

Highlights of the June Sky . . .

1st
First Quarter Moon
8:42 am EDT

3rd
PM: Jupiter is about 2° to the lower right of a waxing gibbous Moon.

PM: A double shadow transit occurs on Jupiter from 10:22 pm to 12:22 am EDT.

9th
Full Moon
9:10 am EDT

PM: Saturn is about 3° to the right of the Moon.

15th
AM: Saturn is at opposition and closest to Earth for the year.

17th
Last Quarter Moon
7:33 am EDT

19th
PM: A double shadow transit occurs on Jupiter from 10:05 pm to 10:39 pm EDT.

20th
AM: A waning crescent Moon is about 8° to right of Venus.

21st
Solstice: Summer begins at 12:24 am EDT and bring the shortest day of the year.

AM: A waning crescent Moon is about 8° to the lower left of Venus.

23rd
New Moon
10:31 pm EDT

27th
PM: A waxing crescent Moon is just 1° from Regulus.

30th
PM: Jupiter is about 4° to the left of the Moon.

Prime Focus

A Publication of the Kalamazoo Astronomical Society

★ ★ ★ June 2017 ★ ★ ★

This Months Events

General Meeting: Friday, June 2 @ 7:00 pm

Kalamazoo Area Math & Science Center - See Page 14 for Details

Observing Session: Saturday, June 10 @ 9:30 pm

Moon, Jupiter & Saturn - Kalamazoo Nature Center

Observing Session: Saturday, June 24 @ 9:30 pm

Jupiter, Saturn & Globular Clusters - Kalamazoo Nature Center

Astrophoto Workshop: Friday, June 30 @ 9:00 pm

Kalamazoo Nature Center - See Page 4 for Details

Inside the Newsletter. . .

May Meeting Minutes.....	p. 2
Board Meeting Minutes.....	p. 3
Observations.....	p. 4
Astrophotography Workshop.....	p. 4
Astronomy Day 2017 Report.....	p. 5
Eclipse Megamovie Project.....	p. 9
NASA Space Place.....	p. 11
June Night Sky.....	p. 12
KAS Board & Announcements.....	p. 13
General Meeting Preview.....	p. 14



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May Meeting Minutes

The general meeting of the Kalamazoo Astronomical Society was brought to order by President Richard Bell on Friday, May 5, 2017 at 7:05 pm EDT. Approximately 57 members and guests were in attendance at the Kalamazoo Area Math & Science Center (KAMSC).

With our new meeting format in place, Richard started off with his President's Report. We are still searching for a new Publicity Manager. We'll continue to enquire at each meeting until the position is filled. Richard then thanked all the Astronomy Day volunteers, and then discussed his disappointment with this event (see his column on page 4). He thanked Scott Macfarlane, Rich Mather, Jack Price, and Roger Williams for volunteering at the Green-A-Thon on April 15th. Richard also thanked Jean DeMott and Rich Mather for volunteering with him at the Earth Day Festival in Bronson Park on April 22nd. He also thanked Frank Severance and Don Stilwell, who missed much of the meeting since they were selling Eclipse Shades at the Rock & Mineral Show at the Expo Center. Solar observers will be needed at Parchment North Elementary on June 2nd at 1:15 pm and again at Lawton Elementary on June 7th at 1:30 pm. Richard then briefly described the latest issue with the robotic telescope and finished up by reminding everyone about the Solar Filter Workshop on May 20th.

A brief "graduation" ceremony was held for those people that attended all five parts of the *Introduction to Amateur Astronomy* lecture series. Richard presented Certificates of Completion to 13 of 25 people that were able to attend the meeting. Frank & Susan Severance were able to receive their certificates after finishing up at the Expo Center. Congratulations, graduates!

Our guest speaker for the evening, [Dr. David Gerdes](#), is the Arthur F. Thurman Professor of Physics and Professor of Astronomy at the University of Michigan. The title of his presentation was *The Coolest Place in the Solar System: New Worlds Beyond Neptune and the Hunt for Planet Nine*. Dr.



Twenty-five people completed the 2017 installment of the *Introduction to Amateur Astronomy* lecture series. Thirteen of those graduates claimed their Certificate of Completion at the May meeting.

Gerdes started his presentation at Neptune and said the most interesting fact about the last [known] planet in the solar system was that it was discovered in 1846 through mathematical inference due to its perturbations of Uranus' orbit. He then gave a brief history of the solar system itself. The four gas giant planets started out in a stable, compact arrangement, exchanging energy with the surrounding protoplanetary disk containing Pluto-sized objects. This energy exchange caused Jupiter and Saturn to shift their orbits and destabilize the solar system when it was about 700 million years old. This in turn caused Uranus and Neptune to migrate further from the Sun. By the time the solar system was 1 billion years old, Neptune had scattered 99.9% of the disk inward and outward and sculpted the remaining Kuiper Belt into its current configuration.

Pluto, described as the first trans-Neptunian object (TNO), was discovered by Clyde Tombaugh in 1930 while searching for the non-existent "Planet X." When it was first announced, it was initially thought to be more massive than Jupiter. It wasn't long before astronomers realized that Pluto is far less massive than first thought and was the oddball of the solar system. Dr. Gerdes then fast forwarded to 2006, which saw the launch of *New Horizons* toward Pluto and Pluto's reclassification as a "dwarf planet." The road to planet Pluto's demise began in 1992, with the discovery of hundreds more TNOs – some of which rivaled, and in one case, exceeded Pluto's mass.

Dr. Gerdes then described the structure of the outer solar system. In general, it's divided into the Kuiper Belt, Scattered Disk, and Oort Cloud. The Kuiper Belt is a fat disk that extends between 35 - 50 Astronomical Units (AU) from the Sun. Scattered Disk Objects have high eccentricity and orbital inclination, and can extend beyond 100 AU. The Oort Cloud is exceedingly distant and largely unknown. It extends from 10,000 - 100,000 AU from the Sun.

The Dark Energy Survey, conducted by the 4-meter Blanco telescope and 3 square degree field-of-view DECam, at Cerro Tololo in Chile was then discussed. The survey will image one-eighth of the sky in five colors during 105 nights per year for the next five years. Year 4 was just completed this past February. Its goal is to measure the expansion history of the universe over the past 6 billion years to address the question: Why is the expansion accelerating?

Using data from the survey, Dr. Gerdes assigned his undergraduate students to search for TNOs. The region the survey covered contained very few known TNOs, so anything found would be interesting. After an extensive analysis of nearly 16,000 images between 2013 - 2016, Dr. Gerdes and his team discovered an object with a semi-major axis (average distance from the Sun) of 109 AU and an orbital period of 1,135 years. He said it was as faint as a candle halfway to the Moon (magnitude 23.2). The object was designated as UZ₂₂₄ and nicknamed "DeeDee" (short for distant dwarf). It is one of the most distant solar system objects known, only the dwarf planet Eris is more distant. Measuring DeeDee's heat with ALMA, its estimated

diameter is 635 km (about the size of the Great Lakes region). This makes DeeDee massive enough to be round, making it a potential dwarf planet.

Dr. Gerdes then discussed a relatively new class of objects known as Extreme TNOs. They take thousands of years to orbit the Sun in highly elliptical orbits. The really suspicious thing is that their elongated orbits are all on the same side of the solar system. This could be an amazing coincidence, but the probability is very low. If it were a coincidence this accidental alignment would not persist over solar system lifetimes. If this is a permanent feature then something massive is stabilizing it. This has led Mike Brown and Konstantin Batygin to propose the existence of a distant, massive object far beyond the Sun dubbed Planet Nine. It would be ~10 times the mass of Earth with a semi-major axis of ~700 AU. One orbit would take 10,000 to 20,000 years to complete. Part of the proposed orbit crosses the Dark Energy Survey field, so Dr. Gerdes and his team have joined the Planet Nine search.

Our usual discussion period followed the snack break. There were no new *Great American Eclipse* updates or observing reports. Joshua Dickey mentioned the [recent news](#) that the planetary system discovered around the nearby star Epsilon Eridani is very similar in structure to our own. Karen Woodward covered the Portage Green-A-Thon in her cable access show and highlighted the KAS's appearance with an interview with Jack Price. The James Webb Space Telescope is moving to Houston for further testing and SpaceX just launched its first spy satellite. The meeting concluded at about 9:15 pm after covering upcoming events.

BOARD Meeting Minutes

The Kalamazoo Astronomical Society Board met on May 21, 2017 at Sunnyside Church. President Richard Bell called the meeting to order at 5:05 pm. Board members present were Joe Comiskey, Mike Cook, Scott Macfarlane, Rich Mather, Jack Price, Don Stilwell, and Roger Williams. KAS member Jean DeMott also attended. The meeting began as usual with the Treasurer's Report from Rich. He noted that the program which summarizes account balances behaved in a previously unseen and unexplained manner to give some clearly erroneous tallies. Rich had made manual corrections, but further work will be required to reconcile the numbers and to explain what had happened in generation of the report.

A more serious problem arose from the book and merchandise sales at Astronomy Day 2017. The intention was to keep a record of every item sold, along with the sales receipts. The press of customers at times combined with internet connectivity issues overwhelmed the volunteers, and the listing of items sold was incomplete. We were then informed by Fred Espenak that he had not received payment for all of his books that were sold. However, our revenues did not match the amount allegedly sold, and the lack of an itemized list of sales kept us from verifying Espenak's

figures. After extended discussion of the problem, Jack suggested that we offer to reimburse Espenak for his cost (but not the retail price) of the books which had not been accounted for. The Board agreed that this was the best way to proceed. The Board also agreed to pay Espenak for the cost of a hotel room in Tucson for one night. Meanwhile, Rich will send by e-mail a corrected set of financial reports.

Richard summarized the May – September events, since the Board would not meet again until September. These included public observing sessions on May 27th, June 10th & 24th, and July 15th & 29th. An astrophotography workshop is scheduled at the Kalamazoo Nature Center for June 30th at 9 pm. The general meeting on June 2nd will feature KAMSC students reporting on a balloon launch. The Perseid Potluck Picnic will be on July 29th, and the September General Meeting on the 8th will feature member reports on the total eclipse experience of August 21st.

In the follow-up category, Richard reminded everyone that he will be doing a number of eclipse talks, associated with selling Eclipse Shades. He will need volunteers for solar observing after the talks. Some board members volunteered immediately, and Richard said that he would send out an e-mail inviting others to help. The Kindleberger Park Festival on July 15th was mentioned, and Jack said that he still needed to confirm this one. The meeting of regional astronomy groups at Stephen F. Wessling Observatory (near Fremont) on July 22nd was also mentioned again.

In the Robotic Telescope Project update, it was reported that Jim Kurtz had ordered a new board for the mount, but further plans were unknown. Mike Cook volunteered to contact Jim Kurtz and Mike Patton about installation plans for the board. Jean suggested getting the robotic telescope committee together for the first test of the new board. She also asked what our plans were going forward, especially if the new board doesn't work. The primary concerns expressed by the board were that a different component might be faulty, resulting in burning out the new board as soon as it is turned on. The subject of Owl Observatory maintenance that was not completed last year was brought up again. Another work session was set for June 10th at 2pm.

A final agenda item was a critique of Astronomy Day 2017. Richard announced that there would not be an Astronomy Day 2018, at least on this scale and on the "official" date. His summary was that the talks were great, attendance disappointing, and hands-on activities very weak. The major effort devoted to advertising did not pay off as much as hoped, leaving us with a high-quality program seen by too few people. Jean suggested that in the future, we should think of taking programs into the schools, rather than trying to bring large audiences into a big event. There was a general discussion of possible ways to go in 2019, after which Mike Cook led the group in thanking Richard and Jean for their extraordinary efforts on this project.

Because of concentration on the August 21st solar eclipse, the Board planned no other meetings until after that date. The next meeting was set for 5:00 pm on Sunday, September 10th at Sunnyside.

Respectfully submitted by Roger Williams



Observations

by **Richard S. Bell**

Have you ever thrown a party, invited all your friends, but hardly any of them bothered to show up? You work really hard for weeks or months on all the decorations and entertainment, but nobody seemed to care. That's how Jean DeMott and I felt on April 29th. As indicated in the Board Meeting Minutes and the extensive Astronomy Day report beginning on page 5, this year's outreach celebration was a disappointment. I'll go a step further...it was a failure.

Like the sinking of the *Titanic*, a chain of events seemed to occur that led up to a disaster. First, we were unable to hold Astronomy Day at our chosen venue, WMU's Fetzer Center. Then we weren't able to reschedule to an earlier date after learning of all the competing events on April 29th because we'd lose some of our guest speakers. When we lost use of the Dale B. Lake Auditorium at KVCC, it was too late to switch to another location. Our extensive publicity campaign made little difference, in fact attendance may have been even worse if it wasn't such a cruddy day. Sometimes I wonder if the lower attendance was in fact due to the weather. At least one person e-mailed to ask if Astronomy Day was going to be canceled on account of the rain. Clearly he thought it was strictly an outdoor event, completely unaware of all our top-notch indoor activities. Perhaps attendance for at least the main presentations would have been better, but even our own membership failed to turn-out.

The KAS currently has 144 memberships, 54 of which are family memberships. Counting families as two people, that works out to be 198 individuals (even more when counting the children in those families). Now, it's simply not realistic to expect all 198 members to attend Astronomy Day. Let's say about half of those people are expected to attend, which I don't think is asking too much - especially considering the quality of this year's speakers (others may disagree). That works out to be 99 people. Only about 90 people attended each presentation. What happened to our membership on Astronomy Day? Several universities and colleges, including Western Michigan University and the University of Michigan, were holding commencement ceremonies that day. Several members had to work as well, both are good reasons to miss Astronomy Day. What about the rest of you? If you stayed at home, went to the movies, or something along those lines then frankly I'm hurt and disappointed. The report on page 5 is pretty long, but it only touches upon the amount of work this event took to put together.

Has bringing in big speakers become too routine? After all, since 2009, we've brought in some pretty big names (i.e. Phil Plait, Story Musgrave, Mike Brown, and Jill Tarter just to name a few). We also had some great guest speakers as part of our 80th anniversary celebration last year. Perhaps it's time for a break. As mentioned elsewhere, there will be no Astronomy Day 2018. Perhaps the entire concept needs to be retooled - go back to the basic premise of "bringing astronomy to the people." This year we asked the people to come to us and it just didn't work.

Astrophotography



WORKSHOP

Friday, June 30th @ 9:00 pm

Kalamazoo Nature Center

Veteran eclipse chasers suggest you forgo photographing the total solar eclipse on August 21st and just enjoy the spectacle for yourself. Do you plan to go against their advice, but need help learning to use your camera and/or other astronomical gear? Or perhaps you just want to learn how to photograph the sky in general? If the answer to at least one of these questions is yes, [then register](#) for the Kalamazoo Astronomical Society's *Astrophotography Workshop*. It'll be held at the Kalamazoo Nature Center on **Friday, June 30th at 9:00 pm** (weather permitting).

Our subject will be the Moon, which will be at first quarter. It is perhaps the easiest celestial object to photograph and the results are instantly satisfying. Snapping pictures of the Moon is also very similar to photographing a total solar eclipse. In addition to assisting you with your camera, we'll also help you properly setup and polar align your German Equatorial Mount (assuming you own one and plan to use it during the eclipse).

What **YOU** need to bring...

- DSLR Camera
- Telescope or Telephoto Lenses
- Tripod or German Equatorial Mount
- Remote Switch, Intervalometer or a Laptop
- T-mount & T-adapter (if using a telescope)

All members wanting to receive help with their camera and astronomical gear are encouraged to participate in the workshop. Registration can be done at the general meeting on June 2nd or through the [contact form](#) on the KAS website. Please be sure to indicate that you're registering for the workshop. We'll inform registrants of any cancellation, either due to the weather or lack of interest. Members wanting to just doing a little observing are also welcome to attend. Here's hoping for some clear skies on **June 30th!**



ASTRONOMY DAY 2017 *Report*

by **Richard Bell & Jean DeMott**

The Kalamazoo Astronomical Society (KAS) celebrated Astronomy Day on Saturday, April 29, 2017. Naturally, this year's theme was the *Great American Solar Eclipse* because of the total solar eclipse that will cross the United States from coast to coast on August 21, 2017. This will give tens of millions of people within a 70-mile-wide, 2,500-mile-long path from Oregon to South Carolina a chance to see the spectacular solar corona, a sight that can only be witnessed during the brief minutes of totality. The continental United States is the only land mass along this narrow path. Occurring during the summer vacation season, this eclipse holds the potential to be seen by more people than any other event of its kind in history. The KAS was excited to spread awareness of this momentous event and, more importantly, to educating the public about viewing it safely.

This year's event was held at Kalamazoo Valley Community College's Texas Township Campus. We knew that past venues, such as the Kalamazoo Valley Museum or Portage District Library, would be unsuitable for our ambitious event. Our first choice was actually Western Michigan University's Fetzer Center, but it was unavailable on April 29th. KVCC was our next option, since their Dale B. Lake Auditorium would have been an ideal location for our main presentations. We knew it would be a challenge to draw a crowd to the Texas Township Campus, but we approached KVCC about co-sponsoring this year's Astronomy Day. In the end, they only agreed to provide space rent free. About a month before our event, we learned that KVCC's nursing department needed Lake Auditorium for a pinning ceremony on April 29th. We were hoping to relocate to Rood Hall at

WMU, but advertising had already been sent out stating we would be at KVCC. Our main presentations would now be held in the gymnasium, while most other activities were held in the cafeteria.

We went to great lengths to publicize this year's Astronomy Day. All past Astronomy Day events took advantage of a built-in audience. It was completely up to us to spread the word and encourage people to join us at KVCC. Like past events, we distributed approximately 1,500 fliers at KAS events, outreach activities, schools, libraries, and museums across Southwest Michigan. KVCC posted 11" × 17" posters around all their campuses. Event details were submitted to every known community calendar. This includes *Kzoo Kids*, which posted a blog about our event on April 24th and listed us as the top "Weekend Pick" on April 28th. We paid for advertisements to appear in the Kalamazoo Public School's newsletter, *Excelsior*, and *FYI Family Magazine*. *Excelsior* is mailed to over 51,000 homes, while *FYI* is distributed free in more than 200 locations in the greater Kalamazoo area.

Two separate Public Service Announcements were sent to all local media outlets by both KVCC and the KAS on February 15th and March 30th. Both releases were written by us. The latter of the two releases resulted in an article on MLive on April 17th and another in the *Kalamazoo Gazette* on April 20th. E-mails were sent to surrounding schools, astronomy clubs, and astronomy and physics departments encouraging their members, students, and faculty to attend our event. Two e-mails were also posted to the Yahoo! Michigan Astronomy group, which over 460 amateur astronomers subscribe to. Jean even reached out to numerous home-schooled groups. We took full advantage of social media. Richard tweeted about Astronomy Day almost daily in the weeks leading up to April 29th. **Kevin Jung** also made regular posts on our Facebook page, and encouraged our friends to spread the word. Many did just that.

Astronomy Day was also covered on radio and television stations. KAS member and WMUK News Director, **Andy Robins**, interviewed guest speaker **Dr. Tyler Nordgren** on April 27th. WMUK also aired regular advertisements for Astronomy Day. Both of us (Richard and Jean) appeared on *The Lori Moore Show* on April 26th, while an interview with Richard by WWMT meteorologist and astronomy enthusiast **Christina Anthony** aired (and appeared on their website) on April 28th.

After months of planning, preparation, and publicity Astronomy Day finally arrived and Mother Nature once



Visitors could enjoy 1 of 5 displays during Astronomy Day on April 29th; this one is on solar eclipses.



Matt DePriest points out a feature on his 18-inch truss-tube Dobsonian. This was part of our traditional “Meet the Telescopes” display.

again seemed to work against us. The high temperature for the day was only 55° F, unusually cool even for late April, with overcast skies. A steady rain even occurred throughout the afternoon. So, for the third year-in-a-row solar observing (and observing later that night at the Kalamazoo Nature Center) was canceled. **Roger Williams** did briefly setup his telescope in KVCC’s courtyard in hopes of taking advantage of brief gaps in the cloud cover, but they were all too brief unfortunately. Our other solar observing volunteers - **Dave Garten, Jim Kurtz, and Randy Matson** – helped out in other areas and managed to enjoy some of our programming.

Attendees were guided by our extensive signage to enter the Texas Township Campus at the “flag entrance.” Our greeting table was located just inside, adjacent to the bookstore. Our greeters helped both volunteers and attendees find their way, and passed out KAS literature. **Becky Csia** and **Angela Newton** welcomed visitors during the morning shift from 10am – 1pm, while **Beverly Byle** and **Lydia Hoff** took over during the afternoon shift from 1pm – 4pm. The hands-on activities and displays were held in KVCC’s cafeteria.

Two of our three hands-on activities followed our eclipse theme. The first activity had children assemble an *Eclipse Pinhole Viewer*, a safe and handy way to view the solar eclipse on August 21st. One of the most noticeable and

enjoyable effects before totality are little crescent suns that appear under anything that can cast a shadow while allowing small amounts of sunlight to peer through. Our *Eclipse Pinhole Viewers* provided a fun and simple way for children to observe this effect. They could select from one of two designs, a map of the United States showing the eclipse path or an eclipsed sun graphic and punch holes in them as they saw fit. Hand-outs were included with each viewer that listed the KAS e-mail address. They were encouraged to take pictures of the crescent suns created by their pinhole viewers on Eclipse Day and send them to us. We look forward to receiving them!

The second eclipse-themed activity was a *Solar Eclipse Flipbook*. Our flipbook showed the progress of the eclipse every 11-minutes as seen from Carbondale, Illinois. We chose Carbondale for two reasons. First, Carbondale is one of the closest destinations to drive to from Kalamazoo and experience totality (and not the 85% partial eclipse Southwest Michigan will see). The second reason is that the duration of totality is longer from Carbondale than anywhere else on the eclipse path - about 2 minutes and 41 seconds. Our third hands-on activity was a *Sundial*, which we have done during Astronomy Day before. After all, children can use the sundial to keep track of when the eclipse begins on August 21st!

Located near the hands-on activities was our ever-popular Freebie Table. Special thanks to *Astronomy* magazine, the Jet Propulsion Laboratory, the Space Telescope Science Institute, NASA Goddard Space Flight Center, and NASA Space Place for sending us more great stuff.

This year, all of our hands-on tables and the Freebie Table were staffed by students from the Kalamazoo Area Math & Science Center (KAMSC). Most of them volunteered the entire day, for which we are very grateful. Unfortunately, we did not have time during the busy day to record who volunteered at what table. For the record, our KAMSC volunteers were: **Liv Ballentine, Addison Krueger, Jack Kujacznski, Brandon Livingston, Savannah McDowell, Kevin Mitchell, Amanda Northrup, Kyleigh Phillips, Danielle Pike, Vaughn Taylor, Duncan Wallis, and Evan Wheat**. Thank you all!



Children create Solar Eclipse Flipbooks; one of three hands-on tables at Astronomy Day 2017. All hands-on volunteers this year were students from KAMSC.

Between visits to the hands-on tables and attending our special programming, visitors could enjoy the five educational displays we had to offer this year – more than any other Astronomy Day. The display that went along with our theme was entitled *Solar Eclipses: Nature's Grandest Spectacle*. This display covered how solar eclipses occur, phenomena to observe during a total solar eclipse, eclipse safety, and some fun eclipse facts. Our light pollution display, *The Vanishing Night*, returned this year. The robotic telescope display also returned this year, but with an updated picture showing the Takahashi telescope we installed on top of the PlaneWave CDK20 in March. Permanent Astronomy Day displays, *Meet the Telescopes* and *KAS Member Astrophotography*, were prominently featured again. **Don Stilwell** supplied the example of a Schmidt-Cassegrain in the form of his Meade 10-inch LX90. **Jim Kurtz** setup his Tele Vue 127mm refractor mounted on an Astro-Physics Mach1GTO. This year, the reflecting telescope was represented by **Matt DePriest's** 18-inch truss-tube Dobsonian. Naturally, this behemoth was a people magnet! Matt and Jim, along with **Joe Comiskey** and **Dave Garten**, volunteered at the *Meet the Telescopes* display. Jean wanted to enhance the astrophotography display this year. Instead of a static display, we created a slide show of member images and showcased them on a large flat-screen television. The images are larger and sharper than before, and it can be easily updated with new member images. Current images were supplied by **Richard Bell**, **Dave Garten**, **Kevin Jung**, **Jim Kurtz**, **Bill Nigg**, **Eric Schreur**, and **Roger Williams**.

Also located in the cafeteria, as well as KVCC's Gallery Hallway, were our sales tables. The table in the cafeteria was relegated to KAS Eclipse Shades only. **Frank Severance** and **Dave Woolf** sold shades during the morning shift, while **Tim Kurtz** and **Stephanie Stratton** helped raise funds for the KAS during the afternoon shift. In addition to Eclipse Shades, the sales area in the Gallery Hallway sold books written by our guest speakers, Miller Planispheres, and KAS clothing. KAS treasurer Rich Mather volunteered in the Gallery Hallway the entire day. **Davin Ball**, **Arya Jayatilaka**, and **Jack Price** assisted Rich during the morning shift, while **Scott and Scotty Macfarlane** helped out during the afternoon shift. Some of our KAMSC student volunteers were also of assistance in the Gallery Hallway sales area.

Astronomy Day 2017 also offered more special programming than ever before. We wanted to cover every aspect of the *Great American Eclipse* as we could and for people of all ages. To that end, we offered two eclipse presentations aimed toward a younger audience. Both "kid's talks" were held in KVCC's conference room, located within the cafeteria. Our original plan was to have KAS members give both talks, but we made an offer to **Patricia Totten Espenak**, wife of "**Mr. Eclipse**" **Fred Espenak**, during our visit to Arizona Sky Village in March. Mrs. Espenak is a retired chemistry teacher and has witnessed 17 total solar eclipses to date. Mrs. Espenak is also the author of *Total Eclipse or Bust*, a book for the entire family. This was also the title of her presentation at 12:15 pm. KAS member and award-winning teacher, **Mike Sinclair**, gave the 2:15 pm talk entitled *Be Safe! Tips for Eclipse Viewing*.

Without a doubt, the main attraction of this year's Astronomy Day were our three special eclipse presentations.

We also offered three presentations during Astronomy Day 2013 when Mars was our theme. This enabled us to cover a wider range of subjects and it was very successful. The first presentation at 11am, *Sun Moon Earth: Solar Eclipses from Omen to Awe*, was given by **Dr. Tyler Nordgren**. Dr. Nordgren is a Professor of Physics and Astronomy at the University of Redlands. He has written peer-reviewed articles on subjects ranging from dark matter in galaxies to the pulsation of stars that are the foundation of our understanding of the size and age of the Universe. His excellent presentation covered how those moments of brief beauty that are a hallmark of total solar eclipses have allowed us to measure our world, and understand the nature of others. After his presentation, Dr. Nordgren was on hand at the book sales area signing copies of his wonderful book, *Sun Moon Earth*, and engaging with attendees throughout the day.

Jay Anderson gave the second presentation, *Moonshadow Madness: The Lure of the Total Eclipse*, at 1pm. Mr. Anderson is a retired Canadian meteorologist and an avid eclipse chaser who, for nearly forty years, has published studies of the climate along eclipse tracks to help those who want to place themselves in the most favorable place to view the passage of the lunar shadow. Since his first eclipse in



Dr. Tyler Nordgren presented *Sun Moon Earth: Solar Eclipses from Omen to Awe* on Astronomy Day.

1979, Mr. Anderson has traveled the world with his wife Judy to stand under the shadow of the Moon; the eclipse on August 21st will be his 30th! His presentation helped attendees prepare for the race of visual treats — a timeline of events to watch for and remember during the *Great American Eclipse*. These included the oncoming shadow, the changes in lighting, the solar corona and chromosphere, sun-bright beads in lunar valleys, blood-red prominences, and ephemeral shadow bands. Hopefully at least some of these will be sought out and remembered in the two minutes of totality.

“**Mr. Eclipse**” Fred Espenak, the most widely recognized name in solar eclipses, was our third presenter. He is known as “Mr. Eclipse” because of his decades of work on predicting and observing solar eclipses. In fact, over the past 47 years, he has witnessed 27 total eclipses of the Sun. Mr. Espenak has also published numerous books and articles on eclipse predictions. Most recently, he co-authored (with Mark Littmann) *Totality: The Great American Eclipses of 2017 and 2024*. This book was officially released on May 1st, but advanced copies were for sale during Astronomy Day. Mr. Espenak actually gave two presentations during our event. The first, *How to Photograph the 2017 Eclipse*, was held in room 8580 (a large lecture hall). His second presentation, *Predicting & Chasing Solar Eclipses*, was held at 3pm. Mr. Espenak shared some of his eclipse experiences through photos and video, including his most recent expedition to Indonesia in 2016. He also gave us a preview of upcoming total solar eclipses beyond 2017.

Several members and friends deserve special thanks. **Fritz Seegers** used his Photoshop skills to help us create both the version of the *Eclipse Pinhole Viewer* that showed the path of totality across the United States, as well as the annular eclipse diagram on the *Solar Eclipses* display. Fritz also allowed us to borrow his flat-screen television for the astrophotography display. **Jack Price** worked with United Party & Event Services on providing a 9’ × 12’ screen and projector for our presentations in the gymnasium. **Rich Mather** took **Jay Anderson** to breakfast on Astronomy Day morning and delivered him to KVCC. He also took Mr. Anderson and **Dr. Tyler Nordgren** to the Kalamazoo airport very early on Sunday morning. Dr. Nordgren’s flight out of



Avid eclipse chaser and retired Canadian meteorologist, Jay Anderson, presented *Moonshadow Madness: The Lure of the Total Eclipse* at 1pm.



“Mr. Eclipse” Fred Espenak shared his eclipse chasing stories in *Predicting & Chasing Solar Eclipses* at 3pm.

San Francisco was delayed, causing him to miss his flight from Chicago flight to Kalamazoo. Fortunately, he was able to spend the night on a friend’s couch and catch a flight to Grand Rapids on Saturday morning. **Kevin Jung** picked up Dr. Nordgren at the Gerald R. Ford Airport and brought him to Kalamazoo just in time for his 11am presentation. Kevin also helped properly document our event with his excellent photography. **Mike & Kathy Patton** also deserve thanks for picking up the Espenak’s at the Ford Airport on Friday afternoon and delivering them to the same airport on Sunday afternoon for their flight home. The Patton’s also hosted the Espenak’s in their home, saving us on hotel expenses. Many members - **Beverly Byle, Joe Comiskey, Jack Price, Frank Severance, and Don Stilwell** - were also invaluable with setup the evening before Astronomy Day and with packing up at day’s end. We are once again eternally grateful to all of our volunteers.

Astronomy Day 2017 was the most ambitious event we have ever attempted. Unfortunately, overall attendance failed to meet our expectations. We had hoped, with excitement for the *Great American Eclipse* on August 21st building, around 800 people would attend. The actual figure was perhaps half that, even after our extensive publicity campaign. Approximately 90 people attended each of our three main eclipse presentations. That’s comparable to past Astronomy Day keynote presentations, but our hopes were to have in excess of 200 people attend each talk. That is why we went through the trouble of holding them in the gymnasium. That was the largest space available after losing access to the Dale B. Lake Auditorium. Participation in the hands-on activities were the real disappointment. Our three tables were very busy for the first two hours, but quickly dropped off during the afternoon. Attendance for the Espenak’s presentations at 12:15 pm were about as expected, but turn-out for **Mike Sinclair’s** talk was very low. Several community events, including commencement ceremonies at many universities, competed for people’s attention. We hoped the poor weather would encourage higher indoor attendance, but maybe it would have been even worse if April 29th was a nice day. In the end, our gamble of holding the event at the somewhat-isolated Texas Township Campus failed to pay off. Let’s hope that those that did attend will appreciate the significance of the upcoming total solar eclipse even more.

The Eclipse Megamovie Project

by **Robert Sanders**

With only two months to go before one of the most anticipated solar eclipses in a lifetime, the University of California, Berkeley, and Google are looking for citizen scientists to document and memorialize the event in a “megamovie,” and help scientists learn about the Sun in the process.

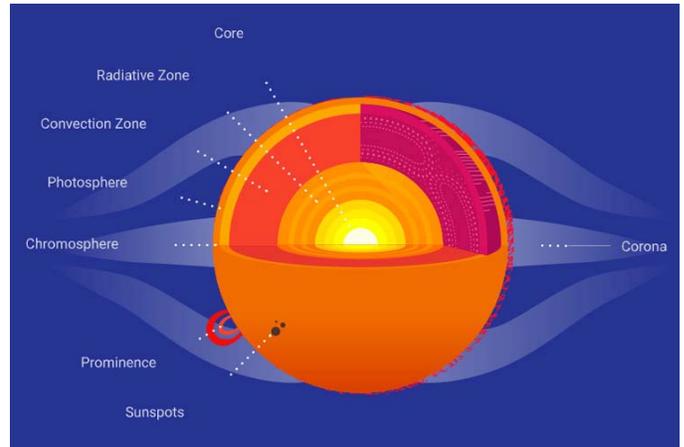
The Eclipse Megamovie Project is seeking more than a thousand amateur astronomers and avid photographers to record the August 21st total solar eclipse and upload their photos to be stitched together into a movie documenting the path of totality from landfall in Oregon until the Moon’s shadow slips over the Atlantic Ocean off South Carolina.

While no one on the ground will see the total eclipse for more than 2 minutes and 40 seconds, depending on how close they are to the center of the path of totality, the images collected by the Megamovie’s volunteer team will be turned into a 90-minute eclipse movie unlike anything seen before. Even an airplane flying along the path of totality can only capture at most a four- to five-minute movie, since the Moon’s shadow moves along the ground at up to 1,500 miles per hour. The last time anyone tried to stitch together eclipse images like this may have been in the 1800s via hand-drawn sketches, without the benefit of today’s modern digital technology.

The volunteers will be selected and trained by the Eclipse Megamovie Project team, but anyone with a smartphone can also contribute. The public will be able to download an app to take time-coded photos of the eclipse and upload them for inclusion in a second, though much lower-resolution movie. The team also hopes to include raw images from any source in its archive.



A classic ‘diamond ring’ effect seen just before the Moon completely covers the face of the Sun during a total solar eclipse like the one that will traverse the United States on August 21st. Image courtesy of Rick Feinberg.



Cutout view of the Sun, showing the various layers that can be studied during a total solar eclipse.

Several team members tested the app in Patagonia on February 26th during an annular eclipse, that is, one in which the Moon does not completely cover the disk of the Sun, leaving a bright ring or annulus. This happens when the Moon is farther from Earth, making its apparent size smaller than that of the Sun.

Both movies will be scientifically useful, said UC Berkeley solar physicist Hugh Hudson, who proposed the Megamovie idea in 2011 along with Scott McIntosh of the National Center for Atmospheric Research’s High Altitude Observatory in Boulder, Colorado. When Google’s Making & Science initiative heard about the idea, they were eager to join the project.

Hudson is primarily interested in studying the corona — the backlit haze of hot, ionized plasma shooting out of the Sun — and its interaction with the hard-to-see chromosphere at the base of the corona. While the corona can be studied with telescopes that block the brightness of the solar disk, the thin chromosphere is still lost in the glare, so questions remain about what in the chromosphere generates the jets of plasma seen in the corona.

“The movie is a tool for scientific exploration,” Hudson said. “We’ll be collecting this level of data for the first time, from millions of observers, and it will be a valuable archive. But we don’t know what we’ll see or what we’ll learn about the interactions between the chromosphere and the corona.”

Diamond Rings & Baily’s Beads

Images taken just before and just after the Moon covers the Sun can also be scientifically useful, Hudson said. The Sun peeks out from behind the Moon at numerous places as

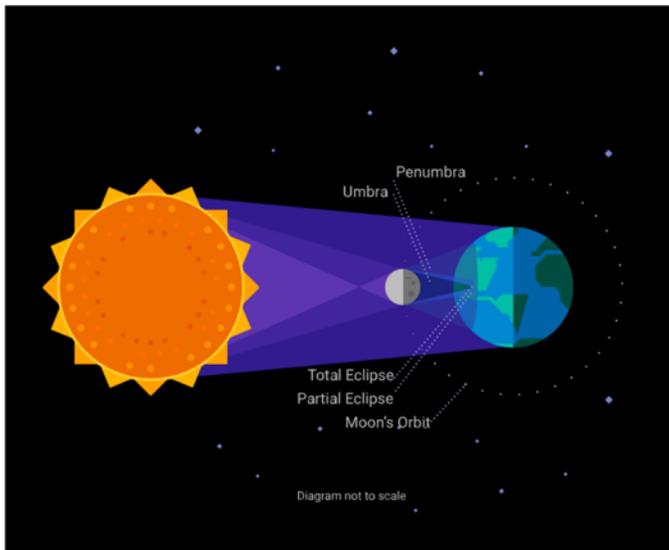
totality approaches, producing multiple bright spots around the rim known as Bailey's beads, which can help astronomers map lunar geography. The last flash before totality and first flash afterward — producing what is known as the diamond ring effect — can also reveal features on the Moon, and may help refine estimates of the size of the Sun. The smartphone app will be able to capture these flashes automatically.

The Eclipse Megamovie Project team is comprised primarily of UC Berkeley's Multiverse education program at the Space Sciences Laboratory and Google's Making & Science initiative. But the team is also partnering with the Astronomical Society of the Pacific (ASP) and others.

For its part, the ASP is reaching out to its network of more than 400 amateur astronomy groups nationwide and encouraging them and other knowledgeable photographers to take a one-hour webinar about how to capture useful data and upload it to the project's online database. These astrophotographers will need a digital single lens reflex camera, or DSLR, with a zoom lens of at least 300mm, plus a tripod and the ability to record their GPS location and time to within a second in coordinated universal time (UTC), the world's clock standard.

Meanwhile, the Multiverse team is visiting communities along the path of totality, which will stretch across 11 states in a band at most 72 miles wide, to encourage safe viewing during the eclipse, municipal coordination for the vast number of visitors expected to descend upon the mostly small towns within the path and participation in the Megamovie project. While those within this band will see a total eclipse, everyone else in the continental United States will see a partial solar eclipse, said Laura Peticolas, a physicist who directs the Multiverse program and oversees the educational component of the Eclipse Megamovie Project.

The path of totality on August 21st will move from west to



A total solar eclipse occurs when the Moon blocks the bright disk of the Sun. The sight is even more impressive because the Sun and Moon have, by pure coincidence, the same apparent size as seen from Earth.



The path of totality on August 21st will move from west to east across the United States, finally slipping over the ocean off South Carolina. Elsewhere in the U.S., people will see a partial solar eclipse.

east across the United States, finally slipping over the ocean off South Carolina. Elsewhere in the U.S., people will see a partial solar eclipse.

“We want everyone to know about the natural wonder, scientific importance and social impact of viewing a live total solar eclipse,” Peticolas said. “It is truly a transformative, life-changing experience and we want to prepare people for that.”

The first version of the Megamovie should be available for viewing online several hours after the eclipse ends at 18:49 UT (1:49 p.m. local time) on the U.S. east coast, “in time for the nightly news.”

Uploads are expected to be about a gigabyte per person, with thousands of people contributing, which adds up to terabytes of data.

The science will come later, but all the data will be available online for anyone to study — including citizen scientists.

Amateur astronomers and knowledgeable photographers who want to contribute to the high-resolution movie can sign up now at <https://eclipsemega.movie/> for project updates and information about the application process. If selected to participate, they will receive an exclusive pin and recognition in the credits for the Eclipse Megamovie Project. They will also be able to register an astronomy club of their choice to receive a free package of solar viewing glasses.

If you miss participating in the August 21st event, the Eclipse Megamovie team plans to repeat the project during the next U.S. total solar eclipse in April 2024. That eclipse will cross the U.S. from Texas to Maine. It can produce a movie about as long as the project will produce for the August 2017 eclipse, counting contributions from Mexico and Canada.

Follow the Eclipse Megamovie Project on [Facebook](#) and [Twitter](#).

Robert Sanders is the manager of science communications at Berkeley News. Article used with permission.



The Fizzy Seas of Titan

by Marcus Woo

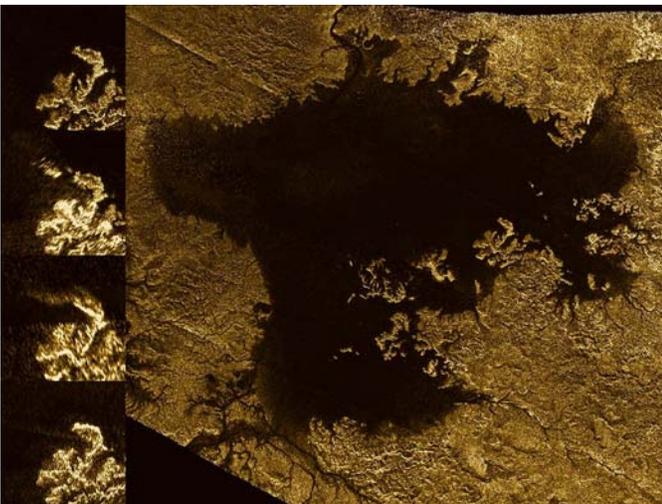
With clouds, rain, seas, lakes and a nitrogen-filled atmosphere, Saturn's moon Titan appears to be one of the worlds most similar to Earth in the solar system. But it's still alien; its seas and lakes are full not of water but liquid methane and ethane.

At the temperatures and pressures found on Titan's surface, methane can evaporate and fall back down as rain, just like water on Earth. The methane rain flows into rivers and channels, filling lakes and seas.

Nitrogen makes up a larger portion of the atmosphere on Titan than on Earth. The gas also dissolves in methane, just like carbon dioxide in soda. And similar to when you shake an open soda bottle, disturbing a Titan lake can make the nitrogen bubble out.

But now it turns out the seas and lakes might be fizzier than previously thought. Researchers at NASA's Jet Propulsion Laboratory recently experimented with dissolved nitrogen in mixtures of liquid methane and ethane under a variety of temperatures and pressures that would exist on Titan. They measured how different conditions would trigger nitrogen bubbles. A fizzy lake, they found, would be a common sight.

On Titan, the liquid methane always contains dissolved nitrogen. So when it rains, a methane-nitrogen solution pours into the seas and lakes, either directly from rain or via stream runoff. But if the lake also contains some ethane – which doesn't dissolve nitrogen as well as methane does – mixing the liquids will force some of the nitrogen out of solution, and the lake will effervesce.



Caption: Radar images from Cassini showed a strange island-like feature in one of Titan's hydrocarbon seas that appeared to change over time. One possible explanation for this "magic island" is bubbles. Image credits: NASA/JPL-Caltech/ASI/Cornell

"It will be a big frothy mess," says Michael Malaska of JPL. "It's neat because it makes Earth look really boring by comparison."

Bubbles could also arise from a lake that contains more ethane than methane. The two will normally mix, but a less-dense layer of methane with dissolved nitrogen – from a gentle rain, for example – could settle on top of an ethane layer.

In this case, any disturbance – even a breeze – could mix the methane with dissolved nitrogen and the ethane below. The nitrogen would become less soluble and bubbles of gas would fizz out.

Heat, the researchers found, can also cause nitrogen to bubble out of solution while cold will coax more nitrogen to dissolve. As the seasons and climate change on Titan, the seas and lakes will inhale and exhale nitrogen.

But such warmth-induced bubbles could pose a challenge for future sea-faring spacecraft, which will have an energy source, and thus heat. "You may have this spacecraft sitting there, and it's just going to be fizzing the whole time," Malaska says. "That may actually be a problem for stability control or sampling."

Bubbles might also explain the so-called magic islands discovered by NASA's Cassini spacecraft in the last few years. Radar images revealed island-like features that appear and disappear over time. Scientists still aren't sure what the islands are, but nitrogen bubbles seem increasingly likely.

To know for sure, though, there will have to be a new mission. Cassini is entering its final phase, having finished its last flyby of Titan on April 21st. Scientists are already sketching out potential spacecraft – maybe a buoy or even a submarine – to explore Titan's seas, bubbles and all.

To teach kids about the extreme conditions on Titan and other planets and moons, visit the NASA Space Place:

<https://spaceplace.nasa.gov/planet-weather/>

LIVING ON TITAN

Titan, the cloudy moon of Saturn, is one of the least hostile places (for humans) in the outer solar system. It has lakes of liquid methane, and even weather.

Titan has no water, but some scientists wonder if life based on methane might live on Titan.

HABITABLE? SORT OF

Titan has a dense atmosphere of 95 percent nitrogen and 5 percent methane at 1.5 times the air pressure on Earth. Titan's atmosphere is unbreathable, but if you were standing on Titan you would not need a pressurized space suit, only a breathing mask and protection from the cold.

From the surface of Titan, Saturn would appear to fill one-third to one-half of the sky.

Size of the sun in Titan's sky

Size of the moon in Earth's sky

<p>TITAN = 0.14 EARTH = 1.0</p> <p>GRAVITY</p>	<p>TITAN = 94K EARTH = 290K</p> <p>AVERAGE TEMPERATURE Kelvin scale</p>
<p>TITAN = 16 days EARTH = 24 hours</p> <p>LENGTH OF DAY in Earth days</p>	<p>TITAN = 16 days EARTH = 365 days</p> <p>ORBITAL PERIOD in Earth days</p>

Gravity on Titan is about 14 percent that of Earth, or just a bit weaker than the gravity of Earth's moon. The average surface temperature on Titan is -290 degrees F (-179 degrees C). Titan's orbital period is the same as its day, so Saturn would appear fixed in Titan's sky over the hemisphere of Titan that faces the planet.

SOURCES: NASA, JET PROPULSION LABORATORY, EUROPEAN SPACE AGENCY, CALIFORNIA INSTITUTE OF TECHNOLOGY, KATH. DATE: © Space.com

SPACE PLACE

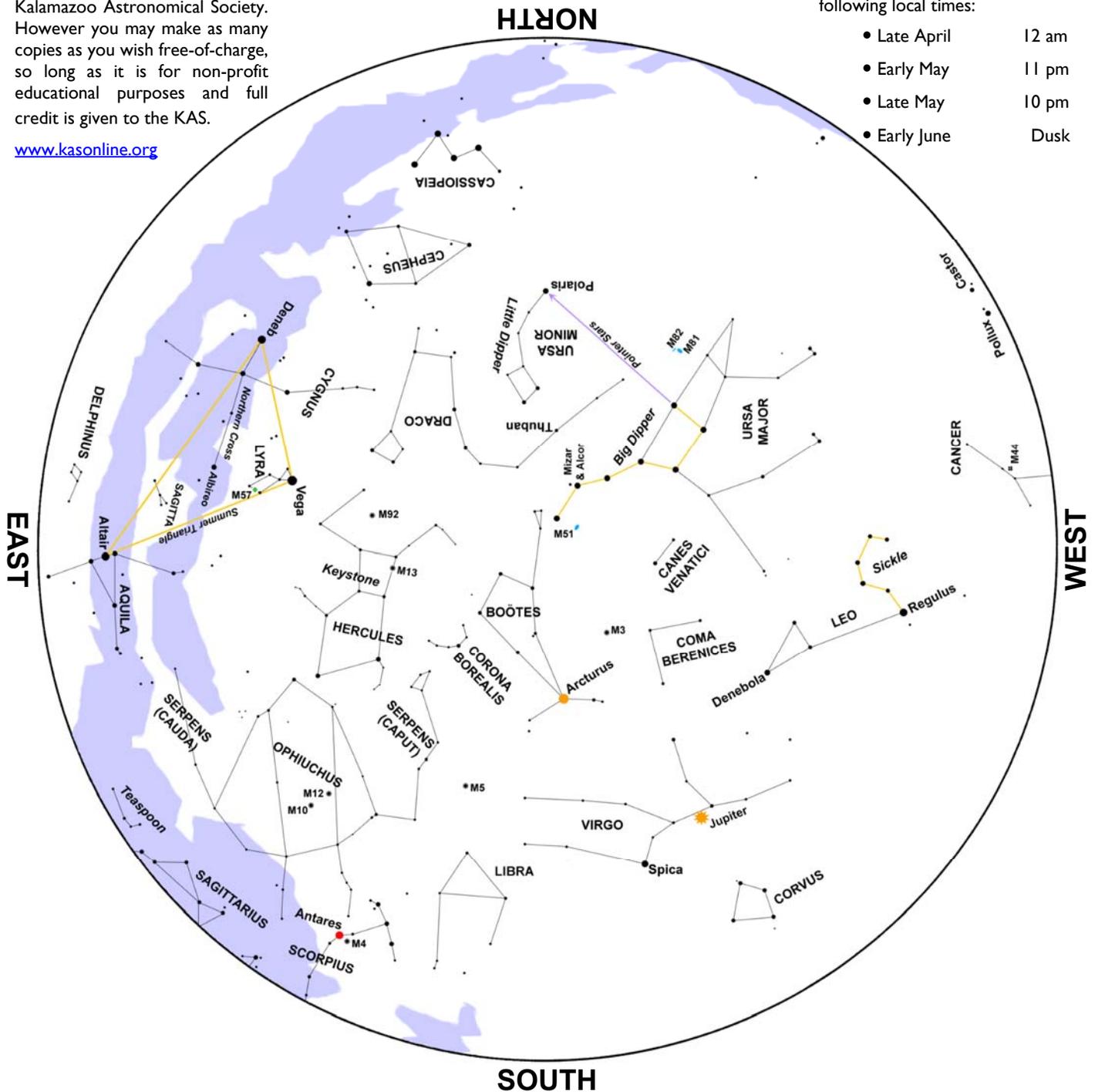
June Night Sky.....

This star map is property of the Kalamazoo Astronomical Society. However you may make as many copies as you wish free-of-charge, so long as it is for non-profit educational purposes and full credit is given to the KAS.

www.kasonline.org

This map represents the sky at the following local times:

- Late April 12 am
- Early May 11 pm
- Late May 10 pm
- Early June Dusk



Q waxing gibbous Moon looms about 2° above the giant planet Jupiter on the evening of June 3rd. The pair will be due south 30 minutes after sunset. Grab your telescope and point it toward Jupiter on June 3rd at 10:22 pm EDT. A double-shadow transit begins at that time and continues until 12:22 am. The shadows of Io and

Ganymede will be cast onto the planet and, as an added bonus, the Great Red Spot will be coming into view.

The ringed marvel, Saturn, will be at opposition on the night of June 14th/15th. Saturn won't be closer to our planet at any other time in 2017. This also means Saturn will move into the evening sky.

The timing is excellent since the rings are tilted 26.5° toward us, very close to their maximum. It's the summer of Saturn!

A waning crescent Moon will be 8° to the right of Venus on the morning of June 20th. They'll be about the same distance apart, but with the Moon to Venus' lower left on June 21st.

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June 2017

Page 13



Owl Observatory

MAINTENANCE SESSION

Owl Observatory is in need of maintenance. We will be making repairs to the building, finish re-staining the outside and cleaning the inside. Would you like to help? Please let us know by sending a note through the [Contact Page](#). We'll let you know if we have to cancel due to rain or other weather conditions.

SATURDAY, JUNE 10TH @ 2:00 PM

ECLIPSE SHADES ON SALE NOW!

On the 21st of August 2017, an eclipse of the Sun will occur across a 70-mile-wide path from Oregon to South Carolina, giving tens of millions of people a chance to see the greatest phenomenon in Nature.

Eclipse shades will allow you to safely view this momentous event. Buy a pair for yourself, friends, family, co-workers, etcetera! Hurry and order now before eclipse fever sweeps the nation!

Send your orders to: kas@kasonline.org



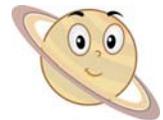
A minimum of \$3.00 each!

Public Observing Sessions



Saturday, June 10th

Features: Moon, Jupiter & Saturn



Saturday, June 24th

Features: Jupiter, Saturn, & Globular Clusters

Gates Open: 9:30 pm • Observing Begins: 10:00 pm

Kalamazoo Nature Center
— 7000 N. Westnedge Ave. —

General Meeting Preview



PROOF OF CONCEPT

Science on a High-Altitude Balloon

presented by **Students of KAMSC**

A group of six 11th graders at the Kalamazoo Area Math & Science Center researched, planned, and executed a launch of a high-altitude balloon carrying a basic scientific package to the edge of space. Although they did not successfully accomplish all their original mission objectives, they managed to attain proof-of-concept: an attempt to do science well above the surface of Earth. Join us as they present the results of their ambitious project.

Friday, June 2 @ 7:00 pm

Kalamazoo Area Math & Science Center

600 West Vine, Suite 400 • Use Dutton St. Entrance

– *Dutton Entrance Locked by 7:10 pm* –

Kalamazoo Astronomical Society
c/o KAMSC
600 West Vine, Suite 400
Kalamazoo, MI 49008

STAMP

