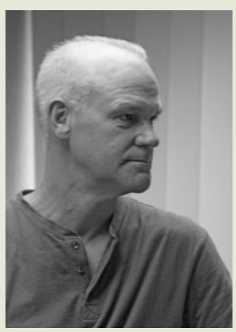
Rochester Skies

A publication of the Rochester Astronomy Club

A Quarterly Newsletter Issue #12 4th Quarter 2009

From the President



Randy Hemann
President of the RAC

It's coming up on that time of the year. Now is a great time to get out and observe. The sun is setting earlier so the nights are lasting longer. The air is chilling and the mosquitoes are dropping like flies. Ha! With the autumnal equinox (*equal night*) our planet tips the other way, providing us a fresh set of eyepiece treats. The Swan is hanging on but soon it will dip its beak into the southwest and fade. Pegasus is now high in the sky. It politely pulls Andromeda to an optimal height for any scope or binoc to gather photons from its famous trio of galaxies. Now is the best time of the year for me to try to seek out the faint structure of Stephan's Quintet and appreciate the rich color of the Blue Snowball. And don't forget M15 off the "hook" of Pegasus; it is one of the best globulars around!

I always tag Capella in Auriga as the official harbinger of the winter constellations. If one stays up late enough you will see it ahead of Gemini and Orion as they rise above the eastern horizon in a virtual tie. Before dawn arrives, the two of them are sitting comfortably up in the sky. But in the evenings now, it's a good time to poke around Cepheus or see if you can show a non-astronomer something in Camelopardalis – if for no other reason than it's just a cool word to say. So get out and enjoy the night sky – it's *primetime*!

- Randy Hemann

Rochester Astronomy Club

Winter - an Observer's Greatest Challenge

"Reach me down my Tycho Brahe, I
would know him when we meet,
When I share my later science,
sitting humbly at his feet,
He may know the law of all things,
yet be ignorant of how
We are working to completion,
working on from then to now."

-From the poem; An Old Astronomer to His Pupil, by Sarah Williams

To work to completion is a phrase whose true meaning only comes with time. My journey in astronomy has lead me on a quest to become a Master Observer, a journey now a bit over halfway done, but to complete that journey, an amateur astronomer has to face astronomy's toughest season, winter.

Winter conjures up all sorts of images; the first snowfall, rosy-cheeked kids with snowballs and sleds, snowmen and Christmas, snowshovels and ice scrapers, waist-high drifts and howling wind, and winter nights. Winter nights are the best and cruelest of all, filled with the most brilliant, beautiful stars in the heavens and blessed with the longest hours of darkness, perfect for astronomy.

Perfect - if ice water flowed through your veins. The hard truth of the matter is that once the Sun goes down, whatever warmth there was to the day disappears and the temperatures

Dean Johnson, warm in cold weather

usually drop another 20 degrees or more. Winter is just brutally cold, and I know a lot of astronomers that put their telescopes away for the season and wait for warmer weather.

I can't - at least not at this stage in my life. Last winter during the Astronomical Winter of Discontent, I only got out once between November 16th and January 27th. It was awful and I swore that I would find a way to get out more often and stay comfortable doing it this time around.

I work outside in the wintertime doing forestry, so I'm no stranger to cold, but there's a world of difference between running a chainsaw and moving constantly as opposed to standing still at the eyepiece collecting photons from objects thousands to millions of light years away. I had to find a way to stay really warm while standing perfectly still.

Luckily for me, I had a pretty good idea of what to get. I buy most of my work clothes from J&R Military Surplus in DeSoto, Wisconsin, and when you go buy something from Jack and Rita, you've got to shoot the breeze with them. They go to military consignment auctions all over the United States and gather in some really unusual stuff.

I saw what I needed in the fall of 2007: a United States Air Force parka, the kind the airmen wear up in Alaska or on the Great Plains of North Dakota. At first I thought $80 was spendy, but after suffering through some previous winter nights with layers of insulated shirts and a fall/spring lined jacket, that much money didn't seem so outrageous anymore. I bought that parka last October and knew it was worth every penny the first time I wore it.

Nights with temperatures down to 20°F are so manageable that I usually leave the zipper part-to-most of the way down. On nights down to 0°F I wear a hooded insulated shirt underneath and leave the parka hood off when I observe, leave the shirt hood up at the eyepiece and pull the parka hood up when I'm journaling or checking a star chart. On the really cold nights down to -10°F, my lovely wife Betty got me a pullover wool hood for my head and neck, and that keeps my neck and ears warm when I have to pull my hood back to observe.

Good boots are an absolute must to have and I've got some dandies: LaCrosse insulated boots with 1300 grams of insulation. My good buddy Dugan Oakes used them for ice fishing, and sold me his not-very-used old pair when he wanted to get another set. With those boots, wool socks, long underwear, a t-shirt, insulated shirt, insulated bib overalls, my parka, wool pullover hood and astronomy cap with red light, I'm an astronomy winter warrior.

The last piece of the puzzle is the hands, but I've found that if I use those chemical heat pads which cost about a buck a time, I can get by with just a pair of thin cotton gloves. This is crucial because you have to have your fingers nimble enough to turn knobs and switch eyepieces and/or filters.

With all these clothes, and all your astronomy gear, you might be thinking, "Wow, that's a lot of stuff." And you are perfectly right, which brings us to the next point of winter observing—**Nothing Is Done Very Fast**. It takes time to get dressed, packed up, longer to get to your observing spot if the roads are icy, more time to get all set up and start observing. You also want to be real careful with your stuff, especially the small items like eyepiece caps, screws and even pens and pencils, because if you drop them in the snow, you might not get them back.

I've even lost a footpad to my Orion SkyView Pro Mount once. I think that got frozen off the tripod leg into the gravel somewhere when the temperatures turned the gravel-sand-winter ice mixture to the kind of icy slurry they think exists on Titan. Now I've got to be very careful not to insert the extension all the way into the upper part of the tripod leg. That happened once this winter and I forgot to fix it at my house when it was warm, and as I was setting up I thought "How the heck am I going to get that out of there?" Tried as I might, it was frozen in. I didn't relish the thought of my 53 year old knees kneeling on the ground with a short tripod all night. But like they teach you in the Marine Corps, "Adapt and Overcome". I had a thermos of coffee with me and simply poured some down the frozen leg, waited until the end dried off enough to grip and pulled the extension out of there. That was a shining moment for winter astronomy.

There are a lot of those moments on winter nights, but you don't make them, you enjoy them. To stand under the winter stars so bright and look at all those beautiful shining constellations is an absolute joy. And as wonderful as that is, it's even better when you're warm. Auriga, Taurus, Gemini, Canis Minor, Canis Major and Orion all overhead with stars so bright they light up the snow. Along with Leo the Lion, Arcturus and the Big Dipper rising in the east, it is so spellbinding that you often find yourself just staring at the heavens.

But like the Old Astronomer to His Pupil, I am working to complete my goals, and one of them is to complete the Herschel 400 this year. I have completed the Fall Group and most of the Summer Group. I had a few from both the Winter and Spring lists, but knew that if I was going to get the Winter Group done this year, I'd have to get out there a lot this winter.

From going back through my journals, depending on the Moon phase, I was getting anywhere from 1 to 9 Herschel 400 objects each time I went out, and the numbers 4 and 6 came up quite often. I set five as my average and hoped to get out eight times to wrap up the Herschel 400 Winter Group.

I did better than I expected. From November 1st to March 19th, I got out 16 times. Not all were efforts at the Herschel 400. Other treats beckoned to me in the night sky. I watched Venus as it went from gibbous phase to half, and then to a marvelously expanding cresent in the low western sky in late March. I watched as the Dwarf Planet Ceres cruised past the beautiful double star 54 Leonis in February and March. Saturn displayed ever thinning rings and its beautiful array of moons and I followed Comet Lulin as it made its way quickly from Virgo to Gemini.

I also accomplished my Herschel 400 goal by getting 9 objects on the night of March 19th. I finished the Winter Group on the last night of winter. Now the temperatures are getting much more manageable. I feel like I have a real shot at finishing the Hershel 400 this year. I'm also leaving my parka in the back of my van for the occasional cold spring and summer night.

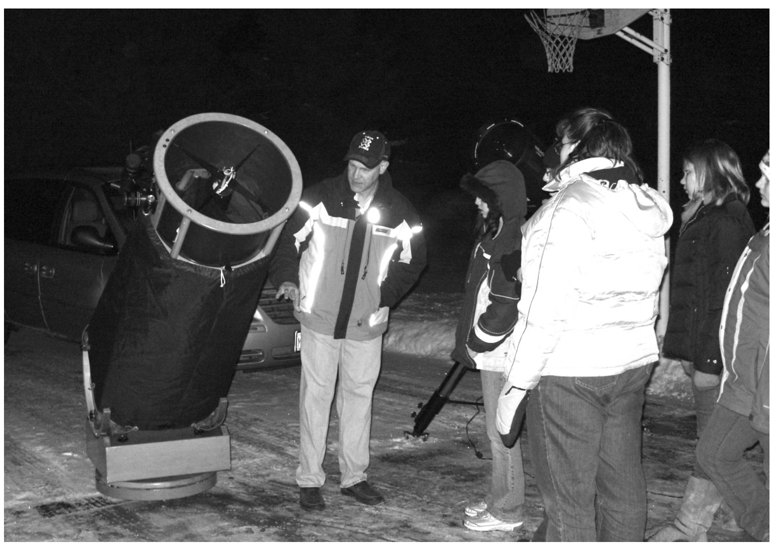
I've gotten strange looks from people when I tell them "I'm going stargazing" and the mercury is hovering near zero, and have heard the words "You're crazy to go out in this weather", but I just recall a few lines from The Old Astronomer to His Pupil:

"But my pupil, as my pupil you
have learned the worth of scorn,
You have laughed with me at pity,
We have joyed to be forlorn,
Though my soul may set in darkness,
it will rise in perfect light,
I have loved the stars too fondly to
be fearful of the night."

- Dean Johnson

January Girl Scout Outreach

One takes a chance trying to have an outdoor activity scheduled in January. That was put to the test when I was asked by a co-worker to hold an astronomy outreach for local Girl Scout troop #40025 earlier this year. Still reeling from the previous week's -20°F degree temperatures, it reduced the troop's size down to just four girls and two parents to attend our get together. However, this pared the group down to a wonderful size allowing everyone - scouts and parents - to participate in the outreach and get a good long look through a telescope.



Armed with materials sent to our club from the Night Sky Network, I decided to get down to the business of solar system scaling. The NSN has a simple yet clever way of demonstrating the incredible difference between the orbits of the inner versus outer planets by having each girl construct their own "pocket solar systems". The rest of the evening's activities pertained to planets and orbit sizes based on a picture of a 1 meter sun supplied by the kit. True-to-scale planet diameters were shown in a handout, and the kit contained supplies for the planet models that we built. But building a solar system takes a lot of energy, so we decided that before we continued with our project outside in the cold dark night, it was time to take a break and chow down some pizza and Girl Scout Cookies! Yum!

Now timing is everything, and that evening I knew I had a visible International Space Station pass at 6:42 pm. I thought it would be a good idea to use the ISS speed of approximately 17,000 mph to get a better feel for the enormity of space. That time was approaching fast, but the girls were jabbering and eating slow. So with the help of the parents, we had them scarf down the last slices of pizza, bundled them up, and herded them outside, pronto. Fortunately, I was able to get them out just soon enough to watch the space station zoom across the top of the Big Dipper, and on my cue, disappear just before approaching the bowl of the Little Dipper. My, did I look like a wizard! (Thank you, Heaven's Above's website!). So then I hung the canvas with our 1 meter sun in the garage and we all paced off the scaled distance to Mercury – end of my driveway, Venus – midway into my neighbor's yard, and Earth – just at my neighbor's garage door, 120 yards away. From there, looking back into my garage, our 1 meter sun looked the same size as the real sun.

I had them all scurry back to look through the telescopes. "Elvis", our donated catadioptric, was locked on Venus, and my dobsonian was hitched on the Orion nebula. Sporting its quarter moon appearance in the eye-piece, Venus was then approximately 160 million miles away from us. If neither Earth nor Venus was moving, it would take about a year to get there at 17,000 mph. The Orion nebula is 1500 light years away. A space craft puttering along with the velocity of our speedy ISS would take over 60 million years to get there!

Finally as fingers and toes were numbing, they gathered up their projects and stuffed themselves back into warmed up minivans. As they headed back into town, their last assignment was to use the NSN handouts and check off the remaining planets distances from my 1 meter sun on their odometers. That evening we all experienced how cold space is! I hoped they appreciated how ***big*** space is!

- Randy Hemann

The Sun Fast Factor

Have you ever wondered why the earliest and latest sunrises and sunsets don't occur on the solstice days, or why we sometimes gain or lose daylight unequally between morning and evening? It is due to sun fast variations.

To simplify things here, we can suppose that the clock is not altered during the year. That is, we can ignore the factor of Daylight Savings Time, because Daylight Savings Time is really just an unnatural alteration of the clock. It's done just to make it **seem** as though all celestial events happen one hour later than they otherwise would have. It has no effect on the natural flow of time or on Earth's rotation and orbit. I'm not saying that DST is a bad thing. I just think it's simpler to set that factor aside here.

The speed of Earth's rotation is by far the greatest factor in deter-mining the length of a solar day. However, there is another factor that has an effect on the exact length of a solar day: the speed of Earth's orbit around the sun. If Earth's orbit weren't a factor, a solar day would be about 23 hours and 56 minutes, because that's how long it takes the Earth to rotate one full turn relative to the background of stars. Since Earth's orbit is a factor, the **average** solar day is 24 hours. Note: a solar day is the amount of time it takes Earth to make one complete rotation, relative to the sun. Due to the slight eccentricity of Earth's orbit, Earth orbits the sun slightly faster at some times than at others. Thus, when the speed of Earth's orbit changes, the solar-day length changes slightly.

Back when sundials were used to indicate time, their readings moved slightly faster at some times of the year than at others. In order for modern clocks to work exactly like sundials, they would need to run slightly faster at some times of the year than at others. Designing modern clocks to vary in speed throughout the year just so they could always be exactly in sync with sundials would be foolish. Not only would the clocks be harder to make, but life in general would be more complicated with a variable-speed clock. Imagine how hard it would be to accurately measure time, especially when precision is critical.

It was much simpler for our civilization to do just what it did -- design a constant-speed clock and let it deviate a bit from sundial readings. The 24-hour period, which many people see as simply the length of a solar day, is actually just the average among all the real solar-day lengths through the year. Some solar days are a tad longer, and some are a tad shorter.

The **meridian**, in this context, is an imaginary vertical line that runs from the due-south point on the horizon (for locations north of the Tropic of Cancer), to the zenith. Generally, the sun is at its highest point for the day when crossing the meridian at the time halfway between sunrise and sunset.

S**un fast** is basically the deviation between modern-clock time and sundial time. For a given location, sun fast values (usually measured in modern-clock minutes) have a range of about 31 minutes through the year, between the lowest value in the second week of February to the highest value in the first week on November). The highest value corresponds to the earliest clock time that the sun crosses the meridian, and the lowest corresponds to the latest such time. The sun fast actually has 2 high points and 2 low points each year. The other high point occurs near the middle of May, and the other low point occurs in late July. However, the high point in May is not as high as that in November, and the low point in late July is not as low as that in February.

S**un's declination** is how far the sun is north or south of the celestial equator. As Earth orbits the sun, this is what changes due to the tilt of Earth's axis, and this is also what causes the seasons to change. Unlike the sun fast factor, this factor has no effect on the time that the sun crosses the meridian.

When somebody has a hard time understanding why we don't simply get the year's earliest sunrise and latest sunset on the summer solstice (and vice-versa on the winter solstice), much of this may be due to the **assumption** of the sun's declination be-ing the only factor that affects the sunrise and sunset times. In reality, it's not the only factor. The sun fast is the other factor. That factor also explains why, between the 2 solstices, we sometimes gain or lose more daylight in the evening than in the morning, and vice-versa.

I think it's worthwhile to focus on the sun fast factor in isolation before digging deeper into detail and discussing how its effect is combined with the sun-declination factor. Consider a place where the sun-declination factor has no effect on the sunrise and sunset times -- the equator, where day and night are basically the same length all year round, regardless of the sun's declination. However, that does not mean that the sun rises and sets at the same time on each day of the year. Due to the changing sun-fast factor, it doesn't. Unlike the sun-declination factor, the sun fast factor affects the sunrise and sunset times on the equator just as it does for just about any place else in the world. It's just that, on the equator, it is the only factor, and thus its effects are pure. Day and night are still basically the same length all year round because earlier sunrises just mean earlier sunsets, and later sunrises mean later sunsets. To be more precise, however, one could say that day and night are **both** a tiny bit longer on the longest solar day than on the shortest. On the equator, the sun rises and sets about 1/2 hour earlier when the sun fast is at its maximum in early November than it does when it's at its minimum in the second week of February.

Before getting much farther into detail, it's important to be aware that the sun declination changes, back and forth, in a manner similar to that of a **sine wave**, **not** like that of a triangle zigzag graph line. That is, not only does it change throughout the year, but its rate of change itself also changes. It changes at the fastest rate while crossing its midpoint values (at the equinoxes) and changes the slowest when around its turn-around points (the highest and lowest points, the solstices). The closer it gets to the nearest solstice, the slower its rate of change gets. That rate of change approaches zero at the solstice and then increases again afterwards (but in the opposite direction). The sun fast factor also changes in a manner somewhat similar to that of a sine wave, but it is more erratic because of there being two unequal high and low points during the year. It's worthwhile to mention that the sun's declination and the sun fast do **not** have their "peaks" and "valleys" at the same time as each other. On some Earth globes a diagram is shown to represent both the sun fast and the sun-declination values, for various times of the year. The diagram is shaped like a "figure 8" and is called an *analemma*.

In places away from the equator, both factors (sun declination and sun fast) play a role in determining the sunrise and sunset times for a given day of the year. In mid-latitude places like Minnesota, the sun's declination is the dominating factor - most of the time. However, around the solstices, there are a few weeks when the sun fast factor dominates. This is because the sun-declination's rate of change is very slow at those times.

In December, around our winter solstice, it just so happens that, just as the sun-declination's rate of change is very slow, the sun fast's rate of change is quite close to it's maximum speed (because it's around its midpoint value). The sun fast decreases at a rate of about 30 seconds per day. This means that the sun crosses the meridian about 30 seconds later each day around that time of year.

Now it's time to focus on a sequential description of what happens around a solstice, with the combined effect of the changing sun-declination and sun-fast factors, along with the sun-declination's changing **rate of change**. This should help clarify the answer to the central question that this article addresses.

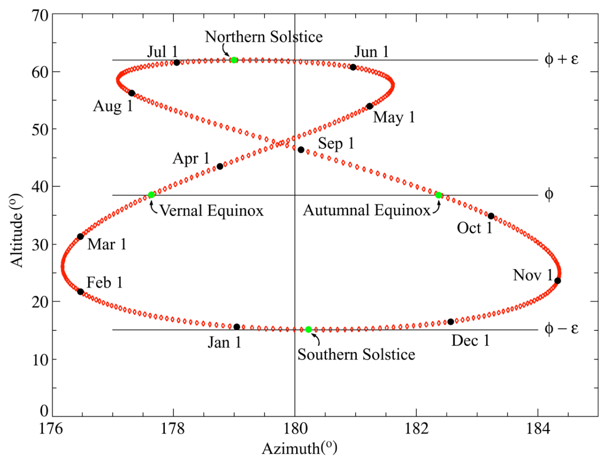
Let's focus on the month of December (and early January) for a mid-latitude place like Minnesota.

At the beginning of December, the sun-declination's rate of change (southerly movement) still has a greater effect on the sunrise and sunset times than the sun fast factor does. Thus, the sun is still rising later and setting earlier each day. However, because the solstice is nearing, the sun-declination's southerly movement is getting slower each day. Yet, at the same time, the sun fast's rate of decrease is **not** slowing down. In fact, it's getting a bit faster.

During the second week of December, the sun-declination's southerly movement has slowed down to the point to where it has less effect on sun-rise and sunset times than the changing sun-fast factor does. Thus, the decreasing sun-fast has temporarily be-come the dominating factor in deter-mining such times. This is the point at which the year's earliest sunset occurs.

By mid-December, the sun starts setting later again each day (once again, because the sun-declination's southerly movement has gotten so slow that it has less effect on the sunrise and sunset times than the decreasing sun-fast factor does. However, the days are still getting shorter, because the rate at which the sun **rises** later each morning outweighs the rate at which the sun **sets** later each day.

At the moment of the solstice, the sun-declination's southerly movement has come to a complete stop. Just after the solstice, the sun's declination starts moving northward again. How-ever, the northerly movement is very slow just after the solstice, just as the southerly movement was very slow just before the solstice. The sun fast continues to decrease and won't turn around until February.



For the first ten days or so after the solstice, the sun continues to rise later each morning because the sun-declination's northerly movement is still so slow that it has less effect on the sunrise/sunset times than the decreasing sun-fast factor does. However, the days have already started to lengthen again, because the rate at which the sun **sets** later each day has started to outweigh the rate at which the sun **rises** later each morning.

As we get farther past the winter solstice, the sun-declination's rate of change (now in the northerly direction) is increasing again. Right around New Year's, the sun-declination's northerly movement has become fast enough to once again have a greater effect on the sunrise/sunset times than the changing (decreasing) sun-fast factor does. Shortly after New Year's, each day is getting both an earlier sunrise and a later sunset. Things have returned to normal. That is, the changing sun-declination is once again the dominating factor affecting the sunrise and sunset times, like it usually is.

Throughout January, the sun fast continues to decrease. As a result, by the end of January, we have gained more evening daylight than morning daylight.

Here is a general run-down of what happens during the rest of the year:

During the second week of February, as stated before, the sun fast reaches its "major valley" -- its lowest point of the year. It gradually increases after that. In a manner similar to that of the sun's declination, the sun fast changes at the slowest rate when it's around its turn-around points.

During March and April, the sun fast is increasing. Thus, during that period, we gain more morning daylight than we do evening daylight. However, due to the switch to Daylight Savings Time, it **seems** like we still gain more daylight in the evening than in the morning. But, as stated before, this is just an illusion caused by the unnatural alteration of the clock. March shows a dramatic rate of progressively earlier sunrises. During that month, not only is the sun declination's northerly movement around its maximum speed, but the sun fast's rate of increase is not far from its maximum speed, either. With these two factors combined, the sun rises around a whopping two minutes earlier each morning during March in the mid-northern latitudes. Another way to describe what is happening is that the increasing sun fast adds to the effects that the sun declination's northerly movement has on the progressive sunrises, while subtracting from such effects on the progressive sunsets.

In May, shortly before mid-month, the sun fast reaches a peak, but this peak is not as high as the one in November. The sun fast then gradually starts to decrease again.

In June, as with December, there is a period where the changing sun-fast factor temporarily dominates over the changing sun-declination factor (in determining the sunrise/sunset times). This is because the sun-declination's rate of change is very slow around the June solstice as well as around the December solstice. However, that period is a bit shorter than the one in December. That is because there is less of a swing in sun fast values ***from*** the "minor peak" in May to the "minor valley" in late July than there is from the "major peak" in November to the "major valley" in

February. Another noteworthy fact is that, because the sun fast has two peaks and valleys during the year, the sun fast is changing in the same direction (decreasing) on the summer solstice as it is on the winter solstice. The earliest sunrise occurs roughly a week before the summer solstice and the latest sunset occurs about a week after it. The longest daylight period happens **on** the solstice. The details behind this are basically the same as those for December. It's just that the sun declination's position and movements are reversed.

In late July, the sun fast reaches another low, but this low is not as low as the one in February. The sun fast then gradually increases again.

The sun fast in on the increase throughout August, September, and October. This causes the days to shorten more on the evening side than on the morning side. September shows a dramatic rate of progressively earlier sunsets. During that month, not only is the sun declination's southerly movement around its maximum speed, but the sun fast's rate of increase is not far from its maximum speed, either. With these two factors combined, the sun sets around two minutes earlier each evening during September in the mid-northern latitudes. Another way to describe what is happening is that the increasing sun fast adds to the effects that the sun declination's southerly movement has on the progressive sun-sets, while subtracting from such effects on the progressive sunrises.

Although the sun declination's movement is obviously in the opposite direction in September as it is in March, the sun fast changes in the same direction (increasing) during both times. This is another result of the fact that the sun fast has two highs and two lows during the year.

In early November, the sun fast hits its "major peak" -- its highest point of the year. It gradually decreases after that. By the beginning of December, we return to the point for which this discussion began.

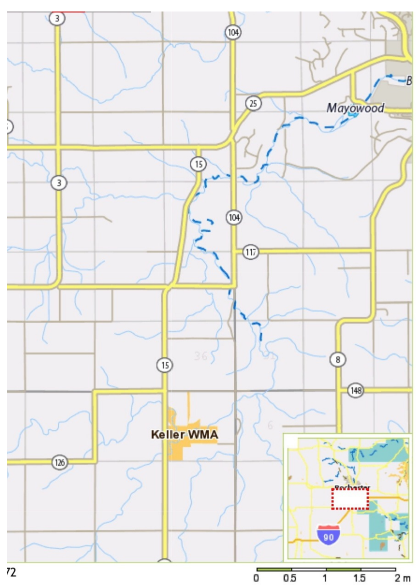
- Daniel K. Stuntz

Keller WMA

Have you been wishing there was a dark sky site close to Rochester that was easily accessible for you to observe the night sky? Well, wish no more. Presenting the Keller Wildlife Management Area (WMA).

What is a WMA? According to the Minnesota DNR website, "they are part of Minnesota's outdoor recreation system. They are established to protect those lands and waters that have a high potential for wildlife production, public hunting, trapping, fishing, and other compatible recreational uses." Turns out, besides the above, some aren't too bad for astronomy viewing as well. I talked to a WMA administrator last year. You cannot camp overnight at a WMA. He said that we could use the parking lot for observing as long as the groups didn't get too large and loud.

Keller WMA has a nice solid parking lot. There are some 8-10' tall pine trees surrounding the lot, mainly to the east and south, but they don't interfere too much. To the east and northeast is Rochester. There is a light dome in those directions. Across the road and a short distance to the south is a farm. It does have a yard light that is on all the time. When you set up, move toward the south end and you can strategically put some of those trees



between you and the light.

To get to Keller WMA, from Highway 52, take County 22 (West Circle Drive) to County 25 (Salem Road). Go about 3.5 miles to County 15 (Garten Marketplatz sign) and turn left/south onto County 15. You then travel about 4.1 miles south. The parking lot is on the top of the first hill after the intersection with County 126. There are no lights or signs for Keller. You may want to check it out in the day time just to be able to find it at night. For me, Keller is only 8 miles from the front door, another reason why I go there.

Okay, okay, Keller is not a dark site on par with Eagle Bluff. It is only a few miles out of town and there is some light glow from Rochester to the northeast and the airport is to the east. It is still pretty good. We have been able to pick up the Perseus Double cluster and the Beehive naked eye. The views to the south with Orion and Sirius have been simply outstanding this winter.

So what are you waiting for? Check out Keller WMA with us. If we are heading out, we will post to the "Observing tonight?" discussion in the RochesterSkies.org forums. On a dark night, check out the latest posts and see if we are there. Head on over and enjoy the view. Bring your own scopes and binoculars or look through ours. I don't think you will be disappointed. See you there!

- Jeff Newland

Rochester Skies

Upcoming Events

October 9	-	LCROSS Mission Impact ~ 6:30AM
October 13	-	Monthly Meeting @ RCTC, Roberta Humphreys
October 16/17	-	Dark Sky Weekend at Eagle Bluff *
November 10	-	Monthly Meeting @ RCTC, 2009 Solar Eclipse Presentation
November 13/14	-	Dark Sky Weekend at Eagle Bluff*
December 8	-	Holiday Party

* Events subject to change due to weather. Check Rochesterskies.org for updates

Rochester Astronomy Club
P.O. Box 513
Rochester, MN 55903-0513