

The Effect of Aperture on Images

Gathering Starlight

When you look up at a star in the night sky, you see it as a point of light. If you get out your telescope and look at the star, it still looks like a point of light. So, you find a bigger telescope and look at the star. To your surprise it still looks like a point of light. If the stars are going to remain looking like points of light, why do we need telescopes with bigger mirrors or lenses? What's the advantage?

The Problem: How does changing aperture size affect the images we get from telescopes

The Experiment: To create an experiment to examine the effect of aperture on telescope images, we decided to take a series of images and change only one variable at a time. In this case the variable we manipulated was the telescope aperture. We tried to keep everything else about the telescope and imaging process the same. The images were taken on the same night, one right after the other. Can you think of some reasons why?

Covering the telescope tube with the various masks, we took images with a 2 inch aperture, a 4 inch aperture, a 6 inch aperture, an 8 inch aperture and the normal size without a mask, 24 inches.



We used the Yerkes Observatory 24 inch telescope for this experiment. It has a 24-inch [mirror](#) to collect the light, so its aperture diameter is 24 inches. We have a wooden cover that fits over the end of the telescope tube.



Image Location: Desktop - HOU Images – Telescope - Aperture

Procedure:

1. Predict the difference in images taken when the telescope aperture was covered, leaving smaller openings to collect the light. What will change? What won't change? Record your ideas and your reasoning before you analyze the images.
2. Compare the images taken using the different apertures; collect quantitative data with Salsa.jar data analysis tools. Explain the results of your analysis.
3. Compare your results with your predictions

Observe, compare and discuss the quality of the images. Collect data for each image using image processing and analysis tools. Here are some ideas for using the Salsa.jar tools. Choose one way to test your prediction.

Compare brightness data between images for individual objects.

- We suggest using Photometry tools.
- Calculate aperture area (area of a circle = πr^2) and compare that to brightness data.
- Use graph paper, or a spreadsheet and graphing program to record, display and analyze your data.

Compare the field of view for each of the images.

- Compare the size of individual objects.

Conclusions: Look carefully at the data and your analysis. Use complete sentences to:

1. Answer the problem question. *How does changing aperture size affect the images from telescopes?*
2. Explain why this aperture experiment was titled, "Gathering Starlight"?

Application:

1. On a particular Friday night, when The University of Chicago Yerkes Observatory was observing for the Science Museum in Tokyo during their Science Live Show, UNIVERSE, the Japanese audience requested to see the beautiful full moon. When the first image was taken, the moon was so bright, no features could be seen. What would you recommend to the astronomers taking the images?
2. When you look at the moon through a telescope or binoculars, it is often so bright that it hurts your eyes. What could you do to make studying moon features more comfortable for your eyes?
3. Astronomers often apply for observing time on very big telescopes. What advantage does a telescope with a large aperture have over smaller aperture telescopes for doing research?