A theoretical model of a wave: an efflux bounce of a solution-particle

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Abstract

A description of a wave as a bounce is developed. A wave that carries a mass is characterised by a bounce and the mass-spring-damper system. Furthermore, an analogy of a wave/bounce to the mass-spring-damper system is suggested. The efflux bounce considered is responsible for dispersion and is part of the drug transportation wave network in the patient’s blood plasma. A four-dimensional length of tug (wave) describing the efflux bounce is modelled by a system of differential equations. A single equivalent fourth-order differential equation system is suggested to model the same wave. The two systems are inferred to share a unique characteristic equation. The theoretical models developed are used to infer on the characterisation of the wave comprising of media and boundary components. The media is found to be rigid \( \omega_f = 0 h^{-1} \) and the boundary as deformable \( \omega_k = 0.1166154 h^{-1} \). A loaded structure-wave-particle analogy is proposed.

1. Introduction

The Navier–Stokes equations presents the closest form to a possible description of a wave [1–3]. The equations describe four important forces (inertia, pressure, body and viscous) which are considered as constituents of a wave [1]. The wave is potentially characterised by mouldability (shape), functionality and symmetricity (conservation) and these describe the shell, content and designation respectively. There is consideration of a transported mass as a load acting on a structure (wave). The associated components that can act on or define a wave/structure are identified. The five types of load which constitute a wave are identified as compression, tension (decompression), shear, bending and torsion [4]. The torsion is inferred to give rise to the mould. The wave’s functionality is described by bending, compression and decompression. The wave’s specificity is a shear relationship.

Herein, there is a presentation of a possible extension to the description of a wave. There is the suggestion to extend the idea of a force (an acceleration field) as defined by Newton to a bounce field [5, 6]. The bounce field is adopted to describe a wave in nature. The bounce being the fourth derivative of the displacement vector. This is illustrated by use of an extended theoretical model analysing the efflux wave in Nemaura (2019) [1]. This work also attempts to identify the ‘particles’ that constitute and characterise a wave [7].

There are two important variables in defining waves which are amplitude (intensity-level field) and framework (buoyancy field). The wave (time-event), an edge-whole is comprised of four amplitude components which are advection (A), saturation (S), passivation (P) and convection (C) [1]. In addition, the wave (time-event) has the following associated properties which are submissive (P), directive (A), dissipative (C) and regulative (S). The wave-specification or the Lagrangian is a shear aggregate given by \( \Theta \). The event (whole-edge) amplitudes \( A, S, C, P \) are torque (time \( t \)-moment–centre–framework) dependent.

Time (mould/buoyancy) is a rotating and translating field of the wave and is inferred to be consisting of a boundary plate (plenum (mass: time’s crust)) and a void (bounded centre). The plenum, a boundary framework basis is considered as a Higgs field [8]. Furthermore, there is a centre framework basis a void field. Time is considered as a torque/moment–centre (generator) which is the bounce-displacement potential. Time moulds the bounce and thus provides the framework. It is comprised of a head framework \( (\hat{t}) \) that moulds advection
(A) and passivation (P) components. In addition, the tail framework (\(t^+\)) that moulds saturation (S) and convection (C) components. The apparent state of time is the tail (expansion vibration) framework measure.

There are two primary one-dimensional causes, advection (boundary causal source) and saturation (boundary causal sink). Furthermore, there are two centralised effects an attractive one that has a sucking effect. It is a passive (superficial effect sink) factor and this passive component is a one-dimensional effect. The convective constituent is a repelling effect (universal effect source) and is three-dimensional [1]. It is the dispensing effect or distribution of the wave. The four extent aggregates are modelled by a dynamical system of equations.

Advection and saturation are boundary units of the plenum and void frameworks respectively. The passivation (P) and convection (C) are environmental components of the plenum and void frameworks respectively. When describing or defining a wave, it is beneficial to model the environment (effect/reaction) and boundary (action) as internal and external phenomena respectively. A wave is a characterised bounded void of action and effect [1]. It is an expression of the interaction of direction and regulation and their in-environment components. Concisely, a wave can be defined as a natural bounce which is a vibrating system.

Herein, there is the representation of an event the vibrating system (wave) into the mass-spring-damper elements. This system’s harmonic motion is modelled by a fourth order differential equation. It is assumed that the vibrating system bounces with displacement (B). A wave can be described as a four-dimensional length of tugs (jounce/snap of position(bounce)). It is the muscle movement of the loaded-structure. A basic unit of the wave is a quad-tug. A tug (\(\xi\)—tug unit) is the momentum of bounce. An oscillation is the tug extent (\(\xi^2\)) and is considered as a square-tug. A bounce is an oscillation extent (\(\xi^4\)) and is a square-oscillation. Thus, a bounce (oscillations area) is a product of two oscillations the external/action (advection and saturation) and internal/ effect (passive and convective). Time \(\xi^{-1}\) can be described as a wave density (ratio of bounce (\(\xi^4\)) to bounce path (\(\xi^4\)):bounce intensification) measure [9]. The functionality/inert(mass) and functionality profile/course/path (trajectory) quantities of a bounce are identified by \(x\) and \(y\) respectively.

The characteristic equations of the two modelling systems are inferred to be unique since they define the same physical system. The unique system is then used to infer and characterise the motion and description in a bounce. The bounce equation of motion models the wave oscillations. It is suggested that a wave consists of causal and external \(O_x\) and effect and internal \(O_I\) oscillations. The bounce motions of these two oscillations are taken to be independent. Furthermore, these oscillations are characterised by dampness and stiffness per unit mass aggregate [10, 11].

2. Methods

Projected Pharmacokinetic/Pharmacodynamic data (plasma concentration-time profile) in a patient on 600 mg daily dose of efavirenz (a drug used in HIV—therapy) is used as an input (advective aggregate (macro-state)) to the efflux wave projection in the development of an illustration (with the aid of a model developed using ordinary differential equations) of the analogy of the mass—damper system to the wave. The hourly projected plasma concentration is for a time period of 24h [1]. The macro-state (multi-bundle) distribution of mass is inferred to be a potential of totalled micro-state (mono-bundle) and is considered to be facilitated by a wave. The software used, is R and Mathematica.

2.1. Wave

The wave has three main constituencies which are shape, functionality and specification with the following properties propelling, impelling and compelling respectively.

2.1.1. Mould

The wave’s shaping is time which is a buoyancy aggregate. Time generates the wave-structure and its basis is inferred to consist of a rotating void/cavity (mould-space) and a translating plenum (mould-fill) (figure 1). It is a torque, a wave propeller. Generally, time (formation store) is a kinetic strain. Time (rotated and translated diameter of a radial bounce) describes an interior-moment and is consistent with functionality.

2.1.2. Functionality

The wave’s occurrence or event (whole-edge) defines the radial bounce which is a cavity-fill (table 1) and these are wave functions and variable. The event is a bulge on the boundary of the plenum and void. In general, the wave’s functionality (formation content) is kinetic stress.

The plenum is a boundary basis and void a centre basis for a wave. A wave has two framework closures the plenum and void. The frameworks are characterised by boundary \((A,S)\) and centre components \((C,P)\) (figure 2).
The unit for the plenum framework is mass an extrinsic aspect of time. The unit for the void framework is time an intrinsic aspect of mass.

The advection \((A)\) component, a plenum fibre describes the pushing capacity of the wave and is continuous. The rule or constitution measure of the wave relates to advection. Advection is an external causal occurrence source. Advection is an action rule on the external surface boundary. It is an aerial-perimeter related component of the mould.

Saturation is an external aggregate and is a cause. The void fibre or regulation \((S)\) expresses itself as a saturating constituent or the co-director. The saturation component describes the pulling capacity of the wave and is suggested to be a continuous fibre. It is the amplitude of the regulatory action on the external surface boundary. It is a volumetric-perimeter related component of the mould.

Integration property \((P)\) of the wave is conveyed as a passivation medium an internal head effect. The passivation component describes the compressive capacity of the wave. The passivation effect is a centripetal suspension. It is an area-related component of the mould. In addition, it has an attractive/sucking effect and is an internal environment centre.

Distribution property \((C)\) of the wave is exhibited as a convection medium. The convective component describes the dispersion capacity of the wave. The convective component is an internal tail effect. Convection describes the centrifugal centre. The convective effect results in a suspended dilation medium. It is a volumetric related component of the mould. Furthermore, it has a repelling centre effect.

There are two boundary causes that are advection (rule) \((A)\) and saturation (regulation)\((S)\). In addition, two environmental effects passivation (superficial suspended-contraction medium) \((P)\) and convection (universal suspended-dilation medium) \((C)\).

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**Table 1.** The event components in the architecture/mould.

| Conduits | Outlets |
|----------|---------|
| Uniform centre | Yielder \((P)\) Distributor \((C)\) |
| Bending edge | Regulator \((S)\) Director \((A)\) |

---

**Figure 1.** The basis of time is comprised of a void centre and plenum boundary. The boundary has form and the centre is hollow.

**Figure 2.** A planar representation of a wave driven by advection, passivation, saturation and convective components.
2.1.3. Conservation:-symmetry
The wave’s designation $\Theta$—(The aggregate wave shear relationship/conservator/specification) is illustrated in figure 3. The conservator specifies or positions the time-event aggregate. Concisely, it is the position in the mould-functionality plane. It is responsible for conserving the wave.

Consider $A$, $S$, $P$, and $C$ to be constituents of a specified wave (time-event) of an efflux wave. The convection constituent ($C$) stores movement due to the tail vibration ($S$). The passive constituent ($P$) stores movement due to the head vibration ($A$). The components $A$ and $S$ are signals and $P$ and $C$ are stores. The position (shear aggregate) of the natural wave is a sum aggregate (conservation) and is given by:

$$0 = A + S - P - C = A + S + P + C = \Theta. \quad (1)$$

It is noted that $\Theta(=0)$ is zero for a specified-global-wave.

2.2. System I: wave-bounce
In general, the efflux wave system is such that;

The continuance constituents;
- $A$-Constitution/rule host (Direction surface-level host),
- $S$-Extension host (Regulation surface-level host).

The suspended constituents;
- $P$-Contraction vector medium (Submission superficial medium (one-dimensional film)),
- $C$-Extension vector medium (Dispersion universal (multi-dimensional film) medium).

The external pushing feature is the advective ($A$) a constitution source. Furthermore, the external pulling feature is the saturation ($S$) is responsible for regulation. The internal attracting (integration) part is a passive effect ($P$), while the internal repulsion feature is a convective effect ($C$). The bounce’s inherent strain is advection a core entity and the auxiliary entity an (advection-)edge is constituted by regulation, submission and distribution ($S, P, C$). The auxiliary entity is an impression of advection on the cavity. Advection is the cavity-bulge, a source or the certainty. The wave is unconstrained and the boundary vibrates with some displacement from integration a centre, the wave both translates and rotates about integration a centre as in figures 4 and 5.

The general representation of a bounce with a matched centre effect is motivated by Bohr’s proposal [12]. A uniform single planar-tug $A$ to the centre, informing its associated projection is illustrated in figure 5.

The efflux wave system is inferred to be given by the following system,

$$\frac{dA}{dt} = -\gamma_{AC}A + \gamma_{AS}A + \gamma_{SA}S + \gamma_{PA}(P + \bar{P}_{sc}), \quad (2)$$

$$\frac{dS}{dt} = -\gamma_{AS}A - \gamma_{SA}S, \quad (3)$$

$$\frac{dP}{dt} = -\gamma_{PA}(\bar{P} + \bar{P}_{sc}), \quad (4)$$

$$\frac{dC}{dt} = \gamma_{AC}A. \quad (5)$$

The parameters are defined as follows;
- $\bar{P}_{sc}$—total submitted amplitude (drug reaching plasma),
- $\gamma_{AC}$—efflux wave aggregate rate proportional constant,
\( \gamma_{AS} \) - efflux wave part rate constant of advection (A) into saturation (S),
\( \gamma_{AP} \) - efflux wave part rate constant of A into \( \bar{P} \), and
\( \gamma_{SA} \) - response efflux wave part rate constant of S into A.

The elimination rate constant \( \gamma_{AC} \) of the wave for a fixed volume \( [V = 1l] \) is given by,

\[
\gamma_{AC} = \frac{P_c}{AUC_\infty V} = \frac{P_c}{AUC_\infty},
\]

(6)

where the shape constant \( AUC_\infty \) is the total distribution propagation measure \([1, 13]\). Furthermore, the loss of coordination \( \gamma_{SA} \) is equal to uptake rate \( \gamma_{PA} \),

\[
\gamma_{SA} = \gamma_{PA}.
\]

(7)

The system (2–5) can be extended to its related natural bounce system and is inferred to be given by,

\[
\text{(Direction Bounce)} \quad \frac{d\vec{A}}{dt} = -\gamma_{AC} \vec{A} + \gamma_{AS} \vec{A} + \gamma_{SA} \vec{S} + \gamma_{PA} \vec{P},
\]

(8)

\[
\text{(Regulation Bounce)} \quad \frac{d\vec{S}}{dt} = -\gamma_{AS} \vec{A} - \gamma_{SA} \vec{S},
\]

(9)
\[
g = \frac{dP}{dt} P
\]

\[
g = \frac{dC}{dt} A
\]

### 2.2.1. Bounce phases

Advection \((A)\) and event-space \((S)\) are considered as integration \((P)\) and distribution \((C)\) determinants respectively. A mechanical system for a description of a wave is shown (figure 6). Considering the stationary (distribution’s reaction/normal bounce) point \(S_{sp}\), it has two immediate (slack) regions \(\nu_e\) and \(\nu_s\), and a remote (taut) \(\nu_u\). These are inferred to be constant regulation phases (Leptons) of the sub-event \(S\)\(^8\). The slack \((\Delta Y)\) and taut regions \((\Delta Z)\) of the coordination amplitude \(S\) are such that \(\Delta Y = \nu_e \cup \nu_s\) and \(\Delta Z = \nu_u\) where,

\[
\nu_e = \{\bar{S}(t): 0 \leq t \leq t_{S}\},
\]

\[
\nu_s = \{\bar{S}(t): t_{S} \leq t \leq t_{S}\},
\]

\[
\nu_u = \{\bar{S}(t): t \geq t_{S}\}.
\]

A summary of state phases of direction, integration and distribution with respect to event-space or regulation is shown in table 2. Coincidence of state phases of advection and saturation is assumed. The event-space is inferred to be the drive in the distribution of a wave. It is an arranging or the balancing constituent a stress action \([1]\).

### 2.3. System II: bounce

There are representations of a number of equivalence relationships in defining a specified-global-bounce. The bounce displacement point is advection (information action) \((A)\) and the other bounce displacement amplitudes \((S, P, C)\) (information reaction) are traces. The order in a specified-global-bounce consists of the following constituents;

**Case I**

Boundary Framework\(_{(A; S)}\) \((t) \iff\) Environmental Framework\(_{(P; C)}\) \((t)\),

Elastic Bouyancy\(_{(A; S)}\) \((t) \iff\) Fixed Bouyancy\(_{(P; C)}\) \((t)\),

Bending Amplitudes \((A; S) \iff\) Uniform Amplitudes \((P; C)\),

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Table 2. Summary of phases of states with respect to boundary leptons \((S)\) of boundary quarks \((A)\), medium quarks \((P)\) and medium leptons \((C)\).

| Framework \((t)\) | Boundary Leptons | Boundary Quarks | Medium Quarks | Medium Leptons |
|------------------|------------------|----------------|-------------|-------------|
| \(0 \leq t \leq t_{sp}\) | \(\nu_e\) | bottom | top | \(\tau\) |
| \(t_{sp} < t \leq t_{s}\) | \(\nu_s\) | strange | charm | \(\mu\) |
| \(t \geq t_{s}\) | \(\nu_u\) | down | up | \(\epsilon\) |

(Submission Bounce) \(\frac{d\bar{P}}{dt} = -\gamma p_A \bar{P}\),

(Distribution Bounce) \(\frac{d\bar{C}}{dt} = \gamma A \bar{A}\).
Translation Amplitudes \((A; S) \leftrightarrow \) Rotational Amplitudes \((P; C)\),
Kinetic Amplitudes \((A; S) \leftrightarrow \) Potential Amplitudes \((P; C)\),
Anti-solvation Amplitudes \((A; S) \leftrightarrow \) Pro-solvation Amplitudes \((P; C)\),
Boundary Action (External) Amplitudes \((A; S) \leftrightarrow \) Environmental Effect (Internal) Amplitudes \((P; C)\),
Directing Amplitude\(_A \leftrightarrow \) Coordination Amplitude\(_A \leftrightarrow \) Submission Amplitude\(_P \leftrightarrow \) Distribution Amplitude\(_C\),
Head Action\(_A\) + Tail Action\(_A\) \(A + S \leftrightarrow \) Head Effect\(_A\) + Tail Effect\(_A\) \((P + C)\),
\(\text{contraction}_A + \text{dilation}_A \leftrightarrow \text{compression}_P + \text{decompression}_C\).

**Case II**

Plenum Bouyancy\(_{A,P}\) \((t) \leftrightarrow \) Void Bouyancy\(_{S,C}\) \((t)\),
Head \((A; P) \leftrightarrow \) Tail \((S; C)\),
External Head\(_A\) + Internal Head\(_P\) \((A + P) \leftrightarrow \) External Tail\(_C\) + Internal Tail\(_S\) \((S + C)\),
\(\text{contraction}_A + \text{compression}_P \leftrightarrow \text{dilation}_S + \text{decompression}_C\).

Time is a conveyor (conduction of the kinetic strain) of the orifice (hollow muscle) a bounce. Time is a transformation of an event. The following relationship between the bounce’s displacement and its rate of change is proposed. Specifically, the displacement of the bounce \(B(\varepsilon, x_4)\) is proportional to its rate of change \(\varepsilon, x_4\),

\[
B \propto \frac{dB}{dt}. \tag{15}
\]

Thus,

\[
B = \xi \frac{dB}{dt}, \tag{16}
\]

which implies that,

\[
\xi = \frac{B}{\frac{dB}{dt}}, \tag{17}
\]

where \(\xi(\varepsilon, x_4^{-1})\), is a constant (consistent) proportionality measure of the functionality profile.

Consider the tugs \(n_z B\) and \(n_s B\) of a bounce displacement \(B\) with the tug aggregate \(n_z(\varepsilon, x_4)\) and tug aggregate rate \(n_z(\varepsilon, x_4)\) with respect to the transportation states \(z = \{A, S, P, C\}\). There are two bounce length laws which are such that for a general bounce displacement \(B\). The plenum is assumed to increase with time. While, the void decreases with time. The plenum length law for the transportation states \(g = \{A, P\}\),

\[
\frac{dn_z B}{dt} \propto B, \tag{18}
\]

and the void length law for the transportation states \(q = \{S, C\}\),

\[
\frac{dn_s B}{dt} \propto -B. \tag{19}
\]

Consider a general position of a bounce given by \(B = \{\text{Bounce displacement}\}\) in a fabric. The push potential, and compression connectedness in the tug respectively are such that,

\[
\hat{n}_A \frac{dB}{dt} \propto B, \tag{20}
\]

and

\[
\hat{n}_P \frac{dB}{dt} \propto B. \tag{21}
\]

Consider the extension in the tug to be such that,

\[
n_s \frac{dB}{dt} \propto -B. \tag{22}
\]

The extension component,

\[
n_s \frac{dB}{dt} + \eta_z B = 0. \tag{23}
\]
The dilated suspension is such that,
\[ n_C \frac{dB}{dt} \propto -B. \]  
(24)

Thus,
\[ n_C \frac{dB}{dt} + \eta_C B = 0. \]  
(25)

Furthermore, for the suspension \( \hat{C} \) it is such that \( \eta_C = 0 \) (zero-course/no path). Let the tug shift by push and attraction respectively be defined by,
\[ L_A[B] = \hat{n}_A \frac{dB}{dt} + \hat{\eta}_A B = 0, \]
\[ L_P[B] = \eta_P \frac{dB}{dt} + \eta_P B = 0, \]  
(26)
and the tug shift due to extension be defined by,
\[ L_S[B] = n_s \frac{dB}{dt} + \eta_S B = 0. \]  
(27)

The tug shift due to suspension be defined by,
\[ L_C[B] = n_C \frac{dB}{dt} + \eta_C B = 0. \]  
(28)

Let the position of the bounce \( B = \Gamma \). The general position of the bounce of a wave is a solution of the zero tug-volume bounce equation given by,
\[ \mathcal{B}_B \mathcal{B}_c[\Gamma] = \mathcal{L}_C \mathcal{L}_P \mathcal{L}_S \mathcal{L}_A[\Gamma] \]
\[ = \left( n_C \frac{d\Gamma}{dt} + \eta_C \right) \left( \hat{n}_P \frac{d\Gamma}{dt} + \hat{\eta}_P \right) \left( n_s \frac{d\Gamma}{dt} + \eta_S \right) \left( \hat{n}_A \frac{d\Gamma}{dt} + \hat{\eta}_A \right) \Gamma 
= 0, \]  
(29)

where \( \hat{C} \) has zero tug rate (\( \eta_C = 0 \)).

2.3.1. External-oscillation

The external-oscillation consists of a two dimensional shifted tug of two components. The advection component is an input. The saturation (regulation) is a pulling (pressure) component. The two-dimesional length of tug in external movements is given by,
\[ \mathcal{B}_B \mathcal{B}_e[\Gamma] = L_S L_A[\Gamma] = \left( n_s \frac{d\Gamma}{dt} + \eta_s \right) \left( \hat{n}_A \frac{d\Gamma}{dt} + \hat{\eta}_A \right) \Gamma 
= \hat{n}_A n_s \frac{d^2\Gamma}{dt^2} + (\hat{n}_A \eta_s + \hat{\eta}_A n_s) \frac{d\Gamma}{dt} + \hat{\eta}_A \eta_s \Gamma 
= 0. \]  
(30)

\( \mathcal{B}_e \) is a two-dimensional tug or the external oscillation. It forms a harmonic oscillator.

2.3.2. Inter-tug

The inter-tug is a suspended compression, a wave damp and is such that,
\[ L_P[\Gamma] := \hat{n}_P \frac{d\Gamma}{dt} + \hat{\eta}_P \Gamma = 0. \]  
(31)

\( L_P[\Gamma] \) is the tug of the bounce in the integration one-dimensional plane.

2.3.3. Extra-tug

The extra-tug describes a wave’s suspended dilation. It is a suspended-decompression effect. Additionally, it can be considered as the lubricity of the wave and is modelled by,
\[ L_C[\Gamma] := n_C \frac{d\Gamma}{dt} + \eta_C \Gamma = n_C \frac{d\Gamma}{dt} = 0. \]  
(32)

This is a floating movement constituent with \( \eta_C = 0 \). \( L_C[\Gamma] \) is the tug of the bounce in the distribution (permeability) multi-dimensional plane.
2.3.4. Internal-oscillation

The internal-oscillation or the effect oscillation consists of the two tugs associated with convection and passivation components and is such that,

\[ \mathfrak{B}_i[\Gamma] = L_C L_P[\Gamma] = \left( n_C \frac{d}{dt} + \eta_C \right) \left( \tilde{n}_P \frac{d}{dt} + \tilde{\eta}_P \right) \Gamma \\
= \tilde{n}_P n_C \frac{d^2 \Gamma}{dt^2} + (\tilde{n}_P \eta_C + \tilde{\eta}_P n_C) \frac{d\Gamma}{dt} + \tilde{\eta}_P \eta_C \Gamma \\
= 0. \quad (33) \]

\( \mathfrak{B}_i \) is an internal-oscillation with \( \eta_C = 0 \).

2.3.5. Bounce

The following is a presentation of the dimensions associated with the bounce for equations (34)–36 and spring and damping relationships (equations (59)–61) deduced shown in table 3.

- \( n \)— tug aggregate measure,
- \( \eta \)— tug rate measure,
- \( m \)— oscillation aggregate measure,
- \( b \)— oscillation rate measure,
- \( k \)— oscillation acceleration measure,
- \( \beta \)— oscillation-related acceleration constant measure,
- \( \omega \)— oscillation-related rate constant measure.

\( B, \Gamma, A, S, P, C \)— bounce aggregate measures,

Generally, the external and internal oscillations (equations (30) and 33) are such that,

\[ \mathfrak{B}_j = m_j \frac{d^2}{dt^2} + b_j \frac{d}{dt} + k_j = 0, \quad j = \{ E, I \} \quad (34) \]

where,

\[ (m_E, m_I, b_E, b_I, k_E, k_I) = (\tilde{\alpha}_A n_S, \tilde{n}_P n_C, \tilde{n}_P \eta_S + \tilde{\eta}_P n_S, \tilde{n}_P \eta_C + \eta_P n_C, \tilde{\eta}_A \eta_S, \eta_P \eta_C). \quad (35) \]

A wave is a zero movement volume dilation of the bounce of \( \Gamma \). It is the product of two oscillations (external and internal) and is modelled by,

\[ \sigma_v[\Gamma] = \frac{L_C}{n_C} \frac{L_P}{\tilde{n}_P n_S} \frac{L_A}{\tilde{\alpha}_A} \frac{L_p}{\eta_P} \Gamma \\
= \frac{d}{dt} \left( \frac{d}{dt} + \tilde{n}_P \right) \left( \frac{d^2 \Gamma}{dt^2} + \left( \frac{\tilde{\eta}_A}{\tilde{\alpha}_A} + \frac{\eta_S}{n_S} \right) \frac{d\Gamma}{dt} + \frac{\tilde{\eta}_A \eta_S}{\tilde{\alpha}_A n_S} \Gamma \right) \\
= 0. \quad (36) \]
2.3.6. System I: wave-bounce

Setting the system (8–11) such that,

\[
\frac{d\tilde{A}}{dt} = \frac{d\tilde{S}}{dt} = \frac{d\tilde{P}}{dt} = \frac{d\tilde{C}}{dt} = 0, \tag{37}
\]

the equilibrium points are given by,

\[
\tilde{A}^* = \tilde{S}^* = \tilde{P}^* = \tilde{C}^* = 0.
\]

The Jacobian matrix for the field inter-system is given by,

\[
J(A^*, S^*, P^*, C^*) = \begin{bmatrix}
- (\gamma_{AC} - \gamma_{AS}) & \gamma_{SA} & \gamma_{PA} & 0 \\
- \gamma_{AS} & - \gamma_{SA} & 0 & 0 \\
0 & 0 & - \gamma_{PA} & 0 \\
\gamma_{AC} & 0 & 0 & 0
\end{bmatrix}.
\tag{38}
\]

The Jacobian determinant describes the volume dilation in the neighbourhood of a point. The volume dilation at equilibrium is such that,

\[
0 = |J - \lambda I|,
\tag{39}
\]

and is described by the characteristic equation of the field system (for the case considered herein \(\gamma_{SA} = \gamma_{PA}\)) is given by,

\[
\lambda^4 + (\gamma_{AC} - \gamma_{AS} + \gamma_{SA} + \gamma_{PA})\lambda^3 + (\gamma_{AC}\gamma_{SA} + \gamma_{AC}\gamma_{PA} - \gamma_{AS}\gamma_{PA} + \gamma_{SA}\gamma_{PA})\lambda^2 + \gamma_{AC}\gamma_{SA}\gamma_{PA}\lambda = 0
\tag{40}
\]

\[
(\lambda^2 + (\gamma_{AC} - \gamma_{AS} + \gamma_{SA})\lambda + \gamma_{AC}\gamma_{SA}\lambda + \gamma_{AS}\gamma_{PA}\lambda = 0.
\tag{41}
\]

The eigenvalues are given by,

\[
\lambda_1 = \frac{1}{2}(-\gamma_{AC} + \gamma_{AS} - \gamma_{SA} - \sqrt{(\gamma_{AC} - \gamma_{AS} + \gamma_{SA})^2 - 4\gamma_{AC}\gamma_{SA}}),
\tag{42}
\]

\[
\lambda_2 = \frac{1}{2}(-\gamma_{AC} + \gamma_{AS} - \gamma_{SA} + \sqrt{(\gamma_{AC} - \gamma_{AS} + \gamma_{SA})^2 - 4\gamma_{AC}\gamma_{SA}}),
\tag{43}
\]

\[
\lambda_3 = -\gamma_{PA},
\tag{44}
\]

and

\[
\lambda_4 = 0.
\tag{45}
\]

The associated eigenvectors are given by,

\[
e_1 = \{u, -1 - u, 0, 1\},
\tag{46}
\]

\[
e_2 = \{v, -1 - v, 0, 1\},
\tag{47}
\]

\[
e_3 = \{0, -1, 1, 0\},
\tag{48}
\]

and,

\[
e_4 = \{0, 0, 0, 1\},
\tag{49}
\]

where \(u\) and \(v\) are given by,

\[
u = \frac{1}{2\gamma_{AC}}(-\gamma_{AC} + \gamma_{AS} - \gamma_{SA} - \sqrt{(\gamma_{AC} - \gamma_{AS} + \gamma_{SA})^2 - 4\gamma_{AC}\gamma_{SA}}),
\tag{50}
\]

\[
u = \frac{1}{2\gamma_{AC}}(-\gamma_{AC} + \gamma_{AS} - \gamma_{SA} + \sqrt{(\gamma_{AC} - \gamma_{AS} + \gamma_{SA})^2 - 4\gamma_{AC}\gamma_{SA}}).
\tag{51}
\]

2.3.7. System II: bounce

The volume dilation of the bounce is \(\sigma_V(\Gamma) = 0\) at the equilibrium point. Consider equation (36), there is an assumption that \(\Gamma = e^{\omega t}\), and the associated auxiliary equation \(\Lambda_{\sigma_V(\Gamma)}\) is then given by,
\[ 0 = \alpha^4 + \left( \frac{\bar{d}_A}{\bar{d}_A} + \frac{\eta_S}{\eta_S} + \frac{\eta_P}{\eta_P} \right) \alpha^3 + \left( \frac{\hat{d}_A}{\hat{d}_A} + \frac{\hat{\eta}_S}{\hat{\eta}_S} + \frac{\hat{\eta}_P}{\hat{\eta}_P} \right) \alpha^2 + \frac{\bar{d}_A \hat{\eta}_S \eta_P}{\bar{A} \eta_S \eta_P} \]

\( = \left( \alpha + \frac{\eta_P}{\eta_P} \right) \left( \alpha + \frac{\bar{d}_A}{\bar{d}_A} \right) \left( \alpha + \frac{\eta_S}{\eta_S} \right) \left( \alpha + \frac{\eta_P}{\eta_P} \right) \) internal movement of bounce

\( = \left( \alpha + \frac{\eta_P}{\eta_P} \right) \left( \alpha + \frac{\bar{d}_A}{\bar{d}_A} \right) \left( \alpha + \frac{\eta_S}{\eta_S} \right) \left( \alpha + \frac{\eta_P}{\eta_P} \right) \) external movement of bounce

\( = \left( \alpha + \frac{\eta_P}{\eta_P} \right) \left( \alpha + \frac{\bar{d}_A}{\bar{d}_A} \right) \left( \alpha + \frac{\eta_S}{\eta_S} \right) \left( \alpha + \frac{\eta_P}{\eta_P} \right) \) environmental inter–movement of bounce

\( = \left( \alpha + \frac{\eta_P}{\eta_P} \right) \left( \alpha + \frac{\bar{d}_A}{\bar{d}_A} \right) \left( \alpha + \frac{\eta_S}{\eta_S} \right) \left( \alpha + \frac{\eta_P}{\eta_P} \right) \) environmental extra–movement of bounce

boundary intra–movement of bounce

and the eigenvalues,

\[ \alpha_1 = -\frac{\bar{d}_A}{\bar{d}_A} \implies \alpha_{EE}, \]

\[ \alpha_2 = -\frac{\eta_S}{\eta_S} \implies \alpha_{EI}, \]

\[ \alpha_3 = -\frac{\eta_P}{\eta_P} \implies \alpha_{IE}, \] and \( \alpha_4 = 0 \implies \alpha_{II}. \)

2.4. Systems equivalence

The solutions of systems I and II coincide (describes a unique volume) at equilibrium thus,

\[ 0 = \left\| F - \lambda I \right\| = \lambda_{AC} (I) \]

and,

\[ \lambda_1 = \alpha_1, \]

\[ \lambda_2 = \alpha_2, \]

\[ \lambda_3 = \alpha_3, \]

\[ \lambda_4 = \alpha_4. \]

It follows from the solutions of equation (35), (36) and (41) that,

\[ \frac{b_E}{m_E} = \gamma_{AC} - \gamma_{AS} + \gamma_{PA}, \]

\[ \frac{b_I}{m_I} = \gamma_{PA}, \]

\[ \frac{k_E}{m_E} = \gamma_{AC} \gamma_{PA}, \]

and

\[ \frac{k_I}{m_I} = 0. \]

2.5. Damping

A mechanical vibrating system of the two unit oscillations \( (O_E \text{ and } O_I) \) which constitute the bounce with springing \( (\frac{k_E}{m_E}) \) and damping factors \( (\frac{k_E}{m_E}) \) is considered (figure 7).

The damping classification parameter \( \beta \) is given and is such that,

\[ \beta_j = \left( \frac{b_j}{m_j} \right)^2 - 4 \frac{k_j}{m_j} \text{ for } j = \{E, I\}, \]

\[ \beta_j > 0, \text{ overdamped} \]

\[ \beta_j = 0, \text{ critically damped} \]

\[ \beta_j < 0, \text{ underdamped} \]
where $\beta_E$, $\beta_I$, defines external and internal damping respectively. The natural frequency is given by,

$$\omega_j = \sqrt{\frac{k_j}{m_j}} \quad \text{where} \quad j = \{E, I\}. \quad (61)$$

3. Results

Let the direction’s (A) position coincide with the mass amplitude [concentration $(mg/l) \times \text{volume}(l)$] [In this case $\text{volume}(V) = 1l$]. The data is fit for the model equations (2–5). The numerical solutions of equations (2–5) and equations (8–11) and the associated parameters are shown in figure 8 and table 4.

The equilibrium points, eigenvalues and eigenvectors are,

$$(A^*, S^*, \vec{P}^*, \vec{C}^*) = (0, 0, 0, 0), \quad (62)$$

$$(\lambda_1, \lambda_2, \lambda_3, \lambda_4) = (-0.161187, -0.084369, -0.03145, 0) = (\alpha_1, \alpha_2, \alpha_3, \alpha_4), \quad (63)$$

with boundary associated eigenvectors given by,

$$[e_1, e_2] = [(0.3011, 0.5067, 0, -0.8078), (0.1503, 0.6199, 0, -0.7702)], \quad (64)$$

and centre associated eigenvectors given by,

$$[e_3, e_4] = [(0, -0.7071, 0.7071, 0), (0, 0, 0, 1)]. \quad (65)$$

The variation of the simple bounce’s planetary system which is motivated by Bohr’s atomic model, Feynman’s lost lectures and the bounce’s eigensystem [12, 14]. Considering $C$ as the displacement trace of $S$ and $P$ being the displacement trace of $A$, for the efflux bounce the following representation is proposed (figure 9).

The dampness, frequency and spring factors of external and internal oscillations of the efflux bounce are given in table 5. The spring factor and natural frequency parameters are greater for the external oscillation as compared to the internal oscillation. The two oscillations are critically damped ($\beta_E \approx \beta_I \approx 0$). The restoring/ spring and damping factors are comparable. The two systems cannot oscillate and their amplitudes decay exponentially.

4. Discussion

A wave-functionality’s characterisation is given in table 6. It has primary (bending) connections which are advection (pushing) and saturation (pulling) frameworks. These are boundary constituents. The secondary
uniform connections are environmental constituents. The compressive effect is a characterisation of the passive constituent of a bounce. Additionally, the suspended dilation effect is a convective aspect of the bounce. Passive and convective constituents are centre effects. The bounce is constituted by the regulated direction (boundary) and distributed submission (centre). The wave is a vibrating entity of an integrated and distributed centre (dispersed damp) and also consists of a boundary (regulated direction) with the following, an instruction-edge (wave-constitution) and a regulation-edge (wave-coordination). The centre is a natural medium which has the following properties, integration (wave-submission) and dispersion (wave-distribution). These properties are rigid frameworks. The boundary is

![Figure 8](image)

**Figure 8.** A representation of the efflux bounce’s amplitudes with respect to time. (a) The advection profile showing initial increasing and then decreasing amplitudes in time. (b) The regulative component initially decreases and then an increase. (c) Shows a gradual decrease in the submission bounce aggregate. (d) A gradual increase in the distribution component.

| Parameters | Estimate | Std Error | t value | $Pr(>|t|)$ |
|------------|----------|-----------|---------|-----------|
| $P_{\infty}$ | 91.67mg | Fix | ... | ... |
| $V$ | 1/l | Fix | ... | ... |
| $AUC_{R}$ | 212mg·h·l$^{-1}$ | 2.694 × 10$^{-8}$ | 78692387 | <2 × 10$^{-16}$ |
| $\gamma_{MA}$ | 0.2183hr$^{-1}$ | 1.05 × 10$^{-8}$ | 20791987 | <2 × 10$^{-16}$ |
| $k_{MA}$ | 0.031456s$^{-1}$ | 9.320 × 10$^{-10}$ | 33747471 | <2 × 10$^{-16}$ |

$^{*}$ $\gamma_{MA} = \gamma_{PA}$

Table 4. Parameter estimates in modelling transportation rates of efflux movement.
a foreign constituent described by moving frameworks which are responsible for direction and regulation. The event-space is responsible for regulating the distribution and advection for directing the submission.

Basically, a particle is an event of a monolith-moment. The monolith-moment’s signal is homogenous and confined. In addition, the wave is an event of a manifold-moment. The manifold-moment’s signal is differentiated and split. The mould occupies the interior-space (cavity) and is inferred to be regular. The event (bulge) occupies the exterior-space (cavity limit) and is irregular or unique. The cavity and cavity-edge are combination and fractionated constituents respectively. Advection is the cavity (wave centre) action and

---

**Table 5.** Damping classification parameter estimates in modelling the efflux movement.

| Parameters | Unit | Value        |
|------------|------|--------------|
| $b_m$      | $h^{-1}$ | 0.245 555 7  |
| $b_I$      | $h^{-1}$ | 0.031 45     |
| $a_m$      | $h^{-2}$ | 0.013 599 16 |
| $a_I$      | $h^{-2}$ | 0            |
| $\beta_E$  | $h^{-1}$ | 0.005 900 962|
| $\beta_I$  | $h^{-1}$ | 0.000 989 1025|
| $\omega_E$ | $h^{-1}$ | 0.116 6154   |
| $\omega_I$ | $h^{-1}$ | 0            |

**Table 6.** Summary of wave-functionality’s characterisation.

| Amplitude     | Internal Reference          | External Reference         | Bounce Property     |
|---------------|-----------------------------|-----------------------------|---------------------|
| Advection     | Pushing environ             | Contracting boundary        | Directing edge      |
| Saturation    | Pulling environ             | Dilating boundary           | Regulating edge     |
| Passivation   | Attracting centre           | Compression medium          | Submitting store    |
| Convection    | Repelling centre            | Decompression medium        | Distributing store  |

---

**Figure 9.** The simple bounce trajectories with distinct centres. The amplitude $A$ is a displacement point/object. The variables, $P$ and $C$ are eccentric and concentric stores of $A$ respectively. Furthermore, primarily $C$ is an isometric store of $S$ (displacement trace of $A$ relative to $P$).
Table 7: Summary of bounce’s characterisation.

| Amplitude   | Framework Basis | Framework Entity          | Functionality Entity | Amplitude Phases                                      | Conservation Entity |
|-------------|-----------------|---------------------------|-----------------------|--------------------------------------------------------|---------------------|
| Advection   | Plenum          | W-Boson                   | Weak                  | Boundary Quarks (bottom, strange, down)                | Neutron             |
| Passivation | Plenum          | Z-Boson (Graviton)        | Gravity               | Medium Quarks (top, charm, up)                         | Proton              |
| Saturation  | Void            | Gluon                     | Strong                | Boundary Leptons (tau neutrino, muon neutrino, electron neutrino) | Neutrino            |
| Convection  | Void            | Photon                    | Electro-magnetic      | Medium Leptons (tau, muon, electron)                   | Electron            |
regulation (pressure) is a cavity-limit secondary action. Thus, space is directed and regulated. A cavity is the primary-space and cavity limit is the secondary-space. The centre-fill effect is submission and the limit-fill effect is distribution. Thus space and fill are action and effect aggregates respectively.

Newton considered space as an empty arena (cavity) and separate from time and Einstein hypothesised its ability to bend (cavity-limit) and as a space-time fabric or in a case considered herein, as a combination of the cavity and its limit in time [5]. This precise close up, notes that time’s basic unit is a moment-centre of bounce, event and specification being bounce functionality and conservation respectively. Herein, event-space is a vibrating boundary-wall which is the kinetic amplitude of the tail framework (time). Alternatively, event-space is the vibration regulation on the void boundary. Thus, event-space is basically the regulation of time. The time-space is the void. Space is the direction and regulation in time. Furthermore, the fill is the submission and distribution in time. Time is the functionality identity or profile.

A universal oscillator equation of the bounce is considered and is proposed to be a product of two independent oscillations the action and the effect oscillator equations. The efflux bounce considered herein is critically damped ($\beta_E \approx \beta_L \approx 0$). This critical damping shows a rapid approach to a zero amplitude for the considered damped oscillator. Furthermore, the natural external frequency ($\omega_L = 0.11661548 h^{-1}$) rate constant at which the boundary vibrates when it is not disturbed by a foreign bounce is positive. In addition, the external spring factor ($\frac{h c}{m_0}$) (stiffness) is positive implying that the boundary is an amplitude of a moving framework.

The effect has (no spring) zero stiffness [15]. The internal oscillation has a zero natural frequency ($\omega_I = 0 h^{-1}$) corresponding to a rigid medium. This shows that the media in the wave is rigid and thus defines a fixed part of the framework. The internal oscillation has dampness characterised by the passivation medium.

The convection amplitude is independent of compressed medium ($P$). Therefore, convection is solely inferred to be a decompressed medium.

5. Conclusion

The void is a null centre and its boundary is for differentiation or the constraint. The void centre’s amplitude is convection. Furthermore, its boundary’s amplitude is saturation. The plenum has a full centre and its boundary the spectrum or range. The amplitudes of the plenum centre and boundary are passivation and advection respectively. The mould is a homogenous component. The mould (time) is a significant component in the description of the bounce. It is a cavity and considered to prompt the wave (time-event) its projection. The event in the field is specified by the Lagrangian or Hamiltonian a law for conservation [9].

A wave is a generalised bounce. A particle is a circumscribed or definite bounce. A particle analogy for the bounce description is suggested (table 7) [8]. The neutron (inherent (real-entity) chamber) is a boundary (glued-quark-boundary) rule and is the weak bounce. The weak bounce’s position is hypothesised to be the constitution or occurrence’s form ($A$). The strong bounce’s position is inferred as the regulation ($S$). The electromagnetic bounce’s amplitude is the distribution ($C$), a multi-dimensional medium. Furthermore, the gravity bounce position, a gravitational plate is responsible for integration ($P$). It is important to note that the passivation bounce is a compression amplitude with respect to the boundary. However, with respect to the centre it is an attractive bounce. The electron/photon (electromagnetic/distribution bounce) is a store for event-space/gluon (glued-neutrino-boundary) vibrations (strong bounce) and the proton (gravity/submission bounce) is a store for neutron (weak/direction bounce) vibrations. Furthermore, there is a bounce position $\Theta$ is responsible for preservation. It is responsible for wave specification or positioning.

A wave is a product of two oscillations the boundary and media. The oscillations are in an acceleration field and the wave in a bounce field. The natural plane to study flow is possibly the bounce field. The system of fourth derivatives (of position vectors) could be key in understanding nano-structures. The wave is a characterised mould. It is a specified event comprising of a boundary and an environment. The wave is a vibrating bounded damped generalised entity. The waves are active on the boundary with an inactive storage. The wave (time-event) is active on the plenum–cavity boundary inside the mould. It is inferred to be a cavity-fill or bulge. The boundary is inferred to be a gluey (event-space to attach advection) coordinated constitution and the centre as a distributed submission. Generally, the cavity interior’s environ is for direction and the cavity interior’s centre is for submission. The cavity limit’s environ is responsible for regulation and the cavity limit’s centre is for distribution.

Generally, a wave is the differentiated distribution of a yield variety. A particle is the homogenous distribution of a constant yield. The universe could potentially be a big bounce [16, 17]. Thus, it can be described as a wave. The following inference is suggested that is the fill and cavity are regulated by neutrinos (open unit) and directed by neutrons (closure unit). Space is directed and regulated and the fill is submitted and distributed.

The closure unit, advection is the wave’s inherent strain component of stress. Potentially the Universe (big
bounce) is occupied by system vibrations (waves). It possibly consists of waves (specified-global-system vibrations) and wave-variants (specified-conditional-system vibrations).

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References

[1] Nemaura T 2019 Modelling the influx and efflux waves in drug movement: a basis for pharmacokinetic-pharmacodynamic link of efavirenz Biomed. Phys. Eng. Express 6 015002
[2] Schneiderbauer S and Krieger M 2014 What do the navier-stokes equations mean? Eur. J. Phys. 35 015020
[3] Darrigol O 2002 Between hydrodynamics and elasticity theory: the first five births of the navier-stokes equation Arch. Hist. Exact Sci. 56 95–150
[4] Megson T H G 2019 Structural and Stress Analysis 4 edn. (Oxford, UK and Cambridge, MA USA: Elsevier Butterworth-Heinemann)
[5] Fleury P 2019 Gravitation: From Newton to Einstein https://arxiv.org/pdf/1902.07287.pdf (Switzerland: Springer)
[6] Blackmore D, Roman Samulyak S and Rosato A 1999 New Mathematical Models for Particle Flow Dynamics, Journal of Nonlinear Mathematical Physics 6 198–221
[7] Wotthe J, Wiener G J and van der Veken F F 2017 Lets have a coffee with the Standard Model of particle physics! Phys. Educ. 52 034001
[8] Anchordoqui L and Halzen F 2011 Lessons in Particle Physics arXiv:0906.1271
[9] Nemaura T 2018 Derived wave of gradient driven diffusion’s convective flux of efavirenz Journal of Physics Communications 2 055008
[10] Georgi H 1993 The Physics of Waves (Englewood Cliffs: Prentice Hall)
[11] Kreyszig E 2011 Advanced Engineering Mathematics 10 edn. (New York: Wiley)
[12] Kragh H 2012 Niels Bohr and the quantum atom: The Bohr model of atomic structure 1913–1925. (Oxford: OUP UK)
[13] Ursu R, Blardi P and Giorgi G 2002 A short introduction to pharmacokinetics Eur. Rev. Med. Pharmacol. Sci. 6 33–44
[14] Goodstein D L and Goodstein J R 1997 Feynman’s Lost Lecture: the Motion of Planets Around the Sun (Great Britain: Vintage)
[15] Schenkel M and Guest S D 2013 On zero stiffness Proc. Inst. Mech. Eng. Part C J. Mech. Eng. Sci. 228 1701–14
[16] Gielen S and Turok N 2016 Perfect quantum cosmological bounce Phys. Rev. Lett. 117 012301
[17] Ijjas A and Steinhardt P J 2017 Fully stable cosmological solutions with a non-singular classical bounce Phys. Lett. B 764 289–94