Barut, A. O.; **Bracken, A. J.**

Compact quantum systems: Internal geometry of relativistic systems. (English)

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A generalization is presented of the kinematical algebra $\mathfrak{so}(5)$, shown previously to be relevant for the description of the internal dynamics (Zitterbewegung) of Dirac's electron. The algebra $\mathfrak{so}(n+2)$ is proposed for the case of a compact quantum system with n degrees of freedom. Associated wave equations follow from boosting these compact quantum systems. There exists a contraction to the kinematical algebra of a system with n degrees of freedom of the usual type, by which the commutation relations between n coordinate operators Q_i and corresponding momentum operators p_i, occurring within the $\mathfrak{so}(n+2)$ algebra, go over into the usual canonical commutation relations.

The $\mathfrak{so}(n+2)$ algebra is contrasted with the $\mathfrak{sl}(1,n)$ superalgebra introduced recently by Palev in a similar context: because $\mathfrak{so}(n+2)$ has spinor representations, its use allows the possibility of interpreting the half-integral spin in terms of the angular momentum of internal finite quantum systems. Connection is made with the ideas of Weyl on the possible use in quantum mechanics of ray representation of finite abelian groups, and so also with other recent works on finite quantum systems. Possible directions of future research are indicated.

MSC:

22E70	Applications of Lie groups to the sciences; explicit representations
22E60	Lie algebras of Lie groups
17A70	Superalgebras
81T60	Supersymmetric field theories in quantum mechanics

Keywords:

kinematical algebra; wave equations; canonical commutation relations; finite quantum systems

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