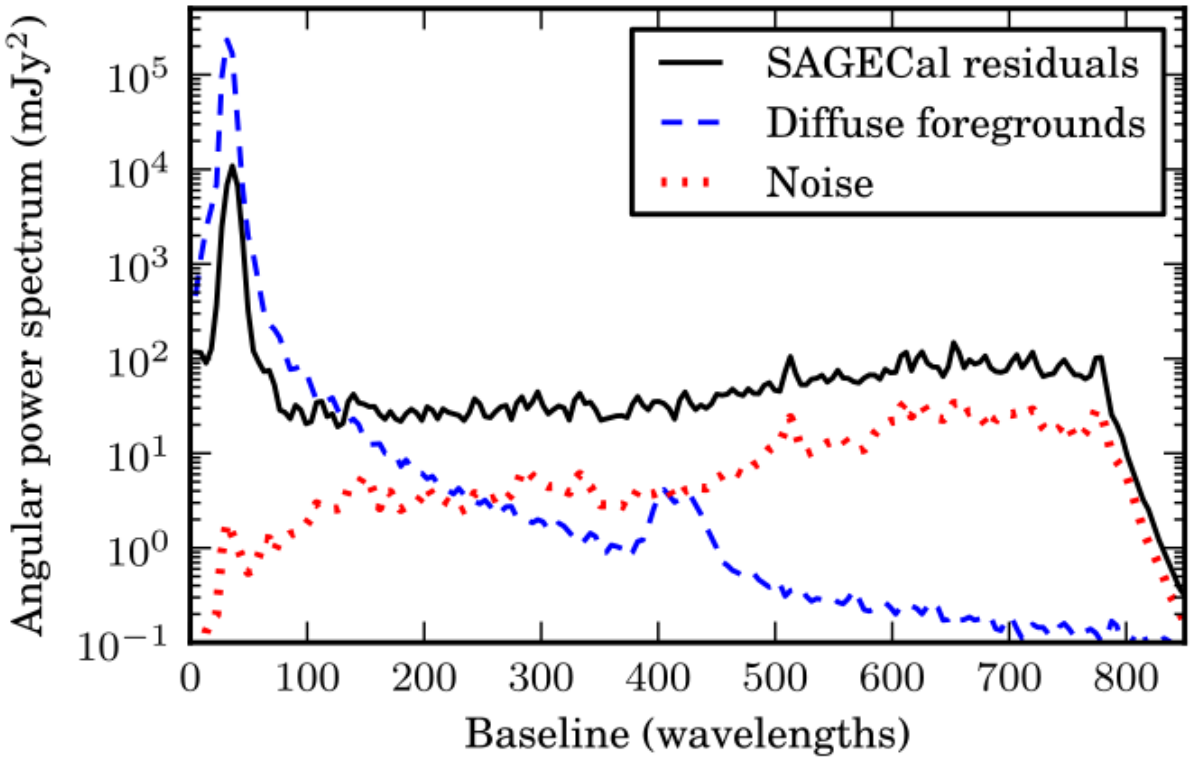
FIRST RESULTS FROM THE LONG BASELINE EPOCH OF REIONISATION SURVEY

CHRISTENE LYNCH (ICRAR-CURTIN)

International Centre for
Radio Astronomy Research

CALIBRATING & SUBTRACTING INCOMPLETE SKY MODELS

Several groups have reported that an accurate and complete sky model, used for data calibration and signal subtraction, is important for a successful detection of EoR signal (e.g. Trott et al. 2012; Patil et al. 2016; Beardsley et al 2016, Barry et al. 2016).



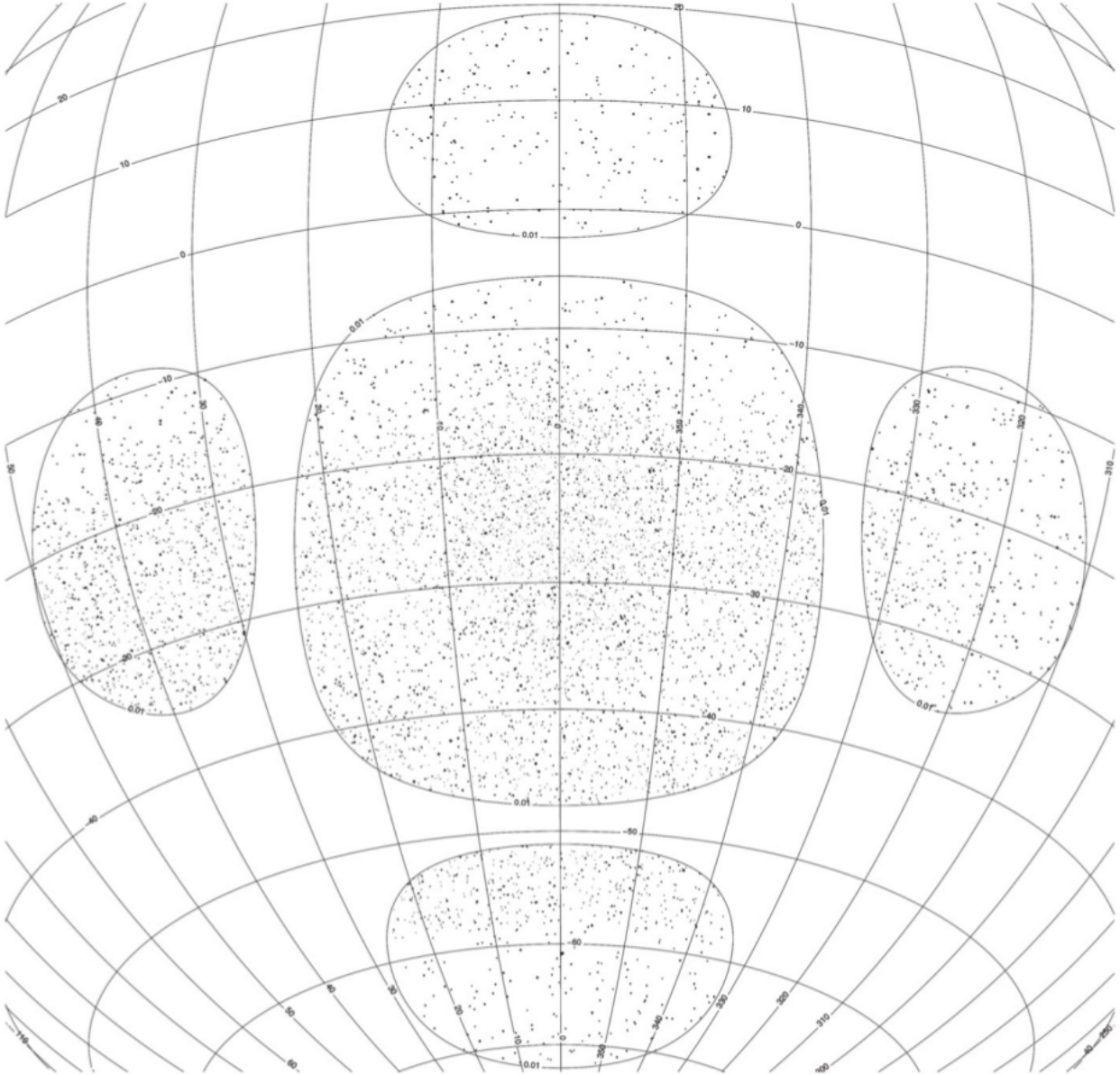
Patil et al. 2016

Two effects seen:

(1) Diffuse foregrounds are suppressed at short baselines

(2) Long baselines show excess power above the thermal noise

CONSIDERING SIDE-LOBE SOURCES

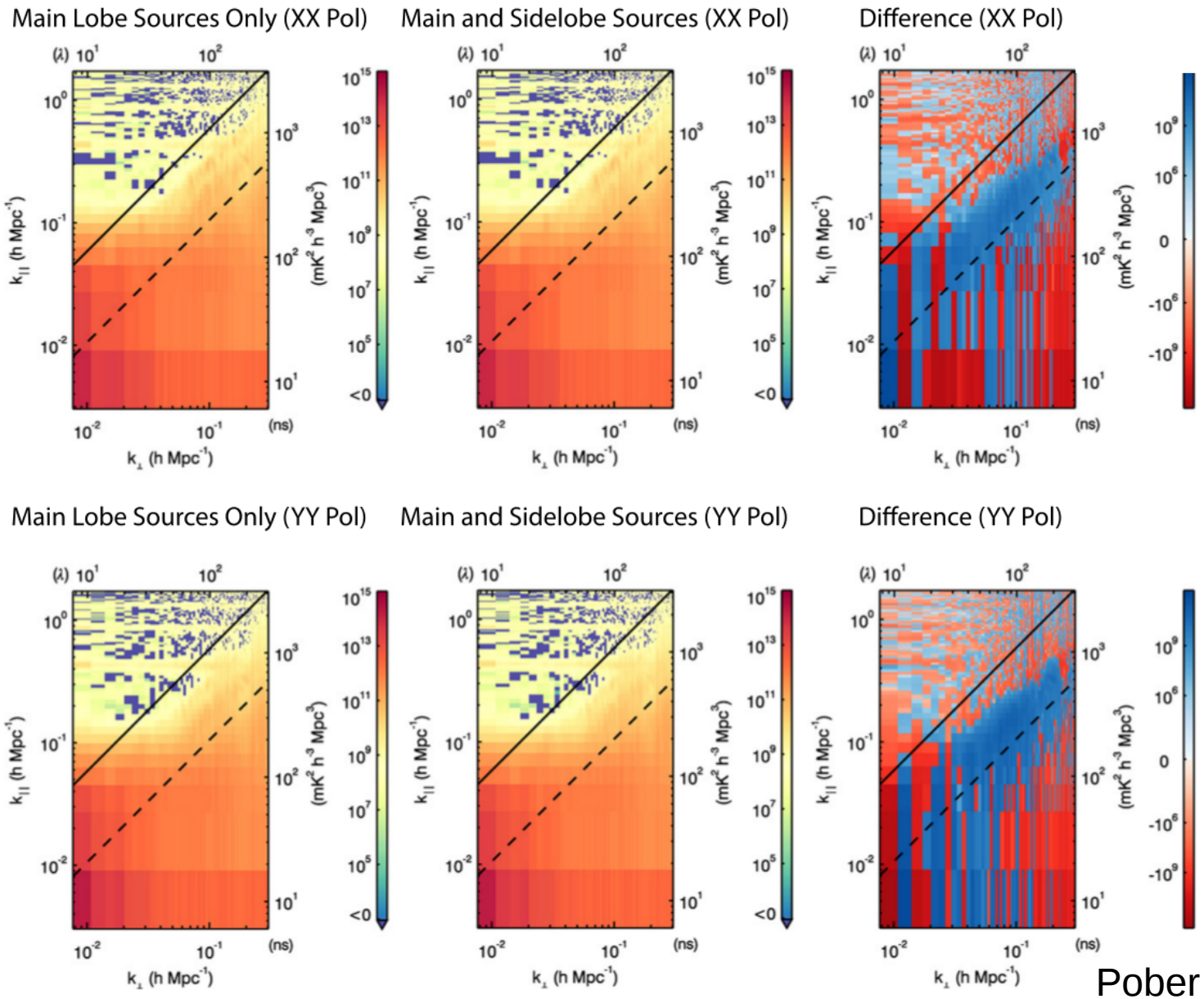


Chromatic effects in the interferometer response become stronger far from pointing centre.

> Expect side-lobe sources to create foreground contamination in higher $k_{\parallel}$ modes than sources near the pointing center.

Pober et al. 2016

ADDITIONAL POWER IN SIDE-LOBES



Subtraction reveals significant difference outside first null of primary beam.

Removing sources in side-lobes removes power at high $k_{\parallel}$.

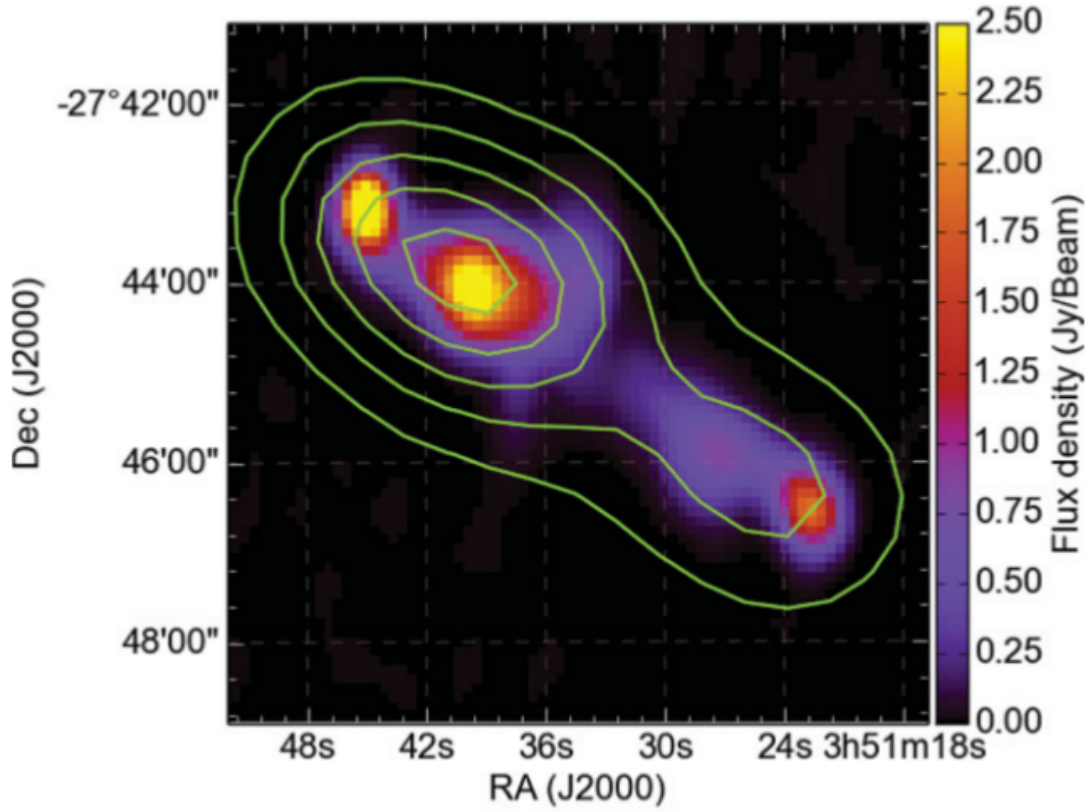
Pober et al. 2016

GLEAM SOURCES IN TGSS

Procopio et al. 2017 cross-matched EoR 1 sources in GLEAM with TGSS:

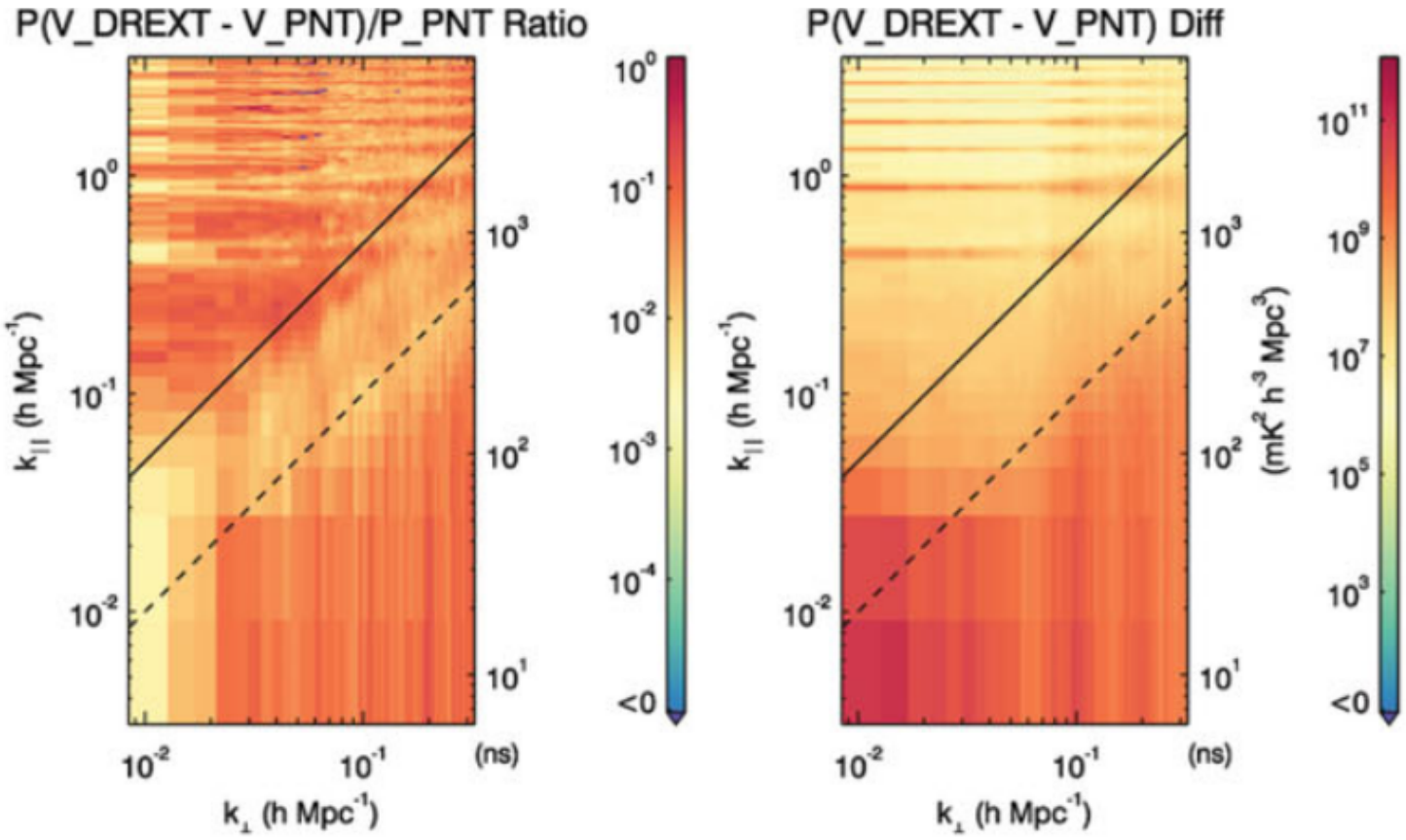
Found ~13% GLEAM sources matched with >2 TGSS sources

How does mis-modelling doubles & extended sources affect PS?



Procopio et al. 2017

IMPACT OF MIS-MODELED SOURCES

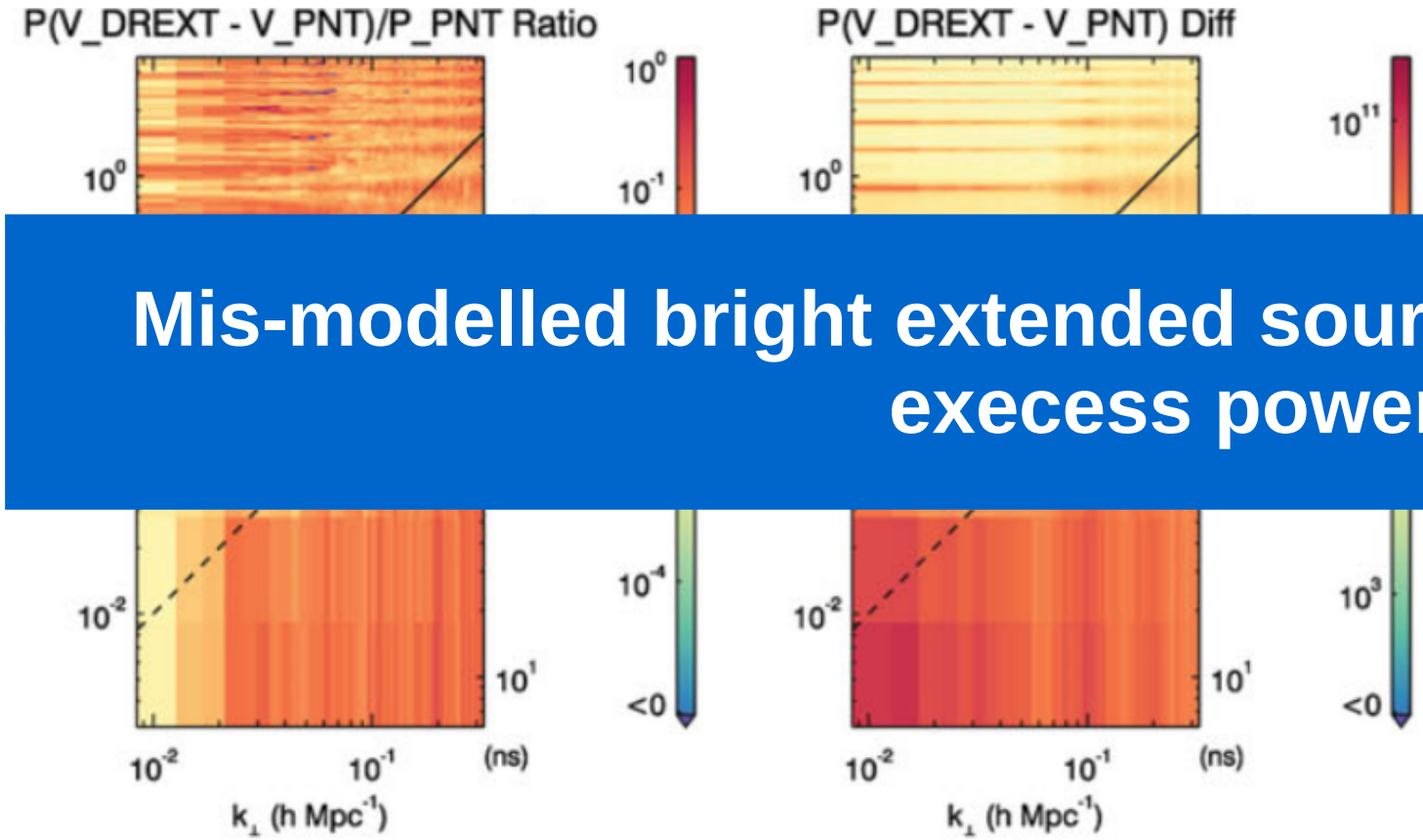


Residuals from modelling multiples & extended sources correctly to modeled as point sources.

Factor of two improvement in residual power in EoR window.

Procopio et al. 2017

IMPACT OF MIS-MODELED SOURCES



Residuals from modelling multiples & extended sources

Mis-modelled bright extended sources contribute the most execess power

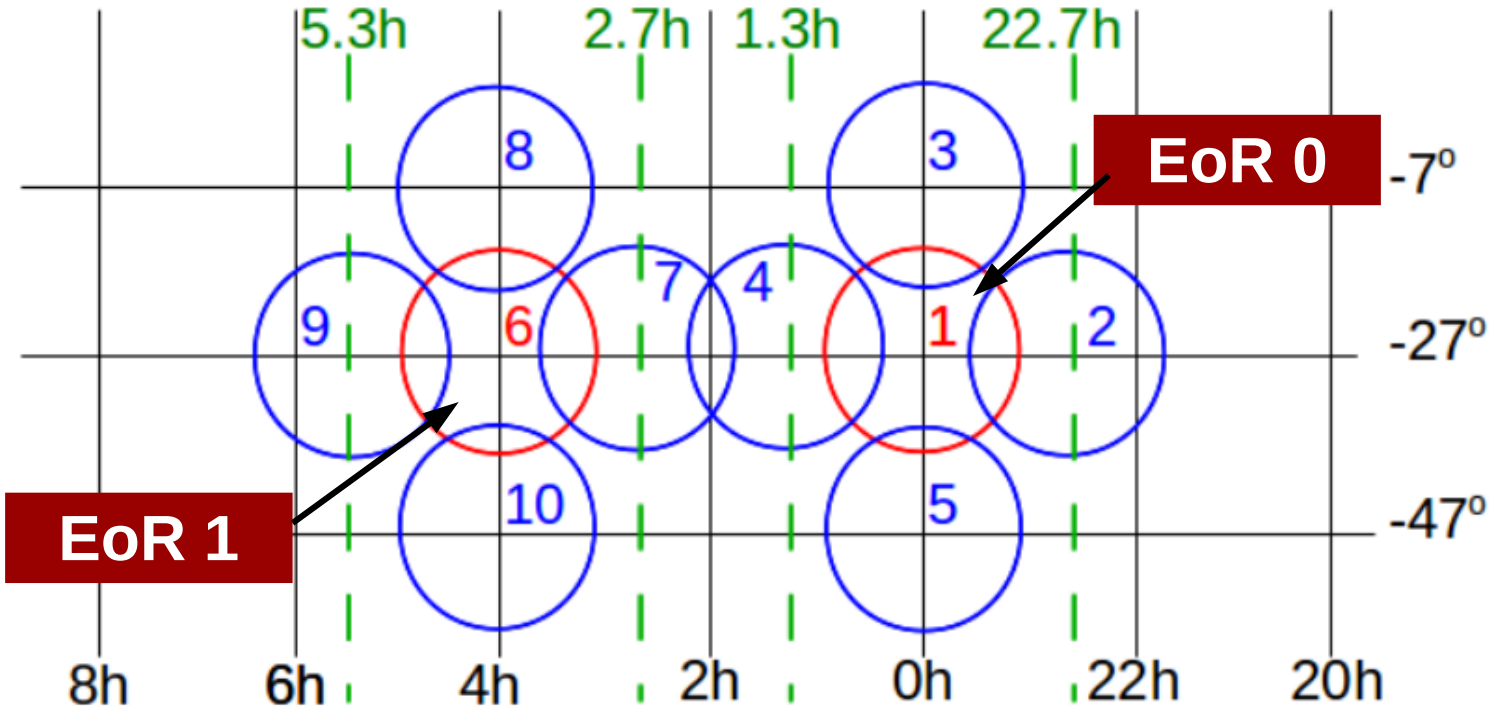
residual power in EoR window.

Procopio et al. 2017

SURVEY DETAILS

The Long Baseline Epoch of Reionisation Survey (LoBES):

MWA phase II extended array observations to improve source models of point and extended sources in the MWA primary beam sidelobes of the EoR0 and EoR1 fields.



Four frequency bands:

103 – 134 MHz

139 – 170 MHz

170 – 200 MHz

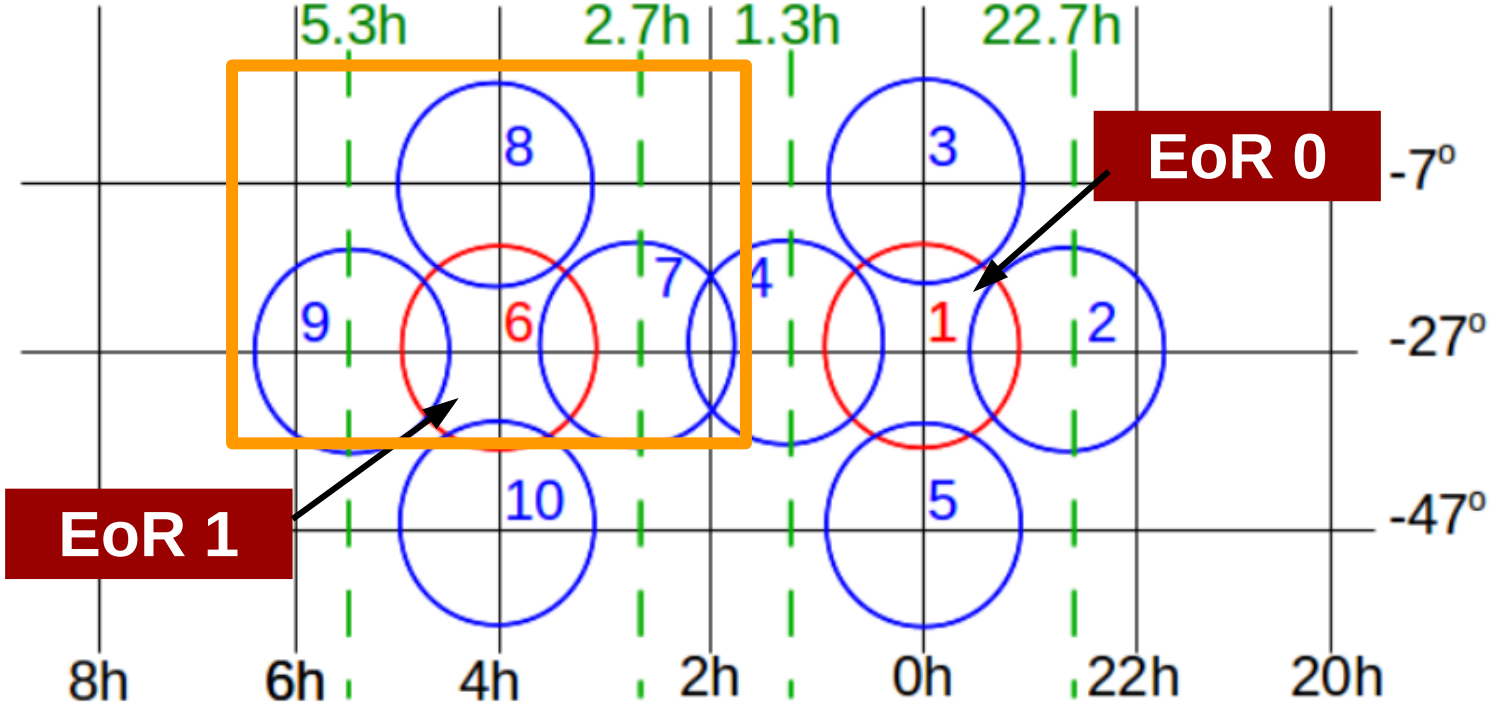
200 – 231 MHz

40 minutes per frequency per field.

SURVEY DETAILS

The Long Baseline Epoch of Reionisation Survey (LoBES):

MWA phase II extended array observations to improve source models of point and extended sources in the MWA primary beam sidelobes of the EoR0 and EoR1 fields.

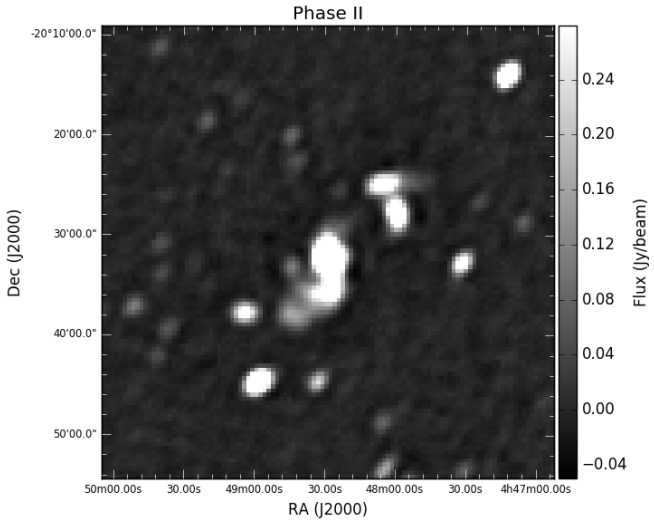


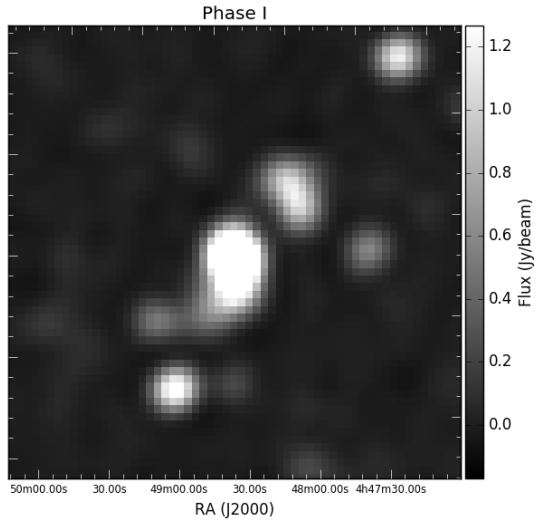
Four frequency bands:

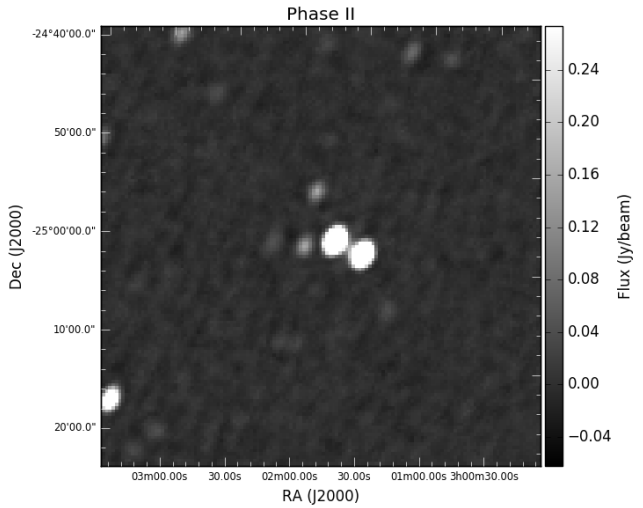
- 103 – 134 MHz
- 139 – 170 MHz
- 170 – 200 MHz
- 200 – 231 MHz

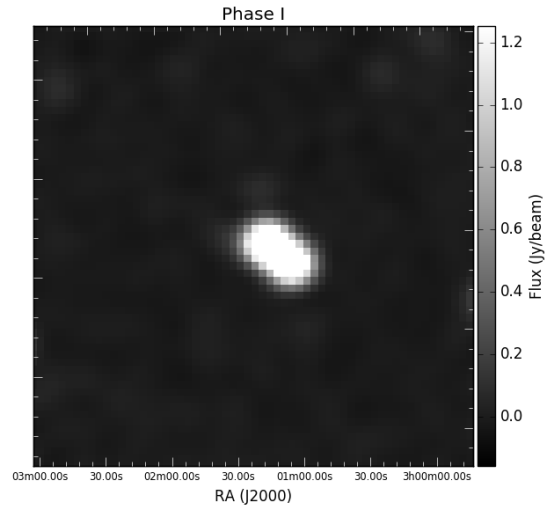
40 minutes per frequency per field.

NEW MULTIPLES & COMPLEX SOURCES

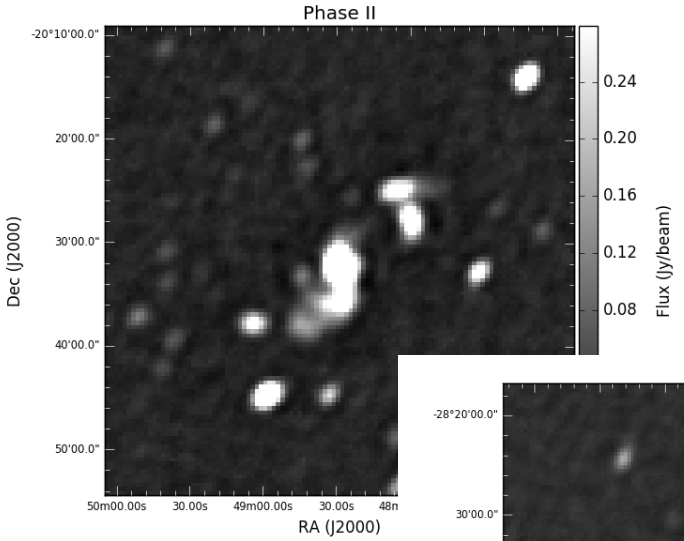


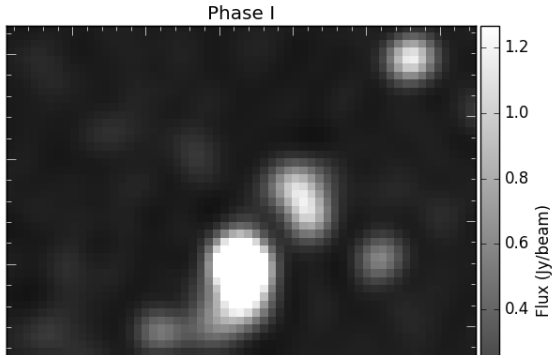


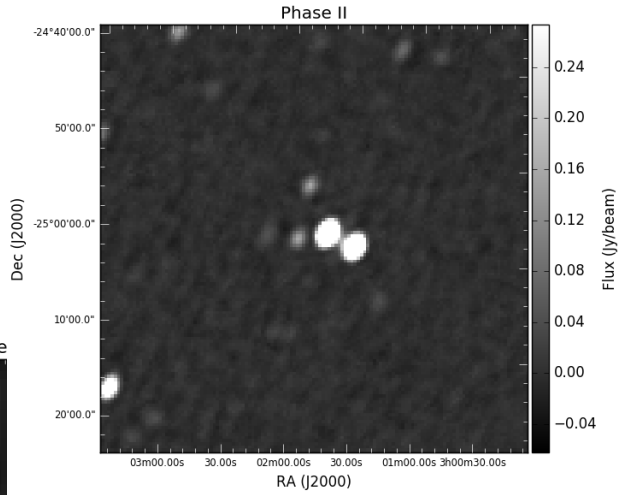


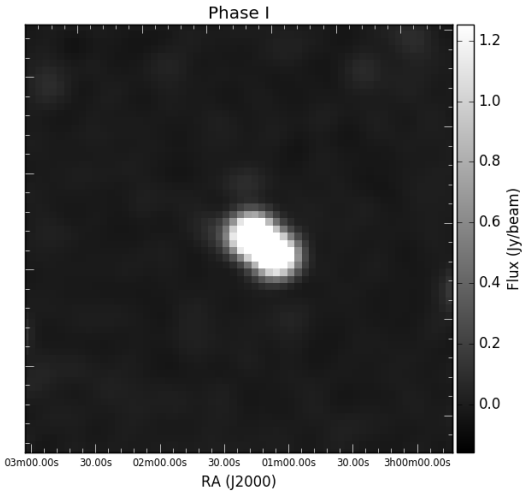


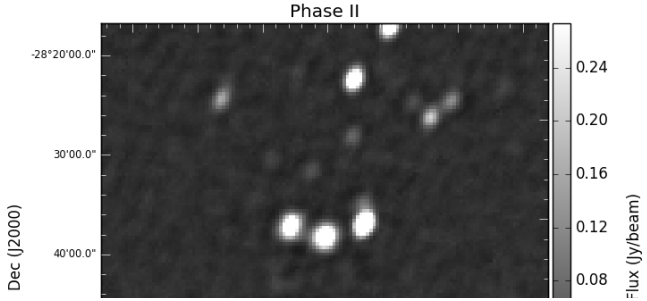
NEW MULTIPLES & COMPLEX SOURCES

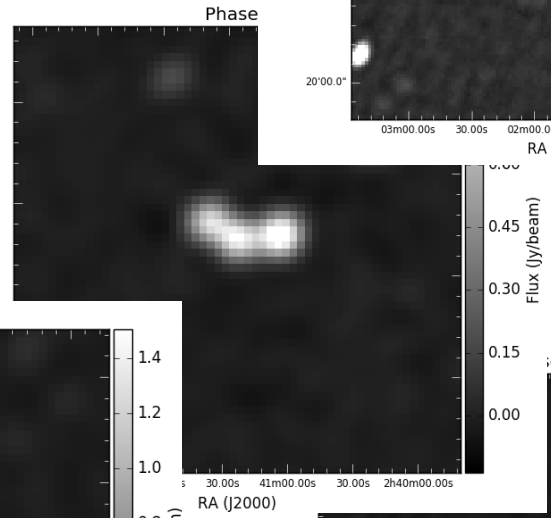


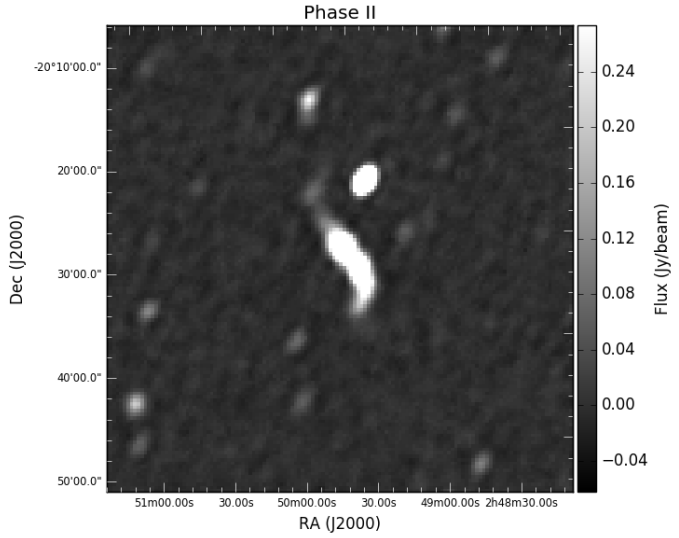


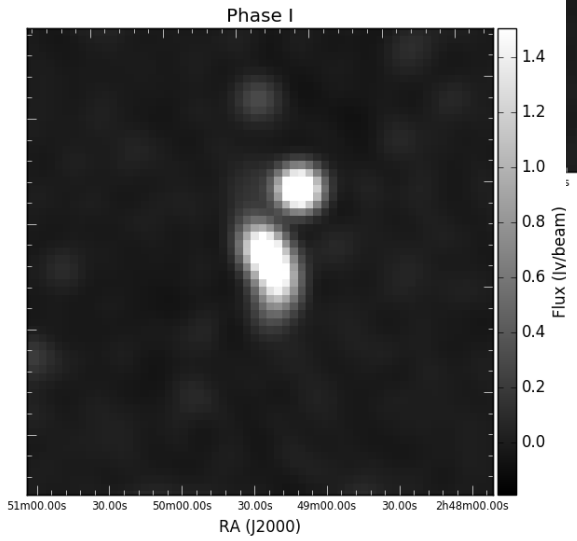


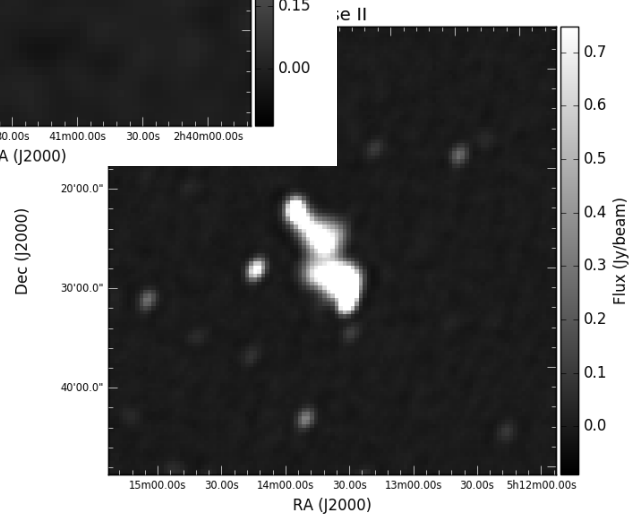


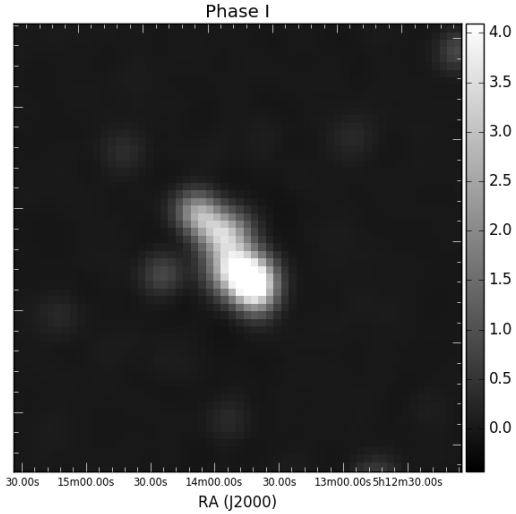




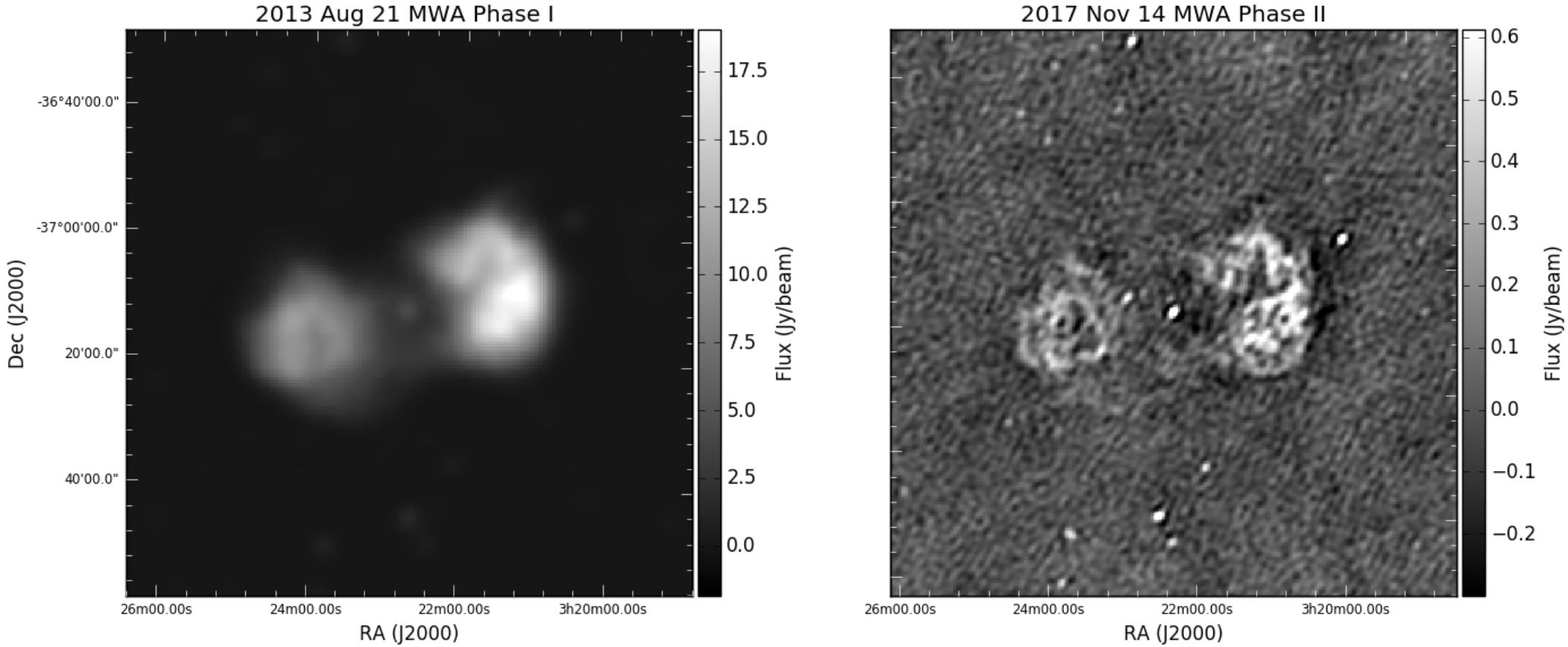








MWA PHASE II FORNAX A



Extended array over-resolves the bright, more diffuse emission – need Phase I & II data to get complete model of this emission.

Phase I image courtesy of B. Mckinley

PRELIMINARY CROSS MATCH RESULTS

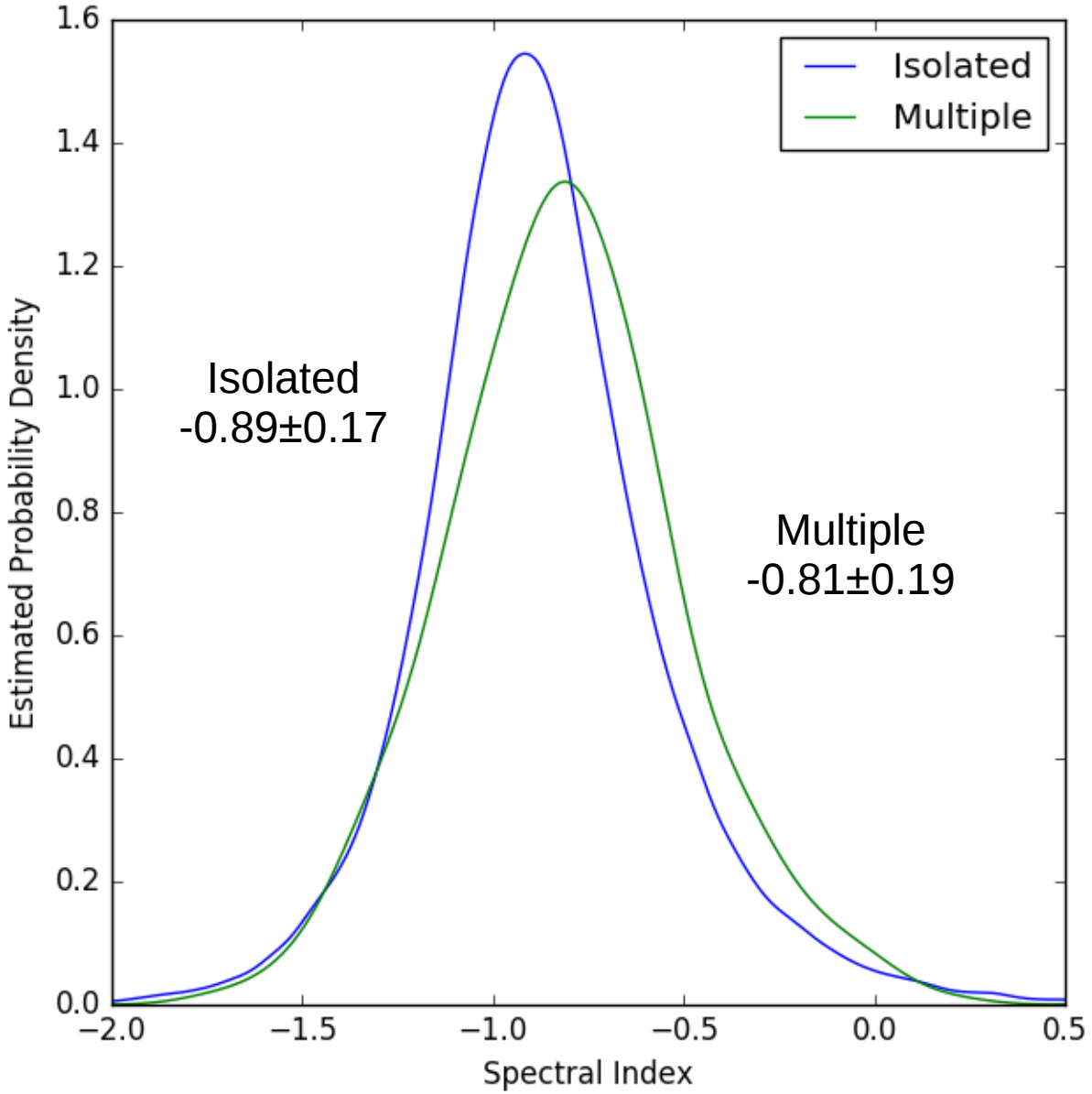


Table 3. Number of LOBES sources matched to a single GLEAM source

Number of LOBES sources	Number of instances
1	40730
2	1721
3	43
4	4

Stay tuned!

SUMMARY

The accuracy of the sky model used for data calibration and signal subtraction is important for a successful detection of EoR signal.

Sources far from pointing centre have largest systematic input into EoR power spectrum; side-lobe foreground source need to be considered.

Extended and multi-component sources need detailed modelling for subtraction – subtracting them as point sources leaves excess power that biases the EoR signal.

LoBES: Uses MWA phase II observations to tackle both extended source modelling and side-lobe source contamination.