Re: Spin

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From: Andr? Michaud (*srp_at_microtec.net*)
Date: 10/04/04

`Date: 4 Oct 2004 09:24:30 −0700`

Dan Bloomquist <EXTRApublic21@lakeweb.com> wrote in message
news:<41604D77.3010000@lakeweb.com>...
> *Andr? Michaud wrote:*
> > *Dan Bloomquist <EXTRApublic21@lakeweb.com> wrote in message*
news:<415EC2DC.4050409@lakeweb.com>...
>
>
> >>*I do understand that particle spin is nothing like classical spin in*
> >>*this respect. But I've also understood the name came naturally because*
> >>*the particle maintains it's orientation through time. Particles don't*
> >>*tumble. This is what I'm curious about.*
> >
> >
> > *You won't find much info on that, because even simply relating to*
> > *"orientation" which implies localisation is incompatible with the*
> > *Copenhagen philosophy view of electrons in atoms.*
> >
> > *Most current textbooks (if not all) were written with the Copenhagen*
> > *school philosophy in the background, and in this philosophy, electrons*
> > *cannot be localized in an atom. This is why most physicists speak of*
> > *spin as merely being "only a quantum number".*
> >
> > *As I said, the reason is that physical magnetic parallel and antiparallel*
> > *association of particles requires physical localisation and this*
> > *is in contradiction with the Copenhagen belief that moving electrons*
> > *are spread out in space (wave packet, uncertainty priciple).*
> >
> > *The problem is circumvented by electron physical magnetic orientation*
> > *being treated only in texts discussing properties of magnetic materials*
> > *with very little reference to QM.*
>
> *Hi André,*
>
> *Yes, I think I see my mistake.*
> *I was trying to categorize spin 'strictly' as a property of the*
> *particle.*

Yes. FreddiFizzx is right on this, spin can hardly be other than a relative property for elementary particles.

> I was thinking of an example of consecutive Stern−Gerlach apparatuses.
> But as the particles are moving through the apparatus it is actually
> the wave nature of the particle that is manifested. The result is that
> for the same reason a plane EM wave does not twist in space, neither
> does the spin of a particle. I believe that's what you are saying, did
> I get that right?

Reading back your first post, I realized that I completely missed the mark, and when I started answering I was under the impression that you were inquiring about particle spin, while I not realize that you were inquiring about atomic spin.

Well, to be frank, Stern−Gerlach did not even come to my mind really, since I was thinking specifically of "elementary particle" spin.

For complete atoms, whose "spin" is the resultant of the combined spins of all the constituting particles, I cannot really make up my mind as to whether it can be seen as an intrinsic property of the atom or if it still remains a relative property.

I lean for the former (intrinsic) in this case, but I am not fully on side.

You see, whatever the outcome of final resultant of the combination of the individual particles physical spins of an atom, about half of all atoms still have an unpaired electron on one of the outer layers, and if you look at the nucleons, they all are made up of an odd (3) number of scatterable EM particles, each contributing its spin.

In the Stern−Gerlach setup, it suffices that even one constituting particle in the atom not be physically paired for the atom to deflect either up or down depending of the spin of that odd particle, and here, each and everyone of the nucleons making up nuclei has an unpaired particles by very structure, and even for the two that form a "pair" in each nucleon, the cancellation cannot be as complete as it is for paired electrons on account of the minimal separating distance that the structure imposes on them.

And yes, I believe that in the field of the SG apparatus, the spin of the traveling atoms cannot rotate.

I personally have reservations however to applying wave treatment an even wave function to atoms as if they were elementary particles, since I think that it can be misleading.

> >>>In other words, either electrons magnetically repel each other
> >>>(parallel spin) or they magnetically attract each other (anti−
> >>>parallel spin).

> >>
> >>It is an additional mystery to me 'why' this orientation is quantisised .
> >
> > Mathematically speaking, the spin, 4th quantum number, is said to be
> > quantized in QM only because it can have only one of two values
> >
> > − 1/2 or + 1/2
> >
> > Physically, it can be said to correspond to only two possible "relative
> > states" because a magnetic field, in this case, that of the electron,
> > is bipolar by definition, and two electrons can either magnetically
> > attract each other (relative antiparallel orientation of two magnetic
> > dipoles) or repel (relative parallel orientation of two magnetic dipoles).
> >
> > We still do not know the precise electromagnetic "structure", so to
> > speak, of the electron, but an image of a small spherical magnet
> > with two poles (north and south) is quite appropriate to picture
> > its magnetic aspect, allowing visualizing relative spin orientation.
> >
> > The particles making up nucleons (scatterable quarks up and down) also
> > have spins and thus also are electromagnetic particles. It seems that
> > the equilibrium of interactions between nuclei and electrons force
> > electrons to magnetically orient only in two possible ways on their
> > layers.
> >
> > Once an electron is captured and stabilized on a layer, whatever
> > magnetic orientation the nucleus forces it to maintain, and possibly
> > to other electrons of the same atom, the only way a second free
> > moving electron can fill that layer is to switch to antiparallel
> > position to associate with it, otherwise it will be repelled.
> >
> > Just like if you get two small circular magnets close enough to each
> > other, at one point they will snap together even if one of them needs
> > to swing 180 deg to it. Antiparallel then means that the north pole
> > of one is drawn to the south pole of the other and of course vice
> > versa for the other two poles.
> >
> > This amounts to physical quantization, since only two relative
> > orientations are physically possible.
> >
> > Of course the question comes to mind as to whether two free moving
> > electrons can associate in this manner. The answer is no.
> >
> > The reason is that electrostatic repulsion obeys the inverse square
> > law of distance, whicle magnetostatic interaction obeys that of
> > inverse cube of the distance. This means that electrons have
> > to be very close to each other for the magnetic interaction to
> > dominate. This can really occur only when one of the electrons is
> > physically captive in an atom and cannot escape the encounter with
> > sufficiently low energy for capture to occur.
> >

> > *This interaction was described by Heitler and London in the early 1920's.*
>
> *Here I have some work to do. I have printed this out. I am still*
> *thinking in terms of the result of the Stern−Gerlach experiments.*

As I said, my comments were for individual particles (electrons), and SG experiments are quite another ball game because we are getting into moving systems of particles (atoms), about which I have had access to too little data to give more than a very superficial and personal opinion.

> *The references I'm working with are:*
> *Lectures on Physics*
> *Particles and Paradoxes, Peter Gibbins.*
> *(I really like this one)*
> *And old books like*
> *Introduction to Quantum Mechanics, Pauling, Wilson.*
> *(Though, I have a lot of work where my math skills are concerned.)*
>
> >
> > *Hope this helps.*
>
> *Yes, very much! Thanks again.*
>
> >
> > *André Michaud*
>
> *Best, Dan.*
>
> *−−*
> *http://lakeweb.net*
> *http://ReserveAnalyst.com*
> *No EXTRA stuff for email.*

Regards

André Michaud