AVALANCHES AND HYSTERESIS AT THE STRUCTURAL TRANSITION IN STRIPE-ORDERED $La_{1.48}Nd_{0.4}Sr_{0.12}CuO_4$

P. G. Baity[1,2], Garima Saraswat[1], T. Sasagawa[3], and Dragana Popović[1,2]

[1]National High Magnetic Field Laboratory, Florida State University, Tallahassee, FL 32310, USA
[2]Department of Physics, Florida State University, Tallahassee, FL 32306, USA
[3]Materials and Structures Laboratory, Tokyo Institute of Technology, Kanagawa 226-8503, Japan

The coupling or intertwining of lattice, spin and charge orders and their effects on superconductivity are of great current interest in the physics of cuprates.[1] In particular, the low-temperature tetragonal (LTT) structure seems to stabilize static charge and spin stripes. The rare-earth-doped cuprate $La_{1.48}Nd_{0.4}Sr_{0.12}CuO_4$ (LNSCO), for example, exhibits a first-order structural phase transition (SPT) from the low-temperature orthorhombic (LTO) to the LTT phase, with the onset of the charge stripe order roughly coinciding with the SPT. In general, the dynamics of first-order phase transitions in the presence of disorder have been well studied, although some questions remain open. In the critical region, physical observables may exhibit hysteresis, return point memory, and a sequence of avalanches that link metastable states as the relevant field is tuned.[2,3] A previous study of the LTO-LTT transition in LNSCO by magnetoresistance (MR) measurements revealed hysteresis, which was attributed to a shift of the SPT temperature with an applied field.[4] However, the origin of the observed behavior was not well understood.

Here we present out-of-plane MR measurements around the LTO-LTT transition in LNSCO single crystals with $H \parallel c$ up to 12 T and $H \parallel ab$ up to 9 T. Hysteresis is observed for both field orientations, but for $H \parallel c$ we also find evidence for the existence of metastable states and collective dynamics in the form of avalanches and return point memory (Fig. 1). Such behavior indicates that, in LNSCO, the LTO-LTT structural transition can be driven with H. A detailed analysis of the avalanche statistics is used to determine their size and field dependence, and to extract information about the domain structure and dynamics of domain walls. Our results shed light on the interplay of lattice, spin and charge degrees of freedom in stripe-ordered La-based cuprates.

This work was partially supported by NSF Grant No. DMR-1307075 and the NHMFL through the NSF Cooperative Agreement No. DMR-1157490 and the State of Florida.

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Category: SC
Email: baity@magnet.fsu.edu

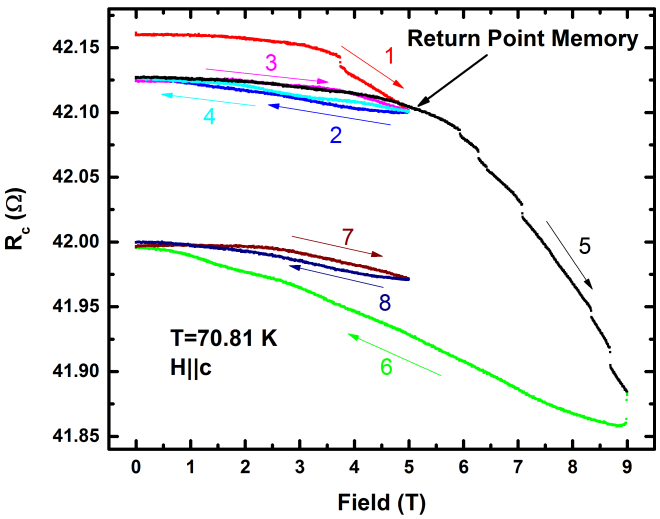

Figure 1: Out-of-plane MR measurent up to 9 T with $H \parallel c$ showing avalanches and return point memory near the LTO-LTT transition.