

Topic Page: [Zeeman, Pieter, 1865-1943](https://search.credoreference.com/content/topic/zeeman_pieter_1865_1943)

Summary Article: **Zeeman, Pieter (1865-1943)**

From *The Hutchinson Dictionary of Scientific Biography*

Place: Zeeman

Subject: (Erik) Christopher

Dutch physicist who discovered the Zeeman effect, which is the splitting of spectral lines in an intense magnetic field. This achievement was important in determining the structure of the atom and Zeeman shared the 1902 Nobel Prize for Physics with Hendrik Lorentz, who had predicted the Zeeman effect.

Zeeman was born in Zonnemaire, Zeeland, on 25 May 1865. He was educated at local schools and at the Gymnasium in Delft before entering the University of Leiden in 1885. There Zeeman studied under Heike Kamerlingh Onnes and Lorentz, gaining his PhD with a dissertation on the Kerr effect in 1893. He then remained at Leiden as a tutor and in 1897 moved to the University of Amsterdam to take up a lectureship. Zeeman became professor of physics at Amsterdam in 1900. He retained this position until he retired in 1935, and in 1923 became director of a new laboratory that was named the Zeeman Laboratory. In addition to the Nobel Prize, among his many honours was the award of the Royal Society's Rumford Medal in 1922. Zeeman died in Amsterdam on 9 October 1943.

While Zeeman was at Leiden, Lorentz proposed that light is caused by the vibration of electrons and suggested that imposing a magnetic field on light would result in a splitting of spectral lines by varying the wavelengths of the lines. Zeeman undertook the first experimental work in search of this in 1896. Using a sodium flare between the poles of a powerful electromagnet and producing spectra with a large concave diffraction grating, Zeeman was able to detect a broadening of the spectral lines when the current was activated. A similar effect was achieved with the sodium absorption spectra, so the changed shape of the flame was not responsible. In 1897, Zeeman refined the experiment and was successful in resolving the broadening of the narrow blue-green spectral line of cadmium produced in a vacuum discharge into a triplet of three component lines. Later work led Zeeman to evaluate the ratio e/m for the oscillating particles involved, which was in agreement with the value obtained for the electron by J J Thomson. This confirmed that the magnetic field was affecting the forces that control the electrons within the atom. However, Zeeman's subsequent experimental work suffered as a consequence of his promotion to the University of Amsterdam, where the facilities were much poorer than in Leiden. By the time he was able to acquire a purpose-built laboratory in 1923, many other workers had overtaken Zeeman's team in expertise and experience.

Study of the Zeeman effect led to important theoretical advances in physics. Zeeman's observations confirmed Lorentz's electromagnetic theory and later investigators were able to show that the spectral effects are caused by electron spin. As a result, the quantum theory was expanded to include these findings. Spectral observations of the Sun carried out by George Hale in 1908 led him to believe that light emitted by sunspots is affected in a similar fashion to Zeeman's laboratory observations. The conclusion reached was that sunspots must be associated with intense magnetic fields within the Sun.

In later years, Zeeman's attention turned to the velocity of light in moving media and his experiments involved glass and quartz. Many difficulties were successfully overcome and Zeeman was able to show that the results were in agreement with the theory of relativity. He also studied isotopes, particularly

those of argon, in which he identified a new isotope with a mass number of 38.

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