



Welcome to NE 204!

Advanced Concepts in Radiation Detection | Fall 2018

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 - Lab: 1140 Etcheverry Hall
- Class Website: <https://ne204-fall2018.github.io/>
- Class Announcements: bcourses



Course Overview and Objectives

In this course, students will...

- Be exposed to advanced concepts in radiation detection relevant for instrumentation research and a wide variety of applications
 - Varying degrees of detail for many topics - driven by lab work and individual interest
- Gain practical experience with advanced detector systems
 - Set of predefined experiments that will be conducted by all students using modern digital signal processing tools
- Learn how to be a scientific/engineering researcher
 - How to write up, present, and peer-review technical work, emphasizing reproducibility and collaboration



Focus Areas

- Digital signal processing in conventional (coax) HPGe
 - Basic DSP, spectroscopic and timing filters, comparison to analog processing
- Pulse-shape analysis in semiconductor and scintillator detectors
- Segmented electrode semiconductor detectors
 - Position sensitivity, signal generation, charge collection
- Charge transport in semiconductor detectors
 - Experimentally determine charge carrier properties in various semiconductor detectors
- Gamma-ray imaging
 - Collimated modalities (pinhole, multiple aperture, coded aperture)
 - Compton imaging
 - Mobile detector systems
- Neutron detection and imaging
 - Neutron/gamma discrimination, kinematic & time-encoded imaging



Experiments

- Digital signal processing in HPGe - spectroscopy
- Digital signal processing in HPGe - timing and pulse shape
- Digital signal processing with liquid scintillators
 - Pulse shape discrimination (PSD) for n/gamma determination
- Segmented HPGe detectors
 - Position determination
 - Charge transport characteristics
- Segmented CZT detectors
 - Position determination
 - Charge transport characteristics
- Gamma-ray imaging
 - Collimated (pinhole, parallel-hole, coded aperture), non-collimated (Compton)
- Neutron imaging
 - Kinematic imaging with neutron scatter camera



Lab Procedure & Reports

- Lab teams for **at least** the first two experiments
 - Data collection & in-lab work will be done in teams
 - Students will have general access to lab, after-hours work is allowed
- Experimental objectives
 - All experiments have **required** and **optional** objectives
 - How the objectives are addressed is left to the student
- Number of labs
 - At least 2 - largely dictated by class enrollment and equipment availability
- Lab reports
 - All lab reports are required to be written in LaTeX
 - LaTeX source files, code, and code tests will be submitted via github
 - Lab report will be compiled from submitted source
 - All data analysis must be done with open-source tools (Python, C/C++ via GCC)



Final Project

- Similar in scope and style to the predefined experiments, with objectives entirely defined by the student teams
- Should be done in teams
 - Doesn't necessarily have to be the same as your assigned lab teams
 - Team selection should be driven entirely by overlapping interests
- Topics can be drawn from the labs we don't get to, expanding on one of the existing labs, or something entirely different
- Each project will have 3 components
 - **Proposal:** <2 pages, due sometime in the middle of the semester.
 - Provide executive summary, motivation, and specific objectives of project
 - **Final report:** In essence, the same as a lab report
 - Generated collaboratively (1 report per team)
 - Due at end of semester
 - **Final presentation:** Conference-style talk to be delivered by the team near the end of the semester



Reading Assignments

- Over the course of the semester, readings will be assigned from the published literature
- Readings drawn from journal articles, white papers, thesis chapters, etc.
- One reading every 1 to 2 weeks depending on length/detail of the reading
- Evaluation of the reading “assignment” requires you to discuss the article amongst your peers
 - Structure and organization of discussion is up to you (class-wide journal club, set aside 30 min during lab group meetings, etc.)
 - If you miss a discussion you can submit a 1-2 paragraph write up instead
- Discussion should be centered around how the paper topic is relevant to the course, lab, and your own individual research



Requirements & Grading

- Attendance of lectures and lab sessions is required
- The course grade will be determined according to the following breakdown:
 - Lab reports: 45%
 - Final project: 45%
 - Final report: 30% of total
 - Final presentation: 15% of total
 - Participation and readings: 10%
- Reports will be judged primarily on their technical merits
 - Accuracy of and evidence for claims
 - Uncertainty analysis
 - Clarity and correctness of figures, images, numerical results, etc.
- Individual contribution to final project determined via version control and peer review



Course Philosophy

- Student-driven
 - A handful of topics (DSP, charge transport, signal generation) will be covered in depth in both lab and lecture
 - Final project: student-defined, iterative feedback on proposal
 - Lab reports are just guidelines - scope and procedure defined by individual students
- Effective autodidacticism
 - Literature review is the bedrock of graduate study
 - Learn to read and review published work, provide context for new work
- “First author” paradigm
 - How to effectively collaborate while maintaining ownership of your work
- Strongly encouraged to define projects & pursue avenues relevant to your personal research interests



Questions?

For further detail and up-to-date information, please refer to the [course website](#)

Housekeeping (your first assignment...)

- Please complete the online training [EH&S 401.3](#) **before the first lab session on 8/29!**
- This is only necessary if you are not already on RUA #8905