Rydberg Constant Encyclopedia Article

Rydberg Constant

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Contents

Rydberg Constant Encyclopedia Article.....1

Contents.....2

Rydberg Constant.....3

Rydberg Constant

The Rydberg constant, 10,973,731.57 m-1 , is the constant used in the Rydberg equation which describes the Rydberg state energies of a Rydberg series. This equation describes many line series of elements very well and the constant is universal to all elements.

In 1885, Swiss mathematician Johann Balmer showed that the **wavelength** of the visible spectrum of the hydrogen **atom** can be described by a formula relating the wavelength to **Planck's constant** times a function of the principle quantum number. Independently, **Johannes Rydberg** analyzed the spectra of many elements. He was the first to relate the principal lines of these spectra to a distinct series. To minimize the number of calculations, he introduced the concept of a wave number, which is the reciprocal of the wavelength and is the number of **waves** per length, more specifically, the number of waves per centimeter. Having made this change he began to see patterns not previously discernable. He found that for a given series when he plotted the difference in wave number versus the principle quantum number he obtained hyperbolic curves that were virtually identical in shape for different series and different elements. From this observation he was able to formulate the Rydberg equation, E = -R /(n-m) [sup2] where E is the **energy** of the line in wave numbers, R is the Rydberg constant, n is the principle quantum number and m is the quantum defect. The quantum defect describes how much the Rydberg series departs from the behavior of the Rydberg states of atomic hydrogen and is directly related to the interaction of the excited **electron** with the leftover ion core. This equation describes the Rydberg series for the elements. The Rydberg series is a set of bound states of the excited electron for a given set of excited electron **angular momentum quantum numbers** and ion core state.

In 1913 **Niels Bohr** showed that the Rydberg constant can be expressed as a combination of the speed of **light** in a **vacuum** c, Planck's constant h, the electron's charge e, and its **mass** m by R = me4 /(8eo[sup2]h[sup3]c), where eo is the permittivity of vacuum.