Opportunities in Africa

Dr Adrian Tiplady
SARAO Deputy Managing Director
atiplady@sarao.ac.za
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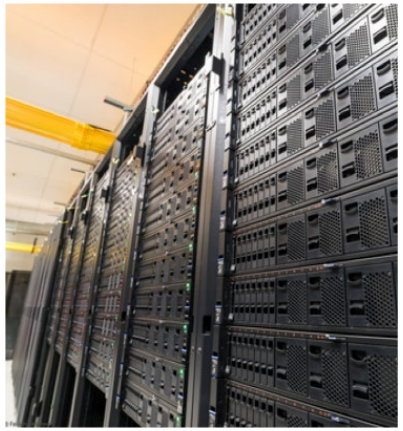
SARAO at a Glance

- **Vision:** Delivering scientific and technical solutions for global astronomy
- Approximately 550 engineering, scientific and related 500 staff
- Delivering a range of high impact programs
  - Positioning SARAO as a reliable partner to global astronomy community
  - Ensuring impact from investments in research infrastructure

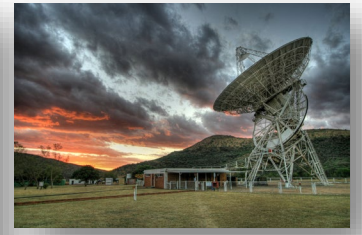
SARAO Astronomical and Geodetic Facilities

MeerKAT Extension



MeerKAT User Supplied Equipment

64 Dish MeerKAT



Hartebeesthoek Radio Astronomy Observatory (HartRAO)

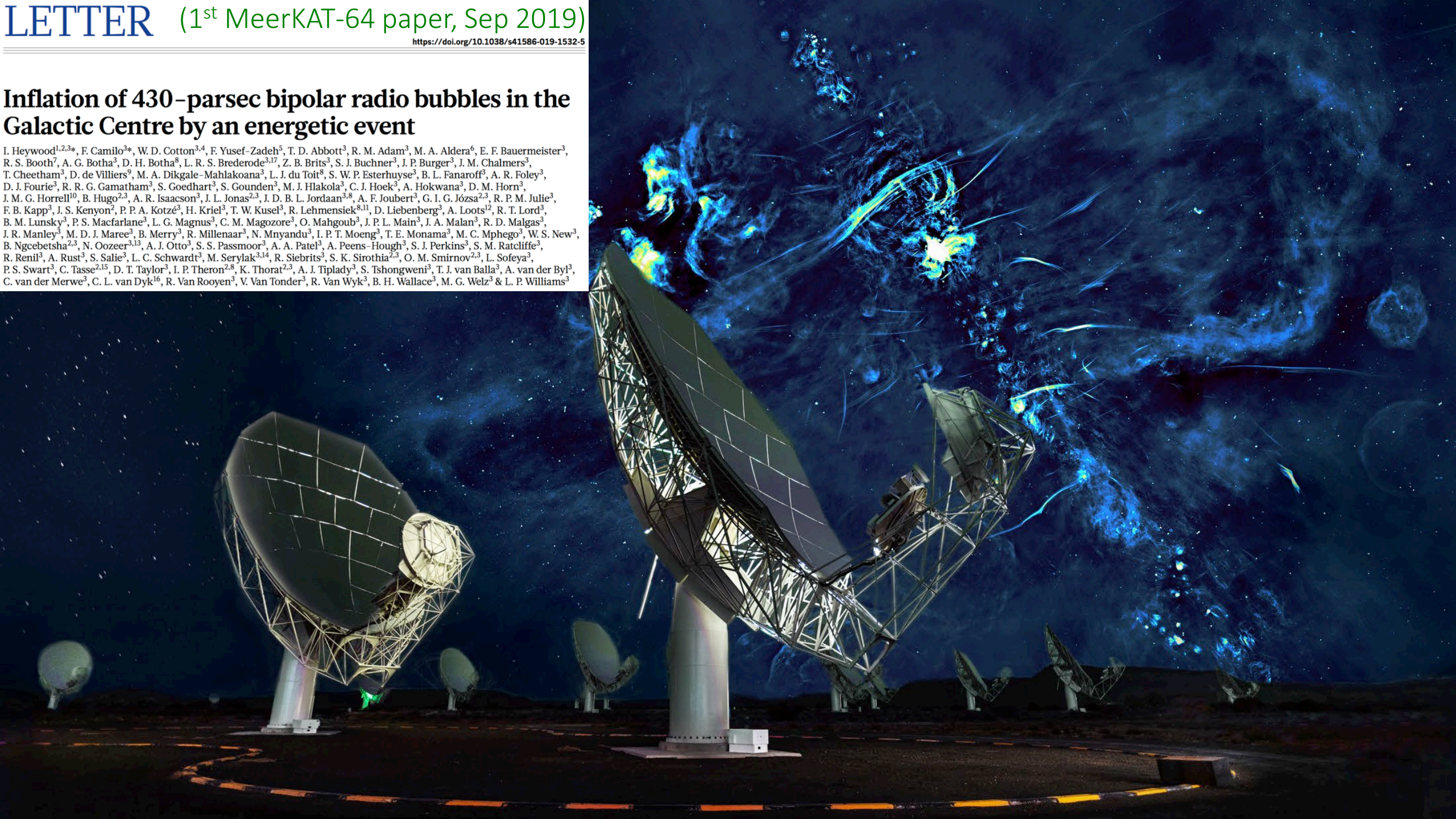
Hydrogen Epoch of Re-ionization (HERA)

LETTER (1st MeerKAT-64 paper, Sep 2019)

https://doi.org/10.1038/s41586-019-1532-5

Inflation of 430–parsec bipolar radio bubbles in the Galactic Centre by an energetic event

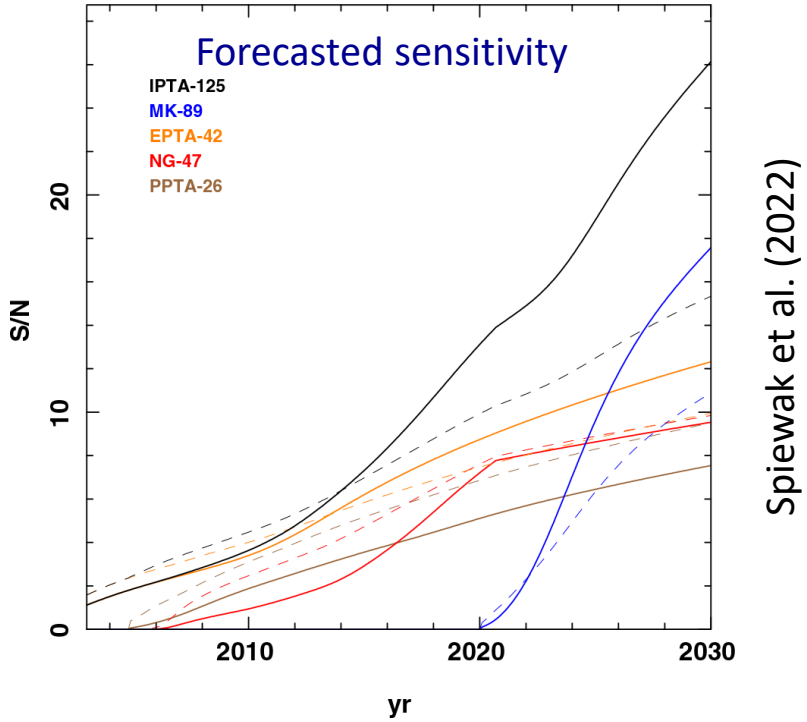
I. Heywood[1,2,3]*, F. Camilo[3]*, W. D. Cotton[3,4], F. Yusef-Zadeh[5], T. D. Abbott[3], R. M. Adam[3], M. A. Aldera[6], E. F. Bauermeister[3], R. S. Booth[7], A. G. Botha[3], D. H. Botha[8], L. R. S. Brederode[3,17], Z. B. Brits[3], S. J. Buchner[3], J. P. Burger[3], J. M. Chalmers[3], T. Cheetham[3], D. de Villiers[9], M. A. Dikgale-Mahlakoana[3], L. J. du Toit[8], S. W. P. Esterhuyse[3], B. L. Fanaroff[3], A. R. Foley[3], D. J. Fourie[3], R. R. G. Gamatham[3], S. Goedhart[3], S. Gounden[3], M. J. Hlakola[3], C. J. Hoek[3], A. Hokwana[3], D. M. Horn[3], J. M. G. Horrell[10], B. Hugo[2,3], A. R. Isaacson[3], J. L. Jonas[2,3], J. D. B. L. Jordaan[3,8], A. F. Joubert[3], G. I. G. Józsa[2,3], R. P. M. Julie[3], F. B. Kapp[3], J. S. Kenyon[2], P. P. A. Kotzé[3], H. Kriel[3], T. W. Kusel[3], R. Lehmensiek[8,11], D. Liebenberg[3], A. Loots[12], R. T. Lord[3], B. M. Lunsky[3], P. S. Macfarlane[3], L. G. Magnus[3], C. M. Magozore[3], O. Mahgoub[3], J. P. L. Main[3], J. A. Malan[3], R. D. Malgas[3], J. R. Manley[3], M. D. J. Maree[3], B. Merry[3], R. Millenaar[3], N. Mnyandu[3], I. P. T. Moeng[3], T. E. Monama[3], M. C. Mphego[3], W. S. New[3], B. Ngcebetsha[2,3], N. Oozeer[3,13], A. J. Otto[3], S. S. Passmoor[3], A. A. Patel[3], A. Peens-Hough[3], S. J. Perkins[3], S. M. Ratcliffe[3], R. Renil[3], A. Rust[3], S. Salie[3], L. C. Schwardt[3], M. Serylak[3,14], R. Siebrits[3], S. K. Sirothia[2,3], O. M. Smirnov[2,3], L. Sofeya[3], P. S. Swart[3], C. Tasse[2,15], D. T. Taylor[3], I. P. Theron[2,8], K. Thorat[2,3], A. J. Tiplady[3], S. Tshongweni[3], T. J. van Balla[3], A. van der Byl[3], C. van der Merwe[3], C. L. van Dyk[16], R. Van Rooyen[3], V. Van Tonder[3], R. Van Wyk[3], B. H. Wallace[3], M. G. Welz[3] & L. P. Williams[3]



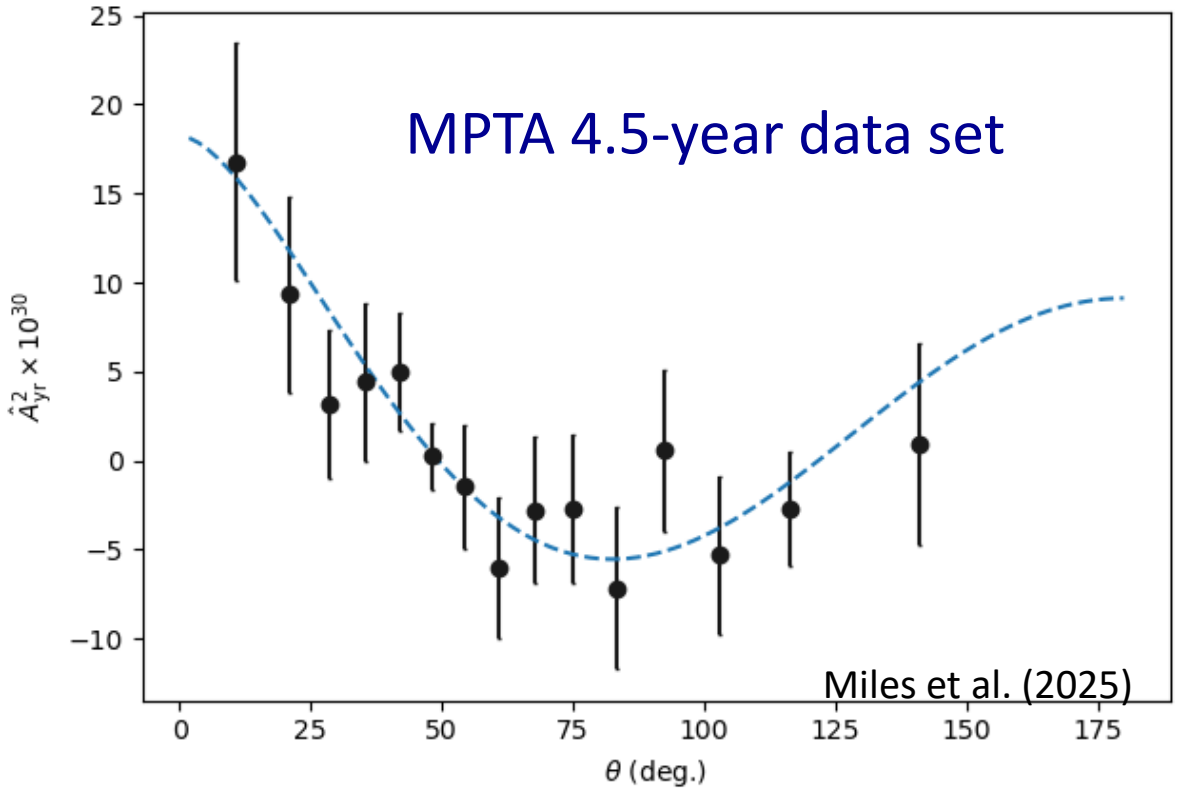

The New York Times
PLAY THE CROSSWORD
Account
OUT THERE
An Electrifying View of the Heart of the Milky Way
A new radio-wave image of the center of our galaxy reveals all the forms of frenzy that a hundred million or so stars can get up to.

Los Angeles County Museum of Art (LACMA)

MeerKAT Pulsar Timing Array



Spiewak et al. (2022)



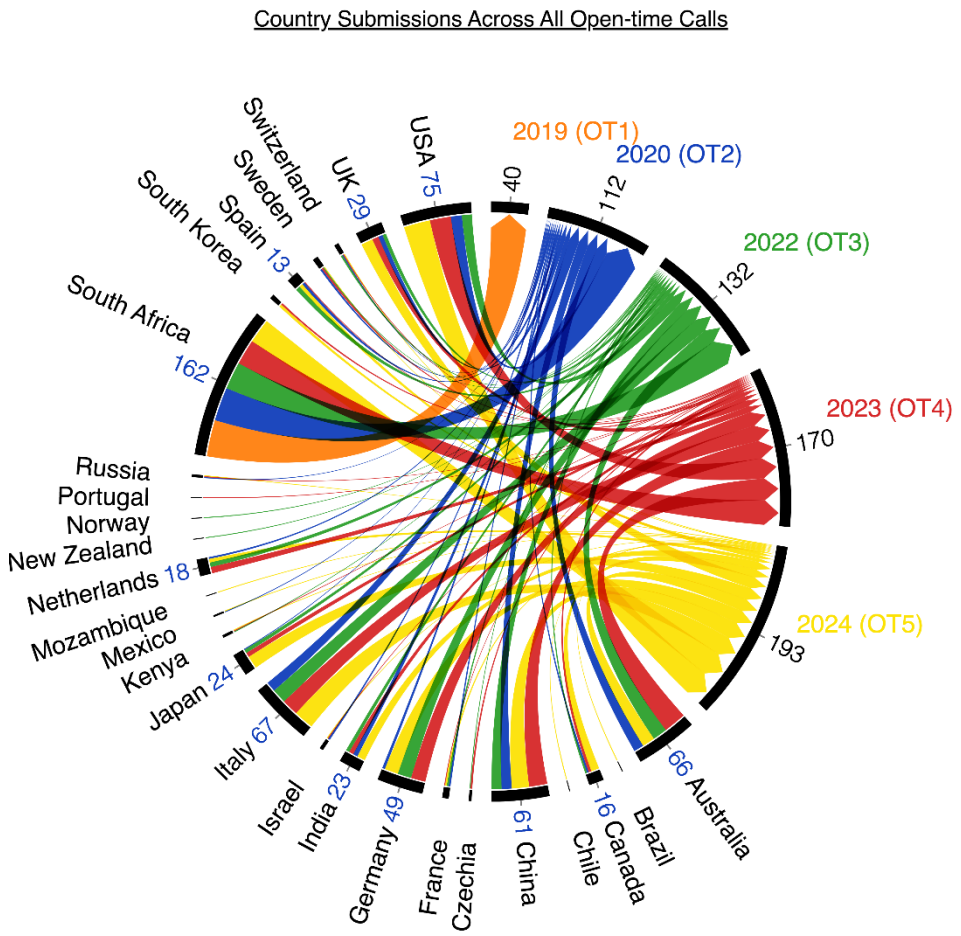
- Predicted to be highly sensitive to *a gravitational wave background (GWB)* – **after only 5 years, becoming the most important contributor to worldwide effort to study GWB**
- Enabled by MeerKAT's superb sensitivity and efficiency (fast slewing) – **the greatest number of millisecond pulsars with sub-µs timing residuals in any Pulsar Timing Array**

- **Timing residuals display evidence for expected** Hellings-Downs (quadrupolar) angular **correlations from GWB**
- Level of correlation depends on assumptions about pulsar noise: **this requires very, very, very careful analysis!**

MeerKAT PTA continued into SKA-MID to play a key role in era of GWB *study*

International Partnership & Cooperation

- Scientific
  - Significant international participation in MeerKAT scientific program
- Technical
  - Engineering capacity makes SARAO a reliable collaborator for new technology developments and instruments
- Skills Development
  - Proven models for international cooperation on skills development initiatives, not only in South Africa but across the African continent



International participation in MeerKAT scientific programs (OT1, OT2, OT3, OT4 and OT5)


EPFL President
Vetterli
EPFL Prof
Kneib
SERI StS
Dell'Ambrogio
Ambassador
Budliger Artieda

Delivering Impact and Sustainable Development

Delivery of impact from radio astronomy investments are informed by 'Impact Framework'

Africa Program

- Vision
  - Sustainable establishment of African science and technology networks and skills, and growth of science and technology capacity in the SKA Africa Partner Countries
- Key Pillars
  - Human Capital Development
  - Research and Technology Infrastructure
  - Funding, Governance and Partnerships

Strategic Interventions (2024-2027)

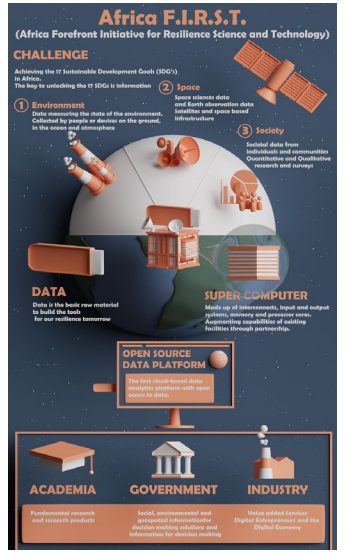
- Human Capital Development
  - Bursaries (>230) in radio astronomy and engineering
    - SARAO, and through international collaborations such as Development of Africa through Radio Astronomy (DARA, UK)
      - 326 basic training, >70 advanced training
  - Big Data Workshops (collaboration with industry)
- Research Infrastructure
  - Recycled High Performance Compute
  - Ghana Radio Astronomy Observatory
  - TART training telescope
  - Two Dish Interferometer training telescope (new)
  - Hydrogen Intensity and Real-time Analysis eXperiment (HIRAX) outrigger in Botswana (new)

Strategic Interventions (2024-2027)

- Partnerships
  - Memorandum of Understanding with SKAO on the Africa Program
  - Memorandum of Agreement on DARA (STFC - UK)
    - Delivering training to further 450 people in high tech skills
    - Encourage business development
    - Establish radio astronomy groups in all SKA African Partner Countries
  - Co-Location Programme
    - Co-location of ground-based satellite stations to support sustainability of science infrastructure

Collaboration Opportunities with SARAO & Partners

- Human Capital Development
  - Researcher and early career scientists mobility grants and residencies, Bursaries
  - E-learning platforms for online science education (particularly schools)
- Research Infrastructure (Training, Funding, Manufacturing, Science collaboration…)
  - Two Dish Interferometer Training Telescope
  - Big Data Workshops – ‘Big Data in the Alps/on Safari’
  - TART Training Telescopes deployment
  - Co-Location Program
  - HIRAX Outrigger(s) - Botswana
  - Africa FIRST & HPC ‘recycling’



"… the project has had a largely positive and significant impact on the national socio-economic conditions and scientific activity. Substantial contribution has been made towards education, skills development and employment opportunities in the country, as well as towards innovation, society and scientific activity."

Independent socio-economic study, 2022