The Electron and De Broglie Wavelength

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Abstract
In this guess at a classical model for the electron, a classical recipe calculation for the electric and magnetic fields isn't done because I don't have the mathematical ability. The circulation speed of the electron is the speed of light, but this is just a number making it a classical model. Without contradicting special relativity, I try to show the reason for the increase in the electric field perpendicular to the direction of translational motion at speed v is due to the deformation of the surfaces of the electron. The same is true for the decrease in the electric field parallel to the direction of motion. The De Broglie wavelength is indirectly related to an actual length of the electron moving at speed v. The reason for the mass of the electron is the binding magnetic force between the two surfaces of the electron.

Introduction

Early in the 1900's it was found from experiments that the electron had an intrinsic magnetic dipole moment or magnetic field. It was well known at the time that a moving charge such as the electron creates an external magnetic field. So during the 1920's two scientists proposed the electron was a rotating sphere of charge in order to account for the intrinsic magnetic dipole field. This was quickly dismissed for a few reasons. If it was a sphere it would have to be rotating at many times the speed of light. The electron would have to be bigger than the whole hydrogen atom. And if you did account for the field, the magnetic energy would be too large.[1]

Around the same time period it was found that the electron exhibited wave properties. So now both light and entities that have mass were found to exhibit both wave and particle properties. A scientist named De Broglie proposed that the wavelength λ_d of a mass particle such as the electron be given by $\lambda_d = h/mv$, where h is Planck's constant, m is the electron's relativistic mass, and v is its speed. This was accepted of course. No one proposed a suitable model of the electron and along came the wave equation and uncertainty principle of Quantum Mechanics. This led to the electron, when in orbit around the nucleus, being represented by a wave probability distribution where it is most likely to be found with the wave's highest amplitude. Because of the wave equation and uncertainty principle the electrons location isn't definitely known like the earth orbiting the sun in our macroscopic world where wave properties associated with an entities mass are considered irrelevant.

Later during the 1900's it was found that a light particle, or photon, of high enough energy could create an electron-positron pair. The positron is the electron's antiparticle. Likewise, an electron and positron can come together and annihilate each other and fly off in opposite directions at the speed of light as two photons. So I assumed the electron must be circulating at the speed of light when it is at rest translationally. And I assumed you should be able to describe the energy of a rest electron the same way as light. The description for the energy of light is hc/λ where λ is the wavelength of the light, and c is the speed of light. The energy of an electron at rest translationally is m_0c^2, where m_0 is the rest mass. So for the rest electron I set m_0c^2=hc/λ_0, where λ_0 would be the length of the perimeter of the rest electron. So $\lambda_0 = h/m_0c$= 2.42x10^{-12} m since we know the values of h, c, and m_0. The known size of the whole hydrogen atom is 10^{-10} meters. [1]

They've done experiments colliding electrons and found its size is 10^{-16} m or less.[1] But when they're doing the collisions I assume they think the electron is a 3 dimensional packet of waves all put together to give its size. As you'll see from the model I chose for the electron, the colliding electrons slide together, one inside the other, to give a smaller result than their actual size. If it turns out this can't be true, and the size is smaller, I can set $m_0c^2 = hc/\eta\lambda_0$, where η is a constant and it won't effect what follows. So next, the equations I discovered.

The Equations

The next thing I did was wonder how to describe the energy of a translationally moving electron in terms of the length of the perimeter of the rest electron, λ_0. I already knew that the energy of a translationally moving electron was given by mc^2, where $m = m_0/\sqrt{1 - v^2/c^2}$ is the relativistic mass in terms of its rest mass. And I already knew about the De Broglie wavelength $\lambda_d = h/mv$ and that I already described the rest electron's rest energy the same way we do for light. So I tried $mc^2 = hc/\lambda_d$+$?$. Then i solved for $?$ realizing that $\lambda_0 = h/m_0c$ and got $? = [hc/\lambda_0]\sqrt{(c - v)/c + v)}$. So this was the equation:

$$mc^2 = hc/\lambda_d + [hc/\lambda_0]\sqrt{(c - v)/(c + v)}$$

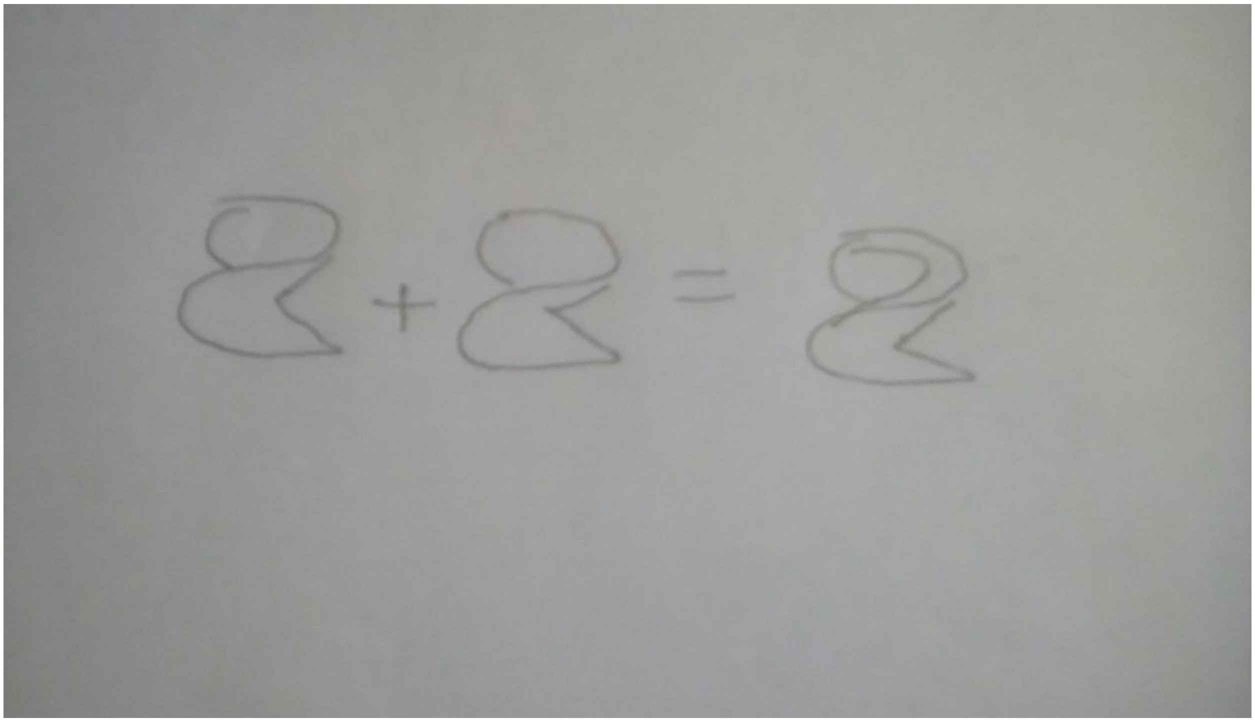
I recognized the term $\lambda_0\sqrt{c + v/(c - v)}$. It is the relativistically shifted wavelength of one of the photons created in an electron-positron annihilation process occurring in a moving frame relative to a stationary observer. So I knew later that there had to be two equations and that you could obtain these equations from that process. I consider them my original equations because of the way I reasoned to get the them.

$$mc^2 = hc/\lambda_d + [hc/\lambda_0]\sqrt{(c - v)/(c + v)}$$

$$mc^2 = -hc/\lambda_d + [hc/\lambda_0]\sqrt{(c + v)/(c - v)}$$

So what do these equations mean when dealing solely with the electron? Immediately after I found the first equation I tried as hard as I could to determine what an electron looked like and only came up with one idea. To know what the equations mean you have to see what the electron looks like.

The rest electron



The rest electron consists of two surfaces of uniform charge density. Each surface is made up of (4) 1/2 right circular cones without their bases connecting to form one continual surface. Since the electron is made from right circular cones, the perimeters must lie on the surface of a sphere. The length of the perimeters is λ_0.

The charge circulates around the shapes of the surfaces in the same direction at the speed of light c. That is, at each point on the surfaces the speed is c. Normally if there were a spinning disk for example, where the outer most edge has the speed c, the speed of the disk would approach 0 as the point approaches the center of the disk. The idea that the speed is c at each point on the surfaces violates common sense. But if you consider relativity theory you know the translational speed of light is the same in all frames moving with respect to one another.

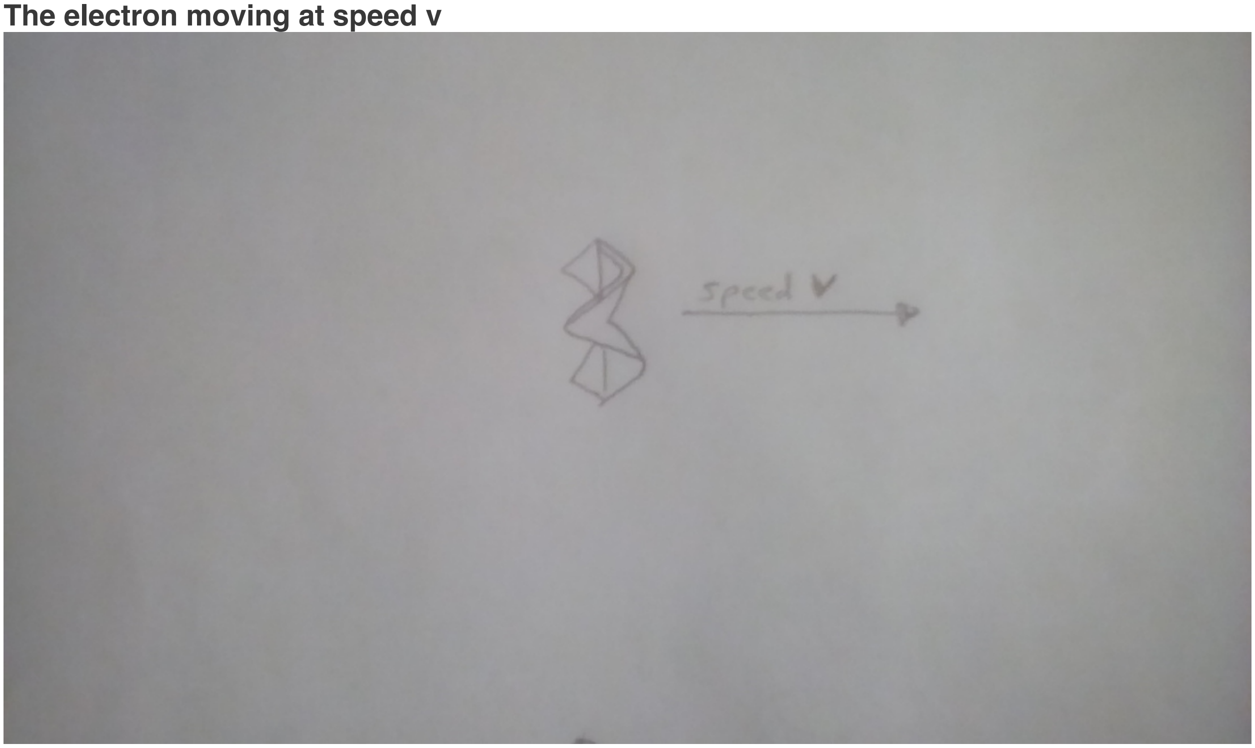
For a translationally moving charge moving at the speed of light the charge density would be infinite from relativity theory. But relativity theory can't be used when dealing with circular motion. Therefore you would calculate the electric and magnetic fields of the rest electron classically. I couldn't do this but later I try to show, with a rough estimate, the relativistic fields of a translationally moving electron are due to the deformation of the surfaces.

Since I can't calculate the magnetic fields from the recipe I'm just assuming there's going to be a magnetic field parallel to the surfaces and magnetic field perpendicular to the surfaces produced from the circulating charge. The parallel components of the magnetic fields cause the attraction between the two surfaces. The perpendicular component of the magnetic field produced by one surface acts on its counterpart surface and would make the surface expand. But that's only along the surface. At the edge, or perimeter, the magnetic field points in the opposite direction acting to keep the charge at the same spherical radius. It's a reasonable guess but I think the only way the two surfaces can remain in place and stable with the electric and attracting magnetic forces being equal in magnitude but opposite in direction is to demand all points have the speed c.

Note from the picture of the rest electron there is only one axis where there is a net circulation around it. This possibly accounts for the magnetic dipole field from the introduction.
The other two axis have no net circulation.

So now to see what the equations mean we need to look at what happens when the electron moves translationally.

The electron moving at speed v



The following is a general description of what I think happens to the electron when it accelerates.

When a negative electric field is applied to the rest electron it's going to accelerate to speed v. The electron moves along the axis in which there is a net circulation of charge. But first consider this. The electric field lines of the rest electron point inward because the charge is negative. That means on two opposite sides of the electron the field lines point in opposite directions because they're both pointing inward toward the electron. The external electric field only points in one direction, back toward the source of the applied field. This means on the side of the rest electron nearest to the source of the applied field there will be a cancellation of field lines. On the far side of the electron there will be an additive effect of field lines.

Remember that my equations can be obtained from an electron-positron annihilation process occurring in a moving frame relative to a stationary observer. If the process is moving away from the observer the wavelength of the photon will be upshifted to $\lambda_0\sqrt{(c+v)/(c-v)}$ from λ_0. If the process is moving toward the observer, the photon's wavelength will be downshifted to $\lambda_0\sqrt{(c-v)/(c+v)}$ from λ_0. For these above reasons i'm just going to assume, when an external field is applied to the rest electron, the perimeter of the surface of the electron nearest to the source of the applied field will increase from λ_0 to $\lambda_0\sqrt{(c+v)/(c-v)}$. The perimeter of the electron furthest away from the source of the applied field will decrease from λ_0 to $\lambda_0\sqrt{(c-v)/(c+v)}$. Since the surfaces are bound together by the components of the magnetic fields that lie parallel to the surfaces from the circulating charges, after the externally applied field is cut off, the lengths of the perimeters come into equilibrium. The end result is both perimeter lengths adjust to become

$$[\lambda_0\sqrt{(c-v))/(c+v)} + \lambda_0\sqrt{(c+v)/(c-v)}]\,/2 = \lambda_0/\sqrt{1-v^2/c^2}.$$

The resultant perimeters lie on the surface of the same sized sphere as the rest electron. The reason I say the perimeters must lie on the surface of the same sized sphere is to make sure the area of the surfaces go up by a factor of $1/\sqrt{1-v^2/c^2}$ compared to the rest electron.

Electromagnetic theory says the amount of charge on the moving electron stays the same as the rest electron, and that the charge density goes up by a factor of $1/\sqrt{1-v^2/c^2}$ because of length contraction from special relativity theory. If I let the amount of charge on my model of the electron stay the same as the rest electron, the charge density would go down by a factor of $\sqrt{1-v^2/c^2}$. But as long as I let the number of curves in the electron go up as $4/(1-v^2/c^2)$, where the curves are no longer circular in shape, a rough estimate shows you get the right values of the electric fields parallel and perpendicular to the direction of motion. The length of each curve is $(\lambda_0/4)\sqrt{1-v^2/c^2}$.

What the equations mean

So let's look at the equations again. The equations are:

$$mc^2 = hc/\lambda_d + [hc/\lambda_0]\sqrt{(c-v)/(c+v)}$$

$$mc^2 = -\,hc/\lambda_d + [hc/\lambda_0]\sqrt{(c+v)/(c-v)}$$

Realizing that $\lambda_0 = h/m_0c$, $\lambda_d = h/mv$, $m = m_0/\sqrt{1-v^2/c^2}$, and multiplying through by λ_0^2, the equations become:

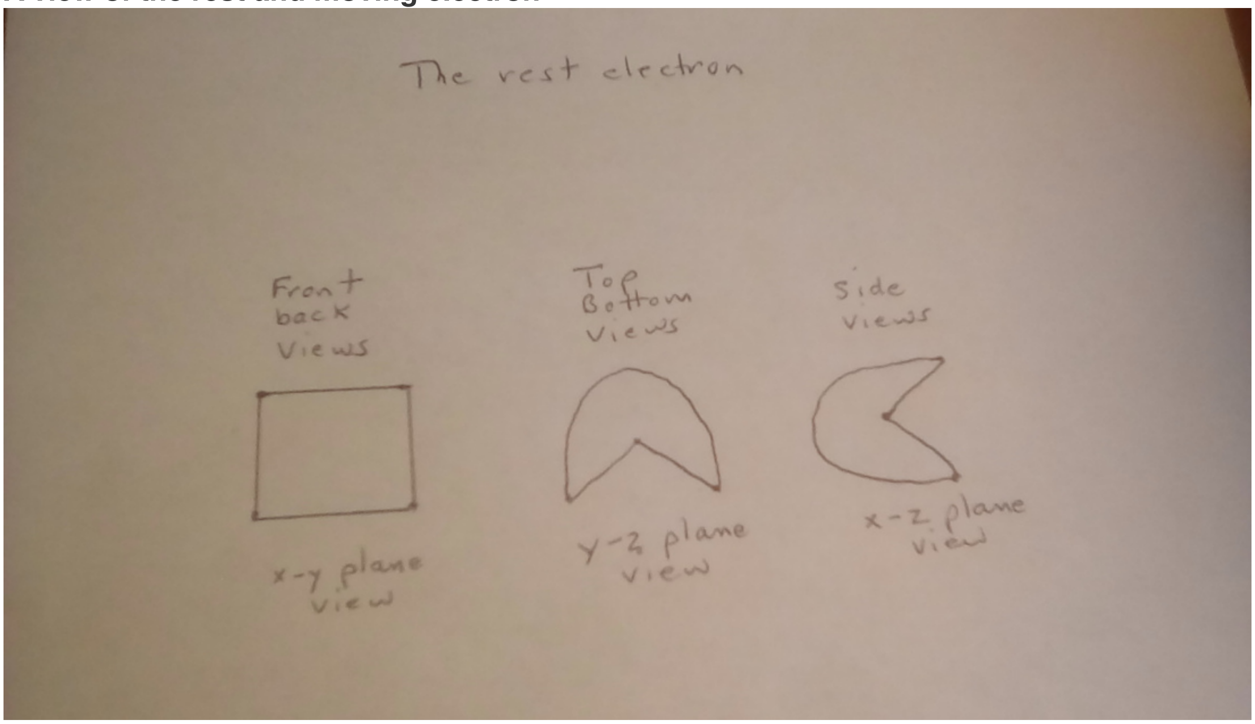
$$\lambda_0/\sqrt{1-v^2/c^2} = \lambda_0(v/c)/\sqrt{1-v^2/c^2} + \lambda_0\sqrt{(c-v))/(c+v)}$$

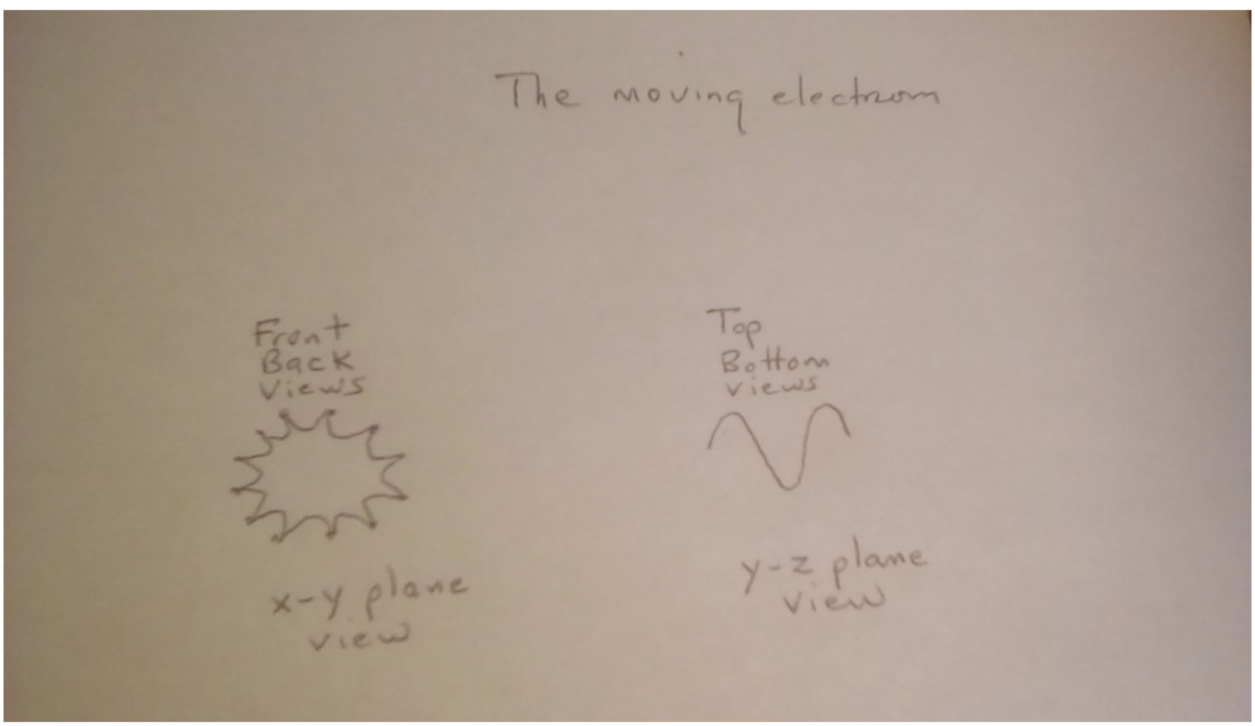
$$\lambda_0/\sqrt{1-v^2/c^2} = -\lambda_0(v/c)/\sqrt{1-v^2/c^2} + \lambda_0\sqrt{(c+v)/(c-v)}$$

You can see the terms $\lambda_0(v/c)/\sqrt{1-v^2/c^2}$ and $-\lambda_0(v/c)/\sqrt{1-v^2/c^2}$ are the adjustments the two perimeters have to make when the electron undergoes an acceleration and become the final perimeter lengths of $\lambda_0/\sqrt{1-v^2/c^2}$. The adjustment terms are inversely proportional to the De Broglie wavelength in the original equations since $\lambda_0 = h/m_0c$ and $\lambda_d = \lambda_0(c/v)\sqrt{1-v^2/c^2}$. So when scientists measure the De Broglie wavelength they are indirectly measuring the adjustments the perimeters have to make.

For a point charge moving at speed v, the magnitude of the magnetic field perpendicular to the direction of motion at a field point on the perpendicular axis and centered on the point charge is $B_\perp = (v/c^2)E_0/\sqrt{1-v^2/c^2}$, where E_0 would be the magnitude of the electric field of the rest point charge at the same field point.[2] Writing $B_\perp$ again as $[(E_0/c)(v/c)]/\sqrt{1-v^2/c^2}$ we see that the term in the original equations containing the De Broglie wavelength is inversely proportional to magnitude $B_\perp$. When the two surfaces of my electron model make the adjustments it creates a relativistic increase in the magnetic field perpendicular to the direction of motion. So when scientists measure the De Broglie wavelength, they're also making an indirect measurement of the magnitude of the magnetic field perpendicular to the direction of motion.

A view of the rest and moving electron





Take the semicircle or curve of the top view of the rest electron and push on it and you get 3 curves instead of one as shown in the top view of the moving electron after one of the curves of the rest electron has been deformed. The same would be true for the bottom and side views.

You recall the length of the perimeter of the rest electron was λ_0. This means the radius of the sphere the perimeter lies on is $\lambda_0/(2\sqrt{2}\pi)$. And therefore the length of a great circle on the surface of the sphere is $\lambda_0/\sqrt{2}$. Now recall the number of curves in the moving electron is $4/(1 - v^2/c^2)$. This means the length along the great circle between two nodes where one of the curves crosses the great circle at two different points is $\lambda_0(1 - v^2/c^2)/(4\sqrt{2})$ $= (\lambda_0/2\sqrt{2}\pi)(2\phi)$. Now let the amplitude of the curve along another great circle perpendicular to the first be $\lambda_0\sqrt{1 - v^2/c^2}/(8\sqrt{2}) = (\lambda_0/2\sqrt{2}\pi)(\theta - \pi/2)$. The curves go back and forth across the x-y plane. This means the direction of translational motion of the moving electron is along the **z** axis.

A rough estimate for the electric fields parallel and perpendicular to the motion

Let the average tangent to the curves be given by $[(\lambda_0/2\sqrt{2}\pi)(\theta - \pi/2)]/[(\lambda_0/2\sqrt{2}\pi)\phi]$ $= 1/\sqrt{1 - v^2/c^2}$. You recall the charge density for the moving electron goes down by a factor of $\sqrt{1 - v^2/c^2}$. Just from that alone the magnitude of the electric field parallel to the direction of motion, $E_{||}$, would be $E_0\sqrt{1 - v^2/c^2}$, where E_0 is the magnitude of the electric field of the rest electron at the same field point on the **z** axis. Now taking into account the average tangent to the curves, a factor of $\sqrt{1 - v^2/c^2}$ of the field lines will be removed from the parallel direction to the motion. So $E_{||} = E_0(1 - v^2/c^2)$. This is the value from electromagnetic theory.

The magnitude of the electric field perpendicular to the motion, $E_\perp$, is more complicated because of the overlapping of the curves as seen by a field point on the perpendicular axis. Recall the length of the perimeter of the rest electron was λ_0. If we just had the rest electron with the decreased charge density, $E_\perp$ would be $E_0\sqrt{1 - v^2/c^2}$. Because of the average tangent there are additional field lines now in the perpendicular direction taken from the parallel direction. This would mean $E_\perp = E_0$. The length of the perimeter of the moving electron is $\lambda_0/\sqrt{1 - v^2/c^2}$. So to get the contribution made to $E_\perp = E_0$ by the remaining overlapping curves I multiply by $1/\sqrt{1 - v^2/c^2}$. So $E_\perp = E_0/\sqrt{1 - v^2/c^2}$. This is the known value from electromagnetic theory. There is no overlapping of curves when dealing with the parallel direction to the motion.

Conclusion

As you may have already gathered, I don't believe the electron is a wave packet. Instead, what I think they're measuring as the De Broglie wavelength gives an indicator of the relative shape of the moving electron compared to the rest electron.

The relativistic electric field magnitudes are a result of the deformation of the surfaces of the moving electron. The charge density on the moving electron as a whole is reduced by a factor of $\sqrt{1 - v^2/c^2}$ compared to the rest electron. But as seen from the field point perpendicular to the direction of motion, the charge density could be said to be increased by the factor $1/\sqrt{1 - v^2/c^2}$ because of the overlapping of the increased number of curves and the shapes of those curves.

The mass, or inertia, of my model for the rest electron is being caused by the magnetic binding forces between the two surfaces. When the electron tries to accelerate one surface contracts the other surface expands. Since the surfaces are still bound together by the magnetic fields that lie parallel to the surfaces, the perimeters of the surfaces come into equilibrium with length $\lambda_0/\sqrt{1 - v^2/c^2}$ when the externally applied field is cut off. The attraction between the surfaces resists the attempt to change the length of the perimeters.

You saw in the introduction I described the energy of the rest electron as hc/λ_0. It will now be possible to describe the relativistic energy of the moving electron as $hc/\lambda_0\sqrt{1 - v^2/c^2}$, where $\lambda_0\sqrt{1 - v^2/c^2}$ is the length of four of the curves.

I'm suggesting that all mass particles circulate at the speed of light, and since light travels translationally at the same speed, the speed of light is a universal noun.

References

[1] Eisberg, Resnick, Quantum Mechanics, copyright 1974, page 300

[2] Roald K. Wangsness, Electromagnetic Fields, copyright 1979, page 570