Snake River Skies

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Club Officers

President
Ken Thomason,
president@mvastro.org
324-4532

Vice President
Terry Wolford,
vp@mvastro.org

Secretary
Rick Widmer
secretary@mvastro.org
423-5974

Treasurer
Jay Hartwell
treasurer@mvastro.org
734-6140

Publicity
David Olsen
publicity@mvastro.org

President's Message

I would like to start with a big Thank You to all who helped with the Video Messier Marathon. We would not have made it with out you. Even though we were clouded out we got good practice for next year! We did have a few visitors during the practice who took the opportunity to hear about the life of Charles Messier, and take a look at the telescope.

Chris Anderson was the voice of the event. Rick Widmer ran the telescope and Shotwell camera from the Rick Allen room. Phil Hafer, the director kept every one on track, and on schedule. Ken Thomason switched the camera between various telescopes, and made sure we had good focus and composition before presenting images. David Olsen selected cameras for the video feed, and uploaded CCD images to the web. Forest Ray ran the video title generator

Paul Verhage will present our April 8th meeting. He will speak about a high altitude balloon launch planned for April 22nd, and other subjects. If you are interested in helping out at the balloon launch or Astronomy Day please be at the meeting!

Our next big event will be Astronomy Day, May We have big plans for the day including a High Altitude Balloon Display, and Paul Verhage's rovers. Please help out if you can!

Then our May meeting will feature Wallace Blacker speaking on neutron stars. Please show your support for our special speakers by attending!

May 27th will be our annual field trip to the Bruneau Dunes Observatory. Mark your calendar!

Ken Thomason

Editor's corner

Sorry the newsletter is so late this month. Still I hope to see everyone turn out for this meeting. We have two fun events planned for later this month, and this will be the time to figure out who will be helping, and exactly what we will be doing.

I hope to see a few people from the Magic Valley Chapter of the Idaho Society of Radio Amateurs this month. We will be depending on them for help with what appears to be a new High Altitude Balloon program starting in the Magic Valley.

http://www.mvastro.org

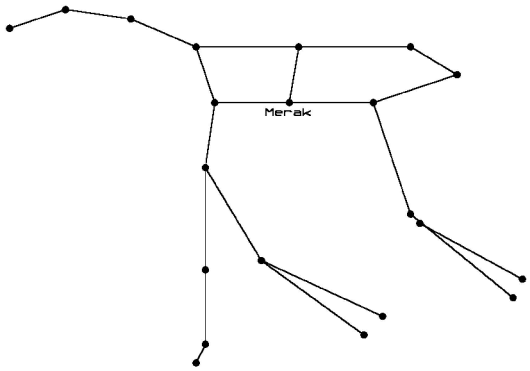
Boise Skies

April 2006

Boise 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 Merak in Ursa Major.

Ursa Major is mistakenly called the Big Dipper. Actually, the Big Dipper is an asterism, or familiar pattern of stars. The Big Dipper asterism represents the bear's hind quarters and extremely long tail. The rest of the bear is made up of fainter stars, which gives the Big Dipper its ursine shape. The constellation's name means Great Bear in Latin.



The month's star is from the Arabic word for "flank of the bear". To astronomers, Merak is known as Beta Ursae Majoris. The name Beta Ursae Majoris implies Merak is the second star of the Great Bear. This is a bit odd since Ursa Major has four other stars brighter than Merak (there are several other constellations where the names are not given in order of brightness). Merak is one of the Dipper's two pointer stars. The two stars are called pointers because a line drawn through them passes very close to Polaris, the Pole Star in Ursa Minor.

Merak is a larger star than our sun. It's three times heavier and is 60 times brighter. Its extra mass squeezes the star's core with greater force, making it fuse its hydrogen fuel faster. The extra weight pressing down on the core is balanced by the increased energy production that results. The greater fusion rate makes Merak a white hot star with a surface temperature of over 15,000 degrees. In the spectral classification of stars, which places our sun in the G class, Merak is in the A class, or two classes above the sun's. Merak is quietly living out its mid life (like your author) and fusing hydrogen into helium (unlike your author). Merak is 79 light years away, so the light you see tonight left the star in 1927. That's the year physicist Georges Lemaitre proposed that the galaxies are receding from one another because of what we today call the Big Bang.

Merak doesn't quite have the proper color for a star of its class. It's missing some blue light and emitting excess infrared light. This color shift in the Merak is caused by dust absorbing some of the star's hotter blue light. The dust warms and emits energy in the cooler infrared portion of the spectrum. So Merak's infrared excess is an indication that a cool disk of dust surrounds the star. Perhaps this means there are planets orbiting Merak. But before we try contacting any potential inhabitants of Beta Ursae Majoris, we should be aware that A class stars like Merak don't live as long as G class stars like our sun. So life that may arises on a planet in orbit around Merak won't have long to evolve before Merak dies.

You'll find Merak and Ursa Major high overhead after it gets dark in April. The dipper will appear to be pouring water in its bowl into the Little Dipper.

April Overview

There's a double moon shadow on Jupiter the morning of the 5TH.

The moon and Antares put on a show the morning of the 17TH.

Mars makes a close pass to the M-35 star cluster on the evening of the 17TH.

The Lyrid meteor shower peaks on the night of the 22ND and morning of the 23RD.

April 1 – 7

Look for the thin crescent moon (it's only four days old) soon after dark on the evening of the 1ST. The moon will be low in the western sky. After locating it, put your binoculars on it and you'll find the Pleiades one degree below the moon. They should make a fine sight in your binoculars.

Daylight Savings begins early on the morning of the 2ND. So don't forget to set your clock ahead one hour before you go to bed.

With a telescope, you can watch two moons cast their shadows on the face of Jupiter. Both shadows are visible between 3:30 and 3:45 AM on the morning of the 5TH. The easiest shadow to see belongs to the giant moon Ganymede. Through a telescope (which inverts images) Ganymede's shadow will be the dark spot on the bottom right of Jupiter. Located on the bottom left will be Io's more difficult to see shadow.

The moon is at first quarter on the 5th at 6:01 AM (5:01 for Oregon and 7:01 for the Midwest). Tonight will be an excellent time to go moon watching with your binoculars or small telescope.

The 5TH is the 15TH anniversary of the launch of the Compton Gamma Ray Observatory (CGRO). CGRO was a massive satellite that tipped the scales at a hefty 17 tons. Its great mass was necessary for it to capture and analyze gamma rays. Since our atmosphere blocks gamma rays (which is a good thing for us), a telescope like CGRO can only function in space. CGRO was one of the four great observatories launched by NASA (the first one being the Hubble Space Telescope). The CGRO is now gone. It was guided to a destructive reentry when its control systems began to fail. The destruction of CGRO also appears to have a political element to it. At the time, the Russians were trying to support both their Mir space station and ISS with a very limited budget. The destruction of the otherwise still functioning CGRO may have been a gesture to the Russians to get them to abandon Mir and focus on only the International Space Station.

April 8 – 14

Mercury reaches greatest western elongation on the 8TH. Elongation means that an inferior planet, like Mercury, appears at its greatest angular distance from the sun. This month's elongation occurs when the angle of the ecliptic, and hence Mercury's position, is very low to the horizon. So if you want a good view of Mercury, you'll need to go south. That or just wait for when Mercury's greatest elongation occurs in a month that the ecliptic rises at a steeper angle above the horizon.

The moon is at apogee on the morning of the 9TH. The moon will be its greatest distance from the earth this month, at a distance of 252,000 miles. That's just 15,966,720,000 (or just under 16 billion) inches away from Earth.

The European Space Agency's (ESA) Venus Express spacecraft enters into orbit around Venus on the 11TH. The Venus Express spacecraft is almost identical to ESA's earlier Mars Express spacecraft, which is still orbiting Mars. Both spacecraft are modified communication satellites. Basing the spacecraft on communication satellites reduced their cost and increased their reliability. The Venus Express carries 204 pounds of science instruments. You can read more about Venus Express at the ESA website, http://www.esa.int/SPECIALS/Venus_Express/index.html.

The 12TH is Yuri's Night, a worldwide celebration of Yuri Gagarin's launch into space. There's information at the website, http://www.yurisnight.net/

Can you believe it, the Space Shuttle is 25 years old! On April 12, 1981, Space Shuttle Columbia was launched into space. Onboard were astronauts John Young and Bob Crippen. The launch of Columbia was the first time an untested spacecraft was launched with a crew onboard. Normally spacecraft are first tested unmanned. Columbia returned to Earth after its two day flight and your author was there at Edwards AFB to see it come home (and hear its sonic boom). Columbia's first mission was a test the Shuttle Transportation System and made 36 orbits around the earth. During its maiden launch several tiles were knocked loose. The number and location of the missing tiles were not considered a hazard for Columbia's reentry. There's more information about this flight at, http://www.astronautix.com/flights/sts1.htm

On the same day twenty years earlier, the first human made his flight into space. Yuri Gagarin's flight left a secret Soviet space port on April 12, 1961. His spacecraft was called Vostok 1. Fifty-two minutes after launch, and before he completed his first and only orbit, the Soviet Union publicly announced his launch. Shortly before completing its first orbit, Vostok 1 firing its retro-rockets and returned home. Since the recovery system of the Vostok spacecraft was not deemed safe enough for a landing, Vostok cosmonauts ejected from the spacecraft before it landed. Vostok, like the American Mercury, was a one man spacecraft with limited capabilities. There were a total of six Vostok flights, with one of them carrying the first woman into space. Yuri never flew into space again. This hero of the Soviet Union died March 1968 in a jet crash while training for his second flight. There's more information on Vostok 1 at, http://www.bbc.co.uk/dna/h2g2/A873902.

The 12TH is also the 155TH anniversary of the birth of the English astronomer Edward Maunder. Maunder is best known for his discovery of the Maunder minimum. In 1893 Maunder discovered that there were virtually no reports of sunspots between the years 1645 and 1715. Normally the number of sunspots varies in an 11 year cycle. So during this 70 year period there should have been six complete cycles of sunspots. Instead it appears to have been none. These years were marked by colder than average temperatures, leading climatologists to believe that the sun's inactivity was responsible for the colder weather.

The moon is full at noon on the 13TH. The full moon of April is often called the Grass or Egg Moon. If you look at the full moon with binoculars your eyes will initially be overwhelmed by bright moon light. You'll find the lunar seas and bright lunar rays easy to find on the full moon, but not craters. Without shadows, craters are more difficult to detect.

April 15 – 21

If you're outdoors incredibly early on the 17TH, then look for the rising moon at 3:00 AM. Within two lunar diameters, or one degree of the moon you'll find the heart of the scorpion, Antares. This is a sight best viewed through binoculars.

Later, on the night of the 17TH, Mars passes less than 1 degree from the star cluster, M-35 in Gemini. M-35 is located to the lower left of Mars and both will easily fit within the field of view of your binoculars (you'll need dark skies to see M-35 well). If you use your telescope, use your lowest magnification. And remember, telescopes invert the view you would see in binoculars, so look for M-35 to the upper right of Mars.
April 19TH is the 35TH anniversary of the launch of the first space station, Salyut 1. The Soviet Union launched Salyut 1 in order to beat America's first space station, Skylab. The first mission, Soyuz 10, was launched to the space station on the 23RD. However, due to poor guidance equipment onboard Soyuz 10, the cosmonauts were unable to properly dock with the space station. The next, and last, crew to Salyut 1 successfully docked with the space station on June 7th and spent over 20 days onboard. Their television reports from space were popular with the Soviet people. Unfortunately their mission ended on a tragic note. The Soyuz 11 spacecraft depressurized during its return to Earth, killing all three cosmonauts. Had the Soyuz 10 only carried two cosmonauts, both could have worn spacesuits inside their cramp Soyuz and survived the depressurization. No other crews visited Salyut 1 and the space station was de-orbited on October 10TH. By the way, Salyut means salute in Russian.

The moon is at third quarter on the 20TH at 9:29 PM (8:29 for Oregon and 10:29 for the Midwest). So you won't see the moon for the next week unless you go outside before sunrise.

April 22 – 30

A mild meteor shower peaks on the night of the 22ND. Meteors from the Lyrid meteor shower appear to originate from the northeast in the early evening. As the constellation Lyra rises higher over the course of the night, meteors follow. In dark skies you may see up to 20 meteors per hour from this shower. To get a chance to see this many, you'll need to observe them before the moon rises.

As the moon rises at 5:30 AM on the morning of the 24th, you'll find Venus just to its upper left. The two will be just over a degree a part in the morning twilight.

On the 25TH the moon reaches perigee. Perigee is the moon's closest point in its orbit around Earth. The distance between the center of the moon and Earth will only be 226,000 miles today.

The moon is new on the 27th at 1:44 PM (12:44 for Oregon and 2:44 for the Midwest) and will not be visible for the next couple of days.

This Month's Topic

The Rocket Equation

One of the many applications of Newton's Laws is the rocket engine. The analysis of the rocket engine lead to the development of an equation, the Rocket Equation. The rocket equation lets us calculate the effects of fuel load and rocket engine performance on the final speed of a rocket or rocket stage. While the derivation of the rocket equation can be complex, the resulting equation is pretty simple. But first, let's make sure we're clear about the definitions of speed and acceleration.

Speed is what you read on your car's speedometer. Speed says your car will travel a specific distance over a specific time. Normally a car's speed is held constant by keeping the accelerator pedal fixed. When the accelerator pedal is pressed down or let up, the speed of the car goes up or down. In physics, a changing speed is defined as acceleration and it can be positive or negative. If the acceleration is positive the speed increases and if the acceleration is negative the speed decreases. An example is when a car leaves an interstate onramp. The car accelerates to highway speed and then travels at a constant speed, or at zero acceleration. When the car reaches its exit, it decelerates and its speed decreases.

There's one more term you often hear that I haven't mentioned. That's velocity. Velocity is a measure of speed and direction. To be strictly correct, we should be using velocity in place of speed because the direction we're traveling strongly influences whether or not we'll arrive at our destination. In addition, changing directions is also a form of acceleration. But we're going to ignore velocity (the direction portion) in this month's topic. Now let's talk about rocket engines.

A chemical reaction inside a rocket engine's combustion chamber provides the thrust needed to propel a rocket ship to the moon and beyond. The function of the rocket engine is to extract the heat (energy) of a chemical reaction. The rocket engine uses the energy to direct the combustion products (exhaust) of the combustion chamber out the back end of the engine bell. And in accordance to Newton's Third Law (for every action there is an equal and opposite reaction), the rocket ship heads off in the opposite direction. As long as the force (thrust) of the rocket engine and the mass (think of this as weight) of the rocket remains constant, the rocket ship experiences a constant acceleration. A constant acceleration means its speed changes at a uniform rate.

But here's where the complication begins. A roaring rocket engine drains the fuel from the rocket ship's fuel tank. So while the thrust of the rocket engine can remain constant, the mass of the rocket won't. As a result, the acceleration experienced by the ever lighter rocket continues to increase. In other words, the rocket goes faster at a continually faster rate. The mathematics used to describe force and acceleration, given the force of thrust, is pretty simple. But this is not the case when the mass keeps decreasing. Fortunately the end result, the rocket equation, is simpler.

Physicists discovered the rocket equation over one hundred years ago. Laymen say Newton's Laws describe mass, speed, and acceleration, three characteristics that we can easily understand. But the way physicists write the equations in Newton's Laws actually describes momentum and not acceleration and mass. The application of calculus (another

of Newton's discoveries) to the changing momentum of a rocket creates the mathematical formula called the rocket equation.

To use the rocket equation we first have to know how the efficiency of a rocket engine is measured. The equivalent of a rocket engine's miles per gallon rating is its specific impulse (abbreviated as Isp). The Isp of a rocket engine tells how much thrust (force) a rocket engine generates when given a specific amount of fuel per second. The unit of Isp is not miles per gallon like it is for a car, but instead is seconds. So for example, if a rocket engine has an Isp of 100 seconds and consumes two pounds of fuel per second, it generates 2 pounds/second * 100 second, or 200 pounds of thrust.

Space Shuttle engines, which are among the most efficient rocket engines ever designed, have an Isp of 400 seconds. On the other end of the scale, the black powder rocket engines of model rocketry have an Isp of only 80 seconds. Since the Space Shuttle engines have an Isp 5 times greater than toy rocket engines, they'll produce 5 times more thrust from the same amount of fuel.

Now that we know the rocket equation is derived from Newton's Laws of Motion (using momentum and not just force, mass, and acceleration) and how rocket engines are rated, lets see the Rocket Equation.

Delta V = g Isp ln(Mi/Mf)

Nice equation. But what does it mean?

Delta V is short for delta velocity, or change in velocity. This is the change in the speed of the rocket after it burns some fuel

g is the constant physicists use for the acceleration due to gravity. It's equal to 32.2 feet/second^2 or 9.8 meters/second^2

Isp is the specific impulse of the rocket engine

ln is the natural logarithm and it's a logarithm based on the number e instead of 10. Logarithms (usually just called log) are functions. You put a number into the log and get a new number out. In the rocket equation, the number you plug into the natural log function is the ratio of Mi divided by Mf. Note that you'll find the **ln** function as a key on your calculator. No way do you want to calculate this on your own. By the way, e is a non-repeating number that begins 2.7..... You can think of e as another number like pi.

Mi is the weight of your rocket, including its fuel, before the engine is fired

Mf is the final weight of the rocket after it burns off the desired amount of fuel

Now let's try using the rocket equation. First, you need to select the Isp of your rocket engine. Here's a small table of the Isp of several popular propellants.

Propellant	Isp
Compressed Air	45 seconds
Hydrazine	220 seconds
LOX and Kerosene	300 seconds
LOX and liquid Hydrogen	420 seconds
Ion Engines	1,000 seconds
Fusion Engines	1,000,000 seconds

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Hydrazine is the fuel the Space Shuttle uses once it's in earth orbit. Hydrazine is one of the poisonous propellants the Space Shuttle uses to make minor orbit changes and reenter the atmosphere. The first stages of many rockets, like the Saturn V, use LOX and kerosene as a fuel. High energy upper stages and the Space Shuttle main engines use LOX and liquid hydrogen. Ion engines are the newest engines used in rockets. They can't be used to leave the earth, but they're great for traveling around the solar system once you're in earth orbit. The Isp for a fusion engine is estimated based on its "combustion" products and temperature.

Next select the amount of the rocket to be fuel. For example, you could have a rocket that is one part fuel and one part rocket. This means the weight of the engines, crew quarters, life support, navigation equipment, etc is equal to the amount of fuel it carries. So this rocket begins with a mass of 2 units and ends up with a mass of only one unit when the fuel is used up. In this case the ratio of Mi/Mf of the rocket is 2/1 or 2. In most rocket stages, the mass ratio is 5.0 or greater. In other words, they carry in weight four times as much fuel as they weigh empty (or over 80% fuel). Don't worry about using pounds or kilograms here; you just need the ratio between the fueled rocket and its empty (or dry) weight.

After dividing your rocket's Mi by its Mf, plug the value into your calculator and press the **ln** key. This will return a new number that is smaller that the ratio you just entered. In the case of a rocket that is half fuel, the mass ratio is 2 and its **ln** is .69.

Now multiply the result by the rocket engine's Isp and multiply that result by 9.8 (for a delta V in meter per second) or 32.2 (for a delta V in feet per second). The resulting number is the final speed of your rocket after it uses up its fuel.

Here's an example that you can check your work on. Let's take a 100 gram pop bottle and fill it with 2 grams of compressed air. This gives it an initial mass of 102 grams and a final mass of 100 grams. The mass ratio becomes 102 divided by 100 or 1.02. The **ln** of 1.02 is 0.0198. The Isp of my engine is only 45 seconds and I'll use a g of 32.2 to calculate the pop bottle's change in speed in feet per second. This gives the pop bottle a delta V of only 28.7 feet per second. This pop bottle rocket will leave the launch pad at a speed of 28.7 feet per second and only reach a peak altitude of just under 13 feet.

Have fun with the rocket equation.

April's Website

This month check out the website, Universe Today

Universe Today is a space and astronomy website. Its focus is on news stories, so you can think of it as the CNN of space and astronomy. If you want the latest updates on space and astronomy, then this is one of the websites you should check out daily.

There are a few advertisements at the top of the homepage, but they're not excessive. The news articles are divided into two sections. The first section is located on the left side of the webpage and it takes up most of the space. These are links to news stories and each has a graphic and short description. There are three additional links with each story. The links let you read the Full Story, read Related Stories, or Discuss This Story. When you click to Read Full story, it's just that, you read beyond the brief introduction on the webpage. In the Related Stories link you're taken to second list of stories that are related (in some way) to the story you were just looking at. In the Discuss this Story link, you're taken to a forum page where readers post their two cents. You don't need to register to read a comment, but you will need to register to post one.

On the right side of the website is a column called Current Stories. These appear to be previous news stories that are still relevant. When you click on one of these stories you can read the full story, a related story, or post a comment on it, just like the main body of the webpage.

On Universe Today you'll also find a weekly astronomy column called, What's Up This Week. This is an astronomy column for beginners, like this one.

You'll find Universe Today at, http://www.universetoday.com/

This Month's Sources

Observer's Handbook 2006, 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/
Compton, http://cossc.gsfc.nasa.gov/docs/cgro/index.html
Venus Express, http://www.esa.int/SPECIALS/Venus_Express/index.html
http://www.daviddarling.info/encyclopedia/M/Maunder.html
http://www.astronautix.com/craft/salyut1.htm
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http://www.daviddarling.info/encyclopedia/R/rocket_equation.html
Micro Spacecraft, Rick Fleeter

Dark Skies and Bright Stars,

Your Interstellar Guide