Quantum Physics

Nonlinear Boundaries in Quantum Mechanics

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Based on empirical evidence, quantum systems appear to be strictly linear and gauge invariant. This work uses concise mathematics to show that quantum eigenvalue equations on a one dimensional ring can either be gauge invariant or have a linear boundary condition, but not both. Further analysis shows that non-linear boundaries for the ring restore gauge invariance but lead unexpectedly to eigenfunctions with a continuous eigenvalue spectrum, a discreet subset of which forms a Hilbert space with energy bands. This Hilbert space maintains the principle of superposition of eigenfunctions despite the nonlinearity. The momentum operator remains Hermitian. If physical reality requires gauge invariance, it would appear that quantum mechanics should incorporate these nonlinear boundary conditions.

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