NOTES AND FORMULAS

Low precision formulas for the Sun

The following are low precision formulas for the Sun. On this page, the time argument n is the number of days of TT from J2000.0. UT can be used with negligible error.

The low precision formulas for the apparent right ascension and declination of the Sun yield a precision better than $1\!'\!.0$ between the years 1950 and 2050.

n = JD – 2451545.0 = 6938.5 + day of year (from B4–B5) + fraction of day from 0^h TT
Mean longitude of Sun, corrected for aberration: $L = 280^\circ\!.460 + 0^\circ\!.985\,6474\, n$
Mean anomaly: $g = 357^\circ\!.528 + 0^\circ\!.985\,6003\, n$

Put L and g in the range 0° to 360° by adding multiples of 360°.

Ecliptic longitude: $\lambda = L + 1^\circ\!.915 \sin g + 0^\circ\!.020 \sin 2g$
Ecliptic latitude: $\beta = 0^\circ$
Obliquity of ecliptic: $\epsilon = 23^\circ\!.439 - 0^\circ\!.000\,0004\, n$
Right ascension: $\alpha = \tan^{-1}(\cos\epsilon \tan\lambda)$; ($\alpha$ in same quadrant as λ)

Alternatively, right ascension, α, may be calculated directly from:

Right ascension: $\alpha = \lambda - ft \sin 2\lambda + (f/2)t^2 \sin 4\lambda$
where $f = 180/\pi$ and $t = \tan^2(\epsilon/2)$
Declination: $\delta = \sin^{-1}(\sin\epsilon \sin\lambda)$

The low precision formula for the distance of the Sun from Earth, R, in au, yields a precision better than 0.0003 au between the years 1950 and 2050.

$R = 1.000\,14 - 0.016\,71 \cos g - 0.000\,14 \cos 2g$

The low precision formulas for the equatorial rectangular coordinates of the Sun, in au, yield a precision better than 0.015 au between the years 1950 and 2050.

$x = R\cos\lambda$
$y = R\cos\epsilon \sin\lambda$
$z = R\sin\epsilon \sin\lambda$

The low precision formula for the Equation of Time, E, in minutes, yields a precision better than $3^s\!.5$ between 1950 and 2050.

$E = (L - \alpha)$, in degrees, multiplied by 4

Other useful quantities:

Horizontal parallax: $0^\circ\!.0024$
Semidiameter: $0^\circ\!.2666/R$
Light-time: $0^d\!.0058$