

# Magnetic fields of planet-host stars

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M. Deleuil*



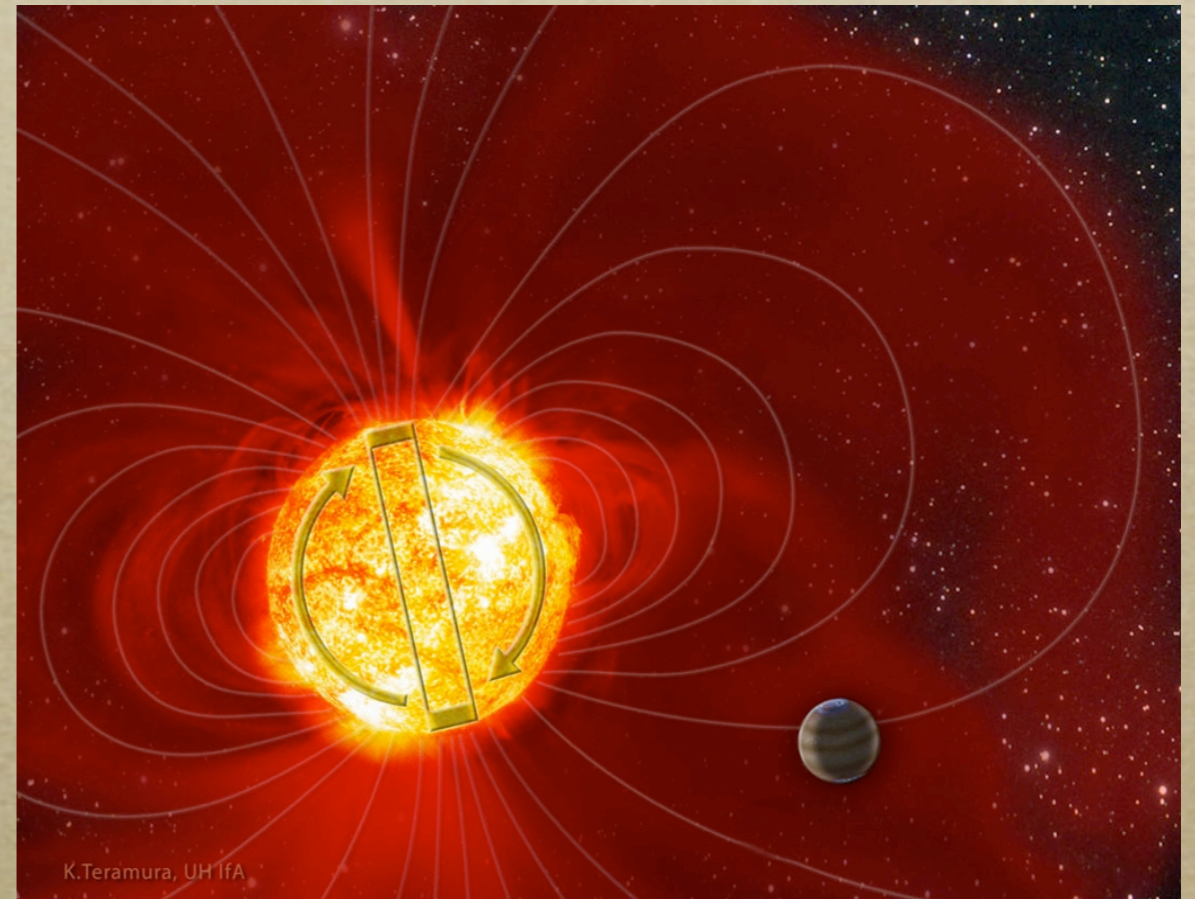
University of  
St Andrews

600  
YEARS

PLATO 2.0 Workshop

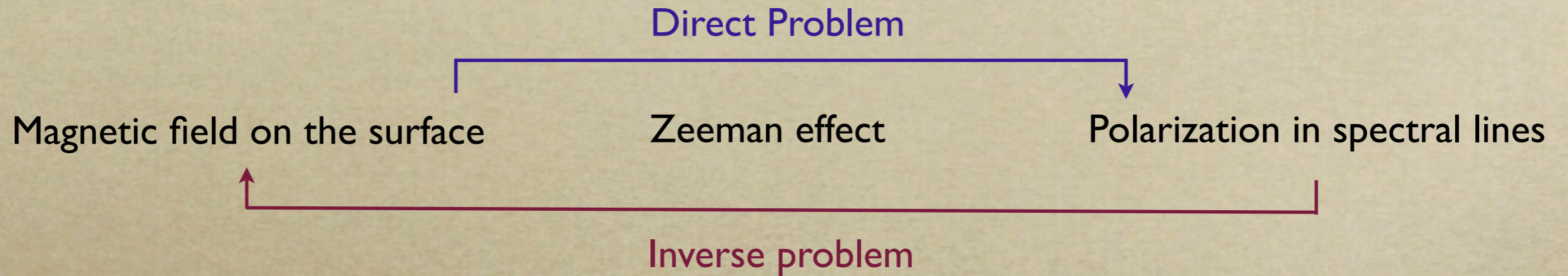
# Introduction

- ★ Magnetic field: key role in magnetospheric interactions
- ★ Interactions observed for different wavelengths
- ★ Tidal interactions might influence the generation of the magnetic field

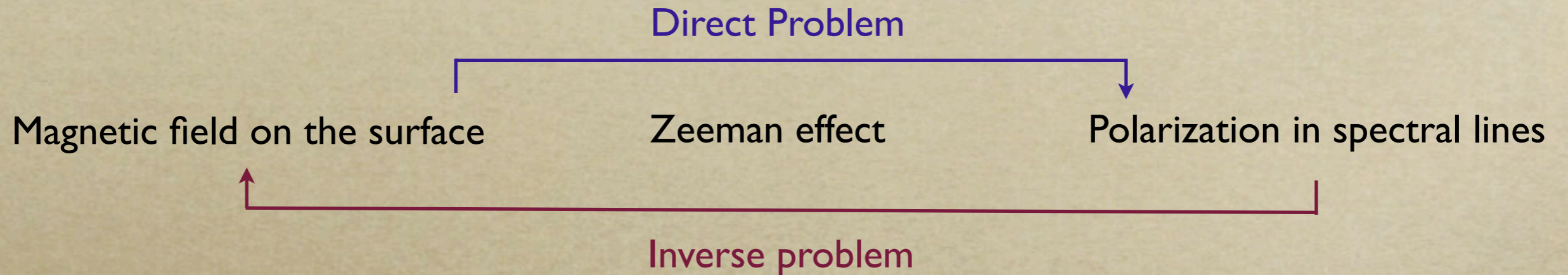


CREDIT: Karen Teramura, University of Hawaii

# Zeeman-Doppler Imaging



# Zeeman-Doppler Imaging

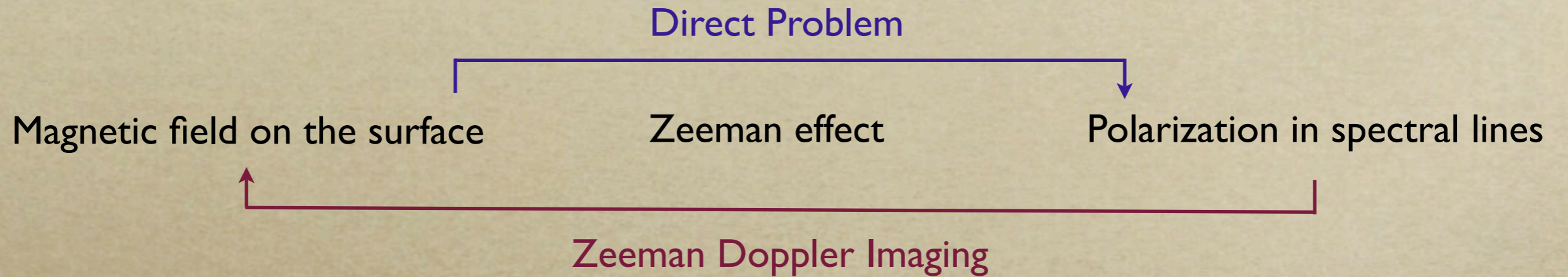


ESPaDOnS (CFHT) - NARVAL (TBL)

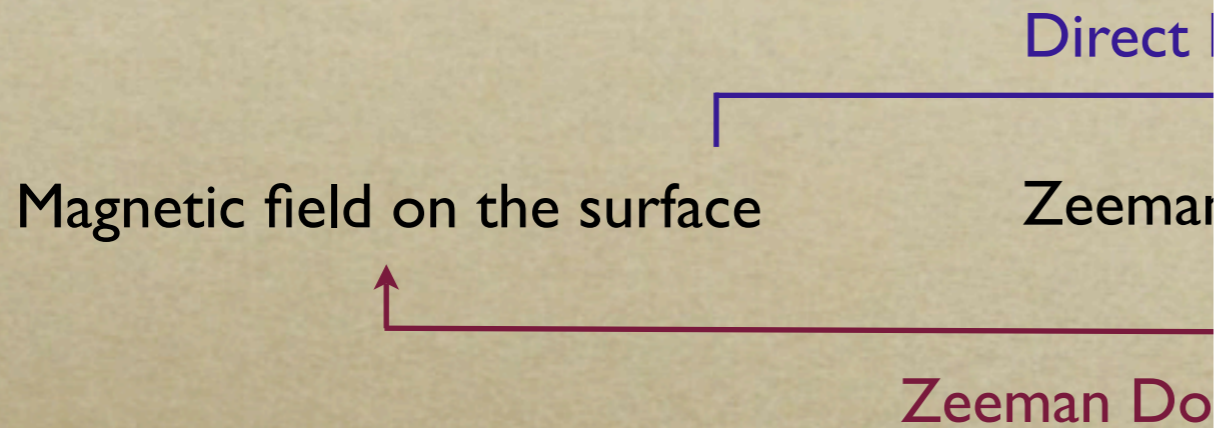
HARPSpol (La Silla)



# Zeeman-Doppler Imaging



# Zeeman-Doppler Imaging

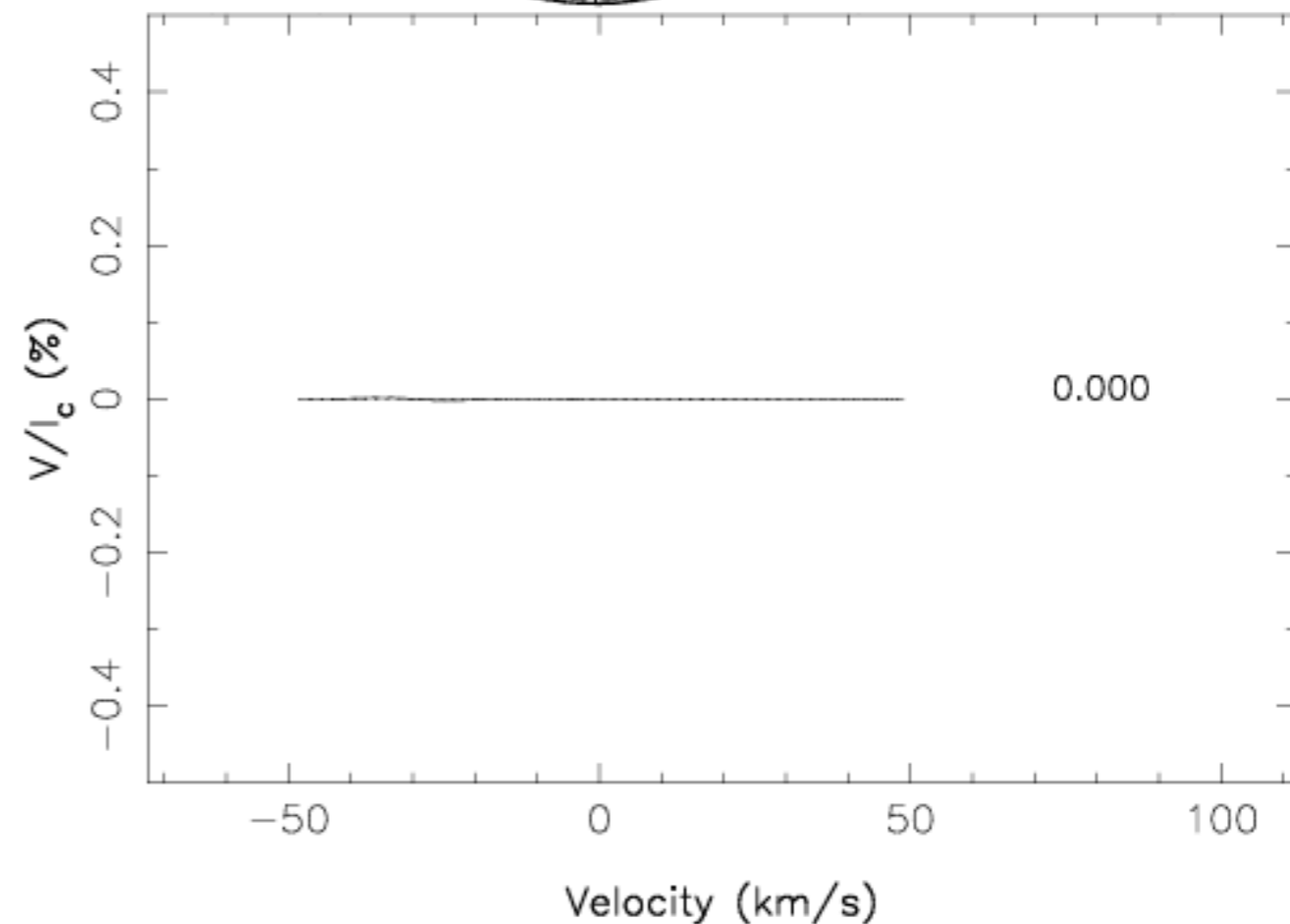
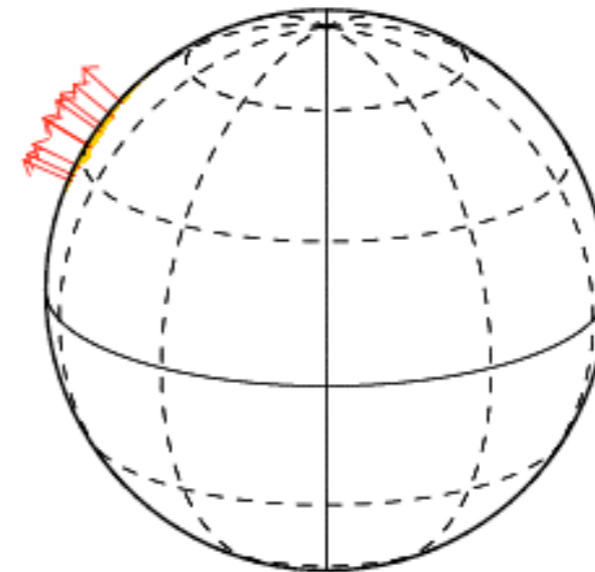


time series of polarized spectra



Magnetic regions localisation  
Field orientation  
Field strength

Vector magnetic field



# Survey

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10 planet host stars

- F, G and K stars
- $P_{\text{rot}}$  : 3 -- 40 days
- Planetary Mass: 0.2 -- 12  $M_{\text{Jupiter}}$
- Semi-major axis < 0.1 AU

# Survey

10 planet host stars

- F, G and K stars
- $P_{\text{rot}}$  : 3 -- 40 days

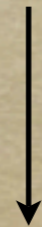


3 stars with no detection  
of large-scale magnetic field

(Corot-7, HAT-P-2, XO-3)

7 stars with detection

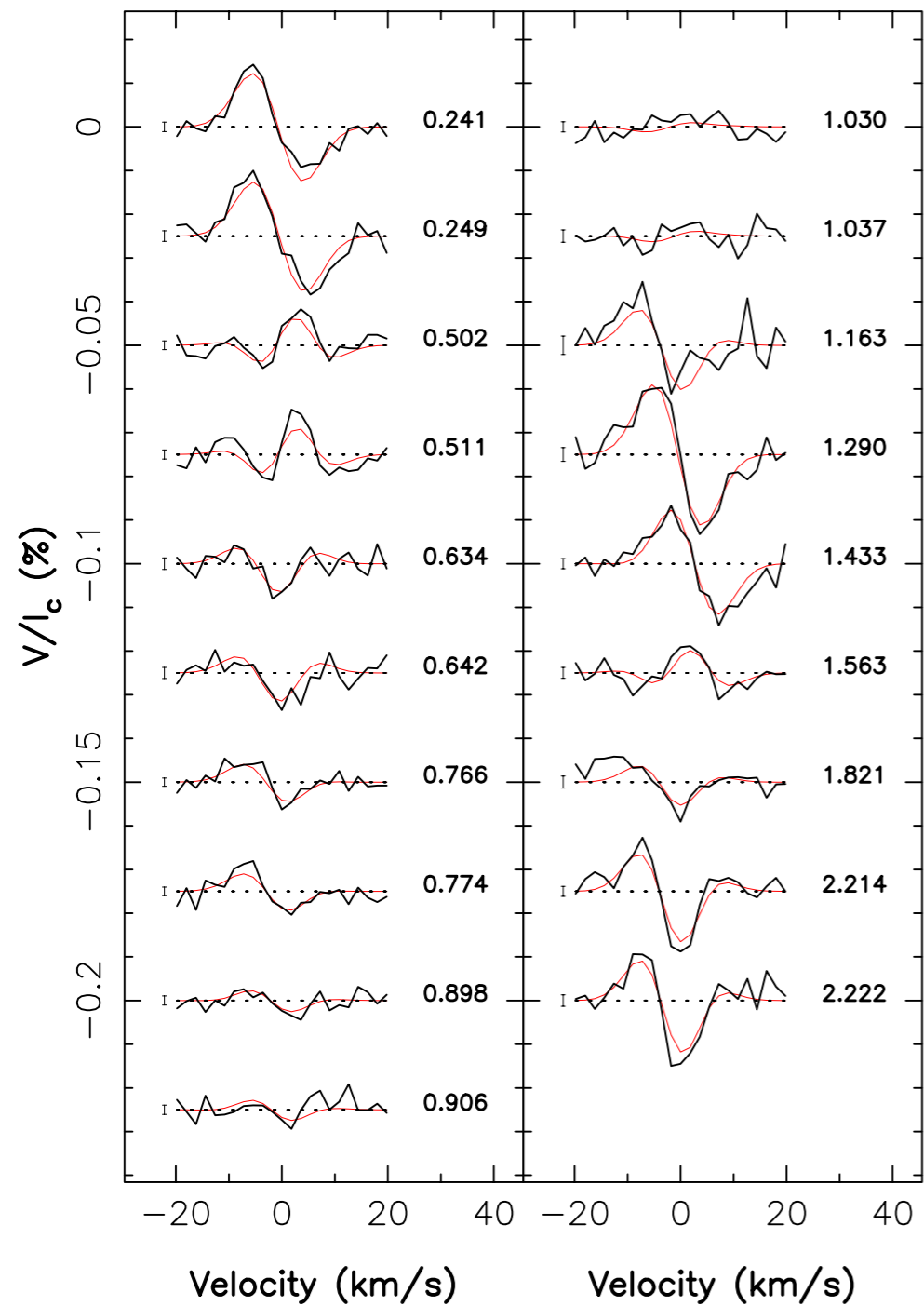
(Tau Boo, HD179949, HD189733  
HD73256, HD102195, HD46375,  
HD130322)



3 stars with multi-epoch  
observations



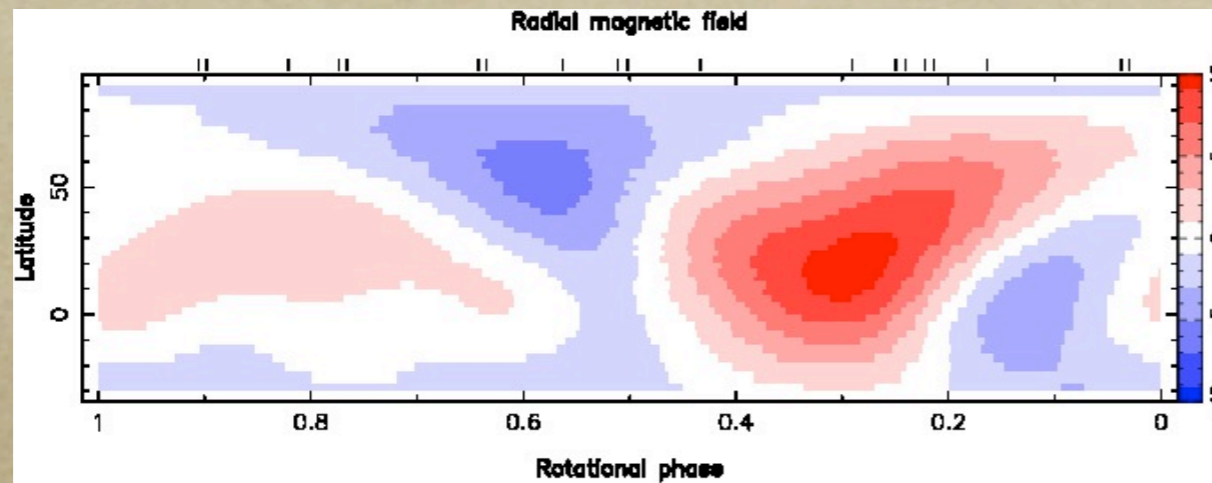
# Spectropolarimetric obs



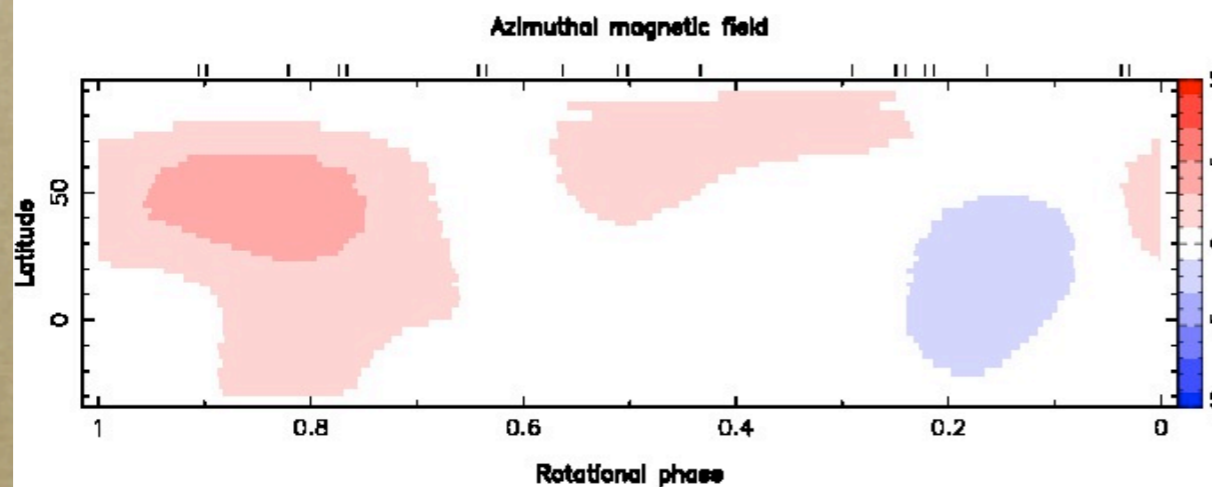
HD 179949, September 2009

# Magnetic maps

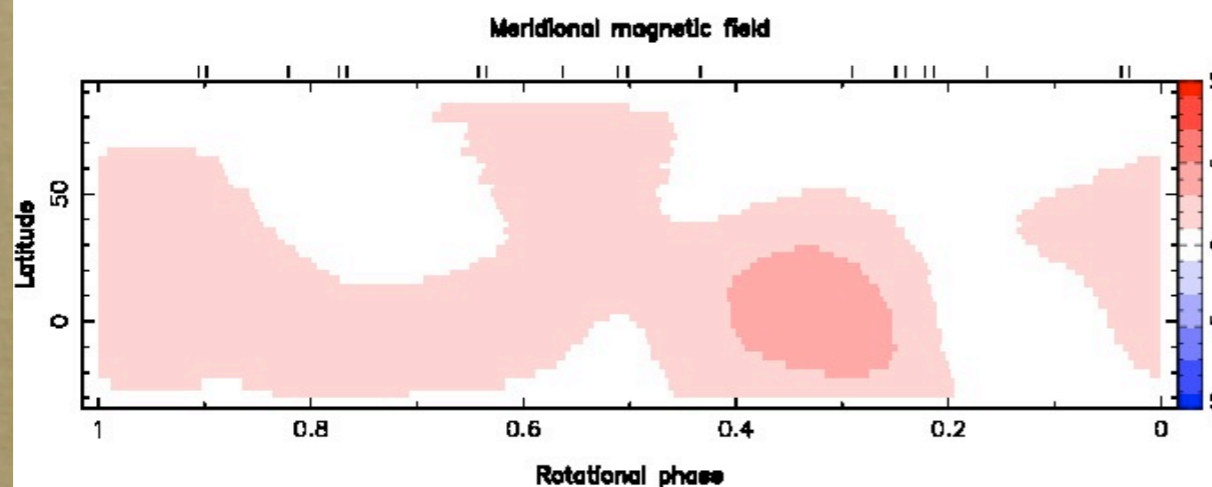
Brad



Bazim



Bmer

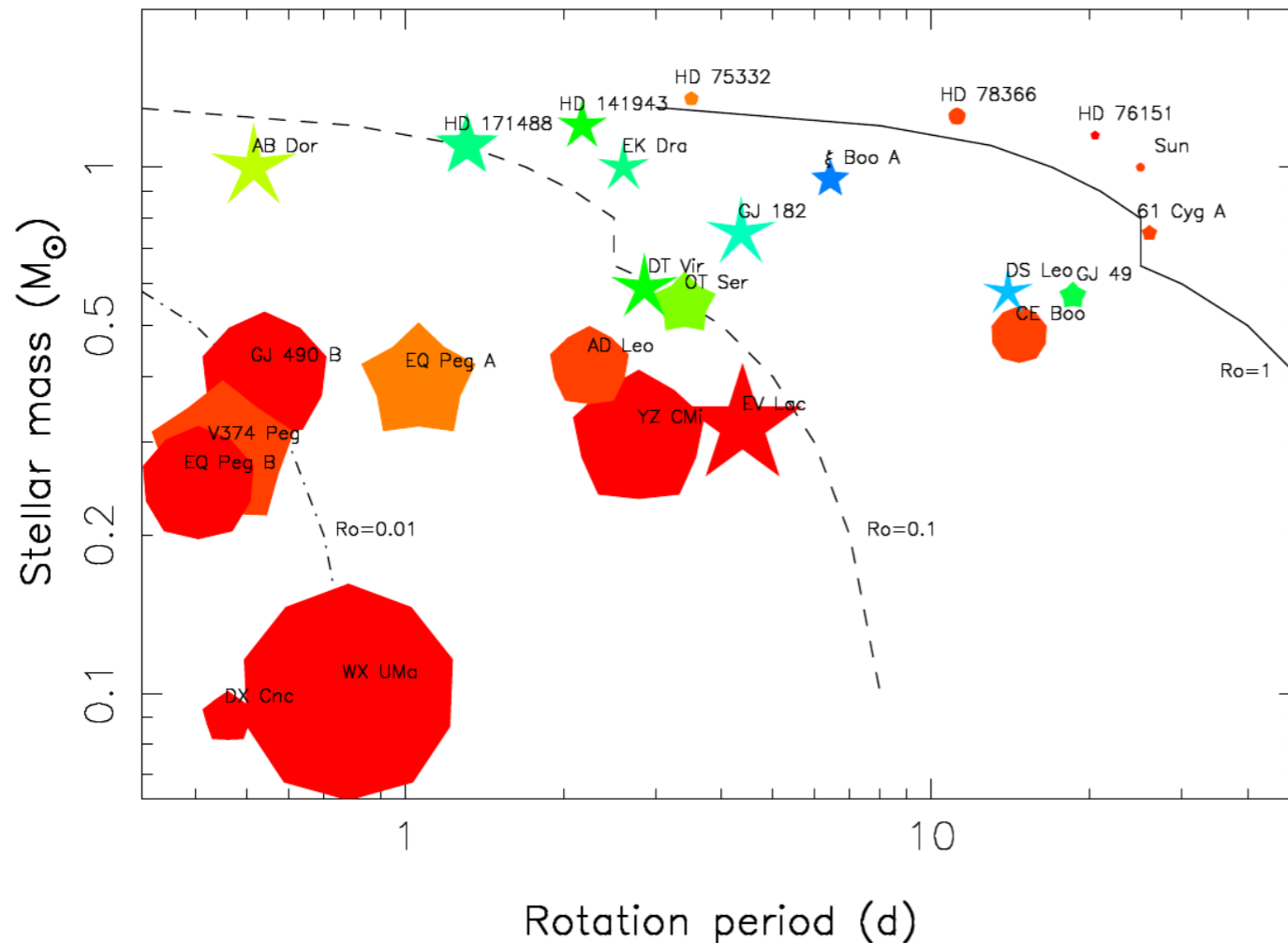


HD 179949, September 2009

- Three components of the field
- Poloidal/toroidal Energy
- Degree of axisymmetry

Magnetic field  $\sim 5$  Gauss  
Poloidal

# Field characteristics



Donati & Landstreet, ARA&A , 2009

Rossby Number

$Ro = \text{Rotation Period} / \text{Convective turnover time}$

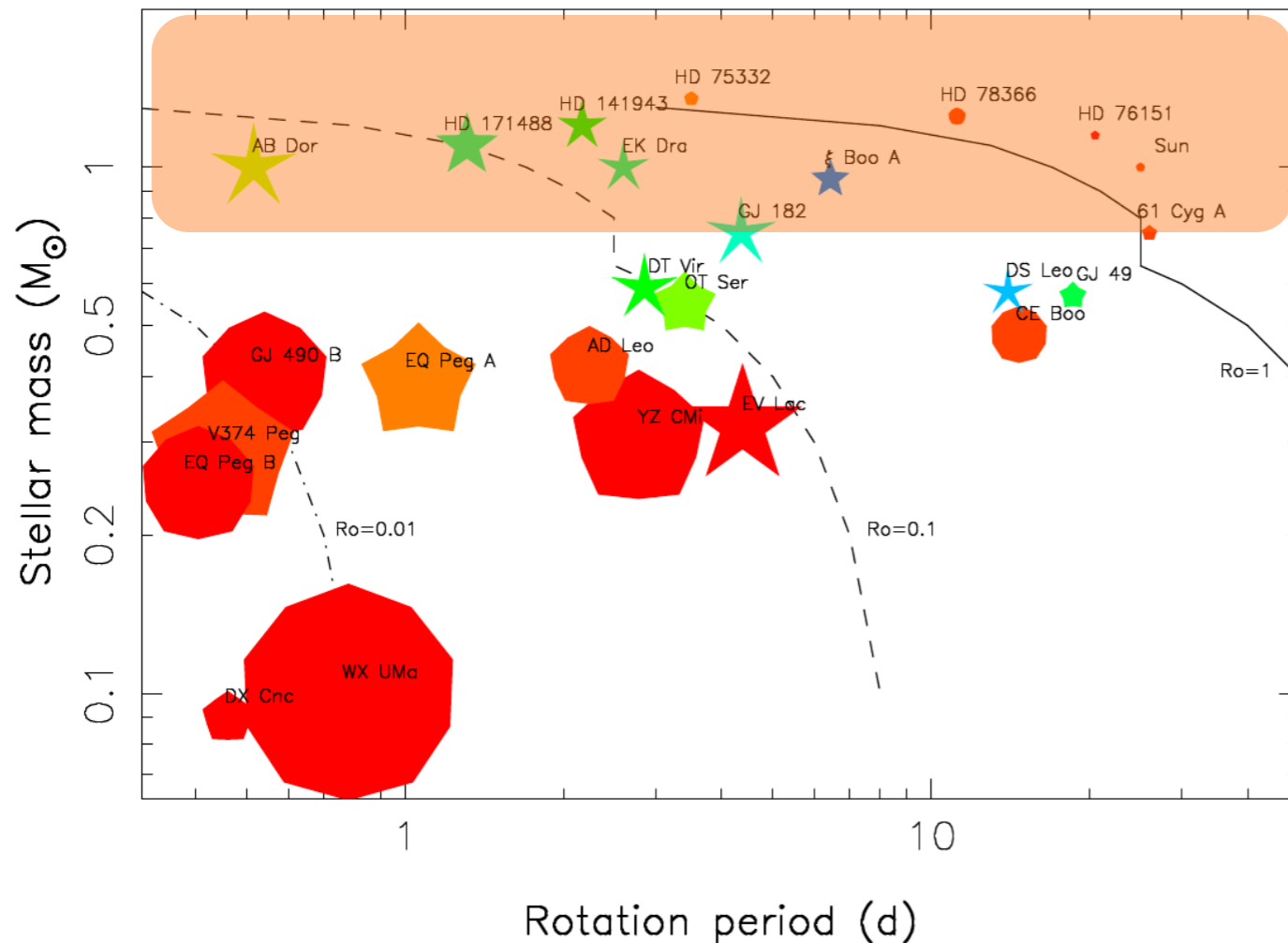
size : field intensity

colour : **poloidal** **toroidal**

shape : pol axisymmetric ●

pol non-axisymmetric ★

# Field characteristics



Donati & Landstreet, ARA&A , 2009

Rossby Number

$Ro = \text{Rotation Period} / \text{Convective turnover time}$

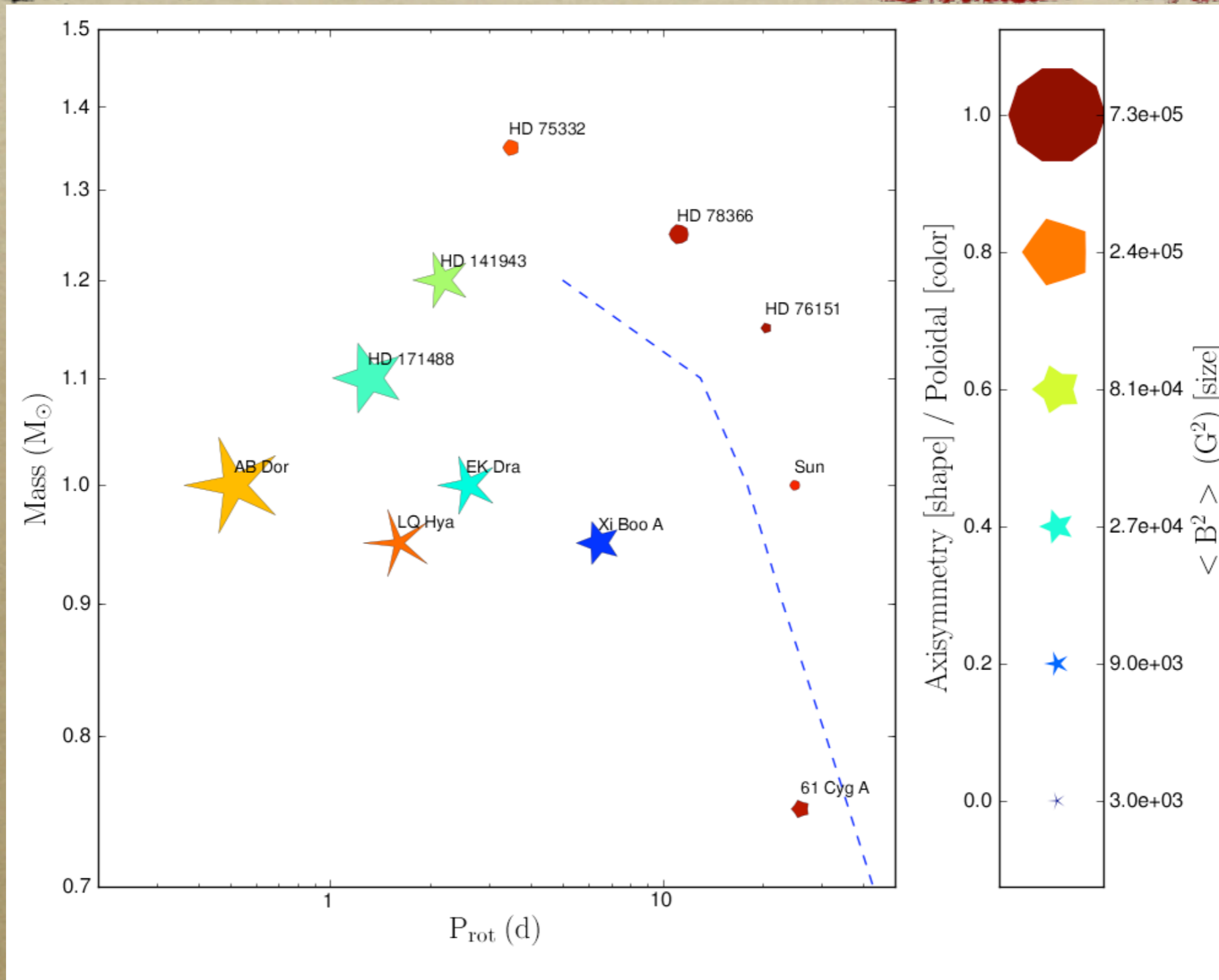
size : field intensity

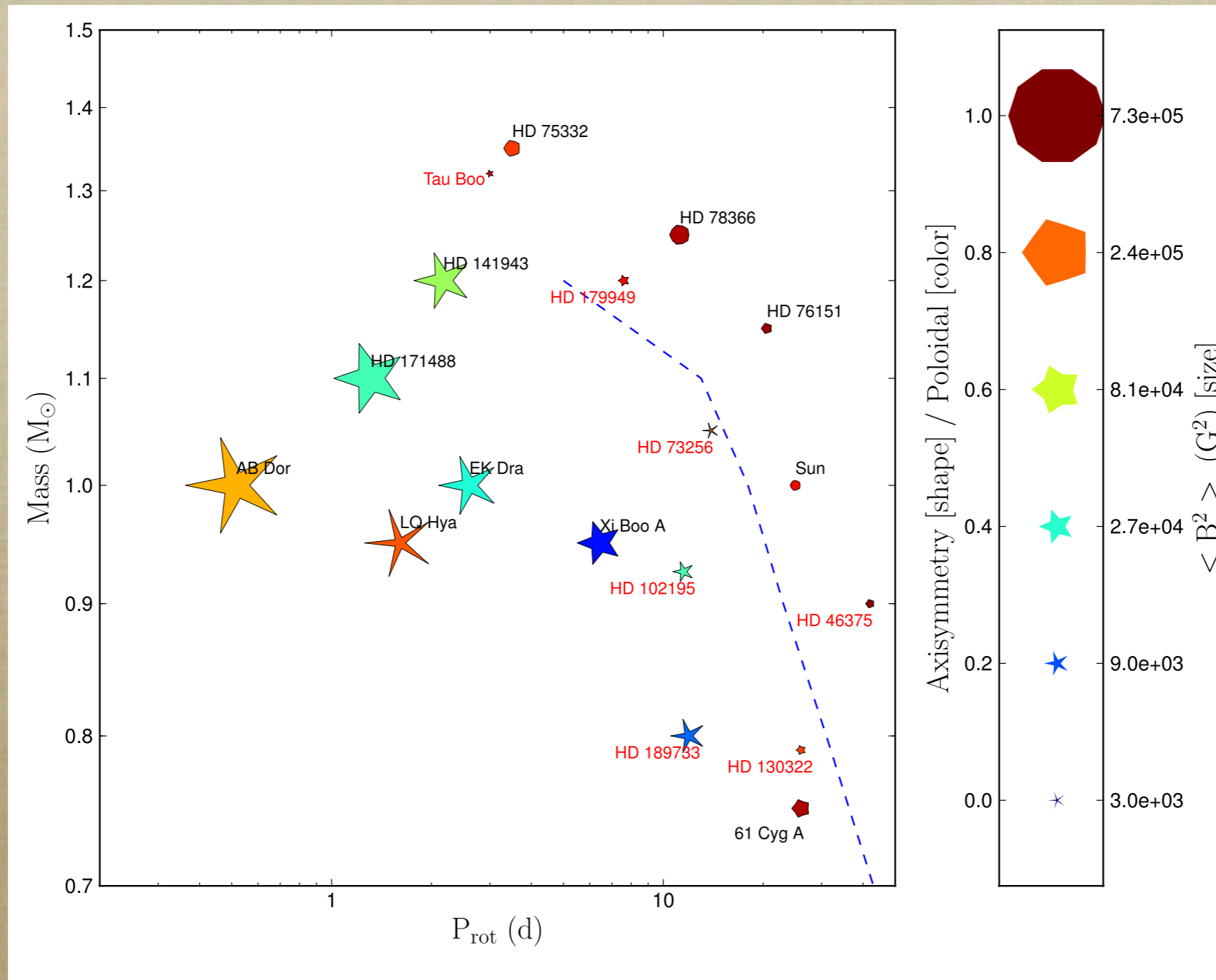
colour : poloidal    toroidal

shape : pol axisymmetric ●

pol non-axisymmetric ★

# Field characteristics

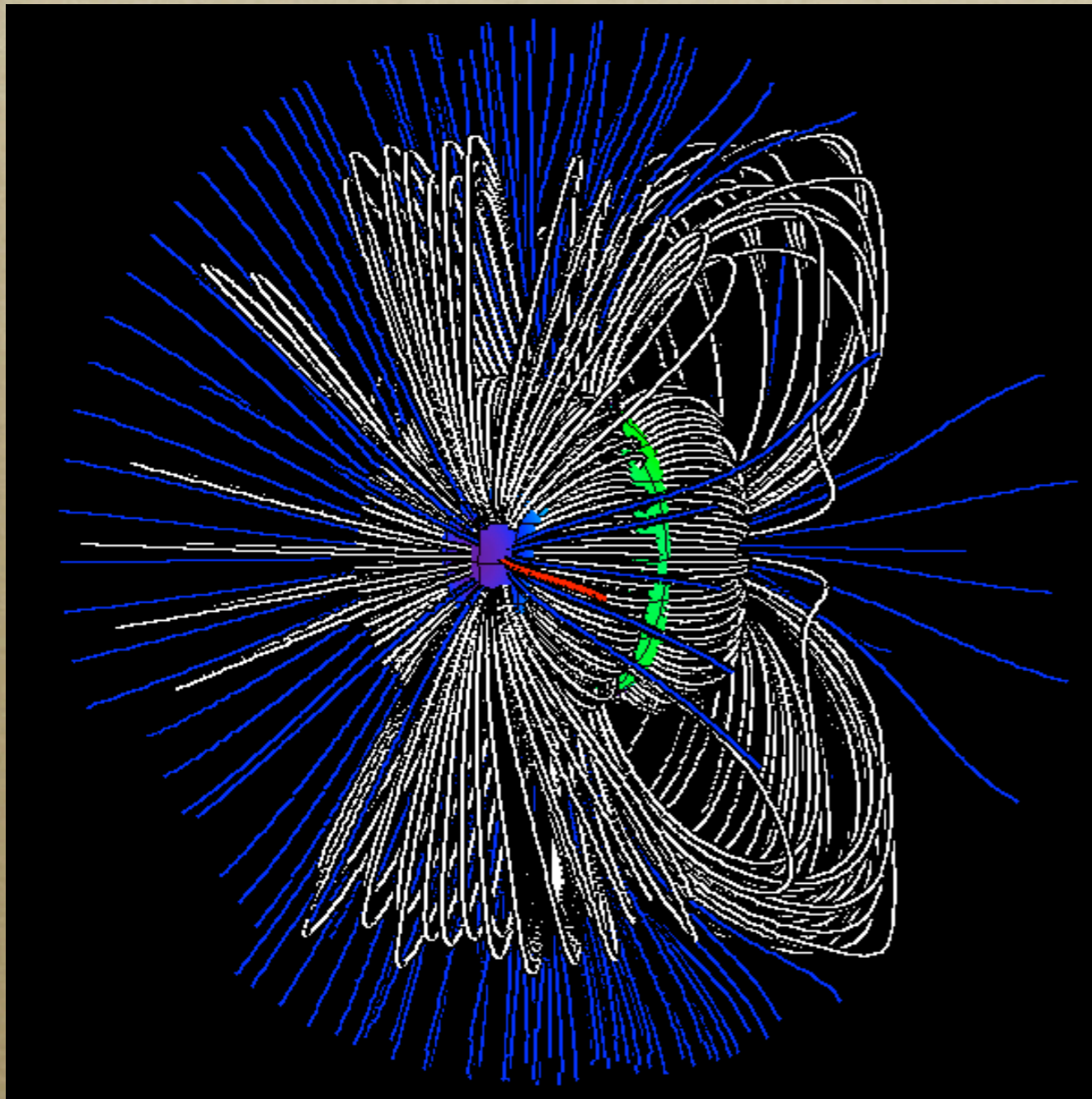




Fares et al,  
MNRAS, in press

- *Hot-Jupiter host stars do not have peculiar magnetic properties - need of a bigger sample*
- *Tau Boo: magnetic cycle of 2 years (or less) - effect of the planet ?*

# Stellar corona and beyond



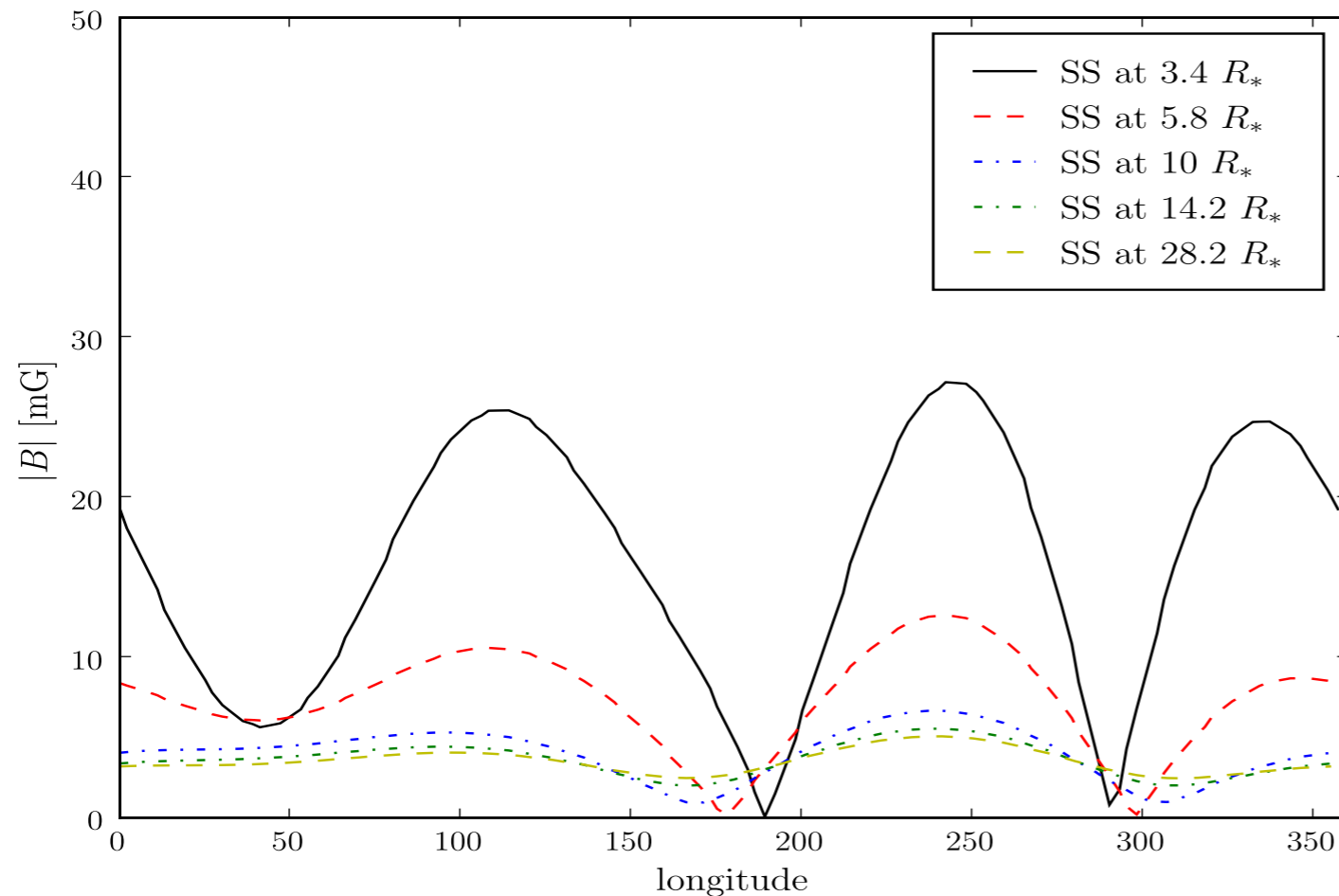
HD 189733

June 2007

$P_{\text{rot}} = 12$  days

$P_{\text{orb}} = 2.21$  days

# Stellar corona and beyond



HD 189733

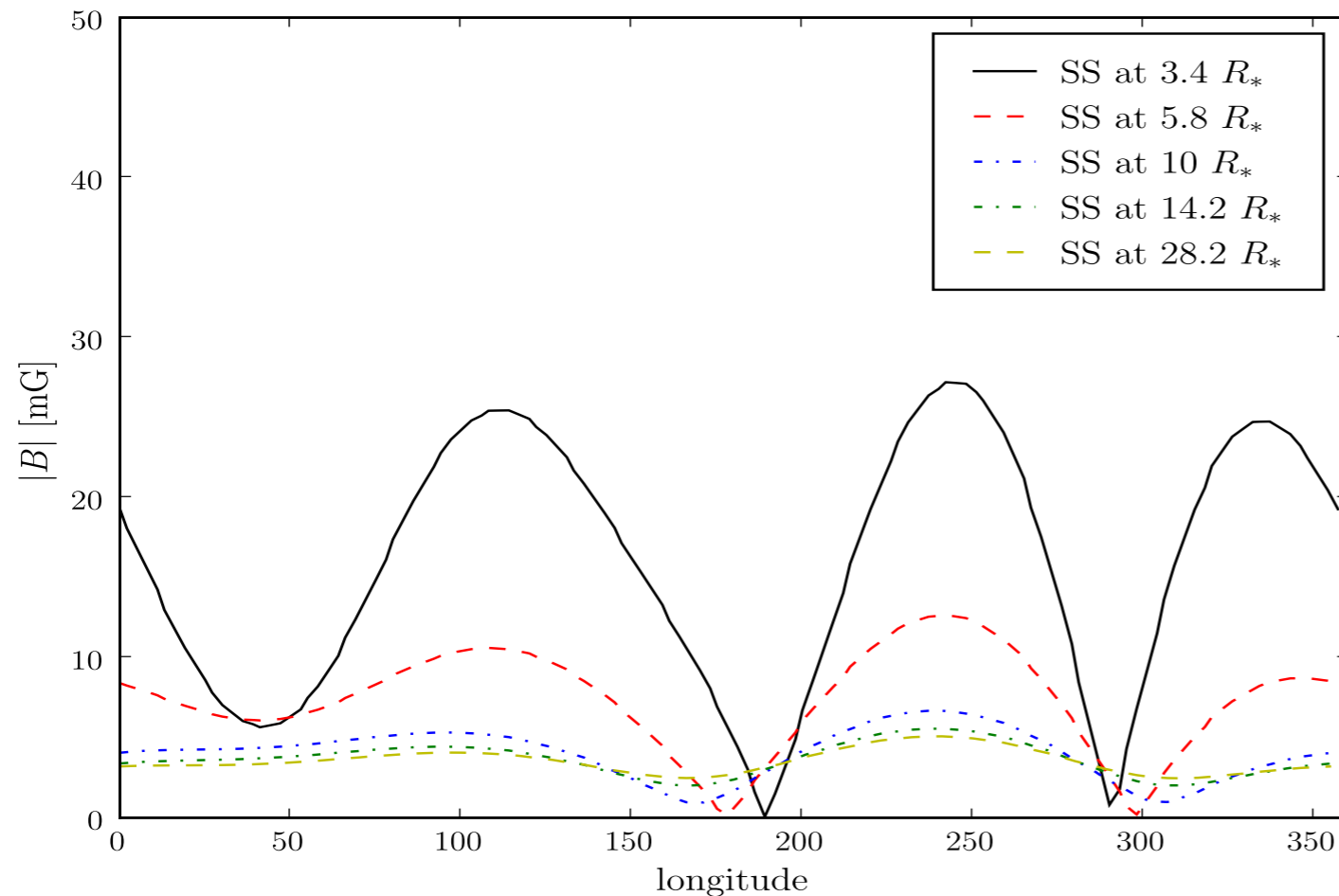
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# Stellar corona and beyond



HD 189733

June 2007

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$P_{\text{orb}} = 2.21$  days

*Planetary radio emission* (Zarka, P&SS, 2007; Griessmeier et al, A&A, 2007 )

*Bow shock formation* (Vidotto et al 2011, Llama et al 2011)

--> *Magnetic field of the planet*

# Conclusions

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*Magnetic fields of hot-jupiter host stars seem to have properties similar to stars without hot-Jupiters*

*Tau Boo: stellar magnetic cycle of 2 years (polarity reversals)*

*Large-scale magnetic field: Studying the planet environment*

*PLATO - bright stars: bigger sample that can be studied with spectropolarimetry*