ASTROPHYSICS

SKAMPI: An eye on the Southern hemisphere

Square Kilometre Array Max Planck Institute telescope (SKAMPI): A prototype dish for MeerKAT+ and SKA-Mid of the Max Planck Institute for Radio Astronomy (MPIfR), Bonn, designed by OHB System AG, and operated in cooperation with South African Radio Astronomy Observatory (SARAO).

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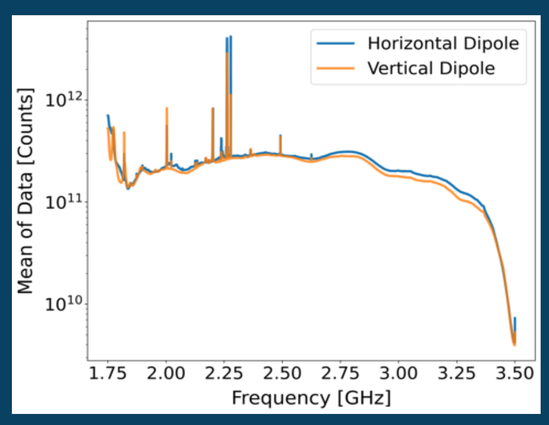
SKAMPI — specifications

- **The Dish: 15-m illumination, offset-Gregorian**
- Located at SKA-Site in South Africa, near the MeerKAT array
- Equipped with two receiver systems operating in 1.75 to 3.5 GHz and 12 to 17 GHz range

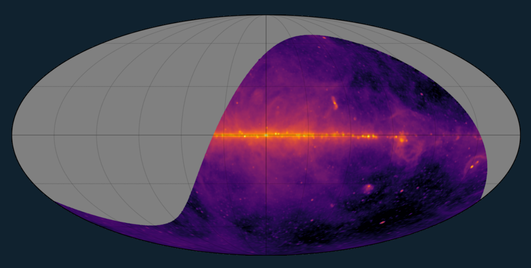
Frequency range	Resolution (FWHM)	Confusion limited point source sensitivity
1.75—3.5 GHz	50—25 arcmin	300—50 mJy (16—2 mK)
12—17 GHz	7—4.6 arcmin	1.7—0.6 mJy (80—30 µK) expected

- **Backend: Effelsberg Direct Digitization system (EDD)** [FFT up to 3 GHz sampling rate]
  - **Spectroscopy:** Dual polarization providing 2k—32M channels
  - **Polarimetry:** Full Stokes providing 4k—8M channels + gated with high-speed noise diode switching (~kHz) + VLBI

- **Receiver system designed by MPIfR** [left image]
  - **S-Band:** 1.75 - 3.5 GHz (1.75 GHz bandwidth)
  - **Ku-Band:** 12 - 17 GHz (2 GHz instantaneous bandwidth)
- State-of-the-art, cryogenically cooled, providing Tsys ~ 20 K
- The plot on the right shows the bandpass response of the S-band receiver for the two dipoles. Aside from narrow band RFI the gain is long-term stable up to ~1 percent even before correction via the noise diode.



S-Band survey

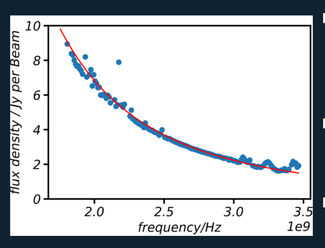


SKAMPI is an excellent survey instrument [wide field of view and low Tsys]

- Unprecedented bandwidth (1.75 GHz) and spectral resolution (64k channels) at S-band
- Can cover entire Southern sky in just 300 h
- Current status: 2*1000 h completed, calibrated and cleaned of atmospheric emission
- The figure above shows the Galactic emission map obtained from the ongoing survey

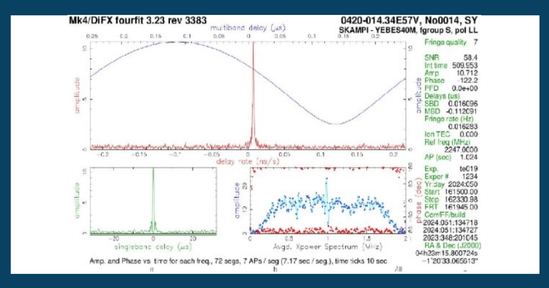
Aim of the full Stokes survey

- 6000 h needed to reach polarization confusion
- Improve modeling of the Galactic emission with realistic models by including spatially varying synchrotron losses, and thermal free-free emission
- Improve models of cosmic ray electron transport
- Reduce foreground residuals for analyzing CMB polarization down to ~10 nK/sq. deg at 80 GHz



- Figure shows a typical spectrum of the Galactic emission integrated over 20 min.
- Noise: 0.2 Jy per 0.15 s, implying ~2.5 mJy over 20 min
- The spectrum is consistent with Galactic synchrotron emission.

VLBI mode

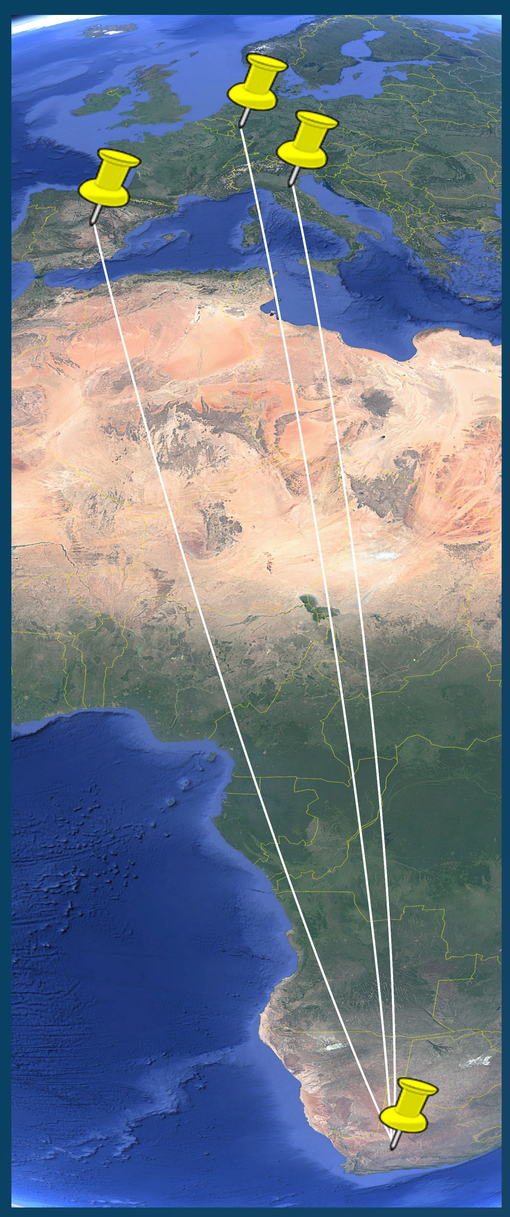


Flexible and configurable EDD backend

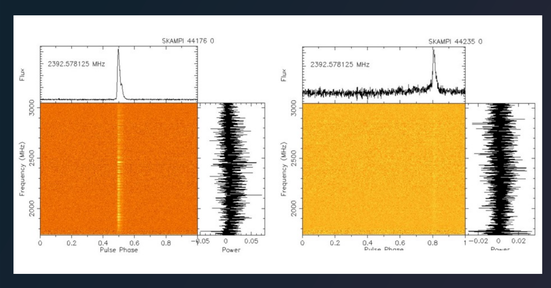
- Allows VLBI with SKAMPI
- Commissioning tests ongoing between SKAMPI, Medicina, Yebes and Effelsberg
- Up to 8800 km baseline shown on right
- Provides an unprecedented resolution down to ~2.5 mas at S-band!
- The plot above shows the first fringes obtained between SKAMPI and Yebes

Planned expansion

- DZA, MPIfR and SARAO are collaborating with the Botswana International University of Science and Technology (BIUST) to set up a sibling-SKAMPI in Botswana
- Planning to improve coverage of the African VLBI Network (AVN)



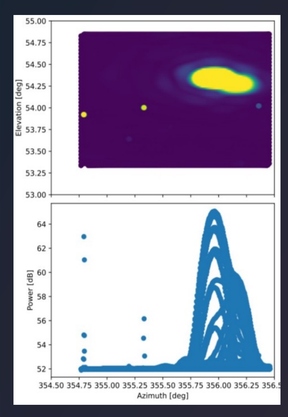
Pulsar monitoring

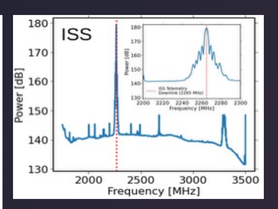


High time-resolution baseband data enables direct pulsar search using the EDD

- The figures on the top show pulsar profiles observed with the SKAMPI
- SKAMPI is ideal for long-timescale monitoring of bright pulsars that allows us to study pulse nulling, giant pulses, and glitching

Satellite tracking





- The figures on the left show a direct image of the ASTRA satellite. The extended emission is due to its trajectory
- Plot on top-right shows the downlink spectrum from ISS telemetry at 2.265 GHz
- Satellite crossing can be predicted or flagged based on their TLE data

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www.deutscheszentrumastrophysik.de

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