



# Dr. Jacek Herbrych

Wrocław University of Science and Technology

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## Appointments

### Wrocław University of Science and Technology

INSTITUTE OF THEORETICAL PHYSICS · FACULTY OF FUNDAMENTAL PROBLEMS OF TECHNOLOGY

Group Leader · Assistant 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

### 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

### 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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### Tunable Hilbert space fragmentation and extended critical regime

(59)

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

2025

Phys. Rev. B **112**, XXXXXX (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-Emery 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. MICHIENSEN, H. DE RAEDT, J. GEMMER, AND R. STEINIGEWEG

2024

Phys. Rev. Res. **6**, 023251 (2024) & arXiv: cond-mat/2402.18177

<b>Long-living prethermalization in nearly integrable spin ladders</b>	(52)
J. PAWŁOWSKI, M. PANFIL, <a href="#">J. HERBRYCH</a> , AND M. MIERZEJEWSKI	2024
Phys. Rev. B <b>109</b> , L161109 (2024) & arXiv: cond-mat/2312.11975	
<b>Emergent dipole moment conservation and subdiffusion in tilted chains</b>	(51)
S. NANDY, <a href="#">J. HERBRYCH</a> , Z. LENARČIČ, A. GŁÓDKOWSKI, P. PRELOVŠEK, AND M. MIERZEJEWSKI	2024
Phys. Rev. B <b>109</b> , 115120 (2024) & arXiv: cond-mat/2310.01862	
<b>Transition to the Haldane phase driven by electron-electron correlations</b>	(50)
A. JAŻDZEWSKA, M. MIERZEJEWSKI, M. ŚRODA, A. NOCERA, G. ALVAREZ, E. DAGOTTO, AND <a href="#">J. HERBRYCH</a>	2023
Nat. Commun. <b>14</b> , 8524 (2023) & arXiv: cond-mat/2304.11154	
<b>The spin-1/2 XXZ chain coupled to two Lindblad baths: Constructing nonequilibrium steady states from equilibrium correlation functions</b>	(49)
T. HEITMANN, J. RICHTER, F. JIN, S. NANDY, Z. LENARČIČ, <a href="#">J. HERBRYCH</a> , K. MICHELSEN, H. DE RAEDT, J. GEMMER, AND R. STEINIGEWEG	2023
Phys. Rev. B <b>108</b> , L201119 (2023) & arXiv: cond-mat/2303.00430	
<b>Spatially-anisotropic <math>S = 1</math> square-lattice antiferromagnet with single-ion anisotropy realized with a Ni(II) pyrazine-<math>n,n'</math>-dioxide (pyzdo) coordination polymer</b>	(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, <a href="#">J. HERBRYCH</a> , P. J. BAKER, A. J. STEELE, F. L. PRATT, I. FRANKE-CHAUDET, R. D. McDONALD, A. PLONCZAK, AND P. MANUEL	2023
Phys. Rev. B <b>108</b> , 094425 (2023)	
<b>Spin diffusion in perturbed isotropic Heisenberg spin chain</b>	(47)
S. NANDY, Z. LENARČIČ, E. ILIEVSKI, M. MIERZEJEWSKI, <a href="#">J. HERBRYCH</a> , P. PRELOVŠEK	2023
Phys. Rev. B <b>108</b> , L081115 (2023) & arXiv: cond-mat/2211.17181	
<b>Real-time broadening of bath-induced density profiles from closed-system correlation functions</b>	(46)
T. HEITMANN, J. RICHTER, <a href="#">J. HERBRYCH</a> , J. GEMMER, AND R. STEINIGEWEG	2023
Phys. Rev. E <b>108</b> , 024102 (2023) & arXiv: cond-mat/2210.10528	
<b>Hund bands in spectra of multiorbital systems</b>	(45)
M. ŚRODA, J. MRAVLJE, G. ALVAREZ, E. DAGOTTO, AND <a href="#">J. HERBRYCH</a>	2023
Phys. Rev. B <b>108</b> , L081102 (2023) & arXiv: cond-mat/2210.11209	
<b>Slow diffusion and Thouless localization criterion in modulated spin chains</b>	(44)
M. MIERZEJEWSKI, <a href="#">J. HERBRYCH</a> , AND P. PRELOVŠEK	2023
Phys. Rev. B <b>108</b> , 035106 (2023) & arXiv: cond-mat/2302.03325	
<b>Quasiballistic transport in long-range anisotropic Heisenberg model</b>	(43)
M. MIERZEJEWSKI, J. WRONOWICZ, J. PAWŁOWSKI, AND <a href="#">J. HERBRYCH</a>	2023
Phys. Rev. B <b>107</b> , 045134 (2023) & arXiv: cond-mat/2206.05960	
<b>From dissipationless to normal diffusion in easy-axis Heisenberg spin chain</b>	(42)
P. PRELOVŠEK, S. NANDY, Z. LENARČIČ, M. MIERZEJEWSKI, AND <a href="#">J. HERBRYCH</a>	2022
Phys. Rev. B <b>106</b> , 245104 (2022) & arXiv: cond-mat/2205.11891	
<b>Multiple relaxation times in perturbed XXZ chain</b>	(41)
M. MIERZEJEWSKI, J. PAWŁOWSKI, P. PRELOVŠEK, AND <a href="#">J. HERBRYCH</a>	2022
SciPost Phys. <b>13</b> , 013 (2022) & arXiv: cond-mat/2112.08158	
<b>High-pressure inelastic neutron scattering study of the anisotropic <math>S = 1</math> spin chain <math>[\text{Ni}(\text{HF}_2)(3\text{-Clpyridine})_4]\text{BF}_4</math></b>	(40)
D. M. PAJEROWSKI, A. P. PODLESNYAK, <a href="#">J. HERBRYCH</a> , AND J. L. MANSON	2022
Phys. Rev. B <b>105</b> , 134420 (2022) & arXiv: cond-mat/2206.06249	
<b>Relaxation at different length-scales in models of many-body localization</b>	(39)
<a href="#">J. HERBRYCH</a> , M. MIERZEJEWSKI, AND P. PRELOVŠEK	2022
Phys. Rev. B <b>105</b> , 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

<b>Magnetization and energy dynamics in spin ladders:</b>	(23)
<b>Evidence of diffusion in time, frequency, position, and momentum</b>	
J. RICHTER, F. JIN, L. KNIPSCHILD, <u>J. HERBRYCH</u> , H. DE RAEDT, K. MICHELSEN, J. GEMMER, AND R. STEINIGEWEG	2019
Phys. Rev. B <b>99</b> , 144422 (2019) & arXiv: cond-mat/1811.02806	
<b>Sudden removal of a static force in a disordered system: Induced dynamics, thermalization, and transport</b>	(22)
J. RICHTER, <u>J. HERBRYCH</u> , AND R. STEINIGEWEG	2018
Phys. Rev. B <b>98</b> , 134302 (2018) & arXiv: cond-mat/1808.00497	
<b>Non-equilibrium mass transport in the Fermi-Hubbard model</b>	(21)
S. SCHERG, T. KOHLERT, <u>J. HERBRYCH</u> , J. STOLPP, P. BORDIA, U. SCHNEIDER, F. HEIDRICH-MEISNER, I. BLOCH, AND M. AIDELSBURGER	2018
Phys. Rev. Lett. <b>121</b> , 130402 (2018) & arXiv: cond-mat/1805.10990	
<b>Spin dynamics of the block orbital-selective Mott phase</b>	(20)
<u>J. HERBRYCH</u> , N. KAUSHAL, A. NOCERA, G. ALVAREZ, A. MOREO, AND E. DAGOTTO	2018
Nat. Commun. <b>9</b> , 3736 (2018) & arXiv: cond-mat/1804.01959	
<b>Density-matrix renormalization group study of a three-orbital Hubbard model with spin-orbit coupling in one dimension</b>	(19)
N. KAUSHAL, <u>J. HERBRYCH</u> , A. NOCERA, G. ALVAREZ, A. MOREO, F. A. REBOREDO, AND E. DAGOTTO	2017
Phys. Rev. B <b>96</b> , 155111 (2017) & arXiv: cond-mat/1707.04313	
<b>Efficiency of fermionic quantum distillation</b>	(18)
<u>J. HERBRYCH</u> , A. E. FEIGUIN, E. DAGOTTO, AND F. HEIDRICH-MEISNER	2017
Phys. Rev. A <b>96</b> , 033617 (2017) & arXiv: cond-mat/1707.01792	
<b>Possible bicollinear nematic state with monoclinic lattice distortions in iron telluride compounds</b>	(17)
C. B. BISHOP, <u>J. HERBRYCH</u> , E. DAGOTTO, AND A. MOREO	2017
Phys. Rev. B <b>96</b> , 035144 (2017) & arXiv: cond-mat/1704.03495	
<b>Self-consistent approach to many-body localization and subdiffusion</b>	(16)
P. PRELOVŠEK AND <u>J. HERBRYCH</u>	2017
Phys. Rev. B <b>96</b> , 035130 (2017) & arXiv: cond-mat/1609.05450	
<b>Dynamics of locally coupled oscillators with next-nearest-neighbor interaction</b>	(15)
<u>J. HERBRYCH</u> , A. G. CHAZIRAKIS, N. CHRISTAKIS, AND J. J. P. VEERMAN	2017
Differ. Equ. & Dyn. Syst. <b>29</b> , 487 (2021) & arXiv: math/1506.07381	
<b>Density correlations and transport in models of many-body localization</b>	(14)
P. PRELOVŠEK, M. MIERZEJEWSKI, O. BARIŠIĆ, AND <u>J. HERBRYCH</u>	2017
Ann. Phys. (Berlin) <b>529</b> , 1600362 (2017) & arXiv: cond-mat/1611.03611	
<b>Interaction-induced weakening of localization in few-particle disordered Heisenberg chains</b>	(13)
D. SCHMIDTKE, R. STEINIGEWEG, <u>J. HERBRYCH</u> , AND J. GEMMER	2017
Phys. Rev. B <b>95</b> , 134201 (2017) & arXiv: cond-mat/1607.05664	
<b>Effective realization of random magnetic fields in compounds with large single-ion anisotropy</b>	(12)
<u>J. HERBRYCH</u> AND J. KOKALJ	2017
Phys. Rev. B <b>95</b> , 125129 (2017) & arXiv: cond-mat/1606.06013	
<b>Universal dynamics of density correlations at the transition to many-body localized state</b>	(11)
M. MIERZEJEWSKI, <u>J. HERBRYCH</u> , AND P. PRELOVŠEK	2016
Phys. Rev. B <b>94</b> , 224207 (2016) & arXiv: cond-mat/1607.04992	
<b>Typicality approach to the optical conductivity in thermal and many-body localized phases</b>	(10)
R. STEINIGEWEG, <u>J. HERBRYCH</u> , F. POLLMANN, AND W. BREINIG	2016
Phys. Rev. B <b>94</b> , 180401(R) (2016) & arXiv: cond-mat/1512.08519	
<b>Light induced magnetization in a spin <math>S = 1</math> easy-plane antiferromagnetic chain</b>	(9)
<u>J. HERBRYCH</u> AND X. ZOTOS	2016
Phys. Rev. B <b>93</b> , 134412 (2016) & arXiv: cond-mat/1505.03004	

<b>Heat conductivity of the Heisenberg spin-1/2 ladder: From weak to strong breaking of integrability</b>	(8)
R. STEINIGEWEG, <u>J. HERBRYCH</u> , X. ZOTOS, AND W. BRENIG	2016
Phys. Rev. Lett. <b>116</b> , 017202 (2016) & arXiv: cond-mat/1503.03871	
<b>Antiferromagnetic order in weakly coupled random spin chains</b>	(7)
J. KOKALJ, <u>J. HERBRYCH</u> , A. ZHELUDEV, AND P. PRELOVŠEK	2015
Phys. Rev. B <b>91</b> , 155147 (2015) & arXiv: cond-mat/1409.1757	
<b>Effective <math>S = 1/2</math> description of the <math>S = 1</math> chain with strong easy plane anisotropy</b>	(6)
C. PSAROUDAKI, <u>J. HERBRYCH</u> , J. KARADAMOGLU, P. PRELOVŠEK, X. ZOTOS, AND N. PAPANICOLAOU	2014
Phys. Rev. B <b>89</b> , 224418 (2014) & arXiv: cond-mat/1404.3064	
<b>Local spin relaxation within the random Heisenberg chain</b>	(5)
<u>J. HERBRYCH</u> , J. KOKALJ, AND P. PRELOVŠEK	2013
Phys. Rev. Lett. <b>111</b> , 147203 (2013) & arXiv: cond-mat/1307.0370	
<b>Eigenstate thermalization in isolated spin-chain systems</b>	(4)
R. STEINIGEWEG, <u>J. HERBRYCH</u> , AND P. PRELOVŠEK	2013
Phys. Rev. E <b>87</b> , 012118 (2013) & arXiv: cond-mat/1208.6143	
<b>Spin hydrodynamics in the <math>S = 1/2</math> anisotropic Heisenberg chain</b>	(3)
<u>J. HERBRYCH</u> , R. STEINIGEWEG, AND P. PRELOVŠEK	2012
Phys. Rev. B <b>86</b> , 115106 (2012) & arXiv: cond-mat/1206.4248	
<b>Coexistence of anomalous and normal diffusion in integrable Mott insulators</b>	(2)
R. STEINIGEWEG, <u>J. HERBRYCH</u> , P. PRELOVŠEK, AND M. MIERZEJEWSKI	2012
Phys. Rev. B <b>85</b> , 214409 (2012) & arXiv: cond-mat/1201.2844	
<b>Finite-temperature Drude weight within the anisotropic Heisenberg chain</b>	(1)
<u>J. HERBRYCH</u> , P. PRELOVŠEK, AND X. ZOTOS	2011
Phys. Rev. B <b>84</b> , 155125 (2011) & arXiv: cond-mat/1107.3027	