Addendum to Proof of Goldbach's conjecture

(Russell's paradox, non-interacting particles)

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Goldbach Proof (Foundation)

The Relativistic Unit Circle

Proof of Fermat's Last Theorem

Russell's Paradox

"A barber shaves all those and only those which don't shave themselves. Does the barber shave himself" – Bertrand Russell

Proof of Goldbach's conjecture

A prime number $a = a^1 = a^1 \log_a(a) = a^1(1_a)$ where $(1_a) = \log_a(a)$

is defined as a set element which only interacts with itself. Consider the "prime" Binomial expansion for the case $n = 2$:

$ct' = ct - vt'$ where

$$(ct')^2 = (ct - vt')(ct - vt') = (ct)^2 + (vt')^2 - 2(ct)(vt')$$

Prime numbers can then be defined by setting the interaction between (ct) and (vt') equal to zero by setting $(ct')^2 = 0$, which results in the expression

$(ct)^2 + (vt')^2 - 2(ct)(vt') = 0$; that is,

$$(ct)^2 + (vt')^2 = 2(ct)(vt')$$

The left hand side of the equation is the sum of two primes ($(ct)^2 + (vt')^2$ in red, and a squared prime number is still prime), and the right hand side is even but the product $S = (ct)(vt')$ (in blue) is not prime. Note that the prime numbers $p_1 = (ct)^2$ and $p_2 = (vt')^2$ on the l.h.s. commute under addition, but do not include the operation of multiplication between p_1 and p_2.

The prime numbers on the right hand side commute as individual primes, but do not include the operation of addition between elements. Moreover, the product is not prime, and the associative rule of multiplication is restored to the product of primes, and (e.g.)

$2(ct)(vt') = 2(ct')(vt) = 2S$ where S can be either even or odd and

$S = \left(\sqrt{(ct')(vt)}\right)^2 = \sqrt{(ct'vt)} = \sqrt{(ct')(vt)}.... = \left(\sqrt{S}\right)^2$.

Example: $23 + 7 = \left(\sqrt{23}\right)^2 + \left(\sqrt{7}\right)^2 = 2(3)(15) = 30$

This means that the left expression is the expression of two (squared) prime numbers under the operation of addition and the right is the product of two prime numbers, where the numbers need not be the same on either of the equality, since the right side is associative under multiplication, and c, t, v and t' are variables over the complete range of integers, and are no longer associated with their mutiplicands, so that all four are variable. Therefore, their actual values will depend on the basis chosen for both sides of the equation, but the r.h.s. set of prime numbers under the operation of addition and power of 2 need not be the same as those on the l.h.s. under the operation of multiplication and power of 1. (Note that both sides of the equation are second order.)

Note that $1_x = \log_x(x)$ where x is a variable over the real numbers.

The prime numbers on the l.h.s. can be represented by

$p_1 = p_1\left(1_{p_1}\right) = p_1 t = ct,\ t = 1_{p_1},\ c = p_1$ so that $p_1 = ct$

and

$p_2 = p_2\left(1_{p_2}\right) = p_2 t' = vt', t' = 1_{p_2},\ v = p_2$ and $p_2 = vt'$

Similarly, $p_1 = ct$ and $p_2 = vt'$ but $p_1 p_2 = (ct)(vt') = ctvt' = cvtt' = (ct')(vt).....n^2$ since the product is no longer prime. Since this result is valid over the complete set of real variables $\{c, t, v, t'\}$ the proof shows that every real number is the sum of two primes, where prime numbers are complete under addition on the l.h.s. and complete under multiplication on the r.h.s.

Since $2S$ is always an even number, this proves Goldbach's conjecture "Every even number is the sum of two primes".

Then $p_1{}^2 + p_2{}^2 = 2p_1p_2$; the sum on the left is that of two primes, and the product on the right is even (but not prime), and holds for all values in the system $\{c,t,v,t'\}$ with prime numbers defines as above.

Example: $12 = 5 + 7 = 2[(3)(2)] = 2^2(3\cdot 1_3)(1_1 \cdot 1_1)$, etc....

(Any even number greater than 2 can be expressed as the sum of two primes)

Goldbach's conjecture is proved for two prime numbers.

By the Prime Factorization Theorem, any factor $p = 2k = 2(p_1p_2p_2......p_n)$ where k is an integer integer on the r.h.s that can be expressed as a product of primes, but since always multiplied by two, it will always be even. (factors of 2 can be moved outside he parentheses so that all of the p's are odd primes, but n will still be an even number). However, the Prime Factorization Theorem of Artithmetic says that every number can be factored into a product of primes. But the product is no longer prime, and hence is adjustable via its internal parameters for each factor of $(p_1)(p_2) \in \{ct\}\{vt'\} \in \{\{c,t\},\{vt'\}\}$ until $(p_1)(p_2) = (ct)(vt')$.

That is, $\dfrac{p_1p_2p_2......p_n}{p_1p_2p_2......p_n} = 1_{p_1p_2p_2......p_n}$ so that $p_1p_2p_2......p_n$ is prime relative to all the other primes in the set $\{p\}$. This is then prime in each number $(p_1p_2p_2......p_n)1_{p_1p_2p_2......p_n} = (p)1_p$ for each factor $(p_i 1_{p_i}),\ i = 1,2$ on the right hand side, where $p_1{}^2 + p_2{}^2 = 2p_1p_2$

Note that the square root of a prime number (and therefore the prime number) is the same whether it represents the radius of a circle or the diagonal of a square, so that geometry (e.g. wave equations, QFT) cannot be used in a GUT…. If the foundations of mathematics are relevant at all…

Note: for $p_1{}^2 + p_2{}^2 = 2(p_1p_2)$ (Goldbach's Conjecture) (Hint: although p_1 and p_2 are prime separately, the product (p_1p_2) is not.....

(Think about Gödel's characterization of wff's… :)

(Hint: does not include 0 as a wff…. ☺

Note that $\log[\exp(1_x)] = 1_x$ That is, 1_x is a basis for the dimension $\{x\}$ for a reified value of arbitrary x , which is complete in the positive real numbers, where $x = \sqrt{x^2}$ For physics, x^2 represents "equal and opposite force" where $x = x*1_x = P_x*1_x$ and P_x is the associated instantaneous momentum at $\gamma = \frac{t'}{t'} = (1_x)', v = 0$

Coordinate Systems

Consider the equations

$p_1^{\ 2}+p_2^{\ 2}=2p_1p_2$, so that

$\frac{1}{2}(p_1^{\ 2}+p_2^{\ 2})=\left(p_1p_2\right)$ so that the rhs expresses the total mass of two indivisible particles, which is not a prime number… This equation can be multiplied by an arbitrary real number, but to preserve the identities of the masses, the primes cannot be individually affected.

Then $x\left[\frac{1}{2}(p_1^{\ 2}+p_2^{\ 2})\right]=x\left[\left(p_1p_2\right)\right]$ where x is a scaling of the prime numbers by a "coordinate" system, which affects any metric as a "density" that is now no longer prime, but a real number. If $x=c\tau$ is first order, it represents a mass scaling o the real numbers; for $x>1$ a mass increase, for $x<1$ a mass decrease, and if $x=0$ there is "nothing there".

This change is then represented in the generalized form

$ct'=ct+vt'$ where "change" is represented by

$\frac{t'}{t}=\gamma=c+v\left(\frac{t'}{t}\right)=c+v\gamma$ so that in first order, $\gamma=0$ means $c=0$, and the speed of light cannot be represented by a coordinate metric. In terms of scaling above, change can be defined as

$x=\sqrt{(x)^2}=\frac{t'}{t}$ where $t'=t$ means no change in mass to the system.

Consider the expression $x^2=\left(\frac{t'}{t}\right)^2=\gamma^2$ If this factor is identified as "velocity" then Newton's law can be identified as

$v^2\left[\frac{1}{2}(p_1^{\ 2}+p_2^{\ 2})\right]=\left[\left(p_1p_2\right)\right]v^2$ so that

$\left[\frac{1}{2}(p_1^{\ 2}+p_2^{\ 2})v^2\right]=\left[\left(p_1p_2\right)\right]v^2$ and $m=$ $m=(p_1^{\ 2}+p_2^{\ 2})$ for the particles considered as a sum, but $m=p_1p_2$ for the particles consider as a product.

Consider the expression:

$\psi=m_1+m_2$, so that $\psi^2=m_1^{\ 2}+m_2^{\ 2}+2m_1m_2$

If m_2 changes, it is then expressed by $m_2 = m_2\gamma$, and if both masses change $(m_1m_2)' = (m_1m_2)\gamma$, so that $(\psi')^2 = (m_1')^2 + (m_2')^2 + 2(m_1m_2)' = (m_1')^2 + (m_2')^2 + 2(\gamma)^2 (m_1m_2)$

If $\gamma^2 = \frac{1}{r^2}$ then the "interaction" term becomes $F(m_1, m_2, r) = 2\left[\frac{1}{r^2}(m_1m_2)\right]$ which is a statement of the "inverse square" law. This law cannot be expressed as

$F(m_1, m_2, r) = 2\left[\frac{1}{r^2}(m_1m_2)\right] = 2\left[\frac{1}{r^2}G(m_1)^2\right]$, where $G = \left(\frac{m_1}{m_2}\right)^2$ where m_1 and m_2 are prime numbers, but the division $\frac{m_1}{m_2}$ is not.

$(\psi')^2 = (m_1')^2 + (m_2')^2 + 2\left(\frac{1}{r^2}\right)(m_1m_2)$ only holds strictly for $r = 0$ so that it doesn't exist as a dimension, and $(\psi)^2 = (m_1)^2 + (m_2)^2 + 2(m_1m_2)$. If the "iinteraction" is interpreted as "curvature" instead of mass, it corresponds to a coordinate "interaction' or change, but only in one dimension, since $\left[(\psi)^2\right]\vec{i} = \left[(m_1)^2 + (m_2)^2 + 2(m_1m_2)\right]\vec{i}$ and only during the interval $t' \neq t;\ (v \neq 0 \text{ or } v \neq c)$

Conclusion: The factor x can either be represented as a coordinate or a mass, but not both, so it is either a figment of the subjective experience of "distance" or "force" (in the case of light, as a sunburn, in the case of a locomotive the end of the observed universe).

Note that if $\left[(\psi)^2\right]\vec{i} = \left[(m_1)^2 + (m_2)^2 + 2(m_1m_2)\right]\vec{i}$ is expressed as

$\left[(\psi)^2\right]\vec{i} = \left[(m_1)^2 + K^2\right]\vec{i}$ where $K^2 = (m_2)^2 + 2(m_1m_2)$ (degeneracy) then **the result is valid only for the unique value of m_2 and cannot therefore be a general law**.

Solution of Russell's Paradox

A set element exists only if it is positive definite

$$(p)\vec{i} = \left(\sqrt{p}\right)^2 \vec{i} = \left(p\cos\theta\right)\vec{i},\ \theta = 0$$

And it is prime only if it interacts (multiplies) itself and no other. For case $n = 2$ (one self multiplication):

$$p^2\vec{i} = \left(\sqrt{p}\right)^2 \vec{i} = \left(p\vec{i}\cdot p\vec{i}\right)\vec{i} = \left[p^2\cos^2\theta\right]\vec{i} = \left[\left(p\cos\theta\right)^2\right]\vec{i},\ \theta = 0$$

If a set element does not interact with itself, then its interaction is zero:

$$p^2\vec{i} = \left(\sqrt{p}\right)^2 \vec{i} = \left(p\vec{i}\cdot p\vec{j}\right)\vec{i} = p^2\sin^2\theta\vec{i} = \left(p\sin\theta\right)^2\vec{i} = 0,\ \theta = \pi/2$$

Consider a barber $p\vec{i} = \left(p\cos\theta\right)\vec{i},\ \theta = 0$ and a villager $p\vec{i} = \left(p\cos\theta\right)\vec{i},\ \theta = \dfrac{\pi}{2}$

If the barber p shaves ("interacts with", multiplies) himself, then the result of the interaction is the inner ("dot") product $\left(p\vec{i}\cdot p\vec{i}\right)\vec{i} = \left(p\right)^2\vec{i} = \left(p\cos\theta\right)^2\vec{i},\ \theta = 0$ where $\theta = 0$

If the barber does not shave himself, then the result of the interaction is the outer product ("cross")

$$\left(p\vec{i}\times p\vec{i}\right)\vec{i} = \left(0\right)^2\vec{i} = \left(p\sin\theta\right)^2\vec{i},\ \theta = \pi/2$$

Consider the case

$$\psi = p(\cos\theta + \sin\theta)$$

Then

$$\psi^2 = p^2(\cos\theta + \sin\theta)^2 = p^2(\cos^2\theta + \sin^2\theta + 2\cos\theta\sin\theta)$$

The interaction term $2\cos\theta\sin\theta$ represents the barber shaving himself and not shaving himself at the same time; for $\theta = 0$ $\psi^2 = p^2$, so the barber can only shave himself, and cannot shave others (also represented by $\sin\theta$ if the barber is not a villager), since the barber does not interact with villagers if they are included in the set $\{p\}$, whether they shave themselves or not.

Relation to Physics (Consistency of particle count under elastic collisions)

The solution to Goldbach's conjecture shows that the count of irreducible elements (prime numbers) is consistent under the unique operations of addition (l.h.s.) and multiplication (r.h.s.) The left hand side then represents the energy of non-interacting elements under addition, and the r.h.s. the energy of non-interacting elements on the r.h.s.; since the process is complete under the positive real numbers, the model represents elastic collisions, where the mass of two individual particles not interacting with each other is on the lhs, and the total mass of the two particles is represented on the right, with the partitions of the mass (number) line different for the two particles.

$$p_1^2 + p_2^2 = 2p_1p_2$$

Then the mass of the noninteracting element p (a "Higgs boson" and the energy p^2 represent of two (unique, non-interacting) particles (or sets of such particles) where there are no other collision products (there are only two particles in the energy representation, so the particles are indivisible, and thus prime). Counting is preserved, and the collisions are elastic.

Note that the representation can be scaled by $x\left[p_1^2 + p_2^2\right] = 2x\left[p_1p_2\right]$, which scales the prime numbers on the real line according to the basis 1_x , where $x(1_x) = x\log_x(x)$

If the collisions are not elastic, then the elements are not prime, there is interaction, represented by "Planck's constant", where Planck's constant and spin are related by:

$$\psi = \cos\theta + \sin\theta$$
$$\psi^2 = \cos^2\theta + \sin^2\theta + 2\cos\theta\sin\theta$$
$$h_\theta^2 = 2\sin\theta\cos\theta = 2S^2 \Leftrightarrow S = \frac{h_\theta}{\sqrt{2}}$$

(See my pdf on "The Relativistic Unit Circle" for the analysis).

Philosophy

The Sum of Two Primes

Consider the following expression:

$$\sqrt{M} = \sqrt{Me}$$

If there are no interactions, M must be a prime number, so

$$M = 1_1 = \log_1(1) \ .$$

Then the prime number Me as a single non-interacting indivisible prime number $p_1 = 1_1 = (p)^0$ for any integer p,

If there are p "Me's", then the set $\{p\}$ of (non-interacting, indivisible) particles is represented by $\{p_1\} \equiv p_1 1_{p_1} = p_1 \log_{p_1}(p_1)$; the number of elements is called the "count" c of $\{p\}$ and is represented by the arithmetic sum Σ, where

$$c_n = nM = n1_1 = n\log_1(1) = \sum_{i=1}^{n} 1_i$$

So that the set $p = c_n \log_c(c) = c_n 1_c, p \in \{P\} \in |\mathbb{R}|$ for any prime number p.

(Note that the square root of a prime number cannot be an integer. However the product of the square root is an integer, which corresponds to the radius $r = p$ of a single circle, where $r = p = 1_1$ represents the radius of a single unit circle).

(Note that for real numbers, $\{c\tau\} = (c\tau)\log_{c\tau}(c\tau) = (c\tau)1_{c\tau}$ where c and τ are variables over the positive definite real sets $\left\{c = \sqrt{c^2}\right\}$ and $\left\{\tau = \sqrt{t^2}\right\}$).

This argument can then be extended to a second prime number $q \in \{P\}$, $q \neq p$

The symbol $c_{p+q} = c_p + c_q$ where "+" represents the sum of the number of elements in the two sets of primes $\{p\}$ and $\{q\}$ and is called the count of elements making up the total set where

$$c_i\{p_i\} = \sum_{i=1}^{n} 1_i = n_i \ .$$

Note that the sets $\{p\}$ and $\{q\}$ are relatively prime; that is, $p \notin \{q\}$ and $q \notin \{p\}$. Then the products

$p = p_1 p_2 p_3 \ldots p_n = \prod_{i=1}^{n} p_i$ and $q = q_1 q_2 q_3 \ldots q_m = \prod_{j=1}^{m} p_j$, where p and q are redefined to represent

two numbers that are relatively prime. Then $L = p + q = \prod_{i=1}^{n} p_i + \prod_{j=1}^{m} q_j$ represents the unique sum of

two relative prime numbers, with each relative prime expressed as the product of primes. By the Fundamental Theorem of Arithmetic, then L can be expressed as a product of prime numbers, where

$$L = l_1 + l_2 + ... + l_k = \prod_{i=1}^{k} l_k$$

(it is instructive to compare i and j with their roles in the expression of two-dimensional vectors.)

The Product of Two Primes

Consider the expression $L = L = 2pq = 2\left[\left(\frac{L}{2}\right)L\right] = 2N,\ N = pq$

Then N can be expressed as a product of prime numbers, where

$$N = (p_1 p_2 p_3 \ldots\ldots p_n)(q_1 q_2 q_3 \ldots\ldots q_m) = \left[\prod_{i=1}^{n} p_i\right]\left[\prod_{i=1}^{m} q_i\right] = n_1 n_2 n_3 \ldots\ldots n_k = \left[\prod_{i=1}^{k} n_i\right]$$

Then L is even, and is the sum of two relative primes $L = p + q$ since is equal to twice the product of two relative primes $2\left[\prod_{i=1}^{k} n_i\right]$, which can be factored uniquely into a product of primes

$$L = (pq) + \prod_{i=1}^{k} l_k = 2N = 2(pq) = 2\left[\prod_{i=1}^{k} n_i\right]$$

Since this is true for all relatively prime numbers for all values of $\{L, i, j, n, m, k, N, n, m, k\}$ related by the above eqiuation, under the operations of addition and multiplication:

Then "Every even number $L = 2N$ is the sum of two primes L " is valid for all numbers, since $L = 2N$

(Note that $\sqrt{L}$ and $\sqrt{L} = \sqrt{2N} = \sqrt{2}\sqrt{N}$ are not integers, but $\left(\sqrt{L}\right)^2 = L$ and $L = \left(\sqrt{2N}\right)^2 = 2N$ are integers.)

Q.E.D.

Compare this result with the hypotenuse of the (relativistic) unit circle in the context of non-interacting (i.e., affine) radii). (Hint: in this case there isn't one… :)