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Review text:

This paper is suitable for graduate students and researchers with an interest in Clifford's geometric algebra applied to modeling charged matter and electromagnetic radiation.

Keller formally constructs a (3+1)-dimensional elastic medium in his previously developed Space-Time-Action-Relations-Theory [The Theory of the Electron: A Theory of Matter from START, Kluwer, 2001.] (Crystal like) dislocations and oscillations of this medium model charged matter and electromagnetic radiation. Displacements along the 4th direction travel as transverse (shear) waves through 3d space. After investigating stationary screw-like dislocations (modeling point particles), Keller considers moving dislocations, their potential and kinetic energy, their mass, scale and interaction energy.

A multivector function in the Clifford algebra $Cl_{1,4}^{(\mathrm{START})}$, that satisfies a (4+1)-dimensional wave equation, has a scalar Hermitian density square, and encodes charge and spin in its multivector components (spinors appear as left and right ideals), serves to model elementary particles. Three $Cl_{1,4}^{(\mathrm{START})}$ projectors define the quantum states of spin, lepton type (chirality) and charge of a family of elementary particles. In START time is added to 3d space to describe velocities and subsequently a 5th action vector dimension is added to represent 4d energy-momenta: $Cl_{0,3}^{(\text{in START})} \to Cl_{1,3}^{(\text{in START})} \to Cl_{1,4}^{(\mathrm{START})}$ In 5d a physical 4d manifold is obtained by restriction to physical null-hypersurface trajectories.

Keller considers the isometries of the underlying vector space $\mathbb{R}^{1,4}$ to allow for physical conservation laws. The basic hierarchy is: Galilei relativity $\subset$

Lorentz relativity $\subset$ START relativity. He describes the multivector structure of $Cl_{1,4}^{(\mathrm{START})}$ and its matrix representation, which includes a Dirac subalgebra. He algebraically defines 4d space-time in 5d START space, and likewise Euclidean 3d space in 4d space-time. Right and left ideals of the START algebra allow to represent 5d wave equation solutions, whose components are classified with the 3 projectors of spin, charge and chirality.

Next follows the introduction of a dual (reciprocal) frame, Lorentz rotation operators (rotors) generated by bivectors, and subsequently connections. A complete representation of Poincaré group rotations is considered. In START an additional two valued spin corresponds to electric charge.

Finally Keller considers equations and constraints for running screw-like dislocations in START to represent elementary particles with mass (wavelength, energy) and spin. The presentation is rounded off by an extensive list of references to the theory of dislocations in solids and (mainly) to Keller's own previous work.