AUCKLAND ASTRONOMICAL SOCIETY

SEPTEMBER 2010

SOCIETY JOURNAL

Burbidge Dinner - with keynote speaker John Hearnshaw

RUTHERFORD ROOM, ALEXANDRA RACEWAY, SATURDAY, OCTOBER 9TH

The keynote speaker will be Professor John Hearnshaw, recently retired from The University of Canterbury where he was professor of Astronomy in the Department of Physics and Astronomy. John's research interests include extrasolar planetary systems, the history of astrophysics, RS CVn stars (tidally locked G & K type binary stars), the spectroscopy of late-type stars, stellar radial velocities and the design of astronomical spectrographs. John was closely involved with the building of the MOA telescope that is purpose-designed for the study of extrasolar planetary systems using Gravitational Lensing. MOA is a highly successful collaboration between New Zealand universities and the University of Nagoya in Japan. He is the author of several books and has made contributions to many more.

Last year John toured much of the world in his role as chairman of the International Astronomical Union's Programme Group for the World-Wide Development of Astronomy as part of the International Year of Astronomy, where he visited and gave lectures to observatories and universities in such exotic places as Mongolia, Trinidad and Tobago, Thailand, Laos and Uzbekistan.

John is an excellent speaker and he has recently published a book to mark the International year of Astronomy and the significant part that he played in it.

ADVENTURES OF A TRAVELLING ASTRONOMER IN CENTRAL ASIA: IN THE FOOTSTEPS OF MARCO POLO AND ULUGH BEG

John will describe his experiences in recent years in three countries of Central Asia where he made astronomical visits, namely Mongolia (2004), Uzbekistan (2008) and Tajikistan (2010). The history and culture of these three countries are all completely different and the problems faced by astronomers there are also different, although they are relatively poor countries struggling to do good science. But they all share one thing in common: some of the world's best high-altitude sites for optical and infrared astronomy are to be found in this region bordering on the Himalayas.

September Society Meeting Astronomy: What have we learned in 100 years?

with Dr Grant Christie - President, Auckland Astronomical Society

One hundred years ago, our understanding of the Universe was quite limited. This talk will chart the progress of astronomy over the last century and explain how better instruments have led to new theories about the formation of planets, stars, galaxies and, indeed, the universe. And yet today we are still confronted by major unknowns and technical challenges - what could we expect in the coming century?

Dr Grant Christie is president of the Auckland Astronomical Society and vice-president of the RASNZ. He enjoys appearing on Graeme Hill's weekly radio show (RadioLive) and explaining astronomy to the public; he has been a leading contributor to the NZ Astronomical Yearbook since 1995. Maintaining his interest in observational astronomy and messing around with telescopes, he is honorary astronomer at the Stardome Observatory. As a member of an international collaboration that hunts for exoplanets using gravitational microlensing, he has so far contributed to the discovery of over 15 new worlds.

Dr Grant Christie.

Waharau Dark Sky Weekend - 10th to12th September 2010

The Auckland Astronomical Society has arranged another astronomical weekend at the Waharau Outdoor Education Centre, located in the Waharau Regional Park, north of Kaiaua on the Firth of Thames.

Waharau is a sufficient distance away from Auckland to be not affected by light pollution. The skies here are dark and we have had many great observing nights at this excellent facility.

These weekends are an ideal way for new and established members to meet each other, find out more about the different types of telescopes which many members bring to the occasion and learn about new aspects of the night sky and its wonders.

The Waharau Outdoor Education Centre incorporates a lodge, five chalets and an ablutions block. There are five chalets, each with two rooms. Each room can accommodate 10 people. The lodge has a fully equipped kitchen and tables and chairs to seat 100 people.

Many unusual and interesting telescopes can be seen, and used, at Waharau events.

The AAS does not provide food at these weekends. However tea / coffee / sugar and biscuits will be provided by the society. If you require food there is a Pub and a Fish and Chip shop in Kaiaua. There is also a Gas Station and a Dairy where you can pick up supplies.

You can arrive from about 5PM on Friday and when you arrive, check in and pay your fees. Allow 90 minutes travel time from the city centre, but do allow extra time if travelling down on Friday evening, due to traffic.

Cost: $20 per person per night.

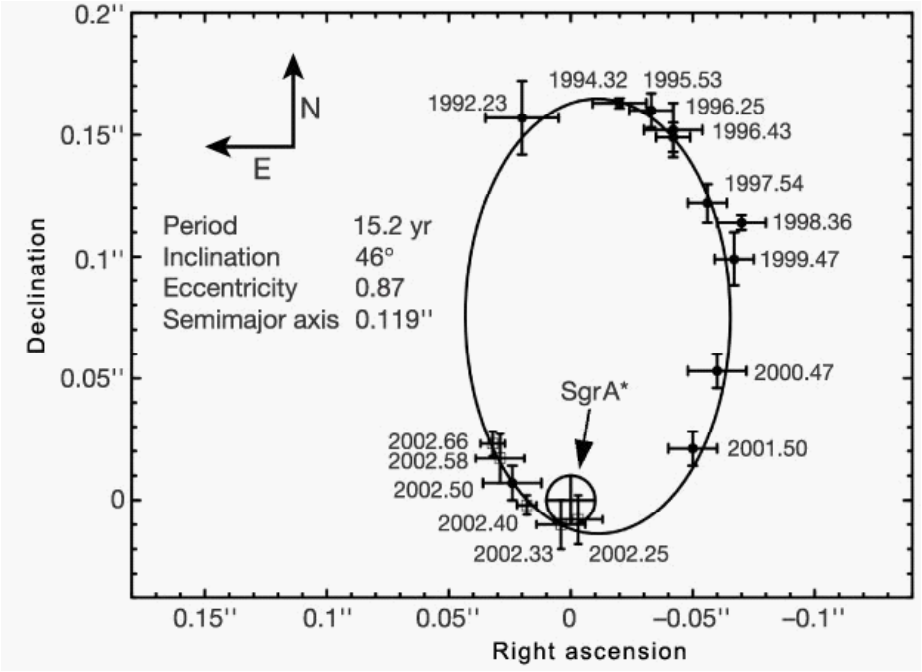
For more information or to make a booking: Ph Dave Moorhouse on 027 481 9089 or email acrux@orcon.net.nz

Payment: Prepayment by Internet banking, Visa or Mastercard can be made by contacting Andrew Buckingham on 09 473 5877 or by email at treasurer@astronomy.org.nz. Otherwise payment can be made on-site by cash or cheque.

August Society Meeting -The Black Hole in the Milky Way galaxy

With Dr. Philip Sharp - Report by Clive Bolt

The giant elliptical galaxy, M87 is about 55 million light years away in the constellation of Virgo. It is the brightest in the Virgo cluster and characterised by a large jet that is assumed to result from a super-massive central black hole of some 3 billion solar masses. Dr Sharp explained that a black hole is an object of large mass condensed into a singularity, something physicists are not keen on whereas mathematicians are entirely comfortable with the concept. The event horizon is the imaginary sphere around the singularity where the escape velocity is just equal to the speed of light. Stephen Hawking proposed the idea that space is full of virtual particle pairs that appear and annihilate, but a pair that forms on the event horizon may lose one of the pair inside the event horizon while the other might escape, effectively seen as emissions of radiation. Because nothing can escape from the black hole, the event horizon would be a very cold, black body radiator.



The motion of the star S2 around the compact object in the galactic centre.

The definition of the size of a black hole is the volume bounded by the event horizon and it turns out therefore, that the density is proportional to the inverse of the square of the mass. The consequence is for very large black holes to have surprisingly low densities. The black hole in the centre of M87, for example, is expected to have a density of about 340 grams per cubic metre, less than the density of water.

The intervening gas and dust along the line of sight between Earth and the Milky Way Galactic Centre attenuates the light by about 25 magnitudes. Near infrared and short-wavelength radio frequencies are required to study objects in the galactic centre. A long baseline radio telescope array is capable of resolutions of about 100 micro arc seconds. For comparison, a person's eyes viewed from a distance of 2000km, the distance between North Cape and the Bluff, is about 7 milliarcseconds.

In 1974 Balick and Brown found a complex radio source in the central region of the Milky Way using long baseline interferometry. The radio source became known as Sagittarius A*, SGR A* for short. A source star, S2, was identified orbiting the compact source and over a period of 10 years the orbit was calculated with a steady improvement in the accuracy as the equipment became more sensitive. Initial measurements of the mass of the central object were put at 2.1 million solar masses, later refined to about 4.1 million solar masses as equipment improved and more of the orbit of S2 was observed. The orbit of S2 is highly elliptical and at its closest approach, S2 reaches about 5000 km per second, nearly 2% of the speed of light. Calculations show that S2 would need to be about 1/70 of that distance from SGR A*, about distance of the orbit of Mars, before it would be disrupted by tidal forces from the huge gravitational field.

A black hole of 4.1 million solar masses in the centre of the galaxy would have an angular radius of about 37 micro arc seconds whereas SRG A* has an angular radius of 52 milli arc seconds. From this we conclude that the complex radio source is not actually the black hole itself but is probably associated with it, perhaps within, or part of, the accretion disc.

It is expected that improvements to radio telescopes will enable them to operate at 1mm wavelength and that will enable direct imaging of the event horizon by very long baseline interferometry.

A very lively question time then ensued, a clear sign that the audience had both understood and thoroughly enjoyed the talk. Thank you to Philip for a very interesting and well-presented talk and to Grant for organising the evening.

A full house of around 130 members listened to Dr. Sharp's talk on the Sagittarius A objects at the Galactic Centre.

The Seven WISE Sisters

by Phil Plait, Bad Astronomy

If you live in the northern hemisphere and go outside in the winter, hanging not too far from Orion's left shoulder is a small, tight, configuration of stars. A lot of people mistake them for the Little Dipper — I get asked about it all the time — but really it's the Pleiades (pronounced PLEE-uh-dees), an actual cluster of stars about 400 light years away. To the eye you can usually spot six of the stars (the seventh, seen in ancient times, may have faded a bit since then), and in binoculars you can see dozens.

But when NASA's Wide Field Infrared Survey Explorer (WISE) looked at it in February, this is what it saw:

Coooool. Literally! WISE looks in the infrared, and can see cool objects that are invisible to our eyes. The Pleiades stars are bound together in a cluster by their own gravity, and are currently ploughing through a dense cloud of dust and gas in the galaxy. The material has been warmed up by the hot stars, and glows in the infrared. Deep images in visible light also show the material, but it looks blue as it reflects the optical light from the stars. In the WISE images, we're seeing the matter actually glowing on its own, emitting infrared light.

When I was younger it was thought that this material was the leftover stuff from which the stars formed. But it was later found that the stars are older than first thought; about 100 million years old. While still quite young — the Sun is 4.5 billion years old! — that's long enough for the original cocoon of material that made up these stars' nursery to have dispersed. So it's a cosmic coincidence that we happen to see the cluster as it's ramming through this material. On the other hand, the Milky Way galaxy is loaded with lots of junk floating out there, and the Pleiades are in an area of high traffic. It's not too surprising we'd see something like this happening, and it's nice that it's going on close enough that we get a good view of it.

WISE doesn't just get pointed wherever astronomers see something interesting: it's an all-sky survey, spinning on its axis and taking snapshots continuously. These are stored, and astronomers on the ground can then put them together in a mosaic. This image is actually pretty big, covering 2×3° of the sky. That's about the size of a postage stamp held at arm's length, and is a fair bit

bigger than the full Moon on the sky. This image was released to celebrate the fact that as of July 17, WISE has now scanned the entire sky, and its primary mission has been fulfilled. Yay!

Funny, too: I've observed the Pleiades a lot, and seen lots of pictures too, yet it's difficult to identify the stars in the WISE image — I had to rotate the visible image to match the one from WISE, but even then it's not entirely obvious how they line up. In the IR, stars are bright that might be dim in optical, and vice-versa! But I'd recognize the sheets and filaments of the disturbed dust anywhere. One of my favorite things in astronomy is seeing a familiar object in an unfamiliar way. It reminds me that there's still plenty to learn about the Universe.

Image credits: NASA/JPL-Caltech/UCLA and NASA, ESA and AURA/Caltech

The Beaumont Memorial Prize for Journalism

The Beaumont Memorial Prize is awarded for the best article published in the Society Journal in the last year. That is including the November 2009 issue and up to , and including, the October 2010 issue. The article must be on an astronomical subject. It must be an original article of at least 500 words and written entirely by an individual author who is a current financial member of the Society. Any supporting images or graphics should contain a significant proportion of original input from the author.

Dr. Roger Feasey will be the Judge for this year's competition. The winner will be announced at the Annual Burbidge Dinner on Saturday the 9th October 2010 and the winning author will receive a cash prize. It is important to maintain a high standard of writing. If there are no articles deemed by the judges to be of sufficient standard, no prize will be awarded. The judges' decision will be final.

You have a month to get an article into the next magazine. Remember that Astronomy is just as much a practical subject as it is an academic one. Articles about observing, personal experiences and the use and maintenance of equipment meet the judging criteria perfectly.

Calendar and Events

SEPTEMBER PROGRAMME

Fri 3	7:30pm	Young astronomers with Margaret Arthur
Mon 6	7:00pm	Practical Astronomy Spring Star Party
Fri 10 & Sat 11	7:00pm	Dark Sky Weekend at Waharau Regional Park.
Mon 13	8:00pm	Monthly meeting Astronomy: What have we learned in 100 years? with Grant Christie.
Mon 20	8:00pm	Film Night September In the Shadow of the Moon with Gavin Logan.
Mon 27	8:00pm	Introduction to Astronomy Continuing course with Bernie Brenner

SEPTEMBER MONTHLY MEETING
Monday 13th September at 8:00pm
Speaker: Dr Grant Christie

Astronomy: What have we learned in 100 years?

This talk will chart the progress of astronomy over the last century and explain how better instruments has led to new theories about the formation of planets, stars, galaxies and, indeed, the universe.

FILM NIGHT SEPTEMBER
Monday 20th September at 8:00pm
with Gavin Logan

This Month: In the Shadow of the Moon.

In the Shadow of the Moon is a 2006 British documentary film that follows the manned missions to the Moon made by the United States in the late 1960s and early 1970s. The documentary reviews both the footage and media available to the public at the time of the missions, as well as NASA films and materials which had not been opened in over 30 years. All the footage is remastered, most of it colour and looks as good as new.

INTRODUCTION TO ASTRONOMY
Monday 27th September at 8:00pm
An introductory astronomy course in various topics.

This Month: The Sun. This session will look at the composition, atmosphere and processes going on in our nearest star, the Sun.

The session will include a video lecture followed by a tutorial session reviewing the material covered.

WAHARAU DARK SKY WEEKEND
Friday 10th September from 7:00pm

Dark Sky Weekend at Waharau Regional Park.

Friday 10th September to Sunday 12th September 2010

OCTOBER PROGRAMME

Fri 1	7:30 pm	Young Astronomers with Margaret Arthur
Mon 4	8.00 pm	Practical Astronomy Observing Planets & the Gas Giants
Sat 09	6:30 pm	2010 Burbidge Dinner
Mon 11	8:00pm	Monthly meeting The 25 Greatest Discoveries in Astronomy and Astrophysics of the 20th Century with John Hearnshaw
Mon 18	8:00pm	Film Night October Einstein and Eddington. with Gavin Logan.
Mon 25	8:00pm	Introduction to Astronomy Continuing course with Bernie Brenner

PRACTICAL ASTRONOMY SEPTEMBER
Monday 6th September from 7:00pm
Spring Star Party

This time we will start telescope viewing early, from 7pm onwards, to enable us to view the planets and for those with early bedtimes. At 8pm we will move into the planetarium and take a look at the highlights of the Spring Sky.

Afterwards we will return to telescope viewing. The EWB Zeiss Telescope will be available for viewing as well as portable telescopes outside in the courtyard. Ivan Vazey (AAS Curator) will be on hand to help people who have questions about telescopes or your own telescope. Feel free to bring your own telescope along.

The event will be weather independent, and if needed we will have a star story session in the planetarium to learn some new constellations and asterisms. Please bring along your favorite star story to share.

OCTOBER MONTHLY MEETING
Monday 11th October at 8:00pm
Speaker: Professor John Hearnshaw

Prof. Hearnshaw will present his personal list of the 25 most important and influential discoveries in astronomy of the 20th century. He will analyse the papers that reported these discoveries by the year they occurred, the age of the discoverers and the country where the people worked.
The decades 1911-20 and the mid-1960s to mid-70s were the most productive of the 20th century, in spite of the later arrival of computers and observatories in space. he will suggest reasons for the decline in the rate of really important papers in the final two decades of the century.

WELCOME TO NEW MEMBERS

Chris Guthrey (family)
Jason Lim (student)

2010 Burbidge Dinner

Rutherford Room, Alexandra Raceway, Saturday, October 9th

The popular Burbidge Dinner will be on Saturday, October 9th at the Rutherford Room, Alexandra Raceway. Support this annual event for the Society - get your tickets!

The keynote speaker will be Professor John Hearnshaw, recently retired from The University of Canterbury where he was professor of Astronomy in the Department of Physics and Astronomy. John's research interests include extrasolar planetary systems, the history of astrophysics, RS CVn stars (tidally locked G & K type binary stars), the spectroscopy of late-type stars, stellar radial velocities and the design of astronomical spectrographs. John was closely involved with the building of the MOA telescope that is purpose designed for the study of extrasolar planetary systems using gravitational Lensing. MOA is a highly successful collaboration between New Zealand universities and the University of Nagoya in Japan. He is the author of several books and made contributions to many more.

Professor hearnshaw will present a talk entitled 'Adventures of a travelling astronomer in Central Asia: in the footsteps of Marco Polo and Ulugh Beg '

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

Ticket price is $70-00 per person, incl. GST

Society members and guests enjoy the 2009 Burbidge Dinner.

Purchasing Tickets: 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 or by phone to 09 473 5877.

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

Auckland Astronomical Society

2010 Astrophotography Competition - Harry Williams Trophy

This competition is open to all New Zealand Astronomical Societies, clubs and groups. Each entrant must have taken the image they submit.

The Categories are:

Solar System: Moon, Planets, comets, asteroids, meteorites, dwarf planets, auroras.

Deep Sky : Nebulae, galaxies, star clusters, deep sky objects.

Miscellaneous: Artistic and interesting subjects with an astronomical theme .

Competition Entries Due by Friday 19th September 2010. The winners will be announced at the Burbidge Dinner in Auckland on Saturday October 9th 2010. Entry forms and conditions of entry can be downloaded from the society website or by request from the email address below.

2009 Harry Williams Trophy Winner by John Drummond

Send entries by email (max 2MB per email) or copied onto CDROM/ or 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. Printed images will not be accepted.

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

The search for life beyond begins below

By Gavin Logan

Hydrothermal vents on the ocean floor.

That was the theme of August's Film Night movie "Aliens of the Deep". Over forty society members were taken on a cinema journey to some of the Earth's deepest, most extreme and unknown environments.

This film which featured some amazing photography was received with great interest by the society members in attendance. Using the Russian research vessel Akademik Mstislav Keldysh a group of NASA scientists and some Russian marine biologists, investigate hydrothermal vents in both the Atlantic and Pacific. Diving in submersible vehicles to depths of over 3000 metres they explore parts of the ocean floor that have their own unique ecosystem, which support diverse organisms such as giant tube worms, swarms of blind white crabs, and vast amounts of shrimp which are capable of "seeing" water that is heated by the vents. These creatures do not require sunlight like other organisms, and instead obtain their energy from the vents. They are able to survive in the superheated and sulfurous water. Because of this, the documentary suggests that this is what life beyond Earth might look like and that these exotic vents might provide an insight into the forms of life we may one day find in outer space, not only on planets orbiting distant stars, but also within our own solar system.

Next Month's film night will screen "In the Shadow of the Moon" and is on Monday 20th September at 8pm at Stardome. It is a 2006 British documentary film that follows the manned missions to the Moon made by the United States in the late 1960s and early 1970s. The documentary reviews both the footage and media available to the public at the time of the missions, as well as NASA films and materials which had not been opened in over 30 years. All the footage is remastered, and most of it is in colour. It contains interviews and commentary with ten of the twenty-four astronauts who orbited, looped around, or landed on the Moon. It premiered at the 2007 Sundance Film Festival, where it won the World Cinema Audience Award. In March 2008, it was the first film to win the Sir Arthur Clarke Award for Best Film Presentation.

Submersible vehicles in action with research equipment 3500 metres deep in the ocean.

A request from the Curator of Instruments

We hired out one of our 200mm Dobsonian telescope in March this year and the member has so far overlooked returning it to the Society.

This can easily happen so we would appreciate any participating hire members simply checking in their garage or back rooms to see if it is hiding there. There are no penalties or back rental fees incurred, the telescope can simply be returned to the society at the Stardome as usual. We need to account for it as soon as possible to enable other members to take advantage of our telescope hire facility.

Contact Ivan at ivazey @surfer.co.nz. Thanks all.

Public lectures at the Stardome Observatory in September

SPEAKER - DR GRANT CHRISTIE

As part of the Auckland Heritage Festival, Dr Christie will present two lectures, which should be of interest to our members and friends. Dr Christie has been associated with the Stardome Observatory since it opened in 1967. Today he leads the research programme that has recently contributed to the discovery of planets orbiting distant stars.

STARDOME OBSERVATORY: ITS GENESIS AND ACHIEVEMENTS

Wed 22, Sun 26 Sep 7.30pm - FREE (bookings essential)

The modern Stardome Observatory had its origins in the 1930s, when some visionary members of the Auckland Astronomical Society first proposed a public observatory for Auckland. The dream was finally realised when the observatory opened in 1967, housing the Edith Winstone Blackwell Telescope, the largest in New Zealand at that time.

Stardome today plays a major role in public science outreach, education and astronomical research. This talk will trace its history and explain some of its significant astronomical discoveries.

THE TRANSIT OF VENUS AND THE QUEST TO MEASURE THE SIZE OF THE UNIVERSE

Wed 29 Sep, Sun 3 Oct 7.30pm - FREE (bookings essential)

To measure the size of the universe, first you have to get a ruler. The most convenient ruler in astronomy is the distance from the Earth to the Sun, but in the 18th century, this key quantity was not precisely known. This talk by Dr Grant Christie will explain how the transit of Venus was used to measure this distance and the role played by astronomers in New Zealand.

Contact Stardome at 624 1246 - email info@stardome.org.nz - website www.stardome.org.nz

Pavo - The Peacock

By Ivan Vazey

Globular Cluster NGC 6752. Image Bernd Flach-Wilken - www.spiegelteam.de.

Pavo is a modern Constellation and was first published by Johann Bayer in his famous atlas of 1603, "Uranometria"

Pavo has a minor mythological twist however, taking its name from a Greek legend.

Zeus's wife Hera had a chief priestess named Callithyia. Zeus, true to form, fell in love with her and changed her into a cow to protect her from his wife. If nothing else, Zeus was imaginative.

But Hera, also true to form, obtained the cow from Zeus and took it to the mountains, placing it under the care of Argus Panoptes. Argus was your everyday hundred-eyed giant and his task was to keep the cow away from Zeus.

Zeus, put out by this new development, sent the fleet-footed Hermes into the mountains where he killed the giant.

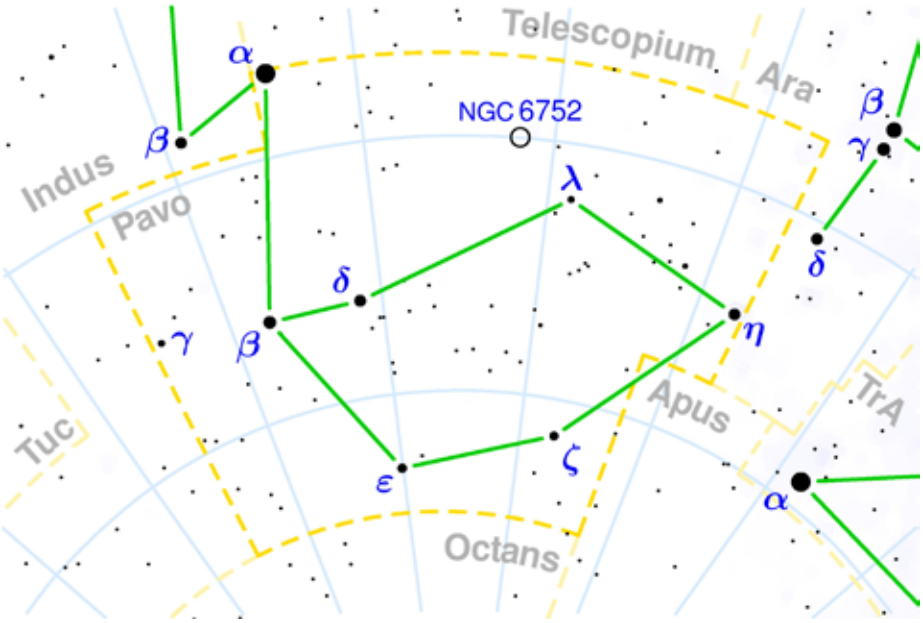
Hera was rather annoyed about the dead giant, and prised out each of his hundred eyes, having them sewed on to the tail of Pavo her favorite Peacock so that Zeus would forever see them.

Notable objects

NGC 6752 or Caldwell 93. Undoubtedly the third best Globular in the sky behind Omega Centauri and 47 Tucanae. (This would be a close rival to M22.) C93 is bright, 5.4 and very large 20'. Caldwell 93 sits 3.1deg NE of Lambda Pavonis.

NGC 6744 or Caldwell 101 is a barred spiral galaxy 2.6deg ESE of Lambda Pavonis. Dreyer called NGC 6744 'bright and quite large, with a sudden brightening to the core and also somewhat resolvable (meaning probably mottled) under dark skies'. Caldwell 101 is actually tipped at around 45 to 50deg to us.

Pavo has at least a hundred galaxies in the NGC and IC catalogues and is well worth a 'visit'. Best of all, Pavo is circum-polar for us.



Pavo sits high in the southern sky in September, easily located by following the arrow of the Triangulum Australe from the familiar pointers of Centaurus. Offering a rich field of galaxies to the larger telescope, and a number of fine clusters for the smaller instrument, it is an interesting area in which to spend a night of observation.

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
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	Shaun Fletcher	09 480 5648
Webmaster	Nick Moore	09 537 1500
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Journal	journal@astronomy.org.nz
Website	www.astronomy.org.nz

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

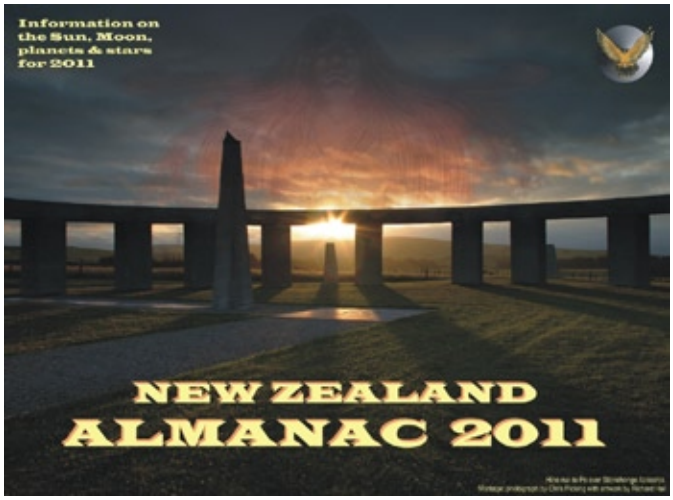
Phoenix Astronomical Society Almanac 2011

THE PHOENIX ASTRONOMICAL SOCIETY NEW ZEALAND ALMANAC 2011 IS NOW IN PRODUCTION.

The Almanac is a beautiful calendar with wonderful photographs taken by New Zealand astronomers. Every year the photographs seem to get better - and this coming year's edition is no exception! The Almanac is also packed with information on various astronomical events occurring through out the year that is presented in an easily accessible calendar format.

Almanacs make wonderful Christmas presents, so consider giving them as Christmas stocking fillers.

The price is $20 plus $2 p&p. We have succeeded in keeping the price virtually unchanged for the last few years. We will continue to give discounts for members, societies and for bulk orders.



We are now taking orders, so please contact Kay Leather: Hellfa@xtra.co.nz to order your 2011 Almanac or post an order to:

Almanac 2011
P.O. Box 156,
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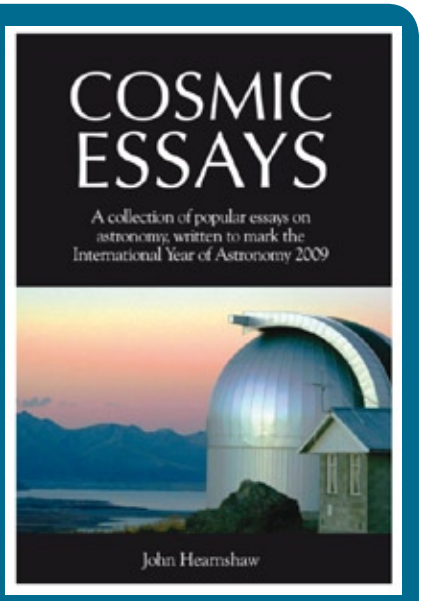
COSMIC ESSAYS

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

Gamma-Ray Bursts

by Andrew Buckingham 2010

INTRODUCTION

In this report I will look at what are gamma rays and Gamma-Ray Bursts and take a brief look at the history of discovering and observing them. This is followed by a overview of the types of bursts, where they are observed and what is thought to be the cause of the bursts.

From this I will discuss some of the current programmes that are working in this field and why these observations are important.

WHAT ARE GAMMA RAYS?

Gamma rays are high-frequency, very short-wavelength electromagnetic radiation typically having frequencies above 10^{19} Hz, larger than X-rays. The Earth's atmosphere shields us from most cosmic gamma rays, so observations have to be conducted from space-based observatories.

Gamma-Ray Bursts (GRB) are described as the most violent explosion known in the universe. They are flashes of gamma rays believed to have come from very energetic explosions and are extremely distant.

HISTORY OF GAMMA-RAY BURSTS[1]

Gamma rays were first discovered in 1900 by Paul Villard in Paris as a form of radiation more energetic than X-rays, and then named by Ernest Rutherford in 1903. Apart from some theoretical physics, little gamma ray research was done until the 1960s. The first cosmic gamma rays were detected in the early 1960s by NASA's Explorer 11 Satellite and later by Solar Observatory Satellites. The first gamma ray burst was detected in 1967 by the US Air Force Vela 4 Satellite, which was designed to detect nuclear weapons tests, but the discovery was deemed not to be important and was kept classified until 1973.

During the 1970s and 1980s cosmic gamma ray research increased with a number of satellite missions, including the first extragalactic source (quasar 3C 273), and was assisted by improved detector technology. As part of NASA's High Energy Astronomy Observatory programme, the Compton Gamma Ray Observatory (CGRO), the second of NASA's great observatories, was built and launched in April 1991. This revolutionised the field of gamma ray astronomy. Its BATSE[2] instrument detected over 2,700 Gamma-Ray Bursts over its 9 year lifetime, averaging one per day. The Italian-Dutch BeppoSAX satellite operated from 1997 to 2003, and was able to provide positions on several long Gamma-Ray Bursts to enable large ground based-telescopes to do follow-up observations, which proved that the bursts occur at very extreme distances. These two missions prompted the increase in development of instruments and missions to observe GRBs, both in space and from Earth. Some of these are discussed in more detail below.

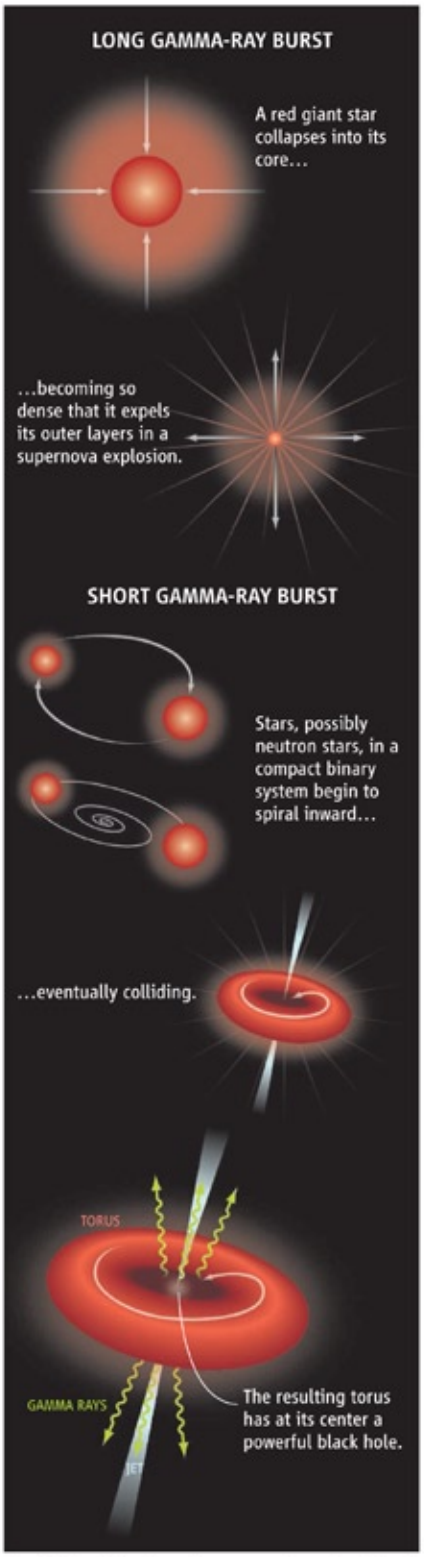
TYPES AND CAUSES OF GAMMA-RAY BURSTS

The observations from the BATSE instrument on the CGRO led to GRBs being divided in to two basic types, long burst and short bust.

Long Gamma-Ray Bursts are defined as lasting longer than two seconds. This type has been the most commonly observed and has the brightest afterglow, enabling follow-up observations. Long bursts have been linked to the death of massive stars in type Ib/c supernova or hypernova explosions. Although the longest observed burst have lasted up to an hour, often they are less than one minute long.

The bursts are released in narrow beams from the two poles of the dying star, meaning we only see the busts where one of the poles of the star faces us. Therefore there are potentially hundreds of GRBs happening each day that we do not see.

Short Gamma-Ray Bursts are less than two seconds long. Little is known about them



Controlling the flow. Gamma-ray bursts originate either from **(top)** collapsing stars or **(middle)** mergers of binary stars. The resulting high-energy event **(bottom)** creates ultrarelativistic outflows and very bright bursts of gamma radiation.

Credit: Science Magazine

1 A full history of Gamma Ray Astronomy can be found at: http://heasarc.gsfc.nasa.gov/docs/history/.
2 BATSE - Burst and Transient Source Experiment.

and we do not fully understood their cause. They do not appear to be associated with massive stars and are often from regions of intergalactic space. The most accepted theory is that short bursts are caused by two neutron stars merging. Other theories include the merger of a neutron star and a black hole, the collapse of a neutron star, or the evaporation of a black hole.

WHERE ARE THEY FOUND?

BATSE-detected GRBs were spread all across the sky in an isotropic distribution. This helped prove they were extragalactic. Observations of GRB970228 and GRB970508 by BeppoSAX, initially of the fading X-ray emission to get a more accurate source location, and then later by ground-based telescopes observing the fading optical afterglow, allow astronomers to identify the host galaxy of the burst and subsequently the distance. It was proven that these bursts were in very distant galaxies and were typically billions of light years away.

The fact that we can observe these GRBs even though they are so far away confirms that these are massive explosions with significant amounts of energy being released.

WHY ARE THEY IMPORTANT?

As most GRBs are extremely distant, it means that we have the opportunity to take a unique look back at a much younger universe when we observe them. An observation by NASA's SWIFT satellite of GRB090423 on the 23rd April 2009, and subsequent observations of the radio afterglow by the NSF's Very Large Array radio telescopes, established that the GRB source was more that 13 billion light years away, occurring only 630 million years after the big bang. This is one of the most distant objects ever observed. It is thought that the universe and the early galaxies in this period contained massive Population III stars, which are the metal-free first generation of stars. It is thought that GRBs with a redshift of ≥ 7 could be released from the collapse of a single or binary pair of Population III stars at the end of their life (Bromm & Loeb), possibly forming a black hole. As we are not yet able to observe Population III stars directly, because they are too faint and extremely redshifted, the GRBs give us a unique insight into understanding these objects and how they formed.

Illustration of GRB080319B. Credit: NASA

Also of interest is trying to understand the puzzle of how the immense amount of energy released in a GRB is produced. A GRB can outshine its host galaxy by several thousand fold or can release more energy in a few seconds than the Sun will in its entire ten billion year lifetime. This process is still not clearly understood and is one of the big mysteries of modern astronomy.

There seems to be no such thing as a standard GRB, with each one producing a slightly different light curve from the others. This adds to the mystery and motivates us to try to understand the causes and processes of a GRB.

CURRENT GAMMA RAY BURST OBSERVING

As mentioned earlier, most cosmic gamma rays cannot be observed from the surface of Earth, as the atmosphere filters them out. Direct observations have therefore been restricted to spacebased equipment. However, GRBs have an afterglow in other parts of the spectrum, such as X-ray, radio and optical, allowing observations of these afterglows to be performed from Earth-based observatories. Because the GRBs are so extremely redshifted (thus distant) and the afterglows very faint, initially observations were restricted to larger telescopes around the world such as those on Mauna Kea in Hawaii, the Canary Islands or the VLA[3]. Now with improved detectors and, more importantly, faster notification and positional data of events from the satellite-based detectors, smaller telescopes are able to participate in observations. Moreover now that we are detecting more GRBs, brighter events are being observed. The optical afterglow of one event, GRB080319B seen in March 2008, reached a magnitude 5.8, bright enough to be just seen by the unaided eye, even though it was 7.5 billion light years away.

After the huge success of the CGRO and BeppoSAX missions, a number of new satellitebased missions are now operating. Future missions such as the James Webb Telescope, with its focus on infrared and near-infrared, will also contribute to GRB afterglow observations. Some of the current missions are looked at below.

3 National Science Foundation's Very Large Array Radio Telescopes.

The High Energy Transient Explorer was a small satellite that operated from 2000 to 2007 when its batteries started to run out, with the mission of detecting GRBs and sending alerts and positional data out to a network of other observers as soon as possible.

INTERGRAL[4] is a European-based satellite that has been operating since late 2002. At the time is was the most sensitive gamma ray observatory in orbit, and has had great success in observing GRBs.

NASA's Swift satellite was launched in December 2004 with the primary mission of observing GRBs. It has one instrument to detect GRBs and then get accurate positional data. It has two other instruments for observing the afterglow in many wavelengths.

The Fermi Gamma-ray Space Telescope, formally known as the Gamma-ray Large Area Space Telescope (GLAST), is NASA's latest gamma-ray mission. Launched in June 2008, one of its main objectives is to research the behaviour of GRBs and to observe the gamma-ray sky. Its two instruments, the Large Area Telescope and GLAST Burst Monitor, have already made a number of discoveries, and are continuing to study more GRBs in detail.

All these missions are international projects with contributions from many countries. These telescopes also support ground-based observing by providing rapid notification and positional data of GRB events.

Now numerous ground based observatories around the world are involved with GRB observations in a variety of wavelengths, with some specially built for the purpose.

Included in these is the BOOTES[5] network of robotic telescopes run by the Instituto de Astrofísica de Andalucía in Spain. The first two, BOOTES-IR and BOOTES-2, are based in southern Spain, and in February 2009 BOOTES-3, a twin of BOOTES-2, was opened near Blenheim, New Zealand, to cover the southern sky. This very lightweight 0.6m Ritchey-Chrétien telescope, fitted with a CCD camera, is designed to lock on to and image a target within a few seconds of receiving a notice from NASA's GRB alert network.

CONCLUSION

Only known about for the last forty years, GRBs are the most massive explosions and single energy-source known in the universe. While long-GRBs have been linked to massive collapsing stars going through supernova or hypernova explosions, and many simulation models are being designed to try to explain the cause and processes of a GRB, still very little is currently understood. Even less is understood about short-GRBs.

BOOTES-3 Telescope near Blenheim, NZ. Credit: Grant Christie

As long GRBs are extremely distant, we are seeing the universe are a very early age. GRBs therefore also have the potential to help us understand the environment when these first generation Population III stars existed.

The intense interest in this phenomenon, combined with improving technology and the increasing volume of satellite-based and Earth-based observing platforms, has the potential to help us unravel the mysteries of GRBs.

4 INTERGRAL - International Gamma-Ray Astrophysics Laboratory.
5 BOOTES - Burst Observer and Optical Transient Exploring System.

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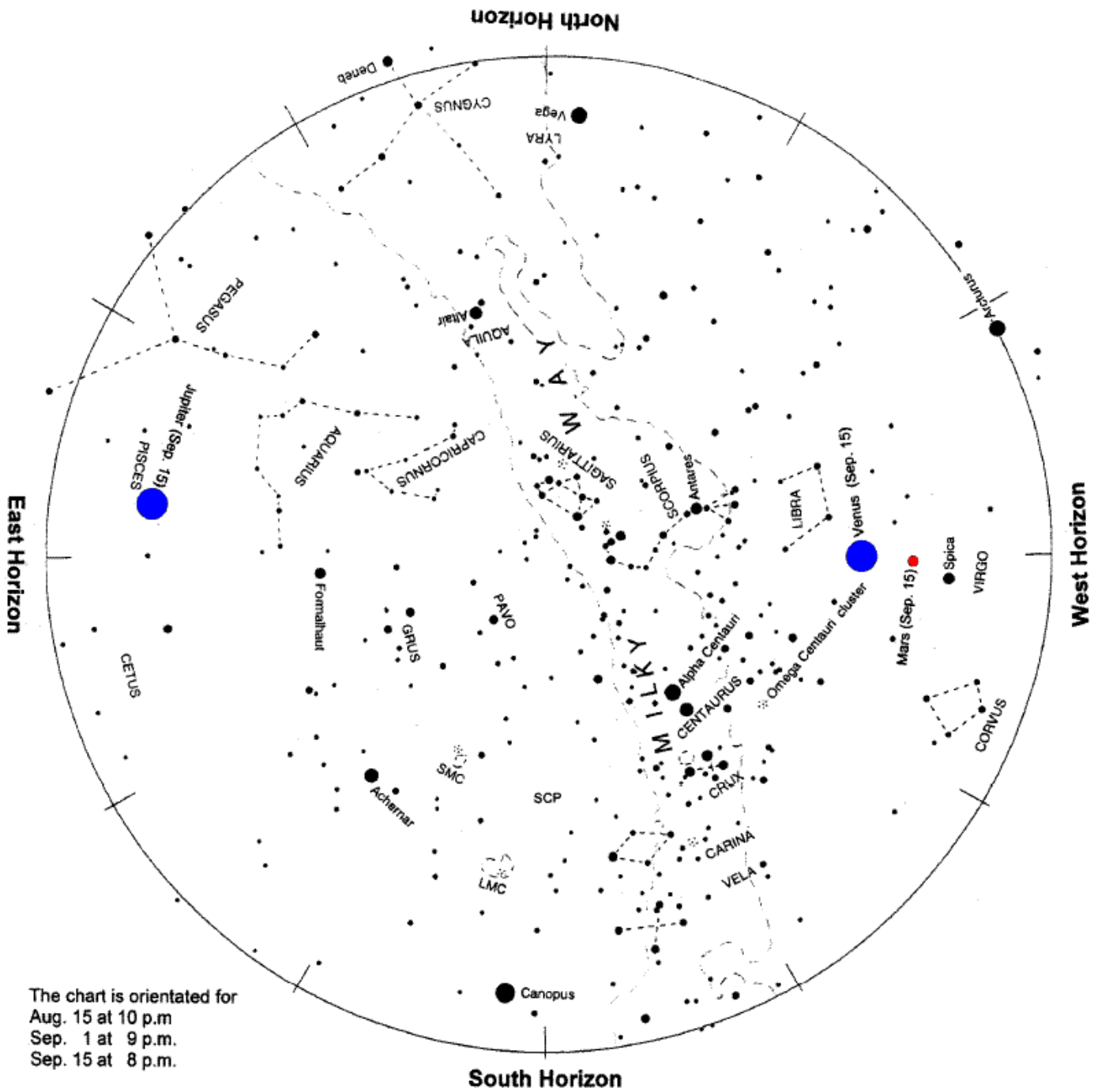
The Evening Sky in September 2010

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



Venus, the brilliant 'evening star' (planet really), appears in the west soon after sunset. You can see it in daylight, if you know where to look. It sets in the southwest in the dark late evening sky. In a telescope it looks like a crescent moon, getting taller and thinner through the month as it comes closer and turns more of its dark side toward us. In September Venus's distance shrinks from 89 million km to 56 million km. Venus is the same size as Earth and is covered with white cloud.

Jupiter is in the eastern sky in the evening. At the beginning of the month it rises before 8 pm; by the end of September it is above the horizon at dusk. It is the second brightest 'star' after Venus and shines with a steady golden light. Binoculars will show the disk of Jupiter. A small telescope easily shows its four big moons and the parallel stripes in Jupiter's clouds. Jupiter is the biggest planet by far, as heavy as all the other planets combined. It is nearly 12 times wider than the earth at the equator and 320 times Earth's mass. It spins once in 10 hours, stretching it at the equator. It is at its closest now, 590 million km from us. Jupiter is north of overhead at midnight and low in the west at dawn.

Canopus, the second brightest star, is near the south skyline at dusk. It swings upward 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. On the opposite horizon is Vega, one of the brightest northern stars. It is due north at dusk and

sets in the late evening. Arcturus, the brightest northern star, sets in the northwest at dusk. It often twinkles red and green as the air splits up its orange light.

Midway down the southwest sky are 'The Pointers', Beta and Alpha Centauri. They point down to Crux the Southern Cross. Alpha Centauri is the third brightest star. 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 split the pair. Beta Centauri, along with most of the stars in Crux, is a blue-giant star hundreds of light years away.

West of overhead the orange star Antares marks the heart of the Scorpion. The Scorpion's tail hooks towards the zenith like a back-to-front question mark, 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 stars wringing the last of the thermonuclear energy out of their cores. Antares is expected to explode as a supernova in the next few million years. Above Scorpius is 'the teapot' made by the brightest stars of Sagittarius. It is upside down in our southern hemisphere view.

The Milky Way is brightest and broadest overhead in Scorpius and Sagittarius. In a dark sky it can be traced down past the Pointers and Crux into the south. To the north it crosses Altair, meeting the skyline right of Vega. 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. The nearer dust clouds appear as gaps and slots in the Milky Way. A scan along the Milky Way with binoculars shows many clusters of stars and some glowing gas clouds, particularly in the Carina region below Crux, and in Scorpius and Sagittarius.

The Large and Small Clouds of Magellan, LMC and SMC, look like two misty patches of light in the south sky. They are easily seen by eye on a dark moonless night. They are galaxies like our Milky Way but much smaller. The LMC is about 160 000 light years away; the SMC about 200 000 light years away.

Notes on the planets in September

MERCURY is at inferior conjunction between the Sun and Earth on September 3. After conjunction the planet will be a morning object rising shortly before the Sun.

This appearance in the morning sky will be a very feeble affair, with Mercury never rising more than 40 minutes before the sun and so always being in strong twilight. This will make it just about impossible to ever see the planet. It will be a big contrast to the easy evening observation of Mercury possible during the second half of July and first part of August.

The planet is stationary on the 12th, less than 9 days after conjunction, and at its greatest distance 18° west of the sun on the 20th.

VENUS will be a very obvious object to the west in the evening sky throughout September. During the month it will set near 10 pm NZST: a little before 10 in the north and a little after in the south of NZ. The planet will set latest mid month.

Venus starts September one degree from Spica, the brightest star in Virgo. Venus will also be just over 4° Mars. On September 11 the three will be joined by the crescent moon which will be a little over 4° from each of the three. The graphic shows their relative positions looking to the west at 8pm.

Venus will be moving to the east through Virgo for most of September, gradually slowing during the second half of the month. Towards the end of the month, on the 25th the planet will cross into Libra.

MARS will be less than 4° below Spica on September 1, with Venus about a degree further away and slightly higher than the star.

Like Venus, Mars will be crossing Virgo during September and almost keeping pace with the far brighter planet, although their two paths will diverge a little. Mars will be a few degrees lower than Venus, as a result it will set about half an hour earlier. Mars crosses into Libra on September 27, two days after Venus.

The chart shows the moon, Venus, Mars and Spica as they appear in the sky to the west at 8 pm on September 11. The circle represents a field 5° in diameter a normal binocular view. A few of the brighter stars are also shown. Apart from Spica, only the two labelled with their magnitudes are likely to be visible to the unaided eye.

JUPITER will be readily visible in the evening throughout September. In early September it will be two or three hours after sunset before it is at a reasonable altitude between east and northeast. By the end of the month it will be readily visible once twilight fades.

Jupiter is at opposition on September 21, when it will rise close to the time of sunset and set close to the time of sunrise and be highest near midnight. At the same time it will be less than a degree from Uranus: they are in conjunction and slightly closer two days before on the 19th. The two planets are under a degree apart from September 13 to 25. Uranus will be an easy binocular object, at magnitude 5.7. In the evenings it will be to the left of Jupiter, changing from being slightly higher on the 13th to definitely lower on the 25th. Monitoring from night to night will readily show their relative motion.

The chart shows the relative paths of Jupiter and Uranus during September. It is orientated for about 9 pm. The circle shows a 5° field. Stars to magnitude 7 are shown, with those brighter than 6 labelled, without a decimal point. On September 23, the day of the equinox, the two planets will be joined by the full moon. Jupiter and the moon will be just over 7° apart. Uranus will be in line between the two, much closer to Jupiter of course.

The conjunction of Jupiter and Uranus is the second this year with both planets at present moving in a retrograde (westerly) sense. Because it is nearer the Earth, Jupiter appears to move more quickly than Uranus even when moving backwards so is overtaking Uranus while in reverse. The third conjunction of the present series will take place on 4 January 2011.

SATURN will be a low object to the west in the early evening, almost directly below Venus. On the 1st it will set about 2 hours after the Sun. Each night during early September, Saturn will sink a little lower to become lost in the evening twilight by about the middle of the month. By then it will set little more than an hour after the Sun.

On the 10th the thin crescent Moon will be about 10° above Saturn, but by 45 minutes after sunset when the sky will be getting dark to see the planet, Saturn will be only about 6° above the horizon.

Diary of Solar System Events September 2010

By Brian Loader RASNZ

DATE (NZDT)	DIARY OF SOLAR SYSTEM EVENTS IN SEPTEMBER 2010 FOR NEW ZEALAND
SEPTEMBER 1	Venus 1° from Spica, magnitude 1.1, evening sky.
SEPTEMBER 2	Moon at last quarter 5.22am NZST (Sep 1, 17:22 UT). Moon furthest north, so lowest southern hemisphere transit for the month.
SEPTEMBER 3	Mercury at inferior conjunction between Earth and Sun.
SEPTEMBER 5/7	Mars, just over 2° from Spica, evening sky.
SEPTEMBER 8	Moon at perigee, its closest to the Earth for the lunar month, 357192 km. New Moon at 10.30pm NZST (10:30 UT).
SEPTEMBER 10	5% lit crescent Moon, 10° above Saturn, very low, early evening sky.
SEPTEMBER 11	11% lit crescent Moon, just over 4° from Venus, Mars and star Spica, evening sky. New Moon at 12:29am NZST (Apr 14, 12:29 UT).
SEPTEMBER 12	Mercury stationary.
SEPTEMBER 14	40% lit Moon 2.4° from Antares, magnitude 1.1, brightest star in Scorpius.
SEPTEMBER 15	Moon furthest south, so highest southern hemisphere transit for the month. Moon at first quarter at 5.50pm NZST (05:50 UT).
SEPTEMBER 19	Jupiter and Uranus, in conjunction, separation 0.8°.
SEPTEMBER 20	Mercury at greatest elongation, 18° west of sun.
SEPTEMBER 21	Moon at apogee, its greatest distance from the Earth for the Lunar month, 406168 km.
SEPTEMBER 21/22	Jupiter and Uranus at opposition.
SEPTEMBER 23	Southern spring equinox, sun crosses equator at 3.10pm NZST.
SEPTEMBER 23	Full Moon at 9.17pm NZST (09:17 UT). Moon about 7° below Jupiter, and 6° fromUranus, closest early evening.
SEPTEMBER 26	Start of New Zealand Daylight time, NZDT, clocks go forward one hour at 2am.
SEPTEMBER 30	Moon furthest north, so lowest southern hemisphere transit for the month.

The Moon as it will appear 12th September 2010.
image credit: Calsky

Many Famous Comets Originally Formed in Other Solar Systems

By ScienceDaily

Many of the most well-known comets, including Halley, Hale-Bopp and, most recently, McNaught, may have been born in orbit around other stars, according to a new theory by an international team of astronomers led by a scientist from the Southwest Research Institute (SwRI) in Boulder, Colo.

Dr. Hal Levison (SwRI), Dr. Martin Duncan (Queen's University, Kingston, Canada), Dr. Ramon Brasser (Observatoire de la Côte d'Azur, France) and Dr. David Kaufmann (SwRI) used computer simulations to show that the Sun may have captured small icy bodies from its sibling stars while it was in its birth star cluster, thereby creating a reservoir for observed comets.

While the Sun currently has no companion stars, it is believed to have formed in a cluster containing hundreds of closely packed stars that were embedded in a dense cloud of gas. During this time, each star formed a large number of small icy bodies (comets) in a disk from which planets formed. Most of these comets were gravitationally slung out of these prenatal planetary systems by the newly forming giant planets, becoming tiny, free-floating members of the cluster.

The Sun's cluster came to a violent end, however, when its gas was blown out by the hottest young stars. These new models show that the Sun then gravitationally captured a large cloud of comets as the cluster dispersed.

"When it was young, the Sun shared a lot of spit with its siblings, and we can see that stuff today," says lead author Levison.

Comet Hale-Bopp photographed on April 9, 1997. (Credit: iStockphoto/Scott Orr)

"The process of capture is surprisingly efficient and leads to the exciting possibility that the cloud contains a potpourri that samples material from a large number of stellar siblings of the Sun," says co-author Duncan.

Evidence for the team's scenario comes from the roughly spherical cloud of comets, known as the Oort Cloud, which surrounds the Sun, extending halfway to the nearest star. It has been commonly assumed this cloud formed from the Sun's proto-planetary disk. However, because detailed models show that comets from the solar system produce a much more anemic cloud than observed, another source is required.

Levison says, "If we assume that the Sun's observed proto-planetary disk can be used to estimate the indigenous population of the Oort Cloud, we can conclude that more than 90 percent of the observed Oort Cloud comets have an extra-solar origin."

"The formation of the Oort Cloud has been a mystery for over 60 years and our work likely solves this long-standing problem," says Brasser.

The article by Levison, Duncan, Brasser and Kaufmann, was published in the June 10 issue of Science Express.

Funding for this research was provided by NASA's Astrobiology Institute, Outer Planets Research and Origins of Solar Systems programs, the Natural Science and Engineering Research Council of Canada, and Germany's Helmholtz Alliance.

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

Learning from SETI: Overcoming the roadblocks to discovery

By John Rachlin, Data-Mining for Astronomy - AAVSO Writers Bureau

The Allen Telescope Array (ATA), formerly known as the One Hectare Telescope (1hT)

Imagine you're a scientist looking to make a discovery – not merely an insight, a profound earth shattering once-in-a-lifetime kind of discovery; a discovery so significant, it will change the course of history, and man's perceived place in the universe. You believe it's out there waiting to be revealed. Logic alone tells you it must be so. You start collecting data. And you collect and analyze, collect, and analyze. And you do this for fifty years, and still you find nothing! Unbelievable!

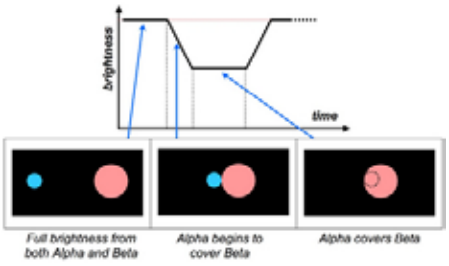
What do you do? Well, you have several options. First, you can try to increase the amount of data you are collecting. Perhaps your signal is very weak and merely hiding amidst the cosmic noise. Secondly, you can change your data. Maybe you've been collecting the wrong type of data. Maybe you've been looking in the wrong places, or at the wrong time. Perhaps you simply need to be a bit more clever about where and when and how you gather your raw observations. Your third and final option is to try to look at your data with a fresh perspective – to change your analysis. Maybe the signal is there all along, but you just aren't sifting through it in the right way. You're looking for the wrong patterns. Maybe the pattern your looking for is really quite alien.

By now, you've probably guessed that what I'm talking about, of course, is that most profound and potentially history-making career-risking data-mining effort of all time: The Search for Extraterrestrial Intelligence (SETI). And which of the above strategies is the SETI Institute currently pursuing to address the fact that after all these years, it has yet to detect a signal from an alien intelligence? Answer: All of the Above!

INCREASING SETI'S DATA RECEIVING CAPACITY.

SETI is pursuing a major technological upgrade to its receivers via the development of the Allen Telescope Array. Amir Alexander offers a brief history of the SETI project in which he describes the Allen Array as "one of the best funded and most promising projects for the future of SETI." He goes on to write:

The Allen Array represents a true breakthrough for radio SETI. As a dedicated observatory, SETI researchers will be using it year-round to search for alien signals, as compared to the several weeks every year, which are allotted to Project Phoenix at Arecibo. In addition, since it is composed of hundreds of separate dishes, the array can be pointed at several points in the sky at the same time, and therefore listen to signals from several stars simultaneously. The latest technology will enable the Array to cover a frequency band 9 gigahertz wide, more than 3 times wider than project Phoenix, which scans the widest band of any of today's searches. All of this represents a qualitative leap in the capacity of SETI searches, and increases the chances of detecting a "real" signal several-fold.



credit: Cosmos – The SAO Encyclopedia of Astronomy

NEW SOURCES OF DATA.

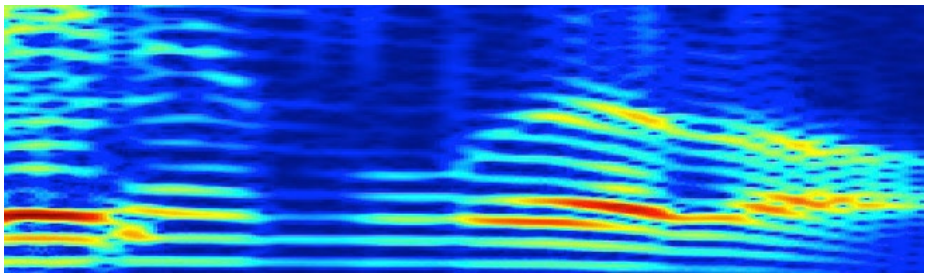
Dr. Seth Shostak gave a talk earlier this year at Foothill College as part of the Silicon Valley Lecture Series entitled: "The Search for Intelligent Life Among the Stars: New Strategies." In his talk, he presents a wonderful range of novel and clever ideas aimed at trying to use the detection resources available in new and smarter ways. One of my favorite ideas: Theoretical modeling suggests that planets can in fact form in binary systems, and some such planets have already been discovered. An intelligent alien race in such a system would likely try to colonize planets in the companion star system. If the orbital plane of the binary system is in the line of sight of our own solar system, we will observe the star system as an eclipsing variable star. Many such stars are known. Now imagine this alien civilization communicating back and forth with its colony. At times when we would observe the eclipse, the communications beam will be focused right in our direction! So why not point our

receivers at eclipsing variables specifically when they are undergoing the eclipse! As with all good strategies, this approach tells you "when to look and where."

NEW ANALYTICAL METHODS.

Here, the SETI Institute as done something truly interesting. Jill Tarter, director of the Center for SETI Research recently announced a new initiative by the SETI institute to enlist the help of researchers and programmers to see if the signal process and pattern detection algorithms can be improved.

We'd like to take the next step and invite all of the smart people in the world who don't work for Berkeley or for the SETI Institute to use the new Allen Telescope. To look for signals that nobody's been able



to look for before because we haven't had our own telescope; because we haven't had the computing power…For people who don't have black belts in digital signal processing, we want to take regions of the spectrum that are overloaded with signals and get those out and have them visualized in different ways against different basis vectors. We'd like to see if people can use their pattern recognition capabilities to look or maybe listen; to tease out patterns in the noise that we don't know about (Source: O'reilly Radar).

So remember: the next time you're stuck in your own efforts at scientific enlightenment and discovery, think about the challenge of SETI and its strategy: more data, more data sources, and better analysis.

Finding cataclysmic variables with a click of your mouse

From John Rachlin, Data-Mining for Astronomy - AAVSO Writers Bureau

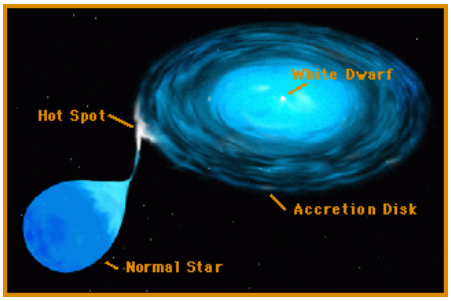
Contributed by Denis Denisenko, Space Research Institute of Russian Academy of Sciences, Moscow, Russia.

Astronomical data mining has three things in common with traditional mining: 1) you work in the dark; 2) it's very hard work; and 3) you never know in advance what you will dig up in the end. Sometimes you finish with a load of coal, but every now and then you find a real treasure! In other words, if you know how, where, and what to search for, you will find many hidden gems that everybody was passing by before! This was the case with our work on discovering new cataclysmic variables from ROSAT X-ray and USNO-B astrophotometric catalogs (Denisenko and Sokolovsky, arXiv:1007.1798).

Cataclysmic Variables (CVs) are a special class of variable stars that continue to surprise astronomers. Some CVs brighten by 100x or even 1000x during periods of outburst, while others can fade by 100x. These amazing objects can change their brightness by 7-8 magnitudes within a day and fade by 5m in a matter of 30 seconds! Nothing else in the sky can vary in almost real time. This is why CVs are perhaps the favorite objects among many fans of variable stars. One would think they are easy to discover because of their huge amplitude of variability. However, cataclysmic variables are relatively rare, constituting only about 1% all known variables.

No two cataclysmic variables are alike. Each has its special quirks and surprises. Despite decades of research, their behavior is not entirely understood. All CVs have one thing in common – they are all compact binary systems with a white dwarf (or sometimes two white dwarfs). There the similarities end. Some have quite heavy components and long orbital periods (up to several days). Others have small red dwarf "satellites" with a mass and radius 1/6th that of the Sun. These latter types can complete a revolution in 90 minutes at an orbital distance of perhaps 400 thousand kilometers. Imagine the Moon making 16 revolutions per day!

Amazingly, many new cataclysmic variables can be discovered by mining publicly available catalogs and sky surveys that are freely accessible online. You just need to use your imagination and have a good eye for pattern recognition in order to notice some common features of these unusual objects. To discover new CVs, we checked the vicinities of approximately 50 thousand X-ray sources in the Northern hemisphere. We identified 1,400 suspicious stars in the USNO catalog that were changing their brightness by 2 or more magnitudes between different epochs in Red or Blue light. After some brain work we were left with just 200 candidates. (Remember: the main tool of the astronomer is his brain, the second most important one is computer, and only afterward does one go to the telescope!) Actually we didn't have to use a telescope even with those 200 objects – the necessary images were already obtained by the Palomar Schmidt camera, by 2MASS infrared



survey telescope, and in some cases by the NEAT asteroid hunter. Using images dating back to early 1950s, we were able to discover the variability of 10 objects, eight of them being new cataclysmic variables in our Milky Way and two probable active quasars with a large amplitude of variability. Surely, we have detected only a fraction of variable objects among our candidates! Now there is a special need for a detailed followup examination of these newly discovered objects.

Perhaps the most amazing thing in this whole story for me was perhaps the fact that we discovered an object with 5 mag amplitude of variability! At the moment one can only guess what it is. Maybe a gravitational lensing event, or a supernova explosion in the far galaxy, or maybe yet another previously unknown type of cataclysmic variable. As I told before, you never know what you will discover today! And this is, in my humble opinion, the main beauty and motivation of Astronomy.

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