

HartRAO Strengthening Astronomy in the North

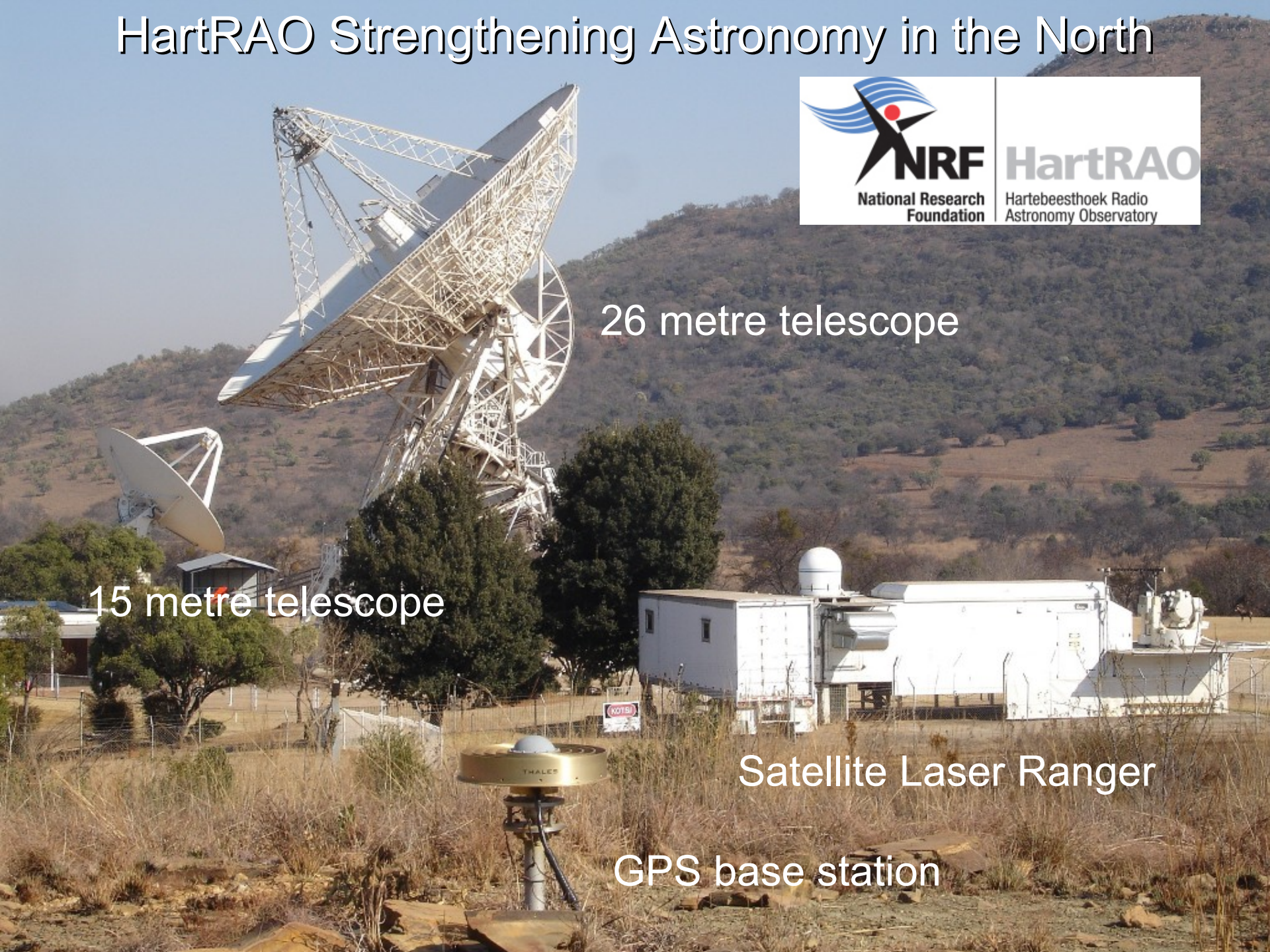


26 metre telescope

15 metre telescope

Satellite Laser Ranger

GPS base station

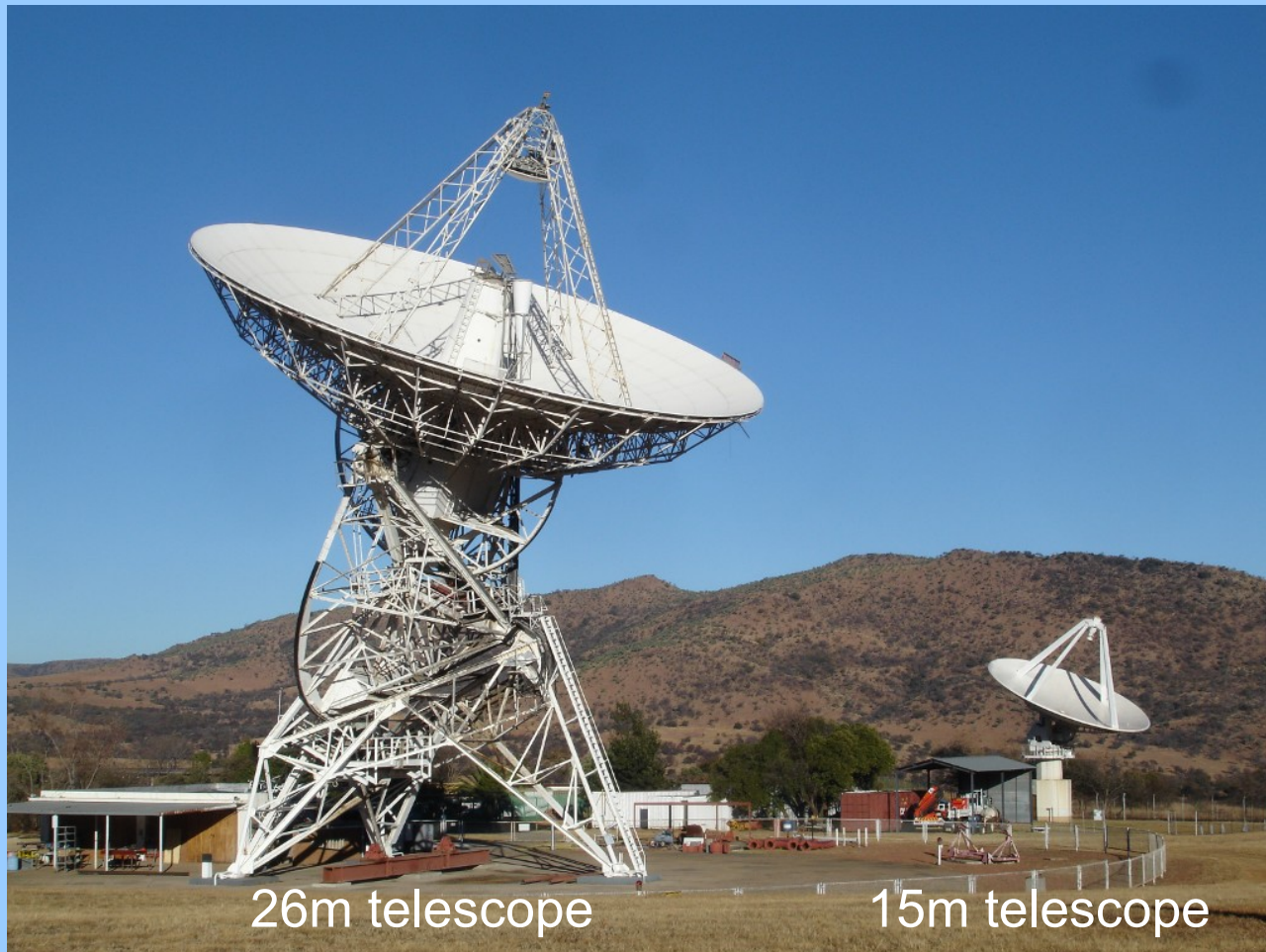


HartRAO Radio Telescopes

for Very Long Baseline Interferometry (VLBI)

Single-dish research

Two-element interferometry – [new opportunity!](#)



Very Long Baseline Interferometry (VLBI) with global networks of radio telescopes

Radio Astronomy VLBI Arrays



Research using VLBI

Astronomy

Detailed images of the emission from radio sources in space:

- Active Galactic Nuclei, Masers, Pulsars, Radio Supernovae...

Fundamental Astronomy - Astrometry

Very precise positions for radio sources in space:

- Celestial Reference Frame – ICRF3 – **new opportunity!**
- Distances through parallaxes - **new opportunity!** ...

Fundamental Astronomy - Geodesy

Very precise positions for the radio telescopes in the network:

- Earth Orientation Parameters, rotation rate UT1 - **near-real time!**
- Terrestrial Reference Frame, Plate tectonic motion,
- Hartbeesthoek 94 datum for surveying, keeping GPS accurate...

Single-dish Research

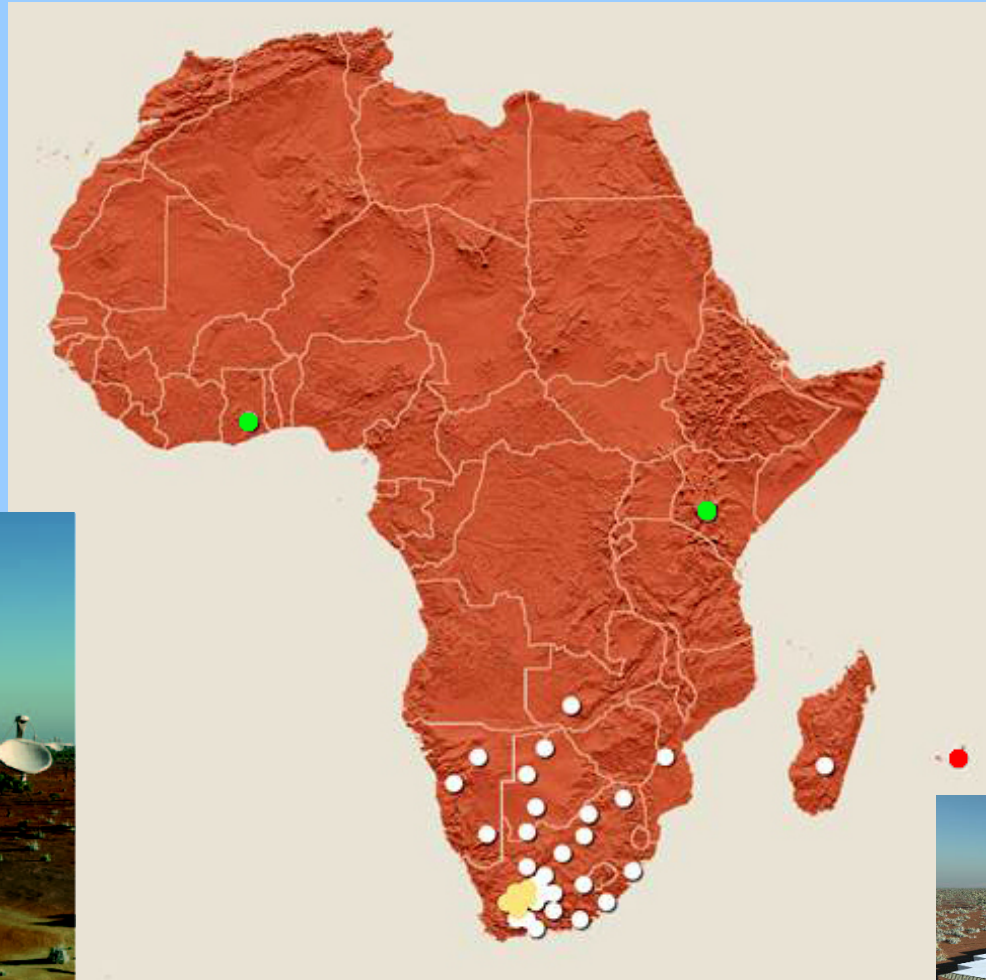
Active Galactic Nuclei producing gamma-ray flares - multi-frequency monitoring of the radio emission – Gaylard, Quick, Nemenashi (NASSP MSc), collaborations

Masers in star-forming regions – monitoring methanol, hydroxyl, water masers – Gaylard, de Witt (NASSP Post-doc), Maswanganyi (NASSP PhD), collaborations

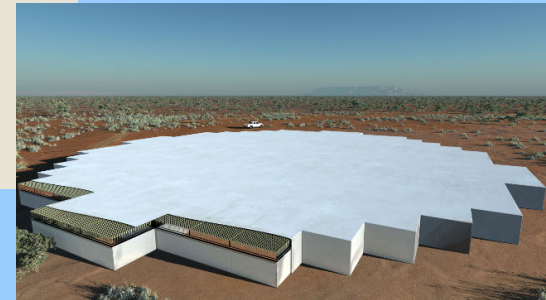
Pulsars - monitoring glitching, timing noise, transients – Buchner PhD), collaborations

Spacecraft transmitter Doppler tracking – VEX collaboration

Square Kilometre Array (SKA) - Sites in Africa



Midband antenna concept for SKA



Midband Tile concept for SKA

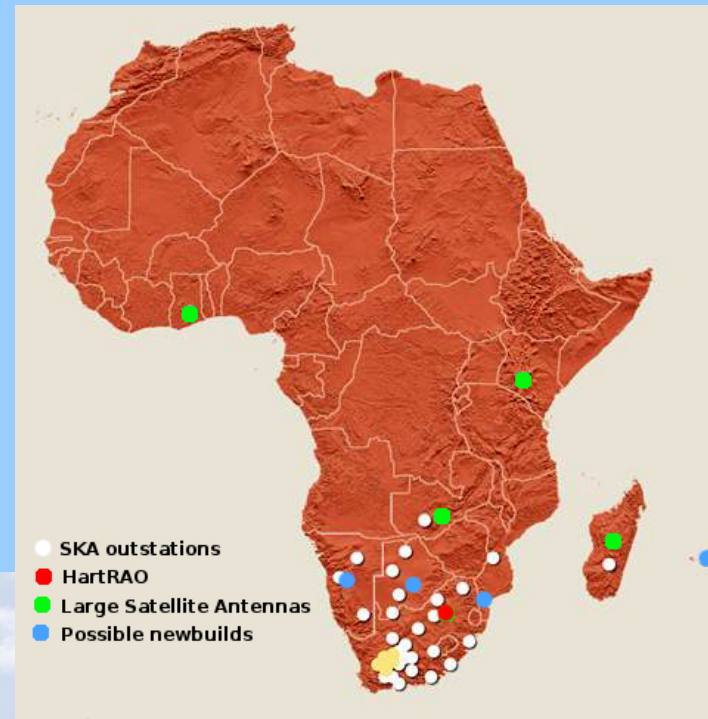
European VLBI Network (EVN)



Map of EVN radio telescopes with Ghana added

32m antenna at Kutunse, Ghana

An African VLBI Network (AVN)?



DST proposal to build capacity for Africa to take advantage of the SKA – partial funding by African Renaissance Fund and DST

Examples of antenna conversion into radio telescopes

Top row are operational as radio telescopes:



Australia Ceduna



Japan Yamaguchi



Japan Ibaraki



USA NASA DSS28



Peru Sicaya – First light
2011/03



New Zealand Warkworth -
handed over 2010/11



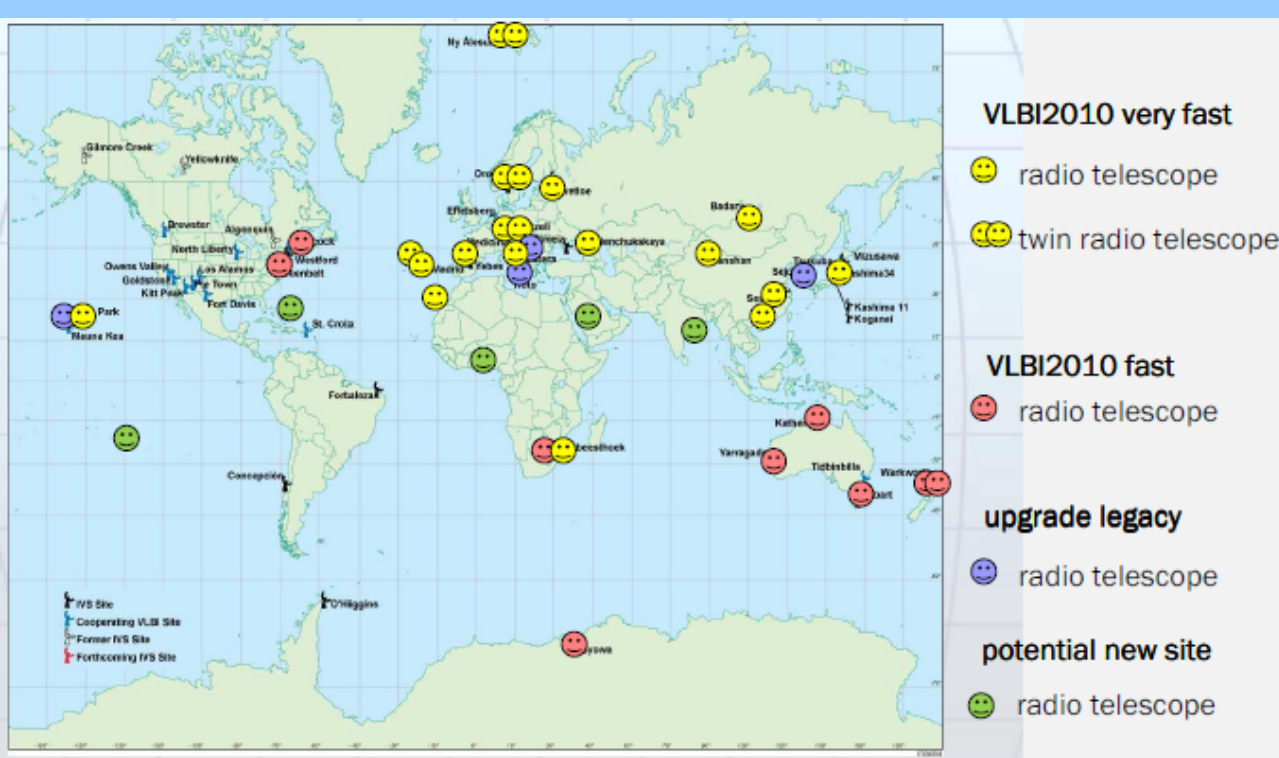
Ireland Elfordstown –
handed over 2011/05



England Goonhilly –
funded 2012

VLBI2010 and the Global Geodetic Observing System

Aim – move from cm accuracy to mm accuracy



12m class rapid slewing telescopes
with 2.3 – 14 GHz receivers

Wetzell, Germany

HartRAO supporting students and outreach

Practicals

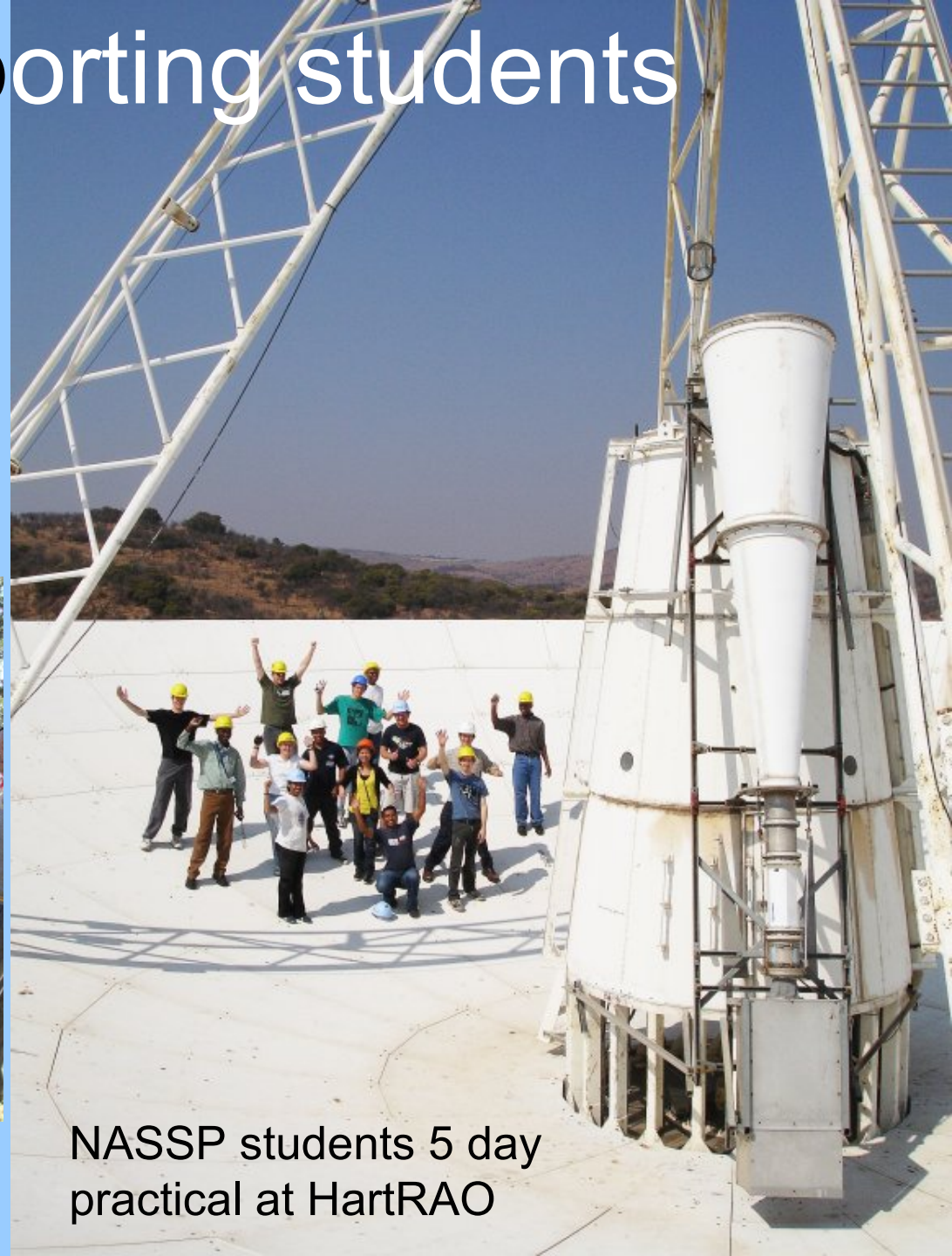
Projects

MSc research

PhD research



How is the Earth oriented in Space?



NASSP students 5 day practical at HartRAO

Strengthening HartRAO

Operations astronomer – current vacancy:

- 50% facility support

- 50% own research

Research astronomers:

- Joint appointments with local universities?

Attracting students

University's interactive science centre – establish astronomy resources, presentations, activities for school groups

Present introductory first year course in astronomy

Establish Science club / society

Establish Astronomy club / society

Put astronomy textbooks, popular magazines into library (but do students still read?)

Provide list of astronomy internet resources – websites, facebook pages, etc.

Get astronomers to visit and give public talks and science talks

We can identify needs – who can supply resources?

Training students

Establish practicals relating to astronomy as part of practical coursework, e.g.

How can we measure the diameter of the Sun with two pieces of paper and a tape measure?

How can we measure the temperature of the Sun – at optical and radio wavelengths?

How can we measure the energy reaching us from the Sun?

Thank you!



12 GHz



4 GHz



1.4 GHz

Training radio telescopes at HartRAO