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Time Wave Function of the Universe

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ABSTRACT

Hartle and Hawaking have obtained expression for the wave function of Universe, using path integral technique. Instead of path integral technique, the author presents an alternative way of calculating the wave function of the Universe by using the Schrodinger equation. From which, it can be seen that there are two time flows of the Universe which travel in opposite direction along the time line. This result may solve the riddle that there is strong evidence that the observable universe is composed almost entirely of ordinary matter, as opposed to an equal mixture of matter and antimatter.

Keywords: wave function of the universe; time wave; advanced wave; retarded wave; antimatter; baryogenesis

INTRODUCTION

Many modern world cosmologists are coming to the conclusion that there is only one logically possible universe. Some of them believe that they have found the key which will permit a mathematically description of single possible universe. Hartle and Hawaking have obtained expression for the wave function of Universe, using path integral technique [1]. The Universe wave function can be shown to have only isolated zeros, if it is an eigenstate of the energy if the Hatre-Hawking Universal wave function is such an eigenstate and the Universal Hamiltonian is a self-adjoint operator. The wave function of the Universe regarded as a function of three spatial variables and time variable, is essentially a list of all possible histories through which the universe could have evolved to its present quantum state, which includes all logically possible particles and arrangement of particles that could exist in the Universe at the present time. They found the ground state corresponds de Sitter space in the classical limit. There are excited states those represent universes which expand from zero volume, reach a maximum size and then recollapse but which have a finite probability of tunneling through a barrier to a de Sitter-type state of contentious expansion. From the point of view of the many worlds interpretation, of a Universal wave function in which the only possibility considered is the radius of the sidereal Universe.

In this paper, the author presents an alternative way of calculating the wave function of the Universe by using the Schrodinger equation instead of a path integral technique.

TIME WAVE FUNCTION OF THE UNIVERSE

The quantum dynamics of the matter can be described by

$$i\hbar\frac{\partial\psi}{\partial t}=H\psi\ , \qquad (1)$$

where ψ is a wave function, $H=\sqrt{p^2c^2+m^2c^4}$, p is a momentum, c is the light speed and m is the mass of the particle.

As we can write the energy of the particle as $E^2=(pc)^2+(mc^2)^2$, then we have

$$i\hbar\frac{\partial\psi}{\partial t}=E\psi\ , \qquad (2)$$

The energy of the particle can be given by

$$E=\frac{mc^2}{\sqrt{1-\beta^2}} \text{ and } dt=\sqrt{1-\beta^2}\,d\tau\ , \text{where}$$

$\beta=v/c$, t is a proper time and τ is the absolute time of the Universe.

From which, we have

$$Edt=mc^2d\tau\ , \qquad (3)$$

Then, we have

$$\int Edt=mc^2\int d\tau\ , \qquad (4)$$

From Eq. (2), the wave equation of the Universe must satisfy the following equations;

$$d\psi/\psi=-i\frac{E}{\hbar}dt\ , \qquad (5.1)$$

$$\int_{-\infty}^{\infty}|\psi|^2d\tau=1\ , \qquad (5.2)$$

We define the rectangular equation Π_δ, which height is 1 and its width is δ as shown in the next figure.

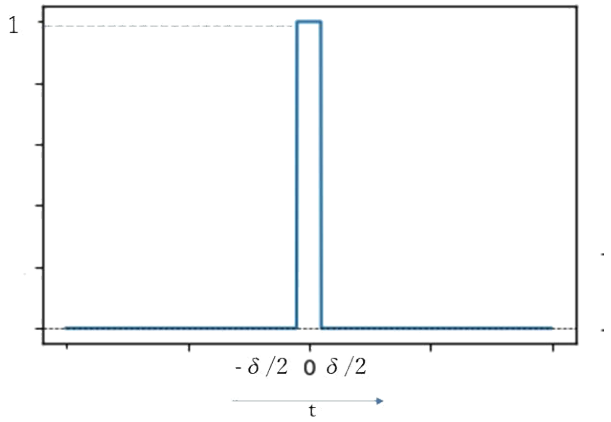

FIGURE 1: Rectangular function which width is δ.

By integrating Eq. (5.1) shown as

$$\int \frac{d\psi}{\psi} = -\frac{i}{\hbar}\int E dt, \qquad (6)$$

then the solution of Eq. (5.1) becomes

$$\psi = C \cdot \Pi_{\delta}(\tau \pm \tau_0)\exp\left[-i\frac{mc^2}{\hbar}(\tau \pm \tau_0)\right], (7)$$

from Eq. (4), which includes an advanced wave and a retarded wave, where τ_0 is the present time, and C is an arbitrary coefficient.

From Eq. (5.2), we have

$$C^2\int_{-\infty}^{\infty}\Pi_{\tau}(\tau)^2 d\tau = 1, \qquad (8)$$

If δ is equal to the Plank time t_p, then

$$C = 1/\delta = 1/t_p = \sqrt{c^5/G\hbar}.$$

Hence the wave function of the Universe becomes

$$\psi = \sqrt{\frac{c^5}{G\hbar}}\Pi_{\delta}(\tau \pm \tau_0)\exp\left[-i\frac{mc^2}{\hbar}(\tau \pm \tau_0)\right], (9)$$

In particle physics and physical cosmology, Planck units are a set of units of measurement defined exclusively in terms of four universal physical constants. The Planck mass is the fundamental unit of mass in the system of Planck units. If we let

$m = m_p = 2.18\times10^{-8}(Kg)$, where m_p is a Plank mass, then $\frac{m_p c^2}{\hbar} = 1.86\times10^{43}$ (Hz), which is almost equal to the cut-off frequency of the zero-point field in the vacuum [3].

This suggests that the time wave is related to the zero-point field in the vacuum.

From this equation, the present time can be regarded as a light spot as shown in Figure 2. This means the time wave is a solitary wave propagating forward or backward along the time line. Past times and future exist as possible states which can be shown as a dark space in the next figure. From which, past times and future exist as many possible states described by quantum mechanics.

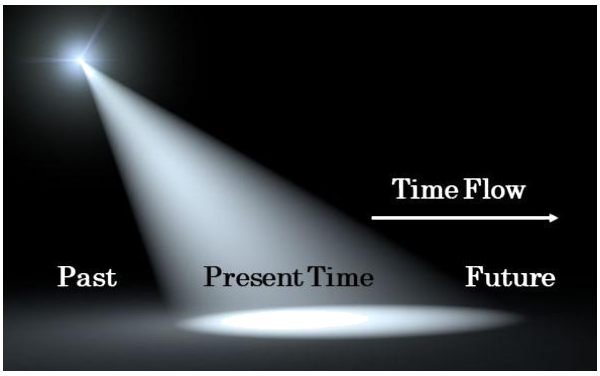

FIGURE 2: Conceptual drawing of the time

The past time exists as a memory for us, but it has many possibilities shown by quantum mechanics. At the creation of the Universe, matter and antimatter are considered to exist equally in the Universe. But there is strong evidence that the observable universe is composed almost entirely of ordinary matter, as opposed to an equal mixture of matter and antimatter.[4] This asymmetry of matter and antimatter in the visible universe is one of the great unsolved problems in physics [5].

The process by which this inequality between matter and antimatter particles developed is called baryogenesis. In physical cosmology, baryogenesis is the physical process that is hypothesized to have taken place during the early universe to produce baryonic asymmetry, i.e. the imbalance of matter and antimatter in the observed universe.[6] But, according to Feynman, the antimatter travels backward in time [7], and the antimatter universe proceeds to opposite direction of the matter universe along the time line as shown in Eq. (9).

As shown in Figure 3, there are an advanced wave (backward time flow) and a retarded wave (forward time flow) of the Universe. If the time line is closed, the positive matter universe and the negative matter universe will collide each other in the time line within a finite length of time as shown in Figure 3.

A collision between any particle and its anti-particle partner leads to their mutual annihilation, giving rise to enormous energy, which may lead to the creation of the next universe.

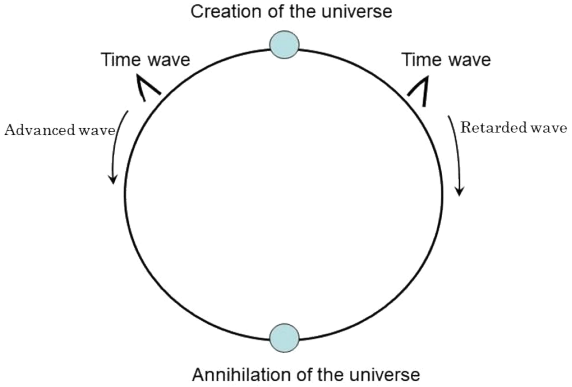

FIGURE 3: Model of the closed loop time line where an advanced wave and retarded wave of the Universe exist.

According to Hartle and Hawking, a wave function of the Universe is non-zero almost everywhere on the domain of possibilities [1].

If there are many worlds created at the beginning of time, the time-space continuum can be shown as Figure 4. If time travel is possible, it may be a travel between many parallel universes created at the beginning of the time.

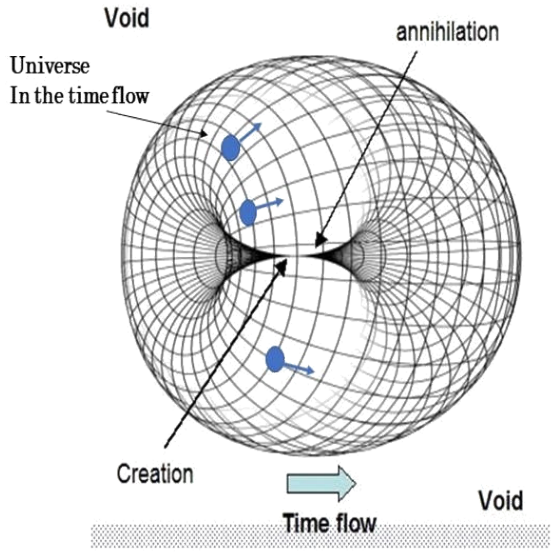

FIGURE 4: Model of Space-Time Continuum with Many Parallel Universes

The wave equation of the Universe suggests that the time has an energy. Maccini also suggested in his paper [8] that the time has an energy, which helps the motion of matter. This may explain the delay of time when the matter is moving without the special relativity theory by Einstein.

CONCLSION

By the Schrodinger equation, the wave function of the Universe can be described. From which, it can be seen that there are two time flows of the Universe which travel in opposite direction along the time line.

This result may solve the riddle that there is strong evidence that the observable universe is composed almost entirely of ordinary matter, as opposed to an equal mixture of matter and antimatter.

The obtained result has shown that the Universe repeats creation and annihilation continuously as claimed by the Indian mysticism.

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