# ECE 592-048
## Building Blocks for Quantum Computing and Communications

**Instructor(s)**: Dr. John F. Muth, muth@ncsu.edu

**Objective or Description**:

This is a one credit survey course.

The course will provide an introduction into the physics and technologies used to build quantum computers and quantum communication systems. The initial emphasis will be on understanding how different technology approaches lead to the fabricating a useful q-bit, how to set and interrogate the quantum state. Each approach will be examined to see how logic operations can be performed and what is necessary to scale up the number of q-bits to build a useful quantum computer of communication systems.

The course will be oriented around the students reading about one technical paper per week, and class participation will be required. The students will be encouraged to program an IBM quantum computer using an open-source quantum computing framework called Qiskit, but the emphasis of the course is more on understanding the currently competing technology approaches.

**Prerequisites:** Senior Undergrad (permission of the instructor), or Graduate Student Standing. Quantum course not required, but helpful. Linear Algebra is also helpful. Course will be more descriptive than mathematical, or theoretical. Ideally the student should become familiar with quantum concepts and be able to talk intelligently about the state of the art of quantum computing and quantum communications.

**Textbook**: The student will be provided selected readings from the literature.

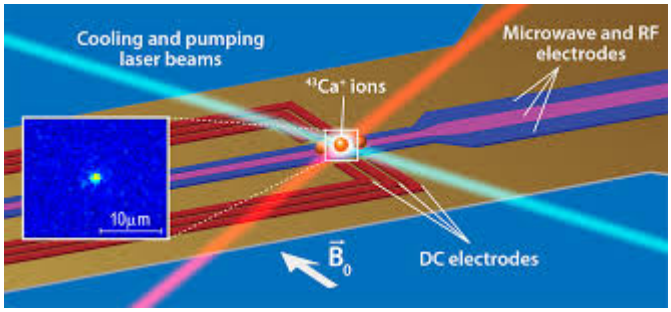
**Topics:**

1. Quantum states, decoherence and entanglement.
2. Electron Spins, Photons and Polarization.
3. Tools for examining quantum states
4. Examples of q-bits: photons, Ion Traps, Nuclear Spins, Defect Centers, and superconducting circuits
5. Forming a q-bit: setting and interrogating the state.
6. Single Photon emitters and detection

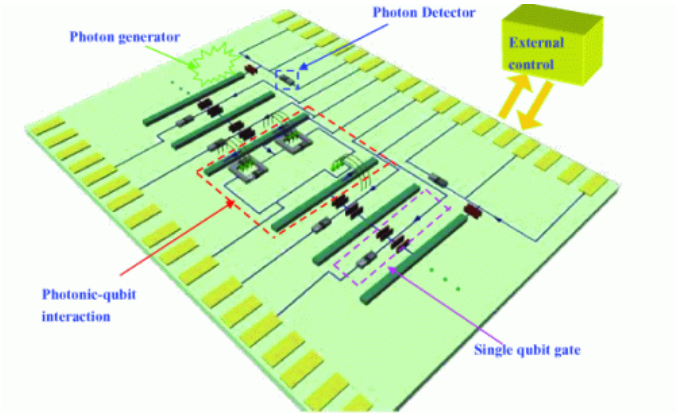
**Grading:**

The course will meet once a week to discuss technologies and share technical information.
Attendance/Participation: 70%
Short Presentation: 30%

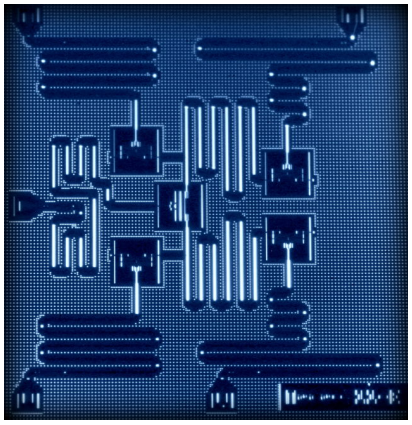
**Cross-listing in other departments:** N/A



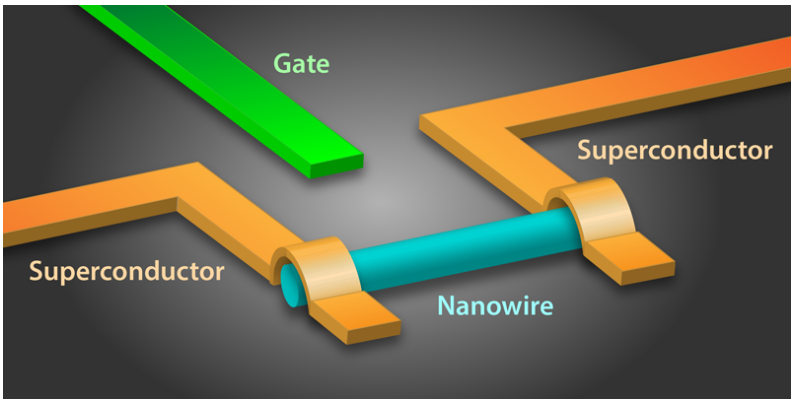

Ion Trap for Quantum Computing



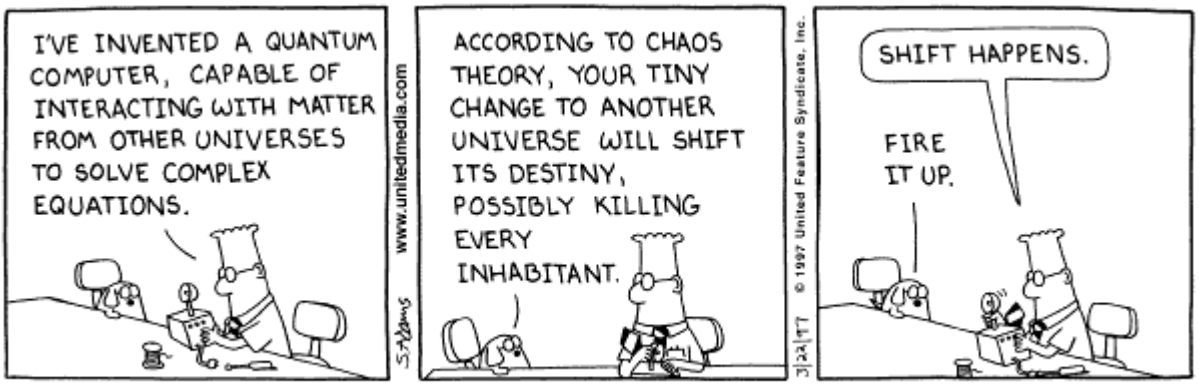

Photonic quantum computer on a chip.



IBM 5 q-bit Universal Computer




Wiring up a qbit, simplifying the computer architecture.






Is quantum computing and quantum communications disruptive? What are the implications of being able to break RSA encryption? How about Quantum Cryptography in communications is that a good thing?