

## Stripe States in the Two-dimensional $t$ - $J$ Model

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Stripe states in high- $T_c$  superconductors are studied using the two-dimensional  $t$ - $J$  model. The effect of strong correlation or the exclusion of doubly occupancies is taken into account via Gutzwiller approximation. The spatial dependence of the order parameters are obtained from the numerical diagonalization of the Bogoliubov-de Gennes equation derived in the Gutzwiller approximation. It is shown that there are two possibilities for the stripe pattern. One is the stripe state without  $d_{x^2-y^2}$ -wave superconductivity, which indicates the competition between the stripe state and superconductivity. However this state has a longer periodicity than that observed experimentally. The other is the stripe state in which the incommensurate antiferromagnetic correlation and  $d_{x^2-y^2}$ -wave superconductivity coexist. This state is consistent with experiments, but in order to stabilize it, some additional pinning potentials for holes are necessary.

**KEYWORDS:** stripe,  $t$ - $J$  model, Gutzwiller approximation