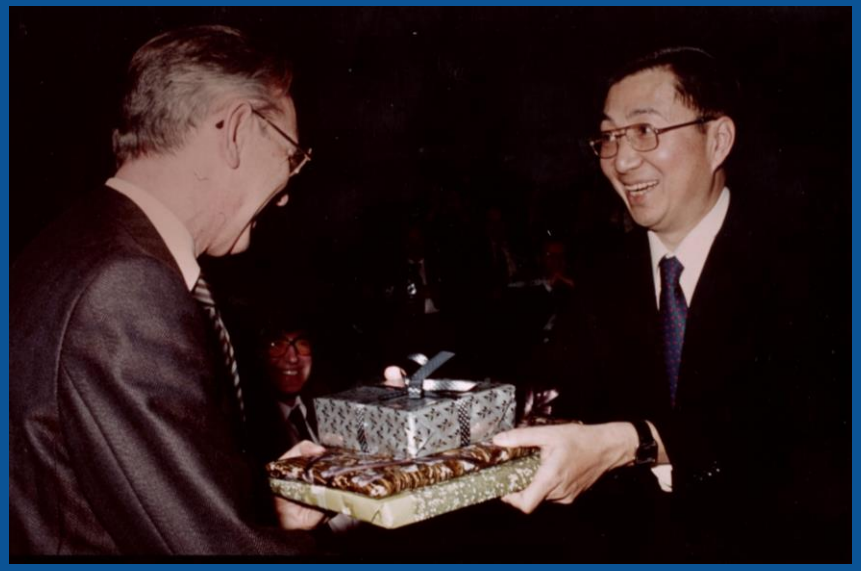
In Celebration of

Herwig Schopper's 100th Birthday



60th birthday celebration, DESY, Feb. 1984

Discussions on L3, Oct. 1993

Discussions on AMS, 1998

In honor of his unique achievements in physics, leadership in international science collaboration, indomitable spirit, and curiosity of nature.

CONTRIBUTIONS to PHYSICS

Optics and solid state physics

Nuclear physics

Elementary particle physics

Detector development

Accelerator technology

MORE THAN THREE HUNDRED PUBLICATIONS

Optics and solid state physics

R. Fleischmann und H. Schopper,
Die Bestimmung der optischen Konstanten und der Schichtdicke absorbierender Schichten mit Hilfe der Messung der absoluten Phasenänderung
Z. Physik 129, 285 (1951)

R. Fleischmann und H. Schopper,
Verfahren zur genauen Messung absoluter Lichtphasen an nichtabsorbierenden und absorbierenden Schichten
Z. Physik, 130, 304 (1951)

H. Schopper
Die Untersuchung 'dicker' Metallschichten und ihrer Oberflächenschichten mit Hilfe der absoluten Phase
Z. Physik 130, 427 (1951)

H. Schopper
Die Untersuchung 'dünner' absorbierender Schichten mit Hilfe der absoluten Phase
Z. Physik, 130, 565 (1951)

H. Schopper
Die Bestimmung der optischen Konstanten und der Schichtdicke beliebig dicker Schichten mit Hilfe der absoluten Phase
Z. Physik 131, 215 (1952)

R.Fleischmann und H.Schopper
Ein photometrisches Präzisionsverfahren zur Messung absoluter Lichtphasen mit Hilfe eines phasengleichen Gesichtsfeldes
Z. Physik 131, 225 (1952)

H.Schopper
Zur Optik dünner doppelbrechender und dichroitischer Schichten
Z. Physik 132, 146 (1952)

H.Schopper
Die Erzeugung von linear polarisiertem Licht mit Hilfe einer dünnen absobierenden Schicht
Optik 9, 498 (1952)

H. Schopper
Zur Deutung der optischen Konstanten der Alkalimetalle
Z. Physik 135, 163 (1953)

H. Schopper
Die Erzeugung von linear polarisiertem Licht durch Reflexion an beschichteten Metallen
Optik 10, 426 (1953)

H. Schopper
Ein optisches Kalkspatinterferometer mit wellenlängenunabhängigem Intensitätsausgleich
Z. Physik 135, 516 (1953)

H. Schopper
Die optischen Anomalien und der Aufbau dünner Metallschichten
Fortschritte der Physik II, 275 (1954)

H. Schopper
Die optische Untersuchung der Diffusion von Metallen ineinander
Z. Physik 143, 93 (1955)

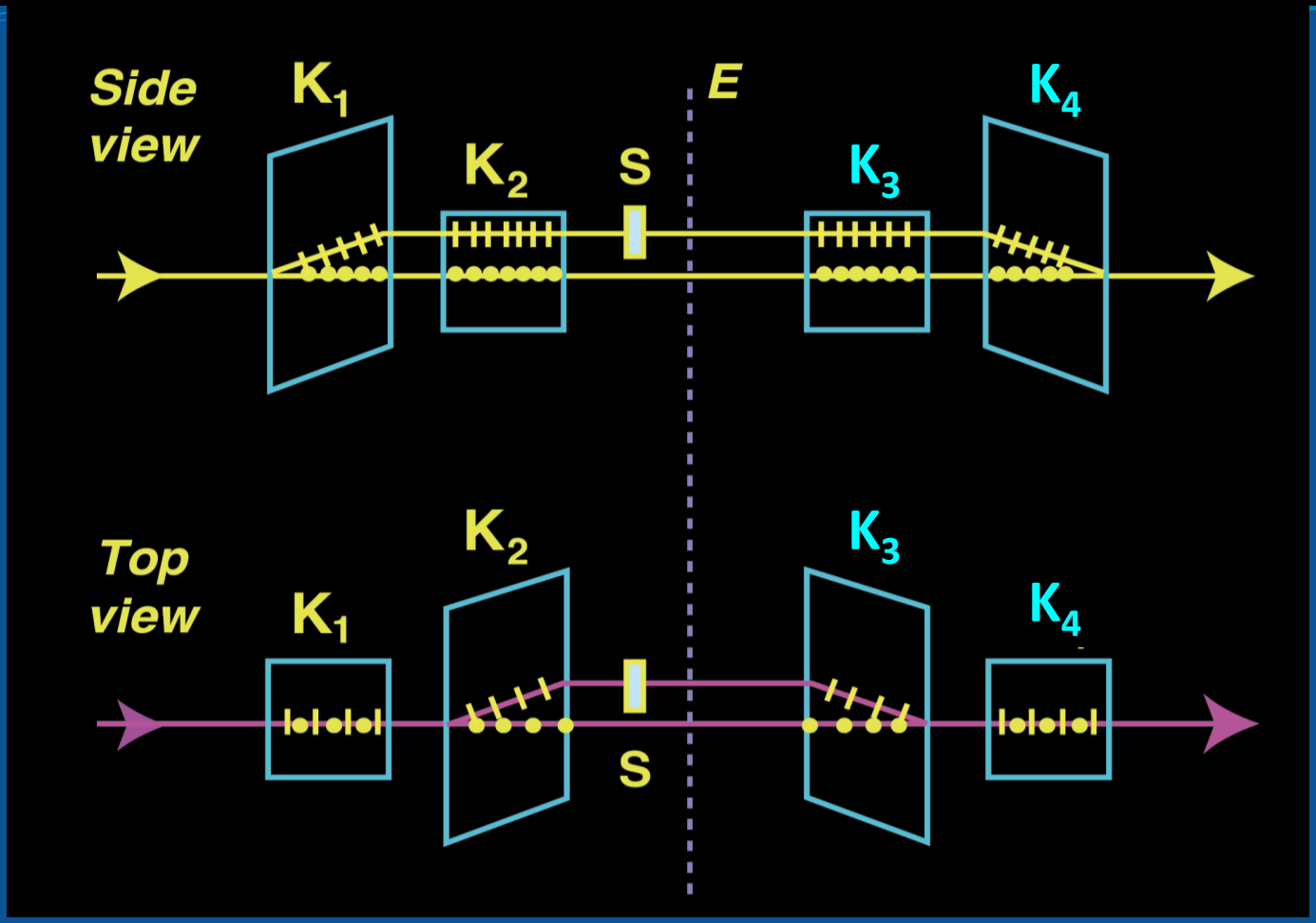
H. Schopper
Neuere optische Verfahren zum Bestimmen der Dicke dünnster Schichten, auch Korrosionsschichten
Forschung Bd. 22/Heft 2 (1956)

H. Schopper
Untersuchungen an dünnen Alkalimetallschichten
Zeitschr. f. Physik 174, 125-135 (1963)

15 PAPERS

An Interferometer which changes polarization independent of wave length

H. Schopper



Linearly polarized light hits K_1 which divides it into two linearly polarized bundles.
Both then hit K_2 (rotated by 90°).
Both bundles after K_2 have passed the same optical length and have the same phase.
K_3 and K_4 are arranged mirror-symmetrically → both bundles join together again.
S causes change of phase of one bundle → elliptically polarized light which can be measured.

Nuclear Physics

H. Schopper
Circular Polarization of γ-rays: Further Proof for Parity Failure in β Decay
The Phil. Mag. ***2****, 710 (1957)*

S. Galster and H. Schopper
Circular Polarization of Internal Bremsstrahlung Produced by β-Rays
Phys. Rev. Lett. ***1****, 506 (1958)*

H. Schopper and H. Müller
Lepton Conservation and Time Reversal in β-decay
Il Nuovo Cimento X, ***13****, 1026 (1959)*

G. Hartwig and H. Schopper
β –γ Circular Polarization Correlation of Sb^{124}
Phys. Rev. Lett. ***4****, 293 (1960)*

S. Galster and H. Schopper
Circular Polarization of Internal Bremsstrahlung Accompanying β Decay
Phys. Rev. Lett. ***4****, 295 (1960)*

P. Bock and H. Schopper
Search of a Parity Violation in the Nucleon-Nucleon Interaction
Phys. Lett. ***16****, 284 (1965)*

P. Bock, B. Jenschke, H. Schopper
Search of a Parity Mixing in 180Hf by a Measurement of the Circular Polarization of γ Rays
Phys. Lett. ***22****, 316 (1966)*

…

33 PAPERS

Circular Polarization of γ-rays : Further Proof for Parity Failure in β Decay

By H. Schopper
Cavendish Laboratory, Cambridge†

[Received March 14, 1957]

Lee and Yang (1956) suggested several experiments for testing the conservation of parity in weak interactions. Two of these have been performed (Wu *et al.* 1957, Garwin *et al.* 1957‡) and have shown that parity is not conserved. Results of a third experiment (thought impracticable by Lee and Yang) are reported here. They confirm the expectation that the γ-rays emitted after β-decay at an angle θ relative to the β-particle should show circular polarization proportional to $\cos\theta$.

The Phil. Mag. **2**, 710 (1957)

Circular Polarization of γ-rays: Parity Violation in β Decay

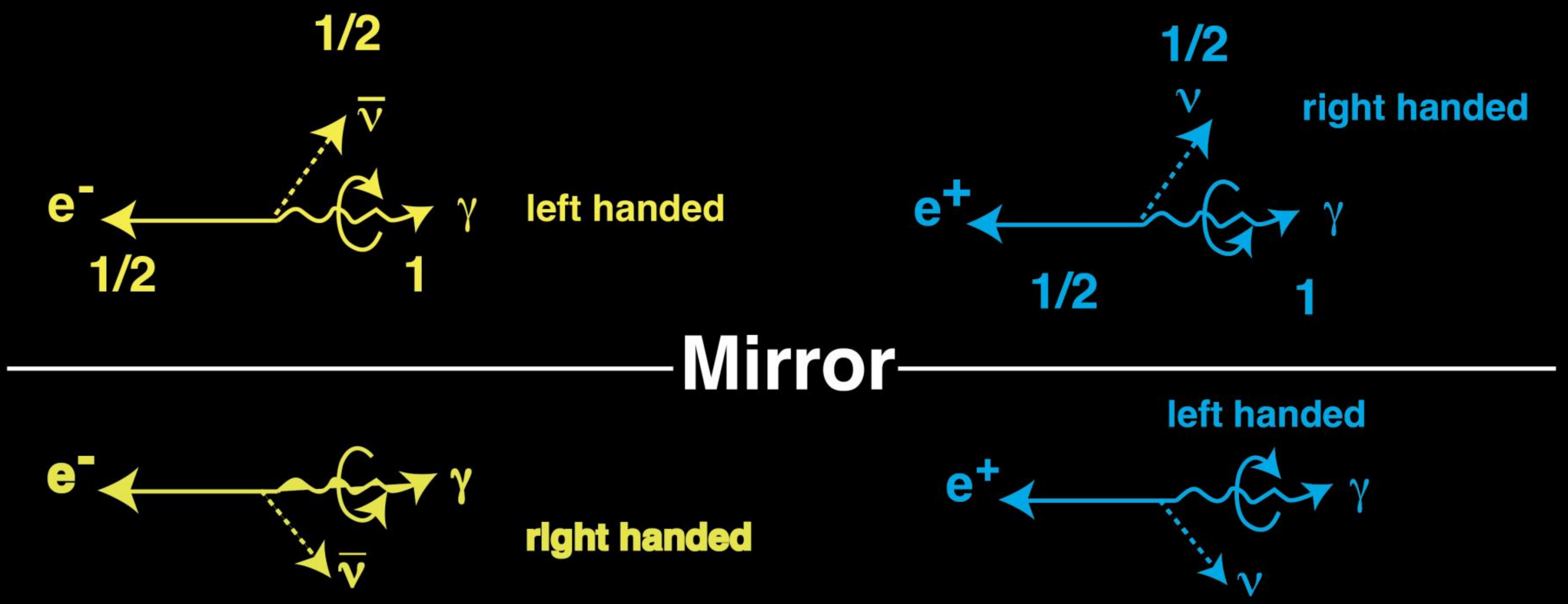
$$^{60}Co \rightarrow {}^{60}Ni^{**} + e^- + \bar{\nu}$$

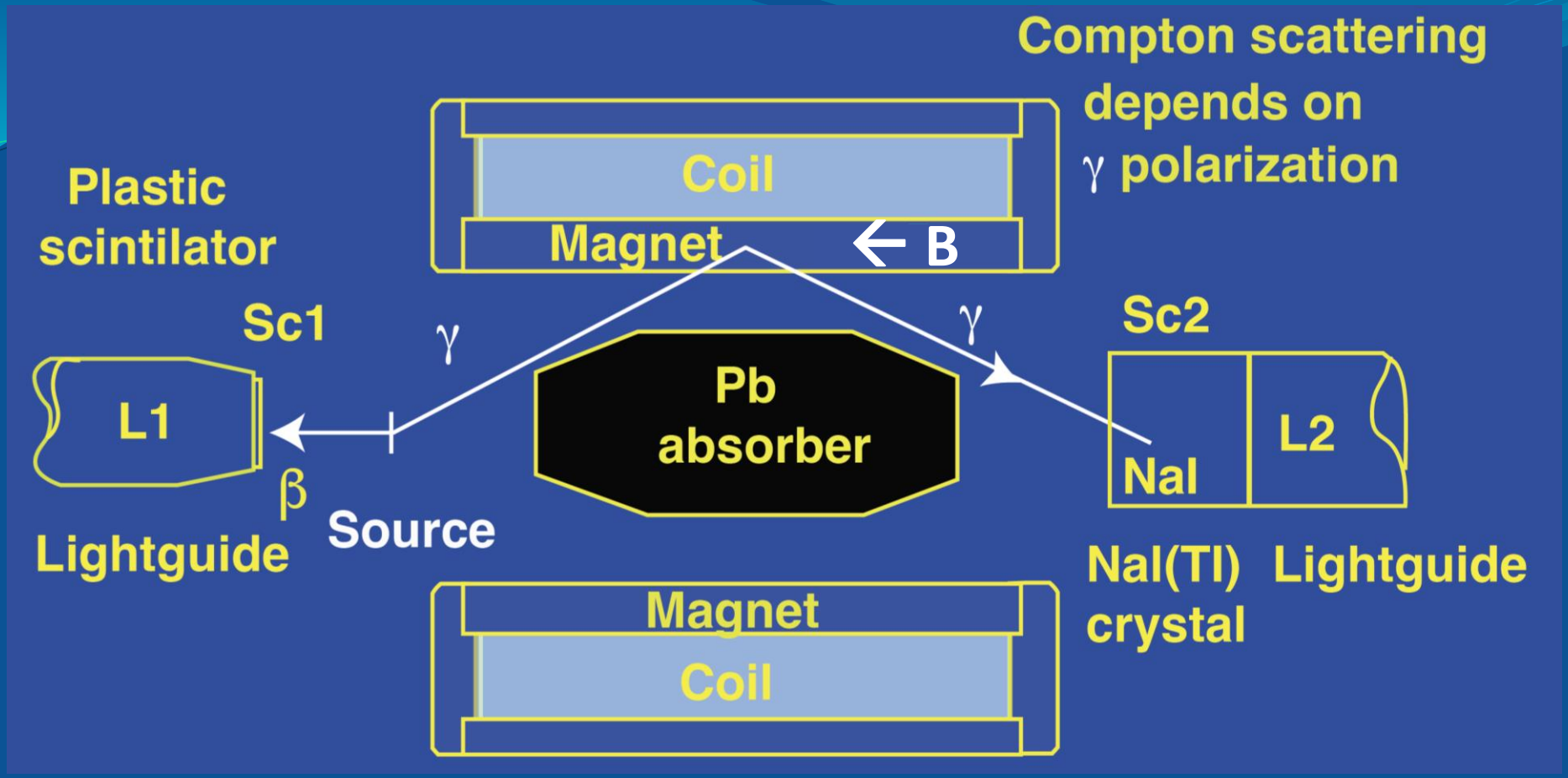
$$\quad \hookrightarrow {}^{60}Ni^{*} + \gamma$$

$$\qquad \hookrightarrow {}^{60}Ni + \gamma$$

$$^{22}Na \rightarrow {}^{22}Ne^{*} + e^+ + \nu$$

$$\quad \hookrightarrow {}^{22}Ne + \gamma$$





$$Asy = \frac{B\uparrow - B\downarrow}{B\uparrow + B\downarrow}\ (\%)$$

		polarization (%)
^{60}Co	+2.16 ± 0.36	+26 ± 4
^{22}Na	–2.33 ± 0.52	–28 ± 6

CONCLUSION

- **Polarization non-zero**
  ➔ parity violated

- Co **and** Na **give opposite polarization**
  ➔ neutrino and antineutrino have opposite helicity

Symposium at CERN in honor of Madame C.S. Wu's 80th birthday organized by H. Schopper

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professor s. ting
desy

i wish to join in paying a warmly felt tribute to herwig schopper on his 60th birthday. my first contact with herwig was in 1957 when he made those remarkable experimental measurements in beta-decay which went far to establish the v-a theory. herwig's beautiful experimental work is matched by his appreciation of beautiful ideas in theory. subsequently we have been together at numerous conferences at desy, in the united kingdom, the soviet union, the united states and, of course, at cern. and of course i have had the pleasure of receiving from him as director general the first cabled news of the discovery of the w's and the z's. i salute his personal graciousness on the occasion of this birthday and wish him many happy returns.

abdus salam
director, ictp trieste =

+
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from Abdus Salam
on the occasion of your 60th birthday

Lepton Conservation and Time Reversal in β-decay.

H. SCHOPPER and H. MÜLLER

Institut für Kernphysik - Universität Mainz

(ricevuto il 17 Giugno 1959)

Summary. — It was investigated which conclusions can be inferred from β-decay experiments taking into account experimental errors but without making theoretical assumptions.

Prior to the time of parity violation in β-decay it was thought that the only way to test the conservation of leptons was the double β-decay or the inverse β-decay. However, discussing the theoretical results obtained by PAULI (1), KAHANA and PURSEY (2) and LÜDERS (3) in the light of the recent experiments it becomes evident that lepton conservation can be checked only in single β-decay experiments (*). Furthermore it can be shown that the negative result found in ordinary time reversal experiments allows no conclusion about time reversal invariance as long as maximum breakdown of parity or conservation of lepton charge has not been established.

1. – General considerations.

The discussion of β-decay is usually based upon the interaction density (**)

$$(1)\qquad \left\{\begin{array}{l} \mathcal{H} = \sum_{i,\alpha} \bar{\psi}_p O_i \psi_n [\bar{\psi}_e O_i (C_i \psi_\alpha + D_i \gamma_5 \psi_\alpha^c)] + \text{h. c.} \\ i = S, V, T, A, P \qquad \psi_R = (1-\gamma_5)\psi_\nu \qquad \psi_R^c = (1-\gamma_5)\psi_\nu^c , \\ \alpha = R, L \qquad\quad \psi_L = (1+\gamma_5)\psi_\nu \qquad \psi_L^c = (1+\gamma_5)\psi_\nu^c , \end{array}\right.$$

(1) W. PAULI: *Nuovo Cimento*, **6**, 204 (1957).

(2) S. KAHANA and D. L. PURSEY: *Nuovo Cimento*, **6**, 1469 (1957).

(3) G. LÜDERS: *Nuovo Cimento*, **7**, 171 (1958).

(*) We shall not consider here the decay of mesons which might involve different kinds of interactions.

(**) We use the notation of KAHANA and PURSEY (2).

Among the first phenomenologic papers to study time reversal

Elementary Particle Physics

At Cornell 1.3 BeV and DESY electron accelerator

- Structure of the proton and neutron,
  Phys.Rev.Lett. ***7****, 141 and 144 (1961) and 6, 286 (1961)*

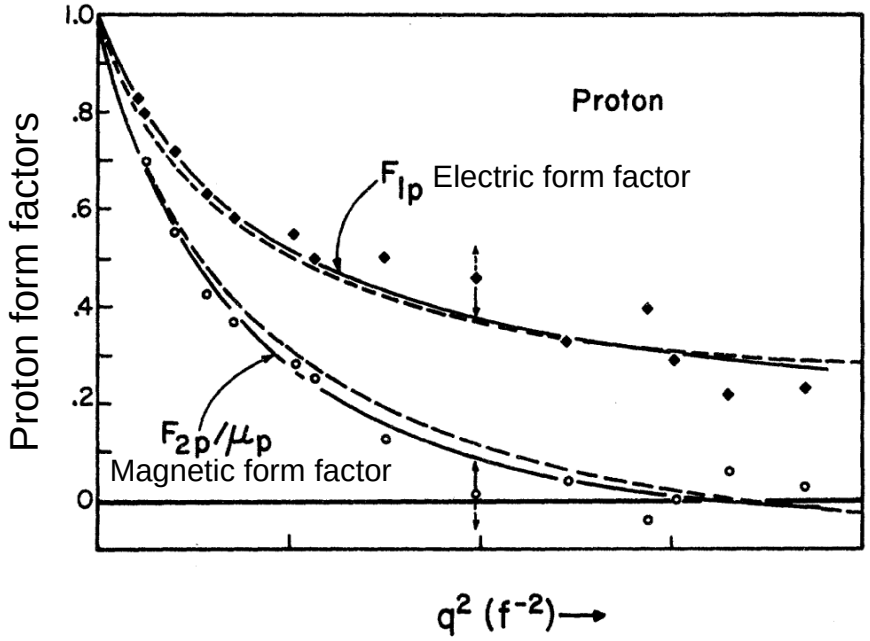
- Form factors of the proton and neutron,
  Phys.Rev.Lett. ***6****, 286 (1961).*

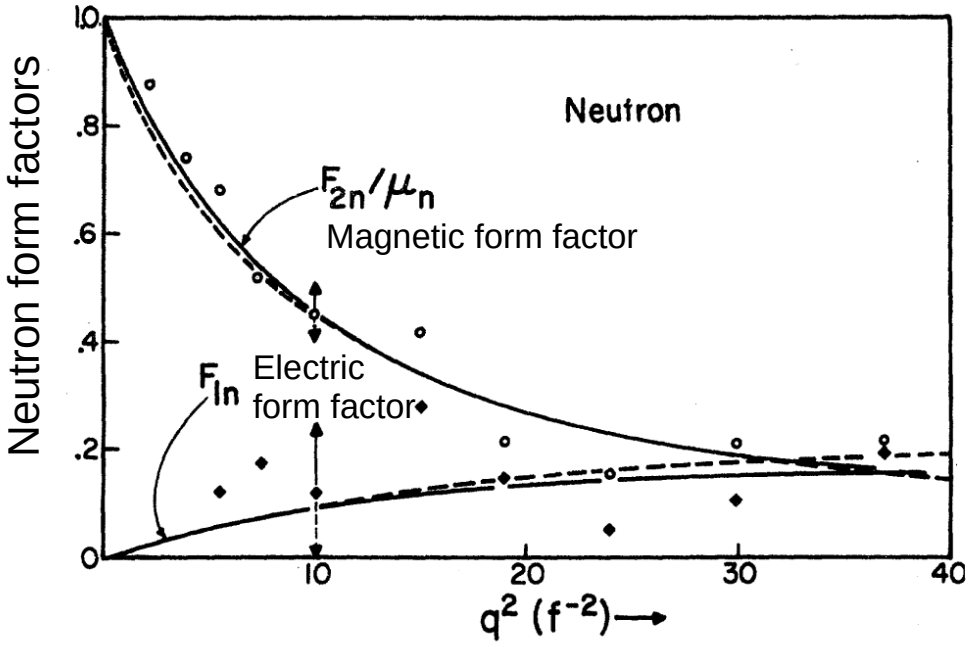
- Elastic electron-proton scattering at momentum transfers up to 110 fermi^{-2},
  Nuov.Cim. ***48****, 140 (1967) and other publications*

SCATTERING OF Bev ELECTRONS BY HYDROGEN AND DEUTERIUM*

R. M. Littauer, H. F. Schopper,† and R. R. Wilson
Laboratory of Nuclear Studies, Cornell University, Ithaca, New York

(Received July 21, 1961)





Our values of F_{1n}/μ_n are positive and between 0.1 and 0.2, in agreement with the earlier Stanford results calculated with a modified Jankus theory.

This disagrees, however, with the reinterpretation of the Stanford results by Durand, which yields values of F_{1n}/μ_n that are small or may even go negative.

IL NUOVO CIMENTO Vol. XLVIII A, N. 1 1° Marzo 1967

Elastic Electron-Proton Scattering at Momentum Transfers up to 110 fermi^{-2}.

H. J. Behrend, F. W. Brasse, J. Engler and H. Hultschig

Deutsches Elektronen Synchrotron - Hamburg

S. Galster, G. Hartwig and H. Schopper

Institut für Experimentelle Kernphysik der Technischen Hochschule und des Kernforschungszentrums Karlsruhe - Karlsruhe

E. Ganssauge

Physikalisches Institut der Universität - Marburg

(ricevuto il 19 Settembre 1966)

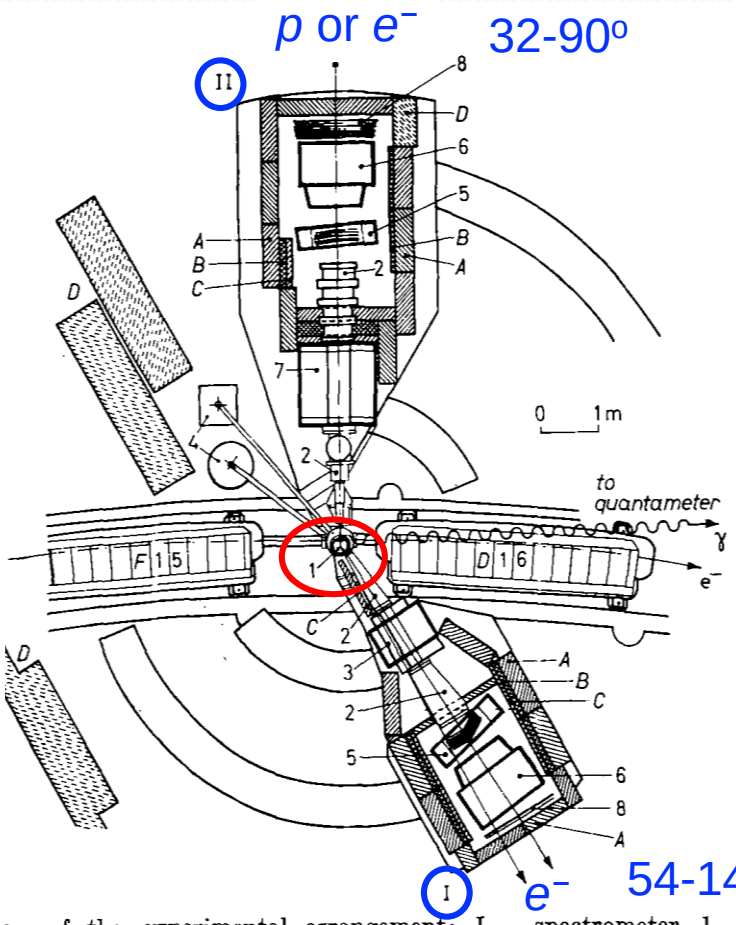


Fig. 1. – Plan of the experimental arrangement: I - spectrometer 1, 54° ÷ 140°; II - spectrometer 2, 32° ÷ 90°; 1) scattering chamber with liquid H_2 target; 2) vacuum chamber with entrance slits; 3) halved quadrupole magnet QC/2; 4) target supply and He dewar; 5) scintillation counters; 6) gas Čerenkov counter (threshold); 7) quadrupole magnet QA; 8) shower counter; shielding: *A*) iron blocks; *B*) B_4C-CH_2 plates + paraffine; *C*) lead blocks; *D*) concrete blocks.

We first met in DESY in 1966

VOLUME 18, NUMBER 2 PHYSICAL REVIEW LETTERS 9 JANUARY 1967

VALIDITY OF QUANTUM ELECTRODYNAMICS AT SMALL DISTANCES

J. G. Asbury,* W. K. Bertram,† U. Becker, P. Joos, M. Rohde, and A. J. S. Smith*
Deutsches Elektronen-Synchrotron, Hamburg, Germany

and

S. Friedlander, C. Jordan, and C. C. Ting†
Department of Physics, Columbia University, New York, New York

(Received 7 November 1966)

Precision measurement of magnetic form factor

H. Schopper et al.

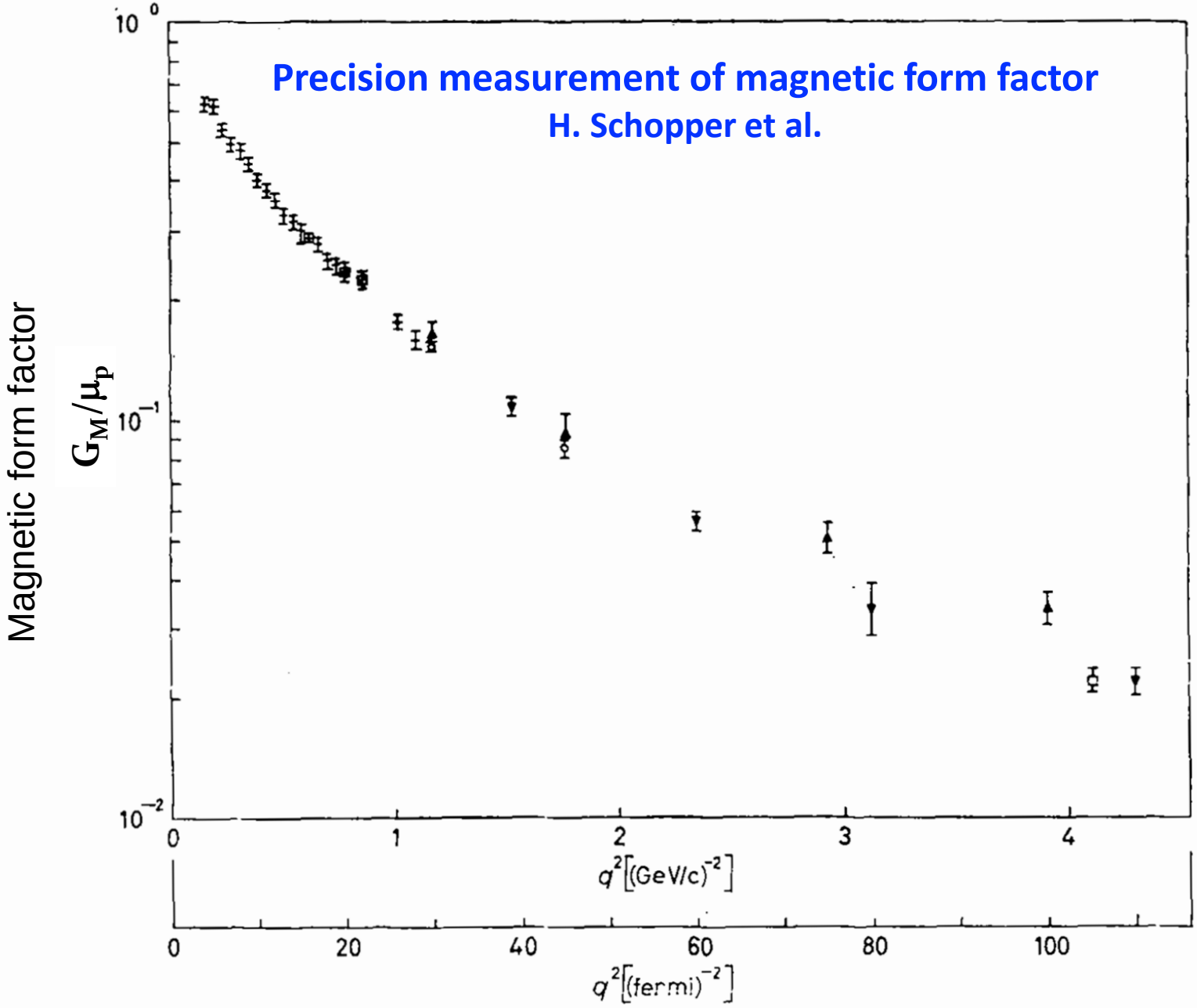


Fig. 13. – The magnetic form factor G_M/μ. + JANSSENS *et al.* (6); ▲ CHEN *et al.* (5); ▼ this work; ▫ combined data, see Table V; ○ combined data, see (14).

Precision measurement of electric form factor

H. Schopper et al.

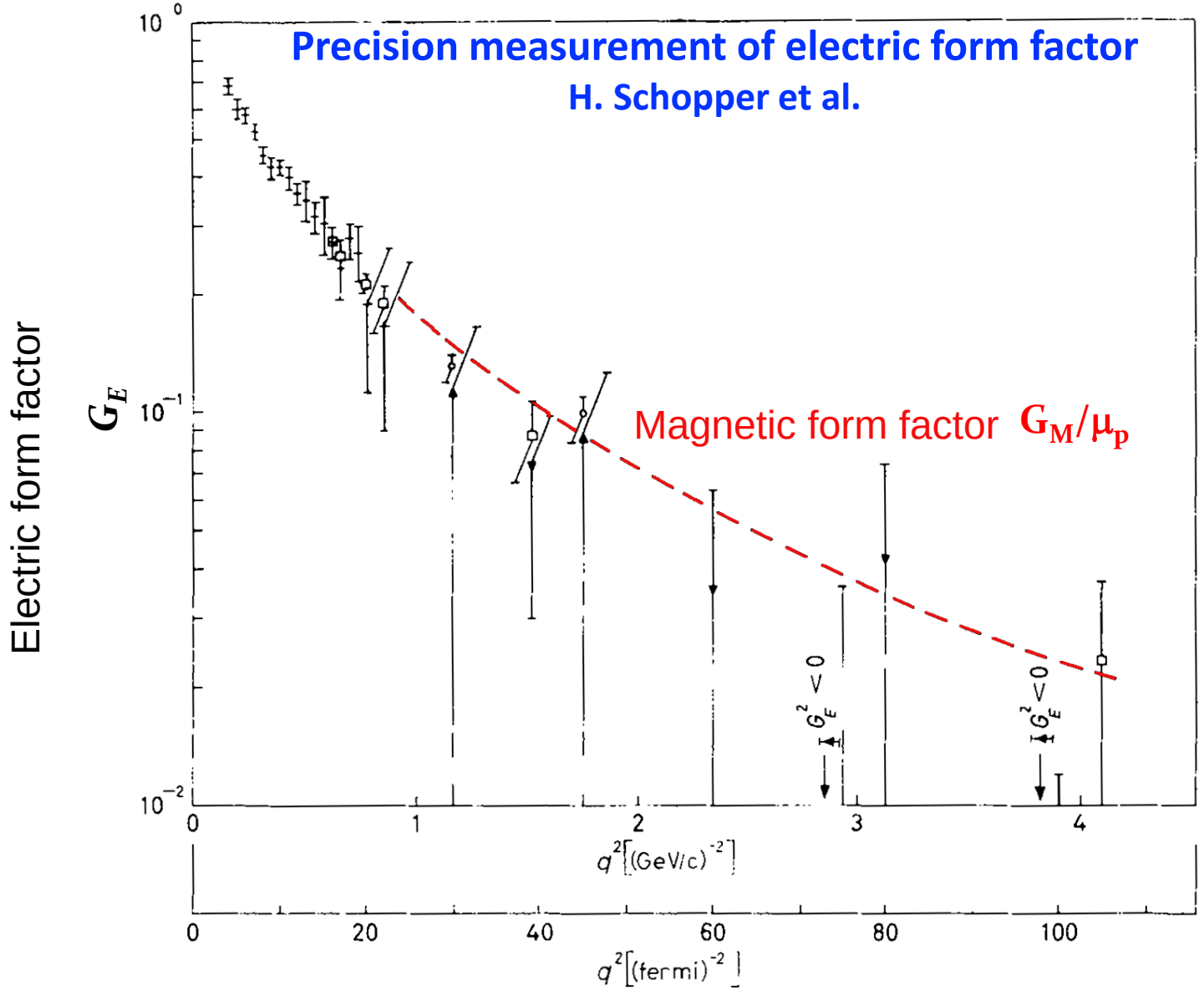


Fig. 14. – The electric form factor G_E *vs.* q^2. The dashed line is a smoothed curve of G_M/μ. + JANSSENS *et al.* (6); △ CHEN *et al.*; ▼ this work; □ combined data, see Table V; ○ combined data, see (14).

CONCLUSION

1. No Deviation from Rosenbluth Formula

2. Real values of G_E, G_M

$$G_E(q^2) = G_M(q^2)/\mu$$

Elementary Particle Physics

Unique Contribution on Neutron-Proton Physics

Neutron-Proton total cross section
Neutron-Nuclei total cross section, and
N-P elastic and charge exchange scattering,
were systematically studied at PS, ISR and Serpukhov…

Hadron calorimetry technique was invented to measure neutron energy and direction

Nucl. Instr. Meth. 106, 189 (1973)

Elementary Particle Physics

Neutron physics at CERN and Serpukhov

Total Cross Sections of n-p and n-d at 10 GeV/c Neutron Momentum
*Physics Letters **27B**, 599 (1968)*

n-p Elastic Scattering in the forward direction between 4 and 16 GeV
*Physics Letters **29B**, 321 (1969)*

n-p Total Cross Sections between 8 and 21 GeV/c
*Physics Letters **31B**, 669 (1970)*

n-A Total Cross Sections between 8 and 21 GeV/c
*Physics Letters **32B**, 716 (1970)*

Measurement of n-p Charge Exchange Scattering at 8, 19 and 24 GeV/c
*Physics Letters **34B**, 528 (1971)*

Inclusive Neutron Spectra at the ISR
*Nucl. Phys. **B84**, 70 (1975)*

N-P Elastic Scattering from 10 to 70 GeV/c
*Nucl. Phys. **B91**, 266 (1975)*

N-P Charge Exchange Scattering from 9 to 23 GeV/c
*Nucl. Phys. **B110**, 205 (1976)*

N-P charge exchange Scattering from 22 to 65 Gev/c
*Nuclear Physics **B110**, 189 (1976)*

NEUTRON-PROTON TOTAL CROSS-SECTIONS BETWEEN 8 GeV/c AND 21 GeV/c

Volume 3lB. number 10 PHYSICS LETTERS 11 May 1970

J. ENGLER, K. HORN, F. MOENNIG, P. SCHLUDECKER ,W. SCHMIDT-PARZEFALL. H. SCHOPPER *, P. SIEVERS
and H. ULLRICH
Institute Fur Experimentelle Kernphysik. Karlsruhe. Germany

R. HARTUNG and K. RUNGE
CERN, Geneva, Switzerland
and
Yu. GALAKTIONOV
Lnslitute.for Theoretical and Experimental Physics. Moscow. USSR
Received 6 April 1970

Neutron-proton total cross-sections were measured in the momentum range from 8 GeV/c to 21 GeV/c with an accuracy of better than 2~ using a 0 ° neutron beam at the CERN Proton Synchrotron.

The np total cross-section drops from 39.7 mb at 8 GeV/c to 38.5 mb at 21 GeV/c. and thus follows closely the pp total cross-sections in this momentum interval.

Physics Letters ***32B,*** *716 (1970)*

NEUTRON-NUCLEUS TOTAL CROSS-SECTIONS BETWEEN 8 GeV/c AND 21 GeV/c

J. ENGLER, K. HORN, F. MONNIG, P. SCHLUDECKER, W. SCHMIDT-PARZEFALL *, H. SCHOPPER *, P. SIEVERS * and H. ULLRICH
Institut für experimentelle Kernphysik der Universität und des Kernforschungszentrums, Karlsruhe, Germany

R. HARTUNG and K. RUNGE
CERN, Geneva, Switzerland

and

Yu. GALAKTIONOV
Institute for Theoretical and Experimental Physics, Moscow, USSR

Measure σ_T to 1% on Be, C, Al, Cu, Pb at 8, 11, 14, 21 GeV/c

If one fits the data to the formula,

$$\sigma_{tot} = 2\pi \{R^2 - \tfrac{1}{2} X_o^2 [\, 1 - (R^2/X_o + \Lambda)\exp(-R^2/X_o)]\}$$

where Xo is the mean free path of a neutron in nuclear matter, and $R = r_o A^{1/3}$,

Results:

a) The unit radius remains essentially constant $r_o = 1.25$ fm

b) Early measurements were wrong

c) The energy dependence of σ_{NA} is the same as σ_{pp} or σ_{NP}

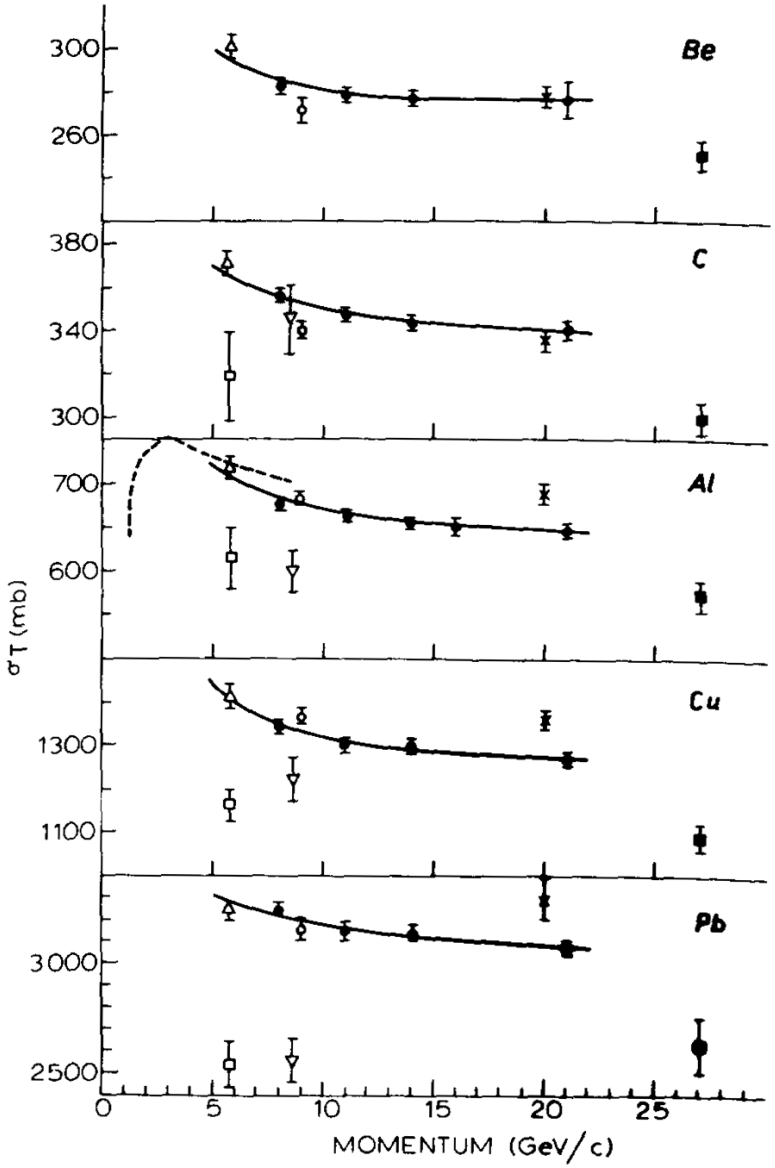


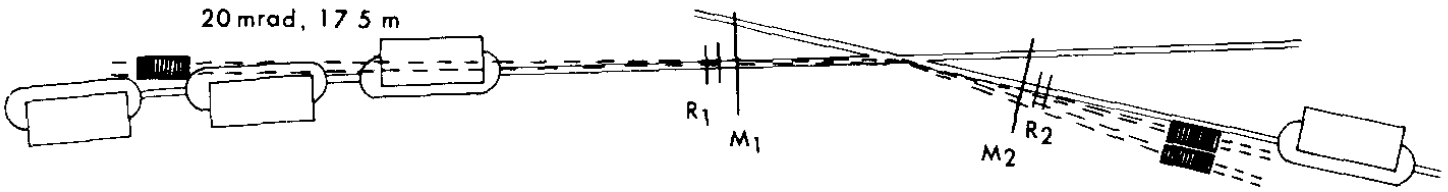
Fig. 1. Total cross-sections of neutrons and protons for nuclei. Neutron data points: ■ Ref. [3], Δ Ref. [4], ∇ Rev. [6], □ Ref. [7], ○ Ref. [2], ● this experiment. Proton data points: × Ref. [5], - - - Ref. [8]. The solid line is a handfit curve through the data points of Refs. [2], [4], and this experiment.

MEASUREMENT OF INCLUSIVE NEUTRON SPECTRA AT THE ISR*

J. ENGLER, B. GIBBARD, W. ISENBECK, F. MONNIG, J. MORITZ, K. PACK, K.H. SCHMIDT and D. WEGENER**
Institut fur Experimentelle Kernphysik, Karlsruhe, Germany

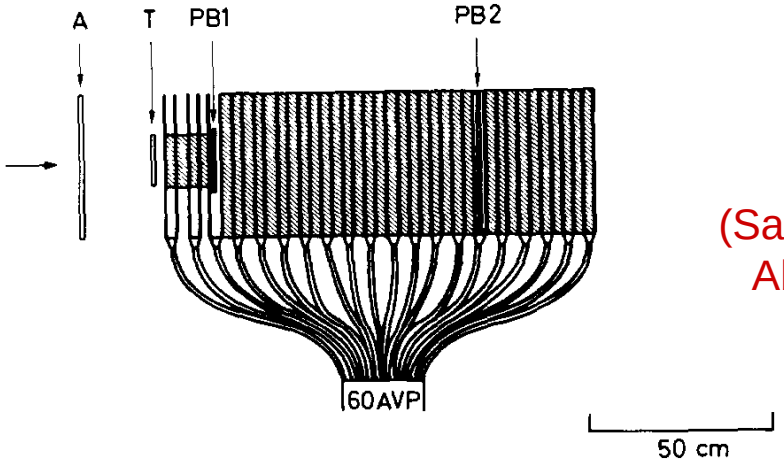
W. BARTEL***, W. FLAUGER*** and H. SCHOPPER***
CERN, Geneva, Switzerland

Position 1



Position 2 66 mrad, 6 8 m

Position 3 119 mrad, 6 8 m



(Sampling Total Absorption Calorimeter)

Fig. 1. Experimental set-up at the ISR and details of STAC.

Nucl. Phys. ***B84****, 70 (1975)*

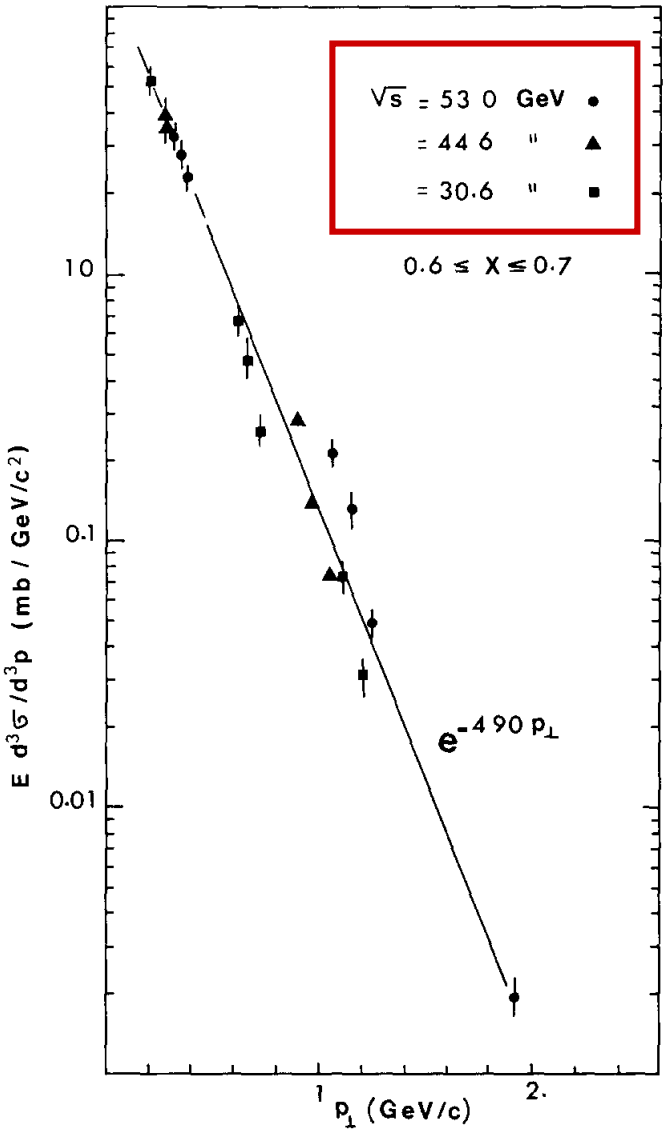


Fig. 5. Cross sections of neutron production as a function of transverse momentum $p_\perp$, high x region.

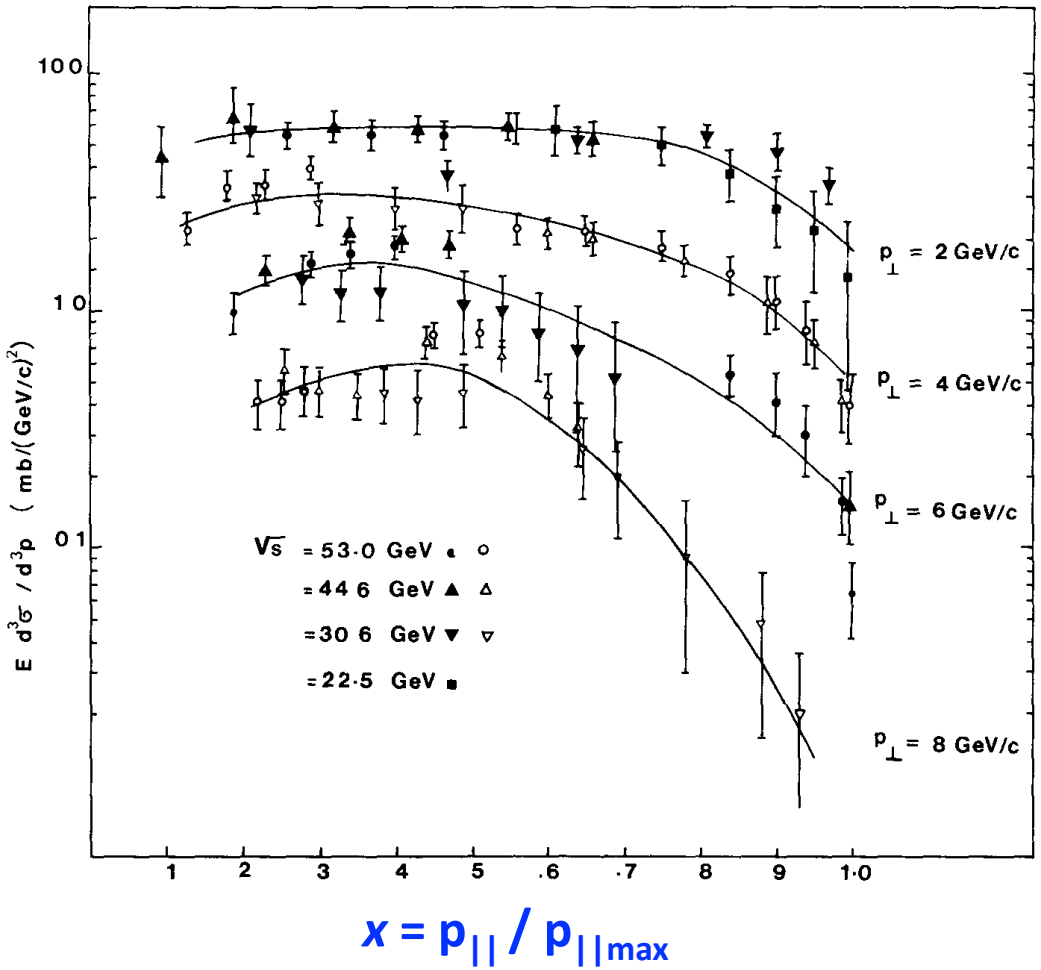


Fig. 6. Cross sections as a function of the Feynman variable x for different transverse momenta. The solid lines are given to guide the eye.

$$E\frac{d^3\sigma}{d^3p} = |G(t)|^2 \left(\frac{s}{M^2}\right)^{2\alpha(t)-1} \sigma_{tot}(M^2, t),$$

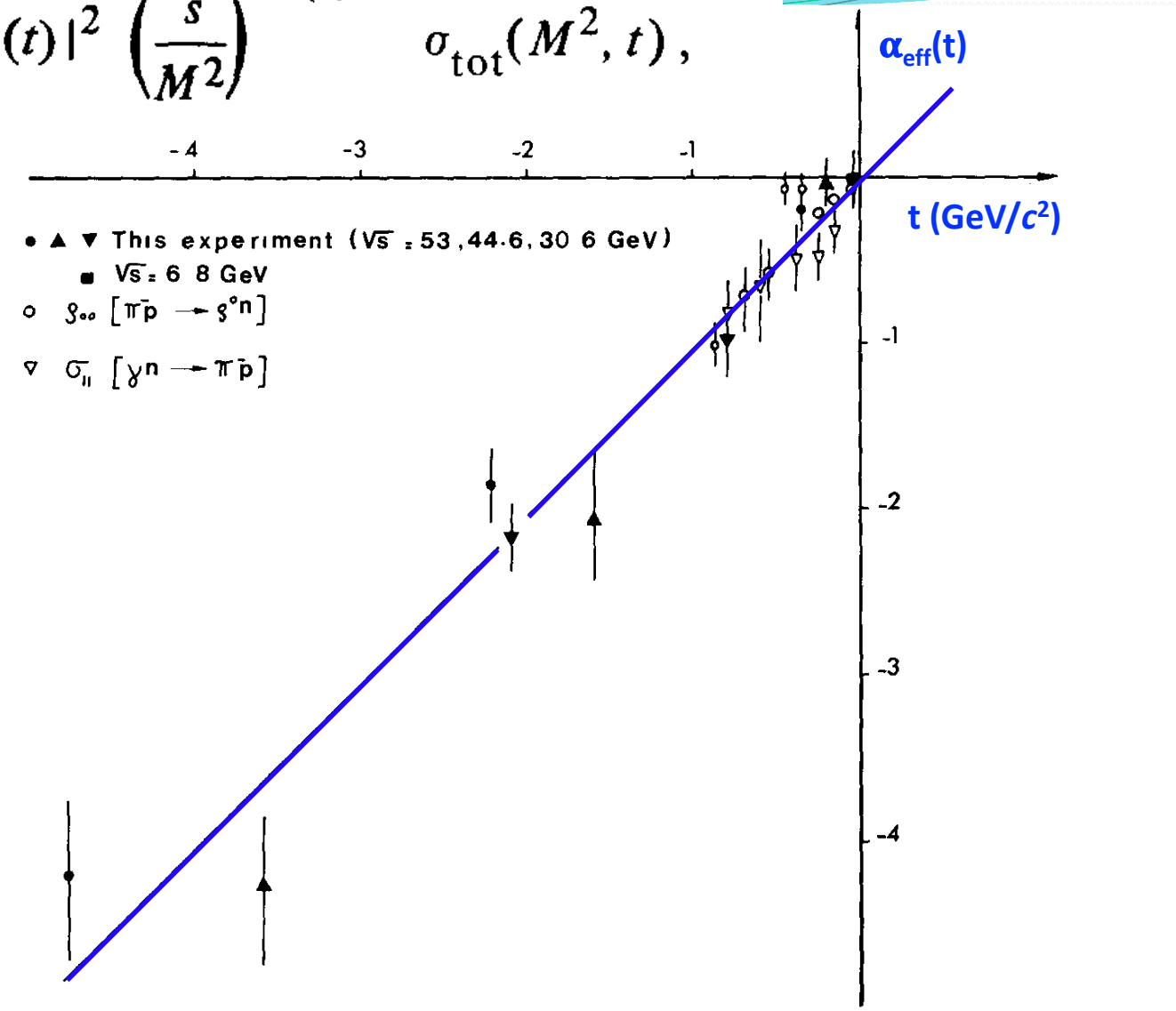


Fig. 8. The effective trajectory as determined from slopes of the inclusive neutron spectra

CONCLUSION

1. SCALING IN x AND $P_\perp$ (Independent of s)
2. NO PEAK AT x=1. (as in pp)
3. MEASURE POMERON TRAJECTORY

NEUTRON-PROTON ELASTIC SCATTERING FROM 10 TO 70 GeV/*c*

V. BÖHMER, J. ENGLER, W. FLAUGER*, H. KEIM, F. MONNIG
K. PACK and H. SCHOPPER*

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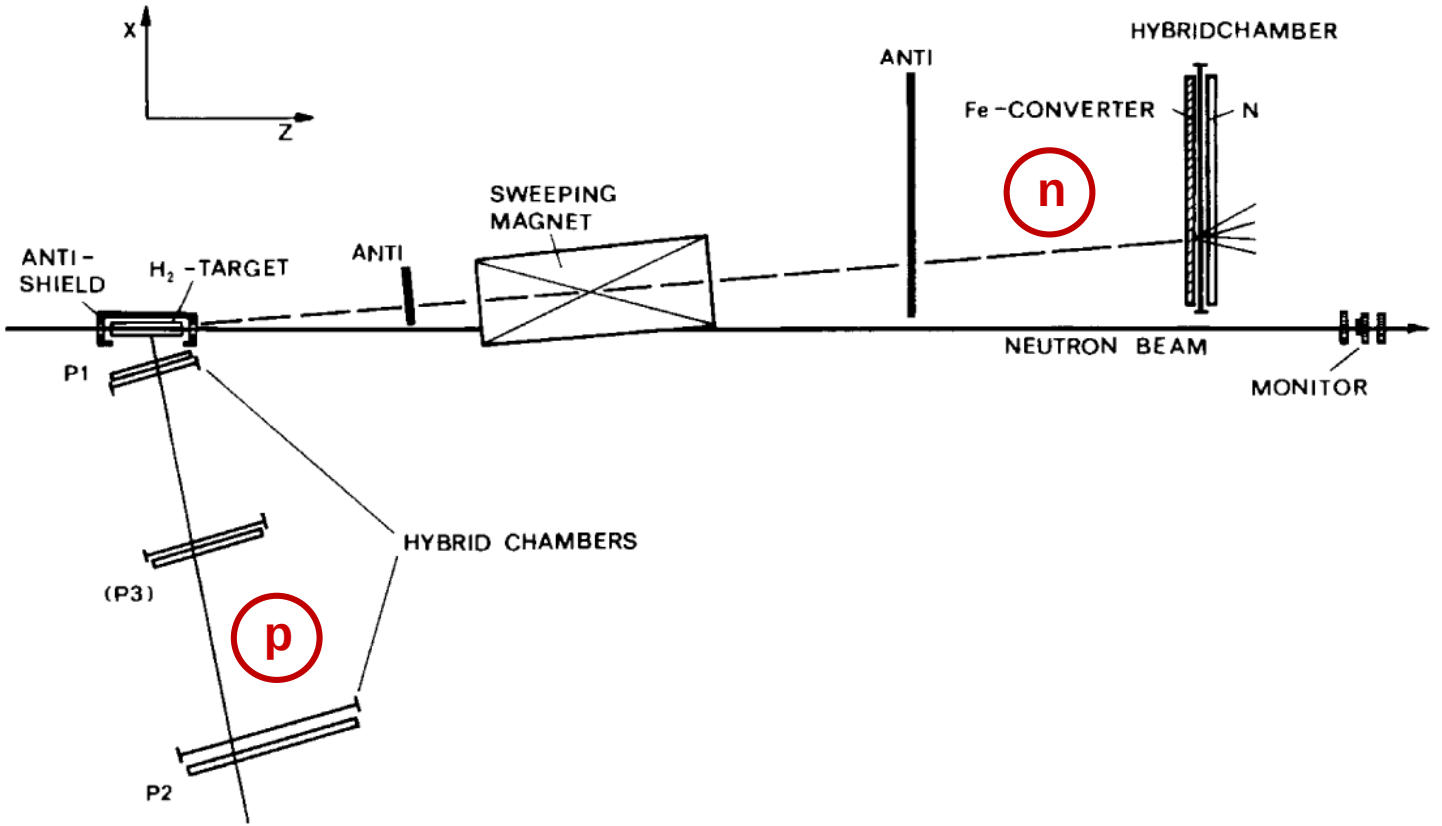

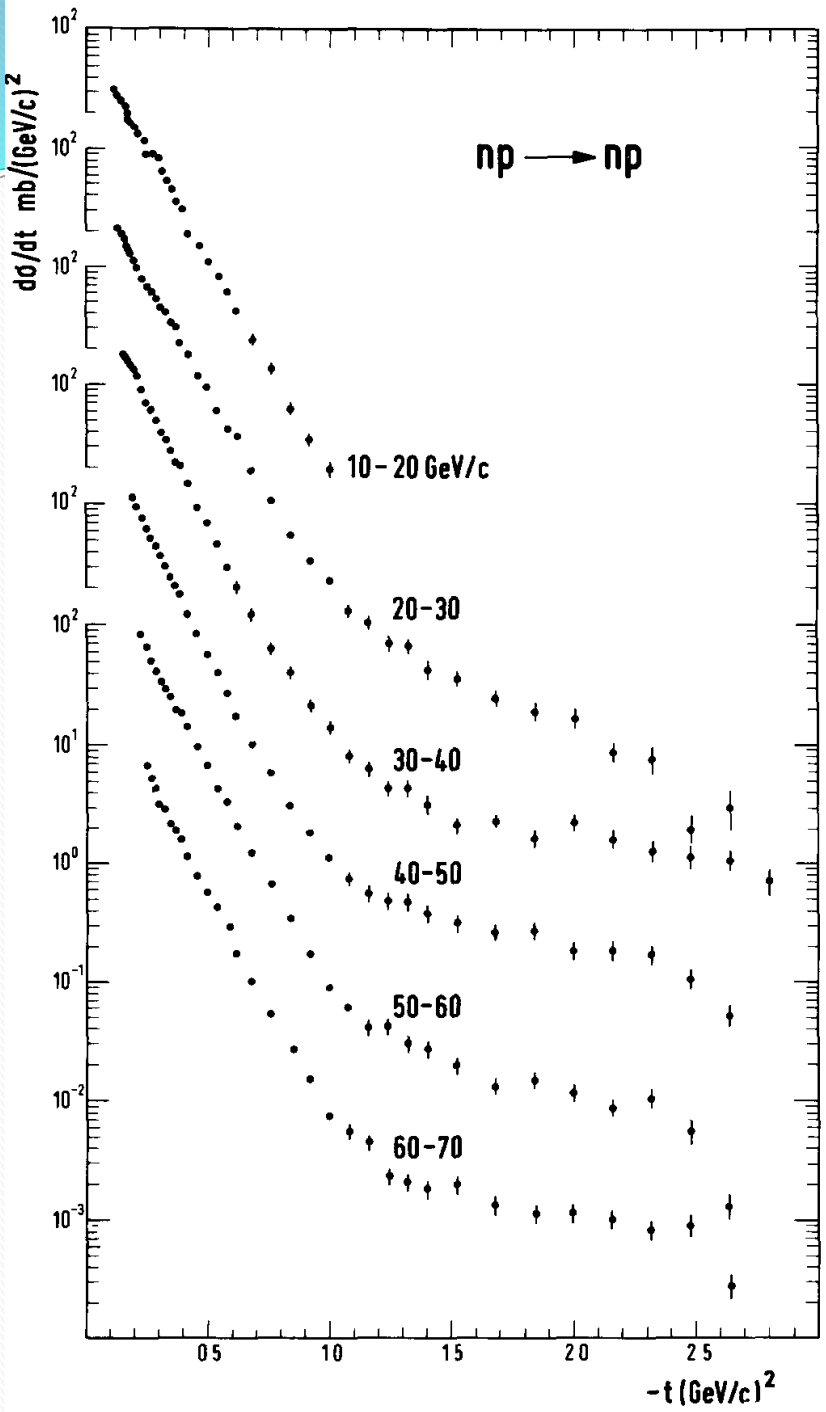

The forward peak and the break at about $|t| = 1$ GeV $/c^2$ are very similar to corresponding pp data

MEASUREMENT OF NEUTRON-PROTON CHARGE EXCHANGE SCATTERING AT 8, 19 AND 24 GeV/c

Volume 34B, number 6 PHYSICS LETTERS 29 March 1971

J. ENGLER, K. HORN, F. MONNIG, P. SCHLUDECKER, W. SCHMIDT-PARZEFALL *, H. SCHOPPER *, P. SIEVERS and H. ULLRICH
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CERN, Geneva, Switzerland
and
Yu. GALAKTIONOV
Institute for Theoretical and Experimental Physics, Moscow, USSR

Received 1O February 1971

The t-dependence of the differential cross-section for elastic neutron-proton charge exchange scattering has been measured at 8, 19.2 and 24 GeV/c. The extremely narrow peak in the forward direction, previously observed for momenta up to 8 GeV/c persists at the higher momenta, and the t-dependence shows practically no change with energy. Approximate values of the absolute cross-section were also determined for these momenta.

NEUTRON-PROTON CHARGE-EXCHANGE SCATTERING FROM 22 TO 65 GeV/c

Nuclear Physics BIIo (1976) 189-204© North-Holland Publishing Company

A. BABAEV, E. BRACHMANN, G. ELISEEV, A. ERMILOV,
Yu. GALAKTIONOV, Yu. GORODKOV, Yu. KAMISHKOV, E. LEIKIN,
V. LUBIMOV, V. SHEVCHENKO, V. TIUNCHIK and O. ZELDOVICH
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V. BOHMER, J. ENGLER, W. FLAUGER *, H. KEIM, F. MONNIG,
K. PACK and H. SCHOPPER *
InstitutfuerExperimentelleKernphysik, Karlsruhe, Germany and CERN, Geneva, Switzerland

Received 9 October 1975
(Revised 22 March 1976)

The differential cross sections for neutron-proton elastic charge-exchange scattering have been measured with a two-arm technique for incident neutron momenta between 22 and 65 GeV/c and for values of the momentum transfer squared between 0.002 and 0.8 (GeV/c) 2. **The sharp forward peak observed previously at lower energies is also present at momenta up to 65 GeV/c; however the s dependence of the cross section is slowing down.**

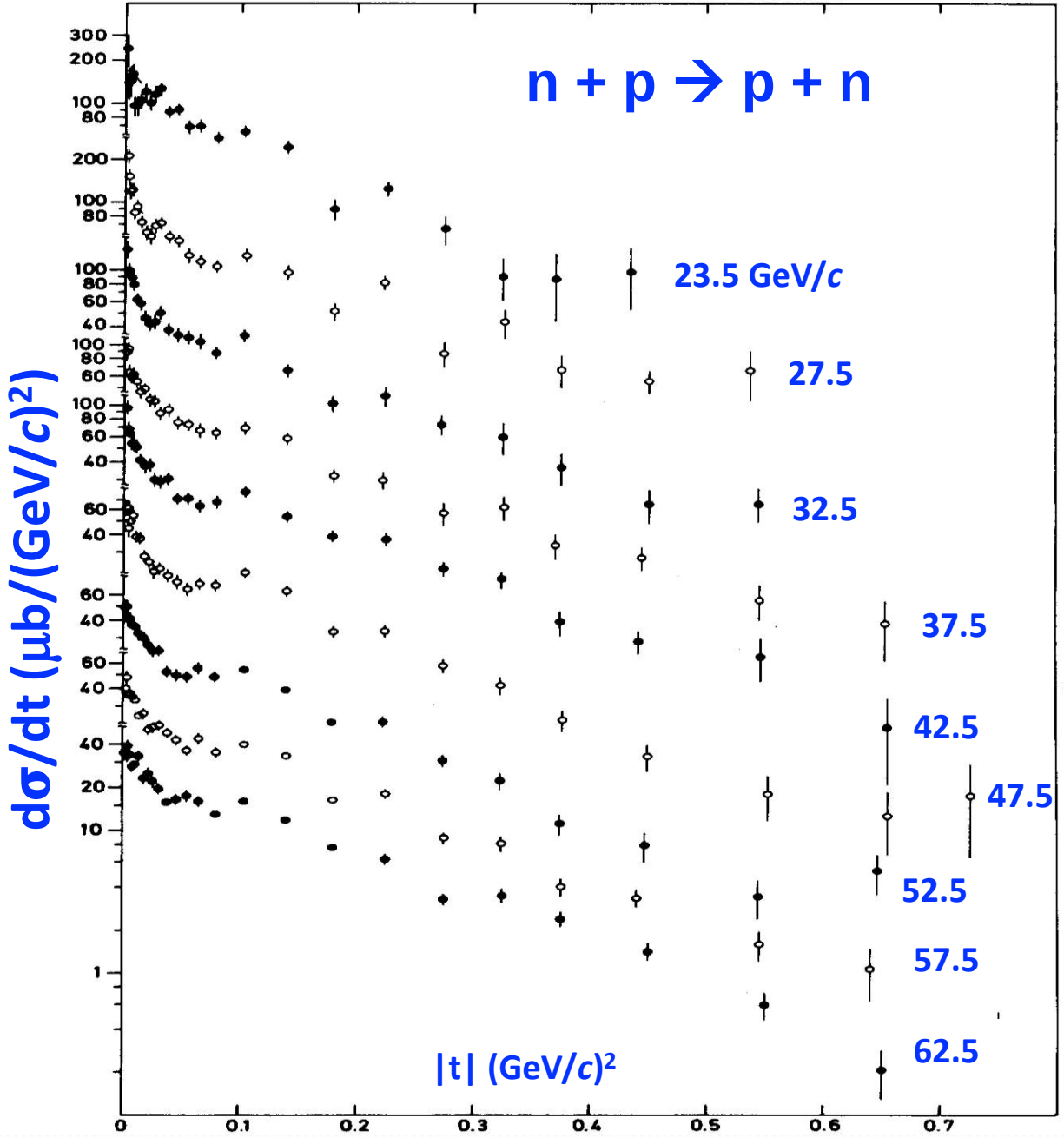


Fig. 5. Neutron-proton charge-exchange differential cross sections dσ/d*t* *versus* |*t*| for neutron momenta between 22 and 65 GeV/*c*.

Accelerator Physics

H. Schopper
The use of AVF-Cyclotrons for Nuclear Physics
KFK 310 (1965)

J. Halbritter, R. Heitschold, P. Kneissel, H. Schopper
Coupling losses and the measurement of Q-values of super-conducting cavities
KFK 758 (1968)

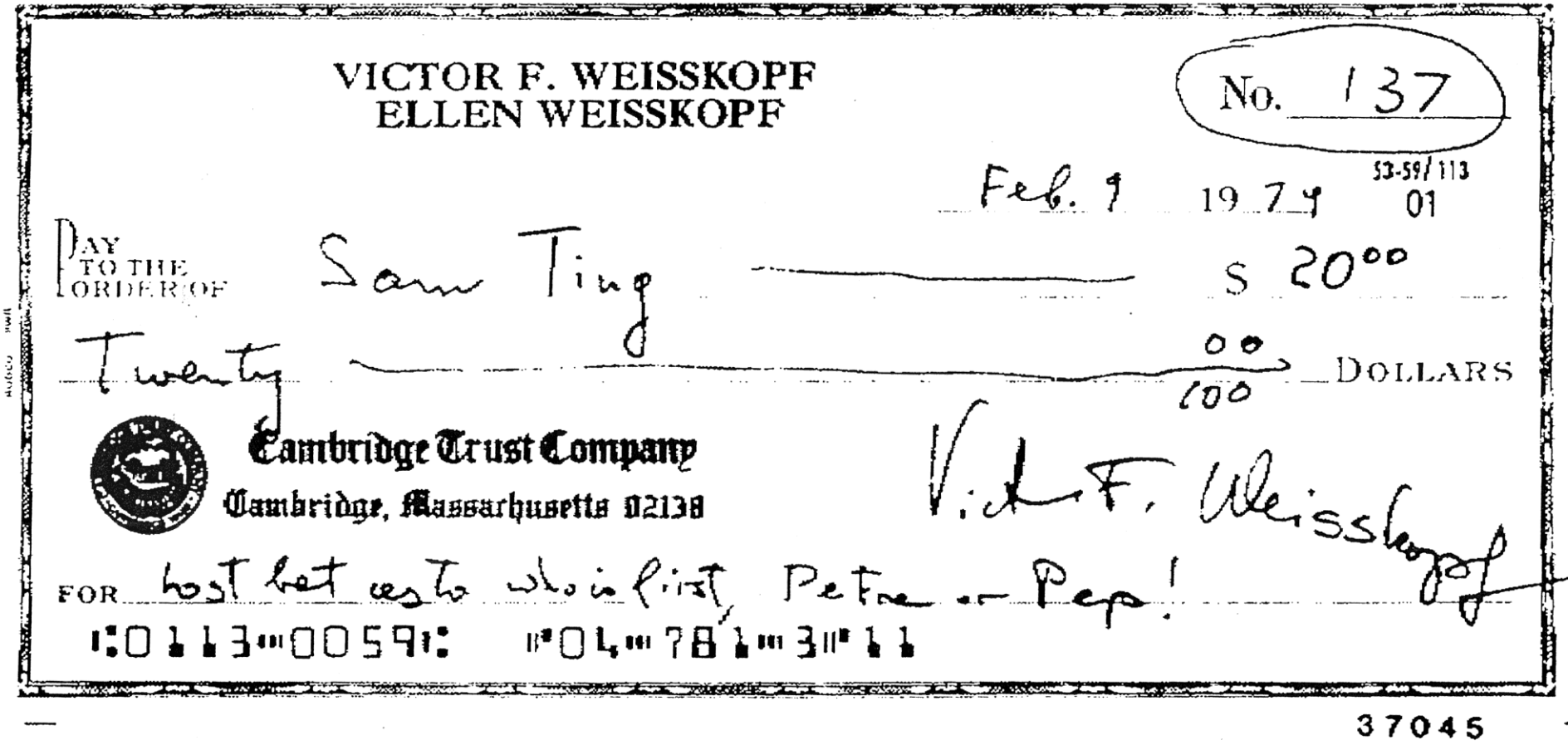
H. Schopper
Is the electron ring accelerator ERA useful for the acceleration of heavy ions ?
KFK – Externer Bericht 3/69-18 (1969)

in **Linear Accelerators,** a book edited by P. M. Lapostelle and A. M. Septier, North Holland, Amsterdam (1970)
A. Citron, H. Schopper,
Chapter: "Superconducting proton linear accelerators and particle separators"

13 PAPERS

Scientific Leadership

- 1957 **Director** of the Institute for experimental nuclear physics, University of Mainz
- 1961 Professor at the University of Karlsruhe and **Director** of the Institute of the Technische Hochschule and the KfK Karlsruhe;
- 1970-73 Division Leader and **Director** at CERN;
- 1973-80 **Director General** of DESY, proposal and construction of PETRA
- 1981-88 **Director General** of CERN, proposal and construction of LEP
- 1999 founding of SESAME
- 2000 founding of The Cyprus Institute


VICTOR F. WEISSKOPF
ELLEN WEISSKOPF

No. 137

53-59/113
01

Feb. 9 19 74

PAY TO THE ORDER OF Sam Ting $ 20^{00}

Twenty 00/100 DOLLARS

Cambridge Trust Company
Cambridge, Massachusetts 02138

Vict F. Weisskopf

FOR lost bet as to who is first, Petra or Pep!

⑆011300591⑆ ⑈04782⑈311⑈

37045

My bet with Victor Weisskopf that PETRA would beat PEP and the MIT group should work at PETRA.

DEUTSCHES ELEKTRONEN-SYNCHROTRON DESY

DESY 79/79
December 1979

NEW RESULTS IN e^+e^- ANNIHILATION FROM PETRA

by

H. Schopper

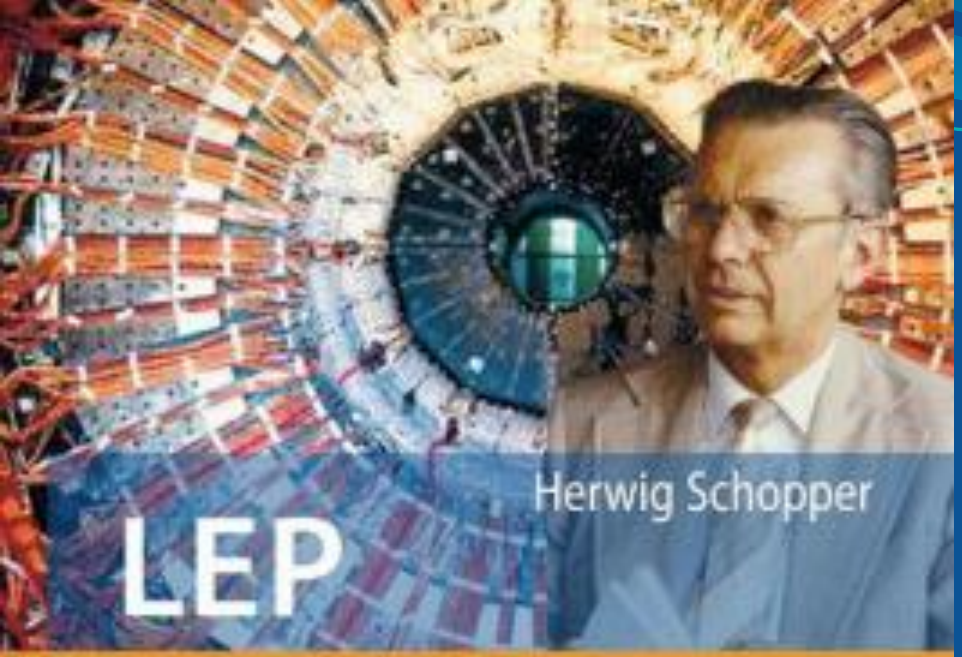
NOTKESTRASSE 85 · 2 HAMBURG 52

LEP Approval

- **Herwig Schopper was Director-General during the approval and construction of the Large Electron Positron collider.**

- "My first personal experience with LEP was a rigorous examination in the Committee of Council. One delegation was against my nomination as Director-General suspecting that I would favour the German DESY site for LEP instead of CERN. After I had explained my intentions the delegate concerned received new instructions by telephone during a coffee break; I was elected unanimously, and the approval procedure for LEP could start.

- While the approval of LEP was still pending, Margaret Thatcher visited CERN. On her arrival she told me that she wanted to be treated as a fellow scientist and not as Prime Minister. She surprised me with the question why we intended to build a circular machine instead of two opposing linear colliders, a very pertinent question and proving her excellent briefing for the visit. I explained to her that in the case of LEP a circular machine was more cost effective. She accepted the argument and asked how big the tunnel would be for the next project after LEP. To my reply that the LEP tunnel would be the last ring at CERN she retorted: "Why should I believe you? When I visited CERN the first time John Adams told me that the SPS tunnel would be the last." Nevertheless, she stated at a press conference that she had been convinced that the funds at CERN were used efficiently, and subsequently the United Kingdom approved LEP."



The Lord of the Collider Rings at CERN 1980–2000

The Making, Operation and Legacy of the World's Largest Scientific Instrument

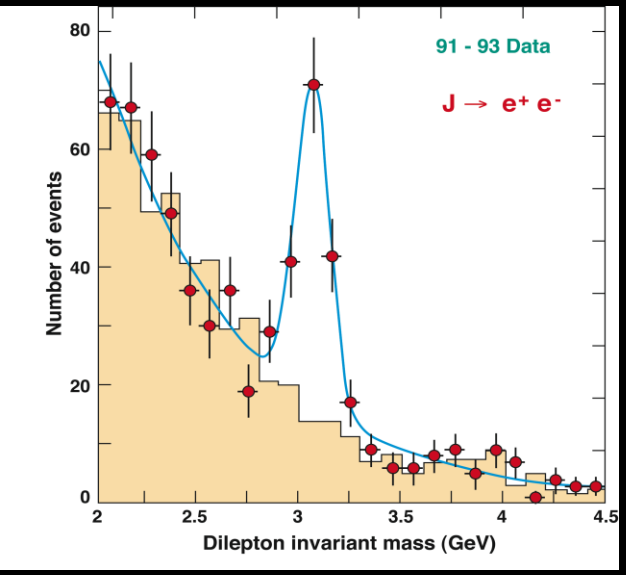
With a Foreword by Rolf-Dieter Heuer

Springer

Written by the main protagonist responsible for making LEP a reality, this is the definitive inside story of a remarkable machine and the many thousands of scientists and engineers from around the world, whose efforts contributed to the new knowledge it produced.

After retiring as DG of CERN, Schopper joined the L3 group and actively worked on heavy quark decays

L3 meeting in Finland

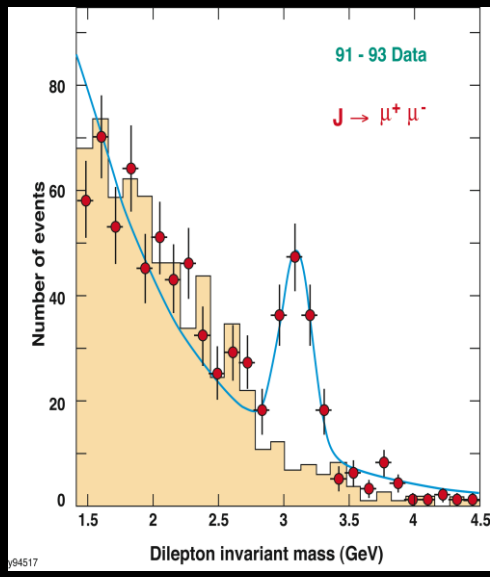


He was the main author of
Phys. Lett. B 413 (1997) 167
and
Phys. Lett B 453 (1999) 94

$Br(Z \rightarrow J + X) = (4.1 \pm 0.7\,(stat) \pm 0.3\,(sys))\ 10^{-3}$

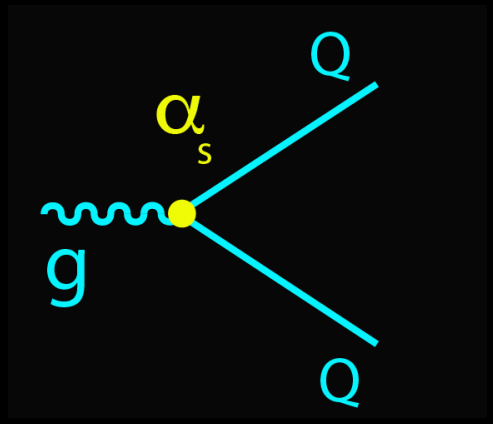
$Br(b \rightarrow J + X) = (1.3 \pm 0.2\,(stat) \pm 0.2\,(sys))10^{-2}$

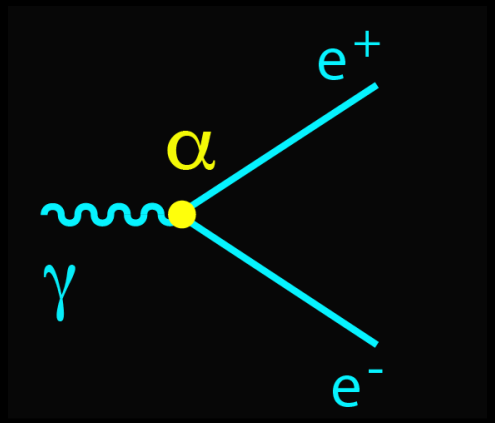
$Br(Z \rightarrow q\bar{q}g^*;\ g^* \rightarrow J + X) < 7.0\ \ 10^{-4}$ at 90% CL.



Other important L3 publications with H. Schopper

Dependence of the coupling "constants" on energy

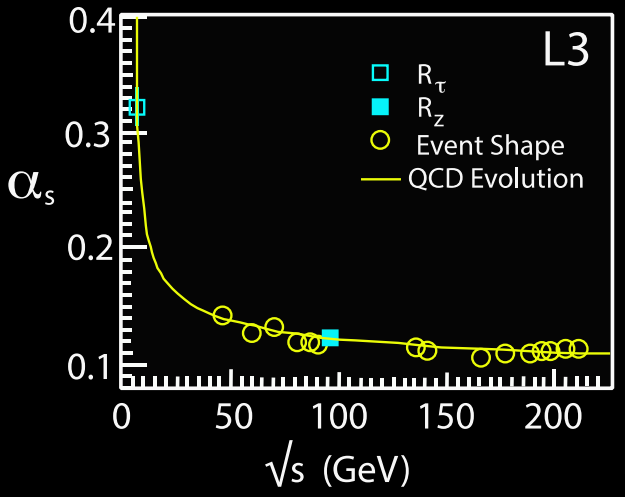




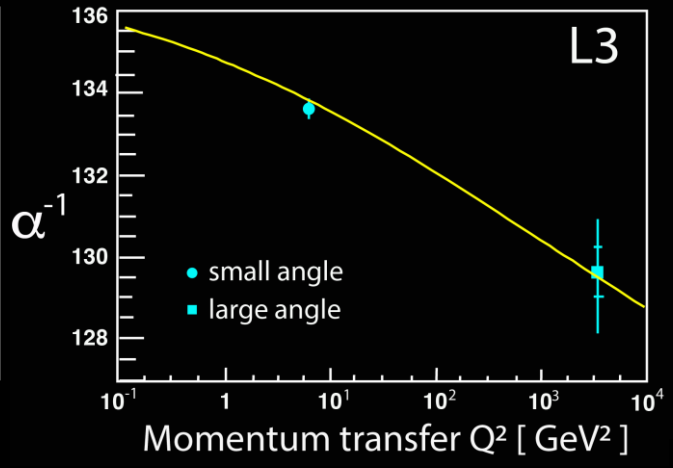
Model independent measurement of the number of neutrinos

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

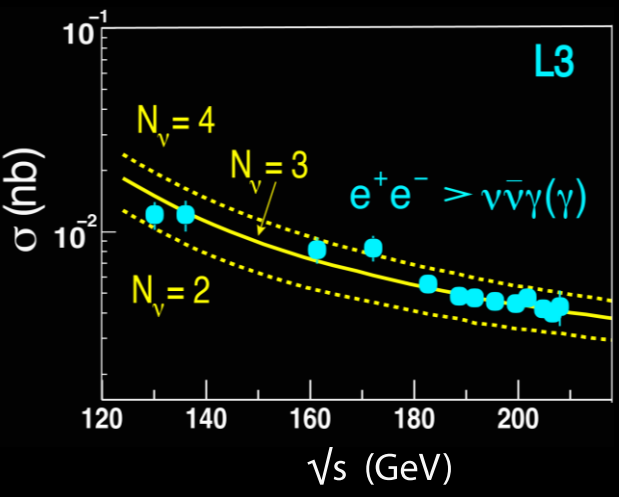
$N\nu = 2.98 \pm 0.064$



Phys. Lett. B 476 (2000) 40



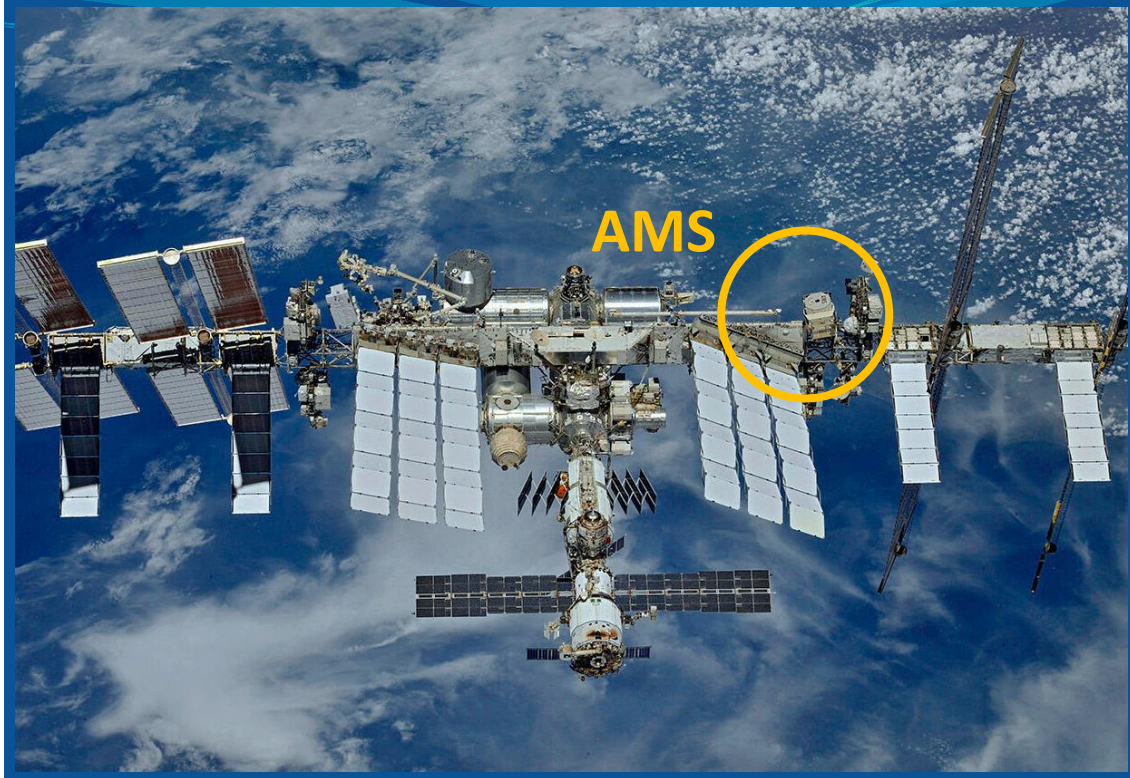
Phys. Lett. B 536 (2002) 217



Phys. Lett. B 587 (2004) 16

2000

The AMS Experiment



National Aeronautics and
Space Administration

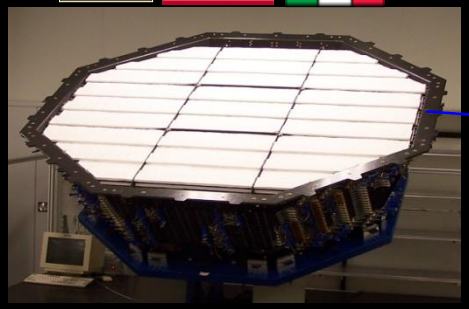
Headquarters
Washington, DC 20546-0001

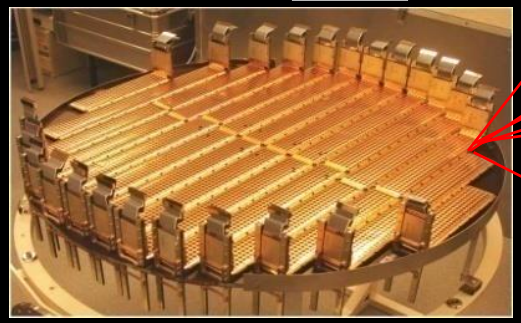
JUN 1 1994

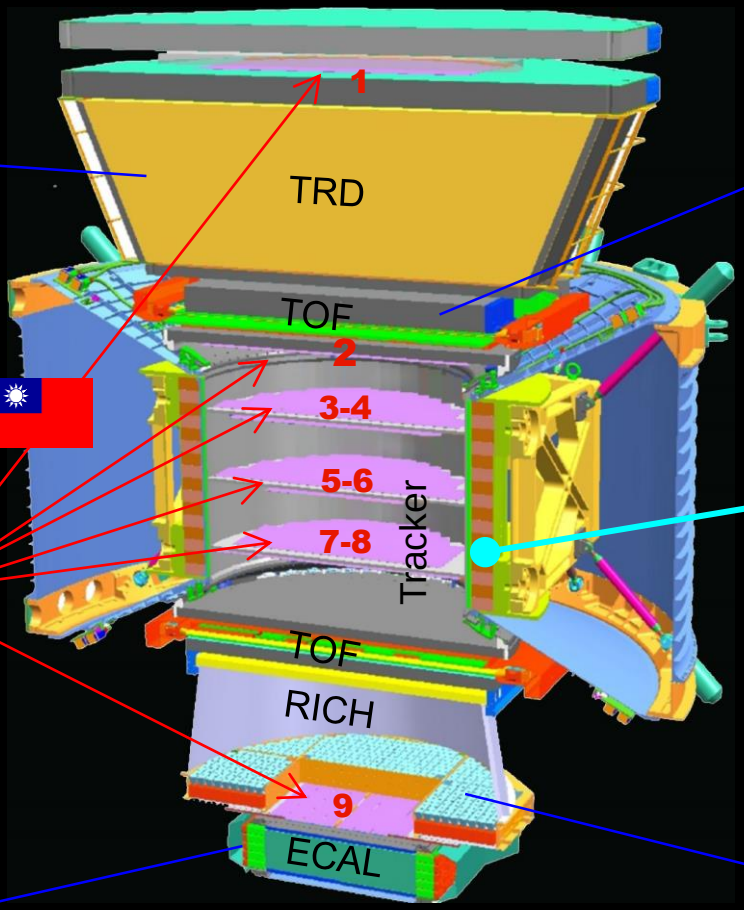
Dear Professor Ting:

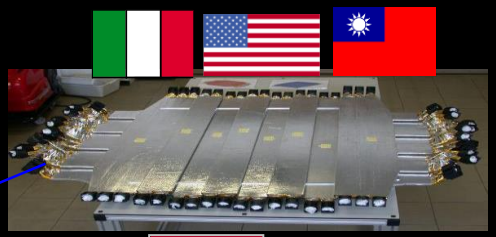
Thank you for your May 9, 1994, presentation on a concept to search for the origin of mass using a magnetic spectrometer on the Space Station. The detection of antinuclei, heavier than hydrogen from cosmic sources, would indeed have a fundamental impact on science and the way we view the universe.

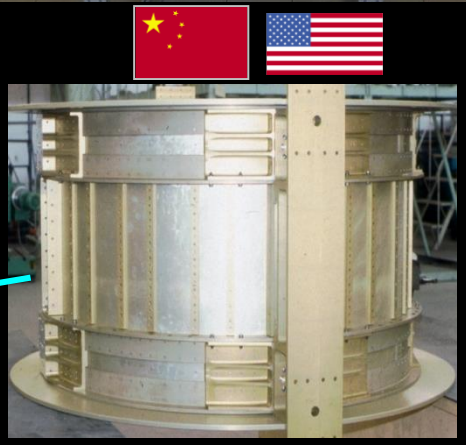
AMS is an international collaboration based at CERN. Herwig Schopper is the most important advisor

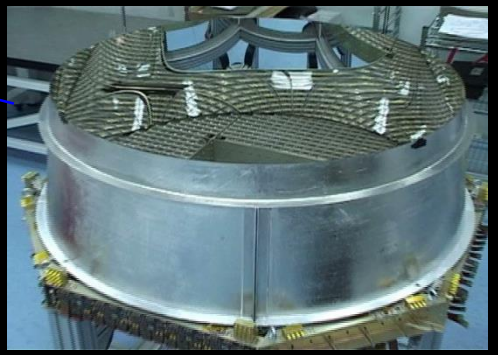












Through Schopper, we had multiple discussions with Joachim E. Trumper, MPI, on precision and redundancy in space experiments

Fabiola Gianotti with Christine Lagarde, President of the European Central Bank, January 2, 2022

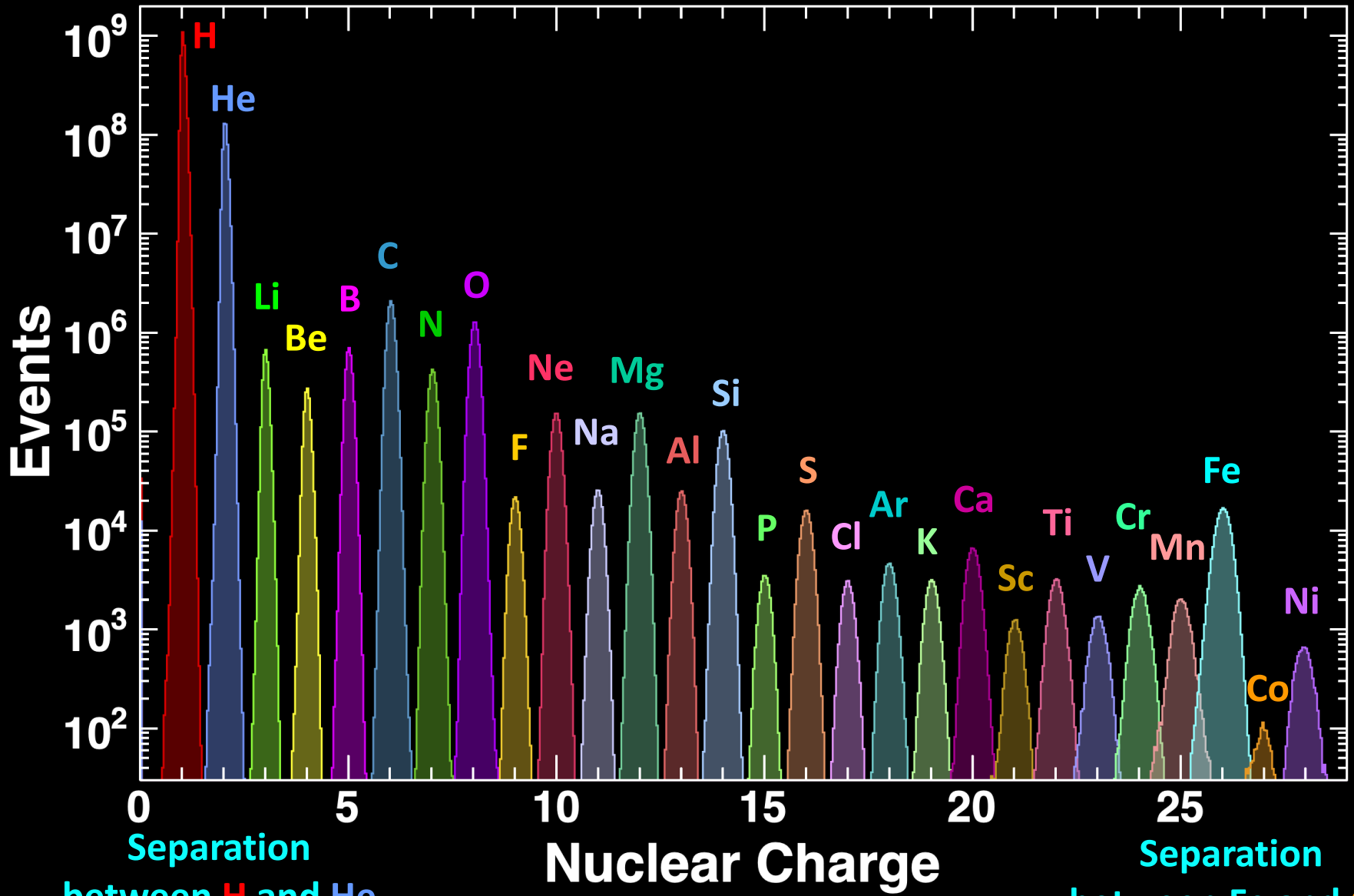
Luciano Maiani with President of China, Jiang Zemin, March 26, 1999

Robert Aymar with Bill Nelson, now NASA Administrator, March 16, 2008

Rolf Heuer at the Kennedy Space Center, April 4, 2011

MATERIE

Today, with 230 billion events, AMS has obtained precise spectroscopy of cosmic ray nuclei

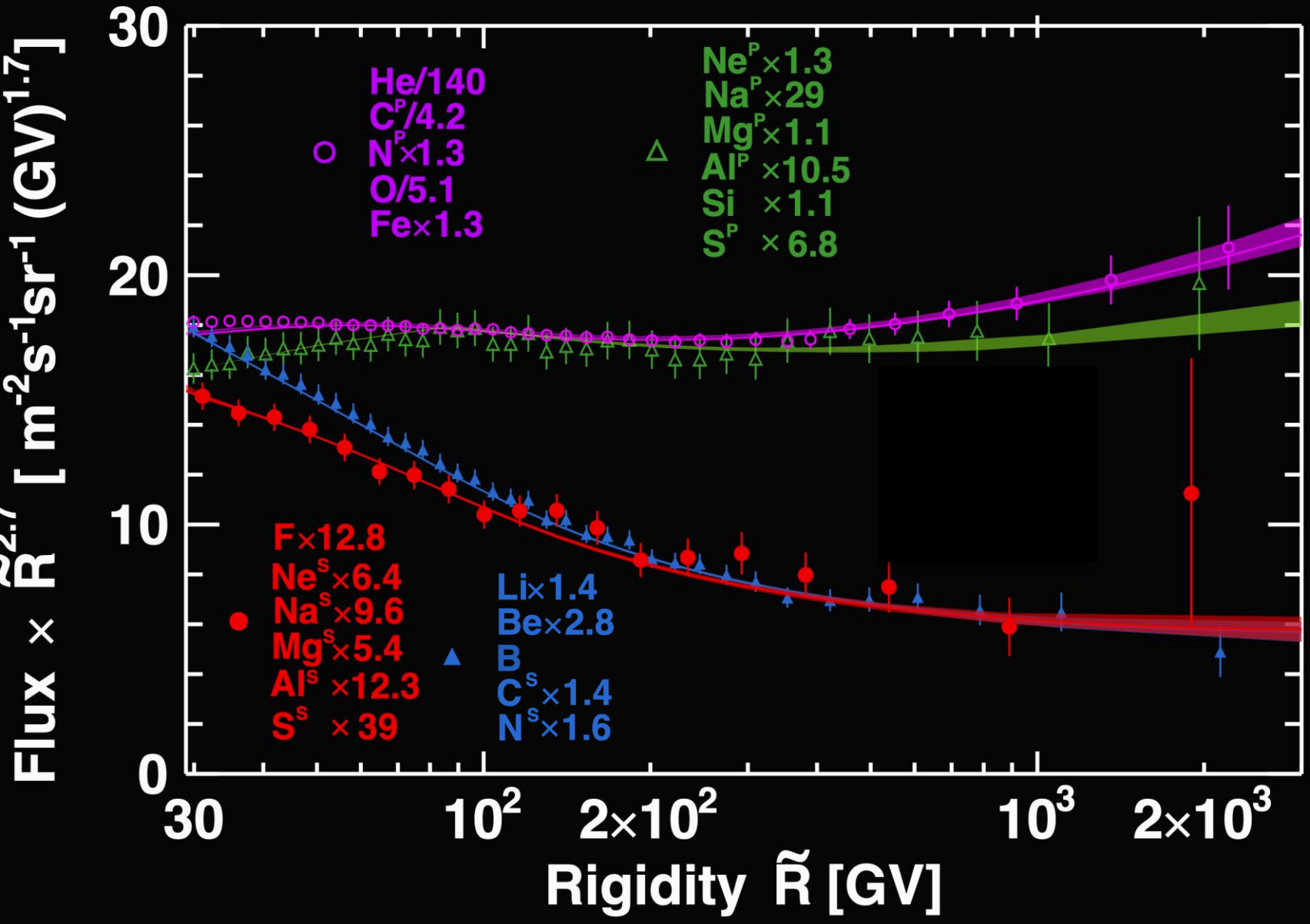


Separation between H and He is better than 1 in 10^9

Separation between Fe and Co is better than 1 in 10^2

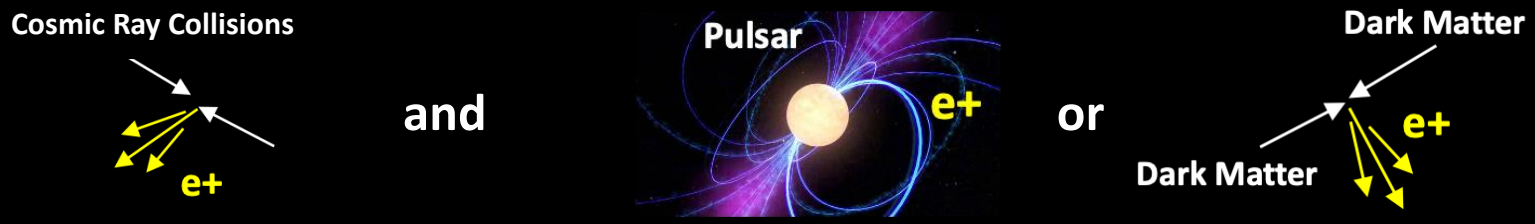
MATERIE

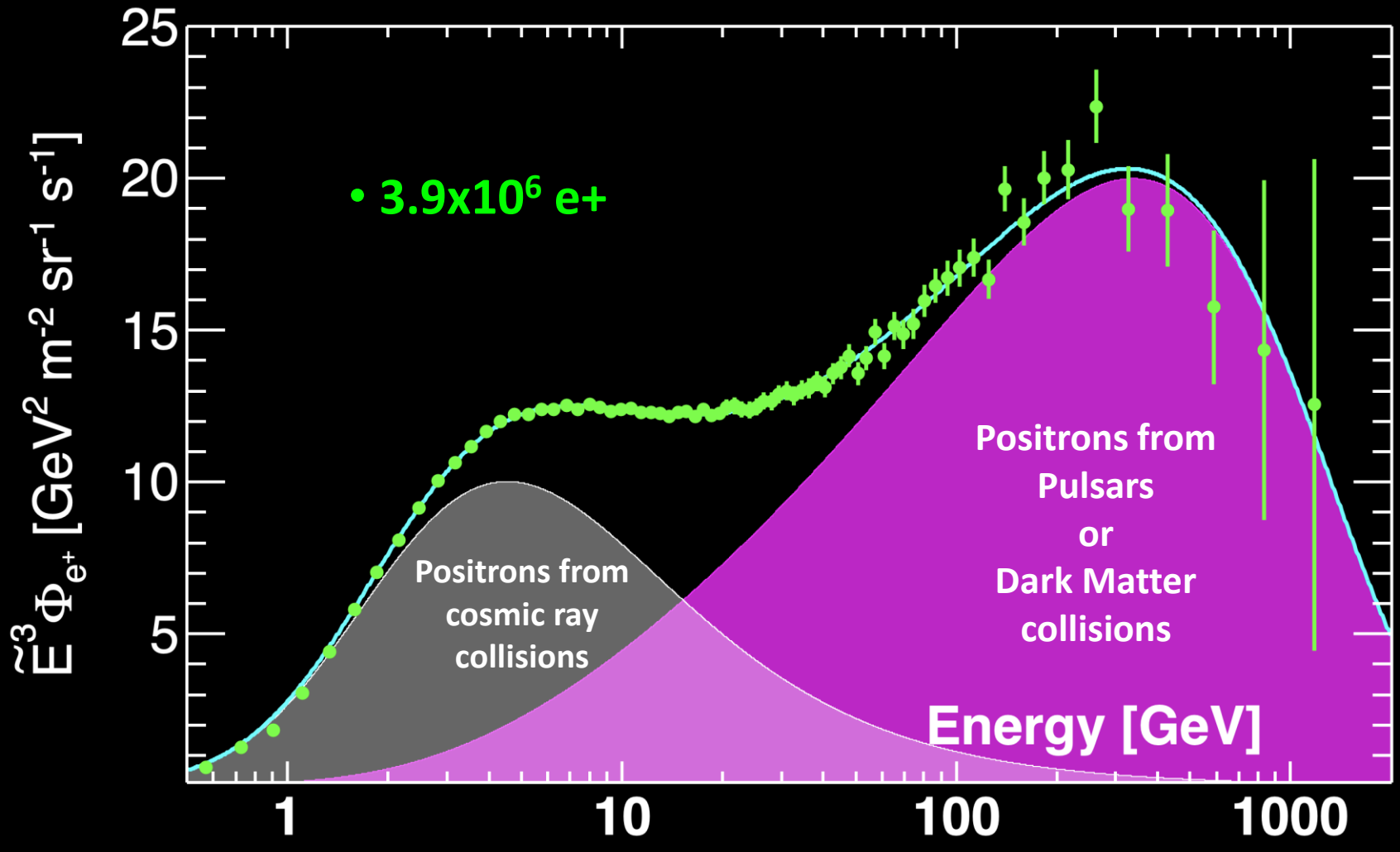
All of the measured cosmic rays can be described by two Primary classes and two Secondary classes



ANTIMATERIE

The positron flux is the sum of low-energy part from cosmic ray collisions plus a high-energy part from pulsars or dark matter both with a cutoff energy



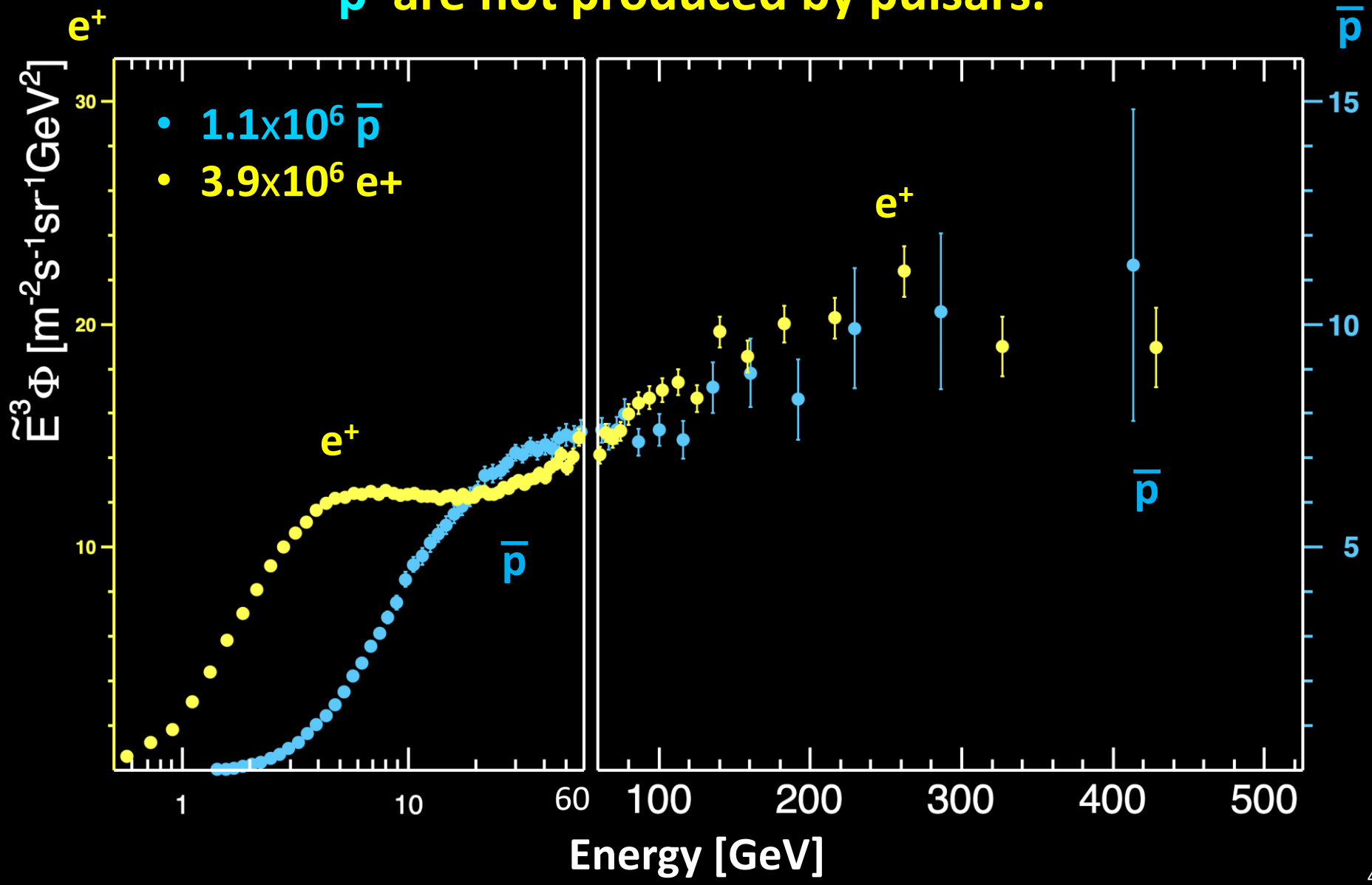


ANTIMATERIE

Results of Cosmic Antiprotons

The $\bar{p}$ and e^+ fluxes have identical energy dependence.

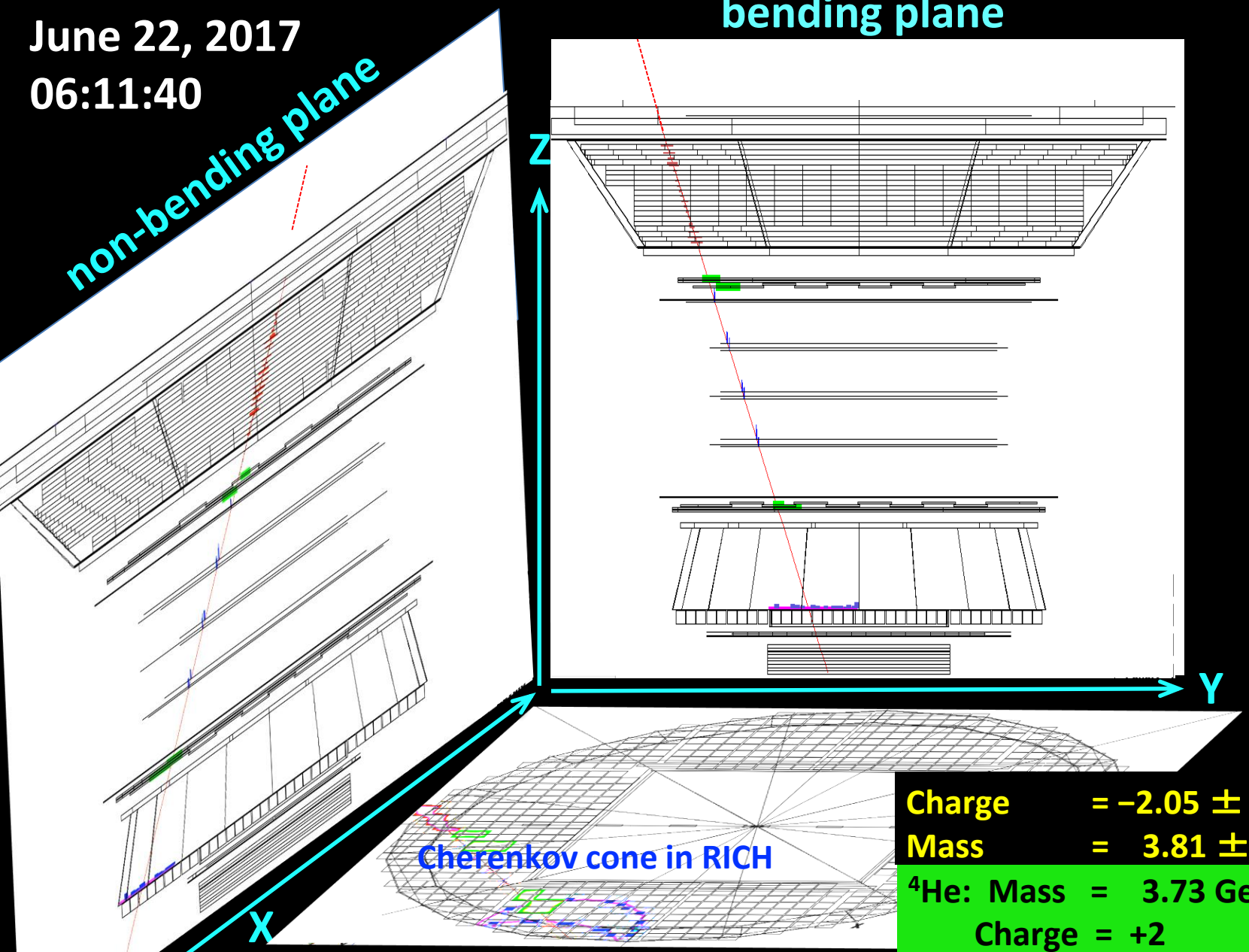
$\bar{p}$ are not produced by pulsars.



ANTIMATERIE

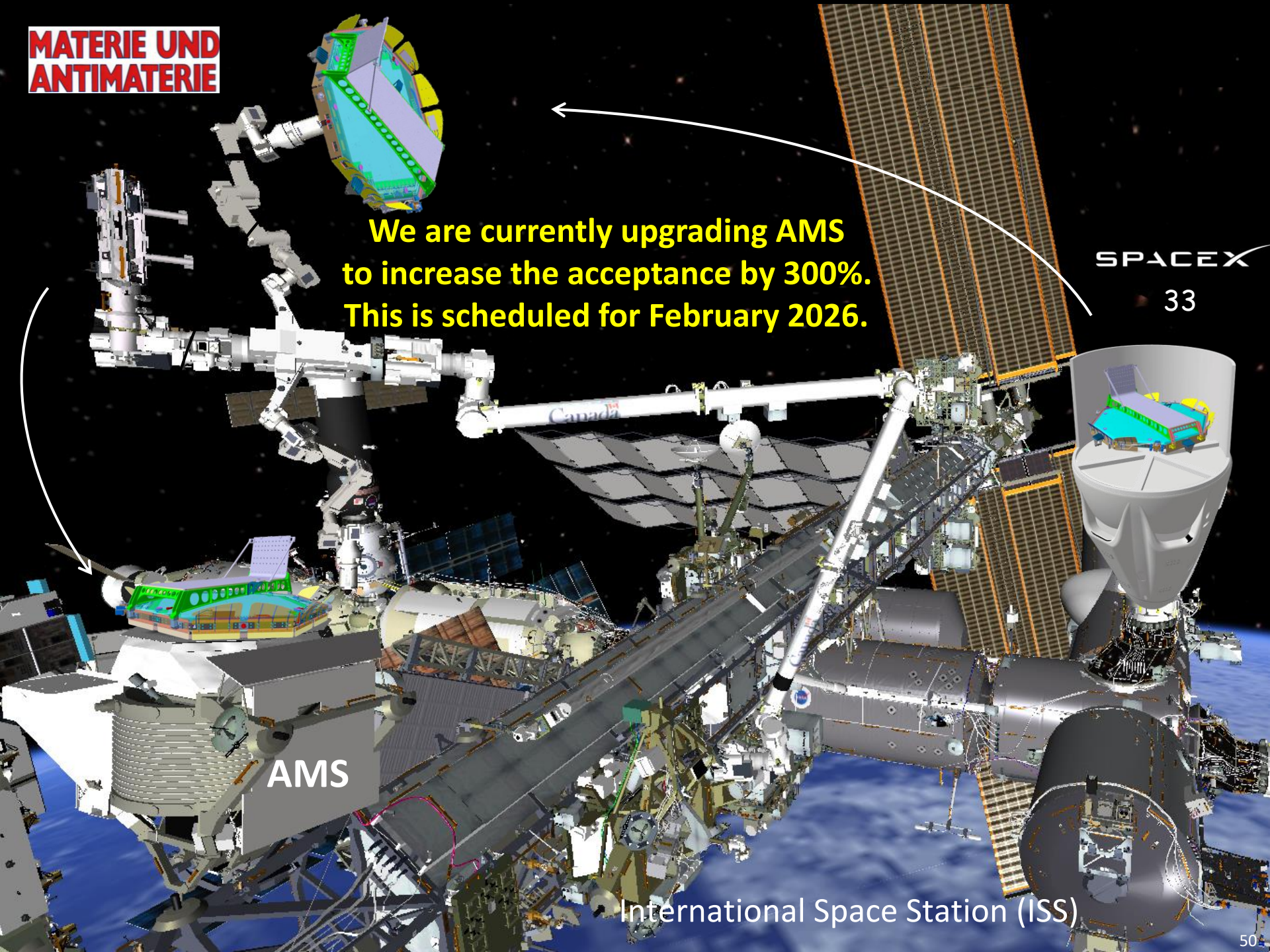
Anti-^{4}Helium Event

June 22, 2017
06:11:40



Charge = −2.05 ± 0.05
Mass = 3.81 ± 0.29 GeV/c^2

^{4}He: Mass = 3.73 GeV/c^2
Charge = +2


MATERIE UND ANTIMATERIE
We are currently upgrading AMS
to increase the acceptance by 300%.
This is scheduled for February 2026.
SPACEX
33
AMS
International Space Station (ISS)

Science and international collaboration

- 1977 Chairman of the Association of German Large Research Laboratories AGF,
- 1992-94 President of Deutsche Physikalische Gesellschaft, member of the Scientific Council of the Joint Institute for Nuclear Research Dubna, Russia, member of Kuratorium of the Max-Planck-Institute for Plasmaphysics, Garching,
- **1994 member of UNESCO Physics Action Council** and chairman of the Working Group on Large Facilities
- **1994-1996 President of the European Physical Society, Chairman of Scientific Council of Regional Office for Science and Technology of Europe UNESCO,**
- 2003- President of International Council of SESAME.

1978 - Herwig Schopper invited the first group of 10 Chinese Scientists after the Cultural Revolution to the Mark-J experiment at DESY

Schopper established effective personal relationships with Chinese science leadership

Vice Premier Fang Yi, China,
in charge of science and technology

Minister of Finance, Zhang Jingfu, China,

Herwig Schopper visiting the
Institute of High Energy Physics, Beijing

Vice Premier Gu Mu,
in charge of economic management

Institute of High Energy Physics

Chinese Academy of Sciences

Address: 19B Yuquan Road, Shijingshan District, Beijing 100049, CHINA

Tel: +86-10-88236076 Fax: +86-10-88233105 E-mail: yfwang@ihep.ac.cn Web: www.ihep.ac.cn

Feb. 26, 2024

Dear Prof. Herwig Schopper,

On behalf of the Institute of High Energy Physics(IHEP) and the Division of High Energy Physics(HEP) of Chinese Physical Society(CPS), I warmly congratulate your 100th birthday and wish you a happy centenarian celebration.

In late 70's of the last century, 10 Chinese physicists went to DESY working at the Mark-J experiment, when you were the Director General of DESY. It would not be possible without your support as an influential figure in the German society and to the German government. This landmark event is now recorded in many Chinese historical books as a symbol of China's openness to the world, which led to the rapid development of China in the last 40 years. This particular event also laid the foundation of Chinese particle physics since they all went back to be leaders of the BES experiment at the Beijing Electron-Positron Collider.

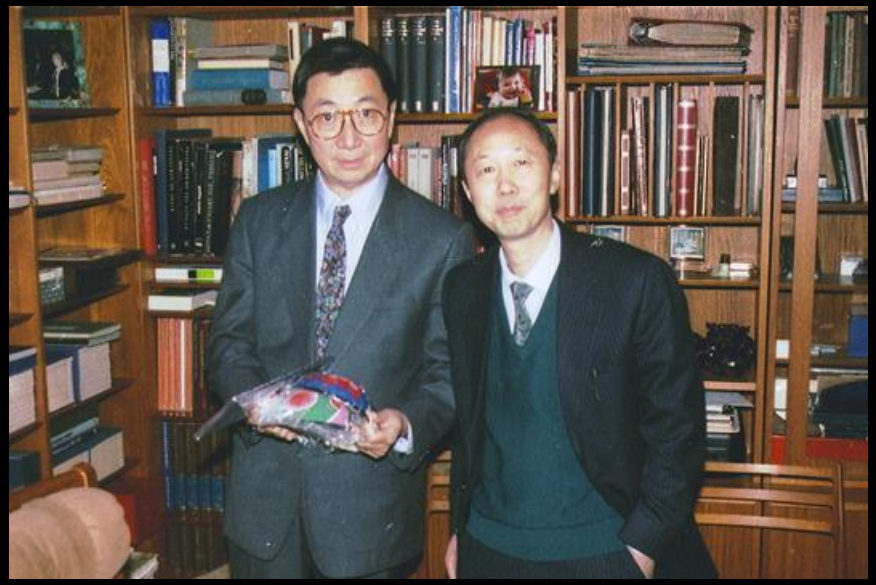
Following this event, many Chinese physicists and students were trained at DESY and later at CERN, with your support as the Director General. I myself had also the fortune to be at CERN for more than 10 years in L3 and AMS experiments, the most critical period of my career and my life. Your numerous visits to IHEP helped significantly the progress of particle physics and accelerator science there, and allowed me to have a career at IHEP for the last 20 more years. I would like to express my greatest gratitude to you.

At this special moment, together with many our colleagues in China, I wish you a very happy birthday, a very healthy and very long life.

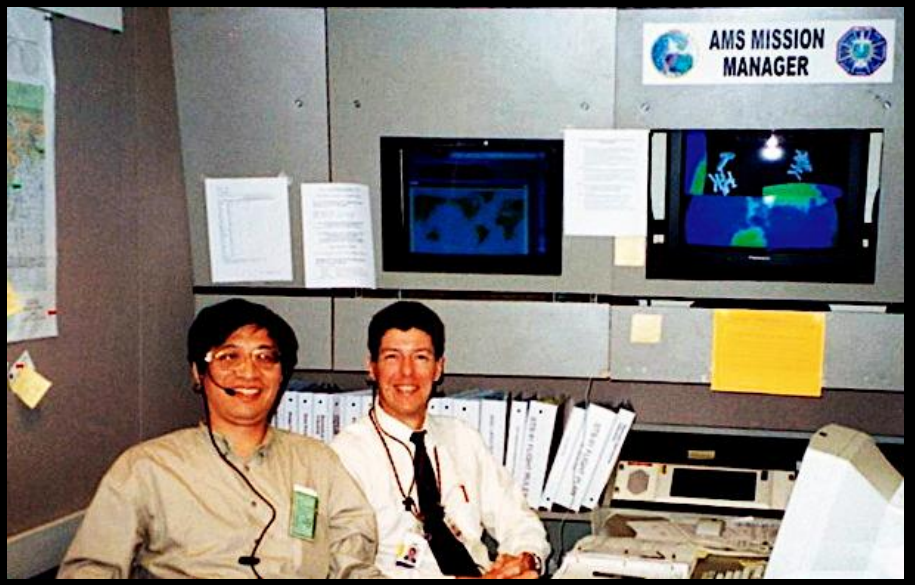
Sincerely yours

Yifang Wang
Director, IHEP, CAS
Chair, Division of HEP, CPS

In the last 3 decades, all the Director-Generals of Institute of High Energy Physics, Beijing, worked at DESY and CERN



Professor Zheng Zhipeng, DG 1992-1998



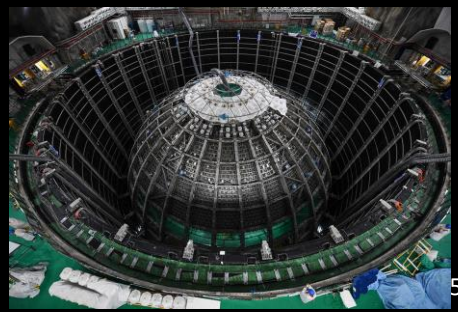
Professor Hesheng Chen, DG 1998-2011

Professor Yifang Wang, DG 2011-present

Examples of Chinese High Energy Physics activities:

1. BEPC: 3 – 5.6 GeV
2. Daya Bay neutrino θ_{13}
3. JUNO mass hierarchy
4. LHC
5. LHASSO
6. DAMPE
7. AMS

...



The Spanish high energy physics group joined DESY and CERN

Spanish group arrives at DESY, 1981

Professor Schopper with King Juan Carlos, 1983

"Thanks to Professor Schopper we got in touch with you at the beginning of the 80s and **were invited to participate in the MARK-J experiment at the DESY PETRA Collider (from july 1981) and at the L3 experiment at the LEP CERN collider. The training of a group of young PhD students at DESY was of fundamental importance for the development and consolidation of the research group in Elementary Particle Physics at JEN-CIEMAT."** Manuel Aguilar

Thank you

for your
extraordinary contribution
to
physics ,
accelerators,
instrumentation,
and
international collaboration

From you I learned that:

If there is not enough time, get up one hour earlier!

and