

# Saskatoon Skies

The Newsletter of the Saskatoon Centre of the Royal Astronomical Society of Canada

Vol. 49, No. 5

May 2018



*Image of aurora and observers from Tim Yaworski out at the Observer's Group at Sleaford on May 5.*



## Saskatoon Centre

The Royal Astronomical Society of Canada  
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To view *Saskatoon Skies* digitally,  
see our website:  
<http://www.usask.ca/rasc/newsletters.html>

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# MEMBERSHIP? JOIN TODAY!

**Regular: \$85.00 /year**

**Youth: \$45.00 /year**

**Family: \$80/year**

The Saskatoon Centre operates on a one-year revolving membership. You will be a member for the next 12 months no matter when in the year you join. Members are encouraged to renew early to avoid disruption in publications. Renew through the National Office at <http://www.rasc.ca/join-us>

## Benefits of Membership in the Saskatoon Centre

- knowledgeable & friendly amateur astronomers
- use of the Sleaford Observatory
- use of the U of S Observatory (after training)
- Saskatoon Skies Newsletter
- Observer's Handbook
- Journal of the RASC (electronic format)
- SkyNews Magazine (bimonthly)
- borrow the Centre's Data Projector to give astronomy outreach presentations – contact Les Dickson at [astrochem@sasktel.net](mailto:astrochem@sasktel.net)
- rent the Centre's Telescopes  
<https://www.usask.ca/rasc/telescopes.html>
- discounts to Sky & Telescope Magazine\*
- use of the Centre library

## U OF S OBSERVATORY

The U of S Observatory is open to the general public every Saturday of the year. Admission is free. The observatory is located on campus, one block north of the Wiggins Avenue and College Drive entrance. On clear nights, visitors may look through the vintage 6-inch and tour several displays. Current events are recorded on the Astronomy Information Line at 306-966-6429.

### Observatory Hours:

January – February	7:30 – 9:30 pm
March	8:00 – 10:30 pm
April – August	9:15 – 11:45 pm
September	8:30 – 11:00 pm
October – December	7:00 – 9:30 pm

## SASKATOON CENTRE'S MAIN OFFICERS:

**President** – Alan Duffy

**Vice-President** – **To be Filled**

**Secretary** – Marcel Müller-Goldkuhle

**Treasurer** – Norma Jensen

**National Council Rep** – Rob Shepard

Bottle Drive &  
Canadian Tire \$  
By Les Dickson

If you cannot attend a meeting but would like to donate your Canadian Tire money please email me at [astrochem@sasktel.net](mailto:astrochem@sasktel.net)

**Newsletter Editor** – Kris Ohnander

**Copy & Collate** – Les & Ellen Dickson

**Labels & Temps** – Mark de Jong

**Web Posting** – Gord Sarty

Saskatoon Skies is published monthly by the Saskatoon Centre of the RASC. Distribution is approximately 100 copies per issue. Saskatoon Skies welcomes unsolicited articles, sketches, photographs, cartoons, and other astronomy or space science material. Submissions should be sent by e-mail to the editor at [krisohn@gmail.com](mailto:krisohn@gmail.com) in msword or text format. Images: any format, less than 30MB, sent by e-mail as attached files. **Deadline for submission of all articles for an upcoming issue is the first Friday of the month!**

A separate by-mail subscription to Saskatoon Skies is available for \$15.00 per year. Saskatoon Skies is also posted on our Saskatoon Centre homepage as a .pdf file and can be downloaded free-of-charge. Members may choose to receive the newsletter by regular mail or via the Internet. Articles may be reprinted from Saskatoon Skies without expressed permission (unless otherwise indicated), provided that proper source credit is given. Saskatoon Skies accepts commercial advertising. Please email the editor at [krisohn@gmail.com](mailto:krisohn@gmail.com) for rates. Members can advertise non-commercial items free of charge.

LIGHT POLLUTION  
ABALEMENT  
WEBSITE AT:  
[www.ras.sk.ca/lpc/lpc.htm](http://www.ras.sk.ca/lpc/lpc.htm)

## RASC CALENDAR OF EVENTS

<b>May 14</b>	<b>Dr. Fran Bagenal Talk</b>	Rick Huziak
<b>June 16</b>	<b>Observers Group at Sleaford</b>	Larry Scott
<b>June 18</b>	<b>RASC General Meeting</b>	Alan Duffy
<b>July 14</b>	<b>Observers Group at Sleaford</b>	Larry Scott
<b>August 8 – 13</b>	<b>Saskatchewan Summer Star Party</b>	Les Dickson
<b>September 8</b>	<b>Observers Group at Sleaford</b>	Larry Scott

For a complete list of club events, please visit: <http://www.usask.ca/rasc/activities.html>

## May RASC General Meeting – Cancelled!

Please note that Dr. Bagenal's visit and talk will take the place of our regular Monday meeting. There will be no Executive or Regular meeting. At the time of newsletter publication, we are not completely firm on the schedule but this is what is proposed.

If things change, we will let you know.

**Sunday, May 13, 6:30 pm** - Supper with the RASC club members - Saskatoon Inn – please indicate your intent to attend with us to <rickhuziak@shaw.ca>

**Monday, May 14, 3:30 pm** - Physics/Upper Atmosphere group seminar - Room 103 Physics Bldg, U of S. This higher level technical level seminar is open to anyone.

**Monday, May 14, 7:00 pm** - Meet and Greet in front of Room #103, Physics building.

**Monday, May 14, 7:30 pm** – Dr. Bagenal's Public Talk, Room #103, Physics building.

**Dr. Fran Bagenal's Public Talk:**

**7:30 pm, Monday, May 14, 2018**

**Room 103, Physics Building**

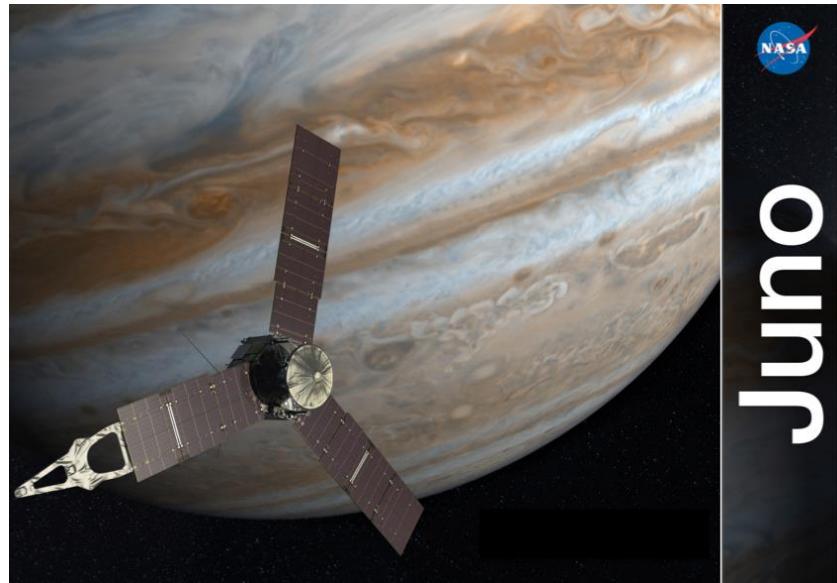
**University of Saskatchewan**

**Free Admission – Doors open at 7:00pm**

Abstract on Next Page

# NASA's Juno Mission to Jupiter: What's Inside the Giant Planet?

Juno's principal goal is to understand the origin and evolution of Jupiter. Underneath its dense cloud cover, Jupiter safeguards secrets to the fundamental processes and conditions that governed our solar system during its formation. As our primary example of a giant planet, Jupiter can also provide critical knowledge for understanding the planetary systems being discovered around other stars. With its suite of science instruments, Juno is investigating the interior structure, mapping Jupiter's intense magnetic field, measuring the distribution of water and ammonia in the deep atmosphere. JUNO is also the first spacecraft to fly over Jupiter's aurora and measuring both the energetic particles raining down on the planet and the bright "northern & southern lights" they excite. A huge bonus is the small public outreach camera that is taking fantastic images of Jupiter's beautiful clouds. The images – some science, some art – are processed and shared by the public around the world. NASA's JUNO mission was launched in August 2011 and has been in orbit over Jupiter's poles since 4<sup>th</sup> July 2016.



**Dr. Fran Bagenal** is a research scientist and professor at the University of Colorado, Boulder and is co-investigator and team leader of the plasma investigations on NASA's New Horizons mission to Pluto and the Juno mission to Jupiter. Her main area of expertise is the study of charged particles trapped in planetary magnetic fields and the interaction of plasmas with the atmospheres of planetary objects, particularly in the outer solar system. She edited the monograph *Jupiter: Planet, Satellites and Magnetosphere* (Cambridge University Press, 2004).

Born and raised in the UK, Dr. Bagenal received her bachelor degree in Physics and Geophysics from the University of Lancaster, England, and her doctorate degree in Earth and Planetary Sciences from MIT (Cambridge, Mass) in 1981. She spent five years as a postdoctoral researcher at Imperial College, London, before returning to the United States for research and faculty positions in Boulder, Colorado. She has participated in several of NASA's planetary exploration missions, including Voyager 1 and 2, Galileo, Deep Space 1, New Horizons and Juno.



**Dr. Fran Bagenal**  
Laboratory for Atmospheric and Space Physics  
University of Colorado, Boulder

*Presented by the U of S Department of Physics & Engineering Physics and the Royal Astronomical Society of Canada.*

# Minutes of the April Meetings – Marcel Müller-Goldkuhle



## Minutes of the Executive Meeting, April 16, 2018

**Attendees:** Alan Duffy, Les Dickson, Ellen Dickson, Darrel Chatfield, Mark de Jong, Rick Huziak, Errol Frazer-Harrison, Tenho Tuomi, Marcel Mueller-Goldkuhle

Meeting called to order by Alan Duffy at 7:06 PM

Approval of March 19 Executive Meeting Minutes: Moved by Les, seconded by Darrel, approved with all in favour.

### Reports:

- Treasurer: No update.
- Membership: 82 members, was 94 at the same time last year.
- National: Position is vacant as Rob stepped down.  
Rick to contact Chris Martin in these regards.
- Observers Group: Observers Group Meeting on April 7 was cancelled, two observers at Sleaford on Mon April 9, one on Sat April 14.
- SSSP: Next meeting on Thu April 19, 7:30-9:30PM.  
Website is open for registration and camp booking.  
Currently waiting for an answer from CASCA regarding speakers.
- Youth Club: Next meeting on April 23.  
Last meeting before summer break on May 28.
- Telescope Coord.: 2 retired telescopes are sold to Youth Club members.  
Mark de Jong donated a telescope to the club.  
Dome from Beaver Flat still needs to be picked up. Rick to contact Rob Sheppard about hauling/lifting equipment. Alan to coordinate. TBD what is happening with the dome, if no one can be found who's willing to buy it, it needs to be stored at Sleaford.
- Sleaford: Ideas how to upgrade Sleaford were discussed:  
All Sky Camera in combination with rural internet connection, so that Club members can check sky conditions from home.  
Roll off roof to be maintained for easier operation  
Astro Camera for LX200  
Eye Pieces  
Upgrade mount for 8"  
Extension of the deck so that telescopes can be set up on it  
Easy to use telescopes, like manual dobsons for visual observing  
It's planned to do a survey to find out who uses / is interested in using Sleaford and what would make it more attractive for Club members.
- Newsletter: No update.
- Events: International Astronomy Day on April 21, Solar Observing at Farmer's Market.  
Dark Skies at Beaver Creek is cancelled.

50th Anniversary: Photos and stories to be sent to Les, to be advertised in the newsletter.

Meeting adjourned at 7:58 PM

### **Minutes of the General Meeting, April 16, 2018**

Meeting called to order by Alan Duffy at 8:10 PM.

Stan Shadick and Yannis Pahatouroglo were honoured by the Club for the support they gave to the Club over the last decades.

An update was given about the Saskatchewan Summer Star Party (SSSP). The website is open for registration and camp booking. Rooms are blocked at the resort for the event, nevertheless they can't be held for a long time.

50th Anniversary: Members to send stories, photos, pictures etc. to Les Dickson.

#### **Presentations:**

Krista Trinder: Photography of the Night Sky, Aurora, and Steve.

Meeting adjourned at 9:20 PM

## **SSSP 2018 Update Report for May – *Les Dickson***

Our website and registration opened up about the 13th of April. Ninety-six campsites have been booked and nearly 60 people have registered so far. The number of campsites booked indicate that we can expect 200 people intending to come, about even with previous years at this time. We expect another 100 people to register by the end of the early registration period in early July.

Our Fr. Lucian Kemble Memorial Lecture presenter for this year is Dr. Michael Earl, post-doctoral fellow who recently joined the Department of Physics and Engineering Physics after receiving a Ph.D. in physics and space science from the Royal Military College of Canada in 2017. According to his website <[www.castor2.ca](http://www.castor2.ca)>, He "...is an experienced astronomer who has been tracking satellites with professional telescopes and CCD cameras for fifteen years. He has designed hardware and software specifically for optical space surveillance." His presentation is titled "Astronomy - An Exciting Introduction to Science". We look forward to hearing his presentation on Saturday afternoon.

Our other Saturday speaker was supposed to be James Edgar of Regina. James, who has served as President of the RASC and is the current Editor of the RASC Observers Handbook, is now unable to speak for medical reasons.

We are looking to find a replacement for James and to fill the open spot for an evening clinic presenter.

We are always looking for volunteers. Especially needed now is a Meadow's Coordinator. Rob Sheppard had to withdraw from this position for personal reasons. Let us know if you are interested in helping us out this year.

For more information, visit our website at <[sssp.saskatoon.rasc.ca](http://sssp.saskatoon.rasc.ca)>.

# Things in the Sky that Change: V392 Persei

— Rick Huziak

**Prelude to this series of articles:** Since Kris is chronically short of newsletter articles and I am chronically on everyone's back to observe things that do NOT change in the sky, such as Messier and the Finest NGC lists, I hope to write a series of articles about sky objects that change in some way. Some will change in short time periods (minutes or hours), other in days or weeks, and some over years. But they will change somehow. The idea of these articles is to observe something different, to use your imagination and sense of wonderment, and to observe in time other than just the new moon period. A great many observers don't take advantage of the sky is the moon is out, so that limits their observing to probably fewer than a dozen times a year, depending on enthusiasm or weather. But if you can observe things any night of the month, why don't you? Hopefully, this series of articles will help you decide of going outside on any clear night is worth your time.

## V392 Persei (Nova Persei 2018)

Well ... so I decide to write a series of articles on things in the sky that change, and had already completed the article on AG Draconis (that you now might read in the June issue [*Editor's Note: AG Draconis article will come in June*]), and what happens? A nova appears, just before I pushed the "send" button to Kris. So ... welcome to Nova Persei 2018 = V392 Draconis, or V392 Per for short.

The nova was discovered at 6.2 magnitude by Yuji Nakamura from Japan in an unfiltered CCD image taken April 29.474, 2018 Universal Time (UT). As a "transient object", it was given the temporary name TCP J04432130+4721280 but it was very soon realized that this was a super-outburst of an already known variable star, V392 Persei. All of a sudden, in about one day, V392 Per brightened about 10 magnitudes!

V392 Per was found on a survey a few decades ago, and was found to "flicker" between 16.9 and 14.1 magnitude - the signs of a close binary star – a red giant feeding gas down to a white dwarf with an accretion disk. At first it was classified as a potential Z Camelopardali (Z Cam) type cataclysmic variable (CV) using spectroscopy, but recently it was reclassified as a U Geminorum (U Gem) type CV, since it did not show small rapid eruptions seen in Z Cam stars. From very recent research by observer Patrick Wils, the star is now known to have had a "minor" eruption in 1999 to 13.1 magnitude for a few weeks, found by reviewing NSVS survey images, but other than that, not much is known about the star. So it is a huge surprise that the flickering star has now become a full-blown nova! This is unprecedented, and of great interest to astronomers, since no star had been identified as a precursor prior to its nova eruption! As a classical nova, it is expected to begin fading fairly quickly, but to remain fairly bright for weeks or months. However, the shape of the light curve cannot be predicted in advance with any great accuracy at time of this writing.

If you want to do visual estimates, I've created a set of standard AAVSO charts. You can get the charts by going to [www.aavso.org/vsp/](http://www.aavso.org/vsp/) and asking for any or all of these charts. (Don't put anything else into the form except the Chart ID.)

X22886DZ 15-degree binocular chart (N-up, W-right) to 9.0 mag – for general location.

X22893MY 5-degree binocular chart (N-up, W-right) to 9.6 mag - comps from 5.7 to 9.6 mag.

X22893MS 2-degree Newtonian Chart (S-up, E-right) to 13.0 mag - comps 8.4 to 13.0

X22893MV 30-minute Newtonian Chart (S-up, E-right) to 17.0 mag - comps 9.3 to 17.0

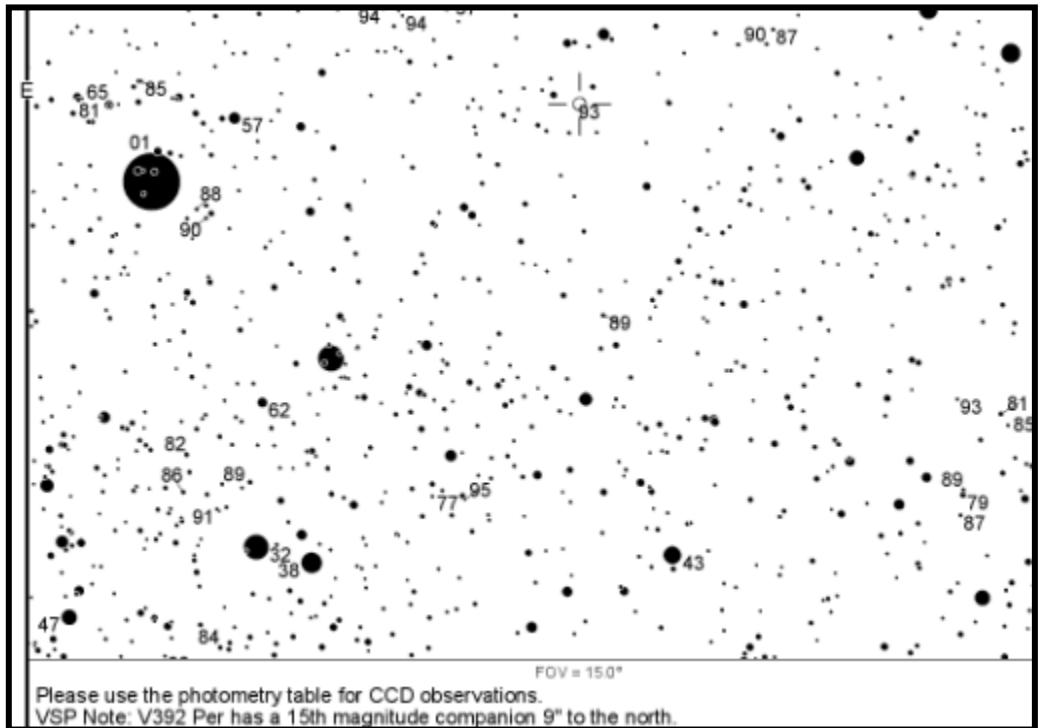
X22893MT 2-degree Cassegrain Chart (S-up, E-right) to 13.0 mag - comps 8.4 to 13.0

X22893MU 30-minute Cassegrain Chart (S-up, E-right) to 17.0 mag - comps 9.3 to 17.0

On the 15-degree binocular chart, the bright star on the left of the chart is Capella, with "The Twins" showing on the chart at lower left. The cross-haired circle at the centre of the chart is V392 Per. The numbers on the chart are standard magnitudes with the decimal removed (i.e. 68 = 6.8 mag., etc.) The "93" by V392 is for a close companion that will become important once the star fades. USE THE AAVSO chart, and not "catalogue magnitudes" from your planetarium program, since the planetarium programs do not have accurate magnitudes. If you can't figure out how to use the AAVSO chart maker, send me an email and I will send you the appropriate chart.

Since it is low in the north for the summer and will soon be in perpetual

twilight, it favours Canadian observers, so if you observe the star, please report your data to the AAVSO!



A portion of the AAVSO chart shows the location of Nova Persei 2018 = V392 Persei. The nova is located about 6-degrees west of Capella (the bright star at left), with the nova indicated by the cross-haired circle on the chart.

Although I had previously mentioned that no nova had been observed before its first eruption, general wisdom is that most novae are not one-time occurrences, and that these stars will erupt several times during this phases of their evolution, but on time-scales of hundreds or thousands of years between eruptions. But a transitional family of similar stars does exist: the Recurrent Novae. Another star that will undergo a drastic change is T Coronae Borealis, which I wrote about the in the May 2016 issue of *Saskatoon Skies*. Keep an eye on that star, too, since for two years now that it has risen about one magnitude above its normal floor brightness, so something is happening, and some night over the next few years, it *will* go boom, and brighten from 9<sup>th</sup> magnitude to 2<sup>nd</sup> magnitude! It did this in 1866 and 1946, and it is expected to do this again soon! If you only observe on moonless nights, you may miss this amazing change, since the whole eruption last less than a week, and you will have to wait 80 years for the next one!

# Prairie Dark-Sky Events in 2018: It's Not All SSSP!

– Rick Huziak

Many of you are already planning your most wonderful observing vacation at the *Saskatchewan Summer Star Party* this August, but there are numerous other astronomy events you might enjoy that are held on the prairies during the spring, summer and fall months. Many of the events are held in RASC-designated Dark-sky Preserves (DSP); some are open to astronomy club members; some are open to the public. Attending other peoples' events is an amazing way to meet all kinds of very interesting fellow (or fella) astronomers and naturalists. You can experience new ideas, get material for a club presentation in the fall, and support the dark-sky effort across the Prairies. Back in my heavy observing days, I had already attended 15 star parties before we even had inkling that maybe we should create the SSSP, and for SSSP we stole a lot of their ideas. Every group has a different way to do things, and everyone has excellent skies! Take some time this year to visit other places! Here's the list of astronomy events this summer, “\*\*” indicates events that some Saskatoon members are already planning to attend:

**Beyond the Big Dipper\*\***, Grasslands East Star Party, (May 16 - 20, Grasslands National Park DSP, East Block, Rock Creek Campground. Public talk & observing on May 19) <https://www.pc.gc.ca/en/pn-np/sk/grasslands/activ/decouverte-tours1/grandeourse-bigdipper>

**NatureCity Festival Northeast Swale Firefly Walk\*\***, (May 27, Northeast Swale, Saskatoon. Watch starts at 9 p.m.; astronomy at about 10 p.m. onward.) Come early and watch for fireflies. This event ties nature to darkness to astronomy in order to educate people that the Swale and the sky need to keep their darkness. Bring a scope and help out. [www.eventbrite.ca/e/firefly-night-walk-tickets-45296268358](http://www.eventbrite.ca/e/firefly-night-walk-tickets-45296268358)

**General Assembly of the RASC\*\*** (June 28 – July 1, University of Calgary, AB) <https://rascga2018.ca/>

**Alberta StarBQ** (July 13 - 15, Eccles Ranch Observatory, Caroline, AB) <http://calgary.rasc.ca/starbq2018.htm>

**Beyond the Big Dipper\*\***, Grasslands West Star Party, (July 14, Grasslands National Park DSP, West Block, Frenchman Valley Campground) <https://www.pc.gc.ca/en/pn-np/sk/grasslands/activ/decouverte-tours1/grandeourse-bigdipper>

**Saskatchewan Summer Star Party\*\*** (August 8 – 13, Cypress Hills Inter-Provincial Park DSP, West Block (S of Maple Creek, SK) Public events: Aug. 10 & 11. <https://sssp.saskatoon.rasc.ca/>

**Beyond the Big Dipper\*\***, Grasslands West Star Party, (Aug. 11, Grasslands National Park DSP, West Block, Frenchman Valley Campground) <https://www.pc.gc.ca/en/pn-np/sk/grasslands/activ/decouverte-tours1/grandeourse-bigdipper>

**Milky Way Days\*\***, star party, (Sept. 1, Miquelon Lake Provincial Park/Beaver Hills DSP, AB) <https://www.pc.gc.ca/en/pn-np/ab/elkisland/activ/spec>

**Milky Way Days**, star party, (Sept. 2, Elk Island National Park/Beaver Hills DSP, AB) <https://www.pc.gc.ca/en/pn-np/ab/elkisland/activ/spec>

\*More Next Month\*

# When Magnetometers and Fireball Cameras Meet

– *Tenho Tuomi*

Fireball cameras and magnetometers are for two separate purposes except when they both record aurora, which happened on the night of April 19-20.

Magnetometers are instruments for measuring a magnetic field. A compass is a simple magnetometer for measuring the direction of earth's magnetic field. Magnetometers for measuring the strength of the earth's magnetic field are usually made of some type of coils.

I started to look after a magnetometer for the University of Saskatchewan after I graduated from there in 1967. Eventually there were underground wires running to several magnetometer coils 100 feet and even 500 feet from the house to minimize electrical disturbances from the house. Equipment in the house consisted of relay racks of amplifiers and a paper chart recorder and eventually a reel to reel tape recorder.

The magnetometer quickly became useful for me for knowing when there was aurora overhead. Aurora is mostly electrons moving along magnetic field lines, and those currents produce magnetic fields that change the earth's magnetic field. Those changes can be measured by magnetometers.

Sometime before 1996 the University of Saskatchewan turned my magnetometer over to the University of Tokyo who run a network of magnetometers over the world. They updated my old equipment with modern digital data recorders. In 2006 they convinced me to get high speed internet so that they could read the data over the internet instead of having me send tapes monthly. Their Canadian magnetometers are looked after now by fellow astronomer Martin Connors at the University of Athabasca. You can see the live readings at <http://step-p.dyndns.org/~khay/htmp/r-lcl.html>

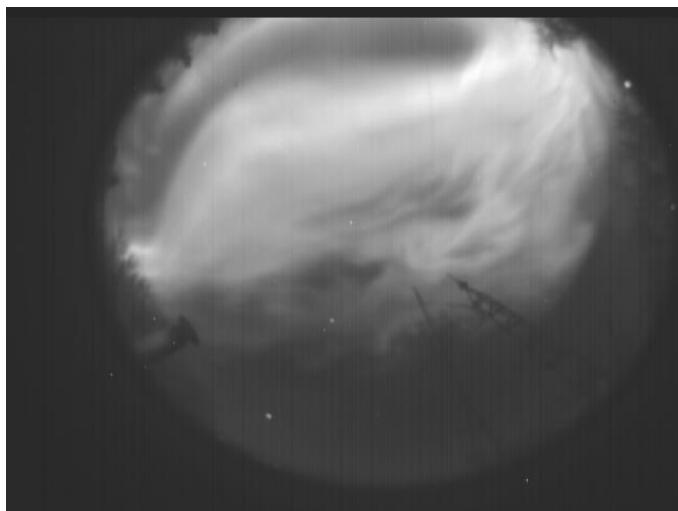
A fireball camera is used for catching bright meteors. With a network of fireball cameras it is possible to calculate where there may be meteorites if such fell to the ground. Gordon Sarty from the U of S set up a fireball camera on the roof of my house in February 2009,

see <http://homepage.usask.ca/~ges125/fireball/index.html>. It ran until 2015 when the camera quit working. Last year I offered to set it going again with help from Dwayne Free of the Sky Sentinel Network. After many trials which included finding a modern enough computer to run the software,



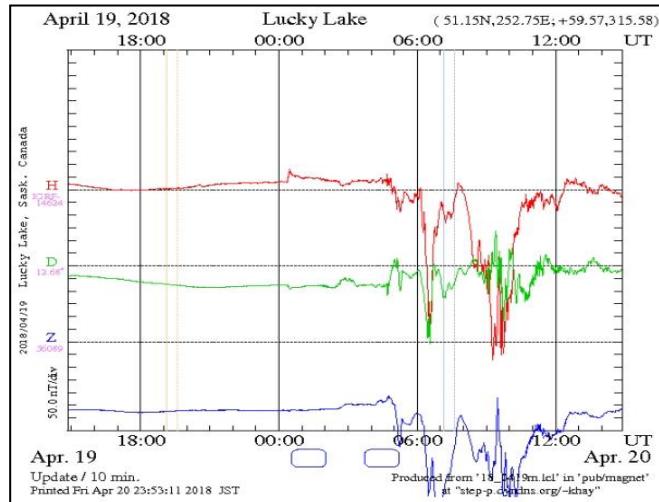
*The aurora photo from Tenho's DSLR*

replacing a noisy power supply, dealing with two old all sky cameras, one that had the iris stuck closed and one that had the iris stuck open, and learning how to focus the cameras, the fireball setup finally



started working on April 4. You can see pictures and videos from my camera and from others on the network at <http://goskysentinel.com/> under Imagery. It seems that Iridium flares are just as good at triggering pictures as meteors. We haven't caught any fireballs yet.

On the night of April 19 there was aurora bright enough to show on the fireball camera. I now have a record of the aurora with my Canon T5i camera and 10mm lens, 10 sec exposure at ISO 1600 at 12:21 am (previous page), a fireball camera image two minutes later (above), and a magnetometer graph for that night (right).



## Observer's Group – Larry Scott

The scheduled April 7th Observer's Group at Sleaford was cancelled due to the usual suspects (clouds and wind). This kept our Observer's Group cancellation streak intact for the year. Two members did make it out the following evening, April 8th, for a terrific evening of observing curtailed by more clouds rolling in at midnight.

Finally, May 5th became our first scheduled 2018 Observer's Group to bear fruit. Six members made the drive to Sleaford under more clouds. As the forecast predicted the skies were mostly clear by the time it was dark, around 23:00. Conditions were good with a light breeze from the north. It was dry, bugless, warm and alive with the constant serenade of birds, frogs and coyotes. Venus and Jupiter showed themselves as well as some light displays of aurora which continued the entire evening. OK, not perfect for observing but it was a gorgeous evening to be outside. As I write this on May 6th we've got another 10 days or so till the moon is back and we are mostly done with dark skies till SSSP. This does not mean put your telescopes away for the summer as Jupiter now and Saturn later will be well positioned in the evening sky.

Next scheduled Observer's Group at Sleaford will be June 16th. As twilight continues throughout the night in June it's a good opportunity to check out some planets and double and/or variable stars.

# Observing Clubs and Certificates

Join the Club! Observe all 110 Messier, 110 Finest NGC, 400 Herschel I or II, 140 Lunar, 154 Sky Gems or 35 Binocular objects, or Explore the Universe and earn great OBSERVING CERTIFICATES!

## MESSIER CLUB

### Certified at 110 Objects:

R. Huziak, G. Sarty, S. Alexander,  
S. Ferguson, D. Chatfield, T.  
Tuomi, L. Scott, G. Charpentier,  
B. Johnson, L. Dickson, B.  
Burlingham, Norma Jensen

Ron Waldron	108
Wade Selvig	75
Marcel Müller-	59
Goldkuhle	
Wayne	43
Schlakohl	
Ellen Dickson	34
Graham	9
Hartridge	

## Chatfield BINOCULAR CERTIFICATE

### Certified at 35 to 40 Objects:

T. Tuomi, R. Huziak

Jim Goodridge	12
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## FINEST NGC CLUB

### Certified at 110 Objects:

R. Huziak, G. Sarty,  
D. Chatfield, T. Tuomi

Larry Scott	110
Scott Alexander	97
Norma Jensen	83
Sandy Ferguson	23
George	13
Charpentier	

## EXPLORE the UNIVERSE

### Certified at 55 to 110 Objects:

T. Tuomi,

Wayne	55
Schlakohl	
Jim Goodridge	35

## Isabel Williamson Lunar Observing Certificate

### Certified at 140 Objects:

T. Tuomi, N. Jensen

## HERSCHEL 400 CLUB

### Certified at 400 Objects:

R. Huziak, D. Chatfield, T. Tuomi

Gordon Sarty	251
Scott Alexander	117
Larry Scott	45
Sandy Ferguson	18

## HERSCHEL 400-II CLUB

Darrell	400
Chatfield	
Tenho Tuomi	378
Rick Huziak	246

## LEVY DEEP-SKY GEMS

### Certified at 154 Objects:

Tenho Tuomi	150
Darrell	70
Chatfield	



The Messier, Finest NGC and David Levy's Deep-Sky Gems lists can be found in the *Observer's Handbook*.

The Explore the Universe list is available on the National website.

On-line Messier and Finest NGC lists, charts and logbooks: <http://www.rasc.ca/observing>

On-line Herschel 400 List: <http://www.astroleague.org/al/obsclubs/herschel/hers400.html>

Binocular List is at: [https://www.usask.ca/rasc/Chatfield\\_Binocular\\_List.pdf](https://www.usask.ca/rasc/Chatfield_Binocular_List.pdf)

"Isabel Williamson Lunar Observing Program Guide:

<http://www.rasc.ca/sites/default/files/TWLOP2015.pdf>

Program details can be found at: <http://www.rasc.ca/williamson/index.shtml>