Basic Phenomenal Objects, or How a Multitude of Fundamental Particles Can Be Reduced to Just One Single Basic Entity

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Basic Phenomenal Objects, or How a Multitude of Fundamental Particles can be reduced to just one Single Basic Entity

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ABSTRACT

This paper introduces a novel unification model, basic phenomenal objects (BPO), which attempts to challenge the standard model. The claim is that BPO performs well on all five major scientific virtues (i.e. simplicity, universality, consistency, empirical accuracy, fertility). Namely, for a universal theory, BPO is very simple, as it only requires one type of basic entity – the basic phenomenal object – possessing only three attributes (basic velocity, basic mutuality, basic inertia), of which the behavior is guided by only two laws (interaction law, asymmetry law). Moreover, these foundations of BPO are also consistent with important theories, such as crucial parts of general relativity and QM, can derive important empirical results (e.g. the gyro-magnetic ratio of particles), provide novel explanations (e.g. the structure of anti-matter), and state novel predictions (e.g. an upper boundary to the energy of a stable neutrino).

Introduction

A theory of everything has long been the holy grail in physics. Such perfect universality has generally been sought via reduction. The current leader of that approach is the standard model. Yet the standard model is not without its flaws. Among them are a lack of simplicity (many entities and physical processes), and ad-hoc assumptions necessary to attain empirical accuracy (Blumhofer and Hutter, 1997). Such flaws in the standard model have caused other universal theories to arise, such as string theory and the multiverse. Yet these theories too have been no panacea, as they tend not to admit any fruitful predictions (Dawid, 2013), and perhaps worse, become widely inconsistent with many theories and basic intuitions. This situation has even led some theorists to become skeptical of the entire reductionist approach (Hossenfelder, 2018), and have thereby, perhaps, given up on the universality dream. BPO attempts to revive that dream by constructing a new theory called Basic Phenomenal Objects (BPO). In this paper we show that BPO satisfies such an ambitious claim by borrowing a proper measuring rod from philosophy of science, namely the five major scientific virtues: universality, simplicity, consistency, empirical accuracy, and fertility (See Kuhn [1977] for an overview or Keas [2018] for a taxonomy). These virtues are treated in the following sections. Section one describes BPO as a pure theory, thereby covering the virtues of universality, simplicity, and internal consistency. Section two then turns to explanatory fertility, which describes the major conceptual leaps implicitly introduced in the first section. Next is section three, which focuses on the virtue of external consistency by contrasting BPO with concepts of major physical theories (i.e. Quantum Mechanics, Relativity, the Standard model). Next, section four discusses empirical accuracy with respect to known data about particles. And, lastly, section five discusses fertility from the viewpoint of predictive novelty (e.g. new radius of the hydrogen atom).

1 Simple, Universal and Internally Consistent

This section shall introduce BPO in its purest form. It starts with only a few assumptions (simplicity), attempts to derive important physical phenomena (universality), and, evidently, attempts to do so only from its foundations (internal consistency). Important to note, is that below BPO's key statements are given up front, and that elaboration of these statements will follow in this section, and that the reasons for unconventional assumptions will be explicitly treated in section two.

1.1 basic statements

BPO needs only the following ontological statements (or basic assumptions) about nature (in abbreviated form):

- Space and time are absolute.
- There is only one basic entity, called a basic phenomenal object (Bp)
- Bp's have three intrinsic attributes, each of which can be considered a physical quantity.
  - Basic Velocity (unity: meters per second): a linear displacement with a constant amplitude and direction.
  - Basic Mutuality (unity: Coulomb): Bp's ability to alter the direction of motion of another Bp.
  - Basic Inertia (unity: kilogram): Bp's ability to resist an alteration of its direction of motion.
- Movement patterns are explained by two laws.
  - Basic Interaction law: how the direction of motion of a Bp is altered by another Bp.
  - Basic Asymmetry law: how attributes of a Bp are altered by other Bp's within a natural particle.

From these basic statements, the posit is that all emergent phenomena can be described, including particles and their properties, the "forces of nature" and atoms.

1.2 Theoretical core

This subsection shows how the interaction law is derived, shows how stable particles are composed of systems of interacting Bp's, shows how Bp's merge and split, introduces a fundamental asymmetry in particles, and shows how the traditional forces of nature cohere with BPO.

1.2.1 Basic interaction law

Bp's have three basic attributes. However, to fully comprehend these attributes, knowing their interrelation is crucial. This interrelation is most easily perceived by means of the interaction law. Therefore, this section starts with discussing the interaction law – the most crucial law for movement patterns – and naturally introduces Bp's basic attributes along the way. To imagine how the interaction law is derived, consider that Bp's – according to assumption three – have intrinsic basic velocity. Interaction between Bp's can therefore not follow familiar classical patterns of motion, in which an object can affect the velocity-amplitude of another object. Instead, a Bp can only affect the direction of motion of another Bp. Curiously, a similar interaction exists in nature, namely the electrodynamic interaction between charged particles. Assuming this similarity is meaningful, we can reverse engineer – with some alterations – the basic interaction from the mathematical formulation of the electrodynamic interaction. To be sure, later, in section 1.2.5, we will show that the electrodynamic force (along with other forces of nature) does in fact emerge from this basic interaction, and that the reverse engineering done here is not artificial.

Let us thus – based on Ampere's law of electrodynamic interaction – consider a spatial configuration, where two charged particles are on a z-axis and an x-y plane is positioned in their midst. In figure 1, the force of Q_2 on Q_1 is given by the arrow, perpendicular to the velocity vector V_1. The electrodynamic interaction is usually quantified as a force. We can follow this convention by describing the Ampère law for the electrodynamic force in the following form:

$$\vec{F} = \frac{\mu_0}{4\pi}\frac{q_1 q_2 v_2 v_1}{r^2}\vec{A} \tag{1}$$

Here we have the classical charges q_1 and q_2 with their respective velocities v_1 and v_2. μ_0 is the permeability of space and r is the distance between the two charges. Vector $\vec{A}$ defines the direction of the resulting force, and its amplitude, which is between 0 and 1, both affected by the alignment of the two velocity vectors. The electrodynamic force does not have an effect in case the velocity vectors point to each other, or away from each other. In these cases, vector $\vec{A}$ will have a zero length. The electrodynamic force will be optimal (i.e. that is vector $\vec{A}$ having a length of 1) in case both their velocity vectors point in a direction, perpendicular to the y-axis (in figure 1).

We can now move on to formulate the basic interaction. Like the electrodynamic force, we assume its properties of space, and of how force depends on velocities. Only two alterations are needed. The first is that since we cannot assume that a classic charge is at the basis of our basic interaction, we replace the classic charge q with the basic mutuality M. The second alteration is based on vector $\vec{A}$ not being able to operate in a manner that stable configurations of interacting Bp's can emerge. We therefore replace vector $\vec{A}$ with another vector $\vec{B}$ to arrive at a general description of the basic force (a derivation of the vector $\vec{B}$ is left out for brevity reasons, see mgpt.vitha.nl/mgpt.pdf for its derivation):

$$\vec{F} = \frac{\mu_0}{4\pi}\frac{M_1 M_2 v_2 v_1}{r^2}\vec{B} \tag{2}$$

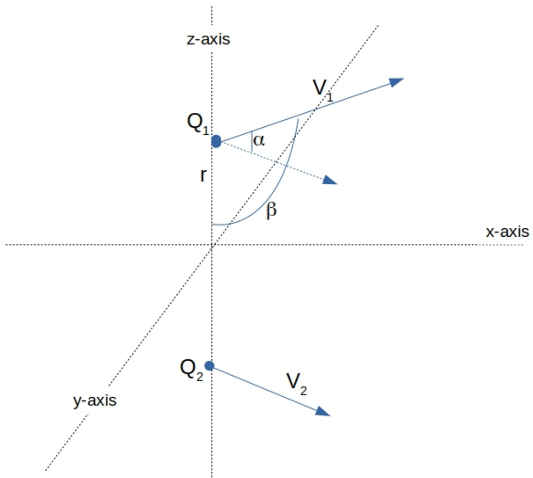

Figure 1. 3D picture of dynamic interaction between two charged objects.

The mutuality and velocity of a Bp are intrinsic properties, so they are not affected by the basic interaction and can be considered constants. Therefore, most of the right part of this equation is a constant for any given set of Bp's. We can thus define a constant P as:

$$P = \frac{\mu_0}{4\pi} M_1 M_2 v_2 v_1 \tag{3}$$

The basic law of interaction can now be simplified to:

$$\vec{F} = \frac{P\vec{B}}{r^2} \tag{4}$$

The direction of the vector $\vec{B}$ differs in a fundamental way from the vector $\vec{A}$. Just as a charge of a particle can be positive or negative, the mutuality of a Bp can also have a positive (B+) or a negative (B-) value. A set of only positive or negative Bp's are called "like" whereas mixed sets are called "unlike". Standard electrodynamic interactions of two charged particles can have attractive as well as repulsive effects for any combination of like or unlike charges, depending on their angle of approach (or recession). Such interactions, however, cannot by themselves produce stable configurations of particles. By contrast, the basic force **always** operates as a repulsive force for like Bp's and as an attractive force for unlike Bp's. (Note that repulsion and attraction as meant here, caused by the basic force, is not the same as electrostatic repulsion and attraction.) This seemingly small distinction makes a big difference. Two or more Bp's can now form stable configurations, solely based on their dynamic interaction. In section 1.2.2. we will further elaborate on how these stable configurations come about.

As a final note, in section 1.2.6, the basic amplitude of the mutuality (M_B) and velocity (V_B) of an isolated Bp are calibrated, using the amplitude of an electrostatic force. Since these values are important for understanding the next paragraphs, they are given here in advance:

$$basic\ velocity\ V_B = 1,1180340c \tag{5}$$

$$basic\ mutuality\ M = 2q_e \tag{6}$$

where c is the velocity of light and q_e is the basic unity of charge for a single proton.

1.2.2 Stable particles as interacting systems of Bp's

In this section, we limit ourselves to stable particles, specifically the neutron, the proton, the electron, and the photon. The primary reason is that stable structures have an equilibrium state and are therefore easier to analyze than non-stable structures. Although we thus concentrate on stable particles, the explanatory capabilities of BPO extend to unstable particles in principle also. Currently, BPO contains two "Stable Asymmetric Configurations (SAC)", one of which is quite promising and is described in this article. Extensions of the theory could be made, describing "Semi-Stable Asymmetric Configurations" which describe the behavior of less stable particles with shorter lifetime like the muon.

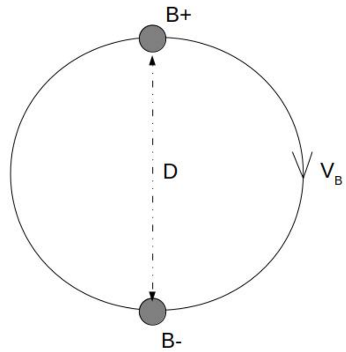

Figure 2. a neutral particle

To prove that interacting Bp's can form stable particles, we must conform to several principles. The first is that Bp's are in a constant motion. For them to become local, like a particle, they must interact in such a manner, that each Bp revolves around a local point in space. The second principle is that the dimensions of the formed particles must follow a fundamental trend in experimental data, namely that mass and size of particles are inverse proportional as suggested by M. Planck (1901), who theorized that heat radiation could be considered as an oscillator that has an energy that was proportional to its frequency, and so inverse proportional to its wavelength in case of a moving oscillator. In this section we will focus on these two principles (later, in section 4, we will also show that BPO conforms to other particle-properties).

The best candidate to start our modeling is a neutral particle since it has no net electrostatic charge. Thus, if such a particle is composed of Bp's, it must be composed of just as many B+ as B-. In such a case, the first and most simple structure to be considered is composed of only one B+ and only one B-. These considerations lead us to depict a neutral particle as in figure 2:

The velocities of the two unlike Bp's in this particle are in an opposite direction. Although the exact properties of the B-vector are not included in this paper for reasons of brevity, the vector $\vec{B}$ in equation 2 has, in these circumstances, a length of exactly one and points exactly in the direction of the other Bp. This means that vector $\vec{B}$ can be taken out of equation 2 altogether. This in turn enables us to treat this basic particle as a simple equilibrium of forces, namely of the attractive force between the two Bp's against the centrifugal force:

$$\frac{\frac{1}{2}I_P V_B^2}{\frac{1}{2}D} = \frac{\mu_0}{4\pi}\frac{M_+V_+M_-V_-}{D^2} \tag{7}$$

D is the diameter of the particle. On the left side of this equation is the centrifugal force and on the right side is the Basic force. Since we are dealing with a Bp and not a mass, we use I_P as a measure of the basic inertia of its Bp's (instead of its mass). And, if both Bp's have the same inertia, each Bp carries half the inertia of the particle, hence the ½ I_P. Now, in order to arrive at a particle diameter that is inverse proportional to its mass, we must accept that the value of M of a single Bp remains stable with an increase of its inertia, because only then can we consider most part of the equation to be a constant. Given this, we can define a constant k as:

$$k = \frac{\mu_0}{4\pi}\frac{M_+V_+M_-V_-}{V_B^2} = \frac{\mu_0}{4\pi}M_+M_- = 1{,}02679029910^{-44}(kg*m) \tag{8}$$

Substitution of k in equation 5 and some simplification gives:

$$I_P D = k \tag{9}$$

This simple equation shows that we can build particles from Bp's that have diameters that are "in principle" inverse proportional to their inertia (and, subsequently, to their mass or energy).

If this is correct, we must accept that nature is constructed so that every Bp, no matter its inertia, has a basic mutuality of M_B. Intuitively, this would be like a mouse making as much noise as an elephant, or a tiny seahorse displacing as much water as a huge whale. Even worse, the same principle applies to Bp's that have infinitesimally small inertia, making the conclusion even more difficult to conceive. For this reason, it seems likely that there is some threshold value for a Bp to attain basic mutuality. If so, a photon can only be constructed of Bp's if it has a minimum frequency (or maximum wavelength). Larger wavelengths are then merely fluctuations in interactions between larger groups of particles, creating a sharp distinction between radio frequencies and light.

Next, we consider a model of the proton by considering the decay of the most prominent neutral particle, the neutron. An isolated neutron has a halftime of around 11 minutes, and decays mainly into two oppositely charged particles (i.e. proton and electron), via a process known as Beta decay. Due to the ultimate simplicity of our basic particle model, we must rely on an additional speculative process in nature to explain how charged particles can emerge out of the decay of a neutral particle. The only process we can imagine is that the B+ of the neutron splits in two Bp's, generating a surplus of mutuality, thereby creating a charged proton. Out of the hubris of this process, the electron emerges, with a similar surplus structure as the proton. Given the previous reasoning, the proton and the electron can be depicted as the structures in figure 3:

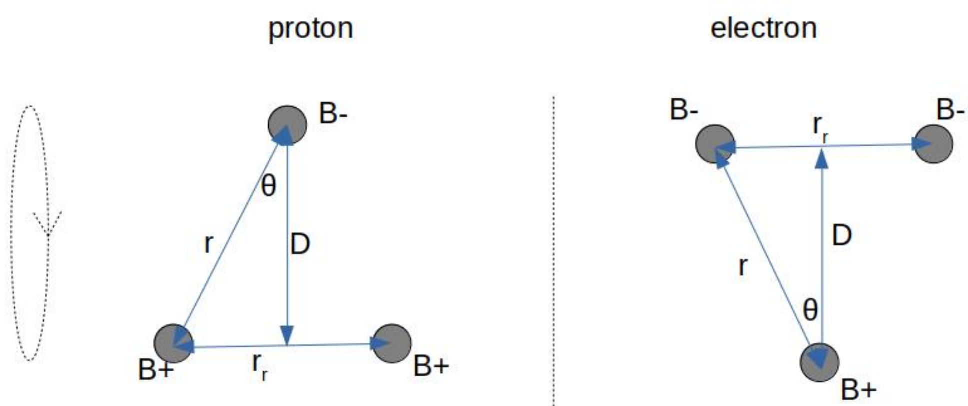

Figure 3. charged particles

The convention here is that the B- move out of the paper and the B+ move into the paper. So, an observer at the left sees a right-hand rotation. The proton has a net mutuality of M+ and the electron has a net mutuality of M-. These net mutualities cause these particles to be "charged". How this dynamic mutuality of a Bp leads to a static charge of the particle is explained in section 1.2.5 and 1.2.6. Also note that, in the proton, the B+ has half the inertia of the B-, as it is the result of a split of a heavier Bp. The same is the case for the electron, where the B- has half the inertia of its opposing Bp. Equilibria of charged particles can be calculated in a manner, slightly more difficult than for neutral particles. For brevity reasons, these calculations are not included in this paper.

The last stable particle to be modeled is the photon. We propose that the photon is a neutral particle with a relatively small inertia. To show the motion pattern of a photon, we must look at its three known polarization forms. Two of these polarizations can be considered as more basic. These are depicted below.

We can describe a linear polarized photon as in figure 4:

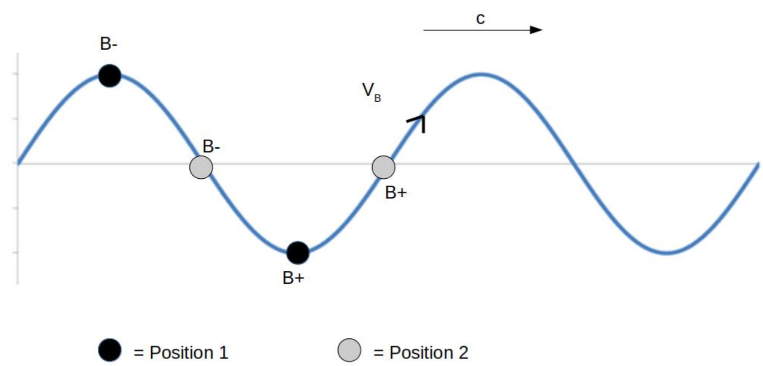

Figure 4. linear polarization of a photon

In this polarization, the Bp's are exactly half a wavelength apart. The angle α between their two velocity vectors is at a maximum at position 2. It can be shown, via equation 4, that the basic force maintains a curved trajectory in a plane for both Bp's, as long as this angle α does not exceed 90 degrees.

A circular polarized photon is, per definition, a photon of which the Bp's are 0 degrees apart, such as in figure 5:

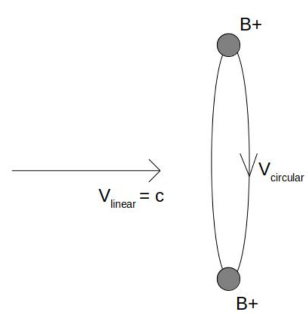

Figure 5. circular polarization of a photon

In this movement pattern, stability is maintained by an orbital plane that is perpendicular to the direction of motion of the photon. The circular motion can be either right-handed or left-handed, explaining the so called "spin states" of the photon.

A third polarization, elliptical polarization, occurs at any position in between these two more basic polarizations (i.e. where Bp's are moving more than 0 degrees and less than 180 degrees apart). An elliptical polarization is thus a combination of both movement patterns (linear and circular).

Of those three polarizations, the circular one has the simplest symmetry and can therefore be more easily modeled in simple mathematical terms. From figure 5, with help of the Pythagorean theorem, we calculated:

$$V_c^2 = V_B^2 - V_l^2 \tag{10}$$

Where V_c is the circular velocity, V_B the absolute velocity, and V_l the linear velocity. Similar as with the neutron, we can now try to find an equilibrium. This equilibrium is where the two forces are in balance, namely an attracting force working on B+ and B- as a result of two components of velocity (linear and circular) and a centrifugal force as generated only by the circular velocity. This can be formalized as follows:

$$\frac{\frac{1}{2} I_P V_c^2}{\frac{1}{2} D} = \frac{\mu_0}{4\pi} \left(\frac{M_+ V_l M_- V_l}{D^2} + \frac{M_+ V_c M_- V_c}{D^2} \right) \tag{11}$$

Note that we once more use ½ I_P instead of I_P. This is because the particle consists of two Bp's, each of which can be considered to carry half of its inertia. Inserting 10 in 11 and using the constant k again yields:

$$I_P V_c^2 D = \frac{\mu_0}{4\pi} M_+ M_- (V_B^2 - V_c^2 + V_c^2) = k V_B^2 \tag{12}$$

If we bring some left side variables to the right side, a simple equation for the diameter can be obtained:

$$D = \frac{k}{I_P} \frac{V_B^2}{V_c^2} \tag{13}$$

or

$$\frac{D I_P}{k} = \frac{V_B^2}{V_c^2} \tag{14}$$

The number at the right side of the equation can now be considered as an attenuation of the size of the diameter of the photon, relative to the size of a standard neutral particle of same inertia as in figure 2. Therefore, we call this the Relative Configuration Size (RCS) of the specific particle type.

Equation 14, however, does not give a clue as to what the optimum circular velocity should be, since the diameter of the particle simply grows to infinity as the circular velocity goes to zero. An optimum could have explained why the linear velocity c is a specific portion of the absolute velocity V_B. Without an upper limit to the velocity of the photon, however, the linear velocity of the photon would approach V_B, which is roughly 12 percent above the velocity of light. Yet from observation we know that this cannot be the case. BPO is therefore not closer to explaining why the speed of light is precisely c than any other theory is. Without such an explanation, we should probably accept the experimental fact that such an upper boundary to the velocity of a system of Bp's exists, and that the dimensions of such a system follow from that limitation. Consequently, by inserting the value of V_B, we obtain an RCS for the circular polarized photon:

$$\frac{D I_P}{k} = \frac{V_B^2}{V_c^2} = \frac{V_B^2}{(V_B^2 - c^2)} = 5 \tag{15}$$

Also note that:

$$\frac{c}{V_c} = 2 \tag{16}$$

It is tempting to believe that there is some physical significance to this ratio. For instance, that there is some sort of optimum after all that makes the velocity of light be exactly two times the circular velocity of a photon. Perhaps future extensions of this theory will shed some light on this issue.

We will now use this model to calibrate basic inertia against mass. To accomplish this, we take the mass equivalent of a photon with an arbitrary λ value of 1 nanometer and use the Planck constant h to attain its energy value $E = hc/\lambda$. Under the assumption of mass-energy equivalence we can obtain the mass of the photon by $m = E/c^2$. Such a photon has a mass of:

$$m_p = 2,210219057 \; 10^{33} kg. \tag{17}$$

If we bring that mass value into equation 15 as a value for I_B, we receive a value for D of:

$$D_{calculated} = 2,32282473 \; 10^{-11} m. \tag{18}$$

Because mass m is used instead of the I_B, we have now found the diameter of the photon on the assumption that $I_B = m$. Based on elementary spatial considerations on the schematic photon of figure 6 however, we find for the diameter:

$$D = 2 \frac{\lambda}{\pi} \frac{V_c}{V_l}. \tag{19}$$

Note that this also means that $\lambda = \pi D$ for all photons. And, because we used a photon with a wavelength of 1 nm, this yields the following reference value for D:

$$D_{reference} = 3,18309886 \; 10^{-10} m \tag{20}$$

The ratio between the reference diameter and the calculated one is then:

$$D_{reference}/D_{calculated} = 13,7035688 \tag{21}$$

This means that we have established the ratio between the inertia of a Bp and that of normal mass:

$$m = 13,7035688 \ I_B \tag{22}$$

Or, put differently: by becoming part of a particle, a Bp obtains a mass of about 13,7 times its inertia. We are not sure if this is meaningful but we would like to mention, as a striking coincidence, that this number is exactly a tenth of the inverse of the fine structure constant. Even more curious, the multiplication of all three relevant ratios of the photon leads us to exactly the inverse of the fine structure constant.

$$RCS\frac{V_l}{V_c}\frac{m}{I_B} = 137,035688 \tag{23}$$

If we now introduce a constant K, such that K = k * 13,7035688 we can rewrite equation 9 as:

$$mD = K = 1,40706915 \ 10^{-43}(kg * m) \tag{24}$$

Consequently, the RCS of equation 15 can now also be written as:

$$RCS = \frac{DI_P}{k} = \frac{Dm}{K} \tag{25}$$

We now have a general relation between mass and diameter of a particle, which also considers a particles' specific configuration.

1.2.3 Merging and splitting of Bp's

In the former subparagraph, protons are regarded to emerge from a split of one of the two Bp's in the neutron. The reason for this is that, if no such merging and splitting would occur, we could not explain – within the confines of the basic statements – the decay of a neutron into charged particles, notably the proton. In effect, merging and splitting is simply a derivative (or consequence) of the fourth basic statement (i.e. the interaction law).

Consequently, Bp's of like mutuality (e.g. two B+) can merge. Such merging has several implications. For example, given that inertia of a Bp is a measure of its size, a merged Bp carries the inertia of both original Bp's before merging. Or, conversely, if Bp's split, the combined inertia of the split Bp's equals the inertia of the original Bp before splitting. This can also be regarded as a conservation principle, namely of inertia.

The mechanism behind merging and splitting is yet unknown. Possibly, however, splitting could be caused by vibration. In such a case, the neutron would start moving in a photon configuration, while its B+ moves at a velocity well below the velocity of light. Consequentially, the system will become unstable and start to vibrate, not having a stable center of mass anymore, and eventually leading to the splitting of Bp's.

1.2.4 A fundamental asymmetry in particles

Above, several particles are modeled. All of these have B+ and B- in perfect symmetry. Empirical results, however, demand an asymmetry between opposing Bp's in a particle. To illustrate, the models above have the following empirical flaws:

- gyro-factors (g_p) are not in line with experimental data. The proton for example, having a net mutuality of $2q_e$, would show a gyro-factor of 2 instead of its experimentally established value of about 5.6. The neutron, having no net mutuality, would show a gyro-factor of 0 instead of the experimental value of about -3,8.
- diameters are a factor 2 or 3 too small compared to experimental data.
- some observed interactions between particles are not explained, such as how a neutron is able to bind two repulsing protons in a nucleus.

Additionally, the particle models above also have a theoretical imperfection, which is that these models give no mechanism for particle instability and splitting and merging behavior.

Fortunately, all these shortcomings can be remedied by postulating an asymmetry between B+ and B-. BPO allows for several stable asymmetrical configurations (SAC's). Two of these have been formalized, of which one, abbreviated as SAC2, closely approximates experimental data. To understand the asymmetry of SAC2, we must compare an isolated Bp with interacting Bp's inside a particle. To do so, we could define the attributes in isolation as I_B, V_B and M_B, and define the attributes in interaction as I_A, V_A and M_A (the A means asymmetrical). We can now define a variable β, such that

$$\beta = Rm \tag{26}$$

where m is the mass of the particle and R is a universal constant, defining the slope of the linear dependency of β on the particles mass. We can now define a variable α such that:

$$(\alpha_+ = 1+\beta) \;\; for\ B+ \;\; and \;\; (\alpha_- = \frac{1}{1+\beta}) \;\; for\ B- \tag{27}$$

The asymmetry of a Bp can now be defined as:

$$V_A = \alpha V_B \tag{28}$$

and

$$M_A = \frac{M_B}{\alpha} \tag{29}$$

Through this form of asymmetry, β can have any value and therefore allow for any amount of asymmetry, whereas the basic interaction with another Bp remains of the same strength, as the product MV remains the same under any value of β. This is in line with experimental data. Such an asymmetry does have an issue, however. Namely, the center of the particles' mass would not coincide with the particles' geometrical center anymore, which would render the particle unstable. To remedy this issue, we postulate that, within particles, inertia is redistributed over its Bp's, in a manner dependent on the α-value. For a particle **composed of two Bp's**, this can be formalized as:

$$I_A = \frac{I_B}{\alpha} \tag{30}$$

and

$$m_A = \frac{1}{2\alpha^2} m_p \tag{31}$$

in which m_P is the mass of the entire particle.

Equation 31 makes sure that the mass of a particle m_P is constant under any asymmetry in inertia distribution inside the particle. Otherwise, a particle's mass would partially disappear due to the inertia redistribution. This also means that the ratio of inertia against mass is not a universal constant. Instead, the ratio depends on the asymmetry of the particle, and this in turn depends on the mass of the particle itself.

To see what this asymmetry entails, consider some resulting quantities. Assuming that the gyro-magnetic properties of the neutron are entirely caused by the asymmetry law, we can obtain the value of α for the neutron: 0,4268830. This value implies that the B- of the neutron travels at an orbit-diameter and velocity of more than five times the B+. This makes the neutron – despite being neutral - highly negative at close proximity. Moreover, given that the mass of the neutron is known, we can obtain the universal constant R – using equation 26 - at a value of $1,603129 * 10^{27} kg^{-1}$. With the use of this R-value, and in case the particle mass is known, the α-values for any other Bp in a particle can be calculated.

To summarize the effects of asymmetry on a Bp's attributes: a) with a Bp's increasing velocity, the velocity of the opposing Bp decreases proportionally, and vice versa, and b) with its increasing velocity, a Bp's mutuality and inertia decrease proportionally, and vice versa. Following sections will further show the effects of this asymmetry.

1.2.5 How the forces of nature emerge from the basic interaction

Newton defined the forces of nature for the purpose of quantifying interaction. He equated a force with the slope in the change of an impulse (Now known as dp/dt). This means that more force causes more change in (patterns of) motion. Following this example, the basic interaction between two Bp's can be quantified as a force, using equation 4. In this subsection, the aim is to show that the forces of nature – electrostatic force, electrodynamic force, strong interaction, weak interaction, gravity – emerge from that same basic interaction, namely as interaction between systems of Bp's.

The electrostatic force is a semi-static force, an average of a multitude of dynamic interactions. To understand this dynamic, we assume – as proposed before – that charged particles are composed of three Bp's. Two of these Bp's have a net mutuality of zero Coulomb, given that they cancel each other. Let us next call the third Bp the "surplus Bp", which moves in an orbital motion, of which the orbital plane represents its spin orientation. Now, if we assume that this spin orientation is unstable (i.e. randomly varies over time), then the third Bp's motion will be confined to a small space, while also having a random direction of motion. This random motion allows us to consider a statistic average over time of all interaction between two of such Bp's in two different charged particles. That resulting statistical average is the electrostatic interaction, also known as the static Coulomb force between two charges. In paragraph 1.2.6, we derive, from this process, the strength of the basic mutuality and the magnitude of the basic velocity.

The electrodynamic force is a macroscopic manifestation of the basic force, under the conditions that systems of Bp's move at low velocities. To show how this force emerges, we can use a two-dimensional representation of the basic force, and imagine a charged particle q_2 to act upon a charged particle q_1 as follows:

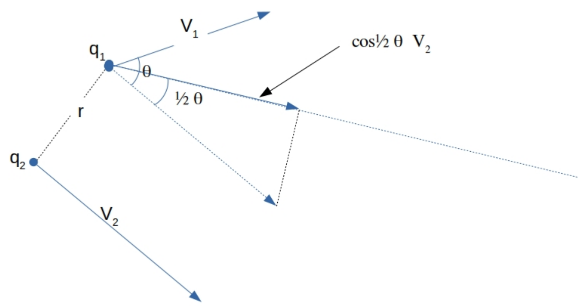

Figure 6. two moving charges

Two physical processes are happening simultaneously. The first is that Bp's in the particle can be regarded as moving with a velocity v instead of the basic velocity (V_B). In the specific situation of figure 6, and if we consider the angle between r and V_2 to be 90 degrees, the vector $\vec{B}$ in equation 2 reduces to a $-cos\theta$. The magnitude of the basic force F_P of q_2, acted on q_1 then depends on the angle θ in the following manner:

$$F_P = \frac{-P'}{r^2 cos\theta} \tag{32}$$

Here we use the constant P' instead of P as in equation 3 and 4, as in this case, the velocities of the particles are far smaller than the basic velocity.

The second physical process is a velocity differential inside the particle. Its Bp's have a higher velocity in reversed direction ($V_B + v$) and a lower velocity in forward direction ($V_B - v$). Therefore, there is a velocity differential of $2v$. This differential will create a "torque" on the particle, the magnitude of which is twice the magnitude of the dynamic interaction between the two particles, as the velocity differential is twice the size of the velocity itself. The dependency of that torque on the angle θ, however, differs from that of the basic force. To illustrate, if we have two vectors for V_1 and V_2 as in the picture, then the magnitude of the resulting torque would be:

$$F_T = 2\frac{P'}{r^2} cos^2 \frac{1}{2}\theta \tag{33}$$

Since $2cos^2 \frac{1}{2}\theta = 1 + cos\theta$, the addition of F_P and F_T renders:

$$-cos\theta + 1 + cos\theta = 1 \tag{34}$$

This unity result shows that the magnitude of the force of particle 1 acted upon particle 2 is independent of the angle θ. This means that this force is always of the same magnitude and always perpendicular to its velocity vector. Since the electrodynamic interaction as described by Ampère shows the same behavior. we can conclude that the electromagnetic force emerges as an interaction between (semi static) systems of Bp's.

Strong interaction is not an independent force in BPO. The attraction of particles on short distances, as in a nucleus, is a direct local manifestation of the basic force. Put differently, the basic force is a nuclear force of which the effects are not limited to local interactions.

To show how this works, we should look at the birth of strong interaction. The reason for its invocation was the need to explain the existence of nuclei with more than one proton. Namely, an attraction between neutron and proton – the strong interaction – should be able to overcome the repulsive electrostatic force between protons. However, such an attraction would only work over short distances and could therefore not be detected on a macroscopic scale, or on any scale outside the nucleus. Therefore, strong interaction – while being consistent with the behavior of atomic nuclei – is impervious to empirical investigation.

BPO simply does not need such an extra force, as the maximum basic interaction between two Bp's is already 5 times stronger than the electrostatic force (see section 1.2.6). This means that the effects of the basic force at sub-nuclear distances are of the same magnitude as the strong nuclear force, rendering the nuclear force obsolete. To solidify this claim, consider that, in BPO, the B- of a neutron has an orbit that is about 5 times the size of its B+ (due to the asymmetry law). This means that the neutron is neutral from large distance, but nonetheless highly negatively charged at close range, and could thus act as a binding intermediary between protons. To get a feeling for the magnitude of forces, let us imagine we have a proton and a neutron that are $8 * 10^{-16}$ meter apart. That distance is about the size of a proton. Next, imagine a Bp that is part of the proton, traveling at its outskirt, interacting with a Bp that travels at the outskirt of the neutron, with a force of about 1800 Newton. Now, if there would be two Bp's traveling at that outer range of proton and neutron, then their mutual interaction would be eight-fold, giving us a force of 15 kN. This brings us in range of the maximum value of the nuclear force, which is roughly 25 kN, as computed by Reid (1968), based on the so-called Reid potential. Thereby we have a model explaining the phenomenon of strong interaction without requiring the ontological entity of the strong interaction (i.e. nuclear force) itself.

Weak interaction is, as the strong interaction, not an independent force in BPO. As a force, it explains decay of particles. According to BPO, such decay is the result of the asymmetry law. The mechanism behind this, is that decay occurs when a neutral particle, with a mass above a certain threshold, transits from a local movement pattern into the movement pattern of a photon (see section 4). According to the asymmetry law (equations 27-31), the velocity of the most inert Bp in a particle will decrease as the mass of the particle increases. At a specific particle-mass – calculated to be $1,47254547 * 10^{-28}$ kg – the velocity of this slowest Bp will decrease below the velocity of light. Therefore, the particle cannot maintain its internal structure in a photonic movement pattern and will become unstable. This instability thus causes decay, making weak interaction superfluous. To illustrate the meaning of the calculated mass threshold, we mention that it is about 9,2 times the mass of an electron and about 8,8 percent of the mass of a proton. This shows for example that light can exist that has a mass-equivalence of its energy that is more than two times the electron-mass. Blacket (1933) showed that light of such energy content can become unstable in the vicinity of a nucleus, thus producing an electron and an anti-electron.

Gravitation is an effect of asymmetry (see paragraph 1.2.4). As described earlier, Bp's have an intrinsic velocity above c. From observation, energy particles travel at c, whereas massive particles are at (relative) rest. We therefore assume that gravitation emerges as a (residual) effect of localization of Bp's.

To illustrate, consider a first localized Bp (like in a particle) to move against a second (set of) Bp's. Because the Bp is not a static object but a dynamic phenomenon, having intrinsic velocity, intermittent time intervals of attraction and repulsion will occur. And, despite the statistical mean effect of attraction and repulsion normally being zero, a slight asymmetry in time intervals of repulsion and attraction could possibly persist due to the asymmetry law. This asymmetry would be enough to cause gravitation as a residual force.

To solidify this claim, we quantify this mechanism. Equation 2 shows that the force of one Bp acting upon another strongly depends on the product of its basic mutuality and its basic velocity $M_B V_B$. From the behavior of particles, we concluded that strong asymmetries between Bp's can exist within a particle. The law of asymmetry (equations 27-31) ensures that the actual product MV remains a constant under this asymmetry (i.e. $M_B V_B = MV$). However, if the Bp is temporarily affected by another Bp outside of the particle, then the Bp is temporarily forced into disequilibrium, which could briefly deviate MV from $M_B V_B$. In case this effect would exist during intervals of attraction and not (or to a lesser extent) during intervals of repulsion, gravitation emerges as a residual effect. To make this more concrete, we calculated that for a single Bp, with the mass of about a proton, the actual product MV would only have to rise a factor of about $3\ 10^{-37}$ above $M_B V_B$ in order to explain how it gravitates towards an object of one kg at a distance of one meter.

Note that this form of gravitation seamlessly accommodates the theory of general relativity. The mutuality of a first Bp can be regarded as to create a "tensor" in the specific part of space where a second Bp resides and the increase in the product MV of that second Bp could be considered as induced by that tensor.

1.2.6 using the electrostatic force to calibrate basic velocity and basic mutuality

Now that we have shown how the forces of nature emerge out of the basic force, we have an opportunity to deduce the strength of the basic force from the strength of one of these forces. We have chosen the electrostatic charge for this due to its well-known empirical characteristics.

To achieve this deduction, let us consider two charged particles as in figure 1. For each particle, the interaction of two unlike Bp's cancel each other. The remaining third Bp interacts with another Bp in a second charged particle according to equation 4. The velocities of these Bp's are random for any given moment. In this situation, considerations of symmetry show that the average direction of vector $\vec{B}$ is either towards or away from the opposing Bp (so not in a tangential direction). An analytical method might be available to calculate the average length of vector $\vec{B}$ (in equation 4), but since such an analytical method lies outside of the competence of the authors of this article, instead, a statistical approach has been conducted by calculating the mean force out of a series of force-values, generated at randomly chosen orientations of two Bp's in space (see mgpt.vitha.nl/mgpt.ods for details).

With this method, the average force on a Bp has been calculated for a multitude of samples of random v_1 and v_2 directions (see figure 1). It turns out that the average length of the B vector gets closer to 0,2 as the number of samples grows. We can therefore conclude:

$$F_B = 5F_q \tag{35}$$

Where F_B is the maximum basic (dynamic) force between two Bp's at a specific distance, and F_q is the (semi) static force between two charged particles with charge q at that same distance.

We can now work towards a calibration if we regard F_B/F_q as an amplitude ratio. We could then compare this ratio with another ratio R, namely between the electromagnetic force (F_D) and the electrostatic force (F_S) $(R = F_D/F_S)$. Under the assumption that we have two charges, Q_1 and Q_2 as in figure 1, moving in the same direction, simple calculus reduces this ratio to:

$$R = \frac{v_1}{c}\frac{v_2}{c} \tag{36}$$

This means that two Bp's moving in the same uniform direction, must have the same elementary charge and a velocity of c to produce the static force, as only then, the ratio of these forces equals one. However, as previously shown, the actual Bp does not move in uniform direction. The randomness of its movements amount to an amplitude-ratio of 5. Consequently, the basic force must be 5 times stronger than a normal electromagnetic force. Otherwise, the Bp will be unable to produce a static force. The Bp's charge is thus bigger than e and its velocity exceeds c. This can also be written as:

$$F = \frac{\mu_0}{4\pi}\frac{q_1 q_2 c_1 c_2}{r^2}5 \tag{37}$$

Apart from the number 5, this equation is the classical formulation of the strength of the electrodynamic interaction between two objects with charge q and velocity c. Since there are no other factors influencing the strength of the force, we need to disperse that factor of 5 over the available charges and velocities. Unfortunately, this theoretical framework does not give a direct clue as to how this factor should be dispersed over the charge and velocity. Reality does give a hint, however. Namely, we can explain why the so-called g-factor of a Dirac particle is exactly the number of two, in case of $M_B = 2q_e$ (section 2.2 explains more about this argument). This consideration can be formalized as follows:

$$F = \frac{\mu_0}{4\pi}\frac{2q_1 2q_2\sqrt{1,25}c_1\sqrt{1,25}c_2}{r^2} = \frac{\mu_0}{4\pi}\frac{M_1 M_2 V_1 V_2}{r^2} \tag{38}$$

Note that $2*2*\sqrt{1,25}*\sqrt{1,25} = 5$, so this covers for the total amplitude ratio. Therefore, we have:

$$basic\ velocity\ V_B = 1,1180340c \tag{39}$$

$$basic\ mutuality\ M = 2q_e \tag{40}$$

where c is the velocity of light and q_e is the basic unity of charge for a single proton.

1.3 Preliminary atomic model.

Below follows only a first outline of the atomic model. Future versions of BPO could extend upon these ideas.

To start thinking about a BPO-atom, let us consider the hydrogen atom to be constructed of a proton and an electron, like those in figure 3. In BPO, the electron is about 1210 times as big as the proton. The proton is nonetheless about 1836 times as massive. This means that in case both particles were to revolve around a common center of mass, then that center would be comparatively close to the proton. For practical purposes, we will therefore ignore the motion of the proton and regard it as fixed. This means we have an almost entirely classical model of the atom. Classical models, as well as quantum models, however, do not explain why the electron would perform such an orbital motion. BPO, by contrast, gives a precise physical process for this motion. In BPO, the electron has a diameter of about 0,2 percent of the radius of a Bohr hydrogen atom. This means that the basic force will act significantly stronger on the side of the electron that is closest to the proton, compared to the other side. This difference causes the electron to move in a direction perpendicular to the radius of the atom. If we now assume that the velocity of this orbital motion depends linearly on this force differential, some spatial considerations lead us to the following approximation:

$$V_o = \frac{N}{r2} \tag{41}$$

Here V_o is the orbital velocity, N is a constant and r is the atom radius.

Furthermore, classical models argue that a charged particle like an electron cannot perform an orbital motion without doing work, since the electron must then be considered to continuously accelerate towards the proton. In BPO, the electron need not always fully be treated like a charged particle. In BPO, a classic charge emerges out of a statistical average over random interactions of Bp's. However, an electron with a fixed spin orientation, with respect to its orbital plane, does not have equally random interactions, and can therefore not be considered as a classical charge. This renders the claim that an electron performs work while orbiting invalid.

So, in effect, the model we propose is a quasi-classical model. To establish this model, we must verify whether such a model can explain the process of absorption of light, since it is this process that led to the first valid atomic models (e.g. Rutherfort model and Bohr model). To this end, we postulate that photons are not absorbed by the electron, but by the atom. To picture this absorption process, consider a circular photon of light, as in figure 5, composed of a B+ and a B-, approaching a hydrogen atom. If the frequency of rotation of this photon matches the orbital frequency of the electron, then a consistent interaction between the photon and the atom occurs. Photon and atom could be aligned so that the B+ of the photon is closest to the electron of the atom, and the B- of the photon is closest to the proton. In that case, the radius of the light photon, being much bigger than the atom, will decrease its radius, whereas the radius of the atom increases. Since the inertia of the atom parts are much bigger than of the photon, this effect will mostly be in the photon. Finally, at the end of this process, as the diameter of the photon has shrunk to the radius of the atom, the B- of the photon will be so close to the proton that it can merge with the proton's B-, whereas the B+ of the photon will merge with the B+ of the electron. Since the photon frequency as absorbed by a hydrogen atom is precisely known, and since the charge and mass of proton and electron are well known, we can calculate the radius of the hydrogen atom. Namely, if we assume an equilibrium of centrifugal force and Coulomb force in a classical model with classical charges, then we can find, after some calculations:

$$r^3 f^2 = Z\ 6,41557 \tag{42}$$

Where r is the radius of the atom, f is the orbital frequency and Z is the number of protons in the atom core. In PBO however, the electron does not always behave like a classical charge. We calculated the interaction between a proton and an electron with their spins aligned in a common plane, using the same method as in the former paragraph, leading to equation 35. It turned out that the interaction is then at a strength of 5/6 times the interaction between standard charges. This means that we have to alter equation 42 to

$$r^3 f^2 = Z\ 5,34631 \tag{43}$$

Given that the absorbed photon has a frequency of 2,4661 10^{15} Hz, the radius of the hydrogen atom (before absorption) will be 9,57960 10^{-11} meter, which is 1,81028 times the Bohr radius for the Hydrogen atom.

2 Explanatory Fertility

This section discusses novel explanatory aspects of BPO. These novelties are categorized into three parts: i) a novel conceptual framework, ii) the explanation of particle structure and behavior, and iii) an amalgam of additional novelties (e.g. atom behavior). While these novelties need not be exhaustive, they do give a sufficient indication of BPO's explanatory fertility.

2.1 A novel conceptual Framework

1.Phenomenal Objects. Physicists currently tend to see the relations between entities and phenomena as follows: phenomena arise out of interaction between relatively passive fundamental entities. For example, a particle can have a potential field around it, but that only results in a dynamic phenomenon in case this field intermingles with the potential field of another particle. Even in string theory, where a string could be regarded as an active resonating entity, a strings‘ position in space is only altered by its interaction with another string.

BPO differs sharply from this interpretation, by stating that fundamental entities are already phenomena, namely by having intrinsic velocity.

2.Stable Asymmetric Configurations. A second dominant feature of contemporary physics is the meaning given to symmetry: new particles are expected to be found solely on the basis of symmetry requirements. For example, if a new particle of matter is found, it is automatically assumed that there is a corresponding anti-matter particle to be found, and if not found, it is theorized for the neutrino, as an example, that it is its own anti-particle (Majorana, 1937). Otherwise, the symmetry would be "broken".

BPO turns this concept upside down by showing that not symmetry but asymmetry is fundamental to the emergence of a plurality in particles. Without this asymmetry, only photons could exist and matter would thus not arise. BPO does so by introducing Stable Asymmetric Configurations of Bp’s (SAC), allowing for an asymmetrical distribution of basic velocity and basic mutuality over Bp’s in a particle.

3.Basic interaction. Another dominant feature of contemporary theories is that fundamental forces are considered to merge into a smaller amount of forces or even into a single force at higher energies. The reason this is believed is that force carrying W and Z bosons are essentially identical at an energy of 100 GeV. Some theorists therefore suppose that the weak and electromagnetic interactions are two low energy manifestations of a single high energy force (Georgi, and Glashow, 1972).

BPO introduces an entirely different concept, namely that there is only one basic interaction between basic entities and that all other known interactions (or the known natural forces) emerge out of that interaction at aggregated levels of reality (as interactions between systems of Bp’s). To be complete in our description, we again add, that this basic interaction does not need force-carrying particles, and as a consequence, none of its emergent interactions do.

4.Attribute affection. Natural theories have two traditional concepts for what constitutes an interaction between objects. The first is that objects interact by means of direct interaction at a distance. The second is that objects interact by means of space as an intermediary. Newtons law of gravitation, for example, uses the first concept, whereas Einstein’s general relativity uses the second one, by treating gravity as a potential field.

BPO offers a third and novel concept. Because we have introduced a “phenomenal object”, having an intrinsic velocity, interaction between such phenomenal objects can be restricted to a mutual affection of direction of motion. Thus, this third strategy could be formulated as: “objects interact by mutually affecting their orientation in space” (or more general: phenomenal objects interact by mutual affections of phenomenal attribute(s)). To be sure, it can be argued that QM uses this same concept, albeit inconsistently. For example, QM states that spin is an intrinsic property. Two electrons, moving in the same atomic orbit would, according to the Pauli exclusion principle, have opposing spin, the one ½ and the other -½, creating two different “states” for these electrons. If we now assume that a physical process underlies the Pauli exclusion principle, then we can interpret spin ½ and -½ as opposing spin orientations in space, which allows these two electrons to mutually affect their respective spin orientation. Under this interpretation, one could say QM follows the third strategy. However, even granting QM does so, it does not do so consistently, as the same exclusion principle is not applied to bosons. This is where the novelty of BPO comes in, as it is the first theory to consistently apply the third concept to any type of interaction.

5.locality-indifference. Physical theories are currently bisected in two categories namely local and non-local that are considered mutually exclusive. Theories that allow for an entity to have an immediate effect upon a distant second entity are non-local and theories that need some form of messaging with limited velocity in between the two entities are called local. This categorization is considered fundamental (Edwards and Ballentine, 1976).

BPO asserts that, on the contrary, locality or non-locality are interchangeable viewpoints when it comes to a basic interaction between Bp’s. In a local variant, a Bp could have infinite dimensions and its spatial position would only be a center with some specific properties, creating a universe with overlapping Bp’s (like overlapping waves). In a non-local variant, the Bp could be a point particle, having an immediate affect on another point particle. The law of basic interaction works equally well for both variants. BPO calls this property of the basic interaction the locality-indifference. Important to note is that emergent interactions between systems of Bp’s could very well have a strict local or non-local character.

6.Non-relativity. A sixth fundamental innovation is closely related to the former concept and is about the origin of relativity. Normally, relativity is assumed to be a universal concept.

BPO however states that relativistic effects do not exist on the most basic level of reality and that they only occur at aggregated levels like matter and energy, which is where (systems of) basic entities interact.

2.2 Particle structure and behavior

In what follows there are seven explanatory novelties regarding particle structure and behavior.

Firstly, BPO offers a completely different model of particles. Namely, all particles, including the elusive electron and the photon are simple and straightforward systems of interacting Bp's (i.e. Bp's revolving around a common point in space, through their mutual interaction).

Secondly, BPO explains why heavier particles are smaller. The current view is that more mass means more energy, and that higher energy is associated with higher frequency (and thus shorter wavelength). By associating the wavelength of a particle with its size (as Bohr does), we obtain a correlation between size and mass. Yet this correlation is based on the idea that a particle can be regarded as a standing wave, and that waves with higher frequency carry more energy or mass. Such models have at least two downsides. The first is an unintuitive ontology, as a medium in which such a standing wave cycles, and how a waving entity is attached to the medium, is difficult to conceive. The second is ad-hocness, such as diverse interpretations of the electron-size, varying from a classical radius and the Bohr radius to the Compton Wavelength or Planck length. By contrast, BPO explains this universal trend in a simple and internally consistent manner, using a simple equilibrium equation (see equation 11 for the neutron and equation 17 for the photon).

Thirdly, BPO explains the genesis of particles. Current theories hold that particles are formed in some sort of energy soup, shortly after the big bang. However, no current theory contains a mechanism for how photons evolve into neutrinos, neutrinos into neutrons and how then a neutron splits into two charged particles. BPO does contain such a mechanism (as stated in section 1 on "merging and splitting of Bp's). The gist of this explanation is that energy particles can merge into heavier neutral particles. Such neutral particles (e.g. the neutron) can become unstable by an increased asymmetry, triggering a split of its slowest Bp, thereby creating a charged particle (i.e. the proton).

Fourthly, BPO explains why the proton has no decay. For this to be an explanation, it first needs to be established that it is indeed a fact that protons do not decay. The reason for this is that, contrarily to BPO, some Grand Unified Theories predict that the proton does have a decay-time. However, that prediction is not corroborated by the Super-Kamiokande project (see http://www-sk.icrr.u-tokyo.ac.jp/sk/sk/pdecay-e.html). In fact, the project implies the opposite (i.e. no decay time). Therefore, we pre-emptively assume that current findings will be upheld.

Given this assumption about no decay being an empirical fact, BPO can explain why that is the case. To see why, consider first the standard model. The standard model assumes conservation of Baryon number (Weyl, 1929; Stueckelberg, 1938; Wigner, 1949; Lee and Yang, 1950). Moreover, according to Sakharov (1966), a matter-antimatter asymmetry requires baryon number non-conservation. Therefore, if symmetry of matter-antimatter is assumed, the proton cannot decay, as that would violate baryon number conservation. BPO offers another explanation, namely that decay occurs when a particle transits from a local configuration into a photon configuration (moving with velocity of light). A neutron, for example, is not fundamentally hindered from making such a transit. It will therefore eventually do so (see section 1.2.2 on merging and splitting of Bp's). In contrast to the neutron, the proton has a specific structure, with three Bp's, that makes it impossible for the particle to transit into a photon configuration. Its Bp's cannot move in a common orbital plane like in a circular polarized photon, nor can they move in a phase shift, as in a linear polarized photon (see section 1.2.2). Through these inabilities, the proton has an inherent stability and cannot become unstable without external influences.

Fifthly, BPO explains why particles have an Electromagnetic moment (Me) and a Moment of Inertia (Mi) and, consequently, a gyro magnetic ratio (Me/Mi). To see why, consider that BPO assumes classical formulas for calculating the values of Me and Mi to be universally applicable, so also on the small scale of subatomic particles. Thus, the cyclic motion of a Bp around a common center of mass in a particle can – on this small scale – be treated as a spinning ring with an evenly distributed charge and mass. Simple classical solutions exist for calculating the Me and Mi for such a ring.

Sixthly, BPO explains why particles have gyro-factors. To see why, consider first the history of the gyro-factor. Based on classical arguments, if one knows the mass and charge of an object, then a fixed ratio between moment of inertia and electromagnetic moment is expected. Particles deviate from this expectation, however. An electron, for example, deviates from this expectation with a factor of about 2,00232. This number is known as the gyro-factor. Other particles have other gyro-factors. To explain this gyro-factor, Dirac depicted the behavior of the electron as a wave package under relativistic restrictions. Dirac thereby constructed the theoretical Dirac point particle, which has a gyro-factor of exactly two. BPO's solution is by contrast quite simple: the mutuality of a Bp is twice the amplitude of a charged particle, which gives us twice the expected gyro-magnetic ratio and, hence, a gyro-factor of two.

Yet that still leaves a gap between the value of 2 and the experimental value of 2,00232 for the electron's gyro-factor. QM solves this by introducing a field theory. In BPO, the asymmetry law bridges this gap. To illustrate, the electron's asymmetry is such that the orbital diameter and velocity of its negative Bp's are slightly bigger than that of its positive Bp, leading to an increase in the gyro-factor. This insight applies to all particles. This is especially remarkable for the neutron, since the neutron has no net charge, which has hitherto made its gyro-magnetic properties an enigma. Namely, in BPO, the neutron, being much heavier than the electron, has a far greater asymmetry than the electron, and its B- has therefore a far greater electromagnetic moment than its B+. This suffices to explain the gyro-factor of the neutron.

Seventhly, BPO explains why light (photons) have different states of polarization. Namely, whereas quantum mechanics must rely on a speculative process (i.e. "superposition of spin states") to explain these various polarizations, BPO only needs a simple phase shift in the travel of Bp's (see section 1.2.2).

2.3 Beyond the particle

Below follow three explanatory novelties for other various topics.

Firstly, BPO explains the existence of antimatter. Within BPO, particles have an internal asymmetry, which is quantified by the so called α-values of the particle. This asymmetry means, for example, that the B+ in a particle can be faster than the B-, or can have higher mutuality. Contemporary natural theories cannot explain why antimatter particles have opposite charge and spin orientation, while having the same mass, compared to ordinary matter. By contrast, BPO explains this by stating that antimatter-particles have the α-values for B+ and B- interchanged (showing an inverted asymmetry). A neutron with inverted α-values (anti-neutron), has its B- as the slowest Bp and thus it is the B- that will split in two, creating a particle with the same mass as a proton, having nonetheless a surplus of negative mutuality (and thus a negative charge). Furthermore, BPO's description of anti-matter also explains why matter and anti-matter annihilate during approach, which no other theory can do. Whereas a proton and an electron for example have mechanisms that cause them to not get intertwined with each other (tangential velocity of the electron). A proton and an anti-proton do not have such mechanisms, or in a lesser degree. A neutron and an anti-neutron, as another example, have opposing mutuality at their boundaries, creating a strong attraction at close distance. Thus, they will mingle, and stability is gone.

Secondly, BPO offers a radically new mechanism for electrons binding atoms into molecules or into crystalline structures. Currently, quantum models assign a momentum with corresponding energy levels to electrons, and this momentum then causes an orbital motion around the nucleus. Such models work fine for isolated atoms, but not for several atoms inside a molecule, as there is more than one nucleus in a molecule. To remedy this problem, Heitler and London (1927) constructed a valence bond model, in which a chemical bond is an overlap between atomic orbitals of participating atoms. This is where BPO's explanatory novelty comes in, as the preliminary atomic model in section 1.3 shows that there is no need for such an orbital overlap. Namely, BPO's atomic model is based on a natural tangential movement of the electron around a charged object, of which the velocity depends upon the distance to the nucleus and the magnitude of the charge. To reiterate the idea, if we place an electron amid two protons, there will be no differential of force between the one side of the electron versus the other side anymore. Thus, the electron will not show an orbital (tangential) velocity anymore. We can thus observe a hydrogen molecule with two electrons at rest in between of two protons, and see that absorption (of photons) has ceased.

Thirdly, BPO offers a radically new way of explaining static charge, namely as a statistic average of dynamic interactions, instead of a simple repulsion or attraction at a distance.

3 External Consistency

Theories compete, and competitors are often incompatible. Yet incumbent theories were often established for good reasons, mostly involving complex problems that needed solving. Therefore, it is the job of novel theories to show either where incumbent theories took a wrong turn, or how old phenomena can also be explained by the novel theory. This section primarily adopts the latter strategy, by focusing on the three most important seeming external inconsistencies with BPO: general relativity, quantum mechanics and the standard model. These are mentioned in turn, with the purpose of highlighting – and deflating the importance of – the inconsistencies. The claim is that some external inconsistencies are illusory, and that BPO saves all old important phenomena. (Note that theories that are obviously consistent with BPO are not mentioned here.)

Firstly, BPO assumes absolute space and time, which seems to contradict relativity (special and general). Yet this inconsistency is illusory. The reason is, very briefly, that Bp's operate in absolute space and time, whereas systems of Bp's (creating mass and energy) can show relativistic effects. To expand somewhat, BPO assumes that relativistic effects emerge only between objects that have mass, whereas a Bp does not yet have mass in its individual appearance. Only systems of interacting Bp's have mass. One relativistic effect is the proportional increase of (relativistic) mass with velocity. To show how BPO models such a relativistic mass, we must look at a particle composed of Bp's as a local system. The intrinsic velocities of its Bp's cause internal cyclic movements. We could call these the "circular velocities" of a particle. Meanwhile, the velocity of the system as a whole can be regarded as an average of all internal velocities of a Bp. System integrity of a particle is largely maintained by these circular velocities (see the law of basic interaction). A circular polarized photon, for example, has a circular velocity of exactly half its system velocity. Its behavior therefore differs from a particle at rest, as the latter particle has all its internal velocities in circular form. However, if the system velocity becomes a substantial part of internal velocity, then circular velocities of the particle will decline. Under such conditions, the centrifugal force of a Bp can only be maintained if its inertia is increased. A particle can increase its inertia by absorbing photons (=energy) from its environment. Thus, energy is transferred from the environment into a moving object, creating a relativistic effect of increased inertia of the Bp's, and, consequently, an increase in mass for the particle.

Secondly, there is an ancillary assumption in BPO, that the universe is deterministic, which appears to contradict the ontological interpretation of quantum mechanics (QM). Yet this contradiction is also predominantly illusory. To see why, consider that BPO and QM share the same assumption of mass and energy entities behaving like both a particle and a wave simultaneously. In QM, this duality is solved by interpreting the change from wave to particle, and vice versa, as probabilistic. The relevant entity is sometimes wave and sometimes particle, and its position can therefore be probabilistically distributed over a spatial volume. This allows QM to explain the illumination pattern of the double-slit experiment, as particles interfere, like waves do, according to these probabilistic properties.

By contrast, BPO offers a different solution. For BPO, (moving) particles have wave properties due to the cyclic motion of its constituent Bp's. And, given that any force between separated entities can be depicted as a field potential, so can the basic force between Bp's. Furthermore, due to these cyclic motions of Bp's within the particle, such a field potential would show a wave patterns in the vicinity of a particle. Therefore, the interaction between two of such moving particles necessarily shows an interference pattern.

Thirdly, BPO in its entirety is largely incompatible with the standard model. We illustrate this by three key differences. Firstly, whereas the standard model models interaction as an interchange of particles between particles, BPO models all interaction between Bp's as a simple mutual affection of their direction of motion. Secondly, the standard model uses several kinds of quarks as building blocks of a specific type of particles (hadrons). BPO does not allow for such quarks, as all sub-particle entities are limited to Bp's. And thirdly, within the standard model, models have been developed, such as lattice QCD, that model the proton as not only composed of quarks, but also of several virtual particles (gluons and virtual quarks) that pulsate in and out of existence. The concepts of dark matter and dark energy are extensions of such virtual particle models. BPO once more only needs Bp's and does not need any of these virtual particles to adequately model the proton. To illustrate, the results of scattering experiments, now explained by virtual particles (moving in and out of existence) could just as well be explained by Bp's (moving in and out of a certain position inside a particle).

4 Empirical Accuracy

Empirical accuracy can generally be determined by looking at six major experimentally corroborated particle characteristics: charge, mass, decay, symmetry, size and shape, and electromagnetic properties. The claim is that BPO conforms to most of these and contradicts none. While this might not seem impressive, the ancillary claim is that empirical accuracy is better than competing theories, including the standard model, and that this empirical prowess is remarkable given BPO's infancy.

Firstly, BPO conforms exactly to experimentally confirmed charge values. Namely, any single Bp carries a mutuality of exactly two electron charges, either positive or negative. And, additionally, two unlike Bp's form a neutral particle, and three Bp's, of which two are of like polarity, form a charged particle with exactly one electron charge (positive or negative).

Secondly, BPO does not independently confirm the mass of particles, but does conform to its experimental values. We use these experimental values, as given by NIST, to calculate the asymmetry of the particle according to the asymmetry law. We then attribute mass to a single Bp within a particle as a measure for its inertia and as a basis for its moment of inertia. Through this we could calculate the dimensions of a particle.

Thirdly, BPO contains a decay mechanism, which shows that all (isolated) neutral particles above a minimum mass are unstable (see section 5). These findings are in line with experimentally established facts about the decay of particles (as modeled in this article). Exact decay time for a BPO-particle cannot yet be calculated but methods for its calculation could be discovered in the future.

Fourthly, the shape of a BPO electron is precisely symmetrical and will therefore not show a dipole moment. This coheres with the most recent results of the ACME EDM Experiment (2019). BPO gives a clear model, as depicted in figure 3, for the electron, The orbital motions of the Bp's inside an electron form perfectly round-and-thin rings. There are three of such rings in an electron. The two outer rings have negative mutualities, and are both at precisely the same distance from the inner ring, which has an opposite mutuality. Such a topology is perfectly symmetrical, and therefore empirically accurate.

Fifthly, scattering experiments provide results that are consistent with size and shape of BPO particles. To be sure, current empirical data about particle size is indeterminate. Only the size of the proton (as held by NIST) is reasonably undisputed due to extensive data of scattering experiments. That leaves the size of other particles undetermined. For example, estimations of the electron differ per theory: Compton (1919) calculated a diameter – based on x-ray and gamma-ray experiments - that is about 370 times the so called "theoretical diameter"; and quantum theory even goes beyond the Compton diameter, portraying the electron more like a wavy cloud which has the size of an atomic orbit. The same indeterminacy also applies to the shape of particles. Compton, for example, also deduces from his scattering data that the electron consists of a thin flexible ring, and that it must be subject to both rotation and translation. The BPO electron conforms to all these properties, as the electron is composed of three thin parallel flexible and fast rotating rings, and it also translates by orbiting around a nucleus. Yet Compton's empirical interpretations are not undisputed. Nonetheless, table 1 shows a result, achieved by calculating the sizes of several particles and comparing them with reference values:

Particle	$D_{reference}$ (in meters)	D_{max} (in meters)	$D_{max}/D_{reference}$
Cirucular photon (1nm)	3,18309 10^{-10}	3,18310 10^{-10}	1,00000
Neutron	8 10^{-16}	1,02633 10^{-16}	0,12829
Proton	8,4 10^{-16}	1,75769 10^{-16}	0,20925
Elektron	5,64 10^{-15}	2,12684 10^{-13}	37,7370
anti-proton	8,4 10^{-16}	1,75769 10^{-16}	0,20925
anti-electron	5,64 10^{-15}	2,12684 10^{-13}	37,7370

Table 1. Calculated Diameters of particles against reference values
All reference values in this table are from NIST. D stands for the diameter of the particle. In BPO, Bp's within a particle can have different orbital diameters. In this table, the biggest of them is given (D_{max}). A Bp's orbital size is calculated by calculating the RCS of the specific particle type, like in equation 15, then calculating the standard diameter on the basis of the particle mass with equation 25, and then multiplying the found diameter with the asymmetry of the Bp, using equations 26 and 27. A comparison is made with a reference diameter, as found in literature, as well as with the theorized size of the proton. For the reference value of the electron diameter, the so called "theoretical diameter" is chosen. For the photon, an arbitrary wavelength of 1 nm is chosen.

Interestingly, the diameter of the proton is only at about 21 percent of the diameter, currently held at NIST. This, however, is not an invalidation of BPO, as the mutuality of a Bp is twice the charge of a particle. Considering that a proton has two of these B+'s orbiting in a much wider orbit than it's singular B-, its diameter must be significantly smaller than conventional models predict to obtain similar experimental results. For similar reasons, we conclude that calculated diameters of neutron, photon and electron are also within the range of experimental verification. That is, if we regard the plausible empirical range of the electron to be in between the Compton diameter and the "theoretical diameter", then BPO falls in that range.

Sixthly, and lastly, the gyro magnetic ratio conforms well to experimental values. To show why, we first ignore the established values for electromagnetic moment and moment of inertia and only accept the gyro magnetic ratio as validation for a particle's electromagnetic properties. The reason for this is that we found that in all research of the last decades on this topic (e.g. Odom et al, 2006), the moment of inertia of a particle is treated as a multiple of the reduced Planck constant. Since the electromagnetic moment of a particle is derived from methods that depend on its moments of inertia, the electromagnetic moment itself depends on the reduced Planck constant. No research has been found that independently confirms the electromagnetic moment of a particle, through a method that does not depend on the reduced Planck constant. The same, however, cannot be said of the gyro magnetic ratio, as it can be deduced directly from measured Larmor frequencies. More about this argument can be found in the prediction section. This argument also led us to focus primarily on calculating the gyro-magnetic ratio of four stable particles and two of their anti-particles. The results are in table 2.

Table 2 shows that the accuracy of the least accurate gyro magnetic BPO particle, namely of the proton, is 4 percent. This is already 87 percentage points better than models based on quarks (Zweig, 1964) as quarks can only provide for about 9 percent of a proton's mass.

Particle	γ	$\gamma_{reference}$	$\gamma/\gamma_{reference}$	F (in Newton)
Cirucular photon (1 nm)	-5,13698 10^8	n.a.		2,8463 10^{-9}
Neutron	-1,8324 10^8	-1,8324 10^8	1	313.415
Proton	2,7908 10^8	2,6752 10^8	1,0432	147.615
Elektron	-1,761387 10^{11}	-1,760859 10^{11}	1,000299	0,03979
anti-Proton	-2,7908 10^8	-2,6752 10^8	1,0432	147.615
anti-Elektron	+1,761387 10^{11}	+1,760859 10^{11}	1,000299	0,03979

Table 2. Gyro Magnetic Ratios of some stable particles and anti-particles
The gyro magnetic ratios are given against a reference value. The reference values are taken from NIST and BPO-values are from a precise calculation of the moments of inertia and electromagnetic moments over their circular paths of motion (using the particle diameters as given earlier). At the end, as a bonus, the force in newton between two opposing Bp's are given within the particle. These internal forces of the particles validate the stability of the particle, even against the vicinity of and interaction with other particles.

5 Predictive fertility

Several novel predictions follow from the theory. Below are six of such predictions, with possible ideas for experimentation if applicable.

The first prediction is that the established values for moments of inertia (Mi) and electromagnetic moments (Me) of particles are inaccurate. To see why, consider the fact that any turning charged object will show a motion of precession when placed in a magnetic field. The frequency of this precession is related to the gyro-magnetic ratio of the object (i.e. the ratio of Me versus Mi of the object). For a particle, this frequency of procession is known as the Larmor frequency, which can be obtained experimentally, thereby allowing deduction of Me and Mi. Currently, Me is deduced based on the assumption that the Mi of a particle is already known, namely as a multiple of ½ $\hbar$ (where $\hbar$ is the reduced Plank constant). In other words, if the ratio Me/Mi can be calculated from the Larmor frequency, the Me can be obtained. However, there is no independent confirmation for this assumption of Mi being a multiple of ½ $\hbar$. By contrast, in BPO, the inertia, mass, circular velocity, and mutuality of Bp's in a particle are all known, which allows Mi and Me to be calculated. Curiously, even though BPO conforms to experimental Larmor frequencies, it does so with significantly differing values for Me and Mi, as shown in table 3, in which Me is given against reference values of NIST.

Particle	$Me/Me_{reference}$
Cirucular photon (1nm)	N.A.
Neutron	0,233233
Proton	0,583575
Elektron	0,615736
anti-proton	0,583575
anti-electron	0,615736

Table 3. Magnetic moments against their reference values

The values in table 3 result from a specific BPO solution for the a-symmetry of particles called SAC2 (Stable A-symmetric Configuration 2). SAC2 thus predicts different values for Me and Mi of these particles (i.e. the fractions given in table 3).

The second prediction is about the size of the particles, who's values have been given in section 3. Experimental verification of these sizes has proven to be difficult. Therefore it is worthwhile to point out that BPO's describes a relation between the electron's tangential (orbital) motion around a charged object and its size (see section 1.3). This relation could be used to devise experiments. For example, a moving electron can be placed in a chamber with an object, having a strong and varying charge. According to BPO, the electron should not only accelerate towards or away from the object, but should also show an additional tangential velocity as well as changes in this velocity, related to charge variation in the charged object. Such experiments could then also validate the calculated size of the electron by comparing these velocities with the strength of the electrostatic field, where the electron moves through.

The third prediction is that an isolated hydrogen atom at rest has a radius of 9,57960 10^{-11} meter, which is 1,81028 times the radius of a Bohr atom. To see why this new prediction arises, consider the process of absorption. The photon – composed of two Bp's – is absorbed by the atom, and not just the electron (see paragraph 1.3). This contrasts with the current view that the photon is absorbed by the electron. Furthermore, the B+ is absorbed by the electron and the B- is absorbed by the proton. Such a process explains why the atom is tuned to absorbing photons with only very specific frequencies. This process, combined with a derivation, using the known absorption frequency, gives the result of section 1.3 mentioned above.

The fourth prediction is that stable neutrinos have an upper energy limit of 82,6037 MeV (mass equivalent of 1,47254547 10^{-28} kg). The reason for this is that at that specific particle-mass, due to the asymmetry law, the velocity of the slowest Bp reduces to below the velocity of light. A particle with a higher mass/energy will therefore be unable to travel in a photon configuration. Given that the neutrino is the heaviest particle, known to travel naturally at near light velocity, we assume that the calculated limit poses a limit to the mass/energy of stable neutrinos. Above this limit, neutrinos are unstable. Such an upper limit could be confirmed or falsified by experiment. Note that the Tau-neutrino is currently considered to have an energy that is far above the calculated limit and the Muon-neutrino is considered to be at about 68 percent of this limit. Thus, the Muon-neutrino could possibly be stable and the Tau neutrino should be unstable.

The fifth prediction is that a proton cannot decay, and its decay time will therefore be infinite. This prediction was already anticipated in the explanatory fertility section, and therefore follows the same reasoning.

The sixth prediction is that an autonomous polarization shift in a photon (i.e. from one polarization state to the other) is possible. The reason for this is that, due to the asymmetry law, there is a difference in the velocity of B+ and B-, even for particles with small inertia such as the photon. The periodicity of this polarization shift can be calculated in a dependency on its frequency (in case a full mathematical description of the photon becomes available). A polarization shift therefore does not have to be induced by an external phenomenon. Experiments could only confirm this if an individual photon can be followed along the path of this periodicity, potentially consisting of distances in the order of millions of miles. Current experimental setups are far removed from this requirement.

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Author contributions statement

P.P.S developed the BPO theory as a physicist and V.S reflected on its scientific virtues as a philosopher of science.

Competing interests

The corresponding author confirms on behalf of all authors that there have been no involvements that might raise the question of bias in the work reported or in the conclusions, implications, or opinions stated.

Figures

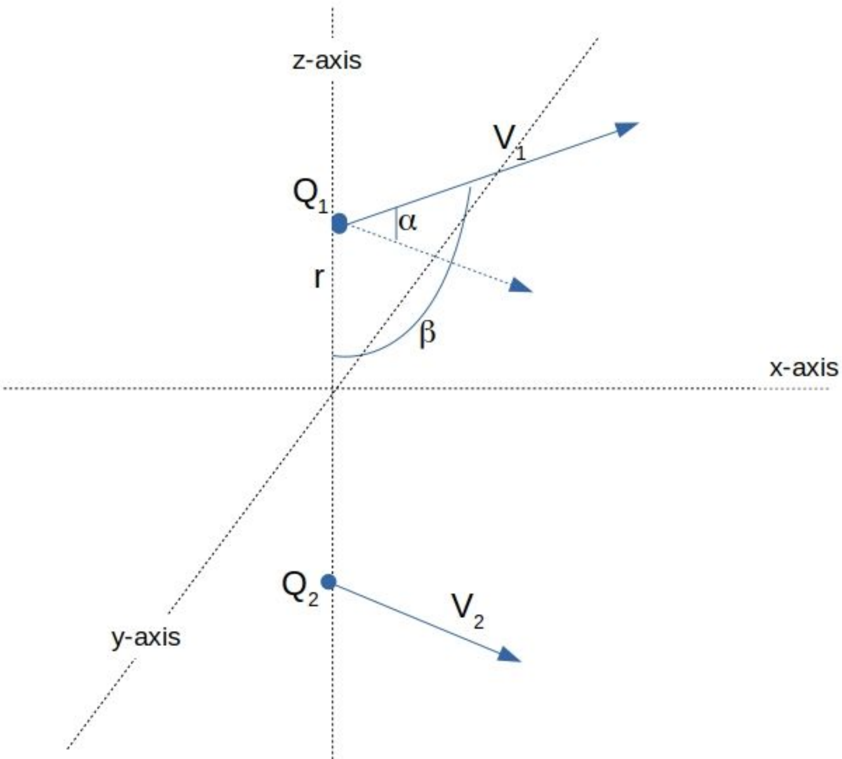

Figure 1

3D picture of dynamic interaction between two charged objects.

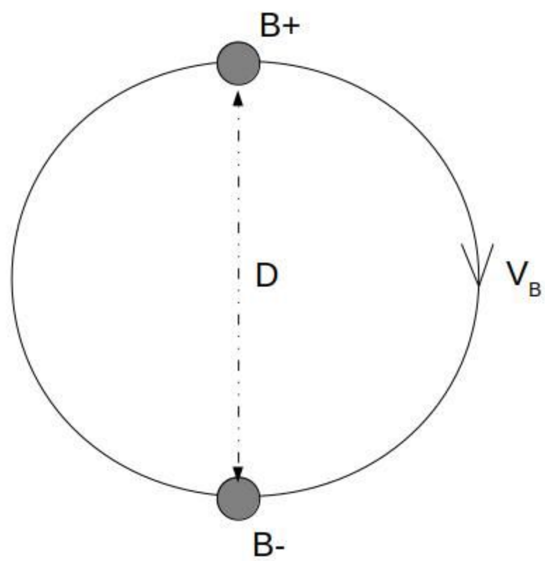

Figure 2

a neutral particle

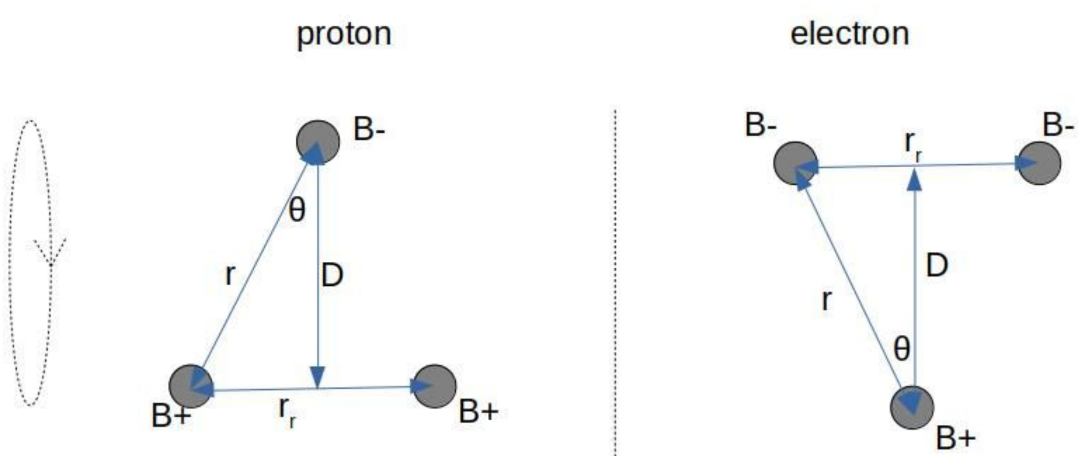

Figure 3

charged particles

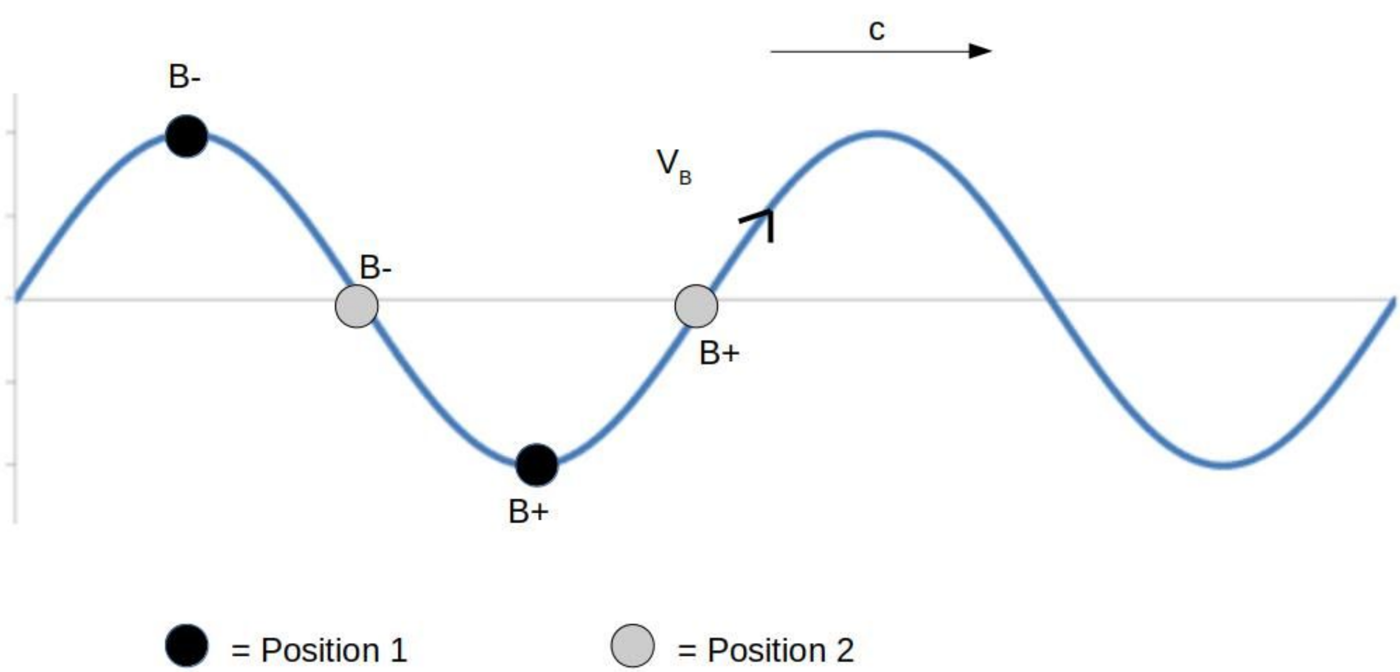

Figure 4

linear polarization of a photon

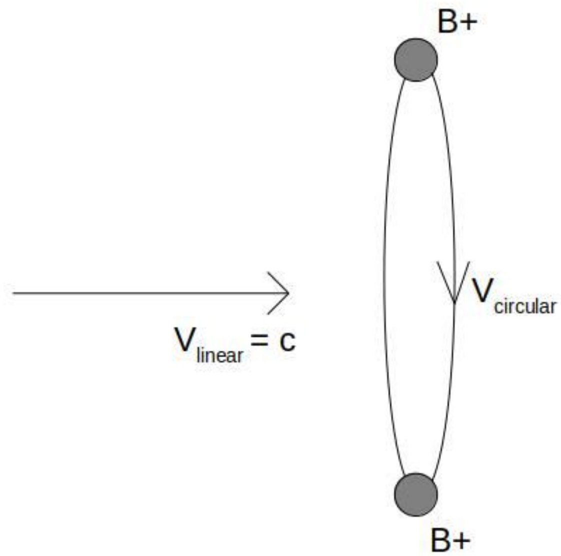

Figure 5

circular polarization of a photon

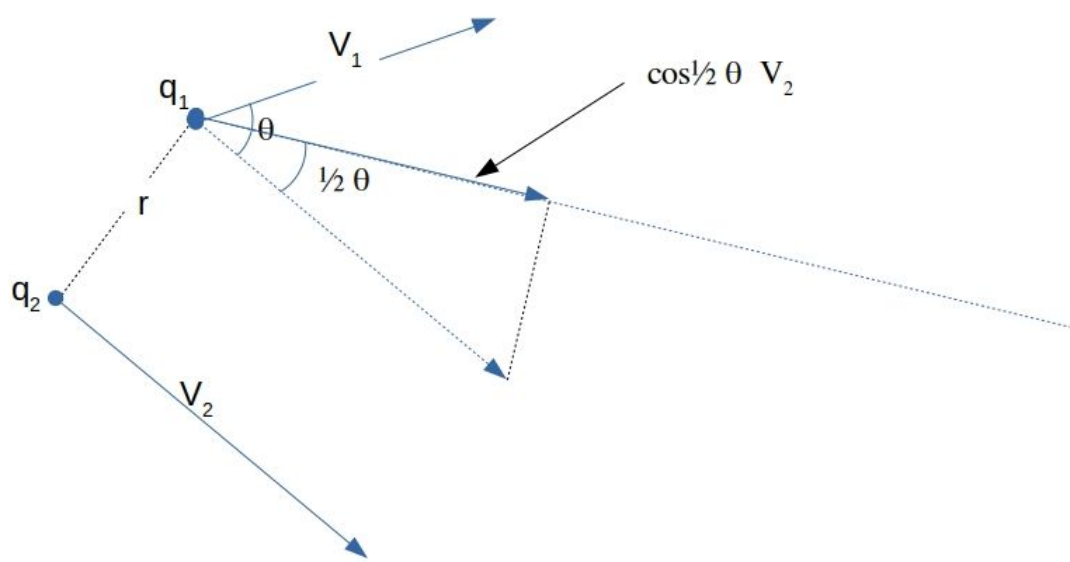

Figure 6

two moving charges