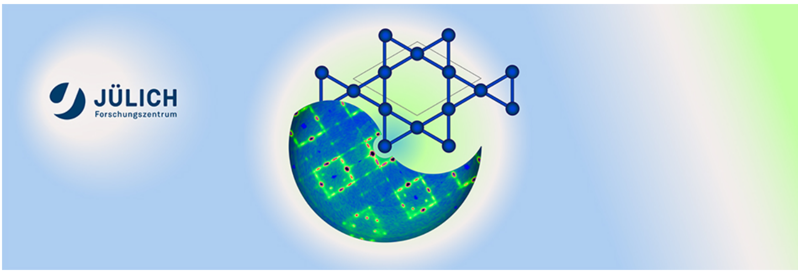

Beitrag ID: **102** Typ: **Talk**

Superconductivity in pressurized trilayer nickelate single crystals

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The search for new high-temperature (high-Tc) superconductors beyond the copper-based paradigm offers exciting opportunities to deepen our understanding of superconductivity mechanisms and explore new applications [1]. Nickel, situated immediately to the left of copper on the Periodic Table, offers a playground for materials and chemistry designs aimed at replicating high-Tc unconventional superconductivity. Ruddlesden-Popper (RP) phase bilayer nickelate La3Ni2O7 was shown to exhibit superconductivity under high pressures, with transition temperatures (Tc) approaching 80 K [2]. This unexpected finding prompted discussions about the underlying mechanisms of superconductivity, including analogies to cuprates and the potential for multi-orbital physics that goes beyond simple cupratelike models.
In this talk, I will present our successful synthesis of high-quality trilayer nickelate La4Ni3O10-δ single crystals with minimal oxygen deficiency, achieved through the high-pressure optical floating zone technique. Our results show that applying pressure effectively suppresses spin and charge order in La4Ni3O10-δ, leading to the emergence of superconductivity with a maximum Tc of around 30 K at 69.0 GPa [3]. Susceptibility measurements reveal a strong diamagnetic response below Tc, confirming bulk superconductivity. In the normal state, we observe ‘strange metal’ behavior, marked by linear temperature-dependent resistance up to 300 K. This system’s layer-dependent superconductivity suggests a distinct interlayer coupling mechanism, distinct from cuprates. Recently, we have observed pressurized bulk superconductivity in Pr4Ni3O10 single crystals [4].
These findings offer insights into the superconducting mechanisms and introduce a new material platform to study the interplay between various electronic phenomena, including spin/charge order, flat band structure, interlayer coupling, strange metal behavior and superconductivity.

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[2] H. Sun, M. Huo, X. Hu, Nature, 621, 493-498 (2023).
[3] Y. Zhu, D. Peng, E. Zhang, et al., Nature, 631, 531-536 (2024).
[4] E. Zhang, D. Peng, Y. Zhu, et al., Physical Review X, 15, 021008 (2025).

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