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An Amplified Standard Model

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Abstract

The Standard Model (SM) consists of 16 matter and force particles: six quark matter particles (up, down, strange, charm, bottom, and top); six lepton matter particles (electron, muon, tau, electron-neutrino, muon-neutrino, and tau-neutrino); and four force particles (photon, W/Z's, gluon, and Higgs). Although the SM is the gold standard of particle physics, it is inadequate because it: does not emphasize Higgs particles' supremacy; does not differentiate between more important permanent and less important transient particles; defines only a single Higgs force; does not include the graviton; and does not include dark matter, dark energy, supersymmetry, and super supersymmetry of Higgs particles. Via amplification of four independent theories (superstring, particle creation, Higgs forces or bosons, and spontaneous symmetry breaking), the SM was amplified to Fig. 6 Fundamental SM/supersymmetric/super supersymmetric matter and force particles containing 64 matter and force particles.

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1. Introduction

The four theories (superstring, particle creation, Higgs forces or bosons, and spontaneous symmetry breaking) were independent of each other because, for example, superstring physicists worked independently of Higgs forces physicists. The four independent theories were modeled as four independent jigsaw puzzle pieces. Each of the four theories' requirements were selectively amplified to integrate them together without sacrificing the independent theories' integrities. Requirements were added not eliminated. For example, to the existing transient Higgs force of 125 GeV, eight permanent Higgs forces or dark energy were added. The result was four snuggly fitting interrelated amplified theories and jigsaw puzzle pieces.

2. Superstring

There are 129 fundamental matter and force particles, each defined by a unique closed superstring in a Planck cube. Table I shows 32 fundamental SM/supersymmetric matter and force particles with SM particles on the left and supersymmetric particles on the right. There are 13 SM matter particles and 3 SM force particles including an added graviton force particle. W/Z's are reclassified as hybrid matter/force particles because they are transient matter particles associated with transient Higgs forces but have force particle spins of 1. There are 4 supersymmetric matter particles and 12 supersymmetric force particles. As the result of particle creation and spontaneous symmetry breaking, each of these 32 SM/supersymmetric matter and force particles has one of 32 associated super supersymmetric Higgs particles. The 32 SM/supersymmetric matter and force particles are related to their 32 associated super symmetric Higgs particles via common subscripts (e.g., up quark p_{11} and associated Higgs force h_{11}, and photon p_{16} and associated Higgsino h_{16}). Seventeen matter particles/Higgs forces and three Higgsinos/associated forces manifested themselves during baryogenesis and spontaneous symmetry breaking. Twelve Higgsinos/supersymmetric force particles manifested themselves during particle creation and were inflatons which expanded our universe during inflation prior to matter creation. Each of these 64 matter and force particles has an associated anti-particle for a total of 128 matter and force particles.

Each of the 128 fundamental SM/supersymmetric/super supersymmetric particles and the 129th super force particle are equivalently represented by: a dynamic point particle, its unique closed superstring, or its associated Calabi-Yau membrane (cloud) as shown in Fig. 1 Electron Calabi-Yau membrane. In traditional string theory descriptions, a one brane vibrating string generates a two brane Calabi-Yau membrane over time. Superstring theory was amplified so that a zero brane dynamic point particle generates particle positions over time for both a one brane vibrating

Table 1. Fundamental SM/supersymmetric matter and force particles.

Symbol	SM	Matter	Force	Symbol	Supersymmetric	Matter	Force
p_1	graviton		x	p_{17}	gravitino	x	
p_2	gluon		x	p_{18}	gluino	x	
p_3	top quark	x		p_{19}	stop squark		x
p_4	bottom quark	x		p_{20}	sbottom squark		x
p_5	tau	x		p_{21}	stau		x
p_6	charm quark	x		p_{22}	scharm squark		x
p_7	strange quark	x		p_{23}	sstrange squark		x
p_8	muon	x		p_{24}	smuon		x
p_9	tau-neutrino	x		p_{25}	stau-sneutrino		x
p_{10}	down quark	x		p_{26}	sdown squark		x
p_{11}	up quark	x		p_{27}	sup squark		x
p_{12}	electron	x		p_{28}	selectron		x
p_{13}	muon-neutrino	x		p_{29}	smuon-sneutrino		x
p_{14}	electron-neutrino	x		p_{30}	selectron-sneutrino		x
p_{15}	W/Z's	x		p_{31}	wino/zinos	x	
p_{16}	photon		x	p_{32}	photino	x	

superstring and a two brane vibrating Calabi-Yau membrane. According to Greene, two basic Calabi-Yau membrane types are beach balls and doughnuts. Conifold transitions are the transformations of the two membrane types into each other. The Planck cube sized beach ball electron Calabi-Yau membrane of Fig. 1 contains periodic surface hills and valleys where particle energy/mass is proportional to their amplitude displacement and frequency [1].

The only differences between the 129 matter and force particles are the amplitude displacement and frequency of their hills and valleys, or their energy/masses. A superstring just touching the sides of a Planck cube with no amplitude displacement and frequency represents zero energy (e.g. photon, gluon, and graviton). In contrast, Fig. 1 shows an electron as a superstring and Planck cube sized beach ball with amplitude displacement and frequency of its hills and valleys and has an energy/mass is .51 MeV.

Other matter and force particles having energy/masses (e.g., up quark, down quark, zino, photino, W/Z's, Higgs, and super force particles) have closed superstrings similar to the electron but with different amplitude displacement and frequency of their hills and valleys. A range of amplitude displacements and frequencies defined the 32 SM/supersymmetric matter and force particles' energy/masses, from the lightest photon (zero) to the top quark (172 GeV) to supersymmetric particles (100 to 1500 GeV) [2].

In Fig. 1, the electron dynamic point particle positions are shown at sequential times t_1, t_2, t_3, t_4…..t_n and define an electron closed superstring. Since the electron has spin of 1/2, the electron closed superstring will trace the three dimensional Calabi-Yau membrane or electron cloud over time. The electron Calabi-Yau membrane or cloud is the sum of individual electron dynamic point particle positions from t_1, t_2, t_3, t_4…..t_m where m is much larger than the n points over a single electron closed superstring. An electron exists sequentially not simultaneously in time as n dynamic point particle positions in an electron closed superstring or m dynamic point particle positions in an electron Calabi-Yau membrane or cloud.

Quantum fluctuations are jitter or a temporary change in energy caused by the uncertainty principle ($\Delta x \Delta p_x \geq h/4\pi$) [3] of a dynamic point particle's position and momentum in a Planck cube. For example, quantum fluctuations jitter the electron's dynamic point particle position by Δ x, Δ y, and Δ z as shown in Fig. 1 by the displaced dots on the dashed closed superstring. Figure 1 shows an electron closed superstring as a solid line with dots whereas the dots on the dashed closed superstring represent dynamic positions of the electron with quantum fluctuations. Although the jitter is three dimensional (Δ x, Δ y, and Δ z), for simplicity jitter is shown in Fig. 1 in only one dimension Δ y.

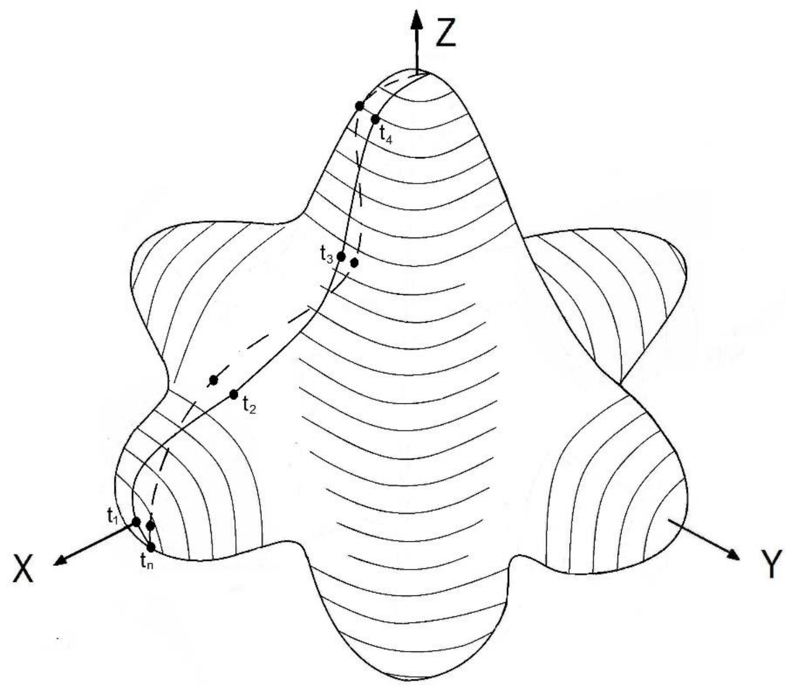

Fig. 1. Electron Calabi-Yau membrane.

3. Particle creation

Our universe's 128 matter and force particle types were created from the super force. Individual matter and force particles manifested themselves during matter creation between t = 10^{-33} s and t = 100 s and at extremely high temperatures between 10^{25} and 10^{10} K as shown in Fig. 2 Big Bang time line of Rees [4]. For simplicity, the figure excluded 64 anti-particles. The X axis was shown both as time in seconds and temperature in Kelvins because of the intimate relationship between particle creation time and the particle's energy/mass or temperature (e.g., W^- at 10^{-12} s, 80 GeV, and 10^{15} K). Energy/mass in electron volts was related to temperature via eV ~ 10^4 K.

Figure 2 shows creation of our universe's 64 matter and force particle types from the super force physical singularity P_{sf} having energy of 10^{54} kg. Upper case letters are exclusively used because particle creation involves total particle energy/mass. For example, total up quark energy/mass or the energy/mass of all up quarks in our universe is P_{11}. Total energy/mass (e.g., P_{11}) consists of three types of energies: rest mass, kinetic (translational and rotational), and potential (gravitational, electromagnetic, nuclear binding) energies.

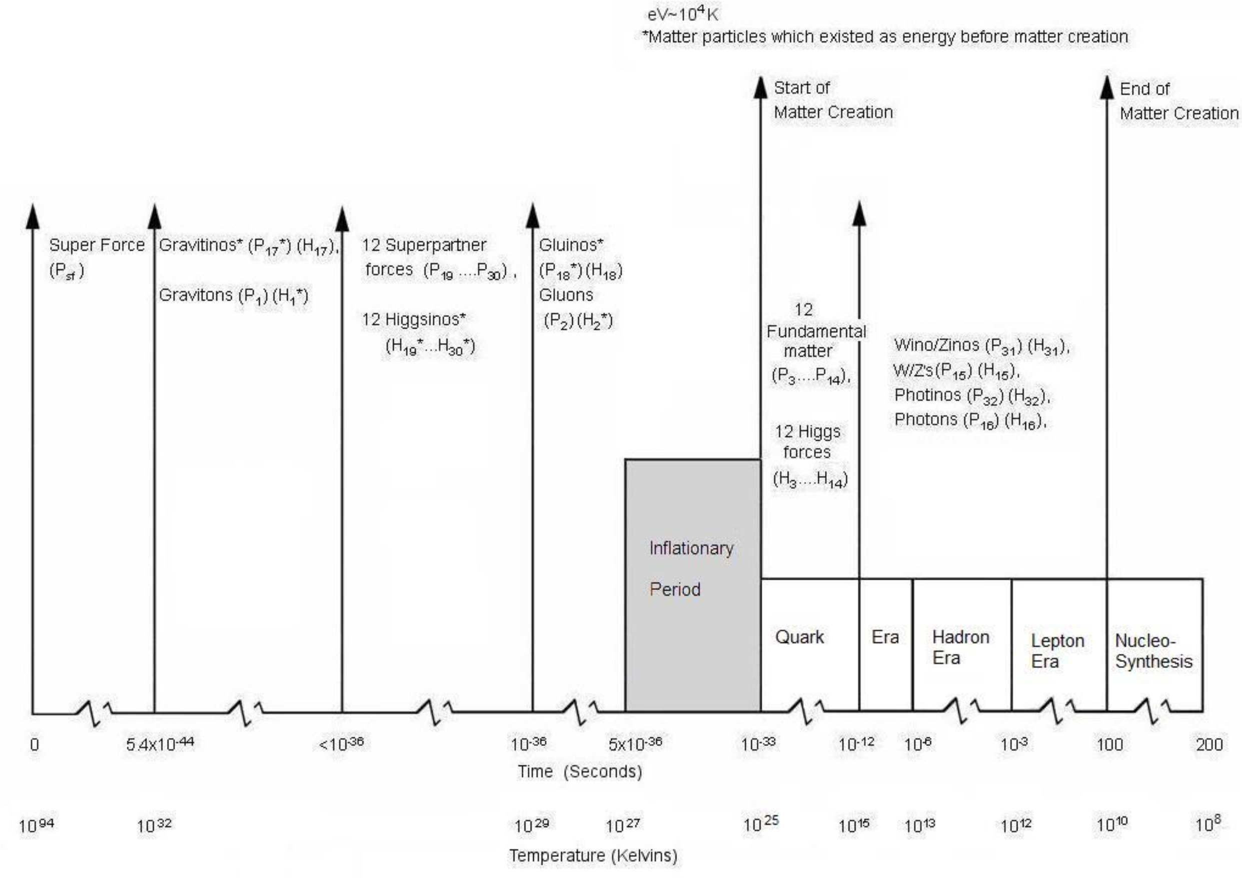

Fig. 2. Big bang.

At $t = 0$ our universe was a doughnut physical singularity at a Planck cube center which immediately transformed to a spherical physical singularity via Greene's conifold transition. Following this conifold transition, our universe was spherical in shape and remained spherical for the next 13.8 billion years. Our universe expanded from a spherical physical singularity at $t > 0$ s, to a larger spherical physical singularity but smaller than a Planck cube at the start of inflation ($t = 5 \times 10^{-36}$ s), to an 8 m radius sphere of individual super force closed superstrings at the end of inflation or 10^{-33} s. Currently, our spherical universe has a radius of 46.5 billion light years.

Inflation start time (5×10^{-36} s) was amplified to be time synchronous with the one to seven Planck cubes spherical physical singularity to individual super force closed superstrings expansion. Since individual super force, matter, and force particles existed as closed superstrings in Planck cubes, they could not exist before the start of inflation at $t = 5 \times 10^{-36}$ s when our universe was smaller than a Planck cube. The one to seven Planck cubes spherical physical singularity to individual super force closed superstrings expansion consisted of six contiguous Planck cubes attached to the six faces of our universe's original Planck cube. The original Planck cube contained a spherical physical singularity of superimposed super force closed superstrings, part of which condensed into individual super force closed superstrings in the six contiguous Planck cubes. The first Planck cube shell was then pushed out and a second individual super force particle Planck cube shell condensed between the center Planck cube and the first shell. This process continued until enough shells with enough Planck cubes existed to accommodate all our universe's individual super force closed superstrings.

Figure 2 describes the creation of the 64 SM/supersymmetric/super supersymmetric matter and force particles as follows. At $t = 5.4 \times 10^{-44}$ s or the Planck time, four fundamental forces were unified. Gravitons (P_1), their gravitino* superpartners (P_{17}*), and their two associated super supersymmetric Higgs particles (H_1*, H_{17}) condensed from the super force. At t = 10^{-36} s or the Grand Unified Theory (GUT) time, three forces were unified. Gluons (P_2), their gluino superpartners (P_{18}*), and their two associated super supersymmetric Higgs particles (H_2*, H_{18}) condensed from the super force. At t = 10^{-12} s, two forces were unified. Photons (P_{16}), their photino superpartners (P_{32}), and their two associated super supersymmetric Higgs particles (H_{16}, H_{32}) condensed from the super force. Also, W/Z's (P_{15}), their Wino/Zino superpartners (P_{31}), and their two associated super supersymmetric Higgs particles (H_{15}, H_{31}) condensed from the super force. At t < 10^{-36} s, 12 superpartner forces (P_{19}….P_{30}) and their 12 associated Higgsinos (H_{19}*….H_{30}*) condensed from the super force. Twelve fundamental matter (P_3….P_{14}) and their associated super supersymmetric Higgs forces (H_3….H_{14}) condensed during matter creation. The asterisk (*) signifies matter particles which existed as energy before condensation to matter particle closed superstrings in Planck cubes during matter creation. Twelve superpartner forces and their 12 associated Higgsinos* were X bosons or the latent energy which expanded our universe during the inflationary period [5]. X bosons were to the inflation period as eight permanent Higgs forces (dark energy) were to our universe's expansion from the start of matter creation to the present time.

The general relativity/quantum gravity (mechanics) boundary was the start of inflation at t = 5 x 10^{-36} s when our universe was a spherical physical singularity inside a Planck cube. General relativity was applicable for all times in our universe between t = 0 and t = 13.8 billion years, whereas quantum gravity theory was applicable for all times except between 0 and 5 x 10^{-36} s. Between 0 and 5 x 10^{-36} s, quantum gravity theory was not applicable because our universe was a singularity smaller than the Planck cube quantum. The latter was required for matter (e.g. electron, up quark) and force (e.g. graviton) closed superstring particles.

4. Spontaneous symmetry breaking and inflation functions

There were two similar but different potential field functions for spontaneous symmetry breaking and inflation. During matter creation, spontaneous symmetry breaking was the condensation of super force particles to matter particles and their associated Higgs forces. In contrast, inflation was the exponential increase (10^{36}) of the spherical size of our universe during the inflationary period, t = 5 x 10^{-36} to 10^{-33} s [6]. Inflation was caused by the condensation of inflatons to expansion energy.

Baryogenesis and spontaneous symmetry breaking is shown in Fig. 4. The true or permanent vacuum state (dark energy density) consisted of space between matter particles, or the sum of eight permanent Higgs force energy densities. Currently in our universe, the true vacuum state between galaxies has an average temperature of 2.72 K or 2.72 x 10^{-4} eV. The false vacuum state was the intermediate or transient state between the super force state and the permanent matter/Higgs force or true vacuum state. During matter creation (10^{-33} to 100 s), there were two false vacuum states. First during baryogenesis for each of 17 matter particles, particle/anti-particle pairs condensed from and evaporated back to the super force. The second false vacuum state occurred during the decay of nine transient SM/supersymmetric matter particles to eight SM/supersymmetric permanent matter particles. This is described in detail in section 6. Spontaneous symmetry breaking and shown in Fig. 4 Up quark baryogenesis and spontaneous symmetry breaking function.

In contrast, inflation was a single field potential field function shown in Fig. 3 [7] and validated by Planck satellite measurements [8]. The vertical Z axis of Fig. 3 represents inflaton energy density V(ϕ) while the X axis represents inflaton (ϕ) time during the inflationary period, t = 5 x 10^{-36} and 10^{-33} s. The instantaneous value of inflaton energy density versus inflaton time is shown by the ball position as it rolls down the Fig. 3 function. When all the inflaton energy density has been expended, inflation is "gracefully exited" as the ball stops rolling at time t = 10^{-33} s. Since inflation expanded space faster than the speed of light and matter particles could not travel faster than the speed of light, if matter particles were created during inflation they would not be uniformly distributed in space. This is contrary to the measured homogeneous and isotropic nature of our universe on a large scale (490 million ly cube) [9]. Thus, no matter particles were created during inflation.

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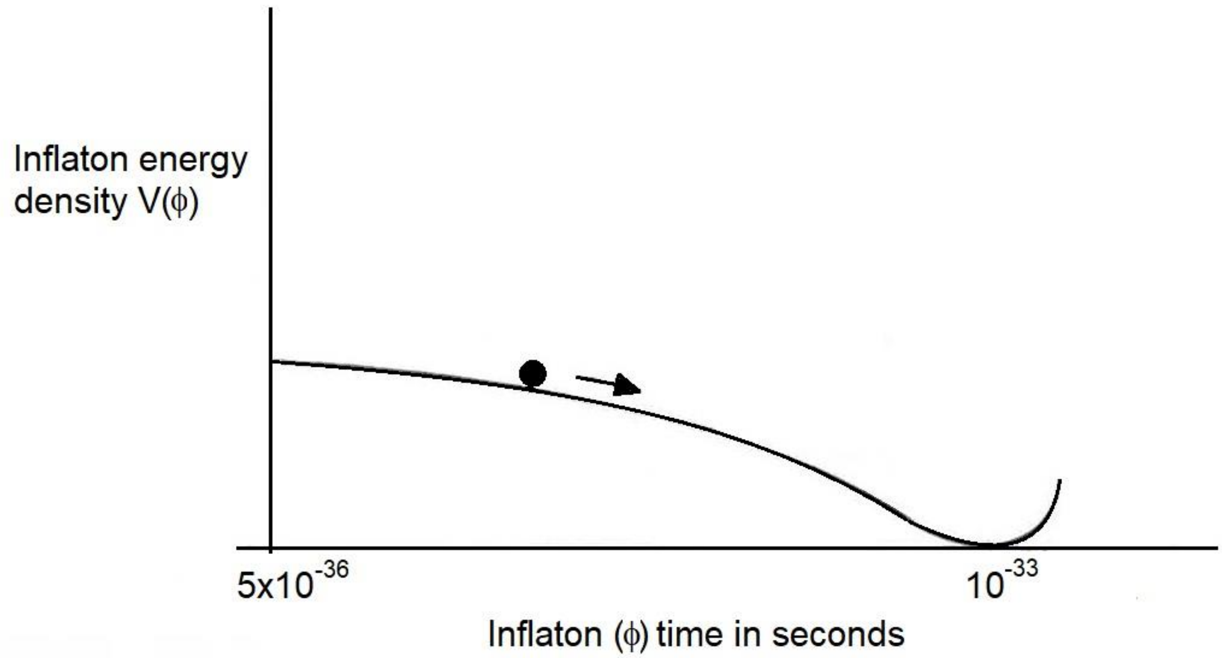

Fig. 3. Single field inflation.

5. Higgs forces (bosons)

Amplifications to Higgs force theory were key to an amplified SM. First, amplifications included 32 associated super supersymmetric Higgs particles, one for each of 32 SM and supersymmetric matter and force particles. These 32 Higgs particles defined a "Super supersymmetry." If a SM/supersymmetric particle was a matter particle (e.g., up quark, gravitino), its associated Higgs particle was a Higgs force. If a SM/supersymmetric particle was a force particle (e.g., graviton, sup squark), its associated Higgs particle was a Higgsino.

Matter creation included a super force particle's condensation to a matter particle/Higgs force. Just as an electron or up quark have electric fields because of their electric charges, an electron or up quark also have Higgs force fields because of their masses. The matter particle/Higgs force were one and inseparable, created simultaneously during matter creation, and modeled as an undersized porcupine (e.g., up quark Planck cube closed superstring) with overgrown spines (e.g., a three dimensional radial Higgs force field quantized into Higgs force Planck cube closed superstrings).

Extremely high temperatures between 10^{25} and 10^{10} K in our early universe caused matter creation via spontaneous symmetry breaking. The Higgs force was a product not the cause of spontaneous symmetry breaking. The super force condensed into 17 matter particles/Higgs forces at 17 different temperatures. There were nine transient matter particles (top quark, bottom quark, charm quark, strange quark, tau, muon, gravitino, gluino, and W/Z's) and eight permanent matter particles (up quark, down quark, electron, electron-neutrino, muon-neutrino, tau-neutrino, zino, and photino). The zino and photino were dark matter particles. Spontaneous symmetry breaking was similar to the three condensation phases of H_2O from steam, to water, to ice as temperature decreased from 212^o to 32^o F. Similarly the super force, three W/Z's/three Higgs forces, down quark/Higgs force, up quark/Higgs force, etc., were the same but manifested themselves differently as temperature decreased from 10^{25} to 10^{10} K. There was an intimate relationship between matter creation time and the matter particle's energy/mass or temperature. That is, 17 SM/supersymmetric matter particles had specific matter creation times and related energy/masses or temperatures (e.g., W^- at 10^{-12} s, 80 GeV, and 10^{15} K). The earlier the matter creation time, the greater was the matter particle's energy/mass or temperature.

Ice evaporated or melted to water which then evaporated to steam as temperature increased from 32º to 212º F. Similarly, particle creation and spontaneous symmetry breaking were bidirectional. For example as temperature increased, the down quark/Higgs force evaporated back to the super force.

Therefore, the super force condensed into a matter particle/Higgs force or a matter particle/Higgs force evaporated to the super force. In Beta minus decay, the down quark decayed to an up quark and a W^-. The W^- then decayed to an electron and an anti-electron-neutrino. The Beta minus decay equation produced correct results with a misunderstood process because indivisible fundamental particles such as the down quark or W^- cannot be split into two other fundamental particles.

Particle decay was the evaporation of a heavy matter particle/Higgs force to the super force and the condensation of the super force to lighter and permanent matter particles/Higgs forces. In the Beta minus decay with Higgs force amplification or "New Physics," the down quark/Higgs force evaporated to a super force particle. Division of energy not matter occurred as one portion of the super force condensed to the up quark/Higgs force, and a second portion to the W^- particle/Higgs force. The three W/Z's (W^+, W^-, and Z^0) were transient matter particles because, for example, within 10^{-25} s of its creation, the W^- transient matter particle/Higgs force evaporated back to a super force particle. The super force then condensed into an electron/Higgs force and an anti-electron-neutrino/Higgs force. Since the W/Z's were reclassified as transient matter particles, this produced the asymmetrical number 17 instead of 16 matter particles, that is, 9 transient and 8 permanent matter particles. By 100 seconds after the big bang, the nine transient matter particles/Higgs forces decayed via evaporation/condensation cycles to and from the super force to eight permanent matter particles/Higgs forces. The latter included the: up quark, down quark, electron, electron-neutrino, muon-neutrino, tau-neutrino, zino, photino and their eight Higgs forces or dark energy.

Mass was given to a matter particle by its Higgs force and gravitons or gravitational force messenger particles. Graviton requirements were amplified to include embedded clocks/computers. The embedded graviton clock/computer calculated Newton's gravitational force by extracting masses of the transmitting and receiving matter particles from their Higgs forces, calculating the range factor $1/r^2$ as $1/ [(t_r - t_t) (c)]^2$ from the graviton transmission (t_t) and reception (t_r) times, and providing gravitational force to the receiving particle. Permanent Higgs forces give mass to their permanent associated matter particles. Transient Higgs forces (e.g., that associated with W^-) cannot give mass to permanent matter particles (e.g. up quark) because the former exist for only 10^{-25} s.

6. Spontaneous symmetry breaking

Baryogenesis and spontaneous symmetry breaking caused by extremely high temperatures in our early universe, created 22 permanent matter and force particles: eight permanent matter particles and their eight associated Higgs forces and three permanent Higgsinos and their three associated forces (graviton, gluon, and photon).

Baryogenesis occurred for 17 transient and permanent SM/supersymmetric matter particles and three permanent Higgsinos, decay for nine transient SM/supersymmetric matter particles, and spontaneous symmetry breaking for eight permanent SM/supersymmetric matter particles. All three occurred during matter creation between 10^{-33} and 100 s and at temperatures between 10^{25} and 10^{10} K. Since baryogenesis was similar for 17 matter particles and three permanent Higgsinos, and spontaneous symmetry breaking was similar for eight permanent matter particles, only up quark baryogenesis and spontaneous symmetry breaking is described. Decay is described for both SM and supersymmetric matter particles.

Baryogenesis, SM/supersymmetric matter particle decays, and spontaneous symmetry breaking had the following time sequential phases with the exception of baryogenesis of three permanent Higgsinos.

1. Baryogenesis of nine transient matter particles
2. Decay of nine transient matter particles to eight permanent matter particles
3. Baryogenesis of eight permanent matter particles and three permanent Higgsinos and spontaneous symmetry breaking of eight permanent matter particles.

Because of the intimate relationship between matter creation time and the matter particle's energy/mass, the three phases occurred for the heaviest matter particle (e.g., assumed to be the gravitino) at the earliest matter creation time and highest energy/mass and for the lightest matter particle (e.g., electron-neutrino) at the latest matter creation time and lowest energy/mass.

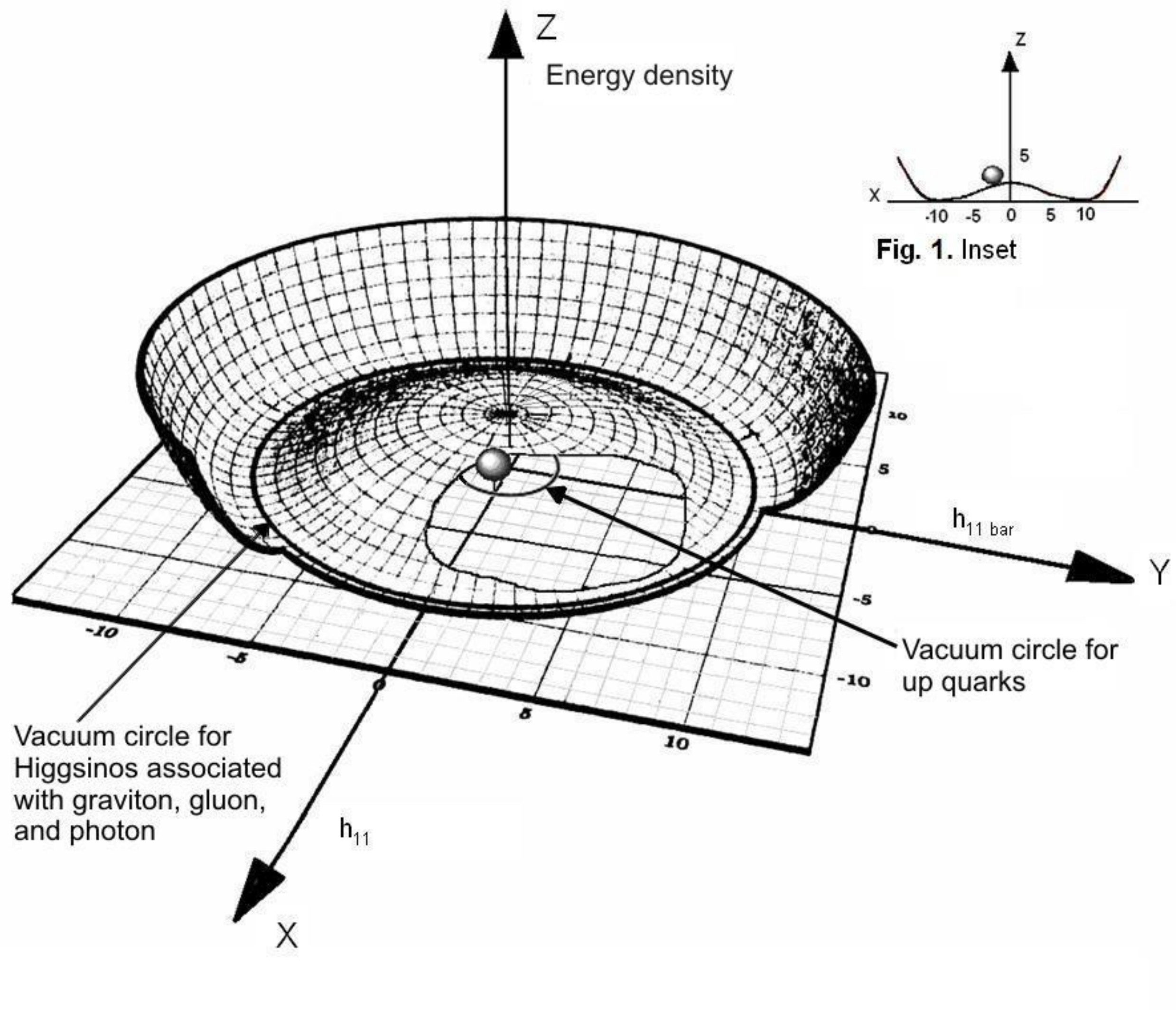

Fig. 4. Up quark baryogenesis and spontaneous symmetry breaking function.

Baryogenesis of nine transient matter particles was similar to the permanent up quark's baryogenesis shown in Fig. 4 from Guth's amplified energy density of Higgs fields [10]. The Z axis represented super force energy density allocated to up quarks/Higgs forces, the X axis a Higgs force (h_{11}) associated with an up quark, and the Y axis a Higgs force (h_{11bar}) associated with an anti-up quark. During up quark baryogenesis, the ball initially at its peak position (x = 0, y = 0, z = 2), moved down the baryogenesis and spontaneous symmetry breaking function equidistant between the X and Y axes. Super force particles condensed in equal amounts to: up quarks and up quark Higgs forces; and anti-up quarks and anti-up quark Higgs forces. A portion of these four particles then annihilated by evaporating back to super force particles as the ball returned to its peak position. Another portion remained as up quarks/Higgs forces. During the second condensation/evaporation cycle, the ball moved down the baryogenesis and spontaneous symmetry breaking function closer to the X axis than the Y axis and then back to its peak position. After n of these condensation/evaporation cycles in the false vacuum state, the ball eventually moved to the Fig. 4 ball position (x = -2, y = 0, z = 1.5) or the true vacuum state. In the true vacuum state the super force condensed totally to the permanent up quark/Higgs force and none to the anti-up quark/Higgs force.

Following baryogenesis of each of nine transient matter particles, each decayed as follows. Decays were gauge mediated where heavier matter particles/Higgs forces decayed in a cascading process to lighter energy/mass matter particles/Higgs forces and intermediate force particles. Intermediate force particles were W/Z's for SM particles and winos for supersymmetric particles. For example, a SM bottom quark/Higgs force decayed to an up quark/Higgs force and a W^-/Higgs force.

A superpartner decayed into a lower energy/mass superpartner and its intermediate force particle. The latter decayed to SM particles/Higgs forces. The decay chain ended with zinos/Higgs forces and photinos/Higgs forces or the stable Lightest Supersymmetric Particles (LSP) and SM particles/Higgs forces. Stable LSPs or lightest neutralinos also included three permanent Higgsino types. Dark matter consisted of zinos, photinos, and three permanent Higgsino types [11] [12].

Following baryogenesis and decay of nine transient matter particles, baryogenesis and spontaneous symmetry breaking of eight permanent matter particles occurred. For the up quark, there were two key ball positions in Fig. 4. When the ball was in its peak position, up quark baryogenesis had not occurred. When the ball was in the Fig. 4 position, up quark baryogenesis had occurred and super force energy density had condensed to up quarks/Higgs forces. The z coordinate of the Fig. 4 ball position was the super force energy density condensed to up quark Higgs forces. The z coordinate of the peak ball position minus the z coordinate of the Fig. 4 ball position was the super force energy density condensed to up quarks. During the hadron era, the ball moved from its peak position to the Fig. 4 position. It took another 13.8 billion years for the ball to move vertically down to its current position just above the vacuum circle for up quarks. As the ball moved vertically down, the up quark's Higgs force (ball's x coordinate) remained constant whereas the up quark Higgs forces' energy density (ball's z coordinate) slowly decreased as our universe expanded.

There were eight baryogenesis and spontaneous symmetry breaking functions associated with eight permanent matter particles. Each had the same generic up quark Mexican hat shape of Fig. 4, but each had a different peak super force energy density (peak z coordinate) and Higgs force (ball x coordinate). By 100 s, only eight permanent matter particles/Higgs forces remained.

There was no spontaneous symmetry breaking for three permanent Higgsinos. However, three permanent Higgsinos associated with three SM force particles (graviton, gluon, and photon) experienced baryogenesis at creation times dependent on the permanent Higgsinos' energy/masses as follows. Higgsino baryogenesis was similar to up quark baryogenesis. Super force particles condensed into four particles (e.g., Higgsino, associated SM force, anti-Higgsino, and associated SM force). During baryogenesis, the super force condensed totally to the Higgsino/SM force and none to the anti-Higgsino/SM force. By the end of Higgsino baryogenesis, the ball position in the Higgsino version of Fig. 4 was at $x = -10$, $y = 0$, $z = 0$ and on the vacuum circle for Higgsinos associated with the graviton, gluon, and photon. All a super force particle's energy condensed to a Higgsino and none to its associated zero energy force particle (graviton, gluon, or photon). In contrast to inseparable matter particles and their Higgs forces, the three permanent Higgsinos and their associated graviton, gluon, and photon forces became independent of each other following their associated creation. Thus by 100 s, eight permanent matter particles/Higgs forces and three permanent Higgsinos/associated forces (graviton, gluon, and photon) for a total of 22 permanent matter and force particles remained.

During matter creation (10^{-33} to 100 s), there were two time sequential false vacuum phases. First during baryogenesis for each of 17 matter particles, particle/anti-particle pairs condensed from and evaporated to the super force. As our universe expanded and cooled and after n of the condensation/evaporation cycles, this baryogenesis process was predominantly from energy to matter rather than to anti-matter. Particles/anti-particles were the intermediate, transient, or false vacuum state prior to the permanent matter/Higgs force or true vacuum state.

The second time sequential false vacuum phase occurred during the decay of nine transient matter particles to eight permanent matter particles and intermediate force particles. The super force condensed to a transient matter particle/Higgs force and bidirectionally evaporated back to the super force in the false vacuum state. Then, the super force condensed to lighter and stable matter particles/Higgs forces and intermediate force particles. This occurred for all nine transient matter particles. By 100 s, all nine transient matter particles/Higgs forces had condensed to eight permanent matter particles/Higgs forces. The true or permanent vacuum state consisted of space between matter particles, or the sum of eight permanent Higgs force energy densities.

Figure 2 shows total particle energy/masses of 64 matter and force particles designated as $P_1....P_{32}$ and $H_1....H_{32}$. These included gravitons (P_1), gluons (P_2), twelve fundamental matter particles ($P_3….P_{14}$), W/Z's (P_{15}), photons (P_{16}), 4 supersymmetric matter particles (P_{17}*, P_{18}*, P_{31}, and P_{32}), and 12 supersymmetric force particles ($P_{19}….P_{30}$)

energy/masses. The 32 super supersymmetric Higgs particles included 17 Higgs force energies (H_3.…$H_{14,}$ H_{17}, H_{18}, H_{31}, H_{32}, H_{15}) which were super force energy residuals following condensations of 12 fundamental matter, four supersymmetric matter, and W/Z's. There were also 15 Higgs matter particles (14 Higgsinos* and 1 Higgsino) energy/masses (H_1*, H_2*, H_{19}*….H_{30}*, H_{16}) for a total of 32 super supersymmetric Higgs particles. Sixty four anti-particles condensed at the same temperature and time as their identical energy/mass particles but were not explicitly shown in Fig. 2 because baryogenesis and inflation eliminated them.

7. Conservation of energy/mass accountability

All 128 matter and force particle types complied with conservation of energy/mass accountability. Accountability of our universe's total 10^{54} kg of energy by the end of matter creation at t = 100 s follows.

Nine transient matter particles (top quark, bottom quark, charm quark, strange quark, tau, muon, gravitino, gluino, and W/Z's) and their nine associated Higgs forces for a total of 18 particles accounted for 0%. By 100 s, these nine transient matter particles/Higgs forces evaporated and condensed or decayed to eight permanent matter particles/Higgs forces.

X bosons or inflatons consisted of 12 transient superpartner forces and their 12 associated Higgsinos for a total of 24 particles. X bosons or inflatons accounted for 0% because all their energy expanded our universe during inflation prior to t = 100 s.

By the end of matter creation at t = 100 s and at a temperature of 10^{10} K, all 64 anti-particles had been eliminated either by baryogenesis or inflation (12 anti-Higgsinos and their 12 associated superpartner forces) for a total of 64 particles.

From the above, there were 106 transient matter and force particles and only 22 permanent matter and force particles remained from the total 128. Three SM force particles (graviton, gluon, and photon) were permanent but accounted for 0%. For example, in transit photons contained radiation energies at t = 100 s, but these photons were assumed to contain zero energy. Transmitted radiation energies were allocated to transmitting particles until the radiation was received and then allocated to receiving particles.

Three types of matter and force particles, or 19 matter and force particles with energy/masses remained at t = 100 s: atomic/subatomic matter, dark matter, and dark energy. However, because of significant photon radiation energy during the opaque era, constant energy/mass percentages of atomic/subatomic, dark matter, and dark energy did not occur at t = 100 s but at approximately 380,000 years. Atomic/subatomic matter or six permanent matter particles (up quark, down quark, electron, electron-neutrino, muon-neutrino, and tau-neutrino) constituted 5% of our universe's energy/mass at approximately 380,000 years. Dark matter or the zino, photino, and three permanent Higgsino types constituted 26% of our universe's energy/mass. Dark energy or eight Higgs forces associated with eight permanent matter particles (up quark, down quark, electron, electron-neutrino, muon-neutrino, tau-neutrino, zino, and photino) constituted 69% of our universe's energy/mass. There was no quintessence or dynamic dark energy in our universe [13] [14] and these percentages remained constant for the next 13.8 billion years [15].

8. Fundamental SM/supersymmetric/super supersymmetric matter and force particles

The SM of Fig. 5 consists of twelve matter particles: six quarks (up, down, strange, charm, bottom, and top); six leptons (electron, muon, tau, electron-neutrino, muon-neutrino, and tau-neutrino); and four force particles (photon, W/Z's, gluon, and Higgs assuming the W and Z particles are combined into one). Although the SM is the gold standard of particle physics, it is inadequate because it: does not emphasize Higgs particles' supremacy; does not differentiate between more important permanent and less important transient particles; defines only a single Higgs force; does not include the graviton; and does not include dark matter, dark energy, supersymmetry, and super supersymmetry of Higgs particles.

Figure 6 shows the Fundamental SM/supersymmetric/super supersymmetric matter and force particles which amplified the SM and resolved its inadequacies. The figure consists of a circular area surrounded by an annular area. The circular area represents 22 permanent matter and force particles. The outer circular area clockwise from the top consists of: atomic/subatomic matter particles (up quark, down quark, electron, electron-neutrino, muon-neutrino, and tau-neutrino) which constituted 5% of our universe's energy/mass between t = 380,000 years and 13.8 billion

	Matter			Force
Quarks	u up	c charm	t top	γ photon
	d down	s strange	b bottom	Z Z particle
Leptons	ν_e electon-neutrino	ν_μ muon-neutrino	ν_τ tau-neutrino	W W particle
	e electron	μ muon	τ tau	g gluon
				H Higgs force

Fig. 5. SM matter and force particles.

years; two of five dark matter components (zino and photino) or half of dark matter (26%) or approximately 13%; and the graviton, gluon, and photon forces or 0%. The inner circular area clockwise from the top consists of: dark energy or the sum of eight Higgs forces associated with eight permanent matter particles (up quark, down quark, electron, electron-neutrino, muon-neutrino, tau-neutrino, zino, and photino or (69%); and three of five components of dark matter or three permanent Higgsinos associated with the graviton, gluon, and photon or approximately 13%. The large inner circular area consists of Higgs particles (eight permanent Higgs forces and three permanent Higgsinos) and emphasizes Higgs particles' supremacy because they constitute approximately 82% of our universe's energy mass.

The annular area represents 44 transient matter and force particles, all of which were eliminated by 100 s after the big bang via particle decay (nine transient matter particles/Higgs forces decayed to eight permanent matter particles/Higgs forces) or inflation (twelve superpartner forces and their 12 associated Higgsinos or X bosons). The outer portion of the annular area clockwise from the top consists of: nine transient matter particles (top, bottom, charm, strange, tau, muon, gravitino, gluino, and W/Z's) and twelve transient force particles (stop, sbottom, stau, scharm, sstrange, smuon, stau-sneutrino, sdown, sup, selectron, smuon-sneutrino, and selectron-sneutrino). The inner portion of the annular area clockwise from the top consists of: nine transient super supersymmetric Higgs forces associated with nine transient matter particles and twelve transient super supersymmetric Higgsinos associated with twelve transient force particles.

9. Conclusions

The subatomic counterpart of Mendeleev's Periodic Table of elements is the fundamental SM/supersymmetric/super symmetric matter and force particles of Fig. 6.

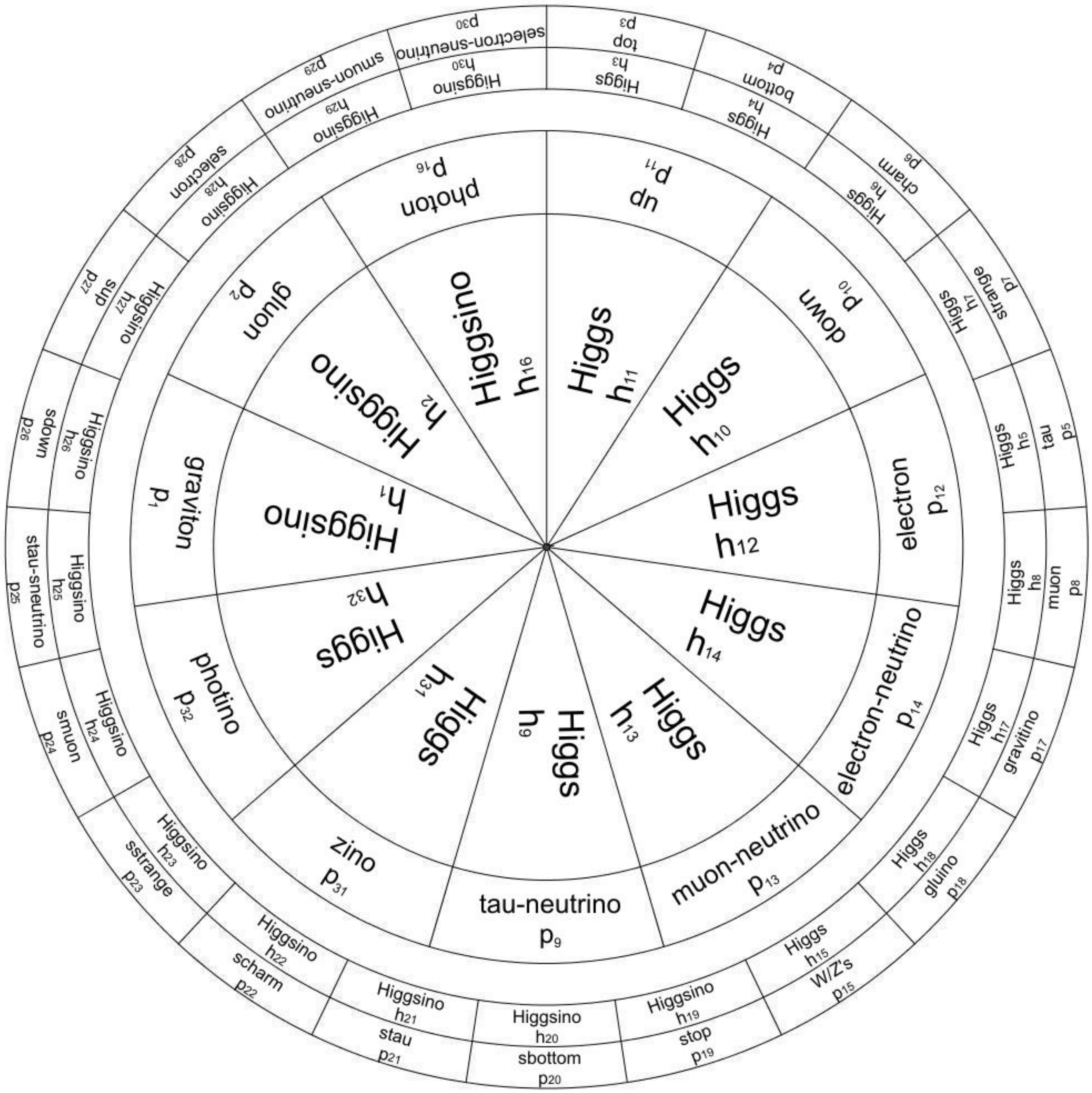

Fig. 6. Fundamental SM/supersymmetric/super supersymmetric matter and force particles.

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