

PY790/590, Fall 2020:

Special Topics: Quantum information: physical principles and applications.

Instructor: Lubos Mitas

The class will focus on:

- Physical fundamentals of quantum information and quantum computers;
- Types of quantum devices based on superconductors, ionic systems, NMR, optical, etc.;
- Physical processes and limits related to quantum coherence/decoherence and entanglement;
- Differences and options between quantum computing, simulation, and emulation (e.g., emulating particular physical phenomena with different physical systems);
- Consideration of problems appropriate and advantageous for quantum processing;
- Recompetition of classical and quantum approaches for new insights, eg, in path-integral formulations and methods for both classical and quantum problems;
- Understanding the important complexity class Quantum Merlin Arthur and problems that even quantum computer cannot solve efficiently, such as electronic structure of matter;
- Pointing out related research opportunities and applications.

The class will involve hands on experience on IBM systems through miniprojects. There will also be individual final projects, for example, theoretical or computational explorations, or experiments on quantum devices.

The class will be 3 credits, fully online with live zoom at class time and lectures recorded for asynchronous learning for class participants.

Prerequisites: A basic knowledge of quantum mechanics, physics, and programming.