MEASUREMENTS OF FAST RELAXING NMR SPECTRA IN CUPRATE SUPERCONDUCTORS

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NMR relaxation times in solids are much shorter than in liquids. This is even more pronounced in strongly correlated systems, such as superconductors or magnetic materials, which typically exhibit a very rich phase diagram. Relaxations in such systems are further enhanced by strong charge or spin fluctuations. In some cases, the NMR signal is completely wiped out due to fast relaxations. Such wipeout effect is often taken as a sign of a phase transition.

The NMR signal is lost if the relaxation occurs within the detector dead time (typically 10 μs). Therefore, by shortening the deadtime, properties of previously hidden parts of the phase diagram can be revealed. We have recently developed an experimental procedure to shorten the detector dead time (to 2 μs) [1]. Here we show two examples of how such detection provides insight into spin and charge dynamics in previously unexplored parts of the phase diagram.

In the cuprate superconductor $La_{1.875}Ba_{0.125}CuO_4$ we show that the of relaxation rate increase is caused by magnetic rather than charge fluctuations, which finally confirms the long-suspected assumption that spin fluctuations are responsible for the wipeout effect [1].

In lightly doped cuprate $La_{2-x}Sr_xCuO_4$ we show that qualitative changes occur when the Sr concentration increases through $x = 0.05$, which we interpret as a transition from an insulating state with unconnected metallic islands to a granular metal state with tunneling between the grains [2].

REFERENCES

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