

Evaluation of MeerKAT

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Overview

- **MeerKAT Design**
 - Motivation and Inputs
 - Tools & Metrics
 - Results
- **MeerKAT Performance**
 - Issues
 - The Bigger Picture
 - Future Work

MeerKAT Design

- **Compact Core ($\sim 1''$)**
 - Low Column Densities, Pulsars, Extended emission
 - *How compact before shadowing becomes critical?*
- **Extended Core ($\sim 5-10''$)**
 - Detailed Mapping of Galaxies
 - *How high without compromising sensitivity?*
- **Medium Resolutions ($\sim 20-30''$)**

MeerKAT Design

- **Tools**

- AntConfig Suite

- *Uses Gaussian weighting to tune for different resolutions*

- Python Libraries

- **Metrics**

- Point Source Sensitivity

- *Hope to keep constant over resolutions*

- Column Density Sensitivity

- UV Coverage

MeerKAT Design

- Sensitivity
$$\Delta I = \frac{\sqrt{2}kT_{sys}}{\epsilon_A A \sqrt{N(N-1)\Delta\nu\Delta t}} \text{Jy}$$

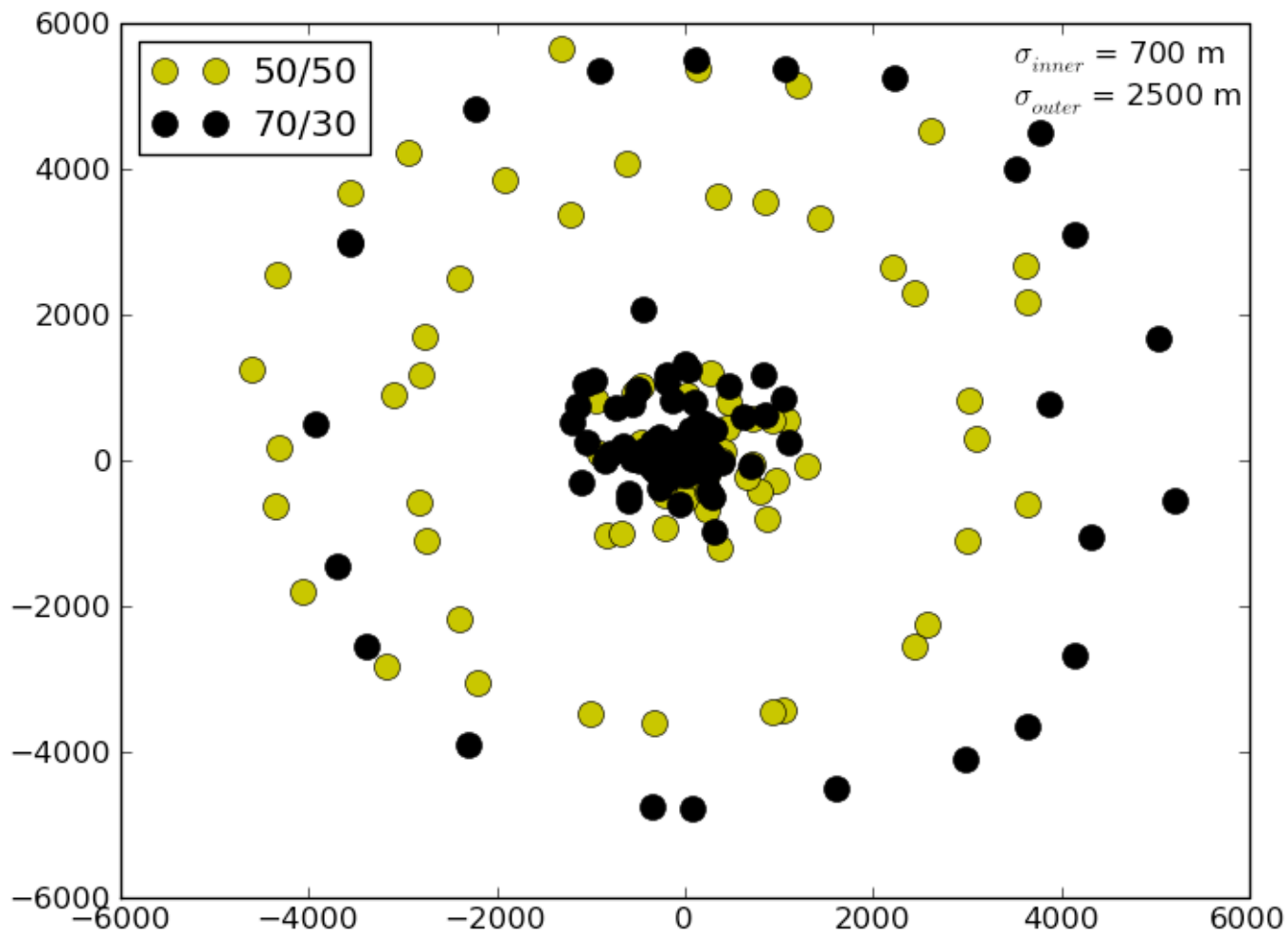
$$\Delta I_{uv}(\sigma) = \Delta I \cdot \frac{\beta(\sigma)}{\beta_{natural}} \text{Jy}$$

- Resolution
$$\sigma \cdot \theta = k$$

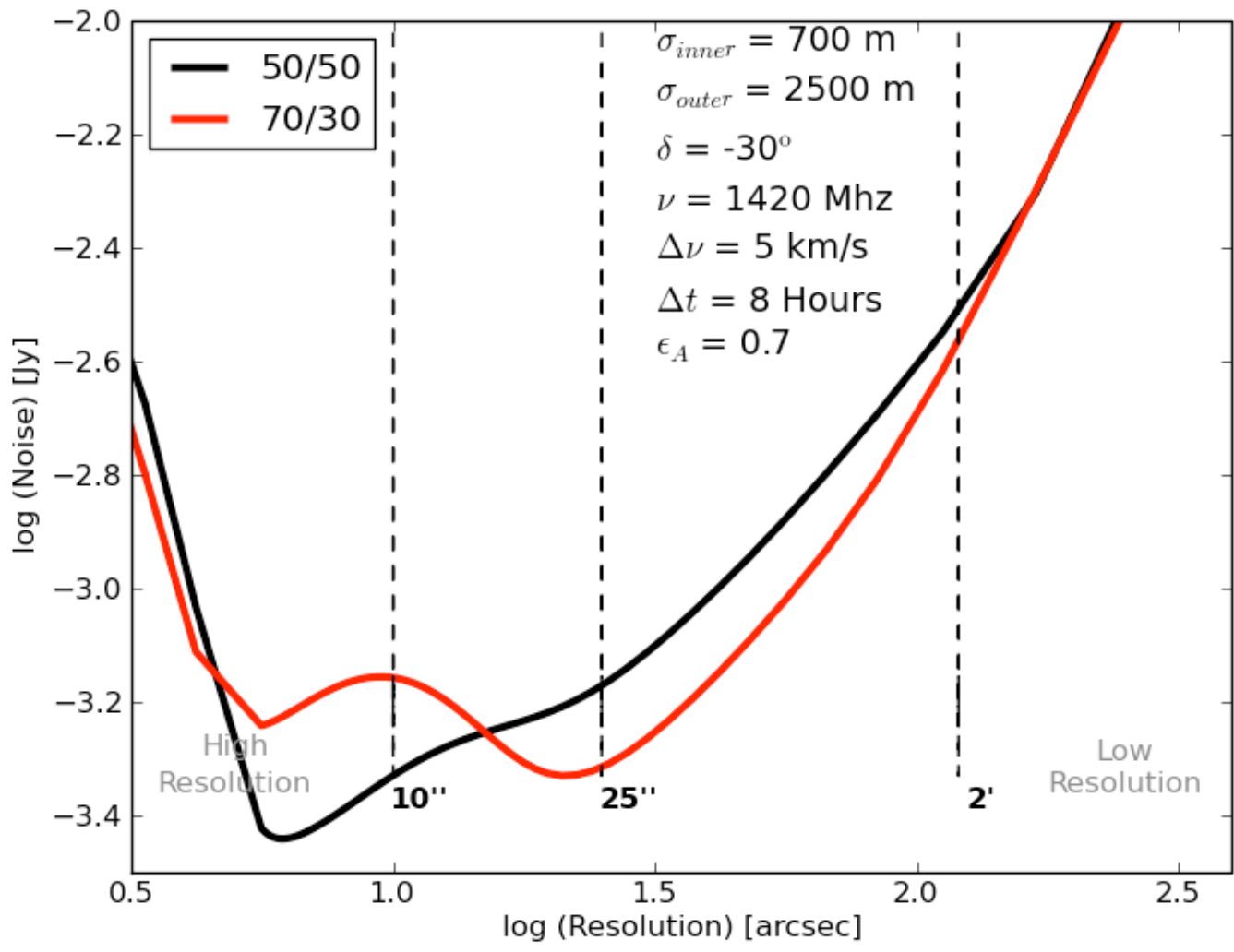
$$k = 700\text{m} \cdot 24''$$

MeerKAT Design

- Hybrid:
 - 80 dishes
 - 2 Cores
 - Each independently optimized to produce Gaussian beams for targeted resolution
 - What is the magic ratio?
 - 70% Inner 30% Outer
 - 50% Inner 50% Outer

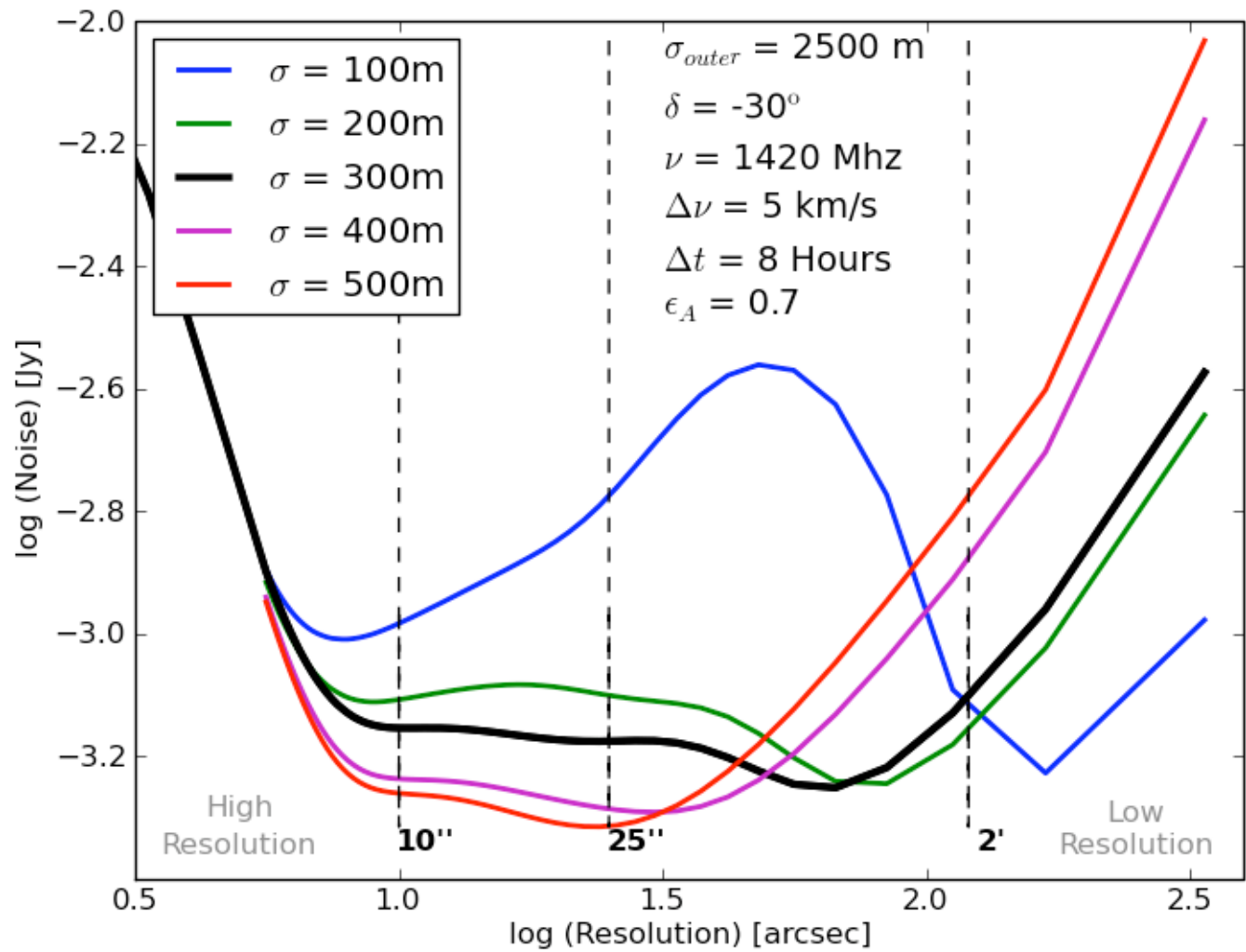


ICRAR Bunker Bay Workshop
2009



MeerKAT Design

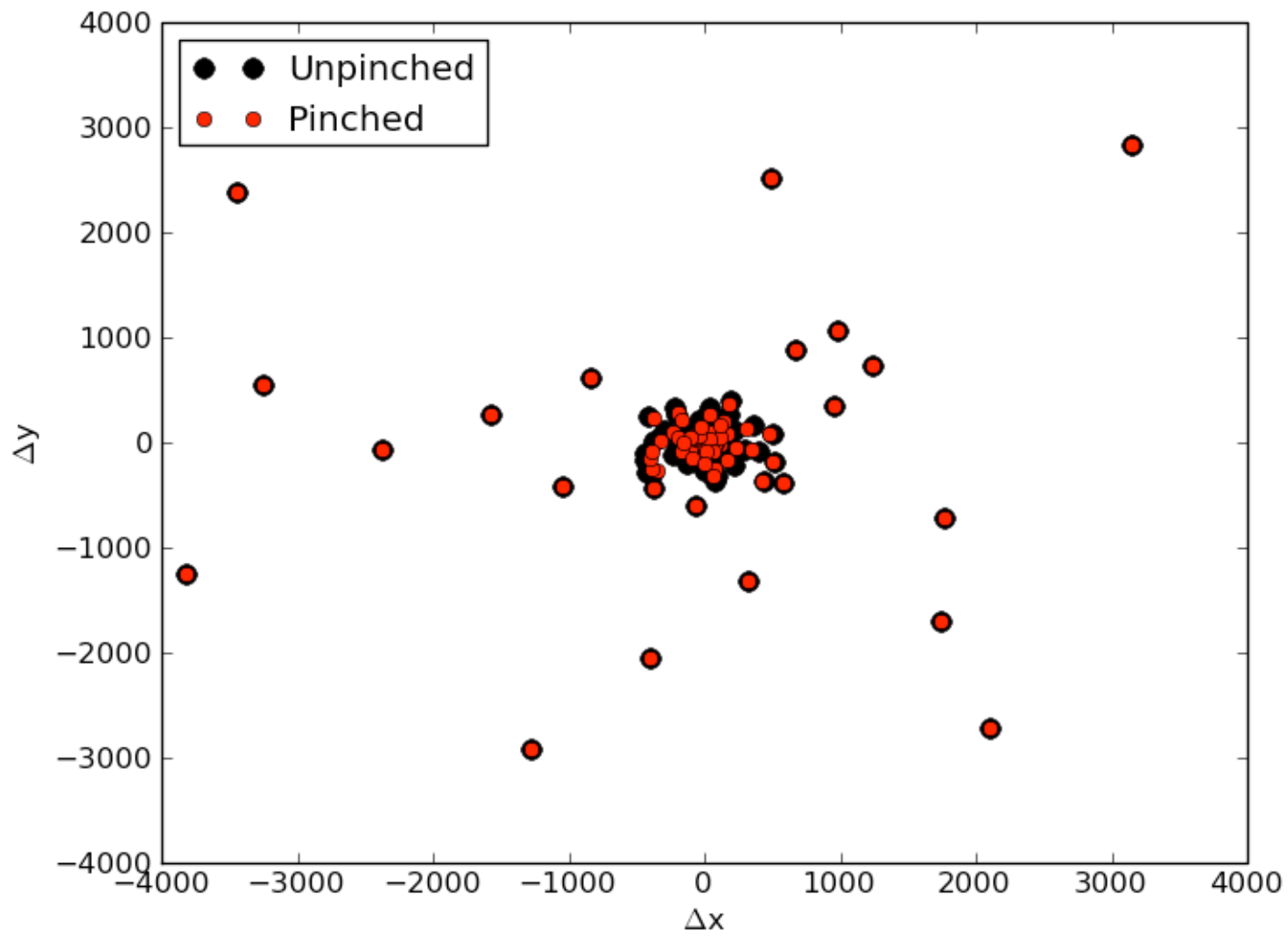
- **70% Inner, 30% Outer**
 - *What σ_{inner} ensures flat intermediate sensitivity?*



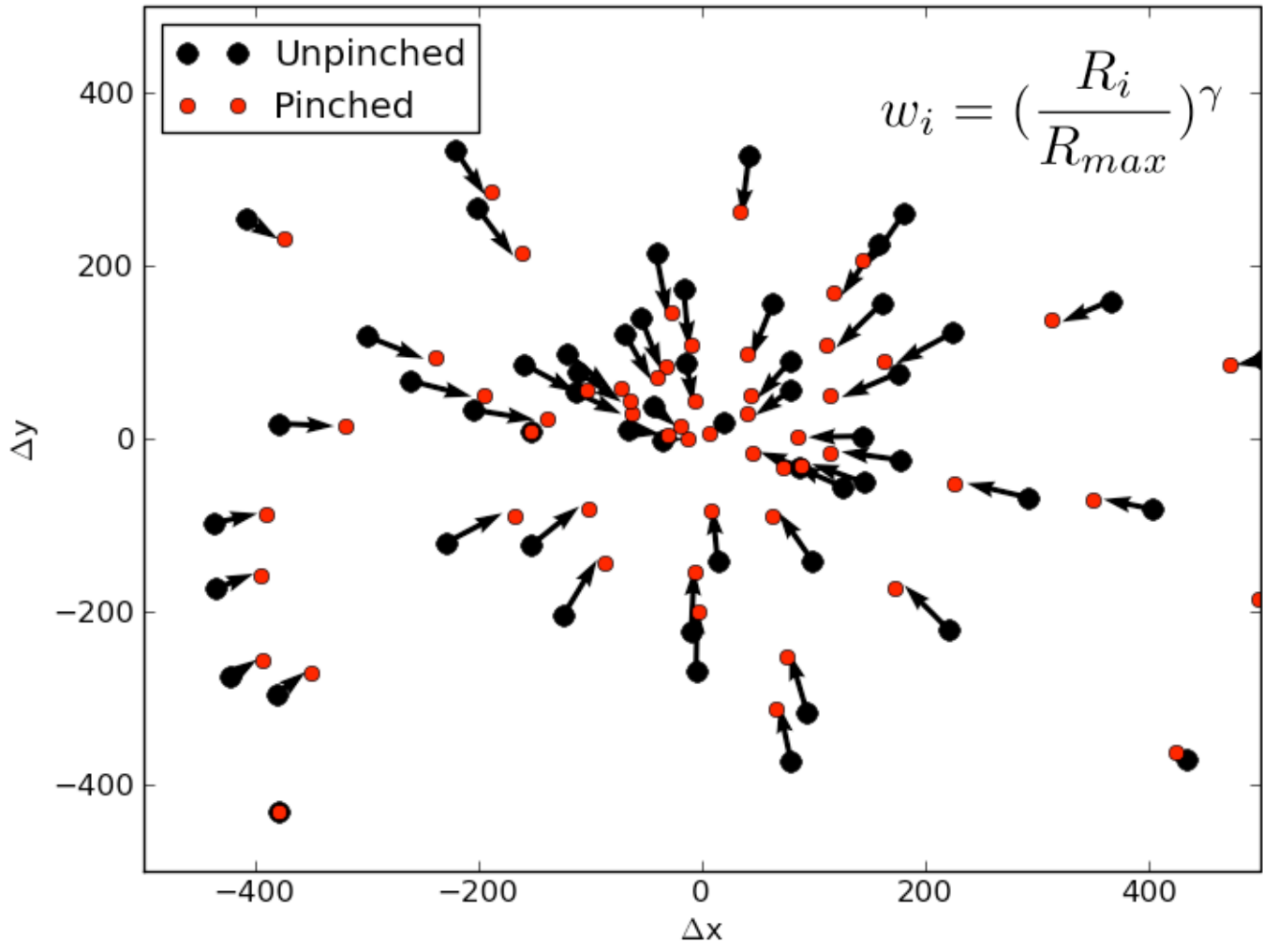
MeerKAT Design

- *Can we emphasize short baselines?*
 - Power Law Scaling / “Pinching”

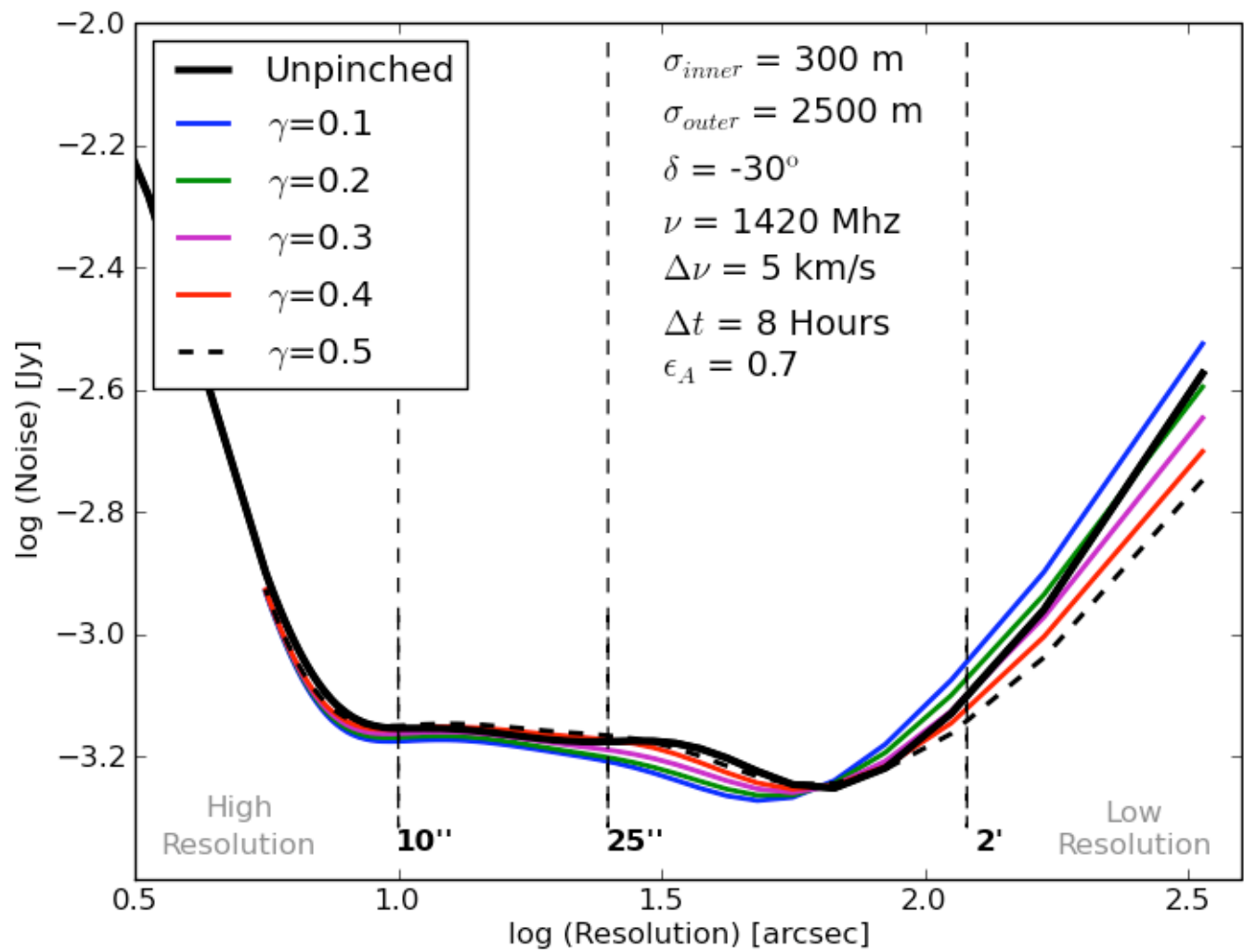
$$w_i = \left(\frac{R_i}{R_{max}} \right)^\gamma$$



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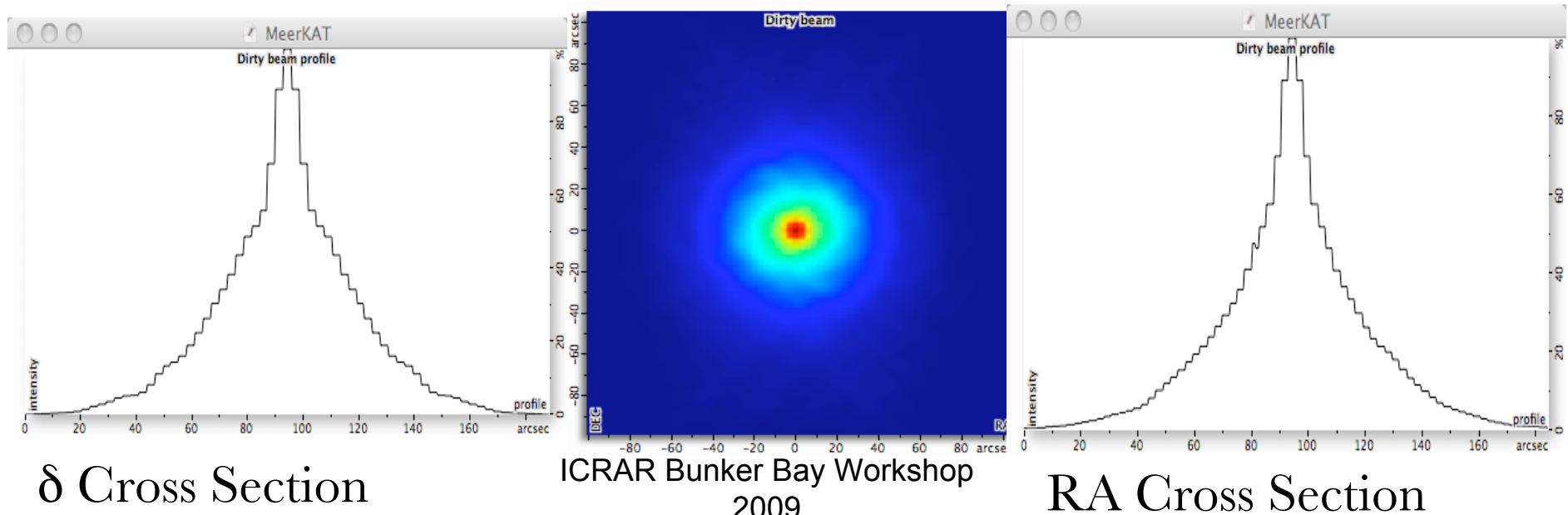


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MeerKAT Design

- **70% $\sigma_{\text{inner}} = 300\text{m}$, 30% $\sigma_{\text{outer}} = 2500\text{ m}$**
 - Best Compromise, Good UV Coverage
 - Decent sensitivity between targeted resolutions

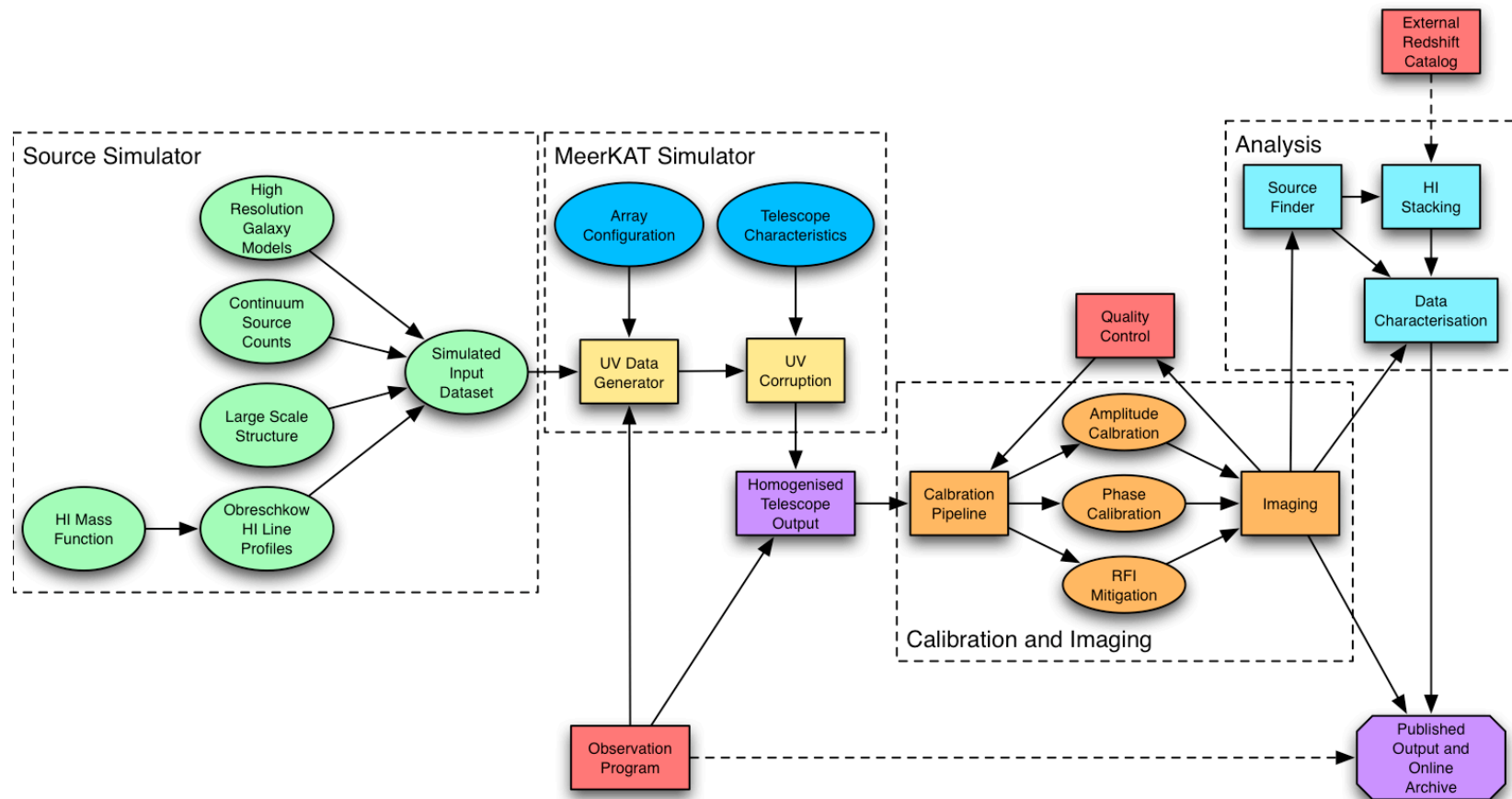


MeerKAT Performance

- **Can we actually tune for resolution?**
 - *How do we reduce the data?*
- **Image Fidelity**
- **Need some numbers**
 - *How long to reach noise level?*

MeerKAT Performance

- **MeerKAT Simulator** - *Being Tested*
 - UVCON
 - Based on HRK's SKADS Simulator
 - Bootstrapped AIPS Tasks, wrapped in ParselTongue script
 - Outputs UV Cubes
 - Input Models:
 - THINGS CC Models
 - S³ SAX



Antoine Boucard, June 2009

MeerKAT Performance

Future Work

- Simulate Real Observing Situation
- Simulate Gain Errors
- Calibration Pipeline

MeerKAT Performance

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Thank You!