

# MATTER THEORY OF EXPANDED MAXWELL EQUATIONS

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ABSTRACT. This article try to unified the four basic forces by Maxwell equations, the only experimental theory. Self-consistent Maxwell equation with the e-current from matter current is proposed, and is solved to four kinds of electrons and the structures of particles. The static properties and decay are reasoned, all meet experimental data. The equation of general relativity sheerly with electromagnetic field is discussed as the base of this theory. In the end the conformation elementarily between this theory and QED and weak theory is discussed.

## CONTENTS

1. Unit Dimension of $sch$	1
2. Self-consistent Electrical-magnetic Fields	2
3. Calculation of Recursive Re-substitution	3
4. Solution	3
5. Electrons and Their Symmetries	4
6. Propagation and Movement	6
7. Conservation Law and Balance Formula	7
8. Muon	7
9. Pion	8
10. Pion Neutral	8
11. Tau	8
12. Proton	9
13. Neutron	9
14. Great Unification	9
15. Conclusion	10
References	10

## 1. UNIT DIMENSION OF $sch$

A rebuilding of units and physical dimensions is needed. Time  $s$  is fundamental.

We can define:

The unit of time:  $s$  (second)

The unit of length:  $cs$  ( $c$  is the velocity of light)

The unit of energy:  $\hbar/s$  ( $h$  is Plank constant)

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*Date:* Mar 27, 2018.

*Key words and phrases.* Maxwell equations, Decay, Electron function, Recursive re-substitution.

The unit dielectric constant  $\epsilon$  is

$$[\epsilon] = \frac{[Q]^2}{[E][L]} = \frac{[Q]^2}{\hbar c}$$

The unit of magnetic permeability  $\mu$  is

$$[\mu] = \frac{[E][T]^2}{[Q]^2[L]} = \frac{\hbar}{c[Q]^2}$$

We can define the unit of  $Q$  (charge) as

$$c\epsilon = c\mu = 1$$

then

$$[Q] = \sqrt{\hbar}$$

$$[H] = [Q]/[L]^2 = [cD] = [E]$$

Then

$$\sqrt{\hbar} : C = (1.0546 \times 10^{-34})^{1/2}$$

$C$  is charge SI unit Coulomb.

For convenience we can define new base units by unit-free constants

$$c = 1, \hbar = 1, [Q] = \sqrt{\hbar}$$

then all physical unit are power of second  $s^n$ , the units are reduced.

Define

$$\text{UnitiveElectricalCharge} : \sigma = \sqrt{\hbar}$$

$$\sigma = 1.03 \times 10^{-17} C \approx 64e$$

$$e_{/\sigma} = e/\sigma = 1.57 \times 10^{-2} \approx 1/64$$

Define

$$s \rightarrow Cs =: \kappa : m_e = 1$$

We always use it.

## 2. SELF-CONSISTENT ELECTRICAL-MAGNETIC FIELDS

Try so-called expanded Maxwell equation for the free E-M field in mass-center frame

$$(2.1) \quad \partial \cdot \partial' A = iA^{\nu*} \cdot \partial A_{\nu}/2 + cc. = -J, \quad \sigma = 1$$

or

$$\partial \cdot \partial' A = ie_{/\sigma} A^{\nu*} \cdot \partial A_{\nu}/2 + cc. = -J, \quad e = 1$$

$$\partial_{\nu} \cdot A^{\nu} = 0$$

with definition

$$(A^i) := (V, \mathbf{A}), (J^i) = (\rho, \mathbf{J}), (J_i) = (-\rho, \mathbf{J})$$

$$\partial := (\partial_i) := (\partial_t, \partial_{x_1}, \partial_{x_2}, \partial_{x_3})$$

$$\partial' := (\partial^i) := (-\partial_t, \partial_{x_1}, \partial_{x_2}, \partial_{x_3})$$

It's deduced by using momentum to express e-current in a electron: the mass and charge have the same movement in electron. The equation 2.1 have symmetry

$$CPT, cc.PT$$

The energy of the field  $A$  are

$$(2.2) \quad \varepsilon := \int dV (E \cdot E^* + H \cdot H^*)/2 = \langle \nabla A^{\nu}, \nabla A_{\nu} \rangle$$

It's also valid with Lorentz gauge. In Coulomb gauge it's

$$\varepsilon = \langle \rho, V \rangle = \langle E, E \rangle$$

As a convention the time-variant part is neglected.

With invariant normalization for one particle, this condition is found:

$$(2.3) \quad 1 = e_{/\sigma} \int_0^\infty dt \langle A^\nu, \partial \cdot \partial' A_\nu \rangle, e = 1$$

by the non-homogeneous equation 2.1, unless the particle is eternal.

### 3. CALCULATION OF RECURSIVE RE-SUBSTITUTION

We can calculate the solution by recursive re-substitution (RRS) for the two sides of the equation. For the equation

$$\hat{P}' B = \hat{P} B$$

make the algorithm (It's approximate, the exact solution needs a rate in the re-substitution)

$$\hat{P}' \left( \sum_{k \leq n} B_k + B_{n+1} \right) = \hat{P} \sum_{k \leq n} B_k$$

One can write down a function initially and correct it by re-substitution. Here is the initial state

$$V = V_i e^{-ikt}, A_i = V, \partial_\mu \partial^\mu A_i^\nu = 0$$

Substituting into equation 2.1 and then we can find

$$\partial_\nu \cdot J^\nu = 0$$

hence

$$\partial_\nu \cdot A^\nu = 0$$

We call the fields' correction  $A_n$  with  $n$  degrees of  $A_i$  the  $n$  degrees correction.

The decay to a stable state is calculated in isolated system. It's a process the EM energy  $\varepsilon_t = \varepsilon - \varepsilon_f$  transfer to mechanical (kinetic) energy  $E_k = \varepsilon_0 - \varepsilon_t$ . With the matter number invariant normalization in space-time (2.3)

$$\begin{aligned} 1 &= \int_0^\infty e_{/\sigma} dt \langle A^\nu, \partial \cdot \partial' A_\nu \rangle, e = 1 \\ &= - \int_0^\infty e_{/\sigma} dt \langle A^\nu, J_\nu \rangle / 2 = - \int_0^\infty dt e_{/\sigma} \varepsilon_0 e^{-Ct}, e = 1 \end{aligned}$$

then

$$C = e_{/\sigma} \varepsilon_0$$

$$\varepsilon_t / \varepsilon_0 = e^{-Ct}$$

$\varepsilon_0 - \varepsilon_t$  is of cause the decrease of the crossing energy of all the decayed blocks.

## 4. SOLUTION

Firstly

$$\nabla^2 A = k^2 A$$

is solved. Exactly, it's solved in spherical coordinate

$$0 = r^2(\nabla^2 f - k^2 f) = -k^2 r^2 f + (r^2 f_r)_r + \frac{1}{\sin \theta}(\sin \theta f_\theta)_\theta + \frac{1}{\sin^2 \theta}(f_\phi)_\phi$$

Its solution is

$$f = R\Theta\Phi = R_l Y_{lm}$$

$$\Theta = P_l^m(\cos \theta), \Phi = \cos(\alpha + m\phi)$$

$$R_l = N j_l(kr)$$

$j_l(r)$  is spherical Bessel function.

$$j_1(r) = \frac{\sin(r)}{r^2} - \frac{\cos r}{r}$$

$$j_1(0) = 0$$

$$\int_0^\infty dr \cdot r^2 j_1(kr) |j_1(k'r) = C k^{-2} \delta(k - k')$$

Define

$$F(x) := N R_1(r) Y_{1,\pm 1}(\theta, \phi)$$

Use discrete coordinates to get more correct calculation:

$$\langle k^{3/2} F(kx), k^{3/2} F(kx) \rangle = 1$$

$$k^{3/2} F(kx)^* * k^{3/2} F(kx) = \delta(kx) = \delta(x)/k^2$$

and

$$F^n(x) F^{n'*}(x) e^{-ict} * \delta(t - r)/(4\pi r) = F^n(x) F^{n'*}(x) e^{-ict}$$

$$\langle F^n(x), F^n(x) \rangle = 1$$

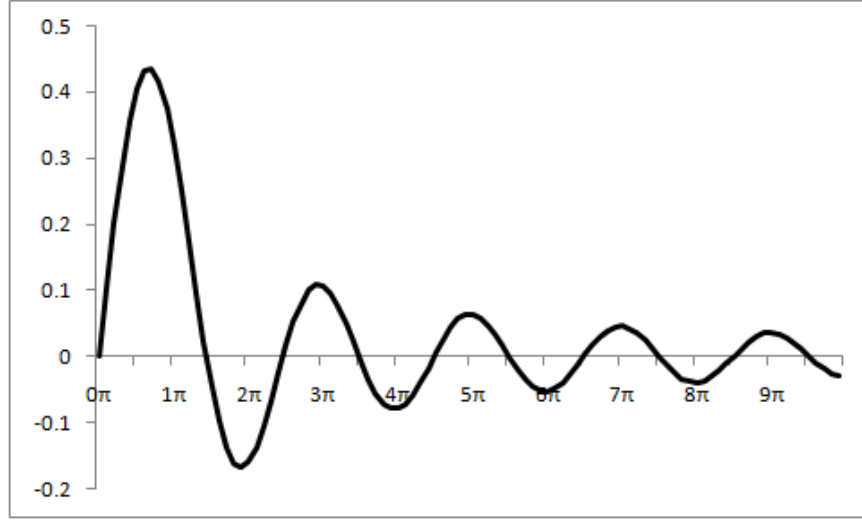
We notice that for

$$\nabla^2 F(x)$$

the point  $O$  is a singular point.

The solution of  $l = 1, m = 1, Q = e_{j\sigma}$  is calculated or tested for electron,

$$V = -N R_1(kr) Y_{1,-1} e^{-ikt}$$

FIGURE 1. The function of  $j_1$ 

## 5. ELECTRONS AND THEIR SYMMETRIES

Some states of electrical field  $A$  are defined as the core of the electron, which's the initial function  $A_i = V$  that is electrical, for the re-substitution to get the whole electron function  $e$ :

$$\begin{aligned} e_r^+ &: NR_1(k_e r)Y_{1,1}e^{ik_e t} \\ e_l^+ &: NR_1(k_e r)Y_{1,-1}e^{ik_e t} \\ e_r^- &: -NR_1(k_e r)Y_{1,-1}e^{-ik_e t} \\ e_l^- &: -NR_1(k_e r)Y_{1,1}e^{-ik_e t} \end{aligned}$$

$r, l$  is the direction of the spin.

Normalize the electron function with charge and mass

$$\begin{aligned} \langle e_\mu | i\partial_t | e^\mu \rangle / 2 + cc. &= 1/e_\sigma, e = 1 \\ \langle \nabla e_\mu | \nabla e^\mu \rangle &= 1, \sigma = 1 \end{aligned}$$

Then

$$|k_e| = 1$$

The magnetic dipole moment of electron is calculated as the first rank of proximation

$$\begin{aligned} -\mathbf{r} \times \partial \cdot \partial' A / 4 + cc. \\ \mu_z &= \langle A_i | -i\partial_\phi | A_i \rangle / 4 + cc. \\ &= \frac{Q_e}{2k_e} \end{aligned}$$

By the discussion in the section 2 the spin is

$$S_z = \mu_z k_e / e = 1/2$$

The correction of the equation 2.1 is

$$(5.1) \quad A_n = A_{n-1} i\partial(A_i - A_i^*) / 2 * u$$

$$= (A_i^*(i\partial_t A_i))((i\partial_t(A_i - A_i^*)/2)^{n-3}((i\partial_t(A_i - A_i^*)/2))$$

$$u = \delta(t - r)/(4\pi r)$$

The convolution is made in 4-d space. In fact

$$\partial' \cdot \partial e = e - A_i$$

and then

$$(5.2) \quad \int d^4 x e^{\nu*} \partial' \cdot \partial e_\nu = 0$$

The function of  $e_r^+$  is decoupled with  $e_l^+$

$$\langle (e_r^+)^{\nu}, (e_l^+)^{\nu} \rangle = 0$$

The definition of  $m_e = 1$  is always used.

The increment of field energy  $e_{/\sigma}\varepsilon$  on the coupling of  $e_r^+, e_r^-$  mainly between  $A_2$  is

$$e_{/\sigma}\varepsilon_e = e_{/\sigma} \langle (e_r^+)^{\nu}, (e_r^-)^{\nu} \rangle \approx -2e_{/\sigma}^3 m_e = -\frac{1}{1.66 \times 10^{-16} s}$$

This value of increments on the coupling of electrons are

$\varepsilon_e$	$e_r^+$	$e_r^-$	$e_l^+$	$e_l^-$
$e_r^+$	+	-	0	0
$e_r^-$	-	+	0	0
$e_l^+$	0	0	+	-
$e_l^-$	0	0	-	+

The increment of field energy  $e_{/\sigma}\varepsilon$  on the coupling of  $e_r^+, e_l^-$  mainly between  $A_4$ , is

$$e_{/\sigma}\varepsilon_x = e_{/\sigma} \langle (e_r^+)^{\nu}, (e_l^-)^{\nu} \rangle \approx -\frac{1}{2}e_{/\sigma}^7 m_e = -\frac{1}{1.09 \times 10^{-8} s}$$

This value of increments on the coupling of electrons are

$\varepsilon_x$	$e_r^+$	$e_r^-$	$e_l^+$	$e_l^-$
$e_r^+$	+	0	0	-
$e_r^-$	0	+	-	0
$e_l^+$	0	-	+	0
$e_l^-$	-	0	0	+

Because

$$\partial \cdot \partial'(-e(-t)) = ie_{/\sigma}\partial(-e(-t))^{\nu*} \cdot (-e(-t))_{\nu}/2 + cc., e = 1$$

	$e_r^+$	$e_r^-$	$e_l^+$	$e_l^-$	$-e_r^+$	$-e_r^-$	$-e_l^+$	$-e_l^-$
$Q$	+	-	+	-	+	-	+	-
$S$	$r$	$r$	$l$	$l$	$r$	$r$	$l$	$l$
$\mu_B$	$r$	$l$	$l$	$r$	$l$	$r$	$r$	$l$
$\varepsilon(m)$	+	+	+	+	+	+	+	+

Define

$$C(-e) = -C(e) = -1$$

## 6. PROPAGATION AND MOVEMENT

The propagation:

$$A := f * \sum_i e_i,$$

$$f * e := \int d^3y f(\mathbf{x} - \mathbf{y})e(\mathbf{y})$$

The following are stable propagation:

<i>particle</i>	<i>electron</i>	<i>photon</i>	<i>neutino</i>
<i>notation</i>	$e_r^+$	$\gamma_r$	$\nu_r$
<i>structure</i>	$e_r^+$	$(e_r^+ + e_r^-)$	$(e_r^+ + e_l^-)$

By the condition of 2.3 or 5.2, their static mass except the couplings is zero.

The movement of the propagation is called *Movement*, ie. the third level wave:

$$f * \sum f_i * e_{ij}$$

Calculating the following coupling system of particle  $x$

$$A := e_x * \sum_c n_c e_c, \langle e_x | e_x \rangle = 1$$

$c$  differ in charge, spin and being negative or not. Make RRS with the initial state

$$e_{xi} = NR_1(k_x x) Y e^{ik_x t}$$

to get the dynamic state.

With the normalization conditions of charge

$$(6.1) \quad \langle e_x * (\sum_i e_i)^\nu | i\partial_t | e_x * (\sum_i e_i)^\nu \rangle = Q_x$$

hence

$$k_x \approx \sum_{cc'} n_{cc'}^2 / Q_x$$

$$(6.2) \quad \varepsilon = \langle \nabla e_x * (\sum_i e_i)^\nu | \nabla e_x * (\sum_i e_i)^\nu \rangle \approx \sum_{cc'} n_{cc'}^2 / e$$

and

$$-J \approx \sum_i \langle e_x * e_i^\mu | i\partial | e_x * e_{i\mu} \rangle / 2 + cc.$$

Then the static MDM (magnetic dipole moment) is

$$\mu_z \approx \sum_i \langle e_i^\mu | \partial_\phi | e_{i\mu} \rangle m_e / (4k_x) + cc.$$

The harmonic wave behaves in Lorentz transform

$$e^{ipx} * e(x) = e^{ip'x'} * e(x')$$

$$p^\nu p_\nu = p'^\nu p'_\nu = 0$$

## 7. CONSERVATION LAW AND BALANCE FORMULA

The reaction

$$A_{1i} - A_{2i} \rightarrow A_{1f} - A_{2f}$$

is equivalent of the same energy emission to

$$A_{1i} + A_{2f}(x, -t) \rightarrow A_{1f} + A_{2i}(x, -t)$$

by the fourier forms of the both. This means we can shift electron to the other side, with the same emission of EM energy.

No matter in E-M fields level or in movement (the third) level, the conservation law is *conservation of momentum and conservation of angular momentum*. A *balance formula* for a reaction is the equivalent formula in positive matter, ie. after all negative terms is shifted to the other side of the reaction formula. Balance formula is suitable for the analysis of the energy transition of decay. The *invariance of electron itself* in reaction is also a conservation law.

## 8. MUON

The core of muon is

$$\mu_l^- : e_\mu * (e_l^- - e_r^- - e_l^+)$$

From the equation 14.1,  $\mu$  is approximately with mass  $3m_e/e/\sigma = 3 \times 64m_e$  [3.2][1] (The data in bracket is experimental by the referenced lab), spin  $S_e$  (electron spin), MDM  $\mu_B k_e/k_\mu$ .

The main channel of decay

$$\mu_l^- \rightarrow -e_l^- + \nu_r - \nu_l$$

with balance formula

$$\begin{aligned} e_\mu * e_l^- + \delta^{1/2}(x - v_1 t) * e_r^+ + \delta^{1/2}(x + v_3 t) * \nu_l \\ \rightarrow e_\mu(-t) * \nu_l + \delta^{1/2}(x - v_2 t) * \nu_r \end{aligned}$$

The main EM effect is

$$\langle \nabla e_\mu(-t) * (e_r^+)^{\nu} | \nabla e_\mu(-t) * (e_l^-)_{\nu} \rangle - \langle \nabla (e_r^+)^{\nu} | \nabla (e_l^-)_{\nu} \rangle$$

Take the formula 6.1 as the correction of the formula 6.2

$$\approx -\frac{\varepsilon_x m_e}{k_\mu} = \frac{1}{2.18 \times 10^{-6} s} / e/\sigma \quad [2.1970 \times 10^{-6} s][1]$$

## 9. PION

The core of pion is

$$\pi_l^+ : e_\pi * e_l^+ + e_\pi^* * (e_r^+ + e_l^-)$$

It's approximately with mass  $4 \times 64m_e$  [4.2][1], spin  $S_e$  and MDM  $\mu_B k_e/k_{\pi^+}$ .

Decay Channels:

$$\begin{aligned} \pi_l^+ \rightarrow -\mu_l^+ + \nu_l \\ e_\pi * e_l^+ + e_\pi^* * \nu_r + \delta^{1/2}(x + v_1 t) * e_\mu(-t) * e_r^- \\ \rightarrow \delta^{1/2}(x - v_1 t) * e_\mu * \nu_r + \delta^{1/2}(x - v_2 t) * \nu_l \end{aligned}$$



The neutrino coupling in  $\delta(x - v_2 t) * \nu_l$  is coupled, and only half of the spectrum support positive emission. In  $e_\pi^* * \nu_r$ , decoupled. The main EM effect is

$$-\varepsilon_x/2 = \frac{1}{2.18 \times 10^{-8} s} / e/\sigma \quad [(2.603 \times 10^{-8} s)[1]]$$

#### 10. PION NEUTRAL

The core of pion neutral is like a atom

$$\pi^0 : (e_{\pi 1} * (e_r^+ + e_l^+), e_{\pi 2} * (e_r^- + e_l^-))$$

It has mass approximately  $4 \times 64m_e$  [4.2][1], zero spin, and zero MDM. Its decay modes are

$$\pi^0 \rightarrow \gamma_r + \gamma_l$$

The loss of energy is

$$-2\varepsilon_e = \frac{1}{8.3 \times 10^{-17} s} / e/\sigma \quad [8.4 \times 10^{-17} s][1]$$

The magnetic coupling in  $e_{\pi 1} * (e_r^+ + e_l^+)$  is  $k_e/k_\pi$  times of its electric coupling.

#### 11. TAU

The core of tauon maybe

$$\tau_l^+ : e_\tau * (5e_r^+ - 5e_l^- - e_l^+)$$

Its mass approximately  $51 \times 64m_e$  [54][1], spin  $S_e$ , MDM  $\mu_B k_e/k_\tau$ . It has decay mode

$$\begin{aligned} \tau_l^+ &\rightarrow \mu_l^+ + \nu_r - \nu_l \\ e_\tau * 5e_r^+ + \delta^{1/2}(x + v_3 t) * \nu_l + \delta^{1/2}(x + v_1 t) * e_\mu^* * \nu_r &\rightarrow \\ e_\tau(-t) * 5e_r^+ + e_\tau(-t) * e_r^- + \delta^{1/2}(x - v_1 t) * e_\mu * e_l^+ + \delta^{1/2}(x - v_2 t) * \nu_r &\end{aligned}$$

The main EM effect is

$$\begin{aligned} &\langle \nabla e_\tau(-t) * (5e_r^+)^{\nu} | \nabla e_\tau(-t) * (e_r^-)^{\nu} \rangle - \langle \nabla (5e_r^+)^{\nu} | \nabla (e_r^-)^{\nu} \rangle \\ &\approx \frac{5\varepsilon_e m_e}{k_\tau} = \frac{1}{1.08 \times 10^{-13} s} / e/\sigma \quad [2.91 \times 10^{-13} s; BR. \quad 0.17][1] \end{aligned}$$

Depending on this kinds of particle including

$$q_r^{n+} := n(e_r^+ - e_l^-)$$

we can construct particles of great mass decaying without strong effect (light radiative), for example

$$e_x * (q^n - e)$$

Perhaps these particles are mingled in some degree as to the detector can't distinguish them completely.

#### 12. PROTON

The core of proton may be like

$$p_r^- : e_p * (-4e_r^+ - 3e_r^- - 2e_l^-)$$

The mass is  $29 \times 64m_e$  [29][1] that's very close to the real mass. The MDM is calculated as  $3\mu_N$ , spin is  $S_e$ . The proton thus designed is eternal.

## 13. NEUTRON

Neutron is the atom of a proton and a electron and a neutrino,

$$n = (p_r^+, -\nu_l, e_l^-)$$

Neutrino circles around proton with

$$m_\nu \omega r^2 = 1$$

The effect is between their (proton and neutrino) magnetic fields of  $A_2$  (gross current)

$$m_\nu \omega^2 r \approx 3 \cdot 3 \cdot 2 \cdot (\varepsilon_e/2) m_e / (m_p r^2)$$

$$m_\nu = e_{/\sigma}^6 m_e$$

The EM energy emitted by neutrino is approximately

$$18^2 e_{/\sigma}^{6+4+2} m_e^3 / (m_p^2 e_{/\sigma}^2) = \frac{1}{971s} / e_{/\sigma}$$

## 14. GREAT UNIFICATION

The mechanic feature of the electromagnet fields is

$$T_{ij} = F_i^{k*} F_{kj} - g_{ij} F_{\mu\nu} F^{\mu\nu*} / 4$$

$T$  is stress-energy tensor,

$$T_{ij} = \sum m u_i u_j, u = dx/ds$$

$T_{00}$  is quantum expression of the energy, by Lorentz transform it's easy to get the quantum expression of momentum. The observed mass in mass-center frame is

$$M = \int dV T_{00}$$

$$(14.1) \quad M = \varepsilon$$

The General Theory of Relativity is

$$(14.2) \quad R_{ij} - \frac{1}{2} R g_{ij} = 8\pi G T_{ij} / c^4$$

Firstly we redefine the unit second as  $S$  to simplify the equation 14.2

$$R_{ij} - \frac{1}{2} R g_{ij} = T_{ij}$$

We observe that the co-variant curvature is

$$R_{ij} = F_{ik}^* F_j^k + g_{ij} F_{\mu\nu}^* F^{\mu\nu} / 8$$

## 15. CONCLUSION

Fortunately, this model explained all the effects in the known world: strong, weak and electromagnetic effects, and even subclassify them further if not being to add new ones. In this model the only field is electromagnetic field, and this stands for the philosophical with the point of that unified world is from an unique source, all depend on a simple hypothesis: the current of matter in a system can be devised to analysis the e-charge current.

Except electron function my description of particles in fact is compatible with QED elementarily, but my theory isn't compatible to the theory of quarks. In fact, The electron function is a good promotion for the experimental model of proton that went up very early.

Underlining my calculations a fact is that the electron has the same phase (electron resonance), which the BIG BANG theory would explain, all electrons are generated in the same time and place, the same source.

## REFERENCES

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