

# Development in Africa with Radio Astronomy: An STFC Newton Fund Project

Melvin Hoare (UK lead)  
University of Leeds

With added slides from  
Peter Wilkinson  
University of Manchester

(Year 4 Unit1 Nairobi October15 2018)



# Outline

- Background to project
- Description of project
- ODA compliance



# Why Africa?

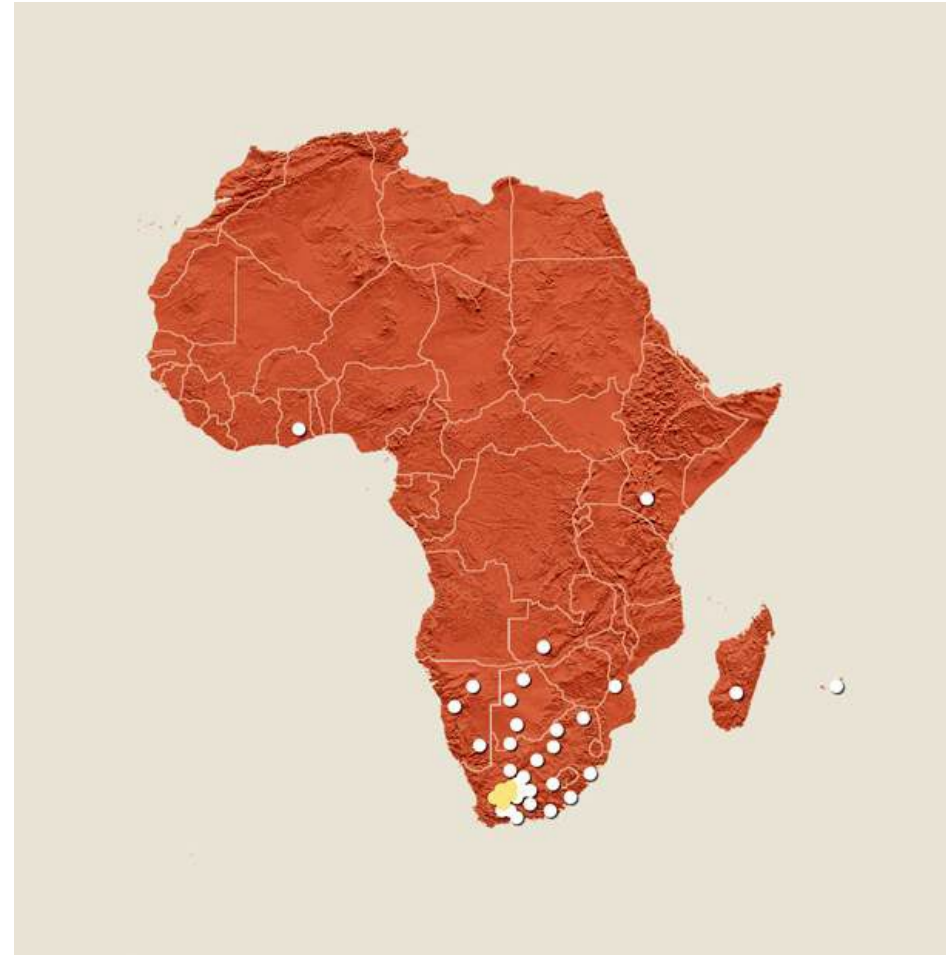
- One half of the world's next generation radio telescope – the Square Kilometre Array – is being built in Africa
- The first phase will consist of ~200 x 15 m dishes located in the Karoo desert in South Africa



# The Square Kilometer Array



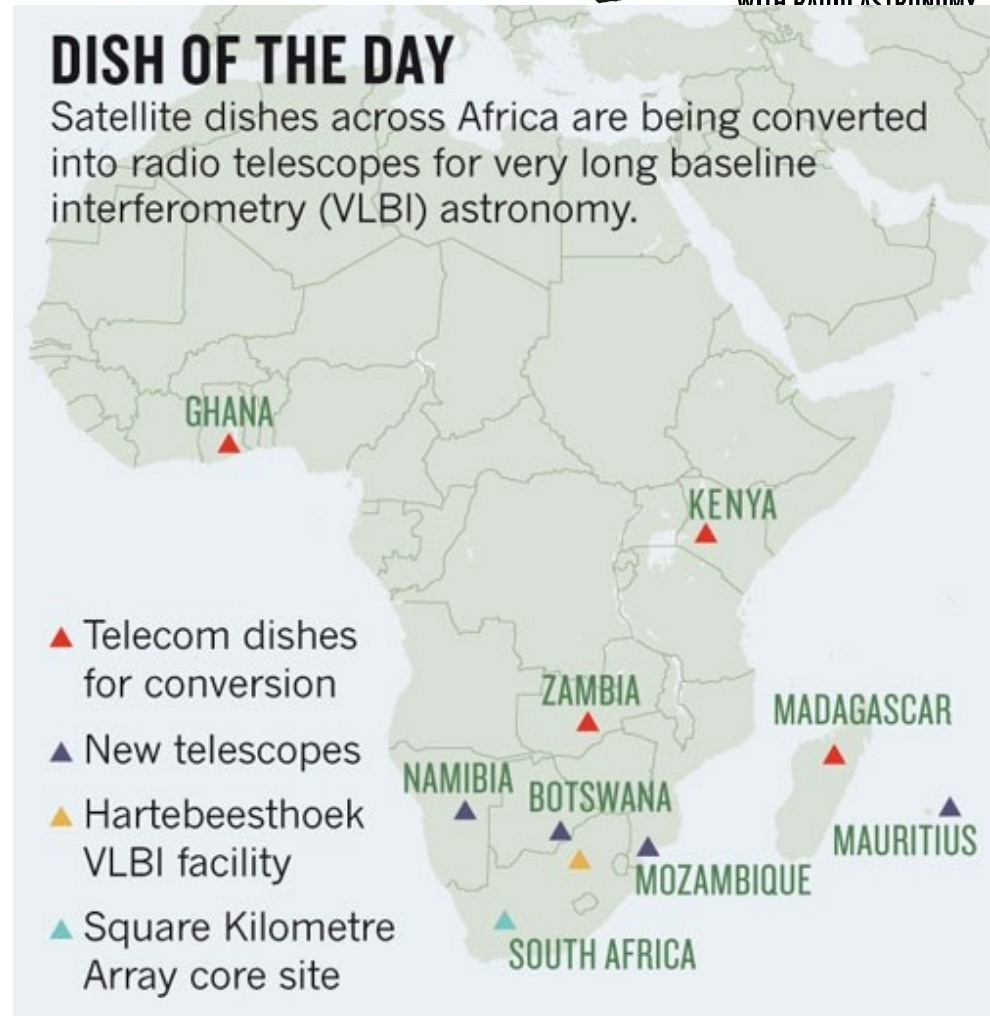
- The second phase envisages ~2000 dishes located across Africa by ~2030
- Located in 8 partner countries: Botswana, Ghana, Kenya, Madagascar, Mauritius, Mozambique, Namibia and Zambia



# African VLBI Network (AVN)



- Prior to the SKA a network of dishes is being established in the partner countries by SKA-SA
- This will form a very long baseline interferometer (VLBI)
- African science network to link with Europe
- Vital precursor experience for SKA



# Ghana Training Programme



- Newton project is building on experience gained in Ghana from a collaboration between the University of Leeds and SKA-SA funded by the Royal Society



THE  
ROYAL  
SOCIETY

Africa Award



The Leverhulme Trust

# The Newton Fund Project



- Joint UK-South Africa project
- Targeted at Ghana, Kenya, Zambia, Namibia and Botswana which will have the first AVN dishes ready
- These are mostly converted from redundant telecommunications dishes



32 m ex-Vodafone dish in Ghana

# Project Partners



## UK Partners:

(PI Prof Melvin Hoare)

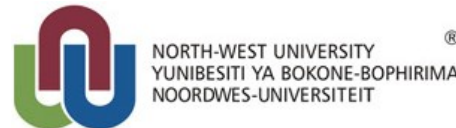


## SA Partners:

(PI Prof Ludwig Combrink)



UNIVERSITY OF CAPE TOWN  
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD



RHODES UNIVERSITY  
*Where leaders learn*



UNIVERSITY of the  
WESTERN CAPE

- Each involved in world leading radio astronomy research

# African Partners



GHANA SPACE SCIENCE  
AND TECHNOLOGY INSTITUTE



TECHNICAL UNIVERSITY OF KENYA

Education and Training for the Real World



UNAM

UNIVERSITY OF NAMIBIA



BOTSWANA INTERNATIONAL UNIVERSITY  
OF SCIENCE & TECHNOLOGY

# Industrial Partners



- Industrial partners who are experienced entrepreneurs
- Expose trainees to related industries such as space science and satellite communications



# Project Structure



- Advanced Training
  - PhD and MSc places in the UK
- Basic Training
  - An introduction to radio astronomy for graduates
- Outreach
  - Using radio astronomy to encourage STEM uptake

# Advanced Training

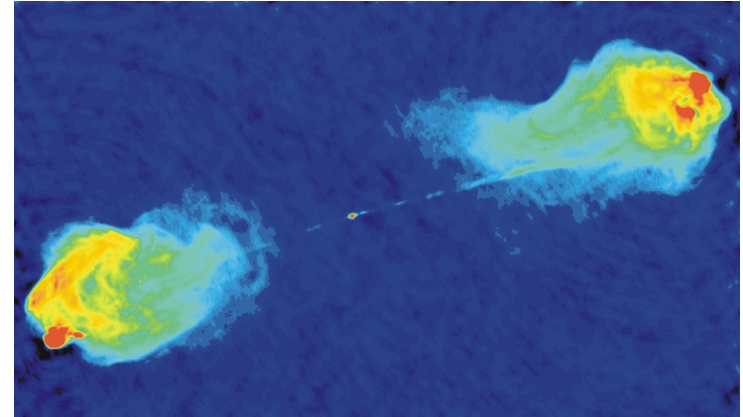
- A number of fully funded PhD and Masters places are being awarded at both UK and SA universities
- 3 UK PhD, 3 UK MSc awarded funding so far + 4 PhD + 4 MSc 2017
- Others in SA
- Students will spend time with partners in the other country to build collaborations



# Basic Training Programme



- Provides an introduction to radio astronomy for ten students per year from each country
- 4 x 2 week courses delivered by experts from UK and SA
- Trainees have a first degree in Physics or relevant related subject



# Training in Zambia



- First cohort started their training in September 2015 delivered by Dr Mark Thompson (University of Hertfordshire)



# And in Kenya



- By Prof Peter Wilkinson (University of Manchester)



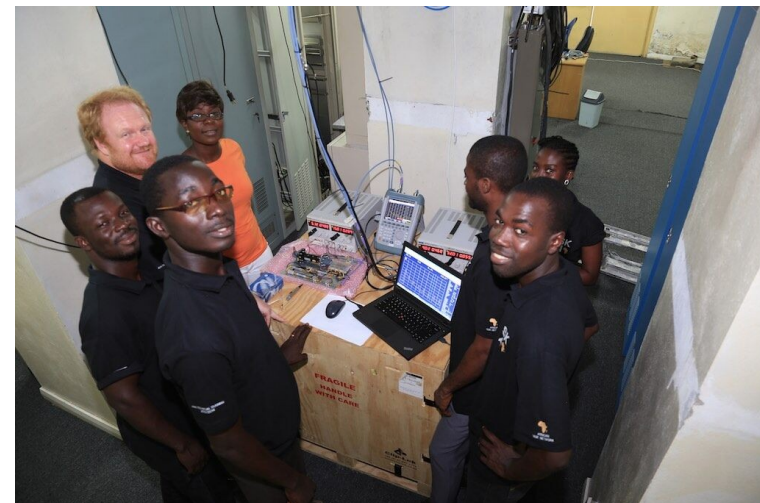
# Astrophysics

- In home country
- Lectures and workshops
- Textbooks and journal subscriptions



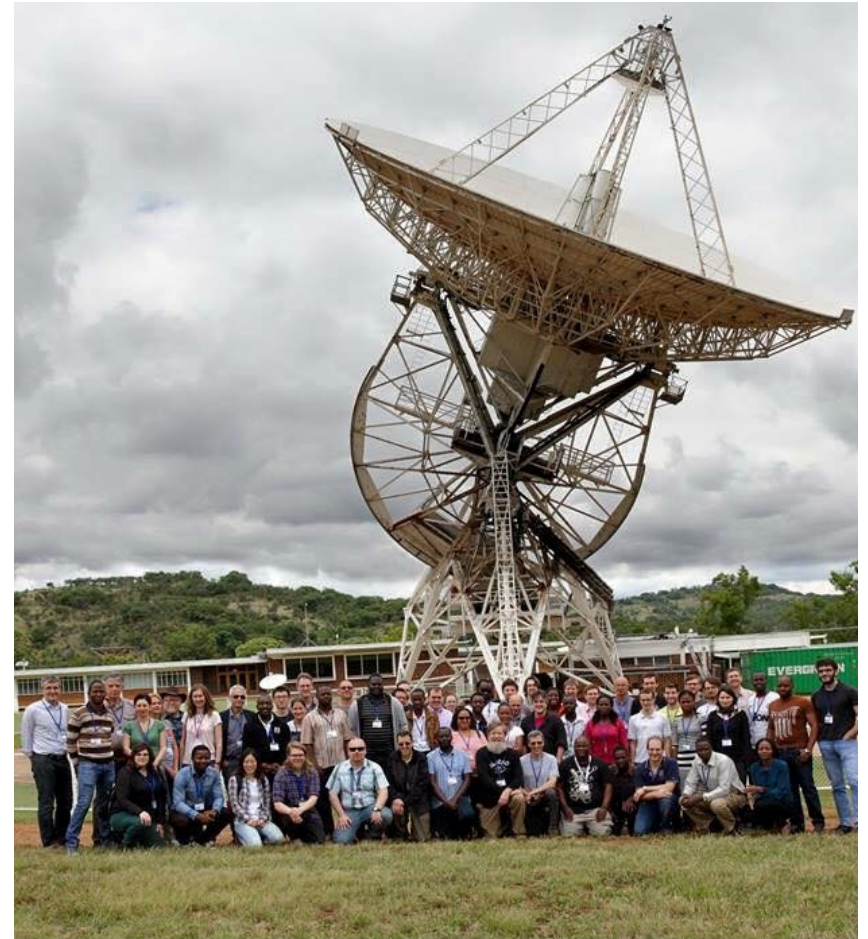
# Technical Training

- At HartRAO in South Africa or Ghana
- Hands-on experience of radio astronomy instrumentation



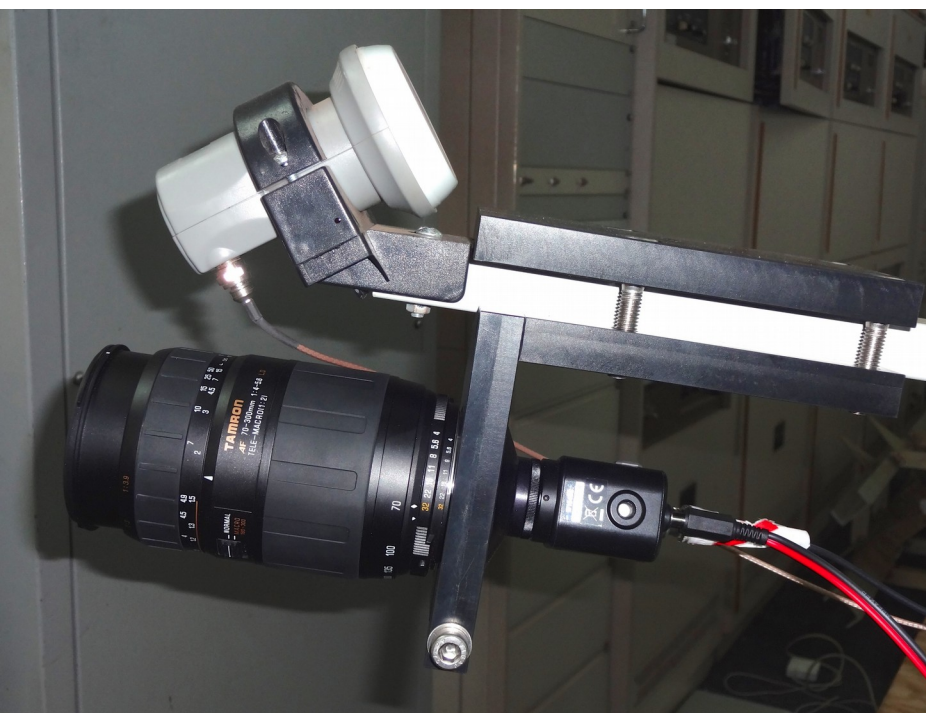
# Observational Training

- Hands-on experience with radio telescopes
- Remote training interferometer at UCT





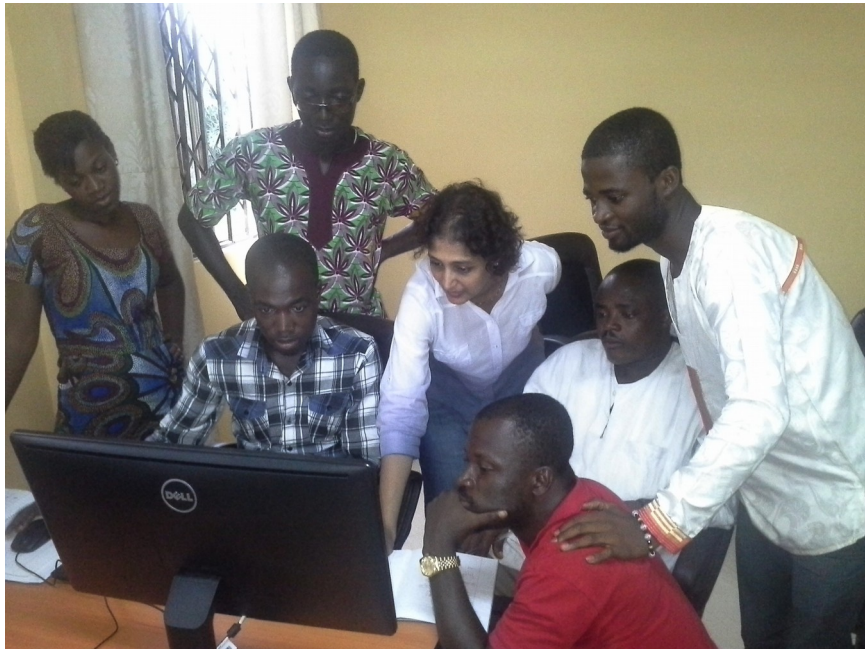
“Baby telescope” in use for outreach, software development, development of the pointing model for the big telescope etc.



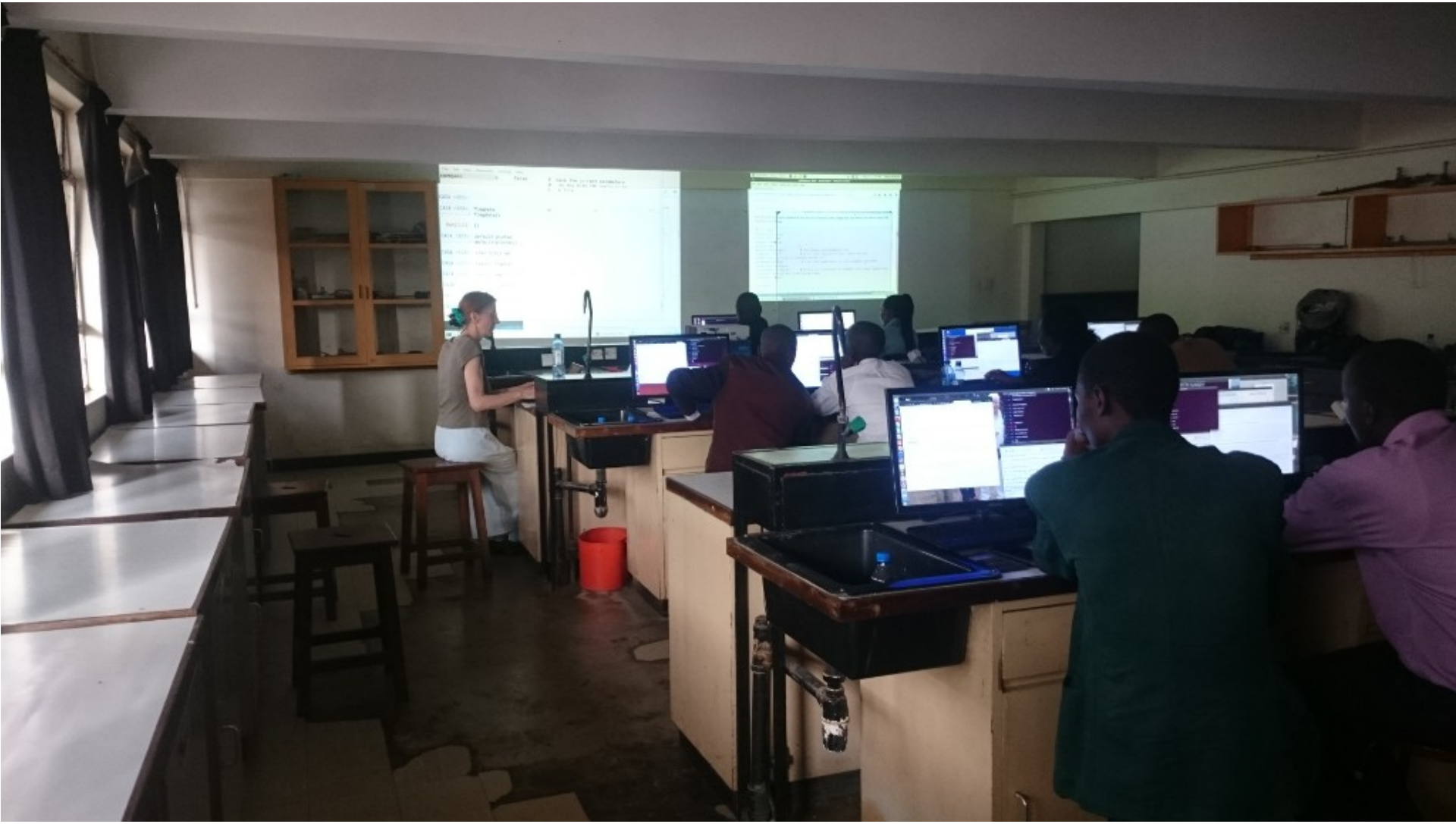
# Data Reduction Training



- In home country
- Computer clusters funded by project
- Note: capital funding very limited via Newton Fund



# Data Reduction Training: Kenya (June 2016)



# Outreach



- Outreach events with schools and the public to encourage STEM take up
- Train the basic trainees and local teachers to build up a network of local outreach providers



Outreach  
Partner:



Office of Astronomy for Development

# Networking



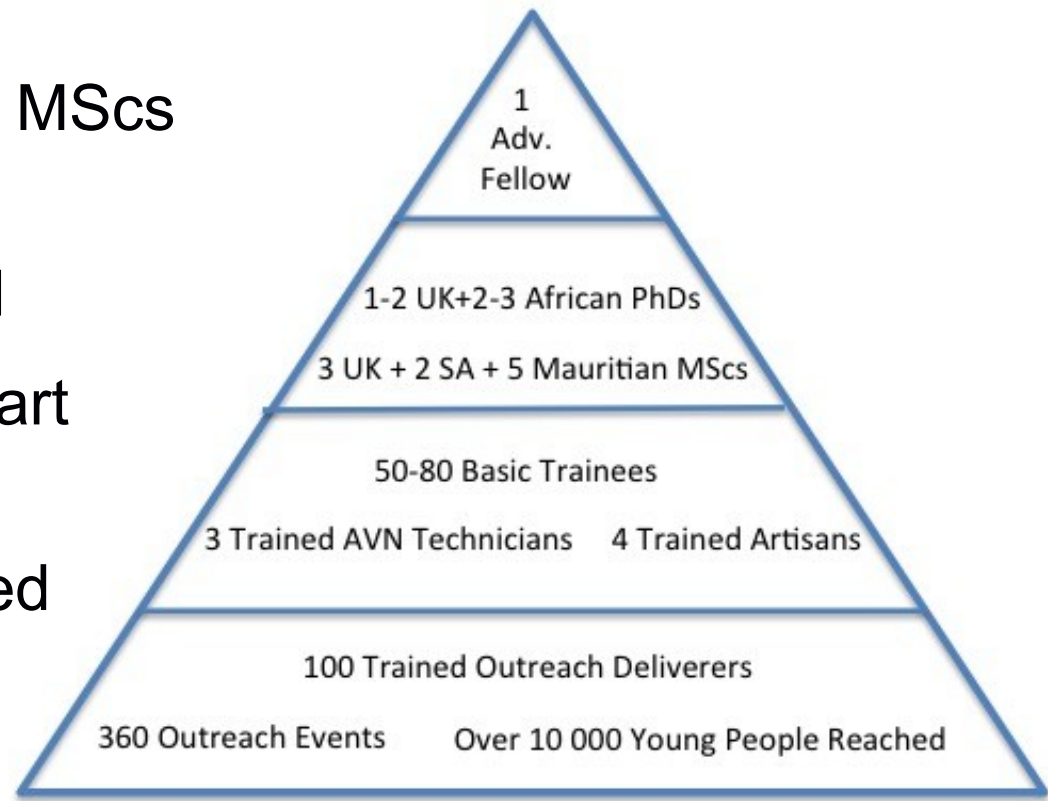
- Annual network training meeting
- Bring together all trainees and partners
- Meet with industry representatives and entrepreneurs



# Status of Project – as of 2016 -



- First cohort of basic trainees just completed training in Kenya and Zambia
- First round of PhDs and MScs about to start in the UK
- Outreach events started
- Namibia/Botswana to start followed by Ghana
- Planning for an enhanced training programme



# ODA Compliance



- DARA comes under the “People Strand” of the Newton Fund – *not a research project*
- Target countries all on DAC ODA Recipient List
- Capacity building aimed at economic development
  - Up-skilling in advanced scientific research techniques
  - Computing skills in Linux and Python
  - Radio technology of relevance to related industries in the space sector, satellite communications, telecommunications....(next slide)
  - Inspire STEM take up in young people

# Impact of radio astronomy



- Telecommunications
  - Via radio and optical fibres
- Space Science
  - Satellite radio technologies
  - Remote sensing from space e.g. for agriculture & monitoring climate change
- Geodetic applications
  - GPS applications and earth sciences
- High performance computing
  - Handling "big data" flows
  - Development of new algorithms e.g. for oil industry

# ODA Compliance



- Sector Specific
  - Partner countries have radio astronomy as a priority through their involvement in the SKA
  - Little or no expertise in partner country at present – a skills gap
- Benefits the Partner country
  - Skilled people remain/return in partner country
  - Any capital investment to be in partner country
  - Build links with local industry

# ODA Compliance



- Sustainable
  - Project and benefits should not stop when ODA funding ends
  - Build self-sustaining groups and institutions
  - Partnership with UK universities and industries to continue after project ends
- Evidence-based
  - Work with social scientists to develop monitoring of the project to measure the impact and demonstrate ODA compliance
  - Leeds Centre for Global Development

# Tips



- Get a project manager
- Set up collaborative agreements and financial arrangements well in advance of training events
- These are long-term, altruistic projects so need a team of committed like-minded people

# Summary



- The programme will deliver:
  - A skilled body of people to operate and conduct research with the African VLBI Network
  - People trained in high tech skills that can be used in the wider space sector
  - Entrepreneurs who can utilize those skills
  - Ambassadors to encourage more young people into STEM subjects

Needs to be long term (10+ years)



# Additional Slides





- Post 2025 Africa will co-host part of the complete Square Kilometre Array with stations in 9 African countries:
- Over next 5-10 years therefore we need to develop
  - Technical skills and institutional capacity in SKA partner countries to optimise African participation.
  - Develop strong radio astronomy science communities.



- Main step: conversions of redundant large (32m diameter) telecommunications antenna systems for science:
  - Ghana, Kenya, Zambia, Madagascar
- Establishing “homes” for the observatories, with funds for engineering, operations and maintenance



## Ghana - Kutunse

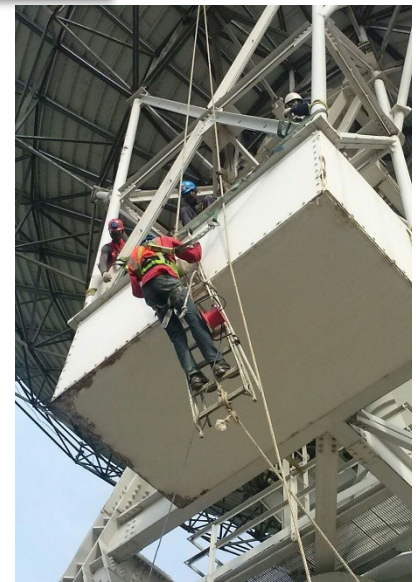
- Major repairs and refurbishment now close to completion
- First science observations in June 2016.

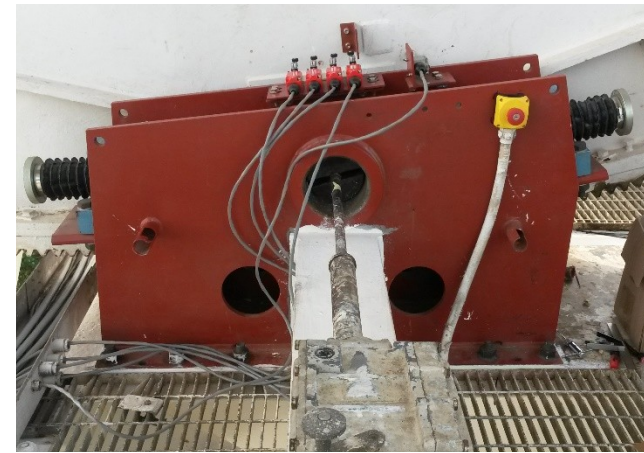
## Zambia - Mwembeshi

- Science impact and spectrum management under way;
- Engage with Zambian Regulator (ZICTA) and Zambian officials to agree next steps.

## Kenya - Longonot

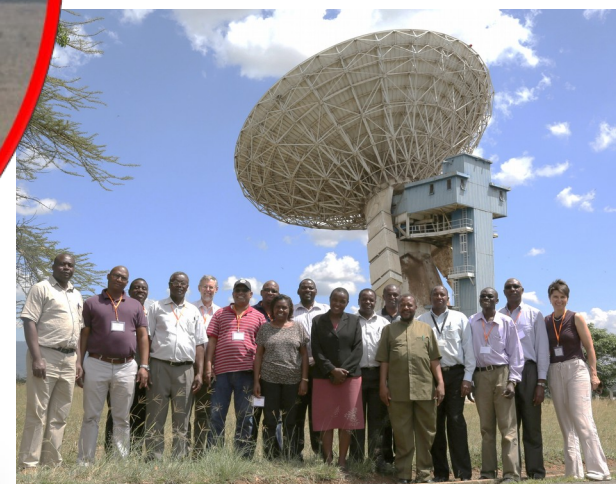
- Final steps by Government to secure site for conversion;
- Project could start when governance issues are settled.







LONGONOT II  
THIS ANTENNA WAS OFFICIALLY OPENED  
BY  
H.E. THE HON. DANIEL T. ARAP MOI, C.G.H. M.P.  
PRESIDENT OF THE REPUBLIC OF KENYA  
AND  
COMMANDER - IN - CHIEF OF THE ARMED FORCES  
ON  
26<sup>th</sup> MARCH 1981



- Post 2020

- AVN for Europe - linked in with
- each wo and engineering



- Post 2020

SKA across Africa and an African scientist make worthy of Nobel Prize



- Develop "current" science infrastructure - the AVN
- Build up a sustainable network of African radio astronomers and technologists with the knowledge, skills and drive to operate & use the AVN and then the SKA



- Newton Fund (UK) and DST (SA) collaboration :
  - Initially ZAR1.5million (SA) and £500 000 (UK)
  - Main participants Zambia, Kenya and Namibia;
- Initial 3-year training programme to develop researchers in radio astronomy fields and related instrumentation,
  - join international science community and ensure optimum use of the new observatories deployed through the AVN & later the SKA



- 8 weeks training per year for the selected trainees;
  - Unit 1: Astrophysics, Radio Astronomy Theory and Multi-Wavelength Astronomy;
  - Unit 2: Observational Methods;
  - Unit 3: Technical (Instrumentation/Engineering)
  - Unit 4: Radio Astronomy Data Reduction and Analysis.
- Unit 1 24/10/16 -4/11/16 at TUK Nairobi
- Units 2 & 3 27 Feb - 24 March (Ghana)
- Annual Network Training Meeting 24-27 March (S.A.)