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Interplay Between Stripe Order and Superconductivity in a Modulated XY Model

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In strongly correlated electron systems, superconductivity and charge density waves often coexist in close proximity, suggesting a deeper relationship between these competing phases. Recent research indicates that these orders can intertwine, with the superconducting order parameter coupling to modulations in the electronic density. To elucidate this interplay, we study a two-dimensional XY model with a periodic modulation of the coupling strength in one spatial direction. Using a combination of tensor network methods and Monte Carlo simulations, we reveal a non-monotonic, dome-like dependence of Tc on the modulation wavelength, with the peak Tc shifting to longer wavelengths as the modulation strength grows. The origin of this phenomenon is traced back to an effective pinning of vortices in the valleys of the modulation, confirmed by a comparison to modulated q-state clock models. These findings shed new light on the phase behavior of intertwined superconducting and charge-ordered states, offering a deeper understanding of their complex interactions.

Reference:
[1] arXiv:2506.16068 (2025)
[2] npj Quantum Mater. 10, 22 (2025)

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