MSSS polarisation update

David Mulcahy (University of Manchester)
George Heald (ASTRON) & the MSSS Polarisation Team

LOFAR

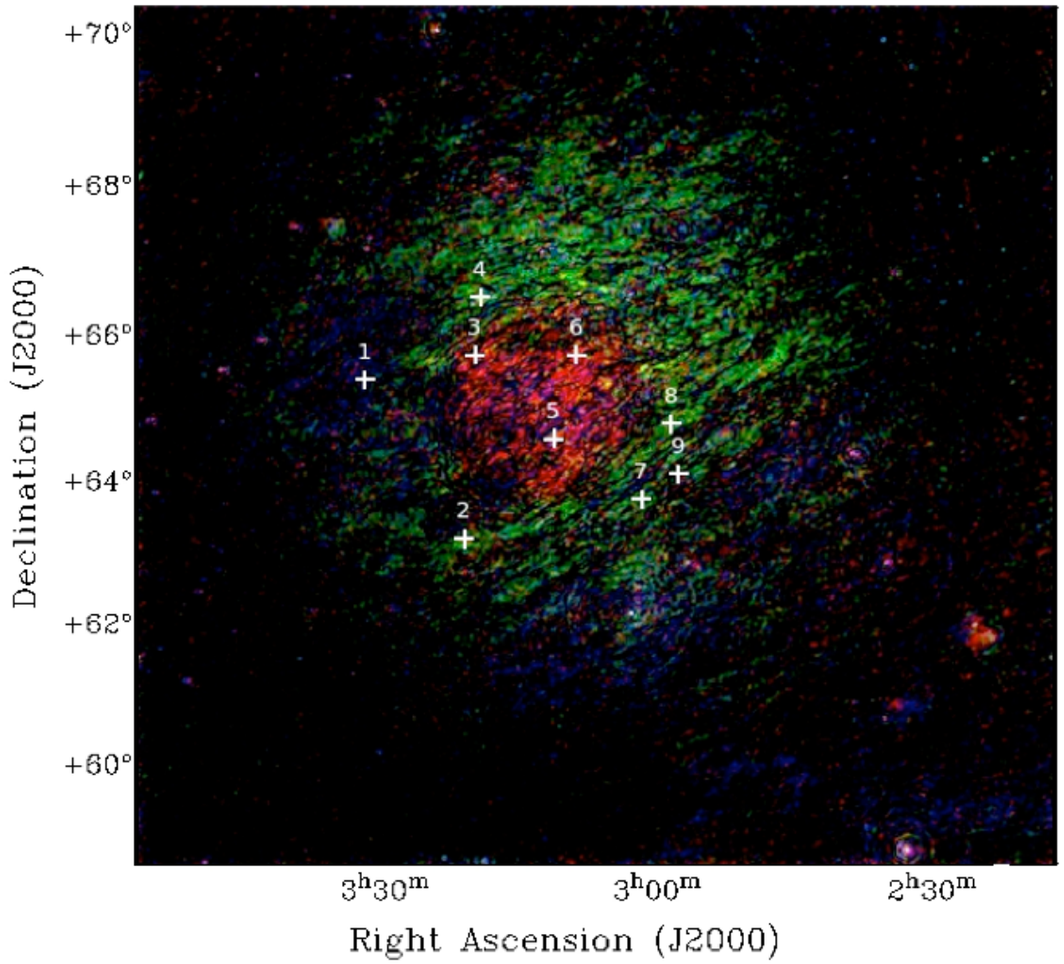
MANCHESTER 1824
The University of Manchester

Why perform an all sky polarisation survey?

Should be possible to identify and catalog discrete structures such as magnetic bubbles or synchrotron screens.

Hope to extract properties of the halo magnetic field from the diffuse synchrotron emission.

Allow for the study of a very large area of the Galactic halo including the disk-halo transition.

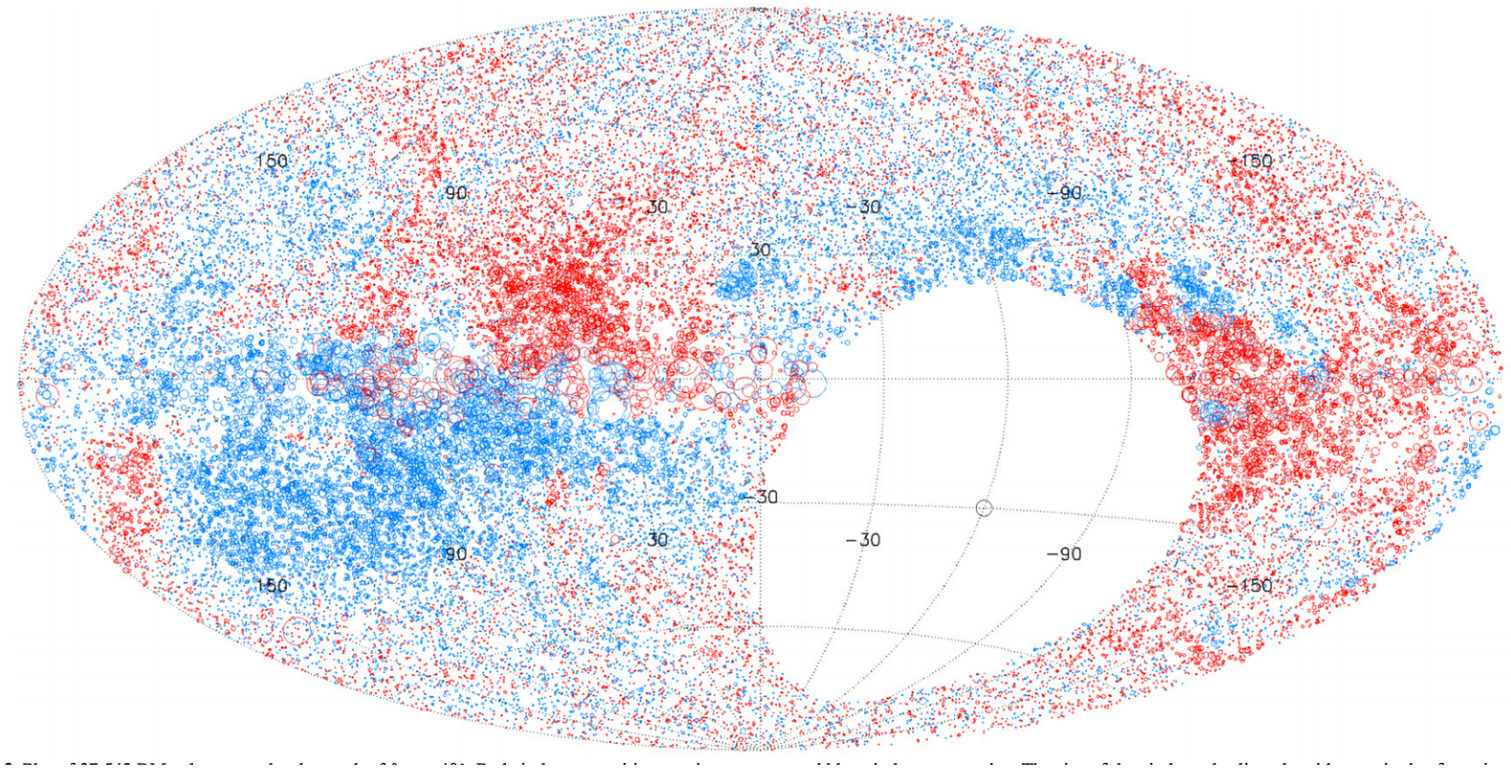


Iacobelli et al. 2013

Why perform an all sky polarisation survey?

- RM grid of the entire sky enable us to learn more about the Galactic magnetic field.

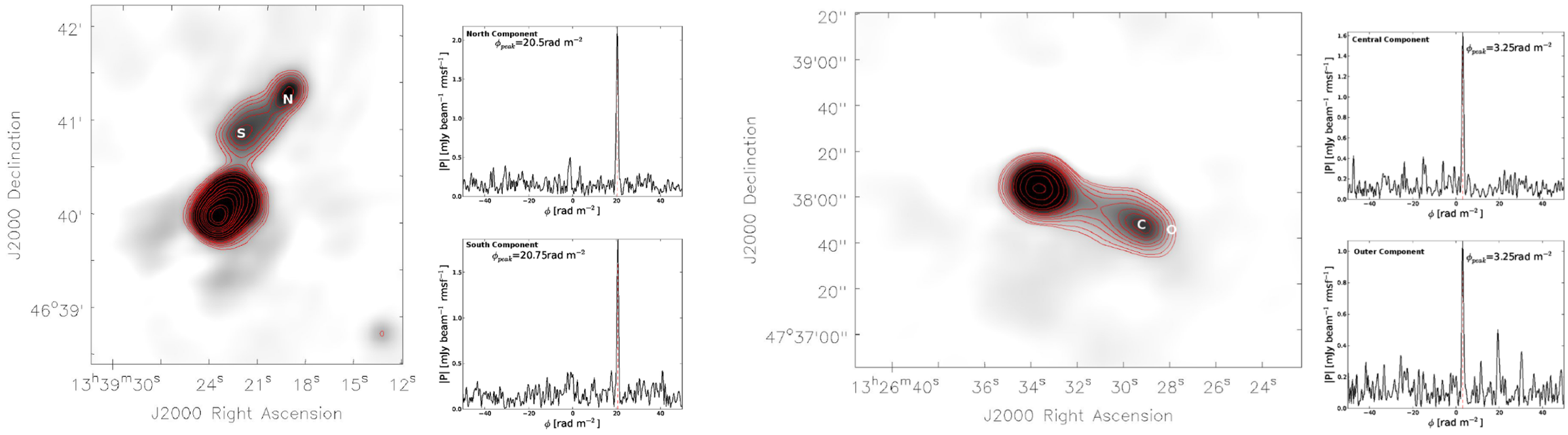
- RM grid in the direction of the Great Wall aiming at studying the intergalactic magnetic field.



Taylor et al. (2009)

Why perform an all sky polarisation survey?

Extragalactic sources - Radio galaxies



Mulcahy et al. (2014)

Testing for MSSS polarisation

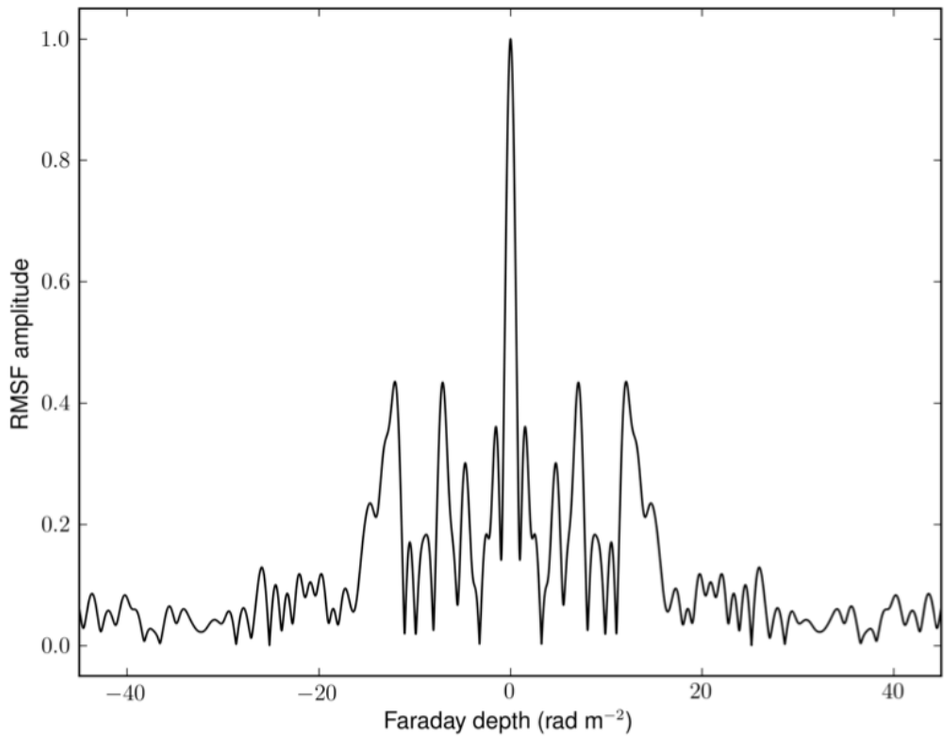
- FD resolution is approx 1.3 rad/m^-2

- Ideal for the recovery of small RM and thus weak magnetic fields

- Max scale is 330 rad/ m^-2

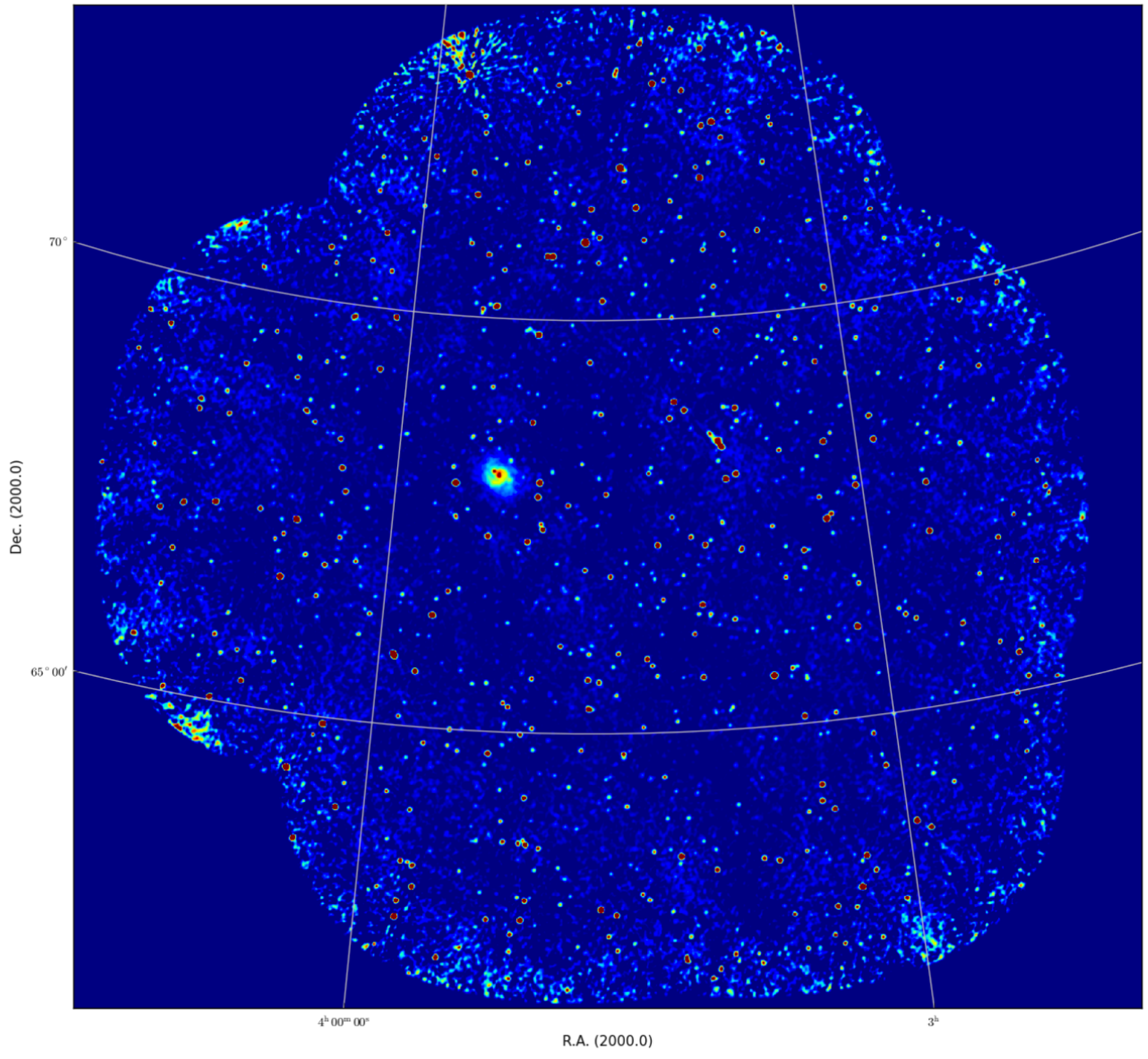
- In a mosaic, we see a rms noise of 1.1 mJy/beam in Stokes U & Q.

MSSS RMSF



Polarisation in the FAN Region

- 6 field mosaic of the fan region.
- Start with the 1 HBA field.



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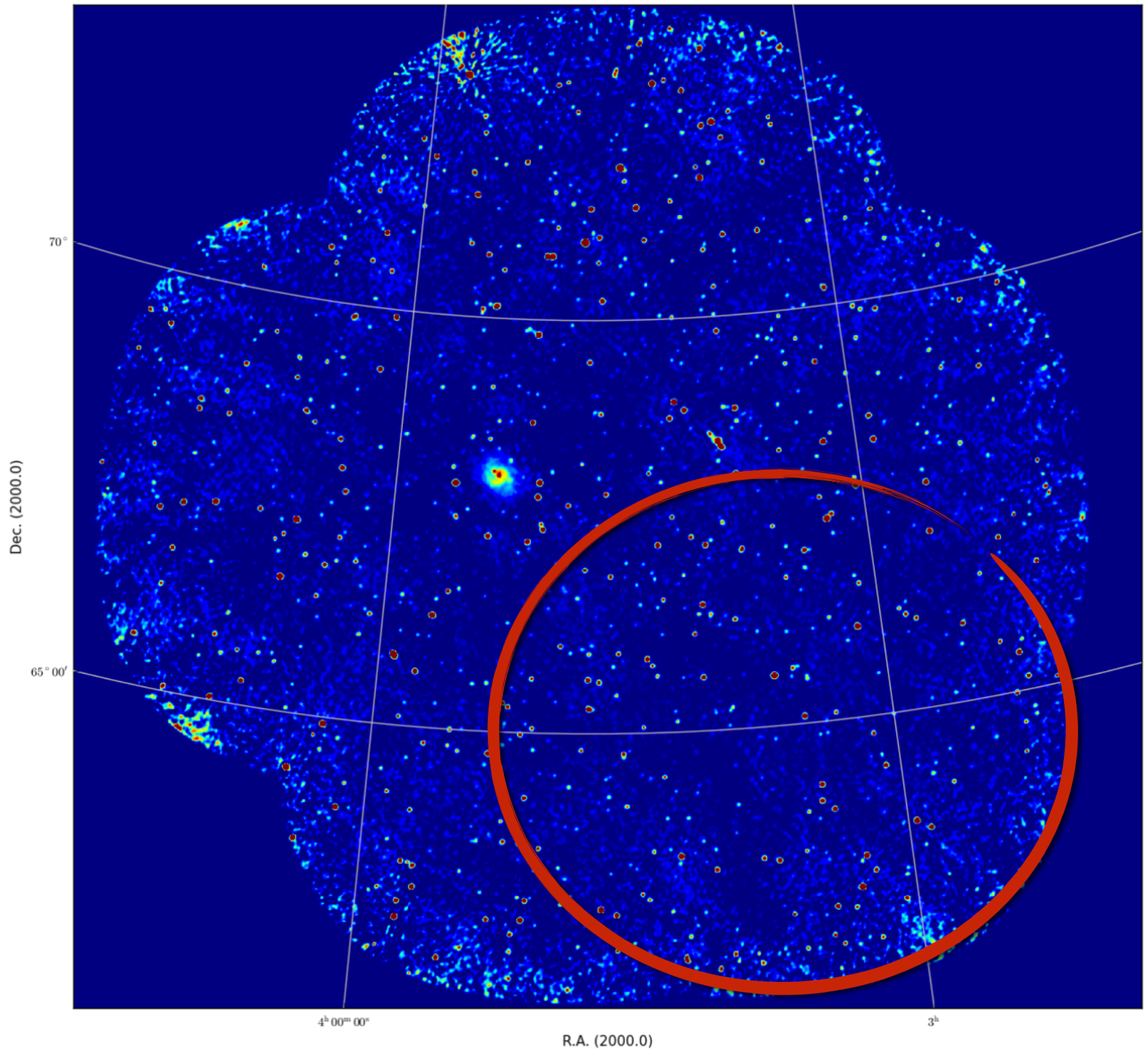


Polarisation in the FAN Region

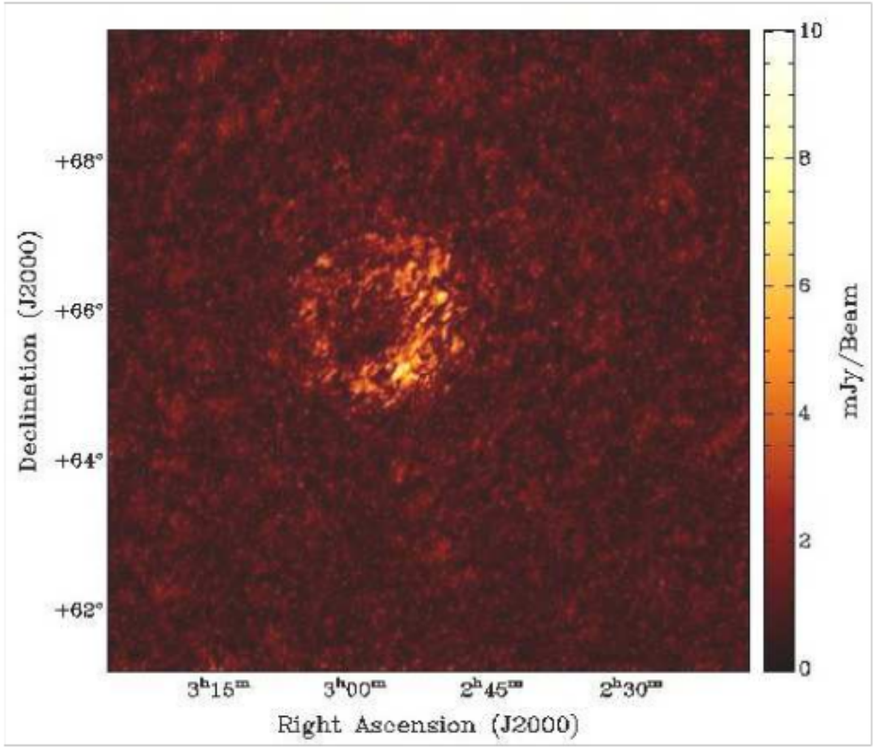
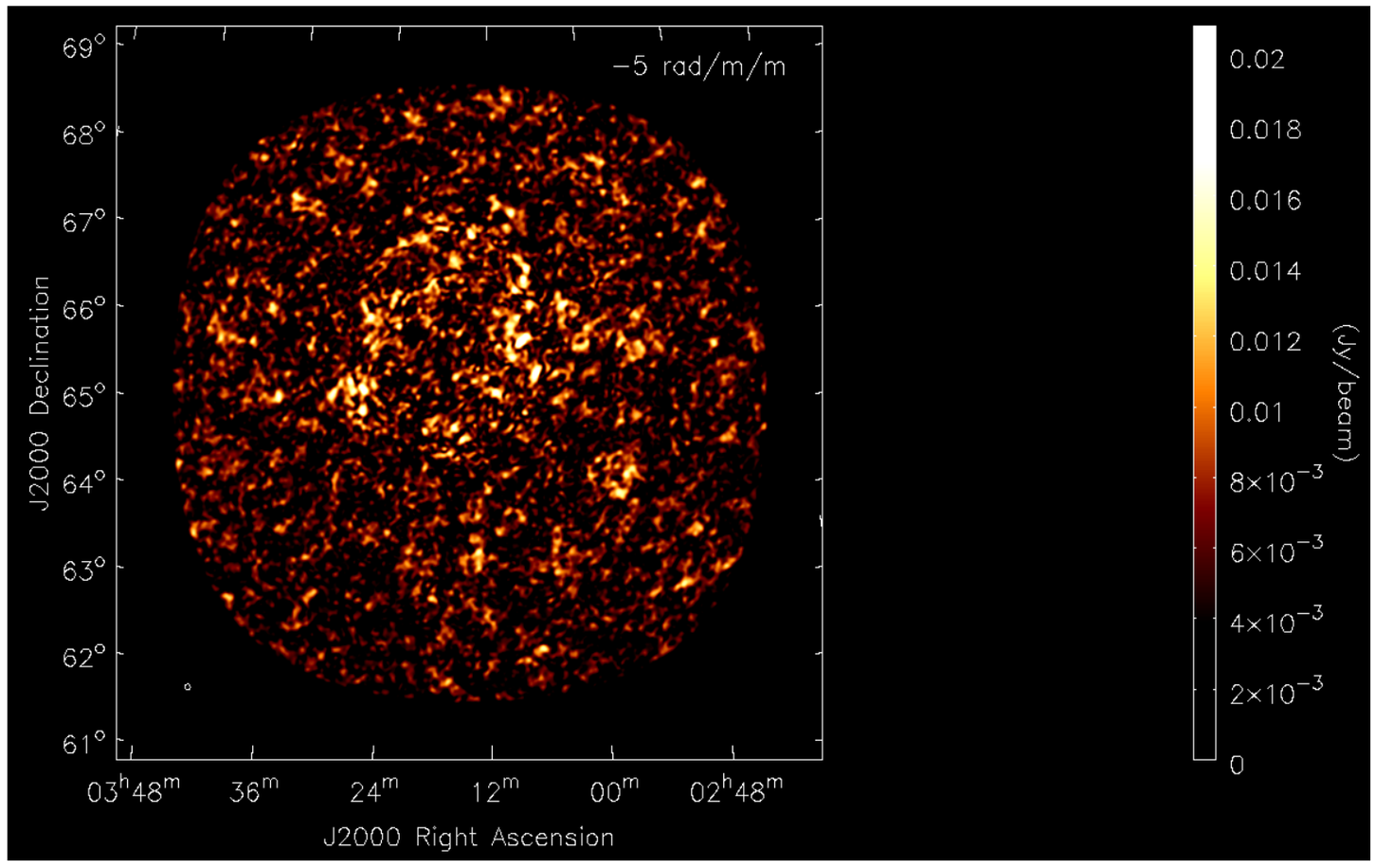


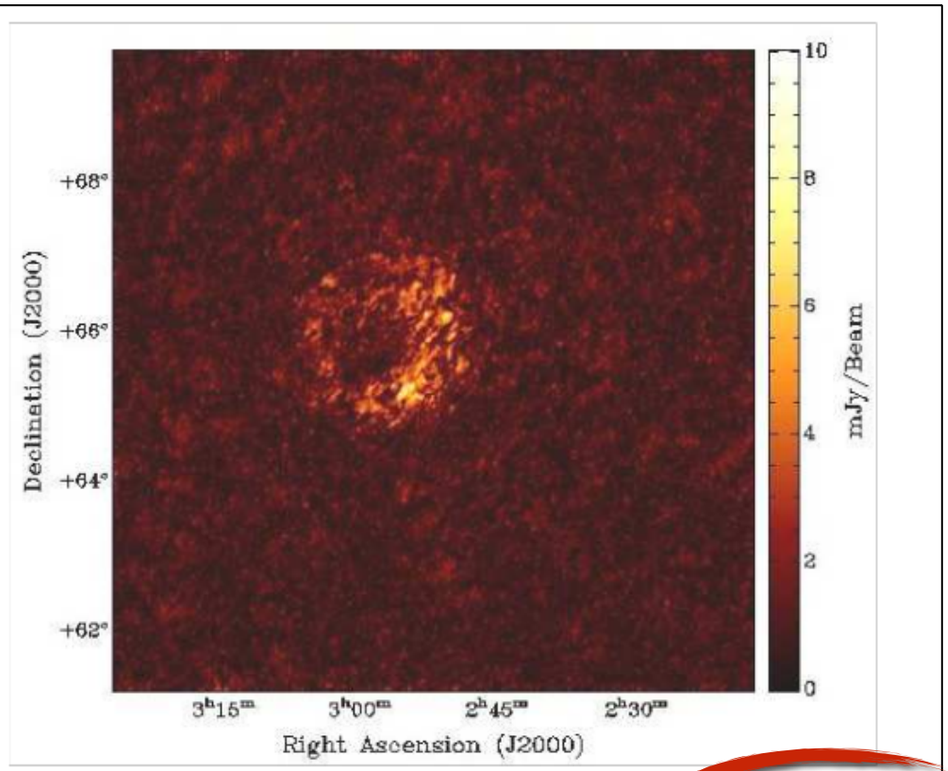
Fig. 7 Same as Fig. 6, but at Faraday depth -5 rad/m^2 (from Marco Iacobelli, University of Leiden, and the MKSP commissioning team).



Beck et al. 2013

Bubble component: a nearby (200pc) Stromgren Sphere

Polarisation in the FAN Region



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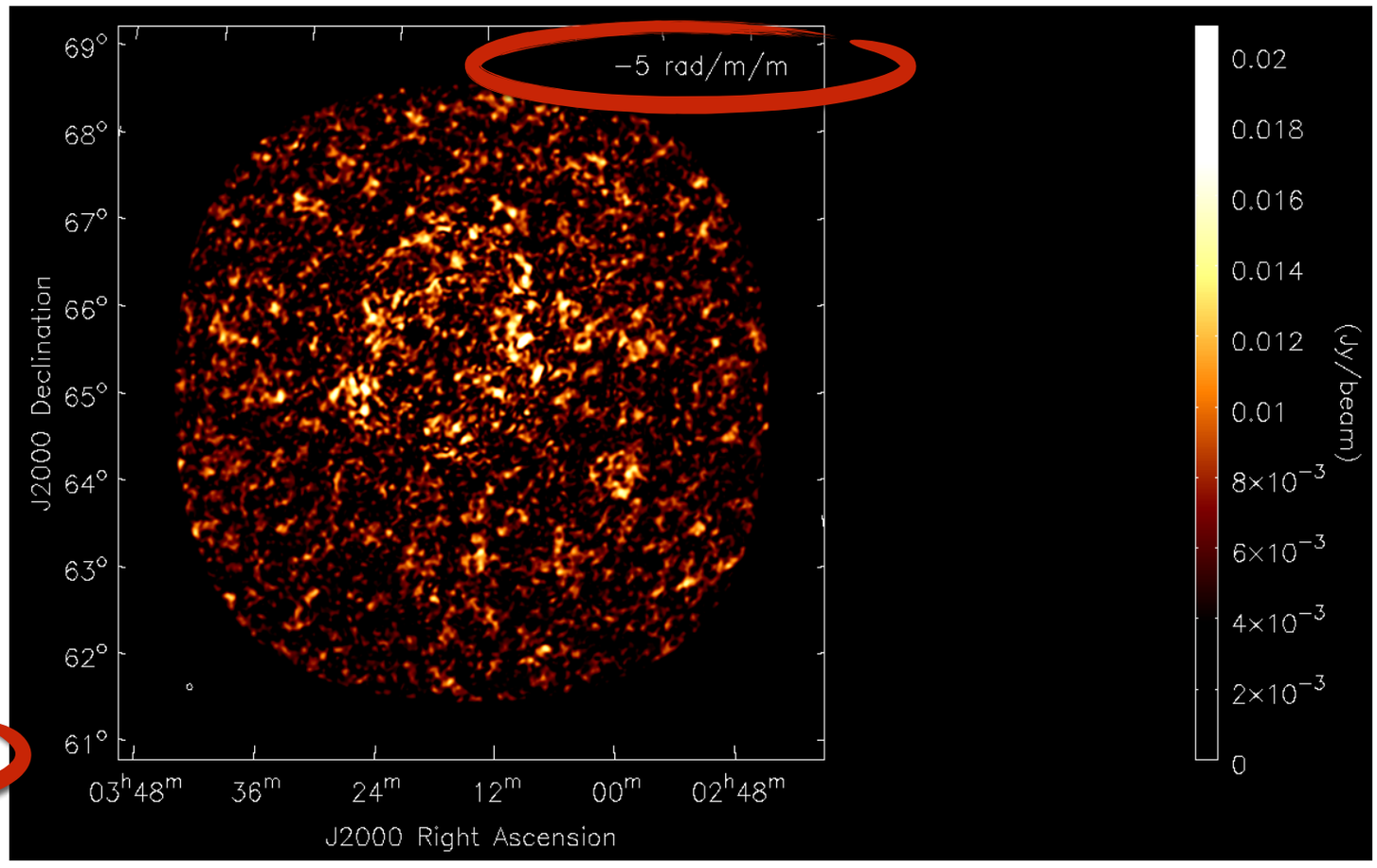

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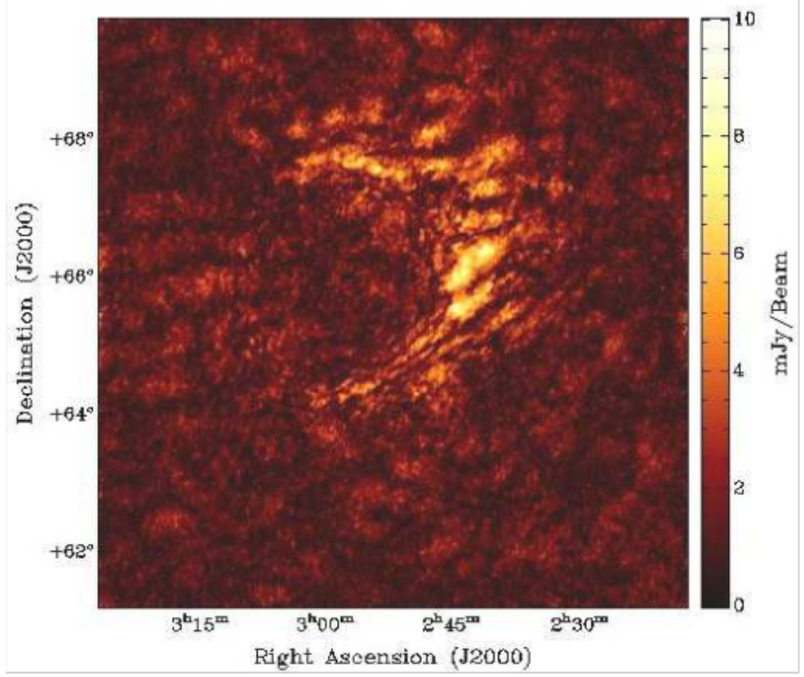
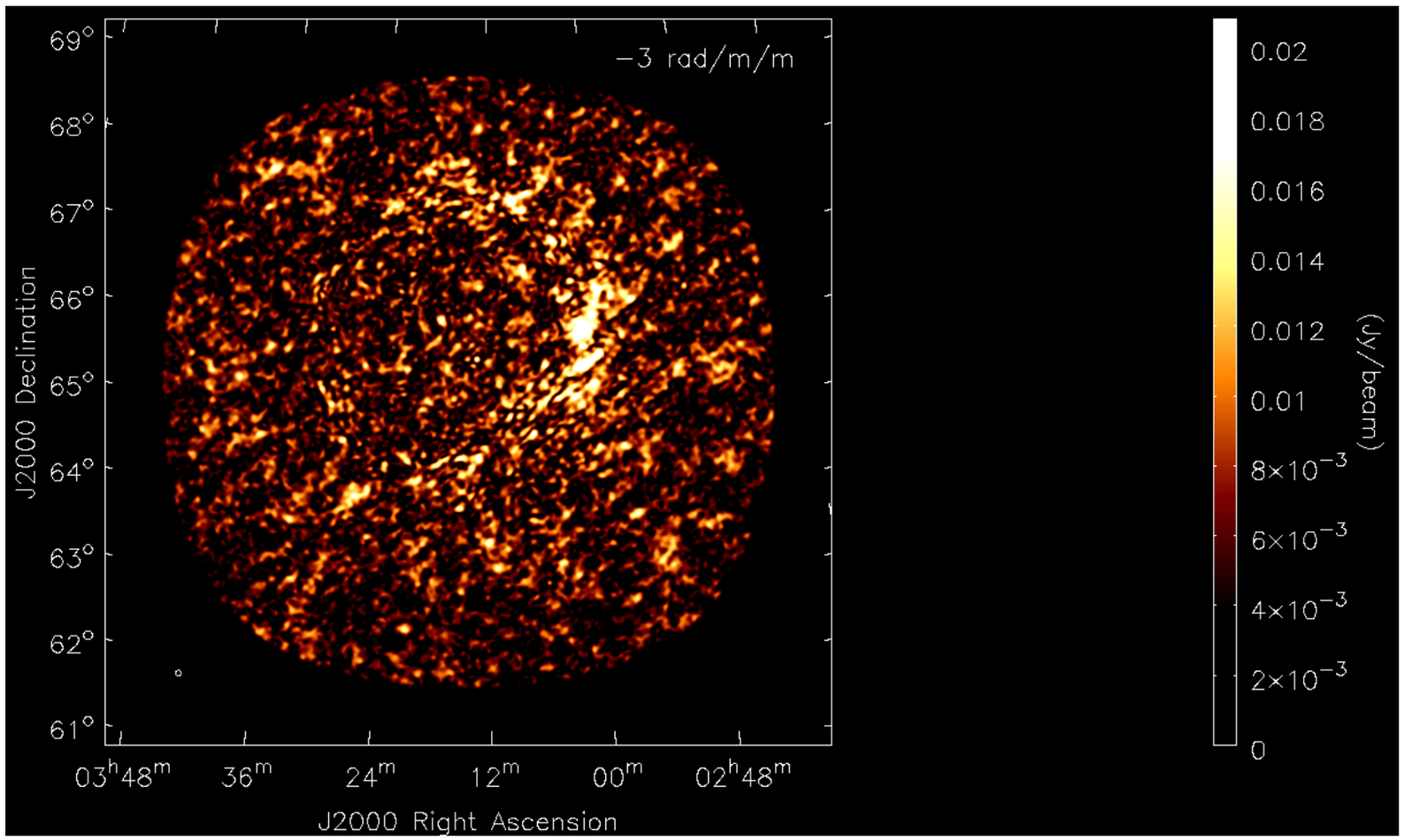


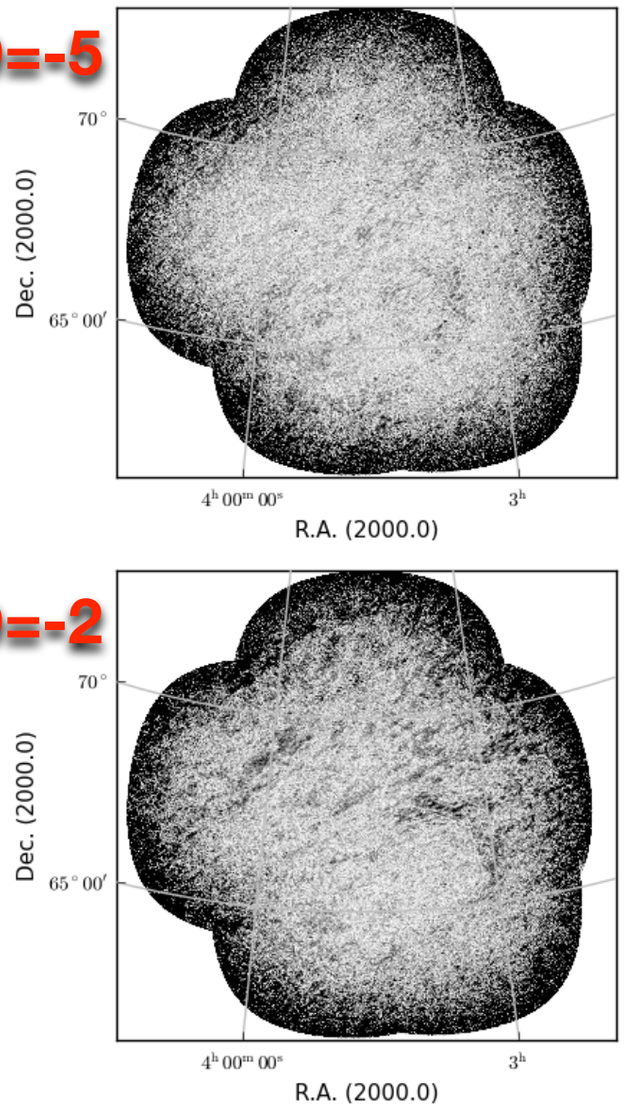
Fig. 6 A region of 15° x 15° in the "Fan" region of the Milky Way's plane centered at $l = 137°, b = +7°$ was observed with LOFAR at 110–174 MHz with 139″ x 126″ resolution. The polarized intensity of a slice through the Faraday data cube at Faraday depth -2 rad/m^2 is shown (from Marco Iacobelli, University of Leiden, and the MKSP commissioning team).



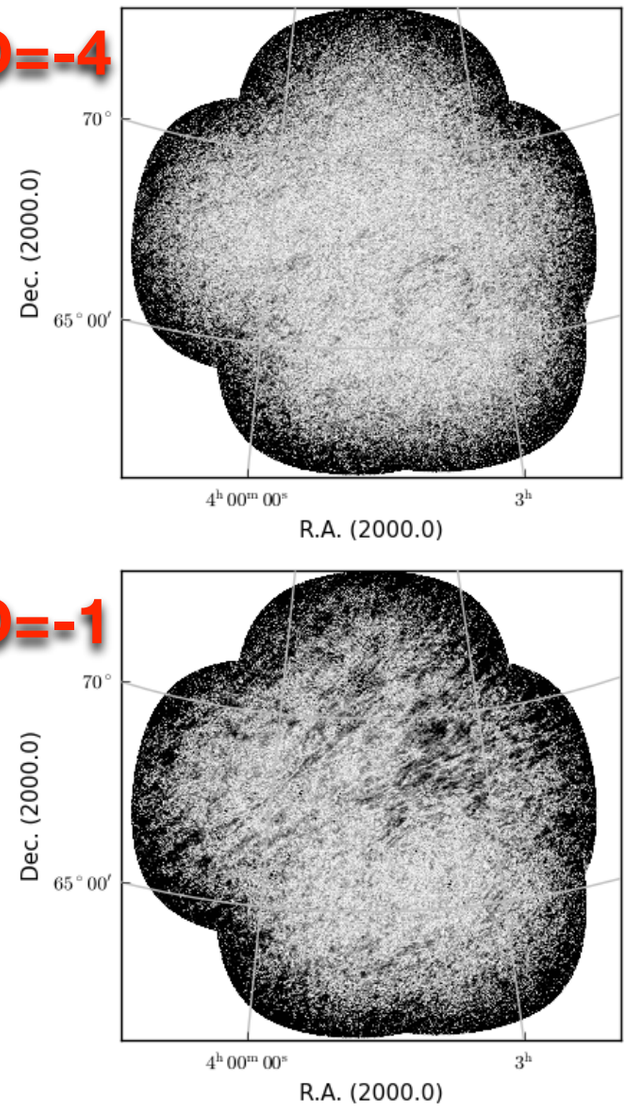
Beck et al. 2013

Ring' component: background Local Bubble (100pc)

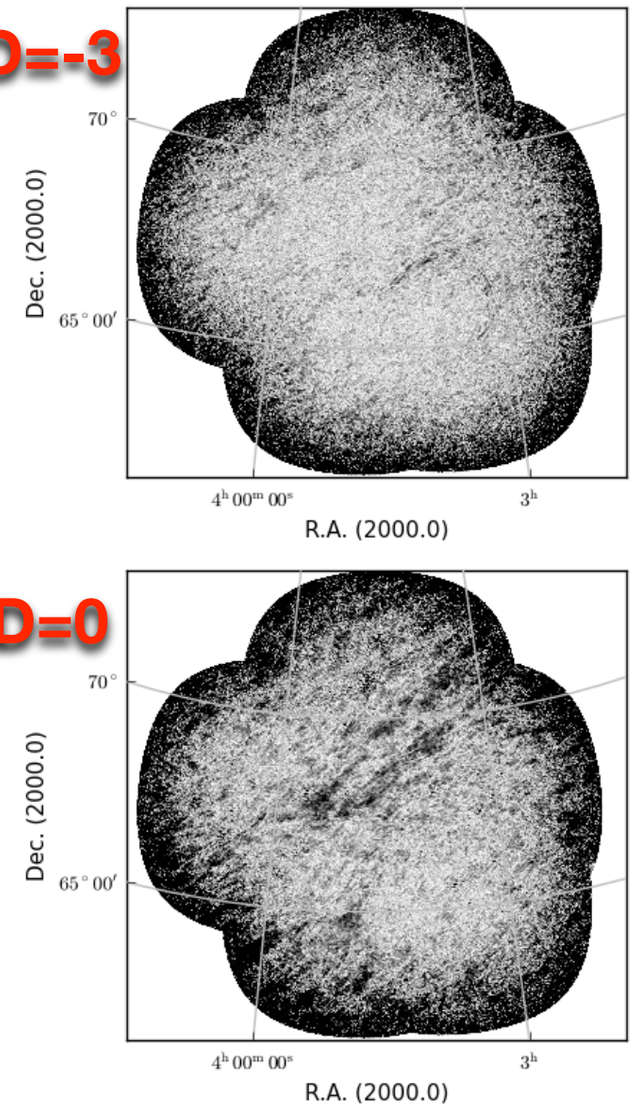
FD=-5



FD=-4



FD=-3

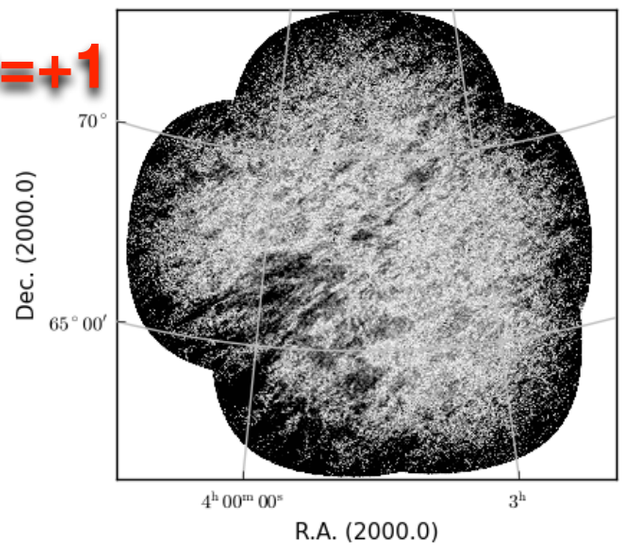


FD=-2

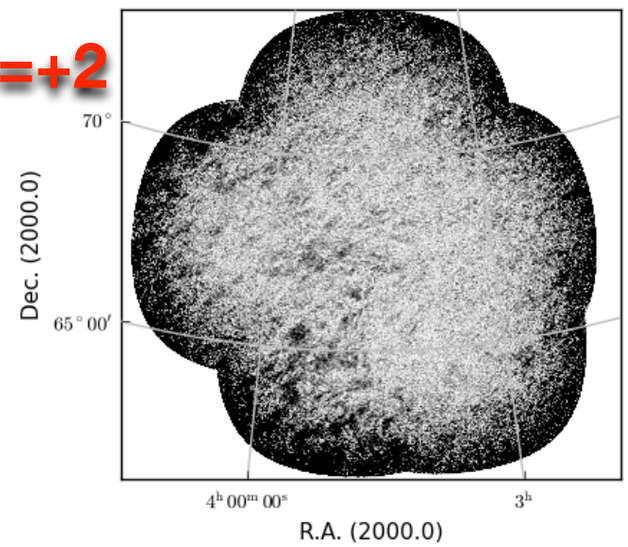
FD=-1

FD=0

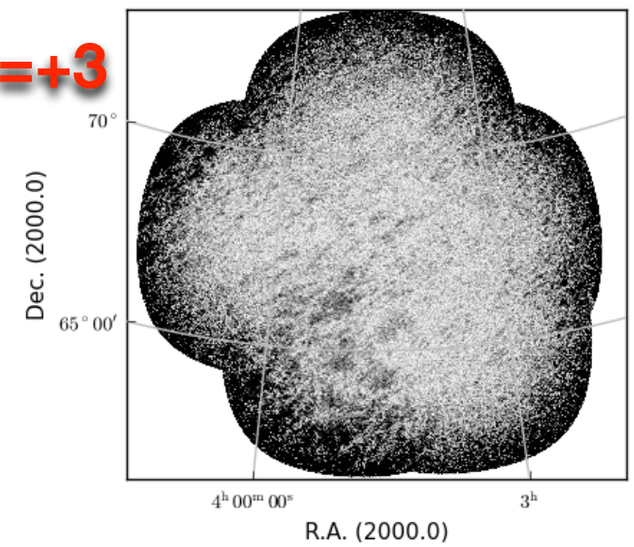
FD=+1

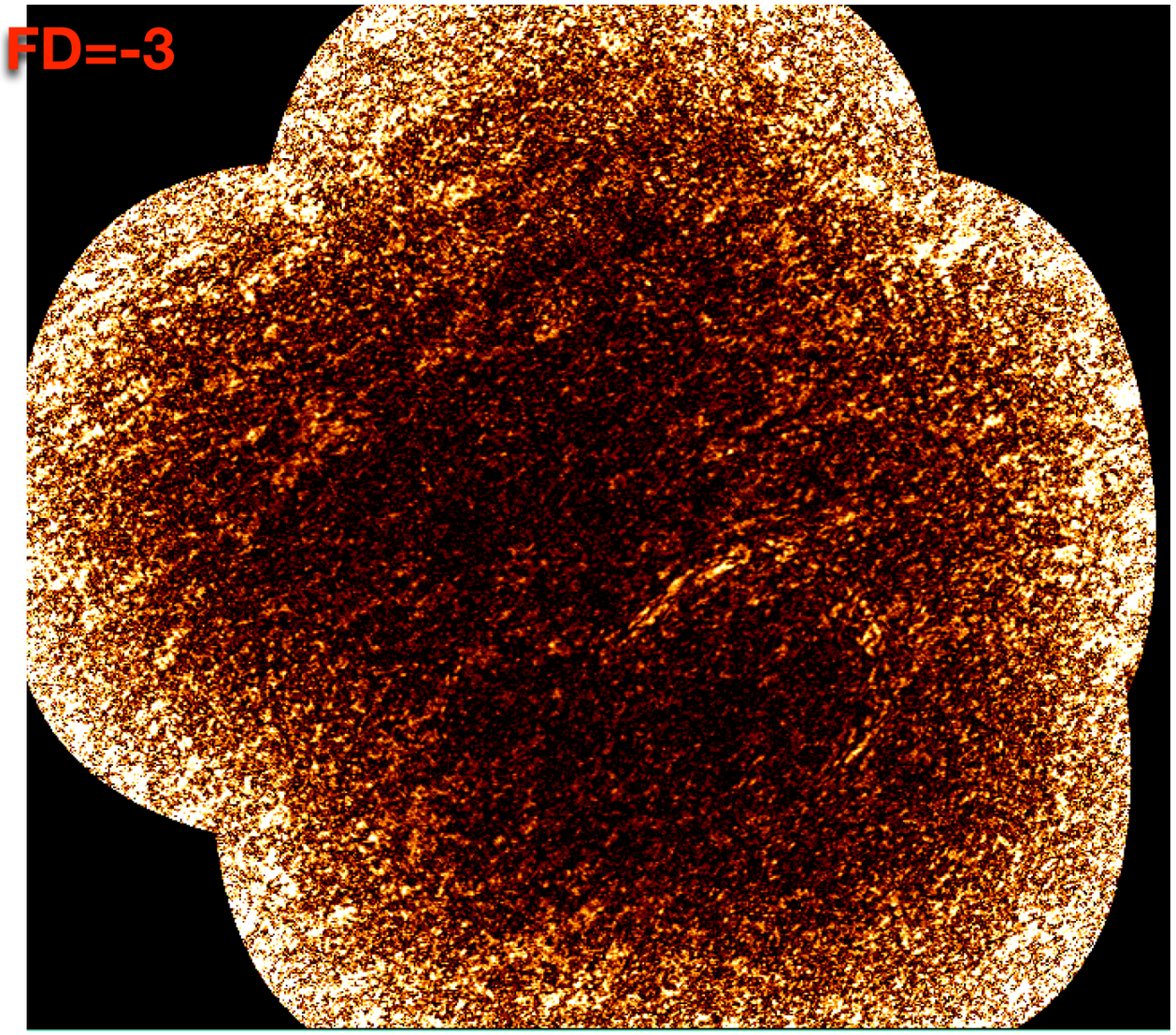


FD=+2



FD=+3

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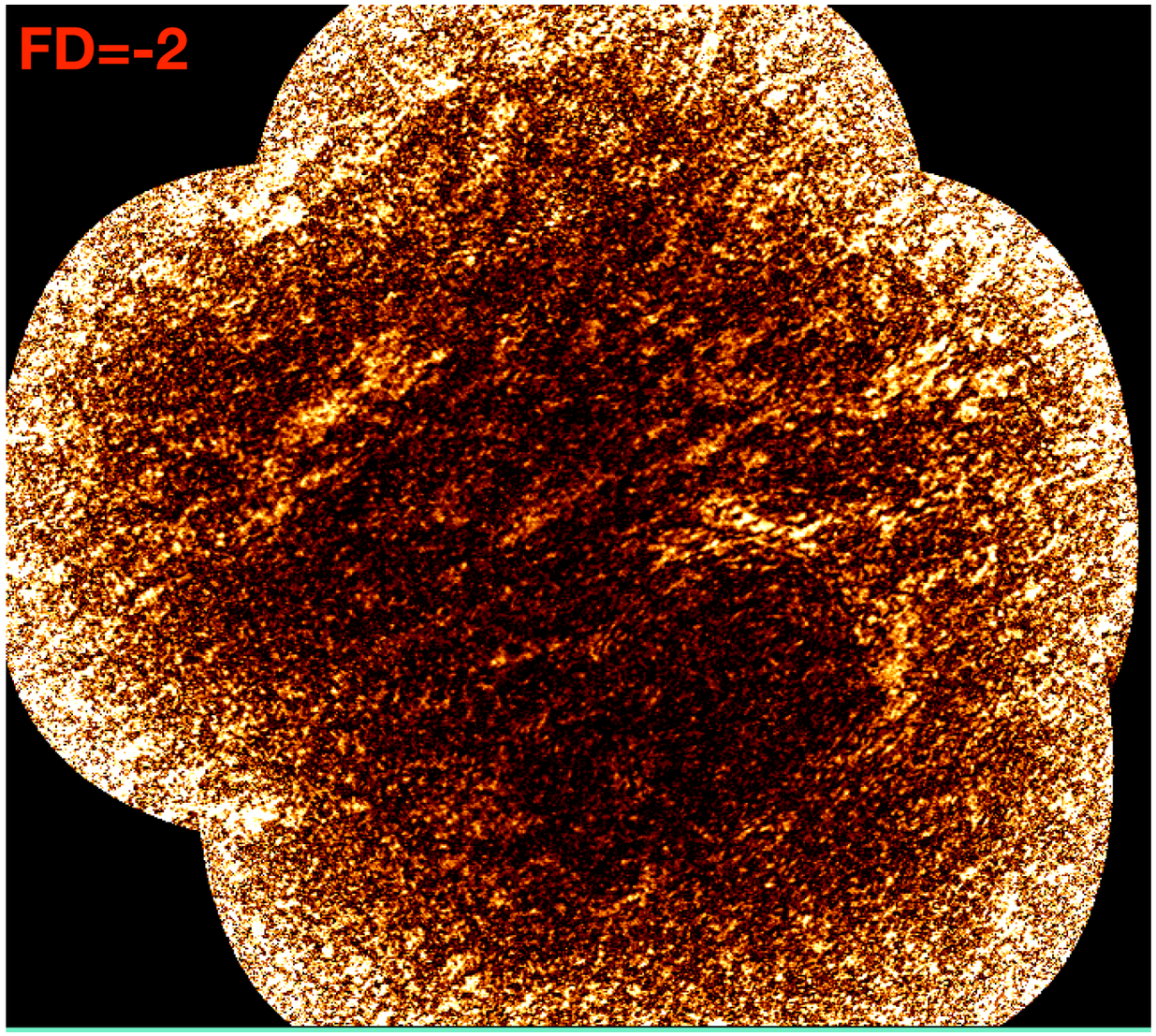
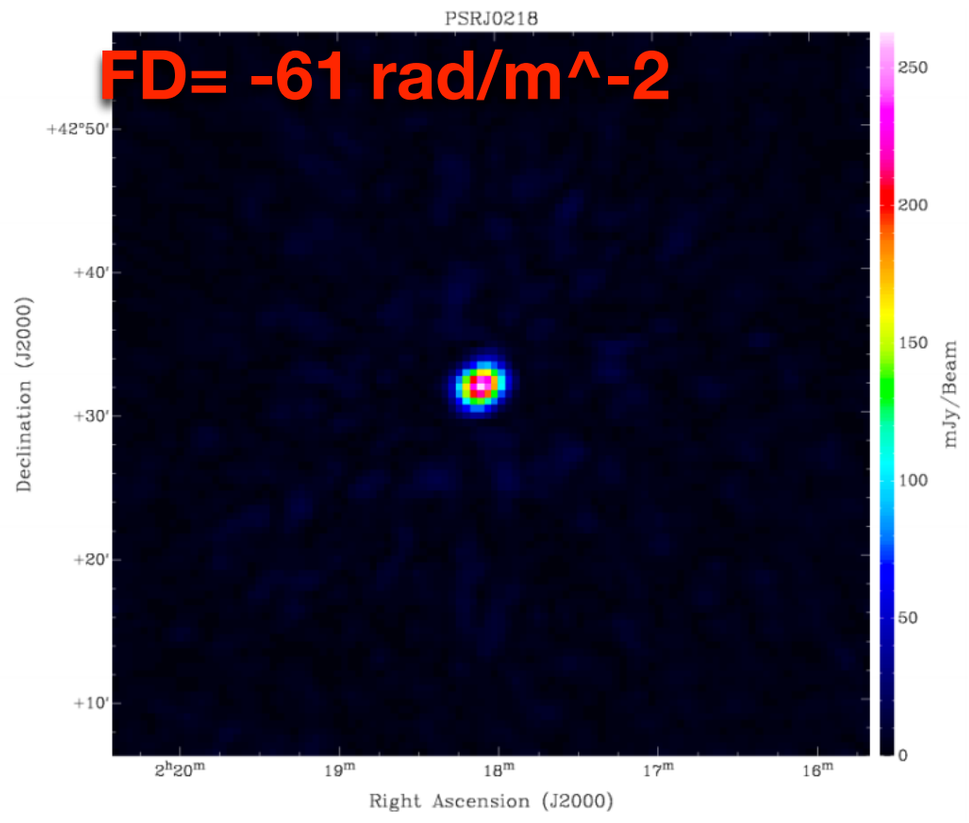
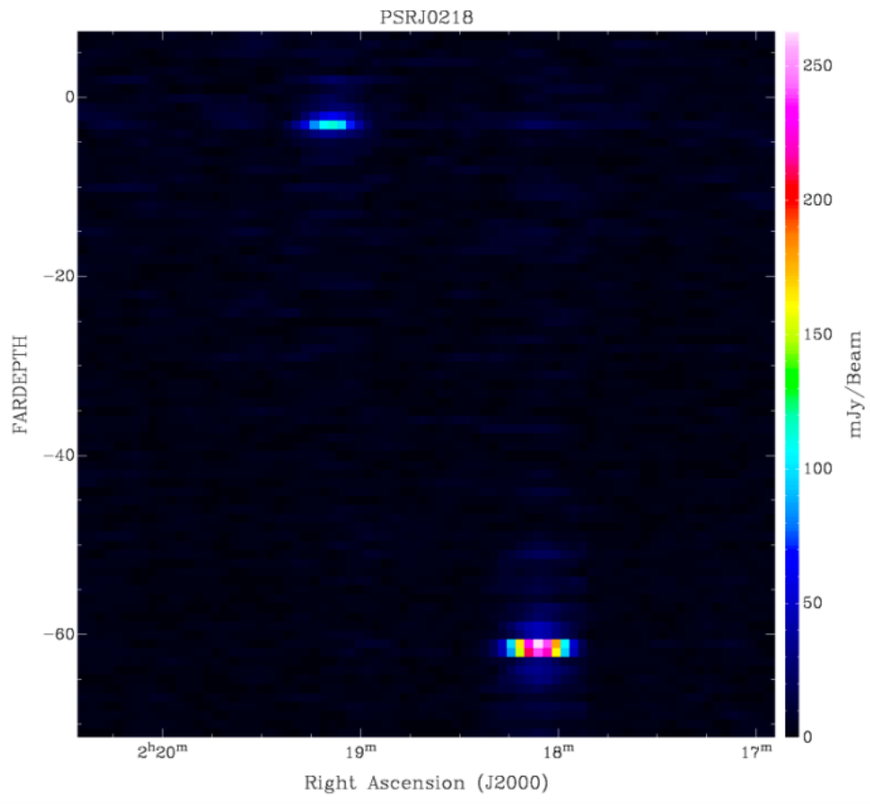

FD=-2

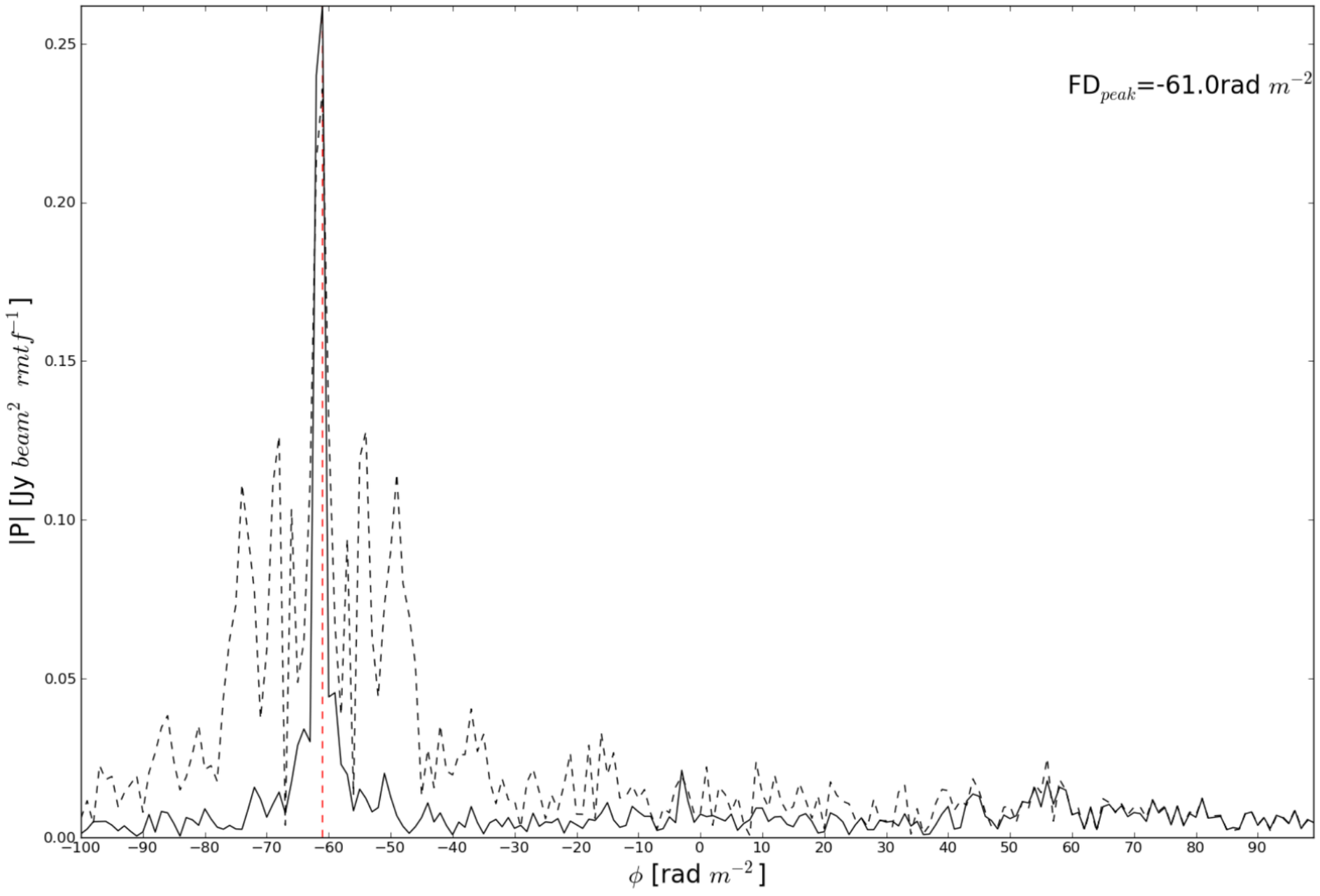
PSRJ 0218+4232
Polarisation Test



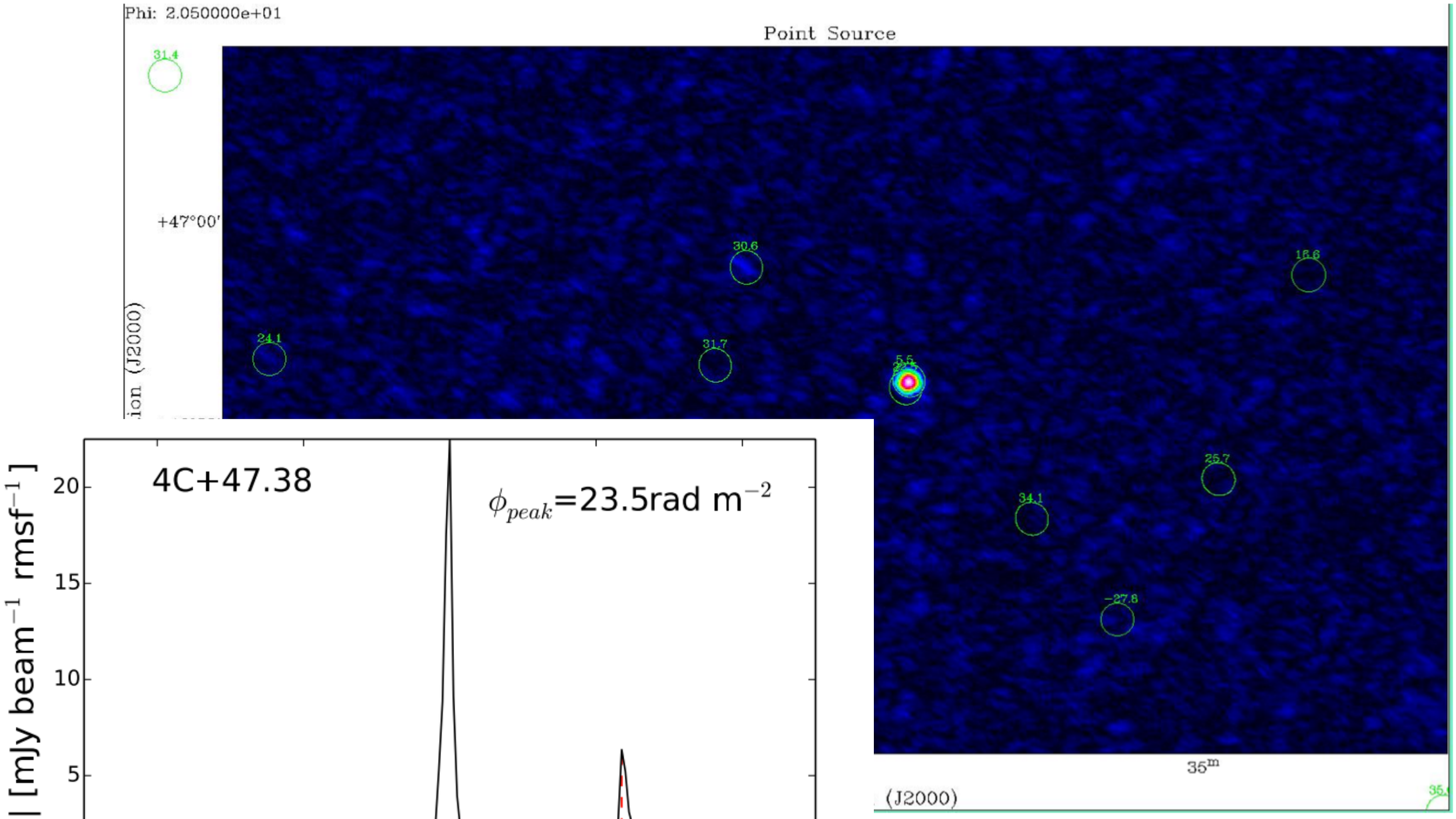


MSSS can give us the correct Faraday Depth when ionospheric correction is taken into account

PSRJ 0218+4232
Faraday Spectra



Would we be able to detect extra galactic sources?



Mulcahy et al. 2014

M51 observation(not MSSS)

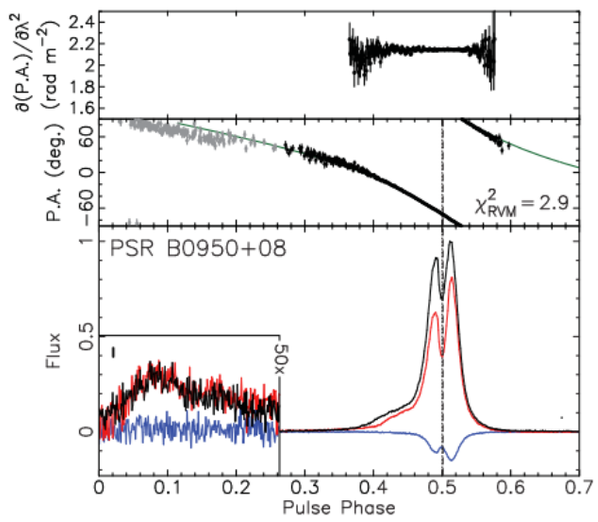
MSSS Polarisation Working Group

- Bjorn Adebahr—MPIfR
- Rainer Beck —MPIfR
- Annalisa Bonafede — Uni of Hamburg
- Justin Bray — Uni of Manchester
- Rene Breton — Uni of Manchester
- Alex Clarke — Uni of Manchester
- Emilio Enriquez — Uni of Nijmegen
- Francesco de Gasperian — Uni of Hamburg
- Martin Hardcastle — Uni of Hertfordshire
- George Heald —ASTRON
- Matthias Hoeft — Tautenberg
- Cathy Horellou — Chalmers
- Andreas Horneffer — MPIfR
- Marco Iacobelli — ASTRON
- David Jones — Uni of Nijmegen
- Henrik Junklewitz —Uni of Bonn
- Maijke Mevius — Uni of Groningen
- David Mulcahy — Uni of Manchester
- Anna Scaife — Uni of Manchester
- Charlotte Sobey — ASTRON
- Sarrvesh Sridhar — Uni of Groningen
- Valentina Vacca — MPA

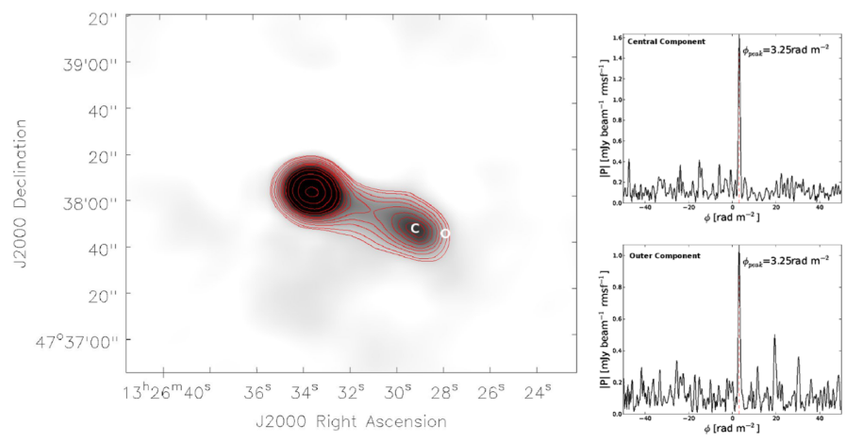
22-members
4 countries
3 different KSPs

A Sample of Science Aims

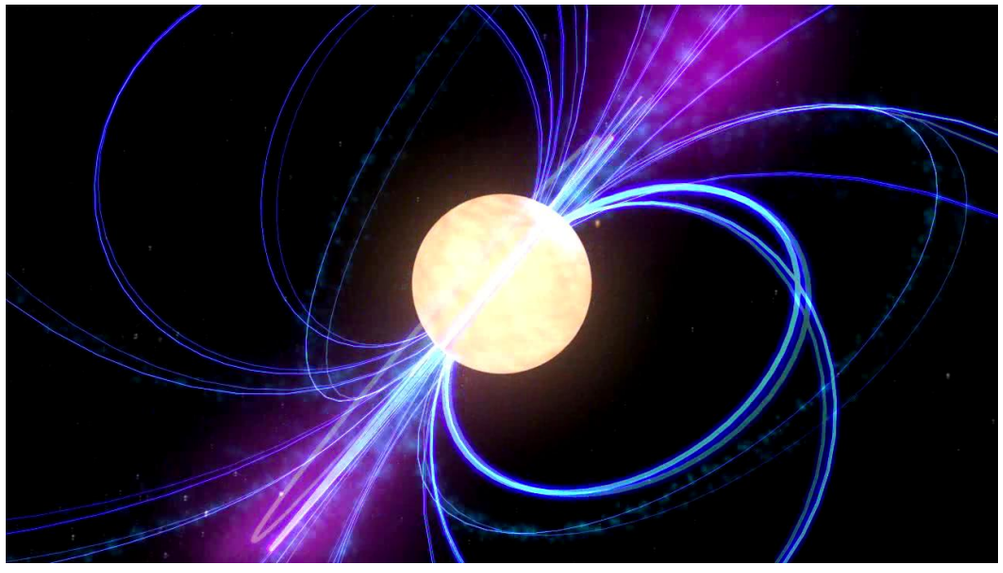
Accurate RMs of MSPs



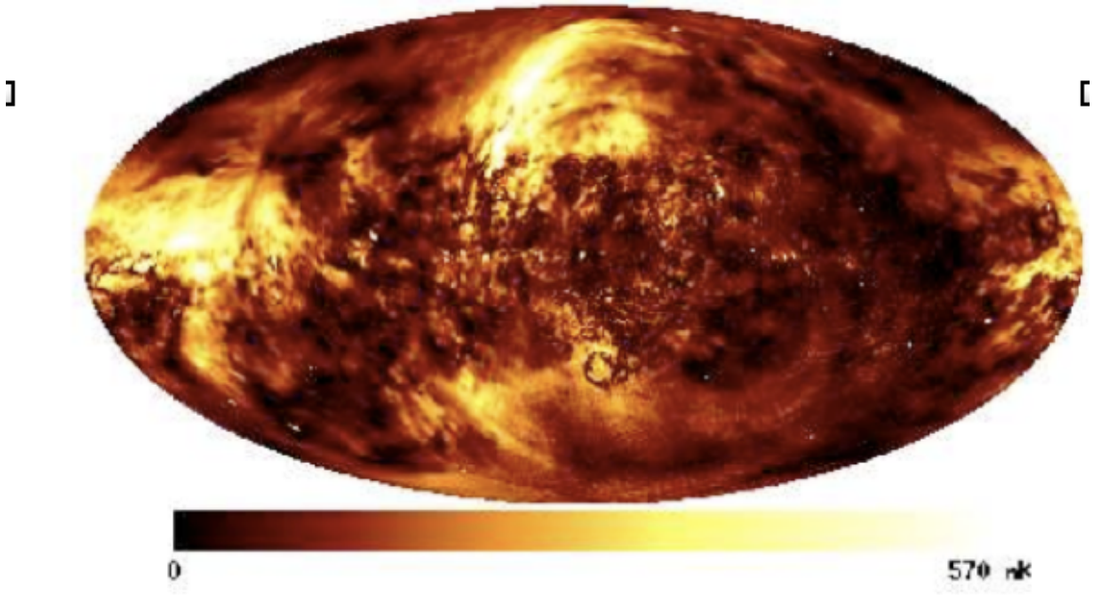
Depolarisation/Polarisation of powerful radio galaxies



Searching for Pulsars



Galactic Foreground



avigation
Viki Startpage

isitor Sections:

- User and LTA access
- Meetings, Workshops, Reports, docs
- LOFAR Science
- International partners
- User Software

rojects:

- Cobalt
- Imaging Tiger Team
- CEP3 cluster
- RRR project
- Dragnet project

ocal Sections:

- Operations
- Engineering
- Maintenance
- LTA (for developers)
- Publication Committee
- Commissioning & MSSS
- Single Station use
- NAA

LOFAR Commissioning Section

This section will contain information on the commissioning of LOFAR, including meetings, busy weeks, etc.

Commissioning Observations

edit

This page traces the status of commissioning observations submitted since late 2011 and evaluated and proritized through the TAG.

- Commissioning Observations

MSSS

edit

MSSS observing status can be found: here for LBA, or here for HBA.

- Publications
- Meetings
- Logistics
- Duty Roster
- Documentation
- Available data and its location, see also Archived MSSS Data
  - Processed data and images (HBA)
- Cluster computing info
- Overview of useful scripts and tools
- Tasks
- Progress reports
- LOFAR System Characterization (LSC)
- Quality control plots
- Source Lists
- Polarisation

MSSS Polarisation section created on LOFAR wiki. Contains reports on processing, minutes and other documents

Two Polarisation Surveys

1. Low Resolution Survey

Using already processed data from MSSS to achieve a low resolution survey to observe Galactic Foreground emission.

Headed by David Jones (Nijmegen)

Currently copying data from CEP to Nijmegen cluster approx 50 % already copied over.

Pipeline already written and producing results

Two Polarisation Surveys

2. High Resolution Survey

Using raw MSSS data, attempt to create an all-sky survey at higher resolution with greater frequency resolution.

Increased frequency resolution (8 channels per subband) will give a max FD of approx 666 rad m^-2.

Will need to perform preprocessing and initial calibration again.

MSSS Reprocessing Team

David Mulcahy —Manchester—

Andreas Horneffer —MPIfR—

Valentina Vacca —MPA—

Emilio Enriquez —Nijmegen—

Reprocessing Team

- Currently having biweekly telecons, to keep track of progress and to seek advice.

- Each member is working on testing a different field in conjunction with the long baseline group:

Horneffer- PSRJ 0218+4232

Mulcahy-Pulsar B1919+21

Vacca-Great Wall

- Have applied 110,000 core hours in JURECA (Julich) for preprocessing of MSSS raw data and testing of pipelines.

In conclusion:

- MSSS Polarisation survey would enable us to perform several varied science projects including studying galactic foreground.

- Polarised Foreground emission has been detected.

- Polarised emission for a polarised pulsar **at the correct FD.**

- **A shallow polarisation survey is possible with MSSS!**

In conclusion:

- A MSSS polarisation team has been created consisting of people from various KSPs.
- MSSS polarisation survey will consist of two parts, low resolution to observe the Galactic Foreground and high resolution to detect extragalactic sources.
- Work on these two respective surveys has now begun!

Questions?