Modern Physics

For the complete bibliography with references as well as an explanation of the classification scheme go to:

Demonstration Bibliography

The **demonstration name** listed in the bibliography is either the name listed on the reference or, if none is given, a simple descriptive name. In cases where there are several common names for a demonstration, the committee has chosen a preferred name.

The **description** is very brief. It is not intended to be a summary of the reference. One sentence is, in general, sufficient to describe the unique characteristics, if any, of an item. Each source has a unique numbering format. These unique formats are used identify references in the Bibliography.

The formats for the **reference** column and links to the sources are listed below:

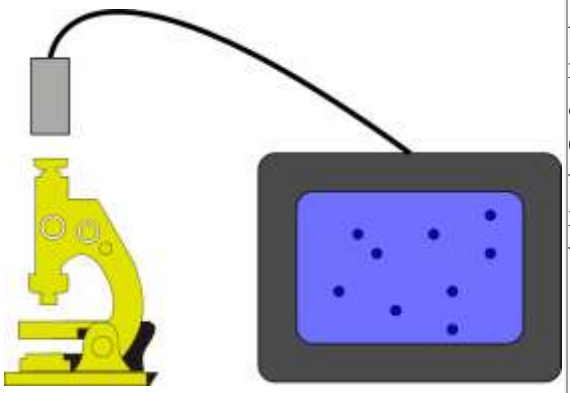
Reference	Source
M-1	Sutton
Ma-1	Freier & Anderson
M-1d	Hilton
8-2.8	Meiners
M-108	Dick & Rae
1A 12.01	University of Minnesota Handbook
AJP 52(1),85	American Journal of Physics
TPT 15(5),300	The Physics Teacher
Disc 01-01	The Video Encyclopedia of Physics Demonstrations
PIRA 200	Physics Instructional Resource Association
PIRA 500	PIRA 500
PIRA 1000	PIRA 1000

Each demonstration is listed in only one location, even if it is commonly used to illustrate several concepts.

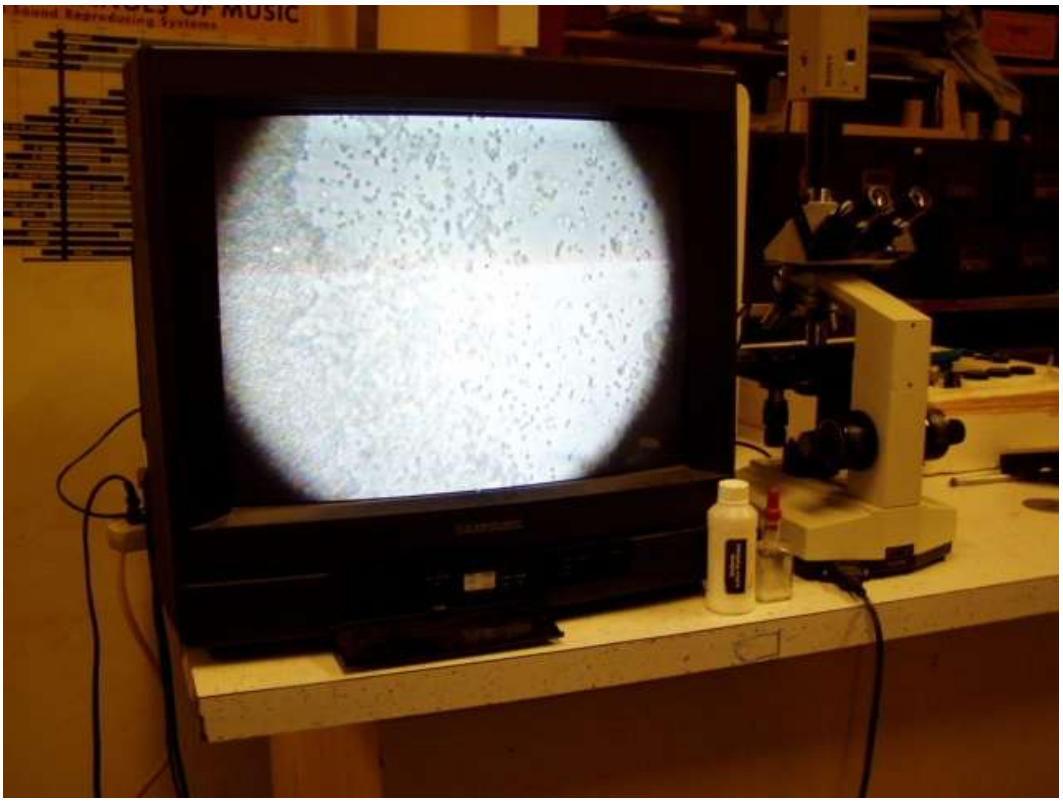
THERMODYNAMICS	4D10.10	**KINETIC THEORY**

Brownian Motion

Brownian Motion Cell



Observe the motion of particles in a smoke cell through a microscope. The balls are about 1 micron in diameter. Put a drop of the solution on a slide then place a cover slide on top of it. Use a drop of oil with the oil immersion objective. The well slide works best (less systematic movement); if you use it, place a drop in the well then dilute it with water.

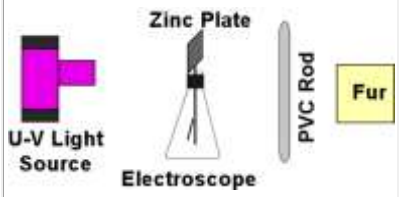


Location: Ga3

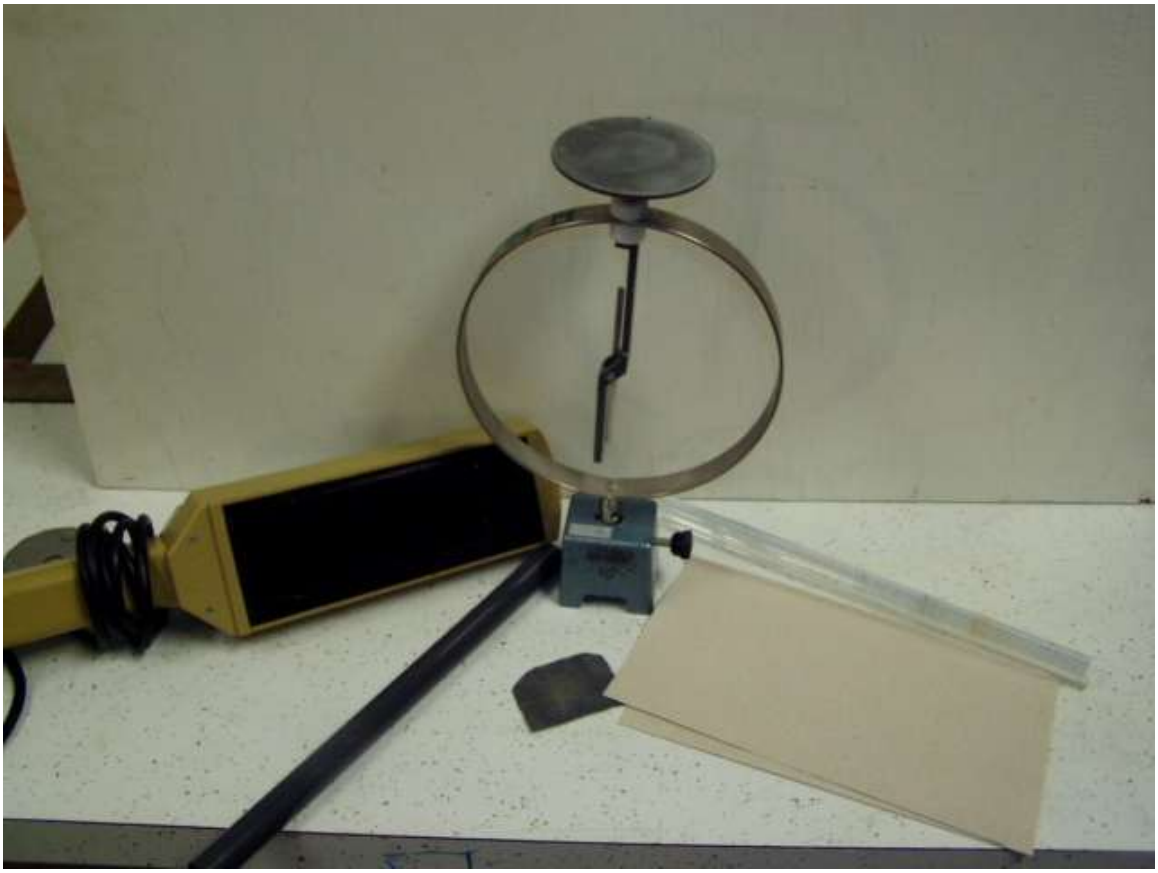
MODERN PHYSICS	7A10.10	**QUANTUM EFFECTS**

Photoelectric Effect

Discharging Zinc Plate

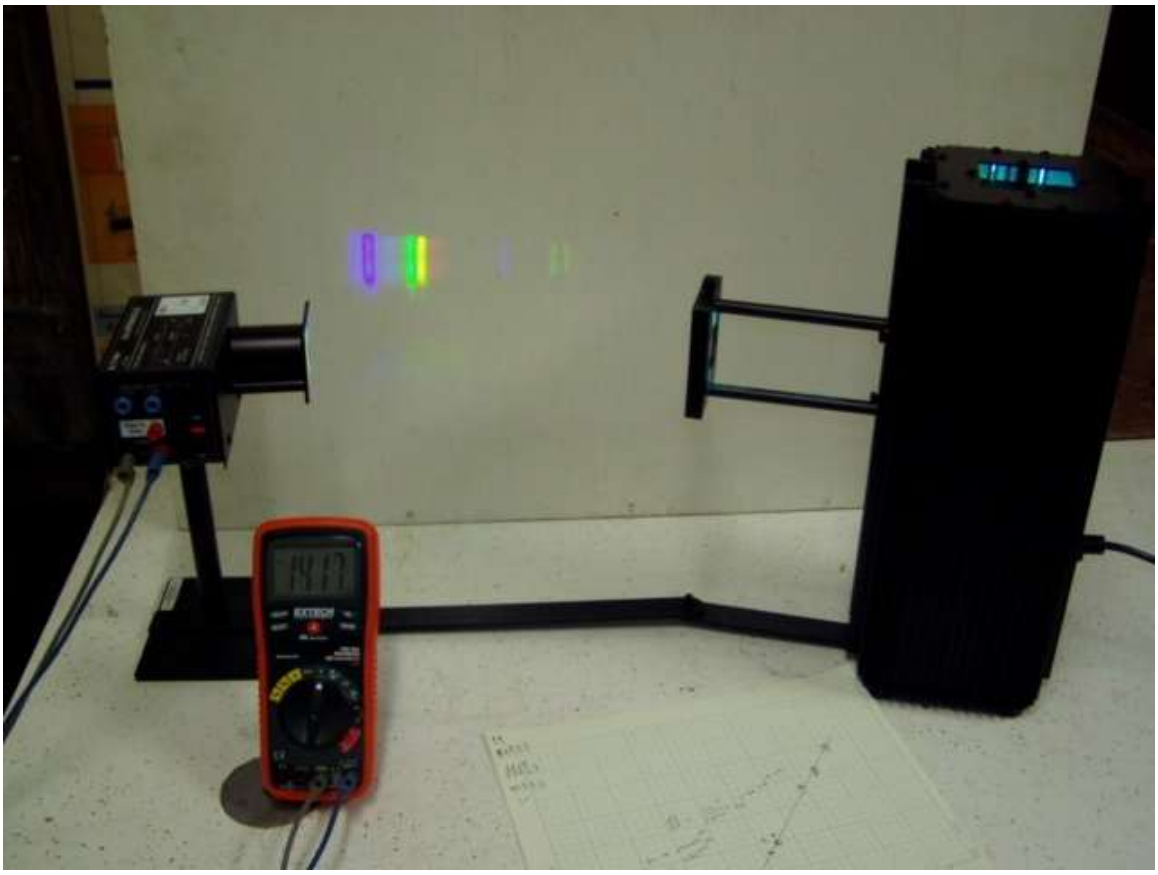


A polished (with fine abrasive paper) zinc plate sits atop an electroscope. Charge the electroscope with a rod. Turn on the UV light. Expose the zinc plate to the UV rays. Do not turn the UV light towards the students. Compare what happens when you charge the plate positively with what happens when you charge it negatively.



Location: Ka2, Gc2

MODERN PHYSICS	7A10.30	QUANTUM EFFECTS
Photoelectric Effect		
Stopping Potential		
	h/e apparatus. Measure the stopping potential of the lines of the mercury spectrum with a photodiode.	

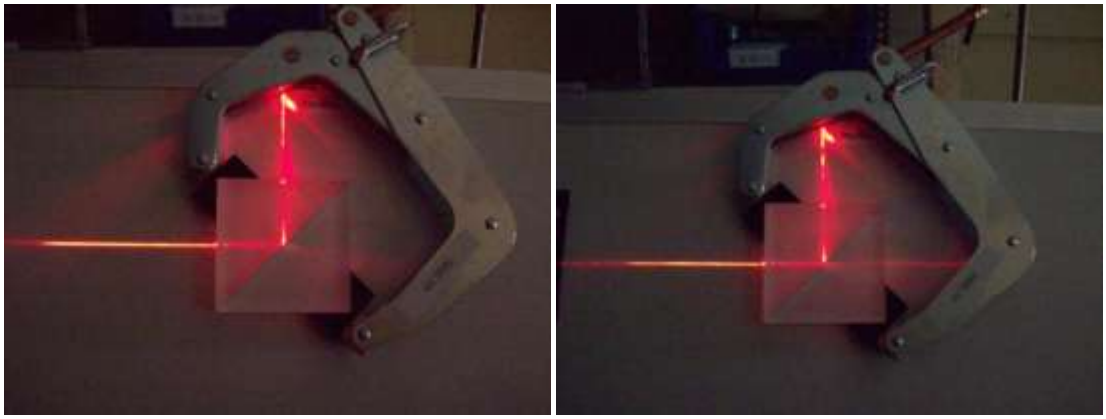


Location: Ka2

MODERN PHYSICS	7A15.10	QUANTUM EFFECTS
Millikan Oil Drop		
# Millikan Oil Drop Experiment		
	The oil drop experiment.	

Location: Ka3

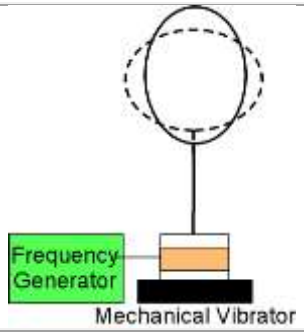
MODERN PHYSICS	7A50.10	QUANTUM EFFECTS
Wave Mechanics		
Frustrated Total Internal Reflection		
	Squeeze two right angle prisms together using a C Clamp and some notched blocks of wood while directing a beam of light at the interface. Use the blackboard optics equipment for this.	



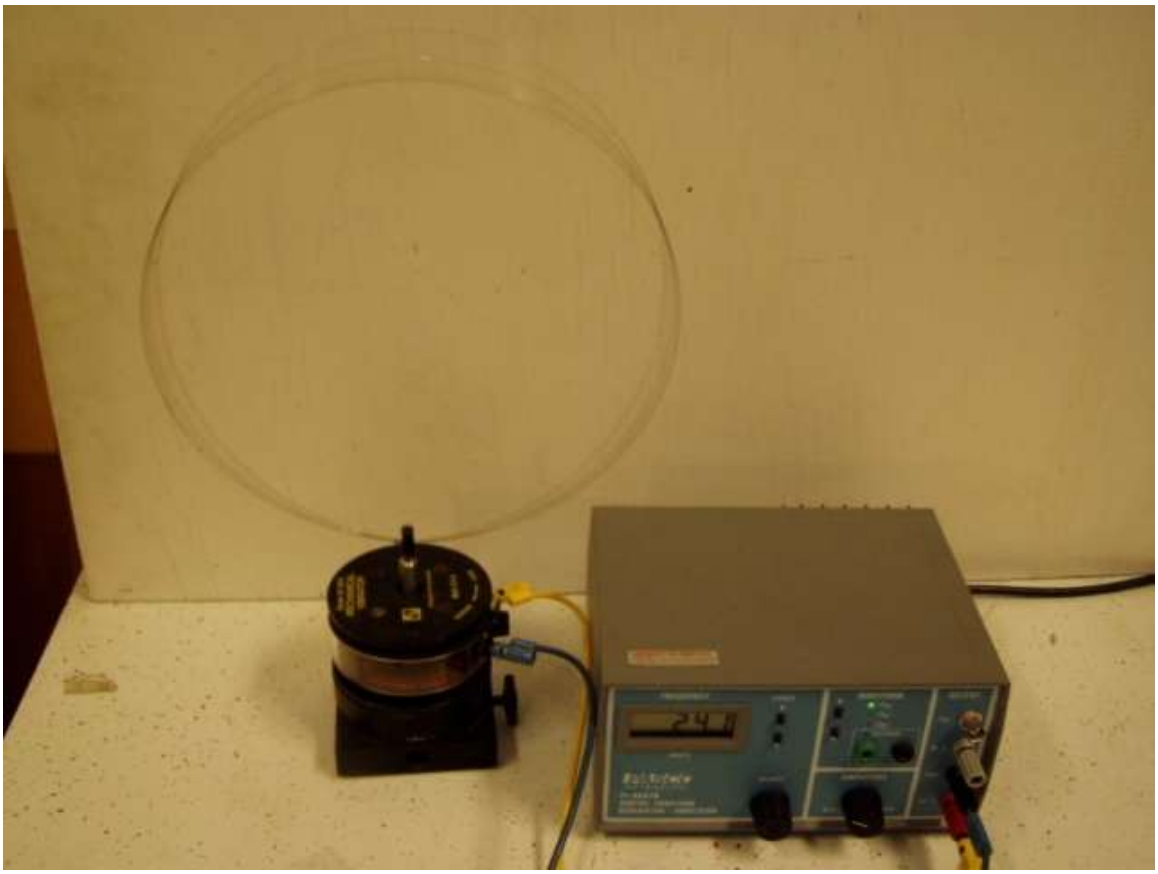
Location: Blackboard Optics Cart

MODERN PHYSICS	7A50.40	QUANTUM EFFECTS
Wave Mechanics		

Vibrating Circular Wire



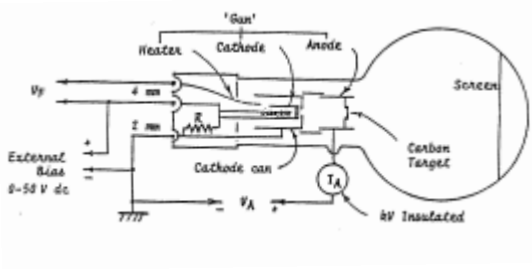
The PASCO signal generator drives the PASCO mechanical vibrator. The three node resonance is at 20Hz. Turn up the amplitude after finding the resonance. Other resonances are at 60, 100, and 140 Hz. Pin the wire at 180 degrees from the mechanical vibrator to get full numbers of waves.



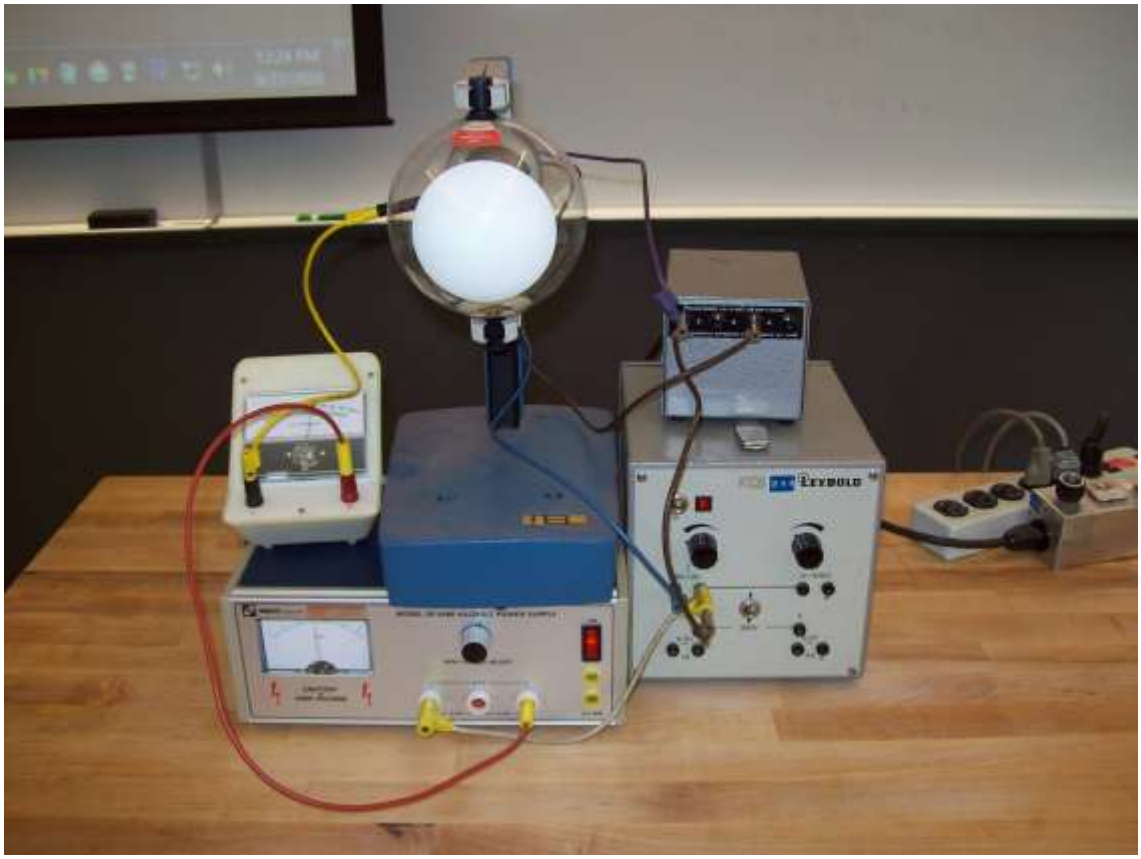
Location: Ka3, Ec2, Fb4

X-ray and Electron Diffraction

Electron Diffraction



Rings or spots diffraction patterns can be shown to the class using a TV camera. The beam and bias will already be adjusted. Turn up the HV until the pattern appears. Do not let the current exceed 170 microamps. Turn down the HV when you are done. The small jack at the back has a negative bias (20 V or so) on it. The filament voltage is 6.3 V and one side is connected to the common ground for the HV and negative bias supply.

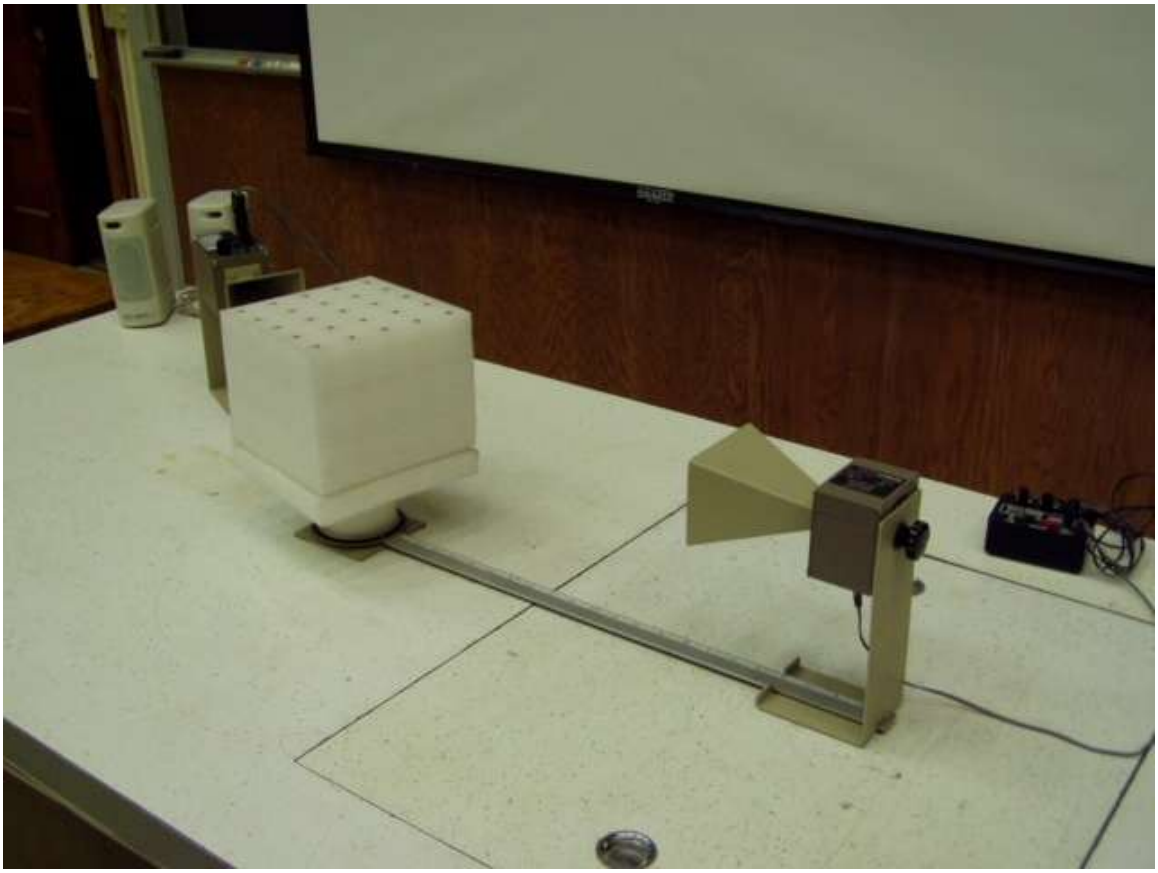


Location: Ka4

MODERN PHYSICS	7A60.50	QUANTUM EFFECTS
X-ray and Electron Diffraction		

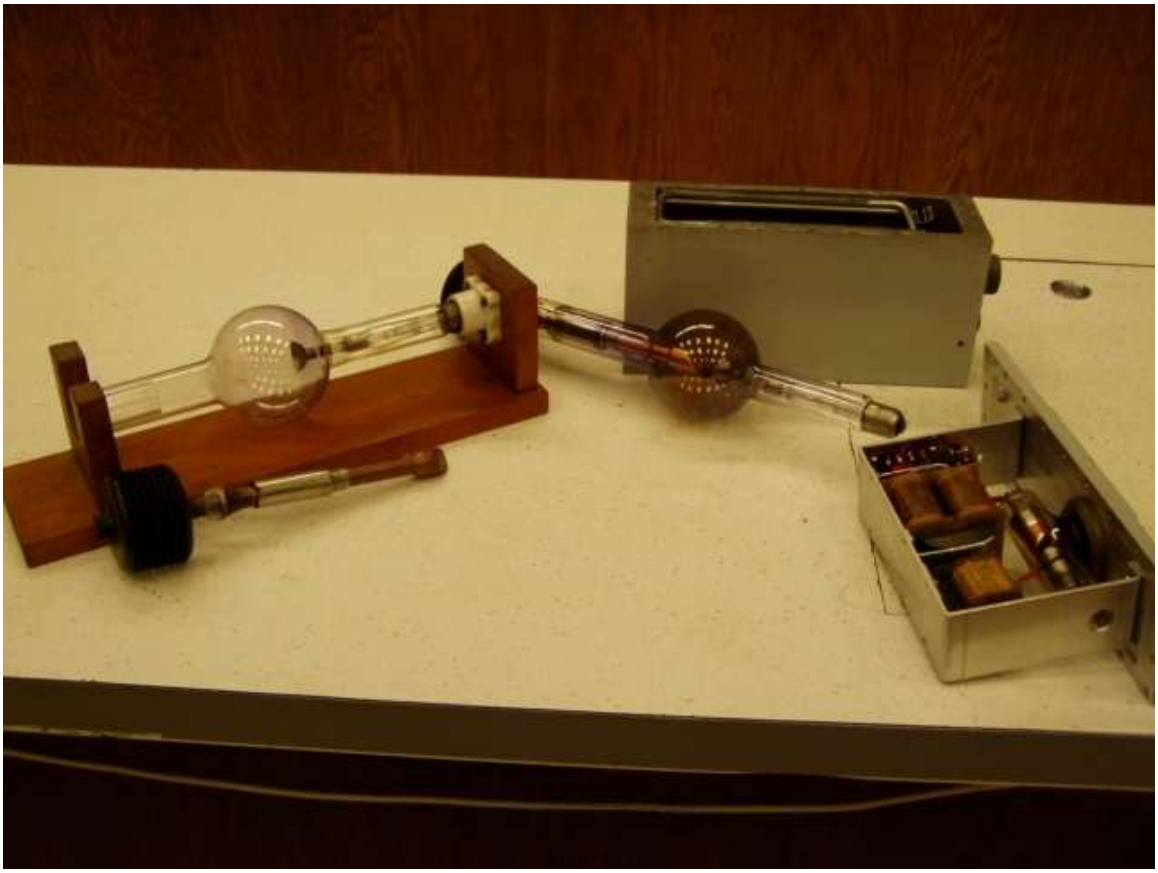
Microwave Bragg Diffraction

	Microwave diffraction is observed from a crystal model made of steel ball bearings mounted in a Styrofoam cube.



Location: Ia7, Ka5

MODERN PHYSICS	7A60.95	QUANTUM EFFECTS
X-ray and Electron Diffraction		
# Sample X-Ray Tube		
	Show a large X-ray tube.	

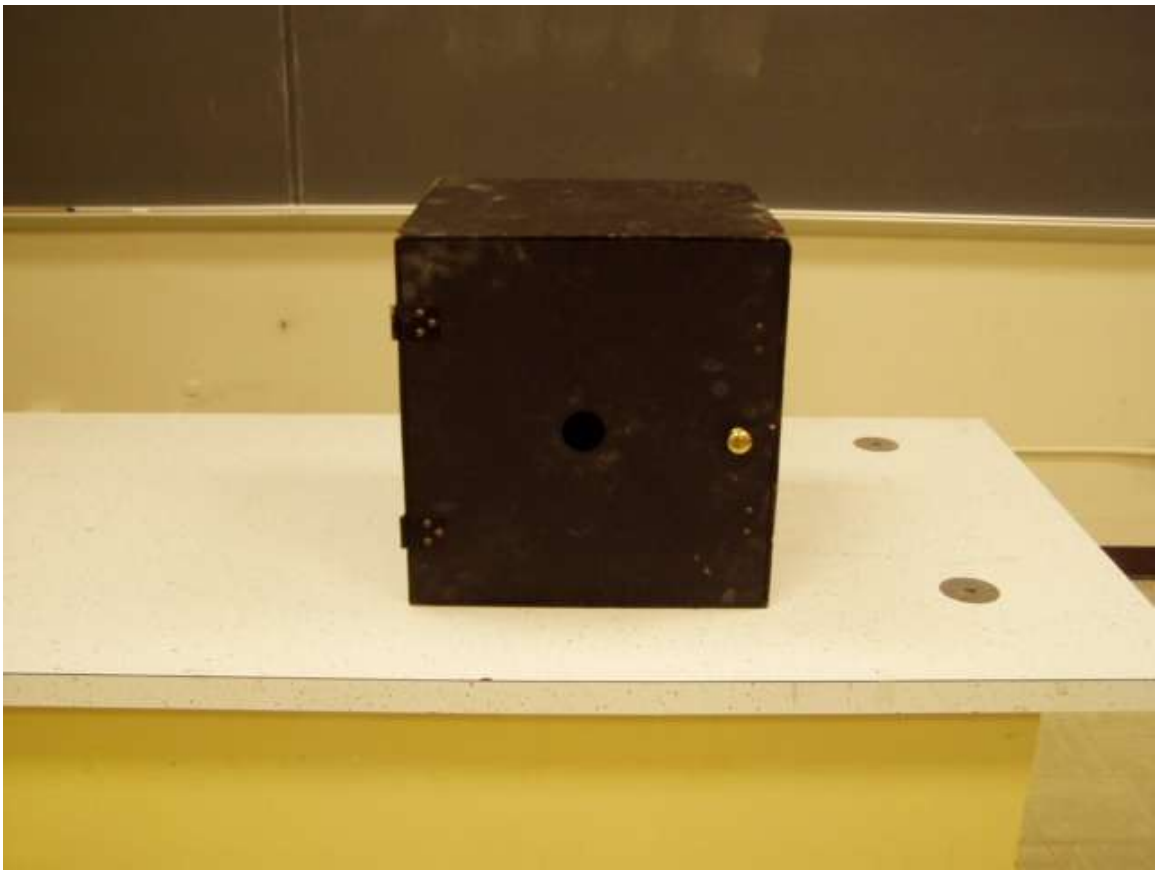


Location: Kd1

MODERN PHYSICS	7A70.40	QUANTUM EFFECTS
Condensed Matter		
Electron Conduction Model		
	The Air Cushion Table is used to show bound charge carriers in an insulator; a free charge in an insulator, conduction in a semiconductor (N type and P type. Air Cushion Table manual: 2.4.9, 2.4.10, 2.4.11, 2.4.12, 2.4.13.	

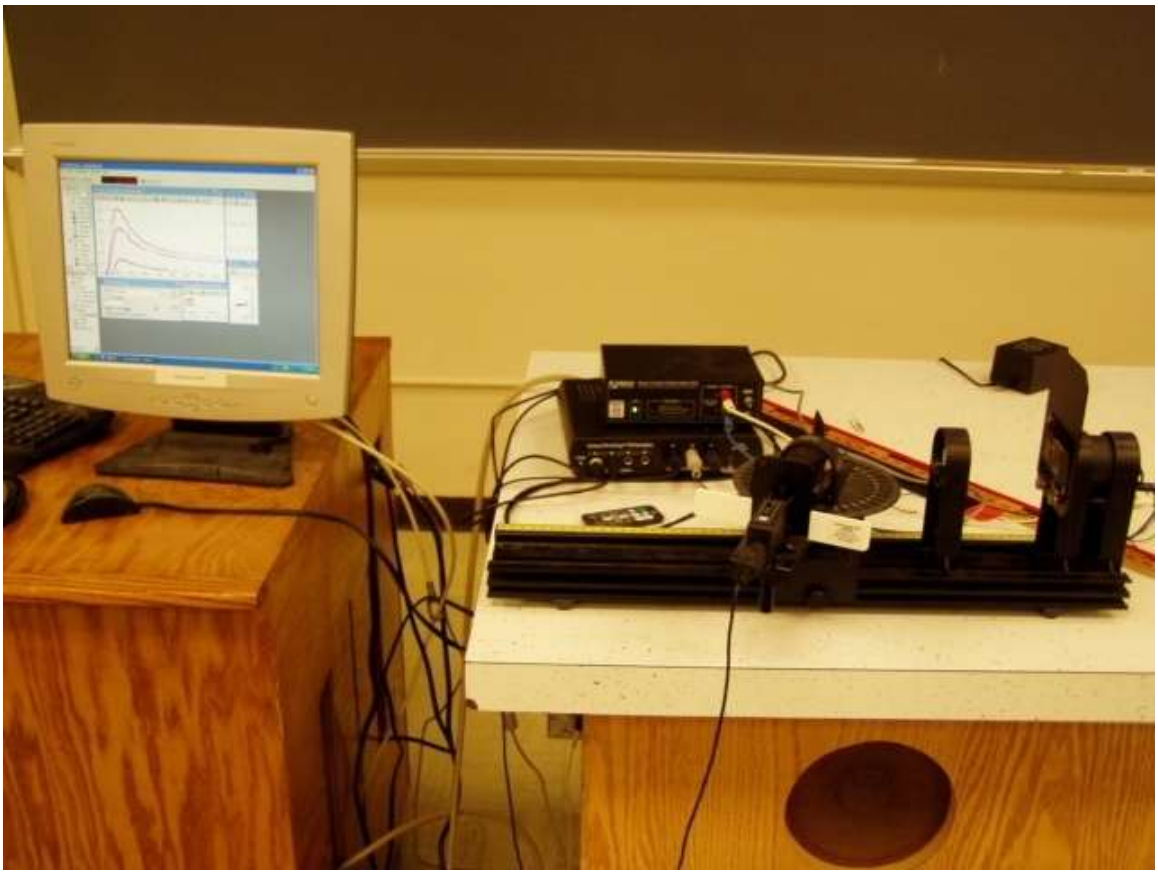
Location: Ga5

OPTICS	6B40.20	**PHOTOMETRY**
Blackbodies		
# Hole in a Box		
	A box that is pained black has a hole in a hinged door. The hole appears blacker than the box, When the door is opened, you see the box is actually painted white on its inside surfaces.	



Location: Jb2

OPTICS	6B40.40	PHOTOMETRY
Blackbodies		
Black Body Spectrum		
	A spectrometer and bolometer connected to Science Workshop is used to record the spectrum from an incandescent bulb at various temperatures.	

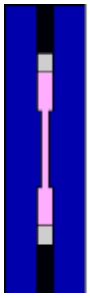


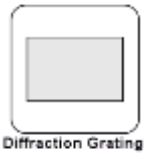
Location: Science Workshop Cabinet, Optics Table Cabinet

MODERN PHYSICS	7B10.10	**ATOMIC PHYSICS**

Spectra

Student Gratings and Line Sources





Pass out the 1"x1" gratings to the students. These have 13,400 lines per inch. Turn on one of the light sources. There is a single filament white light source and three discharge tubes, Hg, He, and Ne. The Didymium filter can be placed in front of the white light source to show selective absorption. Also shown is a spectrometer with a TV camera showing hydrogen Balmer lines and the Ride Tide USB spectrometer showing the line spectrum on the computer. Use the door lite curtains to darken the room.

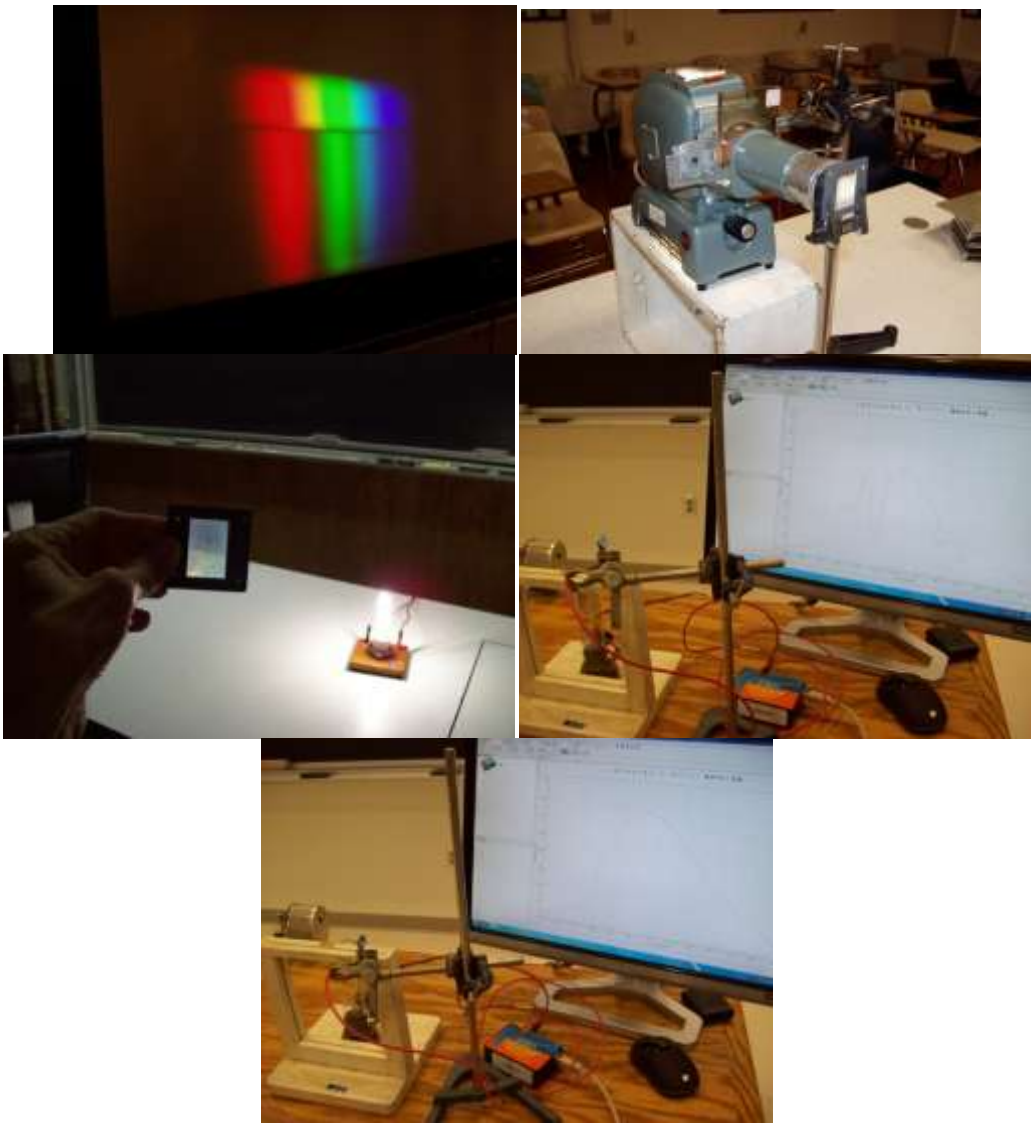
Location: Ja1, Jb2

OPTICS	7B11.65	ATOMIC PHYSICS

Absorption

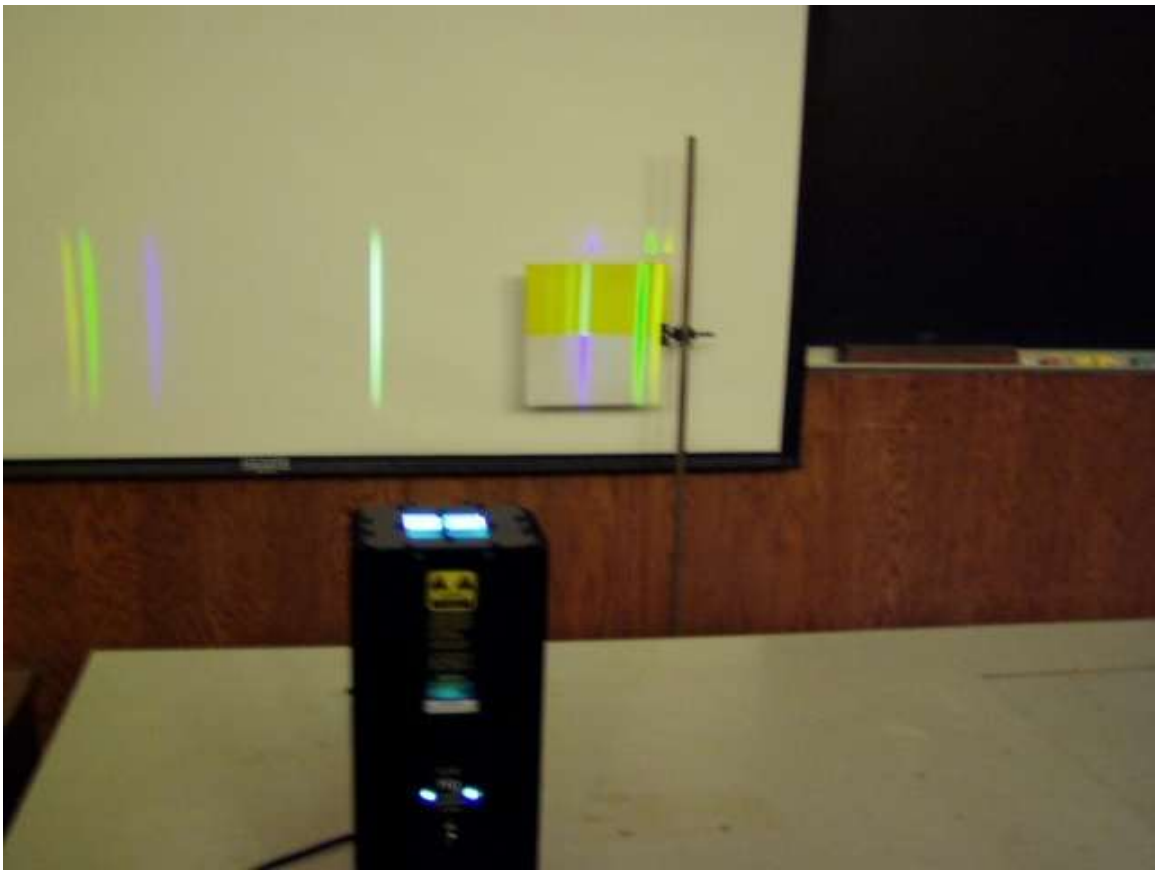
Band Absorption Spectrum

	Didymium glass is used to show band absorption. The Reveal 60 bulb is used with both a grating and the Red Tide spectrometer to show the bands. An ordinary bulb is shown for comparison.



Location: Jb2, Ib1

MODERN PHYSICS	7B13.42	ATOMIC PHYSICS
Resonance Radiation		
# Projected Mercury Spectrum		
	The UV lines of the projected spectrum are made visible using a fluorescent board	



Location: Ka2

MODERN PHYSICS	7B13.50	ATOMIC PHYSICS
Resonance Radiation		

Fluorescence and Phosphorescence

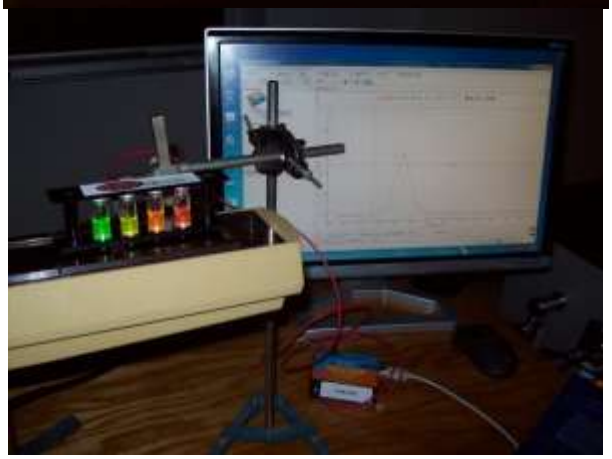
	Fluorescent and phosphorescent materials are shown with a black light.

Location: Kb3

MODERN PHYSICS	7B13.51	ATOMIC PHYSICS
Resonance Radiation		

Particle in a Box

	Nanobeads (quantum dots) of 4 different sizes in solution fluoresce when illuminated with a UV light. The energy calculation is based on the calculation of a particle in a potential sphere (see the appendix of the instructions for more info). The quantum "sphere" or "box" is not empty but filled with a semiconductor. In order for the students to understand this they must first start with the derivation of a 1D particle in a box calculation, the sphere is basically the same physical concept with a different mathematical geometry. Using the Red Tide spectrometer the peaks from the different fluorescing vials can be measured and compared with theory.

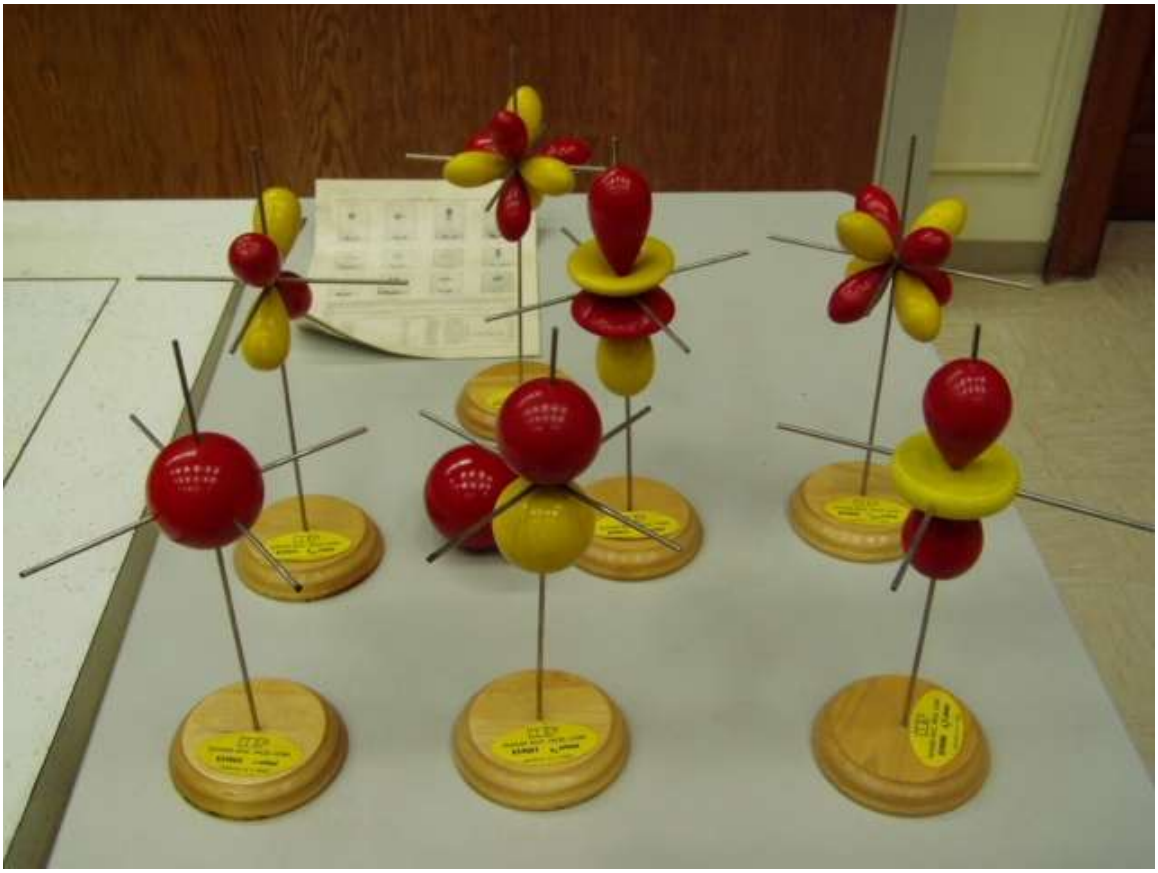


Location: Kb3

MODERN PHYSICS	7B35.75	ATOMIC PHYSICS
Ionization Potentials		
# Plasma Globe		
	Commercial plasma tubes are discussed. Bring your hand near the globe.	

Location: Kb4

MODERN PHYSICS	7B50.10	ATOMIC PHYSICS
Atomic Models		
# Electron Orbital Models		
	A set of Klinger electron orbital models.	

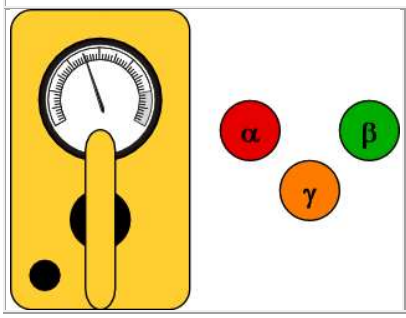


Location: Kb5

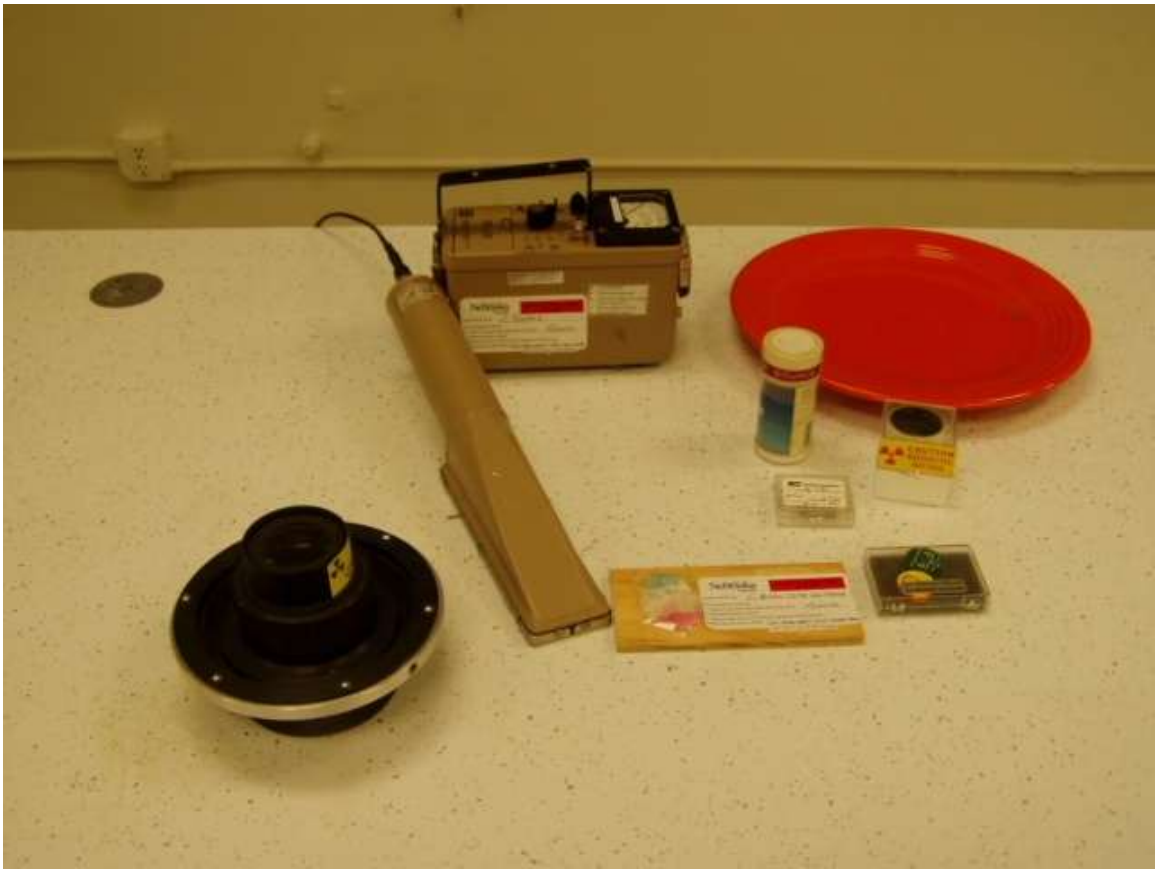
MODERN PHYSICS	7D10.10	**NUCLEAR PHYSICS**

Radioactivity

Geiger Counter and Samples

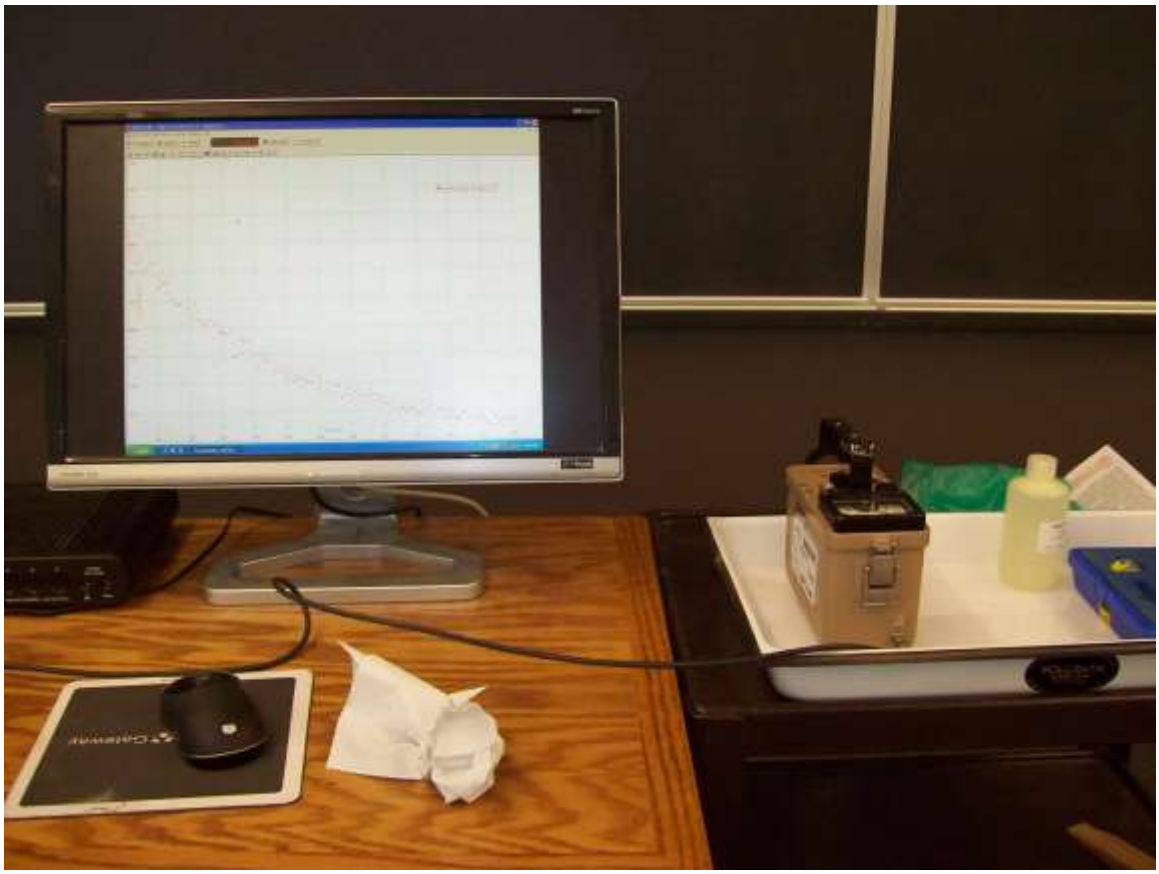


Turn on the counter and place sample under Geiger Tube. Test to see how distance from the sample affects the count. Place objects like: paper, wood, lead and other items between the source and the tube to check their shielding properties. The alpha paddle can be used to selectively detect alpha particles only.



Location: Kb6

MODERN PHYSICS	7D10.20	NUCLEAR PHYSICS
Radioactivity		
Half Life with Isotope Generator		
	Follow the instructions on how to "milk" the generator. It is good practice to survey the work area before and after for contamination. The Geiger counter can be connected to the computer and using Science Workshop one can plot the count rate as a function of time.	



Location: Kb6

MODERN PHYSICS	7D10.33	NUCLEAR PHYSICS
Radioactivity		
# Half Life of Silver		
	Measure the half life of silver activated by a neutron source. Use a glove to handle the “hot” silver as it is a beta emitter. Leave as the closest position to the neutron source for a few minutes to activate it.	

Location: Advanced Lab, Kb6

MODERN PHYSICS	7D10.80	NUCLEAR PHYSICS
Radioactivity		
# Cosmic Rays		
	Scintillator detectors show the passage of a cosmic ray by coincidence counting.	

Electricity and Magnetism	5D40.30	RESISTANCE

Conduction in Gases

Discharge an Electroscope

	Charge the electroscope either positively or negatively by induction (this gives you control over the charge which is necessary as the leaf electroscope is sensitive and can be easily overcharged). Then place the Po-210 source (0.5 mCi when new) in the electroscope and watch the electroscope discharge in a couple of seconds. Use safety protocols when handling the source.

Location: Kb6, Gc2

MODERN PHYSICS	7D20.10	NUCLEAR PHYSICS

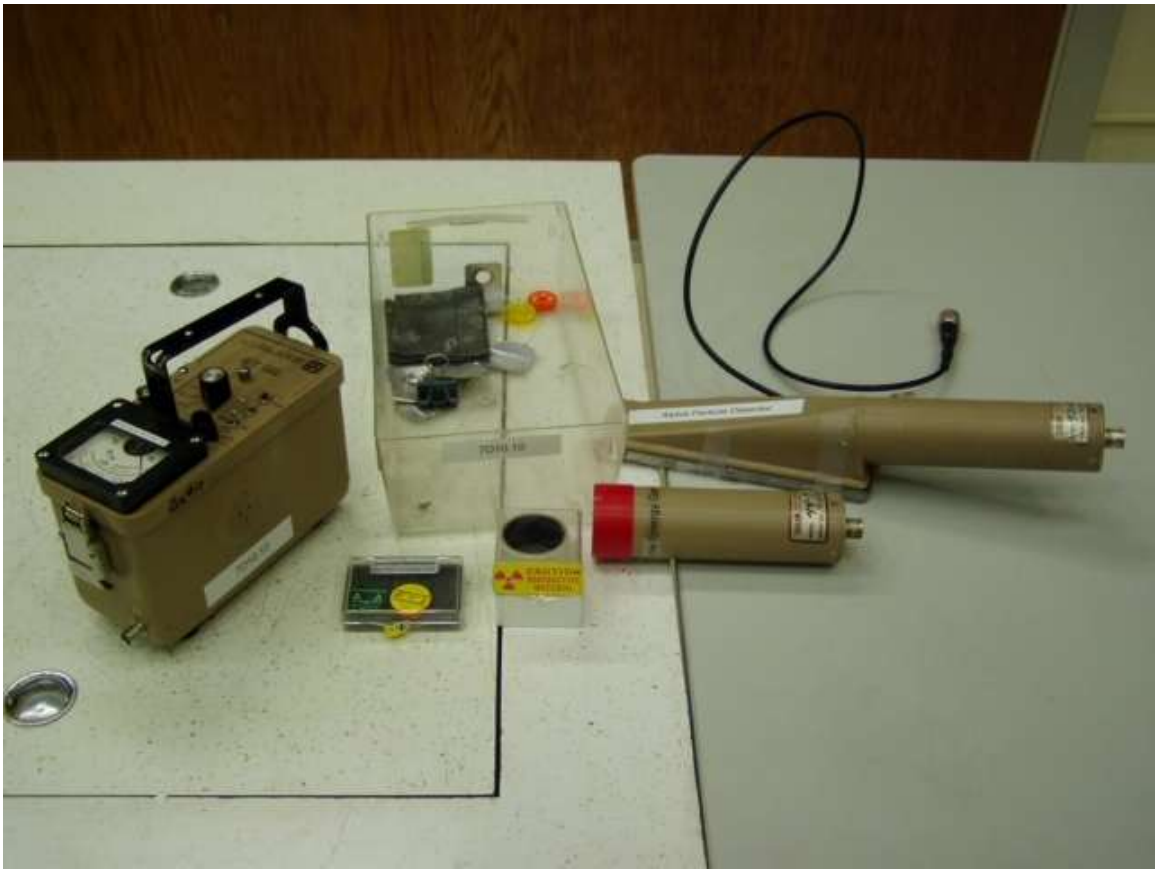
Nuclear Reactions

Mousetrap Chain Reaction

	A 72 mousetraps with corks set on them. Trigger with a single “neutron” (cork). This requires about 20 minutes and nerves of steel to set up. Each trap stores about a joule of energy when set.

Location: KbT

MODERN PHYSICS	7D30.05	NUCLEAR PHYSICS
Particle Detectors		
Ludlum Detectors		
	Ludlum hand held alpha, beta and gamma detectors are used with a variety of sources.	



Location: Kb6

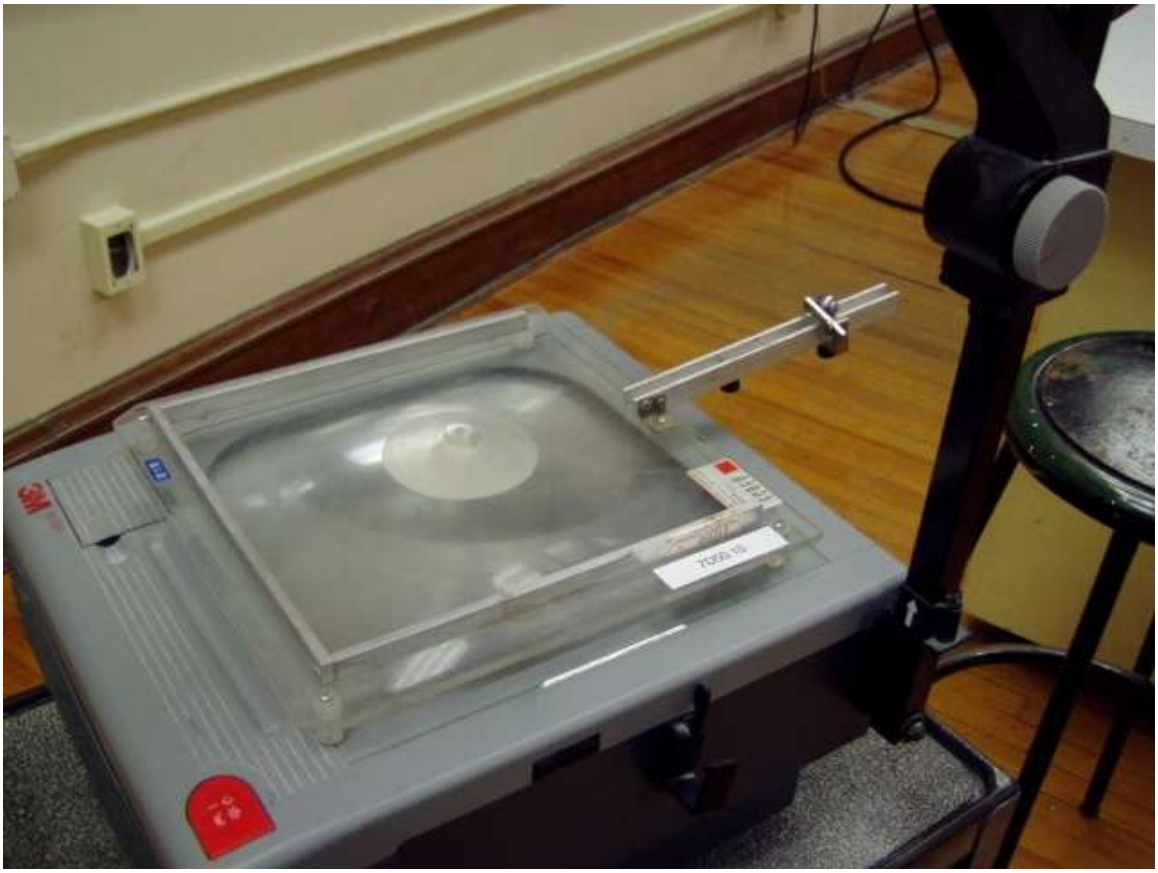
MODERN PHYSICS	7D30.30	NUCLEAR PHYSICS
Particle Detectors		
# Deflection of Beta Rays		
	Turn on the counter and lay it on its side. Open the beta window. Place a beta source nearby, being sure the emitting side is toward the counter. Then bring a strong magnet near the source. The count rate will drop.	

Location: Kb6, Hd5

MODERN PHYSICS	7D30.60	NUCLEAR PHYSICS
Particle Detectors		
# Diffusion Cloud Chamber		
	This demo requires advance notice to obtain ice and let the chamber cool (about 40 minutes). Tracks are most impressive if the students are allowed to view individually. The TV works quite well too. Use either ambient cosmic rays or Pb 210 as a source.	

Location: Kc1

MODERN PHYSICS	7D50.10	NUCLEAR PHYSICS
Models of the Nucleus		
Rutherford Scattering		
	Balls roll down a ramp onto a potential surface to model Rutherford scattering.	



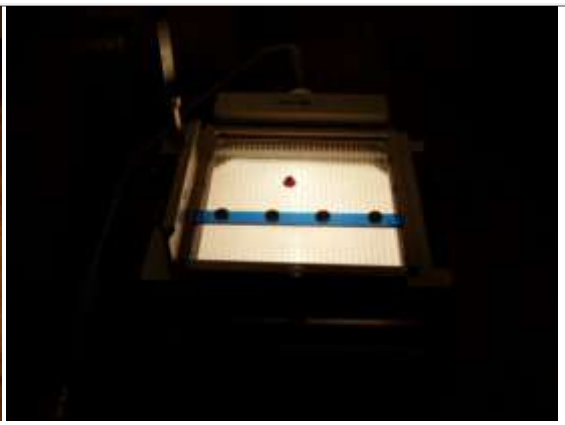
Location: Kc2

MODERN PHYSICS	7D50.14	NUCLEAR PHYSICS

Models of the Nucleus

Rutherford Scattering on an Air Table

	The Air Cushion Table is set up with a plastic platform that holds a magnet which repels a magnetic puck that is set in motion beneath it (Air Cushion Manual, 2.5.1). One can also illustrate the scattering of alpha particles through a foil using a foil made of a 1D lattice four magnets that repel a magnetic puck that is set in motion toward it (Air Cushion Table Manual 2.5.2.



Location: Ga4

MODERN PHYSICS	7D50.25	NUCLEAR PHYSICS

Models of the Nucleus

Rutherford Model

	The Air Cushion Table is set up with a plastic platform that holds a magnet which attracts a magnetic puck that is set in motion beneath it (Air Cushion Manual, 2.5.3). The moving puck goes into orbit beneath the attracting magnet.

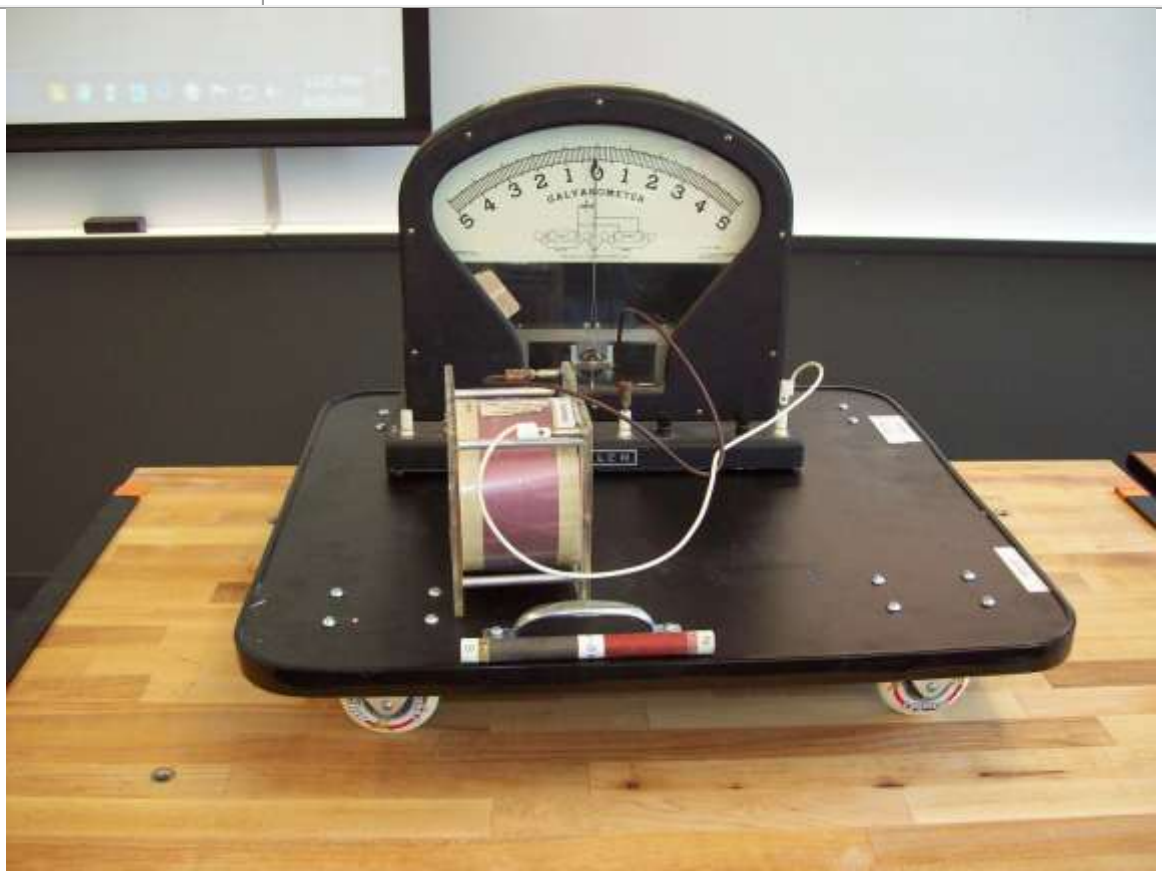
Location: Ga4

MODERN PHYSICS	7F10.35	RELATIVITY

Special Relativity

Induction Coil Relativity

On using the simple induction coil and galvanometer as a special relativity demonstration: AJP 48(9), 780.



Location: BdT, Hc2, Ib3

MODERN PHYSICS	7F10.60	RELATIVITY

Special Relativity

Lorentz Transformation / Time Dilation

The Mechanical Universe, chapter 42, and the Hewitt film "Relativistic Time Dilation"

Location: Ad5