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Opening up a Coulomb Phase in Z_3 Gauge Theory

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The investigation of $\mathbb{Z}_N$ lattice gauge theories was initially undertaken to gain insights into the phase structure of lattice gauge theories. It is established that for $N < 5$, these theories exhibit two phases: an ordered, deconfining phase at low temperatures and a disordered, confining phase at high temperatures. For $N \geq 5$, an additional Coulomb phase emerges at intermediate temperatures. In their recent work, Nguyen, Sulejmanpasic, and Ünsal gave a theoretical argument that even for $N < 5$, the $\mathbb{Z}_N$ theory can be deformed to reveal an intermediate phase. In our research, we propose a deformation of the $\mathbb{Z}_3$ theory by suppressing monopoles and provide numerical evidence suggesting the appearance of a phase with an emergent $U(1)$ symmetry, not present in the undeformed theory.

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