Planckreon Origin of Dark Energy and Singular Nature of Inflation in Semiclosed Friedman Universe

By Noboru Hokkyo
Senjikan Institute

Abstract- Origins of dark energy and inflation in semiclosed Friedman model universe are sought by examining the imaginary pair of gravitationary bound Planckreon-Higgs boson composite requiring temperature $T \sim 10^{15}K$ for thermal creation. Inflation is likely to be related to the singular nature of the transition amplitude $D(s^2)$ of the Higgs boson obeying PC-and T-symmetric Klein-Gordon equation, between neighboring points separated by a space like distance $s^2 = (ct)^2 - r^2 < 0$ in the ultraviolet region outside the light cone, past and future, violating time-symmetry and local causality.

Keywords: general relativity, cosmology, dark energy, monopole, inflation.

GJSFR-A Classification: FOR Code: 020102

Strictly as per the compliance and regulations of:

© 2016. Noboru Hokkyo. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.
Planckeon Origin of Dark Energy and Singular Nature of Inflation in Semiclosed Friedman Universe

Noboru Hokkyo

Abstract: Origins of dark energy and inflation in semiclosed Friedman model universe are sought by examining the imaginary pair of gravitationally bound Planckeon-Higgs boson composite requiring temperature $T \sim 10^{16}$K for thermal creation. Inflation is likely to be related to the singular nature of the transition amplitude $D(s^2)$ of the Higgs boson obeying PC-and T-symmetric Klein-Gordon equation, between neighboring points separated by a space like distance $s^2 = (ct)^2 - r^2 < 0$ in the ultraviolet region outside the light cone, past and future, violating time-symmetry and local causality.

Keywords: general relativity, cosmology, dark energy, monopole, inflation.

I. Introduction

Previous discussions on the Planckeon origin of dark energy are extended to include the imaginary pair of gravitationally bound Planckeon-Higgs boson composite. The inflationary superluminal expansion of the universe is likely to be related to a singular nature of the transition amplitude of Higgs boson between two neighboring points separated by a spacelike interval in the ultraviolet region outside the light cone, future and past, favoring the creation of the boson composites.

II. Standard Inflation

In the standard inflation theory, the universe starts either from a large quantum fluctuation of a pre-existing spacetime metric at Planck radius $l_p \sim 10^{-35}$cm and time $t_p/c \sim 10^{-43}$cm, or from the singular hot Big Bang at temperature $T_B = 10^{27}$K occurring at $r = r_B \sim 10^{25}$cm and time $t \sim 10^{-38}$sec, expanding the radius of the universe from $r_B$ to

$$(T_B/T_0)R = (3/10^{23})(t/10^{36}) \sim 10cm,$$

where $T_0$ is the present temperature and $R$ the present radius of the universe, explaining the large scale homogeneity of the universe.

III. Friedman Inflation

Consider a Friedman universe, filled with a uniform distribution of constant energy density $\rho$, having Euclidean radius $R$, mass $M = \rho_0 V$ and volume $V = 4\pi R^3/3$. The motion of a test particle ticking (quantized) with Planck period $t_p = \hbar/m_p c$ and moving on the surface $r$ of the universe is described by the PC-and T-symmetric line element $ds^2$ with Lorentz-Friedman-Reissner-Nordström metric:

$$ds^2 = c^2 g_{tt} dt^2 - g_{rr} dr^2 (g_{rr} = g_{tt}^{-1}),$$

$$= c^2 \left[ 1 - r^2/r_g^2 + L^2/(m_pl)^2 \right],$$

$$= c^2 \left( 1 - r^2/r_g^2 + L^2 p_l^2/r_f^2 \right),$$

$$= c^2 \left( 1 - r/r_d(1 + r/r_d + L^2 p_l^2/r_f^2) \right),$$

where $r_d = 2GM/c < R$ is the gravitational radius of the closed ($= R$) and semiclosed ($< R$) universe, and

$$L = m_pl^2 dr/dt,$$

$$= \hbar/2\pi, \quad l_p = \text{integer}.$$

is the quantized angular momentum of the test particle crossing the time axis of the future light cone at $ct = l_p$ in Minkowski space.

There the test particle moves on the 4-dimensional hyperboloid, $(ct)^2 - r^2 = l_p^2$, with velocity $dr/dt$ obtained by solving $ds^2 = 0$. We find that the light velocity changes from superluminal to luminal and then to subluminal as

$$dr/dt = c \left( g_{tt}/g_{rr} \right)^{1/2}$$

$$= c(1 - r^2/r_g^2 + L^2 p_l^2/r_f^2),$$

$$= c(1 - l_p^2 r_g^2 + L^2),$$

$$> c \quad \text{at} \quad r = l_p,$$

$$= 0 \quad \text{at} \quad r = r_g,$$

$$= c \quad \text{at} \quad r = r_g^2. \quad (4)$$

The inflationary history of the universe can thus be described as a superluminal expansion of the universe starting at $r = l_p$ and ending at $r = (r_g^2)^{1/2}$. The astronomical observations of the large-scale homogeneity of the distribution of matter and galaxy formation on the scale of $10^{17}$ light years can be explained by the superluminal and bi-directional EPR causal connection between radius $r = l_p$ and $r_c$, while stars, clusters of galaxies, voids and other structures larger than $10^8$ light years, violating a perfect homogeneity by less than a part in a thousand $10^3$, seem to indicate the

Author: Senjikan Institute, Niigata, Japan.
e-mail: noboruhokk@yahoo.co.jp
quantized angular momentum less than $l_0 \sim 10^8$ so that $r_c = (r_p l_p)^{1/2} = l_0 10^{-3} cm = 10 cm$. 

IV. DE-SITTER INFLATION

The de-Sitter universe filled with Planckeon energy $m_p c^2 = \hbar c/l_p$ is described by the line element:

$$ds^2 = c^2(1 - \Lambda r^2) = c^2(1 - r^2/l_p^2),$$

where $\Lambda$ is the cosmological constant. The light velocity is determined from $ds^2 = 0$ as

$$dr/dt = c(1 - r^2/l_p^2).$$

Thus Einstein’s equation with cosmological term $\Lambda$ predicts a subluminal inflation:

$$\exp(\sqrt{\Lambda} ct) = \exp(c t/l_p) = \exp(10^{43} t),$$

starting at $t = 0$ with $dr/dt < c$ and ending at Planck time $t_p = l_p/c$ with $dr/dt = 0$ and $\exp(\sqrt{\Lambda} ct) = 0$, showing an uncertainty relation between position $l_p$ and momentum $m_p c$:

$$l_p m_p c = \hbar \text{ definting the Compton wavelength } l_p = \hbar/m_p c \text{ of a Planckeon.}$$

V. MASS DEFECT OF FRIEDMAN UNIVERSE

Consider the Planckeon model Friedman universe filled with uniform distribution of constant dark energy density $\rho_n$. During the subluminal expansion of the universe from radius $t = r_c$ to $R - l_p$, the mass defect develops between Newtonian mass $M = \rho_n V$ and the general relativistic proper mass $M_p$ calculated from the proper radius $R_p = \int_{l_p}^{d_r} dr$ and the proper volume $V_p = 4\pi R_p^3/3$:

$$M_p = \rho_n V_p = (3/2)(R/r_p)^3 \sin^3(\theta/R_g) M.$$ (8)

We find that $M_p$ increases with the increase of the world radius from $r \sim l_p$ where $l_p/r_g \sim 1$. With further increase of $r$ towards $r = r_g$, the mass $M_p$ decreases towards $l_p$, where $r/r_g \sim 1$, forming a gravitational semiclosure with surface area $4\pi r_g^2$ having holographic information content $4\pi (R/l_p)^2 \sim 10^{126}$. 

VI. MAGNETIC MONOPOLE AND NAMBU’S MASS FORMULA

Recently in June 2016 in Tokyo a successful artificial creation of magnetic monopole, using spin ice of rare earth metals at low temperature below critical, was announced. The magnetic monopole was predicted by Dirac in 1931 and its necessary existence was emphasized by Zel’dovich, t’Hooft and others in the grand unified theory as a primordial problem. We here point out that the monopole mass spectrum

$$m_{mono} = n(\hbar c/e), \ n = \text{integer}$$ (9)

is hidden in Nambu’s mass spectrum for elementary particles discovered in 1952 before grand unification of gauge fields:

$$m_n = n(\hbar c/e) m_e, \ n = \text{integer},$$

$$m_e = n G m_p^2/L = (137n/2) m_p, m_p = \text{electron mass}, \ n = 3, 4, 14, 15, 16, 17, 18, 19, 24, 33$$ (10)

for $\mu, \pi, K, \tau$ (mesons), $P/N$ (proton/neutron), $\Lambda, \Xi, \Omega, \Lambda_c$ (baryons).

The angular term in the line element $ds^2$ of Friedman universe (Eq.(2)) can give magnetic monopoles of mass $m_{mono} = 10^{-3} m_p$ with mass spectrum

$$m_{mono} = l_0 10^{-3} m_p, \ l_0 \text{ integer},$$ (11)

indicating energy emission during quantum transition from higher, say, $l_0 \sim 10^5$ to lower orbit (circular) on the perturbed background radiation at temerature $T = 10^{25}$K. We note that the higher orbit is highly multi-directional, locally violating the spherical symmetry of the Friedman universe.

It is conceivable that the gravitationally bound pair of Planckeon and magnetic monopole creates the binding energy, solving the primordial problem:

$$G m_{mono} m_{pl} = 10^{-3} m_p c^2 \sim 10^{16} aT.$$ (12)

VII. COSMOLOGICAL IMPLICATION OF MASS SPECTRUM

In his Nirshina Memorial Lecture in 1983 t’Hooft asked: Is quantum field theory a theory? and showed an artistic view of mass spectrum of relatively stable point-like paricles. There Nambu’s mass spectrum ranging from 1Mev towards 100Gev (leptons, mesons and hadrons) is extended to include gauge paricles, real and imaginary, required to make a quantum field theory a theory. G. t’Hooft calls the mass range between $10^{16}$ to $10^{19}$Gev a glomorous range, and the range beyond $10^{19}$Gev the blackhole range characterized by the spectrum density $\rho(E) = \exp(4\pi M/m_{pl})^2$ of the blackhole of $10^{43}$Gev scale mass $M$.

We here propose to call the $10^{43}$Gev scale mass $M$ the Newtonian mass of semiclosed Friedman universe ($r_g < R$ having Planck scale proper mass $M_p \sim m_{pl}$ with holographic information content $4\pi (M/m_{pl})^2 \sim 120$.

VIII. PLANKEON-HIGGS BOSON ORIGIN OF DARK ENERGY

In 2014 the CERN high energy proton-proton collision experiment detected the Higgs boson with mass $m_H$ of about 133 proton mass $m_p$:

$$m_H \sim 10^2 m_p \sim 10^{17} m_p \sim 10^{22} g.$$ (13)

Being a scalar field, the Higgs boson has no spin, has no electric and color charge. It has its own anti-particle and CP-symmetry.

© 2016 Global Journals Inc. (US)
The cosmological implication of the graviton-Higgs boson composite has been discussed in curved space time as it may generate huge cosmological constant $\Lambda$ in negative sense, while its anti-boson composite may flatten the curve in positive sense. We here consider a gravitational bound Planck-Higgs boson composite having potential energy:

$$G_m m^2 l_p = 10^{17} m^2 c^2 \sim 10^{55} c T,$$  \hspace{1cm} (14)

in positive sense as a source of dark energy filling the evolutionarily earlier upper hemisphere of the semiclosed Friedman universe. Towards a solution of the primordial problem of observed abense of magnetic monopoles, we may also consider the monopole-Higgs boson composite having potential energy in positive sense:

$$G_m m_{mon}^2 l_p = 10^{14} m^2 c^2 \sim 10^{25} c T.$$  \hspace{1cm} (15)

**IX. SINGULAR NATURE OF HIGGS BOSON**

Consider a scalar field $\phi(r, t)$ created by a Higgs boson at $(r, t) = (0, 0)$ obeying CP and T symmetric Klein-Gordon equation:

$$\left[\partial^2 / \partial t^2 - \partial^2 / \partial r^2 - (m_c / c)^2 \right] \phi$$

$$= \delta(r, t),$$  \hspace{1cm} (16)

giving the amplitude of transition (propagator) $D(s^2)$ between two points separated by 4-dimensional distance $s^2 = (ct)^2 - r^2$:

$$D(s^2) = (\delta(s^2)/4\pi + (\lambda/4\pi s)H_{\lambda}(s/\lambda)$$

$$\sim \delta(s^2)$$

on the light cone $ds^2 = 0$  \hspace{1cm} (17)

$$\sim (1/|s|)^{32} \exp(-is/\lambda)$$

within the light cone $ds^2 > 0$,  \hspace{1cm} (18)

$$\sim (1/|s|)^{32} \exp(-|s|/\lambda)$$

outside the light cone $ds^2 < 0$.  \hspace{1cm} (19)

Here $H_{\lambda}(s)$ is the Hankel function of the second kind and $\lambda = h m_c c$ is the Higgs wavelength. We find that $D(s^2)$ gives a singular attractive potential:

$$D(s^2) \sim (1/|s|)^{32} \exp(-|s|/\lambda)$$

$$\sim (1/|s|)^{32} \sim (1/l_p)^{32},$$  \hspace{1cm} (20)

favoring the superluminal (spacelike) creation of Planck-Higgs boson composites outside the light cone in the transsional region between quantum field theory and the blackhole cosmology.

**X. HISTORICAL COMMENTS**

In the early attempts to find origins of quasistellar radio sources, Zel'dovich, Novikov, Stanyukovich, and others examined models of radiating Planck scale black hole (Planckon) filled with a scalar field obeying Klein-Gordon equation with spherically symmetric metric. For the radiation to be observed, the inner universe is required to be open to an asymptotically flat Euclidean space though a Schwarzschild bottleneck pulsating with Planck period. As the presently radiating black hole can be a final state of the contracting past universe as well as the initial state of an expanding future universe, we are led to an infinite series of (CP and T symmetric) world within world model under the Middle Way doctrine of the Middle Way doctrine inferred as the unitary and holographic principle, to be compared to currently discussed nonlocal and acausal parallel world models.

**XI. ACKNOWLEDGEMENTS**

The author wishes to thank editors and reviewers for encouragements and patience. Thanks are also due to Alexander Alexandrovich Antonov and Antonova for making him aware of the recent references [3] and [13] arrived at Global Journals Blog from Ukraine, and to Jean Claude Zambirini for helpful historical comments on not-fually-acknowledged scientists, airmaile from Lisbon.

**REFERENCES**

14. N. N. Bogoliubov and D. V. Shirkov, Introduction to the Theory of Quantized Fields: Translated into English by G. Volk off, University of British Columbia, Vancouver, from freshly printed copies of the Russian edition airmailed from Moscow. The Jordan-Pauli propagator $D(s^2)$ used there does not allow Feynman’s zigzagging causality including virtual pair creation and annihilation of bosons between points separated by a spaceike distance $s^2 < 0$ in the ultraviolet region outside the light cone.