

Heliocentric Elements Tool

The screenshot shows a software window titled "Heliocentric Elements" with a menu bar containing "Ephemeris" and "Help". The main area is divided into several sections for inputting orbital data:

- Epoch:** 2460987.50000000
- Eccentricity:** 0.10562476
- Inclination:** 10.55426585
- Arg Peri:** 107.93608104
- Lon Asc:** 347.68748075
- Element Type:** Radio buttons for Asteroid (selected), Comet, and Orbit Vector.
- Asteroid-Specific Elements:**
 - Semimajor axis:** 2.38122246
 - Mean anomaly:** 242.16469409
 - Absolute magnitude (H):** 15.20010304
 - Slope parameter (G):** 0.15000000
- Comet-Specific Elements:**
 - Perihelion distance (q):** 2.12970642
 - Time of perihelion passage (Tp):** 2461426.81022851
- Orbit Vector:**
 - Epoch:** 2459767.89973474
 - x:** 2.38185640, **vx:** -0.00094046
 - y:** -0.06714119, **vy:** 0.01092333
 - z:** 0.08220183, **vz:** 0.00195199

Figure 1 - Heliocentric Elements Window; example of elements for minor planet (38826)

The Heliocentric Elements tool allows one to specify a set of orbital elements associated with an object in heliocentric orbit. These elements can then be integrated to a given date and time using the ***Ephemeris*** menu.

Epoch: The epoch associated with the elements, as a Julian Date. Example: 2460987.5, which corresponds to 2025 11 08 at 00:00:00 UTC.

Eccentricity: The eccentricity of the orbit, where 0.0 is perfectly circular and 1.0 is parabolic.

Inclination: The inclination of the orbit, in degrees.

Arg Peri: The argument of perihelion; the angle in the object's orbital plane from the ascending node to perihelion. Unit: degrees.

Lon Asc: The longitude of the ascending node, in degrees. This is the angle from the reference direction (vernal equinox) to the point where the object crosses upward through the reference plane (ecliptic).

Element Type: This specifies which element set to use.

Asteroid: Uses the above quantities, in addition to the "Asteroid-Specific Elements".

Comet: Uses the above quantities, in addition to the “Comet-Specific Elements”.

Orbit Vector: Uses the quantities located inside the “Orbit Vector” group.

Asteroid-Specific Elements

Semimajor axis: One-half of the orbit’s major axis, providing a measure of the size of an elliptical orbit, in astronomical units (AU).

Mean anomaly: Orbital position at the epoch, measured as a uniform angular progress from perihelion. Unit: degrees.

Absolute Magnitude (H): The asteroid’s intrinsic brightness, defined as how bright it would appear if it were 1 AU from the Sun, 1 AU from the observer, and viewed at zero phase angle.

Slope Parameter (G): Describes how the asteroid’s brightness changes with phase angle. Default value is 0.15.

Comet-Specific Elements

Perihelion Distance (q): The perihelion distance is the comet’s closest distance to the Sun. For comet-style elements, this is often used instead of semimajor axis because many comets have highly eccentric, parabolic, or near-parabolic orbits. Unit: AU.

Time of Perihelion Passage (Tp): The time of perihelion passage is the date and time when the comet reaches perihelion, its closest point to the Sun. Together with the other orbital elements, it defines where the comet is along its orbit at a given time. Entered as a Julian Date.

Orbit Vector

The orbit vector gives the object’s position and velocity at a specific epoch using Cartesian coordinates. Instead of describing the orbit with elements like semimajor axis, eccentricity, and inclination, it directly states where the object is and how fast it is moving in 3D space.

Epoch: The epoch is the date and time at which the orbit vector is valid. Since the object moves continuously, the listed position and velocity components describe the object specifically at this reference time. As before, it is a Julian Date. Example: 2459767.89973474, which corresponds to 2022 07 07 at 09:35:37.1 UTC.

x	Heliocentric J2000 ecliptic x-position, in AU.	vx	Velocity along the heliocentric J2000 ecliptic x-axis, in AU/day.
y	Heliocentric J2000 ecliptic y-position, in AU.	vy	Velocity along the heliocentric J2000 ecliptic y-axis, in AU/day.
z	Heliocentric J2000 ecliptic z-position, in AU.	vz	Velocity along the heliocentric J2000 ecliptic z-axis, in AU/day.

Ephemeris Menu

Once the orbital elements have been specified, the ephemeris menu can be used to perform the following actions. Note that the *Find_Orb* software, developed by Bill Gray, must first be configured (via **Settings->Find_Orb** from the main menu).

Action	Description
Attach to Dataset	Computes the object's position and motion for each image in the dataset. This includes the RA/Dec values, speed, and position angle. Allows for easily locating and stacking the object in the dataset.
Attach to Session Planner	Populates the Session Planner with the desired ephemeris of the object.
Attach to Image Viewer	Displays the object's information inside the Image Viewer window. This includes information such as elongation angle, phase angle, altitude and azimuth, Earth-Object distance, Sun-Object distance, PABL, PABB, Speed, Position Angle (PA), and PsAng and PsAMV.
Attach to Photometry	Populates the following columns in the "Photometry Measurements" for the selected sets in the Photometry Sets window: DistTgtEarth, DistTgtSun, Phase, Alt(deg), Airmass, PABL, PABB, Speed, PA This can also be useful for applying (H-G) correction to a lightcurve.

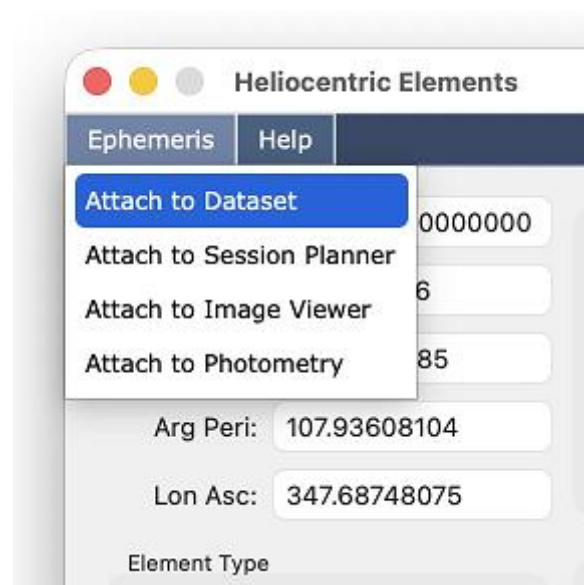


Figure 2 - The Ephemeris Menu