Looking For Roots In All The Wrong Places:

A Comment on ArXiv:1003.5008

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Abstract

The authors of ArXiv:1003.5008 tell us they are searching for the foundations of quantum mechanics, a theory they say was born early in the twentieth century. As a matter of fact, the theory was born in the eighteenth century.

It has been thought that quantum mechanics is postulational, that the Schrödinger equation was inspired. In fact the equation has its roots in the eighteenth century. Jean “Le Rond” D’Alembert wrote a wave equation in the form

$$\frac{\partial^2\psi}{\partial x^2}+\frac{\partial^2\psi}{\partial y^2}+\frac{\partial^2\psi}{\partial z^2}+\frac{\partial^2\psi}{\partial w^2}=0 \qquad (1)$$

which was modified by Henri Poincaré in the nineteenth century. Poincaré let

$$w=ict \qquad (2)$$

and obtained therefrom

$$\partial w^2 = (\partial w)^2 = [\partial(ict)]^2 = -c^2 \partial t^2 \qquad (3)$$

whose placement in D'Alembert's equation produced

$$\frac{\partial^2 \psi}{\partial x^2} + \frac{\partial^2 \psi}{\partial y^2} + \frac{\partial^2 \psi}{\partial z^2} - \frac{1}{c^2} \frac{\partial^2 \psi}{\partial t^2} = 0 \qquad (4)$$

Poincaré then defined the psi-function as

$$\psi = e^{i\omega t} \qquad (5)$$

whose first derivative with respect to time is

$$\frac{\partial \psi}{\partial t} = i\omega e^{i\omega t} = i\omega \psi \qquad (6)$$

The second derivative with respect to time is

$$\frac{\partial^2 \psi}{\partial t^2} = -\omega^2 \psi \qquad (7)$$

which provides equation (4) a new form

$$\frac{\partial^2\psi}{\partial x^2}+\frac{\partial^2\psi}{\partial y^2}+\frac{\partial^2\psi}{\partial z^2}+\frac{\omega^2}{c^2}\psi=0 \qquad (8)$$

We observe that the first three terms on the left of the equals sign can be represented by the Laplacian,

$$\nabla^2\psi+\frac{\omega^2}{c^2}\psi=0 \qquad (9)$$

which very quickly becomes the Schrödinger equation

$$\nabla^2\psi+\frac{\omega^2}{v^2}\psi=0 \qquad (10)$$

when we replace c^2 by v^2.

The point of this brief note is that the Schrödinger equation has historical roots and is not a postulate. The roots of the equation are in classical physics.

Bibliography

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