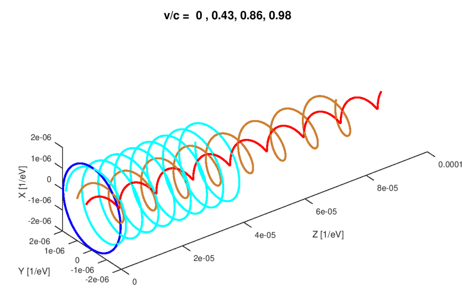
Maxwell-Dirac Theory and Occam's Razor: Unified Field, Elementary Particles, and Nuclear Interactions

Andras Kovacs, Giorgio Vassallo, Antonino O. Di Tommaso, Francesco Celani, Dawei Wang

1. Maxwell's Equations and Occam's Razor



We introduce and use the space-time Clifford algebra, showing that only one fundamental physical entity is sufficient to describe the origin of electromagnetic fields, charges and currents: the electromagnetic four-potential. We get a familiar form of Maxwell's equations: DA=G and DG=0, where A is the vector potential, and D is the space-time differentiation operator. But G now incorporates electromagnetic fields, charges, and also currents. This is shown to be the origin of zitterbewegung.

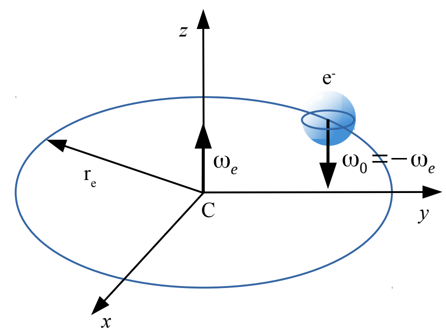
2. Quantum Mechanics and Occam's Razor

Quantum mechanical relations follow naturally from this model, and we derive the electromagnetic formulation of the Dirac equation. The spinor field's space-time gradient is shown to be the electromagnetic energy-momentum. Particles' probability density is electromagnetic Lagrangian density.

Mathematical expression	Physical interpretation	Corresponding Q.M. expression
A_+, A_-	Electromagnetic vector potential	
$G_+ = DA_+$ $G_- = DA_-$	Electromagnetic field: $G = (S, \mathbf{0}) + F$	Complex wave-function: $\Psi \sim G$ when $S = 0$
$N_+ = \frac{1}{2} G_+ \mathbf{e}_t \widetilde{G_+}$ $-N_- = \frac{1}{2} G_- \mathbf{e}_t \widetilde{G_-}$	Electromagnetic energy-momentum density	Dirac spinor field ψ: $d_+\psi_+ \sim N_+$, $d_-\psi_- \sim -N_-$
$L_+ = \frac{1}{2} G_+ \widetilde{G_+}$ $-L_- = \frac{1}{2} G_- \widetilde{G_-}$	Electromagnetic Lagrangian	Probability density: $\Psi\Psi^* \sim G\widetilde{G}$ when $S = 0$

3. The Electron and Occam's Razor

We derive from the model all the essential features of the electron: its mass exactly corresponds to its electromagnetic energy, its charge surface is on a sphere at the classical electron radius, its zitterbewegung radius is the reduced Compton radius (in the rest frame), and we derive its relativistic increase of mass.



4. - 5. Detailed Analysis of Electron Dynamics and Zitterbewegung Orbit calculation

Our calculation shows the existence of a meta-stable electron state at 0.383 pm radius, requiring 35 eV and 80 eV electron energy around a deuteron and proton, respectively. The 2.3 pm inter-nuclear distance in dense hydrogen is also calculated.

6. The Electromagnetic Wave Equation Based Nuclear Model

The same model can be applied to describe nuclear forces and nucleons, and a very large set of "anomalous" or unexplained experimental data suddenly make sense. The figures show data from particle collision experiments, probing the internal structure of the proton and light nuclei.