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High-T_c and t-J model: passions and disappointments

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I will discuss the high-temperature phase diagram of the two-dimensional t-J and related models. Among the many numerical and analytical techniques which have been used to search for superconductivity in these models, only a few provide unbiased results. Particularly, the high-temperature series constructed for a number of thermodynamical correlation functions indicate that in the accessible range of temperatures, $T \geq J/2$, the superconducting fluctuations are only pronounced in the unphysical regime, $J > t$, while they are strongly suppressed in the physical regime, $J < t$. Additionally, in the physical regime, the correlation length for superconducting fluctuations is small on the scale of the lattice constant. This is suggestive evidence that high-temperature superconductivity does not occur in the t-J model. I will analyze the validity of these results by looking at high-temperature series for the t-J model on small clusters and ladders, as well as for related bosonic models, whose finite-temperature phase diagram is relatively well understood from other numerical methods.