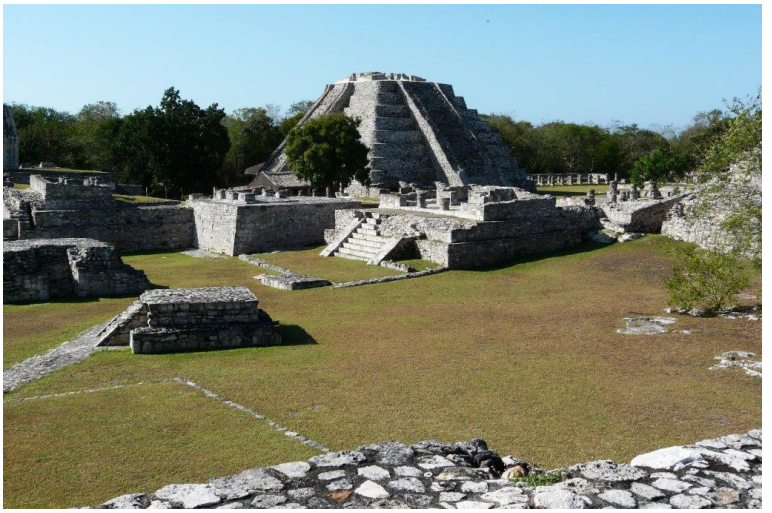
NOVA
NEWSLETTER OF THE VANCOUVER CENTRE RASC
VOLUME 2017 ISSUE 3 MAY JUNE ASTRONOMY DAY 2017

I Stood in the Crater that Killed the Dinosaurs

by Suzanna Nagy

In January of 2017, I had the pleasure of taking a two-week vacation to the State of Yucatan in Mexico. This trip was not intended to be a beach vacation but a chance to experience the colonial history of Mexico. The point of this trip was to explore the city of Merida, the nearby Haciendas, numerous Mayan ruins, and do some snorkelling in the cenotes (underground water caves).



I arrived in the capital city of Merida on January 6 which by chance also happened to be the City's birthday of 475 years. That's right, Merida is 475 years old and the city's history goes back to the times of the Spanish Conquistadors.

But as much as I enjoyed my visit to Merida and other excursions, this essay will focus on two particular days in my 14-day vacation because I had the amazing opportunity to visit the ruins of Mayapan as well visit the village of Chicxulub, where it is said the asteroid that killed the dinosaurs struck.

The ruins of Mayapan are about 40 km south east of Merida. Excavation of Mayapan began in 1939 and remains ongoing. At its high point between the years 1220 and 1440, Mayapan was the political and cultural capital of the region with a city population of approximately 15,000.

While I could have made the day trip over to Chichen Itza, the thought of visiting a site along with many thousands of others tourists did not appeal to me. Also, you are no longer allowed to climb the ruins of Chichen Itza. Mayapan, on the other hand, is a much lesser known archaeological

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MAY 13 SFU	JUNE 8 SFU	JULY 13 SFU
NO REGULAR MEETING IN MAY. Instead, join us for Astronomy Day at SFU on Saturday, May 7. See Meetup for details. SFU	Robert Conrad on the Vancouver Centre Observing Group at the Trottier Observatory; our annual Show and Telescope. Details on Meetup. SFU	Phil Stooke: Mapping asteroids and other non-spherical worlds. See Meetup for details. SFU

Astronomy Day Lectures at SFU

Room AQ3159, Academic Quadrangle

11:00	Stanley Greenspoon	**What's New in the Search for Exoplanets and Extraterrestrial Life**
12:00	Ted Stroman	**Moon 101**
1:00	Robin Adams	**Proxima b, the Planet Next Door**
2:00	Scott McGillivray	**Tales from the Russian Space Programme**

Astronomy Day Activities

11:00am to 3:00pm

- Apollo Rockets and Mission display
- Jim Bernath and his hands-on science activities
- Solar system and Our Planets display
- Planetary Society display
- Solar telescopes (outside the Trottier Observatory, weather-permitting)
- 3 craft tables for the children including alien figures, rocket ships, and phases of the Moon with Oreo cookies.
- Space survival suits
- Solar System Walk and bag toss
- Light pollution abatement display
- *Ambassadors of the Sky* Documentary playing in room AQ3005 at 11am, 12pm, 1pm and 2pm

The Trottier Observatory will also be open for tours throughout the afternoon!

And don't miss out on free door prize tickets for youth to win a telescope!
Details on page 14.

Image credit: Matthew Cimone

President's Message

by Suzanna Nagy

As we celebrate Canada's 150th birthday this year, I would like to draw to your attention to the fact that the Royal Astronomical Society of Canada is only one year younger. In 2018, the RASC will be celebrating our own 150th birthday. The very first meeting of the Toronto Astronomical Club (now the RASC) was on December 1, 1868. On March 10, 1890, the Astronomical and Physical Society of Toronto was incorporated. On February 27, 1903, after petitioning through official channels, His Majesty King Edward VII of England granted permission for the title "Royal" and on March 3, 1903, the society's name was officially changed to the Royal Astro-

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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

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Past President	Mark Eburne
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Trustee	Pomponia Martinez
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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

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Burnaby, B.C.
V5A 4Y0

Map to Meeting Site

Our June meeting is in room SWH10041 of Saywell Hall, halfway down the main corridor. The July meeting is in SWH10081, at the end of the 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).

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nomical Society of Canada. With the change of name, the Society quickly expanded nationally across Canada. The Victoria Centre was established in 1914 and the Vancouver Centre was established in 1931.

In commemoration of our 150th, our National Office has designed a logo for this special event which was just launched and which you will start seeing on all of our RASC promotional materials.

The symbolism of the logo is multi and includes:

- The aurora borealis which is a quintessentially Canadian space-weather phenomenon.
- The crater is the "Manicouagan Astrobleme," an impact crater in the Canadian Shield.
- The stars represent major Canadian contributions to stellar spectroscopy done at the Dominion Observatory, the Dominion Astrophysical Observatory, and the David Dunlap Observatory.
- The globular cluster recognizes the research of Dr. Helen Sawyer Hogg (1905-1993) on variable stars in globular clusters using the Dominion Astrophysical Observatory in Victoria, BC.
- The spiral galaxy represents the work of Canadian cosmologists as well as amateur Canadian observers of deep-sky objects.
- The comet stands for the contributions to cometography by Canadian comet discoverers such as David Levy, Rolf Meier, and Chris Wilson.
- The Moon symbolizes the practice of navigational astronomy on land and water, which was crucial to the exploration and formation of Canada.

As we recognize 150 years for Canada, let's also look ahead with anticipation to 2018 and another year of celebration with the Royal Astronomical Society of Canada. ✸

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site but no less important and it was amazing to find that upon my arrival, I shared the entire site with only two other visitors. In fact, those two other visitors left shortly after my arrival and for about 30 minutes, I had the entire site to myself and my guide for the day (Poncho) before a large tour bus arrived. I also had the opportunity to climb the steps to the top of the main temple which, as previously stated, is no longer allowed at Chichen Itza.

Poncho explained that Mayapan is thought to have been built as a small-scale replica of Chichen Itza with many similar features including temples, gates, frescos, hundreds of pillars, and an observatory—in total over 4,000 buildings.

The observatory (Temple Rodondo) was beautifully restored. It had two circular structures, one inside the other. Visitors are allowed inside the first circle, but no further.

Now I could fill this essay with a bunch of archeological factoids about the ruins of Mayapan but

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Bringing Youth into Astronomy

by Leigh Cummings

Our April monthly meeting of our Vancouver Centre featured an unprecedented number of youth presenters. We had two groups from Harry Hooge Elementary School in Maple Ridge, as well as a student from Templeton Secondary School in Vancouver. Even our first presenter, Scott McGillivray (Global's *Space Talk with Scott*) has no grey hairs (yet). What does this say about our involvement with youth and our role in encouraging their pursuit of learning about the universe they were born into?

Before I get carried away with the bigger picture of science and youth, let me comment on the quality of the presentations we enjoyed at our April meeting.

Caelyn and Ava from Michael Ross's science class at Harry Hooge Elementary, gave a very insightful presentation titled "Should we be Spending Money on Space Research?" Two of their team members who were unable to attend were Cameron and Braydon, however, they were well represented by their two classmates. Their presentation proved to be a good representation of how to approach a question of science ethics in an analytical, critical method. They showed insight not only into how to gather data and analyze it, but also how to put weight on opinions and allow for margin of error. Whether we agree or disagree with their conclusions is not as important as their understanding of how they reached their conclusions. At their age, I believe that understanding the process will serve them better as they progress through their future grades.

The second presentation was by another group from Michael Ross's science class. They were a three-member group represented by Cole and Tristan. Their third member, Jake, was an international student who had already returned home to Korea. Their presentation was in the form of a YouTube video titled, "How Might Solar Flares Affect the Earth?" I was totally entertained by the show. They displayed a talent for video creation and editing beyond their years. As well as entertaining, the show was well researched, informative and factual. I see future documentarians in the making here.

I had several members as well as non-members comment to me about how much they enjoyed both presentations. The staff and parents at Har-

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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

May
13 – Astronomy Day at SFU

Jume
30 - July 3 – RASC General Assembly in Ottawa

July
22 - 30 – Mt. Kobau Star Party
22 – Solar Event, Campbell Valley Regional Park

August
12 – Perseid Meteor Shower at Aldergrove Lake
19 - 26 – Merritt Star Quest

December
14 – AGM

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ry Hooge School should be proud of their young scientists.

After our youngest presenters finished, we had a presentation by our very own youth council member, Francesca Crema. She is a grade 12 student at Templeton Secondary School and has participated in its Mini School as well as a member of Templeton's STEM program. She gave us a presentation that spanned two school years. She started by reviewing her last year's project with teammates Dexter Hines, Huxley Witts, Natasha Roussopoulos, and Philip-Maynard Davies. Their project was muon-detecting. Francesca outlined what muons are, how they detected muons, and then presented the interpretation of the data they were able to collect. She then proceeded to explain the project that she is involved in this year. She is part of a new team consisting of RASC youth members, fellow Templeton student Dexter Hines and Nevada Janzen from Pitt Meadows Secondary. Their ongoing project involves the Trottier Observatory with the aid of SFU's (and RASC member), Dr. Howard Trottier. They are collecting data to do a study of Cepheid variable star, RT Aurigae. Francesca's presentation explained what a Cepheid variable is and how they plan to use the spectrograph and camera on the Trottier Observatory telescope to collect data on the star. Their project will involve studying the star's radial velocity as well as the apparent magnitude. After charting their results they will be able to compare their work with past historical studies of the same star to see if there has been a change in the star's behaviour over time.

The very next day after giving her presentation to our centre, Francesca took her show on the road to Sechelt to share her experiences with the Sunshine Coast RASC Centre. I have heard that her visit was eagerly anticipated by the members as well as the public.

Our last speaker of the night was our own Robin Adams, who gave an entertaining talk about Proxima b, "The Exoplanet Next Door." You will also be able to hear his talk at Astronomy Day.

I have had a number of members as well as the general public tell me how refreshing it was to have an evening of young presenters at our meeting. This is not to detract from the many fine speakers we regularly have at our monthly meetings, but rather an acknowledgement of the quality of the work being done by our young future scientists. I hope that we can make this sort of evening a regular event in the future, as a public showcase for schools that are embracing the project learning format.

Without falling into the worn out dialogue about the "good ol' days when I was in school," I do ponder the vast changes, just in my lifetime, that our school system is going through. It seemed that in my school days the main job of teachers was to pound as much information into our heads as could be crammed, in the hopes that we would figure out how to use it. The teachers that I remember and admired best are the ones that didn't practice the accepted method of the day, but instead tried to relate our new-found knowledge to what was happening in the world around us.

Times have truly changed. Few human brains can keep up with the amount of new knowledge that deluges us every day. We rely on computers to store facts and data in order to free our minds to process this information. Then there is the internet. I find the internet both an indispensable tool as well as a cesspool of nonsense. As we try to navigate one of the most powerful sources of knowledge that humanity has ever had at its disposal, we are also con-

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anyone can Google that. What I want to share with you is my experience of this visit. It was glorious sunshine that day yet 100% humidity as is often the case in the Yucatan. I felt thankful for a small breeze that swept through occasionally. As I walked amid the ruins with Poncho, the silence was overwhelming. The rainforest that circled Mayapan seemed to trap all the sound—the same rainforest that had once completely covered and hidden the ruins until only a few decades ago. As I followed Poncho into the tree-line to view some ruins in the back of the complex that had not yet been restored, I was amazed looking at what seemed like a pile of rubble but was in fact the stones of an ancient house. I was even more amazed at the amount of work the archeologists had done to take a pile of rubble and restore the rocks into an actual building. The main temple

was once a pile of rocks too until the archeologists restored the many tiers and steps. When climbing to the top of the dizzying height of the main temple, Poncho pointed to the tail of an iguana poking out between the stones. I thought it was the tail of a dead iguana but upon taking a closer look, got scared when the tail moved and suddenly disappeared underneath the steps—telling me that the interior of the temple now belonged to the iguanas and not the ancient Mayans. Taking in the sight from the top, there was not a hill or mountain anywhere, reminding me that this entire area of the Yucatan was flattened when it was hit by the dinosaur-killing asteroid (more on that later). Knowing the contributions that the ancient Mayans have made to astronomy, I felt blessed to have had the opportunity to walk the same paths and climb the same steps that the ancient Mayan astronomers had.

I also had the opportunity to visit

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fronted with bad data, half-truths and even outright lies every day. Sometimes this even happens from our more traditional sources. How do we avoid being misled by our own biases and prejudices? We need to develop a new "critical thinking toolbox" to enable us to use the internet sources effectively. This is not an intuitive process but a learned process.

If our children and grandchildren are to become informed and decisive citizens in the future, they will have to develop strong critical thinking skills as well as a greater understanding how science works. When students experience project learning, they gain a deeper understanding of how the scientific method works. They learn how to collect data, how to calibrate data, and how to process the data they collect. They can learn the difference between being a theoretical scientist and an experimental scientist. Their projects will also face a simple form of peer review, and they will gain insight into the importance of that process. This can give greater insight into how to tell the difference between real information and false or "spun" information.

Not all young students today will become scientists but I believe it is more important than ever that, no matter what career they end up pursuing, they learn the language of science.

I believe that The Royal Astronomical Society of Canada has an important role to play in this future of education. Vancouver Centre's alliance with SFU's outreach programs has enabled us to bring our resources to the aid of the public and private school systems to enhance the experience of students in the astronomy and physics disciplines of science. I have found that every volunteer that has helped out with student projects or a science night at our schools has come away richer for it. I know I have. I encourage our members to make themselves and their equipment and resources available to bring more youth into the wonders of astronomy that we love so much. ✸

Start with Imaging the Solar System – It's Easy

by Ken Jackson

Many of us marvel at fabulous images of deep-sky objects like galaxies and nebulae and want to get started with astrophotography. Yet taking such photographs yourself is challenging—there is a long learning curve, a great deal of precision is required, and the equipment is expensive. Starting out by imaging solar system objects—such as the bright planets, the Sun, and the Moon—is much easier and less of a strain on the wallet. After a short start-up period, you will probably be proud enough of one or two images to print and frame them—I did!

Amateur astronomers have developed techniques to produce high-quality images of solar system targets using cheap webcams or video cameras along with a laptop computer. I began imaging solar system objects over ten years ago, starting out with beginner equipment and upgrading the equipment as my skills improved.

There are many advantages in starting with the solar system. Targets such as the Moon, Jupiter, and Saturn are bright and easy to locate through a telescope even in heavily light-polluted skies. Any decent telescope can capture good images, including scopes with small apertures: Scopes as small as 70mm have taken images where Jupiter's bands and Saturn's rings are apparent. Inexpensive (about $100) webcams are capable of producing good results. I took many of my images through an100mm refractor with a Philips SPC900 webcam. Processing the raw videos into a quality image is much easier than with deep-sky objects. The processing software is free, and the software is getting more powerful while becoming easier to use.

The steps involved in taking and processing solar system images includes the following:

Equipment Preparation: setting up the telescope, mount, cam-

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two other Mayan archaeological sites on other days (Xumal and Kabah) but my day at Mayapan was by far the most memorable.

On another day, I visited the village of Chicxulub, about a 30 minute drive from Merida. Chicxulub is a coastal village and the closest town (present day) to the impact crater made by the asteroid that killed the dinosaurs. The crater is now called the Chicxulub Crater.

The Chicxulub crater was discovered in the 1970s by geophysicists, Antonio Camargo and Glen Penfield, who had been looking for petroleum in the Yucatan.

The main plaza of the village of Chicxulub is decorated with statutes and plaques explaining the geological history of the area (written in Spanish of course).

To most Canadians, visiting Mexico means sun, sand, and surf. But if the opportunity presents itself, I highly recommend taking time to visit these lesser known but yet still oh-so-important regions of our most southern neighbour. Mexico, but especially its southern states, is filled with geological and anthropological histories. There is certainly more to a visit to the Yucatan then just beach and margaritas (although I admit to indulging in the latter). ✸

era, and computer to locate and track your target object.

Capture: recording a short video, often just a few minutes long, onto the laptop.

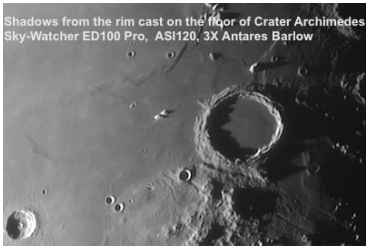
Quality Filtering and Stacking: Accepting only the high-quality frames from the video then combining the high-quality frames to produce a single image.

Final Processing: Sharpening and adjusting contrast, colour, and brightness to produce a final image.

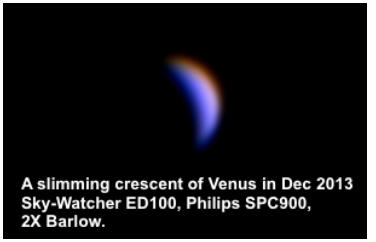
Solar System Targets

A general rule is to try to image objects when they are high above the horizon to reduce the effects of atmospheric turbulence. Jupiter is in good position now. Saturn doesn't rise until around midnight in May but will rise earlier and be in a better position as we progress into summer.

You can use free software such as Cartes du Ciel, Stellarium, or SkySafari to help you pinpoint the location of the planets in the sky. Many of these programs let you zoom in on targets to see more detail such as the phase of the Moon, alignment of Jupiter's and Saturn's moons, and the visibility of the Great Red Spot on Jupiter.



Moon: The moon is a great first object for learning how to image. It is easy to find, is visible during most clear nights of the year, and it shows interesting detail in its craters, valleys, mountains, and "seas." The lunar terminator (the boundary between day/night) sweeps across the moon as its phase changes. Imaging craters and other features along the terminator boosts the contrast and highlights the shadows cast by mountains and the crater rims as seen in the image of Crater Archimedes.


A slimming crescent of Venus in Dec 2013
Sky-Watcher ED100, Philips SPC900,
2X Barlow.

Venus: Although close and bright, Venus is somewhat disappointing because there is little or no detail visible. Its thick atmosphere obscures the surface and the clouds have a uniform appearance. However, an interesting aspect of Venus is its changing phases, similar to the changing phases of the Moon. It appears as a large, thin crescent as it comes around to the near side between the Earth and the Sun but transforms to a smaller quarter phase when at its maximum elongation from the Sun.


Mars at Opposition in May 2016
Sky-Watcher ED100, ASI224, 3X Barlow

Mars: It is difficult to image details on Mars, except when it is at opposition, because of its small apparent size. Oppositions occur roughly two years apart. The next opposition is July 28th, 2018 which will be the closest approach of Mars to the Earth since the record opposition of 2003. As a result, Mars will appear significantly larger than it did during the opposition last year in 2016. Images of Mars during opposition can show surface features such as Syrtis Major, Olympus Mons, and ice at the polar caps. The rotation rate of Mars is close to that of Earth (24.6 vs. 24 hours) but the small difference means that different features are visible if you take images several days apart.


Changes in the Inclination of Saturns Rings from 2008 to 2016.

Saturn: Just the rings are enough, but even small telescopes are capable of showing divisions in the rings and bands in the planet's clouds. If you take images over

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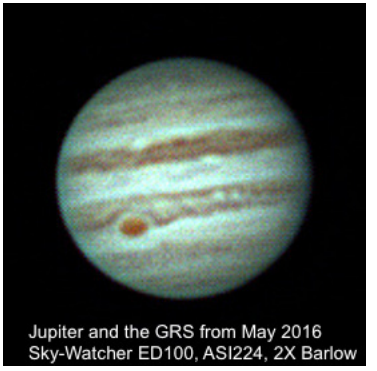
Jupiter and the GRS from May 2016
Sky-Watcher ED100, ASI224, 2X Barlow

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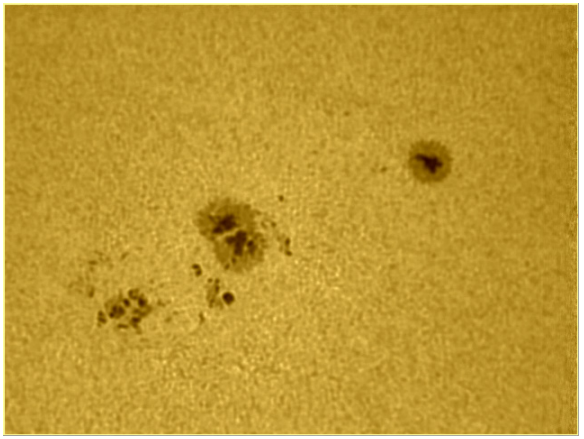
several years then your images will show how the inclination angle of the rings changes.

Jupiter: The Great Red Spot, storms, and the Galilean moons make Jupiter one of the most popular targets. The Galilean moons are constantly changing position and a transit of a moon or its shadow across the face of Jupiter makes an intriguing shot.



Sun: Special filters are required to prevent too much light from damaging your equipment or your eyes! The least expensive filters are homemade using Baader Asrofilm. Sunspots can be imaged using these filters, but imaging solar flares and prominences requires a more expensive Hydrogen-alpha filter.

Techniques

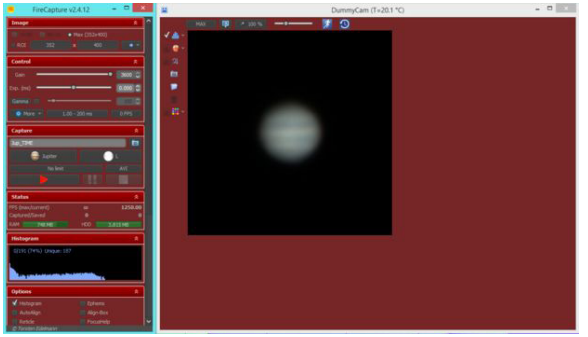
Equipment

Imaging can be done with any telescope that allows interchangeable 1.25" eyepieces. I started out with a no-name/beginner 150mm Newtonian Telescope but have also used an Intes 150mm Mak-Cas, a Skywatcher 100ED Pro refractor, and a Celestron 200mm EdgeHD.

While not strictly necessary, it is recommended to have a mount that tracks the stars as they move through the sky. A tracking mount lets you take a video of your target without it moving out of the field of view. The tracking does not have to be very accurate as the software used in processing can compensate for many tracking errors. I started with a low-end non-tracking equatorial mount but added an RA motor, for less than $100, that provided rudimentary tracking. Now, I often use a Skywatcher EQ-5 Pro equatorial mount that tracks much better. Alt-az mounts can also be used.

Video cameras and webcams that capture many frames-per-second excel at solar system imaging. Even inexpensive webcams (under $100) are capable. I started with hacking a Logitech 3000 webcam: sawing the camera in half and mounting an old eyepiece barrel on it so that the camera fit into the focuser. Today, webcams can be fitted into a 1 ¼" barrel using commercial adapters that cost less than $15. I used one of these adapters with a Philips SPC900 webcam. Last year, I upgraded to a ZWO ASI 224MC—a well-regarded but more expensive planetary camera. The ASI 224MC uses a highly sensitive Sony sensor with low noise. It has a high-speed USB 3.0 port that supports capturing videos at a rate of more than 100 frames per second. The camera includes a nosepiece adapter, so it is ready to use with no hacking. These cameras currently sell for around $400. I do recommend adding an IR-cut filter for an extra $40 to this camera to make the colour adjustment during processing easier.

Almost any laptop computer released within the last ten years can be used. Ideally, the computer and the webcam should both support USB-2 or USB-3. Make sure there are a few gigabytes of free disk space to record your videos. I use a small HP notebook running Windows 7 and installed FireCapture (above) for capturing video (iCap and SharpCap are popular alternatives), AutoStakkert for quality filtering and stacking, Registax for



sharpening, and Gimp for final image processing.

A few other accessories are useful. A wide-field eyepiece helps to locate the object in the telescope because it shows a larger circle of the sky. I often use an eyepiece with a focal length of 25mm to 40mm. An eyepiece with roughly the same field of view as the camera can then be used to precisely centre the target on the camera. I use a 15mm eyepiece for this and have attached a para-focal ring to the eyepiece so that it has roughly the same focus point as the camera.

A Barlow is a lens, mounted in an adapter, that increases the magnification. A Barlow is not required but is helpful in creating larger images of small planets. One end of the Barlow is inserted into a telescope and an eyepiece or camera is inserted at the other end. I use a 3X Barlow when the seeing is good but falling back to a 2X Barlow when conditions aren't as good.

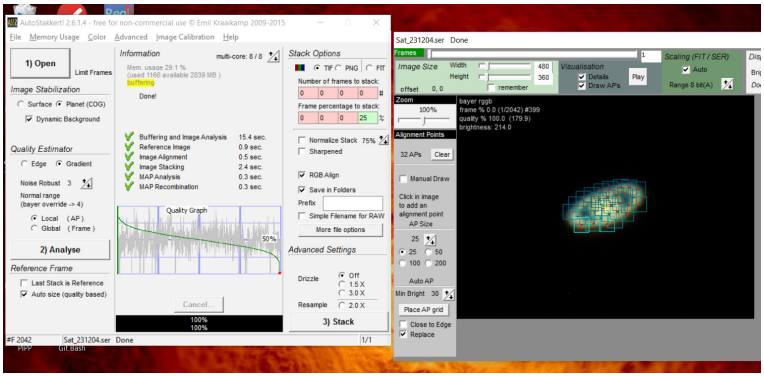
To summarize, you can start with the basics:

- Any telescope that supports 1 ¼" eyepieces,
- Any mount, but preferably a tracking mount to make getting started easier,
- A cheap webcam with 1 ¼" adapter to attach the webcam to the telescope,
- A laptop computer compatible with the webcam.

Then upgrade as your skills improve.

Capture

Set up the telescope on the mount and align the telescope. Precise polar alignment is not necessary as the stacking software can compensate for tracking errors and de-rotate frames from captured videos. I often polar align my equatorial mount by roughly pointing the polar axis towards Polaris. Collimate your telescope to align the mirrors or lens and obtain the best images. Thierry Legault has written about the importance of collimation at http://www.astrophoto.fr/collim.html



Locate and focus your target object through your telescope and a standard eyepiece. I usually run through a series of step-wise increases in magnification using a wide-field 40mm eyepiece, a 15mm eyepiece, and finally the 15mm eyepiece with 3X Barlow (dropping back to 2X Barlow if the seeing is not good).

Boot up your laptop with the camera attached and insert the camera into the telescope using the adapter. Insert the camera into the diagonal or Barlow when using those. Start up your capture software. Hopefully, a live preview of your target will be displayed on the laptop; if not then try increasing the gain and exposure settings to make the object brighter.

Adjust the focus by looking at the preview on your laptop.

Adjust the camera gain and exposure settings. Firecapture has pre-built suggestions for different objects: the Moon, Jupiter, Saturn, etc. I usually start with one of these pre-built suggestions then tweak them a bit. Look at the histogram as you make adjustments. The goal is to get the highest histogram values that do not result in clipping. Clipping occurs when the value exceeds the maximum bit depth of the camera. Webcams like the Philips SPC900 collect 8 bits per pixel so the maximum value is 256 while the ASI 224 can collect up to 12 bits per pixel, so the maximum value is 4096. Fine-tune the focus after adjusting the camera settings.

Start recording a video. Don't capture too much video—just a few minutes is usually sufficient. Longer videos burn up more storage space and object like Jupiter can rotate on enough on their axis in a few minutes to blur details in the image.

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Quality Filtering and Stacking

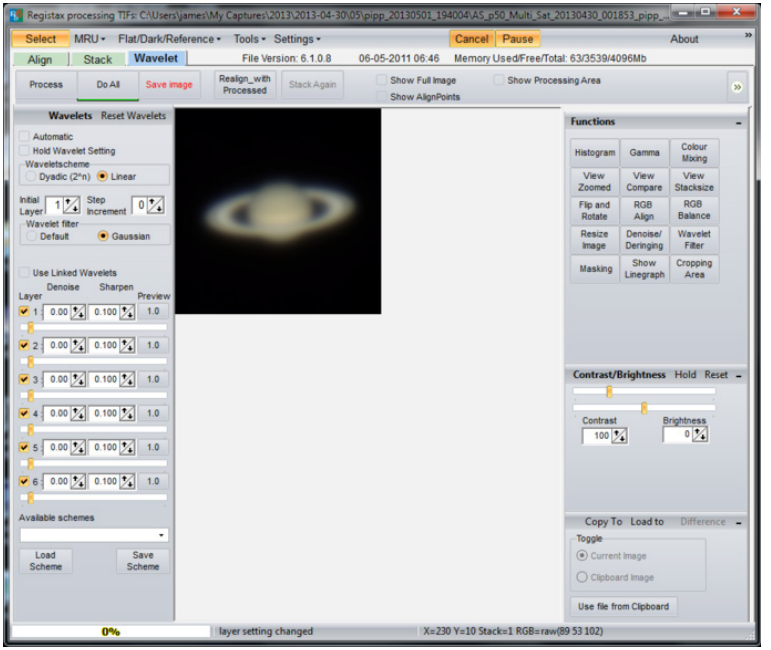
I use the AutoStakkert software (AS!2, previous page) for initial processing of the video. Processing can be done during daylight hours to save precious night hours for additional imaging or observing. Processing can be done on your laptop or using a more powerful computer. I usually transfer the captured video from my laptop to a more powerful desktop with eight processor cores to make the processing go faster.

Open the video in AutoStakkert. In the Image Stabilisation section, make sure that "Planets" is selected for small planetary targets. "Surface" is used for images of the Sun or Moon where the surface takes up a large part of the image.

Click the "2) Analyse" button and AS!2 will scan the frames in the video to determine the quality of each frame and produce a Quality Graph. The Quality Graph shows the quality of each frame as a grey line while the green line is the quality level with the frames re-ordered by quality. The "Stack Options" box at the top right gives you control over how many poor quality frames to accept or reject. In my experience, accepting just 25% of the frames often results in a better final image when I have captured 1000 or more frames in the video. Leave the other options for the time being.

Now go to the window with the capture frame displayed. You need to set the number and size of the boxes used for stacking. To get started, choose a box size of 25 and let AS!2 place the boxes automatically by clicking the "Place APs in Grid" button.

Go back to the first window and click the "3) Stack" button. AS!2 will spend some time stacking the accepted frames and eventually tell you it has done 100%. Save the image in preparation for final image processing.



Final Processing

I use the Registax software (above) for sharpening the stacked image. Click "select" and load the stacked image file. The wavelets section is used to sharpen the image. Adjust the layer sliders on the left to sharpen the image at different scales—the Layer 1 slider affects the fine detail while the Layer 6 slider affects coarser features.

I use Gimp, a free alternative to Adobe's Photoshop, for final image processing including adjusting the histogram using curves, colour adjustment, scaling, and cropping.

Start with the Basics then Advance

Solar system imaging is an easy way to get started with astrophotography. There are a variety of interesting targets to pursue and the required equipment is not expensive. Outstanding images are possible with more advanced techniques and more expensive equipment. Check out Damian Peach (http://www.damianpeach.com/), for some truly superb images of solar system objects. You can try out the more advanced techniques after getting started with the basics outlined in this article. ✸

Jupiter Motion

by Milan B

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Every 13 months or so, Jupiter, the largest planet in Solar System, reaches the same position in the sky relative to the Sun looking from Earth. This is called the synodic revolution. Since Jupiter and other external planets move around the Sun in the same direction as Earth, their synodic periods are always longer than one year.

The two interior planets orbit the Sun in the same fashion as well, but Mercury's synodic revolution is less than one year, making it the only planet in our Solar System that does so. This is due to Mercury's immense speed at which it orbits our star, making it the fastest moving planet in our Solar System.

For exterior planets, orbiting in the same direction, this rule applies: the farther from the Sun an exterior planet is, the shorter the synodic period of that planet is, as it takes Earth, the faster moving planet, less time to "catch up" with the distant planet and overtake it.

11.86

The actual time that it takes Jupiter to make one full orbit around the Sun (a Jupiter year) is about 11.86 Earth years. This is a very interesting number as it is so close to 12, arguably one of the more perfect numbers in nature. This will result in Jupiter travelling, on average, about 30 degrees in the sky every year. In one Jupiter year, Earth will make almost 12 orbits around the Sun while Jupiter will make one full orbit. Since they move in the same direction, Jupiter and Earth will be "aligned" with the Sun 12 – 1 = 11 times in this twelve year period, so roughly, every 12/11 of a year.

Since Jupiter's orbit is fairly elliptical, the speed at which Jupiter orbits the Sun will vary according to Kepler's laws. When it is closer to its perihelion (as in 2010/2011 and 2022) Jupiter will move faster, while when it is at the opposite end, closer to its aphelion (as in 2017) Jupiter will move slower.

65

There is an amazing device that many of us wear on our (mostly left) wrist—an analogue watch, and there is an amazing coincidence that connects an analogue watch and Jupiter. Every 65 minutes or so, the smaller minute hand of an analogue watch crosses paths with the longer, slower moving hour hand. The two hands ac-

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tually cross paths 11 times in 12 hours, so it happens every 12/11 of an hour which is just under 65.5 minutes. The first "meeting" after noon/midnight will happen at around 1:05:27, the next one is firmly scheduled for 2:10:55 and so on. Since the speed at which the two hands move around is uniform, so it is very easy to calculate these times.

For Jupiter, however, the times between two fixed events relative to Earth and Sun (i.e. two oppositions) vary due to variable speeds of both planets in their respective journeys around the Sun. This will result in Jupiter oppositions sometimes falling less than 13 months apart, while sometimes they will happen more than 13 months and 7 days later.

On April 7th, Jupiter reached opposition for 2017. In the current epoch, the oppositions of Jupiter occur in early spring. In 2016, that was on March 8th while in 2018 it will be May 9th. Very soon the oppositions of Jupiter will drift into summer months and if we continue like this long enough, we will end up having an opposition-less year for Jupiter. The previous one was 2013 while the next one is 2025, 12 years later as expected. This actually is the case with all planetary phenomena (conjunctions, stationary points etc.) of all exterior planets. The frequency of these "no-event" years is closely linked to their respective orbital periods around the Sun.

If Jupiter doesn't look as bright these days as it does at other times to experienced observers, there is a reason for that. By reaching aphelion—the most distant point in its orbit around the Sun—in February, just a couple of months before its opposition, Jupiter "rewarded" us with a very special opposition this year; it was the most distant opposition in this epoch. From now onwards, Jupiter will get closer to both Earth and Sun during its oppositions, year after year, until the next perihelic, super-close opposition of 2022.

Unfortunately, the next few oppositions of Jupiter will not be favourable for the northern hemisphere observers as Jupiter continues its descent into southern constellations. After Jupiter reaches the southern-most point in the sky in this epoch (in 2019), it will slowly start heading back towards the celestial equator, and by 2022 Jupiter will be very close to us and much higher in the sky for northern observers, allowing us, amateur astronomers, to see this beautiful giant planet at its best. ✸

Our youth (under 18) door prize for Astronomy Day at SFU is a SkyWatcher 804AZ telescope (pictured at left). Free tickets will be available at the Membership table in the Academic Quadrangle (AQ).

Members' Gallery

The ISS in Orion by Elena Popovici

The ISS traces a path through Orion, grazing by Betelgeuse (mag. 0.5). On the left, bright enough to shine through the tree canopy, is Sirius (mag -1.46) of Canis Major. In the upper right corner Aldebaran (mag. 0.85) marks the head of the bull in Taurus. A 30 sec exposure at ISO 100.

Comet 45P by Robert Conrad

Comet 45P passes in front of the warped spiral Crowbar galaxy NGC 4656/4657. Taken on February 19th (a few days after the comet's closest approach to Earth as it travelled through the constellation Canes Venatici).

The Orion Nebula (M42) by Robert Conrad
Taken on 11 December, 2016 from the Canary Islands using the online SLOOH telescope.