



# Dr. Jacek Herbrych

Wrocław University of Science and Technology

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## Appointments

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### Wrocław University of Science and Technology

INSTITUTE OF THEORETICAL PHYSICS · FACULTY OF FUNDAMENTAL PROBLEMS OF TECHNOLOGY

Group Leader · Associate Professor

Wrocław, Poland

April 2019 - PRESENT

### University of Tennessee

DEPARTMENT OF PHYSICS AND ASTRONOMY

Postdoctoral fellow with Prof. Elbio Dagotto and Prof. Adriana Moreo

Knoxville, USA

November 2016 - March 2019

### Oak Ridge National Laboratory

MATERIALS SCIENCE AND TECHNOLOGY DIVISION

Associate scientist

Oak Ridge, USA

November 2016 - March 2019

### University of Crete

DEPARTMENT OF PHYSICS

Postdoctoral fellow with Prof. Xenophon Zotos

Heraklion, Greece

January 2013 - August 2016

### Jožef Stefan Institute

DEPARTMENT FOR THEORETICAL PHYSICS

Young researcher under supervision of Prof. Peter Prelovšek

Ljubljana, Slovenia

September 2010 - December 2013

## Education

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### University of Warsaw

HABILITATION

*Thesis:* Properties of orbital-selective Mott insulators within low-dimensional multiorbital systems

Warsaw, Poland

October 2022

### University of Ljubljana

PH.D. IN PHYSICS

*Thesis:* Finite-temperature dynamics of quantum spin chains

*Advisor:* Prof. Dr. Peter Prelovšek

Ljubljana, Slovenia

September 2010 - November 2013

### University of Łódź

M.Sc. IN PHYSICS

*Thesis:* Space-time symmetries in deformed Minkowski space

*Advisor:* Prof. Dr. Cezary Gonera

Łódź, Poland

September 2005 - July 2010

## Funding

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### Japan Society for the Promotion of Science (JSPS)

INVITATIONAL FELLOWSHIPS FOR RESEARCH IN JAPAN

Visiting Scientist of Prof. Takami Tohyama (Tokyo University of Science, Japan)

VIII.2026-X.2026

### The National Science Centre (NCN)

#### Properties of low-dimensional quantum systems with charge, spin, and orbital degrees of freedom

SONATA BIS 13 2023/50/E/ST3/00033

Principal Investigator (Wrocław University of Science and Technology, Poland)

2024-2029

## Past:

### The National Science Centre (NCN)

#### Magnetic properties of strongly correlated multi-orbital systems

OPUS 18 2019/35/B/ST3/01207

2020-2023

Principal Investigator (Wrocław University of Science and Technology, Poland)

### Polish National Agency for Academic Exchange (NAWA)

#### Polish Returns

PPN/PPO/2018/1/00035

2019-2022

Principal Investigator (Wrocław University of Science and Technology, Poland)

## Teaching

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### Quantum Mechanics I & II

BACHELOR PROGRAM OF QUANTUM ENGINEERING

Wrocław University of Science and Technology, Poland

### Quantum many-body theory

BACHELOR PROGRAM OF QUANTUM ENGINEERING AND MASTER PROGRAM OF TECHNICAL PHYSICS

Wrocław University of Science and Technology, Poland

### Matrix product state representation of quantum mechanics

MONOGRAPHIC LECTURE; MASTER PROGRAM OF BIG DATA ANALYTICS

Wrocław University of Science and Technology, Poland

### Numerical methods for quantum systems

MASTER PROGRAM OF QUANTUM ENGINEERING AND TECHNICAL PHYSICS

Wrocław University of Science and Technology, Poland

## Publications

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### Boundary-driven magnetization transport in the spin-1/2 XXZ chain: Role of the system-bath coupling strength and timescales

(61)

M. KEMPA, M. KRAFT, S. NANDY, J. HERBRYCH, J. WANG, J. GEMMER, AND R. STEINIGEWEG

2026

Phys. Rev. B **113**, 064431 (2026) & arXiv: cond-mat/2507.16528

### Doping $S = 1$ antiferromagnet in one-dimension

(60)

J. PROKOPCZYK AND J. HERBRYCH

2025

Phys. Rev. B **113**, 024424 (2026) & arXiv: cond-mat/2508.07712

### Tunable Hilbert space fragmentation and extended critical regime

(59)

M. LISIECKI, J. BONČA, M. MIERZEJEWSKI, J. HERBRYCH, AND P. ŁYDŹBA

2025

Phys. Rev. B **112**, 195116 (2025) & arXiv: cond-mat/2505.09346

### Finding local integrals of motion in quantum lattice models in the thermodynamic limit

(58)

J. PAWŁOWSKI, J. HERBRYCH, AND M. MIERZEJEWSKI

2025

Phys. Rev. B **112**, 155130 (2025) & arXiv: cond-mat/2505.05882

### Evidence for valence-bond pairing in a one-dimensional two-orbital system

(57)

M. MIERZEJEWSKI, E. DAGOTTO, AND J. HERBRYCH

2025

Phys. Rev. B **112**, L041107 (2025) & arXiv: cond-mat/2411.03771

### Spin and energy diffusion vs. subdiffusion in disordered spin chains

(56)

J. HERBRYCH AND P. PRELOVŠEK

2025

Phys. Rev. B **112**, 045108 (2025) & arXiv: cond-mat/2504.15705

### Magnon damping and mode softening in quantum double-exchange ferromagnets

(55)

A. MOREO, E. DAGOTTO, G. ALVAREZ, T. TOHYAMA, M. MIERZEJEWSKI, AND J. HERBRYCH

2025

Rep. Prog. Phys. **88**, 068001 (2025) & arXiv: cond-mat/2503.01277

- Luther-Emerly liquid and dominant singlet superconductivity in the two-orbital Hubbard chain** (54)  
P. LAURELL, J. HERBRYCH, G. ALVAREZ, AND E. DAGOTTO 2024  
Phys. Rev. B **110**, 064515 (2024) & arXiv: cond-mat/2311.13440
- Lindblad dynamics from spatio-temporal correlation functions in nonintegrable spin-1/2 chains with different boundary conditions** (53)  
M. KRAFT, J. RICHTER, F. JIN, S. NANDY, ZALA LENARČIČ, J. HERBRYCH, K. MICHELSEN, H. DE RAEDT, J. GEMMER, AND R. STEINIGEWEG 2024  
Phys. Rev. Res. **6**, 023251 (2024) & arXiv: cond-mat/2402.18177
- Long-living prethermalization in nearly integrable spin ladders** (52)  
J. PAWŁOWSKI, M. PANFIL, J. HERBRYCH, AND M. MIERZEJEWSKI 2024  
Phys. Rev. B **109**, L161109 (2024) & arXiv: cond-mat/2312.11975
- Emergent dipole moment conservation and subdiffusion in tilted chains** (51)  
S. NANDY, J. HERBRYCH, Z. LENARČIČ, A. GŁÓDKOWSKI, P. PRELOVŠEK, AND M. MIERZEJEWSKI 2024  
Phys. Rev. B **109**, 115120 (2024) & arXiv: cond-mat/2310.01862
- Transition to the Haldane phase driven by electron-electron correlations** (50)  
A. JAŻDŹEWSKA, M. MIERZEJEWSKI, M. ŚRODA, A. NOCERA, G. ALVAREZ, E. DAGOTTO, AND J. HERBRYCH 2023  
Nat. Commun. **14**, 8524 (2023) & arXiv: cond-mat/2304.11154
- The spin-1/2 XXZ chain coupled to two Lindblad baths: Constructing nonequilibrium steady states from equilibrium correlation functions** (49)  
T. HEITMANN, J. RICHTER, F. JIN, S. NANDY, Z. LENARČIČ, J. HERBRYCH, K. MICHELSEN, H. DE RAEDT, J. GEMMER, AND R. STEINIGEWEG 2023  
Phys. Rev. B **108**, L201119 (2023) & arXiv: cond-mat/2303.00430
- Spatially-anisotropic  $S = 1$  square-lattice antiferromagnet with single-ion anisotropy realized with a Ni(II) pyrazine- $n,n'$ -dioxide (pyzdo) coordination polymer** (48)  
J. L. MANSON, D. M. PAJEROWSKI, J. M. DONOVAN, B. TWAMLEY, P. A. GODDARD, R. JOHNSON, J. BENDIX, J. SINGLETON, T. LANCASTER, S. J. BLUNDELL, J. HERBRYCH, P. J. BAKER, A. J. STEELE, F. L. PRATT, I. FRANKE-CHAUDET, R. D. McDONALD, A. PLONCZAK, AND P. MANUEL 2023  
Phys. Rev. B **108**, 094425 (2023)
- Spin diffusion in perturbed isotropic Heisenberg spin chain** (47)  
S. NANDY, Z. LENARČIČ, E. ILIEVSKI, M. MIERZEJEWSKI, J. HERBRYCH, P. PRELOVŠEK 2023  
Phys. Rev. B **108**, L081115 (2023) & arXiv: cond-mat/2211.17181
- Real-time broadening of bath-induced density profiles from closed-system correlation functions** (46)  
T. HEITMANN, J. RICHTER, J. HERBRYCH, J. GEMMER, AND R. STEINIGEWEG 2023  
Phys. Rev. E **108**, 024102 (2023) & arXiv: cond-mat/2210.10528
- Hund bands in spectra of multiorbital systems** (45)  
M. ŚRODA, J. MRAVLJE, G. ALVAREZ, E. DAGOTTO, AND J. HERBRYCH 2023  
Phys. Rev. B **108**, L081102 (2023) & arXiv: cond-mat/2210.11209
- Slow diffusion and Thouless localization criterion in modulated spin chains** (44)  
M. MIERZEJEWSKI, J. HERBRYCH, AND P. PRELOVŠEK 2023  
Phys. Rev. B **108**, 035106 (2023) & arXiv: cond-mat/2302.03325
- Quasiballistic transport in long-range anisotropic Heisenberg model** (43)  
M. MIERZEJEWSKI, J. WRONOWICZ, J. PAWŁOWSKI, AND J. HERBRYCH 2023  
Phys. Rev. B **107**, 045134 (2023) & arXiv: cond-mat/2206.05960
- From dissipationless to normal diffusion in easy-axis Heisenberg spin chain** (42)  
P. PRELOVŠEK, S. NANDY, Z. LENARČIČ, M. MIERZEJEWSKI, AND J. HERBRYCH 2022  
Phys. Rev. B **106**, 245104 (2022) & arXiv: cond-mat/2205.11891
- Multiple relaxation times in perturbed XXZ chain** (41)  
M. MIERZEJEWSKI, J. PAWŁOWSKI, P. PRELOVŠEK, AND J. HERBRYCH 2022  
SciPost Phys. **13**, 013 (2022) & arXiv: cond-mat/2112.08158

- High-pressure inelastic neutron scattering study of the anisotropic  $S = 1$  spin chain  $[\text{Ni}(\text{HF}_2)(3\text{-Clpyridine})_4]\text{BF}_4$**  (40)  
D. M. PAJEROWSKI, A. P. PODLESNYAK, J. HERBRYCH, AND J. L. MANSON 2022  
Phys. Rev. B **105**, 134420 (2022) & arXiv: cond-mat/2206.06249
- Relaxation at different length-scales in models of many-body localization** (39)  
J. HERBRYCH, M. MIERZEJEWSKI, AND P. PRELOVŠEK 2022  
Phys. Rev. B **105**, L081105 (2022) & arXiv: cond-mat/2110.15635
- Prediction of orbital selective Mott phases and block magnetic states in the quasi-one-dimensional iron chain  $\text{Ce}_2\text{O}_2\text{FeSe}_2$  under hole and electron doping** (38)  
L.-F. LIN, Y. ZHANG, G. ALVAREZ, J. HERBRYCH, A. MOREO, AND E. DAGOTTO 2022  
Phys. Rev. B **105**, 075119 (2022) & arXiv: cond-mat/2112.04049
- Magnetization dynamics fingerprints of an excitonic condensate  $t_{2g}^4$  magnet** (37)  
N. KAUSHAL, J. HERBRYCH, G. ALVAREZ, AND E. DAGOTTO 2021  
Phys. Rev. B **104**, 235135 (2021) & arXiv: cond-mat/2110.11828
- Coexistence of diffusive and ballistic transport in integrable quantum lattice models** (36)  
P. PRELOVŠEK, M. MIERZEJEWSKI, AND J. HERBRYCH 2021  
Phys. Rev. B **104**, 115163 (2021) & arXiv: cond-mat/2107.02454
- Quantum magnetism of iron-based ladders: blocks, spirals, and spin flux** (35)  
M. ŚRODA, E. DAGOTTO, AND J. HERBRYCH 2021  
Phys. Rev. B **104**, 045128 (2021) & arXiv: cond-mat/2105.04391
- Diffusion in the Anderson model in higher dimensions** (34)  
P. PRELOVŠEK AND J. HERBRYCH 2021  
Phys. Rev. B **103**, L241107 (2021) & arXiv: cond-mat/2104.07801
- Ballistic transport in integrable lattice models with degenerate spectra** (33)  
M. MIERZEJEWSKI, J. HERBRYCH, AND P. PRELOVŠEK 2021  
Phys. Rev. B **103**, 235115 (2021) & arXiv: cond-mat/2102.07467
- Interaction-induced topological phase transition and Majorana edge states in low-dimensional orbital-selective Mott insulators** (32)  
J. HERBRYCH, M. ŚRODA, G. ALVAREZ, M. MIERZEJEWSKI, AND E. DAGOTTO 2021  
Nat. Commun. **12**, 2955 (2021) & arXiv: cond-mat/2011.05646
- Resistivity and its fluctuations in disordered many-body systems: from chains to planes** (31)  
M. MIERZEJEWSKI, M. ŚRODA, J. HERBRYCH, AND P. PRELOVŠEK 2020  
Phys. Rev. B **102**, 161111(R) (2020) & arXiv: cond-mat/2003.00495
- Block orbital-selective Mott insulators: a spin excitation analysis** (30)  
J. HERBRYCH, G. ALVAREZ, A. MOREO, AND E. DAGOTTO 2020  
Phys. Rev. B **102**, 115134 (2020) & arXiv: cond-mat/2006.09495
- Prediction of exotic magnetic states in the alkali metal quasi-one-dimensional iron selenide compound  $\text{Na}_2\text{FeSe}_2$**  (29)  
B. PANDEY, L.-F. LIN, R. SONI, N. KAUSHAL, J. HERBRYCH, G. ALVAREZ, AND E. DAGOTTO 2020  
Phys. Rev. B **102**, 035149 (2020) & arXiv: cond-mat/2005.13132
- Block-spiral magnetism: An exotic type of frustrated order** (28)  
J. HERBRYCH, J. HEVERHAGEN, G. ALVAREZ, M. DAGHOFER, A. MOREO, AND E. DAGOTTO 2020  
Proc. Natl. Acad. Sci. USA **117**, 16226 (2020) & arXiv: cond-mat/1911.12248
- Vanishing Wilson ratio as the hallmark of quantum spin-liquid models** (27)  
P. PRELOVŠEK, K. MORITA, T. TOHYAMA, AND J. HERBRYCH 2020  
Phys. Rev. Research **2**, 023024 (2020) & arXiv: cond-mat/1912.00876
- Inelastic neutron scattering study of the anisotropic  $S = 1$  spin chain  $[\text{Ni}(\text{HF}_2)(3\text{-Clpyridine})_4]\text{BF}_4$**  (26)  
D. M. PAJEROWSKI, J. L. MANSON, J. HERBRYCH, J. BENDIX, A. P. PODLESNYAK, J. M. CAIN, AND M. W. MEISEL 2020  
Phys. Rev. B **101**, 094431 (2020) & arXiv: cond-mat/2001.08555

- Charge-density-wave melting in the one-dimensional Holstein model** (25)  
 J. STOLPP, [J. HERBRYCH](#), F. DORFNER, E. DAGOTTO, AND F. HEIDRICH-MEISNER 2020  
 Phys. Rev. B **101**, 035134 (2020) & arXiv: cond-mat/1911.01718
- Novel Magnetic Block States in Low-Dimensional Iron-Based Superconductors** (24)  
[J. HERBRYCH](#), J. HEVERHAGEN, N. D. PATEL, G. ALVAREZ, M. DAGHOFER, A. MOREO, AND E. DAGOTTO 2019  
 Phys. Rev. Lett. **123**, 027203 (2019) & arXiv: cond-mat/1812.00325
- Magnetization and energy dynamics in spin ladders:**  
**Evidence of diffusion in time, frequency, position, and momentum** (23)  
 J. RICHTER, F. JIN, L. KNIPSCHILD, [J. HERBRYCH](#), H. DE RAEDT, K. MICHELSSEN, J. GEMMER, AND R. STEINIGEWEG 2019  
 Phys. Rev. B **99**, 144422 (2019) & arXiv: cond-mat/1811.02806
- Sudden removal of a static force in a disordered system: Induced dynamics, thermalization, and transport** (22)  
 J. RICHTER, [J. HERBRYCH](#), AND R. STEINIGEWEG 2018  
 Phys. Rev. B **98**, 134302 (2018) & arXiv: cond-mat/1808.00497
- Non-equilibrium mass transport in the Fermi-Hubbard model** (21)  
 S. SCHERG, T. KOHLERT, [J. HERBRYCH](#), J. STOLPP, P. BORDIA, U. SCHNEIDER, F. HEIDRICH-MEISNER, I. BLOCH, AND M. AIDELSBURGER 2018  
 Phys. Rev. Lett. **121**, 130402 (2018) & arXiv: cond-mat/1805.10990
- Spin dynamics of the block orbital-selective Mott phase** (20)  
[J. HERBRYCH](#), N. KAUSHAL, A. NOCERA, G. ALVAREZ, A. MOREO, AND E. DAGOTTO 2018  
 Nat. Commun. **9**, 3736 (2018) & arXiv: cond-mat/1804.01959
- Density-matrix renormalization group study of a three-orbital Hubbard model with spin-orbit coupling in one dimension** (19)  
 N. KAUSHAL, [J. HERBRYCH](#), A. NOCERA, G. ALVAREZ, A. MOREO, F. A. REBOREDO, AND E. DAGOTTO 2017  
 Phys. Rev. B **96**, 155111 (2017) & arXiv: cond-mat/1707.04313
- Efficiency of fermionic quantum distillation** (18)  
[J. HERBRYCH](#), A. E. FEIGUIN, E. DAGOTTO, AND F. HEIDRICH-MEISNER 2017  
 Phys. Rev. A **96**, 033617 (2017) & arXiv: cond-mat/1707.01792
- Possible bicollinear nematic state with monoclinic lattice distortions in iron telluride compounds** (17)  
 C. B. BISHOP, [J. HERBRYCH](#), E. DAGOTTO, AND A. MOREO 2017  
 Phys. Rev. B **96**, 035144 (2017) & arXiv: cond-mat/1704.03495
- Self-consistent approach to many-body localization and subdiffusion** (16)  
 P. PRELOVŠEK AND [J. HERBRYCH](#) 2017  
 Phys. Rev. B **96**, 035130 (2017) & arXiv: cond-mat/1609.05450
- Dynamics of locally coupled oscillators with next-nearest-neighbor interaction** (15)  
[J. HERBRYCH](#), A. G. CHAZIRAKIS, N. CHRISTAKIS, AND J. J. P. VEERMAN 2017  
 Differ. Equ. & Dyn. Syst. **29**, 487 (2021) & arXiv: math/1506.07381
- Density correlations and transport in models of many-body localization** (14)  
 P. PRELOVŠEK, M. MIERZEJEWSKI, O. BARIŠIĆ, AND [J. HERBRYCH](#) 2017  
 Ann. Phys. (Berlin) **529**, 1600362 (2017) & arXiv: cond-mat/1611.03611
- Interaction-induced weakening of localization in few-particle disordered Heisenberg chains** (13)  
 D. SCHMIDTKE, R. STEINIGEWEG, [J. HERBRYCH](#), AND J. GEMMER 2017  
 Phys. Rev. B **95**, 134201 (2017) & arXiv: cond-mat/1607.05664
- Effective realization of random magnetic fields in compounds with large single-ion anisotropy** (12)  
[J. HERBRYCH](#) AND J. KOKALJ 2017  
 Phys. Rev. B **95**, 125129 (2017) & arXiv: cond-mat/1606.06013
- Universal dynamics of density correlations at the transition to many-body localized state** (11)  
 M. MIERZEJEWSKI, [J. HERBRYCH](#), AND P. PRELOVŠEK 2016  
 Phys. Rev. B **94**, 224207 (2016) & arXiv: cond-mat/1607.04992

- Typicality approach to the optical conductivity in thermal and many-body localized phases** (10)  
R. STEINIGEWEG, J. HERBRYCH, F. POLLMANN, AND W. BREINIG 2016  
Phys. Rev. B **94**, 180401(R) (2016) & arXiv: cond-mat/1512.08519
- Light induced magnetization in a spin  $S = 1$  easy-plane antiferromagnetic chain** (9)  
J. HERBRYCH AND X. ZOTOS 2016  
Phys. Rev. B **93**, 134412 (2016) & arXiv: cond-mat/1505.03004
- Heat conductivity of the Heisenberg spin-1/2 ladder: From weak to strong breaking of integrability** (8)  
R. STEINIGEWEG, J. HERBRYCH, X. ZOTOS, AND W. BREINIG 2016  
Phys. Rev. Lett. **116**, 017202 (2016) & arXiv: cond-mat/1503.03871
- Antiferromagnetic order in weakly coupled random spin chains** (7)  
J. KOKALJ, J. HERBRYCH, A. ZHELUDEV, AND P. PRELOVŠEK 2015  
Phys. Rev. B **91**, 155147 (2015) & arXiv: cond-mat/1409.1757
- Effective  $S = 1/2$  description of the  $S = 1$  chain with strong easy plane anisotropy** (6)  
C. PSAROUDAKI, J. HERBRYCH, J. KARADAMOGLU, P. PRELOVŠEK, X. ZOTOS, AND N. PAPANICOLAOU 2014  
Phys. Rev. B **89**, 224418 (2014) & arXiv: cond-mat/1404.3064
- Local spin relaxation within the random Heisenberg chain** (5)  
J. HERBRYCH, J. KOKALJ, AND P. PRELOVŠEK 2013  
Phys. Rev. Lett. **111**, 147203 (2013) & arXiv: cond-mat/1307.0370
- Eigenstate thermalization in isolated spin-chain systems** (4)  
R. STEINIGEWEG, J. HERBRYCH, AND P. PRELOVŠEK 2013  
Phys. Rev. E **87**, 012118 (2013) & arXiv: cond-mat/1208.6143
- Spin hydrodynamics in the  $S = 1/2$  anisotropic Heisenberg chain** (3)  
J. HERBRYCH, R. STEINIGEWEG, AND P. PRELOVŠEK 2012  
Phys. Rev. B **86**, 115106 (2012) & arXiv: cond-mat/1206.4248
- Coexistence of anomalous and normal diffusion in integrable Mott insulators** (2)  
R. STEINIGEWEG, J. HERBRYCH, P. PRELOVŠEK, AND M. MIERZEJEWSKI 2012  
Phys. Rev. B **85**, 214409 (2012) & arXiv: cond-mat/1201.2844
- Finite-temperature Drude weight within the anisotropic Heisenberg chain** (1)  
J. HERBRYCH, P. PRELOVŠEK, AND X. ZOTOS 2011  
Phys. Rev. B **84**, 155125 (2011) & arXiv: cond-mat/1107.3027