

Relative Intensity Tables for Spectrum Lines

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Relative intensities for a large number of multiplets have been calculated from well-known theoretical formulas. These intensities have been tabulated for future reference in making analyses of spectra. The tables are grouped

under each resultant spin, from singlets $S=0$, to octets $S=7/2$ and include all probable values of L and J . It is shown how the same tables apply to jj -coupling, to hyperfine structure, and to related multiplets.

IN the analysis of the complex spectrum, or the hyperfine structure of a given element, theoretical intensities of the lines are frequently used to facilitate the work. In each instance numerous and tedious calculations are made by substituting various sets of quantum numbers in well-known intensity formulas. From a time-saving standpoint a tabulation of these intensities for all probable quantum numbers therefore seemed highly desirable.

The intensity formulas usually used were first derived by Kronig,¹ Russell,² and Sommerfeld and Honl,³ from the classical model of the atom and from the sum rules of Ornstein,⁴ Burger and Dorgelo.⁵ They have since been derived on the quantum mechanics by Dirac.⁶

The tables here include those published by H. N. Russell in 1925.⁷ The tables are grouped under each spin resultant from singlets, $S=0$, to octets, $S=7/2$. The values of L are given in heavy type, and the values of J in ordinary type, on either side and above or below each multiplet.

The relative intensities calculated from the formulas have been reduced to the scale of one hundred for the strongest line of each multiplet. The sum rules make it possible to interchange the rôles of the initial and final states. The numbers are given to one decimal point except in a few cases of extremely low intensities where they have been given to two decimal places for the purpose of comparison.

These intensity tables may be applied to jj -coupling by replacing S by j_1 , and L by j_2 . Here j_1 is taken to be the quantum number which, for the transitions in question, does not change, i.e., $\Delta j_1=0$.

The intensity tables may be applied to hyperfine structure by replacing S by I , L by J , and J by F .

Kronig has shown that these same formulas apply to the relative intensities of related multiplets, where the coupling is Russell-Saunders, and the transitions involve a single electron transition. The formulas are modified by replacing S by L_0 , L by l , and J by L , where L_0 is the L value of the parent term, l the orbital value of the transition electron, and L their resultant.

It should be pointed out that these tables give only the values in agreement with the sum rules, based upon the "*a priori* probabilities" of the energy states in question, and assume that temperature and ν^4 corrections have been made where necessary. In hyperfine structure, in particular, these certainly can be neglected.

¹ R. de L. Kronig, *Zeits. f. Physik* **33**, 261 (1925).

² H. N. Russell, *Nature* **115**, 735 (1925).

³ A. Sommerfeld and H. Honl, *Sitzungsber. d. Preuss. Akad. d. Wiss.* **9**, 141 (1925).

⁴ L. S. Ornstein and H. C. Burger, *Zeits. f. Physik* **24**, 41 (1924).

⁵ H. C. Burger and H. B. Dorgelo, *Zeits. f. Physik* **23**, 258 (1925).

⁶ P. A. M. Dirac, *Proc. Roy. Soc.* **A111**, 281 (1926).

⁷ H. N. Russell, *Proc. Nat. Acad. Sci.* **11**, 324 (1925).





