Basic optics lab skills

Optics care, types of optics, alignment tricks
Optics care

Don’t let it get dirty in the first place
- Not all optics can be cleaned
- Probability of damage exists with each cleaning attempt

Never touch coatings -- easy to say, hard to do -- improve with practice
- Handle only by edges
- Have clean hand or wear gloves
- If touched, clean immediately -- oils chemically attack coatings

Don’t let dust collect
- Dust is abrasive -- tends to scratch during cleaning
- Don’t let optics lie face up
  - Dust tends not to collect on vertical surfaces
    - why are most optical setups table-top instead of wall-mounted
  - Ex: set temporarily unused optics on edge
    - optics on edge may fall and be scratched
    - usually smaller problem than dust
Optics cleaning

• Compressed gas
  – sensitive optics
  – loosely bound dust
• Drag and wipe
• Lens tissue held by hemostat
Let solvents do the work
• Methanol -- general purpose
• Acetone -- better organic solvent, toxic
  – excellent as vapor degreaser
  – can dissolve optics glues
• Isopropanol -- non-toxic, safe for most optics glues
• Soapy water -- tough, water based dirt
  – Ex: flood in room above or sewer line breaks above optical table
• De-ionized water -- use as rinse after soapy water -- follow with methanol
Types of optics

Passive
- Mirrors
- Beamsplitters -- partially reflecting mirrors
- Lenses and lens assemblies
- Polarizing elements

Active
- Modulators -- acousto optic, electro optic
- Liquid crystals -- shutters, spatial light modulators (SLM)
- Gain media -- lasers
- Nonlinear optical elements
- Samples under study
- Detectors -- photodiodes, power meters
Alignment tricks

General

• Fix beam height on table -- always keep ruler handy
  – Ex: six inches -- usually high enough
  – Reduces 3-D alignment problem to 2-D problem
  – Polarization rotation issues avoided
  – Allows more stable, fixed height mounting
    • can do sensitive experiments w/o floating table

• Mirrors
  – Tilt angle important -- use tilt plate mount
  – Position less important -- but stay away from edge -- 1.5 beam diameters

• Lenses
  – Position important -- use translation mount
  – Angle less important -- but can cause aberrations

• Other, more complicated elements
  – Better to show than tell
Long-term alignment

Use irises
- Laser beam has position and angle - 4 dimensions
  - two mirrors give enough degrees of freedom
  - two irises needed to define
- Divide complex setups into sub-assemblies
  - 2 mirrors, 2 irises are 1st elements in each sub-assembly
- Can use servo control to stabilize
  - replace irises with position sensing diodes
  - many commercial devices incorporate
  - build one here ?
Mirror mounts

• Tilt plate
  – plate thickness, spring stiffness, contact smoothness
• All not alike
  – test with laser and long room

Mount plate
- Hard, smooth inserts
- groove
- dimple
- flat

Support plate

Adjust screw

Mount plate

Prefer 3/8 -- 1/2 ”
Lens mounts

Translation mounts
• less critical than mirror mounts
• long focal lengths -- large translation gives small alignment change
• short focal lengths -- spatial filters and microscopes
  – all spatial filter designs flawed
Mirror and lens mounts

- Magnetic base -- easy to change setup
- Fixed standard height -- more stable
Experimental technique

• Most people either Type 1 or 2
  – depends on personality

• Type 1
  – Quick setup -- try right away
  – If not successful -- fix something, try again
  – Repeat forever

• Type 2
  – Methodical setup
  – Works 1st (or 2nd) time
  – Takes forever before 1st attempt

• Best approach
  – Start with type 1
  – If not successful after several attempts -- do type 2

• Easier to say than do
  – Difficult for both personalities