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Solving the Alpha Omega Equation

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Abstract: *We find the equation for a rotating system of reference as is the electron and a centrifugal plus a Coriolis force*

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We continue solving the master equation involving total time derivatives as mentioned in the previous articles. We had reached a result for the total time derivative or acceleration. We reproduce it here:

$$\psi * \frac{d\vec{v}}{dt} = i\frac{\hbar}{m}|\psi|\Delta|\psi|\frac{d\vec{r}}{dt} + \frac{\hbar^2}{2m}\nabla\left(|\psi|\Delta|\psi|\right) \quad (1)$$

This result agrees with the results obtained in quantum hydrodynamics and the term inside the gradient is the probability P times the quantum potential Q, We are going to multiply with the exponential times the imaginary phase of the wave function assuming for the time being that psi is not time dependent. Our aim is that the velocity will appear.

$$\begin{aligned} &\psi * \frac{d\vec{v}}{dt} = i\frac{\hbar}{m}|\psi|\Delta|\psi|\frac{d\vec{r}}{dt} + \frac{\hbar^2}{m}\nabla\left(|\psi|\Delta|\psi|\right) \Rightarrow \\ &\Rightarrow |\psi|\frac{d\vec{v}}{dt} = i\frac{\hbar}{m}\psi\frac{d\vec{r}}{dt}\Delta|\psi| + \frac{\hbar^2}{m}e^{i\phi}\nabla|\psi|\cdot\Delta|\psi| + \frac{\hbar^2}{2m}\psi\nabla\left(\Delta|\psi|\right) \end{aligned} \quad (2)$$

Next we gather together terms. Equation 2 leads to equation 3

$$|\psi|\frac{d\vec{v}}{dt} = \frac{\hbar}{m}\Delta|\psi|\vec{v} + \frac{\hbar^2}{m}\psi\nabla\left(\Delta|\psi|\right) \quad (3)$$

To proceed we are going to multiply by the time derivative of the radius to obtain time derivatives of the quantities found in equation 3:

$$|\psi|\frac{d\vec{v}}{dt}\cdot\frac{d\vec{r}}{dt} = \frac{\hbar}{m}\frac{d\psi}{dt}\Delta|\psi| + \frac{\hbar^2}{m}\psi\frac{d}{dt}\left(\Delta|\psi|\right) \quad (4)$$

We remind an old result here to the reader:

$$\Delta|\psi| = |\psi|\left[E - U - \frac{1}{2m}\left(\frac{d\vec{r}}{dt}\right)^2\right] \quad (5)$$

We also know from the previous that:

$$\frac{d|\psi|}{dt} = 0 \quad (6)$$

To save the reader form the full length of the calculations ae are going to produce what results when equations 4,5 and 6 are combined. The result is apparent. The absolute value of psi is cancelled:

$$\frac{d\vec{v}}{dt}\cdot\frac{d\vec{r}}{dt} = \frac{d}{dt}\left(\psi(E-U)\right) + \frac{1}{2}\frac{d}{dt}\left(\frac{d\vec{r}}{dt}\right)^2 \quad (7)$$

Equation 7 informs us about the value of the virial theorem in quantum mechanics. We are going to combine it with the following formula:

$$\frac{d}{dt}\left(\frac{d\vec{r}}{dt}\right)^2 = 2\frac{d\vec{r}}{dt}\cdot\frac{d^2\vec{r}}{dt^2} \quad (8)$$

The combination of equations 7 and 8 leads to the final result:

$$\frac{d\vec{r}}{dt}\cdot\left(\frac{d\vec{v}}{dt}-\frac{d^2\vec{r}}{dt^2}\right)=\nabla\big(\psi\big((E-U)\big)\big)\cdot\frac{d\vec{r}}{dt}\Rightarrow$$
$$\Rightarrow\left(\frac{d\vec{v}}{dt}-\frac{d^2\vec{r}}{dt^2}\right)=\nabla\big(\psi\big((E-U)\big)\big)+\vec{\Omega}\times\frac{d\vec{r}}{dt} \tag{9}$$

In the last equation we took the liberty of adding a vector (the last term) perpendicular to the total time of the radius. The result noe is obvious. As can be even found in Wikipedia this describes a rotating system of reference. The wave function psi times the kinetic energy is the part of kinetic energy going to centrifugal motion. Its gradient is the centrifugal force.

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