## Advances in 21cm EoR Imaging Pipelines

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### PAPER

HERA



### LOFAR

### Power Spectrum Measurement



### Power Spectrum Measurement



#### Fourier Transform

## Foregrounds



### Chromatic Instrument



# Analysis Philosophies

Measured Sky Delay Spectrum

### Reconstructed Sky Imaging

Drives design of instrument and science capability

# Measured Sky

- FT along frequency
  - $f \Leftrightarrow k_{\tau}$
- Combine identical baselines
  - Redundant arrays



# Measured Sky

Single point source simulation



(See Kerrigan J1-6)

#### Morales et al (in prep)

### Measured Sky - Benefits

- Calibrate without sky model
- Robust against frequency independent calibration errors (e.g. delay error)
- Relatively simple analysis

# Reconstructed Sky

- FT along line-ofsight
  - $r_{||} \Leftrightarrow k_{||}$
- Combine nonidentical baselines
  - pseudo-random arrays



### Measured vs Reconstructed



# Effect of uv density



Morales et al (in prep)

### Reconstructed Sky -Benefits

- Reduced wedge amplitude
  - Smaller requirement on FG subtraction
- Bandpass calibration (\*ehem\*, see Dillon J1-7)
- Images! QA + science
  - FFT arrays?
- Direction dependent calibration

# Progress from MWA

Multiple efforts for validation and reproducibility



#### Jacobs, et al 2016







Jacobs, et al 2016

# Improving Catalog

![](_page_16_Figure_1.jpeg)

#### Continuing to improve (GLEAM, etc)

Beardsley et al, 2016 (See Barry J1-9)

## Cable Reflections

![](_page_17_Figure_1.jpeg)

Beardsley et al, 2016

### Super-Resolution Beam

![](_page_18_Figure_1.jpeg)

Beardsley et al, 2016

## Diffuse FG Model

![](_page_19_Figure_1.jpeg)

Beardsley et al, 2016

# Results from MWA

![](_page_20_Figure_1.jpeg)

# Path forward

- Measured vs Reconstructed sky?
  - Probably both/hybrid (e.g. Wenyang Li J5-3)
- Delay spectrum has best limit (Ali et al, 2015)
- New/improved arrays coming online!

# MWA Phase II

![](_page_22_Figure_1.jpeg)

## MWA Phase II

![](_page_23_Picture_1.jpeg)