# Observers Handbook

## Total Solar Eclipse of April 20th, 2023


## For Observers near Exmouth

Compiled by Joseph A. Cali

## Introduction

I the past, like many eclipse chasers I would always eagerly await my NASA eclipse bulletin prepared by Fred Espenak. These NASA bulletins and current offerings of privately published guidebooks also authored by Fred Espenak with Jay Anderson do a good job of covering the whole eclipse path, multiple continents and oceans. These eclipse bulletins are written for everybody located anywhere along the eclipse path.

From a purely selfish perspective, during my eclipse expeditions, I wanted more detailed information about the place I had chosen to observe from and cared little about details on the path thousands of kilometres from my chosen location. As my experience grew, I began assembling information not contained in the eclipse bulletins more specific to my own plans, equipment and location. Beginning around the 2006 eclipse I began collecting other information that I found useful and sharing it with my late solar eclipse chasing partner and friend Bengt Alfredsson. By 2010, I had developed this current format to which I have added blank and ruled pages so it could double as a travel journal and planning workbook.


*Total Eclipse over the Andes July 2019. 50mm lens*


**This publication is dedicated to the memory of my long time friend and eclipse-chasing partner in crime, Bengt Alfredsson [1962-2019]**

**Photo: Bengt Alfredsson at the 2013 annular solar eclipse near Newman, WA**

**Eclipse weather prospects**
See Jay Anderson's site http://www.eclipser.ca

**Local Weather Predictions**
Australian Bureau of Meteorology http://www.bom.gov.au/

**Meteologix https://tinyurl.com/58cmr3ue**
The forecast map allows you to switch between 4 models:-
**ECMWF GFS ICON ACCESS**

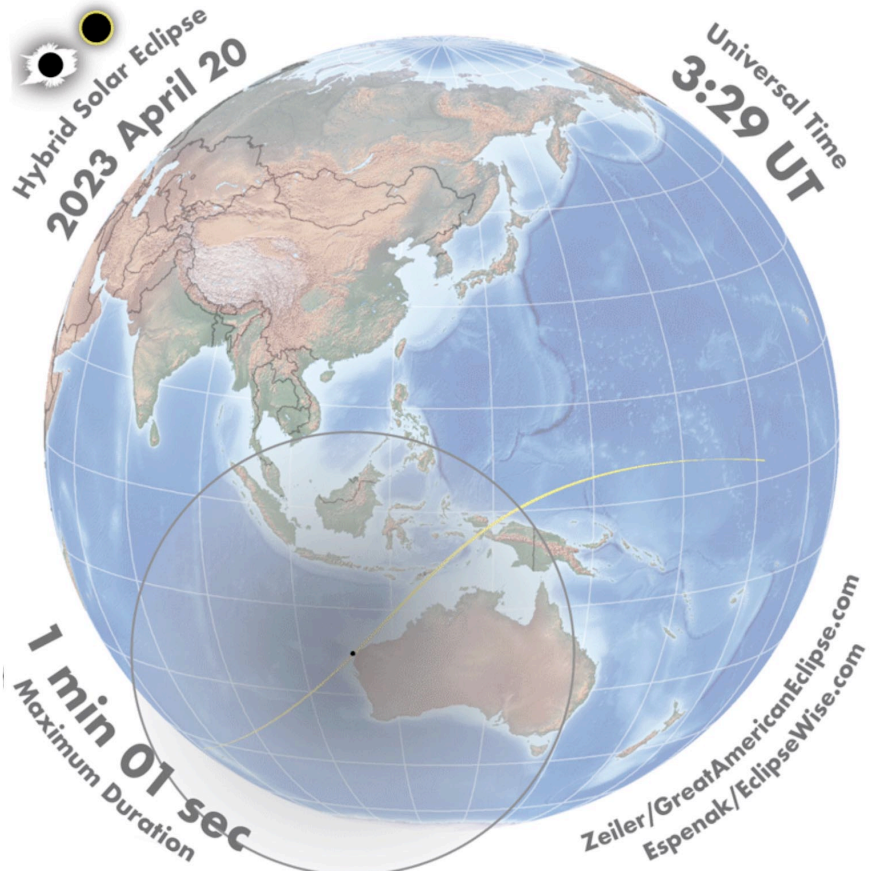
**Cloud Free Night** https://www.cloudfreenight.com/map.html
Choose northwest WA map and Access G or GFS

**Maps of the Eclipse Paths**

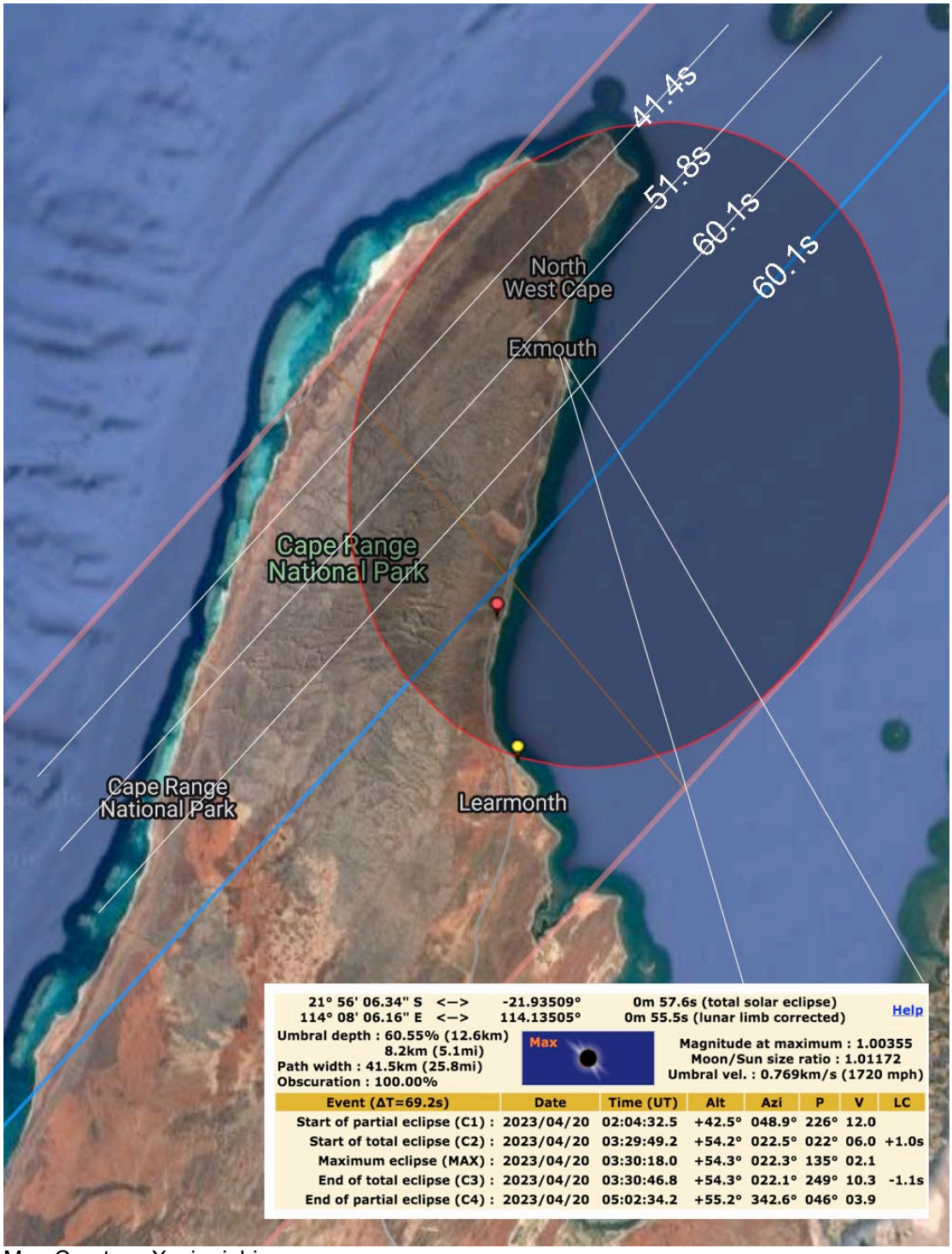
http://xjubier.free.fr/en/site_pages/SolarEclipsesGoogleMaps.html

https://www.eclipsewise.com/solar/solar.html

https://www.greatamericaneclipse.com/solar-eclipses-from-2021-to-2030




Eclipse Path Image Courtesy:
Michael Zeiler/ GreatAmericanEclipse.com / Fred Espenak/EclipseWise.com




Map Courtesy Xavier jubier
http://xjubier.free.fr/en/site_pages/SolarEclipsesGoogleMaps.html

While it may be tempting to head south to the centreline midway between Exmouth and Learmonth to eek out every second of totality on eclipse day, it doesn't make as much difference as you might think. Lunar limb effects, the unevenness caused by valleys and mountain peaks seen around the edge of the limb of the Moon can shorten or lengthen the duration of totality compared to the mean lunar limb, a smoothed average, depending upon your specific location relative to valleys. At the top right of the location information box seen on the map above, two durations are provided. The top one, labelled total solar eclipse, is the duration based on the mean lunar limb. The second, labelled lunar limb corrected, calculates the duration allowing for valleys on both entry and exit sides of the Moon. If you go to the source map on Xavier's site, you can experiment and explore the limb effects.

http://xjubier.free.fr/en/site_pages/SolarEclipsesGoogleMaps.html, you will find that the 60.5s duration on the centreline is almost matched by a location on the beach some 2km south of the town beach with a duration of 60.0s. The beach just south of the marina gets 58.7s. Stay put in Exmouth and you will only lose about 5 ½ seconds of totality (55s) compared to the centreline.

### The eclipse circumstances in Exmouth local time (AWST)

| Event (ΔT=69.2s) | Date | Local Time (AWST) | Alt | Azi | P | V | LC |
|---|---|---|---|---|---|---|---|
| Start of partial eclipse (C1) : | 2023/04/20 | 10:04:32.5 | +42.5° | 048.9° | 226° | 12.0 | |
| Start of total eclipse (C2) : | 2023/04/20 | 11:29:49.2 | +54.2° | 022.5° | 022° | 06.0 | +1.0s |
| Maximum eclipse (MAX) : | 2023/04/20 | 11:30:18.0 | +54.3° | 022.3° | 135° | 02.1 | |
| End of total eclipse (C3) : | 2023/04/20 | 11:30:46.8 | +54.3° | 022.1° | 249° | 10.3 | -1.1s |
| End of partial eclipse (C4) : | 2023/04/20 | 13:02:34.2 | +55.2° | 342.6° | 046° | 03.9 | |

[Source: adapted from data by Xavier Jubier]

# Site Specific Circumstance Information

### CIRCUMSTANCES OF ECLIPSE CONTACTS AND OTHER EVENTS

### Exmouth

| | | | |
|---|---|---|---|
| 21° 56' 02.32" S | <—> | -21.93398° | 0m 56.8s (total solar eclipse) |
| 114° 07' 42.04" E | <—> | 114.12834° | 0m 54.5s (lunar limb corrected) |

Help

Umbral depth : 57.69% (12.0km)
Umbral depth : 8.8km (5.5mi)
Path width : 41.5km (25.8mi)
Obscuration : 100.00%

Magnitude at maximum : 1.00338
Moon/Sun size ratio : 1.01172
Umbral vel. : 0.769km/s (1720 mph)

| Event (ΔT=69.2s) | Date | Time (WAST) | Alt | Azi | P | V | LC |
|---|---|---|---|---|---|---|---|
| Start of partial eclipse (C1) : | 2023/04/20 | 10:04:32.1 | +42.5° | 048.9° | 226° | 12.0 | |
| Start of total eclipse (C2) : | 2023/04/20 | 11:29:49.0 | +54.2° | 022.5° | 020° | 06.0 | +0.9s |
| Maximum eclipse (MAX) : | 2023/04/20 | 11:30:17.4 | +54.3° | 022.3° | 135° | 02.1 | |
| End of total eclipse (C3) : | 2023/04/20 | 11:30:45.8 | +54.3° | 022.1° | 250° | 10.3 | -1.4s |
| End of partial eclipse (C4) : | 2023/04/20 | 13:02:33.5 | +55.2° | 342.6° | 046° | 03.9 | |

Source:
http://xjubier.free.fr/en/site_pages/solar_eclipses/HSE_2023_GoogleMapFull.html?Lat=39.61301&Lng=2.33727&Zoom=8&LC=1

## Sunrise, Sunset & Twilight Times on Eclipse Day

Location & Date

| Location | Latitude | Longitude | Date |
|---|---|---|---|
| Exmouth | 21° 57' S | 114° 7' E | 20/04/2023 AWST |

Results

| Event | Rise | Set | Transit |
|---|---|---|---|
| Times Of Sunrise And Sunset | 06:38 | 18:08 | - |
| Times Of Civil Twilight | 06:15 | 18:30 | - |
| Times Of Nautical Twilight | 05:49 | 18:56 | - |
| Times Of Astronomical Twilight | 05:23 | 19:22 | - |
| Time Of Sun Transit | - | - | 12:23 |

Solar north is approx $25^{o}$ west of celestial north on April 20.

At Exmouth, Magnetic Declination, D = + $0.29^{o}$
(Compass needle points $0.29^{o}$ east of true north)

## AZIMUTH AND ALTITUDE OF THE SUN ON ECLIPSE DAY, APRIL 20

| Time | Altitude | Azimuth (E of N) |
|---|---|---|
| 5:50 | -11.7° | 82.4° |
| 6:00 | -9.4° | 81.5° |
| 6:10 | -7.1° | 80.6° |
| 6:20 | -4.8° | 79.7° |
| 6:30 | -2.5° | 78.8° |
| 6:40 | 0.3° | 77.9° |
| 6:50 | 2.3° | 76.9° |
| 7:00 | 4.5° | 76.0° |
| 7:10 | 6.6° | 75.0° |
| 7:20 | 8.9° | 73.9° |
| 7:30 | 11.1° | 72.9° |
| 7:40 | 13.2° | 71.8° |
| 7:50 | 15.4° | 70.7° |
| 8:00 | 17.6° | 69.5° |
| 8:10 | 19.8° | 68.3° |
| 8:20 | 21.9° | 67.0° |
| 8:30 | 24.0° | 65.7° |
| 8:40 | 26.1° | 64.3° |
| 8:50 | 28.2° | 62.8° |
| 9:00 | 30.2° | 61.3° |
| 9:10 | 32.3° | 59.7° |
| 9:20 | 34.2° | 57.9° |
| 9:30 | 36.2° | 56.1° |
| 9:40 | 38.1° | 54.2° |
| 9:50 | 39.9° | 52.1° |
| First Contact 10:04 | | |
| **10:00** | **41.7°** | **49.9°** |
| **10:10** | **43.5°** | **47.6°** |
| **10:20** | **45.1°** | **45.1°** |
| **10:30** | **46.7°** | **42.4°** |
| **10:40** | **48.3°** | **39.6°** |

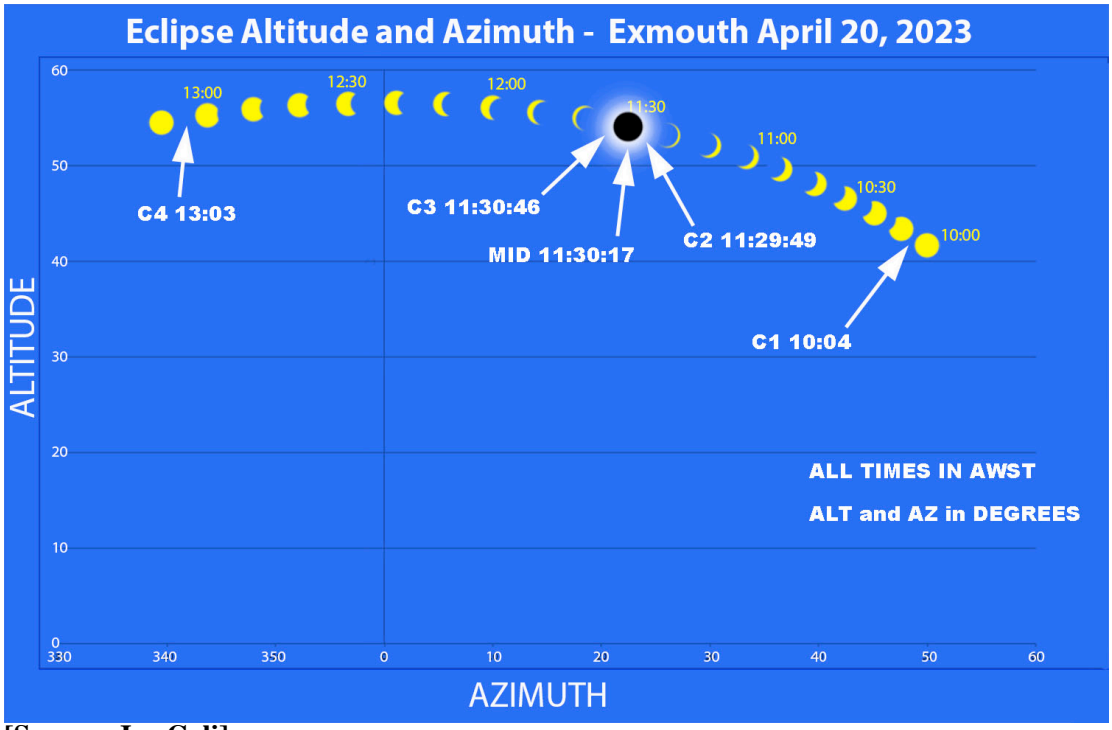
| TIME | ALTITUDE | AZIMUTH |
|---|---|---|
| 10:50 | 49.7° | 36.5° |
| 11:00 | 51.0° | 33.3° |
| 11:10 | 52.2° | 29.9° |
| 11:20 | 53.3° | 26.2° |
| Totality 11:29:49-11:30:46 | | |
| 11:30 | 54.3° | 22.4° |
| 11:40 | 55.1° | 18.4° |
| 11:50 | 55.7° | 14.2° |
| 12:00 | 56.2° | 10.0° |
| 12:10 | 56.5° | 5.6° |
| 12:20 | 56.7° | 1.1° |
| 12:30 | 56.6° | 356.7° |
| 12:40 | 56.4° | 352.2° |
| 12:50 | 56.0° | 347.9° |
| 13:00 | 55.4° | 343.7° |
| Fourth Contact 13:02 | | |
| 13:10 | 54.7° | 339.6° |
| 13:20 | 53.8° | 335.7° |
| 13:30 | 52.8° | 332.0° |
| 13:40 | 51.6° | 328.4° |
| 13:50 | 50.3° | 325.1° |
| 14:00 | 49.0° | 322.0° |
| 14:10 | 47.5° | 319.0° |
| 14:20 | 45.9° | 316.3° |
| 14:30 | 44.3° | 313.7° |
| 14:40 | 42.6° | 311.3° |
| 14:50 | 40.8° | 309.0° |
| 15:00 | 39.0° | 306.9° |
| 15:10 | 37.1° | 304.9° |
| 15:20 | 35.2° | 303.0° |
| 15:30 | 33.2° | 301.3° |
| 15:40 | 31.2° | 299.6° |
| 15:50 | 29.2° | 298.0° |
| 16:00 | 27.1° | 296.5° |
| 16:10 | 25.0° | 295.1° |

| TIME | ALTITUDE | AZIMUTH |
|---|---|---|
| 16:20 | 22.9° | 293.7° |
| 16:30 | 20.8° | 292.4° |
| 16:40 | 18.6° | 291.2° |
| 16:50 | 16.5° | 290.0° |
| 17:00 | 14.3° | 288.9° |
| 17:10 | 12.1° | 287.8° |
| 17:20 | 9.9° | 286.7° |
| 17:30 | 7.7° | 285.7° |
| 17:40 | 5.5° | 284.7° |
| 17:50 | 3.3° | 283.7° |
| 18:00 | 1.2° | 282.8° |
| 18:10 | -1.4° | 281.8° |

[Source:- U.S. Naval Observatory Astronomical Applications Department]

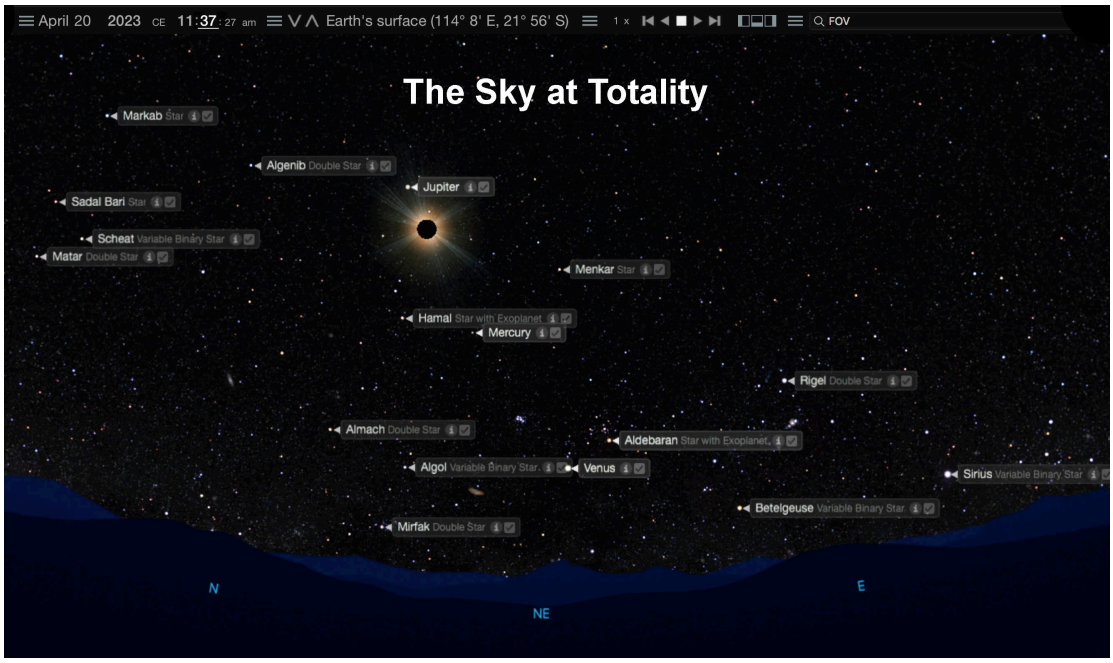
## Wide angle photography-graphic simulation

Graphic simulation of the eclipse in the sky. They are at 10 min intervals from just before C1 to just after C4 showing altitude and azimuth.




**[Source: Joe Cali]**

## The Sky at Totality




Source [Starry Night Pro]. The sky at totality on April 20. Labels have been applied to planets and any stars to about magnitude 2. Jupiter above and Venus well below and to the right are always easily visible. Others depend upon atmospheric effects such as, haze, sky brightness and air pollution.

# Moon RISE AND SET - Exmouth

| Times Of Moonrise And Moonset Exmouth [AWST] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Mar | | Apr | | May | | Jun | |
| | Rise | Set | Rise | Set | Rise | Set | Rise | Set |
| 1 | 14:46 | 00:40 | 15:43 | 02:03 | 15:24 | 02:30 | 15:32 | 03:47 |
| 2 | 15:37 | 01:30 | 16:20 | 02:56 | 15:56 | 03:21 | 16:12 | 04:45 |
| 3 | 16:24 | 02:23 | 16:53 | 03:48 | 16:28 | 04:13 | 16:57 | 05:46 |
| 4 | 17:06 | 03:17 | 17:25 | 04:40 | 17:01 | 05:06 | 17:50 | 06:51 |
| 5 | 17:45 | 04:11 | 17:57 | 05:31 | 17:38 | 06:01 | 18:50 | 07:58 |
| 6 | 18:20 | 05:04 | 18:29 | 06:23 | 18:20 | 07:00 | 19:56 | 09:03 |
| 7 | 18:53 | 05:56 | 19:04 | 07:16 | 19:07 | 08:03 | 21:04 | 10:03 |
| 8 | 19:25 | 06:47 | 19:41 | 08:12 | 20:02 | 09:08 | 22:11 | 10:56 |
| 9 | 19:56 | 07:37 | 20:24 | 09:11 | 21:03 | 10:12 | 23:16 | 11:43 |
| 10 | 20:29 | 08:29 | 21:13 | 10:14 | 22:08 | 11:14 | | 12:24 |
| 11 | 21:03 | 09:23 | 22:08 | 11:17 | 23:14 | 12:10 | 00:17 | 13:01 |
| 12 | 21:42 | 10:19 | 23:10 | 12:20 | | 13:00 | 01:15 | 13:36 |
| 13 | 22:26 | 11:18 | | 13:19 | 00:19 | 13:43 | 02:12 | 14:12 |
| 14 | 23:16 | 12:20 | 00:15 | 14:13 | 01:22 | 14:23 | 03:09 | 14:48 |
| 15 | | 13:23 | 01:21 | 15:01 | 02:22 | 14:59 | 04:06 | 15:26 |
| 16 | 00:14 | 14:26 | 02:26 | 15:44 | 03:20 | 15:35 | 05:04 | 16:09 |
| 17 | 01:18 | 15:25 | 03:29 | 16:23 | 04:17 | 16:11 | 06:03 | 16:55 |
| 18 | 02:25 | 16:18 | 04:30 | 17:00 | 05:15 | 16:48 | 07:00 | 17:46 |

| Times Of Moonrise And Moonset Exmouth [AWST] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Mar | | Apr | | May | | Jun | |
| | Rise | Set | Rise | Set | Rise | Set | Rise | Set |
| 19 | 03:33 | 17:06 | 05:29 | 17:36 | 06:14 | 17:29 | 07:55 | 18:40 |
| 20 | 04:40 | 17:48 | 06:28 | 18:14 | 07:13 | 18:13 | 08:46 | 19:34 |
| 21 | 05:44 | 18:28 | 07:27 | 18:53 | 08:12 | 19:02 | 09:32 | 20:29 |
| 22 | 06:45 | 19:05 | 08:27 | 19:35 | 09:10 | 19:54 | 10:12 | 21:23 |
| 23 | 07:45 | 19:42 | 09:27 | 20:22 | 10:03 | 20:48 | 10:49 | 22:14 |
| 24 | 08:45 | 20:20 | 10:26 | 21:12 | 10:52 | 21:43 | 11:22 | 23:04 |
| 25 | 09:44 | 21:01 | 11:21 | 22:05 | 11:36 | 22:38 | 11:53 | 23:54 |
| 26 | 10:43 | 21:45 | 12:12 | 22:59 | 12:15 | 23:30 | 12:23 | |
| 27 | 11:42 | 22:32 | 12:59 | 23:53 | 12:50 | | 12:55 | 00:44 |
| 28 | 12:38 | 23:22 | 13:40 | | 13:22 | 00:21 | 13:28 | 01:35 |
| 29 | 13:31 | | 14:17 | 00:47 | 13:54 | 01:12 | 14:04 | 02:30 |
| 30 | 14:19 | 00:15 | 14:52 | 01:39 | 14:25 | 02:02 | 14:46 | 03:28 |
| 31 | 15:04 | 01:09 | | | 14:57 | 02:54 | | |

**Notes : -**

## FIELD OF VIEW OF DIFFERENT DIMENSIONS OF SENSOR

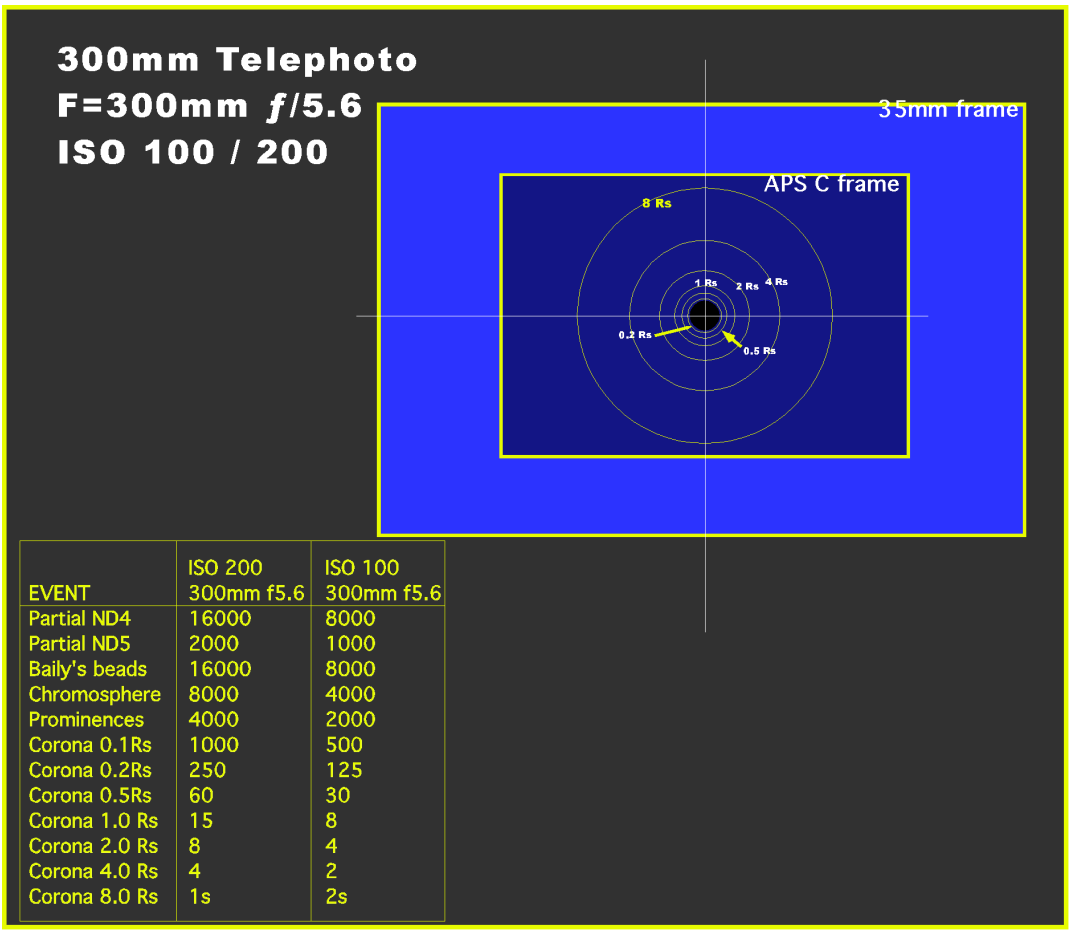
| ANGLE OF VIEW (deg) | APSC vert (mm) | APSC Horiz (mm) | APSC diagonal (mm) | Full Frame vert (mm) | Full Frame horiz (mm) | Full Frame diagonal (mm) |
|---|---|---|---|---|---|---|
| focal length | 15.8 | 23.0 | 27.9 | 25.0 | 36.0 | 43.8 |
| 10 | 76.6 | 98.0 | 108.7 | 102.7 | 121.9 | 131.0 |
| 12 | 66.7 | 87.6 | 98.6 | 92.3 | 112.6 | 122.6 |
| 16 | 52.6 | 71.4 | 82.2 | 76.0 | 96.7 | 107.7 |
| 18 | 47.4 | 65.2 | 75.6 | 69.6 | 90.0 | 101.2 |
| 20 | 43.1 | 59.8 | 69.8 | 64.0 | 84.0 | 95.2 |
| 24 | 36.4 | 51.2 | 60.3 | 55.0 | 73.7 | 84.8 |
| 28 | 31.5 | 44.7 | 53.0 | 48.1 | 65.5 | 76.1 |
| 31 | 28.6 | 40.7 | 48.5 | 43.9 | 60.3 | 70.5 |
| 35 | 25.4 | 36.4 | 43.5 | 39.3 | 54.4 | 64.1 |
| 45 | 19.9 | 28.7 | 34.5 | 31.1 | 43.6 | 51.9 |
| 50 | 18.0 | 25.9 | 31.2 | 28.1 | 39.6 | 47.3 |
| 70 | 12.9 | 18.7 | 22.5 | 20.3 | 28.8 | 34.8 |
| 80 | 11.3 | 16.4 | 19.8 | 17.8 | 25.4 | 30.6 |
| 100 | 9.0 | 13.1 | 15.9 | 14.3 | 20.4 | 24.7 |
| 135 | 6.7 | 9.7 | 11.8 | 10.6 | 15.2 | 18.4 |
| 150 | 6.0 | 8.8 | 10.6 | 9.5 | 13.7 | 16.6 |
| 200 | 4.5 | 6.6 | 8.0 | 7.2 | 10.3 | 12.5 |
| 300 | 3.0 | 4.4 | 5.3 | 4.8 | 6.9 | 8.4 |
| 400 | 2.3 | 3.3 | 4.0 | 3.6 | 5.2 | 6.3 |
| 500 | 1.8 | 2.6 | 3.2 | 2.9 | 4.1 | 5.0 |
| 600 | 1.5 | 2.2 | 2.7 | 2.4 | 3.4 | 4.2 |
| 700 | 1.3 | 1.9 | 2.3 | 2.0 | 2.9 | 3.6 |
| 1000 | 0.9 | 1.3 | 1.6 | 1.4 | 2.1 | 2.5 |
| 1250 | 0.7 | 1.1 | 1.3 | 1.1 | 1.7 | 2.0 |
| 1500 | 0.6 | 0.9 | 1.1 | 1.0 | 1.4 | 1.7 |

Wide-angle field widths apply to rectilinear projection lenses not to fisheye lenses.

## Exposure diagrams

All of the following diagrams show coronal extent marked with circular radii and give exposure recommendations. Capturing with shorter focal length lenses 100-300mm the corona can potentially be captured out to 8 or more solar radii. I have always found that in most low altitude locations, the corona disappears/merges into the ambient sky glow between 4-6 solar radii form the limb. Some photographers seem to have better acquisition technique, better processing, and under clearer skies found at high altitudes or Arctic atmospheres and are able to capture out to very expansive radii.

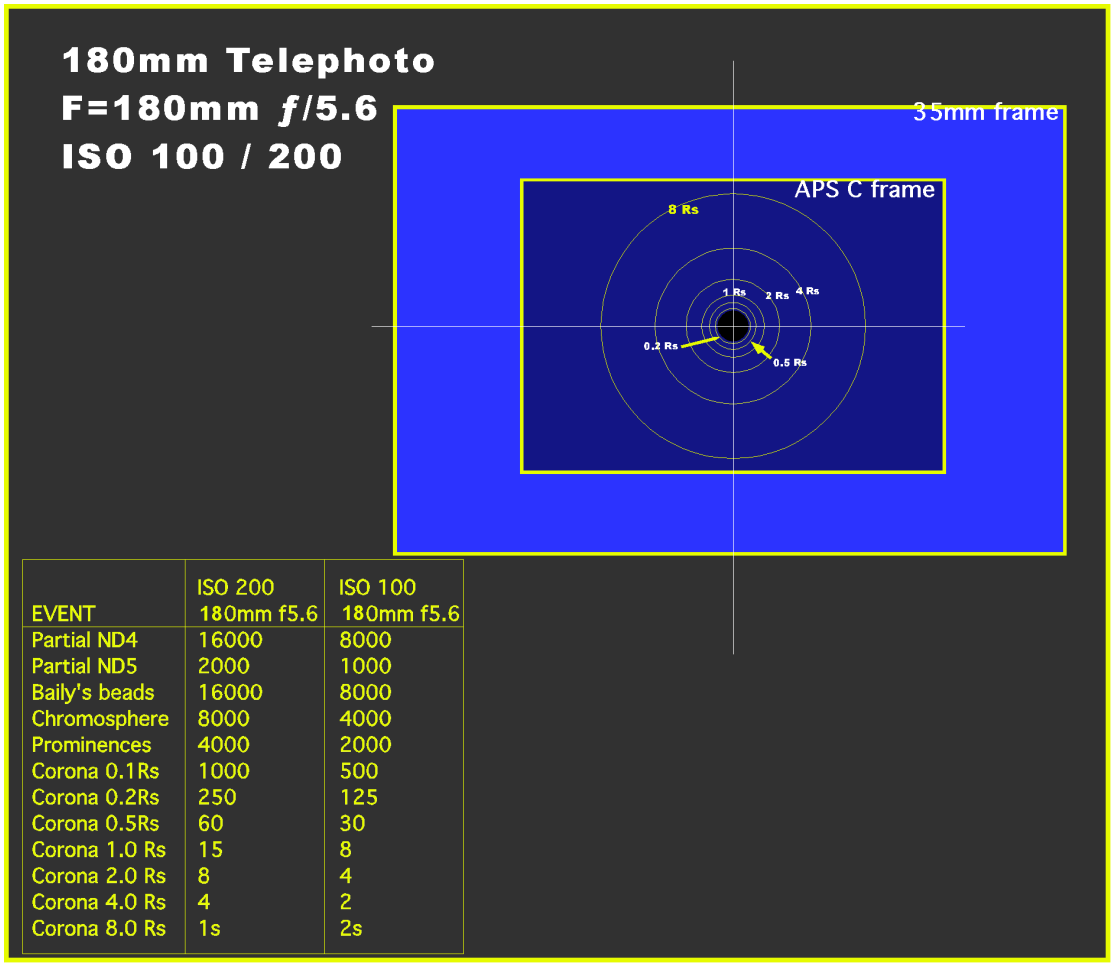
On the other hand, if using a long focal length lens, only the inner corona will be captured. Consequentially, there is no point wasting time on longer exposures bracketing for outer corona that is out of frame. The exposure recommendations with these diagrams give a bracketing range matched to the field of view of the lens. Shorter lenses give a full exposure spread, long focal lengths, a reduced exposure range.




| EVENT | ISO 200 300mm f5.6 | ISO 100 300mm f5.6 |
|---|---|---|
| Partial ND4 | 16000 | 8000 |
| Partial ND5 | 2000 | 1000 |
| Baily's beads | 16000 | 8000 |
| Chromosphere | 8000 | 4000 |
| Prominences | 4000 | 2000 |
| Corona 0.1Rs | 1000 | 500 |
| Corona 0.2Rs | 250 | 125 |
| Corona 0.5Rs | 60 | 30 |
| Corona 1.0 Rs | 15 | 8 |
| Corona 2.0 Rs | 8 | 4 |
| Corona 4.0 Rs | 4 | 2 |
| Corona 8.0 Rs | 1s | 2s |

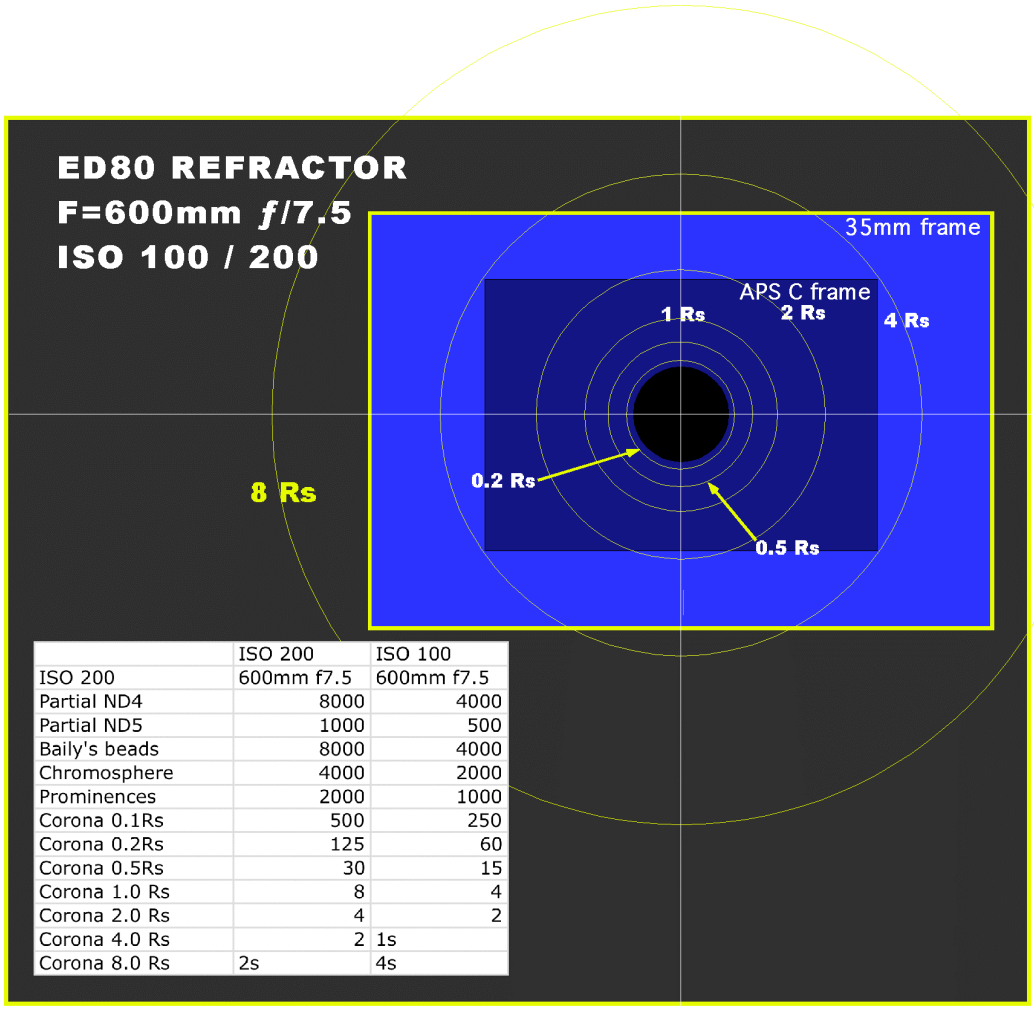
Exposure recommendations for 300mm lens set to ƒ 5.6

*Rs – solar radii



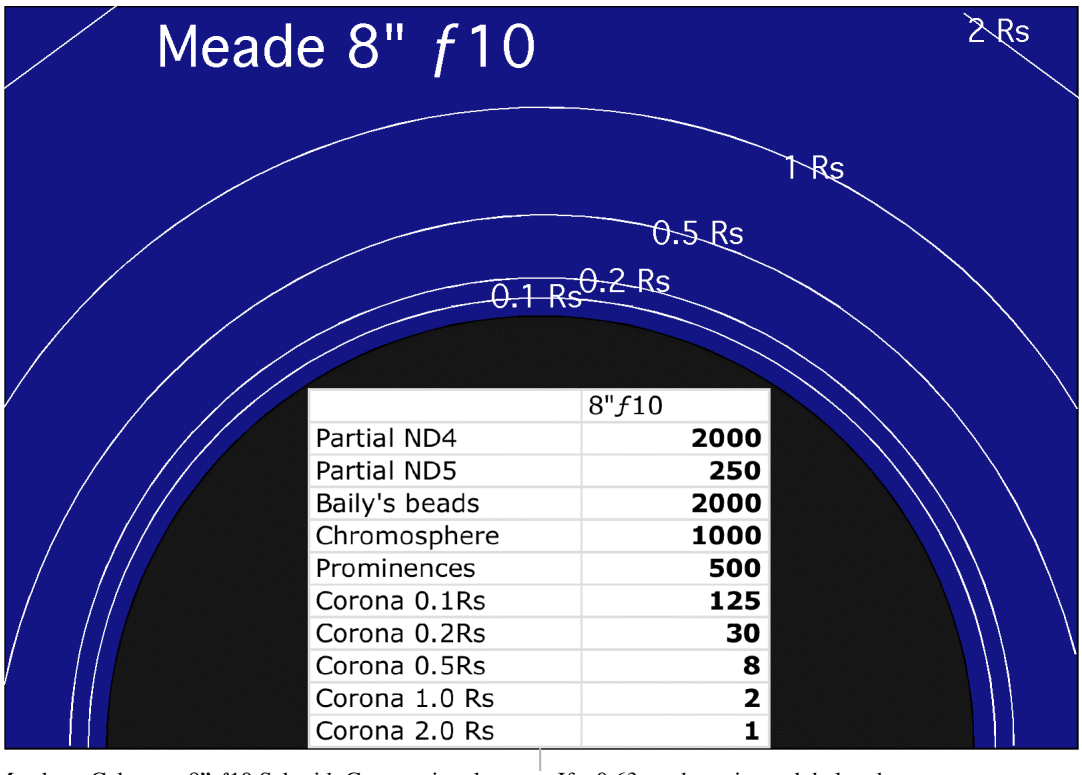

| EVENT | ISO 200 180mm f5.6 | ISO 100 180mm f5.6 |
|---|---|---|
| Partial ND4 | 16000 | 8000 |
| Partial ND5 | 2000 | 1000 |
| Baily's beads | 16000 | 8000 |
| Chromosphere | 8000 | 4000 |
| Prominences | 4000 | 2000 |
| Corona 0.1Rs | 1000 | 500 |
| Corona 0.2Rs | 250 | 125 |
| Corona 0.5Rs | 60 | 30 |
| Corona 1.0 Rs | 15 | 8 |
| Corona 2.0 Rs | 8 | 4 |
| Corona 4.0 Rs | 4 | 2 |
| Corona 8.0 Rs | 1s | 2s |

Exposure recommendations 180mm lens set to ƒ 5.6




| | ISO 200 | ISO 100 |
|---|---|---|
| ISO 200 | 600mm f7.5 | 600mm f7.5 |
| Partial ND4 | 8000 | 4000 |
| Partial ND5 | 1000 | 500 |
| Baily's beads | 8000 | 4000 |
| Chromosphere | 4000 | 2000 |
| Prominences | 2000 | 1000 |
| Corona 0.1Rs | 500 | 250 |
| Corona 0.2Rs | 125 | 60 |
| Corona 0.5Rs | 30 | 15 |
| Corona 1.0 Rs | 8 | 4 |
| Corona 2.0 Rs | 4 | 2 |
| Corona 4.0 Rs | 2 | 1s |
| Corona 8.0 Rs | 2s | 4s |

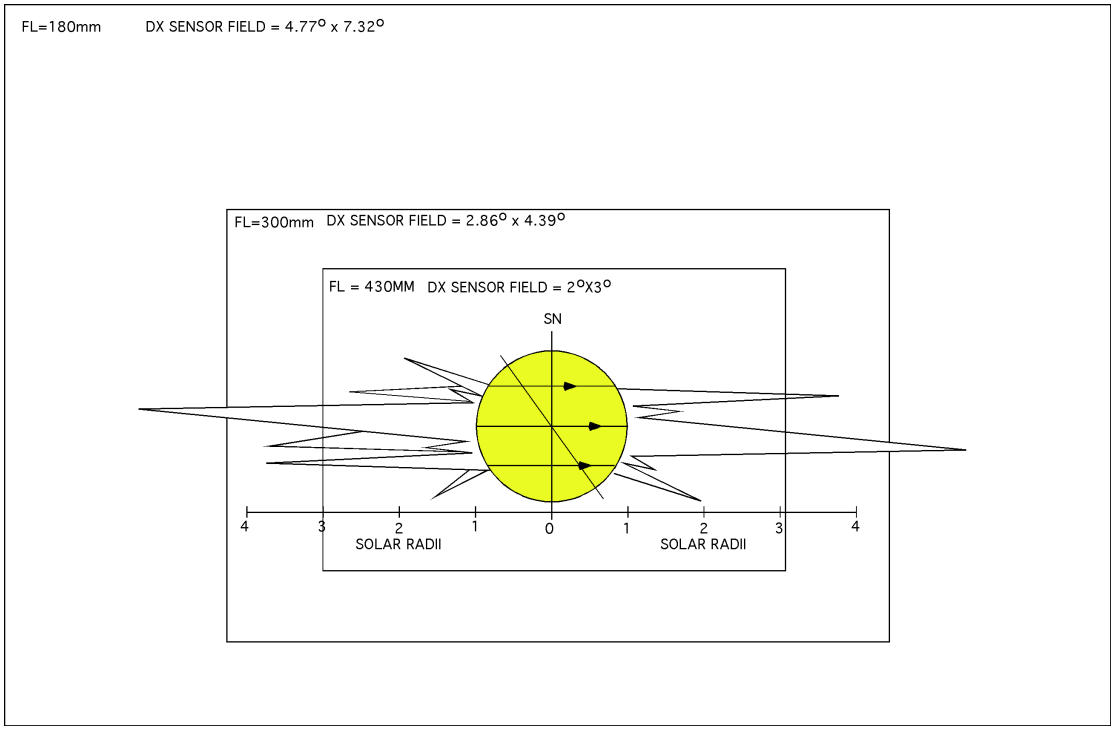
Exposure recommendations ED80 600mm ƒ 7. 5




| | 8"ƒ10 |
|---|---|
| Partial ND4 | **2000** |
| Partial ND5 | **250** |
| Baily's beads | **2000** |
| Chromosphere | **1000** |
| Prominences | **500** |
| Corona 0.1Rs | **125** |
| Corona 0.2Rs | **30** |
| Corona 0.5Rs | **8** |
| Corona 1.0 Rs | **2** |
| Corona 2.0 Rs | **1** |

Meade or Celestron 8" ƒ10 Schmidt Cassegrain telescope. If a 0.63x reducer is used, halve the exposures, eg Prominences go from 1/500s to 1/1000s, Corona at 2 solar radii go from 1s to ½ s.

## Photographic Fields of View - various lenses APSC



Fred Espenak has authored a number of excellent articles on solar eclipse photography and exposure guide tables.

## How to Photograph Solar Eclipses?

**Articles by Fred Espenak**

https://www.nikonusa.com/en/learn-and-explore/a/tips-and-techniques/how-to-photograph-a-solar-eclipse.html

https://www.mreclipse.com/SEphoto/SEphoto.html

## Solar Eclipse Exposure Guide Table

https://www.mreclipse.com/SEphoto/image/SE-Exposure1w.GIF

# The probable appearance of the corona.

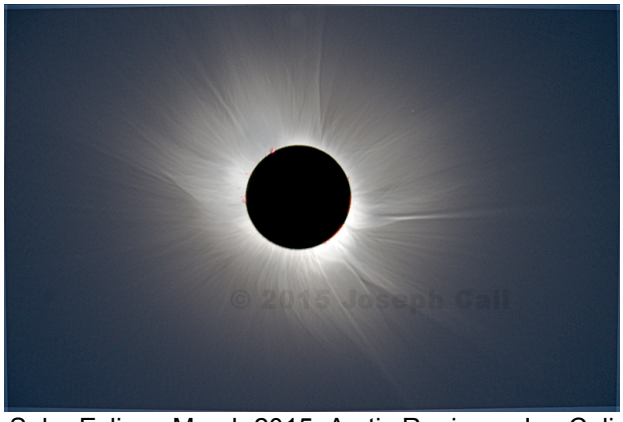
The Sun's magnetic field and hence the distribution of the coronal streamers is quite different at solar maximum and solar minimum.

During **solar minimum**, solar coronal streamers **radiate at fairly equal lengths, radially symmetrical in all directions**.

During **solar maximum**, the coronal streamer distribution closely represents the distribution of iron filings around a bipolar bar magnet that many readers would have seen during school science classes with longer broad equatorial and mid-latitude streamers and fine shorter streamers radiating from the polar regions.

**The Sun is currently moving into solar maximum.** Solar activity such as CME's, flares, prominences and sunspots has been quite high during late 2022. The corona will be asymmetric. Take this into account when orienting your camera frame. See next section on orientation of the Sun to the horizon.

**Solar Minimum Corona Examples**




Solar Eclipse March 2015, Arctic Region - Joe Cali


Solar Eclipse November 2012, Far North Queensland - Steven Shaw

**Solar Maximum Corona Examples** (probable appearance type - April 2023)


Solar Eclipse August 2008, Gansu Province, NW China - Joerg and Gabi Ackermann


Solar Eclipse March 2006, Jalu, Libya, Joe Cali

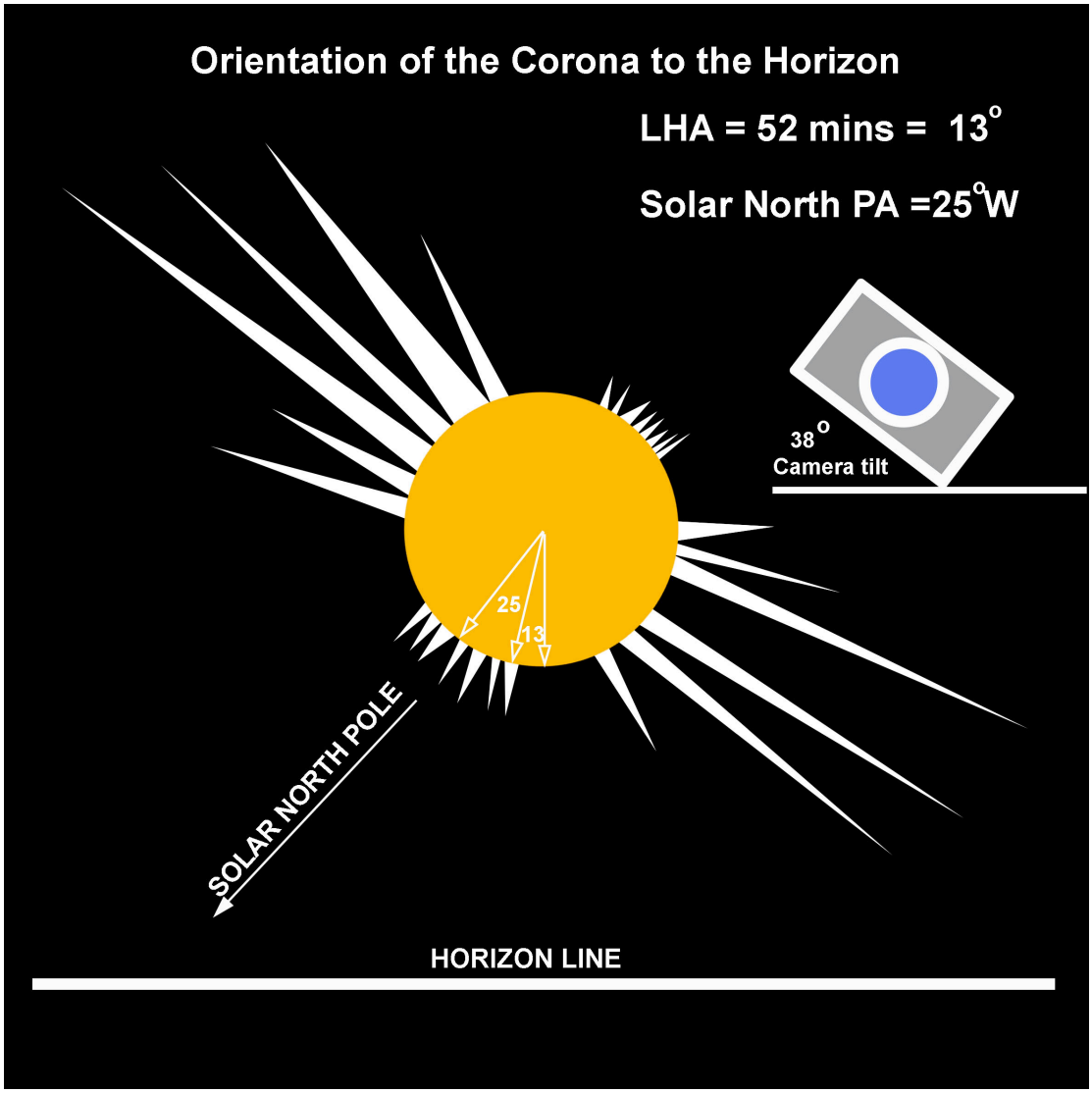
*Note the shorter finer polar streamers compared to the long broad equatorial band streamers. The 2023 eclipse will probably be of this type*

**Notes : -**

## ORIENTATION OF THE CORONA TO THE HORIZON AT EXMOUTH

Using the position angle of the Sun's axis and the local hour angle (LHA) due to the Earth's daily rotation, we can do a simple calculation to determine the orientation of the corona relative to the horizon for an Alt-Az mounting or camera tripod. This enables the camera to be optimally oriented to capture the longest streamers across the longer dimension of the camera sensor.

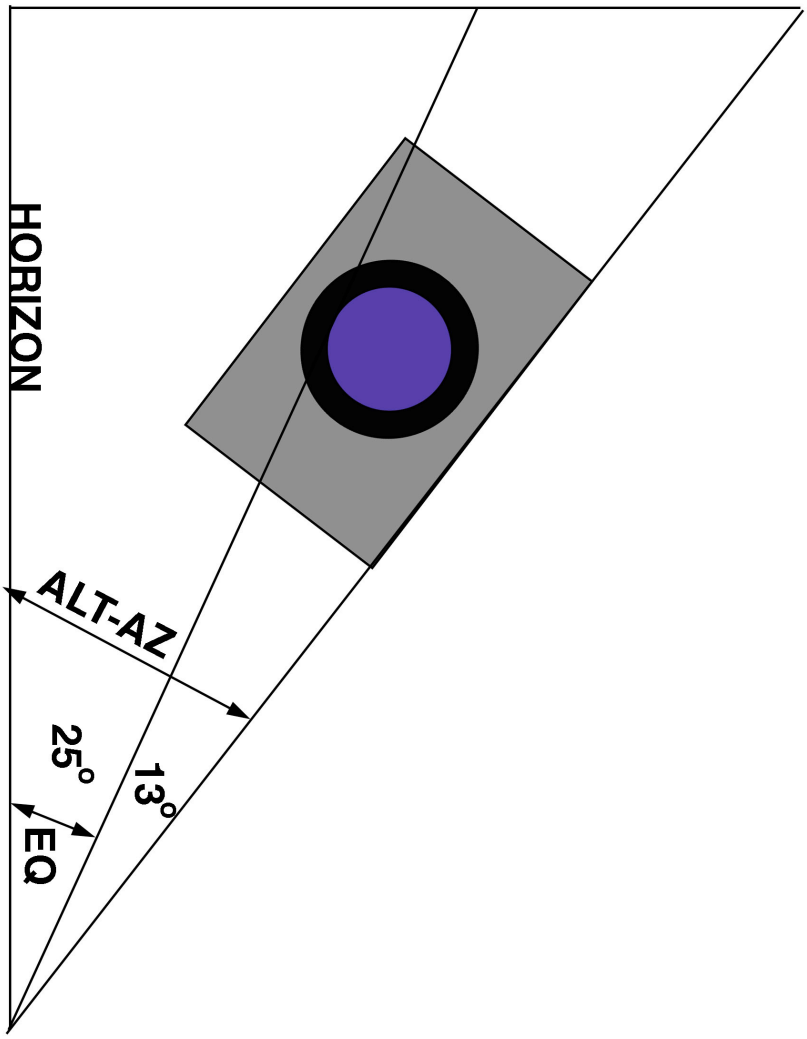
TRANSIT 12:22 pm
MID-TOT 11:30 am
LHA 52mins = $13^{o}$
PA of POLE = $25^{o}$ WEST
ORIENTATION = $-13^{o}$[LHA] – $25^{o}$[PA of POLE] = $-38^{o}$

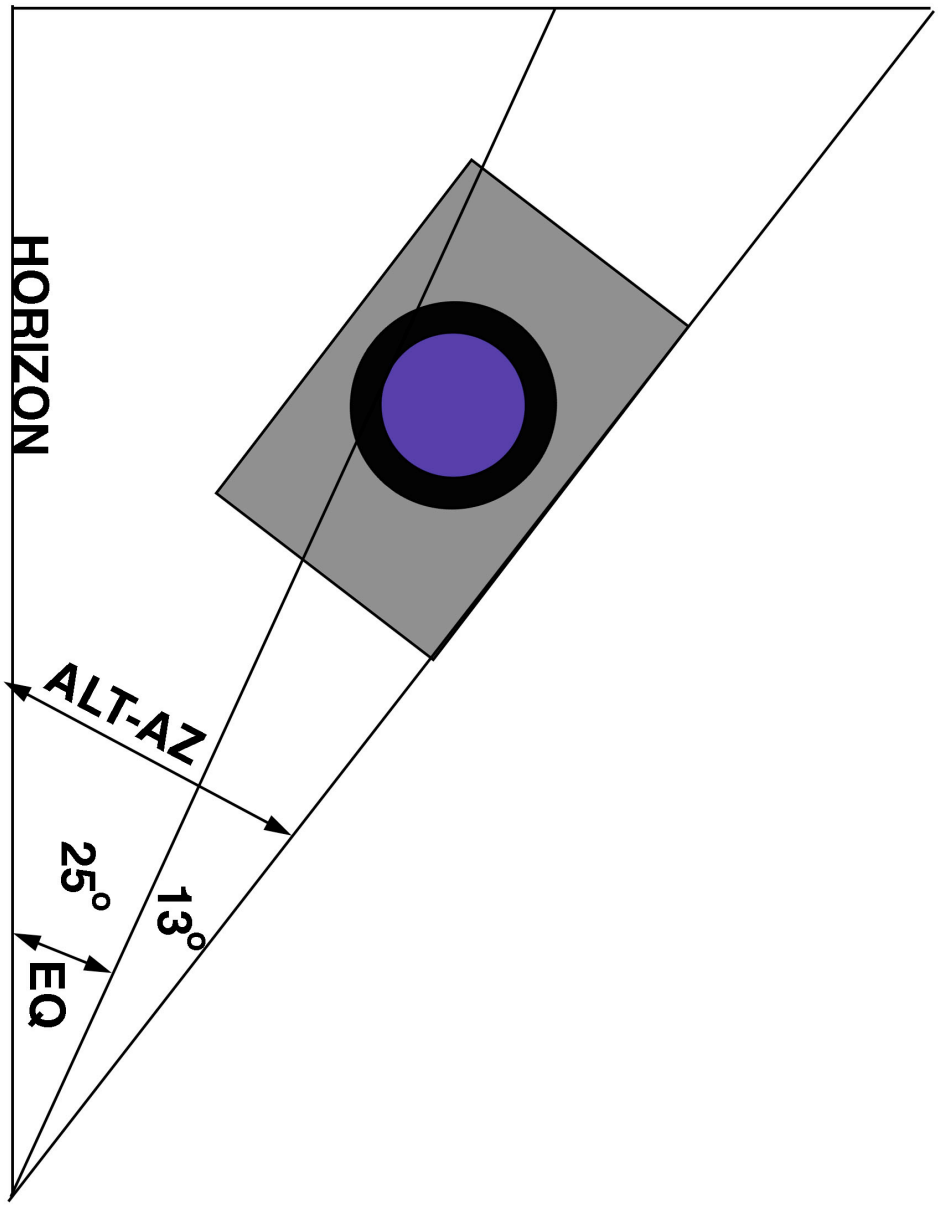



The Sun's corona will be tilted $38^{o}$ to the right as you face north. $13^{o}$ of this is due to the rotation of the Sun due to its local hour angle and $25^{o}$ is due to seasonal shifts in the PA of the Sun's axis as the Earth orbits the Sun and our perspective of the inclination of the solar axis changes throughout the year.

Shooting with a horizontal oriented camera, the longest streamers will orient diagonally through the frame. If you want the poles oriented up and down and you are using an equatorially mounted camera system, tilt the camera 25$^{o}$ clockwise to the declination saddle plane. If you are using a tripod or altaz mount, tilt the camera 38 degrees clockwise. The following jigs will assist with that. There are two, one to leave in the printed book, one to cut out, glue to cardboard and make an alignment jig.

# Camera Tilt Jig





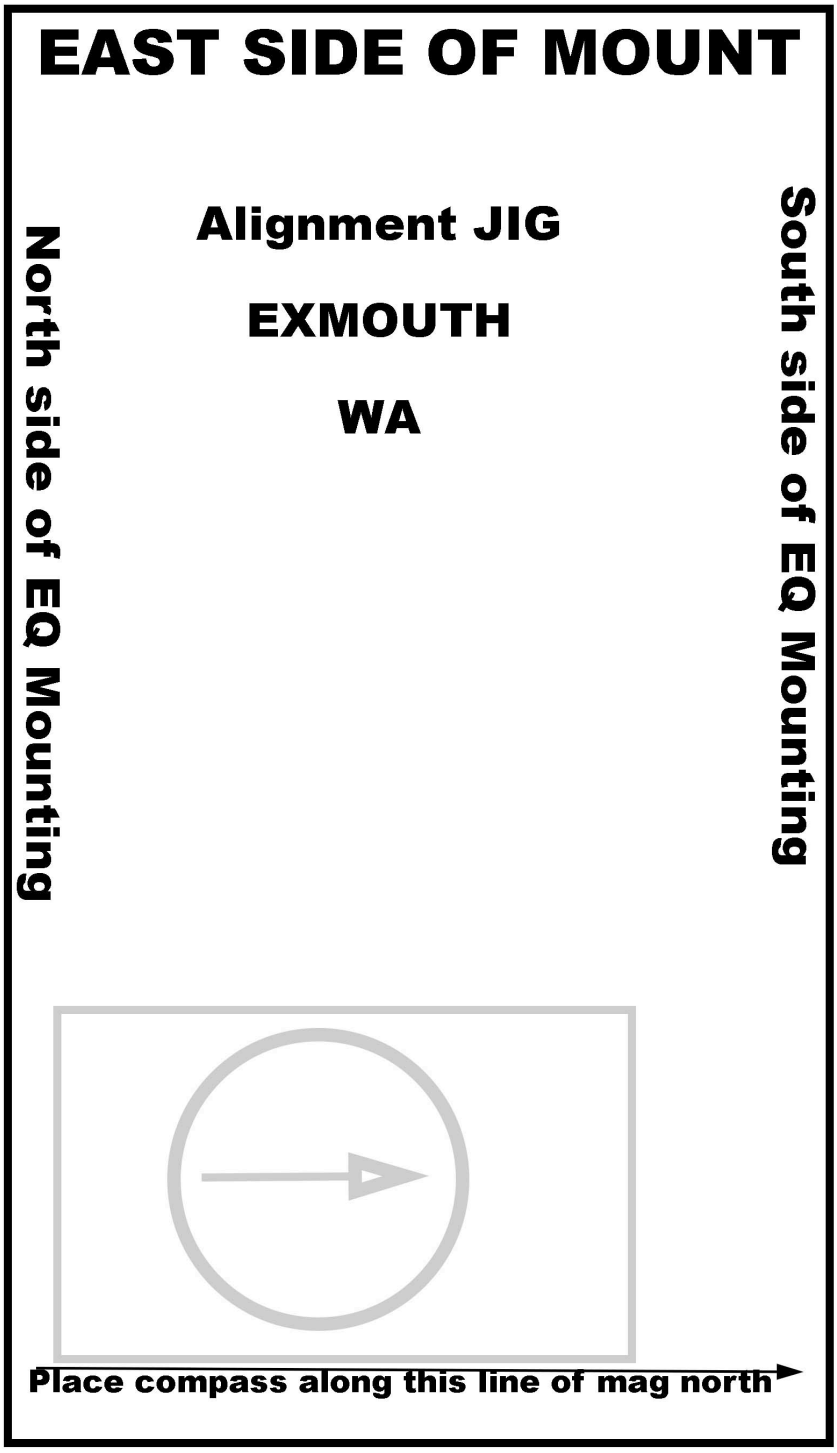

**Camera tilt for a tripod mounted camera and EQ mounted camera for a south UP image of the corona. This page can be torn out and used to make a jig or template.**

# Polar alignment of an EQ MOUNT

A compass needle will point almost true north in this region. Therefore, little to no correction for grid magnetic angle is required. Always be aware of the presence of man made or natural magnetic structures or induced magnetic fields that can deviate a magnet. Examples include man-made steel structures, powerlines, or magnetic minerals. There should not be any magnetic/iron bearing minerals under Exmouth, however, man made steel structures are always possible. The motors in an equatorial mount contain powerful permanent magnets. Keep the compass away from the mount.

Magnetic Declination = + 0.294 degrees Latitude 21$^{o}$ 57’
[A compass needle points 0.294$^{o}$ east of true north]

**Notes:**


EAST SIDE OF MOUNT
Alignment JIG
EXMOUTH
WA
North side of EQ Mounting
South side of EQ Mounting
Place compass along this line of mag north

# Moon Rise and Set EXMOUTH

| Times Of Moonrise And Moonset Exmouth [AWST] | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | | Feb | | Mar | | Apr | | May | | Jun | |
| | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set |
| 1 | 14:23 | 01:19 | 15:58 | 01:57 | 14:46 | 00:40 | 15:43 | 02:03 | 15:24 | 02:30 | 15:32 | 03:47 |
| 2 | 15:17 | 01:54 | 16:51 | 02:45 | 15:37 | 01:30 | 16:20 | 02:56 | 15:56 | 03:21 | 16:12 | 04:45 |
| 3 | 16:13 | 02:32 | 17:41 | 03:36 | 16:24 | 02:23 | 16:53 | 03:48 | 16:28 | 04:13 | 16:57 | 05:46 |
| 4 | 17:08 | 03:14 | 18:26 | 04:29 | 17:06 | 03:17 | 17:25 | 04:40 | 17:01 | 05:06 | 17:50 | 06:51 |
| 5 | 18:03 | 04:00 | 19:07 | 05:23 | 17:45 | 04:11 | 17:57 | 05:31 | 17:38 | 06:01 | 18:50 | 07:58 |
| 6 | 18:55 | 04:49 | 19:45 | 06:17 | 18:20 | 05:04 | 18:29 | 06:23 | 18:20 | 07:00 | 19:56 | 09:03 |
| 7 | 19:44 | 05:41 | 20:19 | 07:09 | 18:53 | 05:56 | 19:04 | 07:16 | 19:07 | 08:03 | 21:04 | 10:03 |
| 8 | 20:28 | 06:35 | 20:51 | 08:00 | 19:25 | 06:47 | 19:41 | 08:12 | 20:02 | 09:08 | 22:11 | 10:56 |
| 9 | 21:08 | 07:29 | 21:22 | 08:51 | 19:56 | 07:37 | 20:24 | 09:11 | 21:03 | 10:12 | 23:16 | 11:43 |
| 10 | 21:44 | 08:22 | 21:54 | 09:41 | 20:29 | 08:29 | 21:13 | 10:14 | 22:08 | 11:14 | | 12:24 |
| 11 | 22:17 | 09:13 | 22:27 | 10:33 | 21:03 | 09:23 | 22:08 | 11:17 | 23:14 | 12:10 | 00:17 | 13:01 |
| 12 | 22:49 | 10:04 | 23:03 | 11:27 | 21:42 | 10:19 | 23:10 | 12:20 | | 13:00 | 01:15 | 13:36 |
| 13 | 23:21 | 10:54 | 23:43 | 12:24 | 22:26 | 11:18 | | 13:19 | 00:19 | 13:43 | 02:12 | 14:12 |
| 14 | 23:53 | 11:45 | | 13:24 | 23:16 | 12:20 | 00:15 | 14:13 | 01:22 | 14:23 | 03:09 | 14:48 |
| 15 | | 12:38 | 00:30 | 14:28 | | 13:23 | 01:21 | 15:01 | 02:22 | 14:59 | 04:06 | 15:26 |
| 16 | 00:27 | 13:34 | 01:24 | 15:34 | 00:14 | 14:26 | 02:26 | 15:44 | 03:20 | 15:35 | 05:04 | 16:09 |
| 17 | 01:06 | 14:34 | 02:27 | 16:38 | 01:18 | 15:25 | 03:29 | 16:23 | 04:17 | 16:11 | 06:03 | 16:55 |

| Times Of Moonrise And Moonset Exmouth [AWST] | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | | Feb | | Mar | | Apr | | May | | Jun | |
| | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set |
| 18 | 01:50 | 15:39 | 03:35 | 17:37 | 02:25 | 16:18 | 04:30 | 17:00 | 05:15 | 16:48 | 07:00 | 17:46 |
| 19 | 02:42 | 16:47 | 04:45 | 18:30 | 03:33 | 17:06 | 05:29 | 17:36 | 06:14 | 17:29 | 07:55 | 18:40 |
| 20 | 03:42 | 17:54 | 05:55 | 19:16 | 04:40 | 17:48 | 06:28 | 18:14 | 07:13 | 18:13 | 08:46 | 19:34 |
| 21 | 04:50 | 18:58 | 07:01 | 19:57 | 05:44 | 18:28 | 07:27 | 18:53 | 08:12 | 19:02 | 09:32 | 20:29 |
| 22 | 06:01 | 19:55 | 08:04 | 20:36 | 06:45 | 19:05 | 08:27 | 19:35 | 09:10 | 19:54 | 10:12 | 21:23 |
| 23 | 07:12 | 20:44 | 09:05 | 21:13 | 07:45 | 19:42 | 09:27 | 20:22 | 10:03 | 20:48 | 10:49 | 22:14 |
| 24 | 08:20 | 21:27 | 10:04 | 21:50 | 08:45 | 20:20 | 10:26 | 21:12 | 10:52 | 21:43 | 11:22 | 23:04 |
| 25 | 09:23 | 22:06 | 11:02 | 22:28 | 09:44 | 21:01 | 11:21 | 22:05 | 11:36 | 22:38 | 11:53 | 23:54 |
| 26 | 10:23 | 22:43 | 11:59 | 23:08 | 10:43 | 21:45 | 12:12 | 22:59 | 12:15 | 23:30 | 12:23 | |
| 27 | 11:21 | 23:18 | 12:56 | 23:52 | 11:42 | 22:32 | 12:59 | 23:53 | 12:50 | | 12:55 | 00:44 |
| 28 | 12:17 | 23:54 | 13:52 | | 12:38 | 23:22 | 13:40 | | 13:22 | 00:21 | 13:28 | 01:35 |
| 29 | 13:12 | | | | 13:31 | | 14:17 | 00:47 | 13:54 | 01:12 | 14:04 | 02:30 |
| 30 | 14:08 | 00:32 | | | 14:19 | 00:15 | 14:52 | 01:39 | 14:25 | 02:02 | 14:46 | 03:28 |
| 31 | 15:04 | 01:12 | | | 15:04 | 01:09 | | | 14:57 | 02:54 | | |

## Other Astronomical Phenomena

### Eta Aquarid & Lyrid Meteor Showers.

The meteor showers listed below are the easiest to observe and provide the most activity from the Canberra region. Particular attention should be noted to the time and moonlight conditions. **Most showers are best seen after midnight when the part of the night sky you are observing is heading towards the oncoming meteors. Early evening, the night sky is trailing the Earth's motion.** Most are not even visible until after midnight. Showers that peak with the moon's phase greater than one half illuminated (first quarter to last quarter) will be affected by moonlight and difficult to observe. While the time each shower is best seen remains much the same year after year, the moonlight conditions change considerably from one year to the next.

**Lyrids**

Active from April 16th to April 25th. Peak night Apr 21-22.

Medium strength shower with decent rates for three nights around the maximum. Fireballs possible. In Exmouth, the radiant is low in the sky, just 33° altitude & due north at 4:35am local. Activity from this shower can be seen from the southern hemisphere, but at a lower rate than the north. Even though these are called the Lyrids, the radiant is in Hercules not far from Vega. At peak on April 21-22 a near new Moon will not interfere with observations in the pre-dawn hours.

**Radiant: RA:**18:04 **DEC:** +34° - **ZHR**: 18 - Velocity: 30 miles/sec (medium - 48.4km/sec) - Parent Object: C/1861 G1 (Thatcher)

**Eta Aquariids**

Active from April 19th to May 26th. Peak night May 6-7

Great shower when viewed from northern Australia where they can produce rates of 40-60 per hour. I saw a display like this from Karjini National Park just near Exmouth just before dawn in 2013 on a couple of mornings. Rates I've observed from Canberra's latitude have been disappointing by comparison to the show at Karjini. Activity is near peak for a week centred on May 6-7. On May 6-7, a near full Moon will make observing difficult.

**Radiant: RA:**22:32 **DEC:** -1° - **ZHR**: 55 - Velocity: 42 miles/sec (swift - 66.9km/sec) - Parent Object: 1P/Halley

## Planning / Notes

# Planning / Notes