

NASA Chat: Aurora Season Has Started!

Expert: Jim Spann

September 9, 2014

Brooke_Moderator: Thanks for being here -- our aurora chat will start in just about five minutes.

Brooke_Moderator: Our chat will begin in just a few minutes. Welcome to all.

Brooke_Moderator: Welcome to today's chat with NASA aurora expert Jim Spann. Please give Jim a few moments to answer your questions. Thanks for being here...now let's talk about auroras!

Brooke_Moderator: Do you have aurora questions? Jim has answers. 😊

Brooke_Moderator: A fun fact: Auroras also occur on other planets in our solar system including Jupiter, Saturn, Uranus, Neptune and Mars. Similar to Earth's aurora, the lights have been seen close to other planets' magnetic poles.

Sunshine: does nasa have a live coverage for auroras?

Jim_Spann: Currently, NASA does not have any live coverage of aurora from space. Our last auroral imagers that were flown were launched around 2000 and are not operating any more. However, ground-based observations, both in the northern hemisphere and in Antarctica, do provide live all-sky camera images of the aurora when conditions allow. These all-sky cameras are operated by universities and other federal agencies such as the National Science Foundation.

Bayside_Science_6: Students would like to know what causes auroras?

Jim_Spann: The light that we see from the aurora is caused by charged particles, electrons and protons, that crash into our atmosphere. As they crash into the atmosphere, they collide with the molecules of our atmosphere, primarily nitrogen and oxygen, and excite or give up energy to those molecules. The molecules then release that energy in the form of light and that light is what we call the aurora. The color of the light and the intensity of the light depend on how much energy was released and which molecules were excited.

Nielsenator3000: Is it true that you can see these from space and that they are higher there?

Jim_Spann: Yes, you can see the aurora from space, just as we can from the ground. Their height does not depend from where you view them.

Brooke_Moderator: Thanks for these great questions...Jim is working on answers.

@cybernova: Where is a good resource to see auroras if we are located in an area out of sight?

Jim_Spann: Auroranotify.com is a good place for aurora alerts, and more information about where you might be able to see the aurora.

Brooke_Moderator: Another fun fact: auroras are named after the Roman goddess of dawn, Aurora.

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Stone_Abdullah: Is there a relationship between Earth's magnetic field and the formation of the Auroras?

Jim_Spann: Absolutely. The charged particles that crash into the Earth's atmosphere are guided by the Earth's magnetic field. If you imagine the Earth's magnetic field as penetrating the atmosphere in the North and South Polar regions, then you can see that the aurora will occur where that magnetic field enters the atmosphere. So yes, the Earth's magnetic field is intimately tied to the aurora.

Mario: Hi Jim, we're traveling to Norway for the total solar eclipse next March. Totality is about 10:00 am, so during the day, but could it be possible to see the aurora during totality?

Jim_Spann: I'm really jealous that I cannot join that trip. Solar eclipses are spectacular. However, it will be too bright to see the aurora at that time. Perhaps in the evening when the sun goes down, you will be treated to another fabulous event, which is the aurora.

Brooke_Moderator: Did you know...images of auroras have even been seen in ancient cave paintings in France.

Bayside_Science_6: What colors can auroras be? What causes the color change?

Jim_Spann: The colors of the aurora range from deep reds to greens and occasionally blues. The colors depend on which atmospheric constituent was excited. The red ones are dominated by oxygen and the green ones by molecular nitrogen.

Lilywhite: What is the rarest color of aurora?

Jim_Spann: The most uncommon color that is seen from the ground is a deep violet color.

Janet: What accounts for the different colors? Are they in any way harmful?

Jim_Spann: The colors depend on what atmospheric constituent was excited.

Brooke_Moderator: A great video showing auroras over Earth, seen from the International Space Station: <https://www.youtube.com/watch?v=M99NywdrFfw>

Jim_Spann: There was a question about whether the aurora is harmful. Viewing the aurora from the ground is perfectly safe, so long as you are dressed for the weather. However, if one were to fly through the aurora while in space, you would experience an increased dosage of radiation. In fact, trans-polar flights are redirected if they are made aware that a large magnetic storm or auroral event will occur. This is because airline passengers would experience additional radiation dosage during that flight equivalent to one X-ray.

Sunshine: and do they see it on other planets too?

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Jim_Spann: Yes, we have seen the aurora on Jupiter and Saturn with the Hubble telescope and the Cassini mission. The aurora is a universal phenomenon.

Nielsenator3000: why are these aurora's shaped like waves

Jim_Spann: The aurora appears in many forms and is dependent on the how these electrons are distributed as they come down into our atmosphere. Sometimes they look like waves, sometimes they look like ribbons and sometimes they look like just a big splash of color.

luna1: How big are auroras? Is there a way to measure them or their intensity? Is it worth measuring?

Jim_Spann: The auroras are huge. In fact, the aurora forms a ring around Earth's polar regions, north and south, that extend all the way across North America and Siberia simultaneously. The aurora exists at nighttime and daytime, all the time. It's just that during the day, it's too dim for us to see. So the aurora is very large and is present at all times.

Simbou: What would happen if an object (debris falling, rocket, etc) passed through an area that have an occurring aurora?

Jim_Spann: Nothing would happen to it. It would just get irradiated and fall to the ground.

Brooke_Moderator: Excellent questions! Jim is working on answers, so thanks for your patience.

Brooke_Moderator: Fun fact: September, October, March and April are some of the best months to view the aurora borealis. The lights are known to be brighter and more active for up to two days after sunspot activity is at its highest.

Bayside_Science_6: How can auroras impact technology here on Earth? Do they have any impact on living things?

Jim_Spann: This is a great question. There are two points I would make with regard to the impact of auroras on technology. I want to introduce the concept of space weather. The aurora is our most obvious manifestation of space weather. Space weather is the dynamic aspect of the plasma that occupies space above our atmosphere. The aurora results from space weather that is driven by the variability of our star, called the Sun. Space weather can cause spacecraft to malfunction or become disabled. This impacts a lot of technology, in particular communications. So that is the first point I would make about the aurora or space weather impacting technology on Earth. The second point is that when there are large space weather events called magnetic storms, the aurora kicks up and becomes very active and very bright. Another consequence of a magnetic storm is that the currents that are created by the charged particles that cause the aurora induce other currents along our power lines and pipelines. These currents in the power lines can cause failures to power transformers on the power grid. An example occurred in 1986 in Quebec that took out the power to millions of people in the Northeast. If

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we were to have a huge magnetic storm, much larger than we've experienced recently, significant damage to society's infrastructure could occur.

Mohimur: why aurora is green(only)?

Jim_Spann: The colors of the aurora range from deep reds to greens and occasionally blues. The colors depend on which atmospheric constituent was excited. The red ones are dominated by oxygen and the green ones by molecular nitrogen.

Brooke_Moderator: For those just joining, welcome and thanks to everyone for being here. Jim is working on answers, so thanks very much for your patience.

Sunshine: do auroras happen in the middle east? or are they just in the north and south pole? and why?

Jim_Spann: It would be very rare for the aurora to appear at such low latitude as the Middle East, however there have been sightings of the aurora as far south as Georgia, Alabama and Arkansas during major magnetic storms. These aurora are generally red and appear as a glow in the sky to the north. There are references in ancient writings of dancing dragons (Chinese) and glowing pots in the Book of Ezekiel in the Bible. So the aurora can appear in lower latitudes, but it is very rare.

Nielsenator3000: How high are these aurora's?

Jim_Spann: The auroras begin around 85 kilometers and extend up to several hundreds of kilometers.

DERP: are there also aurora's on planets of other solarsystems

Jim_Spann: Yes.

Sunshine: okay thanks, do astonauts on the ISS see the auroras on earth?

Jim_Spann: Yes.

luna1: Does global warming or the increase in CO2 in the atmoshere effect auroras?

Jim_Spann: We don't have any evidence that the aurora and global warming are correlated.

Mohimur: why do we see aurora only in the poles..?

Jim_Spann: Because that's where the Earth's magnetic field penetrates the atmosphere.

Lilywhite: And I read somewhere that auroras can make clapping sounds...is that true?

Jim_Spann: No, I don't think so.

Lilywhite: Are there auroras on Mars?

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Jim_Spann: There are two things that are required for auroras. One is a magnetic field and the other is an atmosphere. Mars has an atmosphere, but a very, very weak, disorganized magnetic field. Therefore, you would not see an aurora at Mars. But you would see the atmosphere glow if you had good enough sensitivity. In fact, a NASA mission called MAVEN is arriving at Mars and will observe the Mars air glow.

Sunshine: how long do auroras last?

Jim_Spann: The aurora is present 24/7. It's just that it is very dim and not visible to the naked eye unless there's a large magnetic storm.

Nielsenator3000: are there constantly aurora's somewhere on the world?

Jim_Spann: Yes, at the north and south polar regions.

Stone_Abdullah: What governs the Auroras to move like majestic sheets or waves?

Jim_Spann: The dynamics of the aurora are governed by the motions of the Earth's magnetic field as it is being contorted by the solar wind that is buffeting the Earth's magnetic field. The motion of the aurora is also caused by how the energy is distributed along the magnetic fields.

Auroracraft: are there also aurora's in other solarsystems?

Jim_Spann: Yes, if there are planets with magnetic fields and atmospheres.

Nielsenator3000: Can aurora's occure on planets without an atmosphere?

Jim_Spann: No.

Sunshine: are auroras visible at day time?

Jim_Spann: They are present, but we cannot see them with the visible eye because the sky is too bright. However, if imaged from space in ultraviolet wavelengths, we can observe the aurora during the day time.

Brooke_Moderator: Great news! Due to the volume of great questions, Jim is going to extend the chat until 3:30 p.m. EDT. Thanks, Jim! And thanks to all of you -- these are very high-quality questions.

Mohimur: what is the best thing about aurora that interests you people to study more and become an expert about it?

Jim_Spann: I like to study the aurora because 1. it is the greatest light show on Earth, 2. the aurora is the footprint of the Earth's magnetic field system. If we can image the aurora, then we can model what the Earth's magnetic field looks like at any given time. And that is really cool. 3. The aurora is the most obvious manifestation of space weather, which is the magnetic and plasma connection between our Sun

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and Earth. Advanced technology is sensitive to space weather and therefore understanding the aurora will help us advance our technology on Earth and in space.

Nicollette12: which is the lowest height of the aurora?

Jim_Spann: About 80 kilometers.

haifa99: do aurora's travel quickly ?

Jim_Spann: Auroras can grow very, very quickly when there is a large magnetic storm and therefore they are very fast seen from the ground. Typically, this occurs around midnight local time because that is the most common time when magnetic storms are initiated.

Wakaze: Any reason why there more storms in autumn?

Jim_Spann: Often times the skies during autumn and spring are clearer and darker, therefore the auroras are more visible.

Wakaze: Can auroras be damaging to electronics?

Jim_Spann: Auroras and space weather damage electronics, especially of spacecraft and power lines on the ground.

Sunshine: if an airplane was flying through an aurora, would anything happen to it?

Jim_Spann: First, airplanes don't fly high enough, but if they fly underneath the aurora during a large magnetic storm, the airplane will get radiated equivalent to one chest x-ray per passenger.

Knavery: What do we use to detect an oncoming Aurora and how much "heads up" time do we have?

Jim_Spann: Prediction of auroral occurrence is complicated. We have spacecraft that continually observe the Sun and its solar wind upstream from the Earth to help us understand when a large magnetic storm will occur. We have many scientists using the latest technology in their models and observations to develop space weather prediction tools. Just like it is often difficult to predict whether it will rain or not any given afternoon, it is even more difficult to predict the aurora. The state of the art of space weather prediction is about as good as our terrestrial weather prediction was thirty years ago.

Brooke_Moderator: Terrific questions...thanks for your patience as Jim answers. Busy room today...

Glen: I'd like to plan a trip to Alaska during September or October. Assuming clear weather, what are the odds of viewing the aurora during any seven day span?

Jim_Spann: I can't give you odds on viewing the aurora. It really depends on whether the Sun is very active at that time. If the Sun has a lot of sunspots, then your chances are better. There are several web sites that will help you know whether there will be an aurora. auroranotify.com and spaceweather.com.

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Nicollette12: Are there conditions that can enhance auroras?

Jim_Spann: Yes, if the Sun is very active with flares and sunspots, then the chances of the aurora are greater.

Stone_Abdullah: Can we predict Aurora activity?

Jim_Spann: To a certain extent, we can predict auroral activity, but we still have a lot to learn in order to do it with significant accuracy.

Mohimur: is there any relation between gravity and aurora?

Jim_Spann: No.

Lilywhite: Does altitude affect the color of auroras?

Jim_Spann: Yes, it does. The more energetic the electrons that create the aurora, the deeper they penetrate into the atmosphere and therefore the greener they are. The red are at higher altitudes.

Sunshine: do auroras have sounds?

Jim_Spann: No.

Nielsenator3000: When these molecules react with electrons, are there also new molecules or substances formed?

Jim_Spann: No, the aurora does not have enough energy to create new substances.

Peter: does it occur that you can see them in belgium

Jim_Spann: Yes, if there's a large magnetic storm and the weather is clear.

Mohimur: has aurora any bad effect on our environment or on us?

Jim_Spann: No effect on the environment. But for transpolar flights, you can be exposed to radiation if you fly during a magnetic storm.

MD: Why study auroras? Do they give us insight on how the earth's magnetic field is changing?

Jim_Spann: Good question. Yes, the aurora can be thought of as the footprint of the Earth's magnetic field. So understanding the morphology and dynamics of the aurora helps us understand the dynamic nature of the Earth's magnetic field.

Peter: when did you saw your first aurora?

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Jim_Spann: The first time I ever saw the aurora with my own naked eyes was four years ago in Alaska. It was amazing. I'll never forget it. In the previous twenty years, I had built two cameras to image the aurora from space and always enjoyed looking at that data, but I'd never seen it with my eyes until four years ago.

Seam: Hi Jim. How much (if any) advanced notice can we have of anticipated increased magnetic storm activity? What technology is used to predict it?

Jim_Spann: We have about 2-3 days advance notice under the very best conditions. That is how long it takes for the blast of plasma that is ejected from the Sun to reach Earth. We observe these plasma ejections with solar telescopes and measure their passage upstream from the Earth with plasma and magnetic field monitors at the Sun-Earth L1 Lagrange point.

Nielsenator3000: The electrons who go in our atmosphere, do they all come from solarwinds?

Jim_Spann: No. The Earth has a large radiation belt called the Van Allen Belts that store a lot of energy in the form of electrons. Most of the precipitating particles that form the aurora come from within the Earth's magnetic field. The energy that causes these particles to precipitate comes from the variability of the solar wind as it buffets and distorts the Earth's magnetic field.

Peter: do you think there are many misconceptions about aurora's

Jim_Spann: Yes. One is that they only occur at night when in fact they are present at all times, except that they are just very dim and you can't see them.

NanoPi: do auroras make sounds or music?

Jim_Spann: No.

Mohimur: is there any picture or video of aurora occuring on other planets?

Jim_Spann: Yes. Look at the Hubble space telescope Jupiter images and the Cassini Saturn images for planetary aurora. There may be some for Neptune.

Brooke_Moderator: We have just a few more moments of our chat with Jim Spann. If you have questions, now is the time to ask!

Simbou: Are there any differences with the polarity of the magnetic field (north/south poles) and charged particles in the auroras?

Jim_Spann: The Earth's magnetic field polarity does have an impact on the occurrence of the aurora, because if the solar wind magnetic field is pointing south, it will connect with the Earth's magnetic field in such a way that it loads it up with a lot of energy and stretches it to a point that the Earth's magnetic field will snap back just like a rubberband. That energy that is snapped back follows the Earth's magnetic

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field and when it collides with the Earth's atmosphere, a large magnetic storm occurs and the aurora gets very bright.

Marianne: What can offer Aurora to the new technology ? Improvement in communication ? But how ?

Jim_Spann: The aurora is a manifestation of space weather and therefore understanding the aurora will help us improve our technology to withstand the problems that space weather causes our electronics.

Nielsenator3000: Do aurora's occur on our moon or on other moons? I would really like to know this.

Jim_Spann: If a moon has an atmosphere and magnetic field, it could. Some of the moons of Jupiter may have an aurora. Our moon does not.

Stone_Abdullah: Thanks Jim-bo for extending the questions! What was the largest Aurora event ever recorded?

Jim_Spann: The Carrington Event of 1859. That event marked the birth of space weather. The aurora was so intense that it was seen as far south as India the Southern U.S. The currents that were induced on telegraph lines totally wiped out telegraph communication. It is estimated that if a similar event were to occur today with our current dependence on space communications and power grids, that the impact on society in the U.S. and around the globe would be in the billions of dollars and significantly impact the societal infrastructure.

Nielsenator3000: What is the best country to travel to when you want to see an aurora?

Jim_Spann: I can recommend a couple. Any Scandinavian country, Iceland, Canada, and the U.S. (Alaska). Fairbanks, Alaska is a fabulous destination and is set up to receive auroral-viewing tourists.

Rajendra: hello.... can we create artificial AURORA in here on earth on any specimen ?

Jim_Spann: Yes, we can create artificial aurora if you have a plasma source, a magnetic field and a tenuous atmosphere of oxygen and nitrogen.

Sunshine: what would happen if a plane was flying in an aurora?

Jim_Spann: The people would get irradiated with the equivalent of one chest x-ray per person.

Brooke_Moderator: Jim has done one more extension until 4 p.m. EDT. So we have about 20 more minutes to finish up our question queue...

Nicollette12: is there the possibility that the aurora phenomena happening around Earth might connect to each other?

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Jim_Spann: The aurora forms a ring or halo around the North Pole or South Pole and is there at all times. Sometimes there is a band that goes across that ring and connects the two sides of the aurora. This occurs when the Earth's magnetic field becomes significantly contorted.

Sunshine: can we see auroras in a city with lights?

Jim_Spann: No. City lights are almost always too bright.

Omid: aurora mostly happens in poles can we expect to see the them around the equator?

Jim_Spann: No, we would not expect to see aurora around the equator, but there is air glow around the equator due to other atmospheric and ionospheric processes.

Omid: why we dont try to absorb the transmited energy which governs on aurora to produce for example electricity?

Jim_Spann: We don't know how to do that.

Mohimur: How much powerful should a magnet be to form Aurora? And what about weather?

Jim_Spann: I don't know how powerful a magnet needs to be, but the magnetic field guides the charged particles that cause the aurora.

Mohimur: What is a magnetic storm?

Jim_Spann: A magnetic storm is the manifestation of a lot of energy that has been stored up in the Earth's magnetic field by the variable solar wind, that when released creates a very bright and turbulent aurora.

Eamonn: Given that the ISS reaches only 51.6 degrees latitude, how can its crew photograph the auora apparently close up? Thanks

Jim_Spann: The aurora typically occurs between 60 and 70 degrees latitude. So the ISS, using lenses on their cameras, is able to image the aurora from above and from the side, since it flies higher than the aurora.

Sunshine: will nasa provide live coverage for auroras in the future?

Jim_Spann: I sure hope so because I want to build that camera and that mission.

Omid: can we make a shield of magnet field around the earth independent from the magnet field of the earth, maybe something like HAARP to reduce the effect of aurora or other sun activities on earth?

Jim_Spann: No. HAARP is studying how we can actively impact the aurora, but not to the extent that we could make a shield around the Earth.

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Mohimur: When does a magnetic storm occur?

Jim_Spann: When the Earth's magnetic field suddenly releases its stored energy, a magnetic storm occurs.

Charlie: Does the strength of the magnetic field have an impact on the aurora?

Jim_Spann: The magnetic field guides the precipitating particles to the atmosphere. The stronger the magnetic field the stronger the guide.

Marianne: How Aurora can be exploited ? I mean can we use them like new resources of energy ?

Jim_Spann: We don't know how to do that yet.

Brooke_Moderator: We have about 10 minutes to go in our chat...

Willem: what damage can auroras do to electronics?

Jim_Spann: The damage that auroras can do to electronics are due to the power surges that result from the induced currents caused by the aurora.

Lilywhite: What missions does NASA currently have to study auroras?

Jim_Spann: We have several sounding rocket flights that study the dynamics and energetics of the aurora. THEMIS is the primary mission NASA currently has to study the aurora and magnetic storms. However, I should point out that there are many missions that NASA has that study the connected Sun-Earth system that produces the aurora.

Glen: Would NASA ever consider using a scientist like yourself to go to the ISS as a Mission Specialist specifically to study magnetic field phenomenon like the aurora?

Jim_Spann: The scientists on ISS have a very unique view of the aurora and in fact there are instrument ideas to fly on ISS to study the aurora. So if they need me to go to operate those instruments, I am ready to go!

Mohimur: Why is it called "Aurora"?

Jim_Spann: In Roman mythology, Aurora is the goddess of the dawn.

@cybernova: Thank you for taking the time to do this. Where can we follow you and keep updated with your work?

Jim_Spann: <http://science.msfc.nasa.gov>

Mbsimons: will i be able to view aurora as far south in Kentucky this year?

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Jim_Spann: If there's a big giant magnetic storm and the sky is clear, you might be able to see it.

Shadowsjpt: why is the moon orange

Jim_Spann: This has nothing to do with the aurora. The Moon is orange because of scattered light through our atmosphere. The blue wavelengths more strongly than the red wavelengths and therefore you tend to see more red than blue. This is the same reason that the sun is orange when it sets, especially in the summer when there's a lot of dust in the air.

Brooke_Moderator: Thanks to everyone for being here today! Jim, thank you for all of these excellent answers. Check back within a few days for a posted transcript of today's chat. Have a nice afternoon.

Additional Resources:

Streaming web site for the MSFC INSPIRE VLF receiver can be found [here](#).

[INSPIRE project](#)