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Stefan Mehedinteanu

CITON - Center of Technology and Engineering for Nuclear Projects, Str. Atomistilor No. 409, BOP-5204-MG-4, Oras Magurele, Ilfov, (ROMANIA)
E-mail: mehedintz@yahoo.com

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*Corresponding author's
Name & Address

Stefan Mehedinteanu
CITON - Center of Technology and Engineering for Nuclear Projects, Str. Atomistilor No. 409, BOP-5204-MG-4, Oras Magurele, Ilfov, (ROMANIA)
E-mail: mehedintz@yahoo.com

The quarks (*u*, *d*, *t*) and magnetic monopoles themselves pairs production by the Schwinger effect at the end of inflation at the origin of *CMB B - curl* pattern, matter creation and of the Higgs field

Abstract

In present work, is established a correlation with Inflation Dynamics, especially at the reheating era, when the Inflaton field is sufficiently strong, and the energy of the vacuum can be lowered, in order to create by Schwinger effect pairs, of quarks (*u*, *d*, *t*), gluons, bosons ($W^{\pm}$), gluons (monopoles), the magnetic monopoles themselves (of spin 1). Also, in the work is calculated the Inflation Dynamics putting in evidence all the epochs (quarks, hadrons, leptons). That ours permitting to observe that the potential nears the end of reheating (*at quarks epoch*) is very much reduced, thus, at $H_{end}^{-1} = 10^6[m] \rightarrow 0.003s$, the potential becomes $V_{end} = 100GeV$; at confinement $H_{end}^{-1} = 10^9[m] \rightarrow 3.3s$, $V = 100MeV$, and the quarks pairs created by Schwinger effect, get $2.6MeV$. Therefore, apparently, is not any *trace* of an external residual field like of Higgs field. In others words, the Inflation can not explains the Higgs field, only, if we consider that the top (*t*) and antitop ($\bar{t}$) quarks pairs also, produced by Schwinger effect, they form a *bound state*, that is a composite Higgs boson field as in the frame of Topcolor model. This is a model of dynamical electroweak symmetry breaking in which the *top quark* and anti-top quark form a top quark condensate and act effectively like the Higgs boson. This is analogous to the phenomenon of superconductivity. These theories will ultimately be tested at the LHC in its Run-II commencing in 2015. In our present model, the things are similarly, an equivalence of my model with that of the Standard Model, is given in previously author' works. Thus, in my model the Inflaton potential, by Schwinger effect during the reheating period, generates all kinds of particles: gluons, magnetic monopoles themselves, and fermions (quarks, top quarks). In the model, theses gluon-gluon interactions constrain color fields to string-like objects called "flux tubes", which exert constant force when stretched. The difference with Standard Model, is that it results a probability $\cong 1$ (or a continuously production rates) for gluons, and a number of 10^{90} quarks. Finally, at all the gluons are being captured by all 3 × *flux_tubes* generated by $e\bar{e}$ quarks ($\cong 10^{90}$) pairs, together forming nucleons of an *incredibly exactly* number $\cong 10^{90}$, which is the known number of particles in Universe. Since, the reheating potential continues to diminish, at approximately $V \cong 0.1[GeV]$-that corresponding to confinement, the production of gluons (monopoles) quarks stops. But, a near v.*e*.v field it was created *inside nucleons*, as was found in previously author's works. This field makes possible the beta decay of free neutrons, and later of isotopes. Also, this field creates a *Lorenz force* between quarks flux tube and gluons (in structures of gauge monopoles type current), that is found to explain the gravity of nucleons (mass). There are found the number and mass of top quarks pairs locked in Higgs field and its decay. Also, is discovered the exact origin of primordial magnetic field (*PMF*) which can B-imprints *CMB*, namely, the magnetic flux of magnetic (anti)monopole coupled in strings, and generated by a the same Schwinger effect. Thus, at the end of *CMB* time, all (10^{90}) of magnetic monopoles pairs produced are already *bounded* in strings, and the light of *B - curl* type imprinted is due of theirs magnetic field resulted to be $B_{PMF} = B_{CMB} \cong 1.5 \times 10^{-12}[T]$, either as itself, or by Faraday rotation of $0.051rad \rightarrow 2.95°$ that gives $l = 68$, for a frequency of $41GHz$. Therefore, *the monopoles pairs suppression by bounding* its in strings, that explains the magnetic monopoles absence mentioned in Iflation works. Also, in order to "pass" the *plasma* period as to be formed by particles, it needs to preserve the magnetic field in some way, like in theses strings, till *CMB*. That, it is not the case with gravitational field, which it is not affected by this plasma.

Key Words

Inflation; Reheating; Wave number; BICEP2-B-curl pattern; Quarks; Gluons; Monopoles; Higgs field; Epochs.

INTRODUCTION

Recently were reported the results from the BICEP2 experiment, a Cosmic Microwave Background (*CMB*) polarimeter specifically designed to search for the signal of inflationary gravitational waves in the B-mode power spectrum around $l \approx 80$[1].

Because of the Universe high conductivity, two important quantities are almost conserved during Universe evolution: the magnetic flux and the magnetic helicity.

A near similarly pattern could be obtained if is considered a Primordial Magnetic Flux (PMF).

During the inflationary era the physical wavelength of any given mode will grow with the scale factor $a(t)$, and hence will grow exponentially. The Hubble length H^{-1}, however, is approximately constant during inflation.

The modes of interest will start at wavelengths far less than H^{-1}, and will grow during inflation to be perhaps 20 orders of magnitude larger than H^{-1}.

The Hubble length $H^{-1} = a/\dot{a}$ will grow linearly with t, so eventually the Hubble length will overtake the wavelength, and the wave will come back inside the Hubble length.

During inflation[2], $aH[m^{-1}]$ increases with time, and a commoving scale a/k is said to *leave the horizon when* $aH/k = 1$. After inflation aH decreases, and the commoving scale is said to enter the horizon when $aH/k = 1$.

The scale leaving the horizon at a given epoch is directly related to the number $N(\varphi)$ of e-folds of slow-roll inflation, that occur after the epoch of horizon exit. Indeed, since H is slowly varying we have $d \ln k = d(\ln(aH)) \cong d \ln a = Ht$. From the definition Eq. (38) of[2] this gives $d \ln k = --dN(\varphi)$ as of eq.(46) from[2], and therefore $\ln(k_{end}/k) = N(\varphi)$, or, $k_{end} = ke^{N}[m]$ where k_{end} is the scale leaving the horizon at the end of slow-roll inflation, or usually $k^{-1} << k_{end}^{-1}[m]$, the correct equation being $k = k_{end}e^{N}\ [m^{-1}]$

For a flat universe eq. (1.6.2) of[12]

$$H = \sqrt{\frac{8\pi}{3}G\rho} \qquad (1)$$

$\rho = 10^{90} - 10^{92}\ g/cm^{3}$, or $\rho = 1.e87[kg/m3]$
$\chi = 1.27 \times 10^{39}\,[s^{-1}]$; or, results $H = 7.37 \times 10^{38}\ [s^{-1}]$, or $l = H/c = 4 \times 10^{31}\ [m^{-1}]$

Inflation ended when the *inflaton field decayed into ordinary particles in a process called "reheating"*, at which point ordinary Big Bang expansion began.

When the wavelength ($k^{-1}\ [m]$) is large compared to the Hubble length ($H^{-1}\ [m]$), the distance that light can travel in a Hubble time becomes small compared to the wavelength, and hence all motion is very slow and the pattern is essentially frozen in.

Reheating occurs promptly at the end of inflation. In the simple models that we have explored, this means that the reheat temperature is at least 10^{11} *GeV*.

If the scalar field ϕ falls below ϕ_{inst} before the end of inflation, the false vacuum is destabilized and there is a possibility of a second-order phase transition, of a kind quite different from the usual thermal phase transition.

The cosmological significance of this different evolution depends on when the defects form. If they form after cosmologically interesting scales leave the horizon (50 or 60 Hubble times before the end of inflation), the scaling solution has been established by the time that these scales enter the horizon. If they form before, their typical spacing is still much bigger than the horizon size and we presumably see no defects. Finally, if they form at about the same time, the configuration of the defects will differ from the scaling solution, that being the case of structure forming gauge strings.

A commoving scale a/k is said to be outside the horizon when it is bigger than H^{-1}.

When inflation ends, the scalar field ϕ *begins to oscillate near the minimum of* $V(\phi)$. *As any rapidly oscillating classical field, it looses its energy by creating pairs of elementary particles. These particles interact with each other and come to a state of thermal equilibrium with some temperature* T_r.

It is known that as the temperature decreases to $T \approx T_{c1} \cong 10^{14} - 10^{15}$ *GeV*, a phase transition (or several) takes place, generating a classical scalar field $\varphi \cong 10^{15}$ *GeV*, which breaks the symmetry between the strong and electroweak interactions[3a]. When the temperature drops to $T_{c2} \cong 200GeV$, the symmetry between the weak and electromagnetic interactions breaks. Finally, at $T = 10^{2}\ MeV$, there should be a phase transition (or two separate transitions) which breaks the chiral invariance of the theory of strong interactions and leads to the coalescence of quarks into hadrons (confinement).

Without a solution of the baryogenesis problem, the inflationary universe scenario would be impossible, since the density of baryons that exist at the earliest stages of evolution of the universe becomes exponentially small after inflation. Or, in others words, if it is not generated a new field (the initial one vanishing till today), the universe is collapsed.

This field could be assimilated with Higgs field as being described by the same formula (chaotic inflaton potential), see Linde[3a]. It needs to understand which is the provenience of the Higgs field that generates Higgs particles in Standard Model !.

Also, it is known, that the QCD-monopole has an intrinsic structure relating to a large amount of off-diagonal gluons around its center, similar to the ’t Hooft-Polyakov monopole. At a large scale where this structure becomes invisible, QCD-monopoles can be regarded as point-like Dirac monopoles[6].

In[3b], where is explained how the matter is created, is shown that if the particles produced by the decaying inflaton field interact with each other strongly enough, then the thermodynamic equilibrium sets in quickly after the decay of the inflaton field, and the matter acquires a temperature T_r. Creation of particles leads to the several effects which can change the dynamics of the system. In particular, it terminates the broad resonance particle production. First, the energy from the homogeneous field $\varphi(t)$ is transferred to the created particles. The amplitude of the classical oscillations φ_0 is therefore decreasing faster than it would decrease due to the expansion of the universe only. It is found in[3b], that the decay of the inflaton field typically begins with the explosive production of particles during the stage of preheating in the regime of a broad parametric. During the second stage, the inflaton field decays further in the regime of the narrow resonance, and particles produced at this stage decay into other particles and self-interacting. The third stage is the thermalization.

The inflationary paradigm invokes quantum effects in highly curved spacetime at energies near 10^{16} *GeV* and timescales less than 10^{-32} s[3a].

The detection of B-mode polarization of the *CMB* at large angular scales would provide a unique confirmation of inflation and a probe of its energy scale. Notice that the BICEP2 result at 1σ, $r = 0.16^{+0.06}_{-0.05}$[5], corresponds to the range $V(\chi_0) = (1.8 - 2.2) \times 10^{16}$ *GeV*, and to $H_I = (0.8 - 1.2) \times 10^{14}$ *GeV*.

In the present work are verified all theses known results and, supplementary is discovered an alternative of B-mode polarization of the *CMB*, as due of the primordial magnetic field (*PMF*) of magnetic (anti)monopole pairs generated by a Schwinger effect[4a,4b,6], due of an external field *E* as the above *scalar* potential *V* equally initially with the Inflation Potential at the reheating of $V \cong 4 \times 10^{12}$ *GeV*.

THE ANALYSIS OF UNIVERSE EVOLUTION

In[7] is explained how Inflation works.

Thus, is shows that the time constant χ^{-1} of the exponential expansion would be about 10^{-38}, and that the corresponding Hubble length would be about $H^{-1} = 10^{-30}$ $[m]$ and *H* is the time-dependent Hubble parameter given by (in natural units):

$$H^2 = \frac{8\pi}{3} GV \rightarrow = \frac{8\pi G V^4}{3(\hbar c)^3 c^4}$$

Here, we introduce the following our derivation. Thus, from[8], the Ricci scalar curvature is $\Re = -6(\ddot{a}/a + \dot{a}^2/a^2)$, which reduces to $\Re = \frac{6}{c^2 a^2}\dot{a}^2$, or

$$\frac{6}{c^2}\left(\frac{\dot{a}^2}{a^2}\right) = \frac{V^4 \hbar c}{3M^2_{Plank}(\hbar c)^3 c^4}\ ; \tag{2}$$

$\Re = \frac{1}{R^2} = \frac{6H^2}{c^2}[m^{-2}]$, with the potential when leaves the horizon at the slow-roll end of inflation era $V = 10^{11}$ *GeV*, results $H^{-1} = 1.4 \times 10^{-27}$ $[m]$

Remember the equations derived in[17] which relate the gravitation constant with Planck mass:

$$G = \frac{\hbar c}{M^2_{Planck}}\ ; \tag{3}$$

This relation derives from the equality between Schwarzschild radius $\zeta = \frac{2GM}{c^2}$; with either Compton length $l_{Compton} = \frac{\hbar}{Mc}$; or with Planck length $l_{Planck} = \sqrt{\frac{\hbar G}{c^3}}$; when $M = M_{Planck}$, and the Lorenz force exercised on the surface either of l_P^2, or of Compton length, or Schwarzschild radius; finally as being given as $F_L = ecB$

Where,

$$\frac{2}{R^2} = \frac{8\pi G}{c^4}\frac{F_L}{4\pi l_P^2} = \frac{8\pi G}{c^4}\frac{c^3}{4\pi\hbar G}\frac{ec\pi\hbar c}{\pi\lambda^2 ec} \cong \frac{1}{\lambda^2} \tag{4}$$

Now, we have:

$$\frac{2}{R^2} = \frac{8\pi G}{c^4}\frac{ecBc^3}{4\pi\hbar G} = \frac{2eB}{\hbar}, \tag{5}$$

or with Schwarzschild radius of an object

$$\frac{2}{R^2} = \frac{8\pi G}{c^4}\frac{ecBc^4}{8\pi M^2 G^2} = \frac{ecB_{\text{int}\,eraction}}{M^2 G} \tag{6}$$

R being the object radius, and $B_{\text{int}\ eraction} = B_{pair} * N_{particles}$.

In case of Earth the interacting field between nucleons is $B_{pair} = 10^{-15}$ $[T]$; $N = 10^{51}$ the object number of particles; $M = 6 \times 10^{24}$ $[Kg]$[8], it results $R \cong 6.5 \times 10^6$ $[m]$

$$\text{Or, } H^2 = \frac{6c^2 eB}{\hbar}[m^{-2}], \tag{6.1}$$

that means the Hubble length is given by the magnetic field of gluons (monopoles).

That, with $B_{10^{11}GeV} = 1.7 \times 10^{37}[T] \leftrightarrow V = 10^{11} GeV$, results $\frac{1}{R^2} = 2.7 \times 10^{52}[m^{-2}]$, or, $H = 5 \times 10^{-35}$ $[s]$, or $H^{-1} = 6 \times 10^{-24}$ $[m]$, the same value as above.

If $B_{2.2GeV} = 8.8 \times 10^{15}$ $[T]$, at Confinement, it results $H^{-1} = 2.7 \times 10^{-16}$ $[m] \cong \lambda$

If we use $B_{10^{15}GeV} = 2 \times 10^{42} [T]$; $H^{-1} = 1.5 \times 10^{-29}$ $[m]$, the value obtained in Inflationary models[3a]. In others words, it is found a equivalence between the gravitational potential and the electromagnetic potential due of magnetic monopoles themselves.

For inflation to achieve its goals, this patch has to expand exponentially for at least 65*e*-foldings, but the amount of inflation could be much larger than this. Eventually, however, the inflaton field at any given location will roll off the hill, ending inflation. When it does, the energy density that has been locked in the inflaton field is released. Because of the coupling of the inflaton to other fields, that energy becomes thermalized to produce a hot soup of particles, which is exactly what had always been taken as the starting point of the standard big bang theory before inflation was introduced. Note that while inflation was originally developed in the context of grand unified theories, the only real requirements on the particle physics are the existence of a false vacuum state, and the possibility of creating the net baryon number of the universe after inflation.

First of all, we know that the universe is incredibly large: the visible part of the universe contains about 10^{90} particles

The cosmic background radiation was released about 400,000 years after the big bang, after the universe cooled enough so that the opaque plasma neutralized into a transparent gas. The cosmic background radiation photons have mostly been traveling on straight lines since then, so they provide an image of what the universe looked like at 400,000 years after the big bang.

In some works[3a], it is mentioned the *absence of magnetic monopoles*, even all grand unified theories predict that there should be, in the spectrum of possible particles, extremely massive particles carrying a net magnetic charge.

In present work is re-introduced a such idea, mainly based on the production of gluons (monopoles) and of magnetic monopoles themselves pairs and of electrons (quarks) due of the Schwinger effect. This happens when the field is sufficiently strong, and the energy of the vacuum can be lowered by creating an electron-positron ($e\bar{e}$) which form the quarks (u, d, t), gluons, bosons ($W^{\pm}$), gluons (monopoles), the magnetic monopoles themselves (of spin 1) pairs. The field which makes the vacuum unstable is just considered the Inflaton potential in the reheating period. The absence of monopoles, it will be shown to be due of theirs bounding in the neutral dumbbell strings for CMB B-imprints and for *dark matter*.

The calculation of spacetime windows for electromagnetic-waves (EMW) generation and of matter creation

We have calculated the horizon-crossing wavenumbers for different important epochs (quarks, hadrons, leptons).

Thus, if it is considered a re-entry in horizon at reheating, when from, $k_{leave} = k_{end} e^{N}$, results

$$\boldsymbol{k}_{end\_M1} = \boldsymbol{k}_{leave\_M1} \mathbf{e}^{-N}, \qquad (7)$$

or, $k^{-1}_{end\_M1} = 2.5 \times 10^{-5} << H^{-1}_{end\_M1} = 10^{21} [m] \cong 0.1 Mpc(CMB)$; the scale factor being $a_{end} H_{end} / k_{end} = 1$; and $a_{leave} = 1$ for $H^{-1}_{leave\_M1} = r^{monopole}_{Compton} = 1.87 \times 10^{-27} [m]$; with $N = 51$, results $k_{leave\_M1} = 7 \times 10^{-2}$ $[m]$, and $a_{end\_CMB} = \frac{k_{end}}{H_{end}} = \frac{3.9 \times 10^{4}}{10^{-21}}$ $= 3.9 \times 10^{25}$, see the TABLE 1.

In case of magnetic monopoles, the value of field at end of *CMB* era, respectively at $H^{-1}_{CMB} = 10^{21} [m]$ is given as[9,10]:

$$B_{CMB}(t_0) = B^{PMF}_{end} = B_{leave}(t) * \frac{a_{leave}(t)^2}{a_{end\_CMB}(t_0)^2} = B_{leave}(t) \frac{1}{a^2_{end\_CMB}} \qquad \textbf{(8)}$$

With the above magnetic field at leave horizon $V_{leave} \cong 4 \times 10^{12}$ *GeV* is:

$$E^2 = \frac{(V_{leave})^2}{\varepsilon_0 (\lambda^{e*}_{C})^2 \hbar c} \rightarrow E = 6.6 \times 10^{47} [N/C]; \qquad \textbf{(9)}$$

$B_{leave}(t) = E/c = 2.2 \times 10^{39}$ $[T]$, that results, $B_{PMF} = B_{CMB} = 1.5 \times 10^{-12}$ $[T] \cong 15nGs$, see Figure 1, near that it was obtained in[9,10].

If, the wavelength is $l \approx k^{-1}_{end} \cong 2.5 \times 10^{-5} << H^{-1}_{CMB} = 10^{21} [m] \rightarrow 3.3 \times 10^{12} [s] \cong CMB_{time} = 1.2 \times 10^{13} [s]$, we can see these imprints as *B-curl* type due of *Faraday rotation* (see below) at *CMB* time.

Also, if we consider the primordial moment, when the re-entry in horizon is at $H^{-1}_{end} = 1.8 \times 10^{-27} [m]$, the leave of horizon being at $H^{-1}_{leave} = 1.87 \times 10^{-35} [m]$, with $N = 7$, that results $k^{-1}_{end} = 2 \times 10^{-32} [m]$, or inside horizon at the end of $a_{end} = 8.7 \times 10^{4}$, results $B = 2.82 \times 10^{25}$ $[T]$ and with the value of the potential as $V = 1.1 \times 10^{19}$ $[GeV]$, that means a mass of thesis monopoles (viewed as micro(babies) -blackhole) considered for $V_{monopol} = 10^{19}$ $[GeV] \rightarrow mass = 1.78 * 10^{-8}$ $[kg]$, $r_{Schwarzschild} = l_p = 1.8 \times 10^{-35}$ $[m]$, the number of monopoles pairs (see below the formula) becomes $N \cong 3.9 \times 10^{16}$, that we believe to be *the seeds of the blackholes*.

THE MATTER CREATION

We shall be defining horizon crossing at a given epoch as $k = aH$. We can thus give the horizon-crossing wavenumbers for these different important epochs. If reheating is prompt, we learn that in most models the observable universe leaves the horizon about 62*e*-folds before the end of inflation. If reheating is long delayed *N* could be considerably reduced, being equal to 32 for the most extreme possibility of $V_{reh}^{1/4} \approx 1000\,GeV$ (corresponding to reheating just before the electroweak transition which is presumably the last opportunity for baryogenesis). For most purposes, however, one needs only the order of magnitude of *N*.

The matter creation is due mostly to reheating at about $V = 10^{12} \div 100 GeV \rightarrow T = 10^{15}\,°K$, also, at near the end, this field is being *locked* in the Higgs field via *bounded top quarks* ($t\bar{t}$) *as in Topcolor theory (which needs developments!)*, and appearing as : $V = \nu.e.\nu = 247 GeV$ The top quark is the heaviest known elementary particle which makes it an excellent candidate for new physics searches. Origin of its mass might be different from that of other quarks and leptons, a top quark condensate ($< t\bar{t} >$), for example, could be responsible for at least part of the mechanism of electroweak symmetry breaking (EWSB). An interesting model involving a role for the top quark in dynamical EWSB is known as the topcolor-assisted technicolor (T C2) model. Topcolor scenario also predicts the existence of the top-Higgs h_t^0, which is the $t\bar{t}$ bound state[21].

Again, we have $\ln(k_{CMB}^{-1}/k_{re-entry}^{-1}) = N(\varphi)$; $k_{CMB}^{-1} = k_{re-entry}^{-1} e^{N}$; $k_{CMB} = k_{re-entry} e^{-N}$; $N(\varphi) = 51$
Or, $k_{re-entry}/k_{CMB} = e^{N}$

The results of calculations are presented in TABLE 1, and Figure 1.

The same approach as for inflation and reheating is applied to calculate the evolution of the field locking in the top quarks pairs, see the calculations results in TABLE 2., and Figure 1.

Thus, today, this scaled field becomes: $V_{today} = V_{locked}/a_{end} = 274/2.08 = 119 GeV$, with $N = 39$.

Or today, the value of the field becomes 119*GeV*, near Higgs value.

In other words, theses fields after the reentries do not contribute to the imprint of *CMB*, that are produced by the primordial field (B_{PMF}) of the magnetic monopoles as been locked in strings.

Therefore, the Faraday rotation (see chapter 5.)

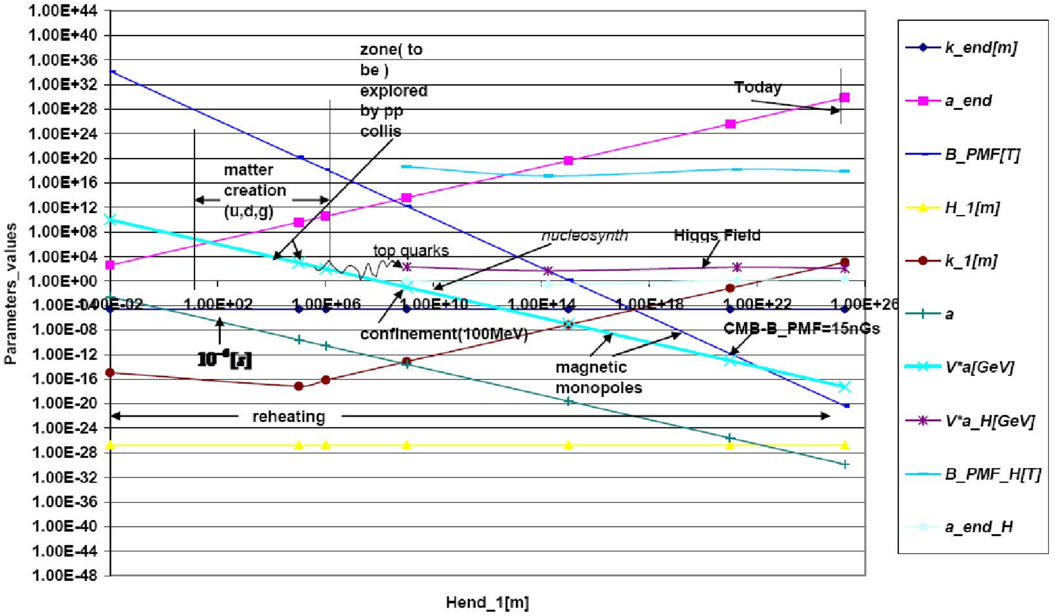

Figure 1 : The evolution of universe correlated with pairs production and matter creation.

TABLE 1

H_end_1[m]	k_end[m]	a_end	H_1[m]	V*a[GeV]	k_1[m]	a	a_end*H_end[m]	B_PMF[T]
1.00E-02	2.50E-05	390	1.80E-27	1.00E+10	1.10E-15	2.50E-03	2.56E-05	1.42E+34
1.00E+05	2.50E-05	3.90E+09	1.80E-27	1.00E+03	7.00E-18	2.50E-10	2.56E-05	1.42E+20
1.00E+06	2.60E-05	3.80E+10	1.80E-27	1.00E+02	7.00E-17	2.60E-11		1.53E+18
1.00E+09	2.60E-05	3.70E+13	1.80E-27	1.00E-01	7.00E-14	2.60E-14		1.53E+12
1.00E+15	2.50E-05	3.90E+19	1.80E-27	1.00E-07	7.00E-08	2.50E-20	2.56E-05	1.42E+00
1.00E+21	2.50E-05	3.90E+25	1.80E-27	1.00E-13	7.00E-02	2.50E-26		1.42E-12
1.80E+25	2.50E-05	7.00E+29	1.80E-27	5.60E-18	1.20E+03	1.40E-30		4.30E-21

TABLE 2

H_end_1_H[m]	k_end_H[m]	a_end_H	H_1_H[m]	V*a_H[GeV]	k_1_H[m]	a_H	B_PMF_H[T]
1.00E+09	8.60E+08	1.15E+00	1.00E-08	2.14E+02	1.15E-08	8.60E-01	3.99E+18
1.80E+14	8.60E+14	2.80E-01	1.00E-02	5.10E+01	2.00E-03	4.81E+00	1.29E+17
1.80E+21	1.30E+21	1.39E+00	1.80E+04	1.78E+02	2.00E+04	7.20E-01	1.56E+18
1.80E+25	8.60E+24	2.08E+00	1.00E+08	1.19E+02	2.00E+08	4.80E-01	6.92E+17

due of B_{PMF} at CMB time is:

$$F = \frac{3}{8\pi^2 e}\varepsilon_0 c^3 \frac{B_{CMB}}{\nu_0^2} \approx 0.051[rad] \to 2.95^0 \qquad (10)$$

Here, the frequency being $\upsilon_0 = 41GHz$ is taken from[11] where are derived current constraints on the magnetic field energy density, B, from the WMAP 7-year polarization data by comparing magnetic field induced theoretical CMB B-mode power spectrum C_l^{BB} as given by Eq. (65) of[11], with the WMAP observed B-mode power spectrum using the χ^2 statistics.

Roughly speaking, the multipole moments C_L^{TT} measure the mean-square temperature difference between two points separated by an angle$(\theta/1°) \approx 200/l$, or that means that $l = 70$, a result mentioned also in all articles[3a,9,10], but without explaining the provenience of PMF, that is done in this work.

Therefore, with $\upsilon_0 = 41GHz \to l = 68$, like the results of gravitational waves[1,7,3a].

The pairs creation at the end of Inflation by Schwinger effect at origin of matter creation

In the following as based on the values of the potential at different evolution eras are calculated the pairs production for spin 1 particles, and for spin 1/2, by applying separately, the Schwinger formulas.

(a) The gluons (monopoles) and magnetic monopoles themselves pairs production

In[4a,6], eq. (44), the following result was obtained for the probability of gluon pair production from arbitrary time dependent chromo-electric field $E^a(t)$ in $\alpha = 1$ gauge via Schwinger mechanism:

$$f(p_T,\theta,C_1) = \frac{dW_{g(\bar{g})}}{dtd^3xd^2p_T} = -\frac{1}{4\pi^3}\sum_{j=1}^{3}\left|g\lambda_j(t)\right|\ln\left[1+e^{-\pi(p_T^2)/\left|g\lambda_j(t)\right|}\right] \qquad (11)$$

$$\lambda_1^2 = \frac{C_1(t)}{2}\left[1-\cos\theta(t)\right] \qquad \lambda_{2,3}^2 = \frac{C_1(t)}{2}\left[1+\cos\left(\frac{\pi}{3}\pm\theta(t)\right)\right]$$

The results of calculations from[6], are given in Figure 2, where we can see, for example, in the case of pp collision at LHC which correspond with our Inflaton Potential (at the end of the reheating) $V_{end} \cong 10^4$, the probability of gluon pair production from arbitrary time $f(p_T,\ \theta = \pi/3,\ C_1 = 7.2GTeV^4) \cong 0.12$, which in fact, it was happen at LHC.

That means, a near continuously rate production during the reheating period.

Next, we have calculated the magnetic monopoles (themselves) pairs production rate. For that, we consider the initial results of Sauter, Heisenberg and Euler and Weisskopf, where, in a seminal work Schwinger derived a central result of strong-field quantum electrodynamics, namely, the rate per unit volume of pair creation R in a constant and uniform electric field of strength E, of leading order behavior,

$$R = (E/E_{cr})^2\,(c/\lambda^4)(8\pi^3)^{-1} * \exp(-\pi E_{cr}/E) \qquad (12)$$

for $E/E_{cr} << 1$, positron charge e, mass m, Compton wave-length $\lambda = \hbar/mc$ and so-called “critical” electric field

$$E_{cr} = m^2c^3/e\hbar \qquad (13)$$

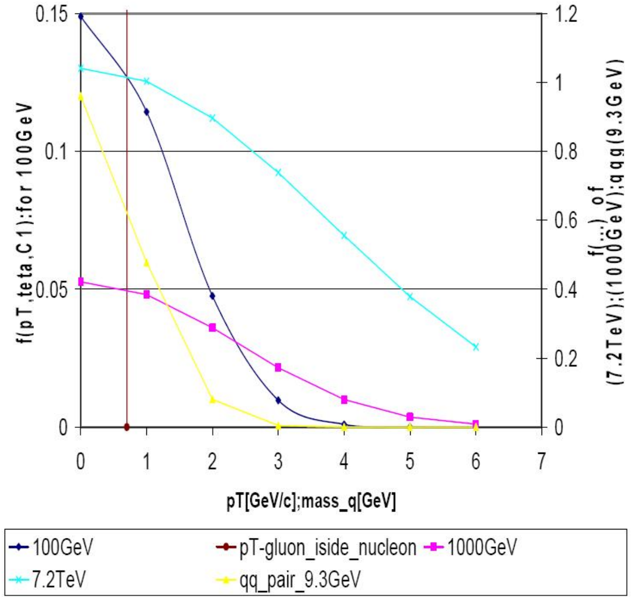

Figure 2 : The evolution of probability of gluon/quarks pairs production for different collision energies.

If we use the zone of reheating for matter creation of Hubble length $H_{end}^{-1} \cong 10^4[m]$, when all the kinds of particles could be created (quarks, gluons, bosons, gluons (monopoles), and top quark which gives Higgs field), the mass of the first top quarks created is $m = 4.6 \times 10^{-25}$ [kg], that resulting from the external potential after scaling with a_{end}, see TABLE 1., $V^* a_{end} = 4 \times 10^{12} \times 2.6 \times 10^{-9} = 10^4$ [GeV], and the top quarks having the mass $V_{monopol} * a_{end} = 10^{11} * 2.6 \times 10^{-9} = 262GeV$, see TABLE 1, and the Compton length being $V_{Compton} = \lambda_C^3 \times (\lambda_C/c)$

The Compton volume is $V_{Compton}$ = 8.5 × 10^{-82} [$m^3 s$], where λ_C = 7.1 × 10^{-19} [m]

Here, is supposed that the vector potential or the Inflaton at reheating of $V_{end} \cong 10^{10}\,GeV$ generates a spectrum for blackbody radiation when photons creation takes place, respectively at temperature $T_c \geq 10^{23}\,K$, then a very precise number of photons it was obtained from eq. (14), ($N \cong 26$), followed by Breit–Wheeler creation of e^+e^- pairs as $\gamma + \gamma \to e^+ + e^-$, with energy $\hbar\varpi_1 = \hbar\varpi_2 = \varepsilon_\gamma = \varepsilon_{e^+e^-pair} = V_{reheat}$, at least resulting $N_{e^+e^-} \cong 1$, that determines a Coulomb electrical flux tube E which captures the vacuum monopoles generating a current $k = curlE$, and an induction $B_{PMF} = E/c$, $B_{PMF} = 8 \times 10^{36}[T]$, finally, forming a vortex, just at reentry into horizon of $H_{end}^{-1} = 3 \times 10^{-27}[m]$, $V_{volume} \cong \left(H_{end}^{-1}\right)^3 \cong 10^{-81}[m^3]$, and $\zeta(3) = 1.20205\ldots$ is the Riemann zeta function,

$$N = \left(\frac{16\pi k_B^3 \zeta(3)}{c^3 h^3}\right) V_{volume} T^3 \qquad \textbf{(14)}$$

In the case of a homogeneous magnetic field directed along the z-axis, the stress-energy tensor is

$$T^{00} = T^{11} = T^{22} = -T^{33} = \rho_B = \frac{\varepsilon_0 c^2 B^2}{8\pi};\ T^{0i} = 0 \qquad \textbf{(15)}$$

where $\rho_B[J/m^3]$-the magnetic energy density

Therefore, in this way is introduced the magnetic field PMF as if we consider the situation of the vortex, that corresponds with the above eq. (15) as following:

$$\varepsilon_{vortex} = \varepsilon_{e^+e^-pair} = \frac{V_{vol}\varepsilon_0 c^2 B_{PMF}^2}{8\pi} = \rho_B V_{vol}[J] = V_{reheat}$$

Thus,

$$E^2 = \frac{(V)^2}{\varepsilon_0 (\lambda_C^{e*})^2 \hbar c} \to E = 4.6 \times 10^{30}[N/C]$$, and E_{cr} = 3.8 × 10^{29} [N/C]; e = 1.6 10^{-19} [C]; $\hbar = 1.04 \times 10^{-34}[Js]$; V-is the electromagnetic potential

With theses result R/V = 5.5 × 10^{80}, that for $V_{Compton}$, results $R/V \times V_{Compton} \cong 0.47 \cong 1$ *pair*,

To note that in[4a,4b], $V[GeV]$ is the energy of a vortex.

The process continues in cascade during the reheating, when is a re-entry in horizon in the electroweak period. Thus, by using the same formula for reheating period till confinement are obtained the number of magnetic monopoles which are locked in strings till *CMB*, as following

$N_{pairs} = R_{M\bar{M}}^{ew} \cong 5.5 \times 10^{80} * V_{matter} \cong 5.5 \times 10^{90}\,pairs$, where the volume is given by:

The pairs production volume is

$$V_{matter} = (H_{end}^{-1}/a_{end})^3 \tau = 10^{10}[m^3 s] \qquad \textbf{(16)}$$

where the Hubble radius at the matter creation is $H_{matter}^{-1} = 10^4[m]$, a_{end} = 3.8 × 10^8 after that the field transfer to nucleons, see Figure 1. The process time is: $\tau \cong$ 10^{-6} ÷ 1[s], the necessary volume is $V_{necessary} = N_{pairs} * \lambda_C^3 = 10^{90} \times (7 \times 10^{-19})^3 = 2 \times 10^{36}[m^3]$, and the available volume is $V_{available} = (H_{matter}^{-1}/a_{end})^3 = 5.4 \times 10^{37}[m^3]$, that it is a very good result.

In the *Electroweak symmetry breaking and the quark epoch* which is between 10^{-12} – 10^{-6} [s] second after the Big Bang, when as the universe's temperature falls below a certain very high energy level, it is believed that in the frame of Standard Model, the Higgs field spontaneously acquires a vacuum expectation value (V = 247GeV), which breaks electroweak gauge symmetry. Via the Higgs mechanism, all elementary particles interacting with the Higgs field become massive, having been massless at higher energy levels. To note that the Hadron epoch is between 10^{-6} [s] and 1[s] after the Big Bang, when the quark–gluon plasma that composes the universe cools until hadrons, including baryons such as protons and neutrons, can form.

But, following the Inflation Dynamics, the potential nears the end of reheating (*quarks-gluons epoch*) is very much reduced, thus, at $H_{end}^{-1} = 10^6[m] \to 0.003s$, the potential becomes V_{end} = 100GeV. Therefore, apparently, is not any *trace* of an external residual field like of Higgs field. In others words, the Inflation does not explains the Higgs field. Only, if we consider that the top (t) and antitop ($\bar{t}$) quarks form a *bound state* that is a composite Higgs boson field.

In physics, a bound state describes a system where a particle is subject to a potential such that the particle has a tendency to remain localized in one or more regions of space. The potential may be either an external potential (in our case the Inflaton (at reheating) Potential), or may be the result of the presence of another particle.

In teorethical physics, Topcolor is a model of dynamical electroweak symmetry breaking in which the *top quark* and anti-top quark form a top quark condensate and act effectively like the Higgs boson. This is analogous to the phenomenon of superconductivity. These theories will ultimately be tested at the LHC in its Run-II commencing in 2015

Therefore, the as formed nucleons embed gluons into some structures of gauge t'Hooft monopoles) and of quarks pairs (u, d), as was shown in[4a].

In the present model, the things are similarly, for more; see the equivalence of my model with that of the Standard Model, respectively, the eq. (23) of App. A of[4a]. Thus, in my model the Inflaton potential, by Schwinger effect during the reheating period, generates all kinds of particles, in our cases gluons with structure of monopoles, magnetic monopoles themselves, and fermions (quarks, top quarks). In the model, these gluon-gluon interactions constrain color fields to string-like objects called "flux tubes", which exert constant force when stretched. The difference with Standard Model, is that all gluons (monopoles) are captured by all 3 × *flux_tubes* generated by $e\bar{e}$ quarks pairs (≅ 10^{90}) by the same Schwinger effect, as will result bellow

(b) Fermions production

The fermions (quark: s, u, d, t) pairs production by Schwinger effect

An interesting aspect of virtual particles (in vacuum), both theoretically and experimentally, is the possibility that they can become real by the effect of external fields. In this case, real particles are excited out of the vacuum. In the framework of quantum mechanics by Klein, Sauter, Euler and Heisenberg, who studied the behavior of the Dirac vacuum in a strong external electric field. If the field is sufficiently strong, the energy of the vacuum can be lowered by creating an electron-positron pairs $e\bar{e}$ (later, bounded in quarks). This makes the vacuum unstable.

Te first $e\bar{e}$ pair seems to be created in the same E as used above for magnetic monopoles ($M\bar{M}$) creation, and with the contribution of the magnetic field generated by thesis magnetic monopole as calculated above, $B_{monopol}$, also, both viewed as external magnetic fields. The next $e\bar{e}$ and $M\bar{M}$ are created in the reheating period ($V = 4 \times 10^{12}$ *GeV* with $V_{cr} = 10^{11}$ *GeV*) at the end of inflation.

Then, the 4-potential is given by $V_\mu = (-Ez, 0, Bx, 0)$, that copy very well with our new understanding, when the electric field E, and B is the magnetic field component.

In[4a,4b,6,12], eq. (73) is obtained the pair-production rate for fermions as

$$\frac{\Gamma_{JWKB}}{V} = \frac{\alpha}{\pi\hbar}\left(\sqrt{4\pi\varepsilon_0}\right)^2 (Bc)\cdot E\cdot\coth\left(\frac{\pi Bc}{E}\right)\exp\left(-\frac{\pi E_c}{E}\right) \tag{17}$$

for spin −1/2 particle,

where $\alpha = 1/137$, $V[m^3\,s]$ and $\sqrt{4\pi\varepsilon_0}$ to convert *cgs* → *SI*, JWKB meaning (Jeffreys-Wentzel-Kramers-Brillouin) model.

The effect of magnetic field is the same as shifting the *effective mass* $m_*^2c^4 = m_e^2c^4 + qB\hbar c^2(2j+1-\sigma)$ for fermions for each Landau level.

The Compton space-time volume of an electron has the size

$V_{Compton} = \lambda_C^3 \times (\lambda_C/c) = 9.4\times10^{-80}[m^3s]$,

where $\lambda_C = \hbar/m_*c = 2.3\times10^{-18}[m]$, **(18)**

the effective mass is

$$m_* = \sqrt{m_e^2c^4 + qB_{monopol}\hbar c^2}\,/c^2, \tag{19}$$

the *critical field* $E_c = \frac{m_*^2c^3}{e\hbar} < E = 3.5\times10^{28}[N/C]$; as from eq.(A.40) of[4a,4b] that results $m_* = 1.4 \times 10^{-25}$ [*kg*] in place of $m_e = 9 \times 10^{-31}$ [*kg*]

The potential B being the same as for monopoles pairs: $V = 10^4$ [*GeV*] → 1.6×10^{-6} [*J*]

$$E^2_{monopol} = \frac{(\varepsilon_{monopol})^2}{\varepsilon_0(\lambda^{monopol}_{Compton})^2\hbar c} \to\cong 4.6\times10^{30}[N/C]; \tag{20}$$

Reheating occurs promptly at the end of inflation. In the simple models that we have explored, this means that the reheat temperature begins at least 10^{11} *GeV*. $B_{monop} \cong E_{monopol}/c = 1.5 \times 10^{22}$ [J/Am^2];

And the external field is

$$E^2 = \frac{(V)^2}{\varepsilon_0(\lambda_C^{e*})^2\hbar c} = \frac{V^2m_*^2c}{\varepsilon_0\hbar^3}; \tag{21}$$

So, it results the same value as above: $E = 1.4 \times 10^{30}$ [N/C]

With these values it results: the number of quarks pairs ($e\bar{e}$) created as $\Gamma_{JWKB}/V = 9.4\times10^{78}\left[e\bar{e}\_pairs/m^3s\right]$.

If the pairs production volume is $V_{matter} = (H^{-1}_{end}/a_{end})^3$ $\tau = 10^{10}[m^3s]$, $\Gamma_{JWKB} = 9.4 \times 10^{88}$ where the Hubble radius at the matter creation is $H^{-1}_{matter} = 10^4[m]$, after that, in case of top quarks the field transfers to Higgs field, see Figure 1. The process time is: τ $10^{-6} \div 1[s]$, the necessary volume is $V_{necessary} = N_{pairs} * \lambda_C^3 = 9.4\times10^{88}\times(7\times 10^{-19})^3 = 3.4\times10^{34}[m^3]$, and the available volume is $V_{available} = (H^{-1}_{matter}/a_{end})^3 = 5.4\times10^{37}[m^3]$, that it is a very good result.

Or, if we consider $V_{Compton}$, it result a rate $\Gamma_{JWKB} * V_{Compton} \cong 0.9[e^{\pm}$ *pairs*], that means a continuously process which ends at quarks epoch, or when both the scaled values of V and V_{cr} (for each known mass-today), becomes $V \le V_{cr}$.

In other words, at very early time inside the Inflation Volume are available only pairs of *massive electron-positron-quarks* (*u*, *d*) which will later form Coulomb flux tubes, and of top quarks ($t, \bar{t}$), which create Higgs field, all that has been created by the conjugation of the field $E(V)$ and of the magnetic field $B_{monopole}$ already generated only by the Schwinger effect based only on the field $E(V)$.

Immediately, at confinement, the quarks forms *Coulomb flux tubes*, thesis capturing gluons organized in monopole type structures (hedgehog) as is explained in[4a,4b,4c], in order to form a *primordial massive vortexes* 1/3 – *nucleon.*

Finally, theses pairs together form nucleons of an *incredibly exactly* number $\cong 10^{90}$, which is the known number of particles in Universe. Since, the potential continues to diminish, thus, at approximately $V \cong 0.1[GeV]$-that corresponding to confinement (10$s \div 20$ min *utes*), see Figure 1, then the production of gluons (monopoles) stops. But, the a near a value of ν.*e*.ν field it was, also, created *inside nucleons*, as was found in the frame of Dual Ginsburg-Landau theory[4a,4b,4c], that due of the interaction between the three vortexes which compose the nucleons, see eq. (42), (45), (46), (47), (66), (69) of my model[4a]. This field is sufficient to create new pairs of $W^{\pm}$, Z, $e\bar{e}$ by the same Schwinger effect, that makes possible the beta decay of free neutrons, and later of isotopes. As a consequence it follows that Eq.(3.15) of[19b] does not depend on $n_{\max}$ and the n → p conversion grows linearly with the field strength above B_c. In the absence of other effects, the consequence of the amplification of $\Gamma_{n \to p}$ due to the magnetic field would be to decrease the relic abundance of ^4He. A such result it was found in[4a].

Also, this field creates a *Lorenz force* between quarks flux tube and gluons (monopoles) current, that is found to explain the gravity of nucleons (mass), as it was already found before.

THE SPECTRUM AT *CMB*

Here, it is defined an “effective magnetic field”, B_{eff}, in terms of the total energy density in the magnetic field,

$$\varepsilon_0 = \frac{B_{eff}^2}{8\pi} \tag{22}$$

Roughly speaking, the multipole moments C_L^{TT} measure the mean-square temperature difference between two points separated by an angle$(\theta/1^\circ) \approx 200/l$.

At this surface an angle θ degrees subtends a comoving distance $x \cong 200\theta Mpc$.

For a dipole, $k = E/\hbar c$; with eq.(21) $E = 4 \times 10^{-36}$ $[J] \to B_{PMF}$; and distance along the tube between two magnetic monopoles $d = 67 \times \lambda$; $\lambda = 2 \times 10^{-16}$ $[m]$ as from[8], resulting $k = 4.3 \times 10^{-11}$ $[m^{-1}]$; $\varpi = kc = 1.3 \times 10^{-2}$ $[s^{-1}]$

For example, to describe the electromagnetic potential, V, from a source in a small region near the origin, the coefficients may be written as:

$$V(r,\theta,\phi) = \sum_{l=0}^{\infty} \sum_{m=-l}^{l} C_l^m(r) Y_l^m(\theta,\phi) \tag{23}$$

From[13], it results that before recombination, Thomson scattering between photons and electrons along with Coulomb interactions between electrons and baryons were sufficiently rapid that the photon-baryon system behaved as a single tightly coupled fluid.

Since the trajectory of plasma particles is bent by Lorentz forces in a magnetic field, photons are indirectly influenced by the magnetic field through Thomson scattering. Let us consider the *PMF* created at some moment during the radiation-dominated epoch.

The energy momentum tensor for electromagnetism is

$$T_{[EM]}^{00} = \frac{B^2}{8\pi a^6} \tag{24}$$

We assume that the *PMF*, B_0 is statistically homogeneous, isotropic and random. For such a magnetic field as result from[13], the fluctuation power spectrum can be taken as a power-law $S(k) \leq \langle B(k)B^*(k)\rangle \approx k^{n_B}$ where n_B is the power-law spectral index of the *PMF*.

Although possible origins of the *PMF* have been studied by many authors[19a,19b], there is no consensus as to how the *PMF* correlates with the primordial density fluctuations. Nonetheless, almost all previous works have assumed that there is no correlation between them. In order to study the possible effects of a *PMF* in a more general manner, in[13] is considered a possible correlations between the *PMF* and the primordial density and tensor fluctuations.

Based on fundamental works, then, it is described a connection between electroweak strings and primordial magnetic fields. The basic idea is that, as the Higgs field acquires a vacuum expectation value, currents are produced that lead to a magnetic field[19b]. Once magnetic fields are generated they can be imprinted in the highly conductive medium and eventually survive.

The first generalized definition of the electromagnetic field in the presence of a non-trivial Higgs background was given by t’Hooft ref. [150] of[19b] in the seminal paper where he introduced magnetic monopoles in a SO(3) Georgi-Glashow model. In this case singular points (monopoles) or lines (strings) where $\varphi_a = 0$ appear which the source of magnetic fields become. t’Hooft result provides an existence proof of magnetic fields produced by non-trivial vacuum configurations model. A possible generalization of the definition (4.21) of[19b] for the Weinberg-Salam model was given by Vachaspati ref. [106] of[19b]. The eq. (4.23) was used by Vachaspati[19b] to argue that magnetic fields should have been produced during the electroweak phase transition (EWPT). Since, here, on dimensional grounds, $D_\nu \approx \nu/\xi$ where ν is the Higgs field vacuum expectation value, Vachaspati concluded that magnetic fields (electric fields were supposed to be screened by the plasma) should have been produced at the EWPT with strength $B \approx \sin\theta_w g T_c^2 \cong 10^{23} G \rightarrow 10^{19} [T]$. Here, the Hubble radius at the EWPT is of the order of 1*cm* whereas $\xi = (eT_c)^{-1} \cong 10^{-16}$ *cm*, where $T_c \cong 100 GeV$ is the critical temperature at which the phase transition occurs. The both values are confirmed in the present work.

In the present work, I have discovered which could be the exact origin of *PMF*, namely, the magnetic flux of magnetic (anti)monopole as been generated by a Schwinger effect due of an external electrical field during the inflation.

In the work[13], are implemented a numerical method to evaluate the *PMF* source power spectrum. Using this method, they are able to quantitatively evolve the cut off scale and thereby reliably calculate the effects of the *PMF* on the observed *CMB* power spectrum.

Also, in[13] are explored the effects of a *PMF* on the *CMB* for the allowed *PMF* parameters (i.e. $B_\lambda < 10nGs$ and $n_B < -2.4$).

In theirs model, the BB mode from the *PMF* can dominate for $l \cong 200$ if $B_\lambda \cong 2.0nGs$. A potential problem in attempting to detect this signal on such angular scales, therefore, is the contamination from gravitational lensing which converts the dominant EE power into the BB mode. Since, our results on value of $B_{PMF} = 1.5 \times 10^{-12} [T] \rightarrow 15[nGs]$, are near identically, all the conclusions of the works[13] remaining the same.

We also point out that the observed power spectrum of temperature fluctuations in the *CMB* is likely to depend on frequency. Such dependence is theoretically expected to originate from foreground effects such as the Sunyaev-Zel'dovich effect at higher multipoles. In contrast, the effects of a *PMF* are frequency-independent because the *PMF* affects the primary *CMB* as a background. Therefore, the correlation between the *PMF* and other foreground effects should be weak. Because of this, one should be able to eventually distinguish the *PMF* from foreground effects by using more than two observational data sets at different frequencies.

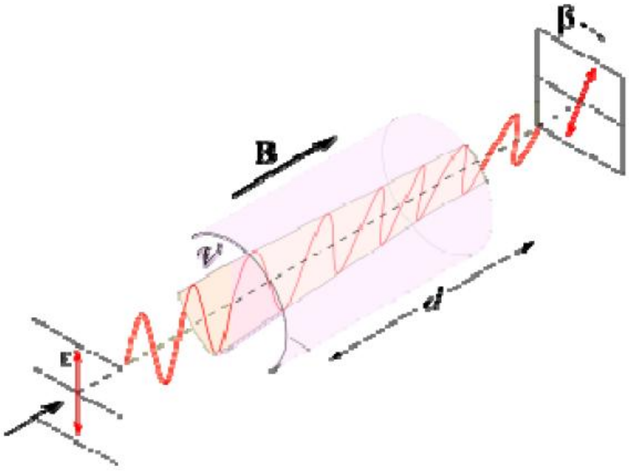

Figure 3 : The Faraday rotation

In the context of anisotropies induced by density perturbations, velocity gradients in the photon-baryon fluid are responsible for the quadrupole that generates polarization[14].

FARADAY ROTATION CORRELATORS

In physics, the *Faraday effect* or *Faraday rotation* is a magneto-optical phenomenon, that is, an interaction between light and a magnetic field in a medium, see Figure 3. The Faraday Effect causes a rotation of the plane of polarization which is linearly proportional to the component of the magnetic field in the direction of propagation. Formally, it is a special case of gyroelectromagnetism obtained when the dielectric permittivity tensor is diagonal.

Let us notice however, that the lensing signal, as well as that generated by gravitational waves, are independent of the frequency, while F scales as ν_0^{-2}, thus multi-frequency measurements should easily distinguish the Faraday rotation contribution.

From[11,15], the *CMB* is linearly polarized and an intervening magnetic field will rotate the polarization vector at a rate given by:

$$F = \frac{3}{8\pi^2 e} \frac{B_0}{\nu_0^2} \tag{25}$$

The coefficient F represents the average Faraday rotation (in radians) between Thomson scatterings[8]. ν_0 is the *CMB* frequency observed today. $B_* = B(t_*)$ is the strength of the primordial magnetic field at a redshift $z_* = 1000$, around the time of decoupling of matter and radiation. Current bounds suggest that a magnetic field pervading cosmological distances, if it exists, should have a present strength below $B_0 \cong 10^{-9}$ *Gauss*. It is conceivable that the large scale magnetic fields observed in galaxies and clusters have their origin in a primordial field, and several theoretical speculations exist about its possible origin[16], like the intergalactic dust. As it was shown above, the primordial magnetic field is expected to scale as $B(t) = B(t_0)\, a^2(t_0)/a^2(t)$, where $a(t)$ is the Robertson-Walker scale factor defined above.

Finally, at the end of *CMB* when the Hubble length arrives at $H_{CMB}^{-1} = 10^{21} [m]$, all ($10^{90}$) of magnetic monopoles pairs produced are already *bounded* in strings, and the light of $B - curl$ type imprinted is due of theirs magnetic field $B_{PMF} = B_{CMB} \cong 1.5 \times 10^{-12} [T]$.

A near the same number of magnetic monopoles pairs are coupled in neutral dumbbell strings as dark mater particles[18], that at the decoupling time.

Also, in classical optics a light ray can be bent if there is a gradient in the refractive index. However in QED it is possible by the vacuum polarization that allows the photon to exist as a virtual e^{-} – e^{+}-pair via which the external field can couple. Thus, the total bending angle due of thesis dark matter particles can be obtained by Kim's formula[7,8,17].

Therefore, only in this way we can explain the both processes, *the monopoles pairs suppression by bounding* its in strings, that explains the magnetic monopoles absence mentioned in[20]. Also, as an magnetic field can "pass" the *plasma* as to be formed by particles till *CMB*. Also, the gravitational field it is not affected by this plasma. And the second, respectively, the generation of top quarks pairs which can explain the preservation of the external Higgs field and, thus is was prevented this field decay. The generation of pairs of magnetic monopoles which couple in strings can explains the "decoration" of *CMB*, and the presence of the dark matter. This because, the Inflation field diminish very fast, the field of individual monopoles becomes very low today, or to explain the dark matter, it needs to be *conserved in* some *neutral* particles, like these magnetic monopoles strings, when the conserved value is B_{PFM} = 10^{-15} [T] in case of dark matter, already found in[8].

We also point out that the observed power spectrum of temperature fluctuations in the *CMB* is likely to depend on frequency. Such dependence is theoretically expected to originate from foreground effects such as the Sunyaev-Zel'dovich effect at higher multipoles. In contrast, the effects of a *PMF* are frequency-independent because the *PMF* affects the primary *CMB* as a background. Therefore, the correlation between the *PMF* and other foreground effects should be weak. Because of this, one should be able to eventually distinguish the *PMF* from foreground effects by using more than two observational data sets at different frequencies.

The present model presents a unitary theory of Universe evolution as from Universe Inflation to matter creation, *CMB* imprints origin, dark matter field value, and the number of primordial blackholes.

CONCLUSIONS

The values of the field for different epochs (quarks, hadrons, leptons) resulted to be correlated with Inflation evolution, especially in the reheating period. The application of Schwinger effect has ours permitted to calculate the numbers and masses for all kinds of pairs (gluons, quarks, magnetic monopoles). The presence of magnetic monopoles (being of spin-1) at quarks creation is mandatory, since its furnishe the necessary magnetic field B.

Thus, in the work is found that *the monopoles pairs suppression is by bounding* its in strings. The generation of top quarks pairs can explain the preservation of the external Higgs field, also by bounding its in some ways like the scalar Higgs particles (H), and thus, it is was prevented the decay of thesis fields. The generation of pairs of magnetic monopoles which couple in strings can explains the "decoration" of *CMB*, and the presence of dark matter. Since, the Inflation field diminishes very fast, the field of individual monopoles diminish also, or to explain:

CMB B-imprints, and the presence of the dark matter, it needs that this field to be *conserved in* some particles, like theses magnetic monopoles strings, where the conserved value today is B_{PFM} = 10^{-20} [T], already found in[8], and that of the Higgs field is 125*GeV*.

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