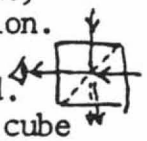
Physics 625

Experiment 0 - Plane Reflection

A. Reflecting-surface collection. Look these over:

1-Opaque. Almost universally metal film on glass.
(a) Front surface. Today usually evaporated Al covered with SiO "hard coat". Can be cleaned, with care. 85-90% maximum reflectivity.
(b) Back surface. Tougher but gives a (weak) second image from unsilvered front surface.

2. Beam splitters. (Some of beam is transmitted.)
(a) Metal films. Absorb a considerable portion.
(1) Hard coated on glass.
(2) Cube — diagonal coated, then cemented. Can still give annoying images from cube faces in certain cases.



(b) "Dielectric" coatings. (Transparent films of different indices.)
(a) Very-high index (TiO_2); other side usually anti-reflection coated. Near 50% and very little color-dependence.
(b) Dichroic. Usually multiple-layer. One color transmitted; its exact complement reflected (since none absorbed). Color changes with tilt.
(c) High reflectivity (>99%). Multiple layers; usually used in lasers, for high entrapment. Very expensive.
(d) Antireflection. (~1%) Usually used on lenses & prisms to decrease ghosts. Appear blue or brown.
(e) Uncoated glass. Can be used if double image not a problem, e.g. in superposing images at infinity.

3. Total Internal Reflection. Used widely in prism designs so long as angles are more glancing than critical angle. Other cases (e.g. Penta); prism surfaces must be silvered (with 10-15% loss per reflection).

B. Handling and cleaning optical surfaces.

1. Handling. Always touch on the (usually ground) inactive surfaces; keep (greasy) fingers off all the active (polished) surfaces. For good quality surfaces it may be advisable to handle only with lens tissue (although this is awkward and could lead do disaster—dropping the element.)

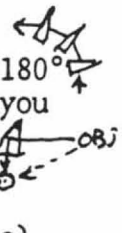
2. Cleaning. (Start with gentle means first. Go farther only if forced to it.)
(a) Gratings, Fabry-Perot's, spherical mirrors, etc. Simply blow off dust with special blow cans. Don't touch or clean, if at all possible.
(b) In the field, camera or binocular lenses can be "puffed off" by mouth, or lightly brushed with clean shirt-tail. If too dirty for this, first brush, then condense breath and wipe with shirt tail with a few short, careful wipes.
(c) Ordinary surfaces in lab can be cleaned with breath and Kimwipes or lens tissue; or if not enough, use ethyl alcohol; wipe dry with fresh tissue; condense breath; and wipe with still another tissue.

3. Donts: Don't place polished surfaces on gritty surfaces - use clean tissue as bed, and turn down an unpolished surface where possible.
Don't: leave optical surfaces exposed to the slow rain of air-dust for extended periods. Cover them.
Don't: Rub over a gritty optical surface and thus scratch it. (First blow, brush lightly, then clean, constantly exposing fresh tissue to get rid of the grit as it is removed.)
Don't: place optical parts where they will be easily knocked off tables in the dark. Coats are the worst offenders.

C. Analysis of prism systems.

1. Plan. Search out simplest, most systematic representations. Use orientation arrows, ROOF, parity count , etc. Half the battle is finding the easy way to draw the system.

2. Common reference for 0°, 90°, 180° systems. These can be compared using a series of imaginary refracting wedge prisms to get 90° and 180° deflections as reference. Equivalent to holding prism in front of you to deflect object from wall, then just turn your head sideways and look directly at same object; compare. E.G., simple 90° prism gives erect, right-left interchanges mirrored; while Amici gives inversion of both directions (image just turned over; readable)



3. Description. In addition to description as in 2, show specific orientation arrows, state parity (readable or mirrored), and remark on any special properties such as "image rotates twice as fast when prism rotates" (Dove), or "optical square" (Penta), etc.

4. Organized Sets on separate tables.
One set of prisms deflects light beam 0° (Rhomb, Dove, Porro-pair, etc); another set deflects 90° (Amici, Penta, etc); a third set deflects 180° (Porro, Corner Cube). It will be perhaps surprising to you how many different 90° prisms we have, and how many equivalent 0° inverting schemes we have. There are one or two wild-looking prisms to challenge you at the end. There is also a sextant, range finder, galvanometer-mirror to demonstrate angle-doubling by rotating mirrors.

D. What to do.

Just move from table to table, and do your analyses with sketches. Then look thru prisms to see if they really do what you deduced they should. Write it all into your notebook as you go. Ask questions if confused, or argue about things with your neighbor.