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Neutron Larmor diffraction on nickelate powder samples

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Recently, the discovery of superconductivity in the Sr-doped nickelates $RNiO_2$ (R = Pr, Nd) has attracted widespread attention. The synthesis of the RNiO2 compounds has been achieved by topotactic reduction of the non-superconducting perovskite phase $RNiO_3$, removing oxygen from the crystal lattice in a controlled fashion. Remarkably, new electronic and magnetic phases can also occur in oxygen vacant phases $RNiO_{3-x}$ with intermediate oxygen content 0 < x < 1. For instance, while $LaNiO_3$ remains paramagnetic down to lowest temperatures, long-range antiferromagnetic order emerges in $LaNiO_{2.5}$. However, it has not been clarified yet whether the new electronic and magnetic phases are accompanied by structural phase transitions. Hence, we aim to use the highly sensitive Neutron Larmor diffraction (LD) technique to investigate structural changes that possibly coincide with the electronic and magnetic transitions emerging in oxygen-deficient phases of $RNiO_{3-x}$. As a first step, we report here that LD is capable of detecting the known subtle structural phase transition in $PrNiO_3$ at 120 K, while no transitions were detected in the $LaNiO_3$ sample at low temperatures. Furthermore, a newly introduced analysis technique for LD data allows us to account for resolution effects that originate from small angle scattering from powder samples.

Primary author: Dr HEPTING, Matthias (MPI für Festkörperforschung)

Co-authors: Dr KELLER, Thomas; Ms ATTERVING, Malin; Prof. BÖNI, Peter; Prof. KEIMER, Bernhard

Presenter: Dr HEPTING, Matthias (MPI für Festkörperforschung)

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