

NATURE OF THE BASIC SUBSTANCE & ELEMENTS

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An element composes other particles but it itself is non-composite. The basic substance composes all and it itself is composed by the basic element(s). The Modern Standard Model with Supersymmetry has over 200 basic particles but none of them satisfies the definition of 'element'. Equation $E=mc^2$ compellingly needs a 'basic substance' composing all forms of E & m, otherwise E & m could not interconvert. Real *Sharmon Medium* propagating light as wave-quantum UNITY is the all-composing and all-pervading 'basic substance' composed by the new particle '*sharmon*', which comprises a positive *positrino* & a negative *negatrino*, the two basic elements named *cosminos*. They compose all forms of energy & mass, material particles and energy-quanta in the Cosmos. Their electric charge is $\pm 1.37 \times 10^{-30}$ esu; mass 2.596×10^{-48} gm & spin $\frac{1}{2}$. Sharmon's mass is 5.192×10^{-48} gm, spin 0 & 1. The $\sim 10^{-33}$ cm Sharmon can pass thru inter-atomic spaces and between orbital electrons. As a kinetic gas, the sharmon medium is irremovable by any means. Its number density is $\sim 10^{15}$ sharmons per cm^3 , mass density 0.519×10^{-33} gm. cm^{-3} . Its inter-sharmon distance of $\sim 10^{-5}$ cm compares with Mean Free Path for real gasses e.g. 1.12×10^{-5} cm for Hydrogen. An element is singly charged since multiple charges imply that many constituents. Cosmino's single unified charge manifests as mass & electric charge via the mediation of gravitational and electromagnetic fields/forces, which also unify into a single *gravitoelectromagnetic* field/force. No particle is massless or sizeless point; neutrinos have mass, size & electric charge. Cosmino compositions of quarks, leptons, neutrinos and photon are worked out.

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1. History of 'element'

Indian sage *Kanaad*, the author of *Vaishesik Darshan*, was the first to conceive *parmanu* (atom) and *anu* (molecule) in the 14th century BC. John Dalton's book '*New System of Chemical Philosophy*' (1808 AD) postulated *atoms* (meaning indivisible) as **elements**, the non-composite particles, which compose compound particles, the *molecules*. That is why the Periodic Table is still called as that of elements. The discovery of subatomic particles has made the term '*atom*' a misnomer because the atom has been found to be divisible.

However, by the end of 19th century the discovered 'elements' were nearing hundred. In 1911 Ernest Rutherford discovered the atomic nucleus. Around 1935 the elements stood at four: proton, neutron, electron and neutrino, or at five if photon is also included.

This parsimonious view of Nature was disturbed in 1950s and 1960s when the proton and neutron were found to be members of a very large family of hadrons, and the electron and neutrino as those of leptons, raising the number of 'elementary particles' again above hundred.

However in 1964, Murray Gell-Mann [1] and George Zweig [2] independently showed all the hadrons as combinations of just three 'quarks'. Thus 'quarks-and-leptons' became the new most basic elementary constituents of matter under the Modern Standard Model.

At present, there are 18 quarks, 6 leptons, 6 antileptons and 13 other quanta mediating 4 fundamental forces plus undefined number of Higgs bosons. With right and left handedness of weak charge the total number of elementary constituents of matter again exceeds hundred. Every one of them is independent and not derivable from other(s). This unwieldy number makes the term "element" meaningless. Nay, the Supersymmetry doubles this number by adding a 'super partner' to every one of them. Thus the Standard Model of the current theories of Physics has over 200 *elementary* particles, all non-composite, independent and not derivable from other(s), hence none satisfying the definition of 'element'.

1.1 *Quarks & leptons are composite, hence not elements*

This author was the first to predict the compositeness of quarks theoretically in his Jan'90 book **Unified Physical Theory** [3]. On its basis he contested, in the 4 Nov'90 interview given to the Press Trust of India, the claim announced in October 1990 of the Physics Noble prize winners of having revealed quarks as the non-composite basic constituents of matter. Since a non-composite particle cannot be compressed the Unified Theory's theoretical prediction for the compositeness of quark [3] got experimental support by the compressibility of quarks observed during measurements of the electric and magnetic polarizabilities of neutron and proton in early 1991 itself [4-6]. Later the D-Zero [7] and CDF [8] collaborations of over 400 international scientists each *observed* transient 'creation' of some Quarks & Leptons during the proton-antiproton collisions at 1.8 TeV kinetic energy. In our Unified Theory [3, 9], the quarks & leptons are composed by cosminos & sharmons, vide sec. 7 below and are therefore assembled out of the cosminos and sharmons composing the energies of the colliding particles.

Compositeness of leptons can be inferred even otherwise. For example, the negatron (or electron) is in volume almost equal to, but in mass 1837th part of, proton, indicating that its contents swell 1837 times on ejection outside the radioactive nucleus during beta/negatron decay.

Therefore, none of the over 200 particle(s) of the modern Standard Model can be considered as an 'element' in the strict sense of the definition as "composing other particles but it itself being noncomposite" The modern Physics is thus inflicted with a conceptual crisis, which our Unified Theory [3, 9] resolves with its two basic elements, positrino and negatrino.

2. The Basic Substance, an inescapable new concept

For a child there is no commonality between the solid ice and the gaseous steam. But with the growing years the child makes out that it is the same liquid water that turns into ice cubes on cooling in a fridge or into steam whistling out from a pressure cooker on heating. On further probing it is found that solid ice, liquid water and gaseous steam are inter-convertible because all the three are made of the same *invisible* water molecule H_2O . The H_2O molecule is subtler than and common in ice, water and steam. Hence there is the composition continuity and inter-convertibility of the three. Let us push this analogy deeper.

Right up to the early twentieth century it was generally believed that matter and energy are entirely different and distinct, which could not inter-convert, although one form of energy could change into another form. For example mechanical energy was known to convert into heat while rubbing the hands and into electric energy on running a turbine, but never into mass or vice versa.

In 1905, however, Einstein [10] gave the thought provoking equation $E = mc^2$ (c squared, c being the velocity of light). It described and predicted the inter-conversion of energy E and mass m , one gram of mass generating about 9×10^{20} ergs of energy. It explained the observations on the creation of the pair (e^-e^+) of the material particles, electron e^- and positron e^+ , from, and their co-annihilation into, the photon(s) of light energy. This equation also paved the way for the developments of the atomic and hydrogen bombs. It has since been repeatedly verified by experiments and found to be correct. For the transient “*creation*” of some Quarks & Leptons during the proton-antiproton collisions [7, 8] the electric charge is conserved and the energy-mass satisfy the equation $E=mc^2$. The mainstream Physics stops here fully satisfied but cannot elucidate the basic physical mechanism underlying the creation of new particles.

In our Unified Theory [9] however, the transiently created Quarks and Leptons [7, 8] are composed by and are assembled from the more basic physical entities, the *cosminos*, which also compose the energies of the colliding particles. The Quarks and Leptons of Modern Standard Model, being compressible and assembleable, cannot be the *noncomposite basic elements*.

The **basic substance** composes all physical entities in the universe and is itself composed by non-composite ‘basic element(s)’. All the above observations and the equation $E=mc^2$, therefore, overwhelmingly and inescapably point to the existence in Nature of an entity, which composes and is subtler than all forms of energy E and mass m . Otherwise energy E and mass m could NOT interconvert to support the equation $E=mc^2$.

Einstein, and with him other physicists, did not go beyond the mathematical equation $E=mc^2$ to inquire into the physical nature of this common subtle entity namely the ‘**basic substance**’. Mainstream physicists therefore have no idea about this new concept, which otherwise is so compellingly forced on us.

Further it is clear that for the overall compositional unity the most basic elements must be those, which compose the subtlest physical entity in Nature. The work of Thomas Young and Augustin Fresnel on interference and diffraction of light had established the wave nature of light by 1827. James DeMeo’s review [11] stresses that Dayton Miller’s ‘*positive*’ results yielded more-than-zero light-medium drift as evidence for the existence of a light-propagating medium in space. The compositional unity of energy and mass into a subtler substance needs to be extended to encompass the space-medium since the electromagnetic radiation including light, as a *wave*, is compositionally one with its propagating medium. Analogously the composition of water wave and the pond water on or through which it moves, is the same. It follows that in reality there is an intrinsic unity or continuity in the compositions of all forms of mass, energy, radiation and the space medium, which propagates light. *The real physical medium in space, which propagates light wave, is the subtlest physical entity in Nature and hence is the ‘basic substance’.*

2.1 Nature of the basic substance

Is this space medium continuous or discontinuous i.e. particulate? Actually, ours is the universe with ubiquitous granularity of compositions at all levels. Moreover a continuum, if existent, would retard, nay prevent the motion of heavenly bodies and even of photons to propagate light through it, which has never been actually observed. According to Unified Theory [9] and the common sense, therefore, the new space medium also is composed by a new particle, say **sharmon**, named after this author. It indicates that the ‘*sharmon medium*’ is not the old classical ether, which for Huygens wave theory of light had to be ‘extremely more rigid than air’ as it has to propagate light (wrongly assumed as longitudinal elastic wave like sound) much faster than sound. The sharmon medium is also different from the numerous multi-dimensional *spacetime continua* and Quantum Theory’s *physical vacuum*, which in a way have already replaced the old ether. No stretch of any concept can bring the old ether or any of its replacements any where near the all-composing & all-pervading sharmon medium as the Basic Substance. I therefore in my 1990-book [3] chose to start afresh with a new distinguishing name, **sharmon medium**. The globally reported PTI interview of 4 Nov’90 had it. Later published 4 books in ref.

[9] carried it and Google search has created numerous references to it. Due to their long, wide usage the names *sharmon & sharmon medium* are no longer new.

2.2 The 'sharmon medium' in space is real

'Hypothetical' is the bad name some mainstreamist might give to sharmon & sharmon medium to ridicule them for the same. But both are very much real, backed by cogent scientific logic and experimental observation.

As mentioned above the work of Thomas Young and Augustin Fresnel on the interference and diffraction of light had established the wave nature of light needing a light medium. James DeMeo [11] gives a comprehensive and up-to-date review of the experimental work on measuring the light-medium drift. Of all the workers Dayton Miller had used the most sensitive instrument and took the largest number of observations spread over the longest period of time. But Miller presents convincing positive evidence for the non-zero medium-drift and hence for the light propagating medium in space. Interestingly DeMeo cites Dayton Miller:

"The effect [of ether-drift] has persisted throughout. After considering all the possible sources of error, there always remained a positive effect." — Dayton Miller (1928)

Dayton Miller's 'positive' results yielded more-than-zero medium drift as evidence for the existence of a light-propagating medium in space, the Sharmon Medium.

The physical parameters of the Sharmon Medium are derived in secs.6 & 6.1 below.

3. Mass & electric charge of cosminos, the new basic elements

The absence of free electric charge in free space demands sharmon to be neutral. Ability of sharmon medium to propagate transverse electromagnetic waves suggests sharmon's polarizability and hence composition from two sub-particles: electrically positive (+ve) *positrino* and negative (-ve) *negatrino*. The positrino and negatrino thus emerge as the most basic non-composite '*elements*' composing all forms of energy & mass, quarks & leptons and particles of matter and antimatter and energy-quanta like photon in the Cosmos, hence given the common name *cosmino*.

The two separate conservations of mass and energy now unifiedly combine into a single *conservation law of the basic substance*.

The total mass-energy content of the universe is eternally conserved at a constant value because no quantity of mass-energy can be created from, or dissolved into, *nothing*. The eternal continuity in time, however, does not impart unending divisibility to mass-energy [12]. The divisibility of mass-energy ends with the indivisible basic elements, the two cosminos. The most basic elements in Unified Theory [9], namely the two cosminos, are neither the Salam-Pati's '*pre...preons*', Dehmelt's massive "cosmon" [12], nor Dirac's point particles [13].

To fix ideas, the cosmino diameter $2r$ is somewhat arbitrarily (this arbitrariness is removed in sec. 4 below) equated to Planck length $l_p = 1.61567 \times 10^{-33}$ cm. If it is thought that the divisibility limit of matter is unknown and l_p is not the smallest *quantum* of length, this assumption is open for future experimental needs to consider even cosminos as composed by still smaller sub-particle(s). This may, for example, be needed to provide for a physical medium for the intra-sharmon inter-cosmino forces.

Thus cosminos, in a way, are the 10^{-33} cm level elementary particles. For cosminos, holds the dynamic Principle of "*equivalence or equipartition of basic charge energies*". This is suggested and supported by unification of the two basic charges, since the cosmino charges cause, carry and propagate the two basic fields in the sharmon medium. That is, negatrino's gravitational mass energy $m_n c^2$ equals the electric charge energy q_n^2/r , m_n being the mass and $-q_n$ the electric charge of a negatrino.

This equality does not hold for any composite particle because then the inter-constituent space wrongly counts in the diameter, and hence q_n^2/r will have to be multiplied by a distribution factor less than unity. Here, the q_n^2/r is not the Weisskopf's logarithmically divergent self-energy,

as the test particle has to be assumed isolated in absolute vacuum, for theoretically computing its intrinsic physical parameters like radius, mass and electric charge. The “vacuum foam” in “superspace” of John Archibald Wheeler at 10^{-33} cm and other Quantum Gravity ideas do not block these considerations because the basis of Quantum Gravity viz. the objectivity of Heisenberg Uncertainty relations is not valid in Unified Theory.

The electron (mass $m_e = 9.109389 \times 10^{-28}$ gm, electric charge $e = -4.806532 \times 10^{-10}$ esu) is composed by, say n_1 negatrinons and n_2 sharmons (mass $m_s = 2m_n$); $e = n_1 q_n$, $m_e = n_1 m_n + n_2 m_s$. Experimental gyromagnetic ratio $g_e = -2.0023193$ for free electron and $-2 + (-11 \times 10^{-11})$ for its 10^{-20} cm Dehmelt core [12]. Its dynamic mass-to-charge ratio $(m/q)_e = (m_e/e + m_n/q_n)/2 = 2/g_e \cdot m_e/e$ is the mean of the values at centre (m_e/e) and periphery (m_n/q_n) as against $-1.0 m_e/e$ for the non-composite point electron of Dirac QED [13]. Hence, $q_n = rc^2(4/g_e - 1) \cdot m_e/e = 1.3729 \times 10^{-30}$ esu; $m_n = q_n^2/rc^2 = 2.596116 \times 10^{-48}$ gm, $n_1 = e/q_n = 3.50 \times 10^{20}$, $n_2 = (m_e/m_n - n_1)/2 = 3.944 \times 10^{17}$ [9]. The positrino has the same mass as negatrino but its charge is equal and positive. The mass density of the primal matter (cosminos) is 1.1756×10^{51} gm/cm³. Both cosminos have a spin $\frac{1}{2}$.

4. Physical parameters of Sharmon, the new particle composing the ‘sharmon medium’

The sharmon, comprising a positrino and a negatrino, has the mass $m_s = 2m_n = 5.192232 \times 10^{-48}$ gm. This derivation supports and is supported by the alternative derivation [3] from the longest wavelength of electromagnetic (e.m.) radiation. Since sharmon is the basic quantum of energy and photon is an energized 1-spin sharmon, the minimal energy photon is equivalent to $2m_s$ and the minimal wave-energy equals m_s , which corresponds to the longest e.m. wavelength $\lambda = h/m_s c = 4.25 \times 10^{10}$ cm or 4.25 hundred thousand (lac) Kilometers. And actually observed [14] electromagnetic spectrum is also found to extend up to few hundred thousand kilometers in wavelength. This strengthens the validity of the Unified Theory’s above dynamic principle: $m_n c^2 = q^2/r$. If we take the cosmino mass $m_n = m_s/2 = h/2\lambda c$ as computed from the electromagnetic wavelength 4.25×10^{10} cm [3] we can deduce, NOT arbitrarily assume, that $2r \sim lp$, as above.

In its 0-spin state, the opposing $\frac{1}{2}$ -spins are attractive to give a positrino-negatrino contact pair 1.616×10^{-33} cm across and 3.23×10^{-33} cm long, having centre-to-centre distance between cosminos 1.616×10^{-33} cm, and hence its Electric Dipole Moment (EDM) as 2.218×10^{-63} esu.cm.

The repulsive co-directional $\frac{1}{2}$ -spins in the 1-spin sharmon keep the cosmino surfaces lp apart giving the centre-to-centre distance $2lp$ and EDM as 4.436×10^{-63} esu.cm. The separation of cosminos in 1-spin sharmon is put at lp as it is the smallest length on the Planck scale [9].

The positron and electron on mutual annihilation convert into sharmons to compose the two photons moving in opposite directions. *A +ve positrino and a -ve negatrino composing a sharmon do not mutually annihilate like a positron-electron pair because positrino and negatrino are the most basic non-composite elements.* Both the scalar 0-spin sharmon and the vector 1-spin sharmon are stable and can inter-convert. Their constituent cosminos not only spin but also vibrate along the common axis, imparting an electric as also a magnetic dipole moment to the sharmon. The potential energy of electric attraction $q_n^2/2lp$ for the 1-spin vector sharmon is half of q_n^2/lp for the 0-spin scalar sharmon. The electromagnetic properties of the material particles, photons and the sharmon medium are generated from those of the composing cosminos and sharmons.

Bosonic condensations of sharmons, supported by close distance electric & gravitational attractions among sharmon’s oppositely charged constituent cosminos, impart gregarious properties to sharmons, which can aggregate to compose energy and neutral mass of material particles. Electrically positive or negative charged mass of the charged particles is composed by the +ve or -ve cosminos. *No particle or energy quantum is therefore massless, sizeless or “virtual” (i.e. unreal).* The neutrinos, photon, graviton &c have more-than-zero mass and size. *Since the negative potential energy of electric attraction for 0-spin sharmon is lower than that for 1-spin state, the matter is more predominant than radiation in the universe.*

5. Unification of Cosmino charges

In Unified Theory [9] the elementary cosminos have only two charges: gravitational (mass), and electric (+ve, -ve) or in reality only a single unified primal charge, the cosmino itself.

As a matter of fact, an ‘element’, being non-composite and having isotropic and homogenous properties throughout its entire whole has to be singly charged. This is because its multiple charges imply that many sub-constituents as the number of charges. And attraction among different charge species namely mass and electric is anti-intuitive. One can think of chargeless (neutral) mass but not a massless electric charge. Therefore the two basic charges, mass & electric, are two different (gravitational & electric) manifestations of a single primal charge, the *mass-electric charge* or the cosmino itself into which they inseparably unify. The gravitoelectric nature of a cosmino appears as its properties of mass and electric charge. The two manifestations of cosmino mass and electric charge are mediated via the two basic fields, gravitational and electromagnetic, which feel and are felt by the two corresponding basic charges. In fact the two basic fields/forces also unify into a single **gravitoelectromagnetic** field/force.

5.1 The idea of separate Higgs boson(s) is unrealistic

The concept of Higgs boson(s), which the bare massless elementary particles in mainstream Physics eat to gain mass, is unintuitive. It is more so since a bare massless electron cannot gain $0.51 \text{ MeV}/c^2$ mass or a bare neutrino the $0.1 \text{ eV}/c^2$ mass by eating an $812\text{-}846 \text{ MeV}/c^2$ or $115 \text{ GeV}/c^2$ Higgs boson. In Unified Theory the mass of a particle is its innate property, not acquired by eating Higgs boson. It is therefore not clear what the wasteful hunts for Higgs boson have so far found or will in future find in its name, say with the Large Hadron Collider.

Gauge Theory first encountered the ‘problem’ of massless elementary particles and then to solve it another problem of mass-generating Higgs boson was created. It is still groping in the dark for experimental support to find non-existent Higgs boson. The Unified Theory rejects the existence of both the massless and mass-generating particles and on the other hand, does not have any conceptual problem.

6. The number & mass densities of Sharmon Medium

In its free state the sharmon medium is an open system. At the time averaged inter-sharmon distance a_s the number of sharmons along 1 cm length is $(1+1/a_s)$, and in a 1 cm cube it is $n_s = (1+1/a_s)^3$ or $n_s \sim a_s^{-3}$ [9]. The a_s equals the $\lambda / 4$ for the shortest electromagnetic wavelength λ , because then the neighbouring sharmons have $\lambda/4$ phase difference. The particle aspect of electromagnetic radiation manifests up to $\sim 7000 \text{ \AA}$ in photochemical effects and up to $\sim 3000 \text{ \AA}$ in photoelectric effects. Their lower double mean $(3+(3+7)/2)/2 \times 1000$ or 4000 \AA is the shortest wavelength in this context. It gives $a_s \sim 10^{-5} \text{ cm}$. The time-averaged inter-sharmon distance $\sim 10^{-5} \text{ cm}$ compares with the Mean Free Path for the real gasses (e.g. for Hydrogen $1.12 \times 10^{-5} \text{ cm}$, Oxygen $0.64 \times 10^{-5} \text{ cm}$, Nitrogen $0.595 \times 10^{-5} \text{ cm}$). Therefore sharmon medium is a kinetic gas with its **number density** $n_s \sim 10^{15}$ sharmons per cm^3 [9]. With sharmon mass $5.192 \times 10^{-48} \text{ gm}$, the average mass density of sharmon medium becomes $d_s = 0.519 \times 10^{-33} \text{ gm.cm}^{-3}$, which can be compared with $3 \times 10^{-31} \text{ gm.cm}^{-3}$ for the Steady State Cosmology.

6.1 Sharmon medium as all-composing & all-pervading basic substance

The sharmon medium is composed by the new particle ‘sharmon’ comprising a positrino and a negatrino, which in turn compose all forms of mass, energy, particles of matter & antimatter, radiation and energy quanta like photon.

Moreover, the sharmon medium is irremovable from any enclosed space or vessel by any means since the tiny sharmon with $\sim 10^{-33} \text{ cm}$ diameter can pass through spaces not only between molecules and atoms of even the densest solid but also between orbital electrons. Due to its

nature as a kinetic gas, the sharmon medium approximates as a '**kinetic continuum**' effectively obliterating the interstices between randomly moving constituent sharmons in fleeting contacts.

This makes sharmon medium as all-composing and all-pervading basic substance.

7. Cosmino-sharmon composition of quarks & leptons

The Unified Theory [9] shows that all leptons contain $\pm 3.50 \times 10^{20}$ cosminos. The sharmon content of electron and positron is 3.94×10^{17} , of 105.7 MeV muon and antimuon 3.6×10^{22} and that of 1807 MeV tau & antitau is 6.19×10^{23} . The positive up, charm and top quarks have 2.33×10^{20} +ve positrinos. The negative down, strange and bottom quarks have 1.167×10^{20} -ve negatrininos. The sharmon contents are: for 0.39 GeV up & down 1.337×10^{23} , for 1.55 GeV charm 5.31×10^{23} , for 0.51 GeV strange 1.749×10^{23} , for 199 GeV top 6.82×10^{25} and for 4.72 GeV bottom 1.619×10^{24} . Further there are other details in Unified Theory [9] to interest the curious reader.

8. Neutrinos have mass, size and electric charge

The modern Standard Model treats neutrinos and antineutrinos as sizeless points due to their non-compositeness and assigns zero mass since they move at light velocity [9]. These also have no charge, hence no interaction with matter. Three neutrinos respectively associated with electron, muon and tau are unique. However, on 5th June'98, 120 Japanese and American Physicists of Super-Kamiokande collaboration [15], announced in Tokyo, the observed mass-dependent "oscillations" in the time-related frequencies of muon-neutrino as evidence for its mass of about 0.1 eV. It stunned the modern Physicists for whom all neutrinos are massless, since the 'unique' neutrinos of modern concepts cannot oscillate or inter-convert.

In Unified Theory [9] however, neutrinos comprise cosminos with non-zero mass, yet move at light velocity without acquiring infinite energy. So, these observed oscillations as evidence of neutrino mass are the experimental confirmations of the correctness of Unified Theory as against the modern Standard Model, which cannot explain neutrino mass from current theories. Thus, all the three neutrinos have mass as also electric charge. The 0.1 eV mass of muon-neutrino comprises 3.43×10^{13} sharmons. Its radius as a compact mass of cosminos is $0.8078 \times 10^{-33} \times (6.86 \times 10^{13})^{1/3} = 3.3 \times 10^{-29}$ cm. It is smaller than that (7.249×10^{-29} cm) of Sodium D-line photon.

Neutron's -ve electric dipole moment (1.2×10^{-35} e.cm, e= electron charge) and its decay into -ve electron and antineutrino, and never into +ve positron and neutrino, suggest that it carries a net -ve charge. So does the antineutrino because it, during negatron decay, is repelled and emitted separately from the negatron. Consequently, antineutron and neutrino are electrically positive. The electric charge on the neutron and various neutrinos equals that of a cosmino i.e. $\pm 1.3729 \times 10^{-30}$ esu. The muonic neutrino & antineutrino carry larger mass than the electronic ones. That is why the former are produced only in high energy accelerators.

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