



Array Configuration Studies for the SKA: Implementation of Figures-of-Merit on Spatial-Dynamic-Range

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Figures of Merit

- ❑ Any parameter which is a measure of (u,v) -plane coverage;
 - ❑ Commonly used:
 - resolution, beam shape, sidelobe level, dynamic range, etc...
 - ❑ Additional:
 - spatial dynamic range, pixel fidelity



Spatial Dynamic Range

- ❑ **Spatial dynamic range (SDR):** the ratio between largest and smallest adequately imaged scales – it measures, effectively, brightness sensitivity of an array on all scales.
- ❑ **SDR reflects a number of aspects of array design,** including the type of primary receiving element (antenna), signal processing, and distribution of antennas / stations.
- ❑ **Array configuration:** SDR can be expressed as a „gap“, $\Delta u/u$, between adjacent baselines (u_1, u_2):
$$\Delta u/u = (u_2 - u_1)/u_2 \quad (u_2 > u_1); \Delta u/u [0,1]$$
- ❑ **Uniform sensitivity is provided by $\Delta u/u = \text{constant}$**



Our Aim

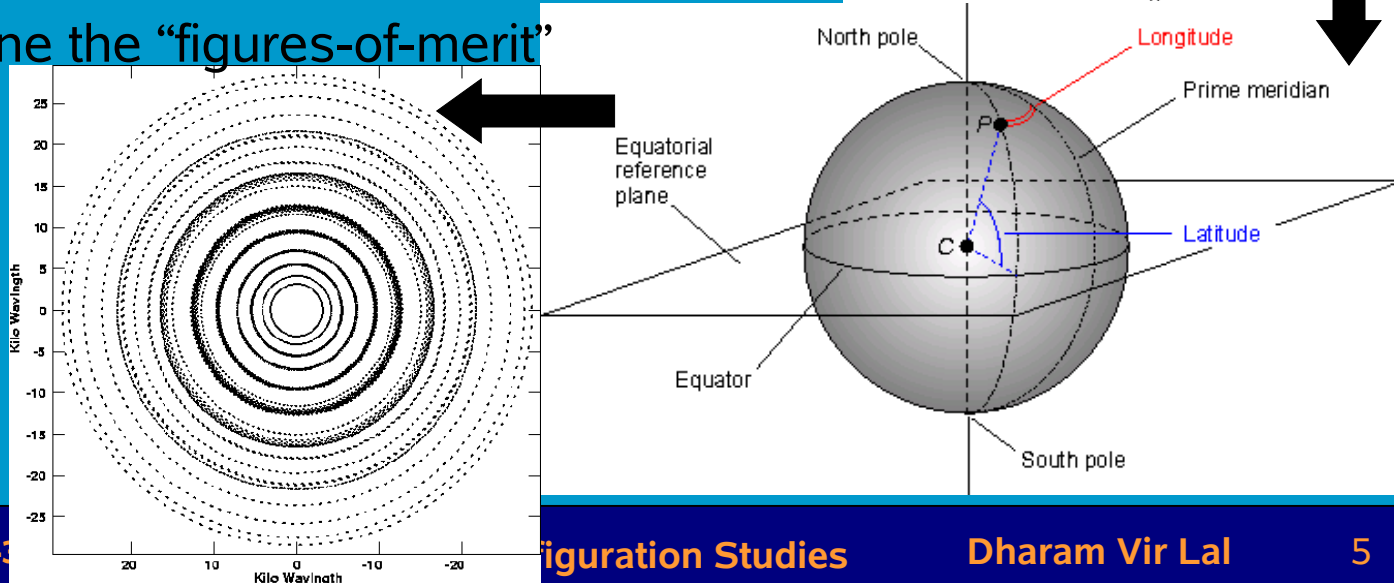
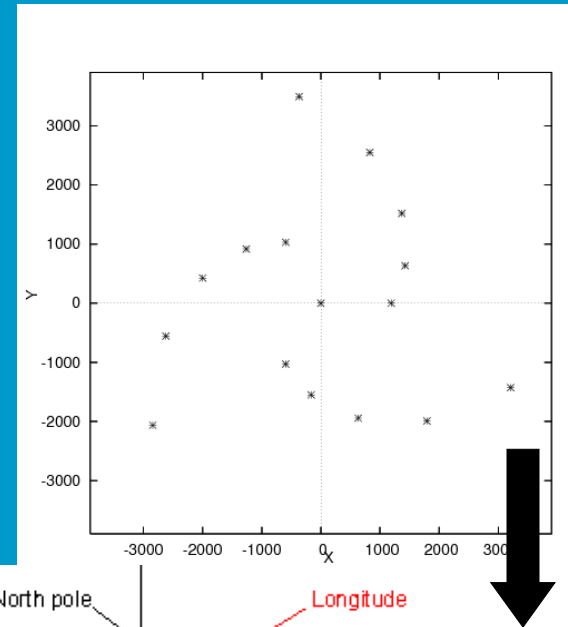


Next, we aim to determine the behaviour of figures-of-merit as a function of (u,v) -gap parameter.



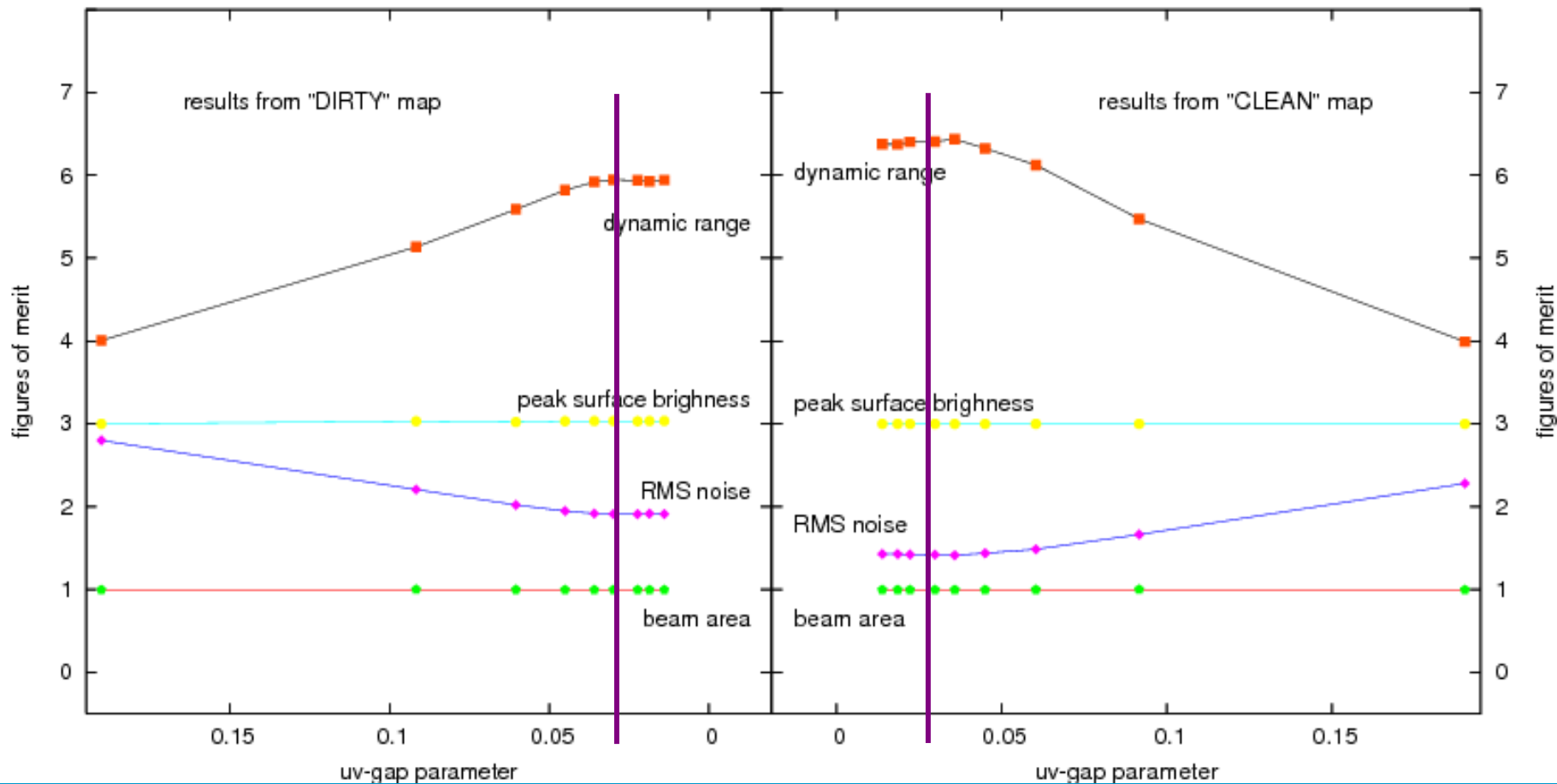
The Methodology

- ❑ Define / Assume $\Delta u/u$ and generate test array (X,Y) configuration
- ❑ Project this array on Earth's surface and determine (Latitude, Longitude, Z)
- ❑ Choose an appropriate input source model
- ❑ RUN simulator to obtain visibilities
- ❑ Use these visibilities and perform mapping
- ❑ Determine the “figures-of-merit”





Experiment : Results



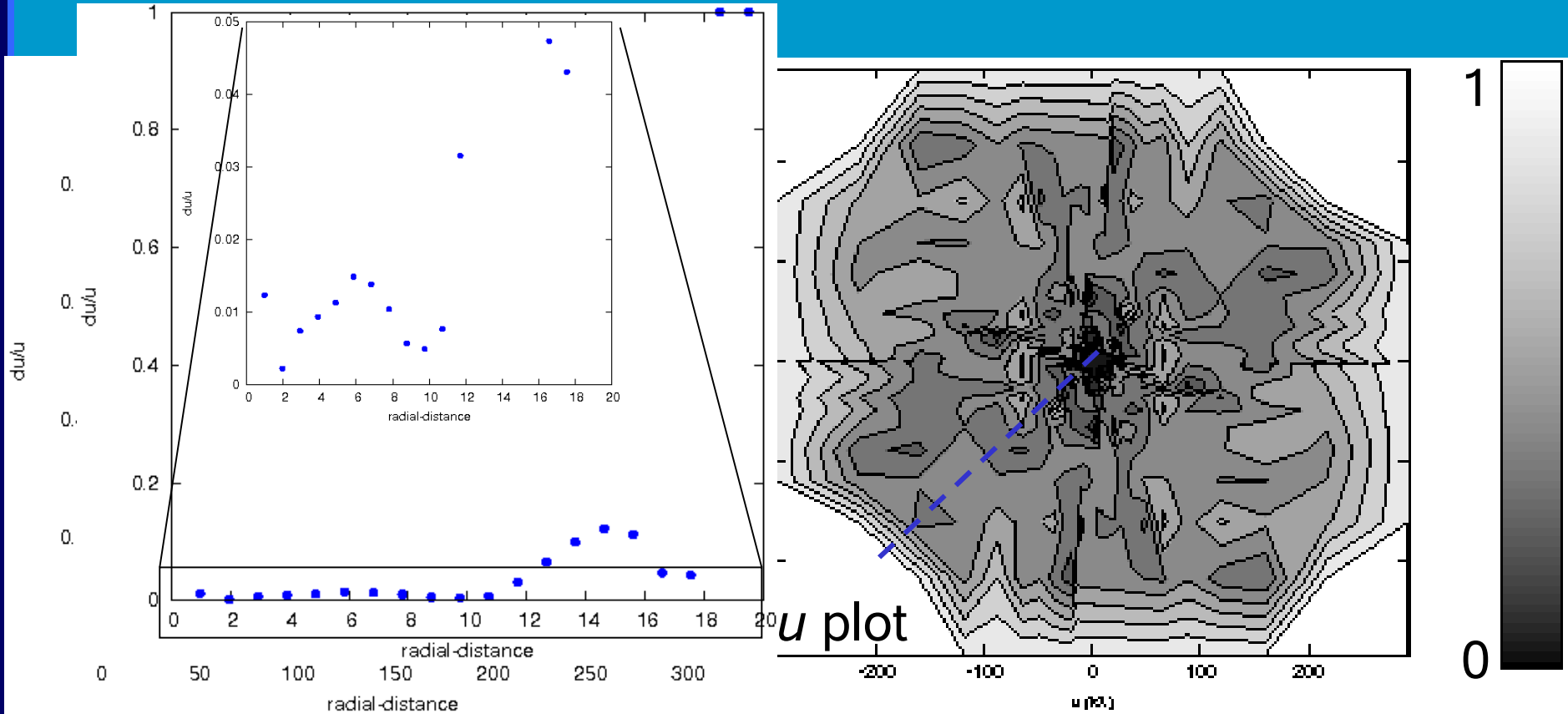


Experiment : Results

- ❑ To make SKA a competitive instrument
 - ❑ resolution of < 1 mas at highest frequency
 - ❑ Fourier plane filling factor
 - $\Delta u/u < 0.03$ over entire range of (u,v) coverage.
- ❑ $\Delta u/u (uv, \square)$ for any given array configuration.



Implementing ... : Results 1/2

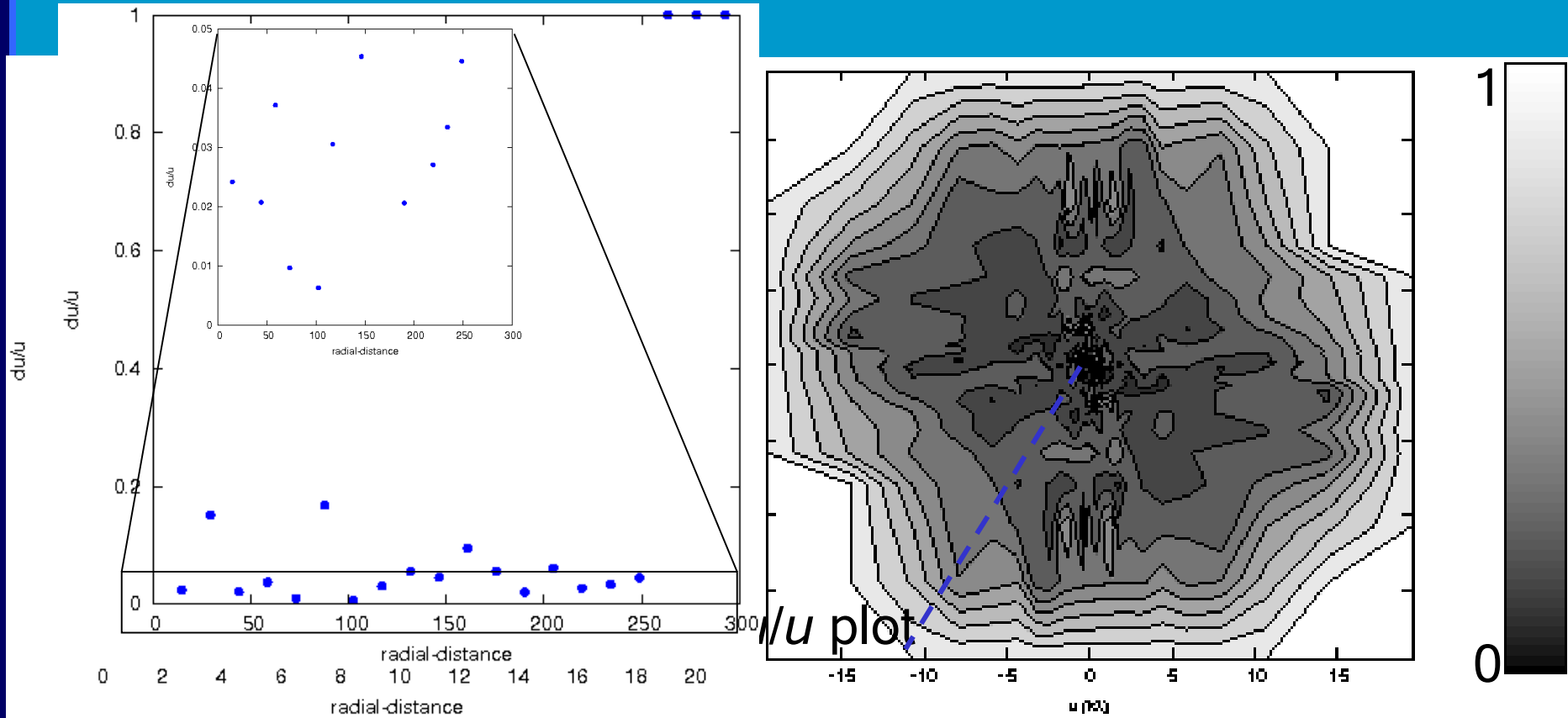


Single-scan snapshot observations

Real data (VLA @8.4 GHz, B-array config)



Implementing ... : Results 2/2



Multi-scan snapshot observations
Real data (GMRT @235 MHz)



Implementing to Realistic Arrays

- These empirical solutions can be implemented into any proposed configuration.

- We are in a position to quantify imaging parameters for the following instruments,
 - KAT / MeerKAT – South Africa**
 - ASKAP – Australia**
 - SKA – Phase I configuration**