

SCIENCE SPAZA SPACE



Knowledge is Ncah!

MEERKAT EDITION - OCTOBER 2018

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Meet the MeerKAT



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We are talking to our future leaders. Are you?



Travel to the stars with Science Spaza

We are so excited about the stars, and what they can teach us! That is why the South African **MeerKAT radio telescope array** is so important! (Do you know what the word means? Find the answer on page 1 of the SARA0 insert!)

The huge MeerKAT radio telescope array – actually a whole group of radio telescope dishes or receivers – is located in the Northern Cape Province of South Africa. We are using this issue of the *Spaza Space* newspaper to show off this new South African telescope and be proud of what our fellow South Africans are achieving! In the end it

will become part of something even bigger, namely the huge **Square Kilometre Array or SKA**. This shows just how important our country has become in terms of this research.

Throughout this edition we hope to provide you with more information about the MeerKAT radio telescope, as well as the people who were involved in the creation of it. Be inspired by the interviews with scientists and learn more about telescopes.

On page 2, read about the fascinating **lunar eclipse** that South Africa experienced in July. On page 4, you will find more information about the **Karoo** and learn about some **new species** that were recently discovered in this area.

On pages 10 and 11, find out about the interesting event that we hosted at Edendale Technical High School for National Science Week. On page 12, we report about what **science clubs** are getting up to and how they are enjoying this newspaper.

Find out about **Minquiz** and enter the competition on page 3 and stand a chance to win some awesome prizes!

We hope you enjoy reading this edition of *Spaza Space*. Remember to send us your suggestions for future articles, as well as the news from your club.

The Science Spaza Team



Into the Shadow of Earth... a Total Lunar Eclipse

On the night of 27 July 2018, the world experienced the longest lunar eclipse of this Century. It lasted almost four hours in total, and the phase during which the moon was completely masked by the shadow of Earth, lasted a full hour and 43 minutes. South Africa was lucky enough to be one of the countries to have a full view of this amazing event, because we were on the “right” side of Earth at the time.

Views of the Moon as it slowly gets darker and the colour changes to dark red during a total eclipse. Wikicommons - By Kahlil Garcia, CC BY-SA 4.0

A lunar eclipse happens when the orbits of the moon around Earth, as well as Earth around the sun, are such that Earth moves directly between the sun and the moon. This means the moon appears to move into the shadow of Earth. As the eclipse begins, Earth's shadow first darkens the moon slightly. Then it begins to cover part of the moon, and finally the moon turns a dark red-brown colour during the total phase. Because of this colour change, a lunar eclipse is sometimes called a “blood moon”.

The dark red has nothing to do with evil, as some people say. The colour changes because when the moon is in Earth's shadow, a little bit

of the sunlight shining on Earth is bent around the edges of Earth by Earth's atmosphere. The atmosphere scatters (or “throws away”) more of the shorter-wavelength light in colours such as green or blue. The longer-wavelength colours such as red then still appear to shine on the moon.

Did you know? Bright Mars

The night of the July eclipse also happened at a time when Mars was at its brightest as seen from Earth. Both planets orbit the sun, but at different distances and speeds. On 31 July, Earth and Mars were at such stages of their orbits that our

planet was “passing between” the sun and Mars and the two planets were relatively close to one another – but still almost 57 million kilometres apart!

This close stage is called opposition. It happens every two years or so, but was special this time because Mars could be seen so brightly at the same time as the lunar eclipse.

VOCABULARY

Orbits – the path of a planet around a star, or a moon around its planet.



“Are you our next Science Whizz?”

So, what is Minquiz™ ?

Minquiz™ is South Africa’s Premier National Science Competition.

Minquiz™ combines the rigors of an Olympiad with the excitement of a live on-stage quiz to produce an entertaining competition for Grade 12 learners that promotes excellence in Physical Science and Mathematics.



PROVINCIAL COMPETITION
May 2019 (Date to be confirmed)

NATIONAL COMPETITION
July 2019 (Date to be confirmed)
(For provincial winners only)

For partnership (sponsorship) and all other queries, contact Dominic.
E-mail: minquiz@mintek.co.za or call (011) 709 4139

Mintek provides bursaries in the following fields:

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- Chemical Engineering (Minerals Processing or Process Control);
- Electrical Engineering (Process Control Systems or Electronics);
- Extractive Metallurgy (Pyrometallurgy, Hydrometallurgy or Biohydrometallurgy);
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- Mechanical Engineering;
- Minerals Processing;
- Mechatronics Engineering;
- Mining-Focused Environmental Compliance

PLEASE NOTE: Mintek does not provide bursaries to students studying towards their National Diplomas. Mintek bursaries cover the full payment of registration, tuition and residence fees, and a generous allowance, in return for a commitment to work at Mintek on a year-for-year basis.



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The closing date for bursary applications is 31 July for support in the following academic year.
To apply, e-mail bursaries@mintek.co.za or call (011) 709 4139 or visit www.mintek.co.za

NAME THE SATELLITE COMPETITION

Learners in grades 4 – 12 are invited to

NAME SOUTH AFRICA'S NANO SATELLITE ZACUBE-2

YOU CAN WIN

- A laptop.
- A tour to selected Space Engineering facilities in the Western Cape for a learner and one adult supervisor.
- A 3D Printed Satellite for the School.



ENTRY FORM

I SUGGEST THE FOLLOWING NAME:

I BELIEVE THIS NAME IS APPROPRIATE BECAUSE:

YOUR NAME AND SURNAME:

NAME OF SCHOOL AND PROVINCE:

IN WHICH GRADE ARE YOU?

POSTAL ADDRESS:

TELEPHONE NUMBER:

SCHOOL TELEPHONE NUMBER:

TEACHER/PARENT'S SIGNATURE FOR CONSENT:

GET YOUR ENTRY TO US BY 12 NOVEMBER 2018 IN ONE OF THE FOLLOWING WAYS:

- Mail it to: NAME THE SATELLITE COMPETITION, c/o SAASTA, PO BOX 1758, PRETORIA 0001
- Hand deliver to: SAASTA, DIDACTA BUILDING, 211 SKINNER STREET, PRETORIA
- Email to: zacube@saasta.ac.za
- Fax to: 086 460 9860

COMPETITION RULES

- Send in one name per entry form only.
- You may make photocopies of the entry form, or download copies from the website www.saasta.ac.za.
- Your entry must reach us by 12 November 2018.
- The organisers will appoint independent judges and their decision will be final.
- The name becomes the property of the Department of Science & Technology and NRF | SAASTA.
- For enquiries, contact Jacky Tshokwe, Telephone (012) 391-9326.
- For more information visit www.cput.ac.za/fsati.





The Mahikeng Astronomy Telescope

A picture of the Mahikeng Astronomy Telescope at the North-West University. Source: North-West University

RIP HHP

Not the only STARS in Mafikeng...

Spaza Space would like to pay tribute to Mahikeng's very own star, Hip Hop Pantsula who is also known as HHP. He gave the people a sense of pride and his contribution to South African music will never be forgotten.

The Mahikeng Astronomy Telescope will allow scientists to study the changes in the brightness of stars and study the inside of stars to show them how the stars evolve.

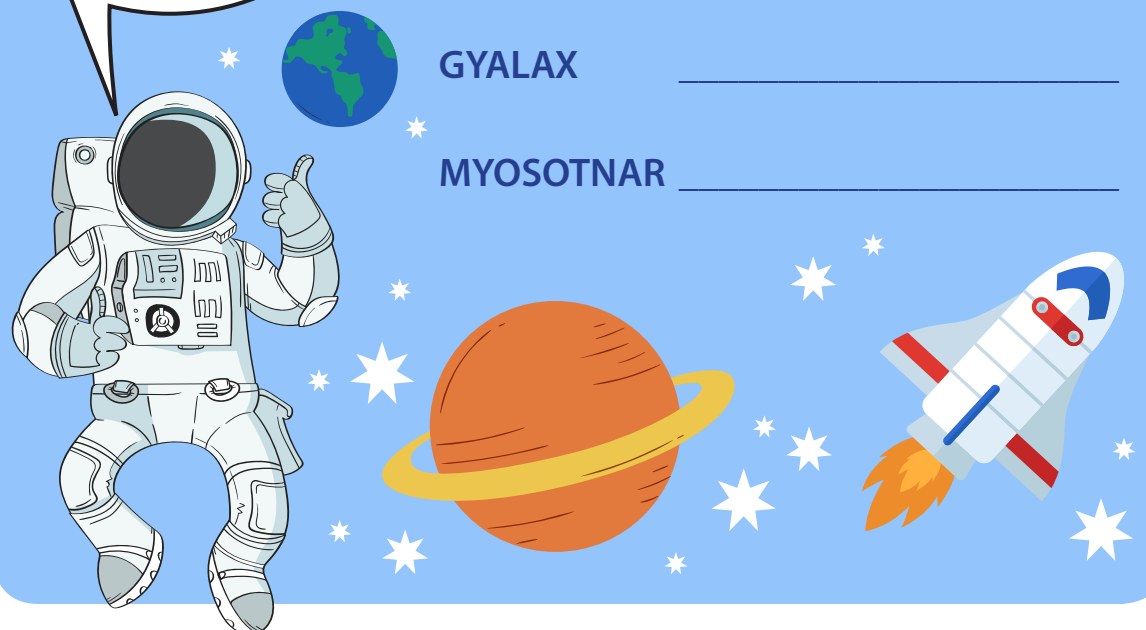
The telescope is based at the North-West University and was co-funded by the South African Department of Science and Technology. The programme is led by Professor Thebe Medupe who started astronomy at this university in 2010. The telescope can be operated remotely, which means that learners like you (yes, you reading this newspaper) can access it from anywhere in the country using the internet. To access the telescope, you need to register with the University and ask them for permission. The Centre for Space Research also hosts schools at the observatory as part of their outreach programme. If you are interested in visiting the telescope or using it remotely, ask your teacher or parent to give the University a call on (018) 389 2374 / 2606.

Check out the fun activity worksheets about this telescope in this edition of Spaza Space!

WORD SCRAMBLE

CAN YOU UNSCRAMBLE THESE LETTERS TO FIND WHAT THE CORRECT WORDS ARE? *HINT: THEY ARE ALL RELATED TO WHAT HAPPENS AT THE CENTRE FOR SPACE RESEARCH!*

- TSCEELEOP _____
- ARSTS _____
- VEEOVL _____
- ESCAP _____
- GYALAX _____
- MYOSOTNAR _____



*These innovations in astronomy and space science are supported by the **Department of Science and Technology** www.dst.gov.za*

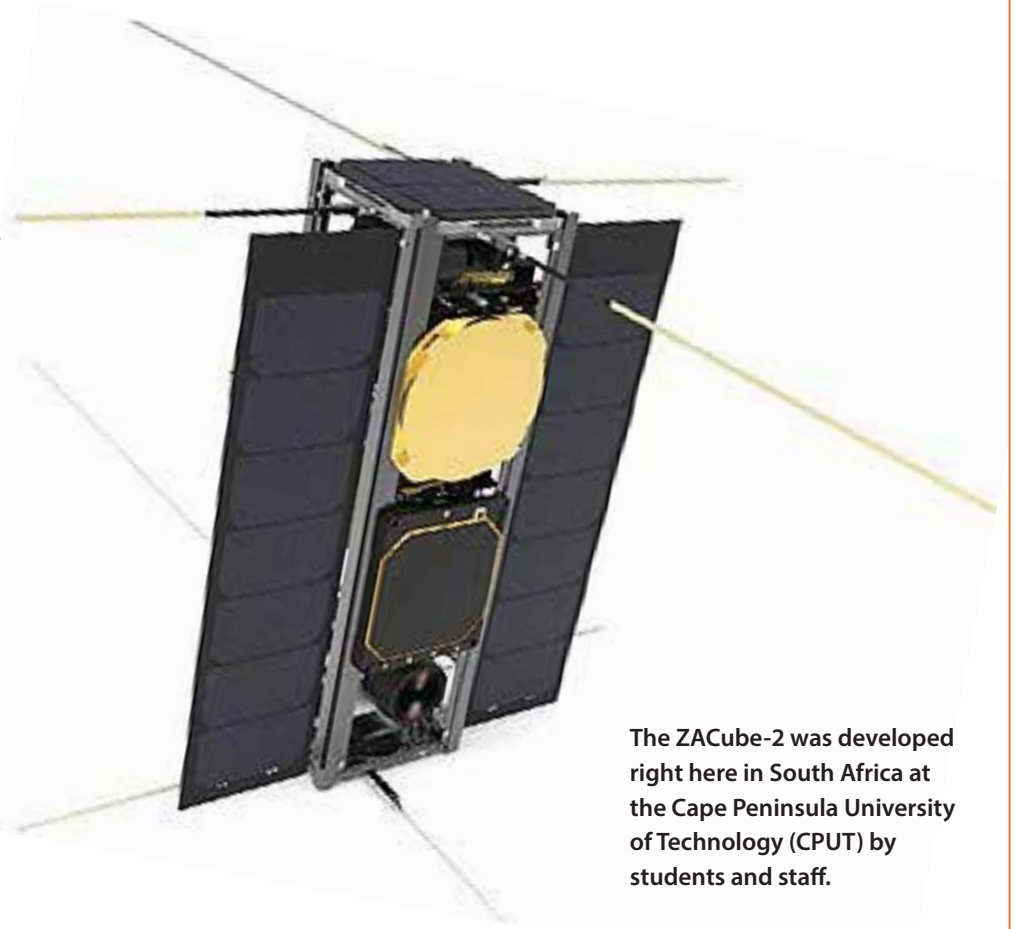
The ZACube-2 Tiny but mighty

The ZACube-2 satellite follows the ZACube-1, which was used for space weather research. The ZACube-2 will be used to track boat activity along the coast of South Africa and detect forest fires. It will receive signals from the ships' Automatic Identification Systems, which will enable authorities to track the position of local and foreign vessels in SA's coastal waters.

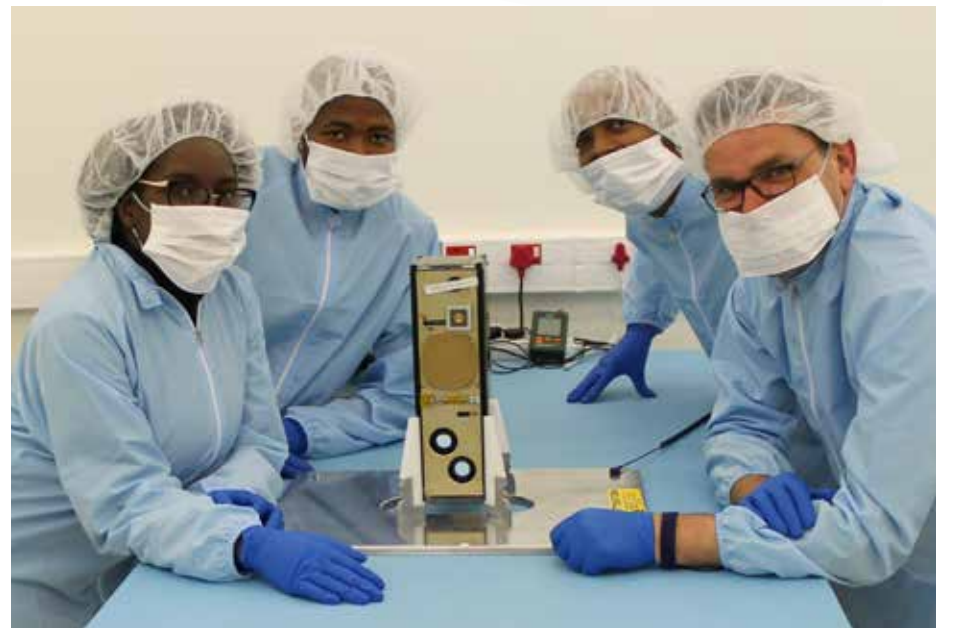
The nanosatellite only weighs four kilograms and has been developed by the Cape Peninsula University of Technology in collaboration with the French South African Institute of Technology and is the second nanosatellite to be developed at the University. The satellite was sent off to India on 17th April 2018, so that it could be launched. The satellite forms part of an expected satellite constellation which South Africa aims to complete within the next four years. The project's

missions are to contribute to the development and transformation of the national space industry, and to serve as a way to start national and international collaborations between South Africa and other countries. In an attempt to develop human capital and skills, the programme involved 18 engineers and technicians, and produced 59 Master's graduates and four PhD graduates.

Check out the fun activity worksheets about this telescope in this edition of the Spaza Space!



The ZACube-2 was developed right here in South Africa at the Cape Peninsula University of Technology (CPUT) by students and staff.



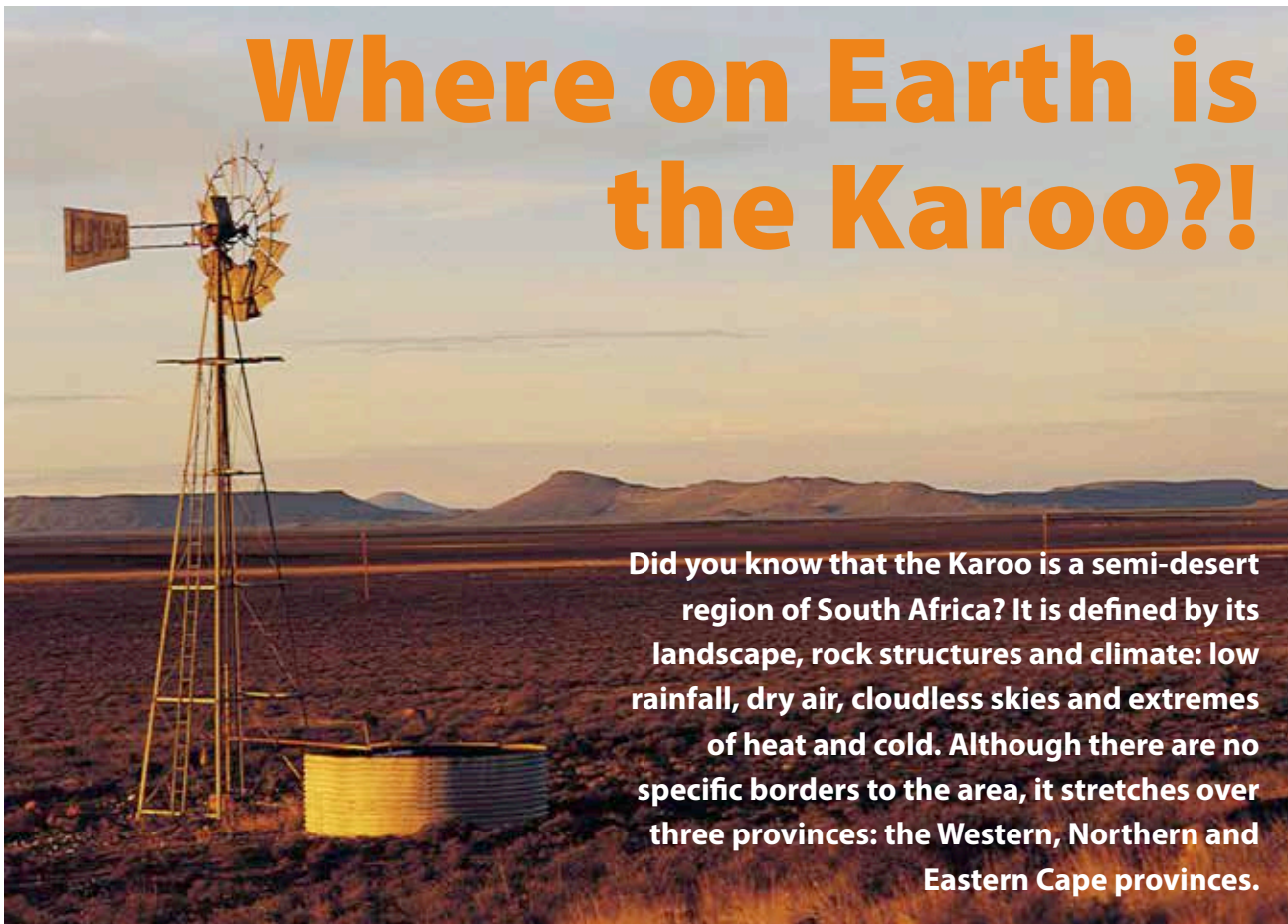
PUZZLE YOUR MIND!!

Can you find the words below in the grid?
The words can be diagonal, horizontal or vertical.

- AFRICA
- ASTRONOMY
- CONSTELLATION
- EARTH
- NANOTECHNOLOGY
- NAVIGATION
- ORBIT
- SATELLITE
- SOUTH
- SPACE
- ZACUBE

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| U | S | E | Q | J | X | F | V | C | A | W | O | V | C | I | K | S | I | L | Y |
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| S | V | Y | M | W | T | C | H | V | Y | M | R | J | L | Y | W | J | Y | J | Y |
| F | L | W | N | Q | E | Z | S | P | A | C | E | T | P | O | G | S | L | W | E |

Where on Earth is the Karoo?!



Did you know that the Karoo is a semi-desert region of South Africa? It is defined by its landscape, rock structures and climate: low rainfall, dry air, cloudless skies and extremes of heat and cold. Although there are no specific borders to the area, it stretches over three provinces: the Western, Northern and Eastern Cape provinces.



A map of South Africa indicating the Great Karoo region. Source: Wikicommons by Oggmus - CC BY-SA 3.0. <https://commons.wikimedia.org/w/index.php?curid=33539488>

The Karoo is very old and has a long story. Almost 400 million years ago, Africa was part of the old continent called Gondwana or Gondwanaland! It connected Africa to the

continents we know today as South America, Asia and Australia. However, over time Gondwana slowly drifted northwards until Africa split off from the rest of the landmass!

Although much of the southern part of Africa was originally covered in ice sheets, the climate warmed up. The icebergs and waters that covered the Karoo slowly dried out until it became the dry area we know today.

We can still see the results of that long history! The Karoo contains many fossils, proving that millions of years ago, it sustained many more forms of animal and plant life than it does now. The Karoo is divided into the Great Karoo and the Little Karoo by the Swartberg Mountain Range.

Filling in the gaps

South African scientists have discovered more than a dozen new species in the Karoo

The Karoo has always been an area that has not been studied enough in the past, because of its high temperatures, huge distances and mostly privately owned land. However, this area has been recognised as an area that is important for future developments, therefore studies needed to be done to learn more about this area so that decisions could be made about future developments.

Many people were under the impression that the Karoo has an ecosystem that does not have a variety of species. Boy were we all surprised to discover these new species!

The Karoo BioGaps project took three years to fill in biodiversity information gaps. New species that were found in this study include:

- Two new scorpion species
- A plant – an undescribed cat's tail (Bulbine genus) in the Aloe family
- Numerous new species of trapdoor spiders have been found in the families Nemesiidae and Ctenizidae (genus Stasimopus) and two new species of ground wandering spiders in the genus Megamyrmaekion.
- While work is still underway, we strongly suspect that three new ground nematodes

(roundworms) have been discovered (important indicators of soil health).

- Two new species of endemic cyprinid minnows (freshwater fish), one in the genus *Pseudobarbus* and another one in the recently erected genus *Amatolacypris*
- At least one new *Fusarium* species (a large genus of filamentous fungi important for soil health)
- Potentially several new grasshopper species
- A new reptile species has been confirmed and will be described.

Species that were updated:

- Two lizards: *Cordylus cloetei* and *Pseudocordylus microlepidotus*
- Several snake species
- The revision of the *Euryphymus* genus of agile grasshoppers
- Taxonomic revision of two stream fishes

You too can help the Karoo BioGaps Project!

The public can get involved in this exciting Karoo BioGaps Project by transcribing data from museum and herbaria collections using the online platform <http://transcribe.sanbi.org/>.



From top to bottom: A picture of a lizard species: *Pseudocordylus microlepidotus Namaquensis*; a plant, which is being described as a cat's tail found in the Aloe family; new species of ground wandering spiders in the genus *Megamyrmaekion*.

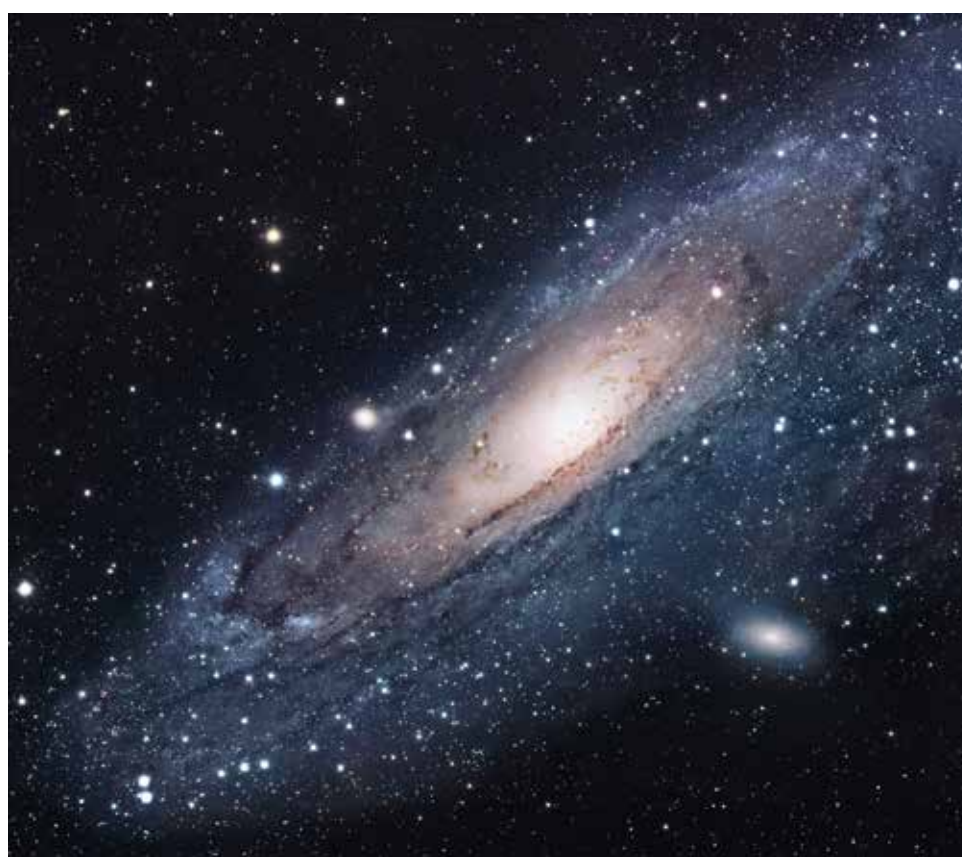
The MeerKAT International GHz Tiered Extragalactic Exploration (MIGHTEE)

Galaxies are vast collections of stars, gases and planets. MIGHTEE is asking questions about how they are formed.

Galaxies can contain several hundred billion stars each. Those stars and everything else that makes up a galaxy are held together by gravity. Each galaxy forms a giant island of “stuff” in the much emptier intergalactic space around it.

Astronomers have studied galaxies for a long time, but there are still many things we don't know about them, which telescopes like the MeerKAT will help us to understand.

How are galaxies born, and how do they evolve? How do the stars form at different times in the



A picture of our neighbouring galaxy, Andromeda. Source: NASA

evolution of the galaxy when the galactic environment changes? Looking at galaxies very far away,

the MIGHTEE project will study how galaxies formed and evolved over the history of the universe.

For example, many galaxies have an active centre. An active centre is the name astronomers give galaxies that have a super-massive black hole at their centre. Because of the black hole's gravitational pull, the black hole consumes the galaxy – gas and stars fall into the black hole. This creates radiation, another word for light, that can shine brighter than the billions of stars of the entire galaxy itself, and that MIGHTEE will observe and analyse.

One of the biggest mysteries in the universe is how magnetic fields emerge within galaxies and, on a cosmic scale, between galaxies. Magnetic fields are everywhere. Earth's own magnetic field is what is used to tell the north-south direction using a compass. The MIGHTEE project will also use MeerKAT to see the magnetic fields found in and between galaxies.

The Science Spaza National Science Week event

In order to create a love for science, it is important to reflect on the importance of science education, especially at high school level. National Science Week 2018 began on 30 July 2018 and ended on 4 August 2018.

The Science Spaza Team hosted an event at Edendale Technical High School during National Science Week. The event aimed to light a passion for science in the hearts of high school students and to emphasize that science is for EVERYONE, not only the select few!

Two students who are currently completing their second year of their Master's degrees at the

University of KwaZulu-Natal spoke to the learners about mathematics, statistics and probability, as well as about environmental science. Learners were eager to ask questions and get involved – and oh, get involved they did!

Students from the school were also keen to ask thought-provoking questions, especially regarding the lunar eclipse that South Africans saw in July this

year. They were encouraged to start their own science club so that they can receive scientific information all year round. The event ended off with an impressive talk about physics by Dr. Couling,

who is a physics lecturer at the University of KwaZulu-Natal. The enthusiasm of the teachers, learners and speakers contributed to the event being a massive success!



Dr. Vincent Couling explaining physics to learners at Edendale Technical High School.



Learners from Edendale Technical High School with their copies of *Spaza Space*.



Banele Mdakane is a researcher in mathematics and Statistics at the University of KwaZulu-Natal.

NEWS FROM THE CLUBS

This is where you, the members of the Science Spaza clubs, get to share your news and have your say about science issues.



Above and right: Learners from Northern Park High School doing fun science activities.

Northern Park High School's science club has been super busy with fun scientific activities! Over the past few weeks they built a super spinner, also known as an anemometer (a device used to measure the speed of wind). They made ooey gooey slime using borax and office glue, as well as a cool lava lamp using oil and coloured water. They have also demonstrated the chemical effects of bleach on coloured substances. Well done to this science club for taking such initiative with cool projects!



Above: The awesome kids from BOOMSciKids Science Club hosted a science expo on 17 August 2018! Our collage shows some of their activities.

Explorers Science Club participated in the Eskom Science Expo that took place at the University of Fort Hare. Three students received gold medals for their projects and one student received a silver medal. Congratulations to all of them!



A gold medal winner (left) and silver medal winner (right) at the Eskom Science Expo.



Above and below: Learners from Northriding High School participating in National Science Week activities.

The Northriding High School's science club outdid themselves for National Science Week (NSW) 2018! They hosted an entire week of science activities at their school. Here is a write-up of activities from Philothea Fundisi, one of their grade 10 students:

On 31 July 2018, we as NRHS science club split up into committees and hosted a power-packed National Science Week Fest. Can I just say WOW, it was AMAZING. From the colourful decor, delectable finger foods, mesmerizing experiments, and fun science quiz, to our two MCs who were so eloquent in speech, our spot-on NSW tees as gear and a media crew to capture all the beautiful moments. A poem by Amanda Phakati and speech by yours truly soothed the hearts of the floor at large. The presence of our guest speaker, Doctor Oosthuizen, graced our event with a lecture. We really understand science from a much more fun perspective. Kudos to NRHS science club for hosting a Grand Fest.



Start your own Science Spaza

Do you want to start a science club at your school? Send us the following information, and Science Spaza will contact you.

School: _____

Name: _____

Telephone number: _____

E-mail address: _____

Postal address: _____

Visit www.sciencespaza.org, email info@sciencespaza.org, sms or WhatsApp us on 076 173 7130 or write to us at PO Box 22106, Mayor's Walk, 3208.

The Marvellous MeerKAT



One of the 64 MeerKAT antennae. It's 19,5 metres tall and weighs a full 42 tons (or almost the same as three school buses). Source: SARAQ

Hey guys! Have you ever considered a career in astronomy? Find out all about the MeerKAT and how you can get involved.

The SKA project is an international effort to build the world's largest radio telescope, with a collecting area of one square kilometre. That's one million square metres!

The MeerKAT radio telescope array has 64 dishes and was preceded by the Karoo Array Telescope, or KAT-7, as it is known. It was primarily built as a precursor to the 64-dish MeerKAT radio telescope array.

The telescope will be used to explore unexplained objects which are normally very difficult to image because they cannot be seen with the naked eye. With the use of the MeerKAT, scientists hope to be able to discover how galaxies are formed, how stars are born and die and what black holes really are. AMAZING!

Did you know that the telescopes have been built all the way near a small town called Carnarvon in the Karoo because it has the perfect climate? The dry climate has very few clouds and very

little moisture, making it easier for the telescope to "see"! The telescopes also need to be very far away from big cities, where cell phones, radios and televisions create a lot of radio waves which interfere with the reception of the signals from space, and the hills surrounding this small town prevent radio waves from interfering with the telescope. South Africa is also positioned in the perfect place for scientists, making it easy for them to see interesting objects in the sky, such as the centre of the galaxy. How lucky are we to live in such an amazing country?

How to go about studying the stars

If you are interested in a science career in the astrophysics and astronomy fields, many universities in South Africa offer undergraduate bachelor of science degrees. You have to begin your degree with a Bachelor of Science in Mathematics, Physical Sciences or Engineering and then move on to postgraduate studies in Astronomy, Astrophysics and Space Science!

Here are a few programmes to check out:

- Wits University offers a BSc degree that allows students to structure and tailor their own degree, depending on what they want to do in the future. The university believes that a BSc is a stepping stone to further study, such as a Master's or PhD degree focusing on the student's interests.
- The University of Johannesburg offers BSc degrees in physics and applied mathematics, or physics and mathematics, for careers in

astronomy and energy sources. This university was also the first in South Africa to be accredited with a BSc programme.

- The University of Cape Town offers a BSc degree with a choice of 21 major subjects, such as astrophysics and applied mathematics. Nine courses must be completed before a student can qualify to specialise through the university's postgraduate programmes.
- Rhodes University offers a unique experience with its BSc programme, because students are

encouraged to be creative with their subject choices. Students are allowed to take a major subject from the commerce, humanities and law faculties.

- The University of South Africa (UNISA) offers distance learning, which means that you can complete your BSc in the comfort of your own home! When you have completed an undergraduate degree in mathematics and physics, you can register for an honours degree in astronomy.
- The University of KwaZulu-Natal has a dedicated BSc course that will allow you to major in applied mathematics, physics and astronomy. You can then go on to study a BSc honours in applied mathematics or physics.

Who's who?

Building a radio telescope is no easy job! There are many different people involved in the process of putting a project like that together. Just check out the job descriptions of some of the people who are involved in the MeerKAT and SKA projects:

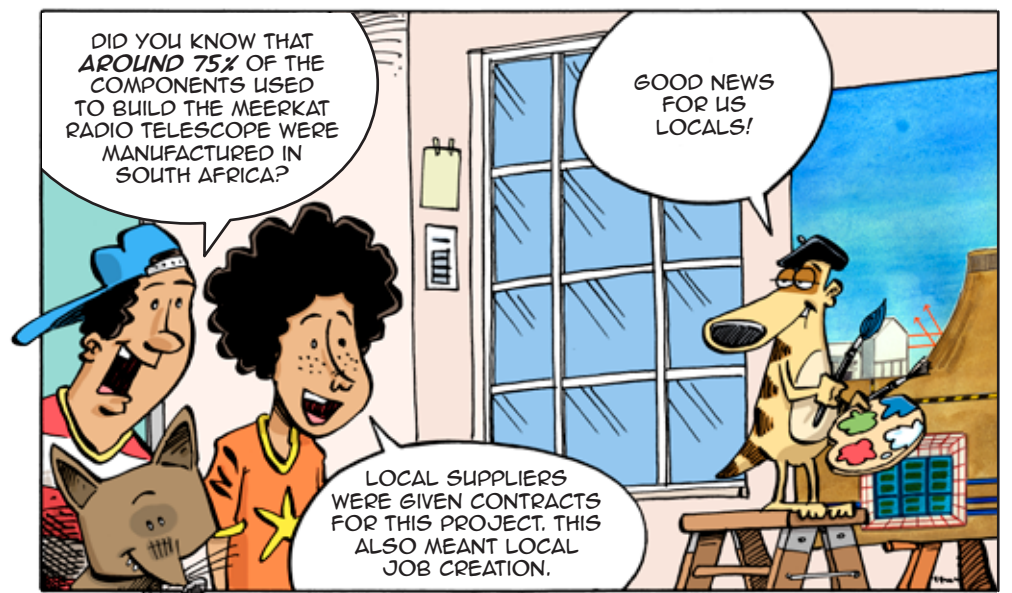
■ **Astronomers and astrophysicists** study physics for several years and then go on to advanced training in astrophysics. They are the people who translate the meaning of the signals that the telescopes gather. It's a bit like rocket science, but just think of having the universe as the lab where you work! They also write the computer programmes to run the telescopes and to get information from the data coming from the telescopes.

■ **Engineers** help to design new telescopes and build parts for existing ones. They also develop the sophisticated software and

computer systems needed to operate the telescopes.

■ **Technicians** are important members of a telescope team. They help to make new components and make sure everything on the telescope is working well.

There are many exciting things you can do if you are interested in working with radio astronomers, or perhaps being involved in designing one of the telescopes of the future. Also read the interviews with scientists who were involved with the MeerKAT project over the next few pages to



find out more about the work they do.

How do I become a radio astronomer?

You can't do it without mathematics and physical sciences as two of your school subjects! With a matric exemption in both, you'll be off to a good start. Computer science will also help.

At university, you will study astronomy and physics before going on to more specialised postgraduate studies.

This link is very useful if you want to view the bursaries available for students who are interested in studying astronomy or engineering: <http://www.ska.ac.za/students/funding/>.

Interview with a MeerKAT scientist Dr. Bradley Frank

Dr. Bradley Frank is one of the scientists who worked on the design of the MeerKAT radio telescope array. He has a BSc Hons (Physics) from Wits University and a PhD in Astronomy from the University of Cape Town. He told *Spaza Space* that the MeerKAT is a cool telescope that will contribute to interesting science.



What is your role in the development of the SKA?

My formal title is Senior Developer in the Science Data Processing Team at the South African Radio Astronomy Observatory (SARAO), and I work very closely with the Institute for Data Intensive Astronomy as a project coordinator for the pipelines project. I am a radio astronomer specialising in the study of the evolution of galaxies, with expertise in scientific computing. I spend most of my time preparing computing systems and frameworks to deal with the challenge of producing high quality science products from raw MeerKAT data. I work with a diverse team of scientists, developers and students.

What are the challenges?

Radio astronomy is generally quite tough and takes years to master. I'm constantly learning and appreciate how challenging and interesting the telescope and the science can be. MeerKAT will deliver huge datasets that cannot be analysed or

visualised in the traditional way, so we have to use high performance clusters and sophisticated computational frameworks to find meaning from our data. Therefore, I've had to learn a lot about stuff outside my field.

What do you love most about your job?

I love working with the MeerKAT team, and I'm really lucky to have the opportunity to work with one of the largest radio telescopes in the world. I've travelled the world, worked with different telescopes, learnt new techniques and worked with some incredibly smart and awesome scientists.

Dr. Frank's advice to aspiring scientists:

A career in science is tough and challenging. You'll need to be brave and have the courage to jump into the unknown. But once you jump, you will discover that science is fulfilling, challenging, interesting, exciting and often fun!

Interview with a SARAO scientist Palesa Nombula

Palesa Nombula is a scientist at SARAO. She is from Soweto and is 27 years old. She completed a BSc in Physics and Mathematics at UNISA, then she completed a BSc (Hons) in Astrophysics and Space Science at UCT, and is currently a Master's candidate for Astrophysics at UWC. You go, girl!



Palesa joined SARAO at the beginning of this year and is employed in the Commercialisation Division, where she and her colleagues ensure that the communities in the Karoo can benefit from the development projects that SARAO is working on. They also look at the technology among other Radio Astronomy projects for ways to commercialise it in various sectors.

Palesa finds that working full-time and doing a Master's can be demanding. It requires focus and time management, but she loves her job because the projects directly impact the company and the communities in the Karoo. It makes her very excited that the work she does will make a difference and leave a legacy, especially amongst local communities.

In the future, Palesa would like to pursue her doctorate and also use her project management experience to engage with social challenges that are impacting this country. She also wants to use her experience to expose more African, especially South African, children to opportunities in Science, Technology, Engineering and Maths.

When being interviewed by the Science Spaza Team, Palesa left us with one piece of advice for our readers: "Be brave, take a chance – the challenges come on the roads less travelled. There is nothing more satisfying than overcoming your fears and doubts."

VOCABULARY

Computational – using computers

Evolution of galaxies – how galaxies form and change over time

Interview with a MeerKAT scientist Dr. Kim McAlphine

Women are very visible in the development of the largest radio telescope the world has ever seen. Dr. Kim McAlphine, who works as a data processor in the SKA team, told *Spaza Space* that curiosity is the key to unlocking success in the science field.

The 36-year-old scientist from the Free State graduated with an undergraduate BSc degree majoring in mathematics and physics, and went on to complete a PhD degree in radio astronomy from Rhodes University.

"I work on developing an automated system to calibrate the data that comes from the telescope. This is the process of removing a number of unwanted effects from the data, so that high quality images of the sky can be produced," she said.

Dr. McAlphine said the most difficult part of her job is to ensure that she can reliably process as much data as possible. She said that this process can be expensive, which puts her team under pressure to make sure that their images are correct.

However, she said, despite the work pressure she enjoys being able to solve new and interesting problems.

"I enjoy being a part of a wonderful team of scientists and engineers who constantly enable me to become a better scientist and developer."

Dr. McAlphine said that she is excited that South Africa has taken the lead in the MeerKAT and SKA projects.

"It is my hope that these projects will make new and unexpected discoveries about our universe during their operational lifetimes. It would be great for Africa to take the lead in something truly unexpected," she added.

VOCABULARY

Calibrate – to adjust results of experiments to take external factors into account, or to allow comparison with other data. Simply, it means to measure accurately or to check how accurate an instrument is.



Interview with a MeerKAT scientist Dr. Michelle Lochner



Having grown up with her head in the stars ever since she was a little girl, Dr. Michelle Lochner is now able to work with them every day. The 30-year-old is part of a cool group of South African astronomers who are leading the world into a science future. While chatting with *Spaza Space*, Dr. Lochner let us explore her mind.

What is your role in the development of the SKA and how long have you worked there?

I've worked for the SKA for the past two years, but I've been involved in the project since 2007. As early as my first year, I'd go to their head office in Joburg during vacations and do admin work at first. But later I started helping some of the astronomers with their research. I am now a full-time astronomer, which makes me an "end-user" of MeerKAT and the SKA.

What are the challenges?

The best and worst thing about being an astronomer is that you are more or less your own boss. That means that you have tremendous freedom, but also that there's no real guidance to make sure you're on the right road. You have to make your own choices about what to research, how to spend your time, etc. This means you spend a lot of time wondering if you're doing the right thing! This is surprisingly stressful,

but is also something you get used to and is worth enduring for the sake of academic freedom.

What do you love most about your job?

I love solving problems. I love that I can wake up every day and work on truly fascinating and difficult problems in science, and I always know that whatever I'm doing, no one has ever done it before. I also really enjoy the people with whom I work. One great thing about being an astronomer is that you get to meet people from all different cultures and countries. I've been lucky enough to travel to many countries around the world and see some incredible things.

What is your advice to young kids who want to study science but find it daunting?

You have nothing to be afraid of, because you are already an excellent scientist. Every child is a scientist because science is about curiosity and exploration. Young children do not learn that things thrown in the air fall down because someone taught them...they learn this by throwing things in the air and observing what happens. They learn about the world through experimentation and curiosity. Because you have all been young children, you are already great scientists. Foster that creativity, never stop trying to understand how the world works and you will learn to think like a scientist.

How does the MeerKAT Radio Telescope work?

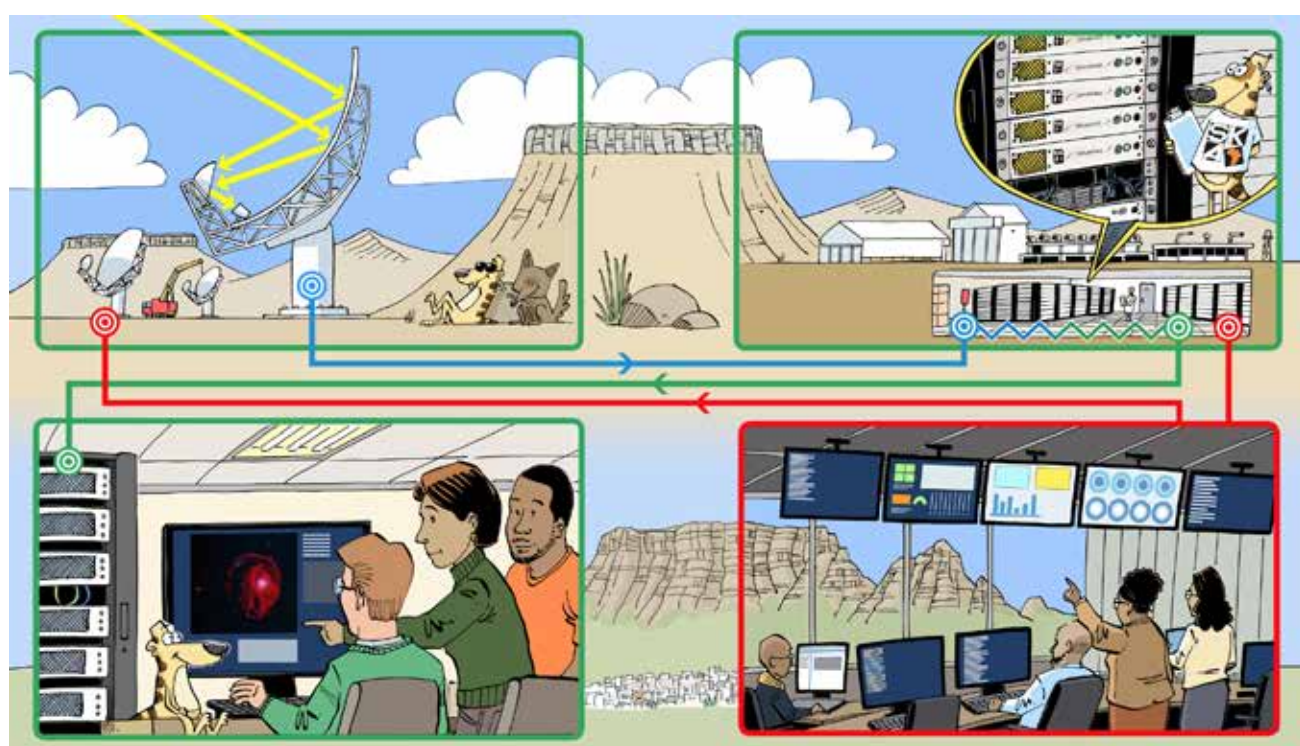
The MeerKAT radio telescope at the SKA site at Losberg in the Northern Cape is made up of 64 antennae that are all linked together. This is called an array of dishes.

The dishes “catch” radio waves from deep space. Each receptor is made up of three main parts:

- The antenna positioner, which is a dish on a pedestal that can be steered to point at different parts of the sky. The antennae (or antennas) are also called “reflectors” sometimes because they “reflect” the waves into the rest of the telescope. The antenna positioners of the MeerKAT have main reflectors that are huge: each dish is no less than 13,5 metres in

diameter. Just imagine: each one is as wide as almost 14 steps taken by an adult man! Even the smaller sub-reflectors are very big and are 3,8 metres in diameter. The pedestal of the dish contains the antenna’s pointing control system.

- A set of radio wave receivers
- A set of digitisers that translate the radio waves into digital signals.



Yellow line: Radio waves, which have travelled millions and millions of kilometres before reaching Earth, are collected by the antennae and turned into electrical signals.

Blue line: These signals are then sent via fibre-optic cables to the correlator inside the Karoo Array Processor Building (KAPB) where they are processed.

Green line: The data is sent via fibre connection to Cape Town where it is used to create images of the area of the sky to which the antennae are pointing. The data is also shared with astronomers around the world.

Red line: The MeerKAT radio telescope dishes are controlled from Cape Town. They can be moved to face different parts of the sky, so that they detect and collect the radio waves arriving from a particular area of space.

More excitement

An exciting project is MeerLICHT (“more light”). A 0,65-metre robotic optical telescope has just been installed at Sutherland and will follow exactly and immediately where the MeerKAT radio telescope is pointing.

This means that the same things are “seen” at the same time and some very exciting science will follow!

MeerLICHT is the result of South African, Dutch and United Kingdom researchers from six different institutes working together.

MeerKAT in the Northern Cape has already shown what a powerful telescope it is. This magnificent view of the hydrogen gas in Messier 83 (also known as the Southern Pinwheel Galaxy, or simply M83) was produced by only 16 of the total of 64 MeerKAT dishes. The small pink area in the middle shows the core of the galaxy. The large red area shows the gas surrounding the galaxy, which cannot be seen in an optical image. Source: SARAQ



ALL ABOUT RADIO WAVES

Radio waves are part of the “electromagnetic radiation” group of waves. The subgroups have names according to their frequencies and wavelengths. Two other examples of electromagnetic radiation (other than radio waves) are the light waves that you can see with your eyes, and the X-rays that are used in medicine.

Radio waves have longer wavelengths than light, and much longer than X-rays. They come from natural sources like lightning, or astronomical objects like stars. Radio astronomy studies objects like stars and galaxies, and the radio waves they emit at specific frequencies. Even though radio waves are long, they travel very far and very fast – at the speed of light!

On Earth, radio wave uses include mobile phones, radio and television, radar, wireless computer networks and many more. Radio telescopes are built in areas where they are protected from some of the radio waves produced by humans.

To ensure that there is some order in the ways people apply them, the use of radio waves is strictly regulated by the International Telecommunications Union.

Compare the MeerKAT radio telescope image with the photograph taken of M83 by an optic telescope. The large dust cloud surrounding the galaxy is much clearer in the radio image. This shows how important radio astronomy is to “see” and study more things. Photograph:

European Southern Observatory (ESO). Source: SARAQ

