Cosmology of Continuum Creation and Annihilation

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This article was reviewed by two referees both of whom recommended publication (above referenced email) pending revision as follows:
Cite references in the body and reformat reference section according to JOC format.
Include additional mention with references of more recent applicable studies
Eliminate excessive capitalizing and punctuation of words and phrases.

It is my belief that I have complied with the requested revisions of the referees, which however somewhat increased the length of the paper.
I hope that this manuscript is now suitable for publication in the Journal of Cosmology.

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CCA Cosmology

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ABSTRACT:

An extensive cosmology hypothesis is presented that was developed over decades and is based on the existence and evolution of the universe via Cosmic Symmetry Breaks (CSBs) or phases with our universe (Cosmos) describable by a Cosmology of Continuum Creation and Annihilation, or CCA Cosmology. The CCA cosmology hypothesis does not belong to a Standard Model Big Bang. This hypothesis not only describes the universe but also the realm of elementary particles and forces. It provides plausible answers to a large number of puzzles in Physics and Cosmology. These answers range from those that can be calculated and values checked by observations, such as: How much and what is dark energy? How much and what is dark matter? How much baryonic matter? How much and why is there a time-delay for GRB energetic photons? When (or did?) the universe started to accelerate? Are primordial galaxies smaller? Why are orbits non-Newtonian beyond an acceleration value, and other calculable parameters. Also, answers which are more fundamental in interpretation, such as: What is mass and gravity? How many families of elementary particles exist and why are there only three generations of each? Why did the universe start with such low entropy? Does the Cosmos violate the First or Second Law of Thermodynamics? Why is there an asymmetry of matter over antimatter in the universe and what is antimatter? These and other questions the CCA hypothesis is proposing to answer. This hypothesis requires minimum assumptions and can build a coherent theory that can arrive at today's complex universe with plausible evolutionary steps from one postulate and one particle.

cosmogony, non-standard cosmology, dark energy, dark matter, new elementary particles, gravity, antimatter, accelerated universe.

Cosmology of Continuum Creation and Annihilation

1. INTRODUCTION:

The presented hypothesis describes both the universe and particles. It is an attempt by a single concise, predictive hypothesis to provide verifiable answers to a large number of fundamental questions in Physics and Cosmology. This hypothesis is based on a universe of a specific geometry and is non-big bang, non-Newtonian and even modified Einstein spacetime. This universe and its evolution are described by the physics of Continuum Creation and Annihilation (CCA Cosmology). CCA also predicts the existence of a third family of fundamental states (xena, some similarities to “shadow” matter) that are the progenitors of leptons and quarks. The existence of such states defines the present universe and is pivotal for CCA. The stable members of this xena group (antimatter, 10^{-23} g) are also the dark matter states. This claim has observable results (below). This hypothesis evolves the present complex universe from a minimum of assumptions and one postulate, via four Cosmic Symmetry Breaks (CSBs, phases) and makes testable and verifiable predictions. Items such as The Cosmological Principle, the Theory of Nucleosynthesis, the existence and behavior of the CMB, black holes, dark energy and dark matter are natural derivable, calculable parameters for this hypothesis. Concepts such as gravity, mass, entropy, antimatter and others, are also given possible, verifiable descriptions.

There are two main assumptions required for this hypothesis to achieve the present complex universe: Our universe (Cosmos) and particle parameters are “coupled-quanta” with different scales; and the “cosmic beginning” is from a four-dimensional, infinite, isotropic, homogeneous, totally symmetric, timeless entity, or Sympan. From this beginning the universe as known can be developed, even in great detail and with testable predictions.

The proposed CSBs with their descriptions and predictions are presented below as phases. The cosmogony of CCA, begins with one assumption and through phase changes (CSBs) describes the foundations of this hypothesis.

The "First Step" is:

2. POSTULATE:

"Prior to time" ("before The Beginning") there exists an infinite, timeless, homogeneous, isotropic, symmetric, n-dimensional ($n \geq 4$) entity, or Sympan, *"That Is All There Is",* and undergoes a perturbation in one of its dimensions (Time starts).

3. PHASE-0: SEPARATION:

(1^{st} CSB, time, physical laws, parameters, continuum, dimensions and geometry are set).

By postulate, or otherwise, a perturbation m, ($m \geq 1$) in the form of a CSB is caused in the postulated, homogeneous, infinite Sympan. M-Theory also has a number of cosmic perturbations (Multiverse ,see Weinberg, 2005; Szabo. 2004; and Gasperini, 2007). This CCA perturbation (m = 1) can be as simple as a fissure or "crack of zero dimensional thickness" within the Sympan. A 4-dimensional fissure area (R^3 if n=4) with one of the 4-dimensions within this fissure now different from the other three (3+1) with a stress-tensor:

$$df_i = \Sigma_j P_{ij} n_j dA \qquad (1)$$

From within this fissure the rest of the Sympan (now Aylon) has become dimensionally inaccessible. Classical vacuum cannot exist in CCA Cosmology.

This fissure, or Proto-Cosmos is finite and vibrating, globally and locally. The size of this fissure can be very extensive. This 1^{st} CSB of the Sympan, is termed as Phase-0.

$$\text{Sympan} + 1^{st}\text{CSB} = m(\text{Cosmos}) + \text{Aylon} \qquad (2)$$

Every point within the perturbation is in contact with the 4-dimensional Aylon, but cannot normally access the Aylon because of dimensional inferiority.

This proto-Cosmos is either non-adiabatic, adiabatic, or is cosmically adiabatic (orthogonal sets).

Such a perturbation with undamped edge vibrations is not uncommon in Nature of a vibrating entity that eventually closes-in on itself or dissipates.

This perturbation to maximize stability by eliminating edges, closes onto itself and forms a 4-dimensional "Hypershell", a $2\pi^2R^3$ Hypersurface. The Hypersurface has two orientations, the (+) normal vector, and the (-) opposite. This Hypersurface is our Cosmos and is a boundary and by Homology has no boundaries. The substance that is within the fissure (background itself) is herein called the Continuum, is not Newtonian and different from "classical" relativity (a Cosmological Constant cannot happen until Phase-2). This continuum becomes what is currently identified as dark energy.

The instant the Cosmos forms a Hypershell Phase-0 ends and Phase-1 begins.

4. PHASE-1: COLLAPSE:

(*2^{nd} CSB, massless "scalar" oscillations, number of states set, minimum entropy, sigma-space dimensions* ≤ 6,)

The Inflation Theory proposed by Guth in 1979, (Guth, 1981; Linde, 1990; Tryon, 1987) eliminates horizon problems by super-luminous expansion. CCA solves any isotropy, and horizon issues by a more physically plausible collapse and the inherent characteristics of the Cosmos.

The parameters set at Phase-0 determine the characteristics for the Hypersurface subsequent evolution.

The oscillations within the Cosmos are defined by the Hypersurface $((4\pi^2R_0^3)/2!)$ including longitudinal waves that can present complex causal issues if the continuum or Aylon are incompressible (Poisson's ratio). This, and the continuum characteristics, make CCA a non-local, holistic, and instantaneous hypothesis (Ierokomos, 1984). It implies the non-local phenomenon of Bell's Theorem (QM) and may explain the experiments by Aspect, Granger, and Roger (1981); Aspect, Dabbarol, and Roger (1982) confirming a non-local universe.

As a Hypersurface, every point within the Cosmos is bounded identically to the 4d homogeneous Aylon with no edges that can cause different local behavior. Every point in the Cosmos will appear as the center of the Cosmos and indeed each point is located at what is called a Pseudo-center and observationally can be taken as the Center (Cosmological Principle).

The collapsing Cosmos is stable, but not static. The points of contact between the Cosmos and Aylon are omnipresent and are crucial to its evolution. The continuum eliminates differences between neighboring oscillations to become homogeneous. These oscillations can be individual resonances, or span the entirety of the Cosmos.

The Cosmos in (3+1) geometry acts as a black body cavity (BBC) and is one, with the collapse similar to a BBC temperature increase. Wavelengths must be correlated to the Cosmos entire size and total number N as standing waves.

These individual vibrations of the continuum are herein defined as ξ_0 and identified in the 1980's as Xena. These oscillations at any instant have equal probability of amplitude in the (+,-) direction. As the Hypersphere collapses the drive is towards one frequency and non-resonances are dissipated.

The Cosmos is adiabatic and any reduction in size is a reduction of ξ_0 wavelength. The number N of these waves is set by the continuum, the cosmic 3+1 area (kR_u^2) and the individual ξ_0 ($k'\lambda^2$) at the instant Phase-1 starts.

$$N = \pi k (R_u^2)/(\lambda^2) \qquad (3)$$

Values of parameters are set the instant Phase-0 starts. All laws and parameters are set and cannot have any other values. The wavelength of ξ_0 decreases to a critical λc when the size of the Cosmos is minimum or critical, Rc:

$$N = k(R_c^2)/(\lambda_c^2) \qquad (4)$$

If the number of ξ_0 remains constant, the individual wavelengths at start and at end of Phase-1 (minimum entropy) are used to determine the number N by the concept of coupled-quanta:

$$N = (1/4\pi) (\lambda/(\lambda c))^4 \qquad (5)$$

To find these wavelengths, one examines what is known about particles. In CCA these wavelengths represent the two continuum "flow forces": Gravity and Strong Force. The first wavelength λ, is 1.321×10^{-13} cm. The composite proton is stable because the Cosmos is what it is (coupled-quanta). The λc is the minimum wavelength within the geometry of the Cosmos (minimum entropy). This λc is the Planck length (Lp) or 1.616×10^{-33} cm. The Lp is a defining parameter for the boundary between the Cosmos "dynamic-time" and the Aylon "static-time". This is shown by photons from observations of Gamma Ray Bursts (GRB) from MAGIC and FERMI, LAT and GBM Collaborations, (Mavromatos 2010; Ellis, Mavromatos and Nanopoulos 2009) that show arrival time delays Δt, by high energy photons. The Lp interpreted as above $(1 - k4\pi Lp^2/\lambda^2)^{1/2}$ as self-gravity time dilation of photons from distant GRBs shows a time delay of arrival (see below). In measurable values within the appropriate range of energies compared to visible photons this is $\Delta t/t_0 < 10^{-17}$ (no z-correction) or:

$$\Delta t \sim t_0((4\pi^{3/2})/\alpha)(Lp/\lambda) \tag{6}$$

A photon with wavelength of $((4\pi^{3/2})/\alpha)(Lp)$ becomes "stationary" at the source (CCA chronic minimum). This dependence on alpha and Lp can correlate the electron (Hartree energy) and proton mass with gravity. Using these values, the Cosmos at Phase-1 has N ξ_0 oscillations:

$$N = (1/4\pi)((1.321\text{x}10^{-13})/(1.616\text{x}10^{-33}))^4 = 3.55\text{x}10^{78} \tag{7}$$

The probability of state of these xena ranges from all identical (minimum entropy) to all different. This determines the total number of nucleons (N_{BM}) at Phase-3 as shown below by the Nucleosynthesis densities (Eta) which can be observationally tested. It may also define the cosmic density of black holes. To obtain the dependence of the ratio of forces to the total number of states N, one defines a constant of the strong force Gs (flow of continuum "beyond" the curl) that is the microscopic equivalent to Newton's constant, Gu. The ratio of these constants is the well known value of:

$$Gs/Gu = 1.06\text{x}10^{39} \tag{8}$$

With some algebra and the definition of Gs, this gives N as:

$$N = \pi(Gs/Gu)^2 = (1/4\pi)(\lambda/\lambda c)^4 = 3.55\text{x}10^{78} \tag{9}$$

The size of the Cosmos at the start of Phase-1, can be comparable to the size of our present universe: Obviously not big bang!

These ξ_0 oscillations are not identifiable with any known states. No matter-antimatter designation, no rest mass, nor any electromagnetic or other force parameters except a possible strong scalar "progenitor" force.

This CCA Cosmology, has a space defined wherein all particles are discrete states. This is called Sigma-space and currently has 10 dimensions. Sigma-dimension number is CSB-dependent. During Phase-1 there are only 6 (maximum) Sigma-dimensions. The ξ_0 in Sigma-space:

$$\xi_0 = X1, X2, X3, Y, E1, E2, 0, 0, 0, 0 \quad (10)$$

In Sigma-space the value of zero indicates two meanings. Not-accessible dimension as those of ξ_0 above and a sum of accessible opposites that equals zero ($^-0^+$) as in photons. Because of Sigma-space, in Phase-1 nothing like photons, leptons, quarks exists. Only a homogeneous, isotropic Hypersurface continuum (future dark energy, DE) with ξ_0 oscillations is possible. The energy increases with collapse, and the possible number of states (phase-space) is decreasing until ξ_0 become degenerate. This dynamic forces the Cosmos into an entropy minimum by collapsing. It provides an answer to

Why did the Universe have such low Entropy in the past?

When ξ_0 become degenerate the Cosmos is at a chronic-minimum where it and time must stop (time dilation) or reverse. In general, Phase-1 is characterized by the change of energy (ΔE) to be inversely proportional to the change of size (ΔR).

$$(\Delta E)(\Delta R) = k(\Delta \nu)(\Delta R) \quad (11a)$$

Or for wave energy of ξ_0 similar to photons.

$$((\Delta E^2)(\Delta t^2))^{1/2} > h/2\pi \quad (11b)$$

The probability of state of these xena is converging to an identical state at Rc, which does not allow any smaller wavelengths (time freezes). The rate of collapse is also fundamental and is at the speed of light at some $(R(t))_c$ from any Pseudo-center.

Chronic-minimum and resonances increase the energy of the ξ_0 states catastrophically, an (almost) “Classical-Ultraviolet Catastrophe”. The Cosmos has become unstable and another phase change (3rd CSB) must occur. The Cosmos “shatters” when this critical resonance frequency is reached. It becomes a Diabatic Hypersurface with individual regions permeable to continuum flow into and out of the Cosmos and Aylon. The ξ_0 states shatter (decay) into entities that allow flow of continuum (chi) out of the Cosmos through defined set areas A_q. From within the Cosmos these are sinks of the continuum

$$(d/dt)\iiint(chi)dV + \oiint(f\cdot n)\mathrm{dS} = < 0 \text{ (annihilated)} \quad (12)$$

and are free to move within the (3+1) environment with the equations of motion given by the local gradients (and Hessian) of the continuum flow.

As with the previous Phase, there is nothing random, ad hoc, or haphazard about how the Cosmos shatters and how the cosmic boundary behaves. Because of the set values, the individual A_q at (+) or (-) orientation of the Cosmos are fixed in size and allow only a calculable rate of throughput. Such constraints are identified as quantum values of a parameter. This means that the rate of throughput (sinks) is defined by this quantized A_q and the continuum parameters. If the Cosmos has only sinks, it could collapse to "oblivion". The chronic-minimum prevents annihilation back to the Sympan and the Cosmos must balance throughputs of continuum into and from the Aylon. The Cosmos must therefore include "sources" of continuum. (***d/dt***=partial)

$$\boldsymbol{d}\phi/\boldsymbol{dt} + \nabla\bullet\mathrm{f} > 0 \text{ (created)} \quad (13)$$

The sinks free to move are only found as discrete entities in specific locations of the Aylon-Cosmos dimensional boundary and local densities only begin as isotropic or homogeneous (CMB). The sources (Continuum Creation, the background itself) however are isotropic, homogeneous and omnipresent.

As the continuum enters the Cosmos an operator causing divergence and also changes the fourth dimension.

$$\Theta\bullet\mathrm{d}\mathbf{x}_4 = \mathrm{cdt} \quad (14)$$

In addition, the rate of influx, changes with age as constant density, while annihilation by sinks remains the same with age for a given sink. The amount of continuum throughput can cause, a static, a collapsing, or an expanding universe. Our Cosmos is expanding in both time and space. The behavior and identification of sinks appears not to be difficult but the sources (include homogeneous isotropic microscopic sinks?) are not simple. In CCA cosmology Poisson's equation always has two of three components. It can be shown that the sources are part of what is recently identified as dark energy and change Einstein's equation (Emc^2) to include enclosed sources (volume).

$$E = (m + \rho_{DE} Vol)c^2 > 0 \qquad (15)$$

(adding 12kg to the Solar mass!!)

If the sources like the sinks are quantized, the Cosmos will suffer another phase change (CSB) in the future. This continuum annihilation-creation cycle can cause information "entering" a black hole to be distributed instantaneously (if incompressible medium) uniformly into the Aylon boundary and then re-enter the Cosmos via the sources (creation). This means that information is conserved but may be spread over the entire Cosmos.

During the first two phases, the Cosmos has no resemblance to the present universe. No gravity as known, no photons, no particles or black holes, no matter or antimatter, no spin, no charges and no mass, only the massless ξ_0. Only a maximum (accessible) 6-Sigma dimensions during Phase-1.

The instant the ξ_0 states decay, Phase-1 ends.

5. PHASE-2: EXPANSION AND BOSONS,

(*8 sigma-dimensions, gravity, mass, spin, generation, matter-antimatter, one tensor exchange state, only xena exist).*

Three decades ago, a set of strange (xena) particles were postulated (search for fourth lepton) that had some peculiar properties. They exist with only 8-Sigma-dimensions that automatically make them totally blind to the EM forces. They cannot annihilate into photons (directly) and may have a peculiar mass-velocity behavior.

In CCA, xena are the third family of states and the progenitors of leptons and quarks. In addition to the massless ξ_0, Phase-2 allows three pairs of massive (A_q) xena with their exchange states (\`$\xi_0$, \`\`ξ_0). All three pairs are spin-one bosons.

$$\text{XENA} \qquad \xi_0; \qquad \xi_{\pm 2}; \qquad \xi_{\pm 4}; \qquad \xi_{\pm 6}; \tag{16}$$

During Phase-2, no leptons or quarks, no photons or vector exchange states, no charges (EM) are possible (xena=shadow matter?). It is possible to have a tensor exchange state (\`ξ_0) that appears to have all the requirements for the graviton.

At Phase-2 the Cosmos becomes non-adiabatic but because of the dimensional difference access to the Aylon from the Cosmos is forbidden except under very specific conditions.

Quantized A_q do not normally combine (limiting forces) to form one larger A_q but the flow is summed. There is however a possibility of summing sinks causing greater then a critical density of the continuum. The summed A_qs then combine and sinks become inaccessible, as black holes. This critical density is >$9\text{x}10^{15}$ equivalent g-cm^{-3}.

The continuum flow through the quantized A_q is irrotational (no curl) to a given accessible distance. If no sinks are present, no gradients makes the continuum an instantaneous constant density isotropic, homogeneous entity of sources (non-vanishing divergence). At some distance to a given A_q the flow changes and at the boundary of the two domains the curl or spin exists (Coriolis).

Because the continuum flow carries momentum it is not difficult to associate the free quantized sinks A_q with mass and the continuum flow field (cm^3-g^{-1}-s^{-2}) with gravity. The above exchange state (\`ξ_0) can be viewed as the quantum of gravity ("pair-formation" energy 10^{13} GeV?). Flow requires time, therefore mass and gravity require the Time dimension (perturbed 4^{th} dimension operator?) providing possible answers to the questions of:

What is Mass?

What is Gravity?

The amount of flow is dependent on the size of the given quantized A_q which can be taken as the mass of a particle, thus the flow (gradient) or gravity, is dependent on the mass, and Newton's and Einstein's equations are obtainable.

Having associated gravity and mass to the continuum flow and A_q the characteristics of Phase-2 are detailed.

A number of diagrams have been developed that reside at the (+,-) orientations of the Cosmos defining the dynamic behavior of A_q-vs-motion within the (3+1) geometry (by a dynamic angle delta which changes the A_q). For baryonic states this reduces to the Special Relativity behavior while for the xena it may be different. Combining the concept of continuum flow, A_q and orientation of throughput the questions

What is Matter?

What is Antimatter?

find plausible answers.

An A_q with (+) can be shown to be "different" from an identical A_q with the (-) orientation. The orientation vector does not change the flow, or the gradients. The only differences are in parameters that have a curl, or some (relative) angular behavior. When combining two such identical opposite A_qs a non-standard summation occurs as exchange state, or force. From the above definitions of what is mass one can immediately assume that one A_q orientation can be defined as matter and the other as antimatter. Any interaction between these two has predictable results. Historically (since 1960s) CCA has defined matter as the negative to the normal and antimatter as the normal. In any interaction the Sigma-quanta are conserved. The Sigma-space designation of matter or antimatter is manifested by the generation (σ-3). For the xena and for neutrinos the spin vector, σ-4 orientation is also fixed. That is why a neutrino spin is always (-) while antineutrino spin is always (+). The neutrinos and the massive xena share a "symmetry" (one-to-two, Phase-3α ``ξ_0?) that also shows up as correlation with dark matter. This may answer the questions:

What is Dark Matter?

Is Dark and Baryonic Matter Correlated?

In CCA the xena are the cause for baryonic matter and are correlated. Dark matter is the 6th generation antimatter stable xena state. Observationally the CMB WMAP Multipole Moment with peaks ($l \sim 200$ etc.,) from the first year observations (Spergel et al. 2003) show that baryonic matter and dark matter must be correlated. By CCA, this proportionality (about 5.5) has been defined and is dependent on the fine structure constant with a likely ratio for the rest mass of the Xi_{+6} to the proton of about ($1/4\pi\alpha$). The ratio of cosmic dark matter to baryonic matter is half that because there are two baryons for every massive Xi.

At Phase-2 the ξ_0 decays into xena with mass (A_q). It can be shown that none of the known particles (leptons or quarks) can assume this role. These xena cannot be baryons because the number of Sigma-dimensions (8) in Phase-2 cannot support baryonic matter (10).

A decay of the ξ_0 requires a minimum of three pairs of particles and antiparticles. This will answer the question:

Why are there three Generations of Leptons and Quarks?

Direct xena annihilation cannot form photons (photons cannot exist during Phase-2) but can form tensor exchange states.

By the Sigma-dimensions the products of ξ_0, are forced to be of specific values in Sigma-space because of conservation rules. These xena with mass can only be of even generation of ± 2, ± 4, and ± 6, the massless ξ_0 is null, (0).

Another peculiar mass behavior of the xena is that the "rest mass" decreases with increasing generation. The second generation, or ξ_2 is the most massive (10^{-11} g) while the sixth generation ξ_6 is the least massive ($>1.8\mathrm{x}10^{-23}$ g) and stable and has all the requirements to be the present cold dark matter. There are several observations that can test this claim of dark matter. A high presence of positrons, specific neutrinos, gamma rays and antiprotons in areas of galaxies where energetic baryons can interact with the ξ_6 (interactions >10 GeV) can indicate ξ_6 populations. Currently the observational results of PAMELA showing such cosmic excesses are being examined for fit with CCA detailed predictions. Spin related antimatter lepton and baryon excess from PAMELA observations analyzed for neutrinos by Barger, Keung, Marfatia and Shaughnessy (2008) and Barger, Keung, Marfatia and Shaughnessy (2009) show spin-1 dark matter states are possible. Also the current low energy experiment CDMSII (Ahmed et al. 2010) should see a "cold" particle ($\sim 1.8\mathrm{x}10^{-23}$ g) that should not annihilate.

The ξ_4 matter is expected to have a "rest mass" of about 10^{-18} g and decays at the next phase.

Phase-2 has the following ξ_0 decay (identical ξ_0 resonance orientation) into exactly 50% matter and 50% antimatter states:

$\xi_0 \Rightarrow (\xi_{+2} + 2\,\xi_{-4} + \xi_{+6})/(\text{opposite}) >> 1$ (17)

It is noted that no strong preference needed (<1 or >1) Phase-3 shows that the present universe could still be as complex. Baryonic matter would be either matter (as it is) or antimatter and dark matter would be opposite. This means that at Phase-2 the Cosmos is made up of massive xena 50-50 matter-antimatter. This xena mixture cannot annihilate, because the opposites are not "identical" and both tensor and scalar exchange states (also photons) require identical opposites. The above interaction provides answers to several puzzles in Cosmology including:

Why is there an asymmetry of Baryonic Matter over Antimatter?

Because Xi_{+6} is stable with the above decay of the Xi-0, it becomes trivial to show (Phase-3) that baryonic matter will have an overwhelming imbalance of matter over antimatter as observed. At Phase-2, the total number of xena states in the Cosmos is $(4)(3.55\text{x}10^{78}) = 1.42\text{x}10^{79}$. It appears that xena have a mass-to-velocity oscillations behavior inhibiting high density concentrations (observed as dark matter "overshooting their target", colliding galaxy observations can verify this, Bullet Cluster as a good example, MOND not applicable). Taking this behavior and having the ξ_{+6} to be the stable dark matter, the behavior of dark matter as large structures can be defined. Velocity-dependent shells and halos with oscillatory gravitational orbits, show the feebleness of the DM cross-section (Clowe et al. 2006; Markevitch et al. 2003) and expected by the xi+6 even if they are antimatter. Such behavior, was proposed by CCA (especially) in colliding galaxies and one can determine more details to be tested by observations. The rate of creation of continuum as dark energy during Phase-2 is very high per unit existing continuum (volume) and can have an impact on the behavior of matter in general.

6. PHASE-3α: EXPANSION , ANTIMATTER-FERMIONS:

(10-*Sigma-dimensions, baryonic antimatter and photons exist).*

When the mass of the expanding, entropy increasing Cosmos is >$6x10^{55}$ g, the xena-2 decay. Phase-2 ends and the last Sigma-plane happens by another (4^{th}) CSB causing Phase-3α. All the current forces and Sigma dimensions (10) are accessible. When this last Sigma-plane occurs baryonic matter and photons, etc., are possible. The beginning of Phase-3α is the instant the ξ_{+2} decays. This massive xena state splits into two groups; two leptons and two nucleons with an assortment of mesons (quarks) to satisfy the conservation laws. In the CCA hypothesis, the quarks can be considered as fractional-vector leptons rotated in the last Sigma-plane (σ-1; σ-2, chiral force results) and are called "endostates". This is why there are no free quarks; only states with integer σ-vectors (exostates) can be free. The quark algebra defines three types (color?) and guarantees the conservation of the Sigma-dimensions. The decay of the ξ_{+2} at Phase-3α, like the ξ_0 decay of Phase-2, is not a familiar decay. The conservation of Sigma quantum numbers is of prime importance. In this Phase-3α, another exchange state ``ξ_0, is allowed (between the xena and leptons-quarks, massive? >100GeV/c^2, "very weak" force?) which can decay into electrons, neutrinos and Z^0 or W^+ or W^- with zero sum of spin. For four lepton decays (with Z^0) both the electron and the positron have the same spin, while a two lepton decay with W^{+-} forces the electron to have the same spin as the neutrino. It appears possible to discover the specific decay products by assuming virtual Xi_2. The recent observance of data from the FNAL Tevatron (CDF Collaboration, Aaltonen et al. 2011) may represent a first observation of this exchange state. For the proposed cosmology however, the important decay for this phase is:

$$\xi_{+2} \Rightarrow (e^+ + \nu_1 + p^- + n^0)_{antimatter} + 3(k^0D^0)_{matter} \qquad (18)$$

The decay of the D^0 and the k^0-long is not slow, so immediately after the ξ_{+2} decay the Cosmos is made up of about 4.5% baryonic antimatter, about 53% ξ_{-4}, ξ_{+6} (dark matter) about 26% and about 16% is high energy photons and lepton excess from the meson decays and annihilations.

These values are not difficult to find by the assumed decays of the xena and the total number N, found above. There are "no" matter nucleons present at Phase-3α.

7. PHASE-3β: GRAND ANNIHILATION, MATTER-FERMION IMBALANCE,

The ξ_{-4} at Phase-3β, with critical mass (>8x10^{-23} g) decays via the second generation muonic leptons and Σ/Λ hyperons. The reason for leptons and quarks higher than generation one now becomes evident. When this mass (or cold life time) is "reached" the decay of the two ξ_{-4} happens:

$$2\xi_{-4} \Rightarrow 2\{(\nu_2 + \mu^- + \Sigma^+ + \Sigma^0)_{matter} + 4(k^oD^o)_{antimatter}\} \quad (19)$$

The matter hyperons and muons decay into matter nucleons, neutrinos and electrons. Half of the ξ_{-4} products immediately annihilate by interacting with the antimatter products of Phase-3α. This, causes matter-antimatter Grand-Annihilation, of about 66% of all existing baryonic states into high energy photons, and mesons. The annihilation eliminates most of the lepton excess and the component densities change drastically. Prior to thermalization the components are: high energy photons (etc.,) ~(71%) or equivalent 1.8x10^{56} g, the xena+6 dark matter about 25%. The least component is now about 4% baryonic matter nucleons. There are no antimatter baryons remaining. All the baryonic component is now matter, thus "Matter-Asymmetry". The dark energy component as constant density is relatively small, but growing at a high creation rate with a negative pressure

$$P \sim (\rho_{DE})((\kappa)_N)(R_u) + (½)(\rho_{DM} + \rho_{BM})(c^2) \quad (20)$$

$$P \sim (\rho_{DE})((\kappa)_N)(R_u) + (½)(\rho_c - \rho_{DE})(c^2) \quad (21)$$

$$\rho_{DE} \sim -(c^2\rho_c)/[6((\kappa)_N)(R_u) - (c^2)/2] = 6.89 \times 10^{-30} \text{ g-cm-3} \quad (22)$$

Cosmic "push" as

$$(\kappa)_N = (1/4\pi)(\text{Grad})(\text{cosmic potential energy}) \quad (23)$$

$$(\kappa)_N = ((\rho_c)G_uRu) = 1.240 \times 10^{-8} \text{ cm-s}^{-2}. \quad (24)$$

After the baryonic Grand-Annihilation, the Cosmos still has high density (~10^{15} g-cm^{-3}) and each baryon and ξ_{+6} can be given up to 10^{12} eV thermal energy. With such temperatures nucleons may break up into their quarks until the Cosmos cools by expansion to temperatures below nucleon condensation. The total nucleons remains conserved through this high temperature period. It is noted that this high temperature causes the Theory of Nucleosynthesis to identically apply to CCA as to the big bang. It is also noted that the defining "predictions" of the SM Big Bang Theory: The Cosmological Principle, the Theory of Nucleosynthesis and the CMB are all "natural" predictions of CCA with the added advantage that CCA is more predictive for other events and can be tested by observations which the SM cannot claim.

8. PHASE-3γ: CURRENT EPOCH, CMB

At Phase-3γ the Cosmos becomes neutral, recombination, or Grand Decoupling Epoch, GDE describable via Saha's and Jeans' equations. Ordinary statistical fluctuations and the creation of continuum during the plasma phase-change (neutralization) gives what appears via the CMB and the present appearance. Because of creation of continuum with a negative pressure (dark energy) there is a "hierarchy" of forming (speeds up) large structures that includes galactic size and down to a first generation star-burst of giant-star and GRB epoch, from "top-down" or "outside-in". Analysis of localized sizes, even galactic clusters via harmonic oscillations of different modes (of continuum) similar to stellar oscillations treatment by Pekeris (1938a,b) and Cox (1980) for homogeneous compressible, constant density, static model eigenfrequencies of oscillations (giving two sets of roots for large n and l, with p-modes and g-modes) shows large structures building "naturally", during this sub-phase . By using the above methods and the creation of continuum it was shown that galaxies and even clusters can form even within 300 million years after recombination or after GDE (private research paper, Graduate School, University of Wyoming, 1986)..

9. PREDICTIONS AND OBSERVATIONS:

To show the predictive ability of CCA some observable examples are presented.

9.1. Nucleosynthesis Eta Value:

To indicate that the Cosmos obeys CCA, the Eta of the Theory of Nucleosynthesis can be calculated. The total number of nucleons in the Cosmos is:

$$N_{BM} = 2\pi(Gs/Gu)^2 = 7.11x10^{78} \qquad (25)$$

For this to hold for any age, black holes must be given limits that may be verifiable. To calculate Eta, a Hubble Cavity, or causal size R_H, is used and the current CCA size of the finite Cosmos is found:

$$Ru = (3/2)R_H = (3/2)(ct_{H0}) = 1.94x10^{28} \text{ cm} \qquad (26)$$

The Hubble age, t_{H0}, taken as the WMAP age of $13.7x10^9$ yr (Spergel et al. 2003) $4.32x10^{17}$ s gives volume (V_0):

$$V_0 = (4\pi/3)Ru^3 = 3.058x10^{85} \text{ cm}^3 \qquad (27)$$

This gives a current number density for nucleons of:

$$N_{BM} / V_0 = (7.11x10^{78})/(3.058x10^{85}) = 2.325x10^{-7} \ N_{BM}\text{-cm}^{-3} \qquad (28)$$

This number density is also verified by observations and the Theory of Nucleosynthesis. This value gives a mass density for cosmic baryonic matter of $3.88x10^{-31}$ g-cm^{-3} that also plays a role in the cosmic Light Element ratios as the Eta (or Eta10) for D/H and others. With the CMB temperature of 2,725 kelvin (Mather, et al, 1999) the current number density for CMB photons is 411 cm^{-3} giving a CCA value of Eta (ratio of baryonic to CMB densities):

$$\eta = (2.325\text{x}10^{-7})/(411) = 5.657\text{x}10^{-10} \quad (29)$$

An extensive analysis of observations of cosmic abundances is presented by Tytler et al. (2000) and by the observed ratio of D/H, conclude that Eta is:

$$\eta = 5.1 \pm 0.5\text{x}10^{-10} \quad (30)$$

Having a primordial (theoretical) value of Eta independent of abundance observations can help to define some non primordial causes for the light elements. It also places a limit on the amount of baryonic matter "consumed" by black holes for the age of the Cosmos if N_{BM} is conserved and no black hole "recycling" mechanism.

9.2. Time Dilation By Photon Self-Gravity

GRB photons from across the universe and about 100 MeV (λ~1x10^{-12} cm) from above must have a delay time (no z-correction) compared to a standard, of approximately:

$$\Delta t \sim (2.15\text{x}10^{17})(4\pi^{3/2}/\alpha)(1.6\text{x}10^{-33}/1\text{x}10^{-12}) = 0.98 \text{ s} \quad (31)$$

The recent observations of GRB 090510 (Abdo et al) by the FERMI satellite of 0.9 seconds time delay with a ratio of wavelengths to standard, of 120x10^6 verifies this prediction and can be calculated to have traveled a "standard" time of:

$$t_0 \sim (0.9)/(4\pi^{3/2}/\alpha)(1.3\text{x}10^{-21}) = 2.2\text{x}10^{17} \text{ s} \quad (32)$$

This is half the age of the universe. The largest gamma-ray burst known (GRB 080916C) detected by FERMI (Piron, 2009; and Briggs, Tajima, Dermer, 2009) was measured to have a time delay of 16.5 seconds for energies 1 GeV at a distance t_0 of about 3.86x10^{17} seconds. The calculated delay time by self-gravity for these parameters (1 GeV ~1.28x10^{-13} cm) at that distance is:

$$\Delta t \sim (3.86\text{x}10^{17})(4\pi^{3/2}/\alpha)(1.6\text{x}10^{-33}/1.28\text{x}10^{-13}) = 16.1 \text{ s} \quad (33)$$

9.3. Accelerated-Universe:

By Phase-3β the dark energy has constant density with age. Observations can be made that can verify the behavior of dark energy with age.

Recent observations indicate that the Universe appears to have accelerated (Riess et al. 1998) in the recent past, about z ~0.5 (Riess et al. 2001) for Ω_M~1/3, Ω_Λ~2/3.

As with Inflation, there is no known mechanism that can cause the universe to accelerate. By assuming a perfect fluid for the continuum and its negative pressure, after some algebra from the equation of state and the CCA Hubble expansion κ_{H0} (calculated 71.4 km-s^{-1}-Mpc^{-1}) the current critical density ρ_c is

$$\rho_c = ((3/8\pi)\ \kappa_{H0})/G\ R_H = 9.58\text{x}10^{-30} \qquad \text{g-cm}^{-3} \tag{34}$$

with the DE density as above 6.87x10^{-30} g-cm^{-3}. With constant matter, there is an age at which dark energy dominates matter densities and the Hubble parameter H(t) changes rate of change to "mimic" an accelerated-expansion. This age is at critical Cosmos density of

$$\rho_c = 2\ (\rho_{DM} + \rho_{BM}) = 2\rho_{DE} \quad \sim 1.4\text{x}10^{-29}\ \text{g-cm}^{-3} \tag{35}$$

The then, baryonic density was 2.17x10^{-30} g-cm^{-3}.

From CCA (Ierokomos, 2010) it is a simple calculation indicating an "apparent" accelerated-expansion at z~0.44 for Ω_M~0.27, Ω_Λ~0.73 compared to above z~0.5.

If this is indeed the case, the universe has not accelerated.

9.4. Age-Dependent Size Of Galaxies:

By CCA galaxies at z >2 can have measurable difference in size and dispersion velocities compared to present galaxies of the same mass. This dependence is an expansion parameter, or acceleration, κ_N, which also partly determines the non-Newtonian threshold for orbits via the negative cosmic pressure, P. This acceleration from the equation of state is defined as:

$$P = (\kappa_N)c^2/(3GRu) \tag{36}$$

and is currently:

$$\kappa_{N0} = (3/2)\ \rho_c\ Gu\ R_{H0} = (9/16\pi)\ \kappa_H = 1.24\text{x}10^{-8} \quad \text{cm-s}^{-2} \tag{37}$$

This value is also known as "Milgrom's law" and in literature is assumed as modifying Newton's equations known as MOND (Milgrom, 1983; Bekenstein, 2004) to eliminate the need of dark matter. This expansion parameter κ_N (t) with dark matter included (no modification) gives a galaxy size that is smaller in the past as:

$$(Rg)^2 = (GMg)/(\ \kappa(t)_N) \qquad \text{cm}^2 \tag{38}$$

$$(R(t))^2 = 2M/(3\rho_c(t)(c\ t_{Hz})) \quad \text{cm}^2 \tag{39}$$

For galaxies more recent than 50% of current age the differences are probably within random local variations. At z >2 the differences by the ρ_c parameter, are sufficient to make a determination for the dark energy behavior. Recently analyzed, Galaxy 1255-0 at z~2.186 similar in mass to the Milky Way (Van Dokkum et al. 2009) shows a size about 5 times smaller. For a non-constant dark energy density by CCA this galaxy is calculated 4.55 times smaller for 22% age. For constant density DE a compactness factor of 5 is at 10% of present age. More observations are needed for a definitive DE behavior.

10. CONCLUSION

As shown above the present components are baryonic matter $1.18\text{x}10^{55}$ g or 4% and $6.7\text{x}10^{55}$ g or >23% xena antimatter dark matter. The biggest component is dark energy with maximum <73% with the total Mass at about $2.9\text{x}10^{56}$ g. The above percentage values are also found by the two supernovae research teams, "The SN Project Search" (Reiss et al. 2001) and "The Supernova Cosmology" (Perlmutter et al. 1999). The CCA mass density limit of black holes can be up to 1.5% of total.

The Proposed Continuum Creation and Annihilation hypothesis seems to provide answers to most cosmological and particle issues simply and as a consequence. Most of the answers are verifiable by observations or experiment.

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