

MeerKAT as an SKA-MID Precursor (J2-5)



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(Presented by Isak Theron)



RHODES UNIVERSITY
Where leaders learn

USNC-URSI - Boulder– 6th January 2016

Precursor Activities



- Site & Infrastructure
 - Electrical power supply, conditioning & reticulation, roads, fibre ducts, support buildings & vehicles
- Operations, Maintenance & Logistic support
- Dish Antennas
 - Optical design
 - Mechanical design and fabrication
- Cryogenic Single-Pixel receivers
 - Horn & OMT
 - RF gain & noise source injection
 - Cryogenics (including vacuum and helium services)
 - Local control & monitoring
- Digitizers
 - Spurious Signal Dynamic Range
 - Self-generated RFI (radiated & internal)

Precursor Activities (...cont)

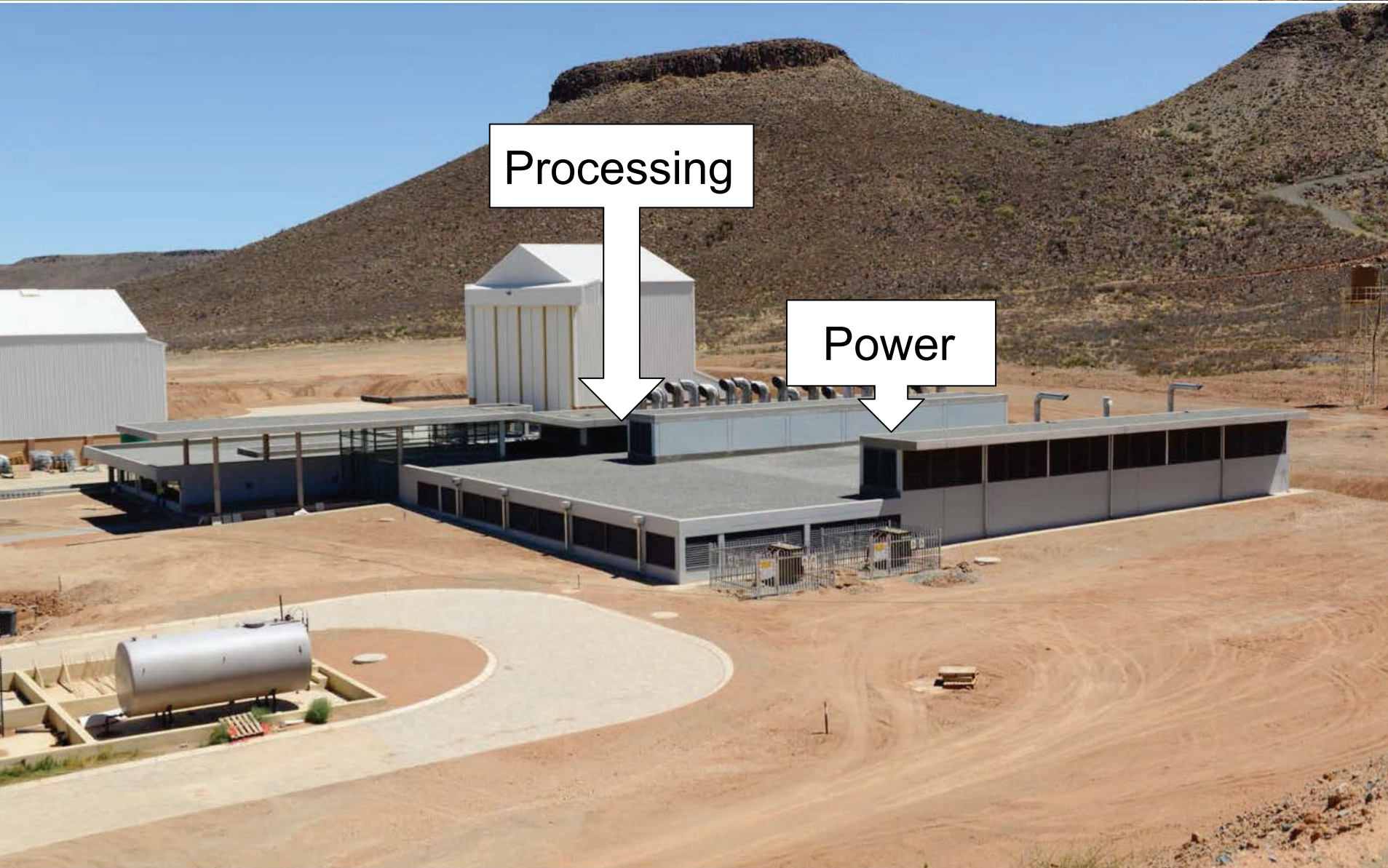


- Signal & Data Transport
 - Distribution of RF clocks and tones
 - Digital signal backhaul & CAM telemetry
 - High-precision absolute time stamping (pulsar timing)
- Central Signal Processing
 - Correlator: CASPER-based (SKARAB aka ROACH-3)
 - Pulsar Search: GPUs
- Science Data Processing
 - 3G+ calibration and imaging
 - Primary beam models and pointing errors
 - Broad range of tools: CASA, MeqTrees, Obit, MIRIAD, etc.
 - Modern deconvolution (MORESANE, etc.)
 - Low-cost/power hardware (compute and storage)
- Acceptance, Integration & Verification
- RFI & EMC

MeerKAT 64 Antenna Array



Bunker – RFI & Temperature



3 (+2) x 1.25 MVA DRUPS



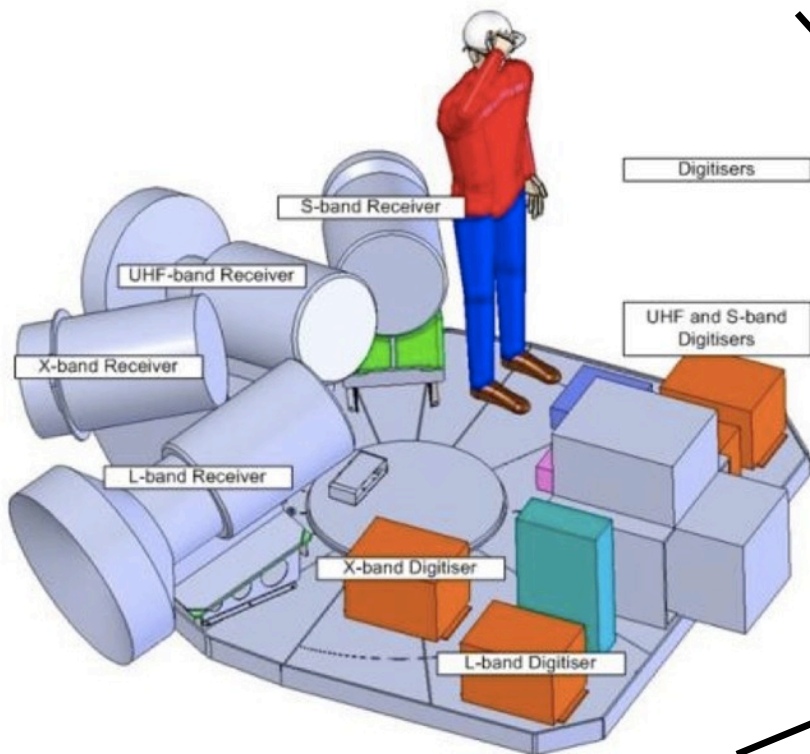
Shielded Room & Equipment Racks



MeerKAT Dish



Receiver Indexer with Horns,
Receivers, Digitizers and
Services



Main
Reflector



Sub
Reflector

Pedestal fabrication & integration



Dish panel factory



Carbon-fibre Sub-reflector



Dish Assembly Facility



On-site Production Line



“Traditional” paneled dish



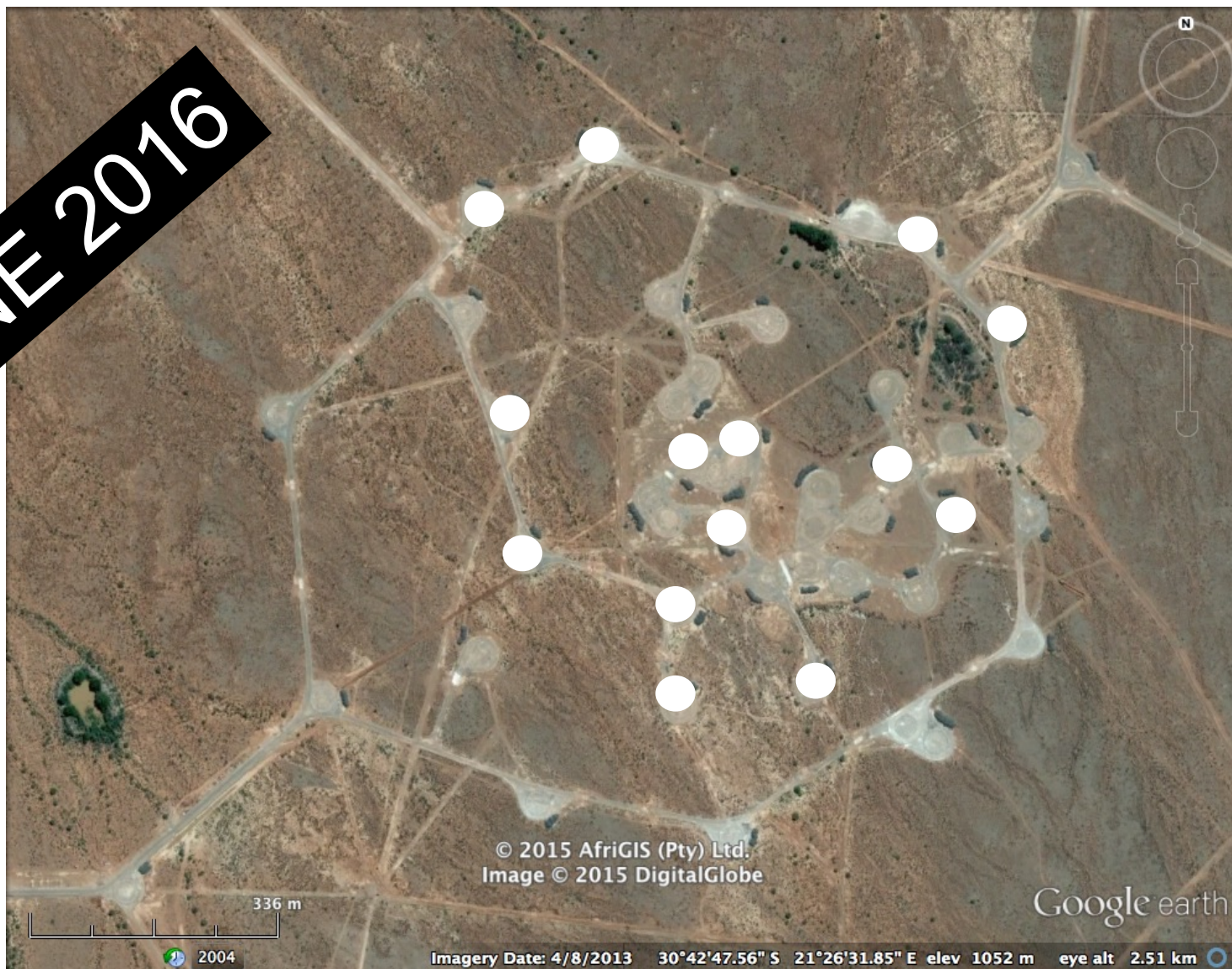
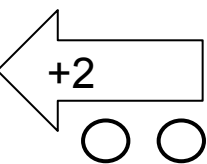


2014/06/06

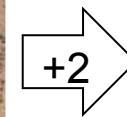
Array Release 1 (14 core + 2)



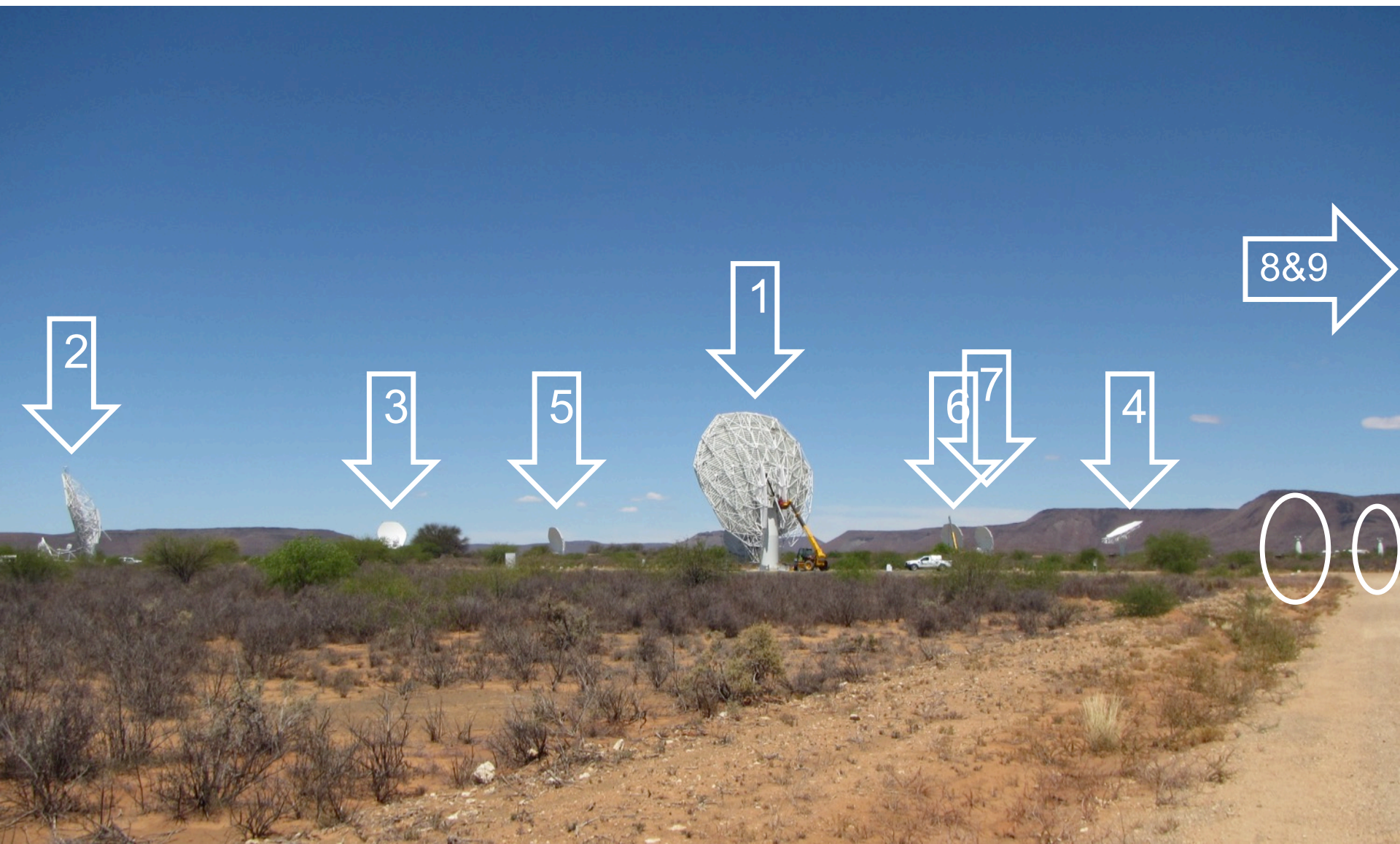
JUNE 2016



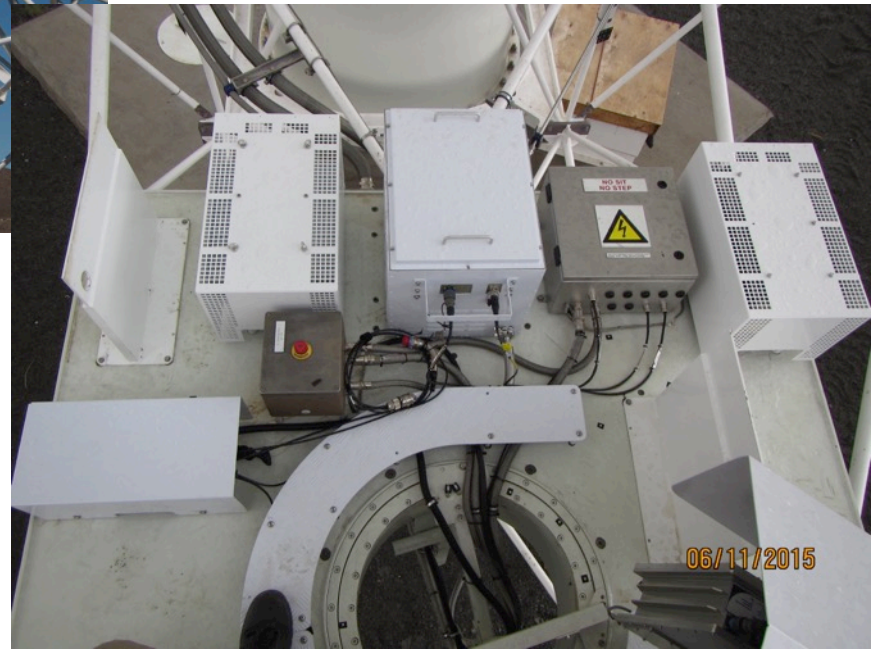
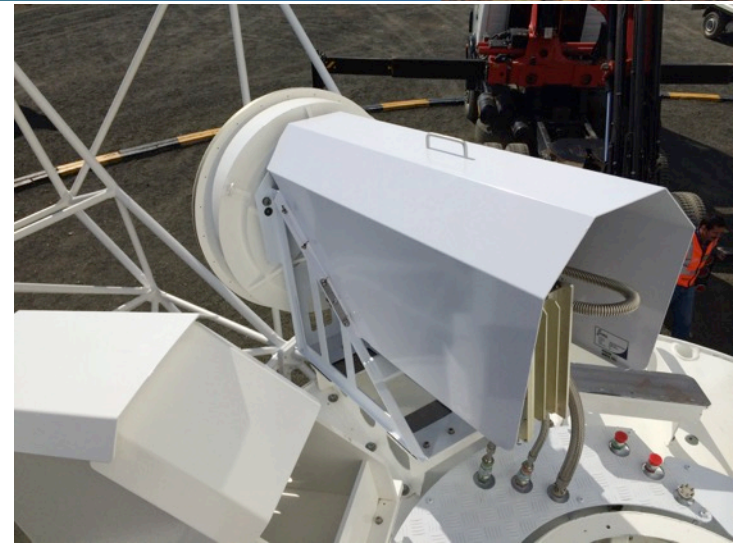
AR1 core



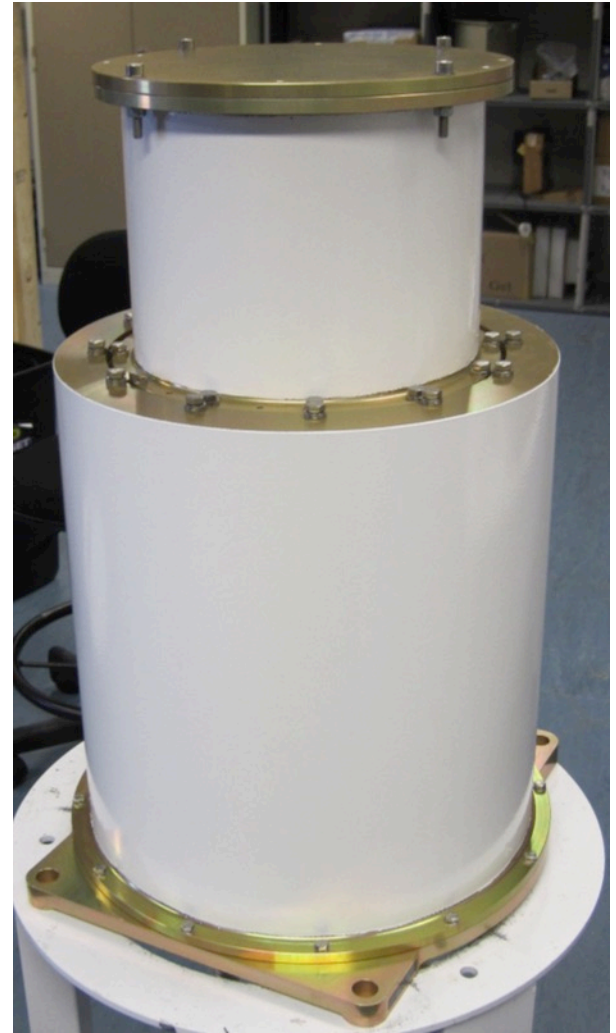
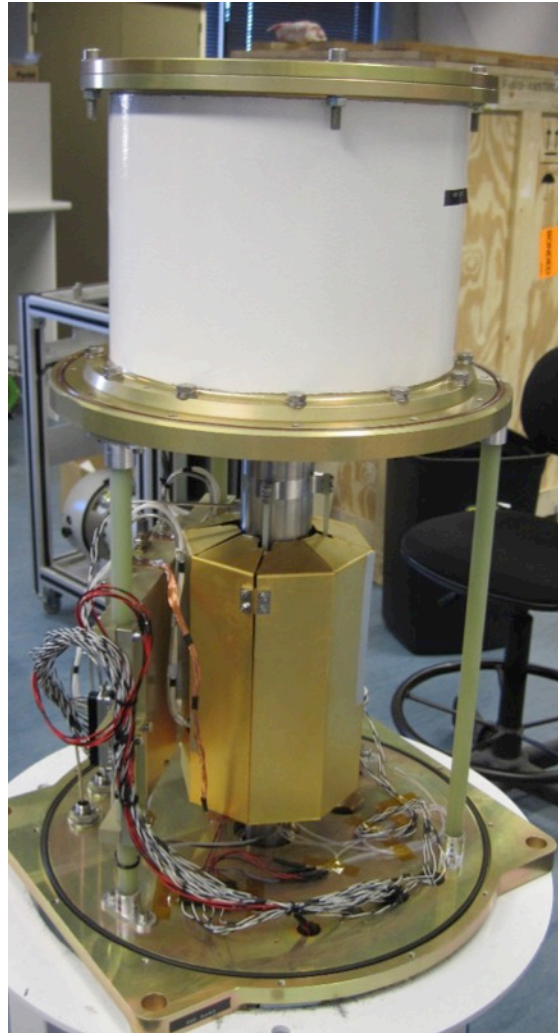
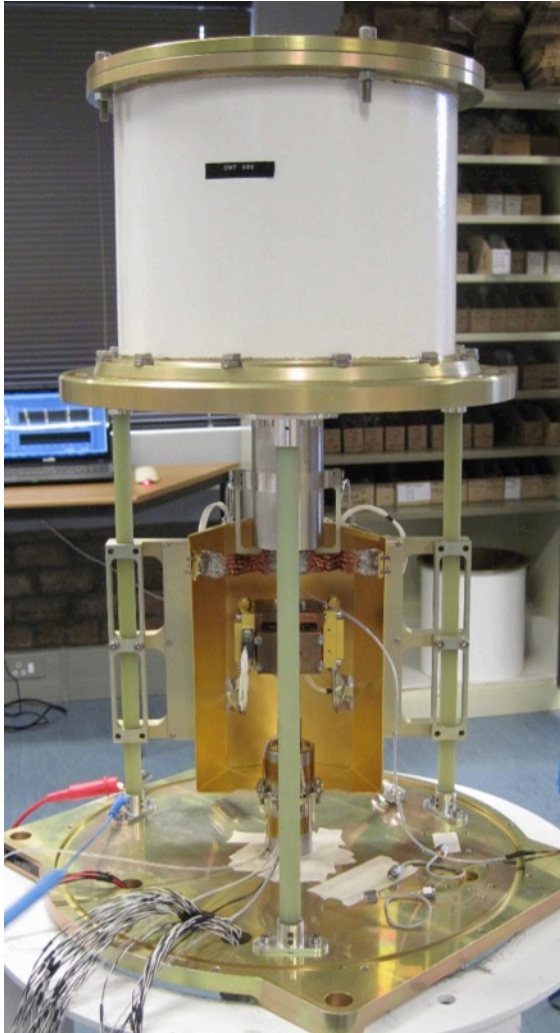
As at end November 2015



Receivers & Services Installed



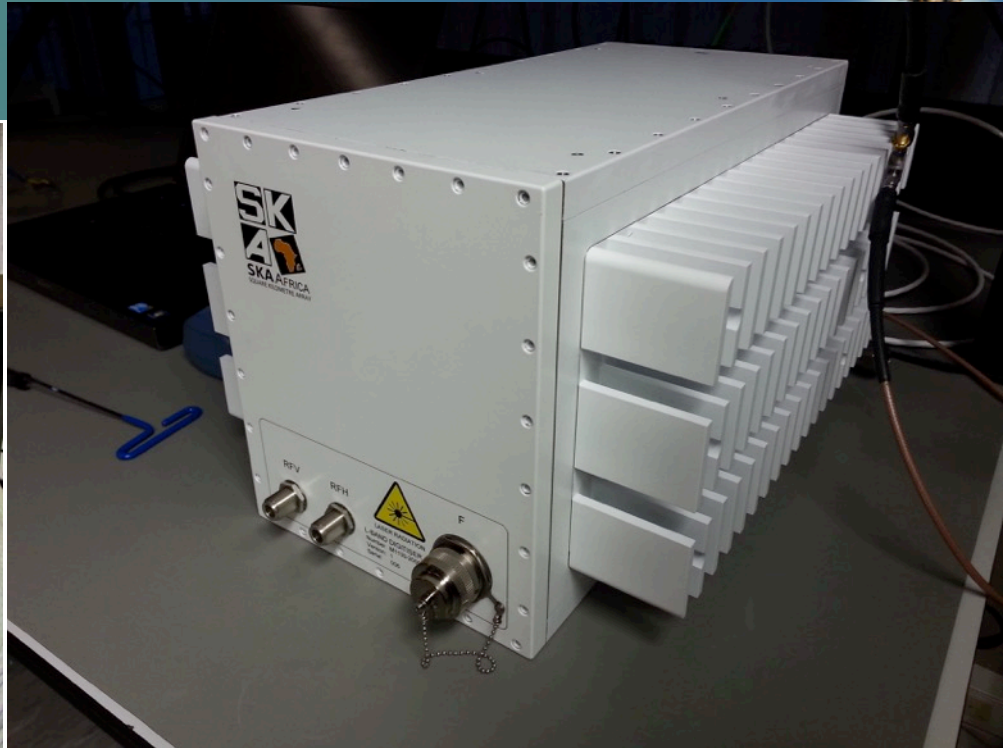
MeerKAT (& SKA) Receiver



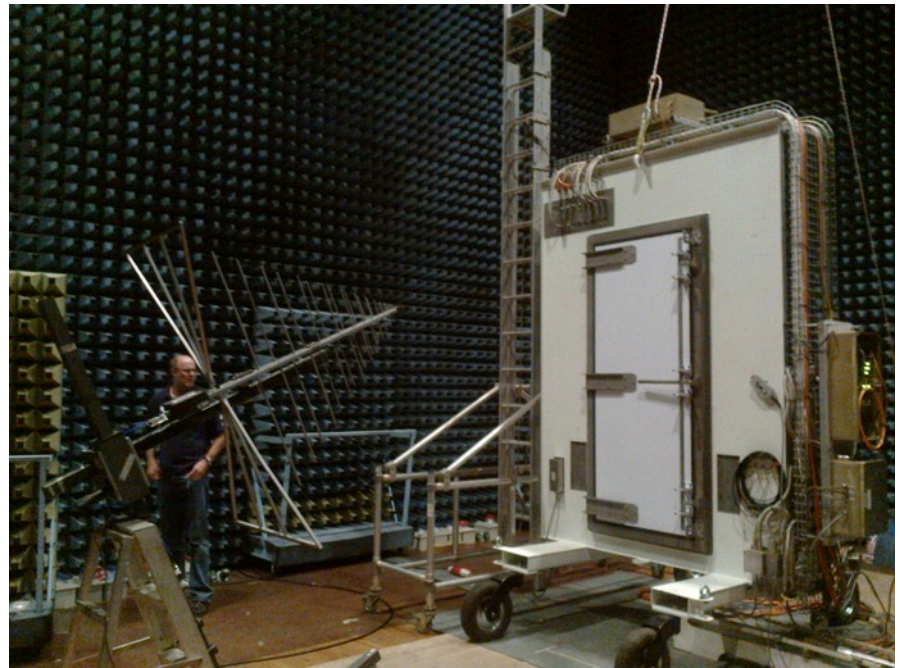
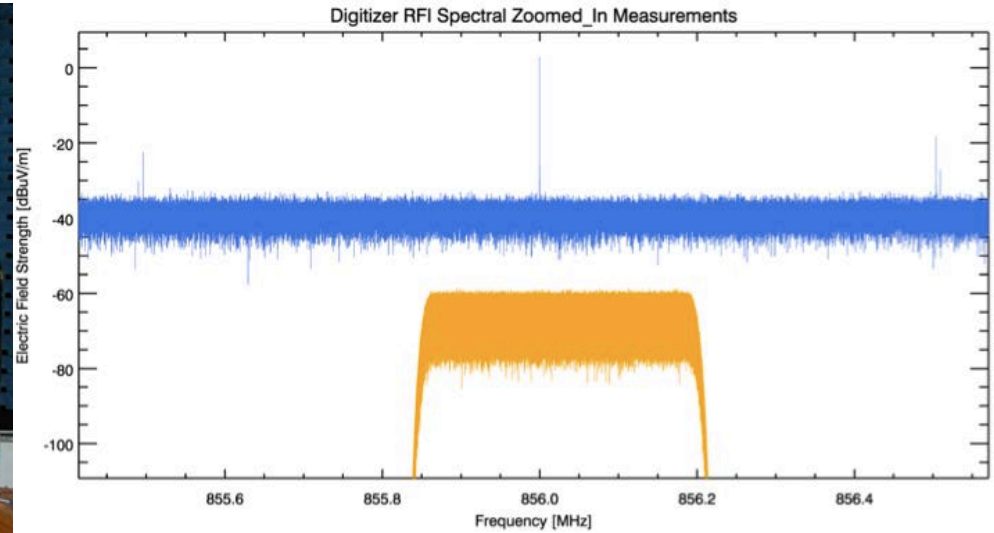
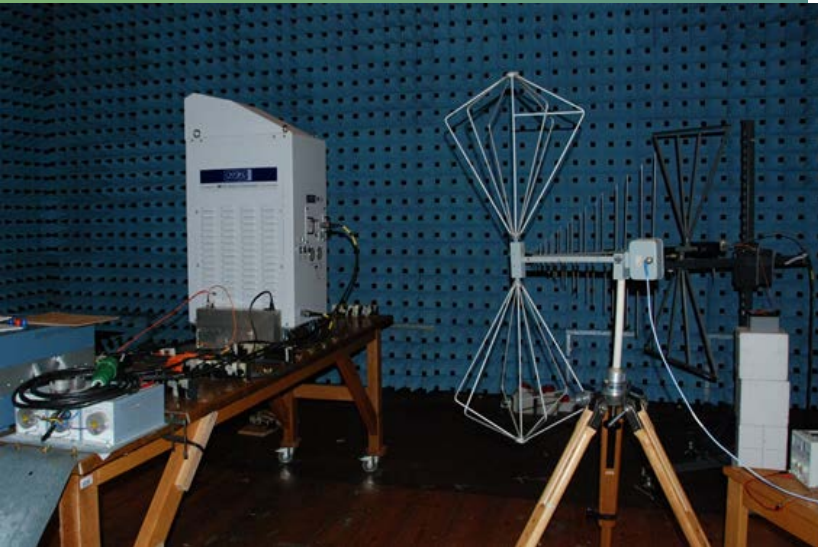
EMSS Rx Production Facility



Digitizer



RFI Qualification and Testing

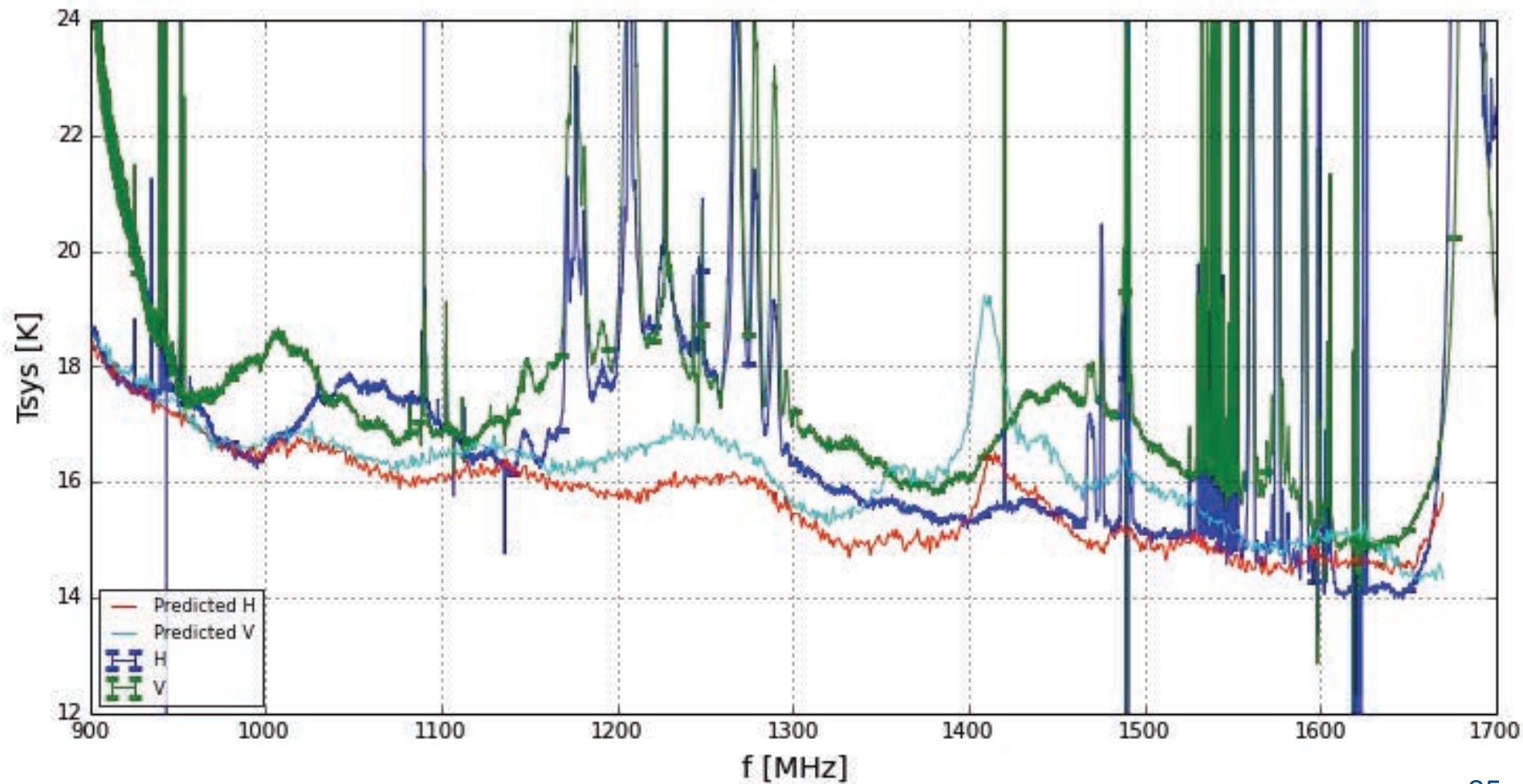


Qualification and Acceptance

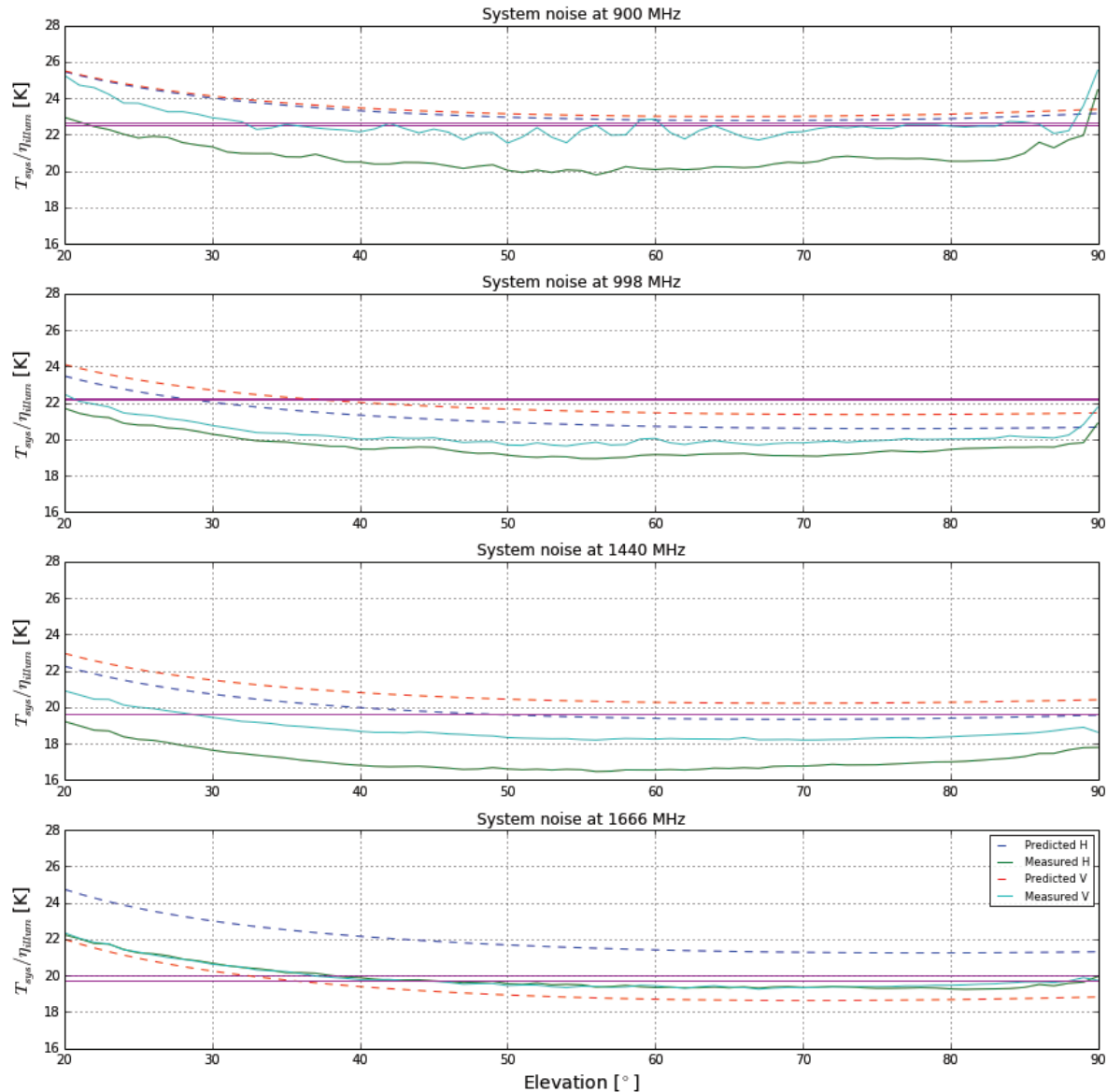


- Receptor Test System (RTS) deployed
 - Single dish tests
 - 2->16 element interferometric tests
- Components:
 - Production receivers & digitizers
 - ROACH-2 correlator/beamformer
 - 2 x Ku-band receivers for holography, pointing and gain tests

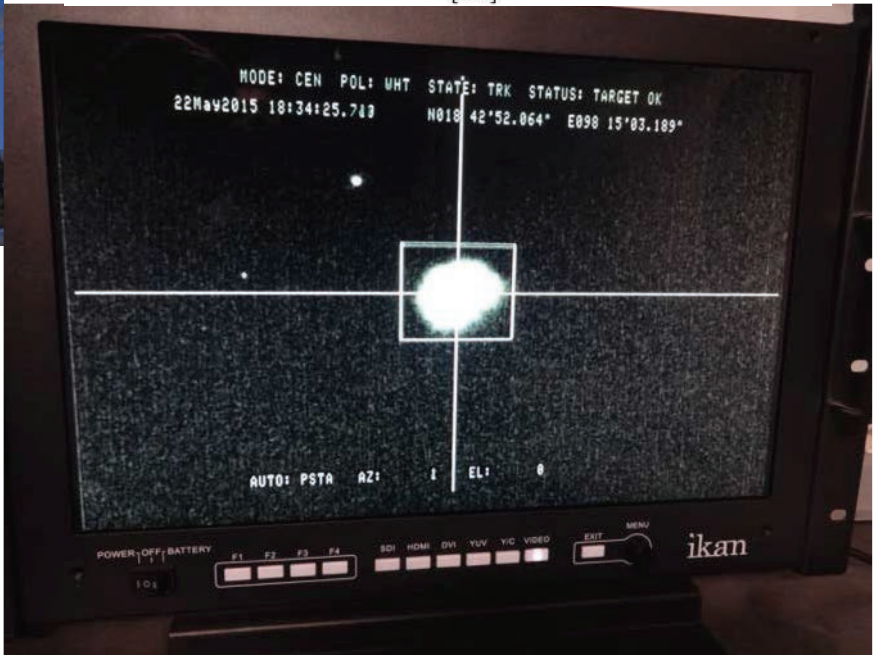
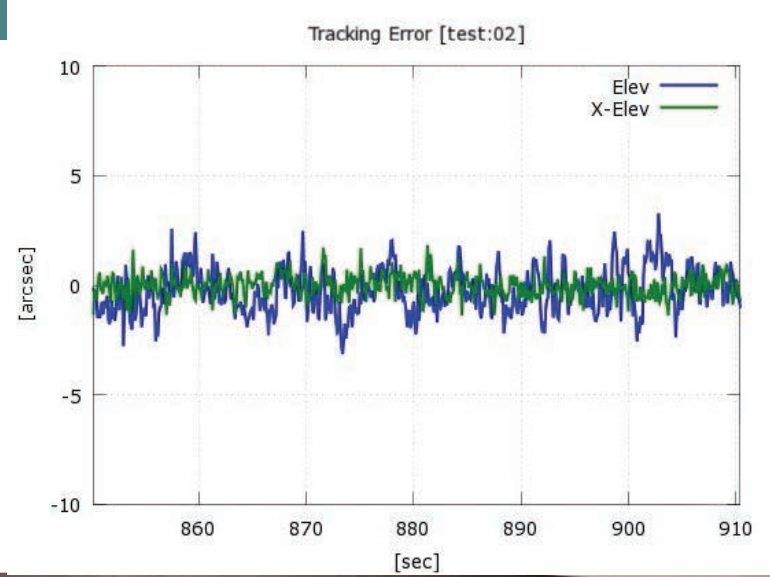
Tsys @ 65° Elevation



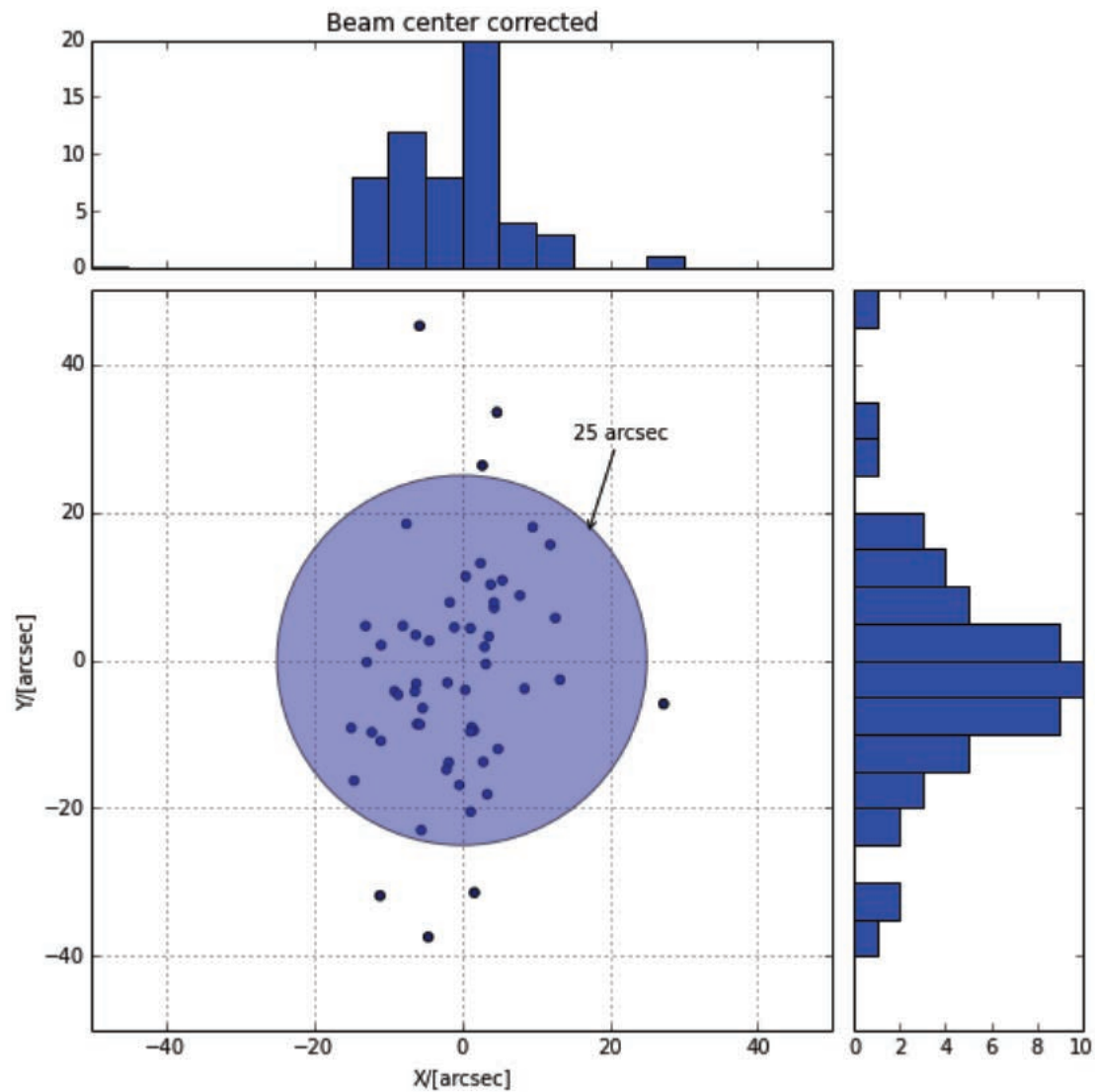
L-band Tipping Curves



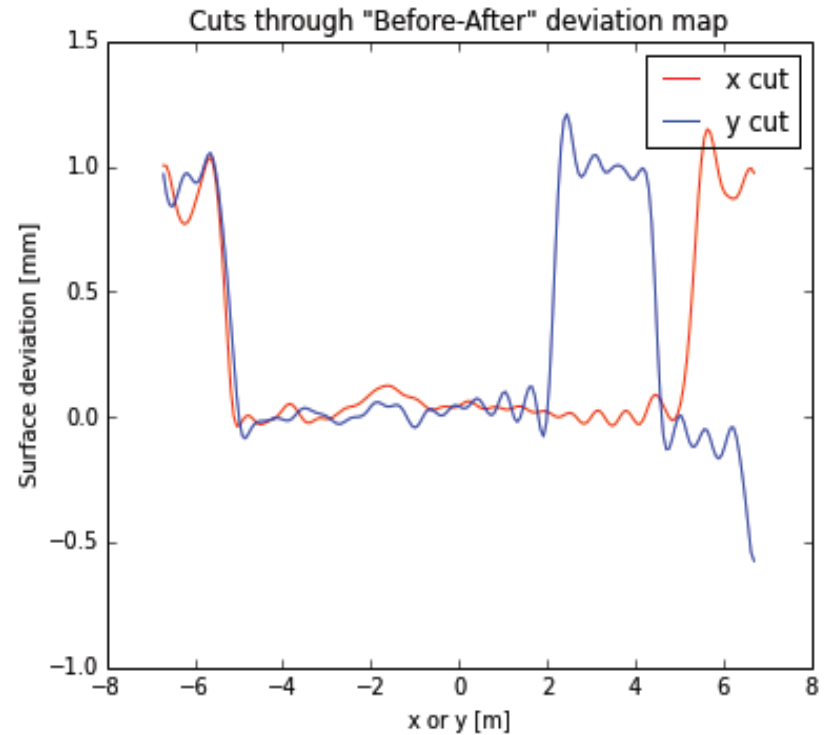
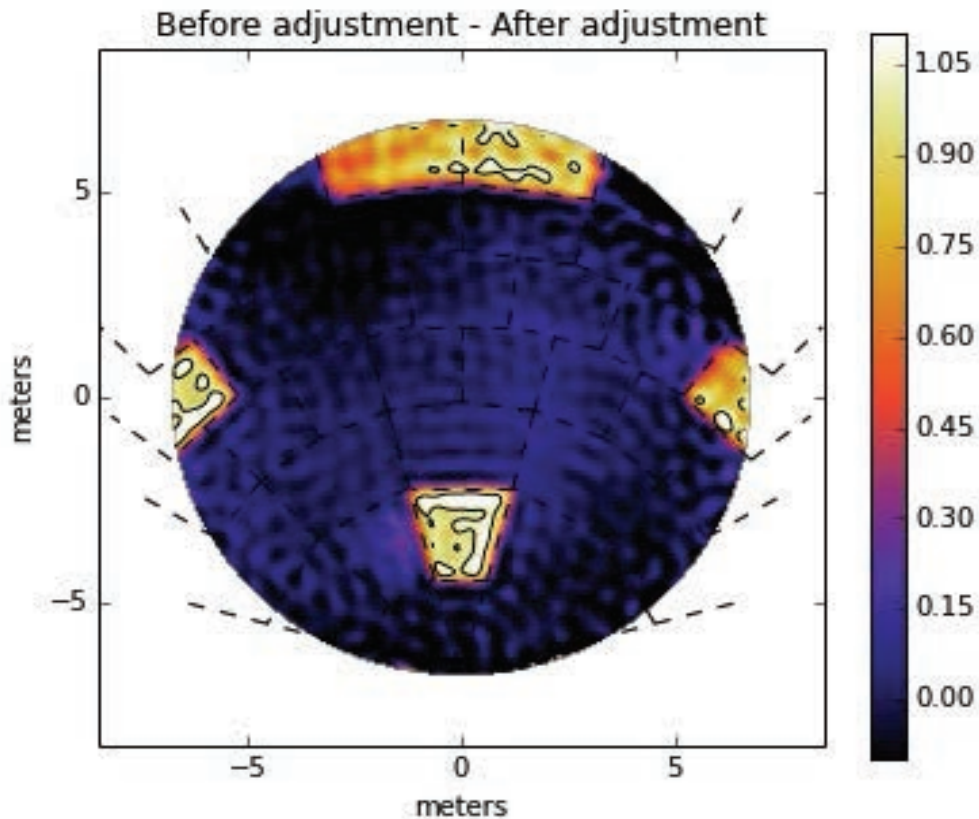
Optical Pointing



Ku-band Pointing



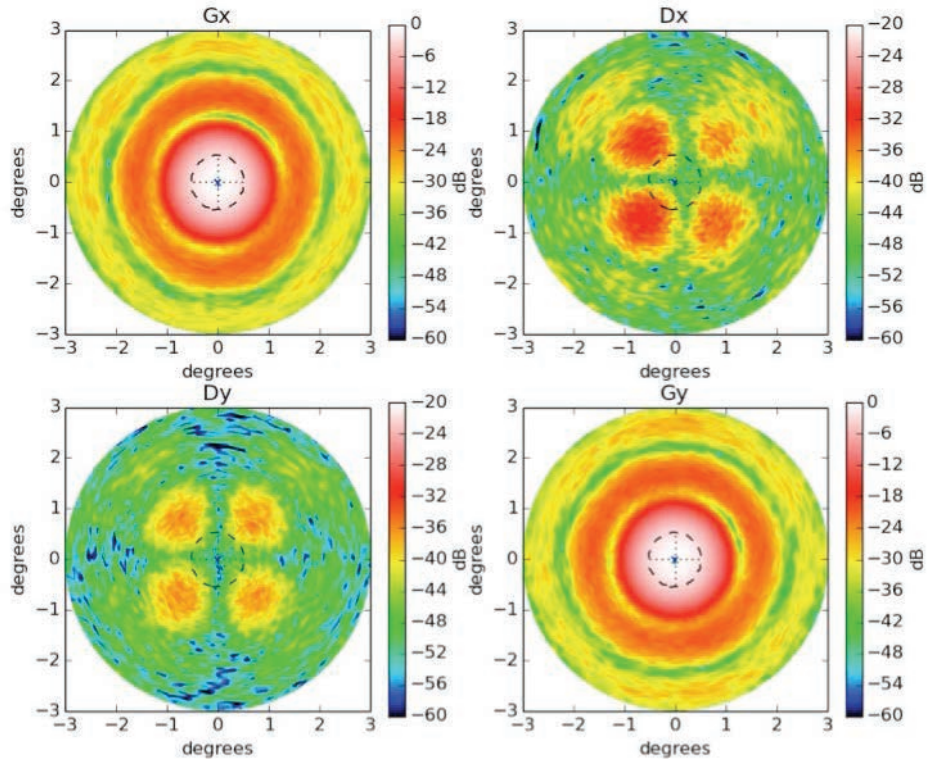
Ku-band Holography



Measurement vs Simulation

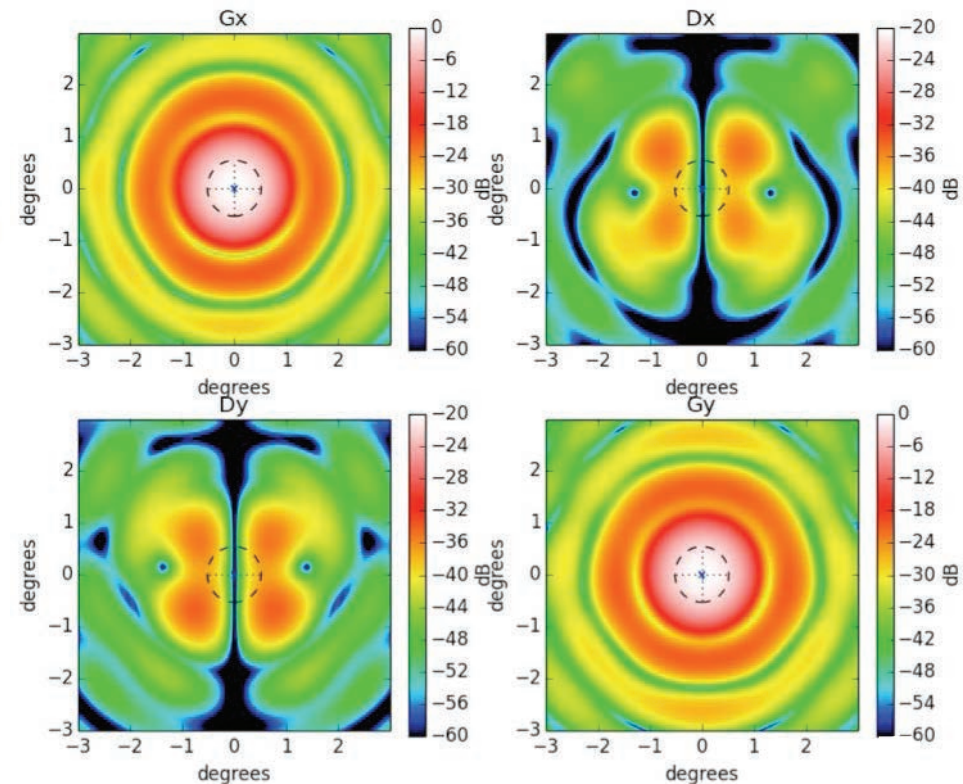


/data/rts/lband/1449551405.h5: m062 1350MHz



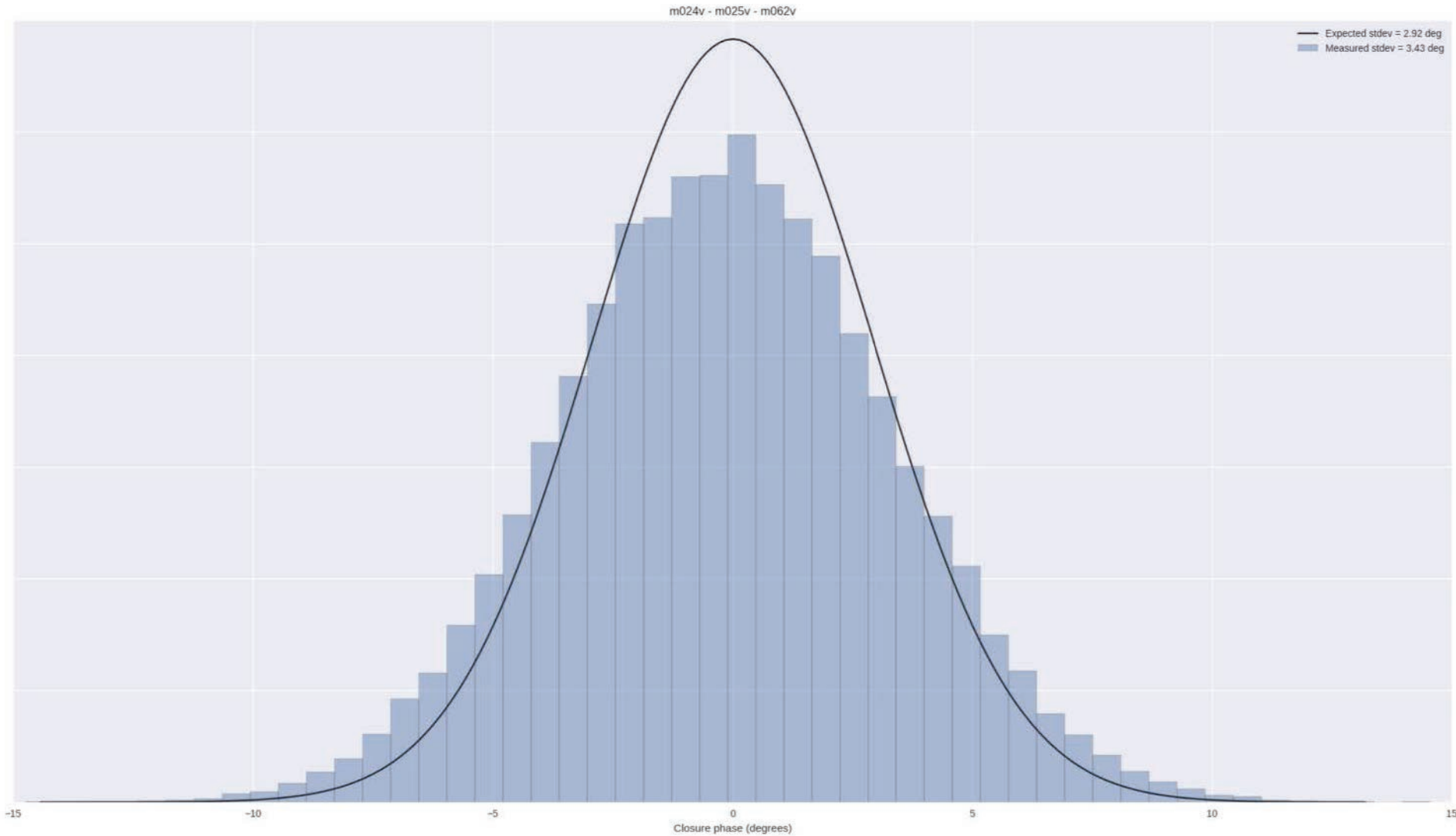
Primary Beam Simulation

MK_GDSatcom_1350.mat: ant1 1350MHz



L-band Primary Beam
Measurement
(Interferometric)

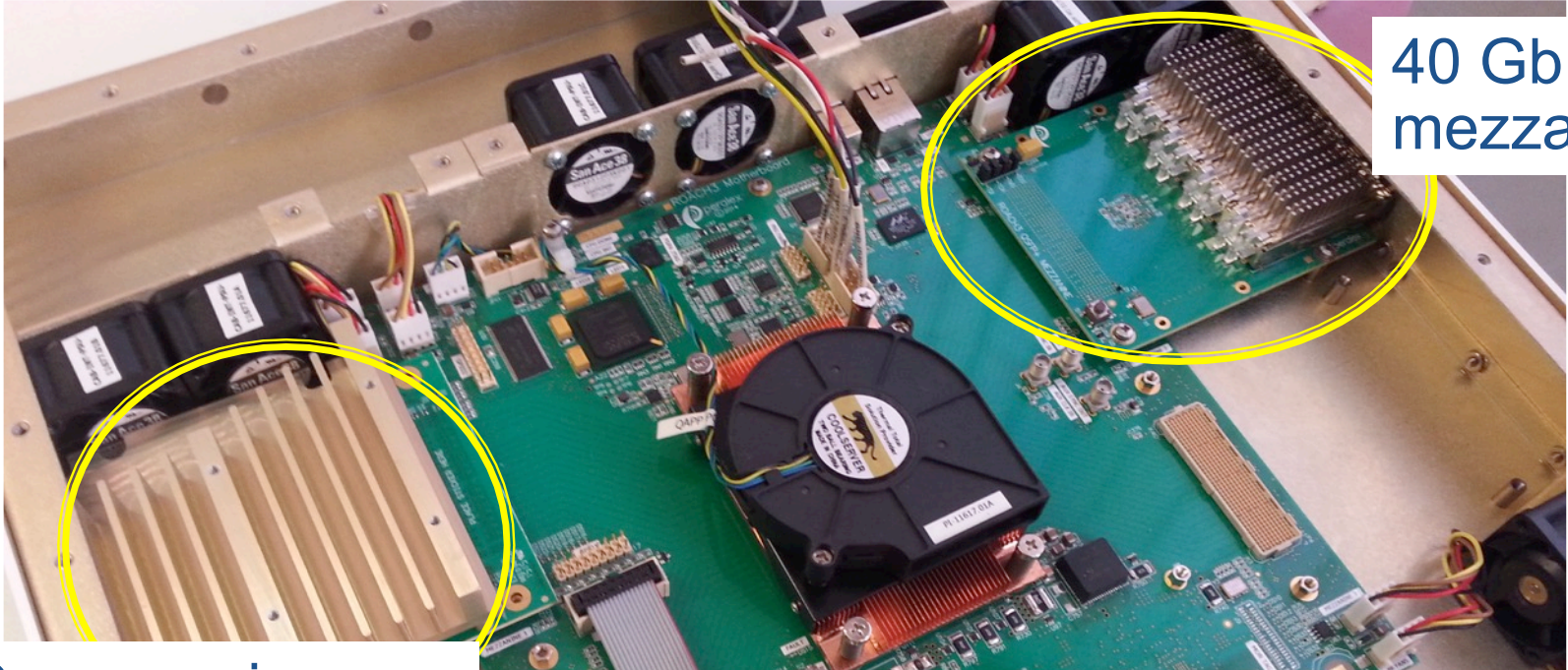
Closure Phase Distribution



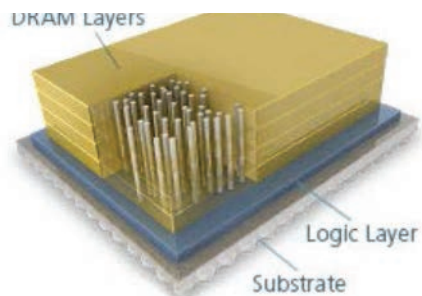
SKARAB – in production



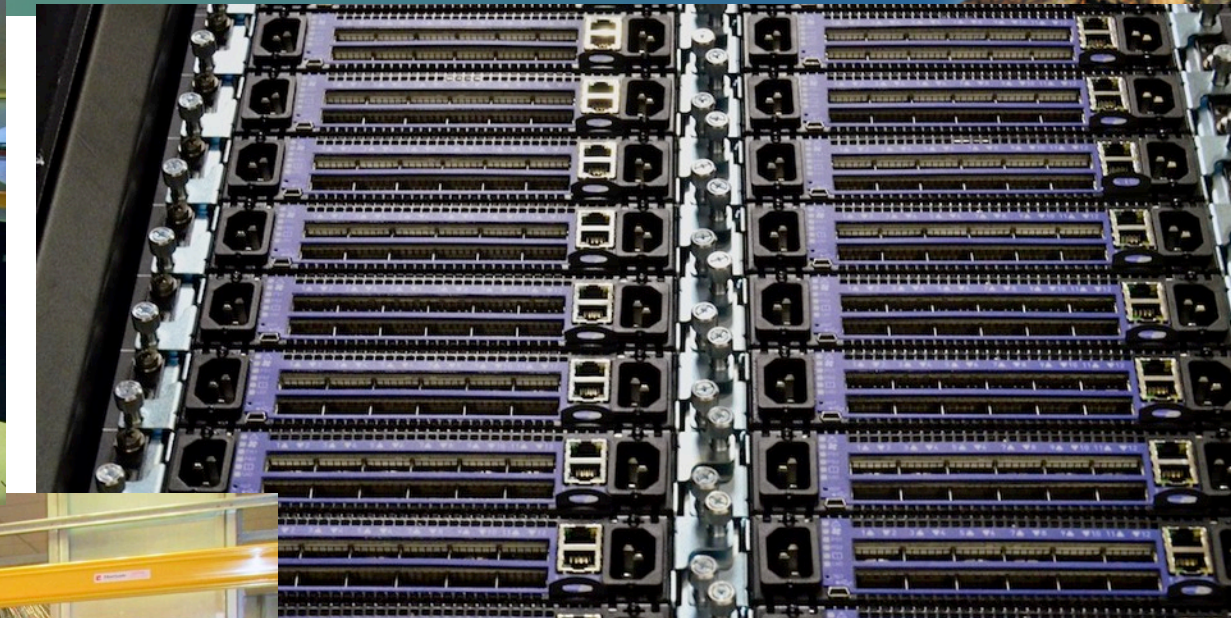
40 GbE
mezzanine



HMC mezzanine
(Micron not providing
production chips yet)



CBF Switch Installed



Science Data Processing



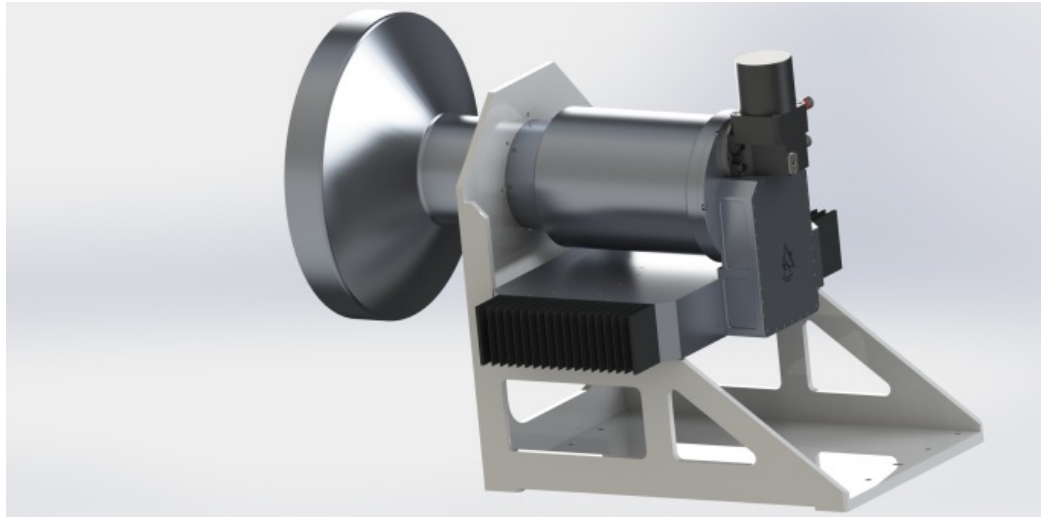
Storage



Micro-servers



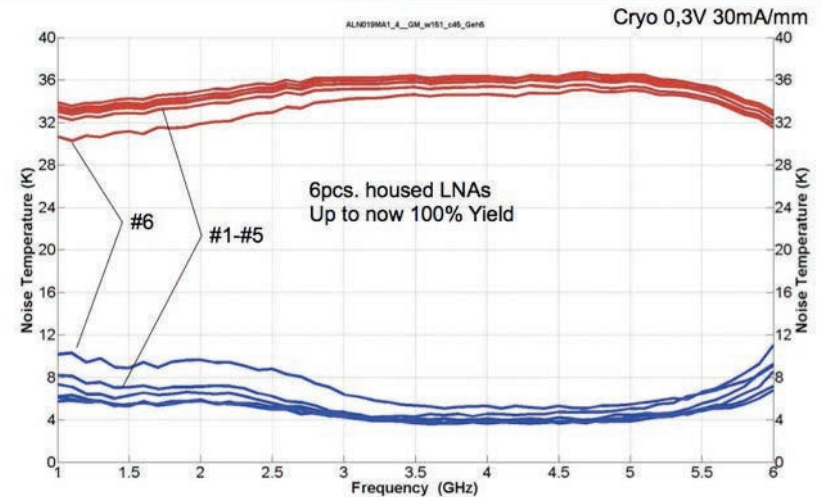
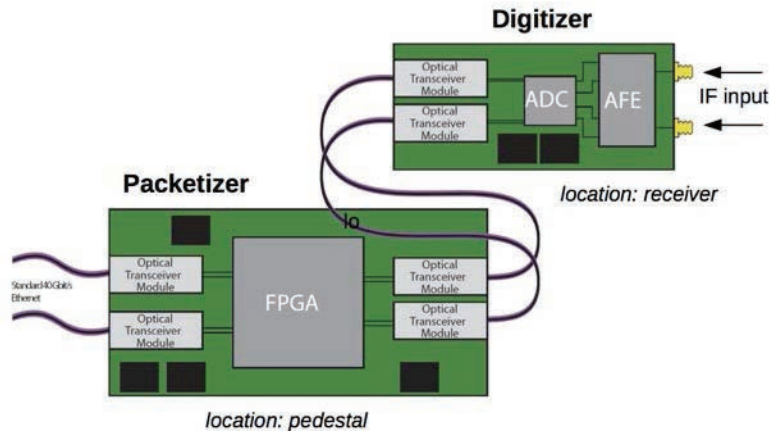
MPIfR S-band Rx development



First Batch S-Band LNAs for MeerKAT



MeerKAT
Concept: Digitizer & Packetizer



ProtoNIP



- STFC grant: Ben Stappers (Manchester) & Aris Karastergiou (Oxford)
- Implementation of the Pulsar Search Sub-element (PSS) within SKA-MID CSP
- Prototype backend for SKA1 to mitigate risks related to the SKA1
 - Power and cooling, but also related to operational aspects of the cluster in a real environment.
 - Qualification model for CSP CDR.
- Processing nodes, network switches, and the software required to perform the pulsar search.