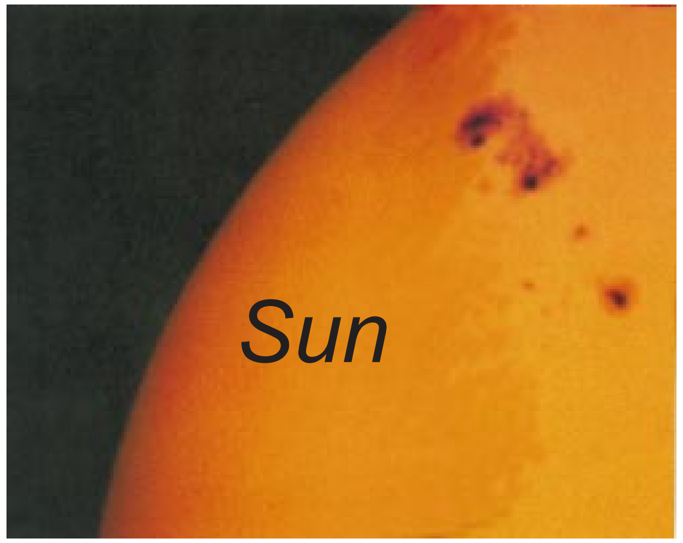
Pieter Zeeman

1865 - 1943

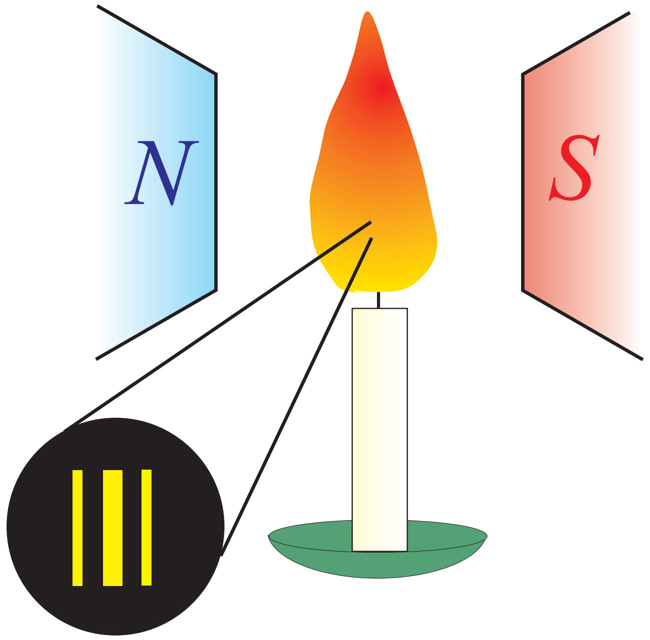
Awarded the Nobel Prize for Physics in 1902

In August 1896 Dr. Zeeman, using a Rowland grating newly acquired by the Leiden Physics Laboratory, observed a frequency change in the light from sodium vapour when this was subjected to a strong magnetic field. This he ascribed to a direct interaction of magnetism and free atoms. Professor Kamerlingh Onnes, Laboratory Director, agreed to communicate the discovery to the Academy of Sciences in Amsterdam. Two days later the Leiden theoretician, Professor Lorentz, informed Zeeman of a possible explanation of the phenomenon on the basis of his corpuscular theory of electricity. This demanded a splitting into 3 components of different polarization modes. Zeeman experimentally verified all the features predicted. Moreover he derived the value of ***e/m*** (the ratio of charge to mass: the specific charge) of the luminiferous particle inside the atom. Herewith he was thought to have found Lorentz's postulated ion. But Lorentz was startled at the high value, more than 1000 times that of the hydrogen ion. He could not reconcile this with prevailing views on the constitution of atoms.

Meanwhile Zeeman, - at Professor Van der Waals's instigation -, had assumed a lectureship at Amsterdam, where he soon found that the particle's charge was negative, opposite to that of the hydrogen ion. After 3 years he was promoted to the rank of Extraordinary Professor. The title of his inaugural address (1900) was: **`Experimental Investigations on Parts smaller than Atoms'.** At that epoch the existence of the ultra light particle had been confirmed in experiments of a different kind by others, and the name `electron' had come into use. In 1902 the assignment of the Nobel Prize to both Lorentz and Zeeman intertwined the names of these two great physicists forever.



Sunspots were shown to carry magnetic fields by using Zeeman's methods



He showed that the magnetic field can 'split' a line in the spectrum

The early quantum theory learned to look upon the Zeeman effect primarily as a splitting of levels (Zeeman levels), but no more than the classical model could it cope with `anomalous' patterns, differing from the Lorentz triplet in the number of components and their separations , as observed since 1898. The mystery was solved in 1925, when Goudsmit (a Zeeman disciple as he proudly used to call himself) and Uhlenbeck attributed to the electron an intrinsic spin and magnetic moment. For technical reasons, Zeeman himself had not been in a position to contribute substantially to the field of the anomalous effect. But after 1923 this changed because a new laboratory building became available. This, and the improved theoretical insight, gave rise to many publications on the analysis of atomic spectra by the Zeeman group, for many years to come, even after his retirement in 1935.

The Zeeman effect has numerous other applications of which we mention only the oldest one: **the detection and measurement of magnetic fields in celestial bodies**. This began in 1908 with observations of sunspots, and Zeeman was involved in the identifications. Later it led to the discovery of a rich class of magnetic stars, of great importance to our notions of the Universe.

Apart from the Nobel Prize, Zeeman received numerous awards and marks of honour, too many to be enumerated here, but he always remained a modest gentleman. As the son of a minister of the Protestant Church in a rural community he may have been most amused at his appointment to membership of the Papal Academy of Sciences in 1936.

P.F.A.K.