

In the latest papers of the Unified Field Theory series of ECE theory the famous results of the original Dirac equation have been looked at in a new way with the Fermion equation, which is a product of geometry. All of ECE theory is based directly on geometry. The Fermion equation has been described in previous essays in this popular series of essays and broadcasts of them by Robert Cheshire and Alex Hill. In some ways the Fermion equation closely resembles the Dirac equation, provided that a certain choice of Dirac matrices is used. The most famous results of the Dirac equation remain the original results, the g factor of the electron, the Lande factor, electron spin resonance, nuclear magnetic resonance, magnetic resonance imaging, antiparticles, the Thomas factor, the spin orbit constant in spectra and the Darwin term. These are all given by the ECE Fermion equation, which has the great advantage of eliminating negative energy and the Dirac sea. Negative energy and the Dirac sea are major weaknesses of the Dirac equation, and neither have ever been observed. They are the first examples of the notorious tendency of standard physics to produce things that can never be tested against nature. In ECE theory these are called “unobservables”, and ECE theory strives to eliminate unobservables as far as possible.

The Fermion equation was developed in UFT249 to UFT253 with a type of Pauli algebra that has been known from the twenties but which was never used with the Dirac equation. The original Dirac equation produced its famous results by use of the original algebra proposed by Pauli. The g factor of the electron and the Lande factor were produced successfully using certain approximations. The same procedure produced the Thomas factor and spin orbit spectra, notably of the hydrogen atom. The Fermion equation produces the same results exactly, but without the unobservables. Probably the most famous outcome of this type of theory is the prediction of Fermion resonance, notably electron spin resonance and nuclear magnetic resonance. These are now the largest subject areas of contemporary chemical physics, so any new discovery in this area is a major discovery.

In UFT249 to UFT253 several new discoveries were made using atomic hydrogen as an example. These include new types of spin orbit resonance, and new types of spectral patterns expressed in terms of energy expectation values. These can be worked out for atomic hydrogen because its orbital's are known analytically. They are very complicated but computer algebra was used at every stage. The new type of Pauli algebra used introduced the position vector  $r$  into the analysis in a new way. That leads to the introduction of orbital angular momentum in a new way. It was soon discovered that there is a hidden or unwritten rule in the original work by Dirac. He used different representations of momentum in deriving different results. There is no rule or law as to how to go about doing this. In deriving the g factor of the electron, the Lande factor, ESR, NMR and MRI the operator representation of momentum is used exclusively, in deriving the Thomas factor and spin orbit coupling the first momentum term in the relevant expression is used as an operator, the second as a function.

In these papers the various relevant terms were examined with great scholarly care with the original and new use of the Pauli matrices. The operator and functional representations of momentum were explored carefully and systematically, and new types of first and second order minimal prescription introduced in order to explore the effect of gravitation. The original work by Dirac, although elegant, was based on a crude approximation of energy as rest energy and in UFT249 to UFT253 more accurate theory was used and relativistic corrections evaluated, giving a host of new results. In each case the energy expectation values were evaluated by computer for atomic hydrogen. The effect of gravitation was explored for earth, the sun and a neutron star.

Among the significant results observed was a kind of dissociation or hidden resonance which arose directly from the kinetic energy term itself provided that this was expressed with the new Pauli algebra. All of these results could have been predicted in the twenties, just after the inference of the original Dirac equation, but they were never realized to exist throughout the twentieth century. They must all be tested experimentally and this is the most severe test of relativistic quantum mechanics to date. Potential energy from spacetime can also be used in the Fermion equation, to explore the circumstances under which spacetime energy can dissociate an atom to give electrons, and an electric current: energy from spacetime. The Fermion equation can also be used for low energy nuclear reactors (LENR).