AVAILABLE EXPERIMENTS

**Faraday Rotation.** Observe the rotation of polarization of light produced by applying a magnetic field as the light propagates through glass. Interesting effect; good use of lock-in amplifier.
*Difficulty:* Low - Moderate  
*Time:* Short  
*Computer Data Acq.:* No  
*Data Acq. Programming:* No  
*Pre-requisites:* Lock-in amp tutorial.

**Lifetime of Cosmic Ray Muons.** Capture cosmic ray muons in a scintillator detector; build up a distribution of decay times from which the muon lifetime can be determined. Learn high energy physics techniques.
*Difficulty:* Low-Moderate  
*Time:* Short  
*Computer Data Acq.:* Yes  
*Data Acq. Programming:* No  
*Pre-requisites:* Basic nuclear counting experiment.

**Resonant Circuit Impedance vs. Frequency:** Construct a capacitor-inductor resonant circuit with variable damping (resistance); use computer-controlled data acquisition to plot impedance response.
*Difficulty:* Low-Moderate  
*Time:* Short  
*Computer Data Acq:* Yes  
*Data Acq. Programming:* Yes  
*Pre-requisites:* AC circuit theory, MATLAB data acquisition programming

**Gamma Spectroscopy.** Use computer pulse height analyzer and scintillator to study the energy spectra of gamma rays from several nuclei; observe evidence for creation and annihilation of antimatter.
*Difficulty:* Moderate  
*Time:* Medium  
*Computer Data Acq:* Yes  
*Data Acq. Programming:* No  
*Pre-requisites:* Radiation Safety; Basic nuclear counting

**Energy gap in a Semiconductor:** Computerized data acquisition of the variation of the reverse saturation current of a p-n diode with temperature; determine energy gap.
*Difficulty:* Low  
*Time:* Short  
*Computer Data Acq:* Yes  
*Data Acq. Programming:* Yes  
*Pre-requisites:* MATLAB GPIB programming

**Specific Heat of Copper:** Fit prediction of Debye theory of heat capacity dependence on temperature; computer collects data using GPIB and MATLAB program which you write.
*Difficulty:* Low  
*Time:* Short  
*Computer Data Acq:* Yes  
*Data Acq. Programming:* Yes  
*Pre-requisites:* MATLAB GPIB programming

**Shot Noise and Electron Charge:** Measure the charge of the electron by observing the fluctuations in current flow from a photoelectric cell. (Computerization possible).
*Difficulty:* Low/moderate  
*Time:* Short  
*Computer Data Acq:* No  
*Data Acq. Programming:* No  
*Pre-requisites:* Knowledge of filters and bandwidth

**Capacitance of a Ferroelectric:** Use computerized capacitance meter to study ferroelectric phase transition as a function of temperature.
*Difficulty:* Low-moderate  
*Time:* Short  
*Computer Data Acq:* Yes  
*Data Acq. Programming:* Yes  
*Pre-requisites:* MATLAB GPIB Programming

**Transmission Lines and Speed of Light in Dielectrics:** Study propagation of voltage pulses on an electromagnetic transmission line (coaxial cable) and determine the speed of light in a dielectric material.
*Difficulty:* Low  
*Time:* Short  
*Computer Data Acq:* No  
*Data Acq. Programming:* No  
*Pre-requisites:* Notes.

**Bragg Diffraction of X-Rays:** Use computer-controlled motor to automate scanning; determine lattice spacing in a crystal.
*Difficulty:* Low-Mod.  
*Time:* Short/med  
*Computer Data Acq:* Yes  
*Pre-requisites:* Knowledge of Bragg Law and crystal structure

**Beta-Particle Magnetic Spectrometer.** Determine energy spectrum of beta particles from a radioactive source by observing magnetic deflection of particles. Show evidence for existence of neutrinos.
*Difficulty:* Low  
*Time:* Med.  
*Computer Data Acq:* No  
*Data Acq. Programming:* No
**Thermionic Emission of Electrons:** Study emission of electrons from heated metal; Stefan-Boltzmann $T^4$ radiation law.

- **Difficulty:** Expt-Low; Anlyz-Med.  
- **Time:** Short  
- **Computer Data Acq:** Option  
- **Data Acq. Programming:** Option  
- **Pre-requisites:** MATLAB GPIB Programming  
- **Notes:**

**High Temperature Superconducting Quantum Interference Device (SQUID).** Observe flux quantization in superconductor and produce quantum state transitions using microwave photons.

- **Difficulty:** Low/med  
- **Time:** Short  
- **Computer Data Acq:** Option  
- **Data Acq. Programming:** No  
- **Pre-requisites:**  
- **Notes:**

**Cavendish Experiment - Measurement of G.** Direct measurement of weakest force of nature. Use capacitive angle detector (or laser “optical lever”) and computer data acquisition to measure G.

- **Difficulty:** Moderate-high  
- **Time:** Medium  
- **Computer Data Acq:** Yes  
- **Data Acq. Programming:** No  
- **Pre-requisites:**  
- **Notes:**

**Mossbauer Effect.** Observe resonant gamma-ray absorption, to incredible precision. Uses computer-based multichannel scaler.

- **Difficulty:** High  
- **Time:** Moderate  
- **Computer Data Acq:** Yes  
- **Data Acq. Programming:** No  
- **Pre-requisites:** Radiation safety; basic nuclear counting  
- **Notes:**

**Hall Effect in p-Germanium.** Observe the magnitude and sign of the Hall effect in p-doped Germanium as the sample temperature is varied. Interesting combination of electrical, magnetic, and thermal measurements.

- **Difficulty:** Low/med  
- **Time:** Short  
- **Computer Data Acq:** No  
- **Data Acq. Programming:** No  
- **Pre-requisites:** Knowledge of basic semiconductor physics  
- **Notes:**

**Earth-Field Nuclear Magnetic Induction-Advanced.** Observe precession of nuclei in the Earth’s magnetic field as their magnetic moments are polarized and depolarized. Observe spin echoes and do imaging.

- **Difficulty:** Low/med  
- **Time:** Short  
- **Computer Data Acq:** Yes  
- **Data Acq. Programming:** No  
- **Pre-requisites:**  
- **Notes:**

**Single Photon Interference.** Use photon counting techniques with a very faint light source to observe two-slit diffraction when only one photon at a time is passing through the system of slits.

- **Difficulty:** Low/med  
- **Time:** Short  
- **Computer Data Acq:** No  
- **Data Acq. Programming:** No  
- **Pre-requisites:**  
- **Notes:**

**Laser Spectroscopy of Rubidium.** Use a tunable diode laser to study the optical absorption spectrum of hot Rubidium gas. Application of a magnetic field allows the Zeeman effect to be observed.

- **Difficulty:** Medium  
- **Time:** Short/Med  
- **Computer Data Acq:** No  
- **Data Acq. Programming:** No  
- **Pre-requisites:** Laser Safety Training  
- **Notes:**

**Pulsed NMR:** Use radio-frequency pulses to polarize nuclear spins, observe spin echoes, and study molecular structure by observing the effect of local magnetic fields on nuclear magnetic moments.

- **Difficulty:** High  
- **Time:** Med  
- **Computer Data Acq:** No  
- **Data Acq. Programming:** No  
- **Pre-requisites:** Completion of Earth-Field Nuclear Induction recommended  
- **Notes:**

**Electron Spin Resonance (ESR):** Use radio-frequency signals to interact with electron spins polarized by a dc magnetic field and achieve resonance with the electron spin precession.

- **Difficulty:** Medium  
- **Time:** Short/Med  
- **Computer Data Acq:** No  
- **Data Acq. Programming:** No  
- **Pre-requisites:** Knowledge modulation spectroscopy and lock-in amp  
- **Notes:**

**Johnson Noise in Resistors:** Study dependence of noise on resistance, resistor material, and current.

- **Difficulty:** Low/moderate  
- **Time:** Short  
- **Computer Data Acq:** No  
- **Data Acq. Programming:** No  
- **Pre-requisites:** Knowledge of filters and bandwidth  
- **Notes:**

**Dark Current & Noise in CCD Detectors:** Study dependence of CCD dark current & noise on temperature and light level.

- **Difficulty:** Mod;  
- **Time:** Short;  
- **Computer Data Acq:** Yes;  
- **Data Acq. Programming:** No  
- **Pre-requisites:**  
- **Notes:**