Observing plan for the engineering night of 6/6/2019; sky brightness measurements before Rosemont construction.

Here are the details of the observations from the Massey & Foltz PASP, 112, 2000 paper:

“The 1988 Mount Hopkins data were taken on the night of 1988 June 6 (UT) with the 4.5 m Multiple Mirror Telescope (MMT) using the Blue Channel of the MMT Spectrograph and an intensified Reticon detector. A 300 line/mm grating was used in first order with no blocking filter. This will lead to some order overlap longward of about 6500 A. The spectral resolution is about 10A (FWHM). A 300s exposure was taken through two 5” diameter circular apertures while tracking near the zenith. Wavelength calibration was carried out using observations of a HeNeAr lamp. As is the case for the KPNO data, no extinction correction was applied to the observations of the night sky. A small dark count correction of 0.004 photons/s/pixel was subtracted from the data. No pulse-pair corrections were made. The instrumental sensitivity function was calculated using observations of the standard star G138-31 assuming a mean extinction law appropriate for Mount Hopkins. The data from the two apertures were reduced independently and averaged to produce the final spectrum.

The second-epoch Mount Hopkins data were obtained by P. Berlind on 1998 November 25 using the 1.5 m Tillinghast telescope at the Fred Lawrence Whipple Observatory and the FAST spectrograph (Fabricant et al. 1998) and a 2688 x 512 Loral CCD detector. A 300 line/mm grating was used in first order with no blocking filter, yielding spectral resolution of about 10 A. Exposures of 1800 s were taken through a 5A slit at the zenith and at the four cardinal points at zenith distances of roughly 50 degrees (except for the eastern exposure, which was taken at a zenith distance of about 35degrees; see Table 1). Wavelength calibration was carried out using observations of a HeNeAr lamp. No dark correction was made, and the data were not corrected for atmospheric extinction. The instrumental sensitivity function was calculated using observations of the standard stars Feige 110 and G191-B2B, again assuming a mean extinction law. The final spectrum was extracted using a median filter applied over the unvignetted part of the slit.”

These are the 1998 observation positions in Table 1 of the paper.

Zenith (ZD = 5 degrees)
North (ZD = 48 degrees)
East (ZD = 34 degrees)
South (ZD = 50 degrees)
West (ZD = 53 degrees)

Input for Don Davis and Chris Luginbuhl (May 8, 2019 email to GGW):

We are using a ZD=70 as the limiting ZD for the “astronomically useful sky”.

The direction of Rosemont is the major focus for the funding of this project. Other directions are for assessing the overall quality of the Whipple sky:

1) Zenith, ZD= 5, for Comparison with M&F.

2) Rosemont AZ. ZD: 70 and very low, say 85-87 degrees?

3) Benson/Vigneto AZ. ZD: 70 and very low.

4) Tucson: N. Az for comparison with F&M. ZD: 70 and 48.

5) Nogales Vicinity: AZ =180, S. ZD: 70 and 50.

I'm not sure how much difference there will be between ZD = 70 and 50(48), so these may be somewhat redundant.

Perhaps we can try to get all-sky photometry with the Dark Sky Partners camera at the same time. Pascal, Emilio and Mike Calkins have been successful in getting data with this camera recently and the plan is to continue monthly observations until the automated system is up and operating.

Background Information

There's a nice website that allows one to enter GPS coordinates and get the bearing between two sites:

https://www.movable-type.co.uk/scripts/latlong.html

The figure below shows that the bearing between the MMT and the Rosemont Ore Processing area is:
Bearing: 37d 36' 34" (37.60944444 degrees)

Villages at Vigneto
31.890299, -110.307551
(approximate based on Google maps and Army Corps of Engineers layout)
Bearing: 67d 31' 09"

Tucson
32.2226, -110.9747
Bearing: 351d 56' 13"
In the direction of Oro Valley (may include a bit of Marana)

Nogales, Sonora
31.3012, -110.9381
Bearing: 186d 38’ 43”

Great-circle distance between two points

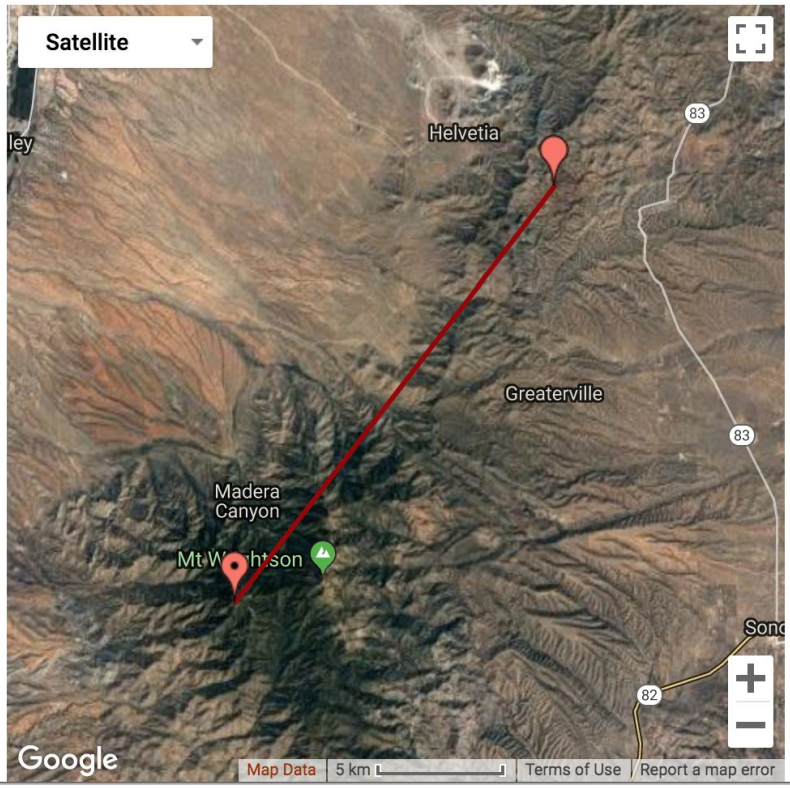
Enter the co-ordinates into the text boxes to try out the calculations. A variety of formats are accepted, principally:

- deg-min-sec suffixed with N/S/E/W (e.g. 40°44’55”N, 73 59 11W), or
- signed decimal degrees without compass direction, where negative indicates west/south (e.g. 40.7486, -73.9864):

Point 1: 31 41 19N , 110 53 07W
Point 2: 31 50 18N , 110 44 58W

Distance: **21.03** km (to 4 SF*)
Initial bearing: **037° 36’ 34”**
Final bearing: **037° 40’ 51”**
Midpoint: **31° 45’ 49” N, 110° 49’ 03” W**

... hide map



Great-circle distance between two points

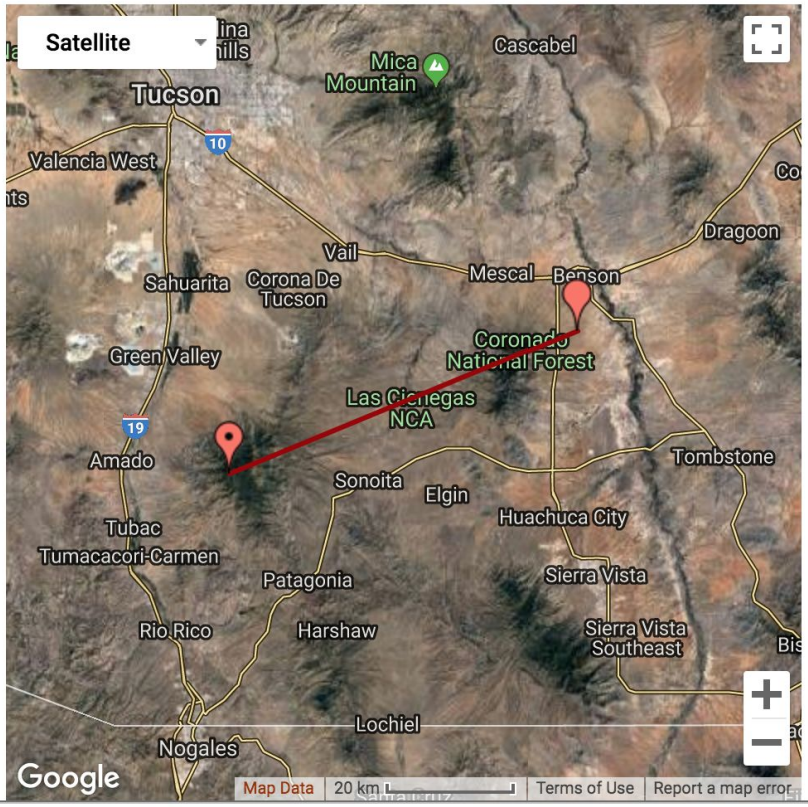
Enter the co-ordinates into the text boxes to try out the calculations. A variety of formats are accepted, principally:

- deg-min-sec suffixed with N/S/E/W (e.g. 40°44′55″N, 73 59 11W), or
- signed decimal degrees without compass direction, where negative indicates west/south (e.g. 40.7486, -73.9864):

Point 1: 31 41 19N , 110 53 07W
Point 2: 31.890299N , 110.307551W

Distance: **59.03** km (to 4 SF*)
Initial bearing: **067° 31′ 09″**
Final bearing: **067° 49′ 25″**
Midpoint: **31° 47′ 23″ N, 110° 35′ 48″ W**

... hide map



Great-circle distance between two points

Enter the co-ordinates into the text boxes to try out the calculations. A variety of formats are accepted, principally:

- deg-min-sec suffixed with N/S/E/W (e.g. 40°44′55″N, 73 59 11W), or
- signed decimal degrees without compass direction, where negative indicates west/south (e.g. 40.7486, -73.9864):

Point 1:	31 41 19N ,	110 53 07W
Point 2:	32.2226N ,	110.9747W

Distance: **59.97** km (to 4 SF*)
Initial bearing: **351° 56′ 13″**
Final bearing: **351° 53′ 23″**
Midpoint: **31° 57′ 20″ N, 110° 55′ 47″ W**

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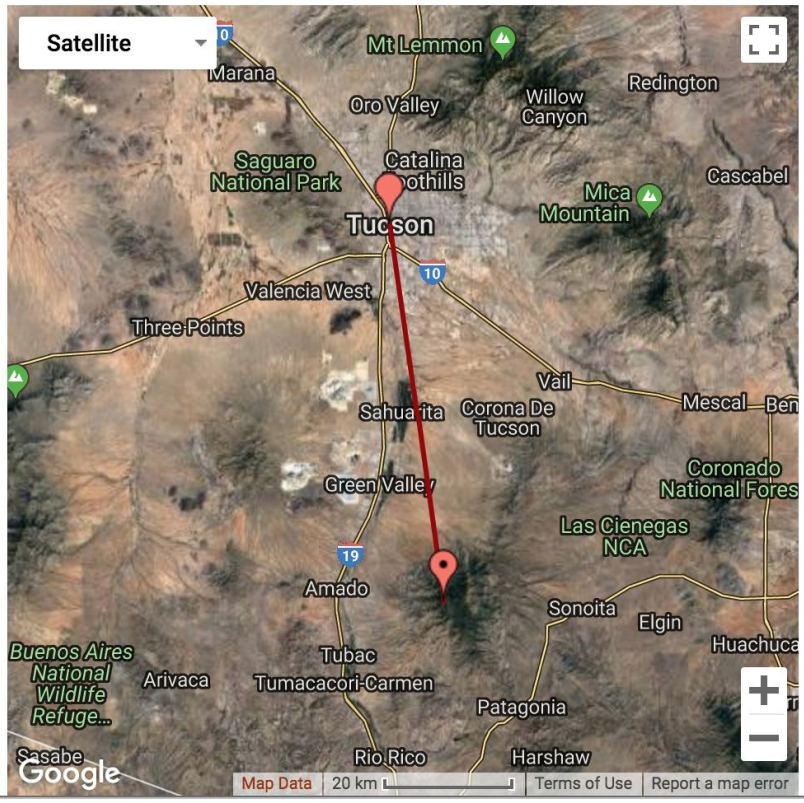


Great-circle distance between two points

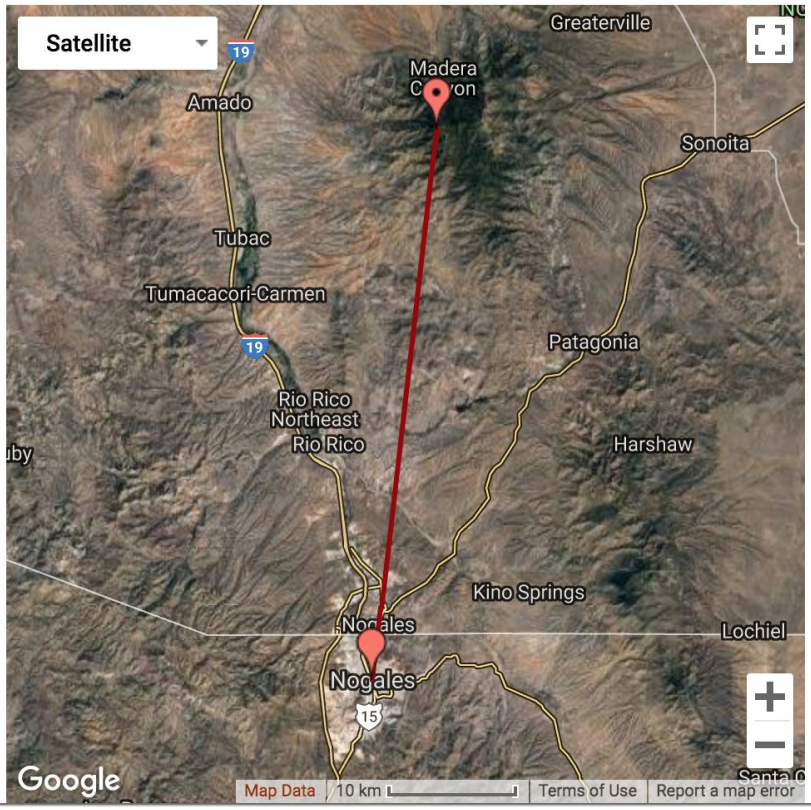
Enter the co-ordinates into the text boxes to try out the calculations. A variety of formats are accepted, principally:

- deg-min-sec suffixed with N/S/E/W (e.g. 40°44′55″N, 73 59 11W), or
- signed decimal degrees without compass direction, where negative indicates west/south (e.g. 40.7486, -73.9864):

Point 1:	31 41 19N ,	110 53 07W
Point 2:	31.3012N ,	110.9381W

Distance: **43.37** km (to 4 SF*)
Initial bearing: **186° 38′ 43″**
Final bearing: **186° 37′ 04″**
Midpoint: **31° 29′ 42″ N, 110° 54′ 42″ W**

... hide map



Observing Plan:

Instrumental Setup:

Blue Channel
300 l/mm grating at a central wavelength of 5800 (see below)
5” slit or two 5” diameter circles (see below)
No blocking filter (will result in order overlap longward of ~6500 A

The Blue Channel 300 l/mm grating has a wavelength coverage of 5268. To get down to the atmospheric cutoff we want the central wavelength of 3200 + 5268/2 = 5834 or about 5800.

Available apertures from the website:

Comb - line of 1" diameter circular holes on 10" centers
3" diameter single circular hole
1.0", 1.4", and 5.0" diameter double circular holes
1.0" x 2.6" and 2.0" x 3.0" double slits

Calibrations:

300 sec (?) HeNeAr with 1” slit for wavelength calibration (done in the morning)

5 x 30 sec (?) bright lamp with 5” slit for flat fielding (done in the morning)

Observe at around 12:00am
300 sec (?)
Standard Star: G138-31
RA(2000) = 16h 27m 53.59s
Dec(2000) = +09d 12' 24.5"
V = 16.12, B-V = +0.36, Spectral type: DC

Observe at around 4:00am
10 sec
Standard Star: BD+28 4211
RA(2000) = 21h 51m 11.07s
Dec(2000) = +28d 51' 51.8"
V = 10.51, B-V = -0.34, Spectral type: Op

Observe at around 4:00am
300 sec (?)

Standard Star: LDS749B
RA(2000) = 21h 32m 15.75s
Dec(2000) = +00d 15' 13.6"
V = 14.68, B-V = -0.06, Spectral type: DB4

Take 3 x 180 second exposures at each of the following Azimuth and Elevation positions:

Near zenith toward dark east
Az:90
El: 85

Rosemont (low and higher)
Az: 37d 36’ 34” (37.60944444 degrees)
El: 20

Az: 37d 36’ 34” (37.60944444 degrees)
El: 45 (ish maybe 42)

Villages of Vigneto (low and higher)
Az: 67d 31’ 09” (67.51916667 degrees)
El: 20

Az: 67d 31’ 09” (67.51916667 degrees)
El: 45 (ish maybe 42)

Tucson
Az: 351d 56’ 13” (351.9369444 degrees)
El: 20

Az: 351d 56’ 13” (351.9369444 degrees)
El: 45 (ish maybe 42)

Nogales
Az: 186d 38’ 43” (186.64527778 degrees)
El: 20

Az: 186d 38’ 43” (186.64527778 degrees)
El: 45 (ish maybe 42)

North
Az: 0
El: 20

North to match M&F
Az: 0
El: 42

East
Az: 90
El: 20

East to match M&F
Az: 90
El: 56

South
Az: 180
El: 20

South to match M&F
Az: 180
El: 40

West
Az: 270
El: 20

West to match M&F
Az: 270
El: 37

Note the MW is at east at 12:00 am and moves to overhead (running NE to SW) by 4:00 am.