

Electron Optics – Summer 2001 session

PH 410, PH 510

M-Th 4pm-6:15pm June25-July19 Room SB2 104

Lab Rooms SB1 35 and 220

- 25 June – Introduction – Drs. Rempfer, Mauck, Tuggle
Introduction to electron optics – Rempfer
Elementary optics- Mauck
 Light optics terminology
 Index of refraction
 Definition of a lens
 Focal length and distance
SIMION program introduction – Tuggle
Homework – Light optics, SIMION setup
- 26 June – Light Optics & Electron Optics Intro
Review of homework problems
Light Optics Demonstrations – Mauck
Elementary Electron Optics
 Electron trajectories in uniform electric and magnetic fields
 SIMION demo of magnetic and electrostatic deflection - Tuggle
 Rotationally symmetric fields
Lab Demos – Glass column optics demo
 Electron Optics Benches and capabilities
Homework – Light Optics, Einzel example run in SIMION
- 27 June – Electron Optics
Review of homework problems
Gravitational model of hyperbolic lens
SIMION potential energy diagram - Tuggle
Lab Demos – Hitachi TEM – Dash
 Elektros TEM - Rempfer
Homework – SIMION index of refraction
 SIMION magnetic and electrostatic deflector
 Electron Optics
- 28 June – Electrostatic optics– Mauck
 Davisson Calbick aperture lens
Computer Simulation – Tuggle
 Review of homework problems in detail
Homework – DavCal accel/decel by calculation and computer trajectory
 Crossover vs. off-axis height

2 July – First-order focusing

Thin lenses formula

Two D-C lenses in series

Three D-C lenses, Einzel lens

Thick lenses, Newton's formula

Lab Demos - Lab Photoelectron Microscope – Rempfer
Shadow imaging of grids in benches

Homework – Application of D-C formula to three apertures
SIMION applied to a three aperture lens

3 July – Aberrations

Lens & image aberrations

Resolution from Cs only

Homework - Computer ray tracing for determination of Cs

4 July – **NO CLASS**

5 July - Focal property determination by shadow imaging

Homework – SIMION applied to actual lab lens for shadow imaging

9 July – Lab Introduction – Mauck

Homework – Take-home mid-term exam, due 12 July

10 July - Maxwell, Laplace, Finite Difference expressions

11 July – Finite Element, Boundary Element methods

Paraxial Ray Equation

Aberration Integrals

12 July – **Mid Term Exam due**

Lab Work

16 July - Analysis

Theory of resolution

Diffraction

Resolution

Optimal resolution

17 July – Sources - Electron Sources, Brightness, Emittance, Perveance

18 July – Optical instrument, imaging, probe forming

Lab Demos – ISI SEM – Dash
FEI FIB - Tuggle

19 July - Hyperbolic lens

FINAL TEST