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General Relativity and the Polarizable Vacuum

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Abstract

Presented herein is a revision of the time-independent solutions of the equations of motion for the Refractive Index, in the Polarizable Vacuum (PV) Model. It is demonstrated that these equations may be used to obtain solutions and equations of motion for the metric component functions, identical to General Relativity (GR). The equations of motion in this Revised PV Model are easier to solve than the equations of GR as they do not require Tensor mathematics or geometrical interpretations to be understood.

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1 TIME-INDEPENDENT SOLUTIONS

The time-independent equations of motion for the Refractive Index in this Revised PV Model are found from the Laplace equation, "$\nabla^2 \phi(r) = 0$" as follows,

$$\nabla^2 \frac{c}{K(r)} = \nabla^2 \frac{1}{K} = 0 \tag{1}$$

where, "$\phi(r) = c / K(r)$", is abbreviated as, "$1/K$" such that, "$c = G = 1$".

2 COORDINATE SYSTEMS

2.1 Cartesian

In Cartesian coordinates "(x_1,x_2,x_3)", solutions for "$1/K$" are a family of straight lines of the form "$1/K = ax_i + b$".

2.2 Spherical

In spherical coordinates "(r,θ,ϕ)" for a spherically symmetric potential, Eq. (1) becomes,

$$\frac{\partial^2 K}{\partial r^2} + \frac{2}{r}\frac{\partial K}{\partial r} - \frac{2}{K}\left(\frac{\partial K}{\partial r}\right)^2 = 0 \tag{2}$$

where, the solution for "K" is identical to the Schwarzschild solution of Einstein's equations of GR as follows,

$$K = \left(1 - \frac{2M}{r}\right)^{-1} \tag{3}$$

The Schwarzschild metric component is then interpreted as the Refractive Index of the vacuum surrounding a spherical, homogeneous mass, "M" centred at the origin of the coordinate system. [1]

Moreover, if we include an Electromagnetic (EM) "source" term, such as a charge "q", located at the origin of the coordinate system, Eq. (2) becomes,

$$\frac{\partial^2 K}{\partial r^2} + \frac{2}{r}\frac{\partial K}{\partial r} - \frac{2}{K}\left(\frac{\partial K}{\partial r}\right)^2 = \frac{2K^2 \varphi_2}{r^4} \tag{4}$$

where, any value of "K" of the form "$K = \left(1 \pm \frac{\varphi_1}{r} \pm \frac{\varphi_2}{r^2}\right)^{-1}$", is a solution such that[2] "$\varphi_2 = \frac{G}{c^4}\frac{q^2}{4\pi\varepsilon_o}$".

2.3 Cylindrical

In cylindrical coordinates, (ρ, θ, z) the equation of motion for an "infinite wire" is derived from Eq. (1) as follows,

$$\frac{\partial^2 K}{\partial \rho^2} + \frac{1}{\rho}\frac{\partial K}{\partial \rho} = \frac{2}{K}\left(\frac{\partial K}{\partial \rho}\right)^2 \tag{5}$$

Eq. (5) is identical to that derived under GR, therefore possessing the same Refractive Index solutions. [2]

3 CONCLUSIONS

Three different coordinate systems were used to calculate the equations of motion of the Refractive Index. In all cases, the solutions were found to be identical to those found under GR. Therefore, this Revised PV Model [1, 2] may provide some insight into alternative models of Quantum Gravity in flat space-time, without the need for the cumbersome geometrical interpretation of background space-time. All that is required is a consistent application of the Refractive Index "c/K", to a typical scalar field theory.

REFERENCES

[1] Joseph G. Depp, *Polarizable Vacuum and the Schwarzschild Solution*, v2 2005, May 3. (Publication TBD, reference available upon request)

[2] Joseph G. Depp, *Polarizable Vacuum and the Reissner-Nordstrom Solution*, v1 2005, May 6. (Publication TBD, reference available upon request)

[2] Including the Reissner-Nordstrom solution, identical to GR. [1,2].