Reflector

Published by the Astronomical League Vol. 67, No. 3 June 2015

A Memorable Evening Dancing with Aurora

The Astronomical Community Loses Two Great Friends

Part 2: Discovering Astronomy

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Dancing with Aurora: A most Memorable Evening

By Al Marcella

The Valkyrior, the Dance of the Spirits, polar lights, goddess of the dawn, the mythical firefoxes of Lapland, the northern lights, Aurora. By any name, auroras have intrigued, scared, excited, and fascinated humans since the dawn of time.

Named after the Roman goddess of dawn, Aurora, and the Greek name for the north wind, Boreas, in the Northern Hemisphere, the display is known as the aurora borealis (or the northern lights). In the Southern Hemisphere, it is called the aurora australis (or the southern lights).

These phenomena are commonly visible between 60 and 72 degrees north and south latitudes, which place them in a ring just within the Arctic and Antarctic Circles. Aurora sightings at lower latitudes are uncommon, so making the trek to extreme northern or southern latitudes is a requirement, if you want to get on Aurora's dance card.

The Science behind Aurora's Display

Where does the auroral light come from?

Auroras are caused by energetic particles hurtling out from the Sun in a steady stream called the solar wind. They can also occur as a result of giant eruptions on the Sun, known as coronal mass ejections or CMEs.

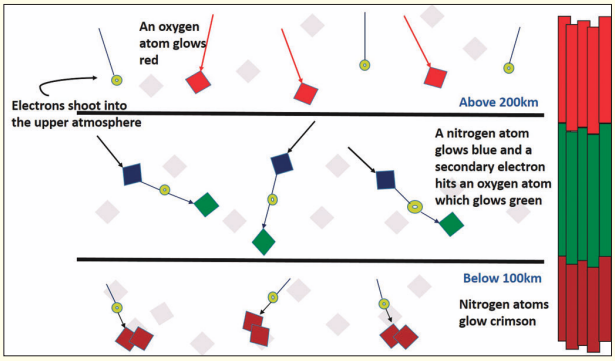
After a trip toward Earth that can take two to three days, these solar particles interact with the Earth's magnetic field and cause the release of particles already trapped near Earth, which in turn trigger reactions in the upper atmosphere. In these reactions, oxygen and nitrogen atoms release photons of light. Most auroral light is emitted by these oxygen atoms, excited from bombardment by charged solar particles.

When a charged particle moves through a magnetic field, a force perpendicular to the particle's motion is created, and that force can divert the particle into a spiral path until it collides with atoms in the upper atmosphere. These upper atmospheric collisions excite oxygen and nitrogen atoms, resulting in the visible auroral light. We artificially create a similar lighting effect here on Earth when we fire electrons into a glass tube filled with neon gas, creating the glow of neon light.

The Colors of the Aurora

When energetic electrons strike an atom or a molecule, they slow down and transfer some of their energy to that atom or molecule. The atoms or molecules can store this energy only for a very short time, and then radiate the energy away as light.

When an atom or molecule emits light as a photon to rid itself of its excess energy, that photon has a wavelength that is characteristic for that atom or molecule. We perceive this characteristic wavelength as color.



Colors of the aurora

Different gases produce different colors when they are excited. Oxygen at about 60 miles up gives off the familiar yellow-green color. Oxygen at higher altitudes (about 200 miles above us) gives the all-red auroras. Ionic nitrogen produces the blue light and neutral nitrogen gives off the red-purple and the rippled edges (see "Colors of the aurora").[1]

The green light emitted from excited atomic oxygen is centered on a wavelength of 558 nanometers, while the rarer red light is emitted around wavelengths in the 630 nanometer region.[2]

The most abundant gas in Earth's atmosphere is molecular nitrogen, and it radiates predominantly in deep blue and red colors. Mixing these together gives purple. The bottom edge of a green auroral curtain gets this purple color when auroral electrons are accelerated to very high energy levels.

On occasion the aurora gets a deep red color. This comes from higher altitudes, around 120–180 miles (200–300 km). It is again oxygen atoms that are responsible for this color. An oxygen atom has an excited state that can produce this red line emission with a mean lifetime of 100 seconds, and only at very high altitudes are collisions infrequent enough to allow this radiation to be emitted.[3]

Viewing the Aurora

Auroras are magical, spellbinding, amazing wonders of nature, produced by solar winds and the Earth's prevailing magnetic and atmospheric conditions. Above all, auroras are not subject to human schedules or timeframes.

Observing the aurora is also subject to local weather conditions, patience, geographic location, sky darkness, patience, minimal ambient light, patience, being in the right place at the right time, patience and some luck. I'll get back to patience later.

Spending an evening with Aurora should be on everyone's life list. However, getting yourself to a good location in either the Northern or Southern Hemisphere that will maximize your potential and opportunity to see the aurora, is your first challenge.

The best Northern Hemisphere latitude? Within the auroral zone—65 to 72 degrees north.

In the Northern Hemisphere you will need to head to destination cities on or slightly above the auroral zone (the auroral zone, also referred to as an auroral oval, is centered about the magnetic poles) and north of the Arctic Circle.

Which cities? That is open to debate, based on whom you ask or which website you search. It also depends on where you live, how far you are willing to travel, and how much you are willing to spend for that evening's dance with Aurora.

You will stand a good chance of viewing an aurora if you head

Kaldfjord, Norway
Nikon D300, Tokina 11–16 mm lens, f/2.8, ISO 1000, 22 sec.

to Tromsø, Norway; Yellowknife, Northwest Territories, Canada; or Bettles, Alaska. Other excellent choices are Svalbard, Norway; Jukkasjärvi, Sweden; Kakslauttanen, Finland; Kangerlussuaq, Greenland; and Reyjavik, Iceland. This is only a representative list as there are many northern latitude cities that make good aurora-viewing destinations.

Possibly the most difficult (unless you are a scientist or a research station support member) and most inaccessible place to see the aurora australis is Antarctica! Because of the limited possibility of travel to remote parts of Antarctica, it is unlikely that this aurora destination will make your aurora viewing hit list.

However, under the right conditions, you can see the aurora australis from Ushuaia, Argentina; Tasmania, Australia; Stewart Island, New Zealand; and the southern tip of South Africa, all Southern Hemisphere destinations that are more easily accessible.

The best time of year? To improve your chances of catching a dance with Aurora, in the Northern Hemisphere, you will need to venture out between late November and March, when the days are short and dark nights are longer. It is also best to schedule three to four days in your destination city to maximize your chances of seeing an aurora and to offset any uncooperative local weather that may roll in.

Although there is a depth of knowledge and science that goes into predicting auroras, in reality, even with perfect observing weather, minimal ambient light, and a 360-degree visibility, there is no guarantee that you will see an aurora. Remember, auroras are not a man-made light show—the Cosmos rules here.

As for actually seeing the aurora, recall my earlier comments on patience. When all is said and done, you are at the complete mercy of the Sun, Earth, the solar wind, nature, and space. That is why, when you do see Aurora's amazing display, it is so very special and you can count yourself fortunate to have been there for the dance.

Oldervik, Norway
Nikon D300, Tokina 11–16 mm lens, f/2.8, ISO 500, 52 sec.

An Evening Out With Aurora

Like most memorable evenings, you will most likely want to take a picture of, and with, Lady Aurora. If the conditions are right and you are prepared, you will have a picture that you will cherish and which will bring you many happy memories long after you have returned home.

Capturing the elusive aurora will take, again, patience, as the aurora may display at any time, without much advance warning and may fade away just as quickly.

In addition to patience, for any long evening that you will spend out in the high arctic, during the cold winter, waiting to photograph the aurora, you will need some advance preparation.

Estote Parati

Being prepared when venturing out for an evening with Lady Aurora means being aware of your surroundings, especially if you are visiting unfamiliar territory, a foreign country, or even your own neighborhood park. Photographing an aurora requires heading out at night, most likely to new and unfamiliar areas, possibly walking in snow and ice or even across frozen bodies of water, typically a distance from city lights into the countryside. Snow can cover up lots of potential dangers!

If possible, try to pair up with someone as excited about viewing an aurora as you are, or who is just willing to sit in a warm car in case you need support. Conduct visual reconnaissance during the day, identify potential ground hazards, lay out a destination path, and test snow and ice conditions on the way to your evening's photographic destination.

If venturing out on your own, it is always best to let someone know your planned destination and anticipated return time. Don't count on your mobile phone working if you are far from mobile phone towers or in a foreign country.

If you are headed to an international destination, joining a professional tour is certainly an option. Most professional "aurora hunting" tour operators have many years of seasonal experience, are very familiar with the local area and the best places for viewing, and know where they can tread both safely and legally (not trespassing on private property).

Estote Parati, your foremost priority out the door, is safety first.

Dressing for the Dance

Plan on wearing and layering clothing appropriate for the season, geographic location, and weather conditions in which you will be photographing, sometimes for several hours. For example, consider a hat, boots, gloves, insulated jacket, insulated/thermal under

Kaldfjord, Norway
Nikon D300, Tokina 11–16 mm lens, f/2.8, ISO 1000, 23 sec.

layer, and windproof outer pants. For outer pants, I prefer loose, baggy snowboarding pants, which allow greater freedom of movement when walking or kneeling.

A fully charged flashlight or headlamp is essential, preferably with a red rather than white light. The red light allows you to easily see where you are walking, yet preserves your night vision so you can easily and quickly operate your camera.

Another important, not-to-forget item is chemical hand and foot warmers. These hand

Kvaløya ("Whale Island"), Norway
Nikon D300, Tokina 11–16 mm lens, f/2.8, ISO 1000, 13 sec.

and foot warmers produce heat when exposed to air. Pack more than you think you will need, because you may need them all, especially if you will be going out to the chase the lights on multiple evenings.

Packing something warm to drink and a snack for energy is always a plus; however, remember that if you drink too much, well, nature rules. Getting undressed through multiple layers of protective cold weather gear is not only time consuming and laborious, it takes you away from your camera and from taking that aurora picture you came all this way to take. So, as the saying goes, "drink wisely, my friend."

Camera Equipment

You don't really need much technical equipment to photograph an aurora, but there are some things you simply cannot do without.

Camera: A camera with interchangeable lenses will be best, but in principle any camera can be used, even your mobile phone. Realize, however, that hand-holding your mobile phone, attempting to capture a shimmering, undulating aurora, will not produce the same quality image that you might get with a digital camera on a sturdy tripod using a remote shutter release. This, however, should not stop you from capturing that moment and preserving your memory of witnessing Lady Aurora's dance.

Be sure to keep your camera dry and avoid contact with snow or moisture as much as possible. When walking, it is a smart idea to place your camera in a large zip-lock bag. Should you trip, slip, or accidentally drop your camera (numb fingers will do that to you) in the snow, it will stay dry and protected from the elements.

Lens: To take in as much of the sky as possible and a bit of foreground, using a wide-angle lens (focal length between 10 and 24 mm, with a maximum aperture of at least f/2.8) will give you the best results overall. In reality, almost any lens will work, but keep in mind that your images will look different than those you see posted on the web, taken with wide- or super-wide-angle lenses.

Sandneshamn, Norway
Nikon D300, Tokina 11–16 mm lens, f/2.8, ISO 500, 72 sec.

Prior to your first shot, focus your camera at a distant point, back off slightly from the infinity setting and then turn off the auto focus feature on your lens. Given the dark sky, you don't want your camera and lens trying to automatically focus on an ever-changing, moving aurora. Locking in on manual focus, set slightly south of infinity, will give you well-focused images.

Sturdy tripod: To avoid blurring your picture due to camera movement, shaking hands, or unsteady footing on snow or ice, a sturdy tripod is essential. Equally important is a quality camera ball head, not only to solidly support your camera but also to allow for ease of movement and independent adjustment of your camera along each axis.

Remote shutter release: A remote shutter release for your camera provides three important benefits in obtaining a memorable photo of the aurora. First, it will be invaluable in its contribution to a sharper image by reducing camera shake, which occurs naturally when you depress the shutter release button. Second, for the longer exposures (three to twelve seconds or longer, depending on conditions and your ISO setting) required for aurora images, you can hold the shutter open without physically touching the camera's shutter release. Third, depending on the type of gloves you select (even a thin second pair under your insulated mittens) you are able to operate the remote release without removing your gloves, thereby keeping your hands warm—a critical consideration in sub-zero arctic temperatures.

Memory cards: Pack extra memory cards, formatted before going outside. Backup and clear your memory cards prior to your next outing. A damaged card or card read/write failure could destroy images taken previously if they remained on the card. Be safe and protect your memorable images.

Spare batteries: Photographing in cold temperatures drains batteries very quickly; photographing in arctic temperatures drains batteries exponentially faster. Always pack extra batteries. I bring eight batteries with me on any high arctic photo trip I take. I went through six fully charged batteries in one evening, photographing in temperatures of –40 degrees Fahrenheit. Running out of fully charged batteries, when the aurora is in full display, is heartbreaking, especially when proper preparation would have prevented this.

While in the field, be sure to keep all extra batteries in an interior pocket of your jacket, close to your body. Trapped body heat, created by your insulated jacket and multiple layers of clothing, will help keep the batteries reasonably warm, holding the charge longer.

Airtight, waterproof, drybag: Tough, waterproof and airtight, a drybag is essential in protecting your camera's sensitive internal optics and circuitry from moisture and condensation buildup that occurs due to the large change in temperature when you bring your camera inside after a long evening photographing outside in sub-zero temperatures. Lens fogging and damage to your camera itself may occur if you don't let your camera acclimatize gradually to the warm indoor temperatures.

Prior to going inside for the evening, slip your camera into the drybag, roll and seal it tightly, and then bring the bag and your camera inside. While there is no official rule as to length of time your camera should remain in the drybag, I typically let my camera remain in the drybag for two to four hours, plenty of time to acclimatize to the much warmer indoor temperature.

If you really, really have to see your images immediately and can't wait a couple of hours,

safely remove the memory card while you are still outside, prior to sealing your camera in the drybag. It is strongly recommended that should you decide to remove the memory card before sealing your camera in the drybag, to do so in a well-lit area where you won't accidently drop the memory card into the snow, not to be found again until spring, if ever.

I also include several small bags of moisture-absorbing silica gel dry-packs in the drybag prior to sealing it. These silica bags may be purchased in many sizes and provide an ideal second level of protection for your camera. The silica protects against mildew, corrosion, fogging, and condensation, which might damage your camera's sensitive electronics.

Taking that Memorable Picture

As if simply watching Aurora's amazing display isn't reward enough for hours if not multiple days of travel, standing outside in sub-zero weather, dressed in multiple layers of clothing, encased in synthetic down from head to toe, many aurora hunters desire to capture the moment in a photo, creating a lasting memory.

While the mechanics of taking a good picture of the aurora are not complex, there are a few guidelines that will enhance your success and the probability of taking a memorable picture.

Always shoot in raw format—this will provide you with the maximum amount of digital information needed to create a final image.

If you use a protective UV filter on your lens (and you should), remove it prior to going out to photograph the aurora. The UV filter could cause concentric rings to appear in your final image.

Set your camera to manual and turn off the camera's flash.

As previously stated, dial the lens focus ring to infinity and back off slightly.

Turn off any auto-focus capabilities associated with your lens. You don't want the auto focus feature of your lens attempting to continually re-focus on the quickly moving, shifting aurora.

Kvaløya ("Whale Island"), Norway
Nikon D300, Tokina 11–16 mm lens, f/2.8, ISO 1000, 13 sec.

Open up the lens aperture as wide as possible. You need to get a lot of light to the camera's sensor, so shoot wide open. This will be when the f-number is as low as possible, that is, f/2.8 or lower for many professional lenses, or f/3.5 or f/4 for many consumer zoom lenses.

Set shutter speed to "bulb." This allows you to use the remote shutter release to keep the shutter open for longer exposures.

Finding the correct amount of time to hold the shutter open will take some experimenting. With your shutter speed set to bulb, depress the remote shutter release opening the shutter. Hold the shutter open between three and twelve seconds. Check your image using your camera's live view function, if it's so equipped. Too long of an exposure will tend to blur both the aurora and the stars as they move across the sky.

Your camera's ISO setting should be set between 100 and 400. The ISO number indicates how quickly a camera's sensor absorbs light. The higher the ISO number, the faster the camera sensor absorbs light. The faster your lens and the longer your shutter speed, the lower your ISO can be, and vice versa.

Increasing the ISO setting is typically done when photographing in low light. Local weather conditions, the presence of ambient and natural moonlight and starlight, and the intensity of the aurora display itself should be your guide to setting an initial ISO value. You may need to modify this ISO setting as conditions change throughout the evening.The higher your ISO setting (for example, 800, 1600, and above) the more noise (similar to grain found in film photographs) you invite into your image. While higher-end (more expensive) "prosumer" DSLR cameras can produce sharp, acceptable images at ISO settings of 3200 and higher, the average hand-held, point-and-shoot camera cannot. To achieve sharp aurora images in low light and long exposures and to keep your camera as still as possible, use a sturdy tripod. If you don't have a tripod, you can use a beanbag, flat rock, or other solid surface. Do not touch the camera until it is done exposing, and shield it from the wind if you can.

Auroras, by their very nature, look best when photographed to include a contrasting foreground. The foreground provides scale, context, and perspective. A suitable foreground can be a tree, a building, a fellow photographer, a car, or even just the horizon.

Good Night, Lady Aurora

Being present during Aurora's magical dance fills the observer with wonder, awe, and excitement, and the experience often leaves one speechless. Capturing Aurora's dance in a photograph preserves that moment for a lifetime. I hope that you may be fortunate enough to be at the right place, during the right months, at the right time, to observe Aurora's magical dance.

Getting to the dance is not easy for most of us, but, once there, none of the logistics, long flights, cost, or cold makes a difference. You are witness to the most spectacular light show orchestrated by nature.

The next time you gaze into the night sky, be assured that Aurora is there, dancing the night away. She is waiting for you to join her.

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Footnotes

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