Abstract Submitted
for the APR15 Meeting of
The American Physical Society

Generalized Pure Density Matrices and the Standard Model

CARL BRANNEN, Washington State Univ — We consider generalizations of pure density matrices that have $\rho\rho = \rho$, but give up the trace=1 requirement. Given a representation of a quantum algebra in $N \times N$ complex matrices, the elements that satisfy $\rho\rho = \rho$ can be taken to be pure density matrix states. In the Standard Model, particles from different "superselection sectors" cannot form linear superpositions. For example, it is impossible to form a linear superposition between an electron and a neutrino. We report that some quantum algebras give symmetry, particle and generation content, gauge freedom, and superselection sectors that are similar to those of the Standard Model. Our lecture will consider as an example the 4×4 complex matrices. There are 16 that are diagonal with $\rho\rho = \rho$. The 4 with trace=1 give the usual pure density matrices. We will show that the 6 with trace=2 form an $SU(3)$ triplet of three superselection sectors, with each sector consisting of an $SU(2)$ doublet. Considering one of these sectors, the mapping to $SU(2)$ is not unique; there is an $SU(2)$ gauge freedom. This gauge freedom is an analogy to the $U(1)$ gauge freedom that arises when converting a pure density matrix to a state vector.

Carl Brannen
Washington State Univ

Date submitted: 08 Jan 2015

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