science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

NRF
National Research Foundation

SARAO
South African Radio Astronomy Observatory

MeerKAT

Engineering background
Integration status
Lessons learned

www.ska.ac.za

The South African Radio Astronomy Observatory (SARAO) is a National Facility managed by the National Research Foundation and incorporates all national radio astronomy telescopes and programmes. SARAO is responsible for implementing the Square Kilometre Array (SKA) in South Africa.

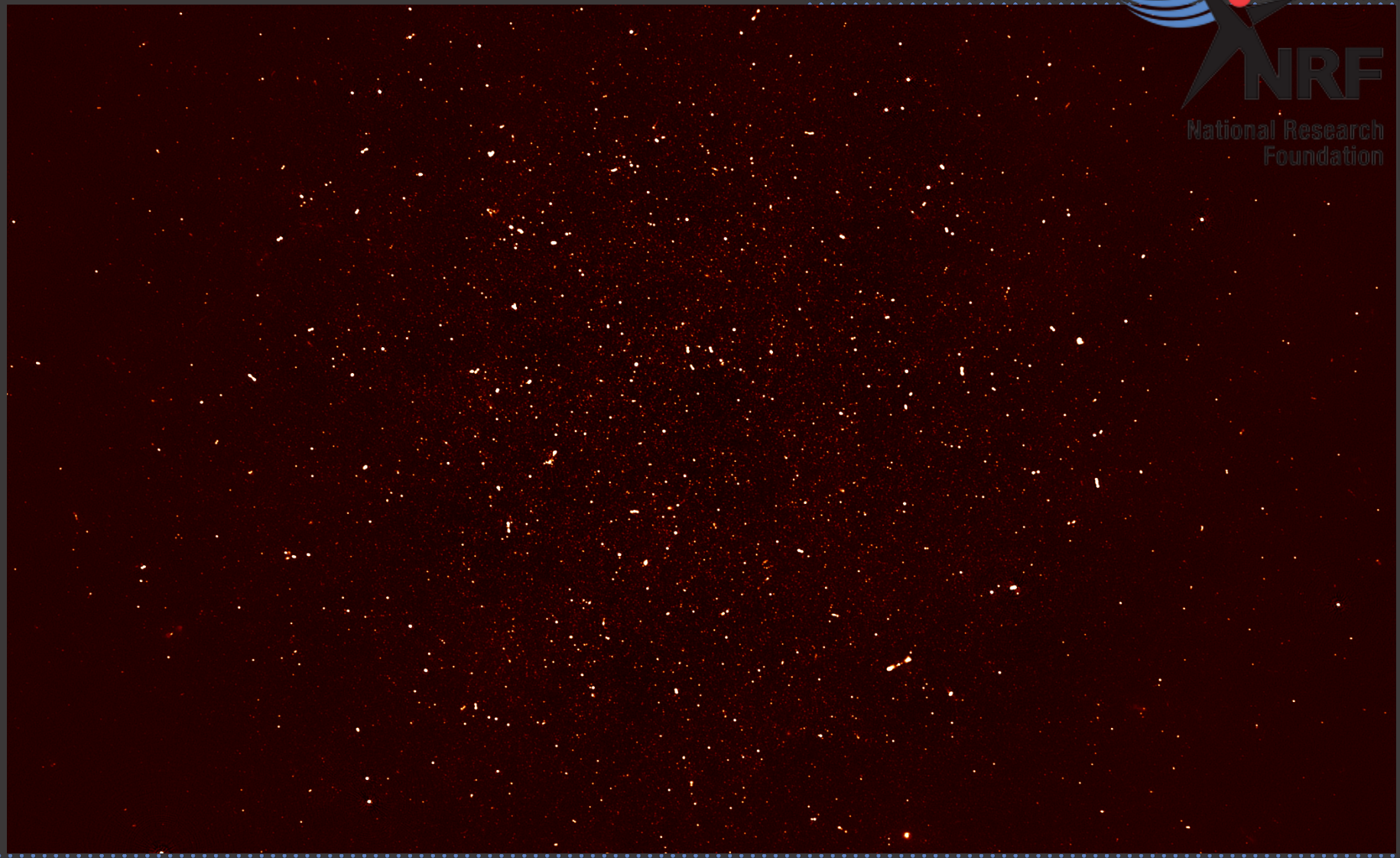
MeerKAT

UHF band

L-band installed first

UHF band receivers and digitisers have been installed over the last year.

UHF band DEEP2 field



NRF National Research Foundation

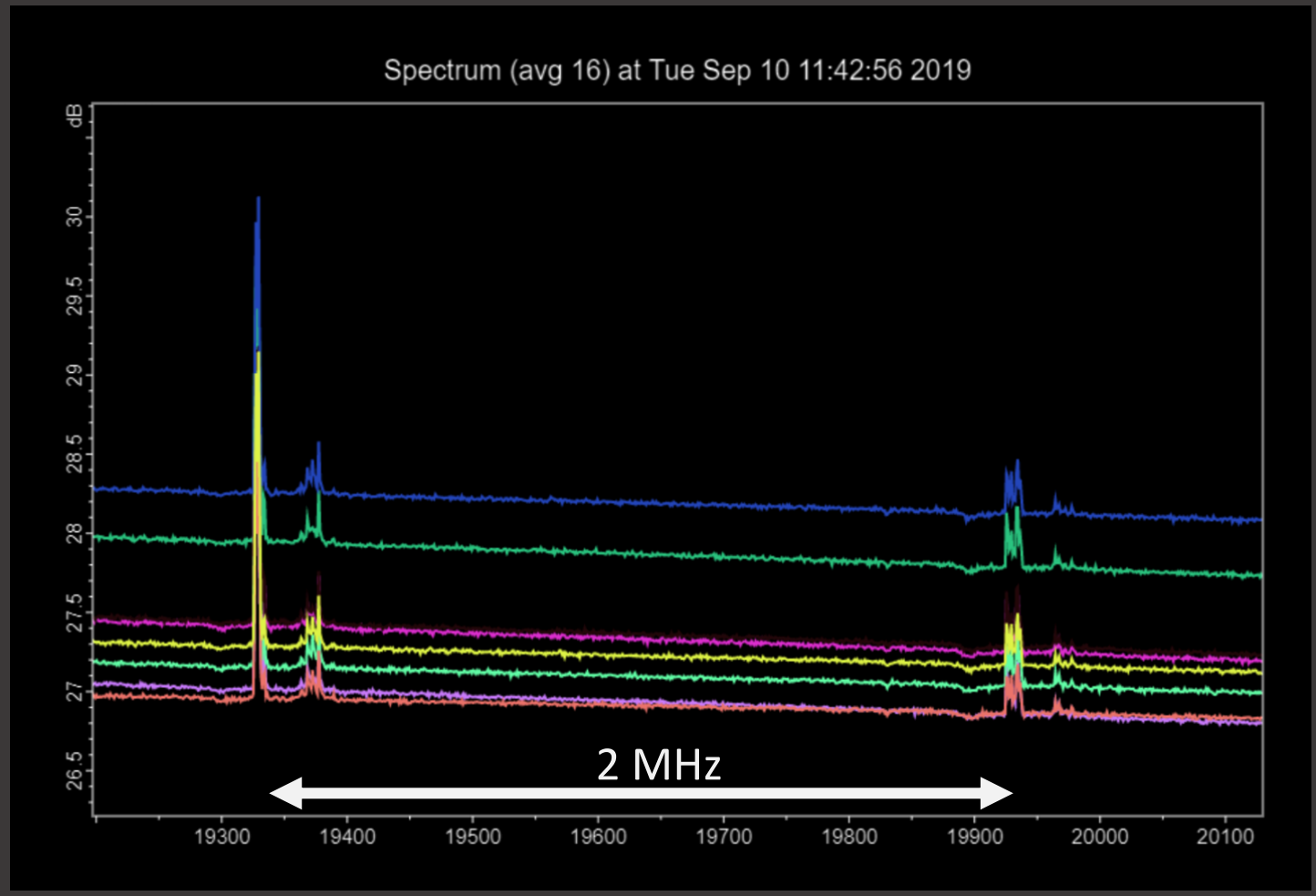
SARAO South African Radio Astronomy Observatory

Narrowband

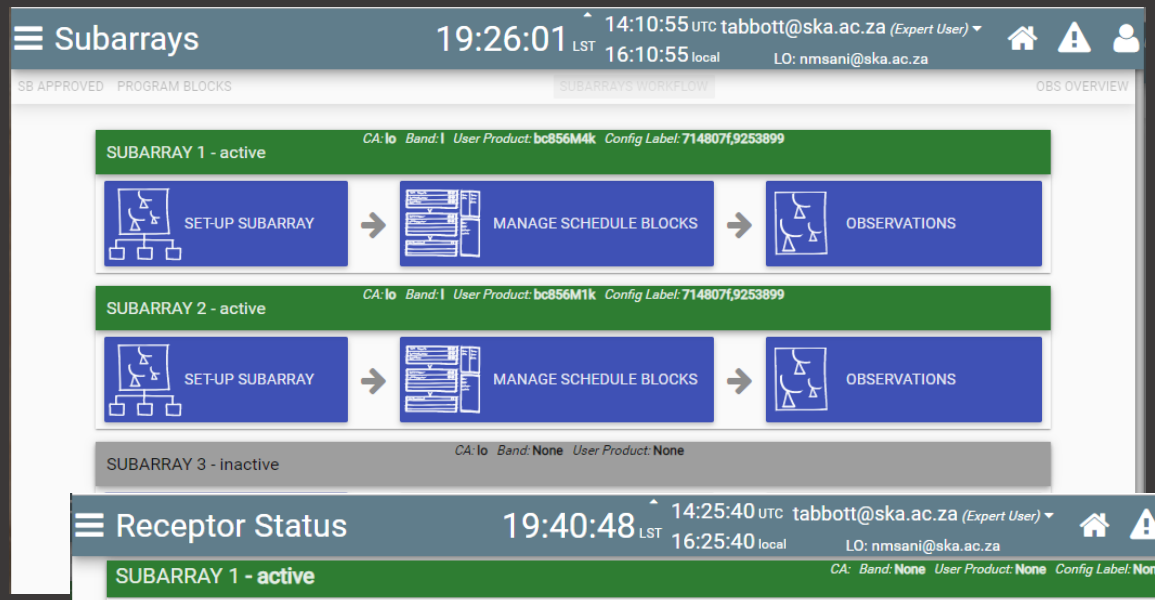
Narrowband Extended mode provides 32K channels over a selected 107 MHz sub-band. (also 56 MHz, 27 MHz, etc)

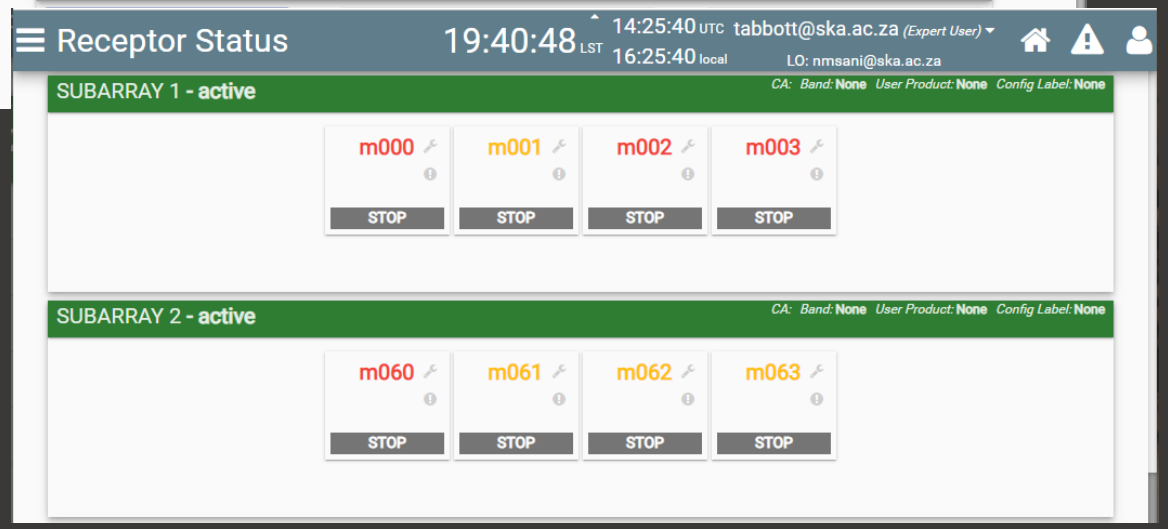
Channel width of 3 kHz for velocity resolution < 1 km/s

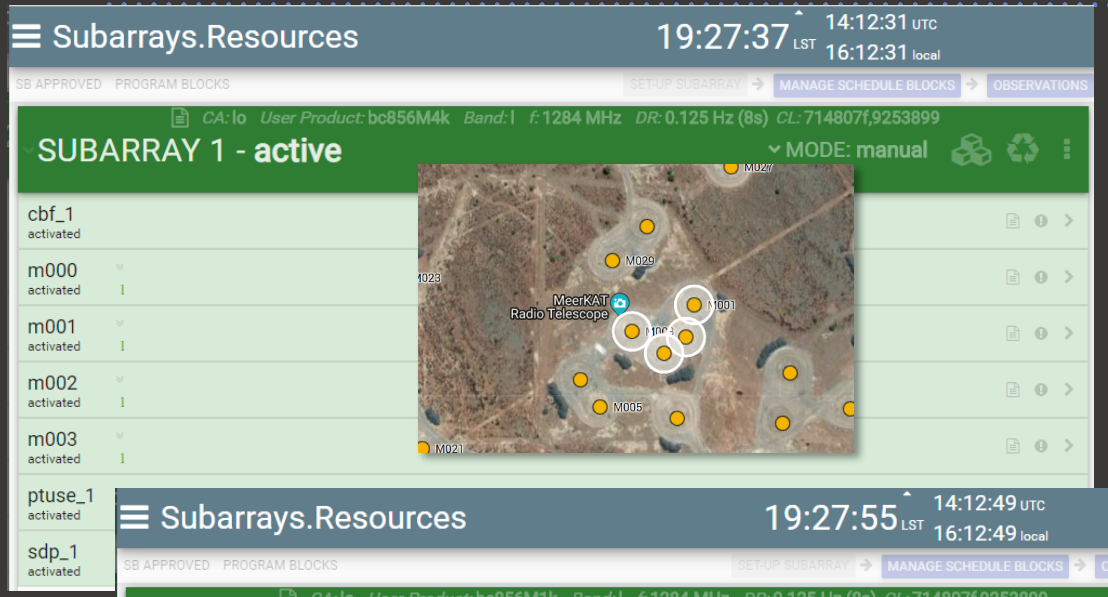
Spectrum on right is of a Maser at G330.89-0.36, lines at 1666 and 1668 MHz.

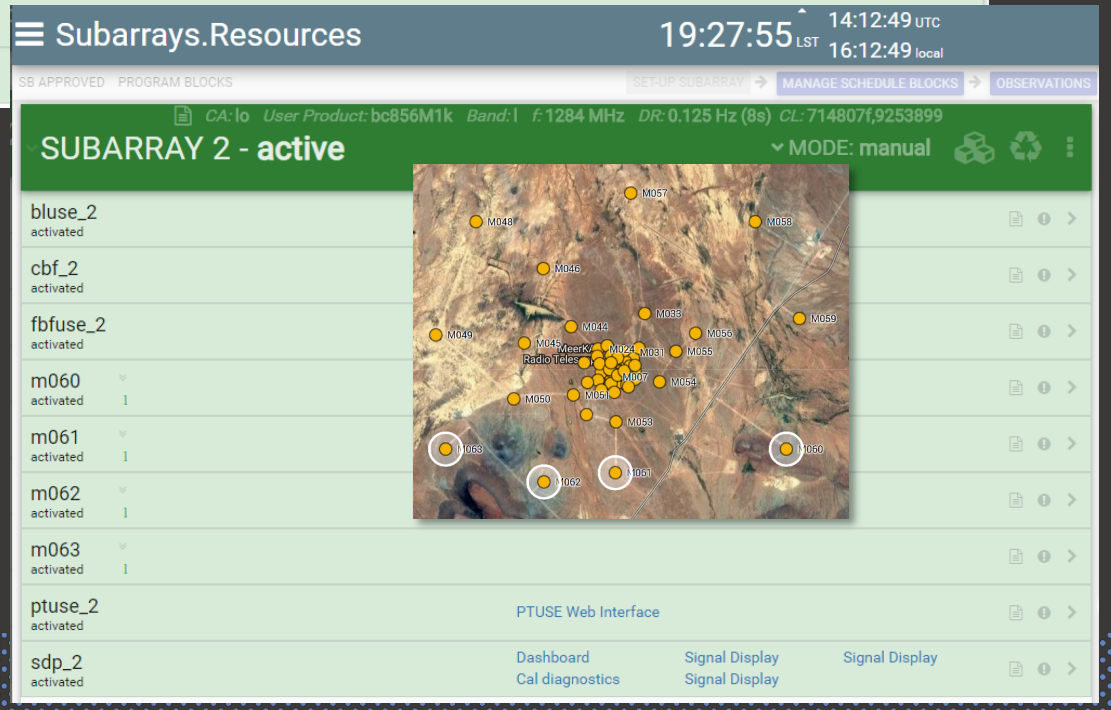


Subarrays


Subarrays
19:26:01 LST
14:10:55 UTC tabbott@ska.ac.za (Expert User)
16:10:55 local
LO: nmsani@ska.ac.za
SB APPROVED
PROGRAM BLOCKS
SUBARRAYS WORKFLOW
OBS OVERVIEW
SUBARRAY 1 - active
CA: lo Band: l User Product: bc856M4k Config Label: 714807f,9253899
SET-UP SUBARRAY
MANAGE SCHEDULE BLOCKS
OBSERVATIONS
SUBARRAY 2 - active
CA: lo Band: l User Product: bc856M1k Config Label: 714807f,9253899
SET-UP SUBARRAY
MANAGE SCHEDULE BLOCKS
OBSERVATIONS
SUBARRAY 3 - inactive
CA: lo Band: None User Product: None

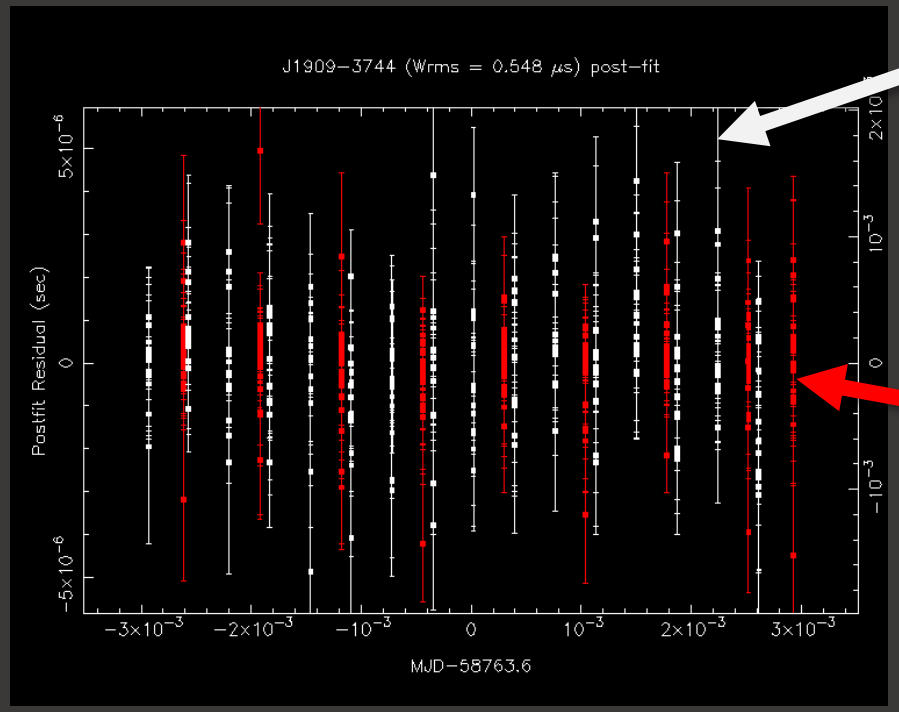

Receptor Status
19:40:48 LST
14:25:40 UTC tabbott@ska.ac.za (Expert User)
16:25:40 local
LO: nmsani@ska.ac.za
SUBARRAY 1 - active
CA: Band: None User Product: None Config Label: None
m000
m001
m002
m003
STOP
SUBARRAY 2 - active
CA: Band: None User Product: None Config Label: None
m060
m061
m062
m063
STOP

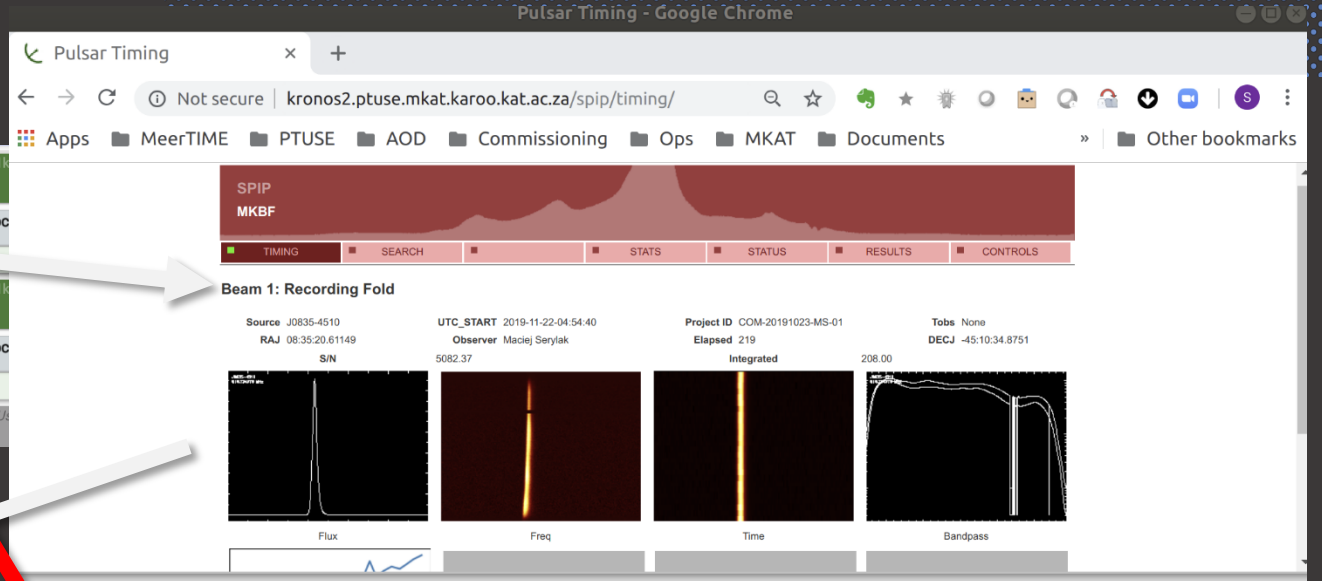

Subarrays.Resources
19:27:37 LST
14:12:31 UTC
16:12:31 local
SB APPROVED
PROGRAM BLOCKS
SET-UP SUBARRAY
MANAGE SCHEDULE BLOCKS
OBSERVATIONS
CA: lo User Product: bc856M4k Band: l f: 1284 MHz DR: 0.125 Hz (8s) CL: 714807f,9253899
SUBARRAY 1 - active
MODE: manual
cbf_1
activated
m000
activated
m001
activated
m002
activated
m003
activated
ptuse_1
activated
sdp_1
activated
MeerKAT Radio Telescope

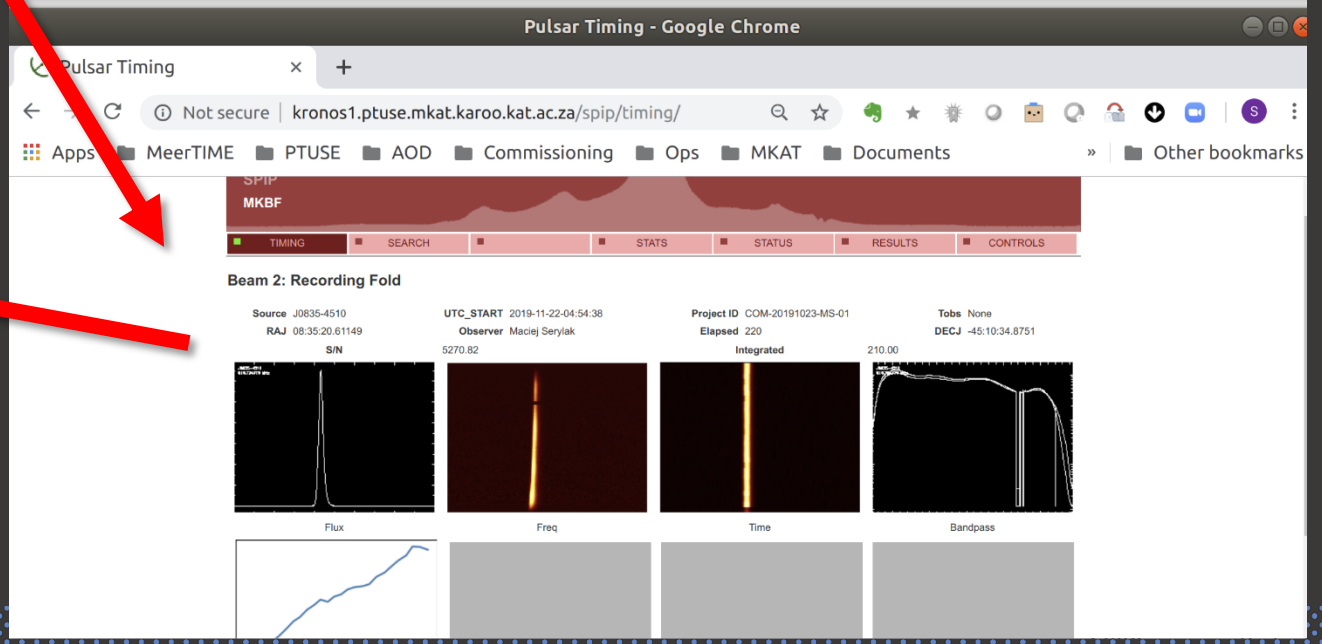

Subarrays.Resources
19:27:55 LST
14:12:49 UTC
16:12:49 local
SB APPROVED
PROGRAM BLOCKS
SET-UP SUBARRAY
MANAGE SCHEDULE BLOCKS
OBSERVATIONS
CA: lo User Product: bc856M1k Band: l f: 1284 MHz DR: 0.125 Hz (8s) CL: 714807f,9253899
SUBARRAY 2 - active
MODE: manual
bluse_2
activated
cbf_2
activated
fbfuse_2
activated
m060
activated
m061
activated
m062
activated
m063
activated
ptuse_2
activated
PTUSE Web Interface
sdp_2
activated
Dashboard
Cal diagnostics
Signal Display
Signal Display
Signal Display

Subarrays

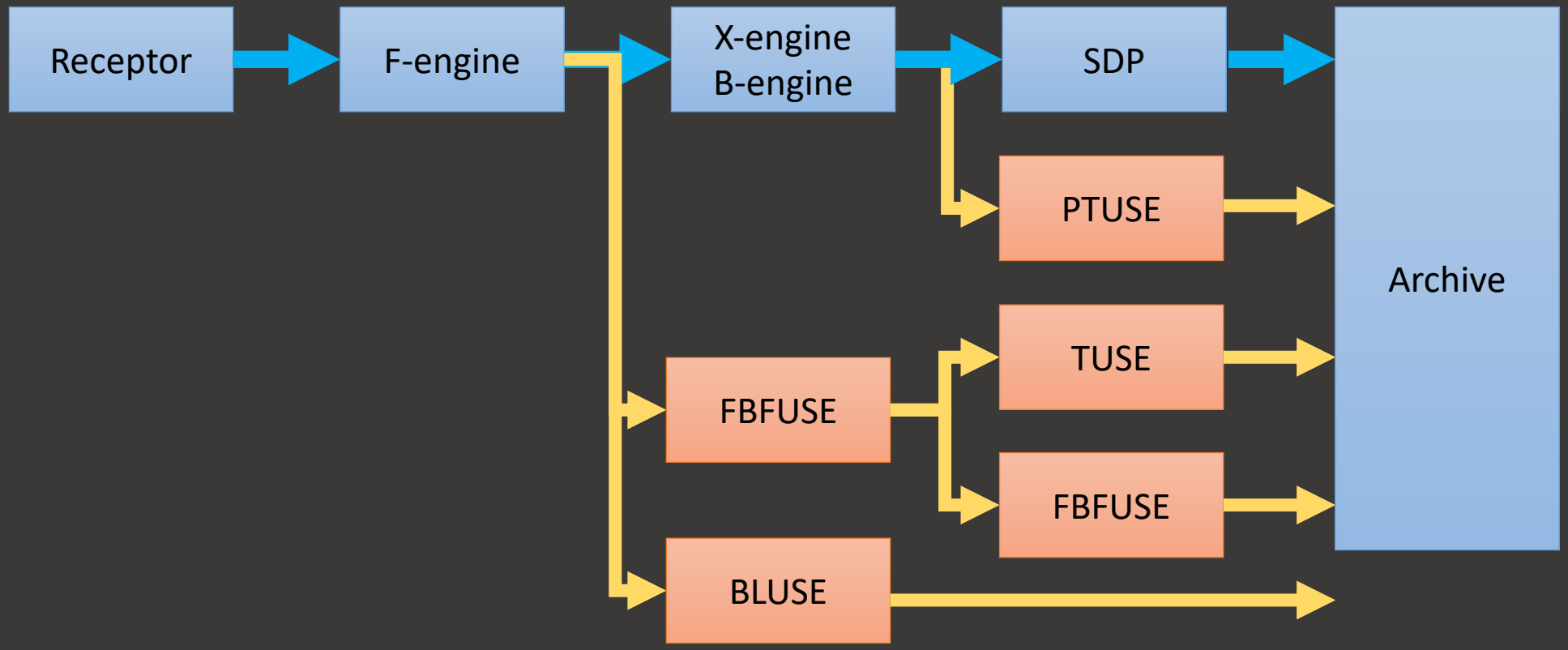
SUBARRAY 1 - active
Unlinked Schedule Bloc
20190919-0019
Subarray1 - 64A test
Sarah
SUBARRAY 2 - active
Unlinked Schedule Bloc
20190919-0020
Subarray2 - 16A test
Sarah
SUBARRAY 3 - inactive


J1909−3744 (Wrms = 0.548 μs) post−fit
Postfit Residual (sec)
MJD−58763.6


Pulsar Timing - Google Chrome
Pulsar Timing
Not secure
kronos2.ptuse.mkat.karoo.kat.ac.za/spip/timing/
Apps
MeerTIME
PTUSE
AOD
Commissioning
Ops
MKAT
Documents
Other bookmarks
SPIP
MKBF
TIMING
SEARCH
STATS
STATUS
RESULTS
CONTROLS
Beam 1: Recording Fold
Source J0835-4510
RAJ 08:35:20.61149
UTC_START 2019-11-22-04:54:40
Observer Maciej Serylak
Project ID COM-20191023-MS-01
Elapsed 219
Tobs None
DECJ -45:10:34.8751
S/N
5082.37
Integrated
208.00
Flux
Freq
Time
Bandpass


Pulsar Timing - Google Chrome
Pulsar Timing
Not secure
kronos1.ptuse.mkat.karoo.kat.ac.za/spip/timing/
Apps
MeerTIME
PTUSE
AOD
Commissioning
Ops
MKAT
Documents
Other bookmarks
MKBF
TIMING
SEARCH
STATS
STATUS
RESULTS
CONTROLS
Beam 2: Recording Fold
Source J0835-4510
RAJ 08:35:20.61149
UTC_START 2019-11-22-04:54:38
Observer Maciej Serylak
Project ID COM-20191023-MS-01
Elapsed 220
Tobs None
DECJ -45:10:34.8751
S/N
5270.82
Integrated
210.00
Flux
Freq
Time
Bandpass

User Supplied Equipment

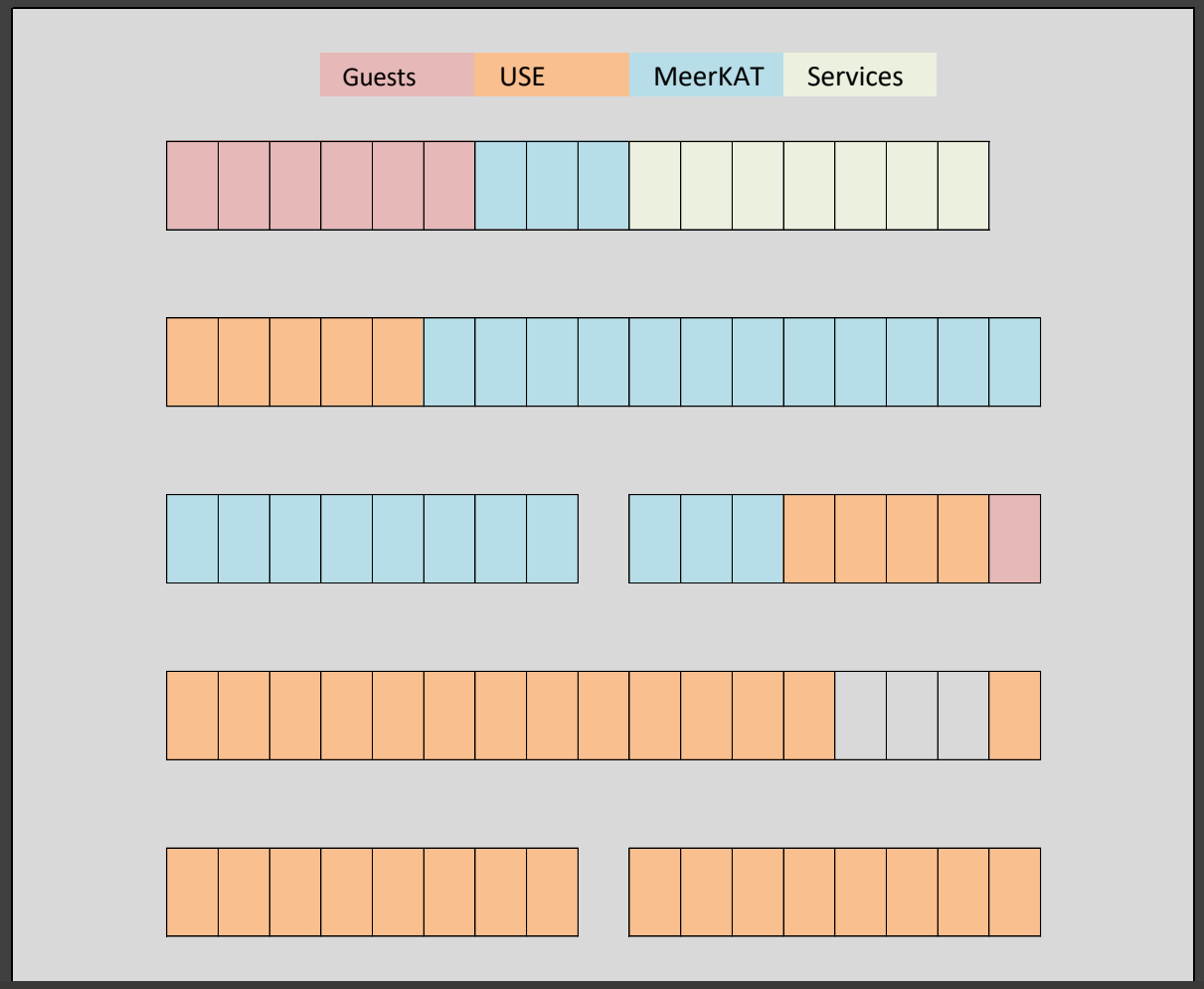


User Supplied Equipment

Making space for USE:

- Rack space
- Power
- Cooling
- Network ports
- Bandwidth to Cape Town

A significant part of MeerKAT observing time



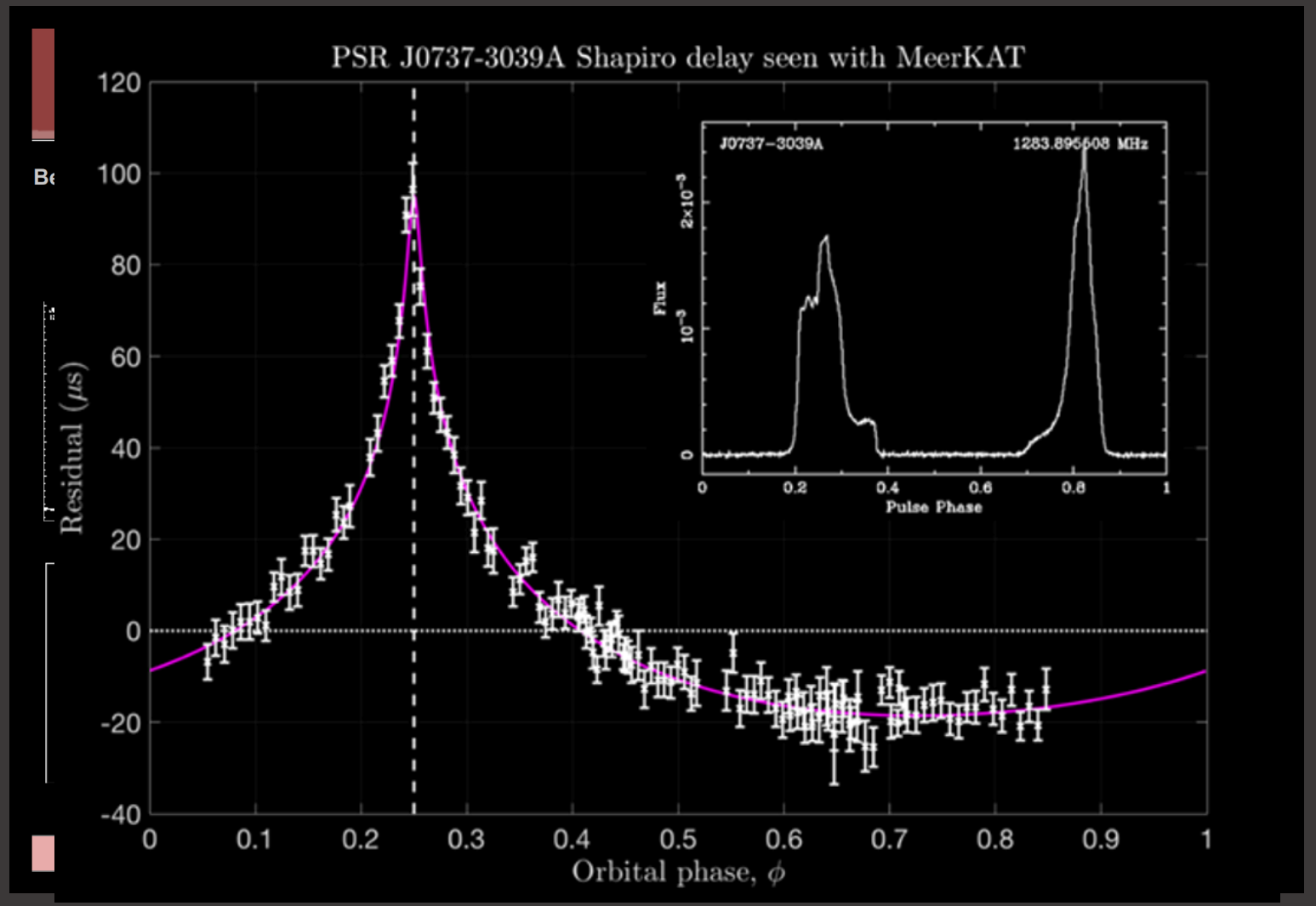
USE: Pulsar Timing USE

Timing back-end developed at Swinburne University

Web interface with real-time displays

Single orbit of the double pulsar.

Credit: MeerTIME Collaboration



USE – FBF+APS+TUSE

Filterbank Beamformer

- Fully commensal, generates >1000 beams
- 60 second voltage buffer

Transient search

Recent results

- Repeated FRB detection
- Simultaneous timing of three known pulsars

USE - APSUSE

Accelerated pulsar search on each of the 1000 beams

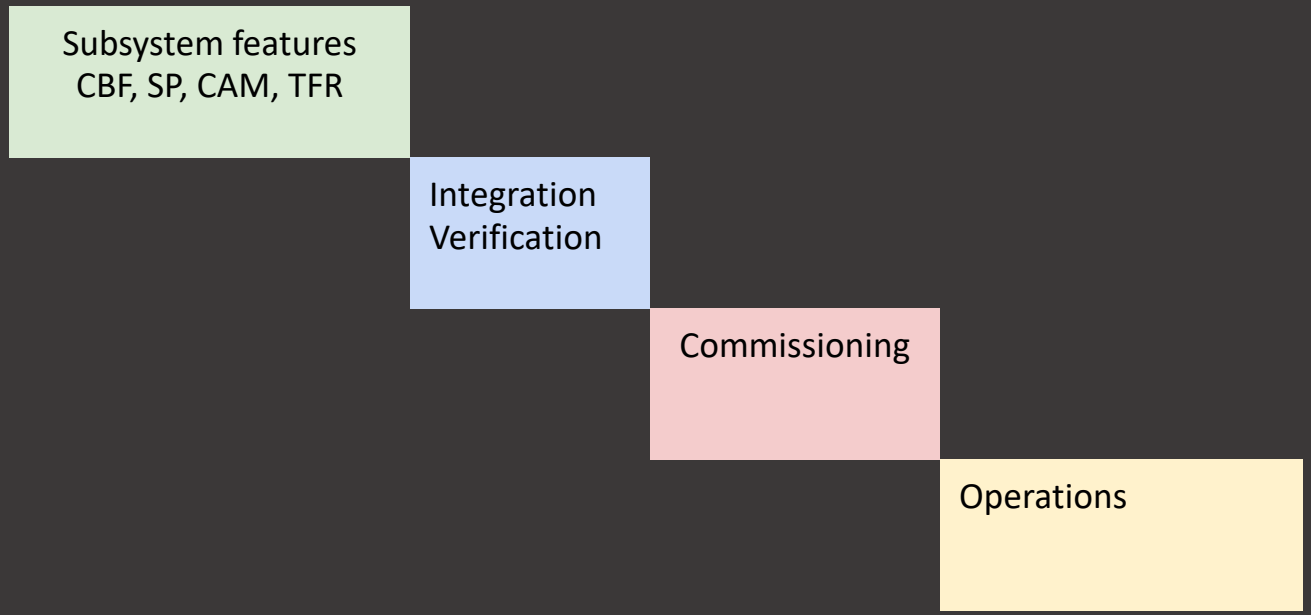
USE - BLUSE

Observing program

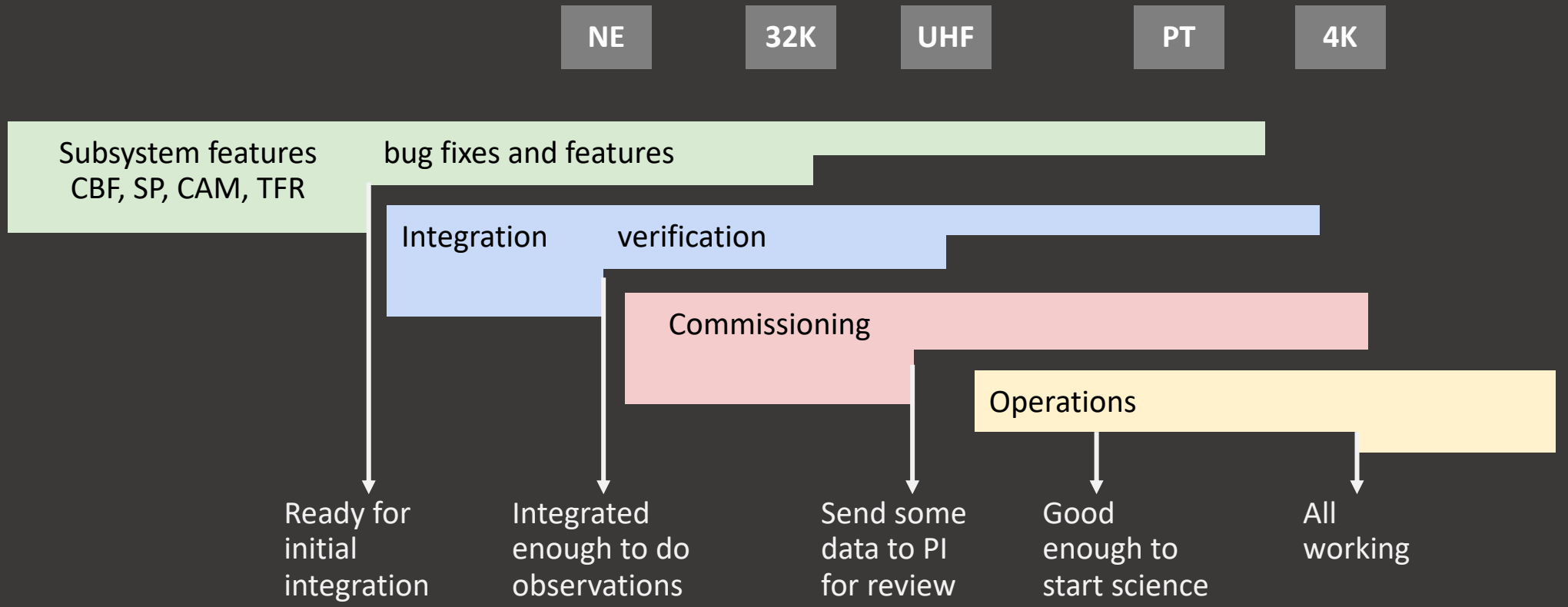
- Observing fraction > 50% from April to date
  - Almost 3000 hours of science observing since 1 April
  - Another 1300 hours of engineering and commissioning observations
- Three of our Large Survey Projects are taking data
- First open time Call to South African PIs resulted in 38 approved projects.
  - 32 projects completed
  - 532 hours observed
- Five DDT proposals observed
  - 53 hours
- MeerKAT data featured in three papers in Nature this year

Integration Lessons Learned

AIV process


Subsystem features
CBF, SP, CAM, TFR
Integration
Verification
Commissioning
Operations

AIV process


NE
32K
UHF
PT
4K
Subsystem features
CBF, SP, CAM, TFR
bug fixes and features
Integration
verification
Commissioning
Operations
Ready for initial integration
Integrated enough to do observations
Send some data to PI for review
Good enough to start science
All working

Integration Lessons Learned

- Early integration
  - a blurring, up and down, in the right hand side of the V
  - before qualification of the subsystems
- Continuous release of features through the sausage machine
- Integration lab
  - Essential for bringing things together in a low-cost environment
- On the real telescope
  - The only full-size laboratory you have

science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

NRF
National Research Foundation

SARAO
South African Radio Astronomy Observatory

The South African Radio Astronomy Observatory (SARAO) is a National Facility managed by the National Research Foundation and incorporates all national radio astronomy telescopes and programmes.

The MeerKAT telescope is operated by the South African Radio Astronomy Observatory, which is a facility of the National Research Foundation, an agency of the Department of Science and Innovation.

Thomas Abbott
MeerKAT Programme Manager
Email: tabbott@ska.ac.za

www.ska.ac.za

The South African Radio Astronomy Observatory (SARAO) is a National Facility managed by the National Research Foundation and incorporates all national radio astronomy telescopes and programmes. SARAO is responsible for implementing the Square Kilometre Array (SKA) in South Africa.

CAPE TOWN Tel: +27 (0)21 506 7300 | 2 Fir Street, Black River Park | Observatory, Cape Town | South Africa 7925
JOHANNESBURG Tel: +27 (0)11 442 2434 | 17 Baker St, Rosebank | Johannesburg | South Africa 2196
HARTEBEESTHOEK Tel: +27 (0)12 301-3100 | Farm 502 Q Hartebeesthoek, Broederstroom Road | Krugersdorp, Gauteng | South Africa 1740