



- Quantum many-body systems (spectral gaps, Lieb-Robinson bounds)
- Random matrices (universal eigenvalue statistics for dynamically defined ensembles)
- Quantitative homogenization theory (Green's function estimates and the Bourgain-Spencer conjecture)
- Matrix analysis (multivariate trace inequalities, quantum entropy)
- Spectral theory of ergodic Schrödinger operators

#### RESEARCH GRANTS

- ERC Starting Grant in mathematics *MathQuantProp: The Mathematics of Quantum Propagation*, funded by European Research Council, 1.48M EUR, 2025–2029
- AIM SQuaRE collaboration (with B. Nachtergaele, S. Warzel, and A. Young), funded by American Institute of Mathematics, Pasadena, 2024–2026
- collaborative research center SFB TRR 352 *Mathematics of many-body quantum systems and their collective phenomena*, funded by DFG (German Research Foundation), co-PI for two projects (with S. Warzel), 570.8K EUR, 2023–2027
- Collaboration grants with Harvard University, funded through German excellence initiative, 2023–2024, 51.8K EUR
  - *Universal statistics of dynamically generated matrices* (with H.-T. Yau)
  - *Use of correlation decay and complexity theory for quantum Gibbs states* (with A. Anshu, A. Alhambra, A. Capel Cuevas)
- AMS Simons Travel Grant, 5K USD, 2020–2022

#### PRIZES AND SCHOLARSHIPS

- Scott Russell Johnson prize of the Caltech Mathematics Department
  - dissertation prize, 2017
  - for excellence in graduate research, 2014, 2015, 2016
  - for excellence in first-year graduate studies, 2013
- Bateman Scholar of Trinity Hall, University of Cambridge, 2011 for performance in Part III
- Scholarship of the German National Exchange Program (DAAD), 2010-2011 to fund master study at the University of Cambridge
- Fellow of the Max Weber Program of the State of Bavaria, 2009-2012
- Fellow of Studienwerk Villigst, 2008-2012
- Fellow of Studienstiftung (German National Academic Foundation), 2008-2012

#### TEACHING AWARDS

- Harvard Certificate of Excellence in Teaching, awarded by the Derek Bok Center for Teaching at Harvard University, fall 2018, spring 2019 and fall 2019
- Associated students at Caltech (ASCIT) teaching award, 2015  
1 of 4 selected by the Caltech undergrad student body across all departments
- Scott Russell Johnson prize for excellence in graduate teaching, 2014 from the Caltech math department
- Outstanding TA award, 2014  
1 of 3 selected by the Caltech registrar's office across all departments

- [52] M. Lemm, B. Nachtergaele, S. Warzel, and A. Young, *The charge gap is greater than the neutral gap in fractional quantum Hall systems*, [arXiv:2410.11645]
- [51] M. Lemm and A. Lucia, *On the critical finite-size gap scaling for frustration-free Hamiltonians*, [arXiv:2409.09685]
- [50] M. Duerinckx, M. Lemm, and F. Pagano, *On Bourgain’s approach to stochastic homogenization*, [arXiv:2406.09909]
- [49] T. Kuwahara and M. Lemm, *Enhanced Lieb-Robinson bounds for a class of Bose-Hubbard type Hamiltonians*, [arXiv:2405.04672]
- [48] M. Lemm and S. Rademacher, *Out-of-time-ordered correlators of mean-field bosons via Bogoliubov theory*, [arXiv:2312.01736]
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- [45] J. González-Carvajal, M. Lemm, and J. Garcia-Suarez, *On the lowest-frequency bandgap of 1D phononic crystals*, [arXiv:2310.05662]
- [44] M. Lemm, C. Rubiliani, I.M. Sigal, J. Zhang, *Information propagation in long-range quantum many-body systems*, Phys. Rev. A **108** (2023), L060401 [arXiv:2303.06506] [Article]
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- [42] P. Hayden, M. Lemm and J. Sorce, *Reflected entropy: Not a correlation measure*, Phys. Rev. A **107** (2023), L050401 [arXiv:2302.10208] [Article]
- [41] M. Lemm and O. Siebert, *Thermal Area Law for lattice bosons*, Quantum **7** (2023), 1083, [arXiv:2207.07760] [Article]
- [40] S. Breteaux, J. Faupin, M. Lemm, and I.M. Sigal, *Maximal Speed of Propagation in Open Quantum Systems*, In: The Physics and Mathematics of Elliott Lieb, The 90th Anniversary Volume I, Rupert L. Frank et al. (eds.), 109–130, EMS Press, Berlin, 2022 [arXiv:2207.08991] [Article]
- [39] R. Andrei, M. Lemm, and R. Movassagh, *The spin-1 Motzkin chain is gapped for any area weight  $t < 1$* , [arXiv:2204.04517]
- [38] M. Lemm and O. Siebert, *Bose-Einstein condensation on hyperbolic spaces*, J. Math. Phys. **63** (2022), 081903 [arXiv:2202.01538] [Article]
- [37] A. Adhikari and M. Lemm, *Universal Eigenvalue Statistics for Dynamically Defined Matrices*, to appear in J. d’Analyse Math [arXiv:2201.00851] [Article]
- [36] M. Lemm and D. Xiang, *Quantitatively improved finite-size criteria for spectral gaps*, J. Phys. A, **55** (2022), 295203 [arXiv:2112.07756] [Article]
- [35] I. Jauslin and M. Lemm, *Random translation-invariant Hamiltonians and their spectral gaps*, Quantum **6** (2022), 790 [arXiv:2111.06433] [Article]
- [34] J. Faupin, M. Lemm, and I.M. Sigal, *Maximal speed for macroscopic particle transport in the Bose-Hubbard model*, Phys. Rev. Lett. **128** (2022), 150602 [arXiv:2110.04313] [Article]
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- [31] M. Keller and M. Lemm, *Optimal Hardy weights for the Euclidean lattice*, Trans. Amer. Math. Soc. **376** (2023), 6033-6062 [arXiv:2103.17019] [Article]
- [30] A. Adhikari and M. Lemm, *Local Law for Singular Values of Oscillatory Matrices*, Int. Math. Res. Not. **2023** (2023), no. 5, 3907-3947 [arXiv:2005.04102] [Article]
- [29] M. Lemm and D. Sutter, *Quantitative lower bounds on the Lyapunov exponent from multivariate matrix inequalities*, Anal. Math. Phys. **12** (2022), 35 [arXiv:2001.09115] [Article]
- [28] M. Lemm, A.W. Sandvik, and L. Wang, *Existence of a Spectral Gap in the Affleck-Kennedy-Lieb-Tasaki Model on the Hexagonal Lattice*, Phys. Rev. Lett. **124** (2020), 177204 [arXiv:1910.11810] [Article]
- [27] P.M. Kielstra and M. Lemm, *On the finite-size Lyapunov exponent for the Schrödinger operator with skew-shift potential*, Comm. Math. Sci. **18** (2020), no. 5, 1305–1314 [arXiv:1904.08871] [arXiv:1904.01043] [Article]
- [26] M. Lemm, A.W. Sandvik, and S. Yang, *The AKLT model on a hexagonal chain is gapped*, J. Stat. Phys. **177** (2019), no. 6, 1077–1088 [arXiv:1904.01043] [Article]
- [25] A. Adhikari, M. Lemm, and H.-T. Yau, *Global eigenvalue distribution of matrices defined by the skew-shift*, Anal. PDE **14** (2021), no. 4, 1153–1198 [arXiv:1903.11514] [Article]
- [24] M. de Courcy-Ireland and M. Lemm, *A central limit theorem for integrals of random waves*, J. Reine Angew. Math. (Crelle) **785** (2022), 1–30 [arXiv:1903.06558] [Article]
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- [22] M. Lemm and B. Nachtergaele, *Gapped PVBS models for all species numbers and dimensions*, Rev. Math. Phys. **31** (2019), no. 9, 1950028 [arXiv:1902.09678] [Article]
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- [20] M. Lemm, *Finite-size criteria for spectral gaps in  $D$ -dimensional quantum spin systems*, Contemp. Math. **741**, 121-132, Amer. Math. Soc., Providence, RI 2020 [arXiv:1902.07141] [Article]
- [19] M. Duerinckx, A. Gloria, and M. Lemm, *A remark on a surprising result by Bourgain in homogenization*, Comm. Part. Diff. Eq. **44** (2019), no. 12, 1345–1357 [arXiv:1903.05247] [Article]
- [18] R. Han, M. Lemm, and W. Schlag, *Weyl sums and the Lyapunov exponent for the skew-shift Schrödinger cocycle*, J. Spectr. Theory **10** (2020), no. 4, 1139–1172 [arXiv:1807.00233] [Article]
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- [16] R. Han, M. Lemm, and W. Schlag, *Effective multi-scale approach to the Schrödinger cocycle over a skew shift base*, Ergod. Theory Dyn. Syst. **40** (2020), no. 10, 2788–2853 [arXiv:1803.02034] [Article]

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- [3] D. Damanik, M. Lemm, M. Lukic, and W. Yessen, *New Anomalous Lieb-Robinson Bounds in Quasi-Periodic XY Chains*, Phys. Rev. Lett. **113** (2014), 127202 [arXiv:1408.1796] [Article]
- [2] D. Damanik, M. Lemm, M. Lukic, and W. Yessen, *On Anomalous Lieb-Robinson Bounds for the Fibonacci XY Chain*, J. Spectr. Theory **6** (2016), no. 3, 601–628 [arXiv:1407.4924] [Article]
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**Conference talks**

Many-body quantum systems and their collective phenomena, conference retreat of SFB TRR 352, Garmisch, Germany, October 2024

Solid Math 2024, conference at University of Tübingen, Germany, August 2024

Operator Theory and Approximation, plenary talk, conference at TU Vienna, Austria, July 2024

XXIst International Congress of Mathematical Physics, session on many-body quantum systems & condensed matter physics, Strasbourg, France, July 2024

Advances in PDEs in Physics and Materials Science, University of Crete, Heraklion, Greece, May 2024

Frontiers in Analysis and Mathematical Physics, conference in Seoul, South Korea, April 2024

Long-range Interacting Quantum Spin Systems Out of Equilibrium, invited guest talk at conference retreat of DFG research unit FOR 5413, Heiligkreuztal, Germany, February 2024

Many-body quantum systems and their collective phenomena, kick-off conference for SFB TRR 352, Garmisch, Germany, October 2023

Annual Meeting of German Mathematical Society, Minisymposium Complex Quantum Systems, Ilmenau, Germany, September 2023

Oberwolfach workshop many-body quantum systems, Oberwolfach, Germany, September 2023

Machine learning meets physics, workshop at University of Tübingen, Germany, February 2023

QMATH 15 Mathematical Results in Quantum Theory, conference at UC Davis, USA, September 2022

Mathematical results of many-body quantum systems, conference in Herrsching, Germany, June 2022

BIRS Workshop on Probability and Quantum Information Science, Banff, Canada, March 2022

XXth International Congress on Mathematical Physics, session on many-body quantum systems and condensed matter physics, Geneva, Switzerland, August 2021

8th European Congress of Mathematics, Minisymposium Harmonic Analysis and PDE, Portorož, Slovenia, June 2021

Fall Eastern Sectional Meeting of the AMS, Binghamton University, USA, October 2019

Mathematical Physics at the Crossings: Celebrating the 65th Birthday of George Hagedorn, conference at Virginia Tech in Blacksburg, USA, May 2019

11th IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena, at the University of Georgia in Athens, USA, April 2019

Spectral Methods in Mathematical Physics, program kick-off conference at Mittag-Leffler Institute in Stockholm, Sweden, January 2019

Many-Body Quantum Mechanics, workshop at CRM in Montréal, Canada, September 2018

Arizona School of Analysis and Mathematical Physics, Tucson, USA, March 2018  
Joint Mathematics Meetings (two invited session talks), San Diego, USA, January 2018  
Current Topics in Mathematical Physics, conference at University of Zürich, Switzerland, July 2017  
35th Annual Western States Mathematical Physics Meeting, Caltech, USA, February 2017  
QMATH13 Mathematical Results in Quantum Theory, conference at Georgia Tech, USA, October 2016  
Young Researcher Symposium on the occasion of the 70th birthday of Barry Simon, Fields Institute, Toronto, Canada, August 2016  
Great Lakes Mathematical Physics Meeting, Michigan State University, USA, June 2016  
Fall Western Sectional Meeting of the AMS, California State University, Fullerton, USA, October 2015  
XVIIIth International Congress on Mathematical Physics, Young Researchers Symposium, Santiago, Chile, July 2015  
33rd Annual Western States Mathematical Physics Meeting, Caltech, USA, February 2015

### **Seminar talks**

Princeton University, Mathematical Physics Seminar, March 2024  
Quantum Lattice Seminar, November 2023  
Harvard University, CMSA Probability Seminar, September 2023  
IAMP One World Mathematical Physics Seminar, June 2023  
University of Geneva, Analysis Seminar, June 2023  
TU Munich, Oberseminar Analysis & Zufall, June 2023  
University of Stuttgart, Analysis Seminar, May 2023  
University of Wrocław, Harmonic Analysis Seminar, April 2023  
Rice University, Spectral Theory Seminar, October 2022  
Keio University, Yagami Statistical Physics Seminar, November 2021  
University of Bonn, Analysis Seminar, October 2021  
University of Leipzig, Functional Analysis and Dynamical Systems Seminar, April 2021  
University of Toronto, Analysis & Applied Mathematics Seminar, April 2021  
University of Warsaw, Mathematical Physics Seminar, January 2021  
UBC Vancouver, Mathematical Physics, Differential Geometry, and PDE Seminar, November 2020  
Imperial College London, Stochastic Analysis Seminar, October 2020  
Harvard University, Condensed Matter Seminar, April 2020  
Georgia Tech, Mathematical Physics Seminar, April 2020

Princeton University, Mathematical Physics Seminar, March 2020  
University of Tübingen, Mathematisches Fachkolloquium, February 2020  
University of Amsterdam, Mathematical Quantum Physics Talks, February 2020  
IST Austria, Physical Sciences Seminar, January 2020  
EPFL, Mathematics Colloquium, January 2020  
Michigan State University, Mathematical Physics and Operator Algebras Seminar, November 2019  
Perimeter Institute, Quantum Information Seminar, November 2019  
Brandeis University, Dynamics and Number Theory Seminar, October 2019  
Yale University, Analysis Seminar, March 2019  
MIT, Probability Seminar, February 2019  
Institut Mittag-Leffler, Workshop Seminar, January 2019  
Binghamton University, Analysis Seminar, April 2018  
Cornell University, Analysis Seminar, April 2018  
Columbia University, Analysis and Geometry Seminar, March 2018  
Institute for Advanced Study, Princeton, Analysis Seminar, December 2017  
Michigan State University, Mathematical Physics and Gauge Theory Seminar, November 2017  
Virginia Tech, Analysis Seminar, October 2017  
Institute for Advanced Study, Princeton, Postdoctoral Talks, October 2017  
LMU Munich, Mathematical Physics Seminar, July 2017  
UCLA, Analysis and PDE seminar, January 2017  
UC Davis, Mathematical Physics Seminar, January 2017  
UCLA/Caltech, Joint Analysis Seminar, April 2016  
Caltech, Mathematical Physics Seminar, February 2016  
University of Tübingen, Mathematical Physics Seminar, September 2015  
UCLA/Caltech, Joint Analysis Seminar, May 2015  
UC Irvine, Mathematical Physics Seminar, January 2015

### **Colloquium talks**

University of Potsdam, Institute Colloquium, November 2024  
Karlsruhe Institute of Technology, SFB colloquium, October 2024  
University of Tübingen, Mathematisches Kolloquium, July 2021  
ETH Zurich and University of Zurich, The Zurich Theoretical Physics Colloquium, October 2020  
Harvard University, Open Neighborhood Seminar, October 2019  
Harvard University, Snapshots of Math, April 2019  
Institute for Advanced Study, Mathematical Conversations, October 2017

## Talks for non-scientists

Science Club Schönaich, talk for town community, March 2025

University of Tübingen, Studieninformationstag, talk for high school students, November 2023

University of Tübingen, Tag der Mathematik, talk for middle school students, March 2023

## EXTENDED RESEARCH STAYS

AIM SQuaRE collaboration (1 week), AIM, Pasadena, USA, March 2023

Workshop *Many-body quantum systems* (1 week), at MFO, Germany, September 2023

Research visit at Harvard University (3 weeks), USA, August–September 2023

Semester program *Spectral Methods in Mathematical Physics* (2 weeks) at Mittag-Leffler Institute in Stockholm, Sweden, winter 2019

Research visit with Prof. Elliott H. Lieb at Princeton University (two months), USA, April–May 2017

Workshop *Many-body quantum systems and effective theories* (1 week), at MFO, Germany, September 2016

Trimester program *Variational and Spectral Methods in Quantum Mechanics* at IHP in Paris (2 weeks), France, June 2013

## POSTDOCS

Sabiha Tokus, University of Tübingen, 2022-2024

Oliver Siebert, EPFL and University of Tübingen, 2021-2024

## PH.D. STUDENTS

Carla Rubiliani, University of Tübingen, 2023-

## TEACHING EXPERIENCE

### **Instructor at University of Tübingen** (on semester system)

*Analysis 2*, winter term 2024/2025

*Mathematical Statistical Physics*, summer term 2024

*Mathematical Quantum Theory*, winter terms 2021/2022, 2022/2023, 2023/2024

*Advanced Topics in Mathematical Quantum Theory*, summer terms 2022 and 2023

### **Instructor at EPFL** (on semester system)

*Mathematical Quantum Theory*, summer term 2021

### **Instructor at Harvard University** (on semester system)

Ma 274Y *Spectral Theory and Quantum Spin Systems*, spring term 2020

Ma 266Y *Topics in Analysis: Matrix inequalities and quantum entropy*, spring term 2019

Ma 116 *Real Analysis, Convexity, and Optimization*, fall terms 2018 and 2019

Ma 1b *Calculus, Series and Differential Equations*, fall term 2018

**Teaching assistant at Caltech** (on quarter system, <sup>†</sup> denotes head TA)

ACM 95/100 *Introductory Methods of Applied Mathematics*, winter term 2017

Ma 3 *Probability and Statistics*, winter terms 2014<sup>†</sup> and 2015<sup>†</sup>

Ma 2a *Ordinary Differential Equations*, fall terms 2013, 2014<sup>†</sup> and 2016<sup>†</sup>

Ma 1c *Calculus of Several Variables*, spring term 2014<sup>†</sup>

**Teaching assistant at LMU Munich** (on semester system)

*Probability Theory*, summer term 2012

*Partial Differential Equations*, winter term 2011/2012

*Complex Analysis*, summer terms 2010 and 2012

*Mathematics for Physicists 3*, winter term 2009/2010

STUDENT  
PROJECTS AND  
THESES

**At University of Tübingen**

Gandeeb Bhattarai, M.Sc. thesis on free probability theory, 2024

Jonte Weixler, M.Sc. thesis on Anderson localization, 2024

Julian Nill, M.Sc. thesis on spectral gaps in quantum spin systems, 2024

Carla Rubiliani, M.Sc. thesis on bosonic propagation bounds, resulted in publication [44], 2023

Alexis Marissaël, undergraduate summer project on Loewner's theorem, 2023

**At EPFL**

Benjamin Nicolas-Noir, M.Sc. thesis on Weyl's law, 2021

Thilbault Juillard, M.Sc. thesis on symplectic geometry and semiclassical analysis, 2021

Eric Ströher, B.Sc. thesis on Lieb-Thirring inequalities, 2021

Théo Fradin, undergraduate summer project on multivariate trace inequalities, 2021

**At Harvard University**

Radu Andrei, undergraduate research project on spectral gaps in Motzkin spin chains, resulted in publication [39], 2020–date

David Xiang, undergraduate research project on finite-size criteria for quantum spin systems, funding from the Harvard HCRP fellowship, resulted in publication [36], 2020-2021

Garrett Brown, undergraduate summer project on quantum tunneling in the semiclassical limit, funding from Harvard PRISE fellowship, 2020

Sofia Dubova, graduate reading course on mathematics of machine learning, spring term 2020

Daniel S. Eniceicu, undergraduate research project on spectral gaps in random quantum spin systems, 2019

Paul Michael Kielstra, undergraduate research project on Lyapunov exponents of cocycles, resulted in publication [27], 2018–2019

## SERVICE ACTIVITIES

### Conference organization

MFO mini-workshop *New Directions in Correlated Quantum Systems* (with E. Giacomelli and J. Lee), Oberwolfach, February 2025

*Locality and complexity in quantum thermal equilibrium* workshop at Harvard University (with A. Alhambra, A. Anshu, and A. Capel Cuevas), August 2023

*Beyond IID in Information Theory, part 11* conference at University of Tübingen (over 100 participants; with A. Capel Cuevas, P. Gondolf, and S. Teufel), August 2023

### Seminar organization

University of Tübingen Oberseminar Quantum Discussions (with A. Capel Cuevas), 2024–date

University of Tübingen Oberseminar Mathematical Physics (with A. Capel Cuevas, S. Keppeler, P. Pickl, S. Teufel, and R. Tumulka), 2021–date

EPFL Analysis Seminar (with B. Buffoni, M. Colombo, and J. Krieger), 2020–2021

Harvard University Random Matrix Theory and Probability Theory Seminar (with A. Jagannath and C. Brennecke), 2018–2020

Institute for Advanced Study Analysis Discussion Group (with W. Schlag), 2017–2018

### Departmental service

Member of the examination committee (Prüfungsausschuss) of the B.Sc. Mathematics, University of Tübingen, 2023–2026

Member of the examination committee (Prüfungsausschuss) of the International Master Program in Mathematical Physics, University of Tübingen, 2023–2026

Member of the examination committee (Prüfungsausschuss) of the M.Sc. Mathematics, University of Tübingen, 2023–2027

Main coordinator and academic counsellor of the International Master Program in Mathematical Physics, University of Tübingen, 2022–date

Deputy member of the examination committees (Prüfungsausschuss) for mathematics teachers, University of Tübingen, 2022–2026

Member of the committee for graduate qualification exams, Harvard University, 2018–2020

## Thesis and hiring committees

Member of hiring committee for W3 professorship in probability, University of Tübingen, 2024

Head of Ph.D. thesis committee of Manuela Feistl (advisor P. Pickl), University of Tübingen, 2024

Member of Ph.D. thesis committee of Marcel Maier (advisor C. Hainzl), LMU Munich, 2022

Member of hiring committee for W1 professorship in mathematical quantum theory, University of Tübingen, 2021

Member of Ph.D. thesis committee of Gaspard Ohlmann (advisor J. Krieger), EPFL, 2021

Member of Ph.D. thesis committee of Patrick Lopatto (advisor H.-T. Yau), Harvard University, 2020

## Board memberships

Member of the Curatorium of the TL foundation (granting scholarships to students and young researchers), 2024-2027

Member of the main selection committee (Hauptauswahl) for student scholarships of Studienwerk Villigst, 2012

## Referee service

Referee service for Advances in Theoretical and Mathematical Physics; Analysis & PDE; Calculus of Variations & PDE; Annales Henri Poincaré; Communications in Mathematical Physics; Communications on Pure and Applied Analysis; IEEE Transactions on Information Theory; Inventiones Mathematicae; Journal de Mathématiques Pures et Appliquées; Journal für die reine und angewandte Mathematik (Crelle); Journal of the AMS; Journal of Functional Analysis; Journal of Mathematical Physics; Journal of Physics Communications; Journal of Physics A: Mathematical and Theoretical; Journal of Spectral Theory; Letters in Mathematical Physics; Mathematical Physics, Analysis and Geometry; Nature Communications; Nature Physics; New Journal of Physics; Nonlinear Analysis; Nonlinearity; Physical Review A; Physical Review B; Physical Review E; Physical Review Letters; Physical Review X; Physical Review X Quantum; Physica Scripta; Proceedings of the National Academy of Sciences; Quantum; Reviews in Mathematical Physics; Transactions of the AMS

Referee for conferences Quantum Information Processing (QIP) and Theory of Quantum Computation, Communication and Cryptography (TQC)

IOP Trusted Reviewer

Reviewer for Mathematical Reviews; Zentralblatt MATH

MEMBERSHIP IN  
PROFESSIONAL  
ORGANIZATIONS

Deutsche Physikalische Gesellschaft (DPG)

International Association of Mathematical Physics (IAMP)

LANGUAGES

German, English, French