

**PES 315 Modern Physics Lab
Fall 2004**

Long Experiments

1. Atomic spectroscopy

Use a Fabry-Perot interferometer to optically determine the hyperfine structure of Mercury atoms and to examine the Zeeman effect (splitting of the lines in the presence of a magnetic field). [optics, atomic physics]

2. Introduction to lasers, optical filters, waveguides, optical fibers

A variety of possible experiments in this general area involving lasers and optics and their applications to optical information transmission. [optics]

3. Electron spin (paramagnetic) resonance

Examination of the interaction of quantum mechanical spin of a molecule with magnetic fields. Uses changes in the absorption of radio frequency (r-f) energy in the molecules. [atomic physics]

4. Single slit diffraction - optics

The diffraction and interference of light can be examined using a single slit of variable size. Experimental results can be compared to relatively simple theory. [optics]

5. Interferometry - optical properties of gasses

Use a Michelson interferometer to determine the optical properties of gasses by placing a cell which can be filled with a gas in one arm of the interferometer. [optics]

6. Hall effect - electron and hole transport in materials

Using a powerful magnetic field and electric fields determine whether positive or negative charges carry current in various materials. [solid state physics, E+M]

7. Scanning Tunnelling Microscope

Examine materials on a near-atomic scale. This makes use of quantum mechanical tunnelling phenomenon. [solid state physics, quantum mechanics]

NOTE: This equipment has not been used in about 7 years !!

8. Computer interfacing of lab experiments

Several existing experiments might be better if computerized. IF you know how to interface experiments with computers, we have them available. You would be expected to use the computer as a tool to do better physics on the lab you are working on. [instrumentation]

9. Rutherford Scattering

The structure of the nucleus can be explored by scattering nuclei from other nuclei. This experiment allows you to probe the size of the nucleus. [nuclear]

10. Ellipsometry

Ellipsometry uses the change in the polarization of light when it is reflected from or transmitted through a material to explore the optical properties (index of refraction and absorption coefficient) of a material. In systems which have multiple layers (like thin film deposited on substrates) you can often determine the thickness of the film as well. (Equipment in storage until about Nov. 19) [solid state physics, optics, E+M]

11. Auger Electron Spectroscopy

When electrons are excited into higher energy states they will decay back to the ground state. When they do energy is released from the atom. This can be in the form of light - but it can also be in the form of an electron being ejected from a solid. This experiment uses a beam of incoming electrons to excite electrons in a solid. As those electrons decay, Auger electrons are emitted which have energies which are characteristic of the particular elements found in the solid. This allows you to identify the elements in a material. [solid state physics, atomic physics]

12. Diffraction of electrons

Electrons display wave-like properties and can be diffracted by a grating with atomic dimensions. This allows us to use crystalline solids to diffract electrons. This experiment will explore the diffraction of electrons from different materials. [solid state physics]

13. Crystal structure measurements by diffraction

Use microwaves to probe model systems which behave like x-ray diffraction from crystalline solids. [solid state physics]

14. Elementary particle physics

Examine bubble chamber photographs to draw conclusions about a variety of processes in elementary particle physics. [elementary particle physics]

15. Your choice

If there is another experiment which you would like to try, and we have the equipment to do it, you are welcome to try. You need to talk to me first (soon) and tell me what you want to do and what you think you will need. I will give you some feedback on whether it is appropriate or not.