

Electro-Gravi-Magnetics (EGM)

Practical modelling methods of the polarizable vacuum - I

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Abstract

It is hypothesized that coupling exists between electromagnetic (EM) fields and the local value of gravitational acceleration “g”. Buckingham’s Pi Theory (BPT) is applied to establish a mathematical relationship that precipitates a set of modelling equations, Pi (Π) groupings. The Π groupings are reduced to a single expression in terms of the speed of light and an experimental relationship function. This function is interpreted to represent the refractive index and is demonstrated to be equivalent to the Polarizable Vacuum (PV) Model representation of General Relativity. Assuming dynamic, kinematic and geometric similarity between the PV and the BPT derivation, it is implied that the PV may also be represented as a superposition of EM fields. It is conjectured that by applying an intense superposition of fields within a single frequency mode, it may be possible to modify the refractive index at that frequency within the test volume of an experiment. This may significantly reduce the experimental complexity and energy requirements necessary to locally affect “g”.

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1 INTRODUCTION

To date, great strides have been made by General Relativity (GR) to our understanding of gravity. GR is an excellent tool that represents space-time as a geometric manifold of events, where gravitation manifests itself as a curvature of space-time and is described by a metric tensor. [1] However, GR does not easily facilitate engineering solutions that may allow us to design electromechanical devices with which to affect the space-time metric.

If mankind wishes to *engineer* the space-time metric, alternative tools must be developed to compliment those already available. Subsequently, the Electro-Gravi-Magnetics (EGM) methodology was derived to achieve this goal. EGM is defined as *the modification of vacuum polarizability by applied electromagnetic fields*. It provides a theoretical description of space-time as a Polarizable Vacuum² (PV) derived from the superposition of electromagnetic (EM) fields. Utilising EGM, EM fields may be applied to affect the state of the PV and thereby facilitate interactions with the local gravitational field, as was conjectured previously in [2].

To demonstrate *practical modelling methods of the PV*, we apply Buckingham's Π Theory (BPT). BPT is a powerful tool that has been in existence, tried and experimentally proven for over a century. BPT is an excellent tool that may be applied to the task of determining a practical relationship between the gravitational acceleration and applied EM fields. The underlying principle of BPT is the preservation of dynamic, kinematic and geometric *similarity* between a mathematical model and an experimental prototype. [3] This will act as an indicator of the design, construction and optimisation requirements for experimentation.

Historically, BPT has been used extensively in the engineering field to model, predict and optimise fluid flow and heat transfer. However, in principle, it may be applied to any system that is dynamically, kinematically and geometrically founded. Typical examples of experimentally verified Π (read Pi) groupings in fluid mechanics are Froude, Mach, Reynolds and Weber numbers. [3] Thermodynamic examples are Eckert, Grashof, Prandtl and Nusselt numbers. [4] Moreover, the Planck Length commonly used in theories of Quantum Gravity shares its origins with the Dimensional Analysis Technique that is at the heart of BPT. [5]

The application of BPT is *not* an attempt to answer fundamental physical questions but to apply universally accepted engineering design methodologies to real world problems. It is primarily an experimental process. It is not possible to derive system representations without involving *experimental relationship functions*. We represent these functions as $K_0(X)$, where "X" denotes all variables, within the experimental environment that influences experimental results and behaviour. This also includes all parameters that might otherwise be neglected, due to practical calculation limitations, in theoretical analysis.

Once the Π groupings have been formed, they may be manipulated or simplified as required to test ideas and determine the experimental relationship functions. Ultimately, it is the relationship functions that will determine the validity of the system equations developed. For the proceeding BPT construct, we shall hypothesise that: *Coupling exists between a superposition of EM fields and the local value of gravitational acceleration*.

2 THEORETICAL MODELLING

BPT commences with the selection of significant parameters. There are no right or wrong choices with respect to the selection of these parameters. Often, the experience of the researcher exerts the greatest influence to the beginning of the process and the choice of significant parameters are validated or invalidated by experiments. [5]

When applying BPT, it is important to avoid repetition of dimensions. Subsequently, it is often desirable to select variables that may be formulated by the manipulation of simpler variables already chosen. The selected variables used in our model are shown in Table 1 of the following section.

These parameters have been selected to facilitate experiments utilising EM fields and assume that there is a physical device to be tested, located on a laboratory test bench. The objective of the experiment is *to utilize a superposition of EM fields to reduce the weight of a test-mass when placed in the volume of space located directly above the device*. Therefore, the significant parameters are those factors that may affect the acceleration of the test-mass within this volume.

Our selection of significant parameters involves the magnitude of vector quantities and scalars. This avoids unnecessary repetition of fundamental units in accordance with the application of

² The Polarizable Vacuum Model representation of GR is a heuristic tool for understanding the theory and is isomorphic to GR in the weak field approximation.

BPT. [5] The significant vector magnitude parameters are acceleration “ $a = |\vec{a}|$ ”, magnetic field “ $B = |\vec{B}|$ ”, electric field “ $E = |\vec{E}|$ ” and position “ $r = |\vec{r}|$ ”. The scalar quantities are electric charge “ Q ” and frequency “ ω ” or “ f_Λ ”.

The selection of these parameters is consistent with testing the hypothesis. Since static charge on the device or on the test-mass may also exert strong Lorentz forces and therefore accelerations, the scalar value of static charge “ Q ” was also included to determine its contribution. If the device is small, then $r \cong z$ and represents the distance between the surface of the device and the test-mass suspended in the volume above it.

In an experiment, mechanical height adjustments and conventional radio frequency (RF) test and measurement equipment may be used to sweep the values of “ r ” and “ ω ” in a controlled manner, throughout a range of practical values. It may also be used to apply a superposition of EM fields within the test volume; by this we mean *many fields with different frequencies, directions and intensity*. Note that this experiment has not yet been conducted. In this paper we are only deriving the appropriate relationship functions that may later be applied in designing such an experiment.

3 MATHEMATICAL MODELLING³

3.1 FORMULATION OF Π GROUPINGS

The formulation of Π groupings begins with the determination of the number of groups to be formed. The difference between the number of significant parameters (a , B , E , ω , r and Q) and the number of dimensions (kg, m, s and C), represents the number of Π groups required (two). Where,

Significant Parameter	Description	Units	Composition ⁴
$a = \overrightarrow{a(B, E, \omega, r, t)}$	Magnitude of acceleration vector	m/s ²	kg ⁰ m ¹ s ⁻² C ⁰
$B = \overrightarrow{B(\omega, r, t)}$	Magnitude of magnetic field vector	T	kg ¹ m ⁰ s ⁻¹ C ⁻¹
$E = \overrightarrow{E(\omega, r, t)}$	Magnitude of electric field vector	V/m	kg ¹ m ¹ s ⁻² C ⁻¹
$r = \overrightarrow{r(x, y, z, t)}$	Magnitude of position vector	m	kg ⁰ m ¹ s ⁰ C ⁰
$Q = Q(r, t)$	Magnitude of electric charge	C	kg ⁰ m ⁰ s ⁰ C ¹
ω, f_Λ	1. Angular / Propagation frequency ⁵ of field 2. Independent scalar variable	Hz	kg ⁰ m ⁰ s ⁻¹ C ⁰

Table 1, significant parameters.

We may write the general formulation of significant parameters as,

$$a = K_0(X) \cdot B^{x_1} \cdot E^{x_2} \cdot \omega^{x_3} \cdot r^{x_4} \cdot Q^{x_5} \quad (1)$$

Where, $K_0(X)$ represents an experimentally determined dimensionless relationship function. Subsequently, the general formulation may be expressed in terms of its dimensional composition as follows,

$$(kg^0 m^1 s^{-2} C^0) = K_0(X) \cdot (kg^1 m^0 s^{-1} C^{-1})^{x_1} \cdot (kg^1 m^1 s^{-2} C^{-1})^{x_2} \cdot (kg^0 m^0 s^{-1} C^0)^{x_3} \cdot (kg^0 m^1 s^0 C^0)^{x_4} \cdot (kg^0 m^0 s^0 C^1)^{x_5} \quad (2)$$

Applying the indicial method [5] yields,

³ All mathematical modelling and output was formed using “MathCad 8 Professional” and appears in standard product notation.

⁴ The traditional representation of mass (M), length (L) and time (T), in BPT methodology has been replaced by dimensional representations familiar to most readers (kg, m and s). “C” denotes Coulombs, the MKSA units representing charge.

⁵ “ ω ” May be substituted by “ f_Λ ” for investigations involving propagation frequency. This substitution does not alter results and conclusions, due to dimensional conservation, stated herein.

$$\begin{bmatrix} x_1 + x_2 = 0 \\ x_2 + x_4 = 1 \\ -x_1 - 2x_2 - x_3 = -2 \\ -x_1 - x_2 + x_5 = 0 \end{bmatrix} \text{ solve, } x_2, x_3, x_4, x_5 \rightarrow \begin{bmatrix} -x_1 & x_1 + 2 & x_1 + 1 & 0 \end{bmatrix} \quad (3)$$

Substituting the expressions for x_n into the general formulation and grouping terms yields,

$$\left(\frac{a}{r \cdot \omega^2} \right) = K_0(X) \cdot \left(\frac{B \cdot \omega \cdot r}{E} \right)^{x_1} \quad (4)$$

Note that the variable for electric charge has dropped out of the general formulation. This means that the acceleration derived here is not to be associated with the Lorentz force.

3.2 TECHNICAL VERIFICATION OF Π GROUPINGS

The formulation of Π groupings may be verified by the simple check of dimensionless homogeneity as follows,

$$\prod_1 = \left(\frac{a}{r \cdot \omega^2} \right) \quad (5)$$

$$\prod_2 = \left(\frac{B \cdot \omega \cdot r}{E} \right)^{x_1} \quad (6)$$

By inspection, both Π groupings are dimensionless; no technical error has been made in their formulation [4].

4 DOMAIN SPECIFICATION

4.1 GENERAL CHARACTERISTICS

We shall now apply some basic assumptions regarding the practical nature of a generalised experimental configuration. This enables precipitations⁶ of the general formulation, where the value of x_1 may be calculated.

To achieve this, we shall assume that all significant parameters have been selected correctly and that the relationship between experimental observation and the general formulation is a single valued function $-\infty < K_0(X) < \infty$. This assumption does not remove the necessity for experimental determination. The form of the experimental relationship function is a consequence of the precipitation process.

Due to the practical nature of experimental investigation, the frequency “ ω ” and position “ r ” are dominating factors because; a) they are repeated in both Π groupings; b) numerically, they have the largest relative contribution to the behaviour of both Π groupings and c) experimentally, they are practical parameters to sweep and modify, respectively.

4.2 PRECIPITATIONS OF THE GENERAL FORM

4.2.1 FREQUENCY DOMAIN PRECIPITATION

For investigations where $0 < \omega < \infty$, solving equation (4) for x_1 and applying limits, yields, Low frequency solution,

⁶ Precipitation is defined as a result derived by the application of limits.

$$\lim_{\omega \rightarrow 0^+} \left(\frac{a}{r \cdot \omega^2} \right) = K_0(X) \cdot \left(\frac{B \cdot \omega \cdot r}{E} \right)^{x_1} \left| \begin{array}{l} \text{solve, } x_1 \\ \text{expand} \\ \text{factor} \end{array} \right. \rightarrow \frac{(-\ln(a) + \ln(K_0(X)) + \ln(r) + 2 \cdot \ln(\omega))}{(-\ln(B) - \ln(\omega) - \ln(r) + \ln(E))} \rightarrow -2 \quad (7)$$

High frequency solution,

$$\lim_{\omega \rightarrow \infty} \left(\frac{a}{r \cdot \omega^2} \right) = K_0(X) \cdot \left(\frac{B \cdot \omega \cdot r}{E} \right)^{x_1} \left| \begin{array}{l} \text{solve, } x_1 \\ \text{expand} \\ \text{factor} \end{array} \right. \rightarrow \frac{(-\ln(a) + \ln(K_0(X)) + \ln(r) + 2 \cdot \ln(\omega))}{(-\ln(B) - \ln(\omega) - \ln(r) + \ln(E))} \rightarrow -2 \quad (8)$$

Hence, the precipitated relationship may be expressed in Π form as,

$$\left(\frac{a}{r \cdot \omega^2} \right) = K_0(\omega, X) \cdot \left(\frac{E}{B \cdot \omega \cdot r} \right)^2 \quad (9)$$

Or in a general form in terms of the acceleration as,

$$a = K_0(\omega, X) \cdot \left(\frac{1}{r} \right) \cdot \left(\frac{E}{B} \right)^2 \quad (10)$$

4.2.2 DISPLACEMENT DOMAIN PRECIPITATION

For investigations where $0 < r < \infty$, repeating the procedure defined above yields,
Solution for small r ,

$$\lim_{r \rightarrow 0^+} \left(\frac{a}{r \cdot \omega^2} \right) = K_0(X) \cdot \left(\frac{B \cdot \omega \cdot r}{E} \right)^{x_1} \left| \begin{array}{l} \text{solve, } x_1 \\ \text{expand} \\ \text{factor} \end{array} \right. \rightarrow \frac{(-\ln(a) + \ln(K_0(X)) + \ln(r) + 2 \cdot \ln(\omega))}{(-\ln(B) - \ln(\omega) - \ln(r) + \ln(E))} \rightarrow -1 \quad (11)$$

Solution for large r ,

$$\lim_{r \rightarrow \infty} \left(\frac{a}{r \cdot \omega^2} \right) = K_0(X) \cdot \left(\frac{B \cdot \omega \cdot r}{E} \right)^{x_1} \left| \begin{array}{l} \text{solve, } x_1 \\ \text{expand} \\ \text{factor} \end{array} \right. \rightarrow \frac{(-\ln(a) + \ln(K_0(X)) + \ln(r) + 2 \cdot \ln(\omega))}{(-\ln(B) - \ln(\omega) - \ln(r) + \ln(E))} \rightarrow -1 \quad (12)$$

The precipitated relationship may be expressed in Π form as,

$$\left(\frac{a}{r \cdot \omega^2} \right) = K_0(r, X) \cdot \left(\frac{E}{B \cdot \omega \cdot r} \right) \quad (13)$$

Or in a general form as,

$$a = K_0(r, X) \cdot \omega \cdot \left(\frac{E}{B} \right) \quad (14)$$

4.2.3 WAVEFUNCTION PRECIPITATION

For investigations involving transverse plane wave solutions in a vacuum, by this we mean the PV *background* field, Maxwell's equations require $E/B = c$, when $r \rightarrow \lambda/2\pi$ in the frequency range $0 < \omega < \infty$,

Low frequency solution,

$$\lim_{\omega \rightarrow 0^+} \lim_{r \rightarrow \frac{c}{\omega}} \lim_{E \rightarrow \frac{\omega \cdot \lambda}{2\pi} \cdot B} \left(\frac{a}{r \cdot \omega^2} \right) = K_0(X) \cdot \left(\frac{B \cdot \omega \cdot r}{E} \right)^{x_1} \left| \begin{array}{l} \text{solve, } x_1 \\ \text{expand} \\ \text{factor} \end{array} \right. \rightarrow \frac{-(-\ln(a) + \ln(K_0(X)) + \ln(r) + 2 \cdot \ln(\omega))}{(\ln(B) + \ln(\omega) + \ln(r) - \ln(E))} \rightarrow 1 \quad (15)$$

High frequency solution,

$$\lim_{\omega \rightarrow \infty} \lim_{r \rightarrow \frac{c}{\omega}} \lim_{E \rightarrow \frac{\omega \cdot \lambda}{2 \cdot \pi} \cdot B} \left(\frac{a}{r \cdot \omega^2} \right) = K_0(X) \cdot \left(\frac{B \cdot \omega \cdot r}{E} \right)^{x_1} \left| \begin{array}{l} \text{solve, } x_1 \\ \text{expand} \\ \text{factor} \end{array} \right. \rightarrow \frac{-(-\ln(a) + \ln(K_0(X)) + \ln(r) + 2 \cdot \ln(\omega))}{(\ln(B) + \ln(\omega) + \ln(r) - \ln(E))} \rightarrow 1 \quad (16)$$

Expressed in Π form,

$$\left(\frac{a}{r \cdot \omega^2} \right) = K_0(\omega, r, E, B, X) \cdot \left(\frac{\omega \cdot r}{c} \right) \quad (17)$$

Or in general form as,

$$a = K_0(\omega, r, E, B, X) \cdot \left(\frac{\omega^3 \cdot r^2}{c} \right) \quad (18)$$

5 EXPERIMENTAL RELATIONSHIP FUNCTIONS

By application of the forms obtained in the frequency, displacement and wavefunction domains, we may determine an ideal solution for the experimental relationship functions. Applying limits corresponding to wavefunction solutions, $\omega \rightarrow c/r$ and $E \rightarrow cB$ to equation (10) and (14) yields,

$$\lim_{E \rightarrow c \cdot B} K_0(\omega, X) \cdot \left(\frac{1}{r} \right) \cdot \left(\frac{E}{B} \right)^2 \rightarrow c^2 \cdot \frac{K_0(\omega, X)}{r} \quad (19)$$

$$\lim_{\omega \rightarrow \frac{c}{r}} \lim_{E \rightarrow c \cdot B} K_0(r, X) \cdot \omega \cdot \left(\frac{E}{B} \right) \rightarrow \frac{c^2}{r} \cdot K_0(r, X) \quad (20)$$

Therefore,

$$K_0(\omega, X) = K_0(r, X) \quad (21)$$

Substituting $\omega r = c$ into (18) yields,

$$a = K_0(\omega, r, E, B, X) \cdot \frac{c^2}{r} \quad (22)$$

Therefore, when wavefunction solutions are applied to each precipitation, the relationship functions are equal $K_0(\omega, X) = K_0(r, X) = K_0(\omega, r, E, B, X) = K_0(X)$. The wavefunction precipitation we require for investigations involving a superposition of waves may then be represented by,

$$a = K_0(X) \cdot \frac{c^2}{r} \quad (23)$$

Where “X” represents all other variables not specified in the equation.

6 THE POLARIZABLE VACUUM MODEL

6.1 REFRACTIVE INDEX

It is known that for complete dynamic, kinematic and geometric similarity between Π groupings according to BPT, $K_0(X) = 1$. This specification represents ideal experimental behaviour. Since BPT is based upon the dynamic, kinematic and geometric similarity between a mathematical model and an experimental prototype, we may usefully represent the polarizable vacuum (PV) by the general form of equation (23).

In the PV Model [6,7] the vacuum is characterised by the value of the refractive index “ K_{PV} ”. Subsequently, if we consider “a”, “c” and “r” in the preceding equation to be at infinity, then “ $K_0(X)$ ” may be expressed locally by “ v_c ” and “ r_c ” such that $a = v_c^2 / r_c$, $c \rightarrow v_c * K_{PV}$, and $r_c \rightarrow r * \sqrt{K_{PV}}$,

$$a = K_0(X) \cdot \frac{c^2}{r} \text{ substitute } c = v_c \cdot K_{PV}, r = r_c \cdot \sqrt{K_{PV}}, a = \frac{v_c^2}{r_c}, \text{ solve, } K_0(X) \rightarrow \frac{1}{K_{PV}^{\left(\frac{3}{2}\right)}} \quad (24)$$

The Equivalence Principle indicates that an accelerated reference frame is equivalent to a uniform gravitational field. Therefore, assuming “a” is gravitational acceleration as in the PV Model, we may determine the value of $K_0(X)$ at the surface of the Earth by using the weak field approximation to the gravitational potential. [6,7]

$$K_{PV} = K_0(X)^{-\frac{2}{3}} = e^{2 \cdot \left(\frac{GM}{rc^2}\right)} \quad (25)$$

6.2 SUPERPOSITION

BPT relates the scale of two similar systems by the Π groupings [5] shown in equation (4). The PV background field is assumed to be derivable from a superposition of EM fields. Therefore the Π groupings are compared directly and scaled to determine the applied fields. Subsequently, the ratio $B_1/E_1 = 1/c$ represents the velocity of light “c” at the ambient background PV conditions, within the test volume. The ratio $B_2/E_2 = 1/v_c$ represents the *modified* velocity of light “ v_c ” within the test volume, as determined by the applied EM fields of the experimental prototype (EP). Scaling of the Π groupings may be experimentally applied according to equation (26),

$$\left(\frac{B_1 \cdot \omega_1 \cdot r_1}{E_1}\right)^{x_1} = \left(\frac{B_2 \cdot \omega_2 \cdot r_2}{E_2}\right)^{x_1} \text{ substitute } E_1 = c \cdot B_1, E_2 = v_c \cdot B_2, r_1 = r_2, \text{ solve, } v_c \rightarrow \omega_2 \cdot \frac{c}{\omega_1} \quad (26)$$

The refractive index may then be determined by the ratio of frequency modes between the EM fields of the EP and the PV. Additional notation is required to indicate the discrete spectrum of the superposition of waves within the test volume. The subscript “ $\vec{k}, \vec{e}$ ” denotes a single spectral frequency mode “k” and polarisation “ $\vec{e}$ ”. Substituting a superposition of wavefunctions, the refractive index may be constructed by design, according to,

$$K_0(X)^{-\frac{2}{3}} = \frac{c}{v_c} = \frac{\sum_{(\vec{k}, \vec{e})} \left[\left(K_{\vec{k}, \vec{e}} + n_{\vec{k}, \vec{e}} \right) \cdot \omega_{\vec{k}, \vec{e}} \right]}{\sum_{(\vec{k}, \vec{e})} \left(K_{\vec{k}, \vec{e}} \cdot \omega_{\vec{k}, \vec{e}} \right)} \quad (27)$$

Where “ $n_{\vec{k}, \vec{e}}$ ” represents the macroscopic intensity of photons within the test volume and “ $K_{\vec{k}, \vec{e}}$ ” is an undetermined relationship function representing the intensity of the PV background field at each frequency mode.

For the zero-point field ground state of the vacuum, predicted by Quantum Electrodynamics, $K_{\vec{k}, \vec{e}} = \frac{1}{2}$ and $n_{\vec{k}, \vec{e}} = 0$. Equation (27) implies that when in a gravitational field, the *curved* vacuum field is not in the zero-point ground state. Therefore, within the test volume of the EP, for the background ambient condition we would expect $K_{\vec{k}, \vec{e}} \neq \frac{1}{2}$ in general. Equation (27) describes the relative change in the spectral energy density and thereby represents a modification of polarizability of the vacuum within the test volume of the EP.

6.3 CONSTANT ACCELERATION

Fourier series, representing the summation of trigonometric functions, may be applied to define a constant vector field “a” over the period $0 \leq t \leq 1/f_\Lambda$. A constant function is termed “even” due to symmetry about the “Y-Axis”, subsequently; the Fourier representation contains only Cosine terms and may be expressed in complex form as illustrated in Appendix A. [8]

We may relate the principles of complex Fourier series to EGM superposition by the application of equation (1), as follows, let an arbitrary⁷ transverse EM plane wave be defined by,

$$\Lambda(k, n, t) := \Lambda_0(k) \cdot e^{(\pi \cdot f_\Lambda \cdot n \cdot t) \cdot i} \quad (28)$$

Where “k” and “n” denote wave vector and field harmonic respectively, such that,

$$B(k, n, t) := \text{Re}(\Lambda(k, n, t)) \cdot (T) \quad (29)$$

Where “T” denotes Tesla,

$$E(k, n, t) := \text{Im}(\Lambda(k, n, t)) \cdot \left(\frac{V}{m}\right) \quad (30)$$

Where “V/m” denotes volts per metre, substituting equation (29) and (30) into equation (10) yields,

$$a(t) := \frac{K_0(\omega, X)}{r} \cdot \left[\frac{\sum_{n=-N}^N E(k, n, t)^2}{\sum_{n=-N}^N B(k, n, t)^2} \right] \quad (31)$$

This may be graphically illustrated by ($N = 20$),

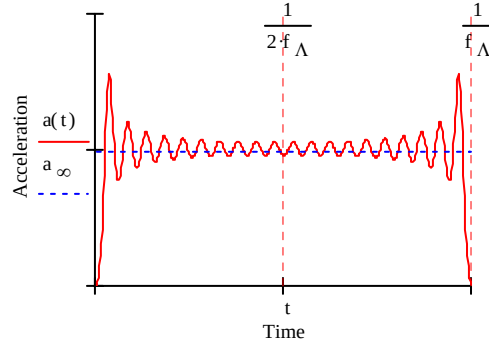


Figure 1,

The mean value “a_∞” of equation (31) over the period $1/f_\Lambda$ also represents the magnitude of the acceleration vector “a” as $N \rightarrow \infty$. Hence,

$$a_\infty := f_\Lambda \cdot \int_{0 \cdot (s)}^{\frac{1}{f_\Lambda}} a(t) dt \quad (32)$$

⁷ Phase (θ) has been excluded for simplicity. It has been numerically simulated that phase contributions may be usefully approximated to zero, when applied to equation (31), for field harmonic values $N \geq 20$ (approx.). Subsequently, as $N \rightarrow \infty$ for $a(t)$ to be constant, $\theta \rightarrow 0$.

Equation (28) is analogous to equation (A1) by the term $\Lambda_0(k)$, which represents the EM amplitude distribution within the experimental environment. Subsequently, we may write the direct equivalence of equation (28) to complex Fourier series representation by the following expression,

$$\Lambda_0(k) \equiv \frac{f \Lambda}{2} \int_0(s) \frac{1}{f \Lambda} \frac{f(t)}{e^{(\pi \cdot f \Lambda \cdot n t) \cdot i}} dt \quad (33)$$

Hence, $\Lambda_0(k)$ may take the form of the complex Fourier coefficient typically denoted as “ C_n ” [8]. This correlation may enable the experimentalist to design and control the geometry of forcing configurations to exact analytical targets.

Therefore, it has been illustrated that we may relate Fourier approximations of a constant vector field to EGM by the summation of EM wavefunctions representing the superposition of waves at each frequency mode. This may be accomplished by the determination of the experimental relationship function $K_0(\omega, X)$.

Moreover, equation (31) represents a useful and practical relationship between experimental observation and engineering research. By sequentially scanning field harmonics between “-N” and “N”, values of $K_0(\omega, X)$ may be calculated when the localised value of ambient acceleration has been reduced. Experimental determination of the function $K_0(\omega, X)$ will permit engineering applications to be developed by direct scaling.

7 CONCLUSIONS

The relationship between EM fields and acceleration has been demonstrated by the application of BPT. Equation (26) and (27) indicate that, for physical modelling applications, manipulating the full spectrum of the PV is not required and optimal PV coupling may exist at specific frequency modes. This dramatically simplifies the design of experimental prototypes and suggests that the PV may be usefully approximated to a discrete wave spectrum, ideally suited for experimental and engineering investigations.

By applying an intense superposition of fields within a single frequency mode, it may be possible to modify the refractive index at that frequency within the test volume of the EP. It should therefore be possible to simplify experiments by investigating a single frequency mode “k” of the background spectrum. This would significantly reduce the experimental complexity and energy requirements necessary to reduce the weight of a test mass within the test volume of the EP.

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APPENDIX A

Complex Fourier series representation of constant acceleration magnitude “a”, by the summation of harmonics, over the interval $0 \leq t \leq 1/f_\Lambda$. [8]

$$a(t) := \sum_{n=-N}^N \left[\frac{f_\Lambda}{2} \cdot \int_0^{\frac{1}{f_\Lambda}} \frac{f(t)}{e^{(\pi \cdot f_\Lambda \cdot n t) \cdot i}} dt \right] \cdot e^{(\pi \cdot f_\Lambda \cdot n t) \cdot i} \quad (A1)$$

And may be graphically illustrated by,

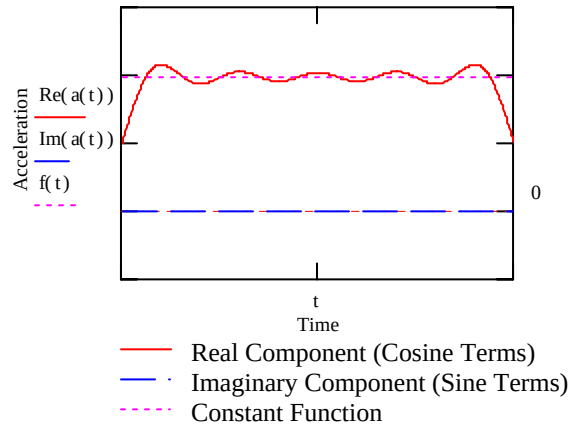


Figure A1,

Where,

Variable	Description	Units
n	n^{th} harmonic of integer value	None
N	N^{th} Fourier polynomial corresponding to the spectral frequency mode such that $-\infty < N < \infty$ - Figure (A1) displays an illustrational value of $N=10$	None
$1/f_\Lambda$	Period over which “a” is constant - Figure (A1) displays an illustrational value of $1/f_\Lambda=1(\text{s})$	s
$f(t)$	Constant function being represented by the summation of Fourier polynomials (eg. “g”)	m/s^2

Table A1,