Chair : **Apoorva Patel**

Violation of Leggett-Garg Inequality under non-hermitian PT symmetric Hamiltonian evolution

A R **USHA DEVI**
17.01.2020
9:30 am
Bangalore University

H. S. Karthik and Akshtha Shenoy Hejamadi

The twilight zone between quantum and classical descriptions continues to attract atention. In particular, investigations on understanding when does a quantum system, confined to a discrete set of states, stops to be in a superposition of these states and approaches a classical macrorealistic limit attract attention even after eight decades of Schrodinger's cat thought experiment. Leggett-Garg inquality (LGI) is constructed to probe macrorealism. Macrorealistic bounds placed on temporal correlation of observables in LGI are not violated when the system is in a well defined state during time evolution, but can get violated when the system is in a superposition of states. Here we consider the three term LGI arising from qubit dynamics generated by a non-hermitian PT symmetric Hamiltonian, when a sequence of projective measurements are carried out at different time intervals. We show that the three term LGI gets violated up to the algebraic maximum value 3, exceeding the quantum bound 1.5 for temporal correlations in a two level system.

High fidelity measurements in superconducting qubits

Rajamani **VIJAYARAGHAVAN**
17.01.2020
10:00 am
Tata Institute of Fundamental Research, Mumbai

Superconducting electrical circuits operating at milli-Kelvin temperatures have emerged as a leading platform for implementing quantum information processing systems. One of the important challenges in this architecture is the implementation of high-fidelity measurements of the quantum state. While tremendous progress has been made in the past decade, there are still some remaining challenges. In this talk, I will outline the quantum measurement problem and describe the various developments in this field like dispersive measurements and parametric amplifiers. I will conclude by discussing some experiments carried out in our research group to tackle some of these challenges.

Chair : **A. R. Usha Devi**

Quantum time and time of arrival

Lorenzo **MACCONE**
17.01.2020
11:15 am
universita' di Pavia

Seth Lloyd, Vittorio Giovannetti, Krzysztof Sacha, Juan Leon

I show how one can give a quantum description of time and time measurements. Our approach requires a minimal extension of standard quantum mechanics. This presentation is based on the following papers:

References

[1] Vittorio Giovannetti, Seth Lloyd, Lorenzo Maccone Quantum Time *Phys. Rev. D*, 47(12):045033, 2015.

[2] Juan Leon, Lorenzo Maccone The Pauli objection *arXiv:1504.04215, Found. Phys.*, 47(12):1597, 2017.

[3] Lorenzo Maccone, Krzysztof Sacha Quantum measurements of time *arXiv:1810.12869*, 2019.

[4] Lorenzo Maccone A fundamental problem in quantizing general relativity *arXiv:1807.01307, Found. Phys.*, 49(12):1394, 2019.

[5] Ekaterina Moreva, Marco Gramegna, Giorgio Brida, Lorenzo Maccone, Marco Genovese Quantum Time: experimental multi-time correlations *Phys. Rev. D*, 96:102005, 2017.

The Second Laws for Quantum and Nano-scale Heat Engines

Manabendra Nath **BERA**
17.01.2020
11:45 pm
Indian Institute of Science Education and Research, Mohali, Punjab 140306, India

Mohit Lal Bera and Maciej Lewenstein

The second law in thermodynamics dictates state transformations. However, the formulation of the second law assumes ensembles with a large number of particles and cannot be extended to the ensembles with a finite number of particles or one-shot regime. Further, the particles could be of quantum nature. We consider heat engines that operate in the one-shot regime and introduce generalized engine operations that allow strong quantum correlations and can improve engine efficiency. With a resource theoretic formalism, we show that thermodynamics of quantum heat engines is fundamentally irreversible and it requires many second laws to characterize the state transformations.

Arrival time distributions and spin in quantum mechanics: A Bohmian perspective

Siddhant **DAS**
17.01.2020
12:00 pm
Mathematisches Institut, Ludwig-Maximilians-Universitat Mu¨nchen, Theresienstr. 39, D-80333 Mu¨nchen, Germany

Detlef Dürr

The arrival time statistics of spin-1/2 particles governed by Pauli's equation, and defined by their Bohmian trajectories, show unexpected and very well articulated features. Comparison with other proposed statistics of arrival times that arise from either the usual quantum flux or from semiclassical considerations suggest testing the notable deviations in an arrival time experiment, thereby probing the predictive power of Bohmian trajectories. The suggested experiment, including the preparation of the wave functions, could be done with present-day experimental technology.

Chair : **Adrian Kent**

Weak values from path integrals

Alex **MATZKIN**
17.01.2020
2:00 pm
CNRS/Univ.
Cergy-Pontoise

Measuring average of non-Hermitian operator with weak value in a Mach-Zehnder interferometer

Surya N. **SAHOO**
17.01.2020
2:30 pm
Raman Research Institute

Gaurav Nirala, Arun K. Pati and Urbasi Sinha

Quantum theory allows direct measurement of the average of a non-Hermitian operator using the weak value of the positive semi-definite part of the non-Hermitian operator. Here, we experimentally demonstrate the measurement of weak value and average of non-Hermitian operators by an interferometric technique. We can directly obtain the weak value from the interference visibility and the phase shift in a Mach Zehnder interferometer without any weak measurement or post-selection. Although experiments discussed here were performed with laser sources,the results would be the same with average statistics of single photon experiments. This can be applied in various applications, one of which is discussed

Quantum circuits with classical versus quantum control of causal orders

Cyril **BRANCIARD**
17.01.2020
2:50 pm
Institut Néel - CNRS,
Grenoble (France)

A standard model for quantum computers is that of quantum circuits, where quantum gates are applied to some quantum systems one after the other, in a well-defined order. It has however been realized in the last decade that quantum theory also allows for quantum operations to be applied in some indefinite order: the paradigmatic example being the so-called « quantum switch », where the state of a « control qubit » controls the order of two operations applied on a « target system ». Here we generalize the idea of the quantum switch; we describe and characterize new classes of quantum circuits, with both classical and quantum control of causal orders. This allows us to investigate new types of quantum processes with indefinite causal order and their potential applications, beyond the quantum switch.

Manipulation of entanglement sudden death in an all-optical experimental setup

Ashutosh **SINGH**
17.01.2020
3:20 pm
Raman Research Institute,
Bangalore-560080, India

A. R. P. Rau and Urbasi Sinha

We have experimentally demonstrated the phenomenon of asymptotic decay of entanglement and entanglement sudden death (ESD) in the presence of an amplitude damping channel for two different initially entangled states. For the state undergoing ESD, we have proposed a local unitary operation (NOT operation, σ_x) such that ESD can be hastened, delayed, or avoided depending on the time of application of NOT operation in the decoherence process. Here, I will present the latest experimental results on the ESD and its manipulation. In the end, I will briefly touch upon the non-equivalence of entanglement measures for two-qubit pure states.