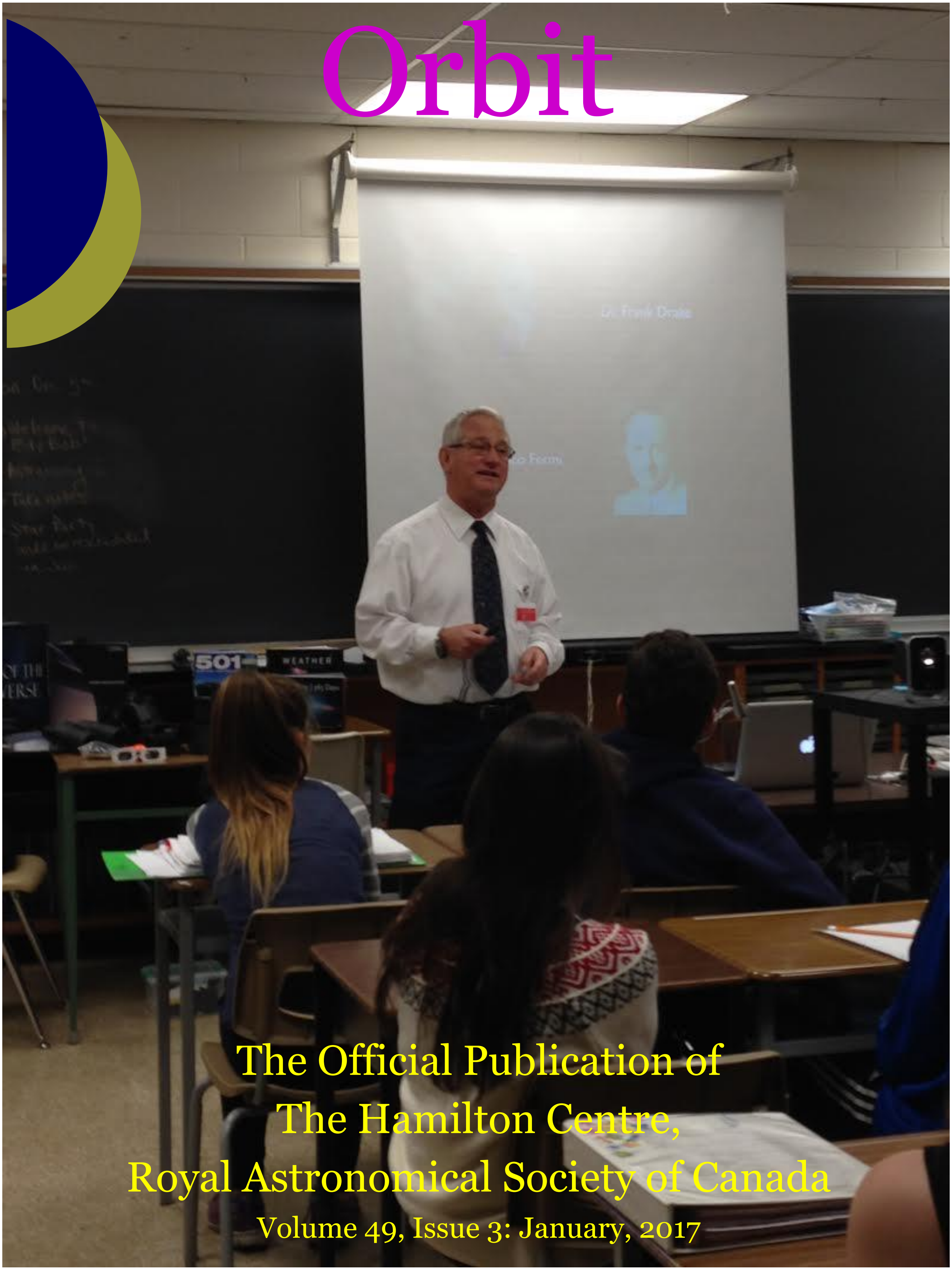

Orbit

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Issue Number 3, January, 2017
Roger Hill, Editor

If you have never seen a total eclipse of the Sun, I cannot urge you enough to make all possible effort to travel to the US in August. If you've decided to wait until 2024, because there's one right through this neck of the woods, you'll be kicking yourself if you're successful or not. If you're successful, you'll have been so amazed at what you saw you won't believe you'll have passed up a good opportunity to see another one. And if you're clouded out in 2024, you won't see another one in North America until 2044.

I have seen three total eclipses: in the Gaspe Peninsula in 1972; Gimli, Manitoba in 1979; and in Baja California in 1991. This works out to about 12 minutes in the shadow of the Moon, and every second is precious. I'm hoping to be successful in three more: Nebraska in August; Chile in 2019; and wherever the weather prospects are best in April, 2024 (probably Texas).

On another note, I finally got my work schedule for the first part of 2017, and the dates for NOVA—New Observers to Visual Astronomy will be:

1. January 30: A Brief introduction to the course and the RASC; Planispheres.
2. February 13: The Motions of the Sky and Seasons.
3. February 20: The Solar System. (Family Day)
4. March 6: Telescopes: Choosing and Using.
5. March 20: The Moon and Eclipses.
6. March 27: Charts, North, Distance, Position and Brightness.
7. April 10: Star Designations, RA, Dec. and Deep Sky Objects.
8. April 24: Stars and a brief history of the Hamilton Centre.
9. May 1: Make up Day.

So, that's about it for this month. See you at a meeting, or at the Observatory.
Roger

Many Thanks, from Mark Pickett

I have been an astronomer for sixteen years with the Toronto and Hamilton Centres and I needed a break. I was still doing astronomy but at a slower pace and on my terms. In the spring I said my goodbyes to the Hamilton Centre and to Westfield. Surprise!!!

We decided to move and started looking in St. Catharines, Paris, Simcoe and other towns in the area. We looked at London too and while there we picked up a 1961 Criterion RV-6 scope at AstroCATS in London.....and we liked the area.

Finally, St. Thomas was on the radar and we ended up buying a 95-year old home in the Courthouse heritage district. We are moving right now and, therefore, no astronomy for a while until I sort out the boxes.

I joined the London Centre a few weeks ago and I mentioned it to Andy Blanchard. He said that he would like to go to the November meeting and introduce the members of the London Centre to me. I went to the meeting and Andy and Gary Bennett were there. Andy was on the speaker list and he and Gary came up to the front and started talking about me. I was really surprised when Gary gave me the Lifetime Associate Membership award. Even now, I don't know what to say other than that I am grateful and amazed.

As a lifetime member I will play a small part in the Hamilton Centre and a greater part in the London Centre. I want to thank you all for many years of memories.

If you are ever going to Fingal or Cronyn for observing, give me a call.

A Visit to St. Andrew Elementary School, Oakville

For four full days, Nov. 21, 23, 24, and 29, Ed Mizzi did Outreach with the students at St. Andrew School. Bob Prociuk joined Ed on the mornings of Nov. 21 and 23 and helped with this exciting program.

The grades 6/7 and 5/6 gifted classes, taught by Ms. Degenhardt and Mr. Smith respectively, were treated to a variety of slide shows, hands-on activities and visual observation and fun was had by all, including Ed and Bob.

On Nov. 21, Bob and Ed took the grades 6 and 7 class outside for a look at the waning Gibbous Moon through both the club's 8" Dobsonian telescope and binoculars. They also invited the students to look at the Moon through the scope (with solar filter) and solar glasses and many wows and oohs were heard. They also taught the students in both classes how to use Star Finders for finding objects in the night sky.

Ed and Bob also quizzed the students with questions about our Solar System, the Milky Way and the Universe and were pleasantly surprised at how much the kids knew. Many students also had questions and comments that were discussed by all.

Ed shared slide shows on Relative Sizes of objects both in our Solar System and beyond, the Moon and Black Holes, but the most interesting conversation revolved around the topic of extraterrestrial, intelligent life and whether we would ever meet other beings beyond our home, the Earth.

Bob and Ed encourage others to do Outreach (adults and children alike) as it is very rewarding and a lot of fun and the great feeling of sharing knowledge with others is well worth the time and effort.

Ed is willing to share his slide shows with others and provide tips and guidance to anyone and everyone.

Please watch the Forum for announcements of upcoming Outreach events and do not hesitate to initiate your own events and post them.

Outreach at Pearson High School—From Ed Mizzi and Bob Prociuk

The Hamilton Centre was involved in another successful Outreach Program, this one at Lester B. Pearson high school in Burlington. Tanya Grigor, a science teacher at the school, invited the centre to share some astronomy knowledge and skills with her grade nine science students, hoping that it would broaden their horizons and expand on the astronomy curriculum she teaches.

Bob Prociuk and Ed Mizzi spend 2 days at Pearson (Dec. 5 & 6) and discussed several topics, using related slide shows. These included the Solar System, relative sizes of planets and stars, exoplanets and extra-terrestrial life, and how to view the night sky, from naked eye techniques to using binoculars and telescopes. A quick lesson on how to use a Star Finder (Planisphere) and a question and answer session rounded out the classes.

Bob and Ed also set up one of the club's 8" Dobsonian telescopes at lunch hour and several staff and students were treated to a view of the Sun along with several sunspots. It was like a mini sidewalk astronomy session with students from grades 9 to 12 participating.

Bob and Ed also planned to return to the school in the evening (7:30 pm – 9:30 pm) to give students a look at the waxing Moon and other objects in the night sky. However, that event had to be cancelled. But the teacher is hoping that we can return in the New Year during a clear evening in January or February, so Ed will be putting out another call for volunteers over the next several weeks.

In conclusion, both Bob and Ed said they had a great time with the students and that it was well worth the visit. They encourage others to get involved in Outreach as it is both fun and rewarding.

Professional Photometry with a Consumer Camera by Gudmundur Stefansson

via Astrobites, Aug 5, 2015

•Title: Precision multi-band photometry with a DSLR camera
•Authors: M. Zhang et al.
•First Author's Institution: Princeton University

Do you own a digital single-lens reflex (DSLR) camera? It's the cameras commonly seen in the enthusiastic hands of photographers and tourists. The authors of today's paper do. Their tourist attraction was the stars in sky. They used their camera for astronomy. They used their camera for science.

The authors wanted to answer the question: "Can consumer DSLR cameras be used for precision photometry from the ground? Can we use them to hunt for planets with the transit method?"

The short answer is, yes, you can.

DSLR: An everyday item for planet hunting

Chances are you have heard of Kepler, the space mission. It uses the transit method to find planets. Kepler has found many of them. Thousands. SuperWASP, HATNet, and KELT are also transit surveys to find exoplanets, but they are run from the ground. Their transit-hunting strategy is similar to the Kepler mission: they look at a large field of view and measure the brightnesses of about 100,000 stars at a time. If a star periodically dips in brightness we have a planet candidate. Collectively, the latter three surveys have discovered around two hundred transiting exoplanets. They are less precise than Kepler, and are really only able to find the biggest, closest-to-the-star planets called Hot Jupiters. They are, however, much less expensive than Kepler. But could they be made even less expensive?

Traditionally, ground based transit surveys use research-grade Charged Coupled Device (CCD) imaging detectors to record their observations. They can cost about 10,000 USD / 6400 €. This is a significant obstacle for the creation of new exoplanet transit surveys, or the expansion of existing ones, as such surveys require a handful of telescopes to monitor the sky effectively. HATNet for example is composed of 7 telescopes. The authors' idea to lowering the startup costs was look for cheaper alternatives to CCDs.

Enter the commercial DSLR camera detectors, called complimentary metal-oxide-semiconductor (CMOS) detectors. These devices have excellent electronic characteristics for their price, driven largely by the demands of the enthusiastic hands. Additionally, DSLRs have the interesting capability of recording three colors simultaneously, while CCDs only see in black and white. DSLR cameras do this with the help of a Bayer filter—a filter with a specific RGB color pattern (see Figure 1)—which sits on top of the CMOS detector. By adding the different color channels together, a broad range of colors can be reproduced. We expect to get the highest brightness precision using the total combined light, but studying the different color channels individually provides an interesting option for simultaneous multicolor photometry. Why not try to use DSLRs to find planets?

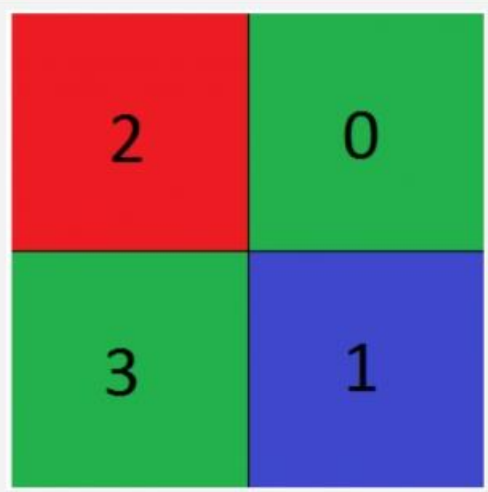


Figure 1: A Bayer filter pattern with 4 color channels, numbered 0, 1, 2, 3, enables DSLR cameras to see in color. Each square represents one pixel on the detector. Figure 2 from the paper.

The authors did. Figure 2 shows their setup: a Canon EOS 60D attached to HAT10, one of the telescope units part of HATNet. The HAT unit itself is a fully automated observatory consisting of a telephoto lens and a CCD. The mount sits inside a small clamshell dome equipped with weather sensors which tell the dome to close during the day and when weather deteriorates.

Figure 2: The inside of the HAT10 telescope unit. The mount holds a CCD, and a large telephoto lens. On the right is the piggybacked Canon EOS 60D DSLR camera with a 135mm f/2 lens. Figure 1 from the paper.

Comparing the DSLR to the CCD—can the former find transiting planets?

The authors had two goals in mind. First, they wanted to compare the performance of the DSLR to the CCD. Second, they wanted to see if the former could find transiting planets.

The authors therefore observed the same field repeatedly using both cameras simultaneously, and took exposures of same length with both. In total, they gathered 4600 frames of the field from February 22 to May 30 inclusive. They had a good reason to choose this field: it was high in the night sky in February, and contains a known transiting exoplanet, KELT-3b. Could they recover it with the DSLR? Could they find other planets too?

Finding a planet

The authors analyze the performance of the DSLR extensively in the paper. In summary, the DSLR performed rather well compared to the CCD. The DSLR reached a precision of 4.6mmag with all color channels combined (mmag, or milli-magnitude is a measure of brightness), which is not much worse than the 3-4mmag the CCD achieved.

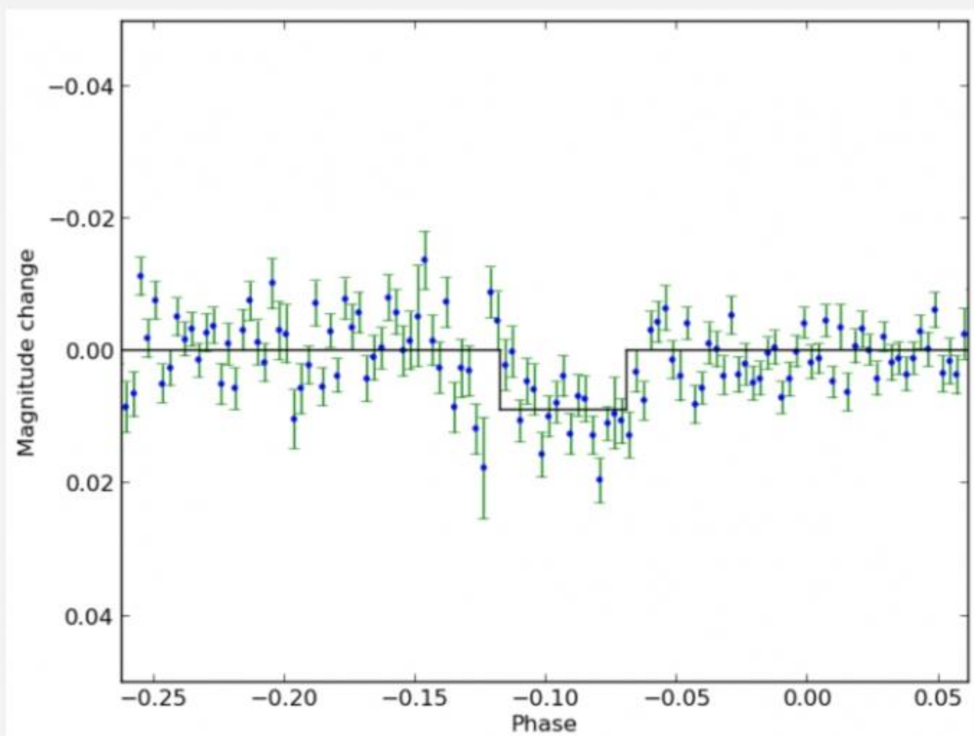


Figure 3: Lightcurve of KELT-3 using the DSLR with all color channels combined. A transit signal can clearly be seen. Figure 13 from the paper.

With this precision the authors found four planet candidates in the field G180. One of them KELT-3b. The lightcurve of the planet is shown in Figure 3. A clear transit signal is seen. Regretfully, follow up with the other three candidates showed that they were all false alarms.

Regardless, this is an interesting result. The authors show that DSLRs are a cheap, and lightweight option capable of finding planets with the transit method. DSLRs are improving at a very rapid pace; each generation is getting better and better. This opens up an array of low-cost options for ground based transit surveys: a spark for their expansion.

The Right Stuff, the Wrong Sex, by Brandon Keim from Wired

IMAGINE IF THE first person on the moon had proclaimed, "That's one small step for a woman, one giant leap for mankind."

It could have happened. In the late 1950s, the United States government contemplated training women as astronauts, and newly released medical test results show that they were just as cool and tough as the men who went to the moon.

"They were all extraordinary women and outstanding pilots and great candidates for what was proposed," said Donald Kilgore, a doctor who evaluated both male and female space flight candidates at the Lovelace Clinic, a mid-century center of aeromedical research. "They came out better than the men in many categories."

The clinic's founder, Randy Lovelace, developed the health assessments used to select the Mercury 7 team, and thought that women might make competent astronauts. It was a radical idea for the era. Women's liberation had just begun to stir, and only a quarter of U.S. women had jobs.

But Lovelace was practical: Women are lighter than men, requiring less fuel to transport them into space. They're also less prone to heart attacks, and Lovelace considered them better-suited for the claustrophobic isolation of space.

In 1959, Lovelace collaborator Donald Flickinger, an Air Force general and NASA advisor, founded the Women In Space Earliest program in order to test women for their qualifications as astronauts. But the Air Force canned it before testing even started, prompting Lovelace to start the Woman in Space Program.

Nineteen women enrolled in WISP, undergoing the same grueling tests administered to the male Mercury astronauts. Thirteen of them — later dubbed the Mercury 13 — passed "with no medical reservations," a higher graduation rate than the first male class. The top four women scored as highly as any of the men.

"They were all motivated to a degree you could not measure. They knew they were ideal candidates, but NASA regulations kept them out of the game," said Kilgore.

Pilot Jerrie Cobb passed the training tests devised by William Randolph Lovelace


Jerrie Cobb on a tilt table

The results of the women's tests are described for the first time in an article published in the September Advances in Physiology Education, and show just how capable they. One set of results, from the sensory deprivation tests, are especially striking.

"Based on previous experiments in several hundred subjects, it was thought that 6 hours was the absolute limit of tolerance for this experience before the onset of hallucinations," write Kilgore and his co-authors. "[Jerrie] Cobb, however, spent 9 hours and 40 minutes during the experiment, which was terminated by the staff. Subsequently, two other women (Rhea Hurrle and Wally Funk) were also tested, with each spending over 10 hours in the sensory isolation tank before termination by the staff."

During the test, the women were immersed in a lightless tank of cold water. By contrast, John Glenn's memoir recounts being tested in a dimly-lit room, where he was provided with a pen and paper. Glenn's test lasted just three hours.

The would-be Mercury 13 astronauts would ultimately be held to a different standard than their male counterparts. Some NASA officials speculated that female performance could be impaired by menstruation. Others wanted pilots who had already flown experimental military aircraft — something only men could have done, since women were barred from the Air Force.

In August 1961, WISP was cancelled. It was not until 1995, when Eileen Collins piloted the STS-63 shuttle around the MIR space station, that the Mercury 13 met again. Collins was the first woman to become a space pilot, but not the first woman who deserved to.

"They knew it was a long shot, but they were willing to take it," said Kilgore. "They were very special people."

Seven members of the Mercury 13 are pictured in front of the space shuttle in 1995. From L to R: Gene Nora Jessen, Wally Funk, Jerrie Cobb, Jerrie Truhill, Sarah Rutley, Myrtle Cagle and Bernice Steadman . Not pictured are: Janet Dietrich (deceased), Marion Dietrich (deceased), Jane Briggs (deceased), Jean Hixson (deceased), Rhea Woltman, and Irene Leverton.

Big Science in Small Packages By Marcus Woo

About 250 miles overhead, a satellite the size of a loaf of bread flies in orbit. It's one of hundreds of so-called CubeSats—spacecraft that come in relatively inexpensive and compact packages—that have launched over the years. So far, most CubeSats have been commercial satellites, student projects, or technology demonstrations. But this one, dubbed MinXSS ("minks") is NASA's first CubeSat with a bona fide science mission.

Launched in December 2015, MinXSS has been observing the sun in X-rays with unprecedented detail. Its goal is to better understand the physics behind phenomena like solar flares – eruptions on the sun that produce dramatic bursts of energy and radiation.

Much of the newly-released radiation from solar flares is concentrated in X-rays, and, in particular, the lower energy range called soft X-rays. But other spacecraft don't have the capability to measure this part of the sun's spectrum at high resolution—which is where MinXSS, short for Miniature Solar X-ray Spectrometer, comes in.

Using MinXSS to monitor how the soft X-ray spectrum changes over time, scientists can track changes in the composition in the sun's corona, the hot outermost layer of the sun. While the sun's visible surface, the photosphere, is about 6000 Kelvin (10,000 degrees Fahrenheit), areas of the corona reach tens of millions of degrees during a solar flare. But even without a flare, the corona smolders at a million degrees—and no one knows why.

One possibility is that many small nanoflares constantly heat the corona. Or, the heat may come from certain kinds of waves that propagate through the solar plasma. By looking at how the corona's composition changes, researchers can determine which mechanism is more important, says Tom Woods, a solar scientist at the University of Colorado at Boulder and principal investigator of MinXSS: "It's helping address this very long-term problem that's been around for 50 years: how is the corona heated to be so hot."

The $1 million original mission has been gathering observations since June.

The satellite will likely burn up in Earth's atmosphere in March. But the researchers have built a second one slated for launch in 2017. MinXSS-2 will watch long-term solar activity—related to the sun's 11-year sunspot cycle—and how variability in the soft X-ray spectrum affects space weather, which can be a hazard for satellites. So the little-mission-that-could will continue—this time, flying at a higher, polar orbit for about five years.

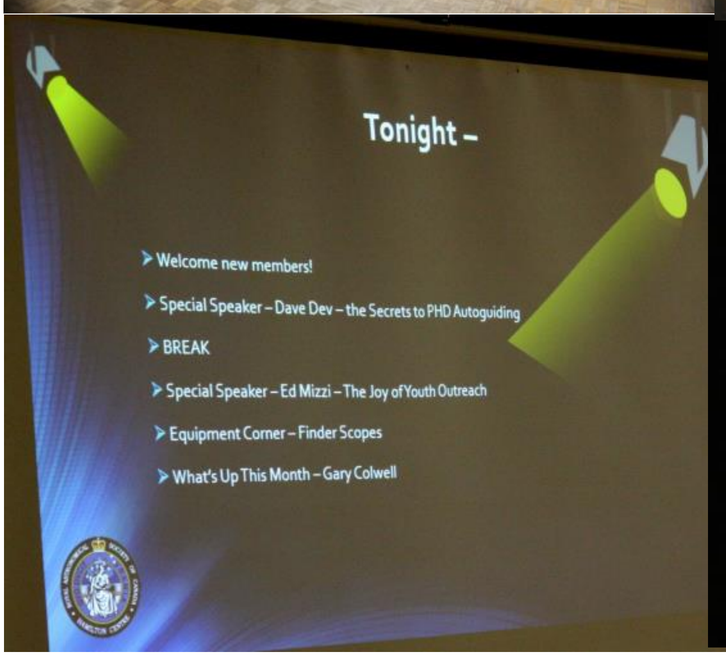
If you'd like to teach kids about where the sun's energy comes from, please visit the NASA Space Place: http://spaceplace.nasa.gov/sun-heat/

Astronaut Tim Peake on board the International Space Station captured this image of a CubeSat deployment on May 16, 2016. The bottom-most CubeSat is the NASA-funded MinXSS CubeSat, which observes soft X-rays from the sun—such X-rays can disturb the ionosphere and thereby hamper radio and GPS signals. (The second CubeSat is CADRE — short for CubeSat investigating Atmospheric Density Response to Extreme driving - built by the University of Michigan and funded by the National Science Foundation.) Credit: ESA/NASA

Hamilton Centre RASC, December 1, 2016: "Monthly Meeting" By Ed Mizzi

Two excellent talks, enlightening, informative, informative and inspiring! The first was by Dave Dev, and anyone who has ever used PHD for guiding needs to see Dave's talk. Fortunately, YOU CAN! Roger Hill recorded it on a small camera, and if you log on to the Forum, you can watch it. We're thinking of doing more of this sort of thing...but it will be for Members Only, and available via the Forum.

The other talk was by Ed Mizzi on his passion for Public Outreach, and there was some good discussion about the Hamilton Centre's outreach program that followed.



Orthodox Christmas from SkyCaramba

If you're not an Orthodox Christian, you probably don't understand why January 7 is Orthodox Christmas. The reason is found, at least partly, in astronomy.

In 46 BC, Julius Caesar set up the calendar system which the Roman Empire would use for centuries and European countries would inherit. The Julian calendar added an extra day every four years to make up for the regular calendar having 365 days in a year but the earth's orbit actually being about a quarter day longer. That kept the spring equinox at about March 21 every year–for some time.

Adding an extra day every four years is actually an overcorrection. It assumes Earth's orbit is exactly 365 days, 6 hours long. But it's really 365 days, 5 hours, 48 minutes, and 46 seconds. Simply adding that extra leap year day every four years without fail adds up to a discrepancy of a full day after 128 years. The equinox happens a day earlier.

That wasn't a big deal at first. An equinox on March 20 instead of March 21 wasn't something most people noticed. By the time the equinox crept back to March 19, the people who remembered it having been on March 21 were all gone. But after about 16 centuries, the equinox was happening about March 11. For the Roman Catholic Church which still used the old calendar for determining when to celebrate religious festivals, it caused problems.

The main problem was that the date of Easter, which happens after the equinox, was also creeping earlier and earlier. The Church's leaders felt it was wrong to celebrate Easter too early. So Pope Gregory XIII ordered an adjustment. He clipped ten days from the calendar in 1582. The day after October 4 was October 15. Another way of looking at the new Gregorian calendar was to say it added ten days to whatever the date was under the Julian calendar. Equinoxes in the years following using the new calendar were returned to about March 21 when the old calendar was only at March 11.

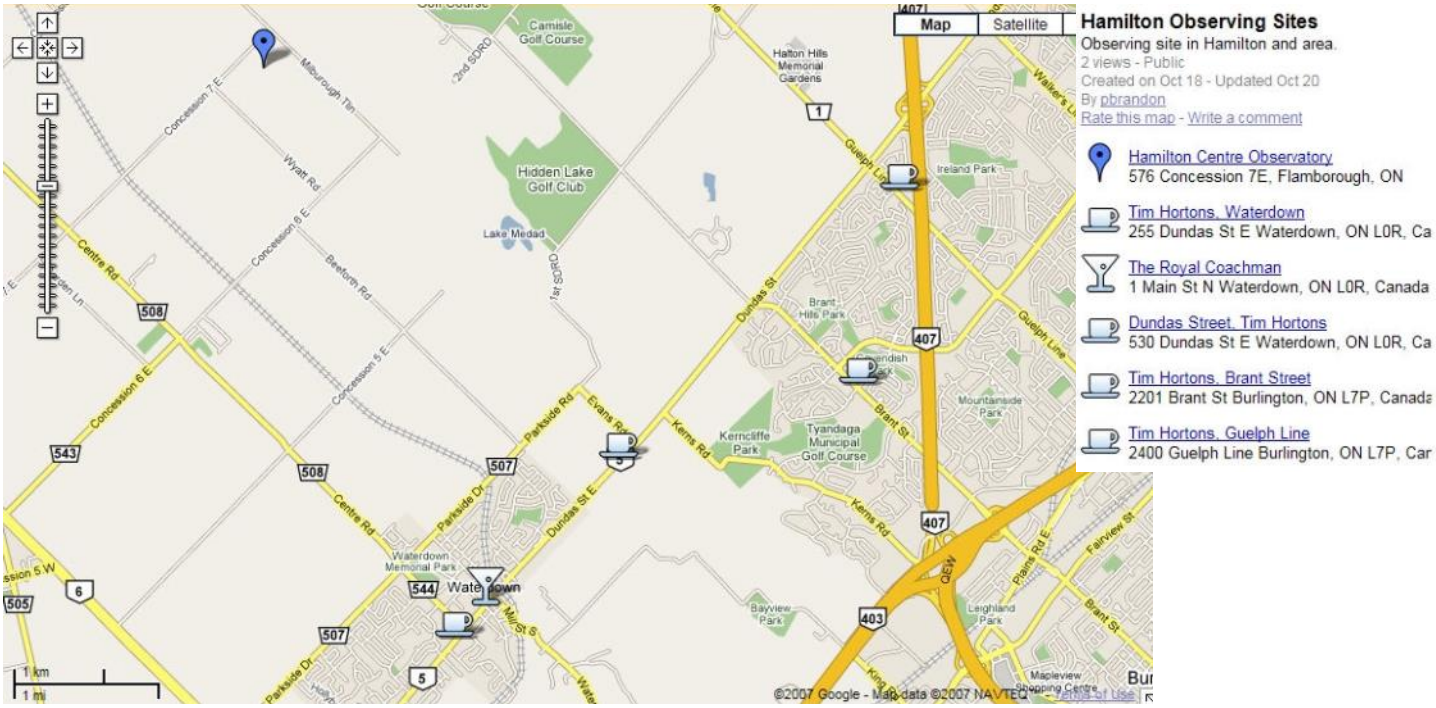
Gregory's order also removed three leap year days every four centuries. If a year is divisible by 100, it is also divisible by 4. However, it is not a leap year in Gregory's calendar unless it is also divisible by 400. So 1600 and 2000 were leap years with 366 days. But 1700, 1800, and 1900 had just 365 days. That's not as close to the ideal situation of removing one leap year every 128 years, but it won't be until 4909 when the Gregorian calendar is again a full day off when it comes to keeping the March equinox on or about the 21st.

In 1582, countries where Protestant and Orthodox Christianity were dominant wanted nothing to do with the Catholic Church's calendar reform. They continued to use the Julian calendar they were familiar with. Sometimes, leaders in the other faiths denounced the Gregorian calendar as part of a Vatican attempt to regain control in Protestant and Orthodox lands. But after more than a century, political and practical considerations merged as the equinox crept even earlier on the Julian calendar and international business relations were increasingly inconvenienced by having to keep track of two out-of-step but nearly identical calendars.

The other countries in Europe began converting to the Gregorian calendar in 1700. The British Empire, including the colonies in North America, switched in 1752. Britain was among the last Protestant countries to make the change. Most churches in those countries accepted the Catholic way of deciding when to observe Easter.

But Orthodox Christians and the countries where they were the majority didn't feel as much pressure to change. They continued using the Julian calendar into the early 1900s. By then, it lagged its rival by 13 days. Deciding it was time to adopt the calendar that even non-Christian parts of the world had begun using, their governments began using the Gregorian calendar. Greece was the last of them in 1923. However, unlike Catholics and Protestants, Orthodox Christians didn't completely set the Julian calendar aside.

As far as today's Orthodox Christians are concerned, when it's December 25 in the United States and Italy, it's also December 25 in Russia and Greece. But they usually prefer not to celebrate Christmas on that day. They wait 13 more days until it's December 25 on the Julian calendar. That Gregorian calendar date is January 7.



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Ed Mizzi not only stars on our cover, but he also took this image of the SuperMoon. He took this on Nov. 14 at 6:24 pm EST, from Boston, MA. He used a hand-held Panasonic Lumix FZ200 bridge camera. ISO 400, f 4.0 at 1/200 sec..

There were some other great pictures of the SuperMoon, too, including a really nice one by Muhammad Ahmad that had the Burlington Skyway in the foreground.

There's lot's of interesting stuff going on in the Forum...it's well worth checking out!