NOVA
NEWSLETTER OF THE VANCOUVER CENTRE RASC
VOLUME 2017 ISSUE 1 JANUARY FEBRUARY 2017

Paul Sykes Lecture – Sat, Jan. 21 @ 7:30

Going Out in a Blaze of Glory: Cassini Science Highlights and the Grand Finale

Featuring Dr. Linda Spilker of JPL – SFU Burnaby Campus, Room SWH 10081

The Cassini mission's findings have revolutionized our understanding of Saturn, its complex rings, the amazing assortment of moons and the planet's dynamic magnetic environment. The robotic spacecraft arrived in 2004 after a 7-year flight from Earth, dropped a parachuted probe named Huygens to study the atmosphere and surface of Saturn's big moon Titan, and commenced making astonishing discoveries that continue today.

Cassini's current mission extension has led to some remarkable discoveries and more are expected when Cassini repeatedly dives between the innermost ring and the top of Saturn's atmosphere during its final six months starting in April 2017. It will be the first spacecraft to explore this region, providing insights into fundamental questions unattainable during the rest of the mission. Cassini will send back its final bits of unique data on September 15, 2017 as it plunges into Saturn's atmosphere, vaporizing to protect tiny Enceladus, one of Saturn's ocean worlds.

What new puzzles will Cassini

solve before it plunges into Saturn's atmosphere rather than risk crashing into one of Saturn's ocean worlds and contaminating it? Come and hear the story of recent science discoveries and the upcoming excitement during the final orbits. Dr. Linda Spilker, Cassini Project Scientist, will present highlights of Cassini's ambitious inquiry at Saturn and an overview of science observations in the final orbits.

This flagship mission is a cooperative undertaking by NASA, the European Space Agency (ESA), and the Italian space agency Agenzia Spaziale Italiana (ASI).

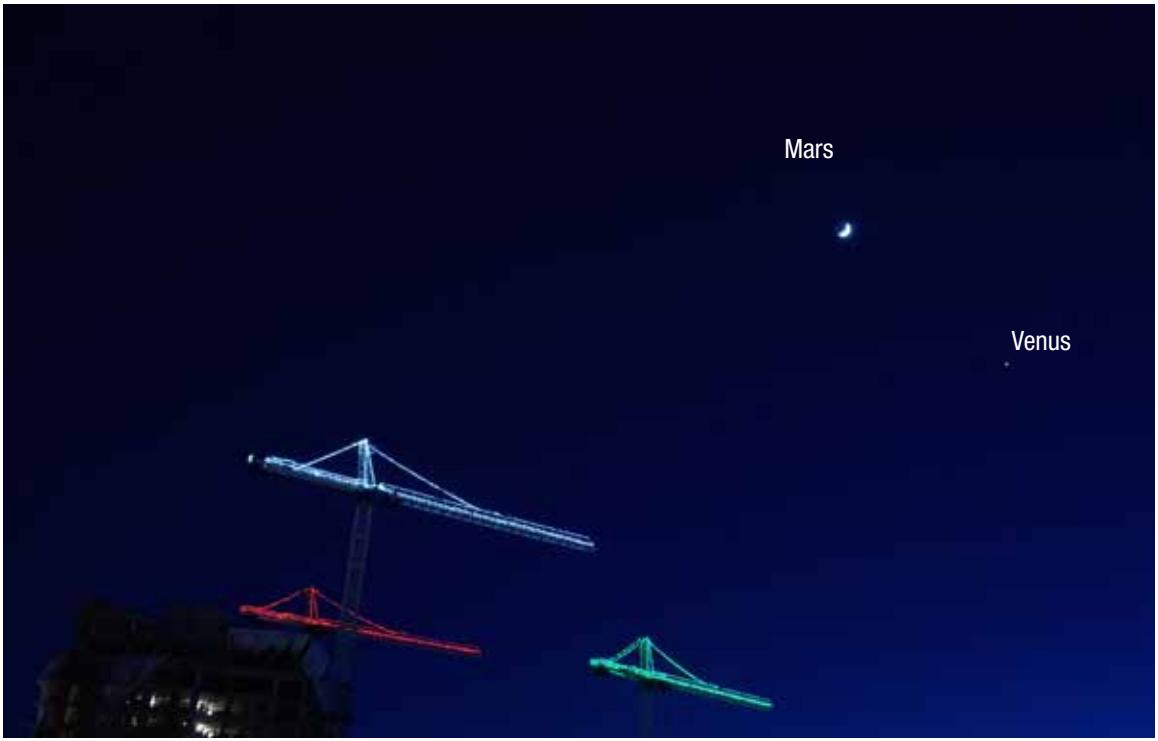
Dr. Linda Spilker is a NASA research scientist at the Jet Propulsion Laboratory in Pasadena, CA. She is currently the Cassini Project Scientist and a Co-Investigator on the Cassini Composite Infrared Spectrometer team and has worked on Cassini since 1988. Since joining JPL almost 40 years ago, she has worked on the Voyager Project, the Cassini Project, and conducted independent research on the origin and evolution of planetary ring systems. She enjoys yoga and hiking in National Parks, including her favourite park, Yosemite. She is married, with three daughters and five grandchildren. She received her B.A. from Cal State Fullerton, her M.S. from Cal State Los Angeles, and her Ph.D. from UCLA. ✸

JANUARY 12 **SFU**
JJ Kavelaars of the DAO in Victoria pesents "New Horizons in the heart of the Kuiper belt." Room SWH10041
SFU

FEBRUARY 9 **SFU**
David A. Rodger, founding director of the HR MacMillan Planetarium: My Life Among the Stars. Room SWH10041
SFU

MARCH 9 **SFU**
Jon Willis, Assoc. Prof. of Astronomy at UVic: "All These Worlds Are Yours: The Scientific Search for Alien Life." Room SWH10081
SFU

Members' Gallery

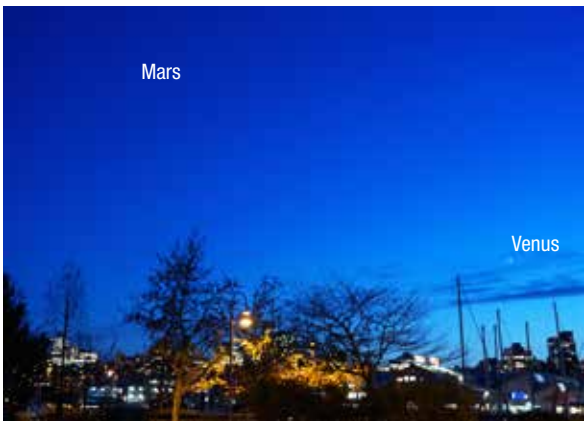


Mars, Moon and Venus by Elena Popovici

"Jewels on a string" at the beginning of the year: a crescent Moon nestled between shiny Venus and inconspicuous Mars. A telescope revealed Neptune as a bluish dot only one degree to the right of Mars. Fingers & toes turned to icicles during the taking of these photos, but the sky was crispy clear and many "wow"-s were uttered by passing children and adults alike seeing Moon craters for the first time at this impromptu sidewalk-astronomy event. Jan. 2, 2017 near Science World, looking south over Olympic Village. SONY ILCE-5000 camera.

Mars and Venus by Elena Popovici

Shiny Venus (in the Teapot's handle) & dim Mars, on what felt like the only clear night in two months. Only enough cloud wisps to make it interesting. Nov. 21, 2016 from Downtown Vancouver, looking south over False Creek and Granville Island. SONY ILCE-5000 camera.



President's Message

by Suzanna Nagy

As I write this President's Message, we are 66 days of rain out of 70. To say that this fall observing season has been frustrating is an understatement.

With the hope of better weather in the New Year, now might be the time to spend these dreary days hauling out your observing equipment and accessories that have been gathering dust. I keep my eyepieces and other observing tools in a briefcase, always ready to go. I also maintain a box with items like water, snacks, observing books, and extra warm clothes like socks, a toque, and mittens. While waiting for those rare fall and winter Metro Vancouver clear nights, some things I will check over are:

- tighten the screws on my mounts (Dob and Alt-az)
- clean my eyepieces (lens cleaner and Q-tips work great)
- check the batteries in my laser pointer, flashlight, and Telrad
- buy some new batteries (I always keep extra packs in my case)

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About RASC

The RASC Vancouver Centre meets at 7:30 PM on the second Thursday of every month at SFU's Burnaby campus (see map on page 4). Guests are always welcome. In addition, the Centre has an observing site where star parties are regularly scheduled.

Membership is currently $78.00 per year ($45.00 for persons under 21 years of age; family memberships also available) and can be obtained online, at a meeting, or by writing to the Treasurer at the address below. 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 below.

Remember, you are always welcome to attend meetings of Council, held on the first Thursday of every month at 7:30pm in the Trottier Studio in the Chemistry wing of the Shrum Science Centre at SFU. Please contact a council member for directions.

2017 Vancouver Centre Officers

President	Suzanna Nagy president@rasc-vancouver.com
Vice-President	Leigh Cummings vp@rasc-vancouver.com
Secretary	Adrian Mitescu secretary@rasc-vancouver.com
Treasurer	Bruce Hutchison treasurer@rasc-vancouver.com
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Trustee	Pomponia Martinez
Honourary President	J. Karl Miller

Library

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

On the Internet

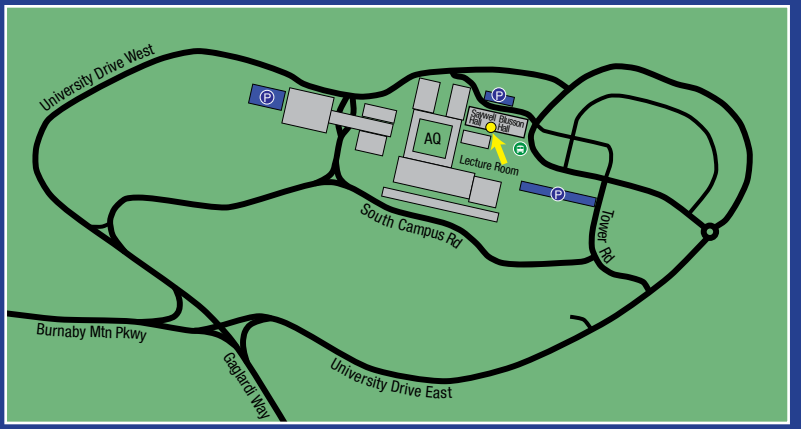
http://rasc-vancouver.com or
http://www.rasc.ca/vancouver
http://astronomy.meetup.com/131/
http://www.facebook.com/RASC.Van

@RASCVancouver

Mailing Address

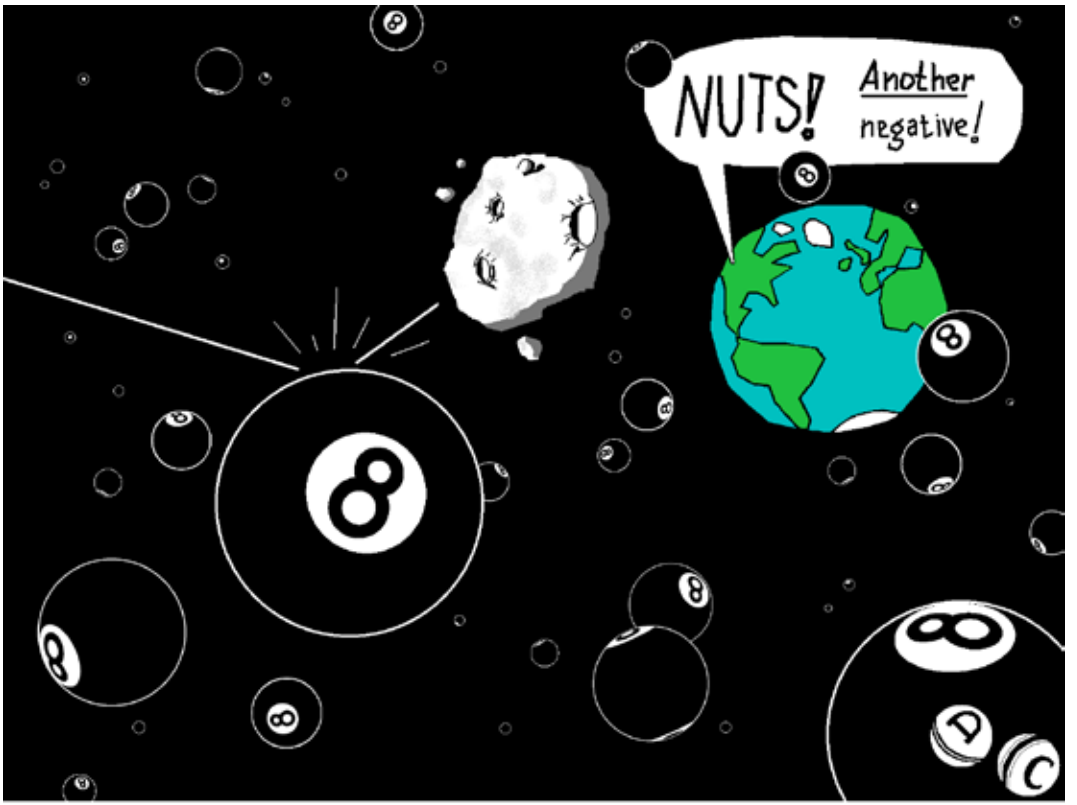
RASC Vancouver Centre
PO Box 89608
9000 University High Street
Burnaby, B.C.
V5A 4Y0

Map to Meeting Site



Our Jan-Mar meetings are in room SWH10041 of Saywell Hall, about halfway down the main corridor as indicated by the arrow on the map.

Pay parking is available at several locations located around campus (indicated as "P" on the map).



Cartoon by Dan Collier

Asteroid occultation workers missed a well-deserved Nobel Prize . . . for almost discovering Dark Matter

AOMO Update

by Alan Jones

Vancouver centre has an observatory in the UBC Maple Ridge research forest where we license the location for amateur astronomy research. The observatory was constructed over twenty years ago by member volunteers, their families and friends using donated materials. Our centre has a loaner telescope program for members and I like to think of the observatory as our largest 'loaner' telescope. You can't take it home with you; you have to go to the observatory to 'borrow' it. This will not appeal to all members, yet we are all inspired by observatories as dedicated spaces for astronomy. Past outreach events have inspired the general public through observatory tours.

Although less than an hour from Vancouver, it has dark enough skies that the Milky Way is observable with the naked eye. This makes it easy to set up a telescope on the concrete pad next to the main building. A clear, darker sky is a great asset for image capture, observing, teaching, learning and the sheer joy of a less light-polluted sky.

The observatory is operated and maintained by member volunteers. Lately it has been non-operational due to much overdue maintenance to replace the dome shutter, maintain the dome, building, grounds and repair and replace equipment including the unreliable computer, upgrade software and repair interface components. It is a slow project due to part-time volunteer effort, however there is "starlight" closer to the end of the telescope tunnel now.

Much progress was made last year including: redesign and construct a new dome shutter; re-caulk dome seams; clean out the inside of the building; patch drywall; clean up surrounding grounds; track down and resolve computer connectivity issues with the telescope; purchase new computer hardware and software; and bench test offsite. The previous year, we removed all equipment to dry safety for repairs and refurbishing, erected scaffolding for safe access to the dome for repairs, patched the roof, made temporary shutter repairs, installed gutters, installed drains, removed mould, dried the building and completed mechanical repairs, and cleaned, lubricated and replaced belts on the telescope mount.

I'm very grateful and offer a

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- restock water and snacks (no one likes a stale granola bar)
- review and update my observing notes, lists, and catalogues

Our annual Paul Sykes Memorial Lecture is also held in either late January or early February each year to break up our dark and cold winters with something exciting to look forward to. 2017's lecture is no exception. On Saturday, January 21, we will be hosting Dr. Linda Spilker of NASA's Jet Propulsion Laboratory. Dr. Spilker is the Cassini Project Scientist and her lecture will be focusing on recent Cassini discoveries as well as the Grand Finale as the Cassini Spacecraft nears its end of life. Look to our website and Meetup.com for more details on this upcoming lecture. ✸

Membership has its Privileges!

New members, did you know? The Vancouver Centre has several telescopes available for loan free of charge! We have telescopes ranging from 60mm to 10" in diameter. For more information see the Director of Telescopes after the members meeting. 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.

Your greatest opportunity as a member of the RASC 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.

For the usual observing sites and times, visit our website at http://rasc-vancouver.com or contact the Observing Chair at observing@rasc-vancouver.com.

Upcoming Events

January
21 – Paul Sykes lecture at SFU (see page 1 for details)

March
25 – Night Quest at Pacific Spirit Regional Park

May
13 – Astronomy Day at SFU

Jume
30 - July 30 – RASC General Assembly in Ottawa

July
22 - 30 – Mt. Kobau Star Party

August
19 - 26 – Merritt Star Quest

December
14 – AGM

Great Northerly Conjunction of Venus – March 2017 by Milan B

19

Every 19 months or so Venus reaches the same position in the sky relative to the Sun looking from Earth. This is called the synodic revolution. 19 is not a "friendly" number in this context, meaning 19 months is much longer than a year, but still quite short of two years. This means that after nineteen months the Sun and Venus will reach the same position in the sky relative to each other, but this will happen in a very different, almost completely opposite part of the sky.

7.99

Five synodic revolutions of Venus, however, add up to almost exactly eight years, just a few days short. Even the ancient Mayans knew about this eight-year cycle of Venus and your local astrologer would probably be aware of it as well. With such close proximity to a whole number of years (8) things will repeat nicely, in the same part of the sky after this period of time.

The recent two transits of Venus followed this pattern as expected, the 2004 transit happened on June 8th while the 2012 transit occurred on June 6th, which the author of this text was very lucky to witness.

5.0

This article is about inferior conjunctions (ICs) of Venus, an event when Venus passes directly between the Sun and Earth. In the current epoch, the five inferior conjunctions of Venus of this eight-year cycle happen in: mid January (2014), late March (2017), early June (2012 transit), mid-August (2015) and late October (2010 and 2018). Positions of Venus relative to the ecliptic during the ICs in the current epoch follow a nice symmetric pattern. During the June series of ICs, Venus is at or near the ecliptic, resulting in transits (2012) or near-transits (2020). From the four remaining ICs, Venus is below the ecliptic at two of them (August and October) while during the January and March ICs Venus is above the ecliptic.

8.1

The late March ICs of Venus are of a special interest for northern hemisphere observers and the upcoming IC of March 25th, 2017 is no exception to this. During this conjunction, Venus will be more than 8° above the ecliptic. This means that Venus would be fairly easy to spot with the naked eye during the day, especially around noon when the dazzling planet is right above the Sun, some 8° or so. In an imaginary Solar System metric called "departure from the ecliptic," Venus, as the undisputed champion, wanders away from the ecliptic at greater distances than any other planet including our Moon. With all this in mind, the author of this text took the liberty of

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heartfelt thank-you to the following volunteers who gave their time, energy, cheerful encouragement and inspiration in undertaking this refurbishing of our observatory: Rick Vandenberg, John Chapman, Tanya Chapman, Michael Levy, Dan Collier, Rick Gregory, Mark Eburne, Wayne Lyons, Kenneth Lui, Leigh Cummings, Terry McComas, Bob Heslop, Rick Clendenning, Chris Redwood, Dale Wilkie, Suzanna Nagy, and the Vancouver Centre Council. Looking ahead, we will re-open the observatory this year. There is still much to do so please contact Alan Jones through aomo@rasc-vancouver.com if you would like to help get our observatory going again. ✸

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coining a new observing term—(the) Great Northerly Conjunction (GNC) of Venus with the Sun.

GNCs are well known for another interesting phenomenon. For a couple of days around a GNC, Venus becomes both the morning and the evening star. Being well above (north of) the Sun, Venus rises well before the sunrise but sets after the Sun. The diagram below shows positions of Venus and Sun relative to the horizon when this phenomenon is best to observe during the upcoming March 2017 GNC.

2049.2

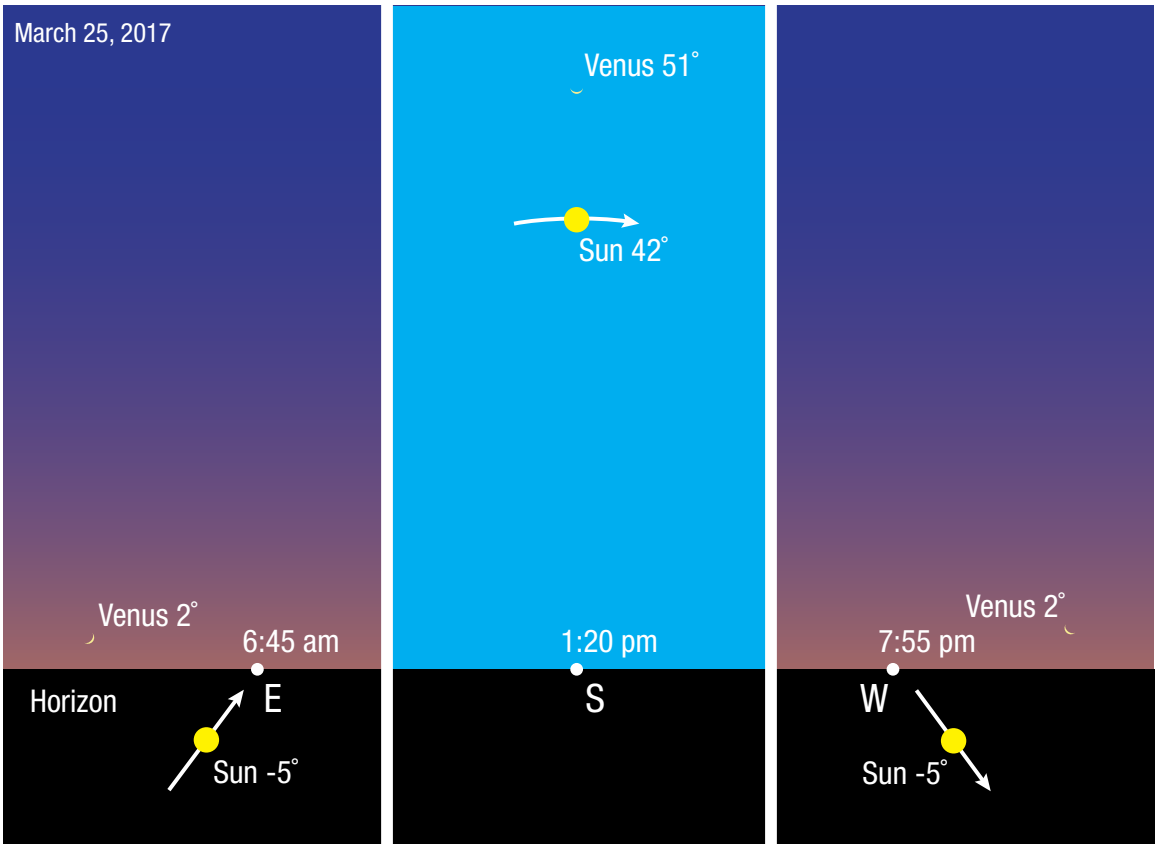
What does the future bring? As each GNC falls a few days earlier in March, Venus is coming closer to the northernmost point in its orbit when it reaches the greatest heliocentric latitude N (above the ecliptic) resulting in even higher departures from the ecliptic. So, the future looks bright, as for the next few decades Venus will keep climbing above the Sun during the March GNCs. However, they will slowly shift from late March into mid-March conjunctions by mid-century (2049).

2117.9

Looking even further into the future, the January ICs, which are now positioned above the ecliptic, will slowly drift into December, turning slowly into near-ecliptic ICs and eventually culminating in a pair of transits. But don't have high hopes of seeing these as the first of them is scheduled for December, 2117.

2017.2

Northern hemisphere observers are encouraged to go out and enjoy this special event, taking precautions of course, as the Sun is always nearby. And as always, this is a weather-permitting event and for Western Canada the late March weather could go either way: a few days of sun in a row or a few days of rain in a row; we certainly hope for the former. ✸

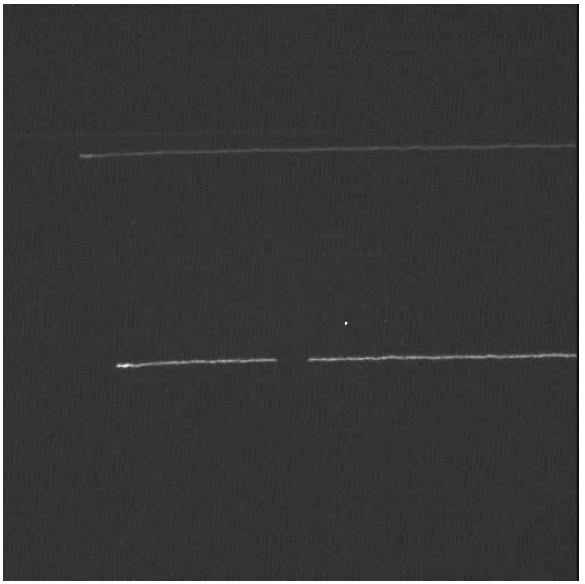


Albedo: Zero Point Zero Low

by Dan Collier

[Editor's Note: This is part 2 of the story from the Nov/Dec 2016 article that appeared under the title, Target for Tonight: Alsatia Niner Seven One*]*

You may recall that in Part 1, Phil Morris and I measured minor planet 971 Alsatia by its occultation of HIP 39077. We were looking good. High fives. Cock of the walk.



But wait! The trail of our two stars ran off the right edge. They had tadpole-like heads. The duration of the dimming seemed long, and it was somewhat too far to the right. Then I noticed the red LED on my telescope drive was still on. I was tired, so I saved the image and soundtrack, dismantled the telescope and the rest of our setup, and loaded the car. The drive home should have taken me a minute. But a heavy dew kept forming on my windshield as quickly as the wipers swept it off. It caught the glare of the rising sun to the extent of complete obscuration. I had to drive around Kits looking for a shady street to get home.

Fatigue caught up with me. Awake at noon, I had a mild cold. I had a queasy feeling about the data, too. I spent an unproductive afternoon studying my image, then put it aside to work on the sound track. Next day as I sipped my morning coffee—I press it French style and take it *con leche*—there came a chill of realization. I opened the trunk to look at my telescope. Ohh! The hemisphere switch had been thrown from North to South. The power switch was identical in shape and close by. I had confused them in the dark!

I have a lot of occultation experience. And let's be honest, my record has all the last-minute cloud-outs, equipment snafus, and downright mistakes that give the word *amateur* its stigma. When everything does go swimmingly, which isn't often, we get appulsed. I feel like a court fool to the Olympians. From my first occultation attempt in 1999, I'd been a video man. I had sensitive TV cameras, a big scope and a real observatory at my disposal. Then it was taken away. I was miffed but accepted the loss. The TV cameras were no good anyway, and the time invested had returned few D/Rs. And I had Phil's feelings to consider too. He has been a loyal, uncomplaining co-observer.

So, I've fallen back on my old 8" Schmidt-Cass and a hand-me-down CCD, and that means drift work. Up to now my experience with drift summed to a couple of negative events. Then, *bam!*—along comes 971.

As far as 1980s telescope design is concerned, this is one of the rare situations where confusing the switches would bite you. It was the kind of mistake two tired operators, even seasoned ones, might make. The lesson had to be learned. Disable the hemisphere switch.

Well, then; so I'd reversed the drive instead of stopping it. Stupid. But there was a chance to save the observation. The star and scope were heading in opposite directions, both at sidereal rate. I would—I thought—simply double the assumed rate of drift. It seemed straightforward. It was not.

What bothered me was how the trail of one of the field stars had run off the field edge. It should have terminated before the edge. My calculation for the trail length was wrong. When I brought up the SIMBAD astrometry for the field and calculated my plate scale, I could see why. The telescope had

not only gone into reverse, it was running faster in reverse than it ran forward. If this was periodic gear error, it was pretty bad. *Back in the day* when I used this scope for hand-guiding my astrophotos, the PE was manageable.

I will skip details and state that for an 8-minute worm, each arc-minute of sinusoidal periodic error (PE) will speed up and slow down the tracking 5 percent. (This is why variable-frequency guiding drive correctors are given 2:1 speed authority.)

Removing the herringbone interference was easy. It had a sine-wave signature and a nearly vertical tilt. Thus, adding the FITS image to itself with just the right downward shift would cancel the interference. This would only work in certain regions of the image, but by trial and error I could clean up the region with the D/R in it.

Now I could correct the brightended "tadpole heads". They cropped up because the telescope had not quite come up to speed when the shutter opened. The star was caught still accelerating. Since the star was bright and the CCD is linear, it was feasible to integrate the data in the tadpole head. First, a constant was subtracted from all pixels to correct for dark noise and skyglow. (My dark frames were affected by herringbone and were useless.) I could now allocate the piled-up CCD charge in the tadpole head into the pixels in advance of it, allowing me to determine where the trail should have started. The correction was about 20 pixels.

A test with the telescope directed at land objects showed that the drive would reverse in 5 seconds. Since the scope was sitting upright for this test, the RA worm was not gravity-loaded. Hence, throwing the switch to SOUTH would push the worm across its axial play limit. A looseness of only .001" here would account for the 5 seconds seen in the test. I think the scope reversed more quickly in the field. The tadpole heads in the science image are not pronounced. The star never stopped on the CCD, and the trails are not fish-hooked. I know from the sound recording that our motions and software delays soaked up 2.23 seconds. I also know the scope had been put well out of balance by the heavy CCD. Its weight would have forced the drive worm constantly toward one end of its axial play. Backlash was present, but primarily in the stepper motor itself.

Whatever the rate, I would measure it from the charge deposited in the pixels along the trail. Again, with plenty of starlight to work with and an instrument that is linear in exposure (unlike TV cameras), it was possible to work out a gain factor in ADU per pixel. The ratio in gain between the trails in the "science" and rehearsal images would be the ratio of the tracking rates in each. I showed that the telescope and the star were heading in opposite directions at 2.15 times the sidereal rate of 13.84 arc-seconds per second (15.041 reduced for dec). My PE is undetermined and is a wild card here. However, the trails in the rehearsal image are just the right length, given the shutter timing and the image scale deduced from SIMBAD.

All the timing phenomena came into perspective. Our D/R times were now within the margin of error for the prediction, and the dimming lasted 1.75 seconds, only a little more than the expected 1.6 seconds for a diametral chord. My goof-up actually made the dimming easier to measure by stretching the trail. This had been a brief occultation because Earth and 971 were moving in different directions. Similar sized Camelia, on the other hand, was coming to opposition, and Earth was overtaking. Camelia's occultation, had we seen it, could have lasted up to 16 seconds.

Just what minor planet 971 is telling us is very interesting. We lucky B.C.'ers are the first to witness its occultation. If we're right, the 61 to 65 km figures in the literature are too small. Because the body has a carbon signature, the albedo is assumed (not measured) as 5 percent—blacker than the Moon's darkest mares. We think it's even darker. The surface is coated with a carbon-rich material whose properties we understand very little. This is why we should engage every opportunity to observe occultations.

Alan was south of the track and turned in a "no D/R". Jim and Guy recorded good D/Rs. They were close to the prediction centreline, and close to one another. Their timings also cross-checked well, notwithstanding how Jim had a problem with WWV reception. Brad Timerson at IOTA stud-

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ied those timings while I was still correcting ours, and published a diagram showing a 52-km minor planet sitting off-centre in the 49-km void between Jim and Guy's D and R events. This would make 971 much brighter, if that's the word, than the average carbonaceous asteroid. When I submitted our D/R, Brad added our points and forwarded the diagram to me for comment with the 52-km depiction of 971 left unchanged. It made our D/R look spurious, while Jim and Guy were awarded an unwarranted finding.

Whether 971 was larger or smaller than the published diameters was a judgment call. However, the smaller 52-km figure seemed to deny our D/R. He could see the gap in the images I sent him. He was waiting for me to make the case for a large, low-albedo body.

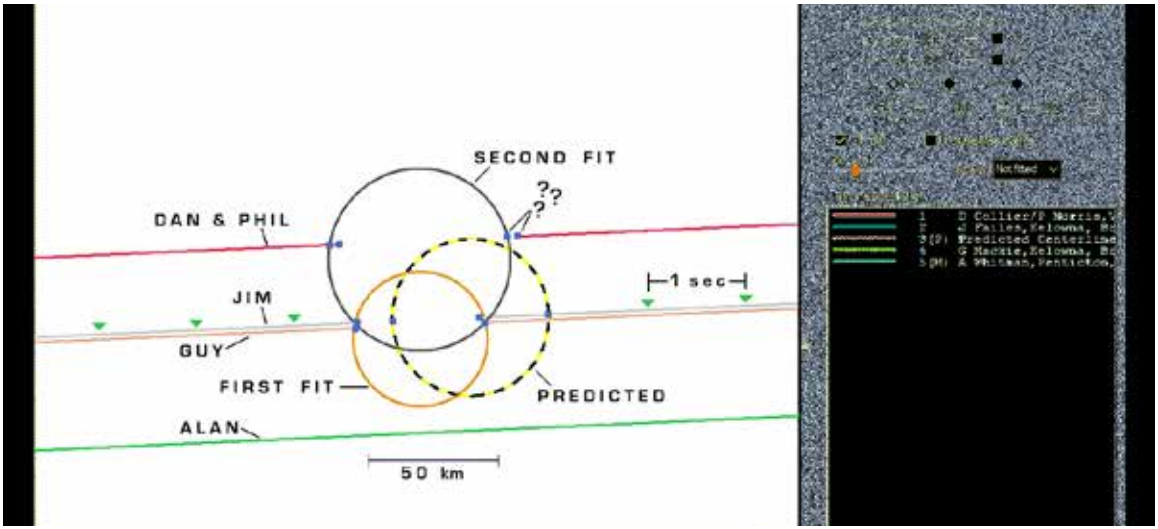
Our D/R would not have happened had 971 gone south. It went north. It went so far north, indeed, that it put its poorly known diameter across our line of sight to HIP 39077. Our dimming was 9 percent longer than the longest predicted, and we don't even know whether we sampled 971's equator or not.

I made these points to Brad who reconsidered. Our "chord" was accepted and 971 was enlarged to fit all the observations. His final result is 69 km and plain round. That's outside the 61-to-65 range in the literature but not overly so, and who is to say we're not right?

We are experienced workers but not champions. Brad has discounted our data. Fitting a circle to 971 is all he can do, with only three observers reporting D/Rs. He has used a circle to make his fit. He has not even given a plus-and-minus for the diameter. That feels right. I have not tried the fitting software myself but I think I can vouch the following. (1) Ours was a nearly equatorial chord, and (2) any major error in my analysis would not change the fitted diameter much.

We had been lucky. The asteroid "shifted" our way—or the star's astrometric position was off, or possibly its proper motion. PM is a major worry of occultation workers and it's getting worse every year. The new astrometric catalogues being collected by ESA's Gaia satellite should help.

Whatever hurt us in the past, it sure worked to our advantage for 971. It's a welcome contrast to our dramatic Ekard appulse in 2009. We drove 2 hours to be under the Ekard centreline and had a serious setback when a tire blew. We observed successfully, but—Dadgummit! *Again!*—no D/R. Precious Ekard skittered away from us and handed brilliant D/Rs to four other guys. Tongue in cheek, I nicknamed myself Asteroid Repellant. Always it was the other observers who were successful. Until now. *Thank you so much, Alsatia!* ✸



Members' Gallery

Moonset over VGH by Milan B

Less than a 2-day-old Moon setting behind one of the VGH buildings in the SW on Dec 30, 2016. You can see the Christmas lights on the building. 2-sec exposure @ ISO 3200 using a Sony Nex3N with *f*7.5 SkyWatcher 80mm ED.

Venus for Christmas by Elena Popovici

Christmas Eve 2016 was a crisp, clear night and Venus (lower centre) sparkled alongside the festive lights. Taken at the VanDusen Gardens Festival of Lights, looking south using a SONY ILCE-5000 camera.