GENERAL TELEPORTATION CHANNEL IN FERMIONIC QUANTUM THEORY

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15 DECEMBER 2025 | **03:00 PM** | **PAMU SEMINAR ROOM**

Quantum Teleportation is a very useful scheme for transferring quantum information. The optimal teleportation fidelity of a shared bi-partite state of a system of distinguishable quantum particles is known to be $(F_{max}d + 1)/(d + 1)$ with F_{max} being the 'maximal singlet fraction' of the shared state. However, Parity Superselection Rule (PSSR) in Fermionic Quantum Theory (FQT) puts constraint on the allowed set of physical states and operations, and thereby, leads to a different notion of quantum entanglement preservation — `locally accessible' and `locally inaccessible'. In the present work, we derive an expression for the optimal teleportation fidelity of locally accessible entanglement preservation, given that the quantum information to be teleported is encoded in Fermionic modes of dimension $2^N \times 2^N$ using $2^N \times 2^N$ – dim shared Fermionic resource state between the sender and receiver. To get the optimal teleportation fidelity in FQT, we introduce PSSR restricted twirling operations and establish Fermionic state-channel isomorphism. Remarkably, we notice that the structure of the canonical form of twirl-invariant Fermionic shared state differs from that of the isotropic state – the corresponding canonical-invariant form for teleportation in Standard Quantum Theory (SQT). In this context, we also introduce restricted Clifford twirling operation that constitute the unitary 2-design in case of FQT for experimentally validating such optimal average fidelity. Finally, we discuss the preservation of locally inaccessible entanglement for a class of Fermionic teleportation channel.

[Based on the work reported in arXiv:2312.04240(quant-ph), together with ongoing works.]

Everyone is invited to attend