



TRR 352

in motion

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Issue 3

Welcome to the third issue of the TRR 352 Newsletter!



We're back with another round of news from our research community! In this issue, we highlight updates on awarded PhDs, international experiences, and the latest career advancements of our junior researchers. This time, we've also added reports on recent events. Get inspired by the diverse paths and accomplishments of our team.

Enjoy reading!

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TRR 352: Mathematics of Many-Body Quantum Systems and Their Collective Phenomena



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Recent Doctorates

Siegfried Spruck successfully completed his PhD defense at the University of Tübingen on July 1, 2025

In his thesis "Derivation of the Effective Dynamics for the Bose Polaron", Siegfried derives an effective description for a dense gas of bosons interacting with a single impurity, starting from the full microscopic quantum dynamics. In such a system most bosons initially occupy the same state, forming a Bose-Einstein condensate, with only a few excitations. He shows that, in the mean-field regime, the system is well described by the Bogoliubov-Fröhlich Hamiltonian—a model for polarons that couples the impurity linearly to the field of excitations.

Congratulations!



Jonas Lampart, Siegfried Spruck, and Peter Pickl

On September 23, 2025, Leon Bollmann successfully defended his PhD thesis at LMU Munich



Leon Bollmann

In his thesis, titled "Szegő-type asymptotics for the free Dirac operator", Leon proves several scaling laws for the entanglement entropy of a free relativistic Fermi gas by studying Szegő-type asymptotics for the free Dirac operator.

In the first part of the thesis, he extends the Widom–Sobolev formula (which yields a logarithmically enhanced area law for symbols which are discontinuous in both position and momentum space) from scalar to matrix-valued symbols.

In the second part, this extended Widom–Sobolev formula is applied to the free Dirac operator in order to obtain enhanced area laws in several cases, depending on the constellation of mass and Fermi energy of the Fermi gas. In the remaining cases only an area law holds. Both of these parts are based on joint work with Peter Müller.

The last part of the thesis concerns the special case where both mass and Fermi energy vanish in higher dimensions. Here, an enhanced term of logarithmic order is obtained as a lower-order term in the asymptotic expansion.

Congratulations!

Paul Gondolf successfully defended his PhD thesis on October 7, 2025, at the University of Tübingen

In his thesis, titled “*Functional Inequalities in Open and Closed Quantum Systems: Continuity, Correlations and Applications*”, Paul explores several mathematical aspects of quantum systems, drawing connections between quantum information theory, many-body physics, functional analysis, and semigroup theory.

A central part of his work focuses on “*Energy-Preserving Evolutions over Bosonic Systems*”, which was motivated by recent experimental realizations of bosonic cat codes — hardware implementations of partially self-correcting qubits. Building on and extending earlier work by Davies, Paul, together with his coauthors Tim Möbus and Cambyse Rouzé, develops a general framework for unbounded quantum dynamical semigroups that relaxes previous restrictions and applies to a wide range of systems relying on a natural moment-preservation condition.



Angela Capel and Paul Gondolf

This result unifies the treatment of Gaussian semigroups, such as the quantum Ornstein–Uhlenbeck process, and non-Gaussian systems like multimode cat gates, and provides new insights into perturbation bounds beyond standard generation theory. The thesis concludes with an outlook on how this framework can be used to study more complex dynamical behaviors in open quantum systems.

Congratulations!

International Stays

Between Cherry Blossoms and Quantum Bounds: A Research Stay at RIKEN – By Carla Rubiliani

From the beautiful cherry blossoms of April to the hot and humid days of August, I had the opportunity to visit Tomotaka Kuwahara and his active research group at RIKEN, Japan.



Carla Rubiliani at the picnic

During my stay, I collaborated with Tomotaka and Shang Cheng on understanding locality in many-body bosonic lattice systems. In particular, we worked on combining the long-range particle propagation bounds that I developed in Tübingen with Marius Lemm and Jingxuan Zhang, with the short-range approach developed by Tomotaka and collaborators, to derive long-range bosonic Lieb-Robinson bounds. I also took part in the group's weekly meetings,

where we discussed a wide range of topics, including entanglement area laws, DMRG algorithms, and fluctuating hydrodynamics.

While in Japan, I also had the chance to visit Tadahiro Miyao in Sapporo, Tan Van Vu in Kyoto, and Sung-Soo Byun in Seoul. In addition, I enjoyed a conference and survived my first typhoon on the tropical Chinese island of Hainan.

Outside of research, I truly enjoyed my time in Japan. In the first month, I had the chance to admire Mount Fuji framed by cherry blossoms, visit ancient shrines and temples, and dive into Japanese culture. Later on, I became friends with researchers from the bioinformatics group at RIKEN, and together we went hiking, climbing, and watched spectacular fireworks during the warm Japanese summer.

Overall, I am very happy about my stay at RIKEN and look forward to visiting again in the future!



Carla Rubiliani and friends from the bioinformatics group at RIKEN

New Career Moves

Back to the SFB TRR 352: From Tübingen via Milan to Munich – By Cornelia Vogel

After having written my PhD thesis “Typical Macroscopic Behavior of Large Quantum Systems” at the University of Tübingen under the supervision of Stefan Teufel and Roderich Tumulka, I started a postdoc in the group of Niels Benedikter at the University of Milan in January 2025. During my PhD I worked on several topics from quantum statistical mechanics and I wanted to also get into a different direction of research afterwards. The postdoc in Milan, funded by the ERC Starting Grant “FermiMath: The Mathematics of Interacting Fermions”, was a great opportunity for me to start working on many-body fermionic quantum systems, more precisely, on questions regarding their dynamics.



Cathedral of Milan



Siegestor (Victory Gate) in Munich

In April 2025 I successfully applied for the “Distinguished Postdoctoral Researcher Position” for female researchers within the SFB TRR 352 and I started my postdoc at the LMU Munich in October 2025 under the supervision of Phan Thành Nam and Christian Hainzl. The position is funded half by the SFB TRR 352 and half by Phan Thành Nam’s ERC Consolidator Grant “RAMBAS: Rigorous Approximations for Many-Body Quantum Systems”. In my postdoc in Munich I will continue to work on questions regarding many-body fermionic quantum systems. The SFB TRR 352 creates a very nice and stimulating environment with many scientific events that leave room for scientific exchange and the initiation of collaborations, I’m very happy to be a part of it again and I’m looking forward to my time in Munich!

Research and City Life: New Chapters – By Larry Read

I joined LMU Munich in March 2023 as a postdoc in the group of Rupert L. Frank. From the start, I found Munich a very welcoming place to work, with a friendly and stimulating research environment. Within the SFB TRR 352, I appreciated the variety of expertise and the opportunity to begin several new collaborations. My research there focused on spectral analysis, particularly on eigenfunction concentration and direct scattering for integrable systems.

Recently, since October 2025, I have been at the Laboratoire de Mathématiques d'Orsay at Université Paris-Saclay, where my work has shifted towards microlocal analysis – so I'm expanding my interactions with h ! I'll miss Munich: the city's calm rhythm, the nearby lakes and Alps, and the beer gardens. But the department in Orsay is tranquil, and I'm looking forward to exploring Paris (I'm already making the most of the pâtisseries).



View from Larry Read's office, Paris

Events

Snapshots from QMATH16 – By Florian Haberberger



Simone Warzel, main organizer of QMATH16

Freshly back from a research visit in Copenhagen, I headed straight to Garching – excited not only to give my own talk but also to meet many familiar faces I hadn't seen in a while.

Right from the start, the conference stood out to me for its interactive web schedule, which fascinated me since I had never seen anything like it, and the broad program. Yet, as usual, the coffee breaks and dinners turned out to be just as important – the best discussions often happen there. And to balance the brainwork, we played volleyball after the talks.

My own talk, based on ongoing work with Lukas Junge that we had advanced during my stay in Copenhagen, went really well – lots of attentive listeners, interesting questions, and lively discussions afterwards.

Before the poster session, each presenter gave a short pitch talk, which helped me decide which posters to concentrate on. For me, the discussion on the Bose-Hubbard model was particularly interesting. A prize for the best posters was sponsored by Springer. Congratulations to the winners!

One session that left me thinking was the “Diversity Talk.” The introductory message was simple but compelling: everyone thrives more and works better in a fair environment. We explored possible reasons for the low representation of women in mathematical physics and discussed different biases and their effects, all illustrated with empirical studies. Still, the points often felt vague and inconclusive, and I left unsure what the real benefit of the session was for me.

All in all, QMATH16 was a wonderful experience – many thanks to the organizers!

Mind the Gap Workshop: A Personal Reflection – By Margherita Ferrero

The *Mind the Gap – Advancing Women in Quantum Maths* workshop offered a very nice and familiar atmosphere that immediately made everyone feel welcome. I expected to meet people from my research community, but I was pleasantly surprised to see so many young female researchers and master's students among the participants.

The event brought together leading experts and early-career researchers in quantum mathematics, representing all academic levels. The talks were given by Ángela Capel Cuevas (University of Cambridge), Soeren Fournais (University of Copenhagen), Simona Rota Nodari (Université Côte d'Azur), Carla Rubiliani (University of Tübingen), Chiara Saffirio (University of Freiburg), and Simone Warzel (TUM), among others. Most of the presentations were accessible to everyone, and I particularly appreciated the balance between talks and open discussions.

The round table session was particularly well structured and participative. I especially enjoyed the first part — interviews with selected professors — which provided valuable insights into academic careers. Sharing experiences and receiving advice for the future was not only instructive but also deeply motivating. As a young researcher, I found these conversations truly inspiring.



Round table session at the Mind the Gap workshop

Overall, I took away many positive impressions — both scientifically and personally. The workshop succeeded in fostering a sense of community, visibility, and encouragement for women in quantum mathematics.

A heartfelt thank-you to the organizers!

A Week in Oberwolfach – By François Visconti

At the beginning of October I attended the Arbeitsgemeinschaft: Analysis of Many-body Quantum Systems in Oberwolfach. The Mathematics Institute of Oberwolfach is located in the middle of the Black Forest, which is a very pleasant environment to be working in. The drawback of this remote location is that it is particularly difficult to reach using public transport, especially because of Deutsche Bahn's infamous unreliability. Namely, I had to take three trains, a bus and a taxi to get from Munich to Oberwolfach. Luckily, I met some fellow mathematicians on the way, which made travelling more enjoyable.



Black Forest cake – best served with beer

It was a pleasant experience being in an Institute full of mathematical history and tradition. One interesting tradition is that seats are assigned at random for both lunch and dinner. This is meant to force people to talk with people they do not know. In practice though, I sat mostly at the vegetarian table with the same people, so I cannot vouch for this tradition... Another important tradition of Oberwolfach is the Wednesday hike to a nearby village, where participants eat Black Forest cake, a regional speciality, and drink beer. Unlike the first one, I can definitely vouch for this tradition, especially since I got a generous slice of cake! Lastly, lectures and meals are announced with a bell (yes, just like in school). Funnily enough, this combined with the fact that there were many young participants made the workshop feel somewhat like a summer camp.

I would describe the concept of the workshop as learn by teaching, which I found very interesting. More precisely, participants had to give a one-hour lecture on a subject which they normally do not work on to learn more about the topic. The lectures were mostly based on papers written by the organisers, which made presenting in front of them somewhat daunting but also very instructive. A total of 15 lectures were given, and most of them were great and pleasant to follow. Personally, I also learned a lot from preparing my lecture on the fermionic jellium at high density. Sadly, I caught a cold towards the end of the workshop (as usual in October), which made presenting more difficult and exhausting. Nonetheless I very much enjoyed the experience!



Lecture by Jinyeop Lee