Solar Eccentricity

The idea was to do Exercise 5.6, on the Solar Theory, together in class. This document will help us get started efficiently.

Input Data — Spring and Summer

On p. 223, we are given that spring in 140 B.C. was about 94.5 days, and summer was 92.5 days.

Converting these to degrees, the Sun's arc of spring KPN is $360^{\circ}\,\frac{94.5}{365.25} = 93.142^{\circ}$ Similarly, the Sun's arc of summer KQL is $360^{\circ}\,\frac{92.5}{365.25} = 91.170^{\circ}$.

Please refer to my re-drawn version of Fig. 5.16, p. 221 on the following page.

Geometry — Arcs QL, SN, and PK

The sum of spring and summer arcs is 184.312° which exceeds 180° by 4.312° and half of that is 2.156°, and that is the lengths of arcs QL and SN.

The next step is to get arc PK, but $PK = KPN - 90^{\circ} - SN = 93.142^{\circ} - 90^{\circ} - 2.156^{\circ} = 0.986^{\circ}$.

Geometry — Lengths CT and CU

We next notice that $CT = VK = CK \sin KCV \ = \ CK \sin KP$. This last step is tricky. We have switched from the sin of an angle to the sin of an arc length, but KP is the arc length associated with the angle.

We also notice that $CU = QL = CL \sin QCL \ = \ CL \sin QL$. This last step is tricky. We have switched from the sin of an angle to the sin of an arc length, but KP is the arc length associated with the angle.

If we take the radius of the circle to be 1 then $CK = CL = 1$, and $CT = \sin KP$ and $CU = \sin QL$. Let us put in $KP = 0.986^{\circ}$ and $QL = 2.156^{\circ}$, both of which were derived above. Then $CT = 0.01721$ and $CU = 0.03762$.

Conclusion — *e* and *A* — Fall and Winter

Study the original diagram. You know CT and CU! Is it not simple trigonometry to get *e* and *A* from CT and CU? What are the formulae? At the top of p. 224 are Hipparchus's results. After you get your formulae and plug in, do you agree? As a final worthy point for discussion, how did we get an answer without knowing the lengths of fall and winter?