NOVA

NEWSLETTER OF THE VANCOUVER CENTRE RASC | VOLUME 2008 ISSUE 2 | MARCH/APRIL 2008

INSIDE

Looking Ahead

Remember, you are always welcome to attend meetings of Council, held on the first Thursday of every month at 7:30pm in the GMSO.

Mar. 13: Dr. Ed Krupp of the Griffiths Observatory: "Inhabiting the Meridian."

Apr. 10: Chris Gainor discusses his new book, "To a Distant Day: The Rocket Pioneers"

May. 8: Mark Halpern of UBC: WMAP update or a first report on Atacama Cosmological Telescope results.

Next Issue Deadline

Material for the May Nova should be submitted by Monday, Apr. 28, 2008. Please send submissions to:

Gordon Farrell (gfarrell@shaw.ca)

Title image: Gordon Farrell

Portable Power 101, Part 1

by Jason Rickerby

An Introduction

This is an article about portable electricity, with an emphasis of solar power. While it may seem a little strange to produce such an article for inclusion in the NOVA, the increasing significance of electronics technology in amateur astronomy combined with the frequent circumstance that where observing is best, AC power is scarce, a reliable source of portable power can be a significant consideration to one's observing plans.

Personally, the central motivator for me to consider the topic is my experiences on Mount Kobau, home of BC's primary annual star party. Located on a mountaintop Northwest of Osoyoos, Kobau provides a reasonably dark observing site with some great astronomy-related history. While in the past it has been possible to access 120-volt AC power from hydro on top of the mountain to charge a portable battery or run a telescope, today this is no longer available.

The amateur astronomy marketplace seems to be continuing to embrace "GoTo" mounts at a rapid pace. GoTo mounts, once set up at a site, provide automated object location and tracking for the observer. While the debate regarding the merits of automated observing are outside of the scope of this discussion, suffice to say that the amount of electronics in use by the average observer is definitely on the increase.

While out observing, I require power for my mount, dew heater, focus motor, primary camera, laptop computer and possibly a guide camera. If I were camping with a trailer, I anticipate the need for interior lighting, a water pump, possibly a radio, battery charger for camera, flashlight and GPS batteries, and additional power for my laptop and small printer to produce finished images during the day. Did I mention my

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daughter's Sony PSP or son's GBA SP (entertainment)?

The Concept

When AC power is unavailable in remote locations, a portable power system can provide convenient electricity for lighting and other applications. Batteries are frequently used as the basis for a portable power system, as once they are charged, the power is instantly available day or night. While generators are an option, there are situations where it is not appropriate to be running one late at night or early in the morning when you want to use energy for lighting, entertainment, etc.

When using electricity away from "the mains," give careful consideration to what you really need and how much (time) you really need it. This will help you determine the size and capabilities of a remote/portable power system. Also remember that for a trip of short duration, say two to five days, the solution may revolve around energy management as much as power generation capabilities. Having a given supply of battery power could meet your energy needs for two days. Simply adding a small solar panel will not prevent you from eventually discharging your batteries, but the solar panel could extend the amount of time before the batteries are discharged. Your two-day battery supply may last as long as five days with daytime solar charging. Solar power systems will be discussed in more detail at the end of this article.

Batteries as a Power Source

Characteristics

A **battery** is actually a collection of **cells**. A single cell is usually 1.2 – 2 volts. Large rechargeable batteries are usually 3, 4, 6, 12 or 24 volts. A 12-volt solution is usually the preferable option as many portable devices are designed to operate directly off 12-volt DC power.

Since a "battery" is just another way of saying "collection of cells", there is a lot of flexibility on how to package for a given voltage. For example, if 12 volts is desired, this could be 4×3-volt batteries, 2×6-volt batteries, or a single 12-volt battery.

The reason that multiple low-voltage batteries may be used together to provide a sin-

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Dunbar Stargaze

by Craig McCaw

Everyone is invited to the third annual Dunbar Stargaze that will be held as part of the Dunbar Salmonberry Days neighbourhood celebration. It's located in Chaldecott Park on May 9th with a cloudy fall-back date of May 16th. The event has been very successful in past years and offers a great way to introduce people to the night sky. Although far from a dark sky event, being next to the UBC forest and the ocean, the sky can be as good as Mag. 4.5 with the Milky Way visible on summer nights. This is a great way to spread the word about Light Waste while you have a captive audience at the telescope. Shield that yard light, and use a motion detector if you must leave it on!

If you can, bring a scope, or just show up and enjoy the vibe. The folks from the Vancouver Telescope Centre will be there and we already have some more optics promised for the evening.

It starts at 9:30PM and is easy to find. Just go west on 25th Ave. (King Edward) until it dead ends (W. 25th and Crown). Chaldecott Park will be to your south with scopes setup on the south east side of the park. Information on the go/no go status of the event—in case of cloud—can be found at www.dunbar-vancouver.org with an 8:30 PM decision on the night of the event.

Hope to see you there. ✸

President's Message

I hope you were fortunate enough to see a glimpse of the lunar eclipse on February 20th. The game plan for RASC volunteers was to be at Trout Lake at John Hendry Park in East Vancouver with our scopes for public viewing at around 5:30 pm. At around 3:00 pm, we were still blanketed with thick grey clouds. David Dodge, our Public Affairs Director, had done a superb job of alerting the media to the coming eclipse, so I was getting calls regarding observing. I used the word "iffy" a lot… But the clear sky clock said it would be somewhat clear, so I was hopeful. By 5:00pm, it was still overcast but there were actually a few small stretches of blue sky.

Undaunted, Bob and I decided to head out to the park at about 5:45. As we drove east on Venables Street, I could clearly see the start of the lunar eclipse. It was breathtaking! At John Hendry Park, the skies got a bit better and quite a few people (and media!) came by for a look through our scopes. Thanks to all of the RASC volunteers who showed up for observing, including Wayne Lyons who came out with the 16" Dob all the way from Maple Ridge. As Luna continued its eclipse, it became increasingly coppery red in colour. Saturn could be seen clearly just to the north of the moon in the eastern sky. What a great evening! It was one of the nicer lunar eclipses that I have seen and, despite the drifting clouds, we

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About RASC

The Vancouver Centre, RASC meets at 7:30 PM in the auditorium of the H.R. MacMillan Space Centre at 1100 Chestnut St., Vancouver, on the second Thursday of every month. Guests are always welcome. In addition, the Centre has an observing site where star parties are regularly scheduled.

Membership is currently $62.00 per year ($36.75 for persons under 21 years of age) and can be obtained by writing to the Treasurer at the address on page 5. Annual membership includes the invaluable Observer's Handbook, six issues of the RASC Journal, and, of course, access to all of the club events and projects.

For more information regarding the Centre and its activities, please contact our P.R. Director.

NOVA, the newsletter of the Vancouver Centre, RASC, is published on odd numbered months. Opinions expressed herein are not necessarily those of the Vancouver Centre.

Material on any aspect of astronomy should be e-mailed to the editor or mailed to the address on page 5.

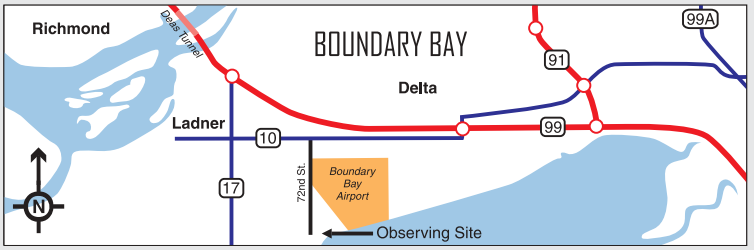
Advertising

Nova encourages free use of its classified ads for members with items for sale or swap. Notify the editor if you wish your ad to run in more than one issue.

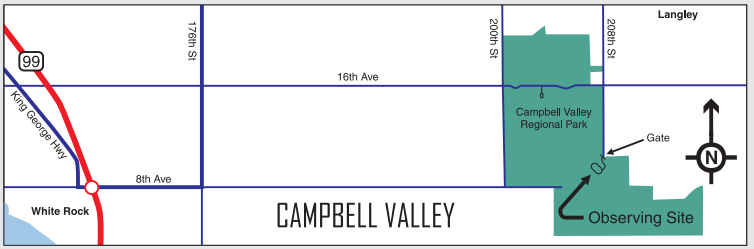
Commerical Rates

1/4 Page: $15.00 per issue
1/2 Page: $25.00 per issue
Full Page: $40.00 per issue
Rates are for electronic or camera-ready files. Payment, by cheque, must accompany ad material. Make cheque payable to:
RASC Vancouver Centre.

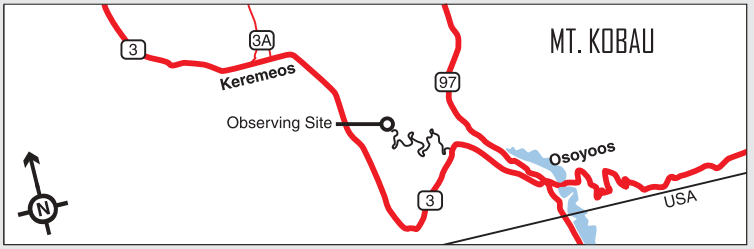
OBSERVING SITES



Site of the regular Saturday night star party. On the dike at the foot of 72nd St.



Our alternate observing site. Contact Bruce MacDonald (604-882-3820) to see if this site is in use.



Site of the annual Mt. Kobau Star Party organized by the Mount Kobau Astronomical Society

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got great observing of a few objects including the Orion Nebula (M42). Getting to use my new Canon 10x30 IS binoculars was another bonus. They were the perfect observing tool—light, great optics and stabilized!

Since Craig Breckenridge, our CGRT chair, is away on and off for work assignments over the next few months, I will give everyone an update on the robotic telescope project. Due to administrative requirements by National, Paul Gray has joined the CGRT project as the liaison for National. As well, The New Mexico robotic telescope owned by Chris Graham has now been sold, so our project work will centre around use of the Pingelly telescope in Australia. It has been exciting to look at the southern sky and its awesome objects like the Large Magellanic Cloud (LMC) which, at a distance of slightly less than 160,000 light years, is the third closest galaxy to the Milky Way. As well, we imaged Eta Carina and the Running Chicken nebula. On behalf of the Vancouver Centre, I want to extend our gratitude to Chris Graham who provided us the use of his robotic telescope equipment that we had in New Mexico these past two years and for our continued involvement at Pingelly. Over the next few months, expect to see some of the exciting new images from the CGRT project. Most recently, M1 from the CGRT image bank was used for a science fair project by four Grade 6 girls.

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On another note, I wanted to say a few words about recent administrative issues raised by National. I have previously mentioned that Vancouver Centre is pursuing our own independent charitable organization status. While in hindsight, we should have done this sooner, we have now been advised to do so by National. Their long-standing practice of handling donations and life-membership money transfers to Centres is now in question in light of taxation legislation that is currently before the house. Although not yet law, National has been advised that it is very likely to become law, and they are making sure that we will be in compliance with it. Life members and anyone who has made a Vancouver Centre-directed donation would have recently received a letter from National. In those letters, National advises life members to pay $22 per year directly to Centre and has returned donations made to Vancouver Centre to 2007 donors. As I mentioned in my recent letter to Vancouver Centre donors and life members, we value our life members highly and appreciate donors who have directed monies to Vancouver Centre to enhance our ability to undertake community outreach and other objectives of our Centre. Due to our fortunate circumstances of past donations, we are able to wait until National has established its new policy.

For life members, this will mean that we will continue to

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CENTRE SERVICES

LIBRARY

The centre has a large library of books, magazines and old NOVAs for your enjoyment at the GMSO. Please take advantage of this club service and visit often to check out the new purchases. Suggestions for future library acquisitions are appreciated.

RASC-VC on the Internet

http://www.pcis.com/rascvan/ or
http://www.rasc.ca/vancouver

H.R. MACMILLAN SPACE CENTRE

The Pacific Space Centre Society is a non-profit organization which operates the H.R. MacMillan Space Centre and Gordon M. Southam Observatory. Annual Membership ($30 Individual, $80 Family) includes a newsletter, discounts on Space Camps, special programs and lectures, Vancouver Museum discounts, and free admission to the Space Centre. Admission to the Space Centre includes: Astronomy shows, Motion Simulator rides, multimedia shows in GroundStation Canada, and access to the Cosmic Courtyard Exhibit Gallery. For Membership information, call Mahi Jordao at 604-738-7827, local 237 for information. You can also reach them on the Internet at http://www.hrmacmillanspacecentre.com/

MEMBERSHIP HAS ITS PRIVILEGES!

New members, did you know? The Vancouver Centre has 8 telescopes available for loan free of charge! We have telescopes ranging from 60mm to 10" diameter. For more information see Bob Parry, Director of Telescopes in the meeting room of the GMSO *after* the members meeting. All telescopes are to be picked up and returned at the GMSO. The loaner period is for one month, to be returned after the next meeting. Telescopes are not allowed to circulate outside of these meetings. You can now reserve two different telescopes per year and use what is left at the end of the meeting anytime. Bob can be reached at 604-215-8844.

Your greatest opportunity as a member of the R.A.S.C. is to take advantage of the company of other enthusiasts to increase your knowledge, enjoyment and skill in astronomy.

The best thing you can do to gain the most from your membership is to get active! Take in the club meetings; engage other members with questions; come out to observing sessions (also known as "star parties"), and, by all means, volunteer to take part in our many public events.

Observing takes place at Boundary Bay on the dike at the south end of 72nd St. in Delta (see map on p. 4). We are there most clear Friday/Saturday nights. Contact Jason Rickerby at 604-502-8158.

RASC
1100 Chestnut Street
Vancouver, B.C.
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UPCOMING EVENTS

March
15 – Night Quest at Pacific Spirit Park (7–10pm)

April
5 – Messier Marathon II at Boundary Bay

May
5-11 – International Astronomy Week
10 – Astronomy Day

June
27-July 1 – GA 2008 in Toronto

August
2-10 – Mt. Kobau Star Party
12 – Perseid meteor shower
30-Sept. 7 – Merritt Star Quest

September
20 – Sidewalk Astronomy at the Inukshuk at Sunset Beach

December
11 – AGM

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maintain you as a Centre member and do not require you to pay Vancouver Centre directly at this time. For donors who have received a refund of donations made in 2007, you should be aware that we are in the process of finalizing our own application for charitable status and, until that is complete, we will not be able to issue tax receipts for donations made to our Centre. Therefore, any donations made in the interim will not be issued a tax receipt. We expect to obtain our status as a charitable organization later this year.

Once we have clear policies from National and from this proposed legislation, we will be finalizing ongoing administration of life members. As well, we will advise our membership as soon as we have obtained charitable status and are able to accept donations where we can issue tax receipts. Gaining our independent charitable status will put us on the same footing as most of the larger Centres in Canada who currently have independent charitable status. These include Victoria, Prince George, Edmonton, Calgary, Regina, etc.

Well, with all of this activity in February, we were lucky to have the extra leap day!

Onwards to March where we hope to have some Messier Marathon observing on March 8th and will hear from Dr. Ed Krupp at our March 13th meeting.

Vic Baker, a longtime RASC member, will be joining Council as Director and Light Pollution Abatement (LPA) Chair. Vic has a lot of plans to highlight practical initiatives for reducing light pollution and I look forward to his involvement on Council.

I wanted to also say a special thanks to our Treasurer, Bruce MacDonald, Norman Song and immediate Past President, Ron Jerome for their work on the Vancouver Centre Charitable donation application. Their work paves the way for successful Centre management for many years to come.

Best wishes,

– Pomponia ✸

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gle, higher-voltage battery is due to capacity and weight (there are some technical merits to debate, but this is not intended to be a book). A single 12-volt, 230 A·h battery could weigh 66kg (168 lbs). Two 6-volt, 225 A·h batteries will weigh 28 kg (61 lbs) each. As the capacity is the same, it is much easier to move and install two 61 lb batteries than one 168 lb battery (the two 6-volt batteries are connected in series to create what is effectively a 12-volt 225 A·h battery).

Battery Types

Deep Cycle batteries are designed to provide reasonable amounts of power over extended periods and to be discharged to a high percentage such as 50-80%, but discharging batteries to a lesser degree

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Night Quest: Saturday, March 15

Weather permitting; RASC volunteers will be on hand with telescopes at the *Night Quest* at Pacific Spirit Park on March 15th from 7-10pm.

Night Quest
Saturday, March 15
7 – 10 PM
Pacific Sprit Regional Park

Experience the magic of the park as it transitions from day into night! Follow a two-kilometre, lantern-lit trail through the forest for fun and exercise. Visit discovery stations and read inspirational poetry posted along the route. Watch for shadowy forms and glowing eyes; inhale the fragrance of cedars, and listen for night sounds. Then gather around a bonfire to enjoy entertainment. Bring a flashlight or lantern. Allow at least one hour to complete the quest, rain or shine. The Girl Guides of Canada will provide refreshments. This event is wheelchair and stroller accessible.

Start your journey anytime between 7 and 9 pm at the Park Centre located on 16th Avenue, 400 metres west of Blanca Street in Vancouver.

Presented by Metro Vancouver in co-operation with the Pacific Spirit Park Society. ✸

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(50% at most) increases their working lifetime and is recommended. Regularly discharging a battery 80% will significantly reduce the lifetime of any battery!

Marine batteries frequently have a hybrid plate design that lets them function as both starter and deep cycle batteries. Flooded, gel and AGM designs are all available for marine applications. However, as a dual-purpose design, marine batteries do not perform as well as dedicated starter or deep cycle batteries for a single application.

AGM – Absorbent Glass Mat – A lead-acid battery that is well suited to deep-cycle, portable, applications.

- They can't spill, won't leak if punctured, can take a bit of knocking around and vibration, and are maintenance free.
- As these are sealed batteries, controlling charge rate is important.
- They are efficient to charge. In other words, more charge from less energy than required by flooded or gel-cell batteries.
- AGM batteries are fairly insensitive to physical orientation, thus they can be mounted to best use available space and/or whatever orientation is most convenient.
- AGM life expectancy is 5 to 10 years: 200 – 500 cycles (internally they eventually dry out).
- AGM batteries can operate under water.

Flooded/Wet Lead Acid Starter batteries are designed to provide large amounts of power for very short periods of time (thin plates).

- Starter batteries are not designed to be discharged more than 5-20%.
- Maintenance may be required due to out gassing (serviceable type anyway).
- These batteries can boil over extremely corrosive sulphuric acid if over charged.
- It is important to keep flooded batteries physically upright, especially the serviceable variety.
- Don't get these batteries wet! Submersing them in seawater is a really bad idea!

Flooded/Wet Lead Acid Deep Cycle batteries are designed differently than starter batteries and are intended for deep cycle applications (thick

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plates).

- Maintenance may be required due to out gassing (serviceable type anyway).
- These batteries can boil over extremely corrosive sulphuric acid if over charged.
- It is important to keep most flooded batteries physically upright so they perform properly.
- Flooded battery life expectancy is 10 to 20 years. Cycle life varies greatly, depending on quality and cost, but can be as high as 2,000 – 3,000 cycles with proper maintenance.
- Flooded cells generally offer the highest capacity for a given volume.
- Don't get these batteries wet! Submersing them in seawater is a really bad idea!

Gel Cells – Another variation of lead acid technology, these batteries are sealed and will not leak—even if punctured.

- Generally designed for deep cycle applications. Gel cells can tolerate very deep discharging better than other designs.
- Gel cells are very sensitive to proper charging, so controlling charge rate is very important (this seems to be the reason AGM batteries are displacing gel cells).
- Gel batteries are less sensitive to physical orientation than flooded batteries, but will still operate best when upright.
- Gel life expectancy is 10 to 20 years: 500 – 1500 cycles.
- Gel batteries are preferable to AGM batteries for high cycle (lots of discharging and recharging) applications.
- Gel cell batteries can operate under water and are least affected by hot weather.
- Presently, AGM technology seems to be replacing gel cells in many applications.

Caution

- Always remember that batteries can contain significant amounts of energy and corrosive chemicals! Thinking safety is the first priority! Read and follow the instructions of any warning labels and read documentation. If you're not confident, get some help.
- Do not mix battery types! AGM, flooded and gel batteries have different charging needs. If there is a need for more than one battery type, each type will need its own battery charger or charge controller.

Care & Feeding of Batteries

Batteries must be recharged and maintained to serve as reliable power sources. They can be reenergized using AC or DC electricity input from mains AC, a portable generator, solar panel(s) or an automotive alternator.

AC mains power can be used with a battery charger and is a cheap way to charge batteries. A quality battery charger can safely and rapidly charge batteries but a cheap charger reduces battery life. Combination battery charger/inverters are available (more below).

A portable **generator** can be used with an AC battery charger to recharge the batteries, but while some generators provide very clean AC power, others do not. Because batteries can only safely be charged at a certain rate, portable generators are generally not efficient for charging batteries. Look at a generator's continuous output ratings, not peak output ratings. You may find that even the smallest generator produces far more power than you need at any given time. Some generators provide DC output for charging flooded lead acid starter batteries, but generally NOT deep-cycle batteries. A portable generator can also be handy in the event of a domestic power outage. Just don't have it running inside the house or garage :-)

Solar panels work with a device called a "charge controller" to recharge the batteries. A photovoltaic cell (PV) is a component in a solar power module/panel (everybody gets the converting sunlight to electricity bit, right?). As solar panels are generally designed for charging batteries, 100% of a panel's output can be used to charge the battery(s) (unlike a generator). Solar panel voltage needs to be matched to the application and an appropriate charge controller.

These are the main types of solar panels currently available:

- **Single-Crystal** – Most efficient, but don't like shading. Most expensive.
- **Multi-Crystal** – Not quite as efficient as single-crystal, and also don't like shading. Slightly cheaper than single-crystal.
- **Amorphous** – Least efficient, but don't mind shading so much. Can operate better on partial-cloudy or cloudy days better than crystal designs, however they are less efficient overall so this may be moot. Least expensive.

"Shade" does not mean working out of the sun, rather a shadow crossing the surface of the panel, from a tree limb, etc. In some module designs, when an area of the panel has a shadow over it, this area will reduce the ability of the other parts of the panel to transfer the electricity to the output terminals. Some single- and multi-crystal solar panels have extra diodes to reduce the effect of shading on part of the panel.

Solar panel efficiency is about solar irradiance—the incoming energy from the Sun. On a clear day on the equator, at noon, solar irradiance is ~1 kW per square meter at sea level. At 49° latitude, on a clear summer day, solar irradiance may be 0.8 kW/m^2. On a cloudy winter day at the same latitude, irradiance may be as low as 0.2 kW/m^2.

A multi-crystal solar panel may be 14% efficient. This means that a 1m^2 panel will produce 140 watts of electricity, at the equator, on a clear day at noon. This same solar panel will still produce 30 - 35 watts at noon on a cloudy winter day in Vancouver.

When purchasing a solar panel, it may be better to think of efficiency as watts output per dollar. To calculate the daily solar panel power generation capability, multiply the size of the solar array in watts by the hours of available sunlight (in southern Canada, usually 5 to 8 hours a day).

"Solar panel size in watts" × 8 = "Daily power generated in watt/hours"

All solar panels operate better in cold temperatures. In hot climates, higher-voltage solar panels may be needed to compensate for higher temperatures. As solar panel efficiency decreases with temperature, installation that facilitates airflow around the panel is advisable.

As sunlight becomes stronger at higher elevations, so does solar panel output. In fact, at higher altitudes, solar panel output can exceed the stated specifications (perhaps by as much as 10%, so don't plan to double the output by going up a mountain).

Ideally, solar panels should be pointed perpendicular to the sun for maximum output. In the majority of applications, especially at northern latitudes, tracking mounts that have the solar panels following the sun across the sky are generally not worthwhile. Save the complexity and simply add an additional solar panel to the array to achieve the same output as a tracking system will provide. Angling a panel towards the sun at noon can be effective. Adjusting the angle for the season is also worthwhile. With a permanent solar installation in

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Canada, one might adjust the panel angle four times per year.

Do not use reflectors or magnifiers in an attempt to produce more energy from a solar panel. The panels are designed to work as efficiently as possible as is, and any additional light can cause damage.

Don't mount solar panels directly to wood as the different expansion characteristics of the materials may result in warping and damage to the solar panel.

When mounting a solar panel(s), ensure any rain water will readily drain off the surface. Due to their dark colour, when mounted at a reasonable angle, solar panels will generally shed snow quickly.

High voltage solar panels are generally used for "grid tie" applications. The difference is the output voltage of the specific solar panel ("Grid Tie" systems are about generating large amounts of 120 or 240-volt AC from an inverter. It is even possible to supply power back to the mains grid during the day—running the electricity meter on the building backwards *[BC Hydro has provided this "net metering" service since 2004 – Ed.]*).

The stock **alternator** in most vehicles is not designed to charge the batteries in a trailer. It may be possible to upgrade the alternator in the towing vehicle, but this solution has a number of challenges, such as wiring to the batteries, etc. Some recreational vehicles may have upgraded alternators intended to charge extra batteries. Using a running vehicle engine, while stationary, to charge batteries is very inefficient.

Things to Know about Battery Charging

A **battery charger** takes 120-volts AC and provides appropriate DC output to charge a battery(s).

A **charge controller** takes

Jaymie Matthews, Professor of Astronomy and Astrophysics at UBC and RASC Vancouver Centre member, points out the image of MOST on his t-shirt as he is inducted as an Officer of the Order of Canada by Governor-General Michaelle Jean at a ceremony that took place on 22 February, 2008. Our hearty congratulations to Jamie on this well-deserved honour!

DC power from solar panels and provides appropriate DC output to charge a battery(s). Charge controllers can also provide "load control"—the connection between the devices consuming the battery power and the batteries. Many charge controllers also include features called "low voltage disconnect" and "high voltage disconnect" to protect the batteries against excessive discharge or excessive input voltage (more below). Charge controller models are designed around ranges of solar panel voltage and current input ratings, and battery voltage(s) and charging ratings. At present, "PWM" charge controllers are good solutions. "MPPT" is the most efficient technology currently available, but it is more costly than PWM and only provides benefits in certain situations—usually where the solar panels are operating in cold temperatures or when the batteries are deeply discharged. Higher-end charge controllers and battery chargers provide a display indicating voltage, current, overall charge status, etc. and system fault indicators.

Batteries can be charged at various "rates." This means that different amounts of power can be applied to the battery to charge it. A 75% discharged battery has different needs from a charger than a 10% discharged battery.

Charging batteries at a low charging rate will maximize battery longevity. Charging batteries at a high charging rate can result in excessive battery heating and can reduce battery longevity.

A given battery, or bank of batteries, can usually only be charged at a maximum rate of capacity (in amp hours) / 8. E.g. A 225 A·h battery can be charged at a maximum of 28 amps (this is why using a portable generator to charge a battery is usually inefficient, as generator current output will usually exceed the batteries maximum charging rate). The most effective battery chargers/charge controllers have different charging stages and are commonly called "smart chargers." These stages change the rate at which the battery is charged, depending on the discharge level and temperature, with the objective of charging a battery as quickly as possible without harming the battery. Better quality solar charge controllers are "smart chargers" by design.

An option to consider is a battery charger/inverter. This type of device has the capabilities to charge batteries from AC power and provide AC power from the batteries (more below).

Battery Maintenance – Lead acid batteries like to be charged. However they don't like to be over-charged. This is why an appropriate charging solution is required to maintain lead acid batteries over the long term to maximize the battery's lifetime. AGM batteries are a bit of an exception here as they can hold a charge quite well, but a float/trickle charge certainly won't harm them. Flooded serviceable batteries benefit from periodic testing and fluid top-up.

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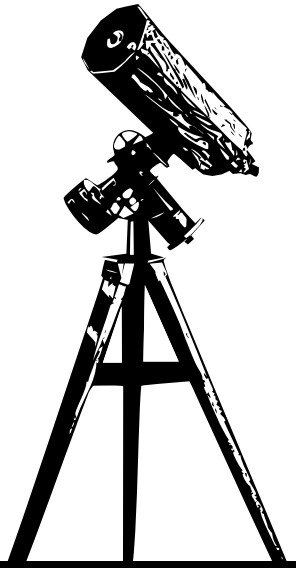
Be sure to read Part 2 of Jason's article in the May issue of NOVA, *where he specs out systems small enough to keep your scope running and large enough to live off the grid!* ✸

Proud To Serve Vancouver's Astronomical Community



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