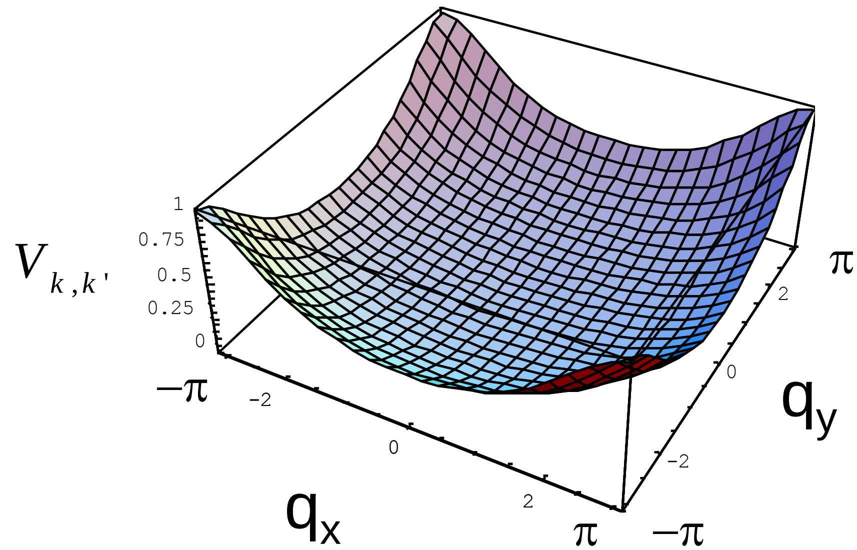
Pairing Interaction in d-wave Superconductors

$d_{x^2-y^2}$



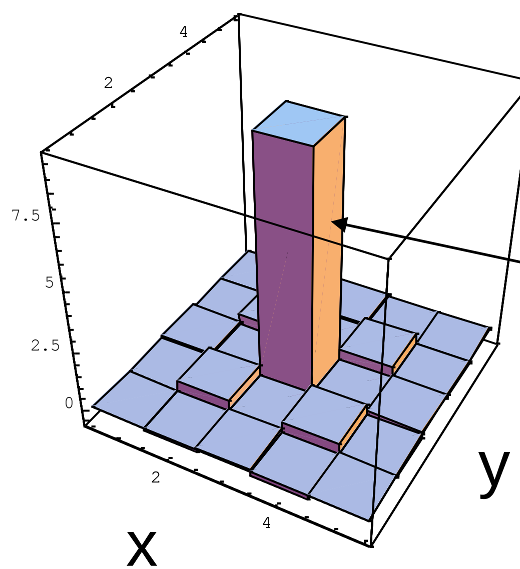
$$\vec{q} = \vec{k} - \vec{k}'$$

$$\vec{Q} = \left(\frac{\pi}{a}, \frac{\pi}{a} \right)$$

$$V_{k,k'} = \frac{V(Q)}{1 + \xi^2 (q - Q)^2}$$

Antiferromagnetic spin fluctuation susceptibility

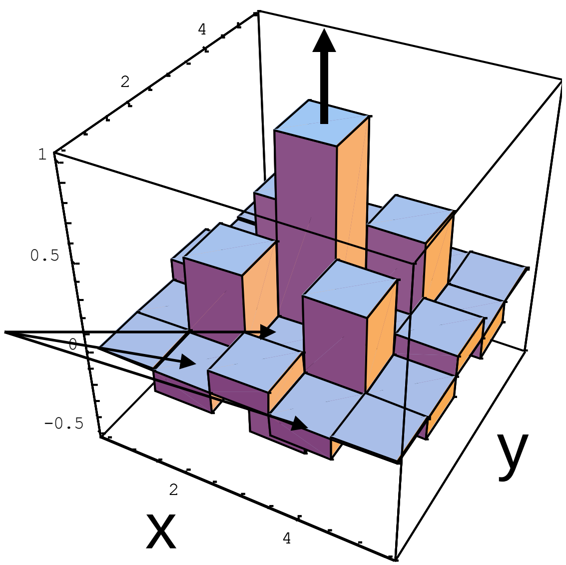
ξ = AF correlation length



On-site Coulomb repulsion

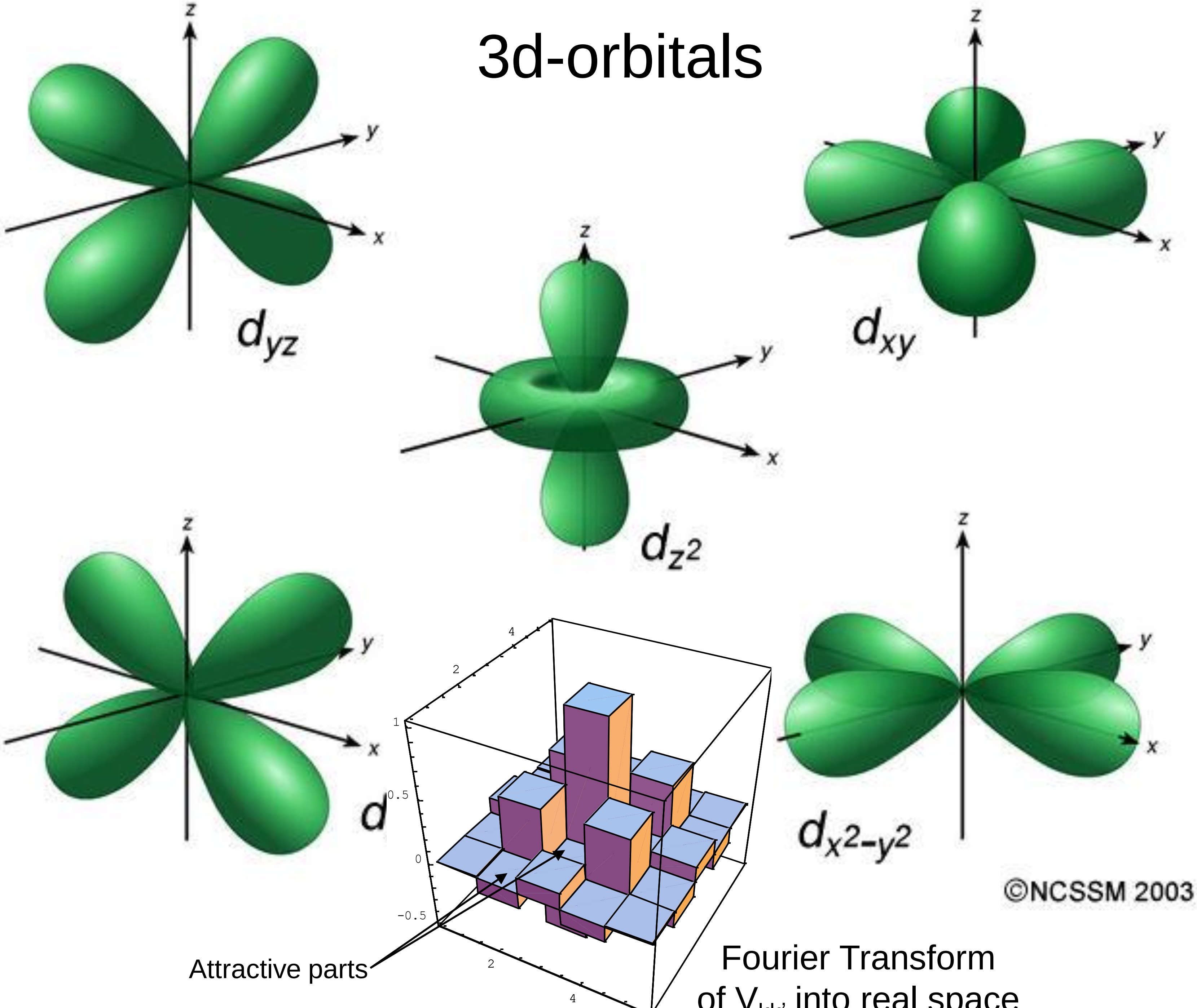
Fourier Transform of $V_{kk'}$ into real space

Attractive parts



Similar to a $d_{x^2-y^2}$ orbital

3d-orbitals



Attractive parts

Fourier Transform of $V_{kk'}$ into real space

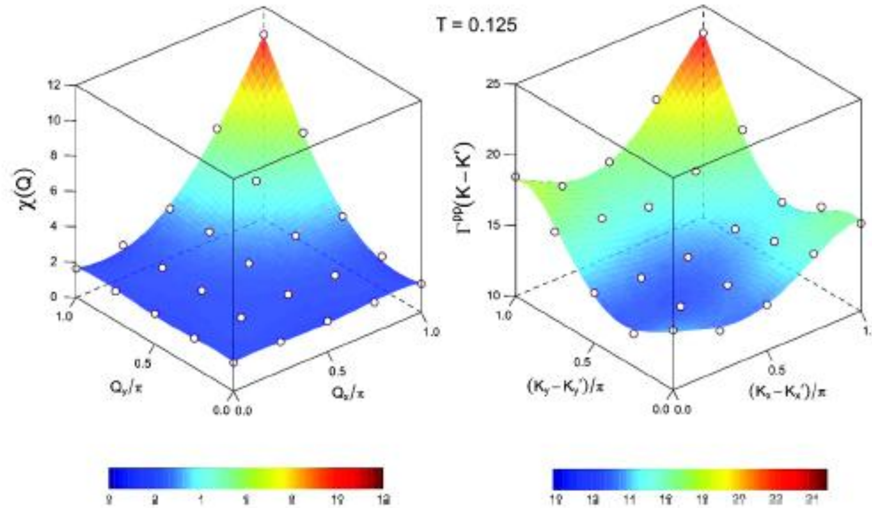


FIG. 18 (color online). The spin susceptibility $\chi(q)$ and the pairing interaction $\Gamma^{pp}(K, K')$ for $U = 4t$ and $\langle n \rangle = 0.85$ are compared at various temperatures. As the temperature is reduced a peak develops in Γ^{pp} reflecting the peak in χ. This peak is the origin of the unconventional superconductivity discussed in this review.

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A common thread: The pairing interaction for unconventional superconductors

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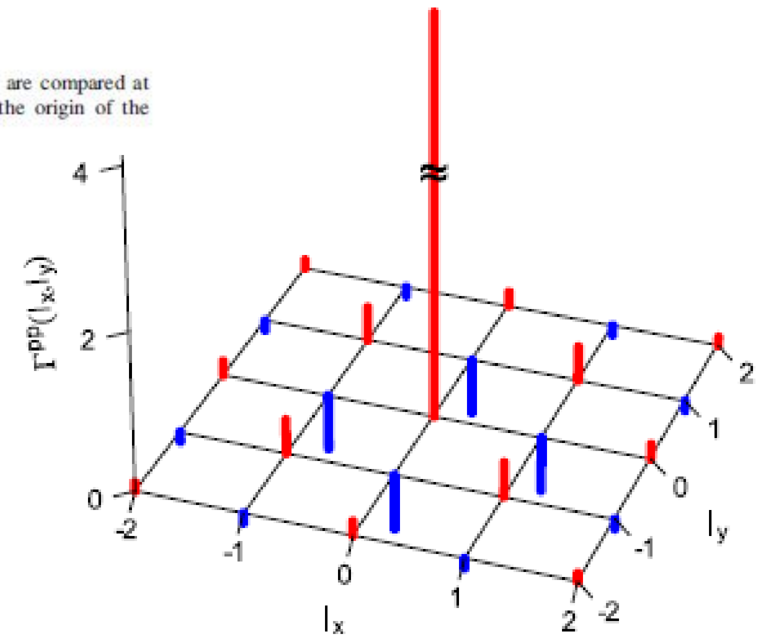

FIG. 19 (color online). The real space structure of the pairing interaction obtained from the Fourier transform Eq. (11) of $\Gamma^{pp}(k, k')$ at a temperature $T = 0.125t$ for $U = 4t$ and $\langle n \rangle = 0.85$. Here there is an attractive pairing interaction for a singlet formed between an electron at the origin and a near-neighbor site. The peak in Γ^{pp} shown in Fig. 18 leads to a pairing interaction which oscillates in space.