CV - Thomas BILITEWSKI

PERSONAL DATA

PLACE AND DATE OF BIRTH:	Hildesheim, Germany | 1^{st} October 1987
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UNIVERSITY POSITIONS

August 2022 Assistant Professor at OKLAHOMA STATE UNIVERSITY, STILLWATER

PROFESSIONAL EXPERIENCE

September 2019 - August 2022 Research Associate in Ana Maria Rey's group at JILA, UNIVERSITY OF COLORADO, BOULDER

NIST director's postdoctoral fellowship (2020)

During my postdoc at JILA I worked on projects closely connected to the experimental efforts in Jun Ye's cold atom and molecule groups. We explored the thermodynamics of quantum degenerate $SU(N)$ Fermi gases, uncovering how the N-fold enhancement results in significant interaction effects even in nominally weakly interacting systems, and disentangling the competing of effects of temperature and interactions on thermodynamic observables, allowing a precise characterisation of the system. In a separate direction we explored the novel capabilities of quantum degenerate dipolar molecules, confined to two dimensions where losses can be suppressed, and demonstrate how this regime enables precise quantum metrology of fields exploiting many-body entanglement in the form of spin squeezing. Furthermore, we studied the interplay of cooperative dipolar interactions and quantum statistics in the emission of optically excited atomic ensembles. We developed a theory description applicable in the deeply quantum degenerate regime where both dipolar interactions and Fermi statistics play a role in the dynamics, and predict Pauli enhanced life-times in agreement with state of the art experiments. Publications are listed below.

October 2016-2019 Postdoctoral researcher at the MAX PLANCK INSTITUTE FOR THE PHYSICS OF COMPLEX SYSTEMS working with director Roderich Moessner

My first project in my postdoc phase branched out from my previous expertise in cold-atomic gases into the field of frustrated magnetism.
Specifically, the project explores aspects of geometric frustration, disorder and glassiness in the paradigmatic classical Kagome Heisenberg Antiferromagnet. We discover a new type of spin-liquid, surprisingly stable to bond-disorder, and in fact only present due to disorder. Furthermore, the model displays intriguing connections to the physics of jamming and the physics of topological lattices.
Related to this model we also discovered disordered flat bands in a hopping model on the kagome lattice allowing to gap the quadratic band touching point, which provides new avenues to study interacting flat band and topological physics suppressing inter-band scattering.
I also had the opportunity to collaborate with an experimental group on a project concerning the observation and explanation of an inverted hysteresis in a pyrochlore compound.
Finally, using classical spin liquids as a platform we were able to study quantitatively the temperature dependence of the butterfly effect in a microscopic model, gaining insight into connections between microscopic chaos and macroscopic transport, and the relation between classical chaos and the (semi-) classical limit of quantum chaos. Publications are listed below.
During my time at the MPI I also had the opportunity to supervise a summer student, guiding a bachelor student through their first independent research project, who has now started a PhD in Felix von Oppen's group.

2013-2016 PhD student in the Theory of Condensed Matter Group (TCM) at the UNIVERSITY OF CAMBRIDGE (UK), TRINITY COLLEGE working with Nigel R. Cooper

During my PhD I worked on the role of interactions in periodically driven systems as relevant to the realisation of artificial gauge/magnetic fields in cold atoms experiments. I explored the novel aspects arising in these quantum many-body systems focusing on both time-dependent effects and collective many-body phases. Generically, these systems are expected to heat up, and I investigated how to obtain and control the heating rates in such systems and applied the results to a current experimental setup in agreement with the experimental data. Understanding and controlling/suppressing these heating rates is a requirement to simulate strongly-interacting topological phases using Floquet realisations. Publications are listed below.

Thesis Title: Interacting atoms in time-dependent potentials and artificial gauge fields

Supervisor: Prof. Nigel R. Cooper

2013 - 2016 — Supervisor for PEMBROKE COLLEGE AT UNIVERSITY OF CAMBRIDGE

Teaching small groups of students (2-3) reading for a degree in Natural Sciences (NST). Includes marking homework assignments and preparing termly supervision reports on the students' progress for their director of studies.

I'm currently taking part in the TEACHING ASSOCIATES' PROGRAMME, a program providing an introduction to teaching and learning in higher education, which after successful completion will lead to the recognition as an Associate Fellow of the Higher Education Academy.

OCTOBER 2012 - SEPTEMBER 2013 — Master-Thesis at the chair for Theoretical Nanophysics at LUDWIG-MAXIMILIANS-UNIVERSITY, MUNICH

In my master's project I investigated (exotic) superfluidity of mixtures of bosons and fermions in 2-dimensional optical lattices employing determinantal Quantum Monte-Carlo simulations. Specifically, I studied whether the bosons can induce (exotic) superconductivity in the fermionic sector.

As part of the project I developed the simulation program from scratch.

The main results have been published as "Exotic superconductivity through bosons in a dynamical cluster approximation" in Phys. Rev. B 92, 184505 (2015).
DOI: http://dx.doi.org/10.1103/PhysRevB.92.184505

Thesis Title: Superconductivity in two dimensional Bose-Fermi-Mixtures: A Dynamical-Cluster- Approximation Study

Supervisor: Prof. Lode Pollet

2011 - 2013 — Student Tutor at LUDWIG-MAXIMILIANS-UNIVERSITY, Munich

Teaching example classes for first year students in Physics to groups of 10-25 students, including marking homework assignments and exams.

MARCH 2011 - OCTOBER 2011 — Bachelor-Thesis at MAX-PLANCK-INSTITUTE FOR ASTROPHYSICS in Munich

In my Bachelor's thesis I worked on radial flows in models of Galactic chemical evolution.

During the project I developed a model of the coupling of galactic inflow/infall of matter onto the galactic disc and to radial flows within the disc and implemented this model in a simulation code. The simulation results allowed to clearly distinguish between different proposed models of matter aggregation in galaxies.

The results of my thesis have been published as "Radial flows and angular momentum conservation in Galactic chemical evolution" in Monthly Notices of the Royal Astronomical Society, 426, 2266 2282, 2012.
DOI: 10.1111/j.1365-2966.2012.21827.x

Supervisor: Ralph Schoenrich

EDUCATION

OCTOBER 2013-OCTOBER 2016	PhD Student at UNIVERSITY OF CAMBRIDGE (UK) TRINITY COLLEGE Supervisor: Prof. Nigel R. Cooper
OCTOBER 2015 - JUNE 2016	Teaching Associates' Programme Program providing an introduction to teaching and learning in higher education accredited by the Higher Education Academy (HEA). After successful completion I have become an Associate Fellow of the Higher Education Academy.
2011 -2013	Master of Science at LUDWIG-MAXIMILIANS-UNIVERSITY, Munich (Germany) Student in the Elite Graduate Program "Theoretical and Mathematical Physics (TMP)", part of the elite network of Bavaria. Final Grade : **1.0**
2008 - 2011	Bachelor of Science at LUDWIG-MAXIMILIANS-UNIVERSITY, Munich (Germany) Bachelor student in Physics Final Grade : **1.02**
MARCH-OCTOBER 2008	Junior-Studies at LEIBNIZ-UNIVERSITY, Hannover (Germany)
1998 - 2007	Abitur (A-level equivalent) **1.0** on a scale from 1 (best) to 6 (worst) Bischöfliches Gymnasium Josphinum, Hildesheim (Germany)
1994 - 1998	Primary school Bonifatius-School (Germany)

SCHOLARSHIPS AND HONOURS

2020	NIST director's postdoctoral fellowship
2013 - 2016	EPSRC Full Scholarship Full funding (tution fees and maintenance) plus travel funding for PhD studies
2010 - 2013	Scholarship of the "Max Weber-Programm" program for highly-gifted students at universities in Bavaria, includes a stipend and offers an advanced study program, both academic and interdisciplinary, language courses and soft-skill seminars. implemented by the German National Merit Foundation (Studienstiftung des deutschen Volkes)
2010 - 2013	Member of the Elite Network of Bavaria The Elite Network of Bavaria is an initiative to support young academic talents. I was supported due to being a student in an Elite Graduate Program and holding a scholarship by the Max Weber-Program of Bavaria.
JULY 2007	Abitur prize of the German physical Society (Deutsche Physikalische Gesellschaft) and Society of German Chemists (Gesellschaft Deutscher Chemiker)

Publications and Preprints

An up-to-date list of preprints and publications can be found at:

https://thomas-bilitewski.com/publications

or

http://www.arxiv.org/a/bilitewski_t_1.html

Preprints

May 2022 **Observation of unitary p-wave interactions between fermions in an optical lattice**
Vijin Venu, Peihang Xu, Mikhail Mamaev, Frank Corapi, Thomas Bilitewski, Jose P. D'Incao, Cora J. Fujiwara, Ana Maria Rey, Joseph H. Thywissen
arXiv:2205.13506
url: https://arxiv.org/abs/2205.13506

Aug 2022 **Long-lived Solitons and Their Signatures in the Classical Heisenberg Chain**
Adam J. McRoberts, Thomas Bilitewski, Masudul Haque, Roderich Moessner
arXiv:2207.08866
url: https://arxiv.org/abs/2207.08866

Peer-reviewed Publications

Aug 2022 **Resonant dynamics of strongly interacting SU(n) fermionic atoms in a synthetic flux ladder**
Mikhail Mamaev, Thomas Bilitewski, Bhuvanesh Sundar, Ana Maria Rey
PRX Quantum 3, 030328
url: https://doi.org/10.1103/PRXQuantum.3.030328

Mar 2022 **Reactions Between Layer-Resolved Molecules Mediated by Dipolar Exchange**
William G. Tobias, Kyle Matsuda, Jun-Ru Li, Calder Miller, Annette N. Carroll, Thomas Bilitewski, Ana Maria Rey, Jun Ye
Science Vol 375, Issue 6586 (2022)
url: https://doi.org/10.1126/science.abn8525

Mar 2022 **Anomalous Dynamics and Equilibration in the Classical Heisenberg Chain**
Adam J. McRoberts, Thomas Bilitewski, Masudul Haque, Roderich Moessner
Phys. Rev. B 105 L100403 (2022)
url: https://doi.org/10.1103/PhysRevB.105.L100403

Mar 2022 **Disentangling Pauli blocking of atomic decay from cooperative radiation and atomic motion in a 2D Fermi gas**
Thomas Bilitewski, Asier Piñeiro Orioli, Christian Sanner, Lindsay Sonderhouse, Ross B. Hutson, Lingfeng Yan, William R. Milner, Jun Ye, Ana Maria Rey
Phys. Rev. Lett. 128 093001 (2022)
url: https://doi.org/10.1103/PhysRevLett.128.093001

Sep 2021 **Collective P-Wave Orbital Dynamics of Ultracold Fermions**
Mikhail Mamaev, Peiru He, Thomas Bilitewski, Vijin Venu, Joseph H. Thywissen, Ana Maria Rey
Phys. Rev. Lett. 127, 143401
url: https://doi.org/10.1103/PhysRevLett.127.143401

May 2021 **Classical many-body chaos with and without quasiparticles**
Thomas Bilitewski, Subhro Bhattacharjee, Roderich Moessner
Phys. Rev. B, 103, 174302
url: https://doi.org/10.1103/PhysRevB.103.174302

March 2021 **Dynamical generation of spin squeezing in ultra-cold dipolar molecules**
Thomas Bilitewski, Luigi De Marco, Jun-Ru Li, Kyle Matsuda, William G. Tobias, Giacomo Valtolina, Jun Ye, Ana Maria Rey
Phys. Rev. Lett. 126, 113401
url: https://doi.org/10.1103/PhysRevLett.126.113401

JANUARY 2021 **Butterfly Effect and Spatial Structure of Information Spreading in a Chaotic Cellular Automaton**
Shuwei Liu, J. Willsher, T. Bilitewski, Jinjie Li, A. Smith, K. Christensen, R. Moessner, J. Knolle
Phys. Rev. B 103, 094109
url: https://doi.org/10.1103/PhysRevB.103.094109

AUGUST 2020 **Thermodynamics of a deeply degenerate SU(N)-symmetric Fermi gas**
Lindsay Sonderhouse, Christian Sanner, Ross B. Hutson, Akihisa Goban, Thomas Bilitewski, Lingfeng Yan, William R. Milner, Ana Maria Rey, Jun Ye
Nature Physics 16, pages 1216–1221 (2020)
doi: 10.1038/s41567-020-0986-6

AUGUST 2020 **Exploring chemical reactions in a quantum degenerate gas of polar molecules via complex formation**
Peiru He, Thomas Bilitewski, Chris H. Greene, and Ana Maria Rey
Phys. Rev. A 102, 063322 (2020)
doi: 10.1103/PhysRevA.102.063322

FEBRUARY 2019 **Dynamics and energy landscape of the jammed spin-liquid**
Thomas Bilitewski, Mike E. Zhitomirsky, Roderich Moessner
Phys. Rev. B 99, 054416 (2019)
doi: 10.1103/PhysRevB.99.054416

DECEMBER 2018 **Disordered flat bands on the kagome lattice**
Thomas Bilitewski, Roderich Moessner
Phys. Rev. B 98, 235109 (2018): Editors' suggestion
doi: 10.1103/PhysRevB.98.235109

AUGUST 2018 **Temperature dependence of butterfly effect in a classical many-body system**
Thomas Bilitewski, Subhro Bhattacharjee, Roderich Moessner
Phys. Rev. Lett. 121, 250602 (2018)
doi: 10.1103/PhysRevLett.121.250602

FEBRUARY 2018 **Inverted hysteresis and negative remanence in a homogeneous antiferromagnet**
L. Opherden, T. Bilitewski, J. Hornung, T. Herrmannsdörfer, A. Samartzis, A. T. M. N. Islam, V. K. Anand, B. Lake, R. Moessner, J. Wosnitza
Phys. Rev. B 98, 180403(R)
doi: 10.1103/PhysRevB.98.180403

DECEMBER 2017 **Jammed spin liquid in the bond-disordered kagome Heisenberg antiferromagnet**
Bilitewski, T. and Zhitomirsky, Mike E. and Moessner, R. (2017)
Phys. Rev. Lett. 119, 24720
doi: 10.1103/PhysRevLett.119.247201

AUGUST 2016 **Synthetic dimensions in the strong-coupling limit: supersolids and pair-superfluids**
Bilitewski, T. and Cooper, N.R. (2016)
Phys. Rev. A 94, 023630
doi: 10.1103/PhysRevA.94.023630

NOVEMBER 2015 **Exotic Superconductivity Through Bosons in a Dynamical Cluster Approximation**
Bilitewski, T. and Pollet, L. (2015)
Phys. Rev. B 92, 184505
doi: 10.1103/PhysRevB.92.184505

JUNE 2015 **Population dynamics in a Floquet realization of the Harper-Hofstadter Hamiltonian**
Bilitewski, T. and Cooper, N.R. (2015)
Phys. Rev. A 91, 063611
doi: 10.1103/PhysRevA.91.063611

MARCH 2015 **Scattering theory for Floquet-Bloch states**
Bilitewski, T. and Cooper, N.R. (2015)
Phys. Rev. A 91, 033601
doi: 10.1103/PhysRevA.91.033601

OCTOBER 2012 **Radial flows and angular momentum conservation in Galactic chemical evolution**

Bilitewski, T. and Schönrich, R. (2012)
Monthly Notices of the Royal Astronomical Society, 426: 2266–2282.
doi: 10.1111/j.1365-2966.2012.21827.x