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Inflationary Origin of Matter-Antimatter Asymmetry in Semiclosed Friedman Universe

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I. Introduction

In 2014 the CERN high energy proton-proton collision experiment detected the Higgs boson with mass m_H of about 100 proton mass:

$$m_H \sim 10^2 m_P \sim 10^{-17} m_{pl}, \quad (1)$$

where $m_{pl} \sim 10^{-0.5}$g is the Planck mass. Being a scalar the Higgs boson has no electric and color charge. It has its own antiparticle and CP-symmetry.

The cosmological implication of the graviton-Higgs boson composite was discussed[1] in curved spacetime as it may generate huge complogical constant Λ in negative sense, while its anti-boson composite may flatten the curve in positive sence.

II. Planckeon Origin of Dark Energy

In 1963 paper: Semiclosed Worlds in the General Thory of Relativity Zel'dovich[1] wrote: "A class of Friedman solutions of general relativity equation is found in which, as we approach the matter from infinity, we reach a singularity at the graviational radius. But beyond this point the metric is continued in an unusual way—the radius decreases again and goes to zero only after passing through a maximum" (Novikov's similar work[2] noted in proof). Andreev, Stanyukovich and others[3,4] found related solutions showing the possible existence of a gravitationary closed point particle with Planck mass m_{pl} and radius l_{pl} moving with light vlocity which they called maximon or Planckeon. These particles can emit radiation only if they collide with massive object, but the radiation is unobservable by the Doppler effect.

We here propose a gravitationally bound Planckeon-Higgs boson composite[10,11]creating negative attractive potential and positive rest mass energy:

$$-Gm_H m_{pl}/l_{pl} = -G(m_H/m_{pl})m_{pl}^2/l_{pl}$$
$$= -10^{-17} Gm_{pl}^2/l_{pl} < 0, \quad (2)$$
$$10^{-17} m_{pl}c^2 = 10^{-17}(\hbar c/l_{pl})$$
$$\sim 10^{15}\kappa T > 0, \quad (3)$$

filling the evolutionarilly earlier upper hemisphere as dark energy and evolutionarilly later hemisphere as dark matter of the closcd Friedman universe. On the equator separating the two hemispheres we have

$$10^{-17}(m_{pl}c^2 - Gm_{pl}^2/l_{pl}) = 0, \quad (4)$$

where the rest mass energy is absorbed by the attractive potential.

III. H⁰Boson and Friedman Universe

We extend the Friedman metric to Lorentz-Friedman-Reissner-Nordström form:

$$ds^2 = c^2 g_{tt} dt^2 - g_{rr} dr^2,$$
$$g_{tt} = g_{rr}^{-1} = 1 - r^2/r_g^2 + L_\theta^2 l_{pl}^2/r^2, \quad (5)$$

Here $r_g = 2GM/c^2$ is the gravitational radius of the universe having Newtonian mass M and radius $R \geq r_g$, and

$$L_\theta = \hbar l_\theta/2\pi, \; l_\theta = \text{integer}. \quad (6)$$

is the quantized angular momentum.

The evolutionary history of the Lorentz-Friedman black hole is containd in the integral

$$l_{pl} = \int^R g_{rr} dr$$
$$= \int^R dr(1 - r^2/r_g^2 + L_\theta^2 l_{pl}^2/r^2)^{-1}. \quad (7)$$

giving the unitary and holographic information content (entropy)[5] of the black hole acquired by an observer approaching the matter distribution through empty space from infinity:

$$(R/l_{pl})^2 = (10^{28}/10^{-33})^2 = 10^{120}. \quad (8)$$

IV. Superluminal Inflation and Subluminal Evolution

The light velocity is obtained by solving $ds^2 = 0$ as:

$$dr/dt = c(g_{tt}/g_{rr}) = c\,(1 - r^2/r_g^2 + L_\theta^2 l_{pl}^2/r^2)$$
$$> c \text{ at } r \sim l_{pl} \text{ and } r \sim r_g - l_{pl}$$
$$= c \text{ at } r = r_C = (r_g/l_{pl})^{1/2}$$
$$= c \text{ in between } r_C < r < r_C = c \text{ and } r \sim r_g - l_{pl} \quad (9)$$

Eqs.(9) show that, starting from quantum fluctuations of preexisting metric for $0 < r < l_{pl}$, the light

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velocity is superluminal at $r \sim l_{pl}$ and $r_g - l_{pl}$. After Big Bang at temperature $T_B = 10^{27}$K, dr/dt decreases with the increse of r towards $r = r_C = (r_g/l_{pl})^{1/2} = L_\theta^2 10^{-2}$cm for $r_g = R = 10^{28}$cm.

During the superluminal and inflationary epoch of electroweak and grand unification of gauge fields by Higgs mechanism, a causaly related small region extends from $r \sim 10^{-25}$cm to $r \sim 10$cm, followed by a brief interlude of reheeting, returning to the pre-inflatioonary temperature of the universe. Further evolution is described by standard Friedman universe starting the radiation dominated phase of Hubble's evolutional history expanding with subluminal velocity. Hubble contant H relates the the velocity v of a massive extragalactic object to its distance d from the Earth:

$$H = v/d \tag{10}$$

The COBE astronomical observations of the large-scale homogeneity of the distribution of matter and galaxy formation on the scale of 10^{10}cm light years can be explained by the superluminal and bi-directional EPR causal connection between radius $r = l_{pl}$ and $r = r_C$, while stars, clusters of galaxies, voids and other structures larger than 10^8 light years seem to indicate the angular momentum (5) $l_\theta \sim 10^3$ so that $r_C = l_\theta 10^{-2} \sim 10$cm, the high l_θ value indicating the multi-directional inflation.

V. Inflation as Ultraviolet Anomaly

The Klein-Gordon amplitude of transition (propagator) $D(s^2)$ for the Higgs boson between two points separated by a 4-dimensional squared distance $s^2 = (ct)^2 - r^2$, is given by[6]

$$D(s^2) = -\delta(s^2)/4\pi + (\lambda/4\pi s)H_1^{(2)}(s/\lambda), \tag{11}$$

where $H_1^{(2)}$ is the Hankel functuion of the second kind and $\lambda = \hbar/mc$ is the particle wavelength. We find:

$$D(s^2) \sim \delta(s^2) \text{ on the light cone } ds^2 = 0, \tag{12}$$

$$\sim (1/s^{3/2}) \exp(-is/\lambda) \text{ within the light cone } ds^2 > 0, \tag{13}$$

$$\sim (1/|s|^{3/2}) \exp(\pm|s|/\lambda) \text{ outside the light cone } ds^2 < 0, \tag{14}$$

The $\pm$ sign in eq.(14) allows the ultraviolet anomaly of the Higgs boson:

$$(1/|s|^{3/2})\exp(|s|/\lambda) \rightarrow \exp(l_{pl}/\lambda)/l_{pl}^{3/2} \rightarrow 1/l_{pl}^{3/2}, \tag{15}$$

to be copmpared to De-Sitter solution of general relativity equation:

$$r(t) \sim \exp(\pm\sqrt{\Lambda}ct) \rightarrow \exp(ct/l_{pl}), \tag{16}$$

where $\Lambda = 1/l_{pl}^2$.

VI. Higgs Boson in Gravitational Field

The PC and T symmetric Klein-Gordon equation

$$[\partial^2/\partial^2/(ct)^2 - \partial^2/\partial^2 r^2 + (\hbar/mc)^2]\psi = 0 \tag{17}$$

obeyed by the Higgs boson wave function $\psi(r, t)$ can be decomposed into two-component Dirac form:

$$(\partial/\partial/ct - \partial/\partial r + \hbar/mc)\psi_+ = 0,$$

$$(\partial/\partial/ct + \partial/\partial r + \hbar/mc)\psi_- = 0, \tag{18}$$

where $\psi_\pm$ represent the positive and negative energy states of the Higgs boson going forward and backward in time.

During the inflation, starting at $r = l_{pl}$ and ending at $r = r_C$, the light velocities $(dr/dt)_\pm$ are given by

$$\begin{aligned}(dr/dt)_+ &= c[(1 - r/r_g + L_\theta l_{pl}/r],\\ &> c \text{ at } r = l_{pl}\\ &= c \text{ for } r = r_C = (L_\theta l_{pl} r_g)^{1/2}\end{aligned} \tag{19}$$

and

$$\begin{aligned}(dr/dt)_- &= c[(1 + r/r_g + L_\theta l_{pl}/r]\\ &> c \text{ at } r = r_g - l_{pl}\\ &= c \text{ for } r = r_C = (L_\theta l_{pl} r_g)^{1/2}.\end{aligned} \tag{20}$$

The CERN high energy proton-proton collision experiment creating H^0 boson, immediately decaying into a counter-propagating pair of photons, seems to tell the preference of H^0 boson, going forward in time, to its antiboson, going backard in time, by the present universe expanding forward in time.

VII. Matter-Antimatter Asymmetry

Matter-antimatter symmetry required by quantum theory and relativity is largely violated in cosmic scale outside high energy laboratory experiments. As there were equal amount of gauge matter and antimatter, immediately after the moment of the hot Big Bang at $r = r_C$, we here propose to consider that the probability of collision between H^0 boson and the gauge matter, comoving forward in time, dominates over the collision between H^0 boson and antimatter, counter-propagating backward in time during inflation expanding forward in time.

VIII. Cosmological Double-Slit Experiment

In his positron theory Feynman[6] extended Jordan-Paulil propagator

$$\begin{aligned}D(r, t) &= t/|t|\delta(c^2t^2 - r^2)\\ &= D_{ret} - D_{adv}\end{aligned} \tag{21}$$

to

$$\begin{aligned}D_F &= D_{ret} + D_-\\ &= D_{adv} + D_+.\end{aligned} \tag{22}$$

Here D_{ret} and D_{adv} are the retarded and advanced propagators. $D_\pm$ are the Fourier contributions from positive and negative frequency sheets. At the

Chicago meeting Pauli criticized Feynman's D_F by applying it to the single electron double-slit experiment. Feynman[17] replied Pauli by showing a delayed-choice double-slit equipped with time-dependent shutters creating $\Lambda + V = N$ shaped electron-positron pairs, zigzagging in time.

A matter-antimatter symmetric cosmology is conceivable by replacing the shutter by the Big Bang and the slit by the 3-diensional Lorentz sphere: $(ct)^2 - r^2 = l_{pl}^2$ filled with point-like Planckeons and joind onto Friedman universe at $r = r_C$, allowing a topological (non-Hausdolff) worm hole where the timelike 3-vectors is undefined.

IX. EPR Correlation on Insect

In 1903 Oudemans[8] discovered a phenomenon of pattern integration on the wings of the insect. When a moth or butterfly settles to assume its natural resting posture fragmental patterns apperaring on the exposed but not necessarily visible surface of forewings, hindwings, head, throx, abdomen, and some of legs are integrated to form a composite but unified and scale invariant spatial pattern. Since the phenomenon is observable for both diurnal and nocturnal insects, and since a single mutation seems to be able to transform as a correlated whole, not aquired by adaptation and selection in which independent biochemical processes occurring in spatially distant parts of organisms are organized to form a predetermined patterns at the final stage of development. O. Costa de Beauregard[8] took the phenomenon as a manifestation of the Leibnizian notion "Preharmony" or the Lamarckian slogan "The function creates the organ." We here propose to call it as the biological EPR correlation between sptially separated pattern elements, zigzagging in time.

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