

Radio constrains on Galactic magnetic field

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Magnetic workshop, CASS, 7.5.2012

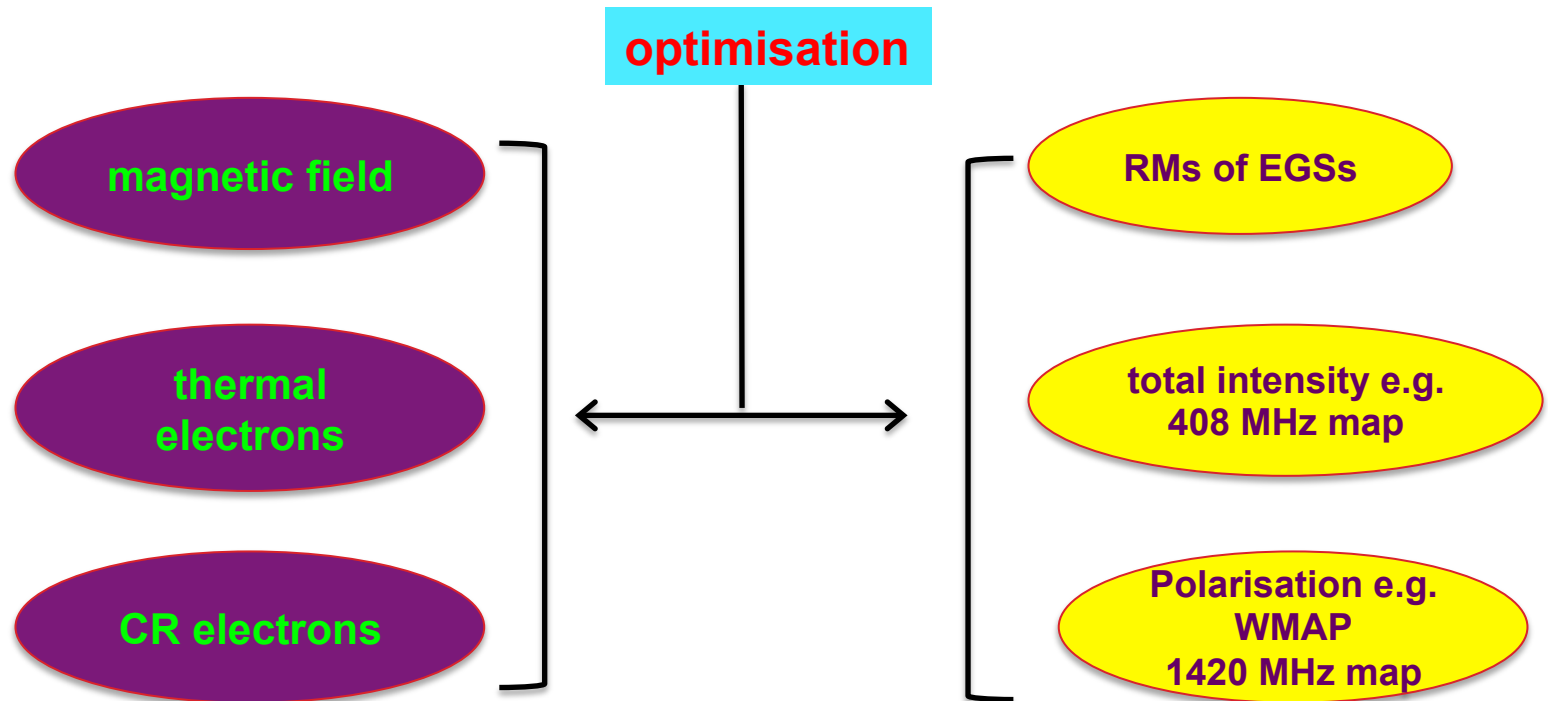


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- **Polarization of starlight:** perpendicular field in 2 or 3 kpc
orientation // $B_{\perp}$ ----- 9000 +? stars
- **Polarization at infrared, mm, submm:** perpendicular field
orientation // $B_{\perp}$ ----- clouds or regions
- **Zeeman splitting:** parallel field, in situ (masers, clouds)
 $\Delta \nu \propto B_{\parallel}$ ----- 137 maser regions & 17 clouds
- **Synchrotron radiation:** vertical field structures (added)
total intensity $S \propto B_{\perp}^{2/7}$, $p\% \propto B_{\perp u}^2 / B_{\perp t}^2$
- **Faraday rotation:** parallel field, integrated (the halo & disk)
 $RM \propto \int n_e B_{\parallel} ds$ ----- 1024 pulsars + >3000 EGSSes



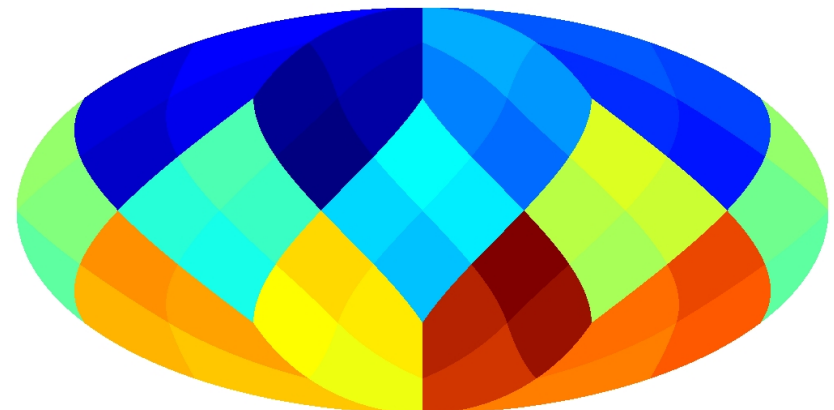
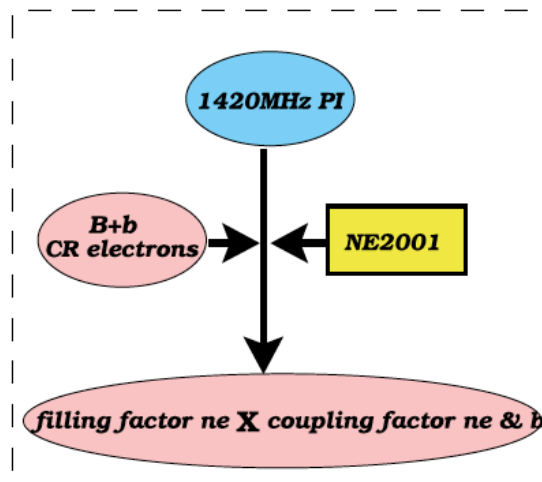
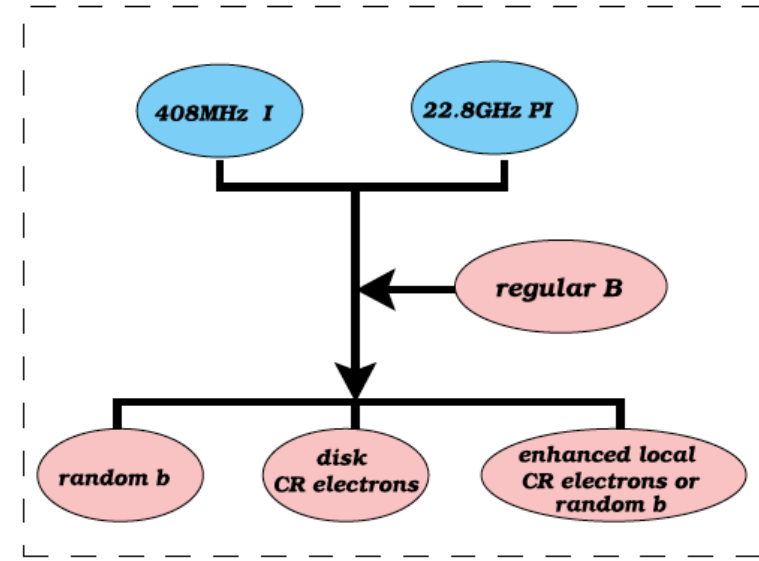
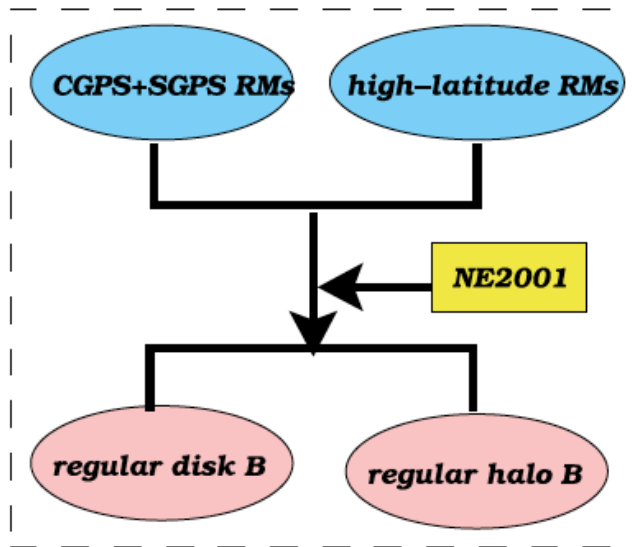
Synchrotron radiation and RM



Jaffe et al. (2010); Jansson & Farrar (2012)



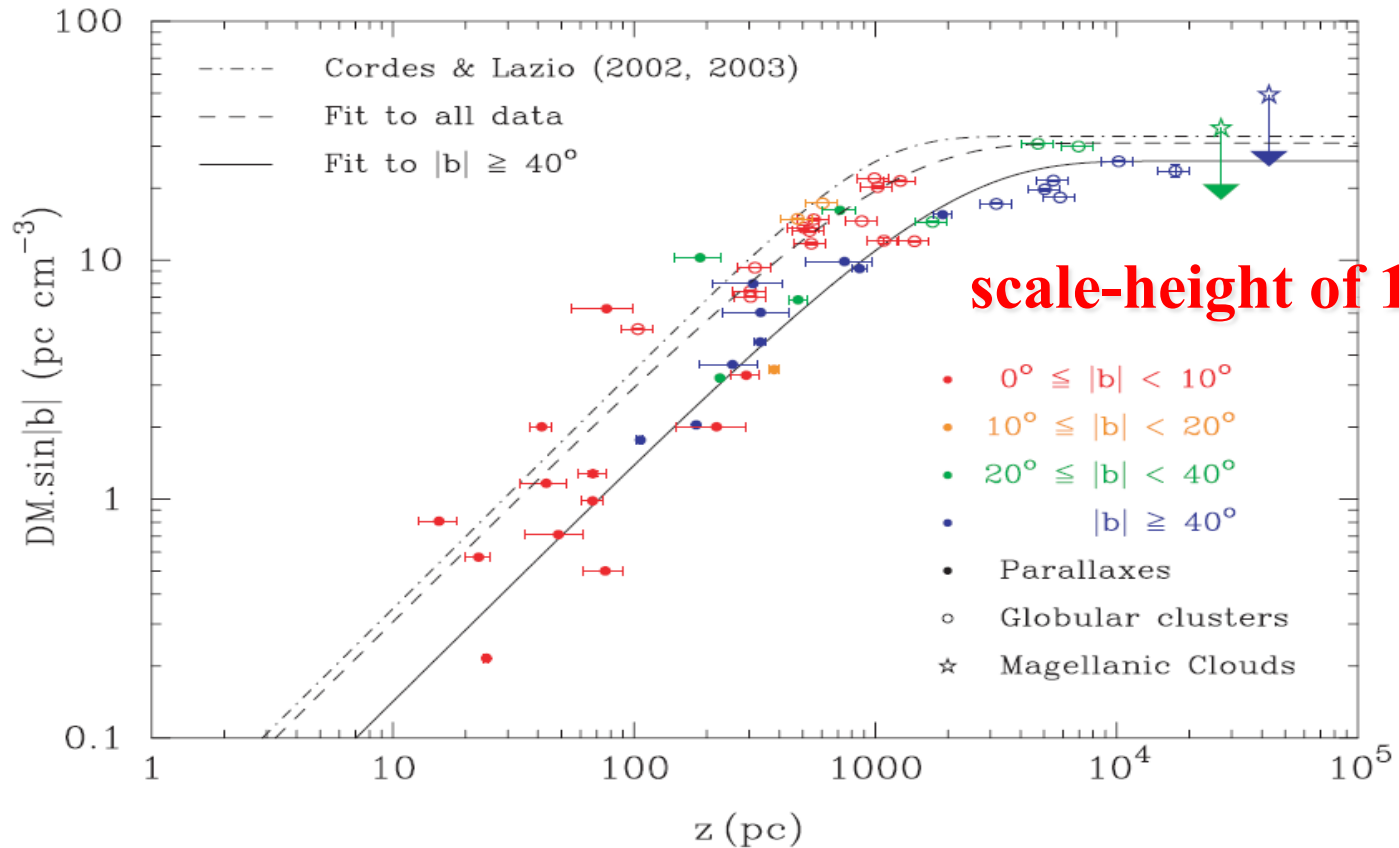
Synchrotron radiation and RM



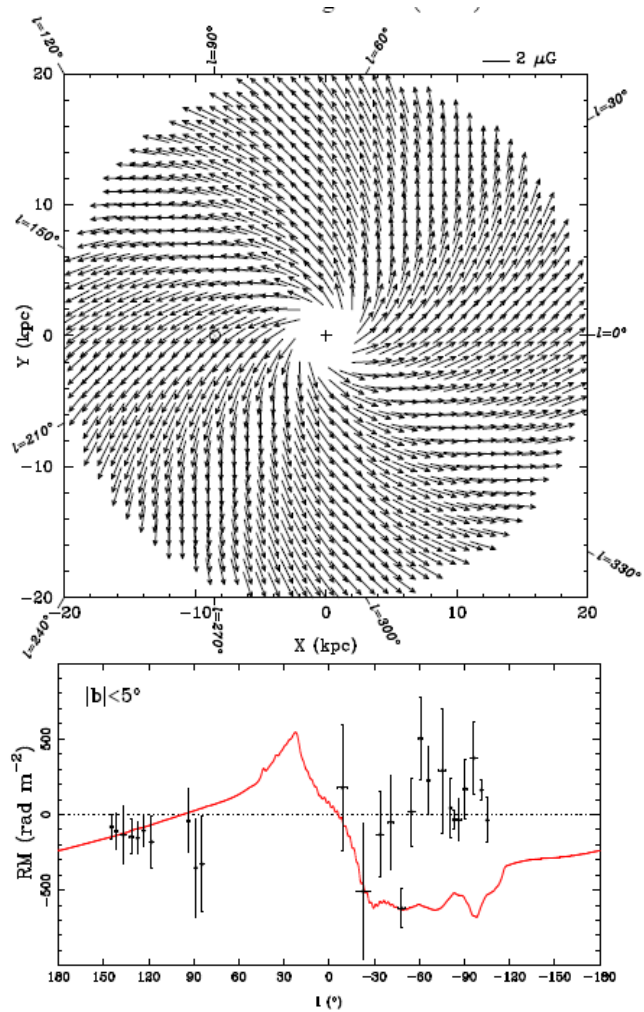
Sun et al. (2008); Sun & Reich (2010)

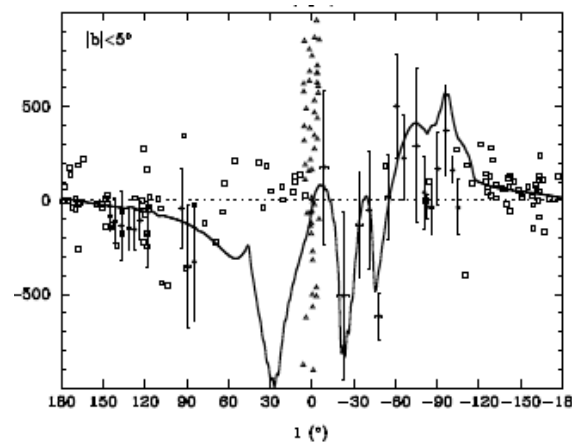
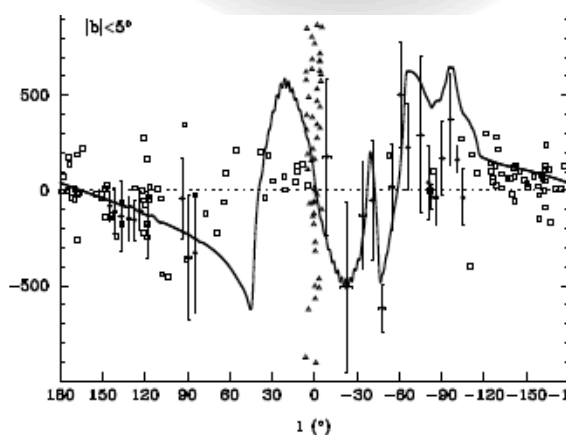
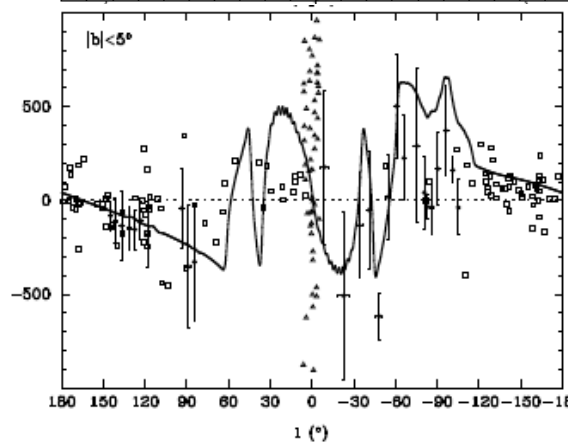
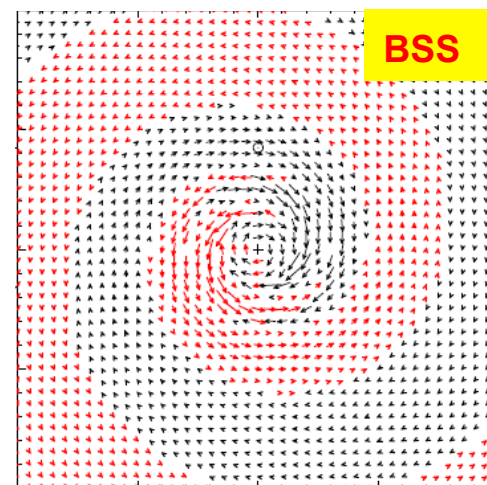
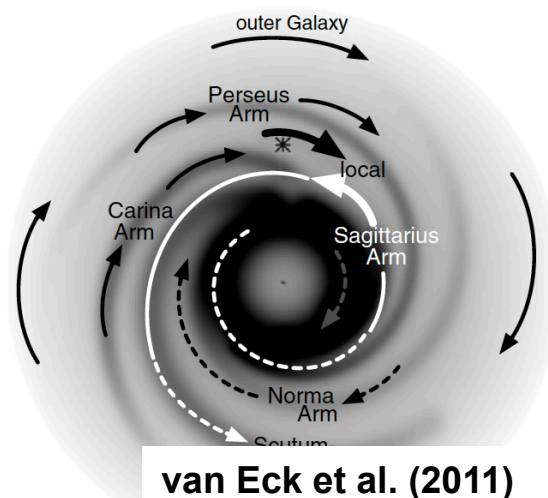
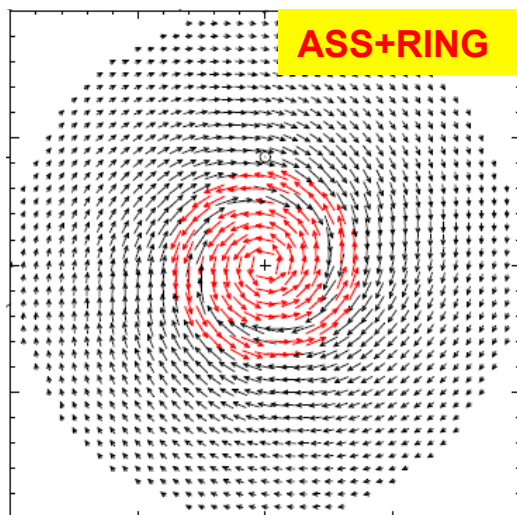


Thermal electron density



Gaensler et al. 2008

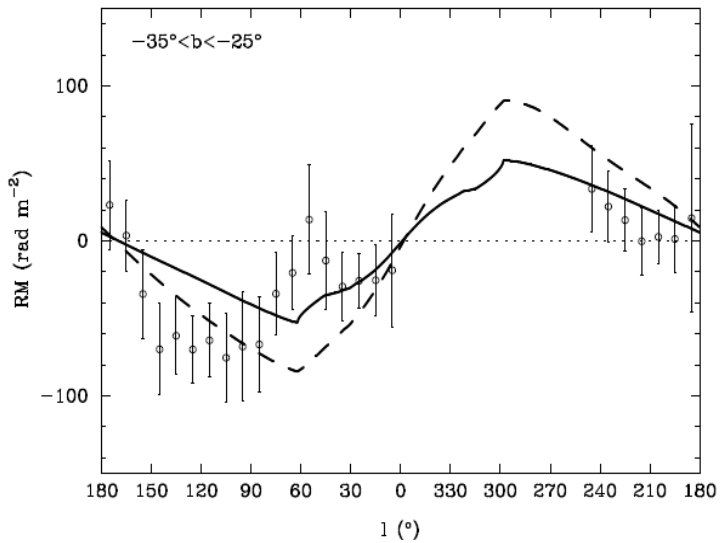
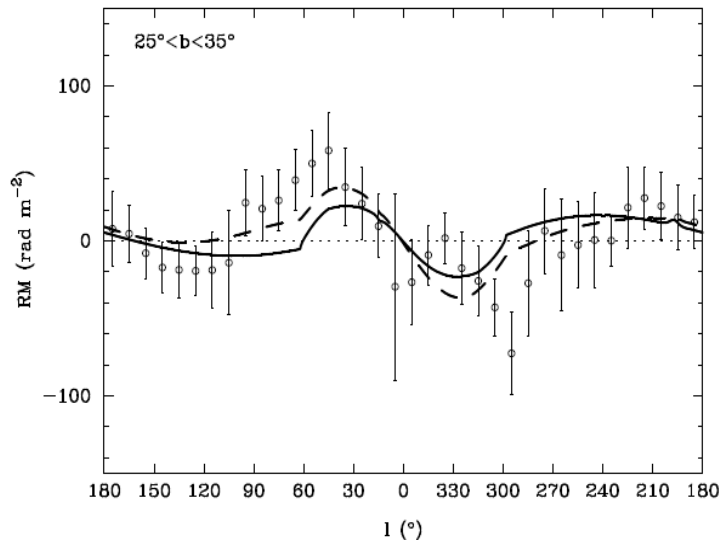
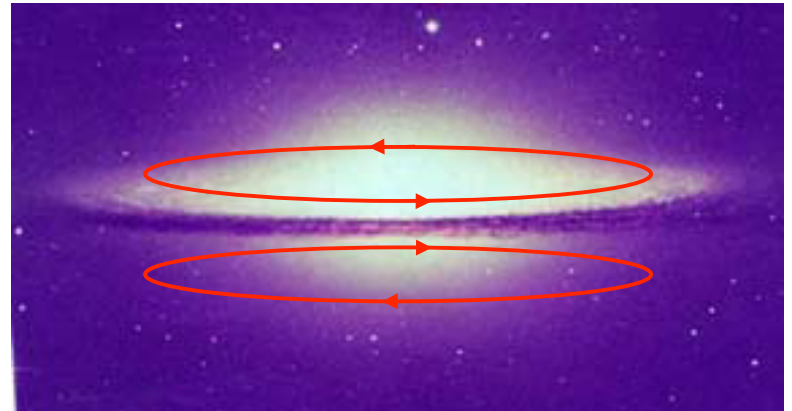
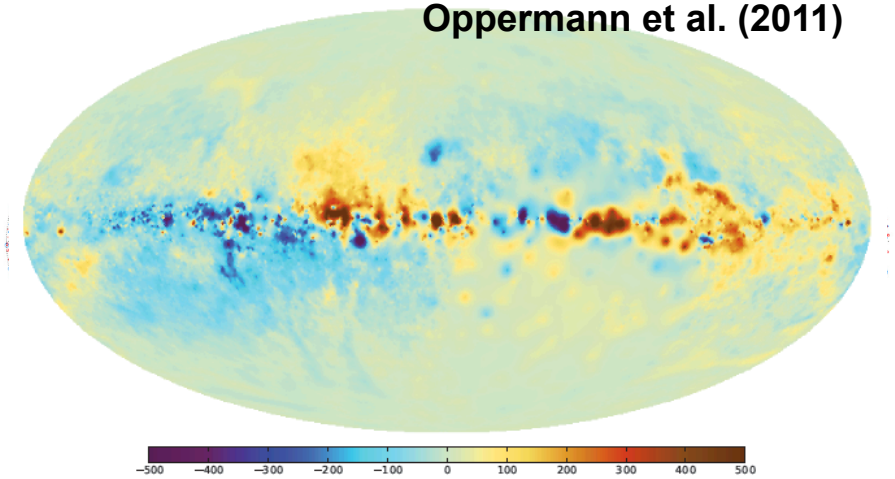




$B_0 = 2 \mu\text{G}$ $z_0 = 1 \text{ kpc}$ Sun et al. (2008); Sun & Reich (2010)



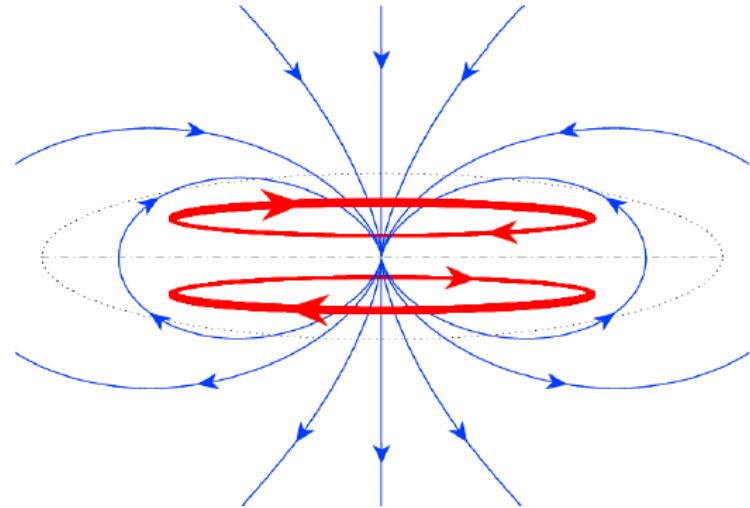
Oppermann et al. (2011)





Halo field: no poloidal component

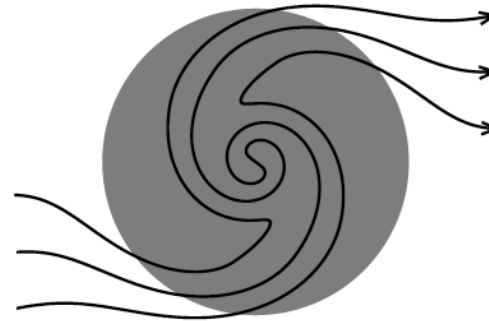
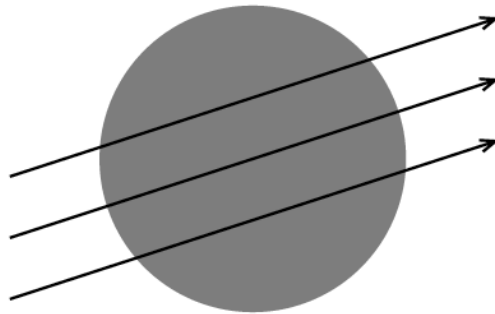
- Han & Qiao (1994)
0.2-0.3 μG
- Taylor et al. (2009)
0.3 μG $z < 0$
-0.14 μG $z > 0$
- Mao et al. (2010)
0.0 $\pm$ 0.5 rad m^{-2} north
+6.3 $\pm$ 0.7 rad m^{-2} south



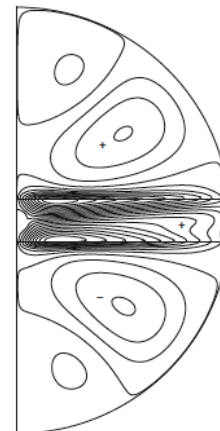
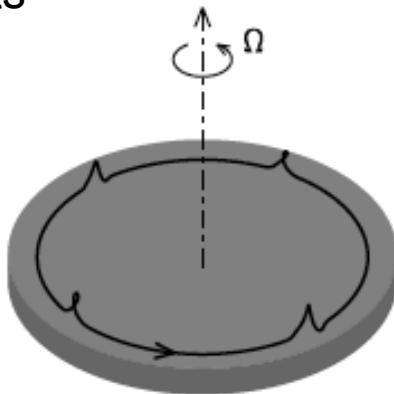
Han (2002)



Disk: stretching of magnetic field lines by large-scale differential rotation



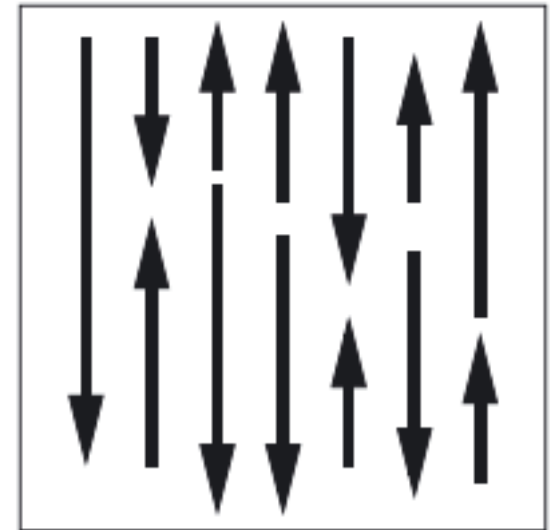
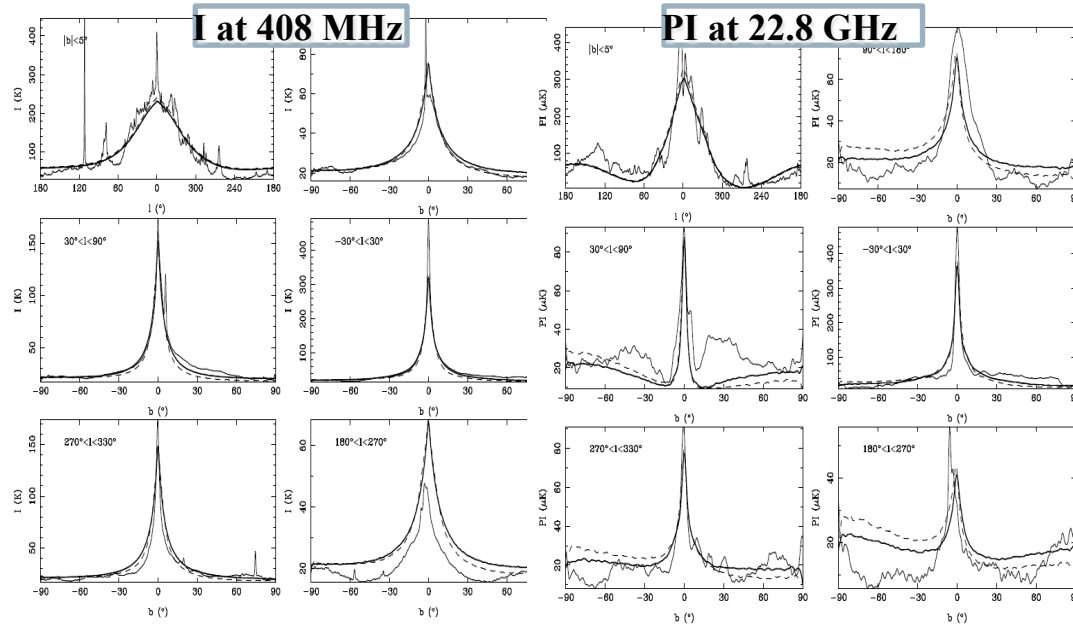
Halo: α -effects



Moss et al. 2010

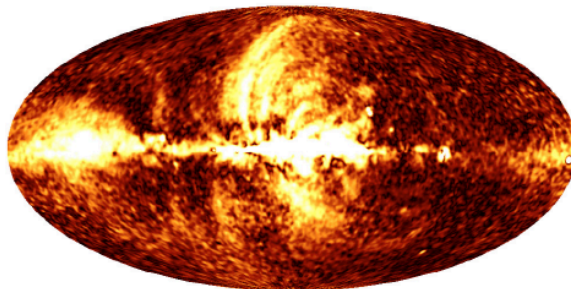


3 μG homogenous

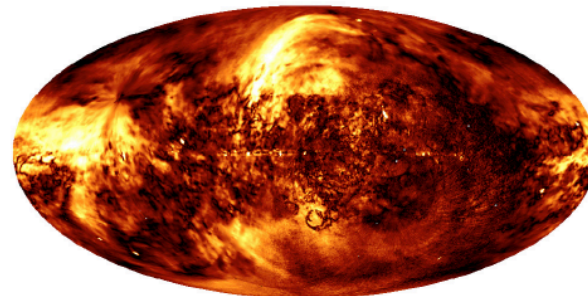


Jaffe et al. (2011)

correlated with ne



WMAP (Gold et al. 2009)



1.4 GHz (Wolleben et al. 2006; Testori et al. 2008)

› Disk field:

ASS + 1 reversal following either ring or arm

local field strength: $2 \mu\text{G}$

scale-height: 1 kpc

› Halo field:

toroidal opposite below and above the plane

maximum field strength: $\sim 2 \mu\text{G}$

› Random field:

homogeneous

strength: $3 \mu\text{G}$