Quantum Numbers of Eigenstates of Generalized de Broglie-Bargmann-Wigner Equations for Fermions with Partonic Substructure

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Generalized de Broglie-Bargmann-Wigner (BBW) equations are relativistically invariant quantum mechanical many body equations with nontrivial interaction, selfregularization and probability interpretation. Owing to these properties these equations are a suitable means for describing relativistic bound states of fermions. In accordance with de Broglie's fusion theory and modern assumptions about the partonic substructure of elementary fermions, i.e., leptons and quarks, the three-body generalized BBW-equations are investigated. The transformation properties and quantum numbers of the three-parton equations under the relevant group actions are elaborated in detail. Section 3 deals with the action of the isospin group $SU(2)$, a $U(1)$ global gauge group for the fermion number, the hypercharge and charge generators. The resulting quantum numbers of the composite partonic systems can be adapted to those of the phenomenological particles to be described. The space-time transformations and in particular rotations generated by angular momentum operators are considered in Section 4. Based on the compatibility of the BBW-equations and the group theoretical constraints, in Sect. 5 integral equations are formulated in a representation with diagonal energy and total angular momentum variables. The paper provides new insight into the solution space and quantum labels of resulting integral equations for three parton states and prepares the ground for representing leptons and quarks as composite systems.

Key words: Relativistic Quantum Mechanics; Many Body Theory; Partonic Substructure of Leptons and Quarks; Group Theoretic Constraints.