



14.4 Lise Meitner

Lise Meitner identified and explained nuclear fission, proving it was possible to split an atom.

Prepared to learn



Lise Meitner was born in Vienna on November 7, 1878, one of eight children; her father was among the first Jews to practice law in Austria. At 13, she completed the schooling provided to girls. Her father hired a tutor to help her prepare for a university education, although women were not yet

allowed to attend.

The preparation was worthwhile. When the University of Vienna opened its doors to women in 1901, Meitner was ready. She found a mentor there in physics professor Ludwig Boltzmann, who encouraged her to pursue a doctoral degree. Physicist Otto Robert Frisch, Meitner's nephew, wrote that "Boltzmann gave her the vision of physics as a battle for ultimate truth, a vision she never lost."

Pioneer in radioactivity

In 1906 Meitner went to Berlin after earning her doctorate, only the second in physics awarded to a woman by the university. There was great interest in theoretical physics in Berlin. There she began a 30-year collaboration with chemist Otto Hahn. Together, they studied radioactive substances. One of their first successes was the development of a new technique for purifying radioactive material.

During World War I, Meitner volunteered as an X-ray nurse-technician with the Austrian army. She pioneered cautious handling techniques for radioactive substances, and when she was off duty, continued her work with Hahn.

Elemental discoveries

In 1917, they discovered the element protactinium. Afterward, Meitner was appointed head of the physics department at the Kaiser Wilhelm Institute for Chemistry in Berlin, where Hahn was head of the chemistry department. The two continued their study of radioactivity, and Meitner became the first to

explain how conversion electrons were produced when gamma rays were used to remove orbital electrons.

Atomic-age puzzles

In 1934, when Enrico Fermi produced radioactive isotopes of uranium by neutron bombardment, he was puzzled by the products. Meitner, Hahn, and German chemist Fritz Strassmann began looking for answers.

Their research was interrupted when Nazi Germany annexed Austria in 1938 and restrictions on "non-Aryan" academics tightened. Meitner, though she had been baptized and raised a Protestant, went into exile in Sweden. She continued to correspond with her collaborators and suggested that they perform further tests on a product of the uranium bombardment.

When tests showed it was barium, the group was puzzled. Barium was so much smaller than uranium. Hahn wrote to Meitner that uranium "can't really break into barium ... try to think of some other possible explanation."

Meitner and Frisch (who was also in Sweden) worked on the problem and proved that splitting the uranium atom was energetically possible. Using Neils Bohr's model of the nucleus, they explained how the neutron bombardment could cause the nucleus to elongate into a dumbbell shape. Occasionally, they explained, the narrow center of the dumbbell could separate, leaving two nuclei. Meitner and Frisch called this process *nuclear fission*.

Meitnerium honors achievement

In 1944, Hahn received the Nobel Prize in chemistry for the discovery of nuclear fission. Meitner's role was overlooked or obscured.

In 1966, she, Hahn, and Strassman shared the Enrico Fermi Award, given by President Lyndon B. Johnson and the Department of Energy. Meitner died two years later, just days before her 90th birthday. In 1992, element 109 was named *meitnerium* to honor her work.



Reading reflection

1. **Research:** Ludwig Boltzmann was an important mentor to Lise Meitner. Who was Boltzmann? Research and list one of his contributions to science.
2. What element did Meitner and Otto Hahn discover? Using the periodic table, list the atomic number and mass number of this element. Does this element have stable isotopes?
3. What is nuclear fission? Explain this event in your own words and draw a diagram showing how fission occurs in a uranium nucleus.
4. **Research** and describe at least two ways nuclear fission was used in the twentieth century.
5. Meitner did not receive the Nobel Prize for her work on nuclear fission, though she was honored in other ways. List how she was honored for her work in physics.
6. On a separate sheet of paper, compose a letter to the Nobel Prize Committee explaining why Meitner deserved this prize for her work. Be sure to explain your reasoning clearly and be sure to use formal language and correct grammar in your letter.