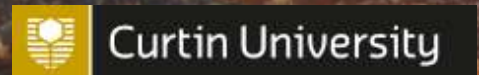


Towards a New Upper Limit on the EoR 21-cm Measurement using FHD

A Celebration and a Lament

Dr. Nichole Barry



Parsons et al. 2010
proto-PAPER
25,000,000 mK²

Paciga et al. 2013
GMRT
60,000 mK²

Dillon et al. 2015
MWA
37,000 mK²

Beardsley et al. 2016
MWA
27,000 mK²

Kolopanis et al. 2019
PAPER
40,000 mK²

~~Paciga et al. 2011
GMRT
60,000 mK²~~

Dillon et al. 2014
proto-MWA
90,000 mK²

~~Alford et al. 2015
MWA
37,000 mK²~~

Patil et al. 2017
LOFAR
6,500 mK²

Barry et al. 2019b
MWA
4,000 mK²



Mertens et al. 2020
LOFAR
5,400 mK²

HERA et al. 2021
HERA
950 mK²

Kolopanis et al. 2023
MWA Phase II
4,850 mK²

Wilensky et al. in review
MWA Phase I
16,000 mK²

Barry et al. in prep
MWA Phase I
? mK²

Li et al. 2019
MWA Phase II
2,400 mK²

Trott et al. 2020
MWA Phase I+II
1,800 mK²

Rahimi et al. 2021
MWA Phase I
5,400 mK²

HERA et al. 2023
HERA
460 mK²

LOFAR et al. in prep
LOFAR
? mK²

Fast Holographic Deconvolution (FHD)

ϵ psilon

Excision



Foreground removal



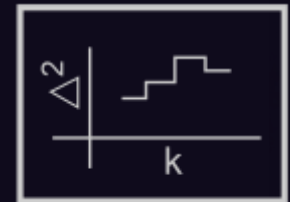
Imaging



DI calibration



Gridding



Power spectrum estimation

FAST HOLOGRAPHIC DECONVOLUTION: A NEW TECHNIQUE FOR PRECISION RADIO INTERFEROMETRY

I. S. SULLIVAN¹, M. F. MORALES¹, B. J. HAZELTON¹, W. ARCUS², D. BARNES³, G. BERNARDI⁴, F. H. BRIGGS⁵, J. D. BOWMAN⁶, J. D. BUNTON⁷, R. J. CAPPALLO⁸, B. E. COREY⁸, A. DESHPANDE⁹, L. DESOUSA^{7,10}, D. EMRICH², B. M. GAENSLER^{10,11}, R. GOEKE¹², L. J. GREENHILL⁴, D. HERNE², J. N. HEWITT¹², M. JOHNSTON-HOLLITT¹³, D. L. KAPLAN¹⁴, J. C. KASPER⁴, B. B. KINCAID⁸, R. KOENIG⁷, E. KRATZENBERG⁸, C. J. LONSDALE⁸, M. J. LYNCH², S. R. MCWHIRTER⁸, D. A. MITCHELL¹¹, E. MORGAN¹², D. OBEROI⁸, S. M. ORD⁴, J. PATHIKULANGARA⁷, T. PRABU⁹, R. A. REMILLARD¹², A. E. E. ROGERS⁸, A. ROSHI⁹, J. E. SALAH⁸, R. J. SAULT¹⁵, N. UDAYA SHANKAR⁹, K. S. SRIVANI⁹, J. STEVENS^{7,16}, R. SUBRAHMANYAN⁹, S. J. TINGAY^{2,11}, R. B. WAYTH², M. WATERSON², R. L. WEBSTER^{11,15}, A. R. WHITNEY⁸, A. WILLIAMS¹⁷, C. L. WILLIAMS¹², AND J. S. B. WYTHE^{11,15}



Celebration

Lament

Data s

lection

Analysis sys

s systematics

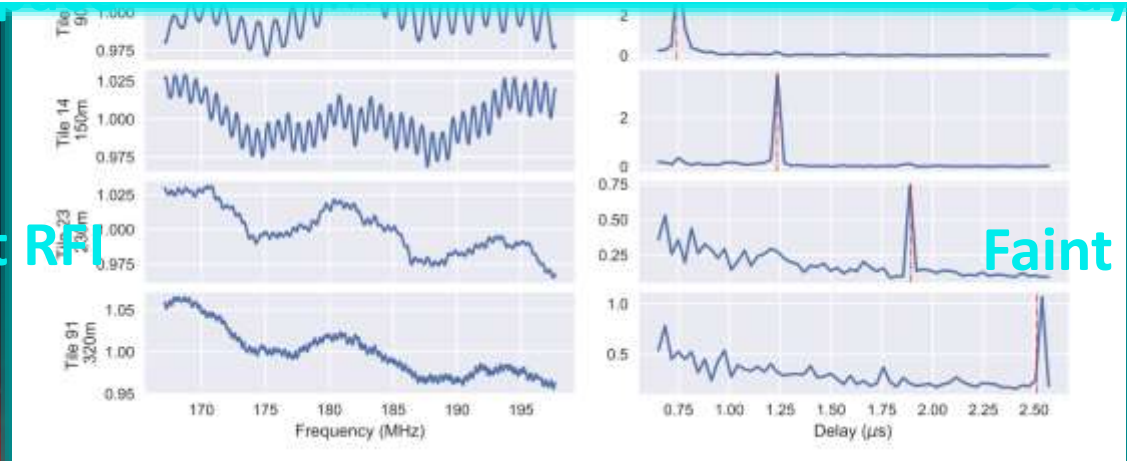
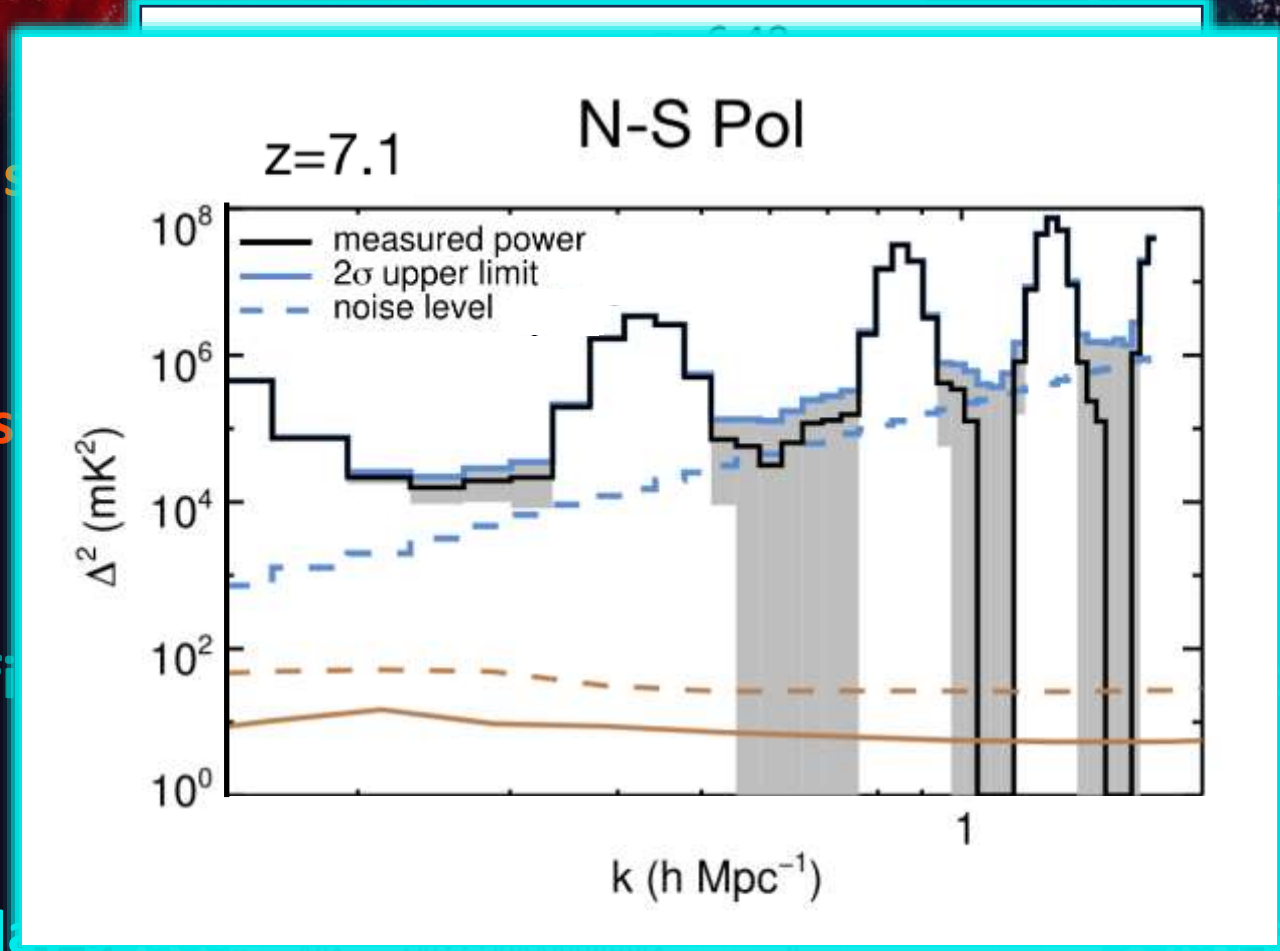
Redundant confi

lant configuration

Delay, space

Faint RFI

Faint RFI



*Where are we going
from here?*

Barry et al. in prep
MWA Phase I
? mK²

Model of the Galactic Plane from the Engineering Development Array 2 (EDA2)

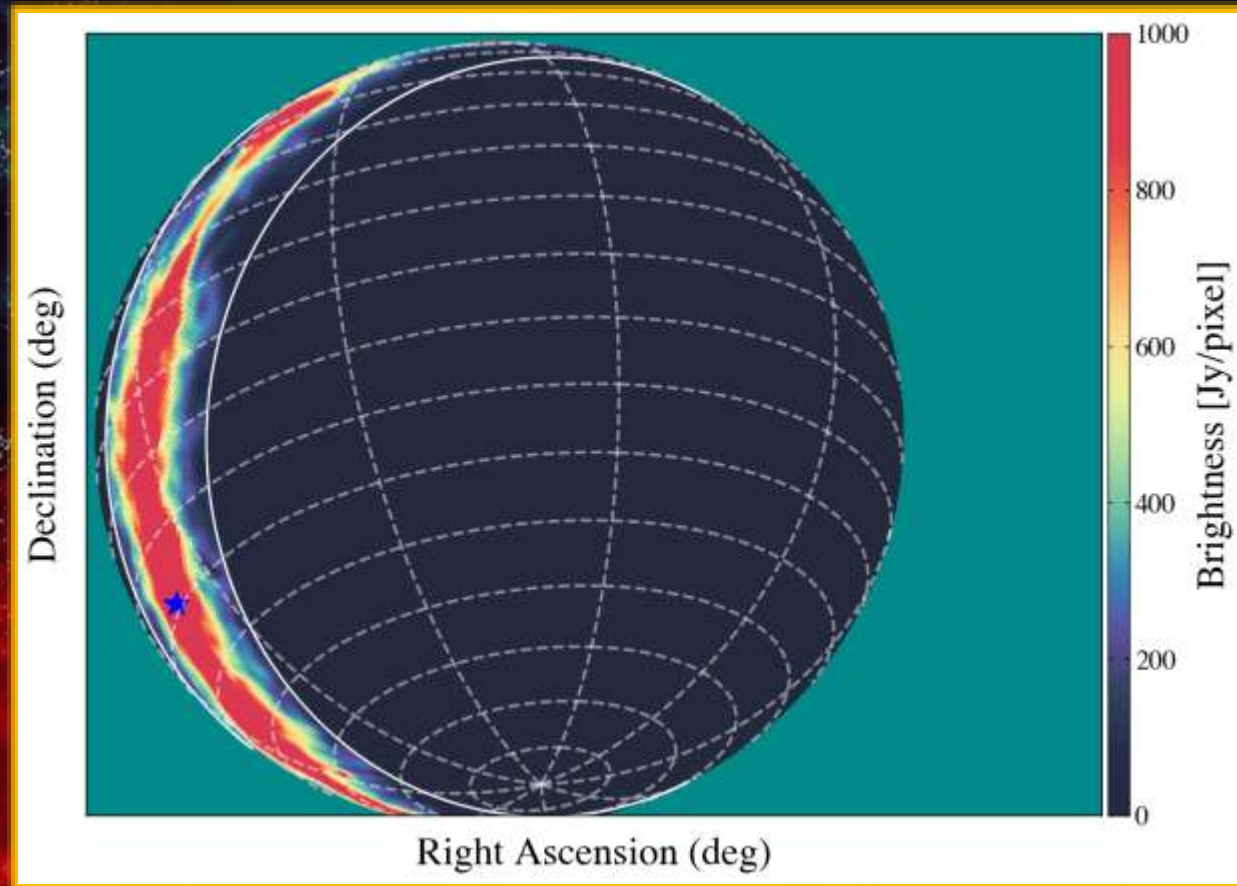
Kriele et al. 2022



The galactic plane sets over the course of a night of MWA observation

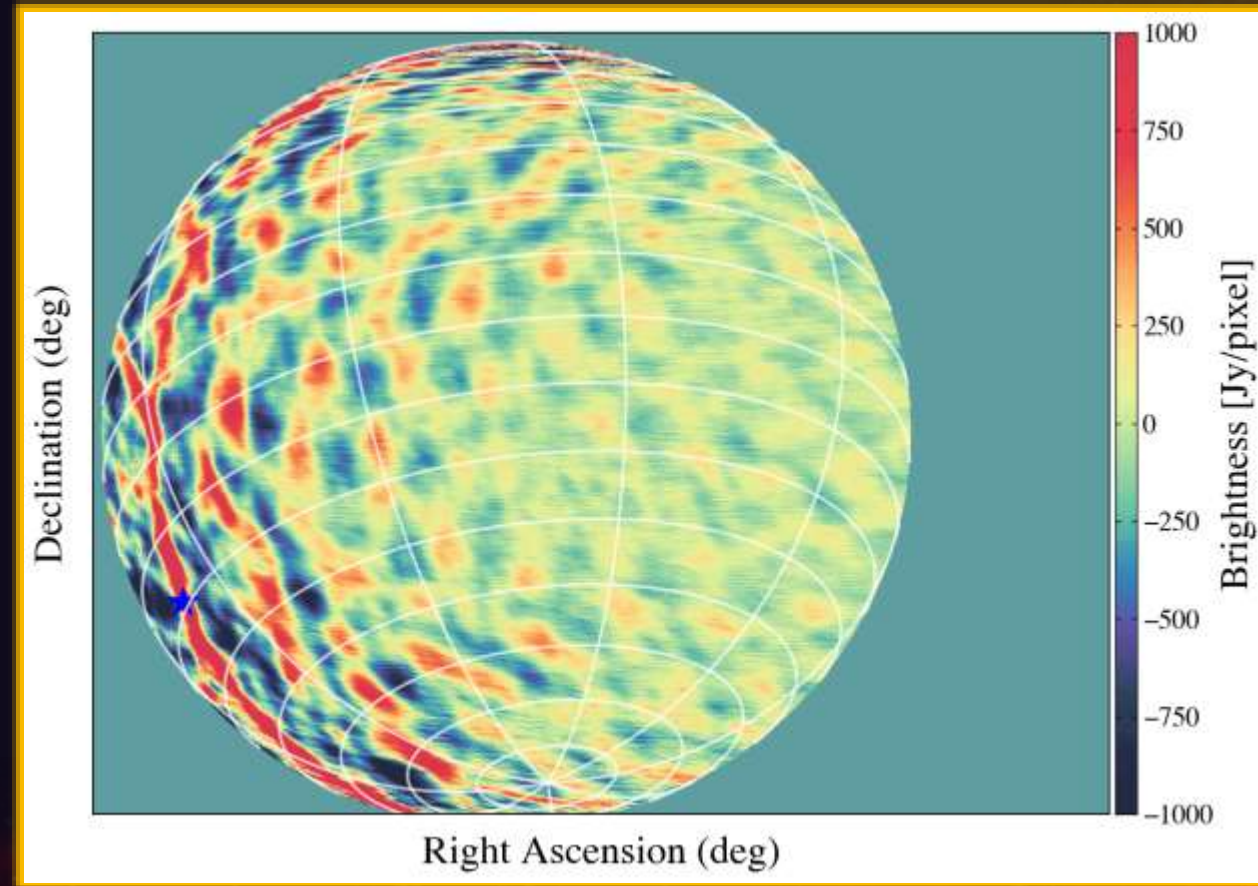
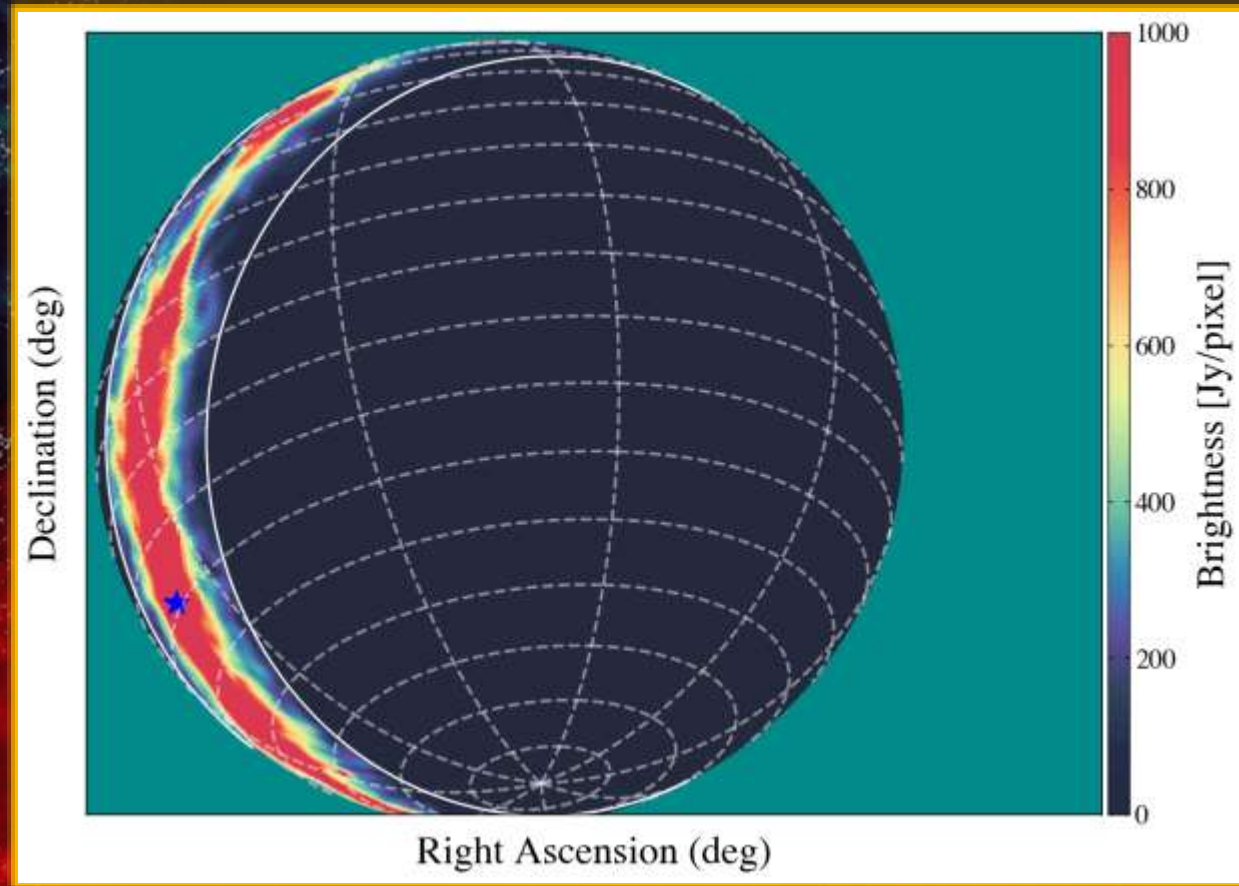
Requires a point source model due to beam gradient, and thus a powerful GPU simulator

Woden -- Line 2022



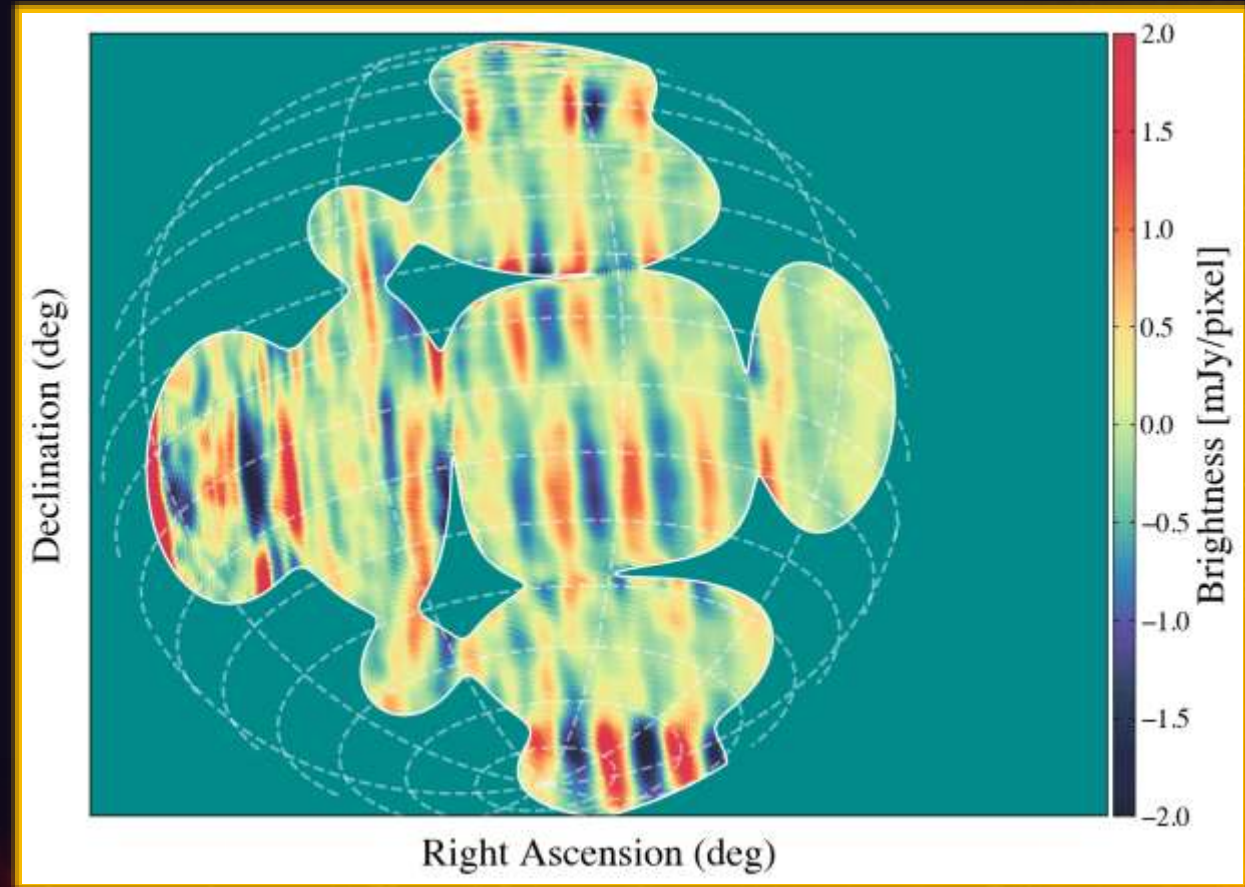
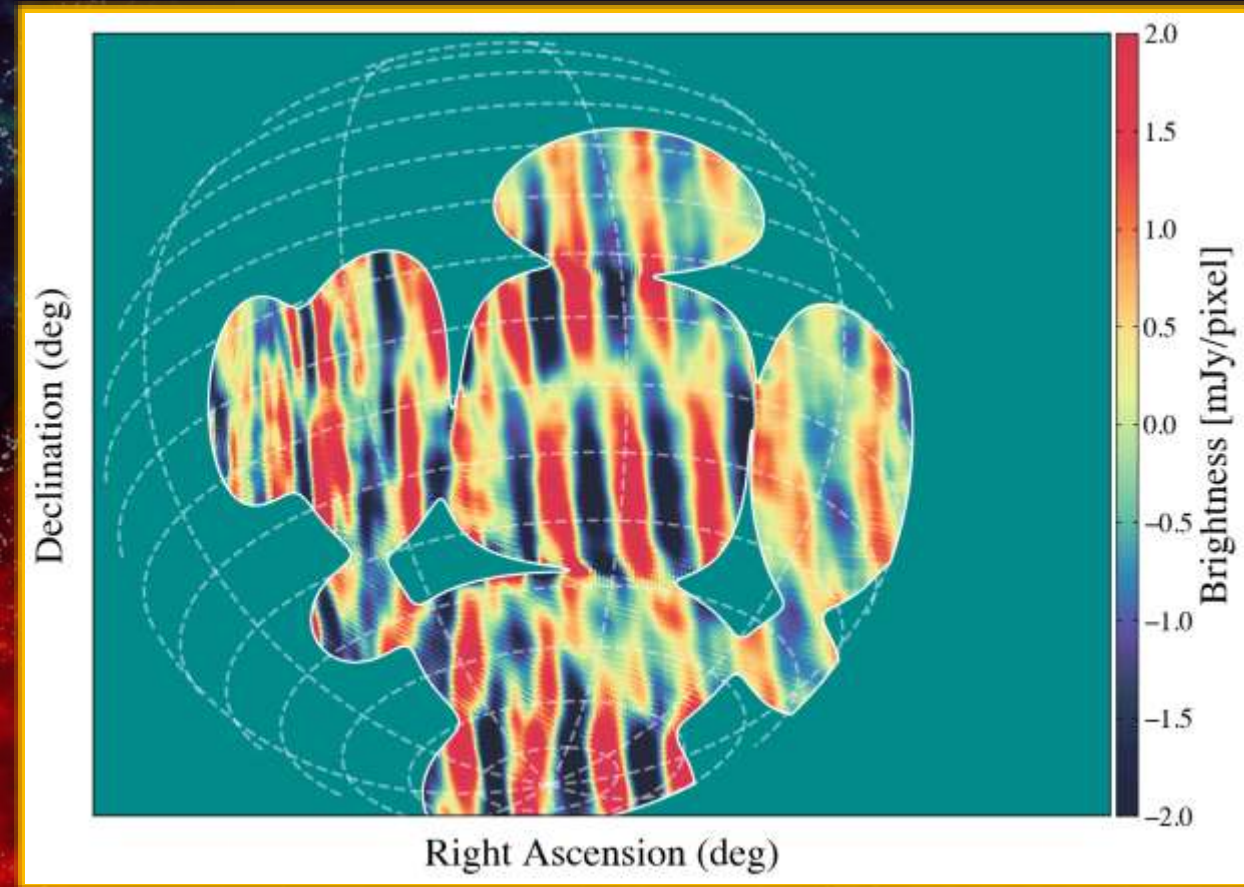
Catalog

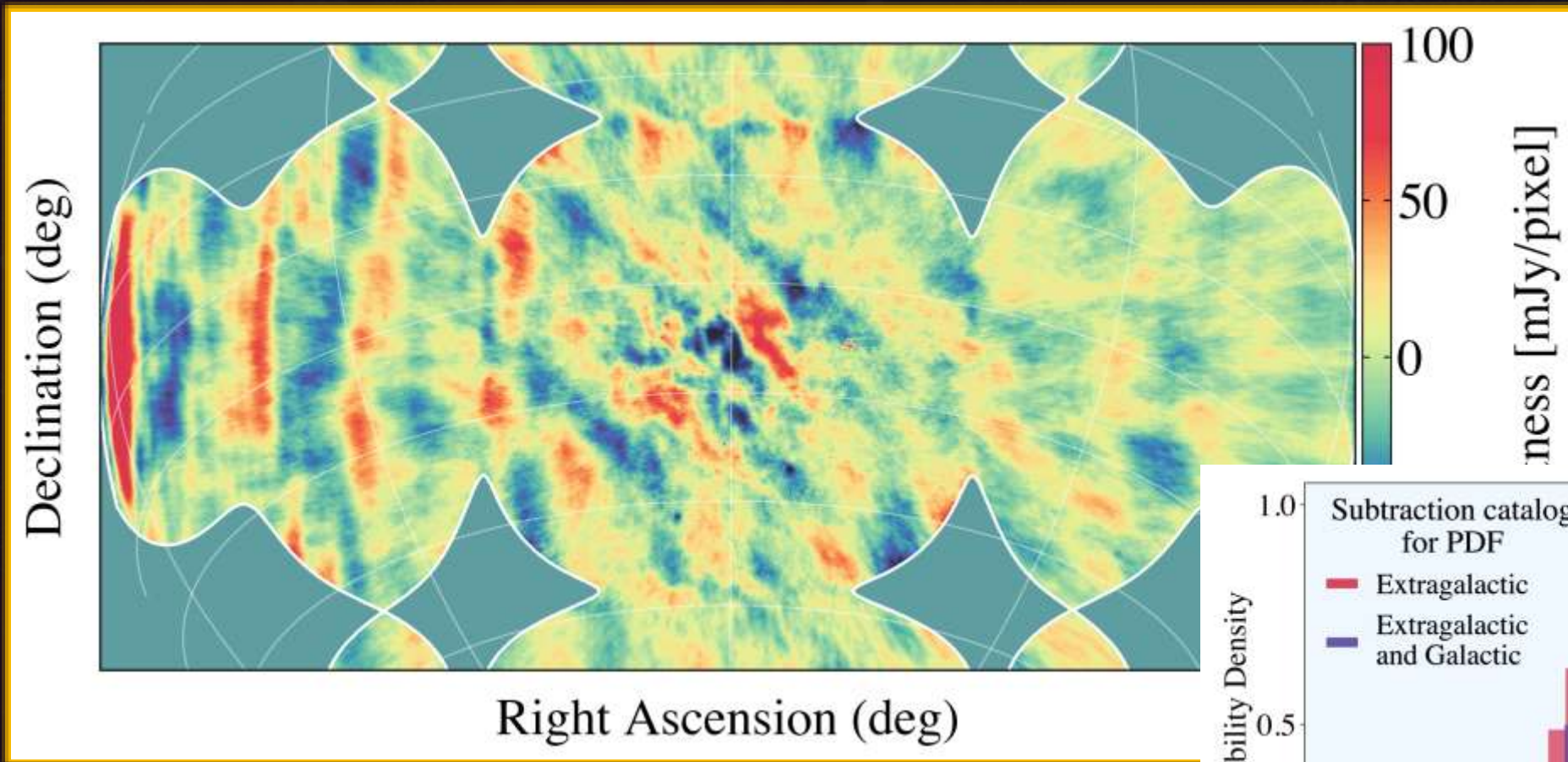
Interferometer



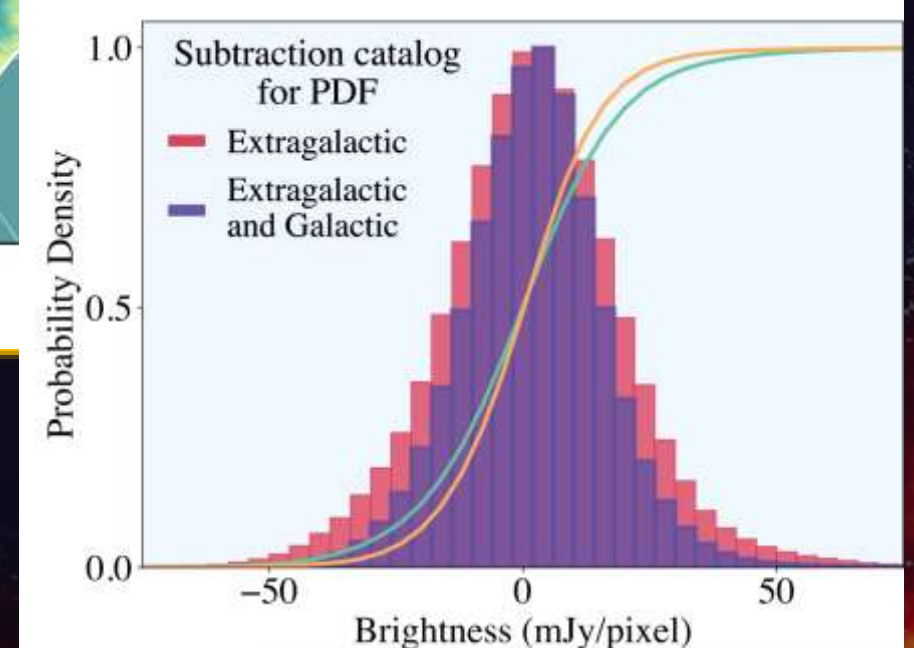
N—S

E—W





Working on building a completeness metric and EoR metric

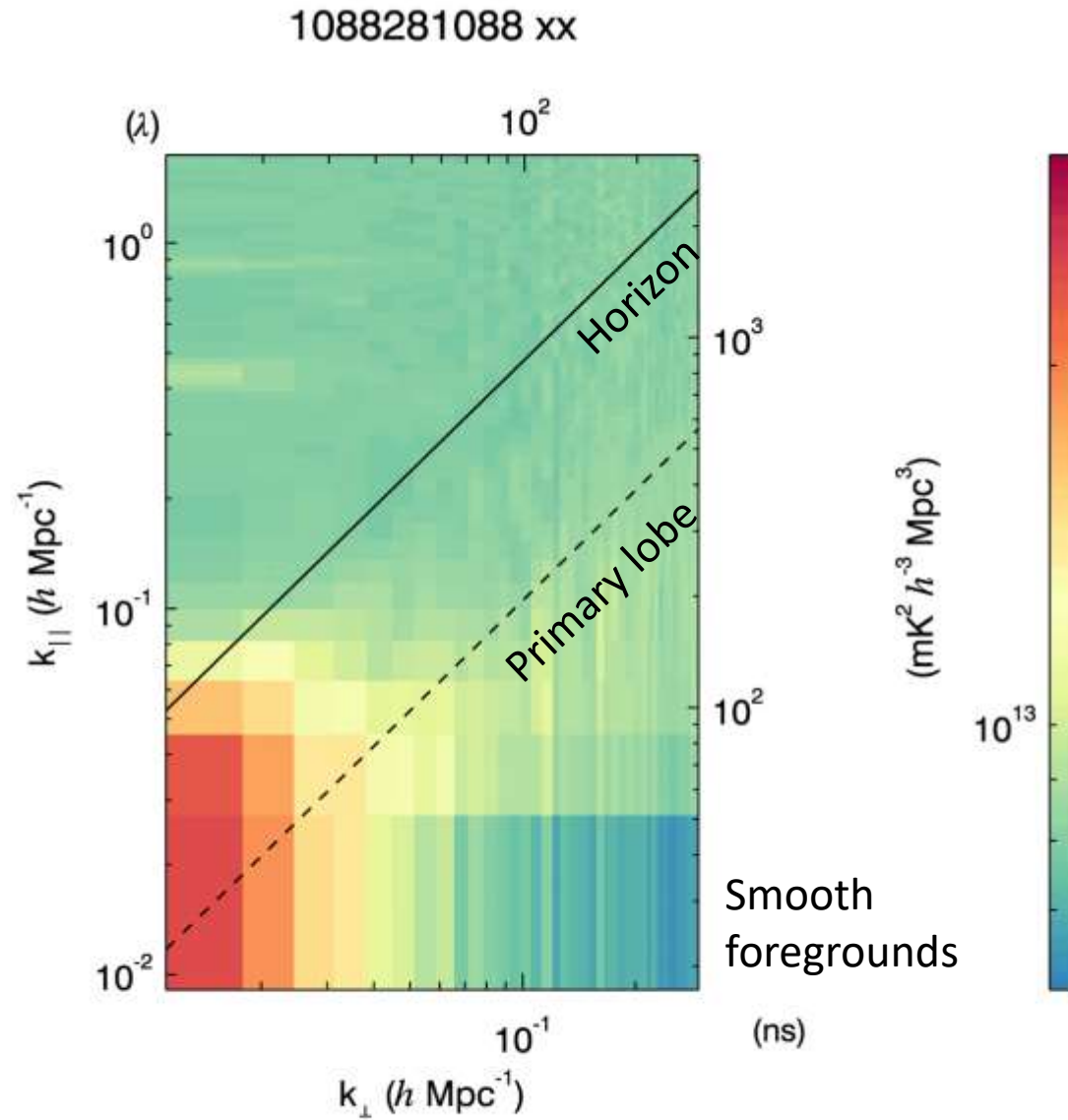


**Processed 50 hrs of high-quality data
from 2014 with GP subtraction**

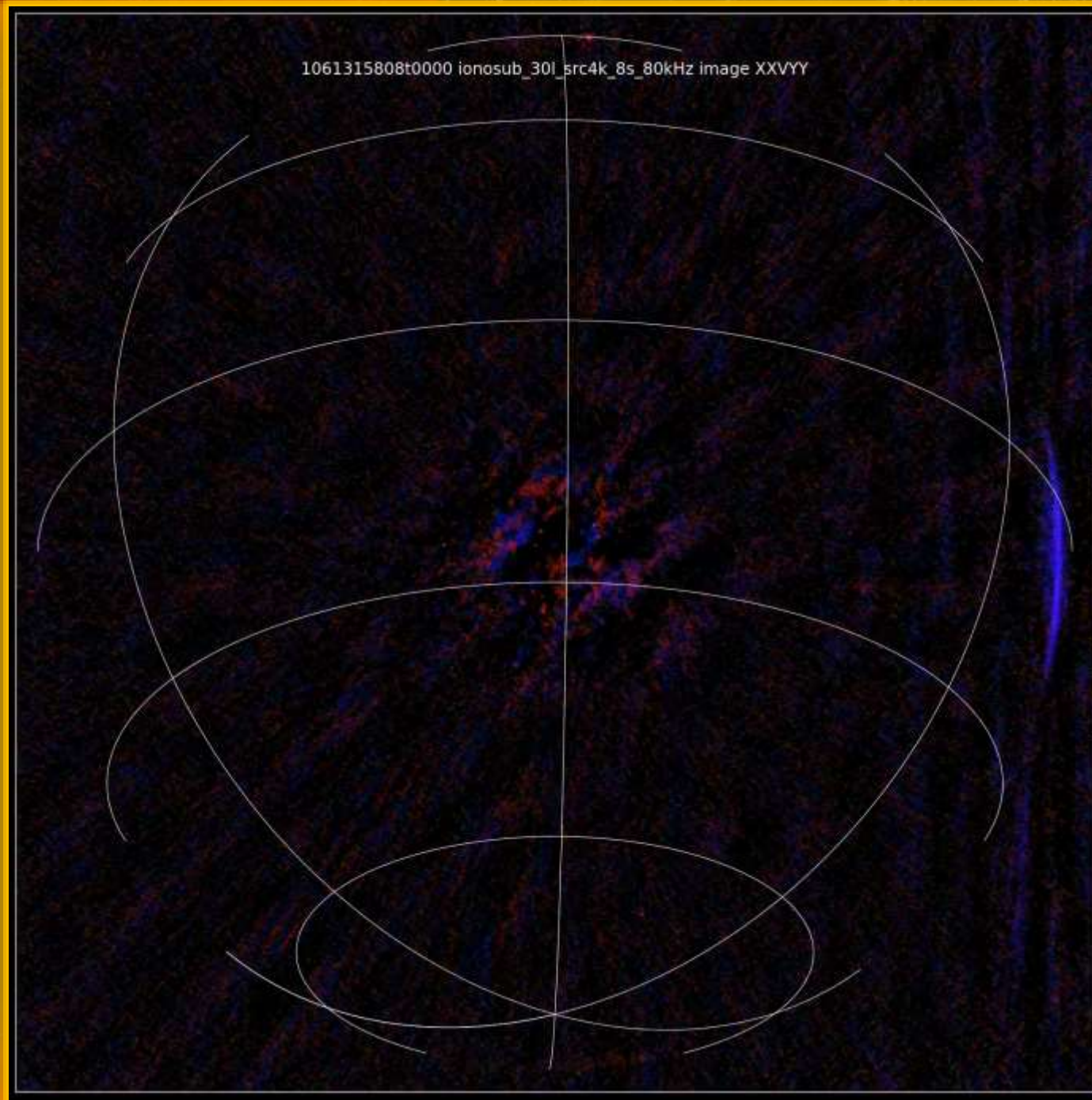
What's the new limit?

Delay spectrum

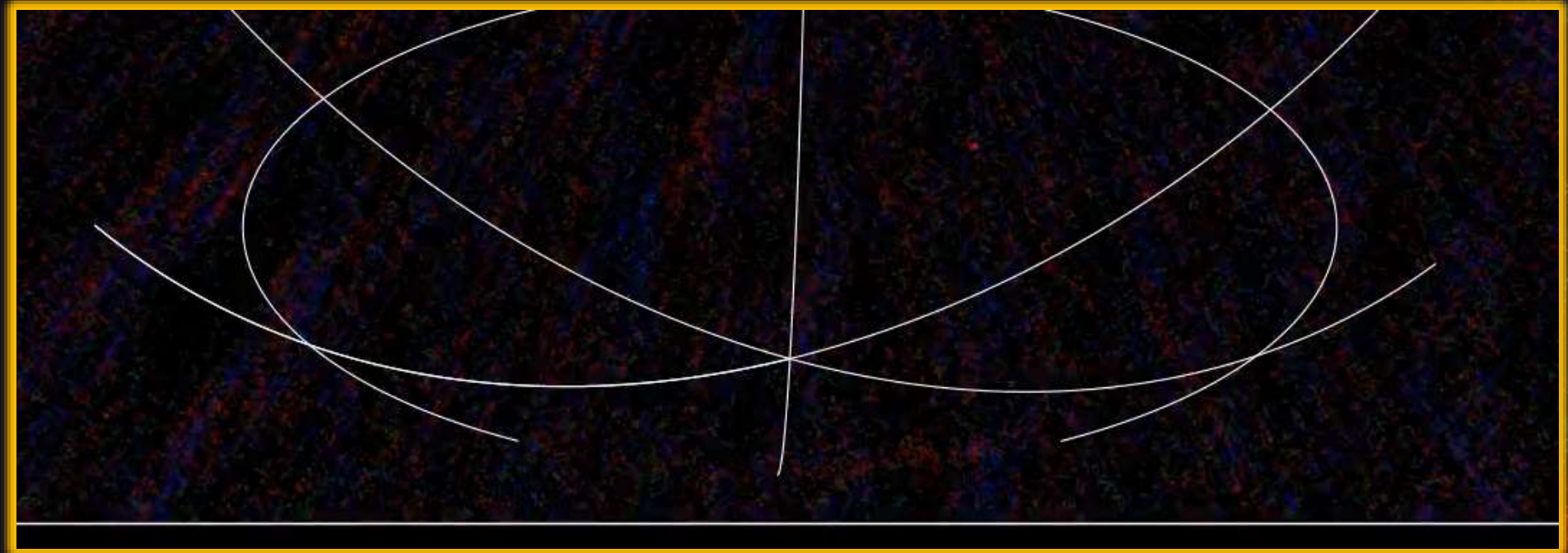
- FFT each baseline
- No imaging required



**Diagnostic
images from
Dev Null using
hyperdrive**

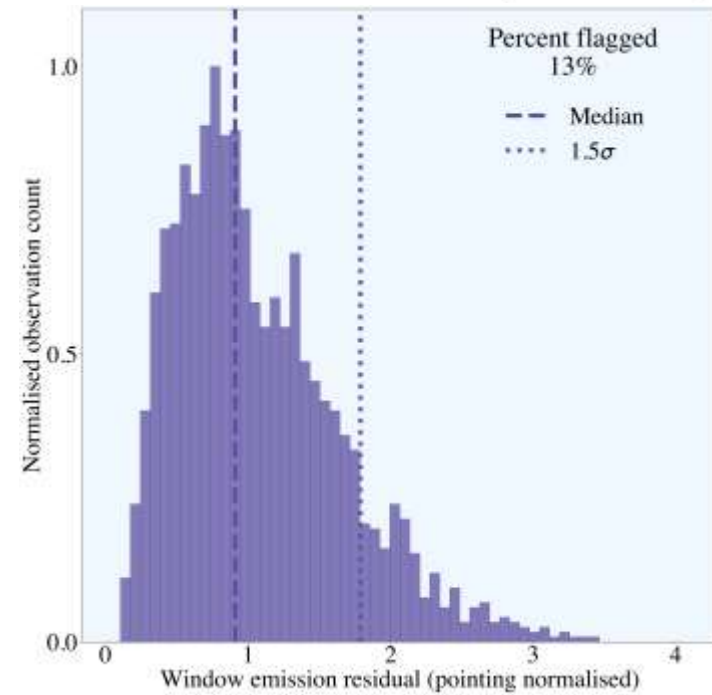
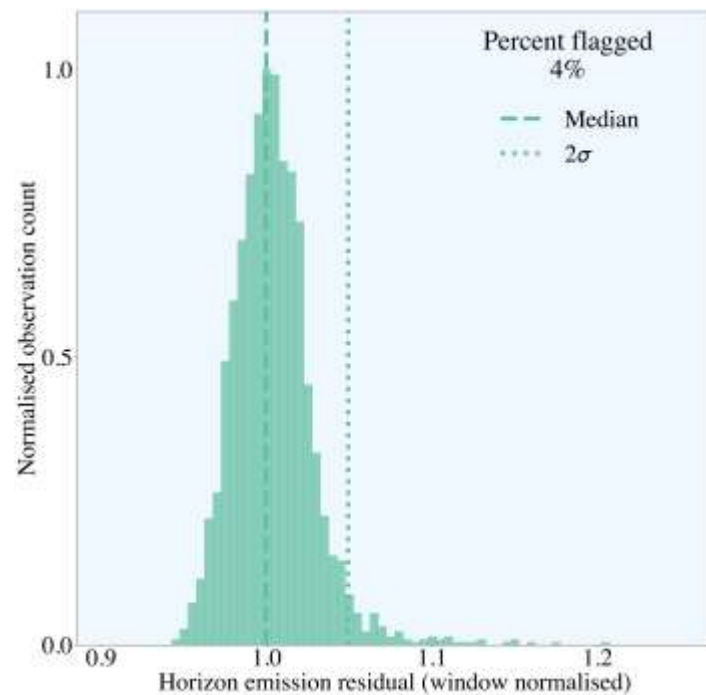
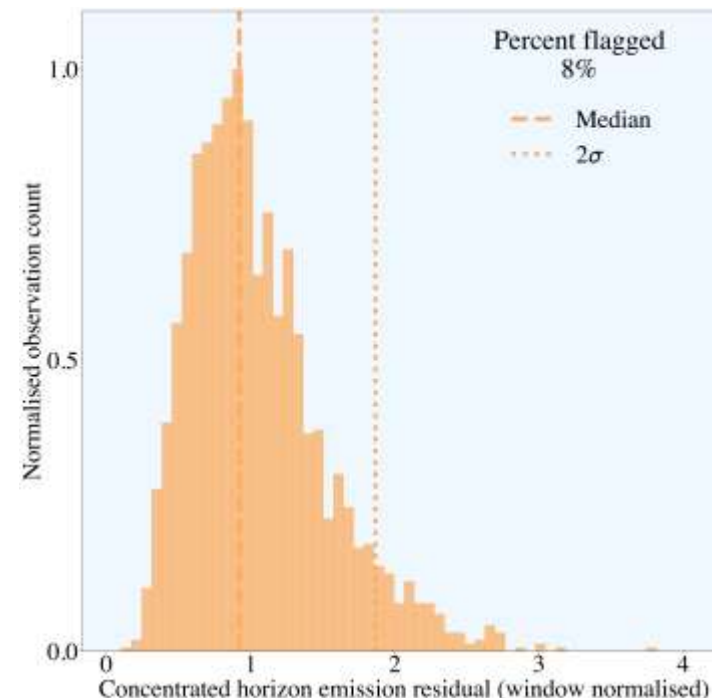
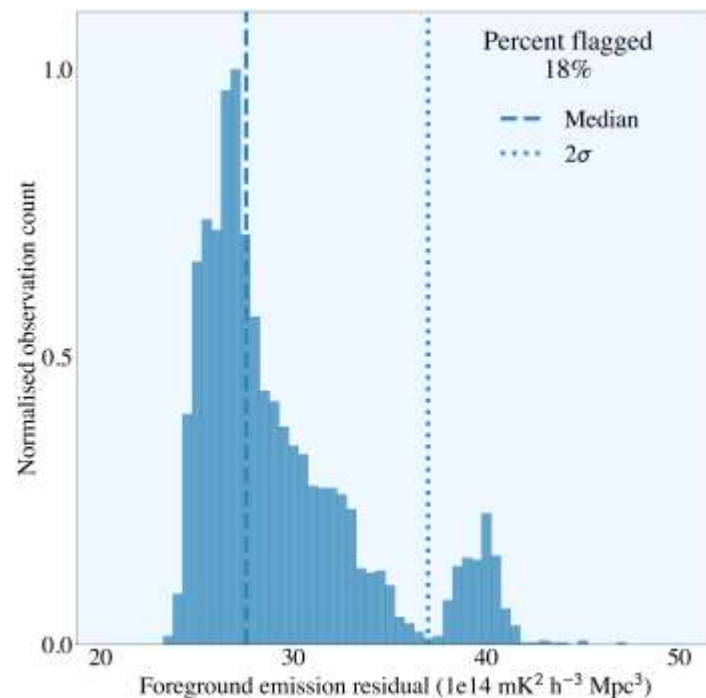


**Diagnostic
images from
Dev Null using
hyperdrive**



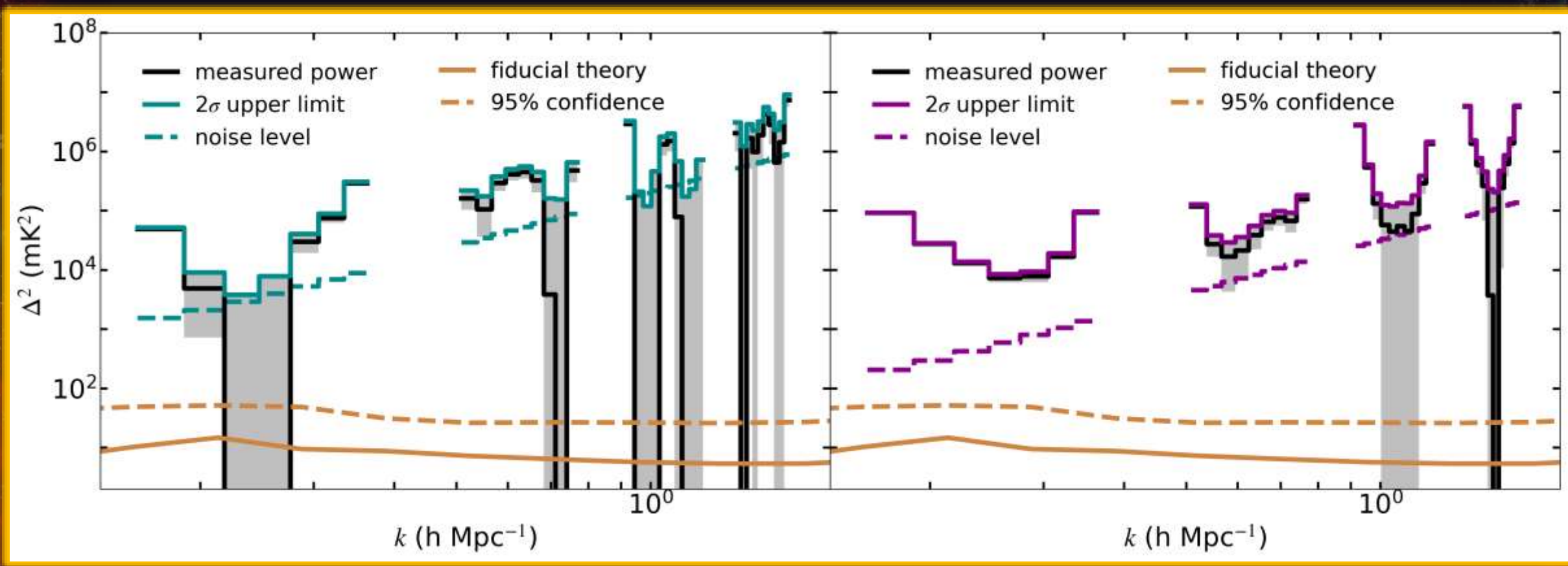
Out of 1400
observations of
processed data...

I'm flagging half



Barry et al 2019b

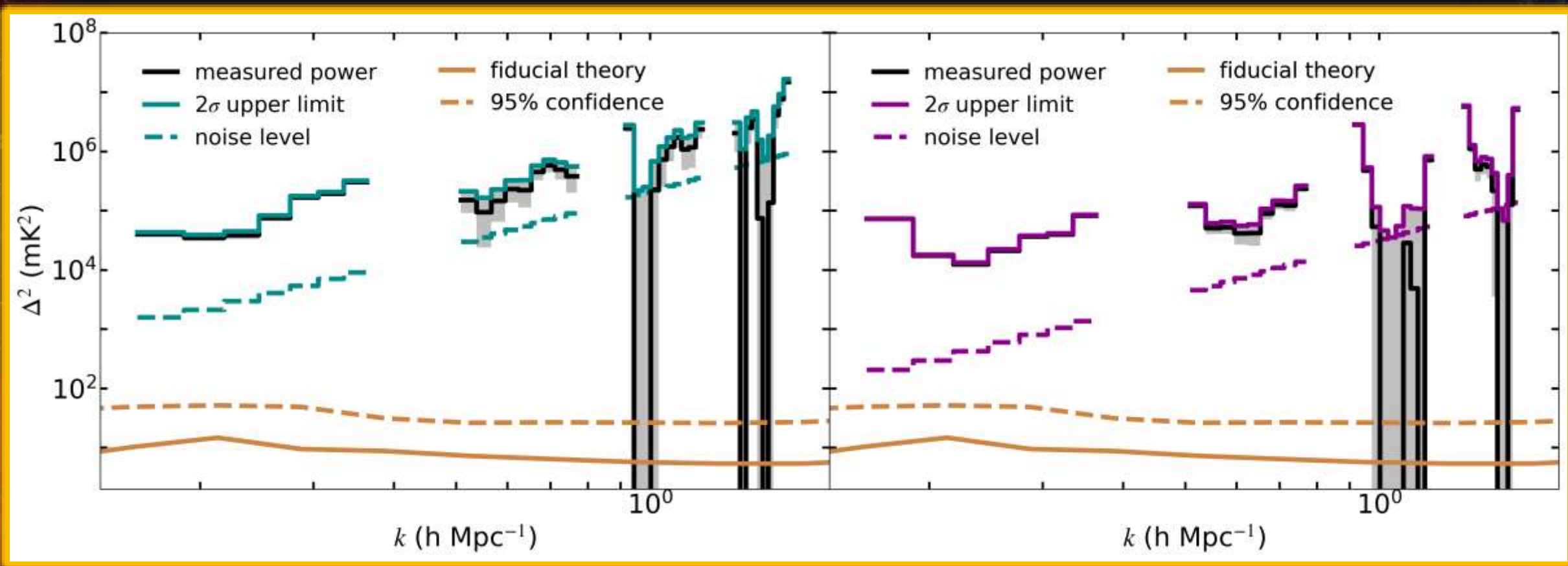
Barry et al in prep



x2 higher

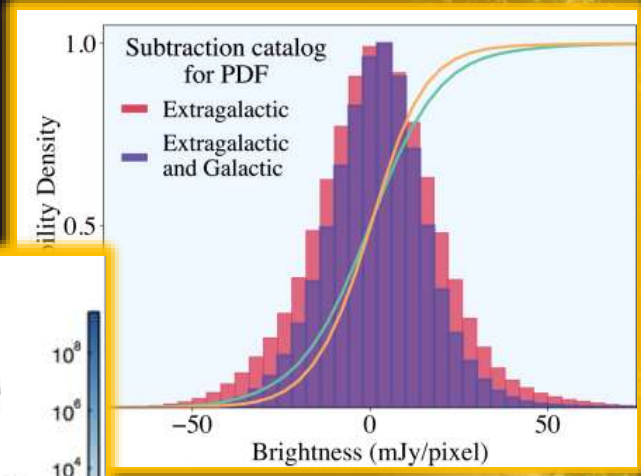
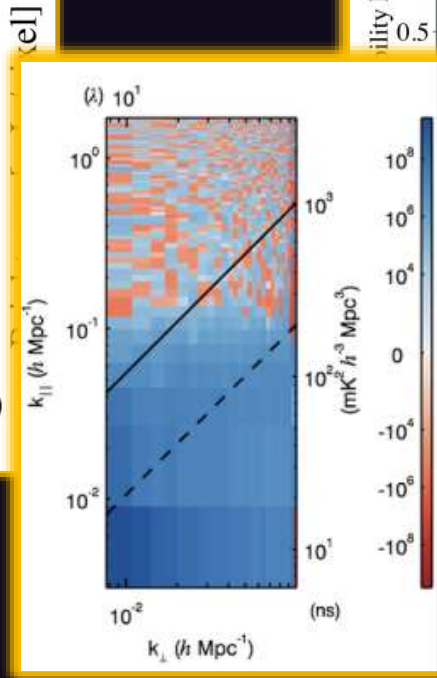
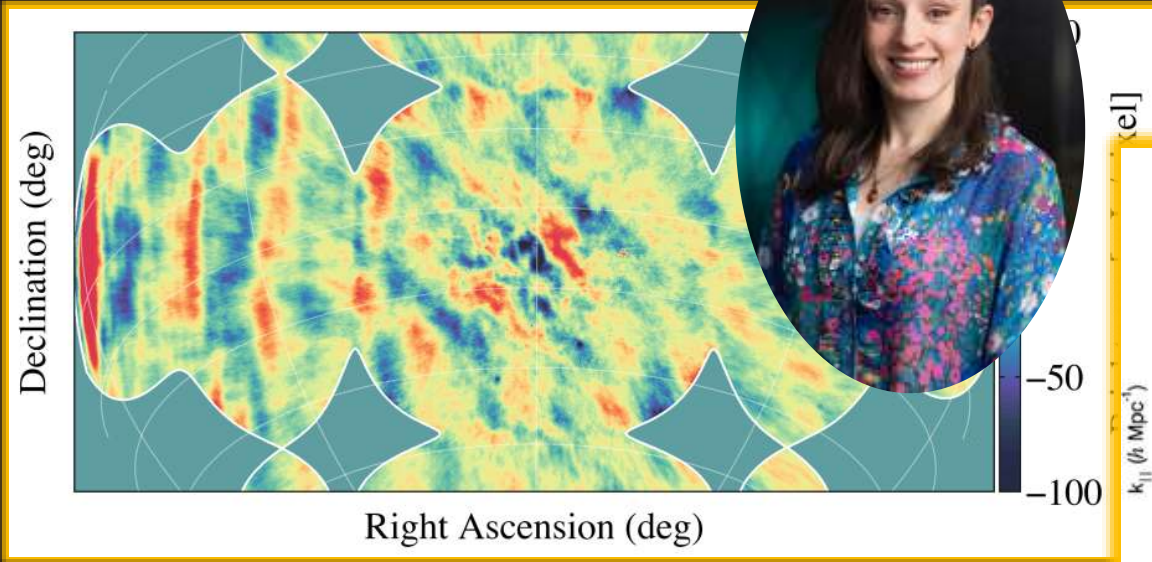
Barry et al 2019b

Barry et al in prep



x3 lower!

Dr. Nichole Barry



The Galactic plane aliases in interferometric radio measurements when it set over the horizon, even at 1% beam sensitivity!

Faint RFI over the horizon may be our main contaminate.

FHD Epoch of Reionisation team is making strides towards deeper limits.