JANUARY, 2000 ISSUE #100!

the PeGASus

Newsletter of the
The Prince George Astronomical Society

The pgas meets next at 7:30 pm
WEDNESDAY January 26 at CNC

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

February 11

Send correspondence to
The PGAS
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Prince George, BC, V2N 1P8
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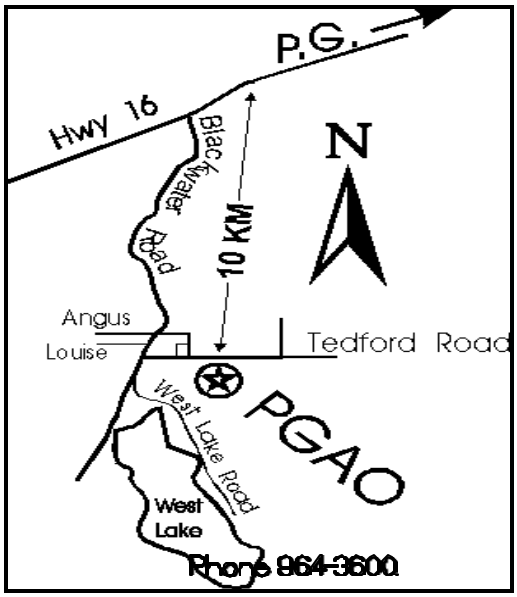
selfs@attcanada.net



http://www.pgweb.com/astronomical/

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Editorial

by Gil Self

The creative side of my brain must be very small, it is a challenge each month to come up with an editorial that is interesting, serves a purpose and may even be clever. Now, please don't take me wrong, I'm not complaining. About the most creative thing I've ever done is a clay ashtray I made in grade 5 or 6. So, it is enjoyable to do something different It is more of a process for some of us ("creatively challenged "). So how does it go? Well, each month around this time I start kicking ideas around in my head, lots of ideas- but not many evolve into sentences- much less paragraphs.

This month pretty well demands comment on the new century and as I thought about it I recall reading science fiction a lot as a teen and of course anticipating those futures. The very best were the books about the near future, the achievable time frame. George Orwell, thankfully , was wrong about 1984. That apocalyptic view was not the future I was looking forward to. But Asimov, Clarke, Niven to name a few, painted an exciting future, a time to look forward to. I think the gutsiest of the lot was (is) Arthur C. Clarke. He wrote a lot of what would be on the border between science fiction and science fact. Apparently none of these writers or many others attempting to see into the mists, were able to predict the times we are in now. For example I don't recall anyone predicting the internet, besides, who would have believed it possible. But Clarke came the closest, predicting a global communications network. And if the NASA budgets had of remained high we likely would be driving dune buggies on Mars and mining asteroids by now or very soon— but hey you never know.

Arthur Clarks future is here, and based on the relative accuracy of his predictions so far, we had better hurry up. We only have a year. We need to get back to the moon, (and don't forget your classical music collection if you go) build a base and start digging holes all over the place, especially near magnetic anomalies.

Now my wife is going to read this and say " are you going to print that" . So I better come back down to earth for a minute and mention that we had one of our very best years last year. We accomplished a lot , our attendance was not what it should be at our Friday open house. This is probably the area we should work on and I know Brian Battersby is the one to turn this around. Technically, we have never been in better shape. The optical equipment is second to none and with some soon to be completed modifications will exceed anything we have done up until now. Maybe we can even get the slide system up and running this spring. It is, of course ,dependant entirely on volunteer time. We make plans for what we think we can get done, but we need your help to complete our plans. If you can afford some time in the upcoming observing season, we will be glad to have you. Just speak to any member of the executive, we will find something for you to do. Thanks

Gil

Coming Events

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

PGAS Meets next, Wednesday January 26 2000
7:30 pm at CNC

The Night Sky for February 2000

by Bob Nelson, PhD

Hi Folks,

As I write this, we are one week into the new year/millenium and the Y2K bug has not shown up in any of our astronomical software (or anywhere else for that matter). Cloudy skies now seem to be the norm, but there are clear nights now and then. I find the moving satellite images (from NOAA's GOES 10 synchronous satellite) available from the Environment Canada site www.cmc.ec.gc.ca/cmc/htmls/satellite.html to be invaluable in predicting clear periods (and I have 78 observing nights in 1999 to prove it!!). [You need a viewer for mpeg images -- if you can't find one, let me know.]

New things are coming up in the spring; your executive is actively planning -- come to the next meeting to find out!!

PLANET ROUNDUP

MERCURY, in Aquarius, is an evening object all month. On the first, it sets about an hour after the Sun; by mid-month, this interval has grown to almost two hours (greatest eastern elongation occurs on the 14th when the elongation is 18 degrees); and by month's end, the setting time interval has shrunk to about 20 minutes after the Sun. This is a favourable aparition for northern observers since, owing to the angle the ecliptic makes with the equator, Mercury should be as high in the sky as it can be at sunset. Look for it immediately after sunset using binoculars. Sweep in an arc angled up from the point where the Sun just set (a little south of due west) and you should just be able to pick it out. (A telescopic view should reveal a tiny disk half illuminated.) Go for it!!

VENUS, is still a morning object all month; on the first it rises about 1 1/2 hours before the Sun, but by the end, this has shrunk to about 40 minutes. On the 15th, it's a 12" gibbous blob of magnitude -4.0. (This is very bright! -- like an aircraft with its landing lights on.)

MARS, in Pisces from Feb 2 on (except for a brief excursion into Cetus on Feb 20), is still an evening object; it sets about 3 1/2 hours after the Sun on the first of the month shrinking to 3 hours by the end as the Earth leaves Mars behind in the celestial race (Mars always loses). Mid- month, it's a 4" tiny blob of magnitude 1.2. No details will be evident from these latitudes.

JUPITER, in Pisces until Feb 11 when it passes into Aries, is STILL a fine evening object to view. At the beginning of the month, it still sets around midnight; that time advances to about 10:45 PM PST by the end of the month. At mid-month it's still a very viewable 37" disk at magnitude -2.2 (down from 50" and magnitude -3.7 at opposition on Oct 22 last year).

SATURN, in Aries until the end of May, is an evening object all month; it sets about 1:20 AM at the beginning of the month; this advances to about 11:30 by the end. At mid-month, it's a 18" disk of magnitude +0.3. Still worth viewing, folks!

URANUS, in Capricornus all year, is lost in the glare of the Sun all month (it reaches conjunction on Feb 9). In March, it becomes a morning object.

NEPTUNE, in Capricornus all year, is lost in the glare of the Sun at month's start (conjunction was on Jan. 26) but becomes visible as a morning object by month's end when it rises about an hour before the Sun. As usual, it's a 2.3" disk at about magnitude 8.0.

PLUTO, in Ophiuchus all year, is a morning object all month. On the first, it rises at about 3:15; on the 31st, it rises at about 1:30. As usual, it's a 0.1" disk at magnitude 13.8

CONSTELLATIONS to look for in February (at 9:00 PM, PST) are Eastern Eridanus, Canis Major, Lepus, Monoceros, Orion, Taurus, and Gemini. However, since I talked about the first five last month, I'll restrict this section to Taurus and Gemini.

Taurus (Tau, "The Bull"), contains The Hyades, the well-known V-shaped open cluster which represents the head of the bull. For astronomers, it's the closest open cluster (after the Ursa Major Group), lying at about 40 parsecs (=130 light years) distant and probably containing several hundred members. It's important because the distance is too great to be measured by normal stellar parallax, but can be determined by a method known as the "moving cluster method". After that, its Hertzsprung-Russell (HR) or colour-magnitude diagram can then be used to determine the distance to clusters lying further away. This cluster is then an important rung in the cosmic distance scale.

Taurus also contains M45, the Pleiades star cluster (the 'Seven Sisters') which lies about 3 times further away -- 126 pc (= 410 light years). On deep exposures, many of the stars exhibit circumstellar nebulosity which is the tip-off that these are young stars. Another attraction in Taurus is M1, the well-known Crab Nebula. The subject of much study, the Crab is thought to be the result of a star that exploded in 1054 (on July 4th, of all days!). It's not too hard to find -- give it a try -- but the image is just an amorphous blob in the sky. Better images are obtained with a CCD camera (yeah!!).

Gemini (Gem, "The Twins"), is a well-known northern constellation that lies just to the east of Auriga. Just missing the Milky Way as it does, it lacks a lot of deep sky objects. (It does have open clusters M35, and NGCs 2158 and 2392 however.) Some of the stars are quite interesting. Alpha Geminorum, better known as Castor (one of the twins), lies about 45 light years from us and has a total luminosity of about 36 Suns. According to Burnham, it's probably the finest double in the northern sky. There is, however, much more to know. Castor A and B form a visual binary (gravitationally bound -- the first to be discovered) making an orbit of about 6 arcseconds in radius (corresponding to a real distance of about 90 astronomical units) and a period of about 400 years (and hence the system has not yet made a complete orbit since it was first measured likely in 1678). There is a third star, Castor C, which orbits the other two at a distance of about 72". The fascinating thing about Castor is that each of the three stars (A, B, and C) is also a spectroscopic binary.

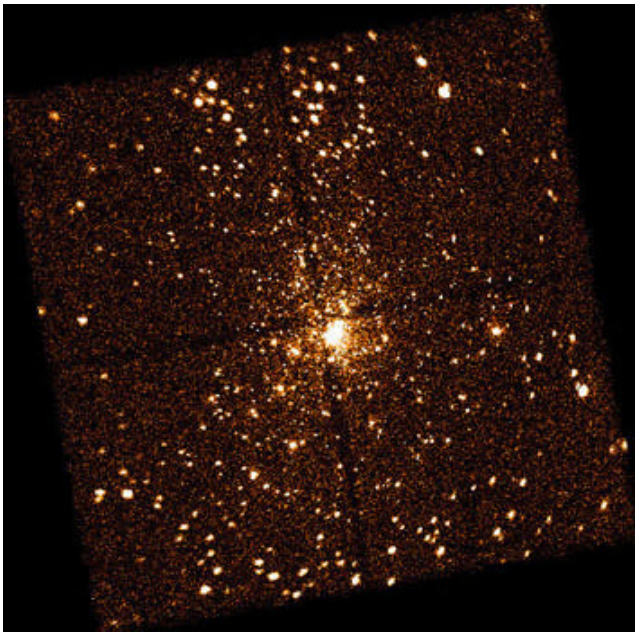
[Spectroscopic binaries are systems of two stars that almost always cannot be resolved as two but are detected as double by the use of spectroscopic analysis. Spectra taken over a complete orbit reveal spectral lines alternately shifted to the blue at one time, then shifted to the red at other times. Mathematical analysis can solve for certain fundamental quantities like mass and orbital speed, however, the 'fly in the ointment' is that, unless the system also eclipses, you never know the orbital inclination, i. Therefore, all you get are quantities like (v sin i) and (m sin3 i) where (sin i) is the sine of angle i and (sin3 i) is the sine of angle i cubed.]

So there you have it, Castor is a system of six stars! (For further details, read Burnham's Celestial Handbook, page 917 -- available at the observatory.) Castor's twin, Pollux (Beta Geminorum) is, alas, just single.

Another interesting system in Gemini is U Geminorum, a 'dwarf nova'; however, I'll have to talk about it at some other time.

Clear skies,

-Bob



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Chandra Finds X-ray Star Bonanza in the Orion Nebula

NASA's Chandra X-ray Observatory has resolved nearly a thousand faint X-ray-emitting stars in a single observation of young stars in the Orion Nebula.

The Orion region is a dense congregation of about 2,000 very young stars formed during the past few million years. The discovery of such a wealth of X-ray stars in the closest massive star-forming region to Earth (only 1,500 light years away) is expected to have a profound impact on our understanding of star formation and evolution.

The brilliant Orion region has awed humankind for millennia. The most massive and brightest of these nascent stars are in the Orion Trapezium, which illuminates the Orion Nebula, also known as Messier 42. The Trapezium and its luminous gas can be seen with the unaided eye in the winter sky in the "sword" of the Orion constellation.

Young stars, such as those found in Orion, are known to be much brighter in X-rays than middle-aged stars such as the Sun. The elevated X-ray emission is thought to arise from violent flares in strong magnetic fields near the surfaces of young stars. The Sun itself was probably thousands of times brighter in X-rays during its first few million years.

"With hundreds of stars observed simultaneously, possessing a wide range of properties such as mass and rotation rates, we hope the Orion observation will help unravel the astrophysical principles underlying this phenomenon," Feigelson said. "X-ray astronomy now penetrates as deeply into the clouds as the best infrared and optical telescopes, permitting us to study high-energy processes during the earliest phases of star formation." (continued on page 12)

8 A Mauna Kea Connection

http://www.jach.hawaii.edu/JACpublic/index.html

Well, this is a little submission to the PGAS from a former PG resident. I have had the opportunity to get a job working at the Joint Astronomy Centre in Hilo, Hawaii, thanks to the Physics and Astronomy Co-op program at the University of Victoria. Myself, Julie Roberts, and three other students, are all here for four months to help other, more established, astronomers with projects. I am working with John Davies on "world beating asteroid science", which is the study of certain asteroids both near earth and in the Kuiper belt. Louis Desroches is working under Chris Davis on a project concerning the molecular outflow from young stellar objects. Jeff Wagg is helping Tim Jennets monitor blazers, which are galactic nuclei with massive black holes that have x-ray streams that are (in this case) pointed straight at us. Jesse Eyer is doing spectroscopy of in-fall velocities of new star forming regions for Gerald Moriarty-Scheilds.

We have only been here one week today and already I have had the opportunity to visit the summit of Mauna Kea, the largest mountain in the world if you start at the bottom of the ocean.. The summit of Mauna Kea is at 14000 ft.. The air is thin with only 60% the oxygen found at sea level. There is no vegetation above 10000ft and the soil is reddish-brown from the lava rock. I was briefed and de-briefed extensively on the effects that the altitude may have both physically and psychologically in safety meetings. The signs and symptoms of the very real altitude sickness range from headaches, to bleeding noses to itching eyes to death. There is also the tendency to go to the bathroom quite frequently because the body is trying to thicken the blood and it is faster to expel excess fluid than to create more red blood cells. Thankfully, I only had a small headache the second day but a couple glasses of water cleared it right up. I was also a little giddy at the summit and brain-processes were noticeably slowr.

John works for the United Kingdom InfraRed Telescope (UKIRT), so that is where I spent most of my time observing the observers. UKIRT is one of the world's largest InfraRed telescopes. It is 3.8m in diameter and can run several different observing machines. UFTI, TUFTI, CGS4, IRCAM, and ORAC-DR to name the ones I can remember. There are also a barrage of different data-reduction packages that may be used to reduce the data including IRAF, GAIA, SURF and Figaro to name a few. I don't quite know the whole process, but I do know that the light received from the star lands on a chip called a Charge Couple Device. Previously photographic plates were used to detect the light, but they were only 10% effective. CCD's are usually around 90% effective. This digital data is fed to the computer in the form of an array which may be further processed, or reduced, by the observer to reveal subtle structures.

The data first of all has the bias removed. The bias is the minimum amount of energy required for the electrons to be able to move. It is applied as a

voltage to the CCD before the exposure and removed after. The data is then "flat-fielded", which is a process that removes the variations in sensitivity from pixel to pixel. There may be "hot pixels" or light from cosmic rays or effects from the electronics of the system that is called noise; this is also removed (subtracted out). The image may then be displayed with different degrees of contrast to improve the signal to noise ratio and to find the object of interest.

As previously mentioned, I am studying "world beating asteroid science" with John Davies. My job at present involves data taken from observations at JKT in Spain nearly one year ago of an asteroid in the Kuiper belt called CU26, discovered in 1999. I will be doing "photometry" on it. Photometry is much like spectroscopy, for those who know how that works, but is used for fainter objects with complex molecular structures. The light arrives from that object and is passed through a filter onto a detector, or CCD, which records the amount of light received. The filters are U (ultraviolet), B (blue), V (violet), R (red), I (infrared), JHK (three more infrared), and physically block out certain wavelengths of light from the object. This amount of energy is compared to that of a star of known brightness, a standard star, under the same conditions, within the same frame. The ratio of the two describes a logarithmic scale of magnitudes. Plotting magnitude against time gives what is known as a light curve. The brightness of asteroids is determined by their size, reflectivity (or albedo), distance from the Sun, and distance from Earth. Repeated photometric observations over hours or days are compared to find any variations. These variations may be caused by the rotation of an irregularly shaped object that may be putting a smaller or less reflective face towards us during its rotation. Using several filters gives a "fingerprint" of the object, by seeing if one color is reflected more than the others. Subtracting the magnitude achieved in one filter from another gives the "color" of the asteroid. For example, (U – B) or (B – V) may be plotted against each other. Doing this often shows the data clustered in specific regions of the graph. These regions and colors ascribe to different minerals within the asteroid, which may reflect the light differently. My job specifically is to reduce the data taken from CU26 and determine its period of rotation, size, and shape through variations in the light curve.

Julie Roberts

We have new members. Welcome Paul Roberts and his daughter Julie. Julie is involved in a very interesting program at U Vic and has kindly taken the time to send us this article. I am very much looking forward to her next update and hope she can keep us informed on her progress throughout her adventures.

Gil

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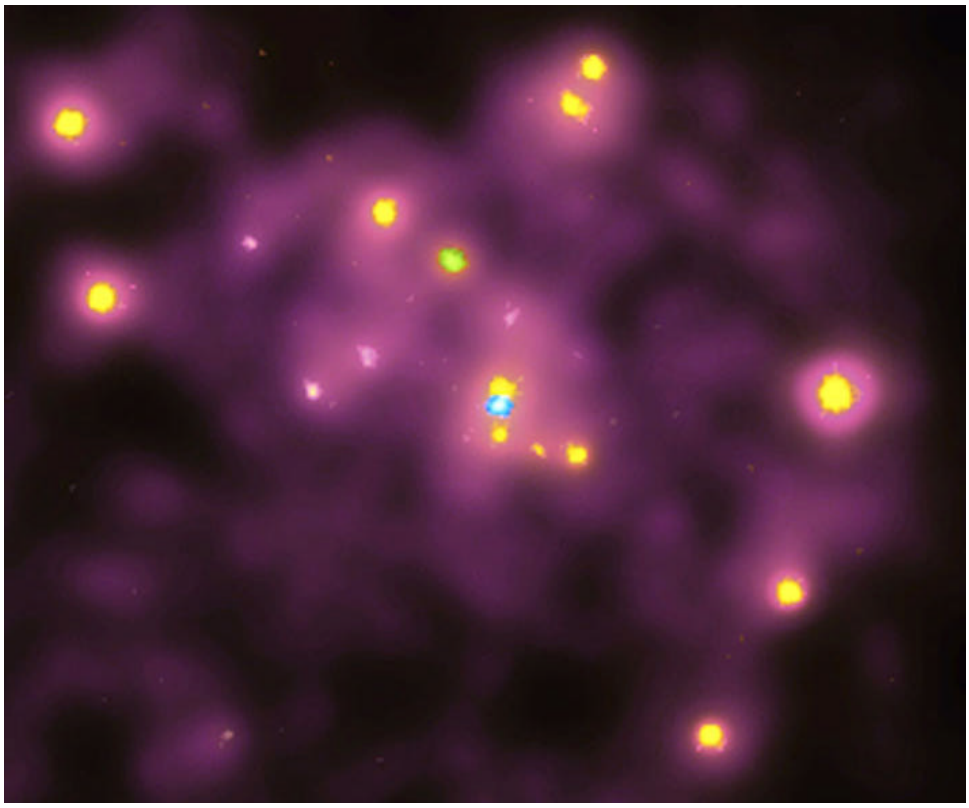
Chandra image of Andromeda galaxy

This X-ray image shows the central portion of the Adromeda Galaxy. The blue dot in the center of the image is a "cool" million-degree X-ray source where a supermassive black hole with the mass of 30-million suns is located. The X-rays are produced by matter funneling toward the black hole. Numerous other hotter

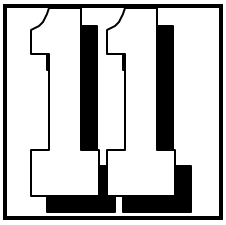
X-ray sources also are apparent. Most of these are probably due to X-ray binary systems, in which a neutron star or black hole is in close orbit around a normal star.



Lots of “good Stuff” from NASA

NASA press releases and other information are available automatically by sending an Internet electronic mail message to **domo@hq.nasa.gov.**
In the body of the message (not the subject line) users should type the words "subscribe press-release" (no quotes). The system will reply with a confirmation via E-mail of each subscription.

Chandra image of Andromeda galaxy



This X-ray image shows the central portion of the Andromeda Galaxy. The blue dot in the center of the image is a "cool" million-degree X-ray source where a supermassive black hole with the mass of 30-million suns is located. The X-rays are produced by matter funneling toward the black hole. Numerous other hotter X-ray sources also are apparent. Most of these are probably due to X-ray binary systems, in which a neutron star or black hole is in close orbit around nomal star.

For Release: January 14, 2000

In its first look at the Andromeda Galaxy (M31), NASA's Chandra X-ray Observatory has found that the gas funneling into a supermassive black hole in the heart of this galaxy is a "cool" million degrees. This unexpected result adds one more quirk to the strange behavior previously observed at the center of M31.

Chandra took its first X-ray picture of the Andromeda Galaxy with the Advanced CCD Imaging Spectrometer on October 13, 1999. More than100 individual X-ray sources were seen. One of these sources was at the previously determined position of the central supermassive black hole, which has the mass of 30 million suns. With many X-ray emitting stars in the center of M31 there was a slight chance that one of them might be at this position just by coincidence. The low temperature of the suspected central source, as compared to the other sources, gave the team the clue they needed.

"When we found that what we suspected was the central object was also anomalously cool, we KNEW we had it— one coincidence might be believable, but two was too much to ignore!" said Garcia.

While the gas falling into the central black hole is cool, it is only cool by comparison to the 100 other X-ray sources in the Andromeda Galaxy. To be detected by an X-ray telescope, the gas must have a temperature of more than a million degrees. The typical X-ray star in the Andromeda Galaxy has a temperature of several tens of millions of degrees. In contrast, the temperature of the supermassive black hole source is a few million degrees.

The Andromeda Galaxy is our nearest neighbor spiral galaxy at a distance of two million light years. It is similar to our own Milky Way in size, shape, and also contains a supermassive black hole at the center. This central black hole has always been a bit odd when compared to central black holes in similar galaxies. Based on its X-ray luminosity, it is much fainter in radio waves than expected.

(continued on page 12)

Such behavior, coupled with Chandra's discovery of the low temperature gas, cannot be accommodated by standard models developed for supermassive black holes in galaxies like the Milky Way and Andromeda.

"The Chandra observation is telling us that an entirely different flow pattern is operating around the Andromeda black hole," said Dr. Eliot Quataert, of the Institute for Advanced Study, Princeton, N.J. "This will require a different class of models than usually considered."

One possibility is that the gas undergoes a large scale boiling motion which slows down the rate at which gas falls into the black hole.

The best previous X-ray pictures were not sharp enough to clearly distinguish the X-ray source associated with the black hole in the center of the Andromeda Galaxy nor did they give information about the temperature of the source.

Another intriguing feature of this observation is the detection of a diffuse glow that extends for a thousand light years around the central region. It is not known if this is due to many individual sources, or to a hot wind expanding out from the center.

"This is just a first, quick look at our nearest Milky Way analog," Murray emphasized. "I expect that our future pictures will lead to more exciting discoveries in the Andromeda Galaxy."

(**continued from page 7**)

"This Chandra image is a milestone in the field of X-ray astronomy and very gratifying to me personally," said Garmire. "Chandra's sensitivity is 20 times better than achieved with the best previous X-ray telescopes."

A number of the ACIS X-ray sources in the Orion observation have special importance. Several are associated with a distinct cluster of higher-mass stars deeply embedded within the murky Orion Molecular Cloud, including the infrared-luminous Becklin-Neugebauer object.

"This is the first time X-ray astronomy has resolved individual massive stars still embedded in their natal cloud," said Dr. Leisa Townsley research associate in astronomy and astrophysics at Penn State.

At least three ACIS sources are associated with cluster members with masses so small (roughly 1/20th of the Sun's mass), that they will evolve into brown dwarfs rather than true stars.

"They more closely resemble proto-Jupiters than proto-stars," said Dr. Yohko Tsuboi, visiting research scholar in astronomy and astrophysics at Penn State. "Over a dozen X-ray sources have no known counterpart, even in the most sensitive Hubble Space Telescope or infrared studies. These too may be very low-mass stars.".

Web Sites and E-Mail Addresses Worth a Visit

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Or send me an E-mail and I will send these links to you as active links

A chance to watch the Next Generation Space Telescope take shape
http://www.ngst.nasa.gov/public_docs.html
or **http://www.ngst.nasa.gov/**

Doug set up this fairly complex address but it is worth the effort
http://www2.gsoc.dlr.de/scripts/satvis/ satvis.asp?Lat=53.750&Lng=-122.850&Loc=PGAS+Observatory&TZ=PST

A ton of links
http://www.search-beat.com/space.htm

HST home page
http://www.stsci.edu/top.html

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S&T's Weekly News Bulletin and Sky at a Glance are available via electronic mailing list. For a free subscription, send e-mail to **join@astromax.com** and put the word "join" on the first line of the body of the message

RASC **http://www.rasc.ca/**

Astronomical Society of the Pacfic **http://www.aspsky.org/**

The American Association of Amateur Astronomers -**http://www.corvus.com**

Seattle Astronomical Society **http://www.seanet.com/~java/seattle.htm**

P G Astronomical Society **http://www.pgweb.com/astronomical/**

14

To Twenty- Nine or Not
(229 or not)

Since this is a leap year, the start of a new century, it's appropriate to talk about the calendar. 'What's so unusual?', you say. 'Isn't every fourth year a leap year?' Wrong! This is a common misconception. Some history is in order
(ref: Abell, Exploration of the Universe, 3rd edition).

In the year 46 BC (astronomers would say the year -45), Julius Caesar, on the advice of astronomers, instituted calendar reform. Amongst other things, he set the length of the year at 365 1/4 days (the best value known at the time). This meant the familiar expedient of having an extra day (a leap day) every four years. This worked fine until the 1500s. The problem was that the actual length of the tropical year (which has to do with the seasons), is 365.242190 days -- which doesn't fit! By the year 1582, the difference (which is 11 minutes, 14 seconds per year) had added up so that the first day of spring had advanced to March 11. Therefore, Pope Gregory XIII (again on the advice of astronomers) instituted another calendar reform. First, 10 days were dropped from the calendar so that 1582 October 4 was followed by October 15. (Laws were passed so that landlords would not profit unduly; even then, there were riots by people that wanted the lost days back!) The second measure was that the length of the year was then adjusted by making the century years not evenly divisible by 400 NOT leap years. (Therefore the year 1600 was a leap year, the years 1700, 1800 and 1900 were NOT leap years and our year, 2000 is a leap year.) This now adjusted the length of the year to 365.2425 days (3 days every 400 years shorter than the Julian calendar) and the whole thing is known as the Gregorian calendar -- a much better fit. As history records, non-Catholic countries were slow to accept this reform -- the British Empire and the American colonies did not do so until 1752. (The Russian Orthodox church never did -- that is why followers celebrate Christmas in January!) So therefore there is a February 29th this year. Enjoy that extra day of winter! <grin>

- Bob

A note from Orla Aaquist (well known, astonomy prof in Edmonton, lecturer with RASC , former PeGASus editor and all around good guy).

Hi Gil,

Newsletter #100. Wow! However, going by the gafaffle over the start of the new millinnium, does this mean that since we didn't have a newsletter 0, newsletter 100 is really not the new decade of newsletters? So, there is really nothing special about newsletter 100. We should wait for newsletter 101 to celebrate.

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
Xerox Canada	1,300
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
Bisque Software	500
Canfor Clear Lake	500

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

Support Community Science

Join the PGAS

The P.G.A.S Would like to thank

BISQUE SOFTWARE

for their donation of

THE SKY (Level 4 software)

To The Prince George Observatory

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