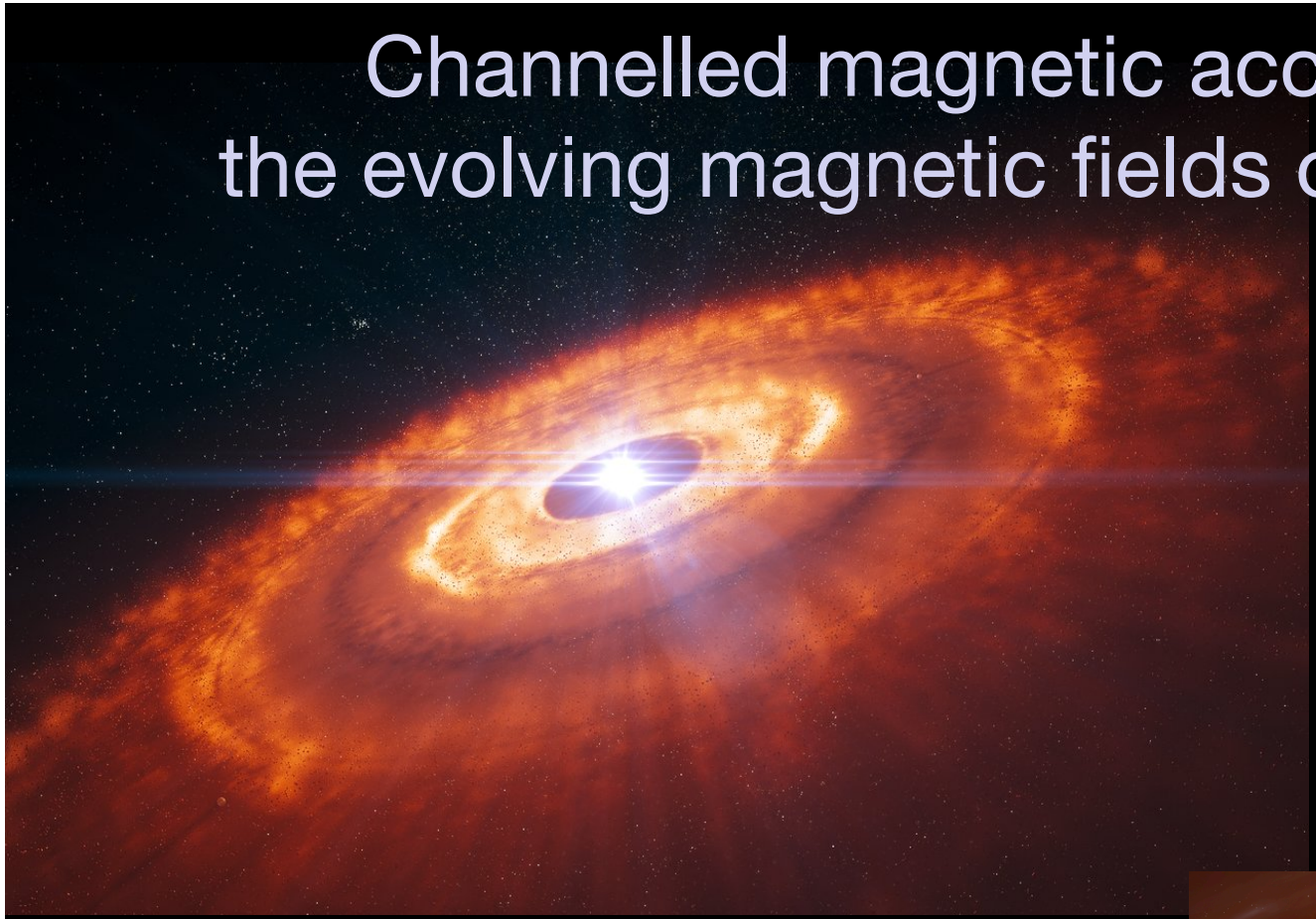
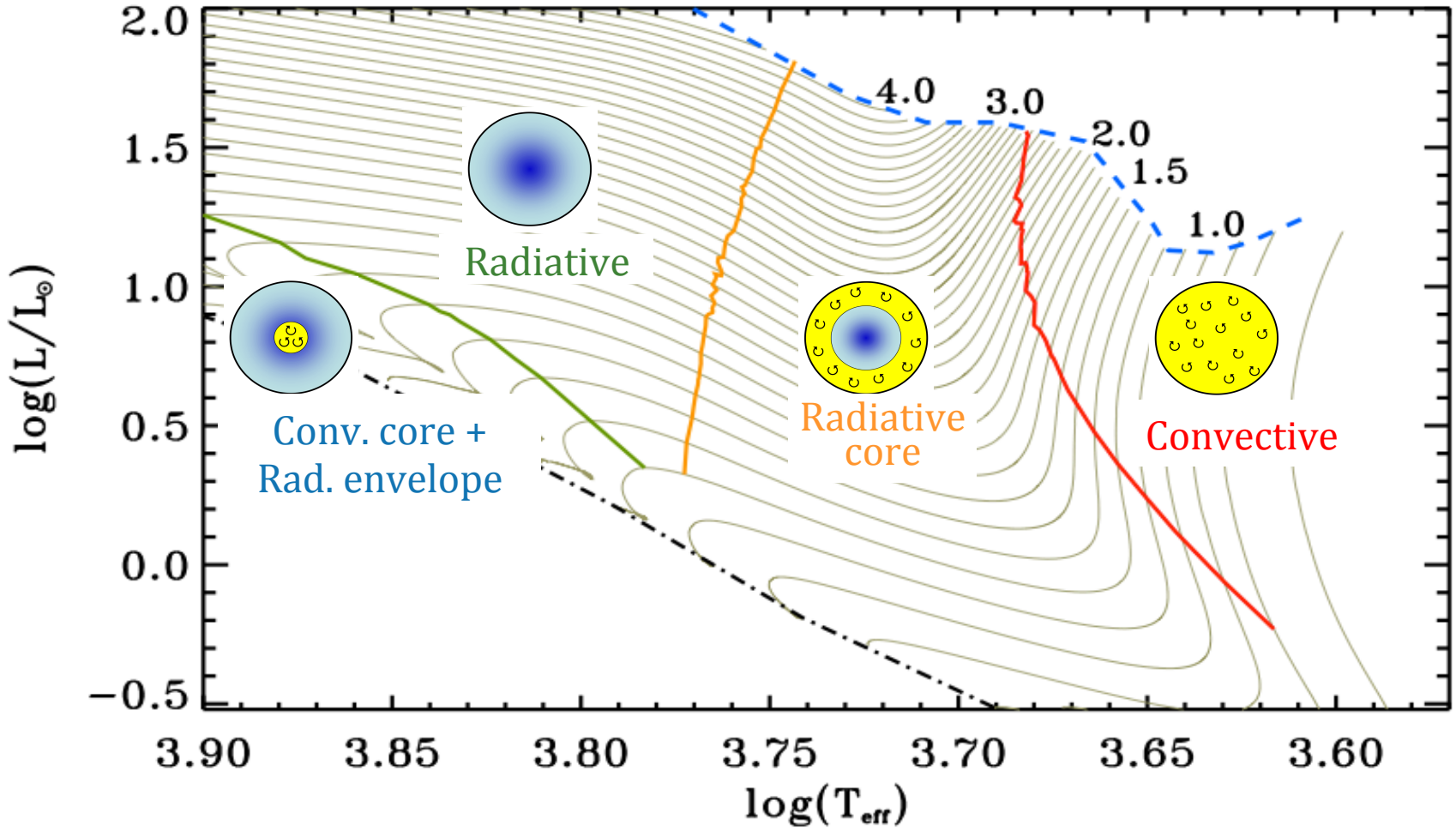
Channelled magnetic accretion & the evolving magnetic fields of PMS stars



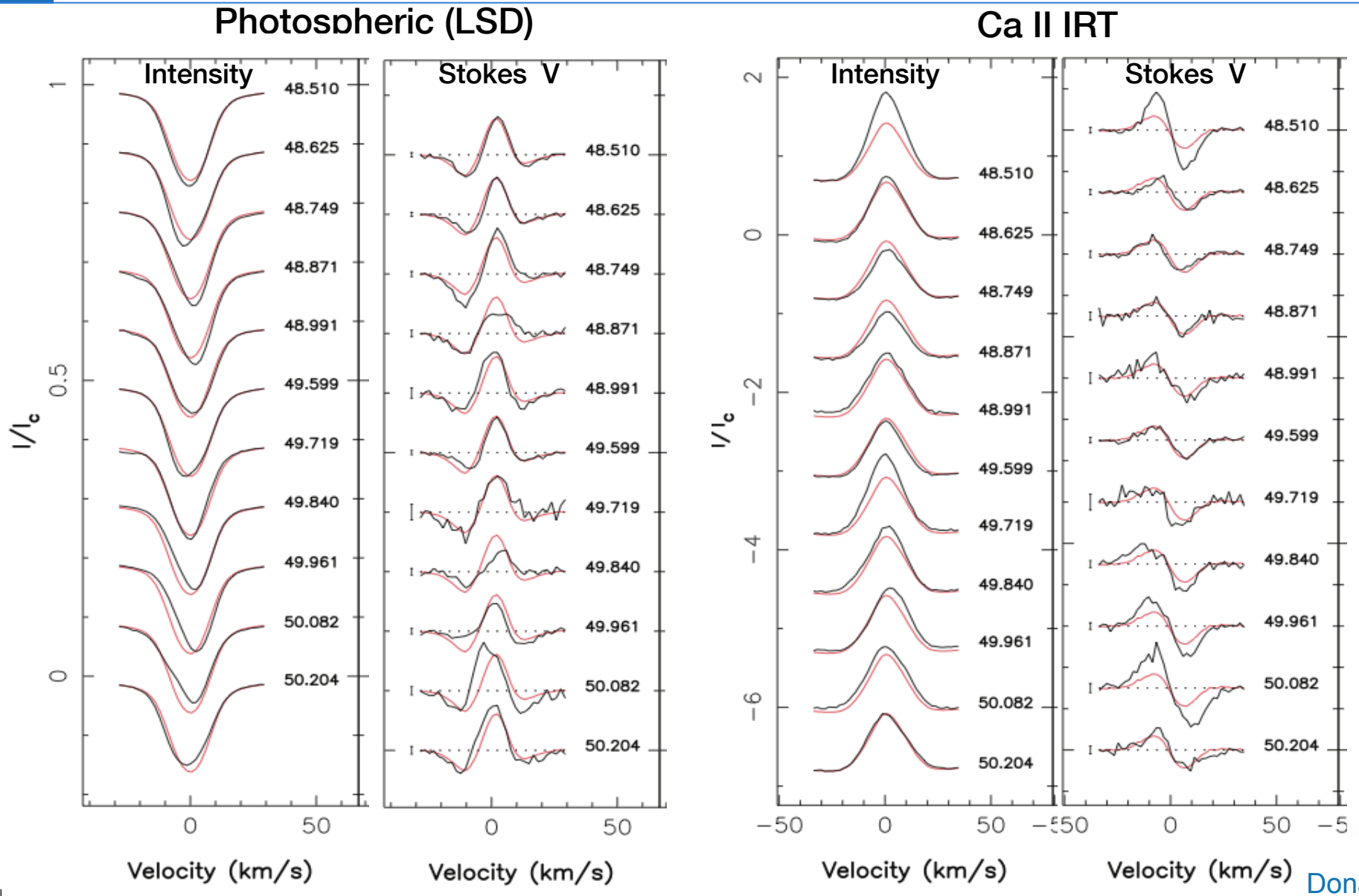
Gaitee Hussain ESO & IRAP

Credit: L. Calcada (top) & M. Garlick (right)

Internal structure across the PMS

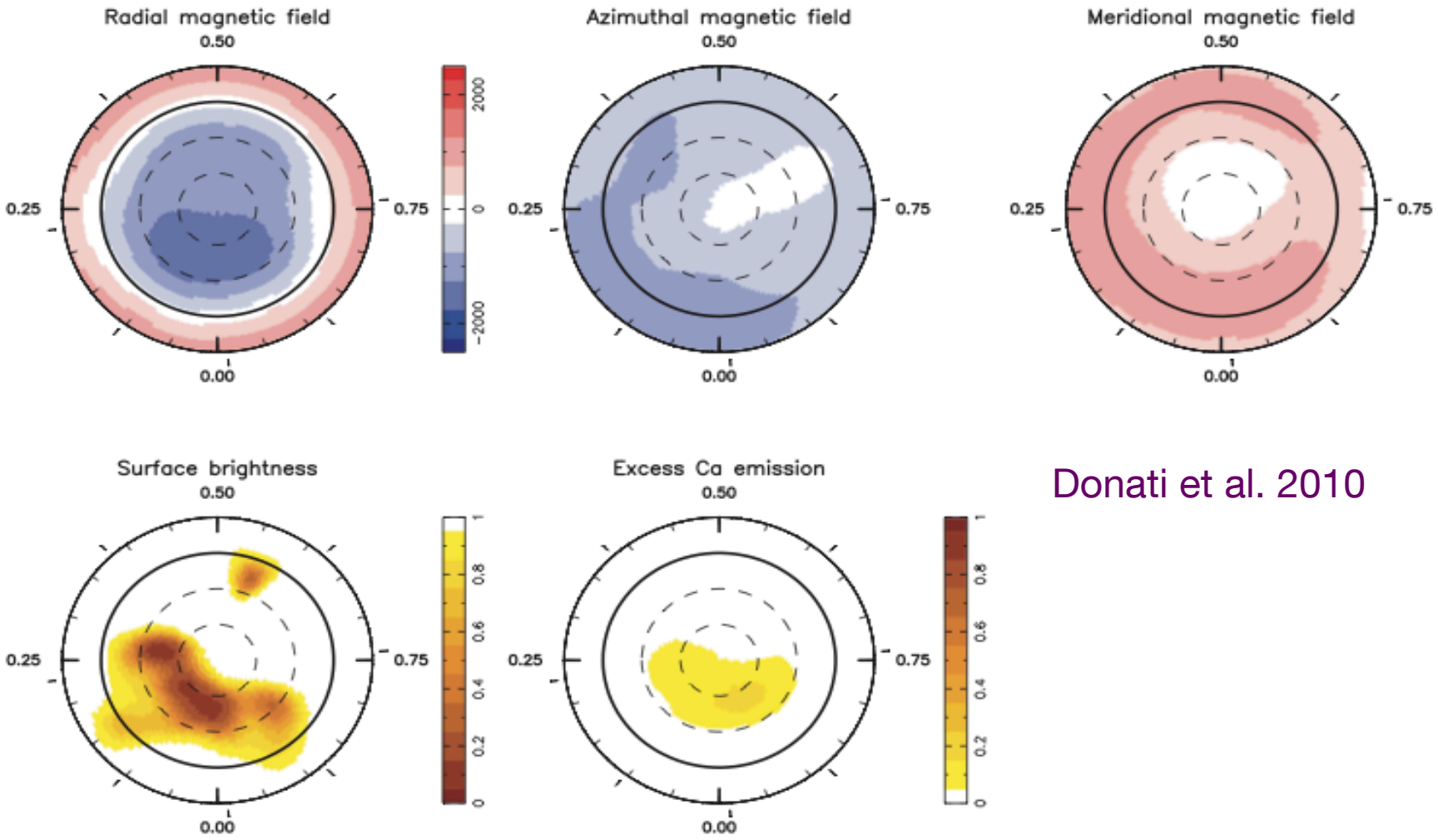


Stokes I and V profiles: axisymmetric field - AA Tau



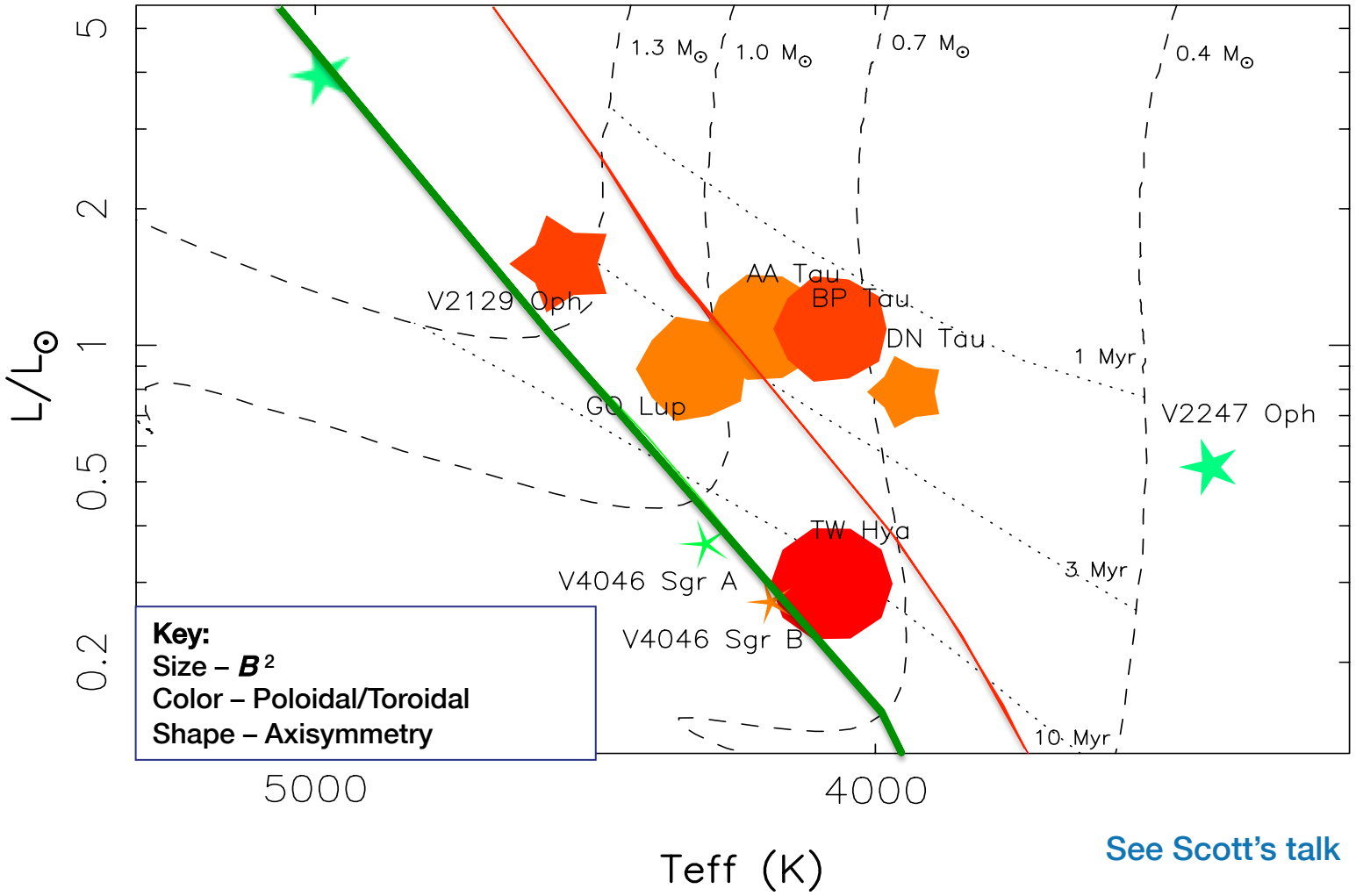
Donati+2010

AA Tau: Magnetic & accretion maps



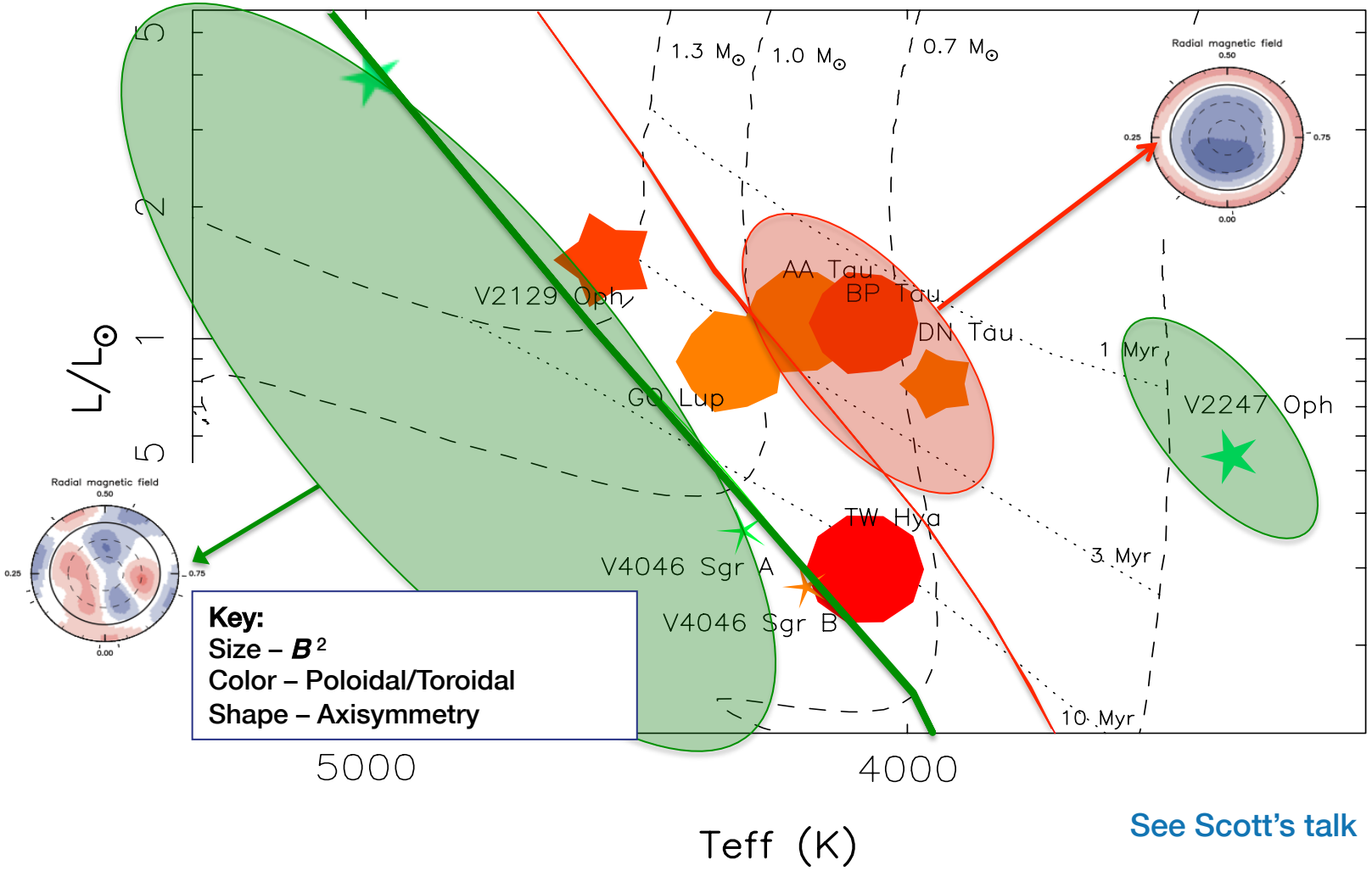
Donati et al. 2010

Magnetic fields & stellar evolution



See Scott's talk

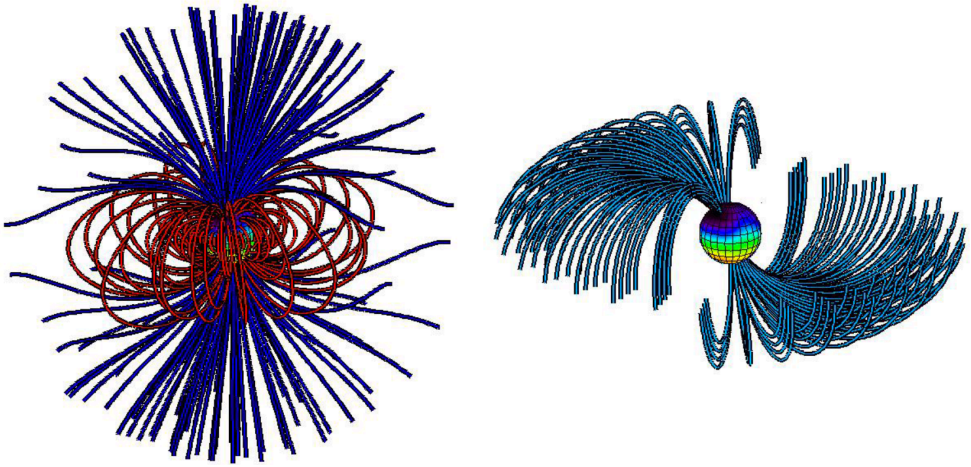
Magnetic fields & stellar evolution



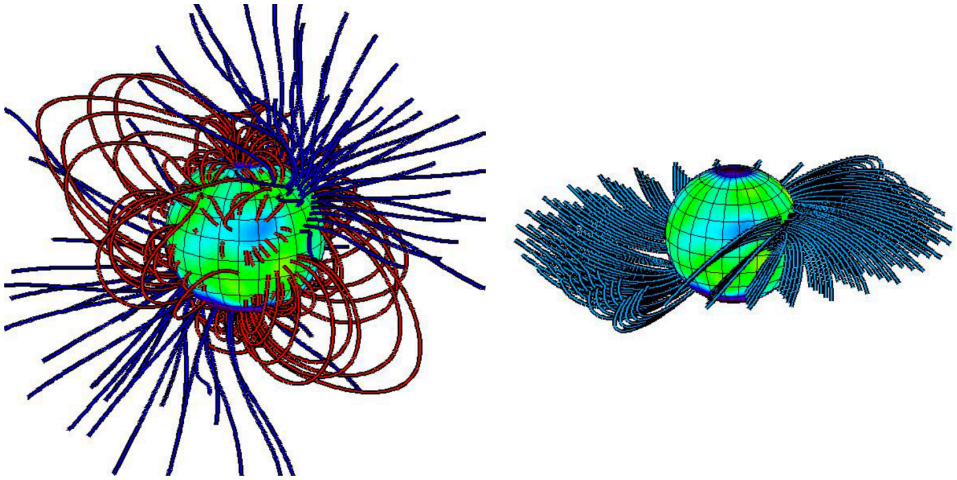
See Scott's talk

Extrapolating to stellar coronae

AA Tau - simple



V2247 Oph - complex

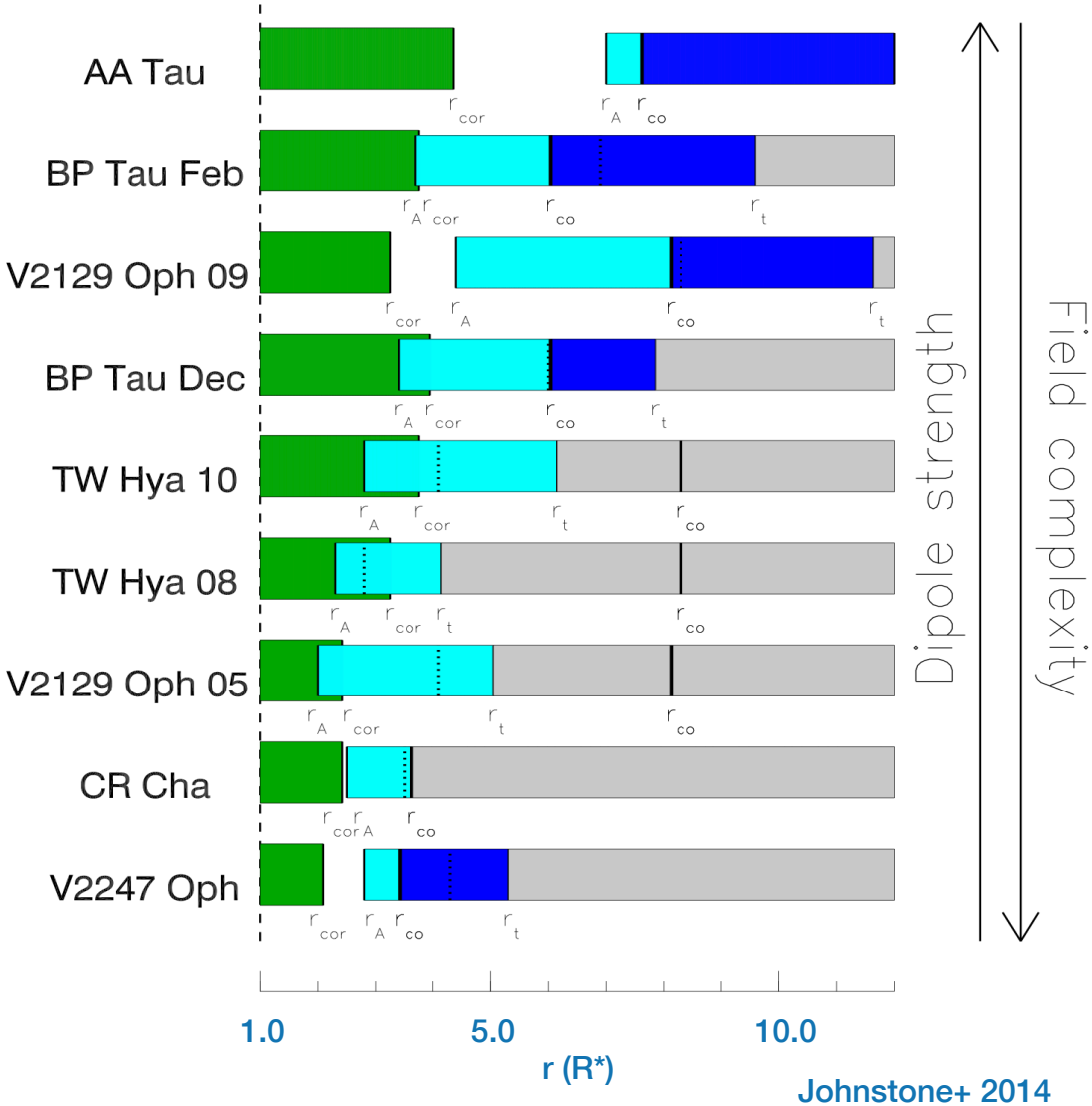


1.0 5.0 10.0

r (R*)

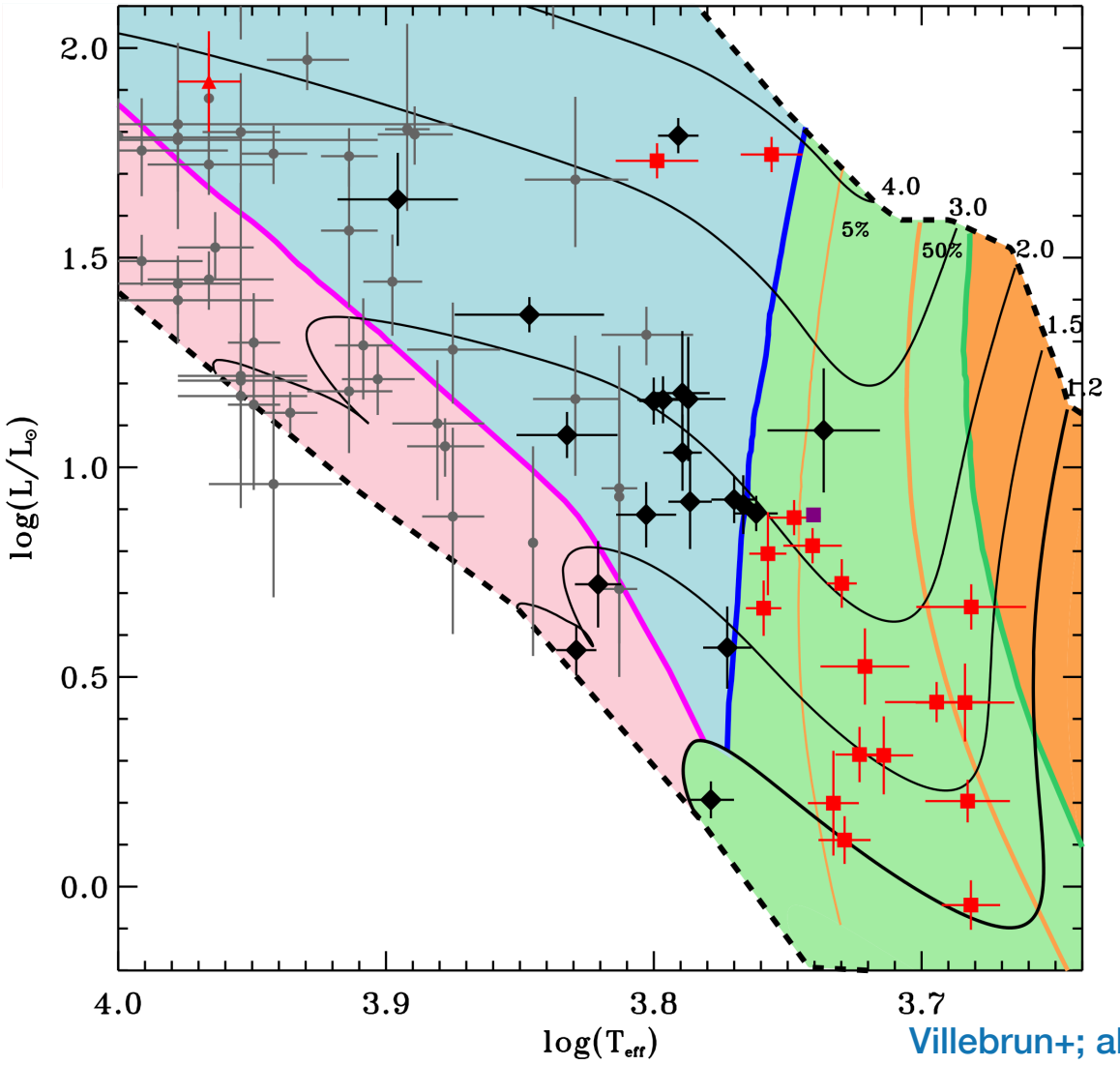
Johnstone+ 2014

Effect on accretion properties



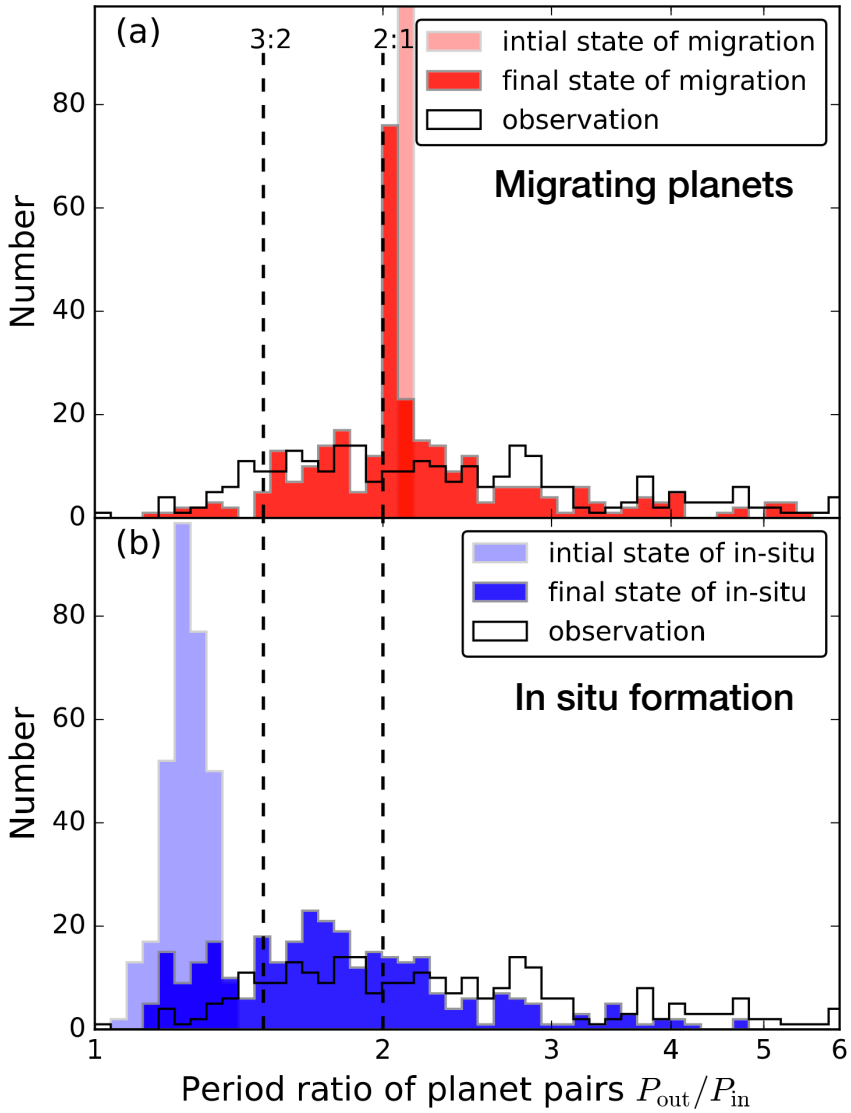
Johnstone+ 2014

Evolution of intermediate-mass PMS stars



Villebrun+; also see Florent V's talk

Planet migration: Eliminating Mean Motion Resonance



- Effect of torques on planets due to magnetospheric gap
- Different Macc considered
- Aligned magnetic fields
- Magnetospheres (size + orientation of B) of all stars same at time of disk dispersal

Migrating planets

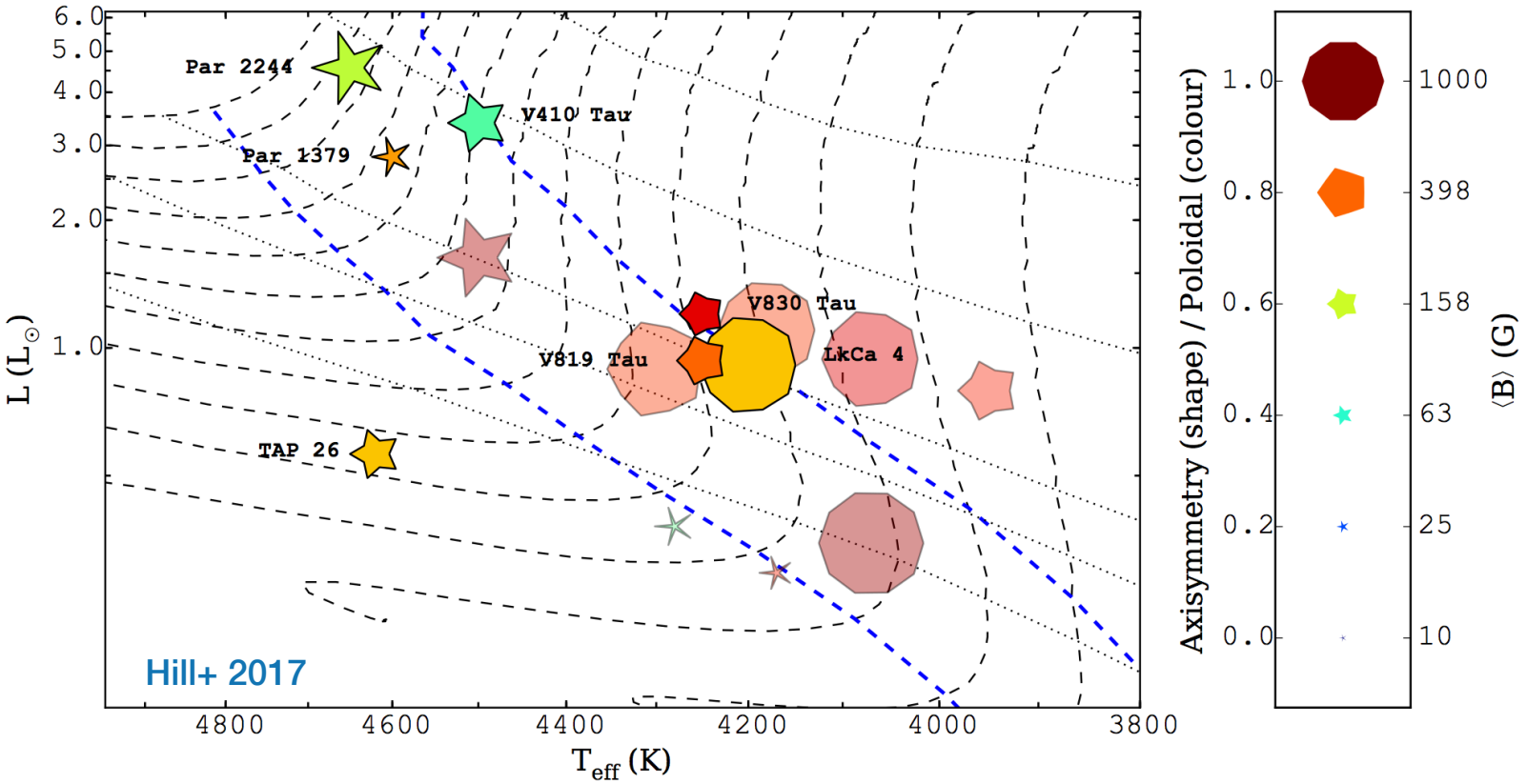
- Planets form near ice line
- Challenging to lose initial conditions

In situ formation

- Planet forms nearer star
- Effectively wipes out initial condition and MMRs

Liu+2017
[also Ormel+2017]

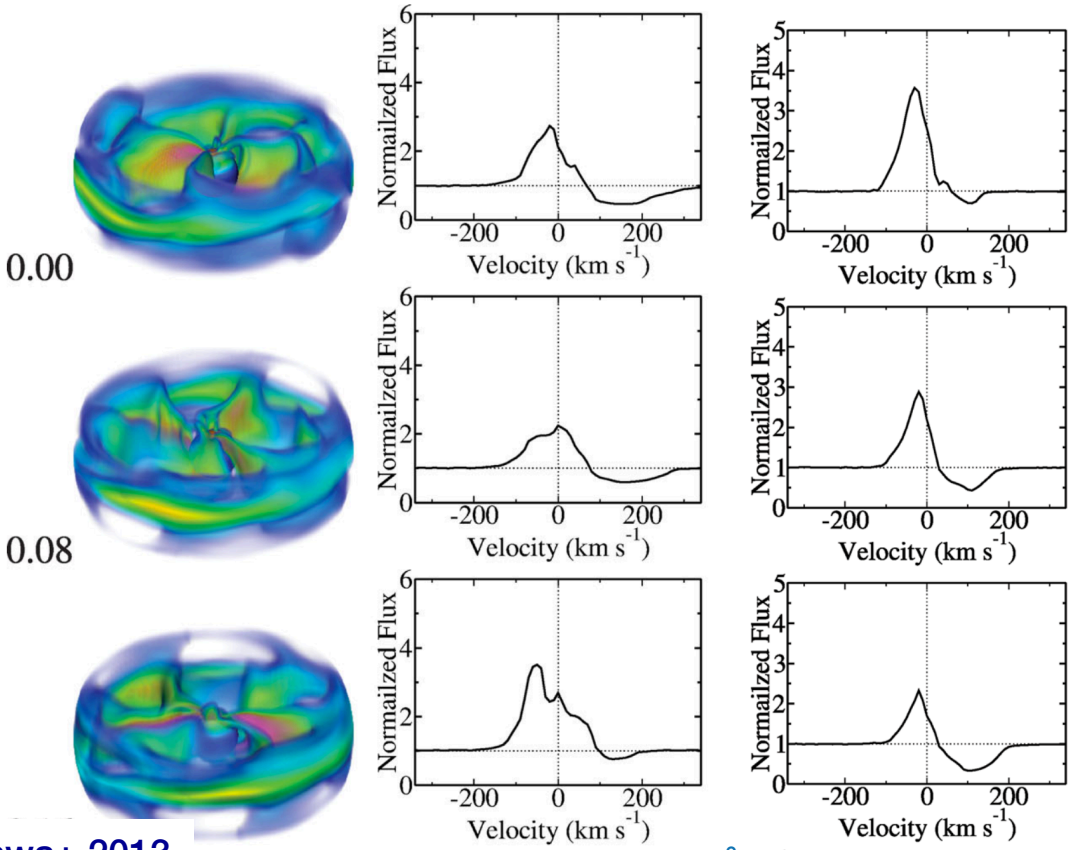
Comparison of *B* in accreting & non-accreting T Tauri stars



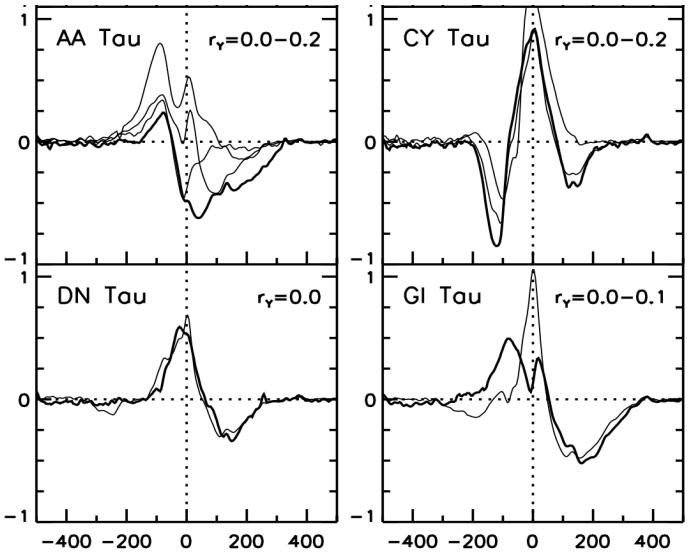
- CTTS trends with internal structure – analog MS M stars
- WTTS fields show more diverse range of *B* properties

Diagnosing accretion flow geometry

- He I 10830 line
  - redshifted absorption tracer of funnel flows (50% cTTS)
  - blue-shifted absorption can also probe outflows



Kurosawa+ 2013



Fischer+ 2008

Summary & Immediate future

cTTS fields

- Trace large scale *B* fields & model magnetospheric accretion
- Dependence on internal structure (at these accretion rates)
- Variability in large scale structure over ~yrs affect accretion efficiency, planetary migration
- Affects architecture of planetary systems (eg magnetospheric rebound model)

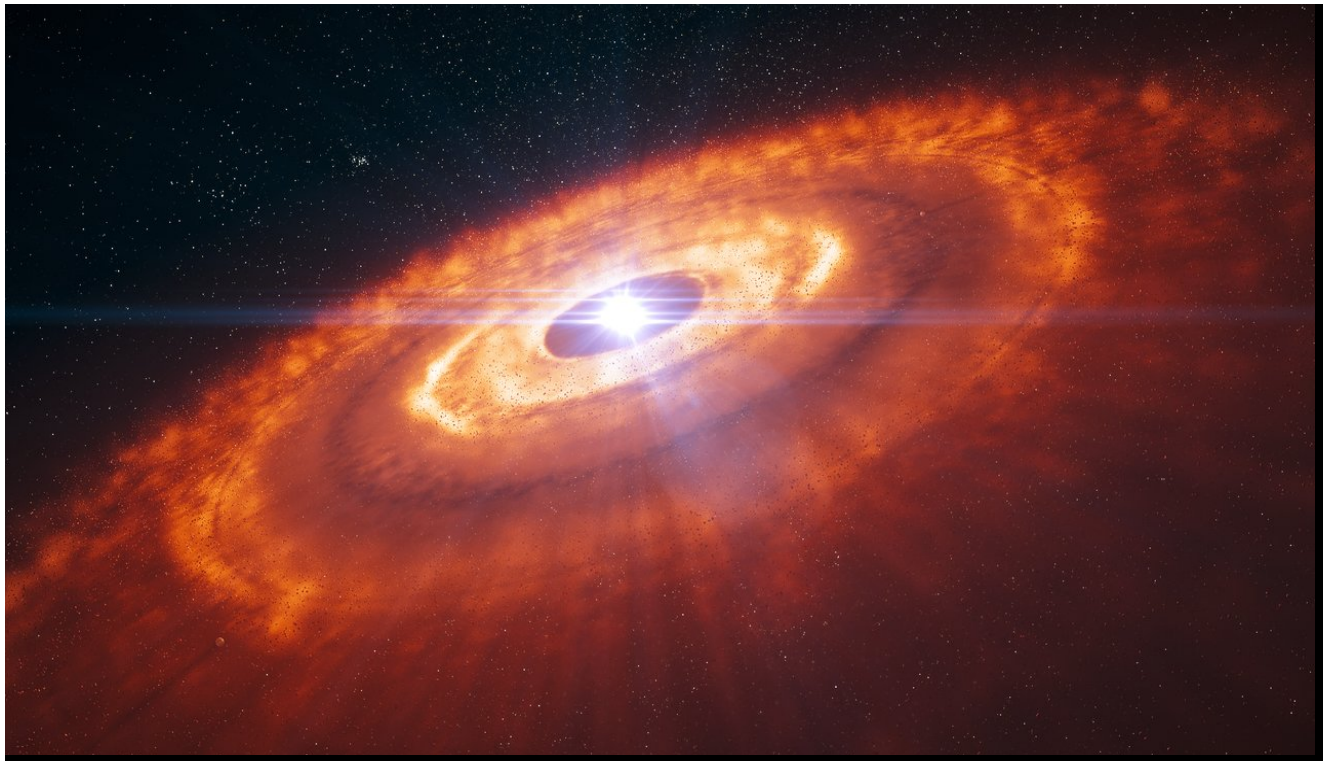
wTTS fields

- What happens when accretion switched off? Wider range of topologies than in cTTS or MS
- Allow us to detect/confirm the youngest close-in planets

→ small scale fields reconstructed simultaneously, accretion geometry probed in detail (e.g. He I 10830)

→ effective multiple spot & magnetic field diagnostics & reduced jitter from plage

→ access to more systems (e.g., Class I, higher accretion states)



ESO Workshop: Garching, October 15-19 2018

Take a closer look:

The innermost region of protoplanetary discs & its connection to the origin of planets

www.eso.org/sci/meetings/2018/tcl2018.html

tcl2018@eso.org / ghussain@eso.org