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Regarding the Total Time Derivative of the Radius

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Abstract: *We define a total time derivative for the vector of the radius being different from what is defined as velocity in quantum mechanics. Useful relationships are derived and some light is shed upon the behavior of atom during the passage of electromagnetic radiation. Not all the evidence for our claim has been produced but rather this article should be the starting point of further research on the possibility of finding total time derivatives in quantum mechanics.*

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I. Introduction

To be serious about our claims first of all the new velocity if it is taken as such, and what we truly mean by that is the total time derivative of the radius vector should have a physical meaning. So we assign it to the vector part of the current density:

$$\frac{d\vec{r}}{dt}=\frac{\hbar}{m}\nabla\phi-\frac{e}{mc}\vec{A}=\vec{\chi} \quad (1)$$

With definition (1) the current density reads:

$$\vec{J}=\frac{|\psi|^2}{N}\vec{\chi}=\vec{\chi}P \quad (2)$$

A demand that seems obvious and should be satisfied from our assumption is the conservation of probability:

$$\frac{dP}{dt}=\nabla P\cdot\frac{d\vec{r}}{dt}+\frac{\partial P}{\partial t} \quad (3)$$

Inserting equation (2) in equation (3) we get:

$$\frac{dP}{dt}=\left(\nabla\cdot\vec{J}\right)+\frac{\partial P}{\partial t}=0 \quad (4)$$

Now we know from the rules of quantum mechanics that the partial time derivative of the radius is zero so we can use this fact in the following:

$$\frac{\partial\vec{\chi}}{\partial t}=\frac{\partial}{\partial t}\frac{d\vec{r}}{dt}=\frac{d}{dt}\frac{\partial\vec{r}}{\partial t}=0=\frac{\hbar}{m}\frac{\partial\nabla\phi}{\partial t}-\frac{e}{mc}\frac{\partial\vec{A}}{\partial t} \quad (5)$$

From equation (5) we deduce that the electric field in case of passage of electromagnetic radiation through the atom, being the partial time derivative of the vector potential as we are well aware of, it is defined as the partial time derivative of the gradient of the phase and the time derivative of the phase acquires what might seem at first look a role of electric potential. It only happens that the phase is time dependent when we have electromagnetic radiation.We are going to discuss this further.

Another rule of the Copenhagen interpretation of quantum mechanics is that the value of the wave function psi is single valued. Therefore:

$$\nabla\times\nabla\psi=0=\nabla\times\left(\nabla|\psi|e^{i\phi}+i|\psi|\nabla\phi e^{i\phi}\right) \quad (6)$$

From equation (6) we obtain:

$$|\psi|\nabla\times\nabla\phi=0 \quad (7)$$

So we see that the rotation of the gradient of the phase is different from zero only where the wave function is zero. It so happens as we know from the theorem of the combs that there are families of surfaces where psi is zero one more for the growth of the quantum number by one. On these surfaces we have quantized flux since the phase is not single valued as is the case of superconductors:

$$\hbar\oiint\nabla\times\nabla\phi\cdot d\vec{S}=\oint\nabla\phi d\vec{l}=n2\pi\hbar \quad (8)$$

The symbol h bar divided by the charge e has dimensions of flux as we know.

Another question that arises is in what degree are the Maxwell s equations being obeyed .We may not give a satisfactory answer yet but one may find right away a useful relationship:

$$\frac{d\vec{P}}{dt} = \frac{d|\psi|^2}{dt}\vec{r} + |\psi|^2 \frac{d\vec{r}}{dt} = \vec{J} \quad (9)$$

We state this fact because it is the partial time derivative of polarization that comes along with the current density in Maxwell s equations.

At this stage with the use of this current theory we are going to derive a term questioned in the previous article [1] :

$$\frac{d\vec{J}}{dt} = \left(\frac{d\vec{r}}{dt}\cdot\nabla\right)\vec{J} + \frac{\partial\vec{J}}{\partial t} \quad (10)$$

Still we can find:

$$\frac{\partial\vec{J}}{\partial t} = \frac{\partial}{\partial t}P\frac{d\vec{r}}{dt} = \frac{\partial P}{\partial t}\vec{\chi} \quad (11)$$

Combining equations (11) and (10) we find:

$$\frac{d\vec{J}}{dt} = P\nabla\vec{\chi}^2 = \frac{|\psi|^2}{N}\nabla\left(\frac{\hbar}{m}\nabla\phi + \frac{e}{mc}\vec{A}\right)^2 \quad (12)$$

This term should account for one of the two terms in the gradient of the difference of pressures found in [1] :

$$\nabla\left|i\hbar\nabla\psi - \vec{\mathrm{A}}\right|^2 = \nabla\left(\left(\nabla|\psi|\right)^2 + |\psi|^2\vec{\chi}^2\right) = \frac{d\vec{J}}{dt} + \vec{\Omega}\times\frac{d\vec{r}}{dt} + \nabla\left(\left(\nabla|\psi|\right)^2\right) \quad (13)$$

So,in equation (13) there appears the Coriollis force.

Finally we are going to give one final argument based on our assumptions on the possibility of electrons appearing as swirling droplets a s mentioned in the previous paper[1] :

$$\int|\psi|^2\frac{d\phi}{dt}dV = \int|\psi|^2\nabla\phi\cdot\frac{d\vec{r}}{dt}dV = \int\int|\psi|^2\left(\frac{d\vec{r}}{dt}\right)^2 - \vec{J}\cdot\vec{A}dV \quad (14)$$

In equation (14) we have what we should name the natural Lagrangian times the possibility. Equation (14) is further transformed to:

$$\int|\psi|^2\frac{d\phi}{dt}dV = \int\frac{dq}{dV}d\phi\frac{dV}{dt} = \int\frac{dq}{dt}d\phi = \int Id\phi \quad (15)$$

In the latter case we should have elementary vortices with magnetic flux at each point and the phase could be describing this flux.

References

[1]. A newly proposed model for the electron
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