ESSAY 24 : Derivation of the Pauli Exclusion Principle from The Fermion Equation

The Pauli exclusion principle was suggested empirically in 1925 on the basis of experimental data from atomic and molecular spectra and is usually regarded as an axiom of quantum mechanics. In its simplest form it states that if there is more than one electron in an atom or molecule, no two electrons can have the same n, l, m, j and s quantum numbers. Another way of stating it is that the total wavefunction including spin is antisymmetric with respect to interchange of any pair of identical fermions. Pauli proposed the rule empirically, and it became a basic principle because it succeeded in describing all known atomic and molecular spectra. The fermion equation is the first true single fermion equation because it does not use the mathematical idea of Ɒnegative energy@. The latter leads to severe complications which are not needed in natural philosophy by Ockham=s Razor. The fermion equation is derived from a generally covariant unified field theory (ECE theory) based on a wave equation whose eigenfunction is a tetrad matrix, a square matrix. For the fermion field this is a two by two matrix containing an arrangement of the components of the two Pauli spinors, right and left.

The fermion equation is therefore a statement of relativity, in which physics is derived from geometry. The fermion equation produces the wave equation of the fermion in the general spacetime and in the limit of the Minkowski spacetime the free fermion equation produces the Lorentz transformations of the right and left Pauli spinors as given by considerations of the Lorentz group extended by parity. Conversely the two Lorentz transforms can be condensed into a single equation - the fermion equation. Similarly the general coordinate transformations of the two Pauli spinors gives again a fermion equation in the general spacetime. The Lorentz transforms of the right and left Pauli spinors do not give the Dirac equation, which is not a fundamental equation because of Dirac=s incorrect choice of his four by four gamma matrices. The latter are not necessary because the single particle fermion field can be described using the Pauli matrices only. The fermion equation is a first order equation of the type that was sought for by Dirac, and the fermion equation solves the problem that Dirac attempted to solve unsuccessfully. The tell tale sign of failure is Ɒnegative energy@, which is a mathematical mirage produced by the Ɒstandard representation@ of the Dirac matrices now known to be unnecessary.

In contrast the fermion equation shows that energy in relativistic quantum mechanics is always positive, and evidently, this is also the very fundamental result of the two Lorentz transforms of the right and left Pauli spinors. Conversely, if the energy is negative, the Lorentz transform is violated, and special relativity is violated. Similarly general relativity is violated by negative energy, and quite obviously so is classical physics in which negative energy never occurs and is never considered as physically meaningful. It goes without saying that negative energy has never been observed experimentally. The fact that the fermion equation can so easily remove negative energy indicates that it is a powerful equation.

The fundamental hydrogenic wavefunctions produced by the fermion equation are combinations of wavefunctions with opposite spin. The Dirac equation does not produce this very fundamental result. So the wavefunction of the single electron of the hydrogen atom must always be expressed as a sum of wavefunctions with spin up and spin down states of the electron. There are signs here already of the origin of the Pauli exclusion principle, which deals with different spin states in atoms and molecules in which there is more than one electron, essentially all atoms and molecules excluding atomic hydrogen and its isotopes, deuterium and tritium. The obsolete physics of the twentieth century was based on an error, Dirac=s choice of gamma matrices. This error led to negative energy and puzzled Dirac greatly. He attempted to solve the problem with the Dirac sea - an abstruse and

experimentally unobservable type of vacuum. This idea introduced the necessity of a multi fermion interpretation and introduced quantum field theory in which second quantization of the field itself is used. Attempts were made by Wigner to deduce the Pauli principle with the use of empirical and abstract anticommutators in quantum field theory, all these attempts were based on the erroneous notion of negative energy. Into this morasse of mathematical abstraction stepped Stueckelberg, who proposed Amotion backwards in time@, and Arenormalization@. Feynman later proposed Avirtual particles@ in quantum electrodynamics, particles that are not directly observable, and without which quantum electrodynamics violates the conservation laws of physics in an incredibly elaborate way. In this area of pure mathematics the Pauli principle was Aderived@ by a transformation of Aimaginary time@. At this point all chemists stopped reading and Feynman himself began to doubt what he described as the Ahocus pocus@ of renormalization. In cold reality this is just a curve fitting exercise, neither QED or QCD have magical ability to produce literally incredible (i.e. not believable) precision. This is all bad physics of the >t Hooft variety, renormalization in QCD is the low point from which sanity must surely start climbing. Piled upon this creaking edifice was string theory, whose strings have never been observed in nature. So much for Francis Bacon.

The Pauli exclusion principle is actually the simple result of parity inversion applied to the wavefunctions produced by the fermion equation. The simplest example is atomic helium, He, in which there are two electrons and two protons. The wavefunction of the helium atom is a product of the wavefunctions for each electron, electron wavefunctions which must be combinations as stated. Simple application of parity to the total wavefunction shows that one part of the total wavefunction is antisymmetric with respect to interchange of the two electrons of the helium atom. This is the part that is observable experimentally. This is also a derivation of the Pauli exclusion principle from relativity and the fermion equation.