Preamble

- Lorsque j'ai accepté votre invitation, j'entrevoyais une véritable gageure. Je ne m'étais pas trompée: résumer en une heure la vie de Wolfgang K. H. Panofsky relève de l'impossible.
- Mon seminaire aujourd'hui est basé
  - en partie sur l'autobiographie de Panofsky, publiée il y a peu,
  - en partie sur des documents officiels, et
  - en partie sur diverses présentations à des conférences, le festival Pief de 1988 et d'autres cérémonies honorant cet homme remarkable.
- Il y a aussi, bien sur, mes souvenirs personnel et ceux de mon défunt mari Karl Brown, ce dernier a été le premier doctorant de Panofsky à Stanford, mais aussi son collègue pendent un demi siècle.
- J'espère que vous me pardonnerez les nombreuses omissions et petites inexactitudes qui, je le crains, ne manqueront pas de se glisser parmi mes mots.

Wolfgang K. H. Panofsky

1919 - 2007

A legendary scientist who devoted his life to

- Research - as director of SLAC
- Science policy – as advisor to U.S. and foreign governments and academies
- Peace – as arms control negotiator

Wolfgang K. H. Panofsky

- 1919 – 1934 Childhood in Germany
- 1934 - 1938 Princeton BSc
- 1938 - 1942 Caltech PhD
- 1943 – 1945 Consultant, Manhattan Project
- 1945 – 1951 UC Berkely Radiation Laboratory
- 1951 - 1963 HEPL, Stanford University
- 1963 - 1984 Director of SLAC
  - Construction of SLAC
  - Science of $e^{\pm}p$ and $e^{-}e^{+}$collisions
- 1984 – 2007 SLAC Director/Professor Emeritus
- 1958 – 2007 International Science Policy and Arms Control Negotiations

Family and Childhood in Germany

- Born April 24. 1919 in Berlin, the second son of two students of art:

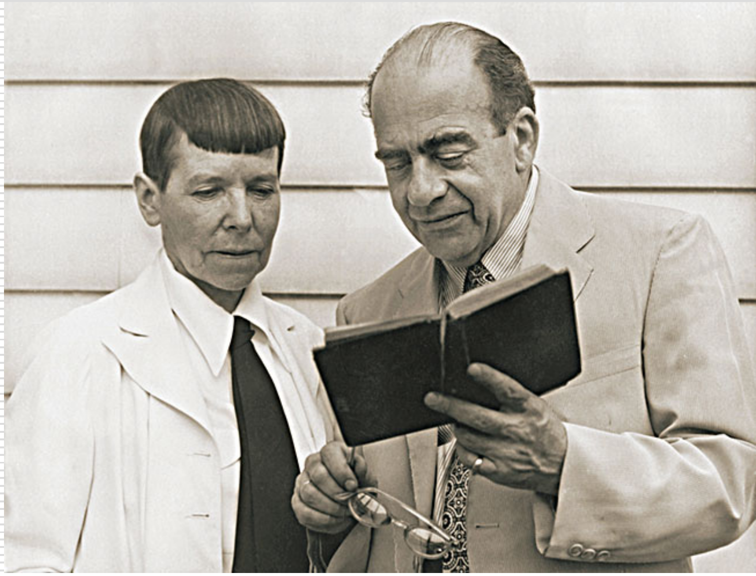
  Father: Erwin,

  Son of a business man

  - One of the most prominent art historians, specializing in Renaissance paintings
  - *Author of more than 100 books:*

    Life and Art of Albrecht Dürer (1943)

    Studies in Iconology (1939)



  Mother: Dorothea,

  - Daughter of Albert Mosse, a famous jurist, who assisted in the writing of the Japanese constitution, Family also owned publishing house and daily newpaper in Berlin

Family and Childhood in Germany

1920-34 - Early years in Hamburg

- At 10 years of age, he entered the Johanneaum, Classical Gymnasium. No science or modern languages
- Travel, extensive visits to art galleries and museums – enough to last for the rest of the boys' lives!
- Scholarly home, music, books
- Brothers showed early interest in science, Märklin trains and erector set, etc.

  Their parents referred to them as "Plumbers"

Princeton University, 1934 - 38

- In 1933 Erwin Panofsky was dismissed from his position at Hamburg University. He accepted a dual teaching position in NYU and Princeton. The family moved to Princeton, where in 1935 he became member of the IAS (first of School of Humanities).
- Family was given free housing and tuition for their sons.

  The boys got acquainted with American life, played basketball, learned to drive, summer trip to California in their first car, etc.
- Wolfgang (Piefke, 15) and Hans (Paffke, 16) entered Princeton, focusing on technical courses and Latin, graduated with highest honors.
- Pief graduated with highest honors, was voted “Most Brilliant” of his class, and as salutatorian he presented the graduation speech in Latin.
- Acquaintance of Wheeler, W. Pauli and A. Einstein

  Since his parents did not drive he often chauffeurred them and their neighbor A. Einstein.

Graduate Studies at Caltech, 1938-42

- Invitation by R.A. Millikan, president of Caltech, arrived in Pasadena by boat from East Coast!
- Courses by Smythe (E&M), Zwicky(Mech), Millikan (Atomic), Lauritsen (Nuclear), Tolman(Stat. Mech), Pauling (QM).
- Fellow students: C. Towns (laser, Nobel Price), V. Hughes
- Thesis Advisor: Jesse Dumond – expert on x-rays
  - Topic: Measurement of endpoint of x-ray spectrum produced from bombardment of electrons of 20 KeV to determine h/e, ratio of Planck constant to charge of electron.
  - Very limited private funding, equipment was designed and built by Professor Dumond and students: x-ray tube, precision voltage divider, bent crystal spectrometer.
  - Panofsky taught undergraduates, as well as military officers and engineers, even though as German citizen he was subjected to strict nightly curfew and 5m travel restriction!

Marriage to Adele DuMond

1942 was a special year

- PhD from Caltech
- US citizenship, following appeals by Caltech president
- First job – National Defense, teaching evening classes to military personnel and doing classified research
- Marriage to Adele DuMond, daughter of his advisor
- The following year, twins were born. The first of five children

War Work at Caltech 1942-45

- Firing Error Indicator (Caltech)
  - Measure miss distance of anti-aircraft bullets:

    Pair of Condenser microphones, directly frequency modulating an oscillator.
- Measure Yield of Nuclear Explosion (Los Alamos)
  - Calibrated shock wave detector, dropped by parachute, transmitting signal by radio to nearby aircraft observing Hiroshima and Nagasaki explosions : 13ktons equivalent!
- First Discussions on impact of Nuclear Bomb
  - Together with R.R. Wilson, who later became Director of Fermilab, Pief prepared one of several proposals to pressure Japanese Government to surrender by demonstration of bomb, rather than dropping on cities - All were rejected by U.S.!!

Shock Wave Sensor Dropped over Hiroshima

Display: Hiroshima Peace Museum

U.C. Berkeley Rad. Lab. 1945-51

The 32 MeV Proton Linac

- First experience in Accelerator design with Alvarez et al.
  - Detailed beam dynamics calculations
  - Design of RF cavity of increasing length to adjust to velocity

    - insert drift tubes

    - now standard for all proton accel.
- Design of gigantic materials testing accelerator (MTA) - never built!

  To be used as intense neutron source for making tritium for nuclear weapons!!
- pp scattering experiment with emulsion:

  No evidence for D wave contributions contrary to predictions

Luis Alvarez, Pief Panofsky (1946)

Panofsky and Fillmore, PR 79, 69

U.C. Berkeley Rad. Lab. 1945-51

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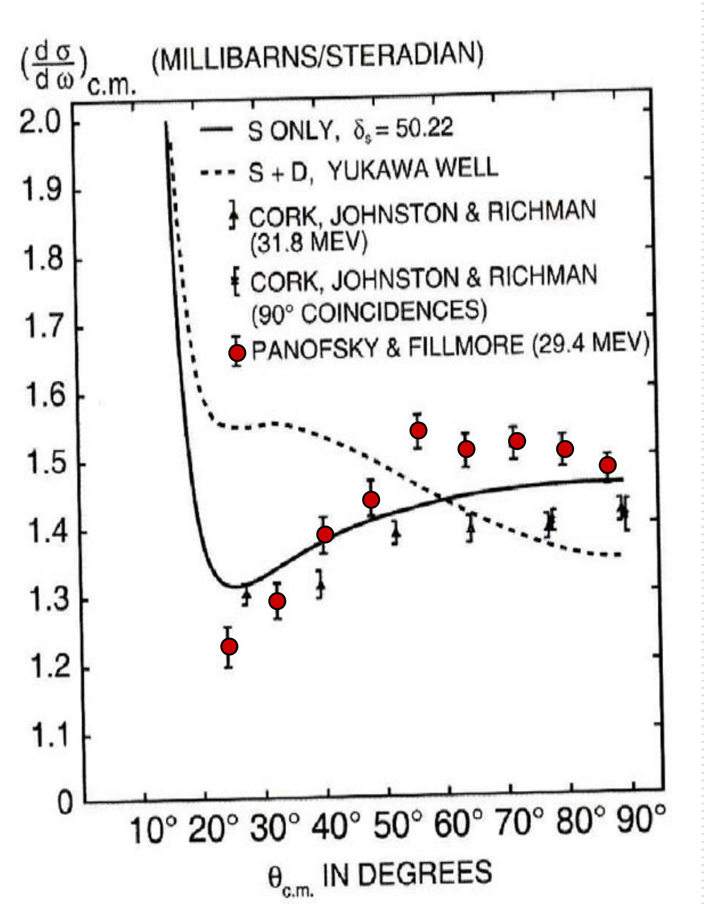
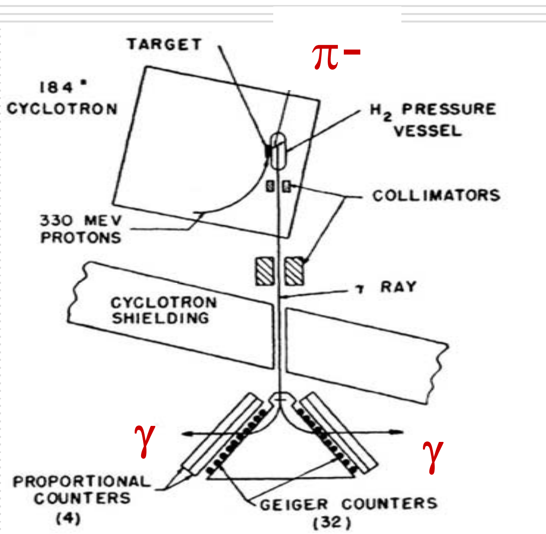
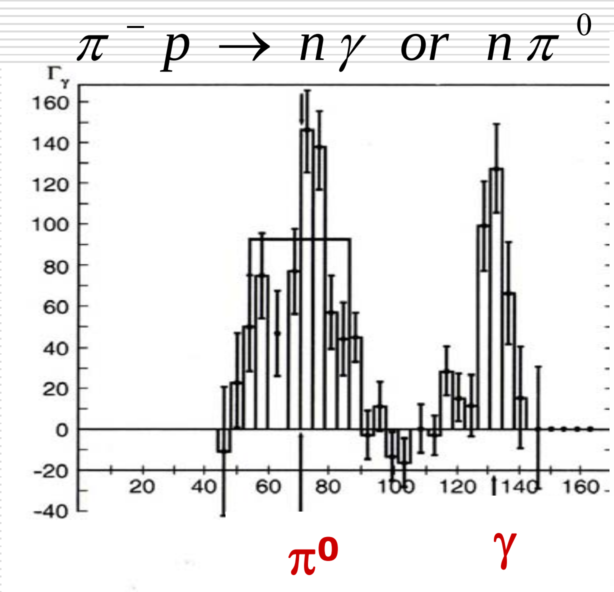


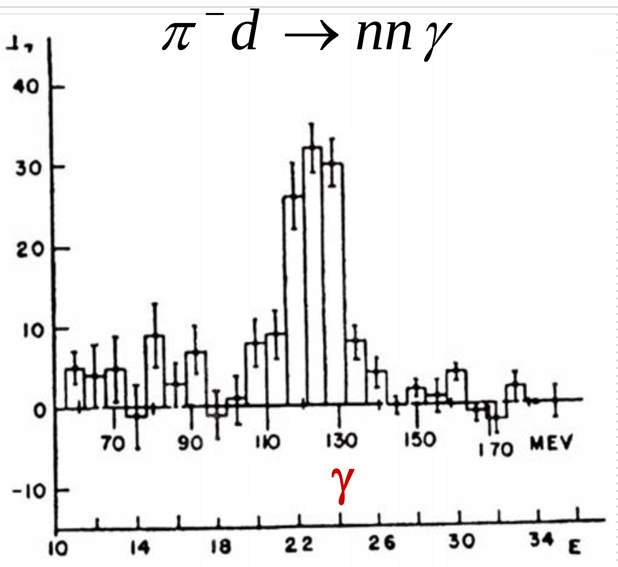
U.C. Berkeley Rad. Lab 1945-51

Panofsky, Aamodt, Hadly, PR81, 565

- Study of π^0 at LBL Cyclotron using pair spectrometer:
  - π-p $\rightarrow$ n γ : Measurement of π^- mass
  - π-p $\rightarrow$ n π^0 : Confirm existence of π^0, $m_{\pi-} > m_{\pi 0}$
  - π-d $\rightarrow$ n n (γ), No evidence for π-d $\rightarrow$ nn π^0: Parity: $J^P=0^-$







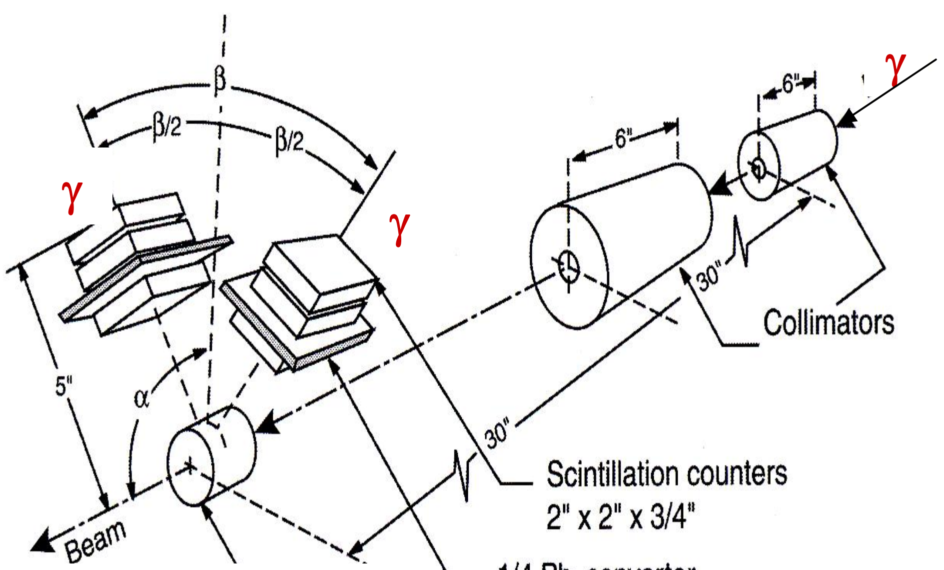
U.C. Berkeley Rad. Lab 1945-51

Panofsky, Steinberger, Steller, PR78, 804

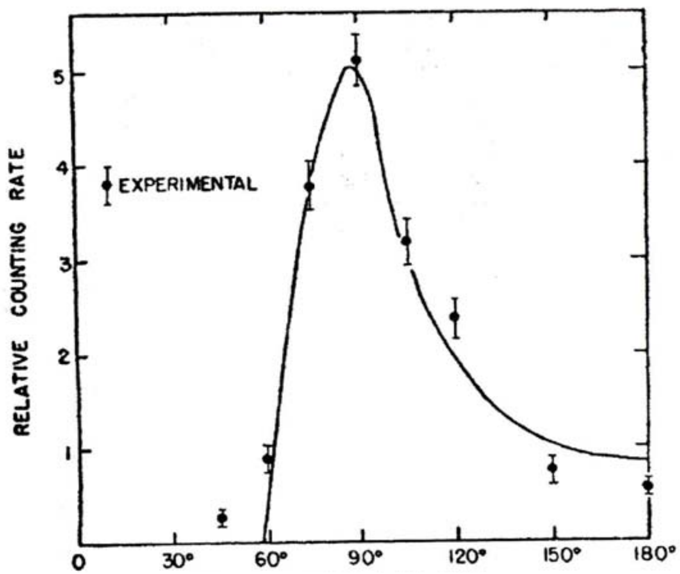
- Study of π^0 at 300 MeV Electron Synchrotron (Ed McMillan)
  - γ Be $\rightarrow$ X $\gamma\gamma$: Establish $\pi^0 \longrightarrow \gamma\gamma$ decay

    Measurement of π^0 mass

    Confirmation of $J^P=0^-$



Be target



$\gamma\gamma$ Correlation angle

Promotion to Associate Professor at UCB

Luis Alvarez's recommendation (1948):

- I think it is no exaggeration to say that Panofsky is an amazing person.
- He has the most thorough grasp of basic physics I have ever seen in a man of his years. He works difficult theoretical problems with no apparent effort. At the same time, he is completely at home in the laboratory, and he is one of the best radio engineers I know.
- He had no contact with microwave radio during the war, but he is now giving a lecture course on theoretical and practical aspects of that field. I am with him a good part of the day, and I haven't the slightest idea how he finds the time to learn what he teaches.
- He not only has the knowledge necessary for a great teacher, but he has the ability to present it clearly and he has the same enthusiasm for teaching that he displays in research.

U.C. Berkeley Rad. Lab: The Loyalty Oath

- In 1949, under pressure from California Governor, UCB required loyalty oath testifying no link to communists.
- Many, including Panofsky, being used to Security clearance formalities, signed reluctantly, partially because this was not a UC problem, but a nation wide problem in the postwar era.
- Tenured faculty who did not sign were fired, among them GianCarlo Wick, Jack Steinberger, Geoff Chew.
- At this point Pief decided to leave, he had several opportunities, and he chose to go to Stanford, accepting a full professorship.
- Much to his parents relief !
- Luis Alvarez tried to dissuade Pief from leaving, warning him:

"Oh Pief, you'll fade away at Stanford, nothing goes on there! You'll never be able to do any significant research at Stanford".

To Hell with the oath,
We’re going to Stanford

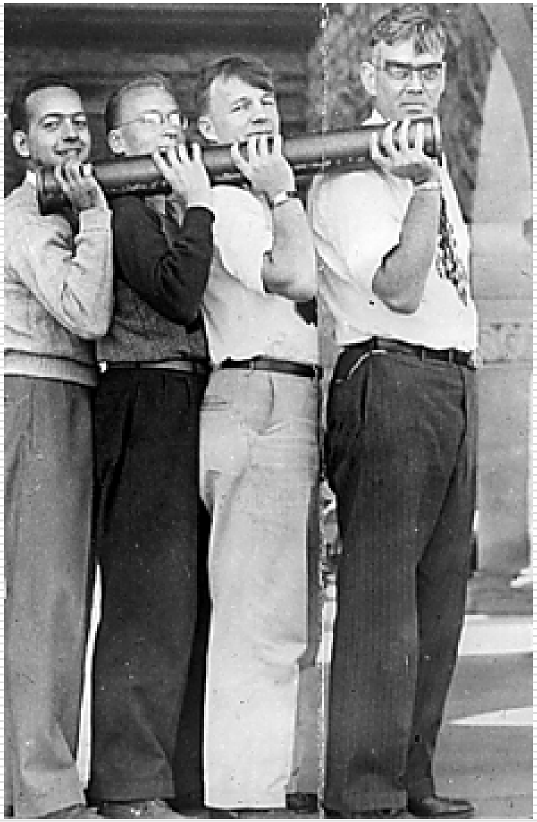
Beginnings at Stanford

- Invention of the Klystron by Varian Brothers and W.W. Hansen was basis for electron accelerator development at Stanford, but also industrial development of microwave tubes and radar.
- After WW II, a series of test accelerators were built at Stanford, funded by the Office of Naval Research:

Date Completion	Name	Energy MeV	length (m)	Klystron Power (MW)	Primary Usage
1947	Mark I	6	3.6	0.9	Acc. tests
1949	Mark II	49	10	20	Nuclear physics
1952	Mark III	900	70	20	Nucleon FF
1955	Mark IV	80	25	2-20	Prototype for M
1955	Med. Acc.	5	2	1	x-ray Cancer Therapy

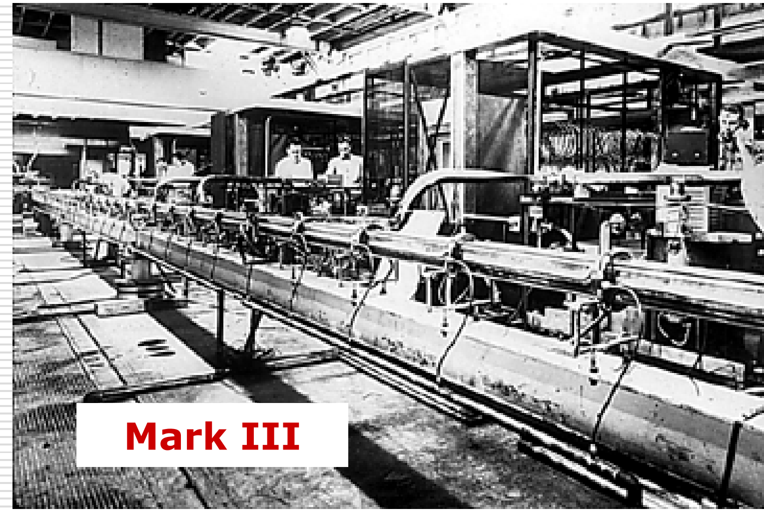
- Many successful experiments,
  - nucleon structure by Hofstaedter
  - Electro-production of pions, baryon resonances by Panofsky
  - muon pair production
  - QED tests using e-e- storage rings (O'Neill and Richter)

Early Accelerators at Stanford

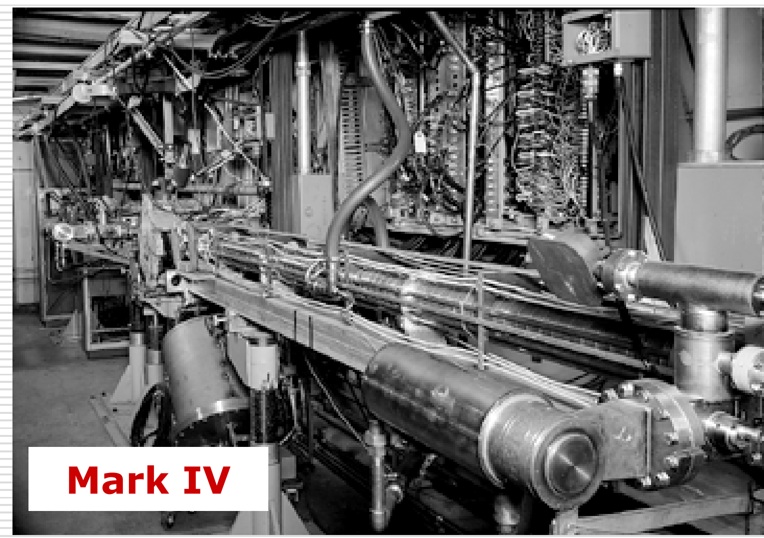


**Mark I Section:
Bill Hansen and Students**

**Mark II Controls:
K.L. Brown**



Mark III

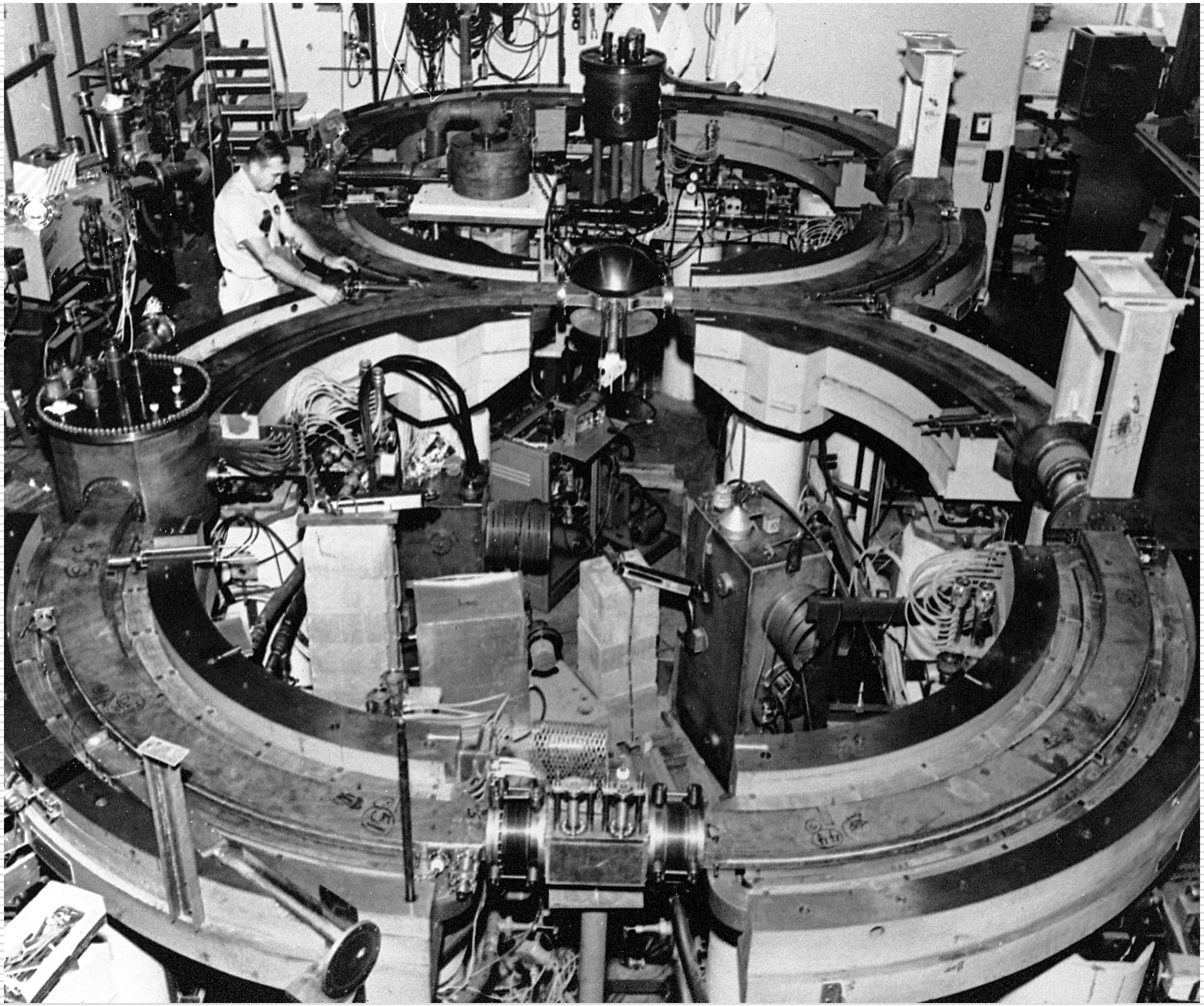


Mark IV

First e- e- Storage Rings at Stanford

- In 1958, Gerard K. O’Neill of Princeton proposed to use the Mark III as an injector to electron storage rings.
- O’Neill recognized that stacking of e- bunches into a ring is aided by synchrotron radiation, damping oscillations of bunches injected off-axis.
- O’Neill was joined by Burt Richter, Bernie Gittelman, and W.Carl Barber, and a small group of engineers and technicians. They wrote a proposal, and within a year Pief raised $800,000 from the ONR (Office opf Naval Research) to fund the project.
- Much what we know about resonances, beam-beam interactions, synchrotron light, desorption of gas from the metal walls, etc. was learned on this machine.
- In 1963, first measurements, testing QED tests in e-e- scattering, and searches for lepton number violation.
- This machine still holds the record with a single bunch current of 600mA.

First e- e- Storage Rings at Stanford



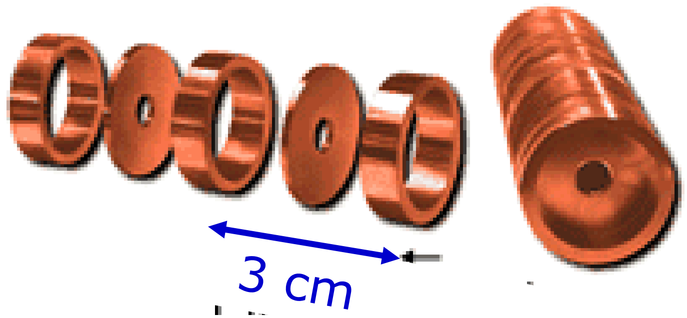
Planning for SLAC – Project M

- During his first years at Stanford, working at the Mark III, Pief attracted a number of excellent students, engineers and technicians, some of whom had served in WWII.
- Ideas for the next machine developed in 1955/6, from group meetings at his home in the evenings, a design for a very large machine, referred to as Project M or Monster, emerged.
- The physics goals were rather vague,
  - Tests of QED, nucleon form factors
  - Electro-production of hadrons
  - Resonance formation
- In 1957, the proposal (64 pages long!) was submitted to Atomic Energy Commission, cost estimate in today's currency ~ 1,000M$

Building of SLAC – the Monster

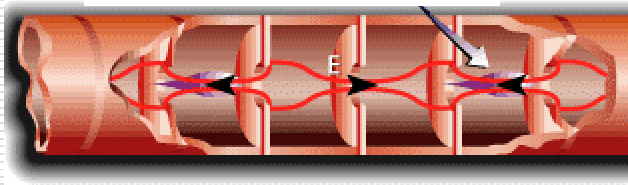
- Technical design largely based on Mark III, major extrapolations
  - 20 GeV, 30x100m long sections, disc loaded wave guide
  - 240 Klystrons, 24 MW each, 2856 MHz, very high peak & average power
- Designed as a national facility – External Committee: PAC
  - Two experimental areas – sharing beams
    - Endstation A: e- p/n scattering, beam/target polarization
    - Endstation B: secondary beams: γ, p K,
- Total cost 114M$, incl. 18M$ for protoyping/preconstruction
- Construction: 1962 – 1966
  - July 1962 Start Construction
  - Dec. 1965 Accelerator Complete
  - May 21,66 First 10 GeV delivered, June 1: 18.4 GeV
  - Jan 1967 Stable beams to experiment, Full program underway
- SLAC was completed on budget and schedule, model for future HEP projects
- SLAC, a National Lab, 1000 Employees, >300 scientists and engineers

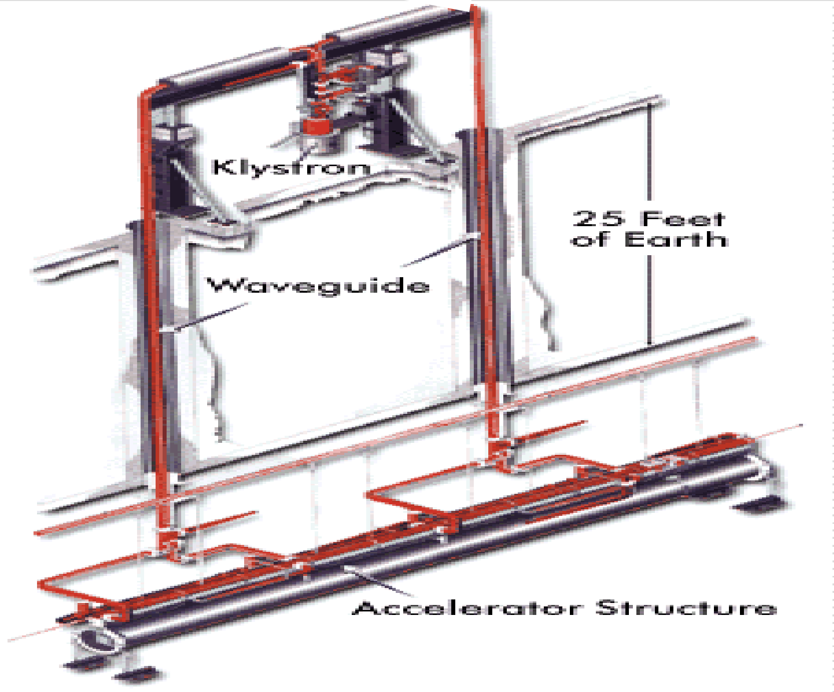
SLAC Accelerator Components

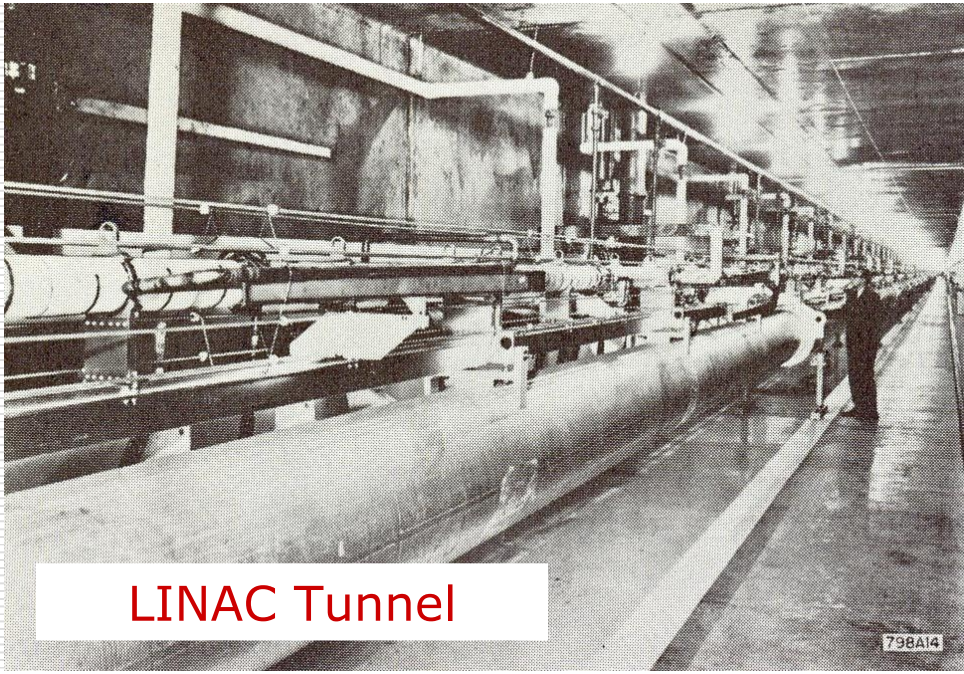


5 μm precision machining
100,000 brazed joints,
No leaks in 40 years !

RF Wave







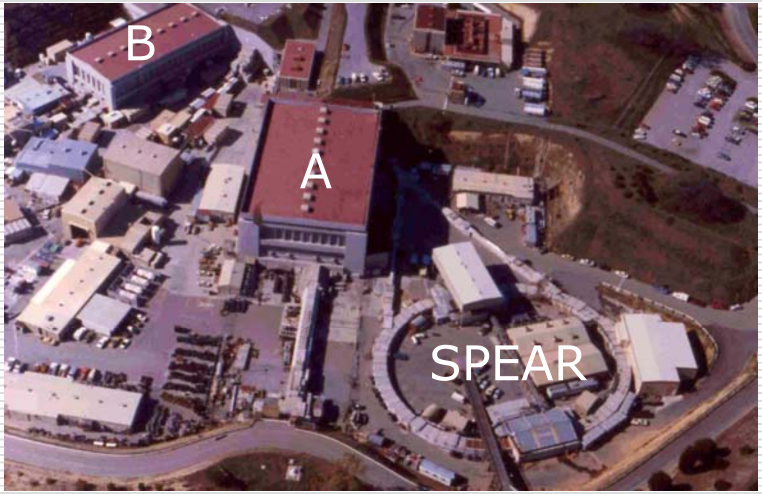
LINAC Tunnel

SLAC - Experimental Areas

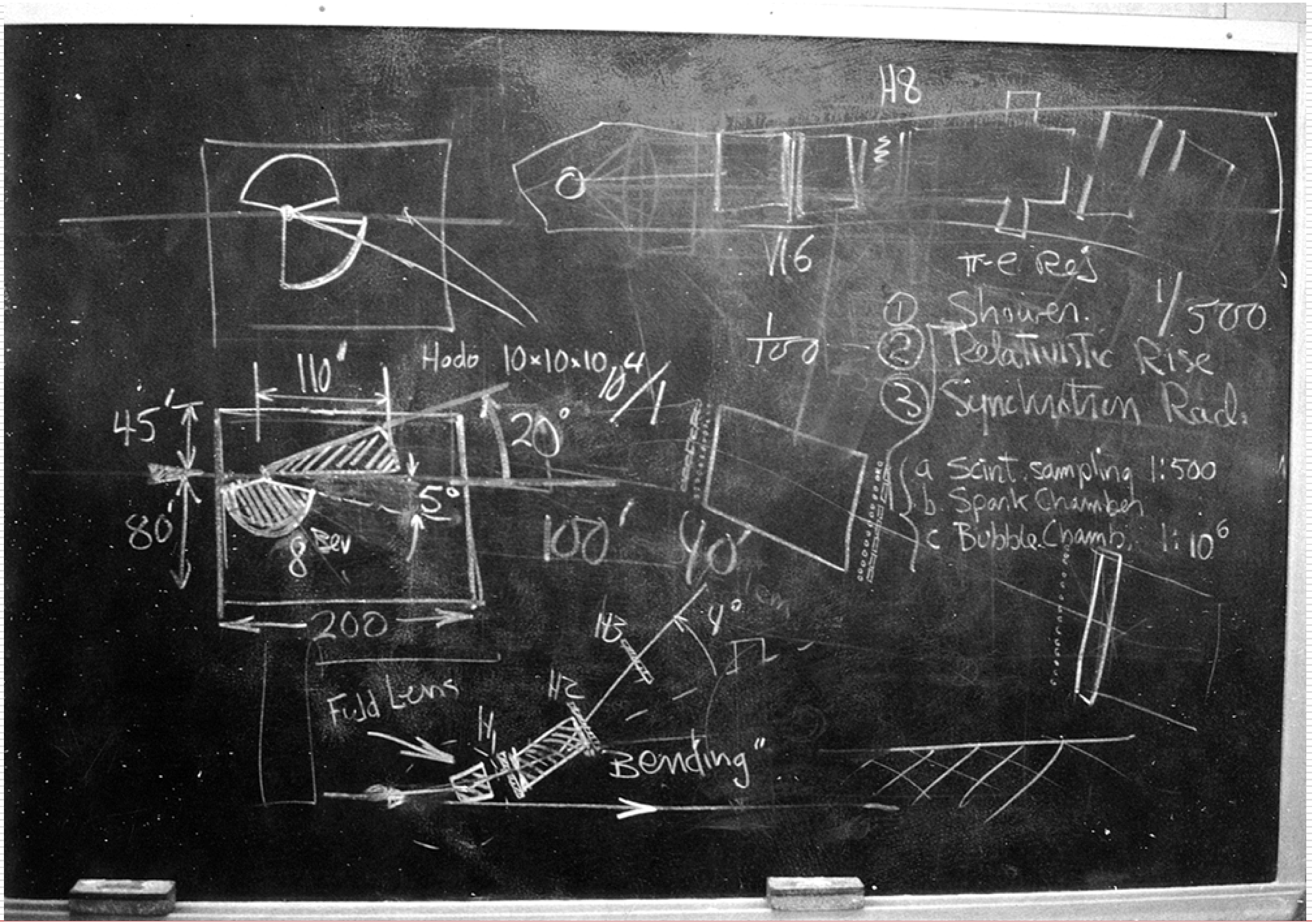
Two experimental areas
– sharing beam time

Endstation A:
e± p/n scattering,
beam/target polarization

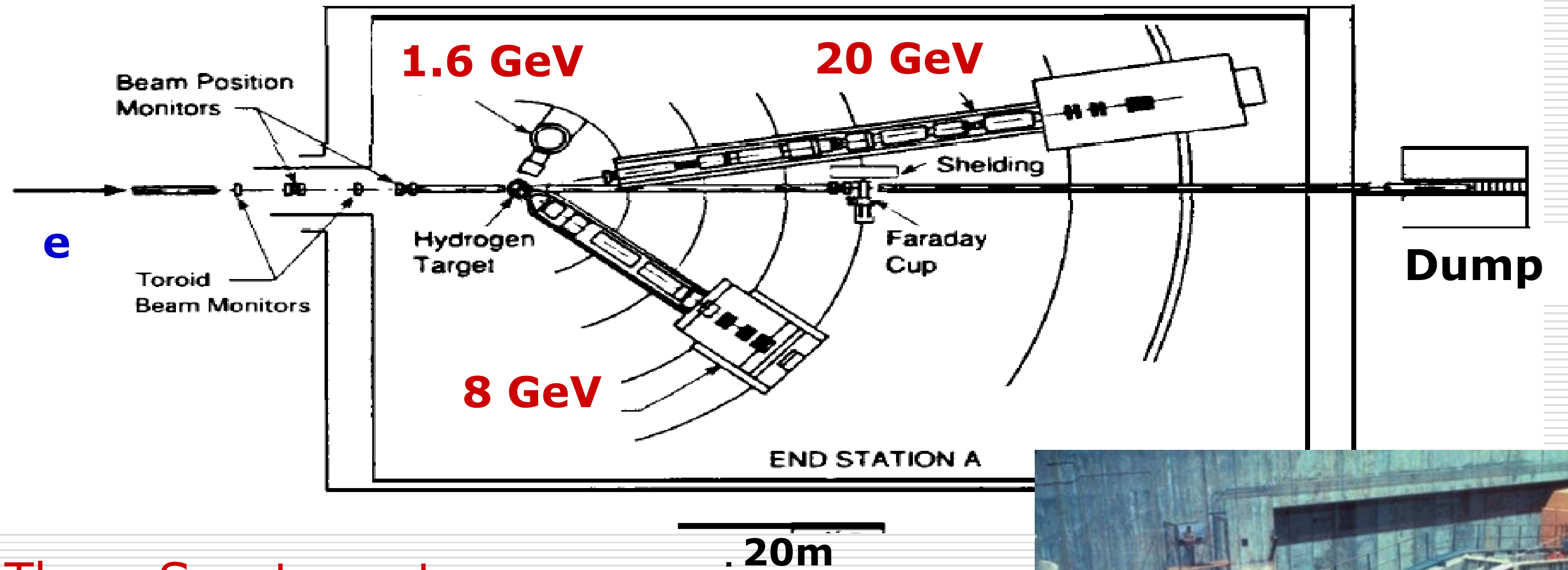
Endstation B:
secondary beams: γ, π K,



Design of the ESA Spectrometers



SLAC Physics Program: Endstation A

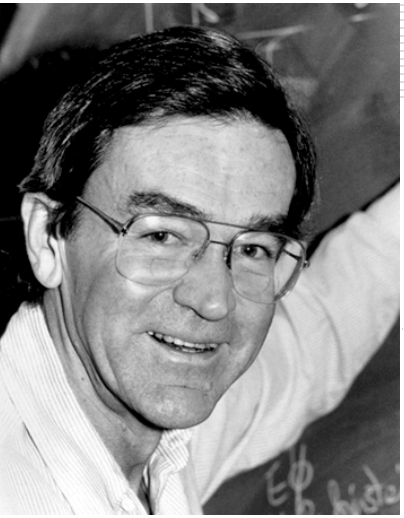


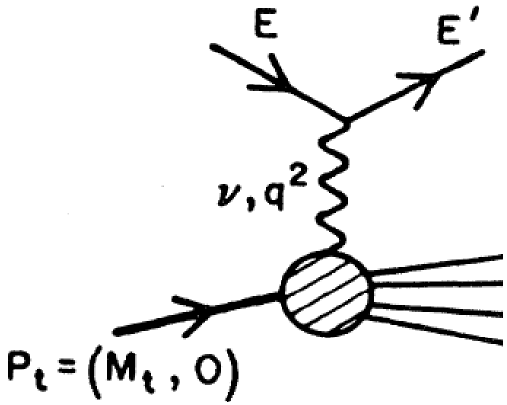
Three Spectrometers, measuring scattered electron

- Variable angle and momentum settings
- Variable incident beam energy, e^- and e^+
- Polarization of beam and targets

From the energy and angle of the scattered electrons one can derive what happened to the proton!

SLAC Physics Program: Electron Scattering





Differential Rate – Structure Functions

$$\frac{d^2\sigma}{d\Omega\, dE'}(E,E',\theta) = \sigma_M[W_2(\nu,q^2)+2W_1(\nu,q^2)\tan^2(\theta/2)]$$

X= { p — Elastic; N* — Resonant scattering; Hadrons — Deep Inelastic

X=		
	p	Elastic
	N*	Resonant scattering
	Hadrons	Deep Inelastic

In 1966, James Bjorken wondered what might happen to the proton if it was hit hard at the higher SLAC energies, deep inelastic processes? Would history repeat itself, and reveal structure of the proton?

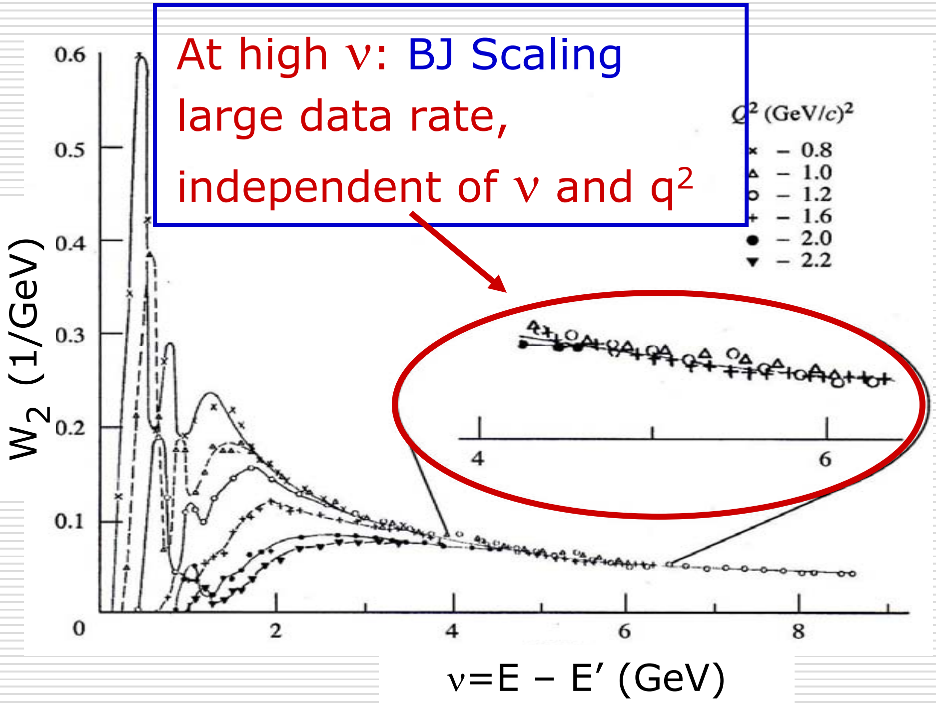
Based on current algebra, he conjectured if there were hard kernals inside, then for large ν and q^2, W_1 and νW_2 would become functions of only the ratio $M\nu/q^2$, they would be independent of the energy "Scale".

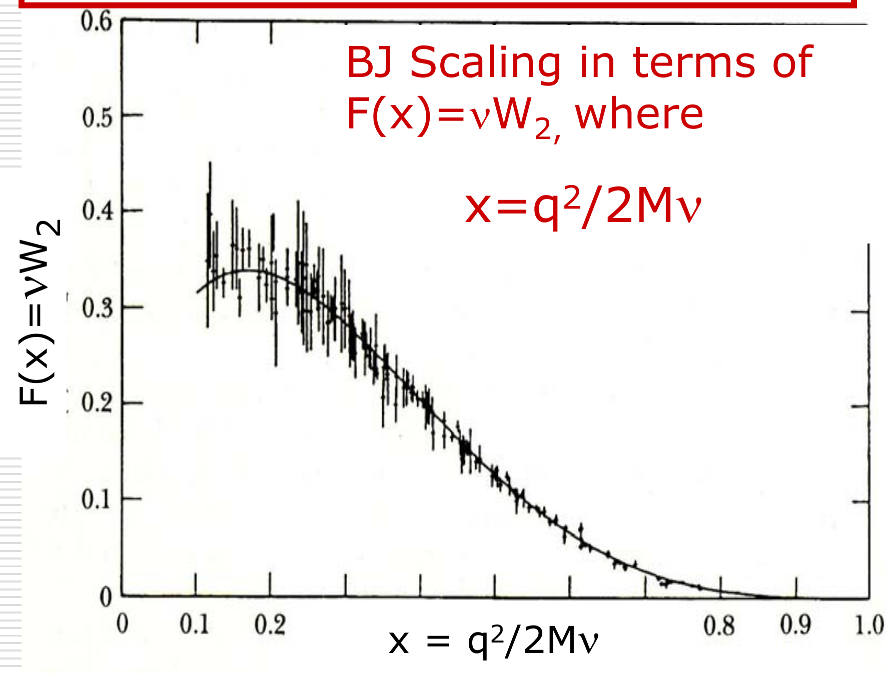
BJ presented this at LP67, few people paid attention! Some laughed!

SLAC Physics Program: Electron Scattering

At ICHEP08 in Vienna SLAC's 1st results were presented by Panofsky –the audience did not understand the implications!

In 1968, R. Feynman confirmed Bjorken's prediction of scaling! He explained that the data revealed the momentum distribution of "partons" inside the proton, F(x).





Endstation A: Polarized Beams

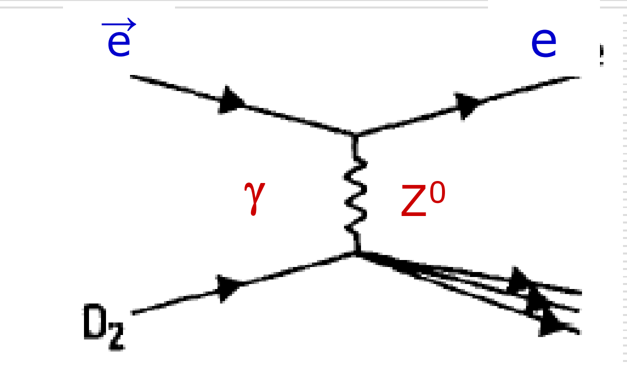
- In 1978, Charles Prescott led a team to search for parity violation in the scattering of polarized e- off Deuterium:
- Longitudinal polarization P=37±2%
- To gain statistics, integration over multiple electrons/pulse, with randomly chosen helicity settings, pulse by pulse!
- Measured Asymmetry

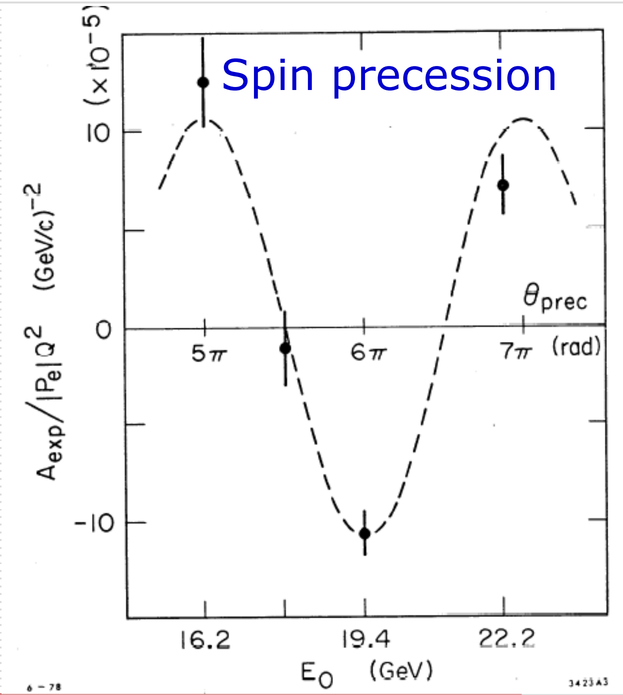
$$A_{exp} = \left(\langle Y_+ \rangle - \langle Y_- \rangle\right) / \left(\langle Y_+ \rangle + \langle Y_- \rangle\right)$$

$$A/Q^2 = (-9.5 \pm 1.6) \times 10^{-5} \ (\mathrm{GeV}/c)^{-2}$$

- This translates to

$$\sin^2\theta_W = 0.215 \pm 0.015 \pm 0.005$$



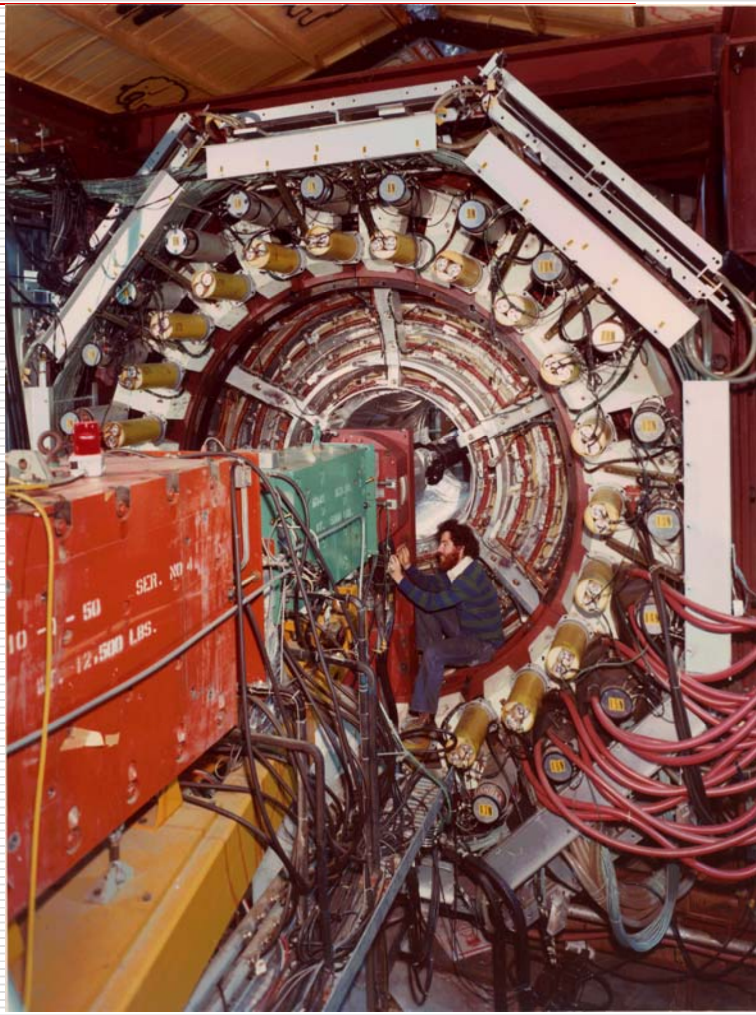


SPEAR – e+e- Storage Ring 2.4 – 7.4 GeV

Proposal prepared in 1964 by B. Richter's group , but no approval !!

Construction started in 1970, in parking lot, concrete block housing! .

First beams in April 1972!

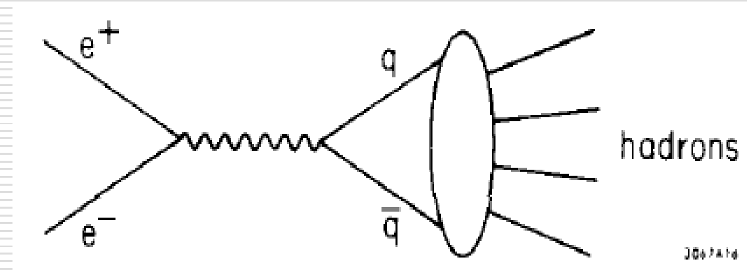


Mark I Detector

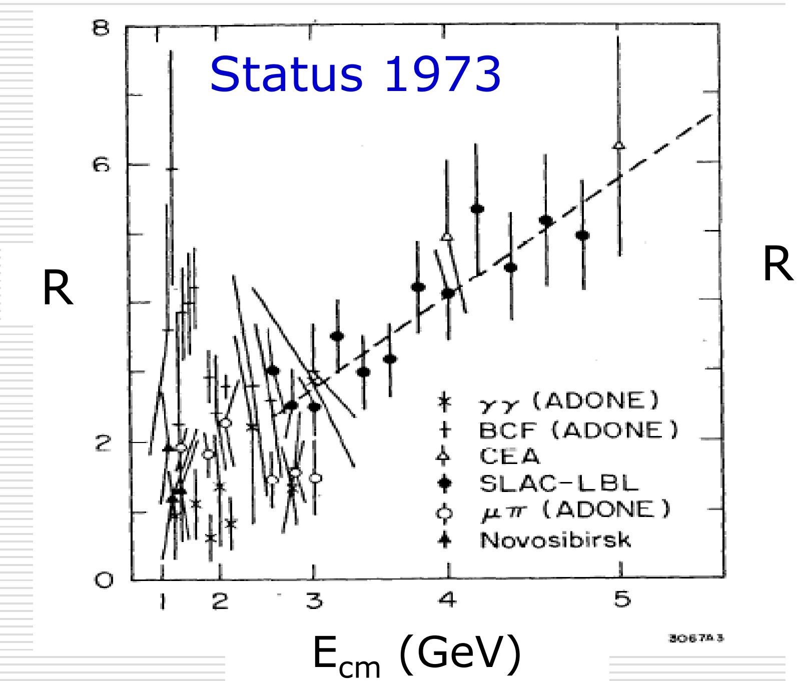
Results from SPEAR: Hadron Production

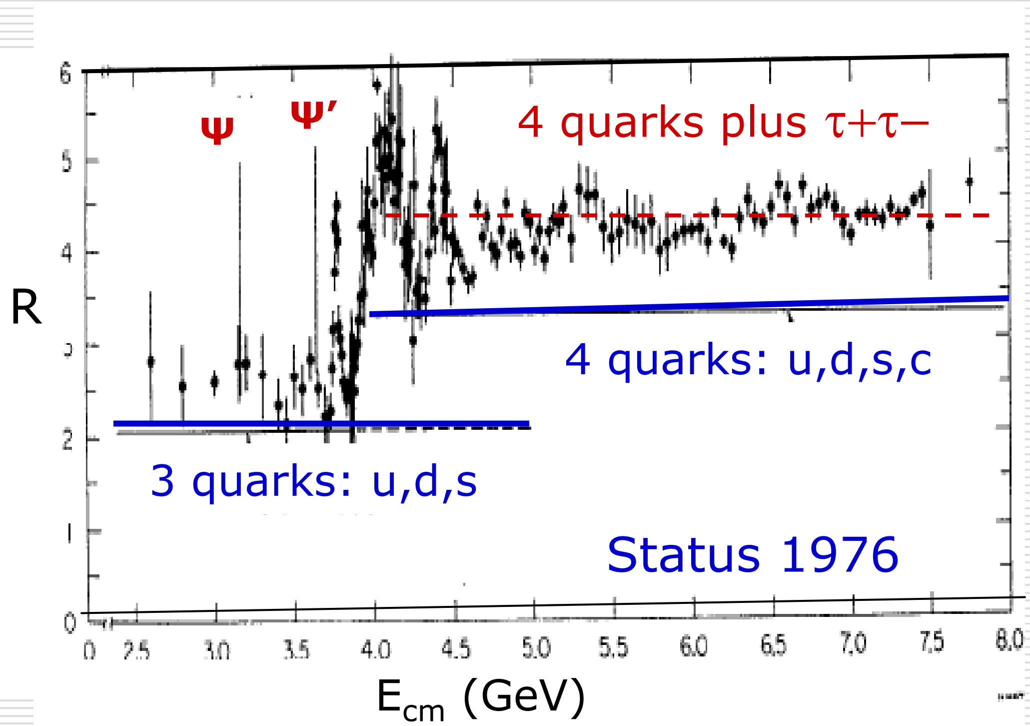
Hadron Production by e+ e- Annihilation

$$R = \frac{\sigma(e^+e^- \rightarrow hadrons)}{\sigma(e^+e^- \rightarrow \mu^+\mu^-)} = \Sigma Q_i^2$$

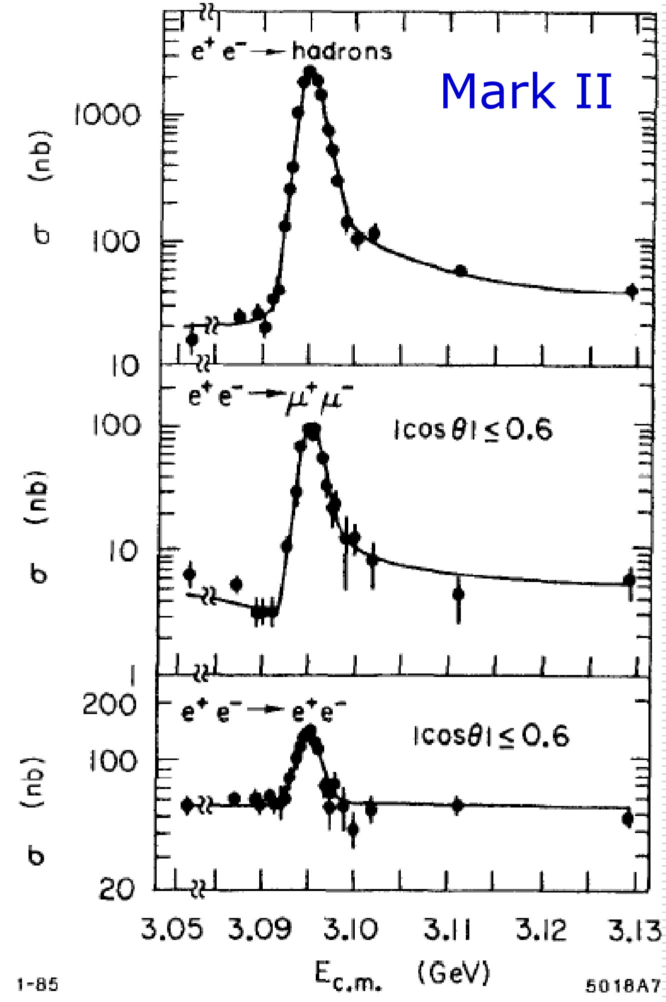


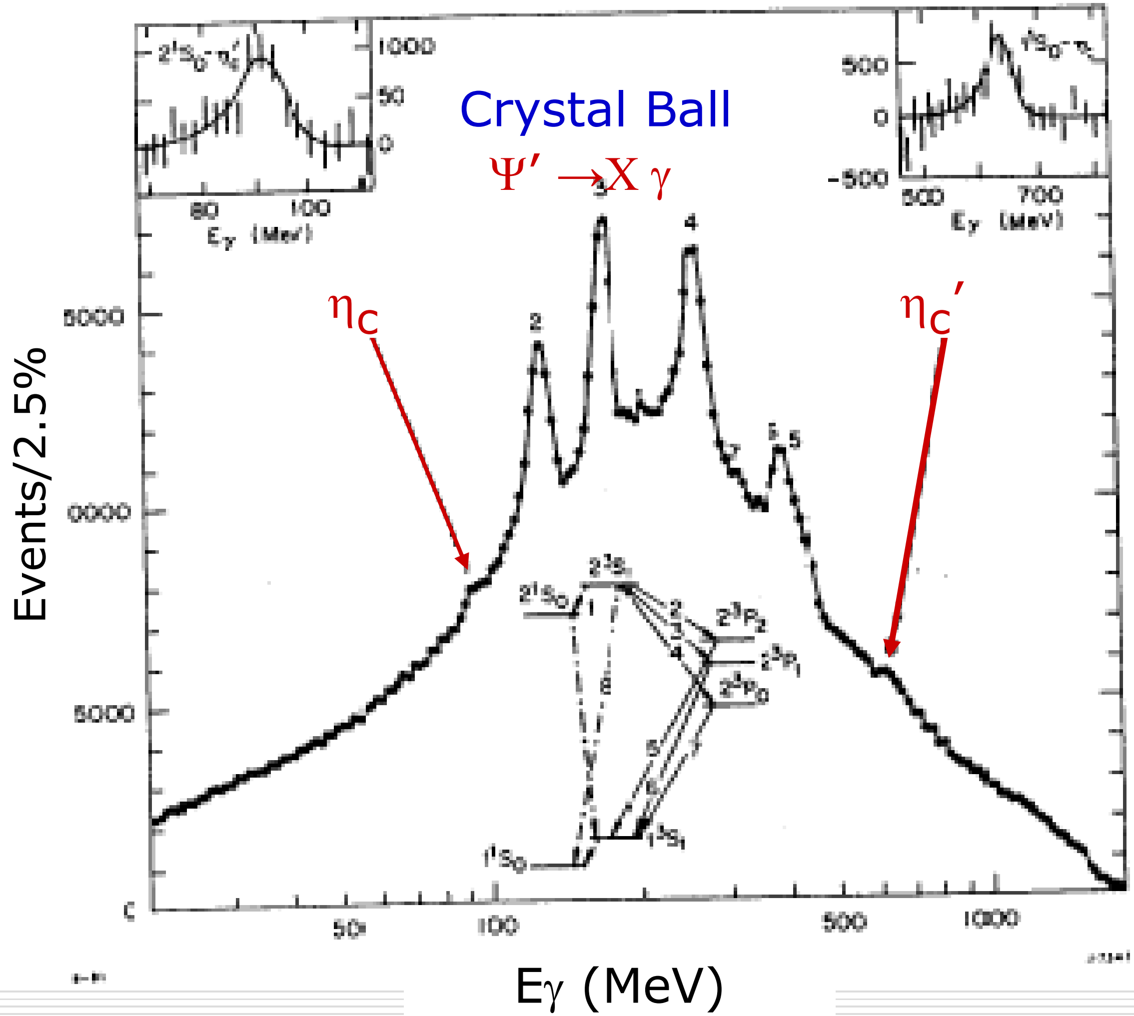
Theory: R=0.36 to ∞



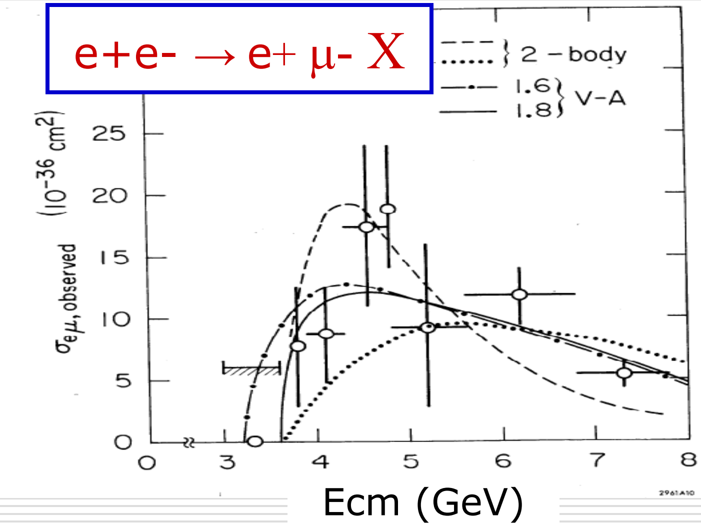


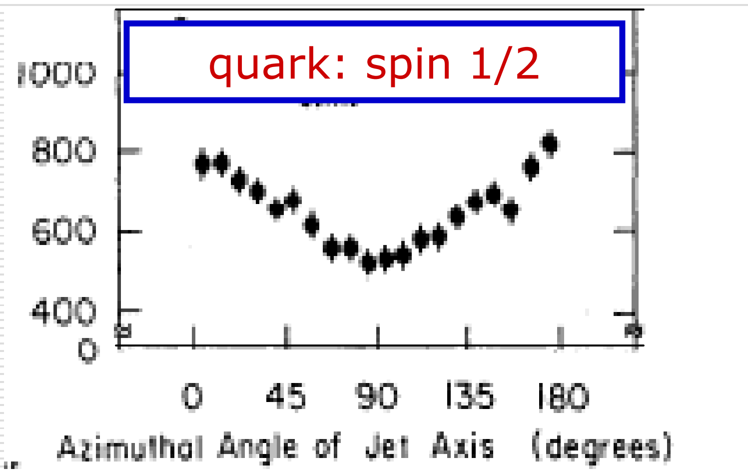
Results from SPEAR: Charmonium





Results from SPEAR: Mark I Detector





1974: Discovery of Narrow resonances

ψ (3100) and ψ(3700)

1975: M. Perl: Evidence for τ lepton

1975: Jet structure of qq events

Evidence of spin ½ quarks

1976: G. Goldhaber et al.

Charm Mesons: D^0, D^+, and Ds^+

1977: Mark I and Crystal Ball:
Charmonium Spectroscopy

Probably the most successful experiment:

A novel detector at a novel machine!

Overview of SLAC Experiments

1967	LINAC	Spectrometers	Nucleon Structure
1974	SPEAR	Mark I	Charmonium, D Mesons, τ lepton
			R, jets, Quark Spin 1/2
1977	SPEAR	SSRL	Protein Structure
1978	LINAC	Pol. Beams	E-W Interference
1980	PEP	4 Detectors	B and τ lifetimes, Gluons
1989	SLC	Mark II, SLD	Z^0 properties, E-W Interactions
1999	LINAC	Pol. Beam/target	Nucleon spin structure
1999	PEP II	BABAR	CP Violation, B, D, τ decays
2009	LINAC	LCLS	free electron laser: x-rays
2019	PEP III		x-rays

International Collaboration - Europe

From the beginning, there was a intense exchange with scientists from around the world.

Many of the prime movers at laboratories building electron or synchrotron facilities have spent time at Stanford or SLAC, and SLAC physicists have worked at labs in Europe, primarily

- DESY and Bonn in Germany
- LAL in Orsay in France
- Adone at Frascati in Italy

Such international cooperation have remained a very important of life at SLAC.

Most recently BABAR benefitted tremendously from a large international collaboration, >300 students received their doctorate based on BABAR data.

Collaboration with Novosibirsk

- First contacts with Russian scientists began in 1956
- From their first encounter Pief was most impressed by the pioneering work by Gersch Budker and his colleagues, who later established the INP in Novosibirsk..
- regular visits/ interactions followed

- In 1973 Panofsky, Richter, and Budker, Siderov, Skrinsky prepared a joint proposal for the construction of a 15GeV/beam storage ring, a collaborative effort w/o transfer of funds. It was rejected by USSR Academy..
- Close collaboration and exchange with Russian scientists continues today, but nothing as ambitious and intense as in 1970s.

Collaboration with Novosibirsk

Collaboration with the P.R. China

- In 1973 China considered the construction of the 50 GeV proton synchrotron at a new laboratory near the Ming Tombs.
- In 1976, Pief visited Beijing (full VIP tour) and suggested that a e+e- collider, as a project with dual purpose, HEP and S.R.
- In 1979, the US-China Agreement on Science and Technology was signed. It still is operational today!
- 30 scientist/engineers came to SLAC for the design of BEPC.
- US scientists participated in the physics analysis: τ mass
- BEPC II is now operating, τ/charm factory!
- Pief remained a frequent consultant to the Chinese Academy and Government.

Nuclear Arms Control and Test Ban

- In postwar years, Pief became more and more concerned about the hawkish attitude of some of his colleagues. He supported R. Oppenheimer who favored a "go slow" on the development of the H Bomb.
- His National Security work began with the "Screwdriver Report", supporting R. Oppenheimer's testimony (1946), that – given the shielding and low sensitivity of detectors - the only sure way to detect a shipment of "one cubic inch" of weapons material, was to open the package. A conclusion that still holds today! Threat of Suitcase Bomb!
- Panofsky entered the international scene in 1958, as a member of the Geneva Conference of Experts (US and USSR) to explore technical means of verifying a ban of nuclear bomb tests.
- Pief headed the US team in subsequent working group meetings with Soviet scientists at the U.N. in Geneva to assess details of verification methods. Very protracted discussions, but the base for future negotiations.
- In 1963, the Partial Test Ban Treaty was signed, banning tests in atmosphere, under water, and in space, but not underground!
- It took until 10. Dec. 1996, for the U.N. to approve the Comprehensive Test Ban Treaty (CTBT). US signed, but Congress never ratified!

Nuclear Arms Control and Test Ban

- In 1957, following the launch of the Sputnik, President Eisenhower created a Presidential Science Advisory Committee (PSAC),
  - To advice on science and national security directly, without filter by Department of Defense, Atomic Energy Commission, or the Military Industrial Complex (Edward Teller et al.).
- PSAC continued under President Kennedy, 1961-1964 Pief was a member, attending plenary and subcommittee sessions in Washington each month. His primary focus was
  - Ballistic missile defense
  - Cessation of nuclear tests
  - Impact of radiation from nuclear explosion on ballistic missiles or electronics of ICBM
  - Explained: Manned Lunar mission not a scientific endeavor!
- PSAC was eliminated by President Nixon over various disagreements:
  - supersonic and nuclear driven air transport
  - ballistic missile defense and nuclear test ban

President's Science Advisory Committee

Oval Office Dec. 19, 1960

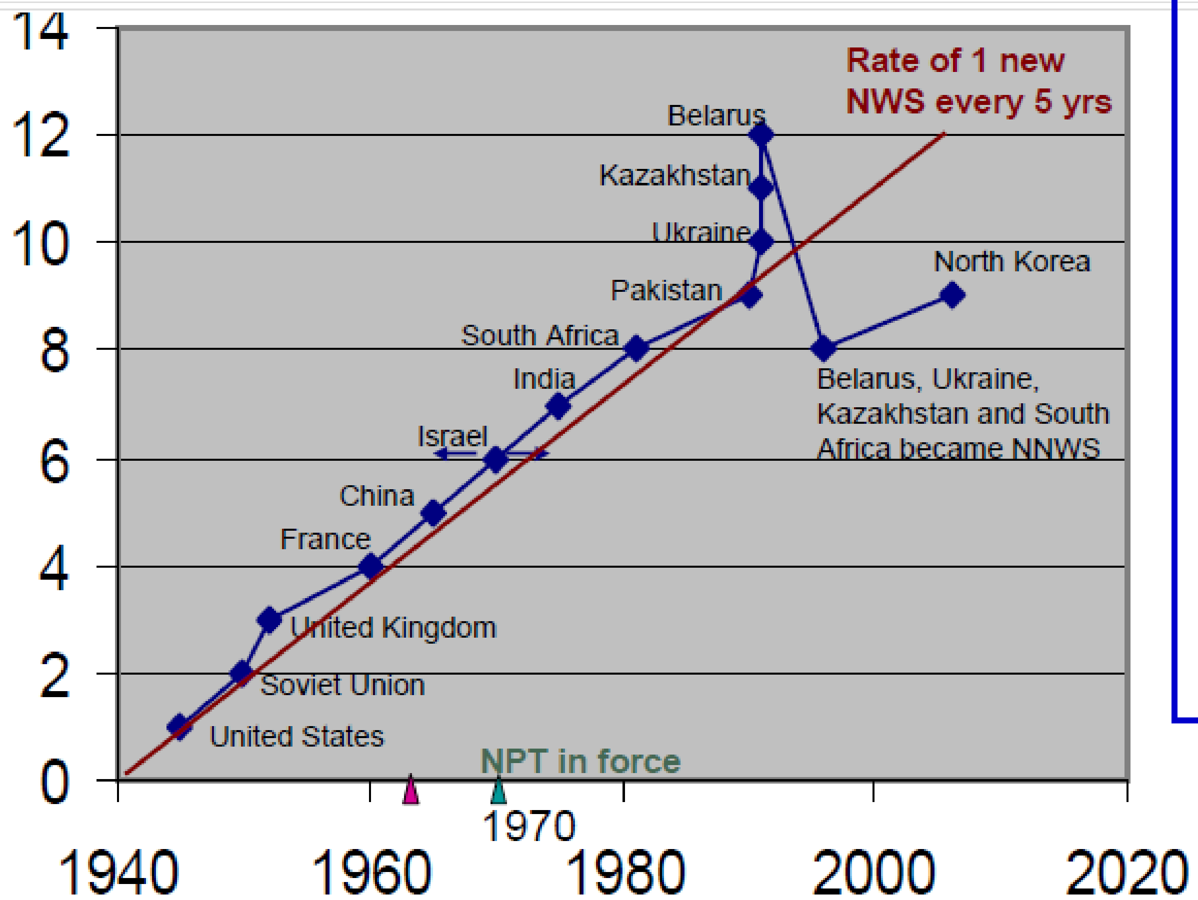
Standing:

G.W. Beadle, D. Hornig,
J.B. Wiesner, W.H. Zinn,
H. Brooks, G.T. Seaborg,
A.M. Weinberg, D.Z. Beckler,
E.R. Piore, J.W.Turkey,
W.K.H.Panofsky, J.Bardeen,
D.W. Bronk, R.F. Loeb,

Seated:

J.B. Disk, G. Kistiakowsky,
President D. Eisenhower,
J. R. Killian, I.I. Rabi

1970: Nuclear Non-Proliferation Treaty - NPT



NPT signed by all countries

except India, Israel, Pakistan, N. Korea

Goals:

- Non-Proliferation of NW
- Nuclear Disarmament
- Right to peaceful use of nuclear technology (safe guards by IAEA)

Many countries ended their NW programs.

Committee on Int. Security and Arms Control

- CISAC chartered to support US–USSR Inter-Academy dialogue
- 1982/83: Examen means of defense against nuclear-armed missiles, so-called Directive Energy Space Weapons (DEW).

  Conclusion: laser or particle weapons would be ineffective
- Nevertheless, a few weeks later, on the advise of E. Teller, President Reagan announced in 1983 Strategic Defense Initiative (SDI), based on DEW, including nuclear explosion by pumped laser weapons!
- Fortunately, M. Gorbachev after consultation with Soviet scientists, not the military establishment, decided not to duplicate US DEW efforts.
- Pief played a very significant role in CISAC and deserves considerable credit for this development!
- CISAC extended its efforts to other countries, initially to China, then Europe.
- CISAC's contacts to Europe led to Amaldi Conferences, a forum to discuss the changes and challenges of the post Cold War Era.

Beyond Cold War – NW Buildup and Policy

- During the Cold War, the NW stockpile grew to 70,000 warheads, with 20x the power of Hiroshima bomb that killed 250,000!
- Today, US and USSR still have >10,000 NW each!
  The goal is to reduce this to <3000 by 2012, hopefully fewer!
- Doctrine of G.W. Bush administration
  - Deter - discourage others from developing and using NW
  - Assure - not to retaliate with NW if attacked by Non-NWC
    - protect Non-NWC if attacked by NW
  - Defeat - US will respond to or preempt any attack – NUTS*
    with ICBMs, SLBMs, Strategic Bombers (B52):
    - US might upgrade NW capability

N.B. NW are great equalizer, a small number can affect great power!

- Major risk of enormous arsenal of NW
  - Accidental detonation, false alarms, insufficient early warning (USSR)
  - Regional conflicts
  - NW Proliferation – terrorist, rogue states – knowledge is no longer a barrier
  - Peaceful Nuclear fuel cycle – reactor grade Plutonium is usable in NW

*) Nuclear Use Tqrget Selection

End of Cold War – from MAD*) to NUTS**)

In an article in the April 2007 edition of "Foreign Affairs", entitled "Nuclear Insecurity" Panofsky concludes:

- The primary mission of nuclear weapons, MAD, is obsolete!
- Now the only mission of US nuclear weapons is to deter threat and use of such weapons by others.
- The risk to benefit ratio of NW is getting very large. The very large number of US and USSR NW is difficult to safeguard and encourages other to acquire NW.
- The US should take leadership on declaring and promoting a universal "No First Use" policy.
- Ultimately, we must create conditions for a worldwide prohibition of NW. Some minimal evasion will remain.
- This will be a protracted process, but the US has most to gain and must take leadership if we want to create a safer world in the future.

Fortunately the Obama Administrations has adopted with this view!

*) Mutual Assured Destruction **) Nuclear Use Target Selection

Honors

Panofsky was awarded many honors, most notably

- Ernest Orlando Lawrence Memorial Award (1961)
- U.S. National Medal of Science (1969)
- U.S. DOE’s Enrico Fermi Award (1979)
- Leo Szilard Award (1982)
- 10 Honary degrees

He was elected to many Honor Societies:

- U.S. National Academy of Sciences
- American Academy of Arts and Sciences
- Council on Foreign Relations
- American Physical Society (Fellow and 1974 President)
- American Philosophical Society
- Foreign member of the National academies of China, France, Italy, and Russia
- Innumarable Advisory Committees and Panels, in the US and worldwide

Memory of Wolfgang K. H. Panofsky

Wolfgang K. H Panofsky was truly a remarkable man,
So diverse and complete were his talents and skills, be they scientific, technical, managerial, or interpersonal,
that it is simply impossible to capture his greatness in a few words.

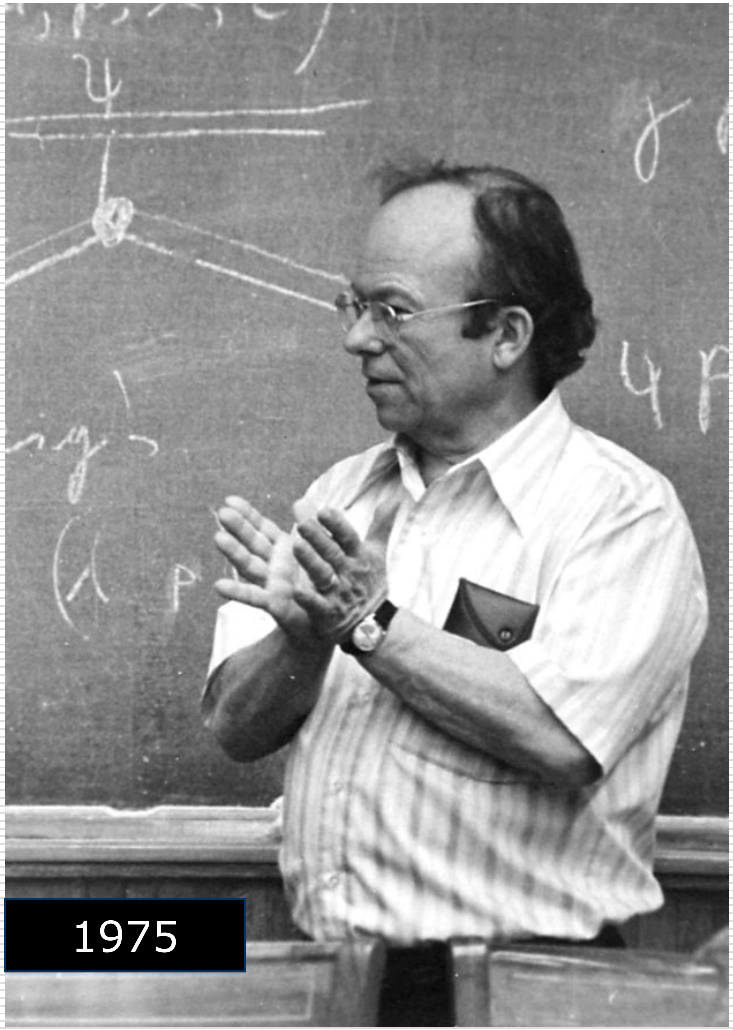
With his passing the world has lost
- a giant of human kind,
- a man of great integrity,
  of moral and ethical rectitude,
- a scientist of extraordinary vision
  and action,
- a champion of world peace and
  human rights.

Wolfgang K. H. Panofsky

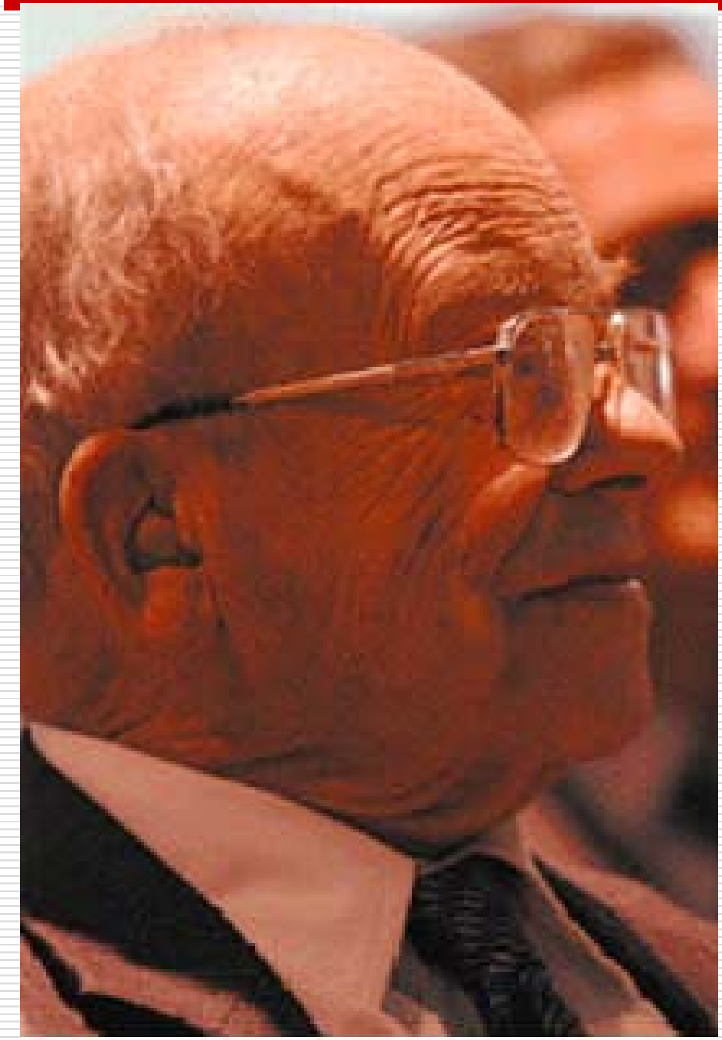
It took only one meeting with Pief to recognize
his exceptional personality,
his clarity of thought,
the incisiveness of his words.

Pief was man of great humility and unselfishness.

He was the same caring, nurturing individual, whether he was meeting a
- a student,
- a technician,
- a janitor (whom he knew by name),
- a director or prominent statesman.



Wolfgang K. H. Panofsky



To scientists of my generation Pief set the gold standard, his was a career to emulate – at last in parts.

His Legacy of scientific leadership and vision, the wonderful research environment, was a platform from which we all could flourish.

Where would we be, were it not for the SLAC Linac, SPEAR, and PEP?

The great laboratory associated with Stanford University!

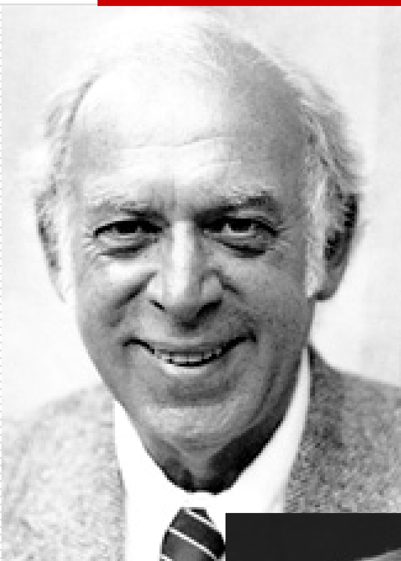
Wolfgang K. H. Panofsky

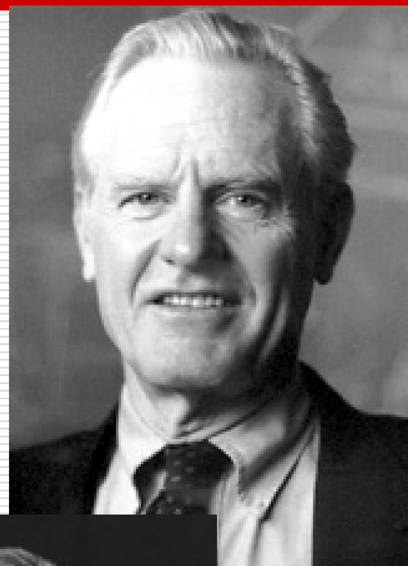
Horace Mann, an American education reformer advised
" Seek not greatness, but seek truth and you will find both"
- Pief lived both!

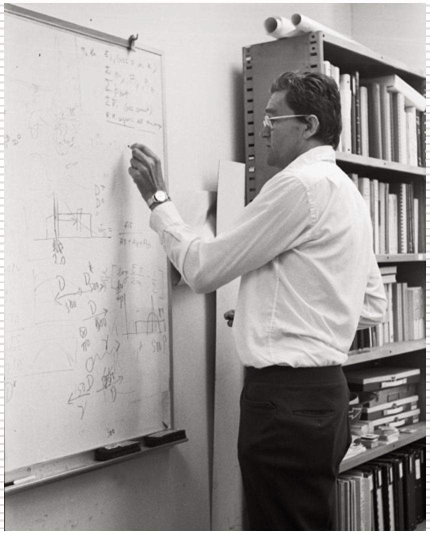
Horace Mann also wrote
" Be shamed to die until you have won a victory for humanity"
- Pief won many!

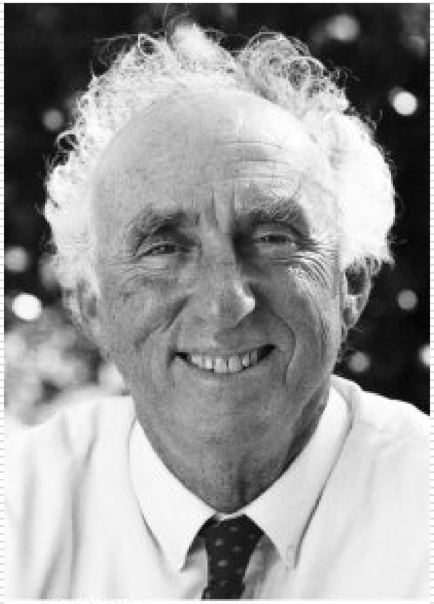
Pief remained vibrant, current, involved until his last day

To say that we miss him is a great understatement.









PERL, Martin L.
Nobel Laureate PHYSICS 1995
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