Computing Fuzzy Time Function

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Abstract. We consider time as a fuzzy concept. Based on this, the Fuzzy Time-Particle interpretation Of Quantum Mechanics is introduced as an interpretation of Quantum Mechanics [4],[5],[6]. Here, we show how to compute the function associated to Fuzzy time.

keywords Schrodinger equation, Dirac Equation, linear system, Fuzzy time, Quantum Mechanics

Introduction

In a series of articles, we reach to consider time as a Fuzzy concept. We proposed some reasons for this in [6], [8]. Also, historically, there are people who supports this idea in general, at least from one hundred years ago, more specifically Jan Brouwer and Edmund Husserl [1]. Also, some similar works are done in this subject [2], [3]. Practically, to continue this way and to have the ability to compute, we need two concepts of time, *"Real time"* and *"Abstract time"* [4], [5].

The real time is related to the considered Physical system we consider in the problem, by changing the system, it will change. Possibly, this point helps us to have a better explanation for "Young's interference experiments", to provide the reason why the light acts as wave in the first type of experiments and as particle in the second type of experiments.

In classical Physics, the abstract time is global across the entire world but if we know general relativity as the basis of our studies, it would be a local concept. Seemingly, to unified theories in Physics, it is essential and sufficient to consider time as a fuzzy concept and to employ Fuzzy time-Particle interpretation of Quantum Mechanics.

We have two major reasons to accept this Theory and Fuzziness of time, in price of employing a little more complicated Theory.

1. The first reason and actually the motivation was started in order to shed a light on P vs NP problem [9]. The approach is applying paradoxes, similar to what we see in Gödel Theorem [4]. It is a solution for the "Unexpected Hanging Paradox".

2. The second reason could be experimental, as it is explained in [4].

Later, we try to present the other reasons to accept this shift in the Paradigm of time.

Computing Fuzzy Time

In this section, we are going to solve the major equation as it is shown in [6], [7].

$$X(t,x,y,z) = \int_{t'=-\infty}^{t'=\infty}\int_{z'=-\infty}^{z'=\infty}\int_{y'=-\infty}^{y'=\infty}\int_{x'=-\infty}^{x'=\infty} X(t'-t,x'-x,y'-y,z'-z)\, f(t',x',y',z')\, dt'dx'dy'dz'$$

(1)

In [6], [7], we show how we reach this equation. Here, we show the technics. To demonstrate the solution better, in the following subsection, we solve a simpler equation.

Solving the simpler equation

To warm up, we solve the following equation:

$$X(t,x,y,z)=\int_{t'=0}^{t'=\infty}\int_{z'=0}^{z'=\infty}\int_{y'=0}^{y'=\infty}\int_{x'=0}^{x'=\infty}X(t'-t,x'-x,y'-y,z'-z)\,f(t',x',y',z')\,dt'dx'dy'dz' \qquad (2)$$

The technic we employ here, is to consider the following equation instead

$$X(t,x,y,z)=\int_{t'=0}^{t'=ct}\int_{z'=0}^{z'=cz}\int_{y'=0}^{y'=cy}\int_{x'=0}^{x'=cx}X(\,(t'-t),(x'-x),(y'-y),(z'-z)\,f(t',x',y',z')\,dt'dx'dy'dz'$$

(3)

Equivalently,

$$X(t,x,y,z)=\int_{t'=0}^{t'=ct}\int_{z'=0}^{z'=cz}\int_{y'=0}^{y'=cy}\int_{x'=0}^{x'=cx}X\left(\tfrac{1}{c}\,(ct'-ct),\tfrac{1}{c}(cx'-cx),\tfrac{1}{c}(cy'-cy),\tfrac{1}{c}(cz'-cz)\right)f(t',x',y',z')\,d\tfrac{1}{c}t'd\tfrac{1}{c}x'd\tfrac{1}{c}y'd\tfrac{1}{c}z'\quad c^4 \qquad (4)$$

By considering this fact that $X(t,x,y,z)$

is an asymptotic function which tends to zero, as at least one of the t, x, y or z tends to infinity,

the equations (2), (3) and (4) would be equivalent. (Applying an old literature of Mathematics!)

By calculating, partial derivation respect to t,x,y,z for equation (4), we have

$$\frac{\delta^4 X(ct,cx,cy,cz)}{\delta x\delta y\delta z\delta t}=c^4\{X\big((c-1)t,(c-1)x,(c-1)y,(c-1)z\big)f(ct,cx,cy,cz,)\} \qquad (5)$$

is the solution of the either Dirac Equation or Schrodinger equation. We find $f(t,x,y,z)$ $X(ct,cx,cy,cz)$

easily from the above.

Solving the Equation:

Now, if we consider the original problem

Fuzzy Time and the impacts of it on Science [4]

$$X(t,x,y,z)=\int_{t'=-\infty}^{t'=\infty}\int_{z'=-\infty}^{z'=\infty}\int_{y'=-\infty}^{y'=\infty}\int_{x'=-\infty}^{x'=\infty}X(t'-t,x'-x,y'-y,z'-z)\,f(t',x',y',z')\,dt'dx'dy'dz'$$

(6)

As it is described in above, roughly speaking the above equation is equivalent the below one for large positive number c,

$$X(t,x,y,z)=\int_{t'=-ct}^{t'=ct}\int_{z'=-cz}^{z'=cz}\int_{y'=-cy}^{y'=cy}\int_{x'=-cx}^{x'=cx}X(t'-t,x'-x,y'-y,z'-z)\,f(t',x',y',z')\,dt'dx'dy'dz'$$

(6)

We could separate the left side into sixteen integrations from either 0 to the positive limits in above or from negative limits to 0.

By derivation we have

$$\frac{\delta^4X(ct,cx,cy,cz)}{\delta x\delta y\delta z\delta t}=c^4\{X(,(c-1)t(c-1)x,(c-1)y,(c-1)z)f(ct,cx,cy,cz)\}$$

$$+c^4\{-X\big((c-1)t,-(c-1)x,(c-1)y,(c-1)z\big)f(ct,-cx,cy,cz)\}$$

$$+c^4\{-X\big((c-1)t,(c-1)x,-(c-1)y,(c-1)z\big)f(ct,cx,-cy,cz)\}$$

....

$$+c^4\{X(-(c-1)t,-(c-1)x,-(c-1)y,-(c-1)z)f(-ct,-cx,-cy,-cz)\}$$

(7)

Actually, the above calculated derivation is summation of sixteen terms.

We try to rewrite the above derivation, by employing a permutation on the first term:

1-term=$c^4\big\{X\big((c-1)t,(c-1)x,(c-1)y,(c-1)z\big)f(ct,cx,cy,cz)\big\}$

To represent the other terms, first we fix the following enumeration

$$S_1:\{0,1\}^4\rightarrow\{1,2,\dots,16\}$$

For $\alpha,\beta,\gamma,\Theta\in\{0,1\}$, we define $\sigma_{\alpha\beta\gamma\theta}$,

$$(t,x,y,z)\rightarrow((-1)^{\alpha}t,(-1)^{\beta},(-1)^{\gamma}y,(-1)^{\theta}z)$$

We can consider $\sigma_{\alpha\beta\gamma\theta}$ as a functor on 1-term to provide the

$.S_1(\alpha,\beta,\gamma,\Theta)-term = \sigma_{\alpha\beta\gamma\theta}(1-term)\ (-1)^{\alpha+\beta+\gamma+\theta}$

By this terminology, we have:

For $\alpha,\beta,\gamma,\Theta \in \{0,1\}$,

$$ب(ct,cx,cy,cz) = \frac{\delta^4 X(ct,cx,cy,cz)}{\delta x\delta y\delta z\delta t} = \sum_{\alpha\beta\gamma\theta} S_1(\alpha,\beta,\gamma,\Theta)-term$$
$$= \sum_{\alpha\beta\gamma\theta} \sigma_{\alpha\beta\gamma\theta}(1-term)\ (-1)^{\alpha+\beta+\gamma+\theta} \qquad (*)$$

In above equation,

$$f\big((-1)^{\alpha}ct,(-1)^{\beta}cx,(-1)^{\gamma}cy,(-1)^{\theta}cz\big)$$

are our sixteen unknown variables, $X(t,x,y,z)$ and its deriviations are considered as known parameters. So, right now, we have one equation and sixteen variables.

But we are able to provide, 16 equation from $(*)$, by the following changing

$$\mathrm{t} \to -\mathrm{t}$$

$$\mathrm{x} \to -\mathrm{x}$$

$$\mathrm{y} \to -\mathrm{y}$$

$$\mathrm{z} \to -z$$

So, we have 16 equations, and the linear system of equations is solvable. We rewrite the equations as following

First, we fix the following enumeration

$$S_2\colon \{0,1\}^4 \to \{1,2,\dots,16\}$$

For $i,j,k,l \in \{0,1\}$, we define τ_{ijkl} ,

$$(t,x,y,z) \to ((-1)^{i}t,(-1)^{\mathrm{j}},(-1)^{k}y,(-1)^{l}z)$$

We can consider τ_{ijkl} as a functor on the first equation to provide the

$.S_2(i,j,k,l)-equation$

By this terminology, we have 16 equations.

In above equations,

$$f\big((-1)^{i}ct,(-1)^{\mathrm{j}}cx,(-1)^{k}cy,(-1)^{l}cz\big)$$

are our variables

The Matrix coefficients of these equations are $\left[\tau_{ijkl} \quad \sigma_{\alpha\beta\gamma\theta}(1 - \text{term}) \quad (-1)^{\alpha+\beta+\gamma+\theta}\ \right]_{S_1(i,j,k,l)xS_2(\alpha,\beta,\gamma,\Theta)}$:

Lemma. In general $\boldsymbol{det}\left(\left[\tau_{ijkl} \quad \sigma_{\alpha\beta\gamma\theta}(1 - \text{term}) \quad (-1)^{\alpha+\beta+\gamma+\theta}\ \right]_{S_1(i,j,k,l)xS_2(\alpha,\beta,\gamma,\Theta)}\right) \neq \boldsymbol{0}$.

Here, 0 is considered as 0-function.

By solving, this linear system we find $\mathrm{f(t,x,y,z)}$.

Remark. One of the major question is, ''Is it essential the Fuzzy Time function depends on the variables x,y,z?'' if it is so, the right side of equation (7) would be zero. By solving the equation, we have a polynomial function. it contradicts the asymptotic behavior of

$X(t, x, y, z)$.

So we should consider f(t,x,y,z) and not f(t) in our formulas, equivalently f is not independent from x,y,z.

Some informal matters:

I hope I didn't make a mistake in the calculations, it is a long time I didn't do this kind of Mathematics!,

I would be grateful for giving any comment about. The author tries for a much simple and more clear solution, seemingly it exists, if the idea works.

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