

Biographical Encyclopedia of Astronomers

© 2007 Springer

Balmer, Johann Jakob

Born Died

Lausanne, Switzerland, 1 May 1825

Basel, Switzerland, 12 March 1898

Johann Balmer's empirical formula was shown to predict the wavelength of electromagnetic energy emitted by the quantized transition of an electron to a lower energy level in an atom.

Balmer was born to Johann Jakob Balmer and Elizabeth Rolle Balmer. He was the eldest son and attended his first school in Liestal, the capital of what was known as the half-canton of Basel-Landschaft. For his secondary education, Balmer returned to Basel where he excelled in mathematics, propelling him into a university mathematics track beginning at the University of Karlsruhe, taking him through the University of Berlin, and ending with his doctorate, which he received at the University of Basel in 1849

Balmer lived the relatively quiet life of a schoolteacher, taking up a mathematics post at a girls' school in Basel, a job he held until his death. He did lecture at the University of Basel, from 1865 until 1890, in geometry. However, his publication record indicates that teaching was his primary focus, and Balmer never made any significant contribution to geometry.

Balmer married late in life, in 1868, at the age of 43. However, he and his wife, Christine Pauline Rinck, had six children. There is a crater on the Moon named for Balmer.

Balmer is remembered for a discovery he first published at the age of 60 (1885). In fact, he only published two papers on his discovery, the second being in 1897.

Balmer's discovery was a formula for calculating wavelengths for the spectral lines of elements. His first paper dealt only with the spectral lines of hydrogen. An initial reading of his work gives one the impression that it was Balmer's mathematical ability that gave him the insight to produce the equation, because he gives no physical explanation for it in the paper. This formula, which predicts the wavelengths of the spectral lines, is deceptively simple:

$$\frac{1}{\lambda} = R_H \left(\frac{1}{m^2} - \frac{1}{n^2} \right),$$

where R_H is the Rydberg constant for hydrogen

In Balmer's second and last paper, he applied the same concept to other elements, including helium and lithium, with results that matched observation to within a fraction of a percent. (They came to be referred to as Balmer lines or the Balmer series.) Balmer correctly predicted that many invisible spectral lines of hydrogen existed.

Balmer's formula is one of the most fundamental in all of modern astrophysics, for it allows astronomers and physicists to predict with a high degree of certainty where certain spectral lines will occur and thus provides a great deal of information on the atomic processes in astrophysical objects. But it is important to remember that despite the incredible accuracy of the prediction, the physical explanation for this phenomenon did not come until Niels Bohr

first developed his model of the atom in 1913, fifteen years after Balmer's death. Still, Balmer's discovery stands with Bohr's as one of the most important in modern astrophysics.

Ian T. Durham

Selected References

Balmer, J. J. (1897). "A New Formula for the Wavelengths of Spectral Lines." *Astrophysical Journal* 5: 199-209.

Carroll, Bradley W. and Dale A. Ostlie (1996). *An Introduction to Modern Astrophysics*. Reading, Massachusetts: Addison Wesley Longman.

Whittaker, Sir Edmund (1951). *A History of the Theories of Aether and Electricity*. Vol. 1, *The Classical Theories*. New York: Harper