

## Lab 1: Measuring the Diameter of the Sun

### Purpose

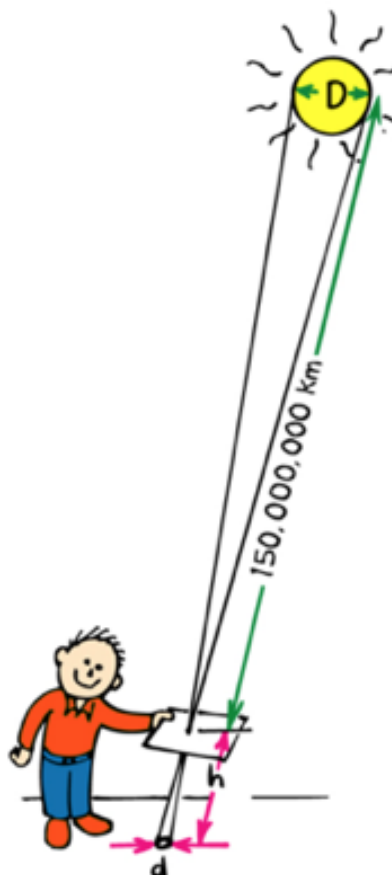
To estimate the diameter of the Sun by an indirect measurement.

### Introduction

In this lab you will measure the diameter of the Sun using the known Sun-to-Earth distance and the result of some basic trigonometry.

The sun is approximately 150,000,000 km from Earth. To give you an idea of how far away this is, consider the fact that traveling at a speed of 300,000 km/s it takes the light from the sun a little more than eight minutes to reach Earth.

Even though the Sun is extremely far away, it is still possible to make an approximate measurement of its size. The Sun's diameter can be estimated by projecting an image of the Sun as sunlight is allowed to pass through a pinhole. The diameter of the Sun is found by solving the proportion,



$$\frac{\text{diameter of Sun}}{\text{distance to Sun}} = \frac{d = \text{diameter of Sun's image}}{h = \text{distance from pinhole to Sun's image}}, \quad \text{Eq. 1}$$

which as demonstrated in class is the result of some basic trigonometry .

### Procedure

To make the measurements for this lab is best if one student holds the pinhole, another student holds and adjust the screen, a third student measures the distance, a

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fourth students measures/draws the sun's image and finally a fifth one records the data.

1. Create a pinhole in a sheet of foil paper. The size of the pinhole will only affect the brightness of the image, not its size. The size of the image is only determined by the distance from the pinhole to the screen.
2. Use a sheet of paper as the screen. You may want to use a rigid surface behind the screen in order to keep it flat and help you draw some marks for your measurements.
3. Use the provided calipers to measure the diameter of the Sun's image on the screen.
4. Use the meter stick to measure the distance from the screen to the pinhole.
5. Record your measurements on the table provided on the next section.
6. Repeat your measurements 5 times by rotating between the students in the team taking turns for each of the measurements.

### Data Collection

<b>Trial #</b>	<b>d = diameter of Image [cm]</b>	<b>h = distance to pinhole [cm]</b>	<b>d/h</b>
<b>1</b>			
<b>2</b>			
<b>3</b>			
<b>4</b>			
<b>5</b>			
		<b>Average d/h =</b>	

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## Analysis

1. Use the average value of  $d/h$  and Eq.1 to calculate the diameter of the Sun. Make sure you convert  $d$  and  $h$  to the same units before computing the  $d/h$  ratios.

2. The actual diameter of the sun is  $1.3 \times 10^6$  km. Use this value to calculate the percent error for your answer.

$$\% \text{ error} = \frac{|\text{accepted} - \text{measured}|}{\text{accepted}} \times 100 =$$

3. List three things that you think produced errors in your measurements.

## Appendix A: How to use a vernier caliper

