# NMR IN IMPURITY CHARGE-ORDERING MANGANITES

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$^{139}$La NMR a sensitive tool in respect to particular spin and orbital configuration of the neighboring Mn. The local magnetic field at $^{139}$La ion originates from the Fermi-contact interaction with the transferred s- spin density of electrons and dipole-dipole interaction with the transferred p-spin density.

We consider La NMR in charge ordering compound $La_{0.5}Ca_{0.5}MnO_3$ and $La_{0.33}Ca_{0.67}MnO_3$.

The crystal and charge structures of mentioned compounds are taken from experimental works [1]. The crystal and charge structures are forming the orbital structures of the both compound. Using the model of the orbitally-dependent exchange and single-ion anisotropy interactions [2], we can predict the magnetic structure. The magnetic structure of a half-doped manganite is of a CE-type with the moments mainly directed along c-axis of the orthorhombic reference frame. The magnetic structure of the manganite with a doping rate 2/3 is frustrated. The magnetic moments could be joined together into trmers with strong ferromagnetic interaction, containing three manganese ions ($Mn^{4+}$– $Mn^{3+}$– $Mn^{4+}$) and coupled with the weak antiferromagnetic interaction. The trimers are mainly directed along x-and y-axes of pseudoperovskite reference frame.

The magnetic structure was used for calculation of NMR spectra. The gradient of the electrical field on the ions of the rare-earth metals was calculated in the assumptions of the point charges, point dipoles distribution of the charges on the manganese ions. The calculation of local magnetic field has shown that hyperfine field, induced by s-wave spin polarization, is rather small. It's provided with a nearly cubic environment of neighboring $Mn^{3+}$ and $Mn^{4+}$ and with nearly antiferromagnetic type of magnetic structures.We investigate a spectrum of a nuclear magnetic resonance for polycrystalline $La_{0.5}Ca_{0.5}MnO_3$ at various temperatures. It contains two peaks with close frequencies. However the shape of lines for different peak is various. The temperature dependence of La NMR spectra in polycrystalline $La_{0.33}Ca_{0.67}MnO_3$ has been studied. It consists of two lines with frequencies near 12 MHz and 23 MHz. In the experiment [3], the La resonance line at zero field is centered at 24.4 MHz.

The increase of temperature is accompanied by decrease of NMR frequencies in both compounds. This effect is connected with a reduction of a sublattice magnetization of manganese subsystems.

Thus, we have shown that La NMR provides a direct probe of the Mn spin and orbital correlations in the charge-ordered phase of manganites.

References

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