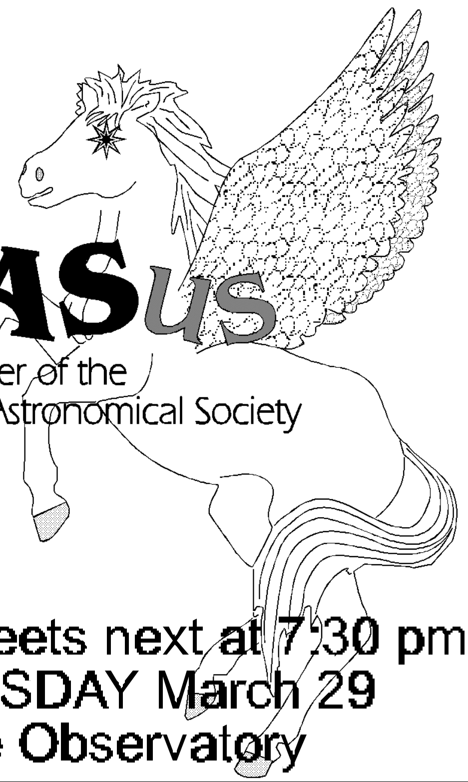
MARCH 2000 ISSUE #102



the PeGASus

Newsletter of the
The Prince George Astronomical Society

The pgas meets next at 7:30 pm
WEDNESDAY March 29
at the Observatory

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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

APRIL 14

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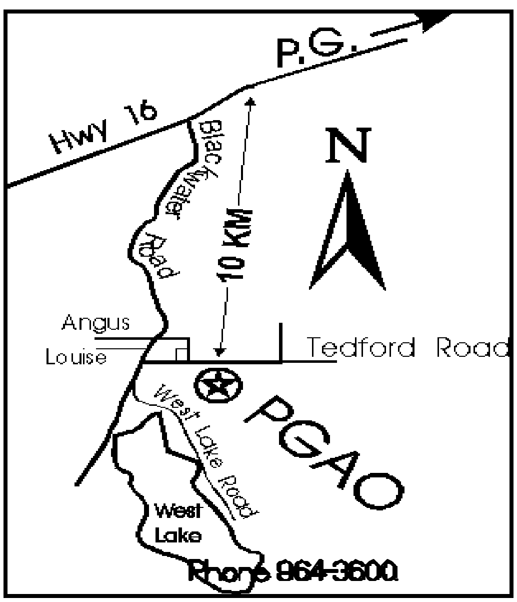

Prince George Astronomical Society Executive, 1999/2000

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

Editorial

by Gil Self

I have had a theory for many years. It is neither astronomical nor, as far as I know, has any firm scientific basis. Although recent research seems to be supporting my long held hunch. The theory basically boils down to “ use it or lose it”. I am talking about thought processes, memory and cognitive abilities. Long lost abilities are easily regained with a bit of exercise (and an application of spell check from time to time). I have always felt the times of mental stimulation have also been the times when you feel the sharpest and catch on the easiest. Spend a week of your vacation sitting in the back yard watching the grass grow and I bet you will notice a difference.

With those thoughts in mind I suggest we help each other stay sharp. I propose a quiz, I can’t take credit for the idea since Orla suggested a monthly quiz some time ago and to kick things off this month I will offer his question. I hope to get an answer with paragraph or two to back it up which I will print in the next newsletter. Each month, the author of the best response, will be awarded The PeGASus Mensa certificate (suitable for framing). But even better than those accolades, I am seeking next months question from one of you. I would like a question that can be answered in one or two paragraphs, but hopefully difficult enough that even Bob will have to open a book to come up with the answer.

This months Question
"On what planet is the year shorter than a day?"

This is not as easy as it looks. Answers by April 14 please to my e-mail
gil@attcanada.net or mail to Gil Self , 7091 Tony Road PG V2n5P4

Daylight savings time returns at 2 AM on Sunday morning April 2 (BOO, HISS!!). This makes observing a late affair for us all (and it gets totally ridiculous from late May onward). However, looking on the bright side, yours truly be able to go out to the observatory after a normal supper and get sky flats in the dusk sky. The last series of flats I took was back in December, so I'm long overdue!! (For accurate photometry you take them every night; however, it's less critical for what I do.) Bob N.

NEW BOOKS AT THE PUBLIC LIBRARY. By Yvonne Whebell

DEEP-SKY COMPANIONS: THE MESSIER OBJECTS
By Stephen James O'Meara. Cambridge University Press, 1998

Explores the objects in the sky that so puzzled Charles Messier, who in the1700's spent his time searching the skies for comets. It also features 20 non-Messier objects. The book contains photos of the objects, diagrams, instructions on how to view them. Everything from the Crab Nebula toM110, and beyond.

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 March 29
7:30 pm at the observatory

The Night Sky for April 2000
by Bob Nelson, PhD
Hi Folks,

Another month, another column. This month features the return of daylight savings time (never popular with astronomers) and with it, later observing. We make the best of it, enjoying the higher temperatures and, hopefully, better weather at this time of year.

Here is what is happening in the sky next month:

PLANET ROUNDUP
MERCURY is not observable by northern observers until late May.

VENUS is not observable by northern observers until September. It reaches superior conjunction on June 11th, when it is occulted by the Sun (unobservable from here on Earth - unless you have really fancy equipment).

MARS, in Aries, until April 24 when it passes into Taurus, is low in the western sky at sunset. On the 15th, it sets 2 hours after the Sun. (At 4", it's barely detectable to us as a disk but at magnitude +1.5 it should be easy to find.) However, it's fading fast, folks.

JUPITER, in Aries until the end of May, also is in the west at sunset. On the 15th, it sets about 1.5 hours after the Sun when it's a 33" disk of magnitude -2.0. Although it's not as big and bright as before, it's still a fine sight.

SATURN, in Aries until the end on May, is also low in the west at sunset. Like Mars it sets about 2 hours after the Sun. Always smaller and less bright than Jupiter (it's about twice as far away!), it's a 16" disk of magnitude +0.3. Still worth looking at.
By May, all of the naked-eye planets will not be visible in the evening sky and the outer planets will not rise until after midnight. In addition, the last week on April and the first week of May will lack a Moon. Oh well, we'll just have to show our visitors deep-sky objects!!

URANUS, in Capricornus all year, rises at about 4:30 AM PDT on the 15th when it's a 3" disk of magnitude +5.9. For the early risers. For those who know where to look, you can see it in binoculars.

NEPTUNE, in Capricornus all year, rises on the 15th at about 4 AM PDT. As usual, it's a 2.3" disk at about magnitude 8.0. Another object for those who can make it out to the observatory in the early hours before dawn (you need a good telescope).

PLUTO, in Ophiuchus all year, rises on the 15th at about 11:30 PDT. As usual, it's a 0.1" disk at magnitude 13.8. Later in the year, it should be a good target for CCD imaging. (Oddly enough, although I have images of most of the other planets I do not have Pluto, which should be easy enough with our setup. We'll have to do something about that!)

CONSTELLATIONS to look for in April (at 10 PM, PDT) are Central Hydra, Crater (Crt), Sextans, Leo and Leo Minor.

Central Hydra ("The Sea Serpent", not to be confused with Hydrus, "The Water Snake" - WAY to the south, hence the "s" at the end of the constellation name) is out of the Milky Way and contains two galaxies: NGC 3923 and 3621. The former is a 2.0' x 1.2' ellipse of magnitude 10.7; the latter, a 12' ellipse of magnitude 10.0. One of the catalogues in Guide 7 tells me that NGC 3923 is travelling away from us at some 1400 km/s and is therefore about 20 megaparsecs (64 million light-years) away, using Ho = 70 km/s/Mpc for the Hubble constant.

Crater ("The Cup") contains galaxies NGCs 3672, 3962, and 3887 plus the 6th magnitude variable star SY Crt. (The Hipparcos catalogue -- available in Guide 7-- tells us that it's a slow irregular variable of spectral type M3 III (that makes it a cool red giant) and is 570 times as bright as the Sun and lies 570 light years away.)

Sextans ("The Sextant") contains the galaxies NGCs 2974, 3115, 3166, and 3169.
Leo ("The Lion") is familiar to most of us. It's a constellation that actually resembles what it's supposed to be. The head of the beast, on the right, contains at its base the first magnitude star Regulus. It also contains numerous galaxies (almost to many to mention) M65, 66, 95, 96, 105, plus NGC 3628, 3384, 2903. Those from the first group are typically 10th magnitude and 5-10' in size. The latter group are generally fainter, typically 11th magnitude (NGC 2903 is 9.5) and smaller 3-5' (NGC 2903 is 12.5'). Note that M65 and 66 is a famous pair visible in the same field of view.
Leo Minor ("The Little Lion") contains galaxy NGC 3344 (10.4 mag, 7.2' in size).

Clear skies, Bob

WHY STUDY ASTRONOMY?

By Julie Roberts, UVIC Astronomy Student, at JAC

"Why study astronomy?" is a question that I am often asked by friends, family, and complete strangers. The usual response is "’cause it’s cool"; and definitely not "for the money". Well I found a better answer (at least partially) last week during a lecture I attended at the University of Hawaii in Hilo by Dr. Bob Williams, the former director of the Hubble Space Telescope Program. He was the director of the program from the very start through the first decade of its operation and had some very pretty pictures at his presentation. He defined Astronomy as a "Pure Science", something that is studied for the sake of studying, for nothing more than settling our curiosity. A person can know nothing about astronomy and still live a very fulfilling life (of course there is a slight benefit to understanding the Sun and it's effect on our everyday lives). So again, why? Two reasons. One, because it has revolutionized the way we think of ourselves. It is inherent in human nature to be curious about everything and anything, especially "Where did I come from?" and "What is the Meaning of Life?". Two, because the act of studying astronomy is leding to the development of faster, better technology. The development of this technology has greatly improved everyday life, even for non-astronomers. As an example: cameras and mammograms. Yes mammograms, but I'll explain that one in a bit.

"In the beginning" there were humans on Earth, put here by God (wait before you argue this), and the whole universe revolved around us. Then we had the Copernican Revolution. It didn't happen immediately, in fact it didn't happen until almost a century after Copernicus died. He discovered that we are not the centre of the universe. He was killed for it, but the true survived. His discovery was considered "taboo" because it removed Humans from their special place in the middle of the universe. It "humbled" humanity, we were no longer the be all and end all of existence. So fine, after several hundred years it settled in and after much debate was generally accepted by the scientific community and adopted into everyday lives. Then we had the "Darwinian Revolution", and although Darwin wasn't killed for discovering evolution, or "survival of the fittest", it definitely raised some controversy. Even now there are still millions of people that aren't convinced. What else can humanity lose?

As proposed by Dr. Williams, I accept that we are beginning a new Revolution, the "Genetic Revolution." A budding issue in our everyday lives (and one recently debated by the Kelly Road Debate Team) is the science and ethics of genetic engineering. Should genetically engineered/manufactured food be labeled in the grocery store? Do we have the right to know? And how ethical is it to grow a human ear out of rat’s back? Or to clone a sheep or pig? Where does it all stop and what will it all lead to? This new genetic revolution, like it's predecessors will strike up controversies as science advances and as people learn to accept that we have lost another aspect of humanity that we thought we understood. Because of science, we are faced again with redefining exactly what constitutes Life.

So this is where Astronomy comes in to improve our understanding of Life. Hopefully through Astronomy's far-reaching goal to understand "The Big Bang" and how one explosion and a large number of amazing coincidences have brought us to where we are today, we may explain why we are wearing what we wear and thinking what we think. That, and you can get some really pretty pictures! Since the beginning of time (whenever that may be) we as humans have been interested in the sky, the stars, the sun, the planets, the moon. We have groups of stars clustered together named after ancient Greek gods and creatures. There are hundreds of telescopes, home, amateur, and professional all over the world designed specifically to look at the sky. But with the questions come answers, which inevitably develop into more questions (you just never know what you don't know). And along came a project to build a telescope that would not be affected by the earth's atmosphere, but would orbit in space; because although the atmosphere does wonders for sustaining life, it really sucks to try to get pretty pictures of extra-terrestria objects since it scatters the incoming light. So after a whole lot of time and effort and preliminary research and funding and cutbacks and more time and effort, the United States, at bargain price of 4.5 Billion dollars, funded the Hubble Space Telescope, the single largest Astronomy project of all time.

The Hubble Space Telescope (HST) is a 2.4meter mirror encased in a 13m long structure that weighs 11metric tonnes, the most that a shuttle could carry to orbit. It was launched in April 1990 and orbits the Earth every 96minutes. Anybody can apply for time on the telescope; you don't need a Ph.D. or any other credentials, just a really good idea. The images taken by HST are turned into bits of electronically transmitted information that are sent to several Geo-Synchronous satellites and then are transferred down to Earth to be analyzed. Dr. Williams showed the very first image that Hubble had ever taken at this point in his lecture... a big red and yellow blob with smaller blobs around it. In other words, something was wrong. They discovered that the mirror suffered from spherical aberration - it was curved to fit a sphere, not a parabola! The focal point for the light hitting different areas of the mirror was not the same, but scattered. Although the images were still better than anything available fom earth, and the first servicing mission was not scheduled for three years (they didn't want to bring it down to fix it out of fear that they might not get the funding to send their big mistake back into space), the HST scientists learned to deal with the aberrations through mathematical algorithms and equations.

Now for the mammography. As a women ages, micro-calcifications develop in the breast tissue; this is a natural occurrence and is not a cause for concern. What the doctors look for in mammograms, (cont. on page 13)

Gravitational collapse

by Steve Senger

There are 4 known forces governing the universe. #1- the strong force (holds protons & neutrons together in the nucleus of the atom), #2- the weak force (involves radioactive decay), #3- the electromagnetic Force (a marriage of electricity & magnetism, and is responsible for Coulumbic forces, Radio waves, gamma rays, x-rays, or just burning a hole in wood using a magnify glass). & finally, #4 - The Gravitational Force.

Of the 4 forces, Gravity is the weakest. I mean it's wimpy! For example, # 3 - the electromagnetic force - is a million trillion trillion trillion times stronger. You could take a magnet and defeat the entire mass of the Earth's gravity times the mass of a nickel, and pull the nickel up to the magnet - and the Strong force is far greater than the electromagnetic force.

What if I told you that Gravity could be far stronger than the other 3 forces (sometimes)?

First of all, the first 2 forces act on very short distance. The electromagnetic force can be attractive or repulsive. Stars and planetary bodies usually will have an even number of positive and negative charges, so they cancel each other out and become close to neutral. Gravity on the other hand works on both short and long distances, and more **importantly**, Gravity is always **accumulative**. The more mass you add the stronger it gets.

So what if under a certain condition, you could compress a large amount of mass into a small space - i.e. super high density? In 1930 a fellow on a boat trip heading to England from India was thinking this thought. Subrahmanyan Chandrasekhar 2 years earlier had met Arnold Sommerfeld one of the worlds leading theoretical Physicists. Sommerfeld explained that old Physics was dead. Newtonian and Relativity couldn't explain what happens to the very small. The new Physics included **Quantum Mechanics** (the behavior of particles of matter).

Chandrasekhar for the next 2 years delved deeply into books and articles recommended by Sommerfeld, like R H Fowlers " On Dense Matter ". He also came across British astrophysicist Arthur S Eddington's book " The Internal Constitution of the Stars ". This dealt with the white Dwarf Stars, of which 3 where known. The most famous was Sirius B. It had been calculated to be 118,000-km circumference and 0.85 suns. This gave it a density of 61,000 grams/cm2 or 1 ton per cubic inch (water is 1g/cm2). Today we now know Sirius B has a mass of 1.05 suns, a circumference of 31,000 km, giving it a density of 4 million grams/cm2 or 60 tons per cubic inch.

In 1930 Chandrasekhar, now 19, had just completed his bachelor's degree. His mind was fertile, and he was about to set sail from Madras to Southampton on a 18 day journey. On the trip Chandrasekhar noted that Eddington's book could not explain how a Star could support it's self by standard **Thermal Pressure** i.e. the equation PV=T. As the Star collapse the atoms vibrate faster, causing the temperature to go up and preventing further collapse. But what happens as the heat radiates from the star causing it to cool down? It should continue to collapse. And if so to what? Fowler's book showed Chandrasekhar a condition called **electron degeneracy pressure**. This is a condition that only occurs at high density; it brings in a theory called the Paulii exclusion principle. This states that 2 electrons cannot have the same position and velocity. This causes the electron to move rapidly. The denser the matter is compressed, the smaller the cell the electron can vibrate in. The wave/ particle duality causes the electron to behave more like a wave. The wave from crest to crest must be smaller than the cell the electron is confined to. This erratic fast moving electron partly acts like a wave, and partly like a particle. It is a **degenerate electron**. It is important to note that this is a non-thermal pressure- no radiation is emitted during this process. In other words when a White Dwarf finally cools down and becomes a **cold dark star**, those erratically moving electrons will still support it without any heat production.

On his boat ride Chandrasekhar wanted to calculate what would happen if one were to add more mass to a White Dwarf. Chandrasekhar would choose a density, then add 1% more mass, and calculate how much the resistance pressure would have to go up to support the star's gravity. Then he would another 1% more mass, and so on. Chandrasekhar discovered that the electron's speed was starting to approach the speed of light as it struggled in a smaller and smaller confined cell. Fowler's book only dealt with Quantum Mechanics of dense matter. Chandrasekhar then applied the **relativistic effects** of such motion. Because Chandrasekhar applied **relativity** to his calculations, he saw there was an upper limit to how much mass one could add to a White Dwarf. Any matter added after this could cause the electrons own mass to approach infinity - according too Einstein's special theory of relativity.

The upper limit turned out to be 40% heavier than our sun. This is now known to be the **Chandrasekhar limit,** about 1.4 solar mass. Four years later, after Chandrasekhar had his Ph.D., he presented his results to the Royal Astronomical Society in London. One of Chandrasekhar mentors - the very well respected Stanley Eddington - gave a talk right after Chandrasekhar. Eddington, who had worked close with Chandrasekhar over the past few years, gave a speech about "relativistic degeneracy ". He put down Chandrasekhar theory. It would be 50 years before Chandrasekhar would be awarded the Nobel Prize.

So what happens to stars more massive than 1.4 solar masses? Will gravitational collapse cause these stars to shrink to an infinite density? Or is there another mechanism that would halt this collapse?

Well that's another story!

Steve Senger

UVIC STUDENT INVOLVEMENT AT THE JAC IN HAWAII

By Julie Roberts, UVIC Third Year

This article briefly describes the current research tasks of the other three UVIC students at the Joint Astronomy Centre. My own work has been described in previous articles.

Mauna Kea, on the Big Island of Hawaii, is home to several different telescopes. There is Subaru, the Keck Twin telescopes, InfraRed Telescope (IRTF - run by NASA), Canada-France-Hawaii (CFHT), Gemini North, University of Hawaii in Hilo 88inch (UH88), and United Kingdom Infra-Red (UKIRT) that line the top of the crater. Down in what is known as "Sub-millimeter Valley" are the Cal-tech Sub-millimeter Observatory (CSO), James Clerk Maxwell (JCMT), and Smithsonian. Here, in Hilo, Hawaii, is the headquarters for Gemini, Subaru, Caltech, UH, and JCMT and UKIRT, all in separate buildings (Except the last two) situated relatively high in Hilo, with a beautiful view of the ocean, and little risk of Tsunami damage. At the Joint Astronomy Center, which runs JCMT and UKIRT, there are four co-op students from the University of Victoria. Louis Desroches is working for Chris Davis, a UKIRT support scientist. Jeff Wagg is working for Tim Jeness, a software engineer. Jesse Eyer is working for Gerald Moriarty-Sceiven, aJCMT support scientist. I am working for John Davies, focusing on asteroids. I finally got around to asking each person what he or she actually does!

Chris Davis' research interests are mostly based around "Young Stellar Objects", and more specifically, their molecular outflows. The geometry of these young stellar objects were explained, in an oversimplified version, by Louis like so: There is a large cloud of dust and gas, which over time gathers into clumps, which in turn collapse into themselves to eventually form stars. As the cloud collapses, it begins to rotate faster and faster nearer to one of these clumps. Looking at one of these forming stars, we see that as it collapses into itself, due to it's own gravity, a spiral like disk is formed around the main clump as it spins. This is known as an accretion disk. As this continues, everything is essentially falling into the proto-star. Then due to the conservation of angular momentum, jets of matter shoot out the "top" and "bottom" of the star; these jets are perpendicular to the plane of the disk. This general geometry is common, and can also be witnessed in galactic nuclei, black holes and neutrn binary systems. By studying the outflows, astronomers attempt to understand the formation process of the star, and perhaps the planetary systems that can form around it. This will eventually lead to a further understanding of how our solar system formed. Most of the data has already been studied in great detail. The present mission is to look very closely at the source of the outflow, and to fully understand the science that is going on there.

Louis' job is the actual reduction of the data. He is looking at data that Chris has taken at UKIRT, with the CGS-4 (a spectroscopy instrument on the telescope) over the last two years. The pictures are taken through a thin slit that is lined up parallel with the apparent outflow direction, and centered on the proto-star. The clouds and outflows are observed through several different filters, the two major ones being H2 (molecular hydrogen) because there are large amounts of H2 emission, and a hydrogen transition filter called Brackett [gamma]. The H2 filter is 2.122 microns, and the gamma is 2.166 microns. If the outflow was not moving with respect to us in any direction, all H2 emissions would be on the slit at the given 2.122 micron wavelength. If it were moving, the Doppler shift in the emissions would be seen as a shift in wavelength. Louis looks at the spectra, calibrates it by correcting for the effect that Earth's intrinsic movement might have on the data (which could be an error often up to 2km/s) and defines a zero point. The zero point is where the wavelengths have not shifted, where the emission is not moving with respect to the Earth. The zero point is not necessarily in the center of the star, because the star itself might be moving, which would change the color of the incoming light (red or blue shifted). From the zero point, the velocity of the jets can be calibrated and put onto a "Velocity Map", showing which part of the object is moving away from us (positive velocity) and which part is moving towards us (negative velocity), which gives the general orientation of the star. This entire process is done using IRAF, a data reduction programme that is unnecessarily user-unfriendly, but seems to do an all right job, if it is working that day.

Jeff Wagg was originally brought to JAC to work on the JCMT pointing observations for Tim Jeness. Although Tim is an astronomer by trade, he is also a self-taught software man, and his skills in that department have been in high demand recently. For some background information: Quazars and Blazars are galactic nuclei far, far away; so far that they are considered essentially immobile with respect to the sky. A Blazar is an active galactic nucleus, whose emission varies in intensity. The theory surrounding Blazars is that at their centre's are super massive black holes, over 10^10 solar masses. This extreme amount of mass is an engine for activity, and is simultaneously collapsing further into itself. It emits jet streams from the center of the galaxy perpendicular to the plane of the disk, much the same geometry as described above, however on a much larger scale. It is postulated that our galaxy may be of this type. Another type is the Quasar, which is a non-active galactic nucleus, it does not have black hole.

The JCMT systematically goes through pointing exercises, where they align the telescope with certain planets like Uranus and Mars. These are used because the flux can be calculated using blackbody radiation laws. They have been doing this for years and there are lots of observations to compare. They calibrate these light sources to get the proper flux, which is in turn used to determine the variability of the Blazars. Jeff's original task was to develop some code to put together these light curves. He was sidetracked by the essentials of the calibration process.

In the sky, the intensity of light of an object as viewed from the ground is given by the formula I=I.e^(-Ta), where I. is the initial intensity seen in space, a is the air mass and T is the sky opacity. The opacity of the sky is the thickness of the water vapour present. There are two methods to measure T. The first is from the Caltech Sub-millimeter Observatory (CSO), which takes measurements every 15 minutes and stores it in a huge data base that dates back many years. Observers always have access to the CSO T measurements; anything above 0.15 means bad observing, so it is essential data. The second method for measuring the sky opacity is at the JCMT, using the Sub-millimeter Common User Bolometer Array (SCUBA). Sky dips are performed by the JCMT. The telescope is pointed to the zenith, directly overhead, as it is slowly lowered to the horizon, it takes constant measurements of the temperature of the sky at 450-micron and 850-micron wavelengths. The temperatures are then fitted to a model of the sy to determine the T at these wavelengths. The 450 and 850 values are different because the 450-micron filter is closer and more heavily affected by the water lines emitted from the atmosphere.

The 850, 450 and CSO T are all related. The JCMT data is usually used as confirmation of the CSO T values, and as a backup, in case something goes wrong in either place. It is beneficial to the observer to have all of the data to aid in calibration of source flux as well. Confirming the calibration code that already exits has become Jeff's new immediate job. He uses a combination of Perl 5, Fortran77 and Cshell computer languages for the coding and for calibration of the graphs and instruments.

Gerald Moriarty-Scheiven is a support scientist for the JCMT (he is also Canadian, and was previously an astronomy teacher at The Royal Military College (RMC), my previous College). Gerald's primary research interest is the star forming regions of molecular clouds. The project that Jesse Eyer is working on is to model anywhere from 12 to 20 different star forming regions to create an "encyclopedia of class 1 molecular clouds". It is essentially "knowledge for the sake of knowledge" to quote Jesse. The star forming region being studied is the 3rd star in the sword of Orion, the big fuzzy star, near the famous Hubble "Pillars of Creation" picture. The data was taken with the regular sub-millimeter camera on the JCMT in 1998. Jesse is using previously developed code, in conjunction with some of his own to reduce the data, model the rotational and infall velocities of the clouds to create a final map of the cloud.

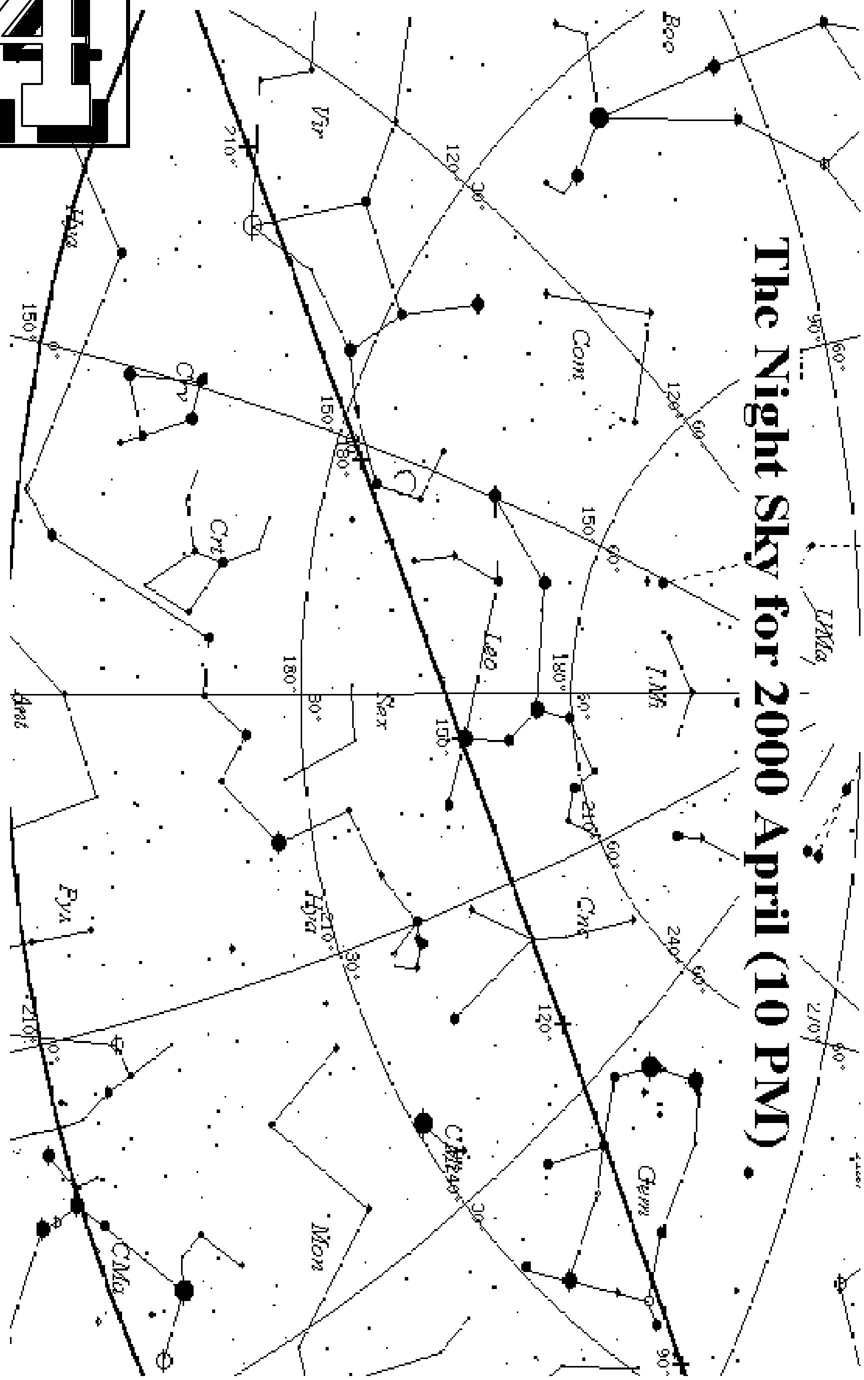
To create these maps, first a "raster map" of the spectra of the star must be created. This is done during observing time, when the telescope scans a certain part of the cloud to get a spectrum of the region. It is then recalibrated onto a known "empty piece of sky", and then returns to the next row of the cloud. The entire cloud is scanned and the spectra come out row by row in a 2-dimensional array. This raster map is then averaged to get a final spectroscopic map of the cloud. SPECEX, another data reduction package like GAIA or IRAF takes this data and models it into thermal pictures of the clouds. Contours from the velocity map are overlaid onto the thermal picture of the cloud in GAIA, so that he can determine which part of the cloud is blue or red shifted. From this and other information from other scientists such as the distance of the cloud, the inclination and estimates of the infall velocity of the area can be deduced, and added to the encyclopedia. Jesse is currently writing a Fortran progam to assist in the data reduction process, it will determine the velocity of the polar outflow from the cloud.

This is just a very small example of the large amount of work and different areas of research currently underway at the JAC, and on the Big Island in general. Astronomy research has put a lot of money into this island, I might even say it brings in more that tourism, but I am biased, and have no numbers on that. The effects of Astronomy here are seen everywhere. The street lights all over the entire island are the yellow sulphur lights and are also designed to keep most of the light "down" to reduce light pollution at the summit. The sulphur is used because its emission line is easily and readily identifiable in spectroscopic data, and therefore easily removed. There are budding controversies about the telescopes as well. The native Hawaiian's are having issues with these large man-made structures sitting plainly visible on the top of "their mountain". The mountain has a very special place in their culture, and to them it is like watching the symbol of their religion being scarred and defaced with thetelescopes. Unfortunately for them, the money involved in the research is so great that it is outweighing their opinion. There is a strong resemblance to native land claims in BC... Originally the agreement for allowing the telescopes on the mountain included benefits for the Natives, such as providing an information booth, rangers, public outreach and education. Well, they built the telescopes and forgot about the rest. So now that the lease is up, the Hawaiians are demanding more, and are threatening with roadblocks and other forceful means. Hopefully they are being heard; more money is planning on being invested up here as we speak (read). As an example, NASA is currently proposing a 27meter optical telescope to sit down in Sub-millimeter Valley, a multi-million dollar event. All knowledge for the sake of knowledge.

J.R.

(cont from page 7)

which is essentially a soft-tissue x-ray of the breast, is where these micro-calcifications occur, their size, distribution and their tendency to cluster together. It's certain combinations of these characteristics that are cause for concern. Well, a woman's breast is essentially a sphere, and the general process of a mammogram is to squish it flat, hence the name "tit squeeze" that my granny uses. This is done in order to see the breast tissue at a uniform thickness, instead of looking through different depths in different areas, to give a (hopefully) more accurate reading of the tissue's activity. Several years ago, Dr. Williams was giving a talk about how the scientists and mathematicians were developing theses ways to "fix" the spherical aberration of the images from HST and (lo and behold) in the crowd wasa doctor. He became interested in this process, and after some collaboration and research, there has been a major breakthrough in mammogram technology. They discovered that it was essentially the same technique to identify the micro-calcifications in a breast x-ray as it was to find stars in an image array from the HST. This has reduced the false negative and positive diagnoses of possible breast cancer by an astonishing 75% (but don't quote me on that). Clinics and doctors are buying these machines that negate the need to flatten the breast. Now, it will probably be some time before these 50 - 100 thousand dollar



Sky Map courtesy Dr Bob Nelson

(cont. from page 13)

So why study astronomy? A long time ago (50 years or so), Béchamel discovered the radioactive properties of Uranium by accident. He was going to put the uranium out into the sunlight on a photographic plate to see what might happen - but it rained. So he covered his experiment with tissue paper and tucked it away in a desk drawer. Three days later, when the rain finally stopped, he removed his experiment and found that some sort of residue was left on the photographic plate, further research yielded the discovery of radium. Now, many discoveries have been by chance, and some have been specifically sought out, but either way, it was the curiosity of the scientist that lead to major discoveries which have helped create a better understanding of our world, and helped out others both directly and indirectly. Perhaps I'll stumble across some way to improve people's lives. It's the least and most I can work and hope for.

J.R.

PGAS CONTRIBUTORS

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