COMPUTATIONAL ASTROPHYSICS

Observatorio
Astronómico
Nacional

Computational Astrophysics 2022

00. Fundamentals of Astrophysics I

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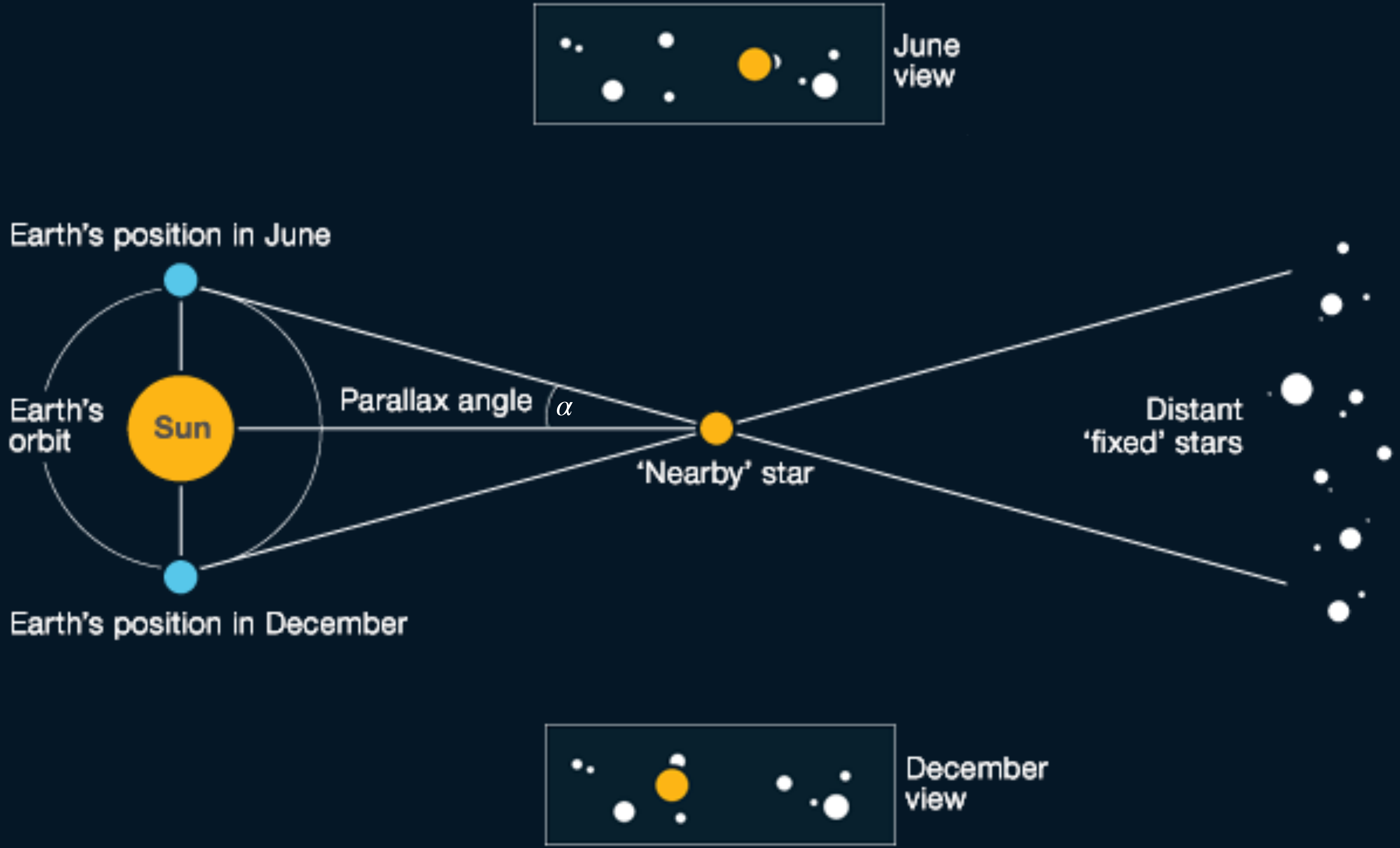
Distances in Astrophysics


June view
Earth's position in June
Earth's orbit
Sun
Parallax angle α
'Nearby' star
Distant 'fixed' stars
Earth's position in December
December view

Parallax Angle

$$d = \frac{b}{\tan \alpha}$$

Apparent Magnitude


65 Cybele
apmag 11.6
HD 217121
apmag 8.7

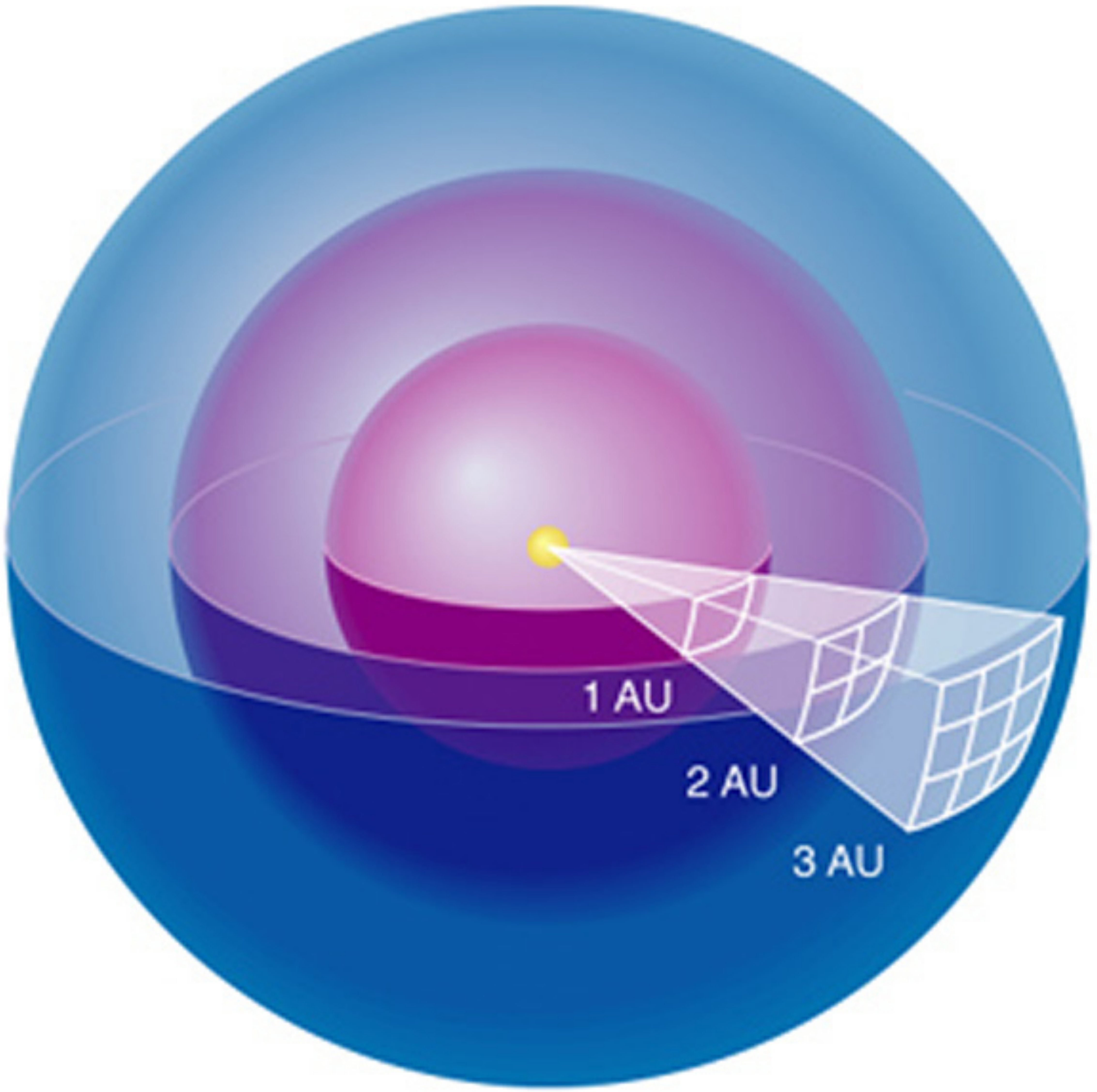
APPARENT MAGNITUDE

Mag. 1	
Mag. 2 x 2.5 dimmer	x 2.5
Mag. 3 x 2.5 dimmer	x 6.25
Mag. 4 x 2.5 dimmer	x 16
Mag. 5 x 2.5 dimmer	x 40
Mag. 6 x 2.5 dimmer	x 100


Venus at brightest
Hubble Space Telescope
Sirius
Full moon
Polaris
Sun
Naked eye limit
–30
–25
–20
–15
–10
–5
0
5
10
15
20
25
30
Apparent magnitude (m_v)

Magnitude	Celestial Object
Sun	-26.74
Full moon	-12.74
Venus (brightest)	-4.6
Sirius (brightest star)	-1.44
Naked-eye limit (urban sky)	+3.0
Naked-eye limit (dark sky)	+6.0
Binocular limit	+9.5
12″ Telescope limit	+14.0
200″ Telescope limit	+20.0
Hubble Telescope limit	+30.0

Flux and Luminosity



$$F = \frac{L}{4\pi r^2}$$

L : Intrinsec Luminosity or Absolute Bright. *[Watt = J/s]*

F : Radiant flux or Apparent Brightness. Total amount of energy (in all wavelengths, crossing a unit area oriented perpendicular to the direction of the light ray, per unit time. *[Watt/m²]*

Absolute Magnitude and Distance

$$M = m - 5(\log_{10} D - 1)$$

D : object’s distance measured in parsecs

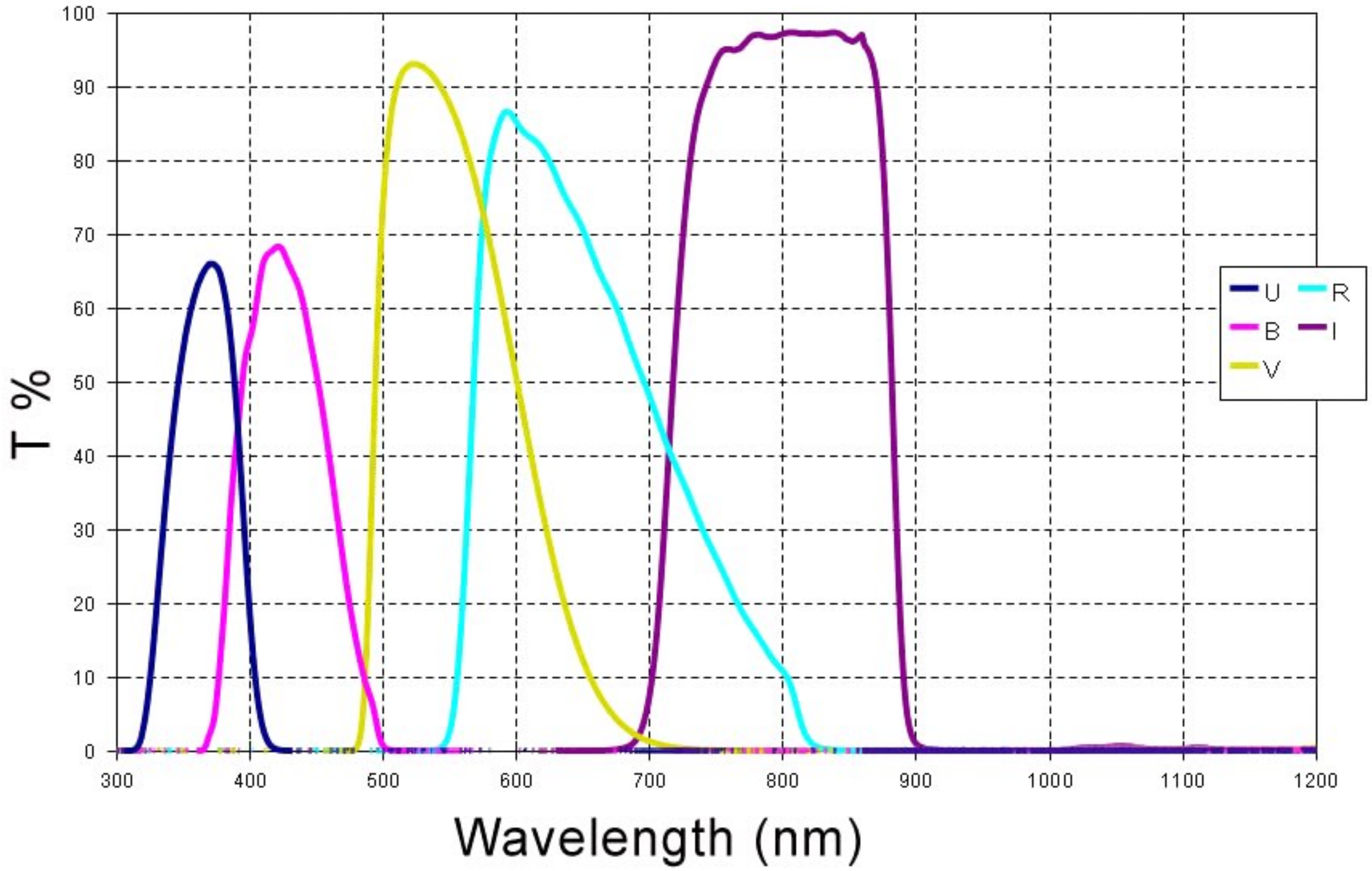
$$D = 10^{\frac{m - M + 5}{5}}$$

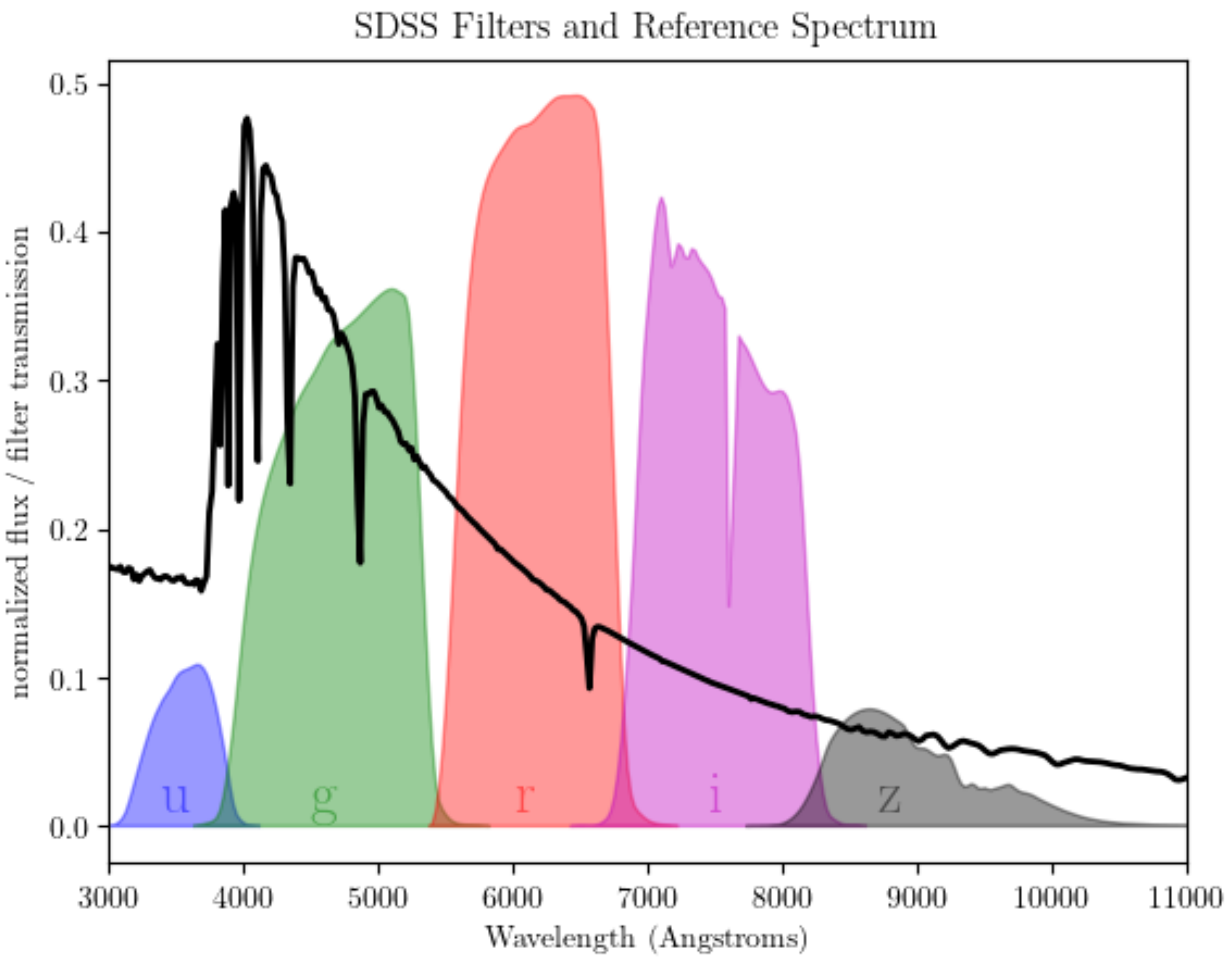
Photometric Filters


Baader Photometric U-Filter 1 1/4"
Baader Photometric B-Filter 1 1/4"
Baader Photometric V-Filter 1 1/4"
Baader Photometric R-Filter 1 1/4"
Baader Photometric I-Filter 1 1/4"

U B V R I

Baader CCD-Photometric UBVRI-Filters
Spectral Trace
(Date 2010-01-19)





SDSS Filters and Reference Spectrum
normalized flux / filter transmission
0.0
0.1
0.2
0.3
0.4
0.5
3000
4000
5000
6000
7000
8000
9000
10000
11000
Wavelength (Angstroms)
u
g
r
i
z

Color Index

In astronomy, a **color index** is a simple numerical expression that determines the ‘color' of an object, which in the case of a Star gives its temperature. It is defined as the difference between two measurements of the magnitude (brightness on a logarithmic scale) of the particular object at different wavelengths (the magnitude at the longer wavelength being subtracted from that at the shorter)

For example, a usual color index for Stars is the B-V, obtained from the blue (B) and the visual (V) as defined in the UBV system.
The lower the color index, the more blue (or hotter) the object is. Conversely, the larger the color index, the more red (or cooler) the object is. This is a consequence of the logarithmic magnitude scale, in which brighter objects have smaller (more negative) magnitudes than dimmer ones.

Color-Color Diagrams

Color–color diagrams are a means of comparing the apparent magnitudes of objects at different wavelengths.

The color defined by two wavelength bands is plotted on the horizontal axis, and then the color defined by another brightness difference (though usually there is one band involved in determining both colors) will be plotted on the vertical axis.

The color-color diagram may be used to directly calibrate or to test colors and magnitudes in optical and infrared imaging data or to find outliers from large observational surveys, such as the SDSS or 2 Micron All Sky Survey (2MASS). Once these outliers are identified, they can then be studied in more detail. This method has been used to identify ultracool subdwarfs or unresolved binary stars (i.e. those which appear photometrically to be points).

Color-Color Diagrams

Color-color diagram for a main sequence star and a supergiant star. Black curve represents the behavior of a black body.

Not that stars emit less ultraviolet radiation than a black body with the same B-V index.