CANOPUS

The Astronomical Society of Southern Africa

Johannesburg Centre

Monthly Newsletter for October 2003

Contents:

The Sir Herbert Baker Library, 18a Gill Street, Observatory, Johannesburg
P.O.Box 93145, Yeoville, 2143

Editorial

What a view we had as the Earth lapped Mars on 27th August. It is quite amazing at the difference in size a couple of (million) kilometers makes when viewing through a telescope - even a moderately sized one and of course the views through the 26" were quite phenomenal with some of the surface features really standing out and the South Polar Cap sparkling very brightly on the edge of the disc.

Several images have been taken by members and we hope to bring these to you in these pages or at least to publish them soon on our website….and talking of our website, **Chris Stewart** and **Lerika Cross** have been working on a new look for our website, and this should be making it's appearance fairly soon. One of the major objectives in this re-design was user friendliness and ease of navigation. I'm sure you'll all find it an improvement over the original website design.

Eben van Zyl takes a different tack this month and shows us how to calculate the age of the Universe. **Brian Fraser** presents the items of Astronomic Interest for October and November, and **Dave Gordon** once again chats with us in a Chairmanly fashion..

Those of you who have received this issue are those who have paid your subs for 2003/4. Many thanks for your promptness – it's your subs that help us plan for the events and presentations for the membership over the next 12 months.

Please send us your requests for what you would like the committee to do for you during this period. *Also, your editor's annual plea for articles once again appears* - anything remotely connected to Astronomy, or the Jo'burg Centre, will be published and the only editing that takes place is grammar and spelling - how easy can it be. And you can be sure you will not be getting any rejection slips in the post.

The Editor

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Notice of Monthly Meeting

The Monthly Meeting of the Johannesburg Centre of the Astronomical Society will be held at the Johannesburg Planetarium at the Witwatersrand University, Yale Road, Johannesburg, on Wednesday, **15th of October**, 2003 at 20:00.

Topic:

Practical Astrophotography

By: **Tony Halliday**

(NOTE THE CHANGE OF DATE)

Telescope Making Classes

Would you like to make your own telescope?…or finish off a partially completed one? Well here's your opportunity. Join the Telescope Making Class being held under the guidance of Brian, Vince and Chris. Contact Chris on (011) 763-3301 or email *cstewart@alcatel.altech.co.za* if you are interested.

ASSA Lists

(Subscribe by sending email to "To Subscribe" address with "SUBSCRIBE" in the body of the message)

	To Subscribe	To send messages
ASSA Jo'burg Centre:-	**This information is changing shortly**	
ASSA Telescope Making:-	**This information is changing shortly**	

Public Viewing *(weather permitting)*

Public viewing nights are held subject to suitable weather conditions on the Friday nearest First Quarter, and are held at the Old Republic Observatory, 18a Gill Street, Observatory, Johannesburg. Starting time around 19:30. See the ASSA event calendar for the proposed viewing dates. Please check with **Constant** on 717-1397 or email- *tabbie@icon.co.za* to ensure that viewing IS taking place on the specified evening.

Welcome to new Members

Nils Schwartz — **Shaun Coetzee**
Werner Kirchhoff — **John Erasmus**
Gerhardt Repsold — **Tokkie & Dave Ehlers**

We wish you clear skies and many happy years of observing

Request for Assistance

There is a loose insert in this issue requesting information on how you may be able to help the society during our drives to tidy up/fix up our site. Please would you be so kind as to fill this in and return it to the committee to help us in our planning for the year ahead.

ASSA Jo'burg Centre - Calendar of Events

Month	Day/ Date	Event	Details
Oct	Mon 6	Committee meeting	
	Wed 8	**Monthly Meeting**	Practical Astrophotography **Tony Halliday**
	Fri 24	*Public viewing*	
Nov	Mon 10	Committee meeting	
	Wed 12	**Monthly Meeting**	Astronomical MASERS **Derck Smits**
	Fri 28	*Public viewing*	
Dec	Mon 8	Committee meeting	
	Sat 13	**Monthly Meeting** *** YEAR END STAR PARTY *** at Skeerpoort Farm	Contacts: Dave Gordon and Chris Middleton *(more information nearer the time)*
		No Public viewing in December	
Jan	Mon 12	Committee meeting	
	Wed 14	**Monthly Meeting**	TCM Demonstration **Vince Nettman**
	Fri 23	*Public Viewing*	
Feb	Mon 9	*Committee Meeting*	
	Wed 11	**Monthly Meeting**	Night of the Midnight Sun **Gil Jacobs**
	Fri 20	*Public Viewing*	
Mar	Mon 8	Committee Meeting	
	Wed 10	**Monthly Meeting**	Galaxy Classification in the 21st Century: The Hubble Tuning Fork Strikes a New Note. **Robert Groess**
	Fri 19	*Public Viewing*	

Reminders

2003	Centenary of Flight
2004	**Centenary:** Sir Herbert Baker Library Building *Johannesburg Centre to host 2004 ASSA Symposium* **June 8:** Venus Transit
2006	**March 29:** Total Solar Eclipse

HOW TO CALCULATE THE AGE OF THE UNIVERSE

In order to calculate the age of the universe, one must determine the distances of the furthest objects. If an object is *x* light years distant, its light must have taken *x* years to reach the earth, so *x* must be the age of the object.

To do this one must measure the redshift of the spectral lines of the object. The redshift is the percentage by which the lines of the spectrum are shifted towards the red end of the spectrum. If the wavelength of the light undergoing redshift is Λ_0 (lambda) when it is at rest and the observed wavelength when redshifted is Λ, caused by its speed of recession, the redshift is given by

$z = \frac{\Lambda - \Lambda_0}{\Lambda_0}$. This can be expressed as a percentage of the speed of light, which in the case of the spectral lines of the quasar 3C273 is 0,16 (16%).

Einstein's formula linking redshift with the speed of recession, is $(1+z)^2 = \frac{c+v}{c-v}$ where c is the speed of light, v is the speed of recession of the radiating body and z is the redshift. In the case of 3C273,

$$(1+0{,}16)^2 = \frac{c+v}{c-v}\text{ , i.e. } (1{,}16)^2 = \frac{c+v}{c-v}$$

or $1{,}3456 = \frac{c+v}{c-v}$

or $1{,}3456c - 1.3456v = c + v$

$\therefore \quad 1{,}3456 - c = v + 1{,}3456v$

i.e. $0{,}3456c = 2{,}3456v$.

$$\therefore \quad \frac{v}{c} = \frac{0{,}3456}{2{,}3456} = 0{,}147 .$$

The speed of recession of quasar 3C273 is thus 14,7% of the speed of light. To find the distance of 3C273 we must apply Hubble's law which states: “the speed of recession of a distant object is proportional to its distance in megaparsecs”**.** This means that the farther away an object is, the greater its speed of recession is**.**

i.e. V = H_o D where D is the distance in parsecs,

$\therefore$ D = V ÷ H_o **.** V is the speed of recession and H_o is the Hubble constant. Today's latest measurements give a value for H_o of 71 km per sec per megaparsec**.**

In the case of 3C273 V = 0,147c = 0,147 x 300 000 km per sec.

$$\therefore \quad D = \frac{0{,}147x300000}{71}x\frac{3{,}26}{1000} = 2{,}0248$$ light years.

We multiply by 3,26 to convert parsecs into light years and divide by 1000 to get milliards (thousand millions) and 300 000 is the speed of light in kilometres per second**.** 3C273 is thus 2,0248 milliard light years distant. Distance divided by speed of recession equals time or age.

At its speed of recession of 0,147 times the speed of light, the light from the quasar has been travelling for 2,0248 - 0,147 = 13,77 milliard years (13,77 thousand millions)**.** So the universe must be at least 13,77 milliard years old.

Let us try it on another quasar, 3C466 which has a redshift of 1,4:

$$(1+1{,}4)^2 = \frac{c+v}{c-v}\text{ so that } (2{,}4)^2 = \frac{c+v}{c-v}$$

i.e. $5{,}76 = \frac{c+v}{c-v}$ so that $5{,}76c - 5{,}76v = c + v$

or $5{,}76c - c = v + 4{,}76c = 6{,}76v$**.**

This gives: $\frac{v}{c} = \frac{4{,}76}{6{,}76} = 0{,}704$ for the speed of recession of 3C466**.**

By Hubble's law:

$$D = V \div H_0 = \frac{0{,}704x300000}{71}x\frac{3{,}26}{1000} = 9{,}697$$

milliard light years. The time taken to reach the Earth is 9,697 ÷ 0,704 = 13,77 milliard years - the same value as for the other quasar.

So we can confidently say the age of the universe is 13,8 milliard years (13,8 x 10^9 years).

Try it out on quasar PHL 957 which has a redshift of 2,69**.** A prize is offered for the first correct solution received.

Jan Eben van Zyl

Chairman's Chat

The Universe and Everything

One sure-fire way of stimulating discussion within any group, small and large, is to pose the question: "where does everything come from?" Every person on planet Earth must surely have pontificated upon such a question at some time in their lives. For the religious folks, the answer is forthright; for the science-minded, the question is a particularly challenging and thought-provoking (if not a downright troublesome) one.

At the September monthly meeting, I opened the floor to an informal debate of certain not-so-basic questions in cosmology: "How large is the Universe? Is it expanding or contracting? Where are we right now within the universe? How will the universe end?"

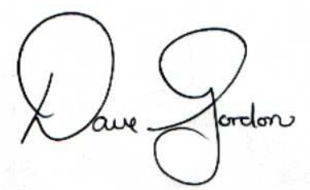
The debate was lively and stimulating. I'm only sorry so many of you missed out on the opportunity to throw your two cents worth into the cauldron of ideas. One of the reasons I enjoy discussing cosmology is that one's ideas cannot be proven absolutely wrong. Yes, current generally accepted evidence can be placed on the table for consideration and the initiator is then free to revise a theory or reinforce it with that new evidence. Refusal to do so will simply entrap one in a dogmatic fervour that soon fails even the most elementary of scientific tests.

We are an open-minded group of free thinkers. At times like this it is as though one is walking down a corridor of possibilities and every new idea is an open door to a new passage of exploration.

- Maybe there hasn't been just one big bang.
- Ours could be just an island-universe within a much grander picture.
- Where is everything RIGHT NOW? Telescopes reveal history, not current affairs at the outer-edge of the universe.
- Are we already on the outer edge?

I opened the debate with a personal view of the cosmos; I closed the debate with an altered one. This is growth. Science (and astronomy, for that matter) allows itself to be tested through open debate. When faced with a more plausible or proven alternative, embrace, mesh and mould it into you own model of the cosmos. Make it yours and make it unique. Very few will agree with your personal theory, but that's what stimulates debate.

Keep thinking and think big …very big!



SMART-1 ion engine fired successfully

ESA News

1 October 2003

SMART-1's revolutionary propulsion system was successfully fired at 12:25 UT on 30 September, 2003, in orbit around the Earth.

Engineers at ESOC, the European Space Agency's control centre in Darmstadt, Germany, sent a command to begin the firing test, which lasted for one hour. This was similar to a trial performed on Earth before SMART-1 was launched.

Several months ago, the ion engine, or Solar Electric Primary Propulsion (SEPP) system, had been placed in a vacuum chamber on the ground and its functions and operation were measured. Now in space and in a true vacuum, the ion engine actually worked better than in the test on ground and has nudged SMART-1 a little closer to the Moon.

This is the first time that Europe flies an electric primary propulsion in space, and also the first

European use of this particular type of ion engine, called a 'Hall-effect' thruster.

The SEPP consists of a single ion engine fuelled by xenon gas and powered by solar energy. The ion engine will accelerate SMART-1 very gradually to cause the spacecraft to travel in a series of spiralling orbits - each revolution slightly further away from the Earth - towards the Moon. Once captured by the Moon's gravity, SMART-1 will move into ever-closer orbits of the Moon.

As part of one of the overall mission objectives to test this new SEPP technology, the data will now be analysed to see how much acceleration was achieved and how smoothly the spacecraft travelled. If the ion engine is performing to expectations, ESA engineers will regularly power up the SEPP to send SMART-1 on its way.

Meteorite wrecks houses in India

At least 20 people are reported to have been injured after a meteorite crashed to Earth in eastern India. Reports say hundreds of people in the state of Orissa panicked when the fireball streamed across the sky.

Burning fragments were said to have fallen over a wide area, destroying several houses.

An official in Orissa said the authorities were assessing the damage and trying to recover what was left of the meteor.

Reports from Kendrapara district in Orissa, where the meteor came to Earth, said windows rattled as it passed overhead.

"It was all there for just a few seconds but it was like daylight everywhere," one resident said.

Rarity

Experts estimate about 100 tons of extraterrestrial dust grains fall to earth each day.

Occasionally, a dark pebble or fist-size object will rain down, with boulder-sized objects or bigger being a historical rarity.

The only recorded fatality from a meteor was an Egyptian dog that had the bad luck to be in the wrong place at the wrong time in 1911.

Seven decades later, scientists recognised the dog had been struck by a meteorite from Mars.

Story from BBC NEWS:

http://news.bbc.co.uk/go/pr/fr/-/2/hi/south_asia/3146692.stm

Published: 2003/09/28 17:39:10 GMT

Submitted by **Chris Stewart.**

NASA Releases Near-Earth Object Search Report

http://neo.jpl.nasa.gov/neo/report.html
10 September 2003 17:56

Study to Determine the Feasibility of Extending the Search for
Near-Earth Objects to Smaller Limiting Diameters

Report of the Near-Earth Object Science Definition Team
August 22, 2003
Prepared at the Request of
National Aeronautics and Space Administration
Office of Space Science
Solar System Exploration Division

Full 166-page report available here as a PDF document:
http://neo.jpl.nasa.gov/neo/neoreport030825.pdf

EXECUTIVE SUMMARY

A Study to Determine the Feasibility of Extending the Search for Near-Earth Objects to Smaller Limiting Diameters

In recent years, there has been an increasing appreciation for the hazards posed by near-Earth objects (NEOs), those asteroids and periodic comets (both active and inactive) whose motions can bring them into the Earth's neighborhood. In August of 2002, NASA chartered a Science Definition Team to study the feasibility of extending the search for near-Earth objects to smaller limiting diameters. The formation of the team was motivated by the good progress being made toward achieving the so-called Spaceguard goal of discovering 90% of all near-Earth objects (NEOs) with diameters greater than 1 km by the end of 2008. This raised the question of what, if anything, should be done with respect to the much more numerous smaller, but still potentially dangerous, objects. The team was tasked with providing recommendations to NASA as well as the answers to the following 7 specific questions:

1. What are the smallest objects for which the search should be optimized?
2. Should comets be included in any way in the survey?
3. What is technically possible?
4. How would the expanded search be done?
5. What would it cost?
6. How long would the search take?
7. Is there a transition size above which one catalogs all the objects, and below which the design is simply to provide warning?

Team Membership

The Science Definition Team membership was composed of experts in the fields of asteroid and comet search, including the Principal Investigators of two major asteroid search efforts, experts in orbital dynamics, NEO population estimation, ground-based and space-based astronomical optical systems and the manager of the NASA NEO Program Office. In addition, the Department of Defense (DoD) community provided members to explore potential synergy with military technology or applications.

Analysis Process

The Team approached the task using a cost/benefit methodology whereby the following analysis processes were completed:

Population estimation - An estimate of the population of near-Earth objects (NEOs), including their sizes, albedos and orbit distributions, was generated using the best methods in the current literature. We estimate a population of about 1100 near-Earth objects larger than 1 km, leading to an impact frequency of about one in half a million years. To the lower limit of an object's atmospheric penetration (between 50 and 100 m diameter), we estimate about half a million NEOs, with an impact frequency of about one in a thousand years.

Collision hazard - The damage and casualties resulting from a collision with members of the hazardous population were estimated, including direct damage from land impact, as well as the amplification of damage caused by tsunami and global effects. The capture cross-section of the Earth was then used to estimate a collision rate and thus a yearly average hazard from NEO collisions as a function of their diameter. We find that damage from smaller land impacts below the threshold for global climatic effects is peaked at sizes on the scale of the Tunguska air blast event of 1908 (50-100 m diameter). For the local damage due to ocean impacts (and the associated tsunami), the damage reaches a maximum for impacts from objects at about 200 m in diameter; smaller ones do not reach the surface at cosmic speed and energy.

Search technology - Broad ranges of technology and search systems were evaluated to determine their effectiveness when used to search large areas of the sky for hazardous objects. These systems include ground-based and space-based optical and infrared systems across the currently credible range of optics and detector sizes. Telescope apertures of 1, 2, 4, and 8 meters were considered for ground-based search systems along with space-based telescopes of 0.5, 1, and 2 meter apertures. Various geographic placements of ground-based systems were studied as were space-based telescopes in low-Earth orbit (LEO) and in solar obits at the Lagrange point beyond Earth and at a point that trailed the planet Venus.

Search simulation - A detailed simulation was conducted for each candidate search system, and for combinations of search systems working together, to determine the effectiveness of the various approaches in cataloging members of the hazardous object population. The simulations were accomplished by using a NEO survey simulator derived from a heritage within the DoD, which takes into account a broad range of "real-world" effects that affect the productivity of search systems, such as weather, sky brightness, zodiacal background, etc. Search system cost - The cost of building and operating the search systems described herein was estimated by a cost team from SAIC. The cost team employed existing and accepted NASA models to develop the costs for space-based systems. They developed the ground-based system cost estimates by analogy with existing systems.

Cost/benefit analysis - The cost of constructing and operating potential survey systems was compared with the benefit of reducing the risk of an unanticipated object collision by generating a catalog of potentially hazardous objects (PHOs). PHOs, a subset of the near-Earth objects, closely approach Earth's orbit to within 0.05 AU (7.5 million kilometers). PHO collisions capable of causing damage occur infrequently, but the threat is large enough that, when averaged over time, the anticipated yearly average of impact-produced damage is significant. Thus, while developing a catalog of all the potentially hazardous objects does not actually eliminate the hazard of impact, it does provide a clear risk reduction benefit by providing awareness of potential short- and long-term threats. The nominal yearly average remaining, or residual, risk in 2008 associated with PHO impact is estimated by the Team to be approximately 300 casualties worldwide, plus the attendant property damage and destruction. About 17% of the risk is attributed to regional damage from smaller land impacts, 53% to water impacts and the ensuing tsunamis, and 30% to the risk of global climatic disruption caused by large impacts, i.e. the risk that is expected to remain after the completion of the current Spaceguard effort in 2008. For land impacts and all impacts causing global effects, the consequences are in terms of casualties, whereas for sub-kilometer PHOs causing tsunamis, the "casualties" are a proxy for property damage. According to the cost/benefit assessment done for this report, the benefits associated with eliminating these risks justify substantial investment in PHO search systems.

PHO Search Goals and Feasibility

The Team evaluated the capability and performance of a large number of ground-based and space-based sensor systems in the context of the cost/benefit analysis. Based on this analysis, the Team recommends that the next generation search system be constructed to eliminate 90% of the risk posed by collisions with sub-kilometer diameter PHOs. Such a system would also eliminate essentially all of the global risk remaining after the Spaceguard efforts are complete in 2008. The implementation of this recommendation will result in a substantial reduction in risk to a total of less than 30 casualties per year plus attendant property damage and destruction. A number of search system approaches identified by the Team could be employed to reach this recommended goal, all of which have highly favorable cost/benefit characteristics. The final choice of sensors will depend on factors such as the time allotted to accomplish the search and the available investment.

Answers to Questions Stated in Team Charter

What are the smallest objects for which the search should be optimized?

The Team recommends that the search system be constructed to produce a catalog that is 90% complete for potentially hazardous objects (PHOs) larger than 140 meters.

Should comets be included in any way in the survey?

The Team's analysis indicates that the frequency with which long-period comets (of any size) closely approach the Earth is roughly one-hundredth the frequency with which asteroids closely approach the Earth and that the fraction of the total risk represented by comets is approximately 1%. The relatively small risk fraction, combined with the difficulty of generating a catalog of comets, leads the Team to the conclusion that, at least for the next generation of NEO surveys, the limited resources available for near-Earth object searches would be better spent on finding and cataloging Earth-threatening near-Earth asteroids and short-period comets. A NEO search system would naturally provide an advance warning of at least months for most threatening long-period comets.

What is technically possible?

Current technology offers asteroid detection and cataloging capabilities several orders of magnitude better than the presently operating systems. NEO search performance is generally not driven by technology, but rather resources. This report outlines a variety of search system examples, spanning a factor of about 100 in search discovery rate, all of which are possible using current technology. Some of these systems, when operated over a period of 7-20 years, would generate a catalog that is 90% complete for NEOs larger than 140 meters.

How would the expanded search be done?

From a cost/benefit point-of-view, there are a number of attractive options for executing an expanded search that would vastly reduce the risk posed by potentially hazardous object impacts. The Team identified a series of specific groundbased, space-based and mixed ground- and space-based systems that could accomplish the next generation search. The choice of specific systems will depend on the time allowed for the search and the resources available.

What would it cost?

For a search period no longer than 20 years, the Team identified several systems that would eliminate, at varying rates, 90% of the risk for sub-kilometer NEOs, with costs ranging between $236 million and $397 million. All of these systems have risk reduction benefits which greatly exceed the costs of system acquisition and operation.

How long would the search take?

A period of 7-20 years is sufficient to generate a catalog 90% complete to 140-meter diameter, which will eliminate 90% of the risk for sub-kilometer NEOs. The specific interval depends on the choice of search technology and the investment allocated.

Is there a transition size above which one catalogs all the objects, and below which the design is simply to provide warning?

The Team concluded that, given sufficient time and resources, a search system could be constructed to completely catalog hazardous objects with sizes down to the limit where air blasts would be expected (about 50 meters in diameter). Below this limit, there is relatively little direct damage caused by the object. Over the 7-20 year interval (starting in 2008) during which the next generation search would be undertaken, the Team suggests that cataloging is the preferred approach down to approximately the 140-meter diameter level and that the search systems would naturally provide an impact warning of 60-90% for objects as small as those capable of producing significant air blasts.

Science Definition Team Recommendations

The Team makes three specific recommendations to NASA as a result of the analysis effort:

Recommendation 1 - Future goals related to searching for potential Earth-impacting objects should be stated explicitly in terms of the statistical risk eliminated (or characterized) and should be firmly based on cost/benefit analyses.

This recommendation recognizes that searching for potential Earth impacting objects is of interest primarily to eliminate the statistical risk associated with the hazard of impacts. The "average" rate of destruction due to impacts is large enough to be of great concern; however, the event rate is low. Thus, a search to determine if there are potentially hazardous objects (PHOs) likely to impact the Earth within the next few hundred years is prudent. Such a search should be executed in a way that eliminates the maximum amount of statistical risk per dollar of investment.

Recommendation 2 - Develop and operate a NEO search program with the goal of discovering and cataloging the potentially hazardous population sufficiently well to eliminate 90% of the risk due to sub-kilometer objects.

The above goal is sufficient to reduce the average casualty rate from about 300 per year to less than 30 per year. Any such search would find essentially all of the larger objects remaining undiscovered after 2008, thus eliminating the global risk from these larger objects. Over a period of 7-20 years, there are a number of system approaches that are capable of meeting this search metric with quite good cost/benefit ratios.

Recommendation 3 - Release a NASA Announcement of Opportunity (AO) to allow system implementers to recommend a specific approach to satisfy the goal stated in Recommendation 2.

Based upon our analysis, the Team is convinced that there are a number of credible, current technology/system approaches that can satisfy the goal stated in Recommendation 2. The various approaches will have different characteristics with respect to the expense and time required to meet the goal. The Team relied on engineering judgment and system simulations to assess the expected capabilities of the various systems and approaches considered. While the Team considers the analysis results to be well-grounded by current operational experience, and thus, a reasonable estimate of expected performance, the Team did not conduct analysis at the detailed system design level for any of the systems considered. The next natural step in the process of considering a follow-on to the current Spaceguard program would be to issue a NASA Announcement of Opportunity (AO) as a vehicle for collecting search system estimates of cost, schedule and the most effective approaches for satisfying the recommended goal. The AO should be specific with respect to NASA's position on the trade between cost and time to completion of the goal.

The Sky this Month

October 2003

dd hh	dd hh
2 19 FIRST QUARTER	20 02 Mercury 3.5 N of Spica
3 22 Venus 3.2 N of Spica	22 00 Jupiter 4.3 S of Moon
5 00 Neptune 5.3 N of Moon	22 16 Neptune stationary
6 11 Uranus 4.6 N of Moon	25 10 Mercury in superior conjn.
6 15 Mars 1.0 N of Moon Occn.	25 13 Mercury 1.3 S of Moon
10 08 FULL MOON	25 14 NEW MOON
14 03 Moon at apogee	25 23 Saturn stationary
17 13 Saturn 4.8 S of Moon	26 14 Moon at perigee
18 13 LAST QUARTER	26 21 Venus 0.1 S of Moon Occn.

November 2003

dd hh	dd hh
1 05 FIRST QUARTER	18 17 Jupiter 4.1 S of Moon
1 06 Neptune 5.3 N of Moon	18 17 Venus 9.8 S of Pluto
2 15 Uranus 4.7 N of Moon	23 23 NEW MOON ***Eclipse***
3 09 Mars 3.1 N of Moon	24 00 Moon at perigee
8 17 Uranus stationary	25 04 Mercury 0.2 N of Moon Occn.
9 02 FULL MOON ***Eclipse***	25 17 Mercury 11.1 S of Pluto
10 07 Venus 4.1 N of Antares	25 18 Venus 1.8 N of Moon
10 14 Moon at apogee	28 14 Neptune 5.2 N of Moon
13 19 Saturn 4.9 S of Moon	29 22 Uranus 4.8 N of Moon
17 05 LAST QUARTER	30 17 FIRST QUARTER
18 12 Mercury 2.8 N of Antares	

LOCAL TIMES of RISE and SET for the MAJOR PLANETS, 2003

Site Location: Long. **+28.0** deg. Lat. **-26.0** deg. Local Time - UT **+2.0** hrs.

Date	**Sun**	**Mercury**	**Venus**	**Mars**	**Jupiter**	**Saturn**
	Rise Set	**Rise Set**	**Rise Set**	**Rise Set**	**Rise Set**	**Rise Set**
Oct 08	5.42 18.09	5.12 17.12	6.25 19.10	14.48 3.53	4.01 15.30	0.42 11.16
Oct 18	5.32 18.14	5.21 17.50	6.24 19.27	14.18 3.17	3.27 14.59	0.03 10.38
Oct 28	5.23 18.20	5.30 18.27	6.25 19.45	13.53 2.44	2.53 14.28	23.24 9.59
Nov 07	5.16 18.26	5.40 19.03	6.30 20.04	13.31 2.15	2.19 13.56	22.44 9.19
Nov 17	5.12 18.34	5.54 19.36	6.38 20.23	13.12 1.47	1.44 13.23	22.03 8.38
Nov 27	5.09 18.41	6.13 20.07	6.51 20.40	12.55 1.20	1.08 12.49	21.22 7.56