Biography of Prof Hayashi

Humitaka SATO

Hayashi in his office in Kyoto University, 1981

Carrier of Chusiro Hayashi　林　忠四郎, 1920-2010

1 9 2 0 .July,25　　born in Kyoto city

1 9 3 8 graduated the Third National High School(now merged to Kyoto University)

1 9 4 2　September , graduated Tokyo University, physics　　40　read Gamow's paper on URCA

4 2 － 4 5　military service in Navy

1 9 4 6　　entered Yukawa's Labo in Kyoto University

47　Giant stars
49　shell source
50　p/n at Big-Bang

1 9 4 9　　Associate Professor, Naniwa Univ.(now Osaka Prefecture Univ.)

50-57　Bethe-Salpeter,non-local FT

1 9 5 4　　PhD　"Hamilton formalism of Non-local field theory"

associate Professor , Yukawa's group, Kyoto Univ.　56—2010　**astrophysics**

1 9 5 7　　Professor　of a newly formed Labo. of "Nuclear energy research(核エネルギー学講座)"

56—Star evolution after MS, 3α、
red-giant、He-flash,・・・
61— Hayashi-phase、H-track
62　HHS-paper
66— ARAA-paper , star-forming cloud
70—origin of solar-system

1 9 8 0　　60 years celebration IAUSymposium (還暦国際会議)

1 9 8 4　　Emeritus Professor

various honors including Kyoto Prize(95),Bruce Medal(04)

2010.Feb,28　　passed away

Honors

1 9 6 3　Nishina prize

1 9 6 6　Asahi prize

1 9 7 0　Eddington Medal

1 9 7 1　Japan Academy Medal

1 9 8 6　Order of Cluture

1 9 9 4　Order of Scred Treasure

(勲一等瑞宝章)

1 9 9 5　Kyoto Prize, Inamori Foundation

2 0 0 4　Bruce Medal

Showa Emperor and Hayashi

Kyoto Prize
in Earth Science and Astrophysics

- 1987 J. Oort
- 1991 E. Lorenz , meteology,chaos
- 1995 C.Hayashi
- 1999 W. Munk , oceanography
- 2003 E. Parker, solar wind
- 2007 H.Kanamori, earthquake
- 2011 R. Sunyaev

Hayashi donated
the prize money of Kyoto Prize
To
Astronomical Society of Japan

Hayashi Prize (under 40y?)

and

Yukawa Memorial Foundation

Hayashi memorial lecture meeting(~annually)

2x10^7 yen + 2x10^7 yen

- At the time of finding the Hayashi-track in 1961, he was already Professor of Kyoto University.

By what research, he had been promoted to position?

- "prestigious post" Yukawa Nobel prize(1948), theoretical physics, particle physics
- proton/neutron-ratio in the Big-Bang paper?

before Penzias-Wilson 1965

- professor position of new Labo for nuclear energy

nuclear power,nuclear fusion,plasma physics was in the stage of Dream, many ambitious candidates

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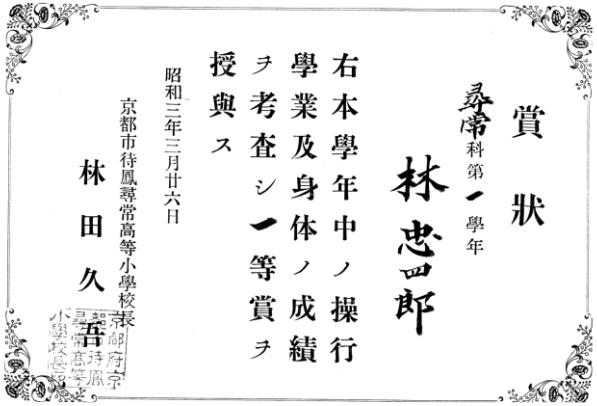
70—origin of solar-system

->Next speaker, Prof. Nakano's talk

1927 待鳳小学校一年生、次の写真の拡大

Elementary School

always President of class



賞狀

尋常科第一學年

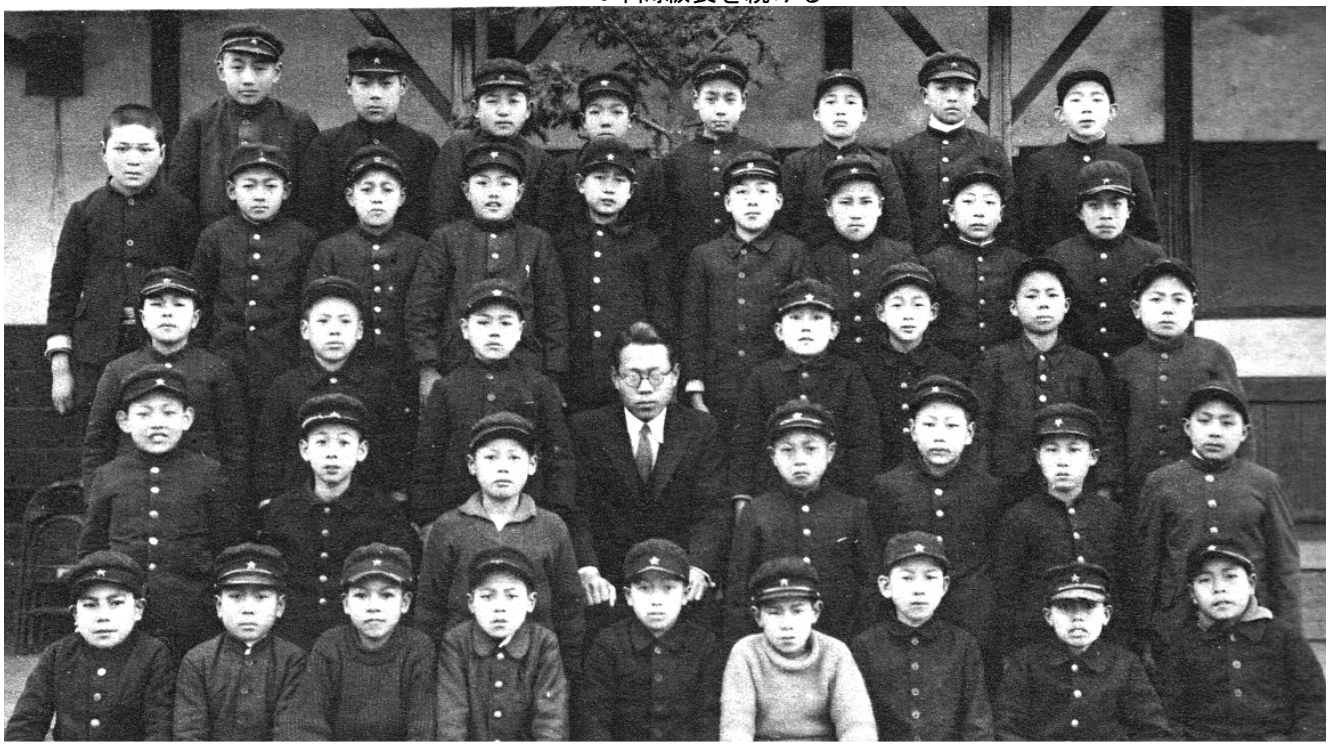
林忠四郎

右本學年中ノ操行學業及身体ノ成績ヲ考査シ一等賞ヲ授與ス

昭和三年三月廿六日

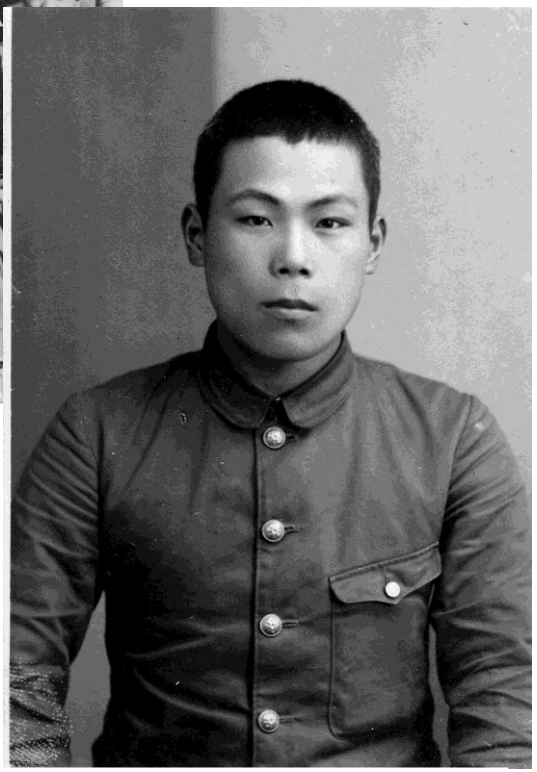
京都市待鳳尋常高等小學校長 林田久吾

1一学年終了時の成績、以後好成績で6年間級長を続ける



1六学年終了時のクラス全員、中央は担任の福田壹一先生、上第二列左端は池田三郎、３人おいて加藤正二郎、右端は立入卓三、最下列左より３人目は吉田潔、５人目は上田長一、第三列の右から2人目は美山祥三

1935 京都一中柔道部の全員、私の四学年終了時、第二列右より同級生の曽和宗雄・林・鈴木公熙君



1937 第三高等学校（旧制）入学時

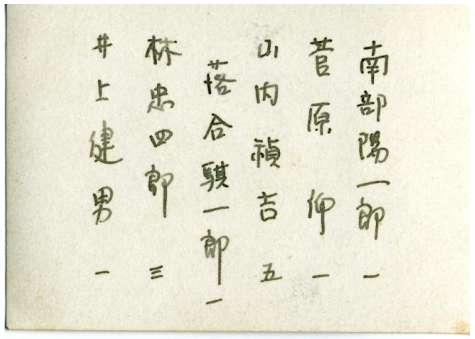
Junior high school
Judo-club

High school
Head of judo-club

1937 三高五月祭でのクラス対抗のデモ行進で、我々理甲一は「人道主義」・「社会主義」などの数枚の旗を競いながら運動場を一周した、日中戦争の始まる２ヶ月前の頃で思想は比較的自由であった

1937 三高柔道部一年生の全員、中央右は栗原民雄師範、左は吉川泰三部長（物理の教授）、後列左より村田・山本・黒田・竹島・安村・吉永、前列左より井上・藤本・林・津田の諸君、於柔道場

Tokyo university,physics
Prof Ochiai



1942 落合騏一郎先生のゼミ（原子核・素粒子理論）、
左より井上健男・山内禎吉・菅原仰・南部陽一郎、
写真は南部氏所蔵、井上氏はベーテの論文を翻刻
し、これはわが国戦時中の海賊版出版の嚆矢となる

Y. Nambu, Nobel prize in 2008
Prof of Chicago Univ.

1942 , before Pearl Habour

1942-45
Navy
Lieutenant(tech)

1943

1943 海軍技術中尉に
任官、於横須賀海軍工
廠・光学実験部

Y. Nambu, Nobel prize in 2008
Prof of Chicago Univ.

Hayashi was borne and grown-up in Kyoto upto high school and entered at Tokyo University, where he was a classmate with Y. Nambu. At undergraduate study, they read Gamow's URCA-process paper(cooling of star by neutrinos)

After military service, returned home and joined the group led by H. Yukawa in Kyoto University.
At this time, Yukawa happened to hold professorship both in physics and astronomy department. This happened due to a drastic political change by the surrender of japan at the WarII. One professor of astronomy resigned suddenly, because he was very enthusiastic to the War .That was a reason why Yukawa held professorship in astronomy.
Yukawa's group was crowded by young members retuned from the military service and Yukawa assigned some members including Hayashi to use the office of the resigned professor at astronomy department, where there were a plenty of books on astrophysics such as "Eddington","Chandraseckar" and others Studying them by himself, Hayashi wrote the papers on giant star and p/n ratio, commuting American-culture-center in the city to copy Phys-Rev paper by hand. The Japanese version of p/n-ratio paper was first written for the memorial volume dedicated to Yukawa's Nobel prize in 1949.

But Hayashi's main interest was still particle physics. In 1950, Nambu and Hayashi, class-mate in Tokyo, rejoined in Osaka and began to collaborate on the subject called now Bethe-Salpeter equation. Hayashi's PhD thesis(1953) was "Hamilton formalism in non-local field theory".

When Einstein lectured at Kyoto University during his visit to Japan in 1922,
Araki addressed a word of gratitude in germany, representing all students.
Einstein was impressed by that and wrote about it in his diary

ARAKI,Toshima（1897-1978）
荒木俊馬
広島高等師範学校を経て京都帝国大学に進学した。京都帝大では総長となる天文学者新城新蔵に師事し、のちに新城の娘と結婚した。保守派のイデオローグとしても活躍、戦後、新設の京都産業大学初代総長。
アインシュタイン来校時に学生代表で感謝の辞、アインシュタイン感銘
ドイツに留学、ドイツロマン主義に心酔、そのまま国粋主義的に

天文学から宇宙物理へ　中性子星など
京大で初めて量子力学を講ず

終戦時に京大教授を辞職
湯川教授がその講座担当を併任する。
林らの湯川研のメンバーの多くは荒木研の後の部屋に
宇宙物理の文献完璧
林はアメリカ文化センターで新着論文情報
全文、ノートに写す

Three “Hayashi Phase” of Hayashi’s Research Career

Phase I (1946-50)
giant star structure(1947,49), p/n-ratio(1950)

Phase II (1950-1957)
Bethe-Salpeter Eq., Non-local Field Theory

Phase III(1956-1984(retirement of Professor)-2010)
astrophysics

The phase II started in 1950. Nambu got a professor position at Osaka and ,in this year,he proposed some equation on relativistic,covariant formalism about a bound state in quantum field theory. Hayashi tried to develop Nambu's idea and this once-classmate at Tokyo reunioned at Osaka to collaborate in research.

Nambu recollected; one day, he visited Hayashi's home in Kyoto for discussion. There, Nambu was impressed by looking Hayshi wearing kimono and smoking by kiseru(japanese traditional pipe). Due to Nambu's sudden disease and his visit to US, this collaboration interapted. But Hayashi continued and the paper was published in 1952.

This subject of research is now called Bethe-Salpeter equation(1951) and Hayashi's work was hided away by BS with time. This work brought a great chance to young Hayashi.

E. Salpeter(1924-2008)
1951 BS
1952 3α-reaction by Be^8

In 1953, International Conference on Theoretical Physics was held in Japan by the initiative of Yukawa, who has just returned after along stay in US(1948-53). This Hayashi's work and his related study of non-local FT was regarded as one of the major contribution from Japan.

This reputation seems to bring him a new position of associate professor at Yukawa Labo. Kyoto Univ. in 1954. Hayashi"s PhD paper(1953) is"Hamiltonian Formalism in non-local FT".
At that time, this theme was very popular in Yukawa7s Labo. Reflecting Yukawas thought on "Divergence Cricis" in QFT. Hayashi quickly became a leader in it.
But this situation of Hayashi did not continued for a along.

H. Yukawa(1907-82)
1935 meson theory of nuclear force
1949 Nobel prize , first as japanese

The phase III of Hyashi's career happened by two outer powers, not by his initiative.

A: in 1955, as a director of new Institute(RIFP),Yukawa proposed interdisciplinary projects such "Star and Nuclei", "Life and DNA",・・・. Hayashi was persuaded to back to the I phase of Astrophysics.

B: in the same time, "Nuclear Power Age" started in Japan also. And Government promoted to create new Labo related to NP in major universities. Kyoto Univ. got several new Labo., one of which was theory Labo. "Study of Nuclear Energy(核エネルギー学)。Yukawa successed to put Hayashi as a head of this Labo, in 1957.

By these two sudden move, Hayashi was forced to stop an esoteric study of non-local FT and was faced to nuclear fusion. So, Hayashi formulate his Labo such as Part I :thermo-nuclear fusion in universe（天の部） and Part II: thermo-nuclear fusion in device(地の部).

However, through his international reputation in astrophysics had grown, Hayashi changed his policy of Labo solely to astrophysics in about 1965

1952夏　広島県竹原市の広島大学・理論物理研究所で行われた、素粒子・原子核理論の研究会の出席者、私は後列左から４人目、多数の若手研究者が参加

1952: Summer workshop on Particle-nuclear physics

1953, Tokyo and Kyoto
International Coference on
Theoretical Physics

Amaldi,Anderson,Bardeen,Bhabha,Frohlich,Heitler,Marshak,Mott,Onsager,Pais,Peierls,Prigogine,Schiff,Slater,Townes,van-Vleck,Wheeler,Wigner,Yang,・・・・・

R. Feymann(1918-88)
Hayashi told him that
“your name in japanese letter
不敗魔“

Bloch

1953 会議出席の仏国人C. Blochと非局所場の理論について会談

1秋の物理学会年会、於東大教養学部本館、前列中央に湯川先生と鳴海元氏、
その後に私、
　　その他は湯川研関係の諸氏

1954-57
Associate professor at
Yukawa Labo

1953 RIFP(now Yukawa Institute)
1953 ICPH
1954 Hayashi to Yukawa Lab in Physics Department
1955 Yukawa proposal of “Star and Nuclei”
1956 ICTP at Seattle

1955頃　湯川研ハイキング、山崎・八幡方面

1955, hiking of Yukawa Labo

1956; to ICTO at Seattle
Hayashi’s first visit to abroad

1956　シアトルの理論物理会議への出発時、左端は永宮健夫先生

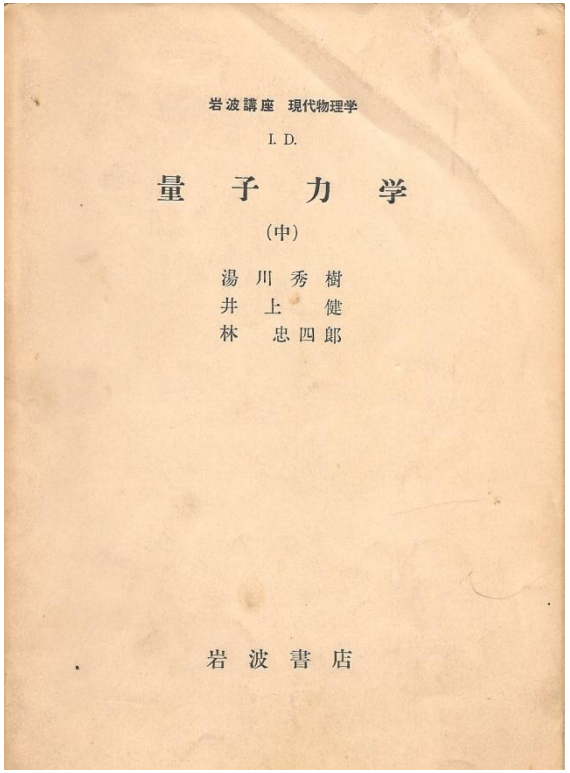
1956, IC on TP at Seattle

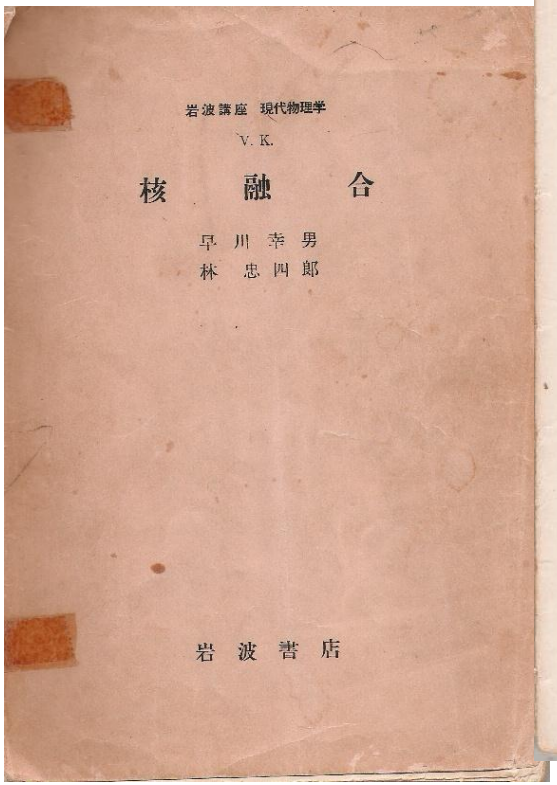
Gamow,Oppenheimer,Toleman,Wigner,Yang,Salam,
Morrison,・・・・

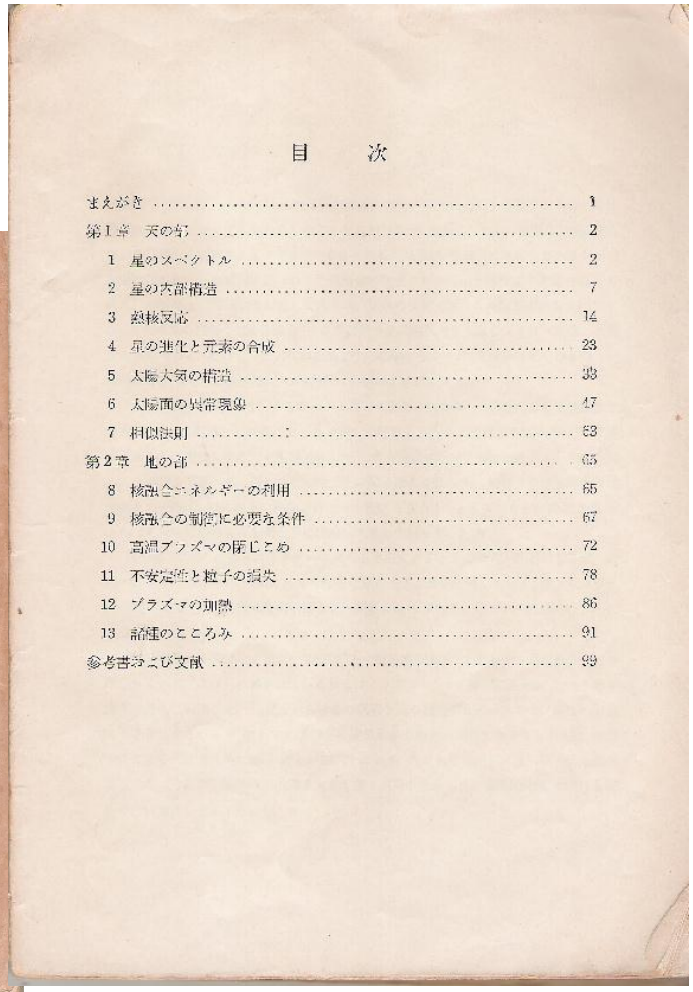
1956　シアトルの理論物理・国際会議、於ワシントン大学、写真の左半分、多分ガモフやバーデと思われる人の顔が見える

Jananese group,
Yukawa,Hayashi,Nagamiya,Hayakawa,・・・

Iwanami-koza on Physica
Ed. By Yukawa, et al
Quantum Mechanics
Hayashi's part
Dirac equation,2nd quantization,
Hayashi's lecture for undergraduate course





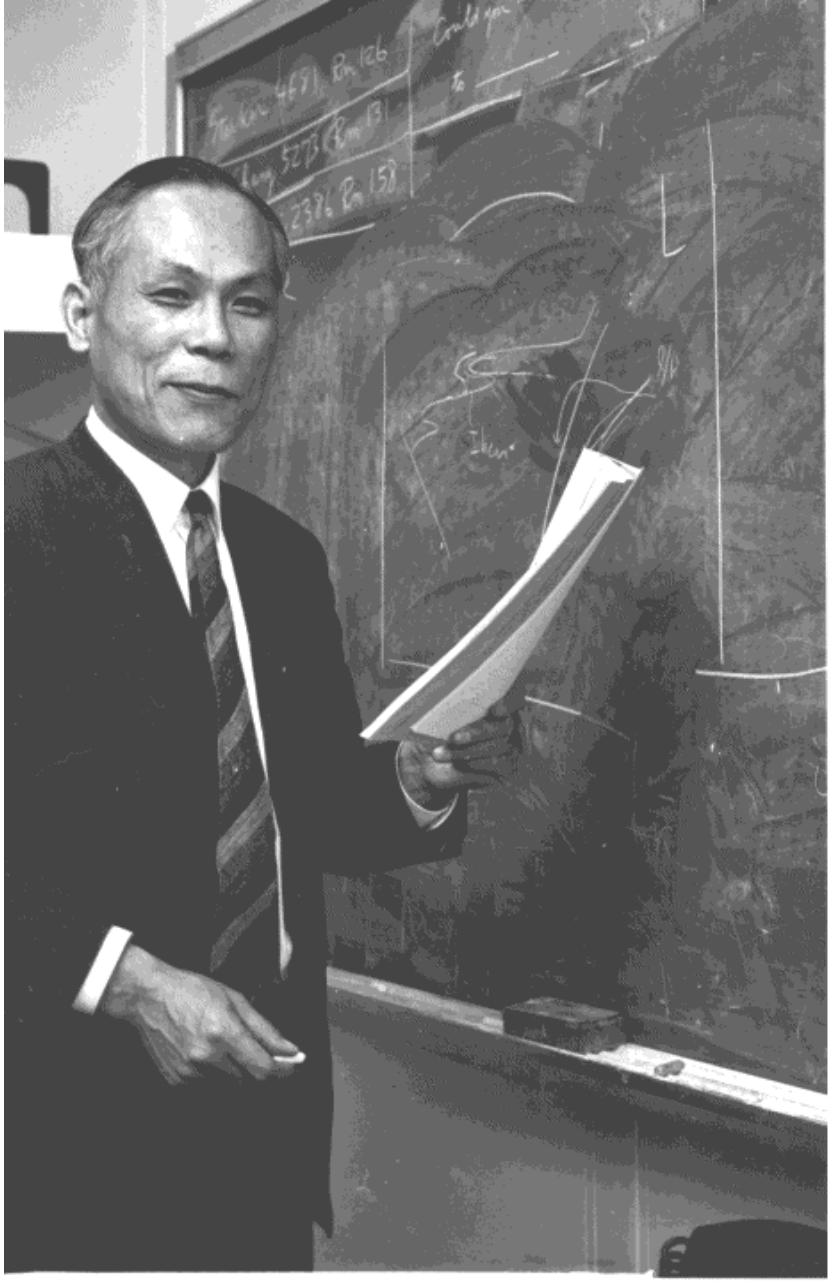

目 次

林： 2－22と第二章

1965
NASA

G. Burbidge

1965年1月 Conference of Stellar Evolution (the Goddard Institute for Space Studies) (左は G. Burbidge)



NASA G-68-10,414

1968 NASA

1967 Hayashi Labo
Staff and undergraduate students

４回生で研究室配属された頃の写真（１９６７年）　前列　左より蓬茨 霊運
佐藤文隆、天野恒雄、林忠四郎、後列左より 佐藤勝彦 林光男、 徳永宏

Hiking of Hayashi's Labo.

1957 林研の亀岡・瑠璃渓のハイキング、これは教授になって最初のハイキングであった

1957

1963

1975年４月　林研究室ハイキング

1975

1969, Sympo. “Stellar Evolution”,
Lieage(Belgium)

1979,3weeks

UC
Santa Curz

Workshop on
Evolution of
star
And
Origin of solar
system

Mestel
Larson

1980　IAU シンポジウム No.93、「星の進化理論の基本問題」、於京大会館、前列私の左は順に R.J.Taylor・E.E.Salpeter・A.G.Massevich・杉本大一郎・鶴田幸子、私の右は佐藤文隆の諸氏、、私の還暦の日の７月 25 日には、祝辞と贈り物を頂いた

IAU-Sympo
Dedicated to Hayashi's
60th anniversary
In Kyoto
H,Taylor,Salpeter,Massevich,Sugimoto,・・・

Retirement in
march 1984

Nakano,Suzuki
,H

Kyoto Prize

1987年 Oort

11月　J.M.オールト(中央)の京都賞受賞時の、ワークショップの役員と講演者、於京都国際会館
私は座長を務めた

シンポジウム
「星と太陽系の形成」

企画・司会:佐藤 文隆 基礎科学部門専門委員会委員長、京都大学理学部教授

13:10	開会	佐藤 文隆
	挨拶	稲盛 豊実 稲盛財団常務理事
	挨拶	甘利 俊一 基礎科学部門審査委員会委員長、東京大学工学部教授
13:25	受賞者紹介	佐藤 文隆
13:30	記念講演	林 忠四郎 基礎科学部門受賞者 「星と太陽系の形成」
14:30	座長挨拶	杉本 大一郎 基礎科学部門審査委員会委員、東京大学教養学部教授
	講演	野本 憲一 基礎科学部門専門委員会委員、東京大学理学部教授 「星の進化と超新星爆発」
	講演	海部 宣男 国立天文台教授 「星の形成」
15:45	休憩	
16:00	座長挨拶	中澤 清 東京工業大学理学部教授
	講演	井田 茂 東京工業大学理学部助教授 「惑星の形成について」
	講演	水谷 仁 基礎科学部門専門委員会委員、宇宙科学研究所教授 「実験・観測惑星科学の最近の進展」
17:15	閉会	佐藤 文隆

1995年 Hayashi

11月 京都賞受賞時の一般講演、於京都国際会館

1994

M. Maskawa
(1940-)
1973 KM-matrix
of CP-violation

Kyoto Univ in
1970-76
1980-2003

2008 Nobel prize

Maskawa, Hayashi, Sato

1995

with Narita and Kiguchi

1995物理教室非常勤講師室のゼミ、成田真二・木口勝義の両氏と毎週土曜に行っていた

2004 星形成・太陽系起源の研究会、於京大会館、京大天体核研究室と私に関係深い人々が出席

2004

Workshop on origin of solar system

2008

88th-annv.

米寿

p/n-ratio paper(1950) was published first in japanese, for celebration-issue dedicated to Yukawa's Nobel Prize

15. 膨脹宇宙内の陽子－中性子の濃度比について

林　忠四郎（浪速大工）

§1. 序

Gamow and Alpher[1] は高温度の圧縮状態にあった膨脹初期の宇宙内には物質粒子としては中性子のみが最初存在したものと仮定し，膨脹の進行とこれに伴う温度の降下に際してその一部は陽子に崩壊して中性子を捕獲して重陽子を形成し，以下逐次的な中性子捕獲とβ崩壊によって次第に重い核が構成されて行く過程を考えることによって現在の元素の頻度分布が良く説明されることを示した．Gamow[2][3] は更に相対論的膨脹宇宙に於ては元素形成の約 10^7 年後には物質気体は凝縮を始めこれは丁度星雲の質量と半径を有することを示し，膨脹宇宙説に更に新しい根拠を提供した．しかしこの考えを基とするときには宇宙の初期に中性子のみが存在したという仮定は以下に論ずるように当然改められなければならない．

元素形成前の高温な（$T > 10^{9\circ}K$）時期には中性子－陽子間の転換の反応として，中性子の自然崩壊を含めて，宿って創られた中性微子及び高エネルギーの輻射によって創られた電子対による次の如きβ過程が進行していたに違いない．

$$n + e^+ \rightleftarrows p + a\nu \qquad (1a)$$

$$n + \nu \rightleftarrows p + e^- \qquad (1b)$$

$$n \rightleftarrows p + e^- + a\nu \qquad (1c)$$

更に高温（$kT \geq \mu c^2$，μ は中間子の質量）に於ては甚だ多数の中間子が存在し

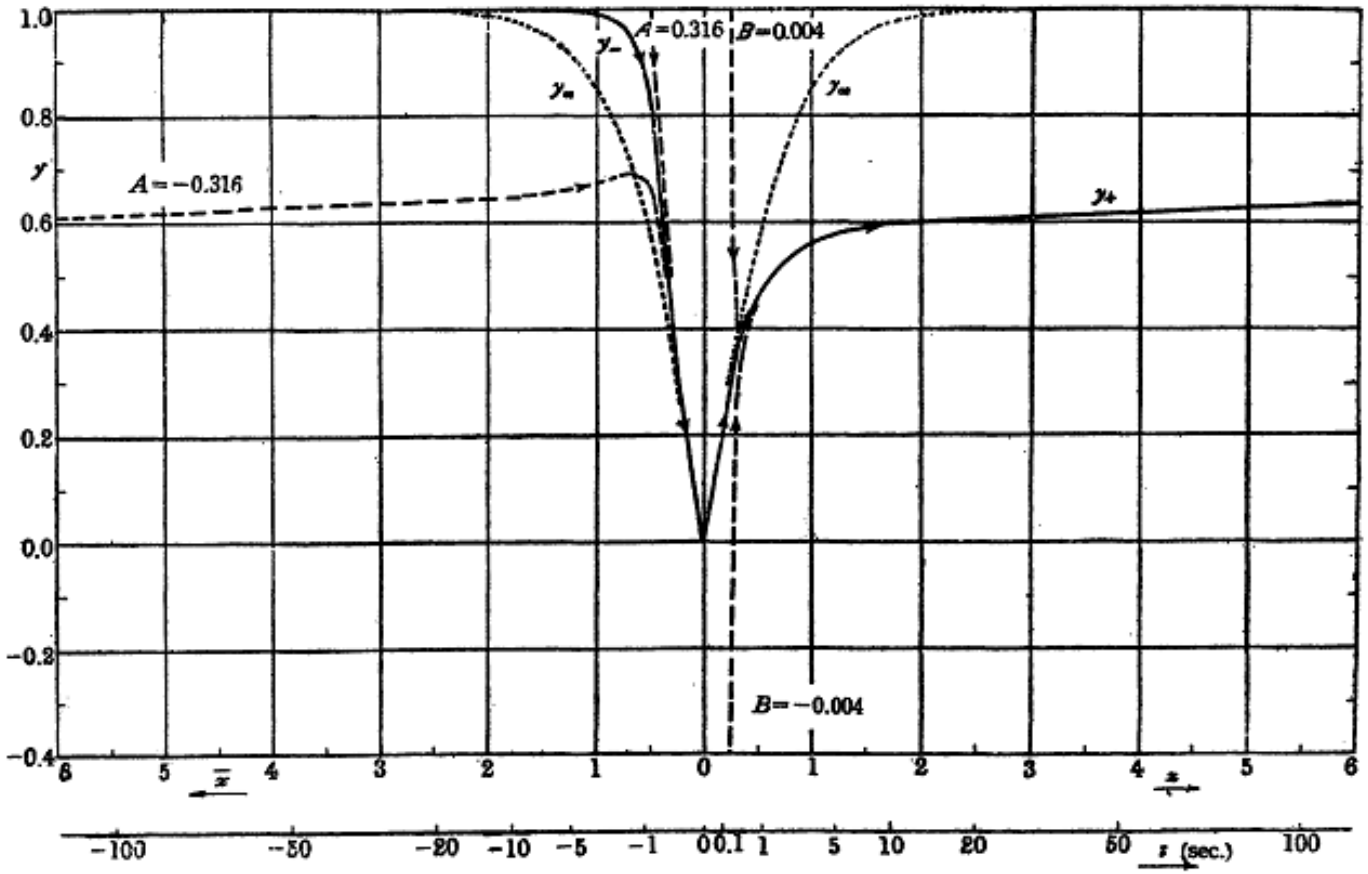
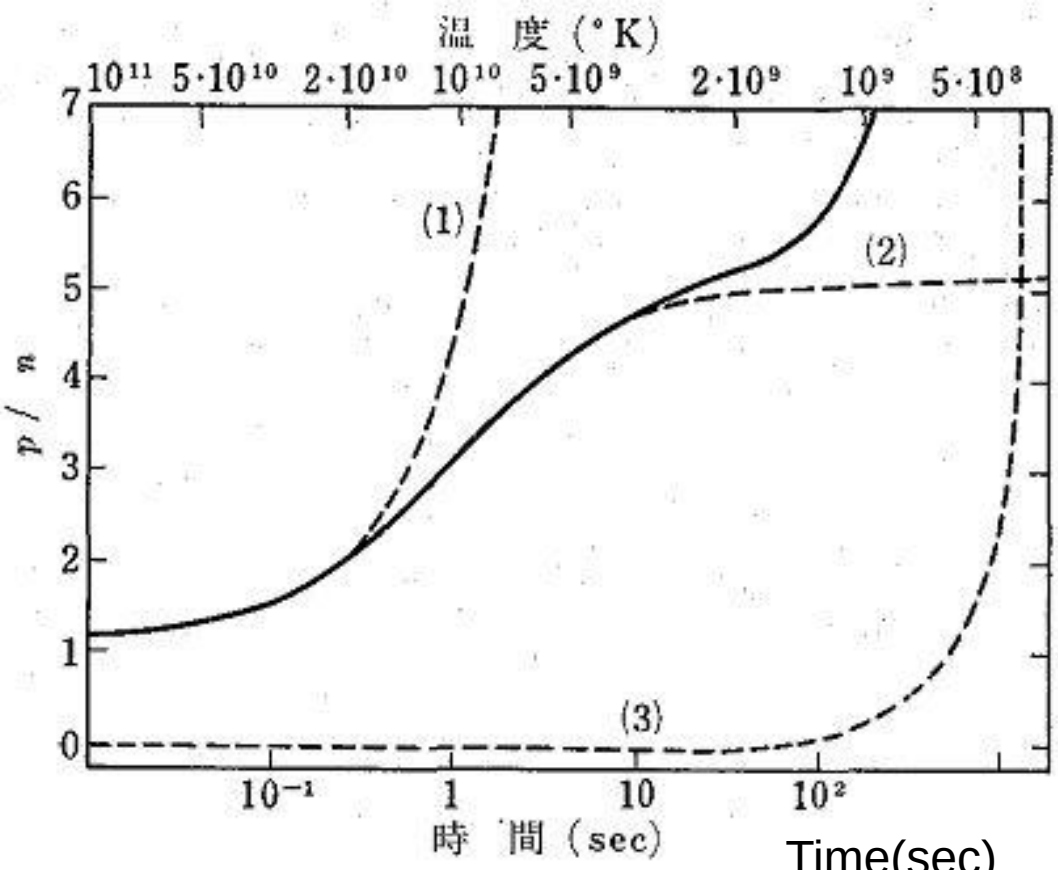


Fig. 2. n-p ratios as functions of $x \equiv mc^2/kT$ and time t of the universe. Dotted line is equilibrium value: $y_{eq} = \tanh(qx/2)$, and broken curves show $y_- + Ae^{f(x)}$ and $y_+ + Be^{-f(x)}$ where x_0 is taken as unity in Eq. (38).

Sato,1967

T (K)

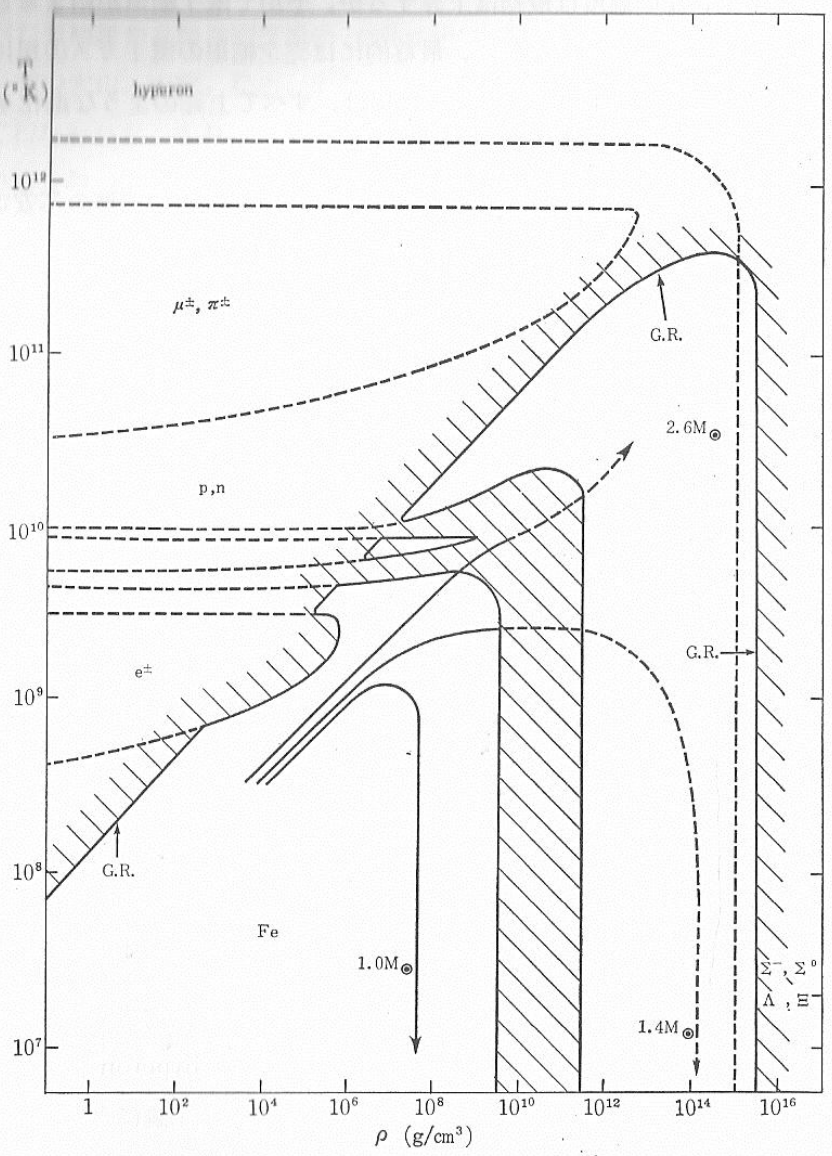
p/n-ratio



Time(sec)

第２図　陽子と中性子の比 p/n の時間変化(実線). 点線は (1) 熱平衡とした場合, (2) (2) 式と (3)式の反応だけ仮定した場合, (3) 初期に中性子だけとして自由崩壊を仮定した場合.

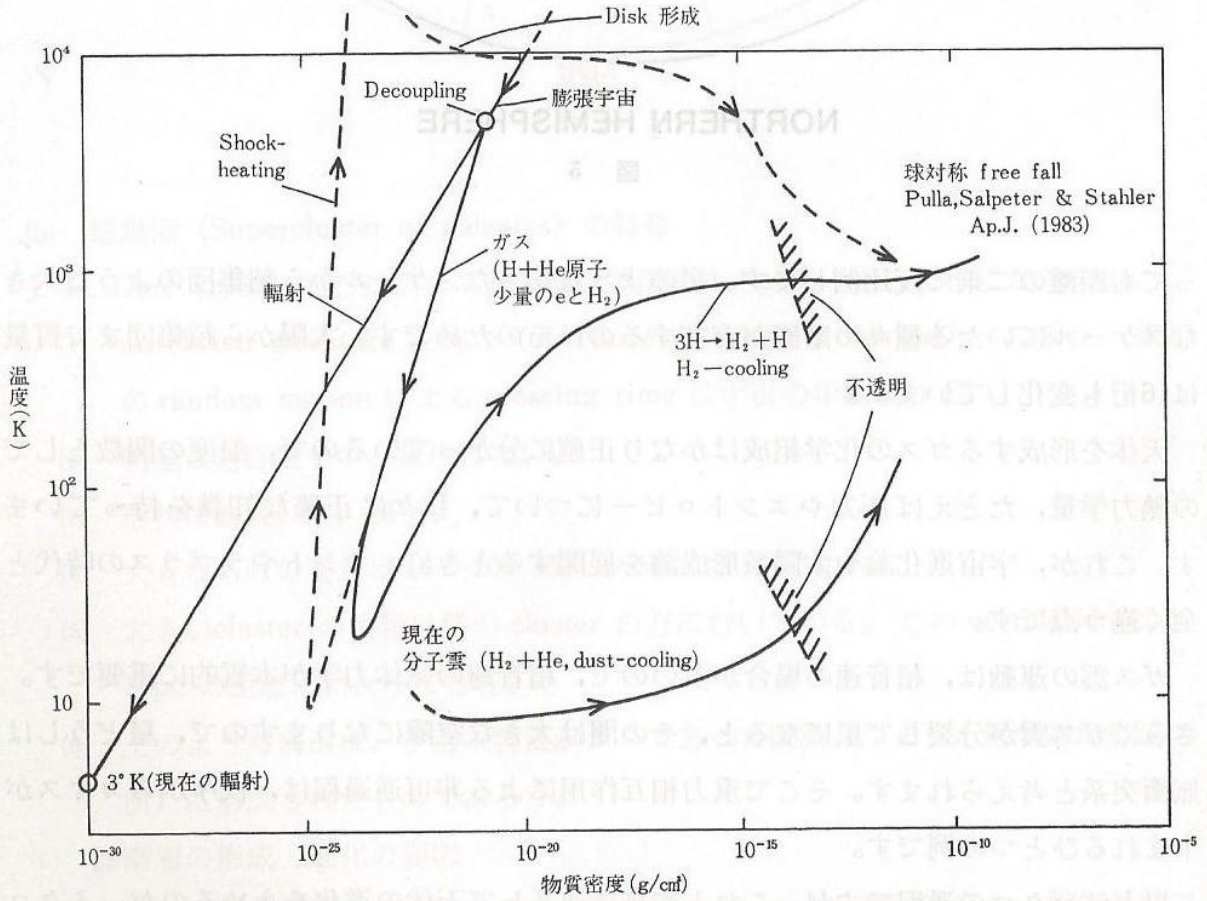
Prediction of neutrino black-body radiation by Hayashi



第5図　高温高密度のガスの組成と星の不安定領域。
低温・低密度の熱平衡状態のガスは Fe^{56} 電子から成るが，高温・高密度になると，まず Fe^{56} は核子（高温では $p+n$，高密度では n）に分解する。この分解の遷移領域（図の斜線領域）では γ の値は $4/3$ より小さい。このほかに，電子対，中間子対の発生の遷移領域（図の $e^{\pm}$, $\mu^{\pm}$, $\pi^{\pm}$ の点線で囲まれた領域）でも γ は $4/3$ より小さい。さらに，図のG．R．で示した実線より高温，高密度の領域（やはり斜線で示してある）では，一般相対論の効果によって，星は不安定である。

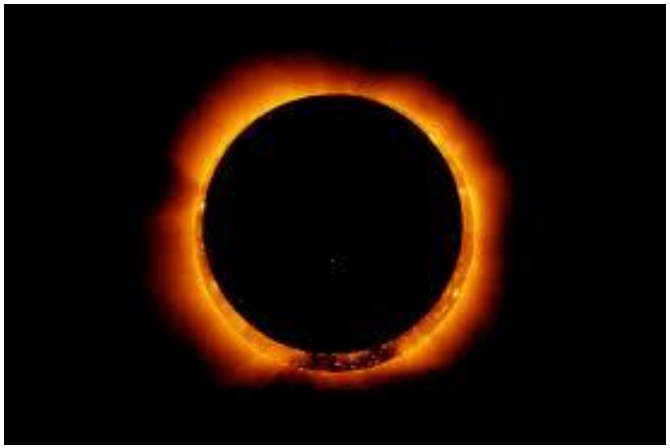
1968
Hayashi
In
“Proc. of 15th Yukawa Institute anniversary Sympo.

Hayashi in Lecture of retirement of
Kyoto Univ. in March,1984



(Big Bang 宇宙のガスと輻射，ならびに現在の銀河内の分子雲の温度・密度の変化)

図 6



“Hayashi” is still so bright to hide totally by later works