

# **SOLAR ECLIPSE USA – MERCED !**

## **Some information about the August 21 Solar Eclipse for the curious UC Mercedian**

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The single most important celestial body to us is the Sun, our own star. It is the source of nearly all energy that sustains life on our planet, Earth.

As you probably know, our Sun will partially or even completely disappear on Aug 21 for a short while, depending on one's location, during daytime! All sort of living creatures may be surprised by that, except astronomers of course!

Solar eclipses were already known a long time ago by ancient civilizations, especially in China, Babylon, Egypt and present day Mexico (Maya, Aztecs; *Ref 1*).

At the time their predictions were not very accurate though and, more important, the reasons why the eclipses occurred were then unknown. For the ancients this was therefore a magic and often scary event, and it was thought to affect all sorts of personal things as well. This mix-up of science (observation) with personal hopes and fears was common and is known as astrology, or *pseudoscience*.

Now we have much more accurate information, *and* we know the reasons why solar eclipses occur (the Moon blocking the Sun), *and* we know the laws of physics that describe their orbits (Newton's laws). So we can now predict eclipses very well using some serious math and computers, and with no personal stuff thrown in. This is known as astronomy; or science.

### **SOLAR ECLIPSE USA – MERCED**

Solar eclipses occur regularly all over the world, but this time it is Solar Eclipse USA! As I mentioned this will occur on Aug 21, and depending on where you are, the Sun may be partially or entirely blocked by our Moon.

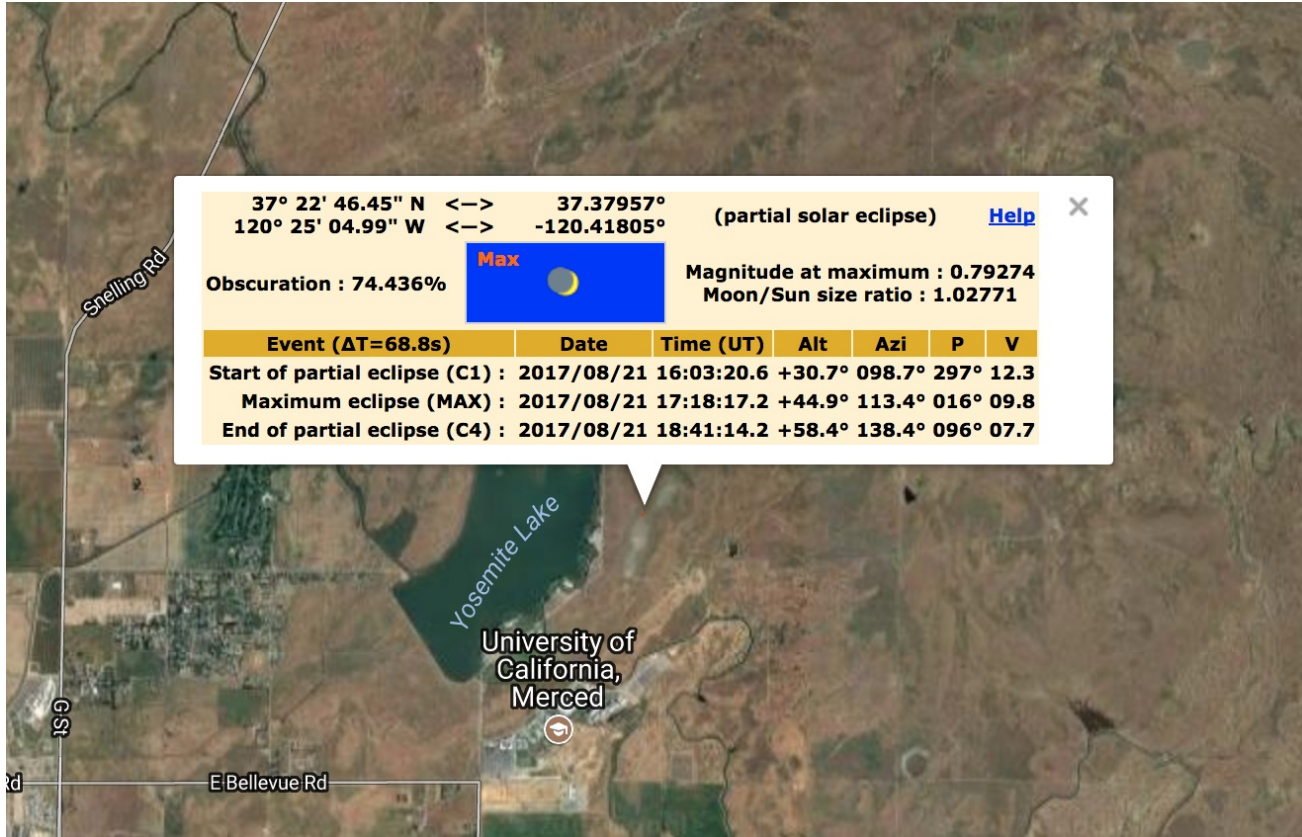
There is a great French website that shows you exactly when and where that will happen (*Ref 2*). Keep zooming in on your favorite location. Then click on that position and you will get detailed information for that location. You can also check other (reputable) websites listed at the end of this announcement as *Refs 3, 4*.

For example, zooming on the UC Merced campus, near Yosemite Lake, you will get the information shown in the below picture. Here the top two lines are the exact location on Earth that you selected (Yosemite Lake near UC Merced). Other parameters shown are:

*Obscuration* : 74.436% (about 25% of the Sun will still be visible.; so it is only a partial eclipse)  
*Magnitude at maximum* : 0.79274 here refers to how much of the Sun's diameter is covered by the Moon (about 79%).

*Moon / Sun size ratio* : 1.02771 is the ratio of the apparent size of the Moon relative the Sun at the time of the eclipse. It shows that the Moon is a bit larger than the Sun, and thus can block the Sun entirely – but not from the vantage point of UC Merced.

*The eclipse diagram* shows the situation during maximum eclipse (I found that you might have to click on your chosen Earth location twice to show this properly).



Solar eclipse information for the UC Merced campus. From *Ref 2*.

Other information is given as well, the most important being when the partial eclipse begins and ends, and when the maximum eclipse is. **This is given in UT, or Universal Time.**

**It is very important to convert this correctly to your local time!**

For us in California, where we currently have Pacific Daylight Time or 'Summer Time', the correct local time is UT – 7. **So at UC Merced the eclipse will occur on August 21 2017, and will start at 9:03:20.6 am, and be at its maximum at 10:18:17.2 am. At that time the Sun will look like a crescent.** If you use *Ref 3* and their 'Tour the Great American Eclipse' web app then the right local times will be automatically listed.

While UC Merced will not be in the path of the total eclipse, there are some interesting things you can observe. First, using very dark (welders) glasses (**not sunglasses!**), you could look at the Sun directly and see the crescent Sun. Take this serious (*Ref 5*).

**But, more interestingly, find yourself a nice tree with leaves that is between you and the Sun, like at Yosemite Lake, and then look at the ground or a house (not the Sun!), and you may see something like shown below:**

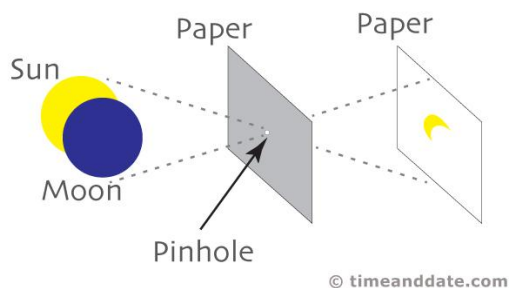


Solar crescents imaged through tree leaves, projected on a house. From *Ref 6*.

Since the leaves are constantly moving you can make a video of this phenomenon (*Ref 6*, or search for *tree leaves as pinhole cameras during a solar eclipse* in your browser). Especially check out the video where the Sun shines through the leaves on a house. Awesome! On Aug 21 you can do this yourself, with your cell phone! And then show them to your friends, or in class!

How does this happen? I will discuss this briefly in my Astrobiology class and in Core I but the principle is very simple and known already since 500 – 400 BC (*Mo Ti*, China, and *Aristotle*, Greece; *Ref 7*). It is based on ‘pinhole imaging’, and you can do this yourself by using a piece of paper or cardboard with a small hole (or many small holes, in any pattern that you like; like a Bobcat!), and then look at the image projected on the ground or on another piece of paper.

### Basic Pinhole projector



From *Ref 8*.

This simple imaging technique is also used by some aliens☺, see the next image. Well ... this particular 'alien' is actually a real creature living in our own oceans and is called a Nautilus.



Pinhole Eyes of a Nautilus. From *Ref 9*.

## **INTO THE DARK ZONE**

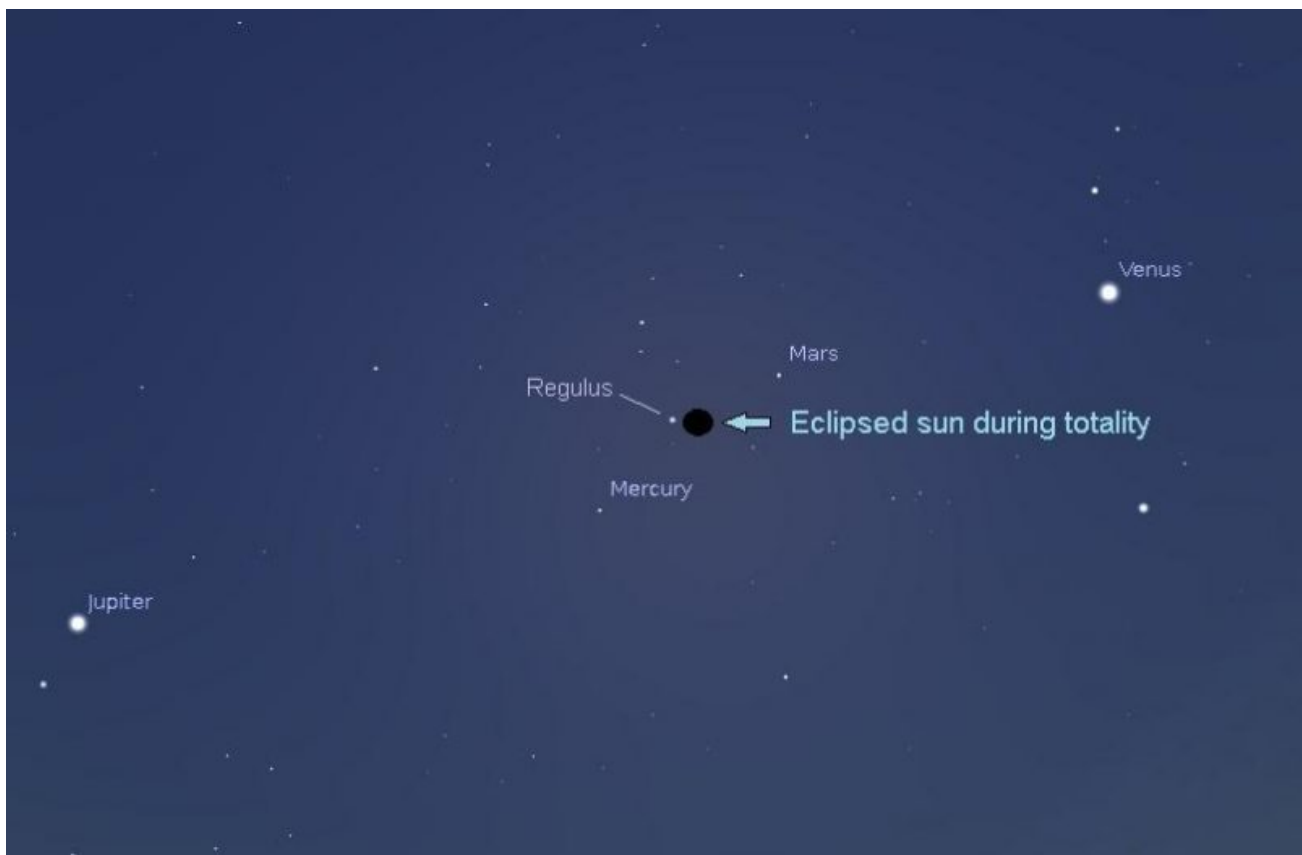
The Sun is only fully eclipsed in a zone of approximately 60 - 70 miles wide on Earth. From 2 you can find where this 'dark zone' starts and ends: it covers the USA from coast-to-coast! If you click on a location in the dark zone you will get some more information, like 'path width' of the zone, and the 'umbral velocity', or the speed with which the shadow of the Moon travels across the Earth's surface. The latter is about 2900 - 1500 mph across the mainland USA going from Oregon to South Carolina. This speed changes because of the Earth's curvature, the Earth's rotation, and the Earth and Moon relative speeds. It is too fast for regular jetliners to chase, and only barely OK for military jets even at the low-end speed, but who knows, some squadron of F-15's might try to chase the eclipse along for some of the way!

NASA will send two high altitude research aircraft (WB-57F), at normal speed and lined up behind each other, to follow the path of the eclipse for science observations. Together this will allow for a total 7 minutes of unique observations of the solar corona and thermal imaging of Mercury (*Ref 10*).

Chasing the eclipse in jets is not the weirdest thing though. About 200 million Americans live within a day's drive of the dark zone. Imagine millions of people driving over to this zone, whether on Aug 21 or a few days before; and then leaving again after the eclipse has occurred.

Campsites and hotels are long booked; prices for everything have skyrocketed; food and gas may run out. There will be traffic jams on roads going to and leaving from the dark zone. For information about Oregon see for example *Ref 11*. So please don't think you can just hop in your car and do a quick return trip from Merced to Oregon! A very useful website app (*'Tour the Great American Eclipse'*) can be found in *Ref 3*. It shows on an interactive map where all the traffic bottlenecks will be in the USA. Keep zooming in to you favorite location.

At any one location in the dark zone the full eclipse lasts only about 2 ½ minutes at most, but it will be total, and the Sun will disappear completely! All that will be left to see is the Sun's corona, hot gas flowing away from the Sun. Bright stars and planets will appear that could not be seen before because of the bright sunlight. Nearest to the eclipsed Sun will be the bright star Regulus, and the planets will be Venus, Mars, Mercury and Jupiter (from top right to bottom left).



From *Ref 12*.

Note that this is a rare occasion where one can actually see Mercury relatively easily because usually it is too close to the (bright, full) Sun to be seen. While we are at it: Why do you think the planets and Sun are all lined up? If you are interested in such things, and want to know where the stars and planets are, night or day, it might be worthwhile to download the excellent apps *SkySafari 5* or *Stellarium* on your cellphone or iPad, as well as the *Eclipse Safari* app specific to the upcoming eclipse.

Other interesting things happen: the Earth's temperature will drop somewhat (like it does at night), and the birds may suddenly become quiet while crickets might actually get into the

action. It is an amazing experience! See *Ref 13* for a whole list of questions that you might want to ask. Note especially the last paragraph about psychological effects on people, but forget about astrology and other nonsense that you might find on other websites!!! Be careful because there is already a lot of 'fake news' going around!

See you on campus or in class Aug 24, unless I am stuck in traffic somewhere between Idaho and Merced after the eclipse because I didn't heed the traffic jam warnings☹

## WEB REFERENCES

*[NOTE: If a hyperlink does not work pick another browser and type in the address yourself, or key words from it. Links may change, be overloaded or even might be blocked as we get closer to the eclipse date]*

1. <https://image.gsfc.nasa.gov/poetry/ask/a11846.html>
2. [http://xjubier.free.fr/en/site\\_pages/solar\\_eclipses/TSE\\_2017\\_GoogleMapFull.html](http://xjubier.free.fr/en/site_pages/solar_eclipses/TSE_2017_GoogleMapFull.html)
3. <https://www.greatamericaneclipse.com>
4. <https://eclipse.gsfc.nasa.gov/solar.html>
5. <https://eclipse2017.nasa.gov/safety>
6. <https://petapixel.com/2012/05/21/crescent-shaped-projections-through-tree-leaves-during-the-solar-eclipse/>
7. <http://pinhole.cz/en/pinholecameras/whatis.html>
8. <https://www.timeanddate.com/eclipse/make-pinhole-projector.html>
9. <https://en.wikipedia.org/wiki/Nautilus>
10. <https://www.nasa.gov/feature/goddard/2017/chasing-the-total-solar-eclipse-from-nasa-s-wb-57f-jets>
11. [http://www.oregonlive.com/eclipse/2017/07/beware\\_this\\_oregon\\_solar\\_eclip.html](http://www.oregonlive.com/eclipse/2017/07/beware_this_oregon_solar_eclip.html)
12. <http://earthsky.org/astronomy-essentials/august-21-2017-solar-eclipse-4-planets-bright-stars>
13. <https://www.sunearthday.nasa.gov/2006/faq.php>