Magnetic fields of fully convective unsaturated M-dwarfs

Does rotation matter for fully convective dynamos?

C. P. Folsom, É. M. Hérbrard, V. See

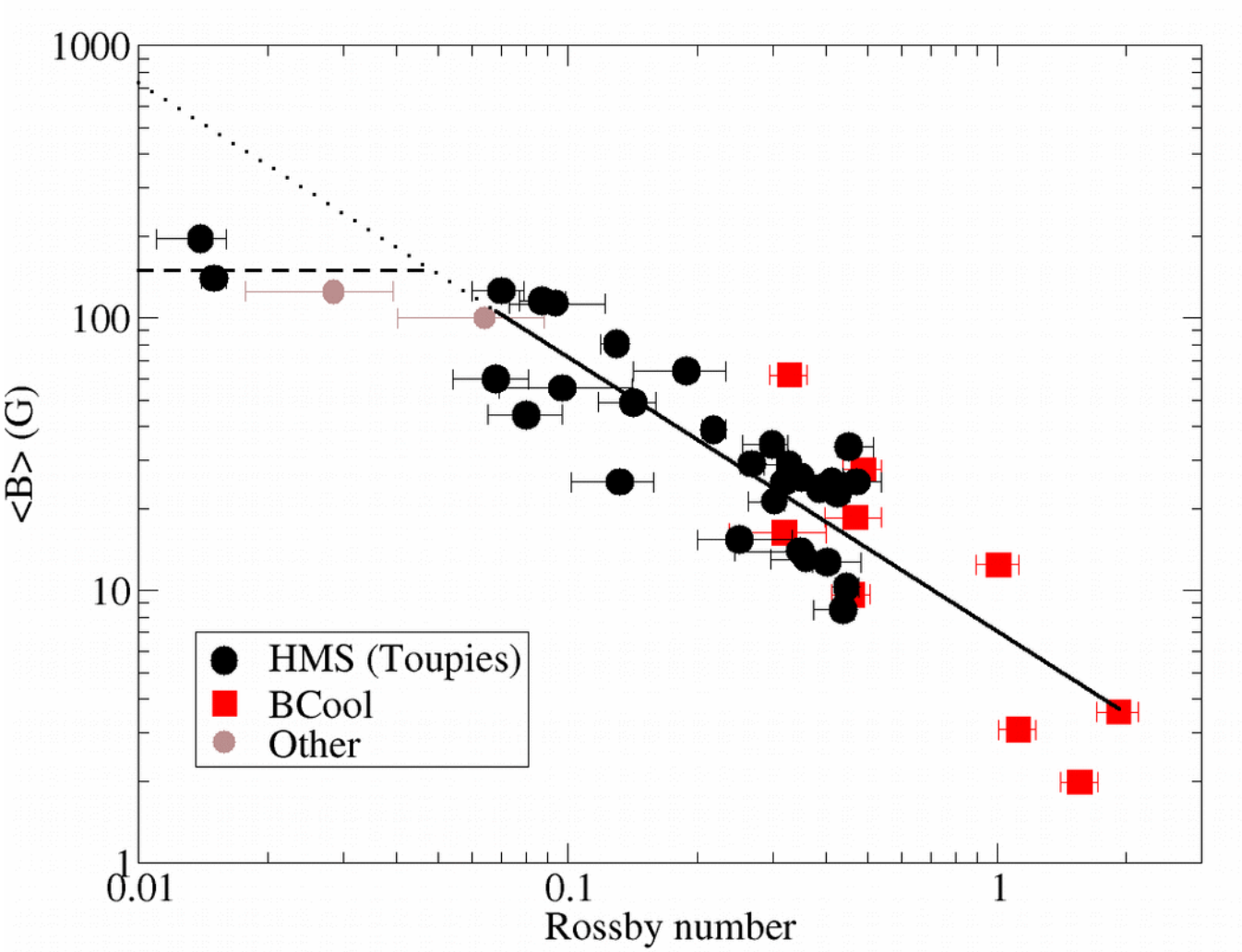
irap
astrophysique & planétologie

UNIVERSITÉ TOULOUSE III PAUL SABATIER
Université de Toulouse

cnrs
dépasser les frontières

Rotation-Activity Relations

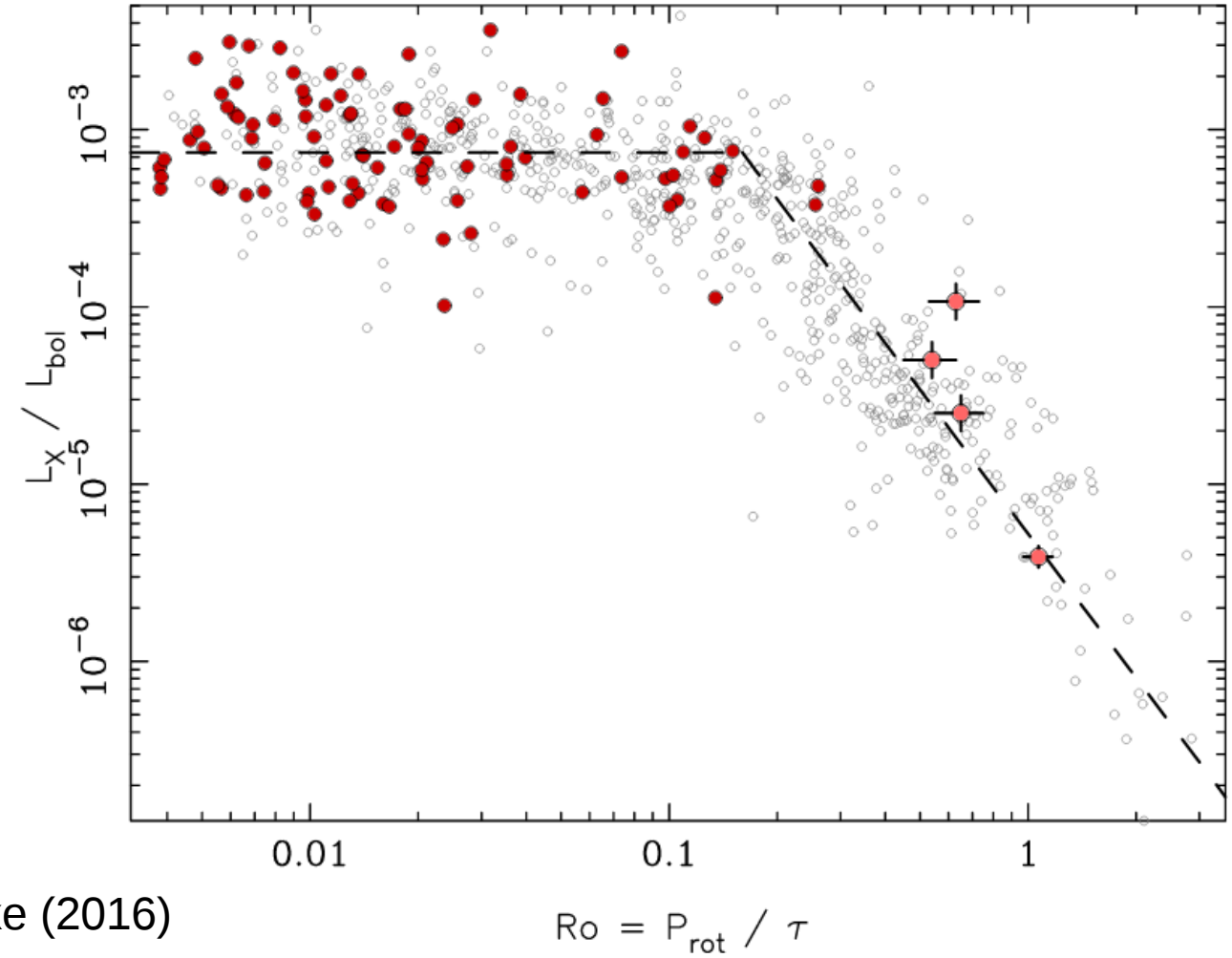
- For partly convective stars, large-scale magnetic fields are increasingly well studied



Folsom et al. (2016, in prep)
Petit et al. (in prep)

Rotation-Activity Relations

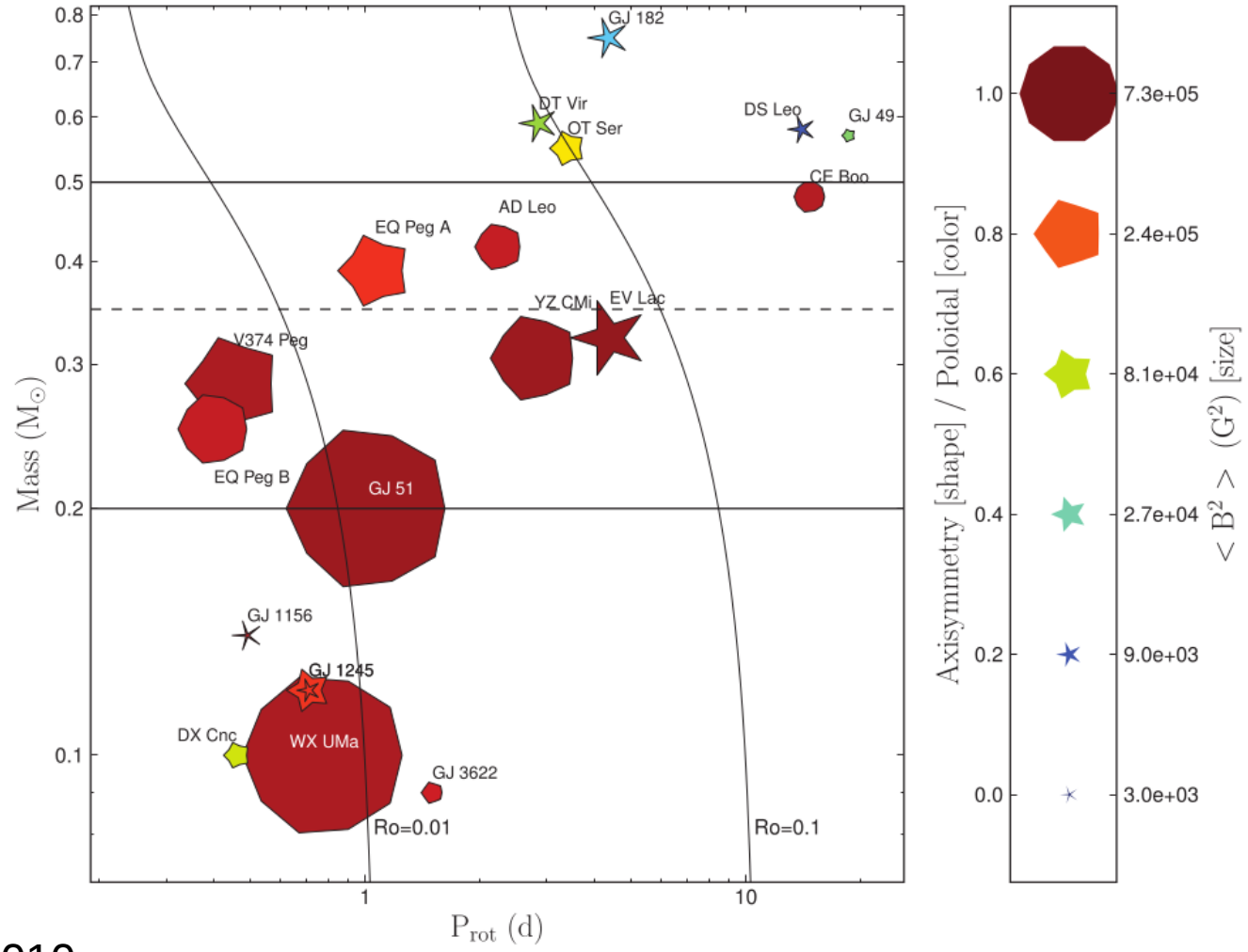
- For M-dwarfs in x-ray:
  (red = fully convective)



Wright & Drake (2016)

Rotation-Activity Relations

- But in large-scale magnetic fields we may see something different for largely convective stars



Morin et al. 2010

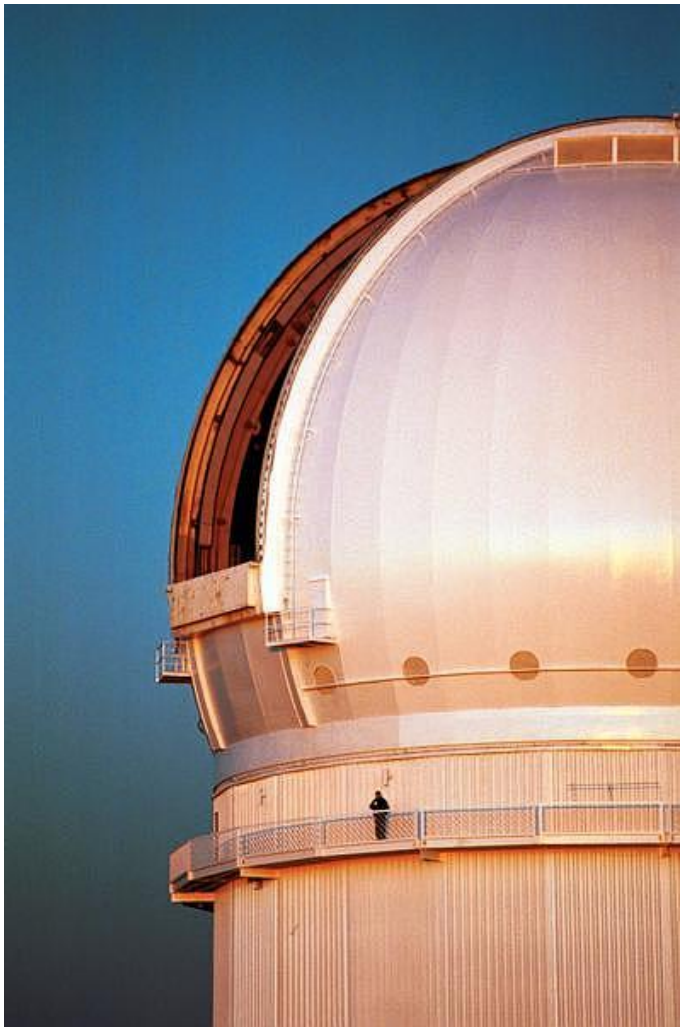
This project

- What large scale magnetic fields to very slowly rotating (unsaturated) fully convective stars have?

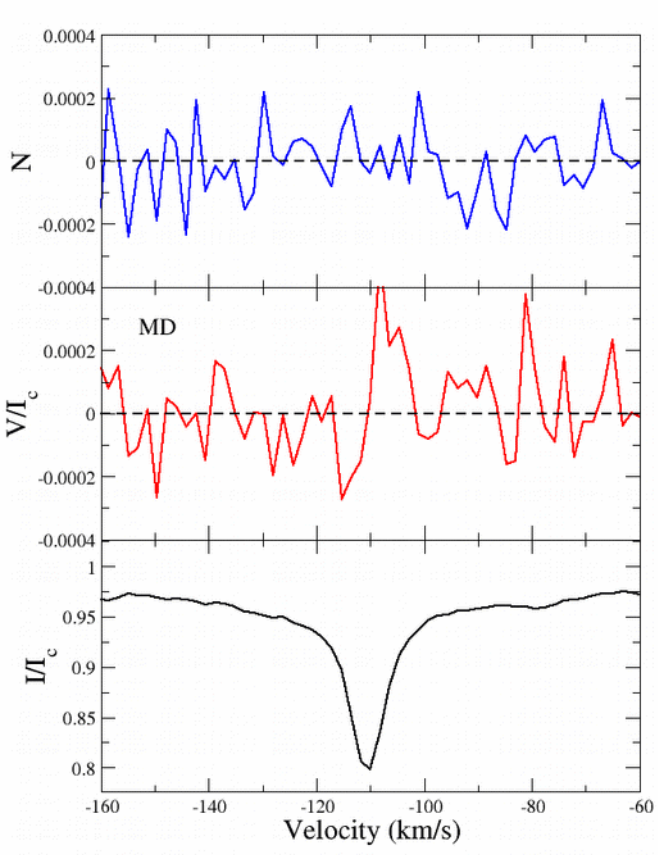
- Does rotation matter for fully convective dynamos?

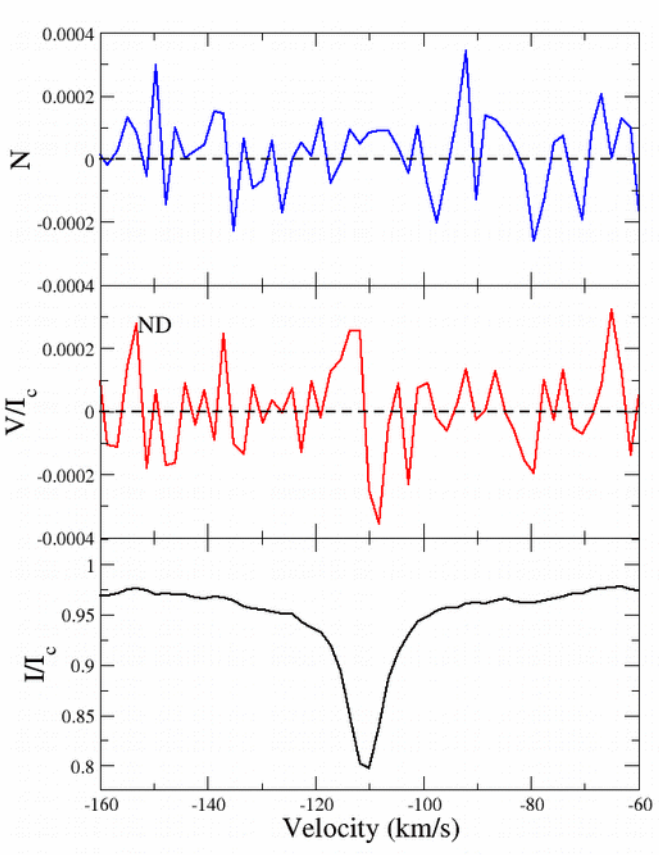
Observations

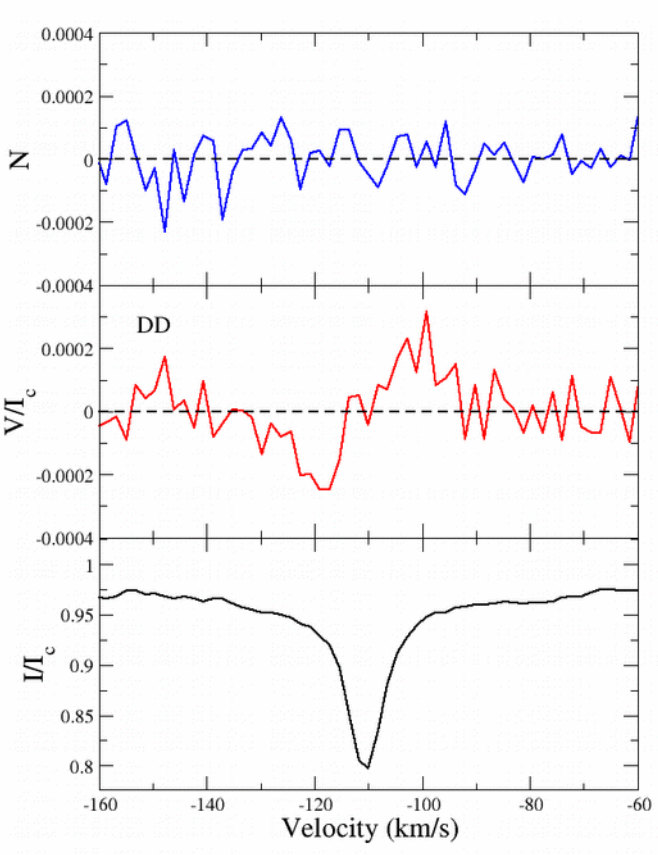
- Target fully convective (ST < M4, M < 0.3 Msun)
  - (red and faint stars)
- Target confidently unsaturated stars
  - very slow rotators (P > 50 days)
  - Rotation periods from Newton et al. 2016 (MEarth project, photometric periods)
- Need to use ESPaDOnS @ CFHT
- Focus on detections and B_l



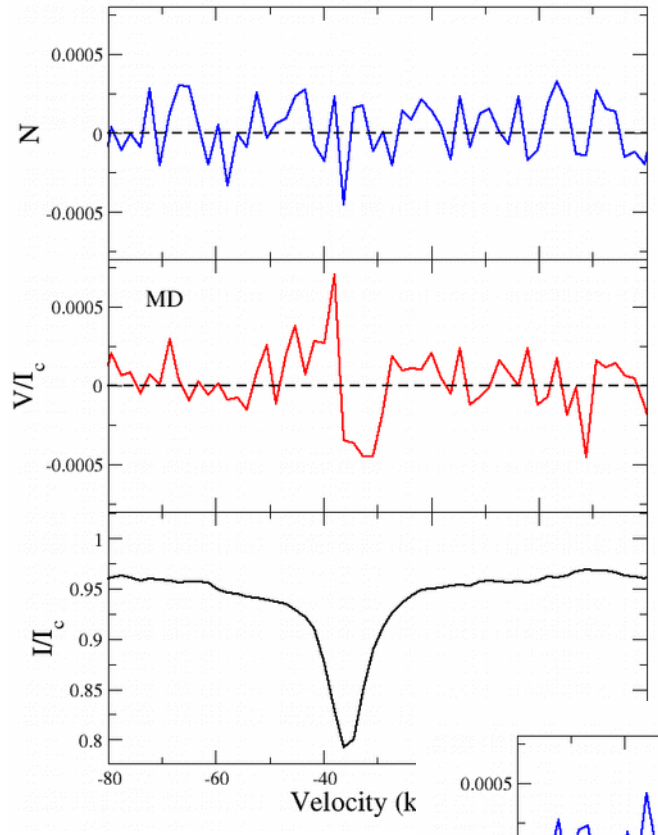
GJ 699

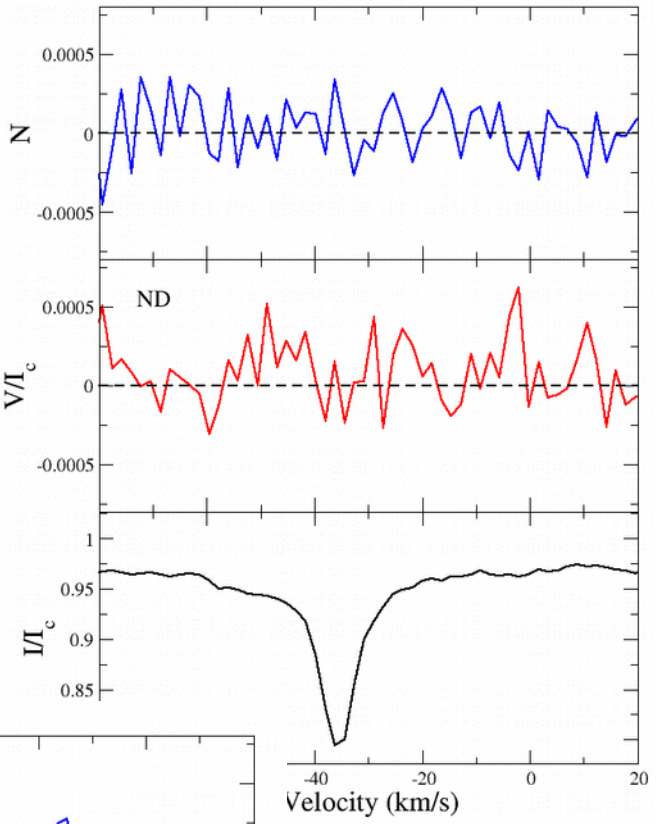

N
V/I_c
MD
I/I_c
Velocity (km/s)

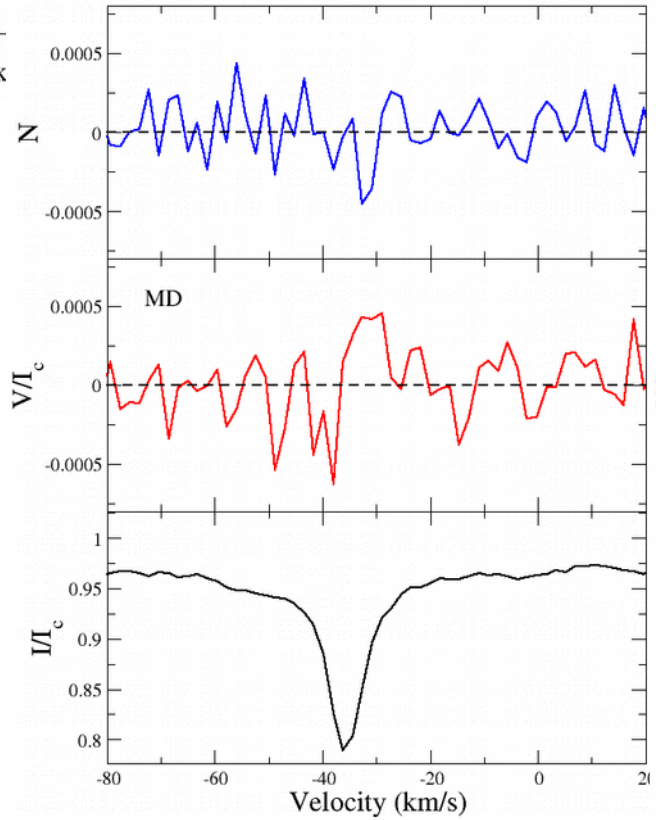

N
V/I_c
ND
I/I_c
Velocity (km/s)

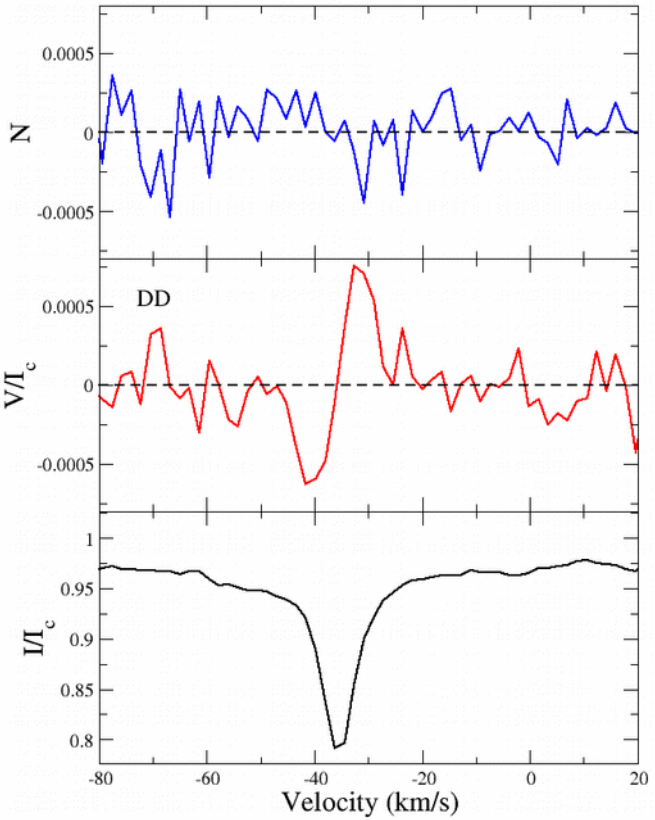

N
V/I_c
DD
I/I_c
Velocity (km/s)

GJ 1151

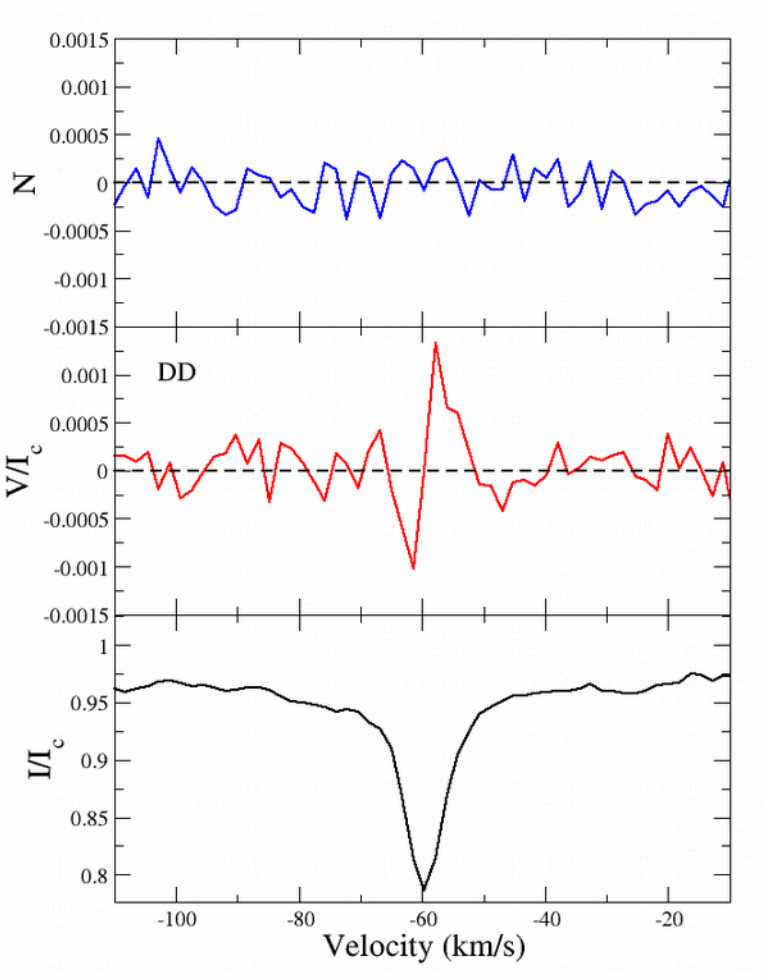

N
V/I_c
MD
I/I_c
Velocity (k

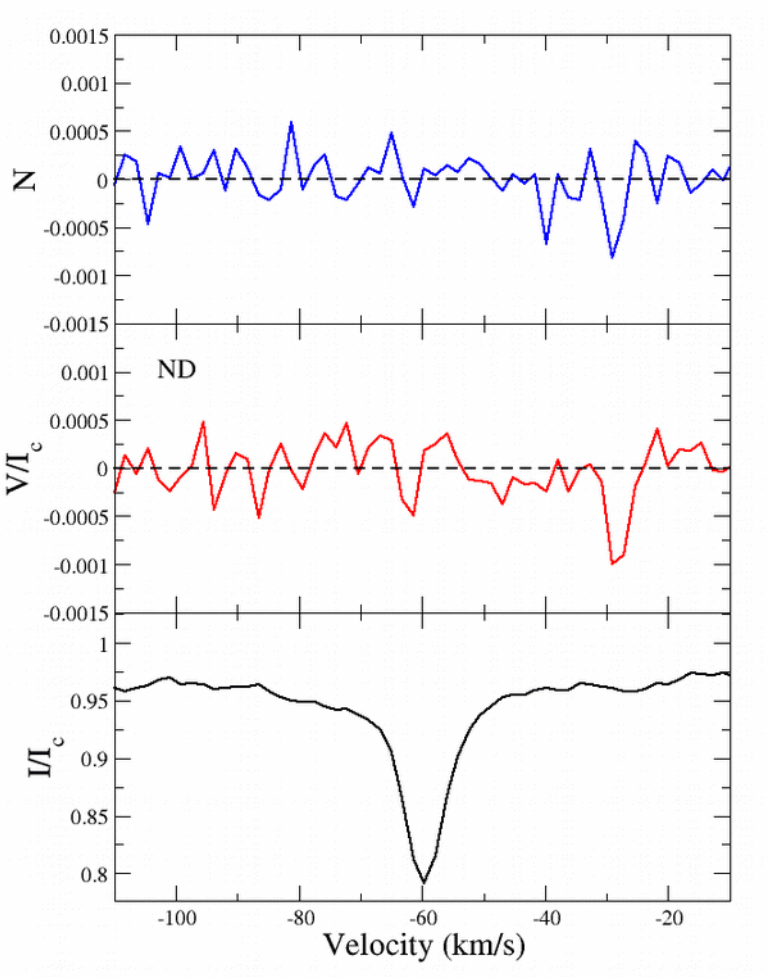

N
V/I_c
ND
I/I_c
Velocity (km/s)


N
V/I_c
MD
I/I_c
Velocity (km/s)

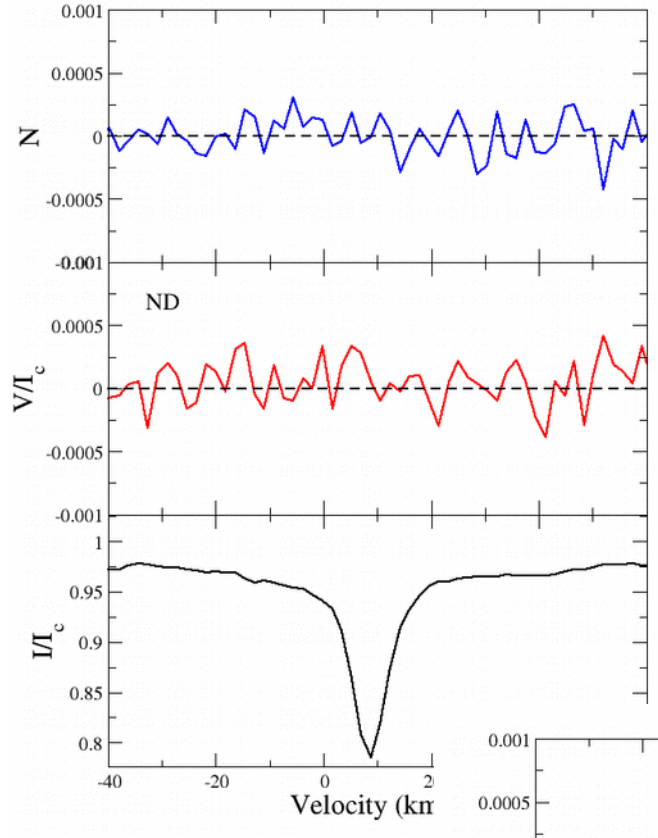

N
V/I_c
DD
I/I_c
Velocity (km/s)

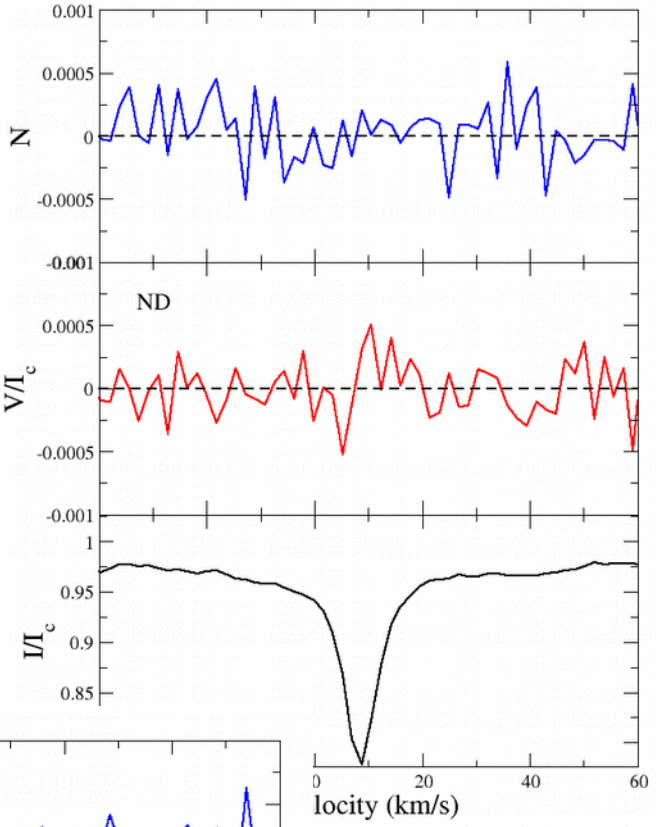
GJ 1256

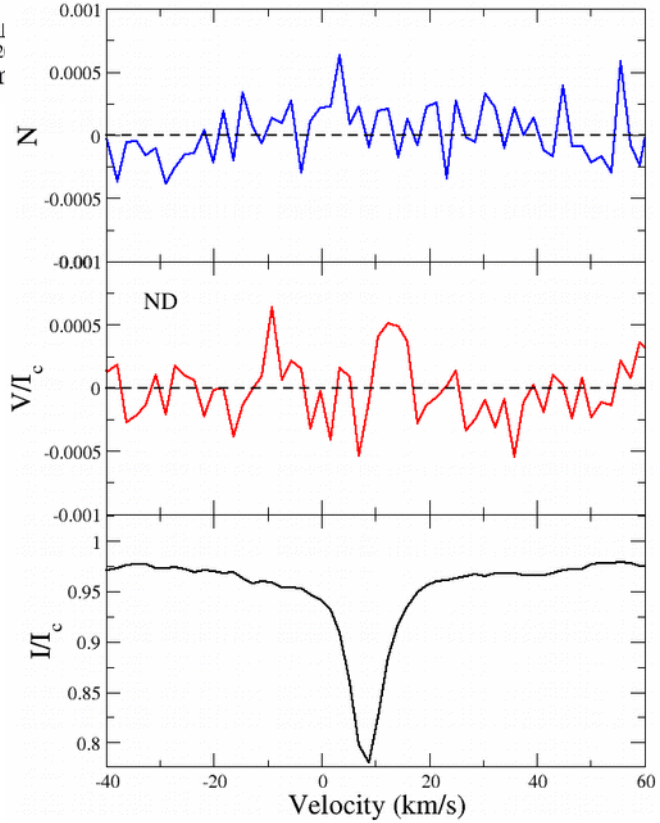


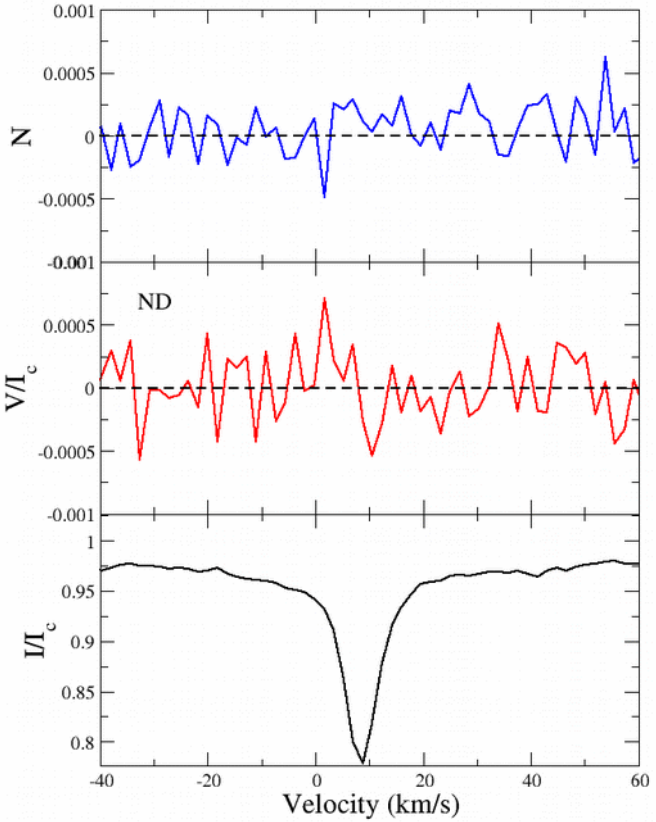


GJ 3843


N
ND
V/I$_c$
I/I$_c$
Velocity (km

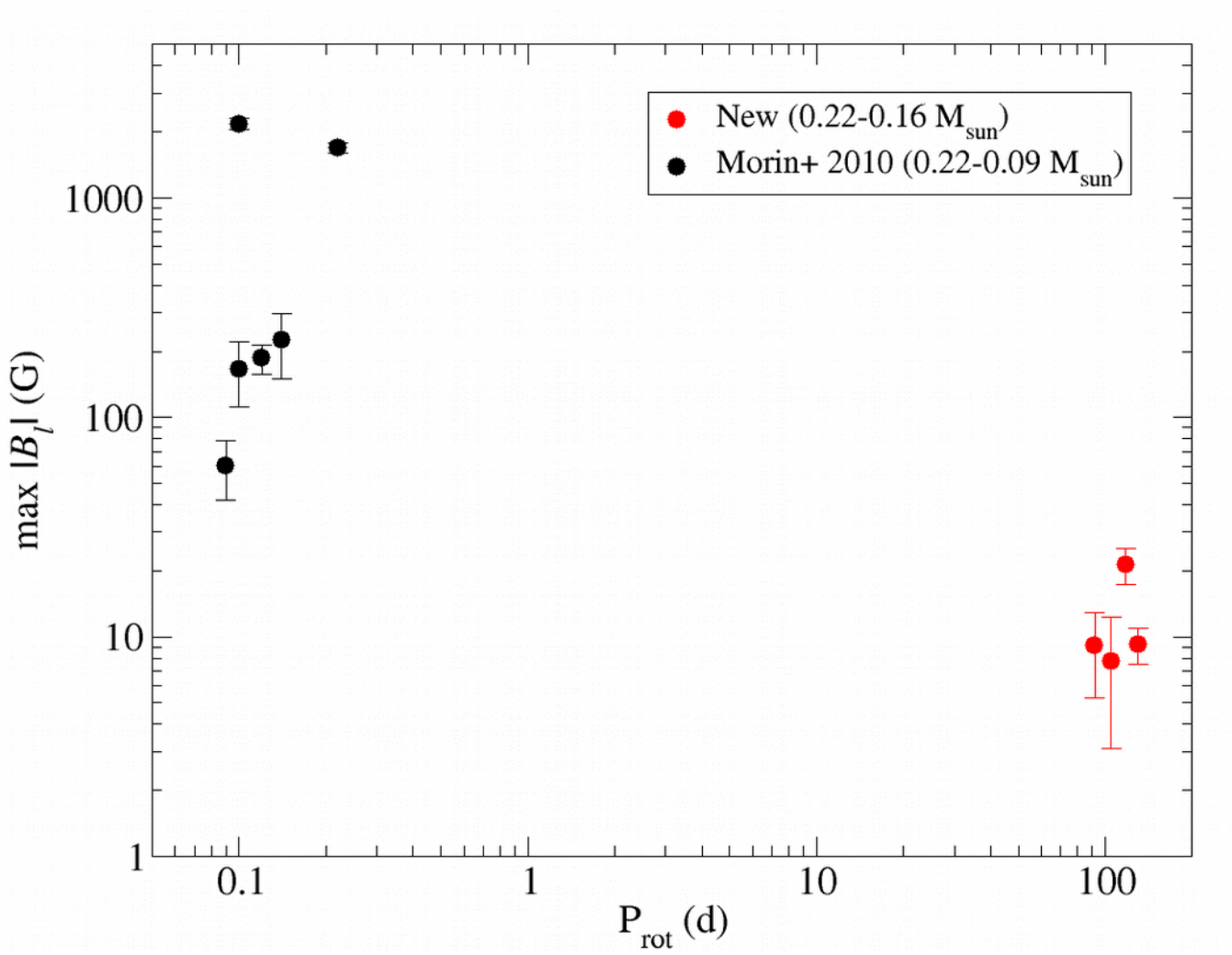

N
ND
V/I$_c$
I/I$_c$
locity (km/s)


N
ND
V/I$_c$
I/I$_c$
Velocity (km/s)


N
ND
V/I$_c$
I/I$_c$
Velocity (km/s)

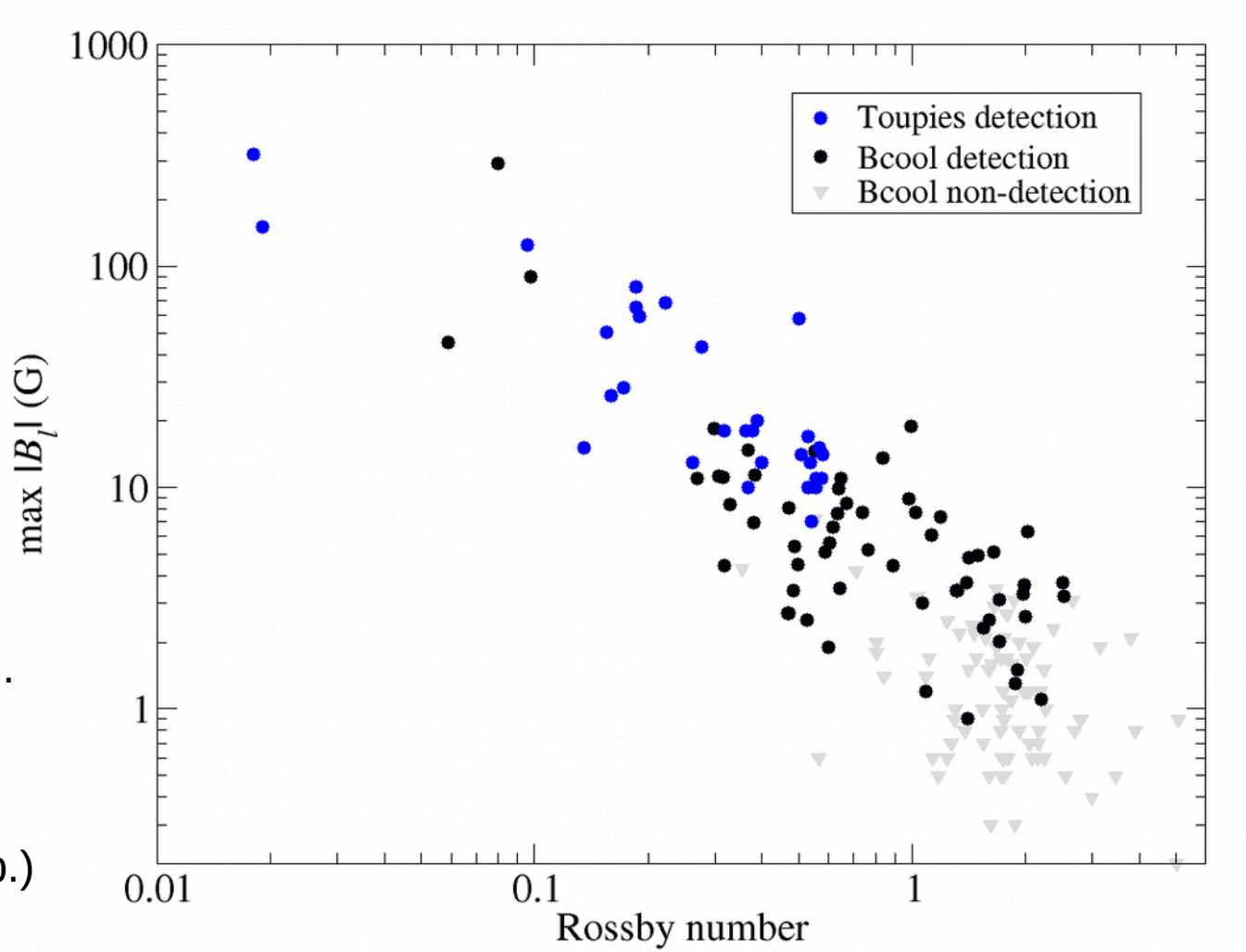
B_l activity-rotation relation

- In partly convective “solar-like” stars
- P_{rot} – B_l for fully convective stars



B_l activity-rotation relation

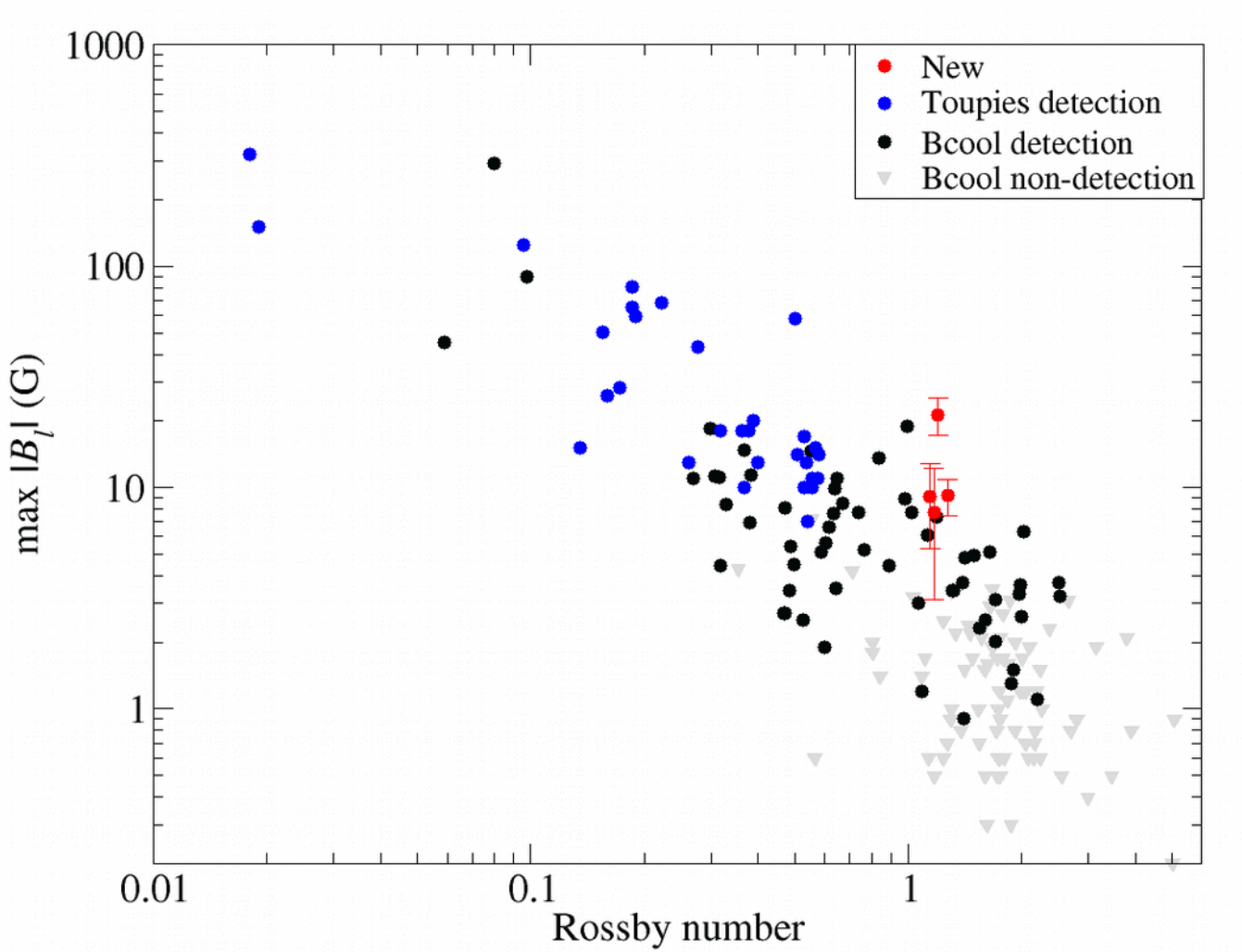
- In partly convective “solar-like” stars
- convective turnover times from Wright et al. 2011 (eq 11)



Bcool: Marsden et al. (2014)
Toupies: Folsom et al. (2016, in prep.)

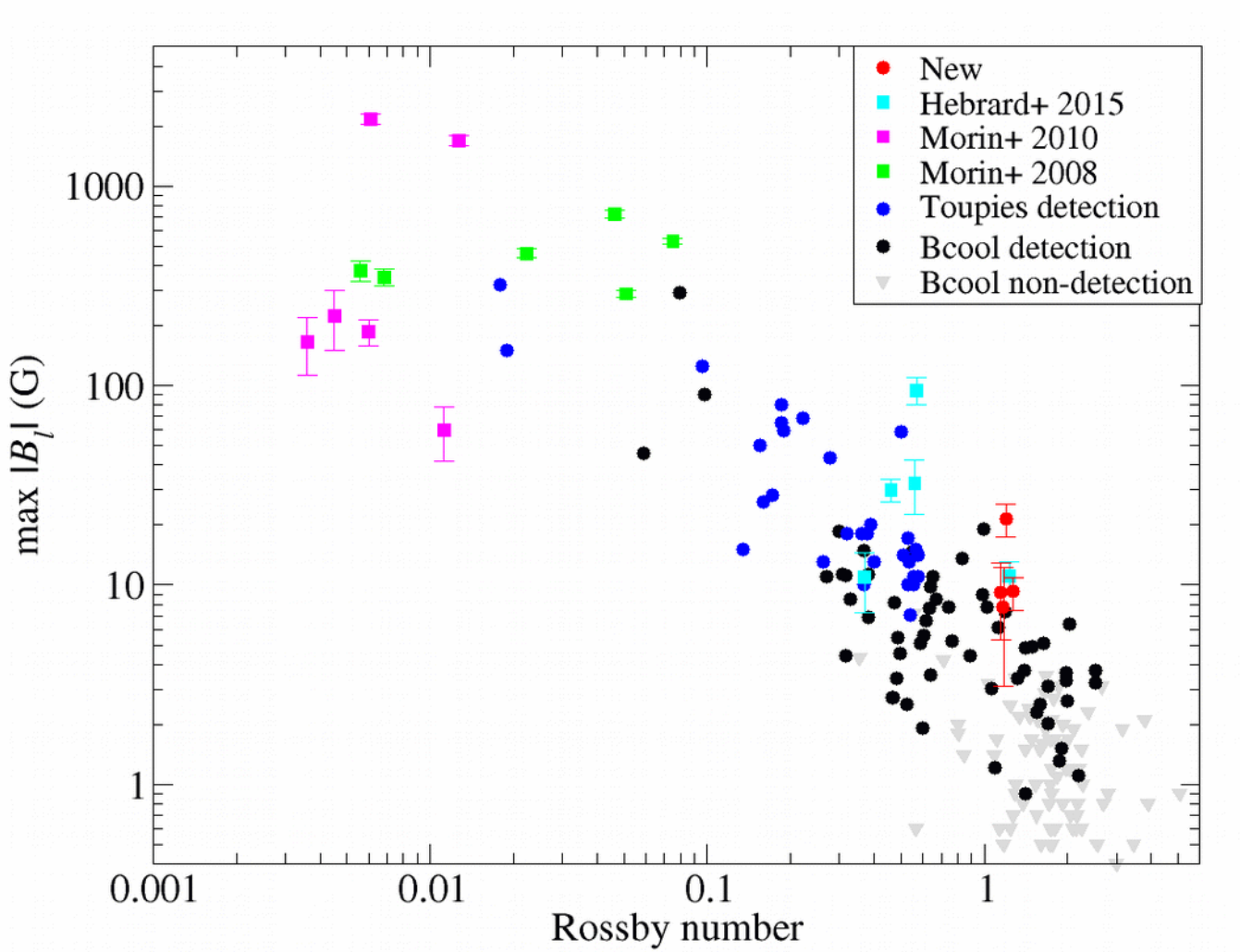
B_l activity-rotation relation

- In our fully convective stars
- convective turnover times from Wright et al. 2011 (eq 11)



B_l activity-rotation relation

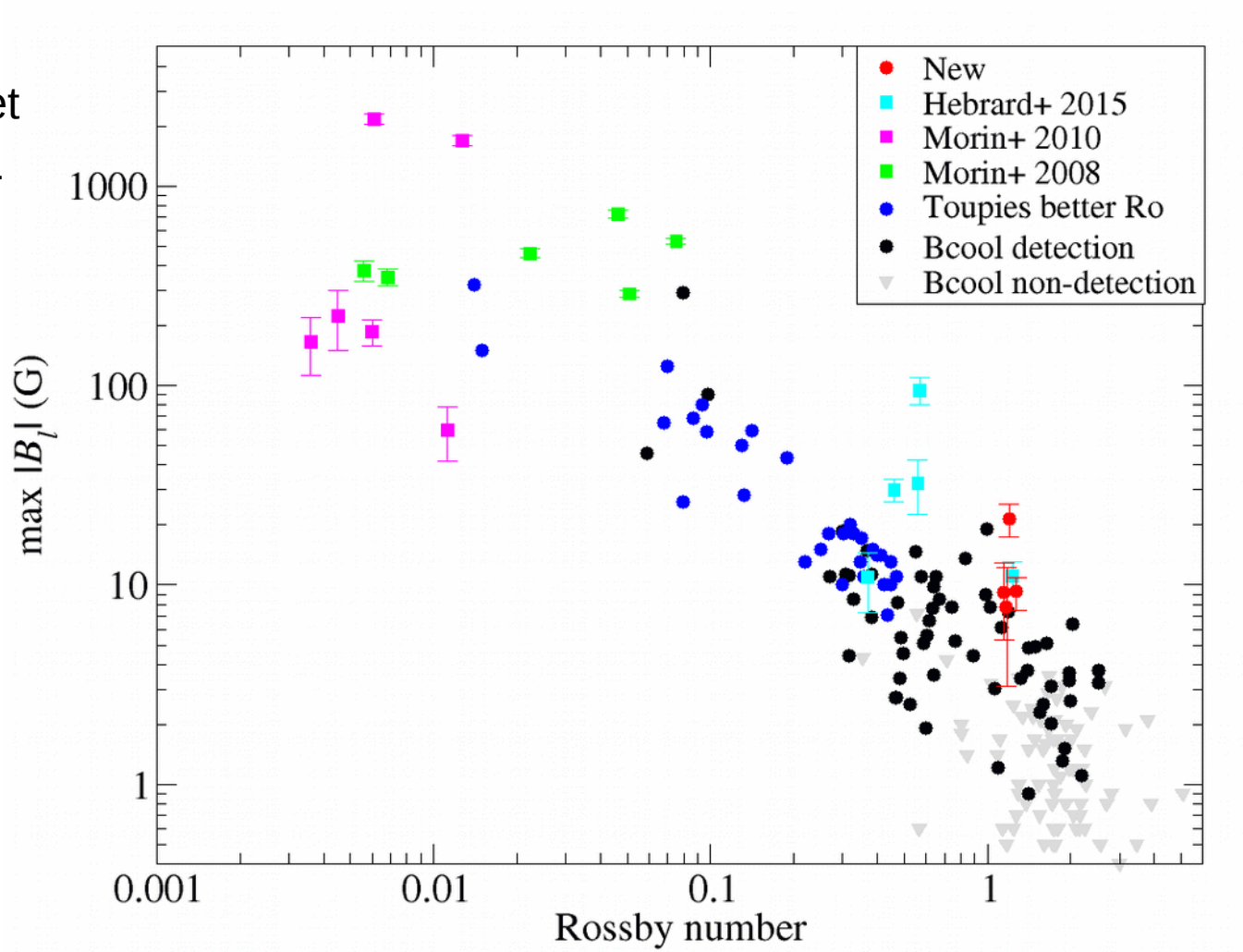
- With other literature M-dwarfs
- convective turnover times from Wright et al. 2011 (eq 11)



Importance of convective turnover time

- Can reduce scatter (e.g. good theoretical values for Toupies)
- Not well established for fully convective stars?

τ_c from Armad et al., STAREVOL models



Conclusions

- Rotation matters!
- General B_l - R_o tend holds
  - existence of a tachocline dose not matter?
- Possible offset in B_l?
  - Or inadequate convective turnover time?

- Reaching the limits of ESPaDOnS
  (need IR spectropolarimetry!)

Rotation-Activity Relations

- But in large-scale magnetic fields we may see something different for largely convective stars