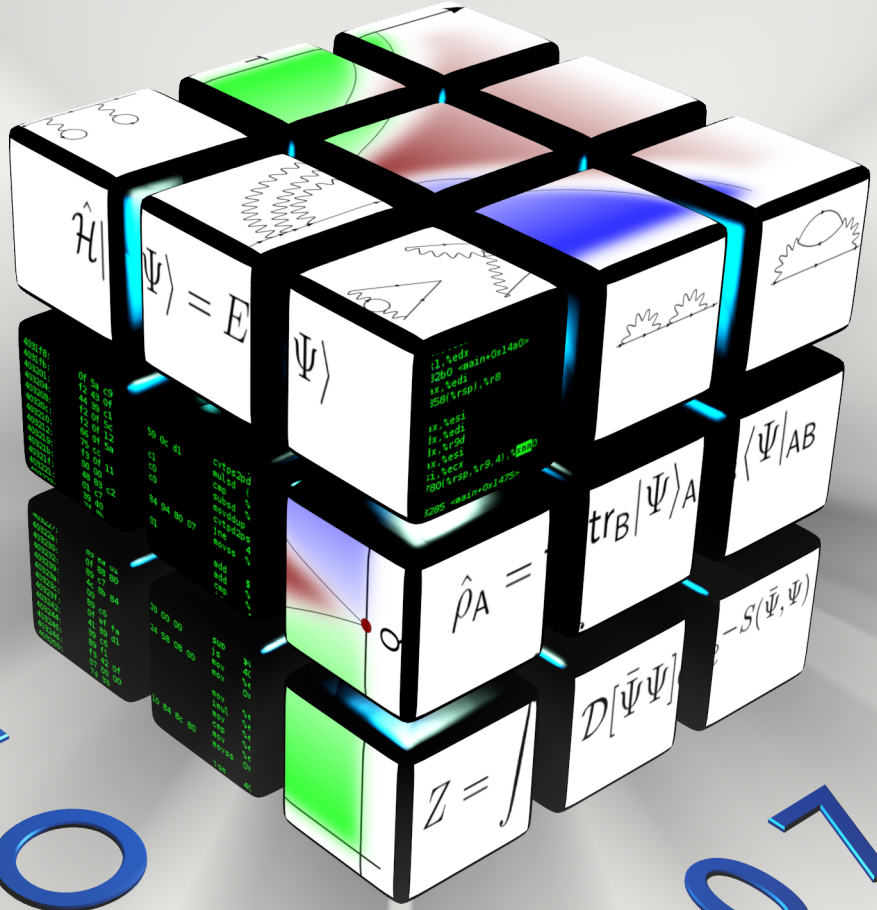
# Advanced Numerical Algorithms for Strongly Correlated Quantum Systems




FOR 1807

Würzburg, February 23 - 26 2015

**P20** **The spin-1 kagome Heisenberg antiferromagnet: an SU(2) PEPS study**
*Wei Li (LMU Munich)*

**P21** **Truncating an exact Matrix Product State for the XY model: correlations and the transfer matrix**
*Marek Rams (Jagiellonian University)*

**P22** **Coherence-incoherence crossover in Hund's metals – Insights into the normal state of iron pnictide superconductors from a Numerical Renormalization Group study**
*Katharina Stadler (LMU München)*

**P23** **Combining Projector Quantum Monte Carlo with Tensor Network methods**
*Brecht Verstichel (Ghent University)*

**P24** **Berezinskii-Kosterlitz-Thouless phase transition of spin-orbit coupled Fermi gas in optical lattice**
*Tang Ho Kin (National University of Singapore)*

**P25** **Composite boson mean field for strongly correlated systems**
*Daniel Huerga (Universitï Stuttgart)*

**P26** **SYMETTS - Symmetric Minimally Entangled Typical Thermal States**
*Benedikt Bruognolo (LMU Munich)*

**P27** **Calculating Conserved Currents and Fermionic Force for the Lanczos Approximation to the Overlap Dirac Operator**
*Matthias Puhr (Universität Regensburg)*

**P28** **Towards a Matrix Product State based description of steady-state non-equilibrium physics in 1D correlated quantum systems using Lindblad driving**
*Frauke Schwarz (Ludwig-Maximilians-Universität München)*

**P29** **Measurement-driven dynamics of large quantum spin systems**
*Hebenstreit Florian (Bern)*

**P30** **An integrability-based class of non-orthogonal geminal wavefunctions for the description of strongly-correlated systems**
*Pieter Claeys (Ghent University)*

**P31** **Effective spin models for edge magnetism in graphene zigzag ribbons**
*Cornelie Koop (RWTH Aachen)*

**P32** **Spin and charge dynamics of a quasi-one-dimensional antiferromagnetic metal**
*Marcin Raczkowski (LMU Munich)*

**P33** **Linear to zigzag transition in dipolar chains**
*Florian Cartarius (Universität des Saarlandes)*

**P34** **Quantum Monte Carlo Study of Long-Range Transverse-Field Ising Models on the Triangular Lattice**
*Stephan Humeniuk (Universität Stuttgart)*

**P35** **Localized excitations on top of a PEPS ground state**
*Laurens Vanderstraeten (University of Ghent)*

**P36** **Extended density-density interactions in auxiliary field QMC**
*Michael Golor (RWTH Aachen University)*

**P37** **Néel transition temperatures for the Hubbard model on layered honeycomb lattice**
*Jakub Imriska (ETH Zurich)*

**P38** **Strongly Correlated Phases and Ferromagnetic Phases of Fermions in an Optical Flux Lattice Model**
*Simon Davenport (University of Cambridge)*

presented together with their implications for the calculation of the quantum trajectories based on Matrix Product States.

**P29** **Measurement-driven dynamics of large quantum spin systems**
*Hebenstreit Florian (Bern)*

We study the real-time evolution of large quantum spin systems in two spatial dimensions, whose dynamics is entirely driven by a dissipative coupling to the environment. We consider different measurement processes of spin pairs and investigate the dynamics from an ordered phase at initial times towards a disordered phase at late times. The corresponding Kossakowski-Lindblad equation is solved via an efficient cluster algorithm for different spin models (Heisenberg model, XY-model). We find that the symmetry of the measurement process determines the time scales which govern the approach towards a new equilibrium phase at late times. Most notably, we find an exponentially slow equilibration if the dissipative coupling conserves any of the magnetization Fourier modes. In these cases, the dynamics can be interpreted as a diffusion process of the quantum spins.

**P30** **An integrability-based class of non-orthogonal geminal wavefunctions for the description of strongly-correlated systems**
*Pieter Claeys (Ghent University)*

Integrable systems take a special place within the theory of quantum many-body systems, having been used to describe a wide variety of physical phenomena. Due to the underlying algebraic structure, all correlations can be captured exactly within a Bethe Ansatz wavefunction at a fraction of the usual computational cost. Unfortunately, the demands for integrability are quite stringent, allowing only for an exact description of a limited number of Hamiltonians. However, the structure of the eigenstates of these systems can also be used as a starting point for the description of nonintegrable systems, either from a variational or a projected point of view. This method has been proposed in quantum chemistry starting from a so-called XXX RG model, leading to a novel family of non-orthogonal geminal wavefunctions capable of describing strongly-correlated atoms and molecules at a cost that scales polynomially (instead of exponentially) with system size. Here we propose an extension of this method starting from the class of more general XXZ Richardson-Gaudin systems.

**P31** **Effective spin models for edge magnetism in graphene zigzag ribbons**
*Cornelie Koop (RWTH Aachen)*

We consider the effective magnetic interactions among edge states in zigzag graphene-based nanoribbons. To leading order, there has previously been shown to emerge a direct ferromagnetic intra-edge coupling and an antiferromagnetic coupling between opposite edges. We study the electronic system by an effective model, yielding a separation between edge and bulk states, and systematically investigate bulk-state corrections within a Schrieffer-Wolff transformation. Using both numerical and analytical methods, fermionic and spin correlation functions are calculated. We show that the reduction to pure edge-state models is well justified for a wide range of general ribbon geometries. Our framework enables a systematic exploration of electronic correlation physics in graphene-based nano-structures beyond the often-employed mean-field approximation on realistically large system sizes.

**P32** **Spin and charge dynamics of a quasi-one-dimensional antiferromagnetic metal**
*Marcin Raczkowski (LMU Munich)*

We use quantum Monte Carlo simulations to study a finite-temperature dimensional-crossover-driven evolution of spin and charge dynamics in weakly coupled Hubbard chains with a half-filled band. The low-temperature behaviour of the charge gap indicates a crossover between two distinct energy scales: high-energy one-dimensional (1D) Mott gap due to umklapp process and a low-energy gap which stems from long-range antiferromagnetic (AF) spin fluctuations. Away from the 1D regime and at temperature scales above the charge gap, the emergence of zero-frequency Drude-like feature in the interchain optical conductivity implies the onset of a higher-dimensional metal. In this metallic phase, enhanced quasiparticle scattering off finite-range AF spin fluctuations results in incoherent single-particle dynamics. The coupling between spin and charge fluctuations is also seen in the spin dynamical structure factor displaying damped spin excitations (paramagnons) close to the AF wave-vector and particle-hole continua near 1D momentum transfers spanning quasiparticles at the Fermi surface. We furthermore compare the results for the single-particle spectral function with the ones obtained within a cluster extension of the dynamical mean-field theory. Finally, we discuss the relationship of our results to the charge deconfinement in quasi-1D organic Bechgaard-Fabre salts.

**P33** **Linear to zigzag transition in dipolar chains**
*Florian Cartarius (Universität des Saarlandes)*