Modifications of Polarizable Vacuum Theory
For Deep Space Transport at High Speed

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Polarizable Vacuum theory has offered an alternative to geometric theories of space time curvature, with some acceptance in the scientific community as a step in the right direction, but not a final theory or replacement for General Relativity. With only one adjustable parameter K to describe the vacuum response to stress energy, PV theory is the simplest of the large scale cosmologies, and the only one to express relativity in terms of local variables that are measurable. As such the PV theory is an attempt to move space science forward with predictions that can be tested experimentally.

A publication by H. E. Puthoff {puthoff@earthtech.org} and S. R. Little in 2010 gave a description of PV as it relates to deep space transport, showing that a field effect propulsion generator must be very powerful, requiring technology that is far advanced beyond the present capability of space science on Earth.
http://arxiv.org/ftp/arxiv/papers/1012/1012.5264.pdf

In principle ($K < 1$) could arise from a powerful field generator, but as Puthoff pointed out in the referenced article, the power requirements are far beyond the capacity of existing equipment.

In this present work the question will be asked about how PV theory is altered local by a fast moving deep space transport vehicle. More specifically an attempt will be made to extended PV sufficiently show the parameter ($K < 1$) arising from a velocity term, for example the speed of a deep space transport vehicle under prolonged acceleration. The accumulated kinetic energy of a starship will be proposed as a substitute to the field effect generator, both of which must interact with the local vacuum.

First the Puthoff system of PV will be evaluated to add a velocity term. Conventional equations of relativistic energy and momentum are used at high velocity, causing the Puthoff energy function to be modified.

Instead of $E^2 = E_o^2 / K$

High speed requires $E^2 = (E_o^2 / K)(1+ v^2/c^2)$

Where $K = c_o/c$

So far this doesn't show how $(K < 1)$ arises from v/c. To do so requires integration of the fundamental equation for energy and momentum.

$dE = v\, dp$

Or in relativistic terms $\{ (pc) = E(v/c) \}$

$dE^2 = c^2\, dp^2$

Planck's equation $\{ E = h f \}$ is used with the Puthoff preference for constant h, but using variable f as frequency.

$E/E_o = f / f_o$

From the reference file table 2, $\{ (f/f_o)^2 = c/c_o \}$

$(E_o^2/c_o^2)d(c/c_o) = (c/c_o)^2\, dp^2$

$p^2 = E_o^2(1 - (c_o/c)) / c_o^2$

$E^2(v/c)^2 = E_o^2((c/c_o)^2 - (c/c_o))$

$(v/c)^2 = K(K^2 - K) = K^3 – K^2$

$K^3 - K^2 = (v/c)^2 \geq 0$

And $\{K > 0\}$

A limit of K occurs when $\{ v = c \}$

$K = (1 + 1/K^2)$

Then ($K < 1$) does not arise from velocity in a high speed deep space vehicle with the PV system unless the theory is modified or new technology achieves the fantastic field energy Puthoff wrote about in the referenced article.

K varies from 1.0000 to 1.4557 as v goes from zero to c, when Planck's constant h does not vary.

All that is remaining is to relate v and c in the Puthoff system of Polarizable Vacuum. In this context relative velocity is compared to the frame in which it is measured. Velocity can also be related to red shifted or blue shifted background microwaves in space, making zero velocity measurable at 2.7 degrees Kelvin in every direction.

Again the energy momentum equation is used in the Puthoff system.

$$E^2 = (E_o^2 / K)(1 + v^2/c^2) \}$$

$$c/c_o = (1 + v^2/c^2)/K$$

$$v = o$$

This demonstrates that in the Puthoff system of PV an invariant Planck's constant applies only when velocities are small.

Planck constant has units of angular momentum which is effective mass, velocity of light, and wave length.

Variation of h is done by dimensional analysis.

$$h/h_o = (m/m_o)(c/c_o)(ƛ/ƛ_o)$$

Puthoff set the mass term arbitrarily to avoid variation of h.

So far this work has proved invariant Planck's constant h is only valid for small velocities in the Puthoff system of PV. However Planck constant is a property of space and should vary when energy density changes.

To advance the theory on vacuum polarization Planck's constant is allowed to vary slowly with stress energy. This will produce results that disagree with Puthoff on energy and mass, but agree with Puthoff on other terms such as light speed, frequency, time, and length.

The key revision to PV theory is taken from a published speech from 1949 by Niels Bohr about Einstein and Heisenberg. $\{\ \Delta t \sim 1/\Delta f\ \}$

$\Delta E/\Delta f \leq \hbar$

Or $\{\ dE/df = \hbar\ \}$ in the limit.

Again $\{ E = h f \}$

$E/E_o = (f/f_o)^{(1/2\pi)}$

$E^2/E_o^2 = (c/c_o)^{(1/2\pi)}$

$E^2/E_o^2 = (1/K)^{(1/2\pi)}$

$(\hbar/\hbar_o) = (f/f_o)^{(1/2\pi-1)}$

$(\hbar/\hbar_o)^2 = (c/c_o)^{(1/2\pi-1)}$ variable Planck's constant

$(\hbar/\hbar_o)^2 = (1/K)^{(1/2\pi-1)}$

$(E_o^2/c_o^2)d(E^2/E_o^2)/(E^2/E_o^2)^{4\pi} = dp^2$

$p^2 = (1/(4\pi-1))(1 - (E^2/E_o^2)^{(1-4\pi)})(E_o^2/c_o^2)$ momentum

$(mc^2)^2 = E^2 - (pc)^2$ giving m

$(v/c)^2(E^2/E_o^2) = (pc)^2/E_o^2$ giving v which does not exceed c although v can exceed c_o.

This exercise demonstrates that when Planck's constant is allowed to vary, the prolonged acceleration of a deep space transport vehicle may be sufficient to polarize the vacuum and cause ($K < 1$) to occur naturally with acceleration.

K goes from 1.0000 to 0.2529 while v goes from zero to c.

There is a predicted limit beyond which ordinary space cannot be stressed which occurs when the kinetic energy density approaches the Planck energy. At the limit ($c = c_w$).

$(4\pi)^{(4\pi/(4\pi-1))} = (c_w^2/c_o^2) = 15.6402917334001$

This is the predicted limit when ($v = c$) suggesting a worm hole worm hole is opened by the extreme interaction of the starship with the vacuum.

$(c_w/c_o) = 3.95478087046553$

In this system the deep space transport vehicle takes 359 days of acceleration equivalent to standard Earth gravity to reach this energy level.

In summary the ordinary equations of energy momentum are used.
$E^2/E_o^2 = (mc^2)^2 + (pc)^2$
$(pc) = E(v/c)$
$dE = v\, dp$

From relativity and metric solutions light speed is related to frequency.
$c/c_o = f^2/f_o^2$

From quantum mechanics Planck's law is used.
$E = h\, f$

Heisenberg uncertainty is used for interchange of energy with the vacuum.
$(\Delta E)(\Delta t) \leq \hbar$

Finally a new interpretation is given to a speech of Niels Bohr.
$\Delta t \sim 1/\Delta f$
$dE/df = \hbar$

In conclusion there is prediction for a polarization of vacuum space arising from velocity of a deep space transport vehicle under prolonged acceleration. Required power is a reasonable extension of existing technology.

The conclusion depends on local variation of Planck's constant under extreme bending of space.

Thanks are given to Puthoff for previous private correspondence and all of the published work on polarizable vacuum. He has not commented on the proposed modification of variable Planck's constant.

Reference notes.

The reference to Niels Bohr is found in the 2010 Dover reprint ATOMIC PHYSICS AND HUMAN KNOWLEDGE, first published in 1961 by Science Editions in New York, shortly before Bohr died. The speech of 1949 was first published in 1949 in Contribution to ALBERT EINSTEIN: PHILOSOPHER SCIENTIST, Library of Living Philosophers, volume 7, starting on page 199. The quoted reference was to page 44 of the Dover edition for a relation of time interval to frequency interval.

Interpretation of the limit { $dE/df = \hbar$ } was not endorsed by Bohr, Einstein, Heisenberg, or Planck. It makes a reasonable extension of existing science, in a situation where a function something like this is needed to modify PV theory.