Black hole laws and potential energy reinterpreted

MICHAEL LAWRENCE
Maldwyn Centre for Theoretical Physics, Park Road, Ipswich, Suffolk, United Kingdom
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The paper considers the interpretation of the four laws of black holes and potential energy in terms of the Extreme Energy-Symmetry Model (EESM) and the foundational pre-fermion hypothesis. The basis of the pre-fermion model is one type of fundamental particle, and anti-particle, that are the densest possible bodies, which cannot be broken inside massive black holes. The mass and charge potential energies of those particles and their composite forms are each shown to exist in two forms, how particle A affects particle B and how B affects A, and that this can be different to current definitions in certain interactions. The size of the potential energies may be the same for each of the particles, but they only act in the way currently accepted between charges and same-sign masses. The extreme symmetry proposed implies that negative masses attract negative masses and that they chase or are chased by positive masses, and vice versa, with these latter actions being the underlying reason why photons travel at a terminal velocity, in the relativistic environment, that is termed light speed. With the extreme symmetry proposed, it is not possible to say whether a body inhabits a positive or negative energy-based environment because the outcomes are the same.

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I INTRODUCTION

The EESM, and its basis in the pre-fermion hypothesis, seeks to start a reassessment of the current interpretations of all physics, although disagreeing with none of the experimentally observed results. Currently there are some sections of the physics jigsaw which fit together well, and some that do not. The diagrams shown below are a simplified explanation of how to assemble, from the fundamental level, the particles that are normally observed in the universe. Symmetry and simplicity underlie what follows. There can be no simpler system than devised here.

Based on the diagrams, and their descriptions of how each building block or composite body can be construed as compliant with the black hole laws, their entropy and potential energy content are considered. The comparison is with the currently accepted four laws of black hole mechanics [1].

The potential energies of two particles are reinterpreted to show that each particle's own mass potential energy, although equal in size, does not always act in the sense currently accepted. The charge potential energy that exists separately for two charged particles, with the same size energy for each, has the action between them as is currently expected. Because the particles we observe have only attractive mass, the potential energy of each particle is the same size and acts in the same way as currently expected. It is only the fundamental mass energies which do not act as expected between meons and anti-meons.

II. BACKGROUND

This paper and the EESM are based on a pre-fermion hypothesis, proposed previously, partially presented in a diagrammatic way, rather than the verbose method with equations used before [2], [3], [4], [5], [6]. The paper uses a modified Double-adjusted Planck unit system which eliminates the gravitational constant G by merger with the SI mass and distance units and adjusts the electron charge q by $\sqrt{1x10^{-7}}$. The Planck constant h could also be eliminated by merger with SI mass and distance units but is retained here for clarity.

The referenced papers have proposed symmetry in the actions of energies and a pre-fermion hypothesis that fermions are composite particles. And that the same unmerged building blocks forming those fermions are also, in partially merged form, the fabric, or base material, from which the universe is made. Our current SI system of units acts to hide the real relative strengths and sizes of those underlying building block fundamental properties of adjusted-Planck sized mass, charge and radius.

III. SIGNIFICANCE and OBJECTIVES

The significance is that only some of the four black hole laws apply to some of the fundamental and composite systems considered here. The only system that complies with all the laws is that of a massive black hole, as would be expected. However, since the building blocks are themselves the densest black holes possible, it implies that the scope and applicability of the laws need to be reconsidered.

The reinterpretation of the nature of potential energy uncovers that it does not, at the fundamental level, act in the same way that is currently understood. The chase/chased action of certain potential energies is the driver of the motion of photons in travelling at a terminal velocity in the local background that is called light speed.

The objectives are to show how the black hole laws fail to apply in systems that they would be expected to apply to and how the structure of, and potential energies acting within and on, a photon and the background produce what we observe in light and in loops.

The paper intends to show why a completely new way of looking at existing observations is required. Many of the current basic physics principles need reinterpretation.

Paradoxes and issues of gravitation, baryon asymmetry, dark matter, dark energy, mass, symmetry breaking (or lack of) and anomalies in cosmology are explained through the model.

The result is a system of one single building block, one single observable composite form and only two fundamental energy types that both underlie and expand beyond the Standard Model.

The following series of figures, with explanations, start from the foundation level and end at atoms and the universe. They also show why quantum mechanics does not exist inside the surface of massive black holes.

IV THE DIAGRAMMATIC REPRESENTATION

All figures are not to scale and are shown in two-dimensions, although the components are all three-dimensional. In some of the figures, some of the components are omitted for clarity. A single column layout of the paper has been used to accommodate the large figure sizes and potential energy equations set out for each body considered.

Unfortunately there has to be a certain amount of skipping backwards and forwards in the explanations because some properties, such as gravity and spin, are emergent energies that depend on structures and interactions at different levels. The paper tries to follow a path from the simplest systems to the more complex ones, but some fundamental environments require interactions from more complex systems in order to better understand them.

The section on potential energies provides a breakdown of all the mass and charge potential energies between different meons, anti-meons and loops.

At the end of the figures section is a table showing which of the laws of black holes appear to apply, in which environment, to which system.

A) A Zero mass black hole (ZMBH)

Figure 1

Figure 1 shows the underlying material from which the universe is made – effectively there is nothing there - but the unit volume hides that it is a composite. A myriad of these zero mass black holes (ZMBHs), of adjusted-Planck radius $R = \sqrt{h/c^3}$ *metre* spheres, is how the universe may have started. These ZMBHs have no mass or charge in total because when fully merged the properties of the two component fundamental particles, a meon and anti-meon, exactly cancel. There are no mass or charge fields within or beyond the physical volume that the ZMBH occupies when the meon and anti-meon are totally merged.

This volume represents the unit size of the fundamental building blocks of the universe, so that in all compound systems, using the component meons and anti-meons which unmerge, they cannot change size and so there is no expansion of 'space' due to this effect in the currently accepted sense. Space only exists where there are meons and anti-meons that are not fully merged. There are no singularities because the building blocks are unbreakable. Meons and anti-meons are the densest

particles possible and cannot be broken, even inside massive black holes, so physics does not break down anywhere.

In terms of entropy, since there is nothing observable within or without the adjusted-Planck radius, there can be no entropy present. There is no discontinuity or net property onto which any external force can act and for the solitary ZMBH, there is nothing else present to act. The black hole laws do not apply to ZMBHs.

B) A meon and anti-meon (both stationary and individually non-rotating)

Skipping ahead slightly, looking separately at the two components of the ZMBH, the meon and anti-meon, each does have fundamental mass and charge fields. The fundamental mass of a meon is $M_+ = +\sqrt{hc}\ kg$ with fundamental charge $Q_+ = +\sqrt{h/c}\ C$. Even though both fundamental mass and charge energies here are positive, they are opposite energy types, so balance to zero for each meon or anti-meon. The anti-meons have fundamental mass $M_- = -\sqrt{hc}\ kg$ and fundamental charge $Q_- = -\sqrt{h/c}\ C$, balancing again to zero.

When stationary and non-rotating, the meon has positive mass energy density $\varepsilon_{M+} = M_+c^2/(4\pi R^3/3) = +3\sqrt{hc}c^2/(4\pi R^3)$ with the same size, but negative, for the anti-meon. These are the densest possible particles and so cannot be broken by any composite or collection of similar meons or anti-meons. All composites composed of meons and anti-meons will always be less dense than individual meons and anti-meons.

When stationary and non-rotating, the meon has charge energy density $\varepsilon_{Q+} = +Q_+c^3/(4\pi R^3/3) = +3\sqrt{h/c}c^3/(4\pi R^3)$ with the same size, but negative, for the anti-meon.

The definition of the entropy of a stationary non-rotating meon cannot take into account any change in radius of a meon or anti-meon because these fundamental particles do not change physical size – these are not, on their own, what we observe as mass, as will be shown later. They have the same surface area regardless of their rotation or external motion, but are still black holes and need to be considered against the supposed laws of black hole mechanics.

Zeroth Law

A stationary non-rotating meon or anti-meon complies with the zeroth law because each is at constant internal mass energy density, unless part of each is merged with its opposite partner when the new enlarged volume encloses two smaller non-overlapping volumes. The extreme case is full overlap/merger when the mass energy density of the pair falls to zero overall as a ZMBH. However, individually each still retains its own mass energy density. Therefore each has its own temperature, which will be the adjusted-Planck temperature because Boltzmann's constant can be eliminated by merging it with the Kelvin scale, leaving the new temperature scale simply as the mass energy that the meon or anti-meon possesses. In this case, for the meon, the Planck mass energy $E_{M+} = M_+c^2 = +\sqrt{hc}c^2 = T_{M+}$. However, where there are other meons or anti-meons present, there will be potential energy changes, although no surface area changes, so that the law is not observed.

Since the meon and anti-meon radius remains unchanged in physical size at the adjusted-Planck radius, this is also their horizon. This is different to the Schwarzchild radius for a massive black hole and is due to the different mathematics of orbital versus meon-in-loop mechanics.

Skipping ahead of the thread of the explanation, and explained later, firstly, quantum mechanics does not exist within massive black holes, only at their surface, so no quantum mechanics is required at this simple level of only one meon or anti-meon. Quantum mechanics requires loops and the meon, or anti-meon, currently being considered is not yet part of a loop.

Secondly, there are no statistical terms in the consideration of a single stationary non-rotating meon or anti-meon. There is only one state that exists because the meon and anti-meon are completely radially symmetric so that no orientation is different to any other orientation. The surface area of each meon and anti-meon is $A_1 = 4\pi\ R^2$.

In the case of a single meon, or anti-meon, there is only one state and one mass energy size E_M, so that entropy of such a meon-only system S_1 will be 1 and the ratio of entropy to energy $S_1/E_M = 1/Mc^2 = 1/T_M$. This latter is different to the usual [7] because there is no cavity within which to observe anything – there are no photons to produce radiation for us to measure, again because the meon and anti-meon here are not components of the double-loop of a photon.

Note that the ratio is not a bound for S_1/E_M but a precise value. It is positive for the fundamental mass energy of a meon and negative for the anti-meon, so that the fully merged pair has zero entropy as is the case for the ZMBH. The pair will appear exactly the same regardless of how they are observed (although as a fully merged pair they cannot actually be observed).

Exactly the same relationships exist for entropy when considering the fundamental charge of the meons and anti-meons. The EESM proposes that for all systems, for every fundamental mass energy there is an equal and opposite fundamental charge energy. It should therefore be the case that entropy be split into mass entropy and charge entropy, with the introduction of equivalent charge temperatures - although how to observe the latter is unclear.

Many such fully merged pairs, the ZMBHs, may be the material from which originally the universe was composed, but we could not observe them. Of more interest is the partially merged pair which introduces the EESM proposal that for all systems, for every emergent mass-related energy there is an equal and opposite emergent charge-related energy, which is the basis for the calculations in the Potential Energy section.

1st Law

Considering the first law of black hole mechanics for a solitary stationary non-rotating meon or anti-meon, there is no change in fundamental mass or charge or angular momentum, so the law is observed for changes in energy, although there is no possible change in energy or in surface area. However, where there are other meons or anti-meons present, there will be potential energy changes, although no surface area changes, so that the law is not observed.

2nd Law

The second law is not observed because there is no possibility of any emission or absorption by a meon of a meon, or by an anti-meon of an anti-meon. External motion may increase the mass energy of a meon, but does not change its surface area. However, without anything existing other than the isolated meon, or anti-meon, a change of reference frame would eliminate the imparted extra energy of motion.

3rd Law

The third law is observed simply because there is no 'forming' of a meon or anti-meon into a black hole. They are each the pre-existing building blocks of ZMBHs and are already black holes. What they have at their horizons is a source of fundamental mass and charge fields which can only vanish when a ZMBH of fully merged meon and anti-meon is formed. Gravity is the emergent property of rotating loops, composed of meons and anti-meons, within the background universe material of myriad partially merged pairs, so does not exist in the accepted form at this foundation level – however its equivalent is the fundamental mass field which is the mass energy property of the meons and anti-meons.

In the isolated case of a meon, or anti-meon, there is no myriad of partially merged pairs existing to transfer those forces due to the fundamental mass or charge energies outside their respective horizons. Where there are other meons or anti-meons present, then it could be said that an unmerger of a pair of meon and anti-meon 'creates' a black (or white) hole.

C) A partially merged pair (no twist or one-sixth charges)

Figure 2

Figure 2 now shows the two partially merged components of the previously fully merged ZMBHs as a pair of meon and anti-meon, of same physical shape and size. As before, the meons have fundamental mass $M_+ = +\sqrt{hc}\ kg$ and fundamental charge $Q_+ = +\sqrt{h/c}\ C$, whilst the anti-meons have fundamental mass $M_- = -\sqrt{hc}\ kg$ and fundamental charge $Q_- = -\sqrt{h/c}\ C$. These are double adjusted Planck units, as defined above and previously [8], [9] but here retaining Planck's constant. The presumption is that, for extreme symmetry, just as positive fundamental mass attracts positive fundamental mass, so negative

fundamental mass attracts negative fundamental mass.

This latter is very different to the normal assumed action of negative mass energies [10], which are usually expected to repel other negative mass energies. The EESM proposes that it is not possible to conclude which is a positive energy system or which is a negative energy system because they both have the same actions and effects. It is only possible to observe that two such different systems are different, although both will produce the same photon double loops.

The fundamental masses are not what we usually term the 'mass' of a 'particle', as mentioned above. The fundamental charge acts in the same way as normal charge, but is never observable at the size Q, only at the electron size q or multiples of $q/3$ in quarks.

In the figure, the pair are partially merged and will stay that way unless they become unmerged. The pair may gain different energies in order to translate, rotate, vibrate, spin and form chains with other partially merged pairs.

The additional energies are called 'emergent' because they are not the fundamental mass and charges that the stationary non-rotating meons and anti-meons had originally.

Initially the concern here is simply that the pair may have external or internal kinetic energies due to translational motion or rotation around a mutual axis. Both types of kinetic energy can be treated in the same way using appropriate translational or rotational frames of reference.

However, there is a vital distinction that needs to be made about what the environment is in which a system of solitary meon and anti-meon as a partially merged pair are considered. Either the system exists within the background of myriad such partially merged pairs, or alternatively without any background.

No-background environment

The no-background environment is essentially the quantum realm where the background is excluded. But the exclusion is usually generated by forming tunnels between entangled loops, whereas there are no loops in this discussion yet. So the no-background system for a partially merged pair is a hypothetical state only.

Background environment

Within the background environment a single partially merged pair would be in contact with, and have to travel through, the background of partially merged pairs. This travel style will lose energy to the background – through a type of shear viscosity opposing their motion proportional to their individual volumes and the local background density. However, because all systems always have zero energy in total, it is the size of the balance of each energy type that reduces in the travelling pair. A meon of the pair may have a reduction in its positive energy whilst travelling through the background, but the partner anti-meon will have a reduction in its negative energy whilst travelling. Since the background is myriad partially merged pairs, the change in size of balance within the background will be to increase some of those background partially merged pairs' balances. This means that whilst a meon suffers a negative energy viscosity drag on its positive mass energy, an anti-meon will suffer a positive energy viscosity drag on its negative mass energy.

Skipping ahead again, in the case of photon double-loops, the energy balance would be taken from the rate at which the photon rotates, so its frequency would reduce. Since this background viscosity affects only the meons and anti-meon components of the photon, the frequency reduction would be independent of the frequency of the photons – producing frequency-independent tired-light. Covered later is the action of the partially merged pairs that form across the two loops of the photon double-loop and power it up to its maximum terminal velocity within the local background – which is the local light speed, dependent on the density of the local background.

However the isolated partially merged pair being considered is not part of a photon, so the total motional mass energy of a meon travelling in the background will include some function of the velocity and viscosity drag $g(d)$ in addition to its rest-mass energy as $E_{MB+} = M_{+}(c^2 + f(v^2)) - g(d)$ with the same form for the anti-meon and for the charge energies of each, but with the addition of the viscosity drag for the anti-meon as $E_{MB-} = -M_{-}(c^2 + f(v^2)) + g(d)$. The function f is in v^2

to match the dimensionality of its expected kinetic energy-like form and the function g is expected to be distance d dependent.

These latter energy equations can be compared with the energy of the photon within the background, where the total motional mass energy of each meon or anti-meon in each partially merged pair within the composite photon (each pair aligned along the direction of travel of the photon) will have the same size as the overall photon, but either positive or negative in sign for the meon and anti-meon respectively.

This energy for a meon will be $E_{MB+} = \gamma M_+c^2 - g(d) = +\gamma\sqrt{hc}c^2 - g(d)$ where γ is the relativistic factor. That same meon in a photon in translational motion within its partially merged pair within the photon will have total motional charge energy $E_{QB+} = +\gamma Q_+c^3 - g(d) = +\gamma\sqrt{h/c}c^3 - g(d)$ which is exactly the same size, but of opposite type, to its mass energy. So the positive meon again has zero total energy, as in the stationary case, but is losing energy size balance to the background as it moves. The same is the case for the anti-meon, although the signs of the mass, charge and viscosity energies are reversed.

The local viscosity sets a maximum velocity in the local background environment that is the variable local speed of light. At this velocity the total energy is still zero for each component and overall zero for the photon, but the balancing size will be the photon energy $E_\gamma = 2\,h\,f(w)$ at each point along the photon path with meon energy $E_{MB+} = h\,f(w) - g(d)$ along the photon path. The function f is the same as for v^2, but along the path the photon mass energy will be $E_\gamma = 2\,h\,f(w) - 2g(d)$, reducing linearly, in constant local background density, over distance. For an anti-meon the mass energy along the photon path will be $E_{MB-} = -h\,f(w) + g(d)$.

Because what we observe as the mass of a loop is only the emergent kinetic part of its rotation, since the fundamental parts all sum to zero for any chosen mass or charge components, the relativistic factor is not observable. Therefore only the emergent part, which still sums to zero over the whole photon, is observable as the rotational frequency of the photon, made of the two loop component motional mass energies.

This means that at low photon frequencies, the f factor will be indistinguishable from ½ so that inside the background for each meon, or the whole photon, we observe the latter and infer the former to have mass energy size $E_{KB+} = (\gamma - 1)M_+c^2 - g(d) = +½\sqrt{hc}v^2 - g(d) = h½\text{w} - g(d)$ along its path, with double that for the double-loop photon.

No-background environment

In the no-background hypothetical state there would be no viscosity energy loss and so the total mass energy of a meon will be $E_{MN+} = M_+(c^2 + k(v^2))$ at all times, where the function k may be a different function to f. However, without any partially merged pairs available to transmit the energies, these will not be observable beyond the enveloping radius of the pair.

With background environment

For the merged portion of the pair, within the background as previously, each mass or charge energy sums to zero, with $E_{MT+} = \gamma M_+c^2 - g(d) = +\gamma\sqrt{hc}c^2 - g(d)$ balanced by $E_{MT-} = -\gamma M_+c^2 + g(d) = -\gamma\sqrt{hc}c^2 + g(d)$ for the mass energies and the same, reversed for the charge energies.

However, in this partially merged case within the background, there will be external fields acting and observable beyond the maximum still-just-merged distance of $2R$ between centres which was not the case for the ZMBHs and the no-background case.

In terms of maximum motional mass energy density at any point within the background – meaning the energy value of one source of potential mass energy when the meon and anti-meon centres are at their maximum distance of $2R$ apart - the positive meon will be $\varepsilon_{m2R+} = \gamma M_+c^2/(4\pi(2R)^3/3) = +3\gamma\sqrt{hc}c^2/(4\pi(2R)^3)$ within the volume that contains the pair of $V = 4\pi(2R)^3/3$. This would seem to be without upper boundary because γ could increase to infinity if the velocity increased to c. However, the actual velocities of meons and anti-meons in stationary rotating loops which we observe are much lower, and in the case of photons travelling at light speed, the pairs are completely merged across loops, so their overall energies

sum to zero again. The viscosity energy change would be over distance, whereas this latter is just looking at the instantaneous value.

As in the ZMBH case, there is no quantum nature to consider, even in the no-background system because there are no loops, and no statistical terms, for this single moving or rotating pair of meon and anti-meon. There are however an infinite number of states when considering the possible directions of travel or of axes of rotation by the pair. The surface area of each meon and anti-meon is still $A_1 = 4\pi R^2$ although the correct area is from the V for the pair within the encircling sphere radius $2R$ and overall at maximum extent is $A_{pair} = 4\pi (2R)^2 = 4A_1$ and, at minimum, is zero when fully merged.

Considering the entropy to mass energy of the meon within a pair, within the background at any instant, the ratio will be $S_{p+}/E_{MB+} = \infty/\gamma M_+ c^2 = \infty/T_{MB+}$ which could take any value, although tending towards unity as $v \to c$ for the meon. The same size, but negative value will be the case for the anti-meon.

Zeroth Law

Looking at the zeroth law of black hole mechanics for a partially merged pair, although it can be said that the temperature at the horizon of each unmerged portion of a meon is a well-defined positive value, or negative for the anti-meon, the merged portion has no temperature. So the pair, as a complex particle, has three distinct temperatures and so cannot be considered to be in thermal equilibrium. This accords well with the expected interaction of such a pair where the meon chases the anti-meon, or vice versa, and each is chased in turn, respectively, so that there is no stable state for a partially merged pair, as explained in the Potential Energy section below.

Within the envelope of their remaining just-partially merged, the pair will be continually rotating about a symmetric axis through the pair or chasing/being chased translationally. It is also the case that in a no-background environment, there can be no fields beyond the volume that the meon and anti-meon occupy, at any instant, because there are no partially merged pairs to transmit those fields. However, within the background, the fields from the unmerged portions will be polar along the axis between them and so will not be constant over that volume.

1st Law

The first law is followed in a no-background environment because the pair always have total zero energy each, regardless of the value of any change or of any viscosity effect. The full or partial merger of a pair of meon and anti-meon is a natural part of the motions of the pair and results in a change in entropy of the merged portion, although not of either of the unmerged portions. Overall such a pair will always have zero total mass entropy, regardless of the individual size of the meon or anti-meon mass entropy, but the surface area varies between zero and $4\pi (2R)^2$. It is not followed when there is a background environment.

2nd Law

The second law does not apply because a pair cannot emit anything because there is nothing to emit and the change in area can be positive or negative as the merged portion increases or decreases due to the relative motion of the meon and anti-meon.

3rd Law

The third law does not apply in part because the merged portion, where a meon and anti-meon overlap, produces a volume where there are mass energies that sum to zero so there is no source of fundamental mass energy fields from that volume – and the latter is not in any case ‘gravity’. What is the case is that the two unmerged portions of meon and anti-meon will have mass and charge fields through that merged portion, so that there will be internal fields within that volume, as well as extending beyond the total volume of the sphere, of the pair’s instant extent if existing within the background,. That sphere will extend between $2R$ at maximum and $1R$ at minimum. If the pair are in a no-background environment, only the internal fields will exist since there would be no partially merged pairs existing to transfer the energy fields.

D) Partially merged pair chains

A major action of partially merged pairs is to interact with other partially merged pairs, as well as unmerged meons and anti-meons. In their chase/chased actions, a pair will be attracted to another similar pair and form a chain.

Chains can be any length and can also attach onto their own tails to form loops of partially merged pairs. Since the energies of all meons and anti-meons and of all pairs always sum to zero, so do all chains and loops made of partially merged pairs.

These chains are what transmit all forces. Where there are no partially merged meon chains, other than directly between unmerged meons or anti-meons, there are no forces able to act.

A myriad of the partially merged pairs are what the background to the universe has become, through which all relativistic motion occurs. Although the mass and charge energies are different energy types, as mentioned above, they are always equal in size in all meons, anti-meons or compound systems. The amount of one energy type in one system interacts with its same energy type in another system, despite the total of all energy types always summing to zero in all systems.

It is the mode of how the chains, and their component partially merged pairs within the chains, move, twist, vibrate, and rotate that enables energies to be transmitted as forces from chain end to chain end.

It is the rotational rate of loops of unmerged meons and anti-meons that enables the production of what we term ‘gravity’ and the ‘spin’ of a particle. Each unmerged meon and anti-meon has multiple chains of partially merged pairs attached to it that are dragged through the background. The dragging effect on the background, and the effect of the background on the loop of unmerged meon, is both gravity and spin, in the normal sense. Specifically it is better to consider them respectively as the mass energy of the loop rotation (‘mass’), although in total there is always zero energy, but the loop still rotates, and the charge energy of the loop rotation (spin) – not the loop charge.

The mass energy of the loop is the size of the kinetic energy of each of its component meons and anti-meons as $E_L = h(½\ w_L)$ at low w_L. The spin energy is the same size, but we currently consider only the spin angular momentum component as $½\ h$.

The laws do not apply to partially merged pair chains individually if they are too short to form double-loop photons.

E) Unmerged meons and anti-meons (with twist and one-sixth charges)

Figure 3

Figure 3 shows a partially merged pair that has unmerged into its component meon and anti-meon, The energy needed to unmerge a partially merged pair is always the same size at $\pm qc^3/6$, which is why the size of charges on our three-pair fermions and bosons are always multiples of $q/3$ or zero.

The unmerger involves the meon and anti-meon spinning about an internal axis with those axes parallel to each other. The result of that spinning (from here-on termed ‘twisting’ to differentiate from loop spin) is the subsequent spiral rubbing of the surfaces of the meon and anti-meon against the background as the pair move translationally. The rubbing against the background generates one-sixth the size of the electron charge, positive and negative together, on the pair such that the total so generated is always zero. The direction of transverse motion coupled with its twist orientation and the identity of meon or anti-meon decide which of the pair has which sign of one-sixth charge.

The action of this unmerged pair is now twofold. The laggard of the pair acts to try to reform the partially merged pair, whilst the leader acts to try to maintain separation from the laggard (see the Potential Energy section below). In this way the unmerged pair is now exactly like the partially merged pairs in its chasing action when in transverse motion, but at a separation greater than $2R$ and with the extra emergent twist and one-sixth charge energies.

The twist energies and one-sixth charge energies are again equal and opposite, with the same distinction between no-background and within background systems, so that only within the background can mass and charge fields exist outside the envelope of the pair. The mass and charge energies/forces directly between them are maintained by chains that remain in place once formed at unmerger, unless the pair is broken during the breaking/reforming of unmerged meon and anti-meon pair chains or loops.

The energies and entropies of an unmerged pair take the same form as the partially merged pair, except that there is no longer any change in total surface area because such a pair does not overlap, with the separation always greater than for partially merged pairs and there are now the twist and one-sixth charge energies. For a meon, within the background, the mass energy is $E_{MU+} = \gamma(M_+ \pm s/6)c^2 - g(d)$ where $sc^2/6$ is the twist energy, which may be positive or negative depending on the orientation of the twisting. The anti-meon mass energy is $E_{MU-} = -\gamma(M_+ \mp s/6)c^2 + g(d)$. The meon charge energy will be $E_{QU+} = \gamma(Q_+ \mp q/6)c^3 - g(d)$ where $qc^3/6$ is the one-sixth electron size charge energy. The anti-meon charge energy will be $E_{QU-} = -\gamma(Q_+ \pm q/6)c^3 + g(d)$.

Once again, each energy is balanced across mass types and charge types within each meon and anti-meon, totalling zero overall. However, whilst the emergent twisting mass energy is internalised as the spiral twisting motion of the meon and anti-meon, the opposite type emergent charge energy is observable as the loop magnetic moment and overall charge of the pair – even though here initially on unmerger that total for any pair will always be zero. After chain formation, breaking and reforming, it will not necessarily be the case that the same meon and anti-meon remain as a pair.

The magnetic moment of the loop is due to the need to have the size of the mass angular momentum, and therefore motional energy, of each meon and anti-meon equal to h. This constrains the equivalent charge angular momentum to have a component that is externalised. The magnetic moment is therefore part of the total charge angular momentum that is already balanced with the motional mass angular momentum. The value of each loop magnetic moment, for an electron, is $2.x$, where x is not the anomalous magnetic moment, but a lower value.

The potential energy between and within pairs, partially merged or unmerged is covered below in the Potential Energy section which shows that the meon and anti-meon chase/are chased. That is not the case when either a meon or anti-meon is not chasing/being chased, which is when each is interacting with another of the same type. There will be attractive potential energies to address within and across the loop for both meon-meon and anti-meon-anti-meon interactions.

For unmerged pairs in a no-background environment, the differences will be that there are no force carriers to transmit energies for either the meon or anti-meon in their separated state. So there will be no forces between the pair and no viscosity acting to retard their motions. But both will still have zero energy individually and in total, regardless of velocity.

In the no-background environment, for meons and anti-meons only the third law is followed, but only if the fundamental mass field is considered to be gravity. In the background environment, the zeroth law is followed for unmerged meons and anti-meons again only if the definition of gravity extends to the fundamental mass field, since gravity requires loops. The first law is not followed because there is no change in area for any change in energy. The second law for the meons and anti-meons is not followed because neither can create photons directly themselves. The third law is followed because there is always a mass field, if that is considered to be gravity.

It is the interaction of multiple unmerged pairs that begins to develop our three-pair fermion and non-three-pair dark matter loops – for which a background of unmerged pairs is required.

F) Unmerged meon and anti-meon chains (with twist and one-sixth charges but no loop spin)

Figure 4

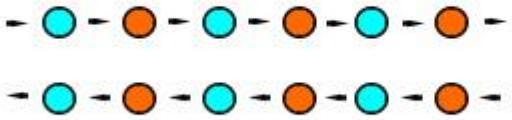

Figure 4 shows the result of an unmerged pair chasing within a volume where many partially merged pairs have been unmerged. The unmerged pair will latch onto the tail of other unmerged pairs to form a chain. The chain chasing becomes the loop frequency when the loop catches its own tail and has formed at whatever radius it achieves, initially at near Planck energy, as part of a myriad of unmerger events – a big bang. The big bang is within our only universe and does not itself create a new universe. The loop size increases due to subsequent inflation, ending at a stable larger loop radius, meaning smaller 'mass'.

The chain cannot be said to have any energy as a whole because it is the sum of all the meon and anti-meon energies – which are all zero individually. However, it is a moving object that is propelled by the chase/chasing potential energy between each meon/anti-meon adjacent pairing.

It is the chains that enter massive black holes, not the rotating loops. The chains retain the meon and anti-meon fundamental mass and charge energies, and emergent twists and observable one-sixth charges. Since there is as yet no rotation of the chain to form a loop, the loop has no 'mass', as currently considered, and no spin.

The energy and entropy of a chain will be the sum of the unmerged meon and anti-meon energies and entropies. A loop of three pairs is our normal matter and loops of other pair-number are dark matter.

To consider our three-pair loops is simplest with the symmetrically charged electron. Each of the three pairs has the same combination of twist and charge on each meon and anti-meon pair. The chain that forms into a loop will change its structural energy from being a reasonably straight line of meon, anti-meon, meon etc into a circular loop structure where there is a new energy balance locked into that loop that now has a different potential energy.

So in addition to the potential energies that drive the chase/chasing force between meons and anti-meons along the line that became a loop, will be those potential energies between same-same meons and same-same anti-meons which add to the forces holding the loop together. Note that there is no central source of any energy or force in a loop.

Although, as covered below, unmerged meon and anti-meon chains are the main components of massive black holes, individually they do not obey the black hole laws.

G) Chasing partially merged pair chains (without twist or one-sixth charges)

Figure 5

Figure 5 shows the same chasing effect as between unmerged meons and anti-meons is also the case for partially merged pairs, with the added motional possibilities of the chains attaching to unmerged meons in loops and being swept about with them, or forming their own loops.

The energy and entropy of such a chain will be the sum of the partially merged pair energies and entropies. The partially merged pair chains do not obey any of the four laws.

H) Loops of unmerged meons and anti-meons (with twist, one-sixth charges, loop 'mass' and spin)

Figure 6

Figure 6 shows the result of a chain of unmerged pairs latching onto its own tail to become a loop. The direction of planar rotation differentiates the loop spin into what is usually referred to as 'spin $+½h$ ' or 'spin $-½h$ ' for what is currently termed a 'particle', although the mass angular momentum of each meon and anti-meon is $\pm h$, not $\pm ½h$.

Within each loop, the fundamental, plus twist generated, energy of the meons exactly matches the same size energy of the anti-meons since each will have $\pm h$ angular momentum around the loop because they need to rotate at the same rate to remain as a stable loop. The $\pm sc^2/6$ twist energy relative to the fundamental mass energy $\pm Mc^2$ affects the radius at which each meon or anti-meon rotates, whilst the $\mp qc^3/6$ charge energies do not affect that radius.

So although the rotational fundamental mass and twist energies of the loop sum to zero, the loop still rotates due to the potential energy chasing forces between meons and anti-meons in the loop. Even though the loop has no total fundamental mass and twist energies, its rotation within the background with the partially merged chains attached to each meon and anti-meon ensures that the loop rotation affects the background and the background affects the loop.

It can be said, as before, that the mass energy of such a loop in the background is $E_L = ½\ hw_L = m_Lc^2$. So what is currently described as the 'mass' of a particle is emergent due to the formation of a loop. The same is the case for the spin of a loop and the time associated with a loop. Space-time only truly exists for loops individually.

The charge on the loop depends on the total of the one-sixth charges that each meon and anti-meon has in the loop.

The total loop charges for a loop of three pairs can be ± 1, $\pm 2/3$, $\pm 1/3$ and 0 q electron charge.

The single three-pair loops are our leptons and quarks. The loop is the only stable form of combinations of unmerged meons.

The three families of single loops only differ by loop radius. Loops of other than three pairs are dark matter.

At a big bang unmerging event, loops will be formed near Planck energy. It is the subsequent impact between loops that drives the loop size, not space, to inflate [11]. The amount of inflation along the three spatial axes sets the three family sizes as the loops end up in one of the three planes formed and thereafter try to maintain those sizes locked-in by the internal potential energy of the loops.

Any 'expansion' of space-time that involved further general increases in loop sizes would result in lower loop frequencies and so lower particle masses.

The loops are so different to our expectation of black holes, that this type of hypothesis has been ignored.

Having formed a loop, the energy and entropy effectively hide the underlying meon and anti-meon nature. However, the summation of properties from foundation meon/anti-meon level must correspond to that of, for example, the electron itself.

Some of the extra energy balance that disappears between a chain forming a loop is locked into the structure of the loop as internal potential energy. As mentioned previously, the same-same interactions of the meons with meons, and anti-meons with anti-meons, within loops, is an attractive potential energy for mass and repulsive for charge. There are also the different alignments of the chasing and chased forces between meons and anti-meons. The hypothesis is that, in a loop, the chasing force is directed by the chasing meon/anti-meon along its line of motion precisely at the opposite partner that is being chased, but that the force of being chased, whilst still acting on the chased anti-meon/meon, does not align with the direction of motion of the latter.

The result, in a symmetric neutrino loop, for example, where all the meons and anti-meons rotate at the same radius, is that the radial component of each force balances on means and anti-meons to align the direction of travel perpendicular to the radial axis of the loop. The loop is therefore stable at that radius, and for symmetric neutrinos at any radius

This means again that each meon and anti-meon in such a loop has exactly the same size mass energy balance, which is the same as the overall loop ‘mass’ energy, due to its rotation.

The charge angular momentum effect is partly internal and partly external as mentioned earlier.

The loops do not obey any of the four laws.

I) Gravity, ‘mass’ and spin of loops

Figure 7

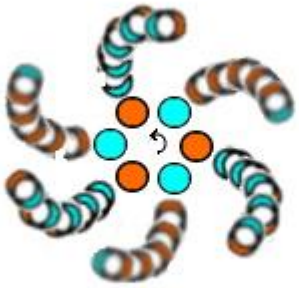

Figure 7 shows how partially merged meon chains attach to the unmerged meons and anti-meons within a loop, and are swept around by the loop. They sweep through the background, but the latter is not shown for clarity.

There are also partially merged meon chains within the loop, directly between all unmerged meons/anti-meons. Because they start and end on an unmerged meon/anti-meon they are not lost on entering tunnels within the background.

It is the rotation of these attached partially merged pair chains sweeping within the background that is what we call gravity. The resut is that the rotation of the meon/anti-meon masses is what we term the ’mass’ of the loop and the rotation of the meon/anti-meon charges is what we term the spin (energy) of the loop.

The loops with attached partially merged pair chains do not obey any of the four laws.

J) The background of the universe

Figure 8

Figure 8 shows the background of the universe where the ZMBHs, partially merged pairs and partially merged pair chains inhabit all relativistic space. The time experienced in such a volume is the average of the inverse of the partially merged pair frequencies – that is the average of the mass energies of the partially merged pairs present. Each partially merged meon/anti-meon pair has its own individual space-time.

Our time exists only within loops for bodies composed of loops. Time for bodies composed of loops did not exist before loops formed. Time exists mainly in loops and when a loop breaks as it falls into a massive black hole it loses all time and reverts to becoming a chain. So massive black holes eat time, but are not home to singularities, because there are none and quantum mechanics does not act there because there are no loops inside massive black holes, other than as created to form photons emitted at their surface.

The background has a different time to the time experienced by the loops within that volume, which are not shown. Motion through the background requires energy because the partially merged pairs act as a form of viscosity that needs to be overcome. The background has fundamental mass and charge fields that produce the shear viscosity experienced by all loops as they travel. Loop time is emergent, along with loop mass, spin and charge.

General relativity requires time because it depends on the frequencies of loop rotations. Quantum mechanics does not require time because its non-local effects are outside the background of partially merged pairs. To some extent it can be said that if a loop is not within the background, it is not within the observable universe since no forces can act from, or on, it.

The background does not obey any of the four laws.

K) Loop gravity, 'mass' and spin within the background

Figure 9

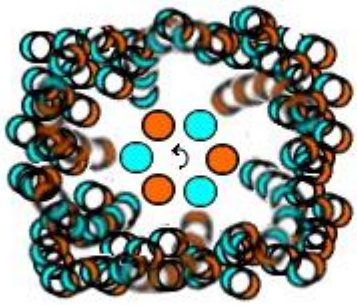

Figure 9 shows a rotating loop with attached chains, where those chains are sweeping through the background (only an outer circle of it is shown for clarity).

It is the action of the loop and its partially merged pair chains sweeping through the viscous background that produces gravity, 'mass' and spin as emergent energies or forces.

The loop rotational frequency affects the lengths and rotational velocities of the chains and so the size of the viscosity experienced by the loop. The density of the background affects how much energy is lost by the loop. Since every loop is always rotating, they will all lose energy and, for those loops whose size has been locked in by inflation, they will require frequent frequency (energy) transfers from photons to top back up to that size.

It needs to be emphasised again, that 'losing' energy does not change the overall zero total across all mass and charge energies of the loop. It is the size of the balance of those energies that declines within the loop and increases within the background so that overall, background plus loop, the total size of the balances remains unchanged. This latter system is why there is conservation of energy and momentum within the universe. It is the transfer of the size of balance that is conserved

The gravity effect of a loop is represented by its emergent mass energy $E_{Lm} = ½\, hw_L = m_L c^2$, which is balanced by the opposite type charge motional energy, that is the spin energy, of the loop $E_{Lq} = -½Qcv_L r_L w_L = -½\, hw_L$. So the mass energy of a loop is always equal in size and of opposite energy type to its charge spin energy.

We call the 'mass' energy of the loop (particle) its 'mass' $m_L c^2$, and the latter charge energy of the loop (particle) spin of ½ h - which ignores the frequency part. The effects of the chains of partially merged pairs is always to drag the local background and so its actions look like positive-only gravity for any loop regardless of whether the loop is a matter or an anti-matter loop. This effect leads to interpreting mass as only being positive and attractive.

Really it is the loop system which has confused. The mass angular moment of each meon/anti-meon is always equal to $\pm\, h$, since all meons and anti-meons must rotate together, but the radius at which each rotates depends on whether its twist energy $\pm sc^2/6$ adds to, or subtracts from, its fundamental mass $M = \pm\sqrt{hc}$ kg.

So there are only two relative radii of rotation for meons and anti-meons in loops. The result is that in order for the mass angular momentum to have the correct value $|h|$, the meon/anti-meon charges must rotate at the 'wrong' radii and the net effect is shown as the loop magnetic moment and its charge. This means that basic loop mass angular momentum is still h, not ½ h, and so the loop frequency is half the expected size. The charge energy expression should be $E_q = h(½w_L)$ not $E_q = ½hw_L$. The consequence of the two different rotational radii is that the magnetic moment of a loop is twice the expected size (ignoring the anomalous part).

The loop with attached partially merged pair chains within the background does not obey any of the four laws.

All figures from this point on do not show the background, unless stated, but it is there and transmitting all the mass and charge type forces.

L) A photon as a double-loop of rotating partially merged pairs

Figure 10

Figure 10 is a very short stack, because here the meons in the two loops have partially merged with their opposite loop anti-meons to form partially merged pairs, since it is a loop and anti-loop, the result being a photon. This is a special case of a spin $\pm 1h$ short stack, and the chasing by the meons/anti-meons is also now perpendicular to the plane of the loops, not just around the loops. The loops accelerate up to their maximum possible speed, driven by their internal chasing/chase potential energy

across the loops, and the maximum speed they can achieve is light speed. But the numerical value of light speed depends on the local density of the background, because of the viscosity drag of the background, and could be zero around a massive black hole where the background density, and so the local viscosity, is very high.

Photons do not transmit forces. They interact with other loops to transfer rotational frequency, meaning the current definition of energy, so that the loops can maintain their original frequency as set by inflation after they were formed. When photons move through the background, they lose energy to it due to the shear viscosity of the background. They always travel at light speed along the axis perpendicular to their rotational planes and so can only lose energy by reducing rotational frequency. This is the basis of tired light in photons. Since all photons are composed of two loops, each of three meon/anti-meon pairs, the meons and anti-meons will all experience the same amount of shear viscosity over the same distance travelled regardless of loop rotational frequency - the tired light effect is frequency independent. This means that the observed red shifts of celestial objects contain a fraction due to shear viscosity that has not yet been accounted for.

The photon does not obey any of the four laws.

M) A hydrogen atom (core proton stack plus orbital electron)

Figure 11

Figure 11 shows the main elements of a hydrogen atom, with a proton core stack and an orbital electron loop. No background or partially merged meon chains are shown, but will be present as those chains are what transmit all forces.

The threefold symmetry of three pair loops is what drives chemistry. In an odd pair-number loop, there will always be an odd number of loops required in a stack in order to balance overall the asymmetries of the component loops. This means in current terminology that the stack will always have a net $\pm ½\ h$ spin, which will require an orbiting loop with $\mp ½\ h$ spin to balance it.

If stacks are composed of even pair-number loops, as is the case for some dark matter loops, their net spins, in current terminology, will be zero or units of 1 h, and no further balance would be required, so no orbiting loops of spin $\pm ½\ h$ and therefore no chemistry would happen.

The latter requirement for balance is the fundamental drive in the universe. The largest imbalance will be sorted first, then smaller ones. All systems tend towards zero total of each energy type, and are always zero overall including all energies.

The current definition of matter and anti-matter confuses this drive. In a loop system, the number of degrees of freedom available when creating a loop and its anti-loop is larger than for a simpler particle system. The loop system shows that replacing all factors with their opposites means that the anti-loop of a loop is simply the oppositely charged loop, but otherwise identical. So the anti-loop of a spin $+½\ h$ electron is a spin $+½\ h$ positron. This makes a photon a perfect loop/anti-loop composite with spin $+\ h$.

Therefore if the definition of matter is chosen to be ‘particles with positive charge’, then anti-matter might be simply ‘particles with negative charge’. However, the definition has to be based at individual loop level, so that the overall matter/anti-matter identity depends on the number of each type of loop in a stack. Thus a proton core of up, down and up quarks counts two positively charged loops versus one negatively charged loop and is therefore a matter stack. In contrast, the neutron core of down, up and down quarks counts two negatively charged loops versus one positively charged loop and is therefore an anti-matter stack, even though it has zero charge.

This definition may seem obtuse, but the result is that nucleon cores are built of matter and anti-matter nucleons, with stability best when the number of each is the same. This is another of the drives to balance that the structure of the components of the universe exerts.

The same is the case at atomic level where a charged matter proton finds balance in an orbiting charged anti-matter electron.

Matter and anti-matter do not annihilate each other on contact, but combine to form neutral composite systems. Nothing is created or destroyed – only merged/unmerged, stacked/unstacked or broken/reformed at meon/anti-meon or loop level. The foundations of matter and anti-matter are created equally at big bang unmerging events, even if the numbers of each type of loop are not necessarily equal all of the time. There is no baryon asymmetry.

The Hydrogen atom does not obey any of the four laws.

N) A boosted orbital electron stack

Figure 12

Figure 12 shows an electron loop with a stacked photon loop. This pairing is what drives emission and absorption of light as different rotational frequency photon loops leave from, or attach to, the electron loop. In the process, the electron plus added photon stack leaves one atomic orbital and arrives at a different orbital, or vice versa when the photon is emitted from the stack.

Whilst stacked, the two loops that comprise the photon will mostly unmerge so that there is less chasing effect between those loops, enabling the photon to remain in the stack.

For loops not in orbitals, the brief attachment of a photon serves to replace the energy lost by the loop to the background viscosity by transferring some rotational frequency, meaning energy in current terminology, from the photon. This is energy transfer by photons, not force transmission.

O) A tunnel through the background between entangled photons

Figure 13

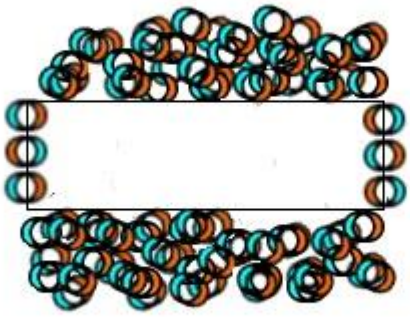

Figure 13 shows part of how quantum mechanics works. Where there is viscosity due to the background, there is relativistic motion. Where there is no viscosity, quantum mechanics and non-locality rule.

A tunnel through the background is shown with a photon at each end.

The two photons were entangled and have separated.

As they separate a tunnel is formed between them, consisting of chains of partially merged pairs which form loops to envelope the expanding gap between the photons. The tunnel excludes the background. The two photons randomly swap position at the ends of the tunnel.

Because there is no background inside the tunnel, there is no viscosity of the background to slow the speed of the photons as they travel. Their motion is non-local. The meons/anti-meons retain their own internal partially merged pair chains within the loop to maintain their structure, but without the rotating and transmitting partially merged pair chains they have no mass, spin or charge effect whilst within the tunnel.

What is seen at one end of the tunnel is the properties of one photon, for the time it is there, added to the properties of the other photon, for the time it is there. The result looks like a superposition, but is actually always the properties of one or other photon which, over sufficient time, will tend towards the average of the properties of the two photons. Superposition is therefore a digital effect, not a steady mix of properties.

When an 'observation' is made at a tunnel end, the tunnel collapses and whichever photon was at that tunnel end is trapped there, whilst the other photon is trapped at the other tunnel end. Due to the random swapping at high frequency along the tunnel, it is very difficult to say which photon will be trapped at which tunnel end on collapse.

The same mechanism acts for entangled electron and positron split apart, from being a photon, and travelling back and forth along a tunnel.

The tunnel ends are constrained to travel through the background, so cannot exceed light speed.

Viscosity acts on all motion within the background, so that any move loses energy from the moving object and the move cannot be reversed without incurring further energy loss. This is the basis of the arrow of time pointing only in one direction.

P) A chain star or black hole

Figure 14

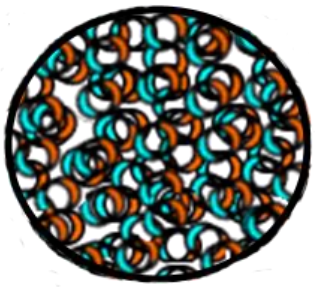

Figure 14 is a much larger scale version of Figure 8. It represents the internal state of a massive black hole. The myriad partially merged pairs, chains of partially merged pairs and chains of unmerged pairs are constantly in a state of turmoil. All massive black holes have the same mix in their interior.

The circular outline in Figure 14 is the surface of the hole, where chains can form high frequency loops and anti-loops, parallel to the hole surface, enabling those loops to escape as double loop photons. The photons will lose most of their energy on exit.

A loop entering a massive black hole, with its rotational plane not parallel to the hole surface, will be broken into a chain by

the differential action of the gravitational field of the hole on the meons and anti-meons comprising the loop. The rotational rate of the loop, being its 'mass' and spin, will be absorbed by the hole as additional mass and charge angular momentum (energy), but the chain will retain its meon and anti-meon fundamental mass and charge energies and its emergent twist energies and one-sixth charges. These meons and anti-meons in the chain will eventually escape, maybe in different pairings or in different chains, but taking their same mass and charge energies on exit, plus whatever rotational 'mass' and spin energies the formed photon double-loop can manage.

Massive black holes with their photon-emitting surfaces obey all four of the laws.

Q) The universe

The universe exist as a single entity, far larger than our big bang volume, with random, mostly, failed big bangs occurring throughout – the latter not giving rise to new universes. The failed big bangs are observable by us if their emitted light has been travelling for long enough after their inception and has not red shifted so as to be unmeasurable. The EESM and pre-fermion hypothesis is a mix of inflation and steady state theories but without any multiverse.

The universe is not subject to any of the black hole laws since its total energy is always zero for all energy types and it has myriad different size balances, within those zeros, across different systems.

R) Table of effects and laws

In the table below, where there is no entry in a square, then the black hole laws cannot be applied to that system, so by default they are not applicable. Where the system is 'pure' as a building block before partially merged pairs have been introduced, the blank entry also means 'not applicable'. A 'No' means that in the environment considered, the system does not obey that law.

Also, specifically, the unmerged pair chain line below is modelled as being too short to form a photon, otherwise it would be the same type as a 'massive' black hole/chain star.

System/Obeys laws With or No Background	Law 0 With	Law 0 No	Law 1 With	Law 1 No	Law 2 With	Law 2 No	Law 3 With	Law 3 No
Zero mass black hole		No		No		No		No
Meon/anti-meon	No	Yes	No	No	No	No	Yes	Yes
Partially merged pair	No	No	No	Yes			No	No
PMP chain		No		No		No		No
PMP background							No	
Unmerged pair	Yes		No		No		Yes	
Unmerged pair chain	No	No	No	No	No	No	No	No
Loop	No		No		No		No	
Loop and PMP chains								
Background PMPs								
Entanglement tunnels								
Photons								
Atoms								
Black hole/ Chain star	Yes		Yes		Yes		Yes	
Universe								

V POTENTIAL ENERGY – THE SOURCE OF THE CHASE/CHASED EFFECT

There is a great misunderstanding currently about potential energies. One potential energy is from particle A to particle B ($A\ on\ B$) and one from particle B to particle A ($B\ on\ A$). In the case of same-same 'mass' interactions, the effect is what we observe, that both act as attractive towards each other. (Here 'mass' is used to mean the motional energy we observe a loop (the form of a particle that is composed of meons and anti-meons) to have and is always positive, but is not the same as the fundamental mass of meons and anti-meons, although the same-same actions of those fundamental mass fields act similarly).

Potential energy is the positional energy that a body transfers to the background so that it can be connected to another body by partially merged pair chains. It is the energy needed by the background to form those chains between the bodies.

The energy will have the same size for each connected body, but its direction of action (force) for the two mass potential energies will depend on the initial relative direction of motion of the bodies, unless the two bodies have the same sign of mass when the direction of both will be towards the each other. In terms of 'active' or 'passive' gravitational mass [12] , the sizes may be the same, but which acts in which way depends on the first-mover effect, so in same-different mass interactions, there must be a third type of gravitational mass – relative – whose effect is relative to the action of other masses. It is the meon and anti-meon that both possess relative gravitational mass.

The potential direction of charge energy is always symmetrically attraction or repulsion.

The maximum potential energy that a stationary meon or anti-meon can transfer in its connection equal to $½\ Mc^2$, set by the minimum distance between two unmerged same-same meons or anti-meons.

The actual transfer of potential energy from a body to the background depends on the local density of the background.

Without a background, there will be no transfer and so no potential energy. As a body moves, so the amount of potential energy required to maintain connection with another body changes.

In the same way that the local background density affects the maximum terminal velocity that is local light speed, that local density alters the potential energy required to connect the two bodies. So the background affects the bodies as the bodies affect the background.

Each different interaction is now considered for both mass and charge potential energies, both fundamental and emergent. It must be emphasised that matter and anti-matter have the same loop positive mass effect, and that negative fundamental mass is not the same as anti-matter.

In the following *Cases*, none of the energies, other than the externally observed spin energy, are motional energies related to the stationary M and Q energies of the form Mc^2, mc^2, qc^3 or Qc^3 being what are usually termed the motional mass or charge energies of a body, as opposed to the potential energy of a body with respect to another body, which is what is being considered here. ½

Case 1 - Two matter (or anti-matter) loops with same sign charges at separation *D*

Potential Energies	+mass m (A) $-q$ charge $(B\ on\ A)$	*Energy/Force directions*		+mass m (B) $-q$ charge $(A\ on\ B)$	*Effect*
Spin energy	$-½hw$			$-½hw$	Orientation dependent
Mass energy	$-mm/D$	→	←	$-mm/D$	symmetric attraction
Charge energy	$+qcqc/D$	←	→	$+qcqc/D$	symmetric repulsion

The result will depend on the relative sizes of the charges and masses of the loops and the relative orientation of the loop spins. Ignoring the spin energies, when $m > qc$ then there is overall attraction. When $m < qc$, there is overall repulsion. Note that the sign of mass or charge potential energy is opposite the sign of mass energy and that the energy/force directions are along the line between the two loops and symmetric in that both masses are attracted to each other and both charges are repelled by each other. Spin energy is of opposite type to the mass energy of a loop.

Case 2 - Two matter (or anti-matter) loops with opposite sign charges at separation *D*

Potential Energies	+mass m (A) $-q$ charge $(B\ on\ A)$	*Energy/Force directions*	+mass m (B) $+q$ charge $(A\ on\ B)$	*Effect*

Spin energy	$-½hw$			$-½hw$	Orientation dependent
Mass energy	$-mm/D$	→	←	$-mm/D$	symmetric attraction
Charge energy	$+qcqc/D$	→	←	$-qcqc/D$	symmetric attraction

The result overall, ignoring spin energies, is attraction between the two loops regardless of the relative sizes of the charges and masses of the loops. The energy/force directions are again along the line between the two loops and symmetric in that both masses are attracted to each other and both charges are attracted to each other.

Cases 1 and *2* are the 'normal' interactions currently expected, except that the potential energies are separated into the two different actions. The mass energies try to lump together to form larger lumps, whist the charge energies try to reduce size towards smaller lumps. The next series of Cases starts at the deepest meon level and works its way up to the *Case 1* and *2* levels, looking at the different interactions that could occur at each level. The first such examples, *Case 3 - 5*, are actually unphysical because it is not possible to have two unmerged meons without them having mass energy twisting and producing one-sixth charges, but they do provide simple energy equations.

Case 3 - Two meons (no twist, one-sixth charges or loop spin energies) at separation *D*

Potential Energies	+ M mass (A) $+Q$ charge $(B\ on\ A)$	*Energy/Force directions*		+ M mass (B) $+Q$ charge $(A\ on\ B)$	*Effect*
Mass energy	$-MM/D$	→	←	$-MM/D$	symmetric attraction
Charge energy	$-QcQc/D$	←	→	$-QcQc/D$	symmetric repulsion

This is similar to Case 1 except that the fundamental mass and charges sizes do not change, so that there is no net energy or force between the meons.

Case 4 - Two anti-meons (no twist or one-sixth charges or loop spin energies) at separation *D*

Potential Energies	- M mass (A) $-Q$ charge $(B\ on\ A)$	*Energy/Force directions*		- M mass (B) $-Q$ charge $(A\ on\ B)$	*Effect*
Mass energy	$+MM/D$	→	←	$+MM/D$	symmetric attraction
Charge energy	$+QcQc/D$	←	→	$+QcQc/D$	symmetric repulsion

This is exactly the same as Case 3 except with two negative mass anti-meons interacting in exactly the same way was the case for two positive mass meons. There is no net energy or force between the two anti-meons.

Case 5 - A meon (A) and anti-meon (B) (no twist, one-sixth charges or loop spin energies) at separation *D*

Potential Energies	+ M mass (A) $+Q$ charge	*Energy/Force directions*		- M mass (B) $-Q$ charge	*Effect*
State 1	$(B\ on\ A)$			$(A\ on\ B)$	
Mass energy	$-MM/D$	→	→	$+MM/D$	$(A \rightarrow B)(B << A)$
Charge energy	$-QcQc/D$	→	←	$+QcQc/D$	symmetric attraction
State 2	$(B\ on\ A)$			$(A\ on\ B)$	
Mass energy	$-MM/D$	←	←	$+MM/D$	$(B \rightarrow A)(A << B)$
Charge energy	$-QcQc/D$	→	←	$+QcQc/D$	symmetric attraction

In *State 1*, the effect $(A \rightarrow B)$ means A chases B and $(B << A)$ means B is chased by A. In *State 2*, the effect is reversed and $(B \rightarrow A)$ means B chases A and $(A << B)$ means A is chased by B.

The chaser is always the meon or anti-meon that has both energies/forces acting in the same direction towards the other body,

trying to catch up with that other. The chased has a balance of energies/forces that keeps it trying to maintain separation.

The difference between *State 1* and *State 2* depends on which of the two moves first. The first-mover will set the direction of motion of the pair. If the first motion is towards the other, then the first mover is the chaser. If the first motion is away from the other, then the first mover becomes the chased one. A pair of meon and anti-meon (unmerged, and in this case without twist or one-sixth charge energies) is an unstable system. This latter effect is what makes the mathematics of interactions between closely adjacent loops so difficult, because as the loops rotate, so the definition of which meon/anti-meon is moving towards, as a chaser, or away, being chased, from an anti-meon/meon in the adjacent loop changes. It is like a digital type of system acting over only parts of the two loops' mutual relative rotations and orientation.

The next cases consider unmerged meons and anti-meons with their twist and one-sixth charge energies, both simplified as $j = s/6M$ for twist and $j = qc/6Q$ for one-sixth charge, omitting c^2 for simplicity, in the *Cases*. Where confusion could arise, the use of $M(-1-j)$ is used to replace the $-M(1+j)$ mass definition and the same change for the charge definition.

Case 6 - Two meons (with twist and one-sixth charges but no loop spin) with same sign $+j$ mass at separation *D*

Potential Energies	$+M(1+j)\ (A)$ $+Qc(1-j)$ $(B\ on\ A)$	*Energy/Force directions*		$+M(1+j)\ (B)$ $+Qc(1-j)$ $(A\ on\ B)$	*Effect*
Mass energy	$-M^2(1+j)^2/D$	→	←	$-M^2(1+j)^2/D$	symmetric attraction
Charge energy	$-Q^2c^2(1-j)^2/D$	←	→	$-Q^2c^2(1-j)^2/D$	symmetric repulsion

Together the net effect of the two energies/forces is to be attractive by $E_{+M+M} = -4j$.

Case 7 - Two meons (with twist and one-sixth charges but no loop spin) with same sign $-j$ mass at separation *D*

Potential Energies	$+M(1-j)\ (A)$ $+Qc(1+j)$ $(B\ on\ A)$	*Energy/Force directions*		$+M(1-j)\ (B)$ $+Qc(1+j)$ $(A\ on\ B)$	*Effect*
Mass energy	$-M^2(1-j)^2/D$	→	←	$-M^2(1-j)^2/D$	symmetric attraction
Charge energy	$-Q^2c^2(1+j)^2/D$	←	→	$-Q^2c^2(1+j)^2/D$	symmetric repulsion

Together the net effect of the two energies/forces is to be repulsive by $E_{-M-M} = +4j$.

Case 8 - An anti-meon $(-j)$ and meon $(+j)$ (with twist and one-sixth charges but no loop spin) at separation *D*

Potential Energies	$+M(1+j)\ (A)$ $+Qc(1-j)$	*Energy/Force directions*		$M(-1-j)\ (B)$ $Qc(-1+j)$	*Effect*
State 1	$(B\ on\ A)$			$(A\ on\ B)$	
Mass energy	$-M^2(1+j)^2/D$	→	→	$+M^2(1+j)^2/D$	$(A \to B)(B << A)$
Charge energy	$-Q^2c^2(1-j)^2/D$	→	←	$+Q^2c^2(1-j)^2/D$	symmetric attraction
State 2	$(B\ on\ A)$			$(A\ on\ B)$	
Mass energy	$-M^2(1+j)^2/D$	←	←	$+M^2(1+j)^2/D$	$(B \to A)(A << B)$
Charge energy	$-Q^2c^2(1-j)^2/D$	→	←	$+Q^2c^2(1-j)^2/D$	symmetric attraction

As in *Case 5*, there are two states that depend on which is the first mover. The net effect of the two energies/forces is to be chasing/chased by $E_{+M+A} = 4j$.

Case 9 - An anti-meon $(+j)$ and meon $(+j)$ (with twist and one-sixth charges but no loop spin) at separation D

Potential Energies	$+M(1+j)\ (A)$ $+Qc(1-j)$	*Energy/Force directions*		$M(-1+j)\ (B)$ $Qc(-1-j)$	*Effect*
State 1	$(B\ on\ A)$			$(A\ on\ B)$	
Mass energy	$-M^2(1-j^2)/D$	→	→	$+M^2(1-j^2)/D$	$(A \rightarrow B)(B << A)$
Charge energy	$-Q^2c^2(1-j^2)/D$	→	←	$+Q^2c^2(1-j^2)/D$	symmetric attraction
State 2	$(B\ on\ A)$			$(A\ on\ B)$	
Mass energy	$-M^2(1-j^2)/D$	←	←	$+M^2(1-j^2)/D$	$(B \rightarrow A)(A << B)$
Charge energy	$-Q^2c^2(1-j^2)/D$	→	←	$+Q^2c^2(1-j^2)/D$	symmetric attraction

As in *Case 8*, there are two states that depend on which is the first mover. Together the net effect of the two energies/forces is to be chasing/chased but $E_{+m-a} = 0$, so they stay at the same separation.

Case 10 - An anti-meon $(-j)$ and meon $(-j)$ (with twist and one-sixth charges but no loop spin) at separation D

Potential Energies	$+M(1-j)\ (A)$ $+Qc(1+j)$	*Energy/Force directions*		$M(-1-j)\ (B)$ $Qc(-1+j)$	*Effect*
State 1	$(B\ on\ A)$			$(A\ on\ B)$	
Mass energy	$-M^2(1-j^2)/D$	→	→	$+M^2(1-j^2)/D$	$(A \rightarrow B)(B << A)$
Charge energy	$-Q^2c^2(1-j^2)/D$	→	←	$+Q^2c^2(1-j^2)/D$	symmetric attraction
State 2	$(B\ on\ A)$			$(A\ on\ B)$	
Mass energy	$-M^2(1-j^2)/D$	←	←	$+M^2(1-j^2)/D$	$(B \rightarrow A)(A << B)$
Charge energy	$-Q^2c^2(1-j^2)/D$	→	←	$+Q^2c^2(1-j^2)/D$	symmetric attraction

As in *Case 9*, there are two states that depend on which is the first mover. Together the net effect of the two energies/forces is to be chasing/chased but $E_{+M-A} = 0$, so again they stay at the same separation.

The pairings in *Case 9* and *Case 10* are one third of an electron or positron loop and show that such a loop is stable with all energies, along the chain that became a loop, having the same net potential energy values. This calculation, however, does not account for the additional loop 'mass' and spin energies which are dependent on the loop rotational frequency and the internal same-same type interactions as shown in *Case 7*.

Case 11 - A meon $(+j)$ and meon $(-j)$ (with twist and one-sixth charges but no loop spin) at separation D

Potential Energies	$+M(1-j)\ (A)$ $+Qc(1+j)$ $(B\ on\ A)$	*Energy/Force directions*		$+M(1+j)\ (B)$ $+Qc(1-j)$ $(A\ on\ B)$	*Effect*
Mass energy	$-M^2(1-j^2)/D$	→	←	$-M^2(1-j^2)/D$	symmetric attraction
Charge energy	$-Q^2c^2(1-j^2)/D$	←	→	$-Q^2c^2(1-j^2)/D$	symmetric repulsion

This is exactly the same as Case 3 with two meons interacting in exactly the same way but with a different energy balance. There is no net energy or force between the meons and $E_{+M-M} = 0$.

Case 12 - A partially merged pair - An anti-meon and meon (without twist, one-sixth charges and no loop spin) at separation b less than D.

Here the meon and anti-meon masses and charges take unoverlapped values, less than their normal totals of M and Qc, as U and Pc, where $U < M$ and $P < Q$.

Potential Energies	$+U(A)$ $+Pc$	*Energy/Force directions*		$-U(B)$ $-Pc$	*Effect*
State 1	$(B\ on\ A)$			$(A\ on\ B)$	
Mass energy	$-U^2/b$	→	→	$+U^2/b$	$(A \rightarrow B)(B << A)$
Charge energy	$-P^2c^2/b$	→	←	$+P^2c^2/b$	symmetric attraction
State 2	$(B\ on\ A)$			$(A\ on\ B)$	
Mass energy	$-U^2/b$	←	←	$+U^2/b$	$(B \rightarrow A)(A << B)$
Charge energy	$-P^2c^2/b$	→	←	$+P^2c^2/b$	symmetric attraction

This pairing, as in *Case 5*, has two states. The difference between *State 1* and *State 2* depends on which of the two moves first. As before, the first-mover will set the direction of motion of the pair. If the first motion is towards the other, then the first mover is the chaser. If the first motion is away from the other, then the first mover becomes the chased one. This merged meon/anti-meon pair (merged, and in this case without twist, one-sixth charge energies or loop spin) is an unstable system, but constrained to stay as a partially merged pair until unmerged.

The actions are either rotation of the pair about a mutual axis, external translation, or internal vibration. These types of action transfer the fundamental and emergent mass and charge energies between meons and anti-meons as part of the background.

Note that the unoverlapped portion of each meon and anti-meon varies between zero and M or Q. At the point where the meon and anti-meon just begin to unoverlap, the very small portion of each will be δM at a distance between the two parts of $2R$. At the point just before the meon and anti-meon are completely unoverlapped, the very large portion of each will be $(M - \delta M)$ at a distance between the two parts of $2R$ again.

Case 13 - A zero mass black hole (ZMBH) - An anti-meon and meon (without twist, one-sixth charges and no loop spin) at separation $b = 0$.

As for the partially merged pair in Case 12, the meon and anti-meon masses and charges take unoverlapped values, less than their normal totals of M and Qc, as U and Pc respectively

Potential Energies	$+U(A)$ $+Pc$	*Energy/Force directions*		$-U(B)$ $-Pc$	*Effect*
State 1	$(B\ on\ A)$			$(A\ on\ B)$	
Mass energy	-0	→	→	$+0$	$(A \rightarrow B)(B << A)$
Charge energy	-0	→	←	$+0$	symmetric attraction
State 2	$(B\ on\ A)$			$(A\ on\ B)$	
Mass energy	-0	←	←	$+0$	$(B \rightarrow A)(A << B)$
Charge energy	-0	→	←	$+0$	symmetric attraction

The ZMBH is unstable because any slight movement between meon and anti-meon will trigger the case/chased effect with some non-zero energy – turning the ZMBH into a partially merged pair. Whilst the ZMBH exists fully overlapped, it has no internal or external effect.

Case 14 - An electron loop of three meons $(+j)$ (A) and three anti-meons $(+j)$ (B) (with twist, one-sixth charges and loop spin energies) at separation from the loop centre R, including cross same-same interactions.

The energies for just one of each meon or anti-meon in the loop are included and those energies of the 'next but one' (nbo) and 'opposite side' (os) same-same interactions. Each meon has the same $+j$ mass twist energy and each anti-meon the same $+j$ mass twist energy, producing a charge overall of $-6jQ = -q$ for the loop.

Potential Energies	$+M(+1+j)\ (A)$ *Energy/Force directions*			$M(-1+j)\ (B)$	*Effect*
	$+Qc(+1-j)$			$Qc(-1-j)$	
State 1	$(B\ on\ A)$			$(A\ on\ B)$	
Loop Spin energy	$-½hw$			$-½hw$	orientation dependent
Loop Mass energy	$+mc^2$			$+mc^2$	external observable
Mass energy	$-M^2(1-j^2)/R$	→	→	$+M^2(1-j^2)/R$	$(A \rightarrow B)(B << A)$
Charge energy	$-Q^2c^2(1-j^2)/R$	→	←	$+Q^2c^2(1-j^2)/R$	symmetric attraction
Cross +M (nbo)	$-2M^2(1+j)^2/\sqrt{3}R$	→	←	by other two $+M$	symmetric attraction
Cross +Q (nbo)	$-2Q^2(1-j)^2/\sqrt{3}R$	←	→	by other two $+Q$	symmetric repulsion
Cross –M (nbo)	by other two $-M$	→	←	$+2M^2(1-j^2)/\sqrt{3}R$	symmetric attraction
Cross –Q (nbo)	by other two $-Q$	←	→	$+2Q^2(1-j^2)/\sqrt{3}R$	symmetric repulsion
Cross +M (os)	$-M^2(1-j^2)/2R$	*	*	by other $-M$	balance chase/chased
Cross +Q (os)	$-Q^2(1-j^2)/2R$	→	←	by other $-Q$	symmetric attraction
Cross –M (os)	by other $+M$	*	*	$-M^2(1-j^2)/2R$	balance chase/chased
Cross –Q (os)	by other $+Q$	→	←	$-Q^2(1-j^2)/2R$	symmetric attraction
State 2	$(B\ on\ A)$			$(A\ on\ B)$	
Loop Spin energy	$-½hw$			$-½hw$	orientation dependent
Loop Mass energy	$+mc^2$			$+mc^2$	external observable
Mass energy	$-M^2(1-j^2)/R$	←	←	$+M^2(1-j^2)/R$	$(B \rightarrow A)(A << B)$
Charge energy	$-Q^2c^2(1-j^2)/R$	→	←	$+Q^2c^2(1-j^2)/R$	symmetric attraction
Cross +M (nbo)	$-2M^2(1+j)^2/\sqrt{3}R$	→	←	by other two $+M$	symmetric attraction
Cross +Q (nbo)	$-2Q^2(1-j)^2/\sqrt{3}R$	←	→	by other two $+Q$	symmetric repulsion
Cross –M (nbo)	by other two $-M$	→	←	$+2M^2(1-j)^2/\sqrt{3}R$	symmetric attraction
Cross –Q (nbo)	by other two $-Q$	←	→	$+2Q^2(1+j)^2/\sqrt{3}R$	symmetric repulsion
Cross +M (os)	$-M^2(1-j^2)/2R$	*	*	by other $-M$	balance chase/chased
Cross +Q (os)	$-Q^2(1-j^2)/2R$	→	←	by other $-Q$	symmetric attraction
Cross –M (os)	by other $+M$	*	*	$-M^2(1-j^2)/2R$	balance chase/chased
Cross –Q (os)	by other $+Q$	→	←	$-Q^2(1-j^2)/2R$	symmetric attraction

This lists the full number of potential energies between meons-anti-meons and meons-meons and anti-meons-anti-meons within an electron loop as well as the two observable external energies of the loop.

Each of the (nbo) effects cancels completely when considered for mass and charge actions together. From symmetry, the circumferential energies cancel, as do the radial energies.

The (os) interaction has charge attraction in each case. The mass (os) interaction would be expected to be chase/chased but is the same size and so is presumed to maintain separation and is thus indicated by the [*] notation.

The direct meon to adjacent anti-meon has the usual two *States*, where the loop could rotate in either direction with constancy of separation and dependent on which is the first-mover. There is no radial energy that requires any specific radius to be changed, so is maintained. This latter aspect enables frequency transfer to take place between families, such that an electron can absorb extra frequency to become a muon, with resultant changes to magnetic moment and observable 'mass'. Because we consider only the angular momentum of a loop, that value of ½ h will not change, but the total spin energy ½ hw will change, being equal and opposite to the 'mass' energy. The same is the case for symmetric neutrino families.

VI STRUCTURES AND OTHER CONSEQUENCES

The following are some of the logical consequences of the EESM and the pre-fermion hypothesis, the structures that can be implied and how physics as a whole can be reinterpreted.

- There is nothing separately physical in the universe except a myriad of the two unmerged meon and anti-meon particles that normally only exist within loops
- The hypothesis uses only one fundamental particle, and its anti-particle, two opposite types of energy and one composite form to explain almost everything. No hypothesis could use fewer foundations to build with.

- Viscosity red shift of photons requires the rethinking of how much, or whether, dark energy exists and the size and age of our big bang.
- Motion of loops which is not against background viscosity is without energy loss, is non-local and the basis of quantum mechanics.
- The shear viscosity of the background partially merged pairs underlies relativity, the arrow of time, electric charge generation and the second law of thermodynamics.
- Relativity, where viscosity is present, and quantum mechanics, where viscosity is absent, are irreconcilable.
- There is only one universe because there is only one size of meon/anti-meon fundamental particles and one composite loop form.
- Our big bang is one of many throughout the history of the only universe - it is only within the universe, not a new universe. Failed big bangs are studded throughout the universe as isolated black holes and collapsing galaxies. The success or failure of a big bang depends on the amount of inflation of loops that occurs along the three dimensional spatial axes. The mix of two axes defines the size of each type of loop inflated in that plane, so there are three families of loops.
- There are only two sizes in the universe, other than the loop sizes ('masses') which were locked-in by big bang loop inflation, which are the Double-Adjusted-SI (DASI) Planck size of the meons and anti-meons and the fine structure constant, a function of the energy needed to unmerge partially merged pairs.
- If the amount of loop inflation of a big bang is sufficiently large, the resulting loops will be large in radius, so small in mass. The large mass energy released by this amount of inflation will drive a large expansion away from the initial site of loop inflation, acting on small mass loops. In this scenario, gravity will be unable initially to overcome the subsequent expansion. If the amount of inflation is not sufficiently large, the resulting loops will be small in radius, so large in mass. The mass energy released by this amount of inflation will not be enough to drive a large expansion away from the site of inflation and it will be acting on large mass loops. In this scenario, gravity will relatively soon overcome the subsequent expansion and the loops will collapse over different timescales to become black holes or slowly collapsing galaxies. Many black holes and galaxies are these failed inflation events. Isolated black holes with no surrounding matter would prove that they were such failed inflation events.
- Inflation is of the loops, not the ZMBHs, so our big bang is moving through the pre-existing background in which failed big bangs should be observable as having 'wrong' red shifts for their positions relative to our big bang expansion flow. Where there are seemingly physically conjoined objects that have different red-shifts, one will be part of our big bang co-moving flow and the other part of the pre-existing universe. The difference in red-shifts for these objects at the same distance from us will enable the calculation of the relative motional rates and the age of our big bang. Since we are unlikely to be at the centre of expansion, there will be significant uncertainties in the calculation.
- The unit size of meons and anti-meons means that space cannot be expanding in the accepted sense of all distances increasing.
- Energy has been misunderstood. Because all meons and anti-meons, and composites composed of meons and anti-meons, have zero total energy at all times, the mathematics currently employed to describe the energies or interactions of systems is insufficient at the foundation level and a different mathematics is required.
- The strength of the energies of fundamental mass and fundamental charge fields is equal. All energies of charge and gravitation fields have equal strengths of interaction when considered in fractional adjusted-Planck terms in DASI form. This is because the gravitational constant G is related not just to the mass of bodies, but also to their separation. By increasing the current Planck mass by the factor $\sqrt{G}$, and reducing the current Planck radius by the same factor, G can be eliminated completely from all equations. This means that there is no difference between gravitational and inertial mass.
- The reason gravity and charge appear so different in size, even after eliminating G, is because the gravitational effect of a loop is proportional to its rotational radius w, which in adjusted-Planck terms is very small in our normally observed loops, whilst the charge effect is proportional to the adjusted Planck charge Q by the fine structure constant α, which is comparatively very large. For a loop to have the same size gravitational effect as a q charge effect, then the energy of each will need to be such that $E = qc^3 = hw_*\sqrt{\alpha/2\pi} = Mc^2\sqrt{\alpha/2\pi}$, where w_* is the adjusted Planck angular frequency.
- Dimensionality shows the underlying relationship between properties. Every property has a dimensionality of Y^x where $-9 \leq x \leq 17$ for those properties already known and two not yet discovered. Dimensionally Planck's constant h is $Y^0$and G is also Y^0 so they are dimensionless ratios. Any equation where the sum of the dimensionalities on each side are equal is a law of nature (h=McR, $Y^0 = Y^1\ Y^2\ Y^{-3}$).
- Laws of nature can be uncovered by equating properties across an equation ($\eta V = h$, the product of shear viscosity and volume is a constant, as is the product of electric field and volume $\xi V = h$, suggesting a deep link between shear viscosity and electric field). This latter is why the background viscosity effect is the same for all frequencies of photons. All photons are composed of meons and anti-meons which all have the same volume, so are all affected equally by the background viscosity. The spiral path of meons and anti-meons in a photon double-loop is the distance over which they are subject to viscosity and, apart from at very high frequencies, this can be considered

equal to the path length of the photon double-loop itself.

- Any property which has a dimensionality of zero is a universal constant. It is possible to eliminate other properties of dimensionality zero in the same way as *G* or *h*. But only the former can be done without the appearance of seemingly (but not) unphysical results. Laws of nature can be used to uncover these dimensionalities and new laws can be found by reversing the process. Light speed c is not a universal constant.
- Elimination of *h* and *G* from all equations shows that size is not what differentiates gravitational from quantum systems. The orbital mass energy equations in both systems are the same when the kinetic energy of loop spin is accounted for.
- Given the dimensionality relationships, the laws of physics could not be any different to what they currently are. Physics is the same everywhere and breaks down nowhere. There are no singularities. The laws of physics can be no different anywhere because the maximal values of all properties, their adjusted-Planck values, are powers of $\sqrt{c}$, or of $\sqrt{c}$ and the fine structure constant α. Loop sizes define the size of interactions but not the relationships between properties. However, the results of those laws (energy levels etc) depend on the sizes of the loops, which could be different in a different big bang to ours.
- The symmetric three pair loops are the electron, positron and some variants of neutrino. Some neutrino and anti-neutrino loops differ by only 60 degrees of rotation. The quark loops are all asymmetric, as are some neutrino loops. Normal matter is loops of three pairs. Dark matter is mainly loops with other than three pairs and partially merged pairs.
- Since the only real particles in a loop stack are the underlying meons and anti-meons which comprise the loops, both electrons and neutrinos can exist within nucleon or other stacks.
- Loops of other than three-pair number are forms of dark matter, unable to stack in our threefold symmetric stacks, because their symmetries are different and unable to produce balance along the stack axis. Dark matter loops can stack with loops of their own pair symmetry to form stacks. However, only odd pair number loops can produce chemistry.
- The requirement of symmetry, to match the local environment where charges are $\pm 1q$ or $0q$, is why fractional charge quarks do not easily appear on their own.
- Relatively stable stacks include protons and neutrons. The main charge change required to change a neutron into a proton is that the electron loop in the neutron stack be impacted and replaced by a neutrino loop of appropriate energy. This change from neutron to proton is usually described as the weak force, but it is only the result of incident neutrinos. A stack has to have all the component loops of the same size in order for balancing symmetry.
- A symmetric zero total charge, zero total twist loop will have no observable mass. A $2/3q$ charge, $2/3sc^2$ twist energy loop will have 2/3 of the rotational frequency *w* of the loop observable. A non-symmetric zero charge, zero twist loop may have some mass observable.
- As a loop, whose rotational plane is not parallel to the surface, enters a black hole, the loop is broken into a chain, but the entering chain of unmerged meons and anti-meons retain their existing additional $\pm q/6$ charges and $\pm sc^2/6$ twist energies.
- Photons and bosons are not force carriers. The background partially merged pair chains provide the means for transmitting forces due to mass (gravity), spin and charge by changes of local density, spinning, moving, vibrating or aligning in chains. Magnetic field lines are real. Partially merged pairs transmit forces via density changes and chains of vibrating, rotating or moving partially merged pairs between two or more unmerged meon and anti-meon sources.
- The background is rather like a form of aether with loops acting on the background and the background acting on the loops. The background itself is a form of dark matter, taking energy from moving meons and anti-meons to increase the background partially merged pair frequencies of rotation, vibration or velocity and varying in density dependent on local loop concentrations. However, the background is not exactly dark because of its interactions via charge fields and shear viscosity in addition to gravitation.
- The effects of spin are not currently included in energy calculations correctly. Although large objects like the Earth and Sun may not have all loop spins aligned (therefore small or no overall spin-spin potential energy) the loops still all have total loop spin energy equal to total loop mass energy. Even if the net loop spin energy across the whole body is zero, the kinetic energy of all the spins still exists and acts directionally like mass kinetic energy.
- Rotational energy is outwards from the centre of rotation. Energy is a vector.
- The total of mass motional and potential energies of a stable system is zero. That is why the system is stable. The energy levels currently measured are changes in the overall balloon size (balance) of the mass kinetic energy, but when spin kinetic energy is included, all mass motional and positional energies total zero overall in a stable orbital system.
- The quantum orbital energy and momentum levels are correct for mass kinetic energy when spin states are included. At this level the relative spin momenta and mass energies are included, although spin kinetic energy has not been included as such so far, rather the spin angular momenta is instead.
- The odd shape of some electron orbitals, where parts of the volume of probability distribution are separated, shows that the electron is ‘skipping’ via entanglement tunnels between allowable volumes. Since the sum of the

probabilities of being in all the orbital volumes must be 100%, then the skipping between volumes must take no time and be via tunnels. The electron is self-entangled in orbitals and moves by skipping at adjusted-Planck frequency, looking like a superposition. Photon emission shells can also have separated but entangled volumes.

- Massive black holes are not black and physics does not break down inside them. Since the meons and anti-meons are Double-Adjusted SI (DASI) Planck radius, mass and charge, plus twist and one-sixth charge energies, they are the densest particles possible and cannot be broken. In comparison, black holes are far less dense than the meons and anti-meons individually. What a black hole can do is to stretch a loop as it approaches the hole. The differential action of gravity across the loop eventually breaks the loop into a chain, plus chasing/attached chains of partially merged pairs, and that is what enters the black hole. The loop's rotational frequency – its mass and spin, will be absorbed by the hole since the meons and anti-meons that formed the loop are afterwards a chain that is now within the hole.
- Each meon and anti-meon retains its fundamental mass/charge and twist/charge energies even inside a black hole. The individual meons/anti-meons or pairs of meon/anti-meon in the chains can be split from their chain and attach themselves to other chains. A black hole is mainly a mass of chains forming, breaking and reforming. A black hole is really a chain star. All black holes are the same, whether pre-existing failed big bangs or formed in our successful big bang because they break loops into chains, then shorter fragments, and spit out very symmetric photons whose maximum frequency of exit depends on the mass of the black hole. Regardless of the loop sizes or pair number formed in the failed big bang, the result of being broken into chain fragments means all black holes are identical overall in their mix of different components.
- Some chains can reform symmetric loops and anti-loops and then photons at very high rotational frequency at the surface, or just inside, a massive black hole and break out, but will lose most of their frequency in escaping. An escaping high frequency photon must exit perpendicular to the surface of a black hole, otherwise differential gravitational action will break the photon back into chains. There is a cut off frequency proportional to black hole mass above which no photons formed inside a black hole can escape due to frequency loss in the process, even if the photons form on the surface at near DASI Planck energy.
- Photon loops escaping from a massive black hole must be very symmetric, having the same mass and charge energies in every meon/anti-meon in both loops. This means that only the equivalent of symmetric neutrino/anti-neutrino and charged lepton loops can combine as a photon and successfully escape from a black hole, if they have sufficient frequency and leave perpendicularly. Black holes transform loops preferentially to dark matter photons since 2-pair loops are more likely to form than 3-pair loops. The need to leave perpendicularly means that the physical size of the black hole cannot necessarily be observed directly. For an observer, the photons being viewed are those that escaped along their line of sight and no photons from other parts of the black hole surface can be observed simultaneously unless there are asymmetric electromagnetic or gravitational fields present.
- Black holes act as symmetry sieves, taking in all symmetry loops and converting them to symmetric photons, in both normal matter and dark matter versions.
- Where a failed big bang has occurred, the loops formed during inflation have too large masses and not enough energy of expansion to resist gravity. The loops formed will break into chains as the contraction occurs to form a black hole. The merger of unmerged meon and anti-meon pairs to reform partially merged pairs is unlikely to occur because the unmerged meons and anti-meons are chasing each other and still have additional twist/charge energies instead of simple non-twisting fundamental mass M and charge Q usual in partially merged pairs.
- The success of our big bang may be a consequence of the small angular frequency, or mass, of the electron. The physical electron loop size is possibly the largest radius (smallest mass) able to produce a successful inflation event and possibly defines the limit between success and failure for a big bang and the subsequent rate of expansion or contraction.
- Matter and anti-matter do not annihilate each other. No meons or anti-meons or loops are ever annihilated, although positive and negative meons might be able to remerge into ZMBHs under certain conditions immediately after unmerging.
- The meons and anti-meons within loops always exist, even though they may switch places with meons in other loops converting two loops into two different loops, maintaining total frequency as mass and spin plus charge. Slower loops cannot speed up faster ones which is the basis of the second law of thermodynamics.
- Since charge is the only differentiator for matter and anti-matter, then all systems tend towards neutral outcomes. Matter and anti-matter are created equally. All stable systems have equal quantities of opposite charges because the only matter/anti-matter differentiator is the sign of charge for loops.
- An electric battery is a matter/anti-matter device, allowing positive and negative charges to be balanced in atoms and compounds.
- Zero point energy is multiple concentric shells of zerons (loop and anti-loop with planes rotating parallel and in opposite sense) centred at every point in space.
- Pair creation is the temporary separation into loop and anti-loop of a zeron that has been impacted by an incident loop of appropriate energy (frequency). The loop pair always exists, but is hidden as zero point energy until impacted. Pair creation is effectively the temporary un-stacking of a zeron. Zerons are also the reason for the Casimir effect. Any zerons of greater diameter than the distance between two parallel plates cannot exist between

the plates and have to be moved aside, creating a pressure on the plates.

- There is no separate strong force in the nucleus. What keeps the stacks of nucleons together is a combination of direct meon/anti-meon fundamental and emergent mass, charge and spin fields acting within the stacks and between stacks. Only two forces exist, due to underlying fundamental mass and fundamental charge. Actions of the apparent strong force are due to the loop nature of interactions between meons and anti-meons in adjacent loops, and the other energies in those loops.
- Except when physically very close, it is the partially merged pair chains acting through the background that affects other loops. Direct partially merged pair chains for loop-to-loop and meon-to-meon/anti-meon forces only occur at very small loop-loop separations, for example, in stacks. These chains could support the formation of tunnels between such stacked loops when entangled.
- The displacement of loops in stacks by collision is the weak 'force'. The colour 'force' is the balancing of asymmetric loops in a stack to produce rotational symmetry along the axis of the stack and integer q or zero charge in total to be stable overall.
- Changes to loop sizes can move loops between families. An electron taking sufficient frequency from a photon or neutrino can change into a muon. It is the change in loop radius that changes the loop mass and spin energies and magnetic moment.
- Retained momentum is what produces inertia. Since energy is a vector in the same direction as an applied force, a body subject to such a force has energy along the same direction and retains that energy, ignoring viscosity loss to the background partially merged pairs, as momentum until it encounters another body or force in opposition. Inertia is the vector mass energy that a particle has in an external frame of reference.
- The twist energy/charge $\pm sc^2/6$ / $\pm q/6$ sizes will be the same in any big bang because they depend on the size of the meon/anti-meons and the energy needed to unmerge them. The terminal local speed of light c in the local background will also be the same in any big bang because the partially merged pairs and ZMBHs are always the same size.
- Quantum mechanics, being supposedly dependent on pair creation as a door to other universes or dimensions is actually already a process within our universe based on dislodging a zeron into its constituent loop and anti-loop.
- Time exists mainly in loops and when a loop breaks as it falls into a massive black hole it loses all time and reverts to becoming a chain. Without loops in massive black holes, there can be no quantum mechanics inside massive black holes.
- Before loops formed, there was no time in our sense since there were no loops, or composites formed of loops, existing to observe in that non-loop environment. Partially merged pairs' rotational, vibrational or motional activities formed the background but only affect the local partially merged pairs themselves in a non-loop environment. There are three levels of time – outside the ZMBH background, which has no time, partially merged pair motion/rotation/vibration and loop time.
- The picture of random big bangs that fail or succeed is a mixture of an inflationary and a form of steady state models. The big bang and steady state theories can coexist, with failed inflation events appearing randomly as isolated black holes or galaxies. Where observations show that two conjoined galaxies have different red shifts, one will be the result of a failed inflation in the 'stationary' partially merged pair background and the difference in red shifts will represent the net relative expansion or contraction of our big bang flow at that point in space. Very high red shift, very massive black holes which appear to have formed too early after our big bang are probably pre-existing failed big bangs that have attracted our subsequent big bang matter around them.
- Dark matter symmetric loops, of non-three pair size, have the same spin and mass energies as the same frequency of symmetric matter loops. This is because it is the physical size of the loops (w frequency at radius r , v=rw) that defines what mass or spin energy the loops have. The number of pairs only defines the range of charges that the loops could have.
- The number of dark matter loops exceeds that of normal matter because loops with less than three pairs are easier to make, black holes convert asymmetric loops into mainly symmetric dark matter photons and the background partially merged pairs soak up viscosity energy which is higher around denser distributions of all types of matter loops. A symmetric 4-pair loop equivalent to the 3-pair electron size will have charge 4/3q, spin $\pm$½h, in current terminology, and electron mass at 100% of the loop frequency w. A similar symmetric neutrino equivalent will have 0% of loop w. The mass of normal and dark matter symmetric loops will be the same as ½hw. Their spin energies will all be ½hw as well, but the magnetic moments will depend on the number of pairs in a loop.
- Chemistry arises from odd loop asymmetries leading to odd numbers of loops in each stack - needed to produce an overall symmetric balanced stack. Where the 'core' stack has $\pm$½h spin in total it needs an orbiting loop of $\mp$½h spin to balance it. The lowest symmetry that this works for with stacks is three, as in our matter. A single loop considered as a stack is already part of our chemistry for example in positronium, but has very limited chemical diversity.
- Chemistry also arises because of the need to balance non-zero loop stack spin by the orbiting of the largest charge symmetric loop of the same pair number. Chemistry for five-pair loops is possible, but the probability of chains forming 5-pair loops is considerably less than forming 3-pair loops.

- The electron and neutrino can both survive in a nucleon stack because they are each composed of adjusted-Planck size meons and anti-meons. The electron needs additional energy (frequency) in order to match the stack loop size when joining a nucleon stack and could take it from an incident neutrino or photon. Electrons also stack and un-stack photons when they change orbital levels, adding to move higher and releasing to move lower. Photons can also stack with other symmetric loops.
- There is a hierarchy of zero total energy states which matter prefers to inhabit. At each stage from unmerging a ZMBH into a meon/anti-meon pair, forming chains, then loops, loops stacking to form nucleons, nucleons combining to form atoms, atoms to molecules and so on, there are preferred states which always have zero totals of all the differing forms of energy present. Stable states exist as multiple levels of zero energy balance. All systems prefer states of zero for each total energy.
- Both inflation and expansion take place against and through the background of partially merged pairs that have not themselves inflated.
- Loops form photons, stacks, atoms, compounds, planets etc which all lose frequency as they move against the background viscosity, which increases the frequency of the local partially merged pairs, which could be considered as a form of heating the background.
- Photons will eventually lose all their frequency and become free partially merged pairs again. Energy balances move from the background partially merged pairs to meons and anti-meons, then chains, then loops, then stacks - at each stage returning some through viscosity to the background until all is returned to the background.
- There is no beginning or end to the universe. ZMBHs have always existed and all loop and unmerged pair energies will eventually return to the background ZMBHs and partially merged pairs. The ZMBH and partially merged pair background is both a continuum and the source of indivisibles, providing a flexible mechanism for transmitting forces and one sort of lightly dark matter. The action of chasing and opposing change of separation, which is driven by the potential energy chasing force, is as fast as partially merged pairs can transmit forces, so at *c* due to their own viscosity effect. The meons and anti-meons themselves have always ‘known’ about all other meons during and after a big bang. When the ZMBHs are fully merged, they are not limited to *c*.

VII CONCLUSION

Since the densest particles possible, the meon and anti-meon fundamental building blocks of our fermions, as individual black holes, do not themselves follow most of the four black hole laws, there is need to reconsider or reinterpret the scope and applicability of the laws.

The asymmetry of action of fundamental mass potential energy fields between meons and anti-meons, producing the chase/chased action that drives photons up to a terminal velocity within the partially merged pair background to the universe, should be acknowledged as a valid logical interpretation that strengthens the case for the existence of negative mass anti-meons, loops and the extreme symmetry hypothesised in the EESM.

The Extreme Energy-Symmetry Model and its basis in the pre-fermion hypothesis are deserving of wider consideration together as a potential theory of everything.

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