Polarisation with the Extended Murchison Widefield Array

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Extended capabilities for the Murchison Widefield Array (MWA) workshop

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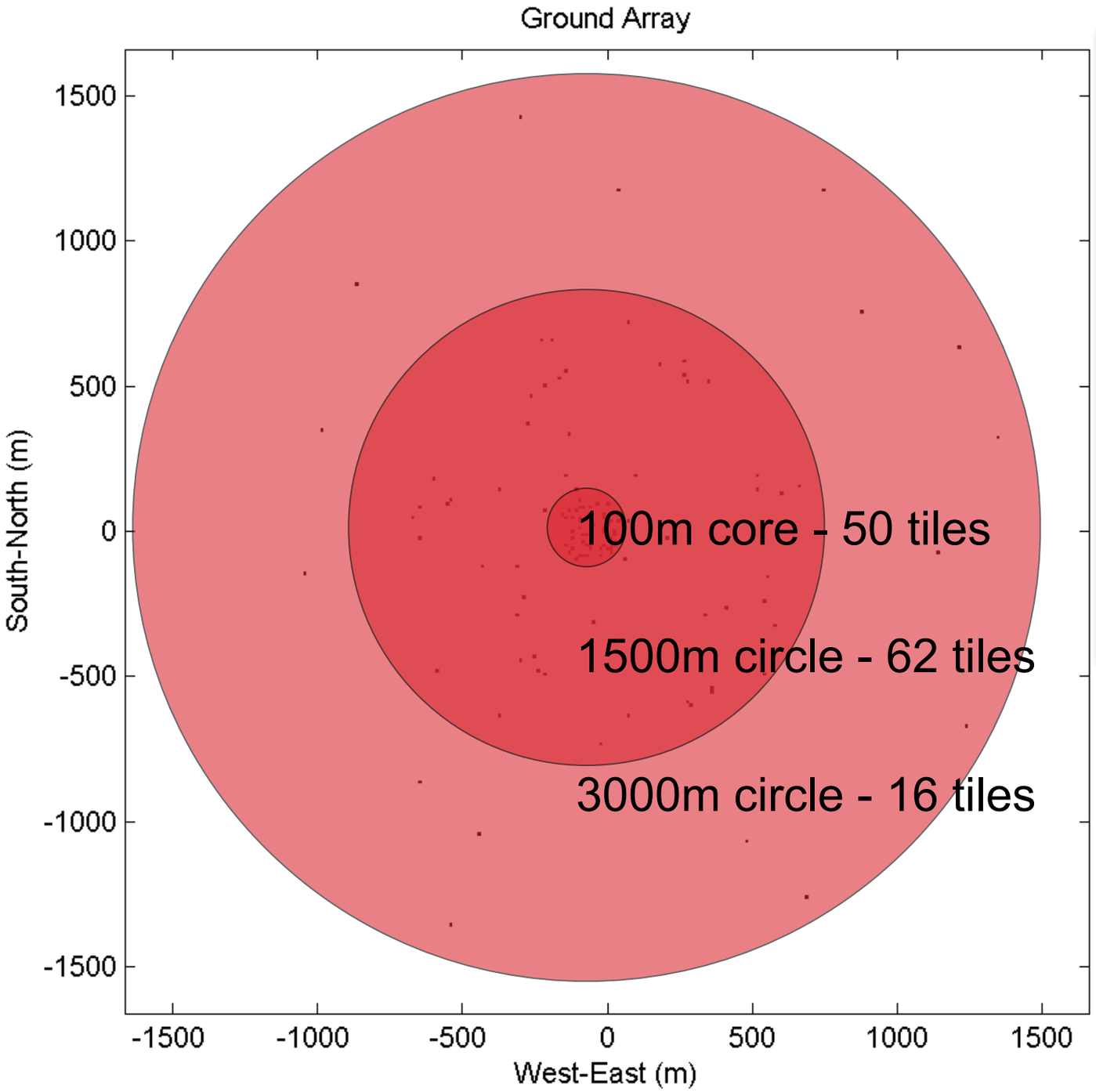
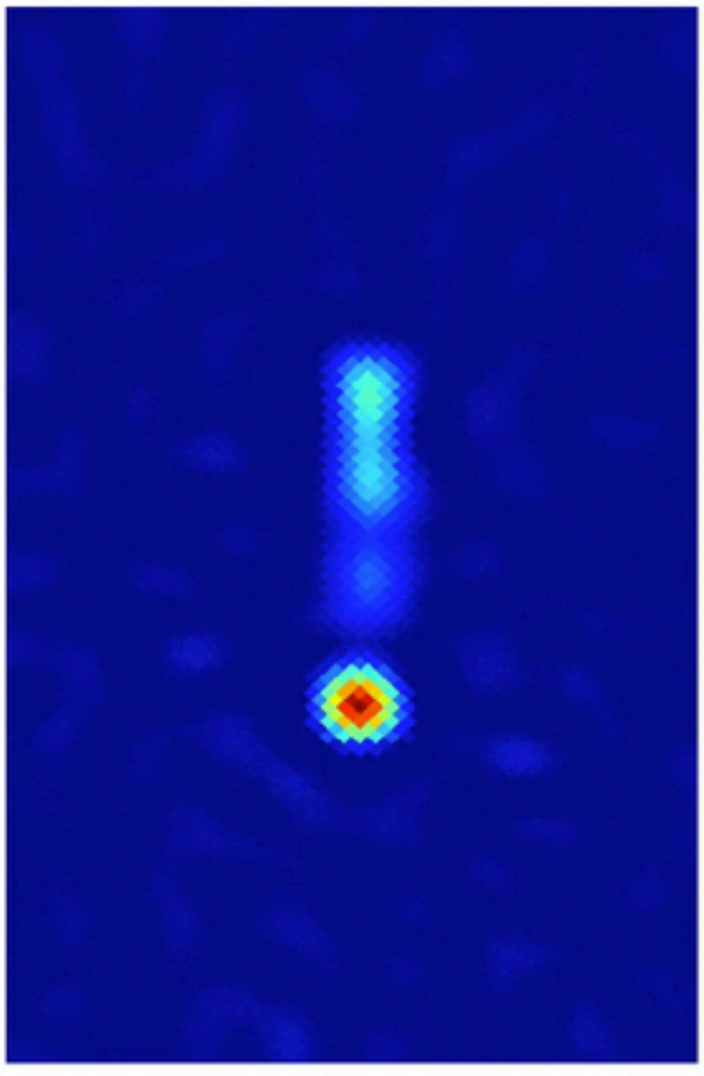
CSIRO; Swinburne

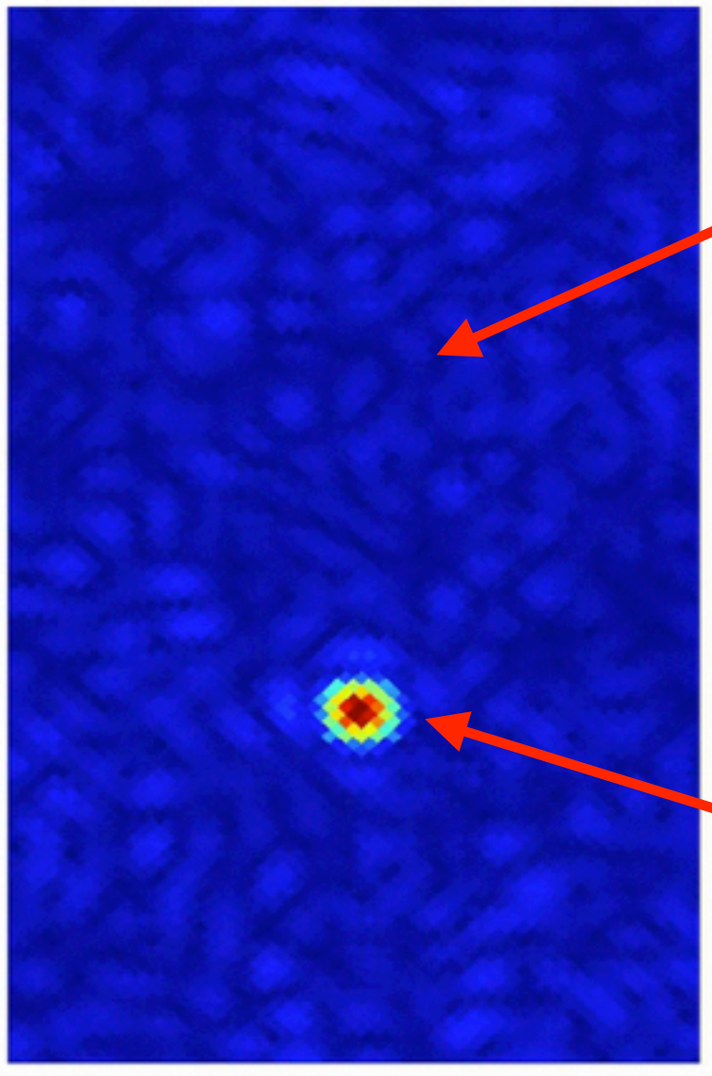
The Murchison Widefield Array

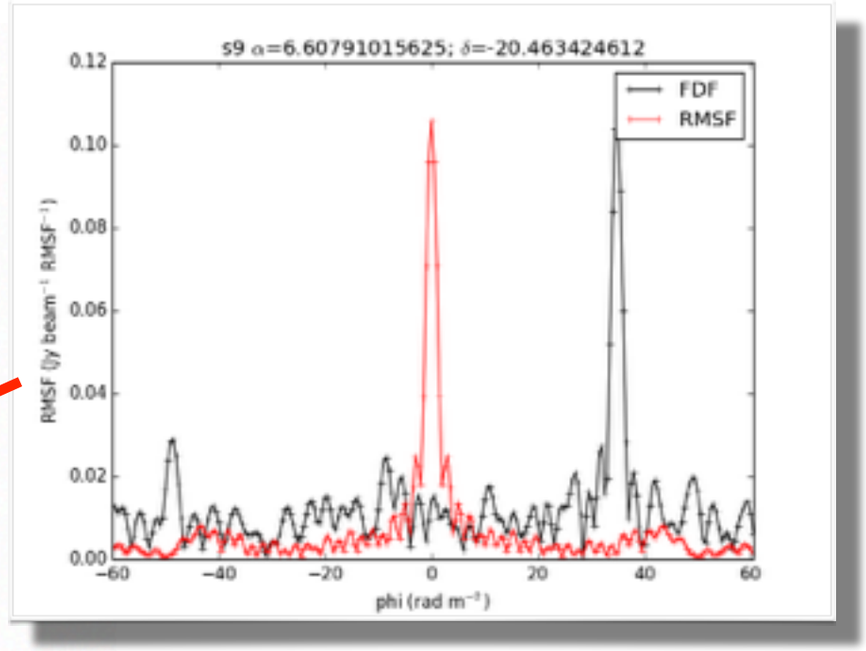


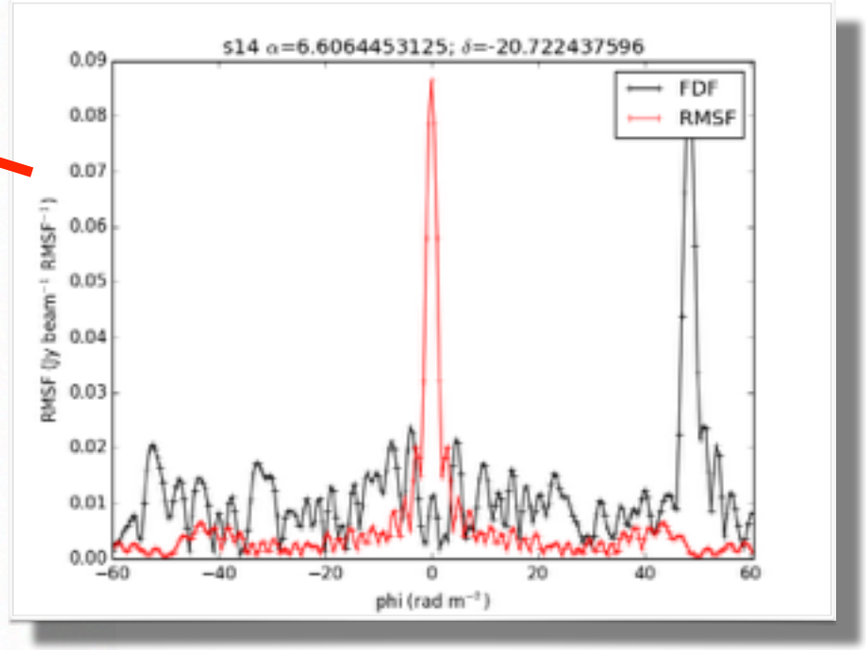
- Electronically “steered”
- 16 dual-pol. dipoles
- Simple design
- 80-300 MHz range
- 15°-50° field-of-view
- Precursor to SKA Low

Polarised point sources with MWA









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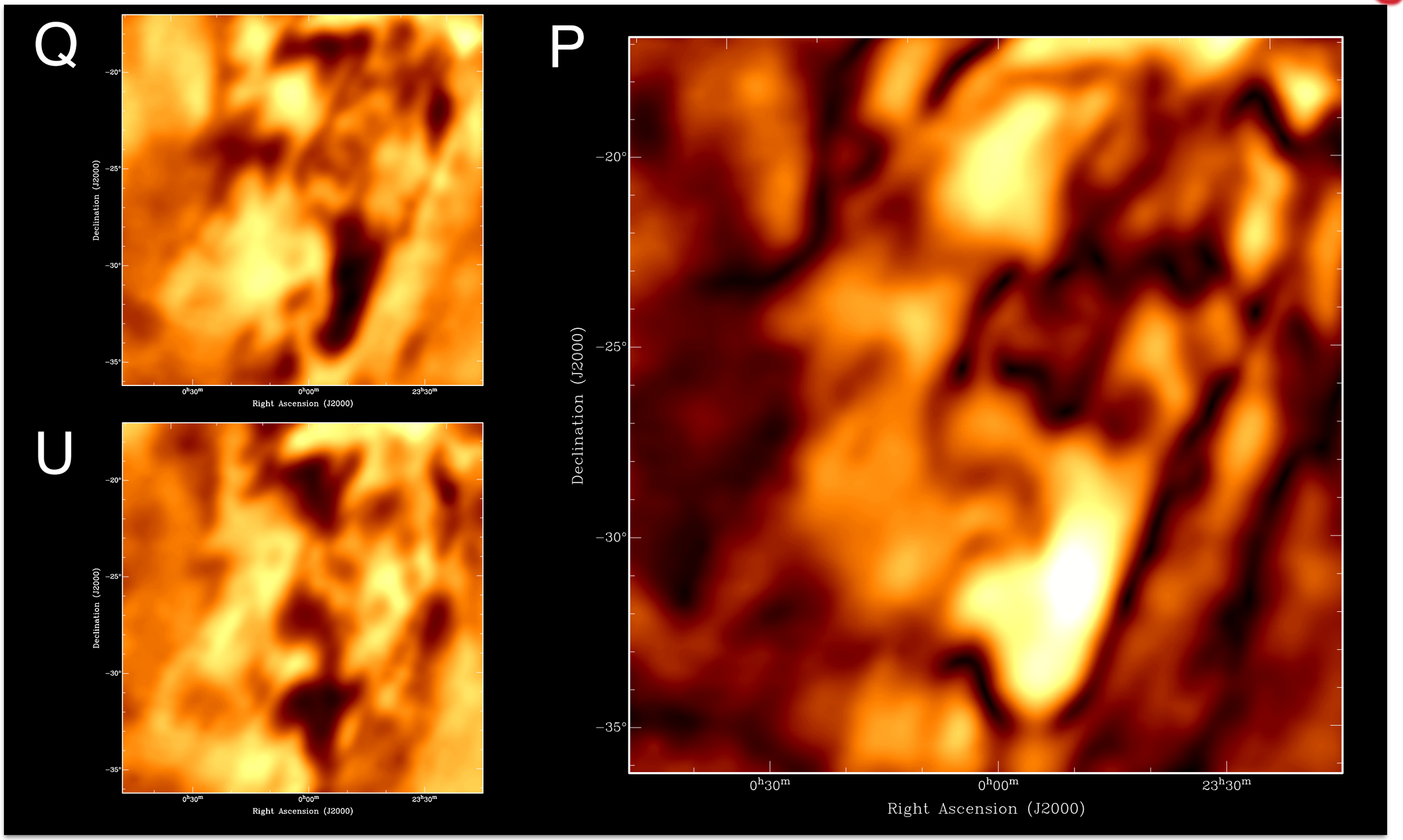
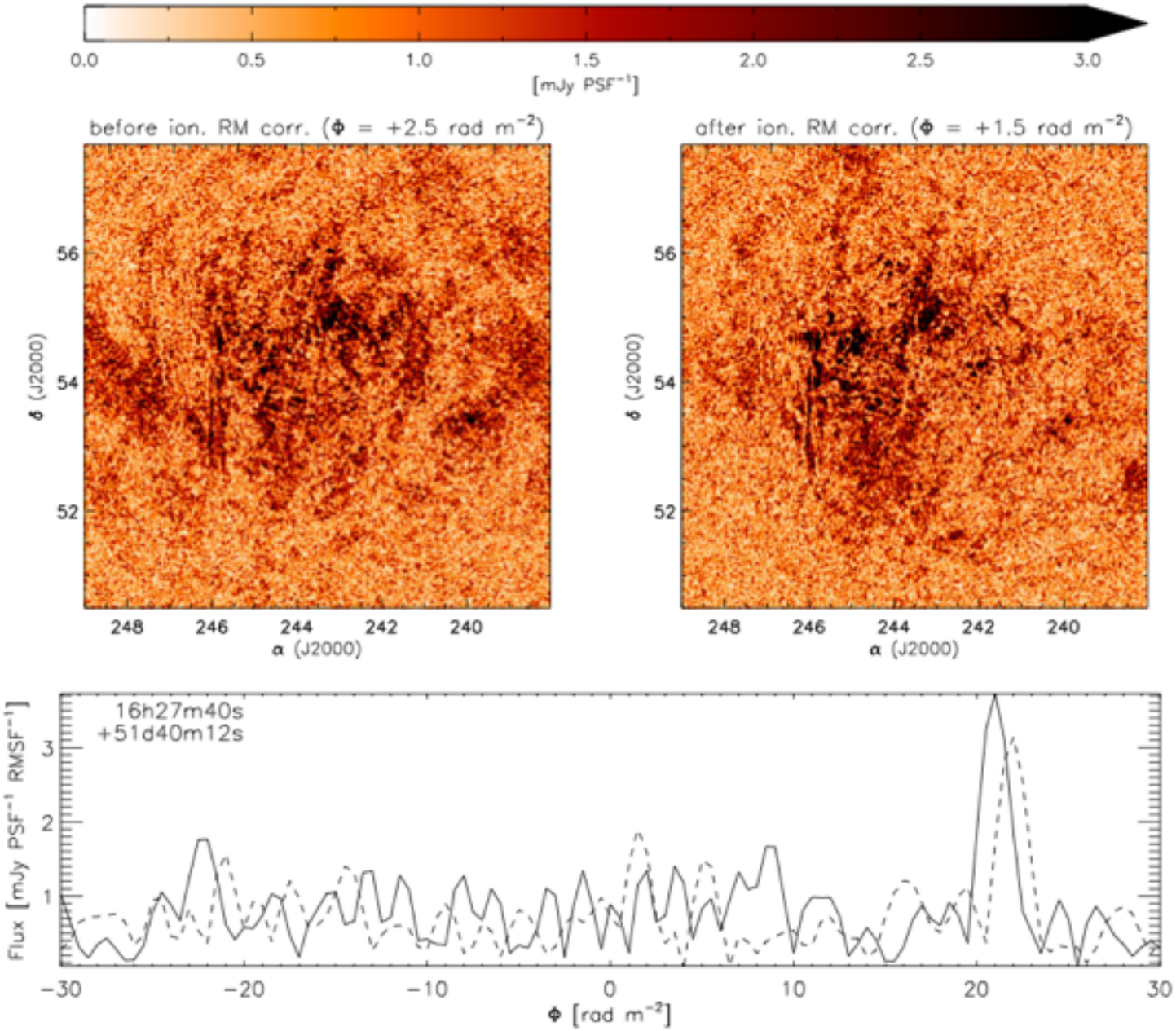
Diffuse Polarisation MWA (1.5 hr)

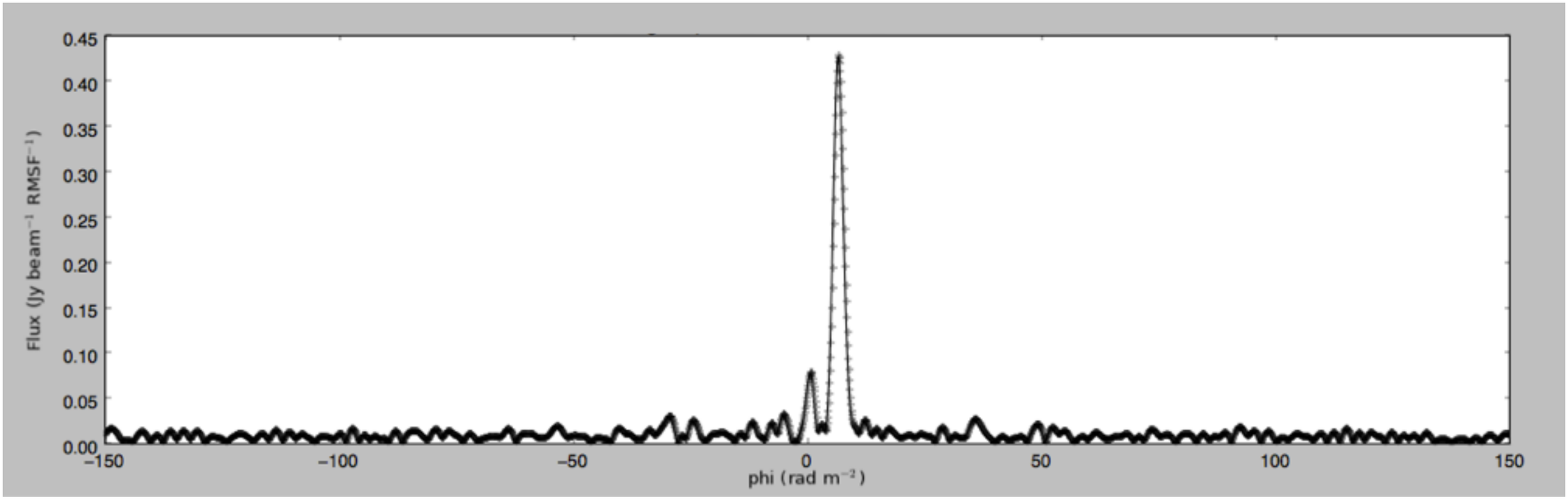


Diffuse Polarisation LOFAR (7 hr)

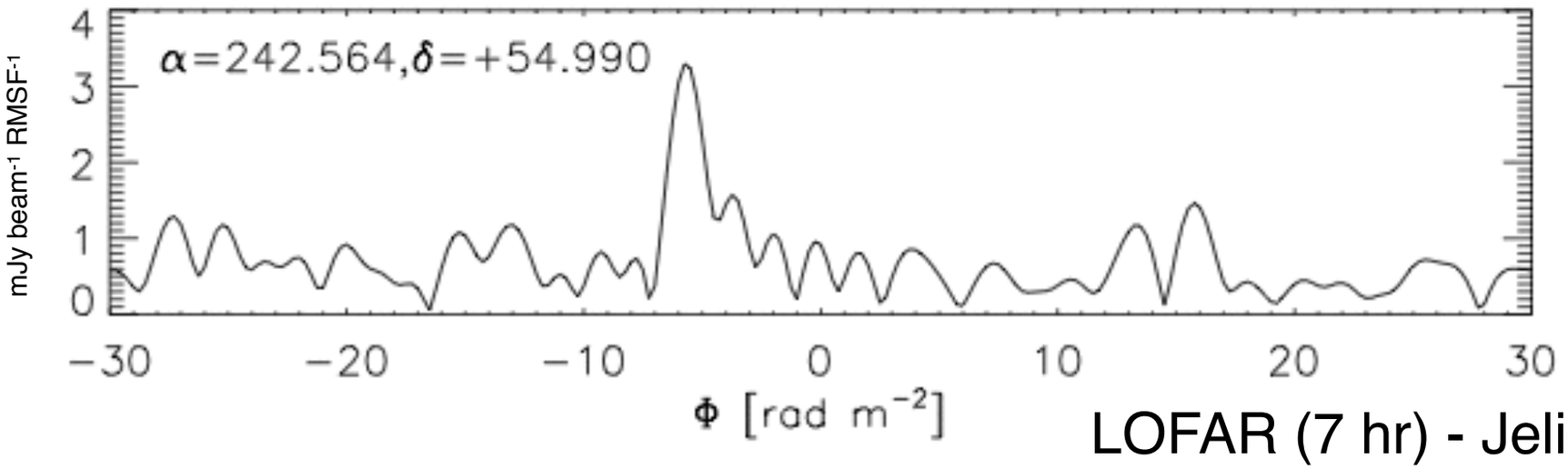


LOFAR (7 hr) - Jelić et al. 2014

Diffuse P - LOFAR vs MWA

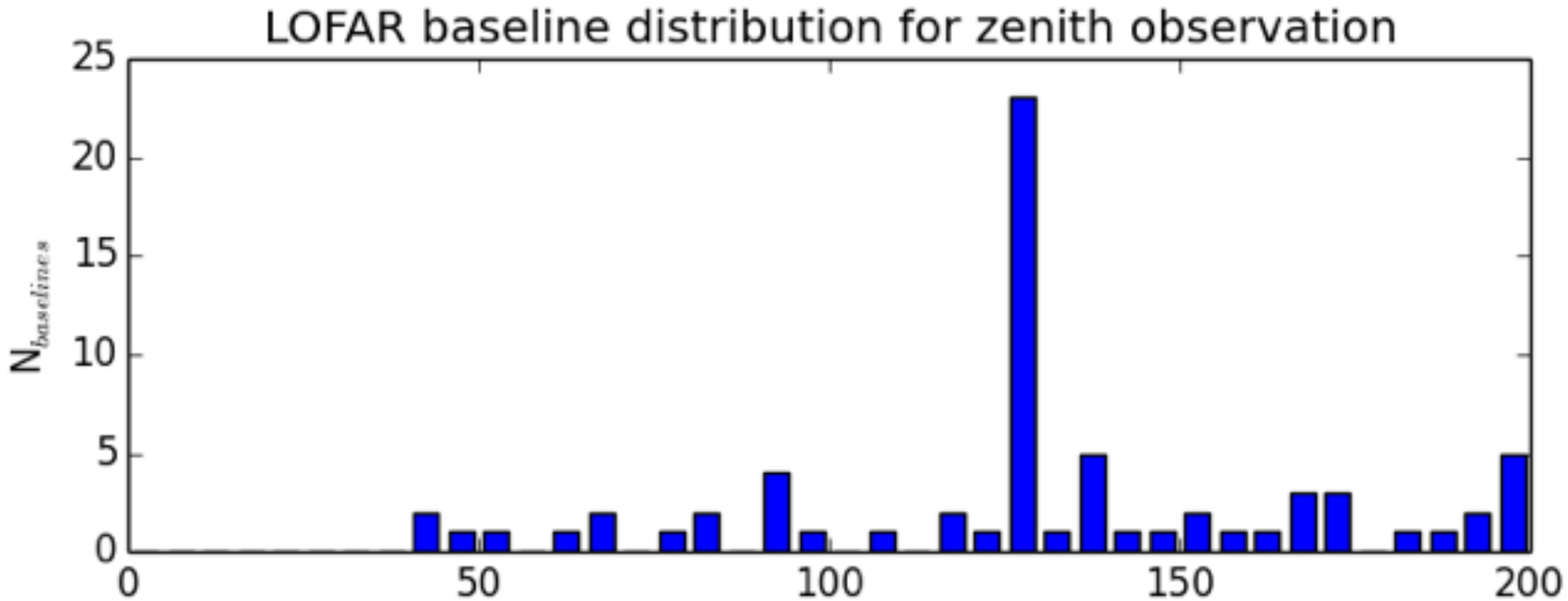


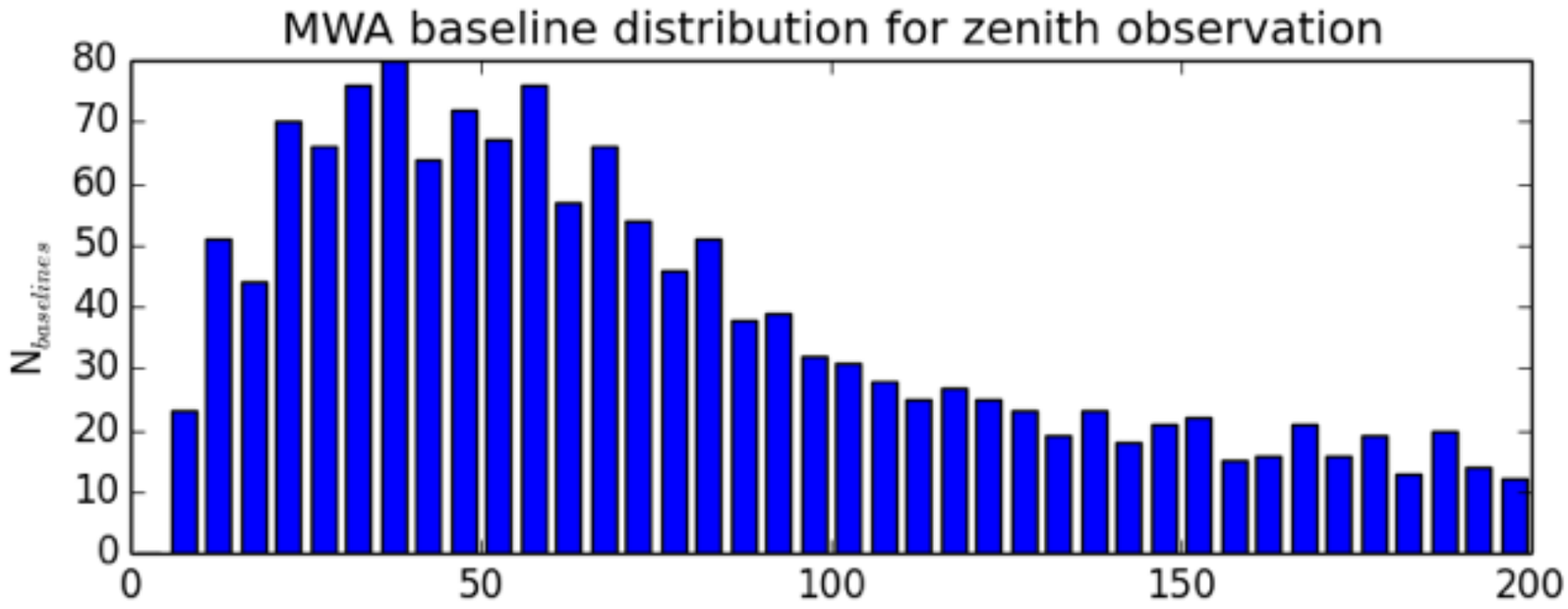
MWA (2 min)



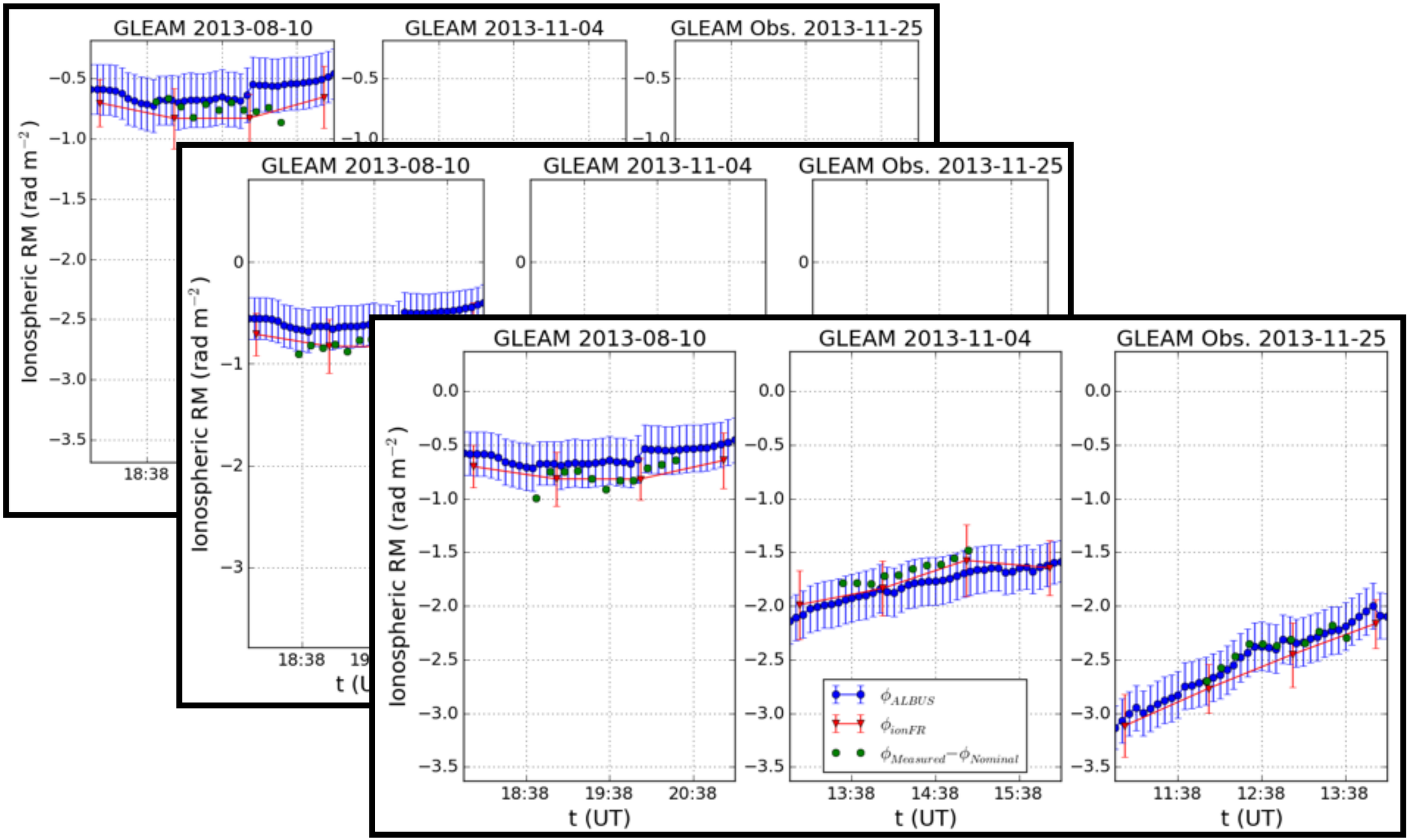
LOFAR (7 hr) - Jelić et al. 2014

LOFAR vs MWA


LOFAR baseline distribution for zenith observation
$N_{baselines}$
0
5
10
15
20
25
0
50
100
150
200


MWA baseline distribution for zenith observation
$N_{baselines}$
0
10
20
30
40
50
60
70
80
0
50
100
150
200

Mapping the ionosphere?



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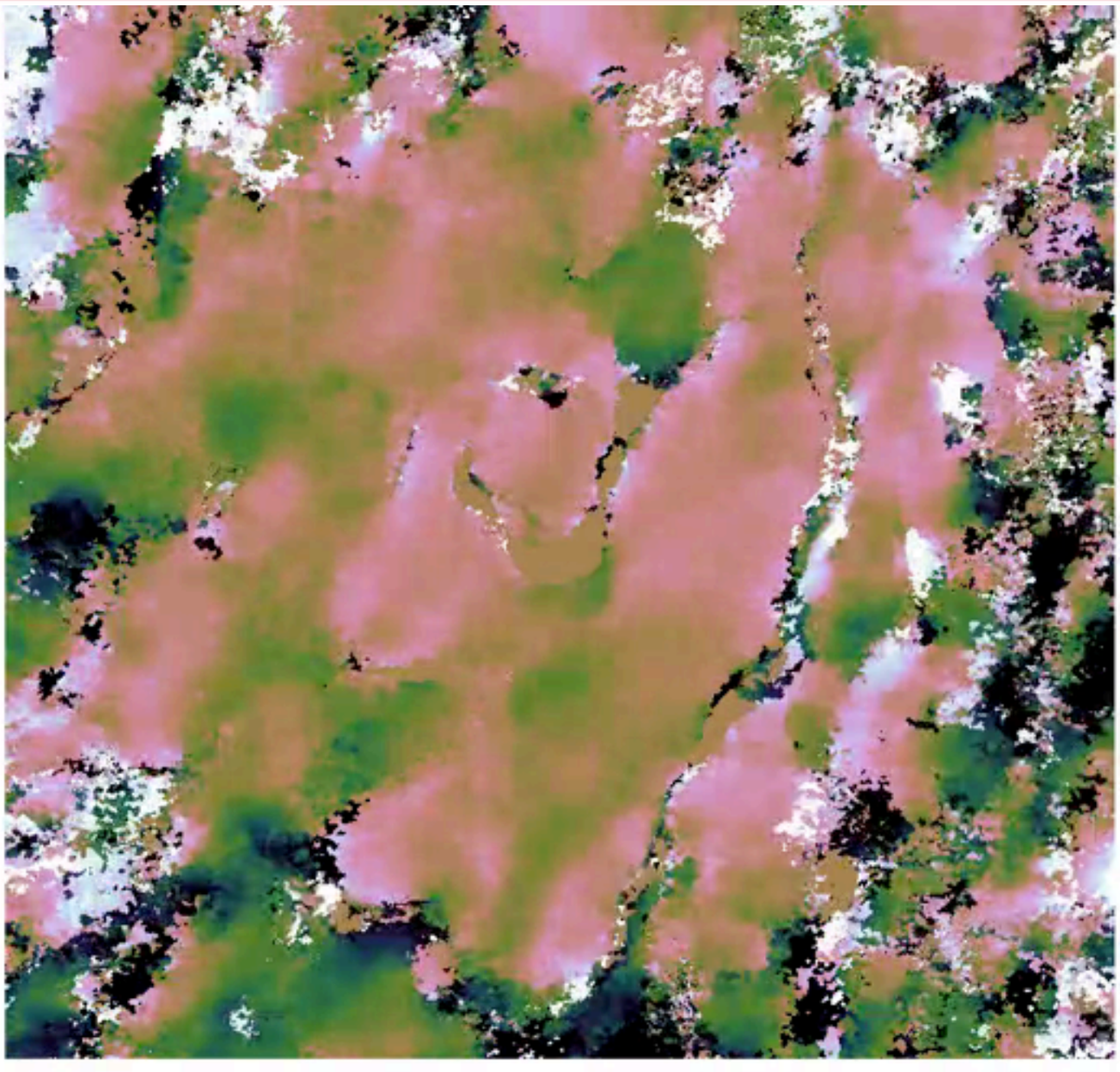
Mapping the ionosphere?



Snapshot RM maps cross-correlated with a single reference snapshot

Things that make you go grr!

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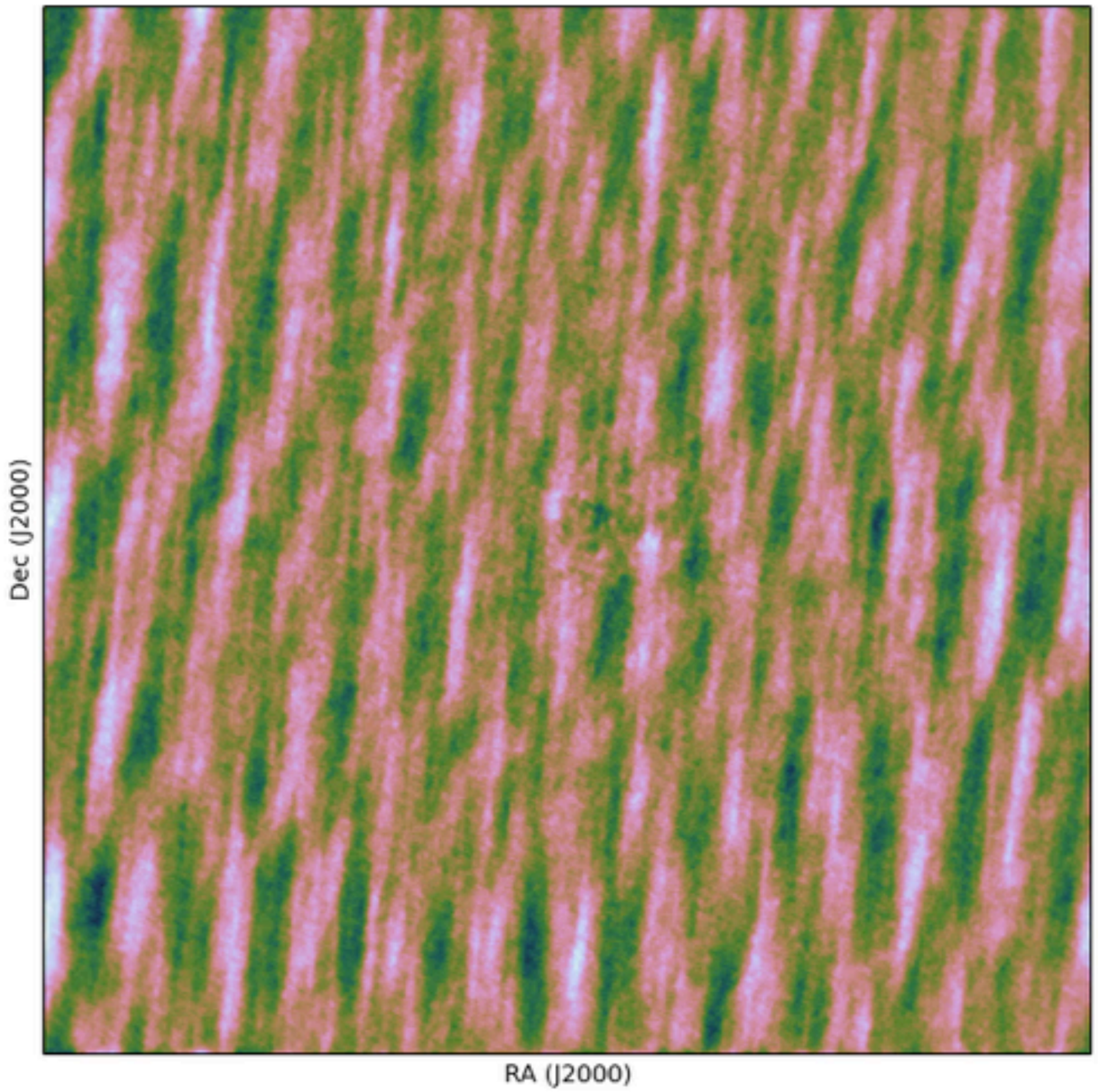
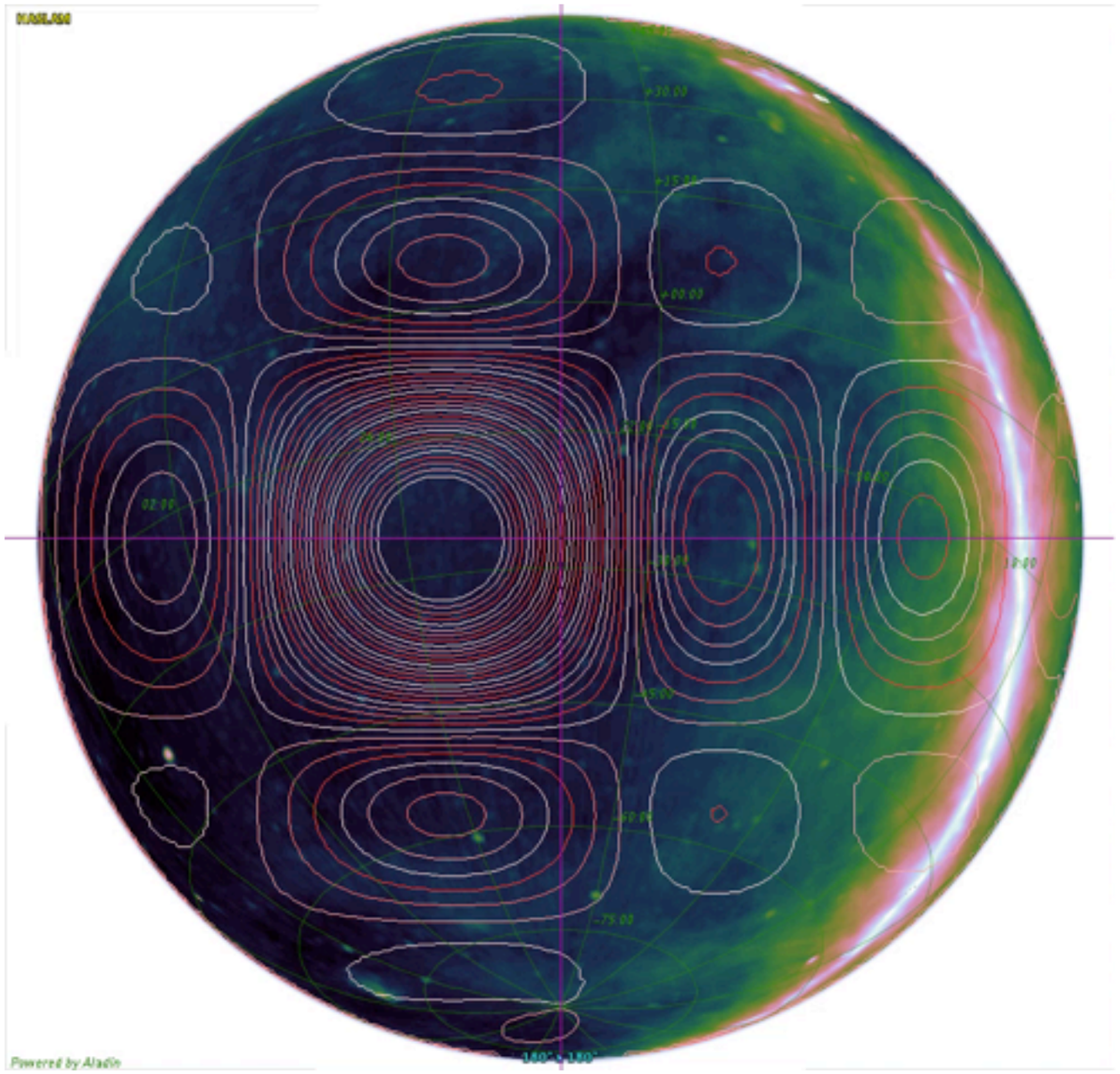
YY Full-sky Image (MWA)



YY Beam pattern (HASLAM map)



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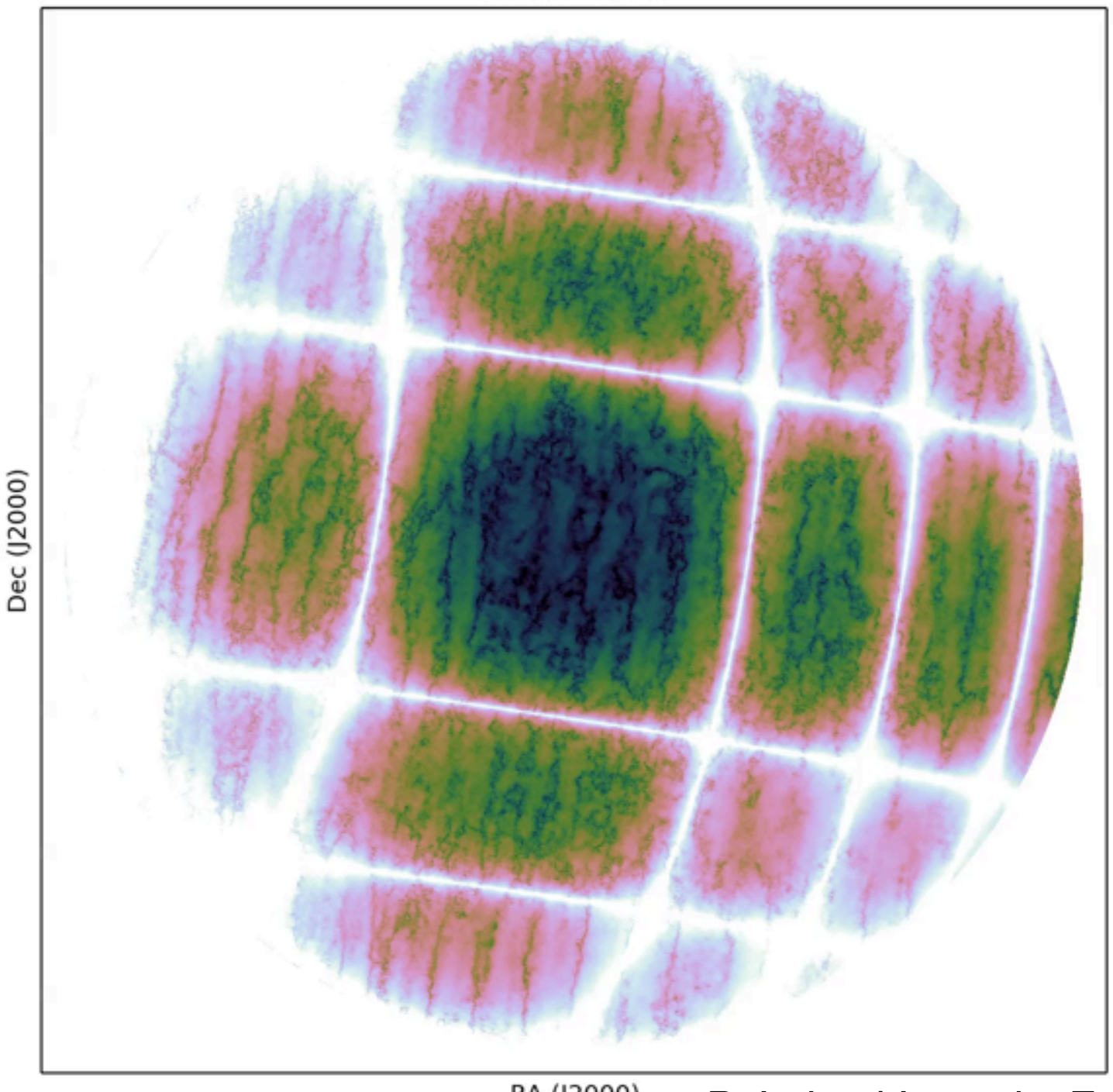
Things that make you go grr!



Polarised Intensity Full-sky Image (MWA)

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Extended MWA opportunities

Compact configuration
- diffuse galactic polarisation
- ionospheric studies
- foreground CMEs?
- EoR foreground removal

Extended configuration
- minimise beam depolarisation
- extragalactic polarisation

More tiles
- improved sensitivity
- imaging with shorter cadences
- improved PSF behaviour
- improved beam characterisation

Extended MWA opportunities

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Lower frequency bands
- EoR foreground removal
- ionospheric studies
- diffuse galactic polarisation

Higher frequency resolution
- reduced bandwidth depolarisation
- potential to study high RM sources?

Improved Signal Path
- Improved RMSF
- Improved sensitivity

Wider bandwidth
- Improved RMSF?
- Improved sensitivity

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Extended MWA wish-list

Higher frequency bands
- depolarisation reduced
- SNR
- extragalactic sources
- frequency overlap with other observatories

Improved GPS data
- Ionospheric studies
- Ionospheric corrections

Improved beam response
- reduce side-lobe effect
- reduce leakage

‘Shirtfronting’ the competition?

- The MWA has unique capabilities for diffuse polarisation studies.
- It is worth exploiting this capability in future.
- Proposed extensions to the MWA will all generally result in opportunities for polarisation science.
- … once a few challenges are overcome.