

# Doping variation charge/orbital order and oxygen hole symmetry in layered perovskite $\text{Nd}_{2-x}\text{Sr}_x\text{NiO}_4$

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High- $T_c$  superconductivity appears close to the Mott transition induced by doping holes into antiferromagnetic parent insulators. Such filling-control insulator-metal transitions are widely observed for transition-metal oxides with strongly correlated electrons, yet the emergence of high- $T_c$  superconductivity remains unique for the layered cuprates and the iron-based superconductors. Layered nickelate  $R_{2-x}\text{Sr}_x\text{NiO}_4$  ( $R$  being rare earth element) with  $\text{K}_2\text{NiF}_4$  type structure is a rare example of a two-dimensional antiferromagnetic insulator-metal transition system, providing a contrastive counterpart to superconducting  $R_{2-x}\text{Sr}_x\text{CuO}_4$  with the same crystal structure.  $R_{2-x}\text{Sr}_x\text{NiO}_4$  shows diagonal-stripe and checkerboard (CB) charge ordering at  $x \sim 1/3$  and  $1/2$ , respectively, and then undergoes an insulator-metal transition at  $x \sim 1$  (see Figure 1) [1].

We have investigated the charge/orbital order and orbital characters of doped holes by systematically measuring resonant x-ray diffraction (RXD) and polarization-dependent O  $K$ - and Ni  $L$ -edge absorption spectra. In  $x = 1/2$ , the incident x-ray polarization angle dependence of RXD indicates that the  $(3z^2-r^2)$ -type hole orbital order is realized in CB type charge order. The doping dependence of the O  $K$ -edge absorption spectra for  $E \parallel c$  suggests that the CB type charge ordering persists above  $x = 1/2$  with introducing the excess holes to  $3z^2-r^2$  orbital states and that the insulator-metal transition occurs with its melting at  $x \sim 1$ .

This research is the collaborations with Mr. Masaki Uchida, Prof. Hironori Nakao, Dr. Jun Okamoto, Prof. Youichi Murakami, Dr. Yoshio Kaneko, and Prof. Yoshinori Tokura.

[1] M. Uchida et al., Phys. Rev. Lett. PRL 106, 027001 (2011)

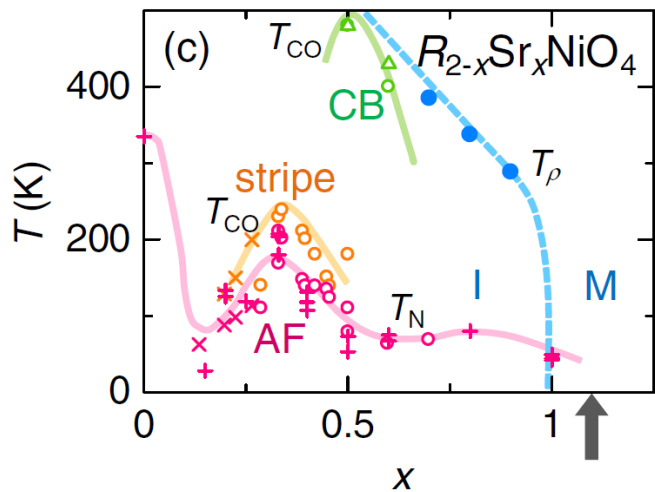


Figure 1: Phase diagram in  $R_{2-x}\text{Sr}_x\text{NiO}_4$  [1]