february 2008

canopus

monthly newsletter of the johannesburg centre of assa

Old Republic Observatory, 18a Gill Street, Observatory, Johannesburg
PO Box 412 323, Craighall, 2024

The Great Nebula in Orion is high in the sky at the moment (Photo by Bert van Winsen)

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notice of next meeting – assa johannesburg

The next monthly meeting of the Johannesburg Centre of the Astronomical Society of Southern Africa will be held at the old Republic Observatory, 18a Gill Street, Observatory, Johannesburg on Wednesday, 13 February 2008 at 20h00. . Guest Speaker:

Karel Nel

"Astronomy and Art"

assa johannesburg calendar

Date	Event	Details
09 February	Committee Meeting	War museum @ 14:00
13 February	Monthly Meeting	Observatory @ 20:00 – Karel Nel
20 February	Introduction to Astronomy – Lecture 1	Observatory @ 18:30 – Gil Jacobs
27 February	Introduction to Astronomy – Lecture 2	Observatory @ 18:30 – Gil Jacobs
05 March	Introduction to Astronomy – Lecture 3	Observatory @ 18:30 – Gil Jacobs
08 March	Committee Meeting	War museum @ 14:00
12 March	Monthly Meeting	Observatory @ 20:00 – Gary Els

assa johannesburg committee members 2007/2008

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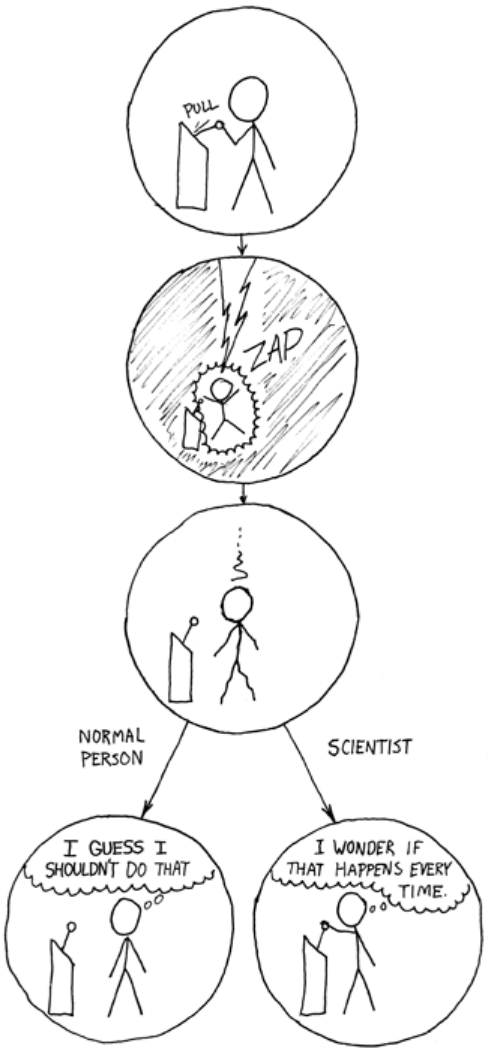
Gil Jacobs is presenting an Introductory Astronomy Course starting 20 February
see page 6 for details.

Also, don't forget to book the date in your diary now for Scopex 2008
When: 9am – 9pm, 24 May 2008
Where: SA Military History Museum, Johannesburg

editorial

by Claire Lee

SETI guys are up in arms over a particularly assiduous Russian scientist who's been using one of the most powerful radio transmitters on Earth to beam messages into the void. Apparently he believes that Earthlings have a "moral obligation" to let other intelligent beings out there know that we're here, and has taken the responsibility upon himself during intervals in the transmitter's official duties in planetary radar studies.



This "Active SETI" program has caused a rift within the SETI community, as some people think that not only is he out of line by independently speaking for the entire population of Earth, but also that the idea of broadcasting our existence to possibly millions of races is downright foolhardy.

I must admit I tend to agree. While the *possibility* of life out there in the cosmos is extremely enticing, the practice of jumping up and down on our fragile little planet we're barely able to hold *ourselves* together on and shouting "YooHooo!!" to the galaxy, expecting them to pop around for a nice cup of tea over dignified exchanges of technology, seems just a little bit naïve. Julianne from *Cosmic Variance* puts it superbly in that "**history is not exactly awash in cases where the technologically less advanced civilization wound up the winner when two cultures collide.**"

In the meantime, we should probably stick to what we're good at, which is observing. Such as observing the CMB, the data for which will be taken to new sensitivities when the Planck satellite is launched later this year (see the article on page 7). Planck follows on a distinguished list of CMB telescopes whose observations over the past 40-odd years have reshaped cosmological theories; from proof of the Big Bang and measurements of the shape of the universe, to dark matter and dark energy, and selecting out inflationary theories. We await with bated breath what exciting results will come from Planck's time in the sky. ■

chairman's chat

by Robert Groess

The year started off with a committee meeting right on the heels of a short respite from the hustle and bustle of life as we know it in 2008. And yes, it's a leap year! One extra day to make the most out of whatever it is that you enjoy doing. Doesn't that feel good?

We've had a most enjoyable monthly meeting with Professor Roy Booth, current director of HartRAO, who gave great insight into other windows of astronomy, such as that in the radio part of the spectrum, or "millimetre wave astronomy". But wait, that's not all. With Mars always generating a great deal of interest, we also had a Mars viewing evening, which although I could not attend, no doubt was a runaway success. I was a mere stone-throw away from the observatory that evening, and the sky was absolutely gorgeous. Mars shone majestically at 8pm and was a real spectacle to behold.

So. What's next? Every month it has been a great honour for me to write about the exiting things that your committee have been able to bring to fruition. The refurbishment of the 26.5-inch telescope. The line up of guest speakers (we are booked out until the new membership year starts in August). The star parties. The ATM classes. The list goes on…

The heart of the astronomical society is precisely that. A society. It's the core reason for its existence. And what that means for you and I, is that it's an organization to provide opportunities to share with information and experiences with others who have something to give. I'd like to invite you to share your experiences and ideas with the society. I'm not asking for the usual banter about suggesting things that you can help the society with. No. There's a subtle difference, and it's all about fun. I'm suggesting that – I'm inviting you – to experiment with ideas and ways in which YOU will get more fun and reward out of the society.

One such "experiment" is already underway in the form of a plan to host a "California-style" mega star party at a dark sky site close to town, near the end of March. (The suggested venue is pending confirmation, so keep a look-out on our website and next month's Canopus for further details.) The idea is to bring together a record number of operational telescopes, on one site, in Africa.

That leaves me to end off by saying that with all the rain we've been having – and good rain it has been at that – it's only the lucky few who have been able to take a peek above the clouds, and confirm we are still in orbit about that great urban-legend of a yellow star. It's true. Flying in from Cape Town yesterday, I witnessed the golden rays of that star, before submerging beneath a blanket of grey rain clouds. With an extra leap-day in February, maybe that means an extra day of rain. Or maybe an extra night of viewing the stars. We'll have to see. Until next month… ■

introductory astronomy course

by Gil Jacobs

ASSA-Jhb is offering an introductory astronomy course titled: **"Theoretical Astronomy – the ideas behind the observations"** by Gil Jacobs.

The course will be four or five one-hour sessions held on Wednesday evenings starting Wednesday 20 February 2008. The lectures are largely self contained, theoretical and on a very elementary level, assuming no prior knowledge.

Venue: Auditorium at the Johannesburg Observatory, 18a Gill St, Observatory.

Starting Time: 6.30 pm

Cost:

ASSA Johannesburg members:	R50 for the course, or R20 per lecture
Non-ASSA Johannesburg members:	R150 for the course, or R50 per lecture

To book, or for further info please email: Lerika@icon.co.za

The course will include:

- The geometry of the Celestial Sphere
- How to make and use a planisphere.
- Altitude and azimuth, almucantars, the astrolabe.
- Sidereal time, Solar time, Dynamical time, the equation of time.
- Celestial co-ordinates: Hour angle, right ascension, declination, the astronomical triangle.
- Planetary motions: Direct & retrograde motions, stationary points, synodic periods, Kepler's laws
- Atmospherical refraction
- Parallax
- Aberration
- The Gyroscope - Precession
- The motion of the Moon, Nutation
- How a telescope works, telescope mountings and setting circles, the orientation of telescopic images
- How to use the Astronomical Almanac.

Looking forward to seeing you there! ■

Planck gets ready for liftoff

from the European Space Agency (ESA)

First it was Arno Penzias and Robert Wilson with their antenna at Bell Labs in the 60's. Next came COBE in 1992, and then WMAP in 2003. This year, the Planck satellite is due to launch, and take the most sensitive measurements to date on the Cosmic Microwave Background…

Planck is Europe's first mission to study the relic radiation from the Big Bang. Ever since the detection of small fluctuations in the temperature of this radiation, called Cosmic Microwave Background, astronomers have used the fluctuations to understand both the origin of the Universe and the formation of galaxies.

Planck will look back at the dawn of time, close to the Big Bang, about 14 thousand million years ago. This satellite is ESA's 'time machine'. Using it astronomers will be able to travel back in time, towards the beginning of space and time as we know it now. Its ultimate goal will be to help astronomers in deciding which theories on the birth and evolution of the Universe are correct.

Some of the key questions Planck will answer are:

- Will the Universe continue its expansion forever, or will it collapse into a 'Big Crunch'?
- What is the age of the Universe?
- What is the nature of the so-called 'dark matter' (which may account for 25% of the total amount of matter in the Universe but that has never been detected directly)?
- What is the nature of dark energy (a hypothetical form of energy that may account for the Universe's expansion at an accelerating rate)?

The Universe is filled with 'Cosmic Microwave Background' radiation (CMB) and Planck will examine this to a sensitivity, angular resolution and frequency range never achieved before. CMB does not originate from one object in particular, but from the whole Universe. It is actually the first light that existed freely in the Universe. For this reason, it can be detected today as coming from everywhere in the sky. Observing the 'first light' today, as the CMB, is like seeing the Universe as it was only 300 000 years after the Big Bang.

Why is the 'first light' of the Universe detected today as microwaves? When the 'first light' CMB was released, the Universe was much smaller than it is now. As a consequence, the waves of that primeval light were much more compressed, that is, their frequency was very high. The Universe has expanded since then, so the waves of that light have stretched, or the frequency of the CMB waves now is much lower than it used to be. They are classified in the 'microwave' range.

Planck is designed to 'see' the microwaves and, in practice, it will detect them by measuring temperature. That temperature is already known to be about 2.7K (which is very cold, about –270°C, near absolute zero). It has been measured to be 2.726K all over the sky to three decimal figures. This degree of accuracy in the measurement may seem good enough, but much more precise measurements are needed. Scientists know, from previous observations, that slightly hotter or colder 'patches' appear in the sky (different by one part in 100 000). Again, this may seem like a small difference, but these differences in temperature are nothing less than the imprints left in the CMB by the primeval 'seeds' of today's huge concentrations of matter — the galaxies and galaxy clusters for example.

The information Planck has to gather lies in the pattern formed by these slightly hotter and colder regions, called 'anisotropies' or 'inhomogeneities'. As a consequence, the Planck detectors will have to be highly sensitive and will have to work at temperatures very close to the absolute zero, otherwise their own emission of heat will spoil the measurements.

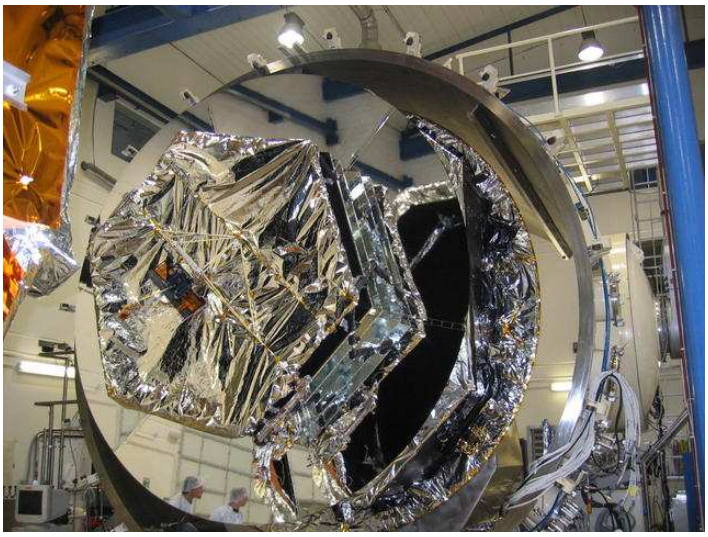
Planck will be launched in tandem with ESA' Herschel space telescope. Together they will study different aspects of the 'old' cosmos.

Spacecraft

The Planck spacecraft, waiting about 1900 kilograms at launch, is 4.2 metres high and has a maximum diameter of 4.2 metres also.

Planck will carry a telescope with a 1.5-metre primary mirror. The telescope will focus radiation from the sky onto the payload, two highly sensitive detectors called the Low

Frequency Instrument and the High Frequency Instrument.



The Low Frequency Instrument (or LFI) is an array of 22 tuned radio receivers that will be operated at –253°C. These receivers will work grouped in four frequency channels, centred between 30 and 70 GHz. They are based on devices called 'HEMTs' (High Electron Mobility Transistors), and work just like transistor radios. The transistors amplify the signal collected by the antenna (the telescope), and the amplified signal is then converted to a voltage. In a normal radio, the detected signal would then be passed on to a speaker, but in Planck it will instead be stored in a computer for later analysis.

The High Frequency Instrument (or HFI) is an array of 52 bolometric detectors, which work by converting radiation to heat. The amount of heat is then measured by a tiny electrical thermometer, the signal from which is converted to a temperature by a computer. The HFI detectors will work in six frequency channels centered between 100 and 857 GHz. They are operated at –272.9°C (only one tenth of one degree above absolute zero). To achieve that temperature a complex system of on-board refrigerators is used, each of which uses a different technology to provide a successively colder temperature.

The Planck telescope and instruments are placed on top of an octagonal service module. A baffle surrounds the telescope and instruments to prevent stray light from the Sun and the Moon to spoil the detection of the microwave radiation. The baffle is also used to effectively radiate to cold space the heat generated by the focal plane units of the scientific payload, and to provide to the instrument coolers a cold and stable background environment of about -223ºC (or 50ºK). Inside the service module are the computers and subsystems that allow the spacecraft to function, and to compress the raw data signals from the instrument detectors. At the base of the service module sits a flat, round solar panel for generating electricity from sunlight to power the spacecraft, and to protect the whole spacecraft from direct solar radiation.

In order to achieve its scientific objectives, Planck' detectors have to operate at very low and stable temperatures. The spacecraft is therefore equipped with the means of cooling the detectors to levels close to absolute zero (-273.15ºC), ranging from about -253ºC to only a few tenths of a degree above absolute zero.

Planck's Journey

Planck will be launched on an Ariane-5 from the Guiana Space Centre, Kourou, French Guiana, at the end of July 2008. It will be launched together with ESA's Herschel spacecraft, in a dual launch configuration.

About 2.5 hours after launch Planck will separate from Herschel and, in less than six months, the satellite will reach its final orbit. This is located at 1.5 million kilometers away from the Earth around a point in space called 'L2', or Second Lagrangian Point. This is far enough away to avoid the undesirable emission of heat from the Earth, the Moon and the Sun which would cause too much interference in the measurements.

Planck' routine science observations at L2 will last 15 months, allowing two sky surveys. The mission could in principle be further extended, depending on the resources still available for the instruments cooling. ■

book your ticket on Virgin Galactic

article from NewScientist.com

Entrepreneur Richard Branson has unveiled a model of the spaceship he hopes will be the first to take paying passengers into space on a regular basis.

SpaceShipTwo will carry six passengers and two pilots on suborbital trips to the edge of space at an altitude of about 100 km. The trips are expected to take about 2.5 hours, with about five minutes of weightlessness. The $200,000 space trips will launch from a spaceport to be built in New Mexico, US, and test flights are to begin later in 2008.

Before firing its engine to reach space, SpaceShipTwo will be carried to an altitude of about 15 km by an aircraft called White Knight Two, which was also unveiled on Wednesday. Both craft were designed by Burt Rutan, whose SpaceShipOne collected the Ansari X Prize for

privately funded spaceflight in 2004. Branson teamed up with Rutan shortly afterwards to design a suborbital spacecraft for Branson's company, Virgin Galactic.

"We really do want to have a situation where hundreds of thousands of people who want to experience space travel are able to do so," said Branson at a media event at the American Museum of Natural History in New York City, US.

"Even though the dollar isn't worth much anymore, $200,000 is still too expensive for the majority of people," he said. "Within five years of launching, I would hope the price would come down fairly dramatically."

Virgin Galactic now has more than 200 people signed up for the ultimate sightseeing trip, stumping up more than $30 million in deposits. Passengers getting ready for the suborbital trip include physicist Stephen Hawking, former soap star Victoria Principal and designer Philippe Starck.

About 100 of Virgin's reserved passengers attended Wednesday's unveiling, to get the first glimpse of the spacecraft's design.

"It's like something out of Thunderbirds," said Trevor Beattie, a British advertising executive, referring to the 1960s TV series. "It's what we as kids in the 1960s thought the future would be like." Beattie, who co-runs the Beattie McGuinness Bungay advertising firm in London, UK, said he bought the flight instead of splurging on a Ferrari, as he can't drive.

Richard "B J" Bjorklund, a portfolio manager for Citigroup's Smith Barney unit in Dallas, Texas, US, said the trip would be his only chance of experiencing space travel after failing to get into the US Air Force's astronaut program years ago.

Satellite launches

"I figured I would never have a chance to go into space again," said Bjorklund. "I'm thinking somewhere toward the end of 2009 (for launch). But I want them to be safe, so I'm ready to go whenever they say it's time to go."

Virgin Galactic says White Knight Two, the world's largest carbon composite aircraft, might be used for unmanned launches, as well. It could potentially carry rockets into the atmosphere, where they could then ignite and loft satellites into orbit while using less fuel than they would have if they had launched from the ground.

Work on SpaceShipTwo's engine was delayed last year by an explosion that killed three people during a test. Rutan's company, Scaled Composites, was cited and fined for safety violations last week.

Virgin Galactic is only one of several high-profile contenders in the new commercial space race. Others include Europe's EADS Astrium; Blue Origin, started by Amazon.com Inc founder Jeff Bezos; Space Exploration Technologies Corp (SpaceX), created by PayPal founder Elon Musk; Rocketplane Kistler, and hotelier Robert Bigelow. ■

astro news: were cosmic strings seen?

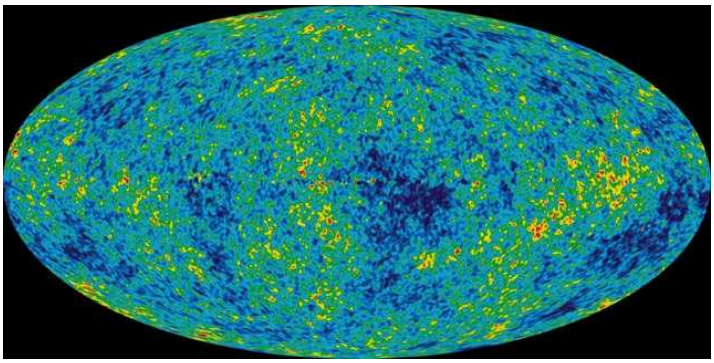
article by David Shiga from NewScientist.com – 21 January 2008

Traces of vast cosmic strings have been found in radiation from the early universe, a controversial new study says. If confirmed to exist, cosmic strings could offer an unprecedented window into the extreme physics of the infant universe.

Snags in the fabric of space may have developed a fraction of a second after the universe's birth – perhaps at the end of a period called inflation when the universe was rapidly expanding.

It is thought that these snags would be shaped like very slender strings, with a thickness far less than the width of an atom but with lengths measured in light years. They would also be very heavy, with a section just a kilometre long potentially having as much mass as the Earth.

Now a team of scientists says that traces of cosmic strings can be detected in the afterglow of the big bang. Led by Neil Bevis of Imperial College London, UK, the team used the Wilkinson Microwave Anisotropy Probe (WMAP) satellite to observe radiation called the cosmic microwave background.



'Cosmic signposts'

This radiation is slightly patchy because of the clumpy distribution of the glowing matter that produced it. If present, cosmic strings should attract matter with their gravity, slightly altering the way it is distributed in the early universe.

The team of scientists used computers to simulate how the microwave background should look with and without cosmic strings, and compared the results to the WMAP observations. They found a slightly better agreement when cosmic strings were included.

"This is an exciting result," says Mark Hindmarsh, of the University of Sussex, Brighton, UK, one of the study's authors. "Cosmic strings are relics of the very early universe, and signposts that would help construct a theory of all forces and particles."

But Charles Bennett, the chief scientist for the WMAP mission, thinks that the apparent preference for the cosmic string scenario is probably just a statistical fluke.

There is a 5% chance that the correlation would be produced simply by random noise, and such flukes should be expected from time to time because so many studies of WMAP data are published each year, says Bennett.

He also points out that the preference for cosmic strings disappears when other observations are considered, such as a Hubble Space Telescope measurement of the current expansion rate of the universe. "Calling it a detection is odd," he told *New Scientist.* "I'd be very surprised if cosmologists were excited about this at this stage."

Bevis admits that when the other measurements are added in, the preference for cosmic strings goes away, although he adds that it is not clear how reliable these measurements are.

Future observations should clarify things. The Planck satellite, due to launch in 2008, will make even more sensitive measurements of the microwave background than WMAP, and could turn up better evidence for cosmic strings, Hindmarsh says. ■

astro news: an "inconvenient" galaxy

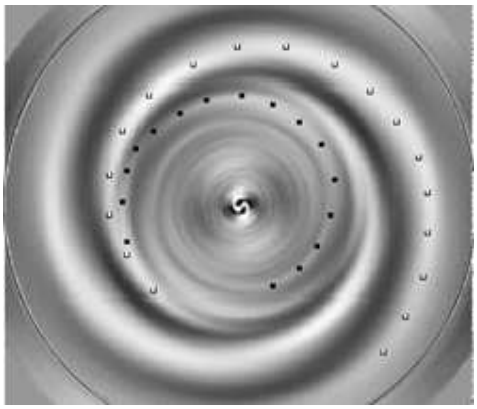
by the University of Alabama on astronomy.com – 14 January 2008

Discovery of two new components within a puzzling spiral galaxy confirm it must have a pair of arms winding in the opposite direction from most galaxies, according to results presented last Tuesday to the American Astronomical Society meeting in Austin, Texas.

"While the existence of a galaxy with a pair of 'backward' arms may seem like an inconvenient truth to many, our latest analysis indicates it is, nonetheless, a reality," says Gene Byrd, professor of astronomy at the University of Alabama.

The galaxy, known as NGC4622, lies 200 million light-years away in the constellation Centaurus.

Spiral arm pairs seen in galaxies are thought to trail, meaning they wind outward, opposite the direction of rotation of the disk material. Leading arms, such as the pair reported by the astronomers for NGC4622, do the opposite, opening outward in the same direction as the rotation of the galaxy's disk.



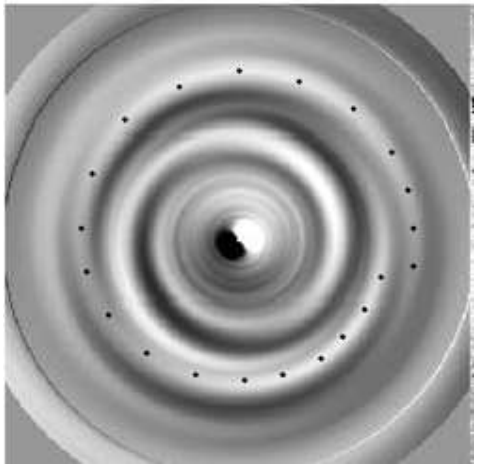
Using a Fourier component image method to further analyze a 2001 Hubble Space Telescope image, the team discovered a previously hidden inner counterclockwise pair of spiral arms.

"Contrary to conventional wisdom, with both an inner counterclockwise pair and an outer clockwise pair of spiral arms, NGC4622 must have a pair of leading arms," Byrd says. "With two pairs of arms winding in opposite directions, one pair must lead and one pair must trail. Which way is which depends on the disk's rotation. The outer clockwise pair must be the leading pair if the disk turns clockwise. Alternatively, the inner counterclockwise pair must be the leading pair if the disk turns counterclockwise.

The team also discovered an outer clockwise single arm (next page, black dots), previously hidden by the stronger outer clockwise arm pair. The galaxy also has a previously identified inner single counterclockwise arm. This confirms the galaxy must have a single leading

arm. The outer clockwise arm must be the leading arm if the disk turns clockwise. The inner counterclockwise arm must be the leading single arm if the disk turns counterclockwise.

The researchers also performed a more complicated analysis of different color Fourier image components. This revealed the stronger outer clockwise pair of arms as the leading pair.

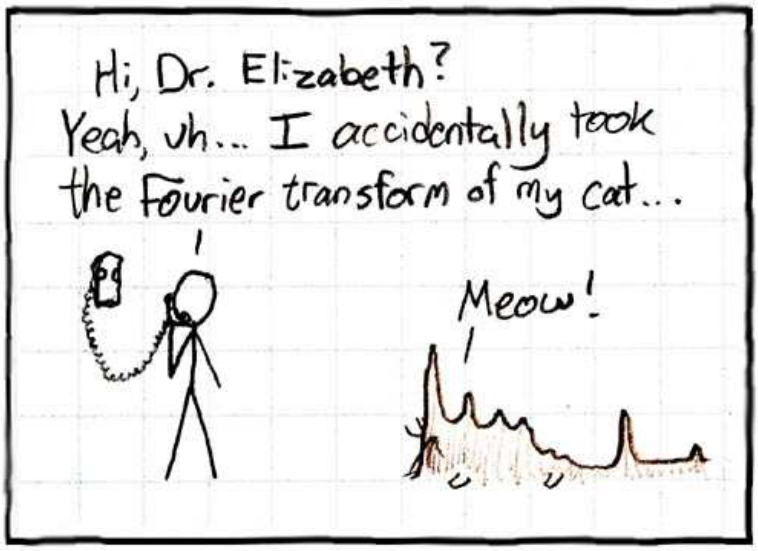


In 2002, team members first published, to great skepticism, results from a previous method that indicated the galaxy had a leading pair of spiral arms.

Other astronomers were skeptical of the 2002 announcement, in part, because the galaxy disk is only tilted about 19 degrees from face-on and because clumpy dust clouds might be concentrated on one side of the disk, creating misleading results. In response, the team's new Fourier component method is actually assisted by the small tilt, and the effects of dust are not used in the latest analysis.

"Two independent methods now indicate that NGC4622's arms do indeed behave in a very unusual fashion, with the outer arms winding outward in the same direction the galaxy turns," says Byrd.

Further studies of the origin of this behavior are needed, the researchers said. The Hubble Space Telescope image reveals a dark dust lane in the center which suggests the galaxy may have consumed a smaller companion galaxy, the researchers said. ■



reader's pics

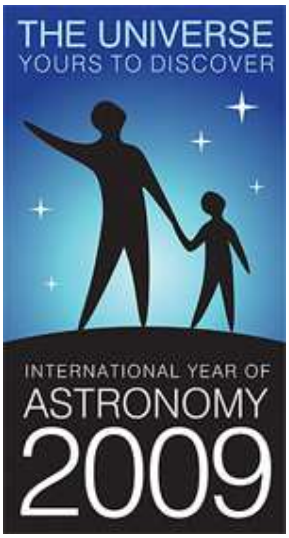
by Bert van Winsen

NGC 247 is a 9.1 magnitude Sbc spiral galaxy about 10 million light years away in the constellation Cetus. It is about 60 000 light years in size left to right, so therefore it is not particularly large or far away. The loop at the left of the galaxy is a spiral arm, making it look a bit asymmetrical in relation to the other side of the galaxy. Although its magnitude is low, it is not particularly bright, has a dim nucleus, and may still be a bit of a challenge for visual observers (maybe you'd like to give it a whirl, Eric?). Some other astrophotographers label it as dim too. The much more spectacular bright NGC 253 is located just 4.5 degrees south (right) of this object. It seems rather awkward referring to this galaxy as an "object", when it could very well be teeming with life, and a whole lot smarter than us! I wonder if they are looking at us too.

This again is a 2 part mosaic (top to bottom). The fov is about 20 x 16 arcsecs. Image capture was standard LRGB; luminance = 1.5 hours, rgb = 1.8 hours. Because of the presence of the 8th magnitude star at the top of the galaxy, individual exposures had to be limited to 90 seconds otherwise the star would have bloomed badly with longer exposures. The start of the blooming spike is just visible. Although the image tended to be noisy as a consequence of the short exposures, I am fairly happy with the result. This time I tried a 2nd stage luminance process (learned from Rob Gendler, and aptly named LLRGB), by using a separately processed luminance image and the modifying the original lrgb as an rgb layer . It seemed to work ok, as I got better color saturation, and an overall more pleasing result. Seeing was about 3.3 arcsecs (FWHM). The fuzzy at the bottom is 15.8 mag PGC2795. Many faint background galaxies are also visible. ■

focus on: 2009 – the International Year of Astronomy

www.astronomy2009.org



The vision of the International Year of Astronomy (IYA2009) is to help the citizens of the world rediscover their place in the Universe through the day- and night time sky, and thereby engage a personal sense of wonder and discovery. All humans should realize the impact of astronomy and basic sciences on our daily lives, and understand better how scientific knowledge can contribute to a more equitable and peaceful society.

The International Year of Astronomy (IYA2009) will be a global celebration of astronomy and its contributions to society and culture, highlighted by the 400th anniversary of the first use of an astronomical telescope by Galileo Galilei. The aim of the Year is to stimulate worldwide interest, especially among young people, in astronomy and science under the central theme "The Universe, Yours to Discover". IYA2009 events and activities will promote a greater appreciation of the inspirational aspects of astronomy that embody an invaluable shared resource for all nations.

The IYA2009 activities will take place at the global and regional levels, and especially at the national and local levels. National Nodes in each country have been formed to prepare activities for 2009. These Nodes establish collaborations between professional and amateur astronomers, science centres, educators and science communicators in preparing activities for 2009. Well over 140 countries are expected to take part in the activities in 2009. To help coordinate this huge global programme, and to provide an important resource for the participating countries, the IAU has established a central Secretariat and this website as the principal IYA resource for public, professionals, and media alike.

Kevin Govender is on the IYA steering committee and the point of contact for South Africans looking to get involved in the action next year. For more information, or if you are interested in participating in any of the IYA 2009 activities, feel free to email him at kg@saao.ac.za ■

the sky this month

site location: lat. **26.0 deg S** long. **28.0 deg E** local time = UT **+2.0 hrs**.

february 2008

dd	hh			dd	hh		
1	12	Venus 0.6N of Jupiter		16	08	Mars 1.5S of Moon)	
1	19	Antares 0.5N of Moon	Occn	18	08	Pollux 3.8 N of Moon	
2	21	Mercury 3.2N of Neptune		18	19	Mercury stationary	
4	7	Jupiter 3.9N of Moon		21	00	Regulus 0.7N of Moon	Occn
4	13	Venus 4.2N of Moon		21	04	FULL MOON	Eclipse
6	19	Mercury inferior conjunction		21	10	Saturn 2.5N of Moon	
7	03	Mercury 4.5N of Moon		24	10	Saturn at opposition	
7	04	NEW MOON	Eclipse	25	07	Spica 2.3N of Moon	
7	11	Neptune 0.3N of Moon	Occn	26	22	Mercury 1.2N of Venus	
9	08	Uranus 2.5S of Moon		28	01	Moon at apogee	
11	03	Neptune at conjunction		29	03	Antares 0.6N of Moon	Occn
14	00	Moon at perigee		29	03	LAST QUARTER	
14	04	FIRST QUARTER					

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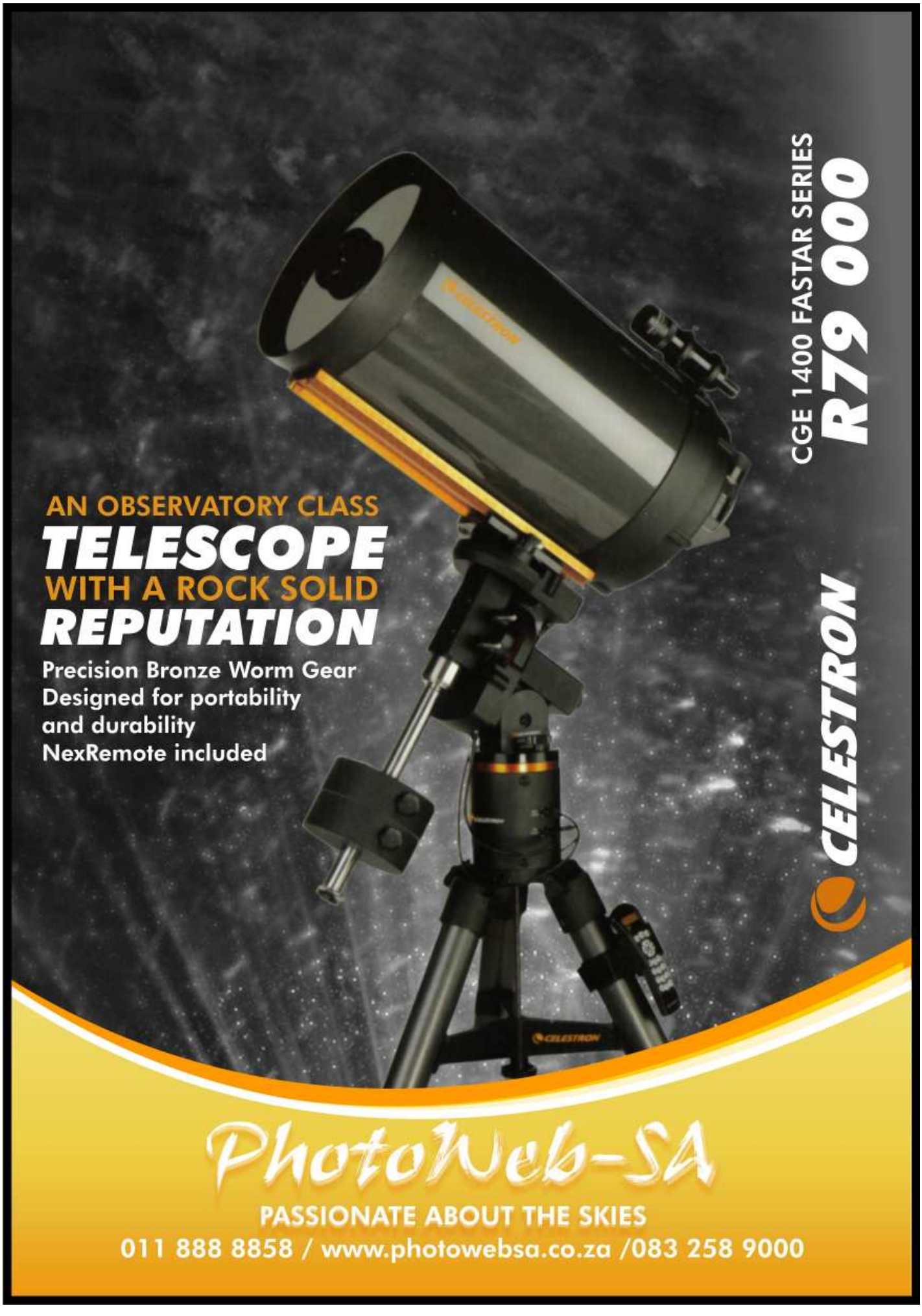
dd	hh			dd	hh		
3	02	Jupiter 3.6N of Moon		16	14	Pollux 3.8N of Moon	
3	14	Mercury greatest elong	W(27)	19	08	Regulus 0.7N of Moon	Occn
5	15	Mercury 0.1N of Moon	Occn	19	14	Saturn 2.4N of Moon	
5	20	Venus 0.3S of Moon	Occn	20	06	Equinox	
5	22	Neptune 0.1N of Moon	Occn	21	19	FULL MOON	
7	01	Venus 0.6S of Neptune		23	15	Spica 2.2N of Moon	
7	18	NEW MOON		24	13	Mercury 1.0S of Venus	
7	20	Uranus 2.6S of Moon		26	19	Moon at apogee	
8	21	Uranus at conjunction		27	11	Antares 0.5N of Moon	Occn
9	09	Mercury 0.9S of Neptune		27	20	Mercury 1.6S of Uranus	
10	21	Moon at perigee		28	24	Venus 0.7S of Uranus	
14	11	FIRST QUARTER		29	22	LAST QUARTER	
15	04	Mars 1.6S of Moon		30	18	Jupiter 3.1N of Moon	

local times of rise and set for the sun & major planets

Date	Sun		Mercury		Venus		Mars		Jupiter		Saturn	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
Feb 10	05.30	19.06	05.03	18.28	03.05	17.24	15.43	1.05	02.27	16.55	19.51	6.56
Feb 20	05.40	18.55	03.55	17.39	03.24	17.30	15.10	0.33	01.56	16.23	19.09	6.12
Mar 1	05.49	18.43	03.39	17.25	03.44	17.32	14.42	0.06	01.26	15.51	18.28	5.29
Mar 11	05.58	18.29	03.51	17.24	04.05	17.31	14.16	23.41	00.54	15.18	17.46	4.45
Mar 21	06.07	18.15	04.19	17.27	04.26	17.26	13.52	23.20	00.21	14.44	17.05	4.02
Mar 31	06.15	18.01	04.59	17.30	04.46	17.19	13.30	23.01	23.48	14.09	16.23	3.20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