Russell–Saunders Coupling

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The ► vector model provides various ways of calculating the vectorial sum of all the contributing angular momenta l_i and ► spins $s_i = 1/2$ for atoms with more than one ► electron. (► Spin; Stern–Gerlach experiment; Vector model). Either all the l_i are first summed up to one L, and then combined with $S = \sum_i s_i$, or all the l_i and s_i are first summed up separately to j_i with $J = \sum_i j_i$. The noncommutativity of ► operators makes these two procedures in general non-equivalent, yielding different combinatorics, and thus different energy levels and transitions. The first possibility is called Russell–Saunders coupling (also referred to as L-S coupling or strong coupling because it assumes that the interaction of L and S to form a joint J for each electron is much stronger than between different ► electrons). For magnetic dipole radiation, the ► selection rules are: $\Delta J = \pm 1$ or 0, and similar for ΔL and ΔM with the additional constraint that a transition from $M = 0$ to $M = 0$ is forbidden for $\Delta J = 0$. The selection rule $\Delta S = 0$ leads to a prohibition of intercombinations. Russell-Saunders coupling is valid for the lighter, hydrogen-like atom ► Bohr's atom model, for which the multiplet splitting is small compared to the energy difference of the levels with the same electron configuration but different L. For heavier atoms and for the energetically higher terms, ► jj-coupling yields the better approximation. Transition cases between the two couplings also occur (see, e.g. [2], 175f.).

Literature

1. G. Herzberg: *Atomic Spectra and Atomic Structure* (New York: Prentice-Hall 1937, 2nd ed. New York: Dover Publications 1944) (http://wwwchem.uwimona.edu.jm:1104/courses/RScoupling.html; accessed July 20, 2006)
2. C. Candler: *Atomic Spectra and the Vector Model* (Princeton: Van Nostrand 1937, esp. chaps. 11, 16–18)

Rutherford Atom

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The identification of the "corpuscle" (later renamed ► "electron") by J.J. Thomson (1856–1940) in 1897 inspired the design of atomic models by the British school of mechanistic physics. The obvious initial assumption, based on relative weights, was