History of Spin at Michigan

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Spin Physics Symposium

University of Michigan

Ann Arbor, Michigan

November 14, 2009

A Symposium in Honor of Alan D. Krisch

- A distinguished colleague who has made extraordinary contributions to understanding the behavior of the mysterious quantum variable spin – whose existence influences all of Nature .

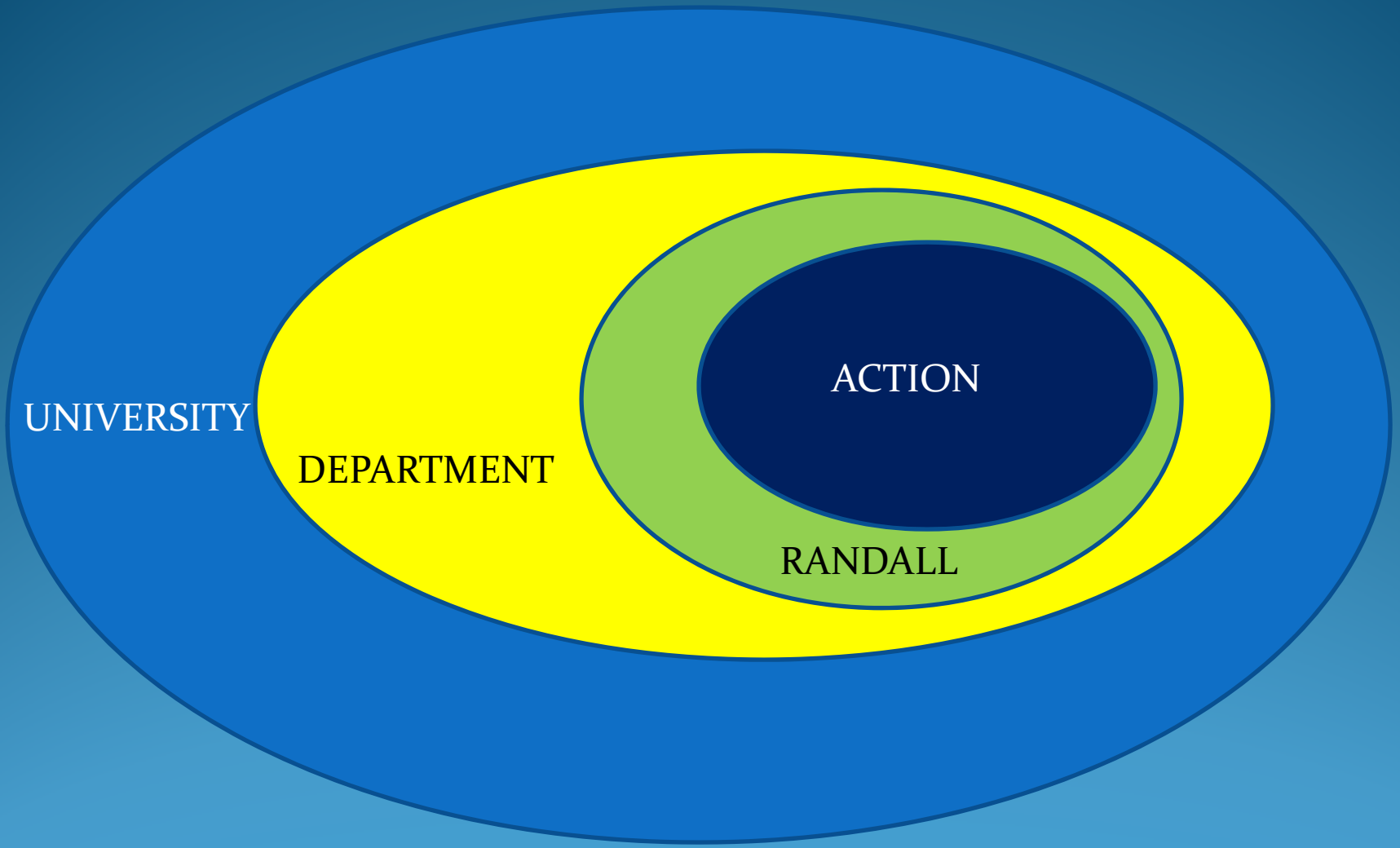
Context of Presentation

- A proud Department which takes this opportunity to celebrate the contributions of Alan Krisch, and uses this opportunity to reflect on the enormous historical role the Department itself has played in elucidating the concept of spin
- A personal retrospective

Some Relevant Michigan Milestones

- The primary professional home of the discoverers of electron spin
- The primary professional home of the discoverer of proton spin
- Site of the first measurement of g-2
- World center for advanced studies of p-p elastic polarization
- Most precise studies of spin correlation effects
- Primary professional home of researcher who measured Λ^0 parity violating parameter -- α
- Unparalleled advances in polarized target technology
- Seminal contributions to polarized beam technology …

Presentation Outline



The UM Early Days: An Administrator's View

- Move of University from Detroit
  - First physics courses taught in 1843, six years later

- Tappan becomes first President and sets the goal of the university becoming a "research university" (1852)

- First Physics Research Building constructed (1888)

- Appointment of Harrison Randall as Physics Department Chair (1917)

The Excitement of the 1895-1905 Decade

Roentgen discovered X-rays

Thompson discovered the electron

Einstein introduced Special Relativity

Einstein and Planck introduced quantization

…can you imagine the excitement of living during this period?

Importance of Presidential Leadership

Henry Philip Tappan was the first President of the University of Michigan, inaugurated in 1852.

Tappan's vision for higher education was to complement the classical course with a scientific course, following the Prussian model.

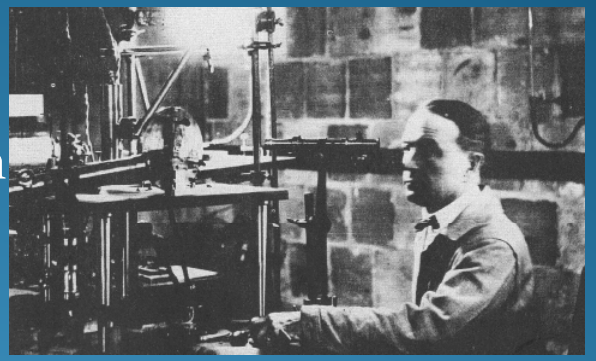
Laboratories were central to Tappan's vision, ... an observatory was a top priority.

The Detroit Observatory is an important physical legacy of the University's early scientific preeminence and of Tappan's efforts to create a research university.

Remembering Tappan; Sandy Whitesell

Harrison Randall

- Born in Burr Oak Michigan
- UM graduate (Ph.D. 1902),
- "..striving to find that one more decimal point of accuracy" -- Dennison
- Sabbatical in 1910 to spend a year in Europe
- Joined Laboratory of Professor Frederich Paschen
- Continued work on spectroscopy upon return
- Published path-breaking work with student Imes
- Became chair of Department (1915 – 1941)
- Soon recognized the importance of building a strong theory group: hired Laporte, Uhlenbeck, Dennison, Goudsmit – a brash group of young physicists (1926-27)
- Sabbatical at Cal Tech/Berkeley in 1934-35; Lawrence cyclotron under development;Recruited Richard Crane, built highest energy cyclotron in world at the time



SUMMER INSTITUES (1924 – 1941)

Dirac
Fermi
Ehrenfest
Kramer
Oppenheimer
Pauli
Bohr
Heisenberg
Gamow
Lawrence
Bloch
Wheeler
Franck
Compton
Weisskopf

Photo courtesy of Niels Bohr Library

University of Michigan Summer School, 1930. From left: Maria Goeppert-Mayer, Joseph Mayer, Paul Ehrenfest, Lars Onsager, Robert d'Escourt Atkinson.

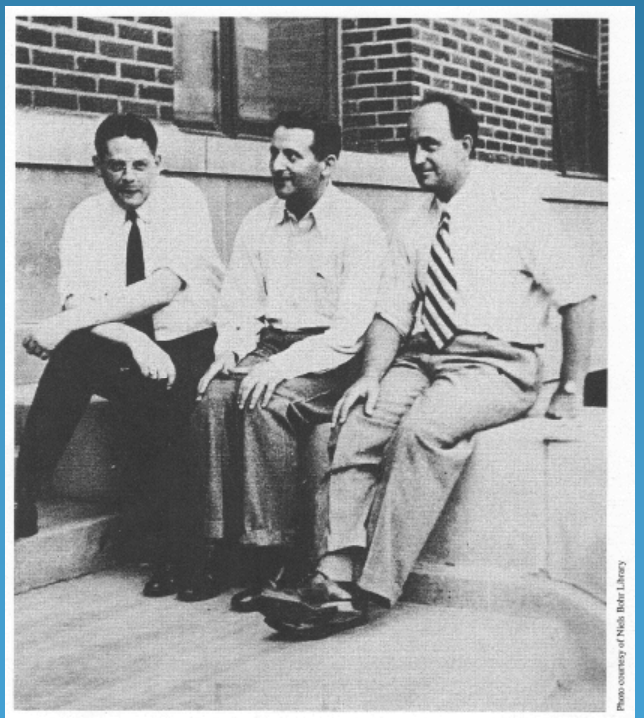


Photo courtesy of Niels Bohr Library

G.S. Timoshenko, Samuel Goudsmit, and Enrico Fermi, at east entrance to West Physics Building, summer 1934.

Electron Spin

TOMONAGA ---The rotation of an electron about its own axis, i.e., the electron spin, was first proposed by Uhlenbeck and Goudsmit in 1925. However, there were many , many intricate developments before this idea was proposed. The story begins with the discovery of the multiplicity of spectral terms and the anomalous Zeeman effect. There was a long period of grouping before the idea of electron spin was born.

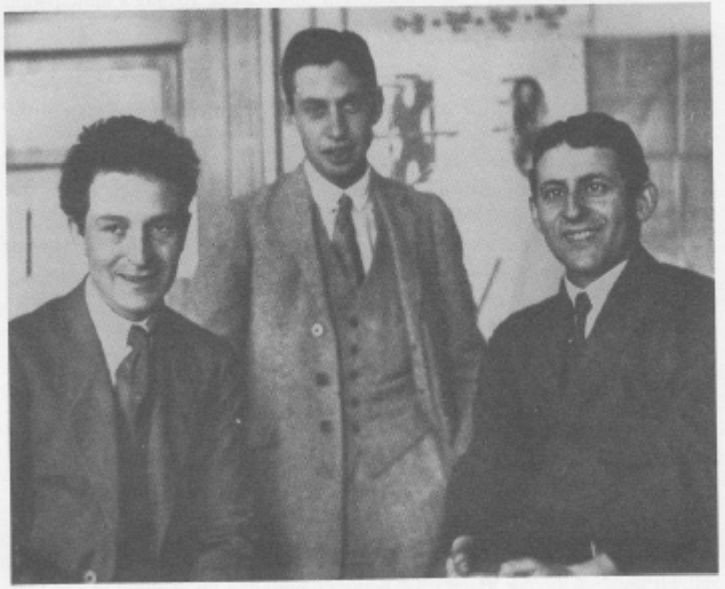


Figure 2.2 Oscar Klein (1894–1977), George E. Uhlenbeck (1900–1988), and Samuel A. Goudsmit (1902–1978), 1926. [Photograph by H. Knauss. Courtesy of AIP Emilio Segrè Visual Archives]

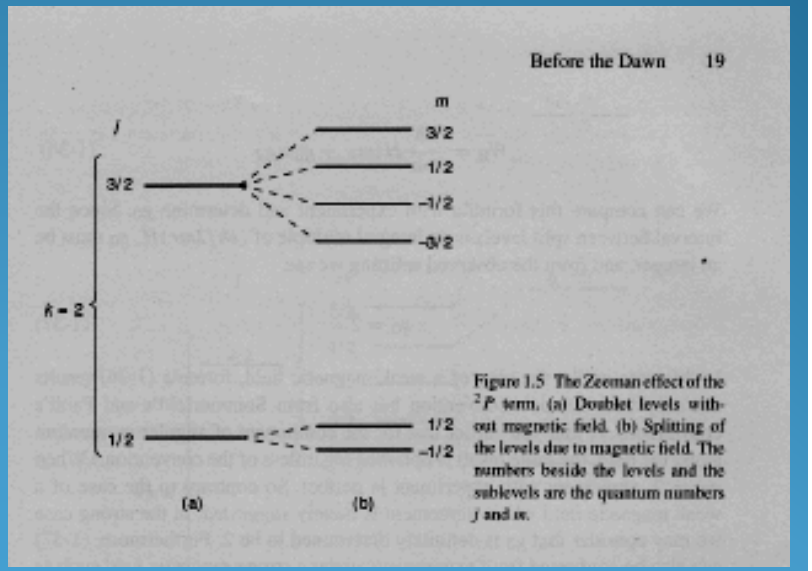
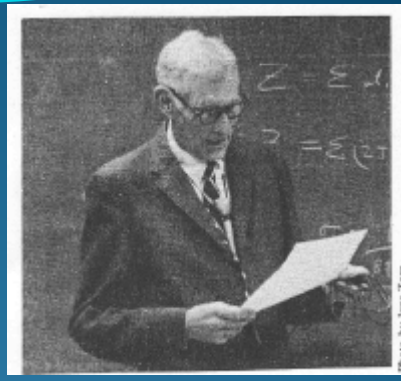


Figure 1.5 The Zeeman effect of the ^2P term. (a) Doublet levels without magnetic field. (b) Splitting of the levels due to magnetic field. The numbers beside the levels and the sublevels are the quantum numbers j and m.

Dennison and Proton Spin



Dennison solved the problem of the specific heat of the hydrogen molecule

In a paper dated June 16, 1927, he pointed out that the mixing ratio of the two types of hydrogen implied that the spin of the proton was ½

By the way – he was my favorite teacher

Another Randall Sabbatical

Observed new device under construction by Lawrence at Caltech/Berkeley

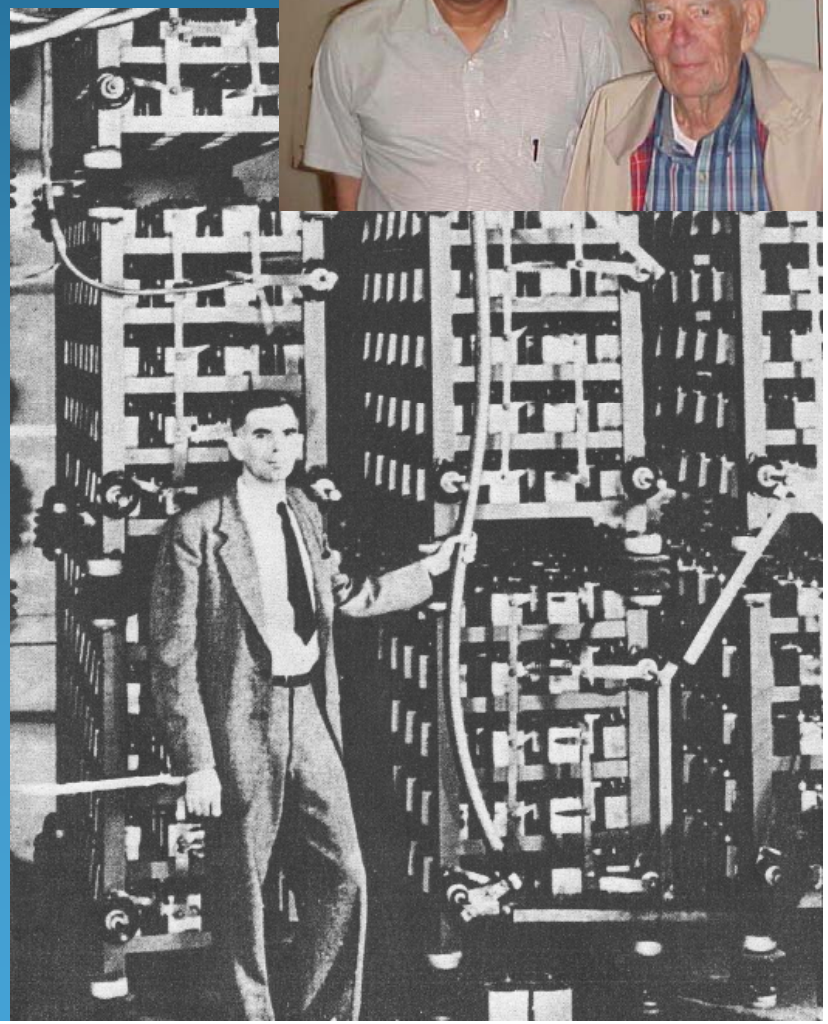
Observed bright researcher – Richard Crane

Recruited Crane

Started Michigan cyclotron project

Led eventually to first measurement of g-2

Led to first instance of the racetrack synchrotron



Continued blossoming of Michigan role in spin physics

Overseth
Longo
Perl
Krisch
Rich
Gidley
Chupp
Lorenzon

Alan Krisch as a Scientist

Keywords:

Engages Nature's huge problems

Skeptical

Meticulous

Innovative

Persistent

Regental Records

Professor Krisch received his B.A. degree from the University of Pennsylvania in 1960 and his Ph.D. degree from Cornell University in 1964. He joined the University of Michigan faculty in 1964 as an assistant professor, was promoted to associate professor in 1966, and to professor in 1968.

He has served the University in many capacities, ranging from leading the University of Michigan Spin Physics Center, service as a member of the University Research Opportunities Program Advisory Committee and service on numerous scholarship and symposium committees. He has supervised 35 doctoral students and delivered more than a hundred colloquia and talks in recent years on the state of spin physics research. Further, he has mentored more than 40 postdoctoral research fellows, many of whom have become current leaders in their own specialities.

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In earlier studies, Professor Krisch had conducted experiments that revealed internal structure of the proton, sparking a high level of attention within the field that only became resolved when proton constituents, quarks, were ultimately identified. The principal area of Professor Krisch's recent research is spin effects in high energy collisions. The role of the spin quantum number in particle collisions remains a mystery, but many advances over the past few decades derive explicitly from the work of Professor Krisch's Spin Physics Center.

The Center led the development of the world's first high energy polarized proton beams, permitting experimenters for the first time to study how the relative orientation of target and beam proton spins at high energies affected scattering probabilities. His research program has spanned several laboratories in the United States, the former Soviet Union, Japan and Germany.

Professor Krisch has received numerous awards for his work, including a Guggenheim Fellowship and designation as a Fellow of the American Physical Society. Over the years he has contributed to service on national research panels for the Department of Energy and the National Science Foundation, and to organizing countless international research symposia.

An example of his service to the Ann Arbor community is his work on the Board of Trustees of the Ann Arbor Hands-on Museum.

The Regents now salute this distinguished scientist by naming Alan D. Krisch professor emeritus of physics

Continuing Frontiers

What is the JCP of the "Higgs Boson"?

Why are the hyperon polarizations so large?

Can we "see" preons through their spin effects – if they exist?

What are the spin manifestations of SUSY?

t-tbar Standard Model tests

Will PQCD finally "work" at LHC energies in terms of describing spin effects? .....

Concluding Remarks

We salute the contributions of a fine colleague who has so significantly advanced our understanding of spin physics and the tools for its further exploration

We thank all of our guests today for joining us in this celebration

We are pleased to note Alan's continuing contributions in his current research and we look forward to benefitting from the new frontiers he will open