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Law of Physics 20th-Century Scientists Overlooked (Part 3): Noninteraction Mass-to-Energy Conversion

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Abstract: Two situations are contrasted. First is a scenario in which a force (an interaction) is applied to a mass particle (or object) in order to increase its speed. When this particle is accelerated it gains kinetic energy. By means of electromagnetic interaction or repeated collisional impact, the mass particle may acquire ever greater speed and ever greater kinetic energy. But, by such means, the particle can never ever attain lightspeed. However, Nature has a noninteraction mechanism by which mass is compelled to travel at lightspeed and in doing so, the mass undergoes conversion to pure photonic energy. Under this *noninteraction* second scenario, the mass merely rests on the surface of a slowly collapsing gravitating body while the surface inflow of the space medium increases to its ultimate limit. With the aid of a schematic energy triangle, it is shown why lightspeed is unattainable under scenario #1; whereas lightspeed IS attainable under scenario #2 and in the process a total conversion of mass to energy occurs. Presented is a remarkably natural 100-percent conversion process that requires no new force, no new particle, and no *radically* new physics. Nor does it require changing any existing force. If theorists of the 20th century had recognized this mass-to-energy conversion mechanism, their understanding of gravitational collapse would have been radically different —it would have been perfectly natural.

Keywords: Mass-Energy Conversion, Photon Propagation, Gravitational Collapse, Black Hole Physics, Aether, Energy Layer, End-State Neutron Star, DSSU Theory

1. Introduction

There are three basic ways by which mass can be converted directly to energy.

The most unambiguous mechanism is that presented by the annihilation reaction between a mass particle and its antiparticle. For example, when an electron encounters a positron (an antielectron) a mutual annihilation takes place resulting in the emission of a pair of gamma photons. The conversion is expressed as

$$e^- + e^+ \rightarrow \gamma + \gamma$$
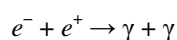
Particle-antiparticle pair annihilation represents a *total* mass-to-energy conversion.

A second way is through *nuclear fusion*. Under this process only a small portion of the interacting mass particles is converted to energy. Energy is released when small nuclei fuse together to form larger nuclei. The fusion process applies when the reactants and the product are classified below iron within the periodic table of the elements. Fusion is the nuclear reaction that takes place within stars. It converts a very small fraction of the mass (of the smaller nuclei) into pure energy —electromagnetic radiant energy.

Lastly, there is mass-to-energy conversion through *nuclear fission*. Again, only a small portion of the mass particle is converted to energy. Energy is released when large nuclei split to form smaller nuclei, as happens in the decay of radioactive elements, or as occurs within particle accelerators, or as takes place within nuclear reactors.

The mass loss corresponds to the mass deficit between the pre-reaction component(s) and the post-reaction component(s). And the energy equivalence of this "mass deficit" is called the *binding energy* (of the pre-reaction nucleus or nuclei).

The mass-to-energy conversion concept goes back to the very early part of the 20th century. The essential feature was succinctly expressed by British physicist James Jeans in one

of his popular books written for a general audience.

"It follows that any substance which is emitting radiation must at the same time be losing weight. In particular, the disintegration of any radio-active substance must involve a decrease of weight, since it is accompanied by the emission of radiation in the form of γ-rays." [1]

Those are the conventional three. However, there is another mechanism for mass-to-energy conversion —one that is total and requires no interaction whatsoever. Here was something —a law of physics— completely overlooked by the 20th-century experts.

2. Conventional Motion Versus "Stationary" Motion

As a preliminary to the explanation of interaction-free conversion (of mass to energy), it will be helpful to examine what is required to drive a mass particle towards lightspeed and also appreciate what happens to the particle during its acceleration to such extreme speed.

What makes this somewhat challenging is that there are actually two distinct kinds of motion —fundamentally different from each other. This, in turn, means there are two ways to bring about the approach to lightspeed. They will be explained as **Scenario 1** and **Scenario 2**.

2.1. Scenario 1

This scenario lies within the realm of conventional motion and 20th-century physics. When a particle is forced (by repeated bombardment, for example, or by powerful electromagnetic fields) to travel closer and closer to the speed of light, it will gain energy. In fact, and this is important, it can and does gain a truly extraordinary amount of energy.

When a particle is accelerate close to the speed of light, the mass equivalence so produced can far exceed the rest mass of the particle. Consider this dramatic example from the CERN laboratory near Geneva. Within the Large Electron-Positron Collider, which operated through the 1990s, electrons and positrons (antielectrons) were accelerated to velocities within about one part in a hundred billionth (10^{-11}) of the speed of light. Speeding around in opposite directions, the particles smashed into each other, producing a lot of debris. A typical collision might produce ten PI mesons, a proton, and an antiproton. Now let's compare the total masses, before and after:

Electron + positron: 2×10^{-28} gram

Ten pions + proton + antiproton: 6×10^{-24} gram

Remarkably, what comes out weighs about *thirty thousand times* as much as what went in [2, p16]. The electron and positron must have gained an amount of energy equivalent to thirty thousand times their rest mass!

Other particles are likewise affected. As particle physicist Frank Wilczek (Nobel Physics Prize, 2004) notes, "If you bang protons together really hard, what you find coming out is … more protons, sometimes accompanied by their hadronic relatives. A typical outcome would be, you collide two protons at high energy, and out come three protons, an antineutron, and several PI mesons. The total mass of the particles that come out is more than what went in." [2, p31]

One may confidently conclude that adding evermore collisional momentum and transferring evermore energy to a particle causes it to gain more and more kinetic energy and brings it closer and closer to the speed of light. But no matter how far the process is pushed, the particle can never attain lightspeed.

The acceleration of particles can also be achieved by photon bombardment. This, in fact, is the mechanism by which stars are able to clear away the enshrouding gas and dust of the cloud from which they originally coalesced; and in the process stars make themselves visible to the rest of the surrounding stellar neighborhood. The mechanism works whether the particle is charged, ionized, or neutral. And, in accordance with conservation rules, the higher the energy of the bombarding photons, the greater will be the transfer of momentum upon impact.

All this was well-understood.

Scenario 1 centers on this key feature: It always involves a transfer of energy from one to the other of the interacting particles; or a transfer of energy from the EM field to the charged particle.

2.2. Scenario 2

Under Scenario 2 there is effectively no interaction between particles. When a particle is compelled to travel ever closer to the speed of light without any particle interaction, *it does not gain energy*.

This counterintuitive situation arises passively through nothing more than a change in the gravitational environment —an *extreme* change in the gravitational setting. The change occurs during the gravitational collapse of sufficiently massive stars. It also occurs when low-mass dwarf stars acquire significant amounts of additional mass.

Gravity is always most intense at the surface of any gravitating body. The surface is special. It is special for two relevant reasons. There the gravity is maximum and there the inflow of the space medium is also maximum. For example, consider the Earth; the effect of gravity is strongest at the surface and the inflow of the space medium (or aether) at the surface is net 11.2 kilometers per second. For the Sun, the surface inflow is net 617 kilometers per second. All else being equal, the more massive the body is, the greater will be the surface inflow speed of aether. Similarly, but this time by holding the total mass constant, the smaller the body is, the greater will be the surface inflow speed of aether (and also the greater will be the surface gravity).

Stated another way, increasing a structure's density increases the surface inflow speed. And here is the point: As the structure collapses towards the neutron density state the surface inflow speed tends towards lightspeed.

Our focus of interest is with the surface mass —its embedded particles. Those particles, because of the described

inflow, are in a very real sense moving through the space medium. Although, apparently "stationary" at the surface, they are speeding upward through the aether flow. The Appendix gives the proof that surface objects/particles possess such a velocity and gives the derivation of the mathematical expression.

Key feature: Scenario 2 does not involve a transfer of energy from one particle to another. There is of course the passive pressure of the underlying mass supporting the surface particles; but practically no transfer of energy as such.

Recapping: There are, within the realm of established physics, two ways to accelerate mass. One requires the transfer of energy, the other does not.

3. Mathematical Underpinning

3.1. The Energy Triangle

For an understanding of the motion of objects and particles at a fundamental level, several forms of energy must be taken into account, namely the *kinetic* energy and the energy associated with *momentum*, as well as the *total* energy and the *mass* energy. The mathematical expressions for these energies have been shown to be valid (if properly interpreted) for all speeds, from zero to lightspeed [3, 4]. Moreover, the four energies are mathematically related; in fact, they are related in such a way that they can be configured into a most useful triangle —the *mechanical energy* triangle. It is also referred to as the relativistic energy triangle.

One of the sides of the triangle represents the total mechanical energy, which includes the particle's rest-mass energy and its kinetic energy. It stands as a graphic for the following total energy expression:

(Total energy) = (Rest energy) + (Kinetic energy);

Expressed with symbols:

$$E = E_0 + E_{\text{kin}} . \tag{1}$$

The relationship that combines all the components of mechanical energy is

$$\left(\begin{matrix} \text{Total} \\ \text{energy} \end{matrix} \right)^2 = \left(\begin{matrix} \text{Rest} \\ \text{energy} \end{matrix} \right)^2 + \left(\begin{matrix} \text{Momentum} \\ \text{energy} \end{matrix} \right)^2 ;$$

Expressed with symbols:

$$E^2 = \left(E_0 + E_{\text{kin}} \right)^2 = \left(mc^2 \right)^2 + \left(pc \right)^2 . \tag{2}$$

Where E is the total energy, E_0 is the rest energy (or mass energy mc^2), E_{kin} is the kinetic energy, and pc is the momentum energy. Since the expression has the basic Pythagorean form, it can be configured as a right-angled triangle as shown in **Figure 1**. Most University-level physics textbooks present the topic in a similar graphic way.
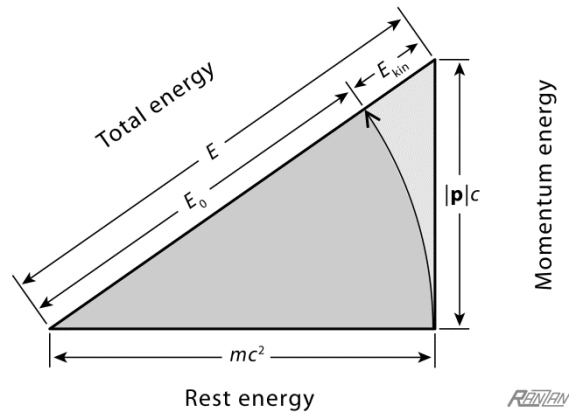

Figure 1. The energy triangle represents the Pythagorean relationship among the energy components associated with bodies or particles. It captures the relativistic relations among the total energy E, the rest energy E_0 (or mass energy mc^2), the kinetic energy E_{kin}, and the momentum energy pc. It can be applied to elementary particles —be they mass or massless, be they stationary or moving at the speed of light. (Since the focus is on the energy associated with motion, the "Total" here refers to total mechanical energy.)

The energy equation, and its graphic representation, works for both mass and massless particles. Moreover, the equation and the triangle are applicable to all speeds —from zero through to lightspeed. **Figure 2** demonstrates how the triangle can be manipulated to represent these diverse situations.

This broad applicability is of particular importance as it means that the energy triangle can be used to explain both of the scenarios discussed earlier.
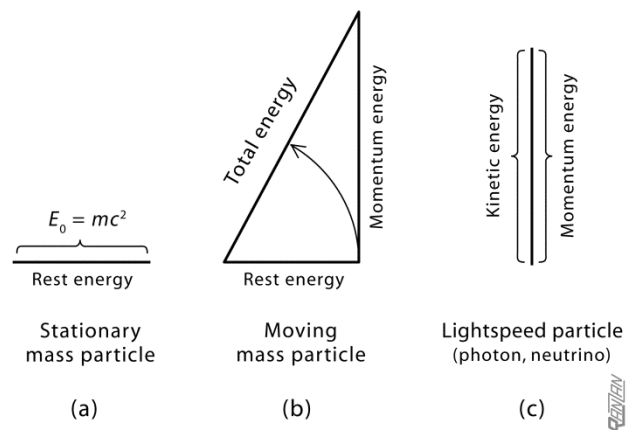

Figure 2. Energy "triangle" works for all situations pertaining to mass and speed that are found in nature. Part (a) pertains to a mass particle with zero speed. Part (b) applies to a moving mass particle and shows its full complement of energy components. Part (c) applies to energy particles, which, by definition, have no mass and propagate in a vacuum at the speed of light; since energy particles have no rest energy, the two other sides of the triangle come together making it clear that the two energies of motion must be equal.

3.2. Mathematical Underpinning for Scenario 1

Background: In the development of the Special Theory of Relativity, a thought experiment of a ballistic nature arose. It

was a situation in which if two relatively moving observers agreed on the mass of a moving object, then they would not be able to agree on its momentum. Similarly, if they instead decide to agree on the momentum (as viewed from their respective frames), they would not be able to agree on the object's mass.

At this point there were two choices available to theorists. They could assume that momentum principles —in particular, the conservation of momentum— do not apply at large velocities. Or, they could look for a way to redefine the momentum of a body in order to make momentum principles applicable to Special Relativity. And the simplest way to do this was to allow mass to change with its speed. And this is the alternative that was chosen by Einstein. He showed that all observers will find classical momentum principles to hold if the mass m of a body varies with its speed υ according to

$$m = m_0 \Big/ \sqrt{1 - \left(\upsilon/c\right)^2}\ , \qquad (3)$$

where m_0, the *rest mass*, is the mass of the body measured when it is at rest with respect to the observer.

And so it was, Einstein and his followers, including the influential Sir Arthur S. Eddington, for a good number of years claimed that mass increases with speed —a belief that became a signature feature of special relativity theory. But, as with several of his other early viewpoints, Einstein reconsidered and changed his stance. In a private letter written in 1948, he made it clear that he had abandoned the idea, stating,

"It is not good to introduce the concept of the mass $M = m \Big/ \sqrt{1 - \frac{\upsilon^2}{c^2}}$ of a moving body for which no clear definition can be given. It is better to introduce no other mass concept than the 'rest mass' m. Instead of introducing M, it is better to mention the expression for the momentum and energy of a body in motion." –*A. Einstein, in letter to Lincoln Barnett [3]*

Gradually, but not without years of confusion, the fixed-mass view prevailed.

The "modern" view: The now-well-established stratagem among physicists is to treat mass as being special and keep it constant —regardless of its state of motion. The modern view is that there is no distinction between *rest* mass and *relativistic* mass. When an object is accelerated, its gain in energy goes entirely into increasing its kinetic and momentum energies. Strange as it may seem, there is no theoretical upper limit.

However, uncertainty persists.

In the CERN accelerator experiment cited earlier, the kinetic energy of the electron and positron pair was great enough to be converted into mass particles equivalent to 30 000 times the actual mass "carried" by the original pair! The question has to be asked, *what form did this energy of motion take?* Sure, it's easy to say this vast energy is manifest in the momentum and contained in the kinetic math-term. But, undoubtedly, there must be something deeper.

Evidently something is being transferred during the interaction that causes the acceleration. Something is given-up by the initiator in the interaction and taken-up by the recipient. The charged particles gain and the magnetic field loses. Yes, the result is a gain in *total* and *kinetic* energy —a neat accounting quantity. But what is it in a nuts-and-bolts sense? What is this something that has been shown to be many thousands of times more substantial than the naked mass particle? … Does the particle's constituent photon (or photons) shorten its wavelength, thereby shrinking the particle —thus becoming more massive? Or do energy particles (photons, neutrinos) somehow attach themselves to the recipient particle?

Based on cognizance of the fundamental process of energy [5, 6, 7], one thing is for certain. As the kinetic energy of a particle increases, there is a corresponding increase in aether absorption/consumption. And for all intents and purposes, this is equivalent to an increase in mass! (However, this does not happen with *noninteraction conversion* via Scenario 2.)

The question remains: At the most fundamental level, what is it that "carries" the extreme energy when Scenario-1 particles approach lightspeed? … It remains one of the deepest mysteries in physics.

Returning to the energy triangle. The established approach in applying the relativistic energy equations (represented by the energy triangle) is to treat the mass energy as a fixed quantity. This means that the base of the triangle does not change in length and makes it easy to demonstrate what happens as a particle or object gains energy as it is accelerated. As can be seen in **Figure 3**, the height of the triangle increases in proportion to the energy gained.
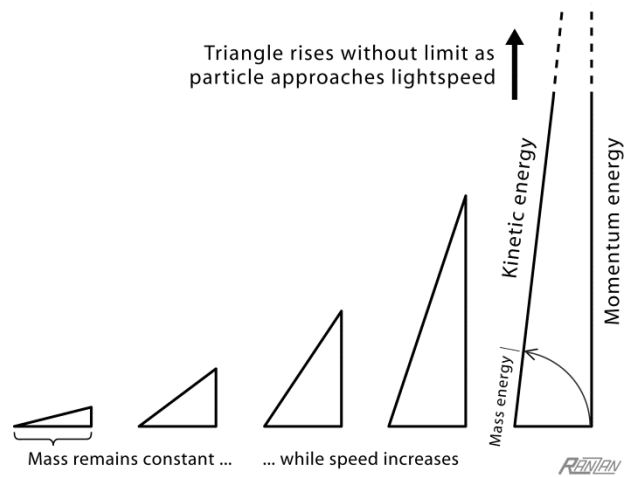

Figure 3. Conventional way of manipulating the energy triangle is to hold the base constant (in keeping with the assumption that mass is invariant) and then adjust the triangle's height. There is no theoretical limit to this process of pumping kinetic energy into a particle, and as the energy grows without restriction, the speed approaches c. However, the particle never attains lightspeed and, therefore, can never become massless. The sequence captures the essential aspects of Scenario 1.

The important thing to note is that when particles are driven toward lightspeed, the triangle representing the energy becomes stretched above a fixed base. There is no theoretical

limit to this process.

In contrast to Scenario 1, the triangle for Scenario 2 has a well-defined height limit, as will be explained next.

3.3. Mathematical Underpinning for Scenario 2

No matter how much energy and momentum is pumped into a particle, one can never bring it up to the full speed of light in a vacuum. It is an incontrovertible fact.

But what happens when a mass particle acquires motion and is brought to ever higher speeds without any interaction —no collisions, no energy fields, no exotic force? Nature has a way of doing this, as will be explained in a moment. But first, the question of what it means for such a mass particle needs to be addressed: In the absence of some interaction, there is no logical way for the particle to gain energy; consequently, *the total mechanical energy of the particle can never be greater than the original mass energy* (its rest energy).

For example, an electron has mass energy equal to 0.511 MeV (corresponding to its mass of 9.11×10^{-31} kilogram); and a proton has 938 MeV (corresponding to its mass of 1.67×10^{-27} kilogram).

When at rest, this is the only energy they possess.

When these particles acquire speed under Scenario 2, they naturally also acquire kinetic energy and momentum. And naturally, the greater the speed, the greater will be the momentum, etc.

Now for the crux of the matter. Since no interaction —no energy field, no impacting— is involved here, where, then, does the energy for the momentum come from? … There is only one place. It comes from the particle's own mass. There simply is no other source. What this means in terms of the energy triangle is shown in **Figure 4**.
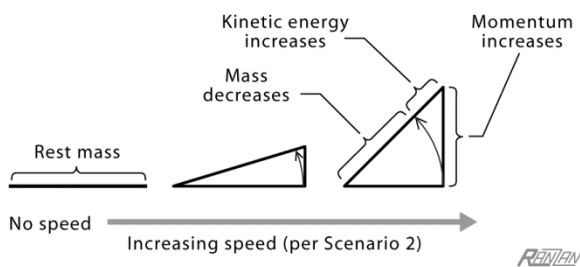
Figure 4. Manipulation of the energy triangle for the situation when there is no interaction and, therefore, no energy gain. As the speed of a particle/object increases, as a consequence of a change in the gravitational environment, its energies of motion increase; while simultaneously its energy of mass decreases. The triangle gains in height, while the base contracts.

3.4. Noninteraction Mass-to-Energy Conversion

In order to accommodate the fact that Scenario 2 requires the referencing of motion to the universal medium (aether) in a specific gravitational environment, the energy triangle is reinterpreted in terms of relabeled parameters. First and foremost, the velocity of the particle/body is taken to be with respect to the aether. Velocity is subscripted with "a" for

aether and becomes "υ_a"; and since mass decreases with speed, it is subscripted with "S2" for Scenario2 and becomes "m_{S2}"; energy and momentum are similarly subscripted. The new labelling is shown in **Figure 5**.
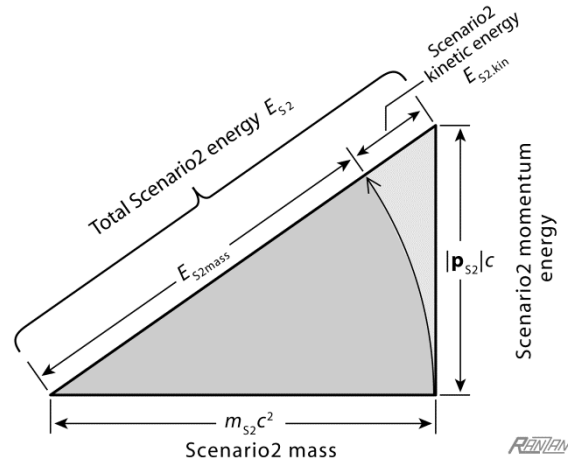
Figure 5. Energy triangle applicable to the Scenario-2 situation —the gravitational situations in which particles/objects suffer practically no interaction. Importantly, the velocity (wherever it appears in the expanded equations) is referenced to the universal space medium. Scenario-2 mass m_{S2} is defined as (m_0/γ_a). And momentum $\mathbf{p}_{S2}$ is defined as ($m_0\upsilon_a/\gamma_a$). Since there is no interaction and, therefore, no energy gain, the "Total Scenario2 energy" stays constant.

The total energy equation, originally introduced as Eq. (1), is now expressed as

$$E_{S2} = E_{S2mass} + E_{S2kin} . \qquad (4)$$

And from the Figure-5 triangle it is obvious that

$$E_{S2}^2 = \left(m_{S2}c^2\right)^2 + \left(\mathbf{p}_{S2}c\right)^2 ; \qquad (5)$$

$$E_{S2} = \sqrt{\left(m_{S2}c^2\right)^2 + \left(\mathbf{p}_{S2}c\right)^2} . \qquad (6)$$

The important difference in Scenario 2 is that mass can vary as it depends on aether-referenced motion. In terms of the gamma factor,

$$m_{S2} = \frac{m_0}{\gamma_a} . \qquad (7)$$

The gamma parameter γ_a is the Lorentzian factor that mathematically allows the mass to vary from rest-mass-value m_0 all the way down to zero (**Figure 6**). Notice that this is the aether-subscripted gamma factor,

$$\gamma_a = \frac{1}{\sqrt{1 - \left(\upsilon_a/c\right)^2}} . \qquad (8)$$

Combining equations (7) and (8) gives the Scenario-2 mass expressed as a function of aether-referenced velocity,

$$m_{S2}(v_a) = \sqrt{1-(v_a/c)^2}\; m_0 . \qquad (9)$$

Note, the conventional usage of m_0; it is the ordinary rest mass and remains constant within the equation (i.e., m_0 is not a variable parameter).

And the S2 mass energy is simply

$$E_{S2mass} = m_{S2}c^2 . \qquad (10)$$

An expression for the S2 kinetic energy follows directly from the energy triangle (**Figure 5**); or by combining equations (4) and (6) and (10).

$$E_{S2.kin} = \sqrt{\left(m_{S2}c^2\right)^2 + \left(\mathbf{p}_{S2}c\right)^2} - \left(m_{S2}c^2\right). \qquad (11)$$
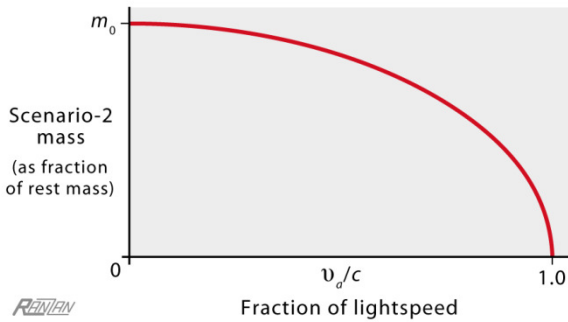

Figure 6. *How Scenario-2 mass varies with speed. The graph shows how mass varies when the cause of the change in speed is not an applied force but, rather, a change in the gravitational environment in which the particle or body finds itself. Mass m_{S2} can diminish from a maximum value of m_0 to a minimum of zero. (Symbol m_0 is the rest mass and v_a is the aether-referenced speed.)*

Here is how the mass-to-energy conversion works mathematically. Consider a particle's *initial total energy*. Its aether-referenced speed v_a equals zero; and its kinetic energy E_{S2kin} equals zero. Equation (4) then becomes

$$E_{S2} = E_{S2mass}. \quad \text{(Initial total energy)}$$

After conversion, now with v_a equal to lightspeed and the mass energy E_{S2mass} equal to zero, equation (4) gives us

$$E_{S2} = E_{S2kin} = E_{photon}. \quad \text{(Final total energy)}$$

Energy, naturally, is conserved; initial energy must equal final energy; and so, in accordance with elementary particle physics

$$E_{S2mass} = E_{photon(s)} ; \qquad (12)$$

$$m_{particle}c^2 = hf = \frac{hc}{\lambda} ; \qquad (13)$$

where h is the Planck constant (6.626×10^{-34} kg·m^2/s). And if it is assumed that a single photon emerges, then f will be its frequency and λ its wavelength.

Returning to our example particles. An electron with its 9.11×10^{-31} kilogram of mass will convert to 0.511 million

electron volts of pure energy. It will, according to equation (13), emerge from the conversion as a photon of wavelength 2.42 picometers.

$$m_{electron}c^2 = \frac{hc}{\lambda} ;$$

$$\lambda = \frac{h}{m_{electron}c} \qquad (14)$$

$$= \frac{\left(6.626\times10^{-34}\, kg \cdot m^2 / s\right)}{\left(9.11\times10^{-31} kg\right)\left(3.0\times10^8\, m / s\right)} \approx 2.42\times10^{-12}\, m.$$

For a detailed treatment on the structural nature of the electron and how it undergoes conversion, see the article *Mass-to-Energy Conversion, the Astrophysical Mechanism* (Section 5 therein) [4].

Turning to the proton. We know that a proton with its 1.67×10^{-27} kilogram of mass will convert to 938 million electron volts of pure energy. But what is not known is the proton's photon configuration. Is the proton an intricate self-looping configuration of a single photon or is it a complex linkage of possibly 3 photons? In any case, when the conversion is complete, only linearly-propagating photons remain. The conversion process changes all self-looping into linear propagation.

The Scenario-2 conversion, from rest mass to photonic energy, may be summarized in terms of the energy triangle. See **Figure 7**.
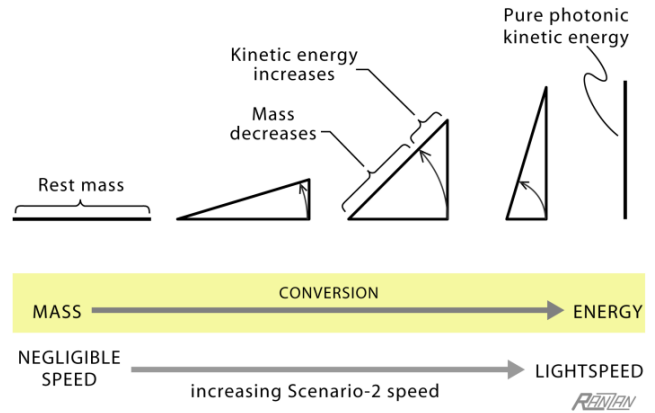

Figure 7. *Schematic demonstration of mass-to-energy conversion. Since under the Scenario-2 conditions described in the text no energy transfer occurs, there is no reason to expect any change to the total energy (mass energy plus kinetic energy). Thus, the energy triangle's hypotenuse remains constant (while the base shrinks) during the conversion. Conservation law is obeyed; with virtually no loss or gain in energy.*

4. Mass-To-Energy Conversion Mechanism

The ideal is to reach proofs by comprehension rather than by computation. –Georg Bernhard Riemann (1826-1866).

4.1. Simplified Stellar Collapse and the End-State Structure

Consider a star with a mass equivalent to about 3.4 times that of our Sun. It is at the end of its normal lifespan and it has no rotation. Imagine the fate of this massive star as it undergoes a simplified gravitational collapse. No sudden implosion, no rebound ejection, no nova event, and no supernova explosion —just an uncomplicated slow-motion contraction.

Depending on the theory being used, there are two radically different outcomes predicted. One aligns with the long-established Einstein theory of gravity, which conspicuously lacks a causal mechanism; the other accords with the validated DSSU aether theory of gravity, and which *does* have a causal mechanism [7]. The one conforms to the 20th-century thinking on extreme gravitational collapse, which, if taken to its logical conclusion, ends in a physical impossibility; the other produces a perfectly natural end-state.

Traditional general-relativity view. Upholding the conventional view is the notion that there is no force in nature that can prevent the star's complete implosion. Given the aggregated quantity of 3.4 Suns, there is simply too much mass. As the star gradually uses up its nuclear fuel, it collapses. As the star collapses, the mass density rises. It rises until it reaches the ultimate density —nuclear or neutron density. The conventional belief is that stationary maximum-density stars cannot exceed 2.16 solar masses. "*With an accuracy of a few percent, the maximum mass of non-rotating neutron stars cannot exceed 2.16 solar masses.*"[8] What this means is that if the collapsed object having neutron-density mass exceeds 2.16 Suns, then Nature's ultimate push-back, the degeneracy pressure of neutronium matter, is not sufficient to sustain the structure. If the mass exceeds such limit, which it clearly does in the hypothetical example of 3.4 Suns, then there is no known force to prevent *total* collapse. The collapse proceeds as shown in **Figure 8a**; and is predicated on there occurring a catastrophic physical breakdown ending in a mathematical entity called a singularity.

As Professor Paul Davies, a professor of mathematical physics, states in one of his popular books, "We now know, from relativity theory, that no force in the Universe can prevent the star from continuing to collapse, once it has reached the light-trapping stage. So the star simply shrinks away, essentially to nothing, leaving behind empty space —a hole where the star once was. But the hole retains the gravitational imprint of the erstwhile star, in the form of intense space and time warps." [9, p265]

In other words, the star becomes a point mass that is somehow able to retain all of the erstwhile star's gravitational influence. Furthermore, it is surrounded by a lightspeed boundary —what in relativity theory is called an *event horizon.*

Admittedly, the nature of the point mass was a mystery; but physicists knew it was there, somewhere deep below the event horizon; and they knew what happens to anything that succumbs to its gravitational influence.

Professor Davies again, "The balance of opinion among the experts is that all matter entering a black hole eventually encounters a singularity of some sort." [9, p272]

Decades earlier a professor of astronomy and astrophysics, Herbert Gursky, had stated, "*Unless some new laws of physics intervene, the matter will shrink down to a singular point.*"[10] Yes indeed, Professor Gursky, a new law of physics does intervene.

We now know the singularity was completely unnecessary. There was something the 20th-century experts failed to recognize. It turns out that no additional force is needed to prevent "catastrophic physical breakdown"!
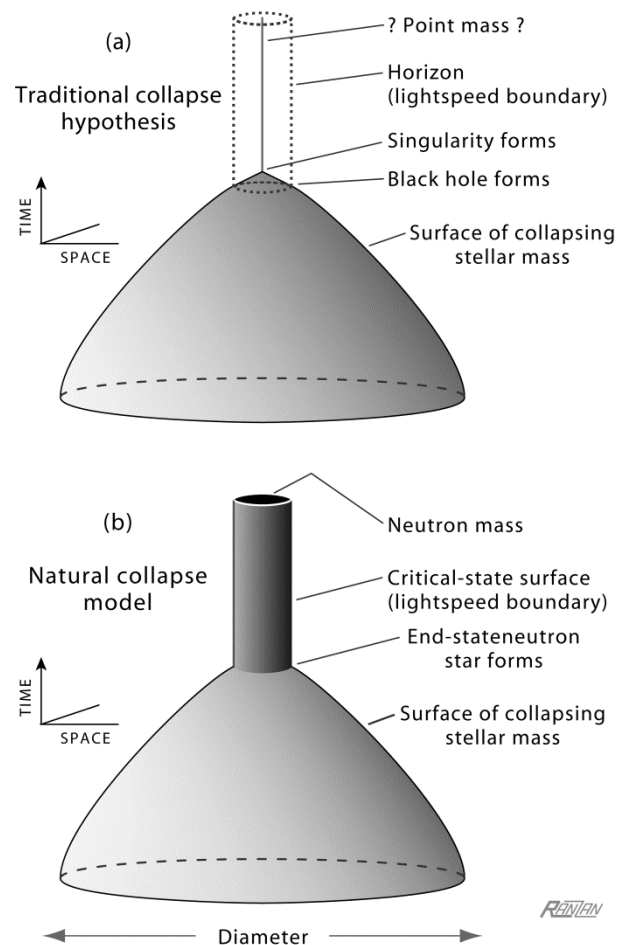

Figure 8. *Contrasting views of stellar gravitational collapse. (a) Schematic of traditional unstoppable gravitational contraction; no traditional force can prevent it, so it is believed; the result is a singularity-type black hole. Its critical boundary is an event horizon located in free space. (b) Natural end-stage collapse results in a critical-state neutron star. Its critical boundary is a pure-energy layer located at the physical surface.*

Natural collapse. The key to understanding the Natural collapse mechanism is in recognizing the convergent flow of aether into mass —any and all mass (and also any energy particles). The defining characteristic of mass is its ontological need to continuously absorb/annihilate aether [11]. The very existence of the mass depends on this steady inflow. Now, the nature of fluid dynamics requires that, as the

medium converges towards a mass body, the speed of the flow increases. From the two facts just cited, it follows that the maximum flow speed occurs at the surface of the mass structure (of the collapsing stellar structure, in this case). After penetrating the surface, the aether is absorbed/annihilated as it continues its convergent course, but with rapidly diminishing speed, towards the center of mass [12].

The important point is this: the inflow is maximal at the surface AND as the area of the surface decreases (due to the contraction of the stellar mass to ever greater density) the flow speed must increase. In order to sustain the same quantity of mass, the same volume of aether needs to flow through a smaller surface area (somewhat analogous to the venturi effect). Therefore, as the structure collapses, and this is still being visualized in our minds as a gradual non-violent contraction, the flow increases until eventually it becomes critical. The aether inflow attains the speed of light; the structure has acquired a critical-state surface (**Figure 8b**).

It is at this stage that the collapse comes to an end. The mass has reached its peak density (neutron density 1.6×10^{18} kg/m^3); it now has a one-way lightspeed boundary; yet it does not violate the speed rule of Special Relativity (as will be confirmed shortly). The final product is an *end-state neutron star* with a radius of 10 kilometers. It simply cannot contract further —*even if more mass is added*.

The significant difference: With a singularity-type black hole, the critical boundary is an event horizon located in free space. With a Natural collapse to a Terminal neutron star (another name for the end-state neutron star), the critical boundary is a pure-energy layer located right on, or at, the physical surface.

The Terminal neutron star has a critical-state surface —a physical one-way boundary.

4.2. Surface Mass Transitions to Energy State

Essentially, what has happened is that the surface material of the pre-collapsed star has transitioned into pure energy.

The mechanism of conversion of mass to energy is confined to the surface region —a rather thin surface layer. This of course is where gravity is always most intense; and hence, this is where aether flow is greatest. The surface region provides the gravitational environment where the transformation takes place.

The stellar mass is the 3.4-Solar-mass spherical body introduced above. The mass constituting the surface —be it gaseous, plasmic, solid, or a crushing superfluid degenerate state —is subjected to an aether "wind" in accordance with the following equation (as derived in the Appendix),

$$v_{\text{aether@surface}} = -\sqrt{\frac{2GM_{3.4\odot}}{R_{\text{surface}}}} \; . \qquad (15)$$

As the structure contracts to smaller and smaller radius, this equation traces the increase in the flow speed at the surface (see **Figure 9**). The simplest way to interpret the graph is to picture a stop-action sequence of the collapse. The

sphere and its surface is shrinking; for each radius reached by the surface as indicated along the horizontal axis, at those points, the speed of the aether flow is calculated. The collapse, necessarily, ends when the flow reaches lightspeed —when the radius bottoms out at 10 kilometers.

For example, at the stop-action point where $R_{\text{surface}}= 1000$ kilometers (beyond the right-hand edge of the graph), the boundary-layer mass will experience an aether flow of one-tenth lightspeed (or 30 000 km/s). When the radius reaches 250 km, the aether flow will be one-fifth the speed of light. Continuing, when the aether speed is calculated at radius 40 km, the surface flow will be one-half lightspeed (150,000 km/s). And if the collapse is checked when the radius shrinks to 15.7 km, the aether flow will be eight-tenths lightspeed (240,000 km/s). Finally, at 10 km from the center of mass, it all ends; a critical velocity boundary then forms, structural stability is attained, further collapse is precluded. Four of the "stopping points" are indicated in **Figure 9**.
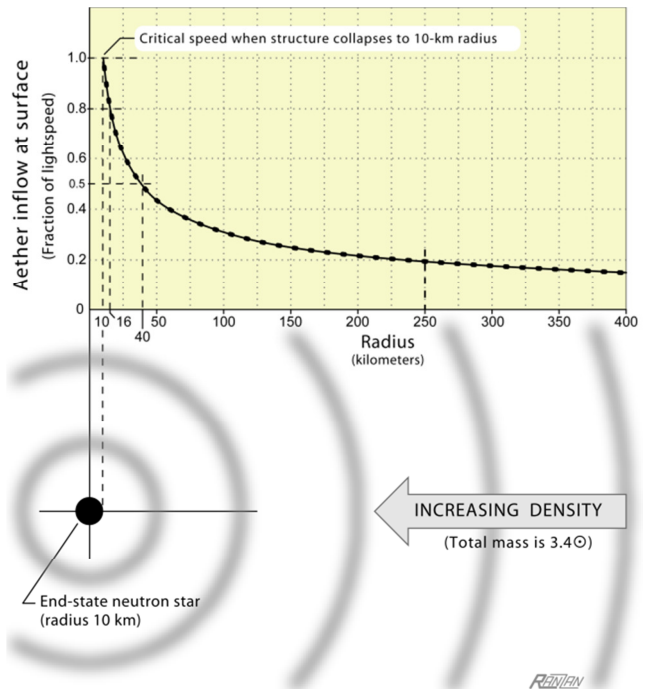

Figure 9. *Gradual collapse of a 3.4 Solar mass (without undergoing any mass loss during the size shrinkage) results in an end-state neutron star. The graph plots the aether inflow speed at the surface of this 3.4⊙-mass structure. The surface-inflow curve is in accordance with equation $v_{\text{surface.inflow}} = (2GM_{3.4\odot}/R_{\text{surface}})^{1/2}$. The collapse necessarily ends at the point where the flow reaches lightspeed —when the radial contraction reaches 10 kilometers. The density of the terminal structure is the maximum that Nature permits —nuclear density, 1.60×10^{18} kg/m^3. There is considerable evidence for such an outcome in the form of pulsar-type neutron stars.*

It may be helpful to clarify the meaning of "surface mass/matter." It is that region of the collapsing structure (in **Figure 8b** and **Figure 9**) which —when collapse stops— experiences lightspeed inflow of aether (popularly called the vacuum or the quantum foam). This surface matter is what becomes the pure-energy skin of the end-state neutron star. Obviously, "surface mass" only has meaning during collapse;

the final structure does not, and cannot, have a mass surface. As for the gravitational process being considered: Think of the described slow-motion collapse as a convenient thought experiment and as an understandable simplification of what actually happens.

The course of the collapse examined in terms of the density (assumed to be uniform): After the star's nuclear energy processes have run their course, with such fuel depleted, the star will contract to become a white dwarf. At this stage, it has a radius of 54,450 km and its matter exists in the *electron degeneracy state* with a density of 10^7 kg/m^3. The contraction continues. Upon reaching the radius of approximately 2528 km, the density has increased to 10^{11} kg/m^3 and the electron degeneracy state is replaced by the *neutron degeneracy state*. This neutronium form of matter increases in density to the ultimate that nature permits — estimated to be 1.6×10^{18} kg/m^3. The radius has shrunk to only 10 km; and the surface is in the critical state. The neutron star now has a lightspeed boundary.

During the collapse sequence, any mass particles embedded in the surface experience the aether flow as a headwind through which they must "propagate" in order to maintain their surface location. As the collapse progresses and the aether wind increases, the mass attribute of the particles undergoes its gradual conversion to pure energy. The photons that constitute those particles are compelled to unravel, so to speak. For the vectorial treatment of the transition as it applies to the electron, see reference [4, Figure 11].

Consider the purely intuitive perspective. Mass objects or particles cannot exist in (or on) the critical-state surface; this is simply because mass cannot travel at lightspeed. During the collapse process, the structure does have a mass surface; upon collapse completion, *that* mass will have lost its "mass" quality. But it is not lost instantaneously. An electron, for instance, does not suddenly go from 9.11×10^{-31} kilogram to zero the moment lightspeed is attained. No, the mass loss is a transitional process —the process accompanying the surface transition to criticality. (Keep in mind, the stellar collapse sequence often involves long periods of stability between very short periods of contraction.) The intuitive answer is found in the *principle of mass variance* as depicted in **Figures 5** and **6**.

The end result is a surface layer of photons (and neutrinos) propagating radially outward but never actually escaping. The layer of radiating particles trapped in this manner is probably only a few centimeters thick (and a few meters at most).

5. Collisional Total Mass-to-Energy Conversion

Although the main theme of this article is the noninteraction conversion to pure energy, attention should also be drawn to a related process, the total conversion of mass to energy involving collision. It too was unrecognized

by 20th-century experts.

The collapse described above ends in a Terminal neutron star. Now, consider what happens when a mass particle, say an electron, falls onto its energy layer. Obviously, this involves a significant collisional interaction.

Case 1, the particle has no kinetic energy. If the electron is comoving with the inflowing aether (meaning it is at rest with respect to aether), it will strike the critical boundary with the full speed of light. The interaction aspect of this would be equivalent to the collision between two electrons each travelling at half the speed of light. Our single electron, during the impact (and during the transformation), gains as much energy as an electron-positron pair together would gain from a collision in which each particle is driven up to one-half lightspeed within a particle accelerator.

The conversion to pure energy must still take place, but now the resultant photon would be more energetic (shorter wavelength), since, as discussed earlier, the particle's *total* energy is the determining factor. See **Figure 10**. The energy can be readily calculated. The energy gained from the collision is two times 0.07905 MeV, which equals 0.1581 MeV. When added to the electrons original mass energy, the energy of the resultant photon must be 0.669 MeV.

(Note: Kinetic energy is calculated with the textbook equation $E_{\text{kinetic}} = mc^2 \left(\frac{1}{\sqrt{1-(v/c)^2}} - 1 \right)$ with v equal to ½c and
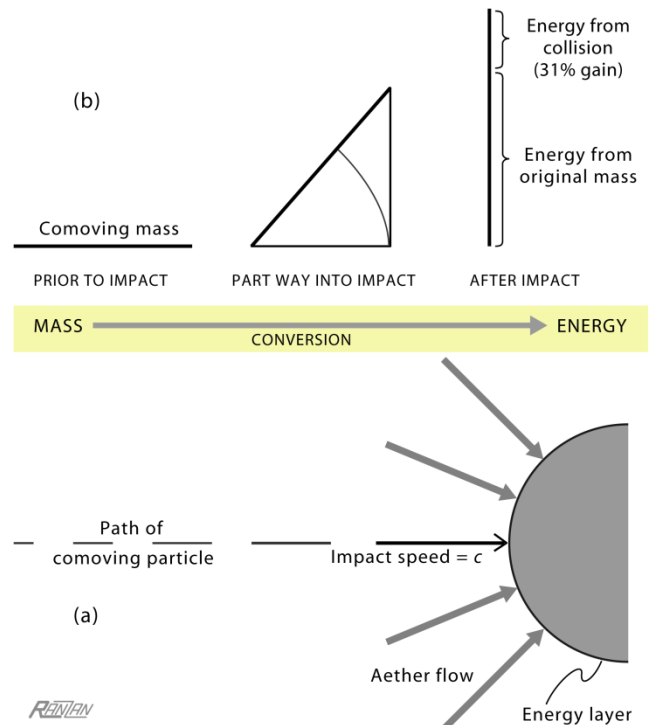

Figure 10. *Conversion analysis for mass particle with no kinetic energy (with respect to the aether medium) that falls onto a Terminal neutron star. Part (a): Since aether is carrying the particle along with it, the speed of the collision must be equal to lightspeed. Part (b) gives the energy-triangle schematic of the mass-to-energy conversion. As described in the text, the energy gained from the collision is equal to 31 percent of the original mass.*

applying the conversion factor based on 1 joule = 0.625×10^{19} electron volts. For Case 1 with υ equal to ½c, this gives half of the energy gain.)

The general prediction for any Case-1 type of collision is a 31-percent gain in the energy conversion process.

Case 2, the particle has significant kinetic energy. If a mass particle is speeding *through* the aether and heading towards the end-state star, then this through-aether speed must be added to the speed of the aether itself. Say the particle is moving with 90% lightspeed, then the speed at the instant of impact must be 190% lightspeed (with respect to the critical surface, and with respect to background Euclidian space). See **Figure 11a**. The mass will actually strike the critical boundary with far more than the full speed of light. The interaction aspect of this would be equivalent to a head-on collision between two identical particles each travelling at 95% the speed of light. The end-state neutron body is, naturally, far, far too dense for anything to penetrate. Most certainly nothing penetrates deeper than the surface layer — not even neutrinos.

The outcome of the almost instantaneous conversion to pure energy is now a photon with considerably more energy than in the previous case. Again, it is the particle's *total energy* that undergoes conversion. See **Figure 11b**. The energy can be readily calculated.

First we note that for this case our single electron, during the impact (and during the transformation), gains as much energy as an electron-positron pair together would gain from a collision in which each particle is driven up to 0.95 lightspeed within a particle accelerator.

Kinetic energy is calculated with the textbook equation as follows:

$$E_{\text{kin}} = mc^2 \left(\frac{1}{\sqrt{1-(v/c)^2}} - 1 \right), \tag{16}$$

$$E_{\text{kin}} = 0.511 Mev \left(\frac{1}{\sqrt{1-(0.95c/c)^2}} - 1 \right)$$

$$= 0.511 \times 3.2025 = 1.636 MeV. \tag{17}$$

This value has to be doubled to obtain the total kinetic energy of the pair, and gives the value of $3.273 MeV$.

So, the total energy gained from the collision is $3.273 MeV$ —gained, that is, from the collision between the 100%-plus-90%-lightspeed electron and the Terminal star's surface.

What about the mass energy? As was explained earlier, mass varies depending on its aether-referenced motion. It does so in accordance with equation (9) $m_{\text{intrinsic}}(v_a) = \sqrt{1-(v_a/c)^2}\, m_0$. The mass energy, then, of the speeding electron (90% lightspeed) will be $m_{\text{intrinsic}}(0.9c) = \sqrt{1-(0.9c/c)^2}\, 0.511 MeV = 0.2227 \text{MeV}$.

One more item needs to be calculated, the original kinetic energy of the electron. Using equation (16) and υ equal to $0.90c$, the electron's intrinsic kinetic energy (i.e., its motion

energy with respect to the aether medium) turns out to be $(0.511 MeV \times 2.294) = 1.172 MeV$.

Putting all this together for the energy-triangle schematic, **Figure 11b**, the total energy of the pre-collision electron is $(0.2227+1.172) = 1.395 MeV$. After adding the energy of $3.273 MeV$ gained from the collision, the final energy value is $4.668 MeV$. This is the incremental energy the Terminal star has gained. This is the energy of the resultant photon.

It is the resultant photon that embeds itself within the star's energy layer.

The significance of this example is that it demonstrates how kinetic energy is almost instantaneously amplified and converted to the photonic form. And the key aspect of the conversion is this: The energy acquired during the Figure-11 impact is the same as (or equivalent to) the energy from having the mass particle (the electron) and the critical surface smash together with each having a speed of 95% that of light.
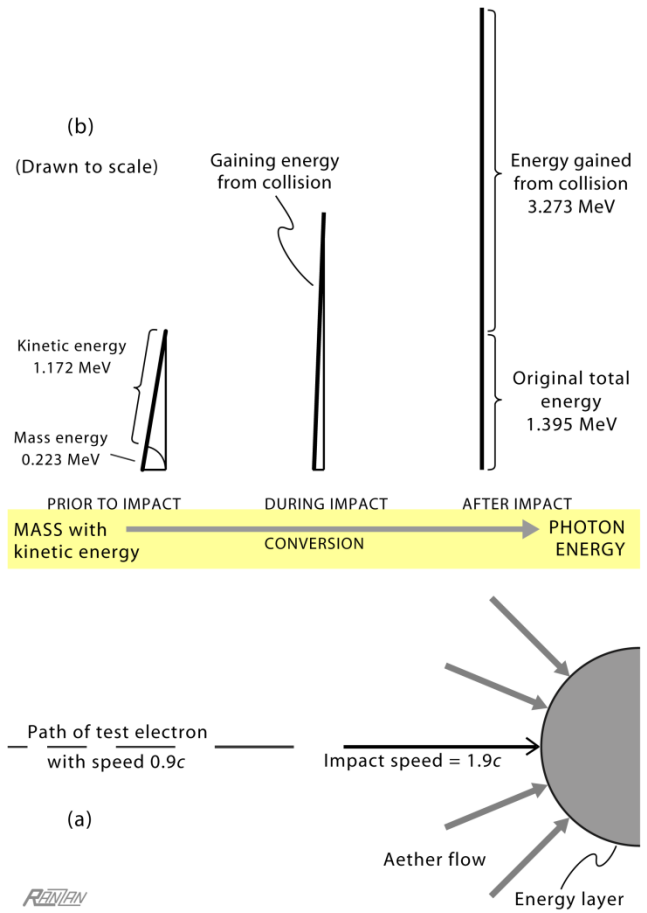

Figure 11. *Conversion analysis for mass particle with significant kinetic energy impacting the energy layer of a Terminal neutron star. Part (a): Since the mass particle (electron) is travelling through aether at 90% of lightspeed, the total speed at the instant of the collision must be equal to 1.9 times lightspeed. Part (b) gives the energy-triangle analysis of the mass-to-energy conversion. As described in the text, the energy gained from the collision is considerably greater than the original total energy of the electron. (The energy generated by the impact is equivalent to two identical particles colliding head-on with each having a speed of 0.95c).*

6. Some Relevant Aspects of Mass-to-Energy Conversion

No further collapse. Can it happen that the end-state neutron star, over time, will collapsing further —say, when it runs out of internal fuel or nuclear energy? … No. All the nuclear energy has long been exhausted. No fuel remains. The neutron degeneracy pressure mentioned earlier is what prevents any further collapse. This degeneracy pressure is rather unique. There is no way to make it go away. It is unaffected by temperature. Even at absolute zero the pressure persists. It can remain in equilibrium with gravity forever. While fuel (internal energy) lasts only so long, degeneracy pressure continues forever [13].

Gravitational heating. Given that gravitational contraction generates heat, how does this thermal interaction affect the conversion process? When surface particles gain gravity-induced thermal energy during final collapse, the process is not altered; it is still by virtue of being subjected to a lightspeed environment that the particles must transform to pure energy. Thermal energy is added to the total energy (the hypotenuse in the energy triangle); and it is this higher total energy that converts to photonic energy.

The energy released by extreme gravitational collapse can be quite significant. The fact remains whatever the energy a particle gains (and however it may have been gained), all of its energy (mass, thermal, kinetic) must transform into elementary photonic energy.

Energy amplification. It turns out that Nature has a remarkably simple process for amplifying the energy within the surface layer. How the surface-trapped energy undergoes this amplification is explained in the article *Law of Physics 20th-Century Scientists Overlooked (Part 2): Energy Generation via Velocity Differential Blueshift* [14].

Energy escape. Equally remarkable is the natural mechanism by which the surface energy continuously escapes to the external world. This feature is detailed in the article *Natural Mechanism for the Generation and Emission of Extreme Energy Particles* [15].

Excess matter. Given that a contiguous mass of less than 3.4 Solar masses is insufficient to form a lightspeed boundary; and given that this same mass is just sufficient to form a lightspeed boundary; the question then is *What happens if the collapsing body is greater than 3.4 Solar masses*? And, say, none of the material is expelled. This contingency is discussed in the book *The Nature of Gravitational Collapse* [16].

No violation of Relativity theory. It should be pointed out that the mass-to-energy conversion mechanism, and the associated gravitational collapse, is not a contravention of relativity. As is well-known, general relativity (GR) is not a complete theory. Einstein himself admitted this. And probably the best evidence of incompleteness is that GR does not say what happens to the matter on the inner side of the critical boundary, the so-called spacetime *event horizon*. And if one pushes the equations too far, GR predicts outrageous nonsense —a singular point of infinite density. It predicts a mathematical object with no connection to reality.

Furthermore, GR says nothing about the interior except that something within the interior *somehow* produces the gravitational effect —*somehow* causes spacetime curvature. But it does not say how. It does not say how the "interior something" can reach through that ultimate one-way barrier and influence the outside world. Therefore, the end-state neutron structure, as it has been presented, cannot be in violation of what is not specified.

Also, there is no violation of special relativity. Not with the gravitational collapse; and not with the Terminal state structure. Nowhere does mass travel at lightspeed with respect to aether; and nowhere do photons or neutrinos travel faster than the *c*-constant, likewise with respect to aether.

I contend that it was the slavish conformance to relativity theories that prevented scientists of the last century from discovering several fundamental laws and structural features of the Universe.

7. Implications and Conclusion

Nature has a way of compelling matter to travel at lightspeed (with respect to the universal medium). It is a situation, as encapsulated in Scenario 2, of not merely striving but of actually attaining the ultimate speed. And in the process of doing so, matter loses its attribute of mass and converts to pure energy —totally and naturally. Dependent only on a radical change in the gravitational environment (as illustrated in Figure 9), this process is essentially the *noninteraction conversion of mass to energy*.

With the failure to recognize this underlying law of physics governing mass-to-energy conversion, Scientists of the 20th century unwittingly had to forego its profound implications.

Three things about the conversion mechanism stand out and point to far-reaching consequences for physical science: Its plain naturalness, its relevance to black-hole physics, and its cosmological implications. Three salient aspects:

ONE. The noninteraction conversion of mass to energy stands as a perfectly natural mechanism. It is a 100-percent conversion process that requires no new force, no new particle, and no radically new physics. Nor does it require changing any existing force. Its validity is rooted in the photonic theory of particles and the natural aether theory of gravity.

TWO. It is of game-changing importance for research into black-hole physics. Crucially important to the study of gravitational collapse, this overlooked process circumvents the breakdown of theoretical physics that plagues the conventional 20th-century view of terminal collapse.

The new interpretation avoids the paradoxes associated with singularity-type black holes. Consider the following:

Black holes, by definition, preclude the existence of any form of energy between the central gravity-causing singularity and its surrounding event horizon. Any energy present in the gap between those two must be absorbed by the point mass. But at the same time, and also by definition,

there is a gravitational field surrounding the singularity and extending out to the event horizon and beyond! So why isn't this energy-possessing gravity field sucked into the singularity? There is no answer —and therein lies the paradox.

Then there is the angular momentum paradox. Black holes, it is claimed, inherit the angular momentum possessed by the pre-collapsed structure. But here's the problem. Angular momentum, most definitely, requires a radius for the material that is present; however, the radius of a singularity, regardless of how much matter it supposedly contains, is always zero. No radius, no angular momentum. Hence, a paradox.

One more self-contradiction worth mentioning. It can be stated bluntly as the outright paradoxical notion of having a vast quantity of matter "inside" a spatial speck of nothing!

Needless to say, there were 20th-century experts on this subject who abhorred the contradictory consequences and strongly suspected something was missing. Sir Arthur Eddington and Lev Landau thought this sort of outcome was ridiculous and repeatedly argued that there must be some law of nature, some law as yet unknown, that would prevent such collapse [17].

THREE. The most immediate implication for cosmology is that the process serves as the key element of the mechanism that drives *astrophysical jets*. These jets are narrow beams of matter spewing out at high speed from (or near) a central object such as a neutron star or a "black hole". They are usually paired and are aligned along the star's spin axis. Although they have been observed for decades, astronomers, we are repeatedly told, are still not sure what produces them, what they are made of, or what powers them. Under the conventional wisdom, the true source of the energy behind these emission beams is a major unresolved mystery.

According to Wikipedia's entry for *Black Holes*, these jets are the ejection of matter, often at relativistic speed, along the polar axis and carry away considerable energy. "*The mechanism for the creation of these jets is currently not well understood.*"

The new insight goes a long way in resolving this long-standing mystery. For additional details, see [14].

In conclusion, the described conversion mechanism is reasonable in its modus operandi, relevant to a proper understanding of gravitational collapse, and revolutionary in its implications for cosmology.

Appendix: Basic Aether-Inflow Equation

Consider an ordinary rock (mass m) resting on the solid surface of a spherical gravitating body (mass M). Although seemingly motionless, the rock is "experiencing" acceleration. Or, as some may prefer, the rock is experiencing the familiar gravity effect and in accordance with the *equivalence principle* it is experiencing acceleration. Something is supporting the rock and *that* something is pushing it upward —

accelerating the rock upward in the equivalent sense. Summarizing the situation, an upward force is imposing acceleration while the rock remains stationary with respect to the surface due to the gravity effect.

Expressed as an equation applicable in the reference frame of the large body,

$$ma = -G\frac{Mm}{r^2}; \qquad (A1)$$

$$a = -G\frac{M}{r^2}; \qquad (A2)$$

where $r \geq R$, R being the radius of M, and G is the proportionality constant. Notice how the two effects are oppositely directed.

Replace a with its definition dv/dt and apply the chain rule:

$$\frac{dv}{dt} = \frac{dv}{dr}\frac{dr}{dt} = -\frac{GM}{r^2}. \qquad (A3)$$

Then replace dr/dt with its identity v, rearrange terms, integrate, and solve for the velocity:

$$\int v\,dv = -\int \frac{GM}{r^2}dr; \qquad (A4)$$

$$\frac{v^2}{2} = -\frac{GM}{-r} + C. \qquad (A5)$$

Essentially, this is an equation of velocity (of the "stationary" rock) as a function of the distance r from the center of the gravitating body.

But the question is *Velocity with respect to what*? There is, naturally, only one answer, and that is with respect to the inrushing universal space medium. More on this in a moment.

What about the integration constant C in the equation? It is a stand-in for any background aether flow that may or may not be present. If it is assumed that the M body is totally isolated, completely at-rest within the aether medium, then this constant-flow component can be discarded. The equation then simplifies to

$$v^2 = \frac{2GM}{r} \text{ and } v = \pm\sqrt{2GM/r}; \qquad (A6)$$

where G is the gravitational constant (whose experimentally determined value is 6.673×10^{-11} N·m²/kg²); and r is the radial distance (from the center of the mass M) to any position of interest (at the surface of M, or external to M).

Final question. *Why two solutions*? Two interpretations are embedded in the equation. The positive solution expresses the upward motion of the test mass *through* the aether (in the positive radial direction). The negative solution represents the *aether flow velocity* (in the negative radial direction) streaming past the test mass.

The negative solution represents a spherically symmetrical inflow field —giving the speed of *inflowing aether* at any radial location specified by *r*.

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