MATTER THEORY OF EXPANDED MAXWELL EQUATIONS

WU SHENG-PING

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 and scattering 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

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)

Date: Mar 27, 2018.
Key words and phrases. Maxwell equations, Decay, Electron function,Recursive re-substitution.

The unit dielectric constant ϵ is

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

The unit of magnetic permeability μ 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

$$UnitiveElectricalCharge : \sigma = \sqrt{\hbar}$$
$$\sigma = 1.03 \times 10^{-17} C \approx 64e$$
$$e_{/\sigma} = e/\sigma = 1.57 \times 10^{-2} \approx 1/64$$

The unit of charge can be reset by *linear variation of charge-unit*

$$Q \to CQ, Q : \sigma/C$$

We will use it without detailed explanation.

2. Self-consistent Electrical-magnetic Fields

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

$$\partial \cdot \partial' A = iA^{\nu *} \cdot \partial A_\nu/2 + cc. = -J, \quad Q_e = 1 \tag{2.1}$$
$$\partial_\nu \cdot A^\nu = 0$$

or

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

with definition

$$(A^i) := (V, \mathbf{A}), (J^i) = (\rho, \mathbf{J}), (J_i) = (-\rho, \mathbf{J})$$
$$\partial := (\partial_i) := (\partial_t, \partial_{x_1}, \partial_{x_2}, \partial_{x_3})$$
$$\partial' := (\partial^i) := (-\partial_t, \partial_{x_1}, \partial_{x_2}, \partial_{x_3})$$

Q_e is the absolute value of the charge of electron. It's deduced by using momentum to express e-current in a electron. The equation 2.1 have symmetry

$$CPT, cc.PT$$

The energy of the field A are

$$\varepsilon := \int dV(E \cdot E^* + H \cdot H^*)/2 = - < A^\nu|\nabla^2|A_\nu > /2 \tag{2.2}$$

It's also valid with Lorentz gauge. As a convention the time-variant part is neglected.

The condition of invariant normalization for one particle is:

$$1 = \int_0^\infty dt < A^\nu, \partial \cdot \partial' A_\nu > \tag{2.3}$$

except eternal particles, because the equation 2.1 is non-homogeneous, and

$$A, A'/(\int_0^\infty dt < A'^\nu, \partial \cdot \partial' A'_\nu >)^{1/2}, A' = nA$$

both describe the same field of one particle and both meet the equation 2.1.

3. Calculation of Recursive Re-substitution

We can calculates 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)

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

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

$$\partial \cdot \partial' A = i A^{\nu *} \partial A_\nu /2 + cc., Q_e = 1$$

We an find

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

hence

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

We calls the fields' correction A_n with n degrees of A_i the n degrees correction. The dynamic process in the mass-center frame also can be solved by recursive re-substitution in the same form, with harmonic (or others) initial wave. The second degree correction (dependence) is

$$< i A_f^\nu \partial A_{f\nu} + cc.|1/(\partial^\cdot \partial')| i A_i^\nu \partial A_{i\nu} + cc. > /4$$

The normalization is on $< A|\partial \cdot \partial'|A >$, the static mass of wave.

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 energy $E_k = \varepsilon_0 - \varepsilon_t$. With the matter number invariant normalization in space-time (2.3)

$$1 = \int_0^\infty dt < A^\nu, \partial \cdot \partial' A_\nu >$$

$$= - \int_0^\infty dt < A^\nu, J_\nu >= \int_0^\infty dt \varepsilon_0 e^{-Ct}$$

then

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

ε_t is of cause the decrease of the crossing energy of all the decayed blocks. We notice that the EM energy emission is the $e_{/\sigma}$ times of the mechanical effect.

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.

$$j_1(r) = \frac{\sin(r)}{r^2} - \frac{\cos r}{r} =: J(\mathbf{x})$$
$$j_1(0) = 0$$

Contrary to the well-known result:

$$\int_0^\infty x^2 j_1(ax) j_1(bx) dx = \frac{1}{a}\delta(a-b)$$

the functions $j_1(ax), j_1(bx)$ are not orthogonal (why? CV), because a direct calculation shows that. In fact

$$J(a\mathbf{x}) * J(b\mathbf{x}) = Nab\delta(\mathbf{x})$$

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

$$V = -NR_1(kr)Y_{1,-1}e^{-ikt}$$

5. Electrons and Their Symmetries

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

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

r, l is the direction of the spin.

By mainly the second rank of correction A_2, a static field, we have

$$< e_\mu | i\partial_t | e^\mu > /2 + cc. = Q, \sigma = 1, |Q| = Q_e$$

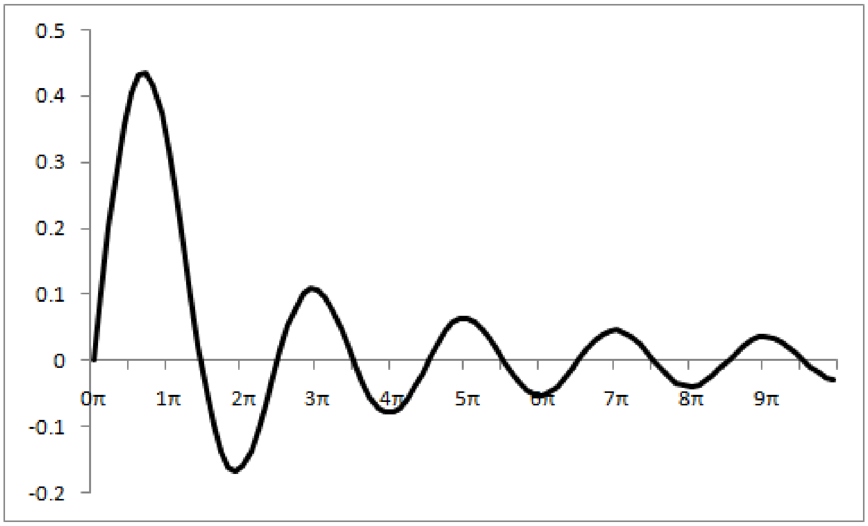

FIGURE 1. The function of j_1

We can use this to normalize the electron functions.

$$< \nabla e_\mu | \nabla e^\mu > /2 + cc. \approx |k_e Q|, \sigma = 1$$

$$< e_\mu | - i\partial_\phi | e^\mu > /4 + cc. \approx \mu_z$$

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

$$-\mathbf{r} \times \partial \cdot \partial' A/4 + cc.$$

$$\mu_z =< A_i | - i\partial_\phi | A_i > /4 + cc.$$

$$= \frac{Q_e}{2k_e}, \sigma = 1$$

By discussion in the section 15 the spin is

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

The correction of the equation 2.1 is

$$A_n = A_{n-1} \cdot (\partial(iA_i - iA_i^*)/2) * u, |k| = 1 \tag{5.1}$$

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

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

The convolution is made in 4-d space.

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

$$< \nabla(e_r^+)^\nu + \nabla(e_l^+)^\nu, \nabla(e_r^+)_\nu + \nabla(e_l^+)_\nu > /2$$

$$- < \nabla(e_r^+)^\nu, \nabla(e_r^+)_\nu > /2 - < \nabla(e_l^+)^\nu, \nabla(e_l^+)_\nu > /2 = 0$$

The increment of field energy ε on the coupling of e_r^+, e_r^- mainly between A_2 is

$$\varepsilon_e \approx -e^3_{/\sigma} k_e = -\frac{1}{1.66 \times 10^{-16} s}$$

This value of increments on the coupling of electrons are

ε_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 ε on the coupling of e_r^+, e_l^- mainly between A_4 is

$$\varepsilon_x \approx -\frac{1}{2}e^7_{/\sigma}k_e \approx -\frac{1}{2.18\times 10^{-8}s}$$

The calculations referenced to latter theorems. This value of increments on the coupling of electrons are

ε_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

$$\partial\cdot\partial'(-e) = -i(-e)^{\nu *}\cdot\partial(-e)_\nu/2 + cc., Q_e = 1$$

the properties of electrons are

	e_r^+	e_r^-	e_l^+	e_l^-	$-e_r^+$	$-e_r^-$	$-e_l^+$	$-e_l^-$
Q	$+$	$-$	$+$	$-$	$-$	$+$	$-$	$+$
S	r	r	l	l	l	l	r	r
μ_B	r	l	l	r	l	r	r	l
$\varepsilon(m/2)$	$+$	$+$	$+$	$+$	$+$	$+$	$+$	$+$

6. Propagation and Movement

Because field F is additive, the group of electrons are express by:

$$F = \sum_i f_i * \nabla e_i, < f_i|f_i >= 1 \tag{6.1}$$

It's called *propagation. The convolution is made only in space:*

$$f*g = \int d^3x f(t,x)g(t,y-x)$$

Each f_i is normalized to 1. We always use

$$\sum_i f_i * e_i, \sum_i f_i * \nabla e_i$$

to express its abstract construction and the field. The following are stable propagation:

particle	*electron*	*photon*	*neutino*
notation	e_r^+	γ_r	ν_r
structure	e_r^+	$(e_r^+ + e_r^-)$	$(e_r^+ + e_l^-)$

Define

$$\varsigma_{k,l,m}(x) := R_l(kr)Y_{l,m}, \varsigma_k = \varsigma_k^{\pm}(x) := \varsigma_{k,1,\pm 1}(x)$$

we can find easily it meets the following result, especially as the normalization is considered,

$$\varsigma_1^n(x)e^{int}\varsigma_1^{*n'}(x)e^{-in't} * \delta(t-r)/(4\pi r) = \varsigma_1^n(x)e^{int}\varsigma_1^{*n'}(x)e^{-in't}$$

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

$$F = f * \sum f_i * \nabla e_i$$

Calculating the following coupling system of particle x

$$e_x : e_x * (\sum_i e_i - \sum_j e_j)$$

Make RRS with the initial state

$$e_x : NR_1(k_x)Ye^{ik_xt}$$

to get the whole function e_x.

Use the condition of charge

$$< A^\nu|i\partial_t|A_\nu > /2 + cc. \approx Q_x, Q_e = 1$$

$$A := \int d\mathbf{x}e_x * \nabla(\sum_i e_i - \sum_j e_j)$$

hence (also reference to the section 7)

$$k_x \approx (< \sum_i e_i^\nu, \sum_i e_{i\nu} > + < \sum_j e_j^\nu, \sum_j e_{j\nu} >)/Q_x, Q_e = 1 \tag{6.2}$$

The static MDM (magnetic dipole moment) of a group of electrons is

$$\mu_x = -\mathbf{r} \times \nabla \cdot \nabla(\int d\mathbf{x} \cdot e_x * \sum_j \nabla e_j^\mu)/4 + cc.$$

Use the two degree static correction of A_i as in 5.1

$$\approx \sum_j < \nabla e_{j\mu}|\partial_\phi \nabla|e_j^\mu > k_{ej}/(4k_x) + cc.$$

The harmonic wave has 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

Consider the reaction

$$e_r^+ - e_r^+ \to e^{ipx} * e_r^+ - e^{ip'x} * e_r^+$$

We find

$$|_{-t}^{t'} < B, A >= |_{-t}^{t'} \int dV(h(t) + h(-t))A \cdot (h(t) + h(-t))B^*$$

with their Fourier expansions. The right is the crossing between initial state and final state, but the left is not. This is the reason why we can shift electrons from one side to the other in the reaction formula:

$$e_r^+ + e^{ip'x} * e_r^+ \to e_r^+ + e^{ipx} * e_r^+$$

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. EM Energy Emission

Generally, there are kinds of energy increments i.e. EM effect
Weak coupling

$$W :< e_r^+ + e_l^- | e_r^+ + e_l^- > - < e_r^+ | e_r^+ > - < e_l^- | e_l^- >$$

e is abstract electron and fits to the correspondent field.
Light coupling

$$L :< e_r^+ + e_r^- | e_r^+ + e_r^- > - < e_r^+ | e_r^+ > - < e_r^- | e_r^- >$$

Weak side coupling

$$Ws :< e_x * (e_r^+ + e_l^-) | e_x * (e_r^+ + e_l^-) > - < e_r^+ + e_l^- | e_r^+ + e_l^- >$$

Light side coupling

$$Ls :< e_x * (e_r^+ + e_r^-) | e_x * (e_r^+ + e_r^-) > - < e_r^+ + e_r^- | e_r^+ + e_r^- >$$

Strong coupling is

$$S :< e_r^+ | e_r^+ >$$

9. Muon

The core of muon is

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

Make RRS on e_μ like 5.1 to get the solution. These e are complete electron functions.

From the equation 15.1, μ is approximately with mass $3m_e/e_{/\sigma} = 3 \times 64 m_e$ [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

$$\mu_l^+ \to -\mu_r^- - \nu_l$$

with balance formula

$$e_\mu * e_l^+ + e^{ip_1 x} * e_{-\mu} * e_r^- + e^{ip_2 x} * \nu_l \to e_\mu * \nu_l + e^{ip_1 x} * e_{-\mu} * \nu_l$$

Generally

$$< e_x * e | e_x * e > = < e | e >$$

The main effect is kind of Ws

$$- < e_\mu * (e_l^+ + e_r^-, A_4) | e_\mu * (e_l^+ + e_r^-, A_4) >$$
$$+ < (e_l^+ + e_r^-, A_4) | (e_l^+ + e_r^-, A_4) >$$

In fact to the second degree correction of e_μ

$$\approx -\frac{2\varepsilon_x k_e}{k_\mu}$$

$$= \frac{1}{2.1\times 10^{-6}s} \quad [2.1970\times 10^{-6}s][1]$$

10. Pion

The core of pion is

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

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

Decay Channels:

$$\pi_l^- \to -\mu_r^+ - \nu_r$$

$$e_\pi * e_r^+ + e_\pi^* * e_r^- + e^{ip_1x} * \nu_r \to e^{ip_2x} * e_{-\mu} * \nu_r + e_\pi * e_r^+ + e^{ip_2x} * * e_{-\mu}\nu_l$$

The main effect is kind of W

$$< e_\pi * (e_l^+, A_4) + e_\pi^* * (e_r^-, A_4) | e_\pi * (e_l^+, A_4) + e_\pi^* * (e_r^-, A_4) >$$
$$- < (e_l^+ + e_r^-, A_4) | (e_l^+ + e_r^-, A_4) >$$
$$= -\varepsilon_x = \frac{1}{2.18\times 10^{-8}s} \quad [(2.603\times 10^{-8}s][1]$$

11. Pion Neutral

The core of pion neutral is like a atom

$$\pi^0 : (e_r^+ + e_l^+, e_r^- + e_l^-)$$

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

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

The loss of energy is kind of L

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

12. Tau

The core of tauon maybe that

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

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

$$\tau_l^- \to \mu_l^+ + \nu_r - \nu_r$$

$$e_\tau * 5e_r^+ + e^{ip_1x} * \nu_r + e^{ip_2x} * e_\mu * \nu_l \to e_\tau * 5e_r^+ + e_\tau * e_r^- + e^{ip_2x} * e_\mu * e_l^+ + e^{ip_3x} * \nu_r$$

The main effect is kind of Ls

$$- < e_\tau * (5e_r^+ + e_r^-, A_2) | e_\tau * (5e_r^+ + e_r^-, A_2) >$$
$$+ < (5e_r^+ + e_r^-, A_2) | (5e_r^+ + e_r^-, A_2) >$$
$$\approx -\frac{18\varepsilon_e}{k_\tau/k_e}$$
$$= \frac{1}{0.5\times 10^{-13}s} = \frac{1}{2.92\times 10^{-13}s\times 0.17} \quad [2.91\times 10^{-13}s; BR. \quad 0.17][1]$$

Depending on this kinds of particle including

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

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

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

This series of particle include μ, τ and in fact almost all light radiative particles are of this kind, they are created in colliding.

13. 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.

14. Neutron

Neutron is the atom of a proton and a muon,

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

Neutrino circles around proton with

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

Their effect is between the correction (ν, A_4) and the charge of proton

$$m_\nu \omega^2 r \approx \frac{1}{2} e_{/\sigma}^4 m_\nu / r^2$$

$$m_\nu = e_{/\sigma}^3 m_e$$

The EM energy emitted by neutrino is approximately

$$e_{/\sigma}^{3+4+4+2} m_e / 4 = \frac{1}{753s}$$

It's surprising that r is macroscopic.

15. 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 with velocity v of the system is

$$M = \partial_v^2 T_{00}/2|_{v=0} = \partial_v^2 tr(T_{ij})/4|_{v=0}$$

Use the presumption as in the equation 2.1: the mass and charge have the same movement in electron.

$$M = tr(T_{ij}) =< \nabla A^\nu, \nabla A_\nu >= 2\varepsilon, \tag{15.1}$$

The General Theory of Relativity is

$$R_{ij} - \frac{1}{2}Rg_{ij} = 8\pi GT_{ij}/c^4 \tag{15.2}$$

Firstly we redefine the unit second as S to simplify the equation 15.2

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

We observe that the co-variant curvature is

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

16. 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

[1] K. Nakamura et al. (Particle Data Group), JPG 37, 075021 (2010) (URL: http://pdg.lbl.gov)

E-mail address: `sunylock@139.com`

8 Hanbei Rd, Tianmen, Hubei Province, The People's Republic of China. Postcode: 431700