GENERALISED DIFFUSION EQUATION IN A PURE GRAVITATIONAL FIELD

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Abstract – The existing theories of the diffusion equation are based upon the Euclidian Theoretical Physics. In this paper we derive the diffusion equation based upon the Riemann's Theoretical Physics.

Keywords: Riemann's Theoretical Physics, Euclidean Theoretical Physics, Riemann's Laplacian

I INTRODUCTION

All Gravitation theories are limited to the speed of light. In these theories, the speed of gravitation is equal to the speed of light. Because light has gravitational property, light is deviated by mass.Due to the fact that gravitational fields are conservative, the work done by gravity from one position to another is path – independent (Ferent, 2019).

It is a well known that there are four interactions in nature, namely gravitational interaction, electromagnetic interaction, strong and weak interactions. The electromagnetic, strong and weak interaction occurs in the presence of gravitational interaction.

Gravitation force gorvern the motion of the planet, moon and galaxies in their respective orbit [Nyam, *et al,* 2015,2019].

Gravitation is the only fundamental force that Physicists can currently describe without using force – carrying particles (Rehm, 2019).

The diffusion equation is a second order differential equation that describes the process of the equalization of the concentration in a medium with an initially non-homogeneous distribution of some substance. In physics, it describe the macroscopic behaviour of many micro-particle in Brownian motion, resulting from the random movement and collision of the particles [www.en.m.wikipedia.org]

II THEORY

It is well known that in the absence of gravitational field (Euclidean Theoretical Physics) the diffusion equation in the presence of some source may be written as

$$\frac{dQ}{dt} = D\nabla^2 Q + S \qquad (1)$$

where Q is the concentration in the medium Dis the diffusion constant and S is the source and ∇^2 is the Euclidean laplacian in spherical coordinates gives as[Nyam*et al*, 2017,2015],

$$\nabla^2 = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial}{\partial r}\right) + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial}{\partial\theta}\right) + \frac{1}{r^2 sin^2\theta}\frac{\partial^2}{\partial\emptyset^2} = 0 \qquad (2)$$

So that equation may be written more explicitly

$$\frac{dQ}{dt} = D\left(\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial Q}{\partial r}\right) + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial Q}{\partial\theta}\right) + \frac{1}{r^2 sin^2\theta}\frac{\partial^2 Q}{\partial\emptyset^2}\right) + S = 0 \qquad (3)$$

Equation (3) is the complete expression for the diffusion equation in the presence of a source S according to the Euclidean Theoretical Physics.

It is well known that the Riemann Laplacian operator is given be [Nyam,*et al,* 2017, 2019]

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$$\nabla_R^2 = \frac{1}{r^2}\frac{\partial}{\partial r}\left[r^2\left(1+\frac{2}{C^2}f\right)\frac{\partial}{\partial r}\right] + \frac{1}{r^2 \sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial}{\partial\theta}\right) + \frac{1}{r^2 \sin^2\theta}\frac{\partial^2}{\partial\phi^2} - \frac{1}{v_p^2}\frac{\partial^2}{\partial t^2} \quad (4)$$

Where f is the gravitational potential given by

$$f = \frac{Gm}{r^2} \quad (5)$$

c is the speed of light in vacuum, t is the coordinate time, ∇_R^2 is the Riemann's Laplacian which can transform according to the transformation equation [Howusu, 2009,2013,Nyam,*etal*, 2017]

$$\nabla_R^2 = \frac{1}{\sigma g^{x^\alpha}}\sqrt{g}g^{-\mu\beta}\frac{\partial}{\partial x^{\alpha\beta}} \quad (6)$$

Substituting equation (4) in (1) and ignoring the time part, we have

$$\frac{dQ}{dt} = D\left[\frac{1}{r^2}\frac{\partial}{\partial r}\left[r^2\left(1+\frac{2}{C^2}f\right)\frac{\partial}{\partial r}\right] + \frac{1}{r^2 \sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial}{\partial\theta}\right) + \frac{1}{r^2 \sin^2\theta}\frac{\partial^2}{\partial\phi^2}\right]Q + S \quad (7)$$

Equation (7) is the diffusion equation in the Einstein Spherical coordinates based upon the Riemann's Theoretical Physics.

III CONCLUTION

The diffusion equation based upon the Riemann's Theoretical Physics as derived in which the gravitational field influence is sufficiently introduced. Finding the sulotion to this equation is a worthy project. Hence the door is open for Theoretical and Experimental Physicist to determine the solution to this equation.

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