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ABSTRACTS

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PROJECTIVE REPRESENTATIONS OF THE HAMILTON GROUP: NONINERTIAL SYMMETRY IN QUANTUM MECHANICS

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Abstract: Symmetries in quantum mechanics are realized by the projective representations of the Lie group as physical states are defined only up to a phase. A cornerstone theorem shows that these representations are equivalent to the unitary representations of the central extension of the group. The formulation of the inertial states of special relativistic quantum mechanics as the projective representations of the inhomogeneous Lorentz group, and its nonrelativistic limit in terms of the Galilei group, are fundamental examples. Interestingly, neither of these symmetries includes the Weyl-Heisenberg group; the hermitian representations of its algebra are the Heisenberg commutation relations that are the foundations of quantum mechanics. The Weyl-Heisenberg group is a one dimensional central extension of the abelian group and its unitary representations are therefore a particular projective representation of the abelian group of translations on phase space. A theorem involving the automorphism group shows that the maximal symmetry that leaves invariant the Heisenberg commutation relations are projective representations of the inhomogeneous symplectic group. In the nonrelativistic domain, we must also have invariance of Newtonian time. This reduces the symmetry group to the inhomogeneous Hamilton group that is a local noninertial symmetry of Hamilton's equations. The projective representations of these groups are studied.