Study of Astronomy Software and Error in Ephemeris

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Abstract- ***Coordinate systems are organized arrangements for specifying three-dimensional positions of celestial objects in space. There are different coordinate systems in astronomy. Ephemeris is a table that gives the calculated positions of a celestial object. The tropical year also known as a solar year is the time that the Sun takes to return to the same position in the sky. So, we define the Sun longitude degree with respect to the year range. Here also review that the Gregorian calendar is synchronizing the solar year at regular intervals. But the error has been found in the sun degrees when JPL Ephemeris and the astronomy software like Voyager 4.5, The Sky and Stellarium etc. coincides with the Gregorian calendar.***

Indexed Terms- astronomy software, JPL ephemeris, ephemeris

I. REVIEW & RESEARCH

Coordinate systems are organized arrangements for specifying three-dimensional positions of celestial objects in space. Currently, there are different coordinate systems used. The two most used coordinate systems are the Equatorial coordinate system and Ecliptic coordinate system. There is also a Horizontal, Galactic and Supergalactic coordinate system in Astronomy. The celestial Equator is 0° latitude for the Equatorial coordinate system and Ecliptic for Ecliptic coordinate system. March Equinox is 0° longitude for both coordinate systems.

Ephemeris is a table that gives the calculated positions of a celestial object. Jet Propulsion Laboratory Development Ephemeris has abbreviated JPL DE (number), or simply DE (number) consists of coordinates of the Sun, eight major planets and Pluto, and Moon. The Jet Propulsion Laboratory is owned by NASA and managed by the California Institute of Technology. JPL planetary Ephemeris are generally created to support spacecraft missions to the planets. Selected Ephemeris are recommended for more general use.[3] Software is available to use the JPL ephemerides for the production of apparent ephemerides for any location and time; these are widely used by professional and amateur astronomers for reducing planetary observations and producing very precise observing guides. DE430 and DE431 can be used with the popular planetarium software Stellarium. [4]

A tropical year also known as a solar year is the time that the Sun takes to return to the same position in the sky, on average approximately 365 days, 5 hours, 48 minutes and 45 seconds long (365.24219 days). For this reason, the calendar year is an approximation of the solar year. The Gregorian calendar is the calendar used in most of the world. It was introduced as a modification of, and replacement for, the Julian calendar. The principal change was to space leap years differently so as to make the average calendar year 365.2425 days long, more closely approximating the 365.2422-day 'tropical' or 'solar' year that is determined by the Earth's revolution around the Sun. Every year that is exactly divisible by four is a leap year, except for end-of-century years, which must be divisible by 400.[6]

That is the reason Sun ephemeris and Gregorian calendar are synchronized. Sun longitude degree and date of the Gregorian calendar have coincided with each other. For example, the Sun longitude degree on the 22nd of September is 180.

The JPL Ephemeris and mostly used in the astronomical software like Voyager 4.5, The Sky and Stellarium etc., we find longitude degree of Sun is 180 on 22nd of September in past around 400 years from 2000 CE. Sun longitude degree remains the same in 400 years.

Table 1: Year vs The Sun Longitude degree (2000 CE – 1600 CE)

Year	SUN Longitude Degree
2000 CE	180
1900 CE	180
1800 CE	180
1700 CE	180
1600 CE	180

But for every 400 years, from1400 CE to 200 CE SUN longitude degree is not remain same but it decreasing from 189 to 180.

Table 2: Year vs The Sun Longitude degree (1400 CE – 200 CE)

Year	SUN Longitude Degree
1400 CE	189
1000 CE	186
600 CE	183
200 CE	180

We get value of SUN Longitude degree 180 in 200 CE, but after that it's also not remain same. Every 400 years SUN Longitude degree is decreasing.

Table 3: Year vs The Sun Longitude degree (200 CE – 1000 BCE)

Year	SUN Longitude Degree
200 CE	180
200 BCE	177
600 BCE	174
1000 BCE	171

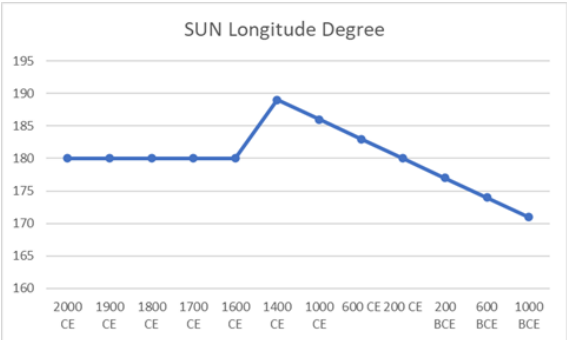

Image 1: Year vs The Sun Longitude degree comparisons (2000 CE – 10000 BCE)

- For First 400 Years Sun Longitude Degree is remain same on the particular date of Gregorian Calendar.
- After that in just 200 years, difference of 9 degree in Sun longitude. Suddenly the Sun longitude degree is hugely increased.
- After that Sun longitude degree is decreasing, 3 degrees in every 400 years.

The Sun Longitude degree for each 1000 years after 1000 BCE is decreasing.

Table 4: Year vs The Sun Longitude degree (100 BCE – 10000 BCE)

Year	SUN Longitude Degree
1000 BCE	171
2000 BCE	164
3000 BCE	157
4000 BCE	150
5000 BCE	143
6000 BCE	136
7000 BCE	130
8000 BCE	123
9000 BCE	117
10000 BCE	110

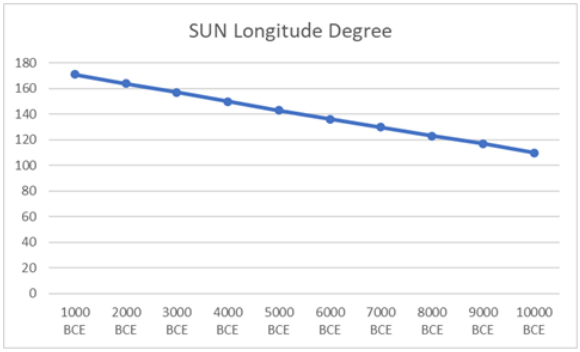

Image 2: Year vs The Sun Longitude degree comparisons (100 BCE – 10000 BCE)

Sun ephemeris and Gregorian calendar are synchronized. Sun longitude degree and date of Gregorian calendar are coincided with each other. The Gregorian calendar is synchronizing the calendar year with the solar year. Solar year is on average approximately 365.242 in past millions of years.

CONCLUSION

There is an error in The JPL Ephemeris and mostly the astronomical software like Voyager 4.5, The Sky and Stellarium etc when it coincides with Gregorian calendar.

REFERENCES

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