

Magnetic activity of interacting binaries

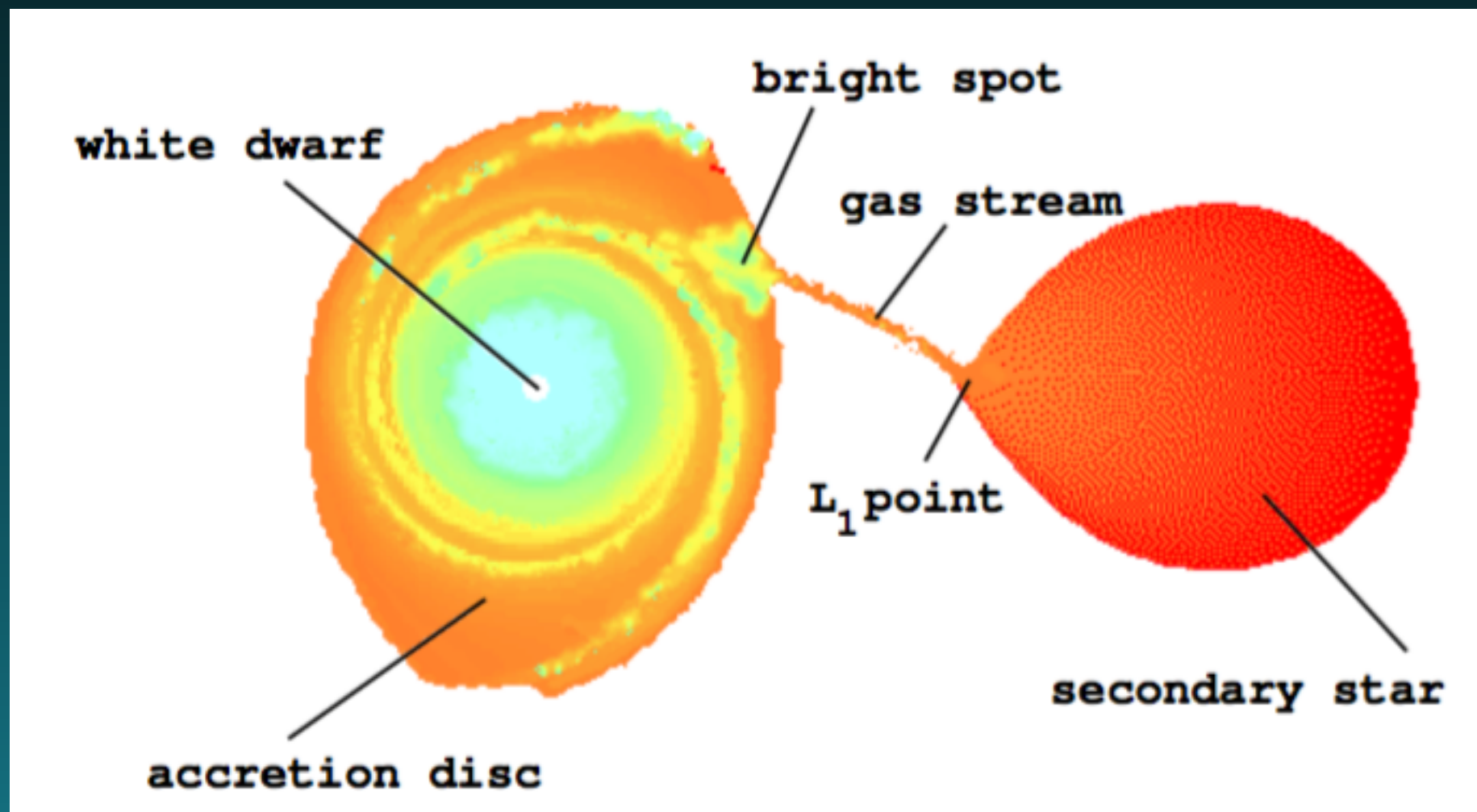
Colin Hill

IRAP / University of Toulouse

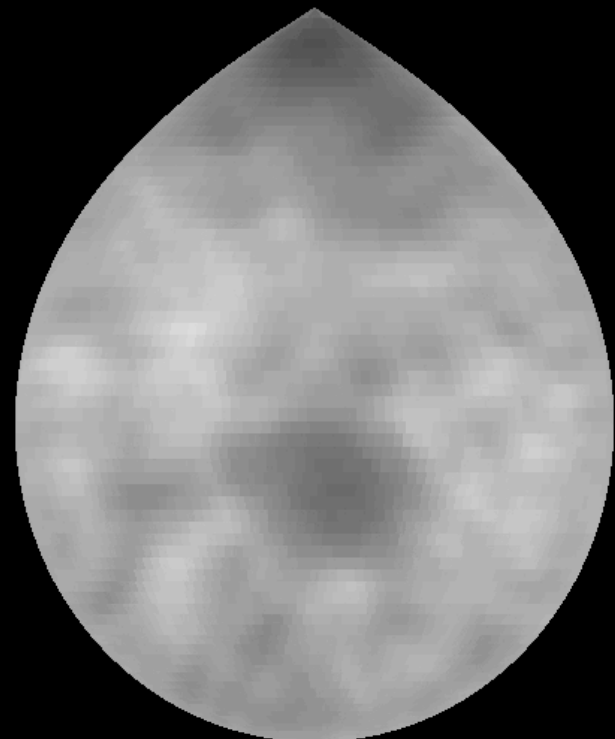
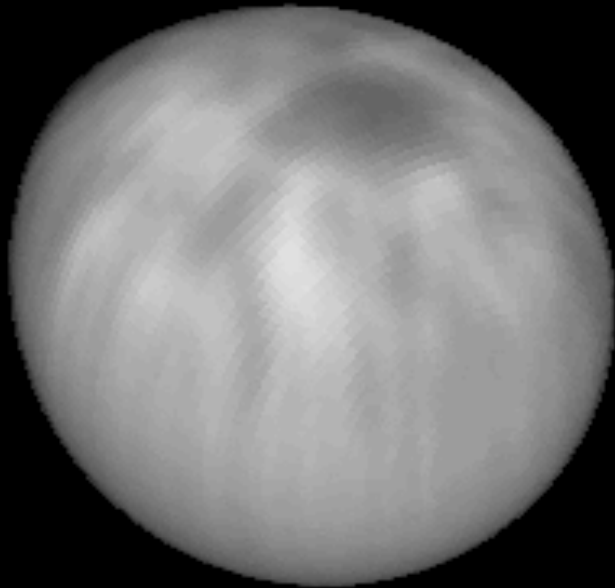
Why should you care?

- Test stellar dynamo theories in a unique parameter regime
 - $P_{\text{rot}} < 10 \text{ hr}$
 - Low Rossby number (P_{rot} / τ_c) < 0.003
 - Tidal distortion (due to companion star)
 - Forced co-rotation as magnetic braking/torques shrink orbit
 - Rapidly-rotating old stars

- Cataclysmic variable - CV



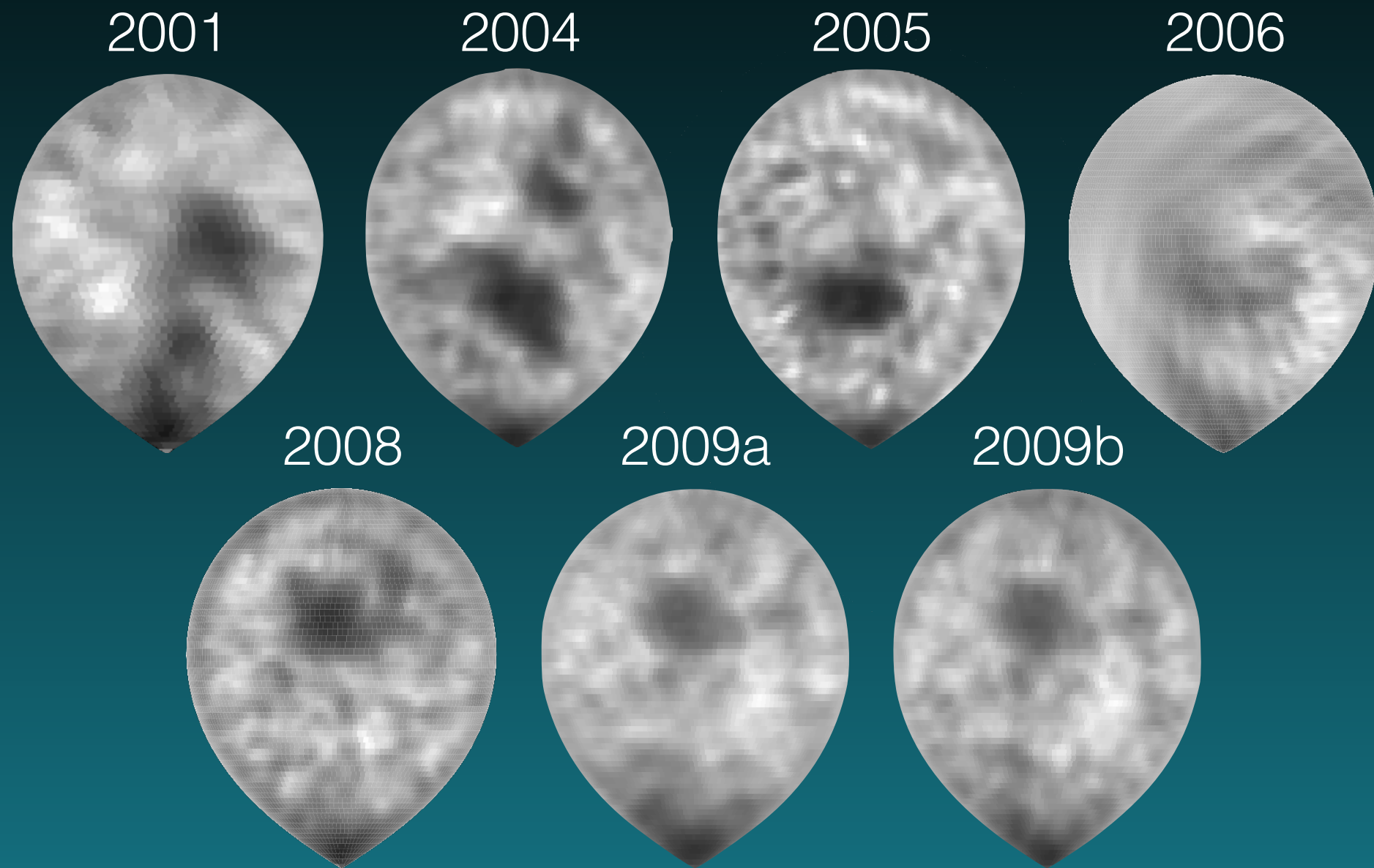
AE Aqr - Differential rotation



Hill et al. 2014

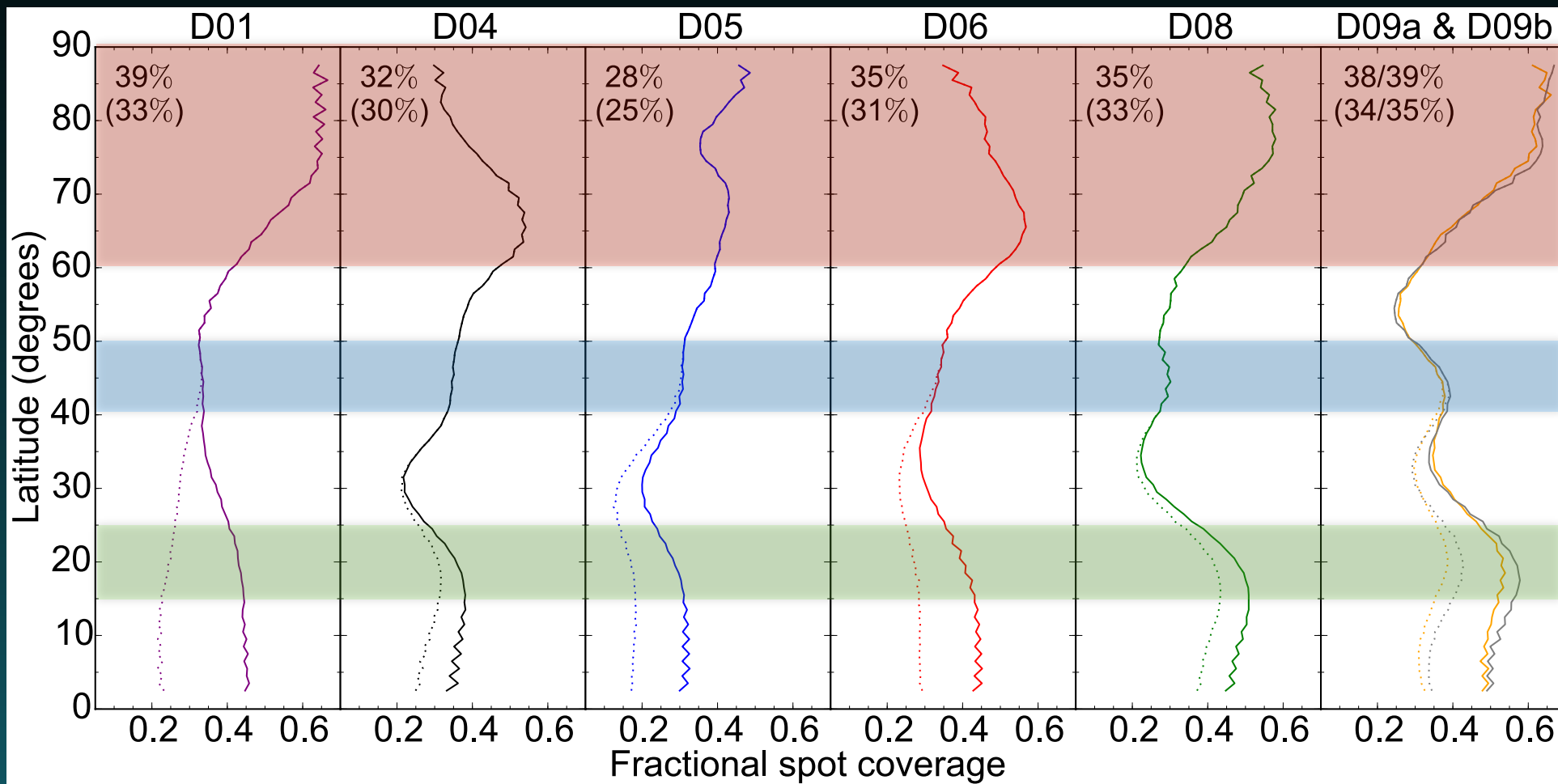
- K4V + White dwarf
- $P_{\text{rot}} = 0.41 \text{ d}$ (1.5% Sun)
- $d\Omega = 40\%$ Sun
- Planets:
 - Misaligned around hot stars $>6250\text{K}$
 - Aligned around cool stars $<6250\text{K}$
e.g. Brothwell et al. 2013
- Outer convective envelope responsible for tidal interactions
- Is a change in internal structure the cause of this transition?
- Test tidal dissipation efficiency - study interacting binaries of different spectral types (Synchronous or differential rotation?)

AE Aqr - Magnetic activity cycle?



Hill et al. 2016

AE Aqr - Magnetic activity cycle?



Prominent spot band $\sim 20^\circ$

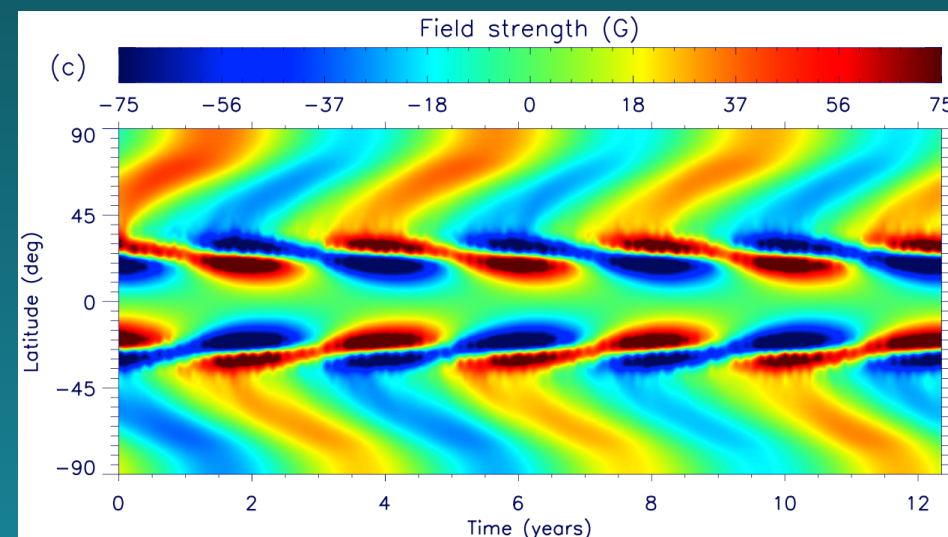
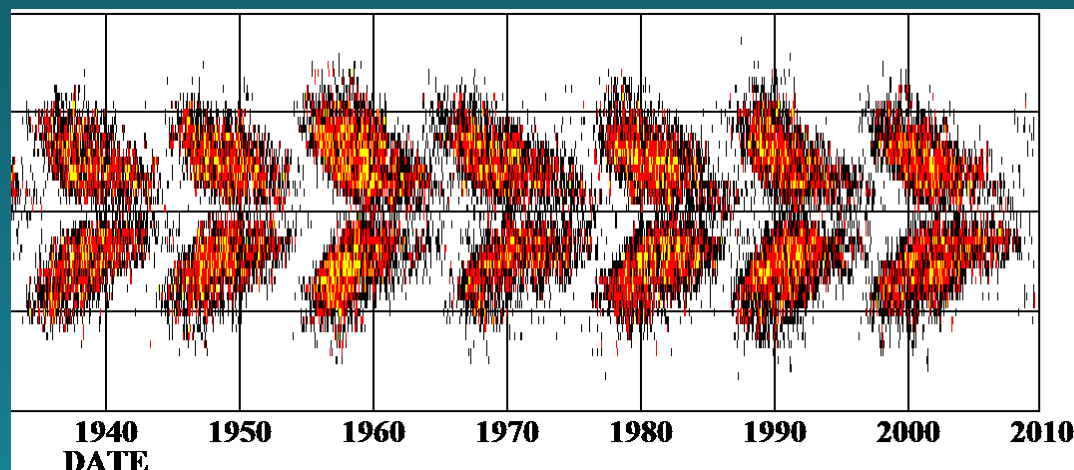
Growth of spot band $\sim 45^\circ$

Dominant dynamo mechanism unclear

Hill et al. 2016

Solar-type $P_{\text{rot}} \sim 2 \text{ d}$

Sun

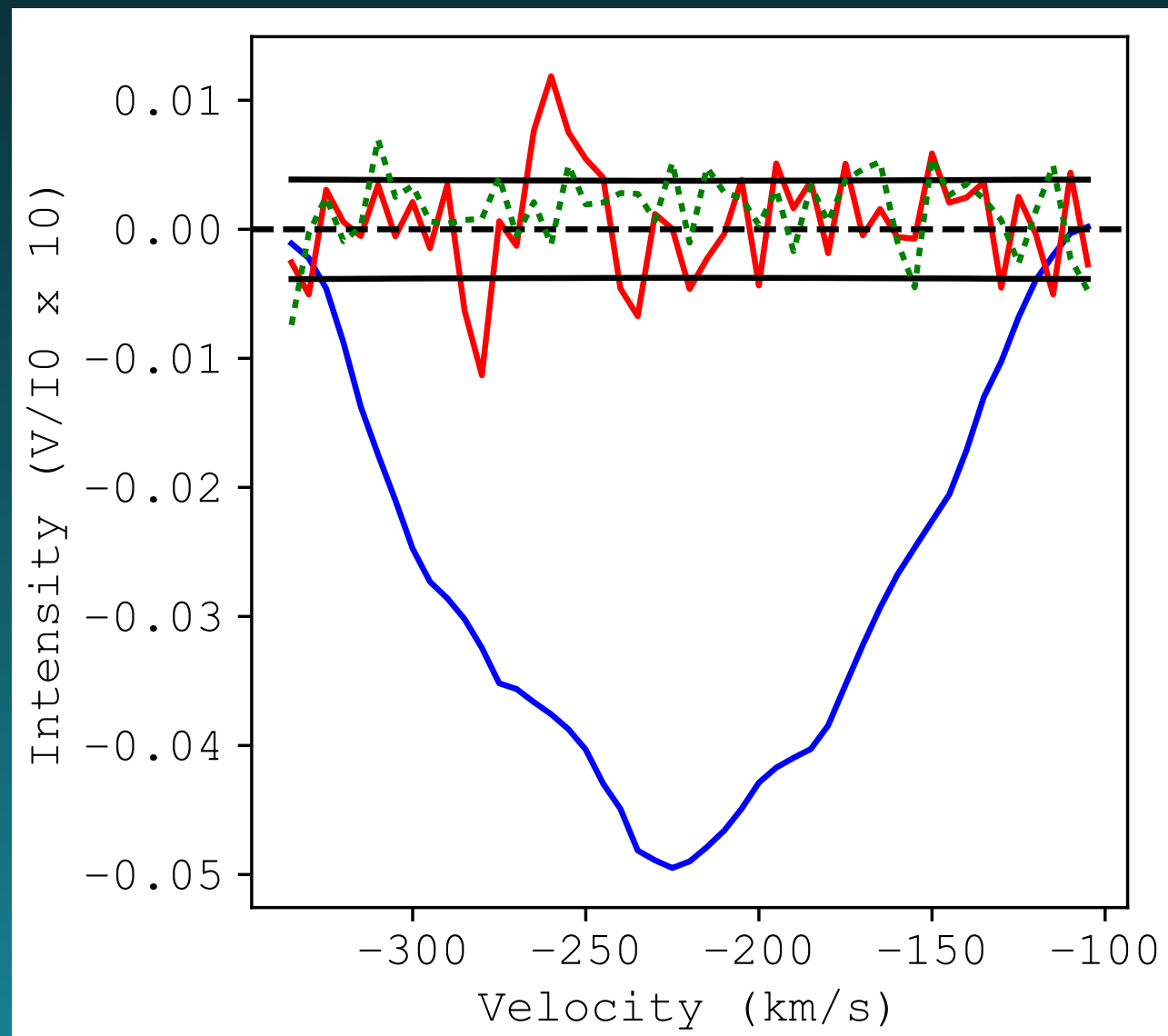


E. Işık et al. 2011

Colin Hill

AE Aqr magnetic field

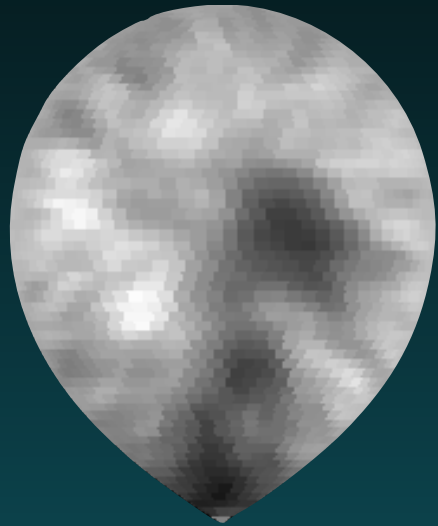
- $B_l \sim -11$ G
- 3 sigma detection...



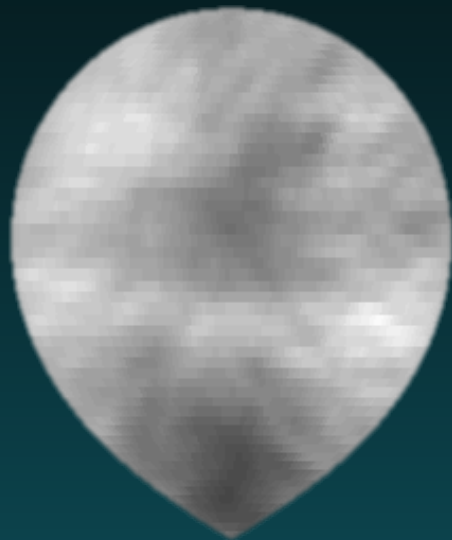
Tidal effects on magnetic activity

- Slingshot prominences observed
 - Material at 0 km/s - Across centre of mass
 - Need \sim kG fields at surface

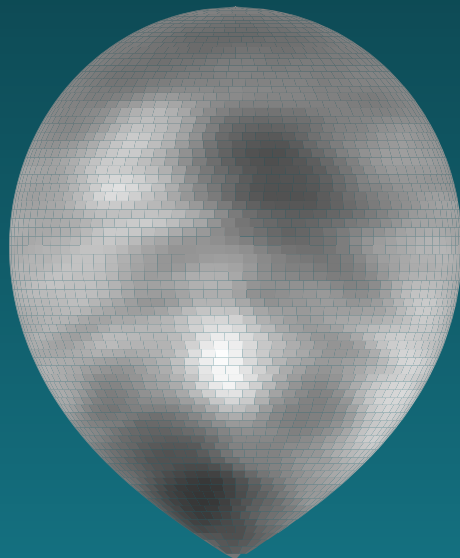
AE Aqr



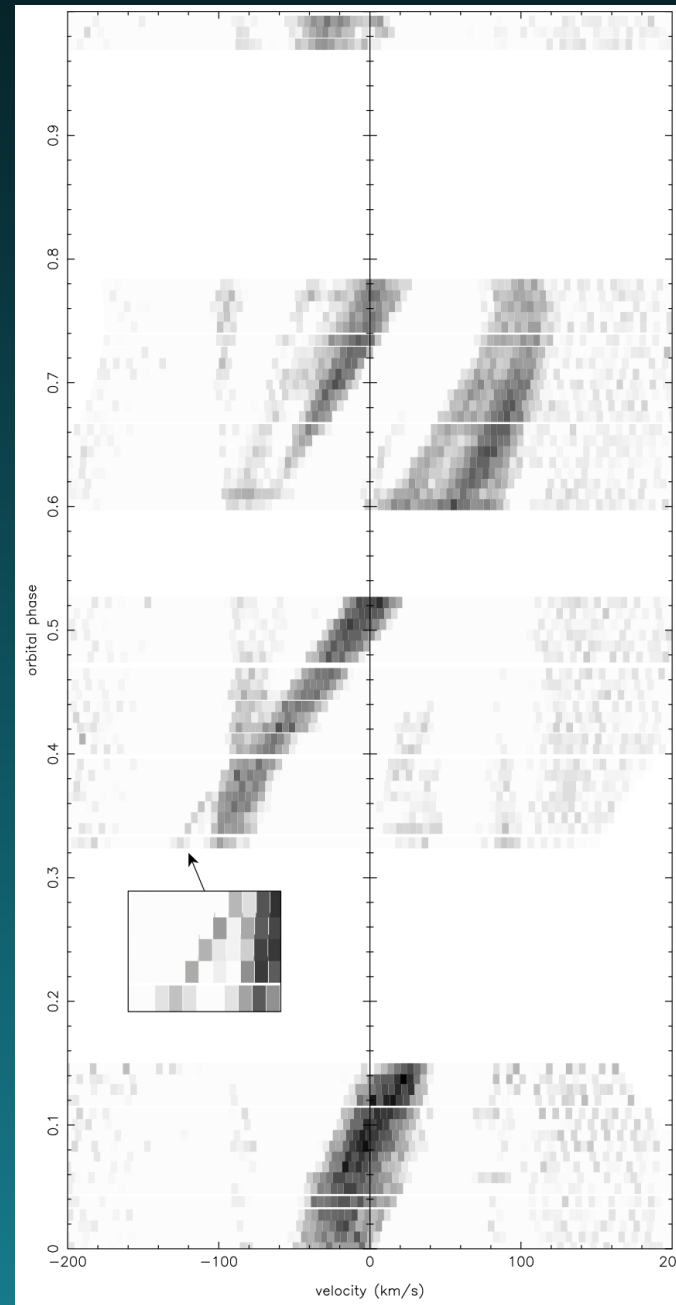
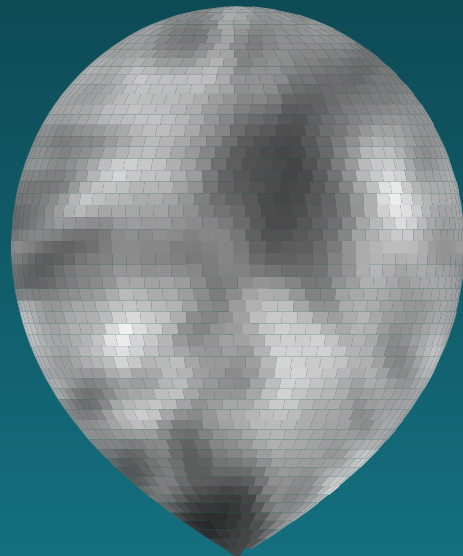
V426 Oph



SS Cyg

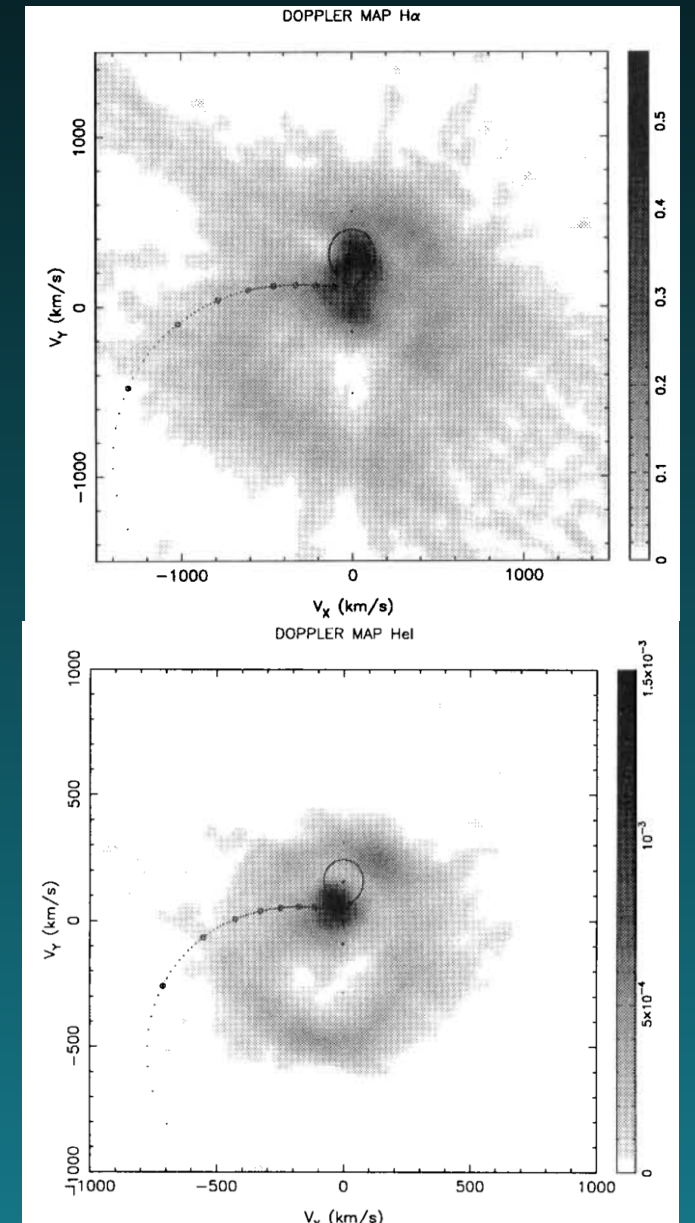


BV Cen



BV Cen

Watson et al. 2007

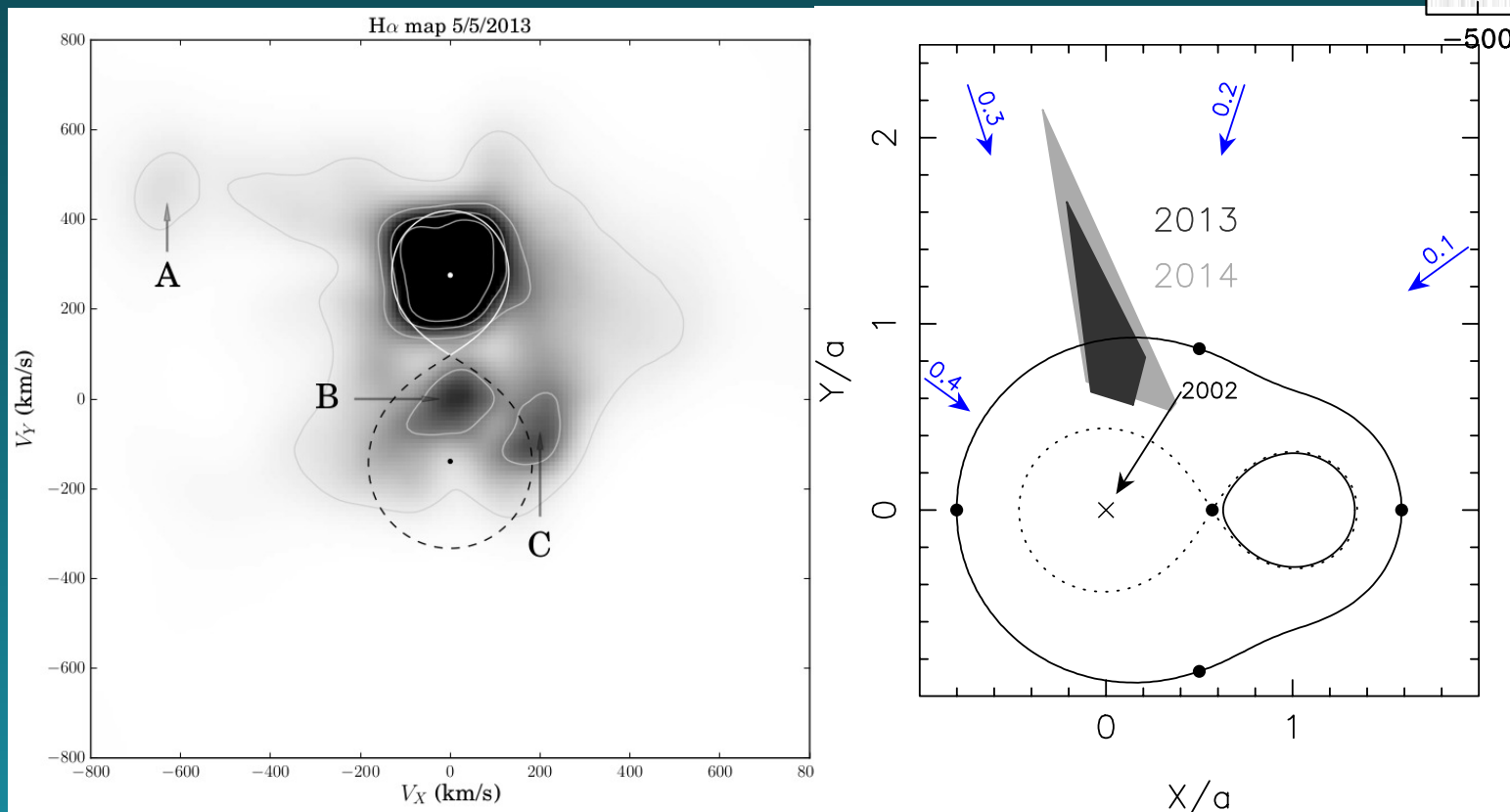
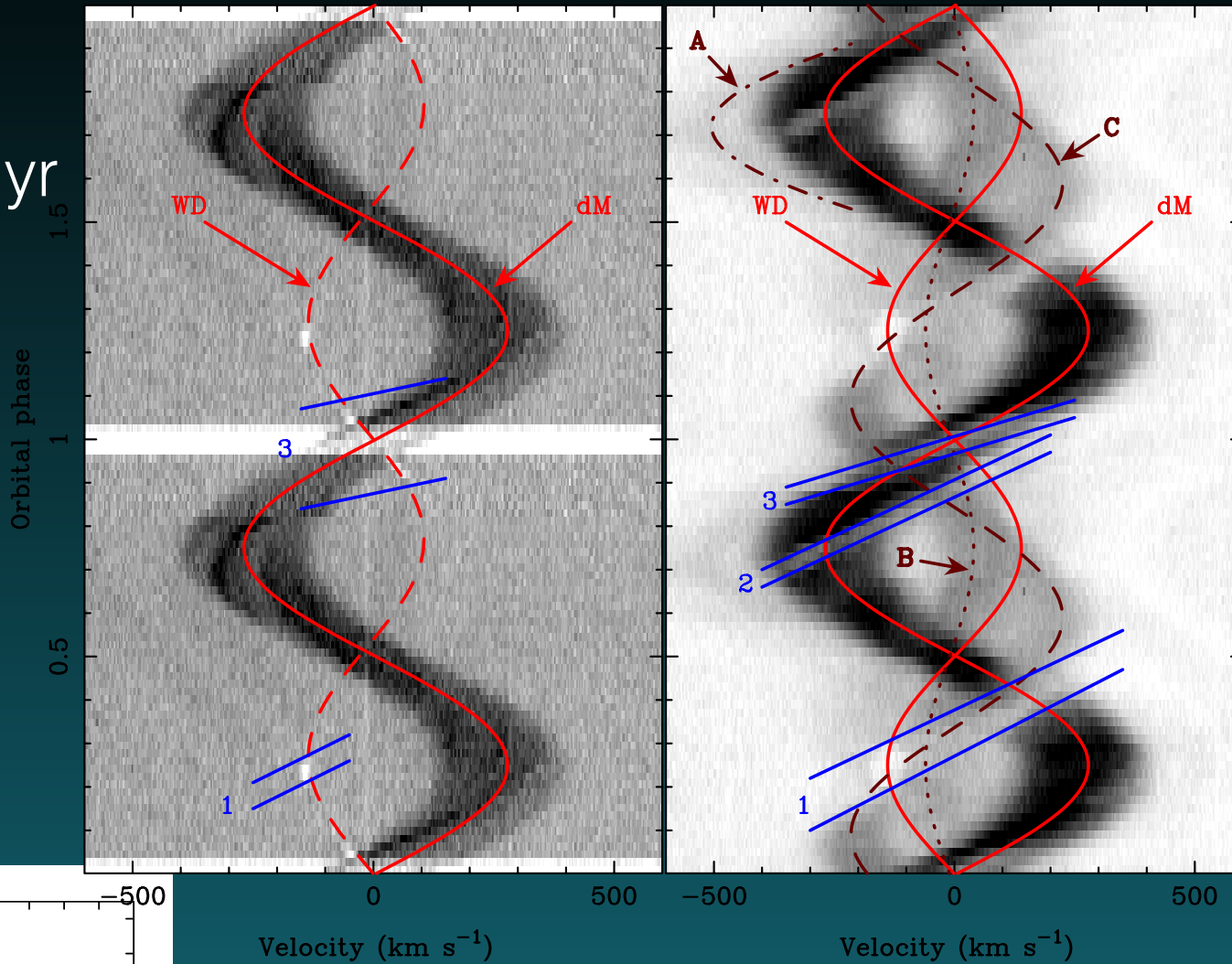
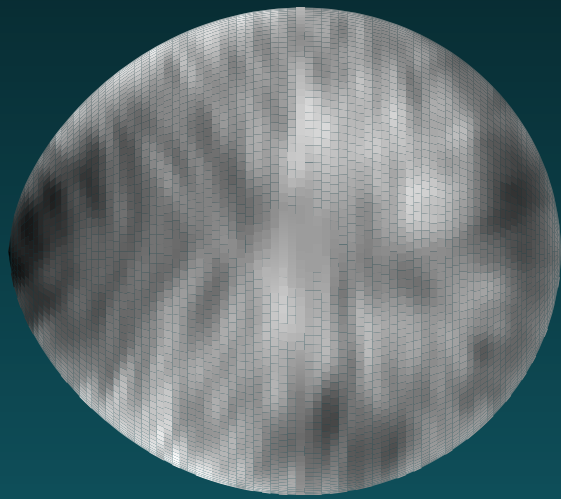


IP Peg, SS Cyg
Steeghs et al. 1996

Tidal effects on magnetic activity

QS Vir (M4 + WD)

- Large prominence(s) held in place ≥ 1 yr (maybe > 10 yr)
- Upper limit of B field on WD = 10^5 G



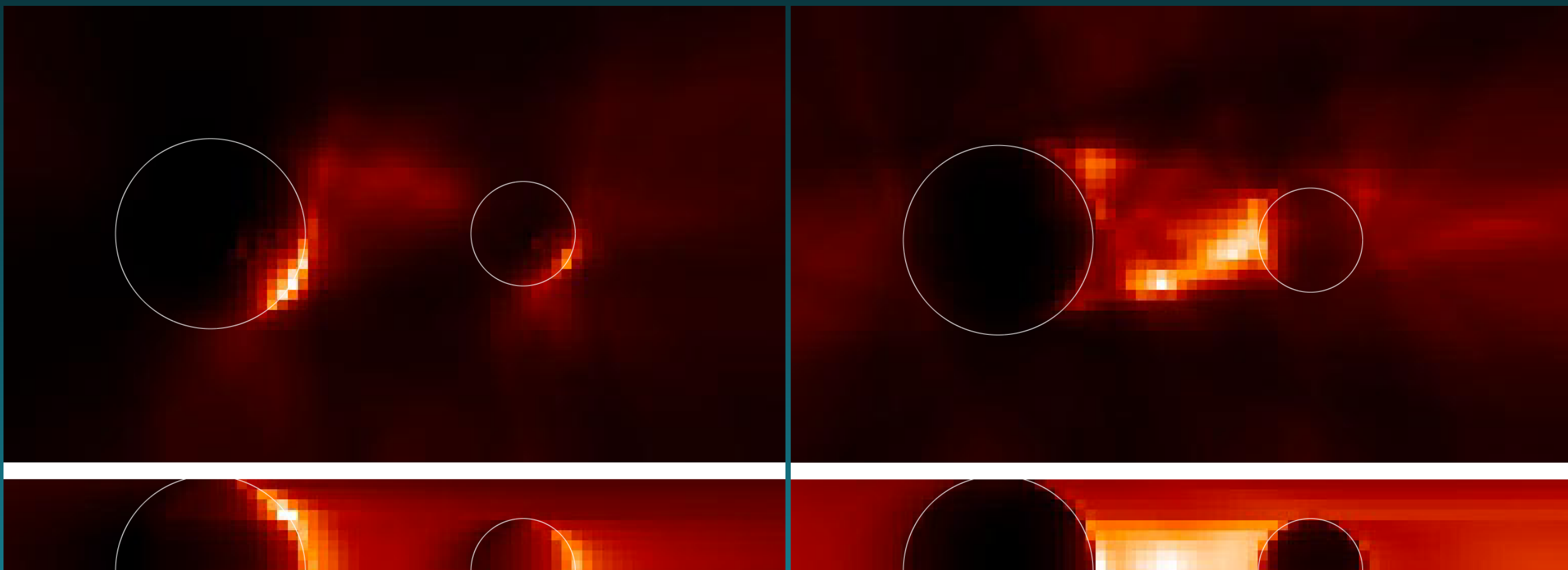
- Ca II 3934 Å absorption
- H α absorption and emission

Parsons et al. 2016

Tidal effects on magnetic activity

AR Lac (RS CVn, K + G)

- X-ray corona emission concentrated on facing hemispheres
- May be extended regions connecting stars.
- Siarkowski et al. 1996



9 yrs separation

Conclusions

- Surface not tidally locked in CVs
- May show activity cycles
- Interaction between stars - Preferential flux tube emergence, hot spots (RS CVn binaries), X-ray emission, prominences
- ZDI map coming for AE Aqr...