# FE Dome Model APP is based on the Heliocentric Model

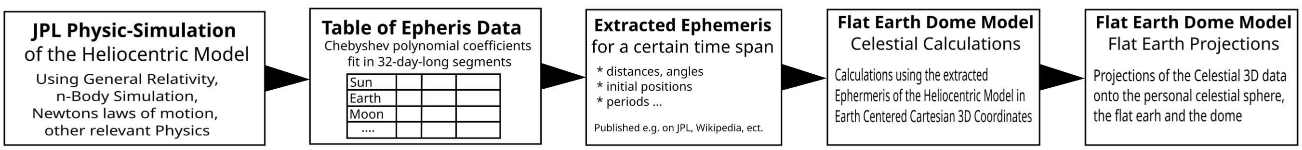
The FE Dome Model uses a simplified heliocentric model, making the following simplifications:

- Orbit of Earth is circluar, using mean distance to the sun DistSun
- Orbit of Moon is circular, using mean distance to moon DistMoon
- Date range is around the year 2021, reference date is 21.8.2017, farther calculations are inaccurate

For accurate calculations I would have to use databases like the Jet Propulsion Laboratory Ephemeris

https://en.m.wikipedia.org/wiki/Jet_Propulsion_Laboratory_Development_Ephemeris

Here is how the data from the JPL pyhsics simulation of the Heliocentric Model is used in my App:




All calculations are done in a **Globe Earth Centered global coordinate system**, where the 3D locations and angles of sun and moon orbits (ephemeris) are calculated using the values listed in the table below, which are extracted from the JPL database, published e.g. in Wikipedia.

So to calculate observations like the Phases, Rotation and Visibility of the Moon, the day/night Terminator Shadow Shape, the Path of Sun and Moon on Celestial Sphere, the Nodes, which determine the dates of eclipses ect. I used a simplified 3D model of the Sun/Earth/Moon system, a fixed, non-rotating cartesian coordinate system centered on the center of the globe earth.

Some 3D locations (Sun, Moon, Stars) are then transformed into a local coordinate system (east,north,up) at the location of the observer on the globe. This locations are then projected onto the private celestial sphere of the observer. Other data is projected onto the dome of the flat earth model (path and symbol of sun and moon and the nodes) and the flat earth (day/night shadow, locations of the observer).

**The source of all locations, paths, Moon Phases, shadows ect. is the Heliocentric Model.** None of this calculations are derived from any flat earth model, because there exists no model with data to derive this calculations for the flat earth.

## Burdon of Proof is on Shane

As Shane claims that the FE Dome Model is not derived from the Heliocentric Model he has to show the code where I calculate moon phases, day/night terminator, Analemma, equinoxes, eclipses, azimuth and elevation angles of sun, moon and stars using only flat earth model and data. It can't be done!

# Used Constants of the Heliocentric Model

These heliocentric mean constants are used in the FE Dome Model:

| | | |
|---|---|---|
| SidericDay | 23.93447 h | |
| SunEcliptic | 23.44° | degrees from earth equator plane |
| SunAngleOffset | 78.5 d | days since Refrence DateTime = 0 (spring equinox = 20.3. at 12:00) |
| SunPeriod | 365.256363004 d | one year |
| MoonEcliptic | 5.145° | degrees from sun ecliptic plane |
| MoonAngleOffset | 0.48 d | days from ecliptic knot to match solar eclipse from 21.8.2017 |
| MoonPeriod | 27.321661 d | sidereal days |
| MoonPrecessPeriod | -6798.383 d | days, moon ecliptic precessed counter moon orbit direction |
| MoonPrecessOffset | -301.996 d | days from solar sclipse 21.8.2017 |
| DistSun | 149600000.0 km | |
| DistMoon | 384000.0 km | |

Sources of this constants are Space Agencies like JPL (NASA), ESA, ISRO, JAXA.

# Jet Propulsion Laboratory Ephemeris

The most accurate source of the values of the Heliocentric Model can be accessed using the Horizon System of the JPL:

Horizons System (nasa.gov)

https://en.m.wikipedia.org/wiki/Jet_Propulsion_Laboratory_Development_Ephemeris

Jet Propulsion Laboratory Development Ephemeris designates one of a series of mathematical models of the **Solar System** produced at the Jet Propulsion Laboratory in Pasadena, California, for use in spacecraft navigation and astronomy. The models consist of numeric representations of positions, velocities and accelerations of major Solar System bodies, tabulated at equally spaced intervals of time, covering a specified span of years. Barycentric rectangular coordinates of the Sun, eight major planets and Pluto, and geocentric coordinates of the Moon are tabulated.

Each ephemeris was produced by numerical integration of the **equations of motion**, starting from a set of **initial conditions**. Due to the precision of modern observational data, the analytical method of general perturbations could no longer be applied to a high enough accuracy to adequately reproduce the observations. The method of special perturbations was applied, **using numerical integration to solve the n-body problem**, in effect putting the entire Solar System into motion in the computer's memory,

**accounting for all relevant physical laws**. The initial conditions were both constants such as **planetary masses**, from outside sources, and parameters such as initial positions and velocities, adjusted to produce output which was a "best fit" to a large **set of observations**.

**The mean values used in my Flat Earth Dome Model are derived from such calculations**, listed in sources like Wikipedia.

## Why did I not use the Masses of the Celestial Bodies?

My App does **not simulate** the Heliocentric Model, it uses published **precomputed values** from the solar system. That's why I don't need the masses of the celestial bodies anymore. The masses are included implicit in the Ephemeris values my App uses.

The masses of the bodies and initial conditions (positions, speeds, accelerations) are used in the numerical calculations of the **ephemeris** using the numerical **n-body physics** simulation of the **Heliocentric Model** using **General Relativity** and **Newtons laws of motion** (see JPL). The simulations are corrected from time to time through very accurate measurements of the solar system.

# Where can I find some Key-Functions in my Code

Code which proves that my App uses the Heliocentric Model can be found in the following functions:

Source Code: FE-Dome App (bislins.ch)

| | |
|---|---|
| DrawMoonPhase | Calculations of the phases of the moon, its visibility and rotation.<br>Note: real solar system distances from earth to sun and moon must be known (DistMoon, DistSun), as well as the camera position and orientation on the globe earth, to calculate the moon phase and orientation. |
| DrawFeNightShadow | Calculation of the day/night terminator line on the globe using the Heliocentric Model and its projection onto the flat earth. |
| DrawSunTrack | Calculates the path of the sun over one year in celestial coordinates and projects its onto the FE dome. It also does this for the Nodes of the solstice |
| DrawMoonTrack | Calculates the path of the moon in celestial coordinates and projects its onto the FE dome. It also does this for the intersection Nodes between sun and moon path, which predict eclipses. |
| DrawFeCelestSphereStars | Calculates some virtual stars in celestial sphere coordinates and projects it onto the private celestial sphere of the observer |