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ABOUT MEASURING TIME IN QUANTUM MECHANICS

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ABSTRACT

We discuss the possibility of a fifth dimension giving explanation for the quantum phenomena. The coordinate of the fifth dimension seems to be related to the phase of the wavefunction measuring internal time. We deduce that there are four types of time. That of the observer which is a thermal time that of the environment which is the usual mechanical time and the aforementioned internal time.

Keywords: Quantum Thermodynamics; Quantum Mechanics; Special Relativity

1 INTRODUCTION

A ring turning is appearing in our five dimensional universe. This appears as a spinning surface of a hypersphere in four dimensions. In our three dimensional world this appears as two spherical balls appearing from zero reaching a maximum perhaps infinite volume and shrinking to a point again. This is the phenomenal transformation of mass due to its spin to monopole antimonopole pairs with the complex wavefunction acting as the magnetic potential. The absolute value of psi the wavefunction is the value of the five dimensional metric and it's phase multiplied both by the curvature K being the fifth coordinate [1, 2, 3]

2 MAIN PART

The phase phi of the wavefunction acts as internal time [4] of the quantum system, volume density of magnetic flux and it is the fifth coordinate in the five dimensional universe. Its gradient is given by:

$$\frac{\hbar}{m}\nabla\phi = \frac{d\vec{r}}{dt} \quad (1)$$

The Laplacian of the probability gives:

$$\frac{\hbar^2}{2mN}\Delta|\psi|^2 = \frac{\hbar^2}{2mN}(\nabla|\psi|)^2 + \frac{\hbar^2}{2mN}|\psi|^2\nabla\phi^2 + (E-U)|\psi|^2 \quad (2)$$

The left part of this equation integrated over volume gives zero therefore we have:

$$Kinetic\ Energy = \frac{\hbar^2}{2mN}\int|\psi|^2\,\nabla\phi\frac{d\vec{r}}{dt} + (\nabla|\psi|)^2 dV = \frac{\hbar^2}{2mN}\int|\psi|^2\frac{d\phi}{dt} + \nabla|\psi|^2 dV \quad (3)$$

The action is integral of the kinetic minus the potential energy over time therefore:

$$S = \int|\psi|^2 dV d\phi - \int E|\psi|^2 dV dt + \int(\nabla|\psi|)^2\, dV dt \quad (4)$$

Equation (4) further strengthens our argument. The action is integral over four dimensional hypervolumes and symmetry demands that the phase must act as a kind of time, an internal time as well as the fifth coordinate. In equation (4) we have omitted some constants for the sake of clarity of the exposition.

We will better recognize the last member of the first part if we talk about vorticity:

$$\vec{\Omega} = \nabla\times\vec{J} = \nabla|\psi|^2\times\frac{d\vec{r}}{dt} = \frac{d\vec{F}}{dV}\times\frac{d\vec{r}}{dt} \quad (5)$$

The force density thus square is just the Power. So we can rewrite equation (4) as follows:

$$S = \int|\psi|^2 dV d\phi - E\int|\psi|^2 dV dt + \int P dV dt \quad (5)$$

Power comes from flow of mass Energy:

$$P = c^2\frac{dm}{dt} \quad (6)$$

$$S = \int|\psi|^2 dV d\phi - E\int|\psi|^2 dV dt + \int c^2 dm dV \quad (7)$$

The last member of the right part of equation (7) has been given as the action formula during the author's research [5]

We come to the conclusion which was mentioned by Stephen Hawking that there are three kinds of time. First of all there is the thermodynamic time which is the normal one and it is that of the environment which interact with the system through the energy E.

Then there is the internal time which comes from a fifth dimension and is described by the phase phi .This is called in some articles as the thermocontextual time[8] and it describes how time continues eternally in the quantum system through reversible procedures. We show that such are the P-V closed cycles in which volume is measured [9]. One way to see this is that because Energy is the generator of time shifts the phase factor is the mathematical operator that advances the system s internal state forward in time.

Finally there is the time of the observer which is described by the mass. There is an associate characteristic time associated with the rest mass. The observer is classical and has a big mass. De Broglie s original idea was that this time associated with mass through the Compton wavelength was the internal time [10]. Actually the parameter involved is the thermal DE Broglie wavelength:

$$\Lambda = \frac{\hbar}{\sqrt{2\pi m K_B T}} \quad (8)$$

The differential of the mass gives the same results with the differential as to Temperature and it gives:

$$\frac{d\Lambda}{\Lambda^3} = dm \quad (9)$$

So the last part of the right member of equation (7) is transformed to the following formula:

$$\int c^2 dm dV = \int K_B T\frac{d\Lambda}{\Lambda^3} dV d\Lambda \quad (9)$$

The characteristic time of the observer is the conjugate of the thermal wavelength:

$$\tau = \frac{h}{K_B T} \quad (14)$$

In big scales the quantum action is cancelled by thermal fluctuations. In equation (9) the integrand which is the inverse of Lambda cubed over volume gives the number of quantum microstates per particle according to Sackur Tetrode equation[11] . The distribution function is:

$Z = \frac{V}{\Lambda^3}$ (15)

In the author's work the big thermodynamic potential plays a central role and it is defined by the flowing formula:

$\Omega = -PV = K_B \mathrm{T} \ln(Z)$ (16)

We omit some detailed calculations but the reader may be convinced that the action for the observer is:

$dS_{obs} = \frac{h}{K_B T_c} d^2\Omega$ (16)

That way we come to believe that the current of the electron in its orbit is superconducting and Tc in equation (16) is its critical temperature. It is known from statistical mechanics that at the threshold of second order phase transitions the grand potential shows discontinuities at the second order.

3 CONCLUSIONS

Ancient Greek and modern Greek language has three names for time. Chronos, kairos and aeon. Chronos is coming from Cronos Saturn. Saturn has a ring around him. The watch has three indices for measuring time. It is like the three indices which come after h and are used for subscripts.

The author has published some 40 papers in small circulation journals apart from the main ones given in the reference section. This short paper is just a demonstration of how our equations are consistent.

We have information that a book with more details discussing the foundations of quantum mechanics will be published in 2027.

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