After sundowners and before sitting down for a nice meal, Magda did a nicely illustrated presentation on her favourite subject, the Deep-sky. Judging by the question session lasting almost as long as Magda's talk, it was well received. This was sparked on by the infectious enthusiasm of OOG member, Carol Botha, who recently earned het first Deep-sky Certificate (currently working on her second), as well as her mentor, Deep-sky Director, Auke Slotegraaf, who also attended. ☆

Magda, dwarfed by Neels Borstslap, who introduced her to the OOG gathering.

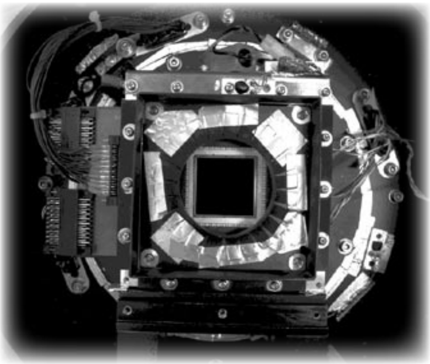
Wide-field cryogenic infra-red telescope in Sutherland

Towards the end of last year a smallish roll-off-roof building was built, making it the 12th dome to appear on the Sutherland hilltop. The facility is officially called the "Sumi-Hut" (named for the Sumitomo Foundation that supplied funding for the project) and it houses the WFCT II (Wide Field Cryogenic Telescope II), a special infra-red telescope whose interior, including detector and optics, is under vacuum and cooled to cryogenic temperatures. This is a project of Nagoya University, Japan, originating with the same group that has been operating the 1.4 m Infra-Red Survey Facility (IRSF) telescope in Sutherland since the year 2000.

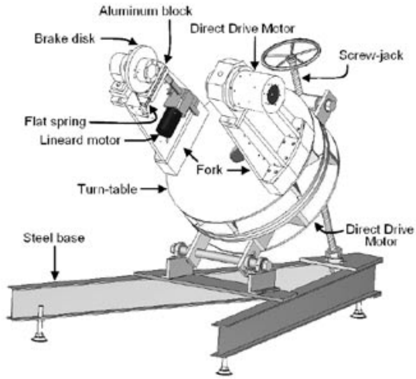
This cryogenic telescope visited Sutherland before (as WFCT I). About 10 years ago it was mounted piggy-back on the 30-inch telescope for a short observing run. It has since been fitted with a larger detector and its optics have been improved. It is now fixed to the original scaled-down mount that was built to try out the concept of the IRSF telescope. The dome opening mechanism was reclaimed from the MRM building in Cape Town before its recent conversion into an IT-centre.

The telescope is a Ritchey-Chrétien system with a clear aperture of 220 mm and a focal length of 1 540 mm. Light from celestial objects enters the telescope through a special window, 240 mm in diameter and 25 mm thick, to withstand being evacuated. It is made of CaF_2 which is transparent to infrared light up to 8 μm wavelength. Incoming light is reflected by the primary and secondary mirrors and passes through a filter before reaching the detector. Spiders, baffles and radiation shields are cooled down to ~80K (-193°C) by a cryogenic refrigerator. The optics are cooled by exchanging heat with the radiation shields. Its 1024x1024 InSb infrared array detector covers a field of view of one square degree with a resolution of 3″.5/pixel. The detector is also cooled by the refrigerator and is kept at 29±0.1K (-244°C).

The main targets of WCFT II are diffuse emissions radiated from hydrogen atoms, molecules, and carbonaceous materials in star formation regions and the Galactic Centre. ☆



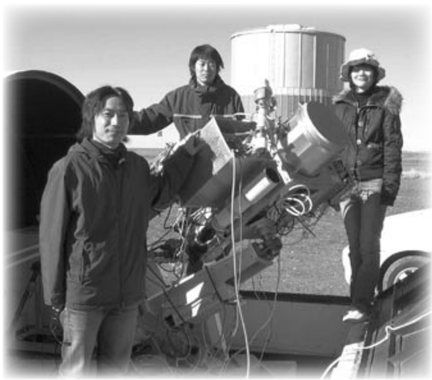
The ALADDIN II detector seen here, attached to the focal plane. A temperature sensor and a heater are screwed to the copper plate attached to the cassette. Four connectors are epoxied to the bottom end of the radiation shields.



The model Alt-Az mount of the IRSF has been reused for WFTC II, converted to an equatorial by tipping its base by means of a screw-jack.

The finishing touches to the SUMI-hut roll-off-roof dome for the Cryogenic Telescope are being done in this photo. Picture: Willie Koorts

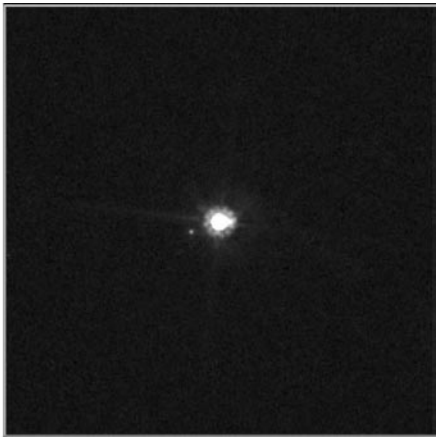
In August 2007 WFCT II was first tried out in another dome. The Nagoya University team members are, from left to right, team leader Dr Mikio Kurita, PhD student Kentaro Haraguchi and MSc student Gu Weilai. Picture: Willie Koorts



New 'Plutoid' classification

Almost two years after the International Astronomical Union (IAU) caused a worldwide stir by downgrading Pluto's status from a 'proper' planet to a dwarf one, the word 'plutoid' has been introduced to describe "Pluto-like trans-neptunian dwarf planets". This new term describes "celestial bodies in orbit around the Sun at a distance greater than that of Neptune, that have sufficient mass for their self-gravity to overcome rigid body forces so that they assume a near-spherical shape, and that have not cleared the neighbourhood around their orbit of debris". Such a body must also have an absolute magnitude brighter than +1 to be considered a plutoid and be named by the IAU as one. If, subsequently, the plutoid candidate turns out to not be massive enough to classified as such, it will keep its name but will be placed in another category.

The new classification system means that Pluto and Eris are the first plutoids of the Solar System. Ceres, however, remains a dwarf planet, because it is located in the asteroid belt between Mars and Jupiter. It is expected that more plutoids will be named as matters progress and new discoveries are made as have already happened with Makemake (see page 108). ☆

Plutoids; (left) Pluto with its moons, Charon, Hydra and Nix and (right) Eris with Dysnomia. Image credit: IAU, NASA/ESA Hubble Space Telescope, H. Weaver (JHU/APL), A. Stern (SwRI), the HST Pluto Companion Search Team and M. Brown.

How the Easterbunny became a Dwarf

Because of its discovery only three days after Easter 2005 (on 31 March 2005), Kuiper Belt object (136472) 2005 FY9 was originally codenamed "Easterbunny" by its Caltech discovery team. On the same day as Eris, its discovery was announced on 29 July 2005. More recently, on 11 July 2008, the Working Group for Planetary System Nomenclature reclassified (136472) 2005 FY9 as a dwarf planet and renamed it Makemake (pronounced MAH-kay—MAH-kay, where the capitals show accent). The name of Makemake, the creator of humanity in the mythos of the Rapanui, the native people of Easter Island, was chosen in part to preserve the object's connection with Easter. Since it also fulfils the criteria of the new plutoid subcategory (see page 107), Makemake has just become the Solar System's forth dwarf planet and its third plutoid.

It is astonishing that, despite its relative brightness of magnitude 16.7, compared to magnitude 15.0 for Pluto, Makemake was not discovered until fairly recently and well after many much fainter Kuiper Belt objects. This is most probably due to its relatively high orbital inclination and the fact that it was at its farthest distance from the ecliptic at the time of its discovery. Most searches for minor planets are conducted relatively close to the ecliptic, due to the greater probability of finding objects there.

In retrospect, Makemake is the only other dwarf planet that was bright enough for Clyde Tombaugh, discoverer of Pluto, to have possibly detected. At the time of Tombaugh's discovery, Makemake was actually only a few degrees from the ecliptic at an apparent magnitude of 16.0. Unfortunately, this position was also very close to the Milky Way, making it almost impossible to find within the dense concentration of background stars. Tombaugh continued searching for some years after the discovery of Pluto, but he failed to find Makemake or any other trans-neptunian objects.

No satellites have been detected around Makemake to a radius of 0.4 arcseconds with a brightness of more than one percent of the primary. This contrasts with the other largest trans-neptunian objects, which all have at least one satellite. Since satellites offer a simple method to measure an object's mass, this hampers an accurate mass determination for Makemake. By means of Spitzer infrared data and spectroscopic comparisons with Pluto, Makemake's size is estimated at roughly 1 500 km diameter. If this is accurate, it makes Makemake the third largest known trans-neptunian object after Eris and Pluto. Makemake's high albedo of roughly 80 percent suggests an average surface temperature of about 30 K (-243°C). ☆

Pipsqueak star unleashes monster flare

On 25 April 2008, NASA's Swift satellite picked up the brightest flare ever seen, found to come from a star emitting only one percent of the Sun's light and having only a third of the Sun's mass. This flare was thousands of times more powerful than the greatest observed solar flare. It was first seen by the Russian-built Konus instrument on NASA's Wind satellite in the early morning hours of 25 April. Swift's early warning X-ray Telescope caught the flare less than two minutes later and quickly slewed to point there. When Swift tried to observe the star with its Ultraviolet/Optical Telescope, the flare was so bright that the instrument shut itself down for safety reasons. The star remained bright in X-rays for 8 hours before settling back to normal.

The star, EV Lacertae, is a run-of-the-mill red dwarf, one of the most common types of star in the Universe. At a distance of only 16 light-years, EV Lac is one of our closest stellar neighbors, but because of its feeble light output, its apparent magnitude is only 10. If it had been better placed for earthbound observers, the flare probably would have been bright enough to be visible with the naked eye for one to two hours. But how can such a small star produce such a powerful flare? The answer can be found in EV Lac's youth. Whereas our sun is a middle-aged star, EV Lac is still a toddler. This young star, with an estimated age of a few hundred million years, is still spinning rapidly. Completing a rotation once every four days, it has a churning interior that generates strong localized magnetic fields, a hundred times more powerful than those of the Sun. The energy stored in these fields is responsible for powering its giant flares. ☆

This artwork depicts the incredibly powerful flare that erupted from the red dwarf star EV Lacertae.
Credit: Casey Reed/NASA

New mineral found in comet dust

The Earth collects an astounding 40 000 tons of dust particles per year from disintegrated comets and asteroids but this is equivalent to only one particle per square metre of planet per day. As can be imagined, such particles are very hard to find. Nevertheless, this 'gold-dust' is extremely important because it is made of the original building blocks of the Solar System.

Researchers have found a new mineral in a material that most likely originated from comet 26P/Grigg-Skjellerup, which orbits the Sun once every five years. As an aside, the co-discoverer of this comet, John Francis Skjellerup was a founder member of ASSA. Grigg first discovered the comet in 1902 from New Zealand and Skjellerup rediscovered it from Rosebank, Cape Town on its next appearance in 1922, the year when ASSA was formed (see *MNASSA* **62**, 3&4, April 2003, 52).

NASA has routinely collected cosmic and interplanetary dust with high-altitude research aircraft since 1982, but this new particle was captured after an innovative method of collection was suggested by Johnson space scientist Scott Messenger, who predicted that comet 26P/Grigg-Skjellerup was a source of dust grains that could be captured in Earth's stratosphere at a specific time of the year. The aircraft collected interplanetary dust particles from this comet stream in April 2003 but the new mineral has only recently been identified in one of them.

Because of their exceedingly tiny size, (0.00025 centimetres), state-of-the-art nano-analysis techniques had to be used to measure the chemical composition and crystal structure of the new mineral. This is a highly unusual material that had not been predicted either to be a cometary component or to have been formed by condensation in the solar nebula.

The mineral has been named 'brownlee-ite' after Donald Brownlee, a University of Washington astronomer who founded the field of interplanetary dust particle (IDP) research and is also the principal investigator of NASA's Stardust mission. Our present understanding of the early Solar System, as established from IDP studies, would not have existed without his efforts. The mineral contains a combination of manganese and silicon (and is therefore known as a manganese silicide) and was surrounded by multiple layers of other minerals that also have been reported only in extraterrestrial rocks. It's official name of brownleeite joins a list of over 4 300 other minerals. ☆

Only two spiral arms to our Milky Way?

Using infrared images from the Spitzer Space Telescope, scientists have discovered that the Milky Way's elegant spiral structure is dominated by just two arms wrapping off the ends of a central bar of stars. Previously, our galaxy was thought to possess four major arms.

This artist's concept (also see front cover) illustrates the new view of the Milky Way, which was presented at the 212th American Astronomical Society meeting in St. Louis. The galaxy's two major arms (Scutum-Centaurus and Perseus) can be seen attached to the ends of a thick central bar, while the two now-demoted minor arms (Norma and Sagittarius) are less distinct and are located between the major arms. The major arms consist of the highest densities of both young and old stars; the minor arms are primarily filled with gas and pockets of star-forming activity.

The artist's concept also includes a new spiral arm, called the "Far-3 kiloparsec arm," discovered via a radio-telescope survey of gas in the Milky Way. This arm is shorter than the two major arms and lies along the bar of the galaxy.

An artist's concept of the structure of our two-armed Milky Way. Just as early explorers sailing around the globe had to keep revising their maps, researchers will keep revising their picture as new results come to light.
Credit: NASA/JPL-Caltech

Our sun lies near a small, partial arm called the Orion Arm, or Orion Spur, located between the Sagittarius and Perseus arms. ☆

GLAST launched

On 11 June 2008 another of NASA's space observatories, the Gamma-ray Large Area Space Telescope (GLAST), was successfully launched. GLAST is an international and multi-agency space mission that will study the cosmos in the energy range 10 keV - 300 GeV. For this endeavor, bringing together the astrophysics and particle physics communities, NASA teamed up with the U.S. Department of Energy and institutions in France, Germany, Japan, Italy and Sweden. General Dynamics was chosen to build the spacecraft.

Several successful exploratory missions in gamma-ray astronomy led to the Energetic Gamma Ray Experiment Telescope (EGRET) instrument on the Compton Gamma Ray Observatory (CGRO). Launched in 1991, EGRET made the first complete survey of the sky in the 30 MeV - 10 GeV range. EGRET showed the high-energy gamma-ray sky to be surprisingly dynamic and diverse.

GLAST has an imaging gamma-ray telescope vastly more capable than instruments flown previously, as well as a secondary instrument to augment the study of gamma-ray bursts. The main instrument, the Large Area Telescope (LAT), has superior area, angular resolution, field of view and deadtime that together provide a factor of 30 or more advance in sensitivity, as well as the capability of studying transient phenomena.

GLAST now offers astronomers a superior tool to study how black holes can accelerate jets of gas outward at fantastic speeds. Physicists will be able to study subatomic particles at energies far greater than those seen in ground-based particle accelerators. And cosmologists will gain valuable information about the birth and early evolution of the Universe. ☆

Phoenix success

In a dramatic reversal of fortune for NASA, which suffered a devastating failure the last time the agency attempted a rocket-powered descent to Mars nine years ago, the Phoenix lander had a successful touchdown on Sunday, 25 May 2008, on flat terrain in the northern plains of Mars at 68.22 degrees north latitude. Assisted by the Mars Odyssey orbiter flying high above the landing site, telemetry relayed from Phoenix to Earth indicated that the small 345 kg lander completed its action-packed descent as planned and was in good health. Subsequent deployment of the solar cells, masts for its stereo camera, its weather station and its stowed robotic arm all occurred as planned.

Twelve days after landing, after several attempts, Phoenix finally succeeded in filling one of its ovens with Martian soil, ready to sniff out and assess its ingredients. It took several days of trying to shake the soil through the screen covers, which were designed to prevent larger bits of soil from clogging the narrow port to each oven so that only fine particles fill the oven cavity. The Martian soil was found to be unusually sticky due to some unknown chemical or mineral constituent. The severe amount of shaking and vibration is thought to have caused an intermittent short circuit problem that, later, on sol 33 (Martian day 33) when the second bake was scheduled, it was feared it would be the last. The long exposure to the Martian atmosphere unfortunately gave any ice that may have been in the sample, time to evaporate which was consistent with the result. The TEGA instrument (Thermal and Evolved-Gas Analyzer)

This photo shows the inflated parachute, 20 seconds after its deployment, and the backshell supporting Phoenix dangling below, with a 10 km-wide crater serving as a dramatic backdrop. This remarkable view was captured by the HiRISE camera aboard the Mars Reconnaissance Orbiter, 300 km above the surface. From this vantage point it looked as if Phoenix would be landing in the crater but in fact it landed on flat ground far from it. Image credit: NASA/JPL/Univ. of Arizona.

did find small amounts of water vapour and carbon dioxide as the oven heated the sample to 1 000˚C, indicating that the soil clearly had interaction with water in the past.

Encouraging results were seen when dice-size crumbs of bright material vanished from inside the trench, four days after being dug by Phoenix's robotic arm scoop. This convinced scientists that the material was frozen water that subsequently sublimated after digging had exposed it. This idea is supported by the resistance felt by the robotic arm during the digging process.

Soil from the right hand side trench, named "Baby Bear", was successfully delivered to the TEGA instrument after several days of attempts. The left trench, "Dodo", was dug as a test. Each trench is about 9 cm wide. Image credit: NASA/JPL-Caltech/University of Arizona/Texas A&M University.

The "wet chemistry lab" housed inside Phoenix's MECA instrument (Microscopy, Electrochemistry and Conductivity Analyzer) also had some positive results. This experiment, which adds water to create a muddy mixture with the Martian soil, found magnesium, sodium, potassium and chloride in a sample retrieved about 25 mm under the planet's surface. They basically found the nutrients that can support life! ☆

SOHO bags 1 500 comets

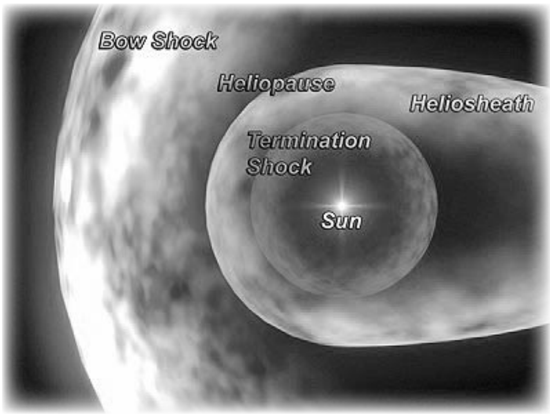
The SOlar and Heliospheric Observatory (SOHO) on 25 June 2008 celebrated the discovery of 1 500 comets since the mission began 13 years ago, making it more successful than all other comet discoverers throughout history put together.

About eighty-five percent of the SOHO discoveries, including this one, are fragments from a once great comet that split apart in a death plunge around the Sun, probably many centuries ago. The fragments are known as the Kreutz group and are comprised of Sun-grazing comets that approach closer than 0.01 AU (1 460 000 kilometres) to the Sun when they return from deep space.

When SOHO is transmitting to Earth, the data can be on the Internet and ready for analysis just 15 minutes after being acquired. A huge network of volunteers help sift through the images for tiny specks that betray the presence of a comet. When someone believes that they have found one they submit their results to the Naval Research Laboratory in Washington, who check the data before submitting the candidate comet to the Minor Planet Centre for verification, cataloguing and orbit determination. ☆

Studying the heliosphere

The influence of our star, the Sun, reaches as far as the heliosphere, the vast bubble in space carved out by the solar wind that separates the solar neighbourhood from the interstellar medium. To study this, the ESA-NASA Ulysses mission has logged over 8.6 thousand million kilometres during its 17.5 year "loop the loop" of the Sun and Jupiter, withstanding some of the most extreme conditions in the Solar Systems and surpassing all expectations of an originally proposed 5 year



The heliosphere is a big magnetic 'bubble' in space carved out by the solar wind. It defines the sphere of influence of the Sun and extends well beyond the furthest fringes of the Solar System. **Image: ESA (C. Carreau).**

mission. Its mission has now been terminated after returning data that forever changed the way scientists view the Sun and its effect on the space surrounding it. These discoveries revealed the complexity of the Sun's magnetic field and the variability of the speed of the solar wind. The welcome extension of the mission allowed a forth dimension, namely time, in which to study the changes in the solar wind in relation to the 11-year sunspot cycle. Ulysses also studied the distribution of dust in deep space as well as measuring rare samples of interstellar helium isotopes and the age of cosmic rays.

But another spacecraft that had been travelling outward from the Sun for 31 years at 60 000 km/h was in a better position to directly measure the solar wind termination shock. Voyager 2 crossed the shock on 31 August 2007 and was then at a distance of 83.7 astronomical units (AU), or roughly twice the distance between the Sun and Pluto. At this great distance, it took 11.2 hours for the radio signal from the spacecraft to reach Earth. At the termination shock the solar wind, which continuously expands outward from the sun at over 1.6 million km/h, is abruptly slowed to subsonic speed by the interstellar gas. Voyager 2 made the first direct observations of this region. ☆

Adaptive optics for the world's largest solar telescope

One of Europe's leading manufacturers of high-precision optics, Optical Surfaces Ltd., has recently delivered three very accurate off-axis parabolic mirrors for the Big Bear Solar Observatory (BBSO) in California. These mirrors will form key focusing components in the adaptive optical system associated with BBSO's new 1.6 metre solar telescope. Optical Surfaces' main workshops and test facilities are deep underground in a series of tunnels excavated in solid chalk, where the temperature remains constant and vibration is practically non-existent. With such stable conditions, testing, particularly with long path lengths, become quantifiable and reliable.

Due for completion later in 2008, the new 1.6 m aperture off-axis Gregorian solar telescope will be the world's largest telescope for precise studies of the physics of the Sun and observation of solar phenomena. BBSO's new solar telescope (NST) benefits from adaptive optics, which will allow atmospheric seeing to be corrected to the diffraction limit. It also has an advanced computer system capable of supporting sophisticated instruments such as Fabry-Perot interferometers and offers improved possibilities for making observations at infrared wavelengths. The adaptive optics will allow the BBSO NST to image features as small as photospheric flux tubes, at about 100 km resolution. ☆