

EINLADUNG zum IFP-SEMINAR

In the Quest for an Orbiton

Krzysztof Wohlfeld

Faculty of Physics, University of Warsaw

Host: Alessandro Toschi
Termin: Mittwoch, 15. Jänner 2025, 16:00 Uhr
Ort: TU Wien, Freihausgebäude
Wiedner Hauptstraße 8-10, 1040 Wien
Seminarraum DC rot 07 (roter Bereich, 7. OG)

Vor dem Vortrag gibt es ab 15:30 Kaffee und Kekse

Abstract:

A correlated electron system with spin, lattice, charge and orbital degrees of freedom should support four basic types of collective excitations: magnons, phonons, plasmons, and orbitons. Whereas the first three have been seen in a plethora experiments, observing the quantised orbital wave has for years been an experimental and theoretical challenge. In this talk I first give an overview of these attempts, starting with the theoretical predictions long time ago [1] and their vivid observation in a rather special quasi-1D setting [2]. The latter has been made possible due to the rapid advancement of the resonant inelastic x-ray scattering (RIXS) during the last 15 years.

In the second part of the talk, I will present our recent work [3] that unambiguously demonstrates the existence of the orbiton in two copper oxides: the infinite-layer [4] CaCuO_2 and the single-layer Nd_2CuO_4 . This observation is rationalized by a novel theoretical analysis which illustrates that the motion of orbitons is often confined by antiferromagnetic excitations – but here, the orbiton escapes such confining tendencies due to favorable circumstances, completely explained by our model. Last but not least, we suggest that the orbital excitations are not "silent" observers of the peculiar physics of high-temperature superconducting cuprates, even though their role in superconductivity is controversial [5, 6].

References

- [1] K. I. Kugel and D. Khomskii, Sov. Phys. Usp. 25, 231 (1982); Y. Tokura and N. Nagaosa, Science 288, 462 (2000).
- [2] J. Schlappa et al., Nature 485, 82 (2012).
- [3] L. Martinelli et al., Phys. Rev. Lett. 132, 066004 (2024).
- [4] L. Martinelli et al., Phys. Rev. X 12, 021041 (2022).
- [5] F. Barantani et al., Phys. Rev. X 12, 021068 (2022).
- [6] G. Merzoni et al., Phys. Rev. B 109, 184506 (2024).