## Latitude & Longitude from the sun meridian passage

07 Oct. 2018 was a nice sunny day. I decided to take this opportunity for sun meridian passage measurements (using mirror artificial horizon).

Having the DR longitude λ = 005° 07.3´ E (which is A.t.T 20min 28 sec) and the meridian massage 11:48 GMT for that day in Nautical Almanac, I can calculate the time of sun's culmination which expected to be at 11:27 GMT or 13:27 MET. At about 15 min earlier I had to start "shooting sun" but I failed because the tripod had to be repositioned in order to see the sun reflection in the artificial horizon. As the result I missed the moment of sun's culmination. In spite of this I decided to measure at least the last portion of the sun's path after the culmination moment:

| GMT | 2*Hs |
|---|---|
| 11:32:03 | 63° 38.6´ |
| 11:32:48 | 63° 39.2´ |
| 11:33:47 | 63° 37.4´ |
| 11:34:37 | 63° 37.6´ |
| 11:35:36 | 63° 37.8´ |
| 11:36:30 | 63° 36.8´ |
| 11:39:23 | 63° 34.1´ |
| 11:41:17 | 63° 32.2´ |
| 11:43:14 | 63° 29.8´ |

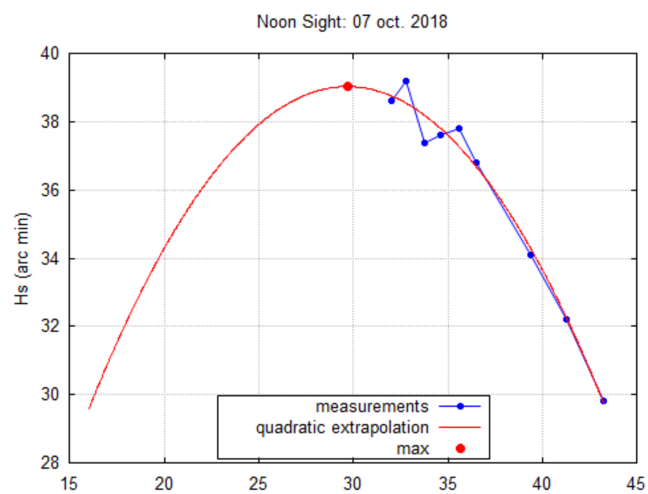


**Figure 1: Quadratic extrapolation – way to find (reconstruct) the culmination time and altitude.**

By quadratic extrapolation (Figure 1, red curve) I could recover the maximum i.e. the culmination moment and culmination height:

| GMT max | 2*Hs max |
|---|---|
| 11:29:41 | 63° 39.0´ |

Having this data we can proceed further. Now we have to determine true altitude of a culmination moment ($H_t$), corresponding zenith distance (Z) and sun's declination ($\delta_{\odot}$). The result we can find in the Table on the next page. After that we can determine our latitude:

φ = 57° 56.1´ (to N) – 5° 34.7´(S) = 52° 21.4´ N.

Sake of clarity I also added a schematic drawing in Figure 2.

If we compare this result to the exact latitude which is $\varphi_{exact}$ = 52° 23.1´ N we find a difference of 1.7' which is quite OK.

| | | |
|---|---|---|
| 2*Hs | = | 63° 39.0´ |
| i.c. | = | – 0.7´ |
| $2^*H_m$ | | 63° 38.3´ |
| $H_m$ | = | 31° 49.2´ |
| Dip | = | Not Applied |
| App. alt. | = | 31° 49.2´ |
| mc (LL) | = | +14.7´ |
| $H_t$ | = | 32° 3.9´ |
| $Z = 90° - H_t$ | = | 57° 56.1´ to N |

| | | |
|---|---|---|
| $\delta_\odot$(h) | = | 5° 34.2´ (S) |
| corr (m) | = | +0.5´ |
| $\delta_\odot$(h:m) | = | 5° 34.7´ (S) |

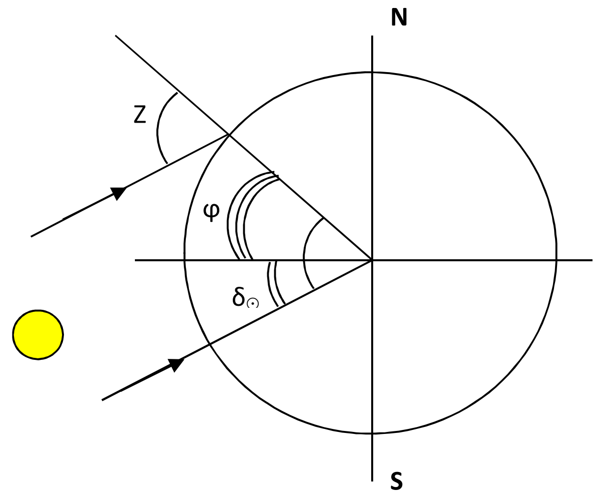

**Figure 2: Schematic drawing from where it follows: $Z = \varphi + \delta_\odot$**

From the sun's meridian passage we can also calculate our longitude (λ), which is *arc*-conversion of the time difference between our culmination time and that in Greenwich. We should not expect it to be as accurate as the latitude but we can give it a try.

The equation of time for 07 oct. 2018 from Nautical Almanac is 12m 10s which means that the GMT time of culmination at Greenwich on that day was 11:47:50. Our calculated time of culmination is 11:29:41 GMT (it happened earlier so we are to the east of Greenwich). Time difference is 00:18:09 converted to *arc* gives us longitude λ = 004° 32.3´ E. This result has a difference with the exact longitude ($\lambda_{exact}$ = 004° 39.0´ E) which amounts to 6.7´ longitudinal minutes or 4.1NM which is 2.4-times that for latitude error but still looks good.

Lesson learned – better preparation for observations and more practice with artificial horizon!