

CROSS-POLLINATION BETWEEN 21 CM EOR EXPERIMENTS

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Science at Low Frequencies IV
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Outline

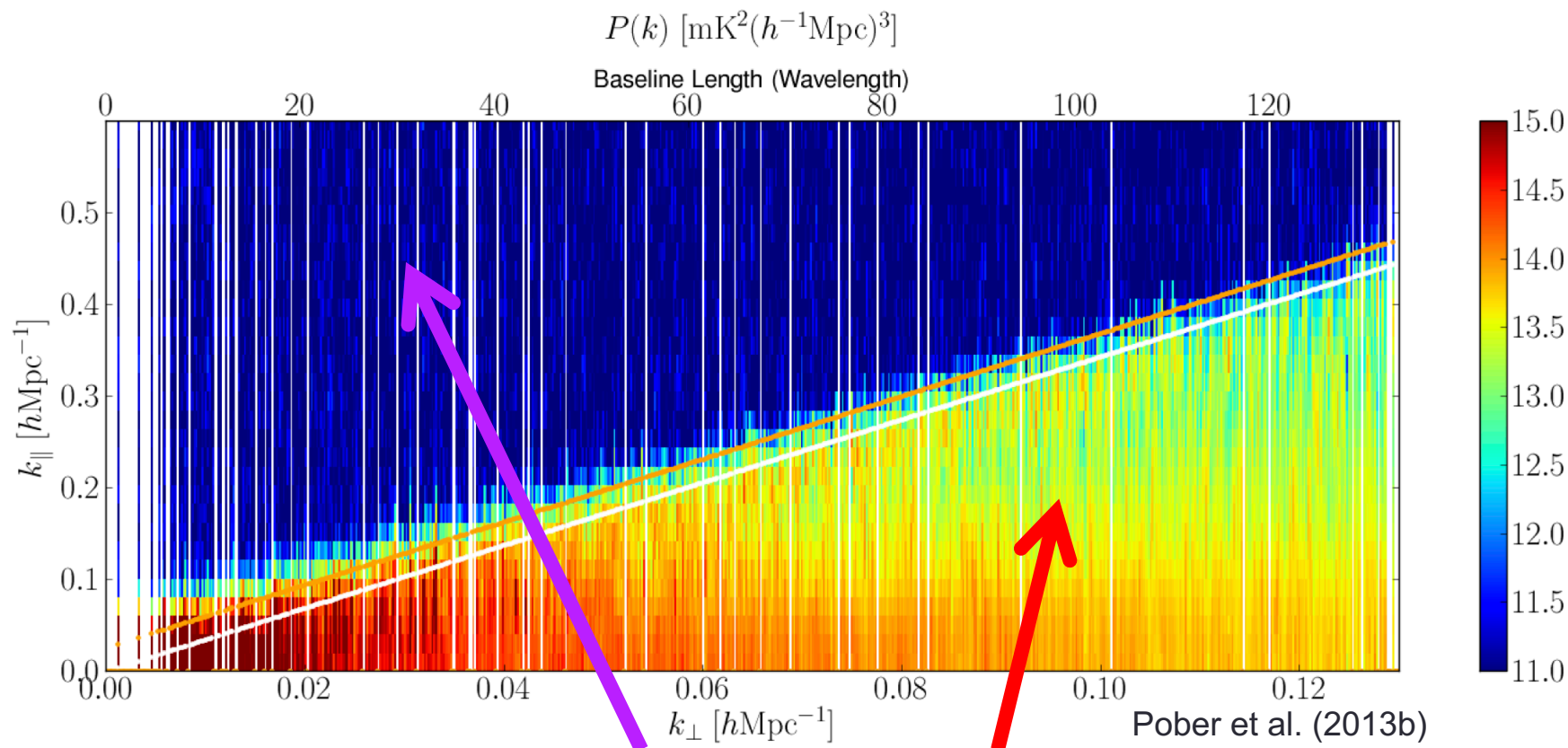
- Analysis “dichotomies”
 - Foreground avoidance vs. foreground subtraction
 - Delay spectrum vs. gridding
 - Redundant arrays vs. imaging arrays
- Examples of Cross Pollination with PAPER and MWA

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Avoidance vs. subtraction

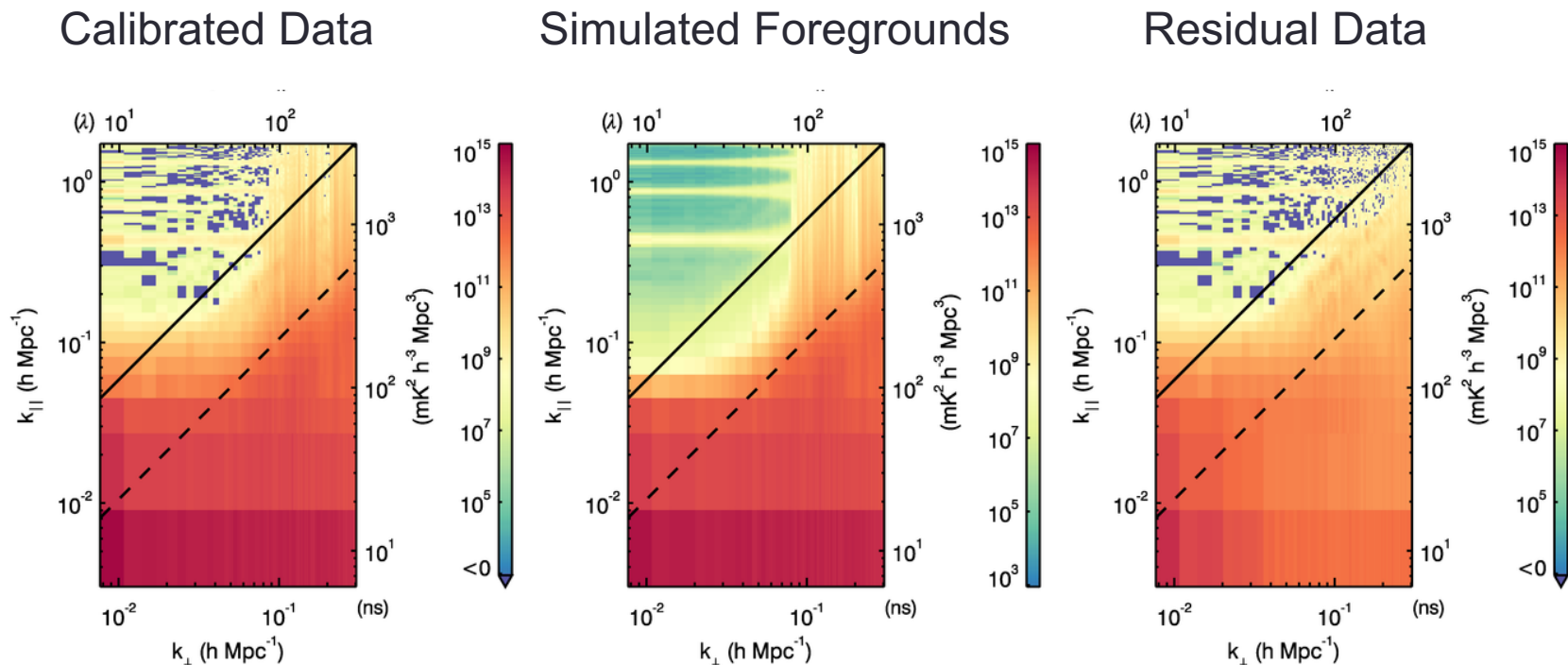
Avoidance vs. subtraction



Avoidance: work **here**, not **here**

- Analysis goal: keep **wedge** from spilling into **window**

Avoidance vs. subtraction



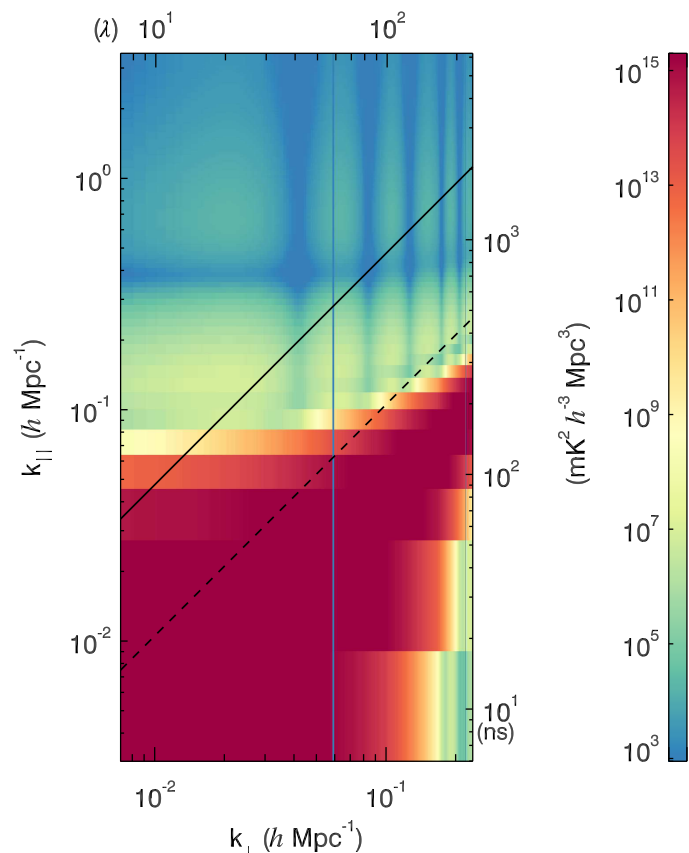
Subtraction: simulate foregrounds, subtract them

- Analysis goal: work **everywhere** EoR signal is stronger than residual foregrounds

Delay spectrum vs. gridding

Delay spectrum vs. gridding

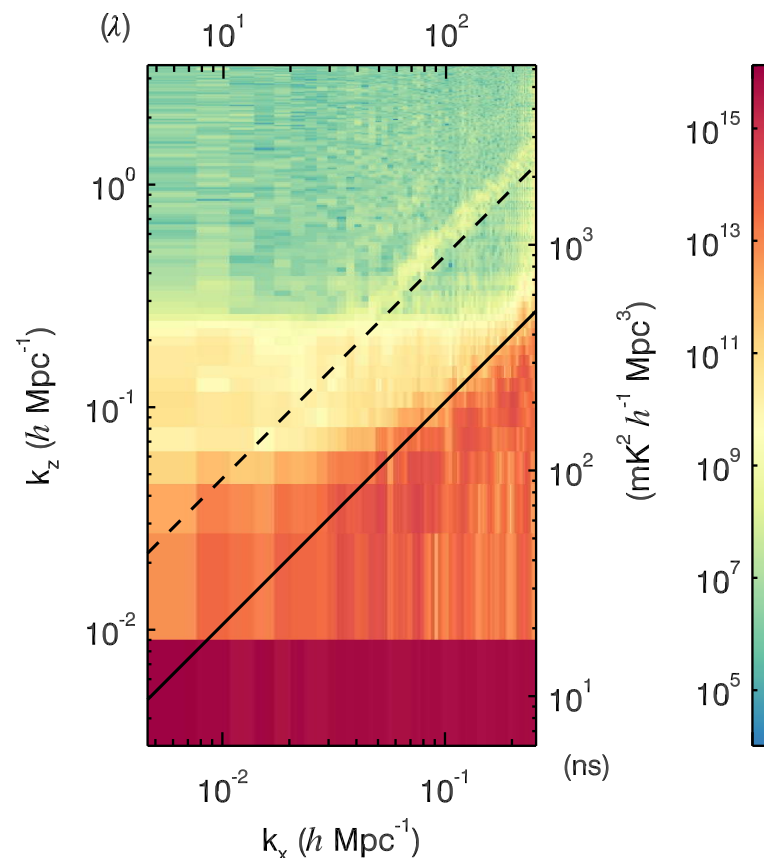
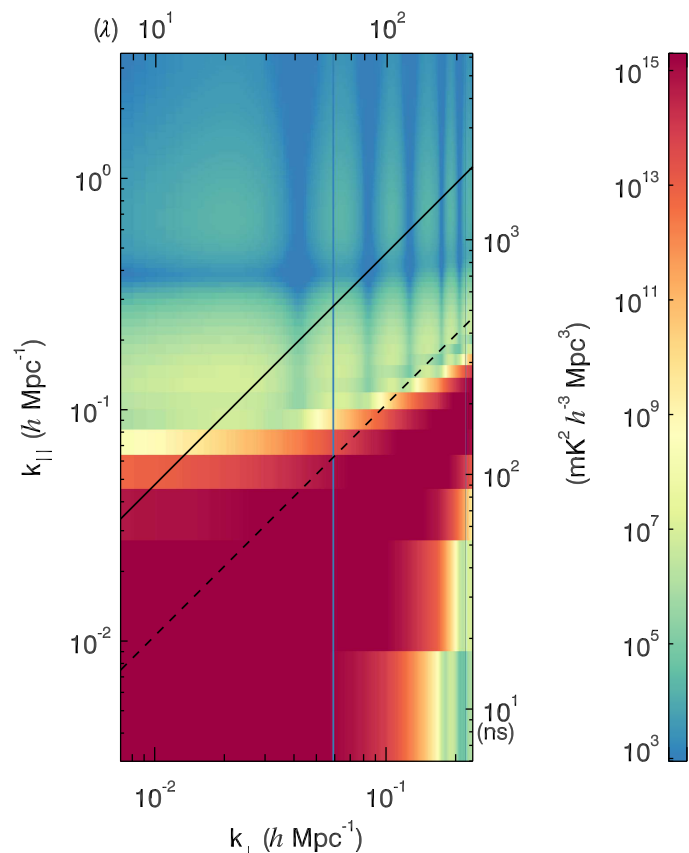
Morales et al., in prep.



- Each baseline is independent probe of power spectrum
- No attempt to distinguish frequency-dependent fringe from intrinsic foreground spectrum

Delay spectrum vs. gridding

Morales et al., in prep.



- Gridding = imaging
- Removes interferometric fringe, preserves intrinsic spectral modes

Redundant vs. imaging arrays

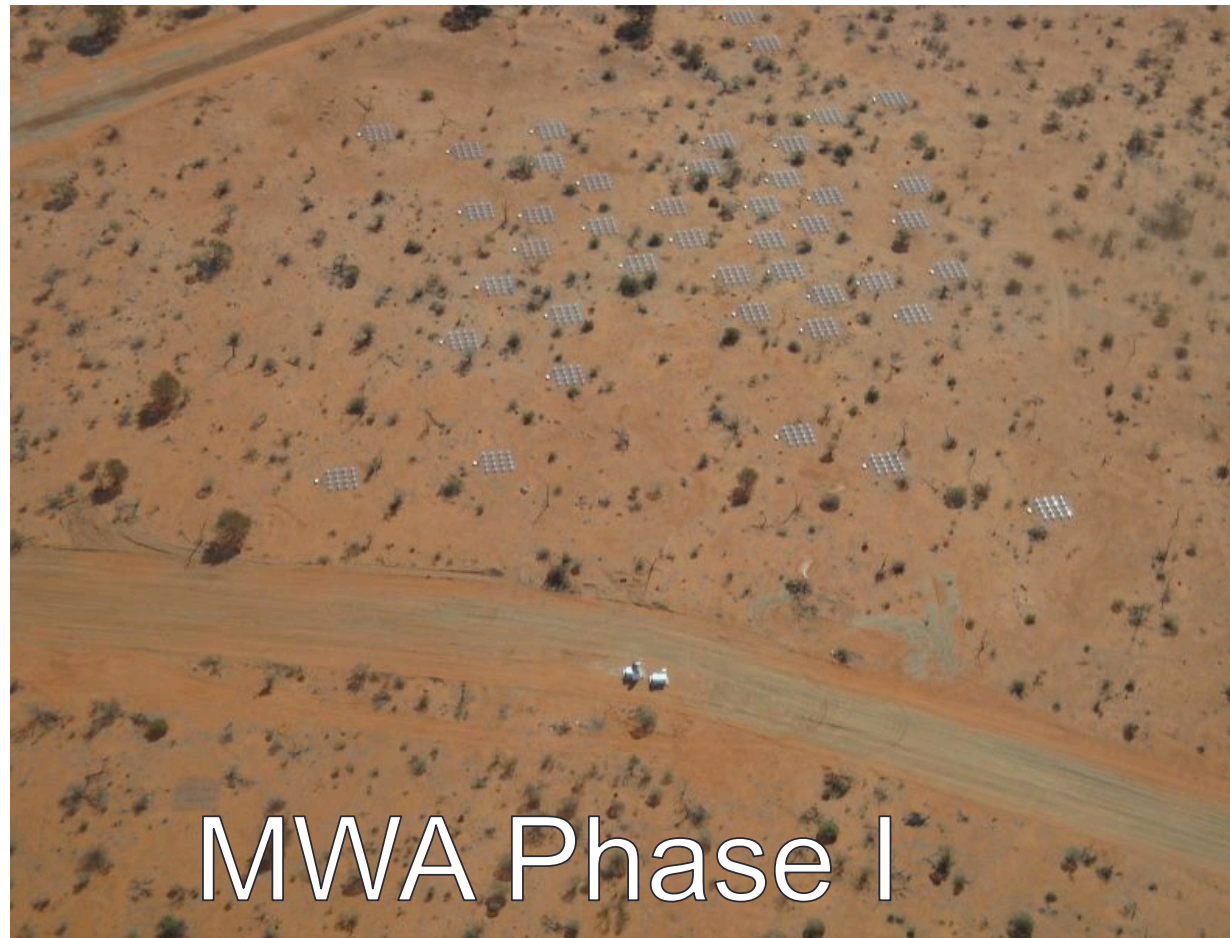
Redundant vs. imaging arrays



- Pros:
 - Increases sensitivity for delay spectrum
 - Enables redundant calibration
 - Powerful axis for bootstrapping and jackknives
- Cons:
 - Atrocious PSF

Redundant vs. imaging arrays

- Pros:
 - Makes good images (and all the powerful things that enables)
- Cons:
 - Sky model calibration dependent



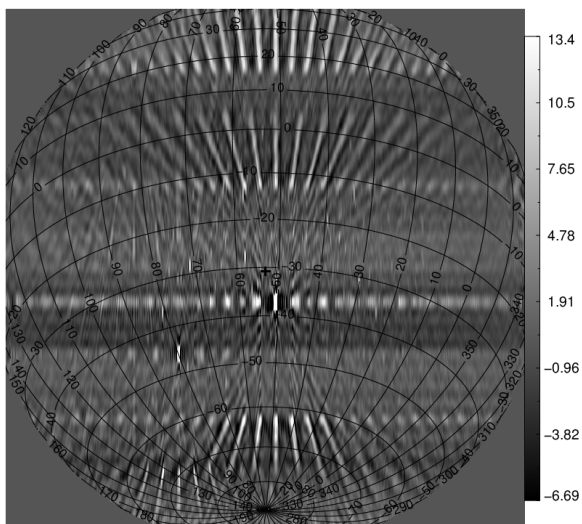
Experiments To-Date

- PAPER used redundant layout, delay spectrum, foreground avoidance
- MWA Phase I and LOFAR use imaging layout, gridded power spectrum, foreground subtraction

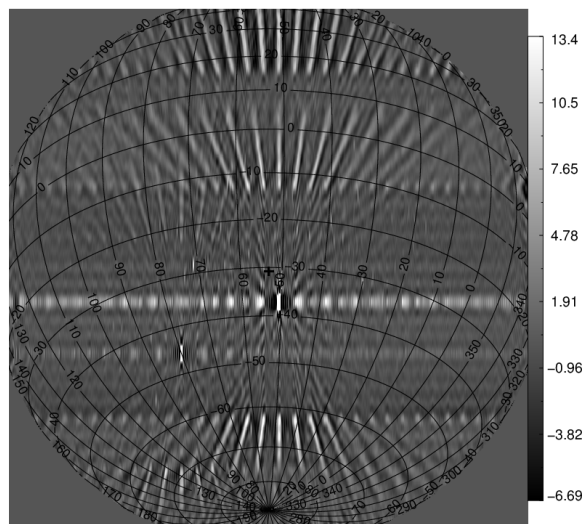
**Historical existence of these three
“dichotomies” has limited cross-pollination
between experiments**

EXAMPLES

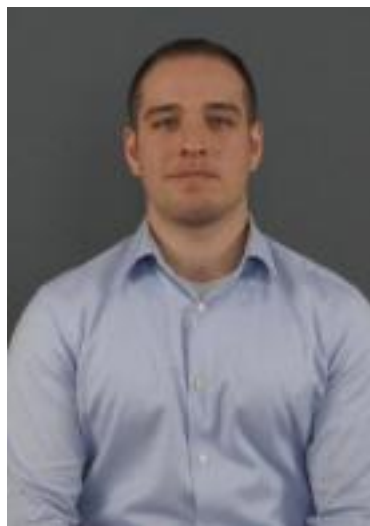
Foreground Subtraction with PAPER-64



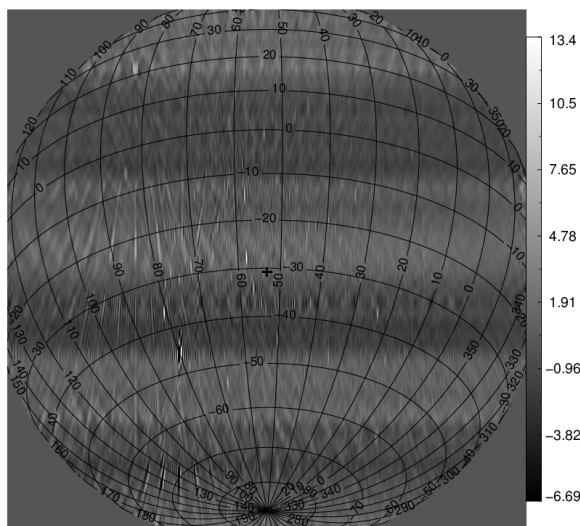
(a) Dirty



(b) Model

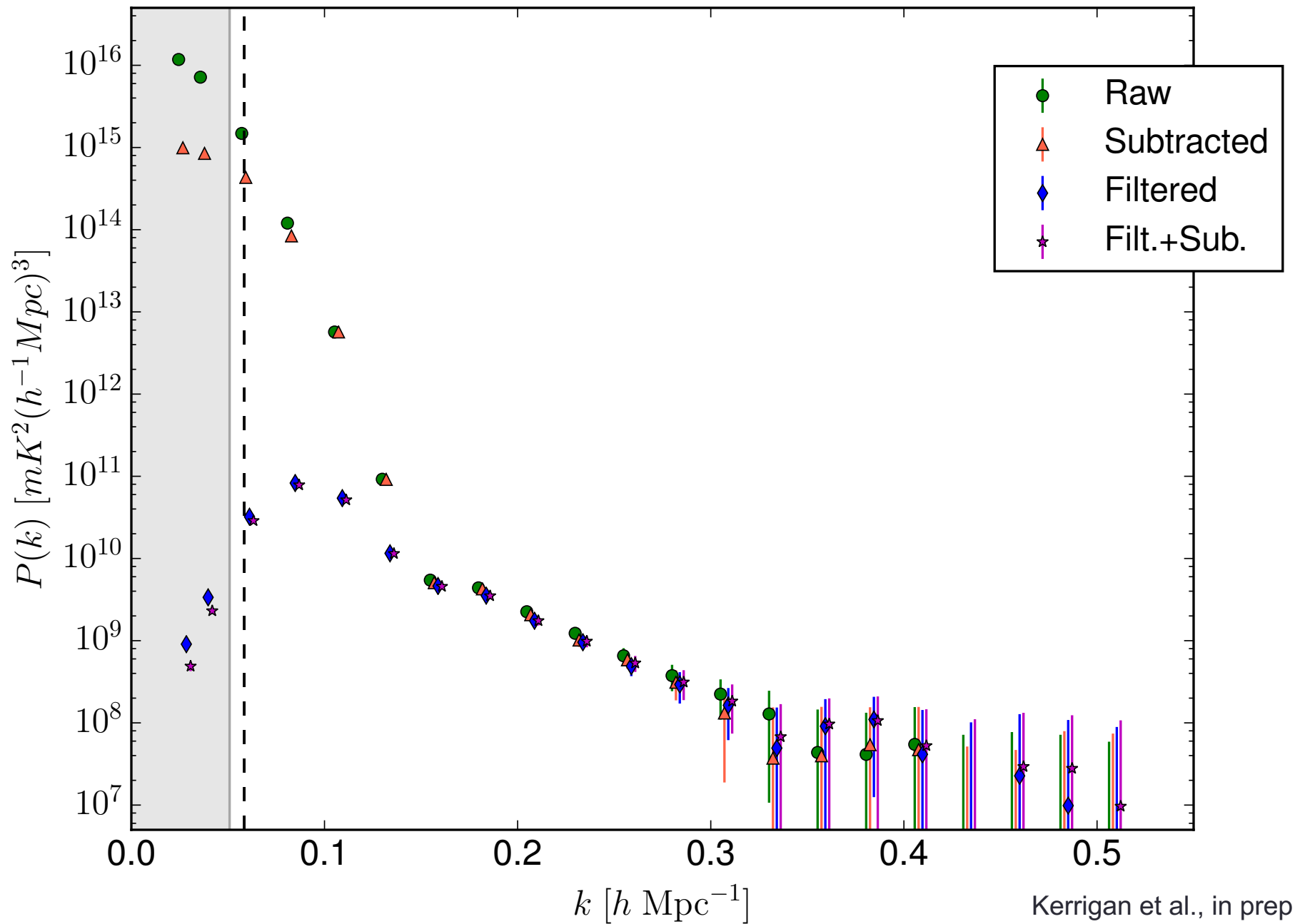


Joshua
Kerrigan

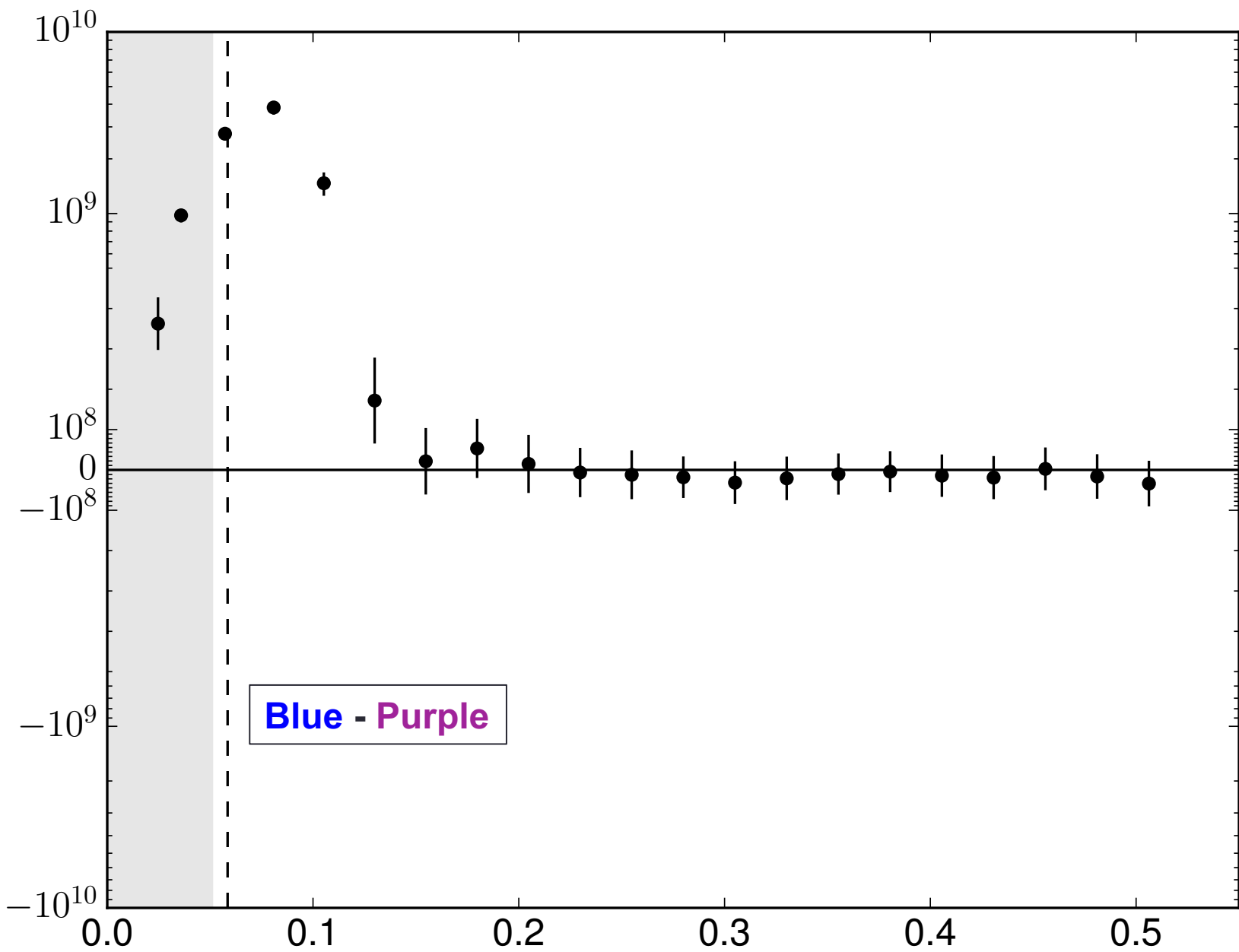


(c) Residual

- Create model visibilities with FHD (using GLEAM + Fornax + Pictor)
- Point spread function is atrocious, but modelable

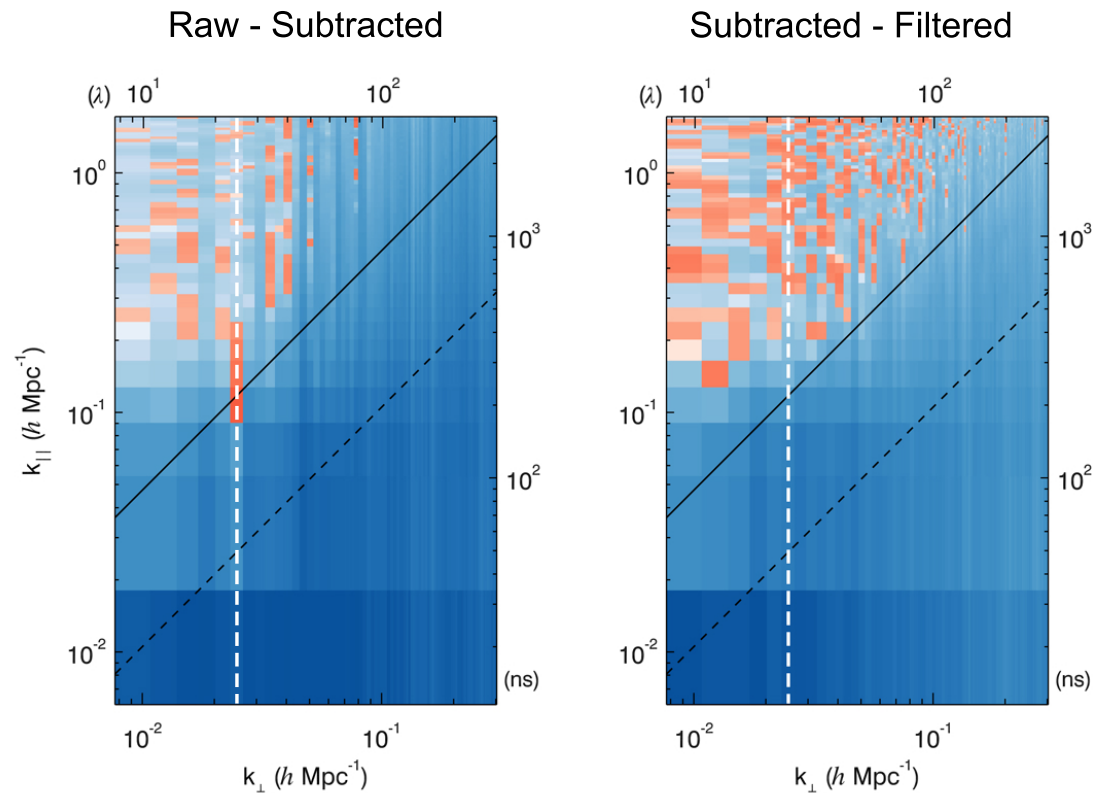


Improvement from Foreground Subtraction ($\text{mK}^2(\text{Mpc}/h)^3$)



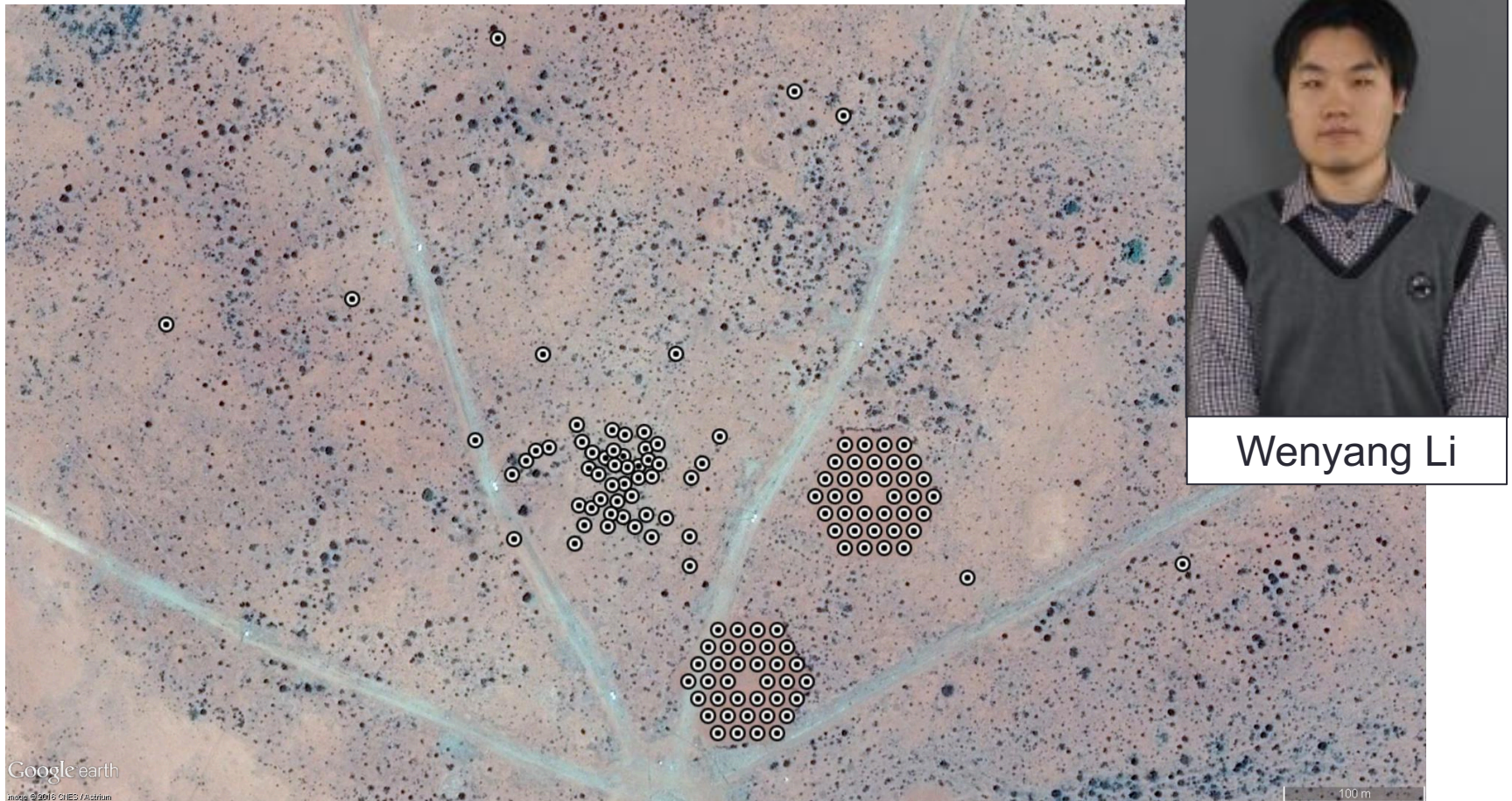
Foreground Avoidance with MWA Phase I

- Use PAPER delay filter to blindly remove foregrounds from MWA visibilities
- Further improvement on top of model-based subtraction



Redundant Calibration with MWA Phase II

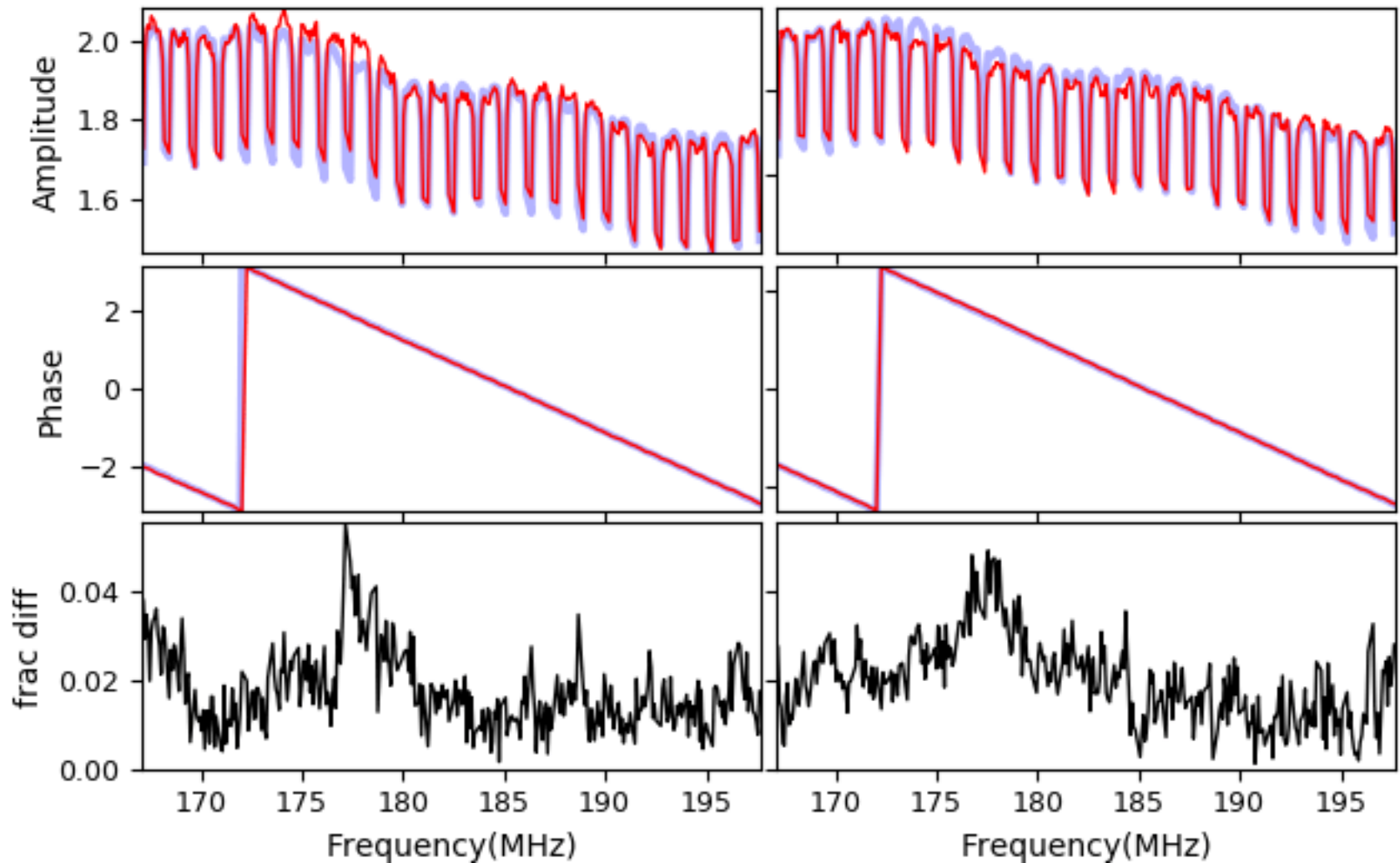
- MWA Phase II provides excellent test-bed for comparing calibration algorithms



Tile 1072 (left: xx, right: yy)

Li et al., ApJ submitted

- FHD calibration
- OMNICAL after degeneracy projection
- fractional difference between FHD and OMNICAL (degeneracy projected)



Conclusions

- Foreground avoidance \neq delay spectrum \neq redundant array
- Foreground subtraction \neq gridded power spectrum \neq imaging array
- Experiments have much to learn from another!
- Increasing cross-connectivity is key to understanding the benefits/trade-offs of analysis choices

Acknowledgements & Collaborators

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