SKYLIGHTS

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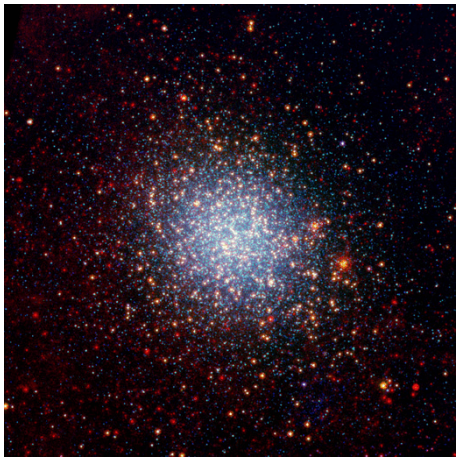
## Looking Back to Look Forward

*by Greg Novacek*

As we celebrate the International Year of Astronomy 2009, it is natural to both look at the important discoveries of the past and to look forward to see what discoveries may occur in the future. The last half of the twentieth century saw great strides in our understanding of stellar evolution. The hope is that we will come to the same level of understanding with regard to the formation and evolution of galaxies during the next few decades.



This sparkling orb of stars, Omega Centauri, could be the nucleus of what was once a small galaxy. It is the biggest and brightest of the globular clusters. Image courtesy of NASA's Spitzer Space Telescope

The current best guess for the way galaxies form has them growing from areas of the early universe that were slightly denser than their surroundings. Now in the early universe everything was moving away from everything else, but the stronger gravity in these slightly denser areas over came the expansion and over time these areas collapsed to form clouds that eventually became galaxies.

Although we don't have a good understanding of dark matter itself, we do know that 90% of a galaxy's mass is composed of dark matter. Therefore, dark matter must play an important role in the gravitational collapse of these clouds. In the next decade or two, astronomers hope to nail down just what this role is.

Astronomer have long known that galaxies collide and merge with each other. Recent discoveries, however, seem to indicate that mergers are much more common than once thought and that perhaps today's massive galaxies acquired a significant number of their stars from mergers with smaller galaxies (otherwise known as galactic cannibalism).

A look at our own Milky Way reveals a number of cases of cannibalism or near cannibalism. Tidal debris has been seen from the dwarf galaxies Leo I, Leo II, Carina, Ursa Minor, Sculptor, and several others. This debris arises because the Milky Way, with it larger mass and stronger gravity, tugs at the closet side of a galaxy more strongly than the more distant side. If the difference is great enough and the galaxy is weakly bound, it can be ripped apart.

Evidence for direct cannibalism of other galaxies has also been found. A group of stars within the disk of the Milky Way has been found to have the same chemical composition as the globular cluster Omega Centauri and may have come from the same parent galaxy. (Some astronomers believe that Omega Centauri is the nucleus of that parent galaxy.)

In the sky near Arcturus are a number of stars, including Arcturus, that all appear to be moving together through space at the same speed. Since the chemical composition of these stars is also different than the other stars in the region, a case can be made that they all came from a disrupted, or cannibalized satellite galaxy.

Some astronomers have ventured to say that all the metal-poor stars in the Milky

*(Continued on page 3, Galaxies)*

## Happy Birthday, ISS

*by Richard Kennedy*

On November 10, 2008 the International Space Station (ISS) celebrated its 10th birthday. So far, 18 different crews have occupied the ISS for almost 3,000 continuous days. Things are going well now as it nears its completion date in May 2010. To date, most of the efforts aboard the ISS have been dedicated to construction and researching how prolonged periods in space affect people.

In one interesting experiment, the acoustic conditions within the space station were studied. It is necessary for scientists aboard the Space Station to communicate while experiments are taking place but at the same time, it is also important that noise be minimized in crew quarters used for relaxation and sleep. The research done has led to better use of noise dampening or amplifying structures placed on the inner walls in different areas of the station.

An interesting set of related experiments studied the various effects on humans of long term exposure to the micro gravity environment of outer space. This study found that, over time, crew members experienced bone loss, muscle atrophy and other forms of tissue degradation. As a result, Space Station crews use a strict regimen of daily physical exercise to inhibit these potentially debilitating effects.

As the ISS nears completion and gets up to full operational status, there are a host of new experiments that researchers want to have run onboard. In fact, many nations are beginning to bid for research time in anticipation of the installation and commissioning of the last major scientific lab module.

As this new era of research in space begins, we can only wonder what incredible benefits the International Space Station will bring humanity.

## From the Director

If you haven't already heard, next year has been designated at the International Year of Astronomy 2009 (IYA2009) to commemorate the 400th anniversary of Galileo Galilei's first astronomical observations through a telescope. Those and subsequent observations of Jupiter's moons, craters on our moon, sunspots, and the phases of Venus forever changed the world of astronomy.

IYA2009 will be celebrated around the globe, recognizing astronomy's contribution to society and culture. A strong emphasis of IYA2009 is on education, public participation, and the involvement of young people. Currently people in over 130 countries are involved in IYA2009 activities. For more information go to: www.astronomy2009.org.

As you might expect, we will also be celebrating IYA2009 at the Observatory through both our regular public programs and special programs. We will start off the year with the programs *The Discoveries of Galileo* and *Astronomy of the Future*. In the *Discoveries of Galileo* we will look back and talk about the significance of those first observations he made through a telescope, as we observe the moon, Venus, and a binary star.

In *Astronomy of the Future* we will take a look forward to see what questions astronomers will be answering during the next 10, 20, or 30 years as we observe Venus, a giant dying star, a star cluster, a gas cloud, and finally a distant galaxy.

Later in the year the program *Famous Astronomers* will look at some of the more significant astronomical discoveries and the astronomers who made them. We will also commemorate both the 30th anniversary (yes it has been that long) of the Voyager fly-bys of Jupiter in 1979 and the 20th anniversary of Voyager 2's fly-by of Neptune in *Voyage Through the Solar System*. Additional special programs will also be held at various time throughout the year.

Last, but certainly not least, I want to give a big thank you to the volunteers (Explainers) that have been helping out with our public programs in many cases for a number of years. I would also like to welcome two new Explainers – Elias Jordan and Jasmine Pfingsten. All of the explainers help us meet our mission of bringing astronomy to the people of south-central Kansas. So, while around the country numerous special events are taking place to give people a chance to look through a telescope, as part of IYA2009, here it is just an every day occurrence.

Have a happy holiday season and may 2009 bring clear skies!

Greg

## Shuttle Update

Space shuttle Discovery is due for launch around February 12, 2009. Mission STS-119 is due to launch from Kennedy Space Center for an assembly mission to the ISS.

The next shuttle mission, STS-125, isn't due to launch until around May 12th, when the shuttle will make the long awaited trip to Hubble Space Telescope for its fifth and final servicing.


**Lake Afton Public Observatory Quarterly Newsletter**

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## IN THE SKY

December 31st brings the great planets of Jupiter and Mercury next to each other in the early evening sky. The sun sets around 5:15 p.m. that evening, so look to the southwest as the planets become more visible as the sky darkens. Then keep watching as the two planets slowly slip below the horizon.

Not to be outdone that same evening is the crescent Moon near Venus. These great pairings in the sky will be easy to find even for the newest of observers. Watch for the crescent Moon to be near Venus again on January 29th and February 27th.

Venus reaches its highest point in the evening sky on February 18th and begins its journey back toward the western horizon, finally vanishing into the sunset around March 25th. It will reappear in the early morning sky during the beginning of April.

The moon continues to make some close calls in the night sky. Look for the waxing moon near the Pleiades on January 7th, February 3rd, and March 3rd. In fact the moon will occult one of the stars – Taygeta – on the night of February 3rd, beginning around 7:45 CST. The star will reappear around 8:20 CST. More occultations of the Pleiades by the Moon will also occur in August. Stay tuned.

Look for Saturn to be visible high overhead in the early morning sky. You will find it almost halfway between Regulus and Spica. The great planet will continue to be visible in the evening sky well into spring.

On January 21st, look for the waning crescent moon near the red supergiant Antares in the constellation Scorpio. The moon will be near the red star again in February and March, but the January pairing will be the closest the two will be seen together until June.

Also look for the waning crescent moon near Jupiter in the early morning sky on March 22nd. It will be a nice pairing to see. Then the next morning the thinning moon will be halfway between Jupiter and Mars. And finally on the 24th, the nearly new moon will be next to Mars in the sky. Get up early to see these before they disappear into the sunrise.

Enjoy some great viewing!

## Winter Photos

*by Jim Fullerton*

From late December to early January, Jupiter and Mercury will be in the southwest after sunset. Use a telephoto lens to find the planets, but include foreground scenery for context and scale. For a 35mm film or full scale (professional quality) digital camera with a 100mm telephoto lens, your maximum exposure is 20 seconds at an ISO setting of 400. For all other digital cameras, the maximum exposure is 16 seconds, if you are using the same setup. You may take longer exposures, but the planets will begin to show trails.

Trails can be good. You can try using Bulb setting, taking a 10-16 second image, then block the front of the lens with a black, opaque object for a minute, then remove the blocking object and let the earth rotate for a few minutes. The result will be a "dot-dash" image for each bright sky object.

From December until the Vernal Equinox is a good opportunity to record Venus' changing altitude and azimuth after sunset. As described in Skylights Spring 2007, use a fixed location to take images. Take the images several days apart and at times that the sky darkness remains nearly constant. Time of sunset will increase from January through March. Use a location that shows objects on the horizon or in the foreground for reference.

The morning of January 3rd is the Quadrantid meteor shower. The peak is expected a few minutes before 7 am CST, which will be bright twilight. The shower peak is narrow, so you may see a decent shower for the last two hours before sunrise.

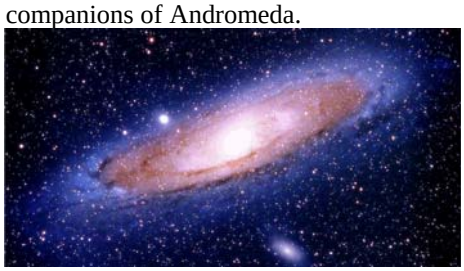
In morning twilight on March 22-24, the waning crescent moon, Jupiter, and Mars will be visible in the east-southeast. They will be low in the sky, so you will need to take pictures while the sky is still fairly dark. Use a tripod-mounted camera and take a range of time exposures several seconds in length.

## Galaxies

*(Continued from page 1)*

Way's disk came from smaller galaxies that have been cannibalized. (To astronomers, “metals” refers to all elements other than hydrogen and helium. Metal-poor stars have a greater proportion of hydrogen and helium than "normal stars and smaller proportions of everything else.)

The same type of observations have been made in the Andromeda galaxy. A number of stellar streams resulting from tidal disruption have been observed. Two of these streams appear to originate from the dwarf galaxies M32 and NGC205, companions of Andromeda.



Andromeda Galaxy. Photo courtesy of Berkely.

These ideas and observations have lead to a new idea of galactic formation – the CDM (Cold Dark Matter) model. Small clumps come together to form galaxies which in turn come together to form clusters and super-clusters. One problem is that CDM predicts that both the Milky Way and Andromeda should have many more dwarf galaxies in their vicinities. A possible solution is that they have already been cannibalized!

The answers to these questions may be provided by the next generation of telescopes over the next decade or so. These telescopes will have the ability to study other galaxies in the same detail as we can study Andromeda today. They may also help us understand how galaxies develop their spin, how central bulges and bars form in spiral galaxies, and how black holes and star formation interact. The most exciting things we will learn are yet to come!

## New and Renewing Members

We would like the thank the following people who have become members or renewed their membership to the Observatory.

| | |
|---|---|
| Dean and Mary Day | Stephen Day |
| Dana and Beth Duckworth | Fred and Carol Gassert |
| Pamela Mingauw | Hans Mulders |
| C.W. Robertson | David Stanislaw |
| Tony Veith | Elias Jordan |

And those who choose not to have their names listed!

## Friends and Stars Program

*March 15, 2009 - 8:00 p.m.*

This is an evening for Friends and Stars to decide what they want to look at through the telescope. The Orion nebula and other winter objects will be in the sky as will Saturn. Most importantly the moon will not be around, so come with a list of objects you would like to observe.

*Remember that an Observatory program is automatically canceled if there is a severe thunderstorm warning or tornado warning anywhere in Sedgwick County during the hour prior to the start of a program. In the event that we have snow, call 978-7827 and choose option 8 to see if the program has been canceled.*

### Upcoming Programs

**Moons, Rings, and Other Things**

*March 6-7*
*April 3-4*
*May 1-2, 29-30*
*June 5-6, 26-27*

This is your chance to come out to the Observatory and use our 16" diameter telescope to get a close up look at the Moon with its mountains and craters, Saturn with its moons and rings ,and a red giant star in its final phase of life.

**Celestial Favorites**

*March 13-14, 20-21, 27-28*
*April 10-11, 17-18, 24-25*
*May 8-9, 15-16, 22-23*
*June 12-13, 19-20*

With so many beautiful objects to view in the night skies, sometimes it is hard for us to pick what you might like to look at. So in addition to looking at Saturn, a dying star, a cluster of stars and a “nearby” galaxy, we will let our visitors choose an object to observe.

# Learn the Sky

*by Jim Fullerton*

This article gives simple directions to finding some great objects to view in the sky, based on the cardinal directions (North, East, West, and South) and the average binocular field of view (FOV) of 5 degrees. Angular distances in the sky will be stated as a number of 5-degree FOVs. When the objects are near the meridian, the directions match (Up, Down, Right, and Left).

The reference stars to use are Betelgeuse (the bright orange star in the east "shoulder" of Orion), Procyon (the brightest star in Canis Minor, about a hand-span east of Betelgeuse), and Sirius (the brightest star in Canis Major, about a hand-span southeast of Betelgeuse). These three form a nearly isosceles triangle with Sirius at the bottom.

### ***M47 and M46***

Center Procyon in the binoculars. Now move south three FOVs to 4th magnitude Alpha Monocerotis. To move one FOV south, place Procyon near the top of the FOV and tilt the binoculars down until the stars near the bottom of the field are moved to the top of the field. From Alpha Monocerotis, move one FOV south again but don't fall off the ship's stern!

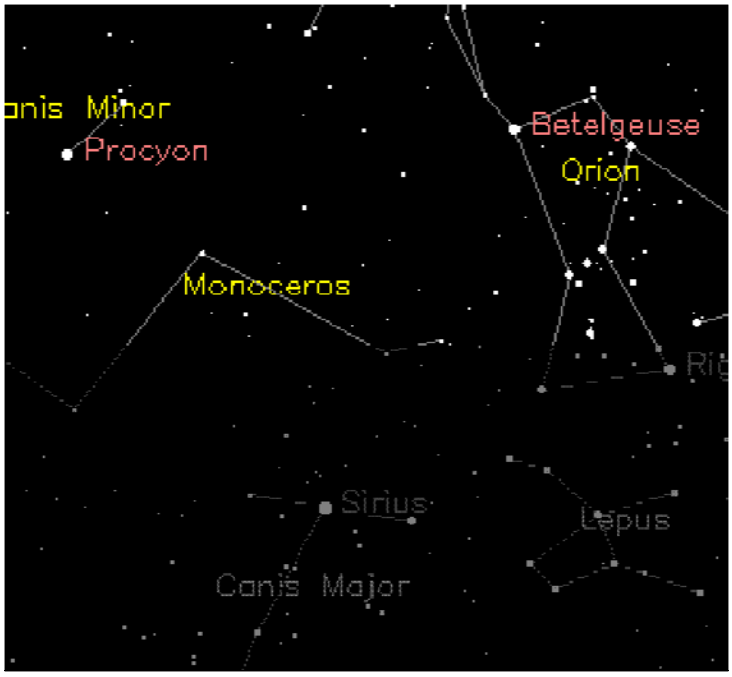
Just right of center, a tight sprinkling of stars is the open cluster M47. One degree east of M47 is a small, faint fuzzy patch called M46, another open cluster. In telescopes, a planetary nebula (NGC 2438) is superimposed on M46. Since open clusters like M46 are made of young stars and planetaries are formed from old sun-like stars, NGC 2438 is probably either in the foreground or background.

### ***NGC 2244***

From Procyon, move 3½ FOVs west to a group of 7-8 magnitude stars that are more or less paired in rows that tilt rather like two slashes ("//"). These are part of the NGC 2244 cluster, which is associated with the Rosette Nebula. You won't see the Rosette in binoculars; it is 1.5 degrees across and very faint. This cluster of stars appears to the eye as a dim fuzzy patch. You can also start at Betelgeuse and move two FOVs east and ½ FOV south.

### ***M50***

Place Sirius at the lower right edge of the FOV. Near the upper left edge of the field is the star theta Canis Majoris. Doggedly move one FOV toward the upper left again so theta is near the lower right edge of the field. A sprinkling of faint stars and a small round fuzzy glow near the upper left edge is the open cluster M50.




This graphic courtesy of the Gemini Observatory.

### ***M41***

Go back to Sirius and place it near the top of the field. A little above the bottom center is the open cluster M41. It can be seen with the unaided eye as a dim, fuzzy glow.

### ***The Horsehead Region***

Center zeta Orionis, the eastern star in Orion's belt, in the field of view. About 1-2 degrees south, there are several bright stars. Look immediately south (½ degree) of zeta and hunt for an arc of four faint stars. They arc down to the right. Mentally connect them with a curve and draw two straight lines from the ends of the arc to a point about one degree to the southeast. This "pie slice" encloses the Horsehead nebula.

The horsehead is a dense cloud that obscures part of the hydrogen emission nebula IC 434. You cannot see it with binoculars. It is easy to photograph, but be aware that most film, and the cutoff filters in most digital cameras cause them to be very insensitive to Hydrogen-alpha (deep red) light.

There are many great sights to see in the night sky. Enjoy!

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# It's Altair to the Moon: The Future of Space Travel

In December 2008, NASA announced the name of the new lunar lander - ***Altair.*** Having established the goal of sending people back to the moon late in the next decade, the Altair lander will be capable of life support and will serve as a base for up to four astronauts on the surface of the moon.

Altair is named for the brightest star in the constellation Aquila. In Latin, Aquila means "Eagle." This should bring to mind the Neil Armstrong lunar landing of 1969 - "The eagle has landed."

Conceptual designs for how Altair will actually look are still under consideration by NASA. Looking to industry experts, the space agency plans to have hardware and test concepts completed no later than 2011. This lays the foundation for the continuation of exploration of the moon and the building of a lunar outpost to come soon after that.

The current plan is to launch the vehicle using an Ares V rocket into a low earth orbit. From there Altair will rendezvous with the Orion spacecraft which will carry the lander and the crew to the moon. The Orion spacecraft will later be used to return the astronauts to Earth.

The dream is to have a new crew of astronauts landing on the moon with Altair no later than 2020. A lofty goal, but a needed step as we seek to explore further into space and our own solar system.

Keep checking the NASA website for more updates and the progress they are making to again reach for the sky and set foot on the moon.

# A Very Special Cepheid

*by Robert Henry*

Peter Michaud, Gemini Observatory

For centuries most people have believed the North Star or Polaris to be a celestial constant in an ever-changing cosmic background. However, recent research is now revealing that this is not the case. It is fairly common knowledge that Polaris' position is slowly changing.

For centuries navigators have counted on Polaris to guide them. It reveals both true north and gives north latitude, the same as Polaris' elevation above the horizon. Today we know that in the past Polaris was not, nor will it always be Earth's north celestial polar star, because the Earth's rotational axis wobbles. It has only been pointed near Polaris for several centuries. Polaris is now within 1° of our celestial north pole and is gradually getting closer. It won't reach its nearest point until 2102.

In 1910, it was discovered that Polaris is a Cepheid variable, a yellow supergiant star whose brightness changes like the slow beating of a heart with a period of 3.97 days. In addition, Polaris' average brightness is slowly increasing. Not only that, but it is believed that Polaris is a member of a select group of variable stars known as overtone pulsators.

Although Cepheids were discovered in 1784 by Edward Pigott, an English astronomer, Polaris' brightness varies so little that it was not identified as a Cepheid until 1910. Cepheids are important to astronomers for a couple of reasons. First, they give off so much light that they can be seen in galaxies beyond our own. Secondly, their period of pulsation is directly related to the amount of light they emit. They make excellent yardsticks for measuring distances to other galaxies. Edwin Hubble first used Cepheids to show that there were galaxies beyond our own and then he used them to measure the rate at which the universe is expanding.

A common public misconception is that Polaris is the brightest star in the night sky. Although it is relatively bright at a respectable 2nd magnitude, it is nowhere near the brightest star in our sky. (It is actually the 48$^{th}$ brightest star!) But it is bright enough to be seen even from light polluted city locations.

What is really interesting is that new research indicates that Polaris is slowly getting brighter. In fact, it appears to have gotten 15% brighter in the last 100 years and is more than twice as bright as it was 2,000 years ago.

It looks like our North Star is not such a constant beacon in our night sky after all. But wait! The story gets more interesting! Recent discoveries have shown that although most Cepheids' period of pulsation is constant, Polaris' rate of pulsation is gaining three to four seconds a year. In 1983, astronomer Armando Ferro discovered that the period and magnitude of Polaris' pulsations were changing.

In the early 1900's the magnitude varied by as little as 0.10 to 0.15. By the 1980s the magnitude variations were down to only 0.05. A team of Canadian astronomers led by Don Fernie predicted that by 1994 Polaris would cease to pulsate. That would have been the first ex-Cepheid ever seen.

However, Polaris did not cease to pulsate. It got down to a variation as small as 0.02 magnitude in the 1990s but is now back up to a 0.03 to 0.05 magnitude variation. Hmmm … so what's going on?

In 1997 the Hipparcos satellite used parallax to determine the distance to Polaris to be 430 light years. That means it is too bright for a Cepheid with a 3.97 day period. So given the amount of light Polaris emits, it should be pulsating more slowly resulting in a period closer to 6 days!

One possible explanation for this discrepancy goes like this: Musical instruments have multiple harmonic modes called overtones. Following this analogy, Polaris seems to be pulsating in its first overtone instead of its fundamental pulsation mode. As it turns out, this is not that uncommon. In fact, many Cepheids pulsate in their first overtone, especially the short-period Cepheids like Polaris.

"Normal" Cepheids brighten quickly and then fade slowly during their pulsations. However, Polaris is taking the same amount of time to brighten as it does to fade. This means it shares traits with a special class of Cepheids known as overtone pulsators.

All this has astronomers a bit baffled. However, Canadian astronomer David Turner has offered a possible explanation. He believes that Polaris may have recently evolved from being a blue main sequence star into a yellow supergiant phase and that it is going through a pulsation phase on its way to becoming a red supergiant. Turner says that this would explain the changes in Polaris' period and amplitude as well as its slow change in average brightness.

Another explanation is that the parallax measurement from the Hipparcos satellite in 1997 was incorrect. So, Howard Bond of the Space Telescope Science Institute and his colleagues plan to use the Hubble Space Telescope's Fine Guidance Sensors to get new parallax measurements for Polaris. This will determine whether Polaris is an overtone pulsator as Turner believes, or a fundamental-mode pulsator as current data indicates.

With all this uncertainty surrounding Polaris, one thing is certain – the research surrounding our North Star will prove to be very interesting for years to come.

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# CURRENT OBSERVATORY PROGRAMS

**Astronomy of the Future**

With faster computers and giant Earth-based telescopes, the tools that astronomers use have changed over the last twenty years. What types of changes might the next 20 years bring? We will explore the answer to that question as we observe Venus, a giant dying star, a cluster of stars, clouds of interstellar gas, and a distant galaxy.

*January 16-17, 23-24 7:30-10:00 p.m.*
*Feb. 13-14, 20-21, 27-28 7:30-10:00 p.m.*

**The Discoveries of Galileo**

Imagine what it would have been like to be Galileo — first person to point a telescope at the heavens. Join us as we "rediscover" craters on the Moon, the phases of Venus and how Galileo tried to use a pair of stars to find the distance to the stars.

*January 9-10, 30-31 7:30-10:00 p.m.*
*February 6-7 7:30-10:00 p.m.*

**Photography Programs**

Venus [2] 6:30 p.m, Jan. 17
Orion Nebula (M42)[1] 10:00 p.m., Feb. 21
Saturn [2] 10:00 p.m., March 21

Bring your 35mm or Digital Single Lens Reflex Camera. You can also use our camera and we will transfer your picture to a USB flash drive.

[1] 800 or faster speed film, telephoto lens, and cable release are required.
[2] We recommend ASA 400 or 800 color film.

## Observatory Hours

The Observatory is open every Friday and Saturday evening. Admission is $4.00 for ages 13 and over and $3.00 for ages 6 - 12. Children under 6 are admitted free. We also have a family rate of $12. Observing through the telescope begins soon after the doors open. Program times are subject to change. Call the Observatory at (316) WSU-STAR to confirm programs and times or to check for weather-related cancellations.

***Closed: Dec. 24 – Jan. 4*** ***Jan.: 5 - Feb.: 28: 7:30 - 10:00 p.m.*** ***March 1 - 31: 8:00 - 10:00 p.m.***

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