Sundials, EOT and the analemma

(You MUST learn the meanings of all words that are highlighted in italics)

In astronomy, an analemma (/ ænə lɛmə/; from Ancient Greek ἀνάλημμα (analēmma) 'support') is a diagram showing the position of the Sun in the sky as seen from a fixed location on Earth at the same mean solar time, as that position varies over the course of a year. The diagram will resemble a figure of eight.



Source: By Tomruen - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=68806680

Use Stellarium to map an analemma for yourself:

- 1. Set the date to 1 January
- 2. Set the time to midday
- 3. Search for the Sun it should be near the *meridian* as the Sun *culminates* around local noon
- 4. Make a table for the ALT and AZ coordinates of the Sun with 12 rows
- 5. Move the date forward by one month at a time and record the 12 ALT/AZ coordinates
- 6. Plot the 12 coordinates on graph paper and see what shape they make.

This is an example of a plotted analemma - does yours look similar?



By PAR - JPL Horizons, Public Domain, <u>https://commons.wikimedia.org/w/index.php?curid=3111462</u> <u>https://www.universetoday.com/126512/solar-analemma-the-2015-sun-in-one-picture/</u>

This is a beautiful photographic record of an analemma with actual images of the Sun superimposed on each other.

Label the following points on this image:

- 1. The summer *solstice* (June 21st in the northern hemisphere)
- 2. The winter *solstice* (December 21st in the northern hemisphere)
- 3. The *vernal equinox* (March 21st in the northern hemisphere)
- 4. The *autumnal equinox* (September 21st in the northern hemisphere)



This annual change in the midday position of the Sun in the sky results in the *Equation of Time (EOT)* which must be <u>subtracted</u> from *Local Solar Time (LST)*, given by reading a sundial, to convert the sundial reading to *Local Mean Time (LMT)*.

Label the same four points listed above on this chart of the EOT:



https://in-the-sky.org/data/eqntime.png

Watch this animation to see how an analemma relates to the EOT: