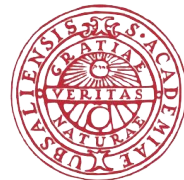


Magnetic Field Mapping of Chemically Peculiar Stars



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Ap / Bp Type Stars - Some Recent MDI Maps

- **53 Cam** - Kochukhov et al. (2004) - Low resolution
- **α^2 CVn** - Kochukhov & Wade (2010) - Low resolution
- **HD 37776** - Kochukhov et al. (2011) - Low resolution - *Stokes IV*

- **α^2 CVn** - Silvester et al. (2014)
- **CU Vir** - Kochukhov et al. (2014) - *Stokes IV*
- **HD 75049** - Kochukhov et al. (2014) - *Stokes IV*
- **HD 184927** - Yakunin et al. (2015) - *Stokes IV*
- **HD 24712** - Rusomarov et al. (2015)
- **σ Ori E** - Oksala et al. (2015) - *Stokes IV*
- **HD 32633** - Silvester et al. (2015)
- **HD 125248** - Rusomarov et al. (2016)
- **49 Cam** - Silvester et al. In Prep

2014 to Present



- **36 Lyn** - Oksala et al. In Prep
- **a Cen** - Work in progress with G Wade

MDI Mapping Data

Data for recent MDI mapping has been obtained using one (or more) of the following instruments:

- ESPaDOnS at CFHT (Mauna Kea)
- Narval at TBL (Pic du Midi)
- HARPSpol on the ESO 3.6m (La Silla)

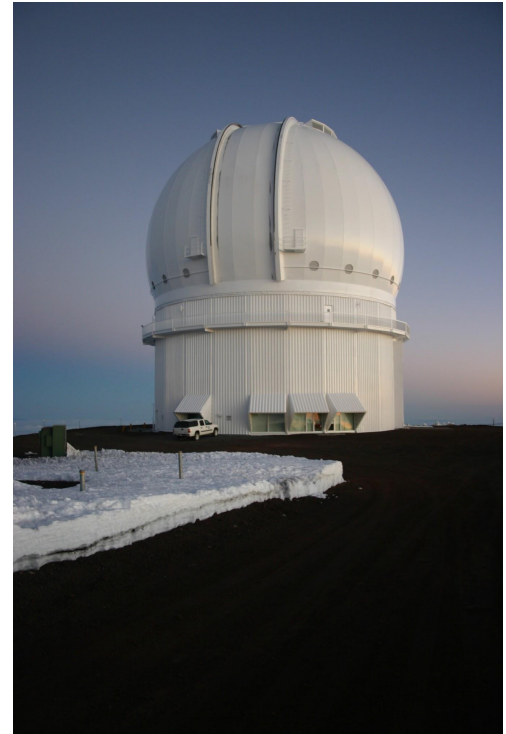
These instruments have proven performance/stability over multiple observing semesters. (e.g in the case of ESPaDOnS/Narval: Silvester et al. 2012).



ESO 3.6m La Silla

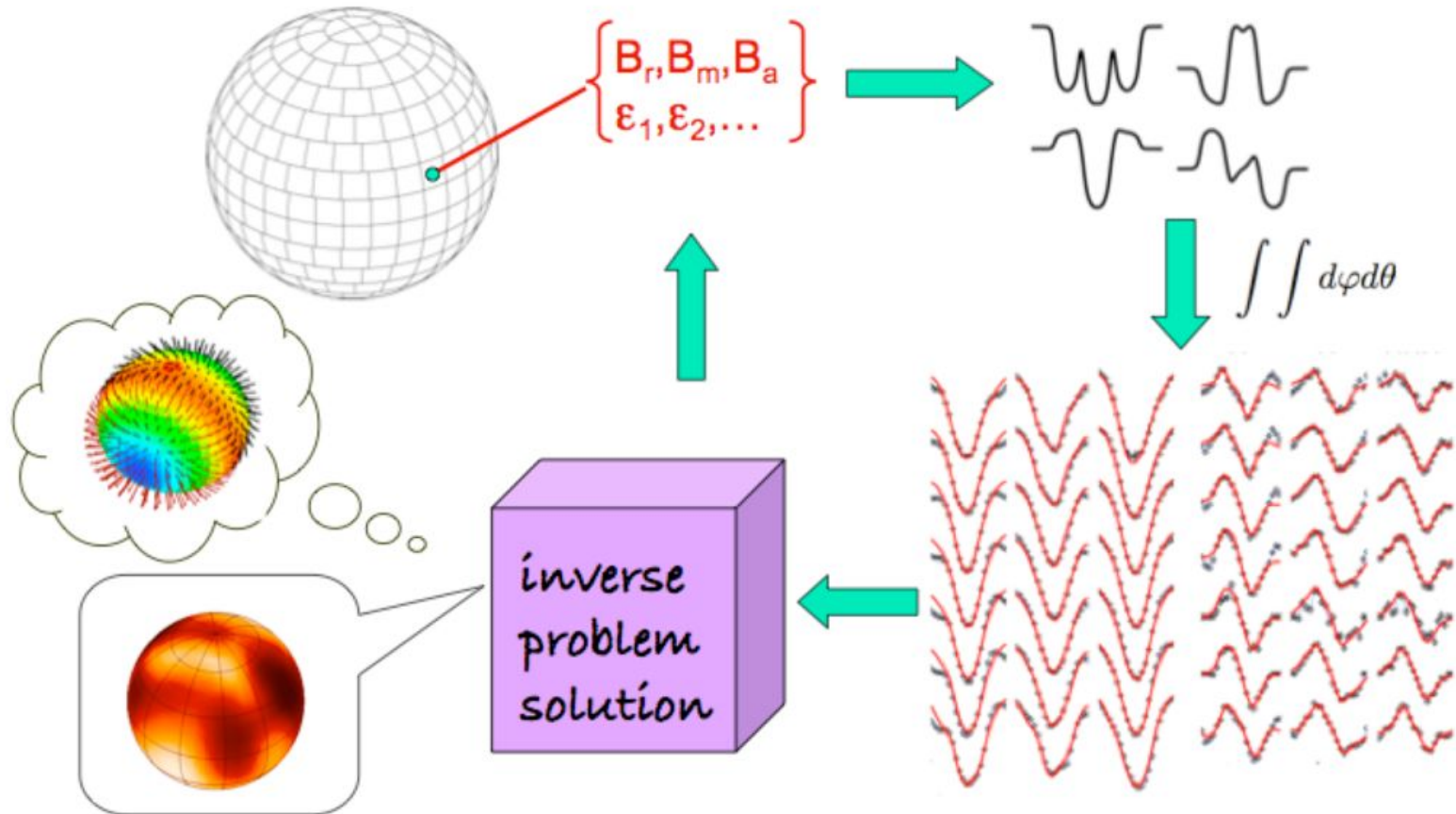


TBL at Pic du Midi



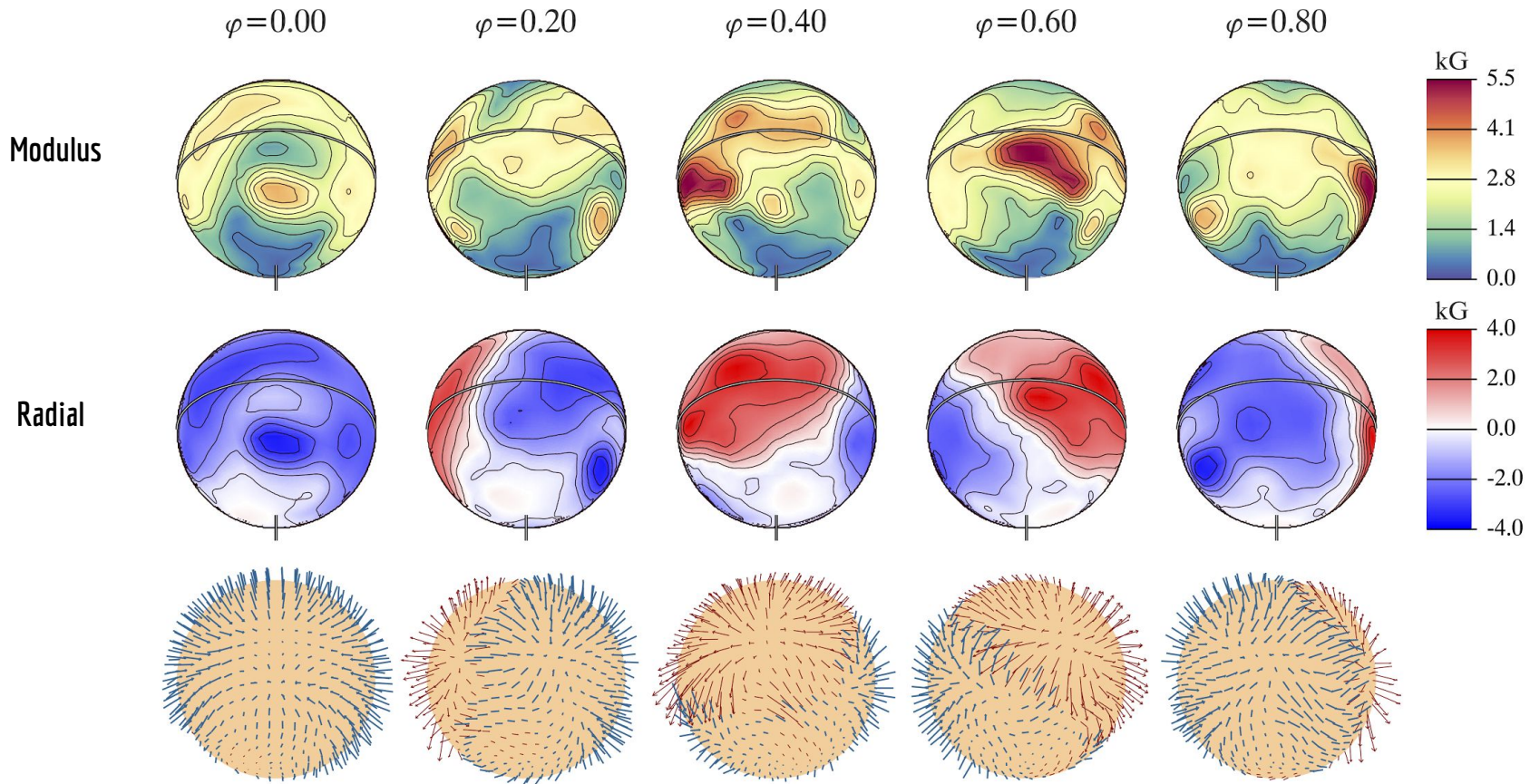
CFHT on Mauna Kea

MDI Inversions Work



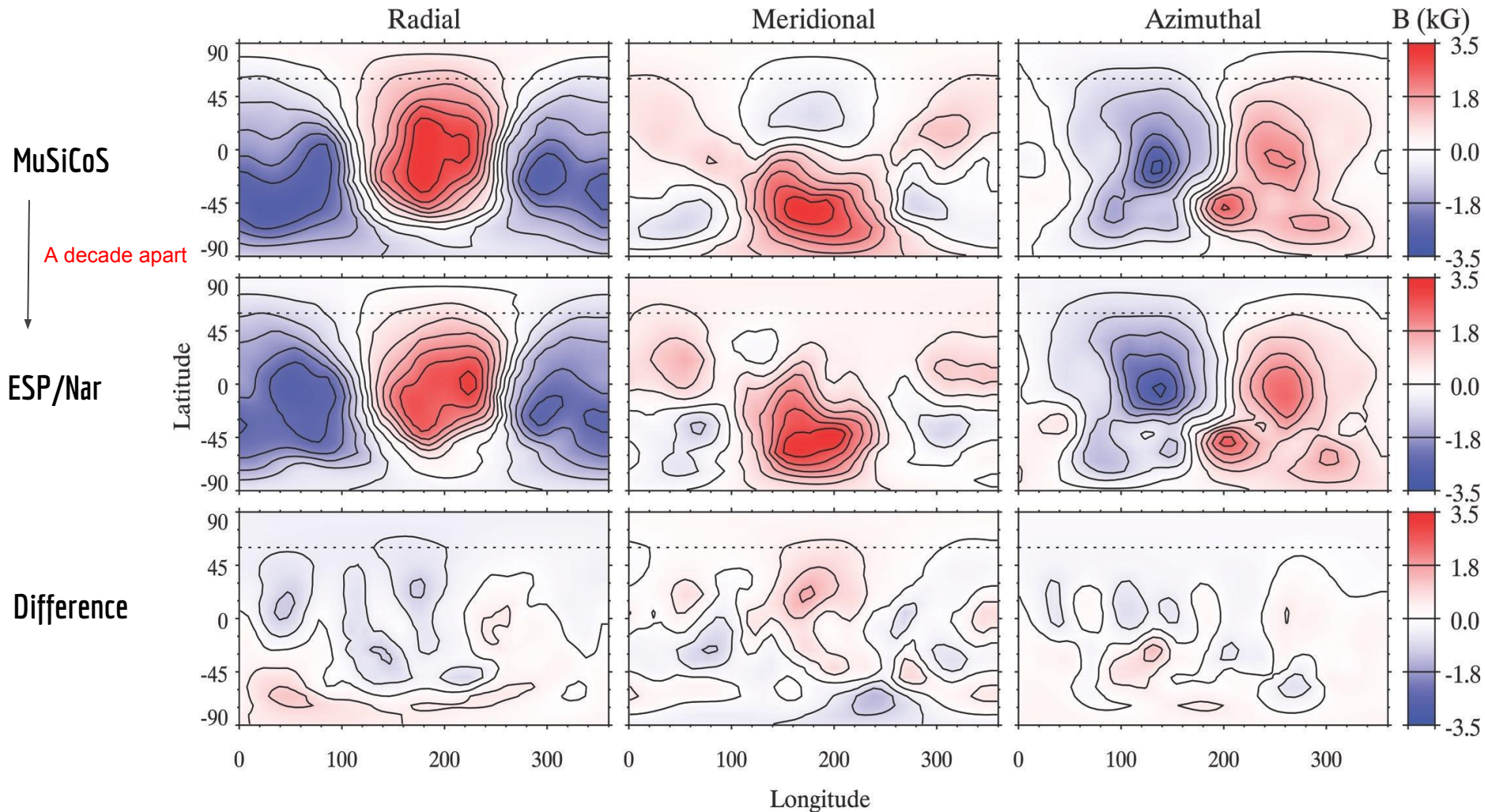
MDI Animation

Magnetic Map of α^2 CVn



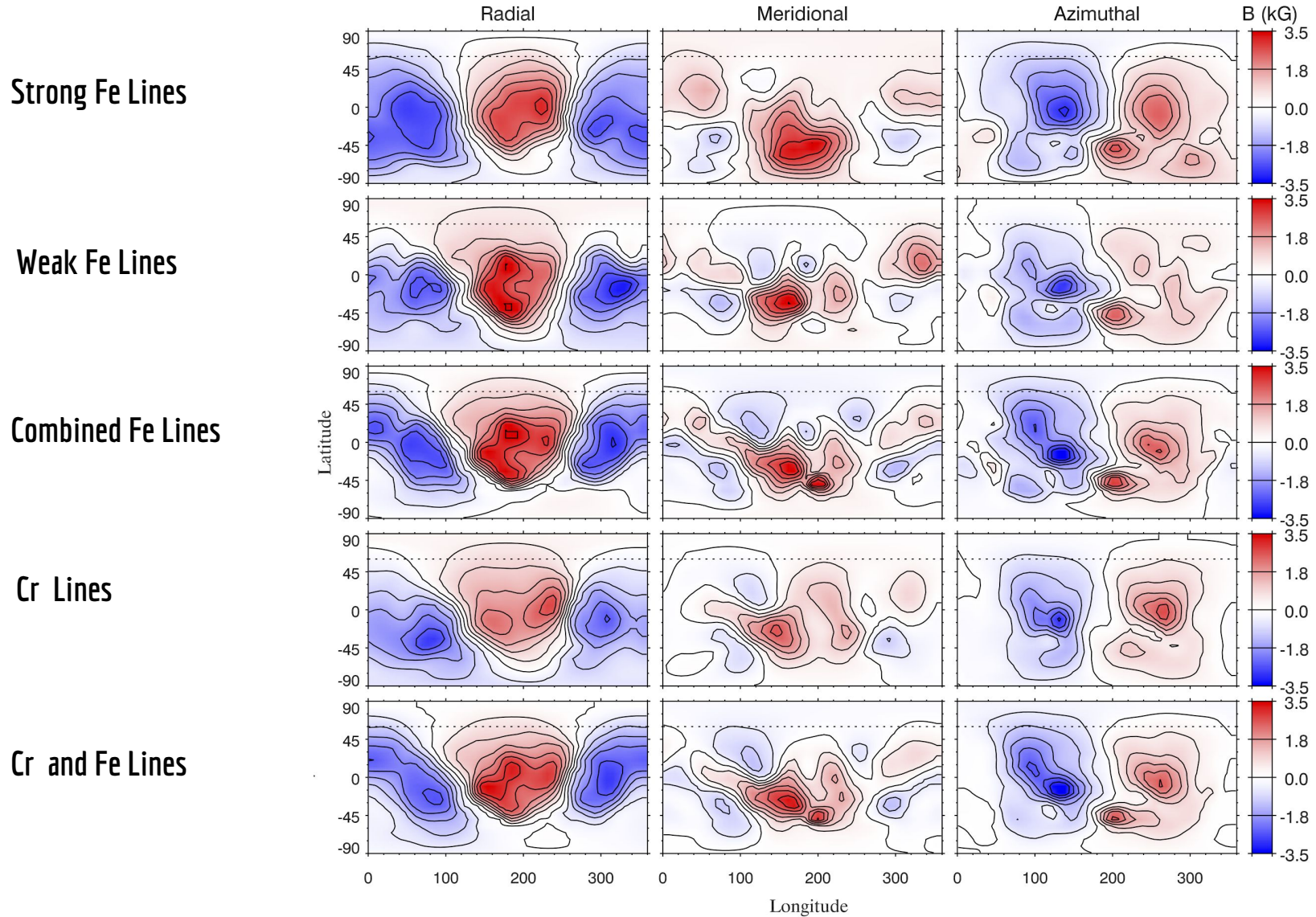
Stokes IQUV Inversions derived *simultaneously with abundance maps*

Magnetic field Map from Iron Lines from MuSiCoS Data vs ESPaDO nS/Narval Data for α^2 CVn



***This result shows: a) Reproducibility of the maps / reliability of the inversion code
b) The stability of the magnetic field over a decade timescale***

Magnetic Field Map from various line sets using ESPaDO nS / Narval data for α^2 CVn



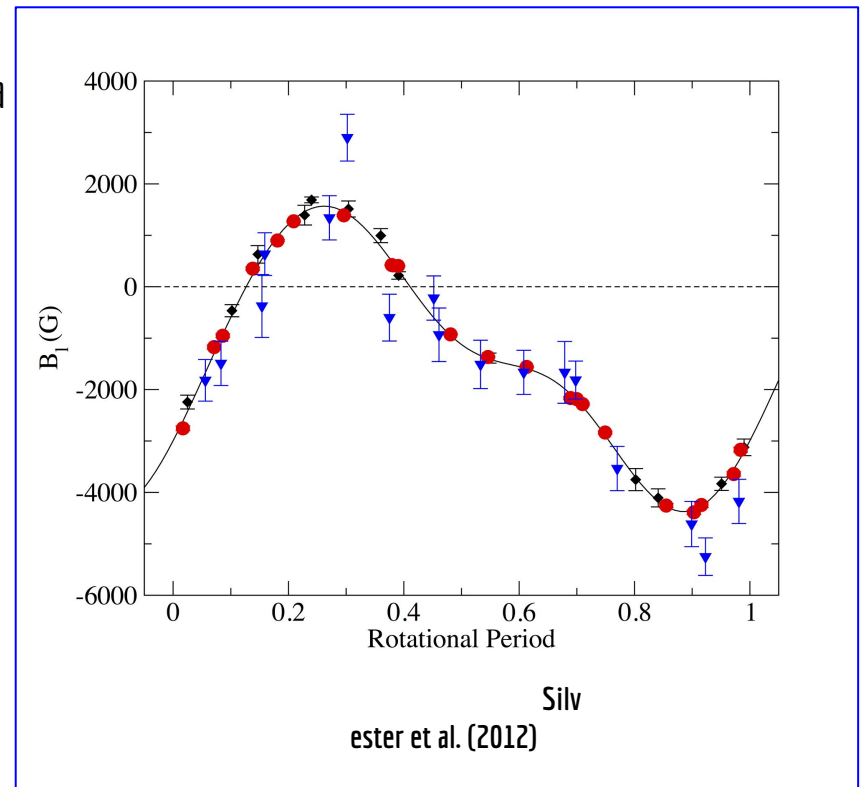
This result shows that very similar magnetic structure is derived from differing line sets

Mapping of HD 32633

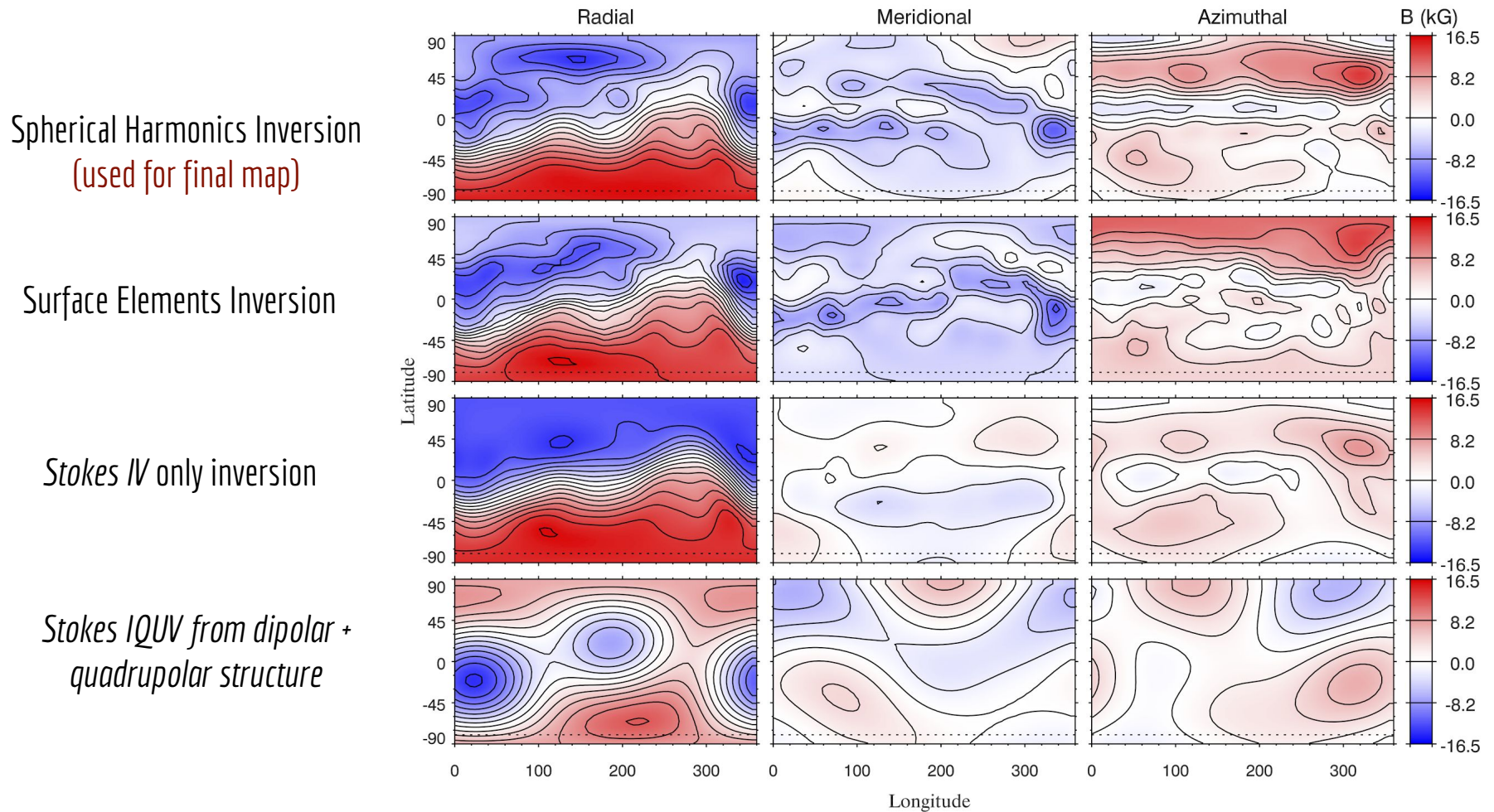
Early observations of the Ap star HD 32633 indicated that the magnetic field was complex in nature (e.g Babcock 1958, Borra and Landstreet 1980).

Glagolevskij & Gerth 2008 suggested even the presence of a two-dipole structure.

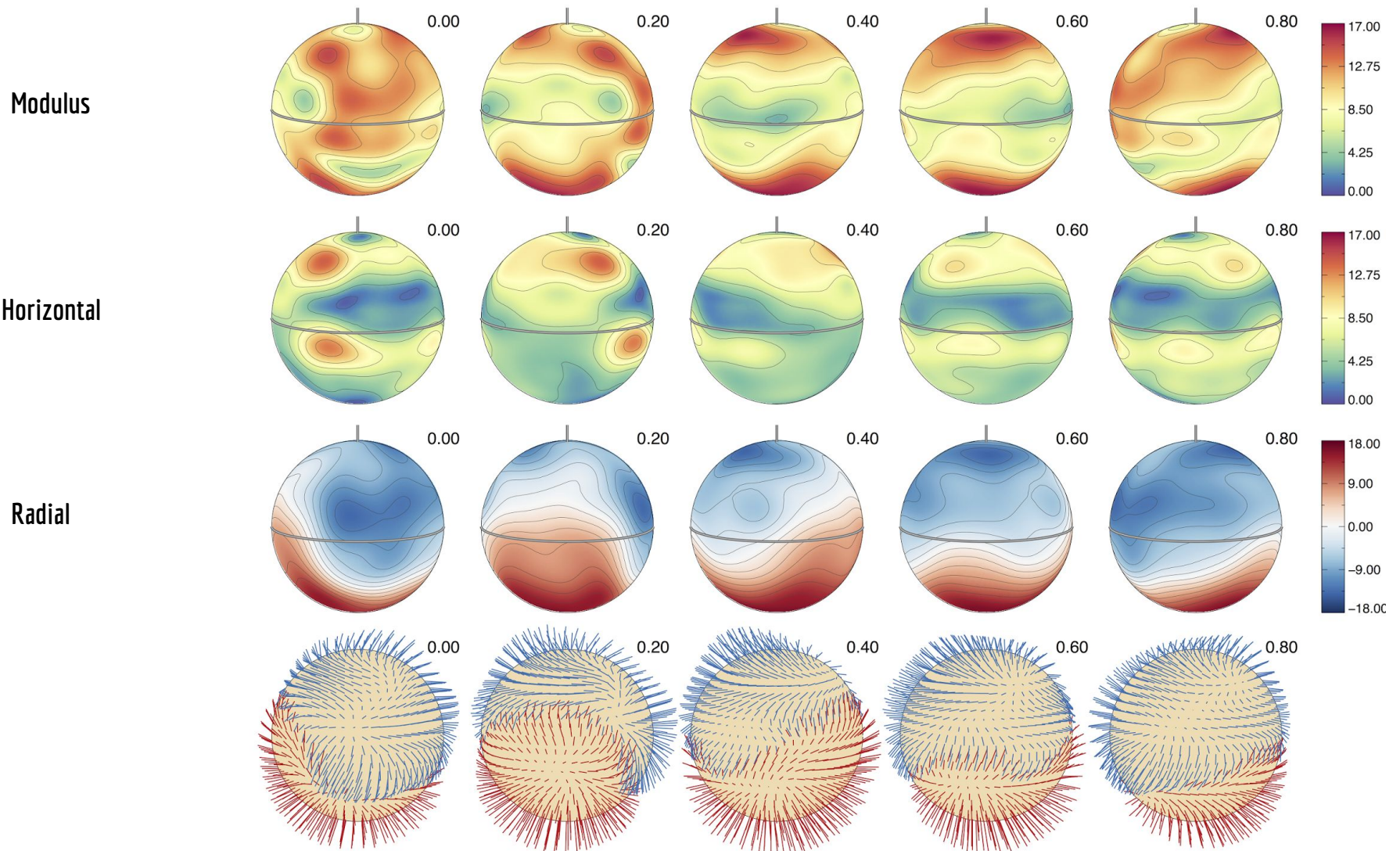
Twenty phase resolved observations of HD 32633 were obtained in Stokes IQUV with ESPaDOnS and Narval (Silvester et al. 2012).



Magnetic Map Diagnosis Comparisons

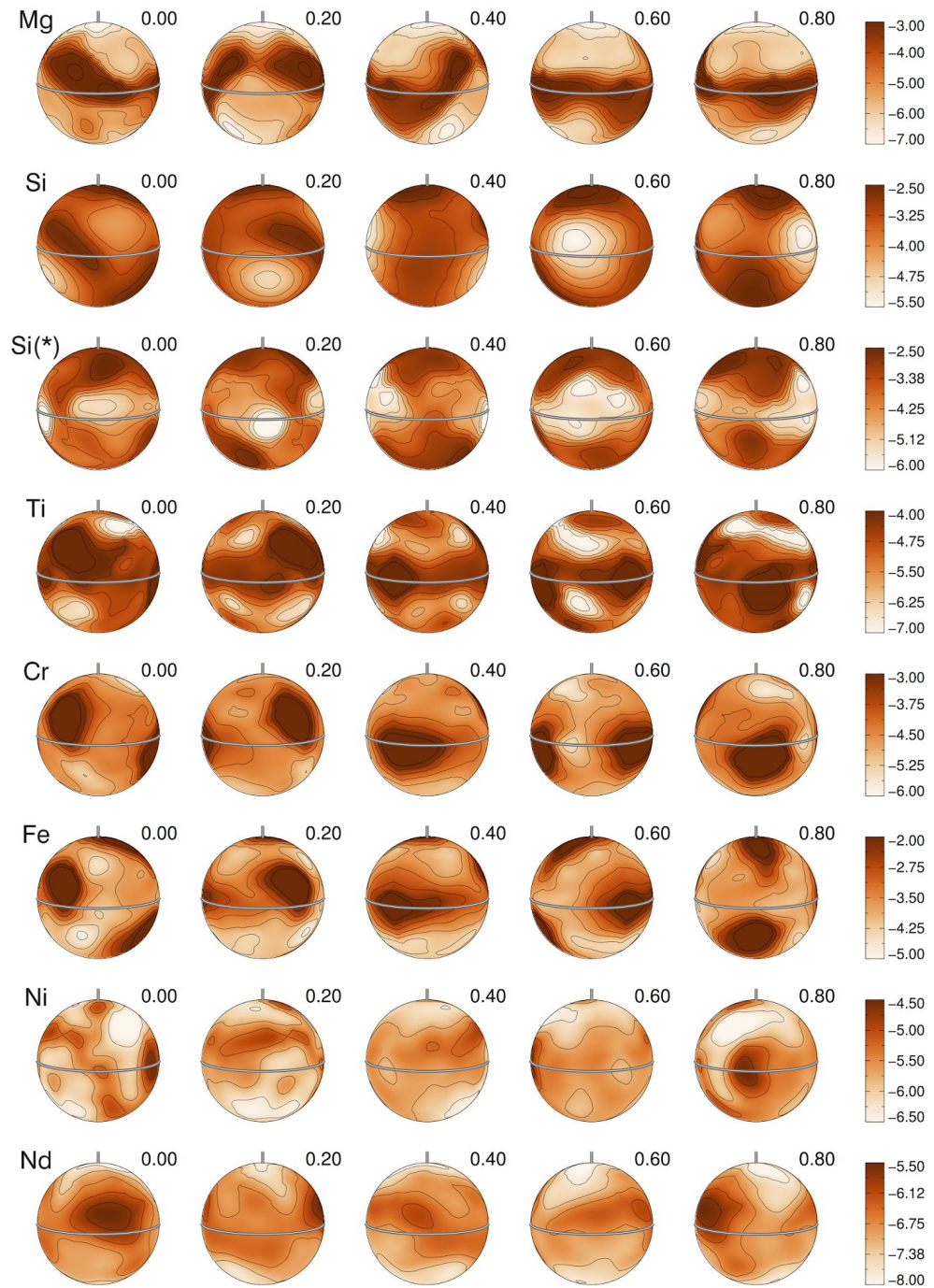


HD 32633

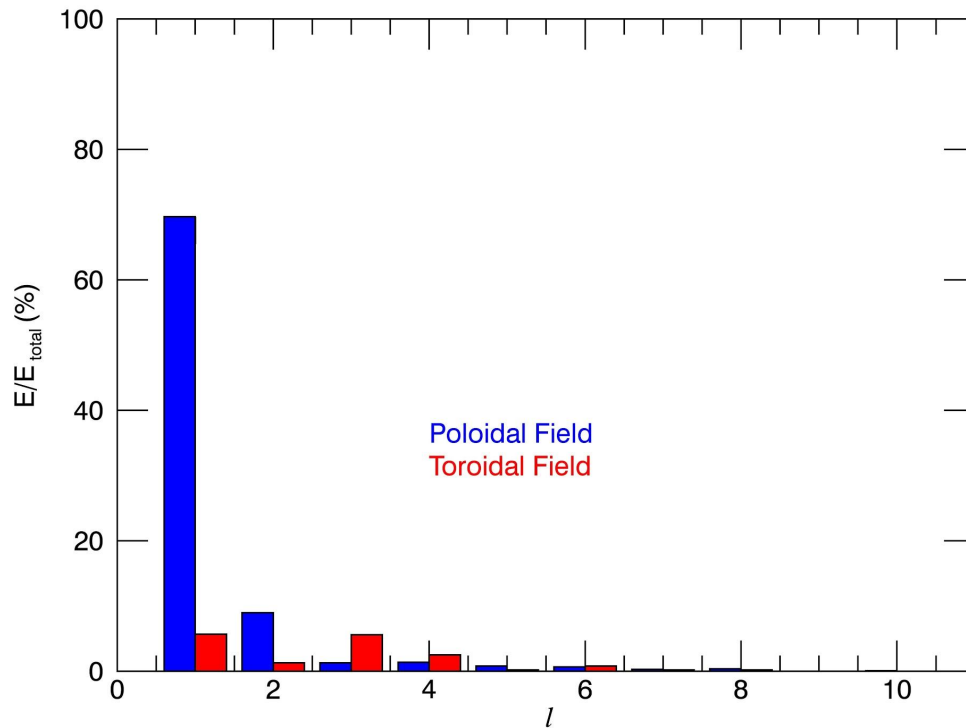


Stokes IQUV Inversions derived *simultaneously with abundance maps*

Abundance Mapping of HD 32633



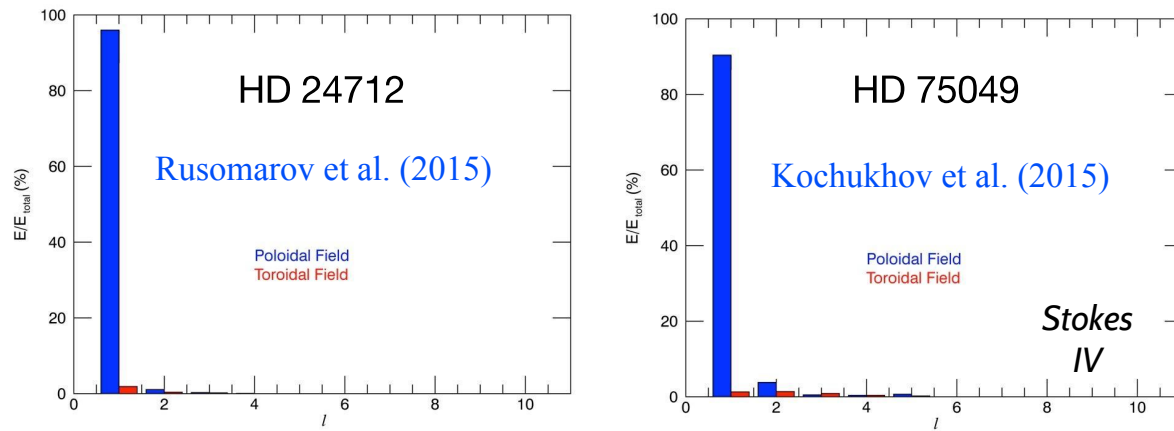
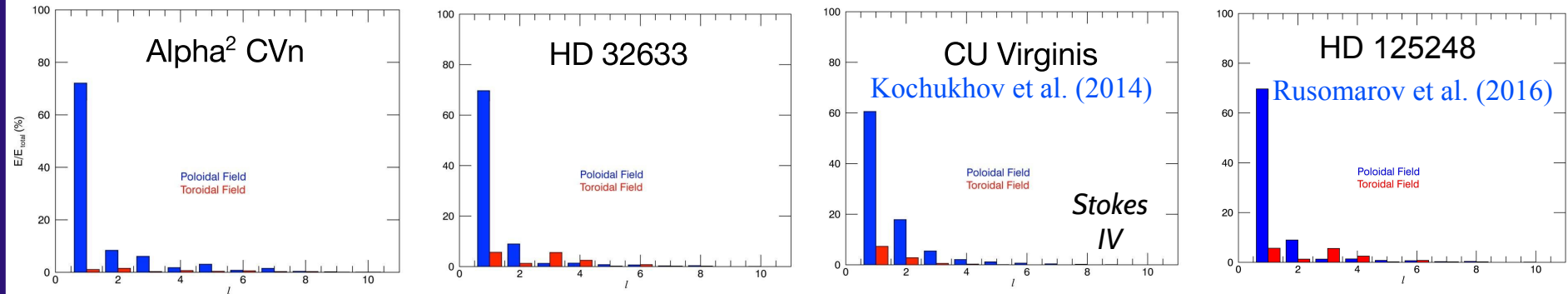
Spherical Harmonic Energies for HD 32633



l	E_{Pol} %	E_{Tor} %	E_{tot} %
1	69.7	5.7	75.4
2	9.0	1.3	10.3
3	1.3	5.6	6.9
4	1.4	2.5	3.9
5	0.8	0.2	1.0
6	0.7	0.8	1.5
7	0.3	0.2	0.4
8	0.4	0.2	0.6
9	0.0	0.0	0.1
10	0.1	0.0	0.1
Total	83.5	16.5	100

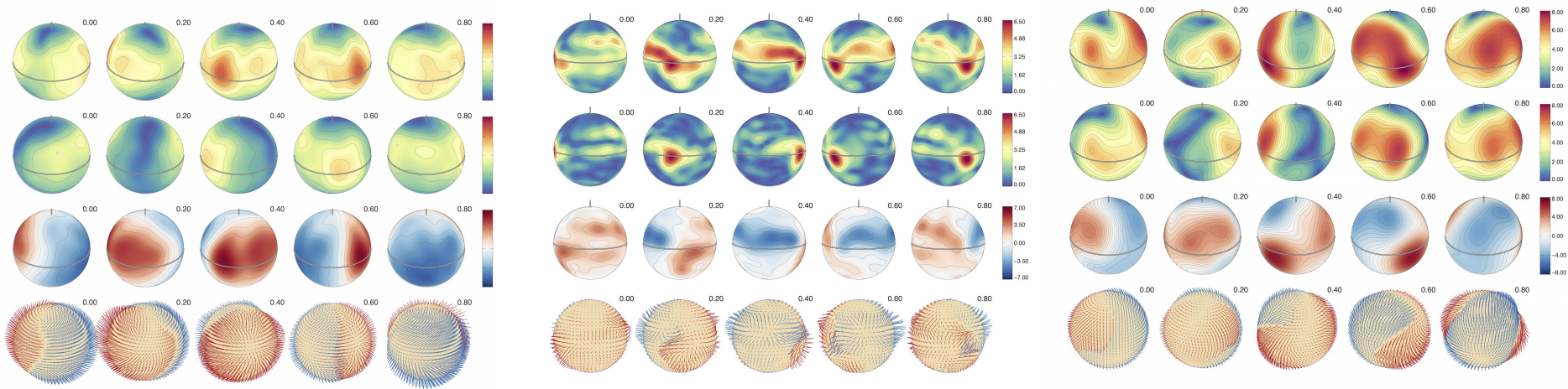
How do the Spherical Harmonic Energies compare?

Similar Level of Complexity



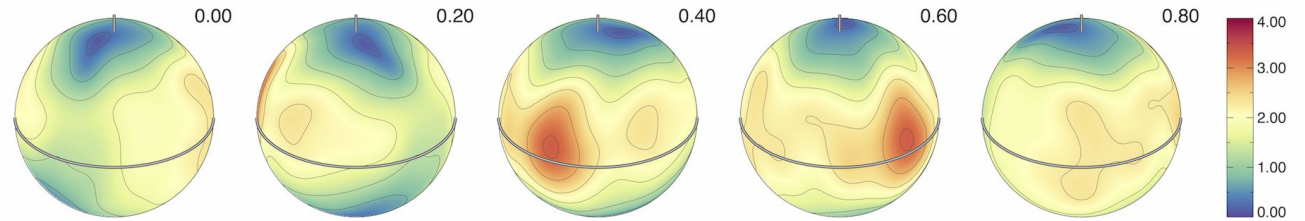
Lower Complexity

New Results and Ongoing Work

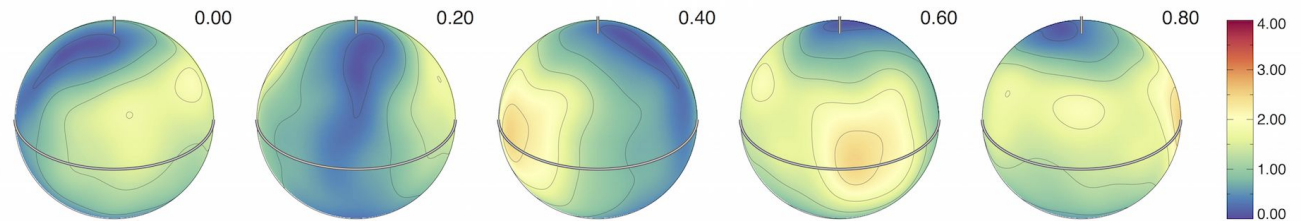


36 Lyncis

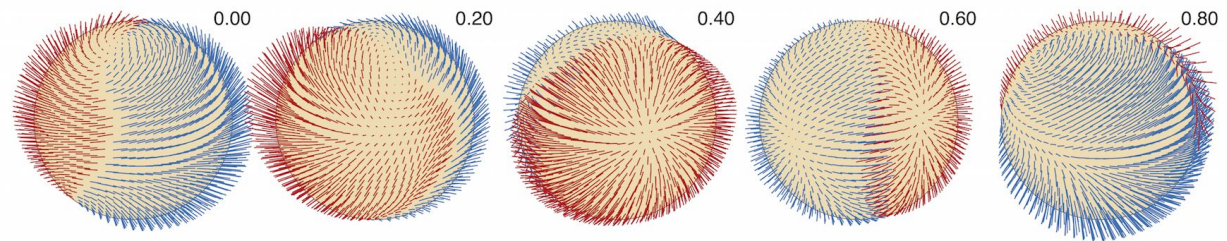
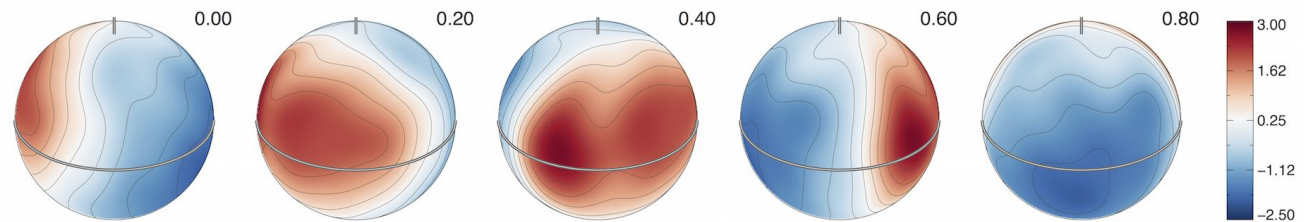
Modulus



Horizontal



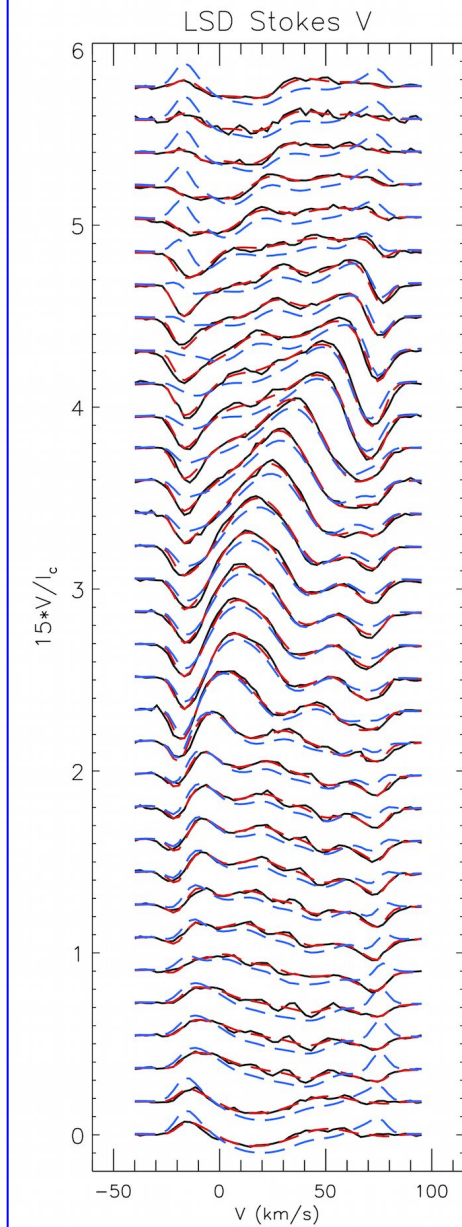
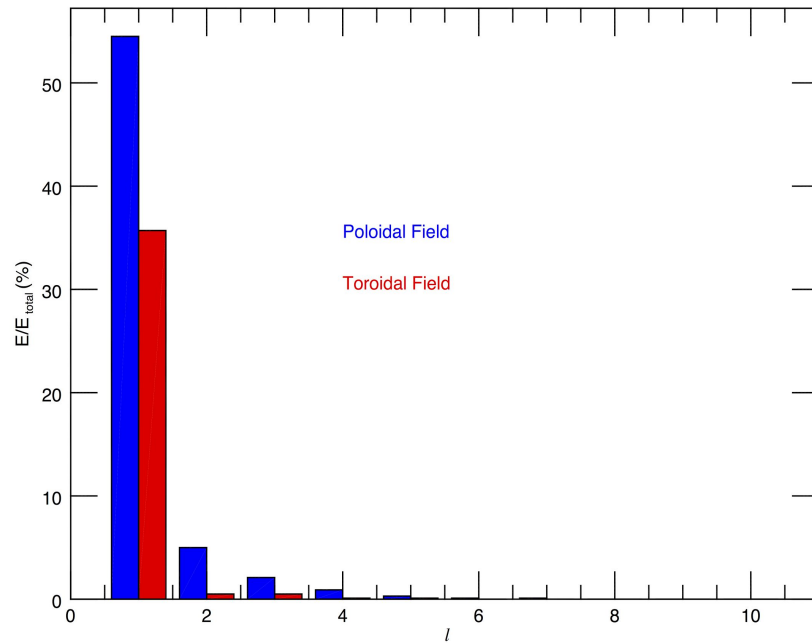
Radial



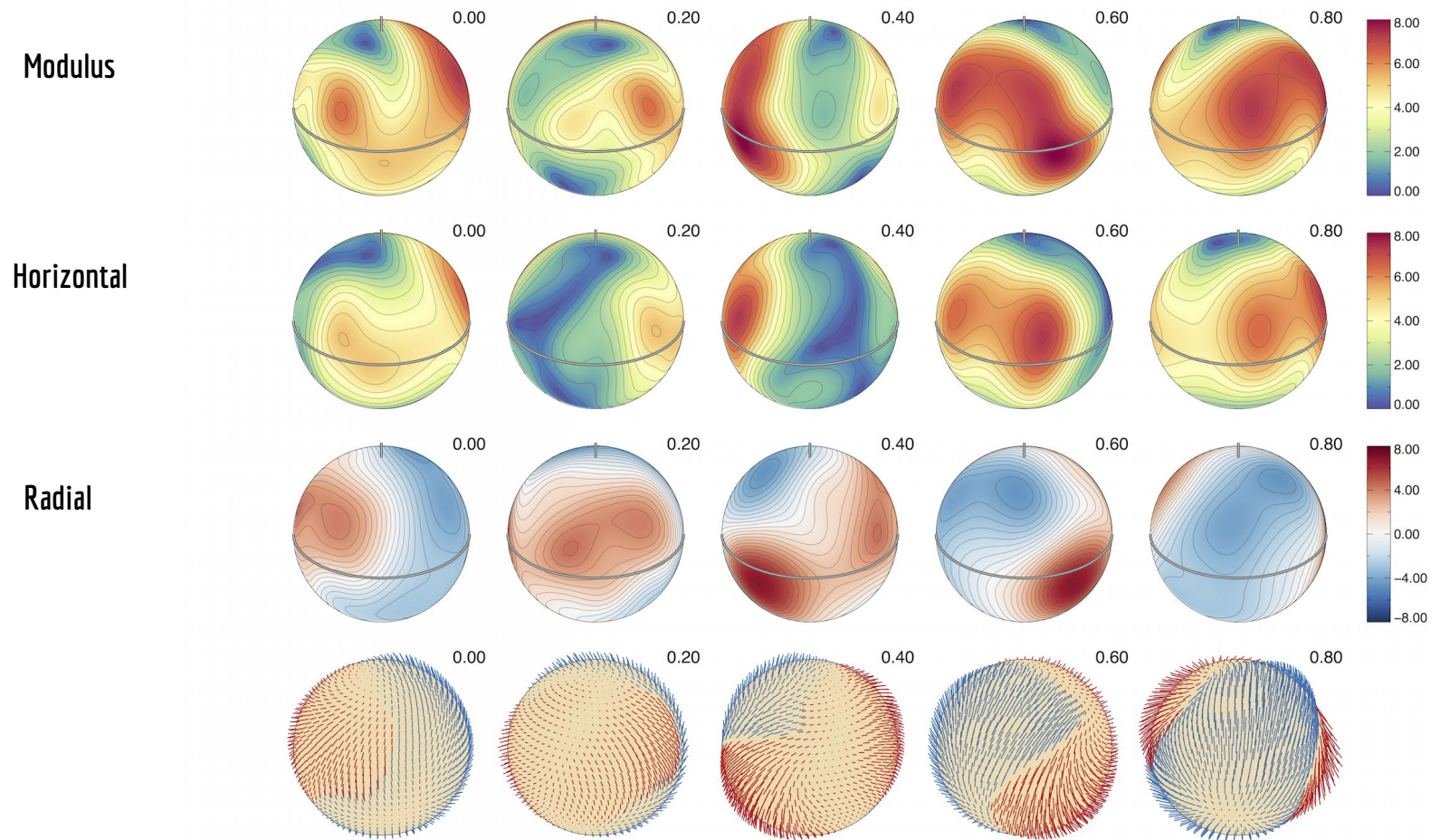
Averaged Line Stokes IV Inversions

Work in collaboration with Mary Oksala

36 Lyncis



A Cen - He Peculiar Star

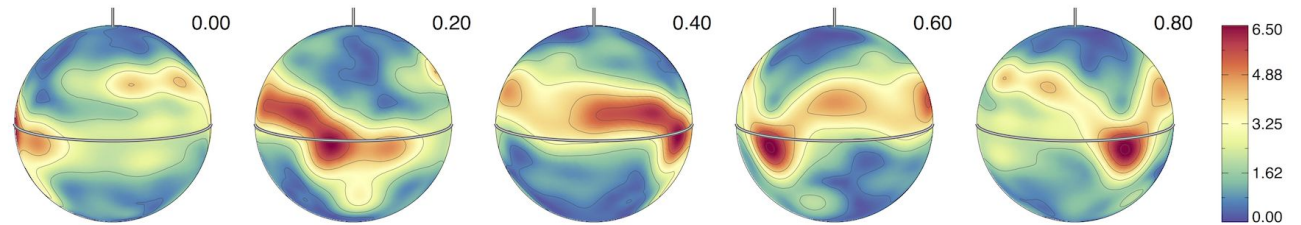


Averaged Line Stokes IV Inversions

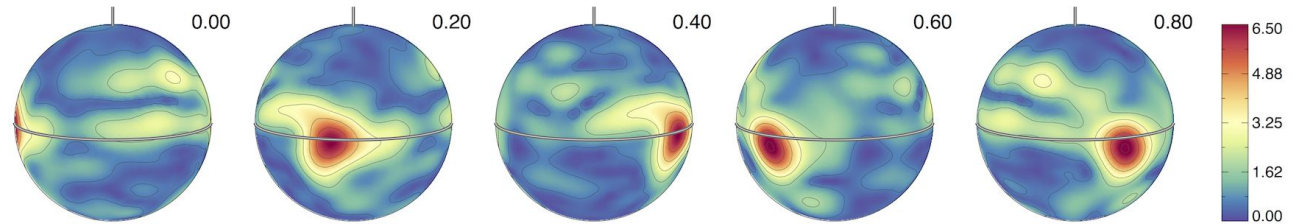
Work in collaboration with Gregg Wade

49 Cam

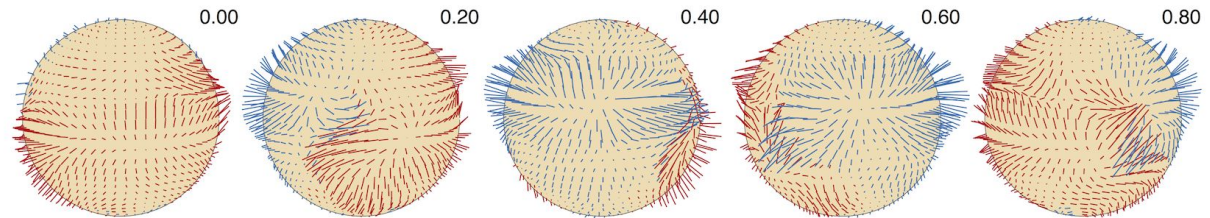
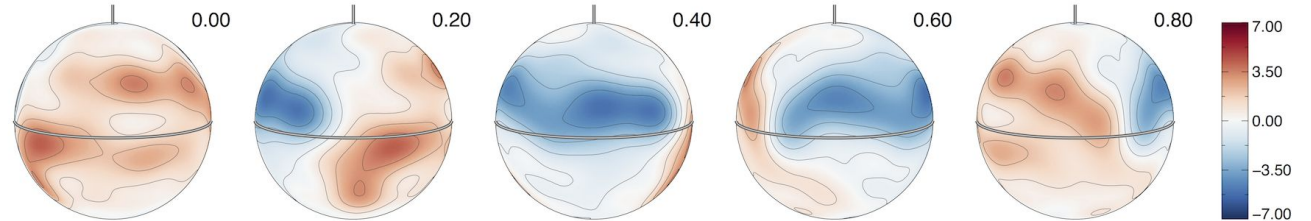
Modulus



Horizontal



Radial



Stokes IQUV Inversions derived *simultaneously with abundance maps*

HARPSpol Open Cluster Ap/Bp Star Project



As introduced in John's talk, this project will allow a probe of magnetic field complexity as a function of age.

The aim is to produce a set of Stokes IV magnetic maps for the target stars.

In Summary

Through recent mapping:

- We have shown the reliability of our inversion procedure.
- With the increasing the number of Ap stars mapped using using MDI:
 - We can now start to investigate how other stellar parameters correlate with magnetic field complexity.
 - We can further look for correlations between abundance structures and the magnetic field.
- HARPSpol Open Cluster Project in particular will allow us to probe age vs magnetic field complexity.

Thank You



Can the magnetic field of HD 32633 be described by a simple dipole or
dipole + quadrupolar field ?

Stokes Q

Stokes U

