XVI

NOTE BOOK

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May 1962
~ Feb. 1963

Wigner
Wheeler
素粒子の構造
Pattern Recognition
Schiff

VOL. XVI

湯川

日章 BA 50

Nissho Note

Discussion Meeting
May 23, 1962, RIFP
(Vigier, Wheeler present)

Morning:

1. H. Shimazu, Interaction of Elementary Particles with Internal Degrees of Freedom
Comment by Yokoyama

2. S. Tanaka, Indefinite Metric with Complex Masses

3. H. Fukutome, Elastic Ether Theory of Elementary Particles II.

Tetsuo Goto, On the Interaction of Elementary Particles in the View of the Extended Particle Model I.
Nuovo Cimento
April 1962

point-like model
Takabayashi, P.T.P. 25 (1961), 901;
23 (1960), 925
Bohm et al. P.T.P. 23 (1960), 496

pseudopotential for a hard core
K. Huang and C.N. Yang, P.R. 106 (1957), 1135

$$(\nabla^2 + k^2)\psi(r) = 0 \qquad r > a$$
$$\psi(r) = 0 \qquad r \leq a$$

s-wave phase shift
$\eta_0 = -ka$ $\quad$ a is also scattering length

$$(\nabla^2 + k^2)\psi(r) = 4\pi a\, \delta(r) \frac{\partial}{\partial r}(r\psi)$$

extended into $r < a$
generalized pseudopotential

$$k^2\psi = \{-\nabla^2 + 4\pi a \delta(r)\frac{\partial}{\partial r} r - \frac{4\pi}{3} a^3 \delta(r) \nabla^2 \frac{\partial}{\partial r} r + \cdots\}\psi$$

non-hermitian operator

M. Ferro-Luzzi, R. D. Tripp
and M. B. Watson

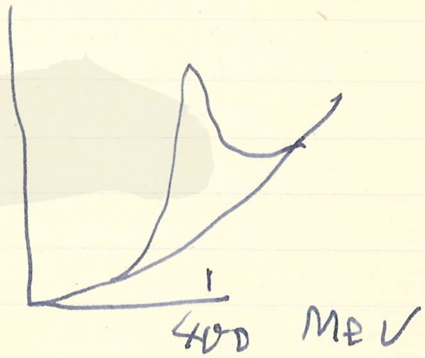
Excited hyperon of Mass 1520 MeV

$K^- + p \rightarrow$ $\quad$ K^- beam ~ 400 MeV/c

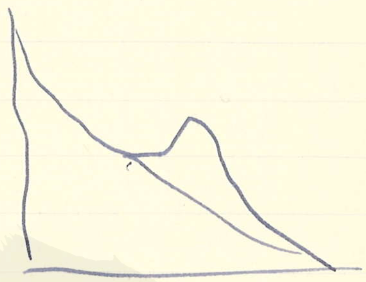
$m = 1520 \pm 3$ MeV
$\Gamma/2 = 8$ MeV
$I = 0$
$J = 3/2$

parity even with respect to $\bar{K}p$ ($D_{3/2}$)
branching ratio
$\bar{K}N : \Sigma\pi : \Lambda 2\pi = 3 : 5 : 1$

$K^- + p \rightarrow \Lambda + \pi^+ + \pi$



$K^- + p \rightarrow \bar{K}^0 + n$



angular distribution

June 9, 1962

"K.Y. を中心とする強い相互作用" "素粒子の構造"
合同研究会.
(CERN 国際会議報告会)
東大核研
CERN会議 出席者
山口, 牧, 宮沢, 　　　西島. 木庭
三浦, 福田. 　　　早川

湯川 — The modified rotator model
Vigier

	$R_3^+ \times R_3^- \times R_3'$		$R_3 \times R_3^{+} \times R_3'^{-}$
(n, p)	$D(\frac{1}{2}, 0)$ $D(\frac{1}{2})$	(e, ν_e)	$D(\frac{1}{2})$ $D(\frac{1}{2}, 0)$
(Λ)	$D(0, \frac{1}{2})$ 〃	$\binom{\mu}{\nu_\mu}$	〃 $D(0, \frac{1}{2})$
$(\Sigma\Sigma\Sigma)$	$D(1, \frac{1}{2})$ 〃		
$(\Xi\Xi)$	$D(\frac{1}{2}, 1)$ 〃		
π^0	$D(0, 0)$ $D(0)$		
$(\pi\pi\pi)$	$D(1, 0)$		
?	$D(0, 1)$ 〃		
$\binom{K\ K}{\bar{K}\ \bar{K}}$	$D(\frac{1}{2}, \frac{1}{2})$		

$$Q = j_3^+ + j_3^- - j_3^+ - j_3'$$

Katayama mass formula ?

$$M = 1 + 16\, j'(j'+1) + \frac{23}{2}\{ j^-(j^- + 1) - j_3^{-2} - j_3 j_3' \}$$

$$+ \frac{1}{2} j^+(j^+ + 1)$$

課題, Ξ, τ, π, λ.

島津 Shimazu - Yokoyama

~~June~~ July 2, 1962

Relativistic Invariance ?

$f(pk) = f(\hat{p}k)$

[illegible] !!!

Heitler :

品田へ　山口情報　CERN　HEPC

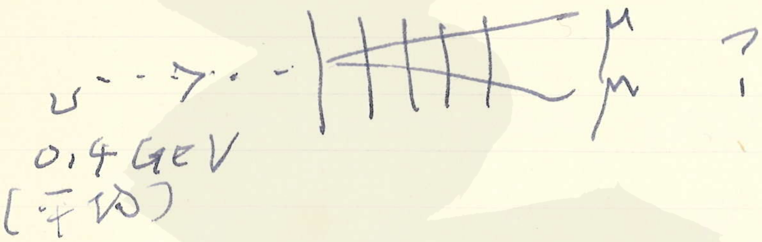
July 9, 1962

Brookhaven　ν-exp.　μ: 50例.

$\nu + "N" \to "N" + W + \mu$

$W \to e + \nu$ or $\mu + \nu$

など 考えられるものがみつかっている。



CERN　$\bar{p} + p$ reaction

$\bar{p}$ at rest $\to$

$$\left.\begin{array}{ll} \pi^+ + \pi^- & 4.3 \pm 0.6 \\ K^+ + K^- & 1.1 \pm 0.3 \\ K_1^0 + K_2^0 & 0.6 \pm 0.1 \end{array}\right\} 10^{-3}$$

CERN　$\pi^- + p$
10.5 ± 0.5 GeV/c

CERN　$\bar{p}p \to \bar{\Sigma}\Sigma$

前→1例

(1) $Y - \pi$　1685 MeV　$I \sim 1$ (?)

(2) $\pi^- + p \to Y + \pi + K$
M　730 MeV
K^*　885 "　?

(3) $K^- + p \to$ res.

山口論文: Model of Weak Interaction
(July 9, 1962)

福留秀雄: Simple Rotator

dynamics
Vigier-Takabayashi と違う.

$$L = \int \left\{ -K(\omega_{\alpha\beta}) + q^\mu (A_{\mu 4} - U_\mu) + \frac{1}{2}\lambda^{\alpha\beta}(A^\mu{}_\alpha A_{\mu\beta} - \overset{0}{g}_{\alpha\beta}) \right\} \sqrt{-g_{44}}\, d\tau$$

$$\omega_{\alpha\beta} = \frac{1}{\sqrt{-g_{44}}} A^\mu{}_\alpha \dot{A}_{\mu\beta} \qquad g_{44} = \dot{x}^\mu \dot{x}_\mu$$

$$A^\mu{}_\alpha A_{\mu\beta} = \overset{0}{g}_{\alpha\beta} \qquad U^\mu = \frac{\dot{x}^\mu}{\sqrt{-g_{44}}}$$

$$\frac{d}{ds} = \frac{1}{\sqrt{-g_{44}}} \frac{d}{d\tau}$$

canonical variables

$A^\mu{}_\alpha$ $\quad x^\mu$

$B_\mu{}^\alpha$ $\quad p^\mu$

$\Omega_{\alpha\beta}$

$H \overset{w}{=} 0$

$p^\mu A_{\mu 4} + m(\Omega_{\alpha\beta}) \overset{w}{=} 0$

Ⅱ-2 [illegible]

CERN High Energy Conf.
July 1962 報告会

July 1962

July 9

I. N and π Phys. Exp.: Puppi

① J_I^{PG} $\omega \to 1_0^{--}$ ◎

$\frac{\omega \to \text{neutral}}{\omega \to \pi^+\pi^-\pi^0} \sim 15\%$

$\omega \to 3\pi$
$\to$ neutral
$\xrightarrow{EM} 2\pi$
(ρ_2)

D-plot 1100 ev.

② $\eta \to 0_0^{-+}$ ◎ D-plot

$\eta \to \pi^0 + 2\gamma$ or 2γ

③ ρ $J = I = 1$

$\pi + N \to N + 2\pi$

④ EJC

a) $\pi + N \to N + \begin{cases} \rho \\ \omega \\ \eta \end{cases}$

$(\pi^+ p)$ 2.7 GeV/c
1.5 mb
1.3 ″
0.45 ″

sizable and comparable

$\pi + N \to N + (\text{meson})^*$
$\to N^* + (\text{meson})^*$

b.) O.P.E. model

c) ABC anomaly

$\gamma + N \to N + \underline{\pi + \pi}$

$\pi + N \to N + \underline{\pi + \pi}$

d) ζ (580 MeV) {ある / ない

II. E.M. Prop. of N and π — Exp. Bishop

Stanford
Cornell
Orsay

$$F_{1S} = \frac{S_1}{1+\frac{2.04q^2}{M_S^2}} + 1 - S_1$$

$$F_{1V} = \frac{V_1}{1+\frac{2.04q^2}{M_V^2}} + 1 - V_1$$

(M_S^2, M_V^2 in m_π^2; q^2 in $10^{26}\,cm^{-2}$)

$M_S^2 = 23 \pm 3$

$M_V^2 = 18 \pm 2$

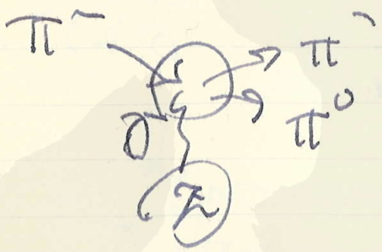
$S_1 = 1.17 \pm .15$

$S_2 = -0.5$

$V_1 = 0.92 \pm 0.10$

$V_2 = 1.10$

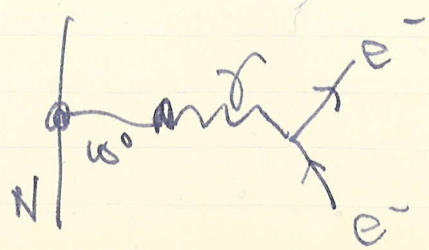
$M_S^2 = M_V^2 \to 19 \pm 3$



$\frac{(CME)^2}{m_\pi^2} = 5 \sim 22$

III. Mandelstam
Reggeized ρ

$\boxed{\omega^0 \to e^+e^-}$



IV. E.M. Prop. of N and π Th: Fubini

Extra: H.E. ν experiment at Brookhaven (Schwartz)

AGS 15 Gev p 2×10^{11} p/sec

ν int Target Al

1 ton spark chamber $\times 10$.

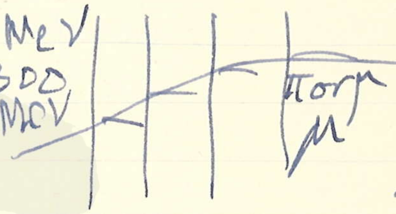
34日 : 5.5 秒

1) short single Track ≤ 300 MeV

2) single Track ≥ 300 MeV

3) "vertex event"

4) " shower



49
34
22
8

$$\nu + \text{"}N\text{"} \to \text{"}N\text{"} + \mu$$

vertex event → μ + electron shower

$$\nu + N \to N + \mu + \pi^0 \ ?$$

$$\nu + N \to N + e \quad X$$

5 interesting events

$$\nu + N \to N + \mu + \pi + 2\pi$$

or $\nu + N \to N + \mu + W$ ↳
- 3π 1
- 2π 1
- $e\nu$ 1
- π^c or $\mu\nu$ 2

July 10

V. S.I. of str. Particles   Exp: Gregory

I. ① Cosmotron

Λ μ_Λ -1.5 ± 0.5 in $\frac{e\hbar}{2M_pc}$
0 ± 0.5

② parity cons. in str. par. prod.
OK.   a few %

③ charge symmetry OK ($\lesssim 10\%$)
~~④~~ charge indep. OK

④ $\bar{p} + p \to Y + \bar{Y}$ CERN
~ 1 GeV.
↳ 3.0 and 3.6 GeV/c

II. Resonance:
Gell-Man   Octet 説.
10 dim $3/2^+$

S = -3	Ω^-	——	I = 0	(weak decay)
-2	Ξ^*	——	1/2	
-1	Y_1^*	——	1	
0	$N^*(33)$	——	3/2	

VI. S.I. of str. Part.   Theor: Snow
$P(\Sigma, \Lambda) =$ even

$\bar{p}p \to K_1^{(0)} + K_2^{(0)}$
at rest   90% として S-wave capture
$\to K^0 + \overline{K^{0*}} \to$ spin 1.

$$\bar{p}\,p \rightarrow \begin{cases} \pi^+\pi^- & 3.95 \pm 0.25 \\ K^+K^- & 1.31 \pm 0.18 \\ K^0\bar{K}^0 & 0.56 \pm 0.08 \end{cases} \times 10^{-3}$$

freq.

K^-p pure "s" is OK

(A) pure hard core 0.31 F ≤ 600 MeV

(B) effective range (a, r_0) ≤ 800 MeV

$K^-p \rightarrow \bar{K}^0 n$

VII. WI (of non-strange particles)

Exp. (+ Th) Wolfenstein

① μ^- capture by hydrogen

Columbia, CERN, Chicago

Dubna ($\mu^- + He^3$)

V−A

V+A ×

② Conserved vector current

Berkeley, Dubna CERN

$\underbrace{\pi^+ \rightarrow \pi^0 + e^+ + \nu}_{\text{exp}}$ $\frac{\pi_{\beta 3}}{\pi_{\mu 2}} = 1.7 \pm .5 \times 10^{-8}$

C.V.C. $1. \times 10^{-8}$

WI of strange part. Exp. Crawford

$J_\Xi = 1/2$?

$\alpha_\Lambda < 0$ -0.62 ± 0.07

$|\delta I| = 1/2$ OK (Λに関してだけ)

why?

α

$\Sigma^+ \to p\pi^0$ $\quad 0.78^{+0.08}_{-0.09}$

$\Sigma^+ \to n\pi^+$ $\quad 0.03 \pm 0.08$

$\Sigma^- \to n\pi^-$ $\quad 0.16 \pm 0.21$

$|\Delta\vec{I}| = 1/2$ だけでなく $3/2$ がある方が
よさそう.

$K_2^0 \to \pi^+\pi^-\pi^0$!
$\quad \to 3\pi^0$!

やはり $\Delta I = 1/2$ だけではない.

K_{e3} : $\dfrac{\Delta Q}{\Delta S} = -1$ あり.

exp. : $\dfrac{\Gamma_1}{\Gamma_2} = \begin{cases} 6.6 \pm {}^{6.0}_{4.0} \\ 11.9 \pm {}^{7.5}_{5.6} \end{cases}$

$(\Delta\vec{I}) = 1/2$
の否定.

$\Sigma^+ \to n + \mu^+ + \nu$
$\quad \hookrightarrow$ e-decay

$\underline{1189}$

VIII. WI Th. Okun

ρ [illegible]

$m(\nu_\mu) < 5$ MeV

$m(\nu_e) \lesssim 200$ eV

$K \to \mu + \nu_e + \pi$
$\quad \to e + \nu_\mu + \pi$ $\quad$ X

IX₁ High Energy Physics: Exp. Cocconi

$E \to \infty$ $\begin{cases} \sigma = \text{const} \\ \gamma \to \infty \\ \text{transparency} \to \infty \end{cases}$

$\pi^- p \to d \bar{p}$

4 Gev/c 29±10 μb

5 Gev/c 21±10 μb

IX₂ HEP Th. Drell

Exp. ra suggestion:

1) $E \to \infty$ $\sigma_{AA} = \sigma_{\bar{A}A}$

$\pi^+ p$ $\pi^- p$

pp $\bar{p}p$

$K^+ p$ $K^- p$

2) Factoring

$\sigma_{ab} = \sqrt{\sigma_{aa}\sigma_{bb}}$

$\left.\begin{array}{l}\sigma_{\pi\pi} \simeq 15 \text{ mb} \\ \sigma_{KK} \simeq 10 \text{ mb}\end{array}\right\}$

3) $\sigma^{el}_{AA} = \sigma^{el}_{\bar{A}A}$ for spin average

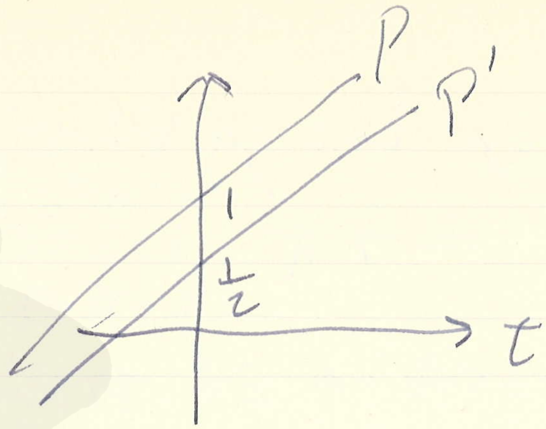
4) pol $\to 0$

No spin correl.

Amati, Fubini, Stanghellini ?

branch cut

Igi:



X. EM properties of leptons and (QED)
Exp + Th : Berman

① $\frac{g-2}{2}$

② μ-pair creation

③ μ-C scattering

④ muonium | HF splitting

⑤ atomic and molecular muonic physics

⑥ EΠC ...

$\frac{K_{e2}}{K_{\mu 2}} = 2.5\times10^{-5}\,[1-18.8\%]$ rad. corr. (soft photon)

XII. Theory of El. Particles (Th: d'Espagnat)
(Group theor. Method)

$\left\{ \begin{array}{ll} \cancel{SU_3} & \cancel{O_4} \\ G_2 & \cancel{O_5} \end{array} \right.$

WI $\Delta I = 1/2 + 3/2$

Aug. 20 ~ Sept. 15, 1962

Pugwash　第9回　Cambridge
　　　　　第10回　London

に出席．雑記．

I. Ia. Pomeranchuk

Equality of Nucleon and Antinucleon Total Interaction Cross-Section at High Energies

Soviet Physics JETP

34 (1958), 499

T. D. Lee and C. N. Yang

Charge Conjugation, a New Quantum Number G, and Selection Rules Concerning a Nucleon-Antinucleon System

N. C. 3 (1956), 749

$G = C \exp[i\pi I_2) \cancel{= C(\cos\pi + iI_2 \sin\pi)}$

$\psi = \begin{pmatrix} p \\ n \\ \bar{n} \\ -\bar{p} \end{pmatrix}$ $\quad I_1 = \begin{pmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{pmatrix}$ $\quad I_2 = \begin{pmatrix} 0 & -i & 0 & 0 \\ i & 0 & 0 & 0 \\ 0 & 0 & 0 & -i \\ 0 & 0 & i & 0 \end{pmatrix}$

$I_3 = \begin{pmatrix} 1 & & & \\ & -1 & & \\ & & 1 & \\ & & & -1 \end{pmatrix}$ $\quad G = \begin{pmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \end{pmatrix}$

$N = \begin{pmatrix} 1 & & & \\ & 1 & & \\ & & -1 & \\ & & & -1 \end{pmatrix}$

$[I_i, G] = [I_i, N] = 0$

$\left. I_1 = \sigma_1, \; I_2 = \sigma_2, \; I_3 = \sigma_3 \right\}$

$G = i\rho_2 \qquad N = \rho_3$

$GN + NG = 0 \qquad G^2 = (-1)^N$

G : multiplicative

$N \neq 0$: $\quad N, I^2, I_3$ are quantum numbers

$N = 0$: $\quad N = 0, I^2, I_3, \; G = \pm 1$

π : $\quad G = -1$

selection rules ~~for~~ $N=0$ states transitions
even number of π <u>cannot</u> go into odd number of π

$S = 2Q - 2I_3 - N \qquad Q = \frac{N}{2} + I_3 + \frac{S}{2}$

$[N, S] = [S, I_i] = 0$

$GS + SG = 0 \qquad G^2 = (-1)^{N+S}$

片山氏:
内部構造をもつ素粒子の理論
Oct. 15, 1962

H. P. model

$$(J^+)^2 = (I^+)^2, \quad (J^-)^2 = (I^-)^2$$

Spin

$$\max S = J^+ + J^-$$

or $$\max S = I^+ + I^-$$

$$\Sigma = S + T$$

$$\Sigma_{max} = I^+ + I^- + J^+ - J^-$$

$$\Sigma_{min} = |I^+ \pm I^+ \pm J^+ \pm J^-|$$

文献; R.M.P., July, 1962
Stapp, axiomatic S-matrix theory
Chew, S-Matrix theory of strong
interaction without elementary
particles

[illegible] Rotator Level Scheme

Oct. 24, 1962

τ: ~~arbitrary~~ proper time ~~time parameter~~ (time τ is monotonous function)

$x^\mu(\tau)$, $A^\mu{}_\alpha(\tau)$

$A^\mu{}_\alpha A_{\mu\beta} = \eta_{\alpha\beta}$

$\boxed{A^\mu{}_4 = U^\mu}$ ← ~~suppl. add.~~ condition (restrictive)

$U = \frac{dx^\mu}{ds}$

$\mathcal{L} = \int L(\dot{x}^\mu, A^\mu{}_\alpha, \dot{A}^\mu{}_\alpha)\, d\tau$

$L = -K(\omega_{\alpha\beta})\sqrt{-\frac{dx^\mu}{d\tau}\frac{dx_\mu}{d\tau}}$

$\omega_{\alpha\beta} = A^\mu{}_\alpha \frac{dA_{\mu\beta}}{ds}$

$p^\mu = \frac{\partial L}{\partial \dot{x}^\mu}$ $\qquad \dot{p}^\mu = 0$

$B^{\mu\alpha} = \frac{\partial L}{\partial \dot{A}_{\mu\alpha}}$

$M^{\mu\nu} = x^\mu p^\nu - x^\nu p^\mu + S^{\mu\nu}$ $\qquad \dot{M}^{\mu\nu} = 0$

$S^{\mu\nu} = A^\mu{}_\alpha B^{\nu\alpha} - A^\nu{}_\alpha B^{\mu\alpha}$

$I^{\alpha\beta} = A^{\mu\alpha} B_\mu{}^\beta - A^{\mu\beta} B_\mu{}^\alpha$

$(S^{\mu\nu}, I^{\alpha\beta}) = 0$

$S^{\mu\nu} S_{\mu\nu} = I^{\alpha\beta} I_{\alpha\beta}$

$S^{\mu\nu} \tilde{S}_{\mu\nu} = \rho\, I^{\alpha\beta} \tilde{I}_{\alpha\beta}$ $\qquad \rho = \|A^\mu{}_\alpha\|$

[illegible]と量子論

$p^\mu \not\parallel U^\mu : \dot{S}^{\mu\nu} \neq 0$

$$p^\mu = m(I^{\alpha\beta})U^\mu + \boxed{} \nearrow \perp U^\mu$$

$$p^\mu p_\mu = -M^2 \text{ (mass)} \qquad m = -p^\mu U_\mu$$

$$\left(\text{classical} : M = \sqrt{1-v^2/c^2}\cdot m \right)$$

$$\left. \begin{array}{l} S^\lambda = \frac{1}{2}\epsilon^{\lambda\mu\nu\xi} S_{\mu\nu} p_\xi / M \\ \dot{S}^\lambda = 0 \end{array} \right\}$$

$$S^i_{(\pi)} = S^{jk}_{(\pi)}$$

$$S^4_{(\pi)} = 0$$

$$(S^\lambda, S^\mu) = \frac{1}{2}\epsilon^{\lambda\mu\nu\xi} S_\nu p_\xi / M$$

$$(S^i_{(\pi)}, S^j_{(\pi)}) = S^k_{(\pi)}$$

$M=0$ の場合:

spin-polarization operator (Wigner)

$$P = \frac{1}{2}\epsilon^{ijk4} s_{ij} p_k / p^4$$

(pseudo-scalar)

$$\dot{P} = 0$$

decoupled case:
hyperspherical $\dot{I}^{\alpha\beta} = 0$

spherical $\dot{I}^{ab} = 0$

simple rotator : single rotator

complex rotator: Double rotator

$x^\mu,\ A^\mu{}_a,\ B^\mu{}_\pi$

$A^\mu{}_4 = B^\mu{}_4 = U^\mu$ (9)

$A^\mu{}_4 = U^\mu$ (12)

or $C^\mu{}_\alpha$ = complex $\quad C^\mu{}_\alpha C_{\mu\beta} = \eta_{\alpha\beta}$

Corson:

$C^\mu{}_\alpha \sigma^\alpha = \chi^\dagger \sigma^\mu \chi$

弱い相互作用 研究会

25日：午前　知恩院会議室　Oct. 25, 1962 ~Oct. 26 (Oct. 27)

報告：Cern Conf.

1) 2ν の確認

2) $\Delta S/\Delta Q = \pm 1$

$\bar{g}^{+}g$ とはかけない　(∵ $\Delta S = 2$ が起こる)

p, n, Λ では出来ない (4個で表わされる)

3) intermediate boson

religion (Lee-Yang) は強固。

$\Delta S/\Delta Q = \pm 1$　$\Delta S < 2$

$|\Delta I| = 1/2$ (non-leptic decay)

3種類の boson が必要 (Takeda)

(anti-particle をふくめて 6種類)

4) $(\bar{e}\nu)(\bar{\nu}e)$　空の エネルギー loss が大きくなりすぎる。(報告)

$\hat{j}_\lambda j_\lambda$ × ?

5) C.V.C.

$$\frac{R(\pi^+ \to \pi^0 + e^+ + \nu)}{R(\pi^+ \to \mu^+ + \nu)} = 1.0 \times 10^{-8}$$

CERN $(1.7 \pm 0.5) \times 10^{-8}$

Barbaro $< 7 \times 10^{-8}$

$G_V = (1.4025 \pm 0.0022) \times 10^{-49}$ erg cm^3

$G_\mu = (1.4312 \pm 0.0011) \times$ 〃

$G_V/G_\mu = 0.98$

c033-693挟込

V - A . F. G.

$(\bar{p}N)[(\bar{e}\nu_e) + (\bar{\mu}\nu_\mu)]$

$\frac{+}{c}(\bar{\mu}\nu_\mu)(\bar{e}\nu_e)$
$(\nu_\mu \bar{\mu})$

6) non-leptonic decay

$\Lambda \to p\pi^-$ $\alpha^- = -0.6$

$\to n\pi^0$ $\alpha^0 =$

$\alpha^0/\alpha^\Lambda = 1.0 \pm 0.27$

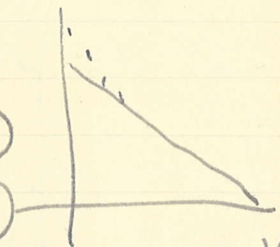
$\Xi^- \to \Lambda + \pi^-$ $\alpha = 0.62 \pm \cdots$

$\Sigma \to$

$|\Delta I| \cong 1$: 近似則[illegible] ?

7) hanger effect

Kurie plot



$In^{114}(\beta^-)$, $Y^{90}(\beta^-)$

$P^{32}(\beta^-)$ $Na^{22}(\beta^+)$

$\left(1 + \frac{b}{W}\right)$

$0.2 < b < 0.4$

Fierz 干渉でない

七不思議	2ν	$\Delta S/\Delta Q$	$\Delta S \pm 2$	$(\bar{e}\nu)(\nu e)$	CVC	$G' \ll G_V$	$\rho_I = 1/2$
Sakata	P	p	O	P	O	P	P
Nagoya	X	X	O	X	O	P	P
(Nagoya)'	O	(O)?	(O)?	X	O	O	P
Taketani-Tati							

p : possible

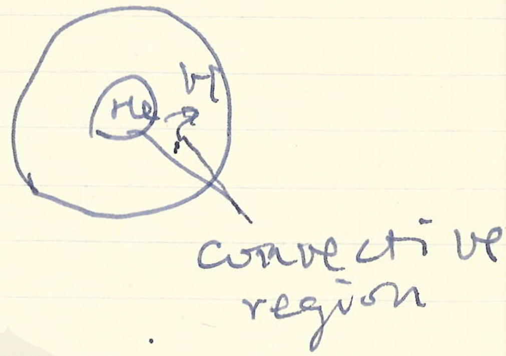
25日: 午後

林忠四郎: $(\bar{e}\nu)(\bar{\nu}e)$

H-burning

He-burning $2\times10^{8}\,°K$

$\frac{M_{core}}{M} \simeq 0.10 \sim 0.20$



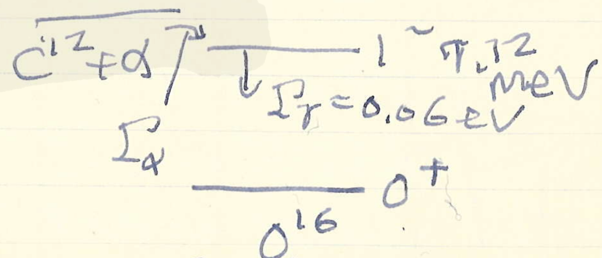
$3\alpha \to C^{12}$

excited state

$\Gamma_\gamma = 2.5\times10^{-3}\,eV$

$(\pm 50\%)$

$C^{12}(\alpha,\gamma)O^{16}$

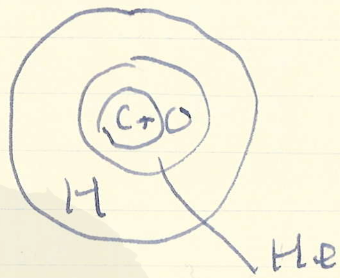


C^{12}, O^{16} の final concentration

Carbon-burning

$C^{12}+C^{12} \to Na^{23}+H^{1}$

$\to Ne^{20}+He^{4}$



Ne, O, S, Si, Mg $\to$ Fe

neutrino loss

$H' = \sqrt{8}\,G\,\bar{J}_\mu J_\mu$ (F. G.)

$J_\mu = (\bar{p}\gamma_\mu a n) + (\bar{\nu}_e\gamma_\mu a e)$

$+ (\bar{\nu}'\gamma_\mu a\mu)$

$a = \frac{1+i\gamma_5}{2}$

$\sqrt{8}\,G\,(\bar{e}\gamma_\mu a\nu)(\bar{\nu}\gamma_\mu a e)$

$G = (1.01 \pm 0.01)\times10^{-5}$

(1) $e^- + A_Z \to e^- + A_Z + \nu + \bar{\nu}$

(2) $\gamma + e^- \to e^- + \nu + \bar{\nu}$ (photon neutrino)

(3) $2\gamma \rightleftarrows e^- + e^+ \to \nu + \bar{\nu}$ (pair-neutrino

(4) $2\gamma \to \gamma + \nu + \bar{\nu}$

Chiu, Morrison
Ida, Uehara

(2) $\sigma = \dfrac{4}{35\pi^2}\alpha\left(\dfrac{G m^2 c}{\hbar^3}\right)^2\left(\dfrac{\hbar}{mc}\right)^2\left(\dfrac{E}{mc^2}\right)^2$

(3) $\sigma = 1.5\times10^{-45}\,\dfrac{c}{v}\left(\dfrac{E_T^2}{m^2c^4} - 1\right)$

$L_{photon} + L_{neutrino}$

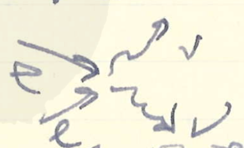
星の寿命が短かくなる。(He-burningにて)

$M = 15.6\,M_\odot$　　loss なし　9×10^5 year
　　　　　　　　　　loss あり　$\lesssim 10^5$ year

星の数は寿命に比例すると。
(以内)

(lossのとしてはよくあう
loss があると factor 5〜40 ぐらい
短かくなりすぎる

Reines:

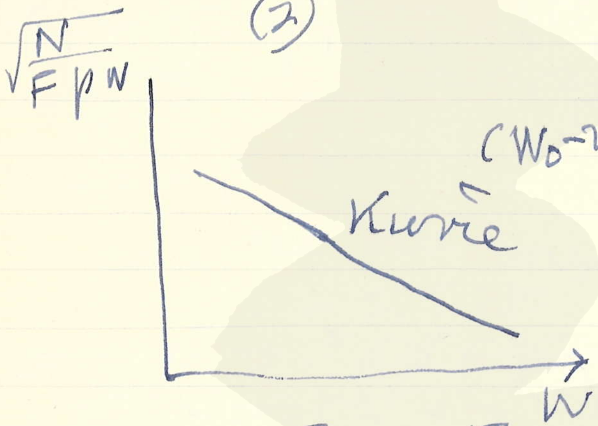


1964年 end 迄に確認。

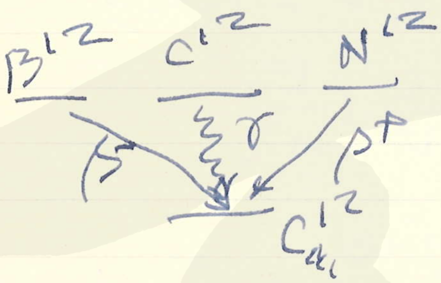
(田中は indefinite metric を入れて)
intermediate boson は

表に同じく(?)：~~Lauger effect~~ CVC
~~Indiana~~ の検討でやれる。

CVC： ① $\pi^+ \to \pi^0 + e^+ + \nu$　CERN yes
②



$(W_0 - W)(1 \pm aW)\left(\begin{smallmatrix} e^- \\ e^+ \end{smallmatrix}\right)$



a： V, A の cross Term.

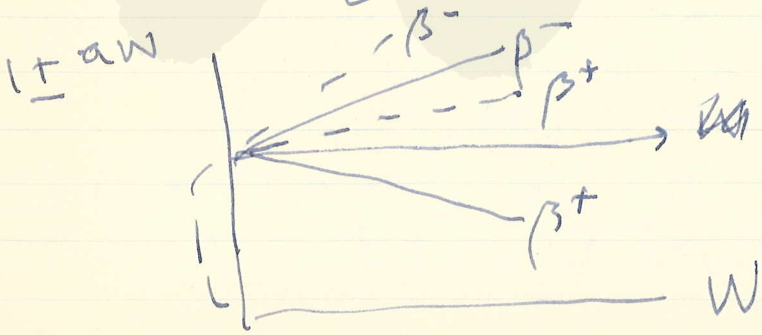
V　1　α

A　σ　γ_5

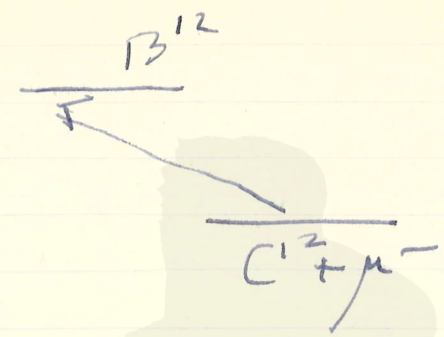
$C_A^2 |\int \sigma|^2 \pm C_A C_V \int \sigma \int \alpha \times r$

$\sqrt{\frac{N^+/Fpw}{N^-/Fpw}} \sim 1 \pm 2aW$

Pasadena　CE は (yes)
$2a \sim 1\%/\mathrm{MeV}$



— CVC
… exp.



no ?

β-spectrum
RaE^{210}

[illegible] : Langer effect
Indiana の [illegible]
$R \times R \times R \times R$
Rot. Invariant
Yukawa Interaction
Isobar (boson) channel (weak)
$$S(W) = [1+\alpha^2(W_0-W)^6]\, pW(W_0-W)^2$$
Na^{22} + G.T. (all)
P^{32} – ,, (all)
Y^{90} – ,, (1st)
A^{198} – G.T. + F (1st)
Pr^{143} G.T. + F (1st)
RaE

26日;

第2日 午前; $\Delta S/\Delta Q = \pm 1$, $2.\nu$.

中心問題 I, 2ν-problem

(i) $g = (\bar{e}\nu) + (\bar{\mu}\nu) + f(\bar{n}p) + g(\bar{\Lambda}p)$

(ii) $\Delta S/\Delta Q = -1$

$$\nu_e \quad \nu_\mu \quad e \quad \mu$$

$$p \quad n \quad \Lambda$$

$$\begin{matrix} \nu_1 & e & \mu & \nu_2 \\ \downarrow & \downarrow & \downarrow & \downarrow \\ p & n & \Lambda & \end{matrix}$$

$$g = (\bar{e}\nu_e) + (\bar{\mu}\nu_\mu) + \cos\delta(\bar{n}p) + \sin\delta(\bar{\Lambda}p)$$

$$\left(\frac{G_V}{G_\mu}\right)^2 + \left(\frac{G'}{G_\mu}\right)^2 = 1$$

$$\frac{G'}{G_\mu} \sim \frac{1}{5} \qquad \left(\frac{G_V}{G_\mu}\right)^2 \sim 1 - \frac{1}{25} \sim 98\%$$

II. $\Delta S/\Delta Q = -1$ problem

ΔS ~~変~~ 変2 で $\Delta S/\Delta Q = -1$

は4体 fermi では不可能.

(i) $p, n, \Lambda \rightarrow$ lepton

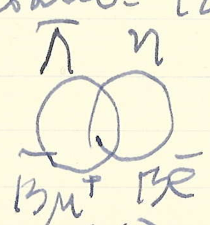
charge の保存 $\rightarrow \Delta S/\Delta Q = \pm 1$ だけ

(+ baryon number)

(ii) composite system の表現の要素

$\rightarrow \Delta S/\Delta Q = -1$

Nagoya group; Takeuchi-Tati



$$K^0 \rightarrow \pi^- + e^+ + \nu$$

$$\pi^+ + e^- + \tilde{\nu}_\mu$$

$\Delta S = 2$? $(K^0 \rightarrow \pi^+ + \mu^- + \tilde{\nu})$

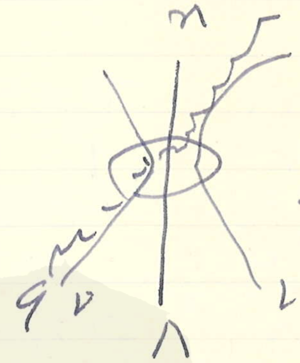
neutrino flip ($K^0 \to \pi^+ + e^- + \bar{\nu}_\mu$)

$\frac{\partial ?}{\partial a} = +1_e$ にて flip がおこる。

6体 fermi

$(\bar{p}n)(\bar{\Lambda}n)(\bar{e}\nu)$

Taketani - Tati



Induced transition

$\nu_e \xrightarrow{\Sigma} e$

$\nu_\mu \to \mu$

$e \qquad \mu$

$\uparrow \qquad \uparrow$

$\nu_e \qquad \nu_\mu$

$\nu_3 \qquad \nu_1 \qquad \nu_2$

$\downarrow \qquad 関 \qquad B\downarrow$

$p \qquad n \qquad \Lambda$

$\Delta S = 0$ の破れたり

$K^0 \to \left\{ \begin{array}{l} \bar{\Lambda} \to \bar{n} \\ n \to p + e^- + \bar{\nu} \end{array} \right\}$

$\to \pi^+ + e^- + \bar{\nu}$

[illegible]: Weak Int. in double Rotator model

$x_\mu \quad a^\mu{}_\alpha \quad b^\mu{}_r$

$a^\mu{}_4 = u^\mu \qquad C_{\alpha\to 3}^{\xi\to 4}$

or $b^\mu{}_4 = u^\mu \qquad C_{\alpha\to 4}^{r\to 3}$

B-repr. $\quad T \quad S \quad t+s \; ; \; T_3 \quad S_3 \quad (t+s)_3$

L-repr. $\quad t, \quad s, \quad T+S \; ; \; t_3 \quad s_3 \quad (T+S)_3$

$\Delta T \equiv 0 \qquad \Delta S = 0 \qquad \Delta(T+S) = 0$

$\Delta T = 0 \qquad \Delta S = 0 \qquad \Delta(t+s)_3 = 0$

strong $\Delta T = 0 \qquad \Delta S_3 = 0 \qquad \Delta(t+s)_3 = 0$

E.M. $\Delta T_3 = 0 \qquad \Delta S_3 = 0 \qquad \Delta(t+s)_3 = 0$

B: $Q = T_3 + S_3 + (t+s)_3$

L: $Q = (T+S)_3 + t_3 + s_3$

$t \quad s$

$1/2 \quad 0 \quad \left(\begin{matrix} e^+ \\ \nu_1 \end{matrix} \right.$

$0 \quad 1/2 \quad \left(\begin{matrix} \mu^+ \\ \nu_2 \end{matrix} \right.$

weak $\quad \Delta(t+s) = 1/2 \qquad \Delta(T+S) = 1/2$

B. $\quad S_\mu(\overset{T}{1}, \overset{S}{0})_{t+s=0,1} \quad S_\mu(1/2, 1/2)_{t+s=0,1} \quad S_\mu(3/2, 1/2)_{t+s=0,1}$

boson $\quad t+s = 1/2 \qquad T+S = 1/2$

L $\quad S_\mu(\underset{t}{1/2}, \underset{s}{1/2})_{T+S=0,1}$

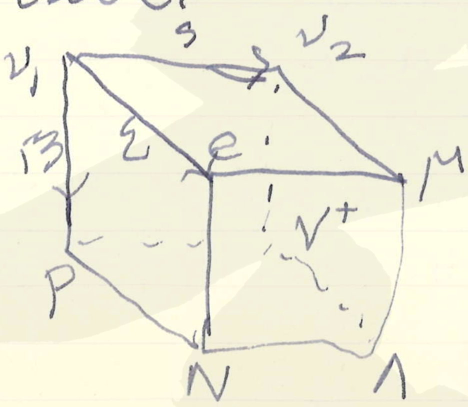
W-boson:　T　S　$T+S$
　　　　　1　$\frac{1}{2}$　$\frac{1}{2}$　　12個

$S(1,0)_{0,1}\, W_{1,\frac{1}{2}}$

$(W+\bar{W})^R_\mu\, J^R_\mu$

今日

山田, 浜田, 呉: Weak Interaction の model



$\varepsilon^1_\mu, \varepsilon^2$

$\Delta S \neq 2$

$\mu^\pm \nrightarrow e^\pm + \gamma$

$\sigma^+\sigma^- = 0$

$\Delta Q/\Delta S = \pm 1$?

-小川修三氏:

大貫義郎氏: Intermediate charged boson
charged current だけ (lepton) の~~理論~~,
$W^\pm$, W^0?
neutral current (baryon)
$|\Delta I| = \frac{1}{2}$ (non-leptonic process)

井本氏：(Nagoya model)'

市村氏：Oscillator model における Weak interaction

$$\Omega^{(a)} = T^{(\varepsilon)} e^{\Sigma} = T^{(\varepsilon)}(1+\Sigma)$$

$$\Sigma = \alpha a_1 b_2 + \beta a_2^\dagger b_1^\dagger$$

$$\Sigma^2 = 0$$

$$\psi' = V\psi \qquad V^2 = 1$$

$$\left.\begin{aligned} \Lambda' &= \Lambda + \alpha\,\Xi^0 \\ \Sigma^{+\prime} &= \Sigma^+ \\ \Sigma^{0\prime} &= \Sigma^0 + \beta\,\Xi^0 \end{aligned}\right\}$$

$$\Sigma^{-\prime} = \Sigma^- + \sqrt{2}\,\beta\,\Xi^-$$

10年後の高エネ物理学

基研　10.29.1962

午前：山口嘉夫氏

物理と結びつける
加速器からの試験

土地の大きさ　　1キロ平方

? ?

70m　300 GeV?

5年後　　10年後

午後：Segrè

いろいろの反応：

$\bar{\Xi}$:　$p + p \to p + p + \Xi + \bar{\Xi}$

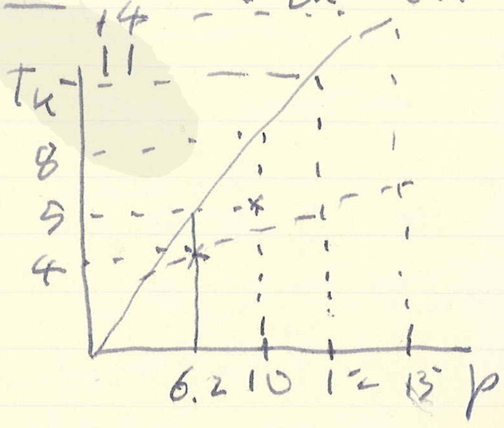
$E_{th} = 9.0$ BeV

$p + p \to p + p + p + \bar{p}$　$E_{th} = 5.6$ BeV

$E_{th} = 1.8$ GeV　$\bar{p} + p \to \Xi + \bar{\Xi}$

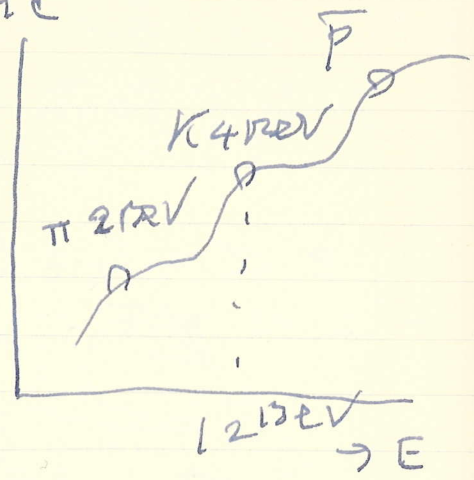
$K^- + p \to \Lambda + \Xi + \bar{\Xi}$　$E_{th} = 6.4$ GeV

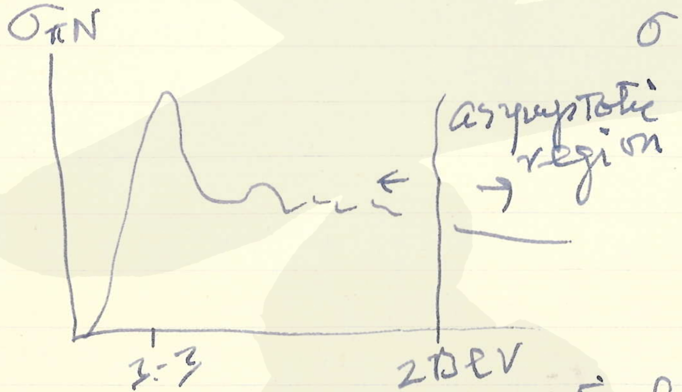
$p + Be \to K^-$

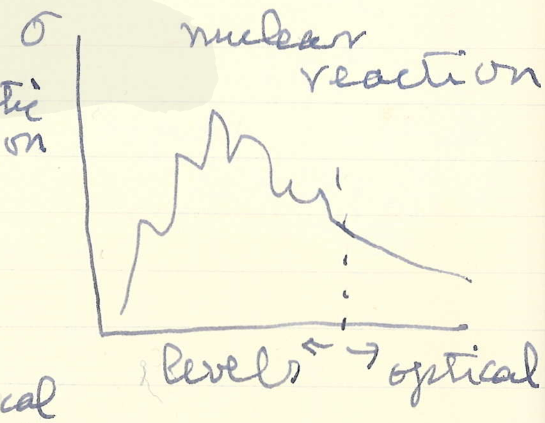


究場氏:

Tı 励起



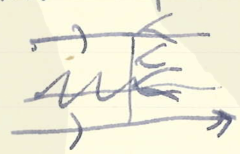




素粒子論

statistical mechanics

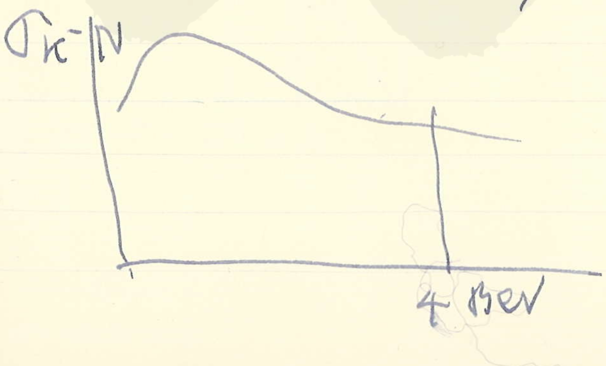
multi-periferal



π : 2 BeV

K : 4 BeV

$\bar{p}$: 2 ?



宮崎氏:
polarization → πN で 5~10 BeV

千円
宮城氏:

5 億円 ○ 10 億円

> 10 GeV ≫ 10 GeV

strong int. は5億円に片付く

TeV までいっても strong int. の information は得られない.

(下)


weak interaction

(P) 1 TeV proton
p → π → μ → ν

(上) 12 GeV で π を作り, 加速する. (10 BeV)
1.4 GeV 60 m
linear acceleration
π±, μ±, ν beam
e± も加速できる.

[illegible]本氏:
シンが[illegible]かも知れません,

小川修三氏:
universal length — dynamics
(new degrees of freedom —)

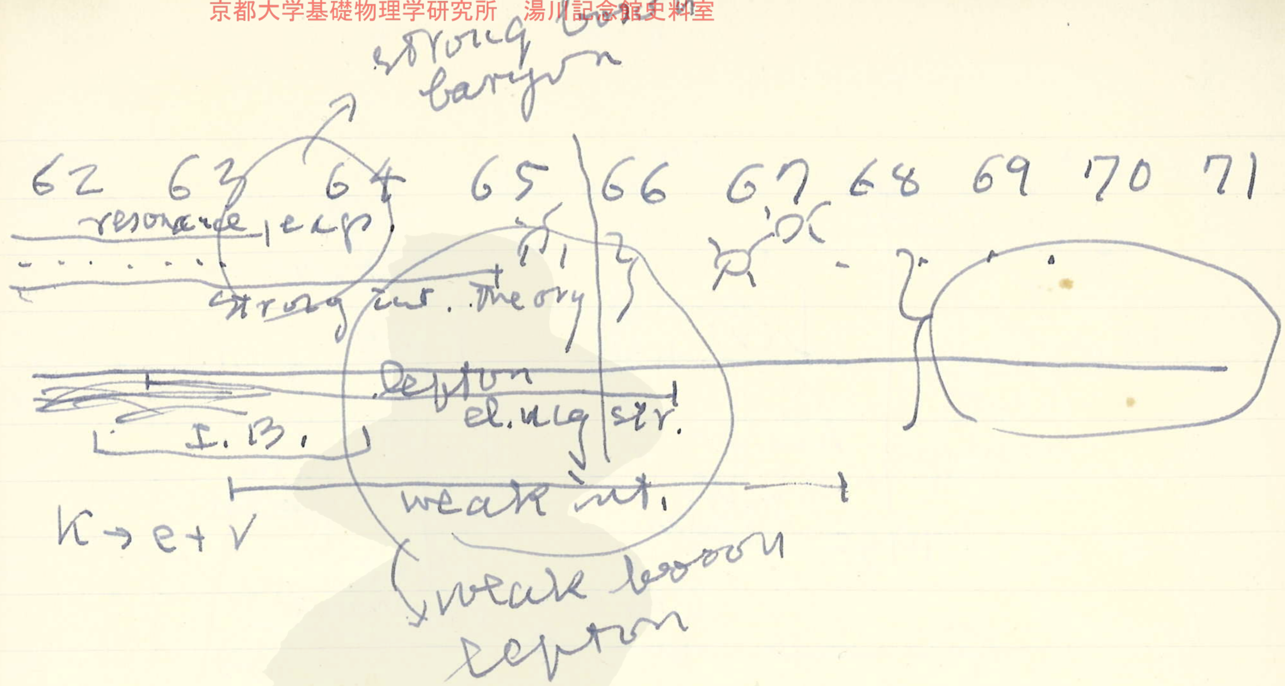
早川氏:
1. 実験:
認識
情報理論

宇宙 ← 物
時空

[illegible]谷氏:
実験 (新しい物 (粒子)
構造
法則

川口氏:
professional になれない
key puncher
spectroscopy
うるおいのない物理

片山氏:
理論 < 3〜5年
実験 < 3

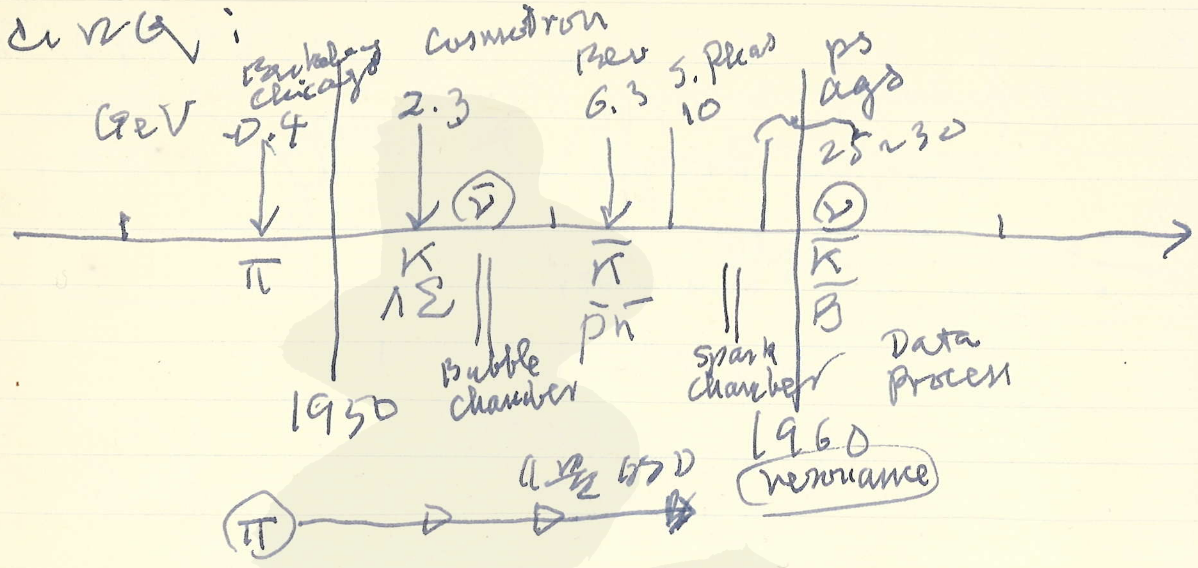


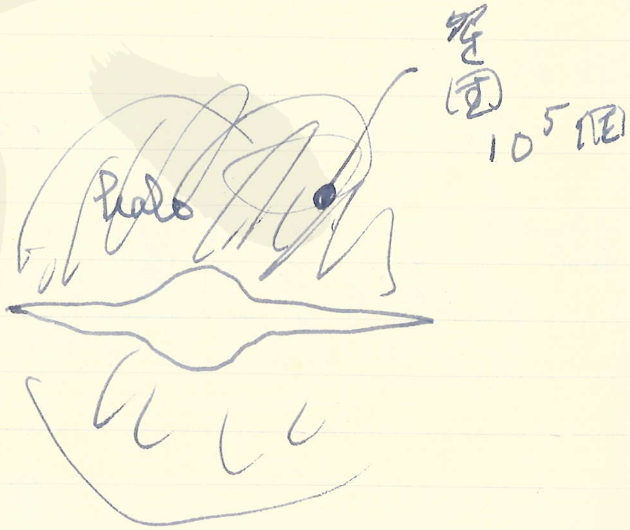
大槻氏:
逆過程に会合をおこす
(eν)(eν̄)

武田氏:
neutrino beam (PS) 20 GeV くらい
が適当がよい.

丸森氏:
原子核距離の構造?

梅沢氏: 分電流の10倍位の相互作用距離
距離の中の異常的なもの,
ここが面白いではないか!

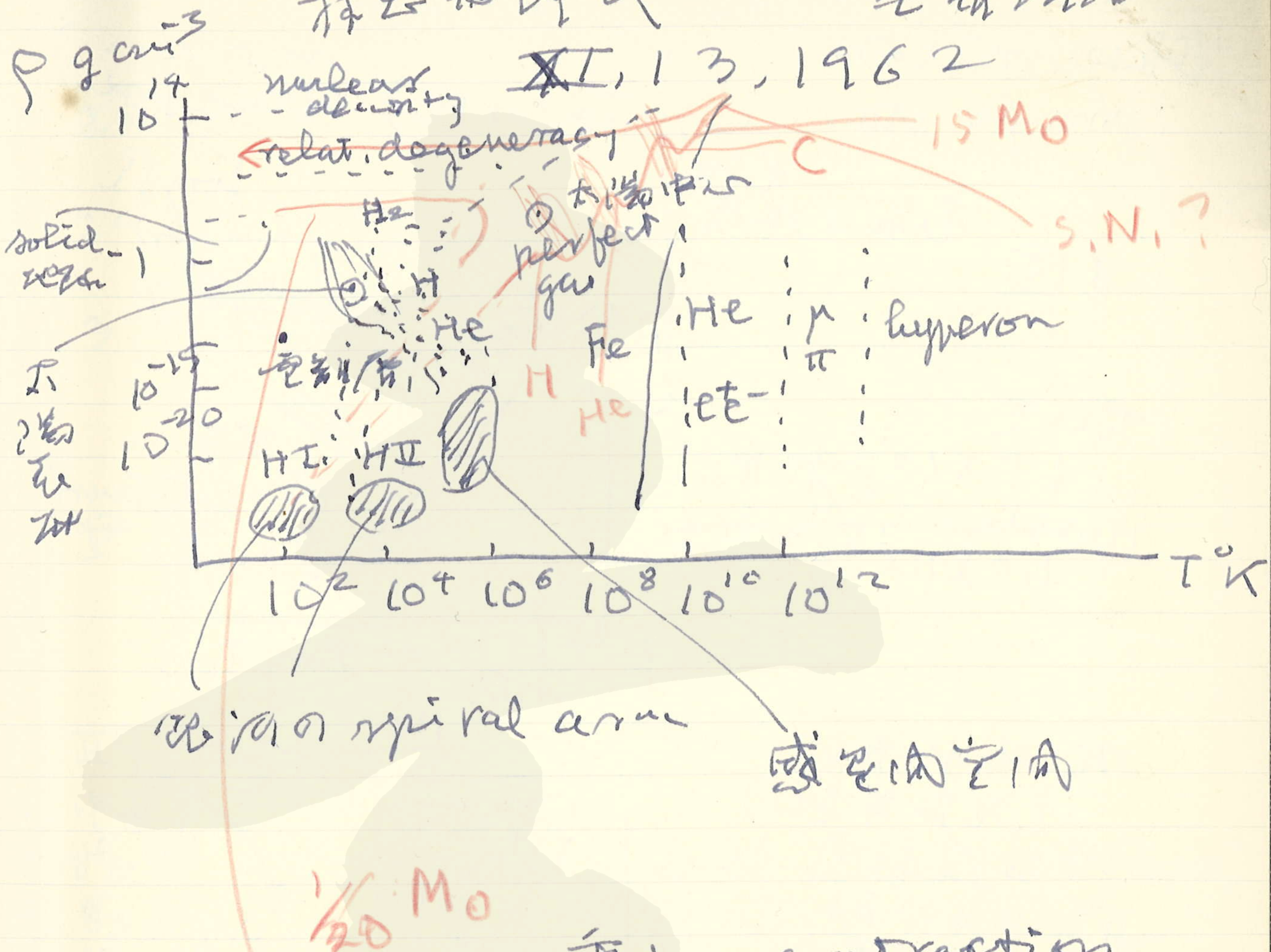

GeV
Berkeley
Chicago
0.4
Cosmotron
2.3
Bev
6.3
10
PS
AGS
25~30
π
K
ΛΣ
K̄
p̄ n̄
K̄
B̄
Bubble chamber
Spark chamber
Data Process
1950
1960
resonance
π


Halo
10^5 個

星の進化と素粒子

林忠四郎氏　　基研談話会

XI, 13, 1962



Energy loss (γ, ν) $\left\{ \begin{array}{l} \text{重力 contraction} \\ \text{核エネルギー 組成の変化} \end{array} \right.$

$\left\{ \begin{array}{l} \text{mass loss} \\ \text{angular momentum} \end{array} \right.$

mixing　convective region

$\left. \begin{array}{l} \text{mass 0.7, 4, 15 M⊙} \\ \text{initial composition} \end{array} \right\}$ で進化の道筋が定まる

Pop I,　X = 0.61　Y = 0.37　Z = 0.02

Pop II,　X = 0.90　Y = 0.10　Z = 0.001

Observation

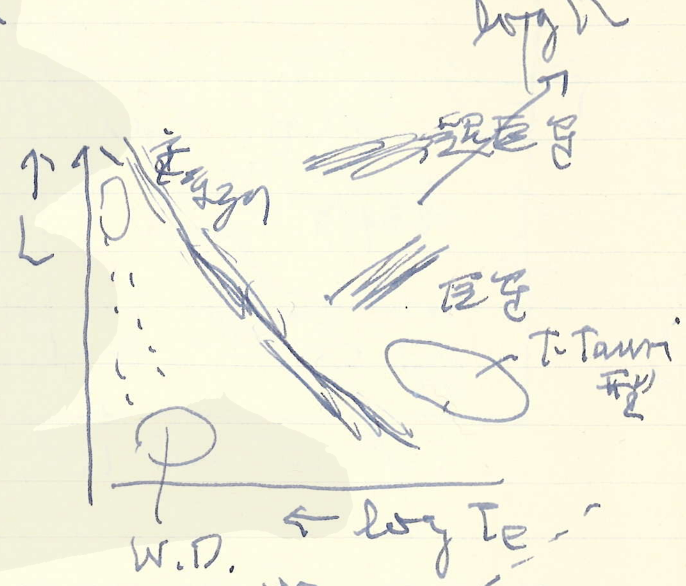
single star L, T_e (or R) (近似的に black body)

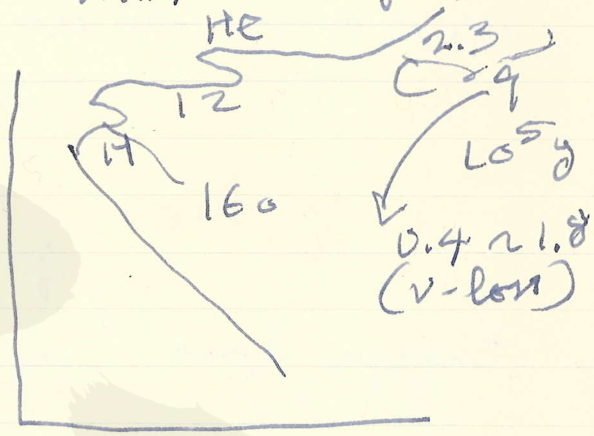
光度
表面の温度

範囲

年令
1.5×10^{10} y

Hubble
1.0×10^{10} y





K: [illegible] 條照.
([illegible])
微分方程式
境界条件にする
energy 生成
neutrino loss

$e^- + \gamma \rightleftarrows e^- + \gamma$
$\rightarrow e^- + \nu + \bar{\nu}$

$2\gamma \rightleftarrows e^+ + e^- \dashrightarrow \nu + \bar{\nu}$

C-C-reaction と ν-loss の競争!!!

$+10^5$ erg/g sec → 光
$+5 \times 10^5$ 〃 → nuclear energy
-4×10^5 〃 → ν

$G(\bar{e}\nu)(\bar{\nu}e)$

c033-696〜703挟込

場の理論研究会
1963年11月28, 29, 30日

28日(木)
29日(金) Plenary (I) Session
30日(土) Plenary (II) Session

(I) 梅沢　小沼 [illegible]
(II) 中野　~~井上~~ 7にきめる

12時半 〜 1時半

(II)
1) 中野　Rotator
5) [illegible]　Rotator の level scheme (＊Regge)
4) 若林　励起スペクトル 内山・[illegible]など
2) 湯川　Rotator model の一例
3) 内山　上例による Weak Interaction
3) 中村　中村理論、non-leptonic Weak Int.
4) 町田・~~[illegible]~~　weak interaction
1) 小沼・島・和田.　Sp lie代数と素粒子模型
2) 玉垣　Broken symmetry をもつ内部空間
5) 片山　~~minimal coupling~~ Interaction (Weak の)
6) 原　Rotator model に対する Comment
7) [illegible]　Regge Pole
(問題：ゲージ　Regge pole
higher spin　indefinite metric)
8) [illegible]　Weak int. のまとめ
[illegible]

28日 午前；

中野：Rotator

$\uparrow\uparrow\uparrow - \longrightarrow \uparrow\uparrow\uparrow\uparrow$　解析接続

inhomogeneous Lorentz transformation

の表現 → unitary (trick を使う)

$I = K$ [但し mass is no zero]

28日 午後；

湯川：Rotator Model の一般

i) $J = I$

$\pi + \varsigma + \mathrm{II}$

$J,\ J_3,\ J_3$

ii) $a_\mu^4 \neq u_\mu$　$a_\mu^4 \propto p_\mu$

片山：Weak Interaction

W_μ　$I + S = 1/2$

$t + s = 1/2$

坂本：mass formulae

(i) 経験 Rule

(i)' m^2

(ii) Term

(iii) 等比級数

$$\begin{array}{ccccccc} \eta & \omega & \Lambda & \quad & N & \Lambda & \Xi \\ 1 & \sqrt{2} & 2 & & 1 & \sqrt[4]{2} & \sqrt{2} \end{array}$$

$$m_{ps}^2(n_1, n_2) = m_\eta^2\left(1 - A(n_1+n_2)^2\right)$$

η (0 0)	4	$A = \frac{1}{4}(1 - \ell^2)$
$K\binom{0\,1}{1\,0}$	$7/2$	
π (1 1)	1	$\ell = \frac{1}{4}$

福留：Rotator
李頌　1962年12月号
x^μ, $A^\mu{}_\alpha$; $A^\mu{}_4 = U^\mu$
$x^\mu(\tau)$, $A^\mu{}_\alpha(\tau)$
$\tau = f(x^4)$

29日午前
梅沢：Session I の報告.
axiomatic Formulation
asymptotic に free につながるか？
荒木・加藤.
江沢.
神谷(strong 相互)：
Bound state
1) Regge pole
spin が energy と共に変わる.
2) 無限の composite (Z=0) は Regge でない. 従って elementary に近い.
尚 photon の場合は spin が energy と共にあまり変らない様子らしい.

中野：Session II の報告.
問題点 i) Gauge
ii) Regge pole
iii) Higher spin
iv) Indefinite metric

29日 午後

係：Rotator model に対する Comment

Interaction → nonlinear

結論：

$$H = (\bar{\Psi}\gamma_\mu\Psi)^2 \varepsilon (\bar{\Psi}\gamma_5\gamma_\mu\Psi)^2$$

Pauli-Gürsey → 西村君.

∵ frame のとり方によるのは当然.

小沼：Lie代数と素粒子構造

定義：素粒子の matrix の代数,

or 有限次元の linear space $\mathfrak{g}$

の元 element X, Y

$$[X, Y] \subset \mathfrak{g}$$

(i) $[\mathfrak{g}, \mathfrak{g}] = \mathfrak{g}$ → semi ~~sp~~ simple Lie ~~g~~ algebra

(ii) $[\mathfrak{g}, \mathfrak{g}] = \mathfrak{g}^{(1)} \subset \mathfrak{g}$　　SU(3)

$[\mathfrak{g}^{(i)}, \mathfrak{g}^{(i)}] = 0$　　or $\mathfrak{g}^{(i)}$ → U(3)

↓

solvable ← SO(3)×SO(3)

semi simple

A_n　$SL(n+1) \to SU(n+1)$

B_n　$O(2n+1)$

C_n　$Sp(n)$

$D_n (n \geq 3)$　$O(2n) \to SO(2n)$

E

F　5

G. → G_2

表現の base

N成分 ψ

同時に対角化できる(linear operator) その

$H_i \quad i=1,\cdots r \qquad r$: rank

$E_\alpha \quad l-r \qquad l$: Lie 群の次元

$H_i \psi = \cancel{x_i \psi}\ \lambda_i \psi$

$\Lambda = (\lambda_1, \cdots \lambda_r)$: weight

$SU_3(3) \to$ rank 2 isospin, strangeness

$U(3) \Rightarrow I + SU(3)$ $2 \to 3$

baryon-number

rank 2: $A_2,\ B_2 = C_2,\ G_2$

$\boxed{\begin{array}{l}\text{rank 3: } B_3 = O(7) \\ \quad C_3 = Sp(3) \\ \quad A_3 = SU(4) = D_3\end{array}}$

(注: $A_1 = B_1 = C_1 = D_1$)

$B\bar{B}$, $L\bar{L}$ 組成成分 $\Rightarrow$ 表現空間の次元

$D_A^4,\ D_A^6,\ D_B^8,\ D_C^6$

$\Lambda p n$

$\bar{\Lambda}\bar{p}\bar{n}$

Lepton

$SU(4)$ $O(7)$ $Sp(3)$

SU(4)
Sp(3)

	I	S	13
Λ	0	-1	±1
N	1/2	0	±1

D^{15}
D^{20}) 2組、

D^{15}

$K\bar{K}$	1/2	±1	0
π'	1	0	0
π_0', π_0''	0	0	0
(ΛN)	1/2	-1	±2
(NN)	0	0	±2

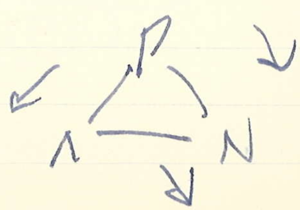
D^{20}

$K\bar{K}$	1/2	±1	0
π'	1	0	0
π_0'	0	0	0
NN	1	0	±2
ΛN	1/2	-1	±2
$\Lambda\Lambda$	0	-2	±2

3組で三がでにく…

O(7): 35次元

武谷: comment
対称性を flexible
に考える。



概要：Broken Symmetry をふくむ内部空間

I. kinematics {微分幾何 / 連続則} 空間

dynamics

Minkowski 空間 P_μ, $M_{\mu\nu}$
荷電空間 I_i
broken symmetry
$[I_i, H] \neq 0$

空間 {holonom (平坦) ⇄ Lie 代数,
non holonom (曲)

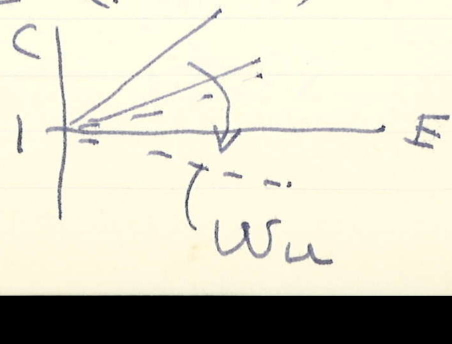
II. ~~荷電空間~~ 拡張空間,
= 複素 complex 空間.

III. Broken symmetry
parity の保存.

実験：β-ray の報告.
RaE　CVC　$\pi^+ \to \pi^0 + e^+ + \nu$

B^{12}　N^{12}
$\underline{15\,\text{MeV}}$　e^-　e^+
C^{12}

$C = (1 \pm aE) \leftarrow e^\mp$



Pm^{148} : 京研で実験

Langer Effect: G.T.

$$C = 1 + \frac{b}{E} \qquad e^{\pm}$$

spin 3/2 neutrino X

Fierz X

intermediate boson X

V−A+P X

2nd forbidden の effect x

neutrino に mass のあるものをまじる X

$N \to p + e^- + \bar{\nu} + \nu + \bar{\nu}$ がまじる x

$N \to p + e^- + \bar{\nu}$ + Bose neutrino ?

or K.U.

阪田

γ soft

Wu は認めず.

数値は認める shake off electron

中村 : Symmetry - Weak Int.

$$R_3 \times R_3 \times R_3$$
$$\tau \qquad \zeta \qquad \kappa$$

$$\Xi^- + p \to \Lambda + \Lambda$$

30日 午前

述来： Session I の報告.

Bound state (elementary & composite)

梅沢

Regge behavior は conventional field theory から出るか？

福留

田中正

Resonance　multichannel

藤井

Particle mixture → asymptotic condition

尾崎

Proper time formulation

江沢

報告

梅沢：　H-op

$$\text{complete}\left\{\begin{array}{l} A_1(t) \xrightarrow{t \to \pm\infty} A_1^{\text{out/in}} \\ A_2(t) \longrightarrow \\ \vdots \\ A_N(t) \longrightarrow A_N^{\text{out/in}} \end{array}\right.$$

incomplete

complete

composite particle B_1, ⋮

$|A_i\rangle$ 　　　　　　　$|B_i\rangle\rangle$

$|$ 無 $\rangle$　無…無　　　$|$ 無 $\rangle\rangle$

$$\langle\langle \underset{\sim}{l} | \underset{\sim}{k}; {}^{in}_{out} \rangle\rangle = \delta_{lk} - \lim_{\varepsilon\to 0} \frac{T(\omega_l|\omega_k; in)}{\omega_l - \omega_k \pm i\varepsilon}$$

$$\langle\langle B_i | \underset{\sim}{k} \rangle\rangle = 0$$

$$\langle\langle B_i | A_j \rangle = 0$$

b.s. と c.p. は同じか違うか?

unstable composite particle?

例えば: Regge behavior ← c.f.t.

2体 Green 函数

$$[D_1 D_2 + K_{12}] G = 1$$

$$[D_1 D_2 + K_{12}] \Psi = \lambda \Psi$$

$$G = \sum \frac{\Lambda_n \Psi_{lmn} \Psi^*_{lmn}}{\lambda_n(E,l)}$$

$$S = \sum_l (2l+1) P_l(\cos\theta) \sum_n \frac{|\Phi_n(E,l)|^2}{\lambda_n(E,l)}$$

$$\Phi_n = \lim_{\text{mass shell}} D_1 D_2 \chi_{nl}$$

$$\Lambda_n(E,l) = 0 \quad \text{b.s.}$$

analyticity が問題?

以下:

field theory から Regge behavior が出そうだという論文がいくつかある.

Pomeranchuk line?

$$+\quad S(s,t) \xrightarrow[s\to\infty]{} \sum_G g_G(t)\, s^{\omega(G)} \left(\log \frac{s}{\lambda}\right)^{n(G,t)}$$

第1種相互作用

Regge: $s^{\alpha(t)} = e^{\alpha \log s}$

$$= \sum_n \frac{1}{n!} \alpha^n(t) (\log s)^n$$

× Regge behavior は 第1種相互作用の特徴ではないか.

~~ある~~ Regge ならば 第1種.

特徴: multichannel → resonance

Y_0^* 　 $\pi\Sigma$, $\bar{K}N$

大要: particle mixture

$\psi_A \to \psi_A^a$ 　 × ← particle mixture

$\psi_i = \sum_j a_{ji} \psi_i^r$

unstable particle?

[illegible]

{ b. s. の定義

{ b. s. (c. p.) への approach

unstable composite

{ c. f. t. → Regge behavior ?

{ Pomeranchuk line ?

axiomatic approach

1) weak limit ?

2) axiom の相互関係

3) axiom を満す field theory の存在 ?

4) 素粒子論の形式での axiomatic

(formulation (non-locality)

(S-matrix

[illegible]: Session II の報告.

片山: 強さ,

中間理論,

Ξ $\alpha > 0$

$\Lambda \to p$ $\alpha < 0$

$\Sigma^+ \to p$ $\alpha > 0$

$\Sigma^- \to n$ $\alpha = 0$

$\tau + \gamma_5 \xi$ S, T.

derivative coupling $f_S = f_T$

30日 午後

[illegible]: plasma oscillation → (el, pos.) bound state → imaginary ~~freq~~ frequency

$$\delta j_\mu = G\left(\delta_{\mu\nu} - \frac{q_\mu q_\nu}{q^2}\right) A_\nu$$

$G \to \infty$

gage invariant

山内: conjecture

π, K: Regge → weak is non-local

高山: 総論

{ Hamiltonian formalism
S-matrix theory { Regge, Dispersion, Mandelstam

Off-shell unitarity condition は Schrödinger と equivalent ?

Takahashi

[illegible]談話会 Feb. 1, 1963

Heitler
Arnous
O'Raifeartaigh
Takahashi

1953 non-local interaction
Pais-Uhlenbeck
Lorentz invariance → ~~[illegible]~~

[illegible] chew-low
1959 non-local interaction

$$\delta m(p) = \delta m(0) \cancel{+ \frac{\vec{p}^2}{m}} - \frac{3m}{2\pi \cdot 137}\frac{2}{3}\frac{\vec{p}^2}{m^2}$$

$$+ \cdots$$

Arnous

$$i\frac{d}{d\tau}\Psi(\tau) = H(\tau)\Psi(\tau)$$

Relativistic Invariance

$$H(\tau) = \int_{-\infty}^{+\infty} d^4x\, \mathcal{H}(x)\,\delta(nx+\tau)$$

$$n \to (0,0,0,1) \to = \int d^3x\, \mathcal{H}(x)$$

S-matrix が rel. inv. になるように

form factor をとれるか?
Heitler: form factor

$$f(k', k'', k''') = \frac{\lambda^4}{\lambda^4 + (k'k'')^2 - (k'k')(k''k'')}$$

$$\langle H_0 + H' \rangle = E_p + \delta E_p$$

$$= \sqrt{\vec{p}^2 + (m + \delta m)^2}$$

$$\delta m_{e^2} = \frac{3m}{2\pi \cdot 137}\left[\log\left(\frac{3K}{m}\right) - \frac{1}{6} - \frac{3}{2}\frac{\vec{p}^2}{m^2} + \cdots\right]$$

$$m^2 K^2 = \lambda^4$$

$$\delta m_{e^2} = \delta m(0)\left[1 + \frac{1}{72}\frac{p^2}{m^2}\right]$$

K = nucleon mass

$$\delta m(p) \xrightarrow[p \to \infty]{} 0$$

$$\delta m(0) \neq 0$$

~~Bell : 実験~~

O'Raifeartaigh : Gauge Invariance

1962 : J. S. Bell ; N. C. <u>24</u>(1962), 554

$$(\delta m + m)^2 = \frac{E^2}{c^4} - \frac{p^2}{c^2}$$

$$\delta m + m = m(0) - b\,\frac{\vec{p}^2}{2m(0)c^2} + \cdots$$

理論 : $b = 0.001$

実験 : $b = 0 \pm 0.0001$

or $b = 0.0002 \pm 0.0002$

演題：神経のモデル　　学術談話会

Feb. 5, 1963

Galvani
電気生理学
Hodgkin-Huxley

wet model

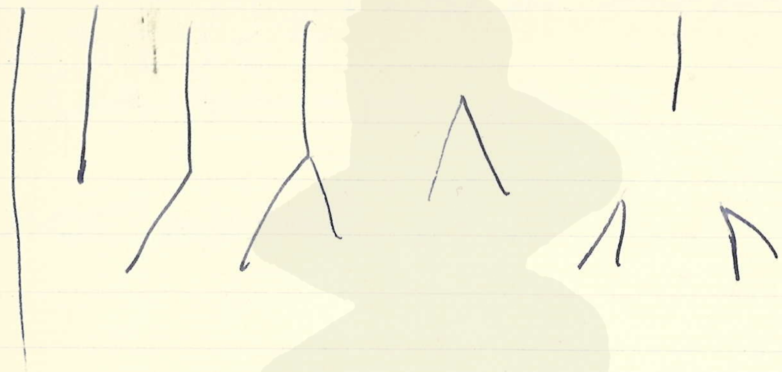
L. I. Schiff
Informal Talk

基研
Feb. 8, 1963

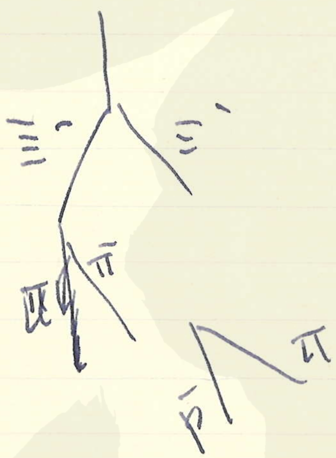
Variational Method in Q.F.T.

国際協議研究会　2月22日
1963

三浦: high energy physics における data 処理

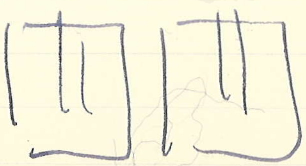


pulse　3 sec に 1 回　(CERN)
24 hr → 30,000 枚
100 日 → 300万枚



Brookhaven 2.4 sec に 1 回.

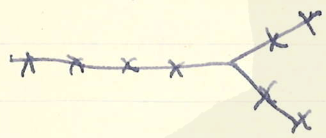
新しい方法:



1分に 1枚. (1 event)
→ 2〜3分

{Frankenstein
IEP

track の足跡を読んでゆく



Teletype の tape に
記録.

1 event ≃ 10分

従来で 15分位かかる

Computor:
曲率 → ± charge, momentum
θ, φ, x, y
どの hypothesis が most fittable か
computor できめる.

CERN 709) 数秒
米 7094

Berkeley の program　　MIST → FOG geometry
→ CLOUD　statistics　　FANG
→ kinematic → FAIR
→ KICK → EXAM, SUMX

CERN の program
REAP → THRESH → GRIND → COOK

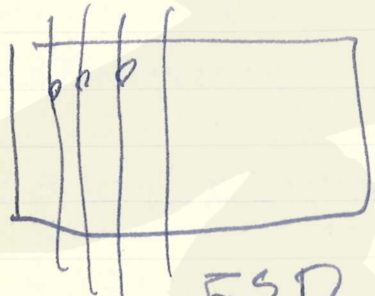
Alvarez: SMP
background ~~写~~ 写真に写し 足跡写真 ~~[illegible]~~ を 9か
がして track を読む
3分間

図形認識

(a) ① differential な認識
② integral な認識

① 正しい図形認識
② 難しいものを仕分けできるか?
③ 早さ

DD　FSD (flying spot device)
Hough, Powell　HPD
光の spot を走らす.　(20μ の sharpness)
bubbleの大きさ ~ 20μ



209
7090

FSD

(magnetic tape)
8 cm の film で 2 sec で記憶装置
へ入れられる.
~15 sec
road　HAZE → 以外の記録は
computer が忘れてしまう

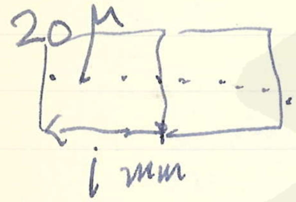
with external gating (人間がやる)

記録の error : ±1μ (film上で)

1個 ~ 2分. (実測で)
かかる.

FSD {CERN BNL Berk} → Rubinovitch (Illinois)

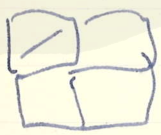
Rabinovitz, Pasta, Marr
FSD-PMR
最初の3点を機械的, それから先は
つないでゆく。



1 mm x 1 mm の図形を magnetic tape にしまう
60 mm x 60 mm → 3600 cell

30 sec

PEPR (precision encorder pattern recognition) (MIT, Pless)
① flying line scanning



20〜30 sec

			年間 10^6 event. scan	proje
1 event:	Frank	> 15分	8人	3台
	FSD-EXT.GAT	〜 2分	24人	8台
	PMSMP →	〜 3分	24人	8台
	FSD-PMR	〜 1/2分	0	0
	PEPR	〜 1/2分	0	0

10^6 [illegible]:
[illegible]
→ 80人 30台
4人
0
4
4

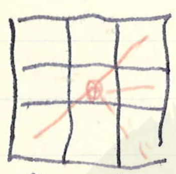
(計算機こみ)

PEPR 40万ドル 1960 →
FSD CERN ~10 数万 1960 →
Berk. 22
BNL 30
(Frank. 10
IEP 15

IBM 709 12 μ sec
7090 2 μ sec
7094 4/3 μ sec

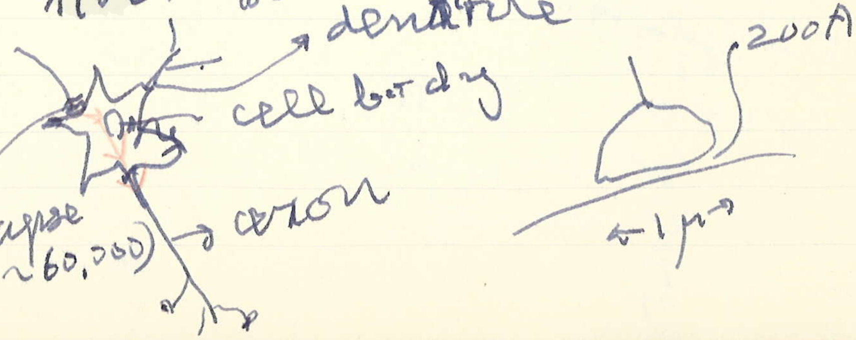
300 GEV

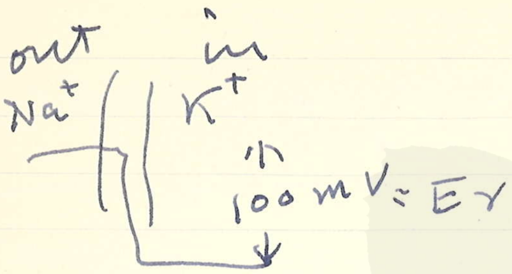
午後:
坂井: 機械による認字.
計算機に図形を入れる. → 出来.
出来でない case
指紋
認字 連続性
invariant parameter

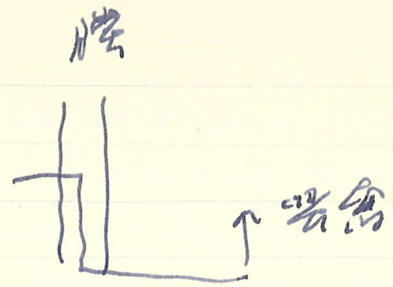


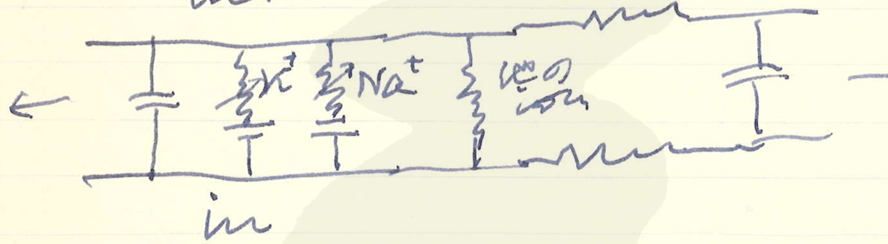
最小 cell 3×3
骨組をひき出す. 太り方
太さ → 細くする.
abcd → a b c d 可逆性 (的索引と違う)

福島: 生物における Pattern Recognition
top
bottom
神経細胞

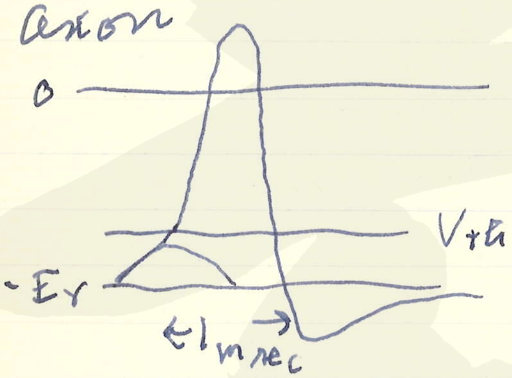






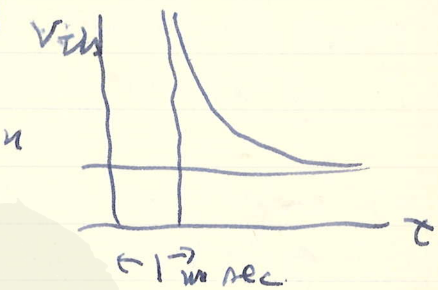


i) axon



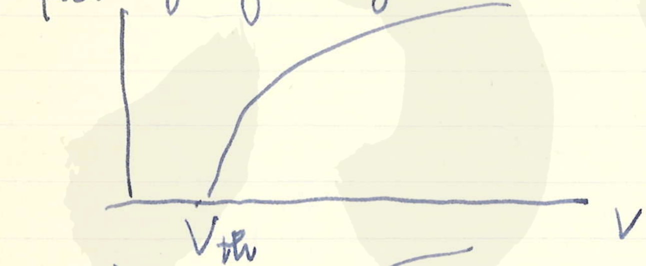
(1) Vth 以上になると pulse の形は一定
all or nothing
regenerative

(2) refractory period



いかの giant axon

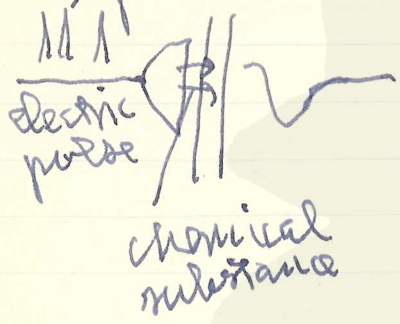
(3) frequency modulation



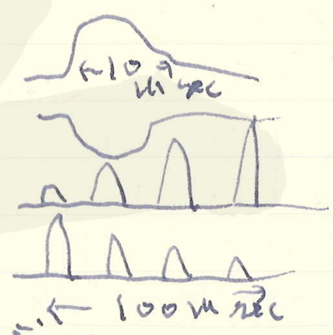
ii) soma-dendrite

1) no threshold, graded

→ passive (damping)



2) excitatory
Inhibitory
Incremental
Decremental

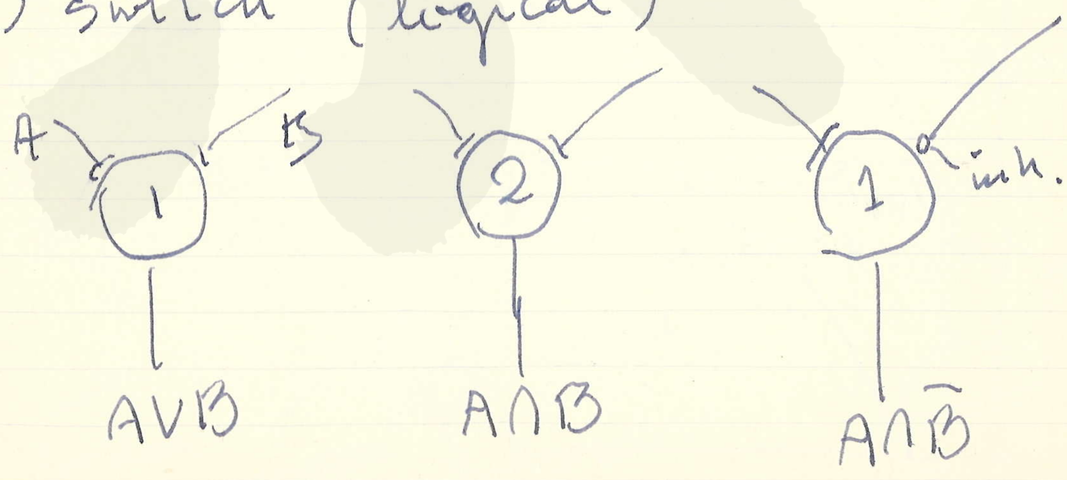


) 細分的
) 積分的

3) space summation
Time summation

pace maker
心臓の神経細胞

(i) information の[illegible] : analog
(ii) switch (logical)



(iii) many grid valve

---

memory　　1.4×10^{10} cells

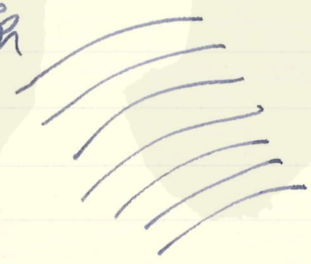
(i) synapse の透過性の change
(ii) synapse 間の interaction による
　透過性 change　(条件反射)
(iii) Formation of new synapses
　神経細胞は成長できる.
　新らしい connection ができる.
　成体は分裂が少ない, 下等動物も少ない.

delicacy ?

(iv) 蛋白合成が盛ん. 当然的に増大.
　核酸の base の pattern として覚えられる.
　(RNA 分子?)

神経系

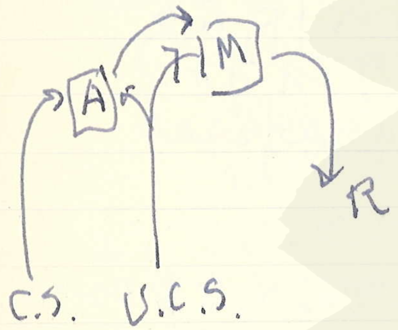
大脳皮質



6層が分化してる

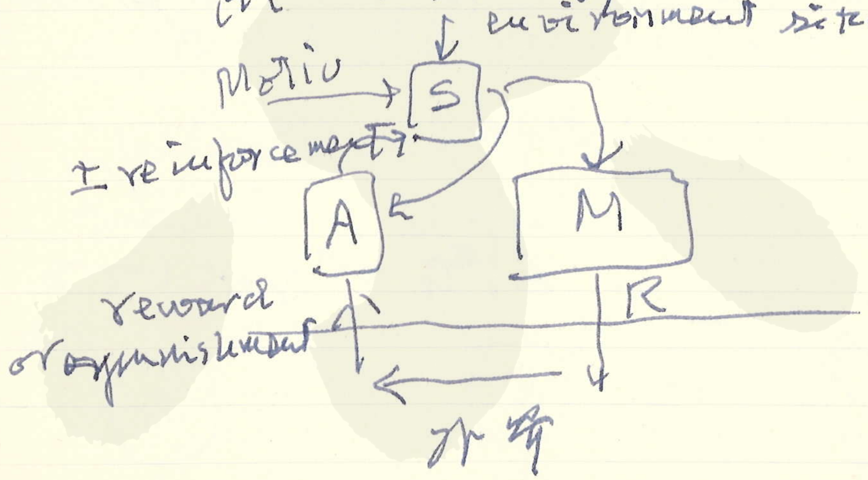
細かく見れば statistical
生長・変化し得る.

Conditioned Reflex　　　動物は言語の法則
black ~~to~~ box
i) 無条件反射
条件反射　　　外界から意味あるものを
抽出.



ii) 第2次反射
第2次信号
iii) 制止
消去
条件制止
遅滞 → 催眠術
分化制止
汎化

Operand conditioning
うろうろやって食物を求める。一種の
手さぐり言語
trial and error
鳩がボタンを押して食物をとる



心理研 : ~~Papa~~ PAPA Machine
Automatic Programmer
& Probability Analyzer
A. Gama, Genova

Maximum likelyhood test

E_i 1, 0

F_j object class

P_{ij}

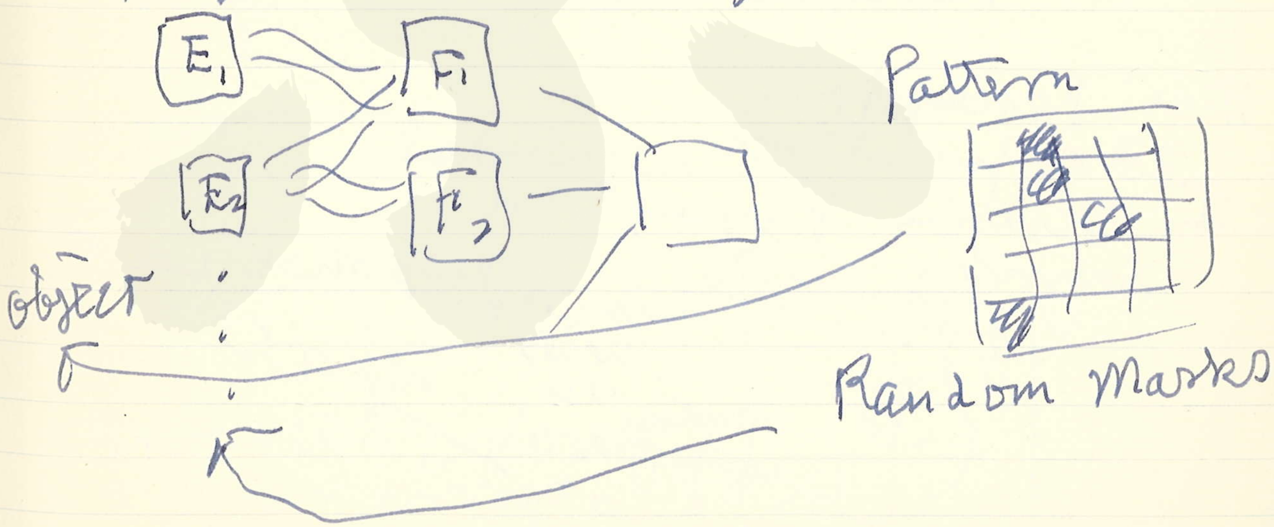
Assumption : $F_j \to E_i = 1$ or 0
排他事象

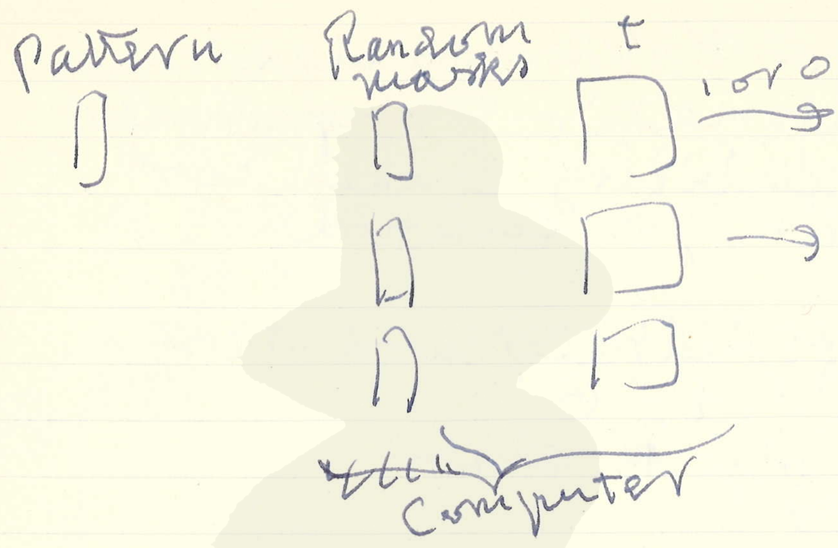
ϕ_j object が F_j に属する確率

$V = \{E_i = 1\}$ character

$$P_r(F_j, V) = P_r(V) P_r(F_j/V)$$
$$= \phi_j P_r(V/F_j)$$

Bayes net $P_r(F_j)$



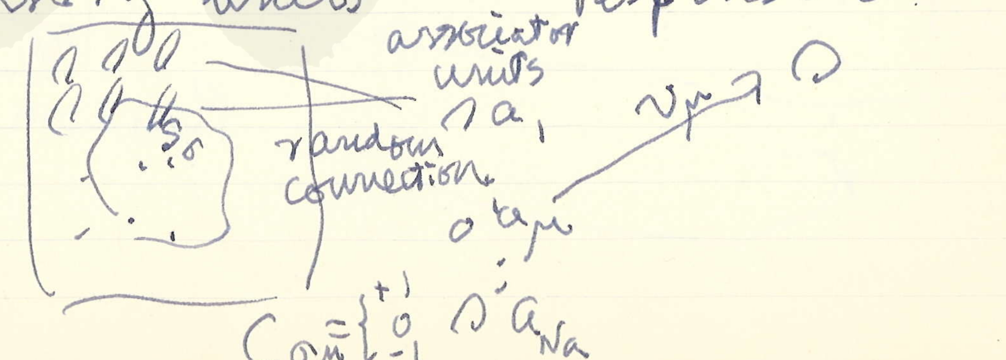


all purpose
mask の orthogonal set
$N = n^2 \gg 1$　([illegible] は orthogonal

[illegible]:

new PARA
Optimization
Pascal's line

木山: Perceptron
I. 脳の function の model
Simple Perceptron
sensory units　response unit



$\sum_\sigma C_{\sigma\mu} \geq \Theta$ なら v_μ から signal

$\sum v_\mu > \Theta \to +1$　　$\Theta > 0$

$< -\Theta \to -1$

response

mark 1　s.u.　20×20
Na = 512
response : 8

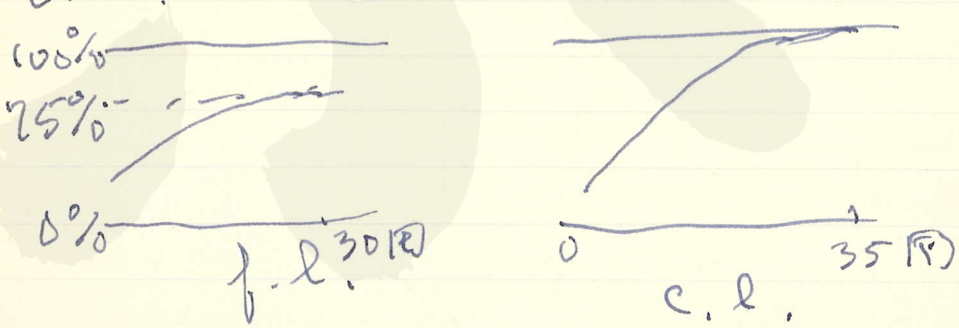
2. Learning by error correction
$v \to v + \eta_\mu f_i$

3. Forced learning

4. Generalization

5. Psychological Test
8文字

f.l.
c.l.



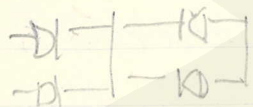
汚れてる図形 (noisy)
trainer error 30%

II. 4-layer perceptron

$$S - A^{I} - A^{II} - R$$

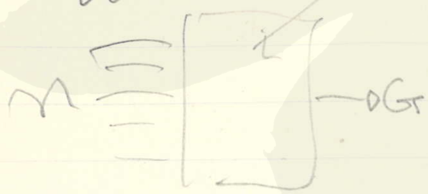
ν_μ

2月23日.
午前
後藤英一: Pattern recognitionの論理回路
論理函数

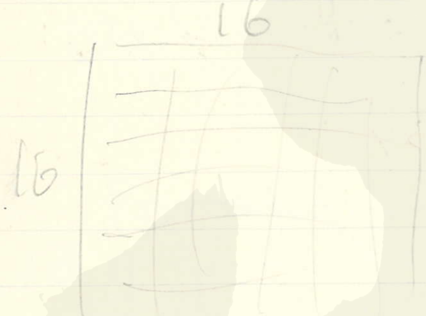


and, or

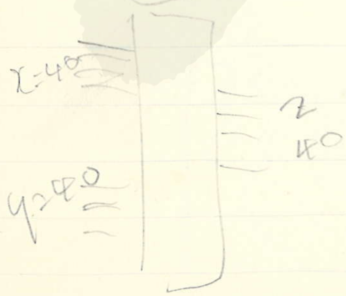
diode d本 $\frac{2^n}{n} \gtrsim d \geq \frac{2^n}{n}$



分解法
$\sqrt{2^n} \lesssim m \lesssim \sqrt[3]{2^n}$



256の論理函数.
2^{256}



G_{80} $\frac{2^{80}}{80}$ 個 diode

Computer の speed

例題. e を 1000桁まで計算.

$$e = \sum_{n=0}^{500} \frac{1}{n!} \quad \left(\left(\left(\frac{1}{500}+1\right)\frac{1}{499}+1\right)\frac{1}{498}+1+\cdots\right)$$

AU　　$n \times m$: $5mn$ AU

　　　$n \div m$: $5mn$ AU

計算量　7,500,000 AU

HSC : 10^6 AU/sec　　7,5 sec

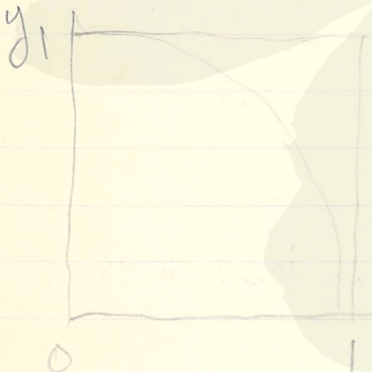
~~MAN~~ Brain : 10 AU/sec　　200 hr.

計算手の数をふやしても、早くはできない

計算の例: Logical Depth の深い計算問題で

計算機に適している

monte carlo 法: 乱数.



(x_i, y_i)　　N

$x_i^2 + y_i^2 \leq 1$　　n

$E\left(\frac{n}{N}\right) = \frac{\pi}{4}$　結果 logical depth 300

10^6 個　π

$3 \cdot 10^8$ AU

HSC 300 sec

MAN 8000 hr

100万人の計算手から 30 sec

人海作戦.

脳　10^{10} neuron

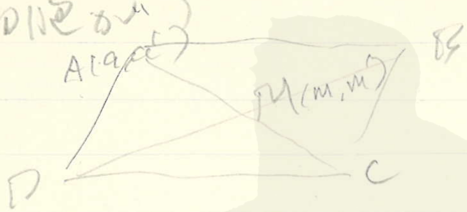
1 neuron = 1 Transitor

10^3 TU/sec　　10^6 TU/sec

Brain　10^{13} TU/sec ; HSC $10^5 \times 10^6$

$= 10^{11}$ TU/sec

parallel に働けるかどうか → pattern recog.
脳細胞が



合同は三角形の数, → pattern recognition
人間：数秒
計算機：
$_5C_3 = 10$
$_{10}C_2 = 45$ $45 \times 6 = 270$
400,000 AU → 0.4 sec

定理の証明 → pattern recognition

大槻：computerによる作曲
1、音楽を聞く {a) 判断基準を作る(する) / b) 基準を使って分類し、経験を集積
2、作る 経験 → 乱数
3、役割.

① 平均値を出す ② 周期 ③ max, min
④ 乱数. {一様乱数 / 経験度に比例した確率で出る乱数

後藤氏 magnetic monopole
MIT.
Dirac 1931. ('48)

$\pm ne$, $\pm ng$

$$\frac{eg}{\hbar c} = \frac{1}{2} \qquad g = \frac{\text{"}137\text{"}}{2} e$$

電磁場の角運動量 (Wilson)

$$\frac{eg}{c} = \frac{\hbar}{2}$$

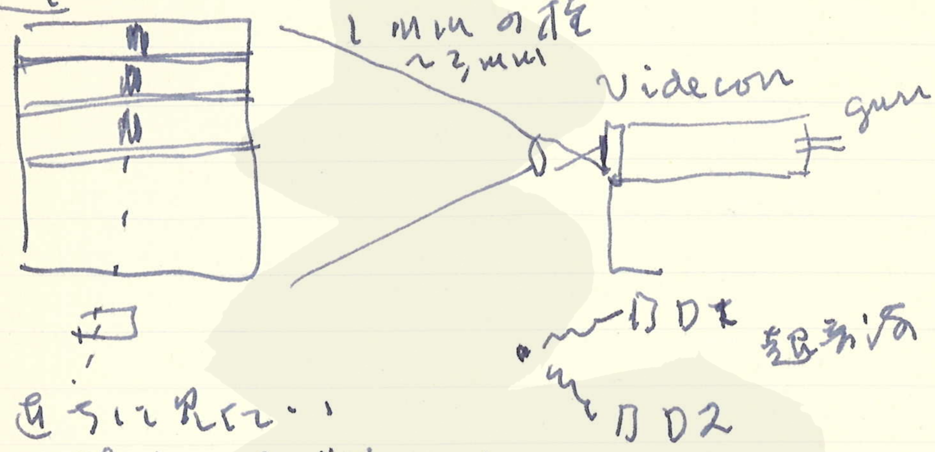
e E g H

$$M_0 = \left(\frac{g^2}{e^2}\right) m = 2.4\ \mathrm{BeV}$$

1958 6 BeV Berkeley
1961~62 30 BeV BNL CERN
$\sigma \leqq 10^{-40}\ \mathrm{cm}^2$

Cosmic ray
1951 Malkus: $< 10^{-10}$ monopole/$\mathrm{cm}^2 \cdot \mathrm{sec}$
1963? (後藤(MIT)) (Kolm, Ford) $< 10^{-13}$ 〃
Fe_3O_4 (Magnetite)
濃縮.

討論:
梶川: 放電箱の自動記録
写真を除く.

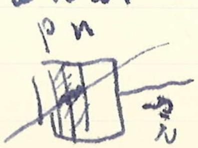


① 直ちに見たい
② 再現して目で見たい.

大槻: 2次元 pattern の noise の除去

西尾(京大工. 化学技術): ' '
田盛図の手帖が standard figures
柴田: 核研電気センターの data process
INS-1: 2048 words 200 μ
1 process: 2~3分

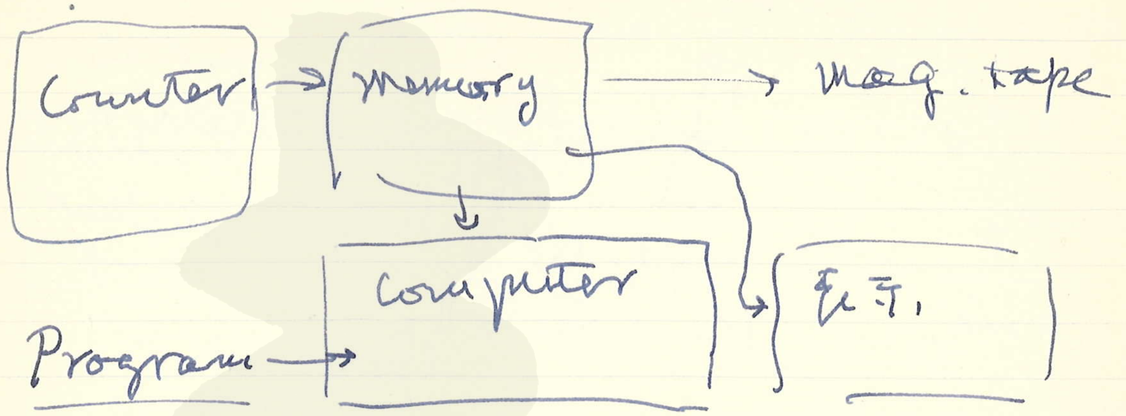
亀井: ~~核研~~ counter を使った時の data processing
核研シンクロトロン
DEAR (CERN)
Berkeley $\pi^- + p \to \pi^+ + \pi^- + n$
林: Proton synchrotron の counter ~~circuit~~ system
① solid detector Si



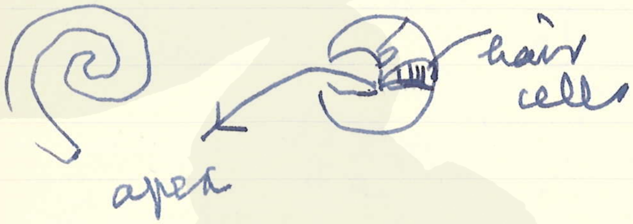
小型

1000個位)

(2)

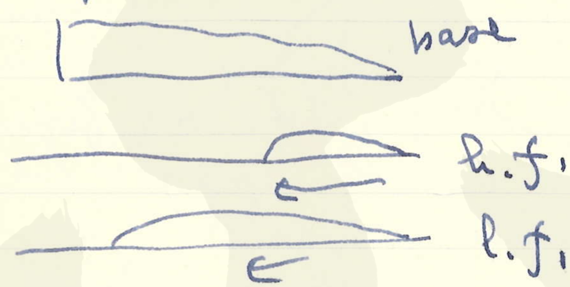


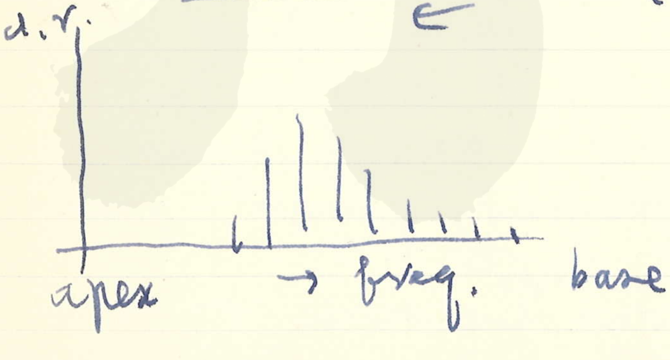
細胞：聴覚
神経繊維：2〜3万　(視覚 100万)

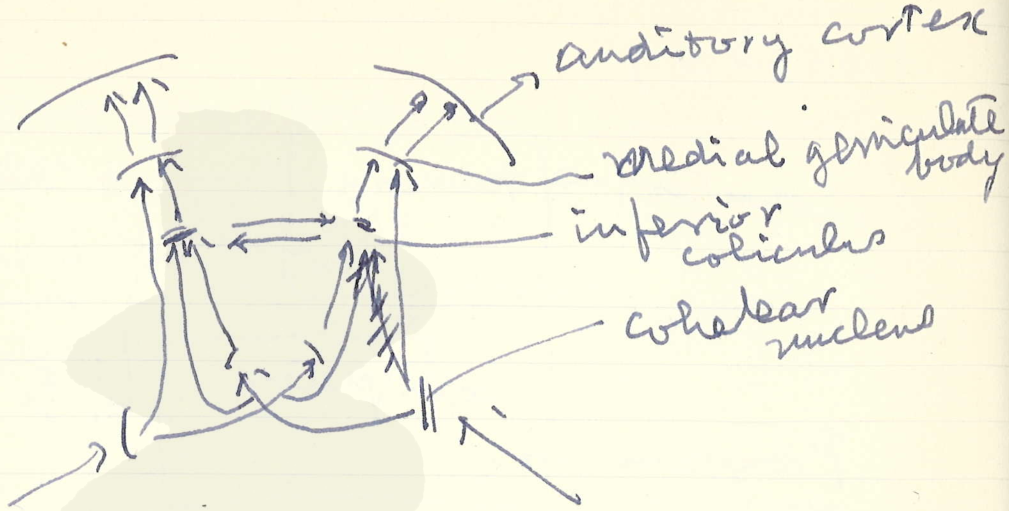


torsion
→ 電位変化

膜



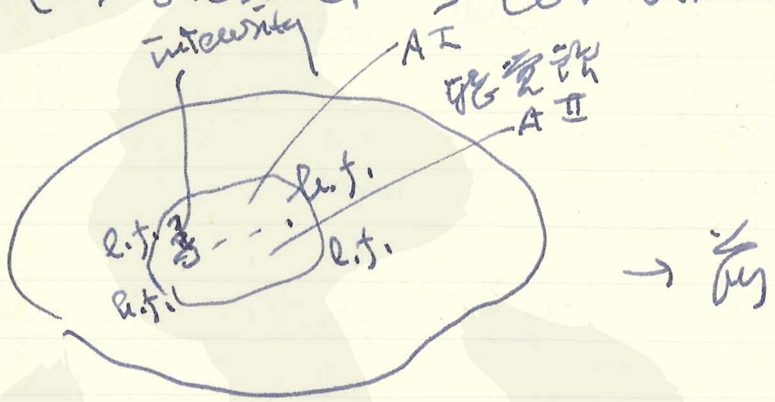




visible speech

contrast affect

click > onsent > continuous tone



宮沢弘成　　　　　　　　基研談話会

MITの会の報告　　　　　Feb. 26, 1963

Gell-Mann : 総合報告 (Regge pole)

	Ang. Mom.	Amplitude ($s \to \infty$)
Regge pole	$\dfrac{\beta(t)}{J-\alpha(t)}$	$b(t)\, s^{\alpha(t)}$
cut	$\displaystyle\int_{\alpha_1(t)}^{\alpha_2(t)} \frac{\beta(\gamma,t)}{J-\gamma}\, d\gamma$	$\approx \dfrac{s^{\alpha_2(t)}}{\ln s}$
fixed essential singularity	$\dfrac{\beta(t)}{J} + \displaystyle\sum_n \frac{\beta_n(t)}{J-\varepsilon_n(t)}$	$b(t)\, s^0 + \sum b_n(t)\, s^{\varepsilon_n(t)}$
$\cancel{\delta_{J0}}$	δ_{J0} ($\varepsilon_n \to 0$)	$b(t)\, s^0$

$$f(\cos\theta) = \sum (2l+1) P_l(\cos\theta) f_l$$

$\cos\theta_t$ 大 $\to$ s 大

---

experiment

1) Schrödinger Equation with Yukawa Type Potential
   $\to$ Regge poles only

I. High Energy Phenomenology

II. Chew's hope　　all singularities in J retreat to the left of $J=0$

exchange forces $\to$ signature

many-2body-channels $\to$ factorization

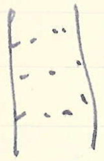
$$\sigma_{\pi N}\, \sigma_{KN} = \sigma_{\pi K}\, \sigma_{NN}$$

spin $\to$ sense and nonsense

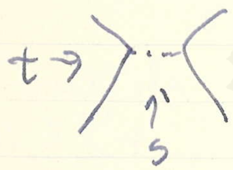
2) Schrödinger Equation with 3-body channels etc

Just Regge Poles (some say not)

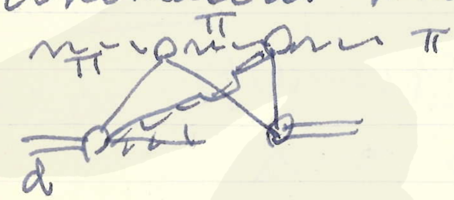
3) Approximation to Rel. Field Theory
ladder appr. Just Regge Poles



4) Field Theory including elementary particle
in t-channel

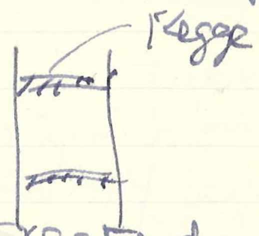


5) anomalous threshold

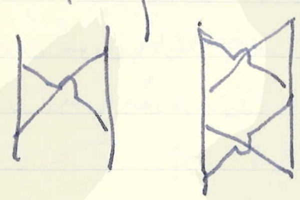


cut if poles assumed
(no shielding)
× $\sigma_d < \sigma_p + \sigma_n$

6) Amati - Fubini
cut if poles assumed
no cut if complete
Feynman diagrams treated

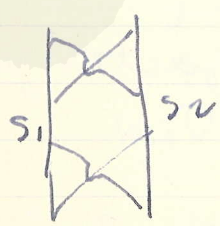


7)



negative integer or
essential singularity
J = −1, −2, ⋯ (spin 0)

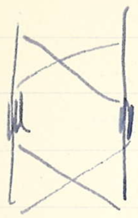
8)



$J = s_1+s_2-1,\ s_1+s_2-2, \cdots$
or essential singularity
$s_1 + s_2 \geq 2$
(↓ Froissart limit s^α $\alpha(0) \leq 1$?)
2nd sheet

cut あり.

4) Mandelstam



Regge poles

$J = \alpha_1(t') + \alpha_2(t'') - 1, \ \ldots \ -2$

が singularity. → cut

Goldberger : Regge poles の trajectory を
摂動論から出す。

$$\frac{g^2}{m^2-s} + \frac{g^2}{m^2-u} + g^4\,\frac{\ln(-t)}{-t}\,f(s) + \cdots$$

$$\text{"}\ \underbrace{\frac{g^2}{t}\left\{1 - g^2\ln(-t)f(s)\right\}}_{g^2\,t^{-g^2 f(s)-1}} \cdots\cdots\}$$

とはならぬ

一つの Regge pole ではすまぬ

δ_{0J} + R. P.

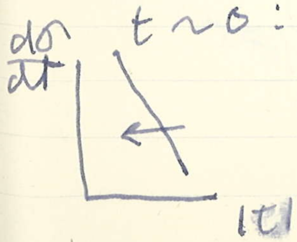
spin ~~1~~ 1/2 なら よさそう?

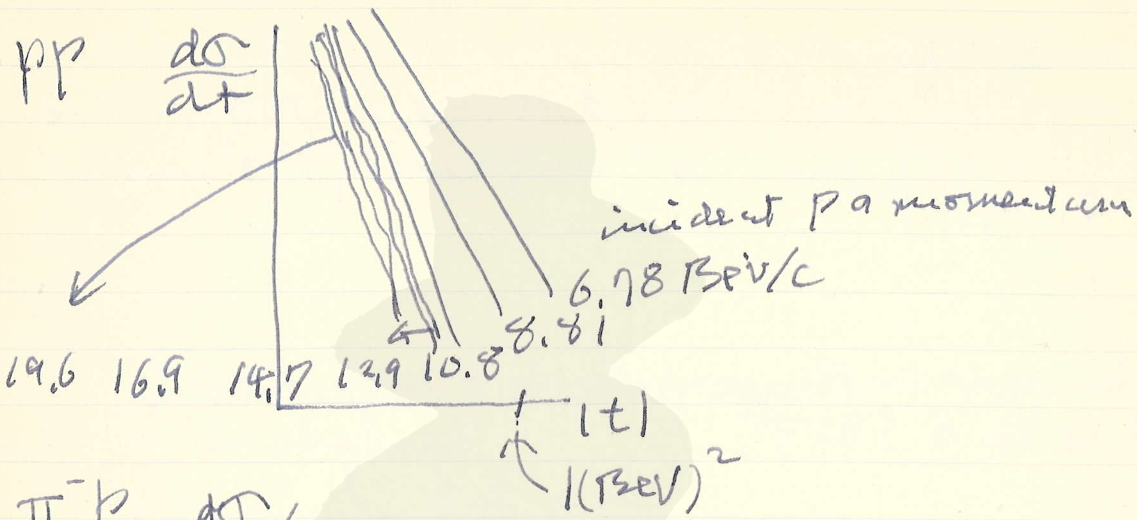
Lindenbaum, Yuan et al :

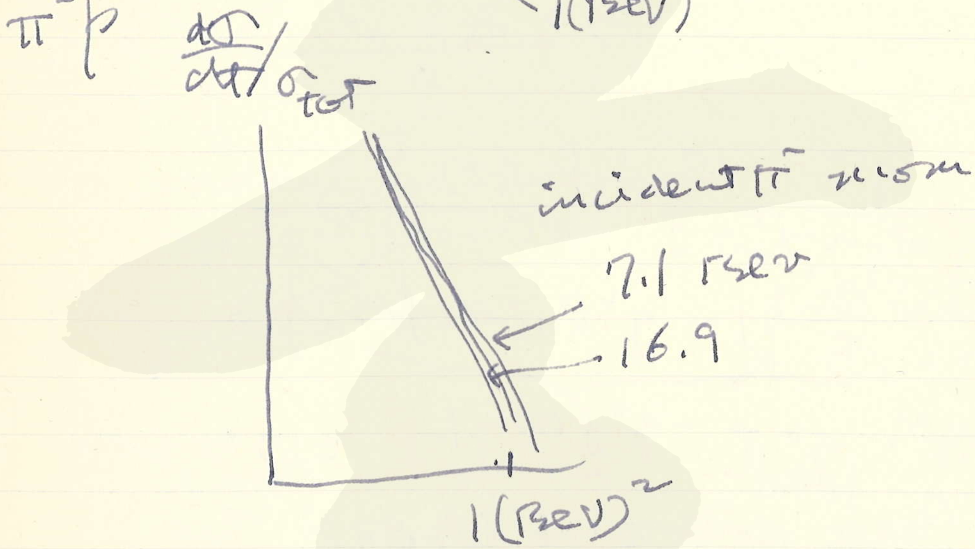
$b(t)(s/s_0)^{\alpha_P(t)}$

$$\frac{d\sigma}{dt} = C\,e^{-2\alpha_P'(0)|t|\ln(s/s_0)}$$

$t \sim 0 :\ b(t) = b(0) \qquad \alpha_P = 1 + \alpha_P' t$







~~だんだん らしい~~ rigidな core ?

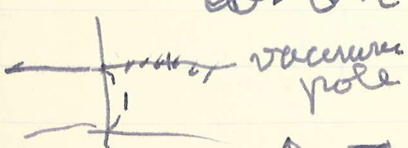
~~数~~ 解釈

1) πp はまだ asymptotic region に達していない. X

2) $\cos\theta_t \sim \dfrac{s}{2M^2}$ for pp

$\sim \dfrac{s}{2M\mu}$ for πp → 早く asymptotic

$\cos\theta \sim 10$ なら asymp.?　$a_p(t) \to 1$



$f \approx s^1$ ($\theta = 0$, t = fix, $t/s \to 0$)

$\theta \propto \dfrac{t}{s}$　unitarity limit

$b(t) \sim e^{\gamma t}$