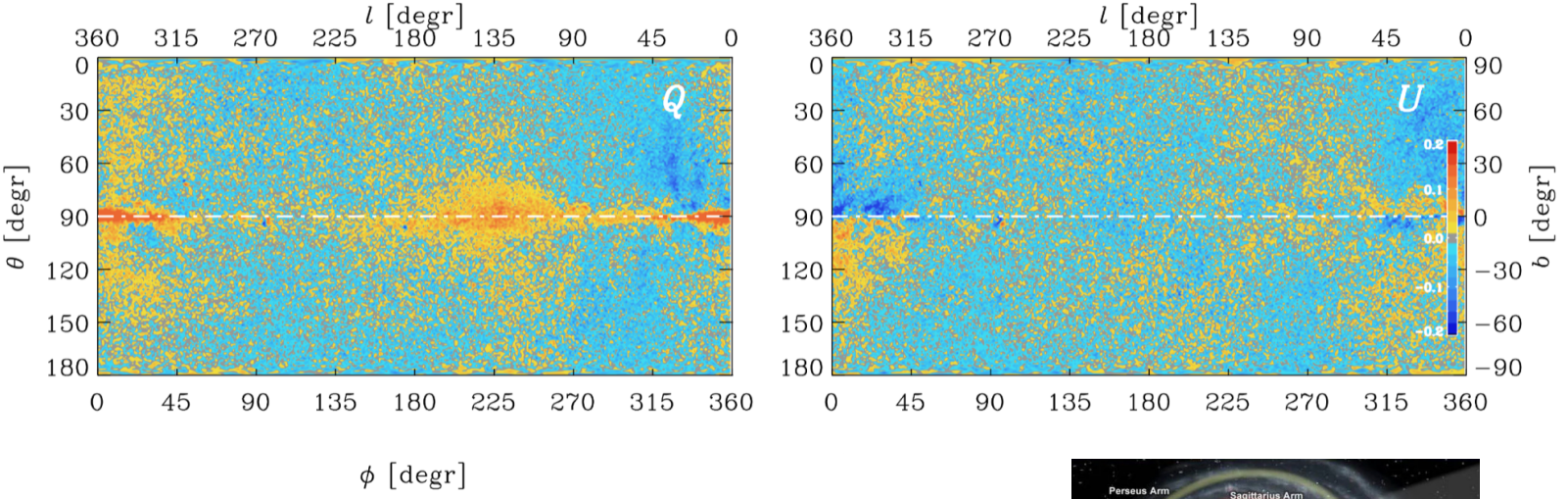
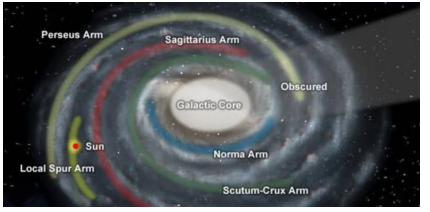
The Astrophysical Journal Letters, 896:L14 (7pp), 2020 June 10 https://doi.org/10.3847/2041-8213/ab974a

Hemispheric Handedness in the Galactic Synchrotron Polarization Foreground

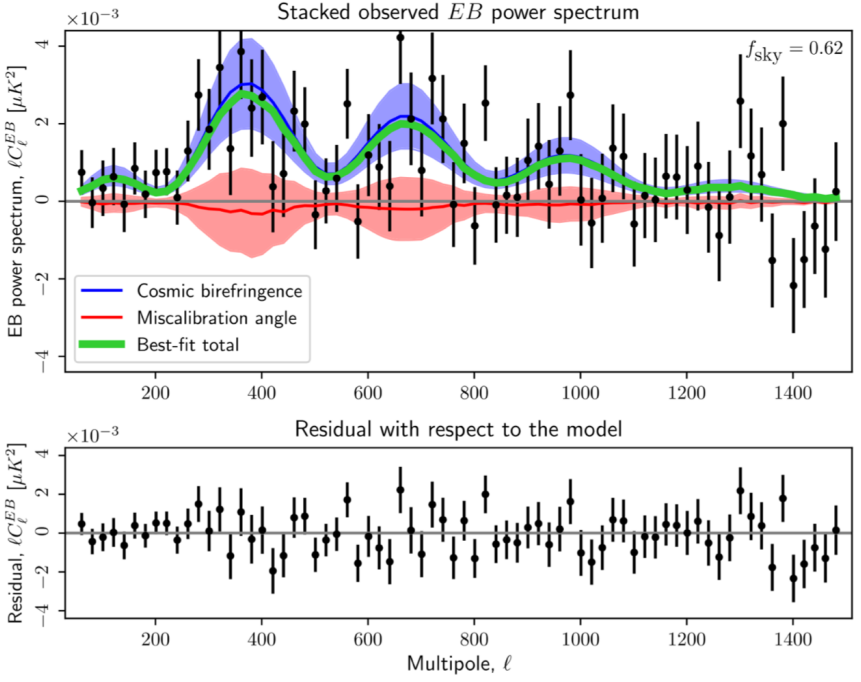
Axel Brandenburg[1,2,3,4] and Marcus Brüggen[5]
[1] Nordita, KTH Royal Institute of Technology and Stockholm University, Roslagstullsbacken 23, SE-10691 Stockholm, Sweden; brandenb@nordita.org
[2] Department of Astronomy, AlbaNova University Center, Stockholm University, SE-10691 Stockholm, Sweden
[3] JILA and Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO 80303, USA



Are there more subtile differences between north & south?
And why I think it has to do with our Galactic spiral!



EB correlation from helical magnetic fields?



ELSEVIER

Available online at www.sciencedirect.com
ScienceDirect
New Astronomy Reviews 51 (2007) 275–280

New Astronomy Reviews
www.elsevier.com/locate/newastrev

Cosmic magnetic fields and the CMB

Ruth Durrer

Université de Genève, Ecole de Physique 24 Quai E. Ansermet, CH-1211 Genève, Switzerland

Available online 16 January 2007

Abstract

I describe the imprint which primordial magnetic fields can leave on the cosmic microwave background (CMB). I show that these are observable only if the field amplitude is of the order of $B \gtrsim 10^{-9}$ G on Mpc scale. I further argue that such fields are strongly constrained by the stochastic background of gravity waves which they produce. Primordial magnetic fields, which are strong enough to be seen in the CMB, are compatible with the nucleosynthesis bound, only if their spectrum is close to scale invariant, or maybe if helical magnetic fields provoke an inverse cascade. For helical fields, the CMB signature is especially interesting. It contains parity violating T–B and E–B correlations.

PHYSICAL REVIEW D **106,** 063503 (2022)

Improved constraints on cosmic birefringence from the WMAP and *Planck* cosmic microwave background polarization data

Johannes R. Eskilt*

Institute of Theoretical Astrophysics, University of Oslo, P.O. Box 1029 Blindern, N-0315 Oslo, Norway

Eiichiro Komatsu†

Max Planck Institute for Astrophysics, Karl-Schwarzschild-Str. 1, D-85748 Garching, Germany and Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU, WPI), Todai Institutes for Advanced Study, The University of Tokyo, Kashiwa 277-8583, Japan

But here we use *B* separately!
Not the EB correlation

Spherical & Cartesian

$$E + iB \equiv R = \sum_{\ell=2}^{N_\ell} \sum_{m=-\ell}^{\ell} \tilde{R}_{\ell m} Y_{\ell m}(\theta, \phi),$$

$$\tilde{R}_{\ell m} = \int_{4\pi} (Q + iU)_2 Y^*_{\ell m}(\theta, \phi) \sin\theta \, \mathrm{d}\theta \, \mathrm{d}\phi,$$

${}_2Y^*_{\ell m}(\theta, \phi)$ are the spin-2 spherical harmonics

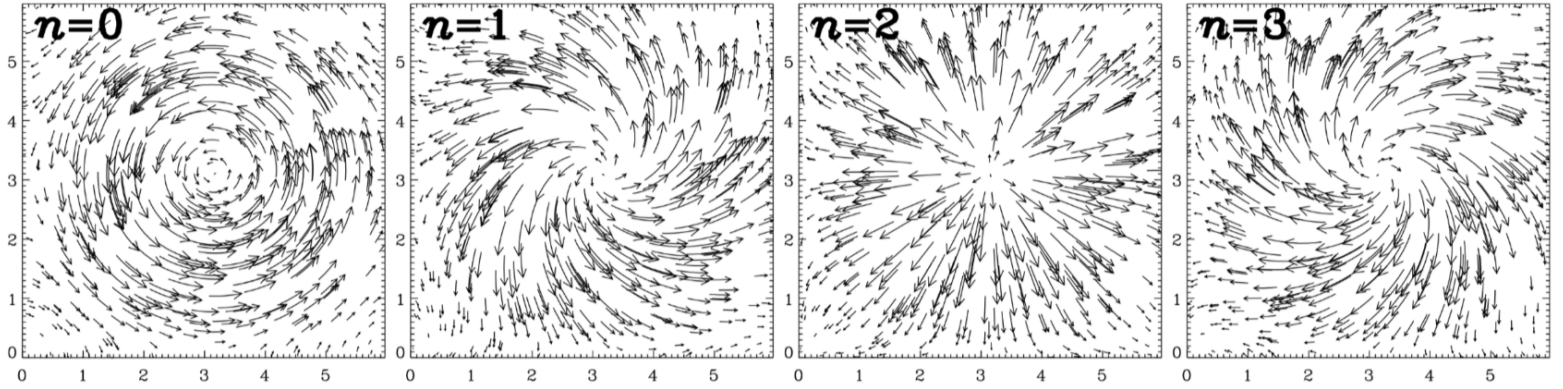
$$p \equiv Q + iU = -\epsilon (b_\theta + i b_\phi)^2$$

$$R(x,y) = \int \tilde{R}(k_x, k_y) e^{\mathrm{i}\boldsymbol{k}\cdot\boldsymbol{x}} \mathrm{d}^2x/(2\pi)^2$$

$$\tilde{R}(k_x, k_y) = -(\hat{k}_x - \mathrm{i}\hat{k}_y)^2 \tilde{P}(k_x, k_y)$$

$$\tilde{P}(k_x, k_y) = \int P(x,y) e^{-\mathrm{i}\boldsymbol{k}\cdot\boldsymbol{x}} \mathrm{d}^2x$$

$$e^{\mathrm{i}\pi n/4}(k_x + \mathrm{i}k_y)/k^3$$



$\mu = \cos\theta$

$\boldsymbol{b} = \boldsymbol{F} + \boldsymbol{G}$

$F_i = \nabla_i f$

$G_i = \epsilon_{ij}\nabla_j g$

$f = -f_0\, Y_{\ell m}$

$g = g_0 Y_{\ell m}$

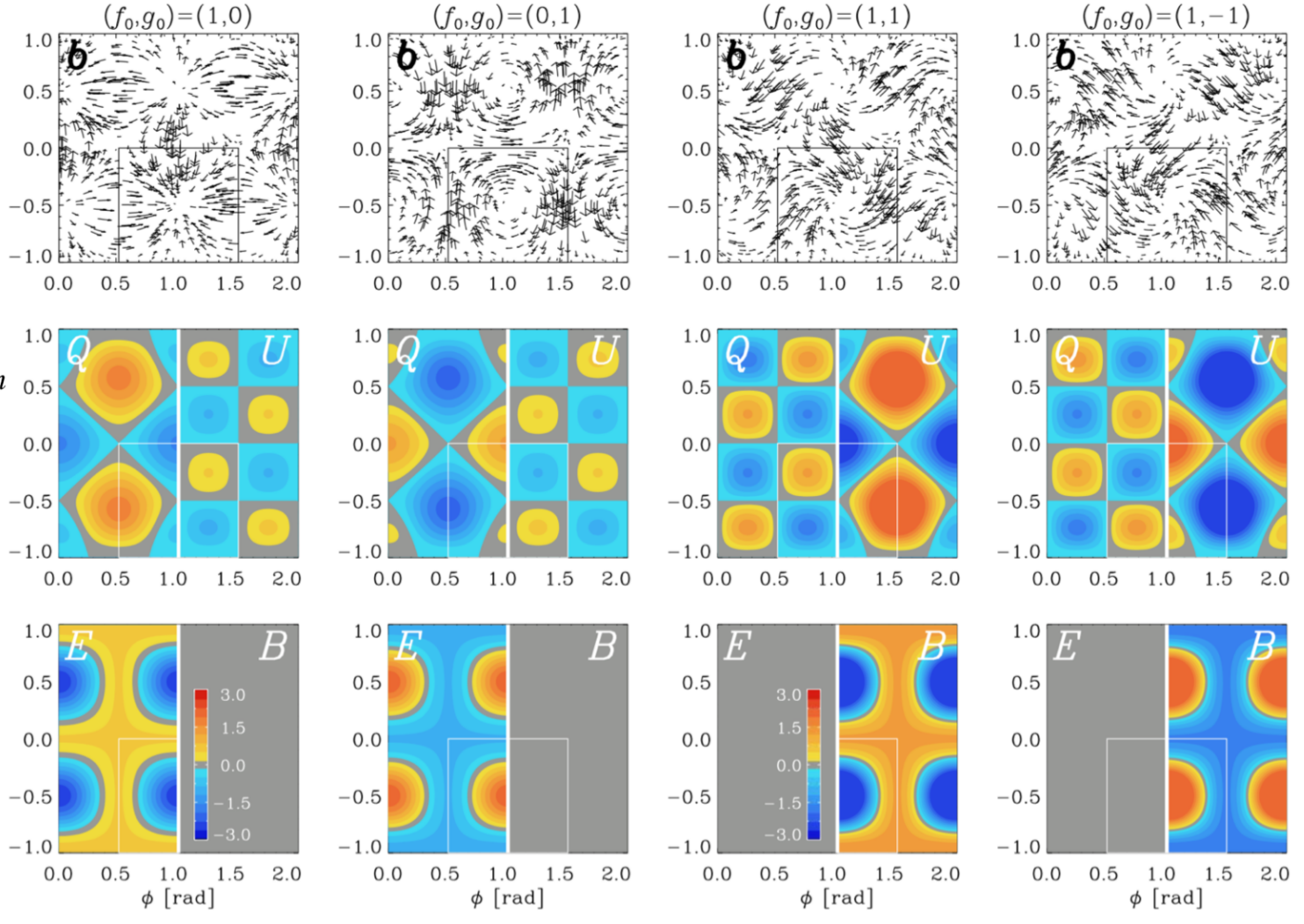
$(f_0,\, g_0)$

(1, 0)
(0, 1)

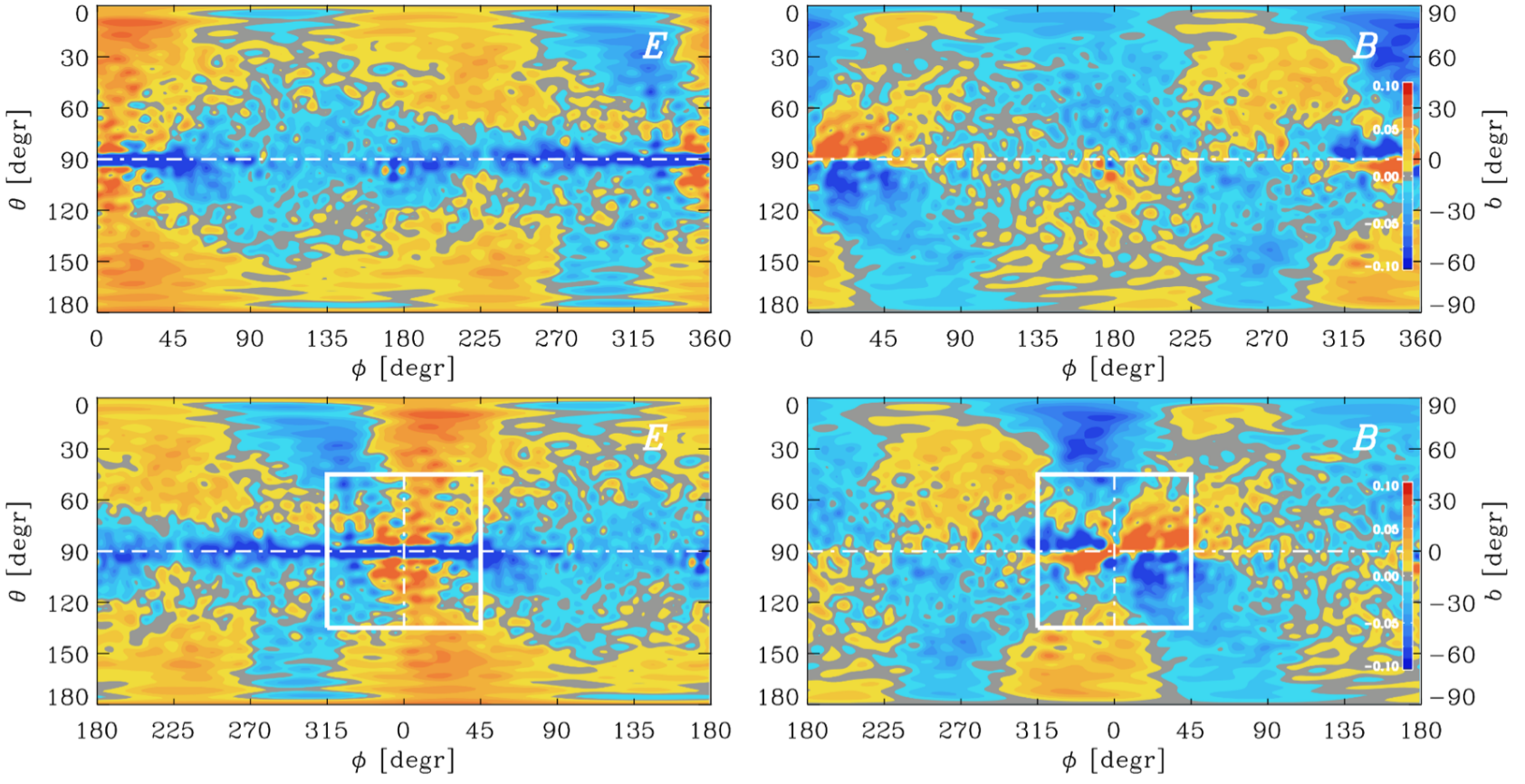
$(1, \pm 1)$

$\ell = 4$

$m = 3$

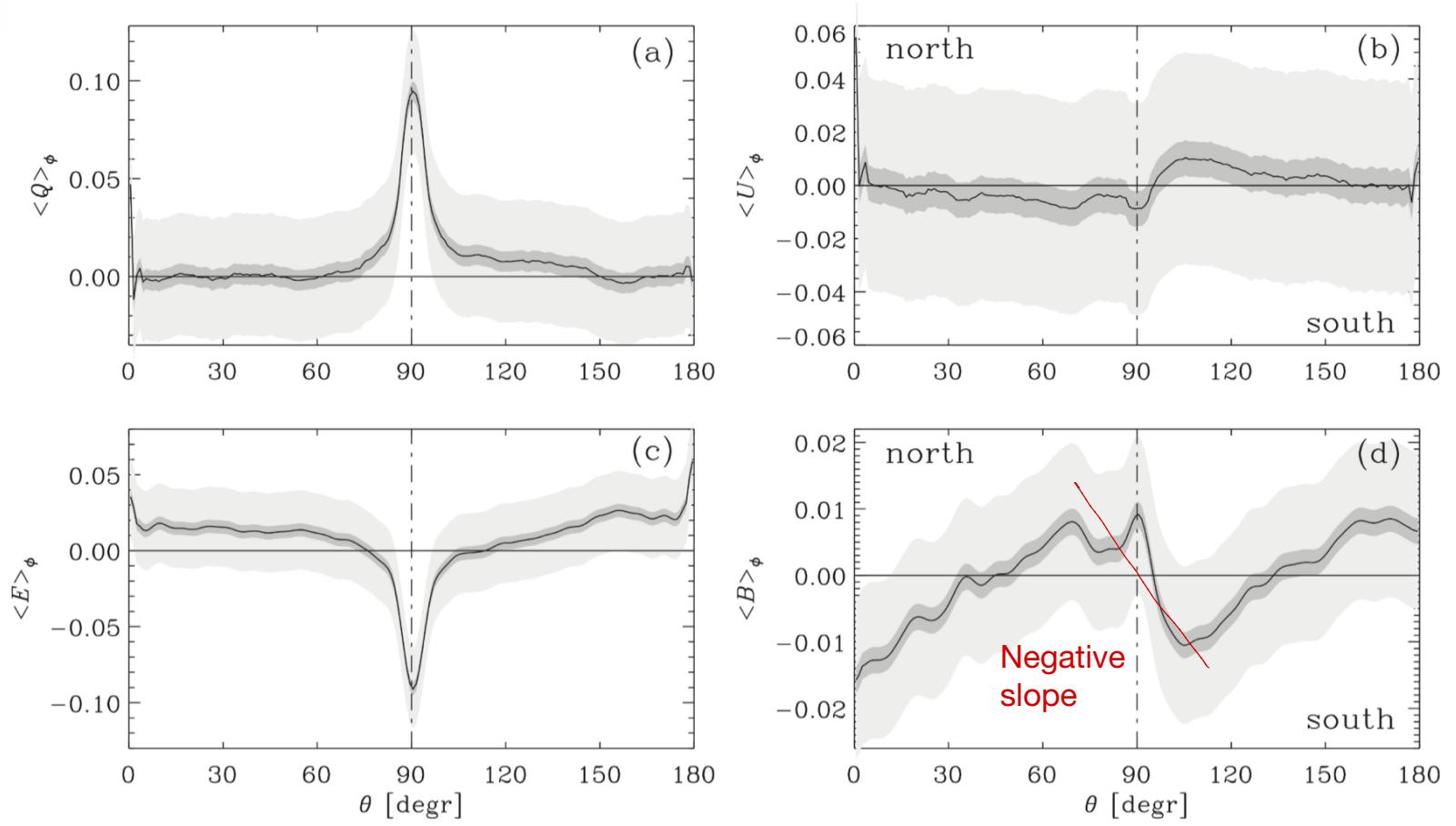


E & B for our Galaxy

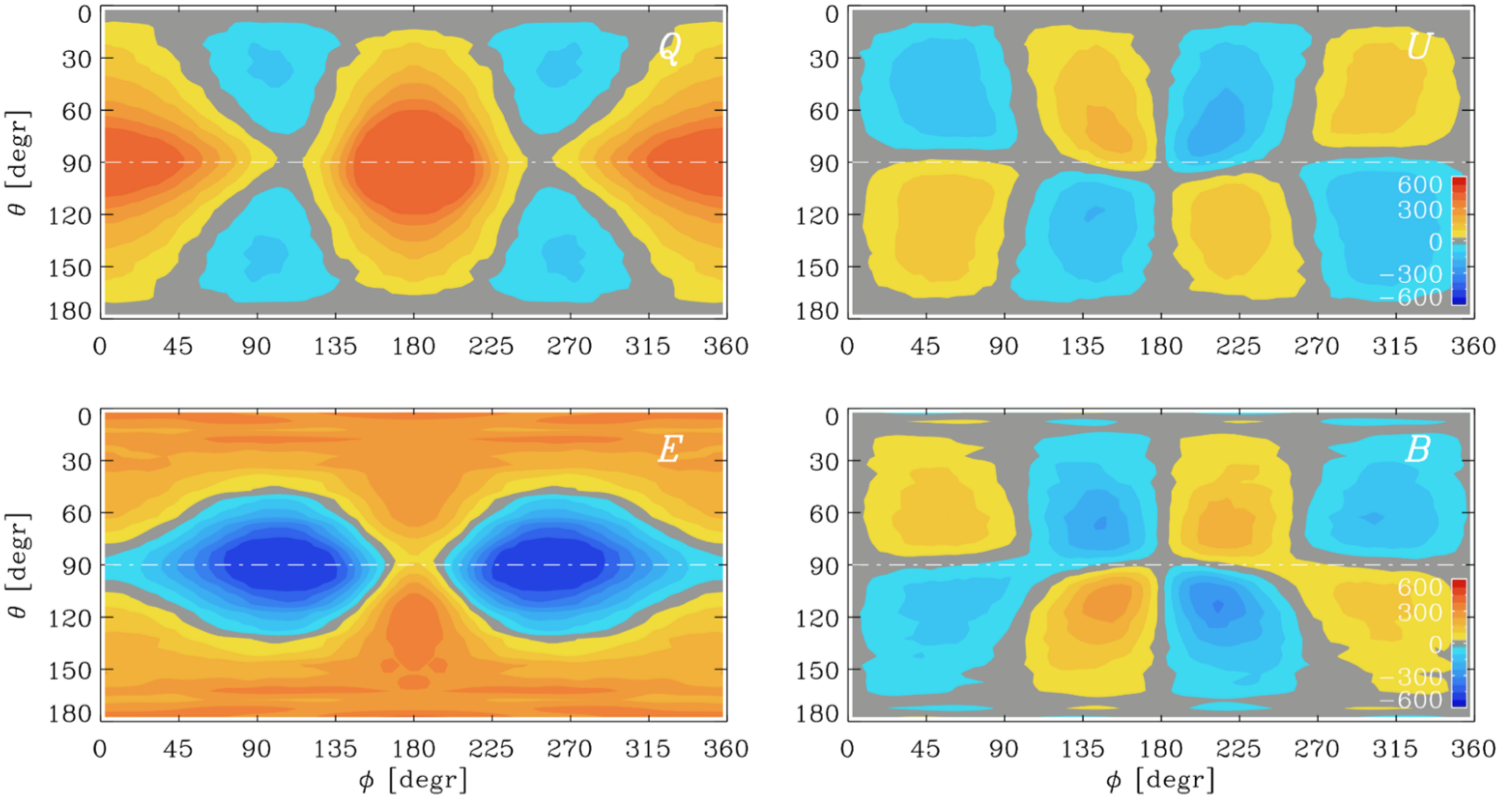


We thank Andrea Bracco for having verified the hemispheric dependence of $\langle B \rangle_\phi$ after we posted our preprint. We also thank

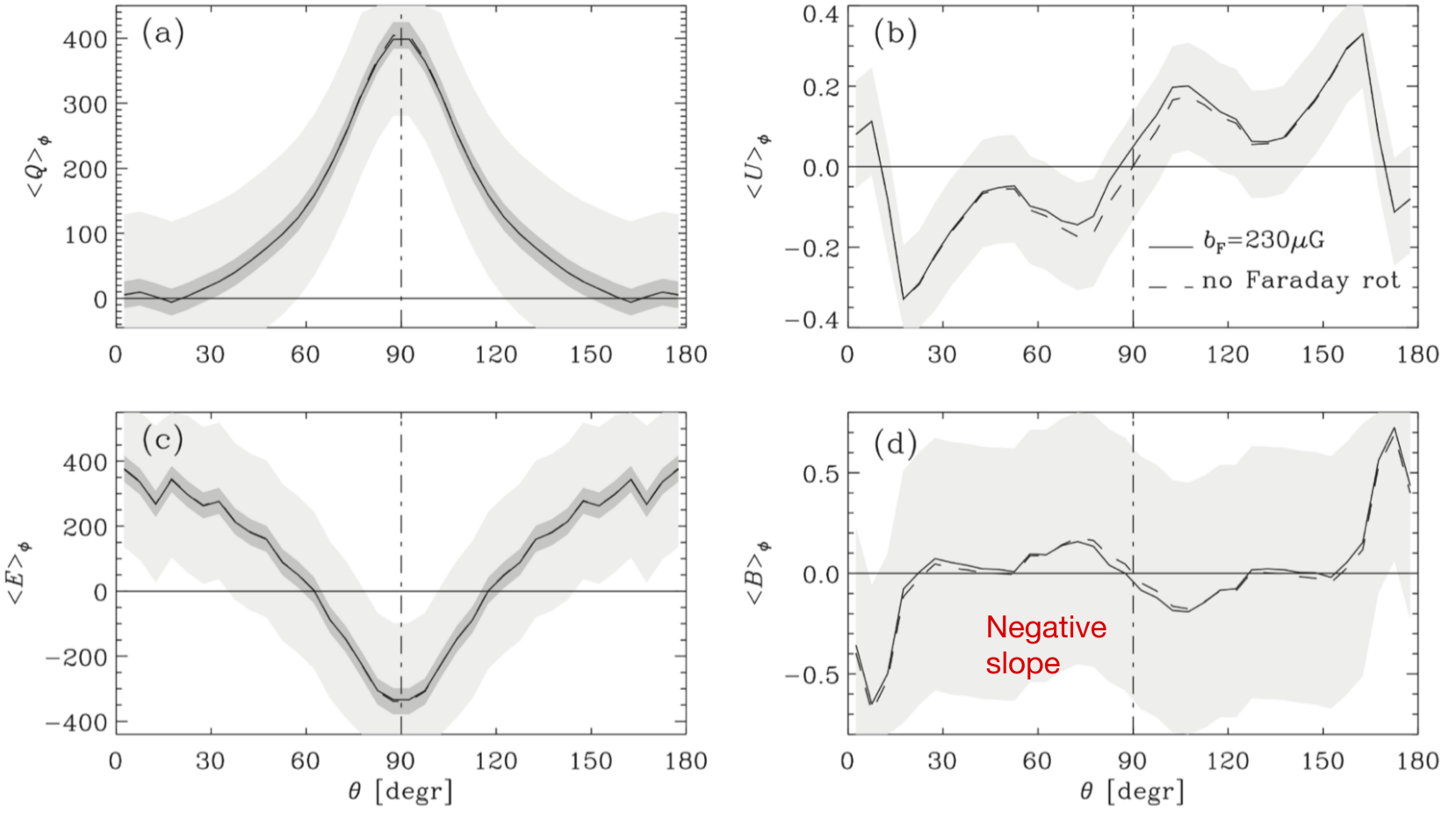
[6] http://lambda.gsfc.nasa.gov/product/map/current
[7] http://healpix.jpl.nasa.gov/
[8] Note a different sign convention in Seljak & Zaldarriaga (1997).



Model results



Model results

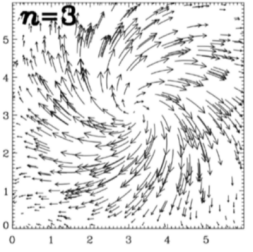


Negative slope

m	μ	κ	$\kappa\tilde{E}^{(\mu)}_{2\,m}$	$\kappa\tilde{E}^{(\mu)}_{4\,m}$	$\kappa\tilde{B}^{(\mu)}_{3\,m}$	$\kappa\tilde{B}^{(\mu)}_{5\,m}$
0	K	1000	56	-34	$\mathbf{-18}$	6
	Q	5000	45	-27	$\mathbf{-35}$	10
	A	0.1	73	-22	$\mathbf{-0.038}$	-0.002
	B	0.1	92	-34	$\mathbf{+0.014}$	-0.13
	C	5000	68	-27	$\mathbf{-7}$	$+8$
	D	0.1	73	-22	$\mathbf{+0.038}$	$+0.002$
1	K	1000	$1-9i$	$4+17i$	$4+i$	$8-5i$
	Q	5000	$1-8i$	$-i$	$-10-2i$	$2i$
	A	0.1	1	1	$-4i$	i
	B	0.1	$-41-i$	13	$12i$	$-5i$
	C	5000	$57+5i$	$-15-8i$	$-2-36i$	$2+9i$
	D	0.1	1	1	$-4i$	i
2	K	1000	$7-8i$	$9-22i$	$-20-17i$	$-13+5i$
	Q	5000	$-1-7i$	$-15i$	-13	-9
	A	0.1	$41+3i$	-4	$2-26i$	$5i$
	B	0.1	$28+2i$	-5	$1-10i$	$-2i$
	C	5000	$31+4i$	$12-4i$	$5-50i$	$-7+13i$
	D	0.1	$41+4i$	-4	$3-26i$	$-1+5i$

Conclusion

The negative slope of B reflects the sense of the Galactic spiral, not helicity!

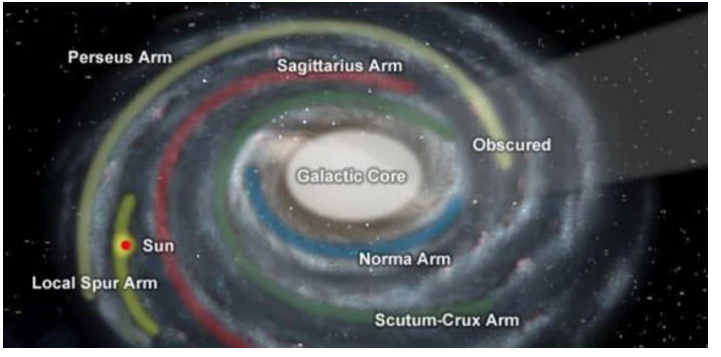


MNRAS **496,** 4749–4759 (2020)
Advance Access publication 2020 June 29

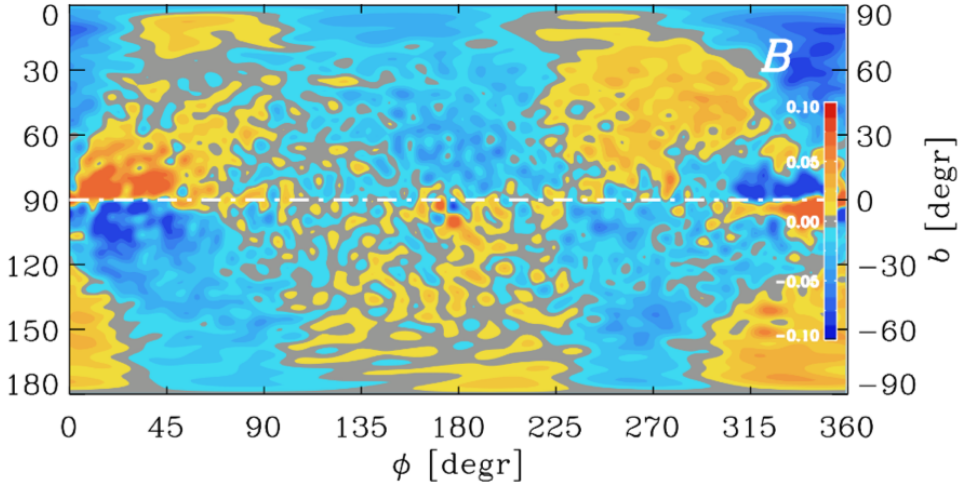
Application of a helicity proxy to edge-on galaxies

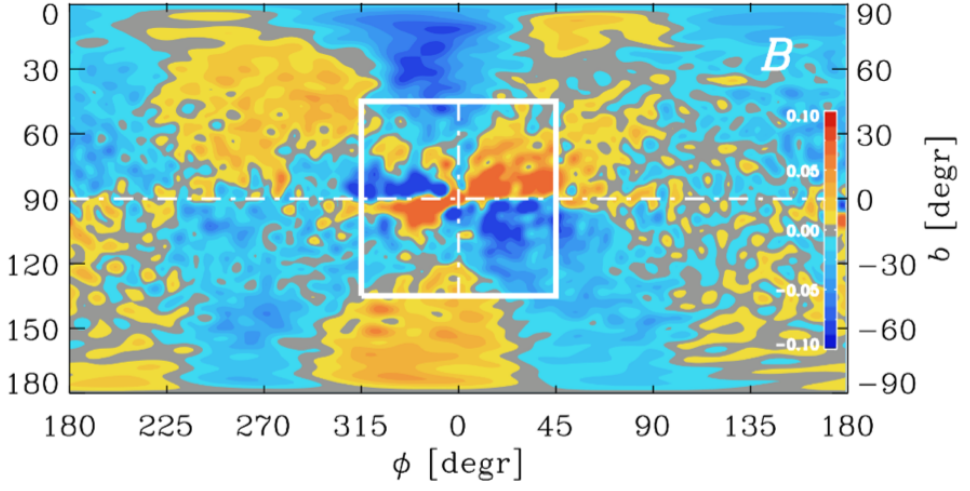
Axel Brandenburg [1,2,3,4]★ and Ray S. Furuya [5]★
[1]*Nordita, KTH Royal Institute of Technology and Stockholm University, Roslagstullsbacken 23, SE-10691 Stockholm, Sweden*
[2]*Department of Astronomy, AlbaNova University Center, Stockholm University, SE-10691 Stockholm, Sweden*
[3]*JILA and Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO 80303, USA*

To see how our results compare with a Galactic mean-field dynamo model, we analyze the model of Brandenburg & Furuya (2020), which was recently applied to assess the parity-even and parity-odd polarizations for an edge-on view of the galaxy NGC 891. In the present work, however, we use the same model to compute a view from the position of the Sun, located in the midplane 8 kpc from the Galactic center ($\mu = \mathrm{A}$). We also compare with 3 kpc distance ($\mu = \mathrm{B}$), and models with opposite signs of the α effect ($\mu = \mathrm{C}$) and both α and Ω ($\mu = \mathrm{D}$).



Backup slide





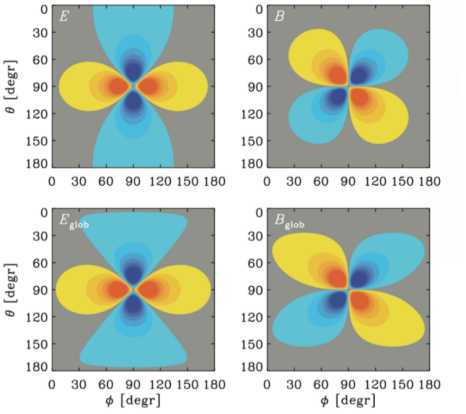


Figure A1. Local representations E and B together with their global counterparts $E_{\rm glob}$ and $B_{\rm glob}$ for a Gaussian patch with just a horizontal magnetic field, $\bar{\boldsymbol{b}} = (0, \bar{b}_\phi)$.

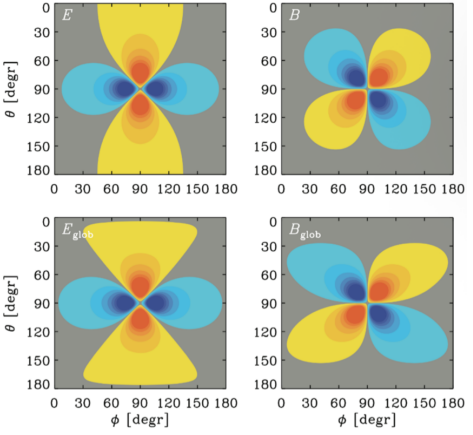


Figure A2. Same as Fig. A1, but for a vertical magnetic field, $\bar{\boldsymbol{b}} = (\bar{b}_\theta, 0)$.