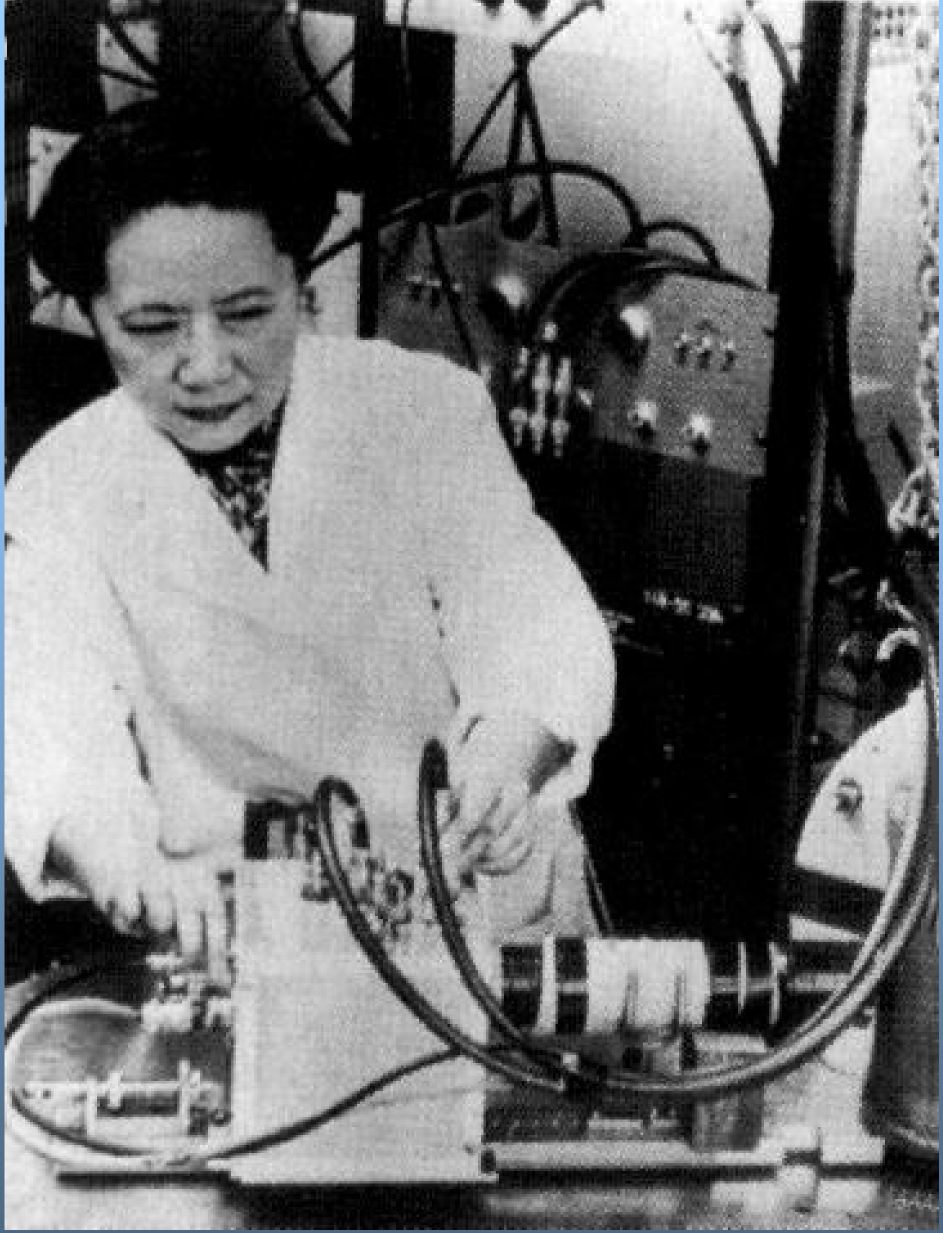
In early January 1957 C. S. Wu announced that her experiment had shown that parity is not conserved in beta decay.



C.S. Wu (1912-1997)

Her famous paper was in preprint form at that time. It was officially published a month later.

The branching ratio of the two modes of decay of Fm^{253}, i.e., E.C./α, was found to be about 8.5—which gives ~89.5% decay by electron capture and ~10.5% by alpha emission. It was not possible to measure the cross section for the $Cf^{252}(\alpha,3n)Fm^{253}$ reaction because Fm^{253} could also be produced from other californium isotopes in the target.

A previous publication[4] on a possible identification of the Fm^{253} gave the values of 6.85±0.04 Mev for the alpha-particle energy, and a half-life >10 days.

It is a pleasure to thank the crew of the 60-inch cyclotron for their extremely careful and skillful operation of the machine during the bombardment. We wish to thank Professor Glenn T. Seaborg for his continued interest.

* On leave from the Israel Atomic Energy Commission, Weizmann Institute of Science, Rehovoth, Israel.

[1] Thompson, Ghiorso, Harvey, and Choppin, Phys. Rev. **93**, 908 (1954).
[2] Harvey, Chetham-Strode, Ghiorso, Choppin, and Thompson, Phys. Rev. **104**, 1315 (1956).
[3] Thompson, Harvey, Choppin, and Seaborg, J. Am. Chem. Soc. **76**, 6229 (1954); Choppin, Harvey, and Thompson, J. Inorg. and Nuclear Chem. **2**, 66 (1956).
[4] Friedman, Gindler, Barnes, Sjoblom, and Fields, Phys. Rev. **102**, 585 (1956).

Experimental Test of Parity Conservation in Beta Decay*

C. S. Wu, *Columbia University, New York, New York*

AND

E. Ambler, R. W. Hayward, D. D. Hoppes, and R. P. Hudson, *National Bureau of Standards, Washington, D. C.*

(Received January 15, 1957)

In a recent paper[1] on the question of parity in weak interactions, Lee and Yang critically surveyed the experimental information concerning this question and reached the conclusion that there is no existing evidence either to support or to refute parity conservation in weak interactions. They proposed a number of experiments on beta decays and hyperon and meson decays which would provide the necessary evidence for parity conservation or nonconservation. In beta decay, one could measure the angular distribution of the electrons coming from beta decays of polarized nuclei. If an asymmetry in the distribution between θ and $180°-\theta$ (where θ is the angle between the orientation of the parent nuclei and the momentum of the electrons) is observed, it provides unequivocal proof that parity is not conserved in beta decay. This asymmetry effect has been observed in the case of oriented Co^{60}.

It has been known for some time that Co^{60} nuclei can be polarized by the Rose-Gorter method in cerium magnesium (cobalt) nitrate, and the degree of polarization detected by measuring the anisotropy of the succeeding gamma rays.[2] To apply this technique to the present problem, two major difficulties had to be overcome. The beta-particle counter should be placed *inside* the demagnetization cryostat, and the radioactive nuclei must be located in a *thin surface* layer and polarized. The schematic diagram of the cryostat is shown in Fig. 1.

To detect beta particles, a thin anthracene crystal $\frac{3}{8}$ in. in diameter$\times\frac{1}{16}$ in. thick is located inside the vacuum chamber about 2 cm above the Co^{60} source. The scintillations are transmitted through a glass window and a Lucite light pipe 4 feet long to a photomultiplier (6292) which is located at the top of the cryostat. The Lucite head is machined to a logarithmic spiral shape for maximum light collection. Under this condition, the Cs^{137} conversion line (624 kev) still retains a resolution of 17%. The stability of the beta counter was carefully checked for any magnetic or temperature effects and none were found. To measure the amount of polarization of Co^{60}, two additional NaI gamma scintillation counters were installed, one in the equatorial plane and one near the polar position. The observed gamma-ray anisotropy was used as a measure of polarization, and, effectively, temperature. The bulk susceptibility was also monitored but this is of secondary significance due to surface heating effects, and the gamma-ray anisotropy alone provides a reliable measure of nuclear polarization. Specimens were made by taking good single crystals of cerium magnesium nitrate and growing on the upper surface only an additional crystalline layer containing Co^{60}. One might point out here that since the allowed beta decay of Co^{60} involves a change of spin of

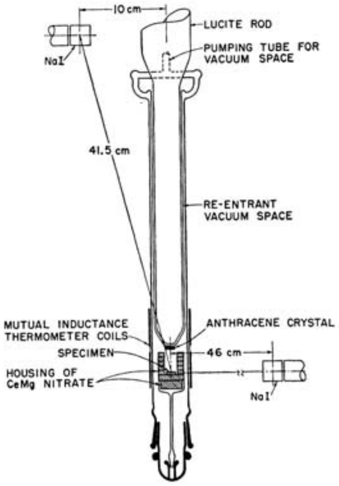


Fig. 1. Schematic drawing of the lower part of the cryostat.

In the meantime, news spread like wild fire in the world of physicists.

At the Annual meeting of the American Physical Society on February 2, at the new Yorker Hotel,

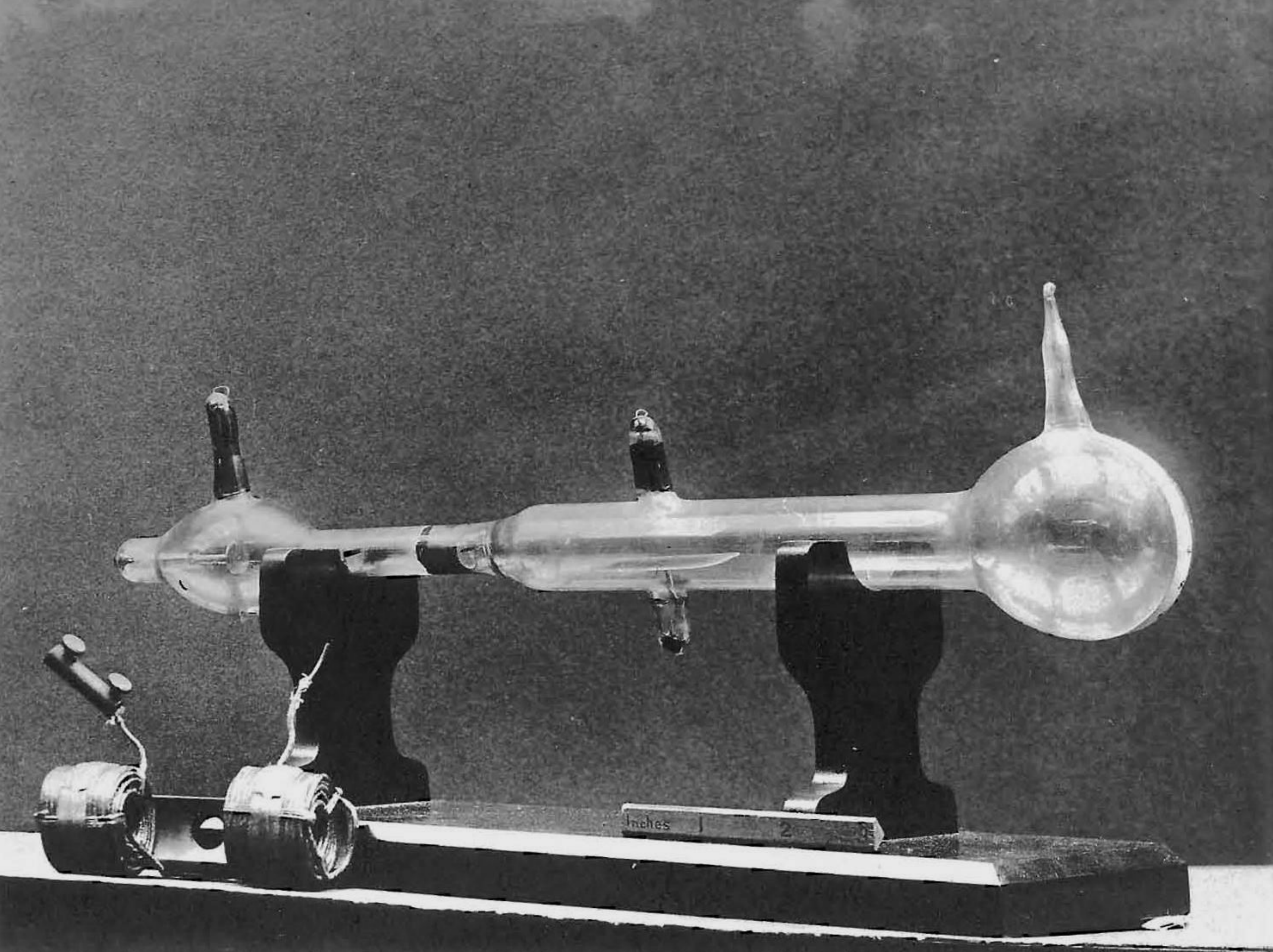
The largest hall normally at our disposal was occupied by so immense a crowd that some of its members did everything but hang from the chandeliers.

That 1957 excitement among physicists was exceeded only 40 years later in the high temperature superconductivity "Woodstock" meeting of 1997.

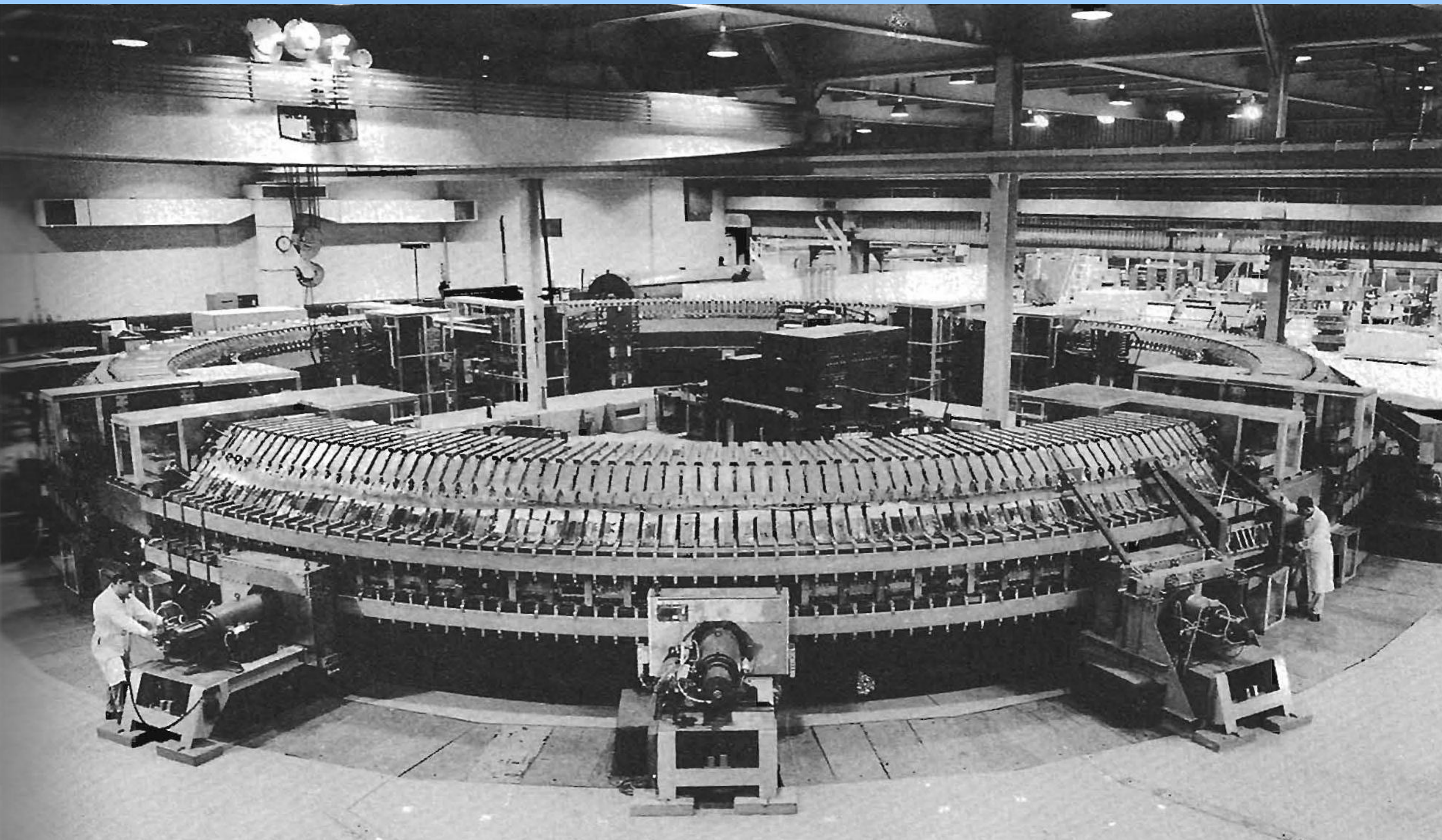
I
Background

Experiments in physics were small in scale before WWII.

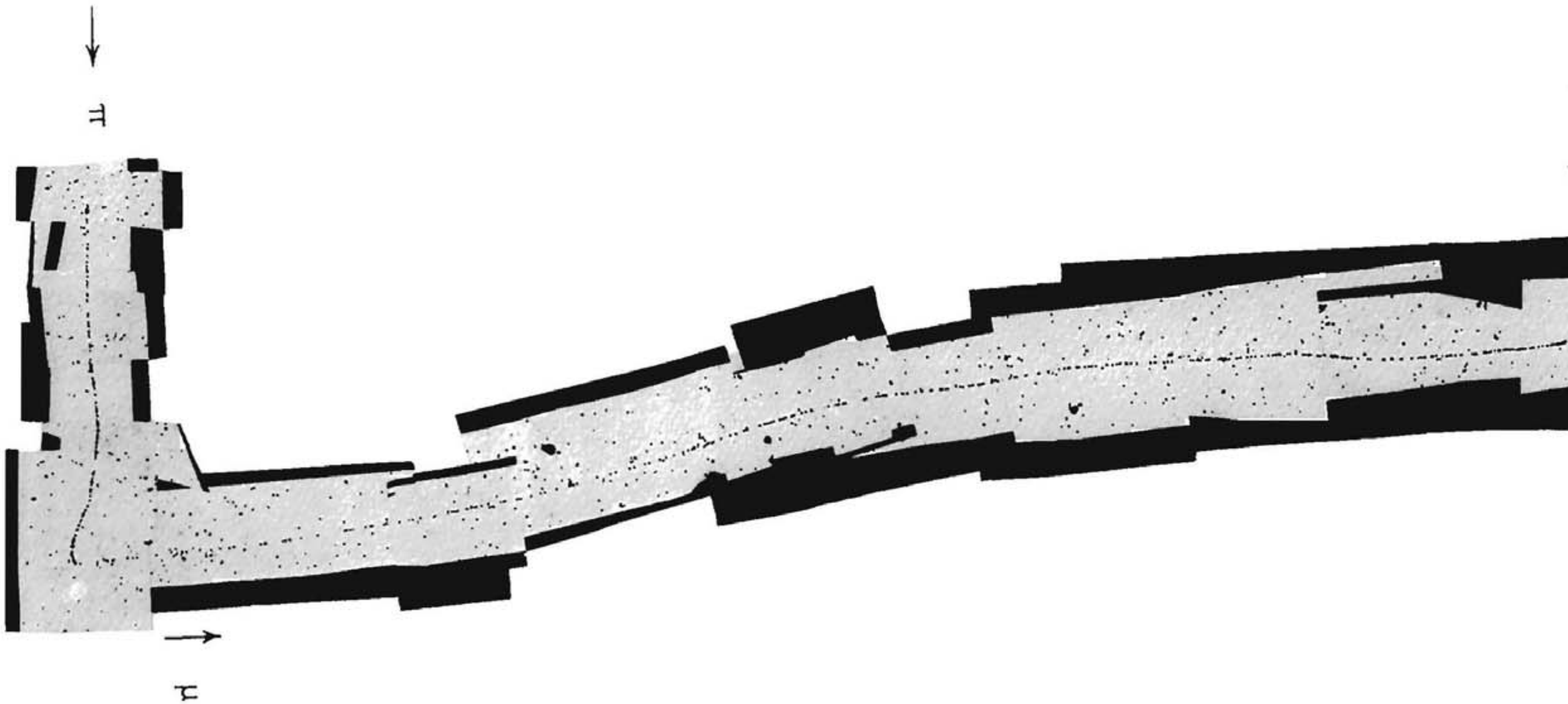
Typical example is Thomson’s 1897 apparatus:


Inches 1 2

After WWII, nuclear physics became a very hot field of research. Larger and larger accelerators were built.



With these accelerators, and with cosmic ray experiments, many new kinds of “elementary particles”, previously unknown, were discovered.



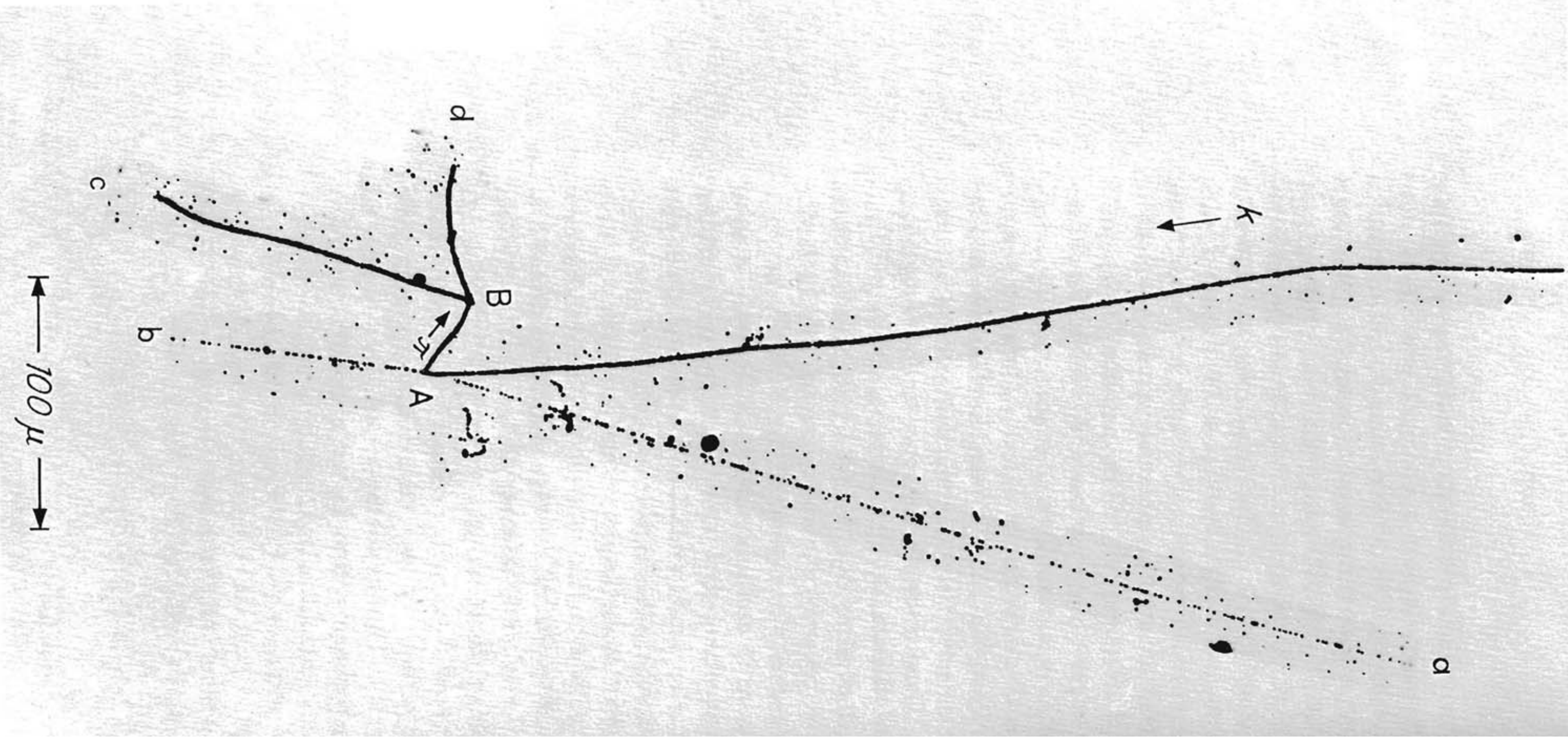
$$\pi^{+} \rightarrow \mu^{+} + ?$$

The particle π had been predicted in 1935 by Yukawa.

Discovery of π, and its daughter μ caused great excitement in 1947.

But then, in the next few years, several additional particles were discovered.

They were unexpected, so they were called strange particles.

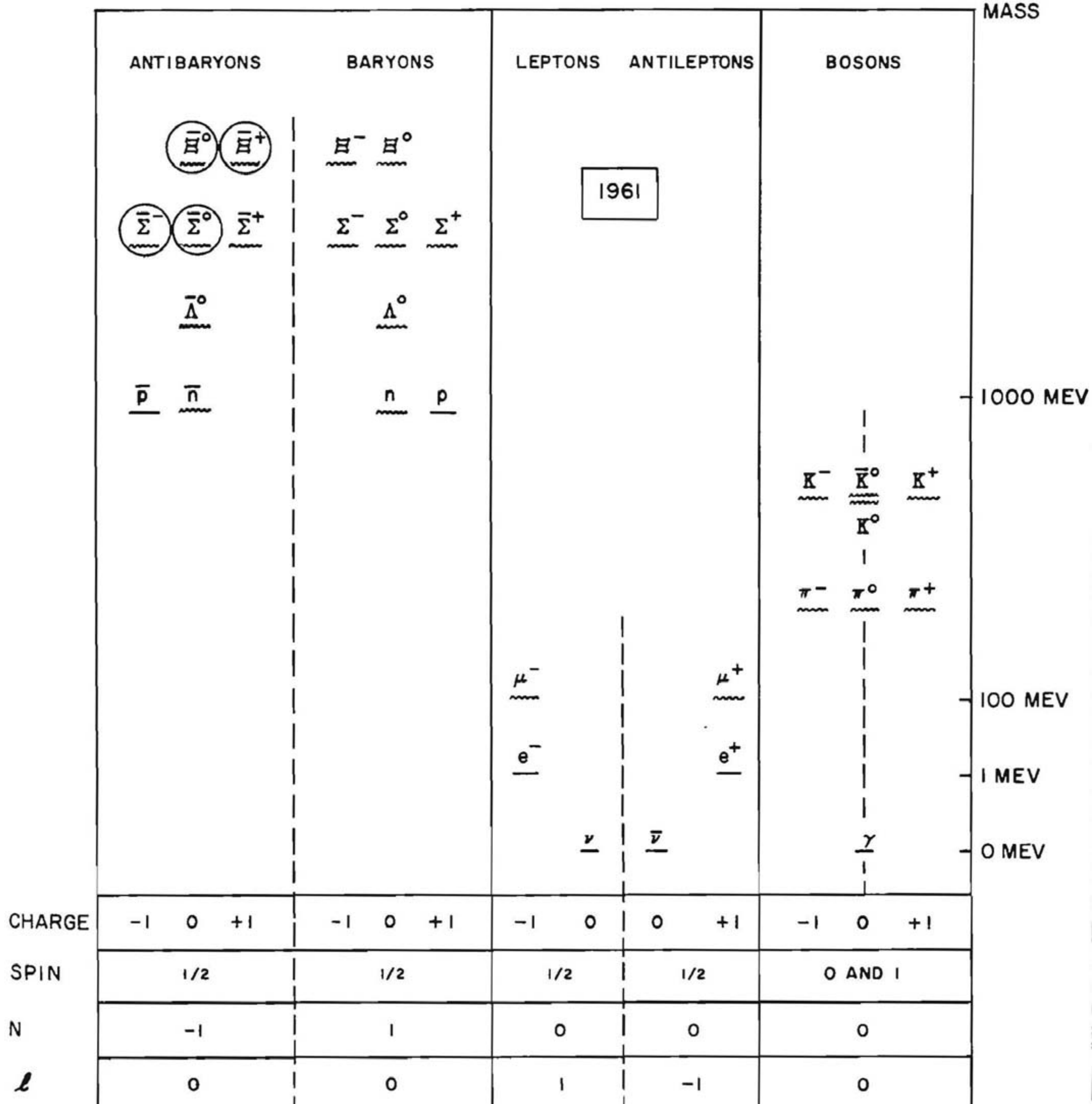


$$K^{+} \rightarrow \pi^{+} + \pi^{+} + \pi^{-}$$

For the next 15 years, 1950-1965, fundamental physics was chiefly occupied with identifying these strange particles, and studying their properties:

- **whether they are charged, ±, or neutral**
- **their masses**
- **how they decay**
- **whether they have “spin”**

etc.


MASS
ANTIBARYONS
BARYONS
LEPTONS
ANTILEPTONS
BOSONS
1961
1000 MEV
100 MEV
1 MEV
0 MEV
CHARGE
SPIN
N
ℓ
-1 0 +1
-1 0 +1
-1 0
0 +1
-1 0 +1
1/2
1/2
1/2
1/2
0 AND 1
-1
1
0
0
0
0
0
1
-1
0

The K particle had first been called τ, to distinguish from θ particles:

$$\theta^{+} \rightarrow \pi^{+} + \pi^{0}$$

τ and θ were thought at first to be totally unrelated particles.

But then other K particles were discovered, so there was great confusion:

$$K_{\pi 2} = \theta, \; K_{\pi 3} = \tau,$$

$$K_{\mu 2}, \; K_{\mu 3}, \; K_{e3} \; etc.$$

There was also great subtlety. E.g. Gell-Mann theoretically predicted there should be 2 kinds of K^0.

II

The $\theta - \tau$ Puzzle

Between 1954-1957, the hottest debate was the

$\theta - \tau$ **puzzle.**

$$\theta^+ \rightarrow \pi^+ + \pi^0$$

$$\tau^+ \rightarrow \pi^+ + \pi^+ + \pi^-$$

<u>On the one hand</u>, more and more precise experiments showed that θ^+ and τ^+ have the same masses,

and have very comparable longevity.

So they seem to be the same particle, with 2 different ways of decay: into 2π's, or into 3π's.

But on the other hand, each particle has a "parity", and there was a FUNDAMENTAL LAW:

Conservation of Parity

Which says in decays, parity cannot change.

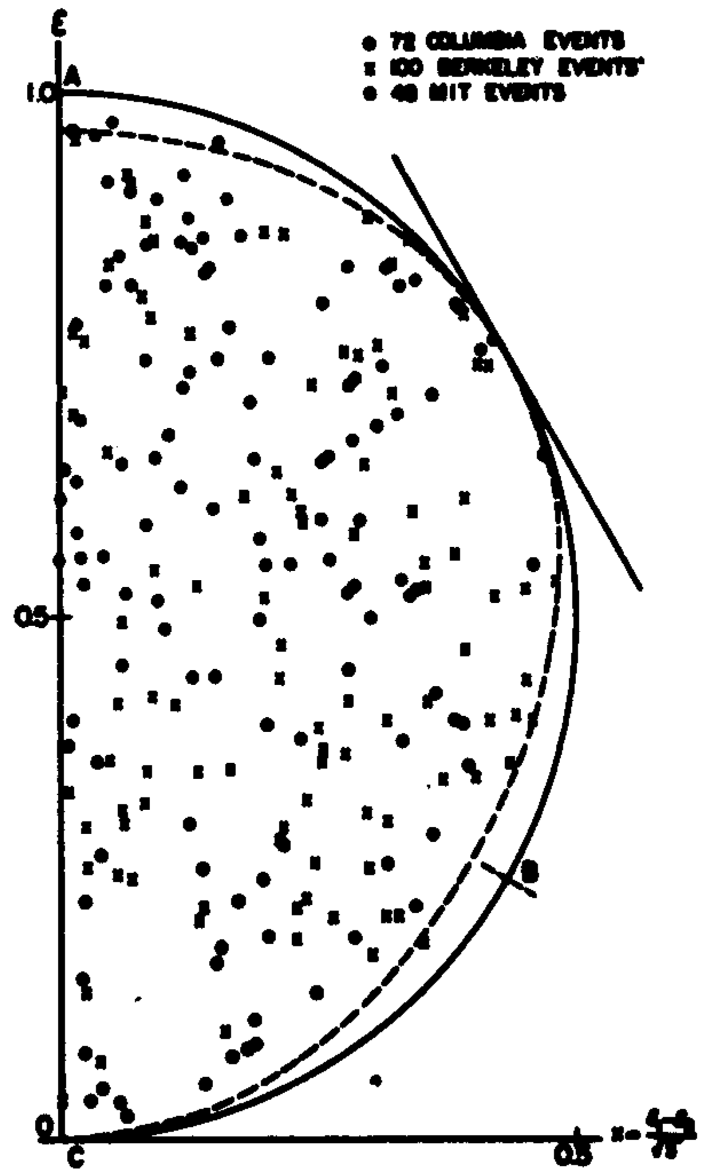
$\pi^+, \ \pi^0, \ \pi^-$ **all have parity of (–1).**

$\theta^+ \rightarrow \pi^+ + \pi^0$ **has parity +1.**

$\tau^+ \rightarrow \pi^+ + \pi^+ + \pi^0$ **has parity –1, (most likely).**

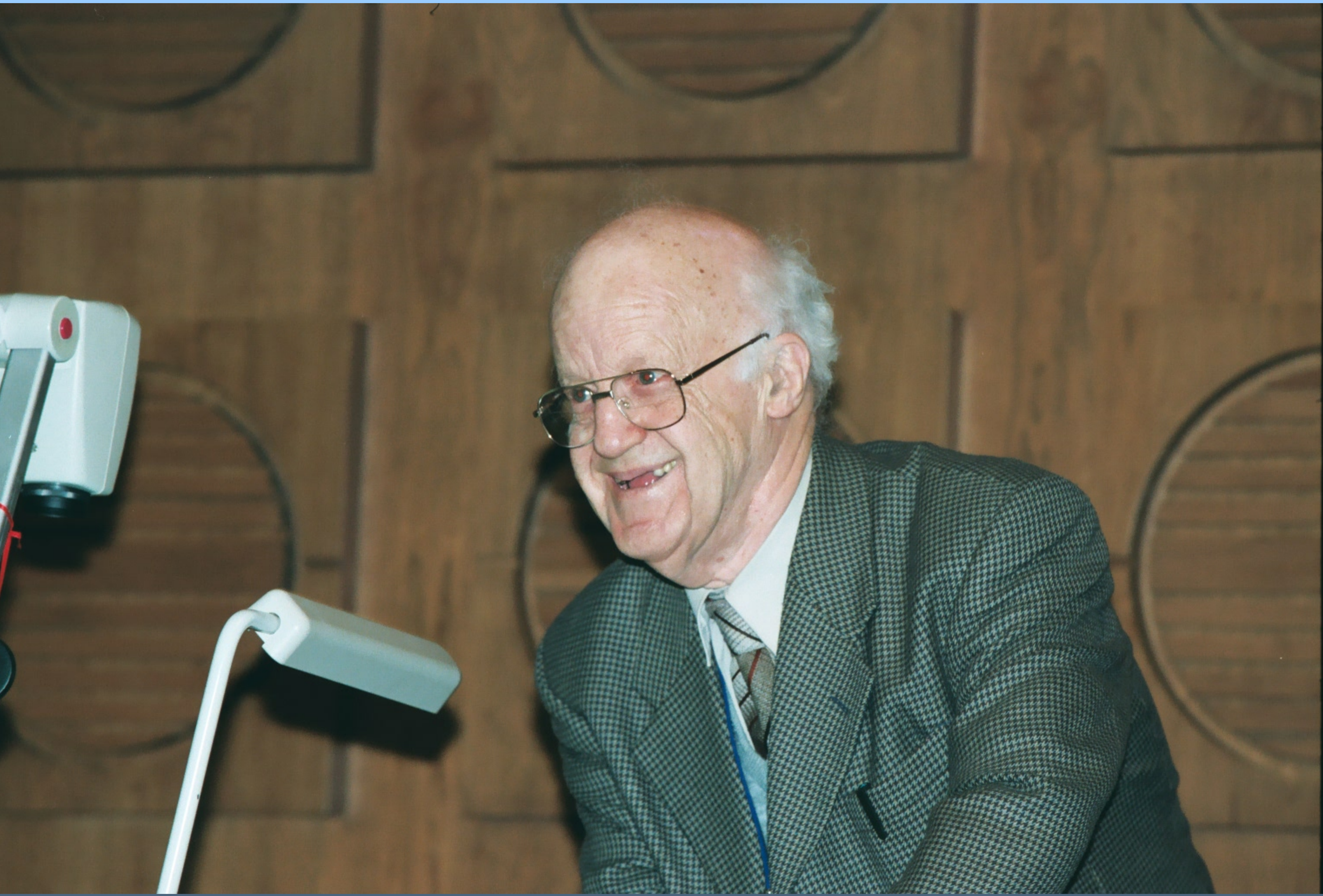
Most likely, because some details about τ decay had to be examined to rule out "orbital" contribution to parity.

Dalitz Plot



72 COLUMBIA EVENTS
100 BERKELEY EVENTS
MIT EVENTS
ε
A
1.0
0.5
0
C
B
0.5

Fig. 4



At the International Conference on High Energy physics, April 3-6, 1956, at Rochester in New York State, (the most important conference in physics in the 1950's)

Dalitz's summarized the works of the previous two years, showing that the hundreds of τ decays studied gave a uniform distribution in the Dalitz plot.

Hence no "orbital" parity.

Hence τ <u>does</u> have parity of (–1)!

Hence by parity conservation, θ and τ cannot be the same particle. Hence PUZZLE!

Explicitly and Implicitly:

Could Parity be
not conserved?

Three reasons why people believed in parity conservation.

I. Parity Conservation means physical universe is right-left symmetrical.

This seems a priori indisputable. And it is also born out by Newton's equations, and Maxwell's equations.

II. Right-left symmetry has great intuitive and aesthetic appeal.

III. After the 1920-1930's, QM showed that parity is accurately conserved in atomic physics.

And indeed that conservation became a <u>powerful tool</u> used effectively in theoretical and experimental research:

- **first in atomic and molecular physics.**
- **then in nuclear decays.**
- **then in nuclear reactions.**

In particular, in hundreds of beta decay experiments,

“selection and intensity rules” involving parity conservation were found to be in good agreement with experiments.

Thus:

It is inconceivable that parity can be not conserved!

“The situation physicists found themselves in was like that of a man in a <u>dark room</u> groping for an exit. He knew there is a door somewhere. But in which direction?”

Ⅲ

Three Key Developments

1. **Maybe for most forces, parity is conserved,**

   but for some forces, it is not.

This led to a detailed examination of parity conservation in weak forces, in particular, in beta decay.

2. All previous experiments in beta decay had nothing to do with parity conservation.

I.e. Parity conservation was, up to then, UNTESTED in beta decay.

3. **We then suggested several experiments to test parity conservation in beta decay and in other weak interactions.**

“The fact that parity conservation in the weak interactions was believed for so long without experimental support was very startling.

But what was more startling was the prospect that a space time symmetry law which the physicists have learned so well may be violated.

This prospect did not appeal to us. Rather we were, so to speak, driven to it through frustration with the various other efforts at understanding the θ - τ puzzle that had been made."

The paper by Lee and Yang was submitted on June 22, 1956.

Is Parity Conserved in Weak Interactions?*

Abstract

The question of parity conservation in β-decays, and hyperon and meson decays is examined. Possible experiments are suggested that might test parity conservation in these interactions.

Reprinted from The Physical Review, Vol. 104, No. 1, 254–258, October 1, 1956
Printed in U. S. A.

Question of Parity Conservation in Weak Interactions*

T. D. Lee, *Columbia University, New York, New York*

and

C. N. Yang,† *Brookhaven National Laboratory, Upton, New York*

(Received June 22, 1956)

The question of parity conservation in β decays and in hyperon and meson decays is examined. Possible experiments are suggested which might test parity conservation in these interactions.

Recent experimental data indicate closely identical masses[1] and lifetimes[2] of the $\theta^+(\equiv K_{\pi 2}^+)$ and the $\tau^+(\equiv K_{\pi 3}^+)$ mesons. On the other hand, analyses[3] of the decay products of τ^+ strongly suggest on the grounds of angular momentum and parity conservation that the τ^+ and θ^+ are not the same particle. This poses a rather puzzling situation that has been extensively discussed.[4]

One way out of the difficulty is to assume that parity is not strictly conserved, so that θ^+ and τ^+ are two different decay modes of the same particle, which necessarily has a single mass value and a single lifetime. We wish to analyze this possibility in the present paper against the background of the existing experimental evidence of parity conservation. It will become clear that existing experiments do indicate parity conservation in strong and electromagnetic interactions to a high degree of accuracy, but that for the weak interactions (i.e., decay interactions for the mesons and hyperons, and various Fermi interactions) parity conservation is so far only an extrapolated hypothesis

PRESENT EXPERIMENTAL LIMIT ON PARITY NONCONSERVATION

If parity is not strictly conserved, all atomic and nuclear states become mixtures consisting mainly of the state they are usually assigned, together with small percentages of states possessing the opposite parity. The fractional weight of the latter will be called $\mathfrak{F}^2$. It is a quantity that characterizes the degree of violation of parity conservation.

The existence of parity selection rules which work well in atomic and nuclear physics is a clear indication that the degree of mixing, $\mathfrak{F}^2$, cannot be large. From such considerations one can impose the limit $\mathfrak{F}^2 \lesssim (r/\lambda)^2$, which for atomic spectroscopy is, in most cases, $\sim 10^{-6}$. In general a less accurate limit obtains for nuclear spectroscopy.

Parity nonconservation implies the existence of interactions which mix parities. The strength of such interactions compared to the usual interactions will in general be characterized by $\mathfrak{F}$, so that the mixing will be of the order $\mathfrak{F}^2$. The presence of such interactions

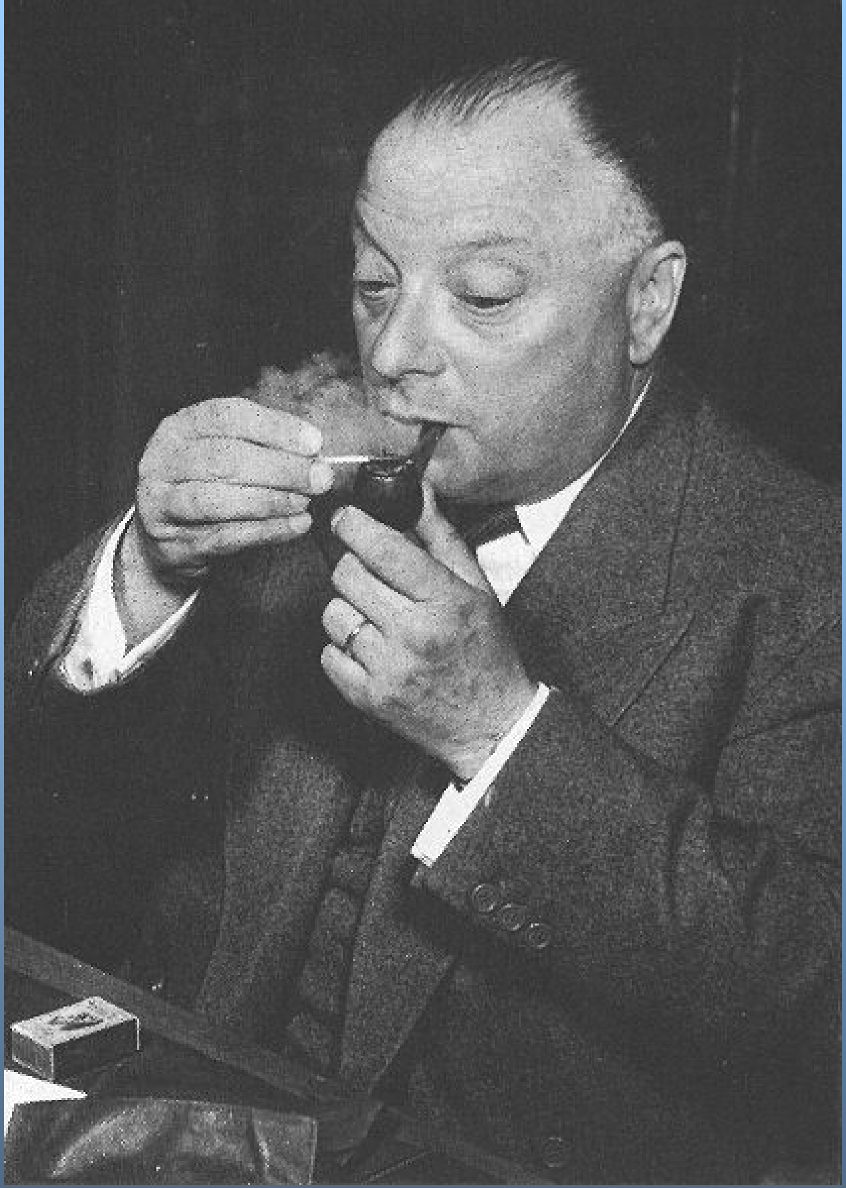
IV
Reaction

General Disbelief

The formidable Pauli wrote:

“I do not believe that the Lord is a weak left-hander,

and I am ready to bet a very high sum that the experiment will give symmetric angular distribution of the electrons.”

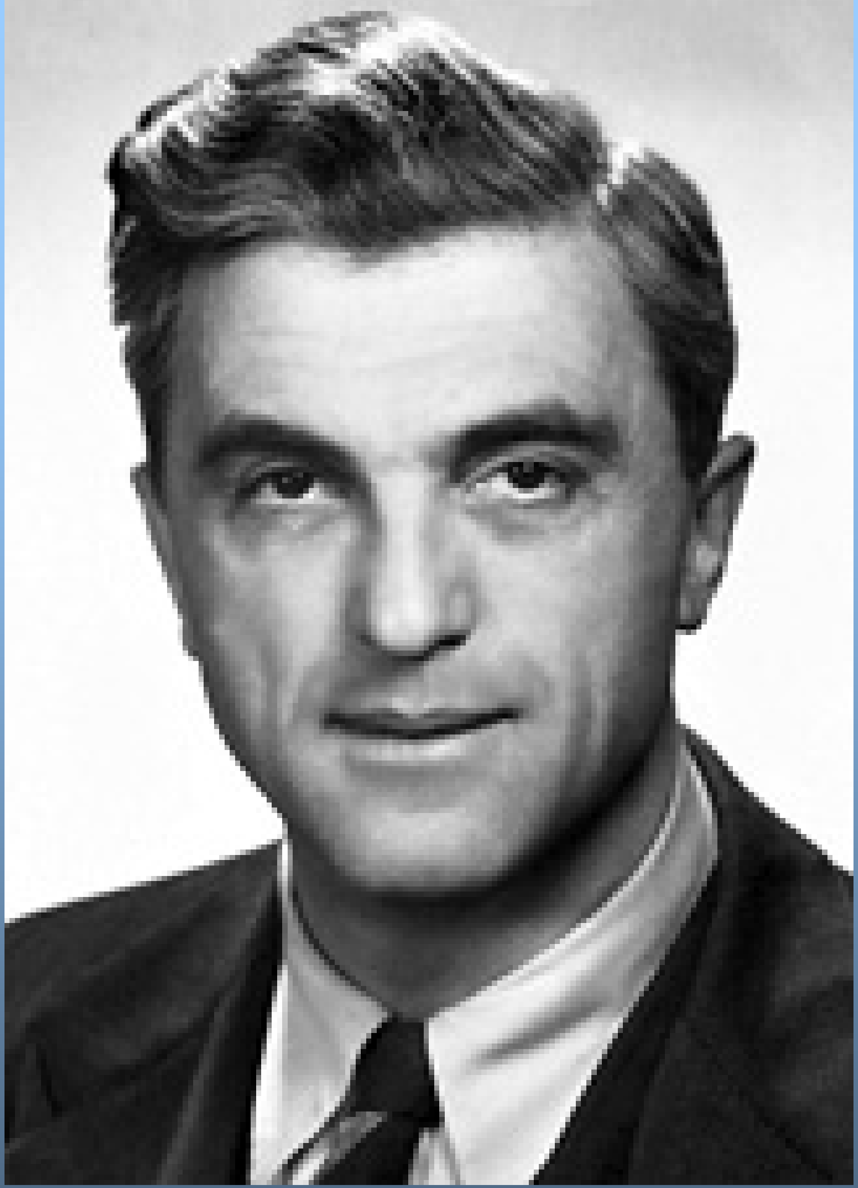


Wolftgang Pauli (1900-1958)

Feynman, a brilliant theoretical physicist, then 36 years old, made a bet that parity is conserved, at the overwhelming odds of 50 to 1.

Richard Feynman (1918-1988)

F. Bloch, who had won the Nobel Prize for NMR, the technology that led later to MRI, said he would eat his hat if parity is not conserved.



F. Bloch (1905-1983)

Lee and I felt we had pointed out an important fact:

the lack of experimental proof that parity is conserved in weak interactions.

But we did not believe that parity is indeed nonconserved in any interactions.

So after our paper was submitted in June 1956, we turned our main attention to another field of physics:

Statistical Mechanics.

V
Wu’s Experiment

In the meantime, most experimental physicists did not want to tackle the experiments we had suggested.

Because they felt the experiments we suggested were all difficult, and doing them would only confirm what everyone already knew was true,

i.e. parity is conserved.

So they were not worth doing.

But Wu had deeper <u>strategic</u> perception:

She also did not feel parity could be nonconserved.
(She was a friend and admirer of the great Pauli.)

But she felt a fundamental law of nature <u>must</u> be tested experimentally.

“獨具慧眼”

She was a great β-decay physicist. She recruited four low temperature physicists from the Bureau of Standards to collaborate on one of the experiments we had suggested:

β-decay of polarized radioactive Co^{60}.

So for the next 5 months she shuttled between New York City and Washington D.C..

They had many difficulties, since β-decay and low temperature were two new technologies which had not yet been brought together in one experiment.

Many <u>tactical</u> problems had to be solved.

For example, the low temperature required them to make a big crystal to hold the Co^{60} sample.

So they had to learn the technology of making big crystals.

After 3 weeks of frustrating struggle, Wu and her Columbia students finally succeeded in making a crystal of about 1cm size.

“Beautiful like a diamond.”

"The day when I brought that crystal to Washington, I was the happiest and proudest person in the world."

The branching ratio of the two modes of decay of Fm^{253}, i.e., E.C./α, was found to be about 8.5—which gives $\sim$89.5% decay by electron capture and $\sim$10.5% by alpha emission. It was not possible to measure the cross section for the $Cf^{252}(\alpha,3n)Fm^{253}$ reaction because Fm^{253} could also be produced from other californium isotopes in the target.

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It is a pleasure to thank the crew of the 60-inch cyclotron for their extremely careful and skillful operation of the machine during the bombardment. We wish to thank Professor Glenn T. Seaborg for his continued interest.

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It has been known for some time that Co^{60} nuclei can be polarized by the Rose-Gorter method in cerium magnesium (cobalt) nitrate, and the degree of polarization detected by measuring the anisotropy of the succeeding gamma rays.[2] To apply this technique to the present problem, two major difficulties had to be overcome. The beta-particle counter should be placed *inside* the demagnetization cryostat, and the radioactive nuclei must be located in a *thin surface* layer and polarized. The schematic diagram of the cryostat is shown in Fig. 1.

To detect beta particles, a thin anthracene crystal $\frac{3}{8}$ in. in diameter$\times\frac{1}{16}$ in. thick is located inside the vacuum chamber about 2 cm above the Co^{60} source. The scintillations are transmitted through a glass window and a Lucite light pipe 4 feet long to a photomultiplier (6292) which is located at the top of the cryostat. The Lucite head is machined to a logarithmic spiral shape for maximum light collection. Under this condition, the Cs^{137} conversion line (624 kev) still retains a resolution of 17%. The stability of the beta counter was carefully checked for any magnetic or temperature effects and none were found. To measure the amount of polarization of Co^{60}, two additional NaI gamma scintillation counters were installed, one in the equatorial plane and one near the polar position. The observed gamma-ray anisotropy was used as a measure of polarization, and, effectively, temperature. The bulk susceptibility was also monitored but this is of secondary significance due to surface heating effects, and the gamma-ray anisotropy alone provides a reliable measure of nuclear polarization. Specimens were made by taking good single crystals of cerium magnesium nitrate and growing on the upper surface only an additional crystalline layer containing Co^{60}. One might point out here that since the allowed beta decay of Co^{60} involves a change of spin of

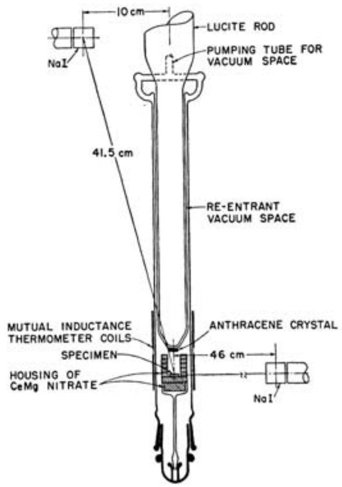
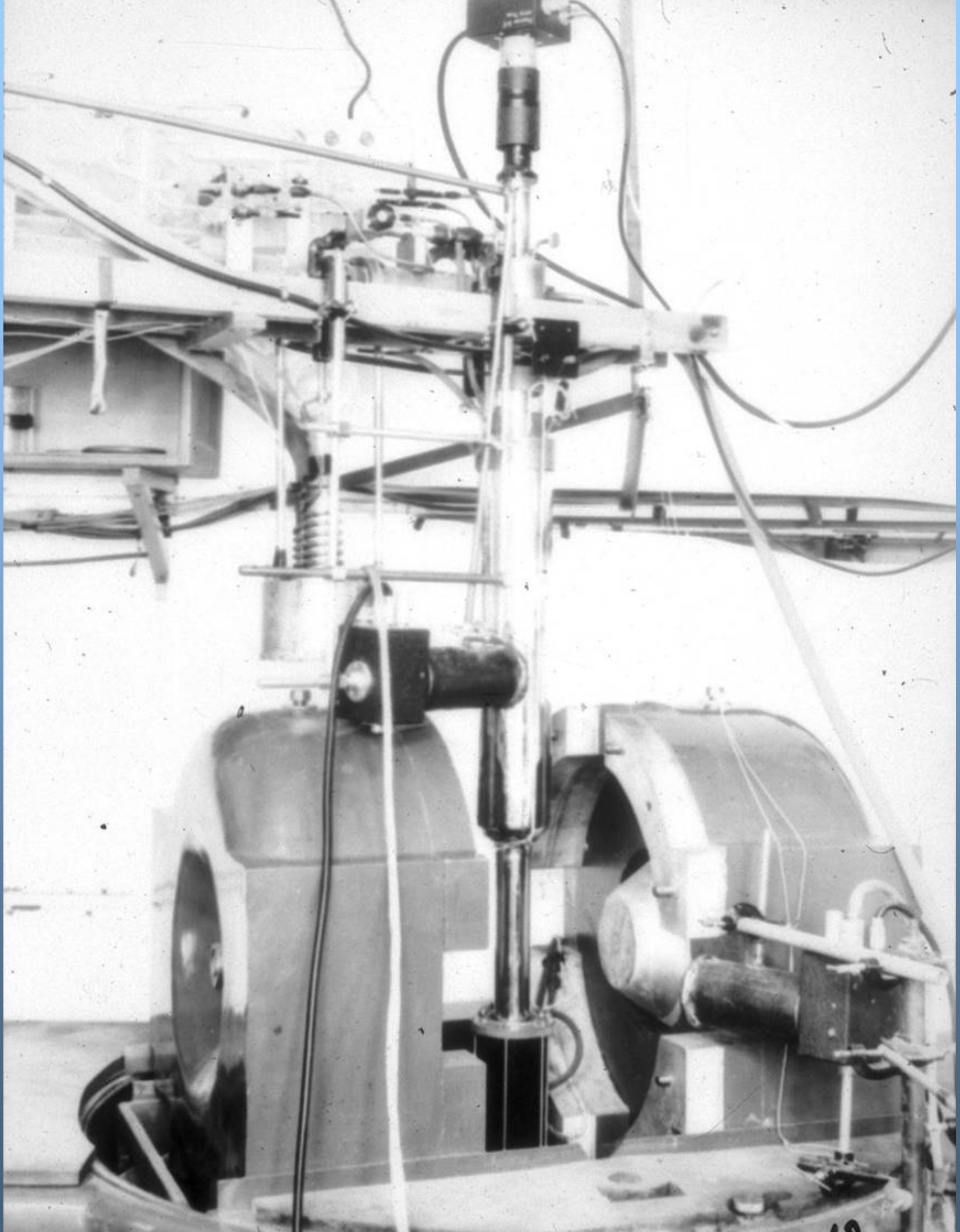


Fig. 1. Schematic drawing of the lower part of the cryostat.



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FULL RATE	
LETTER TELEGRAM	
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NO. WDS.-CL. OF SVC.	PD. OR COLL.	CASH NO.	CHARGE TO THE ACCOUNT OF	TIME FILED

Send the following message, subject to the terms on back hereof, which are hereby agreed to

(A57C)

Princeton, New Jersey, 5 January 1957

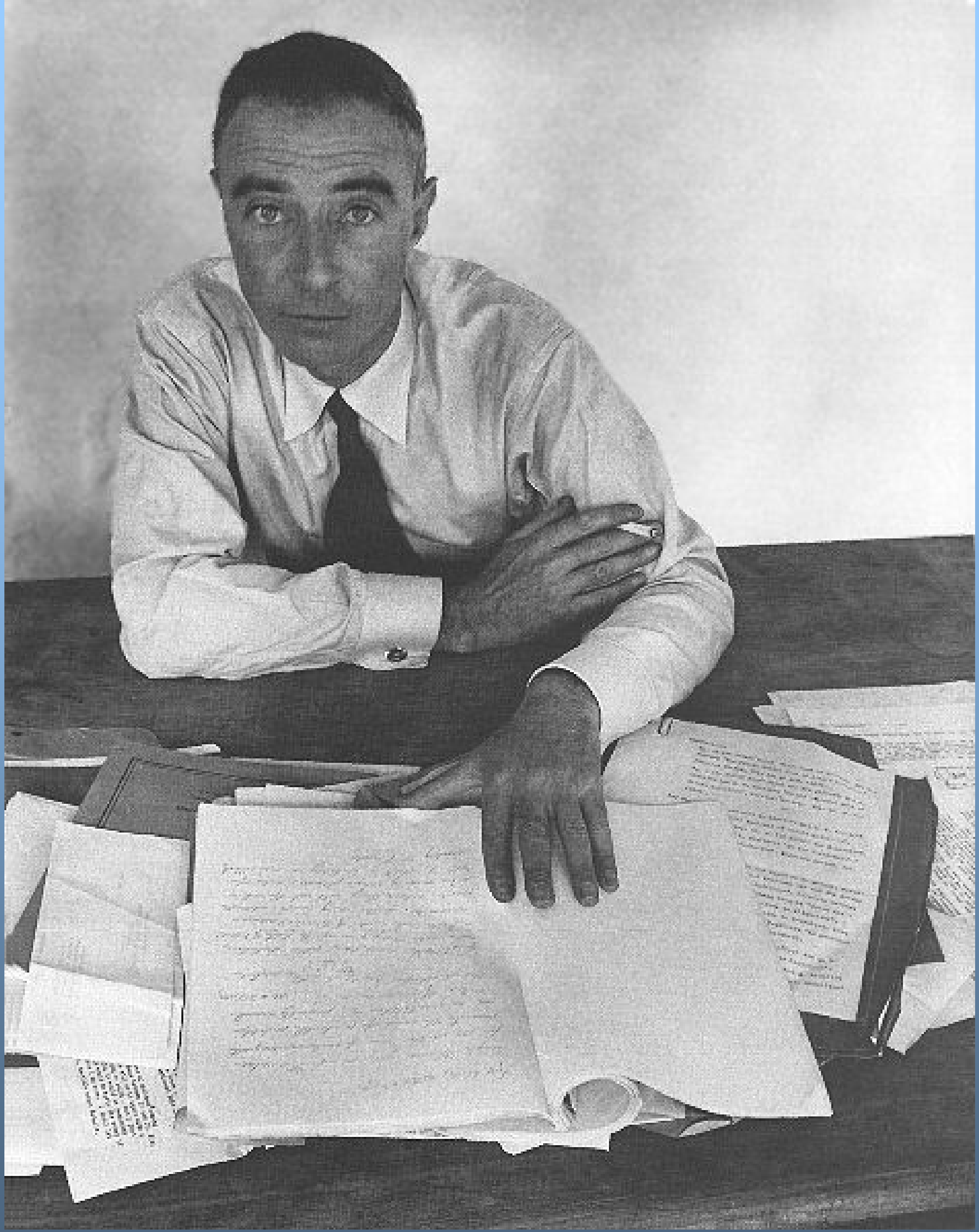
Dr. Robert Oppenheimer
Club Comanche
Christiansted
St. Croix
Virgin Islands

Wu's experiment yielding large asymmetry showing G equal to G prime STOP. Therefore neutrino is a two component wave function STOP. It is a pure screw. Greetings. Frank

---

Answer from JRO

Walked through door greetings



J.R. Oppenheimer (1904-1967)

"All the News That's Fit to Print"

The New York Times.

LATE CITY EDITION

Condensation of U.S. Weather Bureau forecast: Snow this morning, clearing in the afternoon. Fair, cold tomorrow.

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VOL. CVI..No. 36,152. NEW YORK, WEDNESDAY, JANUARY 16, 1957. FIVE CENTS

PRESIDENT SEEKS 76 MILLION FUND TO FIGHT DROUGHT

Assures Wichita Conference U. S. Will Have Other Plans and Will Solve Problem

ENDS GREAT PLAINS TOUR

Strongly Backs Long-Range Research With the Aim of Resisting Dry Cycles

Text of Eisenhower statement is printed on Page 18.

By DONALD JANSON

Special to The New York Times.

WICHITA, Kan., Jan. 15—President Eisenhower ended his tour of parched Great Plains states today with a pledge to seek $76,000,000 in Federal funds for emergency drought relief.

The President also gave strong support to long-range research proposals to resist drought and to cushion its effects when dry cycles do recur.

Basic Concept in Physics Is Reported Upset in Tests

Conservation of Parity Law in Nuclear Theory Challenged by Scientists at Columbia and Princeton Institute

By HAROLD M. SCHMECK Jr.

Experiments shattering a fundamental concept of nuclear physics were reported yesterday by Columbia University.

The concept, called the "principle of conservation of parity,"

The text of Columbia report will be found on Page 24.

has been accepted for thirty years. It must now be discarded, according to the Columbia scientists.

The principle of parity states that two sets of phenomena, one of which is an exact mirror of the other, behave in an identical fashion except for the mirror image effect.

The principle might be explained this way:

Assume that one motion picture camera is photographing a given set of actions and that another camera simultaneously is photographing the same set of actions as reflected in a mirror.

If the two films are later screened, a viewer would have no way, according to the principle of parity, of telling which of the two was the mirror image. The recently completed experiments indicate that there is a way of determining which of the two images is the mirror image.

In communicating with people in an intelligent civilization on another world, the Columbia report explained, it would be impossible, with the principle of parity in effect, to tell whether or not they and we meant the same thing by right-handed or left-handed. This could be true and still the basic physical laws in both worlds would behave ex-

Continued on Page 24, Column 3

MACMILLAN GETS EISENHOWER WISH FOR ALL SUCCESS

Briton Responds With Equal Warmth to Greetings on His Appointment

By DREW MIDDLETON

Special to The New York Times.

LONDON, Jan. 15—President Eisenhower has warmly congratulated Harold Macmillan on his appointment as Prime Minister, wishing him "every success" in his new post.

Mr. Macmillan, in his reply, has pledged his cooperation with the President in furthering friendship between the United States and Britain.

The exchange of letters was made public today by the Prime Minister's office. Mr. Macmillan also received similar messages of congratulation from Secretary of State Dulles and Secretary of the Treasury George M. Humphrey.

Regarded as Rebuttal

Conservative leaders regarded the letters as the beginning of the end of a policy dispute between the two nations arising over British intervention in Egypt last autumn. The President's letter is regarded not only as a generous personal gesture but as a measure of support for both Mr. Macmillan and his new Conservative Cabinet.

DELAYING ACTION IN EGYPT: Israeli soldiers setting up a road block yesterday between El Arish and Rafa during their withdrawal in the Sinai Peninsula. Yugoslav members of the United Nations Emergency force entered the El Arish area after Israelis left.

EGYPT TAKES OVER ASSETS OF BANKS OF BRITISH, FRENCH

Insurance Concerns Affected Also by Nasser Regime's 'Egyptianization' Decrees

NATIVE OWNERSHIP AIM

Other Foreigners' Financial Institutions Get 5 Years Before Control Changes

By OSGOOD CARUTHERS

Special to The New York Times.

CAIRO, Jan. 15—The Government announced today the "Egyptianization" of all British and French banks and insurance companies in Egypt.

All other foreign banks and insurance companies were given five years before they too would be "Egyptianized."

Under decrees to become effective tomorrow, the first anniversary of the promulgation of President Gamal Abdel Nasser's constitution, banking and insurance assets of "enemy alien" concerns virtually have been seized and placed under Government control.

The Egyptianization measures appear to constitute an almost certain guarantee that all foreign financial interests will be driven out of Egypt.

Influx of Capital Wanted

However, Egyptian officials said that the decrees did not affect foreign industrial interests in Egypt. In fact, these officials said, Egypt hopes to try to encourage the influx of more foreign capital for industrial and economic development.

Whether today's move would be considered by foreign-capital interests as encouragement was subject to some question, however.

3.1° Sets 2-Year City Low; Snowfall Imperils Traffic

ELECTRICAL CODE TIGHTENED BY CITY

Council Enacts New Laws to Meet Strains of Modern Appliances on Wiring

By CHARLES G. BENNETT

DULLES SEES PLAN AVERTING A WAR

Tells Senators Use of U. S. Force Is Likely if Mideast Program Is Rejected

By WILLIAM S. WHITE

Special to The New York Times.

WASHINGTON, Jan. 15—John Foster Dulles asserted today that the alternative to President Eisenhower's Middle Eastern program would be "a very great likelihood" that United States troops would have to fight there.

10 MIG-17 Jet Craft Reported Delivered To Syria by Soviet

By HANSON W. BALDWIN

Special to The New York Times.

WASHINGTON, Jan. 15—About ten Soviet MIG-17 swept-wing jet aircraft have been delivered to Syria in the last few weeks.

Other aircraft deliveries are expected. And Soviet technicians to assemble the crated planes and pilots to test them before they are turned over to the Syrians may already be in Syria or will probably soon be there, according to Washington estimates.

ISRAELIS BLOW UP KEY BASE IN SINAI

Troops of U. N. Find Military Installations at El Arish Wrecked After Exit

By HOMER BIGART

Special to The New York Times.

EL ARISH, Egypt, Jan. 15—Yugoslav troops of the United Nations Emergency Force entered El Arish this morning and found that all the military installations except the airstrip had been blown up by the departing Israelis.

FIRE IN SYRACUSE RUINS 4 BUILDINGS

Methodist Church Destroyed —Cold Hampers Firemen

'Eisenhower Democrat' Named As Interim Senator From Texas

But Control of Upper House Will Not Change—Daniel and Shivers in Accord

William A. Blakley

Johnston Says Reds Slip In as Refugees

U. S. 'WELCOMES' EUROPE MARKET

Says Cutting Trade Barriers Should Bolster Members

By EDWIN L. DALE Jr.

"All the News That's Fit to Print"

The New York Times.

LATE CITY EDITION

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Basic Concept in Physics Is Reported Upset in Tests

Conservation of Parity Law in Nuclear Theory Challenged by Scientists at Columbia and Princeton Institute

By HAROLD M. SCHMECK Jr.

Experiments shattering a fundamental concept of nuclear physics were reported yesterday by Columbia University.

The concept, called the "principle of conservation of parity,"

The text of Columbia report will be found on Page 24.

has been accepted for thirty years. It must now be discarded, according to the Columbia scientists.

The principle of parity states that two sets of phenomena, one of which is an exact mirror of the other, behave in an identical fashion except for the mirror image effect.

The principle might be explained this way:

Assume that one motion picture camera is photographing a given set of actions and that another camera simultaneously is photographing the same set of actions as reflected in a mirror.

If the two films are later screened, a viewer would have no way, according to the principle of parity, of telling which of the two was the mirror image. The recently completed experiments indicate that there is a way of determining which of the two images is the mirror image.

In communicating with people in an intelligent civilization on another world, the Columbia report explained, it would be impossible, with the principle of parity in effect, to tell whether or not they and we meant the same thing by right-handed or left-handed. This could be true and still the basic physical laws in both worlds would behave ex-

Continued on Page 24, Column 2

PRESIDENT SEEKS 76 MILLION FUND TO FIGHT DROUGHT

Assures Wichita Conference U. S. Will Have Other Plans and Will Solve Problem

ENDS GREAT PLAINS TOUR

Strongly Backs Long-Range Research With the Aim of Resisting Dry Cycles

MACMILLAN GETS EISENHOWER WISH FOR ALL SUCCESS

Briton Responds With Equal Warmth to Greetings on His Appointment

EGYPT TAKES OVER ASSETS OF BANKS OF BRITISH, FRENCH

Insurance Concerns Affected Also by Nasser Regime's 'Egyptianization' Decrees

NATIVE OWNERSHIP AIM

DELAYING ACTION IN EGYPT: Israeli soldiers setting up a road block yesterday between El Arish and Rafa during their withdrawal in the Sinai Peninsula.

3.1° Sets 2-Year City Low; Snowfall Imperils Traffic

ELECTRICAL CODE TIGHTENED BY CITY

Council Enacts New Laws to Meet Strains of Modern Appliances on Wiring

DULLES SEES PLAN AVERTING A WAR

Tells Senators Use of U. S. Force Is Likely if Mideast Program Is Rejected

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Continued on Page 24, Column 3

The dam has cracked. Physicists rushed to test parity conservation in various weak interactions.

Over the next 5 years, hundreds of such experiments were performed,

Confirming the fact that indeed parity nonconservation is a general characteristic of all weak interactions.

VI
Later Developments

Wu's experiment opened the door to many avenues of research in subsequent years:

1. Elevating symmetry to a central concept in formulating fundamental theories.

2. Detailed understanding of "discrete symmetries":

P (Parity)
C (Charge conjugation)
T (Time reversal),

including CP non-conservation which won the 1980 Nobel Prize.

3. Understanding of the properties of the elusive particle: the neutrino, leading to 3 Nobel Prizes:

1988 “2 neutrinos”

1995 Another neutrino

2002 Neutrino oscillation

But Wu never received the Nobel Prize which she richly deserved.

"This trio of Chinese physicists shows what China's future contribution to physics could be if that great country overcomes the period of revolutionary convulsions and

resumes its historic role as one of the leaders of civilization, as witnessed by the early European travelers, to their astonishment.”