

## DETECTOR PHYSICS

This course will cover an introduction into the theory and use of particle detectors in low-, medium-, and high-energy nuclear physics experiments. It is expected that students come into this course with a working knowledge of undergraduate-level nuclear physics, solid state physics, electrostatics and magnetostatics though proficiency is not required. Knowledge of statistics will be helpful but not required as the relevant elements will be introduced from scratch.

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**Meeting Times:** Mondays @ 2PM in the Main Office Building Auditorium from Oct. 19 to November 23.  
The class on Nov. 2 will be held at 10 AM in the same room because of a scheduling conflict.

**Primary Text:** Leo, William R. 1990. *Techniques for Nuclear and Particle Physics Experiments. American Journal of Physics*. Second Edi. Vol. 58. Berlin, Heidelberg: Springer-Verlag. doi:10.1119/1.16209. – Downloadable

**Secondary Text:** Tavernier, Stefaan. 2010. *Experimental Techniques in Nuclear and Particle Physics*. First. Heidelberg: Springer-Verlag. doi:10.1007/978-3-642-00829-0. – Downloadable

**Website:** <http://trshare.triumf.ca/~dlascar/teaching.html>  
I will post the syllabus, lectures and homework solutions to the website.

**Homework:** Homework will not be graded and is given purely for the students' enrichment. Problems will be given over the course of a lecture and solutions will be made available 2-3 days later.

**Lectures:**

There will be 6 lectures, each covering an hour apiece. Lectures will consist of slides which will be made available prior 2-3 days prior to the class and also blackboard for discussion.

- I. Radiation interacting with matter
  - a. Cross section and mean free path.
  - b. Energy loss.
    - i. Interaction with electrons
    - ii. Cherenkov radiation
    - iii. Bremsstrahlung
    - iv. Photons
    - v. Neutrons
- II. Ionization detectors.
  - a. Deposition
  - b. Transport
  - c. Avalanche multiplication
    - i. Gas choice - quenching
  - d. Proportional Counters
  - e. MWPC
  - f. GEMs
- III. Semiconductor detectors
  - a. Semiconductor refresher
  - b. Doping
  - c. Junctions
  - d. Detectors
    - i. Si and Si(Li)s
    - ii. HPGe
- IV. Scintillation detectors and photomultipliers.
  - a. Scintillators
    - i. Organic v. inorganic crystals.
    - ii. Detection efficiency
    - iii. Light output response
  - b. PMTs
    - i. Photocathode
    - ii. Electron optics
    - iii. Charge multiplication/dynodes.
- V. Support electronics
  - a. Signal basics
  - b. NIM, CAMAC and VME
  - c. Transmission and noise reduction
  - d. Processing electronics
  - e. Analysis electronics
- VI. Statistical methods of data analysis (if there's time)
  - a. Probability distributions
  - b. Error measurement and propagation
  - c. Curve fitting