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Mr Casey Ray McMahon, B.Sci (Hons), B.MechEng (Hons).

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# Nuclear solar cell- converting nuclear waste to electricity.

**Abstract: Trash to Treasure:**

Nuclear waste has been constantly accumulating since the advent of nuclear reactor technology to generate nuclear power. Until now, the waste products of nuclear reactions has been collected and stored in large concrete containers, to remain there for thousands of years because of the danger of radiation to human health. In this paper, I present a theory for the practical use for nuclear waste- a means by which it can be converted into electrical current. Because nuclear waste has a half-life of thousands of years, this technology can provide continuous electrical power for thousands of years. This technology can also be used for any radioactive compound that shows radioactive decay- no nuclear reactions are actually required. This technology also works at night, unlike current solar technology. Basically, we are modifying current solar cell technology and using it to capture some types of nuclear radiation to generate current. I also present evidence via Radiotropic fungi indicating that it is possible.

## What exactly is nuclear waste?

Nuclear wastes are the left over or waste products from a nuclear reaction. These nuclear reactions are typically used to generate heat to turn a steam turbine to generate electricity. However, only the heat energy is used for electrical energy generation. Heat is basically a by-product in itself- heat is usually a result of inefficiency in mechanical machines, hence the bulk of the energy emitted from nuclear reactions is left unharnessed. For example, computers generate heat due to inefficiencies, which is why heat sinks and fans are built into them. Thus, if we were to directly harness the energy of the radiation emitted from radioactive elements, we will have in theory, the potential to convert less than 50% of this energy to electricity- unless excess electrons are present. Allow me to explain:

The radiation from nuclear waste is the result in atoms slowly decaying, and releasing protons, neutrons and electrons into the surrounding environment. Since electricity is in itself a stream of electrons, if we could catch these ejected electrons we could generate an electrical current, hence electricity. However, we are only interested in capturing the ejected electrons- not the protons or neutrons. Hence, a 100% conversion efficiency from radioactive materials is not possible. Even so- these ejected electrons which would normally be released into the environment could be captured, which would allow for the continuous generation of electrical energy for thousands of years. Refer to figure 1.

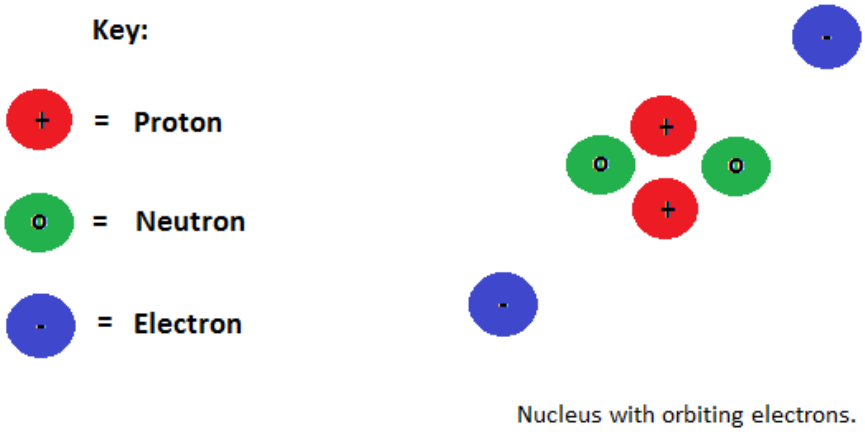


**Figure 1: Atom components.** The nucleus, which contains protons and neutrons, is orbited by electrons. These three particle types are ejected during nuclear decay, during which ejected electrons can be captured to generate electrical current to generate electricity. Because only ejected electrons (the blue spheres) are captured to generate electricity, an efficiency less than 50% is expected, unless excess electrons are present.

## What types of nuclear radiation have been observed?

From Pass my exams (2012), we are given explanations as to how these different types of particles (protons, neutrons and electrons) are released as radiation. These particles are usually detected as Alpha particles, Beta particles, and Gamma rays.

"**Alpha particles** are released by high mass, proton rich unstable nuclei. The alpha particle is a helium nucleus; it consists of two protons and two neutrons. It contains no electrons to balance the two positively charged protons. Alpha particles are therefore positively charged particles moving at high speeds.

**Beta particles** are emitted by neutron rich unstable nuclei. Beta particles are high energy electrons. These electrons are not electrons from the electron shells around the nucleus, but are generated when a neutron in the nucleus splits to form a proton and an accompanying electron. Beta particles are negatively charged.

**Gamma rays** are electromagnetic waves of very short wavelength and high frequency. Gamma rays are emitted by most radioactive sources along with alpha or beta particles. After alpha or beta emission the remaining nucleus may still be in an excited energy state. By releasing a gamma photon it reduces to a lower energy state. Gamma rays have no electrical charge associated with them." Pass my exams (2012).

As described above, Alpha particles are composed of two protons and two neutrons- so we won't be harnessing Alpha particles to generate electricity. However, Beta particles are high energy electrons, which are generated when a neutron splits into a proton and an electron. Gamma rays are described as photon-like, so if photons can be converted into

electricity as in conventional solar cells, Gamma rays can too. Thus, to convert nuclear radiation into electricity, we need to focus on capturing Beta particles and Gamma rays.

**A theory that indicates it is possible to convert radiation (beta particles and gamma radiation at least) into electricity:**

The McMahon field theory (2010) is a theory that attempts to unify quantum physics and relativity theory. I will use it now to show that it should be possible to convert beta and gamma radiation into electricity.

**McMahon field theory (2010) material:**

Special relativity applies to particles or masses moving close to the speed of light, which is the case for electrons moving as electrical current in a wire, as theorized in the paper: **McMahon, C.R. (2015)** *"Electron velocity through a conductor*". Thus, special relativity applies to such particles, which allows us to observe special relativity in the real world as the magnetic field. Thus, through the magnetic field, McMahon field theory (2010) explains that particles moving near the speed of light appear as energy fields.

First, allow me to present a new understanding of energy, which requires us to modify Einsteins theory of special relativity, and our understanding of it.

Let us begin by explaining the nature of energy using an example of electrons moving through an electrical wire. Since the velocity of these electrons can be considered as at or near the speed of light, we can assume that they are affected by both time dilation and length contraction, effects predicted by Albert Einstein's famous theory of relativity.

From Einsteins special theory of relativity, we are presented with equations 1 and 2.

$$T' = \frac{T}{\sqrt{1 - \frac{V^2}{C^2}}} \quad \text{..... equation (1}$$

$$L' = L\sqrt{1 - \frac{V^2}{C^2}} \quad \text{..... equation (2}$$

Where:

T ' = Time experienced by moving object, relative to stationary observer.

T = Time experienced by stationary observer, relative to stationary observer.

L ' = Length experienced by moving object, relative to stationary observer.

L = Length experienced by stationary observer, relative to stationary observer.

V = the velocity of the moving object, relative to the stationary observer.

C = The speed of light, = 299,792,458 m/s.

From Einsteins special theory of relativity, equations 1 and 2 tell us that as a particle approaches the speed of light, the stationary observer tells us that time slows down for the moving particle compared to the time the stationary observer experiences. Also, this stationary observer tells us that the length of the particle appears shorter as it approaches the speed of light. McMahon field theory takes these basic ideas, and expands on them. What if we are interpreting equations 1 and 2 incorrectly- in that the equations are correct, but our understanding of them is incomplete? Note that the term "V" is used for "velocity" in equations 1 and 2, rather than simply "s" for "speed". This means we must consider both the magnitude and direction of the moving body in equations 1 and 2, as velocity is a vector quantity, whereas speed, is a scalar quantity, which only considers magnitude.
Therefore, if the path taken by the moving body is important, since velocity is a vector, thus we have no choice but to consider the path and magnitude of the moving body, then we must apply the effects of special relativity not just to the moving particle, but also to its path. If we do this, our understanding of special relativity changes. This new understanding gives rise to the McMahon field theory.

Let's perform a thought experiment: Let's imagine a stretched out spring. Let the straight stretched out spring represent the path of electrons moving in an electrical wire. Now, since length contraction occurs because of relativity, the electron path is affected. As a result, the straight line path of the electron is compressed. This is the same as allowing a spring to begin to recoil. As a result, the straight line path of the electron begins to become coiled. I call this primary coiling. This is the effect length contraction has on mass as it approaches the speed of light and is dilated by length contraction. When a particle such as an electron reaches the speed of light, it becomes fully coiled or fully compressed, and Einsteins length contraction and time dilation equations become equal to zero and "undefined". This particle now moves as a circle at the speed of light in the same direction it was before. If this particle tries to move faster still, it experiences secondary coiling. Ie: the coil coils upon itself, becoming a secondary coil. This is why energy is observed on an Oscilloscope as waves: we are simply looking at a side on view of what are actually 3-dimentional coiled coils or secondary coils. Waves are not simply 2 dimensional; rather, they are 3 dimensional secondary coils. It was easy for scientists of the past to assume waves were 2 dimensional in nature, as the dimensional calculations and drawings for relativity were carried out on flat pieces of paper which are also 2-dimentional. The human imagination, however, is able to perform calculations in multiple dimensions. Now, let's consider the effect of time dilation.
When an electron approaches the speed of light, according to special relativity, it undergoes time dilation. What does this actually mean? I believe this is the effect: time dilation allows a body, particle or mass- in combination with the effects of length contraction, to exist in multiple places at the same time. This is why we observe magnetic flux. Electricity is composed of high speed electrons, so these electrons would be affected by time dilation and length contraction. As a result, the electron is both inside the electrical wire, and orbiting around the wire as magnetic flux (because of full primary

coiling at the speed of light). Magnetic flux is the combined effect of length contraction and time dilation on the electron. The coiling effect is why electrical wires carrying electricity exhibit magnetic fields- the electron path is compressed into coils, and time dilation permits the electron to occupy multiple positions at the same time, which is why magnetic flux is detected as coils at different distances from the electrical wire. Please refer to figure 2.

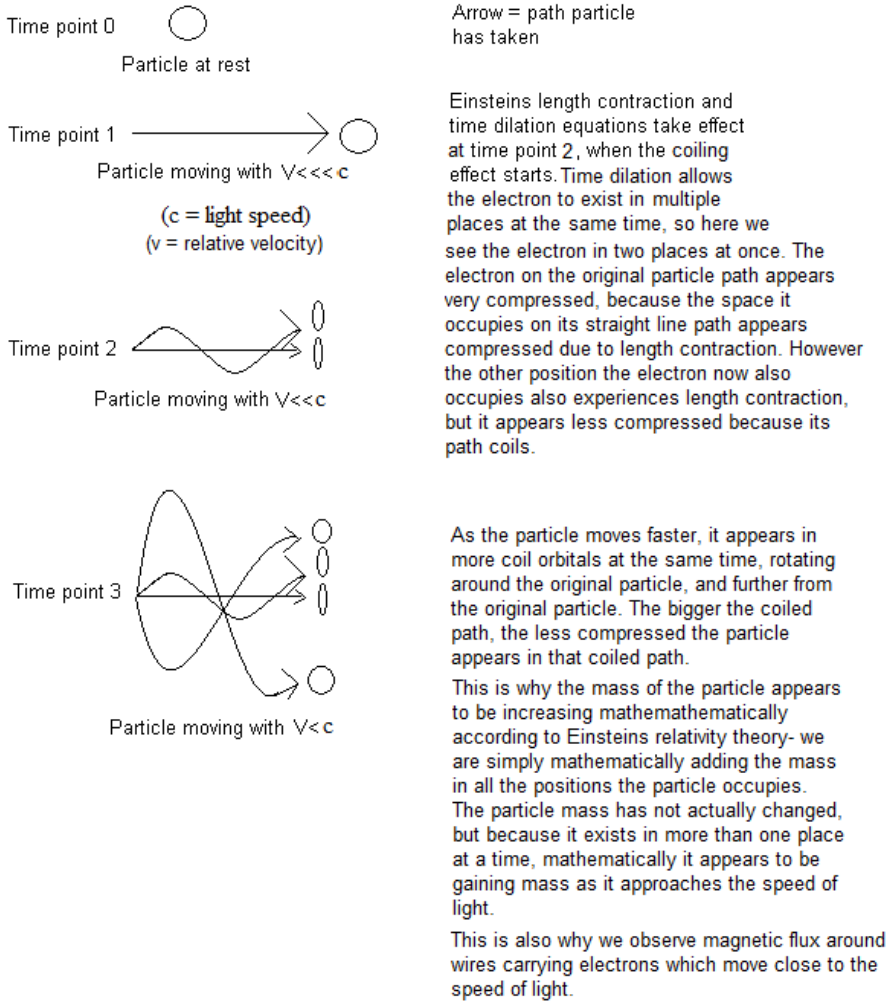


**Figure 2: Particle relativity.** What we observe as relative stationary observers of a particle as it travels faster.

Next, we must consider the fact that nothing appears to be able to travel faster than the speed of light. If this is true, then if we were to try to speed a particle up beyond the speed of light, the true speed that would be observed must be dilated by relativity. Refer to figure 3 below. Let's call the velocity that would be observed for a particle if relativity didn't dilate it the "Newtonian velocity", which has the symbol "Vn". Thus, particles can travel faster than the speed of light, but relativity dilates the velocity we observe back down to the speed of light.

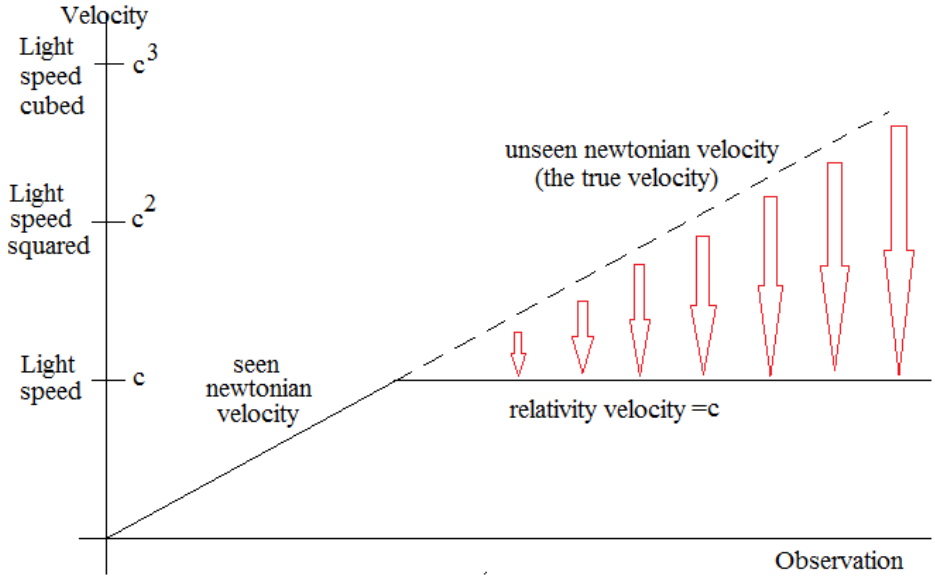


**Figure 3:** The dilation of the true velocity or Newtonian velocity by relativity. Here, we see that the dotted line represents the true velocity of particles travelling faster than the speed of light, but relativity dilates this velocity down to the speed of light which coils the path of the particle, so observers don't ever see particles travelling faster than light. The degree of velocity dilation is represented by the red arrows. Hence, the solid lines represent that which is seen, but the dotted line, which is the true velocity above light, is unseen due to dilation by relativity.

Considering figure 3, we see that once a particle reaches the speed of light, its observed velocity (relativity velocity) appears constant. However, this is only because its true velocity (the dotted line), or Newtonian velocity, is dilated back down to the speed of light by relativity. So, once a particle reaches the speed of light, if we try to make it go faster, we don't see changes in velocity, so something else must change. What changes is observed frequency and wavelength. In other words, figure 3 tells us that, once a particle reaches the speed of light, its speed appears to remain constant, which means that we now observe the particle as energy. This is because all energy forms on the electromagnetic spectrum appear to move at the same speed, namely, c, the speed of light, but if we add or subtract energy from the electromagnetic spectrum, instead of observing changes in velocity, we observe changes in frequency and wavelength. Thus, at the speed of light, a particle appears as energy. In the case of an electron, once an electron reaches the speed of light, if it tries to go faster, we observe this electron as an energy form on the electromagnetic spectrum. Refer to figure 4 below.

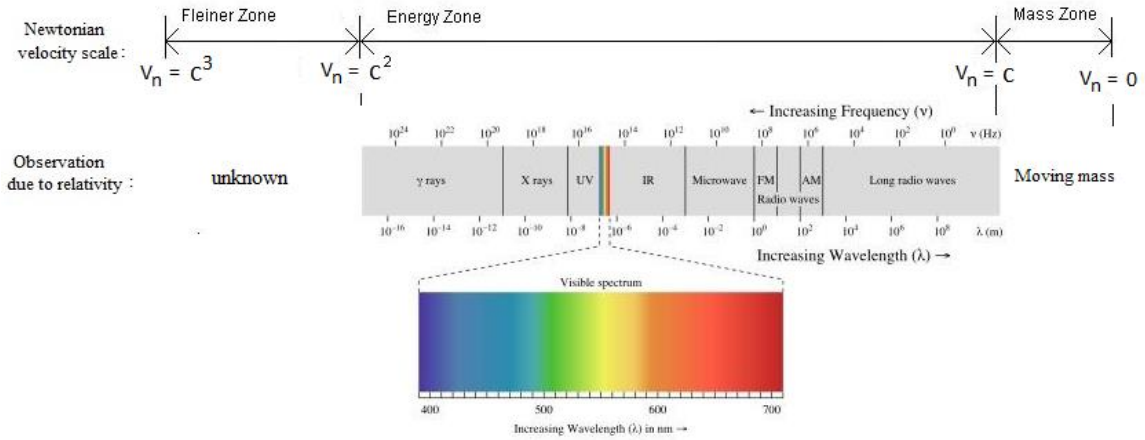


**Figure 4: How an electron is observed at different newtonian speeds: modified from Serway, R.A. (1996).** Here, we see that as an electron moves with increasing speed according to Newtonian physics (although the speed we observe is dilated back to that of light because of relativity as in figure 3) and becomes a coil because of relativity, as the electron speed is increasingly dilated back to light it is observed as different types of energy. This is because the electron becomes more coiled (more velocity dilation) as it tries to move faster, so we say that the frequency increases and wavelength decreases. In this diagram, let the value of true, un-dilated Newtonian velocity due to relativity be Vn as in figure 2, and let the velocity of light be equal to c. I believe that electrons are on the boarder of mass and energy in the case of electricity, so in the diagram above electricity would be at the point where Vn=c. If the electrons in electricity tried to move faster, they would be compressed further into a secondary coil to become long radio waves, then AM radio waves, then FM radio waves, then microwaves, then Infra-red (IR), then X-rays, then y-rays. Hence, the electromagnetic spectrum is nothing more than an electron dilated by different magnitudes of special relativity. Other particles, such as protons and neutrons, will also have their own spectrums, which may be different or similar to that of the electron.

From Figure 4, we see that if electricity or electrons in an electrical wire tried to move faster, the electron path would be compressed further, making it coil upon itself again creating secondary coiling or a coiled coil path. Hence it would be further affected by length contraction. As a result, the electron will be observed as different forms of energy. In the figure above, we see that an electron is considered as mass when it has an un-dilated velocity or Newtonian velocity between 0 and c. If an electron tries to travel faster than this, it enters the energy zone, where the electron path becomes fully compressed and moves as a full primary coil or circle which undergoes secondary coiling or coils upon itself. A particle moving as energy or a secondary coil has an un-dilated velocity or Newtonian velocity range between c and $c^2$. In this range, the particle now experiences secondary coiling, so the coil now coils upon itself. Figure 4 also explains what happens if an electron tries to move faster than $C^2$: The secondary coiled or coiled coil path becomes overly dilated, and the length contraction effect becomes so great that the particle now undergoes tertiary coiling- ie it becomes a coiled coil coil. As a result, because of excess coiling the particle becomes undetectable or unidentifiable. These undetectable states are what are known as dark matter and/or dark energy. See figure 5.

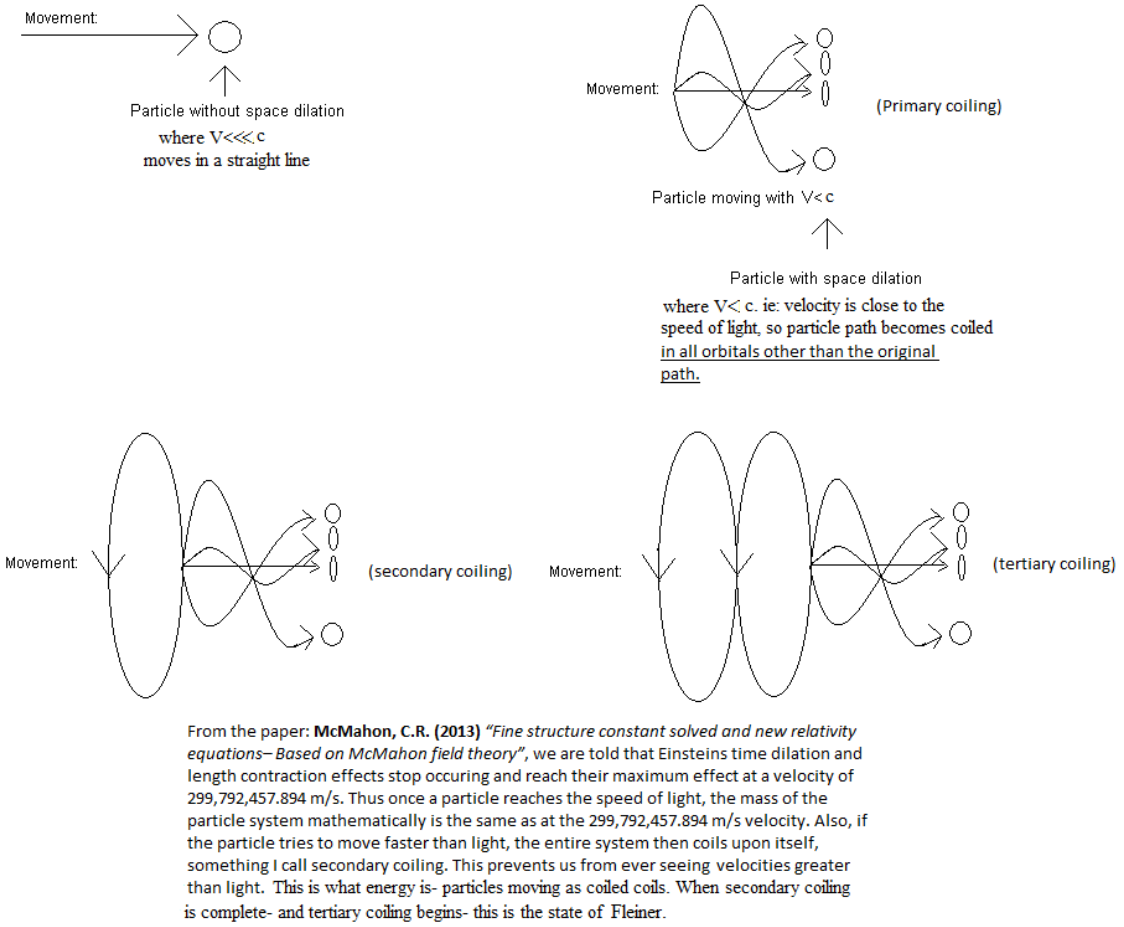


**Figure 5:** The actual affect Einsteins relativity theory has on the movement of a particle, causing it to first appear as mass during primary coiling, then energy during secondary coiling, and Fleiner during tertiary coiling, during which it becomes dark matter or dark energy. Einstein was unaware of this.

Now, we must consider conventional science of the current day. Conventional oscilloscopes are used for energy only. Therefore, the "waves" we see on oscilloscopes are in fact, the side views of secondary coils and higher degrees of coiling. Once full primary coiling is achieved, the fully compressed primary coil remains as it is, but with more momentum it begins to coil upon itself, which is secondary coiling. Thus, "wavelength" and "frequency" according to the science of this day are measurements from the reference point where a full primary coil forms.

From this theory, we realize that magnetic flux must arise due to the length contraction and time dilation of the electron, if we assume that electrons move as electricity at the speed of light relative to us as observers, as in the paper: **McMahon, C.R. (2015)** *"Electron velocity through a conductor*". We observe this flux differently depending on the Newtonian velocity of the electron (ie: the electromagnetic spectrum in figure 4). Keep in mind that relativity prevents observers from measuring the true velocity

(Newtonian velocity) of the electron- relativity dilates velocities greater than light back down to the speed of light. Refer to figure 3.

Now, figures 2 and 5 depict the length contraction effect on the electron, but the length contraction effect occurs simultaneously with the time dilation effect, which causes the electron to exist in multiple places along-side itself at the same time. As a result, as a particle approaches the speed of light, the original electron remains in its original linear position, but it also exists tangentially to itself, which rotates around its original self.

From figure 6 in A), we see a stationary electron in a wire. If this electron moves to the other end of the wire at speeds much less than C for us on Earth, the particle obeys the laws of Newtonian Physics. In B), we see our electron now moves through the wire with a speed of c, so as discussed earlier it undergoes full primary coiling, which results in the appearance of a magnetic field (the magnetic field is the primary coiling) so it obeys the laws of relativity. From Einstein, when the electron moves at a speed where V=c, T'= undefined (time dilation = undefined) and L'= 0 (length compressed to zero). This means that to us, the particle no longer experiences time as in Newtonian physics, and now moves as a full primary coil or circle which propagates along with a speed equal to c. Because T'=undefined, the electron is able to be in more than one place at a time. Because L'=0, the particle is seen to move as a full primary coil or circle, which moves along the wire, always with a relative speed equal to c. This means that the electron is both inside the wire, and orbiting around the wire in multiple orbits multiple distances from the wire at the same time.
These "ghost or flux particles" which are all one particle that exist in different places at the same time, are responsible for the strange observations and theories made in quantum physics. These theories arise from the fact that ghost particles appear in their experiments involving high speed particles, such as the double slit experiment, and physicists cannot explain what they observe.

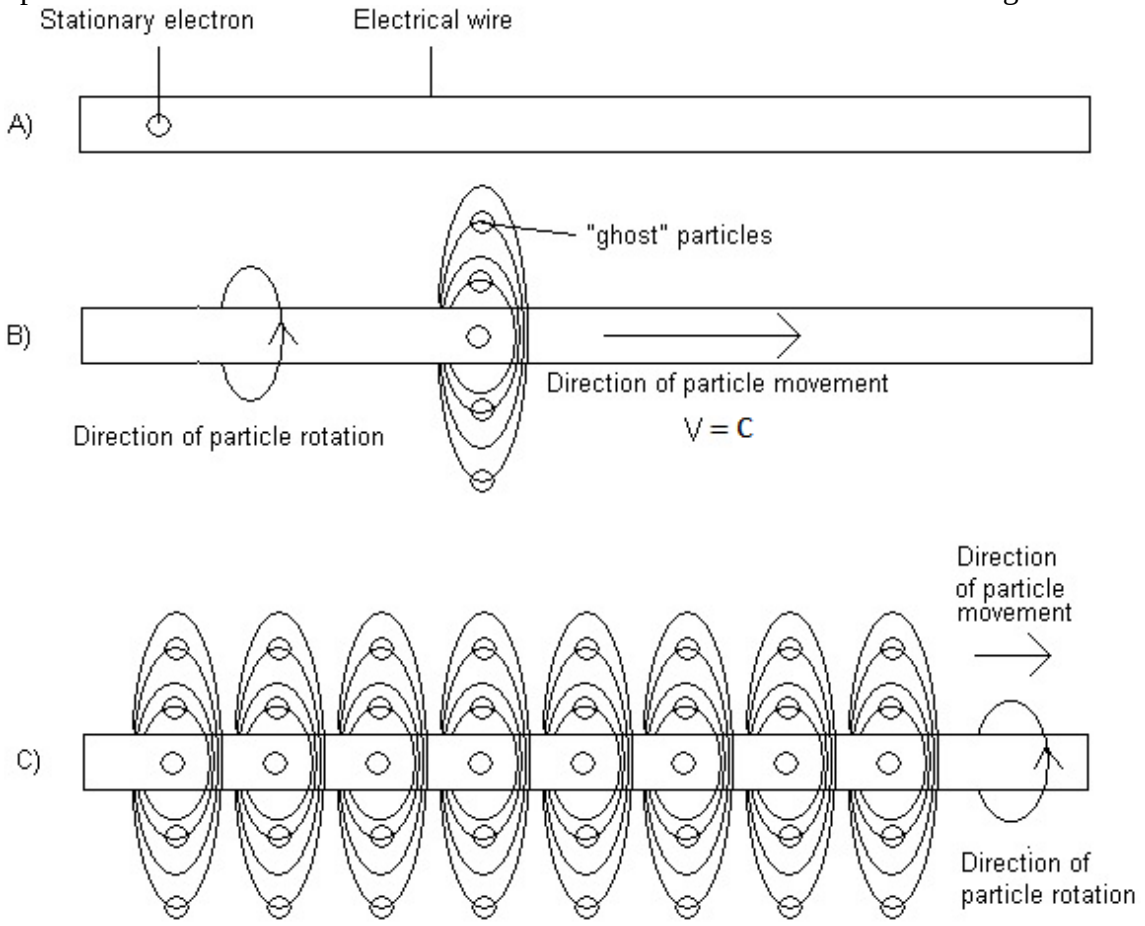


**Figure 6:** In A), we see a stationary electron in a wire. If this electron moves through the wire at speeds far below c, then the particle simply moves in a straight line through the wire, and no magnetic field is observed.
In B), our electron is now moving at c, so space dilation is occurring, causing the electron to now move as a circle (full primary coil) rather than in a straight line. As a result, the entire primary coil is always seen to move at a relative speed of c. However, the particle is experiencing maximum time dilation, T'=undefined. As a result, relative to us as stationary observers, the electron is in more than one place at the same time. In fact, the electron is both inside the wire, and orbiting around it in multiple orbital positions at the same time. As a result, we observe a magnetic field around the wire, which is just the electron orbiting around the outside of the wire. When a particle is seen in more than one place at the same time, I call this a ghost or flux particle. The existence of such particles is described in **Gribbin, J. (1991)**.
In C), the situation described in B) is exactly what is observed when electricity moves through an electrical wire. Note that conventional current moves in the opposite direction to electron flow.

From figure 6, we see that the original moving electrons we observe as electricity still exist inside the wire, but the length contraction and time dilation effects allow these electrons to simultaneously exist tangentially to their direction of movement outside the wire.

Thus, with this new understanding of special relativity, we have the McMahon field theory.

**How McMahon field theory indicates Beta particles and Gamma rays can be converted into electricity:**

When we look at a 3 dimensional coiled coil from side on, it appears as a 2 dimensional wave. This is why light is considered as both a particle and a wave. McMahon C.R. (2010) tells us light is actually composed of electrons experiencing length contraction and time dilation due to Einsteins theory of relativity. In fact, McMahon C.R. (2010) goes into much deeper detail, and explains that the more dilation a particle experiences due to relativity, the more it is compressed like a spring. This causes the particle to appear as different types of energy, even though it is usually just an electron. Hence, McMahon C.R. (2010) tells us that Gamma rays are just fast moving electrons whose observed velocity (= c, light speed) is the result of dilation by special relativity (as in figure 3), thus are experiencing length contraction and time dilation, which make them appear as what we call Gamma rays.

So, if McMahon C.R. (2010) is correct, if we can capture Gamma rays we will be capturing electrons, but McMahon C.R. (2010) also tells us that we must slow these Gamma rays down (momentum wise), thus remove the dilation effect due to relativity (length contraction and time dilation) so that the Gamma rays will be observed as electrons, which are only slightly effected by the dilation effects of relativity. Refer to figure 4.

**So, what are some ideas to capture Beta particles and Gamma rays?**

Beta particles and gamma Rays can pass through a wide variety of materials. We therefore need to find materials that are both electrically conductive and prevent Beta particles and Gamma Rays from passing through. In this way, we can capture them and use them to generate electricity, just as photons are captured and used to generate electricity. Figure 7 below, from the World nuclear association (2012), tells us that lead can stop Gamma rays, as well as X-rays, while aluminum can be used to stop Beta particles. Environmental Management (2012) also tells us that a thin layer of Aluminum foil can stop Beta particles.

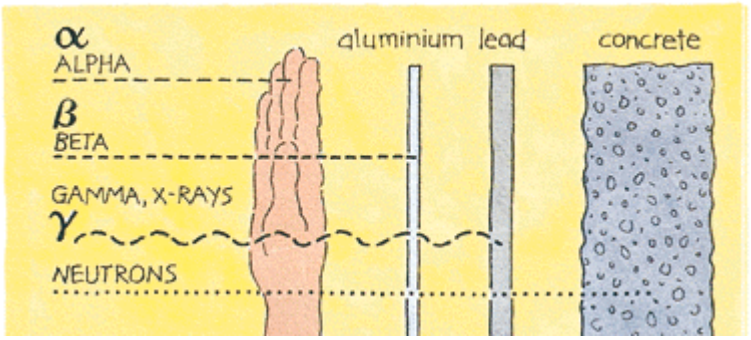


**Figure 7: From the World nuclear Association (2012):** Here, we see that Beta rays cannot pass through Aluminum, and Gamma Rays cannot pass through Lead. We should therefore focus on using Aluminum and lead materials to capture Beta particles and Gamma Rays respectively.

From figure 7 above, since Aluminum and Lead can conduct electricity, and can stop Beta particles and Gamma rays respectively, we should try using these materials in the construction of solar cells to capture electrons from Beta particles and Gamma Rays. Perhaps experiments with different alloys of lead could be investigated to find the optimum composition for highest solar cell functionality.

**Evidence that gamma rays can be converted into electricity**

I was contacted by Mr Augusto Cata, on the 27th of October, 2015. He was an American undergraduate student at the time, studying Mechanical engineering at the University of South Carolina. He pointed out that a species of fungi, known as Radiotropic fungi, use Melanin to convert Gamma radiation into chemical energy, thus he was searching for a way to convert gamma rays into electricity. Thus, to my knowledge, he is the first person to find and realize evidence suggesting that gamma rays can be converted into electricity with solar cells, since, if fungi are basically doing it, why can't we? I therefore acknowledge his brilliant realization. A simple reference to Radiotrophic fungi is provided at the end of this paper, via **Wikipedia (2015)** *Radiotrophic fungus*.

**How are Beta particles and Gamma rays converted into electricity?**

The conventional theory of the photoelectric effect uses a high energy photon to displace an electron from a metal, and this electron can then be conducted as an electrical current. Einsteins photoelectric effect model therefore suggests that gamma rays can be used to generate electricity. If a high energy photon can knock an electron loose since E=hf, then a higher energy form such as gamma rays should also be able to accomplish this feat in the right conditions. McMahon C.R. (2012) "*Max efficiency chemical solar cells and photovoltaics- A new theoretical approach for designing solar cells"* tells us that the photoelectric effect should also work for high energy electrons, and explains that photons themselves are electrons that have been dilated by the effects of relativity (length contraction and time dilation) as explained earlier, causing them to appear as light (and appear massless). Refer to figure 8 below.

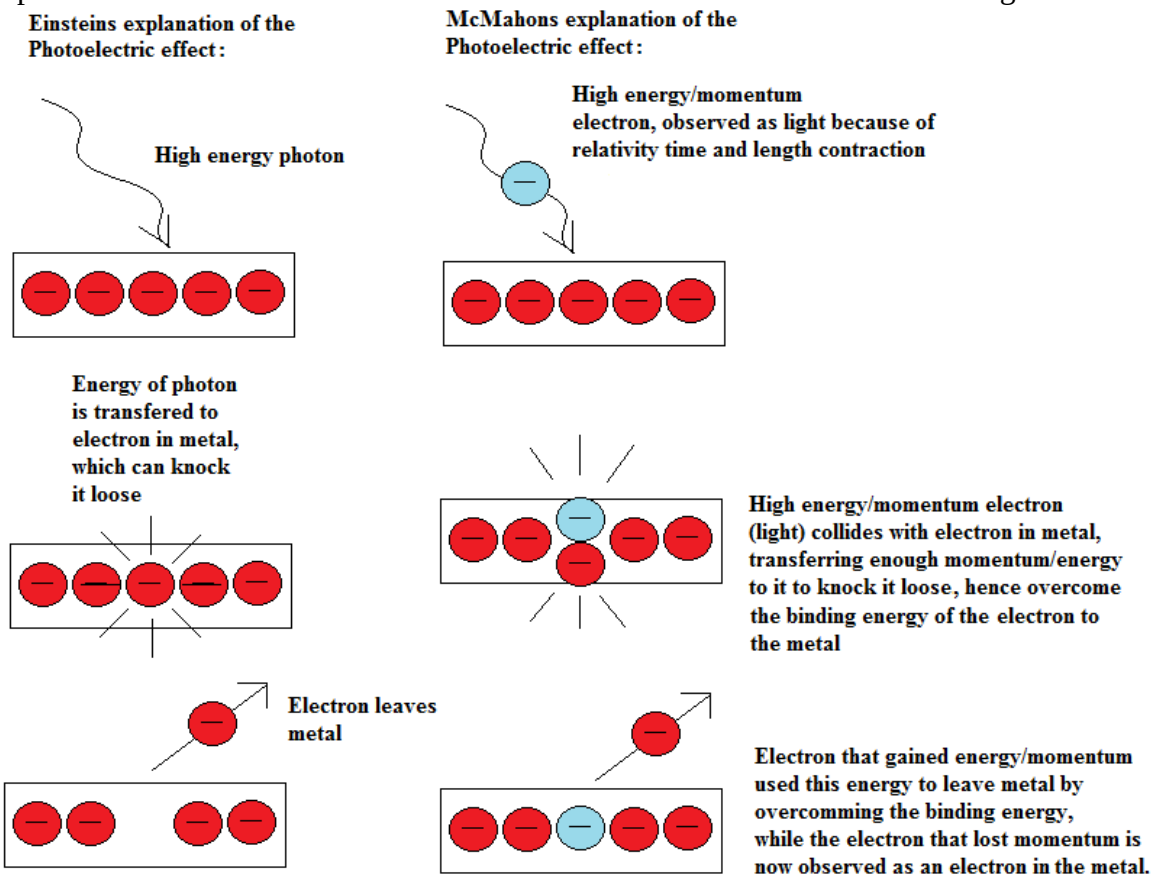


**Figure 8: From McMahon C.R. (2012)** ***Max efficiency chemical solar cells and photovoltaics- A new theoretical approach for designing solar cells.:*** **Einsteins explanation vs McMahons explanation of the photoelectric effect:** Here, we see that according to Einsteins model, the entire photon is absorbed by an electron in the metal. This absorption of energy, if high enough, will knock the electron out of the metal, if enough energy was transferred to overcome the binding energy of the electron. The photon no-longer exists, as it is assumed to be completely absorbed by the electron in the Metal. According to the theory McMahon C.R. (2012) is presenting here, high momentum/energy electrons are observed as light because of the time dilation and length contraction effects of relativity. This electron transfers some of its momentum/energy to the electron in the metal. As a result, the electron moving as light loses enough momentum to allow it to now be observed as an electron. The electron which gains momentum uses this momentum to overcome the binding energy and leave the metal as a free electron (electricity). The final result is that the electron moving as light loses momentum, and takes the place of the electron in the metal, while the electron in the metal gains enough momentum to overcome the binding energy and leave the metal as a free electron, which can be observed as electricity.

According to Einsteins photoelectric effect mechanism shown in figure 8, we should be able to convert Gamma rays into electrical current. However, the McMahon C.R. (2012) photoelectric effect mechanism also shown in figure 8 suggests that both Gamma rays and Beta particles (high energy electrons) can exhibit the photoelectric effect. All that is needed is experimentation to find the optimum conditions and material to achieve this effect. From the previous sections, since Aluminum and Lead can stop Beta particles and Gamma rays respectively, we could look at lead alloys or combinations of lead and Aluminum alloys, as well as the use of Melanin, to capture Beta particles and Gamma rays.

**What current solar cell technology could capture Beta particles and Gamma rays?**

Quantum dot solar cells are currently being constructed using lead to capture light. Thus, the technology to convert nuclear radiation into electricity may already exist. Examples are PbS, PbSe, and PbTe solar cells, as described by Wise (2000). I therefore ask researches using lead in their solar cells to capture light to also try using nuclear radiation rather than light to generate current. Also, try varying the lead composition by trying different lead alloy or lead based compounds, as well as Melanin. Since a thick layer of lead shielding is required to block gamma rays, several lead quantum dot solar cell layers could be used, ie: tandem cells- cells stacked on top of each other. In this way, each successive lead layer can capture energy so as much radiation is captured as possible. This could also be tried with Melanin. I have had experience constructing solar cells in the past, but did not have the opportunity to experiment with nuclear radiation. I am confident that nuclear radiation can be converted into electrical current, thus nuclear waste and radioactive compounds that naturally decay can be used to generate electrical current.

Some may argue that it is impossible to make solar cells to capture radiation, as physical materials may degrade in the presence of radiation exposure. That's like arguing a lead-acid battery cannot be built, as the acid will degrade the battery.

**Why is Melanin of interest for use in solar cells to convert radiation into electricity?**

From figure 9 below, from **McMahon C.R. (2012)** *Production of Grape Skin Solar Cell*, we see that the emission profile of the Sun is identical to the absorption profile of Melanin. So, basically, whatever the Sun emits, Melanin seems capable of absorbing. Melanins absorption profile seems to continue into higher frequencies, so it may be ideal to use to capture Beta particles and Gamma rays. The fact that Radiotropic fungi use it to capture Gamma radiation to make chemical energy is further evidence of its usefulness.

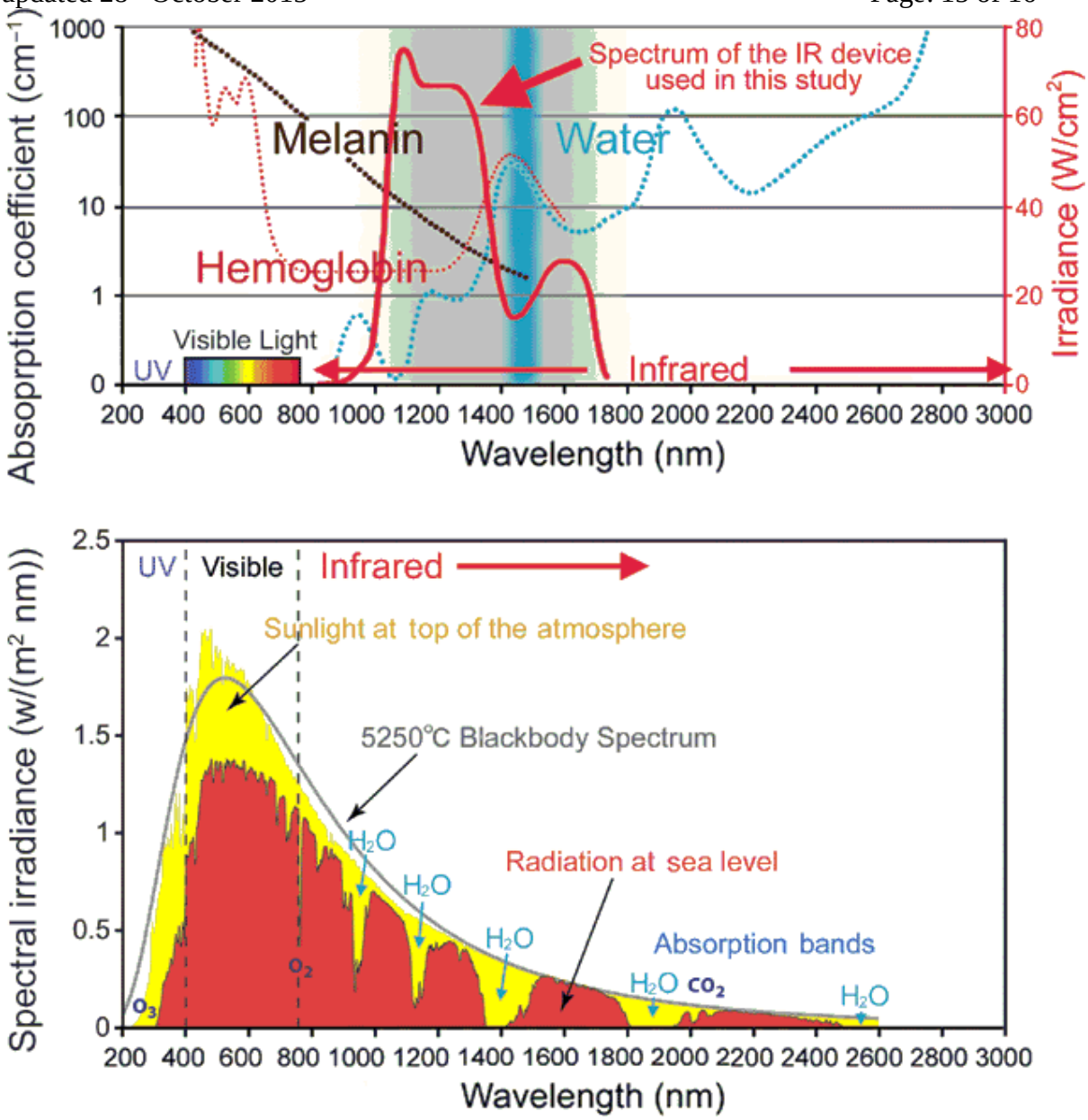


**Figure 9: From McMahon C.R. (2012): *Production of Grape Skin Solar Cell*. Melanin absorbs increasingly better at higher frequencies.**

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