The PRETORIA CENTRE

of the

Astronomical Society of Southern Africa

www.pretoria-astronomy.co.za

JUNE 2004

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

On	Wednesday 23 June at 19h15
Chairperson	Pierre Lourens
Beginner's Corner	Prime Focus Astrophotography by Wayne Mitchell
What's Up	by Johan Smit

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

Main Topic "SATURN" by Barbara Cunow

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

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

INSIDE THIS NEWSLETTER

LAST MONTH'S MEETING

Fifty-five members and visitors attended the Venus Special meeting. Instead of the usual Beginner's Corner, What's Up and Main Topic, we heard about three aspects of the Venus Transit on 8 June.

Neville Young discussed the technicalities of Venus transits with the aid of his model of the solar system, co-opted members and pins. Luckily for us, he did not go into the really complex maths, but we all realised that we are very fortunate to be alive now to see the event.

During the break, we were treated to projections of social photos taken at Nylsvley.

Michael Poll then proved to us that history can be interesting and we learnt that observations of the rare transits of Venus were considered to be about the only way to get an exact value for the astronomical unit. Sod's Law ensured (with cloud, black drop effect, travel problems, etc.) that the AU was never accurately measured during a Venus transit.

Tim Cooper, with the aid of binoculars, telescopes, welding glasses, mylar film, pinholes, etc., showed us the safe ways to observe the transit - and how not to observe - with tea packets, naked eye, etc.

Although there is another Venus transit in 8 years time, it will not be visible from here and observing it will entail travel.

The meeting on the hard seats ended with projections of astronomical photos taken by Mauritz and Koos at Nylsvley. Even the photos taken when Koos' telescope tracking drive battery died, were impressive. The meeting was the first cold one of the year, but the excellent input by speakers and photographers ensured maximum benefit and enjoyment for all.

There was lots of discussion and chat over tea/coffee/biscuits as usual.

Lorna Higgs

LAST MONTH'S OBSERVING EVENING

The Curator of Instruments (observatory/telescope) and most of the keen observers went to Nylsvley for the weekend, but two committee members were at CBC in case anyone arrived. Two members arrived hoping to see the comet through the telescope, but the only observing that was possible was naked eye viewing of Venus and the crescent moon setting and quick glances at Linear comet with binoculars before it sank into the light pollution in the west and when the clouds did not obscure the vital spot.

Planetary Oceans

by Michael Poll

Hydrogen and oxygen are the first and third most abundant elements in the universe, (helium is the second) and, in the presence of large amounts of hydrogen, the water molecule is the natural carrier of oxygen.

Water has some unusual properties:

- The frozen, or solid, form of water (ice) is less dense than the liquid form, and so ice floats.
- Liquid water can exist below 0 deg C if it is ultra pure, or exists as thin layers on particle surfaces or if there is dissolved antifreeze. In the cosmos the most likely antifreeze is ammonia (NH_3). A mixture of one part ammonia and two parts water does not freeze until -100 deg C.
- If ice is compressed, it melts, even though the temperature may be below 0 deg C. Melting will occur at the bottom of a layer of ice because of the pressure created by the mass of overlying ice.

The solar system is flooded with water, but the water exists mostly in the very cold outer regions, in particular in the solid bodies beyond the asteroid belt. Ganymede Callisto and Titan, are about half water by mass. Europa Triton and Pluto all have proportionately more water than the Earth. The non- gaseous portion of the giant planets is probably more water than anything else.

By comparison the inner solar system is a desert. Venus has practically no water, the runaway greenhouse effect has seen it all off. Mars has proof of ancient surface flows of water, and evidence of geologically recent but short lived flows. It probably also has subsurface ice but it has no liquid water. Water covers two thirds of the Earth's surface, and yet the abundance of water on Earth is very low by cosmic standards - only 0.1 % of its mass is water.

The rationale for broadening planetary ocean expectations considers that any body, including a moon, that has an energy source in a lower layer beneath an upper layer that inhibits the outward flow of thermal energy, might be able to sustain an ocean in a middle layer, even though the top of the upper layer may be cold. For example, in the case of Venus, the top of the cloud deck up is at a temperature below the freezing point of water, yet the surface temperature of Venus, only 65 km below, is more

Planetary Oceans continued

than 400 deg C. (The top of the cloud deck can be referred to as “the visible surface”)

The Earth maintains liquid oceans due to a mild greenhouse effect. The main greenhouse gases are water vapour and carbon dioxide (CO2), which prevent the escape of heat received from the sun. Solar energy thus dominates the near surface conditions. Because the heat is retained, the Earth’s surface is warm enough to allow water to exist as a liquid, even though the upper parts of the Earth’s atmosphere - the equivalent of Venus “visible surface”- are cold.

With the greenhouse effect the heat source is external, but internal heat sources can also maintain warmth in a middle layer. The heat sources include tidal flexing of the core of the body, and radioactivity of underlying rock, so that the distance from the parent star would not be a factor in determining whether a body has an ocean.

Planetary oceans can be of different types:

Naked ocean

This is the type of ocean found on the earth, although it is not truly naked in that it is covered by an atmosphere. With a naked ocean, the sea is visible and exposed and can be seen from space.

Capped ocean

This is an ocean buried beneath a layer of ice or rock If the overlying layer is ice, the ice naturally floats on top of the liquid water. The heat source is internal, with the upper layer of ice or rock acting as a natural insulator preventing the escape of heat.

Blanketed ocean

Is an ocean that is preserved because of an overlying dense atmosphere. It may not be possible to see through such an atmosphere.

Solar System Candidates for the Possession of Oceans

Jupiter’s Moons
- Europa

Europa is mostly rock, but its mean density suggests that 10 % of its mass is water. It has a bright water ice surface The surface is very mobile and extensively fractured with upwelling, suggesting the possibility of an ocean beneath an ice crust. Measurement of Europa’s gravity field by the Galileo orbiter determined that a 200 km thick layer of water and / or water ice would be required to fit the observations.

Planetary Oceans continued

However, evidence for an ocean from geologic and spectroscopic observations is circumstantial. The geological activity could arise from the movement of brittle ice over softer warmer ice underneath, but magnetometer readings showed that Europa has conducting layer of global extent, and the most reasonable interpretation is that the readings indicate a layer of water with dissolved salts, (but not necessarily sodium chloride). The proposal is that Europa has a capped ocean. The thickness of the ice layer is estimated at 10 - 40 km, overlying an ocean more than 100 km deep, resting on a rocky floor. The layer of water maintained by heat from tidal flexing of the core, and pressure of ice above.

- *Callisto*

The magnetometer readings also suggested that Callisto could have a subterranean ocean. The heat source would be radioactivity in the core. It was previously thought that Callisto was too small to form an ocean if radioactivity was the only heat source, but current understanding of ice flows and efficiency of convection suggests that an ocean is possible, especially if the rocks contained the cosmic abundance of radioactive potassium. The ocean would be about 150 - 200 km below the surface because at this depth the ice is easier to melt due to the high pressure (2000 atmospheres) exerted by the overlying ice.

Saturn's Moon Titan

Titan is similar in size to Ganymede and Callisto and has a has dense atmosphere. It probably has a water rich sea, which would be classified as a blanketed ocean. Conditions on Titan favour the presence of an ocean, radioactive decay would provide heat

Neptune's Moon Triton and Pluto

These bodies are similar in size and density to, but smaller than, Titan. They could possibly have water-ammonia oceans beneath icy surface

Uranus and Neptune

These planets have large amounts of water molecules mixed with hydrogen, methane, ammonia and other molecules, but probably do not have oceans, because at atmospheric levels where water molecules are highly abundant (about 2500 km down) the temperature exceeds 1000 deg C.

Other Solar Systems

In other solar systems other sorts of planets are possible, considering that no two planets in our solar system are the same. For example, smaller versions of Uranus and Neptune ("sub-Neptunes") could maintain a liquid ocean, whatever the temperature at the cloud tops.

There could also be bodies of similar composition to Ganymede, but with Earth like mass. Bodies like these could have oceans because there is so much water available..External sunlight is not necessarily needed as a heat source:- radioactivity and the heat of formation would suffice.

The Life Question

All life on earth depends on liquid water to survive, so if water oceans are common, and if they are the natural places for life to form, then is life common in the universe? The current understanding of the origin of life is too primitive to answer the question, but life on Earth started at the first opportunity, which was when the Earth had cooled enough.

However, capped and blanketed oceans would have a far lower energy budget than the earth, so that any biosphere would be much smaller and less easily detected, and would not be so diverse. Acceptable habitats for life may exist anywhere in the universe and nothing in our current understanding of life precludes the development of life without sunlight. Extremely hot places may not harbour life but outwardly cold places may do so.

Reference :
Planetary Oceans David J Stevenson in Sky & Telescope November 2002 p 39

ASTRONOMY WEBSITE ADDRESSES

JPL's horizons: http://ssd.jpl.nasa.gov/horizons.html

NASA Astrophysics Data System: http://adswww.harvard.edu/

(See also MNASSA, Vol 61 Nos 3 & 4, p. 44-45.)

ADS abstracts: http://adsabs.harvard.edu/ads_abstracts.html

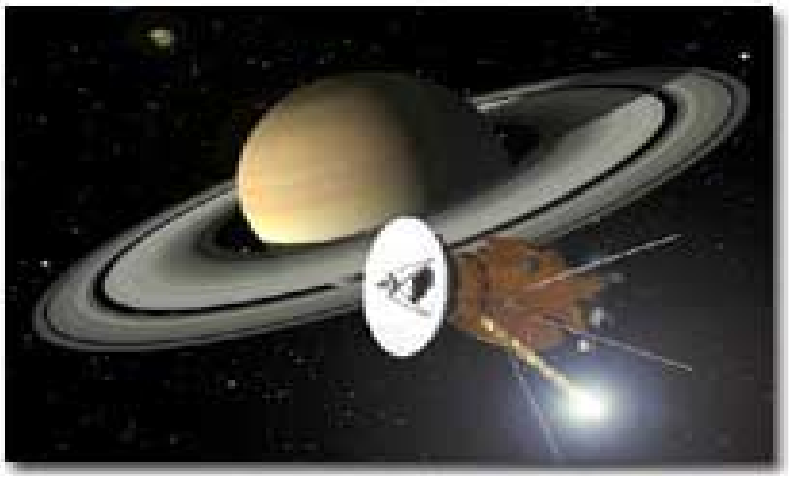
ADS articles: http://adsabs.harvard.edu/ads_browse.html

PDS Map-a-Planet: http://pdsmaps.wr.usgs.gov/

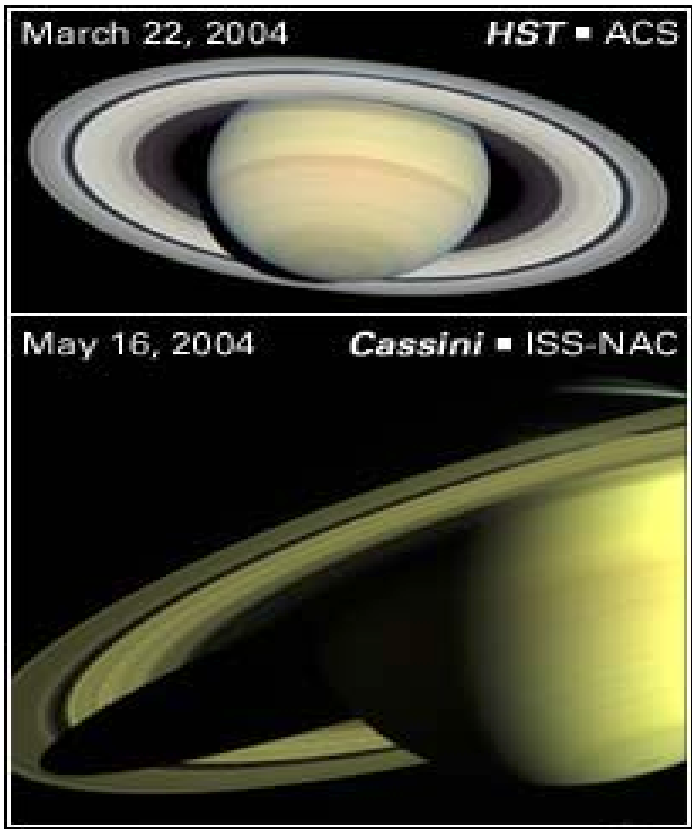
CASSINI ARRIVAL AT SATURN

This is an artist's concept of Cassini during the Saturn Orbit Insertion (SOI) maneuver, just after the main engine has begun firing. The spacecraft is moving out of the plane of the page and to the right (firing to reduce its spacecraft velocity with respect to Saturn) and has just crossed the ring plane.

The SOI maneuver, which is approximately 90 minutes long, will allow Cassini to be captured by Saturn's gravity into a five-month orbit. Cassini's close proximity to the planet after the maneuver offers a unique opportunity to observe Saturn and its rings at extremely high resolution. Website address: www.jpl.nasa.gov/cassini/



Cassinni Schedule



July 1, 2004: Crossing of Saturn's Ring Plane during the spacecraft's critical Saturn Orbit Insertion sequence.

Dec. 25, 2004: 02:00 UTC Huygens probe separates from the Cassini orbiter and begins its 22 day journey to Titan.

Jan. 14, 2005: Huygens begins its descent through Titan's cloudy atmosphere, where it lands on the surface about two and half hours later. The probe is scheduled to encounter the uper fringes of Titan's atmosphere at 09:00 UTC.

Astrophotography

An astrophoto taken by Koos van Zyl, a member of our Centre. It was taken at Nylsvley on 22/05/2004 at around midnight. It shows the Southern Cross area. The Southern Cross is right in the middle, with the Coal Sack just left of it. Alpha and Beta Centauri (the two pointers) are at the top left. Omega Centauri is at the top middle and the Eta Carinae nebula is the pink patch near the bottom, right of the middle. Photo taken through an ordinary 35 mm f4 Topcon camera lens. Exposure time: 15 minutes.

PRETORIA COMMITTEE

Chairman	Michael Poll	012 331 1615(h)
Vice Chairman	Tim Cooper	011 967 2250 083 407 2025
Treasurer & Membership Secretary	Rynhardt van Rooyen	011 441 3458(w) 083 654 1862
Secretary	Tony Viljoen	012 654 5783(h) 072 247 6648
Curator of Instruments	Johan Smit	083 306 1199
Librarian	Janet Cooper	011 967 2250(h)
Newsletter Editor	Pierre Lourens	012 654 6366(h) 072 207 1403
Webmaster	Mauritz Geyser	012 662 0627
Additional Members	Frikkie le Roux	082 507 9917
	Neville Young	083 303 2840
	Mike Haslam	012 667 4845 083 675 4984
	Lorna Higgs	012 333 9366(h)
	Wayne Mitchell	012 719 9065(w) 072 465 7739
	Johann Swanepoel	012 667 4870(h) 082 453 0912

Email addresses at www.pretoria-astronomy.co.za