Snake River Skies

A Publication of the Magic Valley Astronomical Society

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President's Message

Greetings fellow stargazers: Welcome to the return of the Newsletter for the Magic Valley Astronomical Society. I would like to take this opportunity to thank those involved with the Messier Marathon this past month.

Chris Anderson, for his tireless devotion on behalf of the Centennial Observatory

Rick Widmer, for his technical support

Ken Thomason, general assistant

Phil Hafer, MC and keeping things interesting

Terry Wofford, club president

John Hall, video titles

Forrest Ray, telescope operator

Jim Woods, for ordering and getting the pizzas to us

Dr. Jay and Mrs. Deb Hartwell, for bringing their 12" Meade w/o which we would never viewed the targets we did.

Dr. Chris Sutton, who knows his way around the sky when it comes to the Messier list

David West, general assistant

I would like to also thank those whom I forgot to mention. Please forgive me, I should have written names down.

As many of you may recall, I had sent an e-mail concerning a Star Party at Pomerelle Mountain. After meeting with Jody Burrows, I believe we can make this a reality. That said, I took the matter before the board and we agreed to have an open star party and observing session at Pomerelle during August. Chris Anderson has agreed to present his talk that evening. This may become an all day affair with solar observing and then mountain top observing in the evening. We will present more details later.

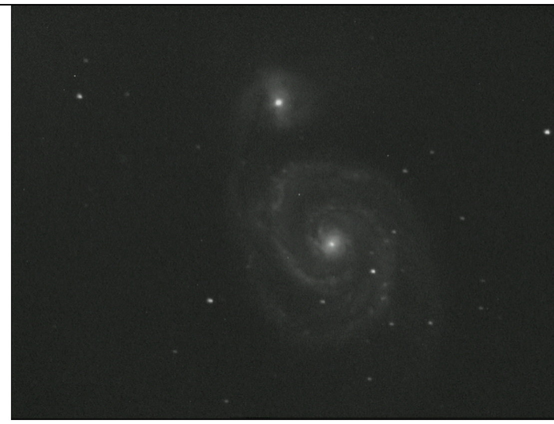
I understand from David Olsen, VP our club has received an invite to do a star party at Great Basin National Park in Nevada. The early date was over Memorial Day weekend, but we are getting short notice for any major plans. The next date will be over Labor Day weekend and may be in conjunction with the S.L.C. Astronomical club.

Speaking of National Parks and Monuments, David has also stated we have been asked to return to Craters of the Moon this year. The dates will be the 15th and 16th of June and the 14th and 15th of September. During the conversation with the contact person for Craters, David learned the Monument would also like to have our club also present a star party during the months of July and August, which is their busy season. They are only wanting one weekend per month. Please let me know what you think of this idea.

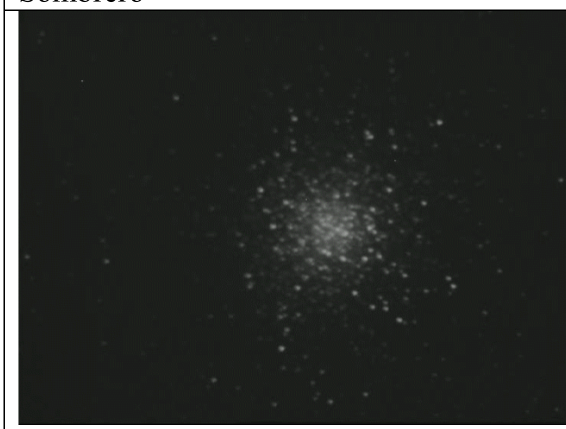
Clear skies and good observing everyone,
Terry Wofford, President MVAS

FIRST LIGHT for our Stellacam!

Sombrero

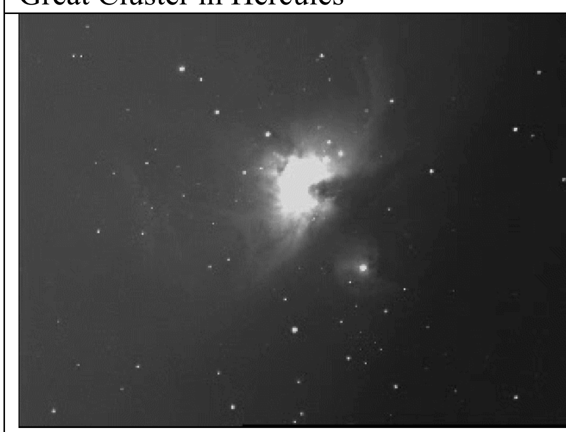


Whirlpool



Great Cluster in Hercules

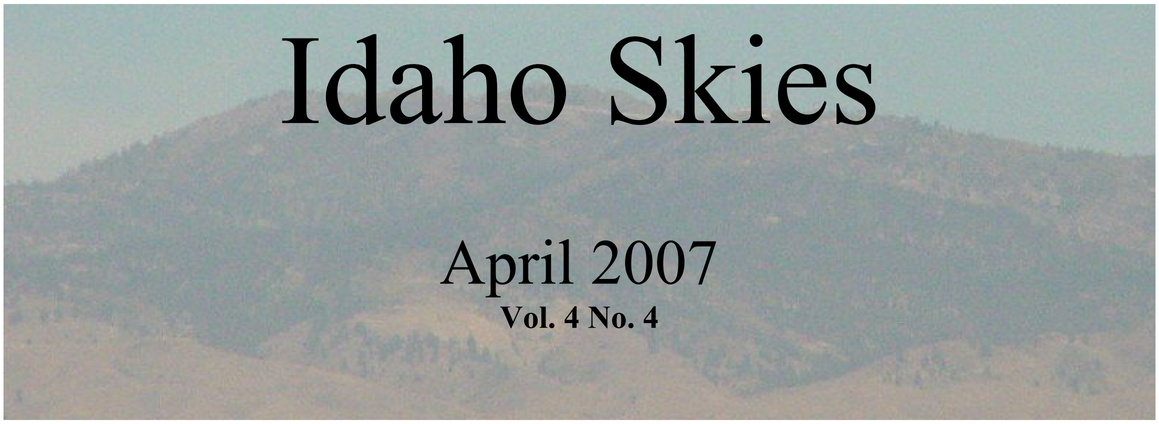
Double Cluster – Tak Astrograph



Great Orion Nebula

They may not be as awesome as the shots taken with the Shotwell camera through the Herrett telescope, but these images are cool in their own way. They were all taken last month at the Bruneau Dunes observatory using the club’s Astrovid Stellacam. We can now show LIVE images like this on a TV anywhere!

These were shot with Bob Niemeyer’s 14” Celestron, with a f/6.3 focal reducer, except the double cluster.



Idaho Skies is a column for beginning amateur astronomers and those interested in astronomy. Suggestions about the column are gladly accepted by the columnist, at paul.verhage@boiseschools.org

This month look for the star Regulus, the lucida of the constellation of Leo the Lion. Regulus is the 25th brightest star in the heavens and 77 light years away. So if you were born in 1930, then Regulus is your birthday star this year. Regulus is Latin for “Little King” and represents the heart of Leo the Lion. Regulus is 3-1/2 times heavier and larger than out sun. Its extra mass squeezes its core harder, making it consume hydrogen faster. As a result, Regulus is 240 times brighter than our sun. We can easily see Regulus, but if we looked for our sun from Regulus, we’d need a telescope to see it. Regulus has two faint companion stars that orbit each other in 1,000 years. The pair of smaller stars orbit the larger Regulus in 130,000 years.

Leo passes overhead at 9:00 PM in early April and 8:00 PM later in the month. When you look for Leo you’ll first probably notice its backwards question mark. The question mark, or Sickle of Leo, consists of six stars and opens to the west. The question mark represents the head and neck of Leo, with Leo’s head looking to the west. The bottom star of this question mark is Regulus. Behind the Sickle of Leo are his hind quarters. It’s represented by three stars forming a triangle that points to the east. Leo is one of the constellations of the Zodiac.

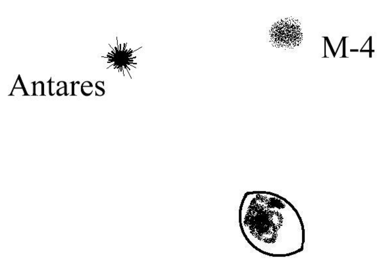
April 1 – 7

The moon is full on the 2nd at 11:15 AM (10:15 for Oregon and 12:15 PM for the Midwest). Since the moon is at apogee tomorrow, this month's full moon is the smallest full moon this year. Here's a simple astronomy experiment that you can perform. Photograph the full moon tonight and compare the photograph to a photograph of the largest full moon of the year. The largest full moon of the year, the perigean full moon, occurs on November 24. Be sure to use the same camera and camera lens for the two photographs. By the way, the full moon in April is often called the Egg Moon.

The moon reaches the apogee of its orbit on the 3rd at 3:00 AM (2:00 for Oregon and 4:00 for the Midwest). Apogee is the greatest distance of an elliptical or oval shaped orbit. The moon's greatest distance this month is 252,481 miles. A stack of dollar bills tall enough to reach the moon tonight would be worth four trillion dollars. That's one third of our gross domestic product or half our national debt.

Look for the moon on the morning of the 3rd as you head to work. You'll see the star Spica (the lucida of Virgo) 3 degrees to the moon's upper left. Three degrees is an angle six times greater than the moon's diameter.

If you can get up early Saturday morning, April 7 you'll find the moon between Antares and M-4. You'll need to go out around 4:30 AM to see this. This should be a nice binocular event, although the moon's light will wipe out much of globular cluster, M-4.



April 8 – 14

As the moon rises on the 8th (roughly at 2:00 AM), brilliant Jupiter is located above it. So if you're not certain where Jupiter is located, let the moon be your guide.

The moon reaches last quarter phase at 11:04 AM (12:04 PM in the Midwest and 10:04 AM in Oregon) on the 10th. So unless you go outside after midnight or look before heading to work, you won't see the moon again for a week.

April 11th to the 17th is Astronomy Week, the goal of which is to bring astronomy to the public. So if you have a telescope, invite a neighbor to look through it. There's more information at the Astronomy Week website, http://www.astroleague.org/al/astroday/astroday.html

Look for the Evening Star on the night of the 11th. When it gets dark (around 9:00 PM) you'll find the Seven Sisters (the Pleiades) close to the upper right of Venus. Both objects fit within your binoculars since they are separated by only 3 degrees (that's about half your binocular's field of view).

April 15 – 21

Astronomy Day, the highlight of Astronomy Week, is Saturday, April 16th. Check with your local astronomy club to see if there are any planned events.

At 11:00 PM on the 16th (10:00 for Oregon and midnight of the 17th for the Midwest), the moon reaches the perigee of its orbit (its closest point to earth). Its distance for this month's perigee is 221,914 miles. That's 30,567 miles closer to earth than it was on the 3rd. Since the moon is both new and at perigee, our beaches will experience larger than average tidal changes.

On the 17th at 4:36 AM (3:36 for Oregon and 5:36 for the Midwest), the moon is new. So don't expect to see the moon again for a few days.

The 35th anniversary of the launch of Apollo 16 is on the 16th. Apollo 16 was one of three moon landings of the J mission configuration. The first Apollo moon landings were G (Apollo 11) and H (Apollo 12-14) missions with lunar modules that could operate for only one or two days, respectively, on the moon. The J mission lunar landers were heavier because they carried more experiments, a moon buggy, and operated on the moon for three days. In addition, the command module in lunar orbit carried a SIM bay with cameras to map the moon from lunar orbit.

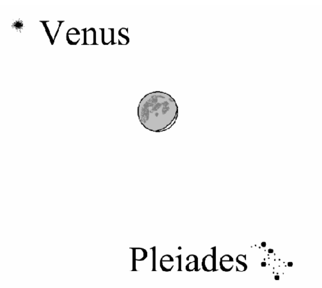
Astronauts John Young and Charles Duke took the lunar lander (LM) Orion to the Descartes Highlands and Ken Mattingly remained in lunar orbit inside the command-service module (CSM) Casper. The four previous Apollo missions landed in dark lunar maria. But Apollo 16 landed in a brighter and older highland region. Apollo 16 returned to earth with 209 pounds of moon rocks and dust.

Wilbur Wright (of Wright brothers fame) was born 140 years ago on the 16th (1867). On December 17, 1903, he and his brother Orville built and flew the first heavier than air vehicle for 12 seconds and covered a distance of 120 feet. This Wright Brother airplane is currently on display at the National Air and Space Museum in Washington DC. Tragically Wilbur died in 1912 from typhus.

April 17th is the 40th anniversary of the launch of Surveyor 3. This was the second soft landing of an unmanned American spacecraft on the moon. The Surveyors were originally designed to do a thorough exploration of the moon. But after Kennedy's commitment to land a man on the moon before the end of the decade, Surveyor was redesigned to test soft landing procedures in preparation of a manned landing. But JPL did manage to keep a few experiments onboard Surveyor to test the composition of lunar soil and rocks.

At 48 miles above the lunar surface on April 20, 1967 Surveyor 3 fired its retro rocket in preparation for landing. Its single retro rocket was jettisoned after the burn and Survey 3 continued landing on a set of smaller vernier rockets. Due to a confused onboard radar, Surveyor 3 didn't shut off its verniers upon landing. It took a signal from earth to finally shut them down. Because of the delayed shut down of the verniers, Surveyor 3 bounced three times across the lunar surface. Surveyor 3 returned over 6,000 pictures of the lunar surface, took a picture of a solar eclipse from the moon, and tested the strength of the lunar surface. Surveyor 3 did not wake up after its first two week long cold lunar night. In 1969 Surveyor 3 received a visitor when the astronauts of Apollo 12 landed 600 feet away. Apollo returned to earth with several pieces of Surveyor 3. One of which was its camera and it's now on display at the Smithsonian National Air and Space Museum.

We have an astronomical treat on the evening of the 19th; the thin crescent moon is located between Venus and the Pleiades. Look in the low west after it gets dark (9:00 PM) for brilliant Venus. In your binoculars be sure to look for earthshine on the moon. Earthshine appears as faint lighting on the dark side of the moon and comes from sunlight reflected off the earth.



The 19th is the 25th anniversary of the launch of Salyut 7. Salyut 7, a Soviet space station, was launched into earth orbit in 1982. Salyut 7 was launched because the better designed Mir space station was running behind schedule. Salyut 7 orbited earth for four years and hosted ten visits by cosmonauts. Two of the cosmonauts were non-Russian guest cosmonauts in a program called InterCosmos. Salyut 7 was a test bed for assembling larger space stations by docking smaller components to it. Salyut 7 was 53 feet long and weighed nearly 22 tons.

April 22 – 30

A mild meteor shower reaches its peak on the night of the 22nd and morning of the 23rd. The Lyrid meteor shower peaks with around 10 meteors per hour, which is small compared to this summer's meteor showers. But at least this year, the moon's light won't interfere with meteors after midnight. The best time to watch Lyrid meteors is after midnight. Their radiant, or point of origin in the sky, rises in the northeast at 9:00 PM and is high overhead after midnight.

The moon is at first quarter on the 23rd at 11:36 PM (10:36 for Oregon and 12:36 AM on the 24th for the Midwest). And over three days the moon makes a handy reference point for locating a star cluster, a planet, and a bright star.

On the night of the 23rd, the Beehive star cluster is located 4 degrees from the moon's left. In your binoculars, put the moon to the right side of the field and the Beehive will be the scattering of stars near the center of the binoculars field of view.

Late on the 24th, creamy yellow Saturn will be less than 3 degrees to the moon's left. A small telescope with a magnification of at least 50 power is capable of showing Saturn's rings and largest moon, Titan. Titan appears as the star closest to Saturn. When you see titan you're looking at a satellite larger than our moon with an atmosphere denser than earth's.

Late on the night of the 25th the moon less then 2 degrees from Regulus, the lucida of Leo the Lion. So look for a moderately bright star to the moon's left. That's Regulus.

The moon is at apogee for a second time this month on the 30th at 4:00 AM (3:00 for Oregon and 5:00 for the Midwest). The moon's distance is 252,406 miles away tonight.

This Month's Topic

Black Holes

Black holes are not a new concept. Believe it or not, geologist John Michell came up with the concept back in 1784. Michell hypothesized that there could exist a star with such high gravity that its escape velocity would be greater than the speed of light. Newton's laws of gravity were well understood and Michell could determine that a star with a mass and volume 500 times greater than the sun would have an escape velocity in excess of the speed of light. In that situation, the star would be invisible to us because light emitted from it would never reach us.

Let's discuss escape velocity for a moment. All objects dropped above the earth fall at the same acceleration. That means two objects strike the surface at the same speed if they are dropped at the same height (we're ignoring air resistance here). In a perfect world, if I drop an object from a height of 16 feet, it will strike the ground at a speed of 32 feet per second. It also turns out that if I throw an object up at a speed of 32 feet per second, it will reach an altitude of 16 feet before falling back down (and hitting the ground at a speed of 16 feet per second). The higher an object is dropped above the surface, the faster it impacts the ground. And the faster its thrown up, the higher it reaches before falling back.

An object dropped from infinite height above the earth strikes the ground at the highest possible speed. It turns out that no matter how high I drop an object, it cannot hit the surface of the earth with a speed any greater than seven miles per second (7 mps). That means if I throw an object up at 7 mps, it will reach an infinite height above the earth before coming to a stop and falling back to earth. In essence, the object has escaped the gravitational influence of the earth. The means 7 mps is the escape velocity of earth. For reference, the escape velocity of the sun is 386 mps and of Jupiter is 37 mps.

The escape velocity of a planet is influenced by the mass of the planet and its diameter. It turns out that the greater the mass of a planet or the smaller its diameter, the greater its escape velocity. If given the mass of a star, you could calculate its escape velocity at difference diameters. This is what Michell did when he calculated the density and diameter of a black hole.

Now back to black holes. What prevented further development of the black hole concept was the understanding that light was a wave and not a particle. At the time physicists believed that massless waves of light were not affected by gravity. So even if the escape velocity of an object was equal or greater than the speed of light, light would still escape.

In 1915 Albert Einstein developed a new description of gravity based on his theory of Relativity. In Relativity, light is affected by gravity just like matter. It didn't take long for physicist Karl Schwarzschild to mathematically show that Relativity allows the existence of black holes. Schwarzschild calculated at what distance from a point source of matter that its escape velocity would equal to the speed of light. Schwarzschild used a point source of matter for his calculation because it was assumed a heavy enough body would collapse itself to a tiny point in space. The distance from a point mass where the escape velocity is equal to the speed of light is called the Schwarzschild radius in honor of Schwarzschild's work. So far, so good. But could gravity really pull on light? In 1919 the proof that Einstein was right was found. During a total solar eclipse, pictures taken of stars around the eclipsed sun showed a displacement that matched exactly what Einstein's theory predicted. Einstein became a celebrity for this discovery.

So if gravity can really bend the path of light, then black holes can exist, but where should astronomers look to find black holes? More specifically, what kinds of stars become black holes?

In 1919 the structure of the atomic nucleus was not understood. Therefore some astronomers and physicists argued that no force could support a star heavier than 1.44 solar masses, once its furnace shut down. This mass limit is called the Chandrasekhar limit, in honor of Subrahmanyan Chandrasekhar, the astrophysicist who calculated it. Once the neutron was discovered in 1932, astronomers realized that stars above the Chandrasekhar limit were stable as neutron stars, but that stars heavier than 3 solar masses are heavier than even neutrons can support. Today we call the 3 solar mass limit called the Tolman-Oppenheimer-Volkoff (TOV) limit and it was discovered mathematically in 1939. Therefore gravity will crush a star heavier than 3 solar masses to a single point once its stellar furnace shuts down (unless the star can find a way to shed the excess mass before being crushed out of existence).

In Relativity, the single point that a star is crushed to is called a singularity. A singularity contains the entire mass of the black hole, its spin, and electric charge and it's smaller than the smallest point you can draw. Astronomers and physicists are fond of saying that a black hole has no hair. That's because every property of the star before it collapsed into a black hole is destroyed except for the three properties mentioned above.

But there's more to a black hole than just a naked singularity. In fact there must be something to hide the singularity. That's because a singularity represents a point in space-time where all physical laws break down. What hides a black hole's singularity is its event horizon. As an object falls into a relativitistic black hole, it picks up speed. And at the point at which it falls at the speed of light, the object passes through the black hole's event horizon. This means an event horizon is a boundary where the escape velocity of the black hole equals the speed of light. Because the escape velocity at the event horizon is equal to the speed of light, the event horizon acts as a barrier that prevents everything inside from being seen by the rest of the universe. Inside a black hole but before the singularity space and time may swap with each other. If so, then when an object moves inside a black hole it moves forwards and backwards in time as time changes its location moves. The event horizon is spherical in shape unless the black hole rotates. Then the shape of the event horizon is stretched at the equator and turns into a flattened sphere.

Falling into a black hole would not be a pleasant experience. As you approached the black hole, the difference in the gravitational force between your toes and head would grow to the point where it would pull you to pieces. Meanwhile, the gravitational force across your body would crush it inwards towards your spine. The end result is that a large object, like a person, gets stretched and narrowed into a spaghetti noodle. But you're not the only thing falling into a black hole. Dust and gas spiraling into the black hole forms a disk or doughnut around the black hole. The disk, called an accretion disk, is filled with atoms slamming into each other at incredibly high speeds. The result is a disk that's warm on the outside and intensely hot near the black hole. Near its inside edge the temperature increases to the point that ultraviolet and X radiation is emitted. So falling into a black hole would result in a lethal dose of radiation as your body was cooked, stretched, crushed, and vaporized.

Adding quantum mechanics to the picture of a black hole changes the classical relativitistic black hole where nothing escapes once it falls in to one where radiation slowly escapes over time. Back in 1970 Stephen Hawking determined that black holes have entropy, or energy that cannot be used to do work. This means black holes have a temperature and therefore emit energy. The energy, called Hawking Radiation, comes from the destruction of virtual particles created too close to the black hole's event horizon.

Virtual particles are subatomic particles created from energy borrowed from space-time in accordance to the rules of the Uncertainty Principle in quantum mechanics. In normal circumstances virtual particles are created in pairs from nothing but borrowed energy and annihilate each other within their allowed time limits. But when a pair of virtual particles is created near an event horizon, one of them has a chance of falling into the event horizon before it can annihilate its partner particle. When this happens, the black hole appears to have emitted a particle of radiation. The energy required to turn this virtual particle into a real particle comes from the black hole. That's because the absorbed partner is considered to have negative energy and the negative energy subtracts some of the positive energy of the black hole 9recall that matter and energy are interchangeable). The amount of radiation that a black hole emits depends on the diameter of its event horizon (which is determined by the black hole's mass). The larger a black hole is, the larger its event horizon and the less radiation that can escape (be emitted). As a black hole emits radiation (that is, virtual particles escape to become real particles), the black hole slowly loses mass and therefore diameter. As a result, the black hole gets smaller faster and faster as it emits more and more radiation. In the end a black hole evaporates with a bang of gamma rays. Least you worry about exploding black holes, the radiation emitted by a stellar sized black hole is so minuscule that it will absorb more energy from the microwave cosmic background than it can emit via quantum mechanics. It will take a black hole the mass of the sun almost a trillion, trillion, trillion, trillion, trillion times older than the universe to evaporate. However, if mini black holes were created at the formation of the universe, they could be exploding now. While Hawking makes a nice case for evaporating black holes, there are many physicists who are still not convinced. We're bound to find out if black holes evaporate within a few years. A particle accelerator, called the large hadron collider (LHC) is due to begin operating this year. It's predicted that it can slam subatomic particles together so hard that they'll be squeezed into mini black holes. The radiation given off by the collisions will tell us if mini black holes are being created and evaporated. Stay tuned.

This Month's Sources

Observer's Handbook 2007, The Royal Astronomical Society of Canada
Space Calendar, http://www.jpl.nasa.gov/calendar/
Night Sky Explorer (software)
Stars, http://www.astro.uiuc.edu/~kaler/sow/
http://hypertextbook.com/facts/1999/DeneneWilliams.shtml
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http://en.wikipedia.org/wiki/Salyut_7
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http://en.wikipedia.org/wiki/Black_hole#History

Dark Skies and Bright Stars,
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