AUCKLAND ASTRONOMICAL SOCIETY

May 2011

SOCIETY JOURNAL

Society Meeting Monday 9th May at 8:00pm

The Mars Base Simulation Project

with Haritina Mogosanu

The Mars Simulation Base first became operational in February of 2007 with the objective to study the problems of living on Mars. The project is now open to volunteers to join the programme and live in the base for periods of two weeks, the expected duration of a Mars landing before the opportunity to return to Earth is lost for another 18 months.

The photograph above shows the base as it might be on Mars, without the wooden steps and the quad-bikes. Come and hear Haritina describe the program and it objectives. Maybe you might like to sign up for a stint.

Meteors from Halley's Comet

The eta Aquarids Meteor Shower May 5/6

From NASA

Looking for an adventure? Get up in the wee hours of the morning May 6th and head out into the country, far from the city lights. You won't be alone. The birds will be up and singing about the coming dawn, and, of course, about the eta Aquarid meteor shower.

The eta Aquarids are best viewed from the southern hemisphere, but there's something special about them no matter where you live: "Each eta Aquarid meteoroid is a piece of Halley's Comet doing a kamikaze death dive into the atmosphere," explains NASA astronomer Bill Cooke. "Many people have never seen this famous comet, but on the morning of May 6th they can watch bits of it leave fiery trails across the sky."

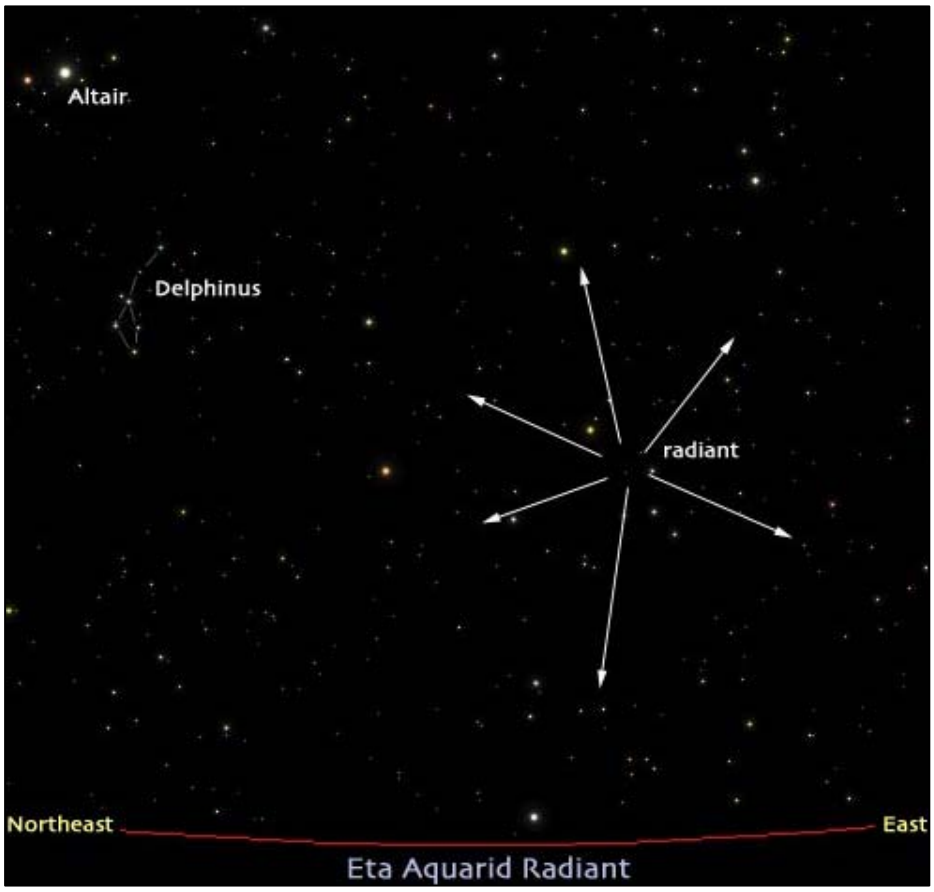
A messenger from the dawn of the universe, Halley's Comet orbits the sun once every 76 years. Each time it swings by the sun, intense solar heat vaporizes about 6 meters of ice and rock from the nucleus. The debris particles, about the size of sand grains, spread along the comet's orbit, filling it with tiny meteoroids.

"Although Halley's Comet is deep in the outer solar system at the moment and won't return to Earth until 2061, it treats us to a meteor shower twice a year as our planet passes by the debris cloud," says Cooke. "In May we have the eta Aquarids, and in October the Orionids."

And there is something especially significant about the 2011 eta Aquarids.

"This is your one chance this year to see meteors blaze across the sky without glaring moonlight dimming them."

A thin crescent moon will vacate the sky in the early evening, leaving a dark canvas for the display. Early risers are in luck, as the best viewing is an hour or two before dawn. Lie down where you can see as wide an expanse of sky as possible to catch more meteors with your peripheral vision. Look up into the darkness and relax.



This represents the view from mid-southern latitudes at about 4:00 a.m. local time around May 6. The graphic does not represent the view at the time of maximum, but is simply meant to help prospective observers to find the radiant location. The red line across the bottom of the image represents the horizon.

The radiant for the eta Aquarids is in the constellation Aquarius: diagram. But you don't need to look toward the radiant to see the meteors.

"Meteors can appear in any part of the sky," says Cooke. "In fact their trails will tend to point back toward the radiant, so if you look that way the meteor may appear somewhat stubby. They'll appear much longer going by you than coming at you."

You won't need binoculars or a telescope to observe eta Aquarid meteors. The naked eye's field of view is usually best for seeing meteors, which frequently streak more than 45 degrees across the sky.

"Eta Aquarids are fast, moving at 66 km/s (148,000 mph!), and often trace long paths across the sky, sometimes leaving glowing, persistent trains. In the northern hemisphere, depending on your latitude [the closer to the equator the better], you should see from 10 to 40 meteors just before dawn."

Remember to pack a reclining chair or an old blanket to lie on, and a thermos of hot coffee would be nice. After all, you'll be up mighty early! The spring night air may be damp and chill, so bring along another blanket--or better yet, a big furry dog, both for warmth and company. Golden Retrievers work nicely.

It's sure to be a memorable experience. A night breeze caressing your cheek, the aroma of hot coffee in the predawn air, a gently rising chorus of birdsong accompanying your own personal light show -- and your greatest admirer by your side. It just doesn't get any better.

Calendar of Events for 2011

May Programme

Mon	2	8:00pm	Practical Astronomy. Open Clusters with Bill Thomas
Fri	6	7:30pm	Young Astronomers. With Margaret Arthur
Mon	9	8:00pm	Society Meeting. Mars Simulation Project
Mon	16	8:00pm	Film Night with Gavin Logan
Wed	18	7:30pm	Council Meeting
Mon	23	8:00pm	Introduction to Astronomy with Bernie Brenner

Film Night Monday May 16 9800pm With Gavin Logan

This film follows the International Space Station through one orbit of the Earth revealing what has been learnt about our planet from being able to watch it from orbit. It has particular emphasis on some of the Earths environmental problems.

The film is about 60 minutes long and will be followed by a 25 minute 2011 Sky at Night programme with Patrick Moore entitled "Volcanoes of the Solar System".

The 2011 Council

President	Grant Christie	(021) 024-04992
Vice President	David Britten	(09) 846-3657
Treasurer & Membership	Andrew Buckingham	(09) 473-5877
Secretary	Kleo Zois	022 691 2055
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Webmaster	Nick Moore	(09) 537-1500
Council	Gavin Logan	(09) 820-6001
Council	Bernie Brenner	(09) 445-3293

June Programme

Fri	3	From 7:30pm	Young Astronomers With Margaret Arthur.
Mon	6	8:00pm	Practical Astronomy Winter Observing Night
Mon	13	8:00pm	Society Meeting. TBA
Mon	20	8:00pm	Film Night with Gavin Logan
Wed	22	7:30pm	Council Meeting
Mon	27	8:00pm	Introduction to Astronomy with Bernie Brenner

Welcome to New Members

Lisa Harnett (family)

Sean Mitchell (ordinary)

Alan & Anneli Torrance (family)

Practical Astronomy - Open Clusters Monday May 2nd at 8:00pm -with Bill Thomas

This session will give some tips and techniques for finding and observing some of the best open clusters visible in the Autumn and Winter Sky.
If weather permits after the session we will try and view the clusters through telescopes.

Society Contacts

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

Rumour: The God Particle Has Been Detected

By Mike Wall for Live Science

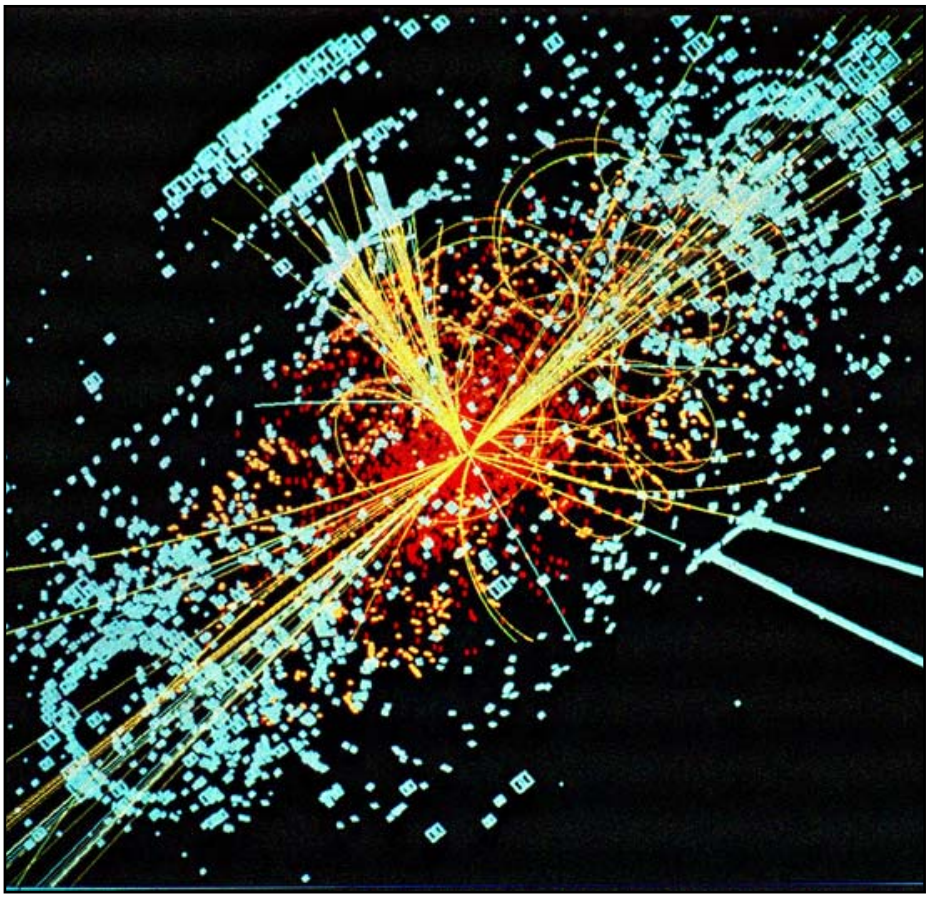
A rumour is floating around the physics community that the world's largest atom smasher may have detected a long-sought subatomic particle called the Higgs boson, also known as the "God particle."

The controversial rumour is based on what appears to be a leaked internal note from physicists at the Large Hadron Collider (LHC), a 17-mile-long particle accelerator near Geneva, Switzerland. It's not entirely clear at this point if the memo is authentic, or what the data it refers to might mean — but the note already has researchers talking.

The buzz started when an anonymous commenter recently posted an abstract of the note on Columbia University mathematician Peter Woit's blog, Not Even Wrong.

Some physicists say the note may be a hoax, while others believe the "detection" is likely a statistical anomaly that will disappear upon further study. But the find would be a huge particle-physics breakthrough, if it holds up.

"If it were to be real, it would be really exciting," said physicist Sheldon Stone of Syracuse University.



This track is an example of simulated data modelled for the CMS detector on the Large Hadron Collider (LHC) at CERN. Here a Higgs boson is produced and then decays into two jets of hadrons and two electrons. The lines represent the possible paths of particles produced by the proton-proton collision in the detector while the energy these particles deposit is shown in blue. CREDIT: CERN

Hunting for the Higgs

The Higgs boson is predicted to exist by prevailing particle-physics theory, which is known as the Standard Model. Physicists think the Higgs bestows mass on all the other particles — but they have yet to confirm its existence.

Huge atom smashers — like the LHC and the Tevatron, at Fermilab in Illinois — are searching for the Higgs and other subatomic bits of matter. These accelerators slam particles together at enormous speeds, generating a shower of other particles that could include the Higgs or other elemental pieces predicted by theory but yet to be detected. [Wacky Physics: The Coolest Little Particles in Nature]

The leaked note suggests that the LHC's ATLAS particle-detection experiment may have picked up a signature of the elusive Higgs. The signal is consistent, in mass and other characteristics, with what the Higgs is expected to produce, according to the note.

However, some other aspects of the signal don't match predictions.

"Its production rate is much higher than that expected for the Higgs boson in the Standard Model," Stone told SPACE.com in an email interview. So the signal may be evidence of some other particle, Stone added, "which in some sense would be even more interesting, or it could be the result of new physics beyond the Standard Model."

Too soon to tell

Stone was quick to point out that the note is not an official result of the ATLAS research team. Therefore, speculating about its validity or implications is decidedly preliminary.

"It is actually quite illegitimate and unscientific to talk publicly about internal collaboration material before it is approved," Stone said. "So this 'result' is not a result until the collaboration officially releases it."

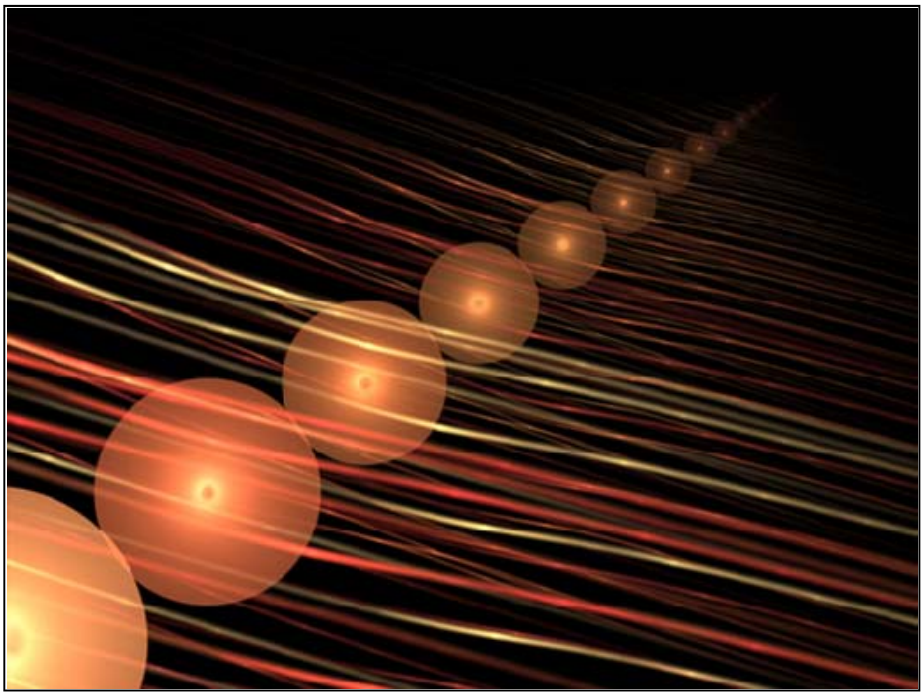
Other researchers joined Stone in urging patience and caution before getting too excited about the possible discovery.

Welcome to the 11th Dimension

Report on the April Film Night

By Gavin Logan

April's film night was shortened due to the Annual General Meeting of the Society being held on the same night. A smaller group stayed behind after the AGM to watch the third film of Brian Greene's Elegant Universe Series. They learned how String Theory requires 11 dimensions in the universe with the possibility of parallel universes and how these might work. It described the advances Greene and other string theorists hope to make in unveiling a single theory to explain the entire universe.



Next month's film night is on Monday 16th May, 8pm at Stardome Observatory and features the film "Around the World in 60 minutes". This film follows the International Space Station through one orbit of the Earth revealing what has been learnt about our planet from being able to watch it from orbit. It has particular emphasis on some of the Earth's environmental problems.

The film is about 60 minutes long and will be followed by a 25 minute 2011 Sky at Night programme with Patrick Moore entitled "Volcanoes of the Solar System"..

The Cosmic Symphony plays and 11 dimensions are proposed and part three of the elegant universe.

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, at ivazey@surfer.co.nz ph(09) 535-3987

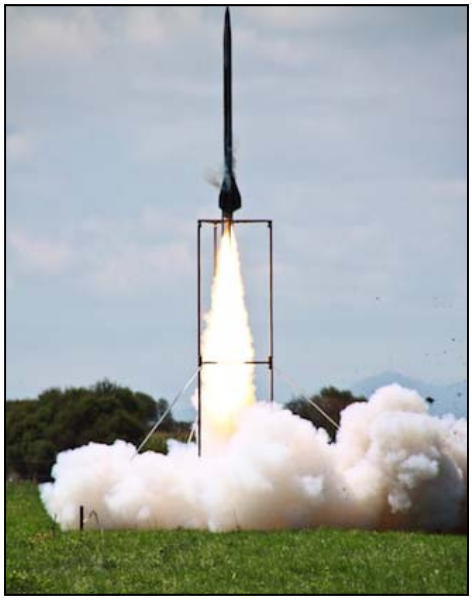
New Zealand Altitude Record Set

By Joel Schiff

A sleek carbon fibre rocket built by two residents of Dairy Flat, Albany, Joel Schiff & Martin Aspell, was launched from the New Zealand Rocketry Association site at Taupiri near Huntly, on 20th February 2011. It took off from a specially built tower built to accommodate their 98mm diameter, 2.6m long rocket. The rocket took off with a great roar and the motor seemed to burn forever (actually 13 seconds) which helped keep the rocket in view.

After 43 seconds, the rocket had coasted to its maximum altitude (apogee) of 10,275m (33,701ft) above ground level, setting a new New Zealand altitude record. Whilst descending by parachute, a tracking device in the nose cone using the GSM cellular network stopped communicating at an altitude of 5,300m.

After a few frantic calculations, the recovery site was reduced to one particular farm 4.7 km away and much of it was searched on the day without success. It was eventually found by the farmer himself two days later very near to where we had been searching! There was no damage at all to the rocket, although the paint work on the edges of the fins got a bit frazzled from going mach 1.5 (one-and-a-half times the speed of sound).



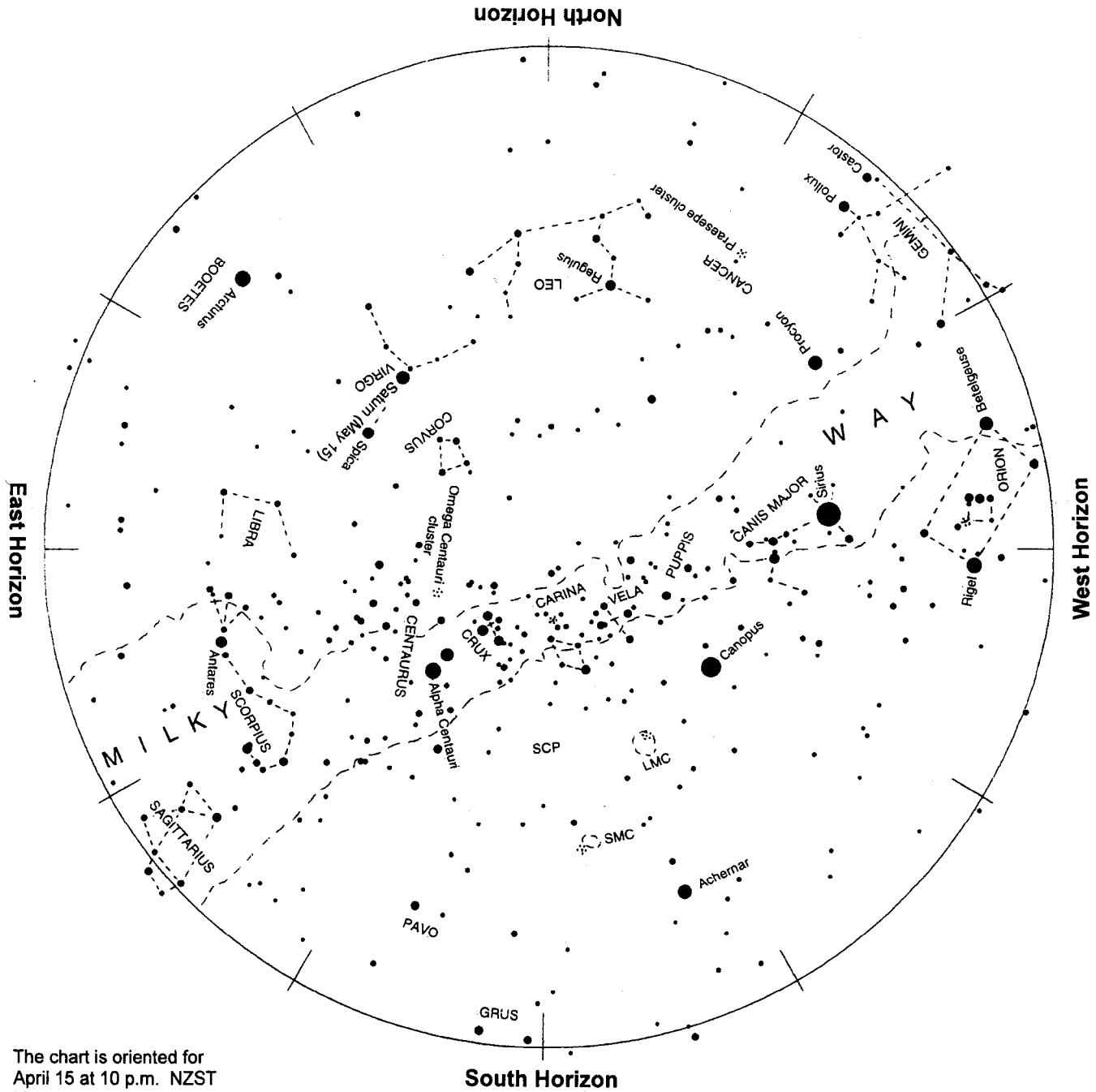
Joel & Martin's rocket lifts off on its way to a New Zealand Altitude Record for an amateur rocket

The vapour trail dissipates soon after the launch

A video of the flight can be viewed at: http://www.youtube.com/watch_popup?v=hqm26ZiaM-Y&vq=large

The Evening Sky in May 2011

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



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

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.

Sirius, the brightest star, is midway down the western sky. Directly below it is Orion with bright stars Rigel and Betelgeuse, and 'The Pot'. Canopus, the second brightest star, is southwest of overhead. Saturn and Spica make a medium-brightness pair in the northeast.

Below them is Arcturus often twinkling red and green. Crux, the Southern Cross, and The Pointers are southeast of the zenith. The Scorpion, on its back, is rising in the southeast. The Milky Way spans the sky.

Chart produced by Guide 8 software; www.projectpluto.com. Labels and text added by Alan Gilmore, Mt John Observatory of the University of Canterbury.www.canterbury.ac.nz

Observing Notes May 2011

By Alan Gilmore

As the sky darkens Sirius appears in the west with Orion below it. Canopus is southwest of the zenith. Crux, the Southern Cross, and the Pointers are southeast of overhead. High in the north east sky is Saturn making a widely-spaced pairing with Spica, the brightest star in Virgo. Below them, low in the northeast is Arcturus, a bright orange star whose colour is often separated into flashes of red and green.

Below Sirius are Rigel and Betelgeuse, the brightest stars in Orion. Between them is a line of three stars: Orion's belt. To southern hemisphere star watchers, the line of three makes the bottom of 'The Pot', now tipped on its side. Sirius, 'the Dog Star', marks the head of Canis Major the big dog. Sirius is the brightest star in the sky though planets Venus, Mars and Jupiter can be brighter.

Crux, the Southern Cross, is southeast of the zenith. Left of it are Beta and Alpha Centauri, often called 'The Pointers'. Alpha Centauri is the closest naked-eye star, 4.3 light years away. It is a binary star: two Sun-sized stars orbiting each other in 80 years. Beta Centauri, like most of the stars in Crux, is a blue-giant star hundreds of light years away. Canopus is also very luminous and distant: 13,000 times brighter than the Sun and 300 light years away.

Low in the east is the orange star Antares, marking the heart of the Scorpion. Antares means 'rival to Mars' in Greek. It is a red giant like Betelgeuse; 600 light years away and 19,000 times brighter than the Sun. Arcturus, in the northeast, is the brightest red star in the sky but, at 37 light years, is much closer than the red-giants previously mentioned. It is about 120 times brighter than the Sun.

The Milky Way is brightest in the southeast toward Scorpius and Sagittarius. In a dark sky it can be traced up the sky past the Pointers and Crux, fading toward Sirius. The Milky Way is our edgewise view of the galaxy, the pancake of billions of stars of which the Sun is just one. The thick hub of the galaxy, 30 000 light years away, is in Sagittarius. The nearby outer edge is by Orion. A scan along the Milky Way with binoculars shows many clusters of stars and some glowing gas clouds, particularly in the Carina region, to the right of Crux, and in Scorpius.

The Clouds of Magellan, LMC and SMC, are midway down the southern sky, easily seen by eye on a dark moonless night. They are small galaxies. The Large Magellanic Cloud is about 160,000 light years away and is about 5% the mass of our Milky Way galaxy. The Small Cloud is around 200,000 light years away and 3% the mass of our galaxy. That's still many billions of stars.

Saturn is the only planet in the evening sky and a great sight in a telescope. Its rings are 'opening' after being nearly edge-on in recent years. Saturn is 1330 million km from us mid month.

The naked-eye planets Mercury, Venus, Mars and Jupiter make an eye catching group low in the eastern dawn sky. At the beginning of the month brilliant Venus is the first up, rising around 5 a.m. A little below and right of it is Mercury. An hour later Jupiter appears, shining with a steady golden light. Close to it, but much fainter and reddish, is Mars. On May 2nd the thin crescent Moon will be below the planet group. In the first week of May Mercury moves level with Venus and stays there till mid month. Together Venus and Mercury slip down toward Jupiter. Around May 10th Jupiter, Venus and Mercury will be close together with Mars below them. Jupiter moves up the sky while the other three sink lower at different speeds. By the last week of May Jupiter is on its own. Below it Mars, Venus and Mercury make a line down the sky. The Moon is near them on the 30th and 31st.

The apparent grouping of the planets is just a line-of-sight effect, of course. Mercury and Venus, on inside tracks, are leaving us behind and moving to the far side of the Sun. At mid month Mercury is 140 million km away and Venus is 230 million km away. We are catching up on Jupiter. It is 870 million km away. Mars is on the far side of the Sun, 350 million km away in mid May.

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.

www.canterbury.ac.nz

Diary of Solar System Events for May 2011

From the RASNZ Website

May 1	Jupiter and Mars in conjunction 25' apart, Mars to left of Jupiter, morning sky.
May 1	Crescent Moon 7° to lower left of Venus, 8° to left of Mercury, and 10.5° to upper left of Jupiter & Mars, morning sky. Chart for May 1.
May 2	Mars 29' to lower left of Jupiter. Very thin crescent moon 6° to lower left of the planets, morning sky.
May 3	New Moon at 6.51pm NZST (06:51UT).
May 6	Moon furthest north, so lowest southern hemisphere transit for the month.
May 7	Venus and Mercury level and 1.5° apart, morning sky. Chart for May 7.
May 8	Mercury at at greatest elongation, 27° west of the Sun and Earth.
May 11	Moon at first quarter at 8.33am NZST (May 10, 20:33 UT).
May 11	56% lit Moon 5° left of Regulus, Leo, magnitude 1.4, evening sky.
May 12	Venus 35' to right of Jupiter and 1.5° to lower left of Mercury, morning sky. Chart for May 12.
May 14	87% lit Moon 7° above Saturn, evening sky.
May 15	93% lit Moon 1.5° to upper right of Spica, Virginis, evening sky.
May 15	Moon at perigee, its closest to the Earth for the lunar month, 362133 km.
May 16	Venus 1.4° to lower left of Mercury, 4.1° to lower right of Jupiter and 3.2° above Mars, morning sky. Chart for May 16
May 17	Full Moon at 11.09pm NZST (11:09 UT)
May 18	Almost full Moon 4° to lower left of Antares, Scorpii, magnitude 1.1, evening sky.
May 19	Moon furthest south, so highest southern hemisphere transit for the month.
May 22	Venus 1.7° left of Mercury and 1.3° above Mars, Mercury 2.2° right of Mars, morning sky. Chart for May 22
May 24	Venus 2.3° to upper left of Mercury and 1.0° to right of Mars, morning sky. Chart for May 24.
May 25	Moon at last quarter 6.52am NZST (May 24, 18:52 UT).
May 27	Moon at apogee, its greatest distance from the Earth for the Lunar month, 405003 km.
May 30	Venus 5.3° to upper left of Mercury and 3.2° to lower right of Mars, with crescent moon 14° to upper left of Venus, morning sky.
May 31	Crescent moon 4° to upper left of Mars, 5° left of Venus and 9.5° to upper left of Mercury, morning sky.

Burbidge Dinner Organising Committee

The Society's annual dinner is planned to be held at the end of October 2011. As one of the Society's major events, we are wanting to form an organising committee to help plan this .

If you are interested in becoming part of this group, please contact Andrew Buckingham on 09 473 5877 or email treasurer@astronomy.org.nz.

Delphinus – Job's Coffin

By Ivan Vazey

No one knows where it got that name from, although it has a distinctly biblical ring to it. The Hebrew refer to the constellation as "Jonah's big fish" though most folks simply think of it as resembling a dolphin.

One story has it that Poseidon saw a beautiful maiden named Amphitrite dancing on the Island of Naxos. He fell in love with her and did what any other self respecting God would do, kidnapped her. She escaped his clutches and fled to the other end of the Island. One of Poseiden's dolphins befriended her and persuaded her that Poseidon meant well and only had her interests at heart. She went back to Poseidon who was so enthralled, he placed the Dolphin in the sky to be admired for evermore.

Delphinus is to be found just to the North East of Altair (Aquila.)

Alpha and Beta Delphinus are better known as Sualocin and Rotenev. It took the Rev. Thomas Webb many years later, to work out that these names spelled the name backwards of Giuseppe Piazzi's assistant at Palermo Observatory.

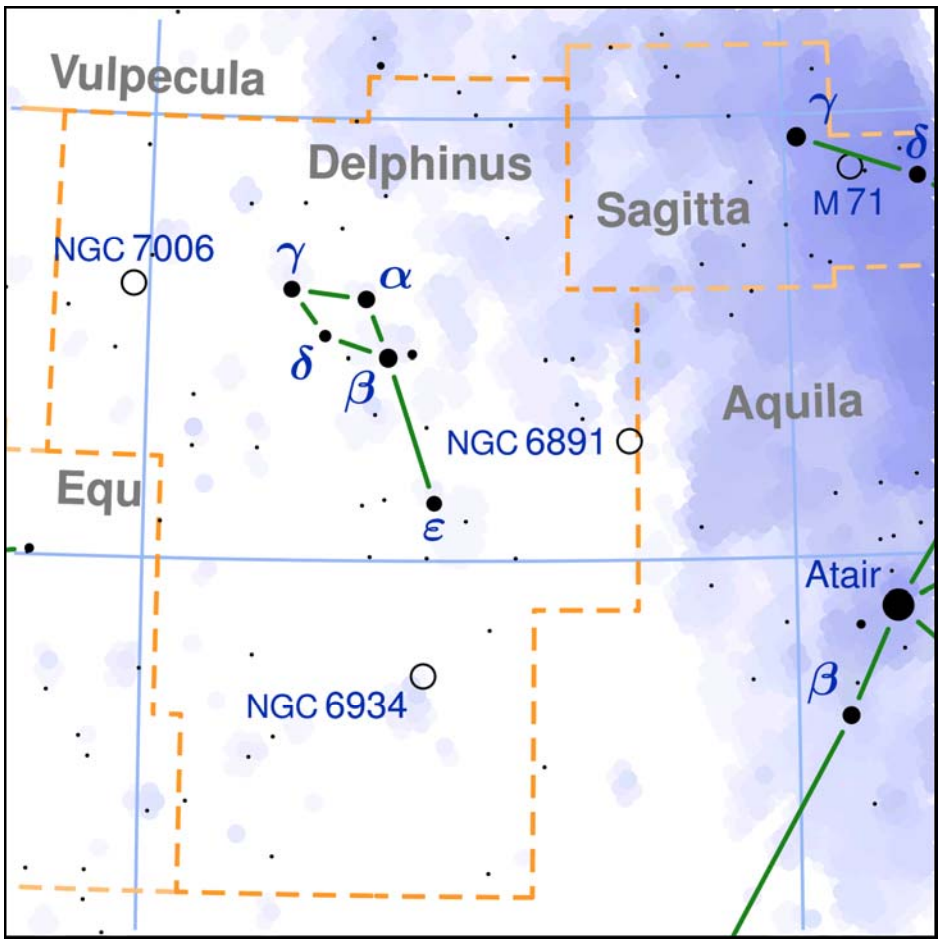
Some notable objects to view in this region.

Gamma Delphini is an optical double of 4.5mag with its double a 5.5mag slightly green star with a separation of 10 arc/secs. These two form the dolphins' beak.

Caldwell 42 (NGC7006) is a bright , large, globular 3.6Deg to the East. Of Alpha Delphini.

Caldwell 47 (NGC6934) is a bright 8.9mag Globular Cluster 3.0 deg to the South of the dolphin's tail.

R Delphini is a Mira star varying from 8.3 to 13mag every 285 days. It is about a third of the distance between the dolphins' tail and Altair



Delphinus is a constellation in the northern sky, close to the celestial equator. Its name is Latin for dolphin. It is one of the smaller constellations, ranked 69th in size out of 88. Delphinus was one of the 48 constellations listed by the 2nd century astronomer Ptolemy, and it remains among the 88 modern constellations recognized by the International Astronomical Union.

Some Deep Sky Objects

NGC 6891: Planetary nebula; 10.5m

NGC 6934: This globular cluster is of magnitude 9.75

NGC 7006: at a distance of about 185,000 light-years this globular cluster is extremely remote; 11.5m

The stars alpha, beta, gamma and delta Delphini form an asterism , or shape, in the sky known as Job's Coffin.

NGC 6891 Planetary Nebula in Delphinius

Vesta--Is it Really an Asteroid?

Source NASA

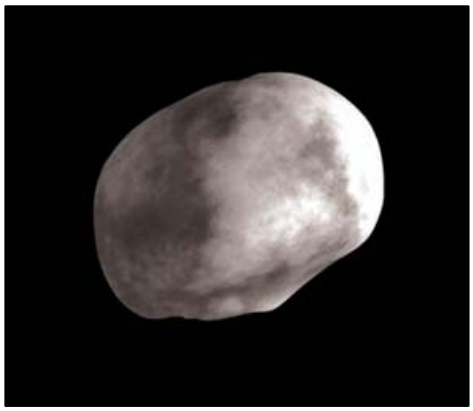
On March 29, 1807, German astronomer Heinrich Wilhelm Olbers spotted Vesta as a pinprick of light in the sky. Two hundred and four years later, as NASA's Dawn spacecraft prepares to begin orbiting this intriguing world, scientists now know how special this world is, even if there has been some debate on how to classify it

Many astronomers call Vesta an asteroid because it lies in the main asteroid belt between Mars and Jupiter. But Vesta is not a typical member of that orbiting rubble patch. The vast majority of objects in the main belt are lightweights, 100 kilometres wide or smaller, compared with Vesta, which is a 530 kilometre-wide behemoth

"I don't think Vesta should be called an asteroid," said Tom McCord, a Dawn co -investigator based at the Bear Fight Institute, Winthrop, Wash. "Not only is Vesta so much larger, but it's an evolved object, unlike most things we call asteroids."

The layered structure of Vesta (core, mantle and crust) is the key trait that makes Vesta more like planets such as Earth, Venus and Mars than the other asteroids, McCord said. Like the planets, Vesta had sufficient radioactive material inside when it coalesced, releasing heat that melted rock and enabled lighter layers to float to the outside. Scientists call this process differentiation. McCord and colleagues were the first to discover that Vesta was likely differentiated when special detectors on their telescopes in 1972 picked up the signature of basalt. That meant that the body had to have melted at one time.

Officially, Vesta is a "minor planet" -- a body that orbits the Sun but is not a proper planet or comet. But there are more than 540,000 minor planets in our solar system, so the label doesn't give Vesta much distinction. Dwarf planets – which include Dawn's second destination, Ceres -- are another category, but Vesta doesn't qualify as



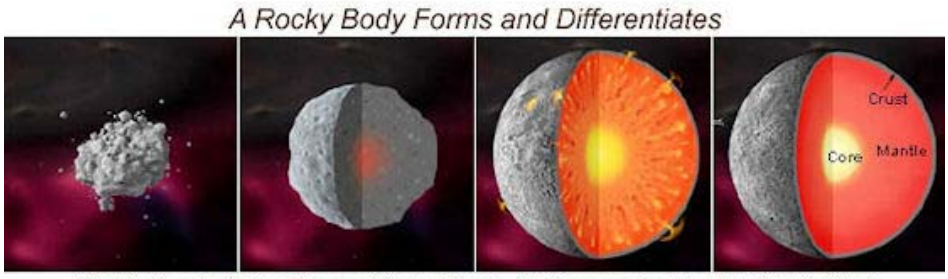
Hubble image of Vesta

one of those. For one thing, Vesta isn't quite large enough. Dawn scientists prefer to think of Vesta as a protoplanet because it is a dense, layered body that orbits the Sun and began in the same fashion as Mercury, Venus, Earth and Mars, but somehow never fully developed. In the swinging early history of the solar system, objects became planets by merging with other Vesta-sized objects. But Vesta never found a partner during the big dance, and the critical time passed. It may have had to do with the nearby presence of Jupiter, the neighbourhood's gravitational superpower, disturbing the orbits of objects and hogging the dance partners.

Other space rocks have collided with Vesta and knocked off bits of it. Those became debris in the asteroid belt known as Vestoids, and even hundreds of meteorites that have ended up on Earth. But Vesta never collided with something of sufficient size to disrupt it, and it remained intact. As a result, Vesta is a time capsule from that earlier era.

"This gritty little protoplanet has survived bombardment in the asteroid belt for over 4.5 billion years, making its surface possibly the oldest planetary surface in the solar system," said Christopher Russell, Dawn's principal investigator, based at UCLA. "Studying Vesta will enable us to write a much better history of the solar system's turbulent youth."

Dawn's scientists and engineers have designed a master plan to investigate these special features of Vesta. When Dawn arrives at Vesta in July, the south pole will be in full sunlight, giving scientists a clear view of a huge crater at the south pole. That crater may reveal the layer cake of materials inside Vesta that will tell us how the body evolved after formation. The orbit design allows Dawn to map new terrain as the seasons progress over its 12-month visit. The spacecraft will make many measurements, including high-resolution data on surface composition, topography and texture. The spacecraft will also measure the tug of Vesta's gravity to learn more about its internal structure



(From Smithsonian National Museum of Natural History - http://www.mnh.si.edu/earth/text/5_1_4_0.html)

"Dawn's ion thrusters are gently carrying us toward Vesta, and the spacecraft is getting ready for its big year of exploration," said Marc Rayman, Dawn's chief engineer at NASA's Jet Propulsion Laboratory, Pasadena, Calif. "We have designed our mission to get the most out of this opportunity to reveal the exciting secrets of this uncharted, exotic *world*."

Melted Crumbs from Asteroid Vesta

Written by Linda M. V. Martel *Hawaii Institute of Geophysics and Planetology*
Article provided by Planetary Science Research Discoveries

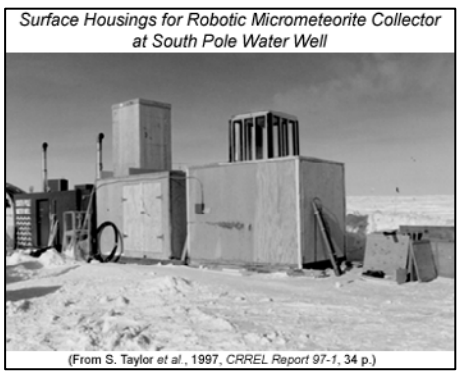
Micrometeorite bombardment accounts for almost 30,000 tons of material entering Earth's atmosphere each year. Though most of the material evaporates during entry or is lost to sea or falls on the land unnoticed, thousands of micrometeorites have been collected successfully from deep-sea sediments and from the snow and ice of the polar caps. Susan Taylor (Cold Regions Research and Engineering Laboratory) and colleagues collected micrometeorites with an ingeniously designed robot from a decidedly out-of-the-way place: Amundsen-Scott South Pole Station water well. She and Greg Herzog and Jeremy Delaney (Rutgers University) selected 10 out of thousands of these extraterrestrial particles, 75 to 700 micrometers in size, because of their unusual shapes and mineralogy, and measured the Fe/Mn and Fe/Mg elemental ratios, which are known to help constrain the type and source of meteorites. The results show that nine of the cosmic spherules are broadly chondritic in composition as expected. However, one, along with six others re-examined from a previous study, are atypical with non chondritic compositions. Taylor and co-authors propose an origin from an achondrite, Howardite-Eucrite-Diogenite (HED)-like parent body such as asteroid Vesta. HED-like objects account for about 6% of all meteorites, and only about 0.5% of all micrometeorites perhaps because of a natural mechanical toughness that would resist break-up and fragmentation.

Concentrations of Cosmic Debris

What better way to handle the summer heat than with a cool little story about ice ...Antarctic ice, that is, studded with the most minuscule grains from the cosmos. Researchers are studying extraterrestrial materials that are literally particles and spherules less than a millimetre in size but whose combined mass accounts for about 1,000 tons of new stuff added to Earth yearly. A micrometeorite is generally defined as a tiny meteorite larger than 50 micrometers but smaller than a millimetre. Micrometeorites that have melted, either partially or completely when plunging through Earth's atmosphere, are called cosmic spherules. Just as the Antarctic blue ice serves as an ideal collector of meteorites (see PSRD articles: Meteorites on Ice and Searching Antarctic Ice for Meteorites) it also preserves micrometeorites and cosmic spherules that land on the surface and are subsequently incorporated into ice layers. In his book, Meteorites, Ice, and Antarctica: A Personal Account, William Cassidy (University of Pittsburgh, and founder of the U. S. Antarctic Search for Meteorites project, ANSMET) retells a detail from the thrilling story of Paul Siple, the Boy Scout on Admiral Richard Byrd's expeditions to Antarctica in 1928-1930 and 1933-1935. One day Siple collected a jar of grains from the bottom of an icy cavity where the crew had melted ice beneath the surface at one of the base camps for drinking water. Though no one knows where his jar is now, Siple's collection no doubt contained micrometeorites mixed with rock bits entrained in the glacier and volcanic debris from past eruptions of nearby volcanoes. Today's researchers are using modern systematic collections of micrometeorites and cosmic spherules from the Amundsen-Scott South Pole water well to make new discoveries in Cosmo chemistry and gain insights into the origin of the Solar System.

Collecting Cosmic Debris

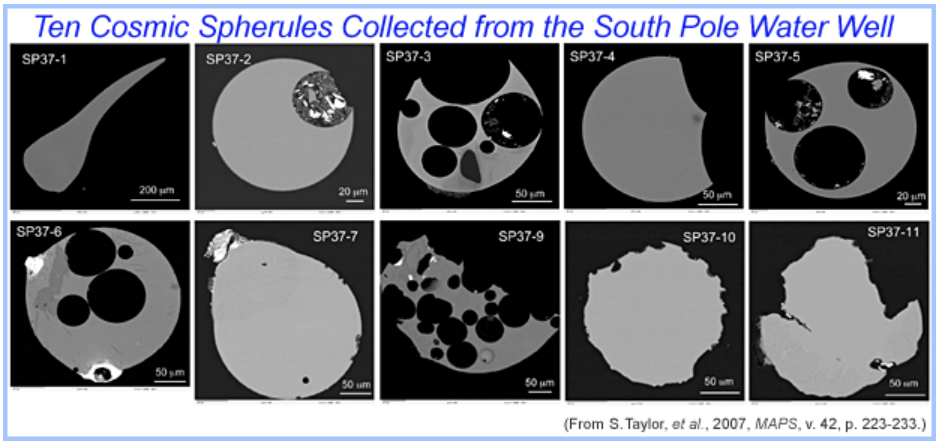
The South Pole Water Well is a 4000-cubic-meter subsurface water pool, 100 meters below the surface. It has supplied the drinking water to the U. S. Amundsen-Scott South Pole Station in Antarctica since January 1995. This well is one of the largest sources of micrometeorites -- cosmic particles less than one millimetre -- exploited to date. The well itself acts to concentrate the micrometeorites because the large pool volume and low circulation rates allow the particles to form a lag deposit on the bottom of the well. There is a small well house on the surface that houses the drilling and operating equipment. An adjacent hole and shelter were constructed in 1997 next to the well house expressly for the collection of the micrometeorites. The remote-controlled robotic collector (designed and built at the Cold Regions Research and Engineering Laboratory in Hanover, New Hampshire) is lowered down a 30-centimeter-diameter well neck to the icy bottom of the well pool where it



These shelters (winch room and laboratory) at the South Pole Water Well house the tower assembly, winch and cable system, video equipment, and control equipment needed to support the remote-controlled collector

manoeuvres to suction, filter, and collect the micrometeorites and cosmic spherules without contaminating the well or water.

After initial electron microprobe analyses of the micrometeorites and cosmic spherules collected from the well, the research team chose ten for further study because of their unusual shapes or mineralogy. Scanning electron microscope images of the ten cosmic spherules are shown below.



SP37-1 is a tiny glass particle with an elongated shape. SP37-2 and SP37-5 are glass spherules with vesicles that were filled with terrestrial oxide grains after landing on Earth. SP37-3 is another glass spherule with vesicles (black areas) with an unusual plagioclase feldspar (An90) grain, which appears as a non-circular dark grey shape in the lower part of the spherule. Anorthite has not previously been reported in cosmic spherules. SP37-4 is a glass spherule with no vesicles but a fractured edge. SP37-6 is a glass spherule with two (bright) metal regions and (darker grey) olivine grains. SP37-7 is a glass spherule with a (bright) bead of iron sulphide. SP37-9 is a vesicular fragment of a larger spherule. It contains some iron sulphide grains and regions that did not completely melt. SP37-10 and SP37-11 are glass spherules with parts dissolved away, leaving etched surfaces.

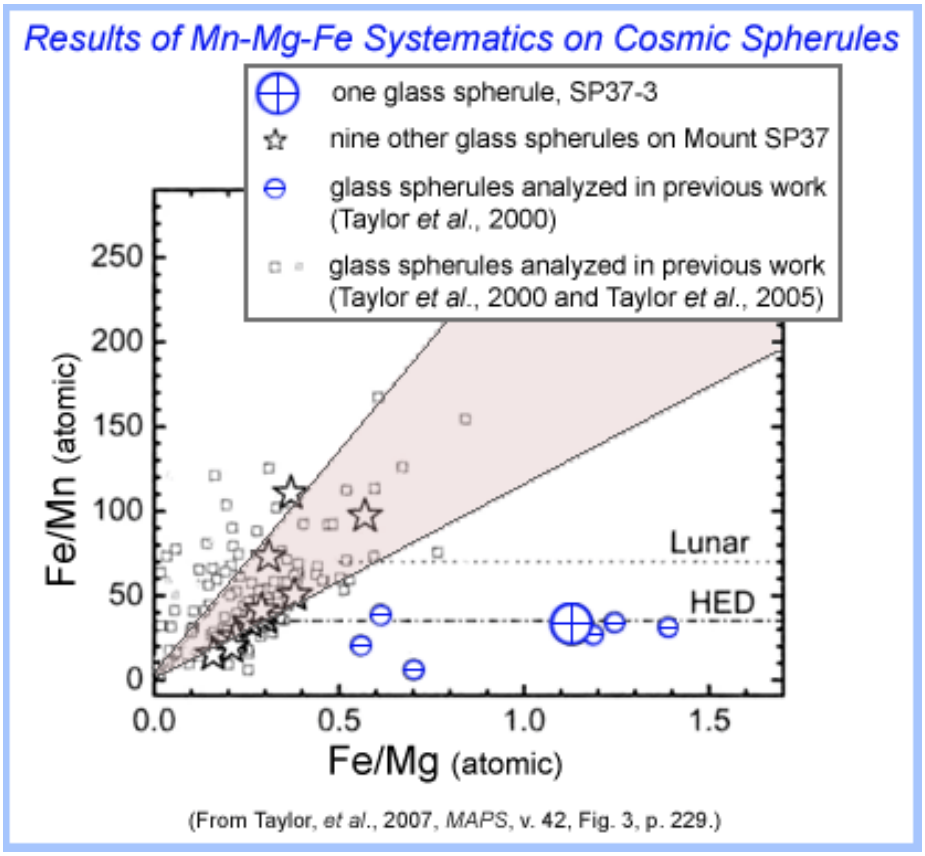
Analyses

Susan Taylor and colleagues, Greg Herzog and Jeremy Delaney, measured the concentrations of major and minor elements, including iron (Fe), manganese (Mn), and magnesium (Mg) of 10 cosmic spherules collected from the South Pole water well. Theirs is one of the first studies to use Fe/Mn and Fe/Mg ratios on micrometeorites. These particular ratios have been shown by previous researchers to be diagnostic tools for distinguishing achondrites from chondrites and have been used to help determine where the meteorites came from .

Seven cosmic spherules, one from the current study (SP37-3) and six others re-examined from a previous study, have Fe/Mn and Fe/Mg ratios (plotted in blue) that lie well below the shaded chondritic region in the figure (shown above). These data points plot near the values typical of HED (basaltic) meteorites (see the dashed line) but clearly not of lunar samples (see the upper dashed line).

Taylor and colleagues also considered whether or not the cosmic spherules are like basaltic Martian meteorites. They found that the mineralogies did not match, yet were not so far off as to rule out a Martian origin. Given that HEDs outnumber Martian meteorites by about 10 to 1, the authors argue the seven noncondritic cosmic spherules are more likely to have come from a HED-like parent body. Trace element and oxygen isotope analyses of the seven cosmic spherules would give researchers even more information to better determine the sources of the spherules.

Another nod to an HED-like parent body



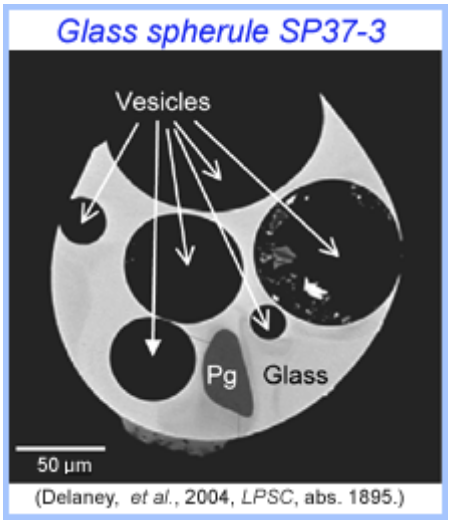
This plot of Fe/Mn and Fe/Mg ratios shows the results for the ten cosmic spherules analysed by Taylor and co-authors and for numerous cosmic spherules from previous analyses. About two-thirds of all the data points plot in the range typical of chondrites (shaded, triangular region) as expected. Significantly, a group of seven cosmic spherules plot below the chondritic region (these data points are indicated in blue). The horizontal dashed line labelled "Lunar" represents ratios of lunar samples. The horizontal dashed line labelled "HED" represents ratios of HED (Howardite, Eucrite, Diogenite) achondrite meteorites.

is the plagioclase feldspar grain found in cosmic spherule SP37-3. Plagioclase feldspar ranges in composition from calcium aluminum silicate (anorthite) to sodium aluminum silicate (albite). Taylor and colleagues found the anorthite relic grain in SP37-3 is much more calcium-rich (An90, which means 90% calcium in the sodium/calcium position in the crystal structure) than found in shergottite Martian meteorites, but is comparable to anorthite (An72-90) commonly found in HED meteorites. In the scanning electron microscope image shown here, the plagioclase feldspar grain is labelled "Pg".

Micrometeoroids are susceptible to mass loss and occasionally perhaps to mass gain when passing through Earth's atmosphere. How do we know that the measured concentrations of Fe, Mn, and Mg represent true concentrations unaltered by the heat during passage through Earth's atmosphere? Fortunately, as the authors point out, Mg is fairly refractory, which means it is not easily lost by evaporation. Also, the relatively constant ratios of Mn to other refractory elements (such as Ca and Al) measured by Taylor and co-authors imply Mn is not lost either. Iron, by contrast, is likely to be lost when cosmic spherules burn through Earth's atmosphere. Loss of iron could occur by evaporation or, more frequently, by physical separation of metal or sulphide. Loss of iron would shift the data points toward the origin, along rather than off the main trend (shaded region), and would not ruin the distinction we see between chondritic and achondritic spherules. So, the authors are confident that their Fe/Mg and Fe/Mn ratios represent the true mineralogy of the spherules.

Crumbs from the Crust of Vesta

Taylor and colleagues show the Fe/Mg and Fe/Mn ratios of the cosmic spherules are similar enough to HED meteorites that a HED-like parent body is likely. The HED meteorites are a class of achondrites that are igneous rocks formed from basaltic magmas. This class represents about 6% of meteorites that fall to Earth and only about 0.5% of all micrometeorites from the South Pole water well. There are far fewer of these HED-like micrometeorites and cosmic spherules than carbonaceous chondrites. The authors infer that a natural



(Delaney, *et al.*, 2004, *LPSC*, abs. 1895.)

mechanical toughness of HED-like material would resist break-up and fragmentation, whereas the comparative mechanical weakness of carbonaceous material would tend to favour break-up and spherule formation.

The HEDs are the only class of meteorites whose spectral data have been matched (but not without some ongoing debate) with spectra from a potential parent body. That parent body is asteroid 4 Vesta. Hubble Space Telescope data show the asteroid has a basaltic surface and a giant impact crater near one pole. Isn't it remarkable that crumbs measured

Pioneer anomaly solved

From COSMOS

It's not dark matter, multiple universes or weird gravity: the strange deceleration of the Pioneer spacecraft is just waste heat – the trouble is nobody's looked at it the right way, Portuguese researchers report.

Known as the 'Pioneer anomaly', the unexplained deceleration of NASA's two Pioneer spacecraft, Pioneer 10 and 11 (launched in 1972 and 1973 respectively) has provoked some exotic theories, including errors in Einstein's theory of gravity or the presence of multiple universes.

More mundane theories including reflection of light from the Sun, or thermal emissions from the spacecraft itself couldn't explain the small discrepancy in the spacecrafts' speed, a tiny drop of less than 0.000000001 metres per second.

Now astrophysicist Frederico Francisco from the Institute for Plasmas and Nuclear Fusion in Lisbon, Portugal, and colleagues said they have the answer.

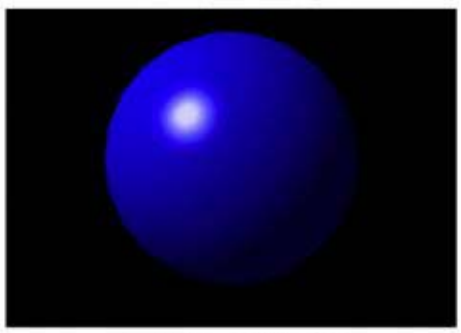
3D solution

The team used a 1970's software program called Phong Shading, originally developed to create a 3D rendering effect on graphics, to model the reflection of waste heat from the spacecraft on their varied surfaces – the 2.7-metre diameter antenna, and rest of the spacecraft behind it. Then they did the maths.

Scientists had previously calculated the effects of heat loss from the spacecraft accounted for just one to two thirds of the deceleration.

The anomaly was first noticed in 1998 when scientists studied radio signals


FLAT SHADING


PHONG SHADING

from the then distant spacecraft and found that they were slowing down faster that theories predicted.

Solved!

In a paper posted on the physics website arXiv, the team said that the new calculations – which take into account how the spacecraft themselves reflect back their internal heat - can account for the deceleration – a tiny 8.74×10^{-10} ms^{-2}.

"This method provides a simple and straightforward way of modelling the various components of reflection, as well as a more accurate accounting of the thermal radiation exchanges between the surfaces on the Pioneer spacecraft," the researchers write.

"With the results presented here it becomes increasingly apparent that, unless new data arises, the puzzle of the anomalous acceleration of the Pioneer probes can finally be put to rest."

While small, the effect was enough to force the spacecraft hundreds of thousands of kilometres from where they were expected to be.

Not a disappointment

Fred Watson Astronomer-in-Charge of the Anglo-Australian Observatory (AAO) at Siding Spring near Coonabarabran, said the solution was "good news".

"I think we've always known that something like this would come out of the woodwork," he said.

"We don't see the same [anomaly] happening with Voyager or other spacecraft leaving the solar system, only the Pioneers showed this anomaly."

Pioneers in space

Watson said the team had showed some lateral thinking in using the software and it "wasn't a disappointment" that the anomaly had a straightforward solution.

"It is nice to see it being confirmed as a real effect that is understood," he said.

The Pioneer spacecraft were the not only the first spacecraft to leave the solar system. Launched before VHS (pre-DVD technology that will be familiar to over 30s), they were the first to pass by Jupiter and the first to map Saturn's rings. The faint final signal of Pioneer 10 was received on 23 January 2003.

Planet formation in action

Dr. Emily Baldwin, ASTRONOMY NOW

Using ESO's Very Large Telescope, astronomers may have detected the first object clearing its path in the dusty, short-lived disc surrounding a young star.

The international team of astronomers studied a faint star 350 light years from Earth called T Chamaeleontis (T Cha), which is a very young star at some seven million years old, still heading towards becoming a sun like our own. Surrounding the young star, like many others of a similar age, is a disc of material that could spawn planets. While planets have been seen in the more mature discs of other stars (e.g. 12 million year old Beta Pictoris, read more here), until now, none had been identified in this early phase of disc evolution.

Artist impression of the dusty disc around T Cha. A companion object, seen in the foreground, has been detected in the gap in the disc. The inner dust disc is lost in the glare of the star on this picture. Image: ESO/L. Calçada.

"Earlier studies had shown that T Cha was an excellent target for studying how planetary systems form," says Johan Olofsson of the Max Planck Institute for Astronomy. "But this star is quite distant and the full power of the Very Large Telescope Interferometer (VLTI) was needed to resolve very fine details and see what is going on in the dust disc."

Using the AMBER instrument and VLT Interferometer to combine light from all four of the 8.2-metre telescopes, the team were able to resolve a narrow dusty ring only 20 million kilometres from the star. Beyond this inner disc lay a region devoid of dust, with the outer disc extending out to more than 1.1 billion kilometres from the star.

"For us the gap in the dust disc around T Cha was a smoking gun, and we asked ourselves: could we be witnessing a companion digging a gap inside its protoplanetary disc?" asks Nuria

Huelamo of the Centro de Astrobiologia in Spain.

Further investigation using the VLT's adaptive optics instrument NACO to remove the blur of Earth's atmosphere, enabled the astronomers to home in on object located in the gap about one billion kilometres from the star – close to the outer edge of the gap at roughly the same distance Jupiter is from our own Sun. The object is much smaller than the star and is likely either a brown dwarf or a recently formed planet. Future observations will enable the astronomers to reach their conclusions, and to learn more about the behaviour and characteristics of the discs in young stellar systems.

Using the Sun As A Magnifying Glass

By Ray Villard,. Article provided by the AAVSO Writer's Bureau

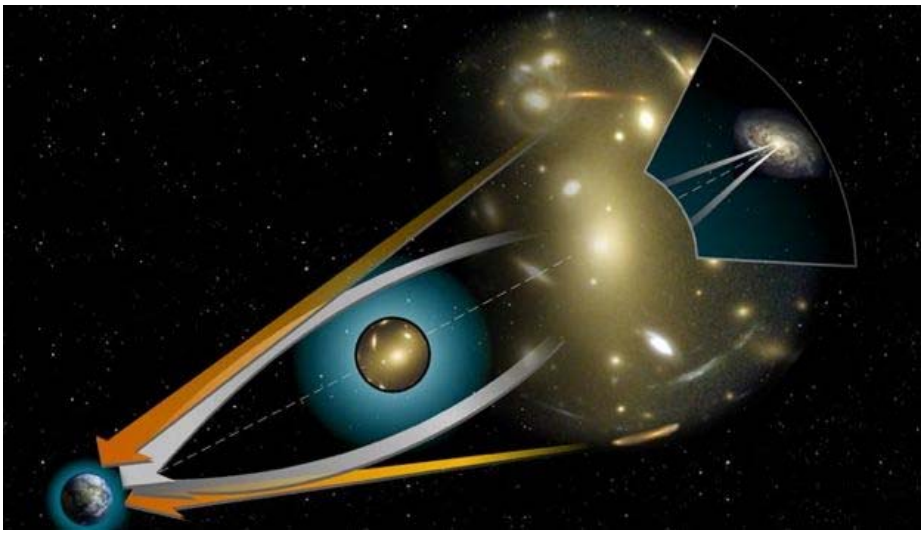
In previous blogs I've lamented that it would take incredibly large telescope arrays to try and see any details on planets orbiting nearby stars. Even space telescopes envisioned for the next 20-30 years from now could only tease out information about a planet by studying how its light fluctuates, and what colours of light it reflects or absorbs. But the planet will remain a dot of faint light in the largest imaginable telescopes.

However, astronomers have exploited "God's zoom lens" in space to see details in some at the farthest galaxies every detected. It's called a gravitational lens.

First predicted by Einstein's General Relativity, gravity warps space like a funhouse mirror. This result is that the gravity of a foreground galaxy will amplify -- and distort -- the light from a very distant background galaxy. When chance alignments do happen, astronomers can peruse the details of very distant galaxies that would be unreachable with conventional large telescopes.

You can simulate a gravitational lens by looking at Halogen desk lamp through the base of a wine glass. The curved glass is an analog to the warping of space. (It helps the experiment if you fill the glass with wine first, drink it, and proceed to make the observation.) The bulb will smear into bright arcs around the glass base.

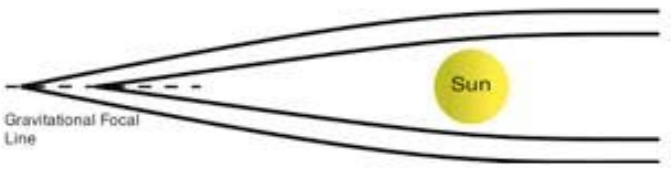
For years astronomers have toyed with the idea of using the Sun as a gravitational lens for spying on nearby stars. The trick is that the Sun needs to be reduced to a pinpoint on the sky rather than a blinding photosphere. This



means placing a space telescope very far from the Sun, about 50 billion miles.

Getting the telescope there would take a while depending on the propulsion system. 100 years might be a safe bet except the project would span at least two generations. Engineers would be motivated to build something moving fast enough to complete the trip within a career lifetime.

The beauty is that the telescope would not have to decelerate to stay at that location but continue racing away from the Sun and a radial trajectory. Unlike a conventional lens everything would stay in focus regardless of distance.



A specific target on the sky than lines up precisely on the opposite side of the Sun from the telescope's path would have to be picked for the first experiment. My bet is on the Alpha Centauri binary system. This is the closest star system to Earth. Within a few years we'll know if one or both Sun-like stars have accompanying planets. Building a gravity lens telescope for scrutinizing Alpha Centauri's planets would be the next big step before trying to travel there.

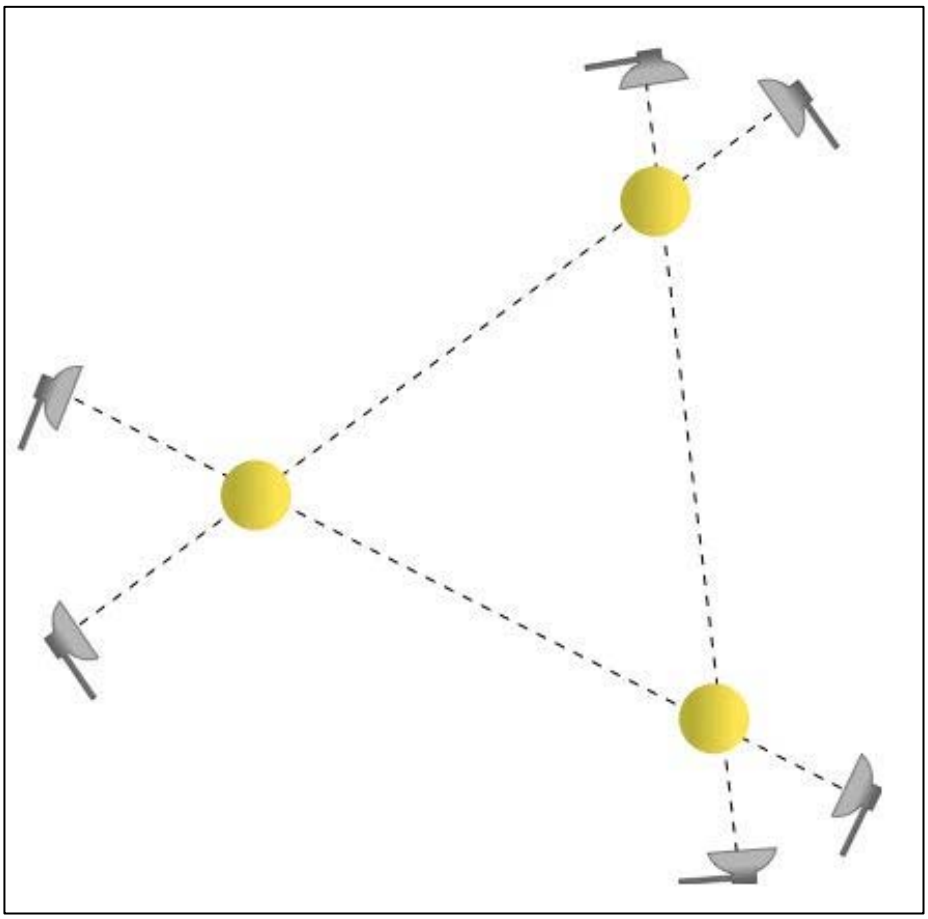
An even more ambitious use of the Sun's lensing abilities would be to locate a radio or optical transmitter 50 billion miles out to send a SETI message, or eavesdrop on the communications of an alien civilization. The advantage is that the transmitter would not need much power because of the Sun's amplification. The disadvantage is that only one nearby star system could be targeted, at least for starters. The

amplification by the Sun could yield detailed images of planetary surfaces. Like a kid perusing an ant colony with a magnifying glass, the space telescope would have to slightly shift it position relative to the Sun to scan the Alpha Centauri system. It might trace out a search spiral pattern that is perpendicular to its direction of motion.

ANALYSIS: Are Aliens Eavesdropping On Us? Not Likely

Transmitter/receiver probes could be mass-produced so that they are stationed all around the Sun to have various sightlines to specific stars. Taking this idea a step further, two neighbouring stellar civilizations might set up pairs of antennas at their respective gravitational lensing points. You might even imagine a galactic Internet where gravity lens amplified transmissions are a common strategy among chit-chatting civilizations.

An extraterrestrial probe visiting Earth might drop off an interstellar transmitter that exploits the Sun's gravitational lensing. This would efficiently serve as a power-saving transponder for relaying information the probe collects about us



to the home civilization. Even extraterrestrials may worry about being energy frugal.

Ultraviolet Spotlight on Plump Stars in Tiny Galaxies

From NASA

Astronomers using NASA's Galaxy Evolution Explorer may be closer to knowing why some of the most massive stellar explosions ever observed occur in the tiniest of galaxies.

"It's like finding a sumo wrestler in a little 'Smart Car,'" said Don Neill, a member of NASA's Galaxy Evolution Explorer team at the California Institute of Technology in Pasadena, and lead author of a new study published in the Astrophysical Journal.

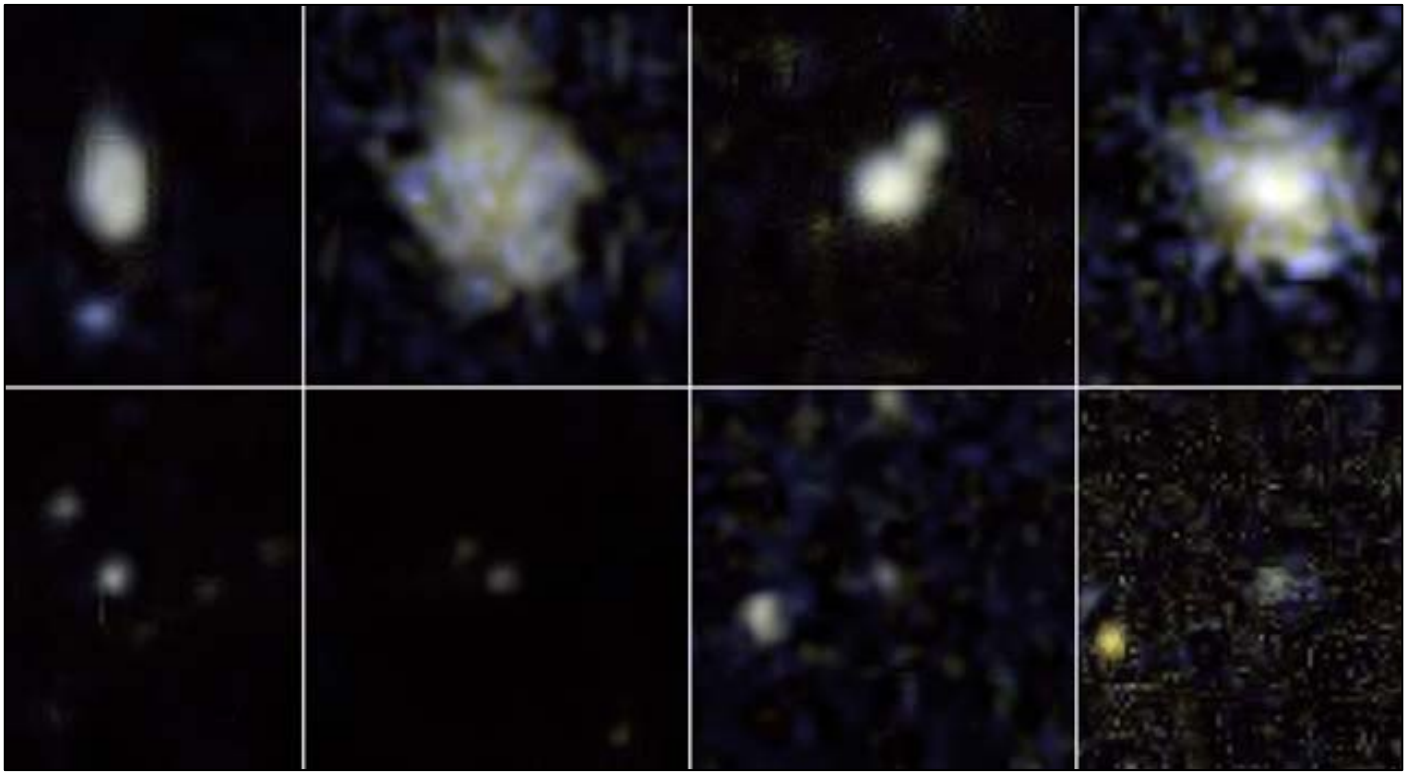
"The most powerful explosions of massive stars are happening in extremely low-mass galaxies. New data are revealing that the stars that start out massive in these little galaxies stay massive until they explode, while in larger galaxies they are whittled away as they age, and are less massive when they explode," said Neill.

Over the past few years, astronomers using data from the Palomar Transient Factory, a sky survey based at the ground-based Palomar Observatory near San Diego, have discovered a surprising number of exceptionally bright stellar explosions in so-called dwarf galaxies up to 1,000 times smaller than our Milky Way galaxy. Stellar explosions, called supernovae, occur when massive stars -- some up to 100 times the mass of our Sun -- end their lives.

The Palomar observations may explain a mystery first pointed out by Neil deGrasse Tyson and John Scalo when they were at the University of Austin Texas (Tyson is now the director of the Hayden Planetarium in New York, N.Y.). They noted that supernovae were occurring where there seemed to be no galaxies at all, and they even proposed that dwarf galaxies were the culprits, as the Palomar data now indicate.

Now, astronomers are using ultraviolet data from the Galaxy Evolution Explorer to further examine the dwarf galaxies. Newly formed stars tend to radiate copious amounts of ultraviolet light, so the Galaxy Evolution Explorer, which has scanned much of the sky in ultraviolet light, is the ideal tool for measuring the rate of star birth in galaxies.

The results show that the little galaxies are low in mass, as suspected, and have low rates of star formation. In other words, the petite galaxies are not producing that many huge stars.



Little Galaxies Pack a Big Punch

NASA's Galaxy Evolution Explorer is helping to solve a mystery -- why do the littlest of galaxies produce the biggest of star explosions, or supernovae?
These postage-stamp images were taken by the ultraviolet-sensing telescope -- the top row shows four galaxies that each produced a typical supernova, while the bottom row shows four galaxies that each produced an ultra-bright supernova. All of the galaxies are located at the very centre of the images. The top-row galaxies are roughly the size of our Milky Way galaxy.
It turns out that the tiny galaxies are producing supernovae that outshine all the stars in the galaxies in the top row. How can this be? Evidence from the Galaxy Evolution Explorer is helping provide an answer. It may be that, because the smaller galaxies contain few heavy atoms than the larger galaxies, their massive stars don't shed as much material and therefore remain plump. The plumper a star is when it explodes, the larger the blast.
Image credit: NASA/JPL-Caltech

"Even in these little galaxies where the explosions are happening, the big guys are rare," said co-author Michael Rich of UCLA, who is a member of the mission team.

In addition, the new study helps explain why massive stars in little galaxies undergo even more powerful explosions than stars of a similar heft in larger galaxies like our Milky Way. The reason is that low-mass galaxies tend to have fewer heavy atoms, such as carbon and oxygen, than their larger counterparts. These small galaxies are younger, and thus their stars have had less time to enrich the environment with heavy atoms.

According to Neill and his collaborators, the lack of heavy atoms in the atmosphere around a massive star causes it to shed less material as it ages. In essence, the massive stars in little galaxies are fatter in their old age than the massive stars in larger galaxies. And the fatter the star, the bigger the blast that will occur when it finally goes supernova. This, according to the astronomers, may explain why super supernovae are occurring in the not-so-super galaxies.

"These stars are like heavyweight champions, breaking all the records," said Neill.

Added Rich, "These dwarf galaxies are especially interesting to astronomers, because they are quite similar to the kinds of galaxies that may have been present in our young universe, shortly after the Big Bang. The Galaxy Evolution Explorer has given us a powerful tool for learning what galaxies were like when the universe was just a child."

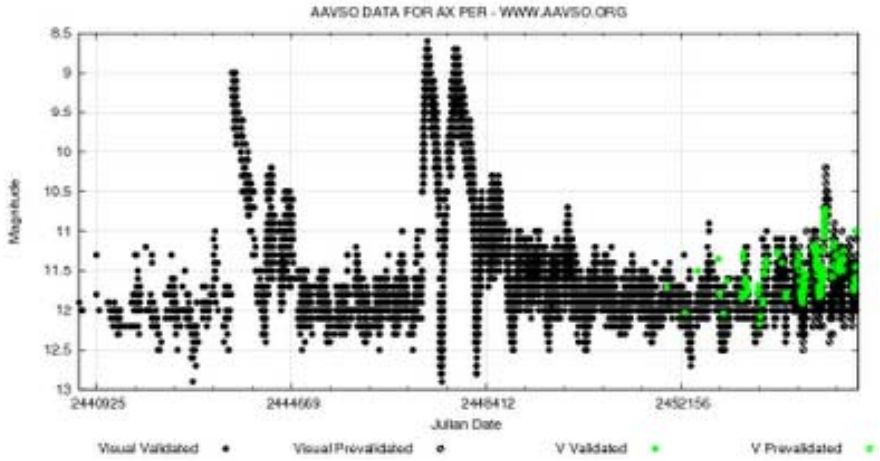
Caltech leads the Galaxy Evolution Explorer mission and is responsible for science operations and data analysis. NASA's Jet Propulsion Laboratory in Pasadena manages the mission and built the science instrument. Caltech manages JPL for NASA. The mission was developed under NASA's Explorers Program managed by the Goddard Space Flight Center, Greenbelt, Md. Researchers sponsored by Yonsei University in South Korea and the Centre National d'Etudes Spatiales (CNES) in France collaborated on this mission.

Symbiotic Variable Star On the Verge of an Eruption?

By Mike Simonsen, Simostronomy

Article provided by the AAVSO Writers Bureau

Symbiotic variables are binary pairs in orbit around each other inside a common envelope. Credit: NASA



November 23rd, astronomers from the Asiago Novae and Symbiotic Stars collaboration announced recent changes in the symbiotic variable star, AX Persei, could indicate the onset of a rare eruption of this system. The last major eruption took place between 1988 and1992. In the (northern hemisphere) spring of 2009, AX Per underwent a short outburst that was the first time since 1992 this star had experienced a bright phase. Now AX Per is on the rise again. This has tempted astronomers to speculate that another major eruption could be in the making.

Symbiotic variable stars are binary systems whose members are a hot compact white dwarf in a wide orbit around a cool giant star. The orbital periods of symbiotic variables are between 100 and 2000 days. Unlike dwarf novae, compact binaries whose periods are measured in hours, where mass is transferred directly via an accretion disk around the white dwarf, siphoned directly from the surface of the secondary, in symbiotic variables the pair orbit each other far enough away that the mass exchanged between them comes from the strong stellar wind blowing off the red giant. Both stars reside within a shared cloud of gas and dust called a common envelope.

When astronomers look at the spectra of these systems they see a very complex picture. They see the spectra of a hot compact object superimposed on the spectra of a cool giant star tangled up with the spectrum of the common envelope. The term "symbiotic" was coined in 1941 to describe stars

Typically, these systems will remain quiescent or undergo slow, irregular changes in brightness for years at a time. Only occasionally do they undergo large outbursts of several magnitudes. These outbursts are believed to be caused either by abrupt changes in the accretion flow of gas onto the primary, or by the onset of thermonuclear burning of the material piled up on the surface of the white dwarf. Whatever the cause, these major eruptions are rare and unpredictable.

AX Per underwent a short-duration flare about one year before the onset of the major 1988-1992 outburst. Now astronomers are tempted to speculate. Could the 2009 short outburst be a similar precursor type event? The present rise in brightness by AX Per might be the onset of a major outburst event similar to that in 1988-1992. The watch begins now, and professional and amateur variable star observers will be keeping a close eye on AX Per in the coming months.

Ranging from 8.5 to13th magnitude, AX Persei is visible to anyone with an 8-inch telescope, and if it erupts to maximum it will be visible in binoculars. You can monitor this interesting star and report your observations to the American Association of Variable Star Observers (AAVSO). Charts with comparison stars of known brightness can be plotted and printed using the AAVSO's Variable Star Chart Plotter, VSP.

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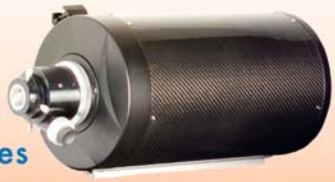
Astrophotographer's Dream Machine

High Grade Ritchey-Chretien Telescopes



- *True Ritchey-Chretien Cassegrain-type optics. Hyperbolic quartz primary and secondary mirrors with 99% reflectivity dielectric coatings*
- *Carbon-fibre optical tubes - for outstanding thermal stability!*
- *Ideal for astrophotography - due to their virtually coma-free imaging!*
- *Flatter image compared to SCT and apalanatic/corrected SCT designs*

Plossl Eyepieces • SuperView Wide Angle Eyepieces
Camera Projection Eyepieces • Barlow Lenses
Crayford Focusers • Diagonals
Adapters • Filters • Telescope Parts

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