The US Technology Development Project for the SKA

TDP Progress Report

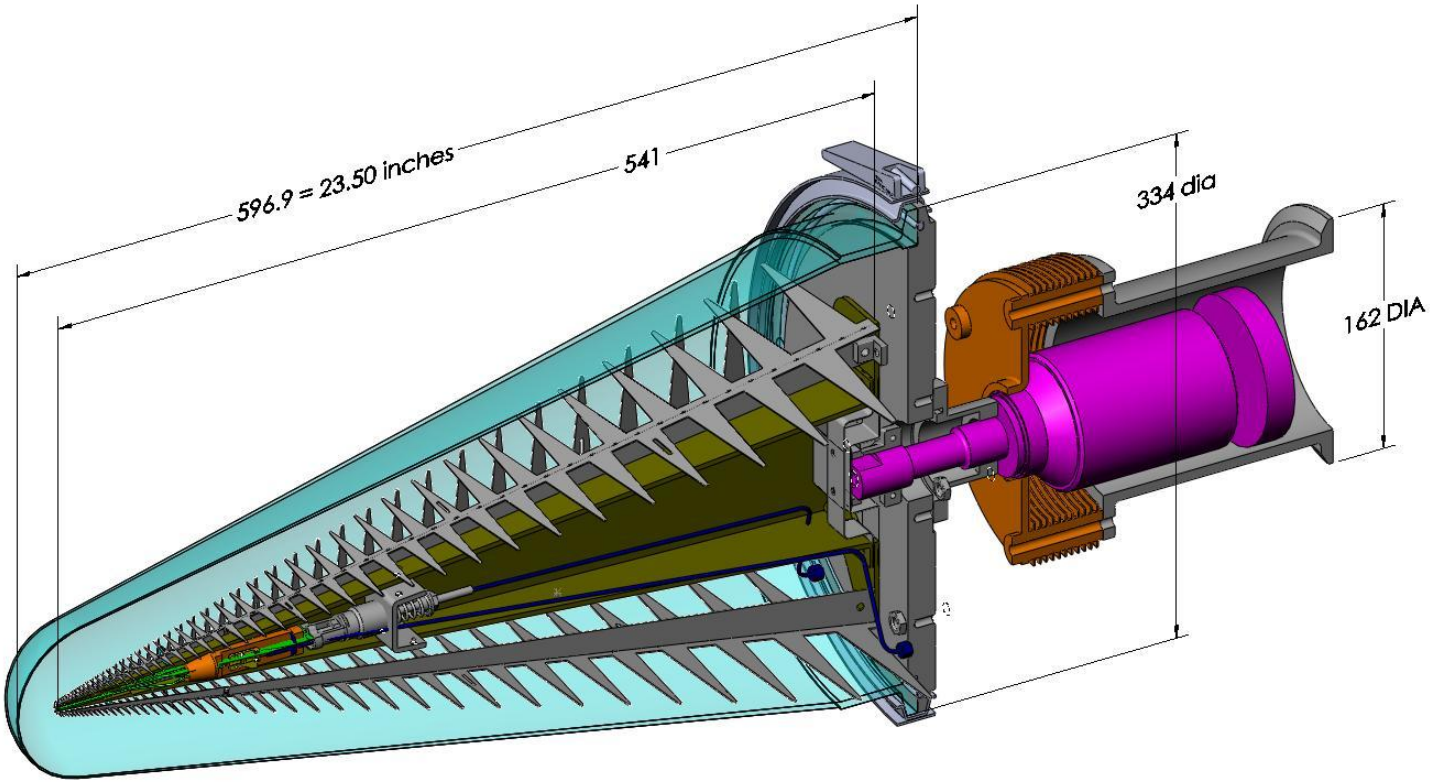
SKA 2010, Manchester

Lynn Baker

Reflectors, Feeds, LNA's

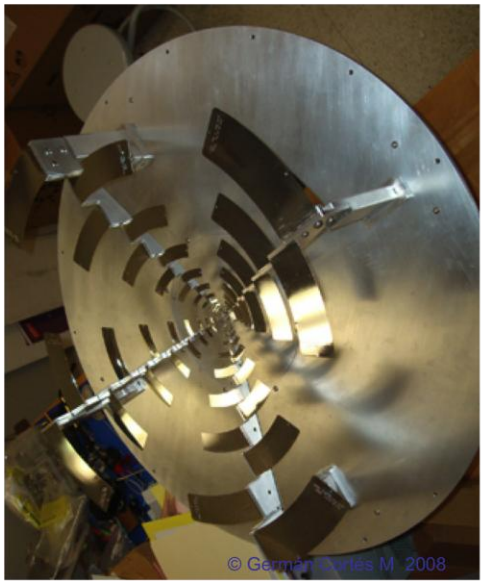
- Several wideband feed concepts moving to second round of design improvements.
- Advanced conceptual designs of reflector optics and structures.
- Continued development of broadband, low noise amplifiers
- Subsystem development is converging to design and construction of the first prototype, DVA-1.

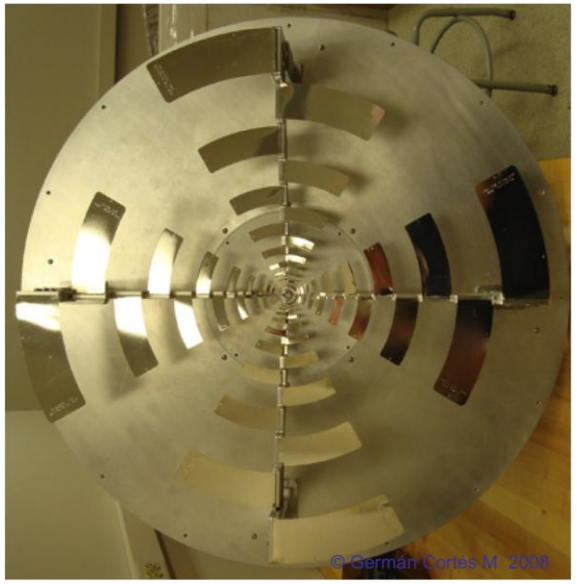
ATA Log-periodic Feed

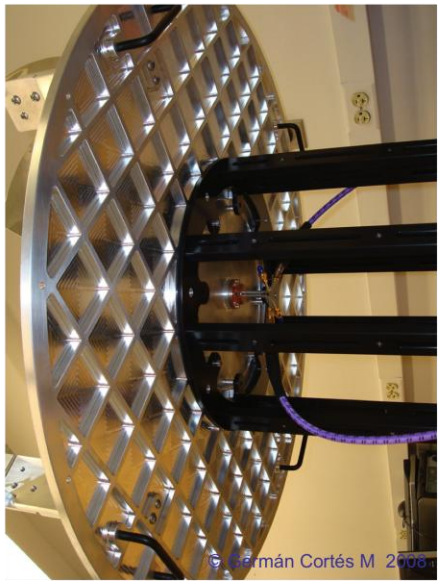


The Ultra Wide Band QSC Feed

300 MHz to 3 GHz Prototype



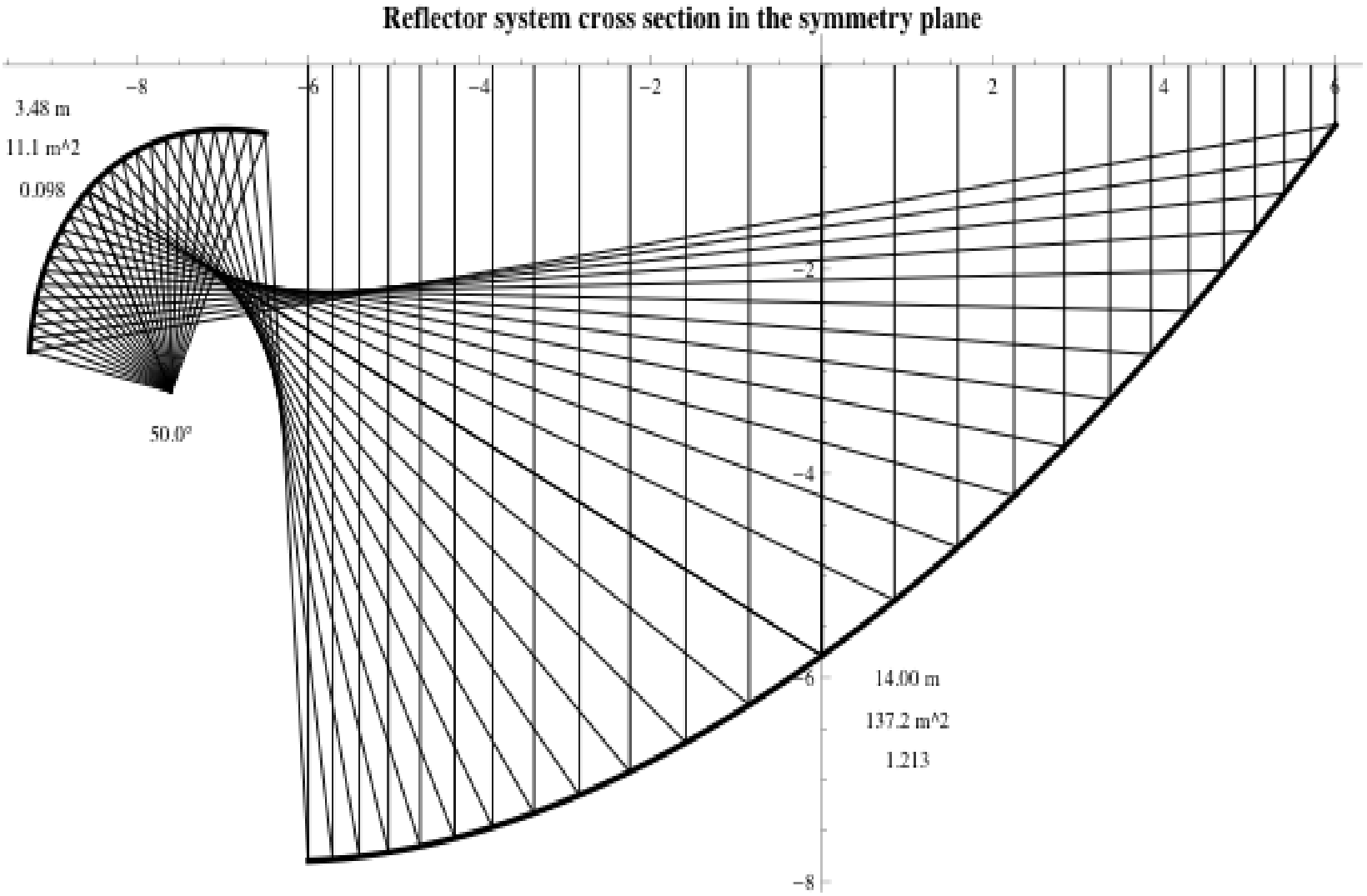




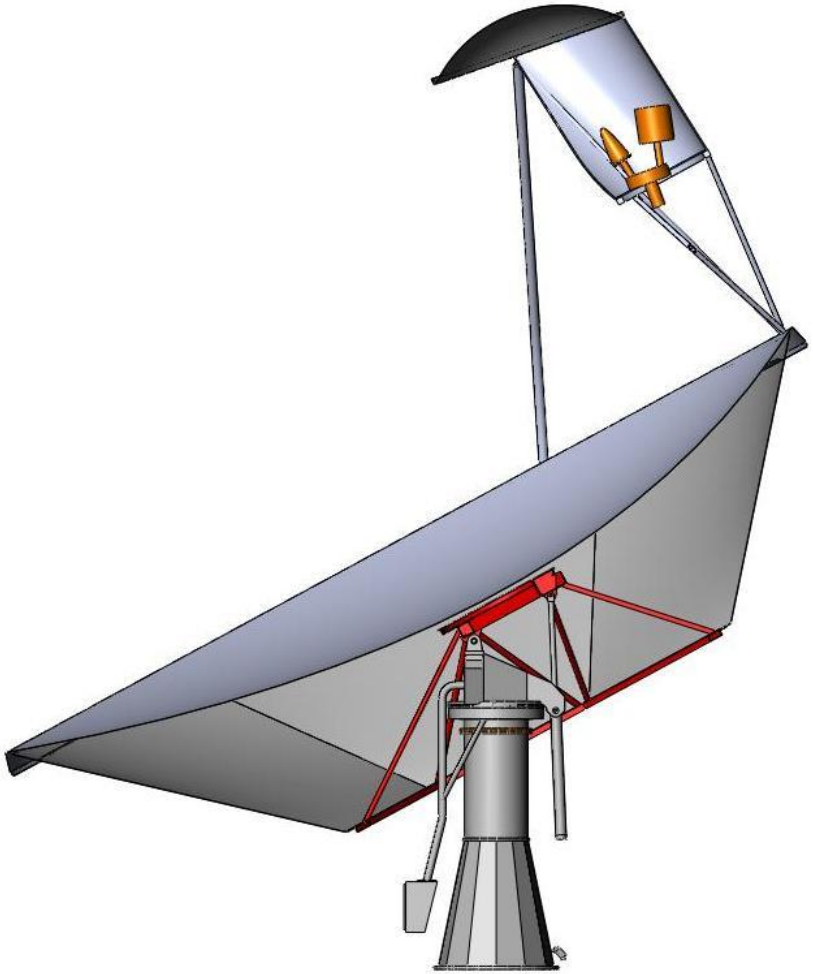
Truncated Ground plane to 500 MHz for Initial testing:
low frequency extension straightforward

Figure 1 - Receiver for 0.5 to 3 GHz in lab at Caltech prior to installation for tests on a 34m radio telescope at Goldstone during summer 2008. The key components of the receiver shown at right are the wideband quad-ridge feed and a long-life cooler to cool the low noise amplifiers to 50K.

Typical Shaped Offset Reflectors

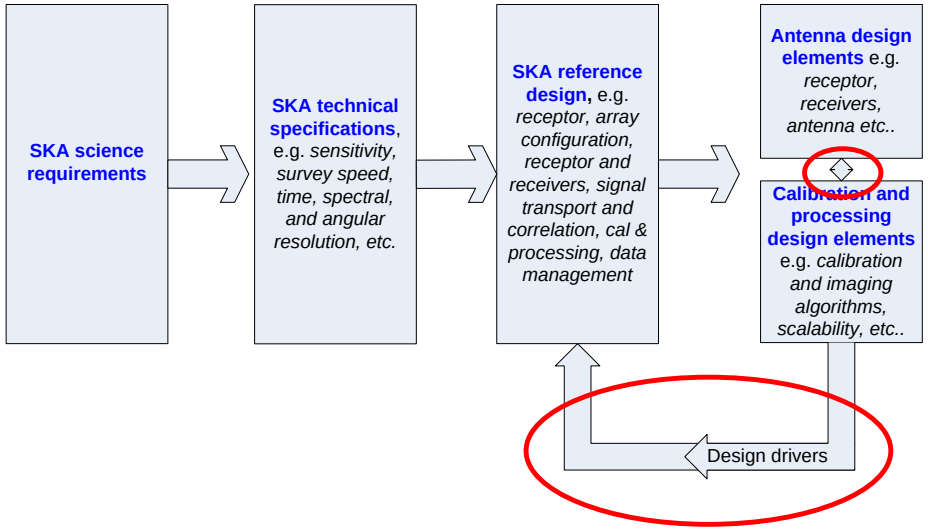


12 Meter Conceptual Design



CPG goals and activities

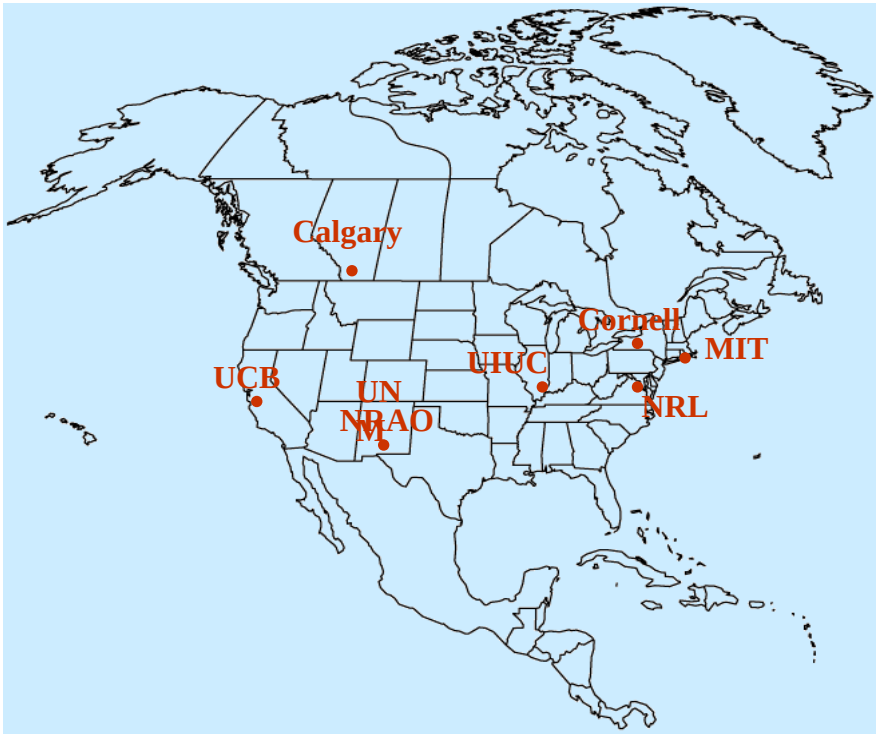
- ***Activities:***
  - Define cost and feasibility of SKA calibration and processing technologies for dish/WBSPF.
  - Identify drivers or constraints on the systems design.
- ***Current focus:***
  - Support DVA-1 and dish verification activities.
  - Deeper quantitative refinement of technological challenges:
    - Level and stability of residual direction-dependent instrumental errors.



Calibration and processing are essential in defining SKA ***cost*** and ***feasibility.***

Current CPG membership

- *Athol Kemball* (Illinois) (*Chair)*
- *Sanjay Bhatnagar* (NRAO)
- *Geoff Bower* (UCB)
- *Shami Chatterjee* (Cornell)
- *Jim Cordes* (Cornell; *TDP PI*)
- *Shep Doeleman* (Haystack/MIT)
- *Joe Lazio* (NRL)
- *Colin Lonsdale* (Haystack/MIT)
- *Lynn Matthews* (Haystack/MIT)
- *Steve Myers* (NRAO)
- *Jeroen Stil* (Calgary)
- *Greg Taylor* (UNM)
- *David Whysong* (UCB)
- *Mark Yashar (UIUC)*

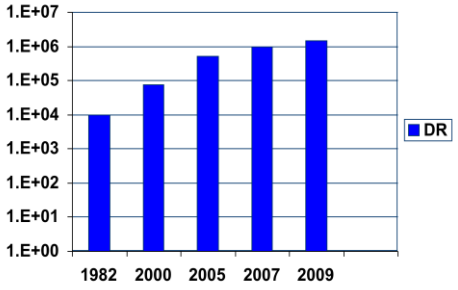


Feasibility: SKA gap analysis

- High imaging *dynamic range* and *sensitivity* algorithms (relative to current state of practice):
  - *Calibration instrumental models* and *signal propagation models* both require:
    - *Accuracy*
    - *Time-, frequency-, and polarization stability*
    - *High-order parametrization*
    - *Inclusion of direction-dependent terms*
  - Calibration and imaging with *complex sky models*; main-lobe confusion and sidelobe contamination are ubiquitious

- *Operational* models are quite different from current arrays:
  - Commensal, high-speed surveys; transient detection
  - Real-time, mostly irreversible data reduction

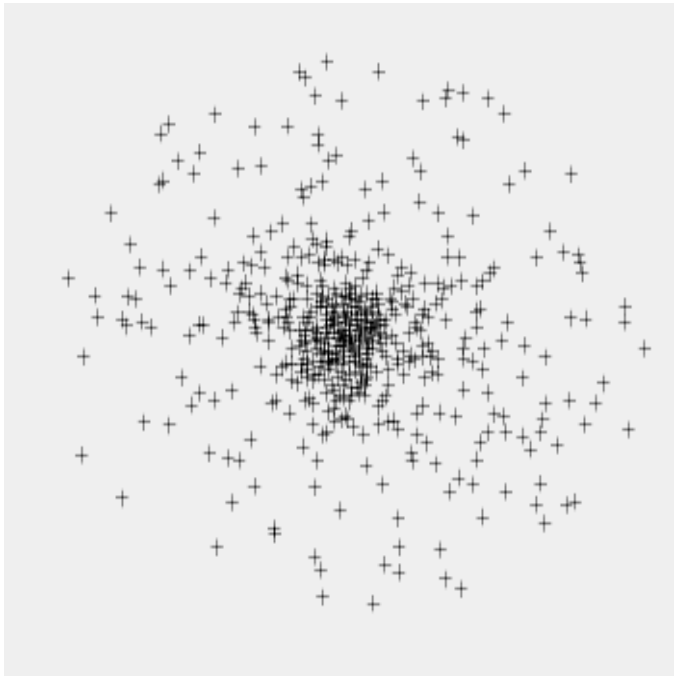
- Extreme-scale *computational* needs



SKA greatly exceeds current imaging dynamic range performance.

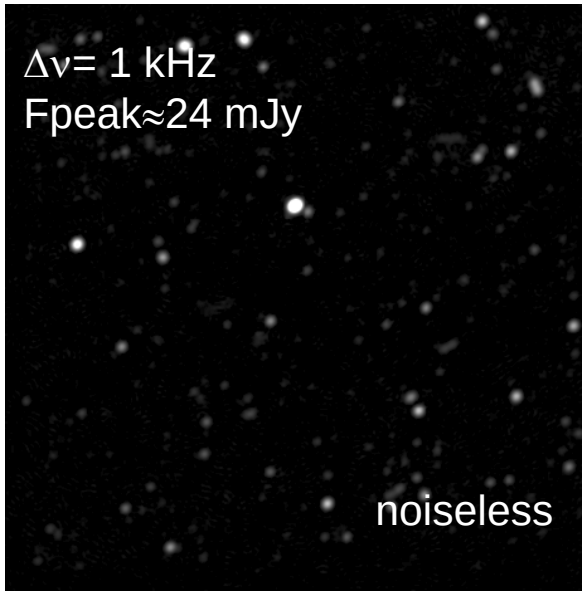
Feasibility: instrumental simulation studies

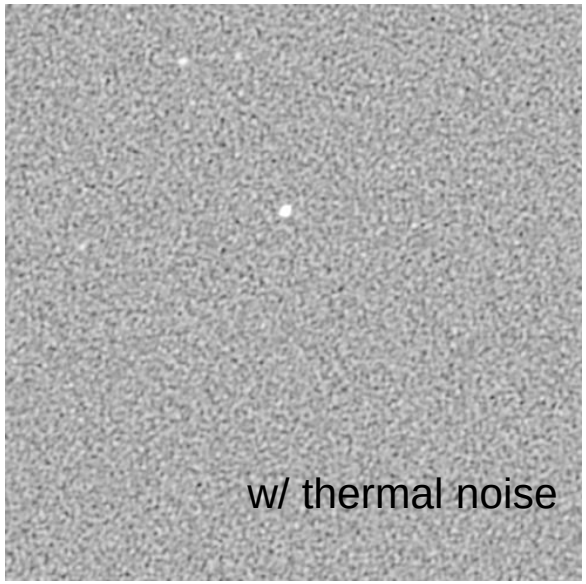
Images of MAPS simulations:



3 km

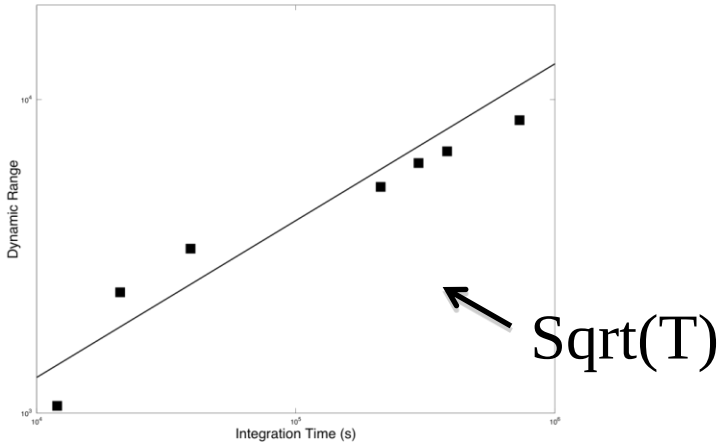
Array of 500 12-m antennas



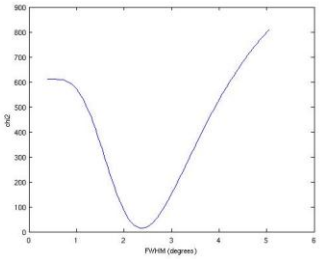


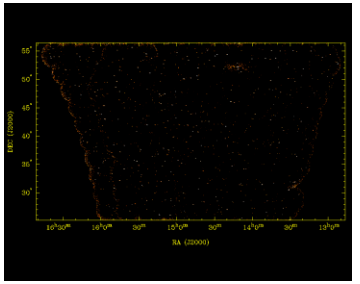
Feasibility: development and verification using pathfinder arrays

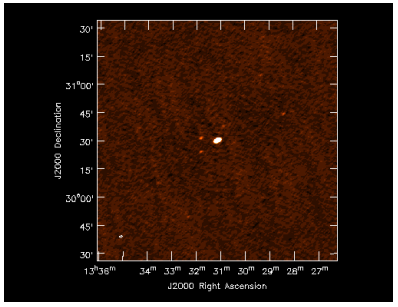
Pathfinder observations are used, along with simulations, and statistical studies, to verify dynamic range performance.



- Solvers for direction-dependent effects:
  - Use multiple observations of the same source in adjacent pointings to calibrate primary beam shape
  - Can calibrate simple Gaussian models as well as more complex models
  - Has the benefit of requiring no additional calibration observations







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Whysong & Bower (ATA)

Hull et al. (ATA)