Relativity implications of the quantum phase

Stephen G. Low

UT Relativity Seminar, RLM 6.116

3:30, Thursday, April 16, 2009

www.stephen-low.net

The quantum phase requires projective representations that are equivalent to the unitary representations of the central extension of the group. The Weyl-Heisenberg group is a central extension of the abelian translation group on extended phase space. Its automorphism group, that is the largest group preserving the Weyl-Heisenberg algebra, is the central extension of (essentially) the inhomogeneous symplectic group. Therefore, this inhomogeneous symplectic group is the largest group for which its projective representations define Heisenberg commutation relations that are preserved under all transformations of the representation acting on the Hilbert space.

This leads us to define the Born orthogonal metric on extended phase space for relativistic concepts of time and causality. This is the only new physical postulate of the theory. The resulting homogeneous group is $\mathcal{U}(1, 3)$. This defines the reciprocal relativity theory of noninertial states in which proper time is affected by noninertial motion and the inertial frame is relative. The quantum theory is given by the projective representations of the inhomogeneous unitary group that may be determined from the Mackey nonabelian theorems. The limit is studied and in addition to the mass central generator of the Galilean inertial subgroup, there is a new central element with dimensions of reciprocal of tension. Like mass, this central element embodies energy and interacts through a Casimir operator that is the noninertial generalization of spin. It is a signature of the theory that is in the accessible regime and should be experimentally verifiable.