SCIENCE FOR SOUTH AFRICA

Quest

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South Africa's contribution to a new era of space exploration

From stargazing in Ancient Africa – to the James Webb Space Telescope

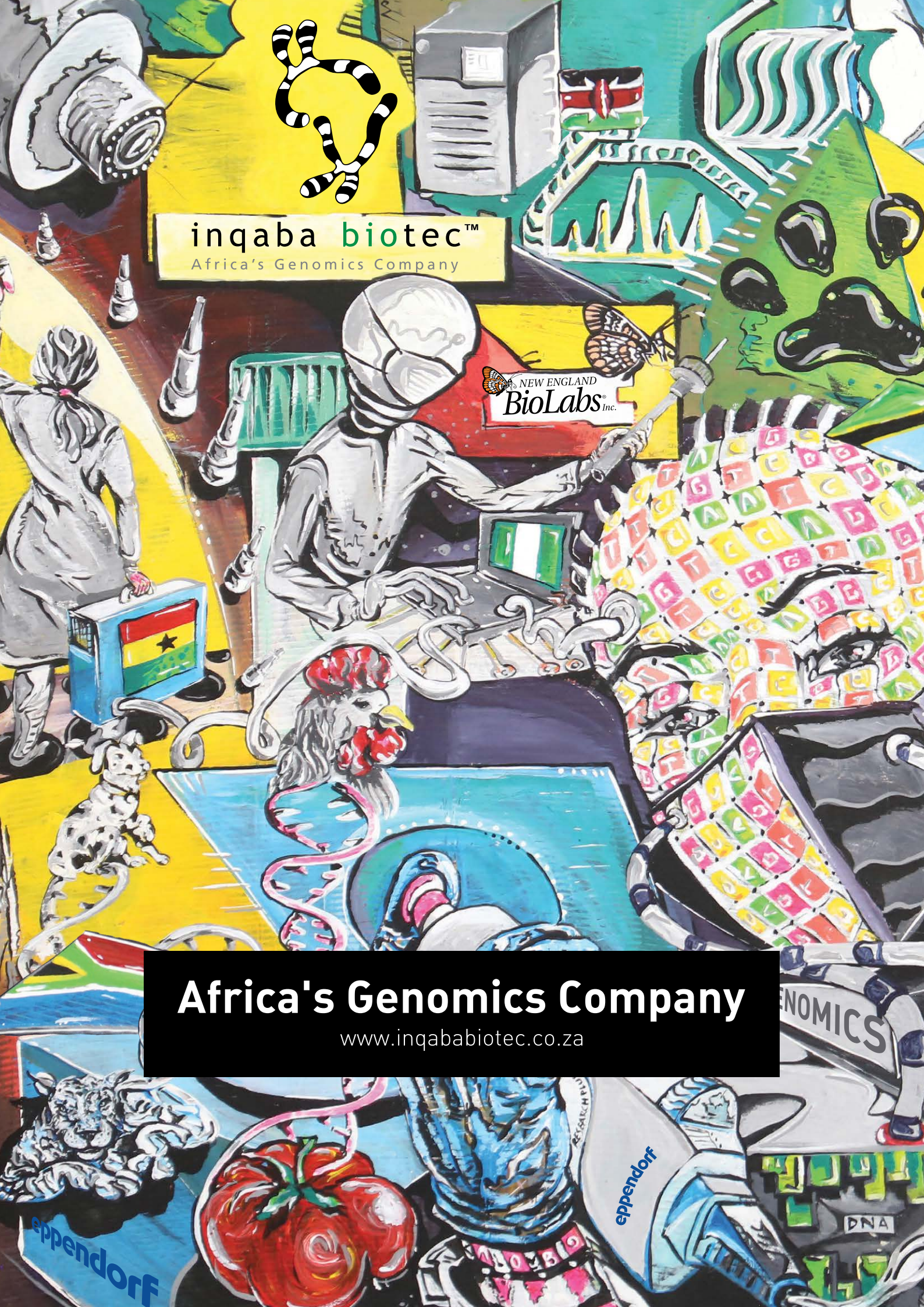
An update from the SKA-Mid radio telescope site – and a chance to win a visit!

Astronomy and space careers focus

Generation SPACE

Special space & astronomy edition

ACADEMY OF SCIENCE OF SOUTH AFRICA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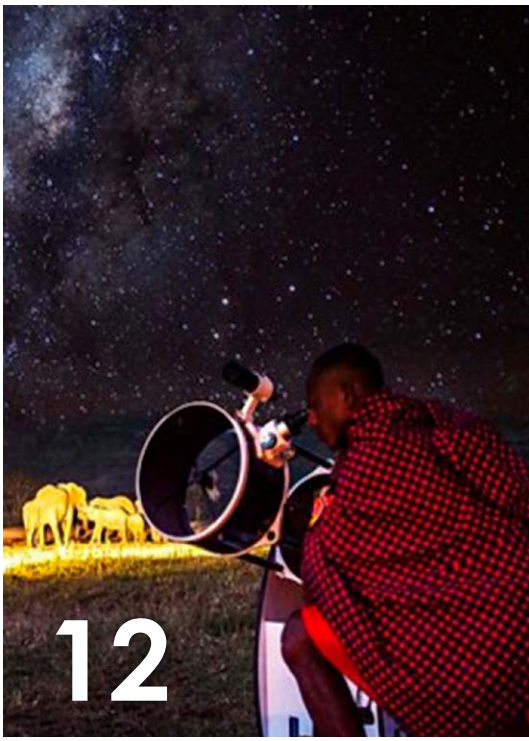

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Cover image
The Pillars of Creation are set off in a kaleidoscope of colour in the NASA/ESA/CSA James Webb Space Telescope's near-infrared-light view. The pillars are filled with semi-transparent gas and dust. This is a region where young stars are forming – or have barely burst from their dusty cocoons as they continue to form.
Image credit: NASA, ESA, CSA, STScI; J. DePasquale, A. Koekemoer, A. Pagan (STScI).

Generation SPACE

Roscosmos's chief, Yuri Borisov, recently **declared** a new space race and pledged his nation's unwavering commitment to lunar exploration, stating that it is "not just about prestige and the achievement of some geopolitical goals...but about ensuring defensive capabilities and achieving technological sovereignty".

India, Japan and China are also looking towards the moon. NASA is setting up a return to the moon with its Artemis missions, and by now everyone knows Elon Musk's SpaceX is aiming not just for the moon, but Mars and beyond. Several other commercial space ventures, like Virgin Galactic and Blue Origin, have also entered the fray and have already come a long way.

It is becoming clear that we have indeed entered a new era of space exploration and innovation, both commercially and at the nation-state level. No surprise then, that many young people are dreaming of a career "amongst the stars". After all, it is today's youth who will be exploring the cosmos tomorrow. That is why we decided to create a special space- and astronomy-focused edition of QUEST, with the theme "Generation SPACE". To help us populate the issue, we approached the South African National Space Agency (SANSA), the African Astronomical Society (AfAS), the Square Kilometer Array Organisation (SKAO), and the South African Astronomical Observatory (SAAO) and the South African Radio Astronomy Observatory (SARAO).

What I did not realise, however, was how involved South Africa has been and is increasingly becoming, in this new space age.

Just the other day, the country's first National Space Conference was hosted at the CSIR in Pretoria, where Humbulani Mudau, CEO of SANSA, elaborated on South Africa's various current and upcoming space projects. From building Earth Observation satellites to a proposed Space Infrastructure Hub, the upcoming Deep Space Ground Station Network that will be situated in Matjiesfontein (a transformative alliance between SANSA and NASA), and Africa's first Space Weather Centre in Hermanus, to the development of a possible future African Space Port.

Not to even mention all the astronomical endeavours that you can read about in this issue, or the other ambitious space projects **being pursued** in the rest of Africa.

Having paged through this edition, I am sure you will also be astounded by South Africa's impressive and growing space presence. And if you want to make a career of these new cosmic ventures, have a look at our careers focus on astronomy and space science. Who knows, you might be the next Neil Armstrong!

With regards,

Fanie (RS) van Rooyen (Editor)

Go tloga go go aga disathalaete tša go Lebelela Lefase go ya go Setsi sa Mananeokgoparara a Sebaka se se šišintšwego, Neteweke ya Seteišene sa Fase sa Sebaka se se Tebilego seo se tlago seo se tlago bewa ka Matjiesfontein (selekane sa phetogo magareng ga SANSA le NASA ka didirišwa tša kgokagano tša maemo a godimo tšeo di lego bohlokwa go baromiwa ba Artemis le go tsošološa go ba gona ga batho ngwedi), go tsebagatšwa ga morago bjale ga Setsi sa mathomo sa Boemo bja Leratadima sa Sebakabaka sa Afrika ka Hermanus, go ya go tlhabollo ya Boemakepe bja Sebakabaka bja Afrika bjo bo kgonegago bja ka moso – Afrika Borwa e netefatša gore e tla ba karolo ya moloko wo o latelago wa go nyakišiša sebaka.

Translated into Sesotho sa Leboa/Sepedi by Tebatso Isaac Makwala

Generation SPACE:

South Africa's contribution to a new generation of space exploration

One of SpazeX's Falcon-9 rocket launches.

SpaceX

In the ever-expanding expanse of space exploration, the 21st century has ushered in a new generation of space explorers that can aptly be called "Generation SPACE". Through the efforts of private commercial space companies like SpaceX, Virgin Galactic and Blue Origin, the dreams of exploring the cosmos are becoming a reality for today's high school kids. This generation is witnessing a remarkable convergence of technological breakthroughs, astronomical discoveries, the burgeoning commercial space race, and South Africa's noteworthy contributions to these domains. In this article, we embark on a mini space quest, delving into the wonders of the cosmos, the new space exploration era, and the significant role South Africa plays in unraveling the mysteries of the universe.

Astronomy – Unravelling celestial mysteries

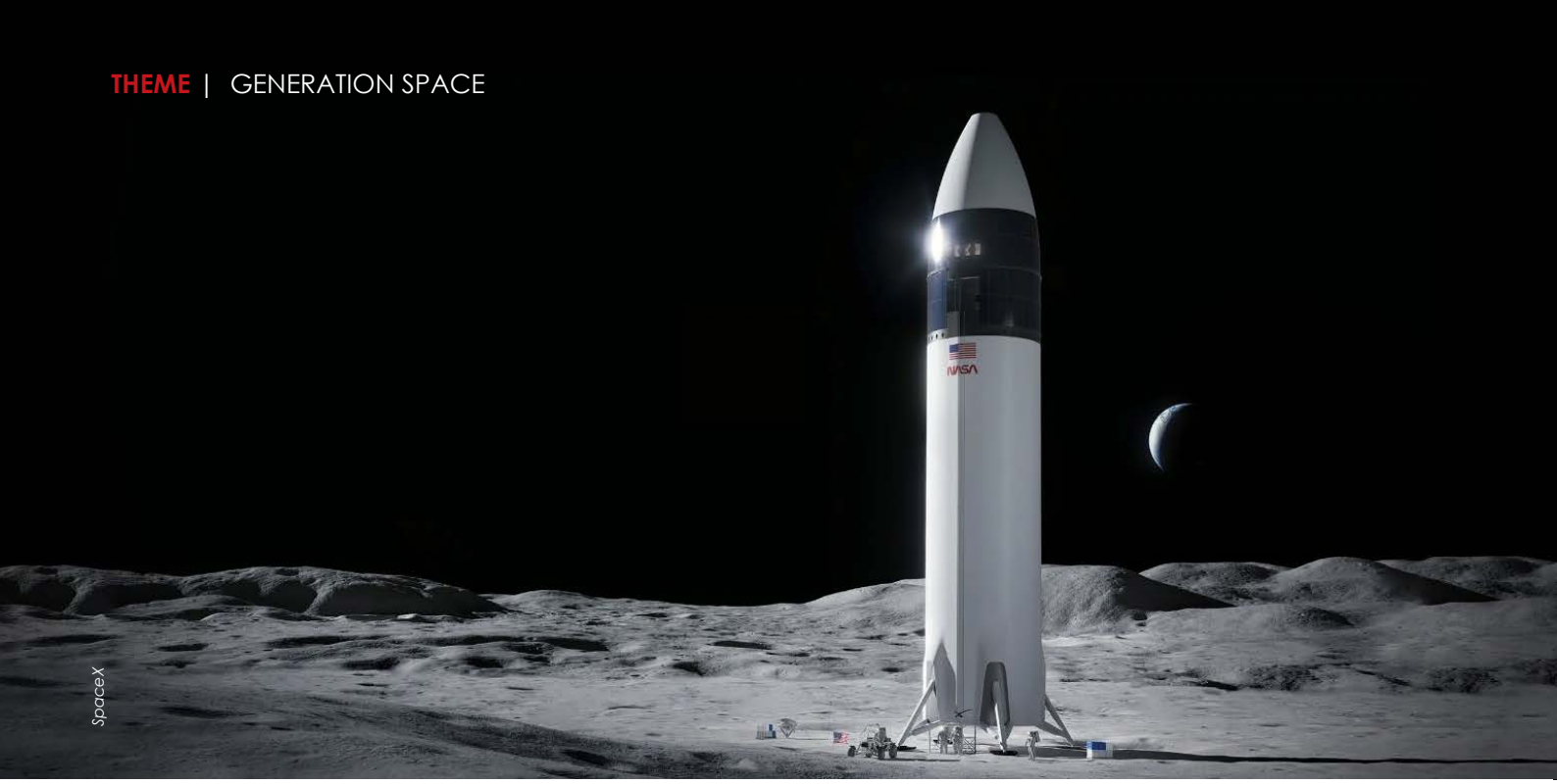
Astronomy, the oldest of the natural sciences, continues to be at the forefront of human curiosity. Generation SPACE is witnessing breakthroughs in telescopic technology, such as the dazzling images from the James Webb Space Telescope, granting us unparalleled access to the heavens. Astronomers use cutting-edge instruments to observe distant galaxies, exoplanets, and celestial events. With each new discovery, our understanding of the universe expands, and we draw closer to unlocking its most profound secrets.

The new commercial space race – Pioneering access to space

The 21st century has seen the rise of a dynamic and transformative industry – commercial space exploration. Private companies, driven by visionaries like Elon Musk, Jeff Bezos, Richard Branson and others, are reshaping our relationship with space. The development of reusable rockets, such as SpaceX's Falcon 9, has made launching payloads and even crewed missions more accessible and cost-effective. These advancements propel us towards a future where space travel could become a reality for the average person. Not to mention, we could see humans revisiting the moon and landing on Mars within the next decade or two.

South Africa's stellar contributions – Uniting Earth and sky

Nestled in the Southern Hemisphere, South Africa plays a pivotal role in the global quest for astronomical knowledge. One of its most significant contributions is the MeerKAT radio telescope, an array of 64 radio dishes located in the Karoo desert. MeerKAT is part of the ambitious Square Kilometre Array (SKA) project, a collaboration of over 20 countries aimed at building the world's most powerful radio telescope. This undertaking allows scientists to explore the cosmos in unprecedented detail, providing insights into the universe's evolution and unravelling the mysteries of black holes, dark matter, and cosmic dawn.



SpaceX

An artist's illustration of SpaceX's Starship spacecraft on the lunar surface.

In addition to MeerKAT, the Southern African Large Telescope (SALT) stands tall in the Karoo region. This cutting-edge telescope is a partnership between several countries and provides astronomers with an unrivalled view of the Southern Hemisphere's celestial wonders. SALT's impressive array of mirrors allows scientists to study distant galaxies, pulsars, and other cosmic phenomena with incredible precision.

Furthermore, South Africa has invested in educational programmes to inspire the next generation of astronomers and space enthusiasts. Through outreach initiatives and educational institutions, they encourage young minds to explore the wonders of the cosmos and consider future careers in astronomy and space science.

Space science education in South Africa – Nurturing future explorers

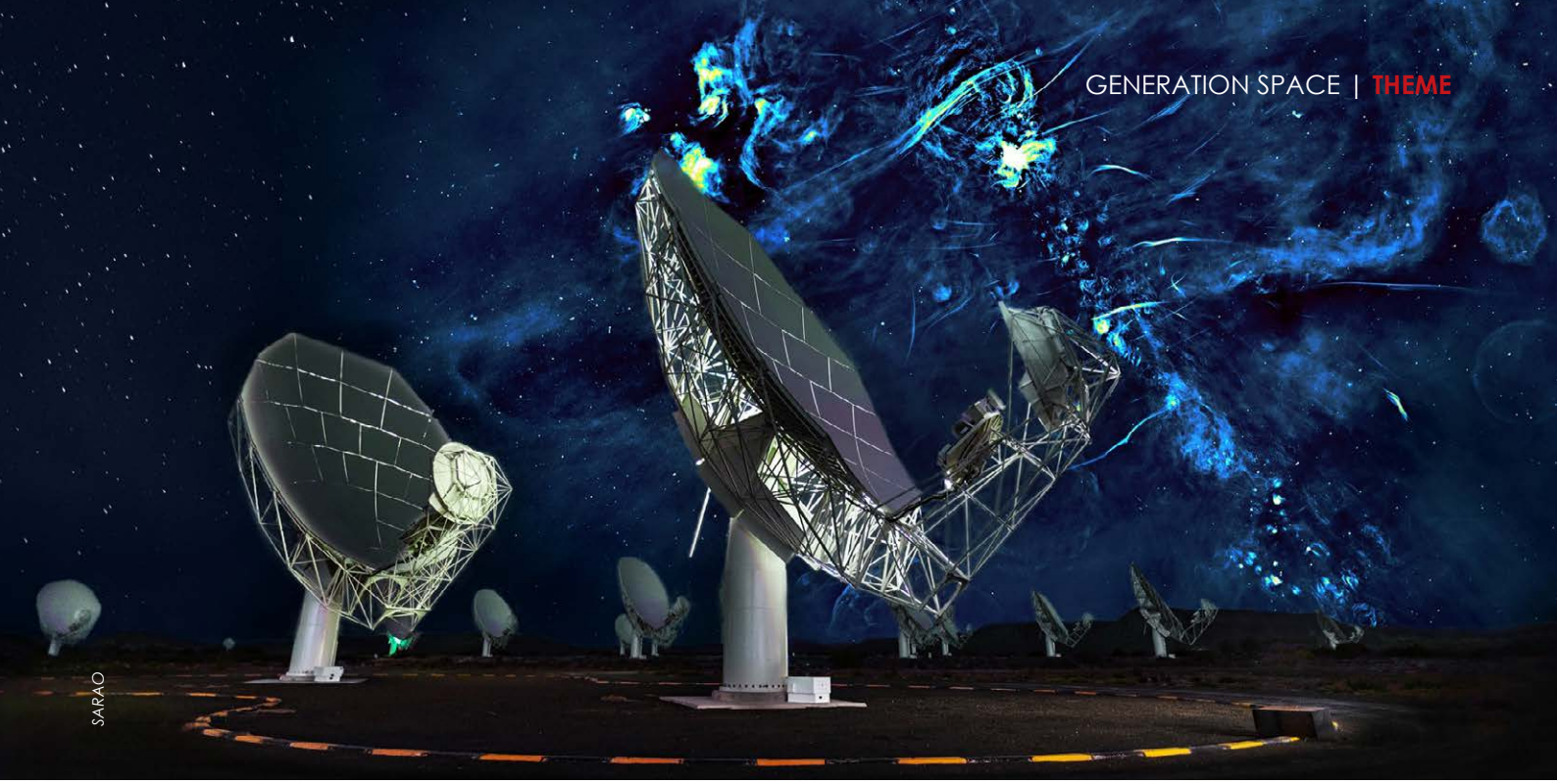
Beyond its research contributions, South Africa is cultivating the next generation of space enthusiasts through education. The country's commitment to space science is reflected in various initiatives and programmes designed to inspire young minds. From astronomy clubs to space science workshops, these endeavours are nurturing a generation of scientists, engineers, and explorers who will continue to shape the future of space exploration. Renowned South African universities offer astronomy and astrophysics programmes, attracting students from around the world. These programmes provide specialised training and research opportunities, enabling aspiring scientists to delve deeper into the mysteries of the universe.

Space science education in South Africa emphasises mentorship and career guidance. Leading experts in the field regularly interact with students, sharing their experiences and insights, and inspiring the next generation of space enthusiasts.

The South African National Space Agency (SANSA) also plays a vital role in coordinating space science education efforts. It works closely

SAAO

The Southern African Large Telescope (SALT), close to Sutherland in the Northern Cape.



South Africa's MeerKAT radio telescope, consisting of 64 dishes, will eventually become part of the international Square Kilometre Array (SKA), encompassing hundreds of dishes in various countries.

with educational institutions, government bodies, and industry partners to promote space-related education and research for the next generation.

To infinity...

Generation SPACE is witnessing an unprecedented fusion of innovation and ambition. The new commercial space race, driven by visionaries like Musk, Bezos and Branson, offers exciting prospects for the future of space exploration. Simultaneously, South Africa's astronomical contributions, through projects like SALT and SKA, provide an inspiring example of scientific cooperation and exploration.

If you are in high school, you are at the forefront of this cosmic revolution. Whether you dream of journeying to the stars or contributing to our understanding of the universe, the opportunities are boundless. Embrace your curiosity, fuel your passion, and join "Generation SPACE" as we explore the cosmos and strive to unlock the secrets of the universe.

Article written by Sinegugu Nzuza, Saturnin Ombinda-Lemboumba, Masixole Lugongolo and Patience Mthunzi-Kufa, researchers in biophotonics at the Photonic Centre of the Council for Scientific and Industrial Research (CSIR). Nzuza is also affiliated with the Laser Research Centre at the University of Johannesburg and Mthunzi-Kufa is affiliated with the Molecular and Cell Biology Department of the University of Cape Town as well as the School of Chemistry and Physics at the University of KwaZulu-Natal.

Definitions translated

Astronomy: "Isayensi yezinkanyezi" – Ukufunda, ukubona, nokuthula imizulu, izintaba, amantengabantengwane, nezinkanyezi, kanye nemizimba engaphansi komhlabathi, ukusuka phakathi kokuphuma komoya ophuma kwezinkanyezi futhi ukuzibonela izilwane ezisemazulwini.

Cosmos: "Umhlaba-wasezulwini" – Inani lezinsimbi, izinkanyezi, izintaba, amantengabantengwane, nokuningi okunye okusetshenziselwa emazulwini, futhi kusetshenziswa ngokuhlanganyela.

Telescope: "Isibonakude" – Isishibhala sokubonisa izinkanyezi kanye nokufunda izinto ezisemazulwini kakhulu, okwamanje ungasivumeli ukuzibonisa ezinye izithombe ezisemazulwini.

Universe: "Indawo yonke" – Konke okukhona emazulwini, izwe, nokuzulu ngemikhondo yalo.

Galaxy: "Umthala" – Inani yezinkanyezi, izinsimbi, nokuphakamisana kwazo, azilula isimo sezulu esiphezulu esiwunzima ukukhohliswa.

Exoplanets: "Izindawo ezindlela" – Izwe ezihlolakalayo ezizibonakala ezweni lokuphuma komoya okuyimisebenzi yezinkanyezi eziningi ezisemazulwini.

Delegates who took part in the inaugural National Space Conference.

South Africa's **'brilliant'** space future celebrated at inaugural **National Space Conference**

The inaugural South African National Space Conference (NSC) took place at the CSIR International Convention Centre in Pretoria from 30 August to 1 September 2023, with the theme "Space for Inclusive Growth". The conference is organised by the National Earth Observations and Space Secretariat (NEOSS) and the South African National Space Agency (SANSA), an initiative and entity of the Department of Science and Innovation (DSI), in collaboration with key national partners including the South African Air Force (SAAF). The conference gave South African stakeholders such as researchers, academics, public servants, business, data suppliers, consultants and NGOs a unique forum and opportunity to interact, share ideas and information, and spark discussions about how to work together most effectively to create a sustainable space ecosystem, programmes, and initiatives for national growth and development. In his welcoming address, Humbulani Mudau, CEO of SANSA, summarised the South African space science landscape. Read his full speech below.

Distinguished officials esteemed invited guests, ladies and gentlemen, and fellow space enthusiasts!

I extend a warm welcome to the National Space Conference 2023, a pivotal gathering that propels us toward a future of limitless possibilities. It is with immense pride and humility that I stand before you today, assuming the role of CEO for our nation's esteemed space agency. Together, we embark on a journey driven by a visionary purpose that kindles our spirits and binds us as one.

In acknowledging the distinguished legacy of South Africa in the realms of innovation and scientific attainment, I am confident that you share my conviction – that our nation has fostered exceptional engineers and scientists whose global contributions remain indelible. Yet, the complexity of the challenges before us calls for collective cooperation that transcends individual capabilities. These intricacies, both multifaceted and multifarious, stretch beyond the capacities of any singular entity present here today. It is incumbent upon us to engineer unity among

engineers, scientists, technologists, policymakers, and private enterprises. Through forging collaborative bonds across disciplines, we unlock the potential of cross-disciplinary ingenuity. This, in turn, lays the foundation for transformative solutions that steer our national space programme towards sustainable, resilient and globally competitive horizons.

Within the cosmic expanse, we not only encounter the vast universe but also glimpse our collective aspirations. Our agency's novel vision epitomises this aspiration – envisioning a South Africa surmounting its confines, propelled by innovation, accountability, and a profound dedication to service.

The tumultuous wake of COVID-19 has imparted an unwavering lesson – adaptability is key to crisis response, but more importantly, to a culture of perpetual evolution. We reside within a world characterised by volatility, uncertainty, complexity and ambiguity – a world we often term as VUCA. This landscape necessitates ceaseless learning, unlearning and relearning for relevance. As SANSA, we shoulder the imperative to evolve while innovating, directing our efforts towards purpose-fit programmes. These programmes fortify our nation's development, enhance service delivery, and bridge the gap between abundance and scarcity.

As the cusp of a new era beckons, leadership is defined not by authority but by service. Our foremost mission is clear – to serve our most vital constituency: the citizens of South Africa. Every stride we take, every choice we make, every resource we steward echoes our unwavering commitment to effect substantial change in their lives.

SANSA's new dawn

A new dawn rises at SANSA. Our trajectory is set to catalyse success across diverse avenues. With profound pride, boundless excitement, and unwavering commitment, our team diligently advances an ambitious endeavour. This endeavour unites physical infrastructure with state-of-the-art Big Data technologies. It takes root in strengthening our engineering capacity and capability to focus on technologically advanced mission development for forthcoming South African satellites, amplifying satellite communication capabilities, and crafting indigenous satellite navigation augmentation systems. These systems hold the promise of significantly heightening the accuracy of the global navigation satellite system within our nation and the broader region.

The recent completion of the cost-benefit analysis for the Space Infrastructure Hub underscores the hub's affirmative influence on the economy, job creation and various sectors. Enhanced planning, cost efficiency, and efficacy stand as outcomes, with the hub's revenues augmenting local governance.

Matjiesfontein, NASA, Artemis and Houwteq

The Matjiesfontein site, where the Deep Space Ground Station Network will be situated, is the location of our new quest to contribute to space exploration. This is a transformative alliance between SANSA and NASA, amplifying lunar exploration. The project spans a state-of-the-art communication facility pivotal to the Artemis missions and the rekindling of lunar human presence. This facility will also contribute to other deep space missions and forge new strategic partnerships. Surveys, ranging from topographical and geotechnical assessments to

radio frequency interference analysis, paved the way. The involvement of local people from Matjiesfontein in the geotechnical survey proved invaluable, fostering community engagement.

We launched the PanEOS antenna project in tandem with Roscosmos, which is vital for space debris monitoring – safeguarding our space assets and future manned space missions. The Agency will be focusing on building capacity in the areas of space situational awareness and space traffic management.

With the exciting Houwteq facility upgrade, SANSA Space Engineering elevates assembly, integration, and testing facilities at Houwteq, Western Cape, which will serve the satellite build programme. This strategic upgrade aligns with the National Space Strategy and national priorities of developing strategic infrastructure. Its core thrust ensures facility readiness for operational ventures. A harbinger of space industry development, the facilities inaugurate space business prospects.

Space Weather Centre

Hermanus is now home to Africa's lone Space Weather Regional Warning Centre, operational 24/7. A milestone marks eight trained operational Space Weather Forecasters, seven being young black women and one, a black male. This Centre fosters financial sustainability and business horizons, in line with supporting science diplomacy and internationalisation as outlined by the DSI.

Earth Observations (EO)

EO Products and Services synchronise with decision-making processes. The offerings span water resource management and the development of a national human settlement layer, contributing to disaster risk reduction, and food security.

Peering into the horizon, our focus intensifies – buttressed by government efforts in the District Development Model, grassroots innovation, and service delivery. These initiatives interface local community centres with Earth Observation visualisation platforms, building technological capacities at local levels to empower communities to use EO to develop relevant and impactful applications and business opportunities. EO will be focusing on and contributing to cross-cutting service areas such as the circular economy, green energy, blue economy, health innovation, security, and defence applications, as well as strengthening capacity in food security through precision agriculture, and disaster risk reduction through the development of early warning systems.

The new EO focus has shifted towards the development of Earth Intelligence (encompassing environmental, social and economic intelligence). There will be a huge focus on

new areas of growth and potential markets in economic sectors such as banking, insurance and mining to ensure the financial sustainability of the Agency.

Space science

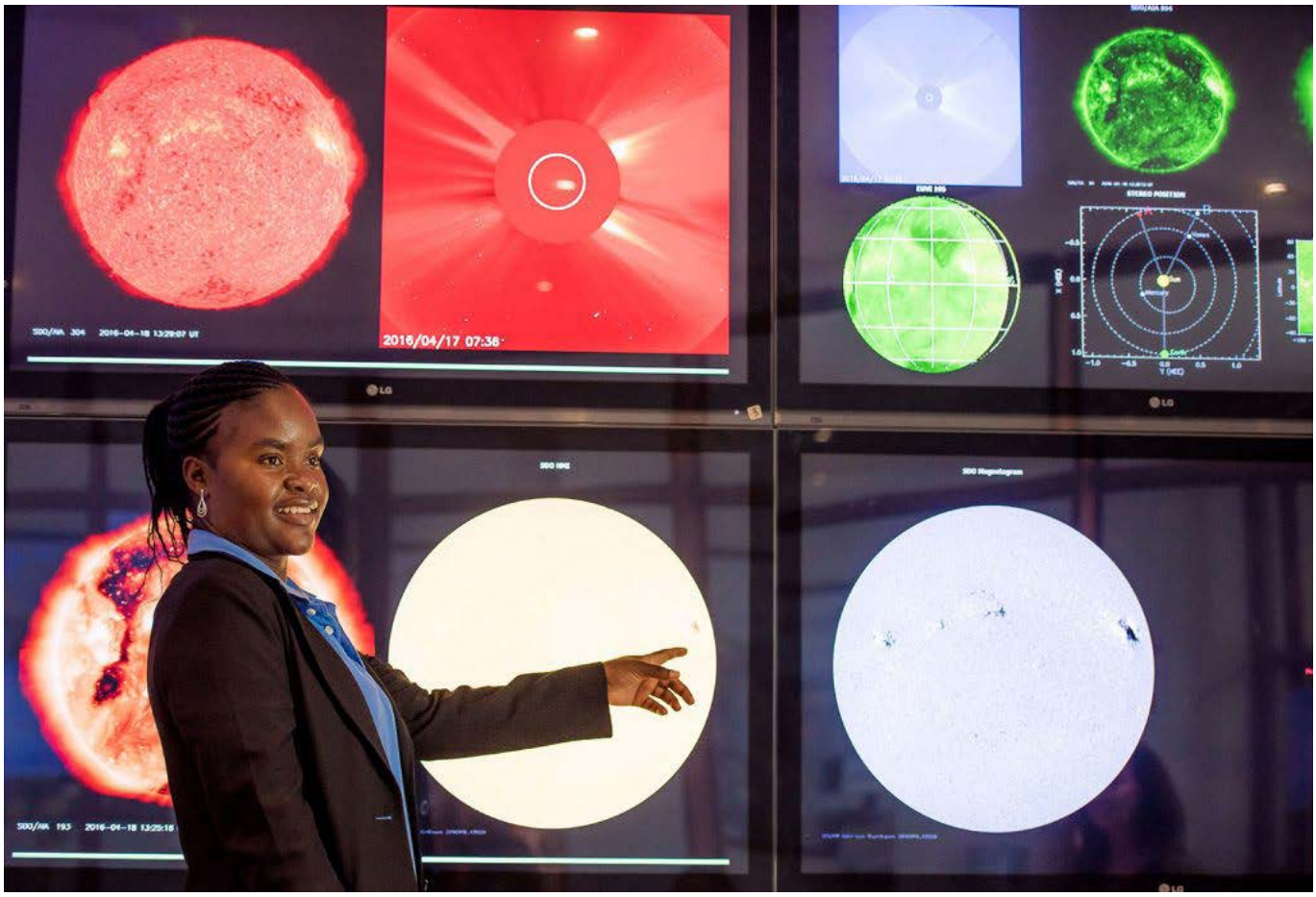
We are fortifying our Space Weather Capability with user requirements for future technology development and expanding our client and stakeholder base to ensure the financial sustainability of the Space Weather Centre. Other initiatives span the National Magnetic Standard development and expanded research in space sciences.

Space operations

The world evolves; the 'new normal' is VUCA. Innovation propels collaboration and partnerships in South Africa's space programmes, accentuating our role in space diplomacy and internationalisation. In responding to the new strategic focus emphasis, our geographic advantage can be used to attract global advanced space agencies and commercial companies to our sites to host facilities and generate revenue that will be re-invested to enhance the space programmes' capacities and capabilities, and ensure the financial stability of the Agency.

Space engineering – and a possible African space port

We have a mission design environment for space missions through our Concurrent Design Engineering Facility, and we are currently finalising a comprehensive Space



SANA

A photograph showing the monitors at the SANSA Space Weather Centre in Hermanus.

Acquisition Framework for the satellite build programme. Launch services and South Africa's launch capability revitalisation underscore industry growth.

We are gearing up to make bold moves, thus we contemplate building a spaceport – a potent testament to our capabilities: A facility that will serve the African region and the global space community. We believe that we have the capability to achieve this goal.

As SANSA, we recognise the taxpayers' trust and assume stewardship of their resources. Every programme, every satellite, and every scientific endeavour echoes our accountability. Our victories are the nation's victories!

In SANSA' new vision and the crafting of the Agency's Investment and Sustainability Strategy. Africa will be our main focus, as we plan to co-design and co-develop future satellite missions and space applications with a number of key and strategic partners in the region.

Innovation is a necessity propelling us forward. We foster a culture of intrapreneurship and entrepreneurship – empowering individuals to innovate and elevate productivity. This will be embedded in all SANSA's flagship initiatives.

Our vision is a shared commitment. Let us be history's participants, shaping it. We break barriers, explore horizons, and inspire future generations.

With that, I commit to leading the team in catalysing the space sector, by continuing to learn as we innovate.

As many of you are aware, we regrettably bid farewell to Dr Lee-Anne McKinnell just a few days ago. May her soul rest in peace. I see it as fitting to dedicate this conference to her, a remarkable individual who played an indelible role in advancing SANSA's mission. Please join me in giving her a resounding round of applause for the profound and far-reaching contributions she dedicated to our cause. May her legacy endure and inspire generations to come. Thank you for joining the National Space Conference. Let's aim for the stars; South Africa's space exploration future is brilliant!

To infinity and beyond!

Konferentshe ya mathomo ya Afrika Borwa ya Bosetšhaba ya Sebakabaka (NSC) e diregile ka Senthareng ya Dikopano ya Boditšhabatšhaba ya CSIR ka Pretoria go tloga ka la 30 Phato go fihla ka la 1 Lewedi 2023, ka morero wa "Sebaka sa Kgolo ye e Akaretšago Bohle". Polelo ya gagwe ya kamogelo, Humbulani Mudau, CEO ya SANSA, o akareditše sebopego sa mahlale a sebaka sa Afrika Borwa. Bala polelo ya gagwe ka botlalo mo.

Translated into Sesotho sa Leboa/Sepedi by Tebatso Isaac Makwala

From **stargazing in Ancient Africa** to the **James Webb Space Telescope era**

Travellingtelescope.co.uk

Staring up at the night sky has been a source of wonder and curiosity for countless generations. As civilisations evolved and technology improved, so did our understanding of the universe. We transitioned from ancient myths and legends about the constellations to sophisticated tools that allow us to peer deep into space. Astronomy, often hailed as the oldest of the sciences, is also one of the most international. The story of astronomy is as expansive as the universe itself, from observing the skies with our eyes to telescopes in our backyards to engineering marvels that push the limits of technology.

The invention of the telescope in the early 17th century revolutionised our understanding of the universe. Suddenly, those distant points of light became planets with moons, and far-off smudges transformed into nebulae and galaxies. For many, the experience of astronomy begins with a simple backyard telescope. These telescopes can bring the moon's craters into sharp focus, reveal the rings of Saturn, or even the bands on Jupiter. The joy of personally discovering these celestial sights often ignites a lifelong passion for the stars. As the centuries went on, the desire to see more led to bigger and more complex telescopes. Observatories were established around the world in locations chosen to minimise light pollution and atmospheric disturbances.

While the tales of celestial exploration span every continent, Africa has its own story that stands distinct, rooted in ancient traditions and bursting into the modern era with unprecedented collaborations and state-of-the-art facilities.

Africa: Ancient stargazing to international observatories

Long before telescopes were invented, African civilisations like the ancient Egyptians were mapping the stars, constructing pyramids aligned with celestial bodies, and charting lunar cycles. Fast forward to the 21st century, and Africa as well is home to some of the world's most advanced astronomical observatories. Africa's contribution to global astronomy is significant, with game-changing projects such as the Southern African Large Telescope (SALT), which remains the largest optical telescope in the Southern Hemisphere until the Extremely Large Telescope (ELT) in the Atacama Desert of northern Chile is completed. In an era when engineering marvels like the Large Synoptic Survey Telescope (LSST) promise to revolutionise our understanding of the universe, the South African Astronomical Observatory (SAAO) has introduced the Intelligent Observatory concept. By utilising advanced algorithms and artificial intelligence (AI), the SAAO envisions

webb.nasa.gov

JWST orbits the sun 1.5 million kilometers away from the Earth at L2 (Image not to scale).

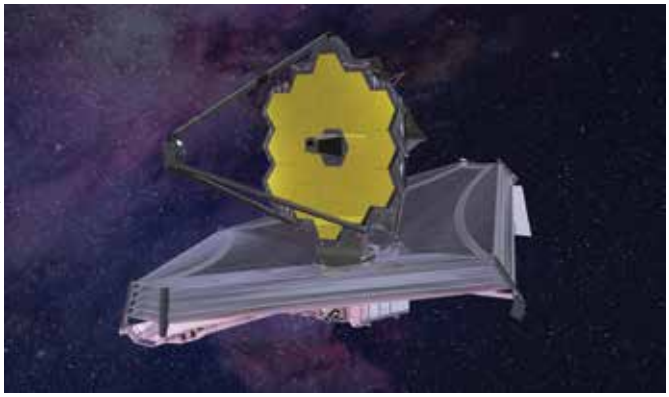
a future where observatories are smarter, more adaptive, and capable of conducting independent observations based on real-time cosmic events.

On the African continent, astronomy is also studied in other parts of the electromagnetic spectrum, including radio, gamma, and infrared. MeerKAT is located in the Northern Cape of South Africa; this radio telescope is among the world's most advanced, paving the way for deeper studies of the cosmos, with HERA (Hydrogen Epoch of Reionization Array) and HIRAX (Hydrogen Intensity and Real-time Analysis eXperiment) aiming to help us to understand the early universe, giving insights into the first billion years after the Big Bang. These projects are also being constructed in the Northern Cape. A next-generation radio observatory being developed in South Africa and Australia, the Square Kilometre Array Observatory (SKAO), will delve deep into cosmic mysteries, from understanding gravitational waves to tracking down the universe's elusive dark matter.

Africa's astronomical journey, from its ancient skygazers to its modern-day cutting-edge facilities, is a testament to its rich heritage and pivotal role in global astronomical exploration. It's a story of unity, being audacious, bridging gaps, and looking up to the stars with a shared vision and dream. As we continue to push the boundaries of understanding, Africa's astronomical contributions promise to illuminate our path with the support of organisations like the African Astronomical Society (AfAS).

Global collaboration of curiosity

AfAS is a professional body for astronomy on the African continent and aims to continue driving the continent's ambition in the ffield. ASAf works with the community in Africa and across the globe towards objectives that highlight the strength of collaboration and efforts to unite the continent through astronomy, forming global partnerships, and leveraging existing infrastructure.



NASA, ESA, CSA, Northrop Grumman

The James Webb Space Telescope (JWST).

Global projects continue to push the limits of what we can achieve. The 20th century saw the rise of space telescopes like the Hubble, which bypassed Earth's atmosphere entirely to capture clearer and more distant images of the universe. In continuing the quest for deeper knowledge and understanding, the James Webb Space Telescope (JWST) comes as a ground-breaking development. The JWST, launched on Christmas Day in 2021, is an international collaboration between NASA, the European Space Agency (ESA), and the Canadian Space Agency (CSA). JWST observes the universe in infrared; it promises to provide unparalleled views of the cosmos, shedding light on the formation of stars, galaxies, and even the conditions that might lead to life on exoplanets. Unlike the Hubble Space Telescope, which orbits the Earth, the JWST is positioned near the second Lagrange Point (L2), a stable gravitational point in space located 1.5 million kilometres from Earth. This unique position offers a stable observational platform and minimises interference from Earth's light and heat.

The advancements from backyard telescopes to ground-based observatories and to space observatories like the JWST represent humanity's insatiable curiosity. As technology continues to evolve, who knows what new frontiers we'll be able to explore next?

Astronomy is a testament to human determination and ingenuity. Our progress from squinting at the night sky with the naked eye to building big observatories like the James Webb Space Telescope, has been nothing short of remarkable. It's a journey that learners, enthusiasts, and scientists can appreciate, filled with wonder, discovery and inspiration. As we continue to gaze up and outwards, one can only imagine what new stories the universe is waiting to tell us.

Article written by Dr Charles Takalana, head of the secretariat of the African Astronomical Society (AfAS).

The #AfricaLookUp campaign

protecting our dark skies

The #AfricaLookUp campaign, spearheaded by the African Astronomical Society (AfAS) and the International Astronomical Union (IAU)'s local Outreach, Education and Development Committee, serves as the pioneering project leading up to Africa's historic first-ever IAU General Assembly. However, its significance transcends the assembly itself, leaving a lasting impact on the conservation of dark skies.

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At its core, the #AfricaLookUp campaign seeks to inspire individuals to actively engage with and appreciate the profound beauty and significance of the African night skies.

It calls upon people to move beyond mere casual observation and truly embrace the wonders they behold. This endeavour holds both literal and figurative meanings. Literally, it urges individuals to pause, gaze at the skies, and deeply appreciate its breathtaking beauty, fostering a heightened admiration and appreciation for the field of astronomy. Figuratively, it symbolises a broader call to actively seek and appreciate the extraordinary aspects of life, cultivating a mindset of wonder, curiosity, and appreciation for the richness that surrounds us.

The campaign aspires to instill a sense of hope and courage within individuals, encouraging them to look up and overcome the limitations and obstacles they may face.

By doing so, it aims to reshape the narrative surrounding Africa, as well as personal narratives, by fostering resilience, determination, and belief in a brighter future. By showcasing Africa's immense potential in astronomy and beyond, the campaign seeks to challenge prevailing misconceptions while inviting people worldwide to share their own encounters and experiences with astronomy on the continent.

Aligned with its objectives, the #AfricaLookUp campaign plays an integral role in advocating for the preservation of dark skies.

Dark skies, brighter discoveries

By inspiring people to gaze at and appreciate the night skies, the campaign emphasises the importance of safeguarding dark skies and reducing light pollution. The captivating beauty and significance of the African night skies serve as poignant reminders of the need to protect and cherish these natural resources. Through educational initiatives, awareness programmes during stargazing events, and engagement with Astronomy in Africa Ambassadors and diverse public groups, the campaign aims to highlight the value of preserving dark skies and encourages individuals to take action within their own communities.

To foster a sense of community and expression, the campaign incorporates various activities.

The "Sharing Astronomy in Africa Memories" initiative provides a platform for the public to share their cherished astronomical experiences through online media channels, fostering connection and a sense of belonging. Engaging with Astronomy in Africa Ambassadors, who inspire and educate others about the wonders of the night sky, plays a vital role in cultivating a deeper appreciation for astronomy throughout Africa.

Stargazing events are also organised to bring people together, offering educational sessions, guided sky tours, and interactive experiences suitable for participants of all ages and backgrounds. These events aim to cultivate a sense of wonder and to ignite a passion for astronomy within attendees. Furthermore, the Astrophotography and Arts Competition showcases astrophotography and artistic creations inspired by astronomy, providing a platform for participants to highlight the unique aspects of astronomy within their local African regions.

By showcasing Africa's diversity, cultural richness and abundance of opportunities, the #AfricaLookUp campaign endeavours to dismantle misconceptions and reshape the narrative surrounding the continent. It sheds light on Africa's vast potential in the field of astronomy and beyond. Through its advocacy for dark sky preservation, the campaign invites individuals worldwide to recognise and appreciate Africa's contributions to the global scientific community.

Now think to yourself, when was the last time you looked up at the night sky and fully immersed yourself in its exquisite magnificence and the marvel it holds? Next time you do, take pictures and videos of the skies and share on social media platforms using the hashtag #AfricaLookUp and let us all unite in the admiration of our shared skies and encourage more people to look up!

Article written by Duduzile Kubheka, the BRICS Astronomy Project Coordinator at the Southern African Astronomical Observatory (SAAO), also affiliated with the African Astronomical Society (AfAS).

A wide-angle artist's impression of what the SKA-Mid will look like upon completion, in the Karoo in the Northern Cape.

SKAO

Science in (Karoo) silence:

Breaking ground on the future of **ground-breaking space science**

In December 2022, the Square Kilometre Array Observatory (SKAO) officially commenced with the construction phase of both the SKA-Mid and SKA-Low telescopes on sites in the Karoo, South Africa, and located at Inyarrimanha Ilgari Bundara, in Western Australia. In this feature, we dish up the details on this vital step towards delivering the largest radio telescope in the world.

The concept of the Square Kilometre Array grew from the simple question: What size telescope would it take to allow us to read the universe's history as written in the language of its most abundant constituent, hydrogen?

What has become apparent is that a radio telescope of this design would also answer fundamental questions about our cosmic origins and hopefully will enable a whole host of discoveries in areas as diverse as new insights into the origins of the universe, the formation of planets similar to Earth, understanding why the expansion of the universe is accelerating and understanding how magnetism has shaped the universe.

To deliver a telescope of the required magnitude and capacity, the SKA radio telescopes have been conceptualised to use interferometry.

Radio interferometry is a powerful technique used in radio astronomy to enhance the resolution and sensitivity of observations. Instead of a single large radio telescope, it relies on an array of multiple radio telescopes spread over a wide area to work together as a single, virtual telescope with an effectively larger aperture (or diameter). This technique allows astronomers to obtain much more detailed and high-resolution sky images than possible with a single, large radio telescope.

Each radio telescope in the array simultaneously collects radio waves from the same region of the sky. The incoming radio waves are captured by the telescope's receiver, amplified, and then converted into digital signals, which are relayed to a correlator, which synchronises these signals by precisely accounting for the time it takes for the signals to reach each telescope from the observed object.

It effectively adds them together, creating what is known as an interference pattern or "interferogram". This pattern encodes information about the spatial distribution of radio emissions from the observed object.

Through the mathematical operation called the Fourier transform, the interference pattern from the time domain is converted into the spatial domain, resulting in a high-resolution image of the observed region of the sky.

Quiet skies

The decision was also taken to design two complementary telescopes across two sites. South Africa will host a mid-frequency instrument, scanning the sky for frequencies between 350 MHz and 15.4 GHz, while the SKA-Low telescope in Australia is designed for the 50-350 MHz frequency range.

The two sites have a few characteristics in common that are critical for radio astronomy. Radio telescopes must be located as far away as possible from human-made electronics or machines that emit radio waves, which could interfere with the ability of the telescopes to detect faint radio signals from the rest of the universe. This is called radio frequency interference (RFI) and is to radio astronomers what light pollution is to their optical counterparts. Both SKA telescopes are being built in nationally designated radio quiet zones, which help to protect the telescopes from as much environmental "noise" as possible. But it is virtually impossible to eliminate all RFI, so spectrum management through monitoring and mitigation measures are needed.

Practically, this means there are strict protocols in place to govern access, devices, equipment and vehicles on site. Much of the infrastructure required, as well as the components of the dishes themselves, emit electromagnetic waves. Dish components are rigorously tested and characterised to understand their RFI properties and to ensure that there are mitigating measures in places, such as shielding to ensure that the waves don't propagate through the system or escape outward.

More on Mid

The SKA-Mid site is located in the vast and arid landscape of the Northern Cape. Previously primarily agricultural land, the area has little radio-emitting infrastructure, is isolated from towns, and has natural features such as mountains and hills that help to further mitigate against RFI.

Located 90 km outside Carnarvon, the site has a core and three spiral arms extending outward. The SKA-precursor MeerKAT telescope, KAT-7, the Hydrogen Epoch of Reionization Array (HERA), and other instruments are already built and operational in the core. Another 80 SKA dishes will be constructed to create a dense core, and 53 more will be configured along the three spiral arms. The existing MeerKAT radio telescope will form part of the array, its 13.5 m-diameter dishes being joined by the slightly larger 15 m-diameter SKA dishes, all integrated into one system.

Even though much of the infrastructure is already in place – including a massive underground signal processing centre (Karoo Array Processing Building), dish and pedestal assembly sheds, roads, and an electrical substation – a lot more infrastructure is needed to construct and operate the additional 133 dishes. Given the vast distances from the core to the spiral arms, solar plants will be built to supply the most distant dishes with power.

While infrastructure construction is under way, the commissioning process, which tests that components work together as a system, is also in progress. Science verification will also begin while the telescopes are still under construction, carrying out end-to-end system tests based on proposals for astronomical observations from the SKAO user community.

The next big milestone is the completion of a four-dish array for SKA-Mid. This brings together the entire design for deployment on-site and is set to be completed in 2024. Construction completion of the full array and operation readiness are set for 2028.

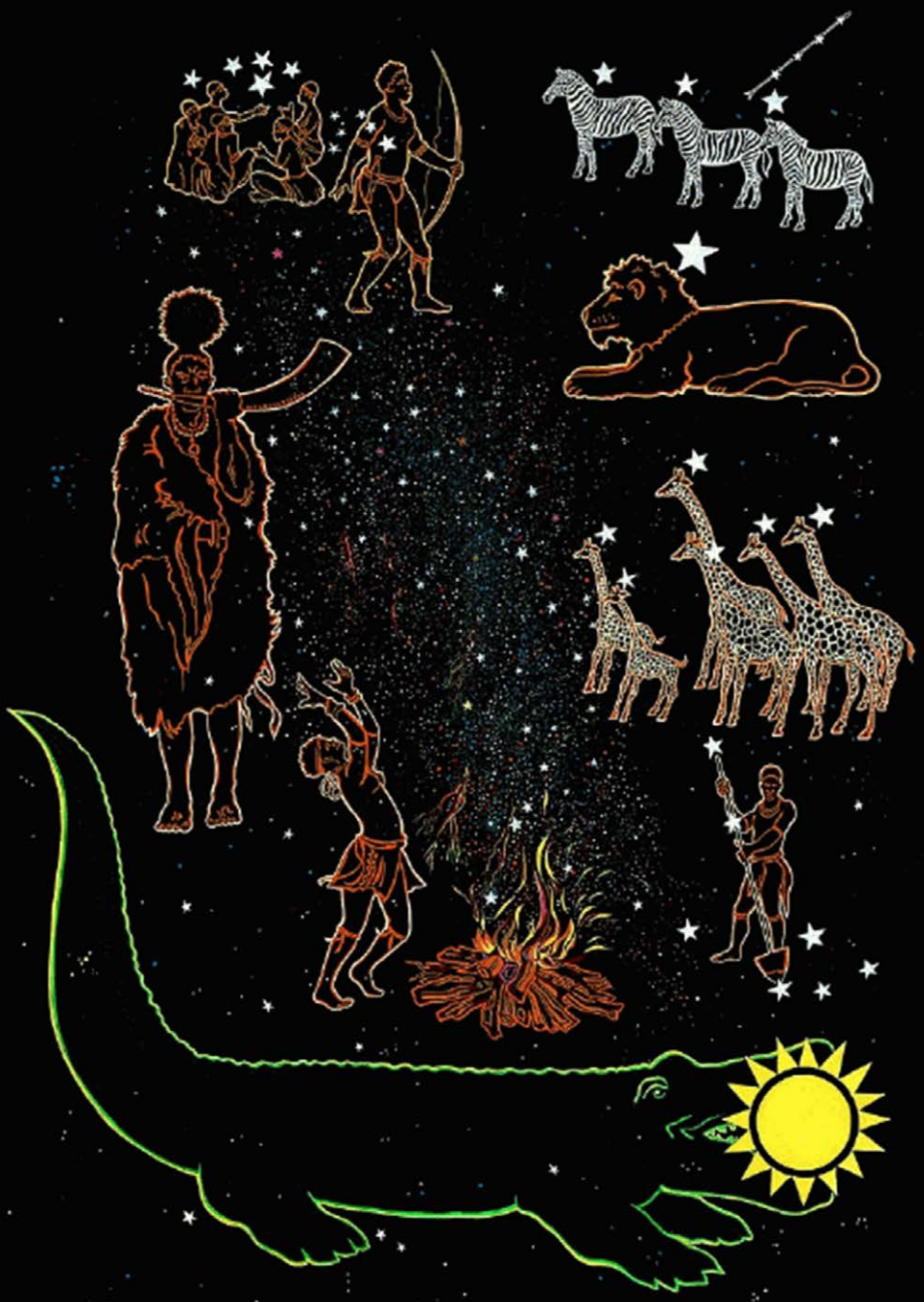
Article written by Alma Viviers, SKA-Mid Communications and Outreach Officer at the Square Kilometre Array Observatory (SKAO).

FAST FACTS

- The SKA-Mid will consist of 197 dishes. The current 64 MeerKAT dishes will be subsumed in the SKA-Mid array.
- The SKA-Mid telescope will observe at frequencies in the range of 350 MHz to 15.4 GHz.
- With 197 dishes, SKA-Mid will have a collecting area of 33,000 m^2 – equivalent to the area of 126 tennis courts.
- SKA-Mid dishes are fully-steerable, equipped with a drive system that can point them with an accuracy of 1/3600th of a degree.
- The whole dish structure stands over 22 m tall.
- The parabolic dish (or main reflector) is 15 m in diameter and comprises 66 individual panels.
- Once operational, the SKAO will archive 700 petabytes of data per year. This would fill the data storage capacity of about half a million typical laptops annually by today's standard.

Turning **stars** into **stories:**

the power of the naked eye to observe celestial objects



Many early African cultures saw pictures among the stars and created stories as they looked up at the night sky.

SAAO

Astronomy in Africa is a fascinating field that reflects the indigenous knowledge systems of various African cultures found in myths, poems and stories crafted by African people. Stories and myths surrounding African skies, the moon, sun and constellations, have been passed down from generation to generation. These mythical stories are known as star lore. Throughout history, indigenous astronomy played an essential role in sustaining the livelihood of African communities. Using their own natural astronomical instrument – the eye – African people developed their own astronomical knowledge based on the observation of stars, planets, the moon and the sun.

The earliest Africans had access to pollution-free, clear skies and naturally established a relationship with the skies, observing them frequently. The existence of ancient astronomy found expression in their daily and seasonal practices. It was a part of holistic living and related to their daily practices and cultural ceremonies. African people

would camp outside, where they made fires and watched the skies. They created narratives based on what they saw whilst looking up at the skies.

When observing the skies, they noted the star patterns visible in the sky. These patterns are referred to as "constellations", which are any group of stars as seen in the sky that seem to have a pattern or seem to form a picture. Some African cultures believed that the first person to see a star would have a prosperous year and good luck. Other African tribes had different interpretations of the stars. For example, the Tswana-speaking people regarded the stars as the spirits of the dead, associating their brightness with the earthly existence of a person. The Selemela, which is the most famous star cluster among the Tswana people, were regarded as signifiers of time to cultivate.

The stars also played an essential role for navigation purposes. When people travelled to new areas, they would be unable to use familiar landmarks and would therefore use the stars to navigate their journeys. When a star is viewed from a particular location, it always rises and sets in the same direction and follows the same path across the sky. They used this knowledge to make travelling and navigation easier. Africans also used the stars for the development of calendars, navigation, and the determination of time.

Other African societies arranged stones aligning the stars and the sun to mark seasons, to know when to harvest crops and to mark celebrations. Celestial bodies were a valuable source of information for those whose livelihood depended on properly timed planting, harvesting and hunting. They relied on the Pleiades stars which they used as guidance to know when it was time to till the soil and when the growing season was about to end.

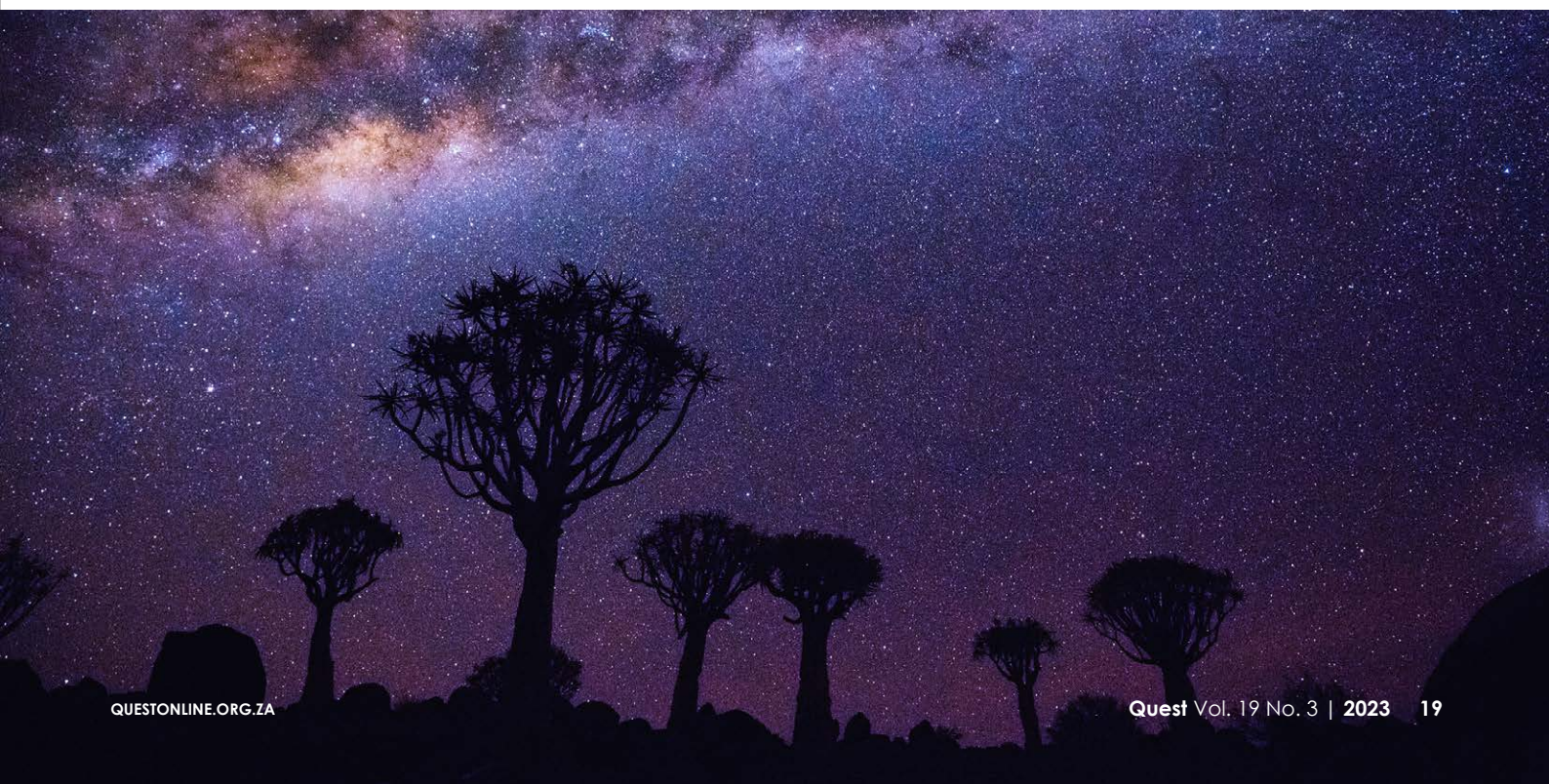
Fun fact: The Pleiades stars were all born at the same time from a gigantic cloud of gas and dust. Their position in the night sky changes from hour to hour and night to night due to the Earth's rotation.

The moon, being one of the most outstanding objects in the sky, also has some mythical stories associated with it. When observed closely, the moon has lighter and darker patches. The pattern formed by the patches has been interpreted differently by diverse peoples and cultures. Some people saw a rabbit, others saw a woman carrying a child, etc. African people also used the moon for celebratory events. For instance, the isiXhosa-speaking people perceived the time of a full moon to be a time of inaction and had rituals performed every month in connection with the new moon. When the moon reappeared as a crescent in the evening sky, it was a cause for celebration.

The Batswana believed that the new moon symbolises prosperity, happiness and that seeds sprout successfully when sown after the new moon. The Sotho-speaking people also practised a similar tradition where young babies were taken outside to perform rituals during the full moon.

Looking at our history and celestial heritage, it becomes clear the early Africans believed that everything happening in the sky reflected what happens on the Earth. We are connected to the universe, and the universe to us.

Article written by Zodwa Tiki, a science communicator affiliated with the African Astronomical Society (AfAS).



CAREERS FOCUS

Exploring careers in astronomy and space science

by Moleboge Lekoloane

If you want to become part of "Generation SPACE", have a look at some of the career paths that might be open to you in the South African space and astronomy spheres, as well as further abroad.

Astronomy has fascinated humanity for centuries. From ancient civilisations gazing at the stars to modern telescopes probing the cosmos, the field has evolved immensely, offering a myriad of exciting career opportunities for those intrigued by the mysteries of space. If you're a grade 10 student with a passion for stars, galaxies and the cosmos, read on to discover the diverse paths that a career in astronomy can lead you down.

The types of positions in astronomy are:

Astronomer: The traditional role of an astronomer involves observing celestial bodies, conducting research, and contributing to our understanding of the universe. Astronomers study various aspects, from the birth and death of stars to the evolution of galaxies and large-scale structures.

Astrophysicist: This field combines physics and astronomy to delve deep into the physical properties and interactions of celestial objects. Astrophysicists often work on understanding the fundamental forces that govern the behaviour of the universe.

Astrobiologist: If you're intrigued by the possibility of life beyond Earth, astrobiology might be your calling. Astrobiologists study extreme environments on Earth and explore the potential habitability of other planets and moons.

Space scientist/Researcher: Space scientists focus on understanding space phenomena, cosmic radiation and planetary environments. They also develop and analyse data from space missions.

Telescope operator/Engineer: Behind every remarkable astronomical discovery is a team of professionals maintaining and operating telescopes. These experts ensure that telescopes capture accurate and clear data from the cosmos.

So what qualifications are required?

Astronomy is a challenging field that requires a strong foundation in science, mathematics, and critical thinking. Here's a general outline of the qualifications you might need:

Education: A bachelor's degree in physics, astronomy, astrophysics, or a related field is the starting point. To advance in research or academia, a master's or PhD is usually required.

Strong mathematics background: Astronomy involves complex mathematical calculations and modelling. Proficiency in calculus, algebra, and geometry is essential.

Computer skills: Modern astronomy heavily relies on data analysis and computer simulations. Learning programming languages like Python can greatly enhance your capabilities.

Observational skills: Astronomers need patience and attention to detail for precise observations and data collection.

With these qualifications, astronomy graduates have a plethora of career avenues to explore, for instance in:

Research & academia: Many astronomers become researchers or professors, contributing to our understanding of the universe and educating future generations of scientists at institutions such as the South African Astronomical Observatory, South African Radio Astronomical Observatory, and the Square Kilometer Array Observatory.

Space agencies: Collaborate with organisations like the South African National Space Agency (SANSA) on space missions, data analysis, and technology development.

Planetariums & science museums: Share the wonders of astronomy with the public by working as educators, science communicators, or exhibit designers.

Private industry: Companies in the aerospace and technology sectors hire astronomers for research, data analysis, and development of innovative technologies.

Dragon spacecraft in orbit over the Earth.

SpaceX

Data science & analytics: The skills gained from analysing astronomical data are highly transferable to data science roles in various industries.

Policy, outreach and science diplomacy: Navigating the complex intersection of science, politics and international relations, careers in policy and science diplomacy offer unique opportunities to bridge the gap between scientific advancements and global decision-making. Professionals in these fields play a crucial role in shaping policies that are grounded in evidence-based research, fostering collaboration across borders, and addressing global challenges.

In conclusion, a career in astronomy can take you on an incredible journey through the mysteries of the universe. By pursuing the necessary qualifications and honing your passion for discovery, you could find yourself contributing to groundbreaking research, inspiring others, and uncovering the secrets of the cosmos. So, if the stars have ever ignited your curiosity, consider a career in astronomy to explore the universe in ways you've never imagined.

The BRICS Collaboration in Astronomy

by Moleboge Lekoloane

The BRICS countries, currently comprising Brazil, Russia, India, China and South Africa, have established themselves as key players on the global stage in various sectors. Beyond economics and politics, these nations have also recognised the significance of collaboration in scientific fields, including astronomy. The exploration of the universe's mysteries has become a unifying factor for the BRICS countries, fostering international cooperation and pushing the boundaries of our understanding of the cosmos.

As technological advancements have allowed us to peer deeper into space, the BRICS nations have risen to the challenge of collectively enhancing our comprehension of the universe. This collaboration is marked by the sharing of expertise, resources, and knowledge, resulting in both practical benefits and a symbolic representation of unity among diverse nations.

The BRICS Collaboration in Astronomy is particularly significant due to its potential to address global scientific challenges. Each member country brings unique strengths to the table. For instance, China has made remarkable advancements in astronomical exploration, showcased through achievements like lunar missions and the construction of the world's largest radio telescope, the Five-hundred-meter Aperture Spherical Radio Telescope (FAST).

Brazil, renowned for its well-established astrophysics tradition, has provided valuable insights into domains such as star formation and galactic structure. Russia brings extensive experience in space technology and research, augmenting the collaboration with additional layers of

expertise. Meanwhile, South Africa's astronomy sector has thrived, largely attributed to the iconic MeerKAT radio telescope. With a rich history of excellence in astronomy, robust high-tech infrastructure, and clear skies, South Africa is driven by a passion for multiwavelength astronomy.

At present, South Africa hosts the Southern African Large Telescope (SALT), a 10-metre optical telescope, the largest of its kind in the Southern Hemisphere. On a related note, India's Department of Science and Technology oversees the Indian Institute of Astrophysics—a lineage tracing back to the Madras Observatory, later known as the Kodaikanal Observatory. Established in 1971, the Indian Institute of Astrophysics operates as an autonomous research institution dedicated to the study of Astronomy, Astrophysics, and related areas of Physics.

The collective endeavours of these nations have led to the establishment of joint research projects, knowledge-sharing platforms and collaborative observatories. One such initiative is the BRICS Astronomy Working Group, which facilitates cooperation in areas like space exploration, satellite communication and astronomical research. This working group aims not only to advance scientific knowledge but also to promote education and public engagement in astronomy within the member countries.

An excellent example of the BRICS collaboration in action is the Thirty Meter Telescope (TMT) project, which involves countries from around the world, including some BRICS members. The TMT, a next-generation observatory, promises to provide unprecedented insights into the cosmos through its cutting-edge technology and vast mirror. The BRICS nations' involvement in such projects showcases their commitment to pushing the boundaries of human knowledge collectively.

Beyond advancing scientific understanding, the BRICS Collaboration in Astronomy has broader implications for international relations. By fostering cooperation in peaceful pursuits like space exploration, these nations build trust and goodwill, paving the way for smoother diplomatic relations. The joint pursuit of cosmic knowledge serves as a reminder that humanity's shared curiosity transcends political and cultural differences. Moreover, Collaboration in Astronomy can inspire the youth in these countries to pursue careers in science and technology, driving innovation and economic growth.

The cultural significance of the BRICS Collaboration in Astronomy cannot be overlooked. Astronomy has played a pivotal role in the cultural heritage of these nations, influencing their mythology, calendars and historical records. By engaging in collaborative astronomical projects, BRICS nations strengthen cultural ties and promote the sharing of knowledge across borders. Public engagement activities, such as stargazing events, planetarium shows and science festivals, contribute to the appreciation of astronomy's role in shaping human perspectives on the cosmos.

In conclusion, the BRICS Collaboration in Astronomy exemplifies the potential of international cooperation in advancing our understanding of the universe. By pooling their resources, expertise and knowledge, the member countries – Brazil, Russia, India, China and South Africa – are collectively pushing the boundaries of human knowledge and fostering goodwill among nations. The collaboration not only enhances our scientific understanding but also symbolises the power of unity in pursuit of peaceful endeavours. As the BRICS nations continue to explore the cosmic mysteries together, they demonstrate that the frontiers of space are not only about science but also about diplomacy, education and shared aspirations for a brighter future.

Three unique career journeys

by Alma Viviers

Here we delve into the unique stories of three individuals working at the Square Kilometre Array Observatory (SKAO), where you'll discover that the path to a fulfilling career in astronomy can be as diverse as the cosmic wonders they explore.

The journey of a Safety Officer: Malefa Maposa (SKA-Mid Safety Officer)

Inspired by a sense that the country was opening up to the world with the dawn of democracy, Malefa was drawn to a career in tourism from a young age. "I wanted to be both a tourist myself and work in tourism. I wanted to experience life beyond South Africa's borders, and a career in tourism would give me that opportunity."

Upon completing her matric, Malefa wasted no time and immediately enrolled in further studies. However, after completing her course, she struggled to find work opportunities. "Tourism was a popular field at the time and the market was flooded," she recalls. She started exploring other work avenues and got a one-year skill development learnership with the Department of Labour. The learnership included block release theory classes for three weeks, followed by three months of practical on-the-job training. The learnership gave Malefa exposure to various sectors within the department, including safety which piqued her interest.

She completed a National Diploma in Safety Management (Vaal University of Technology), a Certificate in Occupational Health and Safety Management System – Lead Auditor (North-West University) as well as certification in ISO 45001:2018 Occupational Health and Safety Management System (Nemalale Eagles

Consultancy) and OHS Act compliance training (Data Matrix).

"My work has taken me to diverse places and given me opportunities to meet different people and work with various organisations. Working in the Eskom Transmission Project Division, I got to interact with people across the stakeholder spectrum, from disadvantaged members of the communities to government officials, mayors and councilors."

Malefa joined the SKAO team in 2023 at the start of the construction phase and is stationed at Klerefontein, on-site in the Northern Cape as a safety officer. She is part of the Health, Safety and Environmental (HSE) team, which ensures that workplace conditions and practices adhere to safety regulations and standards, protecting employees and minimising risks. "The SKAO project is a unique project that focuses on the future of the universe, and the project must uphold the history of being executed in a safe, sustainable, and professional manner. The HSE Department has a big role in achieving this. As a safety officer, I take pride in being part of this team."

Looking ahead, she aims to register as a Construction Health and Safety Manager with the South African Council for the Project and Construction Management Professions and earn a master's degree in health and safety management.

The journey of a Systems Engineer: Vhuli Manukha (SKA-Mid Verification System Engineer)

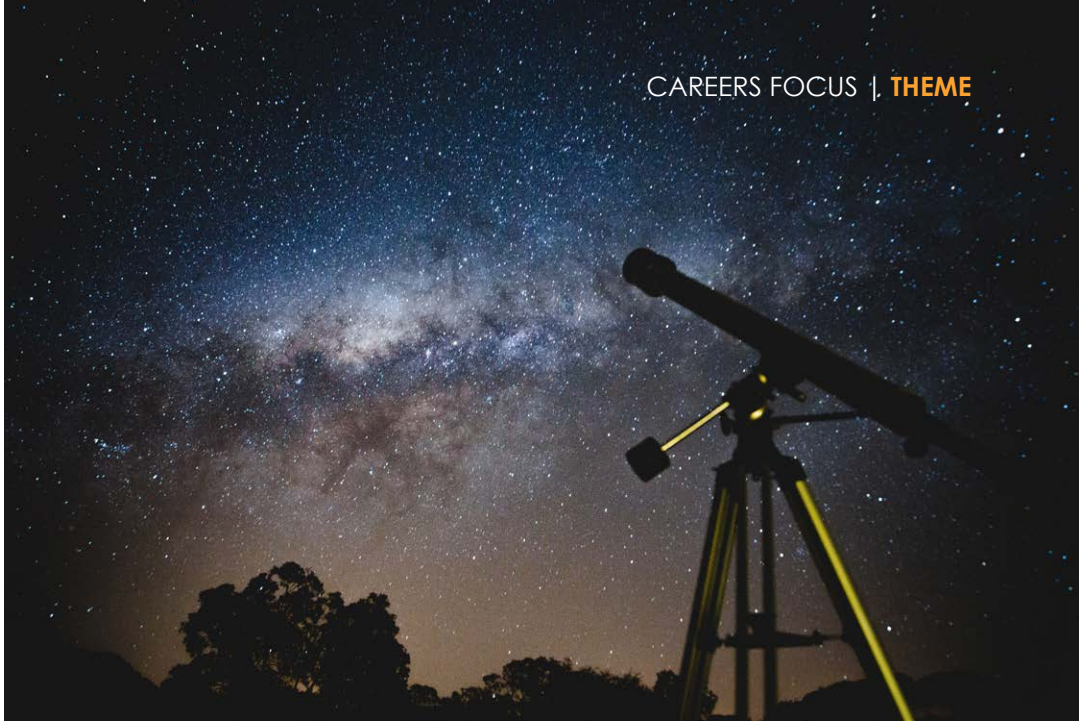
From a young age, Vhuli was fascinated by various scientific concepts, from climate change and meteorological events to understanding how telecommunications worked. "Growing up I really enjoyed learning because I was so curious about how stuff works, and I wanted to be an engineer because I believed that one day, I would develop something that could change the world," Vhuli recalls.

During high school, he participated in the Eskom Science Expo for young scientists competition. Their project on lightning resulted in an invitation to join students from the University of Venda's School of Environmental Studies, on a trip to Polokwane where scientists were using satellites to study the unique environment of southern Africa on a project called 'NASA goes on SAFARI'.

"There were thousands of people, including world leaders, distinguished scientists, and journalists gathered on the tarmac of Polokwane International Airport, right here in our country, and it was in that moment that I knew I wanted to pursue future studies," he says.

After completing his Bachelor of Technology in Electrical Engineering, Vhuli worked back his bursary in the Iron and steel manufacturing industry as a Control and Instrumentation Graduate Engineer, but his dreams of space science kept calling, and he pursued a BSc in Electronic Engineering to design and construct instruments that could help us study and understand our universe better.

From 2018 to 2019 he overwintered on Marion Island as a Very Low Frequency Radio Engineer, working for the South African National Space Agency (SANSA), during which he was also responsible for maintaining the University of KwaZulu-Natal Radio Telescope. The Square Kilometre Array sponsored the project to advance the research priority of astronomical antennas and receivers. "Working for SANSA ultimately led me to overwinter in Antarctica where, amongst others, I also maintained the system that forms part of the worldwide lightning network. Curiosity



led me to go to Antarctica. I wanted to witness first-hand all the phenomena I'd only heard about like sun patterns, aurora formation and extreme weather conditions," Vhuli remarks.

Now, as a SKA-Mid Verification System Engineer, Vhuli is living his dream: "I like the idea of being part of history in the making – constructing the largest radio telescope in the world. Our department is responsible for designing and implementing processes to ensure that the complex telescope components meet predefined requirements and function correctly, to ensure we deliver the instrument the scientists need."

The journey of a Computer Scientist: Khutšo Ngoasheng (Head of SKA-Mid Computing and Software)

Khutšo recalls being fascinated by space from as young as 10 years old and wanting to be a space scientist. At school, he enjoyed subjects such as maths and physical sciences. "I had this friend whose subject included Electric Trade Theory, and I would read his books. I realised that when I went to university, I wanted to study a discipline that combines all three of these subjects which for me meant Computer Science," he explains.

Besides knowing that he wanted to study, this was the 1990s, which saw significant investment in fledgling internet companies, and Khutšo had visions of becoming a dotcom billionaire.

But by 2001, when he started his first job, the dotcom bubble had just burst, and nine months later it was 9/11. "In that year alone, I worked for four companies without changing my seat. I found that writing software for a university project is worlds apart from developing multi-million, multi-year information systems. I became as obsessed with methodologies and risk management as I was with the technology," he recalls.

As he matured as a developer, he realised he wanted to understand the business context of the industry better. Experience had also ignited a sense that all the systems and software in the world cannot make up for poor management and leadership. "I wanted to be a different leader, and I enrolled in a Master of Business Administration from the University of the Witwatersrand," Khutšo says.

In 2014 he joined the South African Radio Astronomy Observatory (SARAO), where he led Science Processing (ingesting and synthesising telescope data to produce images and delivering science-quality data to the science community). Now he heads up Computing and Software for SKA-Mid as part of the Square Kilometre Array Observatory (SKAO): "Initially, I imagined the job would be an extension of my previous role with SARAO, but it's not. The scale of the SKAO makes every piece of the job, every decision, so much more thoughtful."

Besides official recognition and meeting dignitaries such as President Cyril Ramaphosa and President Xi Jinping, highlights of his work include not only the achievement of standing among the metal forest of telescopes that is the MeerKAT, knowing he contributed to it, but also working with ambitious and talented people.

"I would like to be here when SKA-1 is delivered. It'd be a twenty-year full-time journey for me, and I can't imagine spending that time anywhere else! Dr Bernie Fanaroff sold this project as having Nobel Prize potential. He'd better be right because I am here for it!"

These three profiles exemplify the diverse career paths you can follow in astronomy. Whether through safety management, engineering or computer science, these individuals have found their own ways to contribute to humanity's quest for understanding the cosmos.

Moleboge Lekoloane is a BRICS Astronomy Communication Officer at the South African Astronomical Observatory (SAAO) and Alma Viviers is SKA-Mid Communications and Outreach Officer at the Square Kilometer Array Organisation (SKAO).

Ge o nyaka go ba karolo ya "Generation SPACE", lebelela tše dingwe tša ditsela tša mošomo tšeo di ka go buletšwego mafapheng a sebaka le thuto ya dinaledi tša Afrika Borwa, gammogo le go ya pele dinageng tša ka ntle.

Translated into Sesotho sa Leboa/Sepedi by Tebatso Isaac Makwala

Win a trip to visit the SKA site!

Explainer Video Challenge

OUR RADIANT UNIVERSE

Are you fascinated by the mysteries of space and the secrets it holds?

If so, we invite you to participate in our Radio Astronomy Explainer Video Competition! This competition is an opportunity for you to showcase your passion for science and space exploration while helping others understand the fascinating field of radio astronomy in a creative and engaging way.

How do radio waves turn into images of stars, galaxies, and quasars? Are radio telescopes tuning into alien radio stations or extraterrestrial communication? Radio astronomy is a fascinating field, but it is also prone to misconceptions, just like any other area of science. For example, people often think that radio telescopes detect sound waves or that radio waves are like the radio signals we use for communication, that can be "heard". This competition challenges you to get to grips with the basics of radio astronomy and to demonstrate your understanding by developing a compelling explainer video of no more than 10 minutes.

With limited time, you can decide whether you want to do an overview of the basic concepts of radio astronomy such as electromagnetic spectrum, radio waves, frequencies, and radio frequency interference, or you can home in on the process of transforming radio telescope observations into images through a process known as radio interferometry and data processing. Alternatively, you can focus on the telescope as an instrument, explaining the various components of the telescope.

SKAO

How to Enter

Making video content requires a variety of skills including research, writing, conceptualizing content and visuals, filming and presenting. Therefore, we want to encourage collaboration and teamwork. Schools can enter more than one team.

Step 1: Get your team together. Think about people who can bring different skills to the project. Team size is limited to a maximum of 7 participants and 1 supervising teacher.
Step 2: Your teacher needs to register the team here: https://forms.gle/fsawivJwBnxA2Rog9 or scan the QR code to enter.

The deadline for registration is:
30 October 2023.

Step 3: Once your teacher has registered your team, they will receive a submission form that needs to be completed and uploaded with your final video to the link provided.
Step 4: Make your explainer video.
Step 5: Submit your entry by uploading the submission form and video to the link provided. The deadline for submission is 30 November 2023.

Judging Criteria

Scientific Accuracy (50%):

- How well does the video explain the basic concepts of radio astronomy?
- Is the information presented scientifically accurate and up to date?
- Does the video demonstrate a clear understanding of the subject matter?

Clarity and Communication (20%):

- Is the content explained in a clear and understandable manner?
- Does the video use appropriate terminology and avoid jargon or complex language that may confuse the audience?
- Is the narration or text delivery articulate and engaging?

Creativity and Engagement (20%):

- Does the video creatively engage the viewer, making the topic interesting and captivating?
- Are visual aids, animations, or demonstrations used effectively to enhance engagement?
- Does it stand out in terms of creativity and original content?

Production Quality (10%):

- Is the video well-produced, with good audio and video quality?
- Are visuals and graphics clear, visually appealing, and relevant?
- Does the video have smooth transitions and editing?

The Prize

Your team, along with your supervising teacher, stand a chance to win a trip to visit the site where the SKAO – the world's largest radio telescope consisting of thousands of dishes – will be constructed in the MeerKAT National Park, Northern Cape, South Africa.

This once-in-a-lifetime opportunity gives you the opportunity to travel to this remote site. You will explore the operational KAT-7, MeerKAT and HERA telescopes as well as the first prototype of the SKA telescope.

For queries regarding the competition, or if you need assistance with the registration process, please send an email to alma.viviers@skao.int

Pointers for Creating a Great Explainer Video

- **Script:** Write a well-structured script that flows logically. Practise your narration to ensure a confident delivery. The general rule of thumb is to work with 2 words per second. For a 10-minute video, that means a script of approximately 600 words.
- **Clarity:** Use plain language to explain key concepts clearly and concisely.
- **Treatment:** There are different styles of video treatment for explainers. You can do a visual presentation with a voiceover in PowerPoint, or you can be front and centre as the presenter. You can show practical demonstrations or animations, present it like a newsreader or work with a cast of people.
- **Production:** There are a few different ways to record your video. You can use a phone or video camera or try the record function of video conferencing programmes such as Zoom. With PowerPoint you can record your voice while showing the presentation.
- **Engagement:** Use storytelling, visuals or demonstrations to keep the viewer's interest.
- **Citations:** Remember to give credit where it is due. If you use external sources, be sure to provide proper citations for any information or images you include.

Terms and Conditions

The competition is open to all high school learners residing in South Africa.
Videos must be the original work of the participants.
If you use content from a third-party, participants are required to obtain any necessary permissions or rights.
Participants retain the copyright to their videos but grant the competition organisers a non-exclusive, royalty-free licence to use and share the videos for promotional and educational purposes.
The decisions of the judges are final and binding in all matters related to this competition. No correspondence or appeals will be entertained.
The prize will include transport from participants' school to Carnavon, including airport transfers and flights, if required, as well as ground transport to and from the SKAO site. The prize will include accommodation for two nights. All meals will be provided.
The prize does not include a stipend, gratuities, medical insurance or expenses incurred during the course of the trip, telephone calls, laundry services and other incidental costs. The prize cannot be converted to cash.
The dates to take up the prize are non-negotiable and if participants are unavailable to travel, they will forfeit the prize during these dates.
Winners will be notified via email or telephone.
The organisers will collect participants' personal information including, but not limited to, your name, likeness, email address, picture and participation in editorial, marketing, and reporting activities. By entering this competition, you consent to the organisers collecting and storing your personal information for the purposes of the competition and associated activities, including, but not limited to, in websites, social media, other media coverage, blogs, photographs and videos.

The power of solid-state lasers:

A new way of exploring nature

An powerful laser setup used for research in a laboratory.

Lasers, in general, have become a household term in today's world. From barcode scanners to fibre-optic communications, lasers are everywhere. One of the most powerful types of lasers is the diode-pumped solid-state laser. With the ability to deliver a high-power beam in a small and compact form factor, these lasers have found a home in various applications, including nature. In this article, we will explore the power of solid-state lasers and how they are used in nature to unlock secrets that were once hidden from us.

Solid-state lasers are, in essence, lasers that use a solid gain medium instead of a gas or liquid. The gain medium is usually a crystal or glass doped with a rare-earth element such as neodymium, ytterbium or erbium. When an external energy source, such as a flash lamp or diode, is applied to the gain medium, it emits photons of light that bounce back and forth between two mirrors at each end of the laser cavity. This process stimulates the emission of more photons, creating a powerful, highly coherent, concentrated beam of light – a laser.

So, how do we harness the power of solid-state lasers to understand the natural world better?
Let us dive into a few examples.

LiDAR – illuminating forests

One application of solid-state lasers in nature is the study of forests. Forests play a vital role in the health of our planet and are home to millions of species. Researchers use LiDAR, which stands for Light Detection and Ranging, to better understand these ecosystems. LiDAR works by sending out a laser pulse and measuring the time it takes for the reflected light to return to the sensor. By analysing the returned signal, researchers can create a three-dimensional map of the forest canopy, which provides valuable information about its structure, composition, and biodiversity.

Solid-state lasers are ideal for LiDAR applications because of their high power and precision. They can penetrate dense vegetation, providing accurate canopy height and structure measurements. Furthermore, lasers emit light in the near-infrared region, which is absorbed by chlorophyll and other pigments present in vegetation. This absorption allows researchers to determine the health and vitality of the forest, identifying areas that need protection or restoration.

Making waves

Another application of solid-state lasers in nature is in the study of ocean currents. The ocean is a complex

and dynamic system, and understanding its movement is essential to predict weather patterns, marine life and the impact of climate change. To study ocean currents, researchers use a technique called oceanographic LiDAR, which works similarly to forest LiDAR.

Oceanographic LiDAR emits a laser beam into the water, and the reflected signal is measured to determine the distance between the water's surface and the bottom. This information, combined with the speed of the ship, allows researchers to measure the ocean's current speed and direction. Solid-state lasers can also be used to analyse the water's chemistry and the presence of pollutants or harmful algal blooms.

Atmospheric analysis

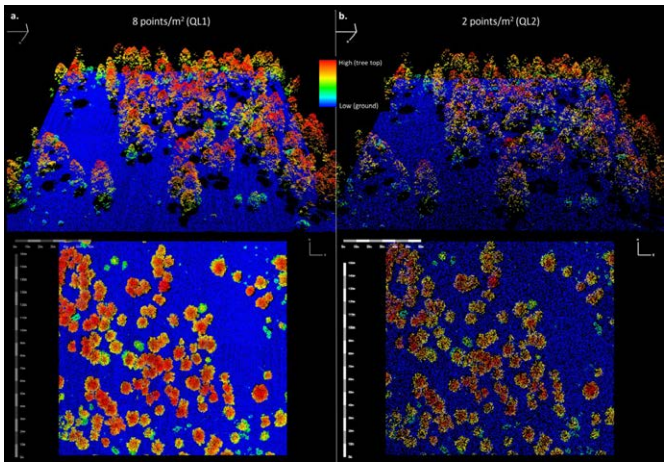
Solid-state lasers also play a crucial role in atmospheric research. The atmosphere is a complex system, and changes in its composition can have a significant impact on the planet's climate and weather patterns. One application of solid-state lasers in atmospheric research is in the measurement of greenhouse gases such as carbon dioxide and methane.

To measure these gases, researchers use a technique called differential absorption LiDAR, which sends out two laser beams of different wavelengths. The first beam passes through the atmosphere, and some of the light is absorbed by greenhouse gases. The second beam, with a slightly different wavelength, also passes through the atmosphere but is not absorbed by the gases. By comparing the two signals, researchers can determine the concentration of greenhouse gases present in the atmosphere.

Satellites, exoplanets and rovers

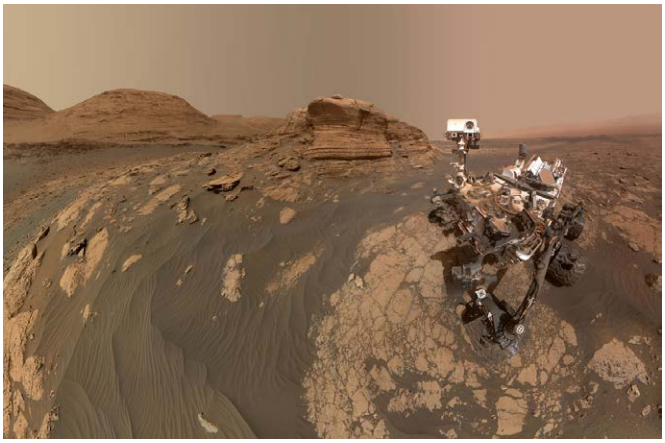
Solid-state lasers are also used for satellite technology, and also have applications in space exploration. Solid-state lasers are used in space missions to explore other planets and asteroids. For example, NASA's Mars rover, *Curiosity*, is equipped with a solid-state laser that is used to vaporise rocks and soil on the planet's surface. The vaporised material is then analysed to determine the composition of the Martian soil.

Another example of solid-state laser technology in space exploration is in the detection of exoplanets. Researchers use a technique called transit spectroscopy to detect the presence of exoplanets. Transit spectroscopy works by measuring the changes in a star's brightness as an exoplanet passes in front of it. Solid-state lasers are used to measure the precise timing of the transit, which can be used to determine the size and composition of the exoplanet.



Zhuofing Wu, USGS

An example of LiDAR point clouds of a forest.



NASA/JPL-Caltech/MSSS

NASA's *Curiosity* Mars rover uses a laser to vaoprise rocks on the Martian surface, to study what they are made of.

In conclusion, solid-state lasers are a powerful tool for understanding the natural world and exploring the universe. Their high power, precision and compact form factor make them ideal for a wide range of applications, from LiDAR and oceanography to atmospheric research and satellite technology. As technology continues to advance, we can expect to see even more applications of solid-state lasers in nature and beyond.

Article written by Dr Lebohang Teboho Bell, a physicist and senior researcher in the manufacturing cluster at the Council for Scientific and Industrial Research (CSIR).

Di-laser, ka kakaretšo, di fetogile lereo la ka gae lefaseng la lehono. Go tloga go di- scanner tša barcode go ya go dikgokagano tša faeba ya optic, di-laser di gohle. Sehlogong se, re tla hlahloba maatla a di-laser tša solidstate le kamoo di šomišwago ka gona tlhagong go notlolla diphiri tšeo di kilego tša re utega.

Translated into Sesotho sa Leboa/Sepedi by Tebatso Isaac Makwala

AFRICA'S BIG DREAM:

Making our own vaccines

Imagine if Africa could make most of its own vaccines. We wouldn't have to rely on other countries to protect us from diseases. We could respond faster to health emergencies like the COVID-19 pandemic and be better prepared to tackle the next one. We could even create more jobs and boost our economy. Sounds like a dream, right? Well, it's a dream that could become a reality very soon.

Right now, Africa imports over 99% of its vaccines. That's a major problem because it means we're heavily dependent on other countries and their supply chains. If something goes wrong and the supply is disrupted, we're ultimately left in a tough spot! This vulnerability became all too real in the wake of the COVID-19 pandemic. That's why the African Union and Africa Centres for Disease Control and Prevention have set a lofty goal that, by 2040, 60% of the vaccines used in Africa is to be made by Africa.

So, how do we plan to make this happen? One key strategy is to create what's called Contract Development and Manufacturing Organisations (CDMOs) across Africa. These are advanced factories that are staffed with skilled personnel equipped with specialised infrastructure that can handle everything from the early development of a new vaccine all the way to making it on a large scale.

They're not tied down by their own products, so they can focus on helping local developers make their vaccines. With the help of our government, one of these CDMOs is currently being built in Pretoria, South Africa, by the Council for Scientific and Industrial Research (CSIR), where we work. This kind of facility can help spark local innovation, reduce our dependence on foreign manufacturers, and attract investment in local production capabilities. The facility can also train young Africans to make vaccines.

Getting the rules right

For CDMOs and the goal of making our own vaccines to succeed, we need to have the right rules and regulations in place across the continent. Right now, our rules in Africa are a bit of a jigsaw puzzle, with different pieces for each country. This can create barriers and make it difficult to

work together. The proposed African Medicines Agency (AMA) could help make these rules more consistent across the continent, making it easier for the vaccine industry to operate and flourish. We also need to make sure our rules are flexible and appropriate for each stage of drug development. For example, in the US, the rules for making new drugs for early-stage clinical trials are a bit more relaxed, while the rules for the latter stages are stricter. A similar approach could work well in Africa, helping us to achieve our vision while keeping safety a top priority.

In conclusion, whilst the journey towards making our own vaccines is a complex one, it's a journey we now must embark on. The creation of African CDMOs can stimulate the growth of other industries like supply chain and support services, further contributing towards capacity development and job creation, but it's not just about creating CDMOs. It's also about strengthening our healthcare systems, making our rules more consistent, investing in research and development, learning new skills and creating new employment and career opportunities. The COVID-19 pandemic has shown us how important this is. It's time for us to seize this moment, transform Africa's health landscape, and make sure we're ready for the continent's future health emergencies. Africa's Big Dream of making her own vaccines isn't just a dream – it's becoming an urgent reality for the continent's sustenance and wellbeing.

Article written by Tsepo Tsekoa, Maabo Moralo, Priyen Pillay and Rachel Chikwamba of the Council for Scientific and Industrial Research (CSIR), jointly working to develop biomanufacturing technologies for vaccines, biotherapeutics and diagnostic reagents.

Nagana ge Afrika e be e ka itirela bontši bja meento ya yona. Re be re ka se swanelwe ke go ithekga ka dinaga tše dingwe gore di re šireletše malwetšing. Re ka arabela ka lebelo go maemo a tšhoganetšo a maphelo a go swana le leuba la COVID-19 gomme ra ikemišetša gakaone go rarolla le le latelago. Re ka ba ra hlola mešomo ye mentši le go godiša ekonomi ya rena. Go kwagala bjalo ka toro, akere? Go lokile, ke toro yeo e ka bago ya kgonthe kgauswinyane kudu.

Translated into Sesotho sa Leboa/Sepedi by Tebatso Isaac Makwala

Breaking barriers, blooming strength:

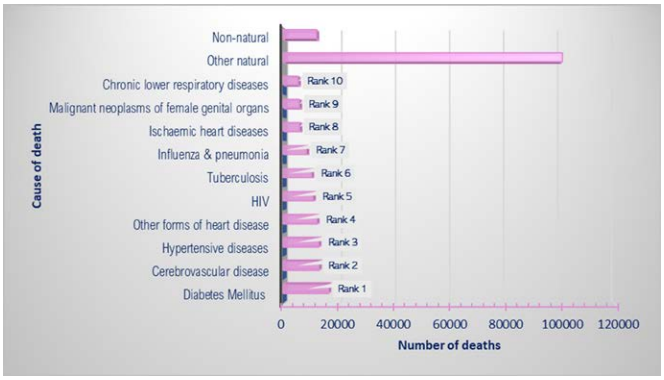
Towards women's health empowerment

Although 'women's health' may is a seemingly simple notion, it covers a wide variety of chronic and other issues that impact how women grow, age and reproduce, how illnesses in women progress and how treatment is received. The importance of painful and chronic disorders related to menstrual health has largely gone unnoticed, becoming an issue that calls for greater attention and support – to help break barriers and to empower women in the pursuit of better health.

The burden of chronic health conditions among women

The reproductive system and biological traits specific to women are given global research attention. It is therefore not unexpected that most South African conversations on women's health follow a similar trajectory, with a particular focus on HIV/AIDS and reproductive health. However, the growing importance of painful and chronic disorders related to menstrual health issues has largely gone unnoticed. Moreover, it has recently been reported that diabetes mellitus was the leading underlying cause of death among females in South Africa, followed by cerebrovascular and hypertensive conditions (Figure 1).

Figure 1: The ten leading underlying causes of death among females (all ages) in South Africa



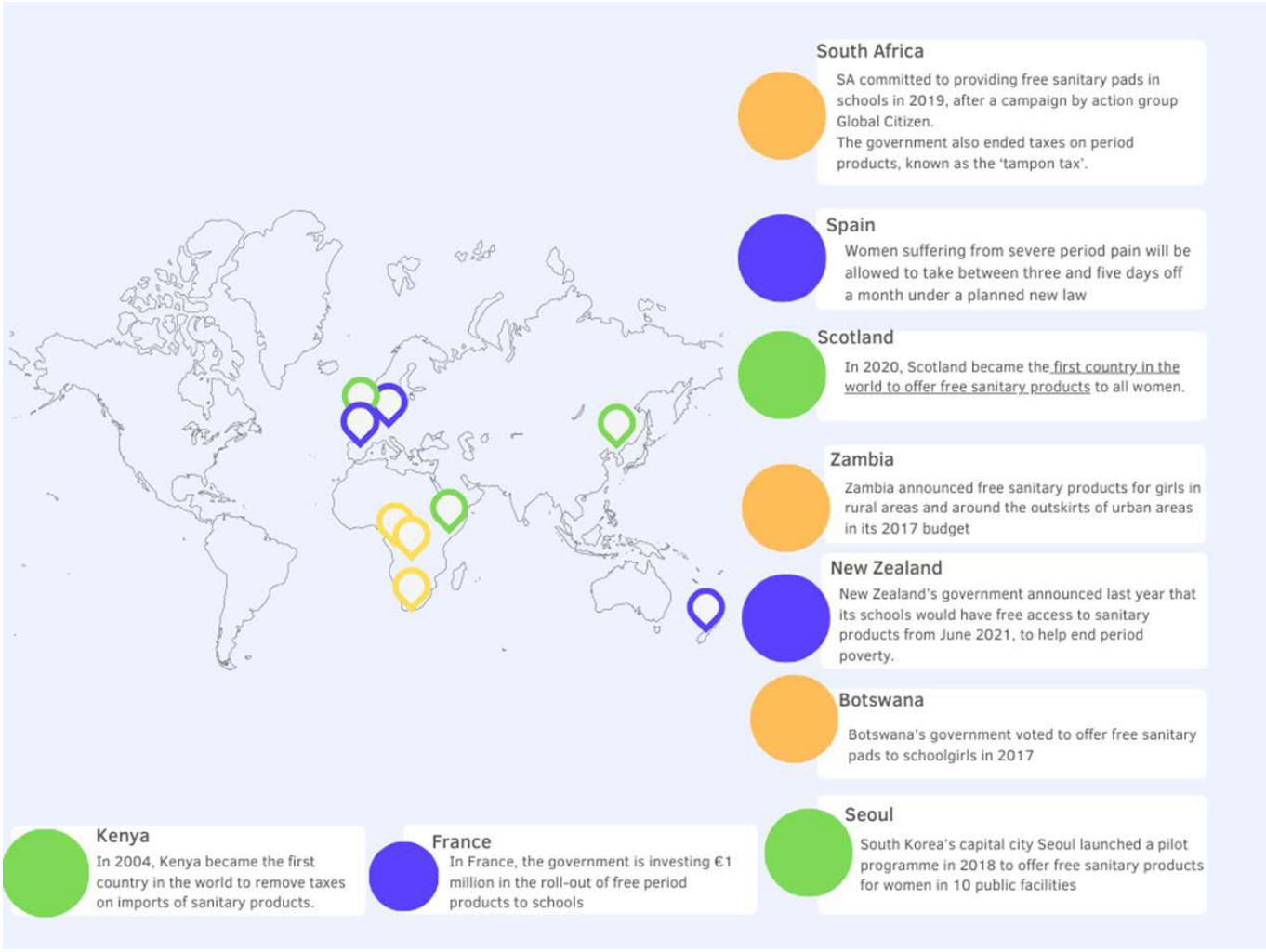
The data used in the graph was sourced from Statistics South Africa (Stats SA) 2022 (Report 03-00-18). Data can be found at *https://www.statssa.gov.za/publications/03-00-18/03-00-182022.pdf*.

These conditions and related illnesses considerably increase the burden of illness and disability. Failing to address these issues creates inequities that persist and widen across research agendas, employment prospects, facility access and healthcare delivery. The burden of chronic and menstrual health conditions among women is a pressing issue that calls for greater attention and support – paving the way for breaking of barriers and empowerment of women in the pursuit for better women's health.

Stigma and taboos associated with women's health

Women generally feel embarrassed to deal with menstrual and related health issues due to the stigma associated with women's health conditions. This is evident in the stress, fear and despair in most patients, which can

Figure 2: Government actions and pledges toward period poverty. The data used in the graph was sourced from the *World Economic Forum*, 2022 (09/06/2022)



The data can be accessed from https://www.weforum.org/reports/global-gender-gap-report-2022.

result in delayed diagnosis, a decrease in the desire for medical intervention, accelerated development of illnesses and delays in medical treatment. This can generally be attributed to deeply ingrained cultural stigmas or taboos where young women are taught to conceal tampons, avoid conversations about menstruation, use code words to discuss their periods and suppress reproductive system effects to shield themselves from observation or criticism. According to one study, community members' discriminatory beliefs, for example presumptions around promiscuity, infidelity or HIV status, were observed as barriers to women's advancement.

Factors other than societal taboos and stigmas also contribute to inequities in women's health. Medical 'gaslighting' is growing more prevalent – doctors frequently judge women who seek treatment for menstrual or reproductive illnesses as being weak or reject their pain symptoms as 'just a bad period'. This negatively impacts women seeking healthcare and makes them anxious, self-conscious and afraid to communicate openly with healthcare providers about health problems. Addressing these stigmas and taboos is essential to foster an environment of understanding and openness.

Menstrual health hygiene

Menstrual health and hygiene are largely influenced by women's personal knowledge, preferences, cultural taboos, societal stigmas and the availability of resources and infrastructure. However, there is an alarming lack of information among young girls about menstrual product options and period symptoms that necessitate medical treatment, and secrecy and shame connected with menstruation-related topics in communities and broader society. This is a problem that must be urgently solved as menstrual hygiene issues are invariably made worse by a lack of such fundamental information. More investigation is required; however, it is known that limited knowledge of menstruation affects women's comprehension of their own reproductive physiology and, consequently, of health and illness related to the reproductive tract. Researchers have also examined the health effects of menstrual hygiene management practices, including the link between poor menstrual hygiene and genital infections.

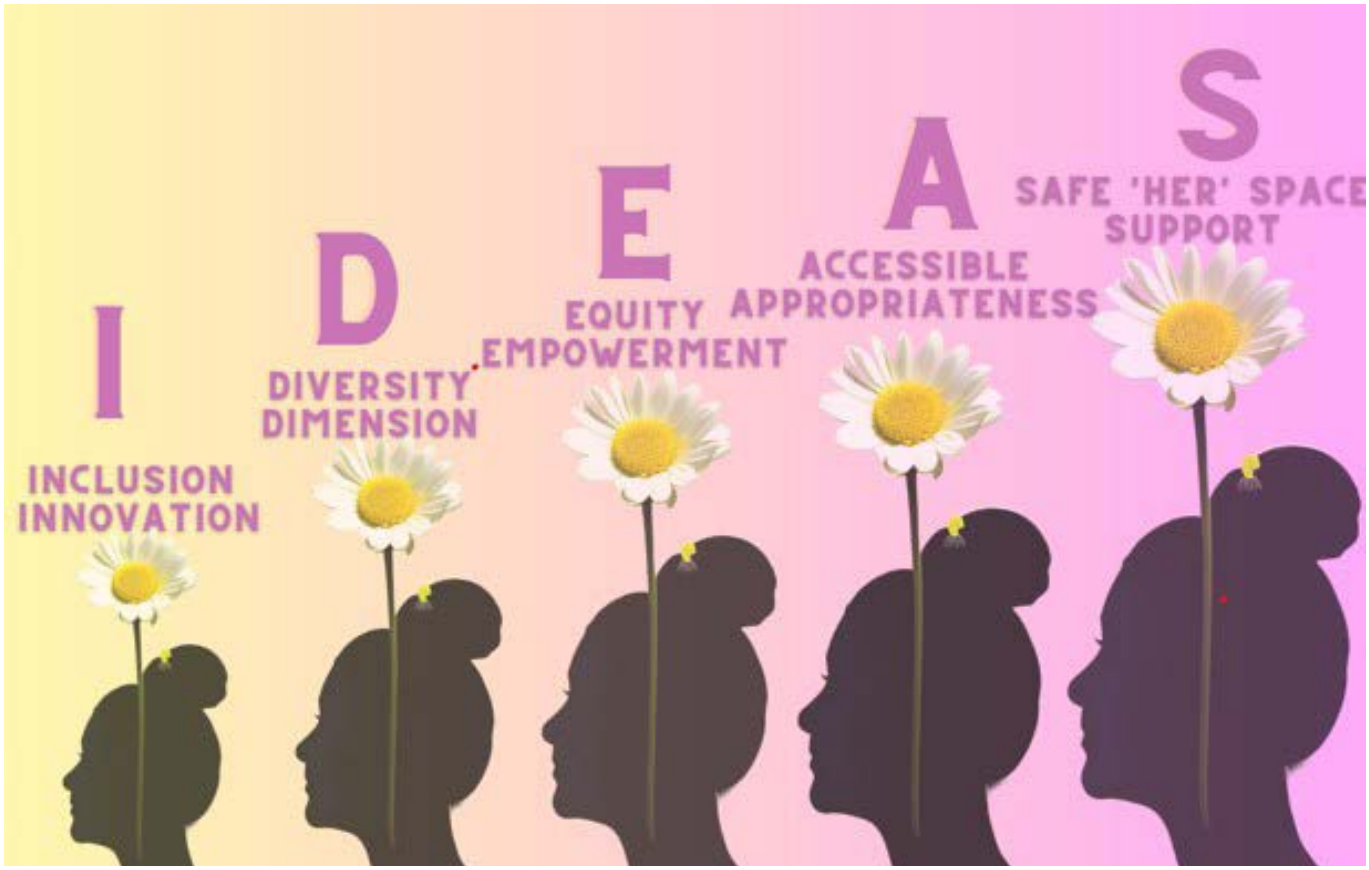
Unwarranted societal norms continue to cast menstruation in a negative light as unclean and impure, encouraging the concealment of menstrual blood. The commodification of menstrual products has also allowed modern industries to 'play up' the embarrassment of menstruation through negative advertising tactics that portray menstruation as 'public staining', with the need to hide or mask menstrual odour. Society has unknowingly played a significant role in shaping how young girls and women view menstruation, and we need to start changing our attitudes, perceptions and messages on this critical topic. Improving access to menstrual hygiene products through cost-effective, sustainable and convenient solutions is an important first step. This must be supported by education and community engagement, addressing taboos and cultural stigmas, while providing accurate information on menstrual health and hygiene. While governments have made some efforts in improving access to menstrual health products, major gaps in access, resources and education remain unresolved (Figure 2).

Reproductive health outcomes

With the prevalence of infertility, more and more women are turning to assisted reproductive technologies, such as in vitro fertilisation (IVF), for fertility therapy. While corporate policies generally accommodate maternity leave, paternity leave and leave for miscarriage, similar provisions do not exist for women undergoing reproductive therapy. IVF cycles necessitate several outpatient appointments for transvaginal sonographs and blood hormone tests, as well as procedural visits (oocyte harvesting, cyst drainage, and embryo transfer), which result in an average of 8 to 10 days away from work. According to reports, IVF-related absenteeism has caused social estrangement, job harassment and subpar performance evaluations. Addressing knowledge among employers and employees regarding fertility treatments and creating safe spaces at work for women undergoing fertility treatments are two ways to address this dilemma.

Debilitating women's health conditions

Painful diseases related to menstruation are frequently discounted and stigmatised within society, among the medical community and in the workplace. Conditions such as endometriosis, which has a global diagnostic delay of 7 to 10 years, can be partially attributed to women's perception of menstrual pain as normal due to societal attitudes, the fear of seeking medical attention or medical gaslighting. This not only causes the disease to progress, but also has a detrimental impact on fertility and significantly lowers quality of life, with many patients being forced to quit their jobs due to the incapacitating nature of this disease. The provision of support structures, workplace policies and educational interventions is thus essential to address the contributing causes of diagnostic delay and to better accommodate women living with such incapacitating diseases. Confronting debilitating women's health conditions requires a multifaceted approach, underlining the significance of research, advocacy and support networks to continue the momentum for women's health empowerment.



The need for safe spaces

The need for safe 'her' spaces is evident as we strive for women's health empowerment, to allow open dialogue, non-judgemental environments and inclusivity to thrive. The establishment of safe spaces has received a lot of attention in the context of mental health. It has obvious positive impacts, and in many situations, has become integral in modern life. It is therefore unfortunate that the area is under-prioritised in the context of women's health, with no safe places established for women to seek treatment in light of the discrepancies in access to women's health services, the stigmas associated with women's health concerns and challenges of gender equality in healthcare. Safe places in the workplace and community, as well as education, offer a respite from taboos, judgement and unsolicited opinions. Such spaces foster an atmosphere where women may openly discuss women's health and feel valued while also receiving reliable health information, benefiting both women's health and mental wellness. These settings also raise awareness of important problems and unmet needs of women in many contexts, which can then be addressed by legislation, activists and academic research.

Women's health innovations

Intentional and genuine measures are needed to drive innovative ideas into actionable steps. However, targeting women's health issues should not be the sole strategy and should be coupled with broader women's empowerment initiatives. More funding and research support should be directed towards researchers working in the field of women's health innovations, including entrepreneurial support to translate research into medical reality. There must also be concerted effort to identify the barriers at the different levels of access to increase the number of researchers in this field, including collaboration to foster a future mindset and skillset that can address women's health innovations today and for the future. For example, merging the dialogue of family planning with screening in women's and men's health would allow both male and female scientists to become more engaged in this field to stimulate innovation, leading to sustainable developments in screening, diagnosis and treatment. Innovation in the development of self-screening home kits could result in better access and facilitate medical consultations.

In a world where women have historically faced obstacles and disparities in healthcare, it is imperative that we collectively champion the cause of women's health empowerment. Breaking barriers within the realm of women's health is not only a matter of justice and equality, but also a crucial factor in fostering healthier societies as a whole.

This article serves as a catalyst for continued advocacy, for policy changes that uplift women's health, and for fostering a culture that respects and prioritises the well-being of women in all spheres of life, work and healthcare. The time to act is now, for a world where women's health is no longer a challenge but a celebration of Innovation, Inclusion, Diversity, Dimension, Equity, Economical Empowerment, Accessibility, Appropriateness, ongoing Support and the availability of Safe 'her' spaces (IDEAS).

Article written by Fatima Kathrada, a pharmacist, women's health advocate and researcher from the Department of Pharmacy and Pharmacology, School of Therapeutic Sciences, University of the Witwatersrand, and Prof. Thashree Marimuthu, associate professor in pharmaceutical chemistry and researcher in the Wits Advanced Drug Delivery Platform (WADDP) research unit, co-chair of the South African Young Academy of Science (SAYAS) and an Organization for Women in Science for the Developing World (OWSD) member.

Le ge e le gore 'bophelo bja basadi' bo ka bonagala e le kgopolo ye bonolo, bo akaretša mehuta ye mentši ya ditaba tše di sa folego le tše dingwe tšeo di amago ka fao basadi ba golago, ba tšofalago le go tswala, ka fao malwetši go basadi a tšwelago pele ka gona le ka fao kalafo e amogelwago ka gona. Bohlokwa bja malwetši a bohloko le a sa folego ao a amanago le ditaba tša maphelo a go hlapa ga basadi kudu bo ile bja se lemogwe, bja fetoga taba yeo e nyakago šedi le thekgo ye kgolo – go thuša go roba mapheko le go matlafatša basadi go phegelela maphelo a mabotse.

Translated into Sesotho sa Leboa/Sepedi by Tebatso Isaac Makwala

Brilliants Programme winner ready to join

GENERATION SPACE

Matimba Manganyi, who is studying for his BSc degree in Astronomy and Astrophysics at the University of the Witwatersrand in Johannesburg, is one of the National Science and Technology Forum (NSTF)'s 2023 Brilliants Programme winning students. Who better to profile for our "Generation SPACE" edition? Read on to find out why Matimba decided to choose this cosmic career path.

Tell us a bit about yourself. Who are you? What inspires you?

I was raised in Mabopane, Pretoria, in Gauteng and I went to Patrick Moloto Primary School and Letlotlo Secondary School, both of which are located in Mabopane, and I am now studying towards a BSc in Astronomy and Astrophysics at Wits University, Johannesburg. I am a quiet person, I don't speak much. I like reading many books about maths and science. I've read many books about physics, astrophysics and mathematics written by famous scientists like Neil deGrasse Tyson and the late professor Stephen Hawking and Carl Sagan before even coming to university. I am dedicated to my studies and I am inspired by how the universe works and how we can establish laws about physical systems and use those laws to improve our lives and find better and more convenient ways to solve the problems that we have.

Why did you choose the course you are studying?

I want to learn about the physics of the universe, I want to know how everything that we see around us came into being, how does the sun remain bright and shining every day whilst a wood fire can only burn for a few hours, I want to know how all the atoms in our bodies were made though fusion in the cores of earlier generations of stars, I want to understand the reasons behind the periodic motion of the moon and its phases as well as the motion of the Earth on its orbit around the sun due to gravity. I also want to be one of the scientists that will do research in the field of astrophysics to advance our understanding of the universe.

Where do you see yourself 10 years from now?

In 10 years from now I see myself as an astrophysicist doing my own research in stellar astrophysics, which is about the birth, life and death of stars, and I will be doing research in

the big bang theory and I hope to be employed in one of the observatories in South Africa such as the SKA and the SALT to do my research at. I also see myself as an award recipient for the NSTF Awards and one of the best scientists on the continent and with international recognition for my research in astrophysics and mathematics.

Why do you enjoy science and maths?

I enjoy science and maths because of the different methods of solutions that the pair offer us for every day problems like figuring out the best way to make a product that will ensure a maximum profit for a business in maths, and I also enjoy working through the complexity of the theories and problems that we come across in maths and science and I enjoy learning about nature and the way that things around us work, like the energy changes that happen when two vehicles collide and how to improve the safety inside vehicles during a collision.

Tell us a bit about your school and your teachers?

Letlotlo Secondary School in Mabopane looks like an average school just like any other but it is where I discovered my potential, it is where I made friends that I will remember for a very long time in my life and it is where I got the help that I needed from my teachers in my subjects whenever I was struggling. I had excellent teachers that were always around at school every day including on weekends during which we received extra lessons in the various subjects that we did at school.

Why do you think some people have problems doing well in maths and science?

Maths and science are not easy, they require time and dedication to study and practise in order to gain a good understanding of the concepts. Some people may not put in enough time studying maths and science which leads to a poor understanding of the concepts and it can make it very difficult to understand or answer questions based on those concepts.

What advice do you have for school learners who struggle with these subjects?

Give yourself time studying and practising because some concepts take time to learn and understand, so keep on working and studying towards understanding the concepts. Ask for help from your teachers, they are there to help you to learn the content in the subjects. Give yourself time to rest and make sure to have enough sleep every day so that your mind can be in its optimum state after waking up every day and don't give up.

Any tips for learners in grades 11 and 12?

Study and practise every day if you want to achieve good grades, even if you are tired just use about 10-15 minutes answering just a single question and I assure you that it will be beneficial. Use question papers from past years to practice and ask for help if you cannot understand or answer questions. Use the examination guidelines given to you or download them from the Department of Basic Education's website or just look them up on Google and download them to look at what you are supposed to know, define, understand and what you will be expected to answer, because the exams are based on what is in the examination guidelines; the exam will not include content that is not in the exam guidelines. Always focus and listen in class because you don't have much time to learn all these concepts and you cannot waste your time in class playing and then use more of your time to read through the same information that you could have just learned right away in class. Set goals for yourself that you want to achieve and work towards those goals every day. Take care of yourself, have regular exercise, try to eat balanced meals as much as possible, don't let the social aspect of your life suffer because of your studies, remember to spend time with friends and family to not let your mental health suffer and make sure to get enough sleep every day. Believe in yourself that you can achieve your goals.

What advice do you have for matriculants who have to apply for places in higher education institutions?

Do research to find out what qualifications are available to study what you like at which higher education institution, set goals for yourself to not only meet but to surpass the minimum requirements for that qualification to improve your chances of getting accepted, apply early and apply to NSFAS if you qualify and apply to as many bursaries and institutions as you can because you don't know whether the bursary that you apply for will accept you and fund your studies or not and you also don't know whether the institution you apply for will accept you for what you apply for or not.

What makes an achiever?

An achiever is not a person who knows everything from the beginning. An achiever is someone who fails at things, time and time again, but he/she uses what he/she has learned from failing to improve and become better and they don't give up when they encounter something that is challenging. An achiever is someone who knows his/her priorities, they wouldn't choose to waste time playing with friends, for example, instead of doing his work. This does not include the time that you set for yourself to say that 'I am going to spend time with friends and take care of the social aspect of my wellbeing.' An achiever is someone who doesn't look down on others just because they are better than them at something, but helps people to understand and improve where they can. Finally, an achiever is someone who never stops fighting for success no matter the hardships that they face. They stare straight into the face of uncertainty and difficulty, knowing what their goals are and what they are going to achieve. I believe that is a good definition of an achiever.

A message to South African youth in general?

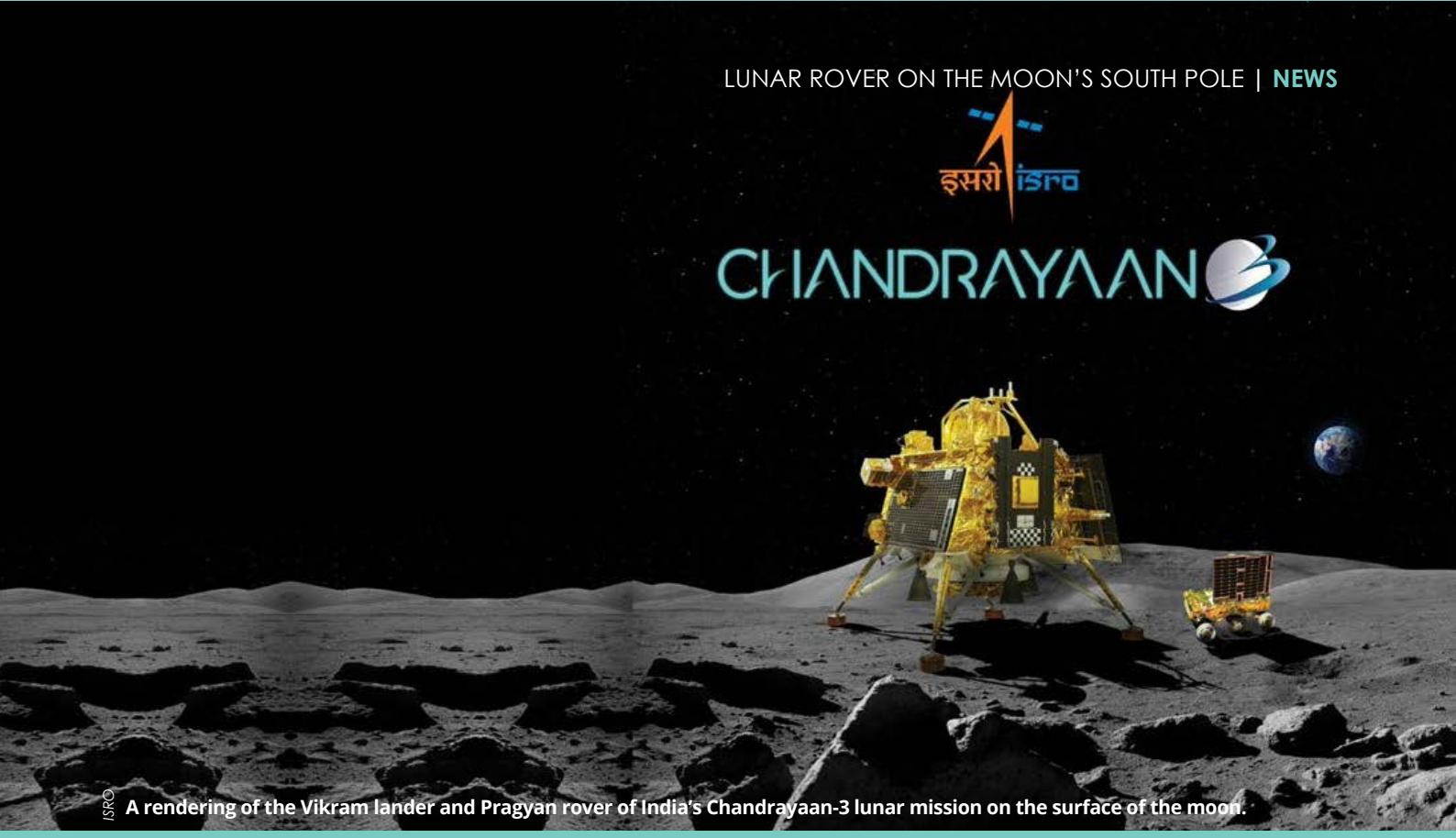
Many of the youth don't see it, but our education system is built in a way such that if you excel or if you pass well, you will be very likely to receive funding from NSFAS or another bursary to study whatever you like at a public tertiary institution of your choice, provided that the institution has accepted you. Many of the youth in South Africa don't give themselves time to try to find out their talents and more about their interests because it is difficult to climb up the ladder of what they like toward success. I want to tell you that you have your own unique talent; follow that talent and your interests and become successful. It is not easy, considering all the distractions that the South African youth face in modern times but you have to try to better yourself to the best of your ability. You can do this.

If you had one opportunity to speak directly to a very influential person, who would you choose and what would you say to them?

I would choose to speak to Neil deGrasse Tyson. I would tell him that I first discovered astrophysics through his television shows and I would tell him that he inspired me to want to work with maths and physics just like him and to become an astrophysicist. I would also ask him what inspired him to become an astrophysicist and a science communicator.

Matimba Manganyi, yo a ithutelago BSc-degree ya gagwe ya Thutadinaledi le Fisiki ya Dinaledi Yunibesithing ya Witwatersrand ka Johannesburg, ke yo mongwe wa baithuti bao ba thopilego Lenaneo la Bosetšhaba la Mahlale le Theknolotši (NSTF)'s 2023 Brilliants Program. Ke mang yo mokaone go profil bakeng sa kgatišo ya rena ya "Generation SPACE"? Bala mo go hwetša gore ke ka lebaka la eng Manganyi a tšere sephetho sa go kgetha tsela ye ya mošomo wa cosmic.

Translated into Sesotho sa Leboa/Sepedi by Tebatso Isaac Makwala



ISRO A rendering of the Vikram lander and Pragyan rover of India's Chandrayaan-3 lunar mission on the surface of the moon.

India puts lunar rover on the moon's south pole – a historic first

On 24 August 2023, India became only the fourth nation to land a spacecraft on the moon, and the first in history to land on the unexplored south pole of the moon. The Indian population and the Indian Prime Minister Narendra Modi cheered on as the Chandrayaan-3 lunar mission completed a long-awaited soft landing on the lunar surface – livestreamed and watched by millions more across the globe – an achievement well worthy of celebration.

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"It is a matter of pride and a pat on the back for Indian scientists," Modi said at the BRICS summit in Johannesburg shortly after the historic landing, according to Reuters.

The successful landing, already hailed as one of India's greatest scientific achievements, came only days after the Russian Luna-25 moon mission failed, crashing onto the lunar surface.

"The Ch-3 Rover ramped down from the Lander and India took a walk on the moon!" the Indian Space Research Organisation (ISRO) said in a post on X, formerly Twitter.

ISRO chief S. Somanath said the "Pragyan" rover has several instruments to conduct experiments on the moon, including element and chemical composition of the lunar dust and rocks.

All of the previous spacecraft to have landed on the moon have landed in the region near the equator, according to *The Indian Express*, because it is easier and safer there. The polar regions of the moon lie in a completely dark region without sunlight, and temperatures can go below 230 degrees Celsius. This creates difficulties with the operation of instruments. In addition, there are large craters all over the place. As a result, the polar regions of the moon have

have remained largely unexplored until now. But the extremely cold temperatures could also mean that anything trapped in the region would remain frozen in time, without undergoing much change, and so the rocks and soil at the moon's south pole could provide clues to the early solar system.

The achievement is all the more laudable in light of the fact that an earlier Indian mission, Chandrayaan-2, also planned to land in this region in 2019, but it was not able to accomplish a soft landing and lost contact after it hit the surface.

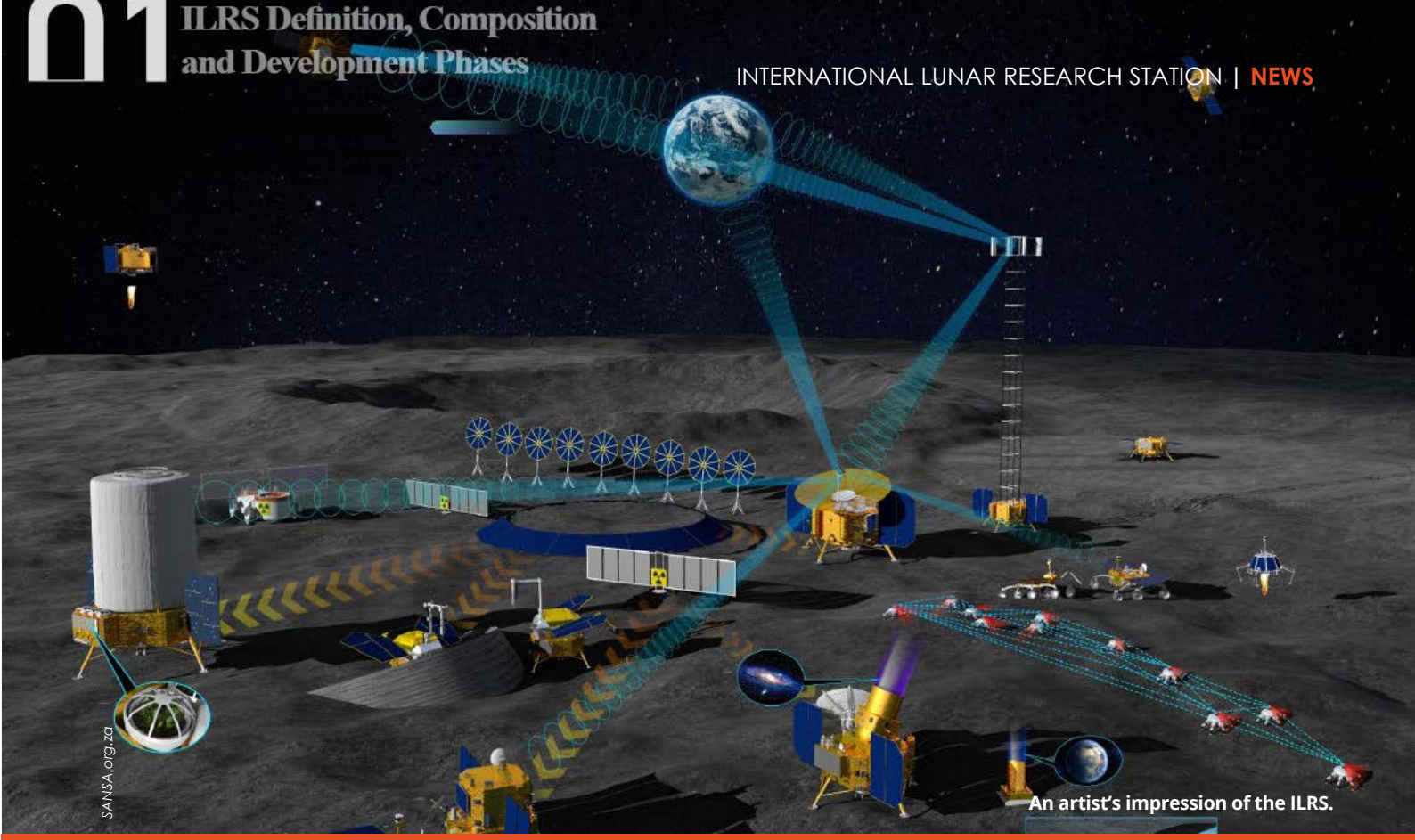
Since the landing, the moon lander Vikram and robotic rover Pragyan has already made significant discoveries, such as confirming the presence of sulfur in lunar soil, and even picking up the seismic activity of a very small "moonquake" that turned out to be from the Apollo 17 lander.

ISRO, Reuters, The Indian Express

Ka la 24 Phato 2023 India e bile setšhaba sa bone fela go kotama sefofane sa lefaufau ngwedi, le sa mathomo historing go kotama ka sou yeo e sa hlahlobjago.

Translated into Sesotho sa Leboa/Sepedi by Tebatso Isaac Makwala

The view from the Chandrayaan-3 Lunar Lander just before it touched down near the moon's south pole.



An artist's impression of the ILRS.

South Africa joins China's International Lunar Research Station

On 1 September 2023, Chen Xiaodong, the ambassador of the embassy of the People's Republic of China in South Africa, on behalf of the China National Space Administration (CNSA), and Humbulani Mudau, CEO of the South African National Space Agency (SANSA), signed a memorandum of understanding to cooperate on the planned International Lunar Research Station (ILRS). The signed MoU marks South Africa's formal entry into China's ILRS programme.

Under the MoU, China and South Africa will cooperate extensively on demonstration, mission implementation, operation and application, education and training for the ILRS. In addition, under the cooperation framework of the BRICS Remote Sensing Satellite Constellation, China's and South Africa's space agencies carried out cooperations on remote sensing data exchange and application, and satellite ground stations.

On the 25th anniversary of the establishment of diplomatic relations between China and South Africa, South Africa's formal entry into ILRS cooperation indicates that China-South Africa cooperation has been extended from near-Earth space to the moon and the deep space beyond. It will play a significant role in boosting technology advancement and building a high-standard community with a shared future for China and South Africa.

SANSA

For a detailed guide to the aims and structure of the proposed International Lunar Research Station, visit the following link: https://www.cnsa.gov.cn/english/n6465652/n6465653/c6812150/content.html

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

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- Bachelor of Architecture (extended)
  English level 4

Department of Building Sciences (APS 26)

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- Bachelor of Building Sciences
  English 4, Maths 3, Physical Science 3

Department of Geomatics (APS 30)

- B Eng. Tech in Geomatics
  English 4, Maths 5, Physical Science 5

Department of Chemical, Metallurgical and Materials Engineering (APS 28)

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- Bachelor of Engineering Technology in Metallurgical Engineering
- Bachelor of Engineering Technology in Materials in Polymer Technology
  English 4, Maths 5, Physical Science 5

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- Higher Certificate in Construction Engineering: Water and Wastewater
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  English 4, Maths 5, Physical Science 5

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  English 4, Maths 4, Physical Science 4
- Advanced Diploma in Electrical Engineering
- Bachelor of Engineering Technology in Electrical Engineering
  English 4, Maths 5, Physical Science 5

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  English 4, Maths 5, Physical Science 5

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- Diploma in Industrial Design
- Advanced Diploma in Industrial Design
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- Bachelor or Engineering Technology in Mechatronics
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With a Higher Certificate qualification, the undergraduate will be able to work in engineering support occupations such as , draftsperson, installers and maintainers of engineering equipment and systems, engineering sales and marketing, sites and production supervisors, etc.

DIPLOMA

The Diploma enables students to register as professional engineering technicians with the Engineering Council of South Africa (ECSA), after having gained a minimum of three years' practical experience once they have qualified. Since these diplomas are internationally recognised through the Dublin Accord, qualified graduates can work as engineering technicians in co-signatory countries. An engineering technician is a competent engineering practitioner with sound technical knowledge who is able to convert ideas into workable plans, contribute to practical knowledge and solve well-defined engineering problems.

BACHELOR OF ENGINEERING TECHNOLOGY (BENG TECH)

The BEng Tech degree in Chemical, Civil, Electrical, Industrial, Mechanical, Mechatronics Engineering, Metallurgical and Materials Engineering in Polymer Technology enable students to register as professional engineering technologists with the Engineering Council of South Africa (ECSA), after having gained a minimum of three years' practical experience after they have qualified. Since these degrees are internationally recognised through the Sydney Accord, qualified graduates can work as engineering technologists in co-signatory countries. In the UK, for example, an engineering technologist an work as an incorporated engineer (IENG) after registration with the Engineering Council of the United Kingdom (ECUK). The Bachelor of Engineering Technology (BEngTEch) degrees have a strong application and practical focus and engineering technologists are competent engineering practitioners who are able to innovatively apply and modify engineering practices, solve broadly defined engineering problems, give managerial inputs and work independently. The BEngTech degrees differ from BEng degrees, which allow registration as professional engineers, in the sense that the focus us more on the application of the technological knowledge than on the derivation of the knowledge from the first principles.

ENGINEERING-SUPPORT QUALIFICATIONS

TUT also offers qualifications for surveying technicians and technologists. A route exists for engineering surveying technologists to register with the South African Geomatics Council (SAGC) as professional engineering surveying technologists (not to be confused with the professional land surveyors).

BUILT ENVIRONMENT QUALIFICATIONS

In Building Sciences, TUT offers qualifications in quantity surveying and construction management for technicians and technologists who can register with the South African Council for Quantity Surveying Profession (SACQSP). After having gained enough practical experience and having passed professional examinations, candidates may register with the SACQSP as professional quantity surveyors. There is also a route for construction management students to register with the Chartered Institute of Building (CIOB) as chartered members.

In Architecture TUT offers qualifications for professional architects and architectural technologists and is accredited by the South African Council for the Architectural Profession (SACAP) and the Commonwealth Association of Architects. It is the only school of architecture at a university of technology that offers a fully accredited professional course.

In Industrial Design talented individuals who successfully complete this programme will be able to able provide junior level Industrial design related services. This may include being a member of a design and development team or a junior design entrepreneur.

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Dragonfly Aerospace ensures EOS SAT-1 sustainability with NEURASPACE partnership

The launch of the Transporter-6 mission aboard SpaceX's Falcon 9 rocket from Cape Canaveral, Florida.

SpaceX

On 11 September 2023, Dragonfly Aerospace (www.dragonflyaerospace.com) announced its partnership with Neuraspace (www.neuraspace.com), a leading provider of smarter space traffic management (STM), to explore Neuraspace's STM platform for space sustainability. Dragonfly Aerospace will be using the STM platform for its EOS SAT-1 satellite for conjunction analysis and receiving manoeuvre suggestions.

Dragonfly Aerospace is one of South Africa's leading commercial space ventures, building satellites for Earth Observation and other purposes.

EOS SAT-1, the world's first agriculture-focused imaging satellite built by Dragonfly Aerospace, was launched from Cape Canaveral, Florida as part of the SpaceX Transporter-6 mission in January 2023. The first of a seven-satellite constellation in low Earth orbit (LEO), EOS SAT-1 is designed to support the implementation of sustainable agriculture methods and forestland monitoring with high-quality data and analysis.

The first remarkable image from EOS SAT-1 was released in May showing the city of Cape Town taken at a resolution of 1.5 m with a swath of 44 km and 11 spectral bands – an unprecedented spatial, spectral and swath combination. Images from EOS SAT-1 deliver valuable information for harvest monitoring, such as soil moisture, yield prediction and biomass levels, as well as applications such as mapping, seasonal planning and infrastructure monitoring. The data from this satellite aims to support growers to develop sustainable agricultural methods with improved yields that can reduce the need to cut down forests and help maintain biodiversity on the planet.

Dragonfly Aerospace

Part of the Dragonfly Aerospace engineering team behind the EOS SAT-1 satellite.

"The partnership between Dragonfly Aerospace and Neuraspace represents a crucial step forward in our commitment to sustainable space exploration," said Bryan Dean, CEO of Dragonfly Aerospace. "We are excited to leverage the Neuraspace STM platform to ensure the safety and increased operational efficiency and longevity of EOS SAT-1."

With EOS SAT-1 providing critical data that will ultimately help inform and promote sustainable agricultural practices, Dragonfly Aerospace reaffirms its dedication to environmentally conscious and sustainable space endeavours and looks forward to helping to improve the lives of people around the world with its cutting-edge Earth Observation technology.

With the integration of the Neuraspace STM platform, EOS SAT-1 will benefit from enhanced capabilities to autonomously manoeuvre and avoid potential collisions with other objects in space, safeguarding the satellite and contributing to the overall reduction of space debris – a growing concern in space.

Dragonfly Aerospace

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REPUBLIC OF SOUTH AFRICA

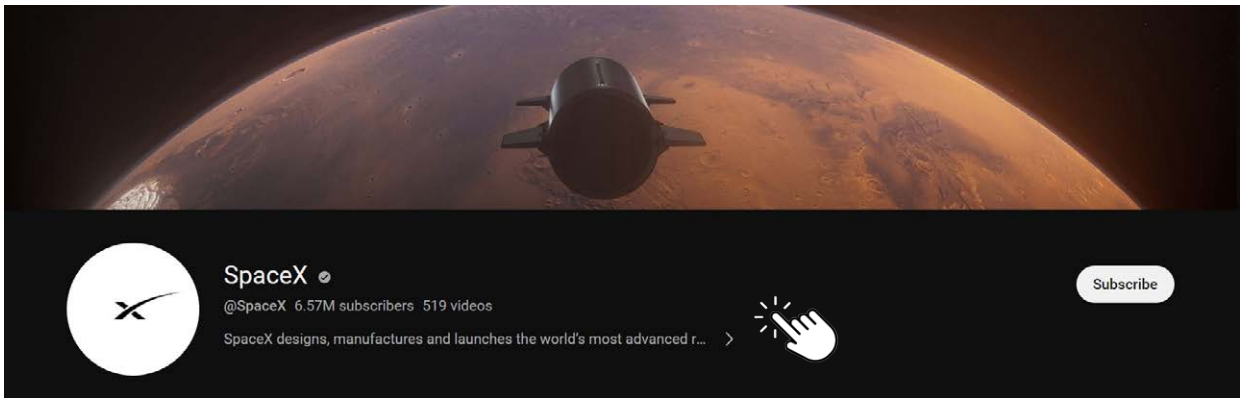
NRF National Research Foundation

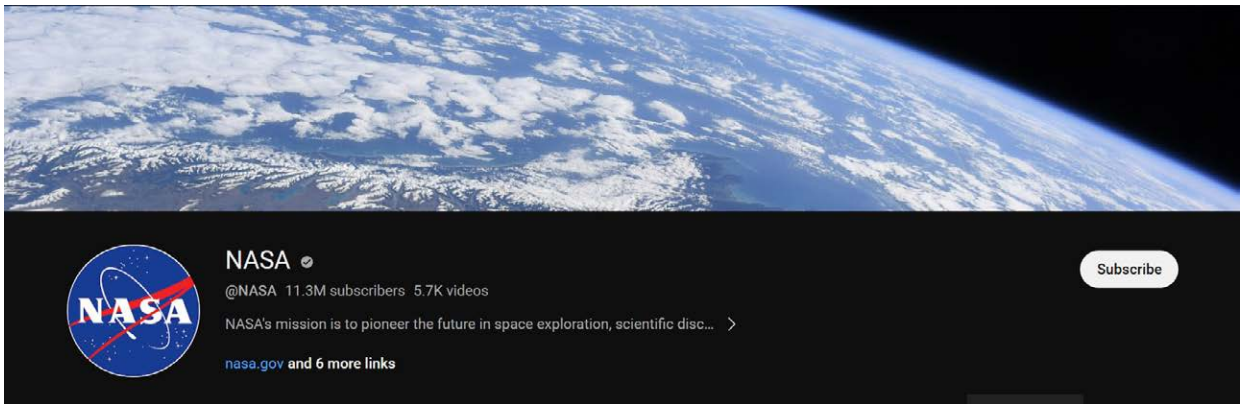
AfAS African Astronomical Society

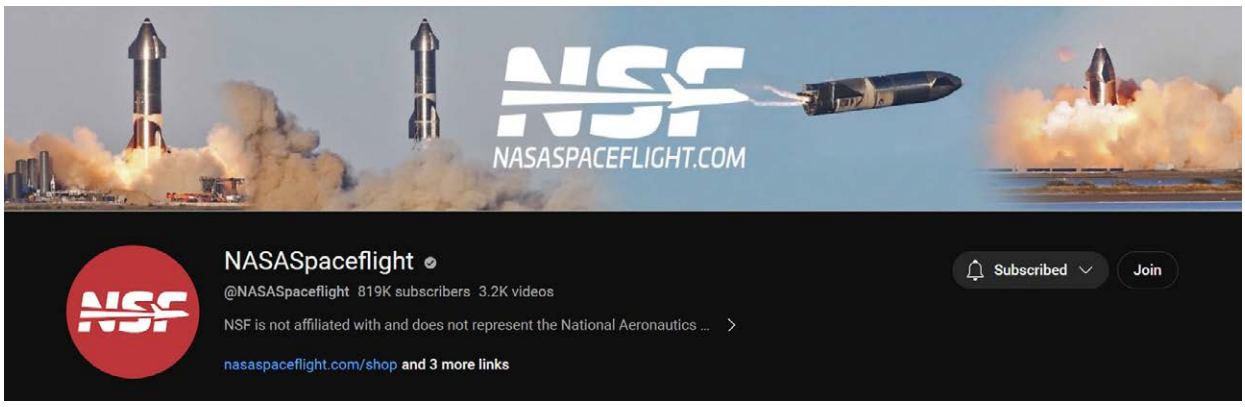
XXXII IAU GENERAL ASSEMBLY
CAPE TOWN, SOUTH AFRICA, 2024

YouTube reviews

If you enjoy watching spectacular rocket launches, news on space inventions and discoveries and general cutting-edge space science, here are some of the YouTube channels we recommend to follow. Happy watching, space cadets!







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