Universität Bielefeld
Fakultät für Physik

Max-Planck-Institut für Radioastronomie

MAX-PLANCK-GESELLSCHAFT

Broadband Polarization Sky Survey with the MPIfR-MT SKA-prototype dish

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Max-Planck-Institut für Radioastronomie

D-MeerKAT Team

05th October 2017, GLOW 2017, Würzburg

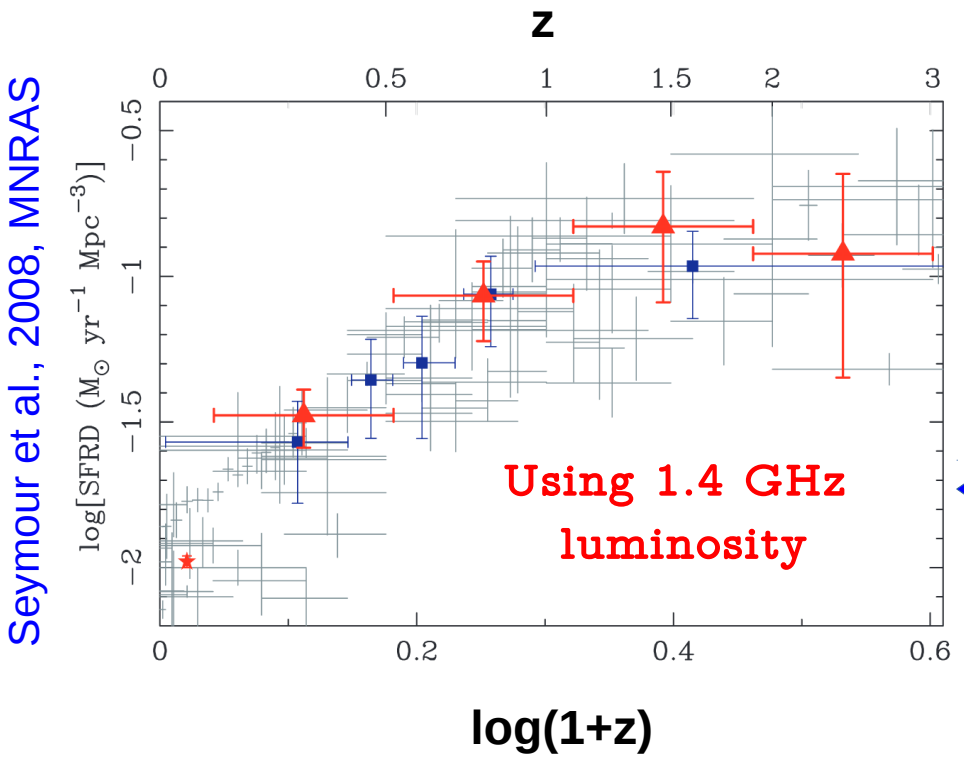
Galaxy Evolution

Radio continuum emission:

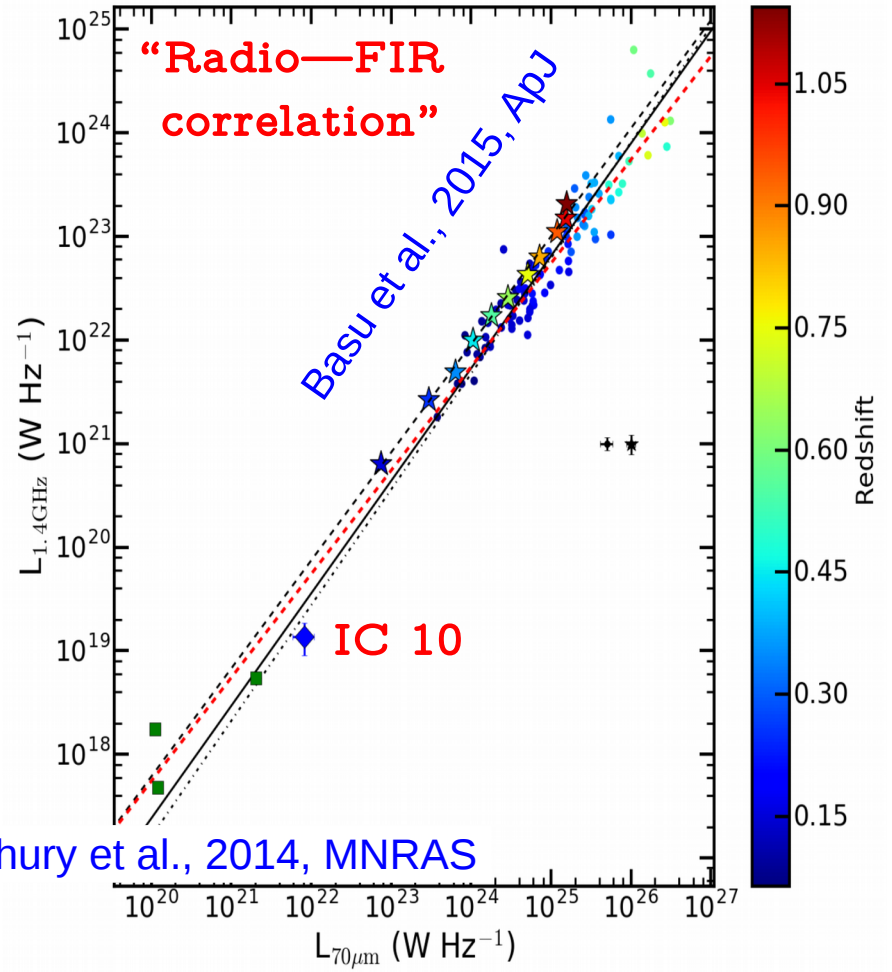
Massive stars end up in SN explosions!

Extinction free

Easy to perform photometry (and stacking)



Seymour et al., 2008, MNRAS



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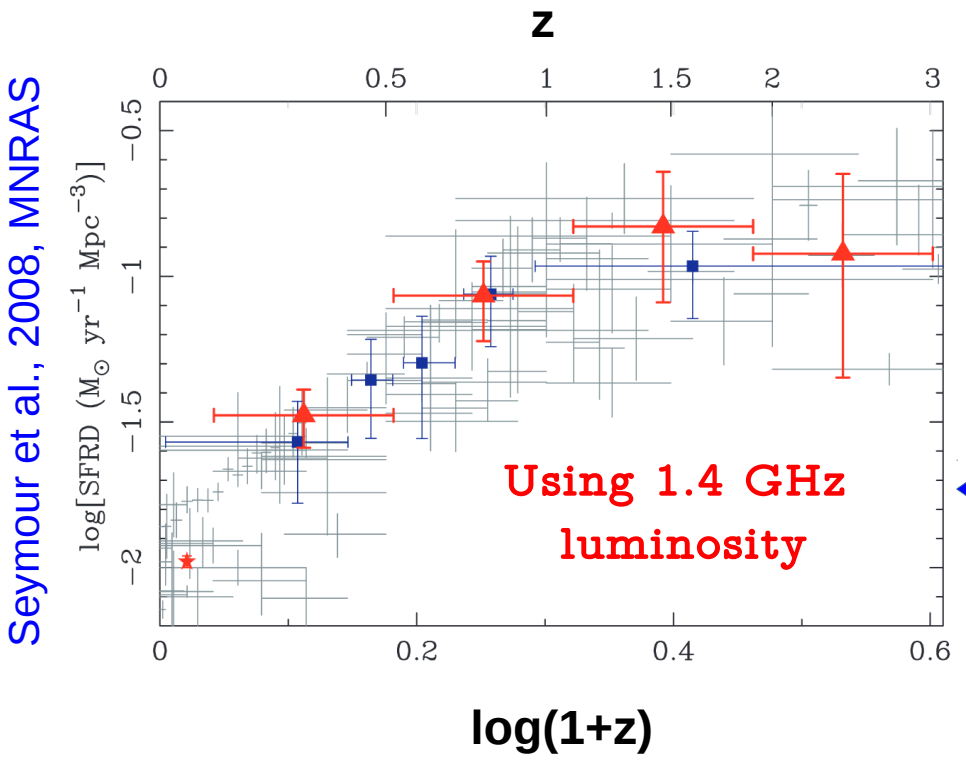

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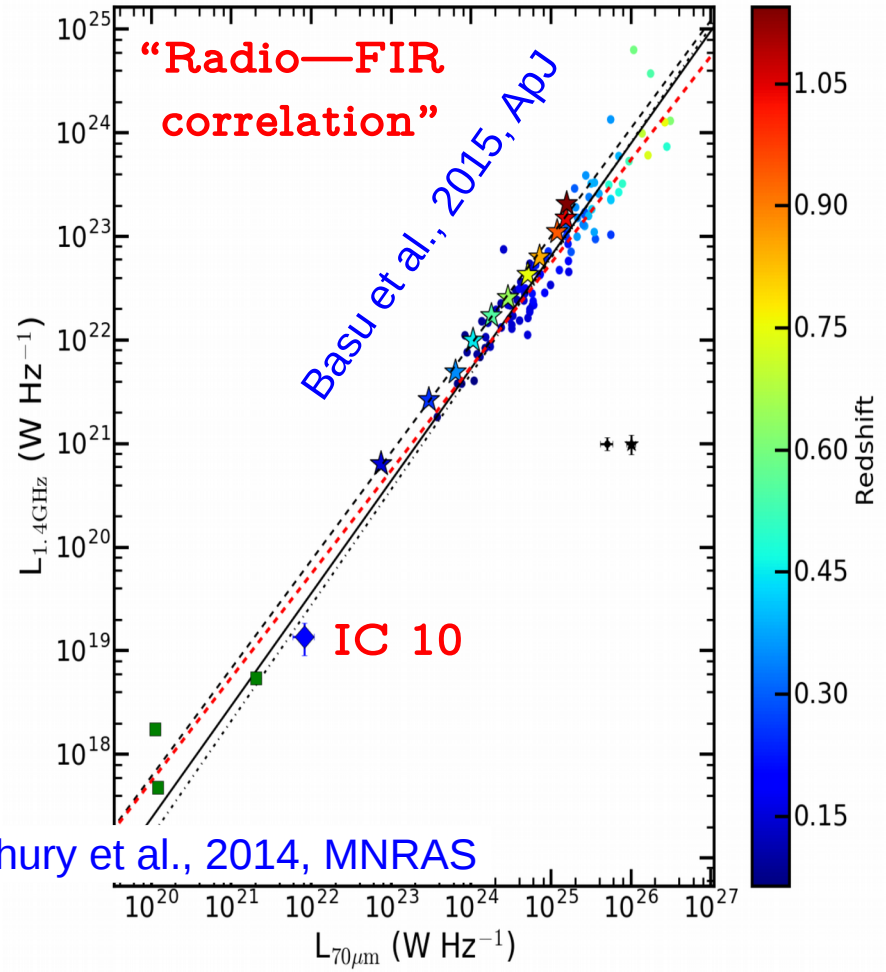
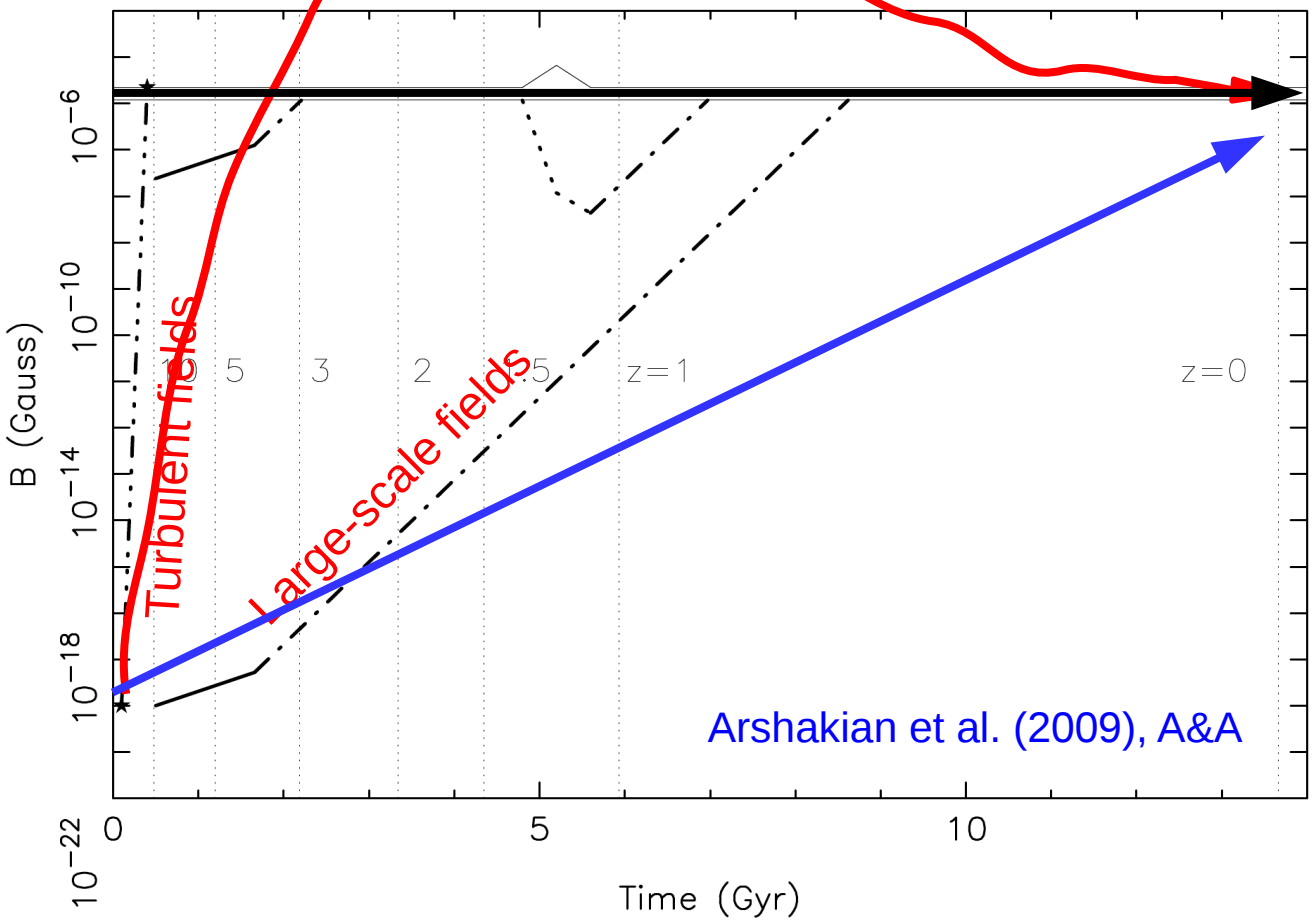


Roychowdhury et al., 2014, MNRAS

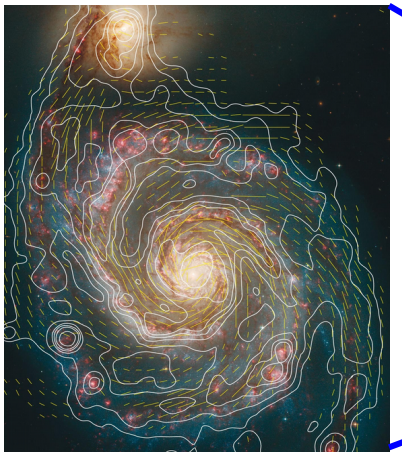
"Magnetic field — Gas density"

Cosmic evolution of magnetic fields

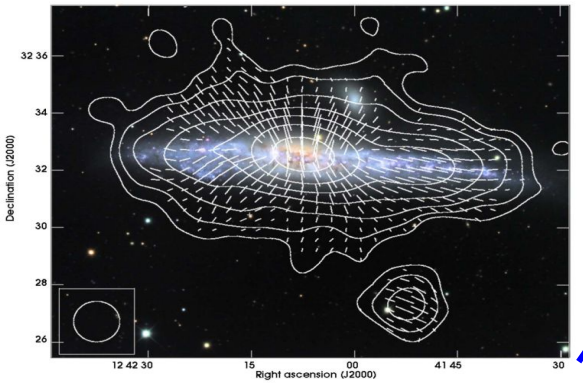
– Steady amplification?
– Follows cosmic SFR history?
– Primordial fields?

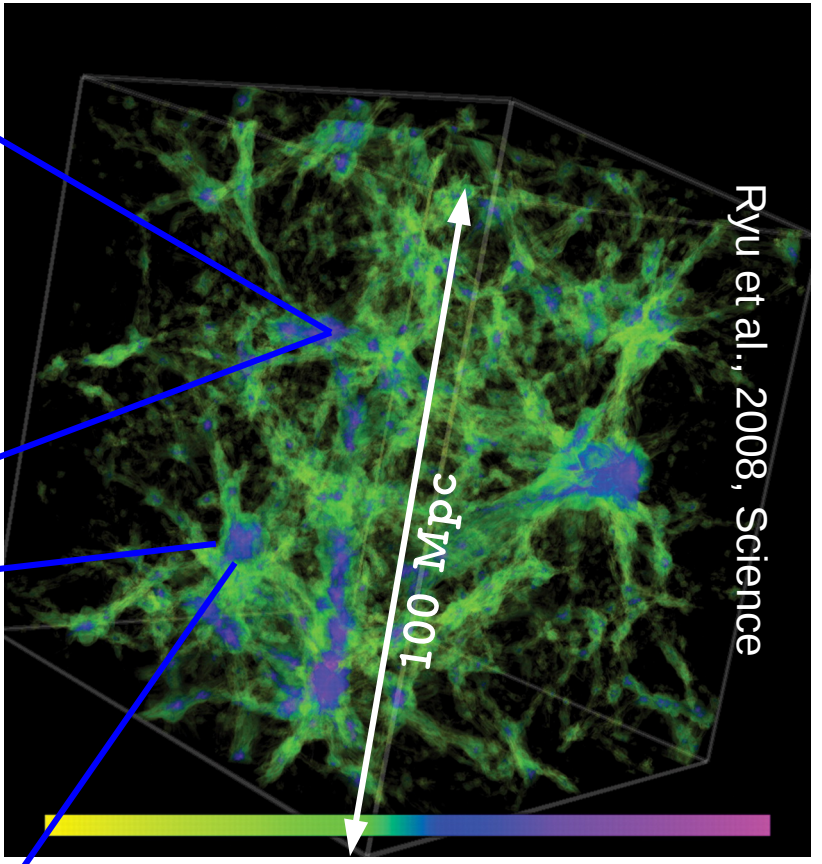


Cosmic magnetic fields



1—10 kpc

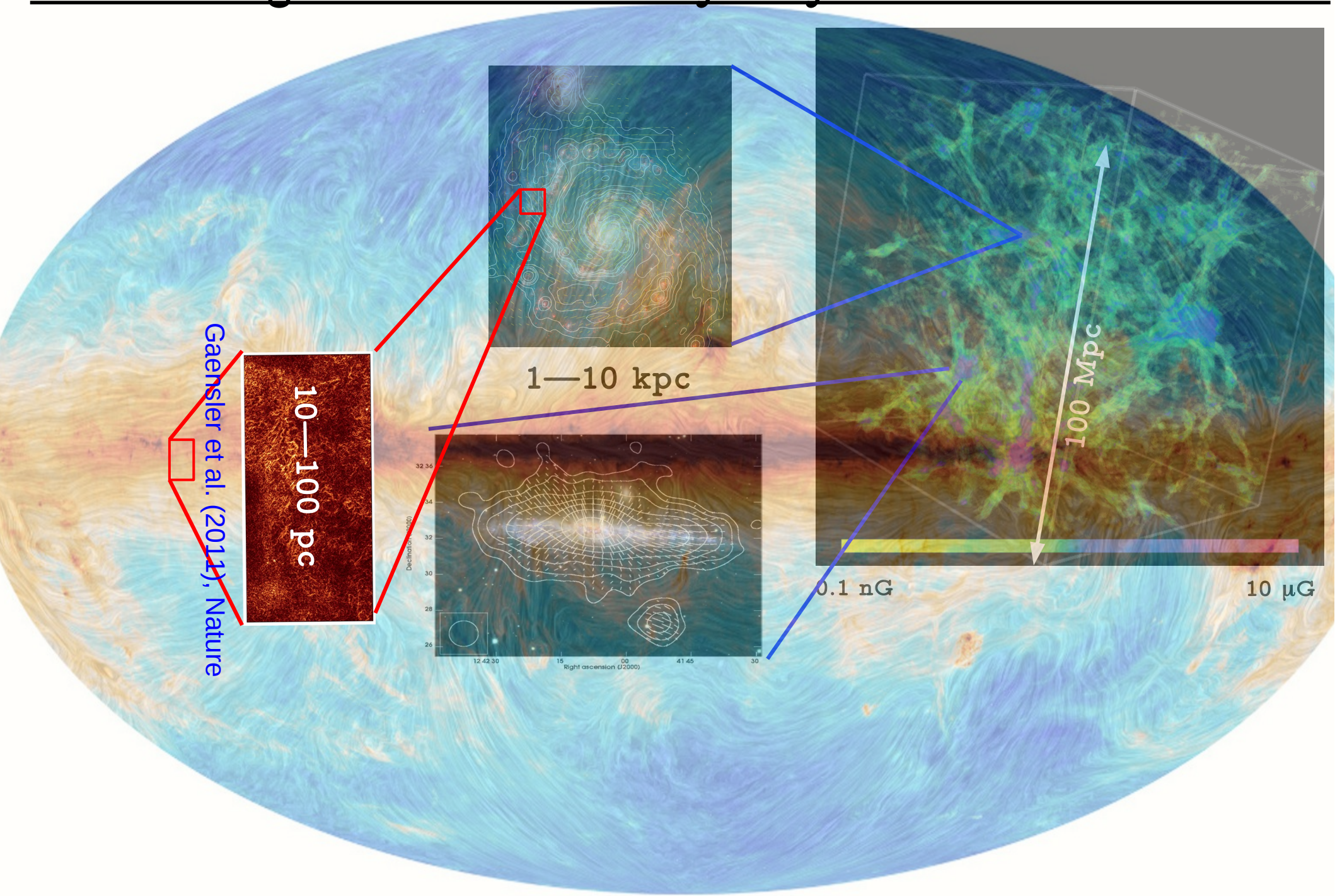




0.1 nG

10 μG

Cosmic magnetic fields + Milky Way



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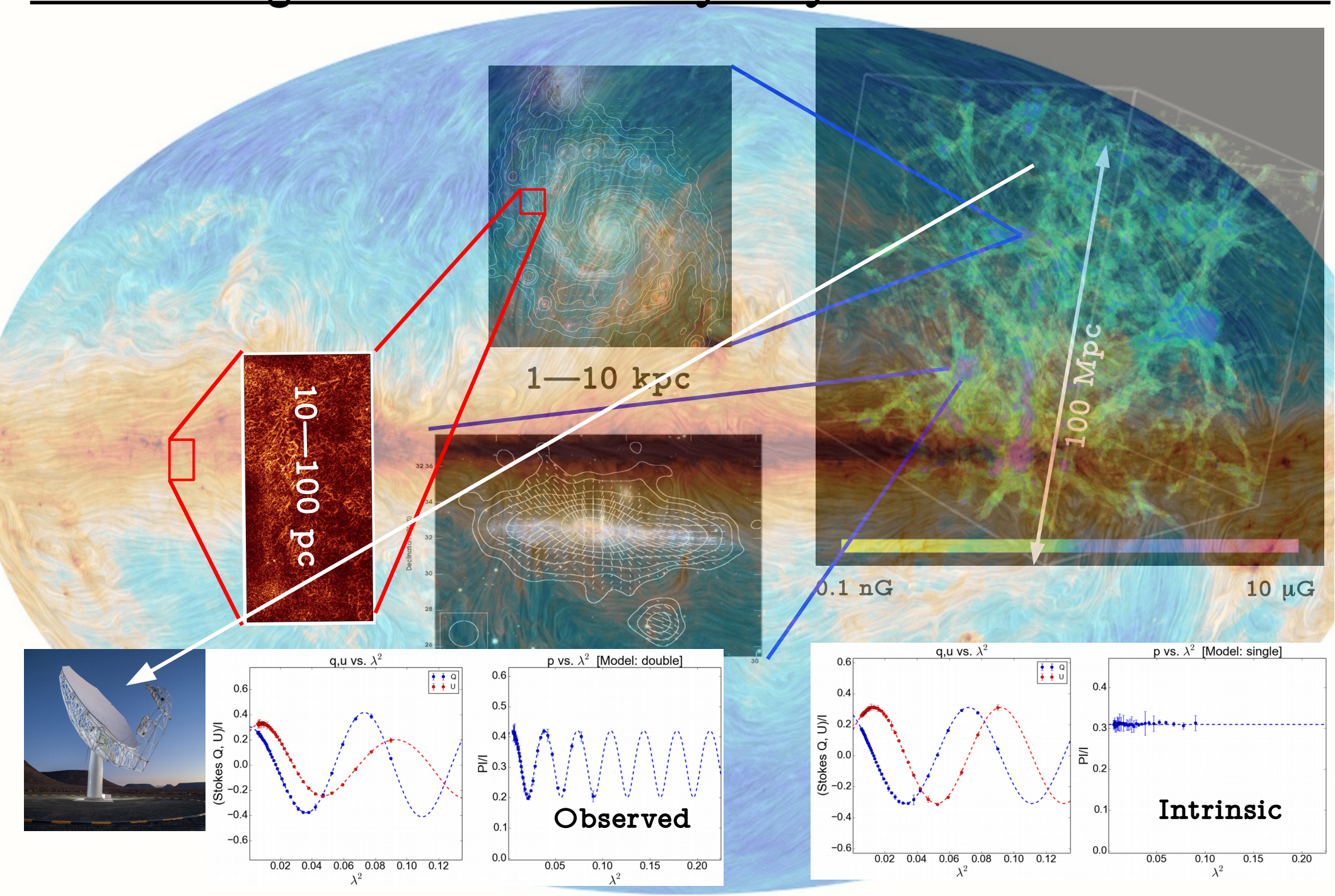
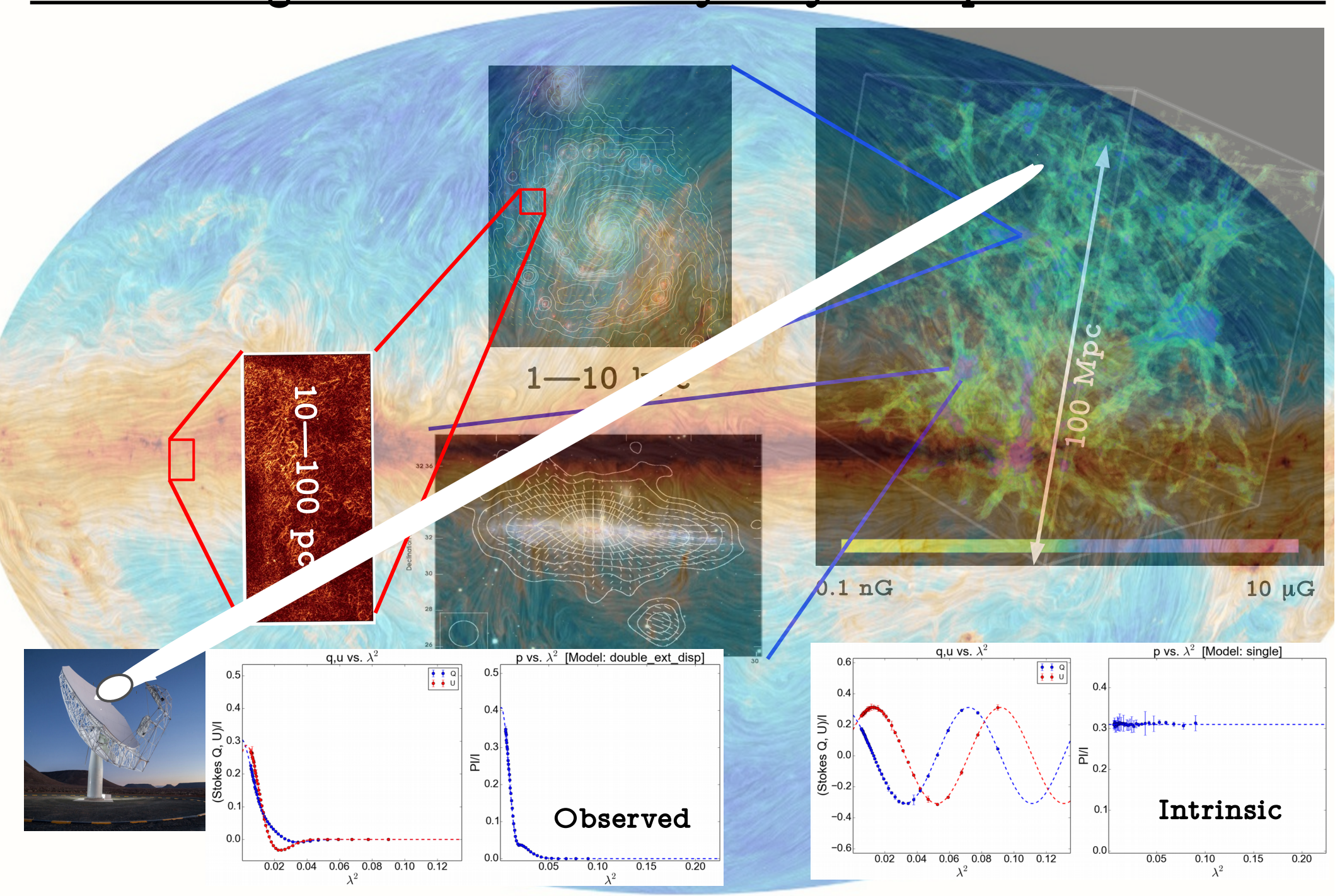


Cosmic magnetic fields + Milky Way + Depolarization



The MPIfR-MT SKA-prototype dish

Diameter: 15 m.

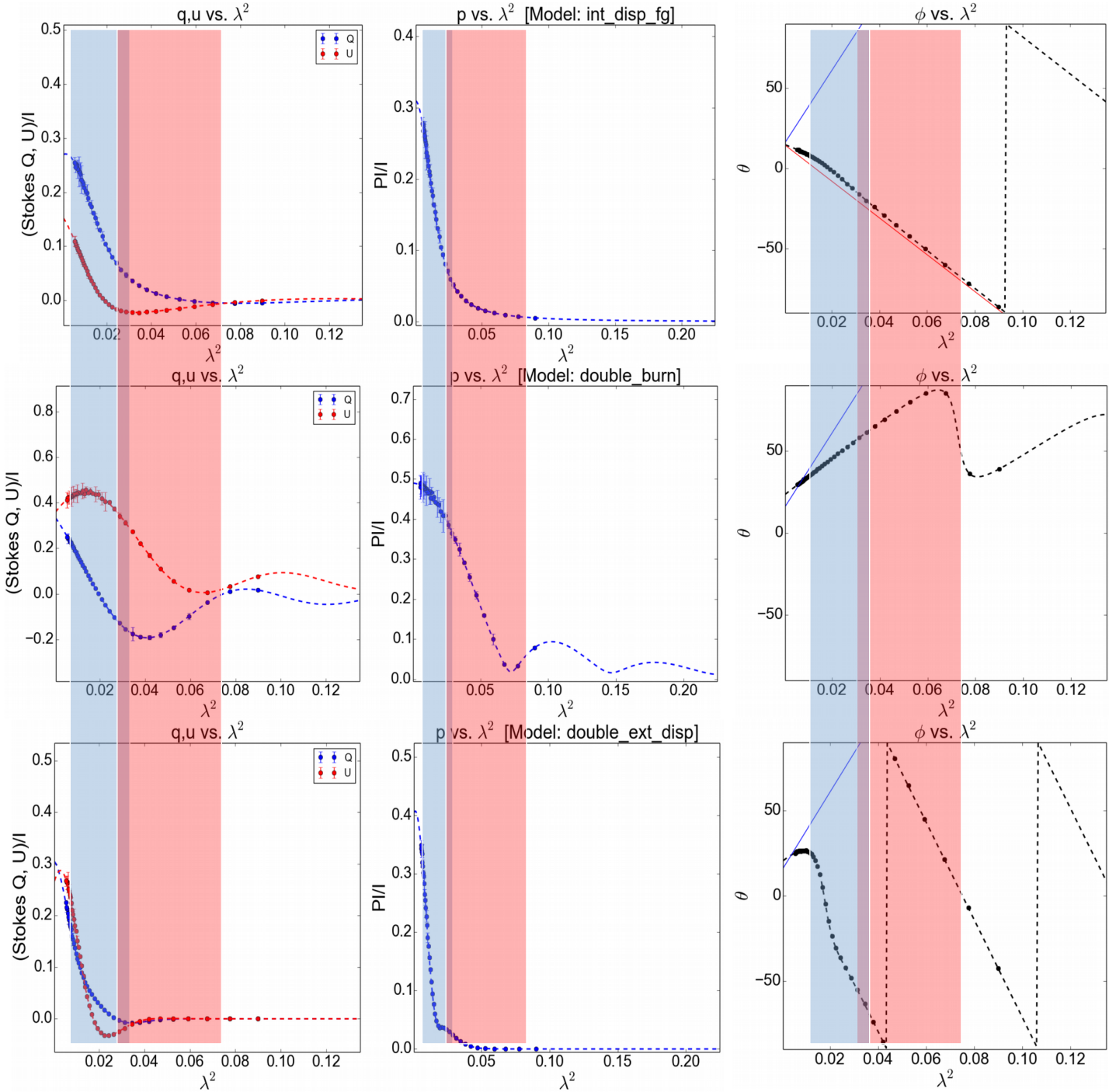
Frequency: 1.6—3.5 GHz (S-band).

T_{sys}/η: 25—30 K.

Beam: ~30 arcmin.

Confusion noise: ~70—100 mJy.

Where does S-band come in?



S-band

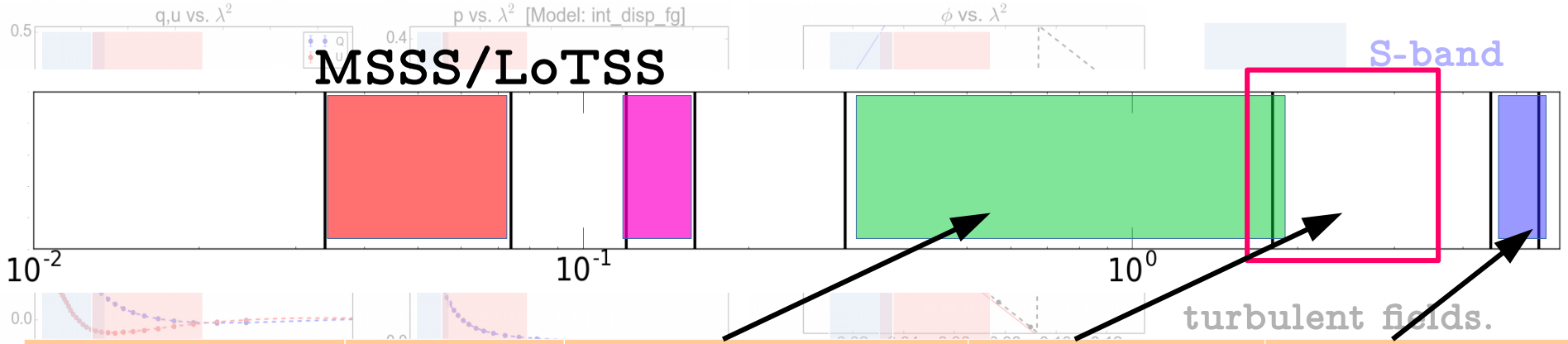
L-band

Rotation+Emission in turbulent fields.

Rotation+Emission in ordered fields.

Rotation by foreground turbulent fields.

Complimentary All Sky Surveys



SURVEYS	S-PASS	GMIMS (Parkes + STAPS + DRAO-26m)	SKA-prototype	C-PASS
Frequency	2.3 GHz	0.3—1.8 GHz	1.6—3.5 GHz	4.5—5.5 GHz
Resolution	9 arcmin	30—60 arcmin	25—30 arcmin	30—40 arcmin

+

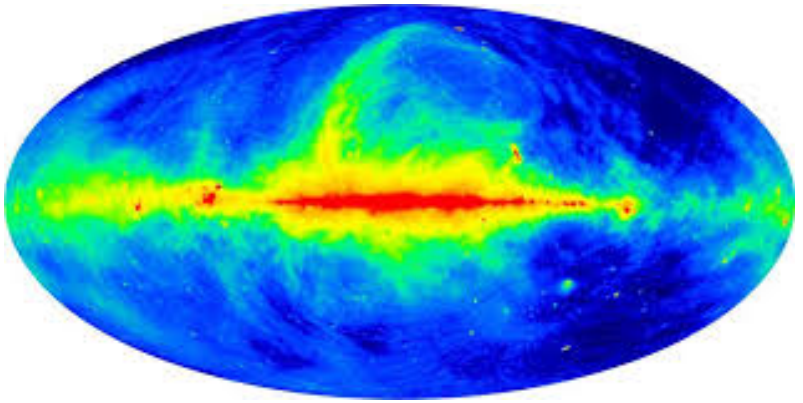
S-PASS ATCA survey of point sources (1.3—3.1 GHz)

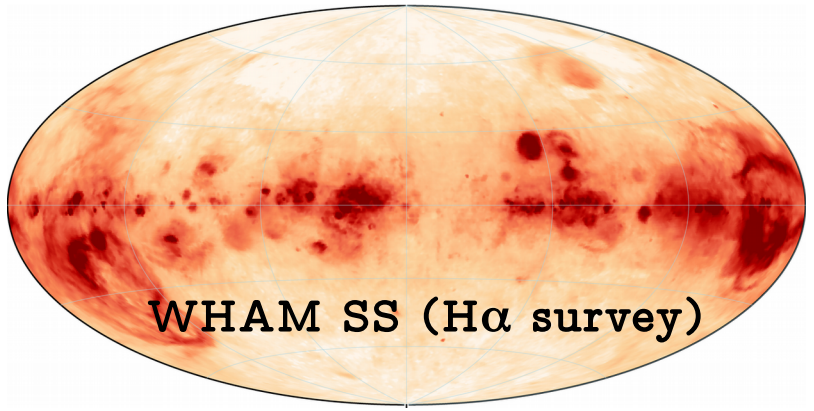
Schnitzeler et al. (in prep.)

Goals

Galactic synchrotron emission

- Thermal emission and free—free absorption





Haslam et al. (1982) Haffner et al. (2016)

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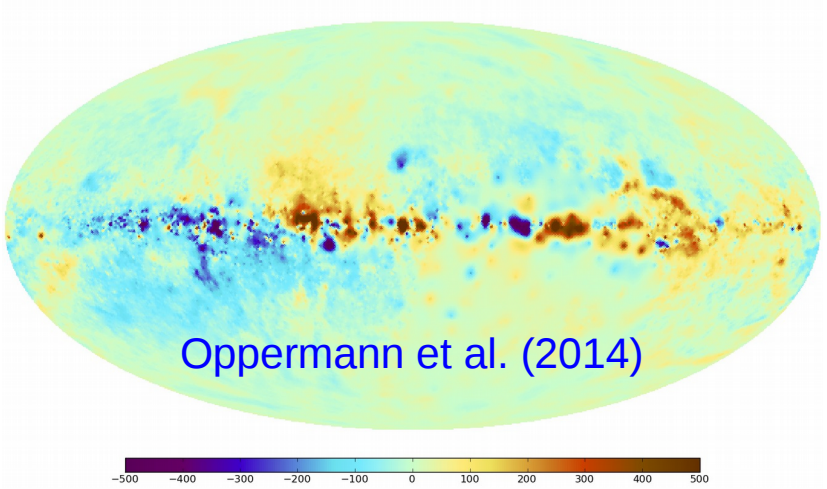
Haslam et al. (1982)

All sky Faraday depth and depolarization map

– Directly from emission
– Stokes Q,U fitting



Haffner et al. (2016)

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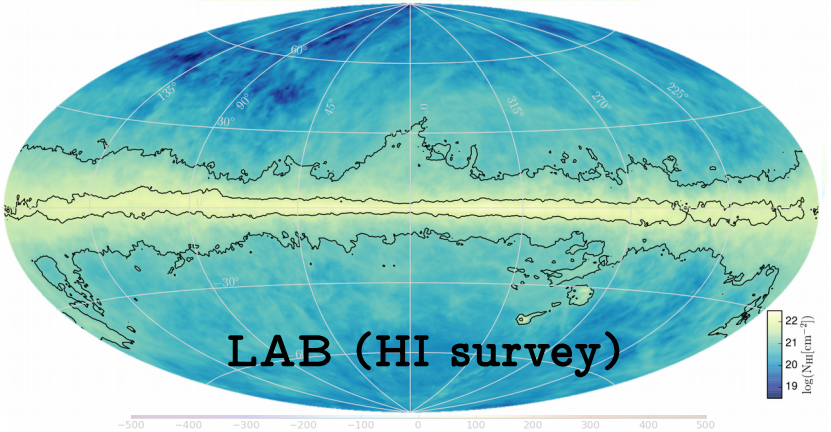
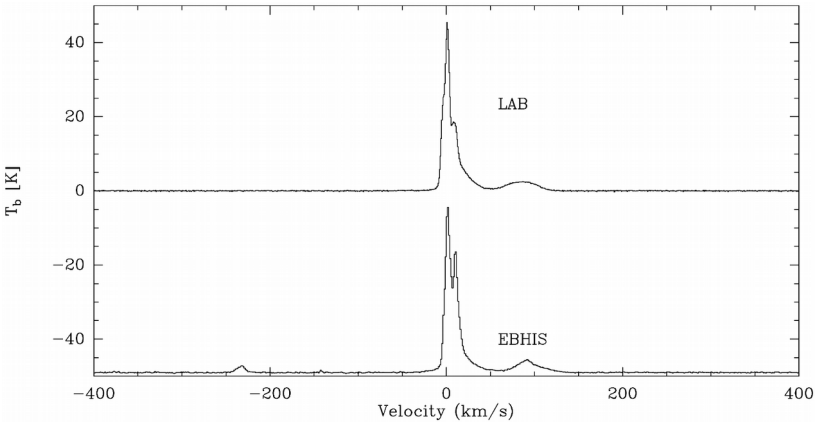


Haffner et al. (2016)

Origin of the Faraday rotating medium

– Cold, warm or hot medium
– Where does the large-scale field reside?



Survey requirements

Primary beam characterization

- **Frequency dependence**
- **Polarization stability (off-axis leakage)**
- **RFI**

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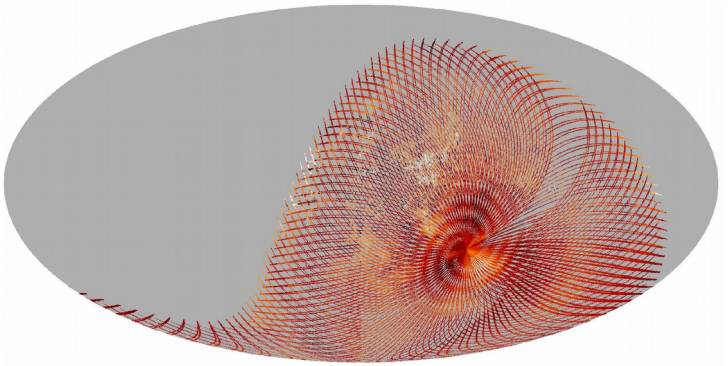
Survey strategy

- **Speed and calibration!**
- **Scanning strategy**
  - **Basket weaving**
  - **Lissajous figure**
  - **Azimuth scans+Earth rotation**



S-PASS PI: E. Carretti

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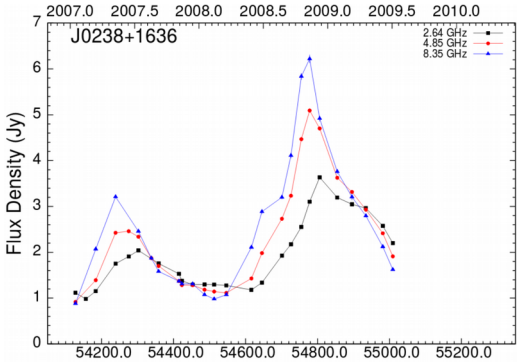
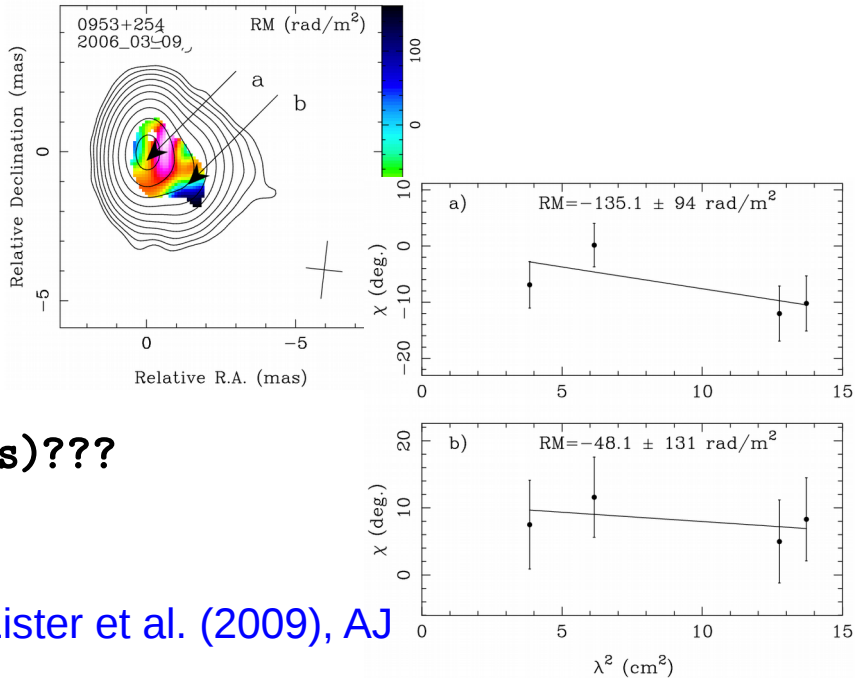
Monitoring of F-Gamma sources



Fuhrmann et al. (2016), A&A

Follow-up of Mojave sources



Lister et al. (2009), AJ

Opening up Transient/Variability capabilities

- **AGNs (hand picked blazars, BL Lac objects)???**
- **Cadence???**

Summary

The MPIfR-MT SKA-prototype dish can deliver polarization science of high importance!

High quality ancillary multiwaveband data are (soon to be) available!

- Thermal/non-thermal emission separation
- Warm and cool neutral medium
- Cold dust emission
- PLANCK galactic synchrotron emission

Will provide the much required complimentary information

- Sensitive to polarized emission from a much larger volume of the ISM
- Sensitive to Faraday depths up to ~5×10^4 rad m^{-2}
- High Faraday depth resolution ~5 rad m^{-2} when combined

Stay tuned!