



R u đ e r B o š k o v i ć I n s t i t u t e



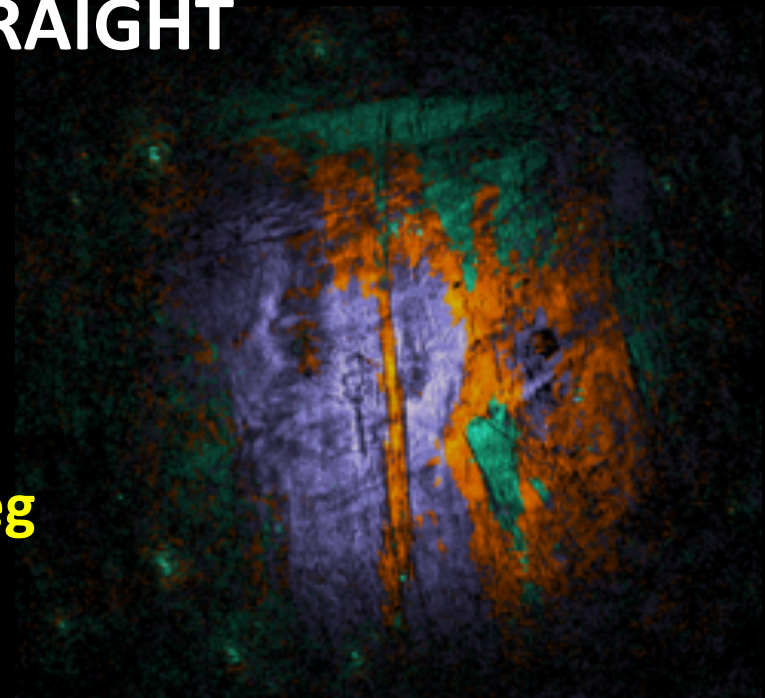
MAGNETICALLY ALIGNED STRAIGHT DEPOLARIZATION CANALS

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Laboratory for Astroparticle physics and Astrophysics

+ LOFAR Survey KSP and Magnetism KSP



HrZZ-IP-2018-01-2889

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 rad/m^2)

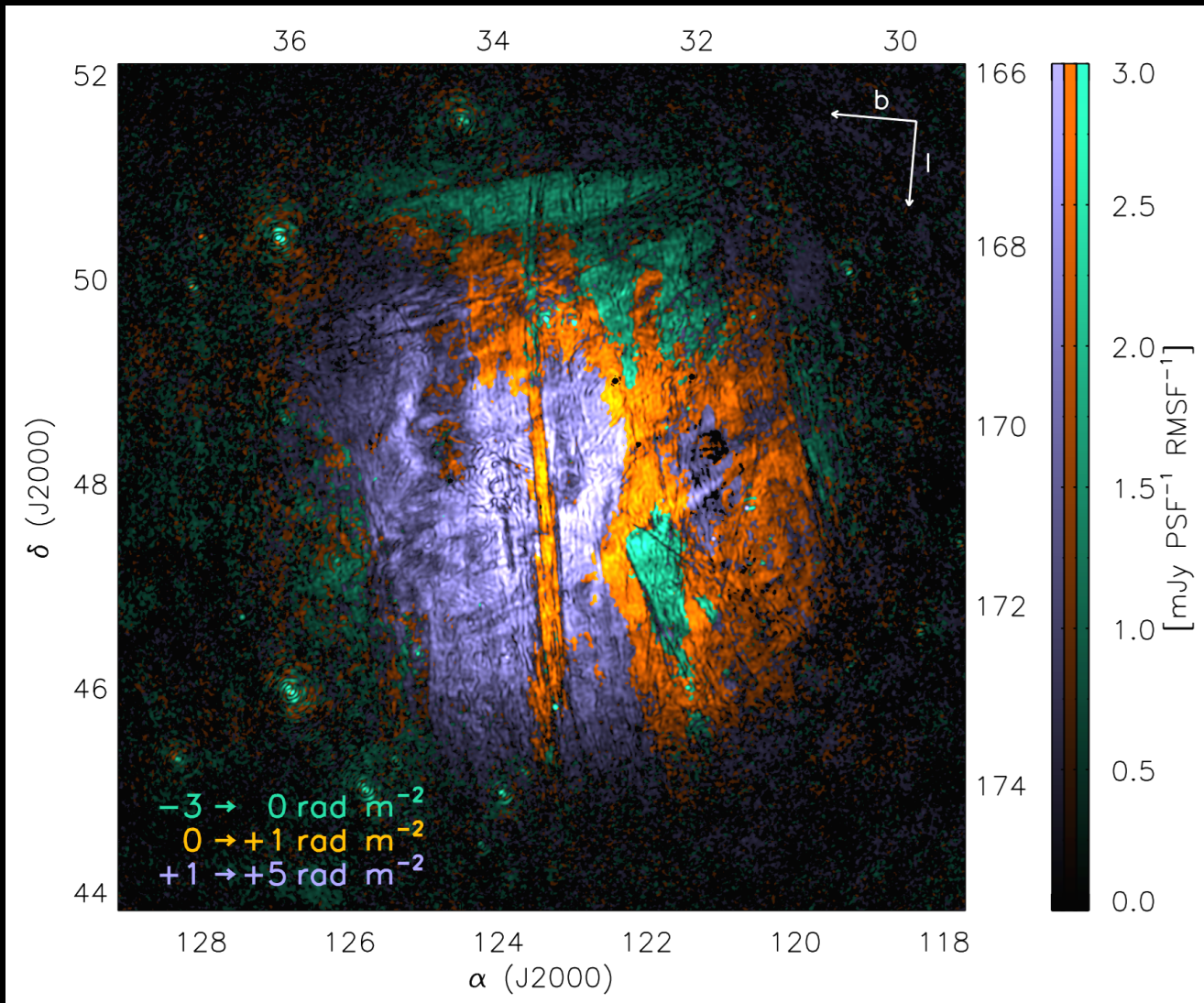
LOFAR results

- *Iacobelli et al. 2013* Studying Galactic interstellar turbulence through fluctuations in synchrotron emission. First LOFAR Galactic foreground detection (**Fan region**)
- *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**
- *Van Eck et al. 2019* *Diffuse polarized emission in the LOFAR Two-meter Sky Survey - HETDEX field*

MWA results

- *Bernardi et al. 2013* A 189 MHz, 2400 deg² 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

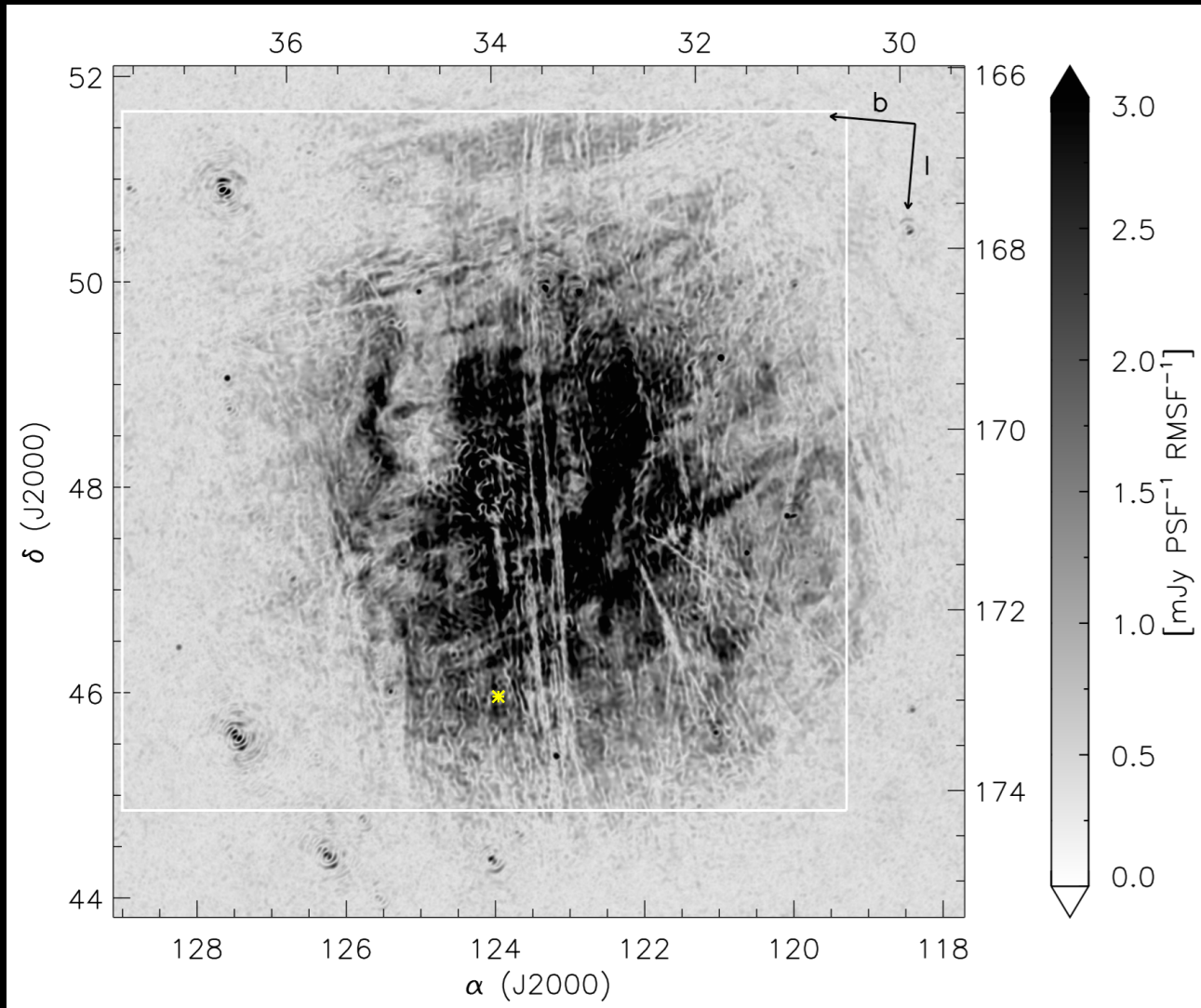
3C196 field



3C196 field

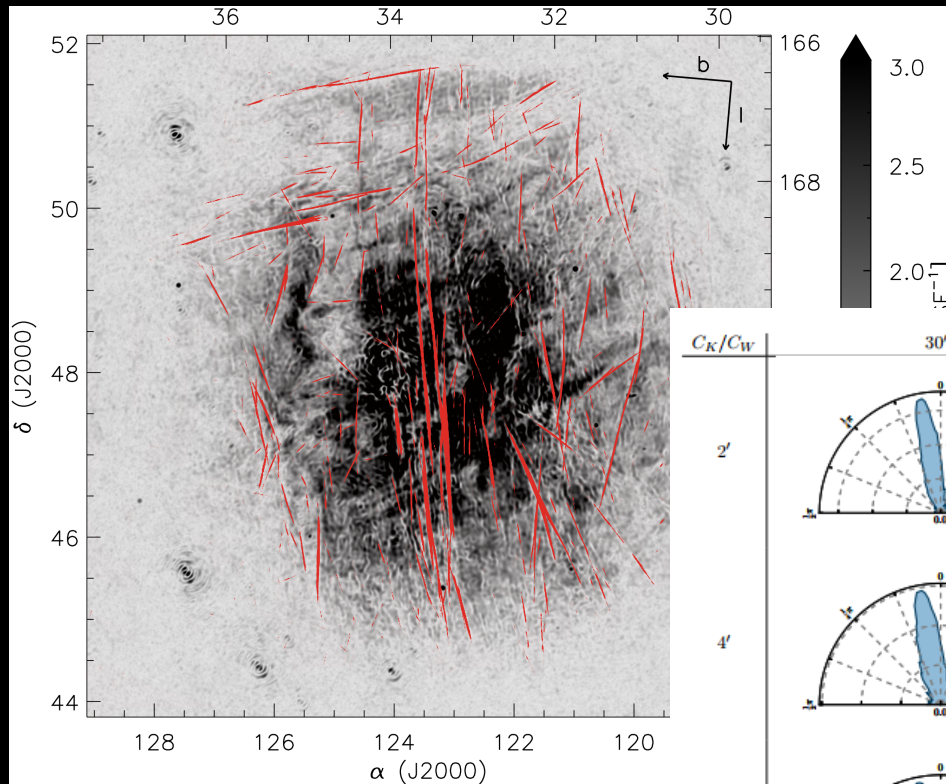
depolarization canals

Haverkorn et al., 2000, 2004

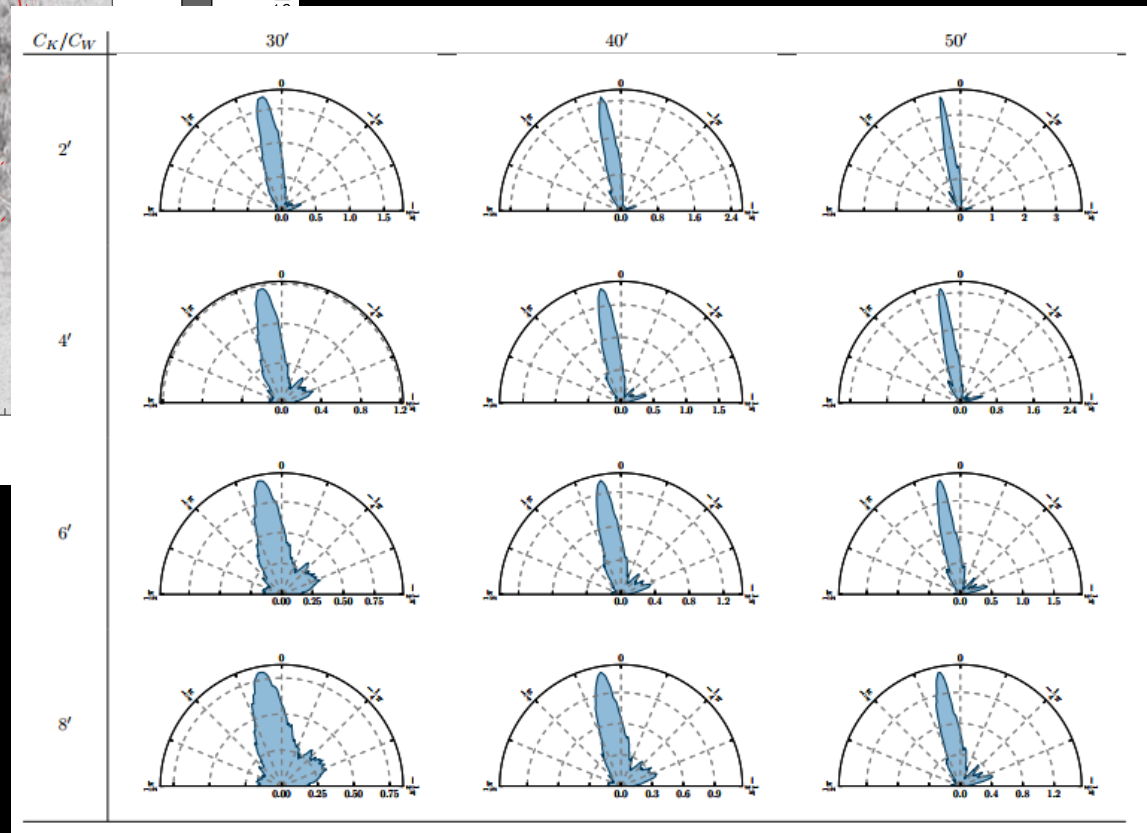


Jelic et al., 2015, A&A

Orientation and motion of depolarisation canals in 3C196 field

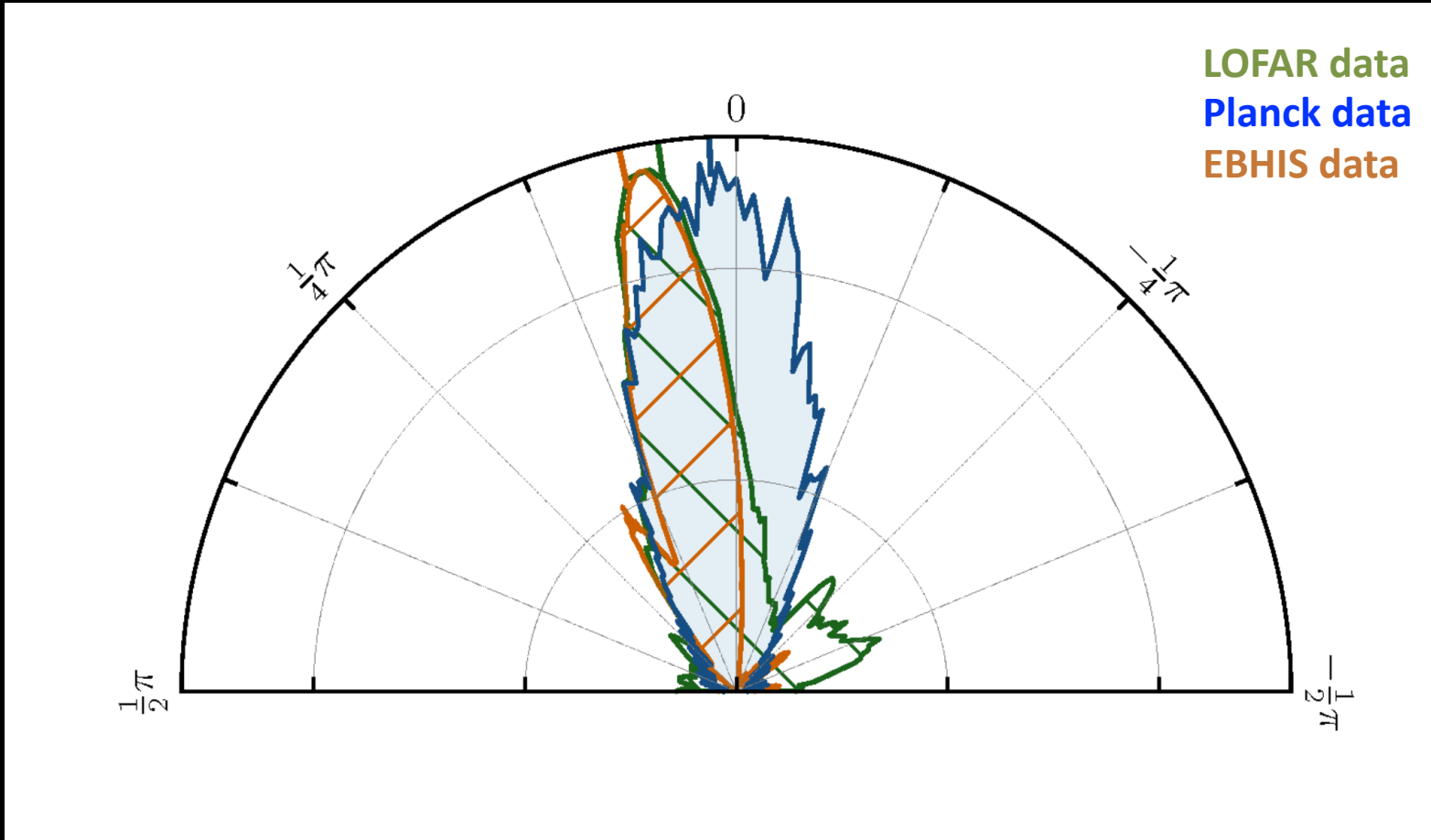


- Rolling Hough Transform (Clark et al. 2013)



- orientation seems to be the same as orientation of HI fibres (EBHIS data) and magnetic field component as probed by Planck in the same field

Orientation of depolarisation canals in 3C196 field

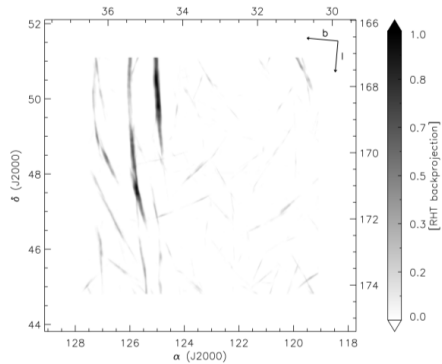
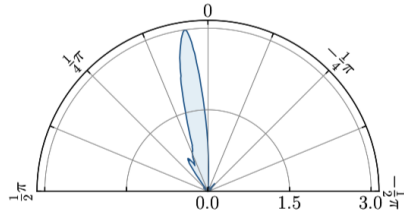


- orientation seems to be the same as orientation of **HI fibres (EBHIS data)** and **magnetic field** component as **probed by Planck** in the same field

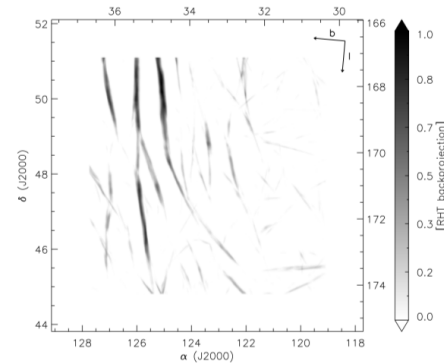
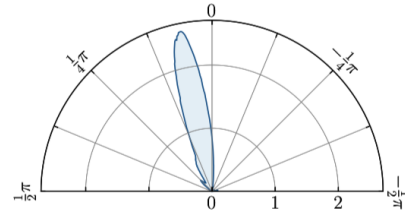
Jelic et al., 2018, A&A

Orientation of HI filaments in 3C196 field

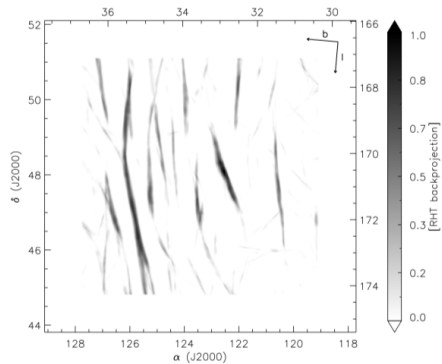
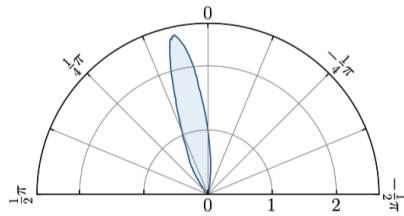
$v = -11.5 \text{ km/s}$



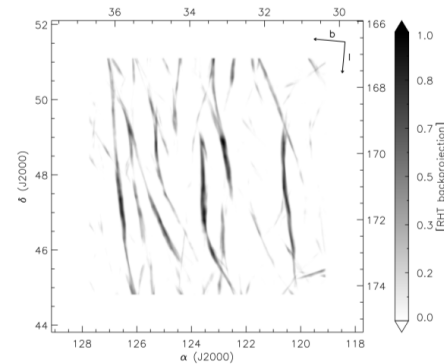
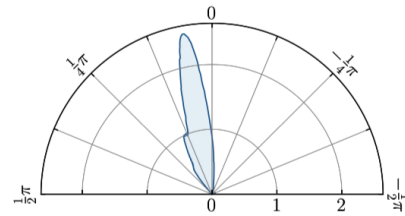
$v = -8.9 \text{ km/s}$



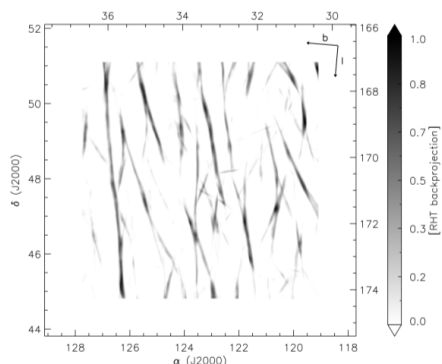
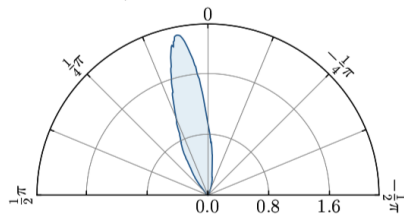
$v = -6.3 \text{ km/s}$



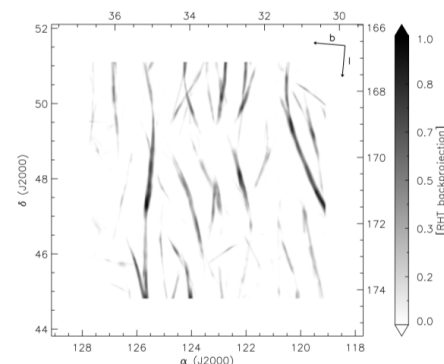
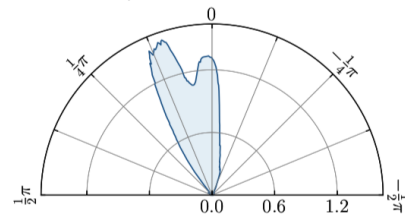
$v = -3.8 \text{ km/s}$



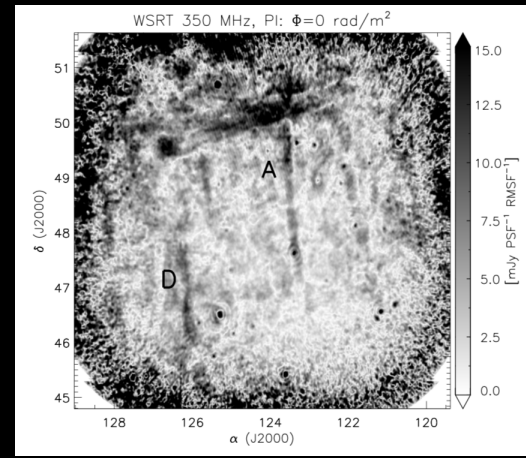
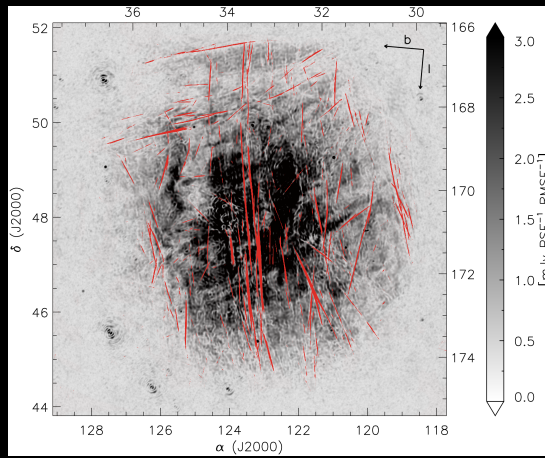
$v = -1.2 \text{ km/s}$



$v = +1.4 \text{ km/s}$

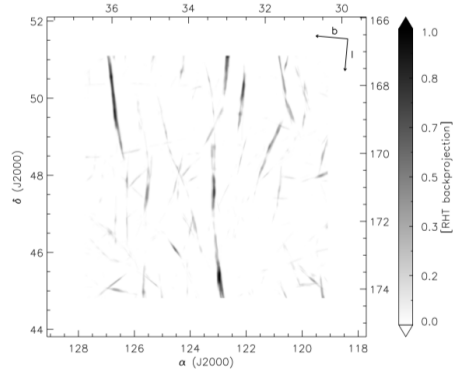
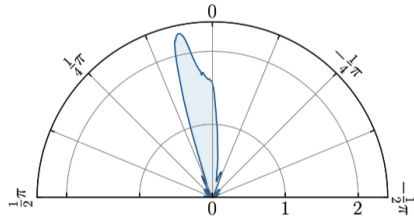


LOFAR@150 MHz

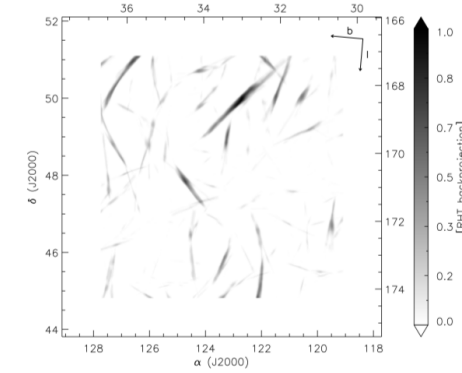
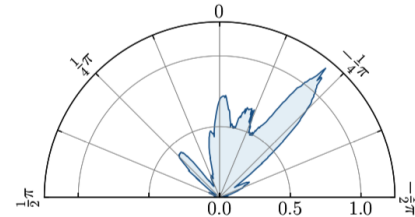


WSRT@150 MHz

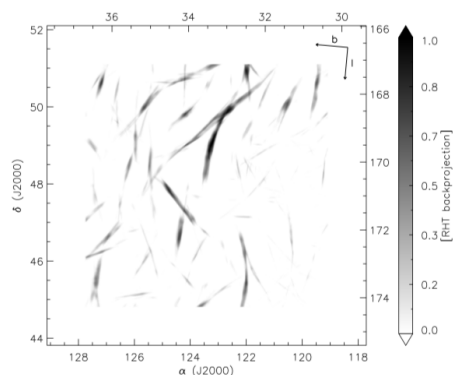
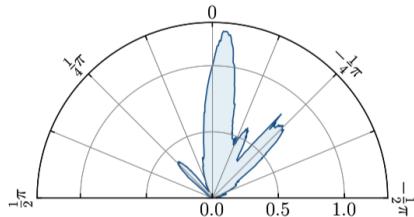
$v = +4.0 \text{ km/s}$



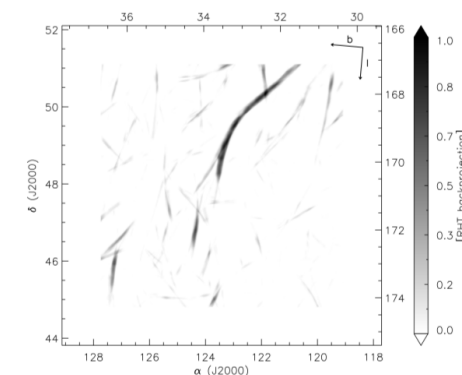
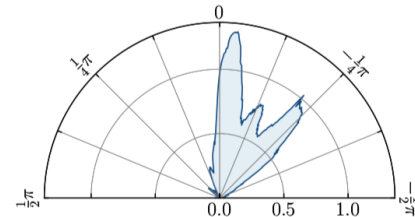
$v = +14.3 \text{ km/s}$



$v = +15.6 \text{ km/s}$

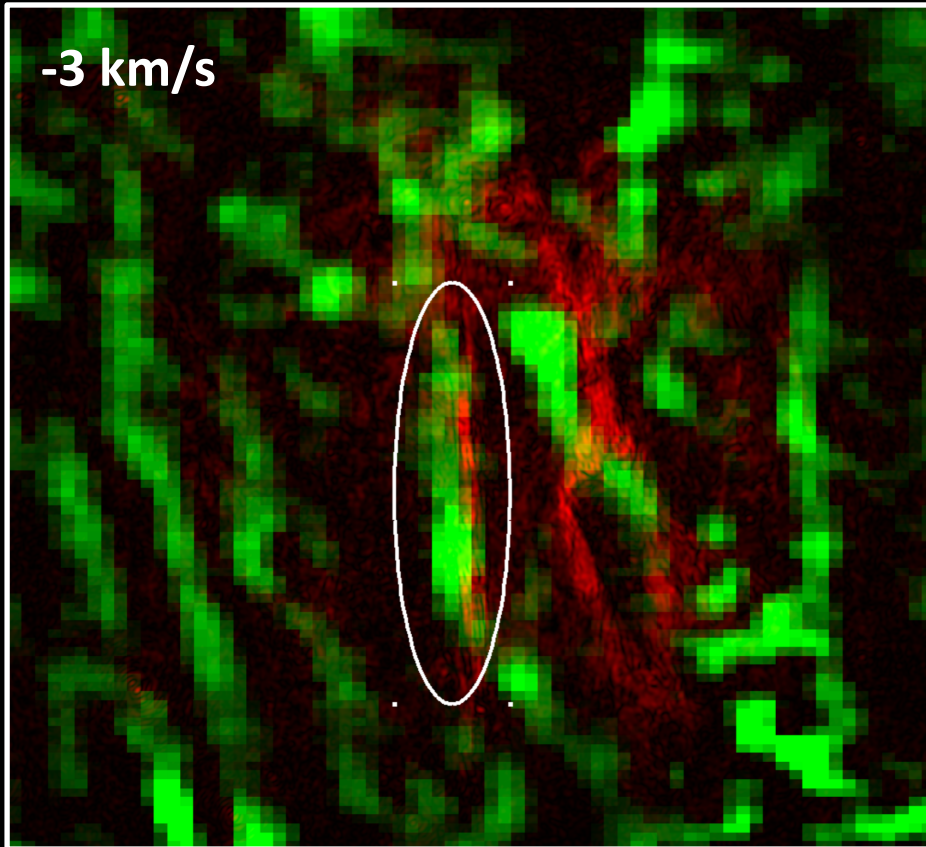


$v = +16.8 \text{ km/s}$



3C196 field

EBHIS and LOFAR

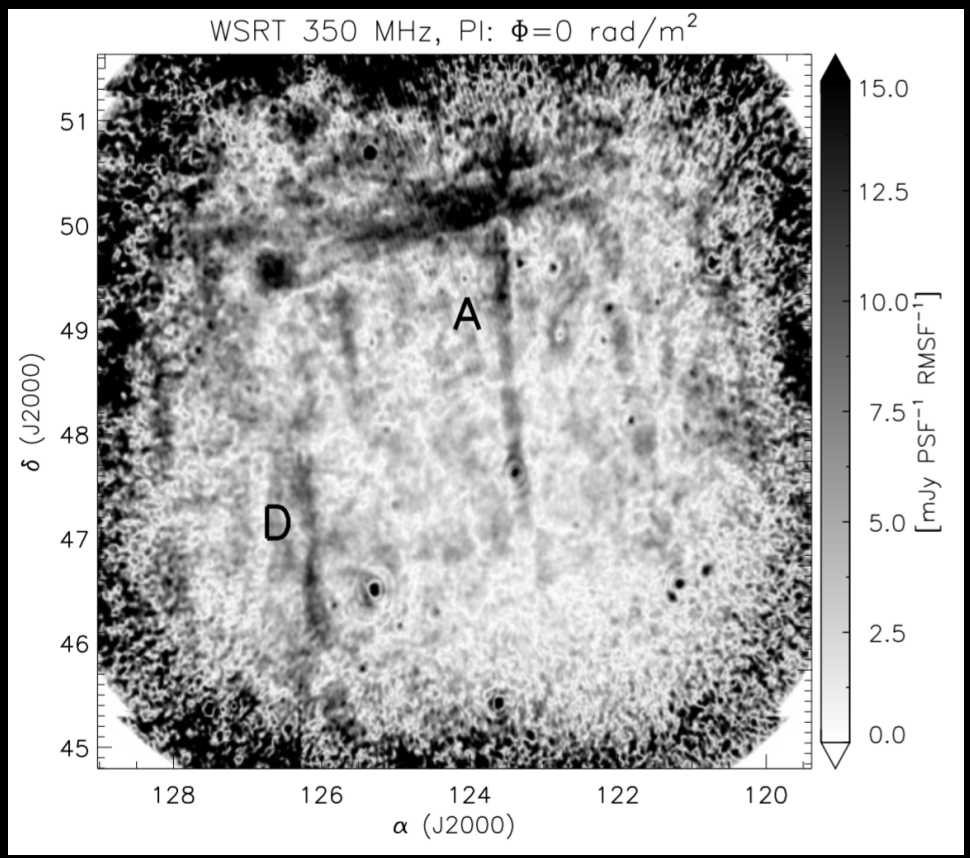
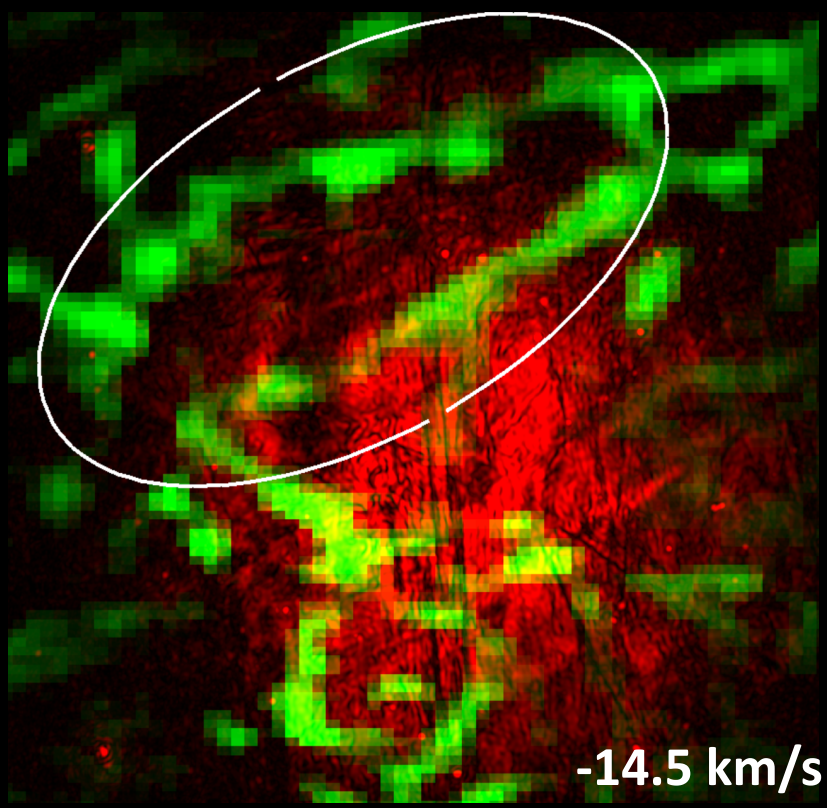


- LOFAR filaments correlate with HI fibres
HI fibres (EBHIS data) - anisotropies of CNM ($T_D \sim 160$ K), probably HI sheets seen edge-on orientated by magnetic fields

3C196 field

EBHIS, LOFAR and WSRT

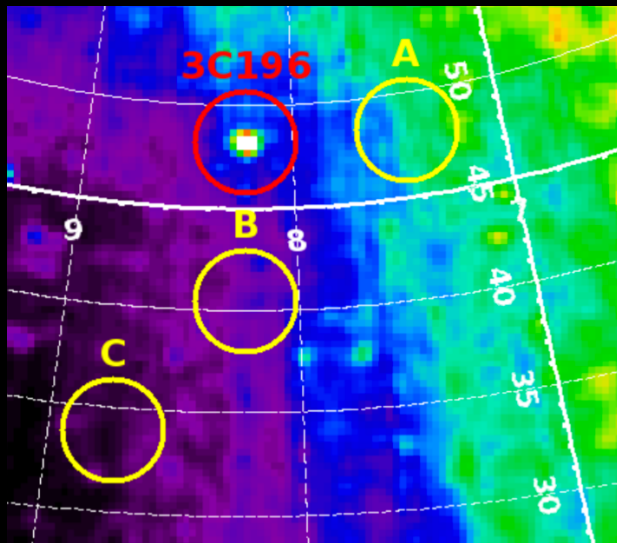
WSRT @350 MHz
 $\delta\Phi = 10 \text{ rad/m}^2$



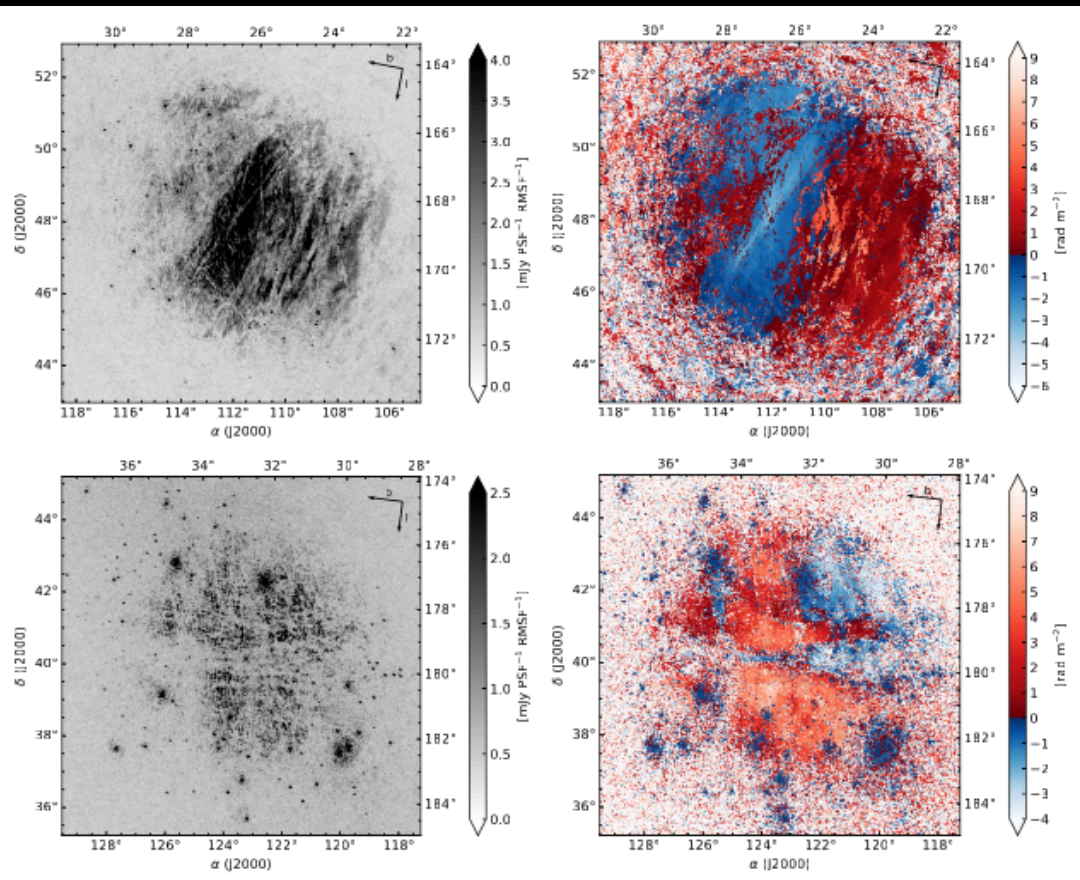
Faraday thickness is frequency dependant !!

(e.g. Faraday thin structure @ 350 MHz is Faraday thick @ 150 MHz)

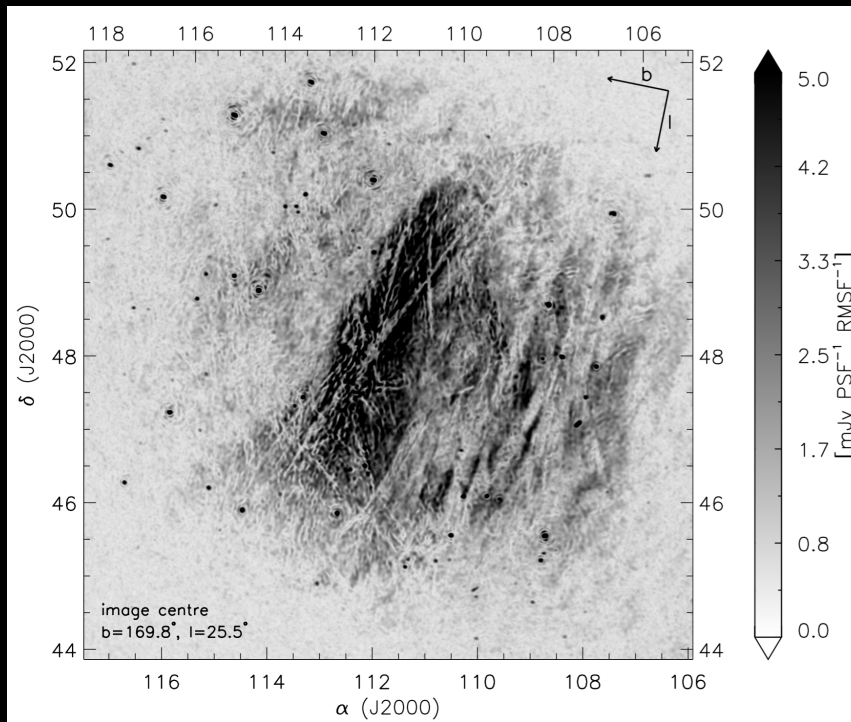
An area around the 3C196 field



Luka Turić
 a PhD student @IRB
preliminary results

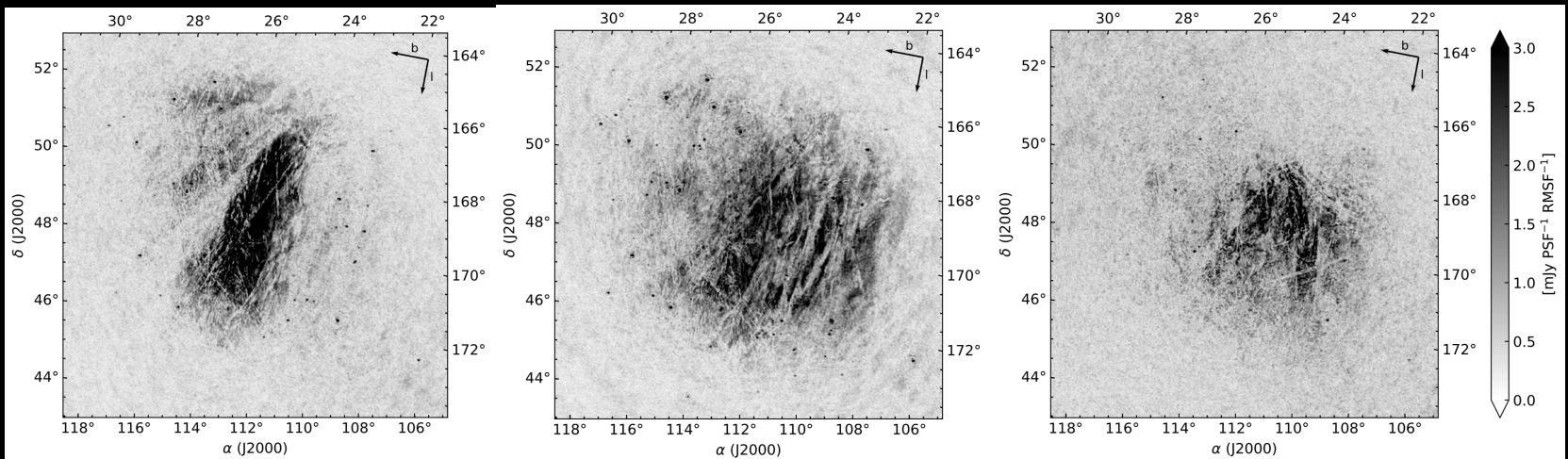


Name of the field	RM range [rad m ⁻²]	$T_{130 \text{ MHz}}$ [K] (polarized intensity)	$T_{408 \text{ MHz}}$ [K] (total intensity)	$T_{130 \text{ MHz}}$ [K] (total intensity)	Polarization fraction
3C196A	-6 - +9	4 ± 1	27 ± 1	470 ± 10	$0.9 \pm 0.2 \%$
3C196B	-4 - +9	2.2 ± 0.9	18.0 ± 0.5	314 ± 9	$0.7 \pm 0.3 \%$
3C196C	+5 - +15	1.4 ± 0.4	15.4 ± 0.5	269 ± 9	$0.5 \pm 0.1 \%$



FIELD A

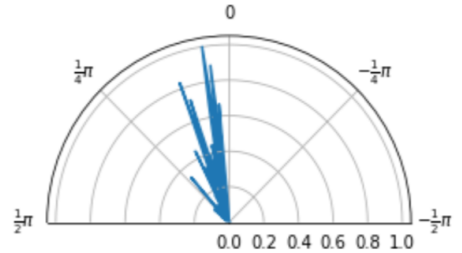
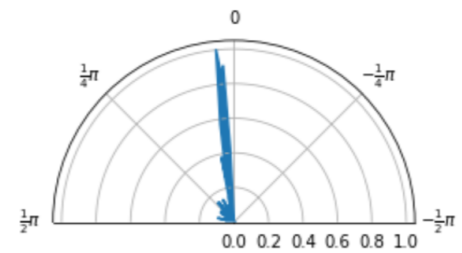
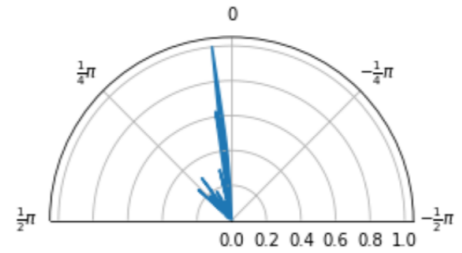
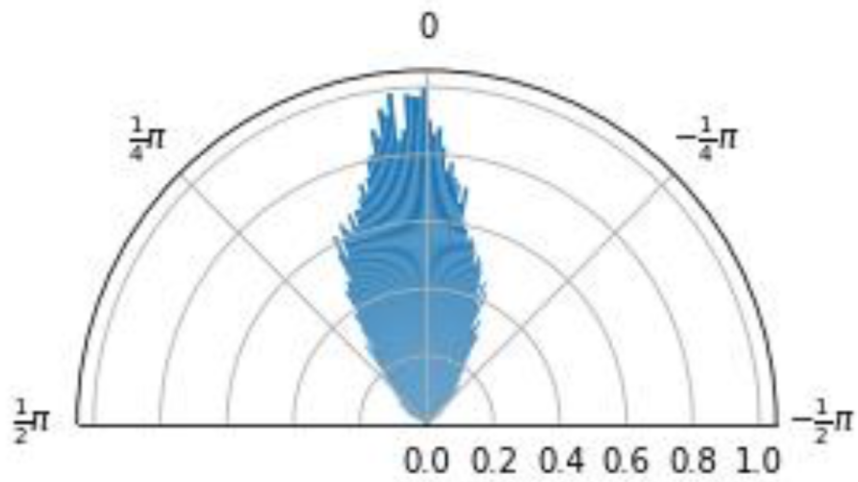
Turić et al., in prep.
preliminary results



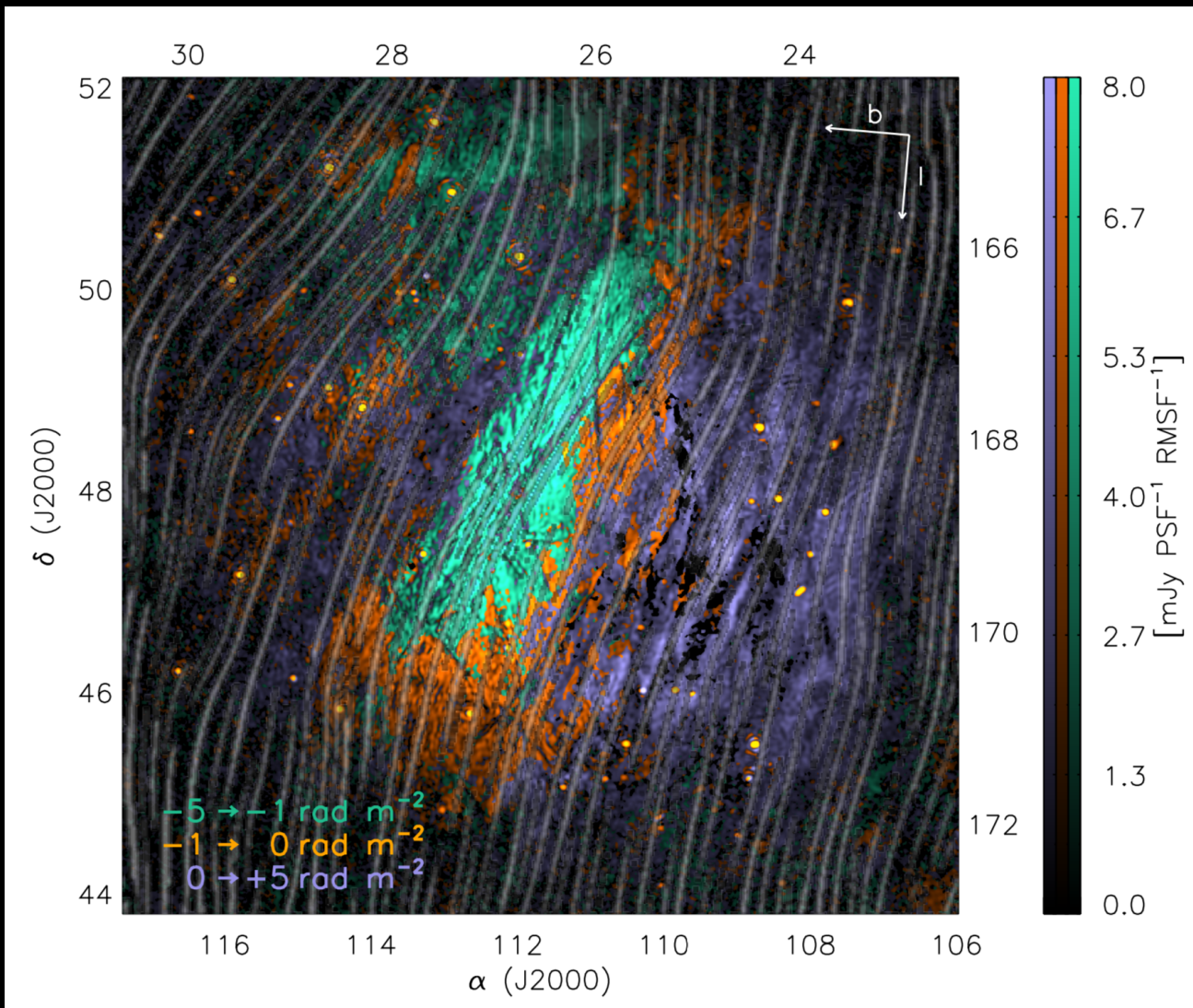
-7 → -1 rad/m²

-1 → +3 rad/m²

+3 → +7 rad/m²



Turić et al., in prep.
preliminary results



Turić et al., in prep.
preliminary results

LOFAR Two-metre Sky Survey

(LoTTS <https://lofar-surveys.org>)

Shimwell et al. 2017, 2019

van Eck et al., A&A, 623, A71

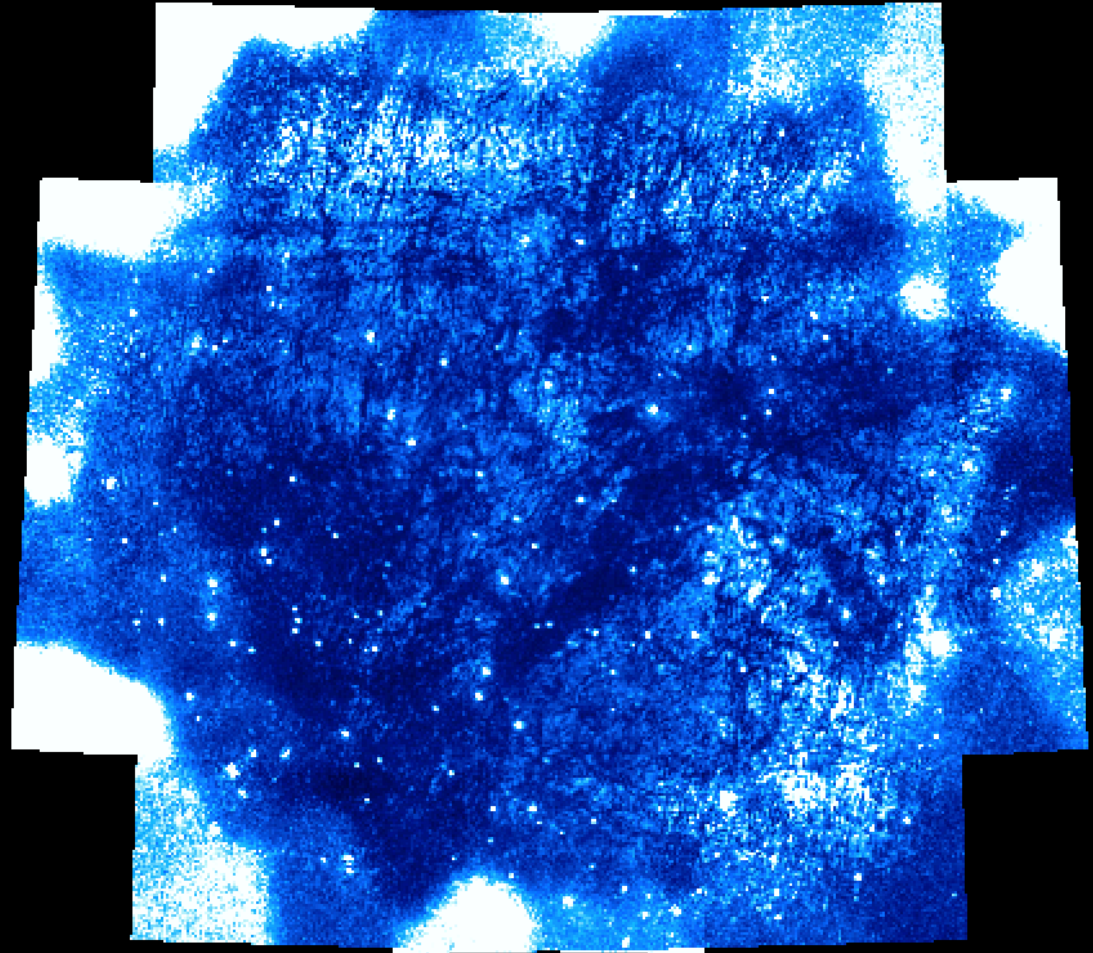
$$\delta\Phi = 1.5 \text{ rad/m}^2$$
$$\Delta\Phi = 1 \text{ rad/m}^2$$

Noise

RM cube P ~ 64 $\mu\text{Jy/PSF/RMSF}$

RM cube Q ~ 98 $\mu\text{Jy/PSF/RMSF}$

RM cube U ~ 98 $\mu\text{Jy/PSF/RMSF}$



Ana Erceg

a (PhD) student @IRB

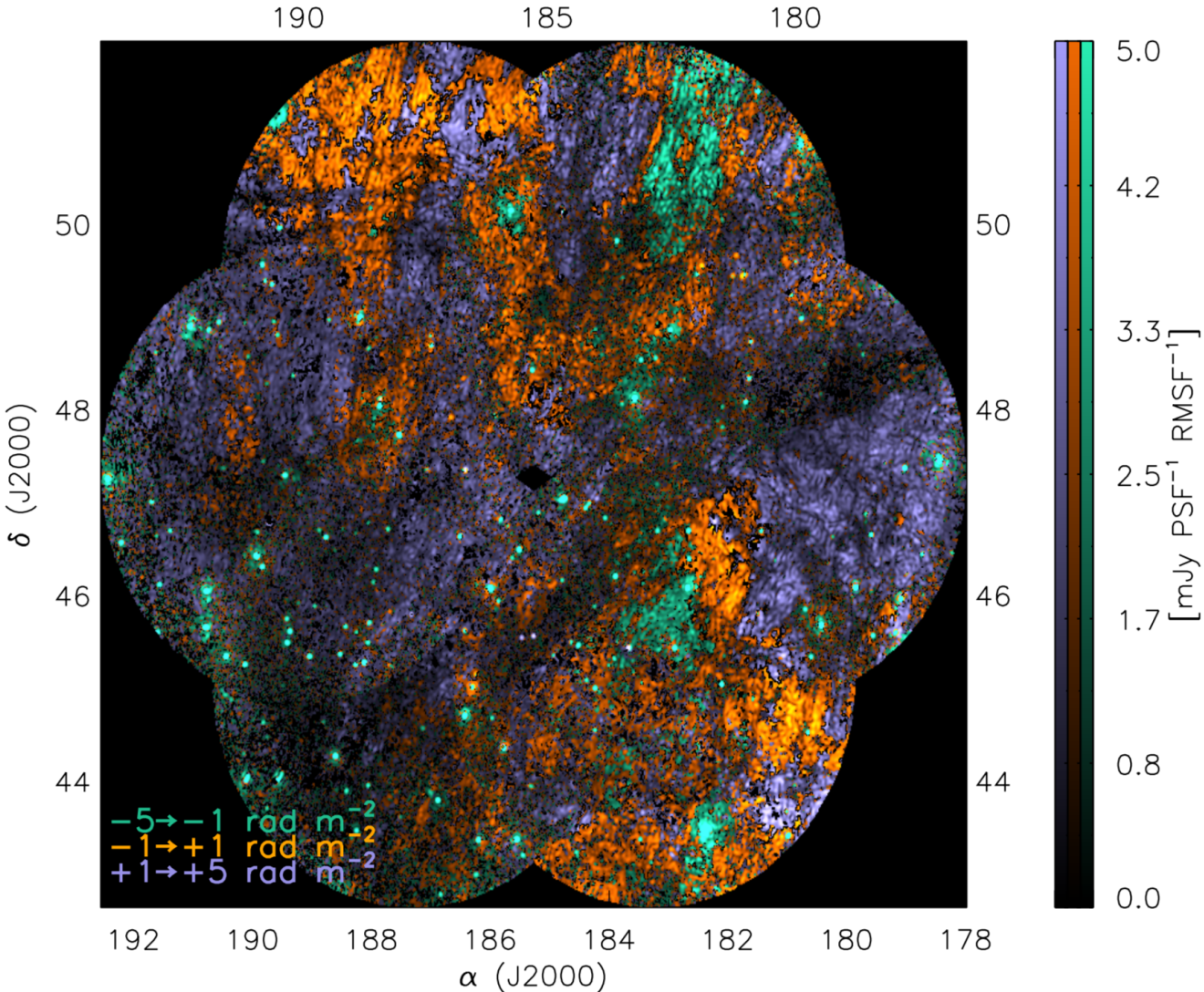
+ LOFAR Survey KSP and Magnetism KSP

HETDEX D2 @ 3arcmin

preliminary results

LoTTS - DR2 preliminary

<https://lofar-surveys.org>



HETDEX D2 @ 3 arcmin
preliminary results