The PRETORIA CENTRE

of the

Astronomical Society of Southern Africa

www.pretoria-astronomy.co.za

NEWSLETTER AUGUST 2007

The next meeting of the Pretoria Centre will take place at Christian Brothers College, Pretoria Road, Silverton, Pretoria

Date and time	Wednesday August 22 at 19h15
Chairperson	Michael Poll
Beginner's Corner	Percy Jacobs
What's Up	Fred Oosthuizen

++++++++++ LEG BREAK - Library open +++++++++++++

MAIN TALK

The Square Kilometer Array

by

Adrian Tiplady

The meeting will be followed by tea/coffee and biscuits as usual.

The next social/practical evening will be held on Friday 17 August at the Pretoria Centre Observatory, which is also situated at CBC. Arrive anytime from 18h30 onwards.

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Report of Last Month's Meeting – Michael Poll

The meeting opened with the Annual General Meeting, the minutes of which will be published elsewhere. Johan Smit is to be congratulated on receiving the Jack Bennett Award.

Hein Stoltz presented "What's Up?" After mentioning that this month was the 38th anniversary of the first moon landing, Hein showed some websites where the phases of the moon and whole sky maps could be found. The globular clusters in Sagittarius, Ophiucus and Scorpius were noted, about half of the approximately 150 globular clusters known in the Milky Way reside within these three constellations. In the northern sky the double star Albireo and the Coathanger asterism can be seen. The constellations of Scorpius and Sagittarius were highlighted. An animation of the changing orientation of Saturm's rings was shown. Neptune and Uranus are available in the evening sky in August, and the asteroid Vesta passes close to Jupiter and will be very close to the star Psi Ophiuci on August 18th. Mercury and Mars are in the morning sky, Mars being in Taurus near the Pleiades. Some deep sky objects visible at present are M27 (The Dumbbell) M57 (the Ring Nebula) and M104, the Sombrero.

The main topic was a highly entertaining and instructive presentation by Fabio Frescura entitled "Watts in a Star". Fabio introduced his talk by refreshing our memories about the Hertsprung - Russell diagram, which plots a star's brightness against its colour (where colour effectively represents surface temperature). As a star evolves it changes its position on the HR diagram ("it moves about"), so that the HR diagram plots the life history of star. Some stars may go through a stage where they become unstable and start oscillating, and therefore vary in brightness. Stars that vary in brightness are classified by the name of the prototype, for example RR Lyrae, W Virginis and Delta Cephei types.

The oscillations are much like standing sound waves in an organ pipe, which is closed at one end and open at the other. The waves at the open end can oscillate, but is no oscillation at the closed end. The parts of a star can be visualised as a number of conical organ pipes, the surface of the star being the equivalent of the open end and the centre, where all the cones meet, as the closed end. At the surface of the star there is no impediment to motion, so that is where the displacement is greatest. Movements die out towards the centre of the star, and right at the centre of the star there is no oscillation.

The pulses of a star represent kinetic energy. The core supplies heat, but not kinetic energy, so the source of pulsation must lie elsewhere, and something is converting the heat into kinetic energy.

The star is composed of particles so it is a thermodynamic system (TDS). The TDS can be seen as a heat engine and each different layer of the star can act as a heat engine – heat in and work out. If a high temperature reservoir acts on a working substance, which can be any physical substance, work results (if the opposite happens there is a refrigeration effect). If the system accepts heat energy as work there is a configuration change in the working substance. When a star acts as a "heat engine" it pulsates, when it acts as a "refrigerator" pulsations are killed. Which mechanism is operating depends on what is happening in the star.

Fabio then outlined how heat engines work and gave us some history. The first was made by Heros of Alexandria in 75AD. The other examples given were made by della Porta in 1601, Brana in 1629, and Thomas Savory in 1698. Savory's engine was the first one put to any useful use – it was used to pump water out the Cornish tin mines. In 1712 Newcomen improved Savory's design. In 1764 James Watt applied some science and devised a means of monitoring what was going on in the steam chamber.

Stellar engines work like heat engines or refrigerators. The question is what the working substance is and where is it in the star. Stanley Eddington considered the energy component – compression at the centre of the star causes the temperature to rise and the rate of reaction rises. The core expands and the rate falls, and the core contracts. However the fractional displacement (the distance moved by a particular particle) is very small in the nuclear region and the atmosphere will damp it. These small displacements do not explain the degree of pulsation in stars like

Mira, where the distance moved at the surface when the star pulsates is greater than the diameter of the sun.

Eddington then considered a valve mechanism – suppose a layer of the star becomes ***more opaque*** (less transparent) to heat on compression and ***less opaque*** (more transparent) on expansion, then on compression the heat energy cannot escape and dams up. The problem with this is that the opacity of a gas ***decreases*** on compression i.e when a gas is compressed the temperature and density rise, and the gas becomes ***more*** transparent, ***unless*** there is a change of phase, in which case it would become ***less*** transparent. When there is a change of phase, the temperature remains constant but the pressure increases. (Think boiling water, which remains at 100deg C - but there is a phase change is from liquid to gas). In the case of the star the phase change is the ***ionisation*** of the gas (i.e the molecules of the gas lose electrons). In most stars there are two ionisation zones – one at a temperature of 1000ºK where Hydrogen I changes to Hydrogen II, and Helium I changes to Helium II (i.e each gas loses one electron), and another at 4000º K where Helium II loses another electron and changes to Helium III - this is called the Helium Partial Ionisation Zone - hydrogen is not involved in this zone because it has no more electrons to lose.

On compression the temperature and density both rise, but opacity is more sensitive to temperature than to the density. Pulsations depend on the position of the partial ionisation zone. The cooler the star is at the surface, the deeper is the partial ionisation zone. With hot stars (7500ºK) the zone is near the surface, where the density is too low. With stars at 6500ºK the zone is deeper, and can excite the first overtone. With stars at 5500ºK stars it is deeper still and excites the first fundamental node. With stars at 3500ºK at the surface, the zone is too deep and therefore it is too dense to drive the oscillations, but this changes when the helium begins to burn, so these cool stars then begin to pulsate.

With Long Period Variable stars, the source of the opacity is not known, the nature of the working substance and how deep the partial ionisation zone is not known. Fabio indicated that this is a fruitful area for research.

A brown dwarf joins the jet set

Astronomers using ESO's Very Large Telescope (VLT) have found the smallest galactic object with jets. Jets of matter have been discovered around a very low mass 'failed star', mimicking a process seen in young stars. The star is a brown dwarf with the name 2MASS1207-3932. This suggests that these brown dwarfs form in a similar manner to normal stars but also that outflows are driven out by objects as massive as hundreds of millions of solar masses down to Jupiter-sized objects. The image is an artist's impression of jets from a brown dwarf.

See website **http://www.eso.org/public/outreach/press-rel/pr-2007/pr-24-07.html**

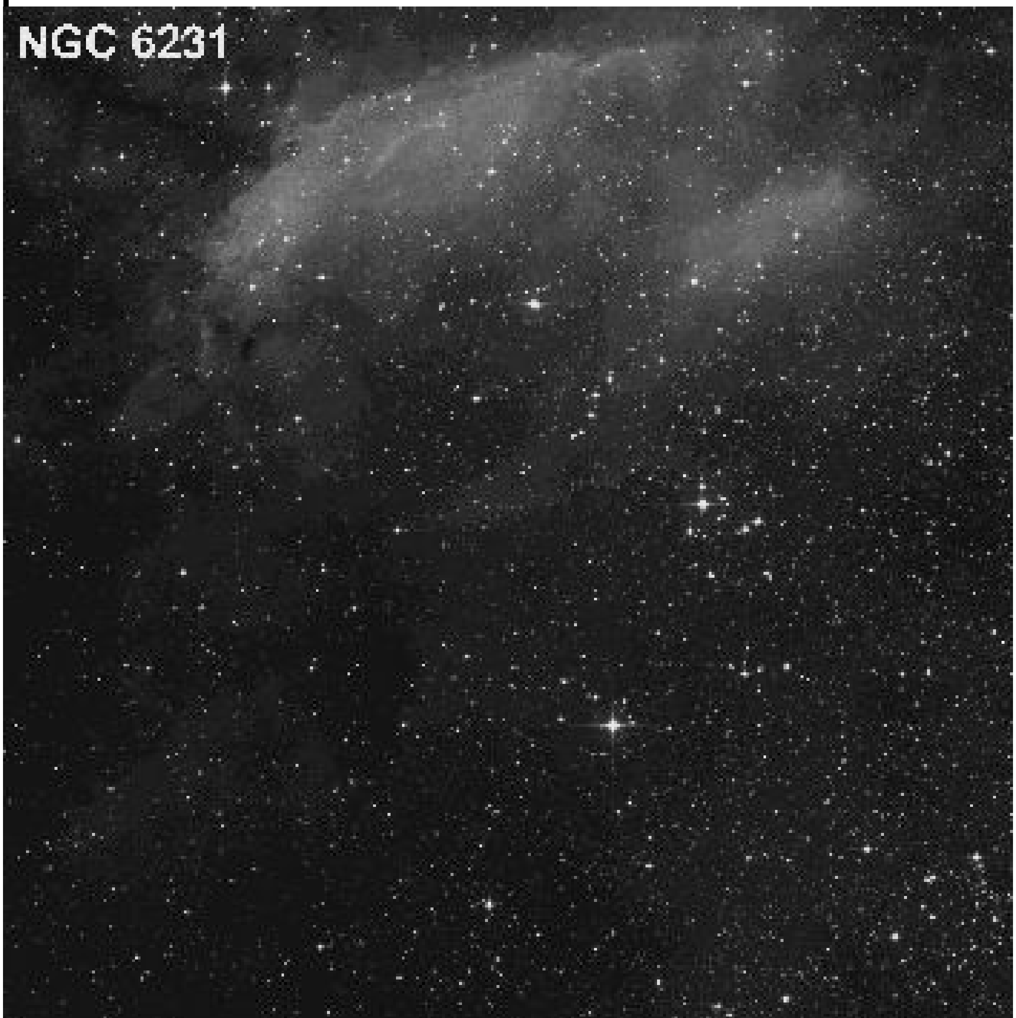
Last month's observing evening — Michael Poll and Johan Smit

Another clear evening and good attendance, both of people and telescopes. A number of enthusiastic visitors were present, including Eban and his two children.

Early in the evening we looked at Saturn and Venus, Saturn very near the horizon, and Venus showing a slender crescent. Both of these objects have been in the evening sky for some months now, but they will not be there for our next observing evening – they will have moved into the morning sky. A half moon in Virgo, near Corvus, attracted attention. The moon will be in the sky for our next few observing evenings, so we will have to get our lunar atlases out!

Jupiter was next, high in the east. The cloud belts were easily seen and the Galilean satellites were two on each side of the planet. There were also some stars in the field.

The double stars Alpha Centauri and Alpha Crucis were inspected, and also some wide doubles that do not get looked at so often, but are easily split with binoculars :- Alpha Librae which is a very wide pair, and Alpha and Beta Capricorni. Alpha Capricorni is a wider pair than Beta, and, whereas the components of Alpha are almost equal in brightness (magnitudes 3.6 and 4.2), the components of Beta are of unequal brightness (magnitudes 3.1 and 6.1) *(See "Sky & Telescope" for October 2006 page 52).* Clusters and nebulae seen included M7 and M6 in Scorpius, the globular cluster Omega Centauri, and M17, also known as the Omega Nebula or Swan Nebula. The appearance of the M17 was nicely enhanced with Percy's nebular filter (OIII), which increased the contrast between the object and the background sky. A "new" globular observed was M55 in Sagittarius (the stars Sigma and Tau Sagittarii point straight to it). This proved to be a fascinating object, quite large in angular diameter (2/3 the apparent diameter of the full moon) and which showed a background haze of stars with a sprinkling of bright ones. *(For more information about M55, see "Sky & Telescope" for September 2006, page 45)*



Further binocular viewing included very nice views of open clusters, particularly NGC 6231 and its associated cloud of gas. *(See picture)* It could be said that NGC 6231 looks prettier in binoculars than in a telescope, because it overflows the field of view in the telescope. The Coathanger Cluster (Collinder 399) in Vulpecula was also observed. The views of these objects in binoculars show that you do not need a telescope to enjoy stunning views of the night sky.

Ontmoet die 10 mees besondere sterre van 2007

In Hollywood word sterre gemeet volgens hulle sukses by die loket, die rolle wat hulle aangebied word en deur die miljoene stemme op programme soos Idols. In sterrekunde is dinge ietwat anders. Sommige sterre trek die aandag omdat hulle die beste kandidate vir planete met lewe is. Ander weer mag ons help om die oorsprong van ons eie sonnestelsel beter te verstaan en dan is daar die sterre wat so eienaardig is dat ons hulle moet raaksien. Kenners gee hulle lys van die top 10 en die redes vir hulle keuse. Die sterre is: **Gliese 581, Upsilon Andromedae, Pollux, HAT-P-1, 51 Pegasi, HD 209458 + HD 189737, Epsilon Indi A, 55 Cancri, HD 69830 en 40 Eridani A.**

Besoek webwerf **http://planetquest.jpl.nasa.gov/intriguing_launch_page.cfm**

Messenger

Die ruimtetuig **Messenger** is op 3 Augustus 2004 gelanseer. Dit het nou al een verbyvlug van die Aarde en twee van Venus gedoen. Na nog drie verbyvlugte van Mercurius, sal dit uiteindelik op 18 Maart 2011 in ’n wentelbaan om Mercurius gaan. Dit sal die eerste ruimtetuig wees wat om Mercurius wentel. Hierdie indrukwekkende reis sal die eerste nuwe data oor Mercurius in meer as 30 jaar inwin.

Sien webwerf **http://messenger.jhuapl.edu/the_mission/index.html**

Die laaste ruimtetuig wat die planeet besoek het was Mariner 10. Hierdie tuig het in 1974 twee en in 1975 nog een verbyvlug van Mercurius gedoen.

Sien webwerf **http://nssdc.gsfc.nasa.gov/database/MasterCatalog?sc=1973-085A**

Many more exoplanets discovered

The world's largest and most prolific team of planet hunters have announced the discovery of 28 new planets outside our solar system, increasing to 236 the total number of known exoplanets.

The planets are among 37 new objects - each orbiting a star, but smaller than a star -discovered by the teams within the past year. Seven of the 37 are confirmed brown dwarfs, which are failed stars that nevertheless are much more massive than the largest, Jupiter-sized planets. Two others are borderline and could be either large, gas giant planets or small brown dwarfs.

An astronomer said the research teams have become much more sophisticated in their analyses of the stellar wobbles caused by orbiting planets, enabling them to detect the weaker wobbles caused by smaller planets as well as planets farther from their parent stars.

Website: **http://www.berkeley.edu/news/media/releases/2007/05/29_exoplanets.shtml**

Low- mass exoplanet

A 7.5 Earth-mass planet orbits the star Gliese 876. It has the lowest exoplanet mass known. See website **http://exoplanets.org/**

Bright Southern Binaries

A detailed and useful list of data for bright southern binary stars, compiled by Andrew James, is available. It reaches from the Southern Celestial Pole to about -30 deg declination. Ideal for either calibration of equipment or for testing small optical telescopes for resolution. You can download it from website

http://assa.saao.ac.za/sections/doublestars/binaries-james.pdf

Globular Clusters As An Indicator Of How Galaxies Form — Michael Poll

We all like to look at globular clusters, being impressed with their spectacular appearance and impressive statistics of size, distance and age. Apart from their beauty, they may hold some clues as to how galaxies formed.

The Milky Way has about 150 known globulars, the Andromeda Galaxy (M31) about 500, and bright elliptical galaxies may have thousands of them.

Globular clusters are very old – they are amongst the oldest known objects in the universe. They are known to be old because there are no hot massive stars remaining – massive stars have short life spans and would have long since passed on. The stars in a globular cluster are old stars – comprising cool evolved giants and low mass long-lived dwarf stars. Also their member stars do not contain many chemical elements other than hydrogen and helium. In astronomy elements other than hydrogen and helium are called metals, and metals grow more abundant in the universe as they are manufactured by succeeding generations of stars - the stars in the globulars formed when there were effectively no "metals" , although there is a population of globular clusters that do have a slight enhancement of metal content. Therefore the globular clusters, including those around the Milky Way, although uniformly old, fall into two groups (a bimodal distribution) with respect to metal content. (Figure 1). The difference in metallicity causes a difference in colour - the metal poor ones are bluer than the metal rich ones, which are redder. This colour difference occurs because metals absorb the radiation coming from within the star, and thus make a metal rich star look cooler than a metal poor star of the same age and mass.

Theories of galaxy formation have to explain how primordial gases and dark matter consolidated into galaxies, and they have to account for the properties of globular clusters, including the bimodal colour distribution.

The *In situ* model of galaxy formation

This is the simplest theory, and it proposes that gravity drew matter together to form galaxies in relative isolation from each other. The "seeds" were density enhancements in the pervading dark matter. The size of the galaxy produced would depend on the size of the "seed" of dark matter. A new galaxy would be a clump of gas surrounded by a collection of blue, metal poor globulars.

However, as there is a bimodal population of globulars, there must be more to this scenario. It is hypothesised that there has to be a lull in star formation during which time first generation stars die and slightly enrich the surrounding gas with heavier elements. Further collapse of the galaxy would cause star formation to resume, creating the majority of the galaxy's other stars, and creating the globulars with stars that are slightly metal enriched, and therefore redder.

The *in situ* theory predicts that most of the galaxy's original stars and the red globulars formed at the same time. The original stars would then evolve and further enrich the galaxy with more metals which would be incorporated into later generations of stars. No further formation of globulars would occur.

Neverthess it is suggested that the *in situ* model cannot have been the only process leading to galaxy formation, because deep field photographs show frequent interactions between galaxies indicating that they rarely formed in isolation.

The hierarchical clustering and merging model (HCM)

The interaction of early galaxies has to be incorporated into galaxy formation theories. In the HCM model galaxies developed slowly by the assembly of scores of dwarf galaxies. The dwarf galaxies would form in the same way as galaxies in the *in situ* model, but in the early crowded universe there would have been frequent collisions and interactions, and eventually mergers, between the dwarf galaxies, forming giant spiral and elliptical galaxies. Globular clusters are massive, but compact, and so would survive the destruction of their parent galaxy in a merger, and the galaxy that results from a merger would inherit the globular clusters from the parent galaxies. These globulars would reflect the age and composition of the parents, so there would be multiple globular cluster populations within a single galaxy.

Support for the HCM theory comes from the fact that some globular clusters are the cores of dwarf galaxies that have been tidally stripped of their stars – Omega Centauri is one such example - there are multiple stellar populations within Omega which indicate that it was once a separate system which lost most of its stars when captured by the Milky Way. One globular cluster belonging to the Andromeda galaxy has a massive black hole at its core, also suggesting that it is the stripped nucleus of a dwarf galaxy. The elliptical galaxy NGC 5128 in Centaurus (the Hamburger galaxy) is surrounded by hundreds of globular clusters. This galaxy, with the dark dust lane, appears like it does because it has undergone a merger with a spiral, (the spiral provided the dust) and many of the globulars around NGC 5128 were probably captured from this spiral. Nearer to home it is known that the Milky Way can collect globulars – for example, observations made in 1994 showed that a dwarf galaxy, the Sagittarius Dwarf Galaxy, is currently merging with the Milky Way, bringing with it a few globular clusters which include Messier 54, and more will be collected when the Milky Way merges with the Andromeda galaxy (an event which could possibly occur before the demise of the sun).

It is thought that the HCM model is the best explanation of galaxy formation but there are problems. One question is whether this method of assembling galaxies could work fast enough, given that the early universe already contained massive galaxies. Also there should be more isolated dwarf galaxies that did not make a merger – within the Local Group of galaxies there are only one tenth as many loose dwarf galaxies as theory predicts. Another problem is that some large galaxies have such large numbers of globular clusters, that an unrealistically high number of mergers would be required.

Hybrid theories

Given the anomalies in both of these theories, it is now generally believed that galaxies are formed by some combination of these two processes, but the balance between the two theories has yet to be determined.

Some of the questions about HCM may be answered if mergers between two full size gas rich spirals are considered. An elliptical galaxy results from such a merger, and, as well as inheriting a collection of blue (metal poor) globulars, a new population of red (metal rich) globulars would be formed from the dynamic interaction of gas from each spiral. This process is seen to be underway in the Antennae nebulae (NGC 4038 and 4039):- Hubble images have shown objects that appear to be new globular clusters, having the size, mass and luminosity of typical globulars, but which would be only about a few hundred million years old.

A problem with this theory is that, because the merger of two spirals results in the formation of an elliptical galaxy, it does not account for the bimodal distribution of globulars around spirals, and yet most nearby galaxies are spirals.

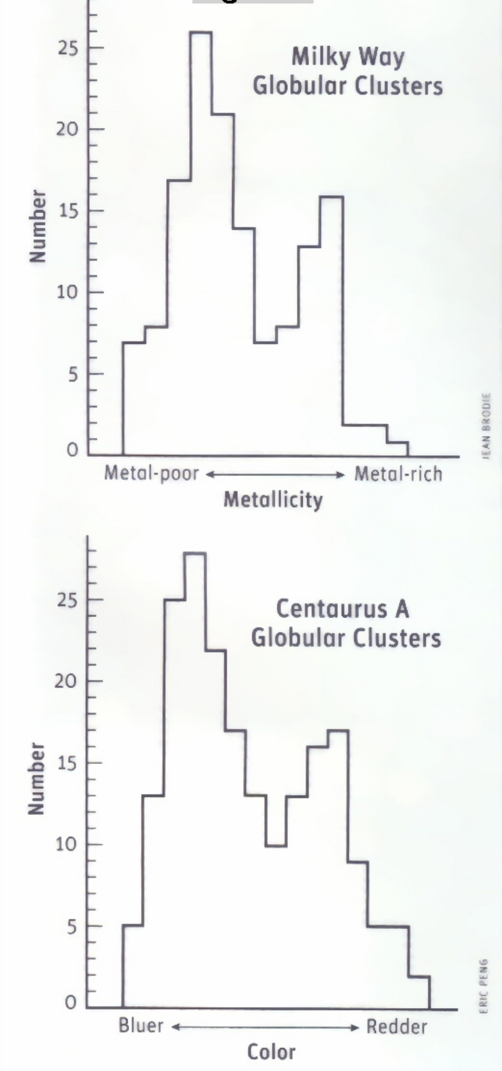
Another problem is that giant ellipticals posses proportionally many more blue (metal poor) globulars than do typical spirals. Considering that a merger would cause an increase in the number of red (metal rich) globulars, (they are formed during the merger) where do the extra blue ones come from? One suggestion is that they came from previously accreted dwarf galaxies.

There is also difficulty with the implication that blue globulars are older than the red ones, yet observations show that both sorts are equally old. The suggested solution to this is that the mergers must have occurred early in the universe, making the age differences too small to measure.

References:

Christine Pullam Deciphering the Globular Cluster Code Sky & Telescope March 2006 p 30

Figure 1



Milky Way Globular Clusters
Number
25
20
15
10
5
0
Metal-poor
Metal-rich
Metallicity
JEAN BRODIE
Centaurus A Globular Clusters
Number
25
20
15
10
5
0
Bluer
Redder
Color
ERIC PENG

Omega Centauri in the Milky Way Galaxy

G1 in the Andromeda Galaxy

Centaurus A Galaxy

Saturn: 60 moons (and counting)

Saturn's brood just keeps on growing, with moon No. 60 officially joining the eclectic collection. Scientists using the Cassini spacecraft first spotted the new moon in pictures taken May 30, 2007. They then backtracked and looked at archived images for more clues. It turns out the moon had been photographed several times between June 2004, when Cassini first arrived at Saturn, and June 2007, when the probe marked its third year as the planet's first and so far only artificial satellite.

The new moon, officially designated as S/2007 S 4, but which has been unofficially nicknamed "Frank," orbits Saturn between the paths of Methone and Pallene, two small sister moons also discovered in Cassini images in 2004. All three moons orbit between the larger satellites Mimas and Enceladus.

Like so many of Saturn's moons, Frank, which is about 1.6 km wide, is believed to be mostly ice and rock. It circles its mother world at a distance of about 196 480 km.

Scientists think Frank and its small sister moons may be the remains of a larger body or a collection of bodies.

"This trio of objects could be remnants of a collision or perhaps they are the lucky survivors of a larger population of material that failed to form a moon," said Cassini imaging team scientist Carl Murray, a professor at Queen Mary University of London. “Either way there does seem to be a family connection," he said.

Cassini, which is now credited with discovering five new Saturn moons, may have more answers in a few years. The probe is scheduled to fly relatively close to Frank in December 2009.

Since Cassini's launch in 1997, the number of known moons orbiting Saturn has more than tripled. In addition to Cassini images, ground-based telescopes have booted the number of Saturn satellites from 18 to 60.

"Every discovery adds another piece to the puzzle and becomes another new world to explore," Murray said.

Johan Smit se verkykermontering

Johan Smit (met die sonbril op), een van ons komiteelede wat nou die Jack Bennett-toekenning gekry het, staan by sy unieke verkykermontering by die **ScopeX 2007** byeenkoms in April vanjaar. In die nuusbrief vir Junie vanjaar is berig oor wat Richard Berry, ‘n beoordelaar, daaroor gesê het.

Besoek aan Bronberg sterrewag – Pierre Lourens

'n Besoek aan hierdie privaat sterrewag en sterre-kyk aand daar is gereël vir Vrydagaand 14 September 2007.

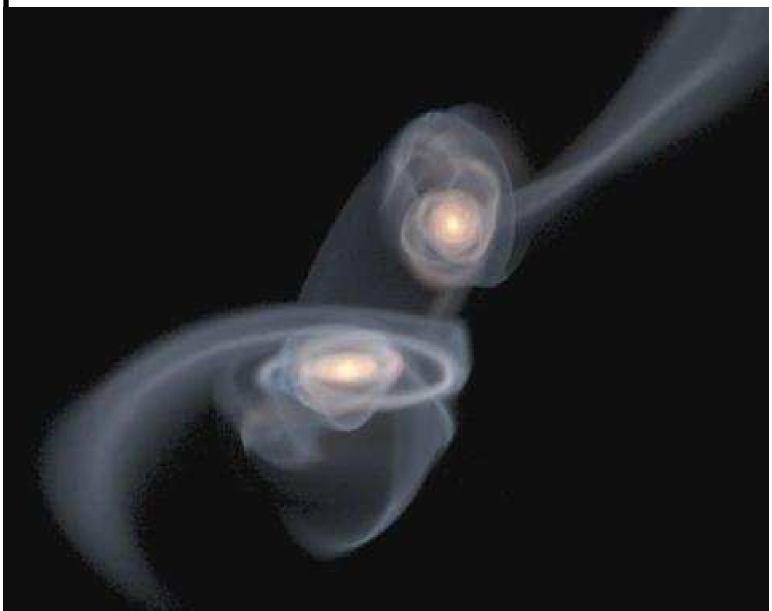
Die sterrewag word bedryf deur Berto Monard. Hy is 'n meganiese ingenieur by die WNNR. Hy beskryf sy pos daar as volg: "Senior R&D Metrologist Optical Radiometry and Radiation Thermometry NMISA". Hy neem in sy vrye tyd aktief deel aan sterrekundige navorsing. (Hy het o.a. al 54 supernovas ontdek.) Sien MNASSA vol 65 nos 3 & 4 April 2006 p 40 vir besonderhede oor sy aktiwiteite by die sterrewag. 'n Kopie word ingesluit.

Hy het twee geboue van klip op sy erf opgerig, albei met plat afskuifdakke. In een is daar 'n 12" teleskoop en in die ander een 'n 14" teleskoop. Beide is toegerus met CCD kameras en is geoutomatiseerd. Sy erf is deel van 'n natuurbewaringsgebied sowat 800 hektaar groot, genaamd die "Bronberg Bewarea", waarin daar baie wildsbokke is. Hy is een van 27 eienaars van die natuurbewaringsgebied. Daar is parkeerplek op sy erf en plek om ons eie teleskope op te sit. Die naghemel is donkerder daar as in Pretoria.

Bring teleskope saam, want ons kan nie deur sy teleskope kyk nie. Ons kan alreeds om 17h00 daar aankom om wild te kyk voor sononder. Bring stapskoene en verkyker saam. Die son gaan om 18h00 onder en die sekelmaan om 20h40. Bring eie aandete en verversings. Persone wat kom, moet asb. probeer om voertuie vol passasiers te maak om die aantal voertuie te verminder. As daar te veel voertuie is, sal sommige buite die hek moet parkeer, waar dit klipperig is.

Hy het versoek dat die ingeslote roetekaart na sy sterrewag nie aan nie-lede verskaf moet word nie. Die uitdraai vanaf Garsfonteinweg is feitlik reg oorkant die kennisgewingbord waarop "Spenmist Engineering" geskryf staan. Die laaste 1.4 km grondpad voor die uitdraai na sy erf is sleg, maar ek het dit met 'n VW Golf gery.

Future galactic collision



The harsh reality of the distant universe with all of its violent interactions seems remote from our human existence and all might seem to be quiet and normal in our home the Milky Way. But it seems likely that in a mere 3 billion years, our neighbouring galaxy Andromeda and the Milky Way will fall together and have a close collision. They will likely merge and be reborn as a single giant elliptical galaxy over the course of another billion years or so. How might this metamorphosis play out and what might you see if you looked up at night over the next 4 billion years? The space between stars is so vast compared to their size that during a galaxy collision no individual stars actually collide with one another. So our sun and its family of planets will be taking a passive but exciting ride through the pair of coalescing galaxies and take on a spectacular view of the unfolding disaster in relative safety.

One image from the simulation is shown here. More information and an animation of this simulation can be found on website

http://cc.msnscache.com/cache.aspx?q=8298231105958&lang=en-US&mkt=en-US&FORM=CVRE3

Planeet Aarde vanuit die ruimte gesien

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