**E**[**ccentricity**](https://en.wikipedia.org/wiki/Orbital_eccentricity)**:** e = (rmax – rmin) / (rmax + rmin) for a circle: e=0, for an elliptic shape: 0 < e < 1:

**Elongation:** apparent angular distance east of the Sun as seen from the earth

## The osculating elements

[[Top](http://www.stargazing.net/kepler/ellipse.html#twig00)]

An elliptical orbit can be specified by the values of various numbers. The plane of the orbit must be specified, as must the size and the eccentricity, and the position of the perihelion, and the position of the planet at the date of the elements. There are a number of different sets of numbers which can be used, and one set can be converted into another set. The Astronomical Almanac provides 7 numbers to specify an orbit;

**Inclination (i)**

angle between the plane of the Ecliptic and the plane of the orbit.

**Longitude of the Ascending Node (o)**

states the position in the orbit where the elliptical path of the planet passes through the plane of the ecliptic, from below the plane to above the plane.

**Longitude of Perihelion (p)**

states the position in the orbit where the planet is closest to the Sun.

**Mean distance (a)**

the value of the semi-major axis of the orbit - measured in Astronomical Units for the major planets.

**Daily motion (n)**

states how far in degrees the planet moves in one (mean solar) day. This figure can be used to find the mean anomaly of the planet for a given number of days either side of the date of the elements. The figures quoted in the Astronomical Almanac do not tally with the period of the planet as calculated by applying Kepler's 3rd Law to the semi-major axis.

**Eccentricity (e)**

eccentricity of the ellipse which describes the orbit

**Mean Longitude (L)**

Position of the planet in the orbit on the date of the elements.

I use the osculating elements taken from page E3 of the Astronomical Almanac for 1997. As explained in the previous section, these elements are referred to the 'mean ecliptic and equinox' of J2000.0, so that positions calculated from these elements will show the correct relationship with the stars when plotted on a J2000 star chart, apart from the effect of light travel time. The osculating elements include the effects of the other planets (perturbations) at the date 8th August 1997, and will give less accurate positions the further we go from that date. This has nothing to do with the coordinate system we happen to want to use, the J2000 mean ecliptic and equinox.

### Values of the Osculating Elements for 8th August 1997

JD = 2450680.5

Equinox and mean ecliptic of J2000.0

Earth Mars

i 0.00041 1.84992

o 349.2 49.5664

p 102.8517 336.0882

a 1.0000200 1.5236365

n 0.9855796 0.5240613

e 0.0166967 0.0934231

L 328.40353 262.42784

The values for the other planets can be found in

the QBASIC program below

Sun and Moon positions: <http://aa.usno.navy.mil/data/docs/RS_OneDay.php>

X = cos(RA) \* cos(Decl)

Y = sin(RA) \* cos(Decl)

Z = sin(Decl)

r = arctan(Y / X)

if X < 0 then ra2000 = r + 180

if Y < 0 and X > 0 then ra2000 = r + 360

Decl = arcsin(Z)

Links: <http://www.stargazing.net/kepler/ellipse.html>