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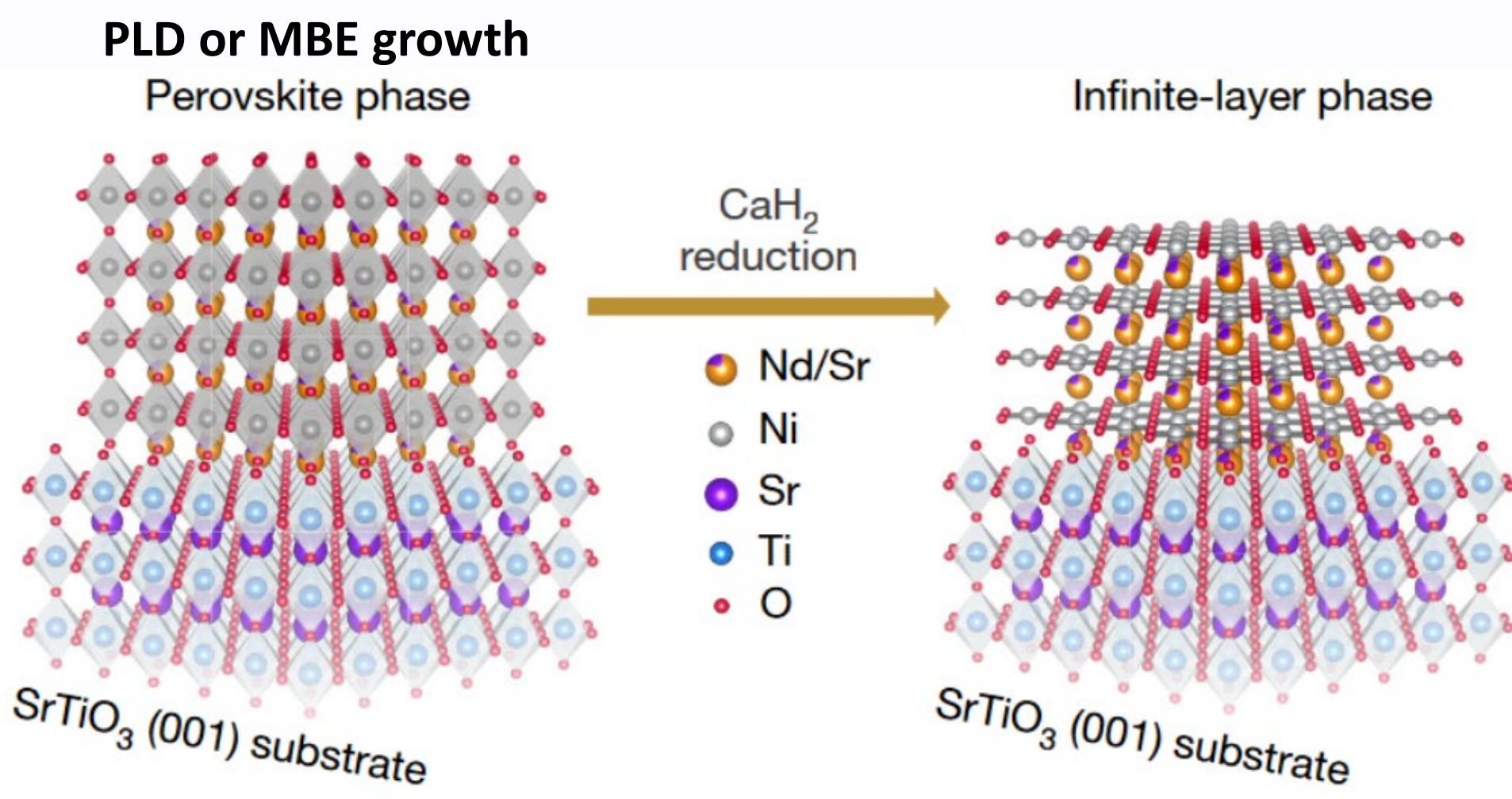
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Infinite-layer nickelates: a new perspective on unconventional superconducting mechanism

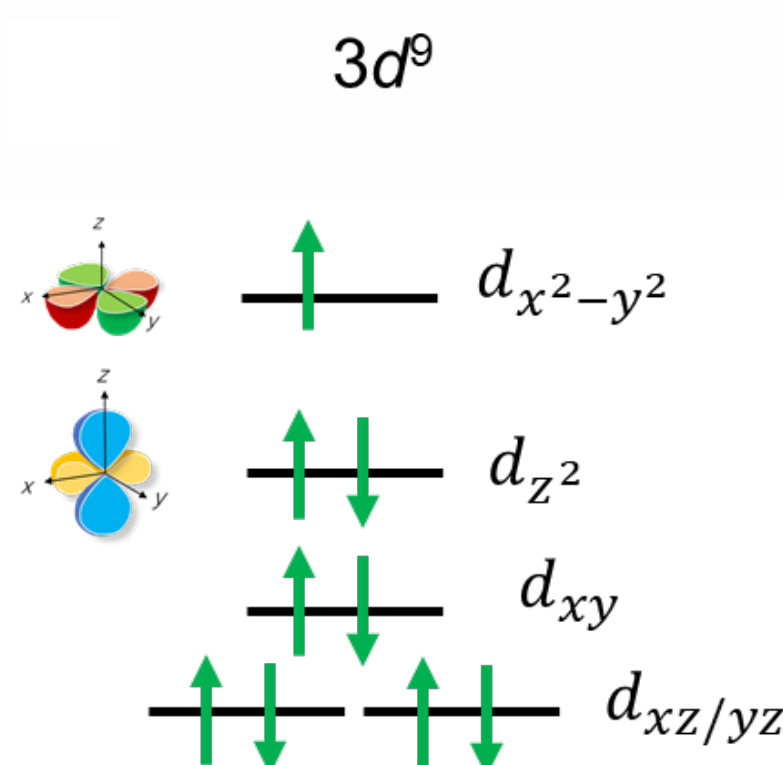
Preparation of infinite-layer nickelates



Nature 572, 624–627 (2019).

❖ Infinite layer nickelates report superconductivity: (Nd,Sr)NiO₂, (La,Sr)NiO₂, (La,Ca)NiO₂, (Pr,Sr)NiO₂, ...

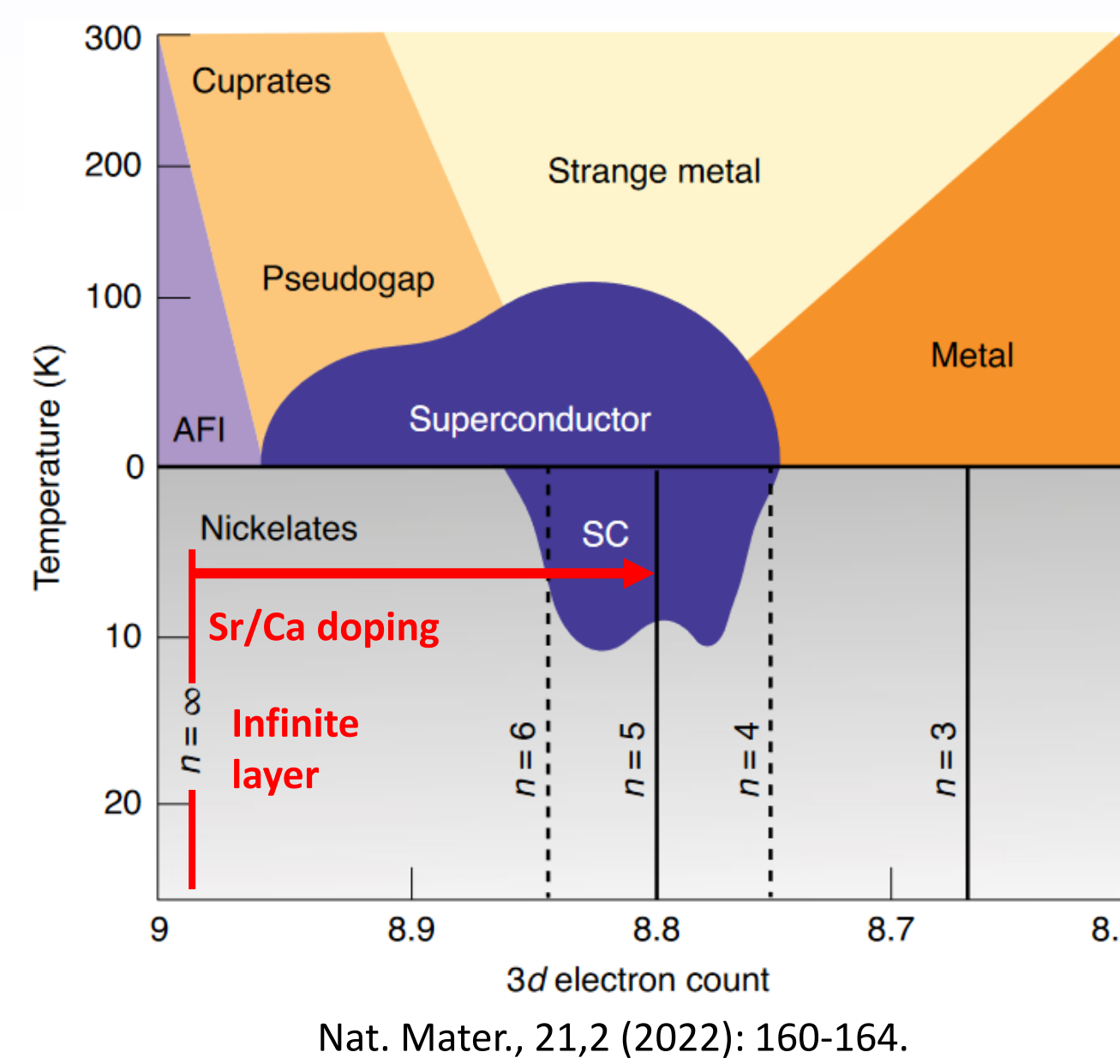
Electron configuration of parent nickelates



Nature 575, 156–163 (2019)

❖ same with parent cuprates

Similar electron configuration with optimal doped cuprate superconductors



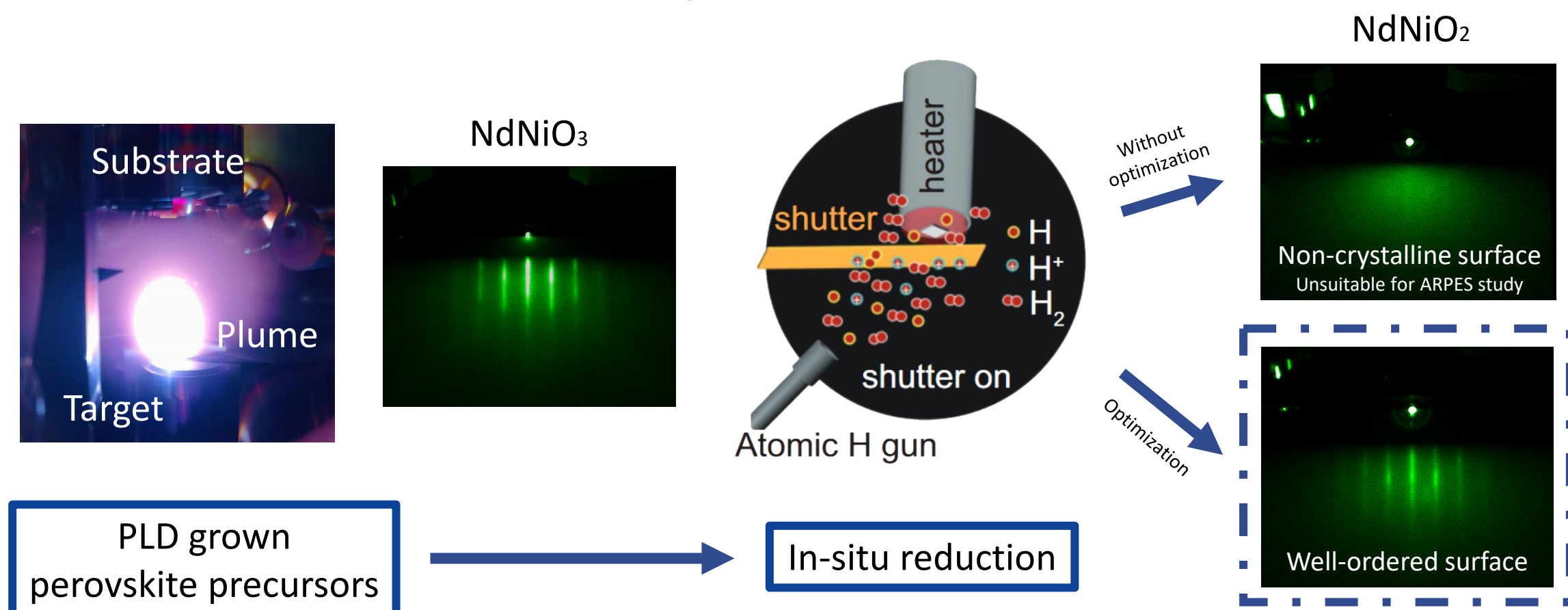
Nat. Mater., 21,2 (2022): 160-164.

Motivation

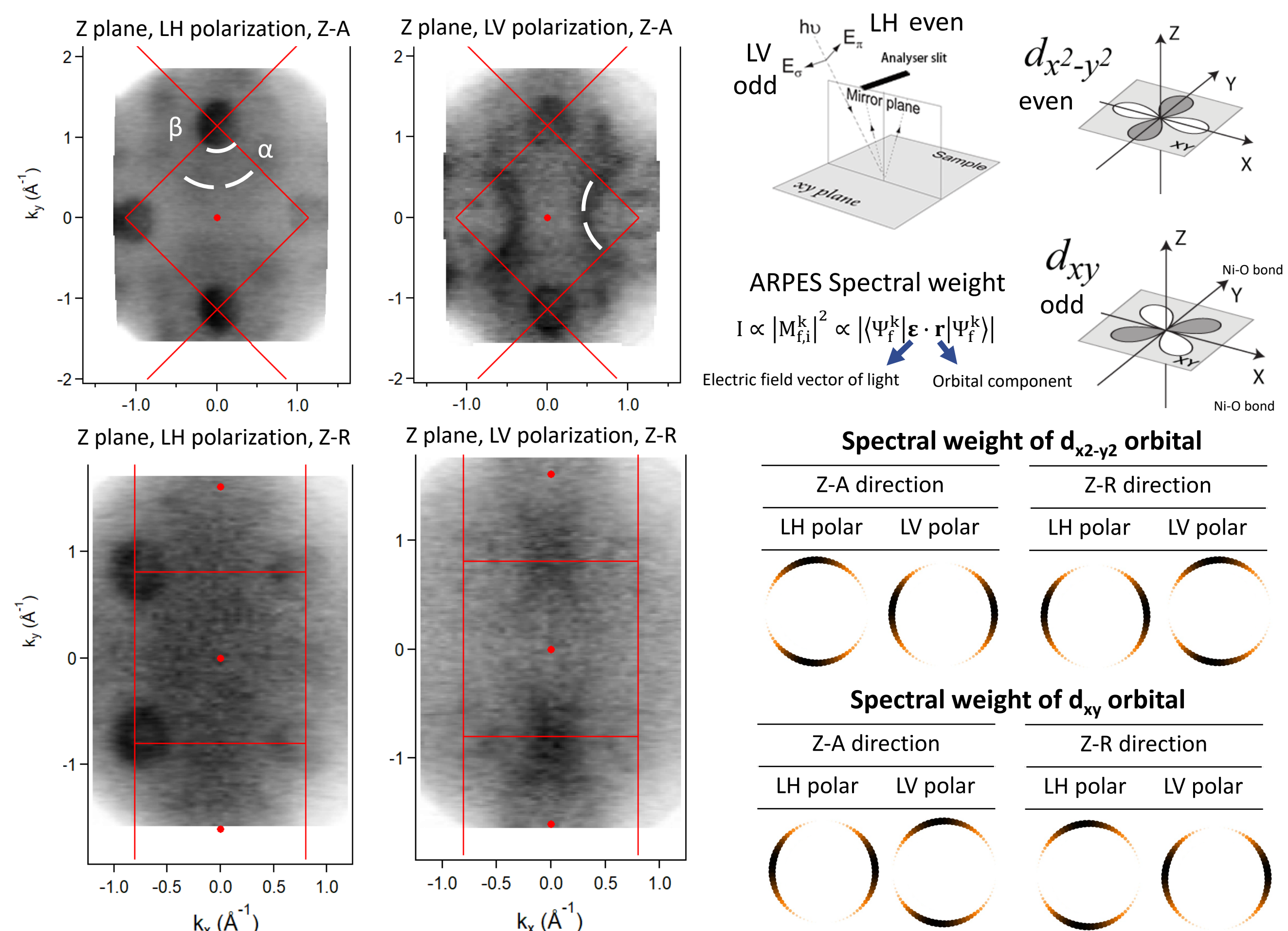
- ❖ In-situ well-ordered films are needed for surface-sensitive ARPES measurement!
- ❖ Possible new clues to unveil the pairing mechanism of unconventional superconductors.
- ❖ Nd-Nickelates are still lack of directly experimental clues on electronic structure!
- ❖ Whether Nd-4f electrons participate in the Fermi pockets?

In-situ synthesis & electronic structure study

In-situ synthesis routine

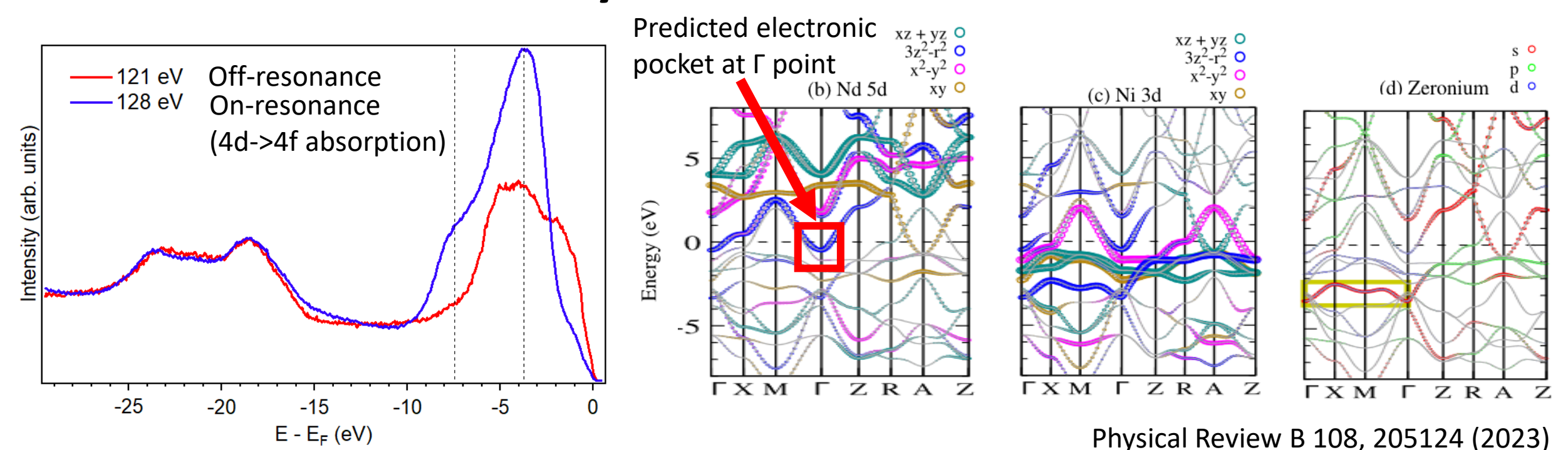


Orbital component of the α and β pockets



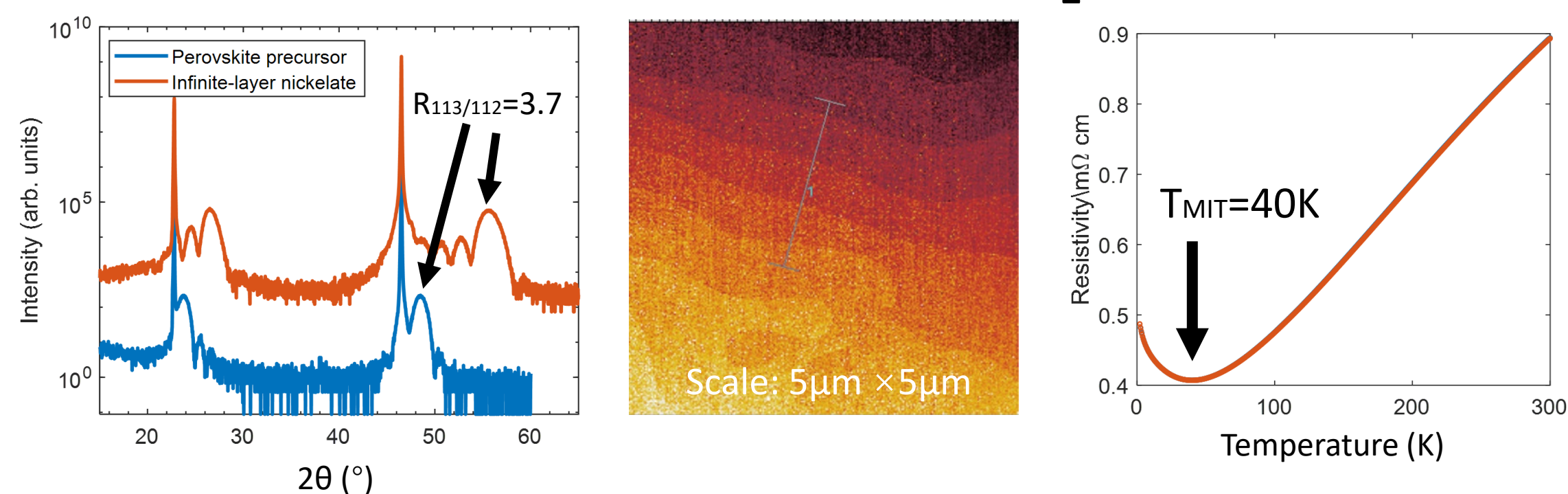
❖ The α hole pocket consists $d_{x^2-y^2}$ orbital; the β electron pocket consists part of d_{xy} orbital.

Element resonance study: Nd electrons would far from Fermi level



Physical Review B 108, 205124 (2023)

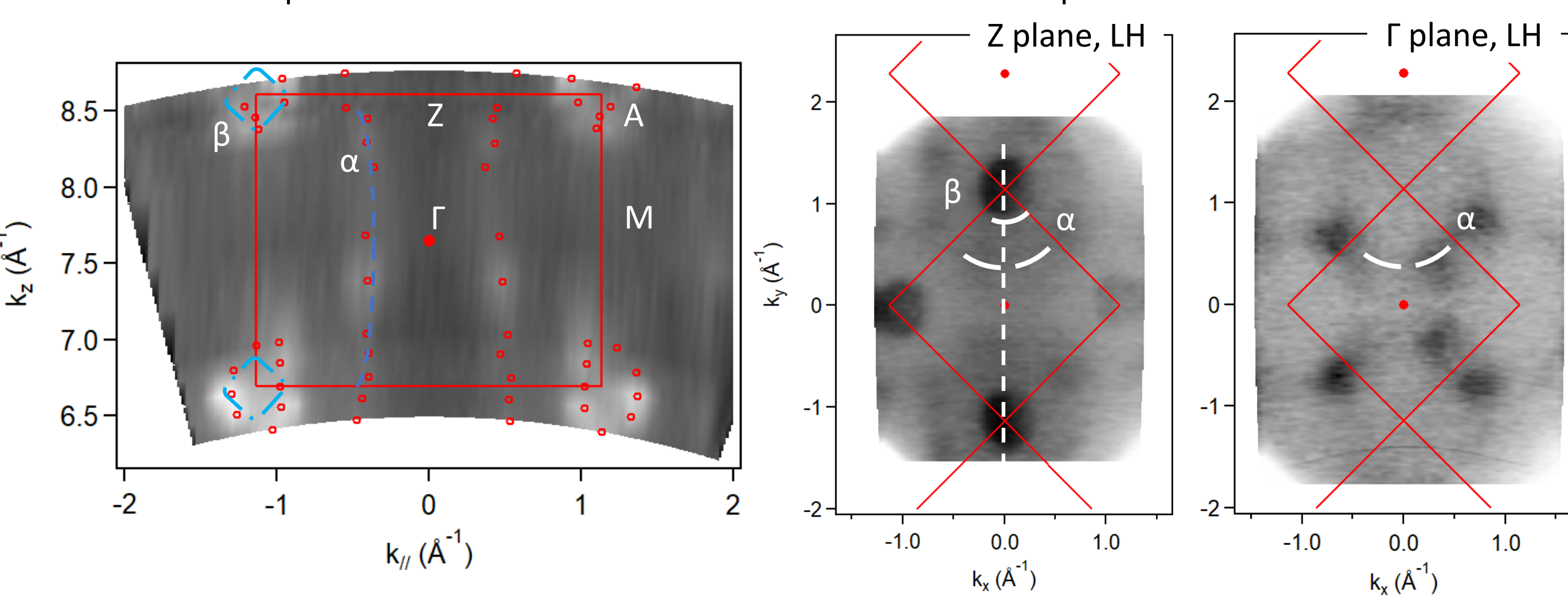
Characterization: well ordered NdNiO₂ were prepared



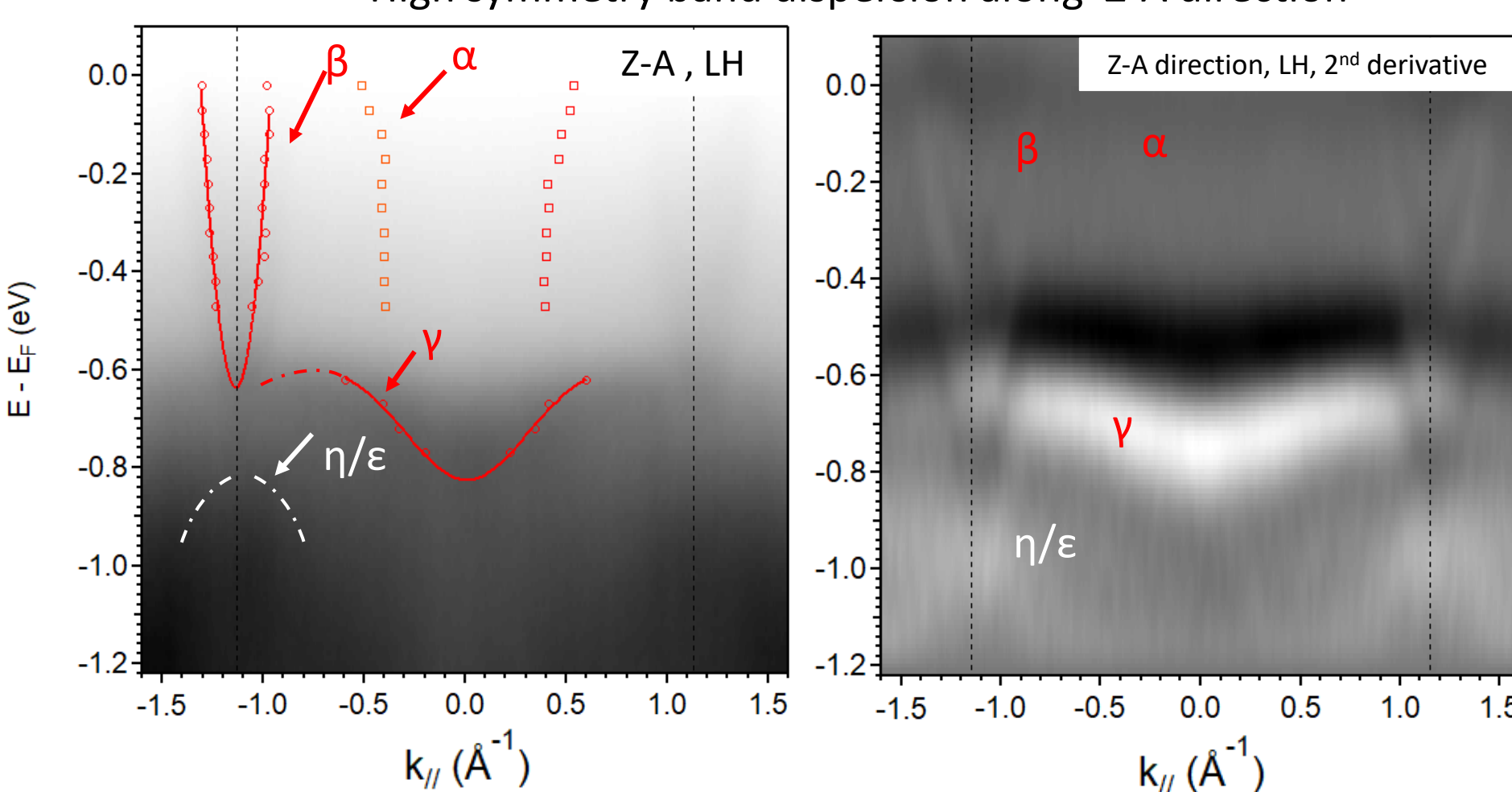
3D Electronic structure and the cuprate-like hole band

K_z dependent band structure

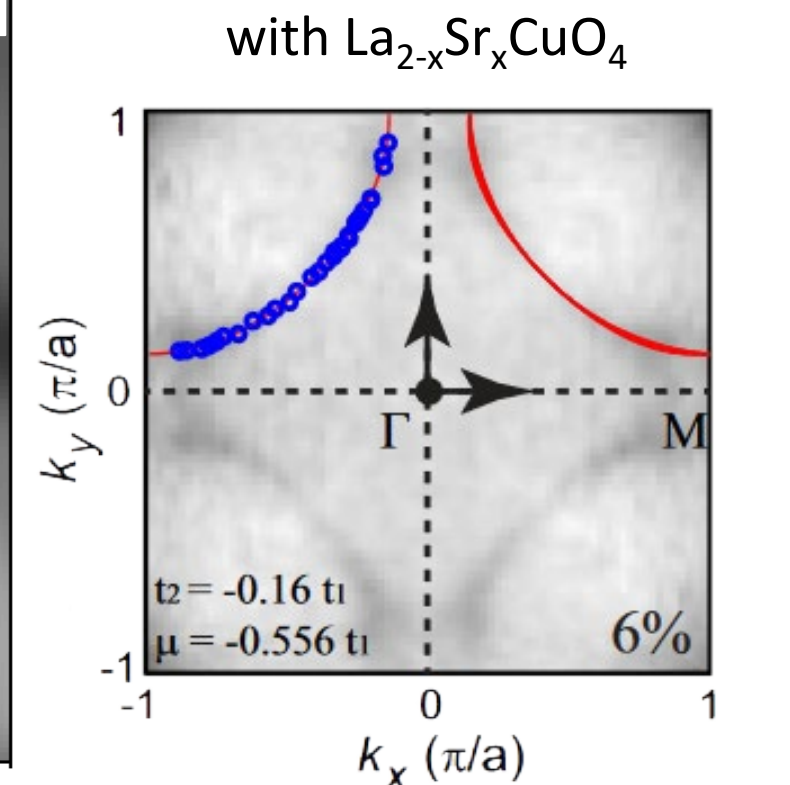
In-plane band structure



High symmetry band dispersion along Z-A direction



Similar hole band with La_{2-x}Sr_xCuO₄



PNAS, 2022, 119(32): e2204630119.

Conclusions & outlook

- ❖ Well-ordered nickelates NdNiO₂ are firstly in-situ prepared.
- ❖ The α hole pocket and β electron pocket around A/M points cross the Fermi level. No pocket cross the Z/ Γ pocket.
- ❖ The α band consists of $d_{x^2-y^2}$ orbital and its band dispersion is closely resemble in hole-doped cuprates.
- ❖ The Fermi level would be lack of participation of the Nd electrons.
- ❖ The cause of deviation with theory at Γ point? Possible magnetic transition happens at Metal-Insulator transition?