



AUCKLAND  
ASTRONOMICAL  
SOCIETY

June 2010

# SOCIETY JOURNAL

**Society Meeting Monday 14th June at 8:00pm**

**BBC Documentary - The Solar System**



## Herschel Crater on Saturn's Moon Mimas

**M**imas, one of the smaller round moons of Saturn, sports Herschel crater, one of the larger impact craters in the entire Solar System. The robotic Cassini spacecraft now orbiting Saturn took the above image of Herschel crater in unprecedented detail while making a 10,000-kilometre record close pass by the icy world just over one month ago. Shown in contrast-enhanced false colour, the above image includes colour information from older Mimas images that together show more clearly that Herschel's landscape is coloured slightly differently from more heavily cratered terrain nearby. The colour difference could yield surface composition clues to the violent history of

Mimas. An impact on Mimas much larger than the one that created the 130-kilometre Herschel would likely have destroyed the entire moon. **Image Credit:** Cassini Imaging Team, ISS, JPL, ESA, NASA

The Society meeting on the 14th June will feature the second of a series of five BBC documentaries about the Solar System entitled "Order out of Chaos". This promises to be an outstanding programme with some of the latest research and images of the planets and their moons. High resolution images such as the image of Mimas, above.

# Society Meeting

## *SpaceTime with Richard Hall*

**By Clive Bolt**

Once again we were treated to one of Richard's fascinating talks, this time on the subject of Einstein's theories of relativity. There were 105 members on the night, which goes to show just how popular his talks are.

Einstein was a great philosopher and he pondered the questions that were raised by some of the great scientists that went before him. One such was of course Galileo, who noted that all motion is relative. Add to this the measurement of the speed of light and the experimental findings that show that the speed of light is the same in all directions, nothing can travel faster, and there are some interesting conundrums that challenge our conventional experience. Richard drew a parallel with the Flat Earth concept. Nothing in our normal day to day experience indicates that the Earth is a sphere. Similarly, our notions of time and space do not indicate any strong interdependence between time and space. In this Einstein developed the principle of relativity and the maths that would allow for experimental verification.

We are all familiar to some extent with the concept of time dilation. Time slows down on an object that is moving quickly relative to a stationary observer. This leads to a fascinating connection between time and distance. On board a spacecraft travelling close to the speed



*Richard Hall entertaining 105 members with his talk about Einstein and his theories of relativity. Photo Gavin Logan*

of light, the time required to reach a distant object shortens considerably. The speed of light is still constant so the distance must also shorten as a consequence. This interconnection between time and distance is more familiar to us when we consider looking out to vast distances in the Universe. We can only see those objects as they were back at the time the light left them, often billions of years ago.

Then a visit to the bizarre world of the

singularity inside a rotating black hole, not that much other than fundamental particles could ever end up there to see if what he described was actually true.

Thanks Richard for a tremendously interesting talk. It was both thought-provoking and informative, as well as very entertaining. We were left with a tantalising snippet for what might be his next talk, about wormholes? See the article further on in this Journal.

## Own a Piece of Another World!

These beautifully cut meteorite specimens were once part of an asteroid orbiting between Mars and Jupiter.

It crashed with another asteroid and some of the fragments eventually landed on Earth in the northwest Sahara Desert. They have been retrieved by nomads and authenticated by an expert.

Your only opportunity to own and touch a piece of another world!



*Asteroid 243 Ida with its little moon Dactyl*

# Celestial Navigation

## *Practical Astronomy with Colin James*

*By Clive Bolt*

Auckland turned on a cloudy night, but who cares when you can have such an informative evening in the Planetarium? The Society is lucky to have such a fantastic facility available to it, supported by the Edith Winstone Blackwell Telescope. Once again it shows how popular the Practical evenings are becoming with about 40 people coming to learn about the Autumn sky.

Colin gave us all a tour of the sky and showed how the major stars and constellations are arranged relative to the navigational supports of the meridian and celestial equator: how to find direction from the stars at any date during the night and some of the fundamentals of determining latitude. Longitude requires the use of a chronometer and tables, something the mariners did not possess until the late eighteenth Century. Prior to that, ships sailed to the latitude required and then tried to sail west or east until the required landfall was reached. With a chronometer and tables it is then possible to measure the angle between where a star can be seen above the horizon and a reference point. A circle can be drawn on which the observer must be located to see the star in that



*Colin James showing the members the way around the southern sky in Autumn in the Stardome Planetarium*

position. Several different stars will return intersecting circles that indicate the observer's position. The first requirement is to correctly identify the important stars.

We even had a short lesson on finding Polaris from the pointers on the Big

Dipper in the Northern Hemisphere. Last time I was in the Northern Hemisphere for a month, I saw 6 stars in total throughout the trip. Polaris was not one of them. Just as well we have GPS available.

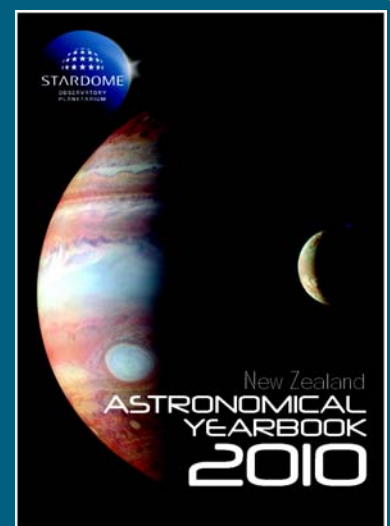
## New Zealand Astronomical Yearbook 2010

The 2010 Yearbook is still available. Members can purchase a copy directly from the Society at the discounted price of \$10.00 + \$2.00 postage (normal retail is \$20).

The 2010 edition contains a number of topical articles plus monthly sky guides and tables.

Payment can be made by direct credit, credit card, cash or cheque.

To order your copy contact Andrew Buckingham at [treasurer@astronomy.org.nz](mailto:treasurer@astronomy.org.nz) or ring him on (09) 473-5877



# Isaac Newton's predicted Apocalypse in 2060

By Gavin Logan

An audience of over fifty Society members who attended May's Film Night saw a BBC documentary about Sir Isaac Newton, revealing him to have been not only a scientific genius, but also an alchemist and religious zealot. They learnt how little publicised manuscripts of Sir Isaac Newton revealed that the father of modern mathematics was strongly religious and for over 50 years studied the Bible trying to unravel God's secret laws of the Universe. He was



Scott Handy stars as Isaac Newton, seen here as the aging Newton working at alchemy.

fanatical in his quest to discover the date for the Second Coming of Christ and the end of the World. The film showed how, buried in his papers, Dr Stephen Snobelen, from the University of King's College in Nova Scotia, found the original document where Newton had written down his prediction.

In 2060, Newton believed the dramatic events forecast in the apocalyptic Book of Revelation would occur: massive plagues and fires; the terrible battle of Armageddon between good and evil and the destruction and eternal damnation of the wicked.

After the main film on Newton, a short "Sky at Night" programme on the exploration of Mars, including the latest Phoenix Probe and Lander, was screened. Phoenix landed in 2008 on a frozen desert at the planet's north pole carrying instruments to "taste and sniff" the polar ice.

Next Month's film is "Alien Planet".



The members enjoying the film night about Newton and also the exploration of Mars.

Based on the book "Expedition" by Wayne D Barlowe. The film is about a simulated robotic space mission to another solar system to a planet called Darwin 4. With scientific commentary by leading scientists it highlights the problems and possible outcomes of such a journey. Next month's Film Night is on 8pm Monday 21st June at Stardome .

## Planet Earth

### Continuing Education Course

With Philip Sharp, BSc (Hons), PhD

Have you ever wondered how the Earth was formed, what caused the five major mass-extinctions, how geologists and palaeontologists are unravelling the enigma of Earth's past, and what the Earth's interior looks like?

This course answers these questions and many more by describing and discussing Earth's structure and 4560 million years of history.

This is not an Astronomical Society course but we wish to bring it to the attention of any interested members.

Centre for Continuing Education Class Number: 38126

Cost: \$141.00 (International Fee \$220.00)

When: 6 sessions, Thursday 29 July - 2 September, 6.30 - 8.30pm

Where: The University of Auckland, Room 018, ClockTower Building No. 105, 22 Princes Street.

Philip Sharp was recently awarded one of the two Faculty of Science annual teaching awards for Sustained Excellence in Teaching.



# Calendar of Events

## June Programme

Fri	4	7:30pm	Young Astronomers with Margaret Arthur
Mon	7	8:00pm	Practical Astronomy
Mon	14	8:00pm	Society Meeting. BBC Documentary "The Solar System"
Mon	21	8:00pm	Film Night with Gavin Logan
Wed	23	7:30pm	Council Meeting
Mon	28	8:00pm	Introduction to Astronomy

## Practical Astronomy June 7 8:00pm

### Winter star party with Andrew Buckingham

The winter constellations explained. First hour in the planetarium followed by viewing through the society telescopes out on the patio and the Edith Winstone if the weather is fine.

## Film Night June 21 8:00pm

### Alien Planet.

Based on the book "Expedition" by Wayne D Barlowe. The film is about a simulated robotic space mission to another solar system to a planet called Darwin 4. Including scientific commentary by leading scientists, it highlights the problems and possible outcomes of such a journey.

## Introduction to Astronomy June 28 8:00pm

### Astronomy Course

Bernie Brenner will continue with the Michigan Technical University course in astronomy.

This month's session is magnitudes and calendars

## Welcome to New Members

Barbara Spicer (family)	Philip Muir (ordinary)
Graham Doggett (ordinary)	Kristin Lange (family)
Michael Lawry (family)	Nancy Dobrodolski (ordinary)
John Nowak (family)	

## July Programme

Mon	5	8:00pm	Practical Astronomy
Mon	12	8:00pm	Society Meeting. Subject TBA
Fri	16	7:30pm	Young Astronomers. Note change of date
Mon	19	8:00pm	Film Night with Gavin Logan
Wed	21	7:30pm	Council Meeting
Mon	26	8:00pm	Introduction to Astronomy Michigan Tech course on Astronomy continues with Bernie Brenner.

## Young Astronomers July 16

### Change of Date

Both Margaret and Andrew will be away so the Young Astronomers Meeting is moved to Friday 16th July at 7:30pm

## Practical Astronomy July 5 8:00pm

With Ivan Vazey. Using your telescope. Practical tips and techniques with the Society's Curator of Instruments.

Bring your own telescope or binoculars or use one of the society telescopes. The Edith Winstone will also be available if the weather is suitable.

## Film Night July 19 8:00pm

### To Infinity and Beyond.

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

## Waharau Dates for 2010

The next date for the Waharau Dark Sky weekend in 2010 is Friday 10th September to Sunday the 12th.

Mark those dates in your diary.

# Observing Notes

June 2010

by Alan Gilmore



**V**enus, the brilliant 'evening star' (planet really), appears in the northwest soon after sunset. It sets increasingly later in the night sky; bright enough to cast shadows in dark places. **Sirius**, the brightest star, appears low in the western sky at dusk before setting in the southwest. It twinkles with all colours like a diamond. **Canopus** is higher in the southwest sky, circling lower into the south later on. **Crux**, the Southern Cross, and Beta and **Alpha Centauri** are south of overhead. **Scorpius**, upside down, is midway up the eastern sky. Below it is **Sagittarius**, its brighter stars making 'the teapot'.

Midway down the north sky are **Saturn** and **Spica**, similar in brightness and colour; Saturn is on the left and the lower of the two. Below and right of them is orange **Arcturus**, often twinkling red and green. Arcturus is 120 light years\* away and 37 times brighter than the Sun.

Midway between Saturn and Venus are **Regulus** and **Mars**. Reddish Mars is below and left of Regulus at the beginning of the month. Around June 6 it passes Regulus, moving above and rightward of Regulus thereafter. Mars is 150 million km away in mid-month and very small in a telescope.

**Crux**, the Southern Cross, is south of the zenith. Beside it and brighter are Beta and **Alpha Centauri**, often called 'The Pointers' because they point at Crux. Alpha Centauri is the closest naked-eye star, 4.3 light years away. A telescope shows it is a binary star: two suns orbiting each other in 80 years. Beta Centauri and many of the stars in Crux are hot, extremely bright blue-giant stars hundreds of light years away. **Canopus** is also very luminous and distant.

**Scorpius** is midway up the eastern sky, lying on its back. Its brightest star is orange **Antares**, marking the scorpion's heart. Antares is Greek for 'Rival to Mars'. Just now one can see why. Antares is a red giant star: 600 light years away and 19,000 times brighter than the Sun. Red giants are much bigger than the Sun but much cooler, hence the red colour. They are dying stars, wringing the last of the thermo-nuclear energy from their cores. Antares will end in a spectacular supernova explosion in a few million years.

The **Milky Way** is brightest and broadest in the southeast toward Scorpius and Sagittarius. It remains bright but narrower through Crux and Carina but fades in the western sky. 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. A scan along the Milky Way with binoculars will find many clusters of stars and some glowing gas clouds. Relatively nearby dark clouds of dust and gas are silhouetted as holes and slots in the Milky Way.

The Clouds of Magellan, **LMC** and **SMC**, are in the lower southern sky, easily seen by the naked eye on a dark moonless night. They are two small galaxies about 160,000 and 200,000 light years away.

They are only a fraction the mass of our galaxy but still contain billions of stars.

**Saturn's** rings are almost edge-on to us now. They look like a thin spike through the globe of Saturn. In steady conditions a telescope shows the shadow of the rings as a dark line on Saturn. In June Saturn is around 1410 million km away.

Jupiter (not shown) rises due east after midnight. It is the brightest star-like

object in the late-night sky, but not as bright as Venus. By dawn Jupiter is north of overhead. Binoculars show the disk of Jupiter. A small telescope easily shows Jupiter's four big moons lined up on either side of the planet. In June it is around 750 million kilometres away. Mercury rises about two hours before the Sun at the beginning of the month: a lone bright 'star' in the northeast sky. It slowly sinks into the dawn, disappearing mid-month.

## Jun. 26: Partial Eclipse of the Moon

This eclipse favours the Hawaiian Islands, western Alaska, Australia, New Zealand, eastern portions of Malaysia and Asia. These locations will see the upper half of the Moon darkened by the Earth's umbral shadow. Across parts of the eastern U.S., some evidence of the eclipse may become evident as the lighter penumbral shadow casts a "smudge" on the moon's left edge just before moonset.

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\*A **light year (l.y.)** is the distance that light travels in one year: nearly 10 million million km or  $10^{13}$  km. Sunlight takes eight minutes to get here; moonlight about one second. Sunlight reaches Neptune, the outermost major planet, in four hours. It takes four years to reach the nearest star, Alpha Centauri

*Notes by Alan Gilmore, University of Canterbury's Mt John Observatory, P.O. Box 56, Lake Tekapo 7945, New Zealand.*

# Observing the Planets in June 2010

By *Brian Loader, RASNZ*

**MERCURY** will rise a good 2 hours before the Sun at the beginning of June so will be quite an easy object rather low to the northeast an hour before sunrise. During the month, Mercury will gradually brighten. With a magnitude close to 0 it will be the brightest star-like object to the northeast.

During June Mercury will brighten but also be moving towards the Sun, so that it will rise later and closer to the time of sunrise. It will move from **Aries** into **Taurus** on the morning of June 6 and move across the constellation so that by mid-June it will lie between Aldebaran and the Pleiades. Mercury will then have a magnitude -0.8 noticeably brighter than the star's 1.0 magnitude. By mid June the planet will rise about 75 minutes before the Sun, so will be low, in a direction a little to the east of northeast as the dawn sky brightens.

Mercury will continue to move towards the Sun for the rest of June, so will become lost to view in the morning twilight. It reaches superior conjunction with the Sun, just before the end of the month, when it will pass the Sun on the opposite side to the Earth.

The Moon will be at its closest to Mercury on the morning of June 11, when the crescent Moon only 3.5% lit, will be some 6° to the lower left of Mercury. Both will be low in the dawn sky. The Moon will be close to occulting many of the stars in the Pleiades, but most of the events will occur after sunrise.

**VENUS** will continue to move a little higher into the evening sky during June.

By the end of the month it will set over three hours after the Sun. During the course of June, Venus will move from **Gemini** into **Cancer** on June 13. It will cross the latter constellation during the rest of June, to cross into **Leo** on the last day of June. On June 9, Venus will be less than 5° to the upper left of Pollux, at magnitude 1.2, the brightest star in Gemini. On the 15th the 10% lit crescent Moon will be 3° to the upper left of Venus.

**MARS** will set 11pm on June 1, and half an hour earlier by the end of the month. So it will be best placed for observation early evening. It is in **Leo**, all month passing Regulus on the 7th, when Mars will be slightly brighter than the star and about 45' below it. This is 1.5 times the diameter of the full Moon. Mars will be slightly brighter than Regulus.

The minor planet **Vesta** will be to the lower right of Mars during June, with the two closing in slightly during the month. By the 30th they will be about 5.5° apart. By then Vesta will be magnitude 7.7, and visible in binoculars.

The chart on the RASNZ Website shows the paths of Mars and Vesta through Leo during June. They are shown in their positions on June 17, when the Moon will be about 7° from Mars. The chart is orientated to show the sky to the northwest as it appears about 7 pm. The circle represents a field of view 5° in diameter, similar to that of many binoculars. Stars to magnitude 8 are show, slightly fainter than Vesta.

**JUPITER** will rise soon before 2am on June 1 and by about midnight at the end

of the month. The planet is in **Pisces** throughout June. During June Jupiter will pass Uranus, with the two less than half a degree apart on the morning of June 9. The conjunction of Jupiter and Uranus in 2010 will parallel that of Jupiter and Neptune in 2009. Thus Jupiter will move past Uranus on three occasions, the second during its period of retrograde motion, the last time in early January 2011 .

The chart shows the paths of the two planets during the month, with the planets shown at their closest. The chart is orientated to show the sky to the northeast about an hour before sunrise. Stars to magnitude 8 are shown.

**SATURN** will still be visible in the evening sky during June, although it will set about midnight by the end of the month. So the best time for observing, when Saturn is highest, will be early evening. During June the planet is in **Virgo**, just over 25° to the left of Spica and is slightly brighter than the star. By the end of the month, Mars will be 15° from Saturn on the opposite side to Spica.

The closest approach of the Moon to Saturn is on the 19th, when the 51% lit Moon will be just under 7° from the planet and to its upper left early evening.

Saturn's rings are still only open a slight amount, so will generally appear as a bar either side of the planet in a small telescope. Viewing at high power will show the rings.

## 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



# Planet Notes for June 2010

Date	Diary of Solar System Events in June 2010 for New Zealand
June 1	Saturn and Neptune both stationary.
June 4	Moon at apogee, its greatest distance from the Earth for the Lunar month, 404267 km.
June 5	Moon at last quarter 10:13pm NZST (Jun 4, 22:13 UT).
June 6	42% lit waning Moon, 8.5° to left of Jupiter, and Uranus, morning sky.
June 7	32% lit waning Moon, 9.5° below Jupiter and Uranus, morning sky.
June 7	Mars 0.8° from Regulus, magnitude 1.4, early evening sky.
June 8 & 9	Venus 4.7° from Pollux, magnitude 1.2, brightest star in Gemini. Low, early evening sky.
June 9	Jupiter less than half a degree from Uranus, morning sky.
June 11	3.5% lit crescent moon, 6.5° to lower left of Mercury, magnitude -0.5, very low in dawn sky.
June 12	New Moon at 11:15pm NZST (11:15 UT), Moon furthest north, so lowest southern hemisphere transit for the month. With the Pleiades now rising in the dawn sky, this is the Matariki New Moon celebrated on June 14 when the New Moon becomes visible.
June 15	10% lit crescent Moon, 3° to upper left of Venus, low to northwest following sunset.
June 16	Moon at perigee, its closest to the Earth for the lunar month, 365 933km.
June 17	28% lit Moon, 7° from Mars, and 3.75° from Regulus, magnitude 1.4, evening sky.
June 19	Moon at first quarter 4.30pm NZST (04:30 UT).
June 19	51% lit Moon 7° from Saturn, evening sky.
June 21	73% lit Moon 3.6° from Spica, magnitude 1.1, evening sky.
June 21	Southern winter solstice, Sun furthest north, at 11:29 pm NZST.
June 24	95% lit Moon 2.5° from Antares, magnitude 1.1, brightest star in Scorpius.
June 25	Moon furthest south, so highest southern hemisphere transit for the month.
June 26	Pluto at opposition.
June 26	Full Moon at 11.30pm NZST (11:30 UT).
June 28	Mercury at superior conjunction.
June 30	Moon at apogee, its greatest distance from the Earth for the Lunar month, 405,036 km.

## 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

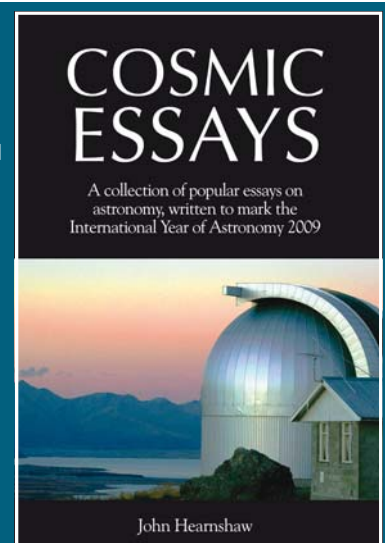
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The book is richly illustrated with over 150 full colour illustrations. pp 105 + vi

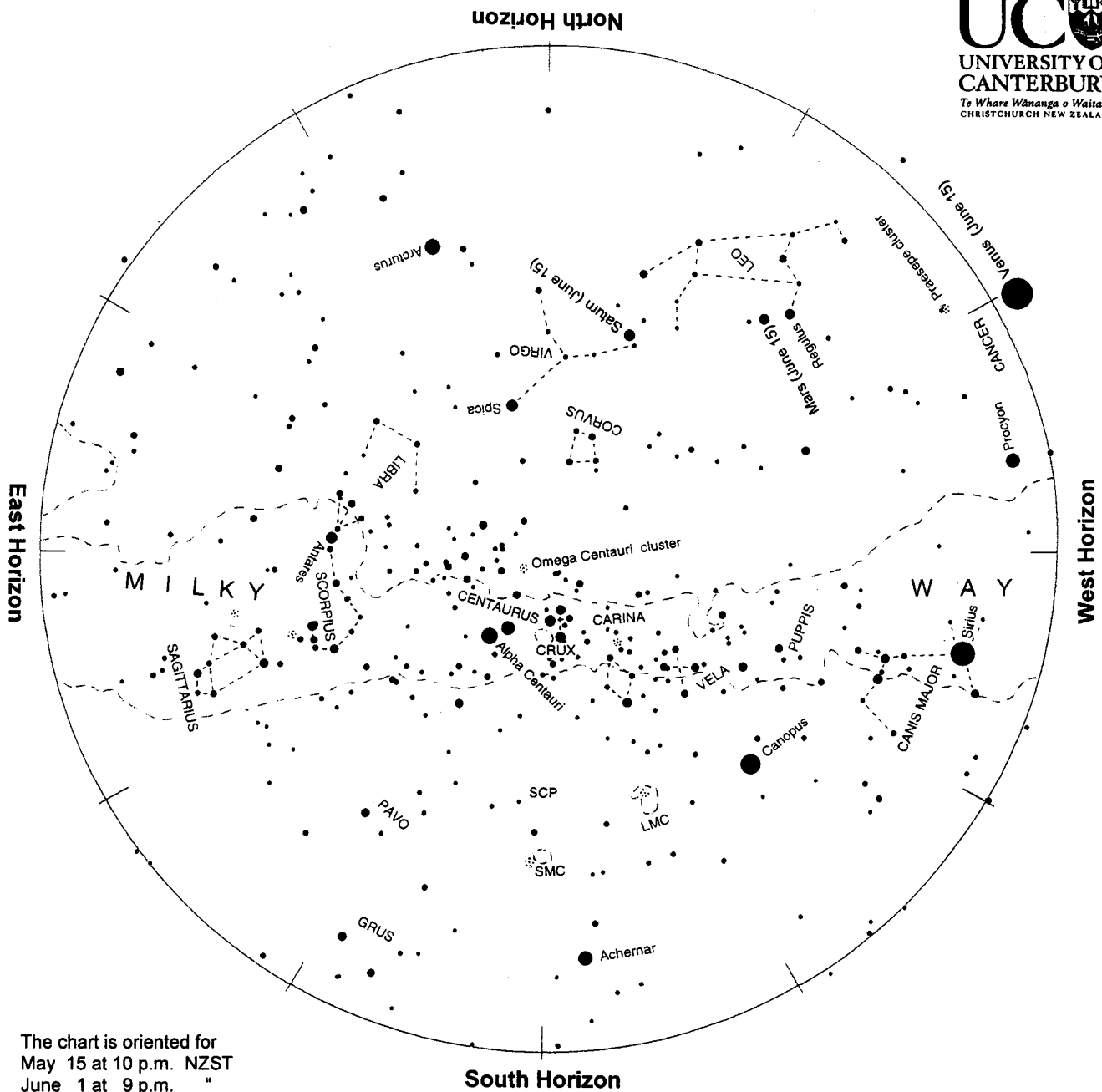
Cosmic Essays is published by the author, who is Professor of Astronomy at the University of Canterbury, New Zealand. Published May 2010. See [www2.phys.canterbury.ac.nz/~jhe25/CosmicEssays/COSMIC\\_ESSAYS.htm](http://www2.phys.canterbury.ac.nz/~jhe25/CosmicEssays/COSMIC_ESSAYS.htm)

To order a copy, email [john.hearnshaw@canterbury.ac.nz](mailto: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](http://www2.phys.canterbury.ac.nz/~jhe25/CosmicEssays/COSMIC_ESSAYS_order.htm))

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



# June 2010 Skychart



The chart is oriented for  
 May 15 at 10 p.m. NZST  
 June 1 at 9 p.m. "  
 June 15 at 8 p.m. "  
 July 1 at 7 p.m. "

## Evening sky in June 2010

To use the chart, hold it up to the sky. Turn the chart so the direction you are looking is at the bottom of the chart. If you are looking to the south then have 'South horizon' at the lower edge. As the earth turns the sky appears to rotate clockwise around the south celestial pole, SCP on the chart. Stars rise in the east and set in the west, just like the sun. The sky makes a small extra westward shift each night as we orbit the sun.

Venus is the brilliant 'evening star' appearing in the northwest at sunset and setting mid evening. Sirius twinkles colourfully in the west before setting. Canopus is in the southwest, swinging down to the south through the night. South of overhead are Alpha and Beta Centauri, with the Southern Cross (Crux) to their right. Further to the right are the Diamond Cross and False Cross, with a bright region of Milky Way above them. Regulus, Mars, Saturn and Spica make a line up the northwest sky. Orange Arcturus in the north often twinkles red and green. The Scorpion is on its back midway up the eastern sky with Sagittarius below it. Jupiter (not shown) rises in the east after midnight.

Chart produced by Guide 8 software; [www.projectpluto.com](http://www.projectpluto.com). Labels and words added by Alan Gilmore, University of Canterbury's Mt John Observatory, P.O. Box 56, Lake Tekapo 7945, New Zealand. [www.canterbury.ac.nz](http://www.canterbury.ac.nz)

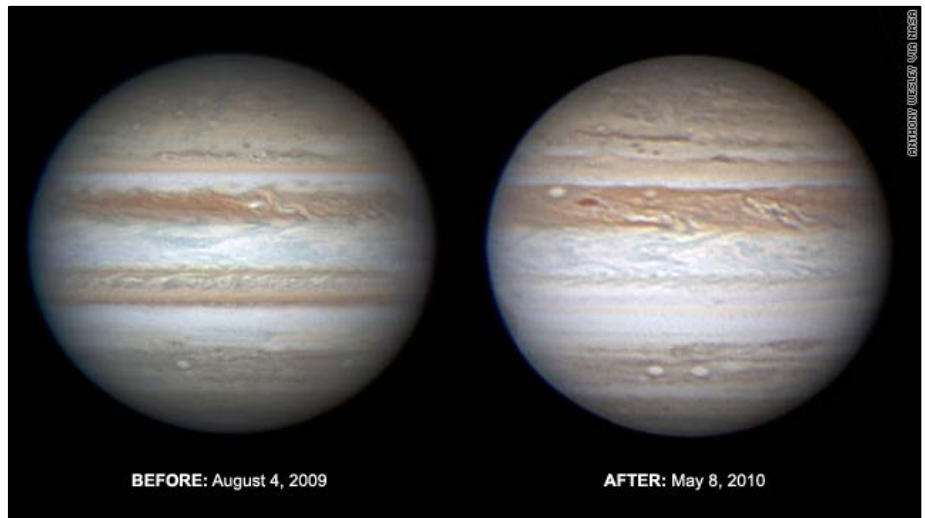
# Jupiter cloud belt missing again

By CNN Wire Staff

Scientists don't know why, but one of Jupiter's two main cloud belts has disappeared, again. Like a wayward pet, the belt has gone missing before and has always returned. "This is a big event," said planetary scientist Glenn Orton of NASA's Jet Propulsion Lab. "We're monitoring the situation closely and do not yet fully understand what's going on."

The brown cloudy band, known as the South Equatorial Belt, or SEB, started fading late last year. "But I certainly didn't expect to see it completely disappear," said amateur astronomer Anthony Wesley of Australia. "Jupiter continues to surprise." Orton says the belt may not be gone, just hidden under higher clouds. "It's possible, that some 'ammonia cirrus' has formed on top of the SEB, hiding the SEB from view."

On Earth, NASA says, white wispy cirrus clouds are made of ice crystals. On Jupiter, the same sort of clouds can form, but the crystals are made of ammonia instead of water. The belt's disappearances can be erratic. "The SEB fades at irregular intervals, most recently in 1973-75, 1989-90, 1993, 2007, 2010," said John Rogers, director of the British Astronomical Association's Jupiter



Jupiter's South Equatorial Belt started fading late last year, NASA

Section. "The 2007 fading was terminated rather early, but in the other years, the SEB was almost absent, as at present." The return of the SEB can be dramatic, NASA said.

"We can look forward to a spectacular outburst of storms and vortices when the 'SEB revival' begins," Rogers told NASA. "It always begins at a single point, and a disturbance spreads out rapidly around the planet from there, often becoming spectacular even for amateurs eyeballing the planet through medium-sized telescopes. "However," he said, "we

can't predict when or where it will start. On historical precedent, it could be any time in the next two years."

"I'll be watching every chance I get," Wesley said. "The revival will likely be sudden and dramatic, with planet-circling groups of storms appearing over the space of just a week or so."

Jupiter, the largest planet in the Solar System, is visible in the eastern sky before dawn.

## The 2010 Council

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## Society Contacts

Auckland Astronomical Society Inc,  
P O Box 24-187, Royal Oak,  
Auckland 1345, New Zealand

**Email** info@astronomy.org.nz  
**Journal** journal@astronomy.org.nz  
**Website** www.astronomy.org.nz

**Membership inquiries** contact Andrew Buckingham at treasurer@astronomy.org.nz or by phone on (09)-473-5877 or 027-246-2446

# Faint Comet in the June Dawn

by Greg Bryant, *Skyandtelescope.com*

We rarely see a good comet when it's at its best. Most comets are brightest when nearest the Sun, just when they're most likely to be hidden in the Sun's glare or below the sunrise or sunset horizon.

That's the situation this spring with Comet C/2009 R1 (McNaught). Even so, observers in the Northern Hemisphere should be able to pick it up with telescopes, and possibly binoculars, just before dawn for at least part of June, during its run-up in brightness.



On May 19th, when Michael Jaeger shot this image from Austria, Comet C/2009 R1 was 8th magnitude and showing the characteristic green comet colour in large telescopes. Note the thin blue gas tail.

And in fact, the comet is turning out to be 1 or 2 magnitudes brighter than we predicted in the June *Sky & Telescope* (page 60). Let's hope this behaviour keeps up!

## Comet Timetable

As of mid-May the comet was about magnitude 8.5 (compared to the 10 we originally predicted), as it rose about an hour before the start of astronomical twilight for mid-northern observers. Throughout this apparition it will be low in the east or northeast when dawn begins to brighten.

**May 31st** will find McNaught, now hopefully 6th or 7th magnitude, passing  $2\frac{1}{2}^\circ$  southeast of the 2nd-magnitude star Beta Andromedae. At the beginning of astronomical twilight it's a respectable  $20^\circ$  up as seen by observers at  $40^\circ$  north

latitude. But the waning gibbous Moon will brighten the sky.

On the morning of **June 5th** the comet skims just north of the large, loose open cluster NGC 752. On **June 6th and 7th** it's within about  $2^\circ$  of the 2nd-magnitude double star Gamma Andromedae. The Moon is much thinner then, but also closer to the comet.

**Mid-June** is when Comet McNaught should be most interesting, offering the best

compromise between its increasing brightness and its decreasing altitude at the start of dawn. Moreover, the sky will be free of moonlight.

The helpful conjunctions continue as the comet passes about  $1^\circ$  north of the open cluster M34 in Perseus on the morning of **June 10th**, and  $3^\circ$  south of 1.8-magnitude Mirfak (Alpha Persei) on the **13th**. It's still about  $15^\circ$  high in the northeast as the sky starts to grow light on **June 15th**, but it appears roughly  $1^\circ$  lower every day after that. The comet passes zero-magnitude Capella on the **21st**, and it's very low by the **24th**, when it passes 2nd-magnitude Beta Aurigae. By now Comet McNaught may be as bright as 4th or 5th magnitude, but moonlight is returning.

The comet will be lost to view by June's end, just before it reaches perihelion on July 2nd, 0.405 astronomical unit from the Sun. It remains far from Earth throughout this apparition, never venturing closer than 1.135 a.u. (in mid-June). After perihelion it will fade rapidly as it heads to the far-southern sky.

The comet is approaching on a hyperbolic orbit, which means that it's making its first trip in from the Oort Cloud. So its brightness is even less predictable than usual. Will it flare unexpectedly or perhaps fizzle right out?

Print out our map, plan where and when



The June comet crosses Perseus, low just before dawn, when at its best in June

to look (find when astronomical twilight begins at your location using our almanac, and don't forget to check the Daylight Saving Time box if necessary), and see for yourself.

## Many McNaughts

This particular Comet McNaught is one of 54 (and counting) named for Robert H. McNaught of Australia's Siding Spring Observatory. He works in the Siding Spring Survey, funded by NASA to record large swathes of sky to find potentially hazardous near-Earth objects. The survey also turns up many other moving objects. McNaught found this comet (which will never come near Earth) at 17th magnitude on an image taken last September 9th. Pre-discovery images quickly established its orbit.

The most famous of the Comet McNaughts is C/2006 P1, also known as the Great Comet of 2007. It was an easy naked-eye sight when passing near the Sun in mid-January of that year, shining at magnitude  $-5$  or  $-6$ , and in the following days it flung a gigantic, multi-banded tail across the Southern Hemisphere's evening sky.

## Footnote

This time Comet C/2009 R1 is in the northern constellation of Perseus and is not visible this far south in the southern hemisphere. ... ED

# Matariki – Māori New Year

by Paul Meredith, Te Ara (teara.govt.nz)

Once a year, twinkling in the winter sky just before dawn, Matariki (the Pleiades) signals the Māori New Year. Traditionally, it was a time for remembering the dead, and celebrating new life. In the 21st century, observing Matariki has become popular again. Heaven-bound kites, hot-air balloons and fireworks help mark the occasion.

## The heavens

Matariki is the Māori name for the small cluster of stars also known as the Pleiades or the Seven Sisters, in the Taurus constellation. In New Zealand it comes into view low on the north-eastern horizon, appearing in the tail of the Milky Way in the last days of May or in early June, just before dawn. This heralds the Māori New Year.

Various Māori tribes celebrated Matariki at different times. Some held festivities when Matariki was first seen in the dawn sky; others celebrated after the full Moon rose or at the beginning of the next new moon.

For all tribes, the importance of Matariki has been captured in proverbs and songs, which link it with the bright star Whānui (Vega):

Ka puta Matariki ka rere Whānui. Ko te tohu tēnā o te tau e!

Matariki re-appears, Whānui starts its flight. Being the sign of the [new] year!

Matariki is also associated with the winter solstice. It appears when the Sun, drifting north on the shortest day in winter, reaches the north-eastern end of the horizon. The Sun then turns around and begins its journey south.

## Legends

Matariki literally means the 'eyes of god' (mata ariki) or 'little eyes' (mata riki). Some say that when Ranginui, the sky father, and Papatūānuku, the earth mother were separated by their offspring, the god of the winds, Tāwhirimātea, became angry, tearing out his eyes and hurling them into the



An annotated image of the Pleiades open star cluster. Image Credit: Anglo-Australian Observatory

heavens. Others say Matariki is the mother surrounded by her six daughters, Tupu-ā-nuku, Tupu-ā-rangi, Waitī, Waitā, Waipuna-ā-rangi and Ururangi. One account explains that Matariki and her daughters appear to assist the Sun, Te Rā, whose winter journey from the north has left him weakened.

## Matariki and Puanga

Some Māori tribes believed that it was the rising of the star Puanga (Rigel in Orion) which heralded the new year, not Matariki. Hence the saying: 'Puanga kai rau' (Puanga of abundant food). This divergence was explained to the scholar Elsdon Best by a Māori elder: 'The task of Puanga is to strive with Matariki (the Pleiades) that he may gain possession of the year.'

## Matariki in Greek myth

According to Greek myth, the Pleiades are the seven daughters of Pleione and Atlas – Electra, Maia, Taygete, Alcyone, Celaeno, Asterope and Merope. While wandering through the woods one day,

they were spied by Orion, who gave chase. To save them from Orion's dishonorable intentions, Zeus transformed them into stars and placed them in the sky. A number of ancient temples on the Acropolis in Athens face the direction where the Pleiades rise.



F. E. Fillebrown engraving of The Dance of the Pleiades by Elihu Vedder  
Courtesy of Art Connections, Houston

## Footnote

We normally see Matariki in the constellation of Taurus, to the west of both Orion and the bright red star Aldebaran, slightly north of the ecliptic during the late spring and summer evenings ..ED

# The Kumeu Observatory

By Dave Moorhouse [acrux@orcon.net.nz](mailto:acrux@orcon.net.nz)

For those of you who either haven't heard of The Kumeu Observatory or haven't visited in the last year there have been a few big changes. I thought I would write a small article about the changes and what's happening up there.

Being only thirty minutes drive from downtown Auckland, 6 Km away from Kumeu township on private land, the Kumeu Observatory is at a reasonably dark site. However, the twenty year old building needed a bit of TLC. So over the last year or so I have been making a huge number of small changes to make it a warm dry environment.

The biggest of these has been the installation of two Northwest facing windows that let in light from about midday onwards. This has increased the temperature and reduced the humidity inside drastically. The windows in both cases were second-hand and came in the size they happened to be. This was a bit of a challenge and I was grateful for the assistance of our neighbour, Peter, who happens to be a builder.

During this installation I needed to remove all the interior lining on these walls to be able to cut the hole for the windows. What I found was no insulation and gaps that let rats into the wall spaces where they had been nesting. So holes were filled, batts installed and Gib board put up. However, I got the bug and continued with another exterior wall. Then the bug became an obsession and now all the exterior walls are re-lined and insulated. The next obvious one was the ceiling which was next to get the treatment. Wow, what a difference! We used to often get to only 2 degrees above the outdoor temperature in the bunkroom for sleeping. Now it's warmer by far and doesn't smell damp.

Also getting the treatment has been our weather monitoring, which is now extensive.

Last year saw the introduction of a La Crosse Weather Station Pro from Dick Smith Electronics. The interface used to



Peter McLeod installing windows at the Kumeu observatory

get the images to the website is Heavy Weather, a New Zealand based software package. The package has an anemometer, rain gauge, wind vane, and indoor/outdoor temperature and humidity readings. You can see this info at. <http://www.binoscope.co.nz/Kumeu.htm>

It updates at every half an hour. We have had the Boltwood cloud detector for several years now. It shows a graph of both the ambient temperature but more importantly the sky temperature, which roughly is very cold when it is clear and warmer when there is cloud. This effect is apparent day and night. This is a great tool. When we are doing overnight observing runs for Planetary Microlensing work we can set the sensor to give an audio alarm when clouds or rain come in to wake us This lets us get some sleep overnight so we can observe even on work nights. This link shows our sensor as well as Jennie McCormick's and the Auckland Stardome's sensors, which are all online as well.

<http://www.binoscope.co.nz/weather.html>

However, if you look at the top of that page you will see a link to our other great bit of weather kit the NOAA Satellite receiving system. This consists of

a 137 Mhz FM receiver in our case an R2FX from Germany, a PC running Wxtoimg image processing software and two external antennas. The four NOAA satellites are in polar orbit and make a total of about eight useable passes over New Zealand per day. They transmit a coded audio tone that is picked up by the antenna and receiver. This tone then goes into the PC where Wxtoimg decodes it to images. These images can then have various enhancements or treatments to them. The software then puts these automatically up onto my webpage for you all to view.

<http://www.binoscope.co.nz/wxtoimg/noaa.html>

Enough for this time. Next month a bit about the finished Wasp roll-off roof, the raising of the horrible floor and our latest results and work with Ohio State University in the hunt for extrasolar planets.

If you want to get involved at Kumeu, just to have a look, to help out with the never ending list of projects or just to have a safe dark sky site to take your telescope to, then get in touch with me.

**[acrux@orcon.net.nz](mailto:acrux@orcon.net.nz)**

# Our Universe May Exist in a Black Hole

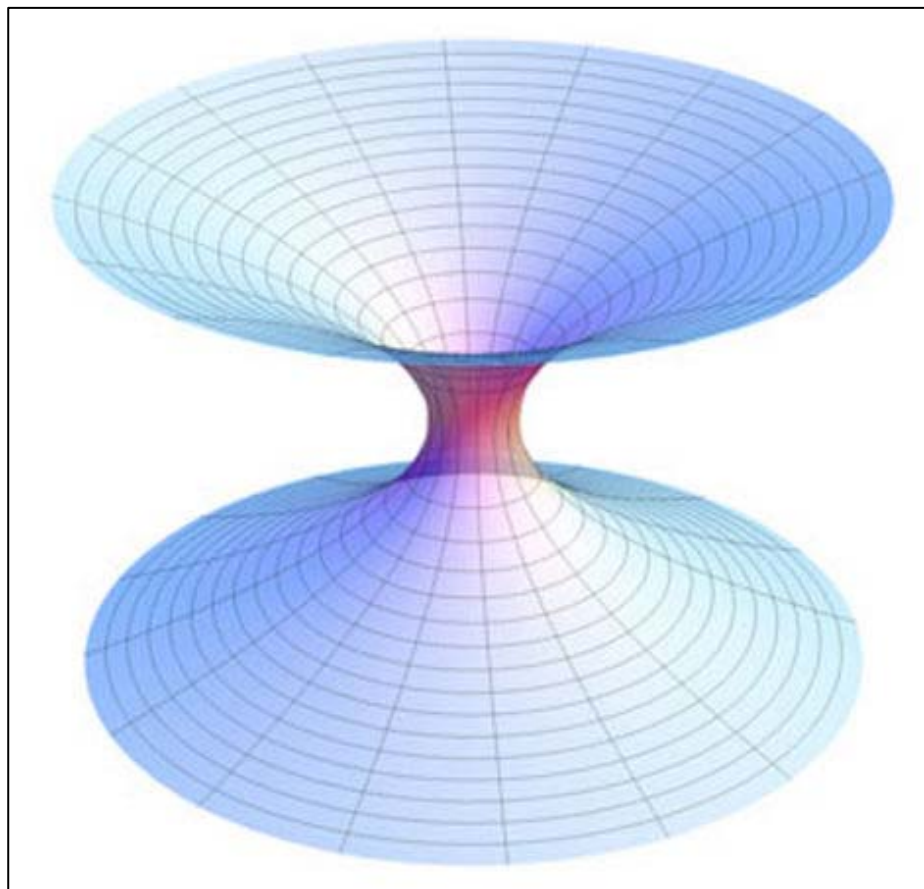
which triggered a white hole when it formed

By Tudor Vieru, Science Editor, Softpedia.com

New wormhole research would seem to indicate that our entire Universe may in fact be located within an Einstein-Rosen Bridge, a structure more commonly referred to as a wormhole. This region of space may itself be located inside a black hole, in a much larger Universe than we could ever hope to imagine. The new idea belongs to expert Nikodem Poplawski, who is a theoretical physicist at Indiana University, in the United States. Details of his proposal will appear in the April 12 print issue of the esteemed scientific publication *Physical Letters B*, and are already available online.

The physicist bases his hypothesis on some fairly advanced calculations. He describes in the journal entry that he used isotropic coordinates for the job. These are components of a Euclidean-based coordinate system, which he uses to describe the gravitational field that a black hole produces around it. Derived from this, the expert calculates the radial geodesic motion that a massive particle may have inside a black hole. Poplawski paid special attention in his work to what happens when this hypothesized particle passes through the event horizon, or what is known as the boundary, of the hole.

Albert Einstein's theory of general relativity allows for the existence of two distinct types of black holes, the Schwarzschild and Einstein-Rosen. Both of them are mathematical solutions extracted directly from the theory. The issue with studying particles inside black holes is that it's impossible. Outside observers can only view the exterior parts of the dark behemoths, and the physicist says that, in order for the motion of a particle falling through the event horizon to be accurately analysed, one would need to be situated past the boundary as well. This is, however, impossible with current technology, and will most likely stay that way for centuries to come.



Artist's rendition of an Einstein-Rosen bridge Image credits: Indiana University

"This condition would be satisfied if our Universe were the interior of a black hole existing in a bigger Universe. Because Einstein's general theory of relativity does not choose a time orientation, if a black hole can form from the gravitational collapse of matter through an event horizon in the future then the reverse process is also possible. Such a process would describe an exploding white hole: matter emerging from an event horizon in the past, like the expanding Universe," the expert explains. Another idea in the paper is that all black holes, regardless of type, may have Einstein-Rosen bridges inside, which means that their formation may be accompanied by the birth of another Universe within.

"From that it follows that our Universe could have itself formed from inside a

black hole existing inside another Universe," he notes further. This new idea could explain a host of difficulties that astrophysicists have in reconciling the Big Bang model, and the inflation theory, with the actual observations conducted via satellites and telescopes. It may be that Poplawski's idea actually explains the origins of inflation, the theory seeking to show why the Universe expands at its current rate, PhysOrg reports.

#### Footnote

With this under our belt, we are now ready for Richard Hall's next talk on Wormholes! ..ED

# A new type of supernova discovered?

By Marlowe Hood *COSMOS*

A new type of exploding star that spews huge quantities of calcium and defies the two known categories of supernovae has been discovered.

Only a handful of these novel star bursts have been spotted over the last few years, but they could explain the abundance of calcium observed in galaxies like our own Milky Way, according to an international group of astronomers who announced the discovery in the British journal, *Nature*.

The new supernova types might even account for the calcium present in our bones, and in all life on Earth, the researchers added.

## Two classes were known

Until now, supernovae - the most energy-intense and brilliant events visible in the Universe - have been grouped into two classes.

Type Ia are thought to arise when the gravity of a burnt-out rump star, called a white dwarf draws, off enough material from a similar star nearby - a process known as accretion - to become unstable.

At a critical tipping point, the star's ultra-dense core of carbon and oxygen ignites into a shattering thermonuclear blast.

Light curves generated by Type Ia supernovae are so regular and predictable that they are used as cosmic benchmarks to measure the speed with which the Universe expands.

## Stellar destruction

The other known path to stellar destruction involves the gravitational and catastrophic collapse of a hot, massive star's inner core.

When these stars - dubbed Type II, or Type Ib or Ic - become supernovae, they give birth to neutron stars or black holes.

But as tools for peering into the heavens become more powerful,

astronomers have come across supernovae that do not fit neatly into either category.

## Unknown physical mechanisms?

The first paper, by Koji Kawabata of Hiroshima University in Japan and colleagues, focuses on Supernova 2005cz, which was observed for six months after its cataclysmic explosion. In the second paper, lead author Hagai Perets of the Harvard-Smithsonian Center for Astrophysics in Boston and colleagues focus on Supernova 2005E, in which the team also found a strong calcium signature. Both supernovae were generated by a low-mass, helium-rich white dwarfs instead of the more common hydrogen-rich white dwarf.

"We're discovering weird ones that may represent different physical mechanisms compared with the two well-known types, or may just be variations on the standard themes," said Alex Filippenko, a professor at the University of California at Berkeley and co-author of one of the studies.

Both studies in *Nature* focus on one such anomalous stellar burst, known as SN 2005E, which became visible in the halo of nearby galaxy NGC 1032 in January 2005. Like a Type Ia supernova, SN 2005E appeared to arise from white dwarfs. But the calcium and titanium thrust out by the blast some 110 million years ago was evidence of a nuclear reaction involving helium, rather than the Type Ia's signature carbon and oxygen.

## Core-collapse theory

At the same time, the lack of any recent star formation nearby, and the relatively paltry mass ejected by the explosion, did not conform well with the Type II core-collapse scenario either. "The SN 2005E was a different kind of 'bang'," said Filippenko. "It and other calcium-rich supernovae may be a true suborder, not just a one-of-a-kind."

If so, the discovery could explain two



*New type of supernovae? Supernova 2005cz (with arrow) suddenly appeared inside the host galaxy NGC 4589. Credit: Subaru Telescope/NAOJ*

puzzling observations. One is the abundance of calcium. Researchers calculate that about half of the mass thrown out by the explosion was calcium, which means that a couple of such supernovae every century would be enough to produce the rich stores of the element found in galaxies such as our own. The other is the concentration of particles called positrons -- the anti-matter counterpart to electrons -- in the centre of galaxies.

## Decay of dark matter?

The most widely accepted explanation for the presence of positrons is the decay of putative dark matter. "Dark matter may or may not exist, but these positrons are perhaps just as easily accounted for by the third type of supernovae," said Avishay Gal-Yam, a researcher at the Weizmann Institute of Science in Rehovot, Israel, and co-author of one of the studies.

# Precisely Calculating the Age of Stars: Key to Evolution of a Type of White Dwarf Found

*From Sciencedaily*

**A**n international team of scientists has precisely calculated the age of a group of white dwarf stars. The research results open up new opportunities for advancing our understanding of the evolution of stars, plasma physics, and the origin of the Universe in general.

A team of scientists from the Universitat Politècnica de Catalunya (UPC Barcelona Tech), the Catalan Institute for Space Studies, the Institute of Space Sciences of the Spanish National Research Council (CSIC), the National University of La Plata (Argentina), and Liverpool John Moores University (UK), led by researcher Enrique García-Berro of the UPC's Department of Applied Physics, has demonstrated that the white dwarf stars in the NGC 6791 star cluster are 8 billion years old, not 6 billion as previously believed. The research opens up new opportunities for extending our knowledge of the origin of the Universe.

The researchers calculated the evolution of the white dwarfs from their birth to the present. Their calculations provide experimental confirmation of theories that have been proposed, but which up until now have not been corroborated by observational evidence. Specifically, the researchers have shown that sedimentation of the heaviest elements (under the strong gravity of the stars) and crystallization of material (due to the enormous pressure) take place in the interior of white dwarfs. These physical processes release energy inside the white dwarfs and slow their evolution. If they are properly taken into account, the age of stars of this type can be calculated with precision.

For years scientists have used the age of white dwarfs to estimate the age of the galaxy and other star systems. Their estimates of the age of these stars were based on theoretical considerations, but the level of uncertainty was very high because the occurrence of sedimentation and crystallization in the interior of white dwarfs could not be demonstrated. Up

until now the proposed theories had not been independently verified based on observational data because in Earth-bound laboratories it is impossible to achieve the extremely high densities and temperatures that exist inside the stars (pressures of millions of grams per cubic centimetre and temperatures of millions of degrees). The calculations of this group of researchers were found to coincide with measurements of the age of NGC 6791 based on images taken by the Hubble Space Telescope.

White dwarfs are the most abundant stars in the Universe. They are also very dense, similar to the Sun in mass but with a radius comparable to that of the Earth. In fact they are stellar remnants, the compact remains of stars that have reached their final evolutionary state, formed when stars exhaust their nuclear fuel. They emit stored thermal energy and are therefore generally stars of very low luminosity.

Most white dwarfs have cores composed of carbon and oxygen, though they have a surface layer of hydrogen and helium. When they form, white dwarfs are very hot and bright, but because they have no source of energy other than stored thermal energy, they gradually cool and become less bright until they reach a point at which they cease to radiate. White dwarfs, however, can have a lifespan of billions of years. Up until now most calculations indicated that the white dwarfs in the NGC 6791 star cluster were 6 billion years old, but the new research has shown that they were actually born 8 billion years ago.

This hypothesis was demonstrated by simulating the entire evolutionary process of the white dwarfs in a way that includes two physical processes that take place in the core of these stars but have not previously been taken into account: the effect of neon sedimentation, and phase separation of carbon and oxygen during crystallization, which occurs at lower temperatures.



**Image of the Galactic cluster NGC 6791, obtained using an Earth-based telescope. NGC 6791 is an extremely metal-rich and very old open cluster which has an abundant population of white dwarfs. (Credit: Luigi Bedin and The Space Telescope Science Institute)**

During these two evolutionary stages, the stars release gravitational energy and cooling slows down. The faintest white dwarfs in the cluster are also the reddest and the coolest, so if scientists have good models for cooling, they can calculate the age of the cluster. Accordingly, the scientists measured the colour and brightness of all the white dwarfs in the cluster and verified that in the faintest white dwarfs in the cluster the effects of these two physical processes slow down the cooling of the stars, such that the age of the cluster and that of its white dwarfs coincide.

## **Reliable chronometers**

The discovery has important scientific implications because it confirms that white dwarfs can be used as independent, reliable chronometers to determine the age of many star systems and thus contribute to advancing our knowledge of the Universe. The knowledge gained can also be applied in other fields such as dense plasma physics.

# Giant Intergalactic Gas Stream Longer Than Thought

From *Sciencedaily.com*

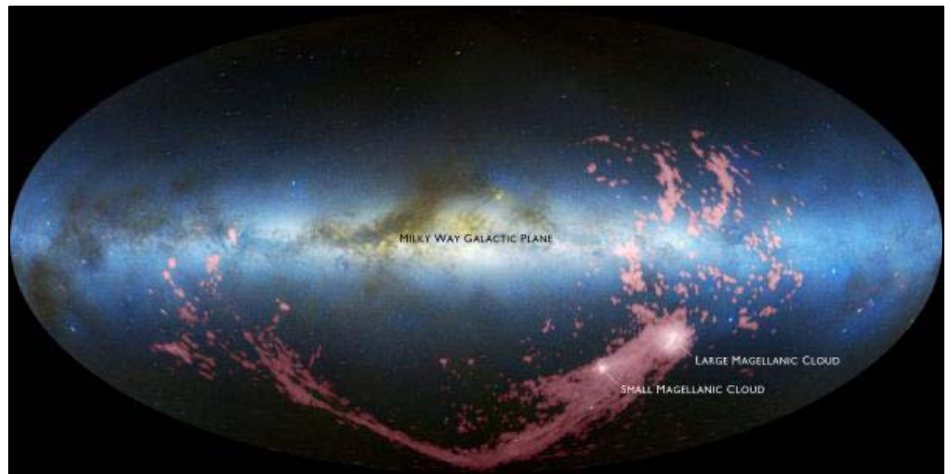
A giant stream of gas flowing from neighbour galaxies around our own Milky Way is much longer and older than previously thought, astronomers have discovered. The new revelations provide a fresh insight on what started the gaseous intergalactic streamer.

The astronomers used the National Science Foundation's Robert C. Byrd Green Bank Telescope (GBT) to fill important gaps in the picture of gas streaming outward from the Magellanic Clouds. The first evidence of such a flow, named the Magellanic Stream, was discovered more than 30 years ago, and subsequent observations added tantalizing suggestions that there was more. However, the earlier picture showed gaps that left unanswered whether this other gas was part of the same system.

"We now have answered that question. The stream is continuous," said David Nidever, of the University of Virginia. "We now have a much more complete map of the Magellanic Stream," he added. The astronomers presented their findings to the American Astronomical Society's meeting in Washington, DC.

The Magellanic Clouds are the Milky Way's two nearest neighbour galaxies, about 150,000 to 200,000 light-years distant from the Milky Way. Visible in the Southern Hemisphere, they are much smaller than our Galaxy and may have been distorted by its gravity.

Nidever and his colleagues observed the Magellanic Stream for more than 100 hours with the GBT. They then combined their GBT data with that from earlier studies with other radio telescopes, including the Arecibo telescope in Puerto Rico, the Parkes telescope in Australia, and the Westerbork telescope in the Netherlands. The result shows that the stream is more than 40 percent longer than previously known with certainty.



*Combined radio/optical image shows Milky Way, Magellanic Clouds, and the new radio image of the Magellanic Stream. Blue and white are the Milky Way and Magellanic Clouds. Red is the hydrogen gas in the Magellanic Stream, in the disks of the Magellanic Clouds, and in the stream's Leading Arm. The Milky Way is horizontal in the middle of the image; the Magellanic Clouds are the light spots at the centre-right portion of the image, from which the gas stream originates. Brown is dust clouds in the Milky Way (Credit: Nidever, et al., NRAO/AUI/NSF and Meilinger, Leiden-Argentine-Bonn Survey, Parkes Observatory, Westerbork Observatory, Arecibo Observatory)*

One consequence of the added length of the gas stream is that it must be older, the astronomers say. They now estimate the age of the stream at 2.5 billion years.

The revised size and age of the Magellanic Stream also provides a new potential explanation for how the flow got started.

"The new age of the stream puts its beginning at about the time when the two Magellanic Clouds may have passed close to each other, triggering massive bursts of star formation," Nidever explained. "The strong stellar winds and supernova explosions from that burst of star formation could have blown out the gas and started it flowing toward the Milky Way," he said.

"This fits nicely with some of our earlier work that showed evidence for just such blowouts in the Magellanic Clouds," said Steven Majewski, of the University of Virginia.

Earlier explanations for the stream's

cause required the Magellanic Clouds to pass much closer to the Milky Way, but recent orbital simulations have cast doubt on such mechanisms.

Nidever and Majewski worked with Butler Burton of the Leiden Observatory and the National Radio Astronomy Observatory, and Lou Nigra of the University of Wisconsin. In addition to presenting the results to the American Astronomical Society, the scientists have submitted a paper to the *Astrophysical Journal*.

# The Milky Way bulges with cannibalized corpses!

By Phil Plait, *Bad Astronomy* Article provide by the AAVSO Writer's Bureau

Why do spiral galaxies have central bulges? Some are bigger, some smaller, but pretty much every spiral galaxy we see has a roughly spherical puffy bulge of stars in its core (like in the edge-on spiral NGC 4565). This downtown region of a galactic city is a bit mysterious. It contains old stars, very little gas, lots of dust... and we're not sure how they form. But a new observation of a cluster of stars in our Milky Way's bulging centre may have the key we've been looking for. Behold Terzan 5.

Pretty, isn't it? My first glance at this image made me think, "Oooh, sweet." My second glance made me think "Hey, wait a sec..." and my third, after reading the scientific paper, made me smile. Terzan 5 is a pretty interesting place. It's just over 19,000 light years away, toward the galactic centre. That area is lousy with thick patches of dust, making it very difficult to see anything, like trying to see a forest through a thick fog. These images were taken with the Very Large Telescope (srsly), an 8-meter Goliath in Chile. The observations were done in the infrared, which can travel more easily through the thick dust, specifically at 1.2 and 2.2 microns (our eyes can see out to about 0.8 microns; anything longer than that is infrared). Amazingly, this image is a total of only four minutes of observations, two minutes in each filter! And while the size of the image is comfortably larger than the full Moon on the sky, the resolution is about 0.1 arcseconds, about that of Hubble! That's why the second time I glanced at the image I was amazed; the star images are sharp and clear.

Also, see how the stars appear to be redder on the left in the picture of the cluster above, and bluer on the right? That's not because the stars themselves are different; it's because the dust between us and the cluster is thicker on the left, making stars appear redder. The astronomers studying Terzan 5 had to account for that when they investigated the stars. The wide-field picture shows

you just how hard this can be; the centre of our galaxy is an awful mess. Terzan 5 is in the centre of a very wide image as the blue glow; everything else is stars and dust obscuring the view. I'll add that this picture is pretty darn cool all by its lonesome, especially if you download the grossly embiggenated 240 Mb version. (which has not been reproduced here..ED) Still, astronomers are clever, and were able to tease solid data out of the observations. And when they did get their results, they were surprised to see two different kinds of stars in the cluster. In the image, Terzan 5 appears to be a globular cluster: a spheroidal ball of stars held together by its own gravity. The Milky Way has well over a hundred globulars orbiting it. But usually, stars in globular clusters are all about the same age, indicating they were all formed at the same time. Terzan 5, however, appears to have two different populations of stars, one older than the other. Moreover, the younger ones appear to be more centrally concentrated in the cluster, with older stars farther out from the centre. That's pretty weird. One possible way this could happen is if Terzan 5 isn't really a globular cluster, which form from collapsing clouds of gas around the same time the Milky Way itself did. Maybe instead Terzan 5 is the remnant of a galaxy in and of itself, a small dwarf galaxy that got torn apart by our Milky Way's gravity. Terzan 5 may have been a snack for our galaxy! That would explain the two kinds of stars. Galaxies, especially dwarfs, typically undergo different epochs of star formation as well as their different positions inside the cluster. But the weird thing here is that the amount of iron in the stars matches the amount of iron in stars in the bulge of our galaxy. That's an odd coincidence, if Terzan 5 formed separately from the Milky Way's bulge.

But maybe, all together, this makes sense. Perhaps Terzan 5 really was once a dwarf galaxy. It fell in to the galactic centre and got torn apart (we know that happens, and may explain how galaxies



Terzan 5: Image Credits: ESO/F. Ferraro; Region around Terzan 5: ESO/Digitized Sky Survey 2.

like the Milky Way grow to such large size). If that happens, the stars from the shredded dwarf 5 get tossed out, and become part of the Milky Way's bulge, which puffs up due to the adding of these stars to its population. The remaining stars form the small ragtag spherical clump which we now see as Terzan 5.

If this is true, then it may be the key we need to understanding why spirals have bulges. They don't necessarily form at the same time the galaxy itself does, but instead grow over time as the galaxy feeds on smaller, weaker galaxies. [Note that this is related to, but different from, a post I put up last week about globular clusters and galactic bulges.] This type of galactic archaeology is amazing to me. We see what looks like one kind of object, a globular cluster, which upon closer examination (which itself was pretty tough to do) turns out to be perhaps a totally different kind of object, a half-digested galactic corpse that itself became part of our own Milky Way, and by the way, may also be the missing link we've been looking for between how spiral galaxies are born and how they form their central bulges. All in all, not a bad piece of detective investigating! But of course, for astronomers, it's all in a night's work.

# Saturn's Eccentric Orbit Could Explain Moon's Lopsided Lakes

*From Space.com*

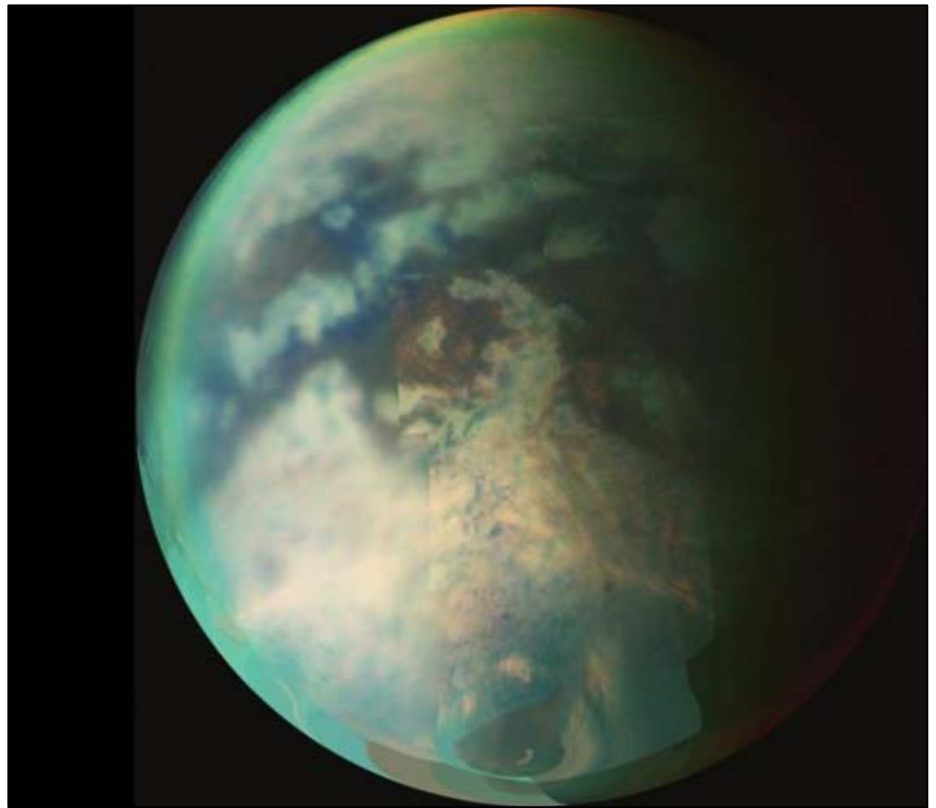
Saturn's eccentric orbit might be the cause of the uneven distribution of ethane and methane lakes on the ringed planet's moon, Titan. Images from NASA's Cassini spacecraft reveal that liquid methane and ethane lakes in Titan's northern high latitudes cover 20 times more area than lakes in the southern high latitudes.

Cassini data also show that there are significantly more partially-filled and now empty lakes in the north. But why Titan showed these north-to-south differences wasn't known, though scientists have floated various ideas to explain the mismatch. Now a new and potentially more plausible explanation is offered.

## Topography vs. seasons

Scientists initially considered the idea that "there is something inherently different about the northern polar region versus the south in terms of topography, such that liquid rains, drains, or infiltrates the ground more in one hemisphere," said Oded Aharonson of CalTech. But scientists didn't know of any such topographic differences between Titan's two poles, Aharonson said. One alternative to this theory is that the differences are seasonal. One year on Titan lasts 29.5 Earth years. Every 15 Earth years, the seasons of Titan reverse, so that it becomes summer in one hemisphere and winter in the other. According to the seasonal variation hypothesis, methane rainfall and evaporation vary in different seasons, recently filling lakes in the north while drying lakes in the south.

The problem with this idea, Aharonson says, is that it accounts for decreases of about 3 feet (1 metre) per year in the depths of lakes in the summer hemisphere. But Titan's lakes are a few hundred metres deep on average, and wouldn't drain (or fill) in just 15 years. Seasonality also can't account for the variation in the number of lakes between the two hemispheres. The north polar



*A composite of several Cassini images shows Titan's varied surface, including possibly a remnant of an old impact basin (large circular feature near the centre of Titan's disk). Mountain ranges to the southeast of the circular feature, and the dark linear feature to the northwest of the circular impact scar may be evidence of past tectonic activity.*

*Credit: NASA/JPL/University of Arizona.*

region has roughly three times as many dried-up lake basins as the south and seven times as many partially-filled ones. "The seasonal mechanism may be responsible for part of the global transport of liquid methane, but it's not the whole story," Aharonson said.

## Eccentric Saturn

A more plausible explanation, say Aharonson and his colleagues, is related to the eccentricity of the orbit of Saturn and hence of Titan, its satellite, around the Sun. "We propose that, in this orbital configuration, the difference between evaporation and precipitation is not equal in opposite seasons, which means there is a nett transport of methane from south to north," Aharonson said. This imbalance would lead to an accumulation of methane,

and hence the formation of many more lakes in the northern hemisphere.

This situation is only true right now, however. Over very long time scales of tens of thousands of years, Saturn's orbital parameters vary, at times causing Titan to be closer to the Sun during its northern summer and farther away in southern summers. (A similarly long shift in Earth's orbital parameters is thought to be a cause of Earth's ice ages.)

This reversal should produce a reverse in the nett transport of methane and lead to a build-up of the methane and ethane and an abundance of lakes in the southern hemisphere.



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