Basic astronomy

Understanding “magnitude”

Magnitude

- The brightness of stars, nebulae and galaxies is measured in “magnitude”
- We can talk of:
  - Apparent magnitude - how bright it appears
  - Absolute magnitude – how bright it really is
- When observers talk of magnitude they normally mean ***apparent magnitude***
- The larger the number the brighter the object

Apparent magnitude

- This is how bright the star appears to us under perfect conditions
- It varies with the distance to the star, its temperature, its size and it composition
- Stars can also be variable in their brightness over time

Apparent magnitude

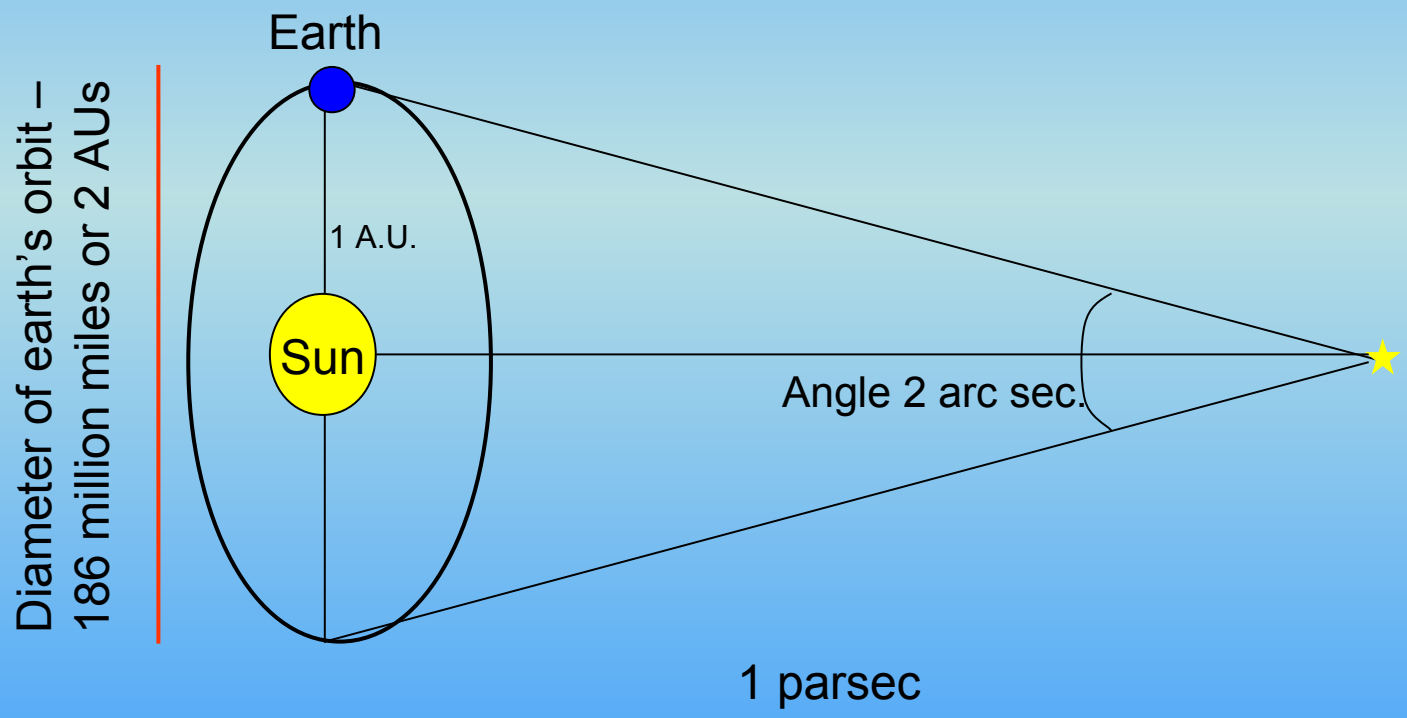
- Started by Hipparcus and Ptolomy – dimmest stars = 6 brightest =1
- Today most visible stars fall in the range 0 to 6, Vega is 0
- Very bright stars have a negative magnitude (Sirius = -1.46), they are brighter than Vega, the Sun is -27
- Planets are mostly negative because they are bright (Jupiter is currently -2)

Absolute magnitude

- This is a measure of the brightness of an object at a ***standard distance*** of 32.6 light years (10 parsecs)
- It allows the true brightness of objects to be compared
- It uses the same convention as apparent magnitude

Parsec

One parsec corresponds to the distance at which the mean radius of the earth's orbit subtends an angle of one second of arc.
3.26 light years (3.086 × 1013 kilometres)



1 light year is the distance that light travels in one year, which is 9,460,700,000,000 km (nearly 6 million million miles)

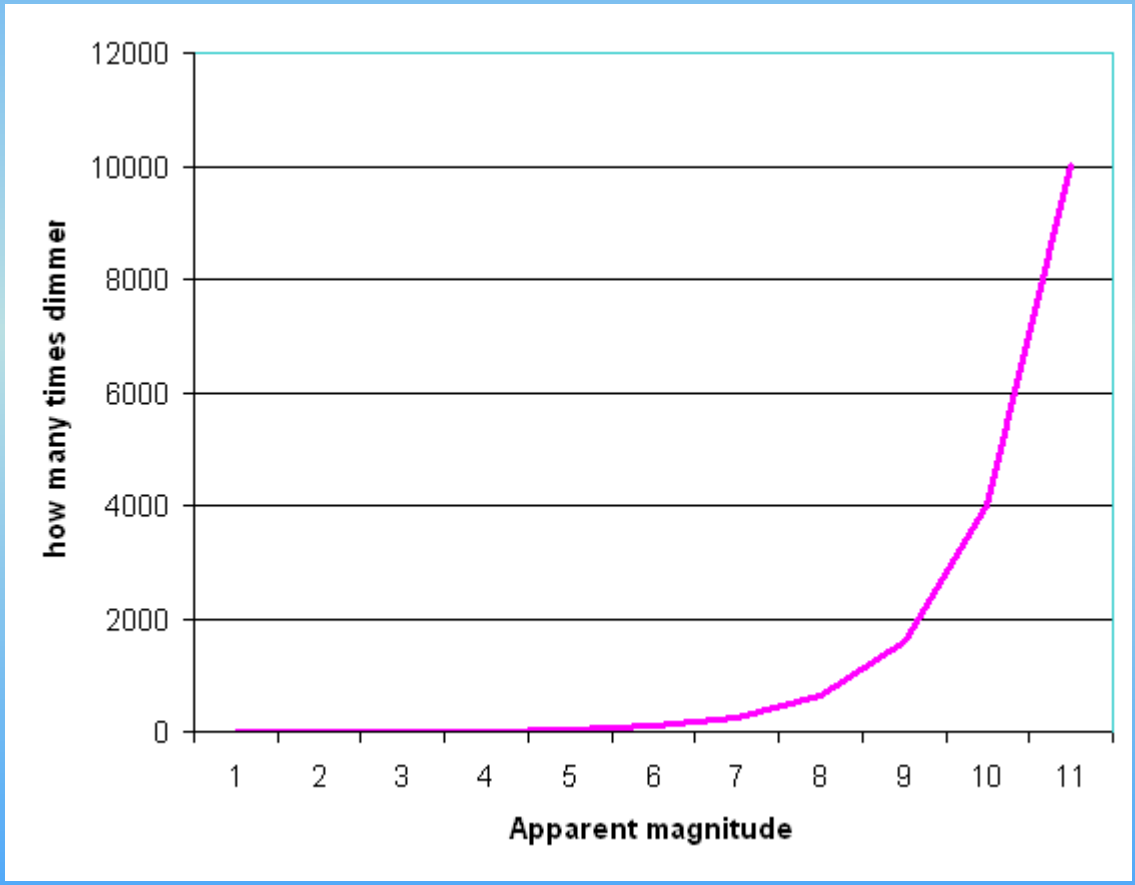
How much brighter?

- Each decrease in 1 magnitude increases the brightness by about 2½* times
- A star of magnitude 0 is 100 times brighter than a star of magnitude 5
- 2.5 x 2.5 x 2.5 x 2.5 x 2.5 =100

* The actual number is 2.512 or the 5^{th} root of 100

Magnitude

The scale is logarithmic



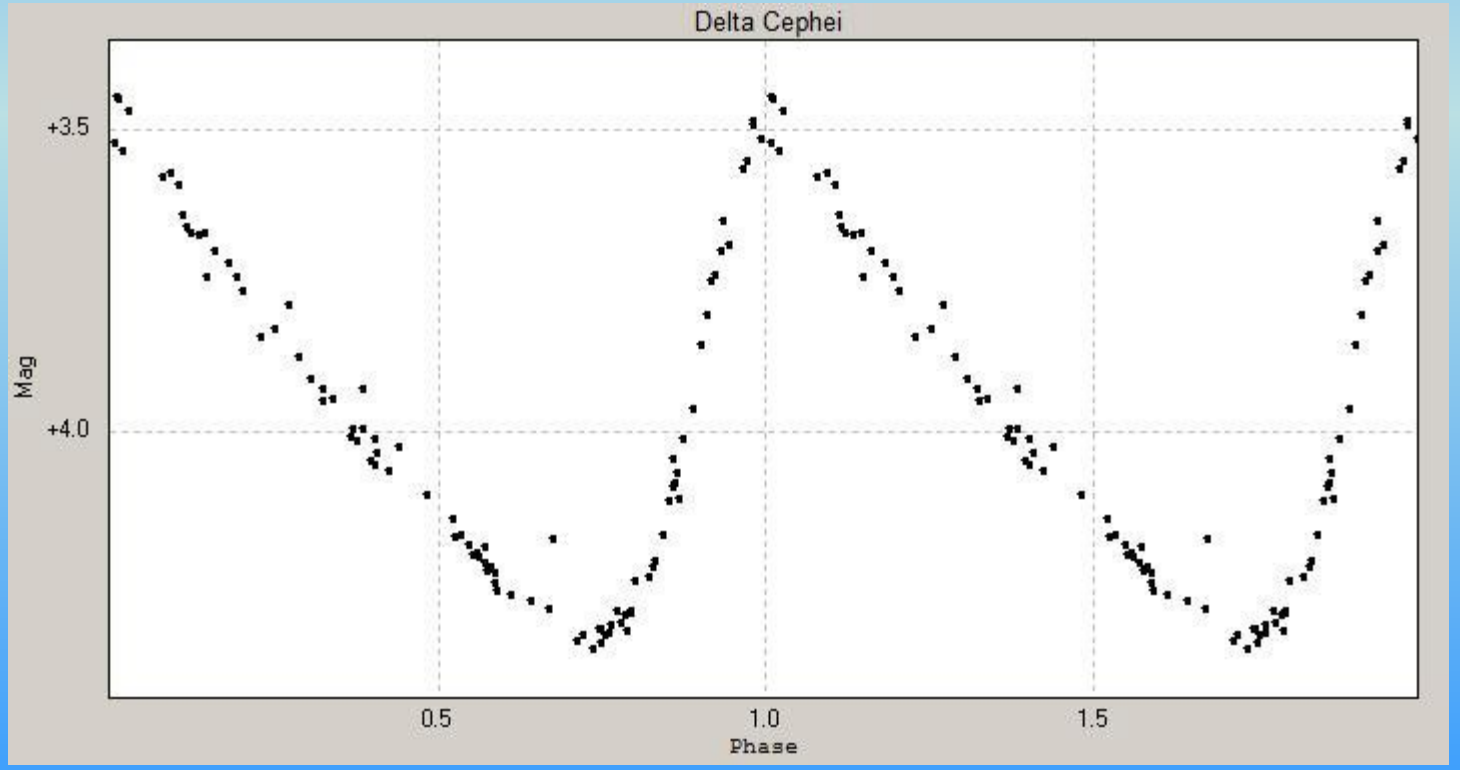

Scheat
2.4
4.75
4.55
Alpheratz
2.05
5.95
4.4
4.6
5.30
Markab
2.45
5.45
5.05
4.75
5.05
5.55
4.50
Algenib
2.8

So what?

- The dimmest star you can see under the best conditions will be magnitude 6.5
- Magnitude 4.5 to 5 would be a good night in the UK away from cities
- For galaxies and extended objects the overall light output is used.
- A 200 mm telescope will just show a mag. 10 galaxy but show a mag. 13 star

Examples

- Vega = 0, Sirius = -1.46, Polaris = 1.98
- Betelgeuse = 0.2 to 1.2



More examples

- Rigel
  - apparent magnitude = 0.12
  - absolute magnitude = -7.84
- Sun
  - apparent magnitude = -26.74,
  - absolute magnitude = 4.83 (115,000 times dimmer than Rigel)
- Andromeda galaxy (M31) app mag = 3.44, abs. mag = -20.9
- Quasars, most luminous object known, average magnitude 12.9, brightest absolute magnitude -31.4
- Full moon around app. mag. -13 and Venus around -5

Questions

- Apparent magnitude of Deneb is 1.5 and Vega is 0
  - Which has the brightest absolute magnitude?

It is not possible to say because there is no information on distance, Deneb at 2600 ly is over 100x further away than Vega (25 ly.) and is one of the brightest stars known (ab. Mag. -8.38).

Questions

- Andromeda galaxy with an apparent magnitude of 3.44 needs a very clear night to see by eye, Albireo (app. mag. 3.35) – the beautiful head of Cygnus - is easy to spot on any reasonably clear night – why such a difference?

Albireo is a point source of concentrated light, Andromeda galaxy is 2.5 times wider than the moon so the same amount of light is spread over a much larger area – so it appears dimmer

Questions

- Albireo has an apparent magnitude of 3.35, Scheat in the square of Pegasus the winged horse an app. mag. of 2.4, which is the brighest and by about how much?

Scheat is brighest by about 2.5 times as it is about 1 magnitude different (lower)