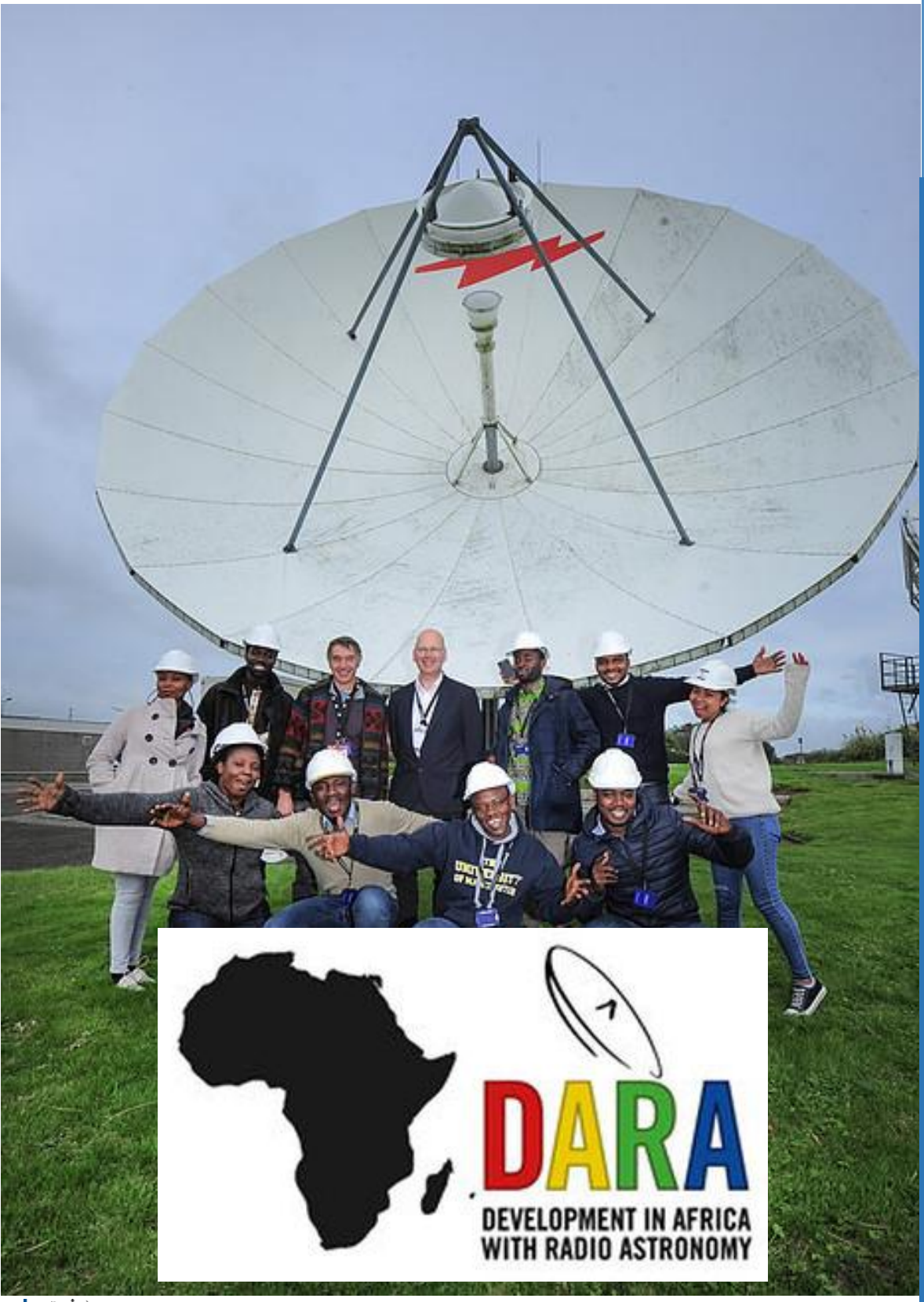
UK-South Africa Newton Fund

The DARA Issue

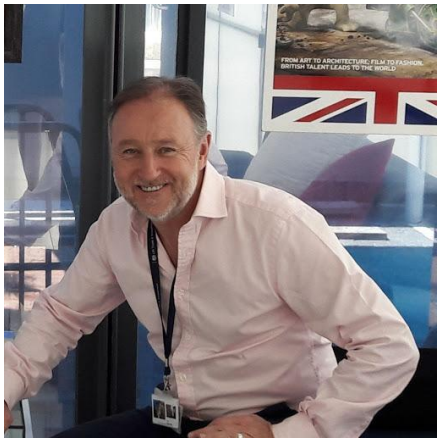


In This Issue:

Department for Business, Energy & Industrial Strategy

science & technology
Department: Science and Technology
REPUBLIC OF SOUTH AFRICA

Foreword



Mr. John Wade-Smith, Regional Head:
Science and Innovation

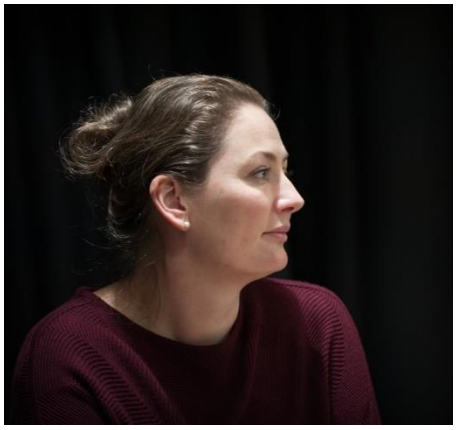
The UK-SA Newton Fund Quarterly Newsletter seeks to showcase and share the breadth, depth and excellence of the collaborations that are supported through this important bilateral programme. In this 4th Edition, we decided to shine the spotlight on the Development in Africa through Radio Astronomy (DARA), a truly successful partnership. It aims to use radio astronomy to develop and inspire a cadre of young scientists and researchers with the high tech skills necessary to support the African Very Long baseline Initiative in 8 African countries as part of their participation in the Square Kilometre Array project.

This edition could not have come at a better time as the partner countries sign the SKA Convention on 12 March 2019. Minister Kubayi-Ngubane will grace the signing in Italy before heading for a visit to the UK that will include the SKA Headquarters in Jodrell Bank near Manchester.

So we are celebrating a major international project which the UK and South Africa are leaders in, with a linked development programme that is making a significant contribution to developing regional skills, particularly in big data. A great example of UK and SA science partnership at the international, regional and bilateral level.

DARA – High Tech, Transformational, Interdisciplinary, Future Facing

By, Prof Anna Scaife (*Professor of Radio Astronomy University of Manchester; Head, Interferometry Centre of Excellence* Jodrell Bank Centre for Astrophysics; *Co-Director* Policy@Manchester)



It's an exciting time to be working in radio astronomy. All over the world, the development of new radio telescopes progresses at a rapid pace and nowhere is that development more marked than in Africa. The African continent is now home to the most sensitive radio instrument in the world, the MeerKAT telescope - an array of 64 dishes operating in the remote and harsh environment of the Karoo desert. But MeerKAT is only the beginning: soon Africa will host not only the mid-frequency component of the Square Kilometre Array (SKA) telescope, certain to be one of the enduring technological marvels of the twenty-first century, but also the African VLBI Network (AVN), a ground breaking partnership that spans deserts, mountains and oceans from South Africa to Namibia, to Ghana, Zambia and Kenya, Botswana and Mozambique, across to Madagascar and Mauritius.

Using African radio astronomy as an enabler, the ***Development in Africa with Radio Astronomy (DARA)*** project aims to inspire and train a new and diverse generation of young people across the countries of the AVN partnership in high-value technical skills applicable not only to scientific research but also to the space sector, as well as numerous other industrial and commercial sectors where diversification, technological upgrading and innovation are key drivers of economic growth. Radio astronomy uses all elements of the STEM (science, technology, engineering and mathematics) skillset underpinning developed economies; modern astronomers not only require knowledge in physics, mathematics and chemistry, but radio astronomy is a subject that also encompasses engineering.
In addition to providing a focus and a draw for high quality technical education and research, radio astronomy is also a driver and an innovator in the digital space. The volume of data created by the SKA, and the speed with which it will be produced, means that Africa will soon be home to one of the biggest big data machines on the planet.

History has shown that it is this drive towards scientific extremes which can produce the most disruptive technologies. From particle physics, in a quest to explore the fundamental components of our existence on a sub-atomic scale, we found the internet; from radio astronomy, seeking out the faintest and most distant corners of the Universe, we found

WIFI. We only have to look at the transformational nature of these technologies to see how dealing with scientific data leads to societal change.

As we enter the fourth industrial revolution, the societal benefits of data-driven development are evident. Inspired by this, a sister project, *DARA Big Data*, aims to harness the interdisciplinary nature of the big data impact associated with SKA and to translate its benefit across a wider range of research areas. Along with astronomy, the parallel themes of DARA Big Data are health data and data for sustainable agriculture. All three of these key areas have significant overlaps in methodology and the potential to benefit significantly from the big data advances of the SKA. Inter-disciplinarity and shared infrastructure are the cornerstone of inclusive growth in the fourth industrial revolution, and by exploiting the synergies between data-driven research areas this project aims to maximise the development benefits of new technology and reduce the potential for creating new digital systems of inequality.

As a consequence, the data-intensive and technical programs of DARA and DARA Big
Data are not only a tool to achieve development outcomes, but also a forum through which development processes are communicated. The multi-lateral partnership between the UK and the countries of AVN represents one aspect of this. More widely, the interconnected community of African researchers built on the fellowship of students who have passed through its programs will be an enduring legacy of the DARA project.

Strengthening UK-SA Science and Innovation Collaboration: *UK Deputy Director for Global Science & Innovation visits South African Stakeholders*

On the 11th February 2019, Tom Child, the UK department for Business Energy and Industrial Strategy's (BEIS) Deputy Director for Global Science and Innovation came to South Africa on a policy mission to engage with and strengthen the countries' innovation and science collaborations. During the 3 day visit Mr. Child met with government counterparts at South Africa's Department of Science and Technology (DST) to discuss, amongst other things, the UK-SA Newton Fund partnership, the Global Challenges Research Fund and the future of collaboration.

"I was briefed about the leading edge indigenous technology which the SKA will bring to bear, and was impressed by the impact DARA is having in supporting the development of skillsets necessary to exploit it." Tom Child

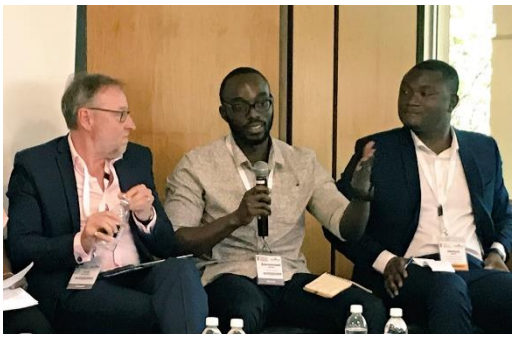
Dr. Alet de Witt (Operations Astronomer) hosted Tom Child at HartRao and gave feedback and overview of the 3 weeks of intensive training that she facilitates for the DARA project on site annually. The training on the African Very Long Baseline Interferometry Network (AVN) sees an annual cohort of 20 students from across the 8 AVN countries learning various aspects of radio astronomy and how to use radio telescopes within the AVN.

"Some of them are already working and some are still studying, but we train them so that they can go back and build the radio astronomy capacity in their own countries," Dr. De Witt

From left: Tom Child (BEIS Deputy Director for global SIN), Dr. Amelia Marutle (Newton Fund Country Manager), Dr. Alet de Witt (SARAO South Africa), John Wade-Smith (Regional Head for Science and Innovation: Africa)

DARA : Science Communication for Policy Engagement

By Samson Mutunga



Science Communication panel at Science Forum 2018

Research often has profound implications for policy, but without effective communication between researchers and policy makers the significance of research findings can easily be lost.

Training early career researchers in science communication for policy engagement is a useful resource for bridging the gap between research and policy. It consolidates the tools and materials that are available to scientists and researchers and enables them to communicate more effectively with policy stakeholders. In today's data-driven world, effective communication with scientists working in data intensive research areas can provide an improved quality of evidence, insight and analysis to these policy-makers - although it also brings the challenge of rapid and adaptive policy-making in return.

Big data presents both an opportunity and a challenge to policy makers. Consequently, developing the skills and the mechanisms of science communication for policy engagement is of particular importance for scientists in working in data-intensive areas. Cultivating the necessary expertise within this scientific community in order to communicate the outcomes of research programs effectively to policy-makers and to facilitate and inform effective evidence-based policy-making is of particular importance, especially now that we are eyeing the fourth industrial revolution.

Many thanks goes to the Development in Africa with Radio Astronomy (DARA) Big Data project funded by the UK's Newton Fund for recognizing this gap and organizing a one month long training program for early career scientists from Africa on how to communicate policy relevant elements of their disciplines effectively to policy makers and other stakeholders. The training was one month long and ran from 1 October - 31 October 2018 at the University of Manchester, UK. The program was open to ongoing PhD students and early career researchers who were within 5 years of completing a doctorate in one of the DARA Big Data key areas of Astronomy, Sustainable Agriculture and Health.

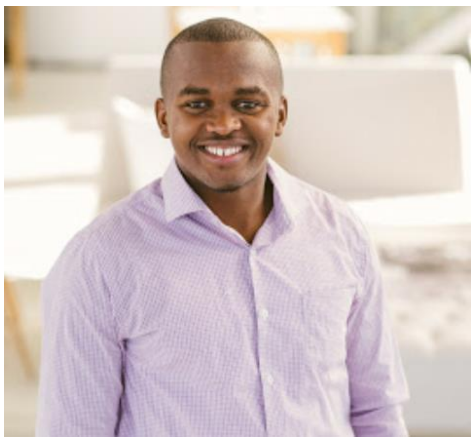
The training program explored the context of science and technology in policy and how it has evolved. This was very helpful in understanding the processes by which research informs the policy environment. It was of great importance to realize the different tools of policy engagement available to modern scientists. These tools included practical introductions to the many ways of communicating through a variety of platforms, including policy briefs, oral presentations, data visualizations, social media, and more. In addition, the understanding of how policy works within science, as well as within government, was shared. This helped us to form a better understanding of the interaction between society and science, and how that interaction affects policy-making. The training equipped the fellows with both intellectual and practical skills to easily identify elements of research with policy implications, target key policy audiences, and how to communicate the policy implications of that research effectively across different audiences.The need for effective communication of science to the public may appear irrelevant to career scientists until one realizes that most science and research projects are funded by the public.

Indeed communicating science directly to taxpayers is one way of being accountable to the funders of science. For scientists, the most important aspect of their research might be how it fits into the wider context of a scientific discipline, but the public wants to know how a new finding might impact their lives. With good training in public communication, scientists can be more effective in bringing the world of science to the general public. They can help the public in understanding science as part of their daily lives by educating them about the threats facing our planet and even how to better shape the direction of political and policy decisions, because how scientists communicate this information may have measurable conservation impacts on the future of our planet.

Traditional scientific training doesn't typically prepare scientists to be effective communicators outside academic circles, but the game has now changed and scientists need to get out of their comfort zones and engage both the public and policy makers - especially now that policy is becoming increasingly data driven for the betterment of our planet.

DARA – Data and the Fourth Industrial Revolution: Opportunities and Challenges for Healthcare in Africa

By Lameck Amugongo



Recently there has been a lot of rhetoric about the fourth industrial revolution (4IR) from heads of state, tech evangelists and futurists across Africa; narrating the disruptive effect that the technological revolution will have on jobs and economies. However, little emphasis has been put on the transformation and improvements that the 4IR can bring to a sector such as healthcare, which is critical for wellbeing and a prosperous society. The fourth industrial revolution brings both prospects and challenges for future healthcare in Africa.

The term fourth industrial revolution originated from the World Economic Forum (WEF) to describe a technological transformation era, characterized by a combination of technologies: digital, physical and biological. At the centre of this transformation is automation, i.e. artificial intelligence and robotics. In healthcare, AI and automation is envisaged to improve patient care and we are already beginning to see this: AI models are improving accuracy in the diagnosis of complex diseases such as cancer and acting as co-pilots in operation theatres.

In recent years, we have also witnessed an unprecedented increase in the generation of data, produced by smartphones, sensors and other devices. In an attempt to deal with these large volumes of untraditional data, the term data revolution (big data) was coined, to encapsulate our ability to leverage complex technology, process and derive insights from data. Big data is an important component of the fourth industrial revolution as it enables artificial intelligence to derive new knowledge that can help improve processes, and data driven models to support clinical decision making for better healthcare.

For many years healthcare systems have been focused on volume of procedures, rather than the quality of treatment being delivered. This has resulted in rising costs, while patient outcomes remain the same. As a solution, value-based or quality-based systems have been proposed. At the centre of such a value-based system is personalized treatment, which aims to individualise treatment for individual patients, based on their singular characteristics.
Personalised treatment is reliant on data. These data may be widely distributed, in different countries or institutions. However, lack of homogeneous information governance remains a major obstacle, hindering the sharing of healthcare data between different institutions and countries. Moreover, in the majority of African countries healthcare data is still stored in filling cabinets. These data need to be digitized and secure techniques explored to regulate its sharing.

Despite these challenges, we are seeing new innovations that are leveraging data and digital technologies to improve, increase access and make healthcare affordable across Africa. Some countries are using SMS and other messaging services for patient education, reducing risk factors for chronic and epidemic diseases. Rwanda is using drones to deliver blood and test results in remote areas. Another African-based innovation is M-SCAN (TechCrunch battlefield Africa 2018 winner), a mobile ultrasound device compatible with mobile gadgets such as tablets, smartphones and laptops. M-SCAN has potential to save mothers during pregnancy and reduce infant-mortality across the continent.

DARA Big Data Policy Fellows

One major challenge is how to increase the impact of African-based innovations.

This will require a multi-dimensional approach, including collaborative efforts between African governments to collectively fund research and development, and develop policies that prioritise the procurement of African-based innovations/products over imports from outside the continent.4IR will not miraculously solve all healthcare issues on the continent, but can pave the way for affordable and inclusive healthcare. Furthermore, the future of healthcare is patient tailored.

Africa cannot be left behind, it has to leapfrog and seize the moment, and empower its youthful population to capitalise on the 4IR to create innovative solutions that will address some of the pressing health challenges on the continent such as cancer, tuberculosis, infant-mortality and HIV.

DARA - Ghanaian Scientists reach for the stars!

By Naomi Asabre Frimpong

As a young scientist who had just finished her MPhil in Nuclear and Radio chemistry, I was recruited to work with the Ghana Space Science and Technology Institute (GSSTI). The GSSTI was a new institute in the Ghana Atomic Energy Commission. It was formed to oversee the space activities of the nation and especially the conversion of the 32m telecommunication antenna at Kuntunse into a radio telescope.

Being involved with this conversion project was an exhilarating and eye-opening experience for me and my colleagues. This important technical and scientific undertaking opened a whole new world of science for me to explore. Astronomy and radio astronomy became my new interest, and the science that can be done with the newly converted telescope my new-found passion. During the conversion of the telescope I met brilliant men and women from the SKA-SA and the AVN Team, who nurtured my new interest in astronomy.

When the DARA basic training was introduced in Ghana for students, young graduates and scientists, I quickly jumped at the opportunity and joined the training. The DARA Basic training program gave myself and the other students the pre-requisite knowledge we needed in astronomy and astrophysics to pursue further studies in various areas of astronomy. The DARA training has been a bedrock for me personally and for most of the students who were privileged to be part of the training, most of whom have gone ahead to further studies in astronomy, astrophysics and its related sciences.

I am currently a DARA advanced training student at the University of Manchester. I have been able to merge my first love chemistry with my new passion astronomy. I am currently pursuing a PhD in astrochemistry, studying the evolution of massive young stellar objects with complex organic molecules under the supervision of Prof Gary Fuller. Understanding this range of complex species, their chemical origin and their excitation is key to the interpretation of the evolutionary status of these young stars and the structure of their circumstellar region.

The DARA program and the Newton Fund have opened a whole new field of study for Ghanaians and given us the opportunity that we will be able to soon operate the telescope and use it for research - research that will be led by Ghanaian scientists and allow them to form research collaborations with the rest of the world. Young scientists and graduates in Ghana are eager for this new research challenge and the SKA. The DARA program and radio astronomy have given us the perfect opportunity to show what we can offer the world.

Instilling data science skills in the next generation of researchers through the DARA Big Data Africa School

By Dr. Bonita de Swardt

Dr. Bonita de Swardt Programme Manager: Strategic Partnerships for Human Capital Development

The Big Data Africa School is one of the flagship training initiatives established within **Development in Africa with Radio Astronomy** (DARA) Big Data. The main concept for running the Big Data Africa School was to introduce fundamental data science tools and techniques to talented young science graduates from a range of disciplines.

In particular, the school caters for those graduates who have an interest to develop their skills and knowledge in working efficiently on extremely large datasets in any research environment when pursuing postgraduate studies.

The South African Radio Astronomy Observatory (SARAO) has taken the lead in hosting an annual Big Data Africa School, with partners from various universities, research organisations and industries from the UK and South Africa playing a key role in delivering lectures and the practical component of the School.

The School has been presented since 2017, with hundreds of applications received from students in South Africa and the eight Square Kilometre Array (SKA) African partner countries, which includes Botswana, Mozambique, Madagascar, Namibia, Kenya, Zambia, Ghana and Mauritius.

The 2018 Big Data Africa School hosted 27 students in Cape Town, selected from the applicant pool, which included incumbents completing Bachelor of Honours degrees, to those currently undertaking Masters degree studies in a science discipline.

Speakers at the 2018 opening event included Dr Bernie Fanaroff, former SKA Project Director; Ben Boddy, the incumbent UK Consul General at the time for the British Government based in Cape Town; and Prof Anna Scaife, the Head of the Jodrell Bank Interferometry Centre of Excellence.

"There is no reason why we as Africa cannot be part of the fourth Industrial Revolution. We have to do that, otherwise we will be left behind. Also, if we want to become wealthy countries and make a better life for our people, we've got to have these skills, and data scientists have these skills. I am very envious of you because you are getting in on the ground floor of what is going to be a very big and important building with huge opportunities," said Dr Fanaroff, referring to the growth opportunities within the Square Kilometre Array.

Boddy spoke about the UK-SA partnerships and his country's renewed undertaking to establish partnerships with Africa.

"A while ago we launched an industrial strategy and one of the biggest challenges we identified was big data and artificial intelligence. Now we are investing in the future, in partnerships around the world, particularly in Africa, in young people and data scientists, not only because we are going to need data scientists, but because we can see that it is going to be an industry that young people can lead. I am sure some of the people in the room tonight will be presenting speeches in twenty years' time to the next cohort," said Boddy.

The week-long programme included presentations, lectures and workshops by an array of speakers, culminating in the students working on a practical computational project during the School with their results to be presented to a panel at the closing of the School. Projects spanned a range of exciting and industry-relevant topics in the areas of astronomy/radio astronomy, cybersecurity, the Internet of Things (IoT) and Health making the Big Bata Africa School one of the most multi-disciplinary training initiatives seen world-wide.

The 2018 Group Award went to the Health project (*Detection of diabetic retinopathy disease by applying Machine Learning image classification techniques*), in which the students aimed to develop a machine learning algorithm to accurately diagnose patients with diabetic retinopathy which can help to save the eyesight of millions of people worldwide.

The winning project was followed closely by the project which focused on the Internet of Things (*How Big Data is powering the Internet of Things revolution*), exploring a data set containing UK Traffic and Accident Data gathered over a period of roughly 16 years. This project moves away from the conventional machine learning type problems and tasked the students with exercising their creativity to explore the given data set and ultimately formulate a story from this data, asking a range of questions.

Individual awards were also given to the students, of which the accolade for the student showing the best leadership ability in a group went to Jordan Bakai, a B.Sc Honours student in Astronomy at the University of Cape Town.

"I expected to learn data science knowledge and application skills, specifically filling the gaps in my knowledge of machine learning. It met my expectations but it also ended up being focussed a lot more on presentation skills, insight and advice from respected people from the field, which I didn't even realise I needed but found it a lot more helpful than something that you can Google," said Jordan.

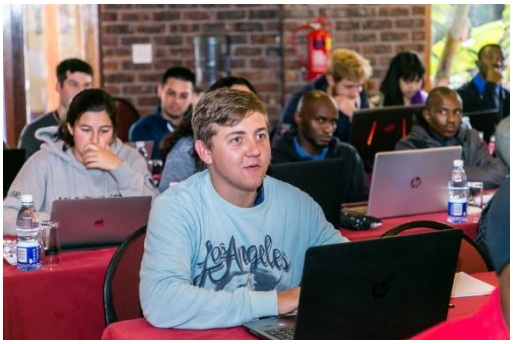
Industry partners play a significant role in the Big Data Africa School with presentations focussing on personal career journeys and data science developments in industry. Partners in the Big Data Africa School have included the Medical Research Council South Africa, the Inter-University Institute for Data Intensive Astrophysics (IDIA), IBM, SIATIK, Microsoft, Tracker SA, amongst many other organizations.

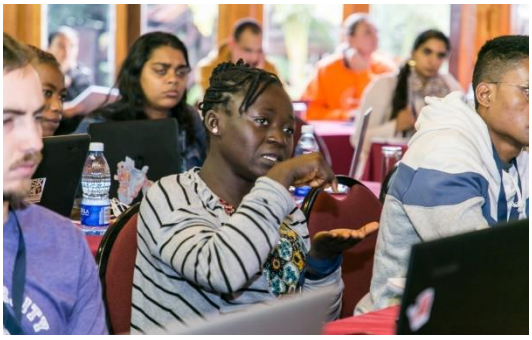
"The industry partners are fundamental to the Big Data Africa School and play a tremendous role in motivating the students and showcasing opportunities for data scientists within different industries. Their personal career journeys serves as further motivation for students giving them inspirational role models to achieve their career goals. I'm always fascinated at how motivated the students are when leaving the School," said Dr Bonita de Swardt, Programme Manager: Strategic Partnerships for Human Capital Development at SARAO and a founding member of the Big Data Africa School organizing committee.

GALLERY OF DARA BIG DATA SUMMER CAMP 2018

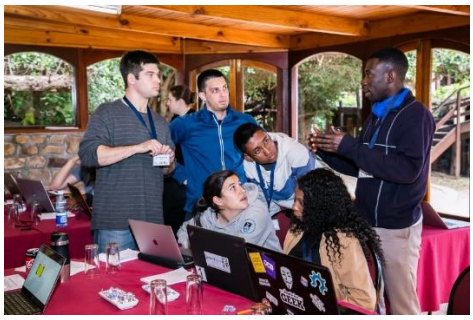
Dr. Bonita de Swardt

Student presentations

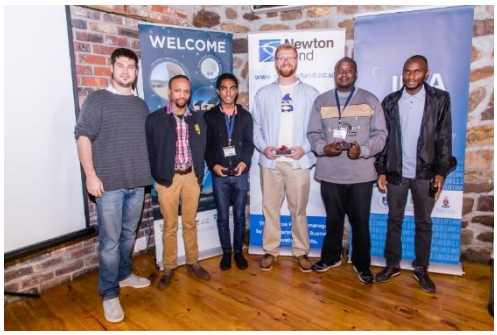




Lecture sessions at the 2018 Big Data Africa School

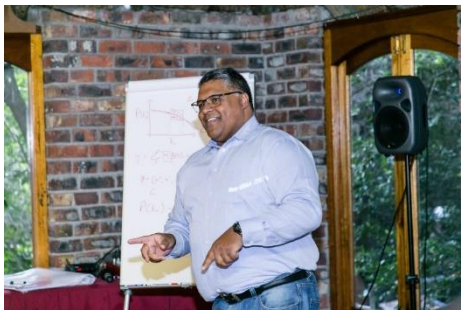


Group project work at the 2018 Big Data Africa School

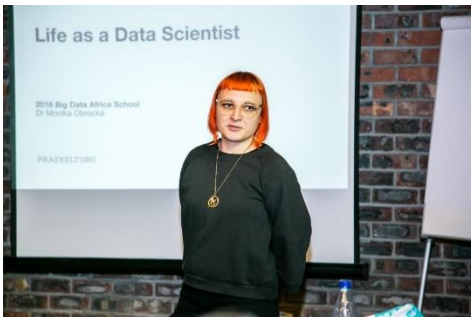


Group Award for the Health project

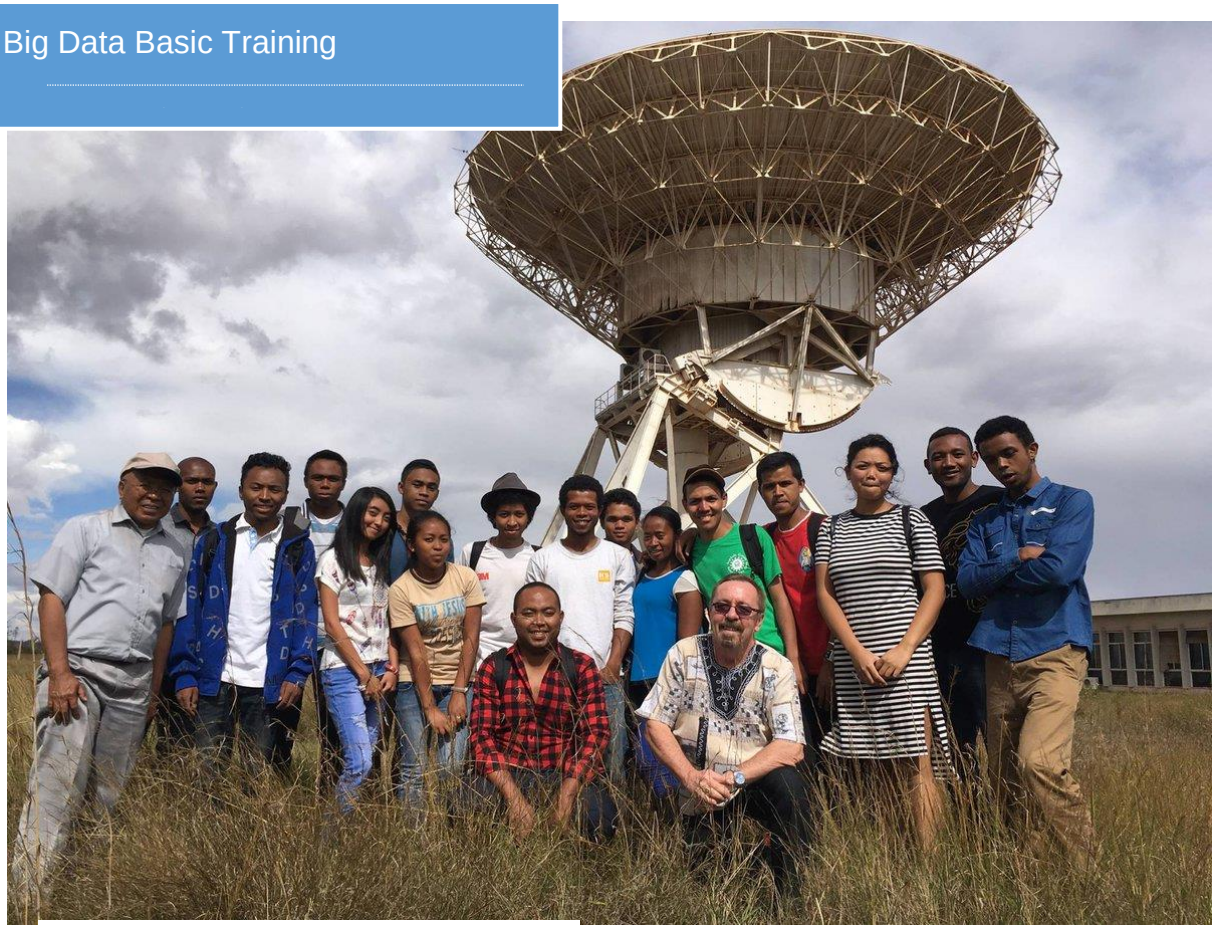
Industry partner Ms Heidi Duveskog (Contextualize (Pty) Ltd) giving a session on “Essential Skills for Industry”



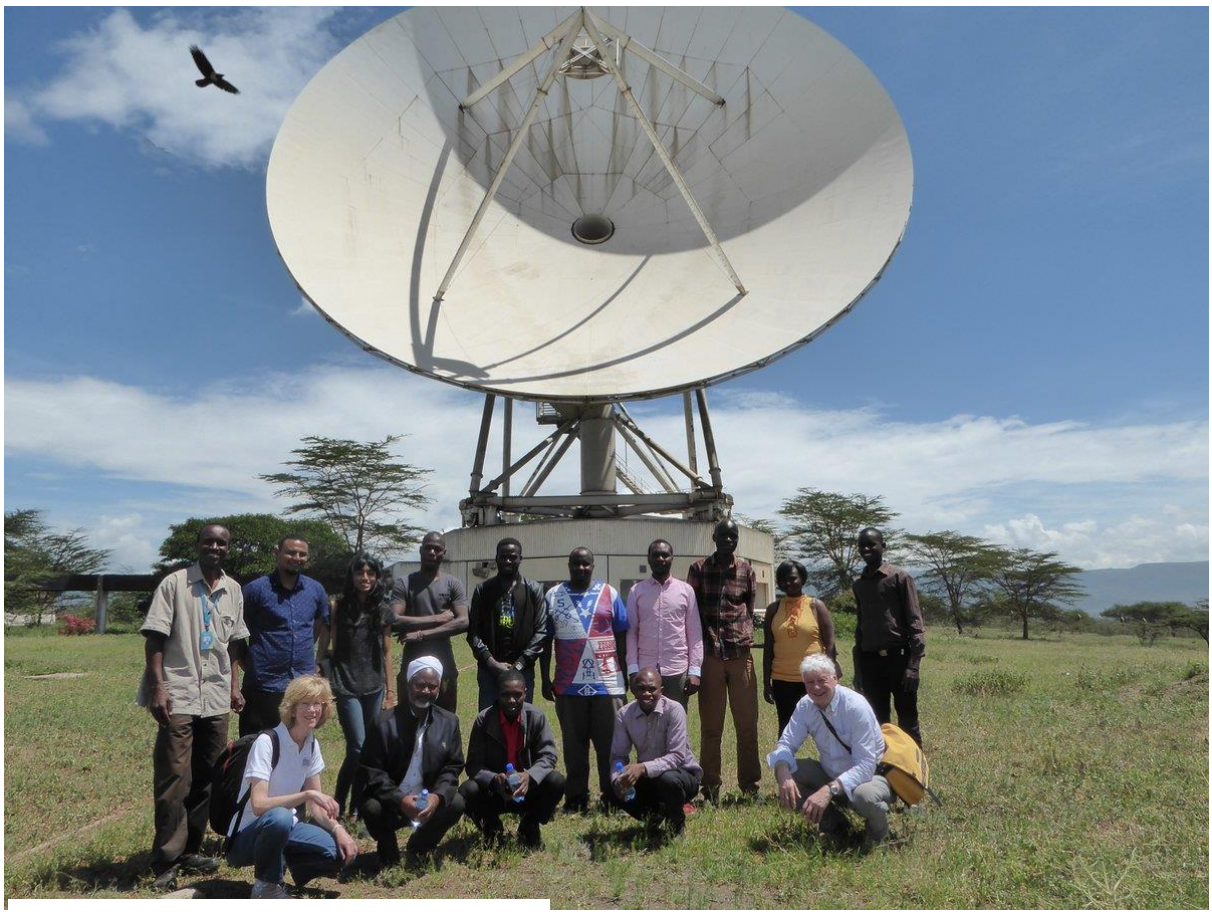
Industry partner Graham Maart (IBM) gave a session IBM Tools and Resources for Data Science



Industry partner Dr Monika Obrocka (Praekelt) gave a session on “Life as a Data Scientist

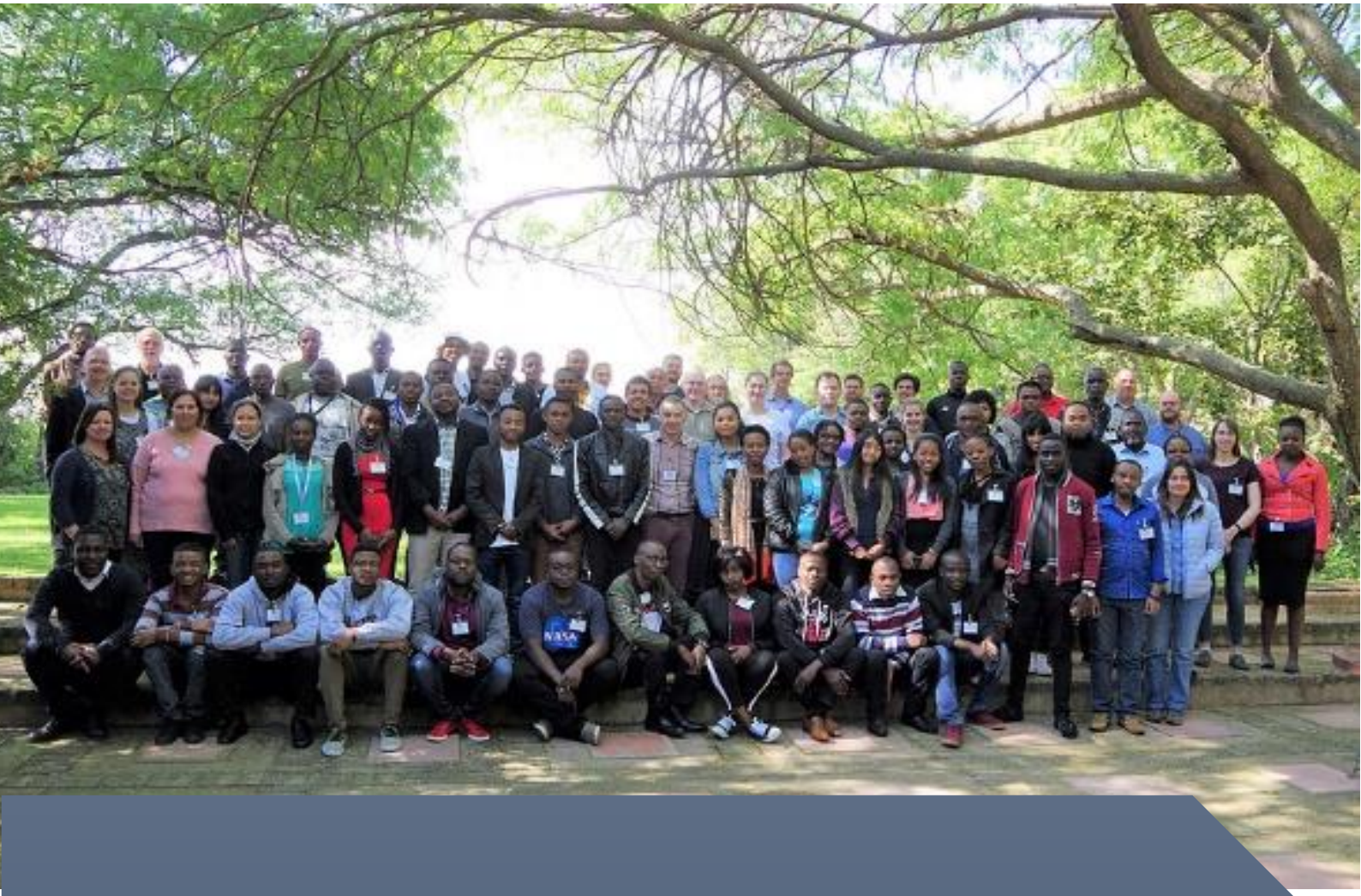


Madagascar



Kenya

DARA: A truly Newton project



This picture was taken at DARA's 2018 annual networking meeting. The group represents a growing alumni of over 100 students that have received training and support through the DARA programme. This includes:

- Each year, in each country; ten graduates in physics or another relevant discipline undergo basic training in radio astronomy (South Africa, Botswana, Ghana, Kenya, Madagascar, Mozambique, Namibia and Zambia)
- 5 MSc, 8 PhDs
- Laboratories established in AVN countries and installation of interferometers

The DARA programme, delivered through a partnership between the Science and Technology Facilities Council (STFC) in the UK, SKA South Africa and the NRF, has truly espoused the essence of the Newton Fund vision. A partnership that identifies, harnesses, and builds on the strengths of the partner country and uses these to develop capacity, promote economic development and increase social welfare.

DARA is the UK-SA Newton Fund's single biggest programme investment. It was expanded to include "DARA Big Data", with an additional £3.7m invested, to create a hub of Data Science experts, capitalising on the unprecedented data capacity of the SKA.

As with DARA, many UK-SA Newton programmes are empowering the youth; ensuring this unique feature of Africa's demographics (a very young population) is positively exploited and celebrated; in the upcoming issue of the UK-SA Newton Fund newsletter we will be showcasing our Young Newtonians, the Youth Month Issue!

Tori Bungane, Newton Fund Officer