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Review text:

This paper is suitable for students and researchers with basic knowledge of special relativity, quantum mechanics and quantum bits (qubits).

Section 2 introduces the quaternion algebra $\mathbb{H}$, the algebra of physical space (APS) $Cl_3 \simeq Cl_{1,3}^+$ isomorphic to biquaternions $\mathbb{H} \otimes \mathbb{C}$, the spacetime algebra (STA) $Cl_{1,3}$ known as Dirac algebra in its matrix representation, and the complex estension of APS (CAPS). For the APS basic methods of calculation are stated. Four-dimensional paravectors are defined as combinations of scalars with three-dimensional vectors. Scalarlike entities are scalars and pseudoscalars, vectorlike entities are vectors and pseudovectors, e.g. energy-momentum. Complimentary ideals of the CAPS are related to particle and antiparticle spaces.

The concept of paravector is extended to multiparavector, in particular to six-dimensional biparavectors (each containing two linearly independent paravectors) representing plane segments in paravector space. A famous example of a biparavector is the electromagnetic field with six components for the electric and magnetic field. Paravector rotations are Lorentz rotor transformations.

In Section 3 the spacetime Lorentz rotor that defines a particle's motion is termed *eigenspinor*. The eigenspinor allows to compute the velocity and orientation of a particle. The eigenspinor has a constant rotor gauge freedom, which allows to choose a reference frame orientation. Next the author discusses free de Broglie waves interpreting the phase as a real angle of *spin rotation*. One of the spatial reference vectors e_3 is interpreted as spin rotation axis. This allows to introduce the spin plane biparavector. In the comoving frame e_3 is transformed to the Pauli-Lubański spin.

The Lorentz transformation of mass from the rest frame leads to a classical Dirac equation. It is equally possible to work with reference frame density and current density related by an eigenspinor field. Even then gauge rotation freedom (choice of spin axis) and free particle de Broglie waves still allow gauge rotations (angle ϕ) around the spin axis. Replacing momentum by the Dirac derivative leads to the Dirac equation. Locally gauging ϕ leads to the electromagnetic potential. In this setting the spin polarization of electrons is discussed.

Section 4 considers single spin systems in the language of qubits in the minimal left ideal Cl_3P_3 with projector $P_{\pm 3} = \frac{1}{2}(1 \pm e_3)$, and higher order qubit systems in tensor products of Cl_3P_3. This leads to algebraic formulations of eigenstates, the NOT operator as a reflection called Hadamard transformation, and raising and lowering operators. Next 2-qubit systems, decomposability, (partial, maximal and full) entanglement, (classical and polarized) mixtures, separability, classical correlation, and Bell states are treated. Finally the extension to N-qubit systems is described allowing to cleanly separate entangled states of various orders.

The conclusion (Section 5) comments on the *interpretation* of spin, measurement and polarization.