PHYS 7895
Gaussian Quantum Information
Spring 2019

Instructor: Prof. Mark M. Wilde, Phone number: (225) 578-4323

Time and Location: Tuesday and Thursday 10:30am-11:50am, Room: Nicholson 262.

Office Hours: TBA

Required Textbook: *Quantum Continuous Variables: A Primer of Theoretical Methods*, Alessio Serafini

Recommended Textbooks: *Quantum Systems, Channels, Information: A Mathematical Introduction*, Alexander S. Holevo (especially Part V).

The Mathematical Language of Quantum Theory: From Uncertainty to Entanglement, Teiko Heinosaari and Mario Ziman

Other Reference: Lecture Notes of Stephane Attal

Prerequisites: Previous exposure to Quantum Information Theory is helpful but not required.

Material: This course introduces the subject of Gaussian quantum information. Due to the experimental "ease" with which bosonic Gaussian states can be prepared and manipulated in the laboratory, and the theoretical elegance and striking simplicity of the bosonic Gaussian mathematical formalism, the topic of Gaussian quantum information seems to penetrate nearly every research area of interest in modern quantum information, including computing, communication, metrology, cryptography, etc. As such, it is thus essential to have a systematic introduction to and presentation of this fundamental topic, and the objective of this course is to provide such an introduction. In particular, we will cover far-ranging topics within Gaussian quantum information, as listed below.

Grading: There will be some assignments and a final presentation. The grading is pass/fail.

Presentation: The final presentation will be a useful way for the students to become more familiar with some of the research topics in the Gaussian quantum information literature.

Week 1	**Week 8**
Separable Hilbert Spaces Bosonic Hilbert Spaces	Minimum Output Entropy Theorem Entanglement of Gaussian States
Week 2	**Week 9**
Faithful Gaussian States Characteristic Functions	Entanglement Cost Capacities of Quantum Gaussian Channels
Week 3	**Week 10**
Gaussian Quantum Channels Semi-Groups of Gaussian Channels	Cramer–Rao Bounds CV Quantum Computing
Week 4	**Week 11**
Gaussian Measurements Homodyne Detection	Encoding Qubits in Oscillators CV Quantum Key Distribution
Week 5	**Week 12**
Heterodyne Detection General-dyne Detection	CV Experimental Realizations
Week 6	**Week 13**
Bosonic Teleportation Teleportation Simulation of Channels	
Week 7	
Fidelity of Gaussian States Entropies of Gaussian States and Channels	

Some of the lectures stated above as a single lecture will likely span more than one lecture.