

湯川秀樹と大阪大学

湯川秀樹の黒板 披露式典

大阪大学理学研究科, H701, 2014年5月13日



細谷 裕

大阪大学理学研究科, 大阪大学総合学術博物館湯川記念室

1907年1月23日 東京に生まれる

1929年 京都帝国大学理学部物理学科卒業

1933年(26歳) 大阪帝国大学理学部講師 (兼任)

1934年(27歳) 大阪帝国大学理学部講師 (専任)

11月17日 中間子論に関する論文発表

1936年(29歳) 大阪帝国大学理学部助教授

1938年(31歳) 4月5日

大阪帝国大学より理学博士の学位を取得

1939年 京都帝国大学理学部教授

1949年(42歳) コロンビア大学 (USA) 客員教授

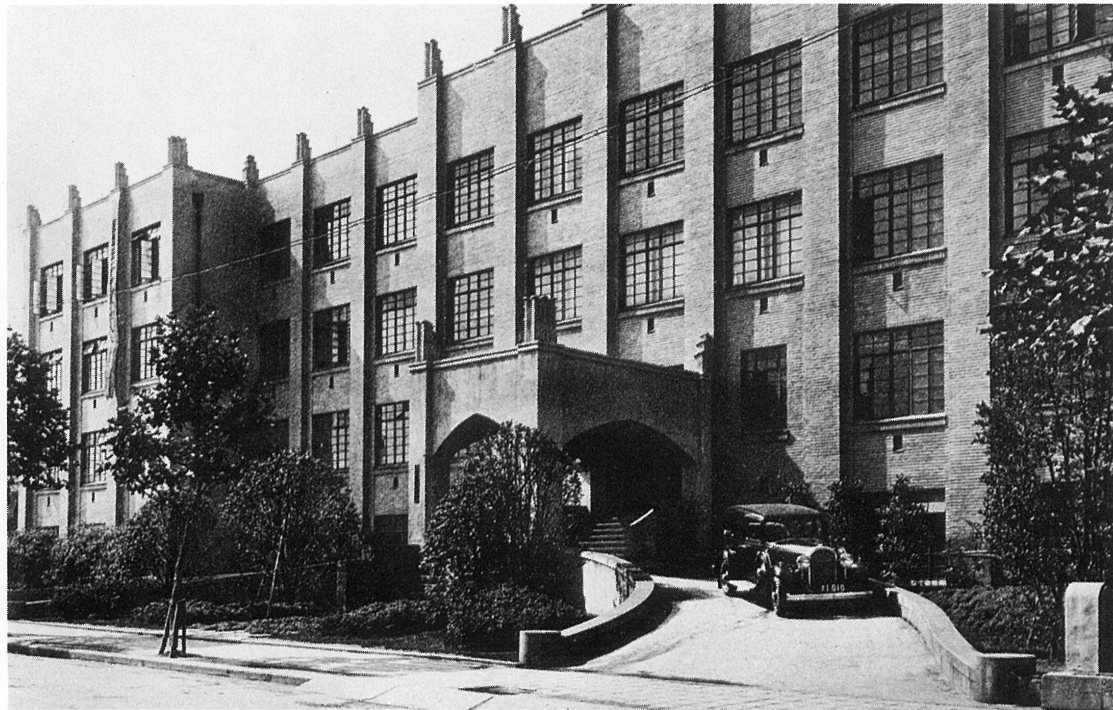
ノーベル物理学賞受賞

1950年(43歳) 大阪大学名誉教授

1953年 大阪大学湯川記念室発足

1981年9月8日 永眠





理学部 中之島

大阪帝国大学理学部（中之島）

大阪大学にて

1933 - 1939

ここにいると、
何か仕事をせずにはおれない
ような気持ちになる

物理学科の構成

八木秀次（通信）	—	岡部金治郎	—	林 龍雄
				渡瀬 譲
岡谷辰治（相対論）	—	湯川秀樹	—	坂田昌一
友近 晋（流体）	—	岡 小天	—	伏見康治
浅田常三郎（物性）	—	沢田昌雄	—	奥田 毅
菊池正士（原子核）	—	山口太三郎	—	青木寛夫
		中川重雄		



理学部（中之島）屋上にて

γ' ray のひらめき

日記 昭和9年(1934) 10/9 ~ 10/12

10月10日 水曜 晴 暑

6時半起床

γ' rayの考へを坂田君に話す

午後4時半頃から堂島空地で野球練習

10月11日 木曜 晴 暑

6時半起床。登校。

午後演習、談話会、池原、山口

γ' rayの話、菊池さん等と話し合う

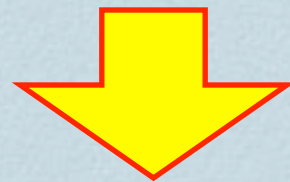
昭和九年十月十日		水曜
時	分	内容
6	30	起床
7	00	坂田君にγ' rayの考へを話す
8	00	野球練習
9	00	
10	00	
11	00	
12	00	
13	00	
14	00	
15	00	
16	00	
17	00	
18	00	
19	00	
20	00	
21	00	
22	00	
23	00	
24	00	

（七和昭）行執利死忌奉李徒達大 （七三同）戦合の河沙 （五一治明）業開立創行銀本日 294

昭和9年(1934)10月10日

γ' ray = パイオン (π 中間子)

湯川は核力を説明するために
新しい粒子の存在を予言した



湯川 of 最初の論文

On the Interaction of Elementary Particles, I

Proc. of the Physico-Mathematical Society of Japan,
Vol. 17, No.2, February 1935, 48 - 57

ノーベル賞

On the Interaction of Elementary Particles, I

Proc. of the Phys-Math. Soc. of Japan, Vol. 17, February 1935, 48 - 57

On the Interaction of Elementary Particles. I.

By Hideki YUKAWA.

(Read Nov. 17, 1934)

§1. Introduction

At the present stage of the quantum theory little is known about the nature of interaction of elementary particles. Heisenberg considered the interaction of "Platzwechsel" between the neutron and the proton to be of importance to the nuclear structure.

Recently Fermi treated the problem on the basis of the hypothesis of "neutrino" (1). According to his theory, the proton can interact by emitting a neutrino and an electron. Unfortunately, the probability of this process is much too small to account for the interaction of neutrons and protons in the nucleus.

To remove this defect, it seems that the interaction between a heavy particle from neutron state to proton state should be accompanied by the emission of light particles, i. e., a neutrino and another heavy particle, which in turn will be transformed from proton state into neutron state. If the probability of occurrence of the latter process is much larger than that of the former, the interaction between the neutron and the proton will be much larger than in the case of Fermi, whereas the probability of emission of light particles is not affected essentially.

Now such interaction between the elementary particles can be described by means of a field of force, just as the interaction between charged particles is described by the electromagnetic field. The considerations show that the interaction of heavy particles with the field is much larger than that of light particles with it.

(1) W. Heisenberg, Zeit f. Phys. **77**, 1 (1932); **78**, 156 (1932); **80**, 587 (1933). We denote the first of them by I.

(2) E. Fermi, ibid. **80**, 161 (1934).

(3) Ig. Tamm, Nature **133**, 981 (1934); D. Iwanenko, ibid. 981 (1934).

Hideki YUKAWA

1935]

On the Interaction of Elementary Particles. I.

57

§5. Summary

The interaction of elementary particles are described by considering a hypothetical quantum which has the elementary charge and the proper mass and which obeys Bose's statistics. The interaction of such a quantum with the heavy particle should be far greater than that with the light particle in order to account for the large interaction of the neutron and the proton as well as the small probability of β -disintegration.

Such quanta, if they ever exist and approach the matter close enough to be absorbed, will deliver their charge and energy to the matter. The quanta with negative charge come out in excess, and those with positive charge come out in deficit, as observed in the case of a negative potential.

The theory, of merely speculative character, agrees with the observation of positive particles in the cosmic rays and the field of the earth, which is charged with positive particles.

The author wishes to express his cordial thanks to Prof. S. Kikuchi for the encouragement throughout the work.

Department of Physics,
Osaka Imperial University.

(Received Nov. 30, 1934)

現代の素粒子物理学の幕が
大阪大学で切って落とされた
1934

Prof. S. Kikuchi for the encouragement throughout the work.

Department of Physics,
Osaka Imperial University.

(Received Nov. 30, 1934)

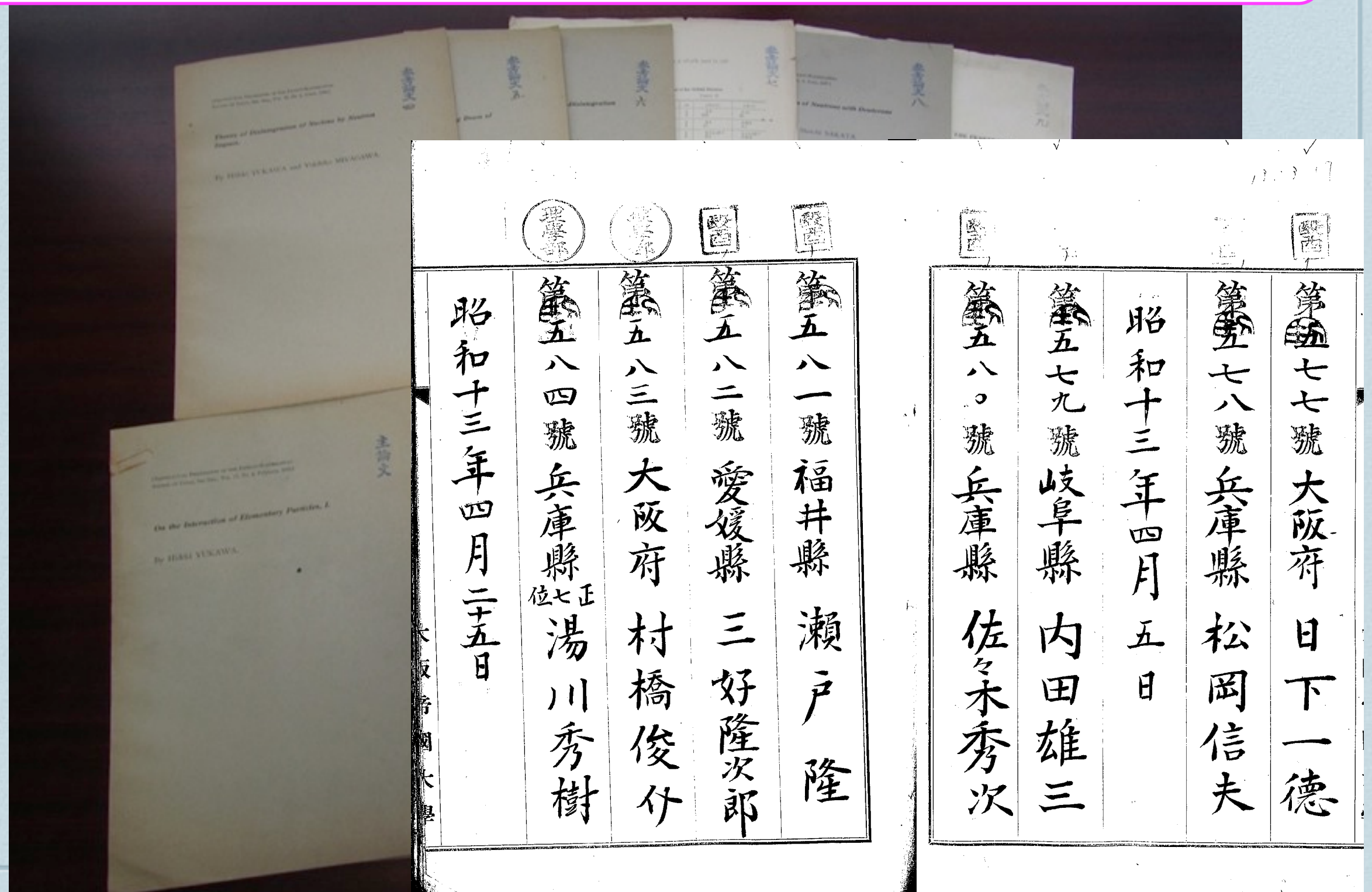
湯川秀樹の学位論文

大阪帝国大学 昭和13年(1938)4月5日授与 第584号



湯川秀樹の学位論文

大阪帝国大学 昭和13年(1938)4月5日授与 第584号



学位論文

物理研究の黄金期 1934 - 1938

主論文 Hideki Yukawa

[On the Interaction of Elementary Particles, I.](#) (Nov. 30, 1934)

参考論文 1 Hideki Yukawa and Shoichi Sakata

[On the Theory of Internal Pair Production](#) (Aug. 22, 1935)

参考論文 2 Hideki Yukawa and Shoichi Sakata

[On the Theory of the \$\beta\$ -disintegration and the Allied Phenomenon](#) (Sep. 5, 1935)

参考論文 3 Hideki Yukawa and Shoichi Sakata

[On the Efficiency of the gamma-Ray Counter](#)

参考論文 4 Hideki Yukawa and Yukihiro Miyagawa

[Theory of Disintegration of Nucleus by Neutron Impact](#) (Feb 28, 1936)

参考論文 5 Hideki Yukawa

[Elementary Calculations on the Slowing Down of Neutrons by a Thin Plate](#) (July 20, 1936)

参考論文 6 Hideki Yukawa and Shoichi Sakata

[Supp. to "On the Theory of the \$\beta\$ -disintegration and the Allied Phenomenon"](#) (Dec 26, 1935)

参考論文 7 Hideki Yukawa and Shoichi Sakata

[On the Nuclear Transformation with the Absorption of the Orbital Electron](#) (February 18, 1937)

参考論文 8 Hideki Yukawa and Shoichi Sakata

[On the Theory of Collision of Neutrons with Deuterons](#) (April 7, 1937)

参考論文 9 Hideki Yukawa

[On a Possible Interpretation of the Penetrating Component of the Cosmic Ray](#) (July 5, 1937)

大阪帝国大学 昭和13年(1938) 4月5日授与 第584号

1937年1月 新粒子（ミューオン）発見さる

1937年7月 湯川の学位論文の参考論文 9

On a Possible Interpretation of the Penetrating Component of the Cosmic Ray

SHORT NOTES

On a Possible Interpretation of the Penetrating Component of the Cosmic Ray.

By HIDEKI YUKAWA.

In spite of many attempts to develop the so-called " β -hypothesis of the nuclear force"⁽¹⁾ there still remains in the current theory the wellknown inconsistency between the small probability of the β -decay and the large interaction of the neutron with the proton⁽²⁾.

More than two years ago, the present author introduced a new field of force, which is responsible for the short range interaction of the neutron with the proton⁽³⁾, but is something different from the so-called "neutrino-electron field." This field was considered to interact with the light particle also, inducing the transition of the latter between the neutrino and the electron states. Thus we could get rid of the above difficulty by assuming the interaction between the field and the heavy particle to be large compared with that between the former and the light particle. The mathematical formulation of the theory was preliminary and incomplete in many respects. For example, we obtained only the exchange force of Heisenberg type between unlike particles and the β -decay

theory of Fermi type. of the force of Majorana forces between like particles. The deduction of the β -Konopinski-Uhlenbeck and will be dealt with place.

The most important time inevitable consequence was that the field was to be by new sorts of quantum statistics and each having charge either $+e$ or $-e$ and mass m , about 200 times electron mass.⁽⁴⁾ It was such a quantum could never the ordinary nuclear energy liberated was than mc^2 , while they might the cosmic ray. At that time no evidence in favour of decision, so that the above be said to be on a sound

Recent development ment⁽⁵⁾ and the theory of ray, however, seems to

(1) See, for example, Bethe and Bacher, Rev. Mod. Phys. 8, 82, Weizsäcker, Zeits. f. Phys. 102, 572, 1936; Iwanenko and Sokolow, ibid.

(2) The assumption of the presence of the higher derivatives of the light particle in the expression of the interaction energy results in life times for radio-elements emitting the β -rays with high upper limits.

(3) Yukawa, Proc. Phys.-Math. Soc. Japan 17, 48, 1935.

(4) The magnitude of the mass was shown to be the measure of nuclear force. A theory of the charged particle with electronic mass statistics, was developed by Pauli and Weisskopf, Helv. Phys. 7, 709, 1934.

(5) Anderson and Neddermeyer, Phys. Rev. 50, 273, 1936; 51, 884, D. D. Montgomery, ibid. 50, 975, 1936; Street and Stevenson, ibid. 51, 1005, 1937; Blackett and Wilson, Proc. Roy. Soc. A, 160, 1937.

(6) Carlson and Oppenheimer, Phys. Rev. 51, 220, 1937; Rhabha and Roy, Soc. A, 159, 432, 1937.

宇宙線に日本名

YUKAWA 湯川博士の學說

隠忍三年遂に世界制覇

宇宙線の研究は物理学界の最近における最も大きな研究結果であり、この正體を説明するために世界の物理學家が心を砕いて研究を重ねてゐる。湯川博士は、この問題を解決するために、三年前に「ミューオン」の存在を提議した。この提議は、最初は「荒唐無稽」と見られてゐたが、最近の研究結果により、その正體が明らかになり、湯川博士の提議が正しいことが証明された。この提議は、物理学界に大きな衝撃を与え、多くの物理學家がこれに取り組むようになった。湯川博士の提議は、物理学界に大きな衝撃を与え、多くの物理學家がこれに取り組むようになった。

湯川博士は、三年前に「ミューオン」の存在を提議した。この提議は、最初は「荒唐無稽」と見られてゐたが、最近の研究結果により、その正體が明らかになり、湯川博士の提議が正しいことが証明された。この提議は、物理学界に大きな衝撃を与え、多くの物理學家がこれに取り組むようになった。

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大阪朝日新聞 1938.10.9

SHORT NOTES

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possibility of explaining most ray showers as the multiplication of the light quantum and, on the other hand, the existence of another particle which is more penetrating, but which is identified with the particle of the proton⁽¹⁾.

If the above theory is correct, we must assume that at least a part of the penetrating component consists of the heavy quantum has smaller specific ionisation due to it

will be far smaller than that due to the proton of the same H_p owing to the smallness of its mass compared with the proton mass. Thirdly, it will be captured, in passing through matter, by the nucleus sooner or later, giving its charge and energy (i.e. the sum of the proper and the kinetic energies) to the latter, so that it will reappear no more.

Thus, this suggestion will not be altogether meaningless as a possible explanation of the hard component of the cosmic ray, since there seems to be no alternative for the time being. Detailed account will be given in the later issue of this journal.

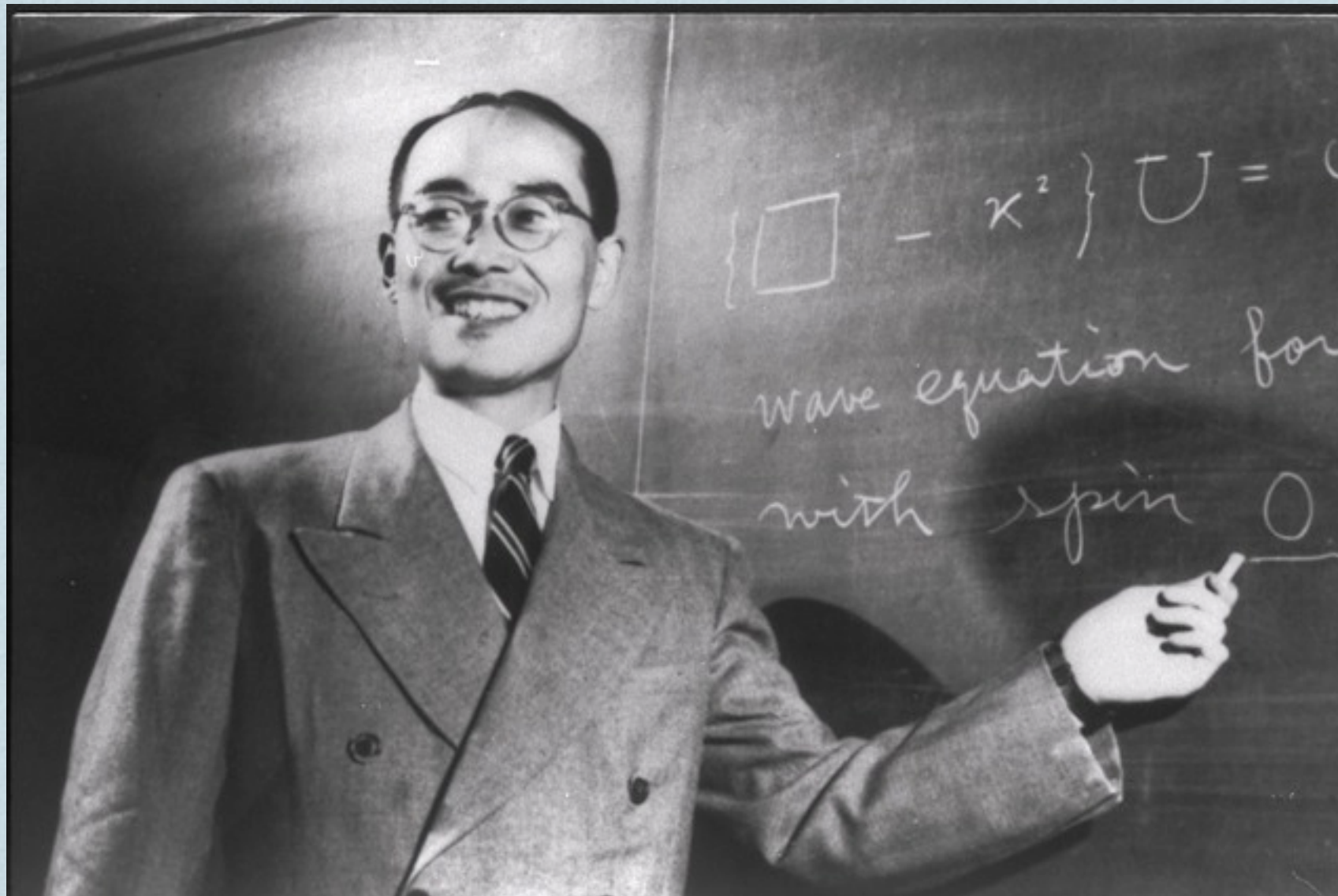
Institute of Physics,
Osaka Imperial University.

July 2, 1937.

(Received July 5, 1937)

It should be noticed, however, that the opinion of Blackett and Wilson (i.e. that the penetrating component consists of the same particles as those of American authors on this point. Compare further Auger, Jour. d. Phys. 8, 204, 1937; Leprince-Ringnet and Crussard, ibid. 8, 207.

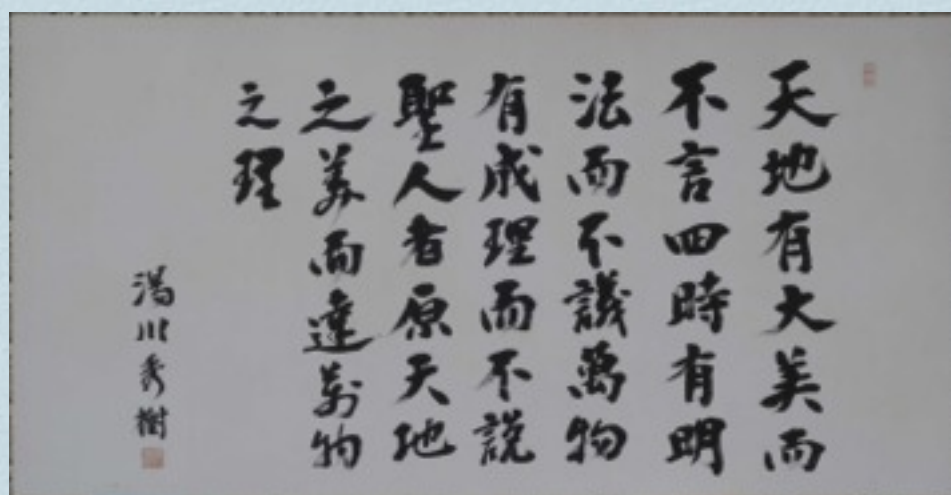
1947年1月 パイ中間子、発見さる
1949年12月 ノーベル賞受賞



1949年 コロンビア大学にて



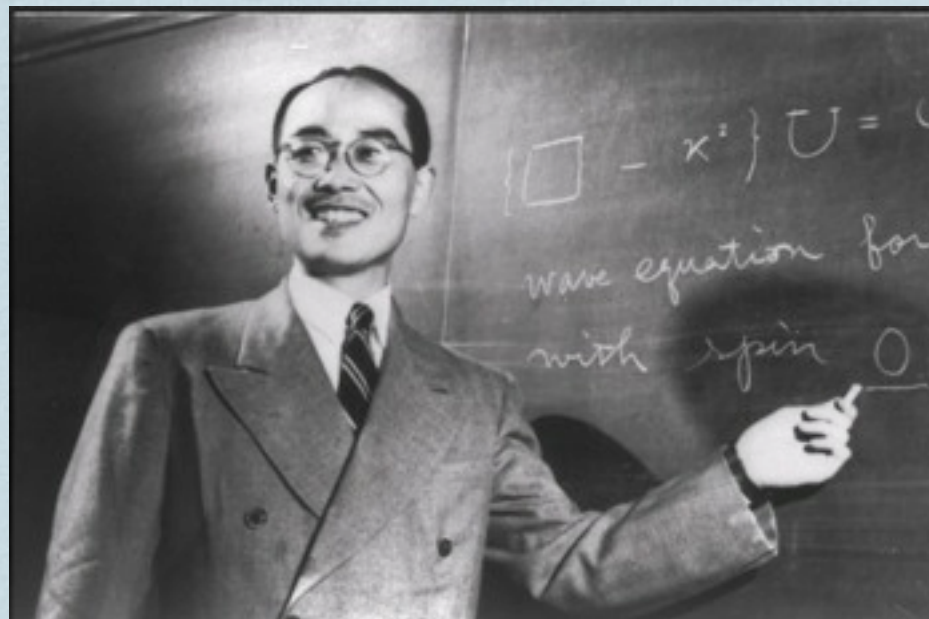
1950年 大阪大学（大阪大学名誉教授となる）



大阪大学理学研究科長室に掲げられた書



1953年 プリンストン



コロンビア大学から 大阪大学へ

湯川が教授室で愛用した
黒板（石盤）



除幕式へ