NOTE BOOK

Manufactured with best ruled foolscap
Brings easier & cleaner writing

[illegible] 資料抜萃

Aug. ~ Sept. 1958

VOL. VII

I. Geneva conference on Atomic Energy
Aug. 29, 1958 ~ Sept. 14, 1958

II. Paris UNESCO
Sept. 15 ~ Sept. 18, 1958

III. Wien
Sept. 18 ~ Sept. 23, 1958

IV. Copenhagen ~ Sept. 23, 1958

Nissho Note

Sept. 1, Monday
9.30: chairman's meeting
9.~12
2.30~5.30
Press Conf.: Monday, Tuesday
garden
Essential Points
○ 8.30: chairman's meeting with Secretary

Door: 19

10.30: Opening Addresses Session 1.
1: ~~Rep. of~~ Switzerland, ~~City of Geneva~~
President of Republic
2: Hammarskjöld

waist disposal — high sea

3: Perrin;
exclude political considerations
start from scientific research,
education, training
importance of pure science.
collective suicide
Promesises back to chain impossible
fallout due to war
remove isolation

regret considerable segment of
mankind could not send representatives
fusion
UNSC report : fallout
X-rays
International Agency
safety

Fermi, Irène Curie
dedication to their memory
Joliot
Lawrence

4: Cole, UNAEA
67 member countries
fellowship
international supervision
bilateral → international

5: , WHO Secr. gen.

6: Messages from Governments
Canada　France
India　USSR
UK　USA

Afternoon 2,30 Session 2
Future of Nuclear Power
Lewis, Canada
heavy water - natural U
NRU 200MW
Gillerat, France
40% | 15 million coal tons
ocean tide
gas natural
coal:
natural U - graphite - CO_2
G2 - 30000 kW
heavy water - CO_2
enrich U from USA
plutonium.
Emelianov, USSR
PWR
fusion Zeta
first D+T then D+D
ship
Strath, UK
1951
concentrated effort
four groups competitive
300 ~ 500 MW electricity
optimistic
old to new

load-factor
32% thermal efficiency
slight enrichment
1961:

heavy water - gas cooled

fusion

Pu:
supply and demand
Davis, USA
24 Power Reactor Projects
water cooled reactors
Shippingport
BWPR
organic coolant

gas cooled

metal coolant
Na
fast breeder reactor

fluid fuel reactor

high temperature reactor

U-Th fuel

Pu reactor
Hg-cooled fast
thermal

safety

20年位: 50-50 proportion

Bhabha, India

(beyond 1 million kW)
Th ≫ U excludes Natural U-reactor
~~400 million~~ → 1.3% →
~~600~~ population increase:
1984 min. 500 million
2000 min. 600 million

5 years → twice power consumption
conventional power cost high

~~1 million~~ Th blanket
U^{233}

Questions
~~[illegible]~~:
[illegible] about India
Power plant
Netherlands: about USSR coal

about USA

Panel ~~Man~~ Discussions
1) Fed. Rep. of Germany : Purely for peaceful use
3 research reactors
american
2 U.K. under constr.
Natural U german 1959
Power reactor 1965
~~gas~~ graphite
heavy water
water enriched
international coop.
2) Italy
Euratom
private enterprise
power reactor
CP5
Swimming Pool
3) Ishikawa, Japan
1956: AEC, Laws
Institutions, Industry
100 million coal tons
↓
270 50% import
1975 6 mill. kw
3000 U tons

4) Netherlands
flexible, tentative
economy　　10 mill/kW
5) Poland
rich coal
natural gas
water power : modest
U-ore rich
choice between them
6) Romania
1970 nuclear power should be introduced

7) Spain
1940 industrialized
10% increase yearly
hydroelectric > thermal
price　" < "
USA, UK
private industry
power plant : type not decided

8) Sweden
no fossile　plenty hydroelectric
lack of oil
heating.
heavy water moderated - natural U

Sept 2, morning session 3.
Experience with Nuclear Power Plants

1. UK: industry group
all problems at each stage should be solved.

2. UK:
positive temp. coef.
slow increase in temp.

Afternoon 2:30
Session 4: Possibilities of controlled fusion
Chairman: Bhabha
declassified since 1955
1) acceleration of plasma $10^{-5} \sim 10^{-6}$ sec
2) confinement

1. Alfvén: Magnetohydrodynamics and the thermonuclear problem
macroscopic
astrophysics
confine first heat later or vice versa

magnetic storm aurora
hot plasma geomag. field
trapped

2. Thoneman, Controlled thermonuclear research in U.K.
1932: Rutherford
1928: Atkinson and Houtermans
1947: G.P. Thomson
1948: Thoneman) Toroid
1956: (pinch dynamics) in UK

Instability
$10^{?}$ ampere current 10^{-1} sec.

10 years electric power generation
10 years economy

3. Artzimovitch. USSR
removal of secret
1956 began from USSR
$H^2\tau > A(1-\eta)$

$T = 4.6 \cdot 10^{12} \frac{I^2}{N}$ → ka

0.5×10^6 amp.
4×10^6 °K
10^{-6} sec.

1 2 meter long
8,000 gauss

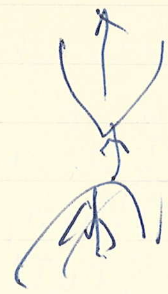
rotational mag. field.

4. Teller, Peaceful Use of Fusion,
collaboration
close 11el.

1952: several groups, several problems

Stellarator; twist
not pulse

neutrons are not thermonuclear



instability due to

i) hydro-magnetic

ii) plasma vibration

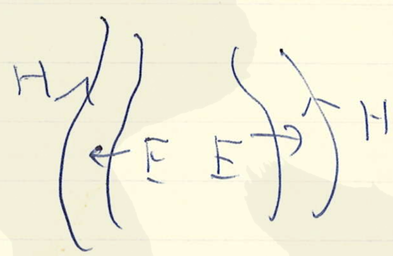
magnetic mirror

adiabatic heating

DCX

stability

Astron



plasma physics

soft X-ray

geographical engineer

5. Biermann, Germany
1956:
Göttingen
→ Munich
Stuttgart
Aachen

Morning:

Session A-5: Theoretical Aspect of Plasma

(1) Kruskall, U.S.A.

stability of Plasma

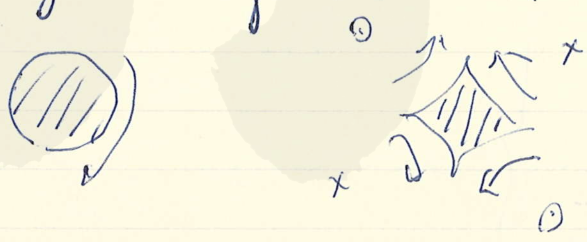
1. normal mode
2. energy principle
a. hydrodynamic
b. Boltzmann equation $q \to \infty$

Chew. Goldberger

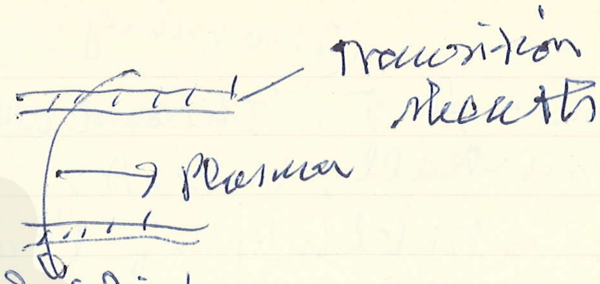
2. Sagdeev, Dynamics of rare plasma
USSR
stability
$T_{\parallel}$, $T_{\perp}$

3. Rosenbluth Pinch Effect
– stability a.w heating

plasma waves
plasma oscillation : Landau.
Alfven " : transverse
hydromagnetic " :



internal mag. field



self-heating
surface instability

4. Taylor, stability of constricted gas discharge UK
surface current

More recent work
surface instability

5. Grad: USA, Shock waves
NYU
irreversible heating
Landau damping
cold plasma

6. ~~Cirilli, Romania~~
Allen, UK, Hydromag. disturbance

$$d = \sqrt{\frac{m_1 c^2}{4\pi n e^2}}$$

$$v = \sqrt{\frac{H^2}{4\pi n m_2}}$$

$$\tau = \frac{\sqrt{m_1 m_2}\, c}{eH}$$

7. Ciulli, Romania. Plasma oscillations
~~statistica~~ Boltzmann eq.
external mag. field

8. Leontovitch, USSR
Plasma radiation in mag. field

absorption coef.

9. Shafranov. Absorption of high frequency el. mg. energy in high temp. plasma
heating by high freq. el. mg. field.
Landau damping
cyclotronic $\omega - \kappa v = \omega_H$ $\omega_H = \frac{eH}{mc}$
Cerenkov $\omega - \kappa v = 0$

10. Fainberg. Ukranian SSR
shock waves
heating problem
injection

11. Dreicer, Run-away electrons
(USA)

Sept. 3. afternoon
A-6: Experimental aspects of
Plasma Physics

International agreement / Channel
for nuclear shipping
USA   France
USSR   Japan

(6)
⓪ H. Brown and G. Johnson, Non-military uses of
nuclear and thermo-nuclear
explosions
clean bomb

1) secrecy (Ozaki)
2) too early because stopping of nuclear weapon experiment is not completely established
3) radioactivity
(Ozaki)

Rotblatt
clean bomb?
fission yield 50%

Sept. 4, Morning

A-7. Chairman, G. P. Thomson

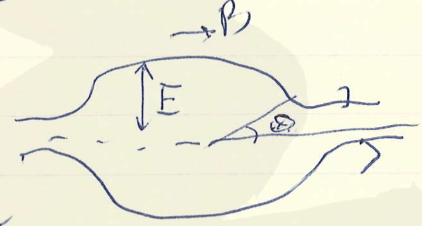
1. Tuck, Los Alamos Controlled thermonuclear research

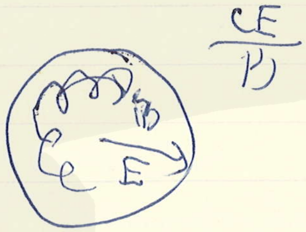
water ~ swim

neutrons

1. exion

large machine



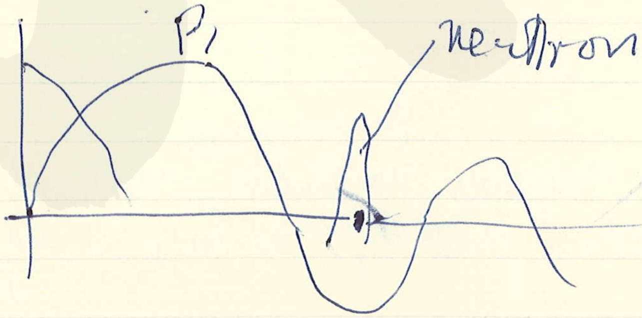


$\frac{4\pi n m e^2}{B^2} \sim 10^6$

(large dielectric const.)

2. scillar

neutrons isotropic



Pinch effect
Hydromagnetic stability
stability by axial mag. field
" complete for infinite
conductivity
stability of diffuse pinch

Columbus S 4
straight pinch
high degree of reproducibility
(high purity)

energy loss of pinch
a) instability
b) runaway electron
plasma vibration

X, Pease, Zeta (UK)
energy containment time ΔT

$$\beta I^2 = 2NLT$$

$$\Delta T_2 = \frac{3}{4}\frac{\beta}{\Omega}$$ → resistance

$$\simeq 100\,\mu$$

$$n\,\Delta T_2 = 10^{10}\ \mathrm{cm}^{-3}\ \mathrm{sec}$$

D-D power producing $= 10^{16}\ \mathrm{cm}^{-3}\ \mathrm{sec}$

3. Taylor, Zeta, Theory
5×10^6 °K, oriffeuler
instability
turbulence — non-linear
motion

4. Golovin, stable plasma
column in a longitudinal
magnetic field
(USSR)
300 μsec ~ 2000 μsec

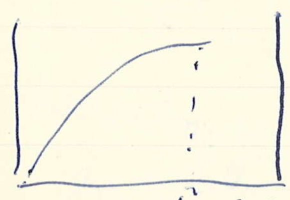
Sept. 4: Afternoon
Informal Meeting on Fundamental Physics. Chairman: Weisskopf

1. Fidecaro, π-e-decay
600 MeV – synchrocyclotron, CERN

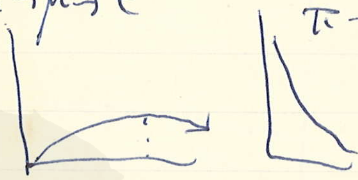
$$\frac{\pi \to e+\nu}{\pi \to \mu+\nu} = 1.3\times10^{-4} \text{ (theor.)}$$

V-A-interaction

background $\pi\to\mu\to e$



decay



$$\frac{\pi \to e+\nu}{\pi \to \mu+\nu} \gtrsim 4\times10^{-5} \text{ (exp.)}$$

2. Winter (Paris)
Saclay Cosmotron
2 weeks ago ~ 3 GeV
$10^8 \sim 10^9$ particles / pulse

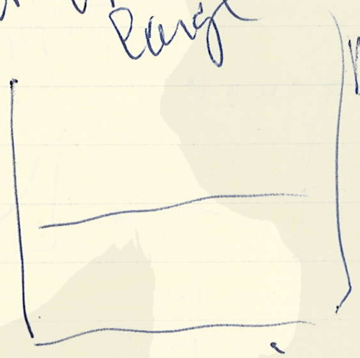
3. Veksler (Dubna)
translated by Tamm.
photo-plates
9 GeV
no slow particles
even : p + p
odd : p + n

p + p

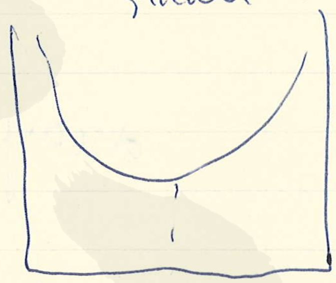
p + n

number of particles
large

small p + p



p+p
6~8

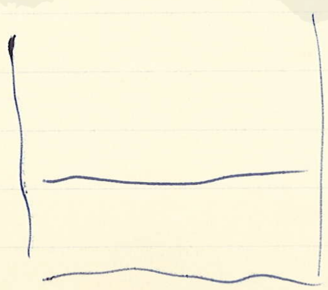


2~4

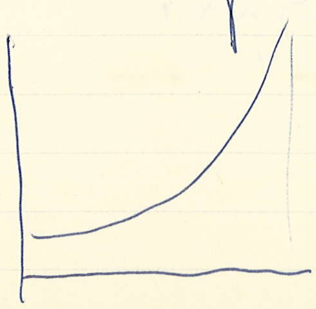
cos θ

isotropic

p+n
5~7



p+n



1~3

small number : large impact parameter
no charge exchange

large number:
individuality lost

$$\vec{p} + \overleftarrow{n} \to \vec{N}'^{(+2)} + \overleftarrow{N}'^{(-1)}$$

$$\vec{N}' \to \vec{p} + \vec{\pi}^{+} \qquad \overleftarrow{N}' \to \overleftrightarrow{n} + \overleftrightarrow{\pi}^{-}$$

excited nucleons

$$\to \vec{N}'^{(0)} + \overleftarrow{N}^{(+1)}$$

$$\vec{N}' \to \vec{p} + \vec{\pi}^{-} \qquad \overleftarrow{N} \to \overleftarrow{\pi}^{+}$$

Yamaguchi
Wataghin : 1 and 3 statistics
Salmeron

Sept. 5, Friday, Morning

A 9: Controlled Fusion Devices. II.

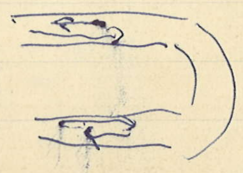
Chairman: L. Biermann

1. Colgate, Livermore shock and pinch programme

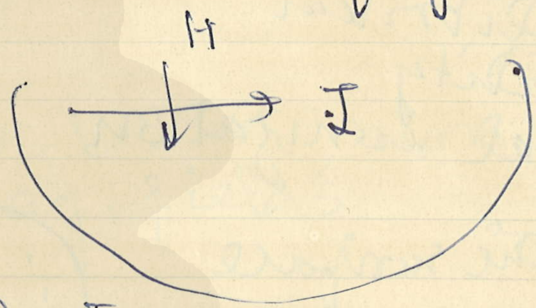
containment and heating

dissipation

- axial mag. field
  helical instability
  axial due to mag. field outside the pinch
- short boundary
- induction current
- neutrons depend on the shortness of boundary
- Where is energy going?
  ~~running~~ away electrons
  ~ 0.5 keV (250,000 A)
  (soft X-ray observed)
  intense
  turbulence
- triax
  hydromagnetic stability



○ homopolar device
rapid rotation of plasma



→ suddenly to rest

diel. const. ~ 10^6 ~ 10^7

○ Shock heating
ion heating
electron heating
axial magnetic field outside.

2. Ware, A.E.I, U.K.
1946. G. P. Thomson
Recent: Zeeta III

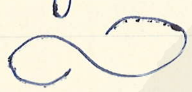
Toroidal
150 μF
30 kV

T_{elec} ~ 10^5 ~ 3×10^5 °K
(He-like)

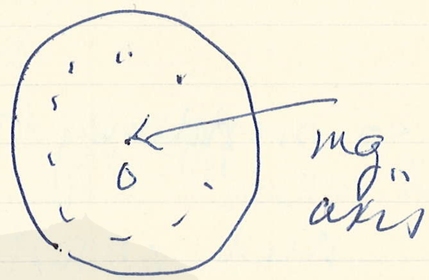
3. L. Spitzer, Stellarator

A. Theoretical
1) equilibrium
2) stability
3) initial ionization

1) magnetic surface

a) 

b) helical winding



2)
b) helical winding : stable

3)
a) ohmic heating
b) magnetic pumping

B. Observation
confinement 10 ~ 20 milliseconds
or 1 ~ 2

○ cooperative phenomena
○ impurity

○ pump out
electron decay rate ∝ $B^{-1/2}$
B : confining field

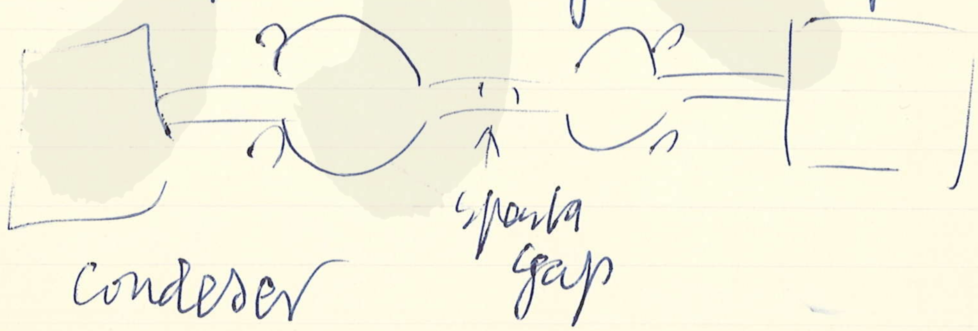
impurity coming in removal
baking
diverter

4. Kadomtsev, USSR, non-uniform
mag. fields

Sept. 5, Friday
lunch with Wataghin

Afternoon
Phillips, Perhapsatron S-4
(USA)

○ Miyamoto, Proposed methods
of obtaining stable plasma.



於毎日新聞会館. 宮田 中村 泰
岡田. 伍田

Sept. 6. Saturday
Look at Exhibition in the morning

Fに訪問, 安田夫妻. 宮田. 中村. 小川.
宮園. 黒田,
Interview with correspondent of BBC
Sept. 7. Sunday
Look at ~~pictures~~ paintings
by Vlamank with Toyoda
in the morning

evening go to Le Chateau,
Collonges-sous Salève
(~~氏~~ Pergamon Press)

Sept. 9 Tuesday
Session 15. Recent developments in fundamental physics, Rabi chairman.

Veksler, Synchrophasotron, USSR.
10 BeV protons ~~20 ~ 50~~
10^9 particles per pulse

p-p
p-n

Winter, Saturne, France.
Cosmotron
$\times 10^7$ per cycle
→ 3 BeV: 2×10^8 particles per pulse

Powell, Cosmic Ray, UK
10 litre stack → go high altitude
10 hrs
80%: π-mesons

satelite

72 hours balloon

Comet flight
30,000 ft. stack
> 1000 BeV
$10,000:

Petukhov, Cosmic Ray by rockets
and satellites, USSR
1947-51 : rocket
2nd satelites . 2 identical
counter systems
altitude 350~700 km
intensity
sudden increase
electrons of small energy < 1 MeV
photons : geiger counter
photomultiplier
1200 km : highest altitude
ionization high
ring of electrons around the
earth

Chew, Pions and Anti-nucleons

coupling const. $f^2/\hbar c$
i) dispersion of π-n-scattering
1955 Goldberger
microscopic causality
CERN conf. 1958
$f^2/\hbar c = 0.08 \pm 0.008$
ii) $\gamma + p \to \pi^+ + n$
Betatron Illinois

$f^2/\hbar c = .073$

iii) nuclear force
Taketani
high energy n-n scattering
of small angle
150 MeV.
two pion exchange
spin orbit coupling → nucleon recoil
hard core

Nucleon-Anti-nucleon Interaction
odd ~~pion~~ number of pion exchange: sign change
hard core → black ball

high ~~energy~~ annihilation ~ 10 mb

Feynman, Strange particles

Discussion:
Vallarta: 1000 km altitude
nature of particles
Petukhov: 200 keV electrons
: Scanning time
Powell:
Jastrow: Allen protons
not electrons

Explorer 4:

Wu, Weak Interaction

Bogolubov, Many-body problem and nuclear matter

superfluidity. Kapitza

superconductivity Onnes

2.30 p.m. Informal Session on Nuclear Structure

1. Bogolubov, Conti.

Weisskopf, Nuclear Structure

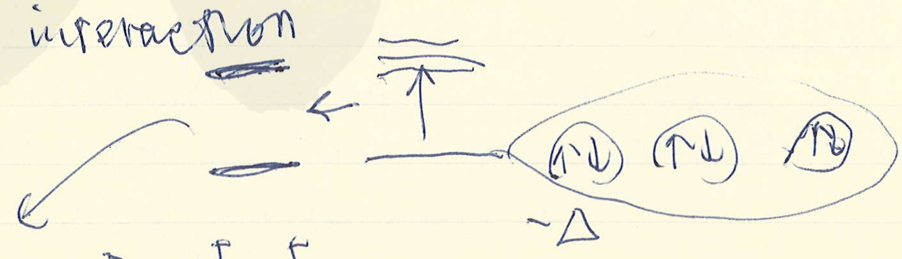
Finite Nuclei!!!

N-outside nucleon

Core

pairing energy

δ-fn interaction



$$H = \sum_{m+m'=0} a^{\dagger}_m a^{\dagger}_{m'} a_n a_{n'}$$ short range

+ long range effect

↓

Large

Rainwater

deformation

↓

$\sim \Delta \propto N$ $\quad$ $\sim \Delta \sim N^2$

$N = N_0$

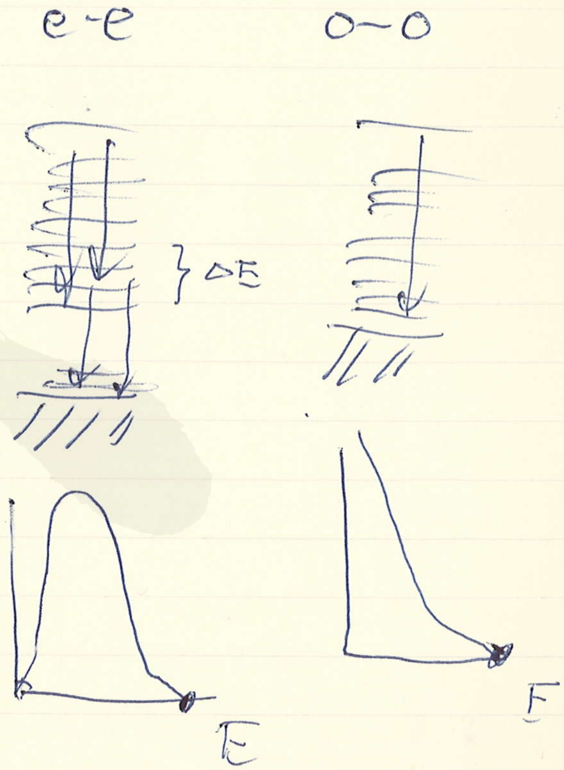
Gauche? Russian?

Th - γ-ray spectrum

even - even

odd - odd

energy gap.



Sept. 10 Morning
Session A 17
Chairman: Y. Kawa

Lunch at Richmond Hotel
invited by Perrin

Evening:
7.30 : Dinner at Minister Kawasaki's
residence
8.15 : Dinner at Hôtel de la Paix
invited by German Minister Balke

Sept 11. Morning
A 19: Nuclear structure
Weisskopf:

Otsuki:

Sept 12:

Sept 13: Closing session
Ses. 23. a supply and Training of technical personnel (Panel discussions)

Migulin, IAEA fellowships proprogram
1. Technical staff of immediate need
2. specialists
3. Research workers

I. Type
Grant fellowship of IAEA enough for tuition etc.

II. Type
Fellowship offered by national Institutions

Type I
$ 25 ~ 30, 000

Type II
14 countries (including Japan)
300 fellowships in national institutions

1959 programme:
Research fellowship

Euratom?

Session 23b. International collabor.
in latest few years.

Bhabha, Canada - India Loop. NRX
$ 15 million

Emelyanov, USSR

Rabi, USA
IAEA
CERN

Boer, Netherlands, Radioactive contamination
in western Europe.
Power Reactor: 100 MW (Fitzgerald)
300 km

Merchant ships
50 MW
10% fission into water
after 100 days: 500 curies
(International) Rivers
International controle

Jolles, IAEA
from bilateral → international
regional group

thermonuclear power problem

Toyoda: International agreement for shipping of nuclear fuel for reprocessing?
Bohr: Yes.

Perrin: Concluding Address
Fusion
π - e
3rd Conference: twice as large?
every 4 years.

Unesco Conference
on Social and Moral
Implications of A Peaceful Use
of Atomic Energy
Paris, New UNESCO Building,
Sept. 15 ~ 18, 1958

Auger:
Peaceful use of nuclear explosives
Yukawa
Doubt about it

Sept. 15, 10.00 ~ 12.30: Unesco
Yukawa: suggestions on science
education
Interdependence on and interpenetration
~~of~~ into each other of
different branches of science
also of various human activities
such as science, industry, literature,
art, philosophy. etc

Sept. 18
Paris 5.30 p.m } AF730
Wien 9.30 p.m.
Ambassador Furuuchi
Ambassador Hotel

Sept. 19
12 a.m. i Fujioka
Prater Restaurant
Mrs. Fujioka
Stadtpark – Parliament
– Rathaus – Stephankirche

Vienna
(Kitzbühel Conference)
Sept. 20, 1958

Sept. 20: 9.30 a.m.
Old University (Academy)
President of Austria
Lord Russell
Powell
Thirring
Luncheon at Hofburg

4 p.m. City Hall (new big building, 10,000 audience)
Public meeting

Sept. 21

7.30 p.m.: Stadtoper, Tosca

Sept. 22
11.00 a.m.: Schönbrunn palace
→ Beethoven 等の墓地
15.50: Vienna airport (SK 979)
for Copenhagen

Copenhagen

Institute for Theoretical Physics

Sept. 1958

Sept. 23 8.45 pm arrive
Copenhagen airport from
Vienna
stay at Ambassador Tatsuke's
Residence in Charlottenlund

Sept. 24 Rain, cold
10 am; Danish Newspaperman (Ekstra-bladet)
11 am; Kamefuchi

1 pm; lunch with Prof. and Mrs.
Niels Bohr

Sept. 25 Cloudy
11 am Charlottenlund — Deer Park
— Hillerød — Frederiksborg
Slot — Fredensborg Slot
— Restaurant
— Helsingør — Kronborg Slot
— Charlottenlund — Tea
at Prof. N. Bohr's Residence
7 pm Dinner at Ambassador's
Residence with Sakata, Suzuki.
Sakamoto's magic.

Sept. 26, Friday
2.30: Institute for Theoretical Physics

3.30: Colloquium: Non-linearity and
Non-locality in Field Theories