of deflection is a six-prong star. The center of the star

The discovery proved for the first time that charged hyperons have antiparticles, bridging a gap in the particle-antiparticle table

Discovery of the of the antihyperon $\overline{\Sigma}^-$



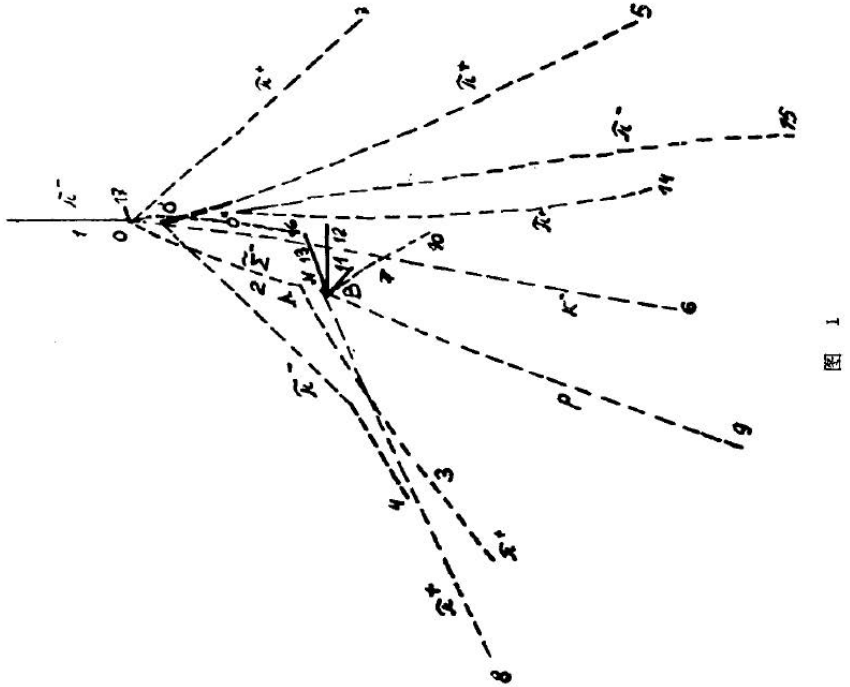


图 1

Propane bubble chamber
More than 40000 photographs analysed

"Hence, the data presented is evidence of the fact that we have observed a new type of particle, the charged antihyperon $\overline{\Sigma}^-$."

Discovery of the of the antihyperon $\overline{\Sigma}^-$

参　考　文　献

[1] 王淦昌, Соловьев, М. И., Шкобин, Ю. Н., *ПТЭ*, № 1 (1959), 41.
[2] Блинов, Г. А., Крестников, Ю. С., Ломанов, М. Ф., *ЖЭТФ*, **31** (1956), 762.
[3] Willis, W. J., Fowler, E. C., Rahm, D. C., *Phys. Rev.* **108** (1957), 1046.

References of the China-USSR discovery paper, translated in English later in 1960:

1) Wang Kang-Chang, Solov'ev, and Shkobin, IlpH60pbl H TeXHHKa 3KCOepHMeHTa (Instrum. And Meas. Engg.) No.1, 41 (1959).
2) S. Otwinowski, Report, High-Energy Laboratory, Joint Institute for Nuclear Research, 1960. **(new)**
3) Blinov, Krestnikov, and Lomanov, JETP 31, 762 (1956)
   English translation: Blinov, Krestnikov, and Lomanov, *Measurement of the Ionizing Power of Particles in a Bubble Chamber*, Soviet Phys. JETP 4 (5), 661 (1957).
4) Willis, Fowler, and Rahm*, Bubble Density in a Propane Bubble Chamber*, Phys. Rev. 108, 1046 (1957)

The Joint Institute for Nuclear research in Moscow celebrates the discovery

Vladimir Veksler
(about 1960)

Ganchang Wang
(Dubna, 1958)

From left: Vladimir Veksler, Ding Dazhao (China), Kim Hi In (North Korea), Nguyen Dinh Tu (Vietnam), Alexandru Mikhul (Romania)

The discovery of antisigma-minus was the first significant experimental result of recently established JINR.

- **1961**: **JINR prizes for outstanding research** awarded for the first time. Three prizes, one awarded for the **discovery of antisigma-minus** and studies about the properties of strange particles

- **1966, 10th anniversary of JINR**: Director Blokhintsek mentions the **discovery as "crowning JINR's research on inelastic interactions of pions and nucleons**"

- **2016, 60th anniversary of JINR**: the discovery still **mentioned as a significant milestone and a triumph for Dubna scientists**

Joint Institute for Nuclear Research

SCIENCE BRINGS NATIONS TOGETHER

RU

DIGITAL JINR | JINR | SCIENCE | STUDENTS & EDUCATORS | PRESS OFFICE | FOR EMPLOYEES | NEWS

ALL | World science | Organization | Education | Grants | Patents | Publications | Interview | Culture | Media | Agenda

Alexandru Mihul. Work at JINR sparked his interest in nuclear physics

News, 01 June 2023

1 June marks the 95th anniversary of the birth of a Romanian physicist Alexandru Mihul (1928 – 2015), JINR Vice-Director in 1970-1973, a co-author of the discovery of the anti-sigma-minus-hyperon particle.

Alexandru Leonida Mihai Mihu was born in 1928 in Iaşi, Romania, in a family of physicists and university teachers. He graduated from the Electromechanics Department of the Polytechnic Institute in 1950. Afterwards, in 1953, he graduated from the Faculty of Physics of the Alexandru Ioan Cuza University of Iaşi (UAIC), at which he defended his thesis in 1957. He started his scientific career at UAIC in 1947-1950 studying gas discharges, astronomy, and conducted experiments on the generalised theory of relativity.

The **relevance given to the antisigma discovery on JINR webpage** dedicated to Alexandru Mihul (1928-2015) “JINR Vice-Director in 1970-1973, a co-author of the discovery of the anti-sigma-minus-hyperon particle” (**June 1, 2023**)

A group of discoverers of the anti-sigma-minus-hyperon particle at the JINR Synchrophasotron headed by Academician Veksler (on the left). Alexandru Mihul – the first on the right.

CERNCOURIER

JINR celebrates 50 years

1 March 2006

This month the Joint Institute for Nuclear Research celebrates its 50th anniversary as a renowned international intergovernmental scientific research organization.

A meeting of the representatives of the the JINR founder states in 1956. Chief scientific secretary of the Presidium of the Academy of Sciences of the USSR Academician, Alexander Topchiev is speaking. (All photos courtesy JINR.)

The Joint Institute for Nuclear Research (JINR) was establis
signed in Moscow
representatives fro
aim was to unite th
potential in order t
properties of matte
February 1957 the i
with the United Na

JINR is situated in

The institute today

JINR's Nuclotron – the superconducting synchrotron accelerates nuclei and heavy ions up to 6 GeV/n.

Since JINR's founding, nuclear research has been marked by important discoveries and crucial changes. In 1961 the JINR Prizes were established, and a group of physicists led by Veksler and Wang Ganchang from China were awarded the first such prize for their discovery of the antisigma-minus-hyperon. No-one doubted at the time that this particle was elementary, but a few years later, this hyperon, the proton, neutron, pion and other hadrons had lost their elementary quality. They turned out to

A discovery still aknowledged many years later in China…

Wang Ganchang (1907-1998) among founding fathers of JINR and Vice-Director 1958-1960

In 1982, Wang Ganchang received China's National Natural Science Award for the discovery of the anti-sigma hyperon

Historical papers discussing the discovery of the of the antihyperon $\bar{\Sigma}^-$

Chinese Annals of History of Science and Technology 5 (2), 031–088 (2021)
doi: 10.3724/SP.J.1461.2021.02031

Chinese Scientists in Dubna (1956–1965)

LIU Jinyan 刘金岩,[1*] *WANG Fang* 王芳,[1†] *Alexey ZHEMCHUGOV* 阿列克谢·热姆丘戈夫[2‡]

(1. *Institute for the History of Natural Sciences, Beijing* 100190, *China*; 2. *Dzhelepov Laboratory of Nuclear Problems, Joint Institute for Nuclear Research, Dubna* 141980, *Russia*)

Jin-yan Liu (Chinese Academy of Sciences), Fang Wang (Chinese Academy of Sciences),Alexey Zhemchugov (JINR), *Chinese Scientists in Dubna (1956-1965)*, Ch. Ann. Hist. Sc. Tech. (2021)

Before and after the discovery of anti-sigma negative hyperon

DING Zhaojun, LI Shouchen

Author information

Department for the History of Science and Scientific Archaeology, University of Science and Technology of China, Hefei 230026, China

Abstract

During the early stage of China's particle physics, as the construction of high-energy accelerator lagged behind China could only 'talk on paper' in theoretical research, and 'depend on Heaven for food to eat' in cosmic ray research or 'find shelter under other's roof' in international cooperation. The establishment of the Multinational Joint Nuclear Research Institute in Dubna created a good opportunity for the development of high energy physics in China. The discovery of anti-sigma negative hyperon left a thick and colorful mark in the history of physics in China. The series of scientific achievements by Chinese scholars in Dubna laid an important knowledge and talent foundation for the development of subatomic physics in China.

DING Zhaojun, LI Shouchen, *Before and after the discovery of anti-sigma negative hyperon*, Science & Technology Review (2020)

Chinese Annals of History of Science and Technology 5 (2), 031–088 (2021)
doi: 10.3724/SP.J.1461.2021.02031

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2.1 The discovery of the antisigma-minus hyperon ($\overline{\Sigma}^-$)

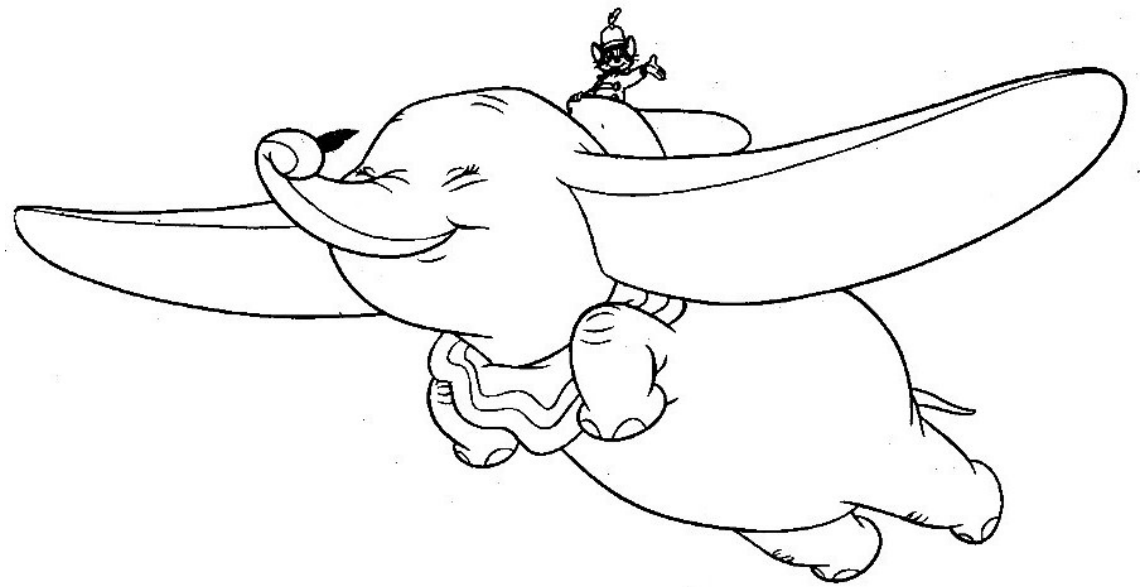
Wang Ganchang graduated from the Department of Physics at Tsinghua University in 1929, received a doctorate degree from the University of Berlin in 1933, and in 1934 returned to China to work. In 1941, he proposed to seek the neutrinos by K-electron capture, which was later confirmed by experiments (Li and Yang 1986). In September 1956, after attending the meeting of JINR member states with Li Yi 李毅, Wang began to work at the Laboratory of High Energy Physics as a senior researcher. From 1959 to 1960, he acted as vice director of the institute (Figure 5).

April 1960: 3rd Meeting of the Members of the Chinese Academy of Sciences. Ganchang Wang presented the discovery process of $\overline{\Sigma}^-$.

"The Conference Chair Qian Sanqiang, after the conference, stated

«***This result points to the large-scale cooperation among twelve socialist countries***. *[…] This team involves the reputable Corresponding Academician V. I. Veksler.* ***The Soviet Union attaches great importance to this work as well. The JINR also belongs to China, and we deem this discovery as one of the major accomplishments of China this year***.
I hope Wang Ganchang will bring the high regard and encouragement for this work from the Meeting of Members of CAS to the JINR, spurring the Chinese members to make greater achievements. »"

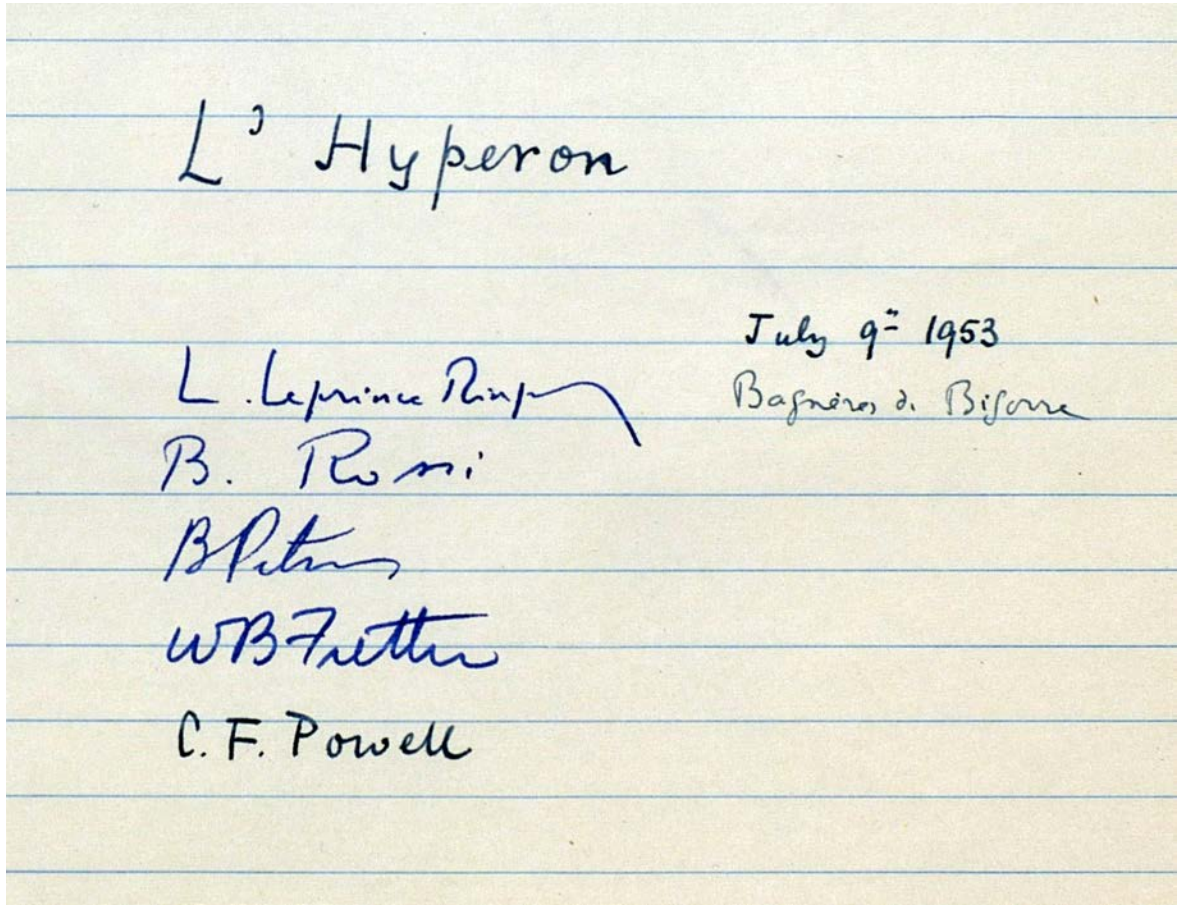
Jin-yan Liu (Chinese Academy of Sciences), Fang Wang (Chinese Academy of Sciences),Alexey Zhemchugov (JINR), *Chinese Scientists in Dubna (1956-1965)*, Ch. Ann. Hist. Sc. Tech. (2021)



Thank you for your kind attention!

Backup Slides

The term «hyperon»



Card marking the coining of the name "hyperon" at the Conference of Bagnères de Bigorre.

July 1953, Conference at Bagnères de Bigorre, organized by Patrick Blackett and Loius Leprince-Ringuet in the framework of the Cosmic Ray Commission of IUPAP

"This conference marked the boundary in time when the field of subatomic physics passed from cosmic ray research to the accelerators. This shift was explicitly recognized at Bagneres de Bigorre."

J. W. Cronin, *The 1953 Cosmic Ray Conference at Bagnères de Bigorre: the Birth of Sub Atomic Physics*, EPJ-H (2011).

Boulevard de l’Hyperon in Bagnères de Bigorre

Amaldi’s following scientific interests

Search for Magnetic Monopoles

"Search for Dirac magnetic poles"
(In collaboration with G. Baroni, P. Bradner, O. De Carvalho, L. Hoffmann, A. Manfredini, G. Vanderhaege)
pp. 155–161 of Comptes Rendus de la Conférence Intern. d'Aix-en-Provence sur les Particules Elémentaires, 14–20 September 1961.

"Experimental data on spectral variations during Forbush decreases"
(In collaboration with F. Bachelet, P. Balata, N. Iucci)
Pontificiae Academiae Sientiarum Scripta Varia, p. 299; Semaine d'Etude sur les problèmes du Rayonnement Cosmique dans l'Espace Interplanétaire, 1–6 October 1962.

"Search for Dirac magnetic poles"
(In collaboration with G. Baroni, A. Manfredini, P. Bradner, L. Hoffmann, G. Vanderhaege)
Nuovo Cimento 28,

"Search for Dirac magnetic poles"
(In collaboration with G. Baroni, P. Bradner, O. De Carvalho, L. Hoffmann, A. Manfredini, G. Vanderhaege)
CERN - 63-14 (1963).

January 26, 1960: a seminar at the Physics Intitute at Sapienza

EDOARDO AMALDI

Istituto nazionale di fisica nucleare

Sezione di Roma

Attività svolta durante l'anno 1959-1960

ROMA
CONSIGLIO NAZIONALE DELLE RICERCHE
1962

A report of the **activities at the Institute in Rome since July 1, 1959 to June 30, 1960**.

The **list of seminars** shows one which turned to be particularly interesting for Amaldi:

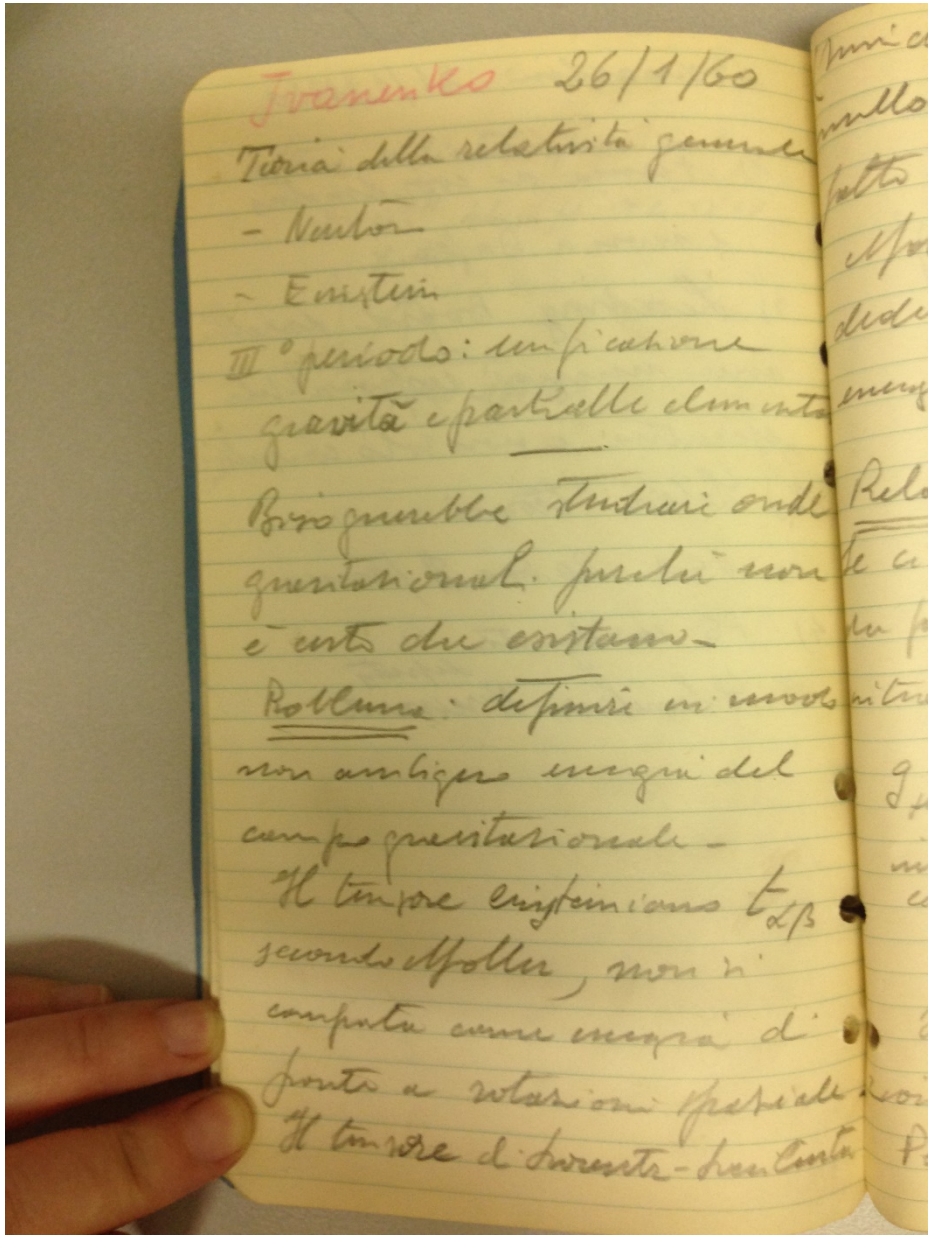
(12) 12 gennaio 1960 – Prof. M. CINI (Roma): Interazione pione-pione.
(13) 19 » » – Dr. B. McDANIEL (Ithaca): La polarizzazione della lambda fotoprodotta in idrogeno.
(14) 21 » » – Prof. L. S. OSBORNE (Cambridge, USA): Fotoproduzione di pioni neutri in nuclei complessi.
(15) 22 » » – Prof. J.D. BERNAL (Londra): A new theory on the structure of liquids.
(16) 26 » » – Prof. D. D. IVANENKO (Mosca): Remarks on transmutation of matter into gravitation.

Amaldi and Dmitri Ivanenko

- **1960 January-February**: during 20 days Ivanenko visited Italy including INFN in Frascati and Universities in Rome, Turin, Milan, Padua, Naples

- **1960 January 26**: Ivanenko gave a talk at the Physics Institute in Rome, titled *Remarks on transmutation of matter into gravitation*. (INFN Activity Report 1959-1960). Amaldi was present; it was only few days before he left for the inauguration of PS at CERN (February 5).

From Amaldi's Diary



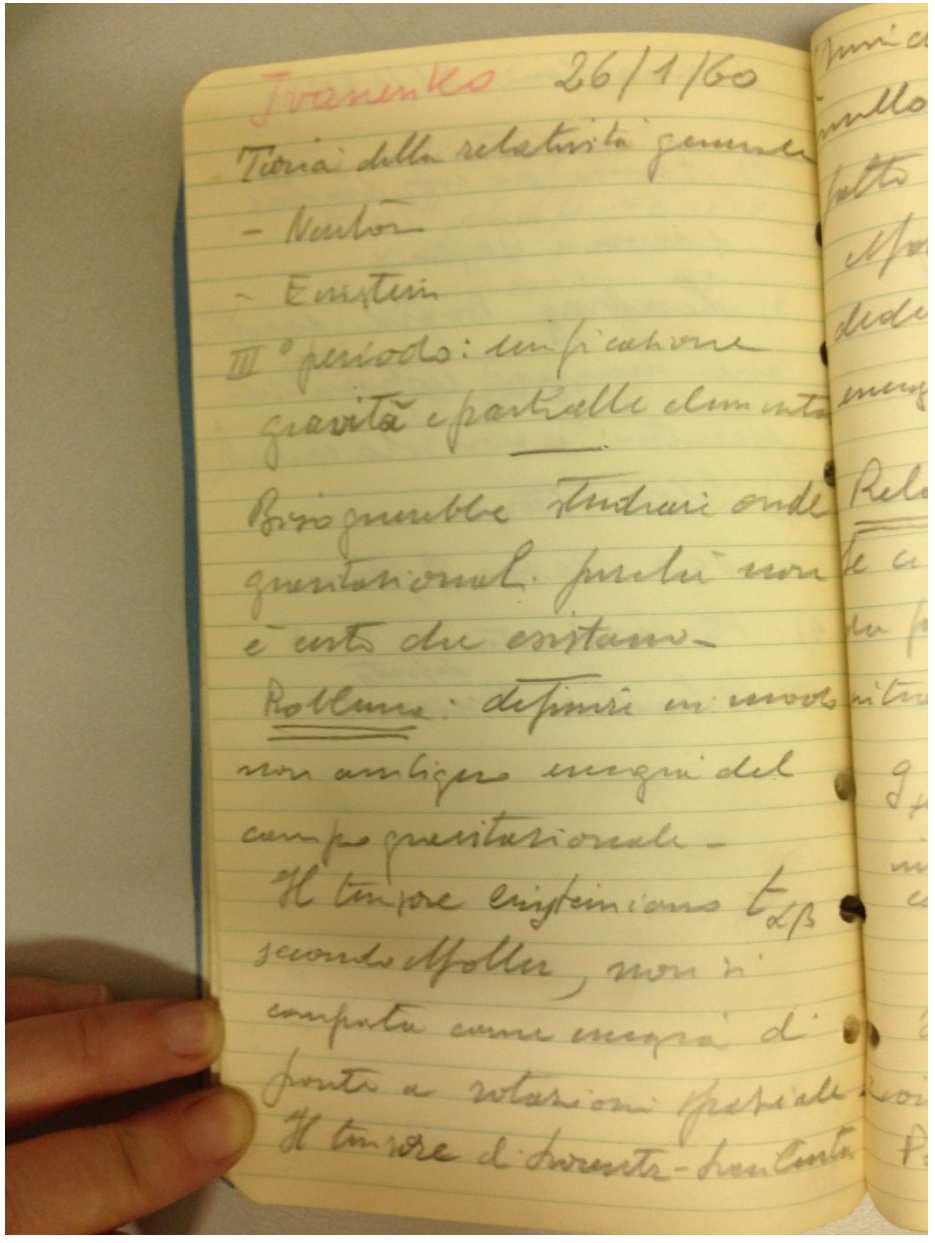
Amaldi and Dmitri Ivanenko

Ivanenko 26/1/60

Theory of general relativity
- Newton
- Einstein
III° period: unification of gravity and elementary particles

It is necessary to study gravitational waves, because it is not sure they exist.

From Amaldi's Diary



Amaldi and Dmitri Ivanenko

Problem: define in a not ambiguous way the energy of the gravitational field. The Einstein tensor $t_{\alpha\beta}$ as defined by Møller does not behave as energy for a spatial rotation. The tensor of Lorentz-Levi Civita is identically null. Now it looks like it has been achieved a relevant progress: Møller, Mitskeric deduct an expression for the energy of the gravitational field.

Relationship between gravity and particles

If gravitational waves exist carrying energy they would interact with particles:

[equation]

interactions among gravitons (spin 2) with all the particles

[equation]

It might be possibile a transmutation of particles in gravitons.

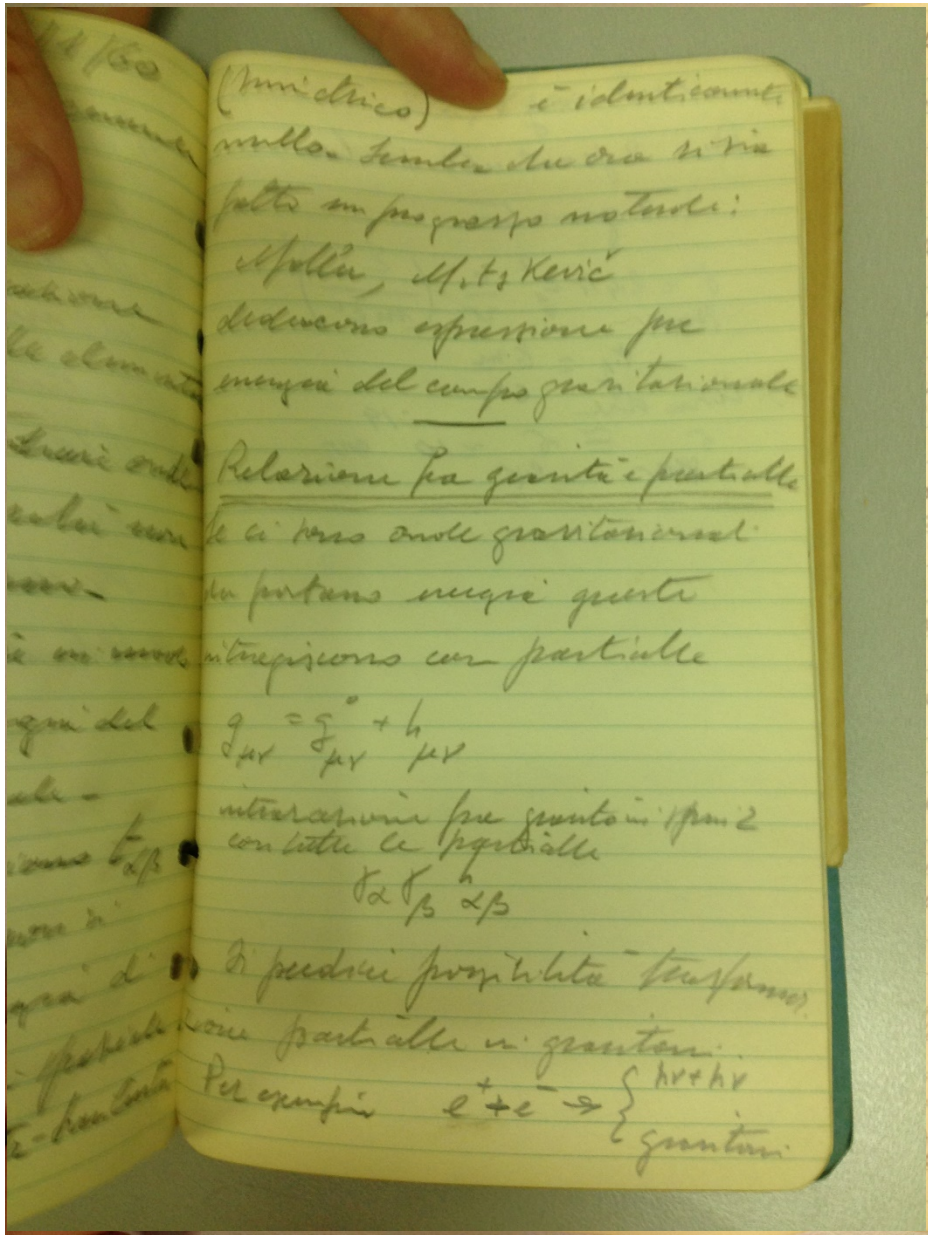
For example: [equation]

For 2 particles in

2 gravitons

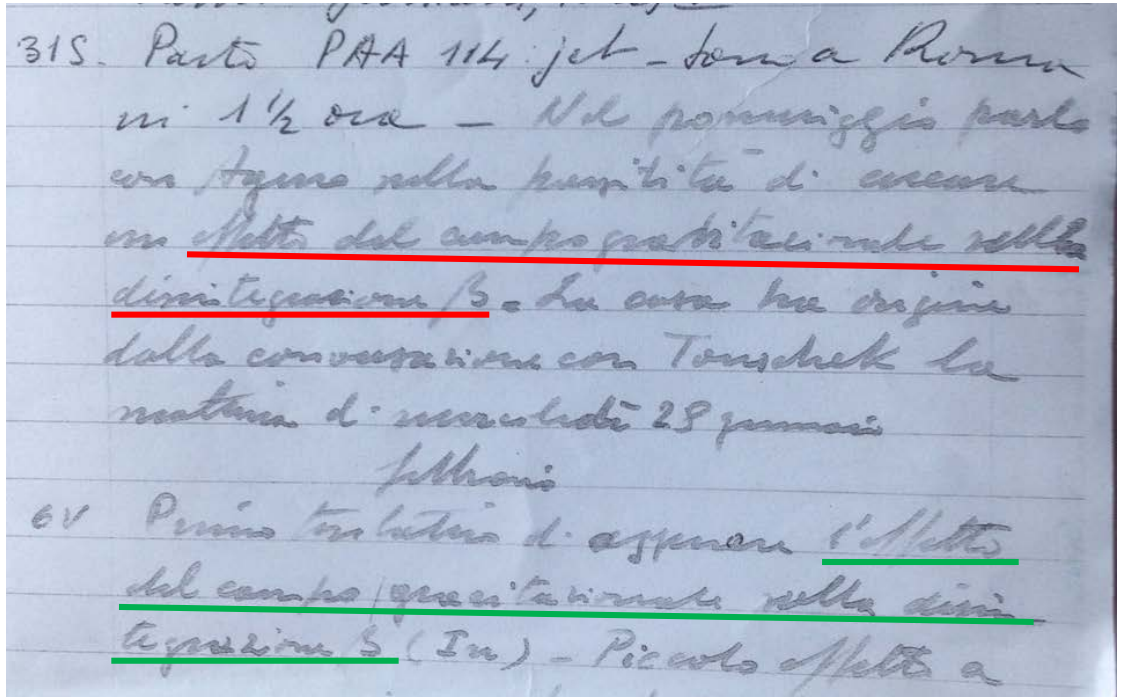
[equation]

From Amaldi's Diary



1959: a question about gravity and the beta decay

From Amaldi's diary, january 1959



31S. Parto PAA 114 jet - Sono a Roma
in 1½ ora — Nel pomeriggio parlo
con Ageno della possibilità di cercare
un effetto del campo gravitazionale nella
disintegrazione β - La cosa ha origine
dalla conversazione con Touschek la
mattina di mercoledì 28 gennaio
febbraio
6V Primo tentativo di cercare l'effetto
del campo gravitazionale nella disin
tegrazione β (In) - Piccolo effetto a

«Is the decay constant of the various beta decay nuclei the same everywhere in the Universe, irrespective of the value of the local gravitational field?»

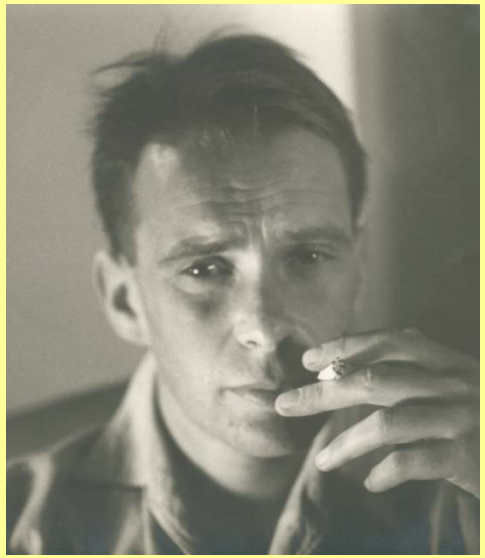
1959, 31 January (Saturday):
«In the afternoon I speak with Ageno of the possibility of looking for an effect of the gravitational field on the beta disintegration. The idea comes from a discussion I had with Touschek the morning of Wednesday 28 january.»

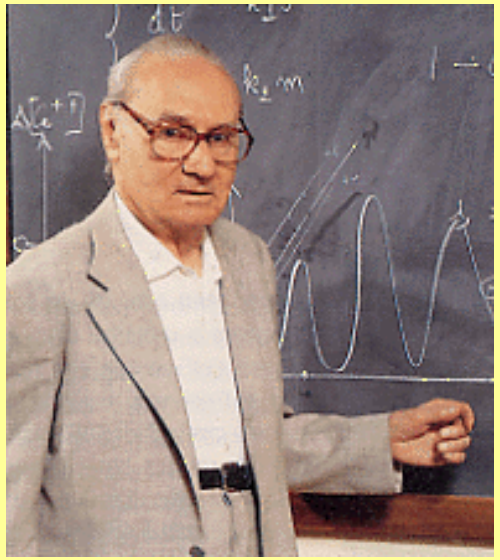
1959, 6 February (Friday) :
«First experiment aiming at verifying the effect of the gravitational field on the beta disintegration (In). Small effect we don't believe in, because the precision of the experimental measurement is not sufficient.»

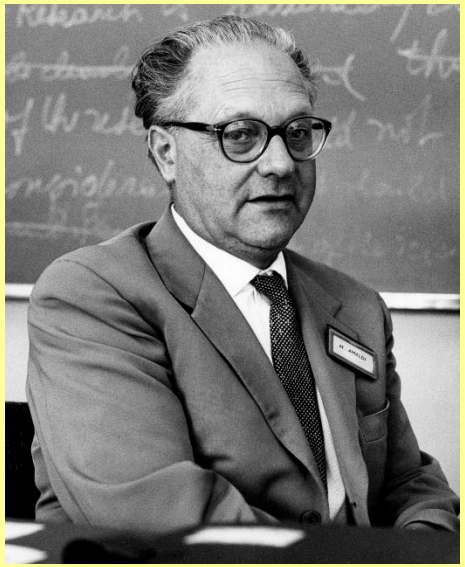
1959: a question about gravity and the beta decay

«Touschek was prompted to raise this question by the fact that in the history of physics it had happened several times that an apparent deviation from a conservative law was found, on close examination, to be the result of the perturbation caused by an external field […]. Could not the non-conservation of parity observed for the weak interaction have a similar origin?
This question as we learned later was raised also by other researchers.»

M. Ageno, E. Amaldi, *Experimental Search for a Possible Change of the β Decay Constant with Centrifugal Force*. Lincei, Memorie Sc. Fisiche, 1966.


Bruno Touschek (1921-1978)


Mario Ageno (1915-1992)


E. Amaldi (1908-1989)

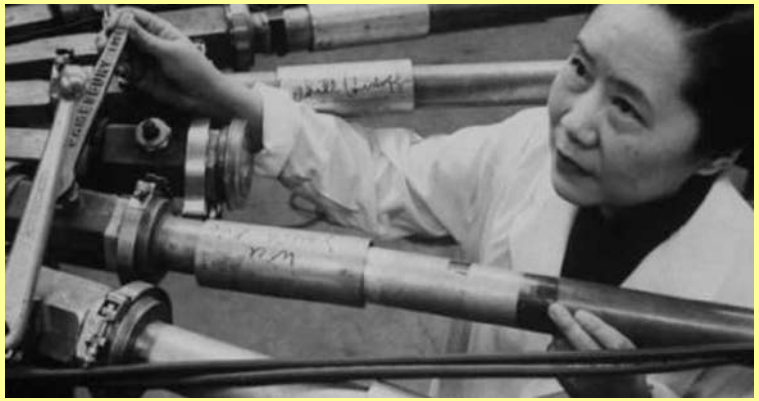
1959: a question about gravity and the beta decay

«Touschek was prompted to raise this question by the fact that in the history of physics it had happened several times that an apparent deviation from a conservative law was found, on close examination, to be the result of the perturbation caused by an external field […]. Could not the non-conservation of parity observed for the weak interaction have a similar origin?
This question as we learned later was raised also by other researchers.»

M. Ageno, E. Amaldi, *Experimental Search for a Possible Change of the β Decay Constant with Centrifugal Force*. Lincei, Memorie Sc. Fisiche, 1966.

Mme C. S. Wu, Rev. Mod. Phys., 31, 783,1959:

«is there any connection between the β interaction and the gravitational field?»



Ageno's and Amaldi's experiments

Experiments based on the equivalence principle, according to which a centrifugal field generated by a rotation is locally equivalent to a gravitational field produced by a proper distribution of masses.

M. Ageno, E. Amaldi, *Experimental Search for a Possible Change of the b Decay Constant with Centrifugal Force*. Lincei, Memorie Sc. Fisiche, 1966.

First experiments:

Sample of β radioactive body with half-life of the order of 1 hour, placed in a centrifuge for about 1 hour: activity measured repeatedly as a function of time, before and after centrifugation

In, G= 150,000 G_E

Papers

- **1961** M.Ageno, E. Amaldi, B.Rispoli, G.Sanna, *Misure di vita media di mesoni pi su traiettoria rettilinea e circolare*, in *Raccolta delle comunicazioni del congressino 1960 sulla fisica e la ricerca di alta energia. Frascati 16-17 Dicembre 1960*
- **1963** M. Ageno, E. Amaldi, G. Matthiae, B. Rispoli, G. Sanna, in *Raccolta delle comunicazioni del Congresso 1962 sulla Fisica e la Ricerca di Alta Energia*, Frascati 7-9 febbraio 1962
- **1963** M. Ageno, G. Fronterotta, G. Matthiae, A. Reale (Laboratorio Fisica dell'Istituto Superiore di Sanità), Edoardo Amaldi (Istituto di Fisica), *Misura e vita media di mesoni π+ e π- su percorso rettilineo e curvo.* Unpublished
- **1966** M. Ageno, E. Amaldi, *Experimental Search for a Possible Change of the β Decay Constant with Centrifugal Force*. Lincei, Memorie Sc. Fisiche

1960: Amaldi visits Robert Dicke's laboratory

1960, July 28: Amaldi writes to Dicke, telling him he would like to visit his laboratory in Princeton on next September, after the Rochester Conference

In a previous letter of 10 February 1960, Amaldi had asked him preprints and internal notes about his results on the comparison between gravitational and inertial mass.

July 28, 1960

Dr. R.H. Dicke
Palmer Physical Laboratory
Princeton University
PRINCETON, NEW JERSEY

I would be very glad if I could see your experiments on the equivalence of inertial and gravitational mass.

Dear Professor Dicke,

I will be in USA in the first half of September and I wonder if I could see the laboratories, coming back from Berkeley to New York around the 15th of September. I would be very glad if I could see your experiments on the equivalence of intertial and gravitational mass.

Best regards,

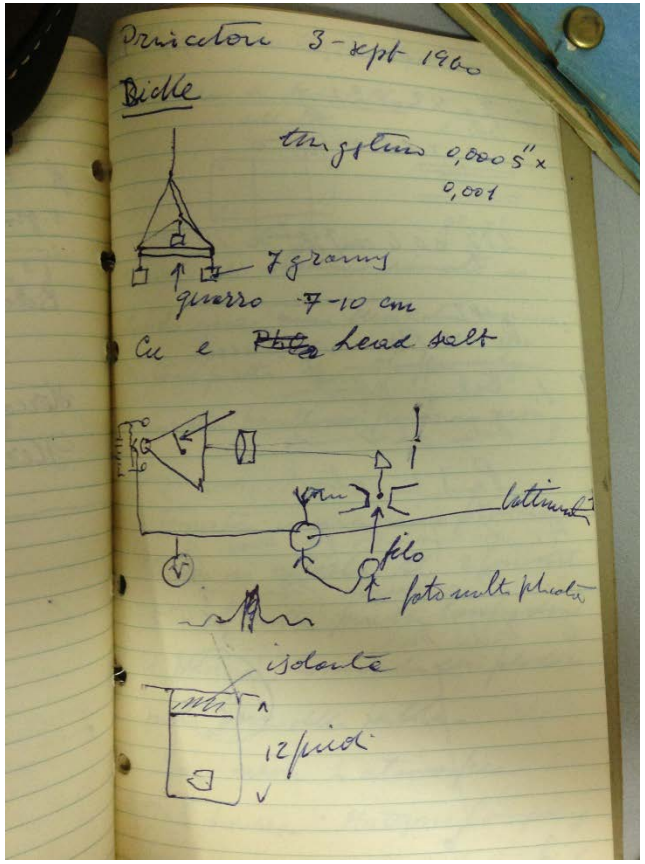
Sincerely yours,

(E. Amaldi)

1960: Amaldi visits Robert Dicke's laboratory

1960, September 3: Amaldi visits Dicke in Princeton. Giuseppe Fidecaro recounts (in a personal mail to Ugo Amaldi): «Dicke discussed his experiments with us for a couple of hours, in front of a big blackboard. Then he called somebody which I cannot remember and we went together to visit the laboratory.»

It was possible to identify the date of Amaldi's visit to Dicke through the notes he wrote in his diaries



Correspondence 1959 between Berkeley and Rome

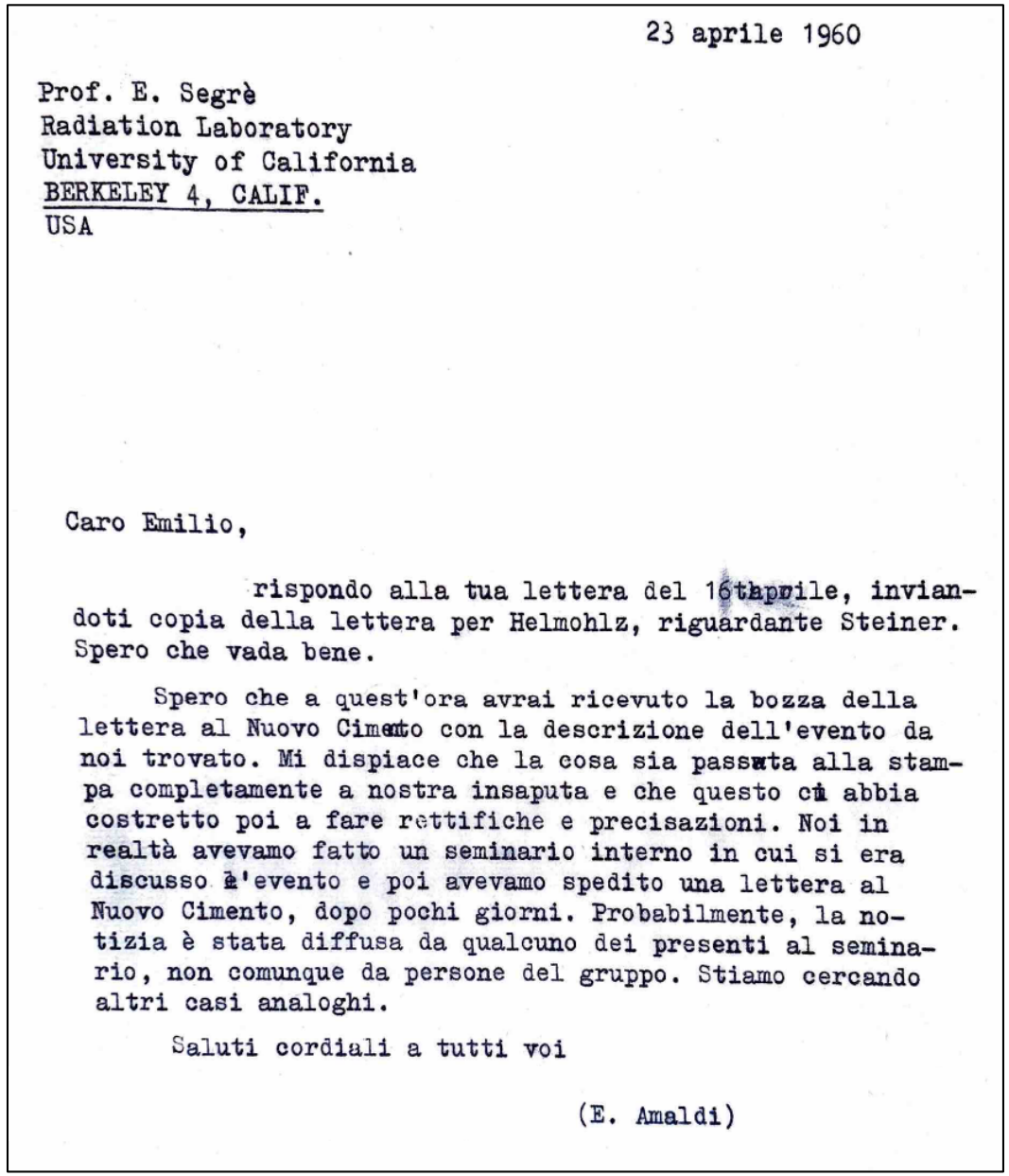
TABLE II.

Star	Track	Range (mm)	Identification	Kinetic energy (MeV)	Binding energy or rest mass (MeV)
A	4	41	p	118	8
	2	—	$\overline{\Sigma^+}$	910 ± 150	1189
	Probable recoil	$\sim 10^{-3}$	—	—	—
B	*a*	1.55	p	18.0	8
	b	1.36	p	16.5	8
	c	0.21	p	5.6	8
	d	14.0	p	64.0	8
	e	—	π	280.0 ± 80	139.6
	f	1.73	p	19.0	8
	g (*)	> 50.0	p	> 135.0	8
	h	0.15	p	4.5	8
	i	36.0	p	115.0	8
	l	0.4	p	8.2	8
	m (**)	> 18.5	p	> 175.0	8
	n	—	π	200.0 ± 60	139.6
	o	23.0	p	85.0	8
	p	1.5	p	18.0	8
	q	29.6	p	98.5	8
			Total	> (1242 ± 100) MeV	383 MeV
			Total visible energy:	> 1.6 GeV	

(*) The identification of this track is uncertain because it leaves the stack and is steeply dipping. The energy balance does not change appreciably if it is attributed to a pion.

(**) Leaves the stack.

Letter between Amaldi and Segrè



23 aprile 1960

Prof. E. Segrè
Radiation Laboratory
University of California
BERKELEY 4, CALIF.
USA

Caro Emilio,

rispondo alla tua lettera del 16 aprile, inviandoti copia della lettera per Helmohlz, riguardante Steiner. Spero che vada bene.

Spero che a quest'ora avrai ricevuto la bozza della lettera al Nuovo Cimento con la descrizione dell'evento da noi trovato. Mi dispiace che la cosa sia passata alla stampa completamente a nostra insaputa e che questo ci abbia costretto poi a fare rettifiche e precisazioni. Noi in realtà avevamo fatto un seminario interno in cui si era discusso l'evento e poi avevamo spedito una lettera al Nuovo Cimento, dopo pochi giorni. Probabilmente, la notizia è stata diffusa da qualcuno dei presenti al seminario, non comunque da persone del gruppo. Stiamo cercando altri casi analoghi.

Saluti cordiali a tutti voi

(E. Amaldi)

Traduzione

Letter

Maintenant je voudrais dire un dernier mot, tiré de ma leçon inaugurale au Collège de France lorsque j'ai remplacé Joliot en 1958 " Les cosmiciens qui s'attaquèrent aux problèmes de ces particules étaient en quelque sorte des aventuriers, pionniers d'une physique nouvelle. Leur laboratoire n'était pas une pièce encombrée d'appareils avec une petite pastille de polonium qui envoyait ses rayons sur des feuilles métalliques. C'était la terre, toute la terre, avec sa surface et un peut de profondeur, avec surtout l'épaisseur de l'atmosphère. Ils transportèrent leurs appareils aussi haut que possible. Les plus lourds électro-aimants et chambres de Wilson dont le poids pouvait atteindre plusieurs tonnes étaient transportés dans des laboratoires de haute montagne : au Jungfraujoch, au Pikes Peak, au Mont Eavans, sur les pentes du Mont Blanc, au Pic du Midi de Bigorre, à la Testa Gregia en Italie : ils passaient des mois, voire des années en se relayant pour servir l'exigeant et capricieux appareil et obtenir de lui quelques photos intéressantes. Ils envoyèrent également leurs appareils le long des méridiens, le long des parallèles afin de suivre les effets géomagnétiques du rayonnement, ils placèrent en profondeur, dans le fond des mines de grandes chambres, des trains de compteurs afin de connaître la composante ultrapénétrante du rayonnement et de lui arracher quelques secrets. Ils installèrent de véritables laboratoires volants dans les avions et même organisèrent des expériences en ballon strastophérique. Certaines d'entre elles furent célèbres. Enfin des blocs épais d'émulsions nucléaires envoyés pendant plusieurs heures aux confins de l'atmosphère, à plus de 30 km d'altitude, reviennent chargés d'informations sur le comportement de tous les rayons qui les ont traversé pendant leur séjour stratosphérique : on comprend à quel point cette forme particulière d'exploration scientifique a pu lier les cosmiciens et leur donner cette fraternité internationale à laquelle je tiens à rendre hommage, tant elle m'a paru heureuse et enrichissante pendant les années correspondantes. On comprend que ces cosmiciens, épris d'altitude, d'indépencance, d'espace, de persévérance pour la découverte de l'objet rare, aient bien de la peine à venir s'enfermer maintenant, pendant toute leur vie, dans les antres des synchrotrons, esclaves des caprices d'une machine puissante, capable dans les meilleurs moments de fournir en moins d'une minute ce que les rayons cosmiques nous distillaient en plusieurs années". Voilà le mode de vie des cosmiciens.

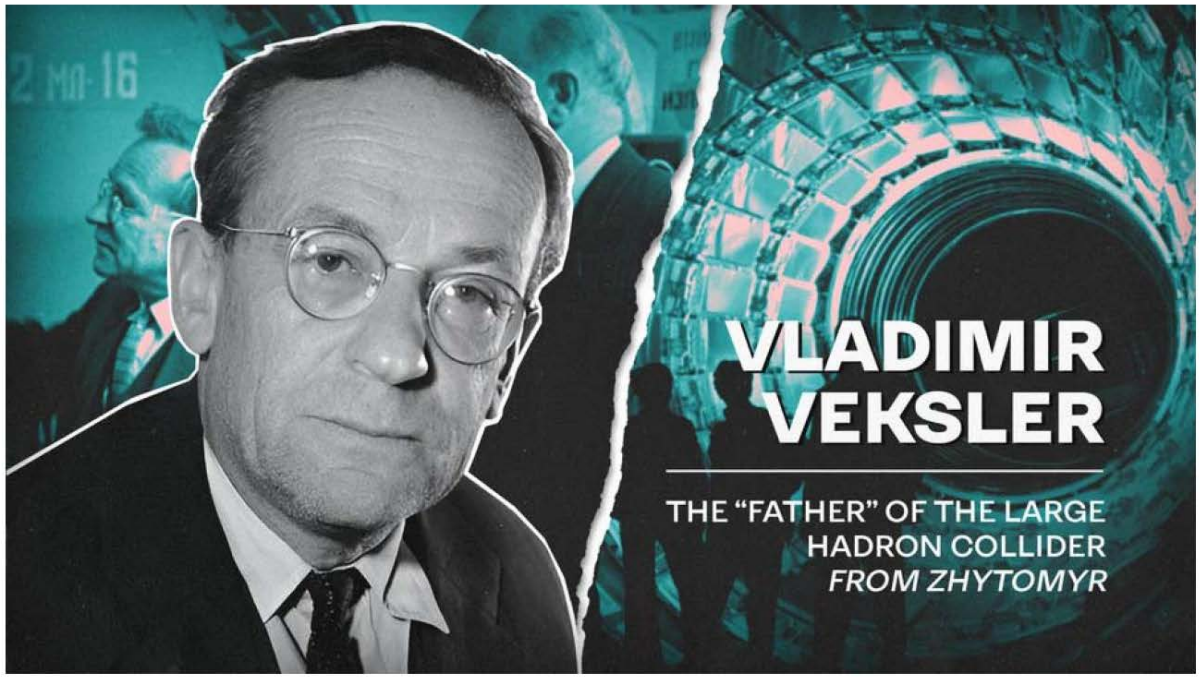
Leprince-Ringuet, Les rayons cosmiques et la physique des particules a l'ecole polytechnique, Le Journal de Physique Colloques, Vol. 43 / C8 - Decembre 1982 Colloque International sur l'Histoire de la Physique des Particules Quelques dcouvertes, concepts, institutions des annes 30 aux annes 50

KYIV POST
UKRAINE'S GLOBAL VOICE

(Un)celebrated Ukrainians Who Changed the Course of History: Volodimir Veksler

The "FATHER" of the large hadron collider, from Zhytomyr.

by Marichka Palamarchuk | August 6, 2023, 9:09 am



Kyiv Post

An article celebrating Veksler in August 2023

Why so less visibility to the Roman discovery? Was it less important? Or was it only because it came slightly later (at the second place in underscoring that all particles have antiparticle)? Why did it give rise only to a paper on Il Nuovo Cimento, without a follow-up a a more international journal?

Why their paper is not quoted or mentioned in other papers?

Questa presentazione dice molto sul lavoro dello storico della fisica, forse più su questo – su come si svolgono le indagini storiche – che sulla vicenda in sé, dove vedrete restano tanti interrogativi…
Per rispondere a tali interrogativi serve ancora ricerca, ma come per ogni ricerca scientifica, potrebbe portare a nulla, a vicoli ciechi o risultato poco interessanti… a motivare tutto c’è una invincibile e pruriginosa curiosità

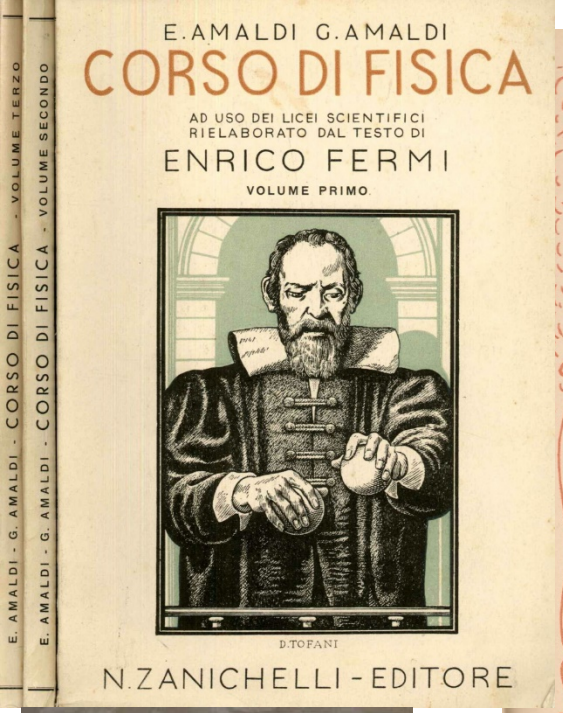
Ginestra Amaldi in 1935

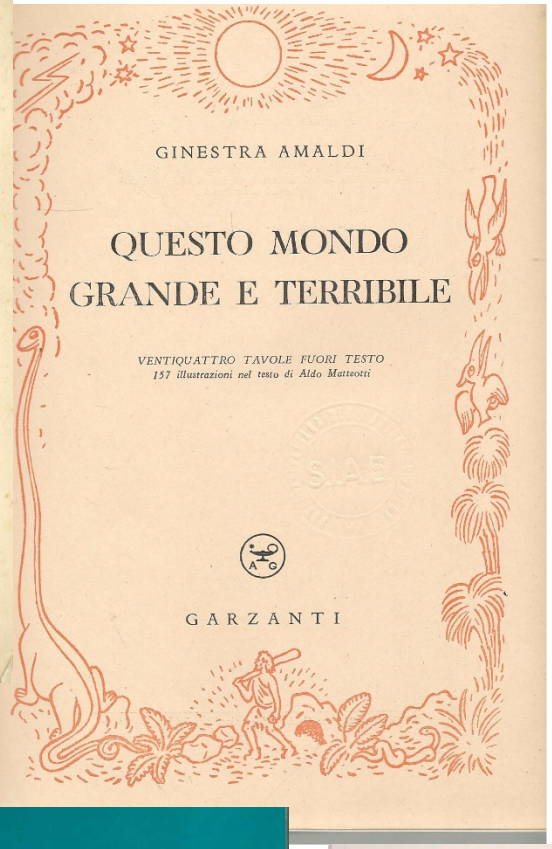
Laura Fermi in 1931

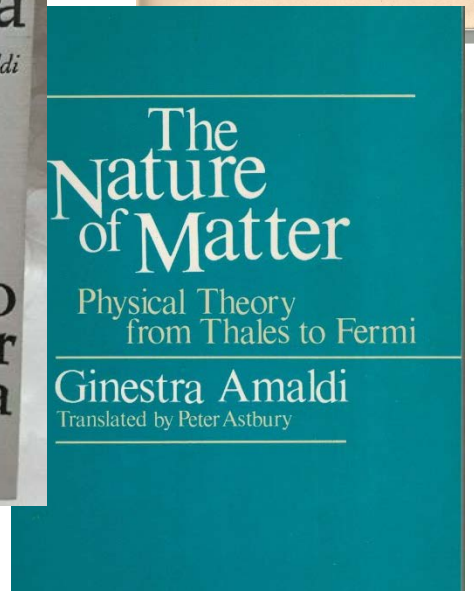
G. Amaldi, L. Fermi, «Alchemy of out times», first published 1936

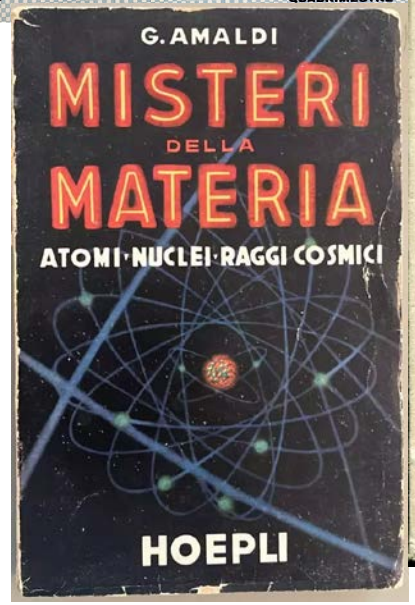
Laura and Enrico Fermi
(late 1920s)

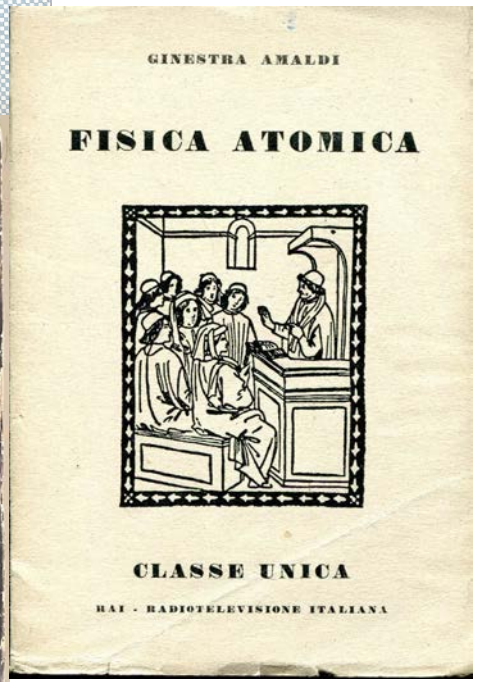
Ginestra and Edoardo
(early 1930s)











Selection of Ginestra's books

Laura e Ginestra at *Il Poggio*, country house of the Amaldis at Carpaneto Piacentino, August 1955

Amaldi and Dmitri Ivanenko

Ivanenko, Dirac and Heisenberg (Berlin, 1958)

- Dmitri Ivanenko (1904, 1994), Moscow University

- In 1947, D. Ivanenko and A. Sokolov restarted the idea of quantum gravity proposed in the Thirties by the soviet physicicst Matvei Bronstein, imprisoned and killed in 1938 for political reasons. They developed a model of a graviton as a quantum (of spin 2) of a weak gravitational field: possibility of transmutations of ordinary particles in a graviton by analogy with creation and annihilation of electron-positron pairs in an electromagnetic quantum . The model was not correct, because of its approximation of weak field. Ivanenko turned again and again to this idea until he developed the new direction – gauge gravitation theory – in 1961.