

# IAS-TUM Workshop

## Recent progress on tensor network methods

April 22-25, 2024

Institute for Advanced Study, Technische Universität München



### Monday, 22 April, 2024

- 09:05 *Welcoming words by the hosts*
- 09:15-09:55 Ulrich Schollwoeck (LMU): Tensor networks for real materials
- 10:05-10:45 Henrik Larsson (UC Merced): Tensor network states for computing vibrational and electronic states
- 10:55-11:20 *Coffee break*
- 11:20-12:00 Thomas Barthel (Duke): Variational quantum algorithm for quantum matter using Trotterized entanglement renormalization
- 12:10-12:30 Dian Wu (EPFL): Variational Benchmarks for Quantum Many-Body Problems
- 12:35-14:10 *Lunch break*
- 14:15-14:55 Mari-Carmen Bañuls (MPI Quantum Optics): Algorithms for non-equilibrium dynamics in 1D systems
- 15:05-15:45 Norbert Schuch (University of Vienna): Tensor networks and the negative sign problem
- 15:55-16:20 *Coffee break*
- 16:20-16:40 Miklós Antal Werner (Wigner Research Centre for Physics, Budapest): Efficient simulation of two dimensional quantum lattice models by a mode optimized hybrid CPU-GPU density matrix renormalization group method
- 16:45-17:05 Julian Rincon (Los Andes): Luttinger/Fermi mixing in one-dimensional quantum fluids: A tensor-network study
- 17:10-17:30 Yaling Ke (ETH Zurich): Tensor network state methods for non-Markovian open quantum system dynamics

## **Tuesday, 23 April, 2024**

- 09:15-09:55 Reinhard Noack (Marburg): Mode Transformation DMRG for Two-Dimensional Electron Systems
- 10:05-10:45 Philippe Corboz (Amsterdam): iPEPS for layered systems and incommensurate spin spiral phases
- 10:55-11:20 *Coffee break*
- 11:20-11:40 Albert Gasull (MPI Quantum Optics): An exact representation of a gapped chiral phase with field theoretical PEPS
- 11:45-12:05 Tatiana Vovk (IQOQI Vienna): Minimising entanglement in tensor-network quantum trajectories
- 12:10-14:10 *Lunch break*
- 14:15-14:55 Natalia Chepiga (Delft): Resilient infinite randomness for a disordered Majorana chain
- 15:05-15:25 Lexin Ding (LMU): Quantum Information-Assisted Complete Active Space Optimization
- 15:30-16:00 *Coffee break*
- 16:00-17:30 *Poster session*

## **Wednesday, 24 April, 2024**

- 09:15-09:55 Mi-Song Dupuy (Sorbonne): Abelianisation of the  $SU(2)$  symmetry for QC-DMRG
- 10:05-10:45 André Uschmajew (Augsburg): Dynamical low-rank tensor approximations to high-dimensional parabolic problems
- 10:55-11:20 *Coffee break*
- 11:20-12:00 Martin Ganahl (SandboxAQ): Tensor processing units and the density matrix renormalization group
- 12:10-12:30 Mathias Oster (RWTH Aachen): Solving High-Dimensional Optimal Control Problems with Empirical Tensor Train Approximation
- 12:35-14:10 *Lunch break*
- 14:15-14:55 Roman Ellerbrock (TerraQuantumAG): Application of Tensor Network optimization to Conformer Search of Molecules
- 15:05-15:25 Riley Preston (Freiburg): Application of hierarchical equations of motion in the tensor train formulation to the scattering of molecules from metal surfaces
- 15:30-15:50 Maximilian Dorfner (TUM): Quantum Dynamics for Coupled Electron - Vibrational Systems with Matrix Product States
- 15:55-16:20 *Coffee break*

## **Wednesday, 24 April, 2024 ....continued**

16:20-17:00 Frank Pollmann (TUM): Isometric Tensor Networks: Efficient numerical simulations and exact representation of quantum states

19:30 - open end Workshop dinner & scientific exchange in the **Augustiner** Bräustuben, Munich

## **Thursday, 25 April, 2024**

09:15-09:55 Christian Schilling (LMU): Quantum Information Perspective on the Ground State Problem: What is Electron Correlation?

10:05-10:45 Christian Mendl (TUM): Riemannian quantum circuit optimization and optimal linear contraction ordering of tree tensor networks

10:55-11:20 *Coffee break*

11:20-11:40 Wei Tang (Ghent): Matrix product state fixed points of non-Hermitian transfer matrices

11:45-12:05 Sirui Lu (MPI Quantum Optics): Variational Neural and Tensor Network Approximations of Thermal States

12:15-12:55 Jens Eisert (FU Berlin): New perspectives of tensor networks

13:05 *Closing words*

### **Scientific organisers:**

Thomas Barthel (Duke)

Gero Friesecke (TUM)

Henrik Larsson (University of California, Merced)

Örs Legeza (TUM-IAS and Wigner Research Centre for Physics, Budapest)

### **Local organisers:**

Diane Clayton-Winter, Gero Friesecke, Örs Legeza