

Apparent and absolute magnitude

Introduction

Apparent magnitude

Apparent magnitude is a measure of an object's brightness as seen from Earth. Hipparchus, a Greek astronomer and mathematician, classified observable stars so that he would have some indication of their relative brightness. He decided to divide the observable stars he catalogued into 6 groups or magnitudes. The brightest stars were classified as apparent magnitude 1 and the faintest or those at the limit of visibility were classified as apparent magnitude 6. This is why a smaller numerical value of apparent magnitude corresponds to a brighter looking star or object.

Later, when the brightness of stars was measured with a photometer, it was found that the first magnitude was roughly 100 times the sixth magnitude. Mathematically, the difference in brightness between each step is the fifth root of 100 = 2.512. The apparent magnitude is calibrated logarithmically because our eyes identify differences in brightness in a logarithmic way.

Using this scale for other celestial objects, negative numbers were required to describe brighter objects like the Sun. The Sun has an apparent magnitude of -26, a full Moon has an apparent magnitude of -13 and the planet Venus -4. The brightest star in the night sky (Sirius) has an apparent magnitude of -1.5.

Absolute magnitude

Absolute magnitude gives a measure of the true brightness of a star by giving an indication of brightness if the stars were at a fixed distance of 10 parsecs or about 33 light years. Keeping the distance of the star fixed, the brightness or luminosity of stars can be compared. (Most stars are much further away than 10 parsecs).

Example

The Sun appears to us with apparent magnitude of -26 (150 million km away). Alpha Centauri appears with apparent magnitude of 0.02 (4 light years away). If we were to put them both at the fixed distance of 33 light years away, both Alpha Centauri and the Sun would have an absolute magnitude of 4.5 (the same brightness).

What to do

1. Explain the difference between apparent magnitude and absolute magnitude. (5)
2. Compare the apparent and absolute magnitude of stars like Sirius, Alpha Centauri, the Sun, Antares, Rigel. (5)
3. Go to the website: <http://antwrp.gsfc.nasa.gov/apod/ap060501.html> This is a photograph of the Open Cluster NGC 290 or the Stellar Jewel Box.
 - a) What might make some of these stars appear brighter than others? (2)
 - b) Why are some of these stars different colors? (2)
 - c) Now go to: <http://antwrp.gsfc.nasa.gov/apod/ap060419.html> Mars appears much bigger and brighter than the stars. Why? (2)
4. With the use of a number of torches with different brightness and a darkened room, design an experiment for young children aged 10-12 years old to explain the difference between apparent magnitude and absolute magnitude of stars. Include two or three questions that they would need to answer to reinforce their learning. (10 points – for the experiment and at least two questions)