Atomic Energy Levels of Electrons

For a hydrogen atom with only one proton and one electron, the allowed energy levels for the electron are simple. There is one energy level for each quantum number **n**: 1, 2, 3, 4……..

When one considers all of the other elements, with many protons and many electrons, there are many more allowed energy levels because:

- The additional protons will attract electrons more strongly.
- The additional electrons will repel each other.
- As electrons fill in the lowest energy levels, they will shield the other electrons from the full attraction of the protons.

Three quantum numbers (**n**, ℓ, and $\mathbf{m_l}$) are now needed to describe the energy levels and electron location, and one quantum number $\mathbf{m_s}$ to describe the fact that electrons can pair up in one location. The term for the location, or region of space where the electron most likely is found, is an *orbital*.

- principal quantum number, **n**, designates the *shell* (allowed values are integers 1, 2, 3, 4.....)
- azimuthal quantum number, ℓ, designates the *subshell* (orbital shapes: s, p, or d)
  (allowed values depend on **n** and are integer values from **n**-1 to 0)
- magnetic quantum number, $\mathbf{m_l}$, designates one of the *subshell orientations* (allowed values depend on ℓ and are integer values from $-\ell$ to **0** to $+\ell$)
- spin magnetic quantum number, $\mathbf{m_s}$, designates the spin state of an electron ($+^1/_2$ or $-^1/_2$)

The order of energy levels in multi-electron atoms is shown below.

Shells and Subshells	5p	↑
	4d	Increasing Energy
	5s	
	4p	
	3d	
	4s	
	3p	
	3s	
	2p	
	2s	One electron goes in each
Electrons fill lowest energy first	1s	orbital first, then they pair up

Electron Configuration - a shorthand notation for the electrons in an atoms that lists *shell numbers*, *subshell letters* and the *numbers of electrons* in each subshell