

**Highlights of the
April Sky...**

--- 3rd ---

PM: A Waxing Crescent Moon passes through the Hyades cluster starting at ~10:15 pm EDT.

--- 6th ---

PM: Moon is near Jupiter.

--- 7th ---

First Quarter Moon
4:31 am EDT

--- 8th ---

Mars is at opposition.

--- 10th ---

PM: The Moon is below Regulus

--- 12th ---

DAWN: Neptune is 0.7° south of Venus.

--- 14th ---

PM: Mars is closest to Earth for 2014.

--- 15th ---

Total Lunar Eclipse begins at 1:58 am EDT

Full Moon
3:42 am EDT

--- 17th ---

DAWN: Saturn is very close to the Moon.

--- 22nd ---

AM: Lyrid meteor shower peaks.

Last Quarter Moon
3:52 am EDT

--- 25th ---

DAWN: A Waning Crescent Moon is to the upper right of Venus.

--- 26th ---

DAWN: A Waning Crescent Moon is to the lower left of Venus.

--- 29th ---

New Moon
2:14 am EDT

Prime Focus

A Publication of the Kalamazoo Astronomical Society

☆ ☆ ☆ April 2014 ☆ ☆ ☆

This Months **KAS** Events

General Meeting: Friday, April 4 @ 7:00 pm

Kalamazoo Area Math & Science Center - See Page 8 for Details

Observing Session: Saturday, April 5 @ 8:00 pm

Moon, Mars & Jupiter - Kalamazoo Nature Center

Observing Event: Tuesday, April 15 @ 12:30 am

Total Lunar Eclipse - Kalamazoo Nature Center

Observing Session: Saturday, April 26 @ 8:00 pm

Galaxies of the Virgo Cluster - Kalamazoo Nature Center

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March Meeting Minutes

The general meeting of the Kalamazoo Astronomical Society was brought to order by President Richard Bell on Friday, March 7, 2014 at 7:15 pm. Approximately 48 members and guests were in attendance at the Kalamazoo Area Math & Science Center (KAMSC).

Joe Comiskey, an analytical chemist at Pfizer and a new KAS Member-At-Large, gave his first feature presentation. It was entitled *My Favorite Light Polluting Menace: Rhapsody on Lunar Observing*. Joe began his presentation by asking everyone in attendance a question: Do they remember what happened on the morning of July 11, 2011? A severe thunderstorm blew through the area and knocked out the power. It was clear later that night, but a bright Moon washed out the sky. The Moon had spoiled every amateur astronomer's dream: a chance to observe the night sky with little interference from light pollution.

Some of the disadvantages of a bright Moon were covered. In addition to interfering with deep sky observations, the Moon can wash out faint shooting stars during a meteor shower. It can also be more difficult to navigate the sky when the Moon washes out all but the brightest stars. Advantages include a wealth of features to observe on its desolate surface. It's observable from the most light polluted cities and under marginal sky conditions. Its ever changing phases present new features from one day to the next. The Moon can also be viewed with a variety of instruments, including binoculars and telescopes of moderate quality. Finally, the Moon is really easy to find!

Joe shared several fun facts about the Moon during his presentation. The first is that most Full Moon's aren't 100% full. This is because the Moon's orbit is tilted by about 5° with respect to Earth's orbit (known as the ecliptic). A shadow line can always be found if you look carefully. The first lunar features Joe discussed were the lunar maria. These are ancient volcanic flood plains carved early in the Moon's history. Individual mare (singular for maria and Latin for sea) are mostly named for emotions, i.e. Sea of Tranquility or Sea of Serenity. Joe then highlighted some of the larger impact craters, including Tycho, Copernicus, and Grimaldi.

The next fun fact asked how much of the Moon's surface can be seen from Earth? Joe pointed out the Moon's revolution was equal to its rotation (27.32 days), meaning we always see the same side of the Moon's surface. The answer is ~59% thanks to libration, the apparent vertical and horizontal rocking motions of the Moon as it orbits Earth. In general, libration is caused by both the Moon's eccentric orbit and orbital inclination with respect to Earth's orbit.

Joe then continued his tour of various lunar features and then introduced his next fun fact. The Full Moon appears highest

in the sky during the winter and lowest in the sky during the summer. The Sun changes its north-south position because Earth's axis of rotation is not perpendicular to the plane of its orbit around the Sun. This is the reason for the seasons. A Full Moon is directly opposite the Sun, so the Moon is at its lowest point in the summer (vice versa for the winter).

Joe pointed out the difference between the Moon's north and south Earth-facing hemispheres. The lunar north is a lowland region and dark due to the maria. The lunar south is a highland region with many impact craters. Features in the north around the Plato crater are Mt. Piton and Mt. Pico, both located south of Plato in Mare Imbrium. The famous lunar Alpes mountain range, with the Alpine Valley, is also located in this region.

Another fun fact is that the Moon is slowly receding from by about 1.6-inches per year. Another prominent feature Joe mentioned was the Straight Wall (or Rupes Recta), a lunar fault about 68 miles in length and 149 - 186 miles in height. It's best viewed about 1 day past a First Quarter Moon. The next fun fact was the well known "[Moon Illusion](#)." The illusion is the Moon looks larger when it's low on the horizon and smaller when higher in the sky.

Joe moved on to the Moon's southern region and the many large craters found there. Among the largest is Clavius, which has many craters inside. The famous Tycho crater and its large central peak was also discussed. Joe also mentioned the Hortensius domes, located in Mare Insularum. Joe concluded his talk with some lunar observing tips. First, keep track of the Moon's phases. Use a Moon filter when the Moon is big and bright (or using larger aperture telescopes). Observe features along the terminator (boundary between day and night) for enhanced contrast. Use a Moon map when observing and have fun identifying lunar features. Finally, Joe encouraged everyone to complete the Astronomical League's [Lunar Club](#).

Richard gave a lengthy President's Report after the snack break. Chuck Bueter, President of the Michiana Astronomical Society and past guest speaker, invited members to attend the [Michiana Star Party](#) from May 30th - June 1st. Richard thanked Jean DeMott, Bob Havira, and Don Stilwell for their help in organizing our *Sky & Telescope* magazine collection on Feb. 22nd. He also thanked Charles Bibart, Jean, Mike Dupuis, Jack Price, and Roger Williams for volunteering at Vicksburg Middle School's Science Night on March 5th. There are many more volunteer opportunities in the near future (see page 7). Richard also mentioned a second grant for the Robotic Telescope Project had been submitted. He also encouraged everyone to watch the premiere of [Cosmos](#) on March 9th. After a discussion of current events, the meeting concluded at about 9:15 pm.

BOARD Meeting Minutes

The Kalamazoo Astronomical Society Board convened for its regular monthly meeting on March 9, 2014 at Sunnyside Church. President Richard Bell called the meeting to order at 5:10 pm. In attendance were board members Joe Comiskey, Mike Dupuis, Scott Macfarlane, Jack Price, Don Stilwell, and Roger Williams, along with KAS regular members Mike Cook and Mike Patton. Rich Mather could not be reached by Skype initially, but he signed on before the end of the meeting.

After approval of the agenda, Richard summarized planned April events. For the April 4th general meeting, Richard had run out of possibilities for a program speaker, and he will therefore give a presentation on the Robotic Telescope Project. The next public observing session was scheduled for April 5th at 8 pm, and new printed schedules for the season were available to hand out. Finally, Richard reminded everyone that the total lunar eclipse which is officially on April 15th is really the night of the 14th/15th and the early morning hours of the 15th (centered on 12:30 am).

In the category of Follow-Up Items, Richard reported that another grant application has been submitted for the Robotic Telescope Project. A third proposal was currently hung up on the requirement for a financial audit. Several board members volunteered to check possible auditors who would give a more reasonable price quote. Richard thanked Don, Jean DeMott, and Bob Havira for helping to clean and organize our rental storage area. The wire shelves are now deployed, and the *Sky & Telescope* issues are organized. On the topic of KAS logo clothing, Richard said that some orders had to be modified due to lack of availability of listed colors. To conclude this category, Richard reported that a grant proposal had been submitted to fund our Astronomy Day speaker Michael Bakich (Senior Editor of *Astronomy Magazine*). After a Motion by Mike Dupuis and a second by Don, the Board voted to pay the speaker's costs from the KAS treasury in the event that the grant is not obtained.

Events discussed under New Business included the Family Math & Science Expo at Kellogg Elementary School (March 25th), Kalamazoo Rock, Gem, Fossil, and Mineral Show at Kalamazoo County Expo Center (May 2nd, 3rd, and 4th), Blast Into Space camp at the Air Zoo (June 17th), and observing at Pierce Cedar Creek Institute (August 23rd). The Rock, Gem, Fossil, and Mineral show particularly will need many volunteers, as it is a 3-day commitment that occurs only a week before Astronomy Day.

Since Rich Mather had joined via Skype at this point, he gave the Treasurer's Report and answered questions about the already-submitted printed copy. The biggest item was the

report that the Paramount ME II had been paid for. Rich said the checks were actually a bit in excess of the current charges, and he suggested leaving the excess with OPT until further accessories are ordered. The Board did not have any objections.

Since a hoped-for meeting with Roger McPherson could not happen at this time, and there being no further business, the meeting was adjourned at 6:05 pm. The next meeting was set for 5:00 pm on April 13, 2014, same venue.

Respectfully submitted by Roger Williams



Most of North America (which includes West Michigan) gets to witness a Total Lunar Eclipse in its entirety during the early morning hours of Tuesday, April 15th. I'm calling it the Tax Day Total Lunar Eclipse! This is the first lunar eclipse we've got to *see* since February 20, 2008. Mike Sinclair, a group of his KAMSC students, and I viewed [that eclipse](#) at the Nature Center inside Owl Observatory. The temperature was only 4° F. Mike's diet coke froze solid! The "Winter Solstice Lunar Eclipse" on December 21, 2010 was largely clouded out. I took one [fuzzy picture](#) of the partially eclipsed Moon through the clouds.

The KAS will hold a special viewing event for the Tax Day Eclipse at the Nature Center. I realize the hours are very inconvenient, but Nature isn't concerned with our schedules. It does what it does. Members will arrive as early as 12:30 am to get setup. You don't need to arrive that early if you're not bringing any gear. The Moon begins to move into the penumbra at 12:54 am EDT. This portion of the eclipse is unobservable. The real show begins at 1:58 am when the Moon begins to move into the umbra (Earth's darker, inner shadow). Totality (when the Moon is completely within the umbra) begins at 3:08 am and lasts 78 minutes.

The Moon passes through the southern portion of the umbra, so the Moon's northern section should look red-orange in color. The Moon's southern section will remain fairly bright. The exact appearance depends on the amount of clouds, volcanic ash, and air pollution in Earth's atmosphere at that time. Odds are the Moon will turn a bright coppery red hue.

I plan to use my TMB 92mm refractor to take a series of images for a time-lapse movie. I've taken a series of images back in the old film days, but have not had the opportunity to do so with a digital camera yet. Pay your taxes early, take April 15th off of work, and join us for this rare phenomena.



Old Tool, New Use: GPS & the Terrestrial Reference Frame

by **Alex H. Kasprak**

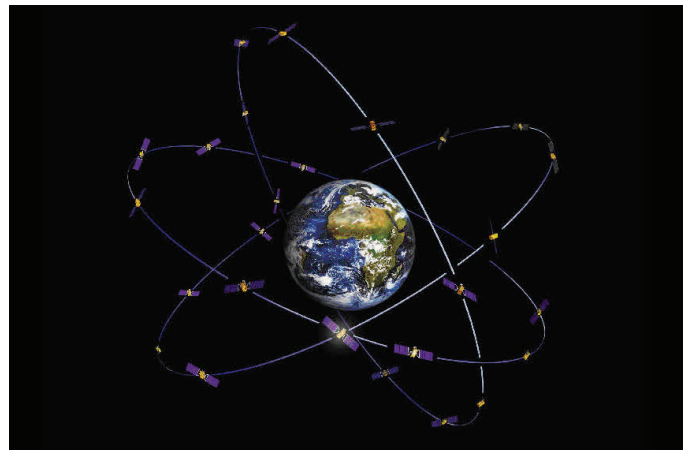
Flying over 1300 kilometers above Earth, the Jason 2 satellite knows its distance from the ocean down to a matter of centimeters, allowing for the creation of detailed maps of the ocean's surface. This information is invaluable to oceanographers and climate scientists. By understanding the ocean's complex topography — its barely perceptible hills and troughs — these scientists can monitor the pace of sea level rise, unravel the intricacies of ocean currents, and project the effects of future climate change.

But these measurements would be useless if there were not some frame of reference to put them in context. A terrestrial reference frame, ratified by an international group of scientists, serves that purpose. "It's a lot like air," says JPL scientist Jan Weiss. "It's all around us and is vitally important, but people don't really think about it." Creating such a frame of reference is more of a challenge than you might think, though. No point on the surface of Earth is truly fixed.

To create a terrestrial reference frame, you need to know the distance between as many points as possible. Two methods help achieve that goal. Very-long baseline interferometry uses multiple radio antennas to monitor the signal from something very far away in space, like a quasar. The distance between the antennas can be calculated based on tiny changes in the time it takes the signal to reach them. Satellite laser ranging, the second method, bounces lasers off of satellites and measures the two-way travel time to calculate distance between ground stations.



Artist's interpretation of the Jason 2 satellite. To do its job properly, satellites like Jason 2 require as accurate a terrestrial reference frame as possible. Image courtesy: NASA/JPL-Caltech.



Weiss and his colleagues would like to add a third method into the mix — GPS. At the moment, GPS measurements are used only to tie together the points created by very long baseline interferometry and satellite laser ranging together, not to directly calculate a terrestrial reference frame.

"There hasn't been a whole lot of serious effort to include GPS directly," says Weiss. His goal is to show that GPS can be used to create a terrestrial reference frame on its own. "The thing about GPS that's different from very-long baseline interferometry and satellite laser ranging is that you don't need complex and expensive infrastructure and can deploy many stations all around the world."

Feeding GPS data directly into the calculation of a terrestrial reference frame could lead to an even more accurate and cost effective way to reference points geospatially. This could be good news for missions like Jason 2. Slight errors in the terrestrial reference frame can create significant errors where precise measurements are required. GPS stations could prove to be a vital and untapped resource in the quest to create the most accurate terrestrial reference frame possible. "The thing about GPS," says Weiss, "is that you are just so data rich when compared to these other techniques."

You can learn more about NASA's efforts to create an accurate terrestrial reference frame here:

<http://space-geodesy.nasa.gov/>

Kids can learn all about GPS by visiting:

<http://spaceplace.nasa.gov/gps>

Watch a fun animation about finding pizza here:

<http://spaceplace.nasa.gov/gps-pizza>

Membership of the Kalamazoo Astronomical Society...

1. Thomas Abraham	Regular	2014	65. Amy Mead	Family	2015
2. Trish Anderson	Regular	2014	66. Michael J. Melwiki	Regular	2014
3. Paul Asmus	Regular	2014	67. John Miller	Regular	2015
4. Harold Ballen	Senior	2014	68. Mark & Ninah Miller	Family	2014
5. Jason Bell	Regular	2014	69. Dave & Carol Mitchell	Senior Family	2015
6. Richard Bell	Lifetime	n/a	70. Katie Morgan	Regular	2015
7. James Bergman	Student	2014	71. Kim & Pat Morgan	Family	2015
8. Karen Berzins	Family	2014	72. David & Michelle Murphy	Family	2014
9. Charles Bibart	Regular	2014	73. Ryan Nehring	Regular	2014
10. Jack Bley	Senior Family	2014	74. Frank Netzel	Senior	2015
11. Donald Bohan	Senior Family	2014	75. Angela Newton	Regular	2014
12. Susan Bond	Regular	2014	76. Bill Nigg	Lifetime	n/a
13. Jacqueline Bonn	Regular	2014	77. Robert Norton	Family	2014
14. Joseph & Patti Borrello	Family	2015	78. Dheeraj Nosina	Student	2014
15. Jose Borrero	Regular	2014	79. John & Teri Olbrot	Family	2014
16. Shawn Brueshaber	Regular	2015	80. Richard Olsen	Regular	2014
17. James Burns	Family	2014	81. Jim Oorbeck	Family	2014
18. Phyllis Buskirk	Lifetime	n/a	82. Kanji Ota	Regular	2014
19. Michael Bussey	Regular	2014	83. Charles Overberger	Regular	2014
20. Beverly Byle	Senior	2014	84. Mike Patton	Regular	2015
21. Joseph Cain	Family	2014	85. Dave & Sue Polus	Family	2014
22. David Carpenter	Family	2014	86. John Ponzini	Family	2014
23. Joe Comiskey	Family	2015	87. Jack & Ruth Price	Family	2014
24. Michael Cook	Family	2014	88. David Puzycycki	Regular	2014
25. Harry Cotterill	Senior Family	2014	89. Sam Qualls	Family	2014
26. Robert & Grace Cox	Family	2013	90. Adrian Quint	Regular	2015
27. Kalman & Becky Csia	Senior Family	2014	91. Jonathan Reck	Regular	2014
28. Jean DeMott	Family	2014	92. Sheila Reuther	Regular	2015
29. Richard Dirrenberger	Senior	2014	93. Jack Roach	Supporting	2014
30. David Doan	Regular	2014	94. Kerry Robbert	Regular	2014
31. Michael & Rachel Dupuis	Family	2014	95. Christopher Roberts	Regular	2014
32. Kristi & Steve Durbin	Family	2014	96. Andrew C. Robins	Family	2014
33. Fred E. Dutton	Senior	2015	97. David Rowe	Regular	2014
34. Maya Fernandez	Student	2014	98. Mark Russell	Family	2014
35. Daniel Flanagan	Student	2014	99. Brent Sanford	Family	2014
36. Dave Garten	Regular	2014	100. Mark Schmanski	Regular	2015
37. Tom George	Regular	2014	101. Frank Severance	Regular	2014
38. Dick & Jackie Gillespie	Senior Family	2014	102. Andrew Schaefer	Regular	2014
39. Tony Gurczynski	Senior	2015	103. Cody Shanley	Student	2014
40. Johnson Haas	Regular	2014	104. Vincent Shen	Regular	2014
41. Alexander Hanchar	Regular	2014	105. Norma J. Simmons	Senior	2014
42. Ron & Barbara Hartgerink	Senior Family	2014	106. Michael & Karen Sinclair	Family	2015
43. Robert & Barbara Havira	Senior Family	2016	107. Greg Sirna	Regular	2015
44. Michael James Higgins	Regular	2014	108. Kenneth Smith	Regular	2014
45. Arya Jayatilaka	Family	2015	109. H. John Steffen	Senior Family	2014
46. Eric Jeska	Regular	2014	110. Don Stilwell	Family	2015
47. Kevin Jung	Regular	2014	111. Stephanie Stratton	Regular	2015
48. Dan Keto	Regular	2014	112. Dennis Stuart	Regular	2014
49. Ahsanuddin (Ali) Khan	Regular	2014	113. Eric R. Sullivan	Regular	2014
50. Kirk & Angela Korista	Family	2014	114. Charles Taricska	Regular	2014
51. Jim Kurtz	Regular	2014	115. Oxnar Theealien	Regular	2014
52. Tim Kurtz	Regular	2014	116. Gary & Karen Theisen	Family	2014
53. Cal & Jean Lamoreaux	Senior Family	2014	117. Henry L. Upjohn II	Family	2015
54. John Lee	Family	2014	118. Michael & Debra Vandever	Family	2014
55. Duncan Lindsay	Family	2014	119. Bill Van Dien	Senior	2014
56. Andrew Loveless	Family	2014	120. Robert Wade	Supporting	2017
57. Gary & Phyllis Lubbert	Family	2014	121. Philip B. Wareham	Regular	2014
58. Dave & Judy Lucio	Senior Family	2014	122. Bob White	Regular	2015
59. Chuck Lund	Senior	2015	123. Jacob Samuel White	Student	2014
60. Scott Macfarlane	Family	2015	124. Sharmini Wickremasinghe	Family	2014
61. Richard Mather	Senior	2014	125. Roger & Molly Williams	Family	2014
62. Dayton Maynard	Senior	2014	126. Klay & Karen Woodworth	Family	2014
63. Ellie McCormick	Student	2014	127. David Woolf	Family	2014
64. Troy William McGuffey	Regular	2014	128. Sharon Zordan	Regular	2015

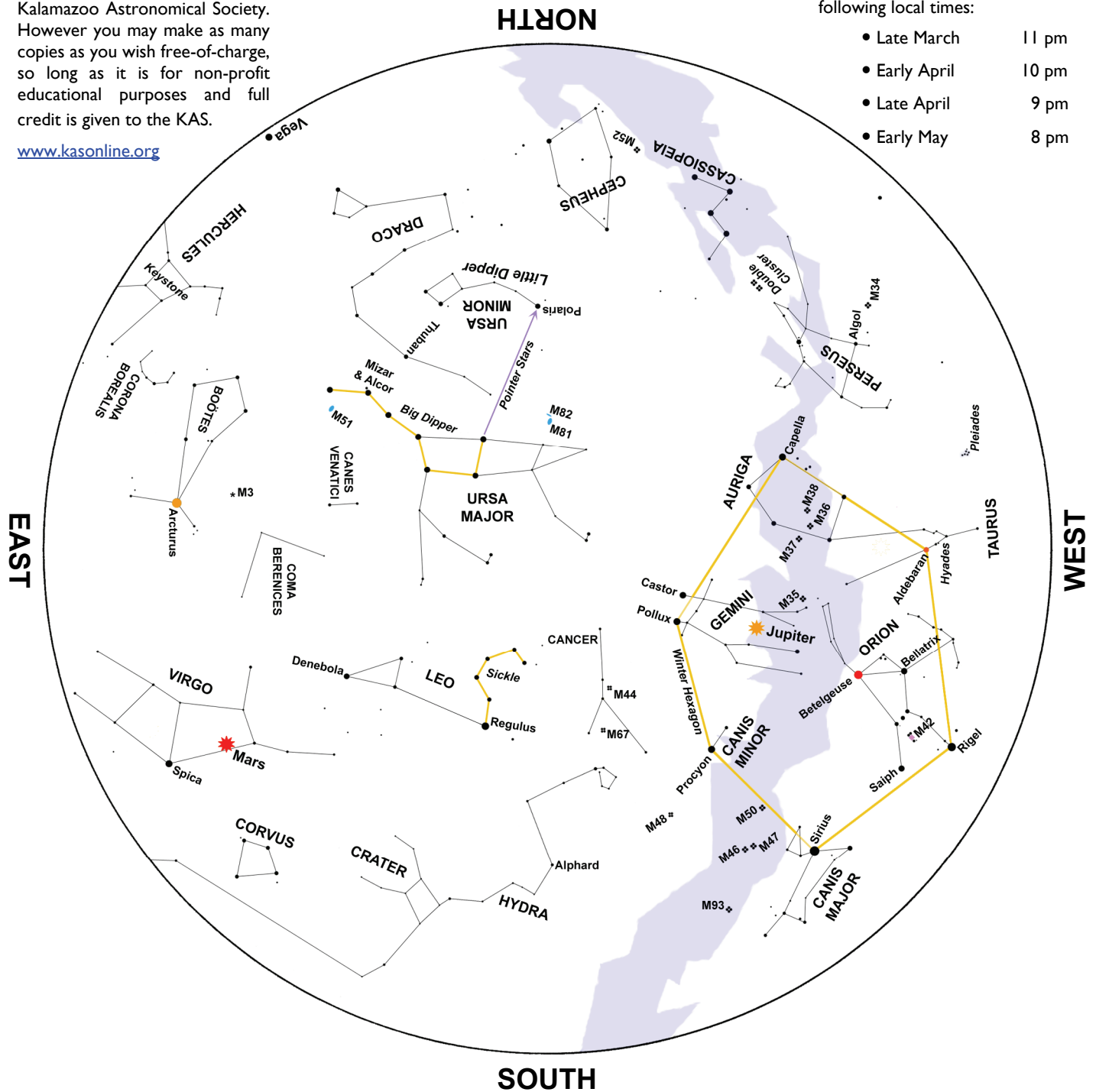
April Night Sky.....

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 March 11 pm
- Early April 10 pm
- Late April 9 pm
- Early May 8 pm



A Waxing Crescent Moon drifts through the Hyades star cluster in Taurus on April 3rd and occults several medium-bright stars. The first star blocked by the Moon is Delta¹ Tauri at ~10:15 pm EDT. It dramatically reappears at ~11:03 pm. Next to vanish is Delta³ Tauri at ~11:33 pm. It reappear at

~12:04 am, but the Moon will be very low on the western horizon. Binoculars or a small telescope are needed.

Mars is at opposition on April 8th. It'll be closest to Earth on April 14th. The Red Planet reaches a maximum angular size of 15.2".

A Total Lunar Eclipse is visible in its entirety during the early morning hours of April 15th. The Full Moon begins its passage through the Earth's inner, darker shadow (umbra) at 1:58 am and will be fully immersed at 3:07 am. Mid-eclipse is at 3:46 am and the Moon exits the umbra at 4:25 am.

KAS BOARD

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373-8942

VICE PRESIDENT

Jack Price
343-3193

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Rich Mather
629-5312

SECRETARY/ALCOR

Roger Williams
375-4867

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Joe Comiskey
329-4251

Mike Dupuis
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Scott Macfarlane
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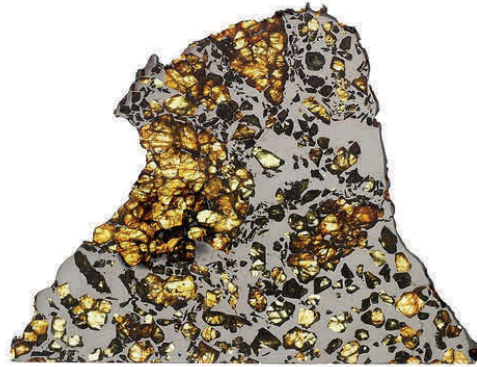
E-MAIL a BOARD MEMBER



April 2014

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Volunteers Needed @ Rock Show



The KAS has been invited to participate in the Kalamazoo Geological & Mineral Society's 55th annual [Rock, Gem and Mineral Show](#) at the Kalamazoo County Expo Center. We'll participate on May 2nd (9am - 3pm), May 3rd (10am - 6pm), and May 4th (10am - 5pm). We need *at least* two volunteers inside on all three days and two solar observers outside on May 3rd & 4th. Please [contact us](#) if you'd like to volunteer for one or more dates.

KAS Apparel is Back!

It's been well over ten years since the KAS has offered a full line of clothing. We now have several items in stock and ready for purchase. These include:

- Short-sleeve T-Shirts: \$17.00
- Long-sleeve T-Shirts: \$20.00
- Sweatshirts (unhooded): \$17.00
- Sweatshirts (hooded): \$22.00
- KAS Embroidered Caps: \$15.00

Full details, including sizes and colors, will be listed on our online store, [The SkyShop](#), soon. Clothing will also be available to purchase at most general meetings.



Public Observing Sessions



Saturday, April 5th
Feature: Moon, Mars & Jupiter



Saturday, April 26th
Feature: Galaxies of the Virgo Cluster

Gates Open: 8:00 pm • Observing Begins: 8:30 pm

Kalamazoo Nature Center • 7000 N. Westnedge Ave.

General Meeting Preview

The Robotic Telescope Project

presented by **Richard Bell**

The KAS received an amazing offer from member Mike Patton in January 2008: In return for technical advice and guidance with equipment for his new observatory at Arizona Sky Village, Mike would provide the KAS with space in that observatory for a robotic telescope. A strong majority of KAS members voted to begin the Robotic Telescope Project in December 2009. Our fund raiser began in September 2011 and to date we've raised over \$67,000! KAS President and Robotic Telescope Committee Chair Richard Bell will discuss this ambitious endeavor at our next meeting. Richard will discuss the area in which the telescope will be located, the equipment we hope to purchase, and long-term goals for the facility.

BONUS: After the presentation we will hold a special unboxing ceremony of our Software Bisque Paramount ME II Robotic Telescope Mount that'll be installed in Arizona. Please join us for this momentous occasion.

Friday, April 4 @ 7:00 pm

Kalamazoo Area Math & Science Center

600 West Vine • Use Dutton St. Entrance • No Entry after 7:10 pm



Kalamazoo Astronomical Society
c/o KAMSC
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Kalamazoo, MI 49008

STAMP

