Workshop Schedule

Events for:
Monday, December 10th - Friday, December 14th

Monday, December 10th

8:30am **Check in - SCGP 102**

9:00am **Luis Alvares Gaumes the director of SCGP - SCGP 102**

10:10am **Dmitri Kharzeev - SCGP 102**

Speaker: Dimitri Kharzeev

Title: The chiral qubit: quantum computing with chiral anomaly

11:10am **Alexander Abanov - SCGP 102**

Speaker: Alexaner Abanov

Title: Odd surface waves

Abstract: Two-dimensional isotropic fluids can possess an anomalous part of the viscous tensor known as odd or Hall viscosity. This peculiar viscosity does not lead to any dissipation in the fluid. I will describe the effects of the odd viscosity in incompressible fluids. In particular, I will present a solution corresponding to surface waves on a free boundaries of such fluids. In linear regime a new surface mode can exist even in the absence of external potential. The dispersion of this mode is $2\nu_o k |k|$. I will discuss the formation and the structure of an oscillating boundary layer accompanying odd surface waves. I will present also the variational principle for surface waves and the corresponding Hamiltonian structure. In the weakly nonlinear and dispersive limit the dynamics of surface waves is given by chiral Burgers equation which allows for exact solutions.

12:10pm **Lunch - Simons Center Cafe**

2:00pm **Sergey Bravyi - SCGP 102**

Speaker: Sergey Bravyi

Title: Approximation algorithms for quantum many-body problems

3:00pm **Andrea Trombettoni - SCGP 102**

Speaker: Andrea Trombettoni

Title: Off-Diagonal Long-Range Order in One-Dimensional Quantum Systems

Abstract: A quantum system exhibits off-diagonal long-range order (ODLRO) when the largest eigenvalue of the one-body-density matrix scales as N, where N is the total number of particles. More generally, if the largest eigenvalue scales as N^C to define the scaling exponent C, then C=1 corresponds to ODLRO and C=0 to the single-particle occupation of the density matrix orbitals. When 0 C 1, C can be used to quantify deviations from ODLRO. In this talk I discuss the behaviour of the exponent C in a variety of one-dimensional bosonic and anyonic quantum systems. For the 1D Lieb-Liniger Bose gas we find that for small interactions C is close to 1. 1D anyons provide the possibility to fully interpolate between C=1 and 0. I will finally focus on the Tonks-Girardeau limit, in which C approaches the value 1/2, discussing the case in which the gas is trapped in a general confining potential and showing the universality of the scaling of the largest eigenvalue of the one-body-density matrix with the number of particles. If time allows, I will also present recent results for the Lieb-Liniger model in a periodically time-dependent external potential.

4:00pm **Break - Simons Center Cafe**

Tuesday, December 11th

9:00am **Bruno Nachtergaele - SCGP 102**

Speaker: Bruno Nachtergaele

Title: Symmetry Protected Topological Phases of quantum spin chains

10:00am **Fumihiko Sugino - SCGP 102**

Speaker: Fumihiko Sugino

Title: Renyi entropy of highly entangled quantum spin chains

11:00am **Olof Salberger - SCGP 102**

Speaker: Olof Salberger

12:00pm **Lunch - Simons Center Cafe**

1:00pm **SCGP Weekly Talk: Bruno Nachtergaele - 102**

Speaker: Bruno Nachtergaele

Title: Robustness of Topological Order by way of Stability of Superselection Sectors

Abstract: Kitaev???s quantum double models provide a rich class of examples of two-dimensional lattice systems with topological order in the ground states and a spectrum described by anyonic elementary excitations. The infinite volume ground states of the abelian quantum double models come in a number of equivalence classes called superselection sectors. We prove that the superselection structure is stable under uniformly small perturbations of the quantum double Hamiltonians.

2:00pm **Andrea Trombettoni - SCGP 102**

Speaker: Andrea Trombettoni

3:00pm **Dmitri Averin - SCGP 102**

Speaker: Dmitri Averin

Title: Indistinguishability of quantum states and rotation counting

4:00pm **Break - Simons Center Cafe**

Wednesday, December 12th

9:00am **Israel Klich - SCGP 102**

Speaker: Israel Klich

Title:

10:00am **Break - Simons Center Cafe**

10:30am **Ismael Zahed - SCGP 102**

Speaker: Ismael Zahed

Title: Entangled AdS/QCD String

11:30am **Robert Konik - SCGP 102**

Speaker: Robert Konik

Title: Rare States and Anomalous Thermalization in 1D and 2D Quantum Ising: Mesons as Quantum Scars

12:30pm **Lunch - Simons Center Cafe**

2:00pm   **Mark Mezei - SCGP 102**

Speaker: Mark Mezei

Title: Effective theory of entanglement dynamics

Abstract: Following the time evolution of entanglement entropy can provide insight into the chaotic process of thermalization in a quench in an isolated quantum system. In this talk, based on a diverse set of examples I propose that there are two universality classes of entropy dynamics in the limit of large entangling regions and late times: the quasiparticle model describing integrable theories and the membrane theory applicable to chaotic systems. The membrane theory reveals connections between entanglement dynamics and chaotic operator growth.

3:00pm   **Jake Reschke - SCP 102**

Speaker: Jake Reschke

Title: Slow transport in some one-dimensional disordered many-body systems.

4:00pm   **Houssam Abdul-Rahman - SCGP 102**

Speaker: Houssam Abdul-Rahman

Title: Localization and Entanglement in Disordered Oscillator Systems

Abstract: We consider a class of disordered oscillator systems associated with an effective one particle Hamiltonian that is localized (only) at the bottom of its spectrum. We establish energy-restricted versions of Lieb-Robinson bounds, quasi-locality properties of the time evolution of local observables, and of dynamic correlations bound at general eigenstates. We will show how this is done through the introduction of projections onto the suitable invariant subspaces for the Hamiltonian. Then we show area laws for the entanglement of a class of non-gaussian states defined as a uniform ensemble of eigenstates associated with a fixed number of modes. Finally, we consider the oscillator systems after a quantum quench and we present some initial results on the disorder-averaged dynamical entanglement of some product local gaussian states.

Thursday, December 13th

9:00am **Jin Wang - SCGP 102**

Speaker: Jin Wang

Title: Coherence and Entanglement Enhancements in Nonequilibrium Quantum Open Systems

Abstract: Nonequilibrium systems are important for quantum transport, quantum information, quantum optics, atomic and molecular physics, condensed matter and astrophysics/cosmology. The questions regarding how the nonequilibriumness shapes the quantum nature and behavior become crucial for understanding the underlying mechanisms and dynamics of the quantum open systems. Here we investigate how nonequilibriumness influences the two key quantum natures as coherence and entanglement through a two site two level system coupled with two bosonic or fermionic baths. The driving force of the nonequilibrium quantum open systems can be globally quantified from both the quantum state landscape and a rotational flux violating the detailed balance. The degree of the detailed balance breaking can be used to characterize the degree of nonequilibriumness which is shown to be strongly correlated to the temperature or chemical potential difference of the environments. We showed that the nonequilibriumness can boost the steady state coherence in a monotonic and entanglement in a non-monotonic way. We give the physical explanations of these behaviors. Furthermore, we derived a generalized quantum fluctuation-dissipation theorem for nonequilibrium system without detailed balance. The response is no longer equivalent to the equilbirium fluctuations, but instead is a combination of two terms with one for the steady state fluctuation and the other for the correlation between the observable of interest and the rotational flux.

10:00am **Break - Simons Center Cafe**

10:30am **Robert Harrison - SCGP 102**

Speaker: Robert Harrison

Title: Many-body quantum chemistry and future computer technologies

Abstract: Discussed will be the state of practice in main stream quantum/computational chemistry, including frontiers in exascale computing. These capabilities are relevant to modeling physical implementations of quantum systems including accurate few/many-body methods. Novel techniques with "guaranteed" accuracy also provide new basis sets of possible relevance to quantum computers simulating materials/chemistry. Also discussed will be possible challenges/limitations to the relevance of (near term) quantum computers to modeling chemistry/materials.

11:30am **Tzu-Chieh Wei - SCGP 102**

Speaker: Tzu-Chieh Wei

Title: Unwinding short-range entanglement

12:30pm **Lunch - Simons Center Cafe**

2:00pm **Predrag Krstic - SCGP 102**

Speaker: Predrag Krstic

Title: Can Quantum Entanglement Increase Our Thirst for Understanding Unknown?

3:00pm **Dominik Schneble - SCGP 102**

Speaker: Dominik Schneble

Title: Spontaneous emission of ultracold atomic matter waves from a tunable open quantum system

Abstract: The question how irreversibility can emerge in quantum mechanics is central to the study of open quantum systems. A simple example is the exponential decay of an excited two-level atom as described by the Wigner-Weisskopf model of quantum optics, in which spontaneous photon emission is viewed as being driven by fluctuations of the surrounding vacuum. However, the Markov approximation underlying this model can be violated under certain conditions, and recent experiments on optical decay in photonic bandgap materials have indeed started to find deviations from its predictions. -- We have recently realzed an "artificial atom" in which the excited-state energy and the vacuum coupling can be controlled at will, thus allowing for a systematic exploration of spontaneous emission beyond the Markov approximation. Naively, a two-level atom may be viewed as a photon trap that is empty or full; we instead realize a microscopic trap for a single atom that can decay, under coherent external driving, by emitting the atom into the surrounding vacuum. The experiments are performed using an optical lattice geometry that provides arrays of such artificial atoms coupled to a one-dimensional matter waveguide. In my talk I will present experimental results on Markovian and strongly non-Markovian dynamics in this system, including exponential and partly reversible oscillatory decay, atom reabsorption, as well as a bound state for emission below the edge of the mode continuum that is the direct analog of the long-predicted atom-photon bound state in photonic bandgap materials. I will conclude with an outlook on future applications of our system in open-system many-body quantum physics.

4:00pm **Break - Simons Center Cafe**

Friday, December 14th

9:00am **Jenia Mozgunov - SCGP 102**

Speaker: Jenia Mozgunov

Title: Simulating large-scale quantum analog devices

10:00am **Break - Simons Center Cafe**

10:30am **Eden Figueroa - SCGP 102**

Speaker: Eden Figueroa

11:30am **Pramod Paranabhan - SCGP 102**

Speaker: Pramod Paranabhan

Title: Semigroup Quantum Spin Chains

Abstract: Inverse semigroups are useful study partial symmetries in physics as seen in the case of aperiodic tilings and quasicrystals. The elements of such structures contain several idempotents and operators which square to zero unlike the case of groups. Thus they provide a natural way to realize supersymmetric quantum many body systems. I will provide a class of such integrable systems and also use inverse semigroups to study example of highly entangled spin chains such as the Motzkin and Fredkin spin chains.

12:30pm **Lunch - Simons Center Cafe**

2:00pm **Michael McGuigan - SCGP 102**

Speaker: Michael McGuigan

3:00pm **Vasilij Semenov - SCGP 102**

Speaker: Vasilij Semenov

4:00pm **Break - Simons Center Cafe**