

Otto Stern, Co-discoverer of Space Quantization, Dies at 81

Otto Stern died in Berkeley this August. He was born in Sohrau, Germany. After receiving a PhD in physical chemistry from the University of Breslau in 1912, he joined Albert Einstein at Prague. When in 1913 Einstein left Prague for the Zurich Technische Hochschule, Stern followed him there and became privatdozent of physical chemistry. From 1914 until 1921 he held a similar position at Frankfurt and in 1923, after one year at Rostock, Stern was appointed professor of physical chemistry at Hamburg. In 1933, compelled to leave Germany, he became research professor of physics at the Carnegie Institute of Technology. In 1945 he retired to live in Berkeley.

Stern died a few weeks ago at 81, an age he never expected to achieve. For more than 20 years he has been retired and therefore not well enough known to younger physicists for them fully to appreciate his qualities and achievements.

Merely to mention some of the contributions in which he played the leading role will suffice for this brief notice and give a measure of his importance to physics. There is the famous Stern-Gerlach experiment, which is really the discovery of space quantization; the measurement of atomic magnetic moments; the development of the molecular-beam technique, which is a lasting contribution to experimental methodology; the discovery of the anomalous magnetic moment of the proton, which still remains a basic problem of particle physics; and the demonstration of the wave nature of atoms and molecules. These contributions represent only the highlights of a great career.

The following remarks are a more personal appreciation of Stern in whose laboratory I, a newly minted PhD from Columbia, first experienced the real flavor of experimental physics.

I first met Stern in the fall of 1927, when Yoshio Nishina and I were sent down from the Niels Bohr Institute of Theoretical Physics in Copenhagen to work with Wolfgang Pauli, Jr, in

the University of Hamburg in Germany. On arrival I was very pleasantly surprised to find Stern's molecular-beam laboratory in full swing, engaged in the very exciting experiments with beams of hydrogen and helium atoms and molecules that established the wave nature of matter, as well as in investigations of space quantization and the magnetic properties of atoms. I already knew something about molecular beams from a close study of the classic Stern-Gerlach experiments because I had had to give a colloquium talk about them at Columbia. No other experimental result made such a great impression on my thinking as this demonstration, one should really say discovery, of space quantization. I was reluctant to accept the ideas of quantum theory, which seemed absurd to me as to many others. With the demonstration of basic space quantization in an external magnetic field I realized that no classical mechanism, however ingenious, could account for this awesome fact.

Fortunately for me Ronald Fraser, a Scotsman, and John Taylor, an American, were then working in Stern's laboratory on fellowships from their respective countries. Although my prime interest was with Pauli in theory, I soon got to understand some of the experimental subtleties and opportunities of the molecular-beam field through discussions with these two gifted physicists (Taylor's PhD was in physical chemistry, from the University of Illinois).

Hamburg University at that time was one of the leading centers of physics in Germany, therefore in the world. What characterized physics in Hamburg was the extremely close collaboration between Stern and Pauli, experiment and theory. Some of Pauli's great theoretical contributions came from Stern's suggestions, or rather questions; for example, the theory of magnetism of free electrons in metals. Conversely, Pauli's researches, which were at that time devoted to the construction of quantum electrodynamics, were very important in directing Stern's thinking. The

PHOTO BY I. I. RABI



OTTO STERN

frequent visits of Niels Bohr, Paul Ehrenfest and others helped to maintain a high level of interest and achievement in all fields.

It was there, from Stern and from Pauli, that I learned what physics should be. For me it was not a matter of more knowledge. I had learned a good deal from my graduate work at Columbia and from fellow students such as Ralph Kronig, Mark Zemansky, Francis Bitter and Shou Chin Wang. The new thing, which was not strong in the then provincial United States, was the development of taste, insight and standards that directed one's attention in the choice of researches, and a feeling for what is good and what is not so good. A trivial research can often be more difficult than an important one. This quality of taste in physics Stern had to the highest degree. To the best of my knowledge he never devoted himself to a minor question. From his earlier work on entropy and Nernst's heat theorem, to his demonstration of space quantization with the glorious Stern-Gerlach experiment, the reality of matter waves and the anomalous magnetic moment of the proton, Stern was always close to the basic problems of physics as they evolved.

Stern's great laboratory came to an end with the arrival of Hitler to the position of supreme power in Germany. German science went into a penumbra from which it is only now emerging. Stern came to the US, to



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the Carnegie Institute in Pittsburgh. It is unfortunate that no major university in the US took advantage of the great opportunity to add this great man to its faculty. Stern's stay in Pittsburgh was not a happy one, and he went into premature retirement at a time when his powers were still great.

His personality did not lend itself to intimacy. A bachelor, he lived alone, but was not what one would call a "loner." Although he cherished his privacy, he could also be excellent company, highly cultivated, liberal, and very much aware of what was happening in the world. Stern was one of the antistuffy generation of German professors who observed with a mixture of amusement and contempt the pomposity of their predecessors. This is not to suggest that they had gone very far down the road to the informality of the current American style. He was a passionate reader of newspapers but shunned publicity of any kind. A candid-camera picture of Stern would show him either buying or reading a newspaper. Somewhat surprisingly he was an avid devotee of the cinema, although he needed Pauli to remind him of what picture he had already seen. It is perhaps symbolic that he was finally stricken in a movie theatre.

Every German professor had his own well known eccentricity that was

cherished by his colleagues; he in turn was expected to live up to this reputation. Stern's was a love of luxurious hotels, good food and first-class railroad accommodation. We always knew at what time he would arrive from his holidays by looking up the best train. He avoided walking when he could ride. From his laboratory to the restaurant that we frequented for lunch was a matter of about four or five blocks, an easy walk for the rest of us. But Stern, only 39 or 40, always took the street car although it involved a transfer to another line.

Never in robust health, Stern was inclined a bit to hypochondria, but nevertheless he spent long hours in the laboratory. His manipulative skills were only fair, and his assistants often felt that progress would improve if he devoted more time to writing. On the other hand he was very inventive, ingenious and bold in overcoming experimental difficulties. Although not unaware of his own great contributions, he was generous in his evaluation of the work of others. He was open to new ideas both in theory and in experimental techniques, as one would expect from one who had a long association with Einstein.

As I look back on the last 30 years or more, I feel extremely regretful that Stern's scientific personality did not make its proper mark on generations of American graduate students. His qualities of physical insight into basic theoretical questions were rare. He

valued experiment not only for the direct result but also for style, the "Witz," the clever and ingenious stratagem or invention that has the quality of grace and beauty that link the researcher to the artist rather than to the craftsman. In this day of vast machines, highly organized researches and a widening gulf between theory and research, the qualities that were so great in Stern must assume a greater importance if physics is to remain an adventure of the human spirit.

ISIDOR I. RABI

King, Head of Purdue Dept. Of Physics, Dies at 45

Richard W. King, head of the Purdue University physics department, died after heart surgery on 12 Aug. at St. Mary's Hospital, Mayo Clinic. He was 45 years old.

King had been a Purdue physics faculty member since 1955 and a full professor since 1961. His primary research interest was in nuclear physics, most recently in the theory of elementary particles. He had been a consultant to various federal agencies and to industry. Before joining the Purdue faculty he was a nuclear physicist with Nuclear Development Associates, White Plains, N. Y. and the National Research Council-National Academy of Sciences.

Science Writing Award Goes To Kip S. Thorne of Cal Tech

The 1969 winner of the American Institute of Physics-US Steel Foundation Science Writing Award is Kip S. Thorne, associate professor of theoretical physics at Cal Tech. He



THORNE

is the first scientist to be named winner of this prize, which is offered to "stimulate distinguished reporting and writing of advances in physics and astronomy." H. William Koch, director of AIP, was scheduled to present the award to Thorne at the annual meeting of society officers and Corporate Associates of the AIP at The Rocke-

feller University on 30 Sept. He will receive a check for \$1500, a citation and a symbol of the award.

Thorne won the award for his article on "The Death of a Star," which appeared in the 1968 edition of *Science Year*, published in Chicago by the Field Enterprises Educational Corp.

Recent changes in the physics department of the University of Pennsylvania, Philadelphia, are: Max E. Caspari has accepted the position of chairman; Ole Hansen, a visiting professor last year, has been appointed a full professor; A. Brooks Harris and Gino Segre have been promoted to associate professor; William E. Stephens, acting dean of the College of Arts and Sciences last year, has been appointed to that position; and Enos E.

Witmer, a faculty member since 1928, was appointed Emeritus associate professor.

Luke W. Mo, formerly at the Stanford Linear Accelerator Center, is now assistant professor of physics at the University of Chicago.

Gordon B. Gaines has been named chief of electronic materials and devices research at Battelle Memorial Institute.

Leland Haworth, retired director of the National Science Foundation, has joined Associated Universities, Inc as special assistant to the president and special consultant to the director of Brookhaven National Laboratory. Haworth was originally with BNL in 1947 as assistant director of special