Essay

An Alternative to the Quantum Leap Paradigm

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Abstract

The primary purpose of this paper is to offer one alternative to the familiar quantum leap model. The key question is this: Is a sequence of different identical particles appearing and vanishing indistinguishable from one particle moving discontinuously?

Key Words: quantum leap model, paradigm, alternative, identical particle, discontinuity.

1. INTRODUCTION

The basic idea proposed in this paper is that a number of different, yet identical, particles which appear and vanish sequentially is one alternative to the concept of a single particle moving discontinuously. For example, imagine that one electron, e^-_1, appears at one set of coordinates then vanishes. After e^-_1 has disappeared, a different electron, e^-_2, appears at another set of coordinates. If e^-_1 and e^-_2 are identical, some observers may believe that only one electron moved discontinuously from the first coordinates to the second. This belief may be reinforced if additional different identical particles are observed appearing and vanishing in a somewhat orderly series. By way of illustration, a sequence of six different identical electrons (e^-_1, e^-_2, e^-_3, e^-_4, e^-_5 and e^-_6) appearing and vanishing is shown in Figure 1.

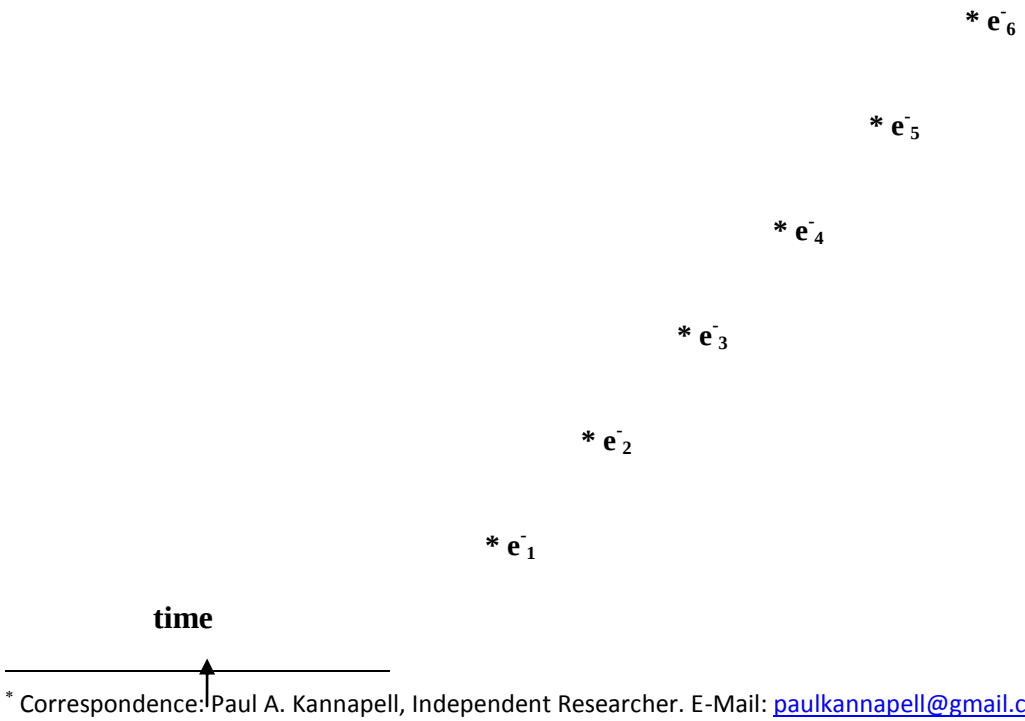

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Figure 1. The locations of different identical electrons appearing and vanishing may be indistinguishable from the positions of one electron moving discontinuously.

This process is somewhat analogous to animations generated by rapidly turning the pages of flip books. For instance, imagine one asterisk on each page of a book with the asterisks in an order that would appear as follows if all of the asterisks were typed on one page: **********. When one flips the pages of such a book, the illusion of a single asterisk in motion is produced.

If a number of different particles simply appear and vanish in a series, without moving from one place to another, then the following question arises. Is information about one particle transmitted to the next particle appearing in a sequence? If the answer is affirmative, then all of the data describing the physical state of one particle that appears in a given series may be transferred to the next particle to appear in the sequence by means of a hypothetical process which will be referred to as a 'quantum data wave.' The speculation made here is that the physical state of a particle, such as e^-_2 shown in Figure 1, is indeterminate unless e^-_2 interacts with a quantum data wave emitted by e^-_1 as e^-_1 vanishes. Subsequently, information about e^-_2 will be communicated to e^-_3 via a quantum data wave emitted by e^-_2 when e^-_2 disappears, and so on throughout the sequence of particles. Although the idea that a number of different particles appearing and vanishing sequentially differs from the concept of a single particle moving discontinuously, the quantum data wave hypothesis permits the proposed model to agree theoretically with the accepted quantum leap paradigm.

However, if the answer to the question raised in the previous paragraph is negative, then there is no quantum data wave or any other connection between particles in a sequence such as that shown in Figure 1. This possibility is considered in Sections 3 and 4 which discuss fundamental forces and particle decay respectively.

Section 2 very briefly discusses the topic of quantum tunneling, without addressing the question of information transfer from one particle to the subsequent particle in a sequence.

2. QUANTUM TUNNELING

Quantum tunneling may appear to occur if one particle in a sequence of particles vanishes on one side of a barrier, and the next particle in the sequence appears on the other side of the barrier. This is illustrated in Figure 2.

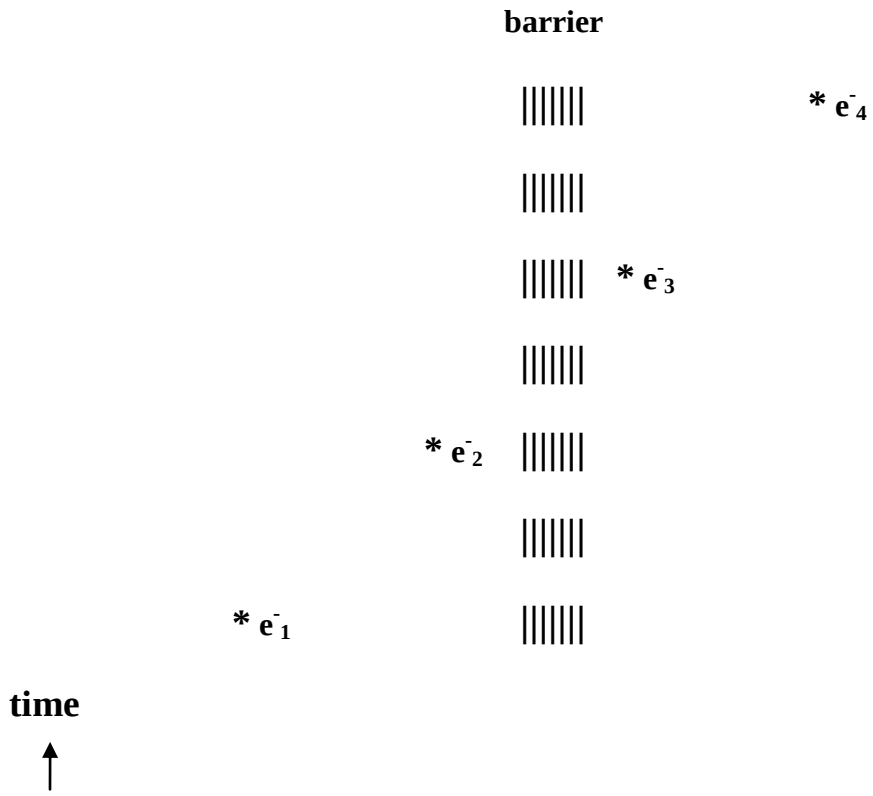

Figure 2. A sequence of electrons may appear to be one electron tunneling through a barrier.

3. FUNDAMENTAL FORCES

If particles do not move through space or time, then the basic ideas of particles in uniform motion and acceleration may stem from interpretations of the patterns of various sequences of particles. For example, the positions of the different electrons in Figure 1 may be the same as the positions of one electron appearing to move discontinuously with a constant velocity. However, if no information about one particle in a sequence is transferred to the next particle in the sequence, then information about any fundamental force(s) acting on one particle in a sequence is not transmitted to the next particle to appear in a sequence. If individual particles simply appear and vanish, then there is no difference between the illusion of one particle appearing to move at a constant velocity, and the illusion of one particle appearing to move as if it is accelerating. Figure 3 shows a sequence of six different identical electrons (e^-_1, e^-_2, e^-_3, e^-_4, e^-_5 and e^-_6) appearing and vanishing. The positions of the different electrons in Figure 3 may be the same as the positions of one electron appearing to move discontinuously as if the electron is accelerating.

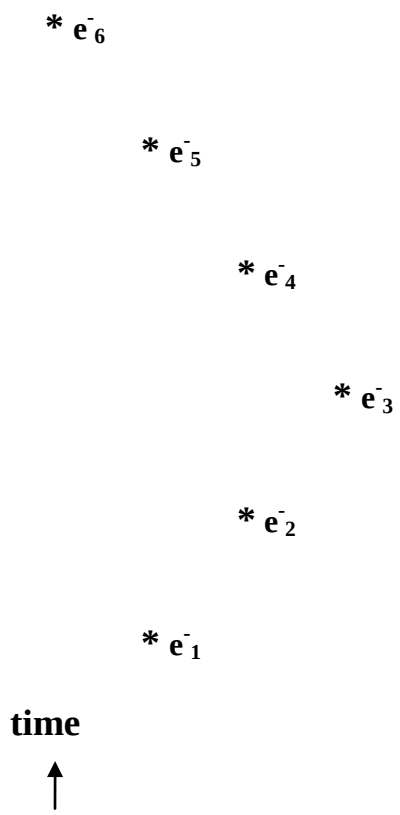

Figure 3. A sequence of different identical electrons may appear to be one electron that is accelerating.

The locations of certain sequences of particles appearing and vanishing may lead some observers to believe that particles are interacting via fundamental forces. For example, Figure 4 illustrates an apparent electromagnetic interaction between two electrons (e^-_a and e^-_b). However, imagine that e^-_a is a of a sequence, $\sigma(e^-_{aN})$, of different identical electrons (e^-_{a1}, e^-_{a2}, e^-_{a3}, e^-_{a4}, e^-_{a5} and e^-_{a6}) that are appearing and vanishing. The second electron, e^-_b, is a sequence, $\sigma(e^-_{bN})$, of different electrons (e^-_{b1}, e^-_{b2}, e^-_{b3}, e^-_{b4}, e^-_{b5} and e^-_{b6}) identical to each other, that are appearing and vanishing.

The terms '$\sigma(e^-_{aN})$' and '$\sigma(e^-_{bN})$' are expressions indicating sequences of particles that appear and vanish. Furthermore, each sequence consists of different particles that are identical. In the example of $\sigma(e^-_{aN})$ and $\sigma(e^-_{bN})$, the lowercase subscripts 'a' and 'b' indicate different sequences of particles. The uppercase subscript 'N' indicates the number of an individual particle in each sequence.

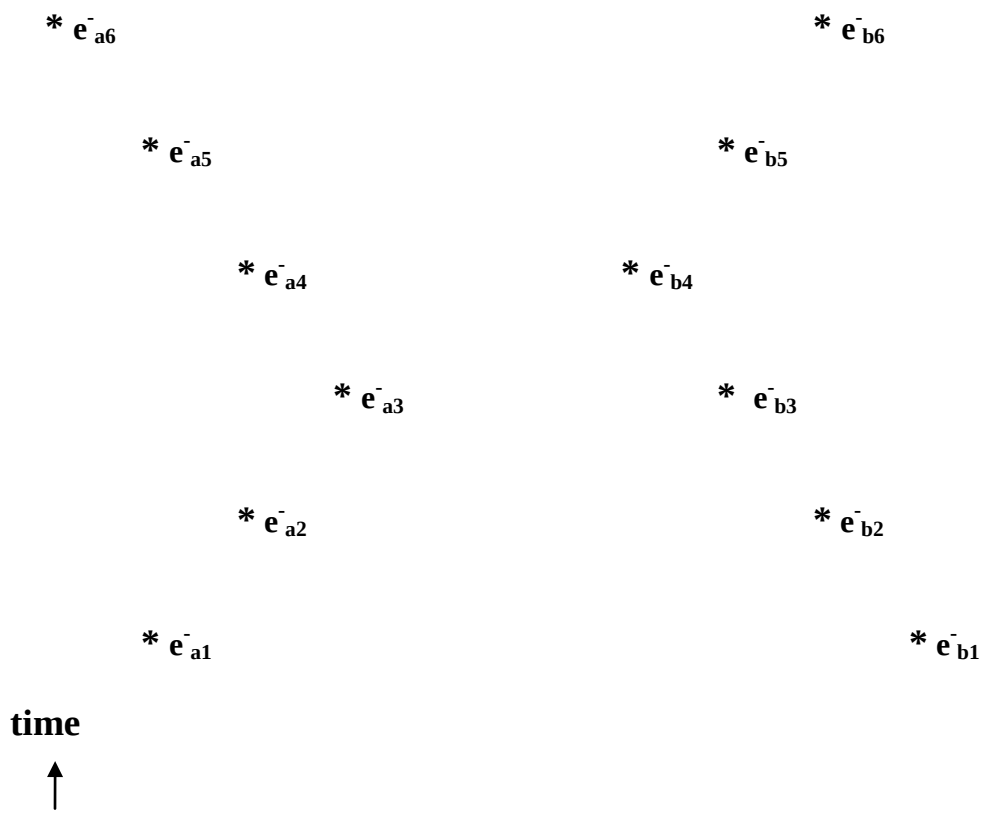

Figure 4. Two sequences of electrons, $\sigma(e^-_{aN})$ and $\sigma(e^-_{bN})$, appear to be two electrons, e^-_a and e^-_b, interacting by means of an electromagnetic force.

The patterns of the two sequences shown in Figure 4 may be interpreted by some observers as the results of two charged particles interacting with each other by means of an electromagnetic force. However, the patterns of the two sequences of electrons in Figure 4 do not require any invisible force fields or virtual force-carrying particles. Therefore, a virtual photon is not included in Figure 4. Each of the particles in $\sigma(e^-_{aN})$ and $\sigma(e^-_{bN})$ are simply appearing and vanishing. The patterns associated with $\sigma(e^-_{aN})$ and $\sigma(e^-_{bN})$ in Figure 4 were made to resemble a Feynman diagram without continuous lines. Any variations in a familiar pattern, or a set of patterns, may lead some observers to think that at least two fundamental forces are involved.

The unlimited variety of sequences of particles, such as $\sigma(e^-_{aN})$ and $\sigma(e^-_{bN})$, that is possible may appear to be individual particles interacting with one another by means of any number of different fundamental forces. This model permits a universe to appear to have two or more different fundamental forces without overlapping force fields, force-carrying particles or any real fundamental forces.

4. PARTICLE DECAY

If there is no physical connection between particles in a sequence, then any sequence of particles may begin without a preceding sequence of particles, and any sequence of particles may end

without a subsequent sequence of particles. When one sequence of identical particles ends, a sequence of new particles may, or may not, begin. Consequently, one type of particle may appear to change into a different type of particle. For example, Figure 5 shows beta decay at the quark level in terms of sequences of particles. In this model a sequence of neutrons $\sigma(n_{aN})$, which consists of three sequences of quarks $\sigma(u_{aN})$, $\sigma(d_{aN})$ and $\sigma(d_{bN})$, appears to decay into a sequence of protons, $\sigma(p_{aN})$, after $\sigma(d_{bN})$ ends and $\sigma(u_{bN})$ begins.

Figure 5 also includes: a sequence of electrons $\sigma(e^-_{aN})$ and a sequence of electron-antineutrinos $\sigma(\underline{\upsilon}_{eaN})$ which both begin after $\sigma(d_{bN})$ ends and $\sigma(u_{bN})$ starts. However, a sequence of virtual W^- particles is not shown. As mentioned in Section 3, force-carrying particles, such as the W^-, are not required in this model.

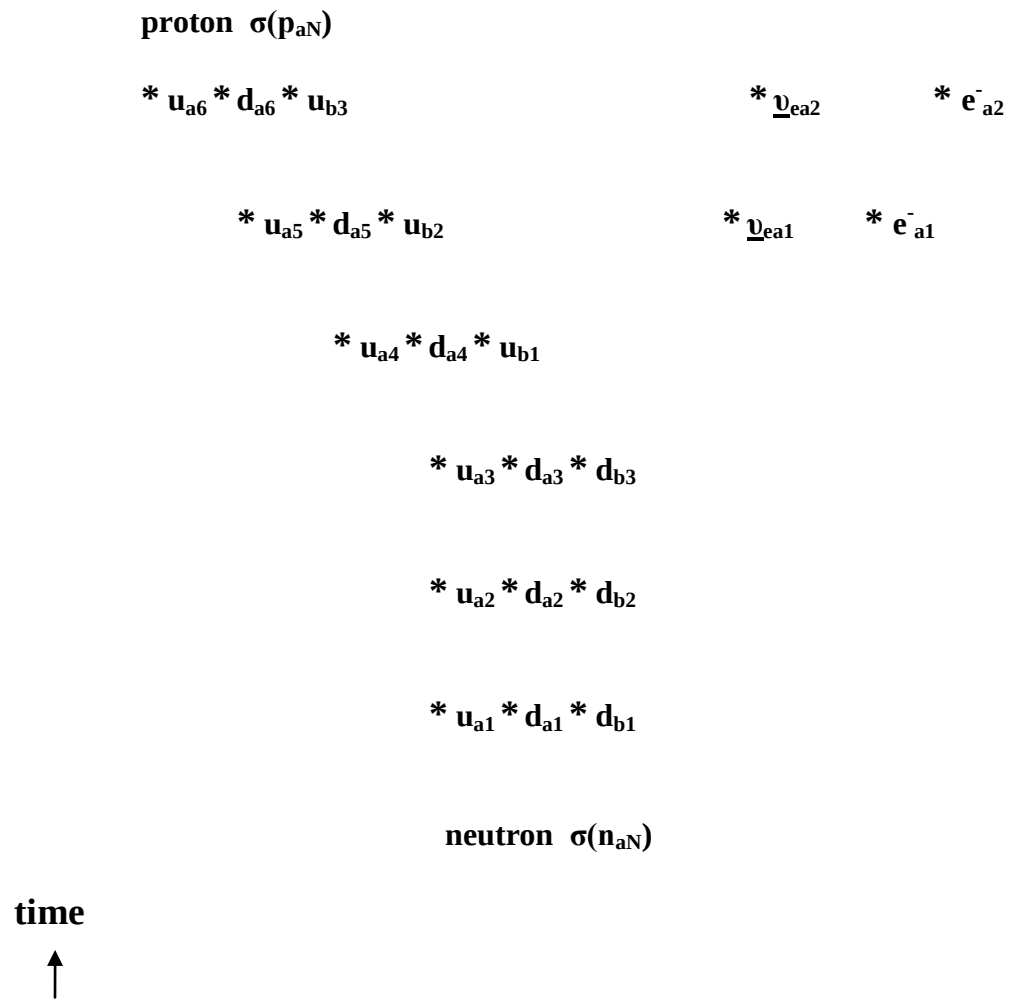

Figure 5. Beta decay at the quark level is shown in terms of sequences of particles. The particles $\underline{\upsilon}_{ea1}$ and $\underline{\upsilon}_{ea2}$ are electron-antineutrinos. The particles e^-_{a1} and e^-_{a2} are electrons. A virtual W^- particle is not required in this model.

5. FINAL COMMENT

The primary purpose of this paper is to offer one alternative to the familiar quantum leap model. The key question is this. Is a sequence of different identical particles appearing and vanishing indistinguishable from one particle moving discontinuously?