AUCKLAND ASTRONOMICAL SOCIETY

JULY 2010

SOCIETY JOURNAL

Nigel Henbest & Heather Couper

COSMIC QUEST - A HISTORY OF ASTRONOMY: PUBLIC LECTURE, SAT 17TH JULY

The Internationally renowned astronomy team of Heather Couper and Nigel Henbest are visiting New Zealand in July, and we are extremely fortunate to have the opportunity to hear these excellent speakers giving a public presentation of their Cosmic Quest lecture and a talk to the Society on Mars.

Heather Couper and Nigel Henbest, two of today's leading science communicators and authors., will be in Auckland this July.

Our glorious night sky is the ultimate landscape, but where do we fit in? For thousands of years humankind has sought to find our place in the Cosmos. Starting with superstition, astronomy has flourished into the most all-embracing of the sciences.

Its progress has been led by inspirational characters – and outright mavericks! - who have pushed our knowledge of the heavens forward, forever testing the limits of our imagination in the quest to understand the Universe.

This presentation concentrates on the people and personalities who have asked questions about the Cosmos. Starting with the Greeks, humans have striven to understand the Universe. Does the Sun travel around the Earth, or the Earth around the Sun? What are fearsome-looking comets? How big is the Cosmos?

With each question answered, dozens appear as if from nowhere: black holes, dark matter, planets around other stars, and the ultimate future of our Universe. And … is there life out there?

The talk will take place at the Raye Freedman Arts Centre, Epsom Girls Grammar School, Silver Road, Epsom at 7pm.

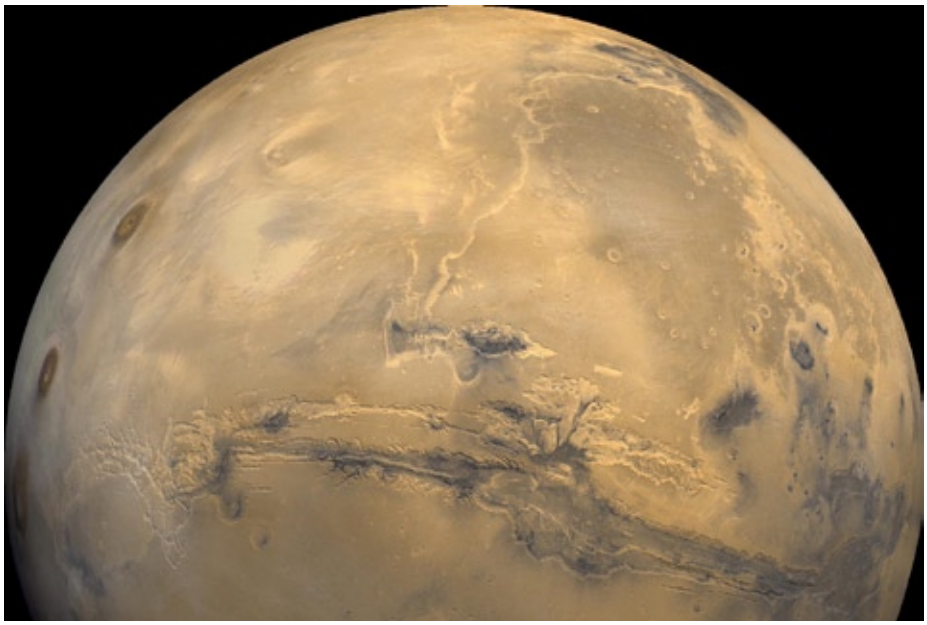
Society guest talk: Mars

with Nigel Henbest & Heather Couper - Sunday 18th July, 5.00pm, Stardome

Is Mars dead or alive? In this presentation, Heather and Nigel take the audience on a behind-the-scenes exploration of the Red Planet. We investigate the latest results from NASA's Spirit and Opportunity rovers, along with stunning views and scientific results from an armada of orbiting probes. Springs gush from ground that is supposedly frozen solid, we find active volcanoes on a planet supposed to have died aeons ago; and traces of methane in its atmosphere can only be generated by… microbial life.

In fact, we reveal that NASA's Viking landers discovered life on Mars in 1976, but the results were suppressed. And we check out the latest on the claims of "fossilised microbes" in a Martian meteorite.

The latest results are set against our perennial fascination with the Red Planet: from the "Canals of Mars," through the "Curse of Mars" that has claimed two-thirds of Mars-bound spaceprobes, to the day when humankind will go to Mars – which may be sooner rather than later. This special talk is for Society members and Stardome staff only, and is presented at Stardome for the only time in New Zealand



The Red Planet continues to fascinate us, and to occupy generations of scientists.

July Society Meeting - Wonders of the Solar System

Documentaries with Professor Brian Cox - Monday 19th July, Stardome

This month we will begin our meeting by showing:

DEAD OR ALIVE

The worlds that surround our planet are all made of rock, but there the similarity ends. Some have a beating geological heart, others are frozen in time. Brian travels to the tallest mountain on Earth, the volcano Mauna Kea on Hawaii, to show how something as basic as a planet's size can make the difference between life and death. Even on the summit of this volcano, Brian would stand in the shade of the tallest mountain in the solar system, an extinct volcano on Mars called Olympus Mons, which rises up 27 km.

Yet the fifth wonder in the series isn't on a planet at all. It's on a tiny moon of Jupiter. The discoveries made on Io have been astonishing. This fragment of rock should be cold and dead, yet, with the volcanic landscape of eastern Ethiopia as a backdrop, Brian reveals why Io is home to extraordinary lakes of lava and giant volcanic plumes that erupt 500 km into the sky.

Refreshments will be provided, following which we will continue with:

EMPIRE OF THE SUN

In this episode Brian explores the powerhouse of them all, the sun. In India he witnesses a total solar eclipse - when the link to the light and heat that sustains us is cut off for a few precious minutes.

But heat and light are not the only power of the sun over the solar system. In Norway, Brian watches the battle between the sun's wind and earth, as the night sky glows with the northern lights.

Beyond earth, the solar wind continues, creating dazzling aurora on other planets. Brian makes contact with Voyager, a probe that has been travelling since its launch 30 years ago. Now 14 billion kilometres away, Voyager has just detected the solar wind is beginning to peter out. But even here we haven't reached the end of the sun's rule.

Brian explains how its greatest power, gravity, reaches out for hundreds of billions of kilometres, where the lightest gravitational touch encircles our solar system in a mysterious cloud of comets.

June Society Meeting

By Clive Bolt

Two episodes of the new BBC documentary Wonders of the Solar System presented by Professor Brian Cox were screened. Professor Cox is a Professor and Royal Society Research Fellow at the University of Manchester.

The first episode was entitled Order out of Chaos and presented the origins of the Solar System and the current theory of the formation of the planets from an accretion disc of gas and debris left over from the formation of the Sun. We saw how the major planets ejected much of the cometary material into the halos around the Solar System that we now call the Oort Cloud. Equally fascinating was the use of Saturn's rings as an example of a modern accretion disc, giving an opportunity to study and model the dynamics and the formation of moons within the system. Particularly notable were the graphics showing the structure of the rings and the perturbations caused by some of the small moons that are embedded in the rings or that have a gravitational influence on them.

We are now becoming familiar with the small moon Enceladus with its geysers and the ejection of material into the rings. Once again, we saw graphic images of the little moon with its polar tiger stripes and plumes of ice crystals.

After supper, a second documentary was shown about atmospheres. Those that stayed on after supper missed another of Brian Cox's treats. We saw the dynamics of planetary atmospheres explained. How temperature and mass affect the retention of a planet's atmosphere and we are all becoming familiar with the extreme atmosphere of Venus with its runaway greenhouse effect and the positive feedback loops that keep Venus so hot and Mars so much cold.

The new information from the Cassini spacecraft that is coming to light from the study of the Saturn's moon Titan is particularly interesting. We saw the short video clip taken from the cameras of the Huygens probe as it descended to the surface of Titan. The images taken from the surface show rounded boulders that have a parallel with the boulders on a river bed. These must have formed from the flow of a liquid that we believe to be largely methane or ethane. On Earth, life as we know it is possible by conditions favourable to the presence of water in all three phases. On Titan the temperature and pressure favour the presence of Methane in all three phases. Whereas on Earth the annual evaporation is the equivalent of a few metres of water from which the atmosphere can only hold the equivalent of a few centimetres, on Titan the evaporation is the equivalent of a few centimetres of lake liquid while its atmosphere can hold the equivalent of several metres of lake liquid. On Titan it probably does not rain very often but when it does, it is likely to be a deluge.

I understand that the documentary is not likely to be shown on New Zealand television. I think we were all very fortunate that Grant arranged such an interesting evening.

Members of the Society enjoy the documentary at the June meeting

The Annual Burbidge Dinner

Remember that the Burbidge Dinner is on Saturday, October 9th at the Rutherford Room, Alexandra Raceway. Support this great event - get your tickets!

The keynote Speaker is Prof. John Hearnshaw, recently retired from UoCant and author of a recent book, Cosmic Essays.

There will be a door prize of a gift hamper. The draw will be made using your ticket number.

The prize winners for the Harry Williams Astrophotography Competition and the Beaumont Prize for the best original journal article by a Society member will be announced.

Purchasing Tickets

Please contact Andrew Buckingham 09 473 5877 or 027 246 2446 or by email: treasurer@astronomy.org.nz

Payment can be made by Internet Banking (Direct Credit) or deposit at any ASB branch, Account No.: 12-3061-0321397-00

Please use your member number or name as the reference.

Credit Cards: Visa or Mastercard payment can be made though our secure website at https://www.astronomy.org.nz/BurbidgeDinner.aspx or by phone on 09 473 5877.

Payment by Cheque: Make out to 'Auckland Astronomical Society' and post to PO Box 24187, Royal Oak, Auckland 1345.

Or give it to Andrew on the night

The Library Corner

By Tony Reynolds

Hello, my name is Tony Reynolds and I have the privilege of running the Society's library.

I have introduced a new segment to the Society Journal called "The Library Corner" that I will use to familiarise you with the Society's library and keep you abreast of the latest news. In addition I will highlight new books, feature a section of the catalogue and discuss some of the library rules and procedures.

INTRODUCTION TO THE LIBRARY

The library maintains a collection of around 1200 titles that are being added to and updated on a monthly basis. In addition to this, we also have available for loan: Sky & Telescope, Australian Sky & Telescope, Astronomy and American Scientific magazines.

There is a growing video collection and internet access.

The library is located in the rear office of the Stardome complex and is open every Society night for browsing, reading and borrowing.

FINDING YOUR WAY AROUND

I have undertaken a project to organise the books on the shelf using an international catalogue system (so that I don't have to guess where a book belongs) and as this rolls out it should make your browsing experience more efficient and enjoyable.

It is based on the American Library of Congress (LOC), an alpha-numeric system with an almost bewildering array of headings. But fear not, we will only be using the sections relevant to our collection and I will generate posters and look-up tables for easy reference. Finding a book on your chosen topic is then simplicity itself.

As this system is being rolled out you are still free to borrow any book from anywhere. As books are returned I ensure that their catalogue identifier is logged and they are placed in the correct section, so you are actually helping me by borrowing them.

Please feel free to approach me with any library-related queries whenever you see me and my contact details are on the Society website. I am happy to help where I can.

Regards, Tony Reynolds.

FEATURED SECTION – TL ASTRONAUTICS

Each month we bring a different section to the reader's attention.

TL Astronautics

Class T is for Technology and TL is for motor vehicles, aeronautics and astronautics. The Apollo missions are here, along with the space shuttle and William Pickering's biography added this month.

Titles include; Moon Shot, Space Race, Apollo 13 and The Iron Sun – Crossing the Universe through Black Holes.

USER'S GUIDE – BORROWING A BOOK

Sooner or later you will spot a book of interest on the shelf and wish to take it home – here's how.

1) If I am in the library ask me and I can put your details directly into the computer with a simple barcode scan.

2) Otherwise, check the book out yourself on the form provided and the details will be transferred to the computer at a later date.

a. The form is usually on the table near the door and looks like this;

b. Locate the AAS Library barcode number of the book you're checking out, usually on the inside front cover for books and directly on the front of magazines.

c. Fill in the form (except the last column) and you're all done.

3) The lending period is:

a. Books – 4 weeks with renewal on request

b. Magazines – 2 weeks for recent releases, 4 weeks for older copies. Please note that the recent magazines are very popular, so please return them on time or even earlier if possible.

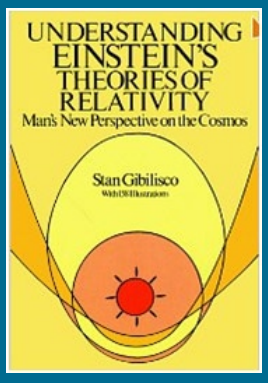
4) Returning a book means simply dropping it in the 'Book Returns' box. There is nothing to sign; the librarian will do the rest.

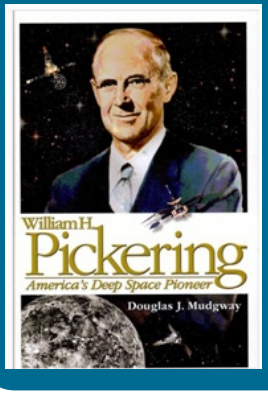
Featured New Books

Understanding Einstein's Theories of Relativity >>

Following on from Richard Hall's May presentation on general relativity, this book is chock-full of diagrams and explanations on the topic.

"For anyone curious about the nature of the Universe and how relativity theory continues to help scientists unlock its secrets, this accessible popular treatment is an invaluable companion and guide"





<< William H Pickering. America's Deep Space Pioneer

Following Douglas Mudgway's presentation to IPENZ at the Stardome earlier this year, the library now has two signed copies of his biography about one of New Zealand's greatest engineering and scientific heroes (well mine anyway).

"More than any other individual, Bill Pickering was responsible for America's success in exploring the planets".

Calendar and Events

JULY PROGRAMME

Mon 5	8:00pm	Practical Astronomy. Using Telescopes
Mon 12	8:00pm	Society Meeting. Documentary: Wonders of the Solar System
Fri 16	7:30pm	Young astronomers with Margaret Arthur
Sat 17	7:00pm	Public lecture: Cosmic Quest with Nigel Henbest & Heather Couper
Sun 18	5:00pm	Special Talk: Mars with Nigel Henbest & Heather Couper
Mon 19	8:00pm	Film Night July To Infinity and Beyond. with Andrew Buckingham
Mon 26	8:00pm	Introduction to Astronomy Continuing course with Bernie Brenner

PRACTICAL ASTRONOMY JULY
Monday 5th July at 8:00pm
Using Telescopes with Ivan Vazey

This Month: Using Telescopes

AAS curator Ivan Vazey will give some tips on using, maintaining and mounting your telescope.

PUBLIC LECTURE: COSMIC QUEST
Saturday 17th July at 7:00pm, Raye Freedman Arts Centre - Epsom Girls Grammar School
Speakers: Nigel Henbest & Heather Couper

Our glorious night sky is the ultimate landscape. But where do we fit in? This presentation concentrates on the people and personalities who have asked questions about the Cosmos.

Raye Freedman Arts Centre, Epsom Girls Grammar School, Silver Road, Epsom

Parking is available in the school grounds, and tea/coffee will be provided

MARS - THE INSIDE STORY OF THE RED PLANET
Sunday 18th July at 5:00pm, Stardome
Speakers: Nigel Henbest & Heather Couper

Is Mars dead or alive? In this presentation, Heather and Nigel take the audience on a behind-the-scenes exploration of the Red Planet. We investigate the latest results from NASA's Spirit and Opportunity rovers, along with stunning views and scientific results from an armada of orbiting probes. Springs gush from ground that is supposedly frozen solid; we find active volcanoes on a planet supposed to have died aeons ago; and traces of methane in its atmosphere can only be generated by… microbial life.

AUGUST PROGRAMME

Mon 2	8.00 pm	Practical Astronomy Names & Catalogues
Fri 6	7:30 pm	Young Astronomers with Margaret Arthur
Mon 9	8.00 pm	Society Meeting Speaker TBA
Mon 16	8:00pm	Film Night August Aliens of the Deep. with Gavin Logan.
Mon 23	8:00pm	Introduction to Astronomy Continuing course with Bernie Brenner

FILM NIGHT JULY
Monday 19th July at 8:00pm
with Gavin Logan

This Month: A BBC Horizon Documentary that explores the concept of infinity. It covers the question of whether the Universe is finite or infinite. This documentary discusses what the implications of an infinite universe are.

PRACTICAL ASTRONOMY AUGUST
Monday 2nd August at 8:00pm
NAMES & CATALOGUES with Andrew Buckingham

This Month: Names & Catalogues

Ever wondered why objects in the sky have so many different names and naming systems? This session will give a guide to some of the different cataloguing systems for objects in the night sky.

FILM NIGHT AUGUST
Monday 16th August at 8:00pm
with Gavin Logan

This Month: Aliens of the Deep.

A Walt Disney film, with Academy Award-winning director James Cameron, about Astrobiologists trips to the deepest part of the ocean to study life-forms that can give us clues about what type of life-forms could exist on other planets and in extreme conditions. This film has some incredible photography, including scenes of volcanic activity on the ocean floor and unusual life-forms living in the deepest parts of the ocean.

WELCOME TO NEW MEMBERS

John and Nichola Lennard (family)
Ira Mautner (family)
Cheri Hotu (family)
Judy Hotu (ordinary)
Andy Feng (junior)
Tim Dodd (family)
John & Tirza Johnstone (family)
John van der Hoven (family)
Graham Lewis (ordinary)

Talking Points Presentation

By Gavin Logan

Gavin Logan and Andrew Buckingham spoke at the Kumeu Arts Centre in June as part of their Talking Points programme. This is a series of talks on current and local issues by resident experts.

A well-attended meeting heard about the history of astronomy and how astronomers have come to hold their current beliefs about the Universe. Gavin went on to briefly explain current ideas and theories about the expanding Universe and the Big Bang. Andrew Buckingham then told them what to look for in the night sky. He talked about the solar system and about the planets. He then went on to talk about the brighter nebulae and star clusters and where to find them in the sky.

Viewing Saturn with the author's 100mm ED refractor.

Andrew Buckingham explaining to the Talking Points audience how the 200mm Dobsonian telescope he has on the table works.

Gavin and Andrew took three different types of telescopes with them and Andrew explained how these worked.

As luck would have it, Auckland produced a perfectly clear night, and so telescope viewing followed the meeting. Attendees were treated to telescopic views of Saturn and a number of stars clusters. The crescent Moon, which was low in the sky, was also viewed by the audience.

Auckland Astronomical Society
2010 Harry Williams Astrophotography Competition

This competition is open to all New Zealand Astronomical Societies, clubs and groups

Competition Entries Due by Friday 19th September 2010, Winners Announced at the Burbidge Dinner in Auckland on Saturday October 9th, 2010

Send entries by email (max 2MB per email) or copied onto CDROM/ USB memory stick and posted with accompanying Entry Forms to;

2010 Harry Williams Astrophotography Competition

Postal Delivery Address: 2/24 Rapallo Place, Farm Cove, Pakuranga, Auckland 2012

Email: farmcoveobs@xtra.co.nz Subject Header: 2010 HW Astrophotography Competition

2009 Harry Williams Trophy Winner by John Drummond

Alien Planet – Film Night

By Gavin Logan

Society members enjoying a virtual film journey with a robotic space mission to another solar system.

Another well-attended Film Night in June gave Society members a chance to explore the possibilities of space travel to a planet in another solar system. The film "Alien Planet" took attendees on a dramatic virtual robotic space mission to a fictional planet known as Darwin IV.

Visually based on Wayne Barlowe's book "Expedition" and using the latest scientific research from the NASA Origins Program, NASA-Jet Propulsion Laboratory (JPL) Planet-Finder Mission and European Space Agency's Darwin Project, this computer-animated film featured some of the world's most renowned scientists, including Stephen Hawking, Michio Kaku and J. Craig Venter, as well as "Star Wars" filmmaker George Lucas discussing the possibilities of life outside our solar system.

The Speculative planet Darwin IV, located 6.5 light years from Earth, has two Suns and 60 percent of Earth's gravity, but a denser atmosphere. Earth sends an unmanned pilot mission consisting of a "mother ship" – named Von Braun – and three probes, Balboa, da Vinci (nicknamed Leo) and Newton (nicknamed Ike). Their goal is to find and assess any life-forms on Darwin IV. It travels the 6.5 light years to Darwin IV at 20% the speed of light, and because it takes 6.5 years for information to get back to Earth the mission must be totally run by computers.

Life on Darwin IV is more reminiscent of the Age of Dinosaurs than what we have on Earth now. The film portrays a world where, due to a different environment, life has evolved very differently from Earth. It showed the problems a robotic mission could have dealing with the challenges and dangers of these surroundings.

Next month's Film Night, on Monday July19th, will feature a BBC Horizon Documentary entitled "To Infinity and Beyond", which explores the concept of infinity. It covers the question of whether the Universe is finite or infinite. This documentary discusses what the implications of an infinite universe are. It will be followed by a short "Sky at Night" film with Sir Patrick Moore called "Galaxy Zoo", which discusses a programme to record and classify galaxies

Dinosaur-like creatures on the speculative planet Darwin IV.

Pigeon Mountain Observatory - update

Since the last Journal, the PODs (Personal Observing Domes) have been built at Shallow Lake Ontario.

SkyShed's Ontario factory is near the Eastern shores of Lake Huron in the triangle between Lake Huron, Lake Erie and Lake Ontario. Nine Pods were despatched down into USA , travelling across Illinois, Minnesota …… to Washington State and then back into British Columbia to meet the ship at Delta Port , Vancouver.

Having left Canadian shores this month, they are now heading across the Pacific to Sydney, where some will be delivered to Australian Astronomers and the remainder shipped on to New Zealand at the end of July. These will be a mix of Base Pods and Pods with computer bays.

Freeware - Stellarium Planetarium

Stellarium is a free open-source planetarium for your computer. It shows a realistic sky in 3D, just like what you see with the naked eye, binoculars or a telescope. Just set your coordinates and go. New Stellarium version released - this release brings some exciting new features. Stellarium now ships with plug-ins for predicting the positions of artificial satellites in Earth orbit, improved telescope-control features, telescope eyepiece simulation (ocular) and more. Plug-ins can be enabled using the new plug-ins tab in the configuration dialogue. More information and program download: http://www.stellarium.org

Planetary movements, image by Stellarium

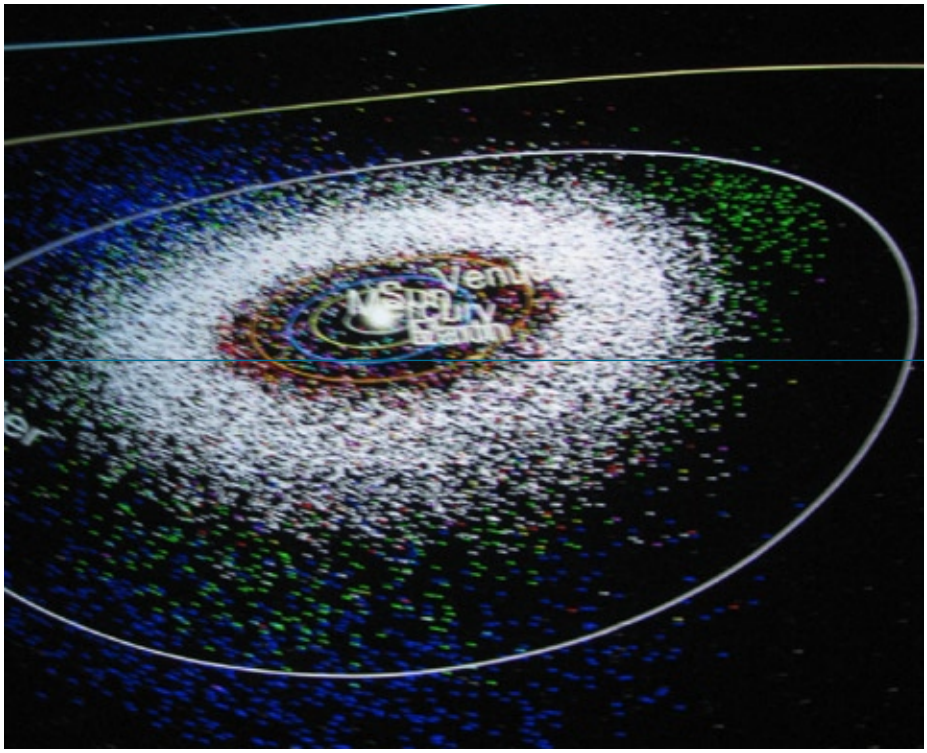
Indoor Star Party

By Gavin Logan

Bad weather prevented telescope viewing of the skies at the Society's June Star Party. Instead the over 50 attendees at the evening were treated to a Planetarium show.

Highlights and the winter sky were shown and discussed. This was followed by a 3D fight around the Solar System demonstrating the effectiveness of some new features of the Planetarium including the capability to show Asteroids. Matariki was the next subject with a 3D journey out to circle the Pleiades.

The evening was facilitated by Andrew Buckingham with Melanie Pohl operating the Planetarium.



The Asteroid Belt displayed in vivid colours by the Planetarium.

Society Telescopes for Hire

The Society has a wide range of telescopes for hire to members.

If you are looking to purchase or upgrade a telescope and are not sure what to buy, this is a very good way to evaluate some of the available equipment. See also the advertisement on the back page.

To inquire about hiring or for advice on what to buy and for information about equipment, contact Ivan Vazey, curator of instruments, on (09) 535-3987

Musca – A bee turned Fly

By Ivan Vazey

Planetary Nebula NGC 5189. Image Travis Rector University of Alaska Anchorage.

Johann Bayer named this constellation after the bee and so named it Apis. Edmond Halley changed it some years later to Musca Apis (the fly-bee).. and not to be outdone, Nicolas-Louis de Lacaille renamed it Musca Australis (the Southern fly).

There is no Greek Mythology involved because such a southerly constellation could not be seen from Greece when the mythologists were sitting sipping red wine and gazing at the heavens.

Bayer drew it in his 'Uranametria' of 1603. Halley decided to compile a Southern Star Catalogue to augment Flamsteed's Northern Star catalogue, which after Flamsteed's demise, was finished by Halley and included the renamed Musca Apis.

De Lacaille followed with his name change and then unfortunately for him, fell afoul of the French revolution.

Some small but lovely sights are contained within this constellation, which is close to Crux, and in a direct line between Crux and the SCP.

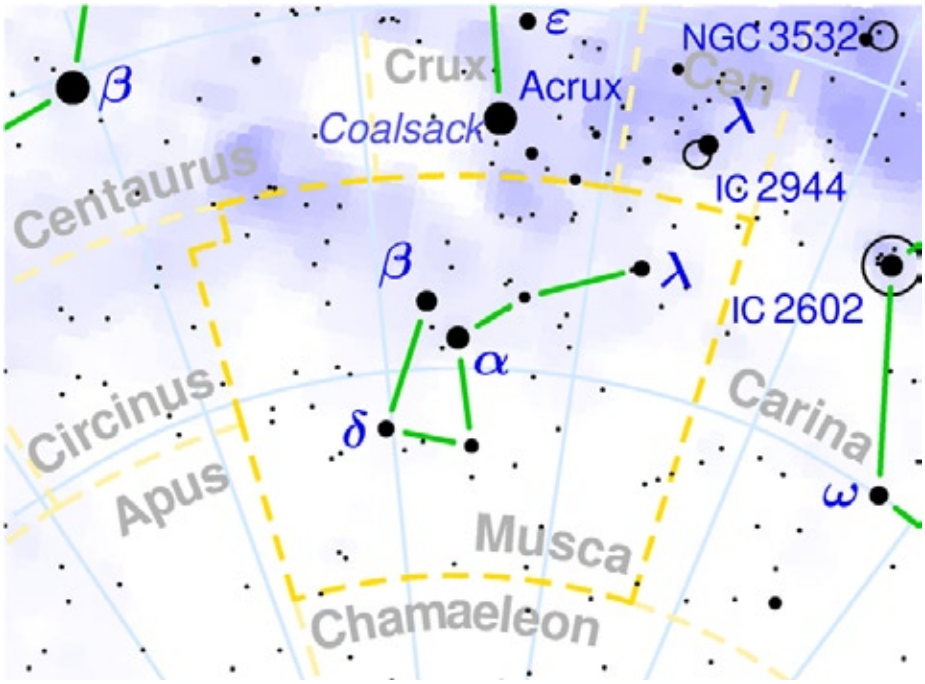
Notable objects

(Information courtesy Wikipedia)

The soft X-ray transient Nova Muscae 1991 is a binary object consisting of a star and a black hole. During the 1991 outburst which led to its discovery, radiation was produced through a process of positron annihilation.

Musca also contains the unusual planetary nebula NGC 5189, located about 3,000 light years from earth. Its uniquely complex structure resembles a miniature crab nebula. Also within the constellation is the Hourglass Nebula (MyCn 18) at a distance of about 8,000 light-years.

The comparatively old globular cluster NGC 4833 near Delta Muscae is 21,200 light-years distant and somewhat obscured by dust clouds near the galactic plane. The globular cluster NGC 4372 near Gamma Muscae is fainter and likewise partially obscured by dust, but spans more arc minutes.



Musca lies almost centrally on the band of the Milky Way, and so presents a rich starfield when viewed through binoculars or a telescope. To the unaided eye, though, its stars are rather dim. The brightest, the blue Alpha Muscae, is only of magnitude +2.7, while the Beta star, which is also blue and lies within a few light-years of Alpha, is slightly fainter at magnitude +3.0.

THE 2010 COUNCIL

President	Grant Christie	021 024 04992
Vice President	David Britten	09 846 3657
Treasurer & Membership	Andrew Buckingham	09 473 5877
Secretary	Michelle Knowler	021 148 6764
Curator of Instruments	Ivan Vazey	09 535 3987
Librarian	Tony Reynolds	09 480 8607
Journal Editors	Clive Bolt	09 534 2946
	Shaun Fletcher	09 480 5648
Webmaster	Nick Moore	09 537 1500
Council	Bernie Brenner	09 820 6001
Council	Gavin Logan	09 534 4103

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Membership enquiries:
contact Andrew Buckingham at treasurer@astronomy.org.nz
or by phone on 09 473 5877 or 027 246 2446

Hayabusa returns to Earth after its 7-year mission

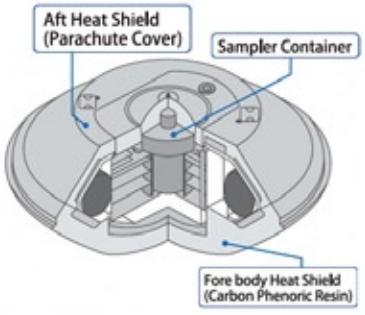
by JAXA/NASA

The sample return capsule of the Japan Aerospace Exploration Agency's (JAXA) technology demonstrator spacecraft, Hayabusa, boomeranged back to Earth on June 13. The asteroid explorer Hayabusa successfully separated its capsule at 7:51 p.m. JST June 13 and re-entered the atmosphere to complete its mission operation at 10:51 p.m. The capsule, along with its mother ship, visited a near-Earth asteroid, Itokawa, 5 years ago and has logged about 2 billion kilometers since its launch in May 2003.

The capsule successfully landed in the Woomera Prohibited Area in South Australia and was retrieved at approximately 4:08 p.m. JST June 14. With the return of the Hayabusa capsule, JAXA has concluded a remarkable mission of exploration.

Launched May 9, 2003, from the Kagoshima Space Center, Uchinoura, Japan, Hayabusa was designed as a flying testbed. Its mission: to research several new engineering technologies necessary for returning planetary samples to Earth for further study. With Hayabusa, JAXA scientists and engineers hoped to obtain detailed information on electrical propulsion and autonomous navigation, as well as an asteroid sampler and sample re-entry capsule.

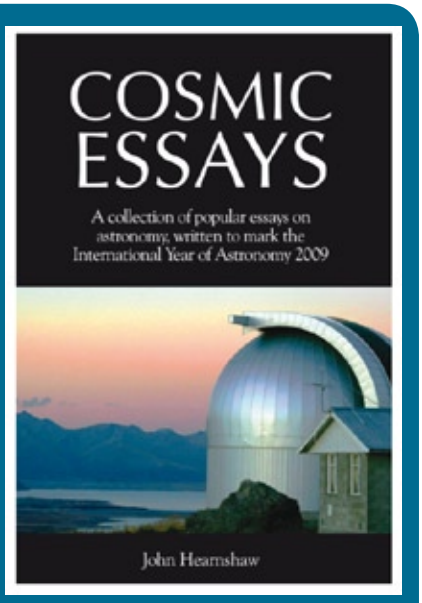
The 510 kilograms Hayabusa spacecraft rendezvoused with asteroid Itokawa in September 2005. Over the next 2.5 months, the spacecraft made up-close-and-personal scientific observations of the asteroid's shape, terrain, surface altitude distribution, mineral composition, gravity, and the way it reflected the Sun's rays. On November 25 of that year, Hayabusa briefly touched down on the surface of Itokawa. That was only the second time in history a spacecraft descended to the surface of an asteroid (NASA's Near Earth Asteroid Rendezvous-Shoemaker spacecraft landed on asteroid Eros February 12, 2001). Hayabusa marked the first attempt to sample asteroid surface material.



Hayabusa capsule internal structure

COSMIC ESSAYS

A new book by John Hearnshaw



Cosmic Essays – a collection of 53 popular essays in astronomy, written to celebrate the International Year of Astronomy 2009, and originally published electronically as the Cosmic Diary as a cornerstone project of IYA2009.

The 53 essays cover a wide variety of topics. The project was conceived to portray the lives of professional astronomers during 2009. The articles in Cosmic Essays include topics such as:

- Mt John University Observatory, New Zealand
- The search for extrasolar planets
- The history of astronomy
- Astronomy in developing countries (such as Mongolia, Cuba, Paraguay, Uzbekistan, Mauritius and Laos)
- Observatories in remote corners of the world (including those in Spain, Uruguay, Thailand and the Czech Republic)
- Astronomical libraries
- Astronomical spectrographs
- Astronomy and society (including astro-publishing and the relationship between astronomy and the economy)
- Famous astronomers of the twentieth century
- Astronomical conferences
- The Starlight Reserve Initiative

and many more!

The book is richly illustrated with over 150 full-colour illustrations. pp 105 + vi

Cosmic Essays is published by the author, who is Professor of Astronomy at the University of Canterbury, New Zealand. Published May 2010. See www2.phys.canterbury.ac.nz/~jhe25/CosmicEssays/COSMIC_ESSAYS.htm

To order a copy, email john.hearnshaw@canterbury.ac.nz and include your name and mailing address. Or go to ORDER FORM

(http://www2.phys.canterbury.ac.nz/~jhe25/CosmicEssays/COSMIC_ESSAYS_order.htm)

Price $NZ25.00. Packaging and postage $5 in New Zealand; $10 international

Distance to the Galactic Centre

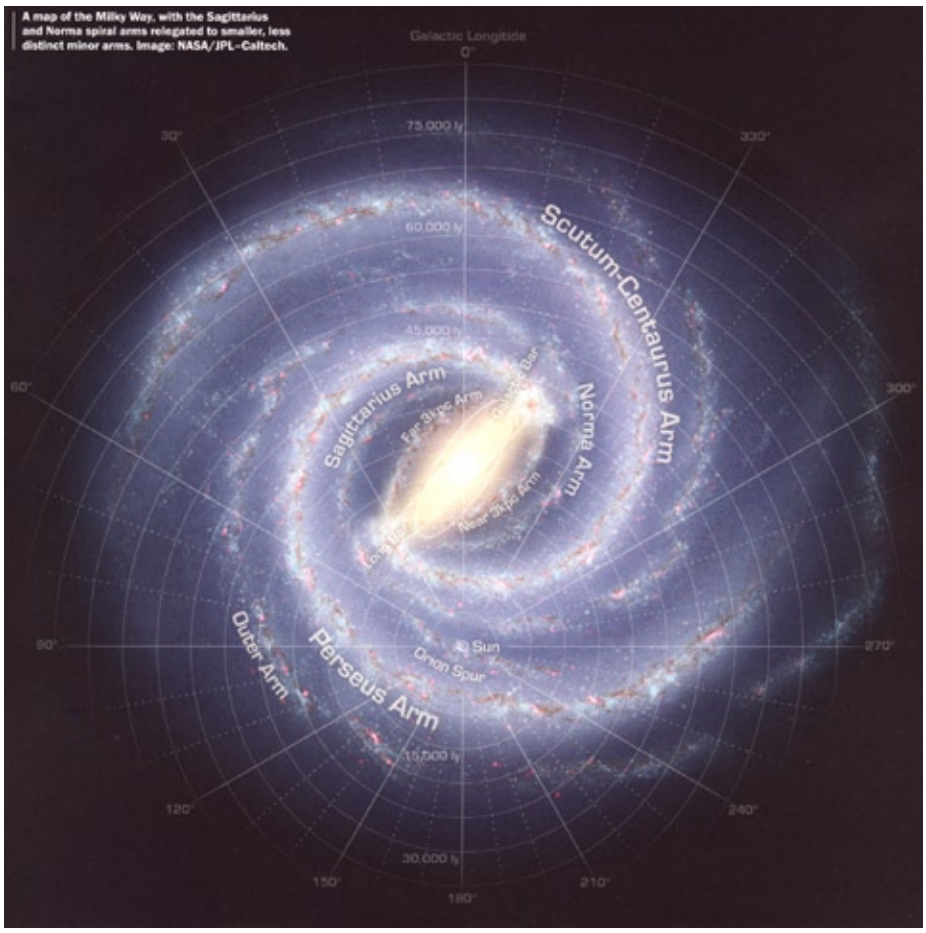
Dr Bernie Brenner June 2010

BACKGROUND – HOW DO WE KNOW THE DISTANCE TO THE CENTRE OF OUR GALAXY?

Nearly 92 years ago in 1918, Harlow Shapley published a paper "Big Galaxy Theory" on the distribution of globular clusters in the Milky Way. He felt that they orbited the centre of our galaxy and he determined that the distance to this centre was around 40,000 light-years and towards the constellation of Sagittarius (Moore 1988). He discovered Cepheid-type variables and used Hertzsprung's calibrations to determine the distances to the nearest globular clusters. Hertzsprung had calculated the average distance from Earth to Cepheids and used Henrietta Leavitt's period-luminosity scale to (incorrectly) calculate the distance to the Small Magellanic Cloud. Shapley, having determined the distances to the nearest galaxies, developed extra distance markers, which are called standard candles. The Cepheids' periods produced absolute magnitudes and from this data he derived the absolute magnitudes of the brightest non-variable stars. He then used the brightest stars in clusters to represent standard candles and so calculate the distance to clusters with no visible Cepheids. Shapley estimated that the Milky Way had a diameter of 300,000 light-years.

Jan Oort in 1927 reported that stars had different rotation speeds. Those closer to the galactic centre travelled faster than those further away. He determined the centre of rotation of the stars and so worked out the galactic centre. His estimate was much lower than Shapley's, at 19,000 light-years (Moore 1988).

Starlight dims as it passes through the gas and dust of interstellar medium in a phenomenon known as interstellar extinction. So if we correct for this, Shapley's estimation is reduced to 25,000 light-years (much nearer the mark). A big jump in technological advancement came with the advent of radio astronomy pioneered by Karl Jansky. Since then the advances in measurement techniques have continued to improve at a phenomenal rate. This essay will, in due course, explore these techniques.



The Milky Way Galaxy. source NASA JPL/Caltech

WHY IS IT IMPORTANT TO MEASURE THE DISTANCE TO THE GALACTIC CENTRE?

Simply put, the importance of knowing the distance to the galactic centre (R0) is enormous for astronomy and astrophysics. Distance, mass and luminosity are directly related to R0. Distances measured from observed radial velocities and a rotational model of the galaxy are directly proportional to R0 (Reid 1993). In addition, many estimates of the gravitational and luminous mass of the galaxy relate in some way to R0. Then there is the mass and luminosity of objects within the Milky Way, like giant molecular clouds which depend on R0. From a practical point of view, if R0 was known with great accuracy, then working backwards, so to speak, the absolute magnitudes of Cepheid, RR Lyrae and Mira Variables could be recalibrated. This would provide more accurate stellar luminosities and explain some X-ray sources that have super-Eddington luminosities for large R0 values (Reid 1993). In a recalibration process of the absolute magnitude of variable stars, we would gain a better scale for extra-galactic distances and thereby be more precise in assessing the age of stars, globular clusters and the Universe itself. The value of R0 affects the value of the circular rotation speed of the galaxy. This in turn affects the estimation of dark matter so it is also an important issue in cosmology.

NEW TECHNIQUES FOR MEASURING THE DISTANCE TO THE GALACTIC CENTRE

Methods of distance measurement to the galactic centre have been categorised as being either primary, secondary or indirect (Reid 1993).

PRIMARY MEASUREMENTS

1. H2O Proper Motions (Expanding cluster parallax method)

Very Long Baseline Interferometry (VLBI) has been used to determine distances – there are strong H2O maser sources in regions of active star formation. Methods have been described for determining distances from a comparison of proper motions and radial velocities (Genzel, Reid et al. 1981). Using the same methodology and performing proper motion studies of Sgr B2(North), an estimate is made of the distance as being 7.1 +/- 1.5 kpc (given that the galactic centre is within 0.3 kpc of Sgr B2(North) (Reid 1993). There are, however, limitations affecting the accuracy of distance measurements. The motions of maser spots have a random component in each co-ordinate and this obviously affects the accuracy of measurements. Also, because the maser spots are not distributed in a uniform fashion around an exciting star, and because there is need to estimate line of sight distance from the central star for each maser spot, correlations need to be undertaken, which result in "systematic modeling uncertainty" of about 1.1 kpc (Reid 1993).

2. OH/IR stars near the galactic centre

The distance to stars that have OH maser emissions can be determined by the angular diameter of the OH maser cell using radio interferometry and also by estimating the time lag of redshifted emissions from the far side relative to the blueshifted emission from the near side of the maser shell. A limitation here is that angular sizes of OH/IR near the centre are affected by scattering caused by electrons in the interstellar medium.

3. Orbiting Binary Technique

A method has been described (Salim and Gould 1999) for measuring R0 by solving for the Keplerian orbit of individual stars bound to Sgr A* from radial and proper – motion measurements. The methodology here is that a star's line of site motion is measured by Doppler shift in terms of absolute velocity and proper motion is measured in terms of angular velocity. The advantage of this technique is that it removes systematic uncertainties in the astrophysical modeling (Eisenhauer, Schodel et al. 2003).

4. NAOS/Conica Adaptive Optics Imaging

The Nasmyth Adaptive Optics System and the near infrared camera and spectrometer CONICA, or combined name NACO, have been used to observe the galactic centre (Eisenhauer, Schodel et al. 2003). This, together with the MPE integral spectrometer for Infrared Faint Field Imaging and Long-slit Spectroscopy. The value of R0 as deduced from the orbit of S2 and after adjustment for errors is considered to be 7.94 +/- 0.42 kpc.

SECONDARY MEASUREMENTS

These all rely on well-calibrated standard candles to estimate distances to objects in the direction of the galactic centre. This is similar to the methodology adopted by Shapley as discussed in the introduction.

1. Globular Clusters

a. Centroid of distribution

This method relies on globular clusters being symmetrically distributed around the galactic centre (Shapley). In a large sample, one can take the distance to each cluster and project the cluster locations onto the line joining the Sun to the galactic centre. One can then work out the distance to the centre by mapping the location of greatest density by the mean of the distribution. Limitations here are firstly statistical, as different statistical estimations provide for different results. Using a table of varying results (Reid 1993) in Table 2, I have estimated the average value of R0 to be 7.95 +/- 0.8 kpc. With crowding in densely populated fields, there can be difficulties with assessing apparent magnitude. Another limitation is that of extinction, where some clusters appear dimmer and may not be detectable.

b. Cone of avoidance

It is noted that the density of globular clusters decreases in a cone with a ~ 15 degree opening angle when the axis is aligned with the galactic rotation axis. If R0 is 9.2 +/- kpc, then the cone angle is maximised and this indicates the distance (Sasaki and Ishizawa 1978).

c. Metallicity distribution

Metallicity of globular clusters decreases with distance from the galactic centre.

Extinction estimates do not affect this methodology, thereby minimising a source of systemic error.

2. RR Lyrae Variables

RR Lyraes are abundant in the galactic bulge and have similar luminosities. Using photometry, an estimate (after correction) of R0 = 8.3 +/- 1.0 kpc has been obtained and methodology of both optical and infrared photometry has been described (Carney, Fulbright et al. 1995).

3. Giants and Miras

Any bright star can be seen through interstellar windows. Mira variables are suitable for measuring R0 because they are bright and can be visualised through moderate-sized telescopes. They are also bright at infrared, so minimising the effects of extinction. Their use is, however, less accurate than with RR Lyraes. R0 estimates with this methodology range between 7.9 and 9.2 +/- 2.2 kpc (Reid 1993).

INDIRECT MEASUREMENTS

1. Rotational models of the galaxy

Radial velocity measurements for a sample set of stars can be used with a kinematic model for the galaxy to derive kinematic distances (Reid 1993). Using the VLA at 6 cm λ and estimating the apparent shift in the position of Sgr A*, R0 may be derived and has been reported at 7.7 kpc.

2. Luminosity limits

X-ray luminosity models can provide estimates of R0 (7.7 kpc) and also the use of the luminosity of planetary nebulae can provide distance estimates. Specifically this method compares the maximum luminosity observed in a large sample with a theoretically-determined maximum luminosity (Reid 1993).

FINDING THE BEST VALUES AND DECREASING MEASUREMENT ERRORS

Shapley and Oort's estimates were inaccurate because of the problem of interstellar extinction. The advent of radio astronomy circumvented these problems. Systematic and statistical errors have persisted.

If one starts with publications in 1974 and plots estimates of the galactic distance

against time, it is interesting to note a decrease in the value of R0 as recorded up to 1993 (Reid 1993). Moving on a decade and using the Very Large Telescope of the European Southern Observatory (Eisenhauer, Schodel et al. 2003), we obtain one of the most accurate estimations to date where R0 = 7.94 +/- 0.42 kpc. This latter estimation, which is a primary distance measurement, has minimal systematic uncertainties. Systematic sources of error have not always been documented in the earlier literature, or indeed, have not been known. Statistical analysis of astronomical data can be rather complex. There is a possibility in analysis of a "bandwagon effect", which can bias results. Weighing all the possible systematic and statistical errors, an estimate of R0 in 1993 (Reid 1993) is 8.0 +/- 0.5 kpc and if we then include the data from 2003 (Eisenhauer, Schodel et al. 2003) as reported above, we again see the same trend of a decreasing value of R0 against time. In the next few years the European Space Agency's Gaia spacecraft (Dambeck 2008) should begin to provide even more exact data of distances in our Milky Way, with the result of perhaps decreasing the margin of error on the current estimates.

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Lunar Eclipse, June 26th 2010 by Gavin Logan and Shaun Fletcher

New Zealanders had the rare opportunity to observe a partial lunar eclipse in our skies on Saturday the 26th of June. The Moon was partially obscured by the shadow of the Earth, as our home planet passes setween the Sun and the Moon.

The eclipse covered approximately 50% of the Lunar surface at its maximum point, and the main visible event lasted altogether around 2 hours from 10:30pm.

In spite of unsettled and cold weather people came out in surprisingly large numbers for public telescope viewing of the Eclipse at Stardome Observatory. Although there had been showers earlier, the skies cleared up and remained clear for the crucial period from 10.15pm until after 12. The viewing of the Lunar Eclipse was supplemented with two Planetarium Shows, both of which were full.

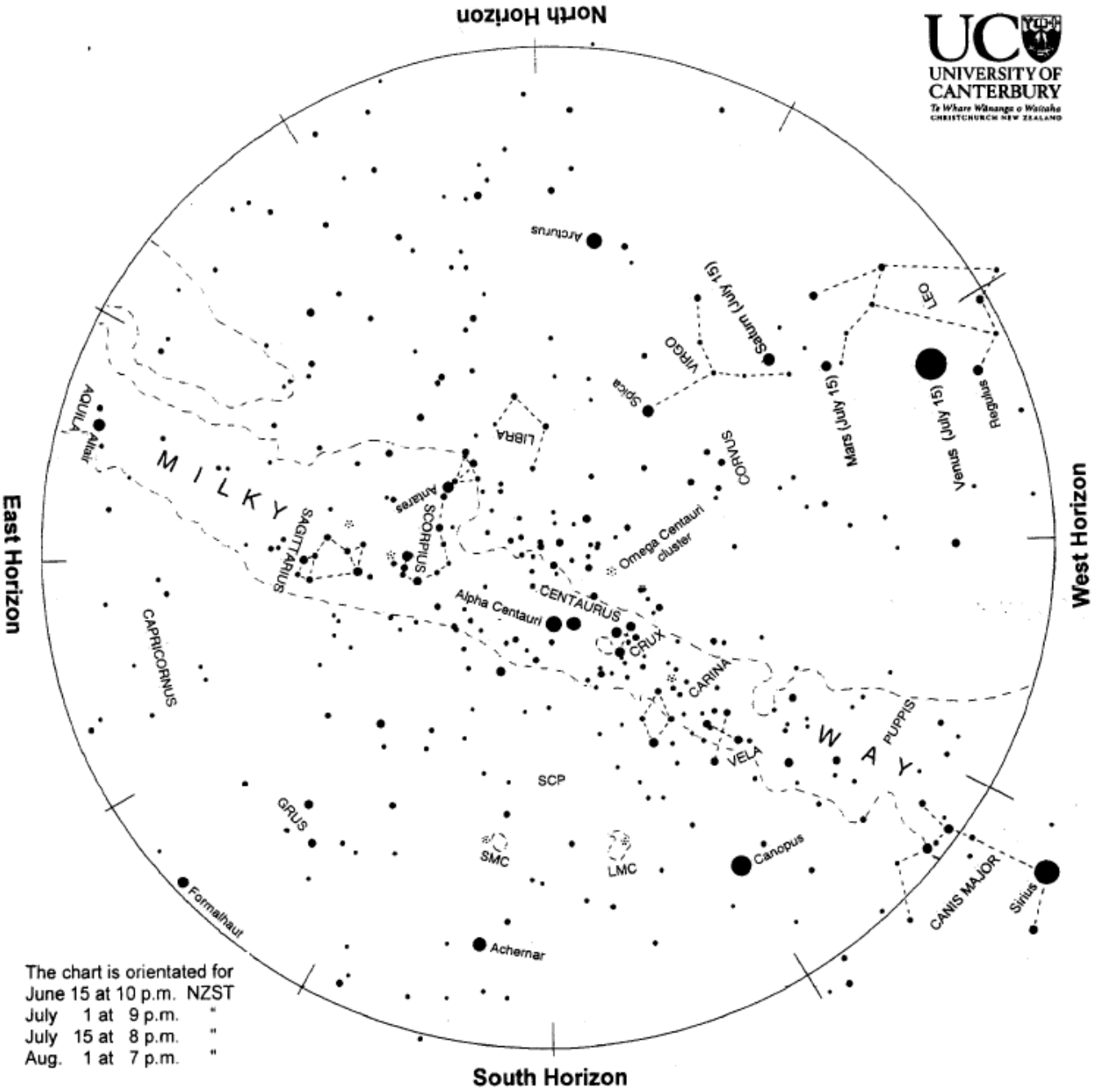
The next eclipse is a full one on the 21st of December this year, when the northern part of New Zealand only will get to see it rise in eclipse, a truly rare event.

Public telescope viewing Of the Eclipse in Stardome's courtyard.

June's partial Lunar eclipse, photograph by Shaun Fletcher.

The Evening Sky in July 2010

By Alan Gilmore, University of Canterbury's Mt John Observatory, www.canterbury.ac.nz



Jupiter rises in the eastern sky before 9 pm at the beginning of the month; before 7 pm by the end. It is the brightest 'star' in the night sky and shines with a steady golden light. Binoculars will show the disk of Jupiter and perhaps one or two of its bright moons. A small telescope easily shows all four moons and the parallel stripes in Jupiter's clouds.

This year we are looking edge-on to the orbits of Jupiter's moons. So the moons frequently hide (occult) each other and their shadows cross over (eclipse) each other. These events last only a few minutes. Some evening events visible from NZ: July 7th, satellite 3 Ganymede occults satellite 2 Europa starting at 10:15; July 11th satellite 1 Io eclipses 3 at 9:09; July13th, 1 occults 2 at 9:55; July 18th 1 eclipses 3 at 11:56.

Saturn is low in the northwest at dusk. In July the rings are nearly edge on to us and even more edge-on to the Sun. So the rings look like a thin line through the planet. A good telescope in steady conditions will show the shadow of the rings as a dark line across Saturn, close to the ring line.

Sirius, the brightest true star, sets in the southwest in early twilight twinkling like a diamond. Canopus, the second brightest star, is in the southwest at dusk. It swings down to the southern skyline before midnight then climbs into the southeast sky through the morning hours. Canopus is a truly bright star: 13,000 times the Sun's brightness and 300 light-years away.

South of the zenith are 'The Pointers ', Beta and Alpha Centauri. They point to Crux the Southern Cross on their right. Alpha Centauri is the third brightest star in the sky. It is also the closest of the naked eye stars, 4.3 light-years away and it is a binary star: two Sun-like stars orbiting each other in 80 years. A telescope magnifying 50x will easily split the pair. Beta Centauri, like most of the stars in Crux, is a blue-giant star hundreds of light-years away.

Arcturus, in the north, is the fourth brightest star in the sky, and the brightest in the northern hemisphere. It is 120 times the Sun's brightness and 37 light-years away. When low in the sky Arcturus twinkles red and green. It sets in the northwest around midnight.

East of the zenith is the orange star Antares, marking the heart of the Scorpion. The Scorpion's tail, upside down, is stretched out to the right of Antares making the 'fish-hook of Maui' in Maori star lore. Antares is a red giant star: 600 light-years away and 19 000 times brighter than the Sun. Red giants are dying stars, wringing the last of the thermo-nuclear energy out of their cores. Big ones like Antares end in massive supernova explosions. Below Scorpius is 'the teapot' made by the brightest stars of Sagittarius. It is also upside down in our southern hemisphere view.

The Milky Way is brightest and broadest in the east toward Scorpius and Sagittarius. In a dark sky it can be traced up past the Pointers and Crux, fading toward Sirius. The Milky Way is our edgewise view of the galaxy, the pancake of billions of stars of which the Sun is just one. The thick hub of the galaxy, 30 000 light-years away, is in Sagittarius. The actual centre is hidden by dust clouds in space. A scan along the Milky Way with binoculars shows many clusters of stars and some glowing gas clouds.

The Large and Small Clouds of Magellan, LMC and SMC, look like two misty patches of light low in the southern sky. They are easily seen by eye on a dark moonless night. They are galaxies like our Milky Way but much smaller. They are about 160 000 light-years away.

Brilliant Venus (not shown) dominates the dawn sky, rising in the northeast after 4 a.m. Above and left of Venus is Mars, much fainter and reddish-coloured. The pair shift slowly eastward against the star background. By mid-month Mars will have the Pleiades/Matariki cluster on its left and orange Aldebaran, (the eye of Taurus the bull, on its right. By then Venus will be below Aldebaran.

Notes on the planets in July

MERCURY was at superior conjunction with the Sun at the end of June. Following this it will become an evening object, but will be too close to the Sun to observe for the first two weeks of July. By July 16 it will be about 6° above the horizon 45 minutes after Sunset. With a magnitude -0.5 it is then likely to be visible very low in a direction between west and northwest.

The planet will move higher into the evening sky during the rest of July, although its brightness will diminish slightly. By July 31, Mercury will set about 2 hours and 20 minutes after the Sun. 45 minutes after Sunset it will have an altitude of 15° and so be an easy visual target.

On July 28, Mercury will be very close to the magnitude 1.4 star Regulus, the brightest star in Leo. The planet will be little more than half a degree above the star and more than a magnitude brighter. Late July and early August are going to provide the best opportunity for seeing Mercury in the evening sky this year.

VENUS will also be in Leo during July but some way ahead and higher than Mercury. It passes Regulus on the 10th when the star will be 1° to the upper left of Venus. Venus will, of course, be far brighter than the star by more than 5 magnitudes, that is over 100 times brighter.

If Venus is being chased by Mercury, Venus in its turn is chasing Mars and Saturn. By the end of July, Venus will be only 8° to the lower left of the two fainter planets, which themselves will be a close pair. By then Venus will be setting after 9 pm.

On July 14 the crescent Moon, 16% lit, will be at its closest to Venus for July. The Moon will be about 7° above and slightly to the left of the planet. The previous night the Moon, an even thinner crescent, will be a little further away to the lower left of Venus and the opposite side of Regulus.

MARS will continue to linger in the evening sky during July, setting by the end of the month about 10pm, depending where in NZ you observe from. It also starts July in Leo, well ahead of Venus, but joins Saturn in Virgo on July 20.

By the end of July, Mars will have caught up with Saturn, the two are closest on the 31st, when Mars will be one-and-three-quarter degrees to the upper left of Saturn. Mars will be slightly fainter than the ringed planet.

The 26% lit Moon will be 5.5° to the upper left of Mars on July 16. The two are closest early evening, their separation increasing slightly during the evening as the Moon moves towards Saturn.

Vesta and Mars continue to move on near parallel paths during July, with Vesta only slowly falling behind Mars. At the beginning of July the two are 5.5° apart, their separation increasing to a little over 7° by the end of the month. By then Venus will be a little closer to Vesta than is Mars.

JUPITER will remain best viewed in the morning sky during July, although by the 31st it will be rising soon after 10 pm, giving the planet a reasonable altitude by midnight. The planet is in Pisces throughout July.

After its close encounter with Uranus early in June, Jupiter will be drawing ahead of the outer planet during July, especially after Uranus is stationary on the 6th. Jupiter is itself stationary on July 24, after which its apparent direction of movement through the stars will reverse to west. It will then begin to move back towards Uranus again.

The Moon does not get very close to Jupiter at present, but it does pass the planet twice in July. On the morning of the 4th the Moon will be about 7° below Jupiter and Uranus, on the morning of the 31st the distance between the Moon and Jupiter will be about 8.5°

SATURN will remain in Virgo throughout July. By the end of the month it will set about 10 pm, the same time as Mars. Thus early evening viewing will be best.

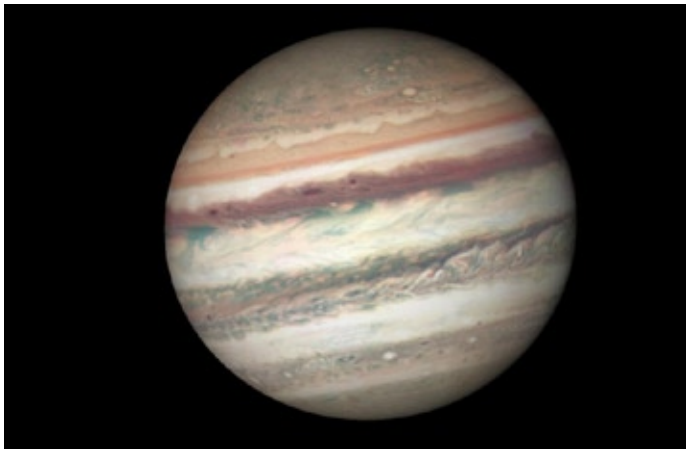
The closest approach of the Moon to Saturn is on the 16th, when the two will be about 7.5° apart, getting a little closer during the evening. The 27% lit Moon will be to the left of Saturn.

Mars will draw closer to Saturn during July, their closest approach being on the 31st, when Saturn will be to the lower right of Mars. Saturn will be the brighter by a fraction of a magnitude.

Diary of Solar System Events July 2010

By Brian Loader RASNZ

DATE (NZDT)	DIARY OF SOLAR SYSTEM EVENTS IN JULY 2010 FOR NEW ZEALAND
July 1	Moon at apogee, its greatest distance from the Earth for the Lunar month, 405036 km.
July 4	59% lit waning Moon, about 7° from Jupiter, and Uranus, morning sky.
July 5	Moon at last quarter 2:35am NZST (Jun 4, 14:35 UT).
July 6	Uranus stationary.
July 6	Earth at aphelion, its greatest distance from the Sun for the year, 1.0167 AU, 152.1 million km.
July 10	Moon furthest north, so lowest southern hemisphere transit for the month.
July 10	Venus 1° from Regulus, magnitude 1.4, brightest star in Leo. Low, early evening sky.
	New Moon at 12:29am NZST (Apr 14, 12:29 UT).
July 12	New Moon at 7:45am NZST (Jul 11, 19:41 UT).
July 12	Total eclipse of Sun with a path arching over the South Pacific, touching little land. Not visible from NZ.
July 13	Moon at perigee, its closest to the Earth for the lunar month, 361116km.
July 14	8% lit crescent Moon, 6° to lower left of Regulus, magnitude 1.4, low to northwest early evening sky.
July 15	16% lit crescent Moon, 3° to upper left of Venus, early evening sky.
	68% lit Moon 6° from Regulus, magnitude 1.4, brightest star in Leo, closest after midnight.
July 16	26% lit Moon, 5.5° from Mars, closest early evening.
July 16	27% lit Moon 7.5° from Saturn, closest late evening.
July 18	48% lit Moon just over 2.5° from Spica, magnitude 1.1, evening sky.
July 18	Moon at first quarter 10.11pm NZST (10:11 UT).
July 21	80% lit Moon 5° from Antares, magnitude 1.1, brightest star in Scorpius.
July 22	Moon furthest south, so highest southern hemisphere transit for the month.
July 24	Jupiter stationary.
July 26	Full Moon at 1.37pm NZST (01:37 UT).
July 28	Mercury just over half a degree above Regulus, magnitude 1.4, early evening sky.
July 29	Moon at apogee, its greatest distance from the Earth for the Lunar month, 405952 km.
July 31	81% lit Moon, about 8.5° below Jupiter, and 7° below Uranus, morning sky.
July 31	Mars 1.75° from Saturn, evening sky.



Jupiter as it will appear 13th July 2010. image credit: Calsky

Crazy Violent Explosion Shoots Out Two Cosmic Bullets

Phil Plait, Bad Astronomy

I deal with superginormously ridiculous energies, velocities, and sizes all the time as an astronomer. You get used to it after a while… then something like this'll slap you upside the head: a star that exploded more than 5,000 years ago launched two epic bullets. One is a cloud of gas screaming away at thousands of kilometres per second, and the other is the cinder of the star itself, an octillion-ton cannonball blasting through space in a totally different direction.

This is a composite picture of the supernova remnant N49: an expanding lumpy sphere of gas about 30 light years across (300 trillion kilometres), located in the Large Magellanic Cloud, a satellite galaxy to our Milky Way. The blue in the picture is the emission from gas heated to millions of degrees, and shows X-rays detected by the Chandra observatory. The yellow and purple are from Hubble data, showing gas being whipped and beaten by shock waves slamming around inside the remnant.

Turn your attention to the little blue blob to the right, marked by the red arrow. It's outside the main bubble of the nebula, meaning that it must be moving faster than the gas in general. This is seen sometimes in supernovae remnants: a bullet or focused blob of gas screaming away. It may be caused by magnetic fields in the expanding gas just after the star explodes, launching the octillions of tons of matter away in all directions, or it may be due to focusing from shock waves, which can sculpt the gas and create little pockets of denser knots.

Either way, this bullet is moving away from the nebula at speeds of more than 2200 km/sec — fast enough to cross the United States in less than 3 seconds. The mass of the blob is unclear, but to give you an idea of the energies involved, it emits 10 times the Sun's total energy in just X-rays alone. Incredible.

Now focus your attention to the star-like point source indicated by the other red arrow, near the top of the remnant. The astronomers took a good look at that object, which was previously known to be an object called SGR 0526–66. SGR stands for Soft Gamma Ray Repeater, an object that periodically blasts out flashes of super-high-energy gamma rays. SGRs are neutron stars, the ultra-compact and überdense (I know, I'm running out of adjectives.. but just you wait…) leftover cores of stars that have exploded. They can have more than the mass of the Sun compressed down into a ball just a few kilometres across! A cubic centimetre of neutron star material (usually called neutronium, a word I love love love) weighs about as much as the combined weight of all the cars in the United States. So there's that.

The astronomers found the age of the SGR to be a few thousand years, which matches the age of the nebula! That means it's very likely this is the leftover core of the star that exploded and created N49 itself. But what's it doing way off centre?

Astronomers think that sometimes the explosion can be off-centre in the star, so that things don't quite expand the same in all directions. Given the energies involved (hint: a LOT) this can give the neutron star a kick, sending it caroming through space at high velocity. If SGR 0526-66 is indeed the leftover cinder from the explosion, to get where it is in the time since the explosion it has to be moving at a velocity of at least 790 km/sec Think about that: this is an object with the mass of the Sun and it got kicked so hard it went shooting off hundreds of times faster than a rifle bullet.

Yeah, you might want to sit for a moment and soak that in.

It gets worse! Since it's seen in the Chandra data, that means it's hot. Glowing at several million degrees, the energy it gives off in just X-rays is a hundred times the Sun's total energy production! If you replaced the Sun with SGR 0526-66, you'd barely be able to see it since it's so small, but it would hardly matter: the X-rays it gives off would cook the Earth like a marshmallow in a furnace. If that's not enough awesome for you, the magnetic field at the surface of the neutron star is about 100 trillion times stronger than the Earth's!

Neutron stars are small in stature, but nothing else about them is.

Studying supernovae remnants is interesting scientifically for lots of reasons, not the least of which is that they create the heavy elements in the Universe, so we literally owe our lives to them. That would be enough… but I know that secretly, astronomers study them because they are simply so frakkin' cool.

Or maybe it's not so secret.

The one PC to rule them all

The Kumeu Observatory Part 2 by Dave Moorhouse acrux@orcon.net.nz

The Nustrini C14 Celestron Telescope at the heart of the Kumeu Observatory

I was intending to write this month about Microlensing activities at Kumeu. However, Murphy's Law took over and we had last month a major computer drama. The motherboard, a fairly essential component of every PC, died. You may think, "Well, what's so hard? Just rebuild the PC! Put the software back on and get going again!" Wrong! It took about two weeks to get things running smoothly again. All so that we can simply find a star, focus, choose the right filter and take a series of five- minute images for the rest of the night. This is, in a nutshell, what we are actually doing when we chase after Microlensing targets to find those elusive extra-solar planets.

So I thought I might give a quick insight into the bits that make a modern observatory

The USB dome controller interface

system tick. It's just a telescope and a camera talking to a PC, isn't it? Again, wrong! Our system has multiple hardware parts as well as multiple software components. In the umm, good old days, it was simple - you had a telescope on some sort of equatorial mount, a film camera that you had cleverly worked out how to get focused without seeing the result until days later and a long focal length finder-scope with a cross hair eyepiece for hand guiding. Then you needed the patience of a saint as you sat at the finder telescope, in the cold, in the dark, staring into the eyepiece for about an hour while the camera image was building up on the film of the main telescope. So what changes? How about almost everything!

The telescope is the same. In fact, our telescope, the Nustrini, was formally used at Stardome for research. It is a Celestron C14 (14" primary mirror) with a fantastic Byers worm and wheel. This telescope is about 30 years old and gives results close to those of today's supposedly superior optics. It does spout a new 1-metre or so dew shield made last year. It is still a fork-mounted equatorial and tracks like a little gem. This is where the similarities to the good old days end.

The mount and telescope, although of fantastic quality, are both old school, made before the age of embedded processors and fancy control systems. So it is dumb, it isn't goto, it hasn't got any idea where it's looking in the sky or, more importantly for us, it can't tell a PC where it is pointing in the sky.

This is the first part of the technology revolution that makes our observatory hum. The Auckland Astronomical Society supplied us with an ArgoNavis digital setting circle computer. This is a very smart box that is an after-market addition to almost any telescope. It relies on two optical encoders on the telescope to keep track of where the telescope is pointing to in the sky. It can also help you find any object in the sky. Finding a specific star in the middle of Sagittarius is very hard to do by hand. This box makes it a much quicker and easier task. The ArgoNavis also talks on an RS232 serial data port to the PC (yes, I have finally got back onto the topic).

The next item is the CCD camera. I bet most of you have one of these somewhere, a cell phone still or video camera perhaps? This one is different. It's 100 % built for taking Astronomy photographs. The camera body has no controls or buttons, just a power and a USB connection. It can only be used connected to a PC. However, it has a few neat tricks: the CCD is cooled, in our case to about -20 degrees Celsius. This is to greatly reduce the ever-present noise on our very long exposures. An automated filter wheel moves to place one of five different filters in front of our CCD. This is because ours is a monochrome (black and white) camera, again under PC control. This camera is made by a company called SBIG, the model being an ST7.

Remember the poor chap with frostbitten hands, sitting for hours staring at the eyepiece to guide the telescope to keep the stars exactly on target during the hour-long exposures? Redundant! The old pal the PC wins again. Our special camera has another card to play - it also has a second camera built into the same body. The light comes from the same telescope that is taking the real picture. This second chip takes images every few seconds. Our mate the PC looks at a star in this second camera's picture and tells the telescope mount to speed up, slow

down or go north/south to get us perfectly on track. We can keep a star on one pixel, all night, unattended, without us being in the cold getting frostbite. This is Autoguiding.

The focuser also gets a makeover. Stepper motors a control box and yip? a serial link to the PC. Our PC is able to take a series of images while moving the focuser in and out of focus, measure the images to see how out of focus they are, then pick the perfect focus point for us!

The last bit of hardware is the Dome, a 4-metre diameter wooden wonder. I still love to look at the workmanship in this Dome. In the bad old days we used to push the Dome by hand, once every twenty minutes in the freezing cold at 3am. Now I have made a motorised controller that interfaces to the PC, via a simple USB Jaycar kitset, a few relays and a highly-geared motor.

The PC then is the hub of everything. It knows where the telescope is pointing due to the Argonavis. We use a fantastic program called MaximDL to join all these

The custom built dome drive

devices together seamlessly. It knows the geometry of the Dome and the position of the telescope so MaximDL can turn the Dome to make sure the telescope is always seeing out the clear opening of the slot, without any intervention. The very sensitive, cooled, CCD camera takes in five minutes what would have taken an hour on film. MaximDL automates the taking of multiple images, choosing the filter and putting them numbered into a directory for you. The PC can focus the images and even help correct for changes of focus, due to temperature changes as the night gets colder and the tube shrinks! Autoguiding is handled by MaximDL taking short guiding images and nudging the mount to make corrections. Every aspect of finding the target, taking perfect images and processing them later is now handled by the PC. Every component of this system needs a driver, some configuration or software to make all these parts play nicely on the PC. This is why it took so long to get it all working smoothly again after our PC meltdown.

Taking good images is still hard work. We have all these things able to talk to a PC. Getting this set up and working is now the hard part, just as sitting in front of the cross hair eyepiece was in the past. The effort is just different now, getting fairly complex integrated systems all talking smoothly and reliably to each other. When they work you can get set up and taking pictures in less than 15 minutes, go downstairs into a warm room and watch the images being taken on a second remote PC, while drinking hot chocolate and discovering planets even in your sleep.

Earth-like Planets May Be Ready for Their Close-Up

by NASA/JPL

Many scientists speculate that our galaxy could be full of places like Pandora from the movie "Avatar" -- Earth-like worlds in solar systems besides our own.

That doesn't mean such worlds have been easy to find, however. Of the 400-plus planets so far discovered, none could support life as we know it on Earth.

"The problem with finding Earth-like planets," said Stefan Martin, an engineer at NASA's Jet Propulsion Laboratory, Pasadena, Calif., "is that their host stars can emit 10 million times more infrared light than the planet itself. And because planets like ours are small and orbit very close to their respective stars, it makes Earths almost impossible to see."

Together with A.J. Booth (formerly at JPL and now at Sigma Space Corp., Lanham, Md.), Martin may have developed a way to make this almost impossible feat a reality.

Their instrument design, called a "nulling interferometer," observes planets in infrared light, where they are easier to detect. It is designed to combine starlight captured by four different telescopes, arranging the light waves from the star in such a way that they cancel each other out. "We're able to make the star look dimmer -- basically turning it off," Martin said.

Nulling interferometry is not a new idea, but what sets the results from Martin and Booth apart is how effective it turned out to be. "Our null depth is 10 to 100 times better than previously achieved by other systems," Martin said. "This is the first time someone has cross-combined four telescopes, set up in pairs, and achieved such deep nulls. It's extreme starlight suppression."

That suppression could allow scientists to get a better look at exoplanets than ever before. "We're able to make the planet flash on and off so that we can detect it," Martin said. "And because this system makes the light from the star appear 100 million times fainter, we would be able to see the planet we're looking for quite clearly."

PANDORA, UP CLOSE AND PERSONAL

Nulling interferometry isn't the only way scientists can find other Earths. NASA's Kepler mission, currently in orbit, is looking for Earth-like planets by watching the light of faraway stars dim slightly as their planets pass in front of them. Another method of observing exoplanets is coronagraphy, which uses a mask to block the optical light of a star, making its surrounding planets more easily visible. And the proposed SIM Lite mission would also be able to find nearby planets by observing the gravity-induced "wobbling" of their host stars.

However, Martin and Booth's nulling interferometer could eventually give astronomers the ability to get up close and personal with Earth-like worlds, analysing their atmospheres for signs of habitability or even possibly life. "We expect to eventually be able to see hundreds of planets with this technique," Martin said.

The technology that they've developed could be used on a follow-up space mission to SIM Lite and Kepler. Martin is now planning to test the system in conditions that better mimic a real-life mission.

Once considered the stuff of science fiction, it may not be long before Earth-like planets, or, in the case of Pandora, Earth-like moons of giant planets, are found to exist in other places besides the silver screen.

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