

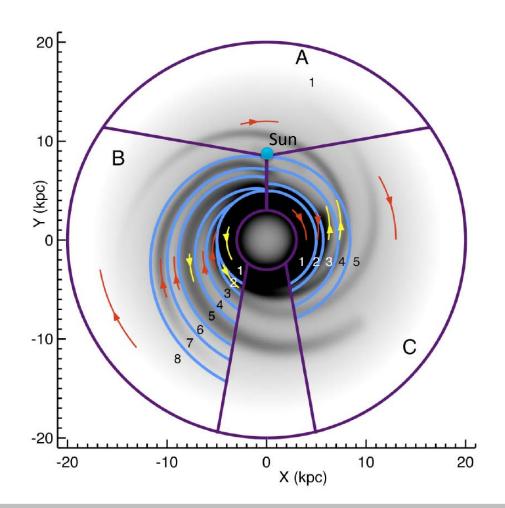
# Future polarization observations at high frequency

**Ettore Carretti** ATUC meeting, Parkes Science Day – 4 December 2013

CSIRO ASTRONOMY AND SPACE SCIENCE www.csiro.au

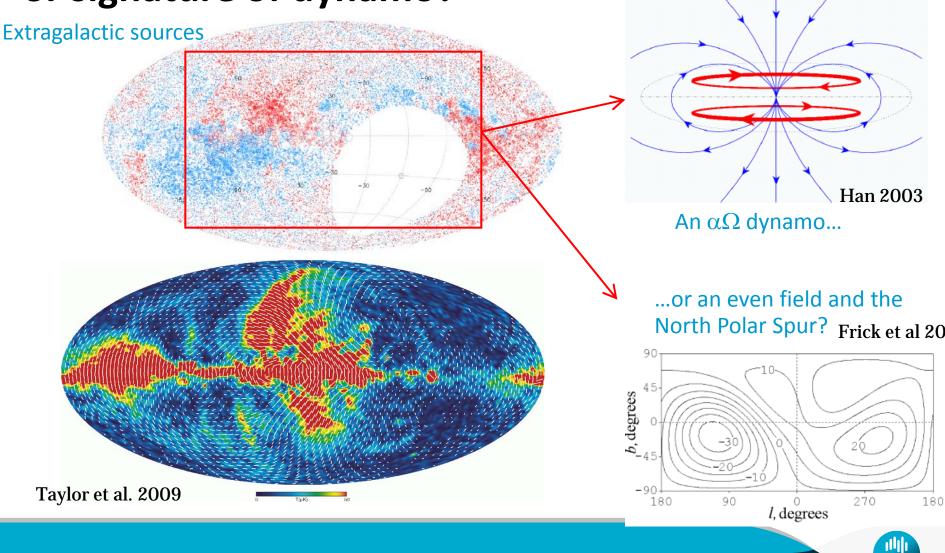


#### **Galactic Disc magnetic field**

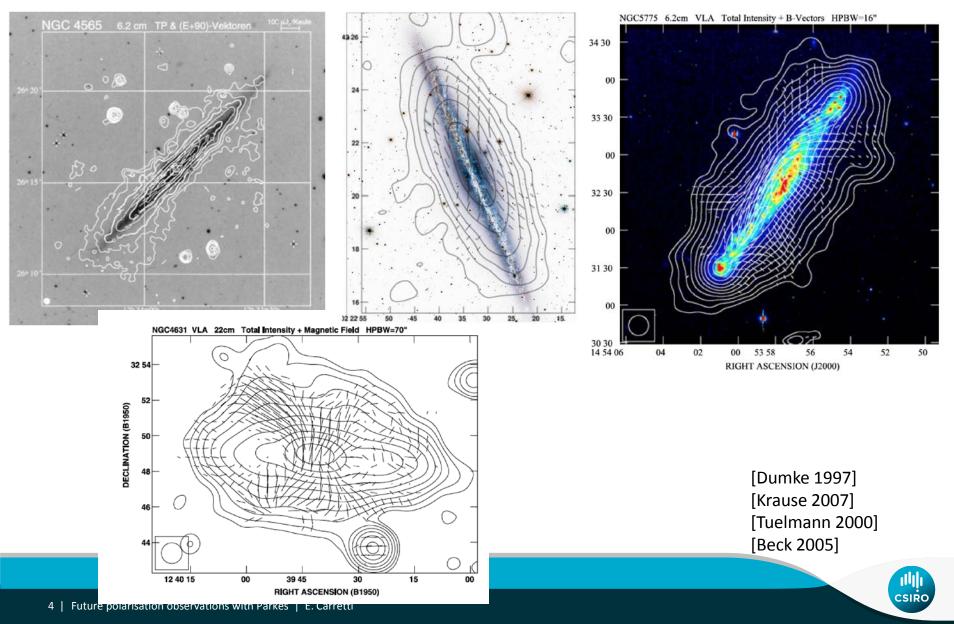




## Anti-symmetry in the inner Galaxy: local structure or signature of dynamo?



#### Halo magnetic field: external galaxies



### Why Diffuse Polarized Emission?

- Compact sources RM: only B parallel (to the line of sight)
- Diffuse emission: polarized emission
  - Diffuse polarized synchrotron emission
  - to probe the ordered magnetic field
  - Faraday Rotation (RM)  $\Rightarrow$  B parallel to the line of sight
  - Synchrotron polarisation angles  $\Rightarrow$  B perpendicular
  - B and ISM turbulence (RM)
  - Galactic structure
- Multiple MIM layers info encoded in
- ... but harder to extract!
- RM maps has higher resolution than those with sources



#### What has been done

- 3 Southern surveys completed (Parkes)
  - 300-480 700-900 MHz (GMIMS Parkes)
  - 1300-1800 MHz
  - 2200-2400 MHz

- (STAPS Parkes)
- (S-PASS -- Parkes)

#### **Polarisation surveys: 1.4 GHz**

- ALL SKY maps at 1.4 GHz, FWHM ~ 36'
- FR modifications:
  - Galactic Disc strongly depolarised |b| < 30°
  - FR modification
  - at |b|<50°

#### V

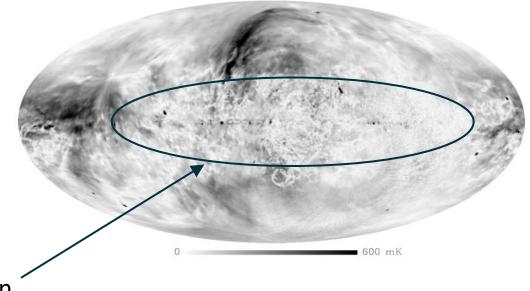
1.4 GHz: not sufficient

#### ↓

• Higher frequency!!

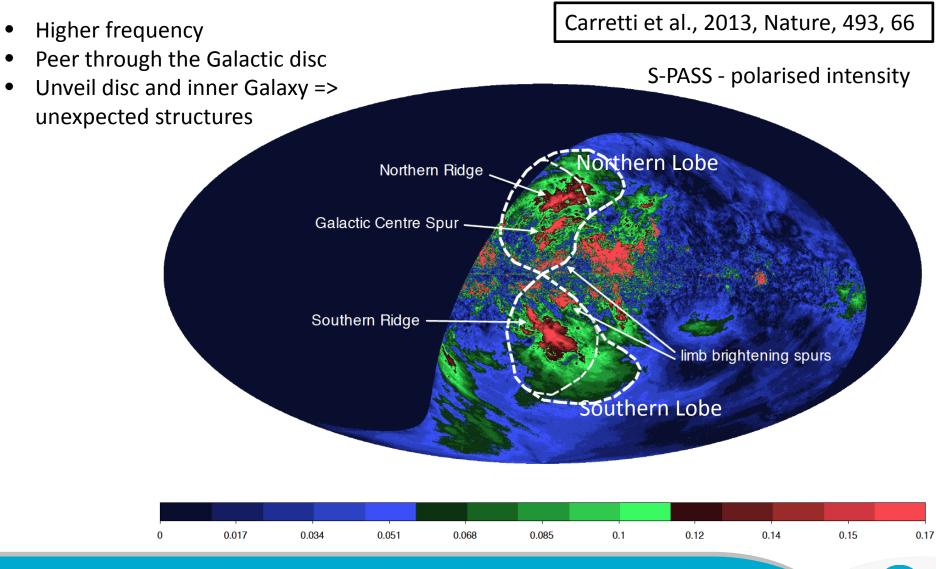
depolarization

1.4 GHz (DRAO + Villa Elisa)



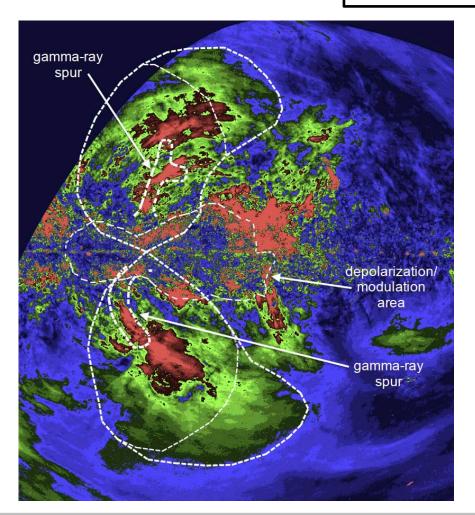


#### **Polarisation surveys: 2.3 GHz**



#### **Polarized radio lobes**

Carretti et al., 2013, Nature, 493, 66



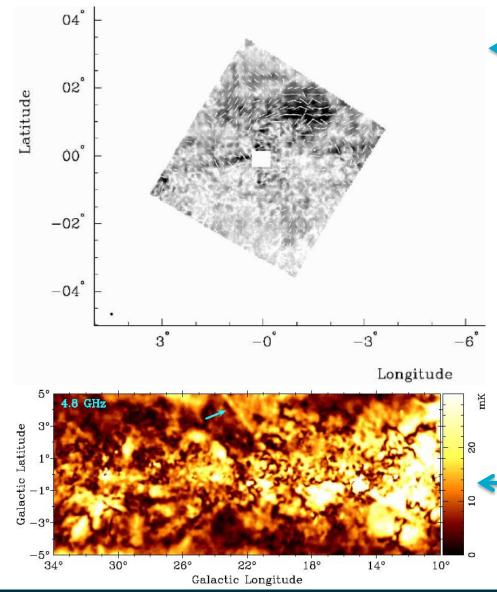


#### Depolarization area: Radio and $H_{\alpha}$

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#### **Polarised emission at 5 GHz**



4.8 GHz: Galactic Centre area still depolarised [Duncan+, 1998, MNRAS, 299, 942]

- Galactic plane emission starts to appear at 5 GHz
- But still depolarisation and Faraday modulation.

4.8 GHz Sino-German Galactic Plane survey (I > 10 deg) [Sun+, 2013, arXiv:1310.8344]



## High frequency polarisation observations (1)

- To complete low frequency mapping (not subject of this talk)
- 1.4 GHz => 2.3 GHz unexpected huge Galactic polarisation structures.
- Going up in frequency has shown us fundamental structures, but invisible at 1.4GHz
- Inner Galaxy at |b| < 5-10° still depolarised at 2.3 GHz
- Observations at 5+ GHz to unveil the emission from:
  - The Galactic plane.
  - The inner Galaxy spiral arms.
  - The Galactic Centre area and the Bulge (8+ GHz).



## High frequency polarisation observations (2)

- How the Milky Way lobes connect to the Galactic Centre?
- What's the polarised emission (and magnetic field) structure on the Galactic Plane?
- What's the polarised emission structure in the spiral arms?
- How the Galactic bar connect to the spiral arms?
- What's the structure and the magnetic field in the GC area?
- Lesson from S-PASS: discovering the unexpected



### What done and what to do.

- 3 Southern surveys completed (Parkes)
  - 300-480 700-900 MHz (GMIMS Parkes)
  - 1300-1800 MHz (STAPS Parkes)
  - 2200-2400 MHz (S-PASS -- Parkes)
- To complete
  - 700-900 MHz with better sensitivity (ASKAP and Galactic physics)
  - 900-1300 MHz
  - 1800-2200 MHz
  - 2400-4000 MHz
  - 4000-12000+ MHz

Gray: not this receiver

Black: science for the UWB high frequency



#### **Summary**

- Inner Galaxy and Galactic plane still depolarized at 2.3 GHz
- Need to go to higher frequencies
- At least 5-6 GHz,
- 8+ GHz for the Inner Galaxy.
- Component separation: 4-12 GHz
  - Polarisation => synchrotron
  - Total intensity:
    - Two components: synchrotron and free-free
    - Free-free emission leads emission budget on the plane at high frequencies
  - 4-12 GHz => precise frequency behaviour
  - Able to discriminate the two components



## Thank you

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