

Atmospheric Extinction and Light Pollution
Earth & Sky

Name: _____

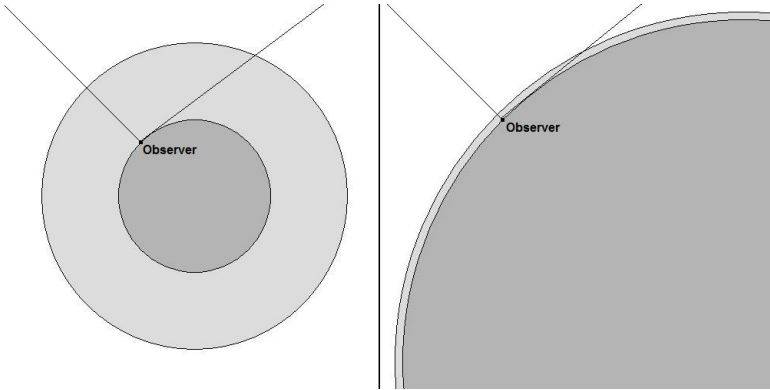
Introduction

The Earth’s atmosphere scatters, absorbs, and bends the light that travels through it. The bending is called atmospheric refraction, and the absorption and scattering is called atmospheric extinction. Both extinction and light pollution from artificial light sources can affect the brightness of the stars.

The magnitude of atmospheric extinction depends on the amount of air through which the light must travel. This can help us determine the relative thickness of the Earth’s atmosphere with some simple observations and reasoning.

Pre-test

The following figure illustrates two models of the Earth’s atmosphere. The one on the left shows an atmosphere with a thickness comparable to the Earth’s radius. The one on the right shows an atmosphere that is thin compared with the Earth’s radius. In each scenario, lines of sight to the zenith and horizon are drawn in.



1. In which of the above models would atmospheric extinction be much greater at the horizon than at the zenith?

Observing light pollution

Apart from any direct interference caused by lights around campus (i.e., shining directly into your eyes), light pollution affects what you can see from the J-ROWL roof. Signs of light pollution include a glow in the sky and the absence of fainter stars.

1. Look around you and observe the whole sky. Is there variation in light pollution depending on the direction in which you look?

2. What are the best and worst directions in terms of light pollution? Remember, the penthouse is north, and the dome is south.

Observing extinction

First, consider the closest star — the Sun.

3. Does it hurt your eyes to look at the Sun (a) at noon? (b) at 4pm? (c) 15 minutes before sunset?

It turns out that 15 minutes before sunset, the Sun is about 21 times dimmer than it is at noon.

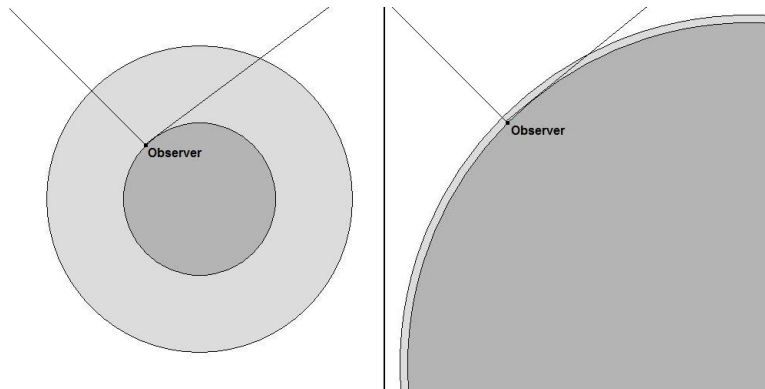
Observing stellar atmospheric extinction from the J-ROWL roof is a bit tricky because of the light pollution and the buildings which block the horizon. The best directions to look are probably straight up and toward the western horizon.

4. Look toward the zenith and toward the horizon. Try to avoid obvious areas of light pollution. In which of these two directions are more stars visible?

At 12.5° from the horizon, the atmosphere contributes about one magnitude of extinction compared to the zenith. This means that the faintest star you can see is one magnitude brighter. With the unaided eye, most people can see stars to magnitude 6 straight overhead at a very dark site.

Conclusions

Here are the two models of the atmosphere from the beginning of the activity:



5. In which scenario would the atmospheric extinction be much greater at the horizon than at the zenith?

6. Compared to the Earth's radius, the thickness of the atmosphere is:

MUCH THINNER

ABOUT THE SAME

MUCH THICKER

7. What are two factors that affect our ability to view stars, as a function of position in the sky?