GRAVITATION and VACUUM POLARIZABILITY

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In this study I equate the Schwarzschild metric terms with a speed-of-light moderated by changing permittivity. This reproduces the phenomenology of the GR equations, but I think it says we can interpret an event horizon as dielectric runaway. A finite 'thickening' of vacuum polarizability produces this, an infinite vaue of permittivity. We can perhaps do physics on a Euclidean manifold, interpreting the geodesics of light, etc., as slowing of light in an optically thick space.

The Schwarzschild solution outside of a spherical mass is expressed:

$$ds^2 = S(cdt)^2 - S^{-1}dr^2 - r^2 d\Omega^2 \quad ,$$

where $S \equiv 1-2m/r$. We can express the speed of light at points near the event horizon in external coordinates as distinct radially and tangentially by setting ds to zero and considering differential changes in one direction:

$$(\partial r/\partial t)_{rad} = c(1-2m/r) \quad \text{and} \quad (r\,\partial\theta/\partial t)_{tan} = c(1-2m/r)^{1/2} \quad .$$

These may usefully be called 'nullspeeds', or lightspeeds in one locale as measured and expressed in the coordinates of another.

Let us presume this might be created by a thickening of the vacuum raising the value of electric permittivity: $\epsilon \neq \epsilon_0$, in a manner similar to dielectrics. We are speaking about the virtual vacuum field as a responsive medium yielding inhomogeneous charge and current response to disturbance. I shall show that a reasonable redistribution of the vacuum dipole field creates a field of increasing permittivity going to infinity at the Schwarzschild radius. It then shows analytic behavior inside. If, then, a dielectric gradient of vacuum polarizability can create the light paths of the relativistic solution, we may claim to have a completely new visualization of the general relativistic differential calculus. The polarizability field is also the substrate of the matter field, so all such physics transforms accordingly. Accepting the GR field solutions, we can try to understand them as generated on a Euclidean space by an anisotropic polarizability field. The electron field solution of my first paper showed how radially oriented dipole divergence offers asymptotic permittivity and optical slowing to zero, but in an azimuthal sense there. So, the near-field solution of the relativistic electron must model that, and the far-field for neutral matter must give the polarizabilities to reproduce the above velocities.

In dielectric hole theory we get a result predicting a singularity between electric field and polarization field: $P(1-R/3\epsilon_0)=(R)E$, where R is polarizability. If we figure permittivity:

$$K=\epsilon/\epsilon_0=\frac{3+2R/\epsilon_0}{3-R/\epsilon_0} \ .$$

One could argue there is no hole to hide in and we should use a fluid model, but this is a good place to start. Further understanding should show if this is justified. Our gravitational theory uses the speed of light in a dielectric and lets polarizability increase to match the GR results. For the two aspects we need:

$$V_{rad}=\frac{c}{\sqrt{K_r}}=c(1-2m/r) \ , \text{ and } \ V_{tan}=\frac{c}{\sqrt{K_t}}=c\sqrt{1-2m/r} \ .$$

Substituting for K, $$\frac{R_r}{\epsilon_0}=\frac{4\frac{m}{r}(1-\frac{m}{r})}{1-\frac{8}{3}\frac{m}{r}+\frac{8}{3}[\frac{m}{r}]^2} \ , \quad \text{and} \quad \frac{R_t}{\epsilon_0}=\frac{2m/r}{1-4/3\frac{m}{r}} \ .$$

The first result to understand is that the event horizon is the result of permittivity blowing up to infinity there. The vacuum polarizabilities required to create this, however, at *r=2m,* are: $R_r/\epsilon_0=3$ and $R_t/\epsilon_0=3$. In the far limit we see the two quantities go as *4m/r* and *2m/r*, respectively, and at the origin both have a limit of *-3/2.* There is no zero for real *r* in the first denominator; there is in the second at *r=4/3m*. There is a zero for the first term at *m=r,* but none in the transverse case.

At this point we need to observe that radial velocity is affected by dipoles oriented in the transverse direction, and *vice versa.* As in an anisotropic crystal there are distinct values of polarizable populations, which here come together at radius *zero* or *2m.* We must look to the physics of particles uncovered in my electron study, *vis-a-vis* the vacuum dipole excitation to illuminate such behavior. I suggest there that the radial dipole population is depleted, and this is the implication of the above results.

Behaviors of the two permittivities are more simple as we can see:

$$K_r = (1-2m/r)^{-2} \quad , \qquad K_t = (1-2m/r)^{-1} \quad .$$

The radial form remains positve coming down from the asymptote at *r=2m.* At the origin it becomes zero. The transverse form becomes negative between the horizon and its zero at the origin. It may well be that magnetic permeability has to be included , since it is the product of $\epsilon\mu$ which is significant in wave propagation. I offer here a theoretical beginning by positing the necessary field changes to permittivity variation as proportional to magnetic permeability, so they both vary with gravitational 'density' of the vacuum.

Let us now assume that inside a gravitational event horizon the magnetic permeability remains positive, and ascribe the metric field to permittivity changes. Locally the speed of light, expressed in external Euclidean coordinates, goes as the inverse of $\sqrt{\epsilon\mu}$. If we allow a negative argument then the result is imaginary. For transverse modes this multiplies the argument of the usual spatial form: $e^{i\omega\sqrt{\epsilon\mu}x_t}$, where x_t refers to any path of angular propagation, and the result indicates absorption of any transverse radiation modes. Radial permittivity is positive and so presents the behavior we previously expected, with propagation slowing near the horizon, and going to infinity at the origin. We have, however, not disallowed transverse modes, and this may offer different understanding of the interior physics. The exterior field has no such pathology; it may be interpreted as dielectric vacuum polarizability, distinct in radial and transverse modes, both reaching critical value approaching the horizon from the outside, and giving the expected far field.