MeerKAT update
(Overview & commissioning)

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Radio Astronomy Schedule

- **Phase 1**: construction of the pathfinder KAT-7 (7 antennae) completed in December 2010 & already in operation

- **Phase 2**: construction of the precursor MeerKat (64 antennae), fully funded (R3Bn ~AUD300Mn), should be completed ~2016 & merged with SKA₁- mid

- **Phase 3**: construction of the SKA-mid (phases 1&2) (~3000 antennae) should be completed ~2025
Karoo Radio Astronomy Reserve
The MeerKAT Programme

• Africa must have the legacy of a large radio telescope
  – Irrespective of the outcome of the SKA site competition
  – But not independent of the SKA
• MeerKAT is an SKA “precursor”
  – Engineering prototype
  – Early science (SKA “Phase 0”)
  – Until the SKA is completed, MeerKAT should be one of the most sensitive radio interferometer in the L-band
  – Phased development: KAT-7, MeerKAT, SKA₁, SKA₂
  – MeerKAT will be the first 25% of SKA₁ (mid-frequency dish array)
Pathfinder: KAT 7

More on KAT-7 Thursday: First HI Observations with KAT-7
64 antennae distributed in two components:

- An inner dense core ~70% of the antennae (baselines: 29m to 1km), distributed in a 2D Gaussian uv-distribution with a $\sigma \sim 300$ m
- An outer component ~30% of the antennae (baselines: up to 8km), distributed in a 2D Gaussian uv-distribution with a $\sigma \sim 2500$ m

Commissioning: 2014 - 2016
Science operations: 2017
## MeerKAT INITIAL PLANS

<table>
<thead>
<tr>
<th>Year</th>
<th>Precursor (KAT-7)</th>
<th>MeerKAT Phase 1</th>
<th>MeerKAT Phase 2 &amp; 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>7</td>
<td>64</td>
<td>64</td>
</tr>
<tr>
<td>2016</td>
<td>0.9 - 1.6</td>
<td>1.00 - 1.75</td>
<td>0.58 - 1.015</td>
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<td></td>
<td></td>
<td></td>
<td>1.00 - 1.75</td>
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<td></td>
<td></td>
<td></td>
<td>8 - 14.5</td>
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<tr>
<td>2018</td>
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<td>0.75</td>
<td>2 (goal 4)</td>
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<td></td>
<td>Max processed BW (GHz)</td>
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<tr>
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<td>Max baseline (km)</td>
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<td>20</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Min baseline (m)</td>
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<td></td>
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</table>
Current MeerKAT Status
(12 June 2013)

Plans on track to complete the 64-dish MeerKAT by the end of 2016. The projected milestones are:

- January 2014: First dish installed (following acceptance testing)
- April 2014: Two dishes installed / First receptor integrated / ready for testing
- November 2014: 6 dishes
- June 2015: 16 dishes
- November 2015: 32 dishes working
- September 2016: All 64 dishes completed & tested
Commissioning of MeerKAT will start in 2014 and ramp up with the increasing number of antennas.

It is anticipated that some early science may be possible/feasible once a significant fraction of the array is constructed (32 ~ Dec 2015) / but commissioning activities will take priority.

The full array will be available for commissioning in 2017, hoping that most significant commissioning issues will have surfaced and be dealt with earlier so that there can be a rapid transition to MeerKAT science data collection by early 2018.
The current planning is that 2018-2020 will be devoted to the MeerKAT large science (L-band) programs with some transition to SKA₁.

The current SKA₁ (190 dishes) construction is expected 2018-2021 (full array 190 + 64 dishes).

The planning is that the sensitivity of SKA₁ dishes should equal that of MeerKAT around end 2020.

At that point, it may make scientific sense to integrate MeerKAT into SKA₁ (and use the SKA correlator, etc).

However, the actual SKA timelines are less certain than those for MeerKAT, at this stage.
• As the longest MeerKAT baselines are 8 km and some MeerKAT surveys (continuum science) require longer baselines (20 km), the planning is to work with the SKAO to ensure that the first few SKA₁ dishes are built at those kind of distances and used for this science in the 2019-2020 timeframe.

• As the MeerKAT correlator would have 64 inputs, some of the MeerKAT core antennas would be disconnected to accommodate SKA₁ inputs for this science.
MeerKAT & SKA$_1$
MeerKAT & SKA_2
MeerKat’s antennae

Offset Gregorian design: metal instead of composite dishes
MeerKat’s antennae

- Development of MeerKAT antennas on track by Stratosat Datacom / GDSatcom
- 1st antenna to be assembled on site and handed over to SKA SA for testing end of January 2014
- 2nd antenna to be handed over in April 2014
- Followed by extensive engineering testing by SKA SA for 6 months
- 62 other antennas delivered by the end of 2016
MeerKat’s Feeds & Receivers

• The L-band feeds and cryo receivers (0.9-1.67 GHz) development is on track (by EMSS)
• Functional prototypes with measured performance were demonstrated June 2013
• The first two production systems will be deployed on the first two MeerKAT antennas beginning 2014
MeerKat’s Feeds & Receivers

• Based on the modeling and the actual performance tests to date, MeerKAT is expected to achieve a sensitivity in excess of 300 m$^2$/K rather than the originally specified 220 m$^2$/K at L-band

• The UHF cryo receiver (0.58-1.015 GHz) development has started. A decision on whether these will be included in MeerKAT end of 2016 will be made in the near future

• The X-band receiver (8-14.5 GHz) remains in the plans, but is not currently funded
MeerKat’s Infrastructure

MeerKAT related infrastructure on site to be completed end 2013. Currently under construction:

- Roads
- Reticulation (power & fiber)
- Foundations for MeerKAT antennas
- On-site tarred landing strip
- Extension of the site complex assembly building
- Karoo Array Processor Building (KAPB)
- Pedestal Assembly building
+ additional workshops at the Klerefontein support base
MeerKat: start of construction

July 25 2012
Road network near the core
Site Complex extension for MeerKAT

- Dish Assembly shed
- Pedestal integration shed
- Bunkered & RFI shielded processor building and power room
Power and Infrastructure
Power and Infrastructure
CONCLUSIONS

• Important milestones for MeerKAT:
  1. First antenna: January 2014
  2. First receptor test system: April 2014
  3. Antennas construction completed: June 2016
  4. MeerKAT large science programmes (L-band + baselines up to 8 km): 2018 - 2019
  5. MeerKAT large science programmes (continuum + baselines up to 20 km) 2019 - 2020
Thank’s to Jasper Horrell
Science processing sub-system manager
on the MeerKAT project
for the current MeerKAT status
as of 12 June 2013