

# VLBI with SKAMPI telescope

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On behalf of D-MeerKAT WP5 and the TANAMI team.

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# Outline

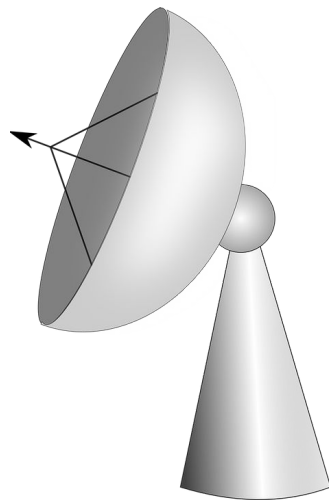
- Introduction to VLBI
- TANAMI program
- SKAMPI telescope
- The first VLBI trial observation
- A TANAMI observation section

# Radio telescopes have lower angular resolutions

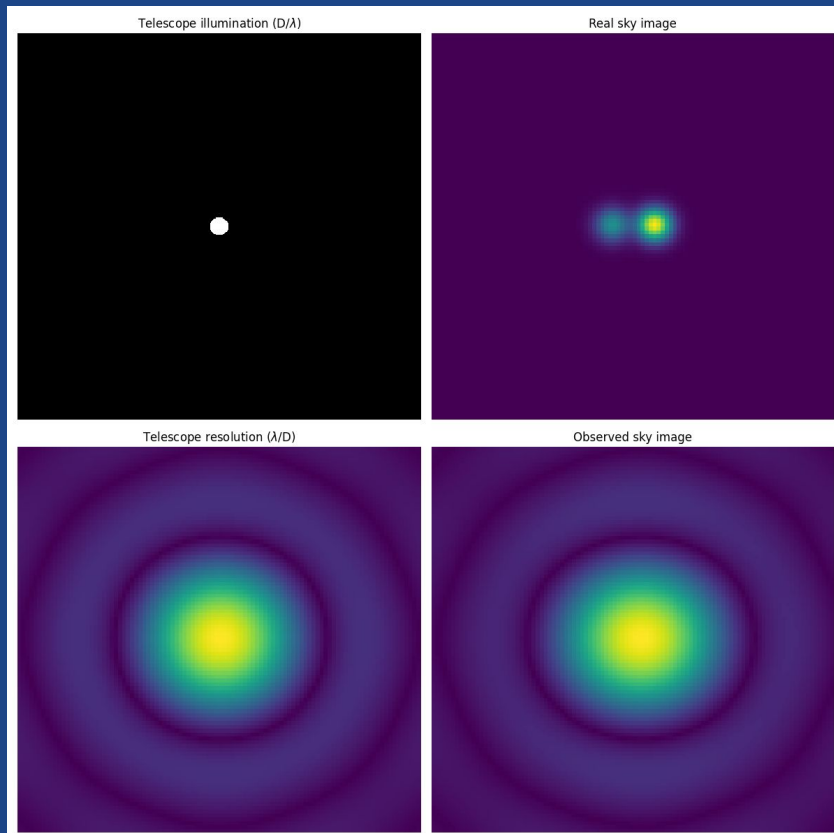


~10M pixels

~1pixel



$$\theta \approx 60^\circ \lambda / D$$

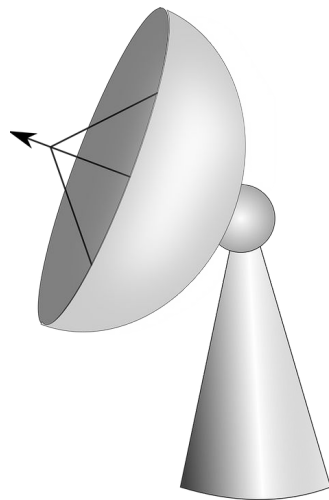


# Radio telescopes have lower angular resolutions

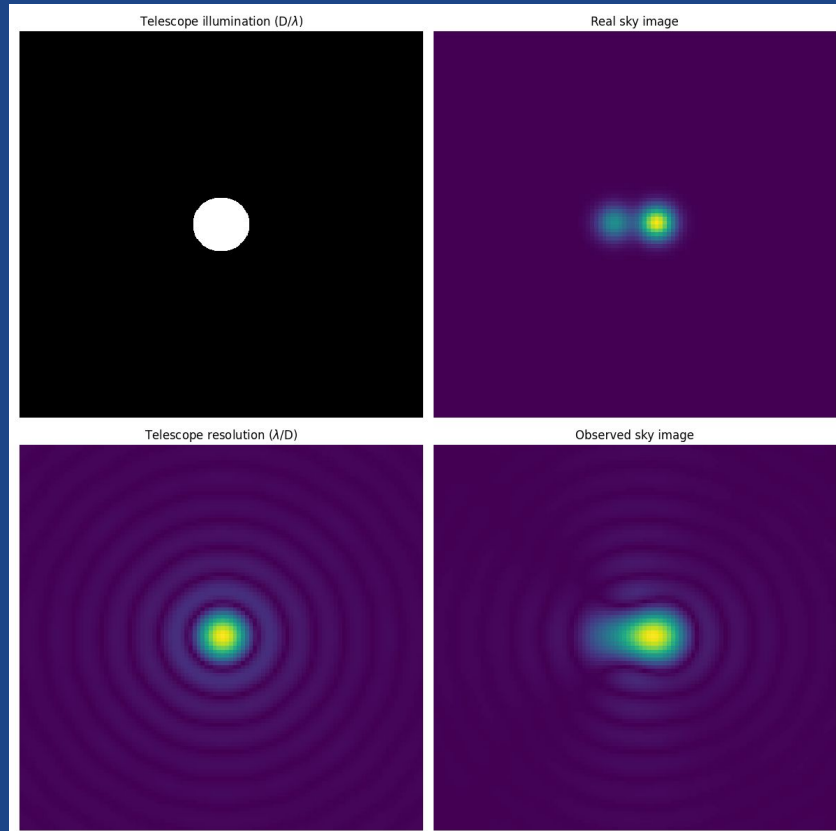


~10M pixels

~1pixel

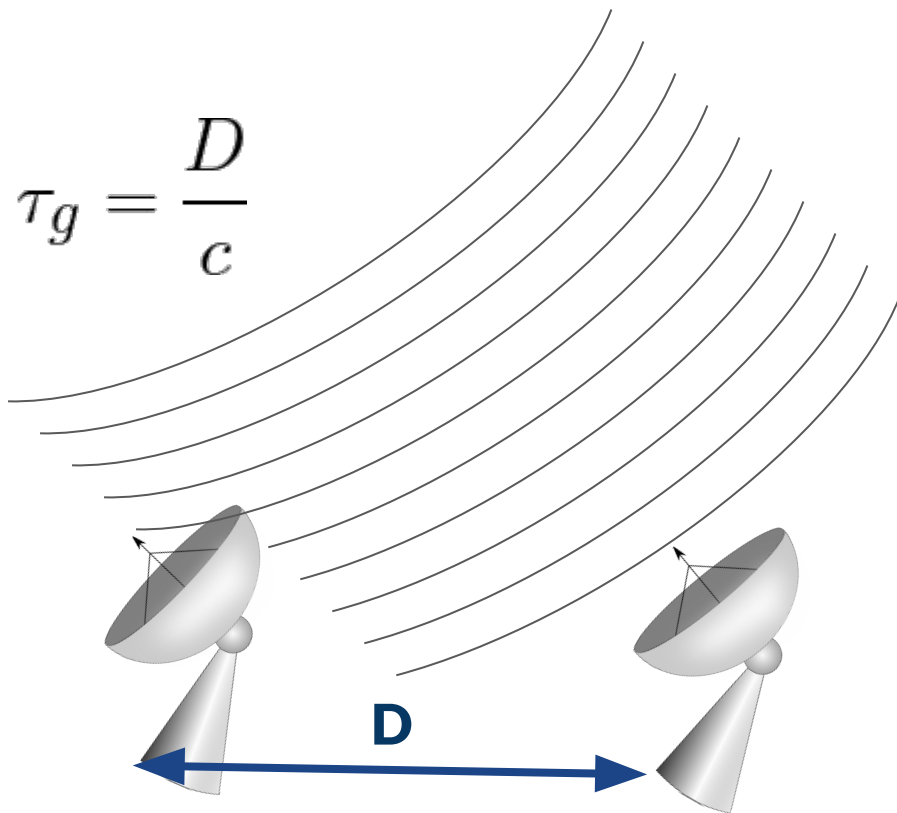


$$\theta \approx 60^\circ \lambda / D$$

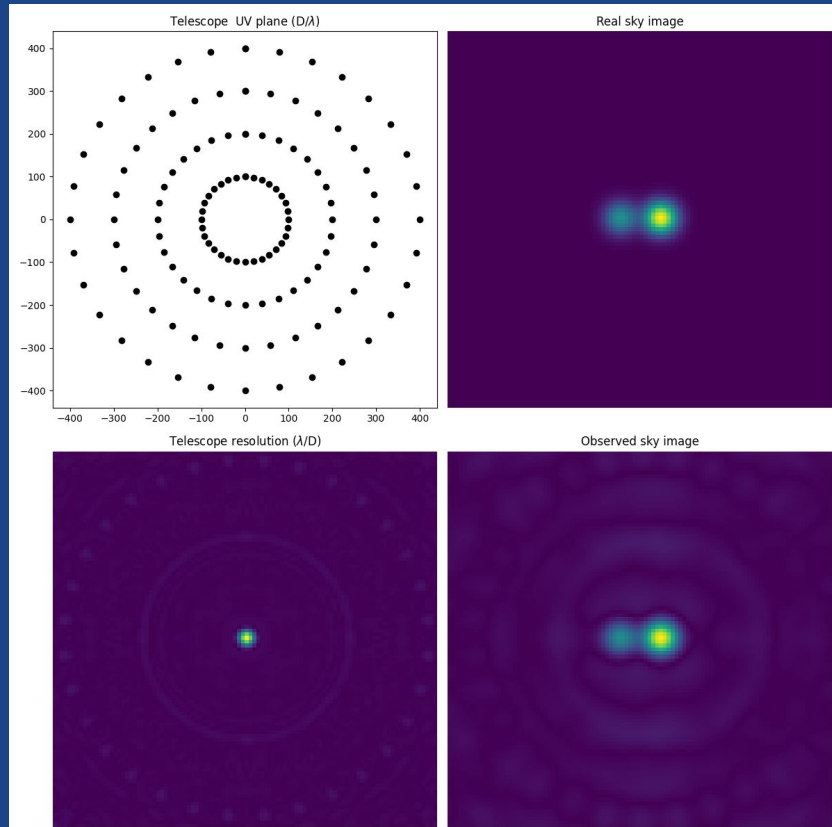


# VERY LONG BASELINE INTERFEROMETER (VLBI)

$$\tau_g = \frac{D}{c}$$

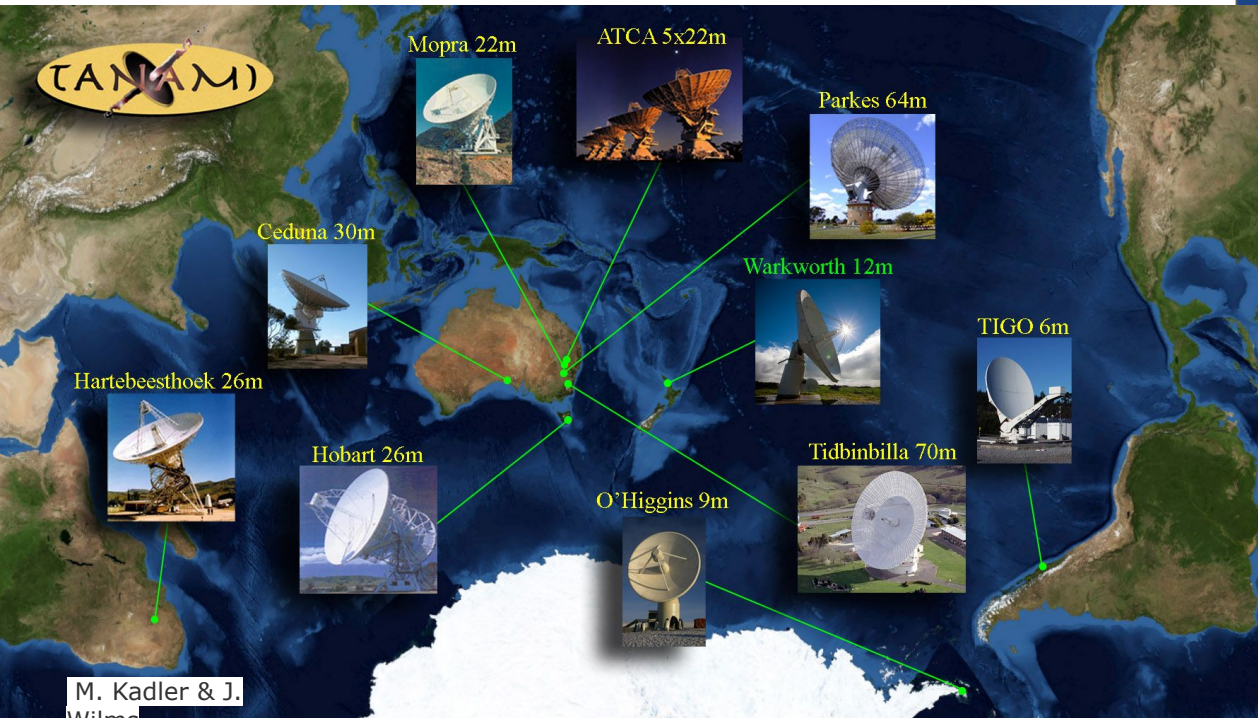


$$\theta \approx 60^\circ \lambda / D$$

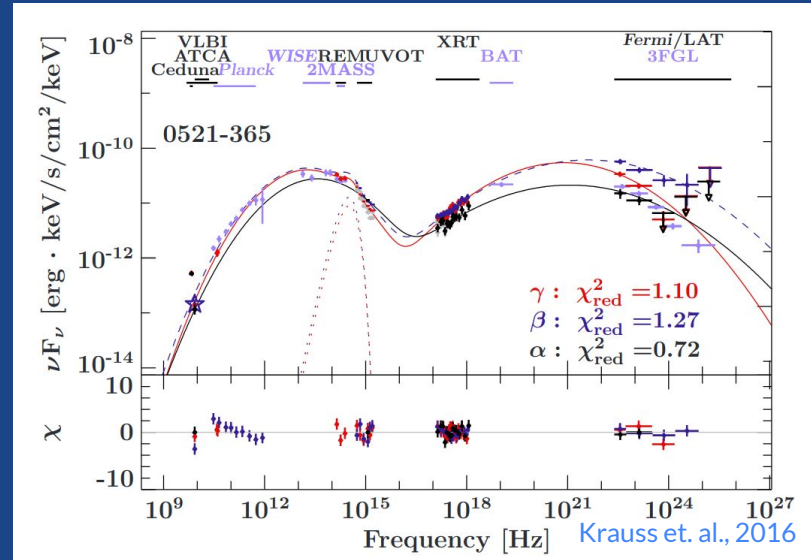
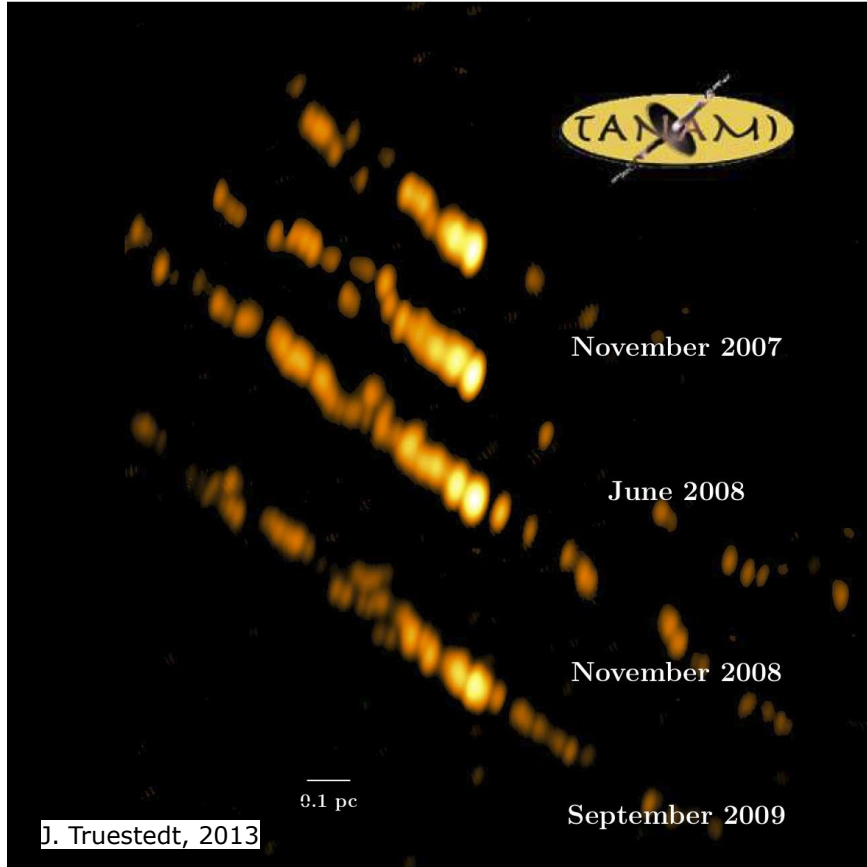


# Tracking Active Galactic Nuclei with Austral Milliarcsecond Interferometry (TANAMI) program

- Multiwavelength monitoring of bright AGNs
- Southern sources
- S-band since 2020 (~2 GHz)

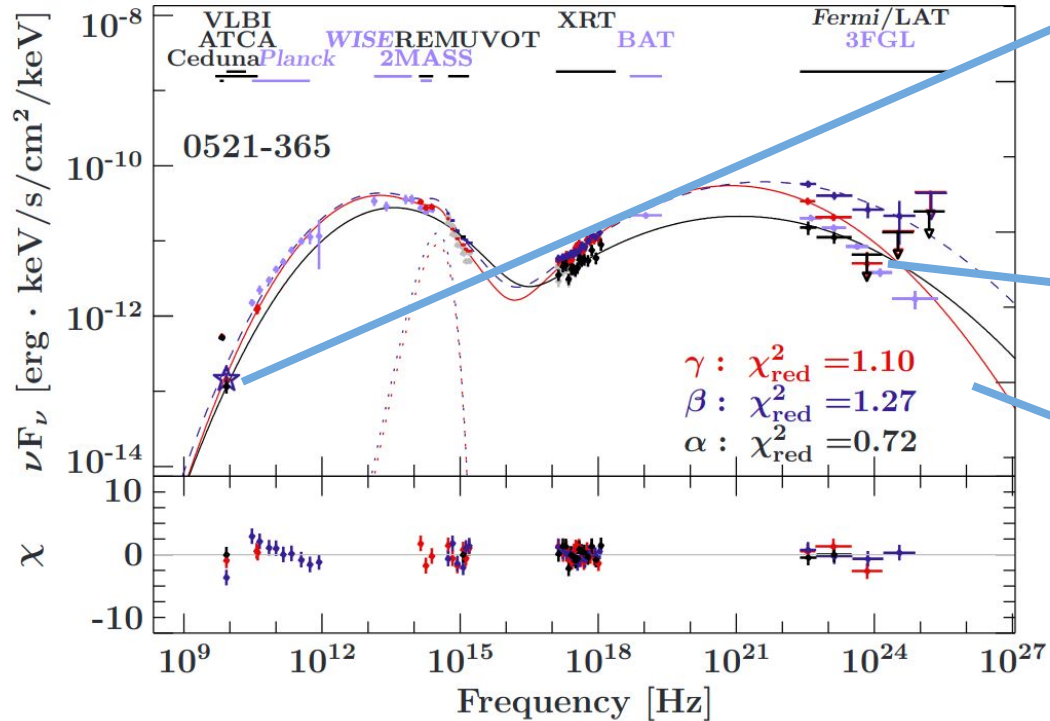


# The TANAMI program

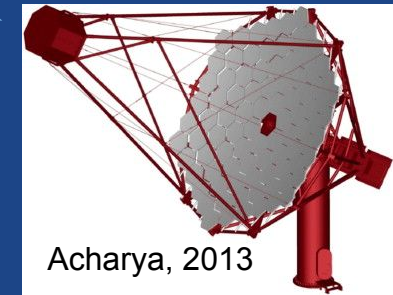
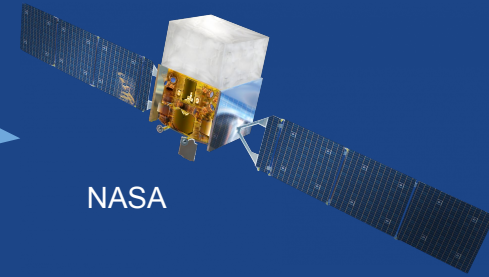
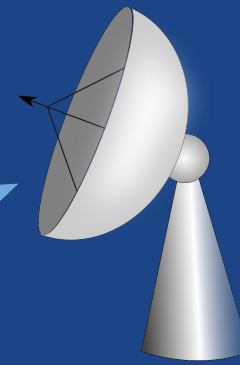


Synergy with Cherenkov telescopes, e.g. CTA

# The TANAMI program



Krauss et. al., 2016



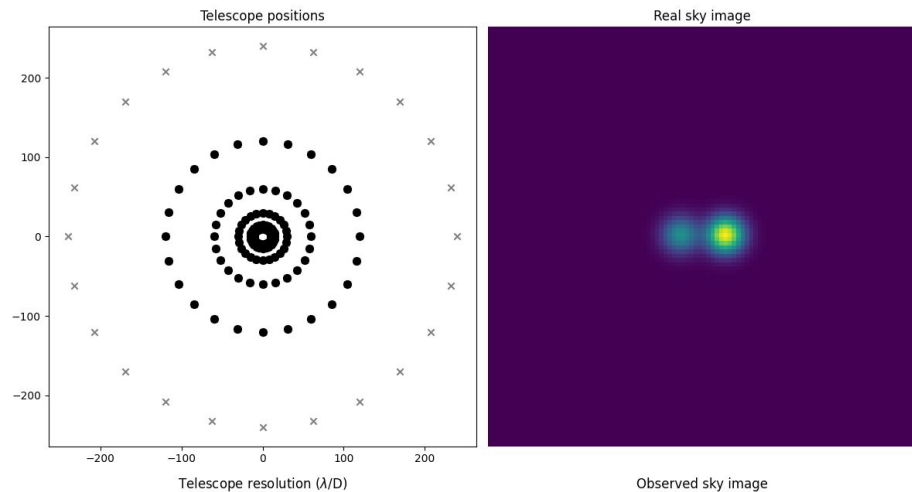
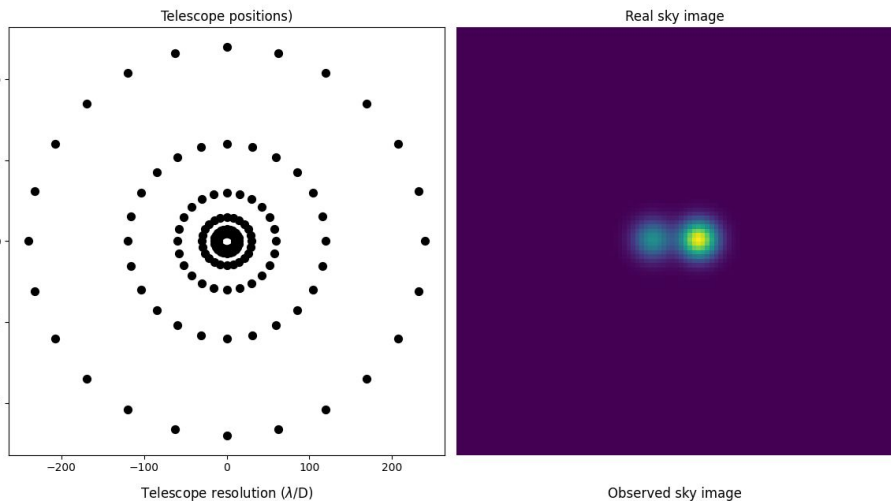


# Tracking Active Galactic Nuclei with Austral Milliarcsecond Interferometry (TANAMI) program



- Only one station in Africa
- Highly dependent on one station

# An array with and without the longest baselines



We want to add a new station in Africa

# The SKA-MPIfR telescope (SKAMPI)

**Dish Side:** 15 m radio telescope at the MeerKAT site in Karoo desert, South Africa

**Receiver:** Equipped with receivers at S-band (1.75–3.5 GHz) and Ku-band (12–18 GHz)

**Funded and operated by the MPIfR, including the implementation of a novel VLBI backend**

See Tobias talk !!!



# The team



**MAX PLANCK INSTITUTE**  
FOR RADIO ASTRONOMY

**MPIfR**

E. Barr, N. Esser, T.  
Winchen, H. R. Klöckner, M.  
Kramer, G. Wieching,



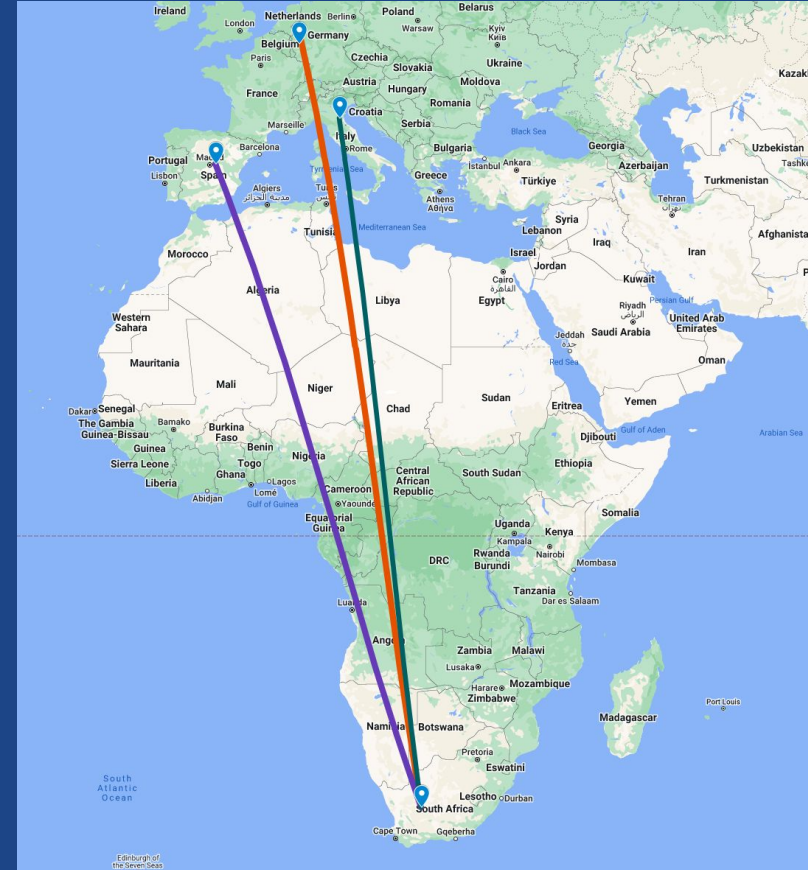
**JMU**

J. Wongphechauxsorn,  
M. Kadler, F. Rösch

**The first VLBI trial observation**

# S-band VLBI trial observations

- Effelsberg, Yebeles, Medicina
- Longest baseline: ~9000 km
- Possible spatial resolution ~a milliarcsecond
- Performed by MPIfR team

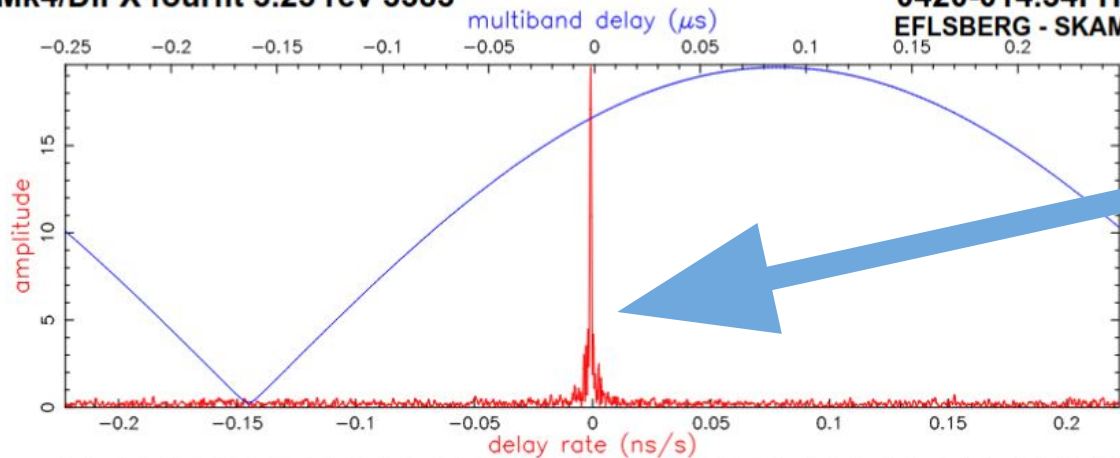


# First fringe with the Effelsberg 100-m

Mk4/DiFX fourfit 3.23 rev 3383

Credit: J. Wagner & U. Bach @mpifr

0420-014.34111b, No0009, BS  
EFLSBERG - SKAMPI, fgroup S, pol LL



Fringe quality 9

SNR 113.3

Int time 569.964

Amplitude 1000

Phase 169.4

PFD 0.0e+00

Delays ( $\mu\text{s}$ )

SBD -0.043208

MBD 0.086765

Fringe rate (Hz)

-0.001747

Ion TEC 0.000

Ref freq (MHz)

2247.0000

AP (sec) 1.000

Exp. te019

Exper # 2000

Yr:day 2024:050

Start 152500.00

FRT 152945.00

Corr/FF/build

2024:051:165345

2024:052:070948

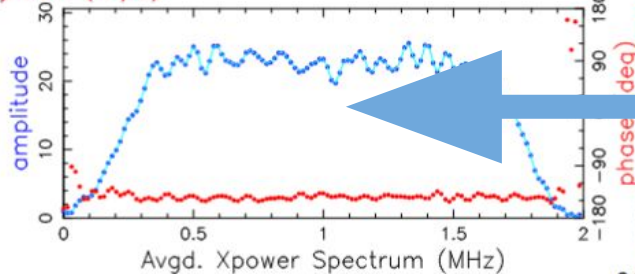
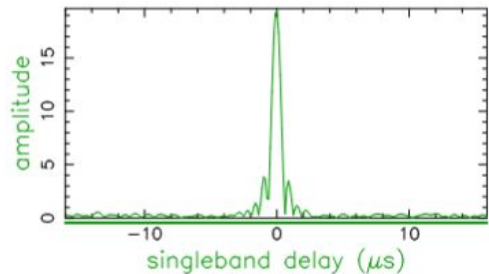
2023:348:201045

RA & Dec (J2000)

04h23m15.800724s

--1°20'33.065613"

Time lag of ~ns



Fourier transform

Amp. and Phase vs. time for each freq., 72 segs, 8 APs / seg (8.00 sec / seg.), time ticks 10 sec

n

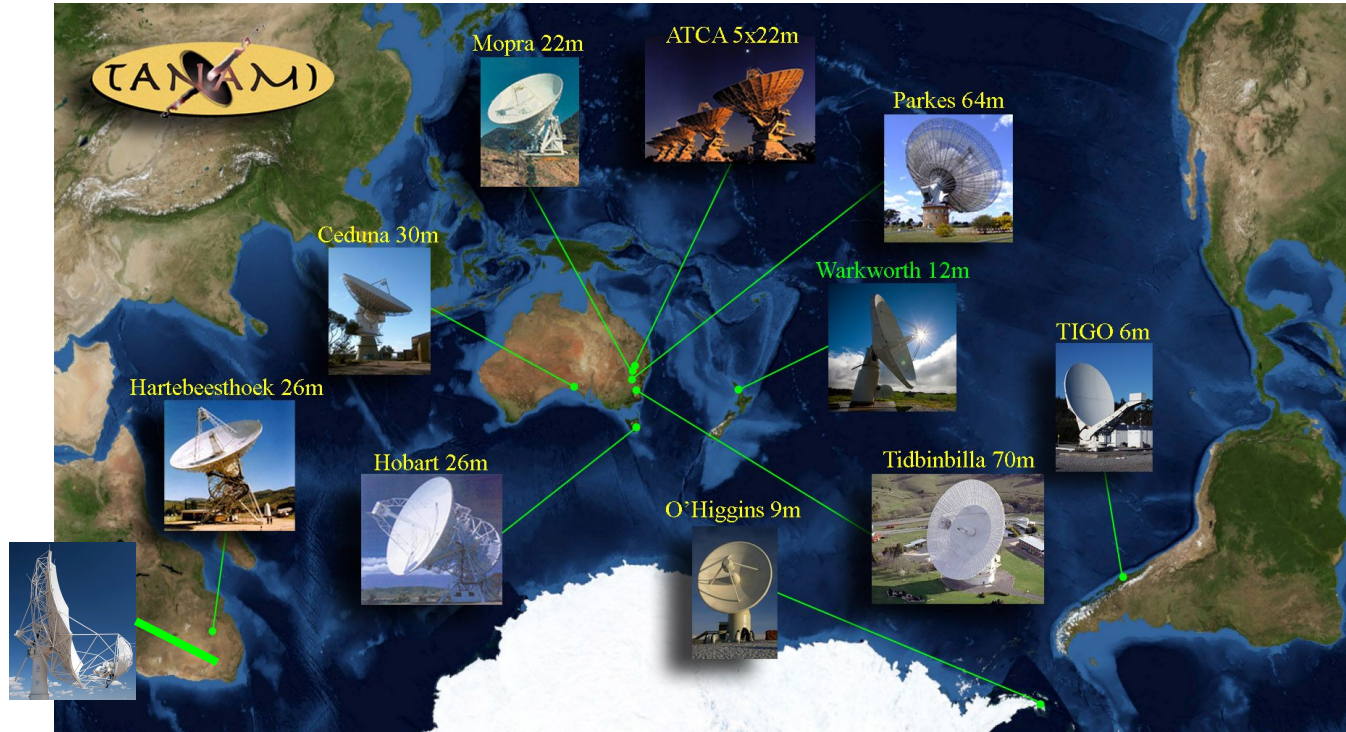
h

All



Participating, a TANAMI S-band observation

# First trial observation of SKAMPI with TANAMI array



# First trial observation of SKAMPI with TANAMI array

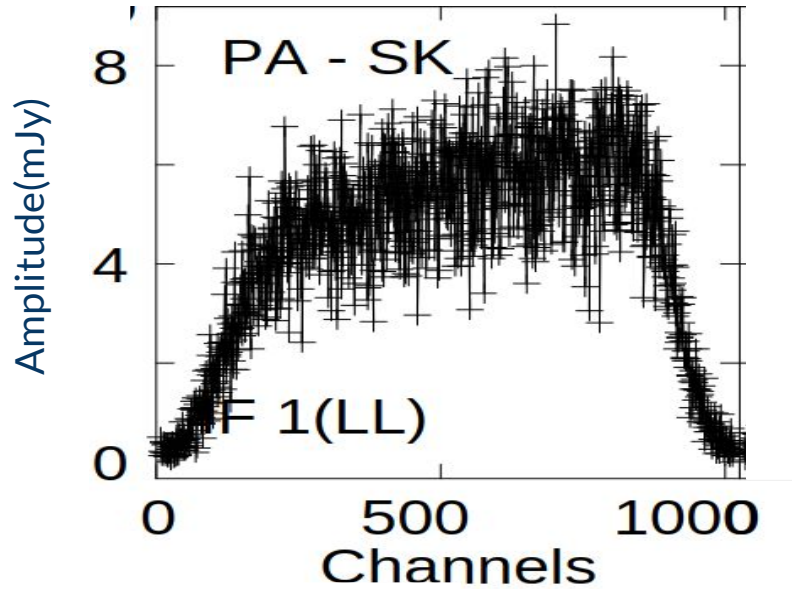
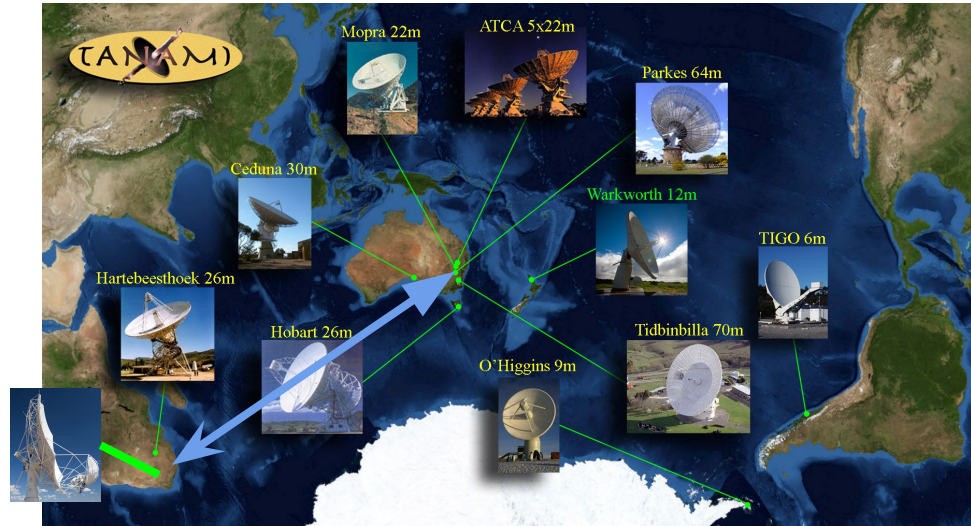
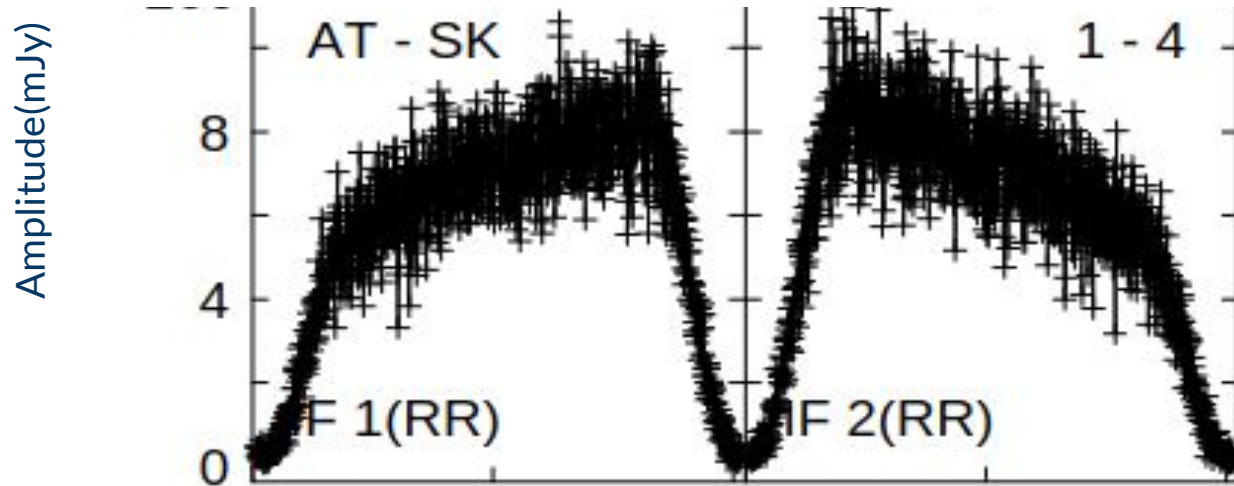


Image credit : C. Reynolds

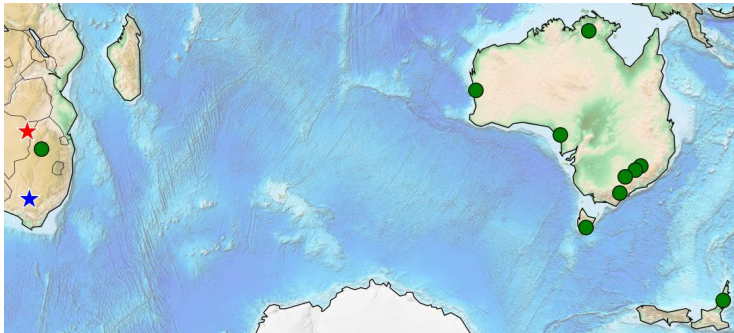


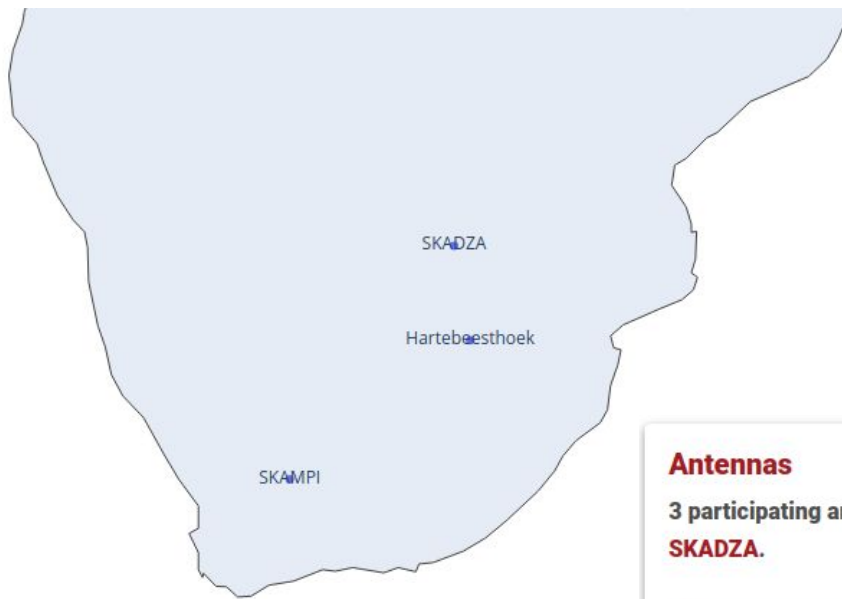
# First trial observation of SKAMPI with TANAMI array



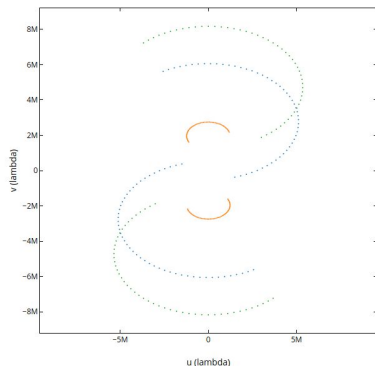
# Future works

- First image from TANAMI observations
- SKAMPI to VLBI networks
- Phased MeerKAT and SKA to VLBI networks





- The first step towards African VLBI network
- Transient follow-ups ?
- Monitoring ?



### Antennas

3 participating antennas: **Hh, SKA1MPI, SKADZA.**



**SKA1MPI-SKADZA** is the longest (projected) baseline with 1063.1 km (8.18 M $\lambda$ ).



**Hh-SKADZA** is the shortest one with 357.61 km (2.75 M $\lambda$ ).

### Resolution



The expected synthesized beam will be approx. 33.6 x 25.2 mas<sup>2</sup>, PA = -79.8 deg.

Note that the synthesized beam can significantly change depending on the weighting used during imaging (natural weighting assumed here).

# Conclusions

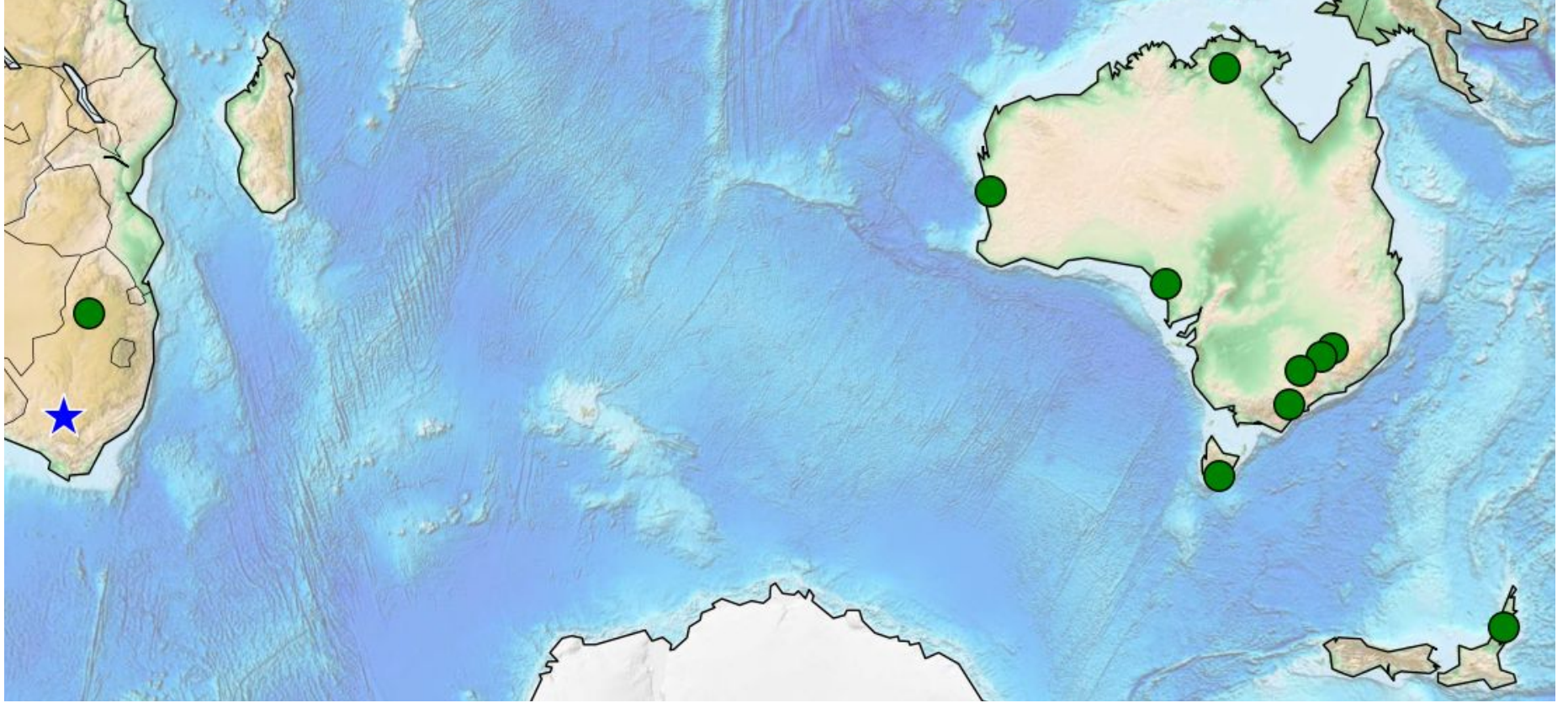
- TANAMI monitors AGN jets using the Southern-hemisphere VLBI array.
- Collaborates with Fermi gamma-ray space telescope, as well as CTA in the future.
- SKA-MPG telescope in South Africa is key for future VLBI, improving resolution and flexibility.
- Recent VLBI developments for SKA-MPG include first fringe detection.

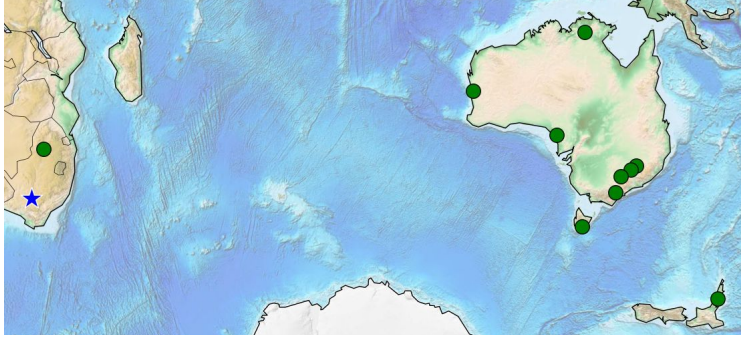


# Acknowledgement

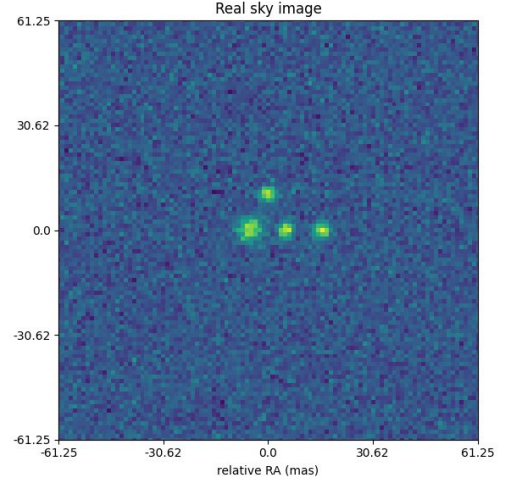
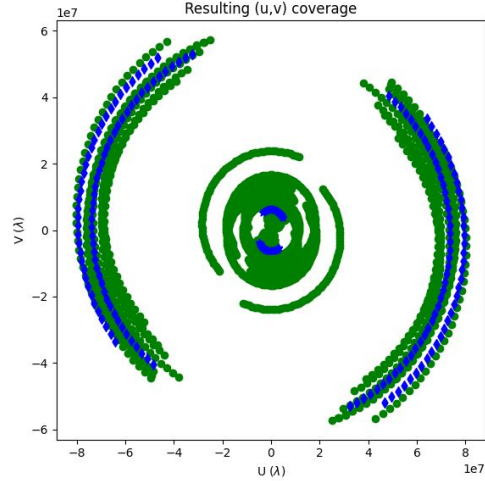
The SKA-MPG prototype telescope, is a facility of the Max-Planck Society (MPG) and was established with the assistance of the South African Radio Observatory (SARAO). It is jointly operated and maintained by the Max Planck Institute for Radio Astronomy (MPIfR) and SARAO. This research was made possible with the support of the MPIfR and SARAO. The Long Baseline Array is part of the Australia Telescope National Facility, which is funded by the Australian Government for operation as a National Facility, managed by CSIRO. We would also like to acknowledge HartRAO for their assistance with data transfer to the correlator.







Simulated observation at Dec=-50°



Not only improve the resolution but also flexibility

