ASTRO 100/G – Experiment 2

Telescopes: Area & Resolution

Links to Lectures 4 and 15

Name:	**Grade**
ID:	
UPI/Username:	/10

Heads up!

This experiment has done all of the unit conversions for you.
Do not convert any units into any other units.

Introduction

A reflecting telescope like the one in front of you is effectively a system of two mirrors. There is one large mirror, called the *primary*, at the back of the telescope, and one smaller mirror called the *secondary*, both shown in blue in the figure below. When light comes in (the purple and green lines), it reflects off both mirrors and into an eyepiece (shown as a red cross on the right), enabling us to see the image it is magnifying.

This lab focuses on the mathematics of telescopes, walking you through calculating the resolutions for the telescope in the room in front of you and the Hubble Space Telescope (HST). You will then compare the two in order to discover why a bigger telescope has a better resolution, and what this means.

In lectures, we learned that the amount of light that can be collected by a telescope depends on the surface area of the telescope. Because telescope mirrors are typically circular, the area is given by

$$\text{Area} = \pi \times (\text{radius})^2, \quad \text{and therefore,} \quad \text{Area} = \pi \times \left(\frac{\text{diameter}}{2}\right)^2$$

Thus, if we double the radius of the telescope, we quadruple (as $2^2 = 4$) the area of the telescope. With more collecting area, we collect more light – so we can see fainter objects.

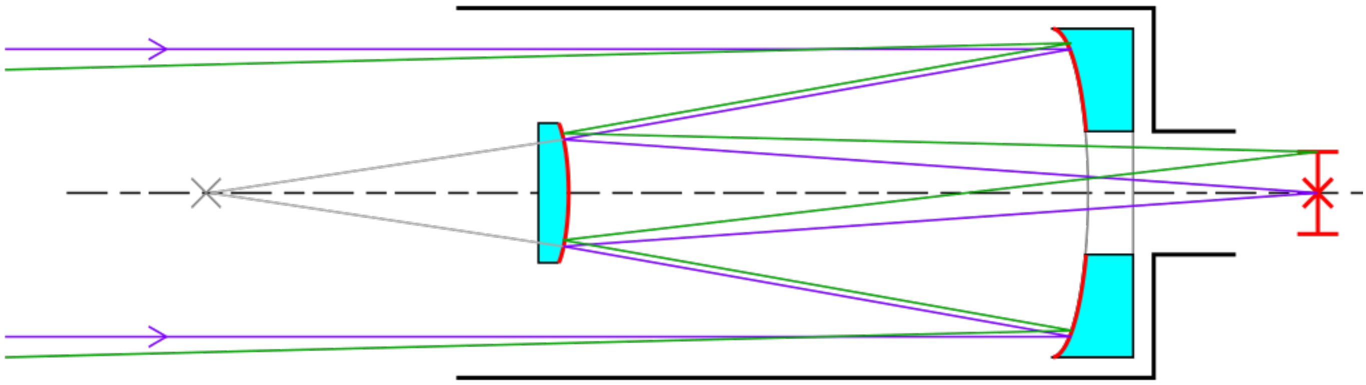

Figure 1: Diagram of a Cassegrain-Schmidt telescope by Krishna Vedala on Wikicommons, licensed under CC-BY-SA 4.0. https://commons.wikimedia.org/wiki/File:Cassegrain_Telescope.svg

At the end of this lab, students will be able to:

- **Compute** the ratio of light collected by two different optical instruments.
- **Qualitatively describe** the resolution of a telescope.
- **Recall** how the resolution of a telescope is related to its diameter.