

Optics and Telescopes

Problem: When looking at the night sky, most stars are simply too faint to be seen with the naked eye. In order to aid our observations, then, astronomers turn to telescopes. How does a telescope work? Our goal in this lab is to explore the principles of optics and their application to the design and performance of astronomical telescopes.

Equipment:

1. Optical benches and mounting hardware
2. Miscellaneous lenses and mirrors
3. Lighted “images” and frosted screens
4. Aperture masks
5. Tabletop optics kit
6. Newtonian telescope

Experimental Goals:

1. Design some experiments to explore the concepts of refraction, reflections, dispersion, and diffraction.
2. Select one of the large lenses to use as an objective lens. Measure its focal length by measuring the image distance for several different locations of a text object (and using the thin lens formula to get the focal length).
3. Using the same lens, construct a simple refracting telescope and measure its aperture, focal ratio, image scale, and magnification.
4. Explore the resolution and image brightness as a function of aperture by masking your objective by various amounts.
5. Evaluate the aberrations of the telescope both in general and while masking the aperture.
6. Compare the performance and aberrations of your telescope with that of the small Newtonian astronomical telescope located in the lab.