

Science AMA Series: I'm Sarah Jaeggli, a solar astronomer at NASA's Goddard Space Flight Center, here to talk about eclipse science. Ask Me Anything!

NASASunEarth <sup>1</sup> and r/Science AMAs<sup>1</sup>

<sup>1</sup>Affiliation not available

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I have a couple questions...

Is there always an eclipse that can be seen from at least somewhere on the world?

Do eclipses last longer/shorter depending from what part of the world they are visible from?

Are there points on the world that will never see an eclipse?

Thanks!

[Nzxh](#)

Q1:From the Earth, total solar eclipses are only visible at rare intervals when the Moon passes precisely between the Sun and the Earth. Only during the "new moon" phase.

Q2:The length of an eclipse depends on both the angular sizes of the Moon and Sun on the sky and also where you are in the eclipse path. If you are at the end or the beginning of the eclipse path (eclipse happens at sunset or sunrise) the eclipse will be short. If you are in the middle of the path, the eclipse will be longest and will happen around local noon.

Q3:There may be some regions on Earth where a total solar eclipse has never been visible, near the north or south pole.

-SJ

I understand that Earth's magnetic field actually change poles through geomagnetic reversal - and if I understand it correctly, we are overdue for one. In a relative view, this reversal process is extremely quick to the Earth's timeline.

What do you think will be the societal impact to mankind and the biological consequences to life in general of such a reversal? What can we do to prepare for it?

Do other planetary bodies display this phenomenon? You mentioned the sun having a magnetic field of its own.

[Calaminh](#)

The Earth's magnetic field does change sign but it usually gets weaker and rebounds. The sign changes can be quick in the geomagnetic data, but are spread out over many years. We have not had a sign change when a society exists. But anything that navigates using the magnetic field will be affected. This includes migratory birds and some insects.

The Sun's magnetic field changes its direction every 11 years (the sunspot cycle). Other planets have a magnetic field but we only now starting to study those changes. Venus and Mars have very weak fields that do not change sign. WDP

Do you think Eddington's 1919 measurements were legit, or just coincidentally looked right?

[iorgfeflkd](#)

Eddington's measurements were legitimate estimates of the change in the positions of stars. They certainly agreed better with the predictions of general relativity than Newtonian gravity. Other people measured the same eclipse and got a similar answer. Five later eclipses also agreed with the predictions of general relativity. The measurements are all noisy, but they reach the same conclusions.

Often an accurate trend (or slope) can be found even with noisy data. That is what happens here. WDP

I have three simple questions. It is my understanding that the moon is slowly moving away from the Earth. Has anyone done a calculation to know when the Umbra and Penumbra of the shadow will no longer be cast upon the Earth? If so, when will that happen? Also, when will the same be said of the Lunar eclipse?

[Drewidian](#)

The last total solar eclipse is about 500 million years in the future. The Moon moves away from the Earth at about 3.8 cm/year and it has to move far enough away for eclipses when the Moon is closest to the Earth to become annular. Lunar eclipses will continue for much longer as the Earth's shadow is much wider than the Moon's diameter. WDP

Is there any eclipse that stood out for you more that the others? (The ones you saw live.)

[lapinas2229](#)

I've only seen two total solar eclipses, so they both stand out from other types of eclipses I've seen. The first was on a high plateau in the Sahara near Waw an Namus, Libya, and the second was on the tropical atoll of Enewetak in the Marshall Islands. The people and the places stand out more to me than what the Sun looked like.

-SJ

Does the sun go through seasons? If so what causes its seasonal shifts and how do those seasons affect Earth and the rest of the solar system? Thank you so much for your time!

[kpsb333](#)

The Sun does have what can be thought of as "seasons" which can be thought of as "active" and "quiet." The Sun goes through an 11 year cycle of activity which is associated with the global solar magnetic field. The magnetic field builds up inside the Sun by the dynamo motion of electrically charged plasma. The magnetic field then emerges through the surface, producing sunspots, and associated flares and mass ejections in the solar corona (the part we see during an eclipse), this is the active time. Then the magnetic field cancels out and the whole process starts over, this is the quiet time.

During the active time the Sun sends magnetic storms outward through the solar system, causing aurorae on the Earth and other planets (Jupiter!) with magnetic fields.

-SJ

If suppose we were all entirely dependent on solar energy, how will an eclipse affect us? Or will it affect us at all?

[uberkip](#)

A solar eclipse lasts only a few minutes at any spot on Earth. Any solar power system that can survive clouds, storms, and night can make it through a solar eclipse. WDP

Do solar eclipse cool the earth, and by how much?

[Notsure\\_jr](#)

Solar eclipses do cool the Earth. The Moon blocks some of the solar radiation that would have fallen on the Earth. The temperature on the ground drops by a few degrees during the eclipse.

-SJ

Has there been any progress on understanding coronal heating?

[godlameroso](#)

With the excellent observations from spacecraft like Solar Dynamics Observatory, Interface Region Imaging Spectrograph, Hinode and also with the improved computing models, there has been tremendous progress on understanding coronal heating problem. These data put very useful constraints on the theories, and we are narrowing in on the precise mechanisms that could be operating. N.V.

What can be studied during an eclipse, that cannot be studied during a regular day with a smaller but much closer obstruction that blocks out the body of the sun to the observer?

How come the difference between the moon and any other object used in the same way?

[z115](#)

Specialized telescopes called "coronagraphs" can be used to observe the solar corona, they block out the light from the solar disk so the faint outer parts can be detected. Coronagraphs can't be built perfectly though, they suffer from scattering and diffraction. These effects are worse the smaller the blocking disk is and prevent us from seeing very close to the solar disk. Using the Moon, which is very

large and very far away is far superior for viewing and measuring the entire solar corona.

-SJ

I'm very excited about the August 2017 solar eclipse here in the United States. According to NASA's prediction, the line of totality comes right over my house. I would like to try and take some photographs during the eclipse using my DSLR.

What is the best (and cheapest) way to protect my equipment? What about to protect my eyes? How do I go about getting good imagery throughout the whole eclipse since the apparent brightness will dramatically fall off, then rise back up?

Edit: clarification

[TheGeorgeBurdell](#)

Observing the Sun with your camera is a great way to record what you see during an eclipse. Outside of totality you must use special filters to block most of the sunlight. (Filters will cost \$50 or so.) During totality you do not need filters but may need to use longer exposure times. Please look at some astronomy magazines (<http://www.astronomynow.com/mag/1007/TheSun.html> for example) for suggestions on how to photograph an eclipse. Even better would be to go to a local astronomy club to talk more specifics about your camera. If you can put your camera on something that tracks the Sun (i.e., someone else's telescope) that makes your job of taking pictures much easier. WDP

Have any attempts been made to track the progression of a solar eclipse using geotagged social media posts (Twitter, Instagram, Facebook, etc.)? It seems that the prevalence of smartphones and the frequency with which people post images online should offer quite a large set of data.

[shiruken](#)

Yes. People will use geotagging to create eclipse movies next August. <http://eclipsemegamovie.org>  
This eclipse isn't good for such an effort because the track is mostly over water. WDP

Are there any unique challenges associated with SDO when an eclipse happens?

[dark\\_magnetar](#)

When SDO sees a lunar transit or an Earth eclipse the front parts of the telescopes cool off a little. We have to run on batteries for the Earth eclipses and the longer lunar transits. WDP

How large is the impact of an eclipse on earth's magnetosphere? Is there significant distortion, or just a small perturbation? How long does it take to get back to "steady state" after the shadow has passed?

How often do you make total eclipse of the heart jokes at work? Or have they gotten stale? :) Thanks for your time!

[Nosty85](#)

Q1: Total solar eclipses should have a very minimal effect on the magnetosphere. The Moon would

block part of the Earth's magnetosphere from flow of charged particles from the Sun for a moment, and I would expect that this is a small perturbation that lasts for a short time around the eclipse.

Q2:Never, clearly I need to make more "total eclipse of the heart" jokes :)

-SJ

As the sun grows ever bigger, possibly becoming a red giant will there be a point at which a complete solar eclipse will not be possible? also how does the sun's growth effect your work?

[Joltz-eons](#)

It will be about 4.5 billion years until the Sun reaches the red giant phase. Before that happens, the Earth's surface will reach the temperature of boiling water, making the surface of the Earth uninhabitable. (That won't happen for 1 billion years.) Even if the size of the Sun kept up with the outward motion of the Moon there would be no one here to watch the eclipses. WDP

I'm wondering about the gravitational pull, is there any interesting phenomenon that could be observed aside from extra tidal height?

Oh yeah, have fun in Indonesia! make sure to try some local food.

[simkuring](#)

There is nothing special about the tides during an eclipse. The Sun and Moon are always producing tides. Spring tides happen during new and full moons throughout the year. Neap tides happen at the first and third quarter moons. A total solar eclipse always happens at a new moon, so a spring tide should be happening today (that is true in Baltimore.)

WDP

Has there ever been a large solar flare/storm during an eclipse that was visible during the eclipse?

That would be amazing.

[AnalogHumanSentient](#)

Current scientists think that coronal mass ejections (often associated with major solar storms) may have been seen in historical observations of eclipses. Modern observations with cameras have not seen major activity, but one of the goals during the 2017 eclipse crossing the U.S. next August is to observe the evolution of the eclipsed corona. -SJ

Has there been a solar eclipse recorded (photographed) outside of the earth-moon system? So, not from the ISS, but maybe by a probe orbiting another planet of the solar system?

[is0ph](#)

In order to see an eclipse like we see on Earth from elsewhere in the solar system you have to be in the right place at the right time so that the blocking planet or moon and the Sun have the same angular size. Here are some examples of planets blocking the Sun, but in these cases the planets have a much larger angular size on the Sun so the corona is obscured, but we do get to see the planet's

atmospheres lit up.

Saturn from the Cassini spacecraft: <http://apod.nasa.gov/apod/ap110904.html>

Pluto from New Horizons: <http://www.nasa.gov/nh/nh-finds-blue-skies-and-water-ice-on-pluto>

-SJ

How long will it take for the moon to be too far away from the Earth to totally block the sun? How long until the moon passing by in front of the sun can't be noticed by the naked eye?

[currentlylurking-brb](#)

See the answer to this question [here](#)

Is looking at the Sun during a solar eclipse worse for your eyes than looking at the Sun on a regular day?

[daegilbert](#)

You should never look directly at the Sun on a regular day. During a total solar eclipse it is safe to look at the Sun and see the corona stretching away, but only during the few minutes or less of totality. Solar filters must be used to look at the Sun at all other times.

Some timing hints about watching a total solar eclipse can be found at

<https://www.nasa.gov/content/eye-safety-during-a-total-solar-eclipse>

WDP

Hi Dr. Jaeggli, thanks for doing this AMA. I hope you have a fun experience here on Reddit :)

My question: I'm quite interested in fusion research, does corona plasma physics have much cross over with fusion plasma research in tokamaks for example? I.e. is there research in one of these fields that benefits the other?

[biledemon85](#)

We see very little, if any, fusion in the corona. But, the magnetic fields in the Sun do look like magnetic bottles and the fields inside tokamaks. Watching the plasma move in those magnetic fields helps us understand what fields are needed to contain a fusing plasma.

The EUV images from AIA (on SDO) and EUVI (STEREO) show us how the plasma inside a fusion reactor glows.

We learn a lot about the plasmas inside a fusion reactor by watching the Sun, but we don't learn a lot about fusion.

WDP

Thanks for this AMA. Is it possible to see eclipses in other planets of our solar system? And...in which of them is more common this phenomenon?

[axel7c](#)

Yes, the Galilean satellites around Jupiter create total solar eclipses of the Sun. They are too close to Jupiter and the disk covers the chromosphere. So Earth Moon eclipses show more parts of the Sun's atmosphere. WDP

What kind of shoes do most scientists wear, if they dont need to wear safety boots? Sneakers? And whats your opinion of the jordan eclipse? (No trolling intended)

[Knightwalker00](#)

Sketchers (I used to wear Birkenstocks.) WDP

What kind of shoes do most scientists wear, if they dont need to wear safety boots? Sneakers? And whats your opinion of the jordan eclipse? (No trolling intended)

[Knightwalker00](#)

I only wear sandals to work in the summertime, and I haven't work Birkenstocks since I left my hometown of Seattle.

N.V.

What kind of shoes do most scientists wear, if they dont need to wear safety boots? Sneakers? And whats your opinion of the jordan eclipse? (No trolling intended)

[Knightwalker00](#)

sneakers, moving toward flip flops this spring

-SJ

Can you tell us some of the unique questions you're trying to address that can only be done during eclipses?

And followup, if the questions you're trying to answer require an eclipse, why not push for a dedicated eclipse observatory out at the Earth-Sun L2 point?

[aolostmaiden](#)

Total solar eclipses are the best chance to investigate the Sun's corona using visible and infrared light, and at these wavelengths we can measure the direction of the Sun's magnetic field in the corona. Solar eclipses are a key part of understanding the 3 dimensional structure of the magnetic field.

The 2nd Lagrange point, behind the Earth with respect to the Sun, is a great place for an observatory. The Earth is actually a smaller angular size than the Sun from this perspective, so the bright disk of the Sun is not completely covered, but combined with a coronagraph telescope, dedicated coronal observations could be taken from this orbit. Getting to the L2 point is expensive (in terms of rocket fuel) since it is more than twice as far away from the Earth as the Moon is.

-SJ

