

Lessons from the forefront of EoR PS Anaysis

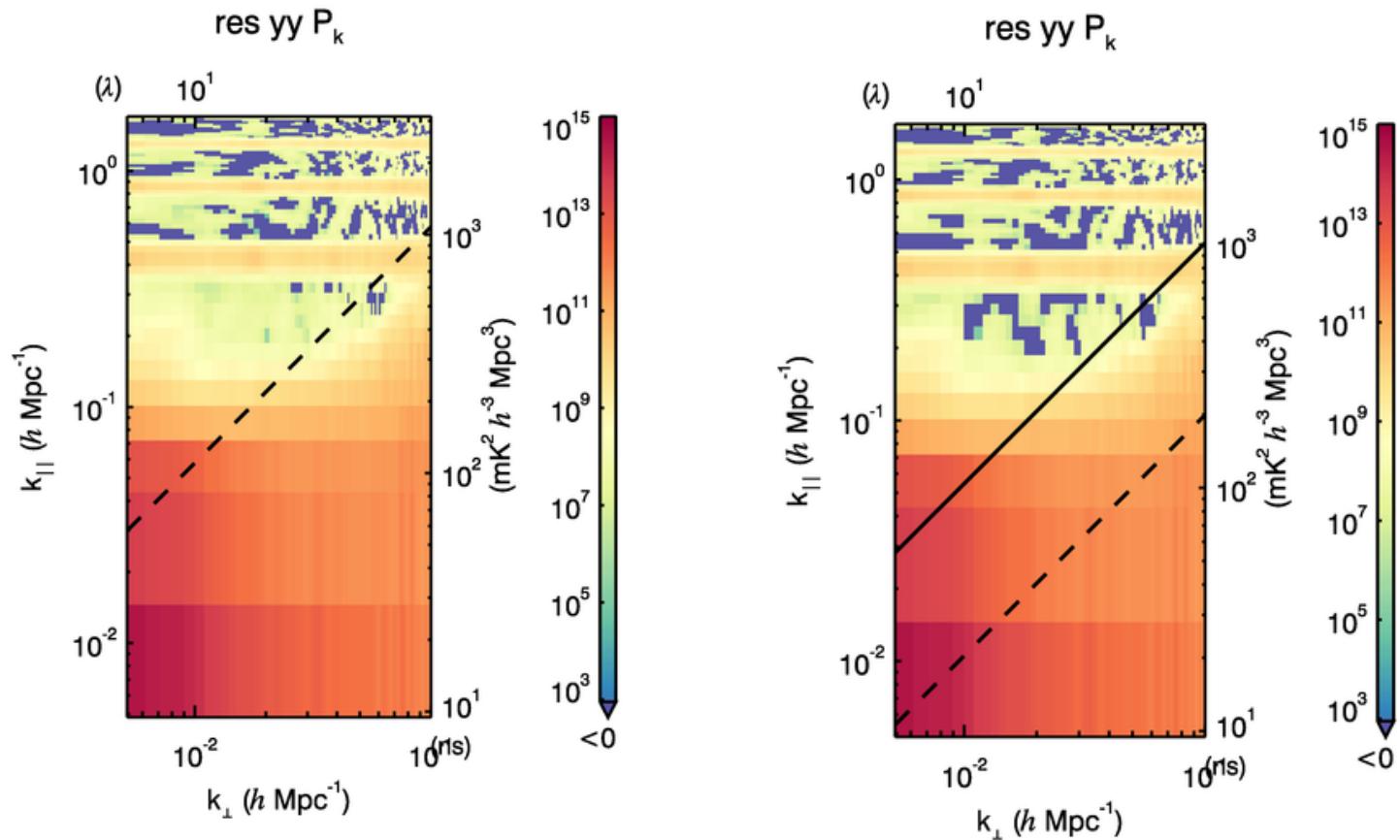
Miguel F. Morales

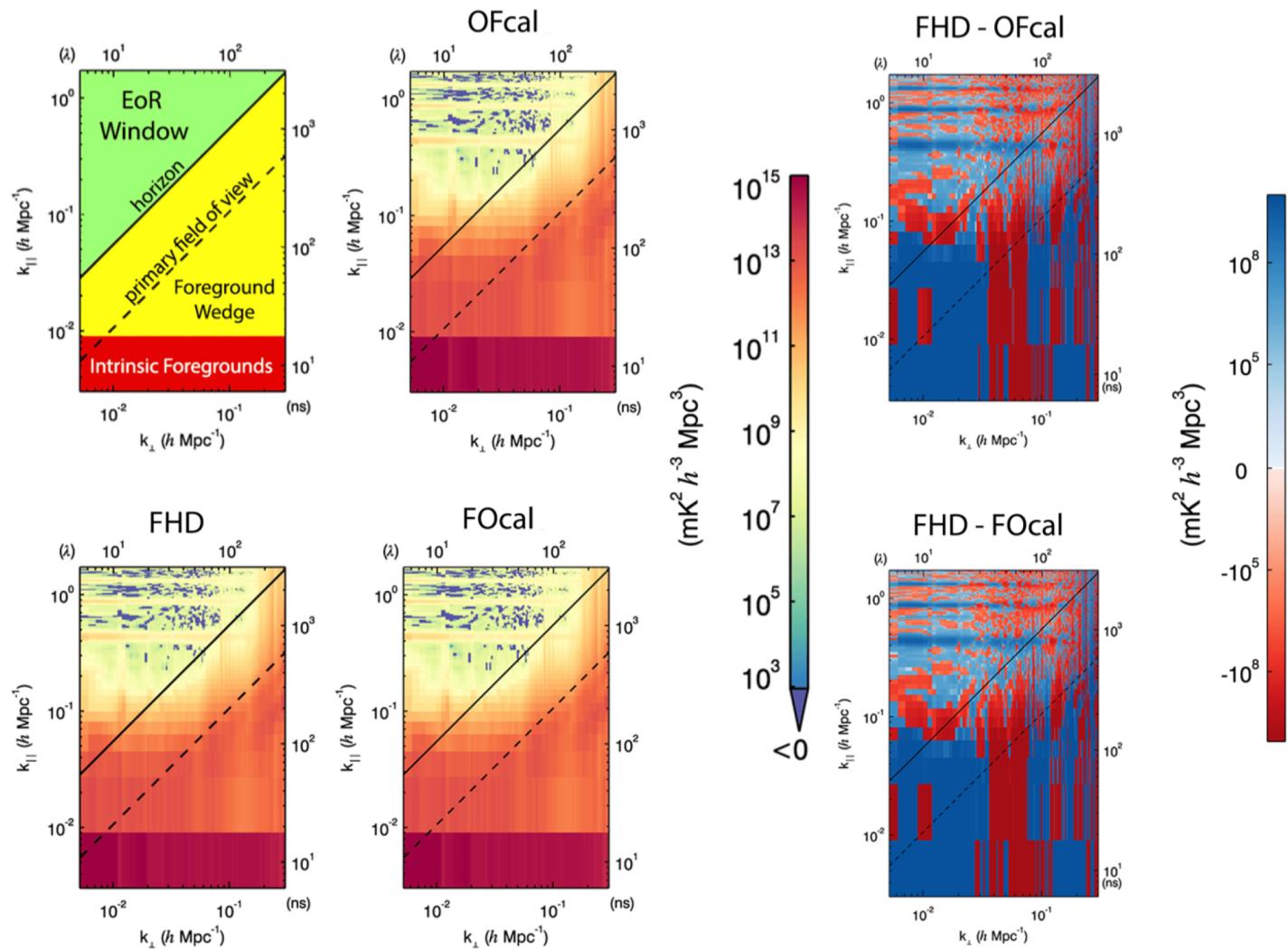
NRSM, Boulder, January 11th, 2019

Calibration is hard



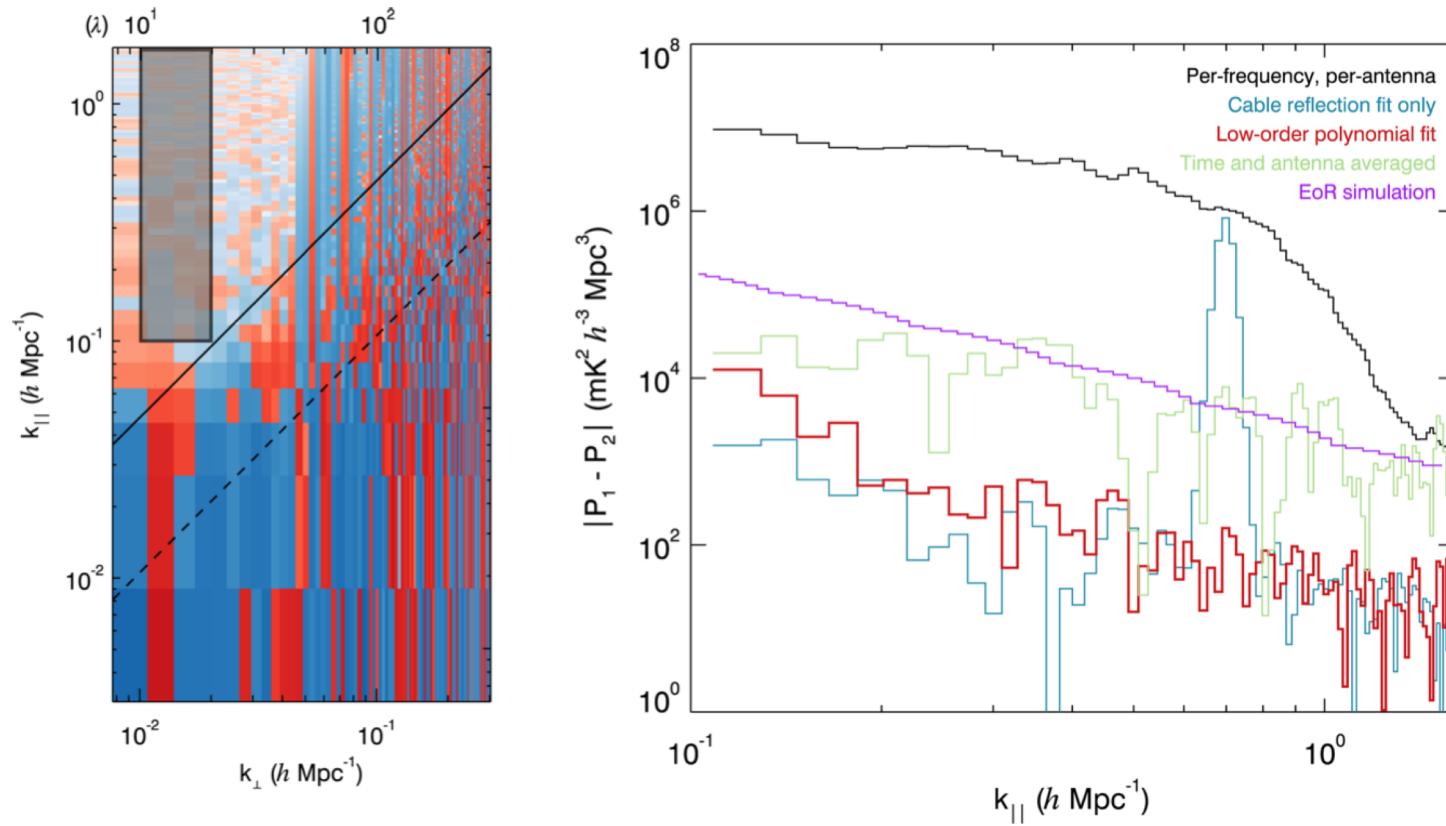
All recent advances associated with improved calibration



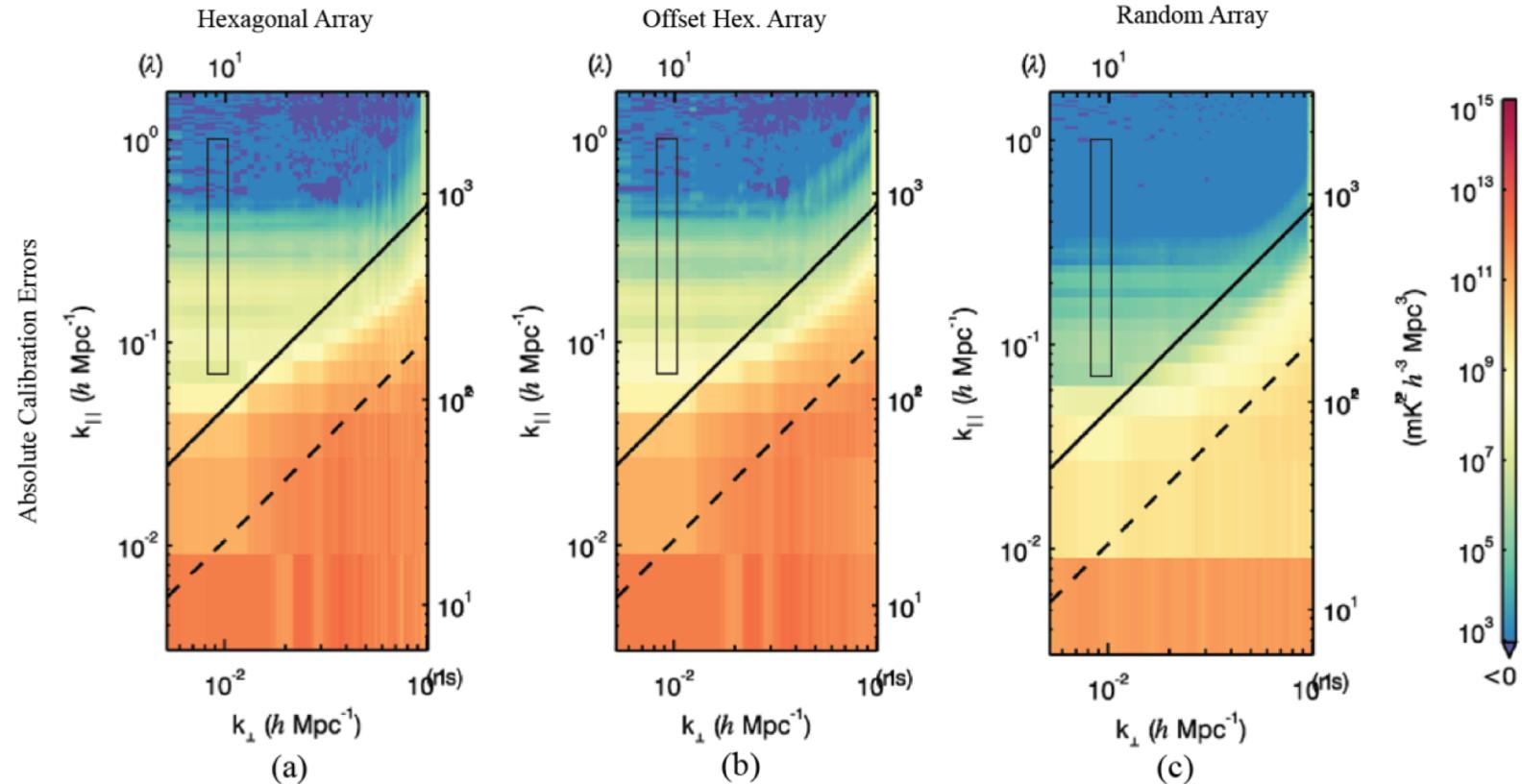


How hard will it be to achieve the necessary calibration?

Barry et al. 2016



**Sky based calibration cannot achieve necessary calibration
(incomplete sky catalog)**



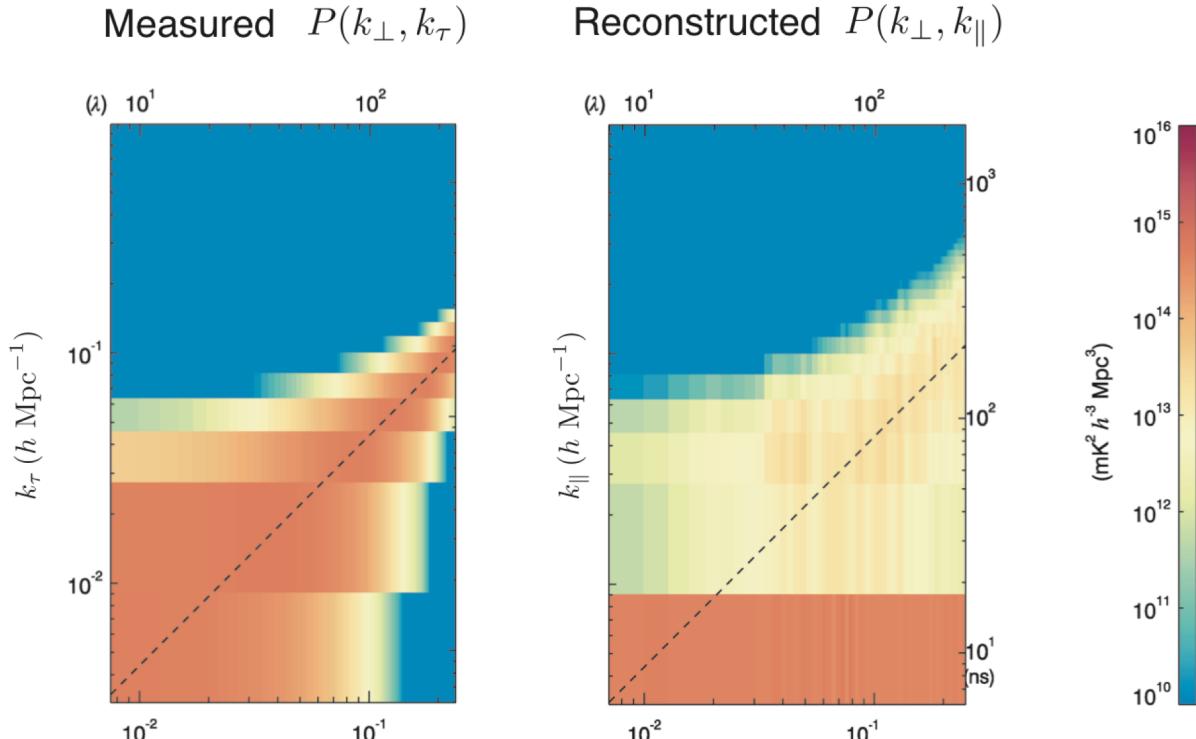
**Redundant calibration cannot achieve necessary calibration
(incomplete sky catalog in absolution calibration step)**



Analysis is hard



Diversity of analysis

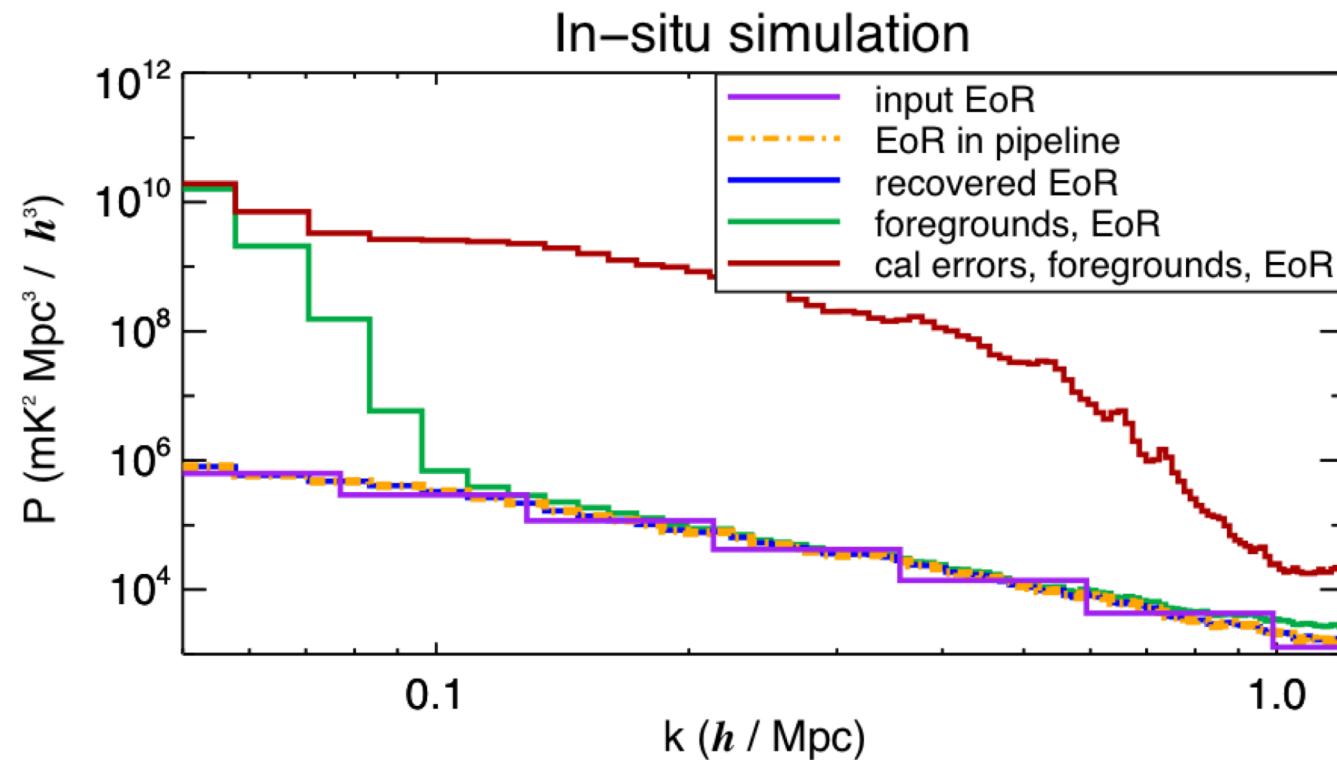


Measured PS $\hat{P}(k_{\perp}, k_{\tau})$	Reconstructed PS $\hat{P}(k_{\perp}, k_{\parallel})$
PAPER & HERA Delay PS (Parsons et al. 2012; Ali et al. 2015; Jacobs et al. 2015; Kohn et al. 2018)	GMRT (Paciga et al. 2011)
MWA Gridded Delay PS (Vedantham et al. 2012; Paul et al. 2016)	GBT auto & cross correlation (Masui et al. 2013; Switzer et al. 2013)
LOFAR Gridded Delay PS (Gehlot & Koopmans 2017)	LOFAR variance (Patil et al. 2014) LOFAR PS (Patil et al. 2017)
	MWA FHD + EmpCov (Dillon et al. 2015; Ewall-Wice et al. 2016)
	MWA FHD + ε ppsipline (Jacobs et al. 2016; Beardsley et al. 2017)
	MWA RTS + CHIPS (Trott et al. 2016; Beardsley et al. 2017)
	CHIME m-mode (Shaw et al. 2014, 2015)

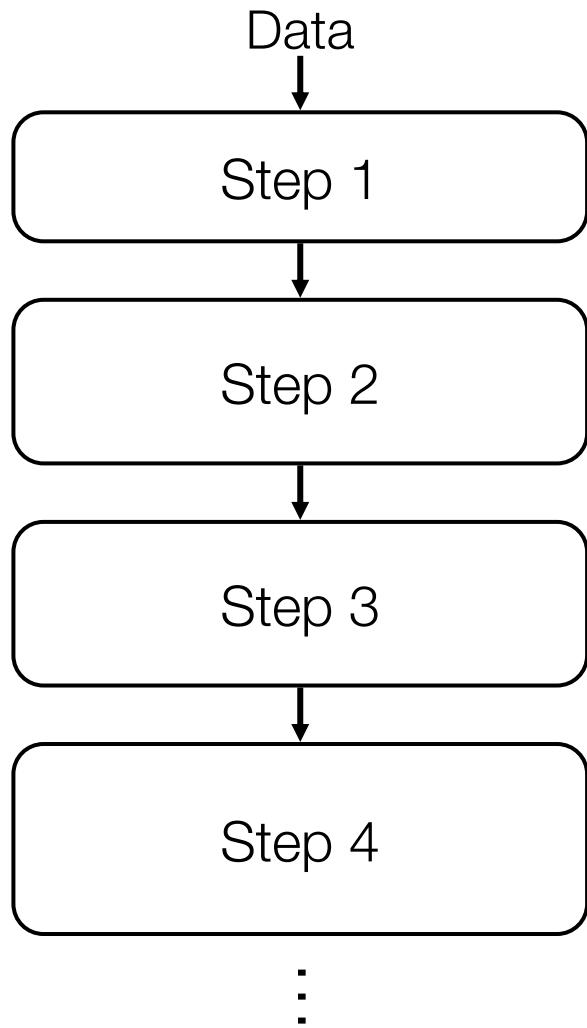
TABLE 1
MAJOR 21 CM PS ANALYSIS EFFORTS.

Morales et al. 2018

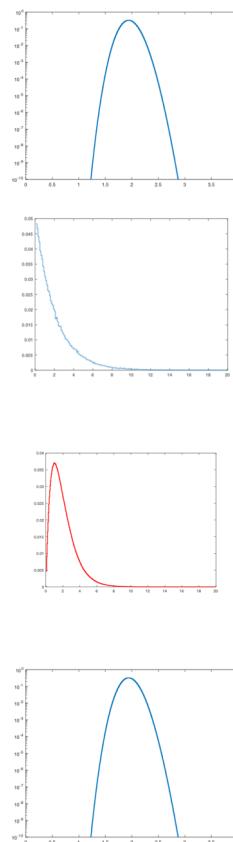
End-to-end simulation: signal loss



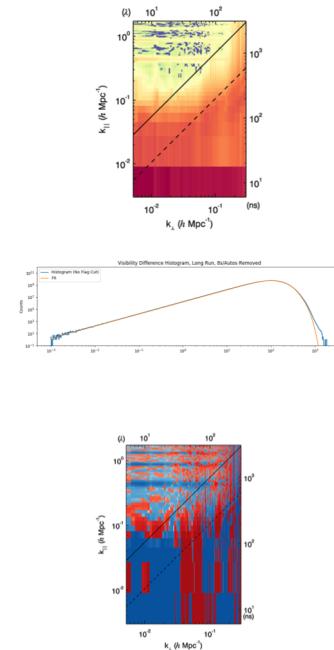
Analysis Steps



Propagated Errors

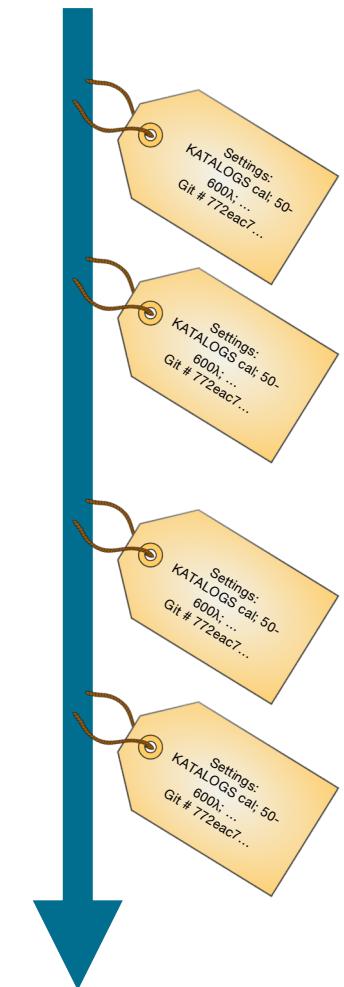


Statistically Valid Tests & Plots

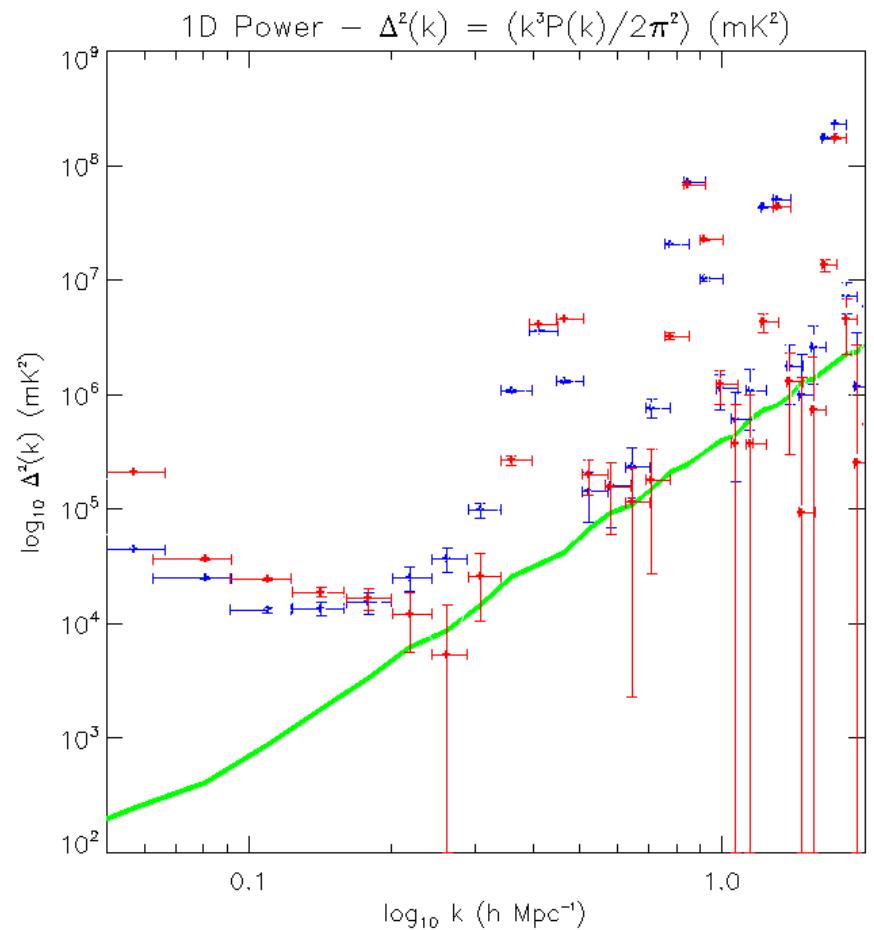
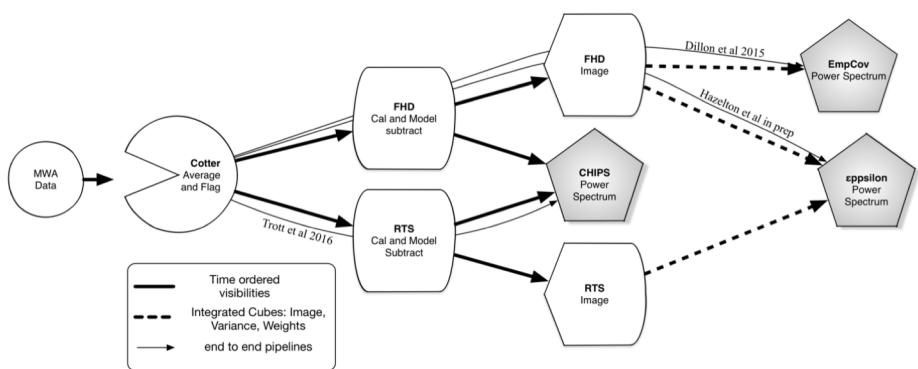


Injection test

Provenance



Parallel pipelines



Jacobs et al. 2016

Trott

US EoR Imaging Pipeline (FHD & epsilon)

- Implements all these techniques
- Open source & open development
<https://github.com/EoRImaging>