



**Faraday tomography  
of the (local) ISM with LOFAR**

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in collaboration with LOFAR-EoR and LOFAR-Magnetism team

# Faraday tomography

## @ low radio frequencies

- very sensitive to small column densities of ISM that are mostly not possible to detect at higher radio frequencies ( $1 \text{ rad/m}^2$ )

### LOFAR results

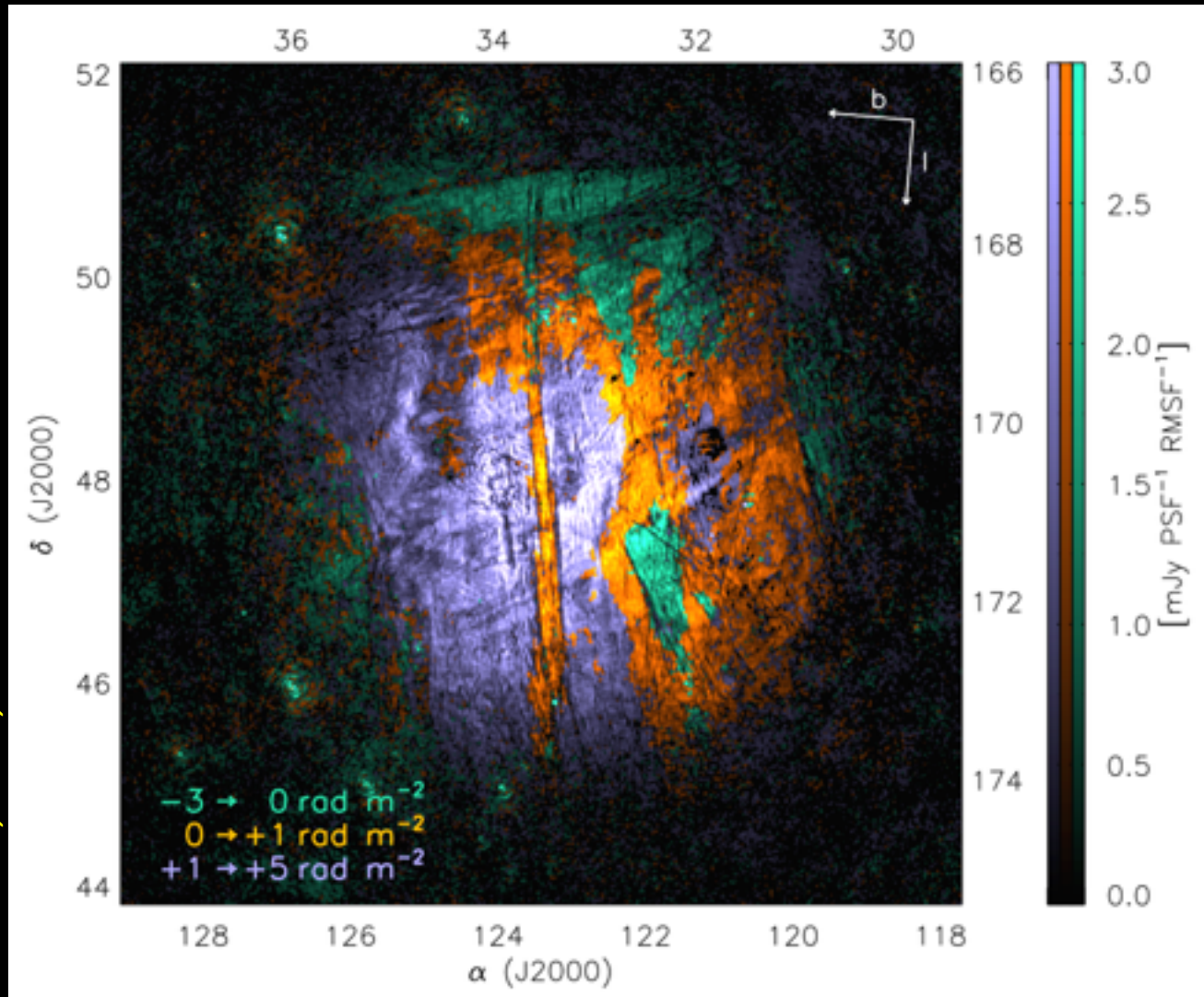
- *Iacobelli et al. 2013* Studying Galactic interstellar turbulence through fluctuations in synchrotron emission. First LOFAR Galactic foreground detection
- *Jelic et al. 2014* Initial LOFAR observations of epoch of reionization windows. II. Diffuse polarized emission in the ELAIS-N1 field
- *Jelic et al. 2015* *Linear polarization structures in LOFAR observations of the interstellar medium in the 3C 196 field*
- *Van Eck et al. 2016* Faraday tomography of the local interstellar medium with LOFAR: Galactic foregrounds towards IC 342

### MWA results

- *Bernardi et al. 2013* A 189 MHz, 2400 deg<sup>2</sup> Polarization Survey with the Murchison Widefield Array 32-element Prototype
- *Lenc et al. 2016* Low-frequency Observations of Linearly Polarized Structures in the Interstellar Medium near the South Galactic Pole

# 3C196 field

*Jelic et al., 2015, A&A*



**LOFAR-HBA (6h) observations**

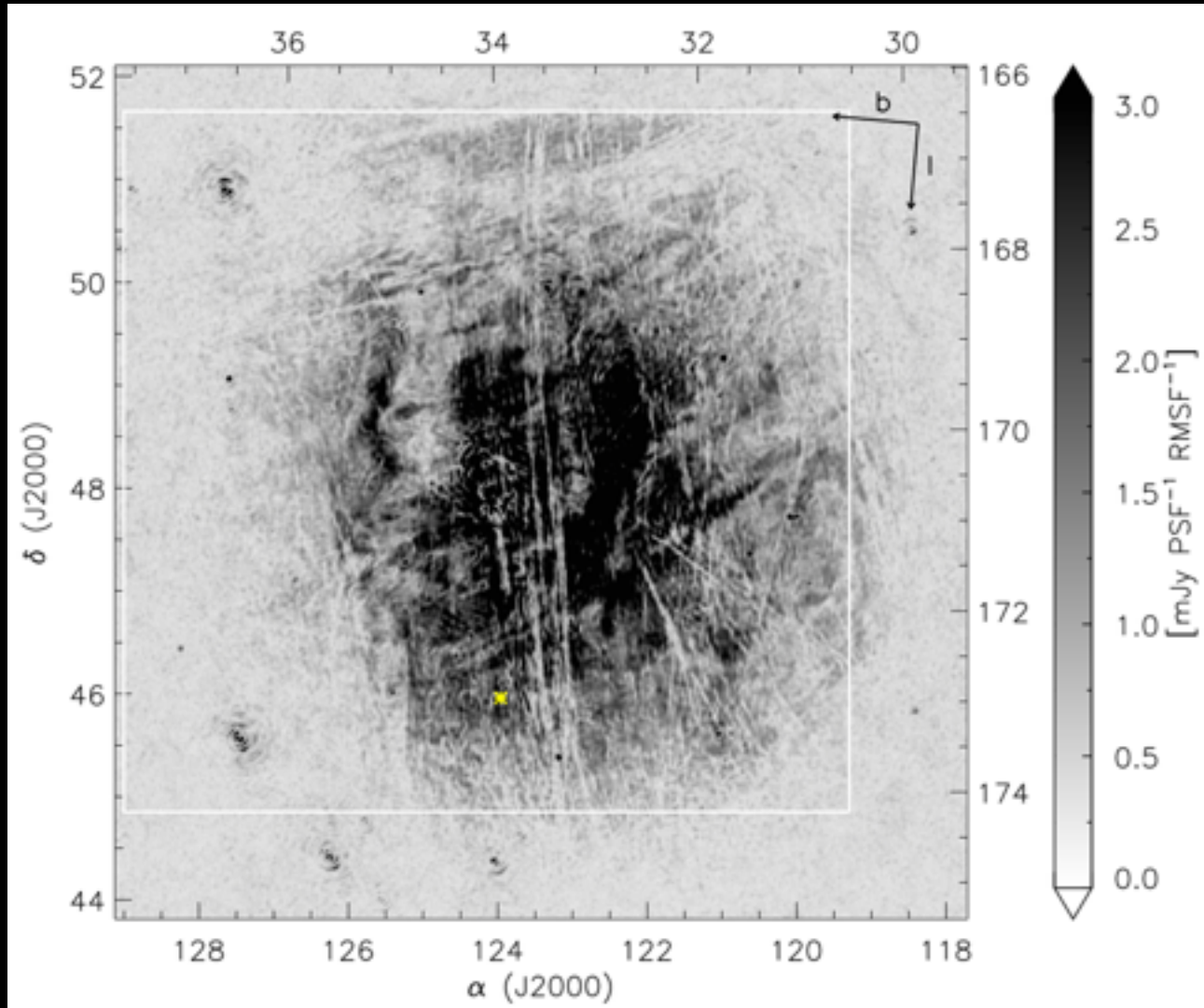
115-175 MHz, 0.2 MHz  $\rightarrow$  1  $\text{rad/m}^2$  5 deg x 5 deg, 3 arcmin



# 3C196 field

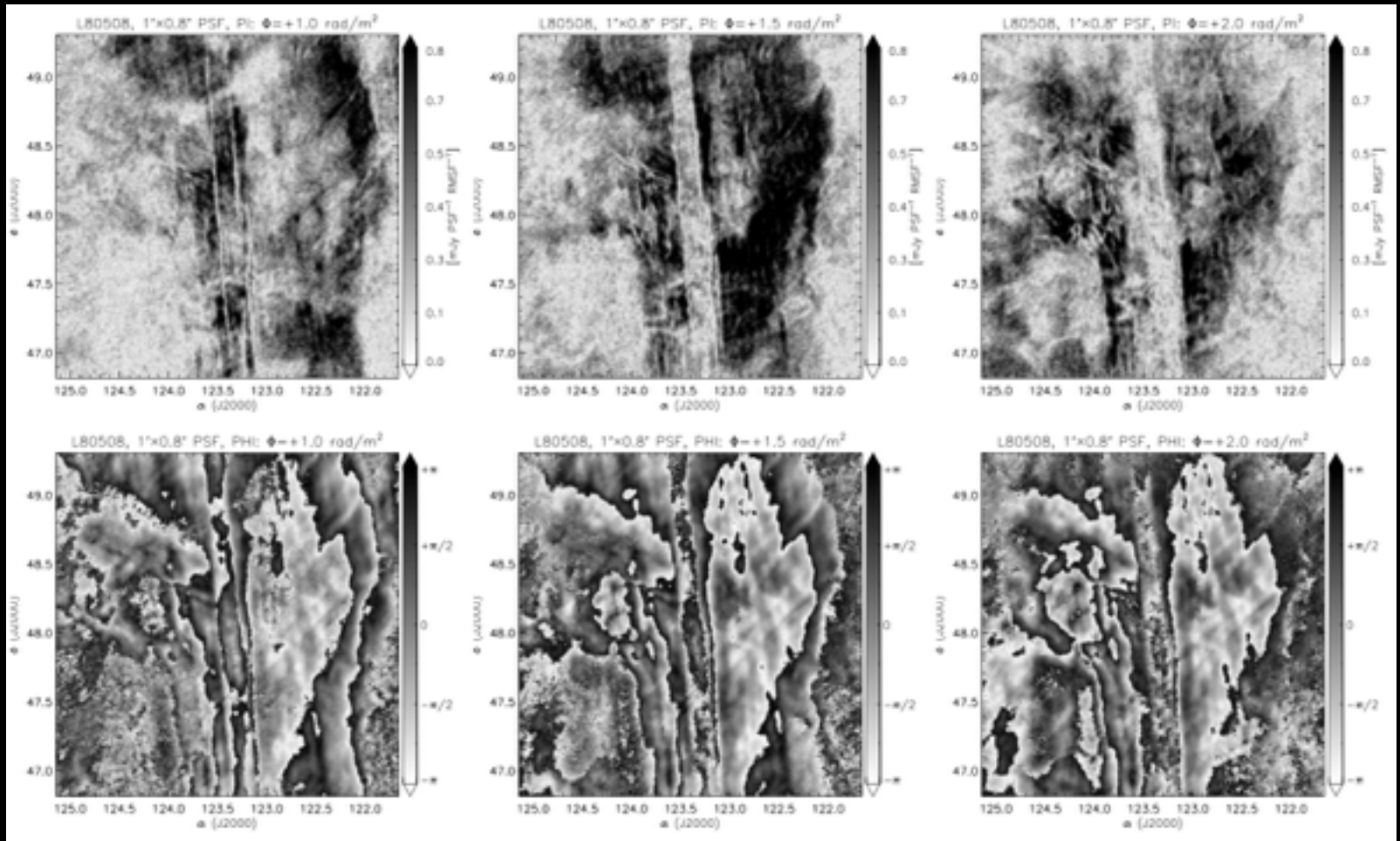
@ 3 arcmin resolution

*Haverkorn et al., 2000, 2004*  
**depolarization canals**



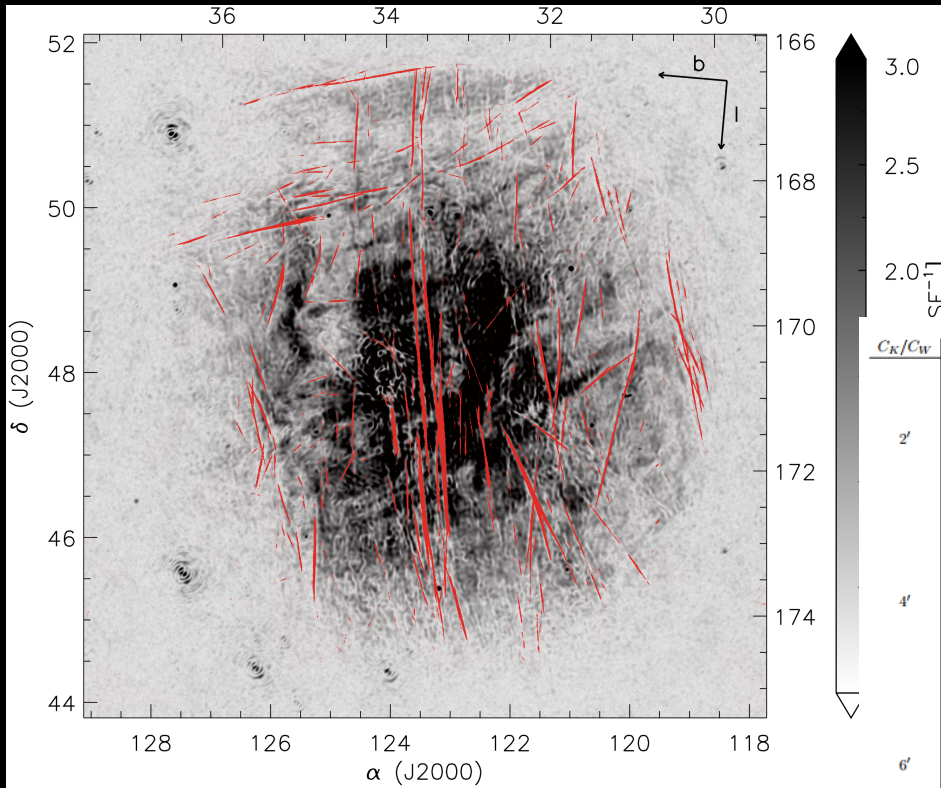
# 3C196 field

depolarisation canals  
@ 1 arcmin resolution

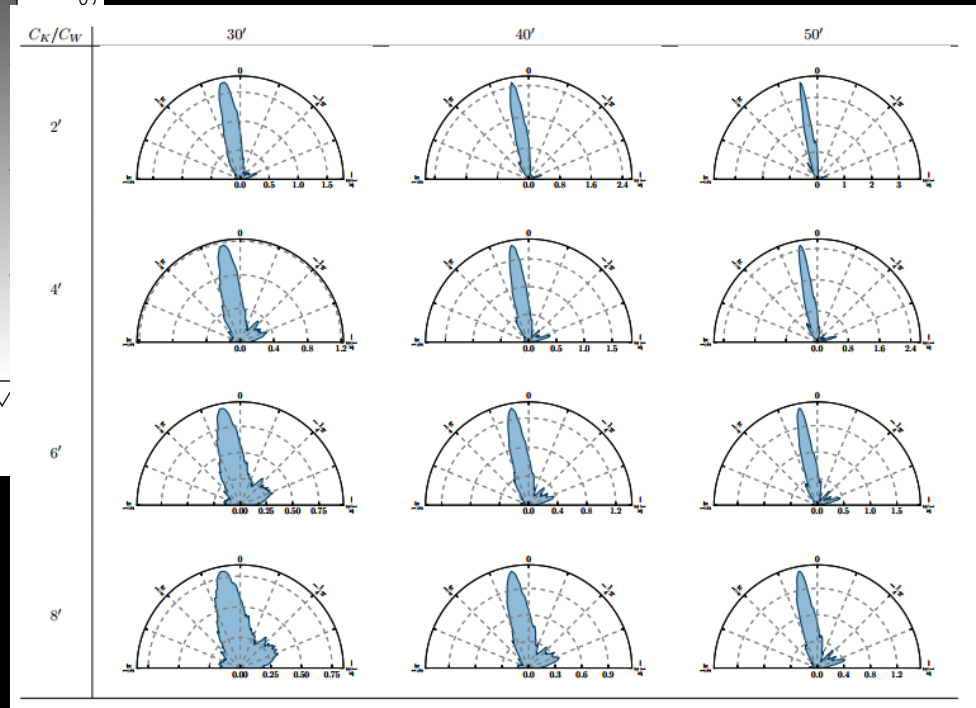


**Origin and straightness  
of the observed structures are mystery ?!**

# Orientation of depolarisation canals in 3C196 field



- Rolling Hough Transform (Clark et al. 2013)

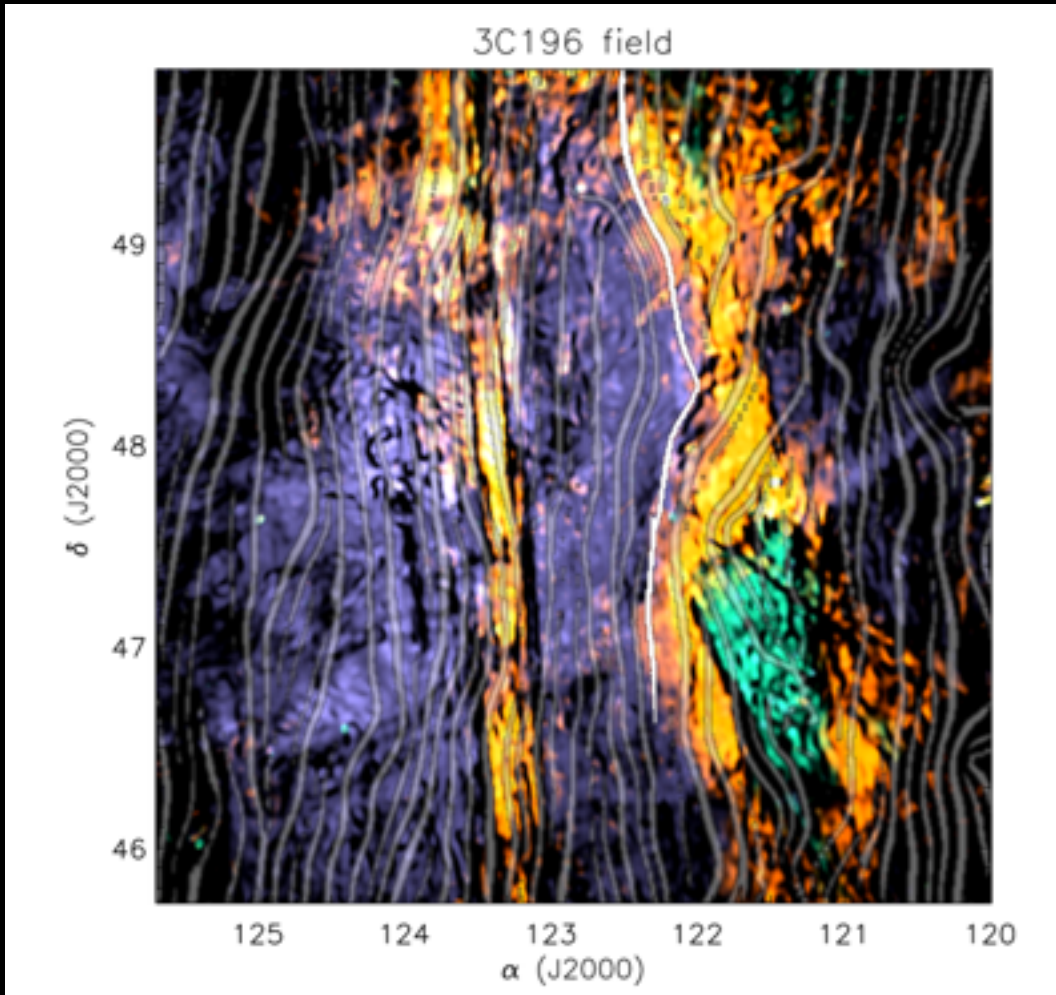


*D. Klindžić (PMF, Croatia) i D. Prelogović (PMF, Croatia)*  
*Jelić et al. in prep.*



# 3C196 field

## Planck and LOFAR

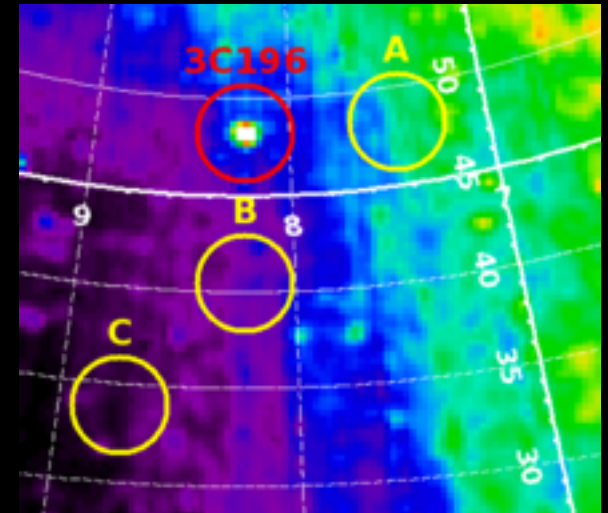
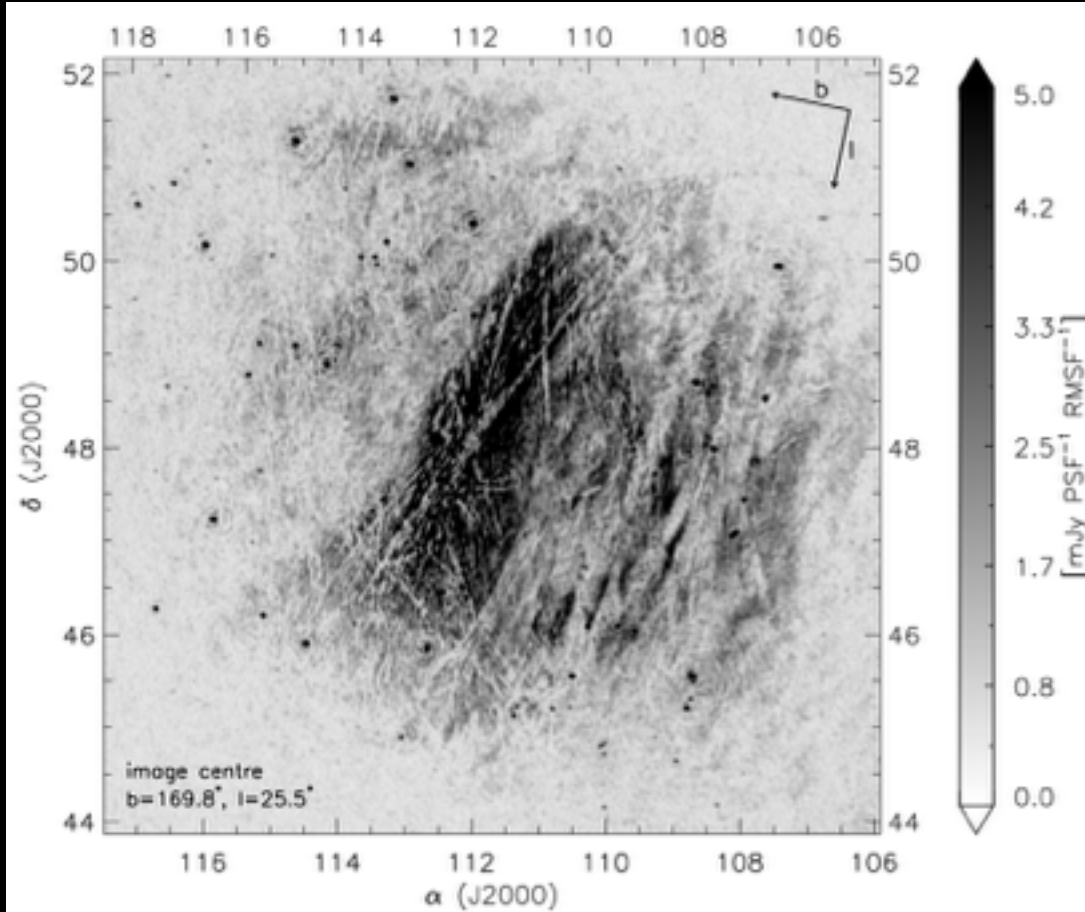


- result is quite surprising as LOFAR and Planck are sensitive to different magnetic field components in different ISM phases (**WIM vs. CNM**)

*Are we seeing the Warm Partially Ionized Medium (Heiles 2001; Heiles & Haverkorn 2012) or interaction between two components!?!*



# Ongoing LOFAR survey at high Galactic latitudes



an area of 400 deg<sup>2</sup>

- rich morphology of polarized emission detected at low-radio frequencies (100 - 200 MHz; LOFAR and MWA), with the brightness temperature of a few K
- probed ISM mostly close by (<200 pc), within the Local Bubble
- discovery of many filamentary structures and linear depolarization canals
- the filamentary structure also shows a signature in Planck dust polarization maps and HI data, a common underlying magnetic field
- surveying a larger area of the sky and multi-frequency observations combined with realistic MHD simulations of multi-phase ISM

**THANK YOU !**