Wave Function Solutions for the Electron and Positron

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Abstract

The Wave/Particle duality of particles in Physics is well known, and every particle has its own characteristic frequency determined by its mass. Charged particles also have associated Electric and Magnetic fields. All of the features of a particle can be brought together in a single wave function equation. From this wave function, all of the other known fields that describe the particle's properties can be derived. Here I present solutions to the wave function for an Electron and a Positron and provide principles that can be used to calculate the wave functions of all Physics particles.

The Solutions

Here I present solutions to the wave functions for the Electron and the Positron. The images located in [fig 1-9] are graphical representations of the fields generated by these wave functions using a 3D finite element vector modeling program I wrote to aid in the visualization and testing of proposed wave function solutions.

For the Electron:

$$\psi_e = \frac{2Q_e}{\varepsilon_0} e^{\left(\frac{-2iM_e c^2}{\hbar}\left(t-\frac{r}{c}\right)\right)} \qquad (1)$$

For the Positron:

$$\psi_p = \frac{2Q_p}{\varepsilon_0} e^{\left(\frac{-2iM_e c^2}{\hbar}\left(t+\frac{r}{c}\right)\right)} \qquad (2)$$

Where:

ψ_e = Electron wave function

ψ_p = Positron wave function

Q_e = Charge of an Electron (negative)

Q_p = Charge of a Positron (positive)

M_e = Mass of an Electron

ε_0 = Permittivity of free space

t = Time

r = Distance from particle's center

c = The speed of light

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Both equations satisfy both the Classical Wave Equation & Schrodinger's Wave Equation, and lead directly to the other known Electromagnetic Fields of the Electron & Positron, through differentiation with respect to space and with respect to time.

Classical wave equation: $$\nabla^2\psi = \frac{1}{c^2}\frac{\partial^2\psi}{\partial t^2} \qquad (3)$$

Schrodinger wave equation: $$-\frac{\hbar^2}{2m}\nabla^2\psi = i\hbar\frac{\partial\psi}{\partial t} \qquad (4)$$

Each of the measurable fields in Electromagnetic Theory, and their connection back to the wave function, can be expressed quite simply by the following set of equations and illustrated by this diagram [ref 1,2]:

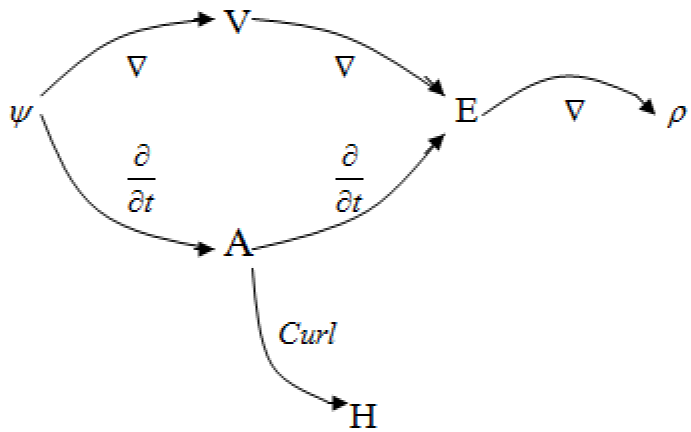

Diagram 1

$$A = -\frac{1}{c}\frac{\partial\psi}{\partial t} \qquad (5) \qquad\qquad V = \nabla.\psi \qquad (6) \qquad\qquad E = -\nabla V - \frac{1}{c}\frac{\partial A}{\partial t} \qquad (7)$$

$$H = \nabla\times A \qquad (8) \qquad\qquad \rho = -\frac{1}{4\pi}\nabla.E \qquad (9)$$

Where:

ψ	=	Wave function
V	=	Voltage (electric potential)
E	=	Electric field vector
A	=	Vector potential
H	=	Magnetic field vector
ρ	=	Charge density

So for the Electron wave function, the Electric Potential (V) is div(ψ_e), which in polar coordinates is

$$\frac{1}{8\pi r}\ \psi_e \qquad (10)$$

This is the divergence of the radial field lines with increasing distance (r) from the centre of the Electron:

$$V = \mathrm{div}(\psi) = \frac{1}{8\pi r}\frac{2Q_e}{\varepsilon_0}e^{\left(\frac{-2iM_e c^2}{\hbar}\left(t-\frac{r}{c}\right)\right)} = \frac{Q_e}{4\pi r\varepsilon_0}e^{\left(\frac{-2iM_e c^2}{\hbar}\left(t-\frac{r}{c}\right)\right)} \qquad (11)$$

Similarly for the Positron:

$$V = \mathrm{div}(\psi) = \frac{1}{8\pi r}\frac{2Q_p}{\varepsilon_0}e^{\left(\frac{-2iM_e c^2}{\hbar}\left(t+\frac{r}{c}\right)\right)} = \frac{Q_p}{4\pi r\varepsilon_0}e^{\left(\frac{-2iM_e c^2}{\hbar}\left(t+\frac{r}{c}\right)\right)} \qquad (12)$$

Both wave functions represent a field of rotating vectors. The pattern described by the phases of the field of rotating vectors is that of a spinning spiral wave. The phase wave flows either away from or towards the centre of the particle [fig 1, 2]. The Electron spins with the phase wave flowing outward and the Positron with the phase wave flowing inwards [ref 3]. The frequency of this phase wave is the same as the Quantum mechanical frequency associated with that particle due to its mass. When viewed close up, the spinning spiral and charge layers that comprise the electron/positron are clearly visible. At large distance scales the undulations of the spinning charge layers are small by comparison, so the fields appear to become smooth and be of a continuous nature [fig 4-9]. So, for example the Electric Potential, for the Electron in this case, appears to be the classical equation:

$$V = \frac{Q_e}{4\pi r\varepsilon_0} \qquad (13)$$

The spinning spiral that the wave function represents is actually two spirals [fig 3], each 180 degrees (π Radians) apart. Thus the angle term in the wave function has a 2 in it, thereby the period of the particle's phase wave is completed with a 180 degree rotation rather than requiring 360 degrees.

$$\frac{-2iM_e c^2}{\hbar} \quad \text{Radians per Second} \qquad (14)$$

This angular frequency from the wave function is derived from the following three known equations, by substituting Equation 16 and Equation 17 into Equation 15 and then solving for ν .

$$E = h\nu \quad (15) \qquad E = mc^2 \quad (16) \qquad h = 2\pi\hbar \quad (17)$$

The outward or inward phase flow will combine with the outward or inward phase flow of other charged particles in space to generate an attraction or repulsion, depending on whether these phase waves are pushing against one another or not. The same principle can be applied to explain magnetic attraction/repulsion too, depending on whether the vector fields of the spirals of two particles are rotating in the same direction or the opposite direction to one other in the same region of space.

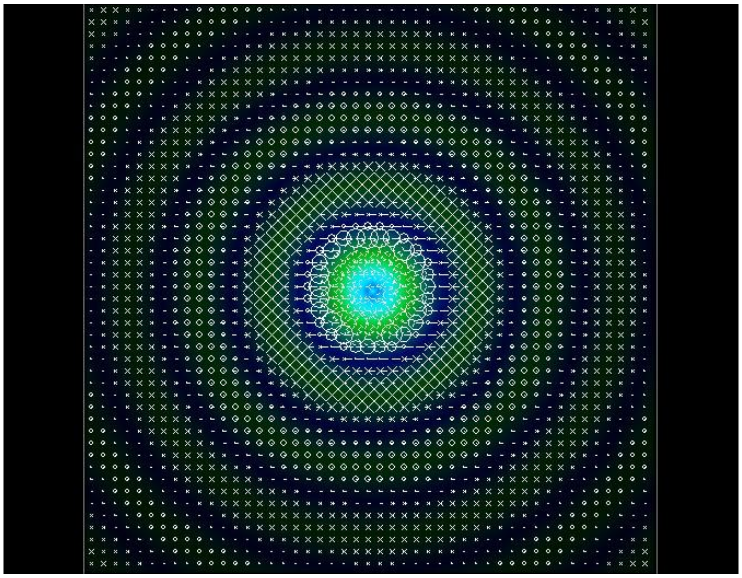

Fig 1. The Electron wave function from the side (spin axis is vertical).

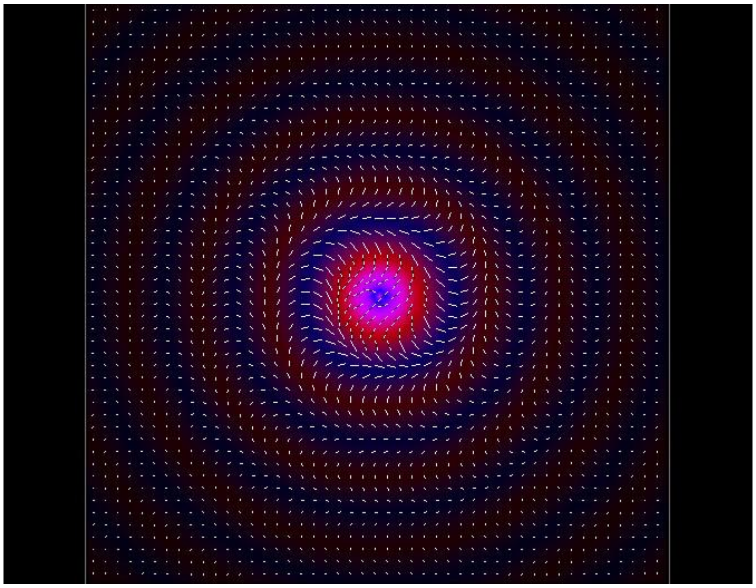

Fig 2. The Electron wave function from the top (down the spin axis).

Fig 3. The Electric Potential showing the double spiral of charge layers.

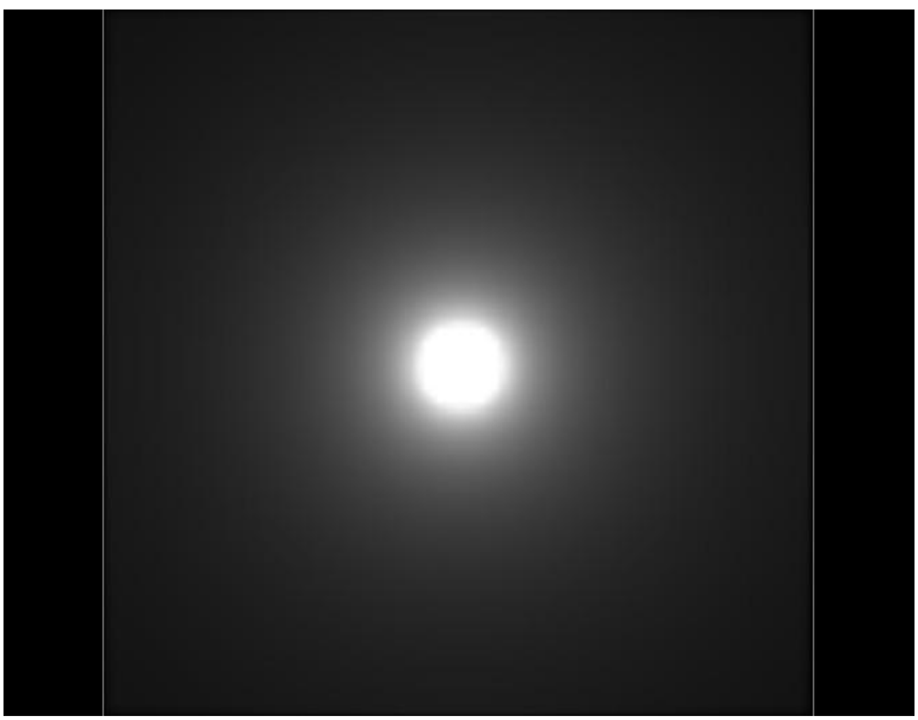

Fig 4. The Electric Potential at large distance scales
where the individual charge layers are not visible (too small to see).

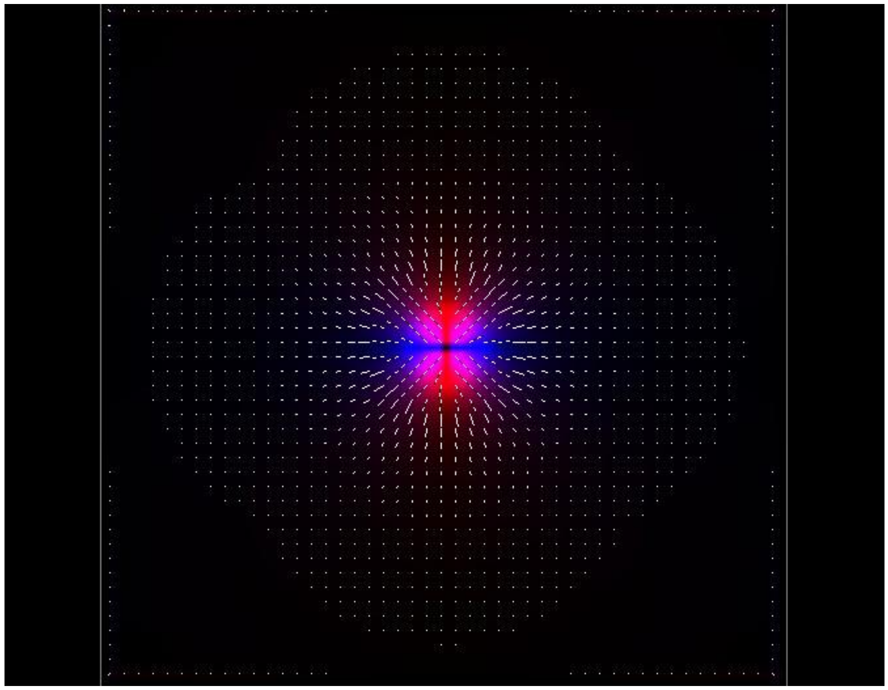

Fig 5. The Electric field at large distance scales
where the appearance of the wave undulations are smoothed out.

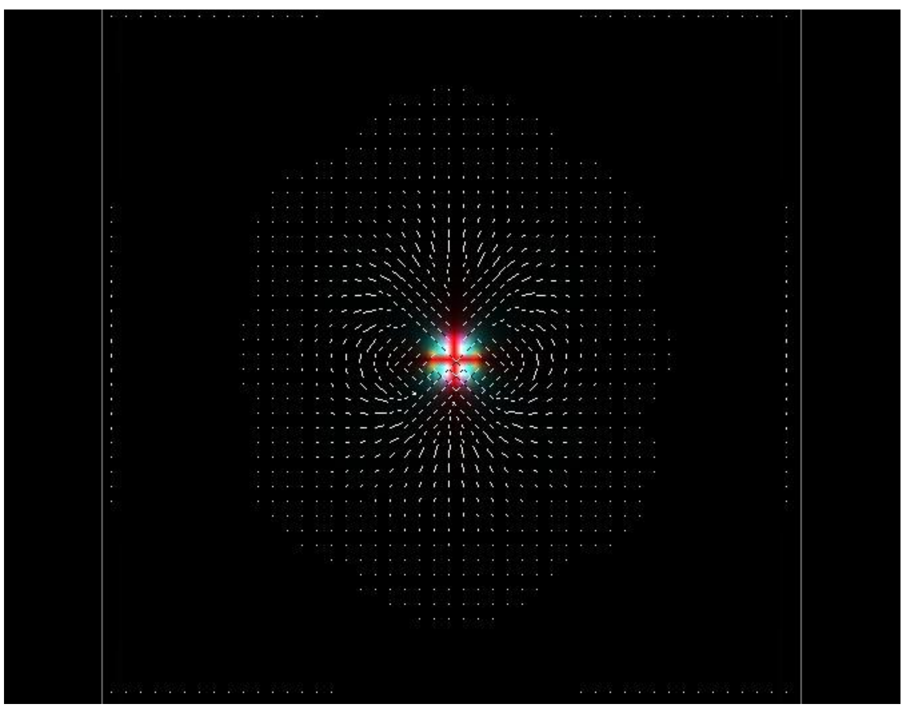

Fig 6. The Magnetic field from the side (spin axis is vertical) at large distance scales
where the appearance of the wave undulations are smoothed out. Also vectors into/out of
the page are not shown in order to reveal the nice magnetic field lines.

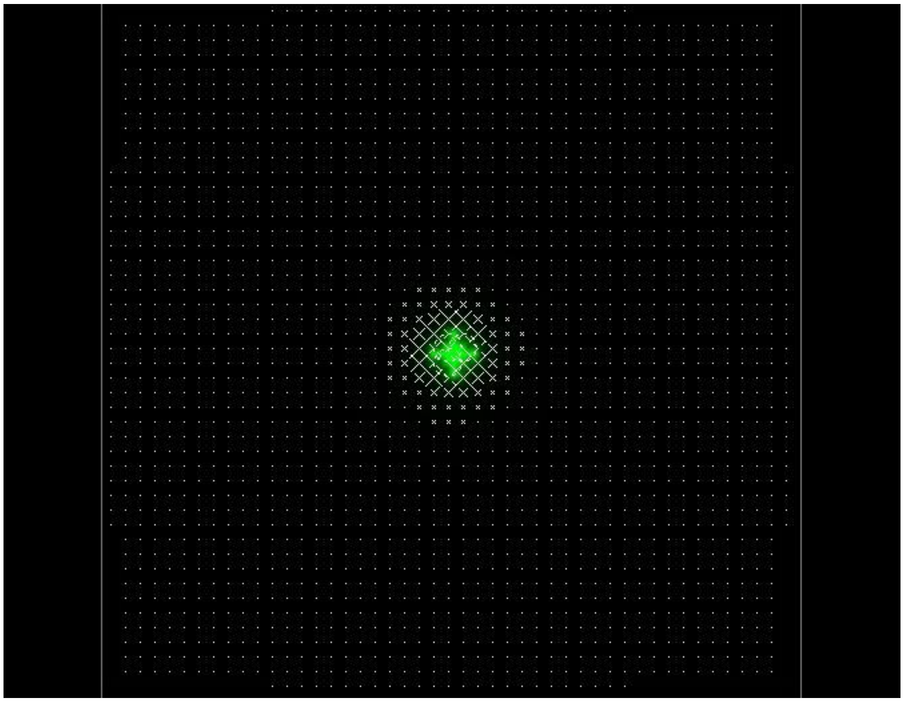

Fig 7. The Magnetic field at large distance scales from the top (looking down the spin axis) where the appearance of the wave undulations are smoothed out.

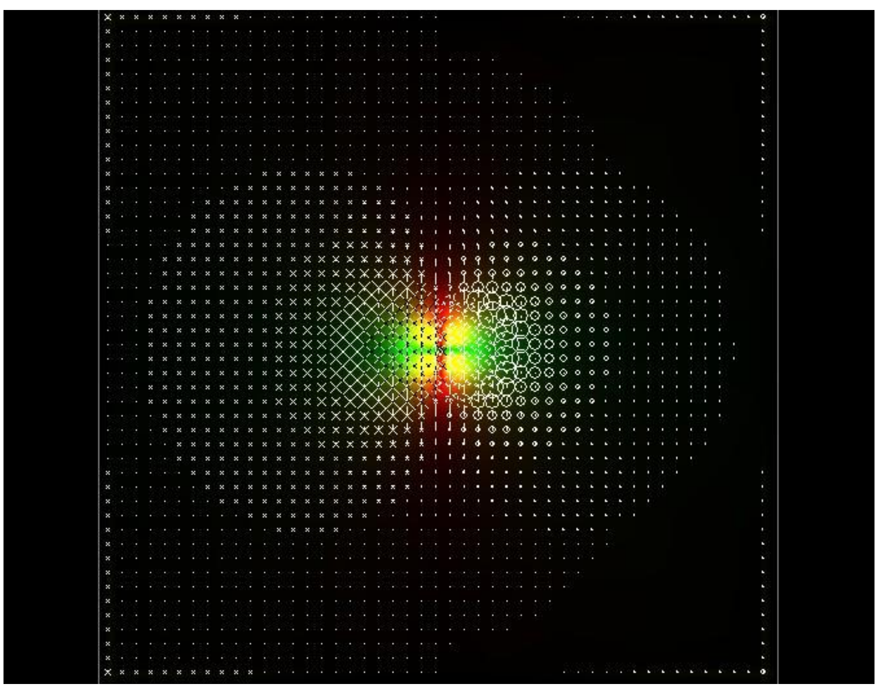

Fig 8. The Vector Potential field from the side (spin axis is vertical) at large distance scales from the top where the appearance of the wave undulations are smoothed out.

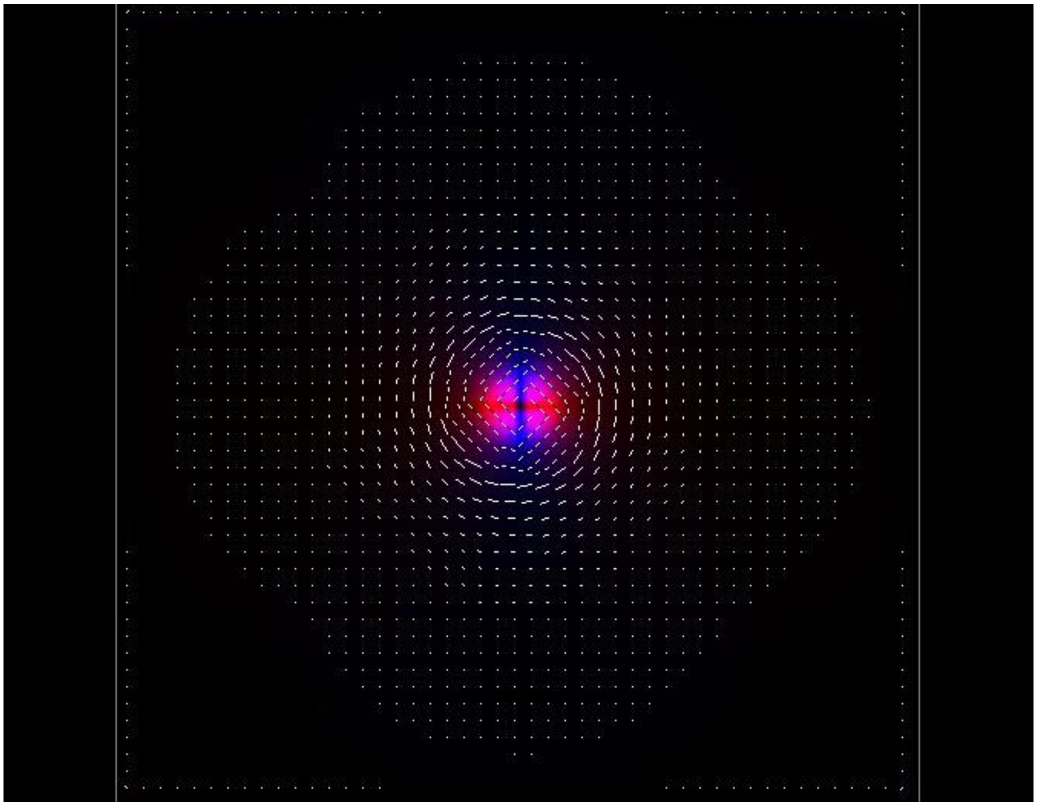

Fig 9. The Vector Potential field from the top (looking down the spin axis) at large distance scales from the top where the appearance of the wave undulations are smoothed out. Note how the energy of the particle flows around the spin axis in closed loops.

Conclusion

The wave functions presented here describe particles with all the correct properties for an Electron and a Positron.

The wave function represents a field of rotating vectors. The spinning vectors form a phase wave that describes a spinning spiral. The phase wave flows either away from or towards the centre of the particle. Interactions between these phase waves of two or more particles cause the Electrical & Magnetic attraction/repulsion between charged particles.

In general, the concepts use to build these two wave equations can be applied to all particles in Physics. The key principles are:

The frequency of the waves in the particle’s three dimensional wave structure are based on the particle's mass (via the calculation shown above).

Particle's charge is defined by either an outward or inward flowing phase wave. A neutral particle would have no net phase flow inward or outward, but may contain regions of either inward or outward flow, which cancel out in the region surrounding the particle.

The completed wave function must satisfy both the Classical and Schrodinger wave equation.

Particles such as Proton (or other particles containing Quarks) would contain several components to the overall wave function, which work together to form a stable particle (i.e. together they satisfy the other three principles stated here).

References

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