CH 221 Guide to Quantum Numbers

Quantum Number	Quantum Name	Values
n	shell	$1, 2, 3, 4, \ldots \infty$
l	subshell	$0, 1, 2, \ldots (n - 1)$
m_l	orbital	$-l \ldots 0 \ldots +l$
m_s	electron spin	$+\frac{1}{2}$ *or* $-\frac{1}{2}$

Each electron in an atom can have its own unique "address" or *set of quantum numbers*.

Example: Consider a **Beryllium** atom with four electrons. Beryllium is in the second period, so possible n values are 1 and 2. Electrons are filled using the lowest value of n (or n + l), so the electrons will be placed into the n=1 shell before they enter the n=2 shell.

<u>When n = 1</u>, the only allowed value of l is 0; likewise, the only allowed value of $m_l = 0$. We will place the first two electrons in a 1s orbital. Each electron can have either a "spin up" ($m_s = +\frac{1}{2}$) or "spin down" ($m_s = -\frac{1}{2}$) configuration.

The first electron's set of quantum numbers (or address) will be: $\mathbf{n = 1, \mathit{l} = 0, m_\mathit{l} = 0, m_s = +\frac{1}{2}}$

The second electron's set of quantum numbers (or address) will be: $\mathbf{n = 1, \mathit{l} = 0, m_\mathit{l} = 0, m_s = -\frac{1}{2}}$

<u>When n = 2</u>, allowed values of l are 0 and 1. Lowest (n + l) values are filled first; hence, a (n + l) value of (2 +0) = 2 will be filled before a (n + l) value of (2 + 1) = 3. When $l = 0$, the only allowed value of $m_l = 0$. We will place the next two electrons in a 2s orbital. Each electron can have either a "spin up" ($m_s = +\frac{1}{2}$) or "spin down" ($m_s = -\frac{1}{2}$) configuration.

The third electron's set of quantum numbers (or address) will be: $\mathbf{n = 2, \mathit{l} = 0, m_\mathit{l} = 0, m_s = +\frac{1}{2}}$

The fourth electron's set of quantum numbers (or address) will be: $\mathbf{n = 2, \mathit{l} = 0, m_\mathit{l} = 0, m_s = -\frac{1}{2}}$