

The Birth of the Nobel Prize in Japan

Hideki Yukawa and Osaka University

Yutaka Hosotani

Osaka University



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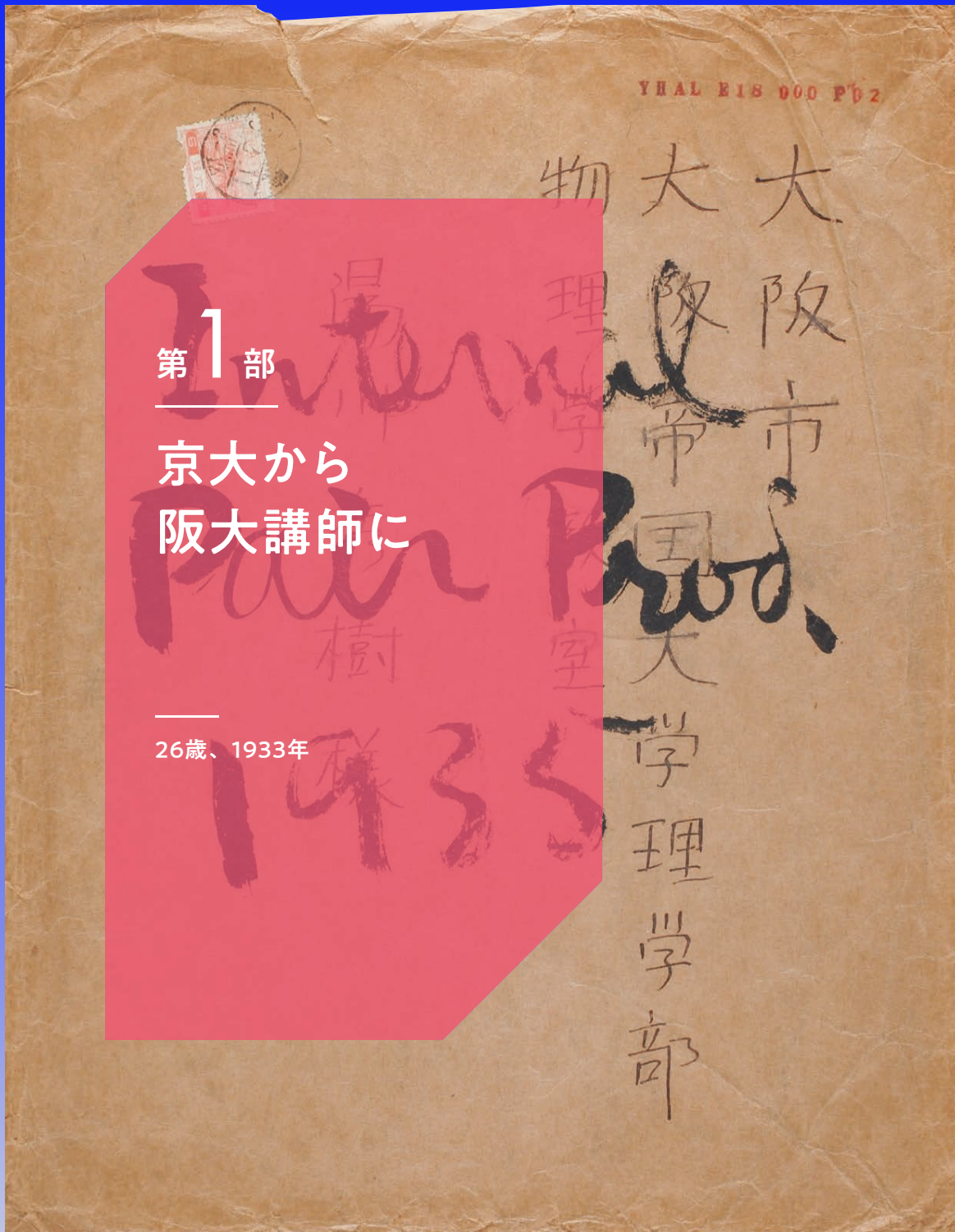
HPNP2021

Osaka University, 25 March 2021

Hideki Yukawa



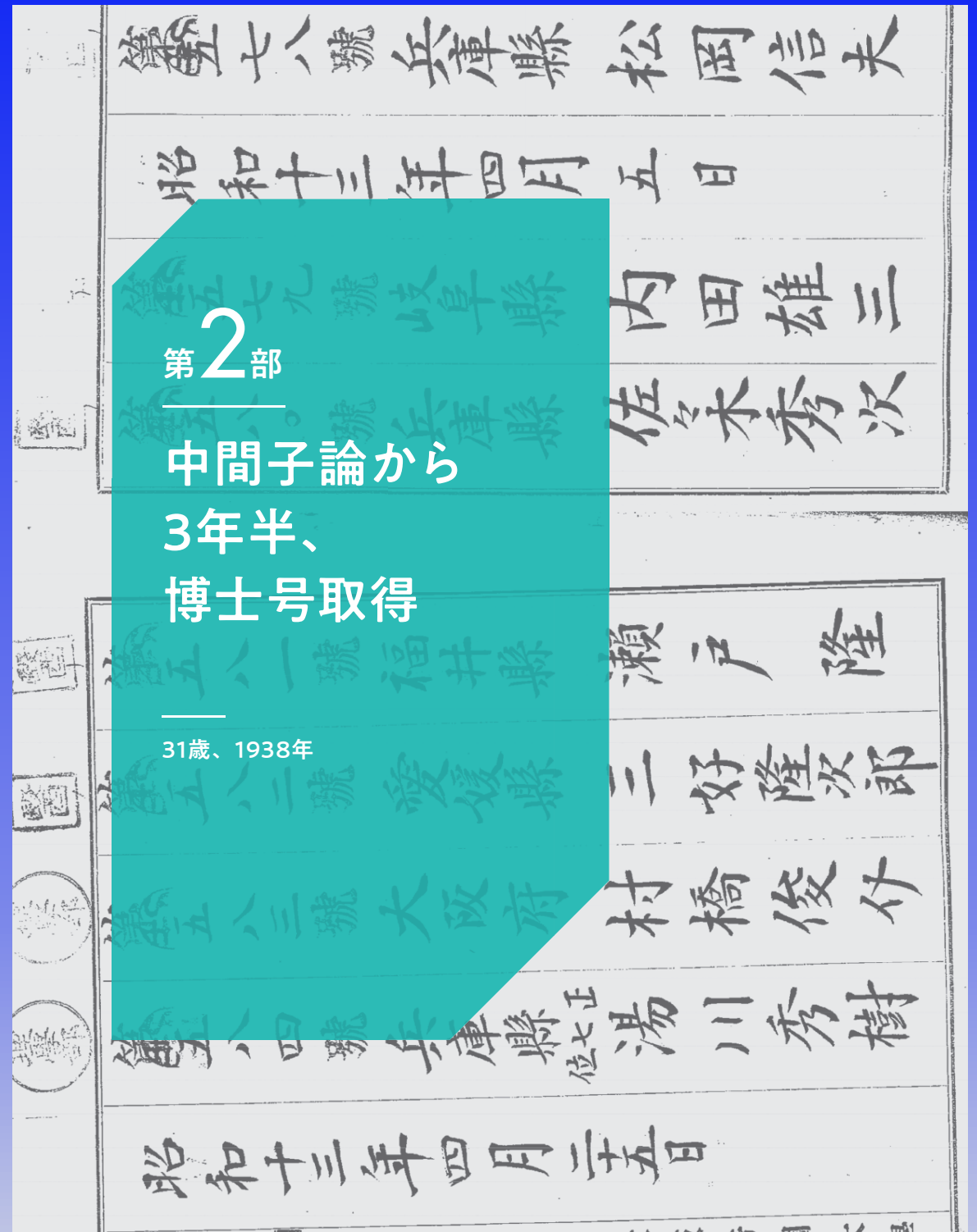
- | | |
|--------------------|--|
| 1907.1.23 | Born |
| 1929.3 (age 22) | Graduated from Kyoto Imperial University |
| 1932 (age 25) | Lecturer, Kyoto Imperial University |
| 1933.5.13 (age 26) | Lecturer, Osaka Imperial University |
| 1934.11 (age 27) | His first paper submitted (→ Nobel Prize) |
| 1936.3.31 (age 29) | Associate Professor, Osaka Imperial University |
| 1938.4.5 (age 31) | Ph.D., Osaka Imperial University |
| 1939.5 (age 32) | Professor, Kyoto Imperial University |
| 1949 (age 42) | Visiting Professor, Columbia University |
| 1949.12 (age 42) | Nobel Prize |
| 1981.9.8 (age 74) | Passed away |



第1部

京大から
阪大講師に

26歳、1933年



第2部

中間子論から
3年半、
博士号取得

31歳、1938年

Historical Documents

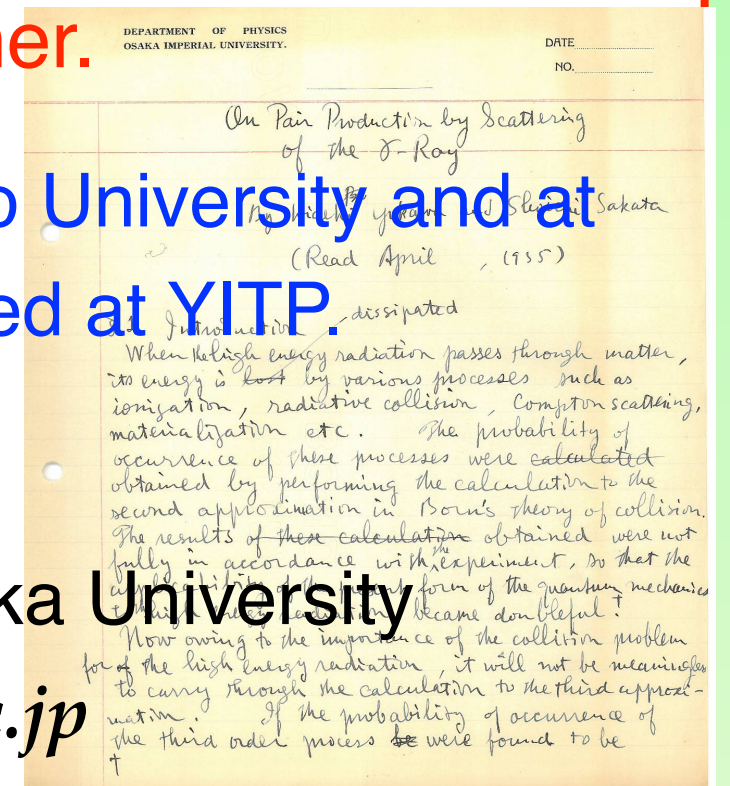
★ Yukawa kept all notes, paper drafts, lecture drafts, letters, in order, in a neat, original, artistic manner.

These documents were discovered at Kyoto University and at his house in the 80's and have been archived at YITP.

Documents in the Osaka Imperial Univ period:

See the homepage of Yukawa Memorial, Osaka University

<https://www-yukawa.phys.sci.osaka-u.ac.jp>



★ Yukawa's Doctor Thesis (Ph.D.) (1938)

application documents, judging process, report ...

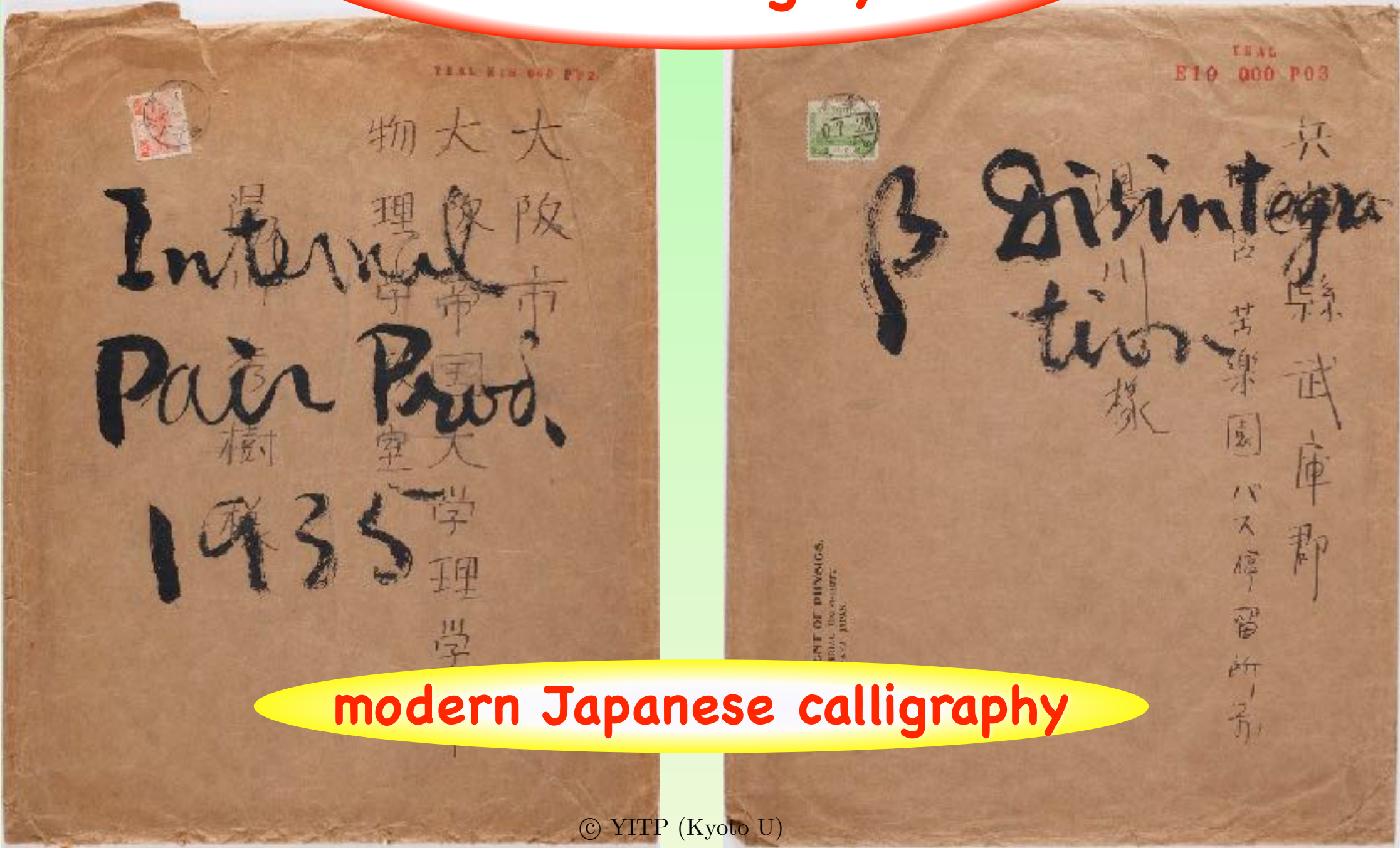
Preserved in a storage room, found in 2020.

— Osaka University Archives



Aesthetics

Yukawa's filing system



modern Japanese calligraphy

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Envelopes tell us about life in the 30's.

γ' ray

Paper draft (Nov 1)

Yukawa's diary

10 October 1934 Fair, Hot

Woke up at 6:30 am.

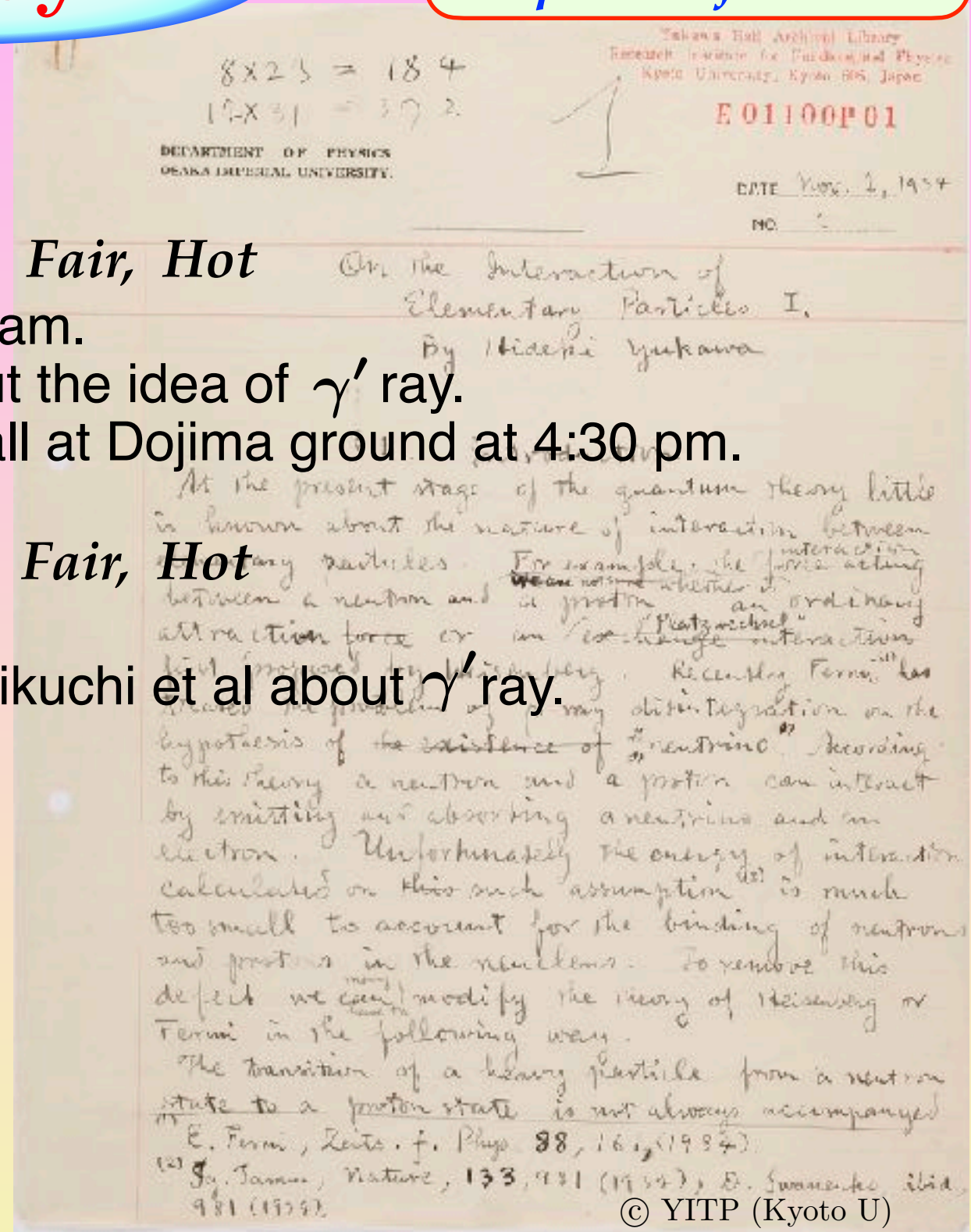
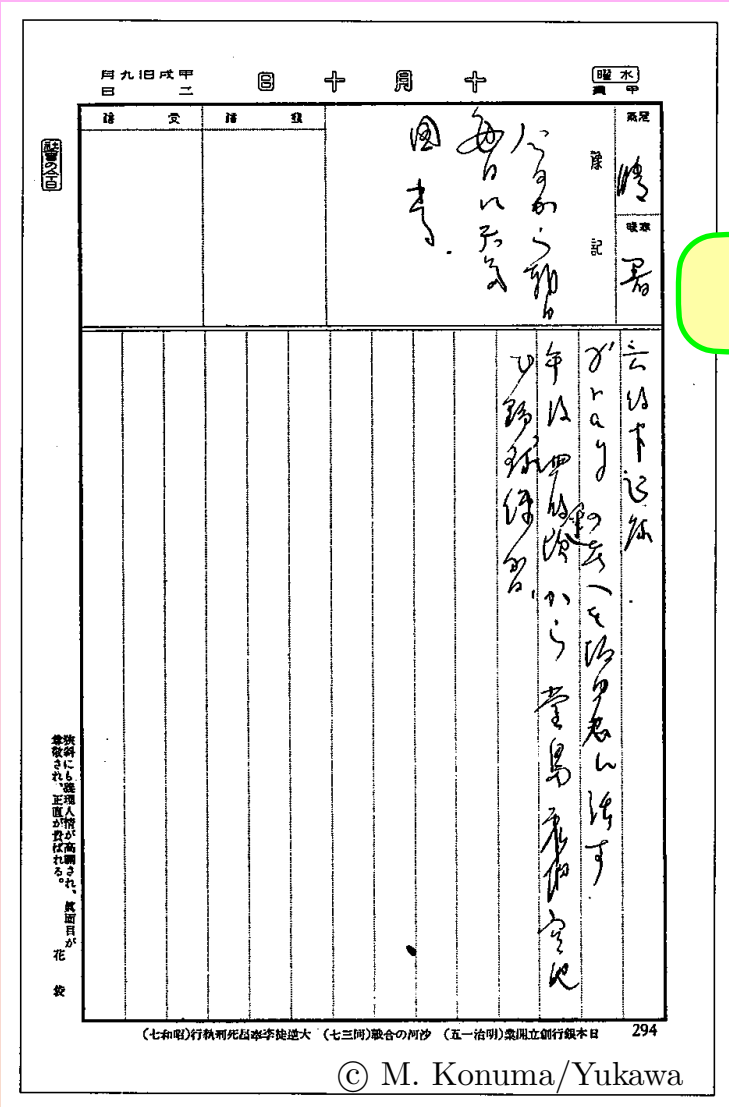
Told Sakata about the idea of γ' ray.

Practiced baseball at Dojima ground at 4:30 pm.

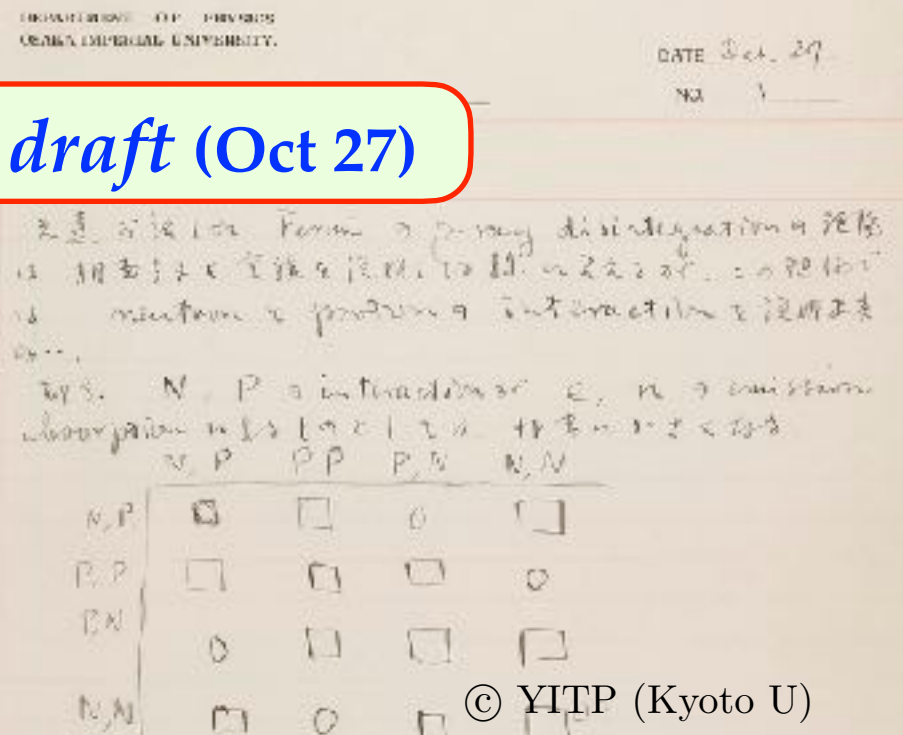
11 October 1934 Fair, Hot

...

Discussed with Kikuchi et al about γ' ray.



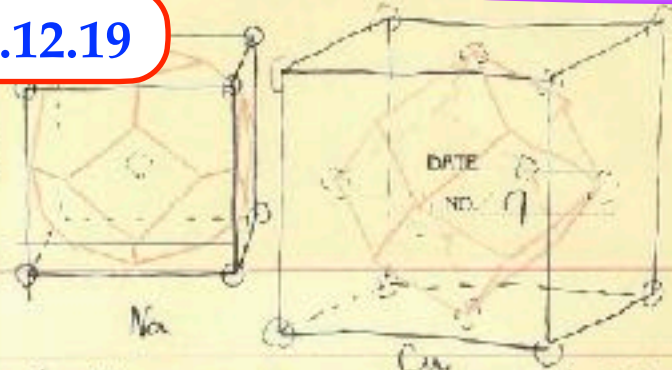
Talk draft (Oct 27)



Explain to, educate, and stimulate colleagues & students

Phys colloquium 1935.12.19

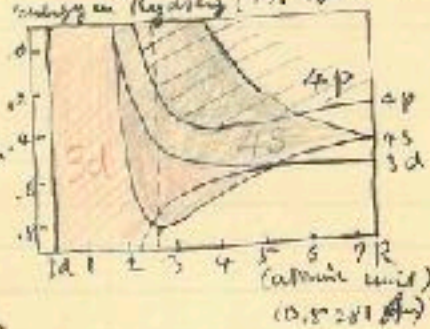
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OSAKA IMPERIAL UNIVERSITY.



E. Wigner & F. Seitz et al. (Phys. Rev. 43, 804, 1933. 26, 1935)
free electron model in a lattice. Body centered
lattice of Na. Sodium's energy electron's binding
energy of free lattice const. 4.175 eV (4.175 A⁻¹ eV)
heat of sublimation 23.2 kcal. (2.8 eV 26.9)
compressibility $\beta = -\frac{1}{V} \frac{dV}{dP}$
structure of crystal

Cohesive force in metals

H. M. Krutter et al. (Phys. Rev. 48, 664, 1935)
face centered cubic lattice of Na
apply level 4s level 3d
overlapping. so distribution
of energy limit a curve
of min. $R = 2.66$ lattice
constant $R = 2.66$ sphere radius $R = 2.66$
stable crystal $R = 2.66$



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Phys colloquium 1936.5.21

F06220T15

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DATE _____
NO. 1

漢字五月二十一日

Fe, Co, Ni of Ferromagnetism's Origin
(J. C. Slater, Phys. Rev. 49, 537, 1936)

理論物理の発展は他の物理の発展と共に進歩して来た。その中でも、特に最近の幾何学的发展は、物理の発展に大きな影響を与えている。この中で、特に興味を引くのは、鉄、コバルト、ニッケルの強磁性の起源である。

Ferromagnetism in Fe, Co, Ni

この強磁性の起源を説明するために、Heisenberg-Diracの交換相互作用の理論が用いられる。Fe, Co, Niの強磁性は、これらの原子の3d軌道間の相互作用による。この相互作用は、原子間の距離が短くなるにつれて強くなる。したがって、強磁性は、原子間の距離が短くなるにつれて強くなる。

この強磁性の起源を説明するために、classical Weiss's Hypothesis or molecular field theoryを用いる。この理論では、原子間の相互作用を分子場として扱う。この分子場は、原子の磁気モーメントに比例する。したがって、強磁性は、分子場の存在による。

この理論では、原子間の相互作用を分子場として扱う。この分子場は、原子の磁気モーメントに比例する。したがって、強磁性は、分子場の存在による。Curie pointの式は、 $T < \frac{2M^2}{3k} = \Theta$ である。ここで、 M は原子の磁気モーメント、 k はボルツマン定数である。

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A sense of mission with courage and heart.

The best friend/rival



From Tomonaga to Yukawa, 1933

Handwritten notes in Japanese, including the text "Nuclear force" and the following equations:

Tomonaga: $\lambda = (4 \sim 7) \times 10^{12} \text{ cm}^{-1}$

Yukawa: $\lambda = \frac{m_e c}{\hbar} \sim 3 \times 10^{10} \text{ cm}^{-1}$

Below the equations is a handwritten calculation:

$$\begin{array}{r} 4.77 \\ 4.77 \\ \hline 19.08 \\ 3.339 \\ \hline 22.75 \end{array}$$

Further down, there are more calculations:

$$e^2 = 0.22 \times 10^{-18}$$

$$\lambda = \frac{m_e c}{\hbar} \quad \frac{m_e c}{\hbar} = 3 \times 10^{10}$$

Handwritten Japanese text, including the phrase "大阪に行かれる由" (Reason for going to Osaka) which is underlined in the original image.

大阪に行かれる由・・・
 ・・・いよいよいいいでせうね

RIKEN and Osaka : frontier centers in Japan

From Tomonaga to Yukawa, 1935.1.23

Nishina's exp. plan : smash a nucleus with electrons
 -> Tomonaga's estimate:

Miserably small number !



各件子は色々お世話になりました。その後御返りありませんか。小並も珍しく
 凡庸ひまです。あれから例の方の理論はどうか発展しましたか。ニシナはβで
 核を二倍すといふも仁科先生の実験でやられたり様子で先づきゅうを計算
 してこれいふことは多分十に五は出さぬと見ておりましたか。やつて見ま
 たら。やうやく今お来た片です。定十を正値です。大津の10のorderといふ
 かわれはかいたものかお出ましたか。ニシナから少し貴兄の理論をつかえやう
 とおぼろげです。もしおとしつかへたならば原稿のプリントか修正刷のおあま
 つかあつた御返り願へばとせか。お手紙をかきそすかまか。坂田君の計算は
 進みまいたか。先日小林君から坂田君へ手紙したことは、有田君と小林君と僕
 と。Discus した時おた話なつたか。何方でモーター店だの。Discus したか。あとで
 又くわしくお話し見たら。あなたには申上なくともよかつたをほないか。おぼろげ
 でおぼろげの。neg. estimate がさうか。つておぼろげといふ多体問題といふとちかか
 作らねば。intermediate state とはいふ。state に上つたといふか。おぼろげをさへ
 ます。intermediate state とはいふ。negative state もとせしまへば。あなたはさ
 まらぬいじむいじむの。た。おぼろげの。おぼろげの。おぼろげの。おぼろげの。
 坂田君かどんなやり方をい居るか。よし見なかつたか。おぼろげの。おぼろげの。
 いたか。一寸見覚えはありますか。小林君は凡見さんと同じこと
 ワイヤワカリーや。やうこと手をつけははりました。例の前の方の計算は
 けづつといたこととおしりました。仁科先生は小林君と。おぼろげの。おぼろげの。
 女がな。おぼろげの上。おぼろげの上。おぼろげの上。おぼろげの上。おぼろげの上。
 はい。おぼろげの上。おぼろげの上。おぼろげの上。おぼろげの上。おぼろげの上。
 仁科研究室で理論だけ。おぼろげの上。おぼろげの上。おぼろげの上。おぼろげの上。
 なかなかです。おぼろげの上。おぼろげの上。おぼろげの上。おぼろげの上。おぼろげの上。
 をいっつてます。

Tomonaga complains:

“Nishina-san is too busy with radio interviews and magazine articles. Wish him to write up our paper quickly.

Please keep it secret.”

これは内証の話

Modern Physics and Common Sense

「近代物理学と常識」 (1935.12.18) for general public

Modern physics (quantum theory) : distant from daily life?

Physics: -> simpler, fundamental processes

-> regularity, how they occur, ...

-> reasons, laws, ...

QM - “probability” Not random, it's like

business, election

there are reasons for success, win/loss!

Physics is close to Common Sense.

Yukawa concludes

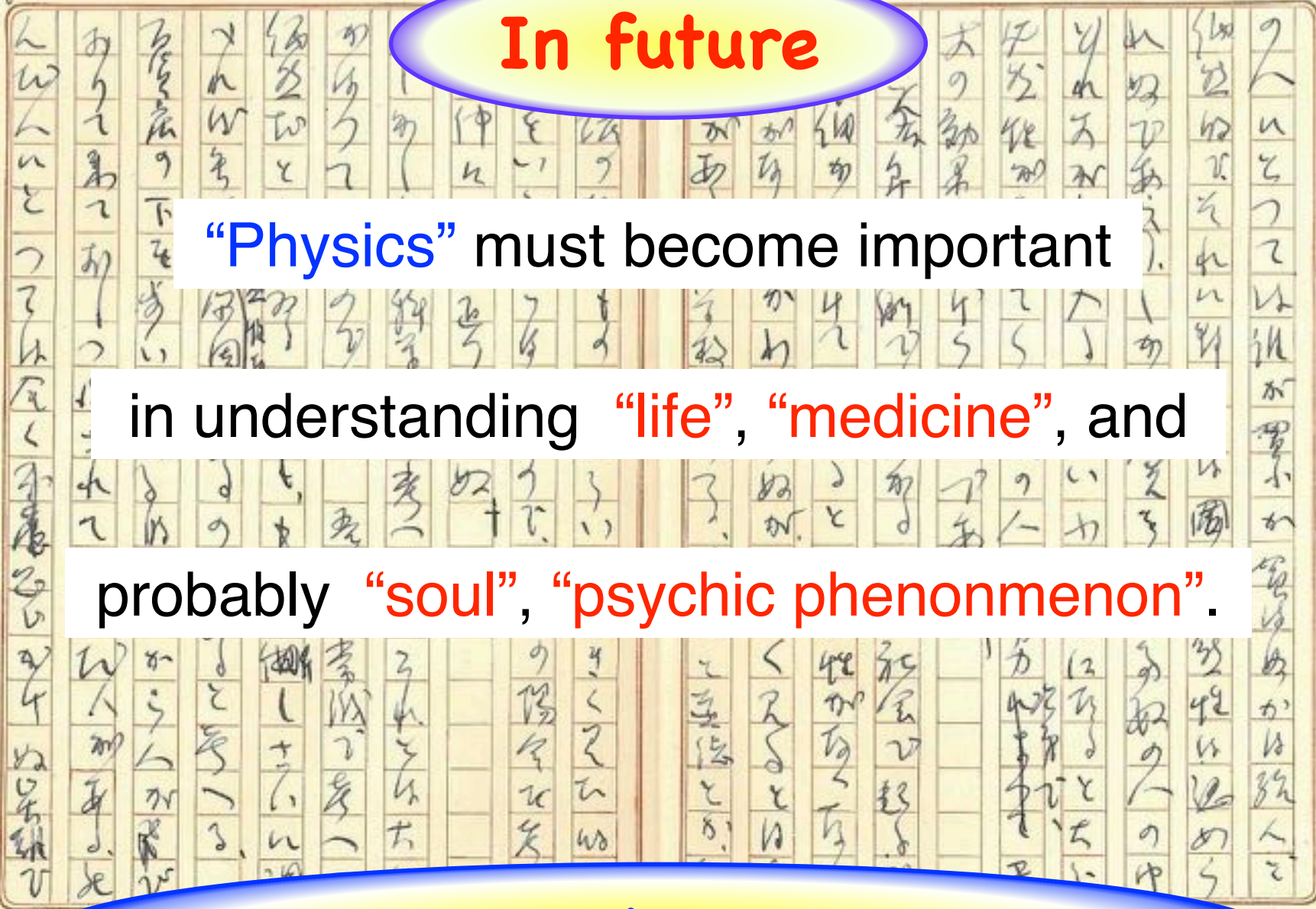
In future

“Physics” must become important

in understanding “life”, “medicine”, and

probably “soul”, “psychic phenomenon”.

We are now in such an age.



Handwritten Japanese text on the left side of the page.

Handwritten Japanese text at the top right of the page.

Handwritten Japanese text on the right side of the page.

Ph.D. in 1938

1934.11

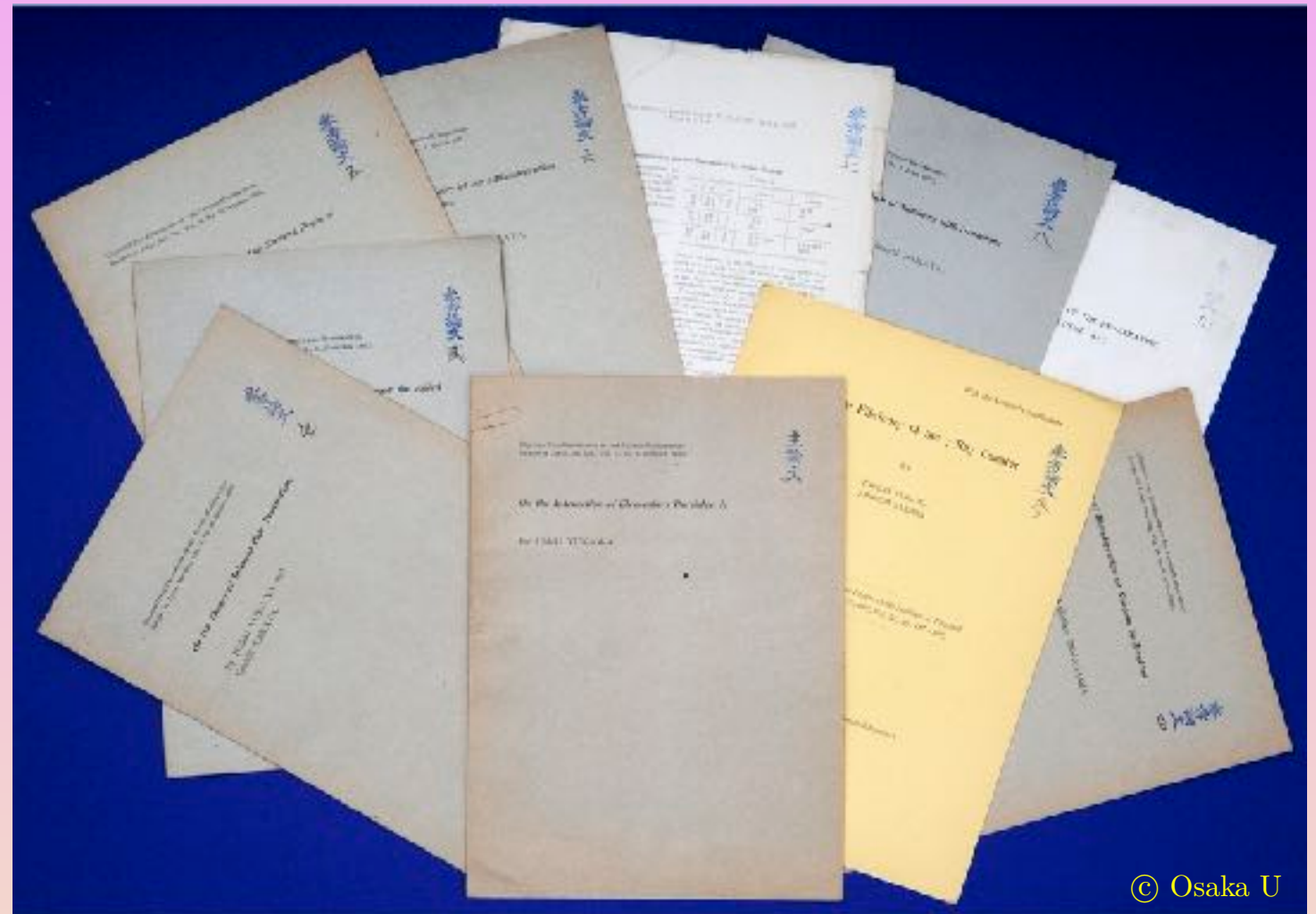
1st paper submitted

1937.11.15

application for Ph.D.

1938.4.5

Ph.D. conferred from
Osaka Imperial Univ

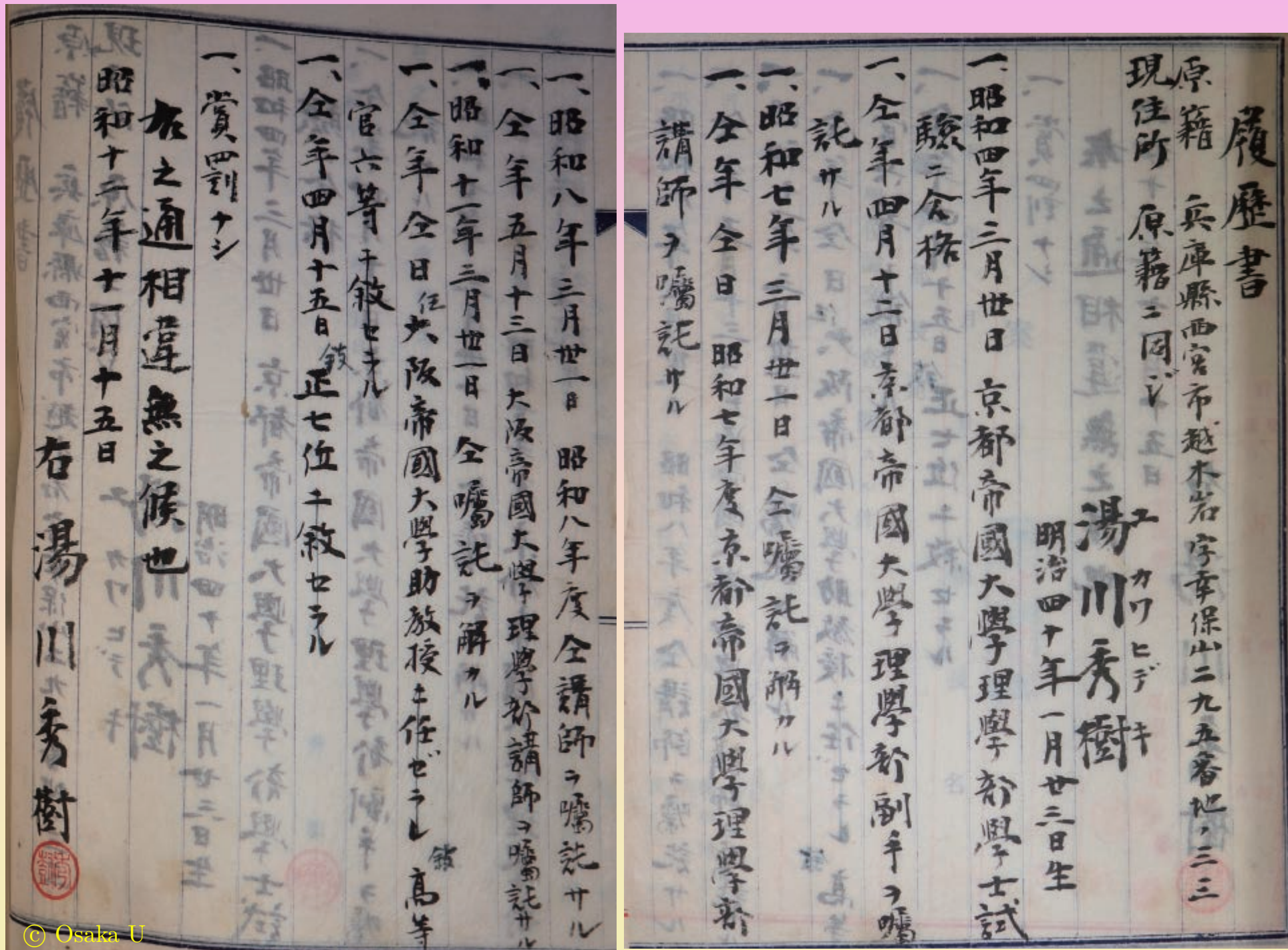


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Yukawa's curriculum vitae



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Judging of the Ph.D. thesis

Jury committee: 1937.11.15

Report submitted to Faculty meeting : 1938.2.17

U. President -> Minister of Education: 1938.2.25

Ph.D. conferred to Yukawa: 1938.4.5

Principal juror: S. Kikuchi

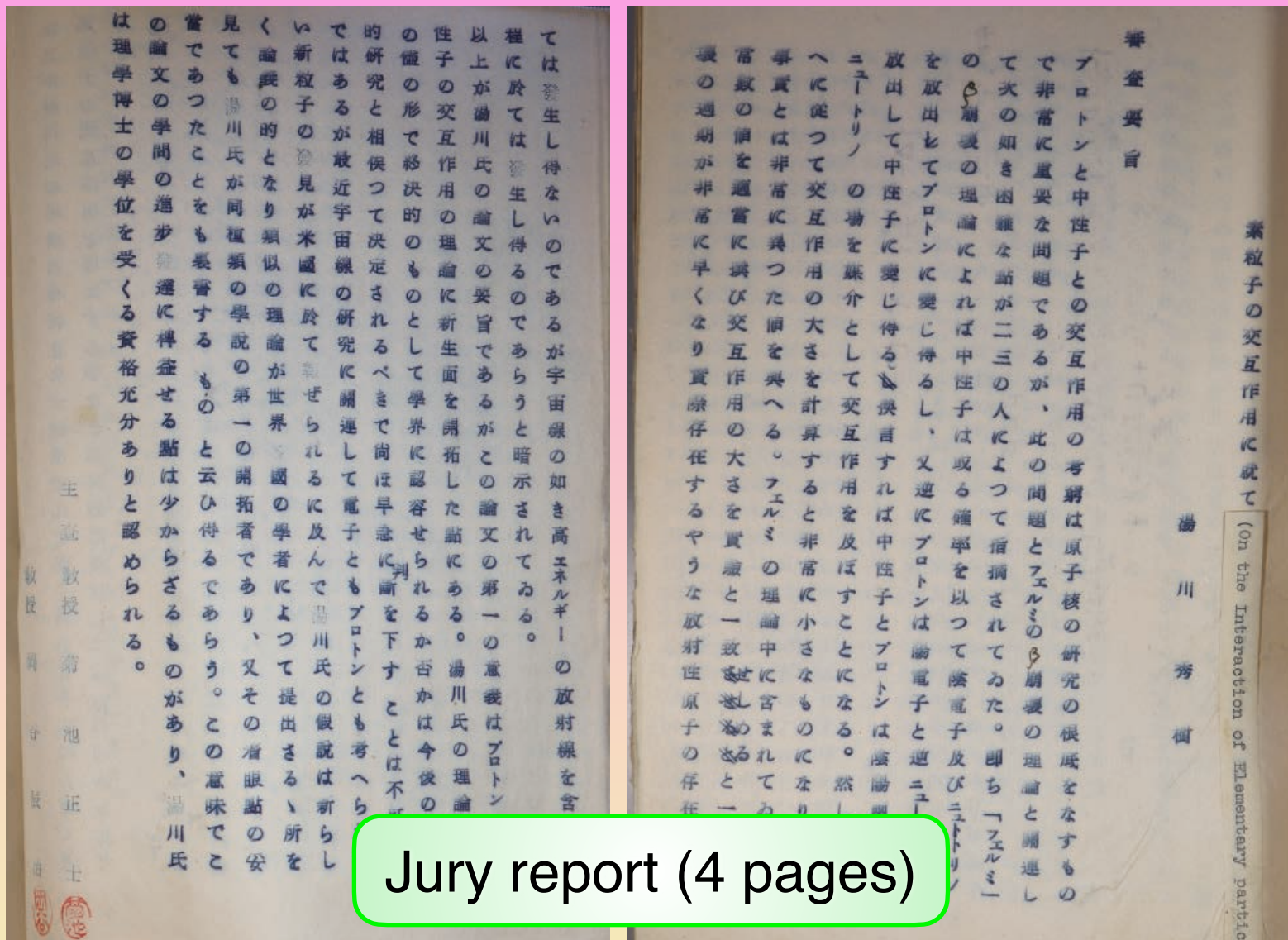
- *Nuclear force & beta decay
- *Yukawa's proposal of a new particle of $m \sim 200 m_e$
- *Can be produced in cosmic rays

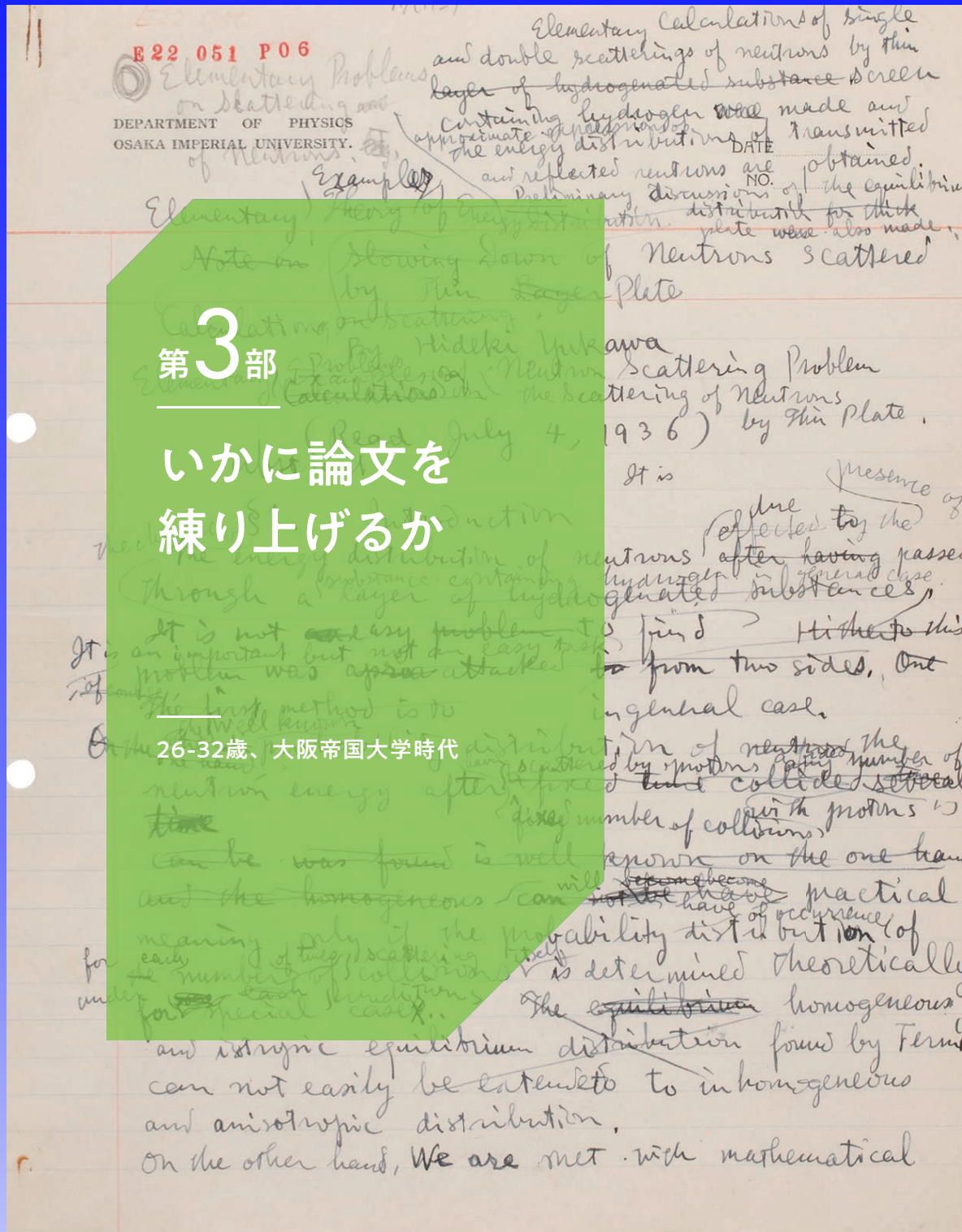
***It is premature to make a judgment. Need to be confirmed by exp. or observation.**

*C. Anderson/Neddermeyer's discovery (1937)

*Yukawa is qualified for a Ph.D.

Jury report (4 pages)





E22 051 P06
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第3部
いかに関論文を
練り上げるか
26-32歳、大阪帝国大学時代



第4部
日本の「博士」に
—ノーベル賞受賞
42歳、1949年

Notes, notes, notes

Yukawa Hall Archival Library
Research Institute for Fundamental Physics
Kyoto University, Kyoto 606, Japan

F 02140

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OSAKA IMPERIAL UNIVERSITY.

DATE Jan. 6, 1935.
NO.

Note on the Theory of Positrons
By Hideki Yukawa

Infinite charge density due to the electrons in the negative energy state. The difficulty of the Dirac's theory of positrons can be ~~discussed~~ ^{discussed} attempts were made to eliminate. Recently, the problem difficulty of infinite charge density due to electrons in the negative energy states in the Dirac's theory of positrons. The present author wants to ~~discuss~~ ^{discuss} this problem on the assumption of complete symmetrical charges.

Theory of Positrons 1935.1.6

First At first ~~considered~~ ^{considered} as if they were independent particles. If we denote the quantized wave functions for them by ψ_k and ϕ_k respectively, where k takes the values $1, 2, 3, 4$, the charge densities for them can be expressed as

$$-e \sum_k \psi_k^\dagger \psi_k \quad \text{and} \quad +e \sum_k \phi_k^\dagger \phi_k$$

respectively. Similarly their current densities can be expressed as by

$$-ec \sum_{k,l} \psi_k^\dagger \alpha_{kl} \psi_l \quad \text{and} \quad +ec \sum_{k,l} \phi_k^\dagger \alpha_{kl} \phi_l$$

where α is the vector velocity vector introduced by

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U-quantum □ □ □ □ rot

($\pi\psi - \pi^*\psi^*$)

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DATE Jan. 6, 1935.
NO.

§ Symmetrisierungsverfahren

$$L = \frac{1}{2} \left\{ \frac{1}{c} \frac{\partial \psi^\dagger}{\partial t} \frac{\partial \psi}{\partial t} - \frac{\partial \psi^\dagger}{\partial x} \frac{\partial \psi}{\partial x} - \text{grad} \psi^\dagger \text{grad} \psi \right\} + \frac{1}{c} \frac{\partial \psi}{\partial t} \frac{\partial \psi^\dagger}{\partial t} - \text{grad} \psi \text{grad} \psi^\dagger$$

$$\frac{\partial L}{\partial \psi} = \frac{1}{c} \frac{\partial \psi^\dagger}{\partial t} = \psi^{*+}$$

$$L = \frac{1}{2} \left\{ \psi^\dagger \frac{\partial \psi}{\partial t} + \psi \frac{\partial \psi^\dagger}{\partial t} - \text{grad} \psi \text{grad} \psi - \text{grad} \psi^\dagger \text{grad} \psi^\dagger \right\}$$

$$\psi + \tilde{\psi} = V$$

$$\psi - \tilde{\psi} = \dots$$

$$L = \frac{1}{2} (L_F \psi) \cdot (L_F \psi) + (L_F \psi) (L_F \tilde{\psi}) \quad L_F (\psi - \tilde{\psi}) = L_F'' (\psi + \tilde{\psi})$$

$$= \frac{1}{2} \left\{ \psi^\dagger (L_F \psi) + (\tilde{\psi}^\dagger) \psi \right\} \quad \frac{1}{2} \left\{ (L_F \psi) + (L_F \tilde{\psi}) \right\} = E$$

$$\frac{1}{2} \left\{ (L_F \psi) - (L_F \tilde{\psi}) \right\} = iH$$

$$(E - iH)(E + iH) + (E + iH)(E - iH)$$

$$\psi^\dagger \psi - \tilde{\psi}^\dagger \tilde{\psi}$$

$$\psi^\dagger \psi = \tilde{L}_F \tilde{\psi} \quad \tilde{\psi}^\dagger \tilde{\psi} = L_F \psi$$

Slowing down of neutrons by thin plate 1936.7.4

E22 051 P06

Elementary Problems on Scattering
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and double scatterings of neutrons by thin layer of hydrogenated substance screen containing hydrogen were made and approximate distributions of transmitted and reflected neutrons are obtained. Preliminary discussion of the equilibrium distribution of neutrons for thick plate were also made.

Example
Theory of Energy Distribution of Neutrons

Note on Slowing down of Neutrons Scattered by Thin Layer Plate

Calculations on scattering by Hideo Yukawa

Elementary Problem on Neutron Scattering Problem
Calculations on the scattering of neutrons (Read July 4, 1936) by thin plate.

abstract It is (presence of)

§1. Introduction
The energy distribution of neutrons after having passed through a layer of hydrogenated substances, It is not an easy problem to find. Hitherto this problem was approached from two sides. One of the first methods is to find the probability distribution of neutron energy after a fixed number of collisions. The other method is to find the probability distribution of neutron energy after a fixed number of collisions. The former method is well known on the one hand, and the latter method is practical in the sense that the probability distribution of neutron energy after a fixed number of collisions is determined theoretically and is in equilibrium distribution found by Fermi's method. It can not easily be extended to inhomogeneous and anisotropic distribution. On the other hand, we are met with mathematical

國大學理學部

試験答案用紙

E22 070 P06 (12)

$$\frac{r dr \cos \theta}{a^2 + r^2} \cdot \frac{h \cdot 2 \cos \theta}{\lambda_0 \cos \theta} \cdot \frac{S \cos \chi}{b^2 + r^2}$$

$$\frac{h \cdot b (ab - r^2) r dr}{(a^2 + r^2)^{\frac{3}{2}} (b^2 + r^2)^2}$$

$$b^2 + 4ab \frac{1 - \frac{E}{E_0}}{\frac{E}{E_0}} \left\} - (a+b)$$

$$\frac{2 \sqrt{1 - \frac{E}{E_0}}}{\frac{E}{E_0}}$$

$$ab + (a-b) \frac{E}{E_0} \left\} - (a+b) \sqrt{\frac{E}{E_0}}$$

$$\frac{r(a+b)}{k} = \frac{\sqrt{\frac{E}{E_0}} r(a+b)}{\sqrt{1 - \frac{E}{E_0}}}$$

$$\frac{1}{2k} \sqrt{\frac{4k^2 ab}{(a^2 + r^2)}}$$

$$\frac{\sqrt{1 - (a+b)^2}}{k} dk$$

$$\frac{4k^2 ab - (a+b)^2 + (a+b) \sqrt{1 - (a+b)^2}}{2k^2 \sqrt{1 - (a+b)^2}} dk$$

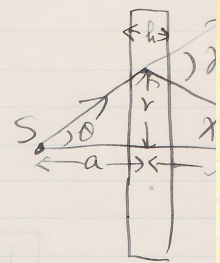
$$= \frac{(a+b)}{k \sqrt{1 - (a+b)^2}} r dk =$$

$$= \frac{(a+b) r}{k \sqrt{1 - (a+b)^2}} \frac{dE}{E_0} = \frac{dE}{E_0} \frac{1}{2 \sqrt{1 - \frac{E}{E_0}}} = \frac{dE}{E_0} \frac{1}{2 \sqrt{1 - \frac{E}{E_0}}}$$

$$= \frac{(a+b) r}{k \sqrt{1 - (a+b)^2}} \frac{dE}{E_0} = \frac{dE}{E_0} \frac{1}{2 \sqrt{1 - \frac{E}{E_0}}} = \frac{dE}{E_0} \frac{1}{2 \sqrt{1 - \frac{E}{E_0}}}$$

$$= \frac{(a+b) r}{k \sqrt{1 - (a+b)^2}} \frac{dE}{E_0} = \frac{dE}{E_0} \frac{1}{2 \sqrt{1 - \frac{E}{E_0}}} = \frac{dE}{E_0} \frac{1}{2 \sqrt{1 - \frac{E}{E_0}}}$$

$$= \frac{(a+b) r}{k \sqrt{1 - (a+b)^2}} \frac{dE}{E_0} = \frac{dE}{E_0} \frac{1}{2 \sqrt{1 - \frac{E}{E_0}}} = \frac{dE}{E_0} \frac{1}{2 \sqrt{1 - \frac{E}{E_0}}}$$



$$\cos \chi = \frac{a}{b}$$

$$k = \tan \gamma = \frac{r}{a}$$

$$= \frac{r}{a}$$

$$\cos \delta = \frac{1}{\sqrt{1 + \frac{r^2}{a^2}}}$$

$$= \frac{a}{\sqrt{a^2 + r^2}}$$

$$k = \frac{r}{a}$$

$$k r^2 + (a+b) r = \frac{r^2}{2k} + \frac{r(a+b)}{2k}$$

$$r = \frac{r(a+b)}{2k}$$

$$k = \frac{1}{2} \sqrt{1 - \frac{E}{E_0}}$$

$$dk = -\frac{dE}{4E_0}$$

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試験答案用紙

字の好みにあつて記述の格式。

$$\frac{d}{dt} (m \vec{v}) = -\frac{e}{c} [\vec{v} \times \vec{H}]$$

$$Hp = \frac{\sqrt{E^2 - (mc)^2}}{e} \quad E = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$T = E - mc^2$$

$$Hp = \frac{\sqrt{T(T + 2mc^2)}}{e}$$

$$(eHp)^2 = T(T + 2mc^2)$$

$$E^2 = \sqrt{(eHp)^2 + (mc^2)^2} \quad E = \sqrt{(eHp)^2 + (mc^2)^2}$$

$$mc^2 = 0.51 \text{ MEV.} \quad 1 \text{ EV} = 1.589 \cdot 10^{-12} \text{ erg.}$$

$$eHp \text{ ergs} = 300 \text{ Hp} \cdot \text{EV} = \frac{0.3}{1000} \text{ Hp (MEV)}$$

Hp	$\sqrt{(eHp)^2 + (mc^2)^2} - mc^2$ (MEV)	$\sqrt{(eHp)^2 + (mc^2)^2} - mc^2$ (MEV)	$\frac{eHp}{mc^2}$
1,000 Gauss	0.09		0.51
10,000	2.53		0.51
20,000	5.51		0.51
50,000	14.50		0.51
100,000	29.00	~ 0.5	0.51
200,000	~ 60.	~ 2.0	0.51
500,000	150.	~ 12.	0.51
1,000,000 = 10 ⁶	300.	~ 30.	0.51
2 x 10 ⁶	600.	~ 176.	0.51
5 x 10 ⁶	1,500.	~ 830	0.51
10 x 10 ⁶	3,000.	~ 2800	0.51

0.51
0.51
0.3
1000
Hp (MEV)
eHp (MEV) = 0.3 Hp (MEV)
mc^2 = 0.51 MEV.
mc^2 = 100 MEV.
器 2
~ 1,10
~ 3.00
~ 17.00
~ 80.00
~ 210.00
~ 500.00
~ 1,400.
~ 2900.
~ 5900
~ 14900

Heavy Quantum and Cosmic Ray 1937

(Entropy in Q)

Irreversible Property of Quantum Mechanical Ensemble

1935.6.13

DEPARTMENT OF PHYSICS
OSAKA IMPERIAL UNIVERSITY.

DATE June 13
NO. 1 1935

量子力学系に於ける不可逆性について

Entropy in Q
Irreversible Property of Quantum Mechanical Ensemble.

§1. Introduction

In ~~statistical mechanics~~ The dynamical system treated in statistical mechanics has so ^{large} many degrees of freedom as we can not usually determine in which state microscopic state it is.

Quantum Mechanics 系 (2nd system) の state の wave function Ψ は $\Psi = \sum c_n \psi_n$ と表わされる。 ψ_n は discrete 又は continuous である。 ψ_n は V 内の eigen 状態の orthogonal normalized eigenfunctions の complete system として expand される。 13 節の系の場合、 ψ_n は discrete である。 ψ_n は orthogonal, normalized である。

2nd system の wave function Ψ は $\Psi = \sum_{n=1}^{\infty} c_n \psi_n$ と表わされる。 ψ_n は eigenfunctions である。

System of 2nd state である。 $\Psi = \sum c_n \psi_n$ である。 c_n は Ψ の成分である。

この場合 wave function は - 2nd time である。 eigenfunctions の time 依存性は c_n の time 依存性に dependent である。

この system の 2nd quantity である。

DEPARTMENT OF PHYSICS
OSAKA IMPERIAL UNIVERSITY.

DATE _____
NO. 6

この系に於ける

2nd system の $\rho = \frac{1}{N} \begin{pmatrix} 1 & & 0 \\ & 1 & \\ 0 & & 1 \end{pmatrix}$ と表わされる

2nd system の unit matrix $\frac{1}{N}$ と表わされる。 2nd system の state である。

$$U(\rho \log \rho) = \lim_{N \rightarrow \infty} \sum_{n=1}^N p_n \log p_n = 0$$

$$= \frac{1}{N} \sum_{n=1}^N (-\log \frac{1}{N}) = 0$$

この場合、 ρ の trace は $\sum p_n = 1$ である。 ρ の maximum である。

2. $\rho = \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix}$ と表わされる。

$$U(\rho \log \rho) = \sum_{n=1}^N p_n \log p_n + \sum_{n=1}^N p_n \log p_n = 0$$

この場合 ρ の trace は $\sum p_n = 1$ である。 ρ の maximum である。

この measurement による system の state である。

この measurement による system の state である。

Dirac sea

Infinite negative charges filled in the vacuum ?

DEPARTMENT OF PHYSICS
OSAKA IMPERIAL UNIVERSITY.

letter to the Editor
of the Physical Review

DATE _____
NO. 1

The Density Matrix in the Theory **1936.4.21**
of the Positron

In the usual theory of ~~the~~ ^{the} electrons and ^{the} positrons, ^{only} one sort of them, is considered at first, the existence of the other ~~the electron for example,~~ ^{i.e. the positron} * being deduced as ~~the~~ necessary consequence of the theory. One can proceed, however, on the reverse way, accepting the existence of both at the beginning and only afterwards introducing possible theoretically possible relations between them. The mathematical formulation of the latter method will be as follows.

The quantized wave functions $\psi_-(x, k)$ and $\psi_+(x, k)$ of the electron and the positron satisfy Dirac's equations

$$\left\{ \frac{W \pm eV}{c} + \vec{\alpha}(\vec{p} \pm e\vec{A}) + \beta mc \right\} \psi_{\mp} = 0 \quad (1)$$

respectively, where x denote position and time of the ~~particle~~ and k takes either of the values 1, 2, 3, 4.

If we adopt a representation, in which all matrix elements of α 's are real and those of β are pure imaginary, the wave functions ψ_-^* and ψ_+^* , which are complex conjugate to ψ_- and ψ_+ respectively, satisfy ^{the same} equations (1) for ψ_+ and ψ_- respectively, so that if the relations

$$\psi_- = \psi_+^* \quad \psi_+ = \psi_-^* \quad (2)$$

are assumed at an instant for all points, they will remain to hold good forever. These are obviously & mathematical expressions of the equivalence of the anti-

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Yukawa:

electron field $\psi_- \rightarrow e^-$ sea
positron field $\psi_+ \rightarrow e^+$ sea } offset

Notion of charge conjugation : yet to be found
C

THE PHYSICAL REVIEW
REVIEWS OF MODERN PHYSICS
PHYSICS

Conducted by
THE AMERICAN PHYSICAL SOCIETY
JOHN T. TATE, Managing Editor

University of Minnesota, Minneapolis, Minn., U. S. A.

May 25, 1936

Submitted to Phys Rev -> Rejected

Dr. Hideki Yukawa
Institute of Physics
Osaka Imperial University
Osaka, Japan

Dear Dr. Yukawa:

I regret that the Board of Editors does not approve the publication of your letter on the "Density Matrix in the Theory of the Positron" in the PHYSICAL REVIEW. I enclose the comments of the referee.

Sincerely yours,
John T. Tate
John T. Tate,
Editor

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JTT:B
enc.

The new particle in cosmic ray

by Yukawa, Sakata, Taketani : submitted to Phys Rev (1937.10.22)

Rejected (1937.12.2)

YHAL E16 011 U05

Letter to the Editor of the Physical Review.

On the Theory of the New Particle in Cosmic Ray.

As already suggested by several authors, a new particle in cosmic ray, if confirmed, will be of great importance. The theory which had been proposed by one of the authors, namely by Stueckelberg. Thus it will not be useful to give an account of further consequences of the theory of cosmic ray and nuclear phenomena.

The aim of the theory was to remove the contradiction of the so-called β -hypothesis of the nuclear force by introducing a new field, which was responsible for the exchange force between the neutron and the proton and β -disintegration. We could arrive at consistent results if the interaction of the new field with the hadrons is larger than that with the light particle. As a possible form, the field was considered to be described by potentials ψ and $\bar{\psi}$ conjugate complex to each other and the wave equations

$$\left(\Delta - \frac{1}{c^2} \frac{\partial^2}{\partial t^2} - \kappa^2\right) \psi = -4\pi g \bar{\psi} \phi$$

$$\left(\Delta - \frac{1}{c^2} \frac{\partial^2}{\partial t^2} - \kappa^2\right) \bar{\psi} = -4\pi g \psi \phi$$

- 1) Oppenheimer and Serber, Phys. Rev. 51, 111, Phys.-Math. Soc. Japan 19, 712, 1937; Stueckelberg, Phys. Rev. 41, 1937. It should be noticed that the theory of Oppenheimer and Serber is not well founded, since many of the current theory do not appear in our theory in the following paragraphs.
- 2) Yukawa, Proc. Phys.-Math. Soc. Japan 17, 47, 1937.

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U particles: nuclear force & cosmic ray

THE PHYSICAL REVIEW
REVIEWS OF MODERN PHYSICS
Conducted by
THE AMERICAN PHYSICAL SOCIETY
JOHN T. TATE, Managing Editor
University of Minnesota, Minneapolis, Minn., U. S. A.

December 2, 1937

Mr. Hideki Yukawa
Kurakuen, Nishinomiya
Hyogoken, Japan

Dear Mr. Yukawa:

The Letter to the Editor by yourself and associated with your name, was read by an associate editor who reports as follows:

"The Letter suggests that the theory proposed is a promising one to account for the facts of nuclear physics which is actually so. The theory as presented gives 1) like-particle forces too small by a factor of 10-20, 2) wrong spin-dependence, and 3) non-saturating like-particle forces. It also gives no account of the anomalous magnetic moments of the proton and neutron. None of the suggested modifications are acceptable in detail.

"A factor of 4π is omitted on page 2."

In view of these criticisms we thought it best to return the paper to you for consideration.

Yukawa et al:

1) neutral meson necessary

3) anomalous mag. moment of n :

quantum effect $n \rightarrow p + U^- \rightarrow n$

Even in 1937 Yukawa's meson theory:

not accepted by most physicists

J. W. Buchta,
Assistant Editor

JWB:B
Enc.

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Meson theory in perspective

1939.4.3 Japan Phys-Math Soc Meeting in Kyoto
— special session on Mesotrons —

talk 30. Yukawa : summary & outlook

- 31. Nishina
 - 32. Tamaki-Ozaki
 - 33. Kobayashi-Okayama
 - 34. Kobayashi-Okayama
 - 35. Sakata-Tanigawa
 - 36. Yukawa-Sakata
 - 37. Yukawa : On the limits of field theories
- } Yukawa's group

Starts in a pessimistic tone;

Our group does not have anything worthy to present.

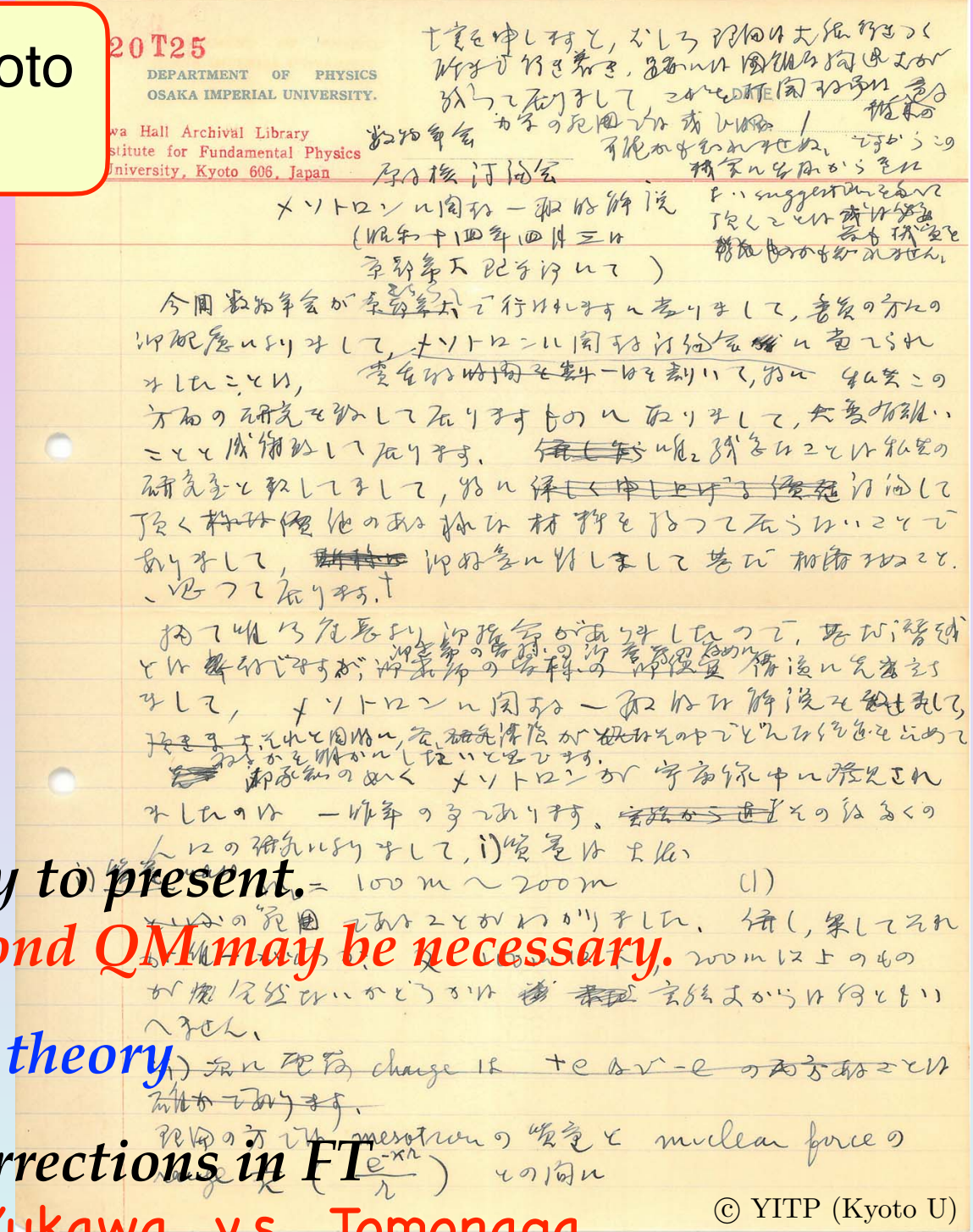
Many difficult problems. Something beyond QM may be necessary.

Brilliant summary: the status of the meson theory

talk 37: *infinities* in quantum corrections in FT

Yukawa v.s. Tomonaga

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Osaka Imperial University period

1933-1939 Age 26-32

Yukawa's endeavor in physics

He struggled and educated colleagues/students/public.

With passion and a sense of mission.

Vision for the future



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