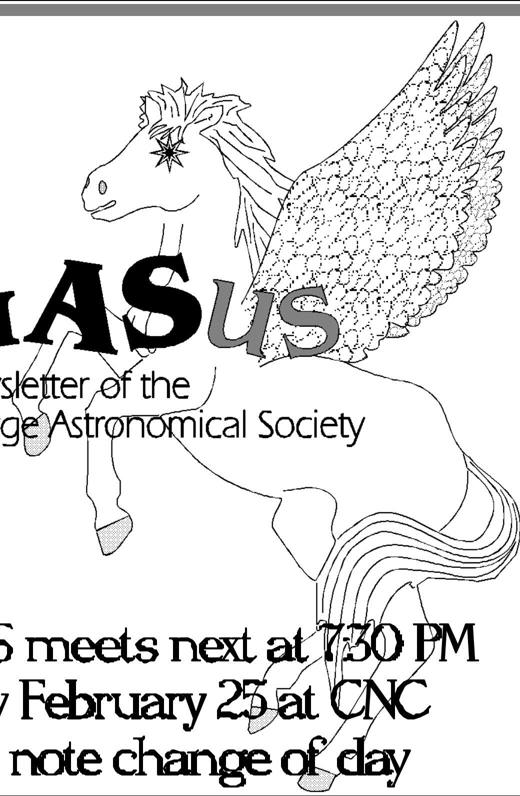
1997 FEBRUARY ISSUE#72



the PeGASus

Newsletter of the
The Prince George Astronomical Society

The PGAS meets next at 7:30 PM
Tuesday February 25 at CNC
Please note change of day

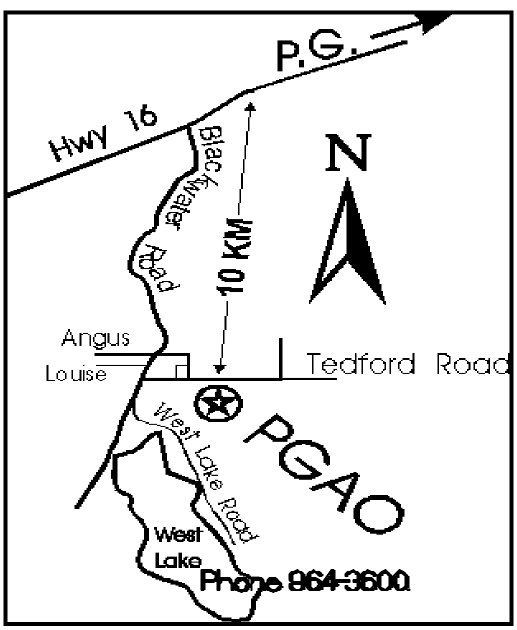
INSIDE :

the PeGASus is published monthly by the *Prince George Astronomical Society*.

Our pursuits are out of this world.
Our activities are astronomical.
Our aim is the sky.

Contributions to the newsletter are welcome.
Deadline for the next issue is March 12

Send correspondence to
The PGAS
3330 - 22nd Avenue
Prince George, BC, V2N 1P8
or
Nelson@cnc.bc.ca
phone: 964-3600
fax: 561-5816



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EDITORIAL

by
Gil Self

This time last month I was talking to you about longing for spring, well I think it is here ! The club's busy season begins, and we need your help. You probably remember the press coverage we had last year following our open house at the observatory. I expect after that, we will have an overwhelming turn out this year, as "Comet Fever" descends upon Prince George. During the next ninety days we are hosting sixteen open house evenings. Of these, twelve evenings need only two people from the club to operate the observatory. The other four evenings need anywhere from six to eight people. That is a total of forty-eight "person evenings"

So far we have four volunteers and about ten evenings covered. HELP!!

I really enjoy hosting an open house . It is our big chance to share our common interest with the community, and as far as I know we have never had anyone leave dissatisfied.

If you are concerned about volunteering because you have not done it before-fear not . We will arrange for you to attend the open house with someone who has hosted an open house before. You are of course welcome to come out any time prior to your turn at the wheel. I think you will find that you will feel comfortable very quickly.

Come help us out and find out how enjoyable it is to share your interest with the community.

GS

Coming Events

If you are involved with any astronomical or otherwise scientific activity on behalf of the PGAS, please list the activity here.

Feb 25	- General meeting at CNC 7:30 ,bring a friend
Feb 28	- Spring open house begins (teachers night)
Mar 7	- open house , public nights begin
Mar 20	- Vernal Equinox
Mar 25	- General meeting at the observatory (finally)

The Night Sky for January - February '97

by Bob Nelson, PhD

Well, as our winter progresses, we live in hope that there will be clear weather ahead. It is sobering to remind ourselves that the Sun, Moon and planets continue in their celestial clockwork, completely oblivious to us here on the good Earth and our annoying weather patterns.

MERCURY, in Sagittarius, is visible in the morning sky. It's a couple of degrees west (upper right) of the much brighter Venus just before dawn. It's half illuminated as it approaches greatest western elongation (the largest angle to the right of the Sun that it gets this time around). If you're up early, pull out your binoculars (or a telescope if you have one) and see if you can see it. (You'd need a telescope to see the phase.)

VENUS, also in Sagittarius, is barely above the southeast horizon at dawn. You should still be able to see it with naked eye or binoculars after the Sun has risen as it is very bright (reaching magnitude -3.9). However, it's only 18 degrees away from the Sun, is in the gibbous phase, and is only 10.5" in diameter (and therefore appears as a fuzzy "blob"). As it races away from the Earth it will get closer to the Sun until it disappears behind it sometime in April.

MARS, in Virgo, now rises at about 10:30 p.m., local time; at midnight, it's about 10 degrees above the eastern sky and barely suitable for telescope viewing (it transits at 4:35 AM -- for you late birds!!). Better viewing is ahead. The big story about Mars is it attains opposition this year on March 18 at about 3:16 a.m. PST. The term opposition means that the planet is 180° away from the Sun and therefore opposite in the sky. Near that time, we are closest to Mars which will then appear as large as it can. This year's opposition is not a particularly favourable one as Mars only attains an angular size of 14" (the maximum is 24", the minimum, 13"). We will see the north pole inclined to us and should, if we

are lucky, see the polar ice cap.
JUPITER is lost in the glare of the Sun.
SATURN, in Pisces, is the brightest object in the southwest in early evening. It sets around 10:30 p.m. and should still be good viewing.
URANUS and NEPTUNE are lost in the glare of the Sun.
Comet HALE-BOPP is with us still. It's both a morning object and an evening object! How can this be? It's because the comet is presently a dozen degrees to the north of the Sun and travelling northeast (towards closest approach which will occur sometime at the end of March).

As for other things in the sky to look at, at mid-evening, at this time of the year, the constellations of Taurus, Auriga, Gemini and Orion are featured prominently overhead and in the southern sky. Therein lie the Crab Nebula, the Orion Nebula, clusters M34, 35 and 36 as well as the Beehive Cluster. All this and more are fine targets for astrophotography (film and CCD) or just plain viewing.

How many astronomers does it take to screw in a light bulb?

Frank Hunter of McBride
is interested in purchasing a mid sized,mid priced telescope.
call collect 250-569-3114

(I had a nice chat with Frank last week. He and his wife are keen observers and are interested in starting a club in McBride.Lets see if we can help start up this group in this great location.)

6 Keplerian Orbits and Elements

Kepler's Laws

1.Planets move in elliptical orbits about the sun with the sun at one focus.

2.The area per unit time swept out by a radius vector from the sun to a planet is constant.

3.The square of a planet's period is proportional to the cube of the major axis of the planet's orbit.

Keplerian Elements

Epoch

Orbital elements are only valid at a given time. This element is just the time for which the elements are correct.

Inclination

The orbit ellipse lies in a plane, and this plane for an angle with the plane of the equator. This angle is called the inclination. Think of it as the tilt between the orbit and the equator. Inclinations of near 0 degrees are called equatorial orbits, and those near 90 degrees are called polar orbits. By convention, orbits that go the same way as the Earth rotates (prograde or counter-clockwise from above) have inclinations of 0 to 90 degrees. Satellites that orbit retrograde, opposite to the rotation of the Earth, have inclinations great than 90 degrees. For example, a satellite with an inclination of 180 degrees is in an equatorial orbit going east to west.

Right Ascension of Ascending Node (RAAN)

This is the second number that aligns the orbit ellipse in space. The intersection of the orbit plane and the equatorial plane is called the lines of nodes. The point where the satellite's orbit crosses the equator going south to north is called the ascending node. The one on the opposite side of the Earth, where the satellite passes into the Southern Hemisphere is called the descending node.

Since the orbit is fixed relative to the stars and not to the surface of the Earth, the astronomical coordinate system of right ascension and declination is needed to measure the position of the ascending node. Right ascension is an angle measured in the equatorial plane from a fixed point in space, called the point of Ares (which is also the point of the vernal equinox, where there Sun crosses the equator in the spring). Declination is the angle measured up from the equatorial plane, just like inclination.

Argument of Perigee (ARGP)

Now that we have oriented the orbital plane in space, we need to determine the position of the orbital ellipse in the orbital plane, using the angle called the argument of perigee. The rest of the elements deal with the shape and position of the orbit in the orbital plane. This restricts the problem to the stylized orbit.

The perigee is the point on the orbit that satellite is closest to the Earth. On the opposite side of the orbit, the satellite is at its farthest point from the Earth called the apogee. The line through the apogee and perigee is called the major axis; it is the long axis of the ellipse.

The angle between the major axis and the line of nodes is the argument of perigee. This is measured in the plane of the orbit. It ranges from 0 to 360 degrees, and is 0 degrees when the perigee is at the ascending node and 180 degrees when the satellite is farthest from the Earth when rises up over the equator.

Eccentricity

The eccentricity determines the shape of the orbital ellipse. An ellipse with an eccentricity of 0 is a circle, and when e is near 1, the ellipse is long and skinny. Formally, this is ratio between distance from the center of the ellipse (which isn't the center of the Earth) to the focus of the ellipse (which is the center of the Earth) and the semi-major axis.

Mean Motion

Next, we need to determine the size of the orbit, or the distance from the satellite to the Earth. This is usually done by giving the mean motion, which is mean angular rotation rate of the satellite. The speed of the satellite is related by Kepler's Third Law to the semi-major axis of the orbit. Basically, satellites that are farther from the Earth move more slowly. A satellite in an eccentric orbit will move faster at perigee and slower at apogee. The mean motion is the average rate of the satellite motion. The mean motion is usually given in revolutions per day for Earth satellites. The period is just the inverse of the mean motion, so a mean motion of 2 revs per day gives a period of one orbit of 12 hours. Sometimes instead of the mean motion, the semi-major axis is given. This is the distance from the apogee or perigee to the center of the ellipse. It is also half the distance from the perigee to the apogee. We could also give the perigee or apigee distances (and the radius of the Earth) and use the eccentricity to convert between the different parameters of the ellipse.

Mean Anomaly

Finally, we need to specify where in the orbit the satellite was at the given epoch. We could do this with the eccentric anomaly, which the angle between the satellites position and the perigee in the plane of the orbit. It is better to use the "average" position becuase, the mean anonaly at a future time is just the time since the epoch times the mean motion, plus the offset of the original mean anomaly.

A satellite in a circular orbit moves at a constant rate around the orbit. A satellite in a non-circular orbit doesn't move at a constant velocity so the mean anomaly does point directly at the satellite. The mean anomly is the position that a satellite in a circular orbit with the same period (and mean motion). Kepler's equation relates the eccentric anomaly and the mean anomaly for an eccentric orbit.

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Nature of Laws

by Orla Aaquist

Physicists are not smarter than you. You simply think they are because you do not comprehend what they talk about most of the time. For the most part, the basic laws of physics are so simple that beings of any intelligence what-so-ever, above that of a common ground mole, accept them as obvious truths that need no further discussion. You are smart enough to accept these truths, but not the physicist. The physicist must publish volumes of discussion, elaborating on the truths until they become unrecognisable in jargon and generalities. Let me provide a specific example.

First, let me state something so obviously true that you will see little worth in further discussion. Let's say you leave your wallet on your night table when you go to sleep at night. You expect it to be there in the morning when you wake up. If it isn't there, then someone has taken the wallet. No one in their right mind would think of writing a law which states that 'a wallet placed on the night table will stay on the night table unless removed by someone.' Of course, this statement does not apply to socks.

Now, it doesn't take much genius to realise that the wallet could represent any object what-so-ever (except for one of a pair of socks). So instead of saying that 'a wallet placed on the night table will stay on the night table unless removed by someone', a physicist would replace the word 'wallet' with the word 'object'. Moreover, it doesn't much matter where you put the object. It could be in your pocket or in your back yard, or in the trunk of your car. Once you put an object down somewhere, it will tend to stay there, without moving, unless someone moves it. You have to put it down on a flat surface, of course.

The genius of a physicist lies in the realisation that a dog could come along and cause the object to move, especially if the object happened to be a cat or an old bone. It doesn't have to be a human 'someone'. So, the physicists replaces the word 'someone' with the word 'something', which cleverly allows for events like tornadoes picking up grazing cows, or the ground suddenly opening up causing the mysterious disappearance of, say, your mother-in-law or ... one of a pair of socks.

So what have we got so far? 'An object that isn't moving will stay unmoving unless something moves it.' Tell me that life doesn't get any simpler than this. If this is not obviously true to you, then please continue fulfilling your burrowing instincts . On the other hand, if you have any desire to discuss this truth further, then perhaps you should consider physics as a hobby or career.

Here is another obvious thought along the same vein. 'If something is moving, it will continue to move unless something causes it to stop moving.' Brilliant! ... NOT!

If you were to pass off these two ideas as thoughts worthy of further discussion, you would be laughed at by your fellow humans. Amazingly, Sir Isaac Newton (1642 - 1727) did just this with his fellow physicists and was applauded for his genius. Specifically, in the first of his three laws of mechanics, Newton states that 'an object at rest will tend to stay at rest and an object in motion will continue in a state of uniform motion unless acted upon by some net external force.' The only new word here is 'force', so we see that in order to make people take notice of his law, he had to use force.

As you can see from the preceding discussion, Newton's first law is pretty simple, and I bet your are kicking yourself for not thinking of it yourself, especially if you were born before Newton.

His other two laws are equally simple.

Newton's Third Law, in layman's terms, goes something like this, 'If you run into a brick wall, it hurts just as much as if the brick wall runs into you with equal speed.' Since brick walls are difficult to move (it can be done in the laboratory, however), here is a simple experiment you can do to test this statement. Get a willing participant (like your brother). Have him hold his fist steady while you smash your forehead into his fist at a particular speed. Note how much it hurts. Then hold your face still while he moves his fist towards your forehead with equal speed You will notice, after repeating this experiment several times, that the you cannot distinguish between the two collisions.

Physicists, of course, hide the truth of this in language more appropriate to academia. They state the law as follows, 'For every action there is an equal and opposite reaction.' Unless you read the entire chapter of a textbook, it is not too clear what is meant by an 'action'. Do they mean that if I raise my hand someone will grab it and try to lower my hand? Or if I raise my hand someone will lower theirs? Or, if I eat my supper with gusto, will someone else regurgitate theirs with equal gusto? Newton's wording seems to imply that if I hit my brother, then he hits me back with equal and opposite force. The truth is that if you hit your brother, he hits you back with at least twice the force, unless your brother is a Christian (in which case he kills you).

One consequence of a common misinterpretation of Newton's Third Law is the 'eye-for-an-eye' philosophy. Basically, this doctrine states that if you bring grief to someone, then you should be punished with equal grief. Such a belief has far reaching ramifications on a society which holds it. But this is not what Newton intended. His meaning is far simpler. The correct interpretation of Newton's Third Law is that 'you cannot place your hand on an object without touching it.' Stated in less personal terms, 'one object cannot make contact with a second object without the second object simultaneously making equal contact with the first.' Does that really need to be discussed among intelligent people? I think not.

O.A.

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RIGHT ASCENSION AND DECLINATION

Although we know that the objects we see in the sky are of different sizes and at different distances from us, it is convenient to visualize all the objects as being attached to an imaginary sphere surrounding the Earth. From our vantage point, the sky certainly looks like a dome (the half of the celestial sphere above our local horizon). The celestial sphere is mapped in **Right Ascension** (RA) and **Declination** (Dec) . Declination is the celestial equivalent of latitude, and is simply the Earth's latitude lines projected onto the celestial sphere. A star that can be directly overhead as seen from the Earth's Equator (0deg latitude) is said to be on the Celestial Equator, and has a declination of 0deg . The North Star, Polaris, is very nearly overhead as seen from the North Pole (90deg North latitude). The point directly over the North Pole on the celestial sphere is called the **North Celestial Pole**, and has a declination of +90deg . Northern declinations are given positive signs, and southern declinations are given negative signs. So, the South Celestial Pole has a declination of -90deg .

Right Ascension is the equivalent of longitude, but since the Earth rotates with respect to the celestial sphere we cannot simply use the Greenwich Meridian as 0 RA. Instead, we set the zero point as the place on the celestial sphere where the Sun crosses the Celestial Equator (0 Dec) at the vernal (spring) equinox. The arc of the celestial sphere from the North Celestial Pole through this point to the South Celestial Pole is designated as Zero hours RA. Right Ascension increases eastward, and the sky is divided up into 24 hours. This designation is convenient because it represents the **sidereal day**, the time it takes for the Earth to make one rotation relative to the celestial sphere. If you pointed a telescope (with no motor drive) at the coordinates (RA=0h, Dec=0deg), and came back one hour later, the telescope would then be pointing at (RA=1h, Dec=0deg). Because the Earth's revolution around the Sun also contributes to the apparent motion of the stars, the day we keep time by (the solar day) is about four minutes longer than the sidereal day. So, if you pointed a telescope at (RA=0h, Dec=0deg) and came back 24 hours later, the telescope would now be pointing at (RA=0h 4m, Dec=0deg). A consequence is that the fixed stars appear to rise about four minutes earlier each day.

INCREMENTS OF MEASUREMENT

Both RA and Dec can be divided into minutes and seconds. One minute of RA is equal to 1/60 of an hour, and 1 second of RA is equal to 1/60 of a minute. At the Celestial Equator, Right Ascension can be measured in degrees equal to those of Declination (since the Celestial Equator is a great circle. With 360deg in a circle, each of the 24 hours of RA is equal to an angle of 15deg. This angle decreases until it becomes zero at the poles (just as the meridians of longitude meet at the poles on Earth).

The angular distance between any two points on the celestial sphere can be expressed in degrees, minutes, and seconds of arc by placing the two points on an imaginary great circle of the celestial sphere. The Full Moon's diameter, for example, is about 30 arcminutes, or 30', or 0.5deg . A close double star might have a separation of 5 arcseconds (5").

DETERMINING ANGULAR SIZES

For rough estimation with the naked eye, it is possible to "eyeball" angles in the sky. For example, one index finger tip at arm's length subtends an angle of a little more than 1deg in the sky. A fist (with the thumb flat against the end) at arm's length subtends about 10deg . This can be useful if you know an object (like a planet in bright twilight) should be 20deg above the western horizon or 5deg South of a brighter object.

In a telescope, we often want to know the field of view with a given eyepiece. So, we point the 'scope at a star near 0deg Dec and put the star on the eastern edge of the field. Because of the Earth's rotation, the star will appear to drift westward. The time in minutes it takes the star to cross the entire field is equal to the telescope-eyepiece combination's field of view in minutes of RA (at the celestial equator only). Because each hour of RA at the equator is equal to 15 degrees of arc, and each minute of RA is 1/60 of an hour, one minute of RA at the equator is equal to (15/60 = 1/4deg). So, if the field of view is 2 minutes of RA, the field of view in degrees is 2/4=0.5deg . Distances between stars or objects can then be measured in fields of view and converted to degrees of arc. If a new eyepiece is used, the field of view for that eyepiece will need to be determined.

LOOSE ENDS

Points on the celestial sphere remain fixed with respect to the stars, except for small changes due to precession of the Earth and independent proper motions of the stars. To an Earth-bound observer, there are a couple of dynamic points and circles that are useful for describing the appearance of the sky. The point directly overhead is known as the **zenith**. The declination at the zenith is equal to the site's latitude; therefore, the zenith for an observer at 45deg N will be +45deg . The Right Ascension at the zenith is not fixed, and varies as the Earth rotates and revolves. If we draw an arc from the North Celestial Pole (in the Northern Hemisphere) through the zenith down to the southern horizon, we describe what is known as the **meridian**. Objects rise in the East, reach their greatest altitude at the meridian, and set in the West. The Right Ascension of the meridian is known as the sidereal time.
A clock adjusted to gain four minutes each day will keep rough sidereal time. It is important to know the time an object crosses the meridian, or **culminates**, since the object will be highest in the sky and most easily visible at that time.
The edge of the visible portion of the celestial sphere is, of course, the horizon . An object will never be visible from a given latitude if it is below the horizon when it is on the meridian. The declination of the horizon at the meridian is

AstroSurfing

Details of the Science News posted here are available on the astronomy forum on the *Prince George Free-Net*.

WORLD's LARGEST MIRROR CAST

A week ago opticians at Steward Observatory cast the world's largest one-piece mirror blank, a whopping 8.4 meters (27.5 feet) across. It all happened inside a giant oven that rotates about seven times per minute. The 41,500 pounds (19,000 kg) of glass reached its melting point on January 18th and assumed a curved shape close to the desired final surface. Now the 20-ton blank will slowly cool, with the oven still spinning, for at least two months. A second blank will be cast later, and when finished the two mirrors will form the heart of Large Binocular Telescope.

Hubble news !

New Astronomy Instruments

The HST was designed to allow new instruments to be easily installed as old ones become obsolete. This was demonstrated during the first servicing mission in December 1993, when, during an 11-day mission that included a record five EVAs, astronauts successfully installed a new camera which had its corrective optics built right in, and a special instrument, called the COSTAR (Corrective Optics Space Telescope Axial Replacement) that would properly refocus light from the flawed main mirror to the other instruments.

The new instruments installed during this mission will again dramatically expand Hubble's scientific capabilities. The Space Telescope Imaging Spectrograph (STIS) provides unique and powerful spectroscopic capabilities for the HST. A spectrograph separates the light gathered by the telescope into its spectral components so that the composition, temperature, motion, and other chemical and physical properties of astronomical objects can be analyzed.

STIS's two-dimensional detectors allow the instrument to gather 30 times more spectral data and 500 times more spatial data than existing spectrographs on Hubble which look at one place at a time. One of the greatest advantages to using STIS is in the study of supermassive black holes.

STIS will search for massive black holes by studying the star and gas dynamics around galactic centers. It also will measure the distribution of matter in the universe by studying quasar absorption lines, use its high sensitivity and spatial resolution to study star formation in distant galaxies, and perform spectroscopic mapping of solar system objects.

The Near Infrared Camera and Multi-Object Spectrometer (NICMOS) promises to gain valuable new information on the dusty centers of galaxies and the formation of stars and planets. NICMOS consists of three cameras. It will provide the capability for infrared imaging and spectroscopic observations of astronomical targets.

NICMOS will give astronomers their first clear view of the universe at near-infrared wavelengths between 0.8 and 2.5 micrometers -- longer wavelengths than the human eye can see. The expansion of the universe shifts the light from very distant objects toward longer red and infrared wavelengths.

LAUNCH WILL CREATE A RADIO TELESCOPE LARGER THAN EARTH

NASA and the National Radio Astronomy Observatory are joining with an international consortium of space agencies to support the launch of a Japanese satellite next week that will create the largest astronomical "instrument" ever built -- a radio telescope more than two-and-a-half times the diameter of the Earth that will give astronomers their sharpest view yet of the universe.

Very long baseline interferometry is a technique used by radio astronomers to electronically link widely separated radio telescopes together so they work as if they were a single instrument with extraordinarily sharp "vision," or resolving power.

The wider the distance between telescopes, the greater the resolving power. By taking this technique into space for the first time, astronomers will approximately triple the resolving power previously available with only ground-based telescopes. The satellite system will have resolving power almost 1,000 times greater than the Hubble Space Telescope at optical wavelengths. The satellite's resolving power is equivalent to being able to see a grain of rice in Tokyo from Los Angeles.

By the 1980s, radio astronomers were observing the universe with assemblages of radio telescopes whose resolving power was limited only by the size of the Earth. Now, through a magnificent international effort, we will be able to break this barrier and see fine details of celestial objects that are beyond the reach of a purely ground-based telescope array. We anticipate a rich harvest of new scientific knowledge.

The 26-foot diameter orbiting radio telescope will observe celestial radio sources in concert with a number of the world's ground-based radio telescopes. The 1,830-pound satellite will be launched from ISAS' Kagoshima Space Center, at the southern tip of Kyushu, one of Japan's main islands, and will be the first launch with ISAS' new M-5 series rocket.

The satellite will go into an elliptical orbit, varying between 620 to 12,400 miles above the Earth's surface. This orbit provides a wide range of distances between the satellite and ground-based telescopes, which is important for producing a high- quality image of the radio source being observed. One orbit of the Earth will take about six hours. The satellite's observations will concentrate on some of the most distant and intriguing objects in the universe, where the extremely sharp radio "vision" of the new system can provide much-needed information about a number of astronomical mysteries.

Baseline Array (VLBA), have revealed fascinating new details in recent years, and VSOP is expected to add a wealth of new information on these objects, millions or billions of light-years distant from Earth

PGAS CONTRIBUTORS

The PGAS would like to thank the following individuals, corporations and government agencies who, since 1991, have donated money, goods or services to the construction and operation of the Prince George Astronomical Observatory.

Ministry of Adv. Ed. Training and Tech.	$25,000
BC Science Council	16,000
BC Lotteries	3,900
Helmar Kotsch (Acme Mas.)	1,932
Northwood Pulp and Timber	1,665
Electrical Services Ltd.	1,583
Royal Bank of Canada	1,500
Regional District of Fraser-Fort George	1,000
Prince George Rotary Club	1,000
The Pas Lumber Co	750
Rustad Broth & Co Ltd	750
Canfor Polar Division	744
A.V. Jay Roofing	600
Xerox Canada	500
Russelsteel	465
Lakeland Mills Ltd.	460
Canfor Clear Lake Division	270
Lutz Klaar	200
Canfor Netherlands Division	200
Carrier Lumber Ltd.	160
Tom Laing	150
Pine Drilling	150
Cloverdale Paint Inc.	100
Claus Schlueter	

The greatest contributors to the construction and operation of the observatory are from PGAS members who have generously contributed their time to this project. The value of their contribution surpasses all external contributions.

The PGAS is a non-profit organization dedicated to the advancement of astronomy and science in general in Prince George and the neighboring northern communities. Donations of money or materials to the society are greatly appreciated and tax deductible.

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Join the PGAS

Prince George Astronomical Society

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