Stochastic model Of universe which constantly creates dark energy (Omega=0.7) and dark matter (Omega=0.3) but instantly at 0.12Gyr created nucleons and radiation.

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An assumption attributing vacuum mass energy to symmetric 'Null' fluctuation which with equal probability either adds or subtracts, virtual planck either particles or antiparticles leads to the following net resultant: 'Dark Energy' virtual particle-antiparticle pairs and 'Dark Matter' real planck particles, constantly give $\Omega_{\text{DE}} = 0.7$ and $\Omega_{\text{DM}} = 0.3$. Second assumption that gravitational attraction propagates as particle-bridging wavelength, leads to following estimates: Instantly, astonishingly recently and utilizing the wavelength, the Dark Energy particles converted into nucleons(n) and the antiparticles into radiation (ultimately CMB). Baryogenesis occurred almost immediately in their ultra-hot clusters. Nucleonic matter declined from $\Omega_n = 0.7$ at creation, to present time $\Omega_n = 0.03$. Famous 'Acceleration' is attributed to the cohesion of a supreme cluster of nucleonic matter, giving $z/\ell = (1 - \ell / \ell_H)^{2/3}$, $z$, $\ell$ and $\ell_H$ being respectively, redshift, luminosity and Hubble distances.

1 INTRODUCTION.
The new Big Bang (BB) model leaves certain questions unanswered [1]. The Universe geometry seems Flat and the density of matter mostly non-nucleonic Dark Matter (DM) is almost but not quite critical at $\Omega_{dm} \simeq 0.3$. The deficit is attributed to Dark Energy (DE) which provides $\Omega_{de} \simeq 0.7$. However the two $\Omega$'s should evolve entirely differently in time so how can we explain their present near-coincidence. Also what does $\Omega_s$ represent? When it is attributed to vacuum energy fluctuation (VF) its energy density seems to exceed today's $\Omega \simeq 1$ by 10$^{120}$. I propose a new approach to these questions with the help of a stochastic model of Universe expanding with constant speed. Deceleration due to gravity is balanced by mass energy constantly created by VF which constantly maintains $\Omega = 1$. (Permanent but different creation has been proposed by Hoyle and Narlikar[2],[3]). Formally the subject studied here belongs to quantum gravity but in order to bring the two together my model starts straightaway from the Planck particle[1],[3]. Often expressed opinion is that VF had created just after BB and possibly continues to create virtual planck particles and antiparticles $\bar{p}$ and $\bar{p}$ respectively. These decay after the planck time and Dark Energy density is simply equated to that of a planck particle. I claim instead, that VF constitutes a four sided Null vacuum fluctuation (NVF) which with an equal probability generates at all times $+\bar{p}$, or $-\bar{p}$, or $+\bar{p}$, or $-\bar{p}$. In this context for example $-\bar{p}$ does not signify decay of an existing $+\bar{p}$, but merely a decrease by one of the total number of $\bar{p}$. Indeed it may be followed by another $-\bar{p}$ on the same site. To first approximation the sum of the fluctuations is null but their so called root mean square (rms) resultant does not vanish. It is to it that I attribute constant creation of mass energy, DM and DE alike.

To begin with let us assume a constantly Flat expanding universe and express our results in terms of a reduced dimensionless radius-time $r$, which constitutes a ratio of the causal ('Hubble') radius and the planck radius $r_p$. Henceforth all distances, times and masses are reduced by corresponding planck quantities. Total number of all planck fluctuations ($\pm \bar{p}$ and $\pm \bar{p}$) created in the sphere demarcated by the causal radius and during epoch $r$, is $r^4$. However the rms number of excess $+\bar{p}$ and $+\bar{p}$ fluctuations referred to jointly as excess $p_+$ particles, is only $r^2/2$. They or rather signals they have emitted over epoch $r$ give rise to cohesive energy $-\Gamma = G \sum m_i / r$, acting on an arbitrary 'central particle'. Here $m_i$ is the mass of an excess $p_+$ in causal contact with a central particle over a distance $r_i$ during unit present time. Excess $p_+$ play a double role, first as past particles which via signals contribute to $\Gamma$ and second as present time central particles acted upon by $\Gamma$. Due to their unit duration the number of excess $p_+$’s in causal contact with a center during unit time is $r/2$ instead of $r^2/2$. We do find that $-\Gamma = G \sum m_i / r_i = G/2$, get a permanently critical energy density[1], in agreement with our starting assumption of constantly Flat universe.

I assume further that actually the excess $p_+$ particles consist of two fractions: The one consists of virtual $(\bar{p} - \bar{p})_+$ pairs and corresponds to DE. The other fraction consists of real planck particles $\bar{p}_+$
and corresponds to DM. The fractions’ relative abundance 0.69 : 0.31 is estimated with the help of a simple Lattice Model of randomly distributed paired and single, particles and antiparticles. Despite profound difference between short lived virtual \((\bar{p} - p)_+\) pairs and the permanent real \(\bar{p}_+\)’s, both play the same role in expanding Universe: their uniform creation keeps \(\Gamma\) constant and the expansion ’balanced’, neither decelerated nor accelerated. Notwithstanding the virtual versus real disparity their effective contribution to \(\sum m_i/r_i\) is still in the 0.69 : 0.31 ratio. Thus the number of the real (DM) \(\bar{p}_+\)'s created is \(r\) times smaller than that of the virtual (DE) \((\bar{p} - p)_+\), but is compensated by their Action which continues indefinitely during \(r\). The overall picture is of a featureless balanced universe which expands without big bang or big inflation. Yet the presence of cosmic microwave background CMB and of nucleonic matter \(r_i\) remains unexplained. Their creation is studied here in detail as an important example of momentary ‘transitions’ viz., deviations from the uniform creation of DE and DM.

In order to explain a transition the basic assumption is amplified by assumptions on the nature of signals by means of which \(p_+\)'s which existed in the past, attract \(p_+\)'s existing at present time. Since quite a few assumptions are introduced before complete picture starts to emerge let me preview the argument briefly. The massless signals propagate indefinitely in spacetime with speed \(c\) and may be associated with a wavelength \(\lambda\). Avoiding reference to a ’graviton’ I only assume that in order to propagate the massless signals have to act on masses uninterruptedly viz., on ’central particles spaced at intervals equal to the \(\lambda\) wavelength. The process creates the cohesive energy \(−\Gamma\). It soon becomes clear that the \(r\) excess \(p_+\) spread over the \(r^3\) causal sphere are too sparsely spaced to meet this requirement. I assume that the role of past-attracting-present particles is played by virtual particles denoted \(q\), generated from excess \(p_+\). It transpires that the radius-lifetime of a \(q\) particle has to be equal to \(s\), where \(s^2\) is equal to the separation distance between the excess \(p_+\) viz., \(s^2 = (r^2/\lambda)^{1/3}\). In that case we can show that everywhere in space \(\lambda\cdot q\) couples are created one after another along signals’ straight line path. However the argument requires several more steps. I assume that each excess \(p_+\) is generated by NVF in a time sequence of interconnected steps, creating on the average one \(q\) per step. The \(s\) longer than planck’s radius-lifetime of a \(q\) particle implies by Uncertainty an \(s\) times smaller mass viz., \(m_q = m_p/s\). Hence \(s\) virtual \(q\)’s may be generated out of each excess \(p_+\) at distance \(s = \lambda\) from each other. A question arises how are the \(q\) particles generated precisely along the straight path of \(\lambda\)’s. Since the two jointly create an increment of cohesive energy I assume that such local minimum favors the creation of \(q\)’s one after another along the straight path of \(\lambda\)’s. In return the creation of \(q\)’s enables the propagation of massless \(\lambda\)’s from one mass to another. This straight low energy path of sequentially created \(\lambda - q\) couples is named here a ’channel’. However the channels cannot propagate in isolated straight lines over radius-time \(r\); they have to create a contiguously connected network in the \(r^3\) space, without big holes. Comparison to percolating clusters indicates that the stepwise generation of \(q\)’s which on the average creates one \(q\) per step, has to bifurcate repeatedly creating a space filling (fractal) Cluster of interconnected divergent channels. The clusters have to be large enough in order to also be contiguously interconnected. The restrictions put together enable one to estimate the number and radius-lifetime of clusters and of their \(s\) constituent \(\lambda − q\) couples.

The results enable me to propose a model of a nucleon and CMB creating transition. Major role belongs to scales whose present time values are: radius \(s \simeq 10^{20}\) of a \(\lambda - q\) couple; radius \(s^{1/2} \simeq 10^{30}\) of a cluster and distance \(s^2 \simeq 10^{40}\) between neighbor excess \(p_+\). The numbers and their combinations bring to mind the large dimensionless numbers to which Dirac\(^4\) has attributed major cosmic significance. His numbers are on the order of \(10^{40}\) and represent the ratio of planck to proton masses, of cosmic to proton radii, etc. The hint worked out systematically led me to the conclusion that not today but quite recently when the universe was merely one hundred times younger than now and \(s\) was equal to \(0.4 \times 10^{20}\) \((10^{-13} cm)\), the energy generated by the \(\lambda\) to \(q\) coupling became precisely equal to the rest mass of a nucleon. At that moment which lasted 14 seconds occurred a transition which in each cluster diverted the generation of DE, into a generation of nucleons and of high energy radiation (which cascaded down to CMB). Simultaneously in same clusters occurred Baryogenesis. Such description of baryogenesis is very different from standard BBN theory but on the face of it seems to fit known facts. All these results are obtained with the sole input of proton’s mass. Injection of observed present time value of \(r_0\) allows us to estimate today’s \(T_0\) and the dilution of nucleonic matter in expanding space. We find the recently reported Acceleration of expanding Universe to be illusory and attributable to self-attraction of nucleons which binds them together retarding dilution.

2 UNIFORM GENERATION OF MASS AND ENERGY BY NVF.

Our story unfolds as follows. The effect of gravity on the expansion is represented by a cohesive negative energy \(m_p\Gamma = -m_pG\sum m_i/r_i\). It results from an attraction of an arbitrary central planck mass \(m_p\) during unit present time by surrounding masses \(m_i\) acting over corresponding distances \(r_i\).
Here $m_i$ and $r_i$ are reduced by corresponding planck quantities however the single mass $m_p$ of the central particle is not reduced in order to display its presence. We sort $\sum m_i/r_i$ into concentric shells around the center, $1 \leq r' < r$. An $r'$th shell contains all particles virtual and real which existed at $r'$th past time and are in causal contact of unit duration with the central $m_p$ at a present time $r$, over distance $r - r'$. At this stage we avoid explicit mention of causal signals. Also in order to simplify the verbal argument all particles are attributed a unit lifetime and those 'existing at..' are identified with their $\Gamma$-energy. We sort these verbal arguments and then identify their contributions to a $\Gamma$-energy. We propose to overcome this problem by redefining VF as Null vacuum fluctuation NVF which with an equal probability density, adds or subtracts either $\bar{\nu}$ or $\bar{\nu}$ particles. Random Walk provides an example for calculating the $\Gamma$-energy. We refer to this decrease as 'range-decimation'. We get

$$\Gamma \equiv \frac{\Gamma}{r} \equiv \frac{\Gamma}{r}$$

To begin with we focus on planck particles constantly generated by VF aiming to show that $\int g_r dr' = 1/2$ we temporarily ignore the distinction between particles and antiparticles, lump together the $\pm \bar{\nu}$ and $\pm \bar{\nu}$ fluctuations, use a $p_{\pm}$ common notation and concentrate only on a deviation from the $\pm$ symmetry. Random Walk provides an example for calculating the $\Gamma$-energy. Let $N$ be the number of random back and forth $b_{\pm}$ steps. Due to mutual cancellation their $\Gamma$-energy result denoted here as $\langle b_{\pm}N \rangle$ is equal to $b_{\pm}N^{1/2}$ only. We return to NVF. The number of $p_{\pm}$ fluctuations of unit duration in a hyper-sphere of radius $r$ is $r^4$ but the $\Gamma$-energy number of excess $p_{\pm}$ at radius time $r$ is only $r^2/2$ or in detail, $r'$ particles created at past time $r'$ and integrated over $1 \leq r' < r$. The $r'$ have been created randomly distributed over $r'$ distinct distances from the center. Only one manages to establish causal contact with the center at time $r$ over distance-time $(r-r')$ with probability $1/r'$. The $\Gamma$-energy associated with this lucky increment is proportional to $(r-r')^{-1}$. Assuming uniform expansion (justified a posteriori), the latter is equal to $r'/r$. Thus the contribution of $r'$ particles created at time $r'$ to $\Gamma$-energy becomes $(r'/r')(r'/r)$ giving $g_r = r'/r$. The lifetime of the $p_{\pm}$ particles hence the attraction they exert on each other lasts one unit of time, $t_p$ (using for the moment unreduced time). Hence the increment of $\Gamma$-Action created by each planck mass is $(Gm_p/t_p)p = c^2t_p$. This increment is assumedly conserved since uniform expansion performs no work (once more justified a posteriori). However the range and epoch of the Action of past $p_+$ on present ones increases without bounds with $r$. Uncertainty requires $\bar{\Gamma} = (m_p c^2)(t_p)$. As time of Action is dilated to $r_p$, the $\Gamma$-energy decreases to $m_p c^2/r$. Hence in order to sum the $\Gamma$-energy of all $1 \leq r' < r$ past particles we integrate over a fraction-time $r'/r$. We refer to this decrease as 'range-decimation'. We get $\int g_r dr' = \int (r'/r)d(r'/r) = 1/2$ and $-\Gamma = c^2/2 = Gm_p/2r_p$. We also wish to evaluate an 'objective' mass energy of excess $p_+$’s irrespective of their irrespective of their contribution to $-\Gamma$. to a particular center. To this end we have to factor out from $g_r$, the aforementioned $1/r'$ and $r'/r$ factors. We get $g_r mass = r'$. Integrating over $r'/r$ we get total reduced mass $M$ of excess $p_+$ contributing to $-\Gamma$, namely $M = r/2$ just the hoped-for result. Summarizing with the help of random walk symbols we write

$$-\Gamma/c^2 = \langle r'p_{\pm} \rangle = (\int_{1/r}^{1-1/r} r'd(r')/r) p_+ = 1/2p_+ \quad \text{or} \quad -\Gamma = Gm_p/2r_p = c^2/2 \quad \text{and} \quad M = r/2.$$  

(1)

The 'range-decimation' plays a major role in Eq. (1): it turns an open ended integral over $1 \leq r' < r$ unit times into a bounded $r$ times smaller integral inside $1 \leq r'/r \leq 1 - 1/r$. It applies to the case of increments of $\Gamma$-Action created by past virtual particles, whose initial time duration was only one $t_p$, but whose past-present $\Gamma$-Action increases indefinitely with $r_t$. However if the creation of $\Gamma$-Action by a past particle coincides with the range of past-present contact, the associated $\Gamma$-energy is not range-decimated (a case arising with a real past particle).
For certain purposes we are not interested in the invariant balance. We are interested instead in properties which in effect belong entirely to a present time viz., to the upper limit in Eq.(1). For example particles' rest mass, number of planck masses created by NVF at anytime, their energy density, temperature, mutual interaction etc. In that case the integration of Eq.(1) becomes redundant. Renaming its upper limit as 'now' I propose that the properties just listed are determined by \( \Gamma_{\text{now}} \) and \( M_{\text{now}} \), defined as follows

\[
- \Gamma_{\text{now}}/c^2 = \frac{1}{r} \frac{1}{2} \int (\int r'dr')/d(\text{now}) = 1; \quad (m)c^2 = -(m)\Gamma_{\text{now}} \quad \text{and} \quad M_{\text{now}}/r = 2M/r = 1. \quad (2)
\]

Verbally, rest energy of mass \( m \) is equal to \( m \) multiplied by \( pm \)-energy \(-\Gamma_{\text{now}} \). The product expresses their present time mutual interaction as opposed to the description of balanced expansion during epoch \( r \). The \( pm \)-energy \( \Gamma_{\text{now}} \) is twice as large as \( \Gamma \). It implies a modified Mach principle saying: "Rest energy \( mc^2 \) is due to a limiting present time attraction of mass \( m \) by the NVF-created \( pm \) cohesive energy \(-\Gamma_{\text{now}} = Gm_p/r_p \)." Incidentally \( \Gamma_{\text{now}} \) also obtains at an \( r = 1 \) discrete limit of the causal radius, viz., there is no singularity if we believe that space must generate planck fluctuations.

3 DARK ENERGY AND DARK MATTER; CRITICAL ENERGY DENSITY.

The \( rms \) resultant of Eq.(1) lumps together \( \bar{p} \) and \( \bar{\rho} \) excess fluctuations into \( p \) ones. In order to progress further we have to sort this resultant into two fractions. A \( \Theta_1 \) fraction results from asynchronous \( \pm \) fluctuation of single \( p \) and \( \rho \) in separate, of single \( \bar{p} \) and \( \bar{\rho} \) and leads to an excess of \( \bar{p}_\pm \), and in separate of (debit) \( \bar{\rho}_\pm \), denoted \( \bar{p}_\pm \). A \( \Theta_2 \) fraction results from synchronous joint \( + \) or joint \(- \) fluctuation of paired neighbor \( \bar{p} \) and \( \bar{\rho} \) and leads to an excess of paired + \( \bar{p} \) and + \( \bar{\rho} \), denoted \( \tilde{p}(\bar{p} + \bar{\rho}) \). We utilize a cubic Lattice Model whose space filling cubic sites are occupied each by either \( \bar{p} \) or \( \bar{\rho} \) with equal probability (signs undetermined). A priori each of the \( \bar{p}(\bar{\rho}) \) is 'single' with probability \( \Theta_1 \) or, it is 'paired' to an 'anti' neighbor with \( \Theta_2 (= 1 - \Theta_1) \). We estimate \( \Theta_1 \) with the help of a Gedanken simulation. We pick at random a \( \bar{p}_{\text{old}} \) and flip it over to \( \bar{p}_{\text{new}} \) (or vice versa). Before the flip \( \bar{p}_{\text{old}} \) was either 'single' or 'paired'. In the first case \( \bar{p}_{\text{new}} \) creates a pair if at least one of its six neighbors corresponds to a single \( \bar{p} \). The respective \( \text{mean-field} \) probabilities that one and that all single neighbors are \( \bar{p} \) is 0.5 and 0.5\( \Theta_1 \) respectively. Thus \( t_{1,2} = 1 - 0.5\Theta_1 \) is the transition probability that \( \bar{p}_{\text{new}} \) and its single neighbor which is \( \bar{p} \) are declared 'paired'. In the second case \( t_{2,1} = 0.5\Theta_1 \) is the transition probability that a \( \bar{p}_{\text{new}} \) which before the flip constituted a paired \( \bar{p}_{\text{old}} \), will not pair with any of its single neighbors because they all are \( \bar{p} \) (the old partner is so automatically), whereupon \( \bar{p}_{\text{new}} \) and its old partner are declared 'single'. Else there occurs a mere exchange of partners. Detailed balance is

\[
\Theta_2/\Theta_1 = t_{1,2}/t_{2,1} \quad \text{giving} \quad \Theta_2 \simeq 0.685 \quad (\Theta_1 + \Theta_2 = 1). \quad (3)
\]

The synchronous evolution of the \( \Theta_2 \) fraction breaks the \( \pm \) symmetry but conserves the particle antiparticle one. Its \( rms \) resultant consists of virtual particles and their anti- linked together in \( (\bar{p} - \bar{\rho})_\pm \) pairs. Hence their contribution to \( \Gamma \) is identical to that in Eq.(1), except that here it is limited to a \( \Theta_2 \) fraction of all fluctuations. The momentary lifetime of \( (\bar{p} - \bar{\rho})_\pm \) pairs precludes their correlation to cosmic structure. Hence we identify the \( \Theta_2 \) fraction with DE. Using previous symbols we write

\[
- \Theta_2\Gamma/\tau_2^2 = \frac{1}{2} (\bar{p}_\pm + \bar{\rho}_\pm)^4 \frac{d}{dx} = (1/2)(\bar{p} - \bar{\rho})_\pm \quad \text{giving} \quad M_{de}/r = \Theta_2/2. \quad (4)
\]

The asynchronous evolution of the \( \Theta_1 \) fraction is divided into hypothetical stages. The \( rms \) resultant of first stage which has been denoted \( \bar{p}_\pm || \bar{\rho}_\pm \), breaks the particle and anti- symmetry and consists of excess \( \bar{p}_\pm \) but also with an equal probability, of excess \( \bar{\rho}_\pm \) `debit' fluctuation. Interpreting the resultant as net gain of \( \bar{p}_\pm \)'s combined with an equally probable net loss of \( m_p \) masses whatever be their source, we view the combination as equivalent to \( \bar{p}_\pm \). The number of these variations is \( \Theta_1 \tau_2^2/2 \). We discard alternative results consisting either of \( \bar{p}_\pm || \bar{p}_\pm \), of \( \bar{\rho}_\pm || \bar{\rho}_\pm \) which would self-annihilate in our particle dominated universe letting NVF generate vast positive energy gratuitously. Our intermediate \( \bar{p}_\pm \) resultant has an approximately null rest mass and exerts null attraction. In the second stage the average \( (\tau_2^2/2)\bar{p}_\pm \) produces an \( rms \) \( (\tau_2/2)\bar{p}_\pm \) net positive but \( r \) times smaller mass. (The one half factor is not affected because one of the two averages should involve \( M_{\text{now}} \)). In the absence of minus variations and of antiparticles the resultant consists of real particles of planck mass. As we have pointed out after Eq.(1) the contribution of a real particle to \( pm \)-energy \( \Gamma \) lasts indefinitely hence in contrast to a virtual particle, is not subject to 'range-decimation'. Alternatively it is convenient to view each real particle as equivalent to a sequence of \( r \) 'Xerox copies' reproducing its mass \( r \) times over again one atop another, each copy of unit duration. In that case the second averaging does not decrease the number of particles by \( r \) but range-decimation does so instead. One way or another a
conversion of $r^2/2$ virtual into $r/2$ real $\bar{p}$ is costless, yielding an $r/2$ and an $1/2$ result for $M_{dm}$ and $\Gamma$ respectively. The extraordinary mass and presumably inertness of real planck particles suggests that they be identified with DM, which participates in cosmic structures. Using previous symbols we write

$$-\theta_1 \Gamma/c^2 = \langle(\bar{p}_x + \bar{p}_z)v^4\rangle_{asym} = \langle\bar{p}_x v^2\rangle/2 = (1/2)\bar{p}_{real}; \quad M_{dm}/r = \theta_1/2. \quad (5)$$

Jointly $M_{de}/r$ and $M_{dm}/r$ give $M/r = 1/2$ and a $\rho_p = (m_{pp}/2)(4\pi/3)^{-1}(rr)^{-3}$ joint mass energy density. Using $m_{pp}/r_p = c^2/G$, $c = r_p/t_p$, $(r_t)^{-1} = H$ (the Hubble coefficient) and the common notation $\Omega = \rho_p/c^2$, we find our $\rho_p$ equal to conventional critical density $\rho_c = 3H^2/8\pi G$. Thus

$$\rho_p = (m_{pp}/r_p)^2/(8\pi G)^3 = \rho_p(\text{always}) \quad \text{or} \quad \Omega_p = \Omega_{de} + \Omega_{dm} = 1. \quad (6)$$

Here $\Omega_{de} = \theta_2$, $\Omega_{dm} = \theta_1$ of Eq. (4). Interestingly critical density $\rho_c$ holds at all times and is simply equal to the density of planck particles $\rho_p$ constantly created by NVF. Constantly critical $\rho_p$ implies constant validity of the Friedmann equation describing Flat universe. This is consistent with our starting assumption of constant Flatness and uniform expansion. It should be stressed that here Dark Energy and Dark Matter constitute two facets of the mass energy constantly created by NQF whose joint uniform generation keeps $M/r$ hence $\Gamma$ constant. This contrasts the role usually attributed to DE namely that of a Universe-Expanding and Matter-Opposing dark energy. In view of our results a more fitting appellation doing justice to the common role and origin of DE and DM would respectively be Virtual and Real excess planck particles constantly created by NVF.

4 $\lambda$'s AND $q$'s ON SCALE $r^{1/3}$, IN $\kappa$-CLUSTERS ON SCALE $r^{1/2}$.

Once more in order to progress further we have to elaborate a previously simplified description. We still focus on the simpler case of DE consisting of virtual paired planck particles and antiparticles denoted jointly as $p_+$ like in Eq. (1). Later it will transpire that our conclusions to DM as well. Thus each $p_+$ has the planck unit rest mass, unit lifetime and prior to extinction emits a signal which inherits the $c^2(=GM_{pp}/r_p)$ unit cohesive $pm$-energy of the parental $m_p$ mass. During emission $pm$-energy and $pm$-Action coincide numerically. The following properties of signals have been attributed before to $q$'s and how to ensure contiguous connection of these lines (strings) in spacetime.
Low energy channel creating \(c^2 m_{\Phi}\) cohesive energy per each \(\lambda - q\) couple. An additional assumption becomes necessary: NVF generates \(s \times q\) particles in a stepwise manner. In that case the ‘lucky’ generation of \(q\)’s along the line of \(\lambda\)’s is explained as follows. A new generation is started by an initial \(\lambda\) having the \(c^2 pm\)-energy, which has been emitted by an ‘old’ generation at the point of vanishing. (As we shall see such immediate replacement is implied by contiguous connectedness). A first \(q\) is generated precisely in the path of the initial \(\lambda\) because the resultant \(\lambda - q\) couple creates a first section of a channel having a \(c^2 m_{\Phi}\) cohesive energy. The mass enables further propagation of the signal and a second \(\lambda\) continues the first. In this manner the growing channel enables the generation of a sequence of \(q\)’s, enabling the propagation of \(\lambda\)’s from one mass to another, enabling the channel to grow, etc. As we shall see a channel bifurcates occasionally forming a network of interconnected straight channels/branches randomly oriented with respect to each other. The network is named ‘\(k\)-Cluster’. In \(s\) steps the target summed mass \(sm_q = m_p\) is attained and the particular generation of \(s \times q\) ceases. A \(\lambda\) having the \(c^2 pm\) energy is re-emitted from the particular branch in which the target mass \(m_p = s \times m_q\) has been attained. This brings us back to a new beginning.

Contiguously connected \(k\)-clusters having \(s^{1/2}\) branches of length \(R_k = s^{1/2} r_q\) each. Let us denote the lifetime (generation-time) and radius of the \(k\)-cluster by \(t_k\) and \(R_k\) respectively. Since the \(\lambda\)’s propagate in straight line, \(R_k\) is equal to \(t_k\). The volume of a \(k\)-cluster and the volume per one excess \(p_+\) are \(R_k^3\) and \(R_{pp}^3\) respectively (to recall \(R_{pp} = \left(\frac{r^3}{r}\right)^{1/3} = s^2\)). One \(k\)-cluster is generated from one excess \(p_+\) and one excess \(p_+\) is created in the \(R_{pp}^3\) volume during unit present time. However the generation of each \(k\)-cluster requires \(t_k\) units of time which define the time scale relevant to what follows. During this ‘extended present time’, \(t_k\) excess \(p_+\) and therefore \(t_k\)-clusters and \(t_k \times R_k^3\) volumes, are generated inside the \(R_{pp}^3\) volume, getting us a third bird. Let \(\Phi_{k,pp}\) denote the volume fraction of \(k\)-clusters in the \(R_{pp}^3\) volume. Focal assumption is that the \(t_k \times R_k^3\) volumes fill the \(R_{pp}^3\) and ipso facto the entire \(r^3\) causal volume contiguously, leaving no Voids. Inter-cluster voids would imply never observed large scale fluctuation of \(\Gamma\) and (in terms of the modified Mach principle), of rest mass of matter. I therefore require \(\Phi_{k,pp} = t_k R_k^3 / R_{pp}^3 = 1\) which gives \(R_k = s^{3/2}\). This implies that typical length of the straight-line branches is also on the order of \(s^{3/2}\) (or less if many sequential branches add up to \(R_k\); however subsequently a ‘Growth model’ supports branch length=\(s^{3/2}\)). It consists of \(q\) particles of length \(r_q = s\). Therefore one branch/channel constitutes a linear sequence of \(R_k/r_q\) viz., of \(s^{3/2}\) \(q\)-particles. However a \(k\)-cluster is generated from one \(m_p\) mass, viz, it consists of \(s \times q\)-particles. We conclude that the cluster (on the average) constitutes a \(d3\) network of \(s^{1/2} \times R_k\)-branches, consisting of \(s^{1/2}\) \(q\)-particles each. We note further that our result that the \(R_k^3\) volumes fill the \(R_{pp}^3\) volume without voids, implies an equality of their respective mass energy densities. Since the density inside the \(R_{pp}^3\) volume is equal to twice the critical density (Eq.6), we get \(\rho_k = \rho_{pp} = 2\rho_c\). Summarizing,

\[
R_k = s^{1/2} r_q = s^{3/2} \quad \text{giving network} = s^{1/2} \times (R_k \text{ - branches}) \quad \rho_k = \rho_{pp} = 2\rho_c. \quad (7)
\]

How to interpret the structure of the network and especially why should we have bifurcation. Another problem arises in connection to our no-voids result, whose derivation is based on the ‘extended present time’ \(t_k = s^{1/2} r_q\). Since the lifetime of a \(q\) particle lasts only one \(r_q\), our derivation mixes vanished-past and existing-now \(q\)’s. That of course is perfectly valid when dealing with a causal effect of past signals upon present time particles. However Eq.7 describes a present time ‘no-voids’ behavior of \(k\)-clusters and nonetheless a branch of length \(R_k = s^{1/2} r_q\) consists of \(s^{1/2} - 1\) past \(q\) particles and only a single existing one. I offer the following reply. In order to decide presence or absence of a rapidly generated-annihilated \(k\)-cluster inside an \(R_k^3\) volume, our experiment has to be equal to the generation time \(t_k\). We realize that our ‘extended present time’ does not represent an ad hoc assumption (that gets us the third bird) but a restriction in the spirit of the Uncertainty principle.

Termination-bifurcation growth In order to explain the bifurcation and network formation I assume that starting from an origin the \(k\)-cluster ‘Grows’ in connected time steps. The steps do not grow in a single linear sequence but constitute instead a ‘tree’ of simultaneously growing sequences of steps or ‘branches’ each of which represents a channel. At a time \(t\) we have a set of still growing branches. Each of them may continue to grow linearly, or terminate or bifurcate, increasing the number of \(q\)-particles viz. \(s^t\), by one, zero or two respectively. The varying outcomes I attribute to random fluctuation of the \(q\)-generating process. The linear increase by one merely gives a constant factor and may be ignored. Termination and bifurcation must have precisely equal probability such that non-exponential growth may continue indefinitely. Despite this precise equality, fluctuation occurs and (in the fashion of a random walk) an \(rms\) resultant causes net bifurcation. Termination at branch’s end implies that it ceases to grow permanently; if all branches terminate growth of chain stops. Bifurcation implies that
two concurrently existing q’s added at branch’s end encounter the excluded volume restriction. Hence I assume that the branch/sequence of steps bifurcates, one channel continues its straight line and the other veers off in a random direction and subsequently continues a new straight line. The subject has been studied in connection to the correspondence of the percolating cluster to branched polymer; our case corresponds to a “T” (termination limited) Growth Model of clusters and of polymers\(^7\), with the following adaptations to our \(\kappa\)-cluster: Both the number and length \(r_q\) of each step are equal to \(s\); there is no excluded volume (except between the concurrently existing neighbor q’s that cause bifurcation) and our channels grow in straight line. Thus adapted T-Growth is equivalent in mean field approximation, to a cluster consisting on the average of \(s^{1/2}\) branches of length \(r_q s^{1/2}\) each. However the product of instant \(s^{1/2}\) and \(s^{1/2}\) values must reproduces the \(s m_q = m_p\) mass precisely. We have seen that what counts in the context of balanced expansion is the generation of the \(c^2 m_p\) cohesive energy in each \(\kappa\)-cluster in separate. The causal sphere constitutes therefore an extensive system of \(\kappa\)-clusters (Eq\(^7\)). Finally due to their contiguous connection, an \(c^2\) signal emitted by a vanishing \(\kappa\) cluster is immediately intercepted by a newborn \(q\) particle, initiating the growth of a new \(\kappa\) cluster.

5 CREATION OF NUCLEONS AND RADIATION AT \(0.12\text{Gyr}\) on \(r^{1/3}\) and \(r^{1/2}\) SCALES.

Brief preview: Let me propose the following description of an instantaneous transition which had occurred at a surprisingly recent radius time \(r_s = 0.7 \times 10^{59} \sim 0.12\text{Gyr}\). All \((\bar{q} \sim q)\) pairs of which consists DE converted on the \(s\), scale in equivalent parts as follows: the \(\bar{q}+\) into nucleons \((n)\) and the \(q+\) into high energy \(\gamma\) photons. The energy of each nucleon and each photon corresponded to \(c^2 m_p/s \sim 9\text{GeV}\). The transition occurred in all \(\theta q\) clusters, whose growth had started precisely at time \(r_s\), terminated at \(r_s + k_2(0.12\text{Gyr} + 0.12\text{Gyr} + 10^{-14}s)\) and which kept their \(s\) constant. Thermal equilibrium and Baryogenesis obtained inside \(\kappa\)-clusters which constituted disjoint islands isolated from each other, at an energy density of nucleons and photons of about \(c^2 m_p/s, 9/2 \sim 7\text{MeV}\), larger than critical by \(2 r_s^{1/2}\). Subsequent very rapid 'global' dispersion of the \(\kappa\)-clusters over the causal sphere turned the \(\gamma\) photons into starting CMB and the \(n\)'s into starting mix of nucleons ('cosmic baryons'). Their respective fractions on global scale were \(\Omega_{\kappa, cmb} = \Omega_{\kappa, s} = \theta_s\) (at the expense of \(\Omega_{\gamma, s}\)). The photons decoupled from matter and attained equilibrium at a 'warmish' \(T_{s, cmb} = 326K\). From \(\simeq r_s\) and until now CMB redshifted due to cosmic expansion by \(r_0/r_s \simeq 115, \sim 2.83K\), versus accepted 2.73K (fair agreement considering that it is derived from the proton mass and Hubble’s \(H_0\) alone). The evolution of nucleons was more complex. Since their creation had ceased while that of DE and DM continued as usual, to a first approximation \(\Omega_{\kappa}\) too decreases by \(r_0/r_s\). However the absence of continuing creation promotes the clustering of \(n\)'s. I therefore propose a model of a Global nucleonic cluster which constitutes a self similar copy of the \(\kappa\)-cluster, scaled-up from radius \(r_\kappa\) to \(r\). The cluster's \(\Omega_{\kappa}\) decreases more slowly than predicted by first approximation namely only by \((r_0/r_s)^{2/3}\). The model fits today's \(\Omega_{\kappa, 0}\) and also seems to explain the extraordinary dimming of far away Super Novae. The latter is commonly attributed to Accelerated Expansion but here it is attributed to nucleonic clustering.

In detail: According to Eq. \(4\) but in terms of \(q\)'s, each DE cluster consists half by half of virtual \(\bar{q}+\) and \(q+\). The separation distance between these particles (irrespective of their type) is \(s\) and is bridged contiguously by the wavelength \(\lambda = s\). However in the context of their conversion into nucleons, the \(\bar{q}+\) skipping over \(q+\) became interconnected by twice longer wavelength \(\lambda_{2q} = 2s\), which bridged the distance between second-nearest neighbors of the same type. Specifically a newly created real \(n\) particle emitted a \(\lambda_{2q}\) which formed the low energy channel favoring the conversion of its second-nearest neighbor from \(\bar{q}+\) to \(n\). The channel could not link the new \(n\) to a \(\bar{q}+\) because that would result in gratuitous energy being released by annihilation. Each \(\lambda_{2q}\) of \(\bar{q}+\) couple generated one \(n\). The associated energy was \(e_{2q} = 2 \pi c^2 m_p/m_\gamma\) (substituting \(\gamma c^2 m_p\)). At the point of transition, \(e_{2q}\) was precisely equal to a nucleon's rest energy \(c^2 m_n\) giving

\[
    r_s \equiv s_n^3 = (\pi m_p/m_n)^3 = 0.069 \times 10^{60} (\approx 0.12 \text{Gyr}/t_p \text{ or } z \sim 114).
\]  

(8)

In parallel, each deserted \(q+\) antiparticle attained by a \(\lambda\) converted into a (real) high energy \(\gamma\) photon. No \(\lambda_{2q}\) was involved because no causal contact with past particles was needed. The creation of an \(n\) with the help of twice as long \(\lambda_{2q}\) involved an energy one half as large as the energy involved in the creation of a \(\gamma\). The half as large energy per step implies that twice as many, twice as long steps were required in order to create nucleons whose total rest energy was equal to that of \(\gamma\) photons. I conjecture that this disparity led to a 'kernel' cluster of \(\gamma\) and of some \(n\)'s surrounded by a 'halo' cluster consisting of remnant \(n\)'s alone. Let us denote the radii of the kernel and the halo clusters by \(R_{n, kern}\) and \(R_{n, halo}\) respectively. Clearly \(R_{n, kern} = R_\kappa\) because both were created with the help of the \(\lambda\) steps. The
conversion at \( r_s \) was creating the \( \gamma \)'s 2\(^{3/2} \) times faster than the \( n \)'s. After time \( t_{p, k, kern}(=R_{p, k, kern}) \) it had completed the creation of the kernel cluster comprising all \( \gamma \) and only a fraction of \( n \). Thereafter the creation of \( n \)'s continued till time \( t_{n, halo} = 2^{3/2} t_{p, k, kern} \) creating a 'halo' cluster of remnant \( n \)'s, initially devoid of \( \gamma \) photons and having radius 2\(^{3/2} \) larger than the kernel cluster. The corresponding mass energy densities were \( \rho_{n, halo} = 2^{-3(3/2)} \rho_{p, k, kern} \), where \( x \) will be determined at once. Let us compare both to a contemporary density of unconverted \( \kappa \)-clusters of Eq. (7). To recall the number of \( \kappa \)-clusters in the \( R_{p, p}^3 \) volume is \( t_q \) and they fill the \( R_{p, p}^3 \) volume continguously. However at anytime they contain only \( s^{1/2} \) existing ‘now’ \( q \)-particles, the rest belongs to vanished ‘past’ \( q \)-particles. Momentarily let us ignore the \( 2\pi \) and \( \theta_2 \) factors and the relatively minor disparity between the \( \eta \cdot k, kern \) and the \( n, halo \) clusters became disjoint. Auxiliary conclusion: \( x = 3 \). Thereafter the \( n, halo \) and the \( \eta \cdot k, kern \) had rapidly spread over the \( R_{p, p}^3 \) volume (hence over entire causal sphere and practically still at time \( r_s \)), their density dropped to \( \rho_{n, q, pp} = (\theta_2/2)\rho_\kappa = \theta_2 \rho_{c, s} \). (The \( \theta_2/2 \) factor is due to equal sharing between \( n \) and \( \gamma \). I surmise that the \( 2\pi \) factor drops out upon averaging the \( \psi_2 \) energy of \( \gamma_2 \) wavelengths (Eq. 8), over the \( \kappa \) cluster). We get

\[
R_{p, p, kern} = 2^{-3/2} R_{n, halo} = R_\kappa; \quad \rho_{p, k, kern} = 2^{9/2} \rho_{n, halo} = 2^{1/2} \rho_{c, s} \quad \text{and} \quad \rho_{n, q, pp} = \theta_2 \rho_{c, s}.
\] (9)

Following the transition and Baryogenesis inside disjoint \( \kappa, n \) clusters, the latter were cooling due to escape of photons and global dispersion over entire causal sphere. The effect of this global dispersion corresponds in Eq. (3) to the passage from \( \rho_{p, k, kern} = 2 r_s^{1/2} \rho_{c, s} \) to \( \rho_{n, q, pp} \simeq \theta_2 \rho_{c, s} \), giving an immediate estimate of a decrease of temperature by \( s^{3/8} \). More explicitly \( \Omega_{n, n} = \Omega_{n, \gamma} = \theta_2 \). Radiation Law combined with \( \rho_{c, s} = 1.3 \times 10^{-25} \text{ g cm}^{-3} \) (Eq. 9 and 8), gives the CMB starting temperature \( T_{c, cmb} = 326 K \). Thereafter the evolutions of nucleons and of CMB diverge. Let us define \( \alpha = r/r_s \). While \( \alpha \) increased from one to today's \( \alpha_0 \), CMB photons redshifted in uniformly expanding space, giving \( T_0 = T_{c, cmb}/\alpha_0 \). Hubble’s \( h_0 = 0.72 \) gives \( \alpha_0 = 115 \). Thus at \( r \simeq r_s \) and at \( r_0 \) we have

\[
\Omega_{s, cmb} = \Omega_{s, n} = \theta_2; \quad T_{c, cmb} = 326 K \quad \text{and} \quad T_{0, cmb} = T_{c, cmb}/\alpha_0 = 2.83 K.
\] (10)

Nucleonic evolution at \( 1 < \alpha < \alpha_0 \). The transition created within the causal sphere a total of \( r_s s_s = s_s^4 \) nucleons of mass \( m_s \) each, a total conserved at all \( \alpha \) (with neglect of creation of higher atomic masses, luminous matter and temporarily of \( \theta_2 \), and of 2\(^{9/2} \)). I stipulate that after dispersion of nucleons on the global \( r_s \) scale they formed a Global nucleonic (\( Gn \))-Cluster. Its structure is determined by that at all \( \alpha \geq 1 \), the distance separating neighbor nucleons was and to this day is equal to the current value of \( \lambda = r_s = s \) separating \( q \) neighbors in a \( \kappa \)-cluster (Eq. 7). This enables the \( c^2 \) pm-energy to propagate in a \( Gn \)-cluster like everywhere else in space, with the help of \( \lambda \)'s in the low energy channels. As we shall see this equivalence of the \( n-n \) and \( q-q \) distances implies that the \( Gn \) cluster expands slower than expanding space. Consequently the low energy generated by the \( Gn \) has to be devoted to 'internal needs', namely to opposing the pull of expanding space trying to stretch the \( Gn \) structure. It therefore seems to me that although nucleonic matter raises total \( \Omega \) above one, its extra cohesive energy is devoted to aforesaid internal needs and does not perturb uniform expansion of space. I also assume that at creation time (\( \alpha = 1 \)) the \( Gn \) cluster consisted of \( s_s^2 \) straight branches, of radius \( R_{s, Gn} = s_s^2 \lambda_\alpha = r_s \) each. The assumption amounts to mere scaling-up of the 'TB' Model[7] of a \( \kappa \)-cluster to the \( Gn \)-cluster: The former consists of \( s \) particles distributed into \( s^{1/2} \) branches of radius \( s^{1/2} \lambda_\alpha \) each. The latter consists of \( s_s^2 \) particles distributed into \( s_s^2 \) branches of radius \( s^2 \lambda_\alpha \) each. Thereafter while the causal radius expands by \( \alpha \), the network structure is essentially conserved. The only variation is a stretching of the \( \lambda \) component of \( R_{s, Gn} \) which (as has been stipulated) expands from \( \lambda_\alpha = s_s \) to \( \lambda_\alpha = \alpha^{1/3} s_s \). Consequently \( R_{\alpha, Gn} = \alpha^{4/3} R_{s, Gn} = \alpha^{1/3} r_s \). The \( Gn \) cluster network of channels contracts and glides effortlessly inside expanding causal sphere, because the cohesive energy of channels is entirely devoted to opposing the restricted expansion of its own radius beyond the allowed \( R_{q, Gn} = \alpha^{1/3} R_{s, Gn} \) increase. At \( \alpha = 1 \), \( \Omega_{s, n} \) is critical (see Eq. (10) with neglect of \( \theta_2 \)), implying \( \Omega_{s, n} \propto R_{s, Gn}^{-2} \) (Eq. 8). Hence \( \Omega_{s, n} \) decreases due to the expansion of \( R_{s, Gn}^{-2} \) as \( \alpha^{-2/3} \). The result refers
to conditional $\Omega_{a,n}$ (or radius $R_{a,Gn}$), stipulating that both the event and the observer belong to the $Gn$ cluster. If one of them belongs to a ‘void’, the corresponding value will tend to the global average $(\Omega_{a,n})_{glob} \propto \alpha^{-1}$. This may be quantified by measurements of the distance from us to an Event’, where both ‘us’ and the event belong to the $Gn$ cluster. Suppose two distances $R_0$ and $R$ are measures at two respective times $t_0$ and $t$. The $R_0 - R$ difference and the $a_0 - \alpha$ one are determined respectively by the expansion of the $Gn$ cluster $\propto \alpha^{1/3}$ and of the causal sphere $\propto \alpha$. We get $(R_0 - R)/(a_0 - \alpha)$ equal to $(\alpha/a_0)^{2/3}$ and the latter is equal to $[(t_0 - \ell/c)/t_0]^{2/3} = (1 - \ell/\ell_H)^{2/3}$ where $\ell$ is the ‘light’-distance corresponding to $a_0 - \alpha$ and $\ell_H$ is the ‘Hubble-length’ (viz. the causal radius). In summary

$$\frac{R_{a,Gn}}{r} = \alpha^{-2/3}; \quad (\Omega_{a,n})_{Gn} = a_0^{-2/3} = 0.042; \quad \frac{(R_0 - R)_{Gn}}{a_0 - \alpha} = (1 - \ell/\ell_H)^{2/3}. \quad (11)$$

Substituting $\Omega_{a,n} = \theta_2$ we get $\Omega_{0,n} = 0.029$, lower than, but not excluded by most data[1]. In contrast the first approximation gives $\Omega_{0,n} = 0.006$ which definitely seems too low, except when referring to a global average density. It should also be stressed that Eq.(11) describes the decrease of $\Omega_{0,n}$ with time $a_0$; it does not describe nucleon concentration during baryogenesis. A decrease of $\Omega_{a,n}$ with $\alpha$ is inherent to our model of constant creation of DE and DM as opposed to the singular joint creation of nucleons and of CMB. However its precise form given in Eq.(11) involves a conjectured existence of the $Gn$ cluster. The ratio $R_{Gn}/r = \alpha^{-2/3} = 0.042$ combined with experimental $r \approx 4100Mpc$ puts the radius of a ‘supreme’ cluster at $R_{Gn} = 170Mpc$, judged to be in fair agreement with a reported $R_{supr} \approx 100Mpc$. The result strongly suggests that our causal sphere contains huge voids which are indeed observed. The fractal structure of the $Gn$ cluster proposed here may be examined with the help of data on inter-galactic distances in clusters and super-clusters of galaxies. (Famous ‘box’ algorithm seems not suited for the purpose, an algorithm tailored for that seems to be ‘growth of clusters’[8]).

6 BARYOGENESIS; DECELERATION; DIRAC NUMBERS; CONCLUSIONS.

**Baryogenesis in $k$-clusters.** Baryogenesis occurred in the $\psi_n$, kern cluster right after its creation at $r_n$. First using $\rho_{\psi_n}$ of Eq.(9) and the radiation law gives $T_{\psi_n} = 0.69MeV$ which matches very well the value associated with the BB baryogenesis (BBN) namely $T_{bbn} = 0.7MeV$[1]. Second, using $\rho_{n,halo}$ and $\rho_{\psi_n}$ of Eq.(9) we find that a ‘nucleon concentration’ defined as the ratio of the two energy densities equals $2^{-9/2} = 0.044$. This concentration lies within bounds derived from the abundance of light elements[1]. We have used the ratio of $\rho_{n,halo}$ to $\rho_{\psi_n}$ because in our model the former has determined the concentration of nucleons and the latter has determined the $T_{\psi_n}$ temperature that existed during baryogenesis. The same result obtains if we base the comparison on a ‘critical density’ invoked in the literature[1] of an ‘BB-equivalent’ causal sphere having a radius we denote $r_{\psi eq}$ as follows. Our model of baryogenesis had occurred in a cluster of radius $R_{\psi,n, kern}$ of Eq.(9), enclosing one $m_p$ mass. A corresponding radius enclosing $m_p$ masses would be enclosed by $R_{\psi,n, kern}^{3/2}$. Hence we expect $r_{\psi eq} = R_{\psi,n, kern}^{3/2}$. Critical energy density is inversely proportional to radius squared (Eq.10), hence $\rho_{c,\psi eq} \propto r_{\psi eq}^{-2} \propto R_{\psi,n, kern}^{-1}$. Giving again the $2^{-9/2}$ neutron fraction but more in the manner of BBN. Third, the BB-equivalent radius $r_{\psi eq}$ also gives $t_{\psi eq} = 5x$ approximating $t_{bbn} \approx 100sec$[1]. The three similarities give rise to hope that a description based on our model will agree with well established parameters of baryogenesis.

**(pseudo)‘Acceleration’=decelerated expansion of the $Gn$ cluster** In Eq.(11) we have described how the recession of a pair of nucleon ‘particles’ from each other (be it intergalactic dust, or ‘us’ and a SNe 1a) is decelerated due to that both belong to the $Gn$ cluster. The deceleration affects the recession as measured by the redshift $z$ of the flash of light reaching from an SNe 1a but not the spacetime ‘luminosity distance’ $\ell$ travelled by this flash with speed $c$ (measured for example by the decrease of apparent brightness). We identify the redshift-measured distance $z$ and the luminosity-measured distance $\ell$ respectively with $R_0 - R$ and with $a_0 - \alpha$ of Eq.(11) and get

$$z/\ell = (1 - \ell/\ell_H)^{2/3}, \quad z, \ell \text{ and } \ell_H = \text{ redshift, luminosity and Hubble distances}. \quad (12)$$

In the range of all available data the result resembles $\ell/\ell \approx 1 + z$. It seems to me that the great scatter of data testifies to the fact that certain SNe 1a are separated from us by a substantial void(s). Possibly the scatter reveals an anisotropy which may enable us to sort the network of our super cluster of nucleonic matter from self similar voids on all scales.

**Dirac numbers related to inter-planck distance.** An enigma considered by Dirac[4] is that seemingly unrelated dimensionless numbers are on the same large order of $\approx 10^{40}$. I claim that Dirac numbers represent the $s^2 \approx 10^{40}$ reduced distance between excess planck particles created at present
or more precisely during recent proton-creating transition. The numbers are derived from ratios involving \( r_0 \approx 8.8 \times 10^{19} \), \( s_\pi / \pi (= m_p / m_n) \approx 1.3 \times 10^{19} \) (Eq. (8) and \( s^2 \)). On this basis the following numbers are reproduced precisely: Ratio of electrostatic and gravitational interaction of proton-electron pair \( N_1 \equiv e^2 / Gm_pm_n \) becomes \( N_1 = (1800/137)(s_\pi / \pi)^2 \). Ratio of the proton Compton and Schwarzschild radii \( N_2 \equiv (l_c / m_p c^2) (Gm_p / c^2)^{-1} \) becomes \( N_2 = (s_\pi / \pi)^2 \). Ratio of \( r_0 \) to classic electron radius \( N_3 \equiv r_0 (e^2 / m_e c^2)^{-1} \) becomes \( N_3 = (137/1800) r_0 / (s_\pi / \pi) \). Present time number of protons whose density is taken to be \( N_4 = (4\pi r_0^3 / 3m_n) \rho_{0,c} \) becomes \( N_4 = r_0 / (s_\pi / 2\pi) \).

**General remark.** Admittedly a shortcoming of the present model is an absence of unified mathematical formulation. Still many of its aspects are more amenable to study with the help of simulation, like the shape of the \( \kappa, n \) and especially of the \( Gm \) cluster. Another remark is that possibly right from start the model should be formulated systematically in terms of fluctuations. One well known outcome of fluctuation is to bring about critical behavior: viz., oppositely acting and equally probable fluctuations generate a vastly smaller but non-vanishing resultant. Here \( r^4 \) fluctuations which with equal probability either add or subtract, either planck particles or antiparticles generate for example \( r = \left( (r^4)^{1/2} \right)^{1/2} \) real planck particles. However a different but equally important role of fluctuation combined with Uncertainty is to bring into causal contact particles which appear to be isolated from each other without invoking Action at Distance. A case in point is the set of \( r \) excess \( p_+ \) separated by the seemingly insmountable distance \( s^2 = (r^3 / r)^{1/3} \). Assistant conditions are needed. First, assumedly each \( m_p \) mass may be generated not at one go but instead ‘Grow’ in a sequence of steps producing each a subunit virtual \( q \) particle. The particles are \( s \) times lighter hence more numerous but also (by Uncertainty) \( s \) times larger. This already enables to link the excess \( p_+ \)’s with the help of straight lines (strings) consisting of a sequence of \( q \) enabling a creation/propagation of the cohesive energy that balances the expansion. However the straight lines leave out vast voids unconnected. A model of a branching-out chain describing Percolation helps us to devise a model of a cluster of \( q \) particles which fills space contiguously. In conclusion, randomness, fluctuation, clusters and probability seem intimately linked to spacetime.

**Tests of the Model:** Fundamental tests are uniform expansion, constantly created critical mass energy density \( \Omega = 1 \) and generation of Dark Matter and Dark Energy, constantly obeying \( \Omega_{dm} \approx 0.3 \) and \( \Omega_{de} \approx 0.7 \). Passing these tests is mandatory but somewhat inconclusive because they fit well known results and as such are not really predictive. However our model of nucleonic matter bound together into a Global Cluster on the scale of the causal radius does predict that \( \Omega_n \) should decrease with time as in Eq. (11); it also predicts that the amazing Acceleration is actually attributable to the Global Cluster of nucleons, as described by Eq. (12) and as such provides information not on cosmic expansion but on the structure of (inevitably declining) nucleonic fraction; supportive in this context is our estimate of the radius of the largest galactic super-cluster and explanation of great voids; another prediction is that the well documented BBN theory may be rewritten in terms of our model of a baryogenesis which had occurred on the \( r^{1/2} \) scale of \( \kappa \)-clusters as late as at 0.1 Gyr. Passing these tests would be supportive however in separate they are not mandatory because each requires an extra assumption (except for mandatory but qualitative prediction that \( \Omega_n \) was much larger in the past).

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