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The Spinning Electron

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Abstract. The notion introduced by Ohanian that *spin is a wave property* is implemented, both in Dirac and in Schrödinger quantum mechanics. We find that half-integer spin is the consequence of azimuthal dependence in two of the four spinor components, relativistically and non-relativistically. In both cases the spinor components are free particle wavepackets; the total wavefunction is an eigenstate of the total angular momentum in the direction of net particle motion. In the non-relativistic case we make use of the Lévy-Leblond result that four coupled non-relativistic wave equations, equivalent to the Pauli-Schrödinger equation, represent particles of half-integer spin, with g-factor 2. An example of an exact Gaussian solution of the non-relativistic equations is illustrated.

Keywords: electron, spin, spinor.

The correct form of equations (3.4) is:

$$-\partial_t\psi_1 + e^{-i\phi}(\partial_\rho - i\rho^{-1}\partial_\phi)\psi_4 + \partial_z\psi_3 = 0 \tag{3.4a}$$

$$-\partial_t\psi_2 + e^{i\phi}(\partial_\rho + i\rho^{-1}\partial_\phi)\psi_3 - \partial_z\psi_4 = 0 \tag{3.4b}$$

$$\frac{2im}{\hbar}\psi_3 + e^{-i\phi}(\partial_\rho - i\rho^{-1}\partial_\phi)\psi_2 + \partial_z\psi_1 = 0 \tag{3.4c}$$

$$\frac{2im}{\hbar}\psi_4 + e^{i\phi}(\partial_\rho + i\rho^{-1}\partial_\phi)\psi_1 - \partial_z\psi_2 = 0 \tag{3.4d}$$