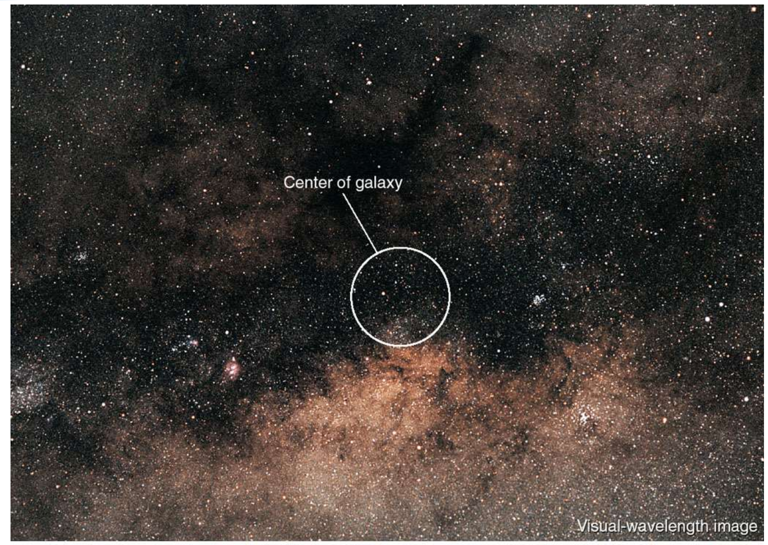
PHOTOMETRY
Extinction

Overview

In Astronomy, we tend to think of Extinction in terms of “Extinction Events”.

However, there is another use of the term. In this case, extinction refers to the removal of light through an interaction with elements such as dust, gas, and atmosphere, or: The overall dimming of starlight by interstellar matter.

Extinction comes in two types: Interstellar and Atmospheric. We’ll talk about both.



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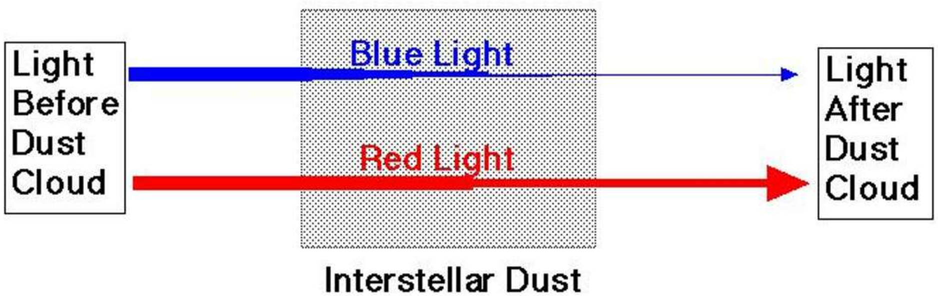
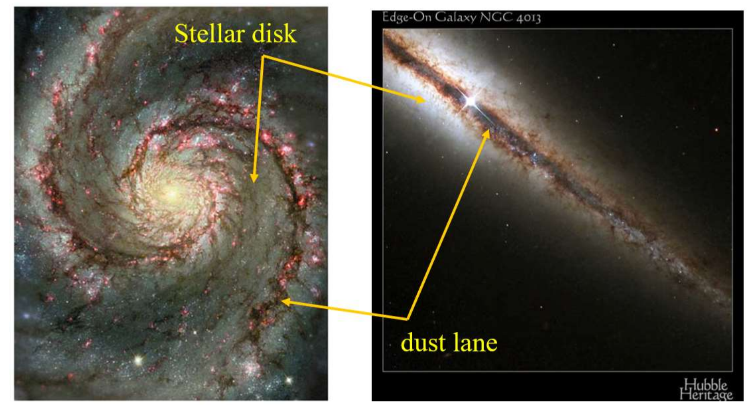
Interstellar Extinction

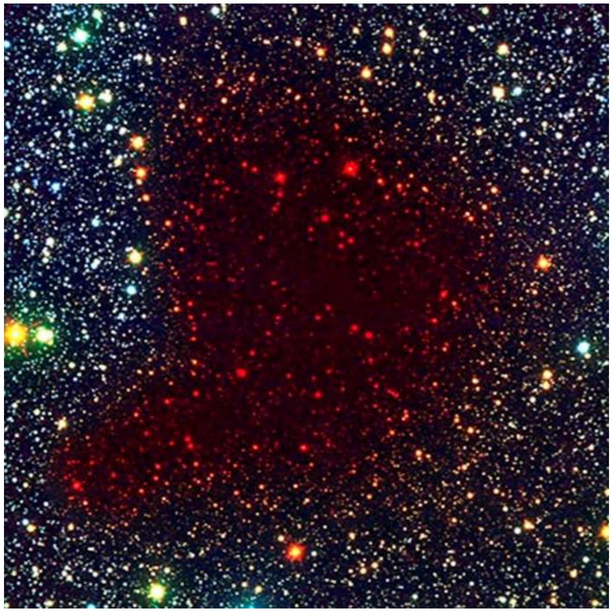
Interstellar reddening occurs because interstellar dust absorbs and scatters blue light waves more than red light waves.

This makes stars appear redder, and dimmer, than they are. This is similar to the effect seen when dust particles in the atmosphere of Earth contribute to red sunsets.

Extinction causes light from distant stars to be preferentially robbed of its higher frequency ("blue") components.







Extinction and Reddening

We can use its effect on starlight to measure both the amount and the size of interstellar dust.

As a rule of thumb, a beam of light can be absorbed or scattered only by particles having diameters comparable to or larger than the wavelength of the radiation involved.

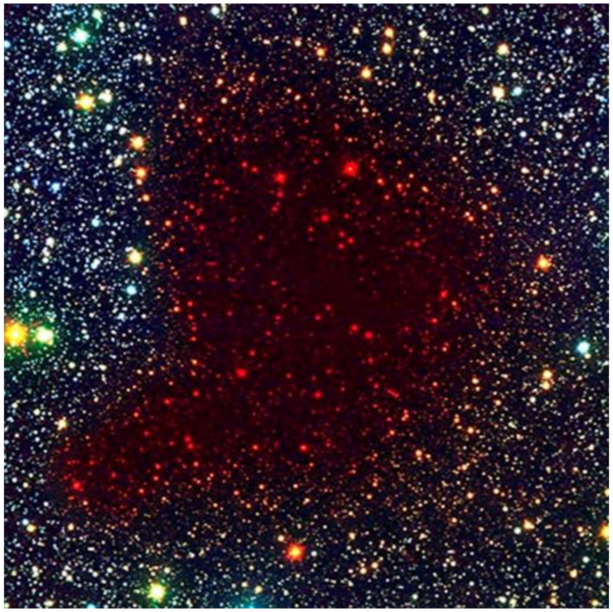
Thus, a range of dust particle sizes will tend to block shorter wavelengths most effectively.

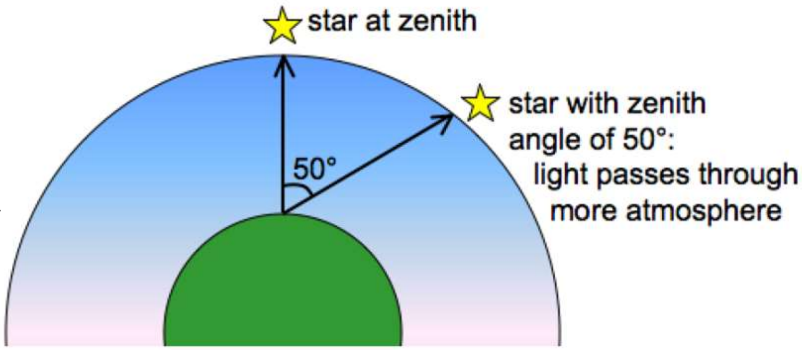
The size of a typical interstellar dust particle, or dust grain, is about 10^{-7} m (0.1 μm), comparable in size to the wavelength of visible light. Consequently, dusty regions of interstellar space are transparent to long- wavelength radio and infrared radiation, but opaque to shorter wavelength optical and ultraviolet radiation.

Extinction and Reddening

This effect, known as reddening.

Astronomers can use this fact to study the interstellar medium. They then measure the degree to which the starlight has been affected by extinction and reddening enroute to Earth, and this, in turn, allows them to estimate both the numbers and the sizes of interstellar dust particles along the line of sight to the star.





Atmospheric Extinction - Airmass

Atmospheric Extinction is the dimming of a star's light caused by passing through the Earth's atmosphere and is expressed in units of magnitudes/air mass.

As the air mass increases, i.e., the star is closer to the horizon, the total extinction increases.

The value for extinction is not the same for all colors: red light is scattered less by the Earth's atmosphere than blue light.

As the object moves towards the horizon, the blue portion of its light is "dimmed" more rapidly than the red portion.

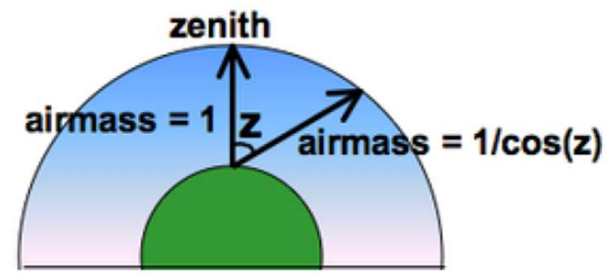
Atmospheric Extinction - Airmass

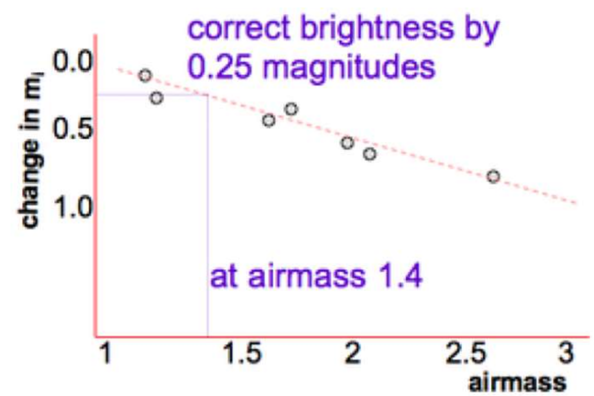
As a rule of thumb, you should try to avoid observing below 30 ° altitude.

The air mass changes rapidly below this altitude and is easily affected by changes i humidity, barometric pressure, clouds, haze, and pollution.

There is a thought that if you're doing differential photometry, you can ignore air mass and extinction issues. This is mostly but not entirely true. There are other reasons as well to stay above 30 °:

- Differential extinction across the frame.
- Differential refraction, which can make objects become miniature spectra and blue stars change position with respect to red stars.
- Increased scintillation.





Summary

Extinction occurs in space and the Earth's atmosphere.

It is easier to avoid atmospheric extinction.

It is not possible to avoid extinction from the Interstellar Medium (ISM). It is what it is.

For ISM extinction there are ways to compensate: Mathematically and viewing in known areas of gas/dust

Questions?