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Experimental inconsistencies of $\Delta E = c^2 \Delta m$ and generalized equation $\Delta E = Ac^2 \Delta M$

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Abstract

The total kinetic energy of fission fragments of U^{235} or Pu^{239} is found experimentally 20-60 MeV less than Q-value of the reaction predicted by Δmc^2. Energy emitted by frequent celestial Gamma Ray Bursts (most energetic event after Big Bang) in duration 0.1-100s is 10^{45}J which is far higher than predicted by $\Delta E = \Delta mc^2$, similar is the case of Quasars. The mass of particle Ds2317 discovered at SLAC is found to have mass lower than current estimates based upon $\Delta E = \Delta mc^2$. The same is yet to be confirmed in chemical reactions. Newly suggested equation $\Delta E = Ac^2\Delta M$ implies that energy emitted can be less, equal or more than $\Delta E = \Delta mc^2$ depending upon value of conversion factor A. The above processes can be explained with different values of A. (depends upon inherent characteristics of the processes like its other existing counter parts). It is also useful in understanding the creation of mass of universe before Big Bang. $\Delta E = Ac^2\Delta M$, is the first equation which mathematically explains that mass of universe 10^{55}kg was created from dwindling amount of energy (10^{-4444}J or less) with value of A equal to 2.568×10^{-4471} J or less. To explain the anomalous total kinetic energy of fission fragments equation $H = mv^2$ has been introduced; it is similar to value of A<1 and liquid drop model has been extended.

1.0 The generalized mass-energy inter convertibility equation $\Delta E = Ac^2\Delta M$

The law of conservation of mass or energy existed in literature since 18th century (or may be even before informally) the French chemist Antoine Lavoisier was the first to formulate such a law for chemical reactions. The very first idea of mass-energy inter conversion was given by Fritz Hasenohrl [1]. Einstein [2] derived first inter conversion-equation between light energy (ΔL) and mass $\Delta L = c^2 \Delta m$, and speculated from it the general equation (for every type of energy) $\Delta E = \Delta mc^2$ (confirmed in nuclear reactions). Some anomalies are observed in fission fragments of U^{235} or Pu^{239}, as total kinetic energy is observed is 20-60MeV less. To explain the astounding amount of energy emitted especially by some heavenly bodies and possibly visualize the origin of universe before Big Bang, the equation is $\Delta E = Ac^2\Delta M$ is anticipated or visualized by author [3-4].
Here the derivation involves calculation of infinitesimally small amount of energy dE when small amount of mass dm is converted (in any process) into energy. The energy may be in any form i.e. light energy, sound energy, energy in form of invisible radiations etc or energy may co-exist in various forms as in case of atom bomb then

$$dE \propto dm$$

In the existing literature in nuclear reactions conversion factor c^2 between mass and energy has been experimentally confirmed. Thus in above proportionality, it can be taken in account as,

$$dE \propto c^2\, dm \text{ or } dE = Ac^2\, dm \quad \textbf{(1)}$$

where A is co-efficient of proportionality, and is dimensionless variable. Its nature and status are precisely same as those of other constants or co-efficients of proportionally in existing physics. Let in some conversion process mass decreases from M_i to M_f and energy increases from E_i to E_f . Initially when no mass is converted into energy, $E_i = 0$. Thus integrating Eq. (1) we get,

$E_f - E_i = Ac^2 (M_f – M_i)$ **(2)**

$\Delta E = Ac^2 \Delta M$ or Energy evolved = Ac^2 (decrease in mass) **(3)**

The general mass energy inter convertibility equation $\Delta E = Ac^2 \Delta M$ is not in confrontation with $\Delta E = \Delta mc^2$, but is applicable in chemical reactions, nuclear reactions and reactions taking place in heavenly bodies depending upon situations with different values of A. Thus $\Delta E = Ac^2 \Delta M$ is general formulation and $\Delta E = \Delta mc^2$ is its special case.
If value of A =1, then Eq.(3) is simply $\Delta E = \Delta mc^2$, if A >1 then energy emitted more than $\Delta E = \Delta mc^2$ and if A<1 then energy emitted is less than $\Delta E = \Delta mc^2$. In $\Delta E = \Delta mc^2$, c^2 is universal constant for all types of existing and expected reactions reaction Whereas in equation $\Delta E = Ac^2 \Delta M$, conversion factor is Ac^2, rather than c . Thus the generalized equation may be stated as

"The mass can be converted into energy or vice-versa under some characteristic conditions of the process, but conversion factor may or may not always be c^2 (9×10^{16} m^2/s^2) or c^{-2} "

The Eq. (3) can be obtained by method of dimensions.
Let the energy emitted (ΔE) , depends upon annihilated mass (ΔM) as dimensions a, depends upon speed of light c, as dimensions b and depends upon time t as dimensions c. Thus
$\Delta E \propto (\Delta M)^a c^b t^c$ or $\Delta E = A (\Delta M)^a c^b t^c$ **(4)**
where A is constant of proportionality and is called Conversion Co-efficient. Hence
$ML^2T^{-2} = A M^a (LT^{-1})^b T^c = A M^a L^b T^{-b+c}$
or a=1, b=2 and –2 = –2 +c or c =0
Thus, $\Delta E = A \Delta Mc^2 t^o = Ac^2 \Delta M$ **(3)**

1.2 The variation in magnitude of ‘A’ is consistent with existing Physics.

Now obvious question is how should the co-efficient A vary i.e. on what factors does it depend or get influenced? The answer for question of dependence or variation of co-efficient of proportionality A is precisely **same** as answer for all other proportionality constants or co-efficients in existing physics. The co-efficient A does not have any special characteristics neither in regard to its origin nor interpretation and estimation. All such constants or co-efficients of proportionality in existing physics depend upon the intrinsic characteristics conditions and parameters which influence the results directly or indirectly; hence the same is precisely true for A . The constant of proportionality may arise by method of conceptual derivation or by method of dimensions always determined experimentally. The co-efficient A is dimensionless due to reason that it is introduced in existing equation of energy, and dimensions of energy has to be ML^2T^{-2} same in both sides, in F=kma , k is also dimensionless. In physics the same entity may behave in different ways under different conditions. For example a single wave of radiations behaves like both wave and particle; also atomic particle electron behaves like both wave and particle depending upon characteristic conditions. Thus status of conversion co-efficient A and its magnitude is consistent with existing physics.
If the constant of proportionality varies from one system to other (which is realistic situation in many cases), then it is termed as co-efficient e.g. coefficient of viscosity, co-efficient of thermal conductivity, co-efficient of elasticity (Young’s modulus, Bulk Modulus, Modulus of rigidity) etc. Analogously Hubble’s constant must be better called Hubble’s co-efficient, as there is significant variation in its value for various heavenly bodies. The generalised trends of various constants or co-efficients of proportionality are shown in Table I.

Table I

Sr No	Constant or co-efficient of proportionality	Variation in magnitude
1	Hubble’s constant	50 to 80 kilometres per second-

		Mega parsec (Mpc)
2	Co-efficient of thermal conductivity	$0.02 Wm^{-1}K^{-1}$ to $400\ Wm^{-1}K^{-1}$
3	Coefficient of elasticity	$(3\text{-}200) \times 10^9\ N/m^2$
4	Co-efficient of viscosity	1.05×10^{-3} poise to 19.2×10^{-6} poise
5	Decay constant ($0.693/T_{1/2}$)	$10^{15}\ s^{-1} – 10^{-10}\ s^{-1}$ (general trend)
6	Constant in Second law of motion (F=kma)	k=1
7	Universal Gravitational constant G.	$6.673(10) \times 10^{-11}\ m^3\ kg^{-1}\ s^{-1}$ (showing increase)
8	Acceleration due to gravity g	$9.80665\ m\ s^{-2}$ (varies from place to place)
9	Einstein's conversion constant ($\Delta E = \Delta mc^2$)	c^2 or $9 \times 10^{16}\ m^2s^{-2}$ (universal constant)
10	Generalized equation's ($\Delta E = Ac^2\Delta M$) conversion co-efficient	Ac^2 or A $9 \times 10^{16}\ m^2s^{-2}$

The co-efficient of thermal conductivity, K is given by

$K = Qd / A(T_1-T_2)t$ **(4)**

where Q is heat transmitted, d is thickness between surfaces, t is time for which heat flows, T_1 is temperature of one face and T_2 that of the other. Similarly Hubble constant, H is ratio of velocity of recession, V and distance of heavenly body, D i.e.

$H = V / D$ **(5)**

Thus to determine H, V and D both are measured. The decay constant in radioactivity,

$\lambda = 0.693/T_{1/2}$ **(6)**

The value of $T_{1/2}$ (half life time) elementary particles vary from 10^{-6} s to 10^{-23} s and for uranium-238 is 4.5 billion years, depending upon their inherent characteristics and accordingly decay constants vary. Further decay constant cannot predict why half life of one particular particle is 10^{-10}s and other element 1 billion year. It simply equates physical quantities in LHS and RHS. Similar is the status of other proportionality constants or co-efficients and including A as in Eq.(3)

Even in Einstein's $\Delta E = \Delta mc^2$, the conversion constant between mass annihilated and energy created (in any form) is c^2 ($\Delta E/\Delta m$), which is like universal constant (as k in F = kma) . However, there are proposals for increase or decrease in value of c [5-6]. If these proposals for variations in values of c matured then Einstein's equation $\Delta E = \Delta mc^2$ will become quantitatively invalid. Then equation $\Delta E = Ac^2\Delta M$ will be applicable, as it predicts energy emitted can be less, equal or more than $\Delta E = \Delta mc^2$ due to presence of A. Similarly the value of A is given by

$A = \Delta E/c^2\Delta M$

Thus irrespective of status of c the generalized equation remains valid.
The variation of value of A can be understood in three categories, as emission of energy is observed in different reactions e.g. chemical reactions, nuclear reactions and reactions taking place in heavenly bodies. Depending upon the inherent characteristics of the reaction the energy emitted in each type of reaction is different, thus like other proportionality factors (constants or co-efficients) the value of A varies as described below.

(i)) If energy emitted (ΔE) corresponding to annihilation of mass (ΔM) is such that ratio ($\Delta M / \Delta E$) is equal to $1/c^2$, then in generalized equation $\Delta E = Ac^2\Delta M$, the value of A equals unity (A =1)
$\Delta E / \Delta M$ depends upon inherent characteristics of the process. In generalized mass energy inter convertibility equation $\Delta E = Ac^2\Delta M$, the value of A is unity (A =1) for nuclear reactions. Thus in this case the generalized equation reduces to Einstein's $\Delta E = \Delta m\, c^2$. $\Delta E = \Delta m\, c^2$, is a basic or standard equation in nuclear physics as used in deriving relationship 1amu = 931.49 MeV, hence all masses are expressed using it. Here basic assumption is that speed of light will always remain constant, i.e.

$c^2 = \Delta E/\Delta m$ = Any type of energy created / Mass annihilated.

Otherwise all estimations will vary. Hence this discussion gives another but indirect method of determination of speed of light. Also there are both theoretical and experimental variations in value of c [5-6], as fine structure constant ($\alpha = e^2/\hbar c$) is reported to be increasing over cosmological timescales, implying slowing down of speed of light, c

(ii) If energy emitted (ΔE) corresponding to annihilation of mass (ΔM) is such that ratio ($\Delta M / \Delta E$) is less than $1/c^2$, then in generalized equation $\Delta E = Ac^2\Delta M$, the value of A is more than unity (A >1).
(a) In this case practical example is energy measured in case of Gamma Ray Bursts and Quasars. It is inherent characteristic of these heavenly events that energy emitted for mass is far higher than predicted by $\Delta E = c^2\Delta M$
(b) In SLAC mass of particle, Ds (2317) experimentally observed, was found less than expected estimates [7] , it can also be explained with generalized mass –energy inter convertibility equation, $\Delta E = Ac^2\Delta M$ with value of A more than one.

(iii)) If energy emitted (ΔE) corresponding to annihilation of mass (ΔM) is such that ratio ($\Delta M / \Delta E$) is more than $1/c^2$, then in equation $\Delta E = Ac^2\Delta M$, the value of A is less than unity (A <1)

In generalized equation $\Delta E = Ac^2\Delta M$, the value of A is less than unity (A <1) if small energy (ΔE) is materialized to large mass (ΔM).
(a) Before Big Bang mass of the order of 10^{55} kg has been produced from diminishing amount of energy which may be regarded as present in the space at that time, and value of A is less than one. In this case Einstein's $\Delta E = \Delta mc^2$, requires reserve energy of order of 10^{72} J created out of nothing this energy is materialized to mass 10^{55}kg (E/c^2).
(b) In chemical reactions $\Delta E = \Delta mc^2$ has not been confirmed, but regarded as precisely true which is unscientific as there is vast difference between chemical and nuclear reactions. The reason for non-confirmation is that experimental precision is too less to measure the mass annihilated in the process. As experimental precision is increasing, and at some stage experiments are conducted and amount of energy created (ΔE) is found less than predicted by $\Delta E = \Delta mc^2$ corresponding to mass annihilated (ΔM) ; then value of A less than one may be confirmed.

1.3 What determines A

The nature and characteristics of A are already made amply clear. The value of A is determined by magnitudes of mass annihilated to energy or energy materialized to mass. i.e.

$A = \Delta E/c^2\Delta M$
The equivalent equation for $\Delta E = c^2\Delta m$ is

$1 = \Delta E/c^2\Delta m$

Following two intrigues are important in understanding of determination of A

(i) The mass of which particular element will be annihilated? If mass is annihilated then what is magnitude of mass annihilated (ΔM) out total mass M? These both aspects depend upon inherent characteristics of elements. For example the elements with comparatively lower binding energy per nucleon undergo nuclear fission and fusion.

(ii) Which factor determines (for the same annihilated mass) whether value of A will be less, more or equal to one? For same annihilated mass, the value of A determines whether energy emitted will be
(a) equal to $c^2\Delta M$ (nuclear reactions)
(b) less than $c^2\Delta$ M (may be in chemical reaction)
(c) more than $c^2\Delta M$ (Gamma Ray Bursts, Quasars etc).
The value of A depends upon inherent characteristics of elements. For determination of magnitude and trend of variation of A all above reactions are required to be theoretically and experimentally extensively conducted. The general trend of variation of A and its magnitude is expected to be different in each type of reaction, due to different inherent conditions prevailing in nuclear reactions, chemical reactions and heavenly processes etc.

In this regard some information (about annihilated mass, ΔM) is available in nuclear reactions only. In nuclear fusion (conversion of hydrogen to helium) mass annihilated (ΔM) per gram is 7-8 times more compared to nuclear fission (splitting of $_{92}U^{235}$). Hence energy emitted in fusion is more. In addition the velocity of neutrons, in fission is in classical region (0.025 eV or 2185 m/s) and in nuclear fusion the temperature required is order of 10^7K. Some anomalies are observed in nuclear fission fragments of U^{235} or Pu^{239}, as total kinetic energy is observed experimentally [8] is 20-60MeV less, which is explained on the basis of wave mechanics equation, $H = mv^2$, obviously given by de Broglie from his wave mechanics

It is interesting to note that the secondary neutrons produced have energy (1-2MeV, velocity may be approaching to relativistic region), these are unable to cause fission. Thus velocity is purposely reduced to 0.025eV or 2185 m/s with help of moderator (in case of graphite it takes about 110 collisions). $_{27}Fe^{57}$ cannot be fissioned, as binding energy per nucleon is maximum i.e. 8.8 MeV. Such different properties are attributed to inherent characteristics.

Einstein's $\Delta E = c^2\Delta m$ is used to explain these but no term which may take in account these characteristics directly. Thus due to diverse conditions of the processes the mathematical formula for magnitude and variation of A can only be developed after extensive experimentations over wide range of parameters. To support this conclusion, two relevant examples of determination of constants or co-efficients of proportionality are quoted below

Determinations of Hubble's constant H and A are equivalent
This determination of A is consistent with determination of Hubble's constant H which is given by

$H = V/D$

The velocity V of receding heavenly body is measured with Doppler shift and distance D by various methods. Now substituting value of V and D, Hubble's constant can be measured. Depending upon inherent characteristics of heavenly bodies the values of V and D are different, hence that of H. The determination of A is also identical, as it is determined after measurement of ΔE and ΔM. The range of variation of Hubble's constant is 50 to 80 kilometers per second-Mega parsec (Mpc), likewise A will have its own characteristic range

Determination of resistance R in Ohm's Law
Ohm's Law establishes relationship between electromotive force E, current I and resistance R i.e

$E \propto I$ or $E = R I$

or $E = R I = I[\rho l/a] = I[m_e l/ne^2\tau a]$ **(7)**

Further the variation of resistively with temperature is also well known

$\rho = \rho_o e^{Eg/kT}$ or $E = R\,I = [\boldsymbol{\rho_o e^{Eg/kT} l/a}]\, I$ **(8)**

where m_e is mass of electron, n is number of electron per unit volume, τ is relaxation time, l is length a is area of the conductor. Thus the resistance R which is constant of proportionality in Ohm's law is further determined as in above equations. Presently this type of determination as in Eqs.(7-8) of A is not possible due to lack of experimental data as described above.

2.0 $\Delta E = Ac^2\ \Delta M$ in Total Kinetic Energy of fission fragments.

In laboratory it is confirmed [9-10] that using thermal neutrons the TKE of fission fragments that result from of U^{235} and Pu^{239} is 20-60MeV less than Q-value of reaction predicted by Einstein's famous $\Delta E= \Delta mc^2$ (200MeV for U^{235}). It is typically assumed that energy [Q-Value –TKE of fragments] is lost in unobserved effects in this case, to explain it.

Attempts have been made to explain the Q-value of reaction on the basis of de Broglie's wave-mechanical equation [8] i.e.

$H= mv^2$ **(9)**

where H is energy , m mass and v is velocity (v<c). Also attempts [11, 12] have been made to explain the total kinetic energy of fission fragments by extending the successful liquid-drop model of Bohr and Wheeler. These existing attempts use the fact that TKE is the Coulomb potential energy equation and in a specific case (TKE should have minimum value), the magnitudes of TKE as given by extended model coincide with wave mechanical equation $H=\Delta\ mv^2$. The theme of discussion is that extension in Bohr-Wheeler model yields the same value of TKE [8] as $H=\Delta\ mv^2$; further the equation $\Delta E = Ac^2\ \Delta M$, is consistent with $H=\Delta mv^2$ with value of A less than unity. Let the TKE of fission fragments is 175MeV (as experimentally it is observed less), instead of expected 200MeV, then according to $\Delta E = Ac^2\ \Delta M$ value of A is 0.875 i.e.

$A = \Delta E / c^2\ \Delta M = 175/200 = 0.877$ **(10)**

Thus energy of fission fragments of U^{235} and Pu^{239} is given by

$\Delta E = 0.877c^2\ \Delta M$ **(11)**

Thus energy annihilated corresponding to annihilation of mass ΔM is less, hence lesser total kinetic energy of nuclear fragments.

Chemical reactions.

The chemical reactions are the oldest reactions available in nature. But $\Delta E =\Delta mc^2$ has not yet confirmed in such cases, reason cited is that currently experimental precisions are not so accurate to measure the mass annihilated and energy emitted. The value of A is expected to be less than one in such cases**,** as even in case of fragments nuclear fission of U^{235} and Pu^{239} it is less than one.

3.0 $\Delta E = Ac^2\ \Delta M$ in Cosmology

For determination of A, the value of ΔM i.e. mass annihilated in case of heavenly body is required; which can not be directly measured like many other parameters. Thus, initially for simplicity or calibration (standard or reference can be chosen) the magnitude of value of ΔM is regarded as 4.322×10^9kg i.e. mass annihilated in case of sun (luminosity of the sun is $3.89\times 10^{26}\ Js^{-1}$), thus

$\Delta M = \Delta E/c^2 = 3.89\times 10^{26}\ Js^{-1}/ 9\times 10^{16}\ m^2s^{-2} = 4.322\times 10^9 kg$ **(12)**

If for some cases the value of Δ M is experimentally measured then its actual value (ΔM) can be used instead of Eq.(12)

3.1 Gamma Ray Bursts

Gamma ray bursts (GRBs) are intense and short (approximately 0.1-100 seconds long) bursts of gamma-ray radiation that occur all over the sky approximately once per day and originate at very distant galaxies (several billion light years away). GRBs are the most energetic events after the Big Bang in the universe and energy emitted is approximately 10^{45} J with the most extreme bursts releasing up to 10^{47} J. This energy cannot be explained with $\Delta E = c^2\Delta m$ (precisely confirmed in nuclear reactions). This is also the amount of energy released by 1000 stars like the Sun over their entire lifetime! It implies that for annihilation of dwindling mass in short time unimaginably high amount of energy is emitted, which can be explained with help of $\Delta E = Ac^2\Delta M$ with exceptionally high value of A. If for simplicity the value of ΔM can be taken standard as in Eq.(12) as actual estimate of ΔM for GRBs is not available, then $A_{grb} = \Delta E / c^2\ \Delta M = 10^{45}/ 9\times 10^{16}\times (4.32\times 10^9) = 2.57\times 10^{18}$ **(13)** or $\Delta E = 2.57\times 10^{18}\ c^2\ \Delta M$ **(14)**

Hence all conversions of mass to energy in nature, is not always according to $\Delta E = c^2\Delta m$. , where c is the conversion factor like universal constant. In the GRBs intense and short bursts of gamma-ray radiation are emitted; which implies for small mass (simply gamma rays), in small region, in small time huge amount of energy is liberated. It is direct confirmation for $\Delta E = Ac^2\Delta M$ with very high value of A i.e. for annihilation of small mass (burst of Gamma Ray), in short time enormous amount of energy is emitted (in this case 2.31×10^{32} J for annihilation of 10^{-3} kg) which is 2.57×10^{18} times more than $\Delta E = c^2\Delta m$. However the actual value of A_{grb} will be more when exact values of Δm corresponding to energy emitted will be experimentally determined, instead of standard value as given by Eq.(12).

3.2 Quasars

The observations taken with the 2.5-meter Isaac Newton Telescope at La Palma in the Canary Islands reveals that the quasar is 4 million-billion ($15.56\times 10^{41}\ Js^{-1}$) to 5 million-billion times brighter than the Sun or this energy is thousand times more than emitted by the brightest galaxy. The most peculiar characteristics of Quasar is reported by Arav et al. [13] that this prodigious amount of energy is generated in a small region approximately **one light year** across. By comparison the diameter of the Milky Way is about **100, 000 light years.** It implies corresponding to a small region (a measure of mass and its hence annihilation) mammoth amount of energy is emitted in case of Quasars. $\Delta E = Ac^2\Delta$ M is useful in explaining such aspects. Now

$$A_{qu} = \Delta E / c^2\ \Delta M = 15.56\times 10^{41} Js^{-1}/9\times 10^{16}\times (4.32\times 10^9) = 4\times 10^{16}$$

With this value of the generalized mass-energy inter convertibility equation becomes,

$$\Delta E = 4\times 10^{16}\ c^2\ \Delta M \quad (15)$$

Thus corresponding to small mass (size) energy emitted is more thus comparatively smaller quasars or in general smaller bright objects are feasible. So in small region even when small amount of mass is annihilated, huge amount of energy is emitted. The lower limit of Quasars mass is not yet determined, Vestergaard [14]. It is further justified from the fact that the Quasars possibly or inexorably ending as super massive black holes, presently the maximum mass is of the order of 2×10^{40} kg, Vestergaard [15]. Thus in spite of emitting huge amount of energy in own life time, significant amount of matter is remnant in Quasar and which are expected to behave like super massive black hole, this aspect is easily explained on the basis of $\Delta E = Ac^2\Delta M$, with high value of conversion co-efficient, A. Normally a black hole have density of the order of $10^{18} kg/m^3$, and even light cannot escape from it, may be regarded as formed after numerous cycles.

It can be concluded that to attain such state Quasars must under go series of large number of exceptionally intense compressions utilizing energy produced in itself. But energy used for this purpose (internal changes) is not taken in account in current measurements of luminous energy, implying that total energy (including measurable and immeasurable) is far higher than current estimates i.e. A_{qu} may be more than 4×10^{16} (it is only for luminous energy). This large amount of energy emitted by Quasar and other heavenly bodies is consistent with $\Delta E = Ac^2\Delta M$ with higher values of A. Similarly energy emitted by supernova and other bodies can be explained. Thus according to this equation $\Delta E = Ac^2\Delta M$ more energetic and abundant such explosions in universe are feasible and universe is more long lived compared to predictions of $\Delta E = \Delta mc^2$ as for smaller mass huge amount of energy is emitted. The values of A for various heavenly bodies are shown in Table II.

Table II : The values of Conversion–Coefficients (A) for various heavenly bodies and phenomena.

Sr. No	Event emitting energy	Energy (Joules)	Δ M (kg)	$A=\Delta E / c^2 \Delta M$
1	Sun	3.89×10^{26}	4.32×10^9	1
2	Gamma Ray Burst	10^{45}	4.32×10^9	2.57×10^{18}
3	Quasar	15.56×10^{41}	4.32×10^9	4×10^{16}
4	Supernova	5×10^{35}	4.32×10^9	1.286×10^9
5	Bright Star	2.73×10^{31}	4.32×10^9	7.02×10^4
6	Creation of mass of universe before big bang (10^{55}kg)	10^{-4444}	4.32×10^9	2.568×10^{-4471}

4.0 Creation of mass of universe (10^{55} kg) before Big Bang

The Big Bang Theory assumes that initially (t=0) whole mass 10^{55}kg of universe was infinitely compact and in singular state enclosing a space even smaller than an atomic particle instantaneously exploded in gigantic detonation (various heavenly bodies figured) and ever since the universe is expanding, Hawking [16]. How the whole mass of universe was formed and condensed to infinitely compact point? How explosion was triggered causing expansion, reduction in temperature and density drastically? Which source provided energy for these events? Why universe of mass 10^{55}kg, instead of getting into a point mass of density of undreamt magnitude did not start moving away in the beginning itself? Like this that energy would have been saved which was consumed in making universe a point mass and causing explosion. Thus Big Bang theory assumes excess energy in the universe.

Currently, transformation of mass to energy or vice-versa is explained with $\Delta E = \Delta mc^2$ i.e. a gamma ray photon of energy at least 1.02 MeV (1.623×10^{-13} J) gives rise to electron and positron pair (18.2×10^{-27} kg) is consistent with it. The mass of universe is estimated to be nearly 10^{55} kg, thus as above it must have been materialized from energy ($\Delta E=\Delta mc^2$) i.e. 9×10^{71}J. Further additional energy (which may be infinitely large i.e. unimaginably high to be appraised) is required to change mass 10^{55}kg *into a point of exceedingly high density*, and *raise the temperature*, trigger an explosion and to impart *kinetic energy* to it (even now accelerating outward continuously). Now it has to be assumed that energy 9×10^{71}J and spectacular amount of additional energy (may be infinitely large amount of energy for above events) as mentioned above is created from nothing or naught or cipher automatically and spontaneously. The law of conservation of energy does not permit creation of mass out of nothing at all (further on such highest scale), hence the law was not obeyed at that stage according to $\Delta E=\Delta mc^2$. How the energy of the order of 9×10^{71}J was produced? How the energy materialized to mass (gamma ray only changes into electron –positron pair when passes near the filed of nucleus) ? Thus conversion of energy to mass is conditional. All these intrigues are neither answered by detractors nor adherents of Big Bang Theory, and are open for plausible elucidation.

The general mass-energy inter convertibility equation $\Delta E = Ac^2 \Delta M$ predicts that in this primordial bang (exceptionally-2 super special event), **diminishingly small pulse of energy**, say 10^{-4444} J (or less) equivalent to 2.4×10^{-4443} calorie (or less), can manifest itself in mass 10^{55}kg if the value of A is regarded 2.568×10^{-4471} . The energy 10^{-4444} J or less is regarded as to exist inherently in the universe, even when there was no material particle or when process of formation of space started.

The primordial value of conversion coefficient A_{uni} :

Now the value of various parameters can be written as

$A_{uni} = 10^{-4444}/9\times 10^{16\times} 4.32\times 10^9 = 2.568\times 10^{-4471}$

or $\Delta E = Ac^2 \Delta M = 2.568\times 10^{-4471} c^2 \Delta M$ **(16)**

Thus $\Delta E = Ac^2\Delta M$, is the first equation which at least theoretically predicts that universe (10^{55}kg) has been created from minuscule or immeasurably small amount of energy (10^{-4444}J or less, which may be easily available compared to 9×10^{71} J).Whereas $\Delta E=\Delta mc^2$ predicts that mass of universe (10^{55}kg) has originated from mammoth energy i.e. 9×10^{71} J (plus additional energy as cited above). Thus the generalized equation explains the origin of mass of universe with ease and simplicity; and in addition universe is more long lived than present estimates. Thus inter convertibility of energy to mass was there, but for small energy amount of mass created was much higher than $\Delta E =\Delta mc^2$

5.0 Discovery of particle having mass less than predicted mass

Recent work at SLAC confirmed discovery of a new particle dubbed as Ds (2317) having mass 2,317 mega-electron volts. But this mass is far less than current estimates, is a mathematical puzzle [7]. This discrepancy can be explained with help of equation $\Delta E = Ac^2 \Delta M$ with value of A more then one.

The annihilation of matter and antimatter or vice-versa is explained by $\Delta E =\Delta mc^2$ and experiments are being continuously conducted in this regard [17]. In case at some stage more anomalies (i.e. magnitude of mass converted into energy in annihilation of matter and antimatter or vice-versa) are observed less or more than predicted by $\Delta E =\Delta mc^2$ are observed then it would further serve as an evidence in favour of $\Delta E = Ac^2 \Delta M$. Thus this equation acts as scientific stimulant. In brief the comparison and conclusions of equations $\Delta E = Ac^2 \Delta M$ and $\Delta E =\Delta mc^2$ are given on Table III.

Table III

Sr. No	Value of A in $\Delta E = Ac^2 \Delta M$	Comparison	Applications.
1	A=1	$\Delta E = Ac^2 \Delta M = \Delta mc^2$	Nuclear reactions
2	A>1	$\Delta E >\Delta mc^2$	Gamma Ray Bursts, Quasars, Supernova etc.
3	A<1	$\Delta E < \Delta mc^2$	Earliest origin of the universe, M $=10^{55}$kg , $\Delta E =10^{-4444}$ J or less. Less total kinetic energy of fission fragments. Possibly in chemical reactions
4	A=0	$\Delta E = \Delta m =0$ or tends to 0	Neutron hits $_{26}Fe^{56}$, no reaction takes place.

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