



# Welcome & Introduction

Aletha de Witt  
DARA-AVN May 2019  
Observational & Technical Training HartRAO



**SARAO**  
South African Radio  
Astronomy Observatory

# HartRAO

**A Facility/site of the South African Radio  
Astronomy Observatory (SARAO)**

operated by the

**National Research Foundation (NRF)**

who report to the

**Department of Science and Technology (DST)**



# HartRAO location in South Africa

Latitude  $25^{\circ} 53' 27.1''$  South  
Longitude  $27^{\circ} 41' 12.7''$  East



# HartRAO Site Map

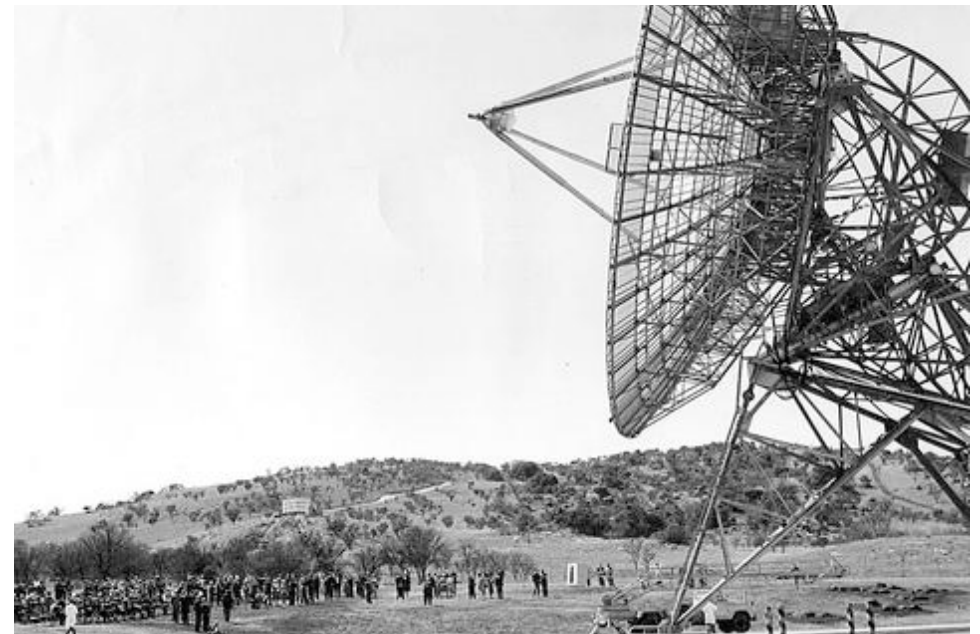
Latitude 25° 53' 27.1" South  
Longitude 27° 41' 12.7" East





HartRAO Image

# 1961 - 1974 NASA Deep Space Station 51 operated by CSIR for NASA

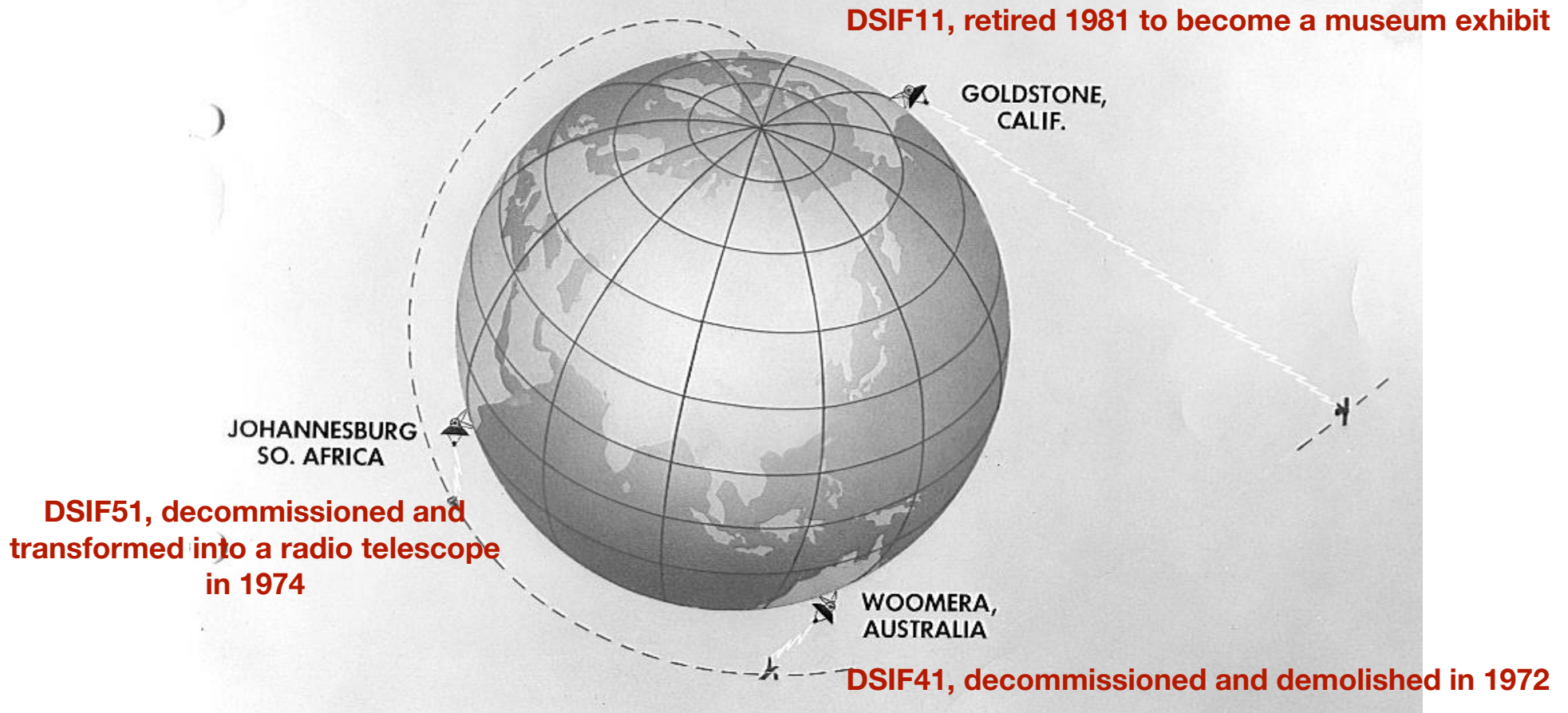


Origins of HartRAO - tracking station



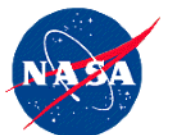
# Station locations of the Deep Space Network

## STATION LOCATIONS OF DEEP SPACE NET



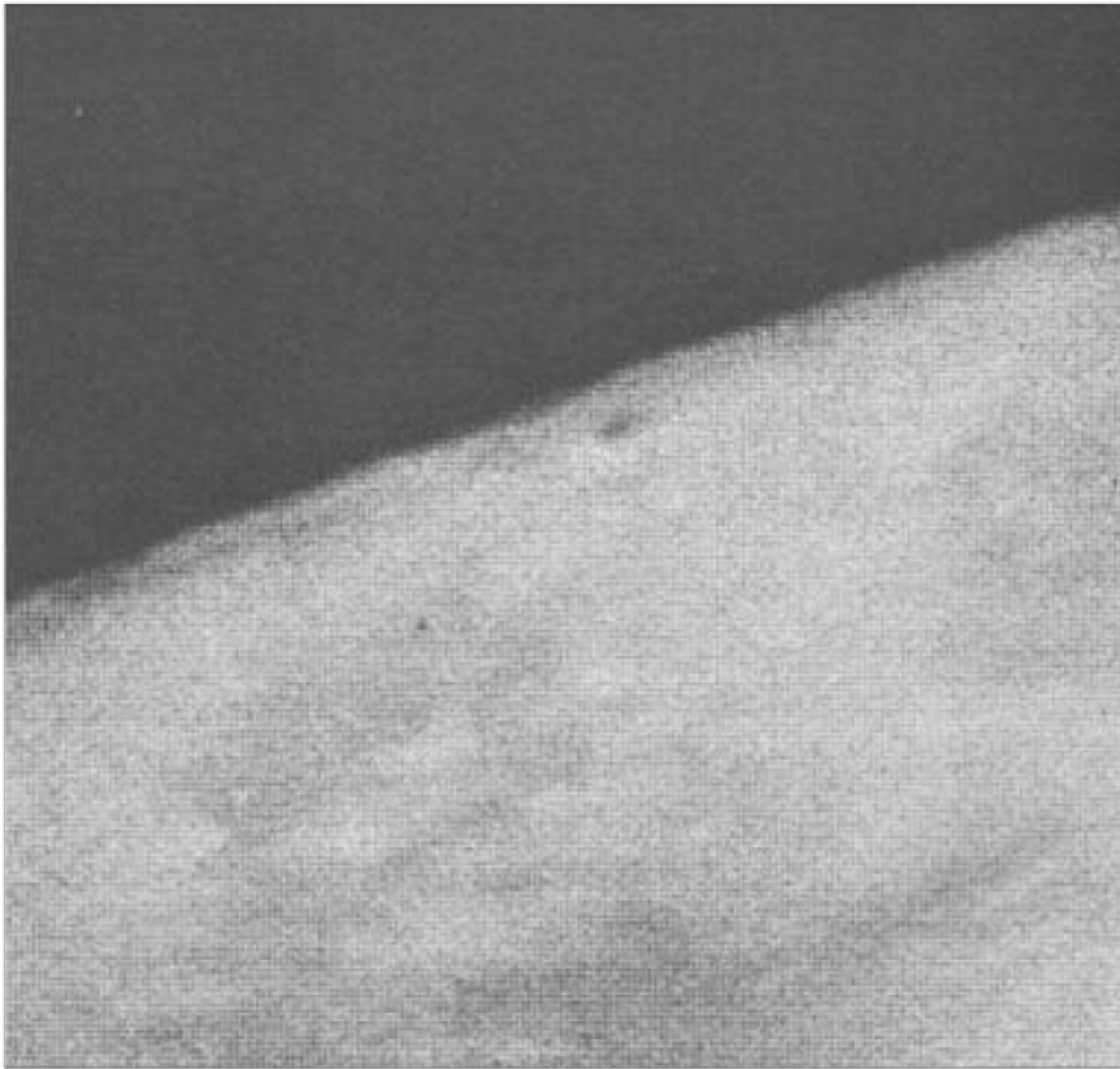
<http://www.hartrao.ac.za/other/dss51/dss51.html>

Origins of HartRAO - tracking station



1961 - 1974 NASA Deep Space Station 51 operated by CSIR for NASA

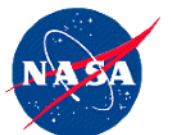
**First pictures of another planet to be taken by a spacecraft !**



**Mariner IV obtained the first closeup photographs of Mars in a fly-by during 1965**

**The very first picture was received here at Hartebeesthoek on July 15 1965, when Mars was nearly overhead at Johannesburg.**

Origins of HartRAO - tracking station





Mariner VI was able to send back colour pictures of Mars.



To Commemorate

LAUNCH  
25 FEBRUARY 1969  
01:29:02 GMT

FIRST  
SPACECRAFT FAR  
ENCOUNTER PICTURE  
29 JULY 1969  
05:28:48 GMT



END OF PRIME MISSION: 31 OCTOBER 1969

### MARINER VI MISSION

Which obtained data during a near fly by of the planet Mars, relevant to the search for extraterrestrial life. Scientific investigations accomplished were dual television resolution imagery, infrared radiometry and spectrometry, ultraviolet spectrometry, S-Band occultation and celestial mechanics. All personnel are commended who participated in this successful mission at the...

### JOHANNESBURG DEEP SPACE STATION DEEP SPACE INSTRUMENTATION FACILITY

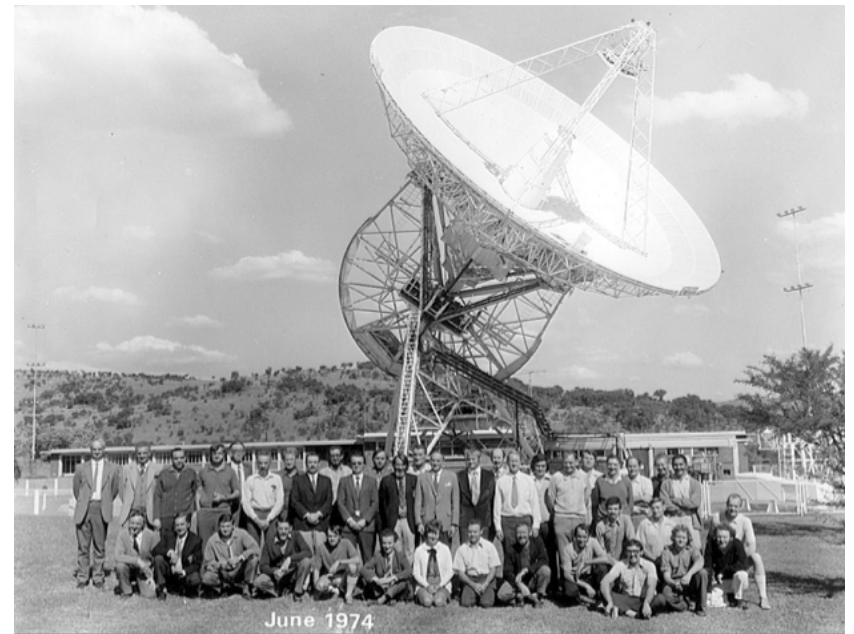
*W. H. Pickering*  
DIRECTOR  
JET PROPULSION LABORATORY

*M. H. Bayler*  
ASSISTANT DIRECTOR FOR  
TRACKING AND DATA ACQUISITION  
JET PROPULSION LABORATORY

Origins of HartRAO - tracking station



# National Facility for Radio Astronomy and Space Geodesy



HartRAO since 1974

<http://deepspace.jpl.nasa.gov/about/history/#>



Jet Propulsion Laboratory  
California Institute of Technology

JPL Home News Images Videos Missions Social

Home About the DSN DSN Now Education Galleries DSN News Commitments Office

DEEP SPACE NETWORK

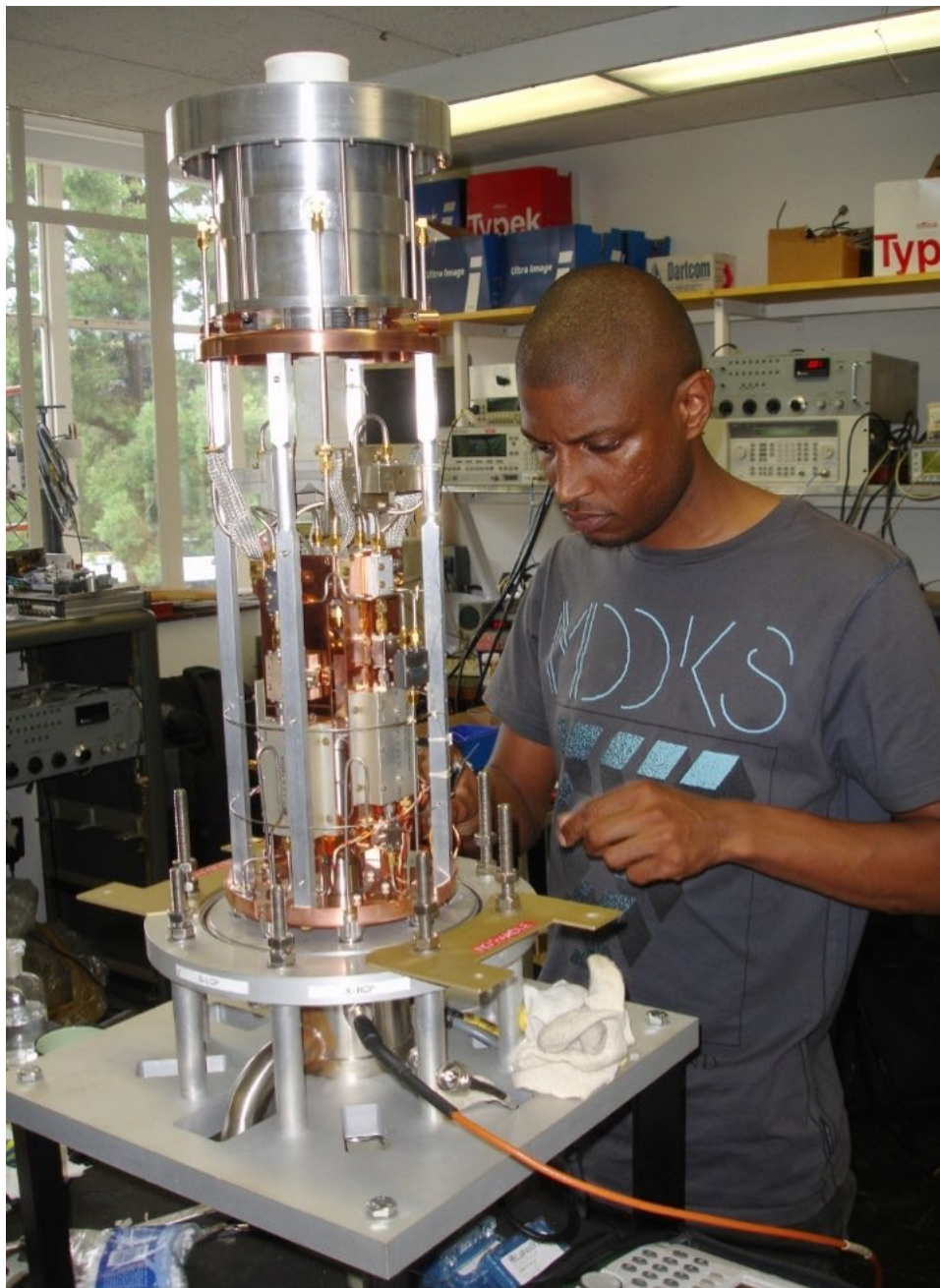
## History

The forerunner of the DSN was established in January, 1958, when the Jet Propulsion Laboratory, or JPL – then under contract to the U.S. Army – deployed portable radio tracking stations in Nigeria, Singapore, and California. That month, when the Army successfully launched Explorer 1, the first successful U.S. satellite, these stations received telemetry and helped mission controllers plot the spacecraft's orbit. NASA was officially established in October of that year to consolidate the separately developing space-exploration programs of the Army, Navy and Air Force into one civilian organization.

[more](#) ▾

HartRAO since 1974

# Continuous upgrading to increase science capability



HartRAO since 1974

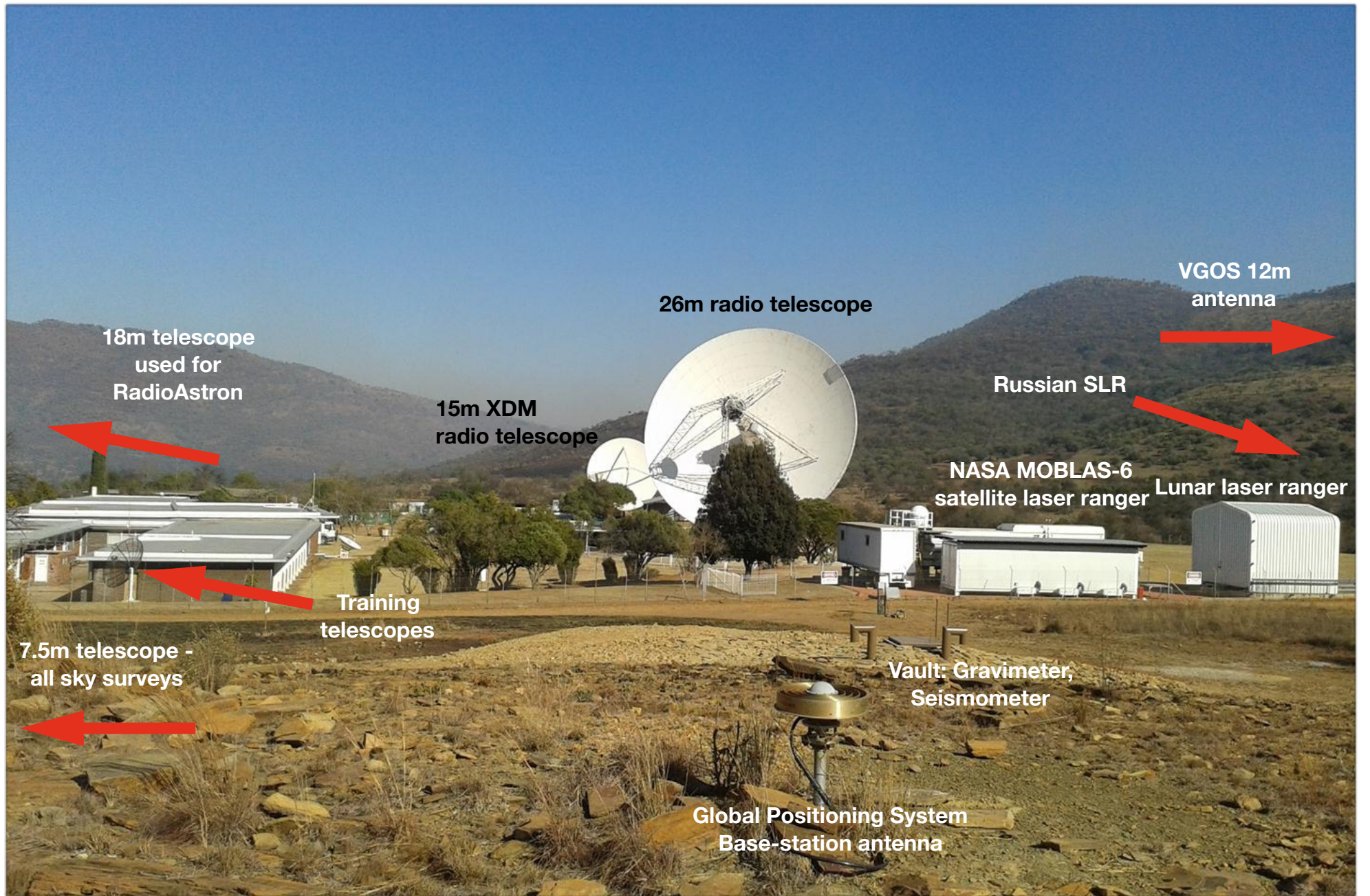


HartRAO today

# What HartRAO does

- Radio Astronomy Research -  
Studying objects in the Universe that produce radio waves (VLBI)
- Space Geodesy Research -  
Using radio astronomy and space techniques to study the Earth (VLBI)
- Engineering and Technical -  
Maintenance, upgrading, testing and development
- Radio Astronomy Development -  
e.g. SKA, AVN, C-bass, VGOS, ICRF-3
- Tertiary Education and Training & Science Awareness and Outreach  
In association with Universities e.g. NASSP, WITS, AVN-Newton Fund/DARA  
public and school visits and workshops for educators





18m telescope  
used for  
RadioAstron

26m radio telescope

VGOS 12m  
antenna

15m XDM  
radio telescope

Russian SLR

NASA MOBLAS-6  
satellite laser ranger

Lunar laser ranger

Training  
telescopes

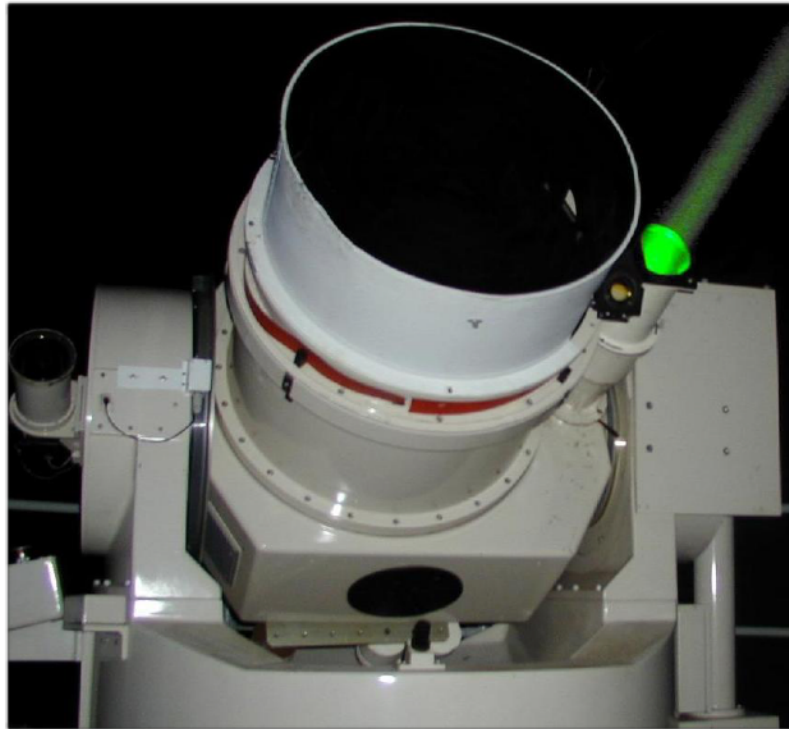
7.5m telescope -  
all sky surveys

Vault: Gravimeter,  
Seismometer

Global Positioning System  
Base-station antenna

# HartRAO Facilities

# HartRAO Facilities



HartRAO/NASA Satellite Laser Ranger

**Global Navigation Satellite System (GNSS)** receivers for GPS, GLONASS and Galileo, at HartRAO and at other locations, for geodesy

**Gravimeter, Seismometer**  
Seismic network across SA,  
Gough and Marion island: 10  
additional seismic stations.

Gough Island **Tide Gauge** installed.



HartRAO  
**Lunar Laser  
Ranger**





# AVN-Newton Fund: Project overview



- **Funding for the SA/UK Newton Fund African VLBI Network (AVN) project was approved in January 2015**
- The aim of this project is to develop researchers in Radio Astronomy fields and related instrumentation, who can become part of the international science community and ensure optimum use of the new observatories deployed through the AVN project.

- **This project is a collaboration involving the following partners in the UK:**

- Universities of Leeds,
- Manchester,
- Oxford and
- Hertfordshire
- as well as the Goonhilly Earth Station Ltd.



<https://www.dara-project.org>

- **And the following partners in South Africa:**

- the Hartebeesthoek Radio Astronomy Observatory (HartRAO),
- Square Kilometre Array (SKA)-SA,
- the Office of Astronomy for Development (OAD),
- the South African National Space Agency (SANSA),
- Universities of Cape Town, Rhodes, Western Cape, North West and South Africa.



# AVN-Newton Fund: Project overview

---



- **Newton Fund (UK) and DST (SA) matching Funds:**
  - Principal SA Investigator: Aletha de Witt (SARAO)
  - Principal UK investigator: Prof Melvin Hoare (University of Leeds)
  
- **Close collaboration with joint delivery and one Steering Committee from SA & UK:**
  - UK/SA 5 year collaboration
  - SA activities funded by DST
  - UK activities funded by Newton Fund
  
- **Training in 2015/16, 2016/17, 2017/18 and 2018/19 in progress** **3 x sessions/yr**
  
- **Participants using the available telescopes at HartRAO and Ghana:** Botswana, Ghana, Kenya, Madagascar, Mozambique, Namibia, Zambia,

A large radio telescope dish is silhouetted against a sunset sky. The dish is the central focus, with its complex metal structure visible. The sky transitions from a deep orange near the horizon to a dark blue at the top. A few other smaller telescope structures are visible in the background.

# Thank You

## Contact Details

Aletha de Witt  
[alet@hartrao.ac.za](mailto:alet@hartrao.ac.za)

Image credit: Lynne Arnold, 2019