Article

Not peer-reviewed version

The Connection of Gravity, Dark Matter, and Supermassive Black Holes via a Set of Particles Associated with Gravity

Nikiforos Ierokomos *

Posted Date: 1 April 2025

doi: 10.20944/preprints202504.0026.v1

Keywords: Gravity; Particle physics-cosmology connection; Dark matter theory; massive black holes; Primordial black holes

doi:10.20944/preprints202504.0026.v1

Article

The Connection of Gravity, Dark Matter, and Supermassive Black Holes via a Set of Particles Associated with Gravity

Nikiforos Ierokomos

Independent Researcher; ierokomosn@gmail.com

Abstract: Gravity by far is the weakest force in the universe and this weakness is not described by the Standard Model. Currently there is no known theory explaining why gravity is so weak or so different from other forces. This paper proposes a solution for this feebleness. In solving the gravity weakness problem, it was found that other unknowns in cosmology find possible answers. It is known that particles are found as groups or as families with special group behaviors. Additionally, not all families of particles interact by all the fundamental forces. For example, neutrals do not interact by the "charge force." This behavior presents the possibility that a special relationship may exist between a specific family of particles and a specific associated force for that family. Such a relationship is believed to have been found and presented in this work. This work finds the coupling constant of strength of a fundamental force and what is an associated family of states for that specific force. This finding has been tested and verified with the known families of particles and forces. This relationship is then used to determine and calculate the parameters of a proposed set of states associated with the force of gravity. The result of this association makes it clear why gravity is different and measured so weak. This hypothesis also provides an explanation why fundamental forces and particles are so related and predicts the possibility of a fifth force.

Keywords: gravity; particle physics-cosmology connection; dark matter theory; supermassive black holes

---

1. Introduction

The force of gravity is the weakest of all the fundamental forces. Gravity is up to 39 orders of magnitude weaker compared to the strong fundamental nuclear force. This weakness is considered a mystery of modern cosmology. Hypotheses, including the Standard Model "SM," for the cause of this feeble strength have been proposed, but none, perhaps till now, have been satisfactory. It is known that not all particles interact by all the fundamental forces, but it is not known why. This may indicate that something fundamental may be missing from the way we understand fundamental particles and forces, especially gravity. Upon comparison of gravity with the other three known forces and the families of known particles, leptons*, quarks* (*indicates fundamental, not composite) baryons, mesons, photons, gravitons, vector bosons and gluons, it is strongly suspected that at least something is missing from the descriptions of gravity.

2. Possible Cause for Gravity's Weakness

In this work, a hypothesis has been developed that can explain gravity's weakness. This proposed hypothesis is the requirement that each fundamental force, including gravity, be associated with, and fundamentally defined in our universe, by a specific, unique family of particles. This also implies a chronological sequence of particles. The connection and behavior between a force and its associated family of particles is not an ad hoc assumption and will be seen here to be a necessity. The groups of particles associated with their related forces, even for gravity, have been identified and are presented

 doi:10.20944/preprints202504.0026.v1

here. This relationship of particles and forces not only explains the feebleness of gravity, but seems to present answers to other universe unknowns and will be pursued here on a limited basis.

The associated family of particles of the long-range electrostatic force are the charged leptons. There is a significance and a necessity as to why the lepton and quark families have two members per generation. For the leptons, it is always a charged state and a neutrino per generation. The significance of this relationship concept is not only with the electrostatic force and lepton states, but it also has dependence, as will be seen, upon the quark family and even over the proposed gravity family of particles and force. The dependence of a specific force strength to its own associated states is through the mass of the associate member particle which is the smallest (least) non-zero generation of each group of associated states. For the electrostatic long-range force, this is the electron. However, since the neutrino is also present along with the electron in the first or the least generation, the force "must split." The split forces are related with one another, and exhibit similar fundamental behavior to the unsplit force. Complications of forces arise from the requirement that the quarks, as well as the leptons, must exist to cause our universe and, in turn, gluons with color and small separations are required. Because of the quarks (can be "assumed" as modified "rotated" leptons?) the neutrino can cause complications for its force, but without the quarks our universe (WE) cannot happen.

For gravity there is no known associated family of states and therefore no known least generation similar to the electron, or the neutrino, or even the u and d quarks. We know however, that gravity exists, which by the proposed hypothesis indicates that a gravity associated family of particles absolutely must exist as given by [1] (Ierokomos N., 2011) and [2] (Ierokomos N., 2011). Assuming this to be true for such group of particle existence, some of the shortcomings of the SM about gravity and possibly some other major unknowns in the universe can be solved. Unknowns such as dark matter, or why the limit of three and only three generations of leptons and quarks exist. This hypothesis also appears to solve one of the most important mysteries in the universe. Every cosmology theory assumes that the universe must start with equal amounts of matter and antimatter. That is a problem then of where all the antimatter is, to balance the known detected or assumed excess matter, and ensure that the universe does not annihilate itself. Gravity by this hypothesis therefore, at a minimum, requires an associated, previously unknown family of particles. This hypothesis determines that the strength of the long-range forces with massless exchange states, have a clear and simple dependence on their associated states. It was found that the strength constant K_i, of a specific force, here for now, the long range of gravity and of electrostatics (G, e^2) is inversely proportional to the mass squared of the associated member particle with the lowest (least) generation, mi, from each fundamental associated family of particles.

$$K_i = f(1/mi^2) \tag{1}$$

This elevates the generation value to a conserved parameter. Neutrino oscillations and complications are special cases. The above relationship of inverse mass squared holds even for the neutrino and is applicable for all forces including gravity. If this is true, the number and strength of all fundamental forces can be predictable because the masses of the least generations of the leptons and quarks are known. The electron and neutrino for the leptons, the up and the down quarks for the quark family and the here proposed particles for gravity. For the long-range electrostatic force, the mass of the lowest generation particle "needs" to be a charged particle and is taken as the mass of the electron, or me. Also, for the other part of the split lepton force (electron and the neutral neutrino) a value for the rest mass of the neutrino, based on the stability and mass of the proton is taken as the mass that was determined in 1979 as $m\nu = 7.2 \times 10^{-33}$ g (in cgs) [3] (Ierokomos N. 1984). This value for a neutrino by Eq. 1 indicates a very strong force compared to that measured for gravity. This strength by the proposed hypothesis indicates possibly some strong anomaly, or erroneous application, or the force is complicated, very strong and becomes apparent at GUT value and very small distances. Also, quarks,

 doi:10.20944/preprints202504.0026.v1

gluons, the strength, and the color "force" in the same domain add to the complications. In addition, a reduction by a factor of $1/2\pi$ was found to be necessary to the above neutrino mass value when all particles participating in the neutron beta decay were considered ($n^0 \Rightarrow p^+ + e^- + \nu^0$). The masses of these quantized particles may indicate a relationship of particles to each other and to the universe. The neutrino, small mass and complicated behavior, may be related to gluon and color force by a process that is not currently understood. This "neutrino-based" force, cannot be explained in greater detail presently other than determining its strength by Eq. 1.

The stable composite proton has a role in these particles, to indicate that perhaps some relationship of the fundamental masses is followed by the particle masses in the universe. The proton seems to be taking the role of a fundamental state of the third generation. If this is the case, the proton is stable and cannot decay in our universe. Because of this relationship, the proton is what it is. It is a composite of 2+1 quarks that absolutely must act as a fundamental state. This means that the force holding the quarks together must be the strongest of the forces but remain as separate quarks to cause our universe (Pauli exclusion principle).

For the neutron decay ($n^0 \Rightarrow p^+ + \ldots$) it is the mass of the d, or u, quarks, with mass mu, or md defining the strength of the "weak nuclear" force. The mass difference of the "basis" proton mass, mp, to the electron mass me, at the neutron decay is: $(\alpha/4\pi\Lambda)$ or fine structure constant and $\Lambda \sim r_o/2\lambda_p \sim 1.066$, giving the electron mass me, a value as measured from the basis proton mass as approximate:

$$me \sim (mp/2\Lambda)(\alpha/2\pi) \sim (9.11 \times 10^{-28}\ \text{g}) \tag{2}$$

The value is based on the composite proton mass but the fundamental lepton mass, determines the proton mass, because the universe dictates the values. Also, the mass "difference" from the electron mass me, to the above antineutrino mass, $m\nu$ in the neutron decay, may indicate correlation to the universe and is taken as $(1/\Lambda)(\alpha/2\pi)^2$ giving the neutrino mass $m\nu$ by the electron mass me as:

$$m\nu \sim (me/\Lambda)(\alpha/2\pi)^2 \sim (1.15 \times 10^{-33}\ \text{g}) \tag{3}$$

This is approximately 0.65 eV/c^2 for the rest mass of the neutrino. This value compares to the value estimated by the recent KATRIN Collaboration of $< 0.8\ \text{eV}/c^2$ [4] (Beglarian, A. E., et al, 2021). Because of these complications and the close relationship of leptons and quarks to each other, the strength of this "neutrino force," relative to gravity would be very strong, and more complicated. It appears that as a result of this particle-force concept some behavior can be assumed. The first critical assumption is that there is a force associated with every least generation of fundamental particles. Also, every such force must have massless exchange states with the speed of light and a range dependent on the range of its fundamental particles. These exchange states are the gravitons, the photons, and the complicated gluons. To show that this hypothesis is valid, the strength of each force is calculated by Eq. 1, and compared to the experimental published value. To compare values, each force is compared to the gravity strength taken as the unit (1) of strength and then to the known value. The neutrino force is presented out of sequence because of the complications.

The strength of this neutrino-based force by Eq. 1 becomes equal to what is known as the strong nuclear force by gluons holding quarks together as protons and others. The known nuclear forces (strong and weak) follow similar rules but with a complicated fashion that is not currently entirely understood of the strong nuclear and neutrinos. As mentioned, for gravity the associated states are currently unknown, but in the 1980s these states were postulated and were named by the author "xena", (ξ). These xena present an impact not only as the gravity particles but surprisingly also assume some changes in the big bang observations such as what is dark matter. All families of states perhaps have a related dependence with sequential cause with each other and why they interact as they do. These proposed xena are required to be fundamental and massive bosons almost up to the GUT and the

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: 1 April 2025 doi:10.20944/preprints202504.0026.v1

Planck mass range. All are of spin one, no charge and of even, 2, 4 and 6 generations with mass value opposing the generation value. The reason for this opposition at first made no sense, but then it was found that the decay of the xena would force the causing of the leptons and quarks on the path to our present universe. This orientation must also all be at the start either matter or antimatter "hinting" of a unidirectional (expanding) universe by a cosmic symmetry break at its creation causing of CP problem. The xena parameters are deduced, because of a similar process as the leptons and photons of zero rest mass exchange states. In this case gravity, also because of some assumed characteristics of the infant developing universe. The reason leptons and quarks are spin 1/2 and two members per generation is because of the way these proposed xena decay. That decay is because of conservation rules in spin and generation that force the non-gravity associated states to have two leptons, or two quarks for each generation of associated states. Because of this relationship, leptons and quarks appear not to be states of initial or primary population at the start of the universe. They appear to be of a secondary "daughter" population materializing at the xena decay. These findings are used to determine the details of the xena associated family of particles for gravity. The value of the mass of the least generation (second) of these gravity xena is identified and determined below.

These proposed xena states appear to complete the relationship of forces and particles to each other and to the universe. The xena therefore, will be seen to be the key to the feebleness of gravity and perhaps to a lot more concepts. A graviton, as predicted by this hypothesis, must be of zero rest mass and spin 2 (tensor) exchange state because of these xena. The associated family of xena particles for gravity must be bosons with spin one and must be left-handed if matter. This conserved chirality, and some of the CP problem appears to be because of a symmetry breaking and matter antimatter separating at an initial specific phase of the universe. The xena decay also forces the neutrino to be left-handed if it is matter.

There are other differences of the xena gravity family of particles. The xena are required to be totally "blind" to all forces except for gravity. One observational proof of this least strong interaction, may be the lack of observance of expected reduction of rotational speed of bar galaxies by dark matter friction indicating that dark matter is made of xena with gravity minimum interaction as detailed below. This proposed behavior with forces and particles is by the presented hypothesis crucial for the understanding of the universe and its coupling to the (required quantized) particles. Some simple calculations are made here to show that such gravity associated xena particles, can exist and may be shown to exist and can be detected. The calculation to find the mass of the unknown xena of minimum generation, $(\gamma)m\xi_2$ uses the known electrostatic long-range force and the value of the gravity long range force. The xena-2 is the least generation xena state. It is the minimum but not the number one generation of the xena family of particles. The xena, are all of even generations (2, 4, 6) and attractive. The smallest (non-zero) generation of the xena is therefore the second generation. This mode is required because the xena are considered the primary states in the universe and provide the particles to cause atoms (electrons, protons, and neutrons by xena decay into baryons in a more mature universe). This second, or least, generation of the xena associated state is one of three boson states in the xena family as with the lepton and quark fermion families of three generations. The cause for three generations in the lepton and quark states is because of these three xena primary states. To complete this xena family, a mass/energy "progenitor" xena (ξ_0) scalar matter-antimatter neutral, "approaching" the Planck mass also needs to exist. This can be taken as zero generation (symmetric universe). By the two following xena decays Nature has guaranteed the universe to be only as "designed" and not random, but minimum and sufficient. The only randomness allowed is for the universe (and us) to be either matter or antimatter with everything else dynamically the same, but opposite.

Because we know some neutrino parameters, by definition it is easier to identify for a plus subscript, in a given particle symbol here to indicate an antimatter state and a minus subscript indicates matter. The following two decay equations of the progenitor causing the xena (separation in equal matter and antimatter) indicate the future state and complexity of the universe. Also, Eq. 4a

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: 1 April 2025 doi:10.20944/preprints202504.0026.v1

defines where all the antimatter can end up in our universe after some decays. It also defines why there are three and only three generations of leptons or quarks. For an expanding, ageing universe the following two decays of the progenitor to xena lead to "either, or," type of universe. That is if the decay is:

$$\xi_0 \Rightarrow (\xi_{+2}) + 2(\xi_{-4}) + (\xi_{+6}) \quad \text{(Eq. 4a.)}$$

This equation 4a (after a photon phase of the universe) can be shown to lead to a matter universe path, with matter baryon dominance, as observed.

Or alternatively, if it has decayed into:

$$\xi_0 \Rightarrow (\xi_{-2}) + 2(\xi_{+4}) + (\xi_{-6}) \quad \text{(Eq. 4b.)}$$

This (Eq. 4b) can be shown to lead to an antimatter universe with antimatter baryon dominance. Either of the universe can have the same complexity of everything else and either would preserve symmetry of equal matter-antimatter and avoid annihilation. As mentioned above, the specific cosmic broken symmetry locks the universe into only one mode. Either always Eq. 4a, or Eq. 4b. other modes go to mostly energy by annihilation. Also, the Eq. 4a is what our universe seems to have experienced. That is indicated by the dark matter, behaving as if indeed it is made up of (ξ_{+6}) particles, as proposed (see below). It seems that the behavior of the universe can bias particle behavior. In the search for the method of decays of the xena it was found that the decays for the second and fourth generations of xena, were complicated, but introducing some assumptions, paths leading through leptons and mesons including k^0s and D^0s to hadrons at high energy and then to the known particles and may be found as needed. The decays must be balanced first in leptons and quarks.

The least massive xena-6 (ξ_{+6}, Eq. 4a) for our universe should be stable and be antimatter, but can only interact by gravity and appears it cannot annihilate directly with baryons. Annihilation for ξ_{+6}, is perhaps only via destructive collision, but satisfying balance of matter and antimatter. This quantity of three types of xena, and four in number (Eq. 4a) is absolutely the minimum and sufficient number and type of particles needed at the start to cause our universe as it is, in both matter and antimatter. The xena, which are assumed to be the primary states, by their decay split and forbid the secondary "daughter" lepton and quark states to be of generations exceeding those of 1/2 that of the xena. This is why there are three and only three generations of leptons or quarks and two fermion members per generation. Also, the boson spin one xena, are "split" in two to the fermions. To find the mass of the xena state of least generation $(\gamma)m\xi_2$, γ is assumed here to be equal to one. The known ratio of strength of gravity and electrostatic force is used with the following gravity constant G $(g^{-1} \cdot cm^3 \cdot s^{-2})$ and of electrostatic e^2, are presented by their associated particle values. The Newtonian constant ($G = 6.67 \times 10^{-8}$ cgs) the fine structure constant, ($\alpha = 1/137$) the electron mass ($me = 9.11 \times 10^{-28}$ g) the proton mass ($mp = 1.67 \times 10^{-24}$ g) representing stable quark composite (d and u quarks) the electrostatic charge ($e^2 = 2.307 \times 10^{-19}$ g $\cdot$ cm^3 $\cdot$ s^{-2}) are used in this calculation. Then, the ratio of strength of the two long-range forces of gravity constant G and of electrostatic e^2 are presented by their associated particles of xena, leptons and quarks and is given as inverse mass squared of their associated least generation states:

$$G/e^2 = 2.90 \times 10^{11} = (\alpha/2\pi)(m\xi_2 mp/me)^{-2} \text{ g} \quad (5)$$

The xena mass of the least generation upon which the strength of gravity is dependent, is the second generation of xena ($m\xi_2$) and is from Eq. 5:

$$\xi_2 = \left[(\alpha/2\pi)(e^2/G)(me/mp)^2\right]^{1/2} = 3.45 \times 10^{-11} \text{ g} \quad (6)$$

Or:

$$(m\xi_2)^2 = (\alpha/2\pi)(me/mp)^2(hc/G) \tag{7}$$

This is in the GUT and almost to the Planck range, where the forces appear to becoming equal.

It is interesting that the three masses (me, $m\xi_2$, mp) form a sequence of generation of one, two and three. This least generation for gravity $m\xi_2$, is a massive (10^{-11} g) particle that will make gravity extremely weak by Eq. 1. If use of the proposed inverse mass squared hypothesis with least generation is made, one can show the relative ratio of strength of all the fundamental forces compared to gravity as shown here. The values determined are all substantiated by observed published values presented below.

For the weak nuclear force, the "up" quark mass ($mu \sim 3.55 \times 10^{-27}$ g) is in the least generation. The strength of the weak force depends strongly on the separation distance of particles and what is used to determine the strength here is the up quark. For the quark-force, or weak nuclear the strength appears as simply to be the ratio of masses. Published weak nuclear strength value is 10^{32} stronger than gravity. The proposed method is:

$$(2\pi)(m\xi_2/mu)^2 \text{ or } \sim 5.9 \times 10^{32} \text{ stronger than gravity.} \tag{8}$$

Along with the u-quark that can form the weak nuclear interactions, there is the d, quark that would have slightly lower strength if there is a separate force, because the d, is approximately two times more mass. Compared to gravity the strength of the d-force would be in this range for the given difference of mass.

$$(2\pi)(m\xi_2/md)^2 \sim 1.1 \times 10^{32} \text{ stronger than gravity.} \tag{9}$$

For distances of less, 10^{-15} cm. This d-force is similar to the above weak nuclear force, or the u-force. There are some benefits to considering the u- and the d- as two different forces in explaining the behavior of the weak and the strong nuclear inside the nucleus. Even considering them as one positive and one negative. The neutron beta decay, see below, may provide some clues for these possible separate forces.

The electrostatic force compared to gravity is well known, but by the proposed finding, based on the least generation (electron) the strength is:

$$(m\xi_2/\alpha me)^2 \sim 2.7 \times 10^{37} \text{ stronger than gravity.} \tag{10}$$

Or published as $\sim 1/137$ for the electrostatic e-force with the value compared to "one" for the strong nuclear force or $\sim 10^{39}$ compared to gravity.

If this proposed hypothesis is valid the following particle families and forces are dependent on each other. Gravity with xena ξ_2, electrostatic with electron, e-force. Weak nuclear u-force? Weak nuclear d-force? This presents four forces by this hypothesis. There are four forces known, but the ones presented here leave the strong nuclear force and the expected neutrino-force unaccounted. It appears that there is a force required for each least generation of a family of particles. Also, it seems that every fundamental particle group needs a massless per pair set of exchange states of forces. Gravity with the xena has the spin-2 graviton. Leptons have the photons with the spin-1 and quarks have the spin-1 gluons. Three groups of particles with three forces with massless exchange states. The exchange states with mass (W,Z) are not included here. To determine the neutrino-force strength, the mass of the neutrino must be found and used. The neutrino mass as stated, is a value given in 1979 above, and corrected as $m\nu = 1.2 \times 10^{-33}$ g. If one assumes that the proposed behavior, or the mass of the least generation is again the primary driver the neutrino as a particle can be taken to define the strength of a neutrino-force similar to those above. By this, the neutrino with the smallest mass is $m\nu \sim 1.2 \times 10^{-33}$

 doi:10.20944/preprints202504.0026.v1

g. Any particle by Eq. 1 can have its force to be the strongest force proposed compared to gravity and would therefore be the neutrino for the known particles:

$$(1/2\pi)(\alpha m\xi_2/m\nu)^2 \sim 7\times 10^{39} \text{ stronger than gravity} \tag{11}$$

The connection of neutrinos and gluons, yet needs to be found. It seems that simply, if the neutrino deep in the nucleus, "transforms" to cause gluons and quarks (mesons) what is known as the strong nuclear force could be this strong "neutrino-based" force without the need of an additional particle group. Also, it can be taken that the quarks inside the nucleus can undergo a mass (energy) increase. By this proposed inverse mass squared behavior, perhaps the strength of the force diminishes as the mass/energy increases in the least generation of quarks within the nucleus. This can be presented in quarks as a form of "asymptotic freedom" with increasing energy or decreasing separation. Also, an increasing separation resulting in less energy could increase the strength of the force with increased separation, or as "quark confinement." This, if real, hints of special coupling of particles with the fields present. It is puzzling why the neutrino and strong interactions seem to be related. At the environment of gluons however it is difficult to separate domains. The neutrino may be the key that opens the gate to new physics.

The proposed relationship for the strength of the forces as presented by the least generation method appears to be correct and can provide more information. The quarks as well as the leptons both have two members per generation. By the proposed hypothesis particles and forces have to align with each other and the concept is strong for alignment to use for other unknowns. The least generation to determine the strength of the fundamental forces indicates that a force needs to exist for each least generation of fundamental states. If this is correct, there is a force missing for one of the quarks.

3. Fifth Force

For several decades now the concept of existence of a fifth force has been examined, but up to now no proof is accepted. The most recent proposals for a fifth force are the experiments of beryllium-8 [5] (Krasznahorkay. A. J., Csatlós. M., Csige, L.; et al. 2018) requiring more data. The search for the fifth force is mostly by experimental data. What is here presented however, is based on the "verified" hypothesis concept of least generation of associate particles. It appears that this verification demands an existence of a fundamental force for every least generation of fundamental particles. This conclusion forces the possibility for a fifth force. Without an additional force the presence of the "d" quark, also in the first quark generation presents a dilemma for the weak nuclear force and the proposed least generation concept as presented. By strict interpretation of this proposed hypothesis there should be another force similar, but slightly weaker to the one given above (weak nuclear). Because only four fundamental forces are known, the concept of least generation mass squared for the force strength was taken with some apprehension. The mass of the up quark is so close to the mass of the down quark it was considered possible that some particle event dependent on each of the possible two forces similar, to neutrino oscillations, perhaps could be found. It is known that the lifetime of a particle has a dependence on the type and strength of the force of decay. Ideally then if the d-quark force exists, there should be a time of decay slightly different for the decay of the d-path and the u-path. This seemed like an impossibility to find and to understand such an event. The neutron beta decay was considered for the two forces. Experimentally the decay of the neutron displays a behavior of having two different lifetimes depending on the method of measurement (probably not fundamental, or "Bottle-vs-beam"). If one assumes that the different methods of measurement change the environment and thus the decay force by one or the other force the delay could verify the existence of another force. The difference in neutron decay times is 8 seconds added to the faster decay time of 14 minutes and 39 seconds.

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: 1 April 2025 doi:10.20944/preprints202504.0026.v1

Use of mesons (quarks) from the Collider with some test results can compare the strength of the u-path and the d-path if they are separate. If this d-force exists, it would complete the connection of the fundamental particle families to their fundamental associated forces. Some analysis currently may be difficult to explain with one force for both the d- and the u- but as two different forces (even one negative and the other positive can help explain some questions). The existence of this additional force may also help explain another astronomical mystery, which is the "missing lithium." Knowledge of the additional force may give required information for "correct" analysis of behavior of lithium, beryllium, and helium to possibly show the correct amounts. Five forces of least generations for "five" families of particles (ξ, d, u; e^2, ν). They are here arranged from less strength to more strength: The xena or gravity force, by definition, the strength is equal to one 1, The proposed possible d-force strength, 2×10^{32} the u-or weak nuclear-force, $\sim 5.5 \times 10^{32}$, the electrostatic or e-force $\sim 2.7 \times 10^{37}$, The strong nuclear or (neutrino-force?) $\sim 7 \times 10^{39}$. This strong force needs much more understanding and possibly can provide answers to unknowns, or to "new physics". It requires more knowledge of the neutrino behavior, mesons, gluons and color and matter antimatter states at "small" separations.

The following section presents some of the observed particle candidates for the xena. The super massive xena-2 causes the strength of gravity by the inverse mass squared hypothesis to become obvious by (Eq. 1) why the gravitational force is so weak.

4. Observed Candidates

The presented cause for the weakness of gravity not only solves the strength problem but also provides possible solutions to major unknowns in cosmology. The solution may be valid because it appears to provide likely answers to several topics and fields. The xena, interacting only by gravity, have become candidates for other universe unknowns such as dark matter particles. With some observed and calculated cosmic parameters for dark matter, it was possible to deduce the approximate rest mass of the smallest mass xena-6. Unlike leptons and quarks, this is not the smallest generation of xena but the highest, or generation-6 but has the least mass. These xena-6 should be stable and have all the requirements to be the dark matter states. From their behavior, of only interacting by gravity, to a rest mass that is about 1.9×10^{-23} g or 11.2 times more massive than the proton. By the proposed hypothesis, after the xena-2 and xena-4 decay and after a radiation phase of the universe, these xena-6 by Eq. 4a, are only half the total number in the universe, compared to the total number of baryons. If these xena-6 are the dark matter states, there would be 5.6 times more dark matter mass than baryonic mass in the universe. This ratio is what is precisely observed in the universe. The total quantity of "stuff" [1,2] based on the proposed hypothesis in the universe, which includes dark energy, is composed of $\leq$ 69% total dark energy, dark matter by the xena-6 is $>$ 26% and $>$ 4.3% approximate baryonic matter. These values are what is observed in the universe. If these xena-6 were to decay or collide anti-tau leptons decaying to antimuons then positrons and anti-neutrinos must be initially in the decay products. The xena masses are required to be the opposite of leptons and quarks in mass-vs-generation. This forces the xena to decay into leptons and quarks and to cause the present universe.

Another interesting phase of the universe that possibly the xena present, is prior to any baryonic matter the xena and only gravity is "all there is" in a dark universe. These primordial xena by gravity can quickly and directly cause collapsing dark gravitational, xena "lumps". There is no need for any intermediate step to form up to supermassive entities by this model. These lumps (antimatter?) can grow to be immense in mass by the time prior to the present epoch of leptons and quarks. In principle these dark lumps can be from mass less than baryonic black holes to dark supermassive xena spheres. These are possibly the primitives of what are now known as supermassive black holes. By this method the antimatter in the universe is not missing but is "safely tucked away" in supermassive black holes. These dark massive xena spheres can then act as seeds to speed up the causing of baryonic galactic systems as we know today and allow gravity to form the "early" fully developed galaxies. By this

 doi:10.20944/preprints202504.0026.v1

model every large size galaxy and some small, must have a supermassive black hole. Any xena outside the event horizon that decay or become cosmic rays with the GZK limit, can assist to form very high energy baryon beams via what is possibly a quasar phase. The xena epoch lasts approximately as long as the lifetime of the xena-2 and the xena-4, expected to be in many years. If the xena period is relatively long it may be possible to detect this epoch. If one can detect the equivalent Hubble parameter during the xena epoch it can be compared to the current Hubble value. The closest early environment available is the CMB. If there is sufficient time separation between the two epochs, an observation using the CMB and baryon acoustic oscillations will result in a lower Hubble value at the early universe than an observation based on current stellar matter environments of leptons and quarks like supernovae. The latest estimate of the Hubble "constant" based on CMB observations by the *Planck* satellite is: $H_0 = 67.4 \pm 0.5$ km s^{-1} Mpc^{-1} [11] (Planck Collaboration VI 2020) with the most recent estimate for the current value by [12] (Riess et al. 2019) who obtained: $H_0 = 74.03 \pm 1.42$ km s^{-1} Mpc^{-1} using the Cepheid calibration of SNe Ia [14] (SH0ES). A new estimate of the local expansion rate is about 73 km s^{-1} Mpc^{-1}. If these data are correct, the xena epoch is expected to show a Hubble value behavior exactly that, with the early universe having the xena expansion epoch with a lesser value. A quasar beam can be a mix of reducing high energy xena number densities and increasing baryon number states. If this is so, a high energy quasar like the recently discovered J0313-1806 could be such a state and a possible source of cosmic rays with baryonic energies limited by the GZK limit unless they are xena. That kind of high energy coming from such quasars can indicate that the xena model may be correct. This kind of quasar is what a team of astronomers led by the University of Arizona has observed as the very luminous quasar. Biggest and most distant yet (J0313-1806) [13] (Wang. F, et al 2021) over 13.03 billion light-years distant. This would date back to when the universe was about 5% of its current age. This quasar has a supermassive black hole equivalent to the combined mass of 1.6×10^9 solar masses. Such super massive black hole this early in the universe age, again is outside the probability for conventional development into such mass so quickly from stellar-size black holes. This xena epoch model can also be an explanation for the unexplained immense size of known large structures that do not fit into a big bang universe age cosmology. Such structures as the Great Wall in Hercules-Corona Borealis, which is over 10 billion light years in length.

5. Possible Detections of Xena

With this minute cross-sectional interaction area that is only by gravity, the xena can traverse through matter almost with the same ease as "slow" neutrinos, but can carry immense quantities of energies. Evidence of such paths and energies, could be the cosmic rays detected by the IceCube Collaboration [6] (Aartsen. et al. 2020) and ANITA (ANtarctic Impulsive Transient Antenna) Collaborations [7] (Bird, D. J. et al. 1995). They have detected neutral high energy cosmic rays coming from below the Antarctic ice after these rays must have traversed through most of the Earth. It is difficult for high energy neutrinos to accomplish such a feat and no known particles can do this. It is possible however, for one of the xena, with the minute cross-section, by gravity to do exactly this with ease. If these signals are sustained as real, indicating neutral energetic states such cosmic rays can be taken as proof of existence of the xena to be the gravity associated family of states as proposed. If these cosmic rays are real and cannot be attributed to the xena, then the SM is probably partly wrong. In addition to the IceCube and ANITA collaborations data with such ultrahigh energy and anomalous trajectories are predicted by the xena as cosmic rays. The xena family is required to be a set of three, spin one bosons with rest masses from about $\sim 2 \times 10^{-23}$ g to $> 3 \times 10^{-11}$ g. Another "peculiarity" of the xena is that they should preserve chirality. Matter xena states should be left-handed (by Cosmic Symmetry breaking early in the universe) while antimatter states should be right-handed.

Considering the rest masses of the xena it is expected to detect cosmic rays with "bumps" in their signature at about 10^{11} eV, to $> 10^{15}$ eV or in the range of what is known as the "knee" of the cosmic ray signature. Particles, with much higher energies in what is known as the "ankle" and above

 doi:10.20944/preprints202504.0026.v1

range with energies above 10^{22} eV should exist. This energy is like the "Oh-my-God" particle (3×10^{20} eV) detected by the Fly's Eye detector (15 October 1991) in Dugway Proving Ground, Utah, US. Also, such ultrahigh energy particles are detected over several years by the Pierre Auger Observatory Collaborations. For proving existence of xena such high energy particles must be the primary parent particles which are the xena. Perhaps, what is occasionally observed in these massive particle showers, could be the result of a collision, or decay of a xena-2, or xena-4, or even xena-6 state. Also, if these observed high energy cosmic rays travel as xena, it explains why they are not obeying the Greisen-Zatsepin-Kuzmin limit above energies 10^{18} eV, relativity limit [8,9] (Greisen. K., Zatsepin, G.T. Kuzmin V.A, 1966). Cosmic rays with energies well beyond this limit are known, but difficult to be explained without the xena.

Also, the Alpha Magnetic Spectrometer [10] (Aguilar-Benitez M, et al 2013) on the International Space Station has tracked more than 100 billion cosmic ray hits and shows an excess of positrons (of 0.5-350 GeV). The xena-6, ξ_{+6} associated states as dark matter particles would fragment with lowest energy $\sim$ 10 GeV to positrons via antitau and antineutrinos. Positrons with the lowest energy is what is observed with AMS. Electrons and antinucleons from the xena would show up at higher energies, above 250 GeV. The ultra-high energy detections can substantiate the value of, γ, as equal to one in the calculation of the mass for the ξ_2 least generation state defining the strength of gravity.

6. Conclusion

It is shown that each force, including the long-range electrostatic and gravity forces must be associated with its own family of states. In addition, the least generation member's mass of these states defines the strength of each associated force. This finding forces the addition of the xena in the SM as a family of massive boson states that only interact by gravity. It is also probable that the observations of unknown high energy states can be these xena states and data should be reviewed and analyzed with this possibility.

The particle, therefore, that defines the strength of force of gravity is about $> 10^{13}$ more massive than the proton. This forces the strength of gravity simply by the proposed inverse mass squared relation to be calculable and be weak as measured. Therefore, gravity has no need for more complex and multidimensional causes for an explanation of this feebleness. Also, the existence of the xena family of states can provide possible solutions to some major cosmological, currently unsolved mysteries. Such as what is dark matter, why only three generations of leptons and quarks, how supermassive black holes formed and where is all the antimatter to balance our unidirectional universe. It is believed that the xena states are probably real since they help explain such large number of unsolved events. The concept of force and least generation state dependence also presents the possibility of a fifth force (d-force) hiding as a twin within the weak nuclear force. The force known as the strong nuclear force, may bring new understanding to forces and to neutrinos.

References

1. Ierokomos, N. (2011). The Universe Via Continuum Creation and Annihilation. Phys. Essays, 23, 451-458.
2. Ierokomos, N. (2011) Cosmology of Continuum Creation and Annihilation. Journal of Cosmology, 17, 7384-7411.
3. Ierokomos, N. (1984). Universes and Stuff: A Unifying Concept of Nature. (140-143) Adams Press, Chicago, Illinois, US.
4. Beglarian, A., E. et al. (2021). Forward Beam Monitor for the KATRIN experiment, arXiv:2101.11495 ast astro-ph.
5. Krasznahorkay, A. J.; Csatlós, M.; Csige, L.; et al. (2018). "New results on the ^{8}Be anomaly". Journal of Physics: Conference Series, 1056: 012028.
6. Aartsen, M. G., et al. (2020). A search for IceCube events in the direction of ANITA neutrino candidates. The Astrophysical Journal, Volume 892, Number 1.

doi:10.20944/preprints202504.0026.v1

7. Bird, D. J.; Corbato, S. C.; Dai, H. Y.; et al. (1995). Energy Well Beyond the Expected Spectral Cutoff due to Cosmic Microwave Radiation. The Astrophysical Journal, 441, 144-150.
8. Greisen, K. (1966). End to the cosmic-ray spectrum? Phys. Rev. Lett., 16, 748–750.
9. Zatsepin, G. T.; Kuzmin, V. A. (1966). "Upper Limit of the Spectrum of Cosmic Rays". Journal of Experimental and Theoretical Physics Letters, 4: 78–80.
10. Aguilar-Benitez M, et al. (2013). Precision Measurement of the Positron Fraction in Primary Cosmic Rays of 0.5-350 GeV. Phys. Rev. Lett., 141102-10.
11. Planck Collaboration VI (2020). The latest estimate of the Hubble constant based on CMB observations by the Planck satellite is $H_0 = 67.4 \pm 0.5$ km s^{-1} Mpc^{-1}.
12. Riess et al. (2019). $H_0 = 74.03 \pm 1.42$ km s^{-1} Mpc^{-1} using the Cepheid calibration of SNe Ia (SH0ES program).
13. Wang, F., et al. (2021). A Luminous Quasar at Redshift 7.642. arXiv:2101.03179 [astro-ph.GA].
14. SH0ES Collaboration.