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A new type of lattice gauge theory through self-adjoint extensions

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A generalization of Wilsonian lattice gauge theory may be obtained by considering the possible self-adjoint extensions of the electric field operator in the Hamiltonian formalism. In the special case of $3D U(1)$ gauge theory these are parametrised by a phase θ , and the ordinary Wilson theory is recovered for $\theta = 0$. We consider the case $\theta = \pi$, which, upon dualization, turns into a theory of staggered integer and half-integer height variables. We investigate order parameters for the breaking of the relevant symmetries, and thus study the phase diagram of the theory, which could reveal a new universality class of $3D$ Abelian gauge theories with a broken \mathbb{Z}_2 symmetry absent in the ordinary theory.

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