William J. Willis

The Early Years at BNL

Nicholas P. Samios

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William J. Willis

Long Association with BNL
Student, Scientist, Advisor, Head

Institution	Years	Post
Yale	1954-1958	Grad Student
BNL	1958-1964	Assist. Assoc. Physicist
Yale	1965-1970	Assoc. Professor
BNL	1985-1997	RHIC Advisory Committee
BNL	1990-1991	Head Accelerator Test Facility
BNL	1994-2010	Assist. to the Director

General Observations –

Government Reaction to Crisis

1914 WWI; 1939 WWII; 1950 Cold War; 1957 Sputnik; 1974 Oil Embargo; 1980 Star Wars; 2009 Energy – Climate Change

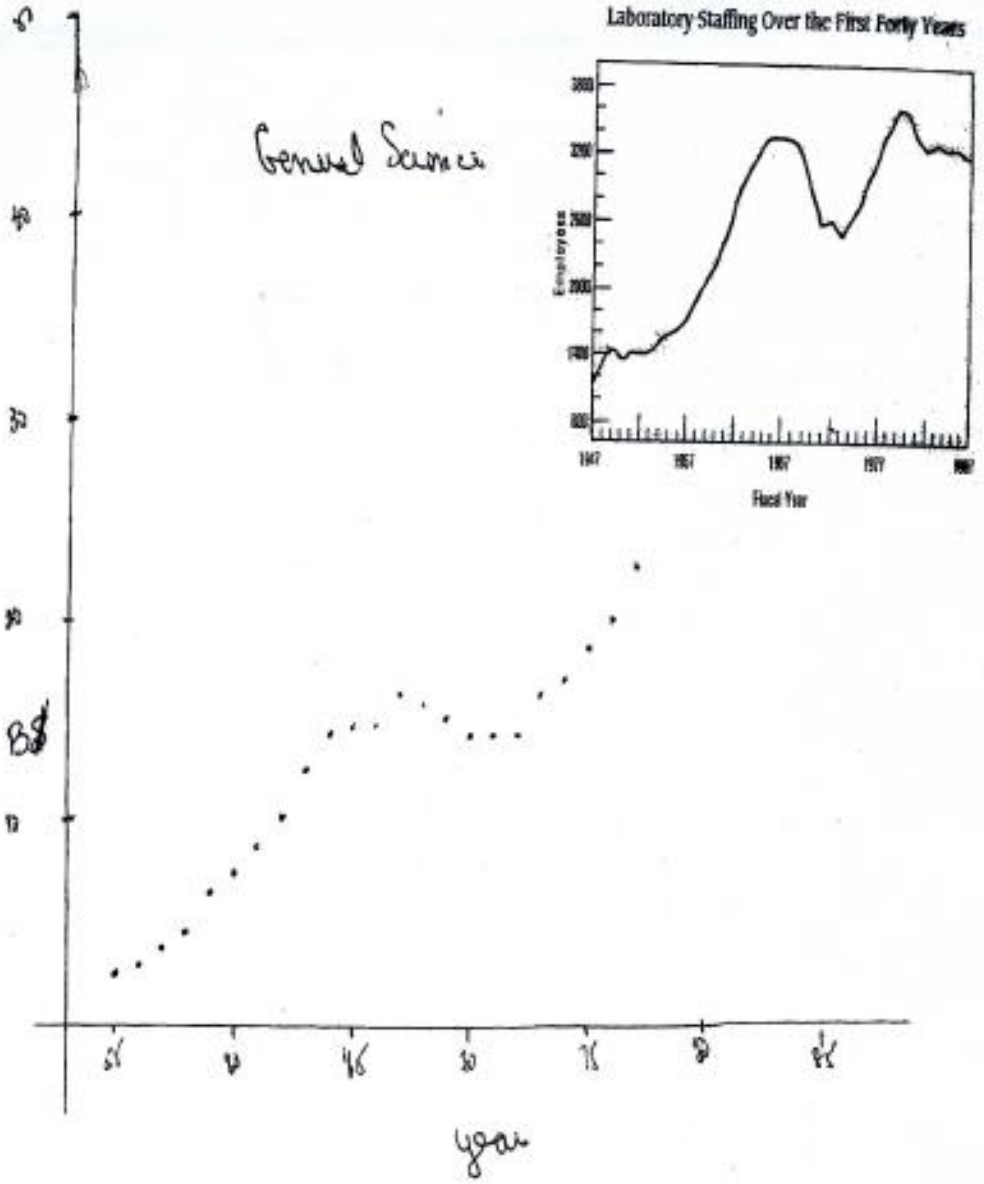
October	1957	Sputnik
November	1957	Special Assist. to President for Science & Technology
		PSAC - Presidential Science Advisory Counsel
	1958	National Defense Education Act

Eisenhower Era	(1952-1960)	President of U.S.
	(1948-1952)	President of Columbia U.

Consequences

General Science (Nondefense R&D)		
Budget	1957-1967	$2B → $16B
BNL Staffing	1957-1967	1600 → 3300 People

Bill's and My Era - Opportunities


Laboratory Staffing Over the First Forty Years
Employees
Fiscal Year
year

Physics

Experimental Situation

1957 **Barkas – Rosenfeld** **Particle Data Group**
Gell-Mann – Rosenfeld

Entries

γ		
e	μ	ν
π^+	π^-	π^0
K^+	K^0	$\overline{K}^0$ K^-
p	N	
Λ		
Σ^+	Σ^-	Σ^0
Ξ^-	Ξ^o	

1961

ρ, ω		
K^* (895)		
Δ (1238)	N(1510)	N(1680)
Y^* (1385)	Y(1405)	Y(1815)

Physics

Era of the Bubble Chamber

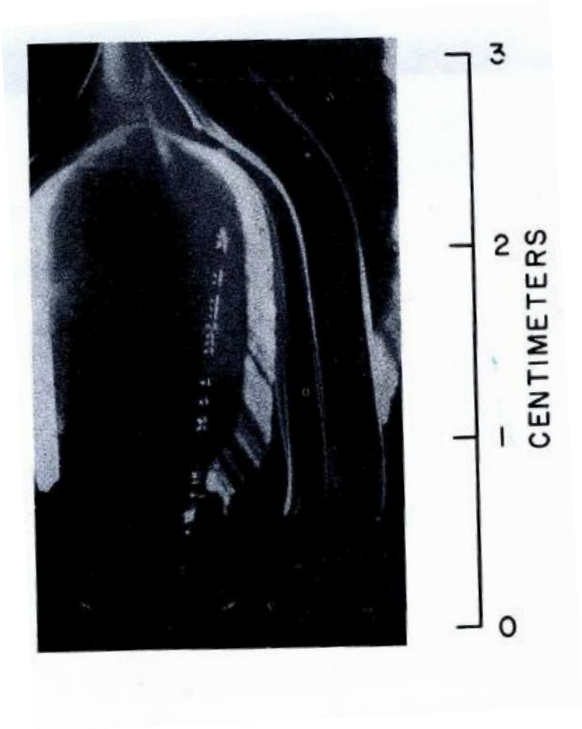
High Resolution

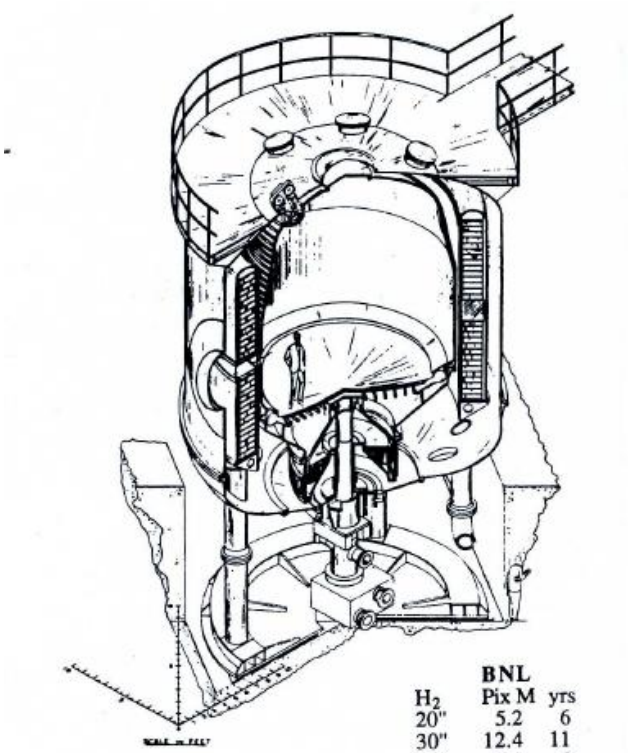
4 π Geometry

Magnetic Field

Volumes – few liters – thousand of liters

H_2, D_2, C_3H_8, Neon, etc.





H_2	BNL Pix M	yrs
20"	5.2	6
30"	12.4	11
31"	7.3	5
80"	11.6	10
7'	3.9	7
	40.4	

Figure 20

Weak Interactions

Universality

$n \rightarrow p\ e^{-} \bar{\nu}$

$\mu \rightarrow e\ \nu\ \bar{\nu}$ G_F

$\Lambda \rightarrow p\ e^{-}\ \nu$ $G_{F/4}$ broken strangeness

Willis – Whole Program of Weak Decays

$K_L^{o} \rightarrow \pi\ e\ \nu;\ \pi\ \mu\ \nu$ 20" b.c. 1964

$\Sigma^{-} \rightarrow \Lambda\ e\ \nu;\ n\ e\ \nu$ 80 cm b.c. 1964

Non-Universality: Verified

Cabibbo Angle: Explanation (13^{o}) Verified

Weak Interaction Conference – BNL 1963

Wick, Willis – organizers (Gell-Mann)

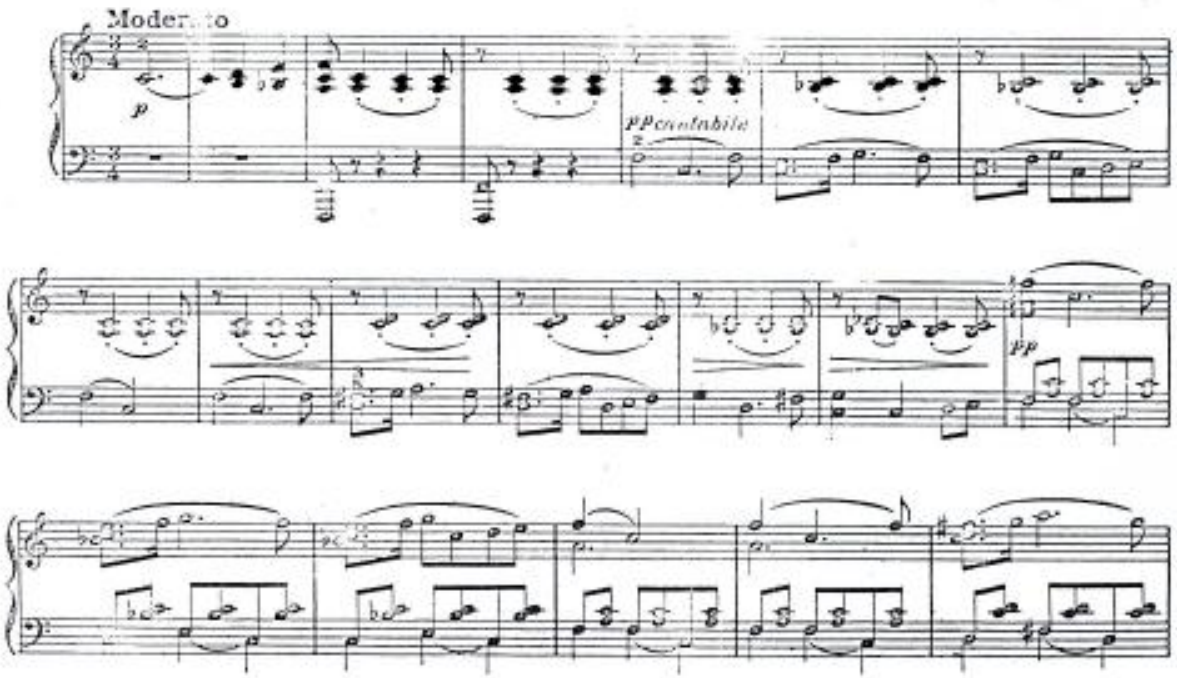
$\Sigma^{-} \rightarrow n\ e\ \nu$ Counter 1974, Hyperon Beam BNL

g_A/g_V Cabibbo

"Conserved Vector Current"

by

Murray Gell-Mann



Particle Properties and Strong Interactions

pp collisions at 2.85 GeV 20" b.c. 1961-1962

Strange particle and multiple meson production

Σ-Λ Relative Parity – Important Issue

Nambu & Sakurai1961

Eight Reasons Why ΣΛ Parity is Odd

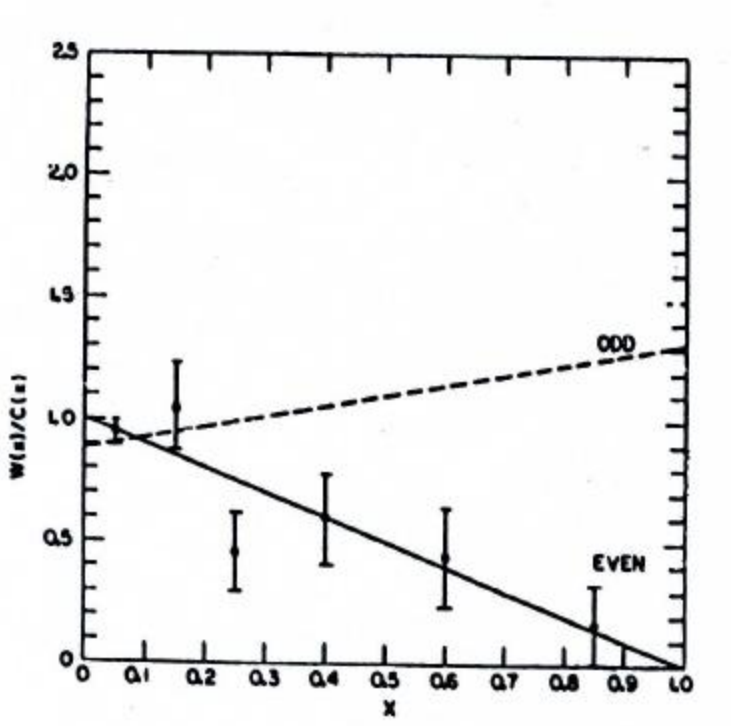
$\Sigma^o \rightarrow \Lambda^o e^+ e^-$ 80 cm CERN b.c. 1963

$x = m^2(e^+e^-)/m^2(\Sigma\text{-}\Lambda)$

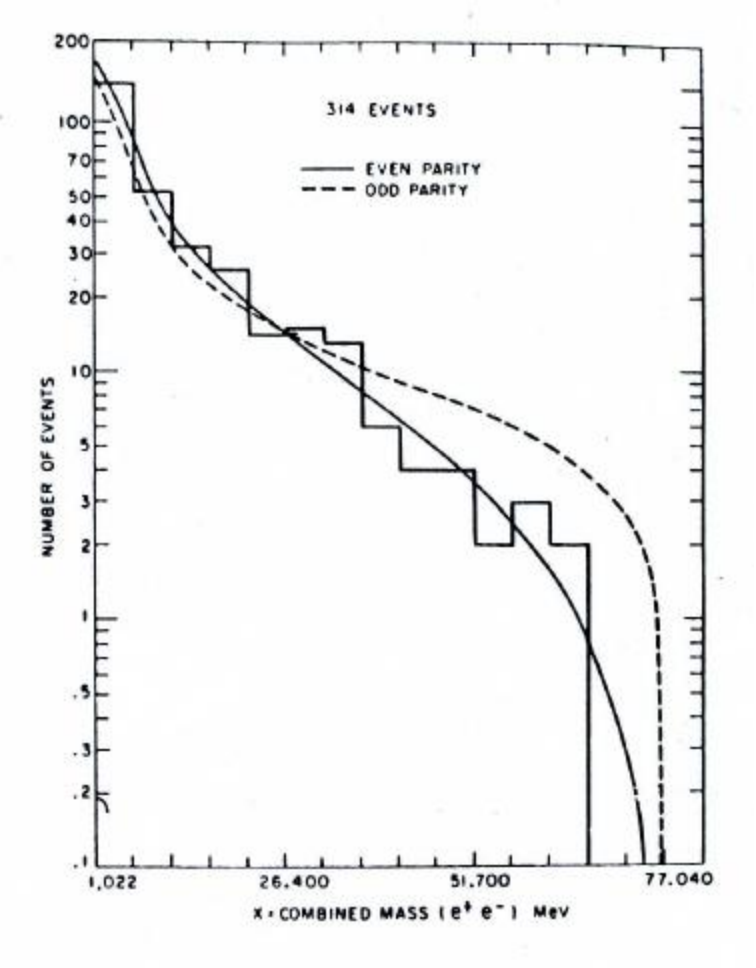
Σ^o-Λ Parity Even (350 events)

Also 30" Columbia 1965

Σ-Λ Parity



Willis 1963



Alff 1965

Member of Ω^- Discovery

80" b.c. 1964

Untangling Λ^*, Σ^* Resonances

30" Columbia b.c. 1968

Search for Σ^*, Ξ^*, Ω^* Resonances

Hyperon Beams 1974

Electronic Techniques

Notes on Bill Willis

Jack Sandweiss – Yale

The first time that I met Bill was in 1957 when I interviewed for a Yale position. I recall conversations with Professors Earle Fowler and Henry Kraybill (then the senior particle people at Yale). I remember that as we discussed the state of particle physics, from time to time they were unsure of some point and would go down the hall to ask their graduate student (Bill) who even at that time seemed to know everything.

When I started at Yale in Fall 1957 Bill was just finishing up. At that time also the nuclear people at Yale were just finishing a linear accelerator which could make heavy ion beams for nuclear structure research. Bill was in his "spare time" building some Cerenkov counters with which he wanted to look for pi zero production which was energetically possible with that accelerator. As it happened, he graduated, went to BNL and never did the pi zero search at the Linac.

Bill and I both worked with the Shutt 20" hydrogen chamber. although on different topics. Bill worked with neutral K beams and I started my work on the development of particle separators. During that time we did meet often and kept up on our respective projects. It was also a time, when at BNL, I met many physicists who became colleagues, collaborators, and lifelong friends.

As always, I was very impressed with Bill. I always wanted to recruit him back to Yale. This was ultimately successful and Bill joined our Yale faculty in 1965 and we worked together for most of the time that he was at Yale.

When he first returned to Yale he was carrying out a large bubble chamber experiment (hydrogen bubble chamber) with a stopping K^- beam. The main purpose of which was to obtain a large sample of Σ^- hyperons to study their beta decay. Despite the 1 million pictures, the statistics were insufficient. He and I were intrigued with the possibility of building a beam of hyperons.

At that time a group of us in the high energy group would often walk down Humphrey street to a Sandwich shop (Sam's) for lunch and discussions. At one of these, the idea of a high energy hyperon came up.

It seemed a good idea if the p-p collisions (at AGS energies) produced a sufficient number of hyperons. We were particularly interested in Sigma minus states. The production cross section for high energy hyperons was however not known at that time. I undertook to specially scan a large sample of p-p pictures in the 20" bubble chamber. After a "significant" effort I found two events with very slow Sigmas. These were emitted in the backward direction and from the symmetry of the p-p collision we knew there must be forward Sigmas and the hyperon beam effort began. Incidentally, he next year I was on sabbatical at CERN (working with Carlo Rubia's group) and had several conversations with Jean Marc Gaillard about this hyperon flux result, which started his work on the CERN hyperon beam.

When I returned from CERN, Bill and I worked on the hyperon beam and on an Argonne ZGS experiment to study CP violation K decay (Muon) by studying muon polarization. The experiment was a success but no violation was found. After that we worked on the BNL hyperon beam program.

In all of these projects it was wonderful and fun to work with Bill. He always had an original direction for the research. For example he made group theory analysis of the possible errors in the Argone experiment which identified those that were important to the CP violation measurement. It was also great to discuss the "larger" questions in our field with him. He always had an original way of looking at things. All in all those were wonderful years.

Bill left Yale, first for Brookhaven, and then for CERN, and finally for Columbia. His work and life at these institutions will be discussed by others. We kept in pretty close touch but did not work as colleagues again. One thing I would mention which illustrates his human side, and his personal generosity, is the fact that he visited Heinz Filtuth in prison. As far as I know he was the only colleague of Heinz to do so. Bill was his friend and would not desert him even in difficult times.

Finally, let me say that I am very sorry that I cannot be at this symposium. Bill was my colleague and dear friend for most of our lives. His passing is a great loss to all of us.

Final Observations

Utilized appropriate devices to explore the physics

20", 80 cm, 30", 80" b.c.

Hyperon Beams, electronic devices

Early indicator of versatility

(transition radiation detector, liquid argon)

Interactions

Democratic – talked to all

Olympian – doled out information commensurate with ability to absorb

Results trump credit