

## Re: "archaic" view of atom structure

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lindas4@aol.com wrote:

>

> *Earlier today, I was told that the view of an atom as a nucleus with  
> electrons in circular orbits was "archaic". As I understand it (I am  
> NOT a "card carrying physicist") this is, indeed a good, simplified  
> view of the basic structure, and thus is useful for teaching and for  
> calculations. In fact, this structure does occur. For example, it is  
> present in hydrogen and helium atoms.*

The ground state of the Hydrogen atom is an "l = 0" state, meaning there is zero angular momentum of the electron motion. It is not "orbiting" at all! It is as close to being at rest as it's possible to get.

The only thing preventing the electron from falling into the nucleus is the Uncertainty principle. Confining it to a small volume around the nucleus means the uncertainty in its position is small, and therefore the uncertainty in its momentum must be correspondingly large, according to

$\Delta x * \Delta p > h$  ( Planck's constant )

"delta x" and "delta p" represent the uncertainty in position and momentum. This means that there is going to be random motion, which raises the average kinetic energy.

The actual size of the "orbit" is determined by a balance point between the lowered energy obtained by getting the negative electron as close ( on average ) as possible to the positive nucleus, and the elevated energy caused by the random motion.

The Helium ground state has two electrons in this most simple "orbit", called "1s". Then with Lithium and Beryllium we add two more electrons to another l=0 ( zero angular momentum ) ground state, giving Beryllium a "1s<sup>2</sup> 2s<sup>2</sup>" configuration, meaning 2 electrons in the 1s orbital and 2 electrons in the 2s orbital. None of these electrons have any circular motion. The spatial

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distribution of the probability functions are spherical blobs, since there is no axis of motion.

It's only with the fifth electron for Boron that we get a correspondence to a circular orbit with the "2p" orbital. The 2p electron can be found to be circling either to the right or to the left about any axis, always with exactly one quantum of angular momentum.

Just so you don't feel too bad, note that Bohr assumed that the electron had to have non-zero angular momentum:

"In the Bohr theory, angular momentum = 0 meant the so-called pendulum oscillation orbit, in which the electron would have had to go through the nucleus, and this was excluded as impossible." ( Herzberg )

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