Hund's Rule Encyclopedia Article

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Hund's Rule

Developed by the German scientist, Friedrich Hund (1896-1997), Hund's rule allows scientists to predict the order in which electrons fill an atom's suborbital shells. Hund's rule is based on the Aufbau principle that electrons are added to the lowest available **energy** level (shell) of an **atom**.

Around each atomic **nucleus**, electrons occupy energy levels termed shells. Each shell is identified with quantum number, n, that defines the main **energy level**. Each main level is made up of a number of sublevels. These sublevels are identified by their shapes: s sublevels have 1 orbital, p sublevels have 3 orbitals, d sublevels have 5 orbitals; and f. sublevels have 7 orbitals. Each orbital can contain only 3 electrons spinning in opposite directions.

Although each suborbital can hold two electrons, the electrons all carry negative charges and, because like charges repel, electrons repel each other. In accord with Hund's rule, electrons space themselves as far apart as possible by occupying all available vacant suborbitals before pairing up with another **electron**. The unpaired electrons all have the same spin quantum number (represented in electron configuration diagrams with arrows all pointing either upward or downward).

The **Pauli exclusion principle** states that each electron must have its own unique set of quantum numbers that specify its energy. Accordingly, because all electrons have a spin of 1/2, each suborbital can hold up to two electrons only if their spins are paired +1/2 with -1/2. In electron configuration diagrams, paired electrons with opposite spins are represented by paired arrows pointing up and down.

For example, if there are three available p orbitals (p^x, p^y, p^z) the first three electons will fill these one at a time, each with the same spin. When the fourth electron is added, it will enter the (p^x orbital and will adopt the opposite spin since this is a lower energy configuration.

Although Hund's rule accurately predicts the electron configuration of most elements, exceptions exist, especially when atoms and ions have the opportunity to gain additional stability by having filled *s* orbitals or half- filled or filled *d* or *f* orbitals.