Spectropolarimetric study of solar-type magnetic cycles

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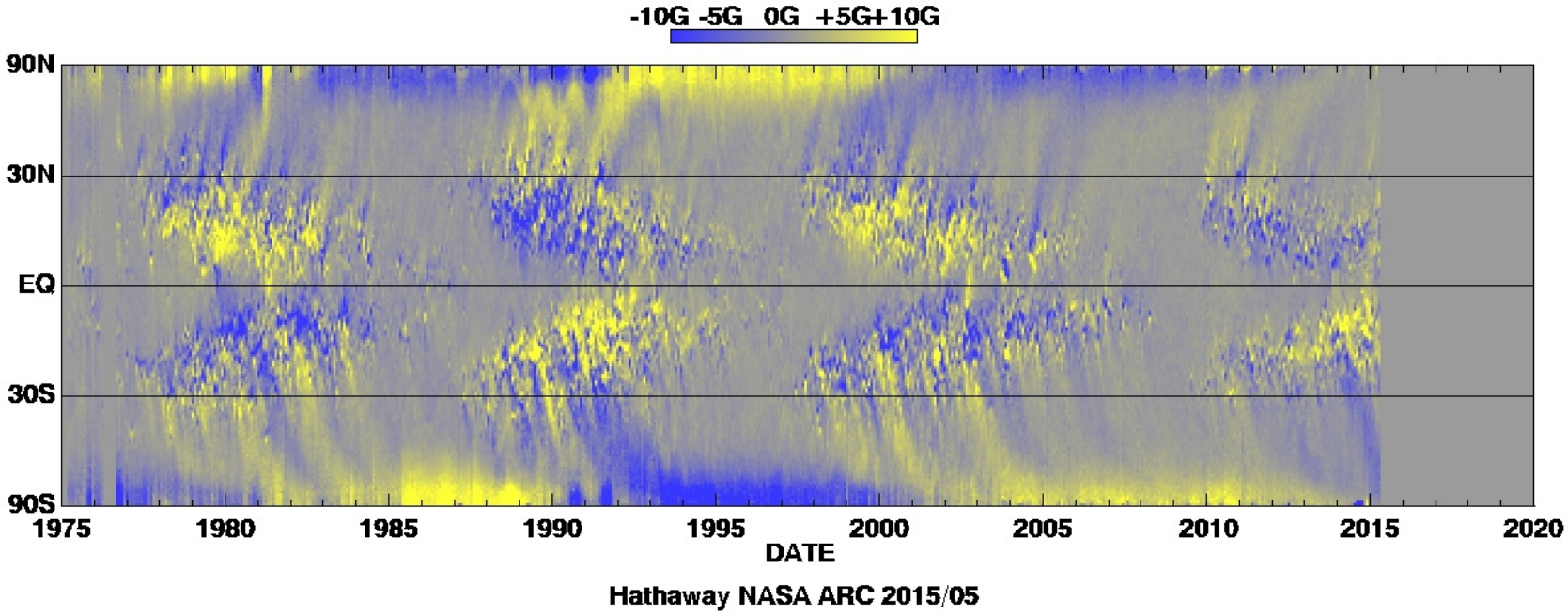
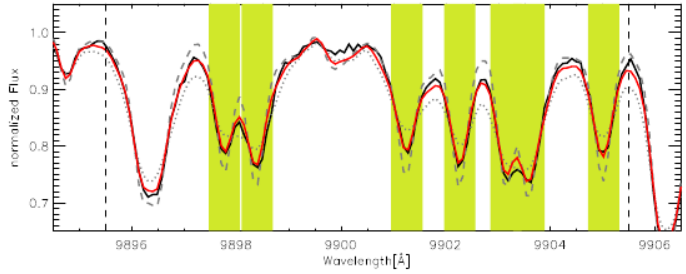
The Solar case



Observations of stellar magnetic field

- Unpolarised spectroscopy:
  - Chromospheric activity as a proxy of magnetic field
  - Zeeman broadening of spectral lines
- Spectropolarimetry:
  - Longitudinal field measurements from Stokes V
  - Zeeman Doppler Imaging

Credit: F. Espenak



Reiners & Basri 2006

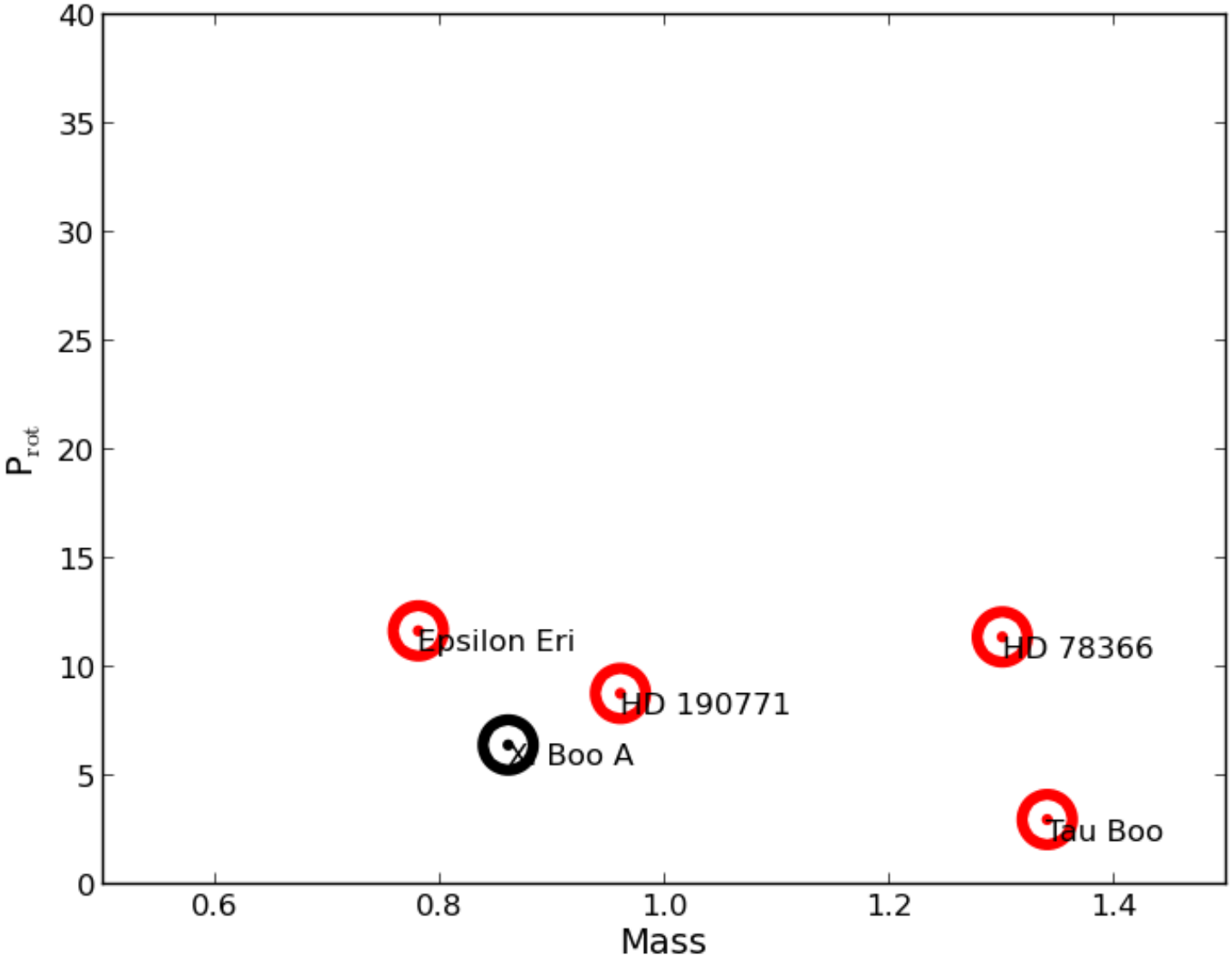
Spectropolarimetric observations of solar-type stars

- Observations taken using NARVAL spectropolarimeter at TBL
- Data taken as part of the BCool collaboration (Marsden et al. 2014)
- Least square deconvolution (LSD) $\Longrightarrow$ assumes similar line profile for all magnetically sensitive line $\Longrightarrow$ Average line profile with increased SNR
- Zeeman Doppler imaging (ZDI) $\Longrightarrow$ tomographic technique. Reconstructs the large-scale magnetic field geometry
- Large-scale field topology of two solar-type stars: **HN Peg**, **61 Cyg A**

TBL, Pic du Midi

`http://bcool.ast.obs-mip.fr`

ZDI detection of polarity reversals in cool stars



HN Peg

- Spectral type: G0 V, Mass: 1.1 $M_{\odot}$, vsini: 10.6 kms^{-1}, P_{rot}: 4.6 days
- Active star : non-cyclic activity

HN Peg: Chromospheric activity

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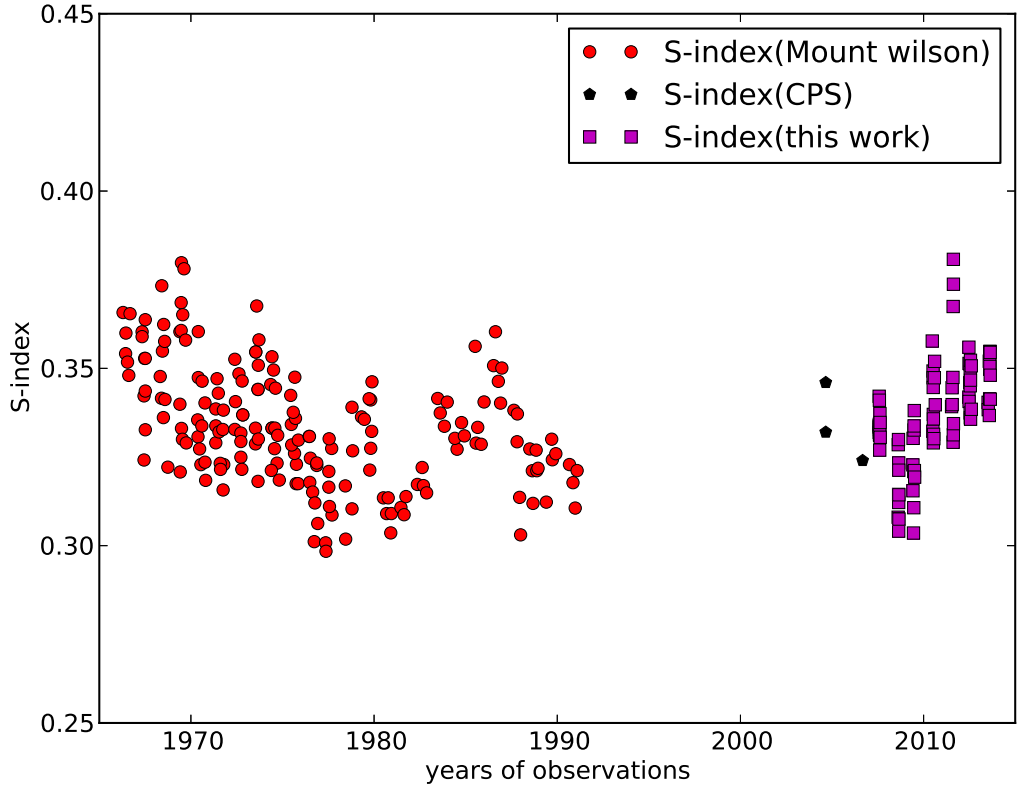
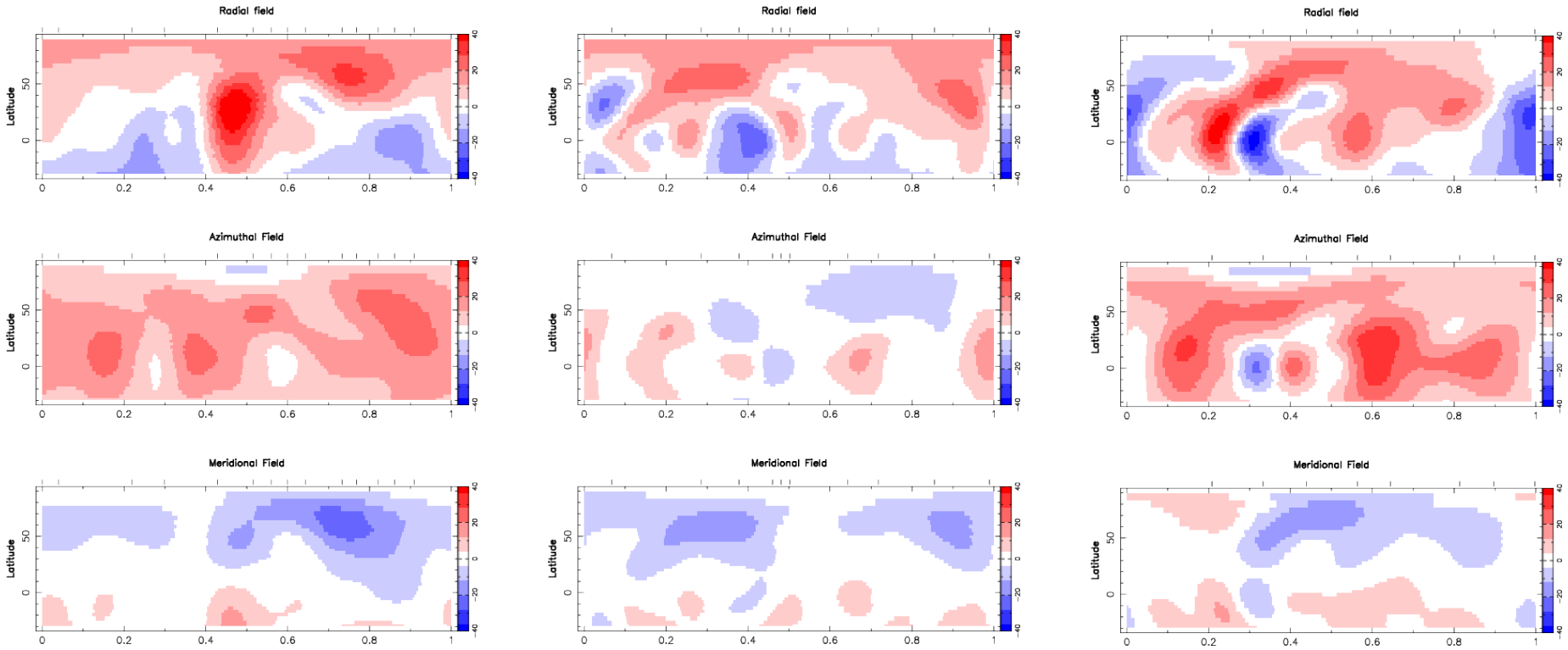


Boro Saikia et al. 2015

HN Peg: Large-scale magnetic field geometry

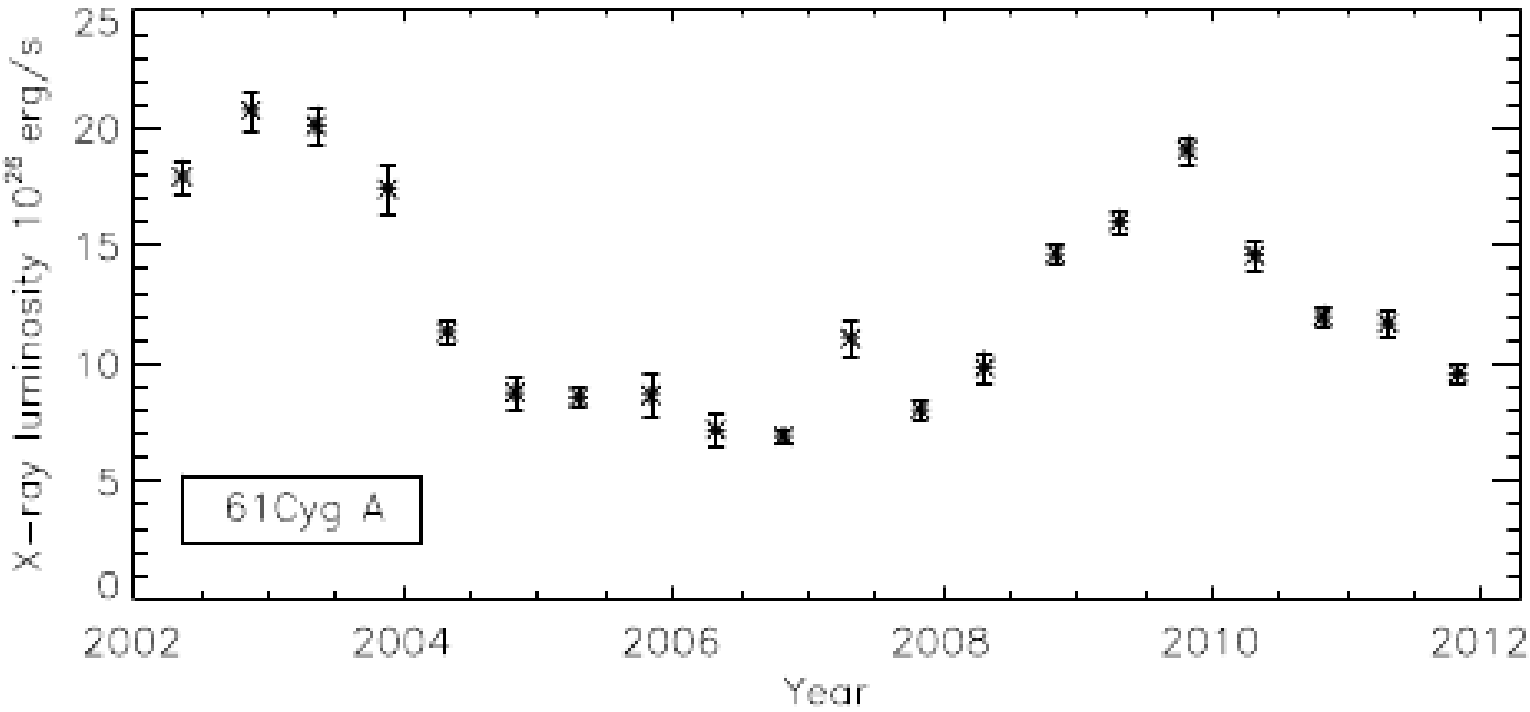
2007.69 2009.54 2011.67



Boro Saikia et al. 2015

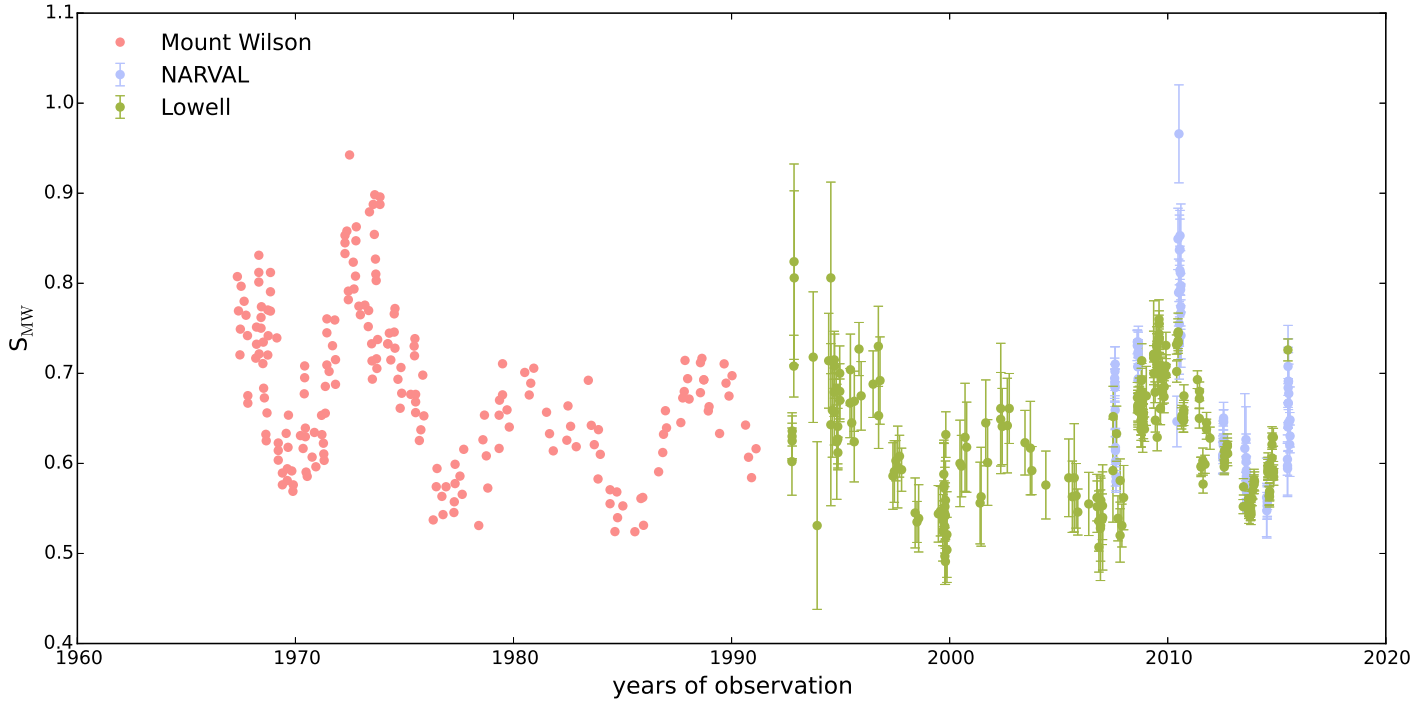
61 Cyg A

- Spectral type: K5V, Mass: 0.66 $M_\odot$, vsini: 4.7 kms^{-1}, P_{rot}: 34.5 days
- Chromospheric and coronal activity cycle of 7.3 yrs



Robrade et al. 2012

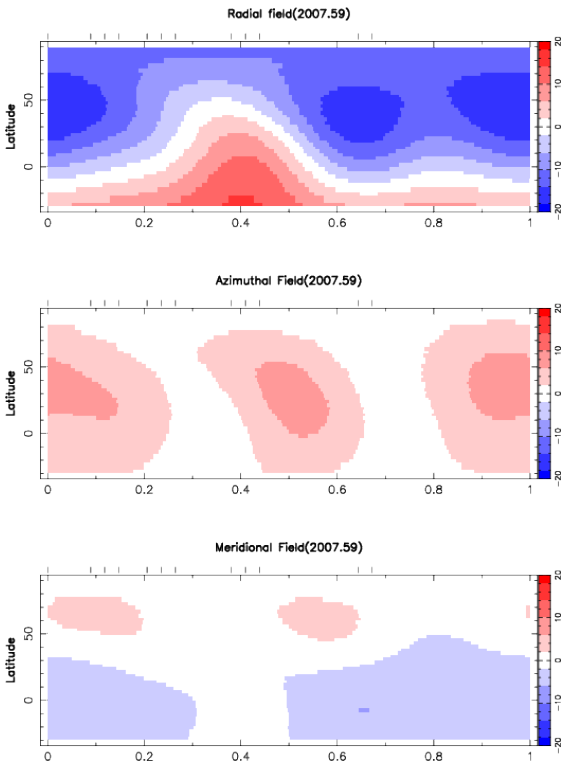
61 Cyg A: Chromospheric activity cycle



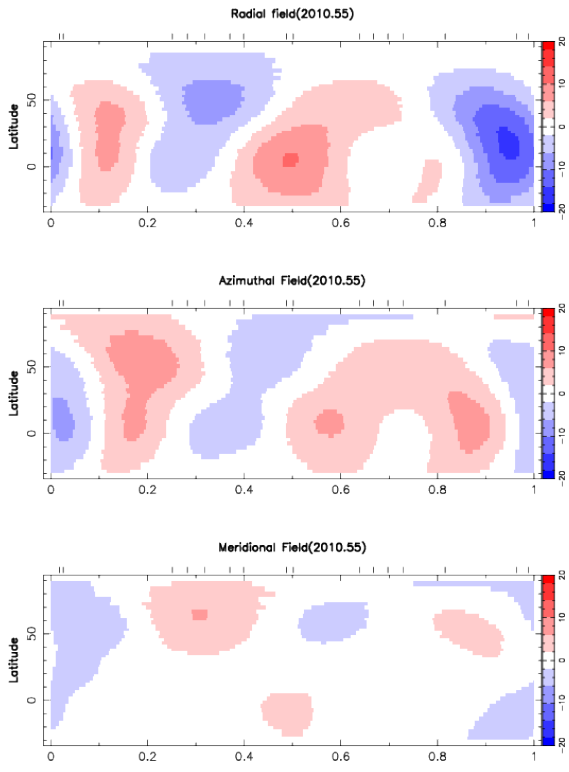
Boro Saikia et al. in prep

61 Cyg A: Polarity reversal of the large-scale magnetic field

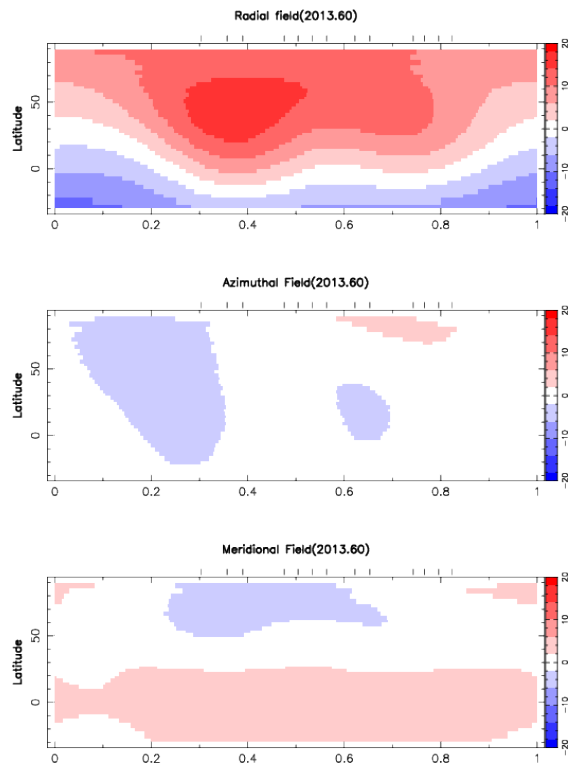
2007.59



2010.55

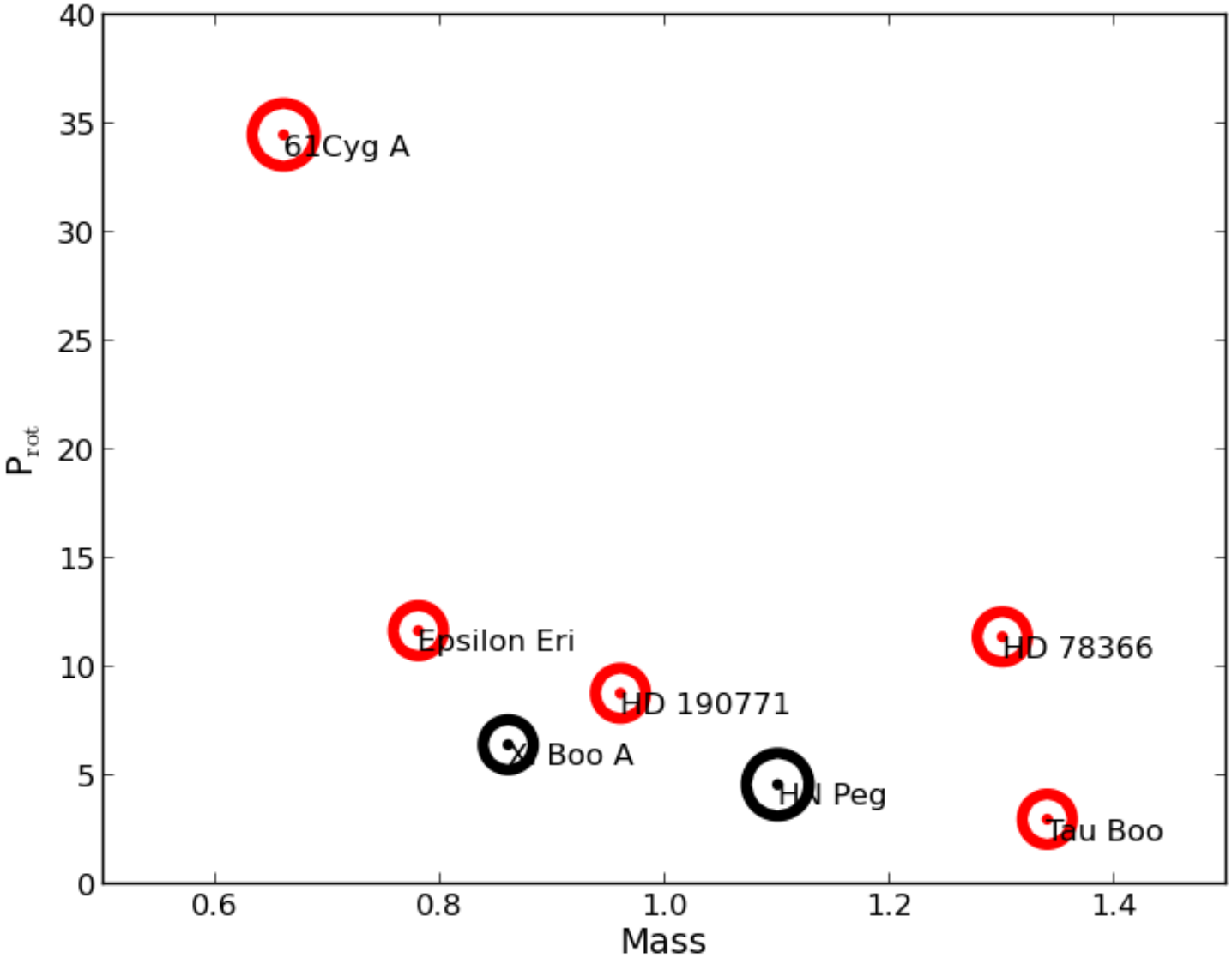


2013.61



Boro Saikia et al. 2015 in prep

Summary


40
35
30
25
20
15
10
5
0
P_{rot}
61Cyg A
Epsilon Eri
HD 190771
χ Boo A
HN Peg
HD 78366
Tau Boo
0.6
0.8
1.0
1.2
1.4
Mass