Magnitude Scale

Filter Bands

Color has large dynamic range in brightness, bands divided into steps. Studies found the steps were actually blue when physical measurements showed 6th - 1st in a factor of 100 in brightness.

\[
1 - 6 = -K \log_{10} \left[ \frac{100}{1} \right] \\
-5 = -K \times 2 \\
K = 2.5
\]

Suppose \( \frac{F_1}{F_2} = 1 + \epsilon \)

\( \epsilon \ll 1 \)

\[
m_1 - m_2 = -2.5 \log(1 + \epsilon) \\
= -2.5 \frac{\ln(1 + \epsilon)}{\ln 10} \\
= -1.048 \ln(1 + \epsilon) \\
\approx -1.087 \epsilon
\]

Colors

Absolute magnitude

Distance from parallel

Catalog of nearby stars

HR Diagram for all stars < 22 pc.

Sun \( B - U = 0.6 \)

\( M_v = 5 \)
29.1 Catalogue of Nearby Stars

The following data for stars nearer than 22 parsecs, or trigonometric parallax, \( \pi_t \), less than 0\(^\circ\).045, have been compiled from the catalogues of Gliese (1969), and Gliese and Jahreiss (1979). The decimal number from the Gliese catalogue, often designated G, or the numbers in the thousands from the Gliese and Jahreiss catalogue, designated GJ, are given on the left side of the tables. Numbers in the DM, HD and Gccl catalogue, and some star names are given in the original catalogues. Right ascensions (R.A.) and declinations (Dec.) in the epoch 1950.0 are given to 1 s and 6 seconds of arc, respectively. Yearly proper motions, \( \mu \), can be used together with precession to obtain positions at another epoch; the R.A. components of \( \mu \) are in seconds of time per year and the Dec. components are in seconds of arc per year. These components have been computed from the total annual proper motions, \( \mu \), and the position angle, \( \theta \), of the GJ catalogue using \( \mu_{\text{Dec.}} = \mu \cos \theta \) and \( \mu_{\text{R.A.}} = \mu \sin \theta/15 \cos(\text{Dec.}) \). The radial velocity, \( V_r \), is given to 1 km s\(^{-1}\); it is followed by spectral type, Sp, and luminosity class, LC. The apparent visual magnitude, \( V \), trigonometric parallax, \( \pi_t \), in units of 0.001 seconds of arc, and absolute magnitude, \( M_V \), for the Gliese stars are from Grenon and Rafter (1981), while the color index \( B - V \) is from the original G or GJ catalogues. Parallax values for those GJ stars marked with an (*) are spectroscopic or photographic. The G and GJ catalogues also contain \( U - B \) and \( R - I \), and the six Geneva colors are listed by Grenon and Rafter (1981). The distance, \( D \), to the star in parsecs can be inferred from \( D = \pi_t^{-1} \) when \( \pi_t \) is in seconds of arc, and the stellar space velocity tangent to the line of sight, \( V_\ell \), in km s\(^{-1}\) can be inferred from the total annual proper motion, \( \mu \), and \( D \) from \( V_\ell = 4.75D\mu \).
Hertzsprung-Russell Diagram for Nearby Stars. This plot of the absolute visual magnitude, $M_V$, against color index, $B-V$, illustrates the heavily populated main sequence running from the hot, luminous upper left to the cooler, less-luminous lower right, as well as the faint white dwarf stars in the lower left. It has been compiled from data for 2,241 nearby stars given in the accompanying tables.