ESRF	**Experiment title:** Study of the pressure dependence of the crystal structure in charge-stripe ordered La5/3Sr1/3NiO4 system by x-ray diffraction.	**Experiment number:** **HS- 4734**
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Report:

The aim of this experiment was to investigate the pressure dependence of the crystal structure in charge-stripe ordered $La_{5/3}Sr_{1/3}NiO_4$ system by x-ray diffraction. Due to the difficulties of a high-pressure study on striped compounds, not many experiments have been performed so far. Nevertheless, high-pressure opens up possibilities for finding new features [1-2] for the understanding of the stripe state in the transition metal oxides [2-3].

In this experiment we carefully investigated the evolution of the crystal structure in $La_{5/3}Sr_{1/3}NiO_4$ (single crystal) as a function of pressure at room temperature (above the stripe ordering transition temperature) and below the stripe formation. We measured the pressure effect on the lattice parameters (Fig. 1) and we detected an anomaly by means of a Finite-strain analysis of the data. This type of analysis allows to detect subtle structural modifications using the F vs f plot, with F the normalized stress and f the Eulerian measure of finite strain.

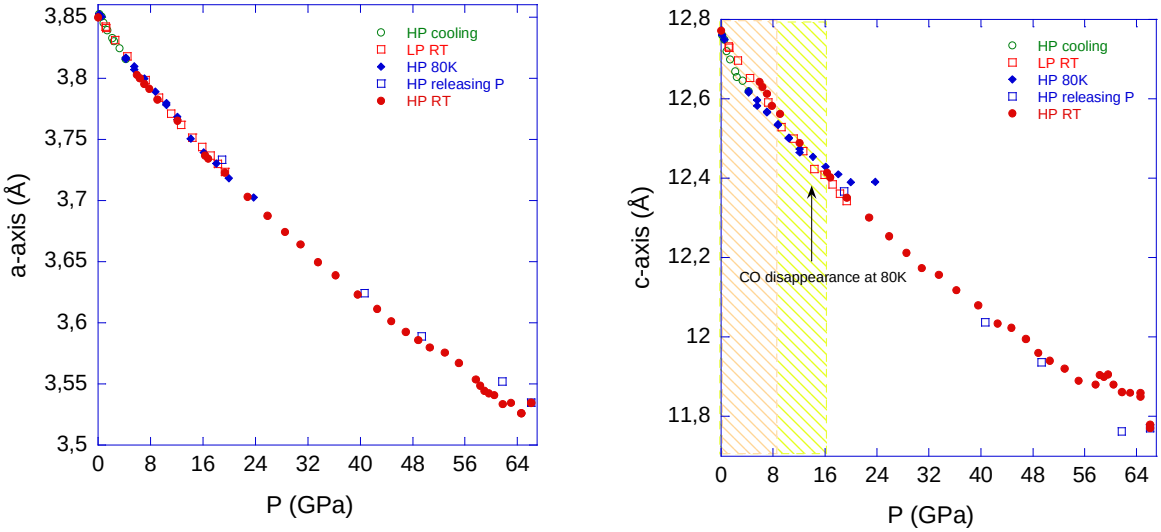

Fig. 1: Evolution of the a-axis (left) and c-axis (rigth) as a function of pressure .

These very interesting results are presented in Fig. 2 left and a deepest investigation is still in progress.
As expected at low temperature we sow the suppression of the stripes increasing the pressure [3] (Fig. 2 right).

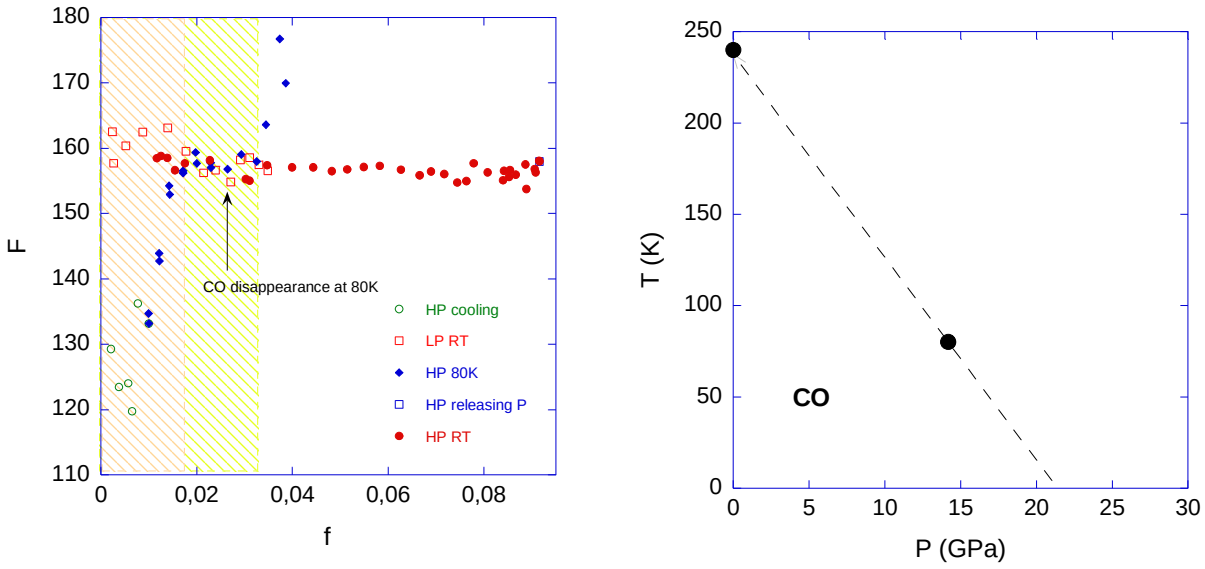

Fig. 2 (Left) Normalized pressure F as a function of the Eulerian strain measure f. (Right) Abroupt phase diagram of the stripe ordering regime.

We compared the pressure effects on the electronic and crystal structure at room temperature [2]. No clear structural change with pressure were possible to be associated with the recently detected high spin to low spin like transition induced by pressure [1-2].
These results are expected to help in understanding of the role of pressure in stripe ordering in strongly correlated materials.

References

[1] Eiji Kaneshita and Alan R. Bishop, "*Pressure-Induced Phase Transition to a Novel Spin State in Striped Nickelates*", Journal of the physical Society of Japan **77**, 123709 (2008)
[2] Simonelli et al., "Pressure effect on the electronic structure of $La_{5/3}Sr_{1/3}NiO_4$ by XES and RIXS", *Phys. Rev. B.* **84**, 195140 (2011).
[3] S. Arumugam et al., "*Competition of Static Stripe and Superconducting Phases in* $La_{1.48}Nd_{0.4}Sr_{0.12}CuO_4$ *Controlled by Pressure*", Phys. Rev. Lett. **88**, 247001 (2002). T. Sasagawa et al., Physica B 359-361, 436-438 (2005). TAKESHITA Nao et al., "Gigantic anisotropic uniaxial pressure effect on superconductivity within the CuO_2 plane of $La_{1.64}Eu_{0.2}Sr_{0.16}CuO_4$: Strain control of stripe criticality", Journal of the Physical Society of Japan **73**, 1123-1126 (2004).