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CV

Education

Degree	**Organisation**	**Duration**
Habilitation	University of Warsaw, PL Faculty of Physics	02.2018 - 12.2018
PhD: theoretical physics advisor: A. M. Oles	Jagiellonian University, PL Faculty of Physics, Astronomy & Computer Science	10.2005- 06.2009
Master: theoretical physics advisor: A. M. Oles	Jagiellonian University, PL Faculty of Physics, Astronomy & Computer Science	10.2000- 06.2005

Employment

Role	**Organisation**	**Duration**
Associate professor (permanent position)	University of Warsaw, PL Faculty of Physics	02.2022 - Present
Assistant professor (tenure track)	University of Warsaw, PL Faculty of Physics	02.2015- 01.2022
Postdoc advisor: T. P. Devereaux	Stanford University, US Stanford Institute for Materials and Energy Sciences	10.2012- 02.2015
Postdoc advisor: J. van den Brink	IFW Dresden, DE [2010-12 as Humboldt fellow]	10.2009- 10.2012
Visiting PhD student	MPI for Solid State Research, DE Department W. Metzner	09.2008- 01.2009
Visiting PhD student	MPI for Solid State Research, DE Department W. Metzner	03.2008- 07.2008
Traineeship	Paul Scherrer Institute, CH Ultracold Neutron Group	07.2003- 09.2003

Major achievements

Achievement 1: Formulation of the spin-orbital separation concept

(A) Together with my theoretical and experimental co-workers about 13 years ago we came up with an idea that in a 1D interacting electronic system electron's orbital quantum number can split from the spin and move separately as a so-called orbiton. In general, this concept is somewhat similar to the established spin-charge separation (splitting of electron's spin and charge quantum number)—though a number of subtle differences between these two ideas exist. We published few of works on this problem, starting with the theoretical foundations [1] and then describing several experimental realizations [2, 5-6] and further theoretical descriptions [3,4].

(B) My role: coming up with the concept, performing the analytical calculations, interpreting the experiments.

References:

[1] K. Wohlfeld, M. Daghofer, S. Nishimoto, G. Khaliullin, J. van den Brink, "Intrinsic Coupling of Orbital Excitations to Spin Fluctuations in Mott Insulators"; Physical Review Letters **107**, 147201 (2011).

[2] J. Schlappa, K. Wohlfeld, K. J. Zhou, M. Mourigal, M. W. Haverkort, V. N. Strocov, L. Hozoi, C. Monney, S. Nishimoto, Singh, A. Revcolevschi, J.-S. Caux, L. Patthey, H. M. Ronnow, J. van den Brink, and T. Schmitt, "Spin-Orbital Separation in the quasi 1D Mott-insulator Sr_2CuO_3"; Nature **485**, 82 (2012).

[3] K. Wohlfeld, S. Nishimoto, M. W. Haverkort, J. van den Brink, "Microscopic origin of spin-orbital separation in Sr_2CuO_3"; Phys. Rev. B **88**, 195138 (2013).

[4] C. C. Chen, M. van Veenendaal, T. P. Devereaux, K. Wohlfeld, "Fractionalization, entanglement, and separation: understanding the collective excitations in a spin-orbital chain"; Phys. Rev. B **91**, 165102 (2015).

[5] V. Bisogni, K. Wohlfeld, S. Nishimoto,C. Monney, J. Trinckauf, K.J. Zhou, R. Kraus, K. Koepernik, C. Sekar, V. Strocov, B. Buchner, T. Schmitt, J. van den Brink, J. Geck, "Spin-orbital separation in the anisotropic ladder system $CaCu_2O_3$"; Phys. Rev. Lett. **114**, 096402 (2015).

[6] R. Fumagalli, J. Heverhagen, D. Betto, R. Arpaia, M. Rossi, D. Di Castro, N. B. Brookes, M. M. Sala, M. Daghofer, L. Braicovich, K. Wohlfeld, G. Ghiringhelli, "Mobile orbitons in Ca_2CuO_3: crucial role of the Hund's exchange"; Physical Review B **101**, 205117 (2020).

Achievement 2: Complete understanding of ARPES on undoped cuprates

(A) Over the last years, together with my colleagues, I have been following a program whose main aim is to fully understand the ARPES spectra of the undoped cuprates. On the theoretical level this translates into a thorough comprehension of the properties of one hole that is being added to the undoped t-J and Hubbard models. All of our main achievements are centered around the concept that to understand this problem one needs to go beyond the idea of a "hole coupled to linear spin waves":

- we attributed the onset of the dominant (the "waterfall") feature of the 2D Hubbard spectrum to the so-called three-site terms [1],
- we understood the origin of the differences between a hole in the 1D and 2D antiferromagnets (i.e. the collapse of the string potential and onset of spin-charge separation) as following from the special role played by the magnon-magnon interactions and the hard-core nature of the bosonic magnons in 1D [2-3],
- finally, we showed that the hole in the 2D Neel antiferromagnet is never in a strictly linear potential, which contradicts the generally accepted paradigm [L.N. Bulaevskii *et al.*, JETP **27**, 836 (1968)], *cf.* [4].

(B) My role here was centered around postulating the above questions, giving first intuitive answers to them and developing some of the analytical calculations.

References:

[1] Y. Wang, K. Wohlfeld, B. Moritz, C. J. Jia, M. van Veenendaal, K. Wu, C.-C. Chen, T. P. Devereaux, "Origin of Strong Dispersion in Hubbard Insulators"; Phys. Rev. B **92**, 075119 (2015).

[2] K. Bieniasz, P. Wrzosek, A. M. Oles, K. Wohlfeld, "Superexponential Wave Function Decay: A Fingerprint of Strings in Doped Antiferromagnets"; SciPost Physics **7**, 066 (2019).

[3] P. Wrzosek, A. Klosinski, Y. Wang, M. Berciu, C. E. Agrapidis, K. Wohlfeld, "The fate of the spin polaron in the 1D antiferromagnets"; SciPost Physics **17**, 018 (2024).

[4] P. Wrzosek and K. Wohlfeld, "Hole in the 2D Ising Antiferromagnet: Origin of the Incoherent Spectrum", Phys. Rev. B **103**, 035113 (2021).

Achievement 3: Intuitive understanding of a spinon exciation

(A) One of the hardest to understand collective excitations in a quantum many-body systems is a "spinon" – a fractional excitations that carries just a fraction of electron's quantum number. While such a mathematical description of this excitation has been postulated more than 40 years ago, its intuitive understanding has been lacking. Hence we recently suggested how one can visualise a spinon as an extra spin site that is being added to a spin chain which, approximately can be described as a collection of the so-called valence bond singlets. In this scenario, a spinon moves by "flowing" in the "sea" formed by valence bond singlets. This scheme was experimentally confirmed by C. Zhao et al., Nature Materials **24**, 722 (2025).

(B) My role here was to formulate and execute this concept – which we jointly did with Mona Berciu and Milosz Panfil.

References:

[1] T. Kulka, M. Panfil, M. Berciu, K. Wohlfeld, "Nature of Spinons in 1D Spin Chains"; Phys. Rev. Lett **134**, 236504 (2025).

Students, grants, longer visits after my postdoctoral stays

(A) Three graduated PhD students (one in 2021 and two in 2023; one *cum laude*); three PhD students starting in autumn 2025.

(B) “Sonata-bis” grant (2017-2023) and “Opus” grant (2025-2029) of the Polish grant agency NCN; several smaller grants.

(C) Referee for the grant agencies: ERC (EU), SNF (Switzerland), DFG (Germany), DOE–BES (USA).

(D) Visits: University of British Columbia (research; host: prof. Mona Berciu; 08.2018); Tokyo University of Science (professorship; host: prof. Takami Tohyama; 01.2023); University of Geneva (professorship; host: prof. Louk Rademaker; 02-04.2024); IIT Madras (professorship; host: prof. Yasir Iqbal; 01-02.2025).