Re: Bohr's Atom still number one

Source: http://sci.tech−archive.net/Archive/sci.physics.relativity/2007−05/msg01328.html

- *From*: The_Man <me_so_horneeeee@xxxxxxxxx>
- *Date*: 8 May 2007 11:40:24 −0700

On May 7, 9:26 pm, bz <bz+...@xxxxxxxxxxxxxxxxxxxx> wrote:

> The_Man <me_so_hornee...@xxxxxxxxx> wrote
> innews:1178572539.034098.14560@xxxxxxxxxxxxxxxxxxxxxxxxxxxx:
>
> > On May 5, 4:29 pm, bz <bz+...@xxxxxxxxxxxxxxxxxxxx> wrote:
> >
> > > "g...@xxxxxxxxxxx" <g...@xxxxxxxxxxx> wrote
> > > innews:1178394138.430885.325220@xxxxxxxxxxxxxxxxxxxxxxxxxxxx:
> > >
> > > > On May 5, 10:41 am, bz
> > > > <bz+...@xxxxxxxxxxxxxxxxxxxx> wrote:
> > > > snip too long
> > >
> > > ....
> > >
> > > > > My main point is that the
> > > > > Bohr model predicts a
> > > > > rapid loss of energy with all
> > > > > electrons collapsing into the
> > > > > nucleus.
> > > > > Bohr could not explain why
> > > > > orbiting electrons would not
> > > > > radiate
> > > > > constantly.
> >
> > Bohr could not (well) explain why electrons would not radiate.

Agreed.

His
best explanation was that the electrons were confined to "orbits" of specific energy.

Not a very good explanation as 'orbits' implied circular motion, centripedal acceleration and radiation.

You are correct. But Bohr defined his "orbits" such that they acted quite unlike classical "orbits". His only justification was that it gave the right answers.

You suggest that electrons would collapse into the nucleus in the Bohr model. This is not accurate.

....

The collapse into the nucleus is the classical prediction. Since Bohr knew already that this didn't happen, he had to model WHY this doesn't happen. He had mostly ad hoc explanations.

You are correct, it is the classical prediction. Bohr did know it didn't happen. He didn't know why.

....

He ran into another problem. His model only works for a hydrogen atom with a single electron.

Correct. However, even direct solution of the Schroedinger equation is only possible for 1 electron.

....

What makes you think they have a high velocity in the atom?

>> One can easily calculate the KE of an electron, and therefore its velocity.

> That assumes that the energy is expressed as a linear motion (along with a centripedal force, producing a circular motion). One can certainly calculate an orbital velocity for the electrons. However it fails to explain why electrons undergoing such motion would not be radiating constantly.

You're right. Bohr just said (effectively) that since the electron was confined to an orbit of a specific radius, the electron COULDN'T radiate, since that would force the electron to come somewhat ccloser to the nuclues, but that was impossible, since there wasn't an orbit "somewhat" closer to the nucleus.

De Broglie had a great explanation − since the electron acted like a wave, the allowed "orbits" were those where the "wavelength" of the electron fit an integral number of times into the orbit (so that constructive interference took place)

>> Core electrons travel at approximately c/ Z, where Z is the nuclear charge. When Z gets large, the speed of the electrons becomes sufficiently close to c, so that relativistic effects become very important.

> Are such effects observed? Wouldn't the atomic mass be effected?

Yes, they are absoltuley observed. The atomic mass isn't affected, but the "effective" mass of the electrons (moving close to the speed of light) is (by a substantial amount)

> If electrons were fired at an atom with the same velocity as the calculated velocity for a Bohr orbit, what would happen?

I don't completely understand your question, but I suspect it would depend on the elctron affinity of the atom.

They don't in the modern atomic theory, but, you are correct when you
think that, in Bohrs model, they will need to be traveling.

They will need to be attracted to the nucleus. That attraction will
'push' them toward the nucleus. Only their speed keeps them from
reaching it.

In fact, s electrons have a non−zero probability of being In the nucleus. Such is the basis of the hyperfine interaction.

Agreed. A significant probability. But this steps outside Bohr's model.

Yes.

Electrons, when ever they travel at a high speed and their direction of
travel is changed, radiate energy.

This is not true.

When is it not true?

When electrons are in an s orbital, they are changing their direction all the time (since they are in a roughly curved path). So long as the 1s electron stays in the 1s orbital (and there are no other things going on), it won't radiate at all.

The KE of a particle can be visualized by examining the wavefunction. Where the wavefunction is highly curved, the KE is high. Where the wavefunction is slowly changing, the KE is low. Since the wavefunction for a 1s orbital is essentially exp(−r), the function is obviously more highly curved near the nucleus, than at infinity.

Agreed, but what does this have to do with showing flaws in the Bohr model?

Not much − sorry.

I am trying to show guskz the problems with Bohr's model and where it fails to correspond with observations.

You are quite correct, that the Bohr model is inadequate, and was quickly superseded, even by Bohr. It is a mistake that it is even taught at all.

We DO observe that electrons, when their path is changed, radiate energy.

I thnk you are referring to a synchotron? However, in atoms, though the elecdtrons are "accelerating", they don't emit photons in the same manner.

−−
bz

please pardon my infinite ignorance, the set−of−things−I−do−not−know is an infinite set.

bz+na...@xxxxxxxxxxxxxxxxxxxx

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bz

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