Spin and Charge Inhomogeneity in the Cuprates characterized by NMR

Jürgen Haase
Max Planck Institute for the Chemical Physics of Solids Dresden, Germany

9.7 cm

Inhomogeneous spin and charge distributions in high-temperature superconductors might be behind many of the strange properties of the cuprates including the pairing itself. Such variations of the charge density or the magnetic susceptibility (spin and orbit) cause distributions of the electric field gradients and magnetic shifts at the nuclear sites and thus affect NMR lines. By analyzing the various nuclear transitions of different nuclei in the unit cell we can characterize the spin and charge inhomogeneity in the material. Our results show the presence of long- range static charge density variations in the Cu-O plane that are correlated with longer wavelength variations of the magnetic susceptibility, as well as short wavelength variations. The longer wavelength magnetic component freezes out as the temperature is lowered, whereas the short wavelength inhomogeneity increases in amplitude. We believe electron spin effects govern the magnetic field variations. Then, the amplitude of the long wavelength spin polarization has to be a linear function of the amplitude of the charge density. For LaSrCuO we determine the second moment of the electron spin polarization, which has 4-fold symmetry, and its correlation function between Cu neighbors. We find the root of the second moments to show Curie behavior for the investigated doping levels of 10%, 15% and 20%. The correlation functions are temperature dependent for 10% and 15% doping levels and approach antiferromagnetic order (-1) near the critical temperature. The overdoped material shows a temperature independent correlation function of -0.6. Further constraints for theoretical models of inhomogeneity from our experiments will be discussed.

13.4 cm

Subject category :

1. Correlated Electrons and High Temperature Superconductors

Presentation mode :
oral

Corresponding author :
Jürgen Haase

Address for correspondence :
Max Planck Institute for the Chemical Physics of Solids Dresden, Germany

Email address :
j.haase@physik.uni-stuttgart.de