

Spring 2024

OPTI 596-004 Advanced Quantum Optics

Instructor: Kanu Sinha

M/W: 9:30 - 10:45 AM

Meinel, 432

Course Description: This course provides a basic introduction to quantum optical phenomena and their applications to quantum information science, with a focus on quantum metrology. Topics covered include:

- Introduction to quantum light: Quantized electromagnetic field, nonlinear quantum optics (spontaneous parametric down-conversion and four-wave mixing) for generation of squeezed states and entangled photons, Quadrature operators, Homodyne and heterodyne detection.
- Experiments with entangled photons: Double slit quantum eraser/delayed choice experiments, Discrete and continuous variable quantum teleportation, EPR paradox.
- Quantum Optics in LIGO: measurement backaction, standard quantum limit, quantum non-demolition measurements, squeezed states for enhanced sensing.
- Precision measurements with atoms: Introduction to atom-field interactions, matter-wave interferometers, gravimetry, measurement of fine structure constant and precision tests of general relativity, atomic clocks.

Projects: There will be regular problem sets and a final course term paper where students will simulate the results of recent quantum optics/quantum information experiments based on the theory covered in the course.

Recommended books: Quantum Optics: Taming the Quantum by P. Meystre. Detailed lecture notes and additional references will be provided.

Pre-requisites: The course requires an understanding of classical electrodynamics and quantum mechanics.

