A bold innovation on artificial neutrinos source

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Abstract

It is well known that neutrinos come out of nuclear β decay, but radioactive materials do harm to human beings, and either energy spectrum or dose cannot be flexibly controlled because of the only dependence on selected nuclide and mass. This paper presents a new way to build neutrinos source by only accurately manipulating electrons motion. Because voltage supply can hardly reach MV-level, thus this method is not competent to generate high energy neutrinos, and only good for low energy, especially a convenient means for range 1eV to 100keV.

How to artificially produce neutrinos or antineutrinos on demand?

Relying on natural radioactive elements to produce neutrinos? Not good idea, it is too low dose, because of the usual super long time half life.

Relying on solar neutrinos? Sounds good and almost decent dose, but neutrinos spectrum not adjustable unless human beings could modify or re-engineer the Sun, and also we have to mechanically track the Sun **7x24** full time, by taking advantage of climate zero influence, unlike harvesting solar photovoltaic energy only from sunshine.

Modern science never tells us how to get high dose of neutrinos beam in cheap means, except by expensive high energy particles collision via accelerator.

My scientific research shows it is possible to get decent dose of low energy neutrinos beam, even as low as a few electron-volt **eVs**, by sudden decelerating or braking high speed linear flying electrons in electric field.

Do not be confused with **Bremsstrahlung** radiation – photons emission that only occurs in angular braking, that means electrons must fly in curved path.

Modern science asserts only electric recharging effect occurs when electrons fly in the same direction with electric field vector between **2** electrodes of power supply, i.e. electrons are being decelerated therein.

But in my theory, there are **2** results simultaneously occurring, one is the recharging effect, the other is neutrino and antineutrino pair production, and the direction of moving neutrinos & antineutrinos are in the same direction with electrons.

In other words, neutrino or antineutrino in electron flavor is just the tiniest constructional component of an electron.

Even seemingly emitted from nucleus while **β-** decay, neutrino and antineutrino should still be regarded as ready-fragment of electron before the electron breaks through and is braked by the "outer wall of nucleus" or so-called coulomb barrier, thereby only antineutrino gets out along with the **β-** particle, i.e. the electron with tiny mass loss duo to ripping of neutrino-antineutrino pair, but neutrino is just absorbed by the "wall", or say, the host nucleus of the proton that has just launched the electron.

The above analysis on **β-** & antineutrino decay can conjugatedly apply to **β+** & neutrino decay, where "conjugatedly" means by logic mapping: electron to positron, **β-** to **β+,** antineutrino to neutrino, proton to neutron, etc.

Whatever angular or linear braking, the direction of emitted photon or neutrino-antineutrino pair is analogue to unseatbelted passenger's forward inertial jerk during a sudden brake of vehicle, as neutrinos and antineutrinos can be regards as "passengers" of electrons.

Modern synchrotron radiation experiments have proved that photons are emitted from the tangent forward direction of the donut-like accumulator ring of high energy electrons.

Modern experiments on **MeV** to **GeV**-level manmade neutrinos have also proved the neutrino's

or antineutrino's direction complying with my theory.

Although the end velocity of electron is same for different interval spacing between electrodes whilst same acting voltage, the order of magnitude of acceleration does matter, only over certain threshold value, can neutrinos-antineutrino pair be thrown out.

Now let's deduce out the threshold by first writing down equation of acceleration:

$$a = q_e*E/m_e = q_e*(V/d)/m_e$$

where **a** is acceleration, q_e standard charge, **E** electric field strength, **V** acting voltage, **d** electrode's distance, m_e electron mass.

According to the reference literature **1**, the minimal neutrino mass m_v is **2.1*10^{-4}eV**, hence the minimal kinetic energy should be at least same with its rest mass in order to enable it fly fast as close as to the light speed.

If an electron revolves around proton at the specific quantum **n**th orbit which energy is equivalent to the said tiny kinetic energy, then its angular acceleration should be equivalent to the linear acceleration of electron running on straight line and emitting the weakest neutrino.

Just follow hydrogen orbit calculation, the orbit number **n** can be solved from:

$$\frac{13.6}{n^2} = m_v = 2.1*10^{-4}$$

i.e. **n ≈ 255,** and its respective orbital radius:

$$R_n = R_{255} = n^2R_0 = 255^2 * 0.53\text{Å} = 3.43*10^{-6}m = 3.43\mu m$$

where R_0 is Bohr radius.

As per classic mechanics, angular acceleration **a** = velocity^2/Radis = v^2/R, inserting data of Bohr model, we get **Bohr acceleration**:

$$a_0 = \frac{e^2}{4\pi\epsilon_0 m_e R_0^2} = 9*10^{22}m/s^2 = 9.2*10^{21}g$$

where **g** is the earth gravity acceleration **9.8m/s^2**.

For the **nth** orbit, we have respective acceleration:

$$a_n = \frac{e^2}{4\pi\epsilon_0 m_e R_n^{\,2}} = \frac{e^2}{4\pi\epsilon_0 m_e (n^2 R_0)^2} = a_0/n^4$$

Inserting **n = 255**, then **a$_{255}$ = 2.13*10^{13}m/s^2 = 2.2*10^{12}g**

Thus, the **a$_{255}$** is just the equivalent threshold acceleration for generating an ultra cold lightest neutrino by suddenly braking a running electron. Of course, such a weakest neutrino is definitely undetectable like as dark matter, its total energy include rest mass is about the cosmic background radiation, i.e. **2.726K** or **0.000235eV**.

As such ultra cold neutrinos useless, so it is necessary to ante up at least **10** thousand times on the threshold acceleration in reality. In contrast, acceleration of electrons in accumulator ring of synchrotron is also exponentially reduced, comparing with the Bohr acceleration.

No wonder even the super long high energy LINAC accelerator, such as the famous **3km** long SLAC, cannot produce neutrino-antineutrino pairs, as in fact its sectional electric field strength is still not enough high to meet the threshold of acceleration, though its end energy is accumulated so high.

For low energy neutrinos production, voltage cannot be too large, so technically, the linear braking distance is very tricky, i.e. how fast to stop electrons, the more sudden or instant the braking action, the more higher the energy of neutrino-antineutrino pair and its production rate.

The fact that **β** decay induced neutrino has on par energy with associated electron should thank the extreme short braking distance in femtometer level, i.e. the radius of coulomb barrier virtual sphere surrounding nucleus.

In fact, not only linear braking, but also linear speeding by electric field (not by collision) can produce neutrino-antineutrino pair, and in case of speeding, the pair's direction is opposite to electrons flying direction. All analysis on braking induced neutrino-antineutrino pair can

conjugatedly apply to accelerating induced one.

Although shortening distance of either acceleration or deceleration can benefit pair generation of neutrino-antineutrino, however shortening distance of acceleration should pay the cost of power input rate, hence If pursuing both ends, it will be prohibitedly expensive, that is why emphasis only on braking induced neutrinos is enough.

Strictly speaking, it is not my theory that linear braking electron can produce neutrino, but the lemma of the **virial theorem** in current textbooks.

Remember how is the classic radius **2.82fm** of electron deduced? Indeed, the virial theorem is applied thereby to the imagined transition of electron-positron head-approaching mutual acceleration, which is proceeded with the gradual "evaporation" of electron's mass by some unspecified radiation, so as to facilitate linear acceleration, as well as counterbalance the reduction of potential energy of electric field, i.e. to honor energy conservation.

Anyway textbooks do not claim what type of radiation, but obviously it is not photon, because boson photon can only occur in angular braking or angular speeding, so we have to assert the unspecified radiation is fermion neutrino.

Because the minimal emission is one pair of neutrino & antineutrino for one stopped electron, hence, the max energy is **0.5Vc eV**, where **Vc** is the applied voltage between electrodes, e.g. a regular **1.5V** battery may get **0.75eV** neutrino at max energy.

If considering recharging energy to the power supply during electron deceleration, the max energy of neutrinos should be further discounted. As no accurate record, just speculatively yet reasonably assuming **50/50**, hence the max energy of neutrinos is probably **0.25Vc eV**.

Just like nuclear beta decay, the artificial neutrinos are also in continuous distribution of energy spectrum from **0** to the aforementioned max, and the mean value is likely **$0.1V_c$ eV**.

The advantage of such artificial neutrinos source is with energy spectrum adjustable and super low energy reachable by simple regulation on acting voltage and electrode-spacing.

The reaction equation can be described by following equation:

$$e \rightarrow e' + n*(\nu_e + \overline{\nu_e}) + Q$$

Here **e** = electron with larger energy, **e**$'$ = linear braked electron with lower energy, **n** = arbitrary integer number, ν_e = neutrino with electron flavor, $\overline{\nu_e}$ = antineutrino with electron flavor, and **Q** = recharging energy to power supply.

Theoretically above equation meets all conservation laws, e.g. energy, linear and angular momentum, lepton, baryon.

Angular momentum conservation does impose restriction on directions of neutrinos and antineutrino, i.e. they must fly in same direction so as to cancel their angular momentum, because the neutrino's chirality is left-handed, and antineutrino is right-handed.
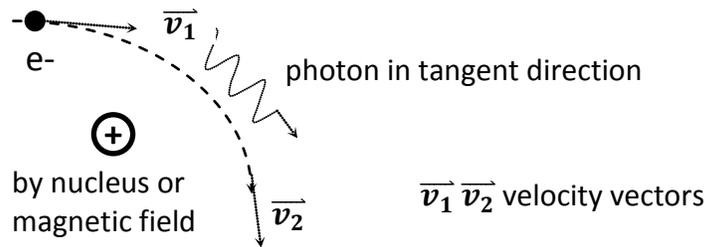
In future, if Majorana conjecture is confirmed, i.e. neutrino and antineutrino is same particle in chirality and other aspects, then neutrinos and antineutrinos must fly oppositely, but thus far all experiments do not support the conjecture.

The **fig. 1** illustrates how to brake fast moving electron in angular and linear ways with different radiation particles: photons vs. neutrinos.

There is a challenge problem: how to separate neutrino or antineutrino from mixed ray? If this problem not fixed, then the mixed ray mainly excite nuclei to higher energy level via neutral current energy attenuation, though catalysis still functions in so-so extent, but the more important charged current catalysis may not work because of cancellation each other.

Currently the needed filter is still under research for resolving above challenge.

a: angular braking on flying electrons produces photons (Bremsstrahlung effect)

$\overrightarrow{v_1}$

e-

photon in tangent direction

by nucleus or
magnetic field

$\overrightarrow{v_2}$

$\overrightarrow{v_1}\,\overrightarrow{v_2}$ velocity vectors

b: linear braking on flying electrons produces neutrino & antineutrino pairs

e-

$v\,\overline{v}$

straggled e-

voltage = V_1

slow accelerating zone

$V_2 < V_1$

sudden
braking
zone
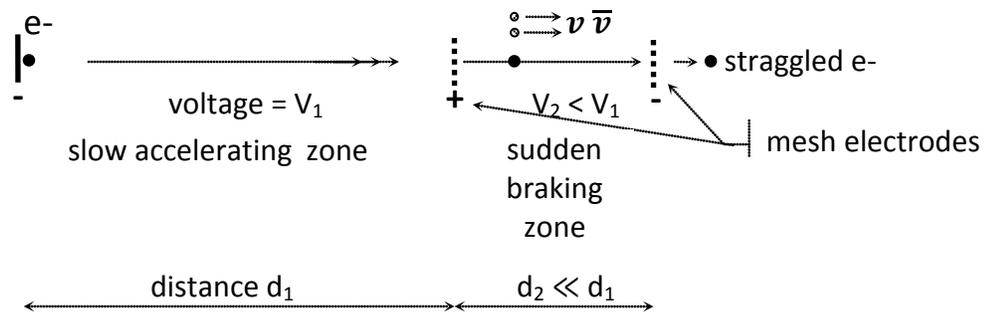
mesh electrodes

distance d_1

$d_2 \ll d_1$

Fig. 1 photons and neutrinos generated by different braking methods

An embodiment of artificial low energy neutrinos source

Without high energy accelerator or strong radioactive element, neutrinos source can still be built in low cost means, though orthodox physics temporarily does not confirm my theory.

This invention illustrated in **fig. 2** presents such a neutrinos source system based on the theory that linear braking on electrons can not only recharge the power supply, but also generate pairs of neutrino and antineutrino, provided some prerequisite conditions are met.

Thermal electrons are emitted from heated filament or grilled filaments matrix as cathode, and then electrons are accelerated in swarm towards the sieve-like anode by main DC power supply.

With high kinetic inertia, electrons continue to pass through the anode sieve, via very short distance, until suddenly stopped or scattered by the Faraday cup which is covered by another electro-sieve functioning as cathode. Such is called sudden braking stage.
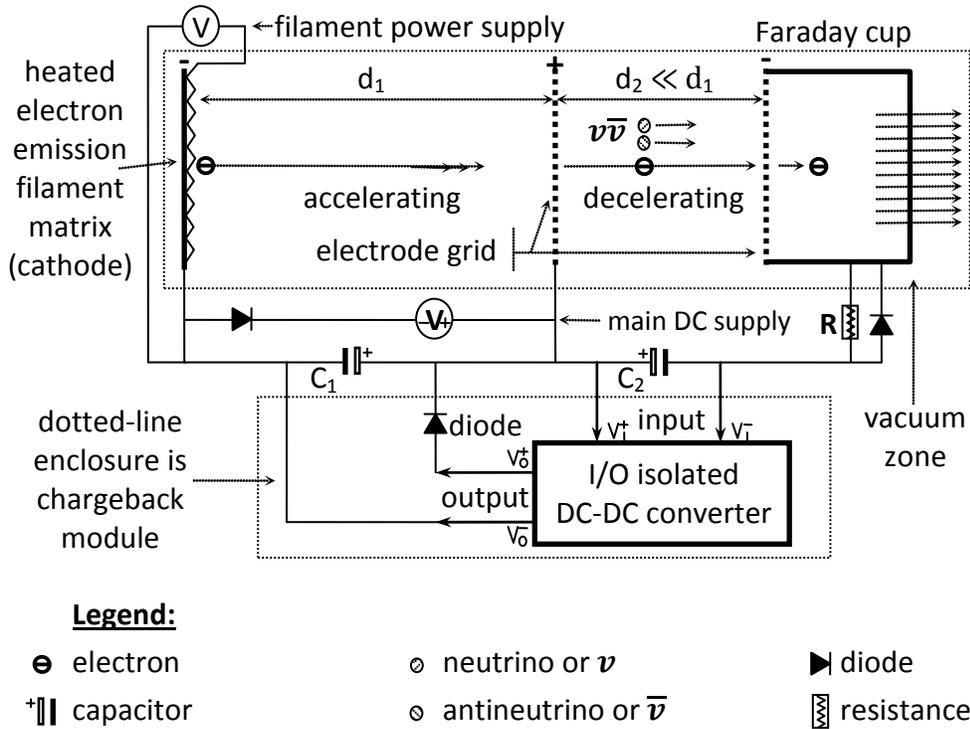
heated electron emission filament matrix (cathode)

←filament power supply

d_1

$d_2 \ll d_1$

Faraday cup

$\nu\bar{\nu}$

accelerating

decelerating

electrode grid

main DC supply

C_1

C_2

R

dotted-line enclosure is chargeback module

diode

V_o^+

output

V_o^-

V_i^+ input V_i^-

I/O isolated DC-DC converter

vacuum zone

Legend:

⊖ electron   ⊘ neutrino or ν ▶ diode

$^+$‖ capacitor   ⊘ antineutrino or $\bar{\nu}$ ▨ resistance

Fig. 2. Embodiment of artificial low energy neutrinos source

In the initial or warm-up time, the Faraday cup will get temporary hot as the bombardment effect, because deceleration electric field that is powered by the capacitor C_2 can be only gradually established.

The initial bombardment provides big electric current to recharge the said capacitor, and soon its voltage is saturated, as well as stable braking electric field becomes ready, in turn, Faraday cup can collect gently moving electrons and no longer hot. Now equilibrium state is reached.

It is just in this short sudden braking stage that neutrino and antineutrino pairs radiate out, of course, this stage also continues to recharge the "volatile power supply", i.e. capacitor C_2 with most braked energy.

To reclaim braked energy, a chargeback module is applied to transfer surplus electric energy stored in C_2 to capacitor C_1 that is also serving the first stage acceleration.

As the main DC supply and C_1 cooperate "shoulder to shoulder", if voltage-of-C_1 + 0.7V (the

saturated voltage of diode) is larger than main DC supply, then input power temporarily pauses serving acceleration stage, and C_1 takes over full duty at this moment, else they share the duty.

In principle, the chargeback module is a DC to DC converter, and its in-out ports should be isolated by internal magnetic coils of transformer.

As per aforementioned theoretical analysis, if **50keV** is the expected neutrino mean energy, then the voltage upper limit is about **500kV**.

Filaments can be wired in planar grill or matrix in any shape and area, anyhow, large area and dense arrangement can always exhibit better performance.

By adjusting the cathode filament electric current, its temperature will be changed, so as to affect the thermal electrons generating rate and density, anyway the polarity of filament voltage does not matter, even AC power supply works too.

As the acceleration pathway d_1 is reasonably long enough, according to my theory, such gradient of acceleration is not supposed to produce neutrinos, in contrast, the deceleration pathway d_2 should be short enough, so as to produce neutrino-antineutrino pairs effectively.

All electrodes, filament & Faraday cup should be enclosed in **vacuum** capsule as in conventional vacuum tube, because air molecules can disturb electron's speeding and braking.

Discuss on tricky braking voltage and short braking distance

Instead of intricate **I/O** isolated DC-DC converter, why not directly use the main DC supply for braking stage?

Fig. 3 illustrate the embarrass situation if deceleration voltage is equal to the acceleration voltage.

Sub-figure **3a** is the sandbox model that features equal voltage for both speeding and braking, and sub-figure **3b** shows the transient curve of electron velocity and position as time goes by.

At t_0 moment, the electron starts to leave cathode, then it is linearly accelerated to max at t_1

moment and arrive anode, then penetrates anode and begins to be decelerated with linear reduction of velocity until standstill at t_2 moment while it is very close to the final cathode, but unfortunately **no chance of landing** on final cathode, because of minor energy loss in collision with anode & residual air and feedback to DC supply.
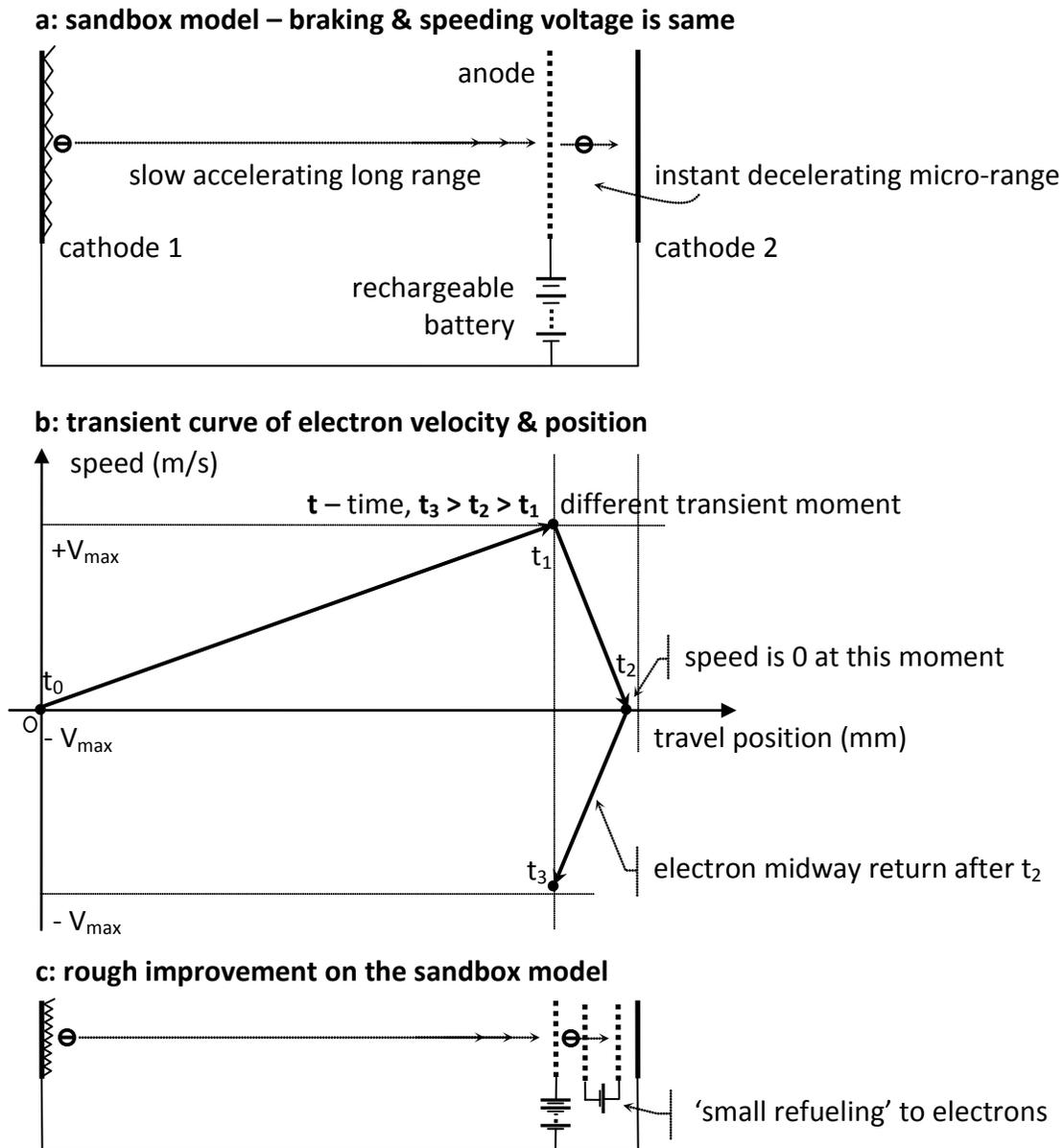
a: sandbox model – braking & speeding voltage is same

b: transient curve of electron velocity & position

c: rough improvement on the sandbox model

Fig. 3. tricky braking voltage and short braking distance

Of course, because velocity **= 0** state is unstable, therefore U-turn then re-acceleration will occur at t_2 moment until max velocity is regained at t_3 moment.

It will also render same situation if deceleration voltage is greater than the acceleration voltage.

Sub-figure **3c** expresses a rough improvement on the sandbox where a "small refueling" low voltage mini acceleration stage is inserted midway, so as to make sure electrons can land on final cathode and be still warm but not hot. It may overcome the drawbacks, but more complicated improvement is still needed.

Conclusion and the outlook

Manipulation on electron linear motion should be capable of radiating neutrinos ray, as long as proper conditions are applied.

Nowadays, the instrumentation of low energy neutrinos detection is still not yet mature, though the technology of detecting middle energy to high energy neutrinos seems available but too clumsy and expensive.

In future, if the technology of focusing low energy neutrinos is proved to be workable, or as easy as visible light focused by optical lens, then this kind of neutrinos can play an important role in catalyzing beta decay nuclear fuels.

I am actively working in these fields, even preliminary inventions are under patent pending, and probably good prospect is looming soon.

References

1. Neutrino and graviton rest mass estimations by a phenomenological approach, Dimitar Valev, preprint **arXiv:hep-ph/0507255**.