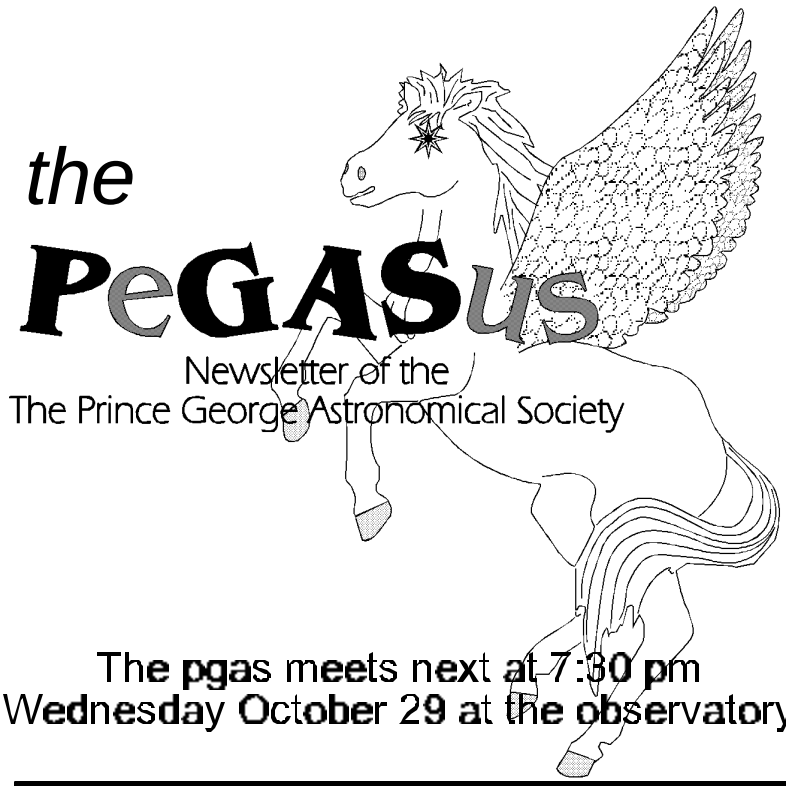
1997 OCTOBER ISSUE #78

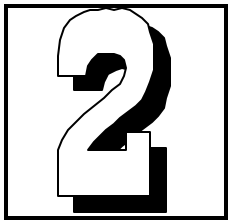


the PeGASus

Newsletter of the
The Prince George Astronomical Society

The pgas meets next at 7:30 pm
Wednesday October 29 at the observatory

INSIDE :

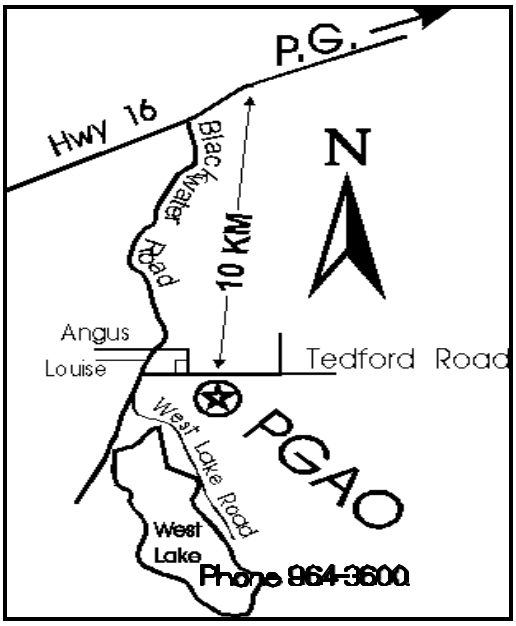


the PeGASus is published monthly by the *Prince George Astronomical Society*.

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 *Nov 14*

Send correspondence to
The PGAS
3330 - 22nd Avenue
Prince George, BC, V2N 1P8
or
Nelson@cnc.bc.ca
phone: 562-2131
fax: 561-5816



Prince George Astronomical Society Executive, 1996/97

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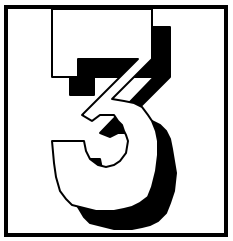


EDITORIAL

by Gil Self

Ask not what your club can do for you, but what you can do for your club.

Yes, it is election time again and we all need your help. We have, without a doubt, the best facility we could ask for. We operate a public program we can be proud of, and we have easy access to an excellent observatory. Perhaps our greatest asset is the many great people we are fortunate to have supporting this institution.

But ,if you want this club to *be all it can* be- we need you. Come to the meetings - Volunteer for the events - participate. It's worth it. Have you written an article for the newsletter yet? I welcome almost anything. We have quite a collection of bright articulate people in this club and I would much rather print our own local work as something pulled from the net. Did you know our newsletter is now part of the library's local history collection?

Back to the election, you may not want to commit to the extra time required to be on the executive but you are still welcome to bring suggestions or projects to any member of the executive. Perhaps there is a single project you could take on. Since this is an all volunteer club, it takes a long time for a small group to finish projects. *Many hands make light work.* If you can plan to take on a small, medium, or large job, we could see some big improvements at the observatory

There is an non-elected position open at this time. We need someone very interested in promoting the society in the community. This position will be a key roll in the coming year since we have several projects in the planning stage and we need someone to help make them happen, please speak to anyone in the executive if you are interested.

Before the decade is up we will put a ma——-

Too far!

G.S.

Belated thanks are in oder to Bill Stanley and Yellowhead Road and Bridge for the 5 yards of gravel for the driveway-that entrance way was getting pretty bad and the gravel made a big differance. Thanks! PGAS

Coming Events

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

Oct 29 - Annual General Meeting at the observatory—
Election of officers.

Nov 26 - PGAS monthly meeting. **at CNC**

The Night Sky for November '97

by Bob Nelson, PhD

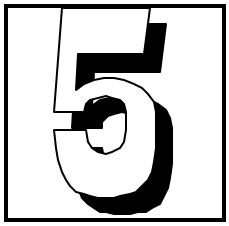
MERCURY is visible in evening skies but is below the celestial equator and is therefore low in the sky for us northern observers. A difficult object.

VENUS, in Sagittarius, is low in the southwest at sunset and sets almost three hours later. Greatest eastern elongation (47°) occurs on the 6th. [Elongation is the angular distance or separation from the Sun. Therefore eastern elongation is to the left of the Sun, and objects there are visible in the evening sky.] In November, Venus has a magnitude is -4.5 (making it the brightest object in the evening sky -- much like an aircraft with its landing lights on). Its angular size is 24" at the beginning of the month, growing to 34.6" at the end of the month, at which time it will be a fine crescent (50% illumination occurs on the 6th).

MARS, in Sagittarius, is a difficult object low in the south-southwest at sunset and sets over an hour later. Its magnitude has dimmed to 1.1 and it has shrunk to a 4.7" disk.

JUPITER, in Capricornus, is in the south at sunset and sets around 10 P.M. It's a 39" disk at magnitude -2.3. It undergoes a double shadow transit on Nov 4 (at 17:38 PST) and a triple shadow transit on Nov 11 (at 19:34 PST). Watch for these events if it's clear.

Also, Jupiter's Great Red Spot is visible at the central meridian at the following dates and times (all PST): Mon Nov 3 at 18:43, Wed Nov 5 at 19:56, Mon Nov 10 at 18:03, Wed Nov 12 at 19:16. (You should still be able to see it an hour before or after.)



SATURN, in Pisces, is in the southeast at sunset and sets around 4 A.M. (PST). It's a 19" disk at magnitude -0.13 and is well placed for observations. Saturn is occulted by the Moon this month (Nov 12 at 1:00 UT) but the event is regrettably not visible north of latitude 25°. Check it out on your planetarium program (Redshift, The Sky, Guide n).

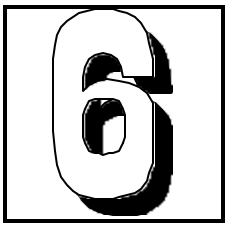
URANUS, in Capricornus, is low in the southwest at sunset and sets around 9 P.M. (PST). It's a 3.5" disk at magnitude 5.8. It should easily be visible with any small telescope or binoculars if you know where to look.

NEPTUNE, in Sagittarius, is a 2.3" disk at magnitude 8.0. It sets around 10 PM.

DEEP SKY observing should be good in early November with the first quarter Moon occurring on Nov. 7. There is a meteor shower on the 17th -- the Leonids but these regrettably occur near the full Moon (ugh) and will therefore be largely washed out. The first four asteroids are all visible at some time of the night in November. On the 15th, 1 Ceres (at magnitude 8.85) sets at midnight, 2 Pallas (at magnitude 10.5) sets at 10 PM, 3 Juno (at magnitude 10.4) rises at 2 AM, and 4 Vesta (at magnitude 6.9) sets at 4 AM.

The constellations Pegasus, Aquarius, Pisces and Cetus are visible to the south at 10 PM and contain objects that we don't often see.

Check them out! B.N.



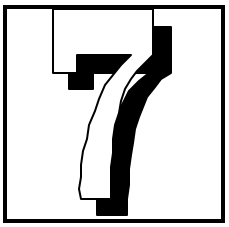
Twinkle Twinkle

By Steve Senger

STEVE_SENGER@bc.sympatico.com

I HAVE TAKEN THE PLUNGE . I hardly look at any astronomical articles any more. Sometimes when the sky is clear at night I will go out side and view the stars and Jupiter. I'm starting to forget some of the planet and star trivia I once new. I'm not to worried about that though I can always pick up a book and go over star and planet attributes, like distance, orbital period , mass etc. Or with a bit of data I could calculate the rest (hopefully). I like what Einstein had said " Ideas are more important than knowledge " I HAVE TAKEN THE PLUNGE, I get less and less sleep. I am filling my head with new DATA and I am an old dog with few new tricks. If you are wondering what the heck I'm talking about, I'll enlighten you. I have let Bill into my living room. Bill has been in my living room for a few months now, he was very expensive at first, but now he only costs me a little bit once in awhile. I HAVE TAKEN THE PLUNGE! It's my time that he is really stealing from me. Come to think of it, It's Bills toys that are costing my time and money. Things like MS WORKS, WORDPERFECT, QUATRA-PRO, INTERNET(cyberspace city) SCANNER, Kodak image programs, Epson Printer. WELCOME TO THE WORLD OF WINDOWS 95 brought to you by Mr. Bill Gates. Yes I bought a little 200 MMX Pentium. You are probably wondering why if I,m going to buy new why not the latest Technology.? Simply the cost, you pay big bucks for the latest. To prove that my machine is actually over the hill , the other day I bumped into one of the Radiologist that works at the hospital. He had the latest Printshop Edition and National Geographic software (30 CD's for National alone with J-peg images). I find out the next day that he had bought a new computer a * PENTIUM 2 300 MMX * SO YOU SEE MINE IS TRULY OBSOLETE but I think it will do for the time being. I have slowly been switching my treasury account data from my 286 to the Pentium , and in the new year I will use Quatro - Pro for my spreadsheet . Bob Nelson has graciously donated his Template of Quatra-Pro Banking which I will model our two Banking accounts on too. Do not feel sorry for me because I am having fun, it's quite the toy. And I did tape PBS's Hawking's Universe thanks to Rob Frith . And I did see the Cassini lift off successfully with its 70 lbs of non weapons grade Plutonium dioxide . So you see I do keep a little twinkle in my eyes when I hear anything about the Heavens above Any how I better get back to work now, or maybe I'll just cruise the Internet. S.S.

The Visible Universe - Just the Tip of the Iceberg



The visible universe is - to mix metaphors just the tip of the iceberg. Apparently almost 90% of the matter in the universe (or what we think there should be) is not visible to us.

Clusters of Galaxie

In 1933 the American Astronomer Fritz Zwicky stumbled across a puzzle. He was measuring the velocities of the galaxy in the Coma cluster. To his surprise the galaxies in the outer part of the cluster were speeding! They were travelling with speeds significantly higher than what would be expected if:

1. the Coma cluster was a gravitationally bound object
2. the mass of the cluster was concentrated in the visible galaxies of the cluster

The fact that we see clustering of galaxies leads us to believe that they are gravitationally bound. Remember the "look-back" effect. As we look farther into space we see clusters at earlier and earlier times (say 500 million years ago). Now look at this in another way. The Virgo cluster is relatively "young" -we see it at a later epoch (60 million years ago). Assuming clusters of galaxies formed at the same time in the early universe the Virgo cluster has been around for a long time. So to has the Coma cluster.

Zwicky found that in order to explain the stability of the Coma cluster of galaxies the mass of the cluster would have to be increased almost by a factor of ten! The conclusion - just like the iceberg - we only see the top 10% of the matter in the cluster. 90% of the mass of the Coma cluster and other clusters is invisible to us.
This invisible matter has been given the name Dark Matter .

Dark Matter in Galaxies

Recall the work of Vera Rubin and her associates. Orbital velocities in spiral galaxies reveal a great deal of unaccounted for mass. Up to 90% of the mass of the galaxy is in a form invisible to us. The connection with Zwicky's work is compelling.

Gravitational Lensing of Distant Galaxies

One of the most exciting discoveries of the mid 1970's was the observational confirmation of an exotic prediction of Einstein's theory of gravity. According to the general theory of relativity (GR) light paths should bend in the vicinity of large masses. Star light is deflected as it passes the sun for example and this effect was measured in 1919. By 1975 astronomers had begun to detect curious multiple images of distant galaxies. In some cases the galaxies would appear as almost identical galaxies separated by small angles. Too many of these were found to be explained as chance alignments of

distinct galaxies - especially when these galaxy pairs were found to have identical red-shifts.

The explanation? Light from a distinct galaxy was encountering a region of space between itself and us that had a strong enough gravitational field to be distorted and broken into multiple images. A piece of "ribbled" glass does the same thing creating multiple images of a street lamp for example.

This effect was exploited by the astronomer Anthony Tyson and his students in a very clever way. Tyson reasoned that a cluster of galaxies should be massive enough act as a gravitational lens. Tyson discovered that the images of very faint and very distant galaxies were often distorted into ring shaped arcs when they happened to lie along the line of sight of visible clusters of galaxies. The amount of distortion present supports the idea that the clusters are more massive than their visible structure would suggest. By studying the way in which faint background galaxies were affected by foreground clusters

Tyson found a method of looking at the dark matter in clusters of galaxies. A spectacular example of gravitational lensing is seen in an image of the cluster ABELL 2218

The Case for Dark Matter

galaxies in clusters move too fast
rotation rates in galaxies are too great
gravitational lensing implies extra mass in galaxies

What Dark Matter Isn't and Maybe What It Is

1. Faint Red Dwarfs

Until very recently it was thought that faint red M-type dwarfs would be the most common of stars and that they might account for a significant part of the missing mass. The problem with using them as the "missing mass" is that they would have to be so numerous that detection by now would be almost certain. Recent HST findings, however, have made this scenario very unlikey.

2. Black Dwarfs

When white dwarfs cool they become black dwarfs. We wouldn't see them but the universe just isn't old enough to produce even 1 black dwarf. Important: black dwarfs are entirely different ideas than brown dwarfs.

3. WIMPS

One of the most intriguing candidates today is the possibility that very massive subatomic particles created in the first moments of time are the dark matter of the universe. The particles are called Weakly Interacting Massive Particles (
WIMPS). The universe is immersed in these particles which, in today's universe, are basically inert and act only gravitationally. The really fascinating idea here is that Dark Matter affects the largest scale structures known in the universe but an understanding of this enigma may require that we look at the smallest structures in the universe.

4. Brown Dwarfs and MACHOS

Massive Compact Halo Objects may be yet another way in which the enigma of missing mass or dark matter may eventually be resolved. The idea here is that the halo contains many sub-luminous brown dwarf stars. The detection of these stars would be very difficult and an intensive campaign has been mounted by some astronomers to detect the presence of MACHOS by the effect that they have on the curvature of space as they pass across our line of sight and - by gravitational lensing - cause background stars to brighten. Here is a quote from The MACHO Project Homepage:

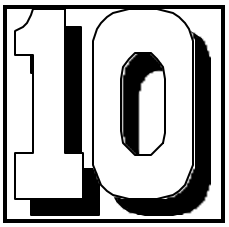
Our primary aim is to test the hypothesis that a significant fraction of the dark matter in the halo of the Milky Way is made up of objects like brown dwarfs or planets: these objects have come to be known as MACHOs, for MAssive Compact Halo Objects. The signature of these objects is the occasional amplification of the light from extragalactic stars by the gravitational lens effect. The amplification can be large, but events are extremely rare: it is necessary to monitor photometrically several million stars for a period of years in order to obtain a useful detection rate. For this purpose we have built a two channel system that employs eight 2048*2048 CCDs, mounted on the 50 inch telescope at Mt. Stromlo. The high data rate (several GBytes per night) is accommodated by custom electronics and on-line data reduction. We have taken ~27,000 images with this system since June 1992. Analysis of a subset of these data has yielded databases containing light curves in two colors for 8 million stars in the LMC and 10 million in the bulge of the Milky Way. A search for microlensing has turned up four candidates toward the Large Magellanic Cloud and 45 toward the Galactic Bulge.

5. Massive Neutrinos

Another "new-type-of-particle" explanation for the missing mass is provided by the possibility that neutrinos - usually considered to be massless - in fact may have a small latent mass. This idea has also been used in attempts to explain the Solar Neutrino Problem . This is still a very controversial idea and far from resolution. If it does turn out to be correct it could have very profound implications for galactic astronomy and cosmology.

Kings University College
Lecture notes

I PLAN MY LIFE ONE DAY AT A TIME, OFTEN NOT DECIDING WHAT TO DO UNTIL THE DAY AFTER I SHOULD HAVE DONE iT. O.A.



Learning to Starhop

by John Barra

The easier it is to find deep sky objects, the more fun you'll have with amateur astronomy. You won't need setting circles or computers. All you'll need is your telescope, a finderscope, and a low power eyepiece. Add some star maps and you're ready to go.

The art of starhopping requires you to locate a naked-eye star near your target deep sky object. Put the star in the center of your finderscope. Then use one of the techniques explained below to locate your object. Any fair finderscope will work; I prefer the Telrad reflex sight because of its versatility. It's non-magnified but has three concentric illuminated rings: 4º, 2º, and ½º wide.

I will describe five starhopping techniques using different Messier objects as targets. You should use the lowest power eyepiece with the widest field of view that you have, to make it easier to locate objects. You can then switch to higher power as needed.

IN LINE WITH TWO STARS

The simplest technique is to "hop" from one star to another to your object. M31, the Andromeda Galaxy, can be quickly found using this technique. Aim your finder at the bright star Beta Andromedae. Then move your finder to another naked-eye star above it, Mu Andromedae. Continue to move your finder in the same direction, to a distance the same as the distance between the two bright stars. Now look in your eyepiece and you should see this great galaxy.

BETWEEN TWO STARS

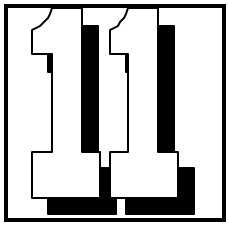
The small globular cluster M80 in Scorpius can be elusive but you should have no difficulty if you use this technique. Locate the two brightest stars in Scorpius: Antares (Alpha) and Beta. Aim your finder exactly halfway down an imaginary line between the two. M80 should be right there.

Vary this technique. Look at star atlases to see which objects lie on a straight line between two bright stars. Aim your scope the appropriate distance between the two, whether that distance is ½ or ¹/3 or some other fraction that is easily approximated.

IN A TRIANGLE WITH TWO STARS

While still in Scorpius you can learn another technique by locating the large globular cluster M4. It forms an isosceles triangle with Antares (Alpha) and Sigma.

Aim your finder 1º below the center of a line between Alpha and Sigma, the longest leg, and at a right angle to it. If you have a Telrad, aim it so that the 2º circle touches the halfway point between the two stars. M4 should be in your view.



You can find many other patterns of triangles among two naked-eye stars and a deep sky object. For example, the galaxy M94 is approximately 2º above and at right angle to the halfway point between the stars Cor Caroli (Alpha) and Beta, in Canes Venatici. Place the edge of the largest Telrad circle here.

AT THE INTERSECTION OF TWO LINES OF STARS

Some deep sky objects are not close enough to a naked-eye star to use any of these techniques. However, they usually fall along lines between several pairs of stars that are farther away. Aim your finder where these lines intersect to find your object.

For example, M3 is on an imaginary line between Arcturus and Cor Caroli. It is also on a line that connects Epsilon Bootis and Beta Comae (Berenices). Point your scope to where these lines intersect. With a low power eyepiece, you should be able to see the bright cluster almost in the center of your view.

IN THE EYEPIECE

To locate fainter objects, you will need to learn how to starhop through your eyepiece. Find a nearby bright star and aim your finder at it. Starting with your eye on the eyepiece with the bright star in the center, move the scope while following stars or star patterns to get to your target object.

To find the galaxy M108, aim your finder at Beta Ursa Majoris, the lowest star to the right in the bottom of the Dipper's bowl. You will notice two fainter stars near Beta in the eyepiece. Starting with the one nearest Beta, move your scope to Beta; keep going in the same direction about ²/3 of a degree to a brighter star. Continue on this line, passing two more fainter stars which are an equal distance apart. Follow the last star to another star close to it at a 135º angle. On that line, the same distance away as these last two stars are from each other, is M108. Making a right angle to the south, you will find a bright star 1º away. Within the eyepiece will be M97, the Owl Nebula.

As you become more experienced, get out your star atlas and pick objects to find. Look at the brighter stars or star patterns nearby and determine which technique to use for each object. Then have fun finding them.

AstroSurfing

An E-Mail from PGAS member Owen Salava

Hi Gil,

Remember I said I found out about the club on the net? Here's the page if you're interested.

http://www.skypub.com/astrodir/canada.html

Owen Salava
Prince George, B.C., Canada
sharpe@netbistro.com

NEW GIANT EYE IN TEXAS

On October 8th, the William P. Hobby-Robert E. Eberly was dedicated at McDonald Observatory near Fort Davis, Texas. The primary mirror of this giant eye of Texas is composed of 91 separate one-meter hexagonal mirrors. Computers control the mirrors' alignment so they work in concert as a single 11-meter mirror. Because of the way the Hobby-Eberly Telescope will be used, only 9.2 meters of its surface will be accessible at any given time. Thus, while its primary mirror is larger than the twin 10-meter Keck telescopes in Hawaii, the Hobby-Eberly Telescope is effectively the third-largest telescope in the world.

ROBERT BURNHAM DIES IN OBSCURITY

Last month, the Phoenix New Times reported that Robert Burnham Jr. passed away virtually unnoticed in 1993. Burnham's name is familiar to many astronomers because of his observing guide, Burnham's Celestial Handbook. This work spans three volumes and gives detailed information on objects to observe, constellation by constellation.

The publication grew out of Burnham's dissatisfaction with the star charts of the time. He was anxious to learn all he could about the objects in the sky but could not get that information quickly and easily anywhere. He began his 'celestial survey' in 1955, patiently observing the sky and recording what he saw. His skill as an observer led to his being offered a job at the Lowell Observatory. He took the position and, as well as conducting his new duties, he used the library to research the objects he included in his handbook.

Burnham published the first edition himself in 1966 and ten years later signed a deal with Dover Publications Inc., who still publish the work today. In 1979, however, his employment at Lowell came to an end and this appears to have precipitated a personality breakdown.

In the final years of his life, Burnham lived in a San Diego hotel, selling paintings of cats in a local park. He purposely covered his tracks from his family and it was not until two years after his death that his sister finally learned the details of his passing. She did not communicate this information to the astronomical community because, sadly, she had no idea Burnham's work was so revered.

TWIN TELESCOPES WITH NEAR-INFRARED "Ee"EYES" BEGIN ALL-SKY SURVEY

The first of a pair of new telescopes, funded primarily by NASA, has begun an ambitious three-and-a-half year near-infrared survey of the entire celestial sky, peering through the curtain of interstellar dust in the Milky Way galaxy.

The Two-Micron All-Sky Survey (2MASS), based at the University of Massachusetts, Amherst, MA, features two 1.3-meter telescopes, one at a Smithsonian Astrophysical Observatory site atop Mount Hopkins, near Tucson, AZ, and the other at a National Optical Astronomy Observatories site in Cerro Tololo, Chile.

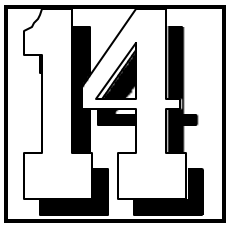
"The sky survey catalogues produced 100 years ago are still useful to astronomers," said Project Manager Rae Stiening. "We expect this new, greatly updated survey will be an invaluable resource for the next 100 years."

The survey is designed to catalogue one million galaxies and 300 million stars in the local universe, along with quasars, which are strong, extremely bright radio sources, and galaxies with black holes, the intriguing entities with gravity so powerful not even light can escape.

2MASS will observe many known asteroids and possibly some comets, and it is uniquely sensitive to exotic objects like brown dwarfs, which lack the mass needed to ignite and become full-fledged stars. The telescopes are equipped with near- infrared detector arrays that will provide the most complete census to date of cool stars in the Milky Way galaxy and provide
new data for detailed studies of the galactic structure. Near- infrared emission is at wavelengths roughly two-to-four times longer than visible light and permits astronomers to "see through" the obscuring effects of interstellar dust in the Milky Way galaxy.

The 2MASS survey will measure accurately the positions
and infrared brightness of stars and galaxies. Combined with complementary ground-based red shift surveys, the 2MASS extra- galactic data will provide a three-dimensional view of large-scale structures in the local universe. The enabling technology for this survey is the breakthrough in large-format infrared detector arrays. These technologies, funded through the U.S. Department of Defense and NASA, are being adapted for astronomical purposes to increase sensitivity dramatically. It's expected the new survey will be some 25,000 times more sensitive than a precursor survey at the California Institute of Technology, Pasadena, CA, nearly 30 years ago. 2MASS uses the type of detectors developed for the Near Infrared Camera and Multi Object Spectrometer on NASA's Hubble Space Telescope.

"Observing time at most telescopes is divided among a variety of scientific programs using a suite of different instruments. 2MASS telescopes will be completely dedicated to mapping the sky using one instrument, a three-color infrared camera," said Principal Investigator Dr. Michael Skrutskie, a University of Massachusetts physics and astronomy professor, who leads the science working group that will evaluate the data products. He also managed the design and fabrication effort for the infrared cameras, which are attached to an identical pair of
telescopes.



Data will be processed at JPL's Infrared Processing

Astrophotos Wanted

Hello

My name is Stan Shadick. I am the author of the annual Canadian Skywatcher's Trivia Calendar (Fifth House Publishers 1-800-360-8826)**.** This wall calendar is designed to introduce readers to the exciting astronomical discoveries being made about our universe. Each month, a star map depicts a portion of the evening sky visible from Canada. The star maps include a reference horizon to make it easy for novices to orient themselves to the maps.
Each date in the calendar grid contains a short commentary about some fascinating star, planet or other celestial object that is located on that month's map.

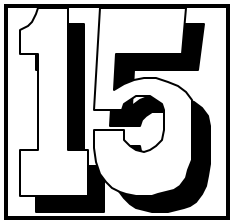
I am now searching for astronomical images taken by Canadians to include in the 1999 edition of this calendar. (The 1998 edition is already in most bookstores across the country.). The images used in the 1999 calendar will be selected in November or December 1997I hope these images will assist the reader in appreciating the grandeur of the heavens and help provide a showcase for astronomical CCD images and photographs taken by both professional and amateur astronomers across Canada. Where possible, the images selected should enhance the daily commentaries. Most images used will be printed in black-and-white about 5 or 6 cm in size to fit in the extra grid cells of the calendar. A few images may be printed larger for use in the introductory or supplementary pages. Each photographer will receive credit in the calendar and will receive an honourarium from the publisher of $25 per image used.

If you have taken some astrophotos that you would like to submit, please forward a list of images available to me by email or snail mail. If they are in digitized form, you may wish to send me the image in TIFF format as an attachment to an email. If they are photographic prints, please mail 1 sample print that I may keep along with a list of other available prints. At this time, I regret I cannot guarantee returning prints sent by mail. If you know of anyone else who has taken astrophotos, please forward this message to them.

I would also appreciate receiving summary details of noteworthy research results conducted by Canadian astronomers that would be of interest to the general public. If you send me an abstract, I will consider incorporating it into one of the daily trivia commentaries in a future edition of the Canadian Skywatcher's Trivia Calendar.
Thank you for your assistance.

Stan Shadick
Dept. of Physics and Engineering Physics
116 Science Place
University of Saskatchewan
Saskatoon, Saskatchewan
Canada
S7N 5E2

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.

	$25,00
Ministry of Adv. Ed. Training and Tech.	0
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	465
Russelsteel	460
Lakeland Mills Ltd	270
Canfor Clear Lake	200
Lutz Klaar	200
Canfor Netherlands	150
Art Beaumont	

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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