NAME
Howard Carmichael

TITLE
Monitored quantum jumps: A quantum trajectory view

ABSTRACT

"Quantum jumps are emblematic of all things quantum. Certainly this is so in the popular mind, and, more than an echo of Bohrâ€™s atomic model, the term â€œquantum jumpâ€ survives within the lexicon of modern quantum physics. What, however, is the character of the jump on close inspection? Is it discontinuous and discrete, as in Bohrâ€™s conception, or some form of continuous Schrodinger evolution that might be monitored and interrupted? Considering the jumps of single trapped ions observed in the mid-1980s [1], quantum trajectory theory favours the latter option. It also provides a framework for the recovery of the continuous path in experiments with superconducting circuits [2].
[1] W. Nagourney et al., Phys. Rev. Lett. 56, 2797 (1986); T. Sauter et al., Phys. Rev. Lett. 57, 1696 (1986); J. C. Bergquist et al., Phys. Rev. Lett. 57, 1699 (1986).
[2] Z. K. Minev, S. O. Mundhada, S. Shankar, P. Rheinhold, R. GutiÃ©rrez-JÃ¡uregui, R. J. Schoelkopf, M. Mirrahimi, H. J. Carmichael, and M. H. Devoret, arXiv:1803.00545 (2018)."

NAME
Sen Yang

TITLE
Towards measurement induced quantum state engineering

ABSTRACT

Quantum theory predicts that a quantum system will collapse from superposition of several possible states, to just one, in the moment it is measured. As quantum systems are never isolated from their surrounding environment (quantum bath), its measurement and the associated collapse should also affect the environment coupled to it. The affected spin bath will then affect the trajectory of the quantum system. We demonstrate the role of measurement back-action of a coherent spin environment on the dynamics of a spin (qubit) coupled to it, by inducing non-classical (Quantum Random Walk like) statistics on its measurement trajectory. We show how the long-life time of the spin-bath allows it to correlate measurements of the qubit over many repetitions. We have used Nitrogen Vacancy centers in diamond as a model system, and the projective single-shot readout of the electron spin at low temperatures to simulate these effects. We show that the

proposed theoretical model, explains the experimentally observed statistics and their application for quantum state engineering of spin ensembles towards desired states.

NAME
Mandilara Aikaterini

TITLE
Quantum compiling with diffusive sets of gates

ABSTRACT

Given a set of quantum gates and a target unitary operation, the most elementary task of quantum compiling is the identification of a sequence of the gates that approximates the target unitary to a determined precision Îµ. The Solovay-Kitaev theorem provides an elegant solution which is based on the construction of successively tighter `nets' around the unity comprised by successively longer sequences of gates. The procedure for constructing the nets, according to this theorem, requires accessibility to the inverse of the gates as well. In this work, using the theory of random walks we propose a method for constructing nets around unity without this requirement. The algorithmic procedure is applicable to sets of gates which are diffusive enough, in the sense that sequences of moderate length cover the space of unitary matrices in a uniform way. We prove that the number of gates sufficient for reaching a precision Îµ scales as O(ã€–logâ¡(1/Îµ)ã€—^(log 3 / log 2)) while the pre-compilation time is increased as compared to the Solovay-Kitaev algorithm by the polynomial factor 3/2.

NAME
Moshe Goldstein

TITLE
Entanglement and Conservation Laws in Many-Body Systems

ABSTRACT

How are symmetries, which give rise to conservation laws, manifested by entanglement measures? Similarly to the system Hamiltonian, a subsystem's reduced density matrix is composed of blocks characterized by symmetry quantum numbers, or charge sectors. I will present a geometric method for extracting the contribution of individual charge sectors to a subsystemâ€™s entanglement measures (entropies and negativities) within the replica approach, via threading of appropriate conjugate Aharonov-Bohm fluxes through a multi-sheeted Riemann surface. Specializing to the case of 1+1D conformal field theory, I will describe a general exact result for the entanglement characteristics, in the ground state as well as following a quench. I will apply it to a variety of systems, ranging from free and

interacting fermions to spin and parafermion chains, and verify it numerically. For example, I will show that the total ground-state entanglement entropy, which scales as the logarithm of the subsystem size, is composed of square-root of log contributions of individual subsystem charge sectors for interacting fermion chains, or even subsystem-size-independent contributions when total spin conservation is also accounted for. I will also describe how measurements of the contributions to the entanglement or negativity from separate charge sectors can be performed with ultracold bosons or fermions and similar systems.

NAME
Archan S. Majumdar

TITLE
Can nonlocal correlations be shared among multiple observers

ABSTRACT

"We investigate the issue as to whether the nonlocality of an entangled pair of particles can be shared among multiple observers on one side who act sequentially and independently of each other. Considering a pair of spin-1/2 particles, we first show that the optimality condition for the trade-off between information gain and disturbance emerges naturally in a quantum measurement when one employs a one-parameter class of positive operator valued measures (POVMs). Using this formalism we then prove analytically that it is impossible to obtain violation of the Bell-CHSH inequality by more than two Bobs in one of the two wings with an Alice in the other wing. We next consider the steering scenario for two-qubits with two measurement settings for each observer. We show that the analogue steering inequality can be violated for an Alice and at most two Bobs on the other side. Finally, we consider the nonlocal advantage of quantum coherence (NAQC), and show that the NAQC correlations can also be shared by a maximum of two Bobs with Alice on the other side."

NAME
Alok Kumar Pan

TITLE
Quantum violation of variants of Leggett-Garg Inequalities upto algebraic maximum for qubit system

ABSTRACT

"In 1985, Leggett and Garg formulated a class of inequalities for testing the compatibility between macrorealism and quantum mechanics. In this paper, we point out that based on

the same assumptions of macrorealism that are used to derive Leggett-Garg inequalities (LGIs) , there is a scope of formulating another class of inequalities different from standard LGIs. By considering the three-time measurement scenario in a dichotomic system, we first propose an interesting variant of standard LGIs and show that its quantum violation is larger than the standard LGI. By extending this formulation to n-time measurement scenario, we found that the quantum violations of variants of LGIs for a *qubit* system increase with n, and for a sufficiently large n algebraic maximum can be reached. We then compare the violations of standard and variants of LGIs in unsharp measurement scenario and show that for any arbitrary n, the violation of later is more robust to unsharpness than the former. Further, we examine the relation between the quantum violations of the variants of LGIs and an another formulation macrorealism, known as, no-signaling in time conditions.

Ref: arXiv: 1806.01219 (https://arxiv.org/abs/1806.01219)"

NAME

Tamoghna Das

TITLE

No purification in all discrete theories and the power of the complete extension.

ABSTRACT

Quantum theory has an outstanding property that each state has its well defined purification in larger Hilbert space. It is known that the classical theory and the theory of non-signaling boxes does not have purification for all of their states. These theories are examples of the so called generalized probabilistic theories (GPTs), where each state has a number of extensions to a larger system. We single out the most relevant one, called a complete extension, unique up to local reversible operations on the extending system. We prove that this special, finite dimensional extension bares an analogy to quantum purification in that
(i) it allows for an access to all ensembles of the extended system,
(ii) from complete extension one can generate any other extension.
It then follows, that an access to the complete extension represents the total power of the most general non-signaling adversary. A complete extension of a maximally mixed box in two-party binary input binary output scenario is up to relabeling the famous Popescu-Rohrlich box. The latter thus emerges naturally without reference to the Bell's non-locality. However the complete extension is not a purification (a vertex) in the generic case. Moreover, we show that all convex discrete theories does not provide purification for almost all of it states. In particular the theory of contextuality does not possess purification. The complete extensions are by nature high-dimensional systems. We were able however

to provide explicit structure of complete extension for the noisy Popescu-Rohrlich-boxes and the 3-cycle contextual box.

NAME
Jaewan Kim

TITLE
Pseudo Single Photon for QKD

ABSTRACT

"We introduce an optical quantum state that can fundamentally mimic a single photon state not only with respect to the number of photons but also in terms of an indeterminate phase. It becomes close to a perfect single photon state with almost unit fidelity as well as exhibits fundamental features of single photons such as antibunching and Hong-Ou-Mandel interference. The emergence and vanishing of single photon characteristics can be directly observed by changing two variables, i.e., mean photon number and number of phases. Moreover, we propose a feasible scheme to generate such a state at room temperature by using atomic vapor in hollow-core optical fiber, which is suitable for integration in fiber-optic quantum network. Finally, we demonstrate that quantum key distribution (QKD) with these states outperforms the typical approach using weak coherent states."

NAME
ANIL KUMAR

TITLE
Quantum Information Processing by NMR: A status Report

ABSTRACT

TBA

NAME
Dieter Suter

TITLE
Optimal control of electronic and nuclear spins as building blocks for robust quantum computers

ABSTRACT

The exponential growth of digital electronics, known as the "digital revolution", has transformed many aspects of our lives, starting with information and communication technology. As this trend is approaching fundamental physical limits, new directions are explored for even more powerful computational devices operating by the laws of quantum mechanics. Such devices can solve problems that will remain out of reach for conventional computers. One of the main difficulties for their implementation is the fragility of information stored in coherent superpositions of quantum mechanical eigenstates. One possible approach is to combine different types of qubits, such as electronic and nuclear spins, to harness their different strengths. Clearly, this approach also faces challenges, such as the different coupling strengths of the different types of quibts. Some of these issues can be circumvented by adaptive optimal control techniques, which avoid direct driving of the nuclear spin species, replacing it by indirect controls. The system that we use to study these issues are single NV centers in diamond.

NAME
M. S. Santhanam

TITLE
Effect of classical structures on quantum correlations

ABSTRACT

It is by now well established that the measures of quantum correlations such as the entanglement is affected by the classical phase space structures. In this talk, using quantum kicked top as a model for interacting spins, we will discuss some of these earlier results on entanglement and new results for other measures such as quantum discord and other multipartite entanglement. In the last part, briefly, we will also discuss interesting periodicity properties of quantum correlation measures in the context of quantum kicked top.

NAME
Amit Mukherjee

TITLE
Bayesian Games, Social Welfare Solutions, and Entanglement

ABSTRACT

"Interesting connection has been established between two apparently unrelated concepts, namely, quantum nonlocality and Bayesian game theory. It has been shown that nonlocal

correlations in the form of advice can outperform classical equilibrium strategies in common interest Bayesian games and also in conflicting interest games. However, classical equilibrium strategies can be of two types, fair and unfair. Whereas in fair equilibrium, payoffs of different players are same, in unfair case they differ. Advantage of nonlocal correlation has been demonstrated over fair strategies. In this work we show that quantum strategies can outperform even the unfair classical equilibrium strategies. Furthermore, we call a quantum strategy as a quantum social welfare solution if it is advantageous over a classical equilibrium strategy in the sense that none of the players has to sacrifice their classical equilibrium payoff, rather some have incentive and at the same time it maximizes the sum of the payoffs over all possible quantum advantageous strategies. Quantum state yielding such a quantum social welfare solution is coined as quantum social welfare advice. Interestingly, we show that any two-qubit pure entangled states, even it is arbitrarily close to product state, can serve as quantum social welfare advice in some Bayesian games. Our result, thus, gives cognizance to the fact that every two-qubit entanglement is the best resource for some operational tasks.

Related references:-
Phys. Rev. A 94, 032120 (2016); arXiv:1703.02773."

NAME
Jasleen Lugani

TITLE
Programmable 8x8 linear optical network based on silicon nitride waveguides for quantum information processing

ABSTRACT

"On-chip universal linear optical networks based on tunable beam splitters and phase shifters are well suited for quantum information processing due to their phase stability and reconfigurability. Many examples and demonstrations have been given on different material platforms such as silicon-on-insulator for e.g., bosonic transport simulation and doped silica for e.g., universal linear optics.

Here, we report the demonstration of an 8x8 mode transformation circuit for quantum information processing implemented in a photonic processor based on single-mode stoichiometric Si3N4 waveguides, with propagation loss as low as 0.2 dB/cm. The advantage of this platform compared to others is the unique combination of high index contrast, enabling a dense waveguide arrangement, ultra-low straight-propagation loss and spectrally wide transparency range from the visible to the mid-infrared. Our photonic processor, fully reprogramable and remotely controllable, consists of 128 thermally

tunable elements arranged in a square mesh, enabling any 8x8 transformation.

We observe on-chip quantum interference with high visibility, i.e., ~76%, on various beam splitters within the photonic processor, and we show bosonic coalescence/anti-coalescence on a 4x4 subsystem. Finally we implement high-dimensional single-photon quantum gates over the whole mode structure of the processor obtaining an average fidelity of ~95%.

Our findings demonstrate the suitability and reliability of low-loss, integrated linear optical photonic processors based on Si3N4 waveguides. These results show the high potential of Si3N4 for the development of large universal linear optical quantum circuits."

NAME
Sandeep K Goyal

TITLE
Photonic quantum memory using intra-atomic frequency comb

ABSTRACT

Photonic quantum memory, such as atomic frequency comb (AFC), is essential to make photonic quantum computation and long distance quantum communication scalable and feasible. In standard AFC the frequency of different atoms must be stable relative to each other which presents difficulties in realizing the quantum memory. Here we propose a quantum memory using intra-atomic frequency comb which does not require frequency stabilization. We show that the transitions between two degenerate energy levels of a single atom can be used to construct the frequency comb. The spacing between the teeth of the comb is controlled by applying external magnetic field. Since the frequency comb is constructed from individual atoms, these atoms can be used alone or in ensembles to realize the quantum memory. Furthermore, the ensemble based quantum memory with intra-AFC is robust against Doppler broadening which makes it useful for high-temperature quantum memory. As an example, we numerically show the intra-AFC in the Cesium atoms and demonstrate a photon-echo which is essential for quantum memory.

NAME
Gautam Paul

TITLE
Integer Factorization using CTC

ABSTRACT

Closed Timelike Curves (CTCs) arise as one of the admissible solutions to Einstein's field equations of the general theory of relativity. Their existence was thought to be highly implausible by Stephen Hawking, as they seemed to violate the chronology protection conjecture. The situation changed when David Deutsch, imposed a self-consistency condition for CTCs, resolving the causal violations and giving scientists an information theoretic tool to study such curves. In this talk we revisit Todd Brun's factoring algorithm using CTC. We find a flaw and propose a solution to circumvent the flaw.

NAME
Shreya Banerjee

TITLE
Bounds for Positive Partially Transposed States and 1 and 2 distillable Werner States Using Geometry

ABSTRACT

Using a geometric measure of entanglement quantification based on Euclidean distance of the Hermitian matrices [1], we obtain the minimum distance between a bipartite n- qudit density matrix with a positive partial transpose and the maximally mixed state. This minimum distance is obtained as $1/\sqrt{d^n(d^n-1)}$, which is also the minimum distance within which all quantum states are separable. An idea of the interior of the set of all positive semidefinite matrices has also been provided. A particular class of Werner states has been identified for which the PPT criterion is necessary and sufficient for separability in dimensions greater than six. We have then calculated the minimal and maximal distance of 1-distillable for this particular class of Werner states from the maximally mixed state for $2 \otimes 2$ systems. Moreover we have found that there is no possible 2-distillable state for this class of states.

Ref: arXiv: 1806.01219 (https://arxiv.org/abs/1806.01219)"

NAME
Ujjwal Sen

TITLE
No purification in all discrete theories and the power of the complete extension.

NAME
Apoorva Patel

TITLE
Quantum simulations with noisy devices

ABSTRACT

"First impact of quantum information processing is expected in development of high precision sensors and simulations of few-body quantum systems. Given that the upcoming quantum devices will be noisy, it is necessary to devise techniques to make them error-resilient as well as to validate and verify their results. Development of hybrid quantum-classical algorithms for solving optimisation problems, with tunable parameters that can be improved by feedback, is an attractive area of research. Another important area of investigation is the study of non-equilibrium quantum processes. Ongoing explorations in these directions will be described."

NAME
Yuval Gefen

TITLE
Weak Measurement-Induced Geometric Phase: A topological transition

ABSTRACT

I will provide a pedagogical introduction to Weak Quantum Measurement. I will report on recent analysis of measurement-induced geometric phase, and will discuss how modification of the measurement strength from strong to weak involves a topological transition.

NAME
Moshe Goldstein

TITLE
Entanglement and Conservation Laws in Many-Body Systems

ABSTRACT

"How are symmetries, which give rise to conservation laws, manifested by entanglement measures? Similarly to the system Hamiltonian, a subsystem's reduced density matrix is composed of blocks characterized by symmetry quantum numbers, or charge sectors. I will present a geometric method for extracting the contribution of individual charge sectors to a subsystemâ€™s entanglement measures (entropies and negativities) within the replica approach, via threading of appropriate conjugate Aharonov-Bohm fluxes through a multi-sheeted Riemann surface.
Specializing to the case of 1+1D conformal field theory, I will describe a general exact result for the entanglement characteristics, in the ground state as well as following a quench. I will apply it to a variety of systems, ranging from free and interacting fermions to spin and parafermion chains, and verify it numerically. For example, I will show that the total ground-state entanglement entropy, which scales as the logarithm of the subsystem size, is composed of square-root of log contributions of individual subsystem charge sectors for interacting fermion chains, or even subsystem-size-independent contributions when total spin conservation is also accounted for. I will also describe how measurements of the contributions to the entanglement or negativity from separate charge sectors can be performed with ultracold bosons or fermions and similar systems."

NAME
Ray-Kuang Lee

TITLE
Quantum Noise Squeezing and its Applications to Gravitational Wave detectors

ABSTRACT

In this talk, I will report our recent implementation of squeezed vacuum states at 1064 nm. With a bow-tie optical parametric oscillator (OPO) cavity, and our home-made balanced homodyne detectors, noise reduction up to 10dB below the vacuum is measured. Applications of our squeezer to the gravitational wave detection will be discussed, with the collaboration with Japanese KAGRA project.

NAME
Alessandro Romito

TITLE
topologically protected heat pumping from Majorana zero modes

ABSTRACT

"Quantum systems can have degenerate ground states where the degeneracy is protected against local fluctuations with exponential accuracy in the system size. This protected degeneracy stems from topology (as opposed to symmetry), which also induces zero energy edge modes with potential non abelian statistics. These excitations are of extreme interest for their fundamental properties and as a platform to implement unitary operations which are topologically protected, i.e. exponentially insensitive to local noises. A number of experiments have reported signatures of the simplest of such excitations, Majorana zero modes, in superconducting nanostructures. The actual focus is on controlling and detecting their topological dynamics.

In this talk, after reviewing the general properties of Majorana zero modes, I will discuss the energetics associated with the topological protected dynamics. I will present specifically the case of a Majorana zero-modes exchange via an adiabatic driving realizable in 1-dimensional networks (e.g. quantum wires). This is a topologically protected non-trivial operation. I will show that when the system is opened to external reservoirs the exchange operation is able to pump energy (heat) between them, as opposed to a vanishing pumped charge. The pumped heat is entirely due to the system dynamics and is topologically protected from local fluctuations. This protection is reflected in a universal coefficient of the pumped heat per temperature. I will finally discuss the robustness and generality of the findings."

NAME
Sibasish Ghosh

TITLE
Measurement-based coupled quantum heat engine without feedback control

ABSTRACT

Role of entanglement is yet to be fully understood in quantum thermodynamics. We shed some light upon that direction by considering the role of entanglement for a single temperature quantum heat engine without feedback, introduced recently by J. Yi, P. Talkner and Y. W. Kim [Phys. Rev. E 96, 022108 (2017)]. We take the working medium of the engine to be a 1-dim Heisenberg model of two spins. We calculate the efficiency of the engine undergoing a cyclic process at a single temperature and show that for a coupled working medium the efficiency can be higher than that of an uncoupled one.

NAME
A R Usha Devi

TITLE
Which-way information with entangled detectors

ABSTRACT

In this talk I outline generalized duality relations between visibility and path distinguishability in double slit interference experiments. Structure of generalized visibility of "dressed" quanton and generalized which-way distinguishability information using detector with "quantum memory" are discussed. Furthermore, other extensions of visibility-distinguishability trade-off relations in terms of information entropies are sketched.

NAME
Jayendra N Bandyopadhyay

TITLE
Floquet analysis of periodically driven systems

ABSTRACT

Periodically driven classical and quantum systems are ubiquitous in nature. This systems can be studied under Floquet theory, and therefore these systems are called Floquet systems. Recently, Floquet systems have got prominence because of its application in designing desired quantum systems starting from a fundamentally different systems. This talk will start with a brief discussion about Floquet theory. We shall then discuss some of our recent results related to the application of Floquet theory to different quantum systems.

NAME
Apoorva Patel

TITLE
Quantum Simulations with Noisy Devices

ABSTRACT

"First impact of quantum information proceesing is expected in development of high precision sensors and simulations of few-body quantum systems. Given that the upcoming quantum devices will be noisy, it is necessary to devise techniques to make them error-resilient as well as to validate and verify their results. Development of hybrid quantum-classical algorithms for solving optimisation problems, with tunable parameters that can be

improved by feedback, is an attractive area of research. Another important area of investigation is the study of non-equilibrium quantum processes. Ongoing explorations in these directions will be described."

NAME
HSI-SHENG GOAN

TITLE
Single-nitrogen-vacancy-center quantum memory for a superconducting flux qubit mediated by a ferromagnet

ABSTRACT

We propose a quantum memory scheme to transfer and store the quantum state of a superconducting flux qubit (FQ) into the electron spin of a single nitrogen-vacancy (NV) center in diamond via yttrium iron garnet (YIG), a ferromagnet. Unlike an ensemble of NV centers, the YIG moderator can enhance the effective FQ-NV-center coupling strength without introducing additional appreciable decoherence. We derive the effective interaction between the FQ and the NV center by tracing out the degrees of freedom of the collective mode of the YIG spins. We demonstrate the transfer, storage, and retrieval procedures, taking into account the effects of spontaneous decay and pure dephasing. Using realistic experimental parameters for the FQ, NV center and YIG, we find that a combined transfer, storage, and retrieval fidelity higher than 0.9, with a long storage time of 10 ms, can be achieved. This hybrid system not only acts as a promising quantum memory, but also provides an example of enhanced coupling between various systems through collective degrees of freedom.

NAME
Ray-Kuang Lee

TITLE
Quantum Noise Squeezing and its Applications to Gravitational Wave detectors

ABSTRACT

In this talk, I will report our recent implementation of squeezed vacuum states at 1064 nm. With a bow-tie optical parametric oscillator (OPO) cavity, and our home-made balanced

homodyne detectors, noise reduction up to 10dB below the vacuum is measured. Applications of our squeezer to the gravitational wave detection will be discussed, with the collaboration with Japanese KAGRA project. At the same time, based on the niche of silicon photonics technologies and semiconductor industries in Taiwan, we will also introduce our proposal toward the implementation of scalable quantum photonic chips by integrating photonic qubits (single photon source, entangled photon pair, squeezed light), optical components based on silicon photonics, and photon detector arrays (single photon avalanche diode, homodyne detector).

NAME
Sai Vinjanampathy

TITLE
Observing Quantum Synchronisation

ABSTRACT

Synchronisation is the mutual adjustment of the rhythms of nonlinear oscillators. The effect is observed at all length scales in nature. There has been a keen interest in observing synchronisation in the quantum regime. I will discuss how to define, discuss and observe synchronisation in the quantum regime.

NAME
Kavita Dorai

TITLE
Experimental classification of entanglement in in three-qubit pure quantum states on an NMR quantum information processor

ABSTRACT

"The detection of entanglement and its characterization is a foundational problem and is a key focus of research in quantum information processing. We have experimentally determined the entanglement class of arbitrary three-qubit pure states on an NMR quantum information processor. Measurements of only four observables suffice to experimentally differentiate between the six classes of states which are inequivalent under stochastic local operation and classical communication. The experimental realization is achieved by mapping the desired observables onto Pauli z operators of a single qubit, which is directly amenable to measurement. The detection scheme is applied to known entangled

states as well as to states randomly generated using a generic scheme that can construct all possible three-qubit states. We also use concurrence as an entanglement measure. Computing the concurrence experimentally under three different bipartitions, for an arbitrary three-qubit pure state, reveals the entanglement class of the state. The results are substantiated via direct full quantum state tomography as well as via negativity calculations and the comparison suggests that the protocol is indeed successful in detecting tripartite entanglement without requiring any a priori information about the states."

NAME
Heung-Sun Sim

TITLE
Non-Abelian Evolution of a Majorana Train in a Single Josephson Junction

ABSTRACT

"In this talk, I will present theoretical studies on two topics about fusions of Majorana fermions.

In the first topic [1], we propose a single Josephson junction to detect a non-Abelian statistics effect of Majorana fermions, formed by two finite-size s-wave superconductors on a topological insulator under a magnetic field. At certain field strengths, a train of three localized Majorana fermions appears along the junction, while an extended chiral Majorana fermion encircles the train and the superconductors. A DC voltage bias across the junction causes the train to move and collide with the extended Majorana fermion. This involves interchange of fusion partners among the four Majorana fermions, leading to non-Abelian state evolution. The evolution gives rise to a $2n \pi$ fractional AC Josephson effect with an arbitrary integer $n \ge 2$ tunable by the voltage.

In the second topic [2], we study topological entanglement in a one-dimensional topological superconductor. We find that the entanglement appears in the bulk of the 1D system, its properties depend on the topological classification of the superconductors (the number of end Majorana fermions), and the entanglement exhibits nontrivial temperature dependence. In a system having one Majorana fermion at the each end, the topological entanglement has a Bell-state form at zero temperature and decays as the temperature increases, vanishing suddenly at a certain finite temperature. In a system having two Majorana fermions at each end, it is in a cluster-state form and its nonlocality is more noticeable at a finite temperature.

[1] Sang-Jun Choi and H.-S. Sim, Non-Abelian Evolution of a Majorana Train in a Single Josephson Junction, arXiv:1808.08714

[2] YeJe Park, Jeongmin Shim, S.-S. B. Lee, and H.-S. Sim, Nonlocal Entanglement of 1D Thermal States Induced by Fermion Exchange Statistics, Phys. Rev. Lett. 119, 210501 (2017)."

NAME
Wei-Min Zhang

TITLE
Decoherence dynamics of Majorana zero modes in topological quantum computing

ABSTRACT

Topological quantum computing based on Majorana zero modes is commonly thought to be robust against decoherence, but no real investigation has been carried out for such a claim. Based on the theory of open quantum systems we developed, we investigate decoherence dynamics of Majorana zero modes in the prototype topological model, of a 1D p-wave spinless topological superconducting chain (TSC), disturbed by charge fluctuations through gate controls. We find that at zero temperature, there still is a zero-energy localized bound state associated with the perturbed Majorana zero mode after included the charge fluctuations, but this zero-energy localized bound state only partially protects Majorana zero modes from decoherence. In finite temperature regime, the zero-energy localized bound state cannot be formed and the decoherence of Majorana zero modes is inevitable. The advantage and the disadvantage of the decoherence dynamics of Majorana zero modes to topological quantum computing will be discussed.

NAME
Hishamuddin Zainuddin

TITLE
Pure 3-Qubit Geometry, Tensor Decomposition & Reduced Density Matrices

ABSTRACT

It is known that complex projective spaces can serve as classical phase spaces for finite-dimensional quantum systems. Canonical group quantization is used to formalize the

required geometric setting via globally well-defined expansion coefficients of the quantum states. In particular, we consider the case of pure three-qubit states and use higher order singular value decomposition (HOSVD) for the tensorial coefficients of three-qubit states to reproduce known entanglement classes. The matrix unfoldings of such HOSVD can be used to construct reduced density matrices of the 3-qubit states, which eventually characterize the local and nonlocal information of the system.

NAME
P. Durganandini

TITLE
Front scaling dynamics in quantum walk models

ABSTRACT

We discuss the dynamical scaling properties of propagating fronts in a single particle quantum walk on a one-dimensional lattice where the particle is allowed to hop to nearest and next nearest neighbours.

NAME
Sristy Agrawal

TITLE
Genuinely entangled subspace with bi-distillable entanglement

ABSTRACT

In a multipartite scenario quantum entanglement manifests its most dramatic form when the state is genuinely entangled. It is, therefore, of significant operational interest to identify subspaces of multipartite quantum systems that contain such states only. In this work, we introduce the notion of unextendible biseparable bases (UBB) that provides an adequate method to construct such genuinely entangled subspaces (GES). We provide explicit construction of two types of UBBs--party symmetric and party asymmetric--for every 3-qudit quantum system, with local dimension d >=3. Further we show that the GES resulting from the symmetric construction is indeed a bidistillable subspace, ie, all the states supported on it contain free (distillable) entanglement across every bipartition.

NAME
P. Durganandini

TITLE

State Key Laboratory of Low-Dimensional Quantum Physics and Department of Physics, Tsinghua University, Beijing 10

ABSTRACT

We discuss the dynamical scaling properties of propagating fronts in a quantum walk model on a one-dimensional lattice where the particle is allowed to hop to nearest and next nearest neighbour

NAME

Chitra Shukla

TITLE

Group multi-party Quantum Key Agreement Protocol

ABSTRACT

Since the advent of quantum key distribution (QKD), several aspects of secure quantum communication have been explored, such as; quantum secret sharing (QSS), quantum secure direct communication (QSDC), quantum dialogue (QD), hierarchical quantum communication, etc. One such idea is quantum key agreement (QKA), where all the parties involved in the key generation process contribute equally to construct the key. This is in contrast to QKD where a single party can control the entire key. Here, we have proposed a new group multi-party quantum key agreement (QKA) protocol, where two small groups can join together using measurement-device-independent subroutine to make a big group by sharing their group keys securely with an untrusted measurement device in the middle. Specifically, it allows to increase the number of parties involved in a QKA protocol, for instance, we have shown an example of a 5-party QKA protocol prepared by joining two small groups of 2-parties and 3-parties, respectively. Hence, two groups can combine into one group easily that features thermodynamic nature to be helpful to deal with the real-world situations. The advantage of this type of scheme would be that for n-partite QKA, we would not require n-qubit entangled state, infect Bell state would be enough for any number of parties. We also analyse the security and efficiency of the protocol.