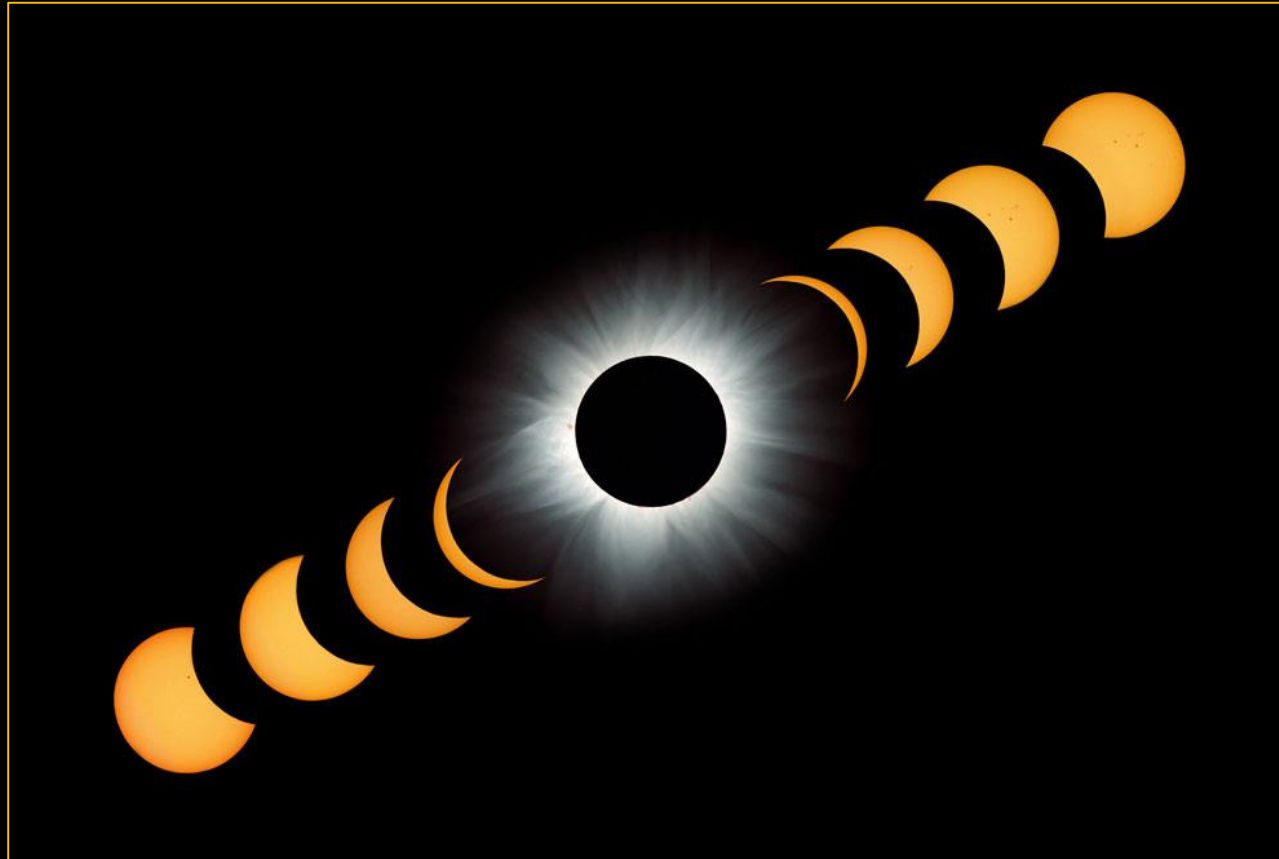


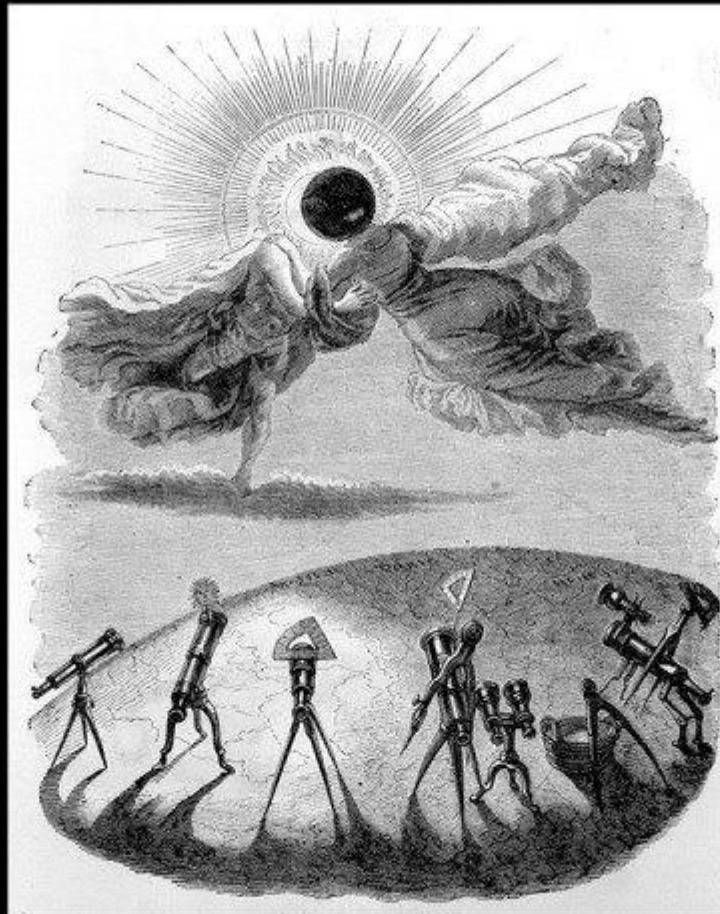
# Photographing a Solar Eclipse

How to prepare for and photograph the total Solar Eclipse on August 21<sup>st</sup>, 2017



June 21, 2001 total solar eclipse, Chisamba, Zambia. Nikon N90s, Vixen 90mm Refractor f/9.  
Composite shows the various phases of the eclipse. The central image of the corona during totality is a composite of 22 negatives which reveal subtle details and structures in the Sun's atmosphere. *Photo by: Fred Espenak*

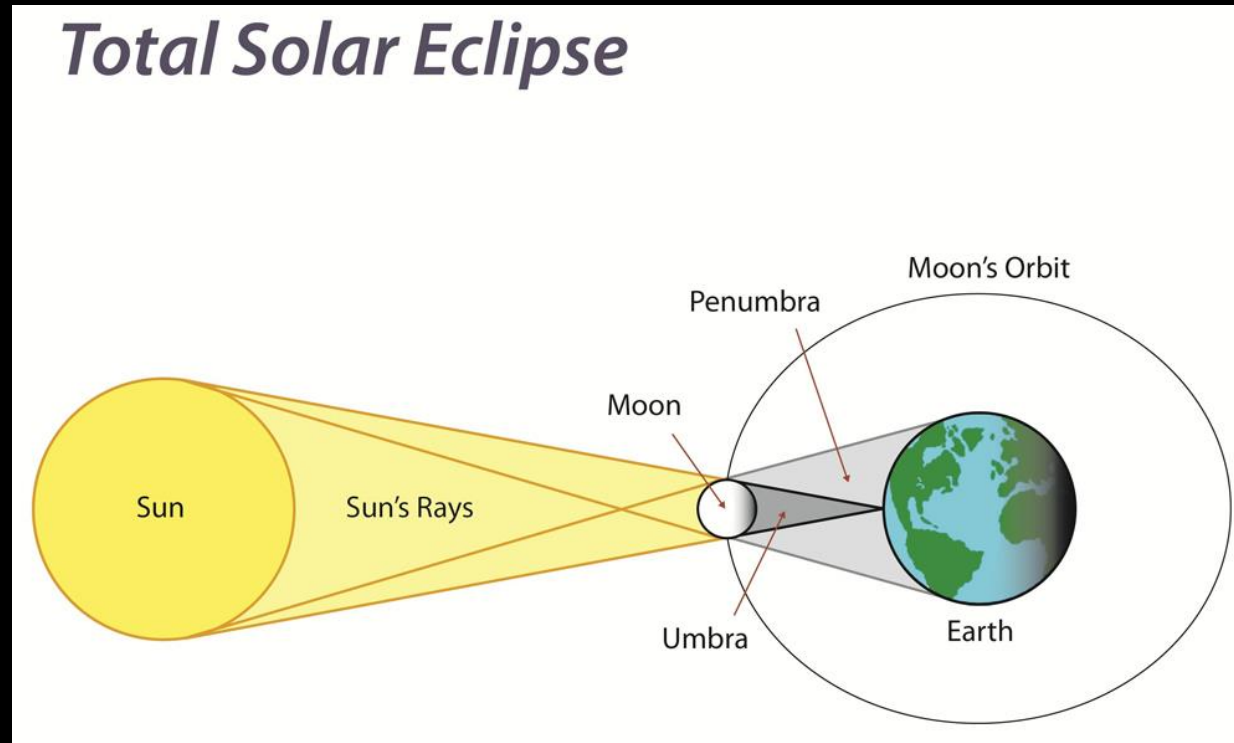
# San Jose Camera and Video



Presented By: Paul Dileanis

# What is an Eclipse?

As seen from the Earth, a solar eclipse occurs when the Moon passes between the Sun and Earth and the Moon fully or partially blocks ("occults") the Sun. This can happen only at new moon when the Sun and the Moon are in conjunction as seen from Earth in an alignment referred to as syzygy. In a total eclipse, the disk of the Sun is fully obscured by the Moon. In partial and annular eclipses, only part of the Sun is obscured.



From space, the Moon's shadow during a solar eclipse appears as a dark spot moving across the Earth.



By NASA - NASA Earth Observatory, Public Domain,  
<https://commons.wikimedia.org/w/index.php?curid=47460291>

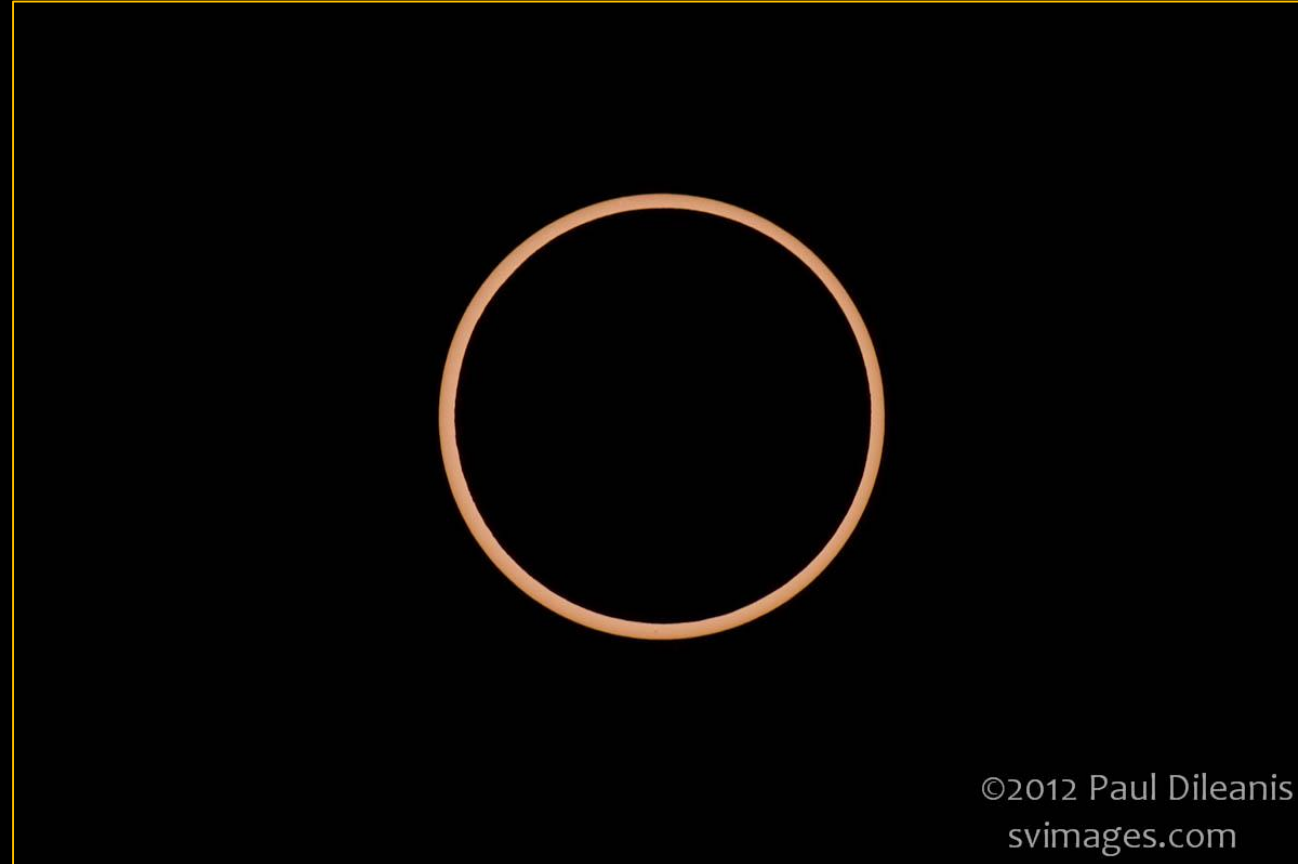
# Types of Solar Eclipses



Total solar eclipse

# Types of Solar Eclipses

Annular eclipse



Annular Eclipse May 20, 2012 Canon 7D w/400mm. Taken from Lassen Volcanic Park.

# Types of Solar Eclipses

Partial eclipse



Partial Eclipse October 23, 2014. Canon 5D mk III w/ 800mm ( 400mm plus 2x Extender)  
Taken at Sentinel Dome, Yosemite NP

# Planning and Preparation

- Pick a Location
- Choosing a Camera
- Choosing a Lens
- Using Solar Filters
- Determining Exposure

## Safety First

When viewing or photographing the partial phases of a solar eclipse or the maximum phase of an annular eclipse, you must use a solar filter. Even if 99% of the sun is covered by the moon, the remaining 1% crescent is dangerous to view with the naked eye and can cause serious eye damage or blindness



# Planning and Preparation

Links to help with planning your Eclipse Experience:

[www.greatamericaneclipse.com](http://www.greatamericaneclipse.com)

[Timeanddate.com](http://Timeanddate.com)

[The Photographers Ephemeris](#)

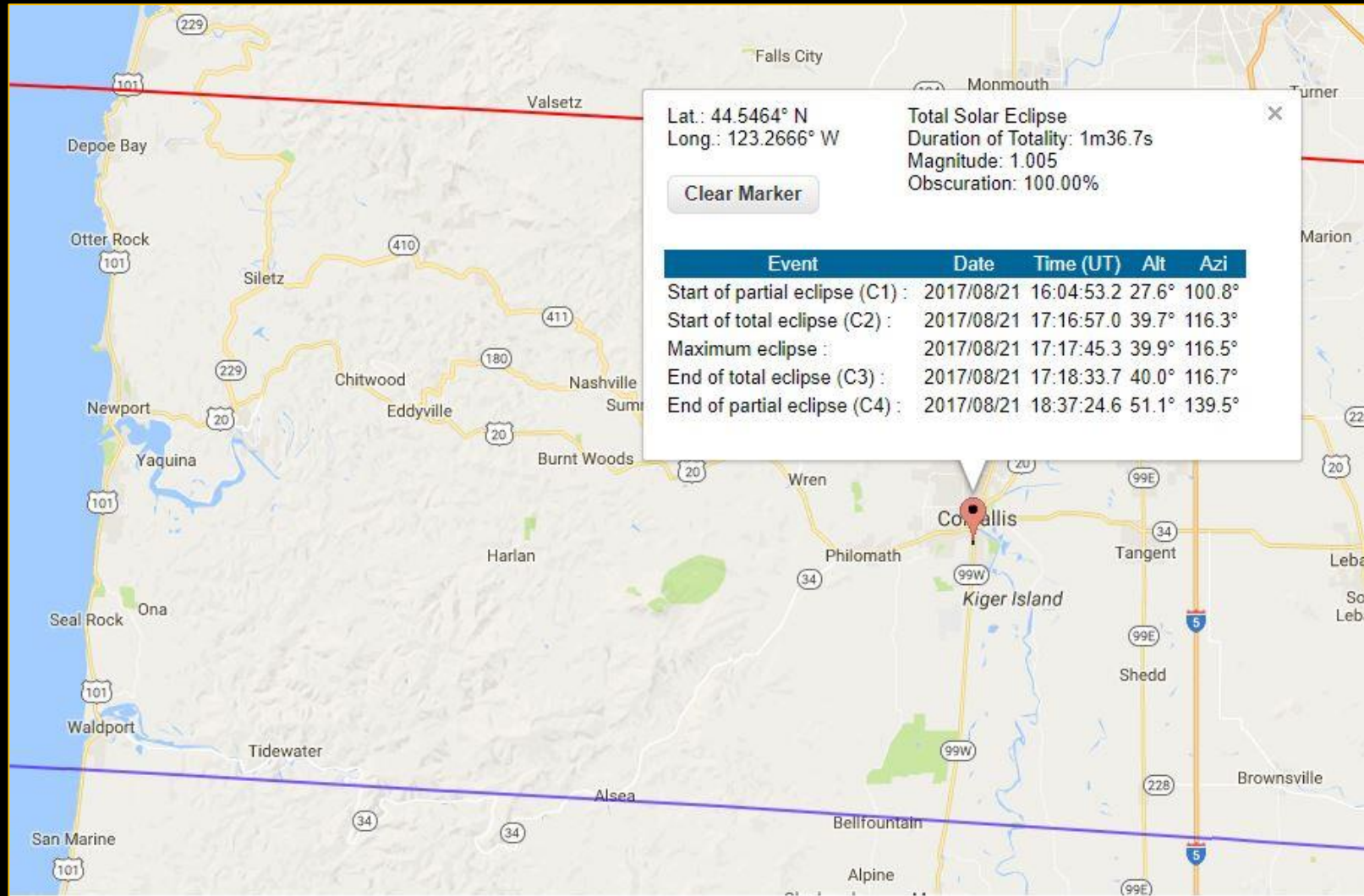
[Nasa Total Solar Eclipse Interactive Map](#)

[Google Earth](#)

[Nikon: How to Photograph a Solar Eclipse](#)

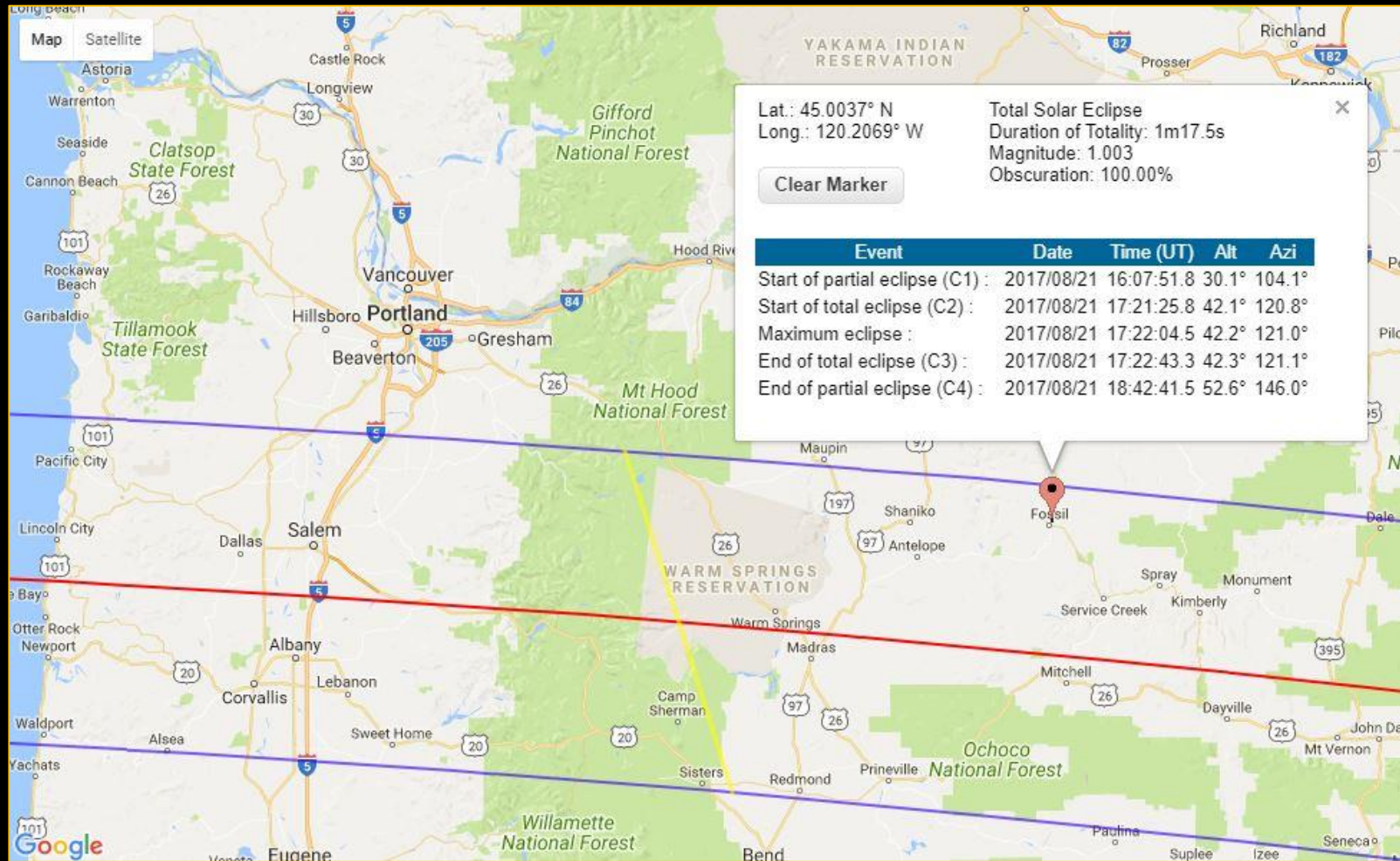
[Canon DLC: A total Guide to Solar Eclipse Photography](#)

# NASA: Total Solar Eclipse Interactive Map



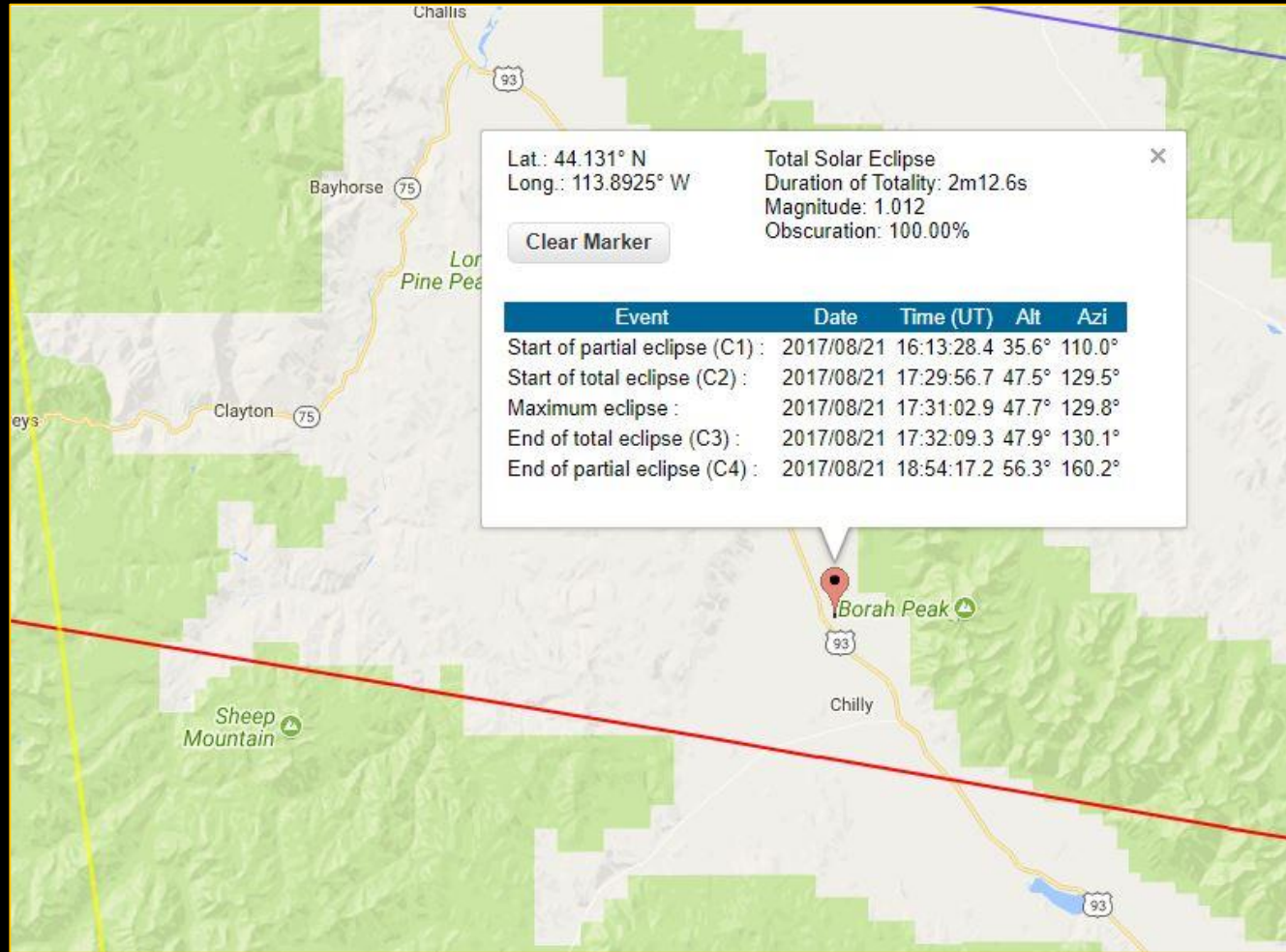
[https://eclipse2017.nasa.gov/sites/default/files/interactive\\_map/index.html](https://eclipse2017.nasa.gov/sites/default/files/interactive_map/index.html)

# NASA: Total Solar Eclipse Interactive Map



[https://eclipse2017.nasa.gov/sites/default/files/interactive\\_map/index.html](https://eclipse2017.nasa.gov/sites/default/files/interactive_map/index.html)

# NASA: Total Solar Eclipse Interactive Map



[https://eclipse2017.nasa.gov/sites/default/files/interactive\\_map/index.html](https://eclipse2017.nasa.gov/sites/default/files/interactive_map/index.html)

# The Photographers Ephemeris

THE PHOTOGRAPHER'S EPHEMERIS

Ephemeris Locations Settings Tutorials About

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+2,159 m | 44.1737°N | 113.8575°W

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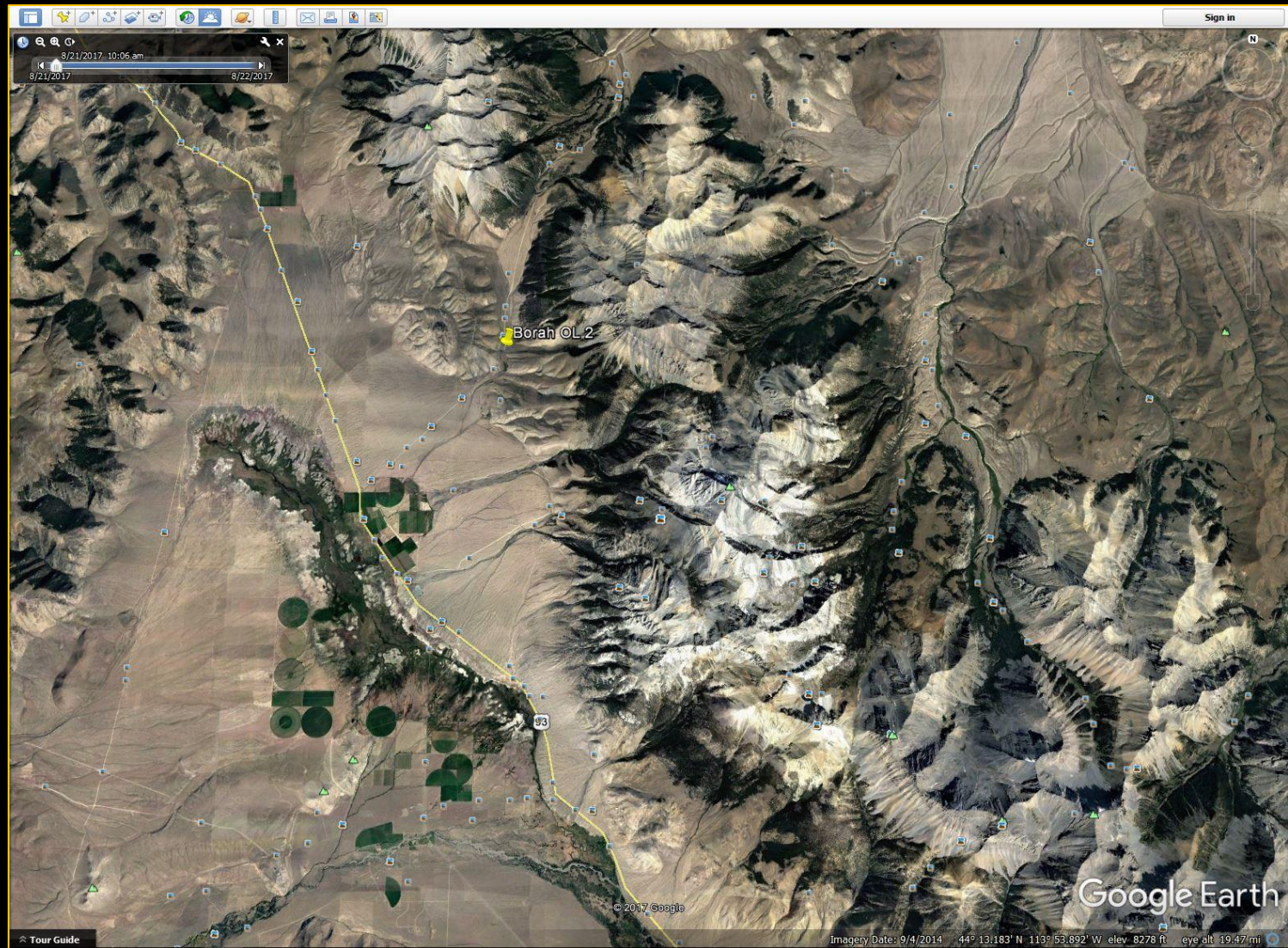
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Help

App.photoephemeris.com

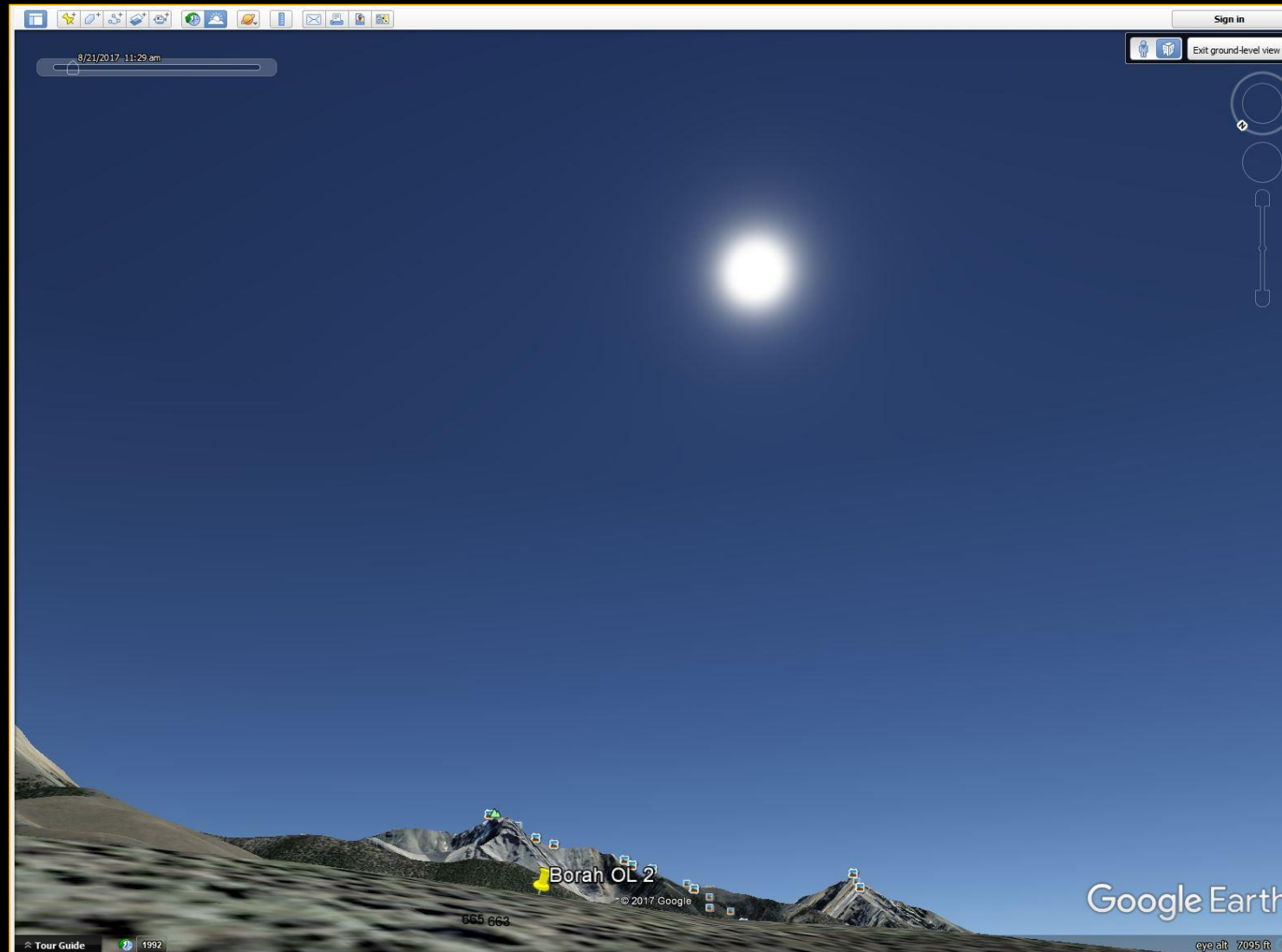
# Google Earth



# Google Earth



# Google Earth





# Google Earth



# Choosing a Camera



Any camera can be used to photograph a solar eclipse as long as you can safely and securely attach a solar filter in front of the lens. Small, automatic P+S cameras will have limitations. Features to look for include:

- Interchangeable lenses
- LCD live view
- Manual focus
- Manual exposure settings

## APS-C sensors



Just like wildlife, sports and macro photography, solar and lunar photography will benefit from the smaller APS-C sized sensor due to the 1.6x crop factor. The smaller sensor produces a cropped image compared to the uncropped full-frame sensor. Your sun disk will be significantly larger with the APS-C sensor than with the full frame sensor.

## Full-frame sensors



The full-frame sensors can produce high resolution images with low noise

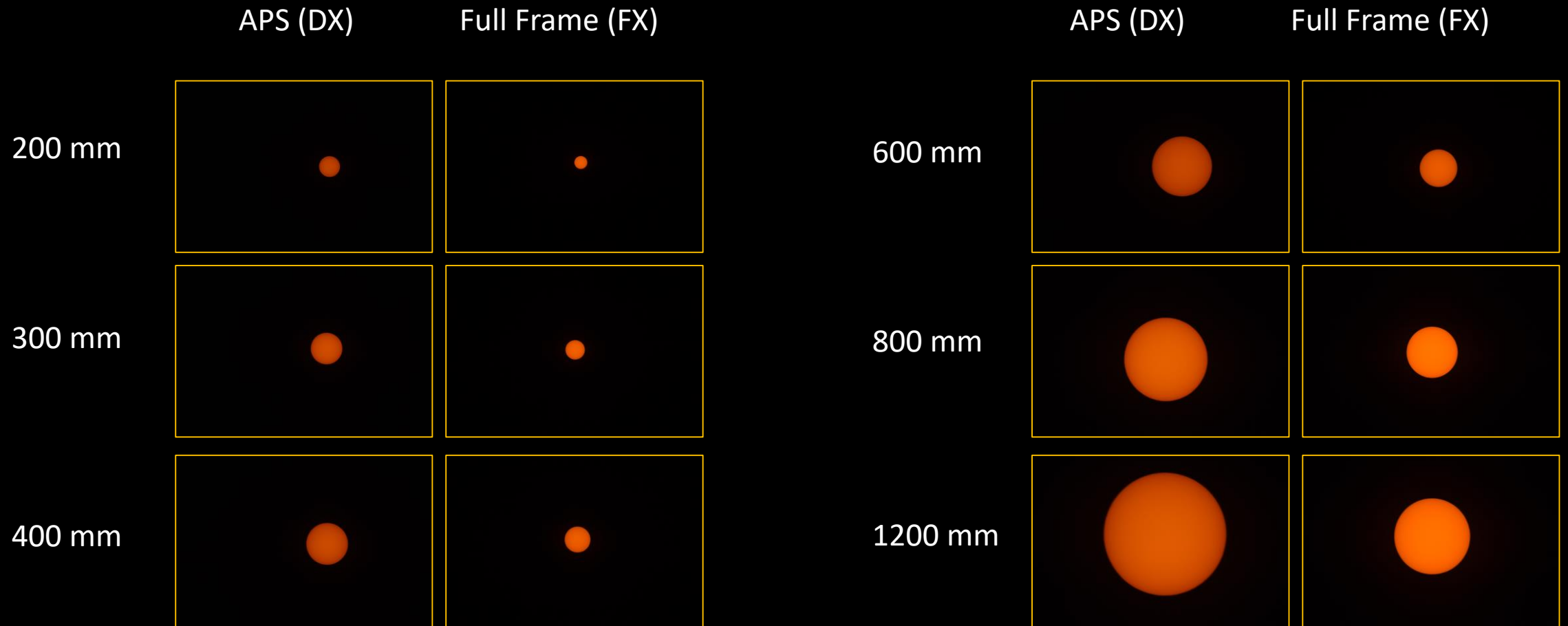
# Choosing a Lens



Choosing a lens to photograph the sun or moon depends on how large of a sun or moon disk you want. The size of the disk is controlled by two things: your DSLR's sensor size and the focal length of your lens.

When shooting a rare event such as an eclipse, you don't want to leave anything to chance. Tape down the focus and zoom rings on your lenses to avoid zoom creep or an inadvertent shift in focus. Gaffers tape is strong and most importantly leaves little or no sticky residue when you remove it.

# Sun Disk Size at Different Focal Lengths





Do not crop too tight if you want to capture the Sun's corona. The corona can be up to 5 times the diameter of the sun.

## Lens Field of View Chart

The Earth is the only planet in the solar system to experience a total eclipse. This is because ours is the only planet from which the sun and the moon appear as approximately the same size.

### Field of View and Size of Moon's Image for Various Camera Focal Lengths

<u>Focal Length</u>	<u>Field of View</u> (35mm)	<u>Field of View</u> (digital)	<u>Size of Moon</u>
14 mm	98° x 147°	65° x 98°	0.2 mm
20 mm	69° x 103°	46° x 69°	0.2 mm
28 mm	49° x 74°	33° x 49°	0.2 mm
35 mm	39° x 59°	26° x 39°	0.3 mm
50 mm	27° x 40°	18° x 28°	0.5 mm
105 mm	13° x 19°	9° x 13°	1.0 mm
200 mm	7° x 10°	5° x 7°	1.8 mm
400 mm	3.4° x 5.1°	2.3° x 3.4°	3.7 mm
500 mm	2.7° x 4.1°	1.8° x 2.8°	4.6 mm
1000 mm	1.4° x 2.1°	0.9° x 1.4°	9.2 mm
1500 mm	0.9° x 1.4°	0.6° x 0.9°	13.8 mm
2000 mm	0.7° x 1.0°	0.5° x 0.7°	18.4 mm

Size of Moon's Image (mm) = Focal Length (mm) / 109







*Track of the Partial Solar Eclipse October 23, 2014  
Sentinel Dome, Yosemite National Park  
©2014 Paul Dileanis*

# Solar filters



In order to photograph a solar eclipse it is necessary to have a solar filter for your camera or telescope. Photographic neutral density filters are not recommended since they do not block out the more harmful wavelengths of UV light when looking at or photographing the sun. I recommend purchasing a true solar filter.

# Solar filters



Solar filters will have an optical density of 5.0. This means that they block out 99.9999% of the sun's visible light. In addition, they block out 100% of the sun's harmful radiation. While photographic filters with an optical density of 3.8 (15 stops) can be used to photograph an eclipse they do not block out the harmful radiation and improper use can result in eye damage.

# Solar filters

An economical solar filter can be made by purchasing a sheet of solar film and making your own filter. There are two type of solar film available, black polymer and Baader astro solar film. Black polymer solar film will provide a more pleasing and natural Yellow-Orange image of the sun. This color also offers more contrast and clarity than other solar films. It is also stronger and more durable than other thin film solar filters.

Black polymer sheets in 6"x6" size are available locally from San Jose Camera and Video.

Baader AstroSolar film leaves the sun a more natural white, provides a brighter image, reveals sharper and more contrasty detail.

# Focusing

To get a sharp image, use the magnification feature in live view. Using Live View during an eclipse is the safest way to view the eclipse and also allows you to periodically recheck focus.



Continually check your set-up before, during and through the last moments of the eclipse.

# Exposing for a Solar Eclipse



Berkowski made the first solar eclipse photograph on July 28, 1851, also using the daguerrotype process, at the Royal Observatory in Königsberg, Prussia (now Kalinigrad in Russia). Berkowski, a local daguerrotypist whose first name was never published, observed at the Royal Observatory. A small 6-cm refracting telescope was attached to the 15.8-cm Fraunhofer heliometer and a 84-second exposure was taken shortly after the beginning of totality. Wikimedia.org

# Practice, practice practice...

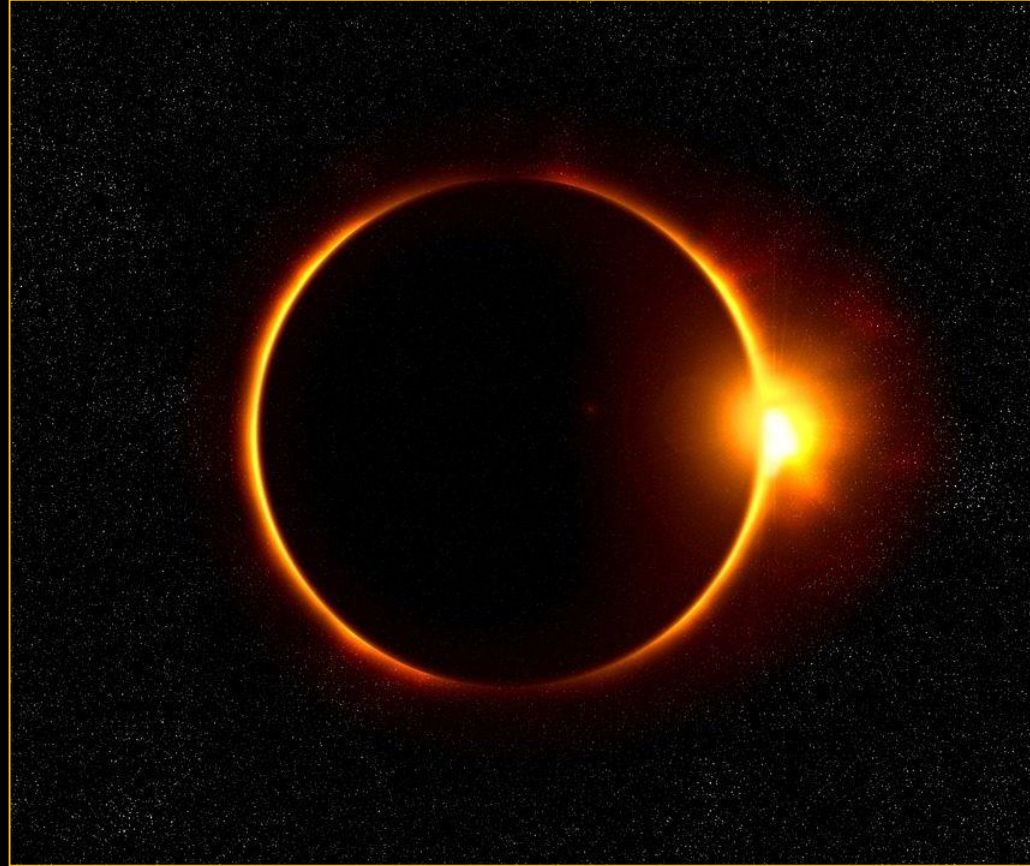
To come up with your optimum exposure for all the partial phases (where the sun is fully or partially visible), you have to test your lens/extender and solar filter combination all together, well in advance of eclipse day. To be prepared, try shooting your exposure tests with your solar filter in place in different weather/cloud conditions.

With ISO and aperture selected for your test images, simply bracket your shutter speed exposures and one of them will reveal itself as the perfect exposure. Make sure you will have a shutter speed fast enough to compensate for the rotation of the earth and freeze the movement of the sun in your viewfinder. Longer focal length lenses magnify the apparent movement of the sun and thus require faster shutter speeds.



*Tip: Learn to use your camera's Auto Exposure Bracketing (AEB)*

# Diamond Ring



About 15 seconds before totality we see the diamond ring effect



# Bailey's Beads



Bailey's Beads effect taken Dec. 4, 2002. Credit: Arne Danielson, NASA.gov

About five seconds before totality, there are still a few tiny rays of sunlight peeking between the valleys of the craters on the moon. This creates what has been named Baily's beads, after English astronomer Francis Baily.

# Total solar eclipse



During totality, with the solar filter removed from the lens, the exposure will be quite different and you'll want to bracket your exposure as much as possible. If your camera's AEB will allow you to bracket seven frames, in RAW, bracket in two-stop intervals with your slowest speed at about 1/2 second at ISO 400.

# General Camera Settings

General camera settings include:

- Setting High-Speed continuous shooting
- Bracketing 3-7 frames at two-stop intervals during totality
- Daylight white balance
- Use a high ISO setting: Set your camera to ISO 400 (or higher) to keep exposures very short and prevent blurring from vibrations.
- Manual Focus by turning off Autofocus on the lens
- Tape down your zoom and focus rings on your lenses
- Make sure your Date and Time are accurate
- Turn off image stabilization on the lens, if you are using a solid tripod
- Set the Image Quality to RAW or RAW + JPEG if you're doing social media
- You'll be using Live View during the eclipse so you won't have to use Mirror lockup
- During partial phases you might consider using the Interval timer
- If you have it, turn on your LCD grid display so you'll have a center mark to help center the sun throughout the eclipse

# Recheck Everything !

Just before the eclipse begins double check all your camera settings, zoom rings and focus rings. Make sure everything is taped down. Do this periodically up to just before totality begins. Once totality begins, you'll have more than enough to keep you busy.

Remember, your exposure will remain the same for all the partial phases of the eclipse. Do not remove the filter or look at the sun without safety glasses as long as there is any portion of the sun visible.

About 15 seconds before totality you will see the diamond ring effect and about ten seconds later you will see the Baily's Beads effect. Once the Baily's Beads occur there is approximately 5 seconds before totality.

During Totality remove the filter, bracket your exposures at 2 stop intervals. Start with 1/125 sec. at ISO 400. A 7-frame bracketed sequence should deliver shutter speeds of 1/2 sec., 1/8 sec., 1/30 sec., 1/125 sec., 1/500 sec., 1/2,000 sec. and 1/8,000 sec.

## Safety

We can't stress the importance of safety for your eyes and your camera gear enough. Now that we're actively involved with looking at and photographing the eclipse, we need to pay close attention to the use of the solar filter.

Partial phases absolutely need a solar filter. Once Bailey's beads disappear you can remove the filter for about two minutes until Bailey's beads reappear again. Then replace the solar filter on the front of your lens. Do not remove it again until you're finished photographing the sun. Always use your LCD screen to position the sun. Don't use your camera's viewfinder.

Never look at the sun without accredited and approved solar filtration over your eyes. There are special solar viewing frames that can be used over your eyeglasses or solar viewing glasses for those that don't wear glasses. Permanent, irreversible eye damage and/or blindness can result in seconds.

Never improvise, modify or use general photography neutral density (ND) photography filters regardless of how many stops they are. They don't block the infrared and ultraviolet radiation and are totally insufficient to provide the protection your eyes, and your equipment, need. There are reasons for this.

## Safety

Never point your camera into the sun without a special solar filter. All camera lenses need an accredited and approved solar filter mounted on the front of the lens. Not using a solar filter at eclipse magnifications will ruin your camera in seconds.



Nikon D7000 shutter damage from 2012 Annular Eclipse solar eclipse.