

ELISE MEITNER

Elise (Lise) Meitner, (7 November 1878 – 27 October 1968)



Lise Meitner

was an Austrian, later Swedish, physicist who worked on radioactivity and nuclear physics.

Meitner was part of the team that discovered nuclear fission (the first theoretical explanation of the nuclear fission process), an achievement for which her colleague Otto Hahn was awarded the Nobel Prize (1944). Meitner is often mentioned as one of the most glaring examples of women's scientific achievement overlooked by the Nobel committee. In 1966 Hahn, Fritz Strassmann and Meitner were jointly awarded the Enrico Fermi Award by President Lyndon B. Johnson and the United States Atomic Energy Commission (USAEC) in Washington D.C.

The Element with atomic number $Z=109$, is named Meitnerium in her honor.

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periodic table

❖ Her first years in Vienna

“And even today I am filled with the deep gratitude for the unusual goodness of my parents and the extraordinarily stimulating intellectual atmosphere in which my sisters and brothers and I grew up.” Lise Meitner

Meitner was the third of eight children of a Jewish family. As an adult, she converted to Christianity, following Lutheranism and being baptized in 1908.

Meitner's earliest research began at age 8, when she kept a notebook of her records underneath her pillow. She was particularly drawn to math and science, and first studied colors of an oil slick, thin films, and reflected light.

Her father, Philipp Meitner was one of the first Jewish lawyers in Austria. Women were not allowed to attend institutions of higher education in those days, but thanks to support from her parents, she was able to obtain private higher education, which she completed in 1901 with an "externe Matura" examination at the



Lise Meitner in 1906

Akademisches Gymnasium. Owing to these Austrian restrictions on female education, Lise Meitner only entered the University of Vienna in 1901. She was inspired by her teacher, physicist Ludwig Boltzmann who taught her to see physics as “a battle for ultimate truth”. She studied physics and became the second woman to obtain a doctoral degree in physics at the University of Vienna in 1905.

❖ Scientific career

“Science makes people reach selflessly for truth and objectivity; it teaches people to accept reality, with wonder and admiration, not to mention the deep awe and joy that the natural order of things brings to the true scientist.” Lise Meitner

Encouraged by her father and backed by his financial support, she went to Berlin in 1906. Max Planck allowed her to attend his lectures, an unusual gesture by Planck, who until then had rejected any women wanting to attend his lectures. After one year, Meitner became Planck's assistant.

The director of the Institute of Chemistry in Berlin, Emil Fischer, allowed Meitner to work with the chemist Otto Hahn in a room which had formerly been the carpenter's workshop and had its own entrance from the street. When she needed the lavatory she had to visit a nearby restaurant. During these years when she worked together with chemist Otto Hahn she

discovered with him several new isotopes (they become a research group). In 1909 she presented two papers on beta-radiation. In the period between 1900 and 1910 Meitner was one of just thirty women working in the new field of radioactivity. She was such a rarity that even Rutherford, who encouraged women in his own laboratories, committed a gaffe. Passing through Berlin in 1908 after receiving his Nobel Prize, he was introduced to the thirty-year-old Lise Meitner. He had seen her name in publications, but even 'Lise' had failed to alert him. He exclaimed, 'in great astonishment, "Oh, I thought you were a man!"

In 1912 the research group Hahn–Meitner moved to the newly founded Kaiser – Wilhelm - Institute (KWI, today the Hahn - Meitner Building of the Free University) in Berlin-Dahlem,



Research group: Hahn–Meitner

south west in Berlin. She worked without salary as a "guest" in Hahn's department of Radiochemistry. It was not until 1913, at 35 years old and following an offer to go to Prague as associate professor, that she got a permanent position at KWI.

In the first part of World War I, she served as a nurse handling X-ray equipment. She described that period saying “At night I

feel homesick for physics, but during the day I think only of the patients.”

She returned to Berlin and her research in 1916, but not without inner struggle. She felt in a way ashamed of wanting to continue her research efforts when thinking about the pain and suffering of the victims of war and their medical and emotional needs.

In 1917, she and Hahn discovered the first long-lived isotope of the element protactinium, for which she was awarded the Leibniz Medal by the Berlin Academy of Sciences. That year, Meitner was given her own physics section at the KWI for Chemistry. In 1926, Meitner became the first woman in Germany to assume a post of full professor in physics, at the University of Berlin.

When Adolf Hitler came to power in 1933, Meitner was still acting as head of the physics department of the KWI for Chemistry. Although she was protected by her Austrian citizenship, all other Jewish scientists, including Szilárd, Fritz Haber, her nephew Otto Frisch, and many other eminent figures, were dismissed or forced to resign from their posts. Most of them emigrated from Germany. Her response was to say nothing and bury herself in her work.



Lise Meitner

In 1935, as head of the physics department of the KWI for Chemistry she and Otto Hahn, the director of the KWI, undertook the so-called "transuranium research" program (the elements with atomic numbers greater than 92 named as transuranium elements). This program eventually led to the unexpected discovery of nuclear fission of heavy nuclei.

After the Anschluss in March 1938, her situation became difficult. On July 13, 1938, Meitner, with the support of Otto Hahn and the help from the Dutch physicists Dirk Coster and Adriaan Fokker, she departed for the Netherlands. Meitner later said that she left Germany forever with 10 marks in her purse. Before she left, Otto Hahn had given her a diamond ring he had inherited from his mother: this was to be used to bribe the frontier guards if required. It was not required, and Meitner's nephew's wife later wore it.

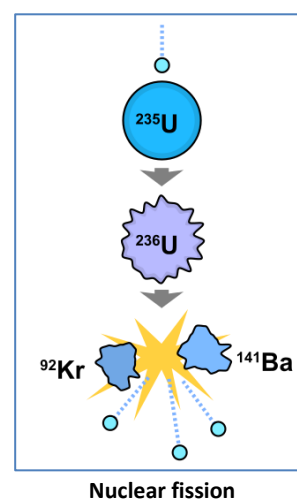
Finally she went to Stockholm, where she took up a post at Manne Siegbahn's laboratory, despite the difficulty caused by Siegbahn's prejudice against women in science. Here she established a working relationship with Niels Bohr, who travelled regularly between Copenhagen and Stockholm. She continued to correspond with Hahn and other German scientists.

❖ Nuclear fission

“You must not blame us scientists for the use which war technicians put our discoveries.” Lise Meitner

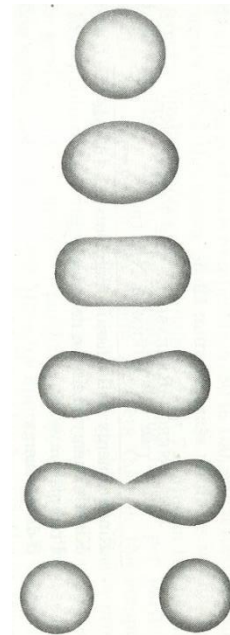
After English physicist James Chadwick discovered the neutron in 1932, Enrico Fermi and his colleagues in Rome studied the results of bombarding uranium with neutrons in 1934. Fermi concluded that his experiments had created new elements with 93 and 94 protons. However, not all were convinced by Fermi's analysis of his results. The German chemist Ida Noddack notably suggested in print in 1934 that instead of creating a new, heavier element 93, that "it is conceivable that the nucleus breaks up into several large fragments." However, Noddack's conclusion was neglected.

Meitner drew Hahn and also his pupil and assistant Fritz Strassmann into a new collaboration to probe the possibilities (they exchanged opinions via correspondence). In December 1938 Hahn and his assistant Fritz Strassmann performed the difficult experiments which isolated the evidence for nuclear fission at their laboratory in Berlin-Dahlem. The surviving correspondence shows that Hahn recognized that 'fission' was the only explanation for the proof of barium but, baffled by this



remarkable conclusion, he wrote to Meitner. Hahn was unsure of what the physical basis for the results were.

By coincidence, her nephew Otto Robert Frisch, also a refugee, was also in Sweden when Meitner received a letter from Hahn dated 19 December describing his chemical proof that some of the product of the bombardment of uranium with neutrons was barium. Meitner and Frisch employing the existing "liquid-drop" model of the nucleus (George Gamow had suggested, and Bohr had agreed that a nucleus was much more like a liquid drop), and articulate a theory of how the nucleus of an atom could be split into smaller



Nuclear fission
explanation using the
liquid drop model

parts: Perhaps a drop could divide itself into two smaller drops in a more gradual manner, by first becoming elongated, then constricted, and finally being torn rather than broken in two. Via this mechanism uranium nuclei had split to form barium and krypton, accompanied by the ejection of several neutrons and a large amount of energy.

They also first realized that Einstein's famous equation, $E = mc^2$, explained the source of the tremendous releases of energy in nuclear fission. Lise Meitner worked out that the two nuclei formed by the division of a uranium nucleus together would be lighter than the original uranium nucleus by about one-fifth the

mass of a proton. Whenever mass disappears energy is created, according to Einstein's formula $E= mc^2$, and one - fifth of a proton mass was just equivalent to 200 MeV.

❖ *Later years:*

I will have nothing to do with a bomb! [Lise Meitner's response to the invitation (1943) to work with Otto Robert Frisch and some British scientists at Los Alamos during the Manhattan Project to create the atomic bomb.]

After the war, Lise Meitner, was bitterly critical of Hanh and other German scientists who collaborated with the Nazis and done nothing to protest against the crimes of Hitler's regime. She also said: "Heisenberg and many millions with him should be forced to see these camps and the martyred people." She wrote to Hanh: You all worked for Nazi Germany. And you tried to offer only a passive resistance. Millions of innocent human beings were allowed to be murdered without any kind of protest being uttered.

Meitner became a Swedish citizen in 1949. She finally decided to retire in 1960 and then moved to the UK. Later, she suffered from a heart attack, atherosclerosis and was unable to travel to US to receive the



Statue of Meitner

Humboldt University in Berlin

Enrico Fermi prize. Eventually, she moved into a Cambridge nursing home.

She died on 27 October 1968 at the age of 89. The inscription on her headstone reads:

“Lise Meitner: a physicist who never lost her humanity.”



Lise Meitner's sketch drawn by the pupil Anna Boufidi.

Bibliography

Diana Preston, Before the Fall-Out The Human Chain Reaction from Marie Curie to Hiroshima, CORGI BOOKS.

Berkeley Nuclear Research Center: <http://bnrc.berkeley.edu/Famous-Women-in-Physical-Sciences-and-Engineering/lise-meitner.html>

<https://www.sdsc.edu/ScienceWomen/meitner.html>

ENCYCLOPÆDIA BRITANNICA: <https://www.britannica.com/biography/Lise-Meitner>

<http://www.aps.org/publications/apsnews/200712/physicshistory.cfm>

https://en.wikipedia.org/wiki/Lise_Meitner

Lise Meitner quotes: https://www.goodreads.com/author/quotes/4126366.Lise_Meitner