

The **Quantum Dynamics Lab** at the University of Kashmir's Department of Physics is dedicated to advancing the understanding of quantum systems, particularly in the realms of **quantum entanglement**, **open quantum systems**, and **non-equilibrium quantum dynamics**. Under the leadership of **Dr. Muzaffar Qadir Lone**, an Assistant Professor with expertise in these areas, the lab engages in both theoretical and computational research to explore the intricate behaviors of quantum systems.

### Research Focus:

**Quantum Entanglement:** Investigating the properties and applications of entangled quantum states, which are fundamental to quantum computing and secure communication.

1. **Open Quantum Systems:** Studying systems that interact with their environments to understand decoherence mechanisms and develop strategies for maintaining quantum coherence.
2. **Non-Equilibrium Quantum Dynamics:** Exploring the behavior of quantum systems out of equilibrium, which is essential for the development of quantum technologies.

### Recent Publications:

- **Non-Markovian Effects on the Steady-State Properties of a Damped Harmonic Oscillator:** This work analyzes how non-Markovian environments, characterized by memory effects, influence the steady-state behavior of quantum harmonic oscillators.
- **Decoherence Dynamics in a Polaron System with Collective Dephasing:** This study delves into the decoherence dynamics of a dressed qubit, represented by a spinless fermion hopping between two lattice sites strongly coupled to a collective bosonic bath, providing insights into managing decoherence within quantum information frameworks.

**Opportunities for Students:** The lab offers internship opportunities for students interested in:

- **Tensor Network Algorithms (TEBD, DMRG, etc.)**
- **Stabilizer Formalism for Clifford Circuits**
- **Bethe Ansatz Techniques**
- **Non-Fermi Liquids from Gauge/Gravity Duality**
- **Quantum Control**

These internships provide practical experience in cutting-edge quantum research areas. Through its focused research and educational initiatives, the Quantum Dynamics Lab contributes

significantly to the advancement of quantum physics, preparing students and researchers to tackle complex challenges in the field.