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Crossover from localized spins to weak coupling charge carriers: Theory for nuclear spin-lattice relaxation in copper oxide HTSC

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Abstract

The dynamic spin susceptibility $\chi_{+,-}^{\text{total}}(\omega, q)$ that takes into account the interplay of localized and itinerant charge carriers exhibits a diffusive-like, extremely narrow and sharp symmetric ring of maxima at very small wave vectors: $|q|=q_0$ where $q_0 \propto \omega/J \approx 10^{-6}$ with the Nuclear Magnetic Resonance (NMR) frequency ω and the superexchange coupling constant J together with the peak at the antiferromagnetic wave vector $Q=(\pi, \pi)$. The calculated plane copper ^{63}Cu and oxygen ^{17}O nuclear spin-lattice relaxation rates from carrier-free right up to optimally doped $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$ are in good agreement with experimental data. © 2013 Springer Science+Business Media New York.

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Keywords

Copper oxide HTSC, NMR/NQR