The PRETORIA CENTRE

of the

Astronomical Society of Southern Africa

www.pretoria-astronomy.co.za

MAY 2004 NEWSLETTER

A STORM ON SATURN'S EQUATOR

A conservative estimate of the north-south diameter of the storm can be made as follows. From the picture, using a ruler, it can be determined that the N-S diameter of the storm is about 1/10 of the polar diameter of Saturn. Then $((1/10)\ d_{Saturn}) / d_{Earth}$ = (1/10)107700 / 12700 = 0.85. This means that the N-S diameter of the storm is about 0.85 times the diameter of the Earth!

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

on Wednesday 26 May at 19h15

The June 8 2004 Transit of Venus

Welcome : by Chairperson Lorna Higgs

Session 1 : The Mechanics of Venus Transits by Neville Young

BREAK (Library open)

Session 2 : The History of Venus Transits by Michael Poll

Session 3 : Viewing the Venus Transit by Tim Cooper

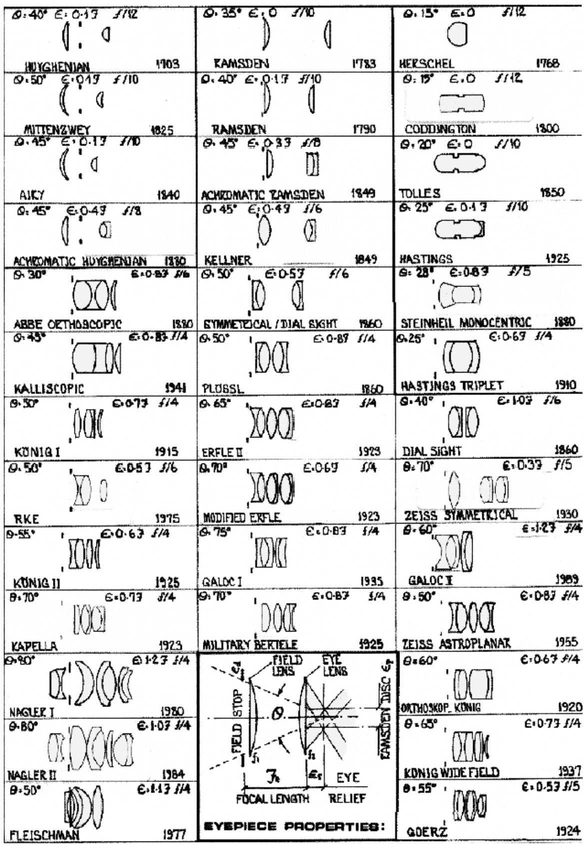
The meeting will be followed by tea/coffee and biscuits as usual.

The next social/practical evening will be held on Friday 21 May at the Pretoria Centre Observatory, also situated at CBC. Arrive anytime from 18h30 onwards.

THE APRIL MEETING

Report back by Neville Young

This meeting was characterised by 3 excellent presentations and by a sad goodbye to Theo Pistorius leaving for Australia after 10 years as a fellow member of the Pretoria Centre. We were, however, delighted to see Siegie Liebner making a grand entrance, returning after being laid low by a stroke earlier this year. Siegie – we wish you a speedy and complete recovery and look forward to seeing you at many more astro meetings and functions.



Ad Sparrius started the evening with a Beginners Corner that made us all experts on the Oort and Kuiper belts. Tim Cooper then told us what to look for in May, with particular attention to the May 4 Lunar Eclipse. This inspired members to embark on an observing program at Fort Schanskop where much was learned about Danjon estimates and brightness measurements.

After the break, Chris Stewart launched into a comprehensive discussion of eyepieces, giving his opinions of specific eyepieces and also explaining how the eye works in seeing faint objects. There are many more eyepieces than most of us are aware of – see the accompanying chart. The talk certainly inspired me to experiment with a number of lenses extracted over the years from old cameras and to be pleasantly surprised by the quality of some innocuous pieces of glass.

OBSERVING EVENINGS IN APRIL 2004

contributed by Michael Poll & Johan Smit

April was quite busy with two special observing evenings arranged at short notice to observe 2 double shadow transits of Jupiter's moons Io and Europa. The first one on Friday 9th of April was well attended by 25 people. The shadows overlapped for a nice long time and gave everyone time to look as long as they wished. The seeing was quite good and both the shadows were seen by most of the people present.

Some members were chatting so much that they actually missed seeing both shadows on the planet. The pleasant social interaction made up for this disappointment. As a bonus the "big red spot" also became visible during the evening. On the centre website are some photos taken during this event.

The second event was arranged for the next Friday the 16th. The seeing on that night was disappointing due to a very unstable atmosphere. Only 3 people attended. The shadows were seen with some difficulty. Due to the short overlap between the shadows, it was not as spectacular as the previous Friday.

After a week of clear skies we had some irritating high cloud, which made for a hazy sky on the normal observing evening of April 23rd.

Early in the evening, Venus and the Moon hung close together in the north west, with Mars also nearby. Venus had been 1½ ° north of the moon during the day and had been seen by some members in daylight. The objects in the northwest, including Saturn, were soon lost in the haze, but Jupiter was well placed and later the start of a transit of Io was seen in Manuel's 10 inch telescope.

It was an evening for open clusters: In Carina we looked at Theta (I 2602) also known as the Southern Pleiades; Eta Carinae, the star and the associated cluster and nebulosity, with NGC 3324 nearby; NGC 3114, which is near the variable star S Carinae; NGC 3532, one of the best; and NGC 2516 near epsilon in the False Cross. Elsewhere we looked at the Jewel Box (NGC 4755) in Crux; and M47 in Puppis. M46, which is next to M47 was washed out by the haze.

After the previous two sessions, the Centre telescope operator had seen enough of Jupiter and it was avoided! Views of the thin crescent moon were first up, just before the moon settled behind the trees. After that it was Saturn's turn--spectacular as usual despite the hazy atmosphere. We then we turned the telescope to the other favourites—the Orion Nebula, and Omega Centauri amongst others. The star clusters were very good with many of the, by now well-known, comment "WOW" coming from the observers.

In spite of the doubtful conditions, it was again a very successful evening attended by quite a few new prospective members. Nearly a dozen people were still present after 10.30 pm, by which time the sky had cleared up a little.

WATER IN SPACE AND WATER ON EARTH

contributed by Michael Poll

Water in Space

The interstellar clouds from which stars and planets form are being probed to see if they contain life's essential ingredients. So far more than 120 molecules have been detected, but one molecule of great interest is the water molecule. Two satellites - the Infrared Space Observatory (ISO) and the Submillimetre Wave Astronomy Satellite (SWAS) - were launched in the 1990s to look for, amongst others, molecules of water. ISO looked for water in the relatively "warm" 100° - 200° Kelvin (K)* range, whereas SWAS looked in the 10° – 20°K range, which is only just above absolute zero. Water was found "everywhere", and was prevalent in the interstellar molecular clouds. Vast quantities of water vapour were found. For example, in the Orion Nebula water is being produced at a rate that would fill Earth's oceans once every 24 minutes. Most of water now present on Earth was created in such places.

Stars are formed when clouds of gas and dust collapse under gravity. The collapsing gas heats up and wants to expand, so the gas must cool itself for collapse to continue. It is thought that collisions in clouds cause molecules and atoms to absorb the energy created in contraction, and become excited to higher energy levels. They rid themselves of this energy by re-emitting the radiation away from the cloud, and so the cloud cools. It is this radiated energy that the satellites detect. The energy released by each particular molecule is at a specific and characteristic wavelength and when the signal is analysed the source molecule can be identified. It is believed that carbon monoxide (CO) is the dominant molecule for the dispersion of the energy at the lowest temperatures. Water is the coolant when the temperature is about 300°K

Although much water has been found in cold molecular clouds, the quantity detected as vapour is not enough to satisfy most models of star and planet formation – the quantity observed was only 0.1 -1% as much as predicted. It is proposed that the "missing" water is frozen as ice onto dust grains, and so there is more water bound in this form than was originally thought. Ice coated dust is not detectable by these satellites. Although water is thus rare in the gaseous state, it is not rare in space, and is present in sufficient quantities to support systems analogous to the solar system. It would therefore be available as a medium to support life. However, conditions for life require it to be kept in liquid state. Each "solar system" would require a "habitable zone" where water would remain liquid over a substantial portion of a planet's surface. Life depends on liquid water, organic molecules, and an energy source such as a star.

Another technique used was to look for water where none was expected. Water vapour around the carbon star CW Leonis was found to be 10 000 times more than predicted. Very little water was expected, because any oxygen available would be quickly attached to the carbon drawn up from interior of the star, forming carbon monoxide. It is surmised that the as the star gets bigger and more luminous in its red giant stage, water is released from hundreds of billions of icy bodies in a belt analogous to our solar system's Kuiper Belt.

Where did the Earth's water come from?

The Earth has abundant liquid water. There are two main possibilities as to the origin of this water : either it was tied up in the rocks that made the Earth, or it could have been carried here by comets and asteroids, or it was a combination of both.

Water is present in the diffuse molecular clouds and could be incorporated into bodies that form during the collapse of the cloud. The earth formed in an environment that was too hot for water to condense directly on to it, but if planets like Earth formed from debris left when the sun was made, ice coated grains could have been incorporated into its material. Initially the earth was very hot and the water would have been in the atmosphere, but the earth had sufficient gravity to hold on to the water. When the earth cooled the water would condense to form the oceans.

The ice covered grains in the molecular clouds might also clump to form comets, which could then impact onto to the Earth. Comets are about 50% water. Examples of this abundance - Comet Halley was losing 12 tons of water per second when approaching the sun in January 1986,and when it was closest to the sun in February 1986 it was losing 30 - 60 tons of water per second. It is estimated that Comet Shoemaker Levy 9 delivered about 2 000 000 tons of water onto Jupiter when it impacted in 1994.

Cometary impacts were more frequent early in the Earth's history. It has been calculated that 1 impact per 1000 years in the first billion years would provide enough water to fill all the oceans and lakes. It has even been theorised that a swarm of comets swept into the solar system 4 billion years ago and bombarded the terrestrial worlds, but it has not been explained how so many comets could arrive in such a comparatively short time. The theory that comets brought the water has flaws, one of which is that the ratio of deuterium to hydrogen in comets is about twice the ratio in the Earth's oceans.

Asteroid impacts also were more frequent in the past, and are 50 times more likely than cometary ones even now. (Note that current tracking programmes are, for example "Near Earth Asteroid Tracking" but not "Near Earth Comet Tracking", and the recent "near misses" are all of asteroids, and not comets).

However, asteroids are only 10% water, but could they have supplied the Earths water? A recent theory suggests that they could have. According to the model, early in the planetary accretion process Jupiter had already grown so large that its gravitational force was altering the orbits of most objects in the region of what is now the asteroid belt. At the time the region teemed with planetary embryos and asteroids, some as big as the Moon or Mars, and they would contain 10% water. Within a few tens of millions of years, 99% of these objects were cleared out – some fell into Jupiter, some into the sun, and others were ejected from the solar system. However it has been shown that some of the larger objects could have collided with the infant inner planets. In fact the Moon is now considered to have formed after a Mars sized object hit the Earth. The Earth would have been massive enough to retain the ejecta from these impacts. The impacts could have contributed about one third of the Earths mass, and would deliver enough water to fill the Earth's oceans. This theory does not exclude comets as a source of the water – it suggests that comets could still have delivered about one tenth of the Earth's water.

* Kelvin temperature scale: 0° Kelvin = minus 273° Centigrade
273° Kelvin = 0°C

References

Molecules of Life in Space. Steve Nadis Sky & Telescope, Jan 2002 p. 32
Did Asteroids Supply Earth's Water? News Note Sky & Telescope, Feb 2001 p. 26

JIMO

NASA plans to dispatch a hulking nuclear-powered spacecraft to determine whether three of Jupiter's icy, planet-sized moons have the potential to harbour life. The Jupiter Icy Moons Orbiter, or JIMO, would spend monthlong stints circling the moons Callisto, Europa and Ganymede, which are believed to have vast oceans tucked beneath thick covers of ice.

The unmanned craft, far larger and more powerful than any other sent to explore the outer solar system, would spend years studying the moons' makeup, geologic history and potential for sustaining life, as well as Jupiter itself. Besides water, the moons appear to contain two other ingredients necessary for life: energy and the right chemicals. Along with Mars, they are considered the most likely places to have extraterrestrial life within our solar system.

"We don't know if life is there. But this mission will allow to ask that question with some pretty sound tools," said Christopher McKay of the National Aeronautics and Space Administration's Ames Research Center. JIMO won't launch until at least 2011. Scientists at the meeting of the American Geophysical Union briefed reporters on the mission's progress.

The spacecraft would be the first in a series of robotic NASA probes that rely on uranium-fueled fission reactors to generate large amounts of electricity. While probes such as Galileo and Cassini have made do with hundreds of watts of electricity, JIMO might have thousands of watts to power its thrusters and instruments.

The reactor conceivably could produce enough electricity to power several U.S. homes. That could provide JIMO a hundredfold boost over previous missions in the amount of data it would be able to beam back to Earth.

JIMO would carry high-resolution cameras and other instruments, including radar and lasers to map the thickness and elevation of the ice that envelops each moon. Scientists are keen to study the Jovian system because of its complexity. The planet and its stable of moons represent, in many ways, a miniature solar system. "These are worlds in their own right," said Ron Greeley, of Arizona State University, Tempe.

The spacecraft is envisioned as being 60 to 100 feet in length. Early conceptions place its nuclear reactor at the end of a boom to shield the scientific instruments from radiation. JIMO also would bristle with fins to dissipate the intense heat from its reactor.

JIMO Website: http://www.jpl.nasa.gov/jimo/

TOWARDS AN INTERNATIONAL VIRTUAL OBSERVATORY

Contributed from www by Editor Pierre Lourens

The basic idea of such an observatory is to put vast amounts of astronomical data as well as software to manipulate it with, on the Internet. People with a PC will then be able to download the software and use it to process some of the data, and in this way contribute to astronomical knowledge. This is an extremely exciting development looming on the horizon for astronomy.

Astronomers, like meteorologists, have an insatiable thirst for data and yet more data. However, amassing data in itself is not science. It has to be complemented by fitting it into some coherent scheme. It is only when this is also done that one is practicing science.

The Digital Data Revolution

Over the past thirty years, astronomers have moved from photographic and analogue techniques towards the use of high speed, digital instruments connected to specialized telescopes to study the Universe. Whether these instruments are onboard spacecraft or located at terrestrial observatories, the data they produce are stored digitally on computer systems for later analysis.

This data revolution has created two challenges for astronomers. Firstly, as the capability of digital detector systems has advanced, the volume of digital data that astronomical facilities are producing has expanded greatly. The rate of growth of the volume of stored data far exceeds the rate of increase in the performance of computer systems or storage devices.

Secondly, astronomers have realized that many important insights into the deepest secrets in the Universe can come from combining information obtained at many wavelengths into a consistent and comprehensive physical picture. However, because the datasets from different parts of the spectrum come from different observatories using different instruments, the data are not easily combined. To unite data from different observatories, bridges must be built between digital archives to allow them to share data and 'interoperate' - an important and challenging task.

AVO webpage: http://www.eso.org/projects/avo/index.html
NVO webpage: http://www.us-vo.org/

SOUTH AFRICAN ASTRONOMICAL WEBSITE ADDRESSES

South African Astronomical Observatory: www.saao.ac.za
Southern African Large Telescope: www.salt.ac.za
Hartebeesthoek Radio Astronomy Observatory: www.hartrao.ac.za
Hermanus Magnetic Observatory: www.hmo.ac.za
Square Kilometre Array: www.ska.ac.za
Cape Town Planetarium: www.museums.org.za
Johannesburg Planetarium: www.wits.ac.za
SA Agency for Science & Technology Advancement: www.saasta.ac.za

Left to right: Theo Pistorius, Tim Cooper, Chris Stewart, Ad Sparrius. Theo, a committee member of our Centre, is emigrating to Australia. Tim, Chris and Ad were the speakers at the April meeting. Tim and Ad are members of our Centre and Chris Stewart is a member of the Johannesburg Centre.

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