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Additional Evidence and Predictions for the ABC Preon Model

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In the years since the ABC Preon Model was first proposed, relevant and important experimental discoveries have been made. Neutrino oscillations, predicted by the ABC Preon Model, have been observed. Signatures for the Top Quark and Higgs Boson have also been experimentally verified. And while the Top Quark and Higgs Boson are not themselves predicted by the ABC Preon Model, the signatures for them are. Hence, these new experimental results provide additional verification of the ABC Preon Model. These new experimental results also point the way to additional predictions for future high energy physics experiments.

Key Words: elementary particle physics, quarks, leptons, standard model, ABC preon model

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Prologue. The ABC Preon Model[1] is an elementary particle model for what makes up our world. Since there is a substantial difference between the classical philosophy underlying the ABC Preon Model and the positivist philosophy underlying the presently prevailing Standard Model it is useful to begin with a review of these important philosophical concepts.

A distinct demarcation in physics occurred in 1905 when classical physics gave way to what is known as modern physics. The seminal work was of course the path-breaking publication of Einstein's special relativity theory, or SRT[2]. In SRT, Einstein abandoned the classical idea that physics should be based upon a mental picture involving underlying models or concepts. Instead, SRT was one of the first works to build upon the positivist philosophy promoted by Ernst Mach. Positivist philosophy asserts that underlying physical models and concepts are unnecessary, since all we can really be certain of are empirical results. Einstein embraced the positivist philosophy, began with simple postulates, and then applied an operationalist approach in his derivation of the Lorentz transformation equations for space, time and electromagnetism. In doing this, Einstein not only revolutionized our thinking about space and time, but he also revolutionized how physics was done. Underlying physical models and concepts that themselves could not be proven - such as the aether, or primitive concepts of space and time - were abandoned as superfluous. Instead of underlying models and concepts, simple principles – such as the relativity principle and the principle of least action – became the foundational axioms of physics. From those axioms, logical derivation of mathematical formulas follow, and the positivist worldview only requires that those mathematical formulas be in agreement with the empirically observed data.

Following Einstein, work on quantum mechanics embraced the positivist paradigm, as developments by Dirac[3] and others further separated the mathematics from any recognizable underlying physical model for nature. Whereas the wave-functions of Schrödinger[4] could perhaps be thought of as the square root of the density of a real existing object, the four component spinors and sixteen component matrices of Dirac defied understanding within such a simple worldview. At the present time the Standard Model is a glorious extension of the path-breaking work of Mach, Einstein and Dirac, as it involves an equation with over 150 terms[5] (many of which are themselves comprised of multiple terms) and approximately 20 free parameters. The Standard Model now stands as a definitive description of nature that is well backed by all presently existing, empirically observed data.

However, the sheer complexity of what now stands as the Standard Model should perhaps give us pause. Given enough terms and enough free parameters we can of course arrive at an extremely accurate mathematical model for anything. Could there be a better way? Could we have gone too far in the direction that Mach and Einstein directed us? While the positivist idea of the supremacy of empirical observations certainly has some merit, could it not yet also be true that a physical reality does exist along the lines of what the classical physicists believed?

In what follows, an underlying physical model for elementary particle physics will be described that returns to the classical way of thinking. A model is proposed that envisions real, existing particles - called preons - that will be theorized to be the underlying cause for presently observed experimental results.

To demonstrate the philosophical difference between the classical physics of the ABC Preon Model and the positivism of the Standard Model, a concrete example may be helpful, and one such example concerns the Weinberg angle. In the philosophy underlying the Standard Model, the Weinberg angle plays a significant role in the Weinberg-Salam theory of the electroweak interaction. The Weinberg angle is the angle associated with spontaneous symmetry breaking and it additionally relates the coupling strengths associated with the understanding of the weak force. The Standard Model of the electroweak force emanates from a mathematical formulation based on a principle of the symmetry of primordial quantum fields in the SU(2)xU(1) gauge group. The theory is that this symmetry holds at high energy and is spontaneously broken to arrive at the electromagnetic and weak forces we observe at low energy. One important result of this mathematical line of thinking is that the Z and W boson masses are related through the relation $\cos(\theta_W) = M_W/M_Z$, where θ_W is the Weinberg angle.

In the classical philosophy of the ABC Preon Model, W and Z events are understood to simply be observations of unbound preon pairs. The mass of what is known as the W is simply the sum of the masses of a B and an anti-A preon. The mass of what is known as the Z is simply the sum of the masses of an A and an anti-A preon. The Weinberg angle does not play any important role in the ABC Preon Model. Unlike the group theoretic symmetry principle that underlies the Standard Model, there are no similar principles underlying the ABC Preon Model. Instead, the ABC Preon Model simply hypothesizes that all particles are made up of precursor particles which are called preons. The ABC Preon Model proposes that those preons actually exist and that they have measurable physical properties – the underpinning is that of a classical physical model involving tangible things, not a principle.

Further differences in approach between the ABC Preon Model and the Standard Model arise in association with the concept of running coupling constants and the goal of a Grand Unified Theory. At the present time, the neutrinic charge assigned to the various preons of the ABC Preon Model is empirically determined as a result of the observed particles found in nature. While the coupling is clearly strong (the free preon masses greatly exceed the masses of the particles that contain them) the coupling itself is at this point not well-defined. Since the coupling is not yet well-defined, it is not now known whether or not it varies with interaction energy. (It is not yet known if the neutrinic force involves a "running" coupling constant.) Also, since the ABC Preon Model is a reversion back to the classical approach to physics it has little connection with present efforts to extend the Standard Model or to attempts at a Grand Unified Theory since those present efforts are generally based on a positivist philosophy and approach.

Despite the lack of complex mathematical underpinnings, the ABC Preon Model nonetheless has considerable predictive power. Certain combinations of preons are predicted to form the massive leptons, and other combinations of preons are predicted to form hadronic matter, based on a simple rule that the total neutrinic charge of composite particles is zero. Since all of the massive leptons, mesons and baryons can be constructed in this way, much of the observed experimental data is readily understood. Further, the ABC Preon Model allows numerous puzzles of nature to be solved. The generational problem is readily understood, and a great reduction in the number of elementary constituents and forces are obtained by the model. And perhaps most important is the ability of the ABC Preon Model to make quantitative predictions for experiments. As will be described below, by using only three free parameters - the preon masses - 18 quantitative predictions are made for the results of high energy physics experiments, and six of those results have already been seen. Hence, the ABC Preon Model shows that an understanding of nature can still be made with a philosophy utilizing a simple, classical, physical model. The positivist philosophy pioneered by Mach and Einstein and extended to tremendous complexity within the Standard Model need not be our only path to understanding our world.

1. A Review of the ABC Preon Model. The ABC Preon Model[1, 6] is a simple model for elementary particle physics that postulates the existence of three massive preons as the underlying constituents for all massive matter. In this section, a brief review of references 1 and 6 will be presented; please refer to the references for further details.

Figure 1 shows the elementary particles of the ABC Preon Model. The elementary particles include three preons (the A, B and C), their antii-preon counterparts, the photon, and the neutrino. A solid line above a letter indicates an anti-preon. Each preon is assigned an electric charge (that may be zero) shown in the trailing superscript. Each preon is also assigned a neutrinic charge shown in the preceding subscript. The rule for formation of composite particles is that the total neutrinic charge of the composite particle is zero.

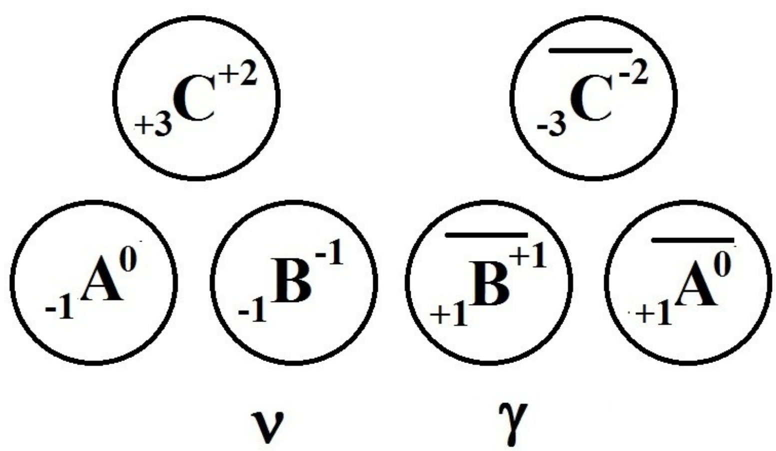


Figure 1. The elementary particles of nature as described by the ABC Preon Model.

The preons are postulated to be bound by a force carried by the neutrino, and the total spin of any composite particle is equal to the sum of the spins of the constituent preons plus the spin of any binding neutrinos.

The ABC Preon Model identifies the massive-leptons as bound states of a B preon and an anti-A preon plus a binding neutrino. Quarks are identified as the bound state of a C preon with an A preon or a B preon plus a binding neutrino. Subsequent generations of quarks and massive-leptons are understood to be higher energy states of the same underlying system. Figure 2 shows a representation of the massive-leptons, and Figure 3 shows a representation of the quarks, as understood by the ABC Preon Model. (In this paper, the term “massive-leptons” refers to all leptons except for neutrinos.)

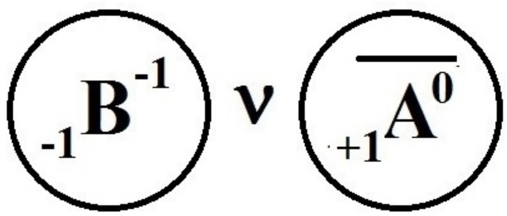
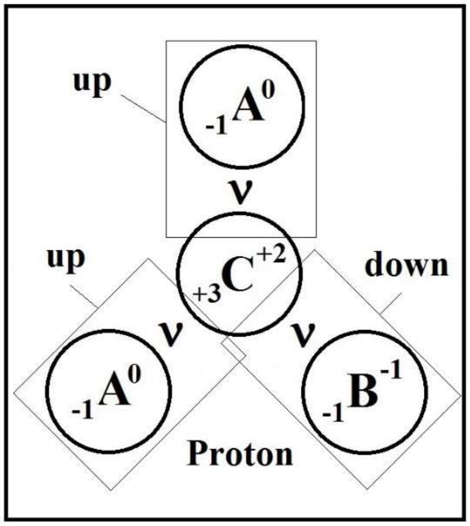


Figure 2. The massive-leptons as modeled in the ABC Preon Model. The electron is the ground state of a quantum system comprised of a B preon, an anti-A preon and a neutrino, the muon is the first excited state, and the tauon is the second exited state. The positron, anti-muon and anti-tauon are the ground, first excited, and second excited states, respectively, of a system comprised of an anti-B preon, an A preon and a neutrino.



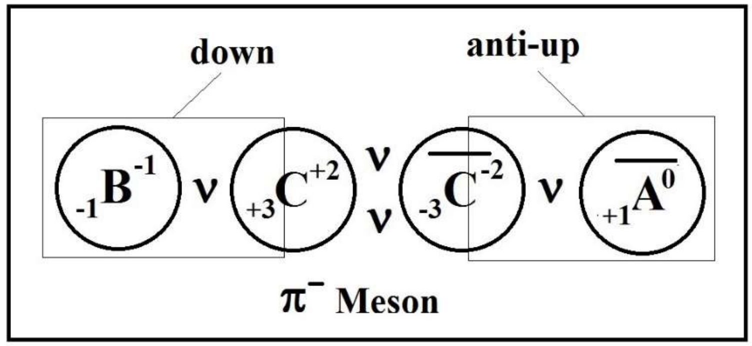


Figure 3. Left: The proton (and comprising quarks) as modeled in the ABC Preon Model. Right: The π^- meson (and comprising quarks) as modeled in the ABC Preon Model. Baryons (such as the proton) are modeled as a C preon bound by neutrinos to three other preons, where those other preons can be either an A or a B. Mesons (such as the π^- meson) involve a C doubly bound by neutrinos to an anti-C, with the C bound to an A or a B by a neutrino and the anti-C bound to an anti-A or an anti-B by a neutrino. An up quark is the ground state of a C preon bound by a neutrino to an A preon; the charm quark is the first excited state of that system. A down quark is the ground state of a C preon bound by a neutrino to a B preon; the strange quark is the first excited state, and the bottom quark is the second excited state of that system. Anti-quarks involve the anti-preons in corresponding bindings.

Weak interactions are centrally important to the ABC Preon Model. Figure 4 shows the beta decay of a neutron as understood by the ABC Preon Model. A neutron is shown in the upper left. An intermediate state (shown in the upper right) is formed when a B preon undergoes quantum tunneling to momentarily escape its bond. While in the intermediate state, neutrino/neutrino and A/anti-A pairs form out of the vacuum. In the final state, the preons and neutrinos rearrange to form a proton, an electron and a free neutrino. (In the ABC Preon Model a neutrino is its own anti-particle, and so a neutrino and an anti-neutrino are the same thing.)

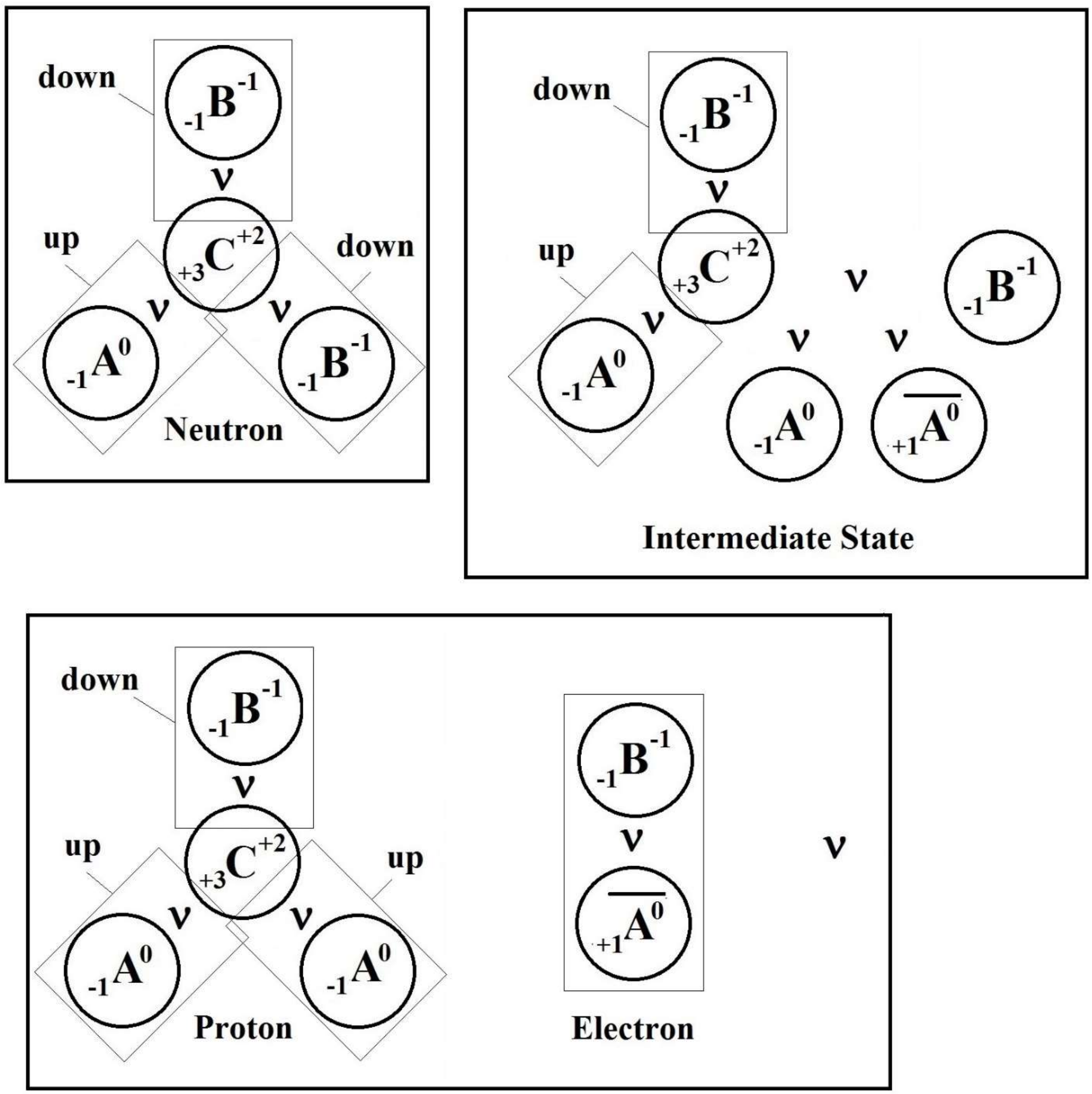


Figure 4. Neutron Beta Decay as understood by the ABC Preon Model.

High energy physics events presently believed to be signatures of intermediate vector bosons are understood to be evidence of free preon production by the ABC Preon Model. Figure 5 shows a

“W event” as understood by the ABC Preon Model. In the figure, we see a free B preon and a free anti-A preon that are liberated in a high energy collision. Then, a neutrino/neutrino pair is produced from the vacuum, with one neutrino combining with the preons to form a massive lepton and another neutrino remaining free. This signal, involving a massive lepton and a neutrino is of course recognized as a “W signature”.

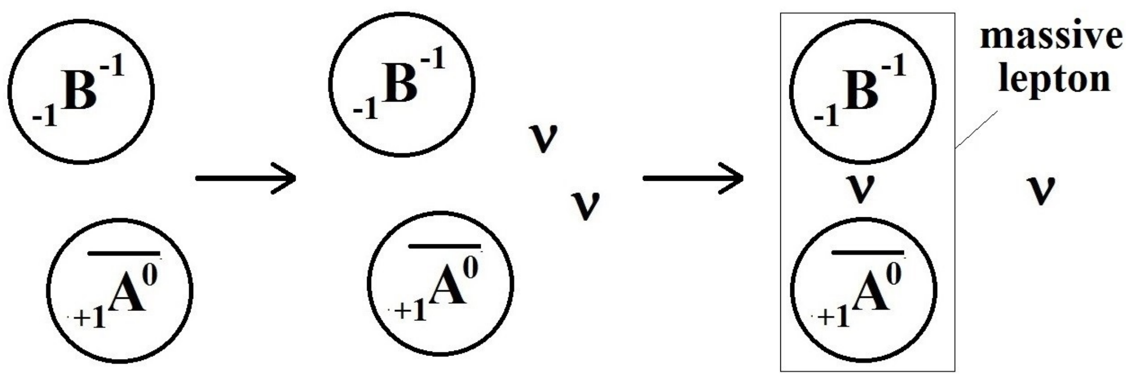


Figure 5. A “W event” as understood by the ABC Preon Model.

Figure 6 shows one type of “Z event” as understood by the ABC Preon Model. An A/anti-A pair is formed in a high energy collision. The A annihilates with the anti-A to produce a pair of high energy photons. Figure 7 shows a second type of “Z event”. Again, an A/anti-A pair is formed in a high energy collision, but this time a B/anti-B pair and a neutrino/neutrino pair are produced from the vacuum, and this then leads to the formation of a massive lepton/anti-massive-lepton pair. Figure 8 shows a third type of “Z event”. Again, an A/anti-A pair is formed in a high energy collision, but this time a C/anti-C pair and a neutrino/neutrino pair are produced from the vacuum, which then leads to the formation of a quark/anti-quark pair.

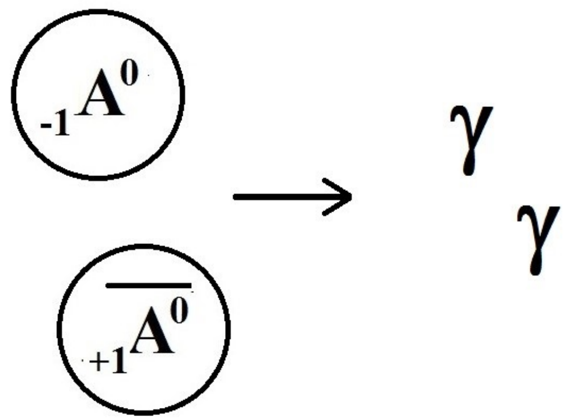


Figure 6. A "Z event" leading to photon pair production as understood by the ABC Preon Model.

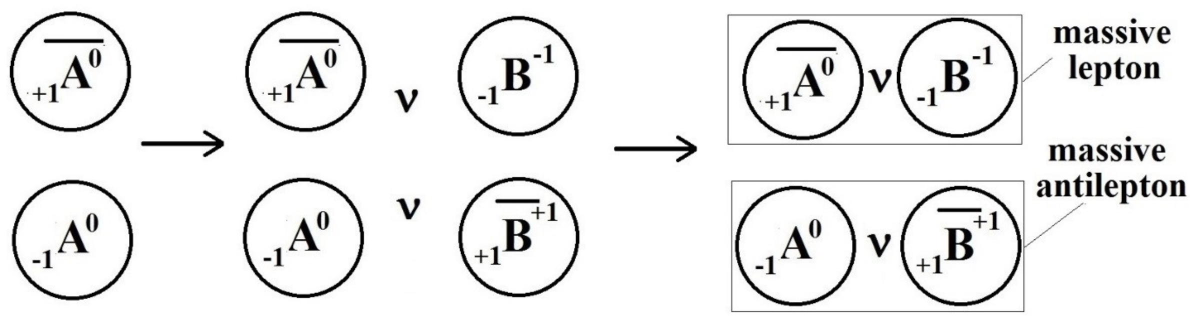


Figure 7. A "Z event" leading to massive lepton pair production as understood by the ABC Preon Model.

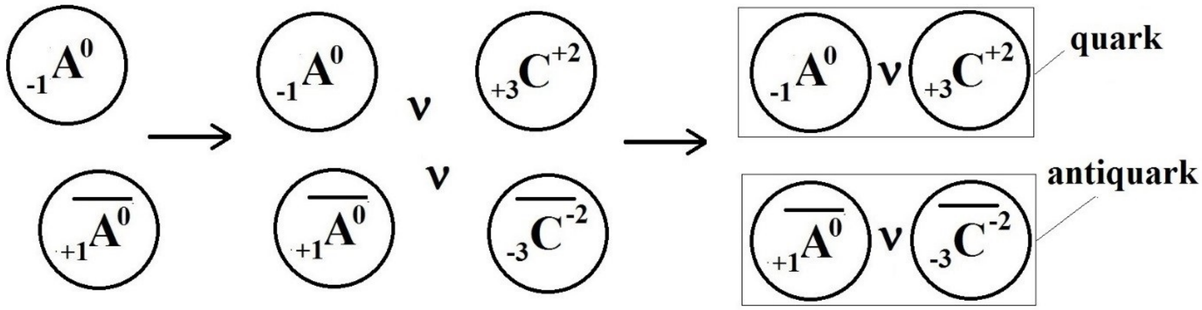


Figure 8. A "Z event" leading to quark pair production as understood by the ABC Preon Model. Following quark/anti-quark production, additional vacuum creation of preons, anti-preons and neutrinos will occur to hadronize the quarks.

2. Updating the Preon Masses.

It is the total free preon mass that becomes the center of mass total for the events in Figures 5-8. Hence, from Figure 5 it is seen that the mass of the B plus the mass of the anti-A is equal to the mass of what is presently known as the W particle, and from Figures 6-8 it is seen that the mass of the A plus the mass of the anti-A is equal to the mass of what is presently known as the Z particle. These mass relations were given in reference 1, however since the masses of what are known as the W and Z are better known now than at the time of the original publication, the masses of the A, B and C will now be updated. (Note also that in the ABC Preon Model[1,6] the mass of the anti-A is equal to the mass of the A, the mass of the anti-B is equal to the mass of the B, and the mass of the anti-C is equal to the mass of the C.)

The mass of the W is now known as 80.4 GeV/c^2 and the mass of the Z is now known as 91.2 GeV/c^2. This results in the mass of the A being equal to 45.6 GeV/c^2, and the mass of the B being equal to 34.8 GeV/c^2. Reference [1] uses deep inelastic scattering results to set the mass of the C particle. Deep inelastic scattering experiments show that 47% of the momentum of the proton is carried by uncharged particle(s) (two A's in the ABC Preon Model), 35% is carried by positively charged particle(s) (the C in the ABC Preon Model) and 18% is carried by negatively charged particle(s) (the B in the ABC Preon Model). By setting the C mass to 67.9 GeV/c^2, it is found that the total constituent mass of the proton is one C (67.9 GeV/c^2) plus one B (34.8 GeV/c^2) plus two A's (91.2 GeV/c^2) for a total constituent mass of 193.9 GeV/c^2. Hence, the portion of the proton momentum carried by uncharged particles is 91.2/193.9 = 47%, the portion of the proton momentum carried by the positively charged particle is 67.9/193.9 = 35%, and the portion of the proton momentum carried by the negatively charged particle is 34.8/193.9 = 18%. By setting a single parameter, the C mass, all three percentages agree with experiment.

Table 1 summarizes the masses and charges of each of the preons of the ABC Preon Model.

Table 1. Mass and Charge Values of the Preons.

Preon Name	Neutrinic Charge	Electric Charge	Mass (in GeV/c^2)
A	-1	0	45.6
B	-1	-1	34.8
C	+3	+2	67.9
anti-A	+1	0	45.6
anti-B	+1	+1	34.8
anti-C	-3	-2	67.9

3. First Further Evidence of the ABC Preon Model: Neutrino Oscillations Have Been Found.

The original publication of the ABC Preon Model made several predictions. Quoting from section 4.4 of reference [1]:

"The model presented here leads to some predictions for future results in high-energy physics experiments. First, 'neutrino oscillations' should be seen at some level. For the model proposed here to be as simple as possible, once helicity is accounted for, all neutrinos should otherwise be the same, although scattering cross sections and the excitation of an electron into a muon may have radically different cross sections."

The above prediction listed in reference [1] has been verified experimentally in the intervening years, as "neutrino oscillations" have indeed been found [7,8], providing additional evidence for the correctness of the ABC Preon Model.

4. Second Further Evidence of the ABC Preon Model: The Top Quark Signature.

Reference [1] postulated that the top quark might not exist. The reason can be seen by carefully considering Figure 3. The up quark is the ground state of a C and A binding, and the charm quark is the first excited state of that system, but it is entirely possible that the second excited state may not exist at all. If the energy associated with that second excited state exceeds something similar to $2m_Ac^2$, where m_A is the A mass, then it is expected that the A will be freed from its binding to the C, and hence no second bound state would exist. (Both the free A and the remnant from which it escapes will increase in mass during the escape of the A. The free A will have a mass of m_A, and the mass of the remnant from which it escapes is expected to be about m_A as well.) Therefore the ABC Preon Model predicted that there would be no top quark at a mass much above 91.2 GeV/c^2. However, the top quark was claimed to be discovered [9, 10] with a mass of 172.4 GeV/c^2. If such a quark actually exists it would be counter-indicative of the ABC Preon Model.

However, it is critical to note that what was found was not actually a top quark, but rather, its decay products. (In the Standard Model's telling, the top quark decays too rapidly for it to be seen by itself in the detector). So what was really seen was the signature for the top quark, which was in turn the signature of a bottom quark and a W boson. And the ABC Preon Model readily predicts just such a signature.

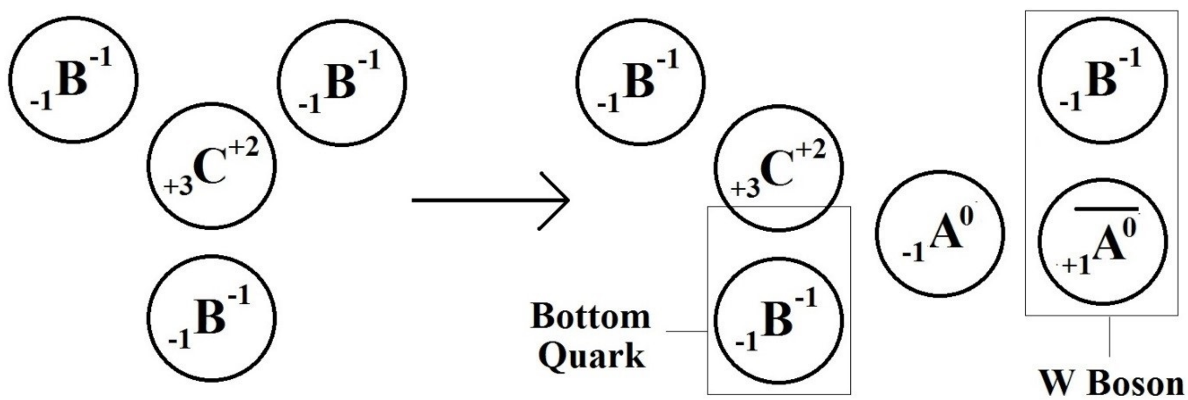


Figure 9. Top quark signature as understood by the ABC Preon Model.

Figure 9 shows the top quark signature as understood by the ABC Preon Model. In Figure 9 we see the case where a C particle and three B particles are produced in a high energy collision. This combination of particles has a total mass of 67.9 GeV/c^2 + 3(34.8) GeV/c^2 = 172.3 GeV/c^2, which is an excellent fit to the mass of the observed top quark signature (the observed top quark signature has a mass of 172.4 GeV/c^2). If an A/anti-A pair forms out of vacuum, the anti-A B combination can be recognized as leading to the W signature (see section 1 and Figure 5 above), and one of the remaining C B bindings can form a bottom quark, while the other remaining B and the A hadronize the bottom quark. Hence, the ABC Preon Model fully predicts both the total center of mass energy and the decay channels of what is known as the top quark signature.

5. Third Further Evidence of the ABC Preon Model: The Higgs Decay Channels.

The discovery of the Higgs Boson was proclaimed in 2012.[11, 12] But, as was the case with the top quark, this is again a situation where the particle itself has not been discovered, but rather, it has been claimed to have been discovered through the decay products observed.

And, as was the case with the top quark, it is possible that what is known as the Higgs signature actually results from the formation of free preons in a high energy collision; in this case an A, a B and an anti-A. The combined mass of a freed A, B and anti-A is 126.0 GeV/c^2 – consistent with what is observed in proton-proton colliding beam experiments.[13] Additionally the observed decay channels can be readily understood via the ABC Preon Model.

Figure 10 shows how two high energy photons will be produced from an A, a B and an anti-A as understood by the ABC Preon Model. The A, B, and anti-A preons are formed from a high energy collision, with the B being knocked out of a proton and the A and anti-A being formed from vacuum out of the energy of the collision. The remnant of the proton, now missing its B preon, is shown in Figure 10 as well. Next, a B anti-B pair forms out of vacuum, with the B combining with the proton remnant to create a hadronic shower. (Hadronic showers often accompany high energy physics events because the violence of the collision tears apart the colliding particles. One portion of what has been torn away may lead to rather clean decay products, but the remainder must hadronize, often leading to a shower of particles.) The remaining A and B are shown grouped with the anti-B and anti-A, respectively to result in what is understood to be the preonic constituents of the massive leptons (see Figure 2 in section 1 above.) Those constituents then annihilate into to a high energy photon pair in a process similar to lepton anti-lepton annihilation.

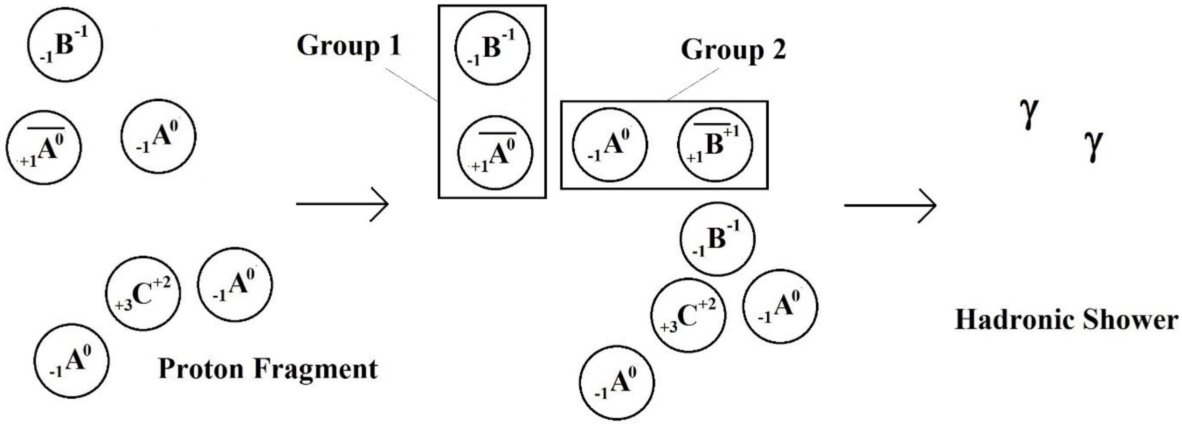


Figure 10. A photon pair Higgs Signature as Understood by the ABC Preon Model.

Straight-forward modification of Figure 10 also explains the production of W pairs, lepton pairs, and quark/anti-quark pairs. W pair production results if a neutrino/neutrino pair forms in association with Group 1 and another neutrino/neutrino pair forms in association with Group 2 of the figure, as then both groups lead to a W signature as is discussed above in section 1 and shown in Figure 5. Lepton/anti-lepton pair production will occur if a single neutrino/neutrino pair forms, with one neutrino combining with the anti-A and B of Group 1 to form a lepton (see Figure 2 above) and the other neutrino combining with the A and anti-B of Group 2 to form an anti-lepton. Quark/anti-quark production will occur if the A and anti-A (or the B and anti-B) annihilate into a C and anti-C followed by neutrino/neutrino production out of vacuum, with the C, neutrino and B (or A, if the B and anti-B annihilated) forming a quark and the anti-C, neutrino and anti-B (or anti-A, if the B and anti-B annihilated) forming an anti-quark (see section 1, Figure 3 above).

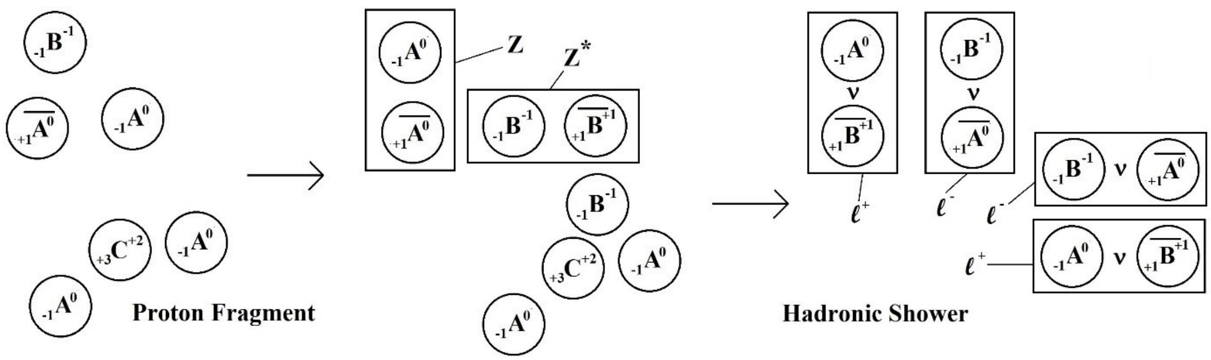


Figure 11. A Four-Lepton Higgs Signature as Understood by the ABC Preon Model.

Figure 11 shows how four high energy leptons will be produced as understood by the ABC Preon Model. An A particle, B particle and anti-A particle are formed from a high energy collision, and what is left of the proton is shown nearby. One B/anti-B pair forms out of vacuum, with one B combining with a portion of the proton fragments. The remaining A and B are grouped with the anti-A and anti-B, respectively. The A/anti-A pair is understood within the ABC Preon Model to be what leads to the various Z signatures (see Section 1 and Figures 6 through 8 above). The B/anti-B pair, labeled Z* in Figure 11, is one of the predictions of the ABC Preon Model that has not yet been seen, and, as mentioned in reference 1, it will lead to signatures similar to those produced by an A/anti-A pair, only at a lower energy.

In one of the free A/anti-A pair decay modes, a B/anti-B pair and a neutrino/neutrino pair will form out of vacuum resulting in the components needed to make a lepton/antilepton pair. In one of the B/anti-B pair decay modes an A/anti-A pair and a neutrino/neutrino pair will form out of vacuum and join with the B/anti-B pair resulting in the components needed to make a second lepton/antilepton pair.

Once again, just as in the case of the top quark signature, the ABC Preon Model predicts all of the decay modes, this time for what is known as the Higgs signature.

6. The Higgs Mass and the ABC Preon Model.

At the time of writing of this publication, the Higgs mass is believed to be 125.09 +/- 0.24 GeV/c^2.[13] This is between three and four standard deviations away from the 126.0 GeV/c^2 prediction of the ABC Preon Model for these events. However, it is possible that further experimentation will lead to an estimate for the Higgs mass closer to what the ABC Preon Model predicts. In reference 13, four separate measurements are discussed, with two of those consistent with a mass of 126.0 GeV/c^2, while the other two are consistent with a lower mass. If after further testing it turns out that the measurements consistent with 126.0 GeV/c^2 are the better results, the ABC Preon Model will again predict both the decay modes and the center of mass energy of the events. If however, the mass of the Higgs events are determined to be significantly less than 126.0 GeV/c^2 then some addition to the model will be needed to explain such a result. (Note that while it would be unfortunate for the ABC Preon Model to require such an addition, the Standard Model has itself grown over the decades by its own series of additions.)

7. Further Predictions for the ABC Preon Model.

Two-Preon AB Signatures. The ABC Preon Model[1] predicts the following two preon signatures: 1) a W^- (W^+) event signature at 80.4 GeV/c^2 resulting from the production of a free anti-A (A) and a free B (anti-B) preon; 2) a Z event signature at 91.2 GeV/c^2 resulting from the production of a free anti-A and a free A preon; and 3) an as yet unseen Z* signature resulting from the production of a free anti-B and a free B preon. With a mass of the B and anti-B preons of 34.8 GeV/c^2, this latter prediction should occur at a center of mass energy of 69.6 GeV/c^2. As described in reference 1, the 69.6 GeV/c^2 signature should involve decay channels similar to that of the Z events, only at a lower total center of mass energy. (Note that reference 1 predicted the Z* event to occur at 69 GeV/c^2 because measurements at that time indicated a B mass of 34.5 GeV/c^2. With better experimental data the prediction is updated herein to 69.6 GeV/c^2.)

Three-Preon AB Signatures. Section 5 above explains that the Higgs signature is the result of the formation of a free B, a free anti-A and a free A, and that this signature is predicted to occur at a center of mass energy of 126 GeV – which is the sum of the masses of the B, anti-A and A. Likewise, we should also see other three-preon signatures in future HEP events. An event involving three B preons should occur at a mass of 3×34.8 GeV/c^2 = 104.4 GeV/c^2. An event involving two B's and an A should occur at a mass of 2×34.8 GeV/c^2 + 45.6 GeV/c^2 = 115.2 GeV/c^2. An event involving three A preons should occur at a mass of 3×45.6 GeV/c^2 = 136.8 GeV/c^2. Of course, in these examples one or more anti-A or anti-B preons may be involved instead of A or B preons, respectively, and the mass value will be the same as indicated here.

Four-Preon AB Signatures. Four-preon AB signatures are also possible. Four B's should appear at a center of mass of 4×34.8 GeV/c^2 = 139.2 GeV/c^2. An A and three B's should appear at a center of mass of 3×34.8 GeV/c^2 + 45.6 GeV/c^2 = 150 GeV/c^2. Two A's and two B's should appear at a center of mass of 2×34.8 GeV/c^2 + 2×45.6 GeV/c^2 = 160.8 GeV/c^2. Three A's and a B should appear at a center of mass of 34.8 GeV/c^2 + 3×45.6 GeV/c^2 = 171.6 GeV/c^2. And four A's should appear at a center of mass of 4×45.6 GeV/c^2 = 182.4 GeV/c^2. As was the case for the three-preon AB events, in these examples one or more anti-A or anti-B preons may be involved instead of A or B preons, respectively, and the mass value will be the same as that indicated here. Also note that the signature involving two A's and 2 anti-A's is recognized as a Z pair event; the signature with an A, anti-A, B and anti-B is recognized as a W pair event (or a Z Z* event), and the signature with two A's, an anti-A and an anti-B is recognized as a W Z event.

Four-Preon ABC Signatures. Above in section 4 we see that the top quark signature is the result of a free C and three free B's being produced, and that this signature is predicted to occur at a center of mass energy of 67.9 GeV/c^2 + 3(34.8) GeV/c^2 = 172.3 GeV/c^2 – which is the sum of the masses of the C and three B's. Likewise, we should also see other four-preon ABC signatures in future HEP events. An event involving a C, an A and two B's should occur at 67.9 GeV/c^2 + 45.6 GeV/c^2 + 2(34.8 GeV/c^2) = 183.1 GeV/c^2. An event involving a C, a B and two A's should occur at 67.9 GeV/c^2 + 2(45.6 GeV/c^2) + 34.8 GeV/c^2 = 193.9 GeV/c^2. And an event involving a C and three A's should occur at 67.9 GeV/c^2 + 3(45.6) GeV/c^2 = 204.7 GeV/c^2.

Summary of the Above Predictions. Two-preon AB signatures should exist at 69.6, 80.4 and 91.2 GeV/c^2, with the latter two of these already being seen as the W and Z signatures, respectively. Three-Preon AB signatures should exist at 104.4, 115.2, 126 and 136.8 GeV/c^2, with the result at 126 GeV/c^2 already having been found and identified as the Higgs signature. Four-Preon AB signatures should exist at 139.2, 150, 160.8, 171.6 and 182.4 GeV/c^2, with the last three being identified as W pairs (or Z Z* events), W-Z events, and Z pairs, respectively. Four-Preon ABC signatures should exist at 172.3, 183.1, 193.9, and 204.7 GeV/c^2, with the first one presently being identified as the top quark signature.

Dressings. This section on predictions focuses on the predicted total mass of the events and does not go into detail on the various decay channels available at that mass. Of course, all of the various free preon combinations will quickly become "dressed" into leptons, hadrons or photons in ways similar to the "dressings" that occur in the cases of W, Z, top, and Higgs events discussed in greater detail above. (The dressings will occur by preon/anti-preon and neutrino/neutrino pairs forming out of vacuum and then combining with the existing free preons.) These dressings will follow the simple rule that the total neutrinic charge of final bound states are zero, and that preon/anti-preon combinations can also annihilate to form photon pairs. Neutrino/neutrino production is also possible, but exceptionally hard to detect!

Discussion of the Predictions.

As just described, preon signatures are predicted to be seen at many different center of mass energies in high energy physics experiments. Of those that are predicted, several have already been seen, and all of those that have been seen are in agreement with the predictions of the ABC Preon Model. Some of the predictions, such as W pairs and Z pairs, are expected by the Standard Model, while several of the remaining predictions are not anticipated by the Standard Model. Lastly, note that there are other possibilities as well, as more than four preons could be formed in a collision; C preons could form with one, two, or more other preons; C pairs could form; and so on. The present paper simply lists several of the events that the author believes are most likely to be seen next based upon what has recently been seen; the present paper does not present a complete list of all possibilities.

8. Summary and Conclusions.

References 1 and 6 describe the following attributes of the ABC Preon Model: 1) The ABC Preon Model uses three preons, three anti-preons and binding neutrinos to construct all known quarks and leptons; 2) The ABC Preon Model is consistent with all known experiments; 3) The ABC Preon Model reduces the number of known forces from four to three, as the weak force is identified not as a force but as a simple quantum tunneling; 4) The ABC Preon Model reduces the number of elementary particles from the 61 of the Standard Model to just eight. (Note that in this counting, different colors of quarks and gluons are counted as different particles, just as a positron and electron are not the same particle.); 5) Neutrino oscillations should eventually be found.

In the present paper it is reported that the passage of time has been kind to the original predictions of the ABC Preon Model. The qualitative prediction of neutrino oscillations has been experimentally verified. Further, additional high energy physics experiments (presently known as the top quark and Higgs signatures) have produced results consistent with the ABC Preon Model both qualitatively (the decay channels are predicted) and quantitatively (the center of mass energies are consistent with predictions).

The present paper also shows that the ABC Preon Model leads to several predictions for new physics that should be observable in the coming years. Many predicted events resulting from the formation of preons freed and/or formed during high energy collisions are predicted at specific masses. The decay channels for the events can be arrived at by assuming various particle/anti-particle formations from vacuum, with those particle/anti-particle formations combining in various ways with the preons that are freed and/or formed in the high energy physics experiments. While the decay channels are numerous, they are also specific, and it is hoped that the process of predicting them is clear to the reader after a period of study and reflection upon the present paper and references 1 and 6.

Importantly, three input parameters of the ABC Preon Model (the three preon masses) are sufficient to accurately predict many quantitative results. One of the two deep inelastic scattering ratios and the center of mass of the W events and Z events are used to experimentally determine the preon masses, and from that point on those preon masses can be used to predict the center of mass for the remaining inelastic scattering ratio, as well as the mass of top quark events, Higgs events, and several other predicted events. So far, all predictions are in line with experiment, as the ABC Preon Model accurately predicts the remaining inelastic scattering ratio and top quark mass, and is within the margin of error of experiments measuring the Higgs mass.

The ability of the ABC Preon Model to make predictions concerning both the decay channels and the center of mass of high energy physics events, along with its innate simplicity, makes the ABC Preon Model a superior model of nature when compared to the presently prevailing Standard Model. High energy physics experimentation is very difficult, due to the significant background and attendant "shrapnel" that so often accompanies the desired signals from the high energy collisions. The ABC Preon Model can enable future high energy physics searches that are easier than what they are with the Standard Model, since researchers can now know what energy to look for in addition to the decay channels, which will help them make proper data cuts during experimentation. Be forewarned that as was the case with neutrino oscillations, the cross sections for the predicted events may be small and the events hard to find. Yet eventually the events predicted herein should be observed.

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