Topic Page: Meitner, Lise (1878 - 1968)

Summary Article: **Meitner, Lise (1878-1968)**
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Austrian-born Swedish physicist who was one of the first scientists to study radioactive decay and the radiations emitted during this process. Her most famous work was done in 1938, in collaboration with her nephew Otto Frisch, describing for the first time the splitting or fission of the uranium nucleus under neutron bombardment. This publication provoked a flurry of research activity and was of pivotal importance in the development of nuclear physics.

Meitner was born in Vienna on 7 November 1878. She became interested in science at an early age, but before studying physics, her parents insisted that she should first qualify as a French teacher in order to be certain of supporting herself. She passed the examination in French and then entered the University of Vienna in 1901. She obtained her PhD from that university in 1905, becoming only the second woman to do so, her thesis work on thermal conduction having been supervised by Ludwig Boltzmann.

In 1907, Meitner entered the University of Berlin to continue her studies under Max Planck. She met Otto Hahn soon after arriving in Berlin. He was seeking a physicist to work with him on radioactivity at the Kaiser-Wilhelm Institute for Chemistry. Meitner joined Hahn, but their supervisor Emil Fischer would not allow Meitner to work in his laboratory because she was a woman, and they had to set up a small laboratory in a carpenter's workroom. Despite this inauspicious start, Meitner became a member of the Kaiser-Wilhelm Institute in 1912, and in 1917 was made joint director of the institute with Hahn and was also appointed head of the physics department.

In 1912 Meitner had also become an assistant to Planck at the Berlin Institute of Theoretical Physics. She was appointed docent at the University of Berlin in 1922, and then made extraordinary professor of physics in 1926. Meitner, who was Jewish, remained in Berlin when the Nazis came to power in 1933 because she was protected by her Austrian citizenship. However the German annexation of Austria in 1938 deprived her of this citizenship and placed her life in danger. With the aid of Dutch scientists, she escaped to Holland and soon moved to Denmark as the guest of Niels Bohr. She was then offered a post at the Nobel Physical Institute in Stockholm, where a cyclotron was being built, and Meitner accepted. It was shortly after her arrival in Sweden that Meitner and Frisch, who was working at Bohr's Institute in Copenhagen, made the discovery of nuclear fission.

During World War II, Meitner was invited to participate in the development programme for the construction of the nuclear bomb, but she refused in the hope that such a weapon would not be feasible. In 1947, a laboratory was established for her by the Swedish Atomic Energy Commission at the Royal Institute of Technology, and she later moved to the Royal Swedish Academy of Engineering Science to work on an experimental nuclear reactor. In 1949, she became a Swedish citizen. In 1960 she retired from her post in Sweden and settled in Cambridge, England. The Fermi Award was given jointly to Meitner, Hahn, and Fritz Strassmann (1902-1980) in 1966, Meitner being the first woman to be so honoured. She died in Cambridge on 27 October 1968.

Meitner's early work in Berlin with Hahn concerned the analysis of physical properties of radioactive substances. Hahn's primary interest lay in the discovery of new elements, but Meitner's work was concerned with examining radiation emissions. They were able to determine the beta line spectra of numerous isotopes, leading to the discovery of protactinium in 1918. During the 1920s, Meitner studied the relationship between beta and gamma radiation. She examined the basis for the continuous beta spectrum, her results leading Wolfgang Pauli to postulate the existence of the neutrino. She was the first to describe the emission of Auger electrons, which occurs when an electron rather than a photon is emitted after one electron drops from a higher to a lower electron shell in the atom.

The rapid developments in physics during the 1930s, such as the discovery of the neutron, artificial radioactivity, and the positron, did not leave Meitner behind. In 1933 she used a Wilson cloud chamber to photograph positron production by gamma radiation and in the following year, she began to study the effects of neutron bombardment on uranium with Hahn. They were interested in confirming the results of Enrico Fermi that suggested the production of transuranic elements - that is, elements with atomic numbers higher than that of uranium (92). In 1935 Meitner and Hahn used a hydrogen sulphide precipitation method to remove elements with atomic numbers between 84 and 92 from their neutron-irradiated sample of uranium. They thought that they had found evidence for elements with atomic numbers of 93, 94, 95, and 96. Then in 1938, after Meitner was forced to flee from Germany, Hahn and Strassmann found that the radioactive elements produced by neutron bombardment of uranium had properties like radium. From Sweden, Meitner requested firm chemical evidence for the identities of the products. Hahn and Strassmann were surprised to find that the neutron bombardment had produced not transuranic elements but three isotopes of barium, which has an atomic number of 56.

Meitner and Frisch realized that these results indicated that the uranium nucleus had been split into smaller fragments. They predicted correctly that krypton would also be found among the products of this splitting process, which they named fission. A paper describing their analysis appeared in January 1939, and immediately set in motion a series of discoveries leading to the first nuclear reactor in 1942 and the first atomic bomb in 1945.

Meitner had also found evidence for the production of uranium-239 by the capture of a neutron by uranium-238. Beta decay of this new, heavy isotope would yield a transuranic element with the atomic number 93. This element was found by Edwin McMillan (1907-1991) and Philip Abelson (1913-2004) in 1940 and named neptunium.

Meitner continued to study the nature of fission products and contributed to the design of an experiment whereby fission products of uranium could be collected. Her later research concerned the production of new radioactive species using the cyclotron, and also the development of the shell model of the nucleus.

Meitner was a distinguished scientist who made important contributions to nuclear physics despite having to overcome both sexual and racial discrimination.

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