Wednesday, 23.08.2017, CICG: Room 3

Time	ID	Theoretical Physics I *Chair: Gian Michele Graf, ETH Zürich*
14:00	251	**Non-uniqueness for the Navier–Stokes initial value problem** *Julien Guillod, Université Paris-Diderot, Vladimír Šverák, University of Minnesota* We will discuss the initial value problem given by the incompressible Navier–Stokes equations in $\mathbb{R}^3$. All known well-posedness results for this problem are in the perturbative regime and in this talk we will show numerically that the problem is ill-posed outside the perturbation regime. More precisely, we numerically construct two different solutions having the same initial datum in borderline spaces.
14:30	252	**Universal upper bounds on the Bose-Einstein condensate** *Christian Schilling, Felix Tennie, Vlatko Vedral, University of Oxford* For N hard-core bosons on an arbitrary lattice with d sites and independent of additional interaction terms we prove that the hard-core constraint itself already enforces a universal upper bound on the Bose-Einstein condensate given by $N_{max} = (N/d)(d - N + 1)$. This bound can only be attained for one-particle states $\|\varphi\rangle$ with equal amplitudes with respect to the hard-core basis (sites) and when the corresponding N-particle state $\|\Psi\rangle$ is maximally delocalized. This result is generalized to the maximum condensate possible within a given sublattice. We observe that such maximal local condensation is only possible if the mode entanglement between the sublattice and its complement is minimal.
14:45	253	**Renormalization group approach to time-periodic driven-dissipative bosons** *Steven Mathey, Sebastian Diehl, Institute for Theoretical Physics Cologne* I investigate the critical dynamics of a periodically driven Bose gas. The inclusion of dissipation enables the system to reach a far-from-equilibrium steady state where the periodic drive plays an essential role. Combining the Renormalization Group (RG) and Floquet formalisms, I describe the steady state by allowing for an arbitrary number of Floquet modes to be occupied. In practice, this means that the coupling constants become periodic functions of time as they are renormalized. As a first step, the RG flow equations are computed at one-loop. They are then linearised at the (Wilson-Fisher) equilibrium fixed point and an infinite number of relevant directions emerge because of the non-equilibrium drive.
15:00	254	**Physical Relevance of Generalized Pauli constraints** *Felix Tennie [1], Daniel Ebler [2], Vlatko Vedral [1], Christian Schilling [1]* *[1] University of Oxford, [2] University of Hongkong* The fermionic exchange symmetry does not only imply Pauli's exclusion principle but even further constraints on fermionic occupation numbers. In particular, generalized Pauli constraints become relevant whenever they are (approximately) saturated. We explore the occurrence of such (quasi)pinning through a comprehensive analysis of an analytically solvable model (Harmonium). By analysing the strength of quasipinning as function of the particle number, coupling strength, spatial dimension and degree of spin polarization we reveal the mechanism behind it. It is the conflict of energy minimization and fermionic exchange symmetry. Consequently, our results suggest the existence of a microscopic Pauli pressure which forces the system into an approximate saturation of the generalized Pauli constraints.
15:15	255	**Exploring non-local observables in shock wave collisions** *Philipp Stanzer, TU Wien* We study the time evolution of 2-point-functions and entanglement-entropy in anisotropic and time dependent $\mathcal{N}$ = 4 super-Yang-Mills-theory in the large N and large 't Hooft-coupling limit using AdS/CFT. On the gravity side this amounts to calculating geodesics and extremal surfaces in the back

		ground of two colliding gravitational shockwaves, which we do numerically. Discriminating between three classes of initial conditions corresponding to wide, intermediate and narrow shockwaves, we show that the behavior of the non-local observables is different. Another interesting result is that 2-point-functions can be sensitive to the inside of a black hole apparent horizon while we could not find such dependence for the entanglement-entropy. This talk is based on arXiv:hep-th/1609.03676.
15:30	**256**	**Swift state-of-the-art calculations of the 2D Electron Liquid** *Clemens Staudinger, Raphael Hobbiger, Dominik Kreil, Jürgen T. Drachta, Helga M. Böhm, Robert E. Zillich, JKU Linz* Understanding electron correlations is nowadays crucial for advances in quantum electronics and nano-sciences. Quantum Monte-Carlo simulation (QMCS) methods, being highly time consuming, are limited to yield selective data points only. We here employ a Hyper-Netted-Chain-theory based approach to compute the spin-resolved pair distribution functions and static structure factors of the two-dimensional, partially spin-polarised electron liquid. Compared to QMCS, remarkable accuracy is achieved in a fraction of time. For a broad range of densities and polarisations we apply this to investigate how increasing the layer-width alters the correlations.
15:45	**257**	**Entanglement of Gaussian Fermionic States** *Katharina Schwaiger [1], Géza Giedke [2], Cornelia Spee [3], Barbara Kraus [1]* *[1] University of Innsbruck* *[2] Donostia International Physics Center* *[3] Naturwissenschaftlich-Technische Fakultät, Universität Siegen* We consider Gaussian fermionic states and their entanglement properties. Among continuous variable systems Gaussian states stand out prominently, because of their simple and elegant mathematical description in terms of first and second order correlations. Moreover, the subclass of Gaussian fermionic states has the distinguished feature, that they can be mapped onto systems consisting of qubits via the so-called Jordan-Wigner transformation. We characterize possible transformations of (pure) single- and multimode states via Gaussian (fermionic) local operations assisted by classical communication. Thus, also the most useful states in this context, i.e. states in the maximally entangled set, are determined. Furthermore, their entanglement is quantified and qualified by computing operational entanglement measures.
16:00	**258**	**Bulk-Edge Duality and Complete Localization for Chiral Chains** *Jakob Shapiro, ETH Zürich* We study 1D insulators obeying a chiral symmetry in the single-particle picture where the Fermi energy is assumed to lie within a mobility gap. Topological invariants are defined for infinite (bulk) or half-infinite (edge) systems, and it is shown that for a given bulk system with N.N. hopping, the invariant is equal to the induced-edge-system's invariant. We also give a new formulation of the topological invariant in terms of the Lyapunov exponents of the system, which sheds light on the conditions for topological phase transition extending to the mobility gap regime. Finally we give a proof of complete dynamical localization for our model via Furstenberg's theorem and the fractional moments method, which justifies the deterministic assumptions we make.
16:15	**259**	**Reconstructing quantum states from single-party information** *Carlos L. Benavides-Riveros, Martin-Luther-Universität Halle-Wittenberg* *Christian Schilling, University of Oxford* *Péter Vrana, Department of Geometry, Budapest University of Technology and Economics, Budapest, Hungary* The possible compatibility of density matrices for single-party subsystems is described by linear constraints on their respective spectra. Whenever some of those quantum marginal constraints are saturated, the total quantum state has a specific, simplified structure. We prove that these remarkable global implications of extremal local information are stable, i.e. they hold approximately for spectra close to the boundary of the allowed region. Application of this general result to fermionic quantum systems allows us to characterize natural extensions of the Hartree-Fock ansatz and to quantify their accuracy by resorting to one-particle information, only.
16:30		***Coffee Break***

19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

Thursday, 24.08.2017, CICG: Room 6

Time	ID	**Theoretical Physics II** *Chair: Gian Michele Graf, ETH Zürich*
16:30	**261**	**Symmetry and Topology of Unconventional Superconductors** *Manfred Sigrist, Theoretische Physik, ETH Zürich, 8093 Zürich* Unconventional superconducting phases incorporate most intriguing features through the symmetry and topological properties of their order parameters, as has been observed already several decades ago in the superfluid He-3. Among the known unconventional superconductors only few are considered to be true candidates to realise topological phases. The most prominent cases are the so-called chiral superconductors, such as Sr_2RuO_4 most likely with chiral p-wave and SrPtAs possibly with chiral d-wave pairing. Cooper pairs form here with finite angular momentum. We will discuss the basic phenomenology of the two systems and give an overview on experimental implications.
17:00	**262**	**SLOCC hierarchy for generic states in 2 x m x n level systems** *Martin Hebenstreit [1], Mariami Gachechiladze [2], Otfried Gühne [2], Barbara Kraus [1]* *[1] University of Innsbruck, [2] University of Siegen* We consider entanglement in the three partite system consisting of a qubit, an *m*-level and an *n*-level system. In particular, we use tools introduced in [1] to characterize entanglement transformations under stochastic local operations and classical communication (SLOCC). We find evidence indicating that the following picture is true. In case $m = n$, generic states belong to one of infinitely many SLOCC classes. Surprisingly, in case $m \neq n$, generic states belong to one single SLOCC class only. Furthermore, we show that any generic state is convertible to any other generic state of lower dimension. [1] E. Chitambar, C. A. Miller, and Y. Shi, J. Math. Phys. 51, 072205 (2010)
17:15	**263**	**Understanding hybrid strong/weak thermalisation of the QGP** *Alexander Soloviev [1], Anton Rebhan [1], Ayan Mukhopadhyay [1], Florian Preis [1],* *Eero Aleksi Kurkela [2]* *[1] Technische Universität Wien, [2] CERN* Iancu and Mukhopadhyay have proposed a semi-holographic model for heavy-ion collisions, where the saturated hard gluons produced at initial stages are coupled consistently to a holographic theory representing the radiatively emitted strongly coupled soft gluons. The goal is to study thermalization with the ultraviolet (UV) modes described by pQCD and the infrared (IR) modes by gauge/gravity duality. I will describe further progress made in this direction, particularly in the limit where the UV description reduces to kinetic/hydrodynamic theory and the IR description to a strongly coupled fluid. The UV and IR are coupled by self-consistently determined effective metrics. We find novel qualitative behavior of the combined system.
17:30	**264**	**Simplified models of heavy Higgs bosons decaying to supersymmetric particles** *Lukas Lechner, Suchita Kulkarni, Austrian Academy of Sciences* The search for heavy Higgs bosons is an important step to probe the parameter space of the minimal supersymmetric Standard Model. We define simplified models for heavy Higgs bosons decaying to supersymmetric particles by using the SModelS framework. We evaluate the viable parameter space by taking into account limits from the Higgs and flavor sector as well as limits from LHC searches for supersymmetry. Furthermore, we characterize the parameter space resulting in maximal signal at LHC.

17:45	**265**	**Measurement of entanglement dynamics in the many-body localized phase: A random matrix approach** *Andreas Elben, Benoit Vermersch, Peter Zoller, IQOQI Innsbruck, University of Innsbruck* We discuss a technique for measuring nonlinear functions of a quantum many-body density matrix, such as Renyi entropies with direct connection to entanglement, without performing full state tomography. Our approach, which has direct connection to Random Matrix Theory, consists in implementing an ensemble of random unitary evolution operators, applying them on the many-body state and extracting the desired functions from ensemble averaged observables [1]. We show that our approach is readily implementable with current technology and present applications in one dimensional Spin-Chains and bosonic systems and discuss the possibility to measure therein entanglement dynamics, characterizing intriguing phenomena such as many-body localization. [1] S. van Enk and C.W.J. Beenakker, PRL (2012)
18:00	**266**	**Flexible resources for Quantum Metrology** *Davide Orsucci, Nicolai Friis, Michalis Skotiniotis, Pavel Sekatski, Vedran Dunjko, Hans Briegel, Wolfgang Dür, Uni Innsbruck* Quantum Metrology allows one to perform measurements which are quadratically more precise than classically possible. However, the hurdle of implementing the necessary quantum probe states and measurements, whose complexity varies drastically for different metrological scenarios, is usually not taken into account. We show that for a wide range of tasks in metrology, the 2D cluster state can serve as a flexible resource that allows one to efficiently prepare any required state for sensing; the required (entangled) measurements can be performed using only single qubit operations on the cluster. Crucially, the overhead in the number of qubits is less than quadratic, thus preserving the quantum scaling advantage.
18:15	**267**	**Confidentiality of the hashing protocol and applications to the quantum repeater** *Alexander Pirker, Michael Zwerger, Vedran Dunjko, Wolfgang Dür, Hans Briegel* *University of Innsbruck* We focus on the generation of entanglement among distant parties in a secure way, and with high communication rates. We show that hashing protocols, a particular class of entanglement purification protocols, enable arbitrary privacy in the presence of noise, even in a setting where the information which noise was applied leaks to the eavesdropper. As an application thereof we propose a quantum repeater based on hashing. The overhead per repeater station is constant, thanks to the finite yield of hashing. This is in stark contrast to all other long-distance quantum communication schemes previously considered, and opens the way for long-distance communication of big quantum data.
18:30		***END; Postersession and Apéro***
20:00		***Public Lecture***